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## S7 Communication between S7 CPU and PC station

S7 variable services with SIMATIC NET OPC UA server

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# 1 Introduction

## 1.1 Overview

### SIMATIC NET OPC server communication functions for OPC UA

The OPC server provides standardized access to the SIMATIC NET industrial communications networks.

The SIMATIC NET OPC Server supports the interfacing of applications with any automation components networked over PROFIBUS or Industrial Ethernet. SIMATIC NET OPC server offers the following communication functions for OPC UA:

- S7 communication
  - S7 OPC UA server (see chapter [4.1.1](#))
  - S7OPT OPC UA server (see chapter [4.1.2](#))
- Open communication services (SEND/RECEIVE)
  - SR OPC UA server (see chapter [4.1.3](#))
- PROFIBUS DP
  - DP OPC UA server (see chapter [4.1.4](#))

### Services of the communication functions

The SIMATIC NET OPC server communication functions for OPC UA support the following services, among others:

- Variable services
- Buffer-oriented services
- Block services
- Server functionality

### Tag services

This application example demonstrates how to use the variable service to exchange data between PC station and S7 CPU. This service is supported by the following communication functions:

- S7 communication
- Open communication services (SEND/RECEIVE)

The following components are used in this application example:

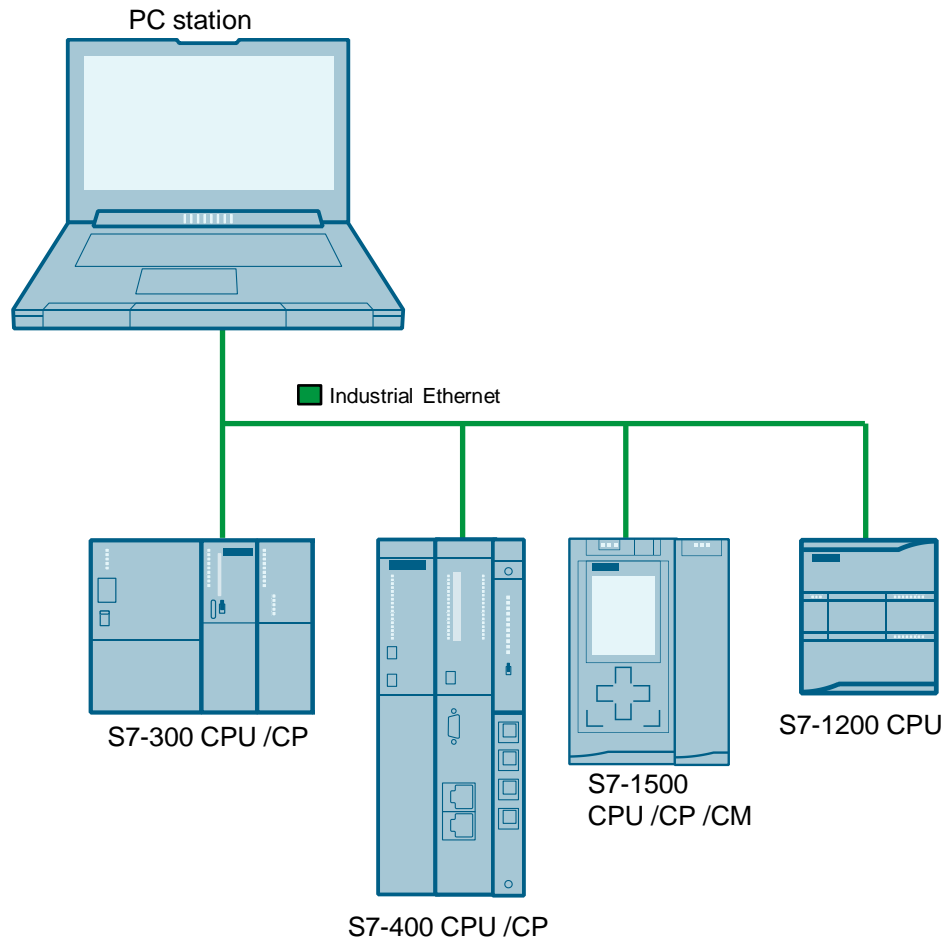
- SIMATIC NET OPC UA server on the PC station
  - S7OPT OPC UA server
  - S7 OPC UA server
- S7-1200 CPUs, S7-1500 CPUs, S7-300 CPUs and S7-400 CPUs

## 1.2 Plant configuration

The following figure shows typical plant configurations for Industrial Ethernet and PROFIBUS in which the data communication between S7 CPU and PC station is implemented using S7 variable services via optimized S7 connections or standard S7 connections.

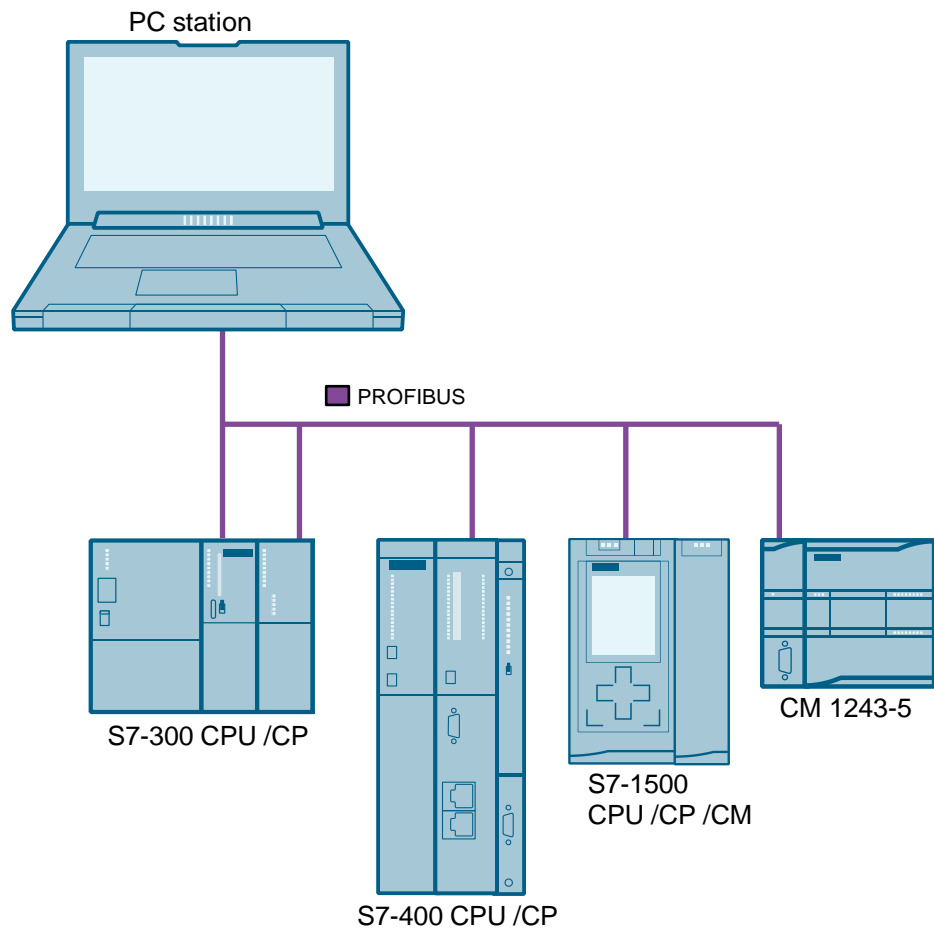
### Industrial Ethernet

Figure 1-1



## PROFIBUS

Figure 1-2



## 1.3 Principle of operation

### 1.3.1 S7 tag services

#### S7OPT OPC UA server

The S7 variable services of the S7OPT OPC UA server enable access and monitoring of S7 tags via standard access and access to optimized data blocks.

The S7OPT OPC UA server supports the following objects with standard access:

- Data blocks (standard access)
- Instance data blocks and multi-instance data blocks (standard access)
- Inputs
- Outputs
- Timers (only S7-1500)
- Counters (only S7-1500)
- UDTs

**Note** Not every S7 CPU supports all object types.

The S7OPT OPC UA server supports the following objects with access to optimized data blocks:

- Data blocks (Access to optimized data blocks)
- Instance data blocks (Access to optimized instance data blocks)

**Note** S7 communication with access to optimized data blocks via OPC UA is supported by the S7-1200 CPUs (V4 onward) and the S7-1500 CPUs.



### S7 OPC UA server

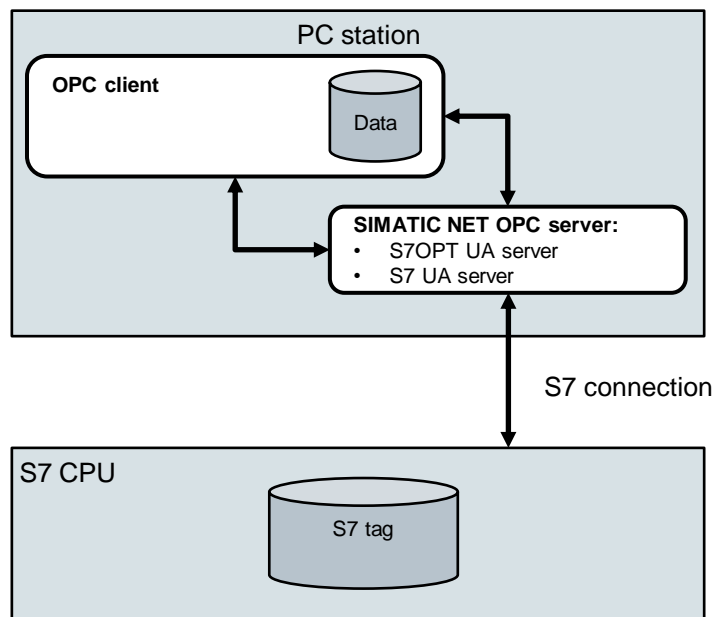
The S7 OPC UA server supports the following objects:

- Data blocks
- Instance data blocks
- Inputs
- Outputs
- Peripheral inputs
- Peripheral outputs
- Bit memories
- Timers
- Counter

**Note** Not every S7 CPU supports all object types.

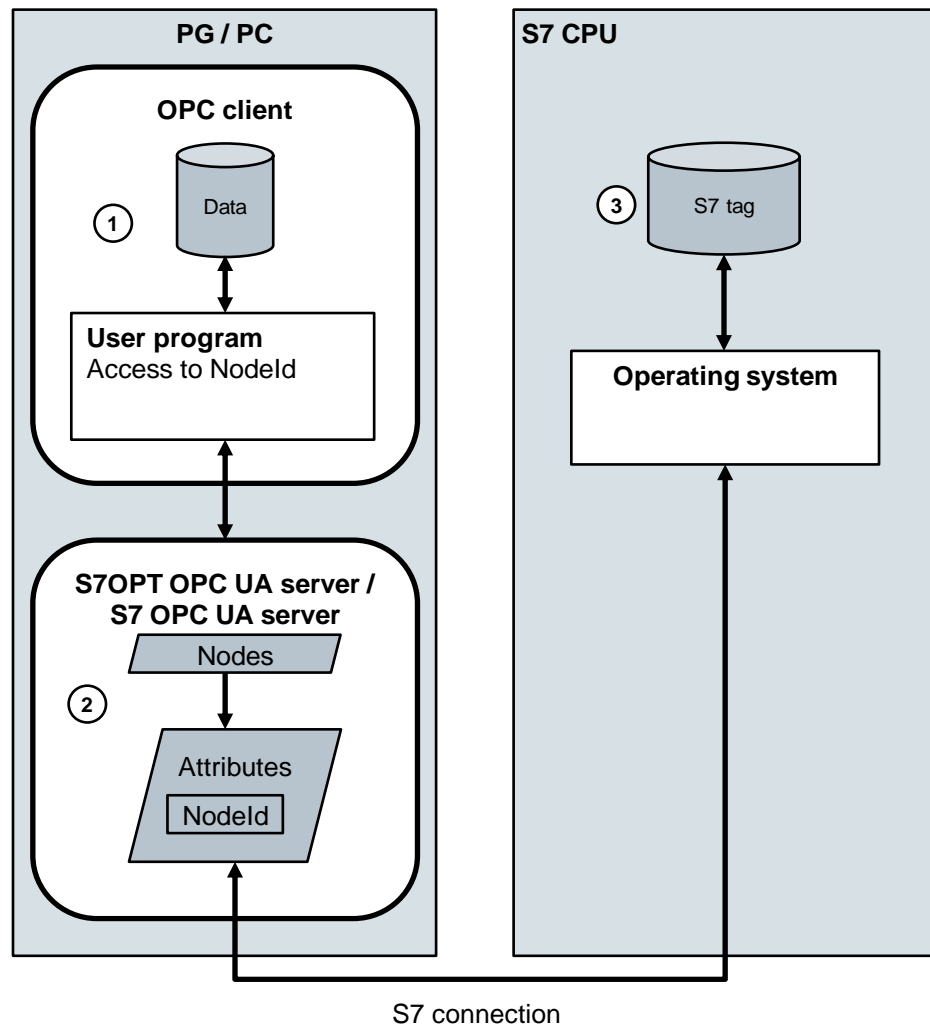
The following figure shows an overview of the application example.

Figure 1-3



**Note** The application example provides an introduction to using the S7 tag service with the S7OPT OPC UA server and S7 OPC UA server from SIMATIC NET. Details are described in the SIMATIC NET manuals (see [3](#), [4](#) and [5](#)).

Figure 1-4



OPC UA accesses objects and their sub-objects. Data tags, for example, are sub-objects of an S7 connection object.

The following S7 connection objects exist:

- **Productive S7 connections**  
These are used for data exchange between S7 CPU and PC station and are generally configured with STEP 7.
- **DEMO connection**  
This is used only for testing.
- **@LOCALSERVER connection**  
This provides the local S7 data blocks for the S7 server functionality.

Attributes define the objects in greater detail. Each individual access to an object, sub-object and attribute uses its Nodetd.

Using the S7 variable service, it is possible for the OPC client to read, write and monitor attribute values.

1. The OPC client uses the NodeId to access attributes in order to access the S7 tags in the S7 CPU with the following commands.
  - Read
  - Write
2. Nodes are defined in the namespace of the S7OPT OPC UA server or S7 OPC UA server in order to organize the objects and sub-objects. The OPC client access the S7 tags in the S7 CPU via the nodes. The S7OPT OPC UA server or S7 OPC UA server executes the commands of the OPC client.
3. STEP 7 (TIA Portal) contains a data block or a tag table with symbolic S7 tags. For the S7-1500 CPUs and S7-1200 CPUs the "Optimized block access" option is enabled by default for the data block.

## 1.4 Components used

The application example was created with these hardware and software components:

Table 1-1

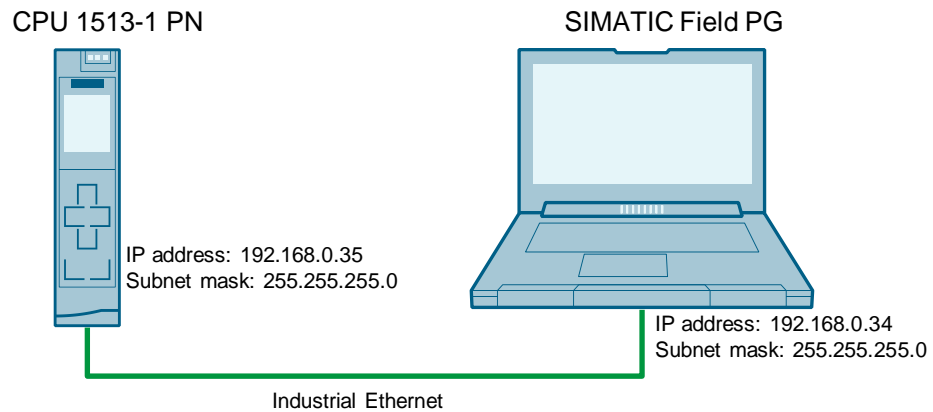
Components	Quantity	Item number	Note
CPU 1513-1 PN	1	6ES7513-1AL01-0AB0	Alternatively, you can use any S7-1500 CPU, S7-1200 CPU, S7-300 CPU, S7-400 CPU, ET 200SP CPU, ET 200S CPU or ET 200pro CPU.
CPU 315-2 PN/DP	1	6ES7315-2EH14-0AB0	
SIMATIC NET DVD V16	1	6GK1704-1LW16-0AA0	In the Sales and Delivery Release you will find the article numbers for the SIMATIC NET products (see article <a href="#">109775589</a> ).
STEP 7 V16	1	Package: 6ES7822-1AA06-0YA5 Download: 6ES7822-1AE06-0YA5	

## 2 Engineering

### 2.1 Hardware setup

The following figure shows the structure of the application example.

Figure 2-1



The SIMATIC Field PG is deployed as a PC station, i.e. the SIMATIC NET PC software is installed on the SIMATIC Field PG. The following SIMATIC NET OPC UA servers are used to access the S7 CPU's S7 tags from the PC station:

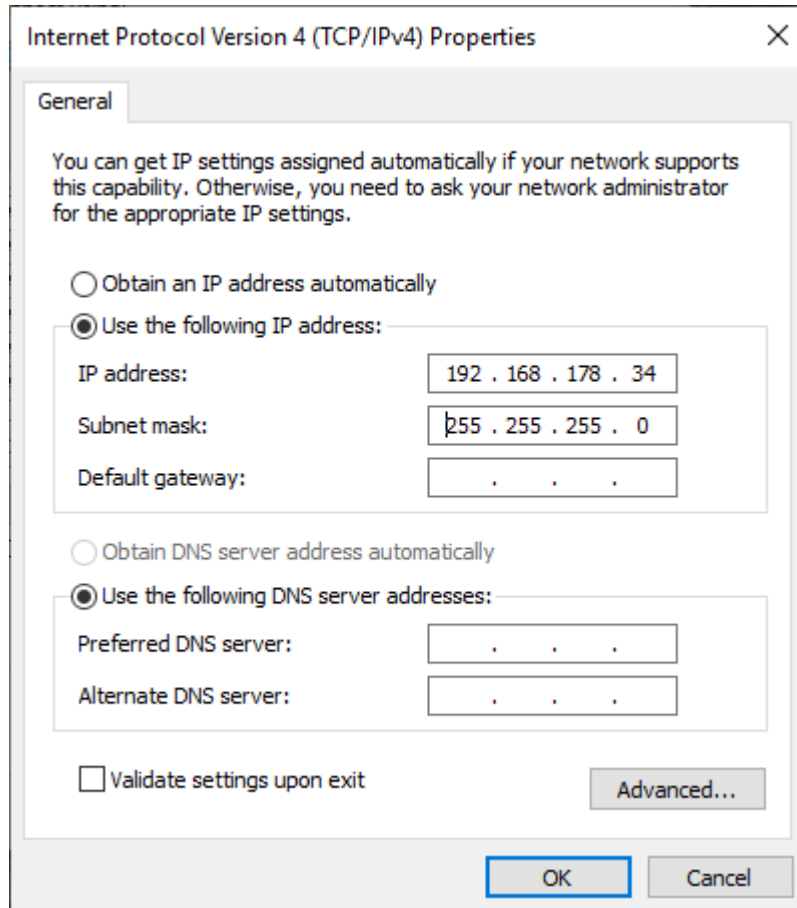
- S7 OPT OPC UA server
- S7 OPC UA server

## 2.2 Setting IP addresses and subnet mask

### 2.2.1 IP address and subnet mask for the PC station

In the Windows properties for the network adapter through which the PC station is connected with the S7 CPU, set the IP address and subnet mask for the PC station.

Figure 2-2



1. In the "Control Panel", open the "Network and Sharing Center" under "Network and Internet".
2. Select the function "Change adapter settings".
3. Right-click on the corresponding network adapter and select the "Properties" context menu.  
The Properties dialog for network adapter opens.
4. Select the "Internet Protocol Version 4 (TCP/IPv4)" element and click the "Properties" button.  
The Properties dialog box for the "Internet Protocol Version 4 (TCP/IPv4)" element will open.

5. Set the IP address and subnet mask and apply the settings with "OK".
  - IP address: 192.168.178.34
  - Subnet mask: 255.255.255.0

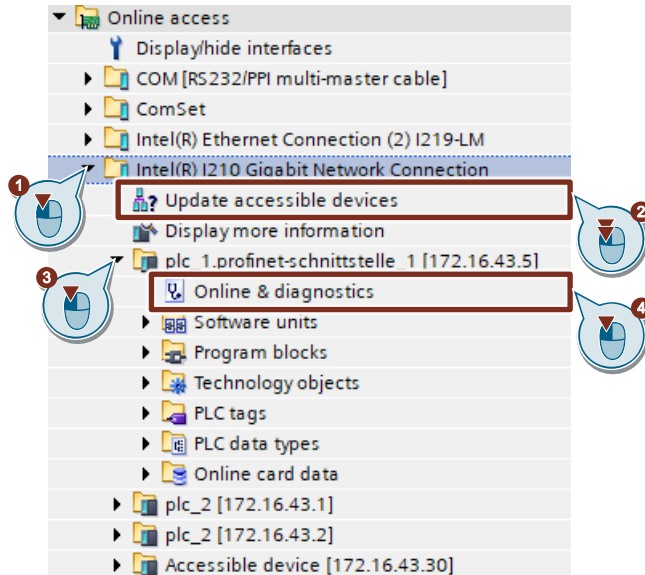
**Note**

You will configure the IP address and subnet mask later during hardware configuration for STEP 7.

## 2.2.2 IP address and subnet mask for the S7 CPU

### Opening the "Online & diagnostics" dialog

Figure 2-3

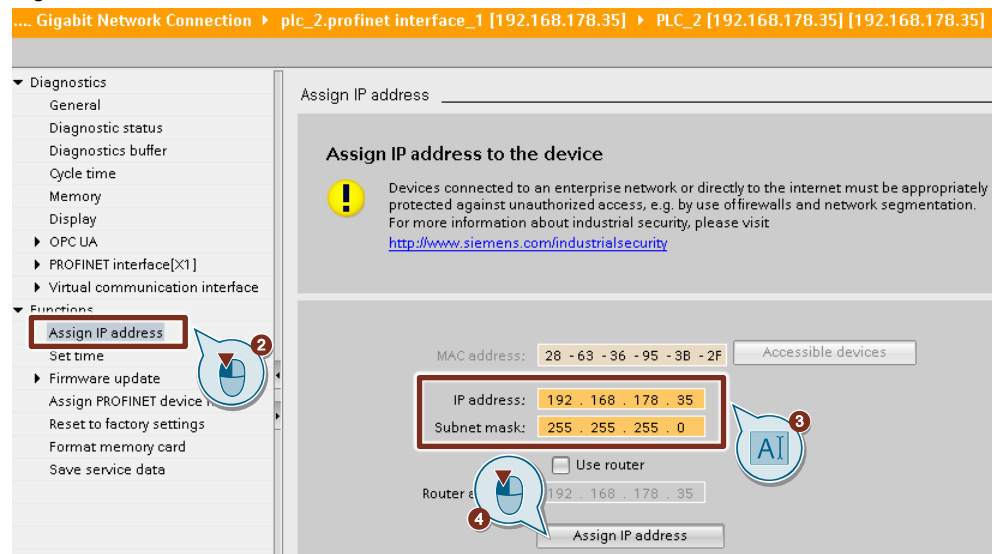


1. In the project tree under "Online access" click the arrow to the left of the network adapter that is connected with your S7 CPU.
2. Double-click the "Update accessible devices" command. All devices available to the network adapter will be shown.
3. Click the arrow to the left of the S7 CPU to which you wish to assign the IP address and subnet mask.
4. Double-click the command "Online & diagnostics". The "Online & diagnostics" dialog will open.



## Assigning IP address and subnet mask

Figure 2-4



1. Switch the S7 CPU to "STOP" mode.
2. Under "Functions", click "Assign IP addresses".
3. Enter the following IP address and subnet mask:
  - IP address: 192.168.178.35
  - Subnet mask: 255.255.255.0
4. Click "Assign IP address" to set the parameters.

### Note

- You will configure the IP address and subnet mask later during configuration.
- If you have an S7-1500 CPU, you can also set the IP address and subnet mask on the display.

## 2.3 "Communication settings"

Open the program "Communication Settings" via the Windows Start Menu "Siemens Automation > Communication Settings".

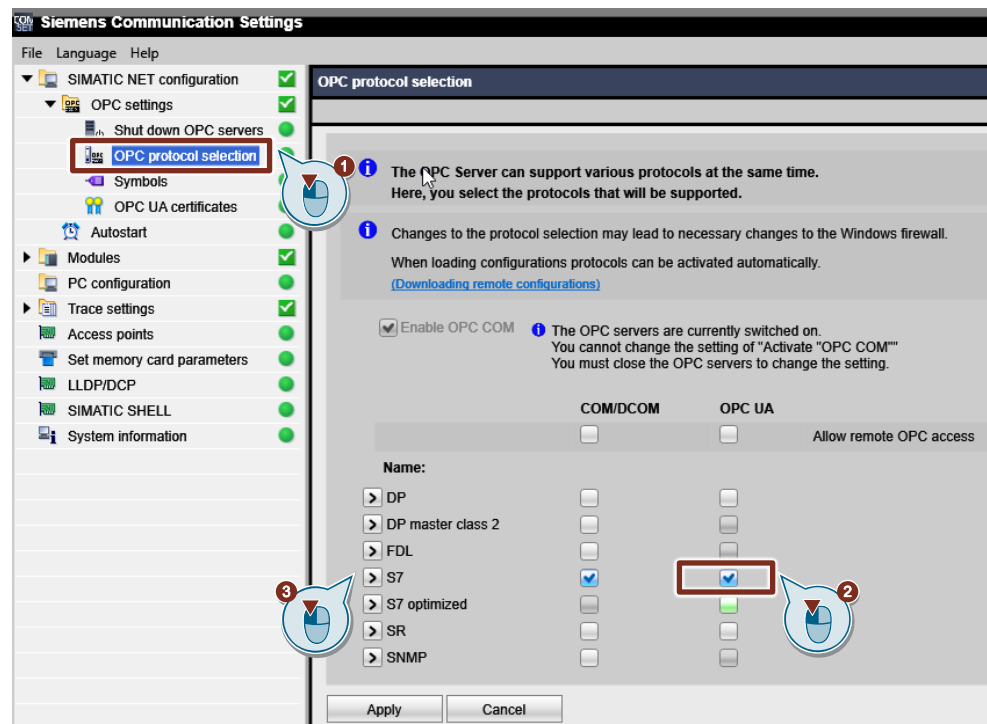
The "Communication Settings" program provides a number of ways to configure and diagnose PC hardware components, PC user programs and the SIMATIC NET OPC server.

### Enabling protocols for the OPC server

The SIMATIC NET OPC server supports various protocols to the controller level. All protocols are activated in the initial configuration.

You can disable protocols that you don't want to use.

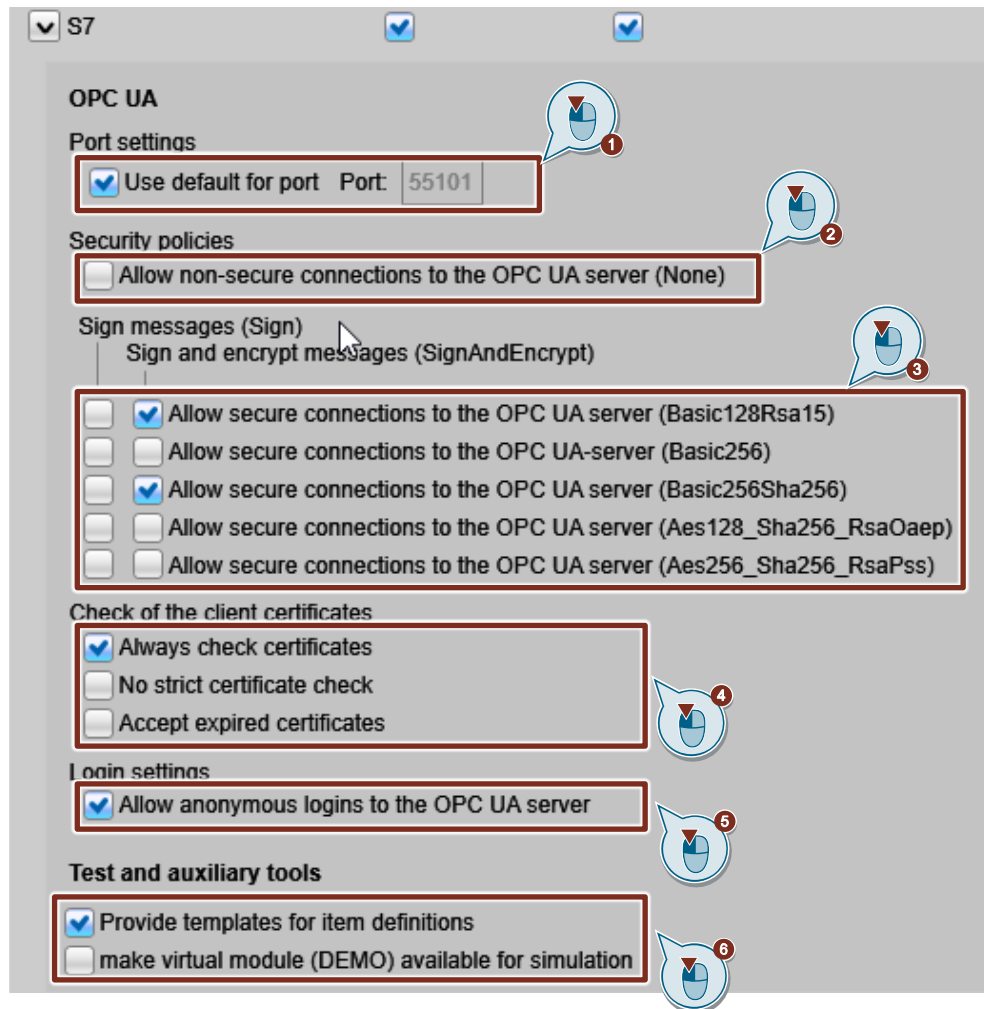
Figure 2-5



1. In the navigation area, navigate to "SIMATIC NET configuration > OPC Settings > OPC protocol selection".
2. Enable the following protocols for OPC UA:
  - "S7": SIMATIC S7 communication via PROFIBUS and Industrial Ethernet
  - "S7 optimized": SIMATIC S7 communication with S7-1200 (V4 onward) and S7-1500 via Industrial Ethernet (access to optimized data blocks)
3. Click the arrow icon next to the protocol, such as "S7 optimized", to reach the advanced parameter list for that protocol.

## Setting parameters for the protocols

Figure 2-6



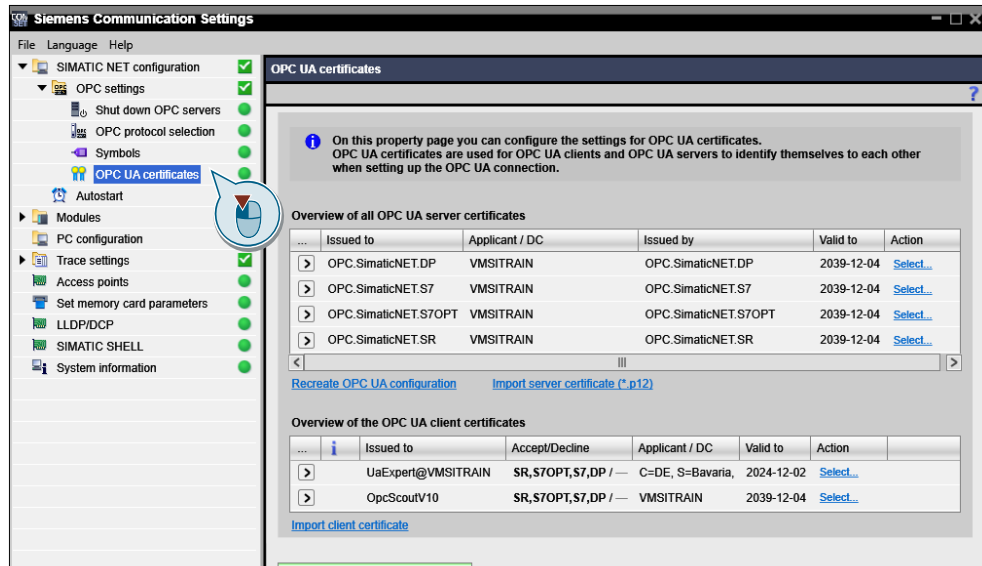
1. Port settings:
  - If the checkbox is selected, the default setting is used for the specified port.
  - If the checkbox is not selected, you can edit the input field for the port.
2. Security policies:
  - If the checkbox is selected, unsecured connections (none) to the OPC server are allowed.
  - If the checkbox is not selected, no unsecured connections (none) to the OPC server will be allowed.

3. Define which connections to the OPC server will be allowed and determine whether the messages will be signed (Sign) or signed and encrypted (SignAndEncrypted):
  - secured connections based on the security policy "Basic128Rsa15"
  - secured connections based on the security policy "Basic256"
  - secured connections based on the security policy "Basic256Sha256"
  - secured connections based on the security policy "Aes128\_Sha256\_RsaOaep"
  - secured connections based on the security policy "Aes256\_Sha256\_RsaPss"
4. Check of the client certificates
  - Always check certificates  
Enabled: The certificates will always be checked.  
Disabled: The certificates will not be checked.
  - No strict certificate check  
Enabled: Certain certificate checks will be ignored, e.g. CertificateRevocationUnknown, CertificateIssuerRevocationUnknown, NonceLengthCheck, TokenPolicyIdCheck.  
Disabled: The certificates will be fully checked.
  - Accept expired certificates:  
Enabled: The certificates will be accepted even if the time stamp of the certificate is invalid, i.e. the certificates are not yet valid or have already expired.  
Disabled: The certificates are only accepted if the time stamp is valid.
5. Login settings
  - If the checkbox is selected, the SIMATIC NET OPC server allows anonymous login of OPC UA clients.
  - If the checkbox is not selected, anonymous logins are not allowed. User authentication with Windows login and password is then required.

**Note**  
The SIMATIC NET OPC server uses the Windows user management for user authentication. In the OPC client, log in to the SIMATIC NET OPC server with your Windows user name and password.
6. Test and auxiliary tools
  - Provide templates for item definitions:  
If the checkbox is selected, the OPC server creates templates for item definitions in its namespace, which can be used to easily define a new item.
  - make virtual module (Demo) available for simulations:  
The SIMATIC NET OPC server gives you the ability to use the OPC interface for tests, presentations and development work without a communication module. For this purpose, the OPC server provides a virtual module or "DEMO" connection, depending on the protocol (CP simulation). This option enables activation of the simulation function depending on the protocol.

**"OPC UA certificates"**

Figure 2-7



1. In the navigation area, navigate to "SIMATIC NET configuration > OPC settings > OPC UA certificates". Here, the certificates of the local OPC UA server and the certificates the OPC clients used to identify themselves to the servers are displayed and managed.
2. Accept the OPC client certificate, if applicable.

## 2.4 Overview

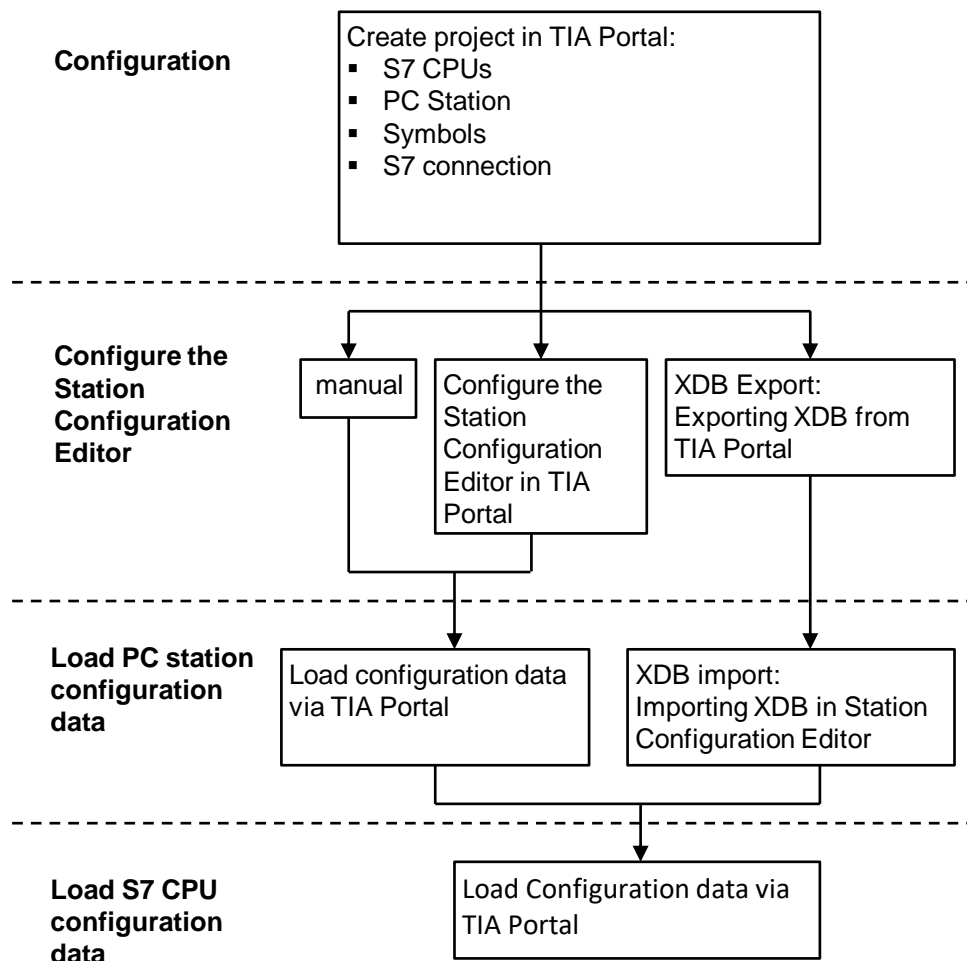
The following figure shows an overview of the steps performed during the engineering stage.

- Configuration
- Configure the Station Configuration Editor
- Load PC station configuration data
- Load S7 CPU configuration data

There are multiple ways of performing the engineering step when configuring the Station Configuration Editor and loading the PC station configuration data. Performing either one of the options for the engineering step is sufficient.

This application example describes all possibilities for the engineering steps.

Figure 2-8



## 2.5 Configuration

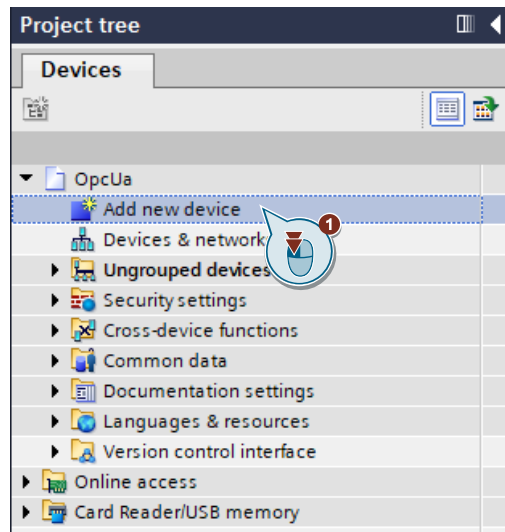
### 2.5.1 Create S7 CPU in STEP 7 (TIA Portal)

#### Requirements

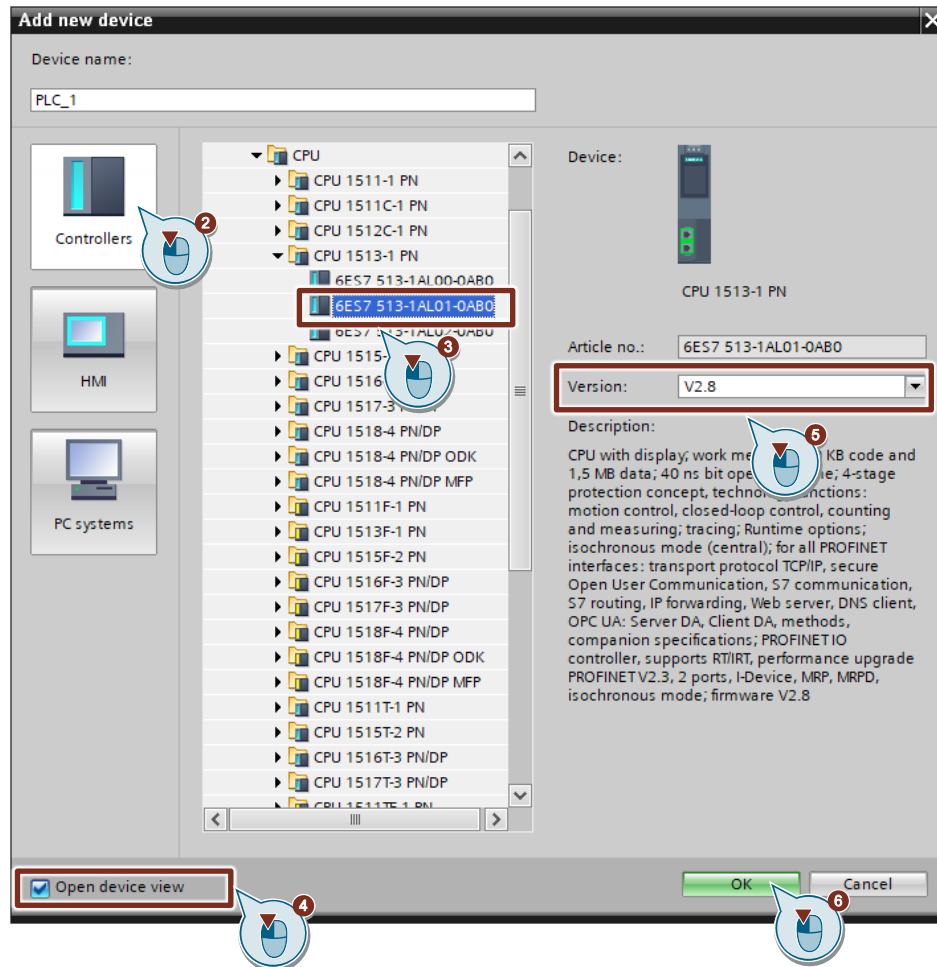
- STEP 7 (TIA Portal) is open.
- A new project is created, or an existing project is opened.

#### Insert device

1. Double-click the command "Add new device" in the project tree.



The dialog box "Add new device" opens.



2. Click the "Controllers" button.
3. Select the S7 CPU according to your hardware setup, e.g. CPU 1513-1 PN.
4. Enable the option "Open device view".
5. Under Version, select the firmware version of the S7 CPU.
6. Click the "OK" button.  
The selected S7 CPU will be added.

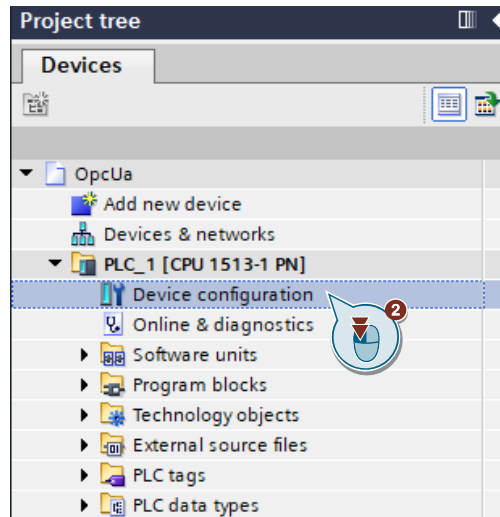
**Note**

If you enabled the option "Open device view", the "Device view" for the S7 CPU will open automatically in the hardware and network editor.



### Opening the device view

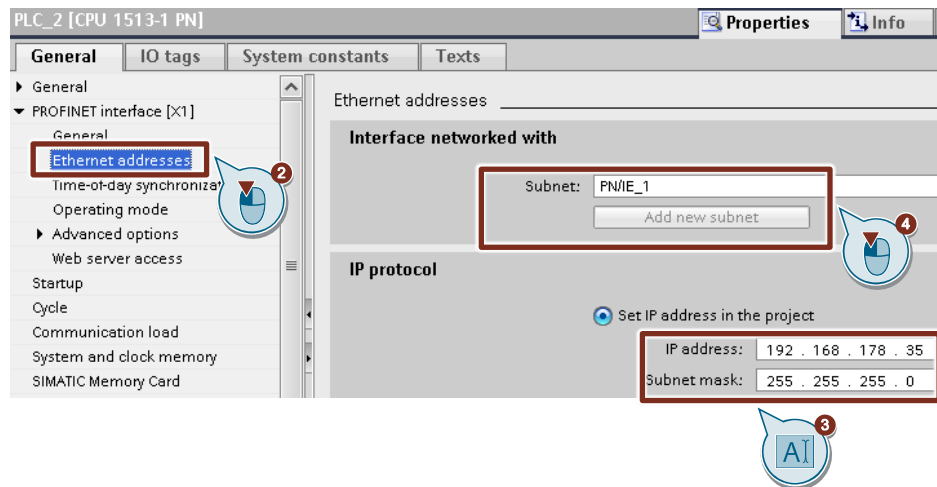
1. In the project tree, open the device folder of the S7 CPU.
2. Double-click on the "Device configuration" command.



The "Device view" of the S7 CPU opens in the hardware and network editor.

## Setting address parameters

1. Select the S7 CPU in the device view.  
The properties of the S7 CPU are displayed in the Inspector window.

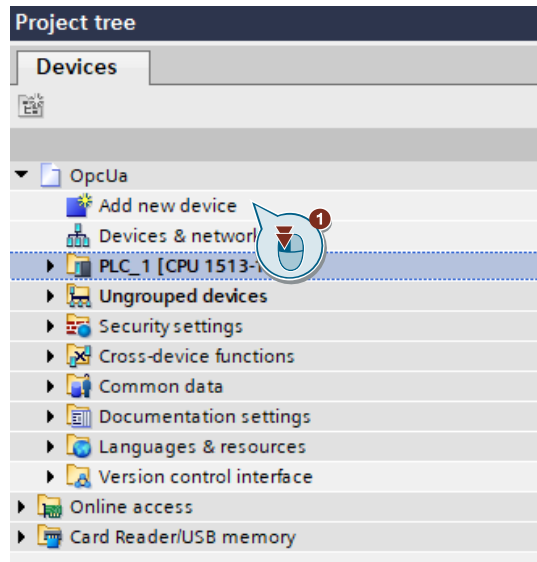


2. In the "General" tab, navigate to "PROFINET interface [X1] > Ethernet addresses".
3. Enter the following address parameters:
  - IP address: 192.168.178.35
  - Subnet mask: 255.255.255.0
4. Click on the "Add new subnet" button to create a new subnet, or select an existing subnet.

## 2.5.2 Create PC station in STEP 7 (TIA Portal)

### Insert device

1. Double-click the command "Add new device" in the project tree.



The dialog box "Add new device" opens.



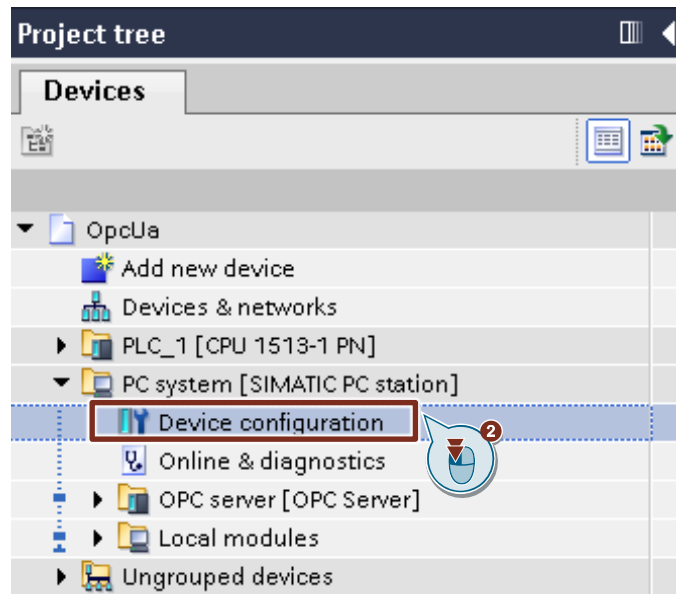
2. Click the "PC systems" button.
3. Select the user application "OPC server".
4. Enable the option "Open device view".
5. Set the version of the "OPC server" user application, e.g. "SWV16...".
6. Click the "OK" button.  
A PC station with the user application "OPC server" will be added.

**Note**

If you enabled the option "Open device view", the "Device view" for the PC station will open automatically in the hardware and network editor.

### Opening the device view

1. In the project tree, open the device folder of the PC station.  
Double-click on the "Device configuration" command.

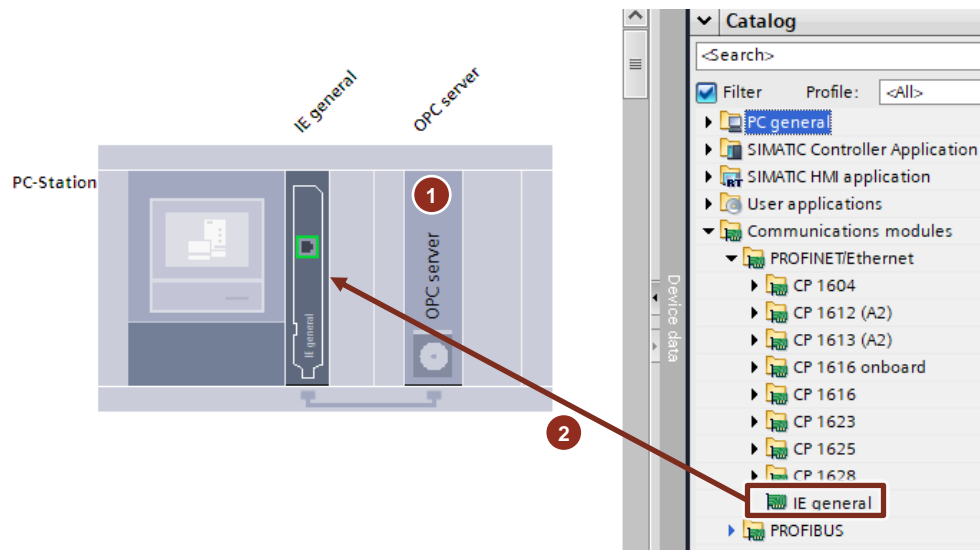


The "Device view" of the PC station opens in the hardware and network editor.

### Configuring the PC station

Configure the PC station in the Device view.

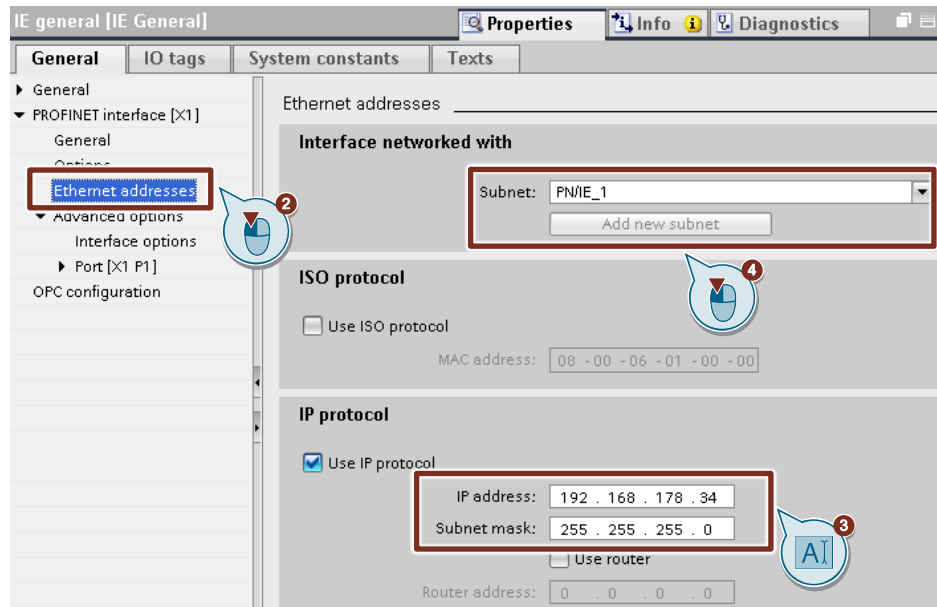
Figure 2-9



1. The OPC server has been automatically added in slot 2.
2. Insert a communications module, e.g. "IE general", into slot 1 of the PC station by dragging and dropping.

### Setting address parameters

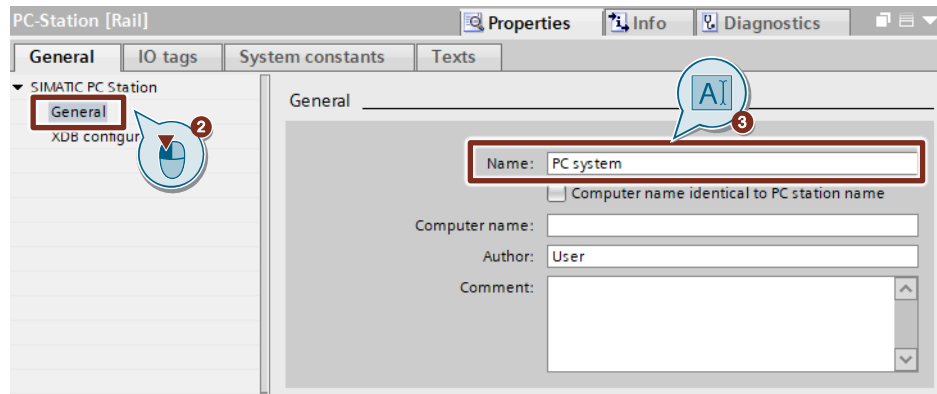
1. In the Device view, select the communications module "IE general". The properties of the communications module are displayed in the Inspector window.



2. In the "General" tab, navigate to "PROFINET interface [X1] > Ethernet addresses".
3. Enter the following address parameters:
  - IP address: 192.168.178.34
  - Subnet mask: 255.255.255.0
4. Click on the "Add new subnet" button to create a new subnet, or select an existing subnet.

### Setting the name of the PC station

1. Select the PC station in the device view.  
The properties of the PC Station are displayed in the Inspector window.



2. In the "General" tab, navigate to "General".
3. Enter the name of the PC station, e.g. "PC system".



### 2.5.3 Configuring a connection

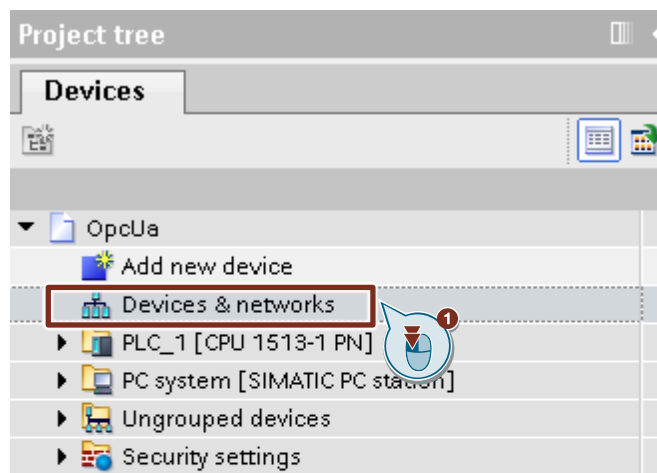
#### S7 CPU and PC station are created in the same project

Adding a specified connection:

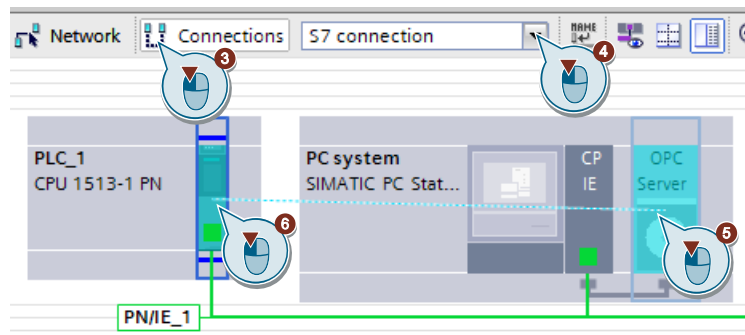
#### Note

If you have configured the user application "OPC server" with version "SW V12..." or higher, an optimized connection to S7-1500 CPUs and S7-1200 CPUs (firmware V4 or higher) will be created automatically.

1. Open the "Project tree".
2. Double-click "Devices & networks".



The graphical area of the "Network view" opens in the hardware and network editor.

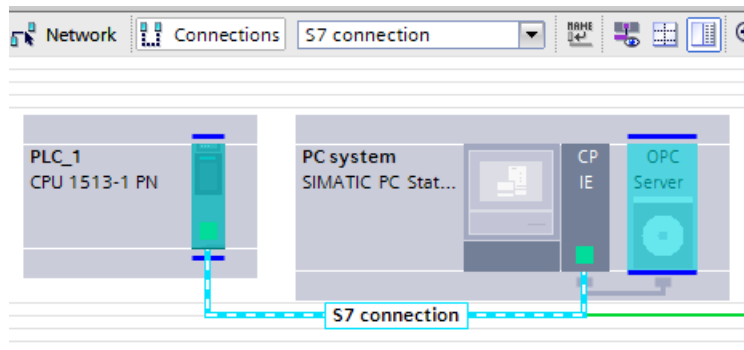


3. In the function bar, click "Connections" to enable the connection mode.
4. Select the connection type "S7 connection" in the nearby dropdown menu. All devices that are relevant to an S7 connection are highlighted in color in the "Network view".
5. Click and drag the mouse from the OPC server to the S7 CPU.
6. Release the mouse button on the target device in order to create the S7 connection between the OPC server and the S7 CPU.

Result:

A specified S7 connection is created.

- The connection path is highlighted.



- The S7 connection is entered in the connection table.

Local connection name	Local end point	Local ID (hex)	Partner ID (hex)	Partner	Connection type
S7 connection	OPC server [OPC Server]	S7 connection		PLC_1 [CPU 1513-1 PN]	S7 connection

- The OPC server actively establishes the S7 connection. The S7 CPU is a passive participant as the connection is established.

S7 connection [S7 connection] Properties

General | IO tags | System constants | Texts

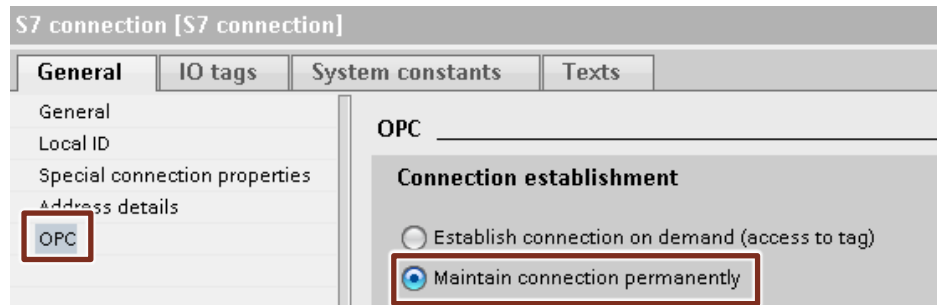
Special connection properties

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

Setting connection parameters:

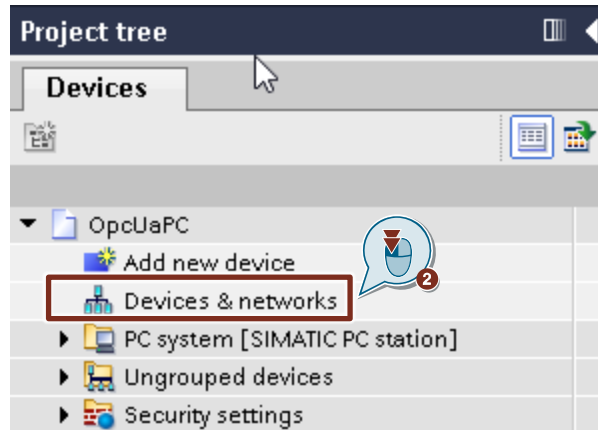
1. Select the S7 connection in the connection table.  
The properties of the S7 connection are displayed in the Inspector window.
2. In the "General" tab under "OPC", enable the function "Maintain connection permanently".



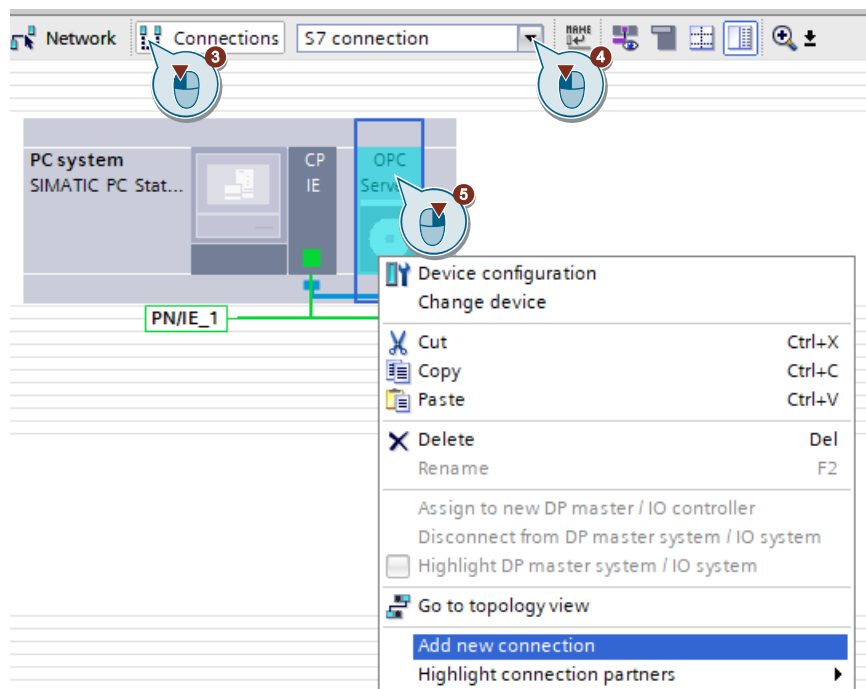
### S7 CPU and PC station are created in different projects

Adding an unspecified S7 connection:

1. Open the "Project tree" in the PC station's project.
2. Double-click "Devices & networks".

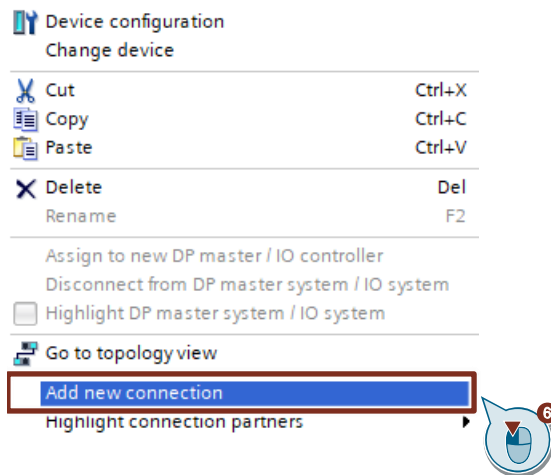


The graphical area of the "Network view" opens in the hardware and network editor.

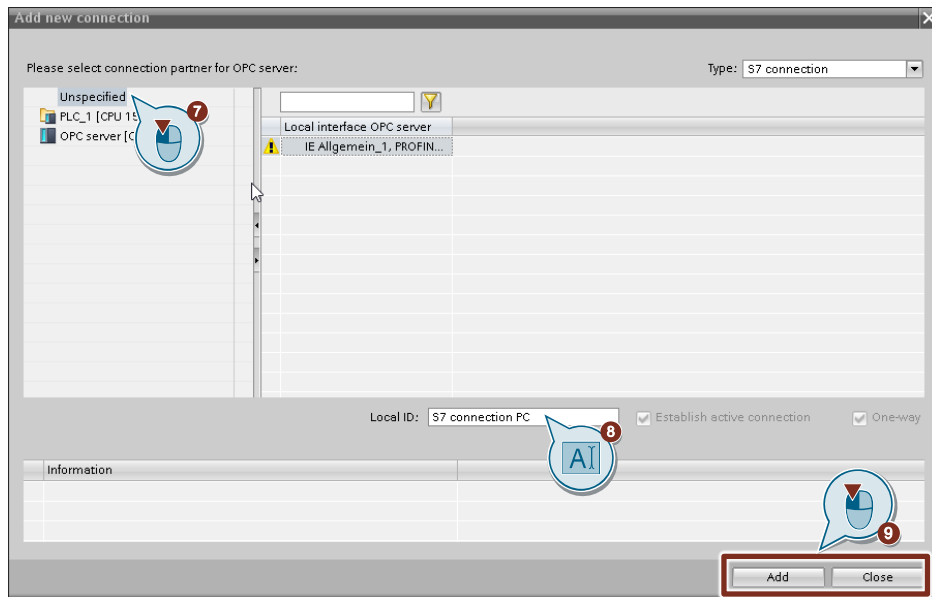


3. In the function bar, click "Connections" to enable the connection mode.
4. Select the connection type "S7 connection" in the nearby dropdown menu. The OPC server that is relevant for an S7 connection will be highlighted in color in the "Network view".
5. Right click on the OPC server. The context menu opens.

6. Select "Add new connection".



The "Add new connection" dialog will open.

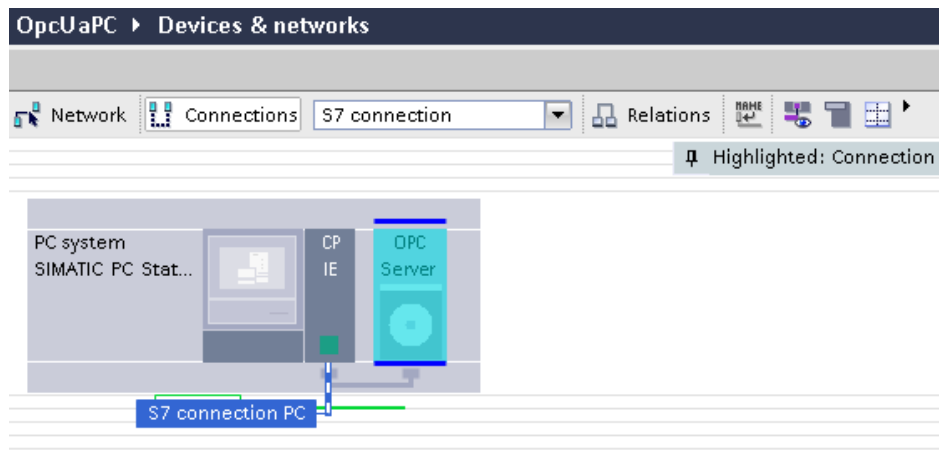


7. Specify the following connection partner: "Unspecified".
8. Enter the local ID, e.g. "S7 connection PC".  
The local ID is visible in the OPC client if the OPC client has established the connection to the SIMATIC NET S7 OPC UA server.
9. Click "Add" to add the unspecified S7 connection; click the "Close" button to close the dialog.

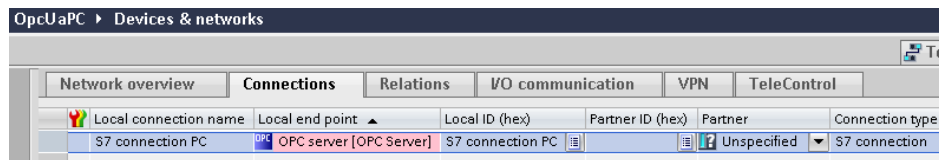
Result:

An unspecified S7 connection is created.

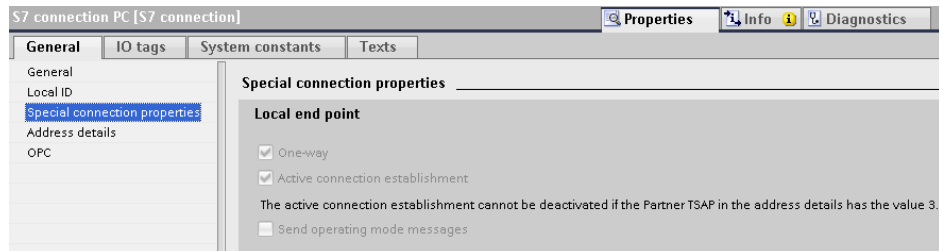
- The connection path is highlighted.



- The S7 connection is entered in the connection table.



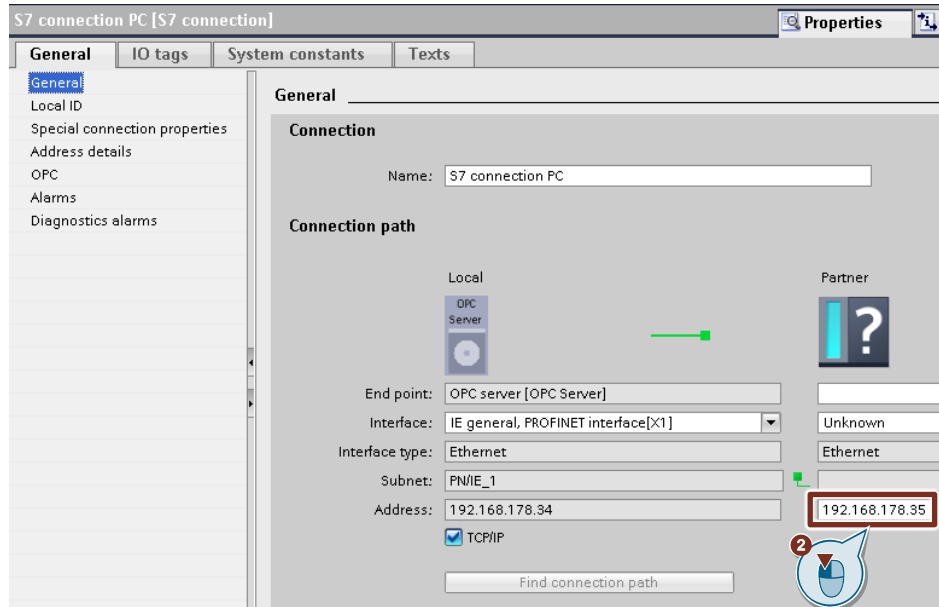
- The OPC server actively establishes the S7 connection.



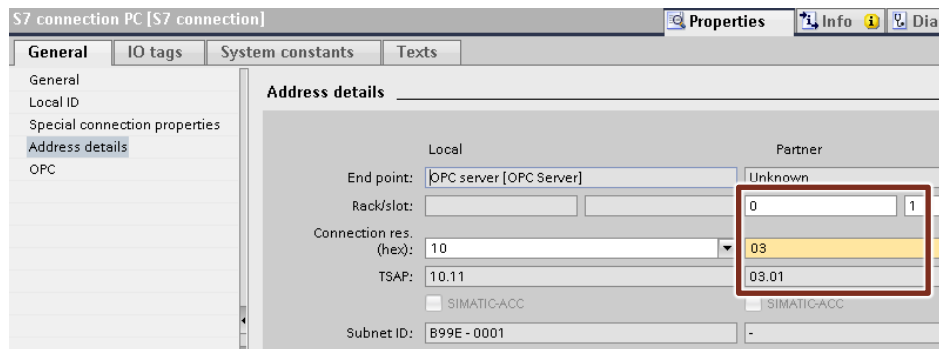
**Note** If the connection parameters are not yet fully set up, the S7 connection will be shown with errors in the connection table.

Setting connection parameters:

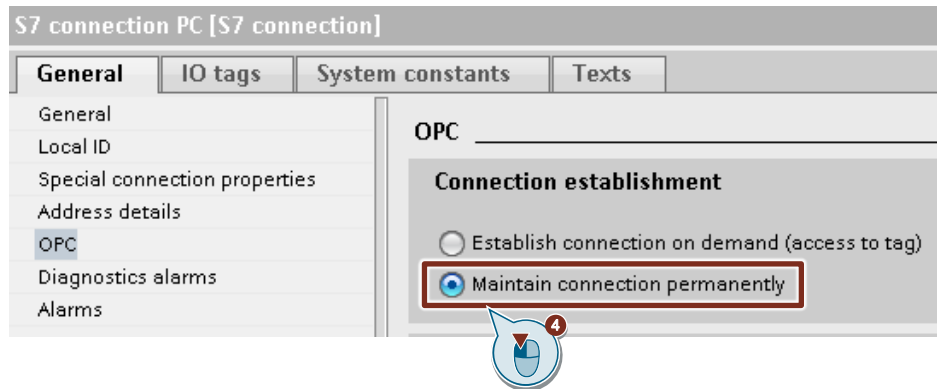
1. Select the S7 connection in the connection table.  
The properties of the S7 connection are displayed in the Inspector window.
2. In the "General" tab under "General", enter the IP address of the communication partner, e.g. 192.168.178.35 (IP address of the S7 CPU).



3. In the "General" tab under "Address details", enter the partner TSAP. The partner TSAP is composed as follows: 03. Slot of the CPU, e.g.:
  - S7-1500/S7-1200 CPU in slot 1: 03.01
  - S7-300 CPU in slot 2: 03.02
  - S7-400 CPU in slot 3: 03.03



4. In the "General" tab under "OPC", enable the function "Maintain connection permanently".





## 2.5.4 Creating S7 tags

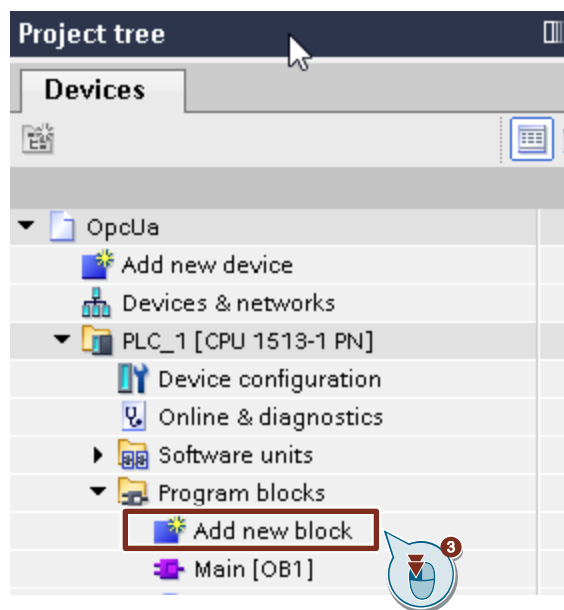
### Overview

- Access to the S7 tags of a data block with optimized access is only possible via optimized S7 connections and the symbolic name.
- The S7 tags are stored symbolically in the data block with standard access. There are two options for accessing the S7 tags:
  - via the symbolic names
  - Using the "PUT" and "GET" services via the absolute address
- There are two options for accessing S7 tags that are defined in a tag table:
  - via the symbolic names
  - Using the "PUT" and "GET" services via the absolute address

### Insert data block (DB) with optimized block access

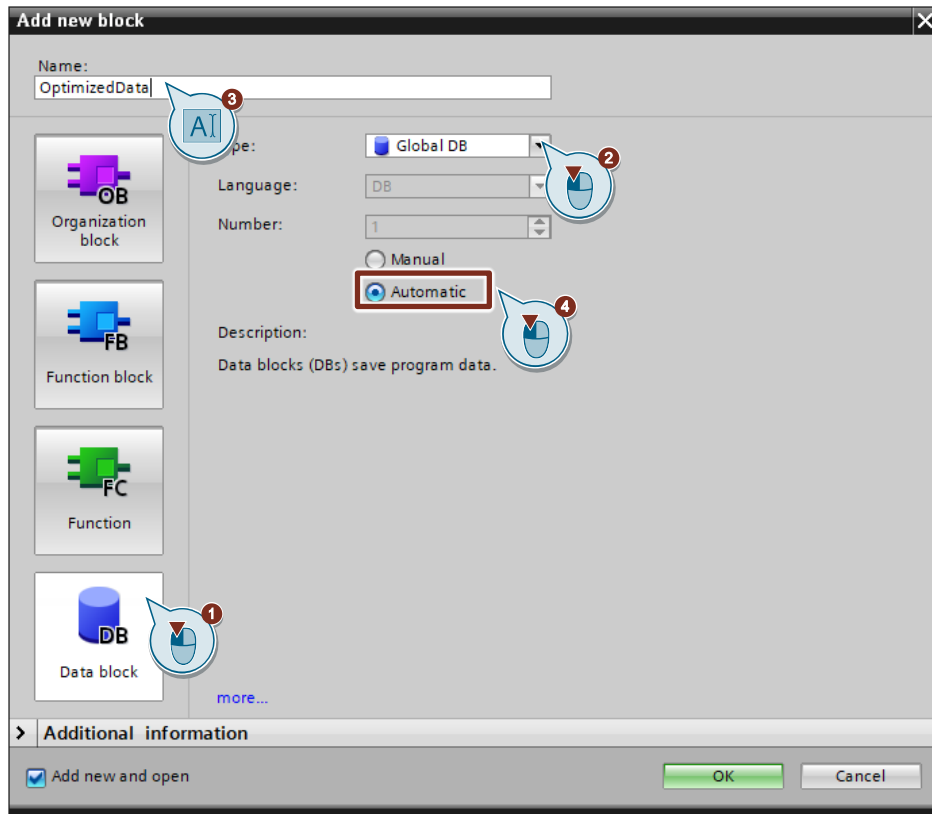
Data blocks (DBs) with optimized block access are only available with S7-1500 CPUs and S7-1200 CPUs. Access to the S7 tags of a DB with optimized block access is only possible symbolically via an optimized S7 connection.

1. Navigate in the "Project tree" to the device folder of the S7 CPU.
2. Open the "Program blocks" folder.
3. Double-click the "Add new block" command.



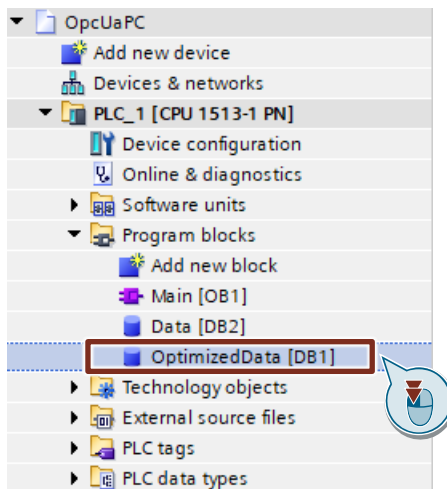
The dialog "Add new block" opens.

4. Make the following settings and then confirm your entries with the "OK" button.



- Click the "Data block" button.
- Select the "Global DB" type.
- Enter the name of the DB, e.g. "OptimizedData".
- Activate the "Automatic" radio button for automatic number assignment. The number of the global DB is assigned by TIA Portal.

5. Double-click the newly inserted global DB "OptimizedData". The data block opens.



6. Double-click "<Add new>" to create S7 tags.

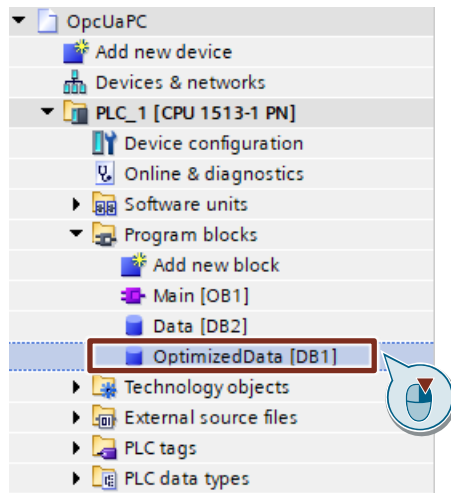
Figure 2-10

OptimizedData			
	Name	Data type	Start value
[-]	▼ Static		
[-]	dataInteger	Int	0
[-]	dataBool	Bool	false
[-]	dataReal	Real	0.0
[-]	dataArray	Array[0..9] of Byte	
[-]	▼ typeDataArray	Array[0..9] of "typeDataArray"	
[-]	▶ typeDataArray[0]	"typeDataArray"	
[-]	▶ typeDataArray[1]	"typeDataArray"	
[-]	▶ typeDataArray[2]	"typeDataArray"	
[-]	▶ typeDataArray[3]	"typeDataArray"	
[-]	▶ typeDataArray[4]	"typeDataArray"	
[-]	▶ typeDataArray[5]	"typeDataArray"	
[-]	▶ typeDataArray[6]	"typeDataArray"	
[-]	▶ typeDataArray[7]	"typeDataArray"	
[-]	▶ typeDataArray[8]	"typeDataArray"	
[-]	▶ typeDataArray[9]	"typeDataArray"	
[-]	▼ dataPlcDataType	"typeDataArray"	
[-]	▶ dataArray	Array[0..9] of Byte	
[-]	dataInt	Int	0
[-]	dataReal	Real	0.0
	<Add new>		

7. Create the S7 tags that you need. Use the following data types, for example.

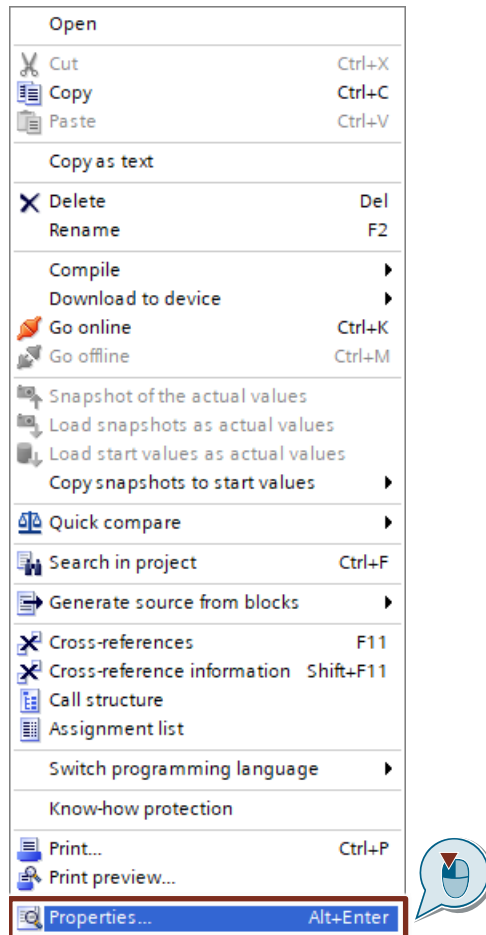
- Integer
- Bool
- Real
- Array: A data structure which consists of a fixed number of components of the same data type. This application example uses the data types BYTE and PLC data type for the components.
- PLC data type: composite user-defined data type. It represents a data structure composed of multiple components of different data types.

8. In the "Project tree", right-click the newly added global DB "OptimizedData".



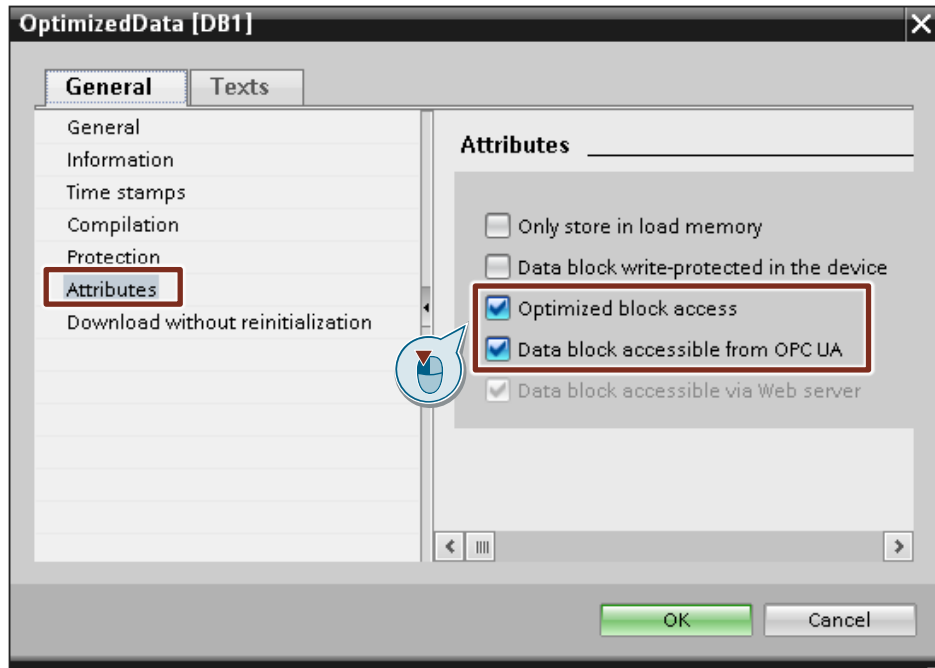
The context menu opens.

9. Select "Properties".



The Properties dialog for the DB will open.

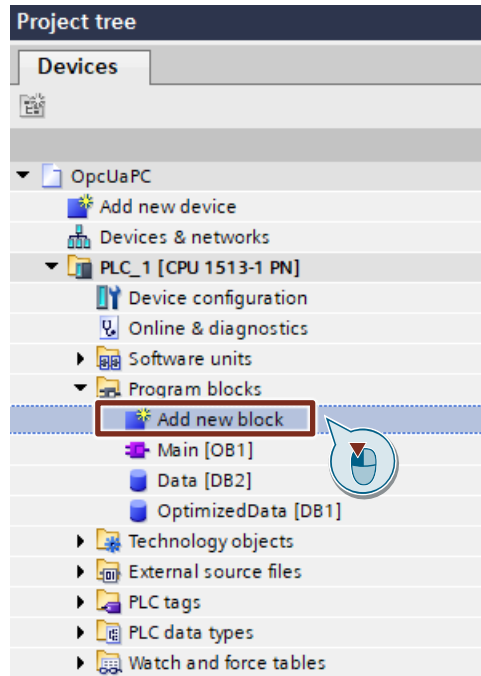
10. Enable the following functions in the "General" tab under "Attributes" and then apply the settings by clicking "OK":



- "Optimized block access"
- "DB accessible from OPC UA"

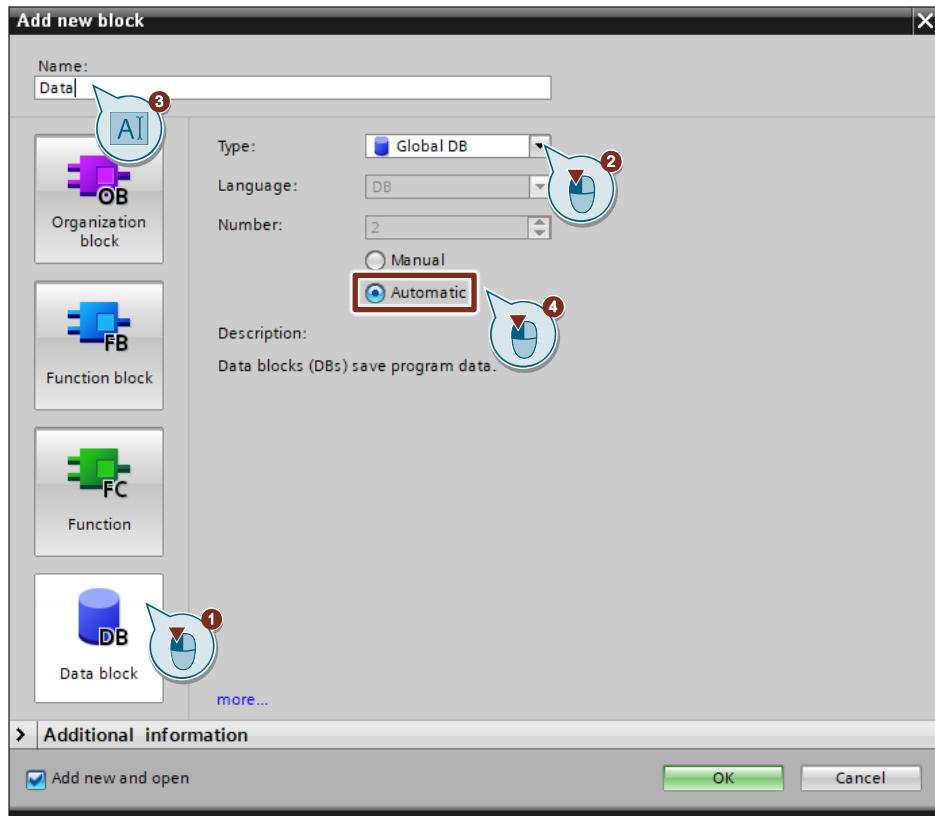
### Insert data block (DB) with standard access

1. Navigate in the "Project tree" to the device folder of the S7 CPU.
2. Open the "Program blocks" folder.
3. Double-click the "Add new block" command.



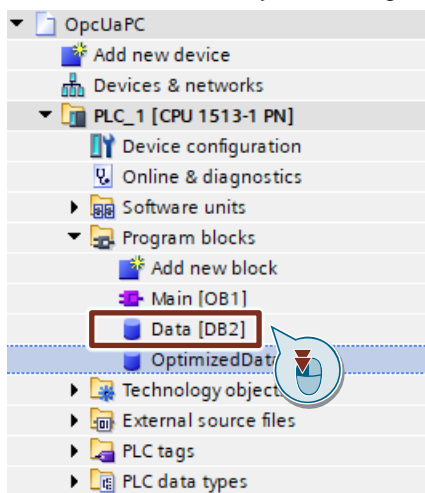
The dialog "Add new block" opens.

4. Make the following settings and then confirm your entries with the "OK" button.



- Click the "Data block" button.
- Select the "Global DB" type.
- Enter the name of the DB, e.g. "Data".
- Activate the "Automatic" radio button for automatic number assignment. The number of the global DB is assigned by TIA Portal.


5. Double-click the newly inserted global DB "Data".



The data block opens.

6. Double-click "<Add new>" to create S7 tags.

Data				
	Name	Data type	Offset	Start value
[-]	▼ Static			
[-]	dataInteger	Int	0.0	0
[-]	dataBool	Bool	2.0	false
[-]	dataReal	Real	4.0	0.0
[-]	dataArray	Array[0..9] of Byte	8.0	
[-]	▼ typeDataArray	Array[0..9] of *typeDataArray*	18.0	
[-]	▶ typeDataArray[0]	*typeDataArray*	18.0	
[-]	▶ typeDataArray[1]	*typeDataArray*	34.0	
[-]	▶ typeDataArray[2]	*typeDataArray*	50.0	
[-]	▶ typeDataArray[3]	*typeDataArray*	66.0	
[-]	▶ typeDataArray[4]	*typeDataArray*	82.0	
[-]	▶ typeDataArray[5]	*typeDataArray*	98.0	
[-]	▶ typeDataArray[6]	*typeDataArray*	114.0	
[-]	▶ typeDataArray[7]	*typeDataArray*	130.0	
[-]	▶ typeDataArray[8]	*typeDataArray*	146.0	
[-]	▶ typeDataArray[9]	*typeDataArray*	162.0	
[-]	▼ dataPlcDataType	*typeDataArray*	178.0	
[-]	▶ dataArray	Array[0..9] of Byte	178.0	
[-]	dataInt	Int	188.0	0
[-]	dataReal	Real	190.0	0.0
	<Add new>			

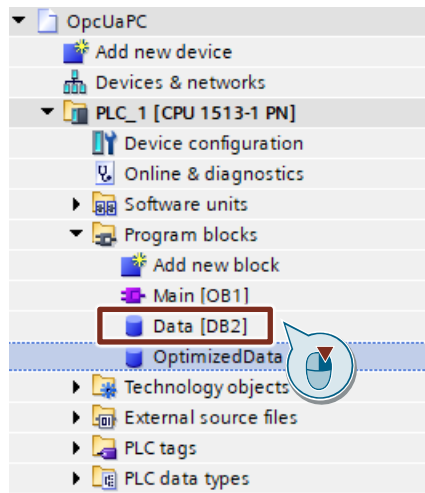


7. Create the S7 tags that you need. Use the following data types, for example:

- Integer
- Bool
- Real
- Array: A data structure which consists of a fixed number of components of the same data type. This application example uses the data types BYTE and PLC data type for the components.
- PLC data type: composite user-defined data type. It represents a data structure composed of multiple components of different data types.

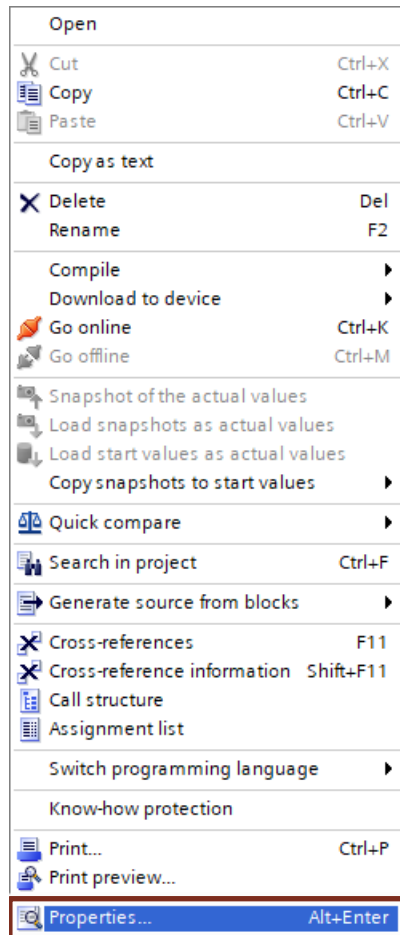


8. In the "Project tree", right-click the newly added global DB "Data".



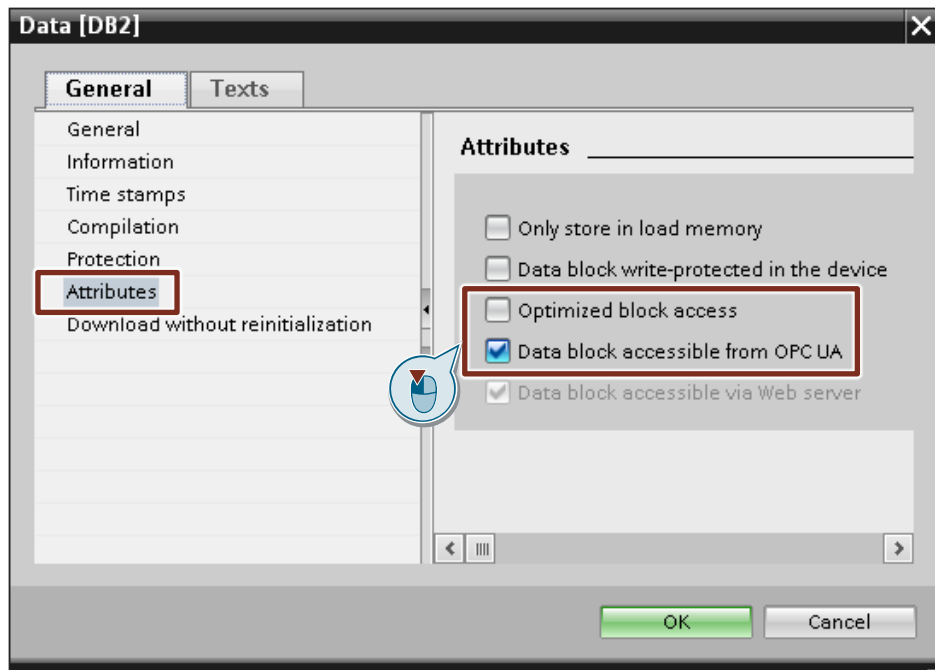
The context menu opens.

9. Select "Properties".



The Properties dialog for the DB will open.

10. Make the following settings in the "General" tab under "Attributes" and then apply the settings by clicking "OK":



- Disable the function "Optimized block access".
- Enable the function "DB accessible from OPC UA".

### Define S7 symbols in the tag table

Define the S7 tags in the tag table with symbolic names, e.g.:

- Bit memories
- Inputs
- Outputs
- Times
- Counter

In this example, memory byte MB 0 is activated in the S7 CPU as clock memory. In S7-1500 CPUs and S7-1200 CPUs, the clock memories are automatically entered with their symbolic names in the tag table.

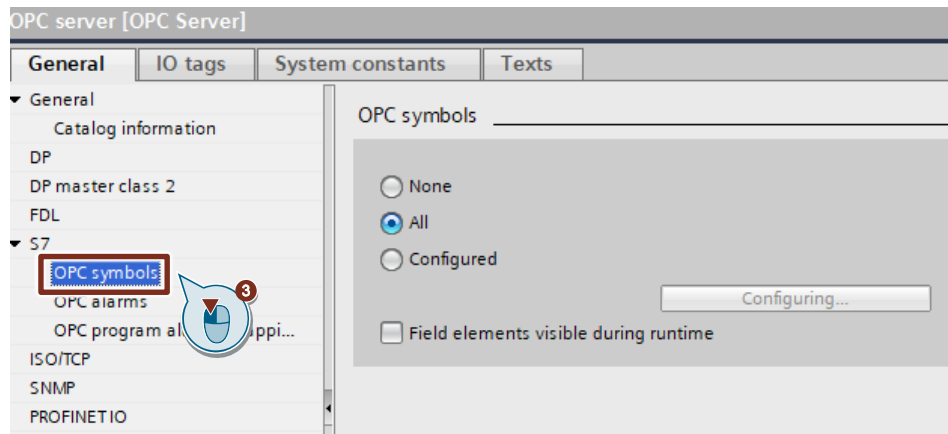
Manually enter the addresses and symbol names of the clock memories in the tag table if you are using an S7-300 CPU or S7-400 CPU.

Figure 2-11

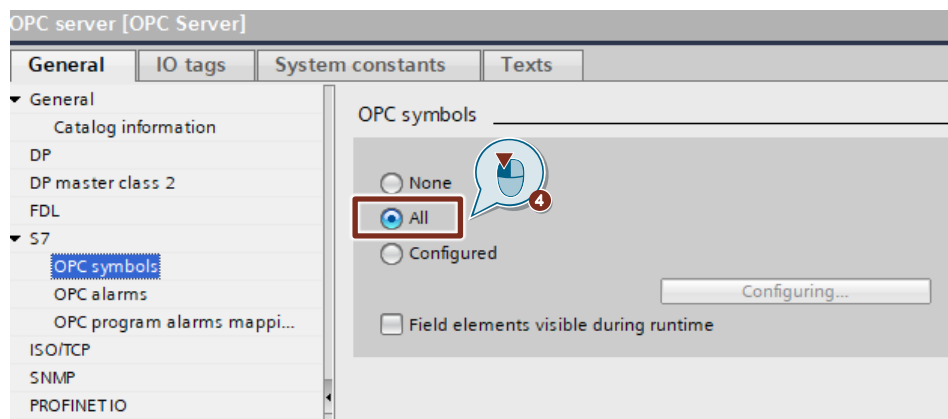
	Name	Data type	Address
1	Clock_Byte	Byte	%MB0
2	Clock_10Hz	Bool	%M0.0
3	Clock_5Hz	Bool	%M0.1
4	Clock_2.5Hz	Bool	%M0.2
5	Clock_2Hz	Bool	%M0.3
6	Clock_1.25Hz	Bool	%M0.4
7	Clock_1Hz	Bool	%M0.5
8	Clock_0.625Hz	Bool	%M0.6
9	Clock_0.5Hz	Bool	%M0.7
10	<Add new>		

### 2.5.5 Declaring S7 symbols to the OPC server

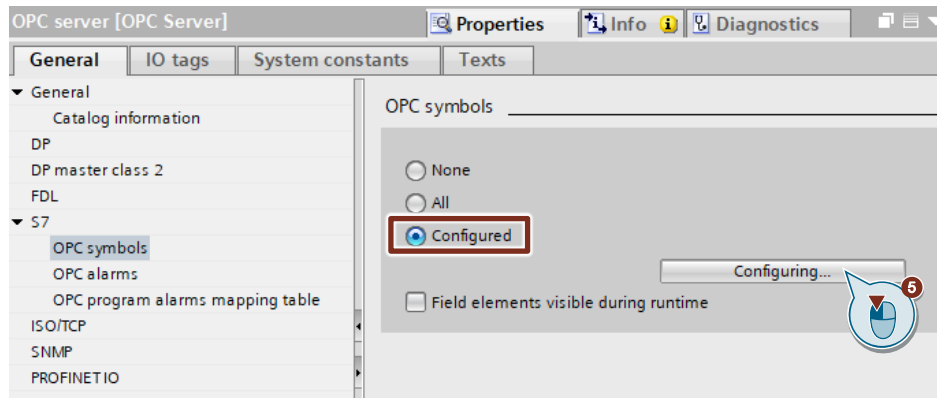
1. Open the "Device view" of the PC station.
2. Select the OPC server.  
The properties of the OPC server are displayed in the Inspector window.
3. In the "General" tab, navigate to "S7 > OPC symbols".



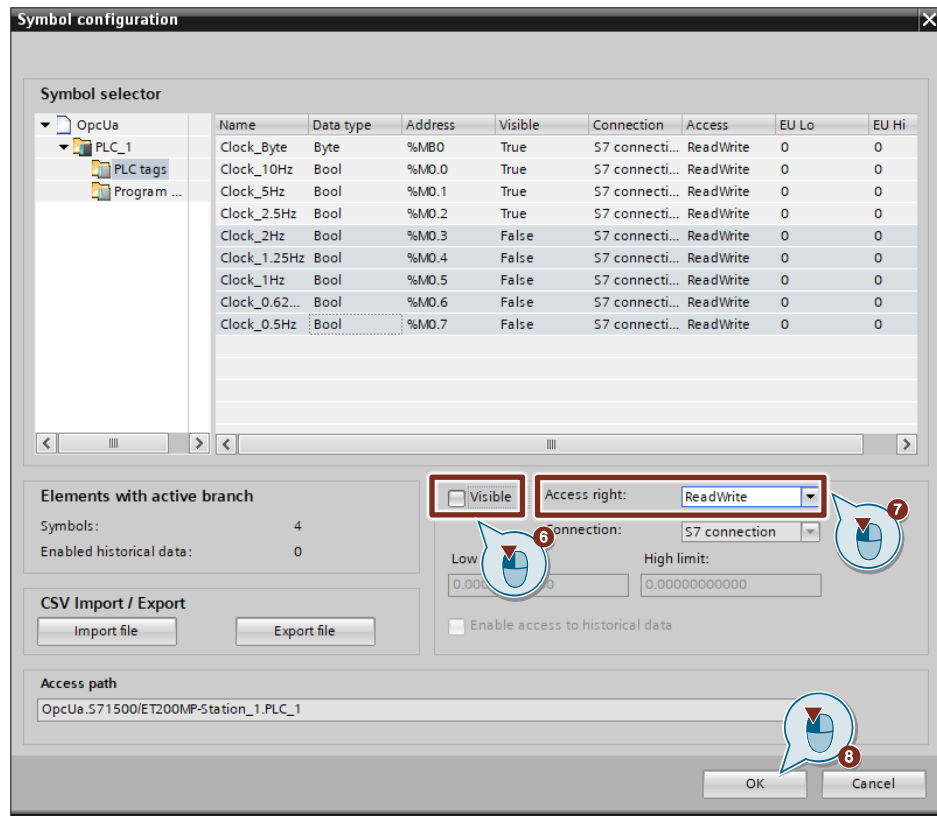
4. Enable the option "All" in order to access all symbolic S7 tags in the OPC server.



- In order to access configured symbolic S7 tags in the OPC server, enable the option "Configured" and click the "Configuring" button.



The "Symbol Configuration" dialog opens.

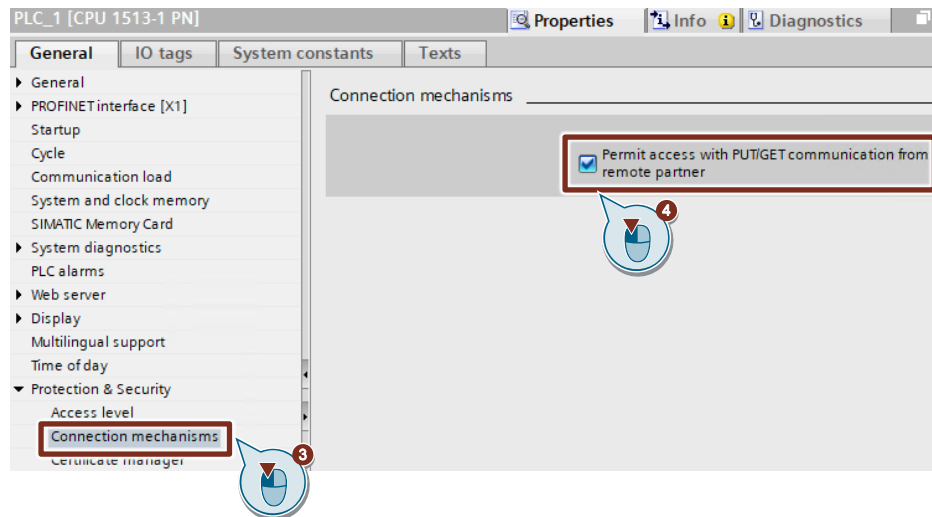


- Define which S7 tags will be visible in the OPC server so that the OPC client can access them. By default, the option "Visible" is enabled for the S7 tags.
- Define the access permissions for the S7 tags. The access permission "ReadWrite" is set by default.
- Click "OK" to apply the settings.

### 2.5.6 Allow access via PUT/GET communication from a remote partner

For the S7-1500 CPUs and S7-1200 CPUs, it is necessary to allow access via PUT/GET communication from a remote partner so that the SIMATIC NET OPC UA server can access the S7 tags in the S7 CPU using the "PUT" and "GET" services with the absolute address.

1. Open the device view of the S7 CPU.
2. Select the S7 CPU in the device view.  
The properties of the S7 CPU are displayed in the Inspector window.



3. In the "General" tab, navigate to "Protection & Security > Connection mechanisms".
4. Enable the function "Permit access with PUT/GET communication from remote partner".

## 2.6 Configuring the "Station Configuration Editor"

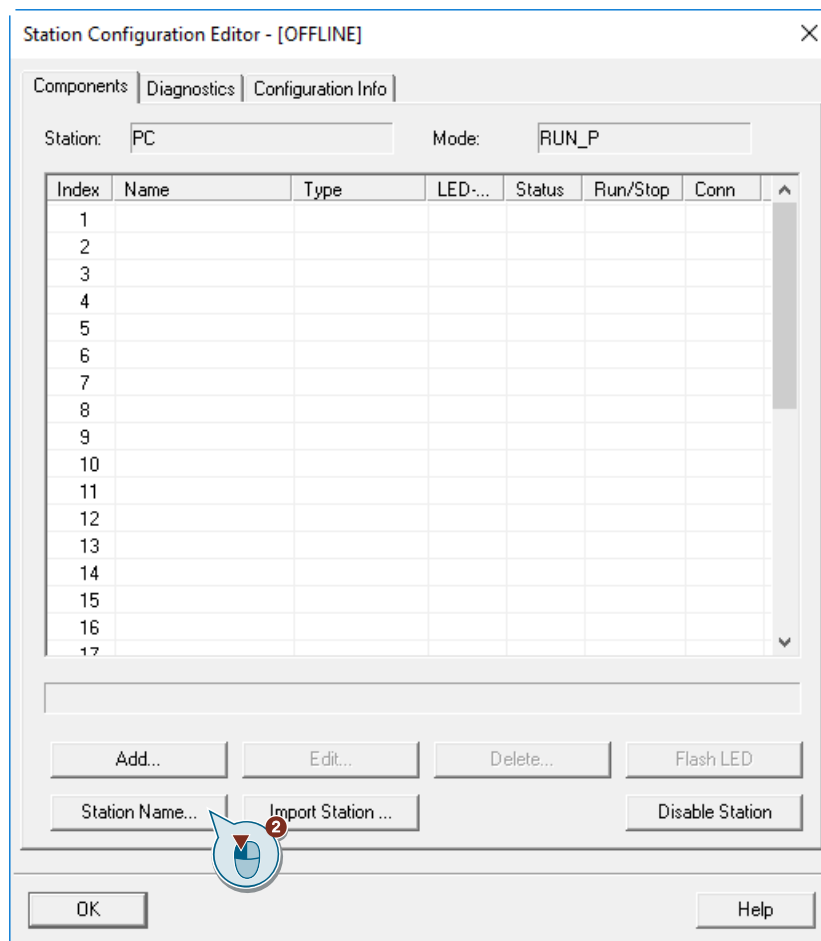
### 2.6.1 Manual configuration

#### Note

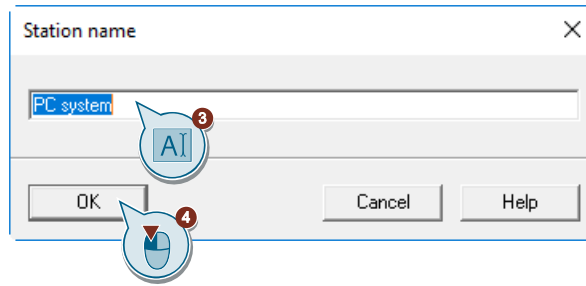
Insert the components in the same order as in the component image that you created in TIA Portal in the "Device view" of PC station. If the configuration differs from the list, the configuration data that you download from TIA Portal to the PC station will not be adopted correctly.

When configuring for the first time it is necessary to enter the station name.

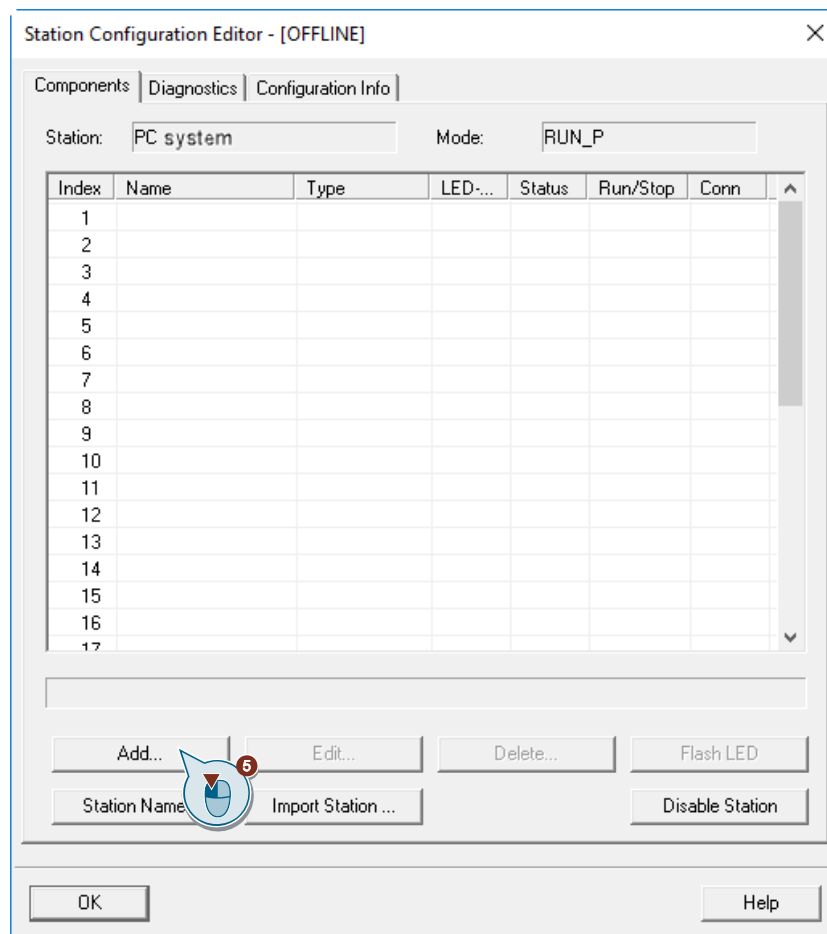
1. Double-click the corresponding icon on your desktop to start the "Station Configuration Editor".
2. Click the "Station Name" button.



The "Station name" dialog will open.



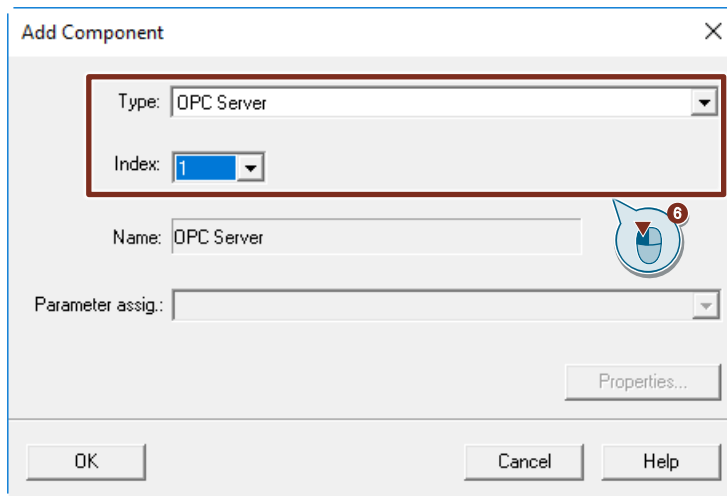
3. Enter the station name, e.g. "PC system".  
It is imperative that the name in the "Station Configuration Editor" matches the name that you assigned when configuring the PC station with TIA Portal.
4. Click "OK" to apply the settings.
5. Click the "Add" button.



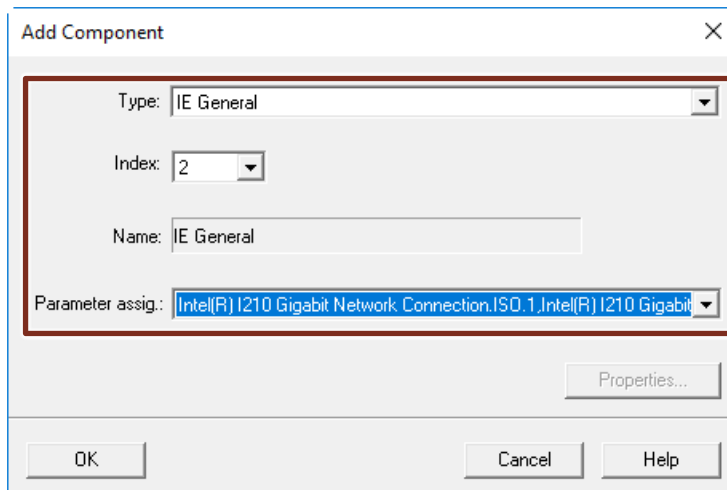
The "Add Component" dialog box opens.



6. Make the following settings in order to add the "OPC server" user application.
  - "Type": "OPC Server"
  - Index: 1



7. Make the following settings in order to add the "IE General" component.
  - "Type": "IE General"
  - Index: 2
  - "Parameter assign.":  
Select the network adapter via which the PC station is connected to communicate with the S7 CPU.

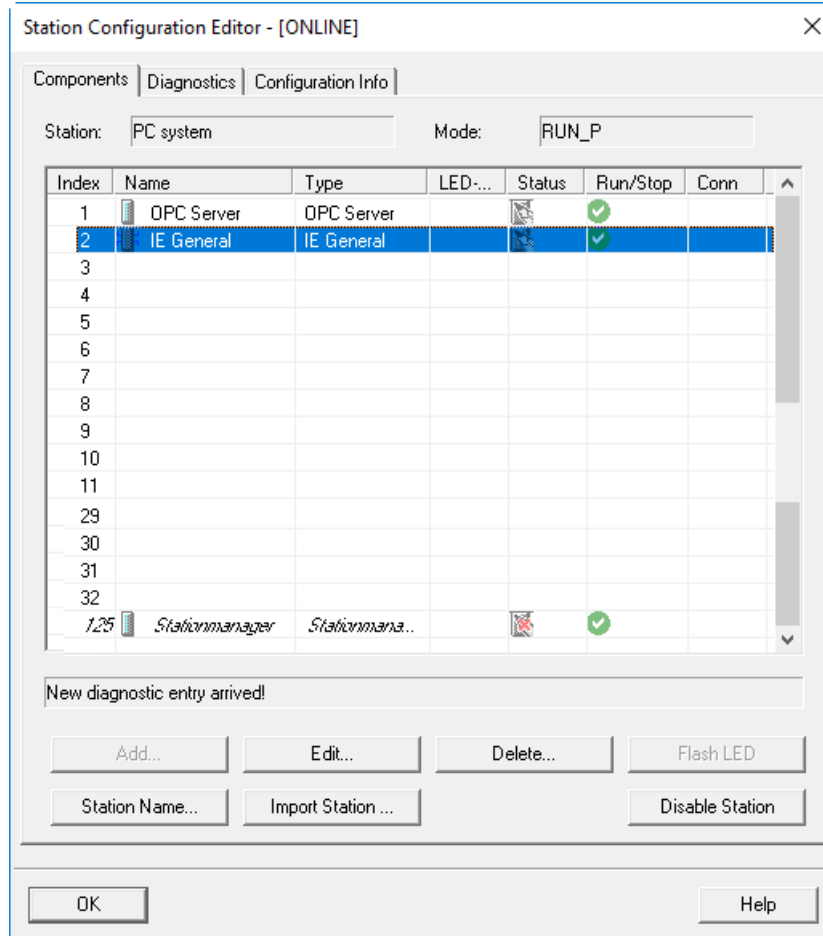


## Result

The added components and the station name will be displayed in the "Station Configuration Editor":

- Station name: "PC system"
- Index 1: "OPC server"
- Index 2: "IE General"
- Index 125: "Stationmanager"  
"Stationmanager" will be automatically added at this index by the system.

Figure 2-12



The following status icons for the components show that the configuration data are not yet loaded:



- The component is available in the current configuration of the PC station.
- The component has a configuration that is derived from a default parameter set. The default parameter set allows a component to be accessible via network without further configuration immediately after its installation. Make sure that the default parameter set you use has parameters that match the other network parameter settings.

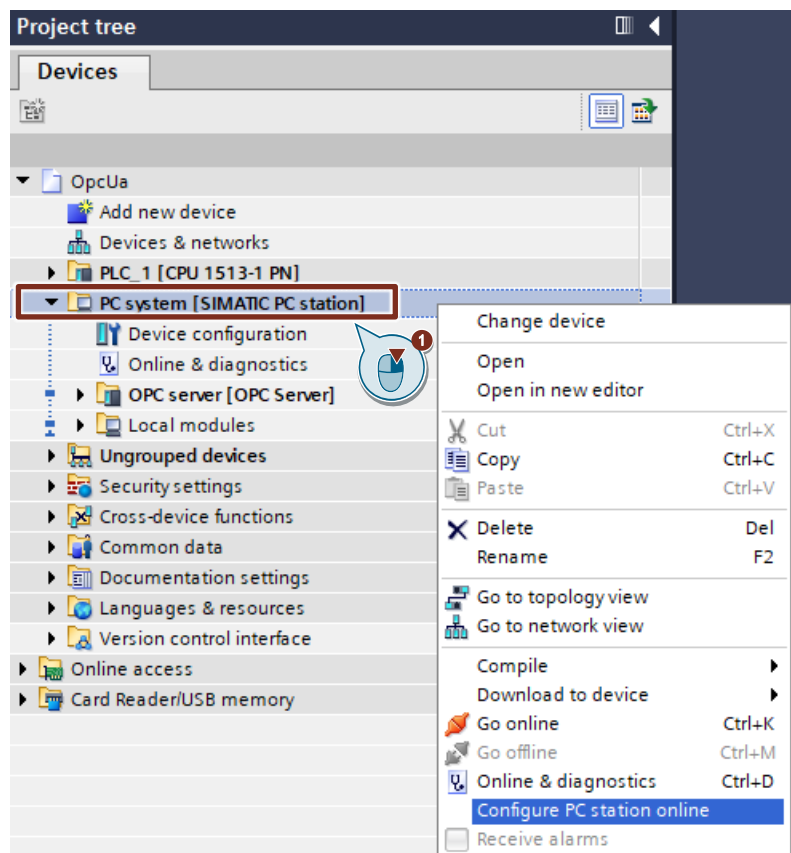


- The component exists in the current configuration of the PC station, but it was not created in the project engineering. Depending upon the intended application, the component must still be configured in STEP 7 and the configuration data must be loaded.

Once you have manually configured the "Station Configuration Editor", load the PC station's configuration data (see chapter [2.7.1](#)).

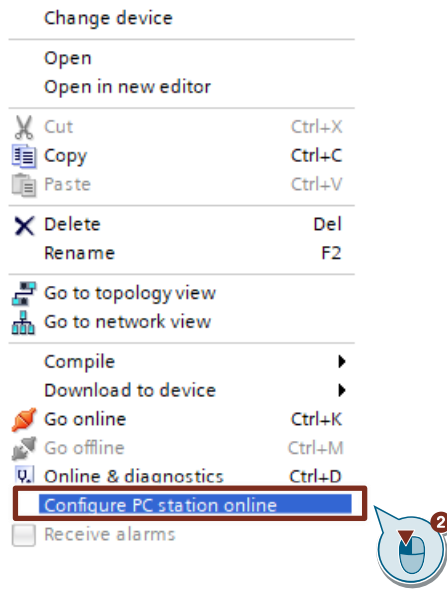
### 2.6.2 Configuring the "Station Configuration Editor" in TIA Portal

1. Right-click on the device folder of the PC station.

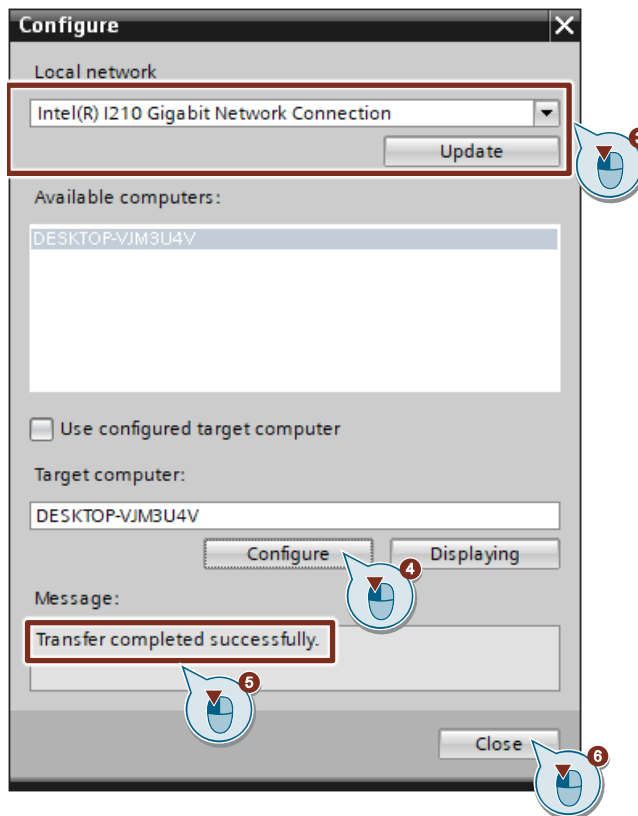


The context menu opens.

2. Select "Configure PC station online".



The "Configure" dialog will open.



- 3. Select the network adapter via which the PC station communicates with the S7 CPU, then click "Update".
- 4. Click "Configure" in order to transfer the configuration of the PC station to the Station Configuration Editor.

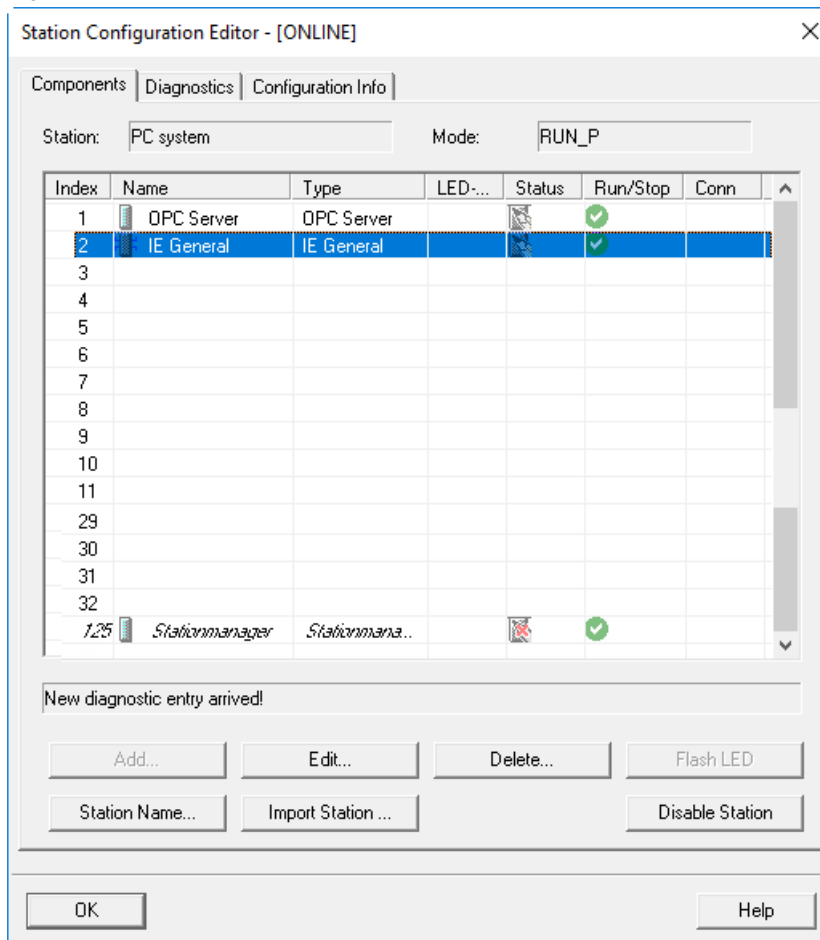
5. The message "Transfer completed successfully" will appear once the transfer has completed successfully.
6. Click "Close" to finish the dialog.

**Result**

In the "Station Configuration Editor", the components and the station name are created according to the configuration in TIA Portal:

- Station name: "PC system"
  - Index 1: "OPC server"
  - Index 2: "IE General"
  - Index 125: "Stationmanager"
- "Stationmanager" will be automatically added at this index by the system.

Figure 2-13



The following status icons for the components show that the configuration data are not yet loaded:



- The component is available in the current configuration of the PC station.
- The component has a configuration that is derived from a default parameter set. The default parameter set allows a component to be accessible via network without further configuration immediately after its installation. Make sure that the default parameter set you use has parameters that match the other network parameter settings.

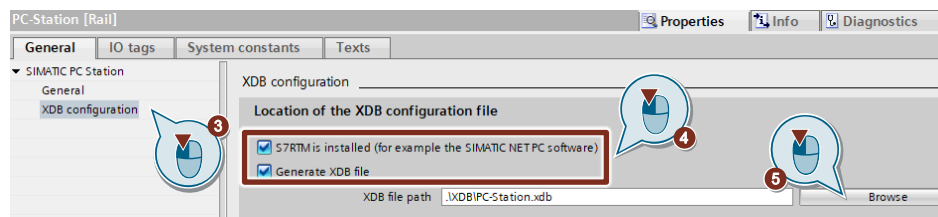


- The component exists in the current configuration of the PC station, but it was not created in the project engineering. Depending upon the intended application, the component must still be configured in STEP 7 and the configuration data must be loaded.

Once you have configured the "Station Configuration Editor" in TIA Portal, load the PC station's configuration data (see chapter [2.7.1](#)).

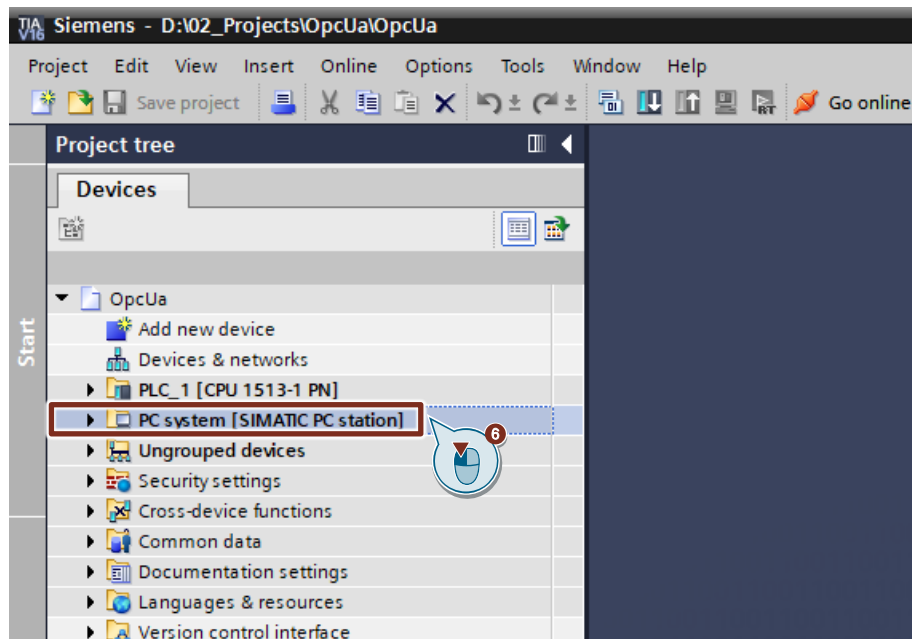
### 2.6.3 XDB export: Exporting XDB from TIA Portal

1. Open the "Device view" of the PC station.
2. Select the PC station.  
The Inspector window displays the properties of the PC station.

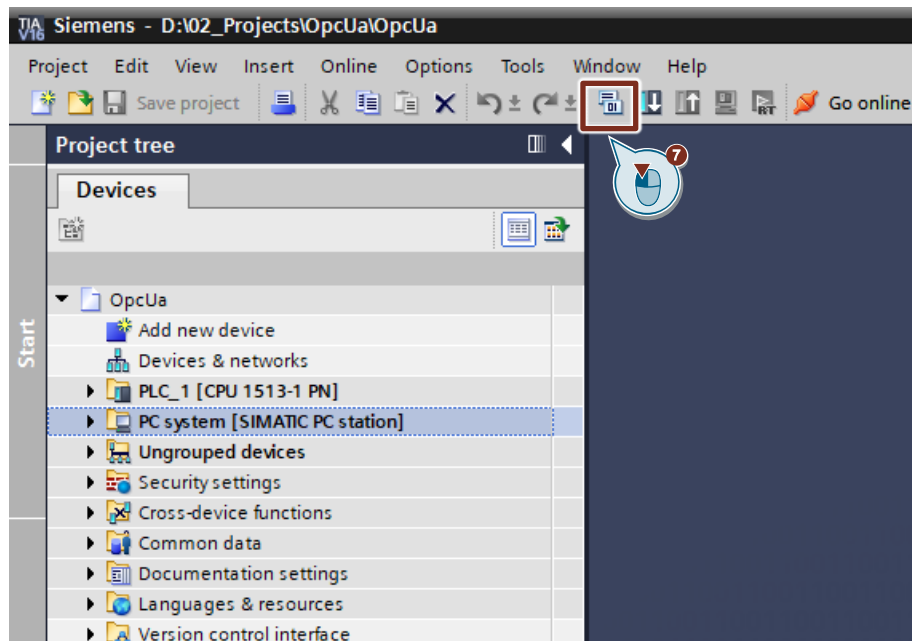


3. In the "General" tab, navigate to "XDB configuration".
4. Activate the following functions:
  - "S7RTM is installed (for example SIMATIC NET PC software)"
  - "Generate XDB file"
5. Click on the "Browse" button to set the path where the XDB file will be stored.

6. Select the PC station in the "Project tree".



7. Click on the "Compile" button in the function bar.



### Result

The XDB configuration file will be generated and saved in the directory that you set when configuring the PC station.

## 2.7 Loading configuration data

### 2.7.1 Load PC station configuration data

For productive operation, you require not only the component configuration but also the project engineering data for the communication connections and possibly also for the S7 tag symbols. You can load the configuration data to the PC station in the following ways:

- Loading via TIA Portal in online mode
- XDB import: Importing XDB in the Station Configuration Editor

#### Loading via TIA Portal in online mode

The online mode allows you to download the configuration data directly to a PC station connected to the network, or to load the data to the local PC station if you are using this as the Engineering PC.

#### Note

Loading via TIA Portal in online mode will only successfully install the communication services on your PC station if the component layout in the project engineering data is identical to the layout in the configuration data on the PC station.

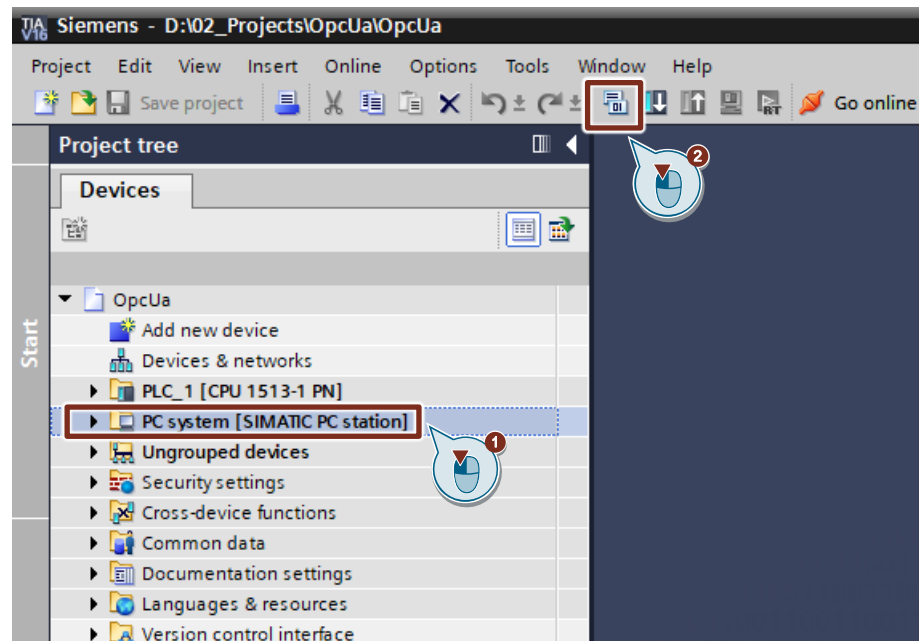
#### Requirements:

- Engineering PC and PC station are in the same subnet
- You set the same IP address and subnet mask for the PC station network adapter as you did in the hardware configuration (see chapter [2.2.1](#)).



Compiling:

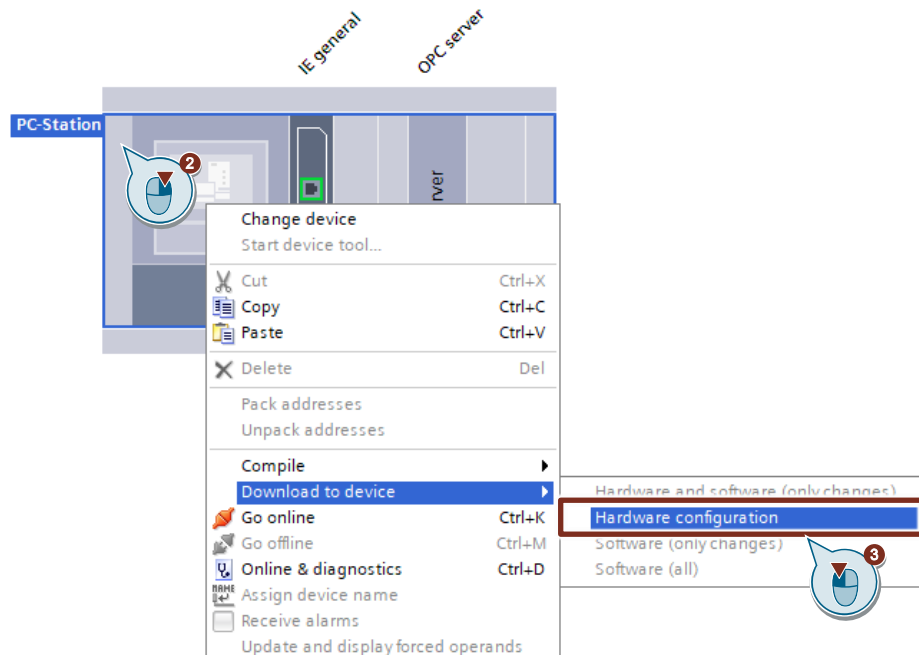
Figure 2-14



1. Select the PC station in the "Project tree".
2. Click on the "Compile" button in the function bar.

Loading:

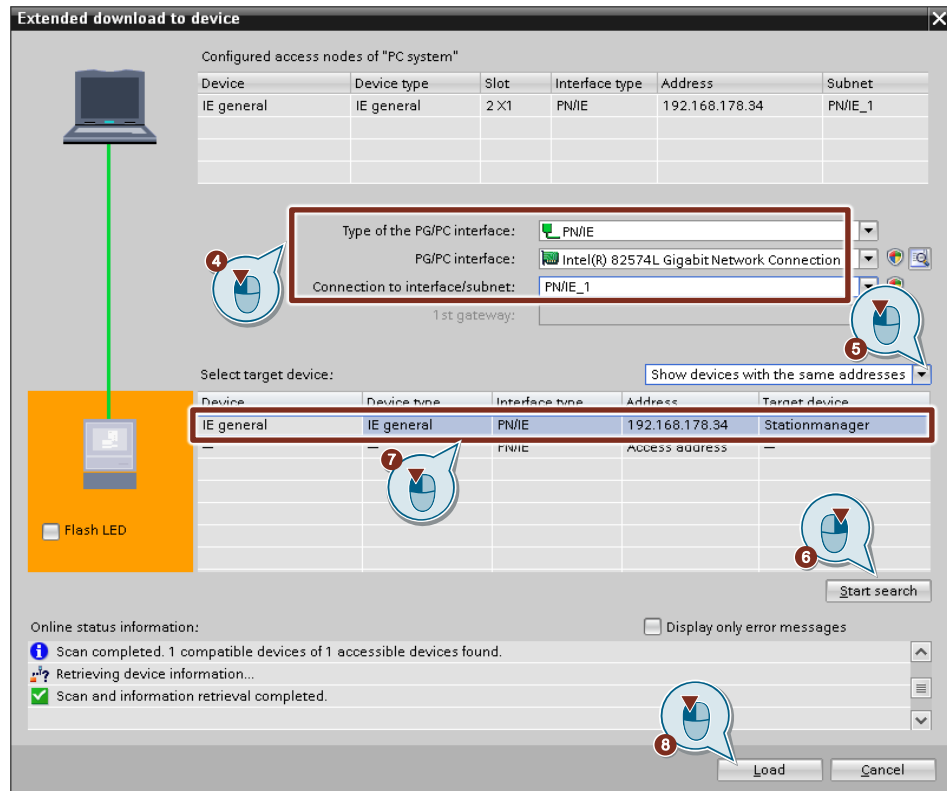
1. Open the "Device view" of the PC station.



2. Right-click the PC station.  
The context menu opens.
3. Select the "Download to device > Hardware configuration" command.  
The "Extended download to device" or "Load preview" dialog opens automatically.

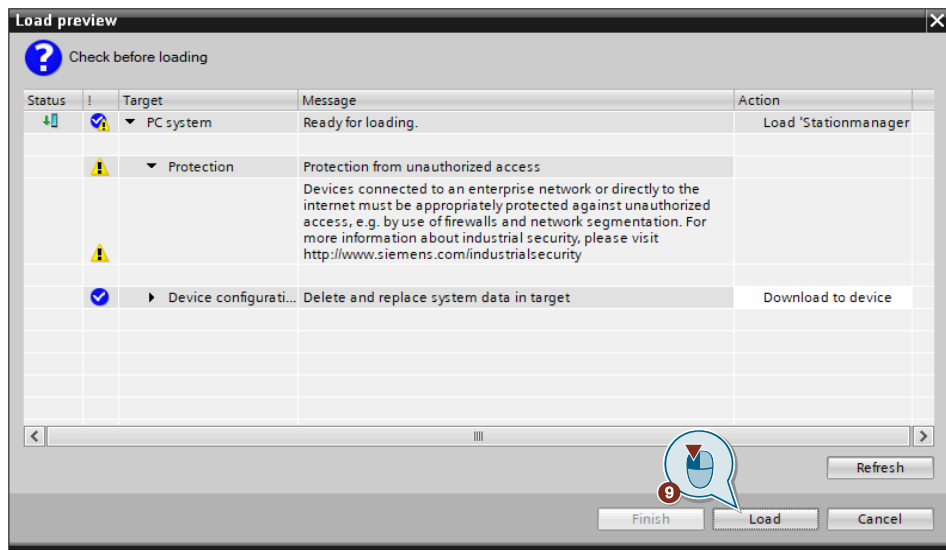
**Note**

The "Extended download to device" dialog is only opened automatically if the access path to the PC station has to be reset.



4. In the "Extended download to device" dialog, make the following settings:
  - Type of PG/PC interface: PN/IE
  - PG/PC interface: Network adapter of the PC station
  - Connection to interface/subnet: Subnet of the PC station, e.g. PN/IE\_1
5. Select the option "Show devices with the same addresses".
6. Click the "Start search" button.
7. Select the Station Manager as target device.
8. Click "Load".  
The "Load preview" dialog window opens.

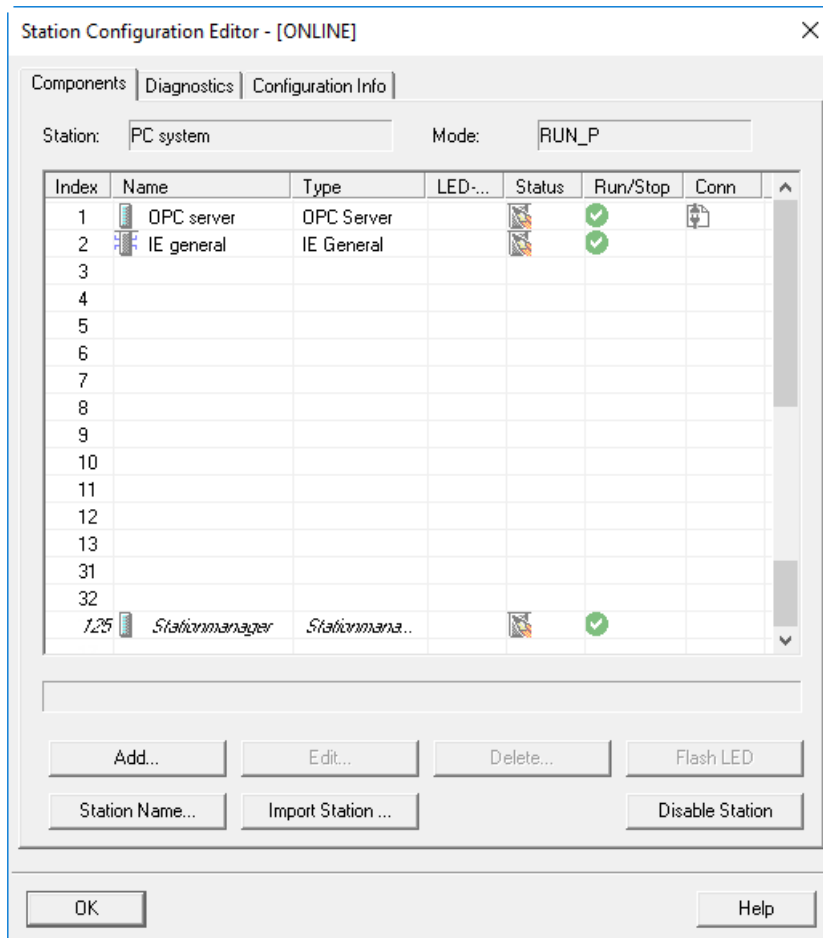
9. Click the "Load" button to start the load process.



Result:

The PC station configuration data have been loaded successfully.

Figure 2-15



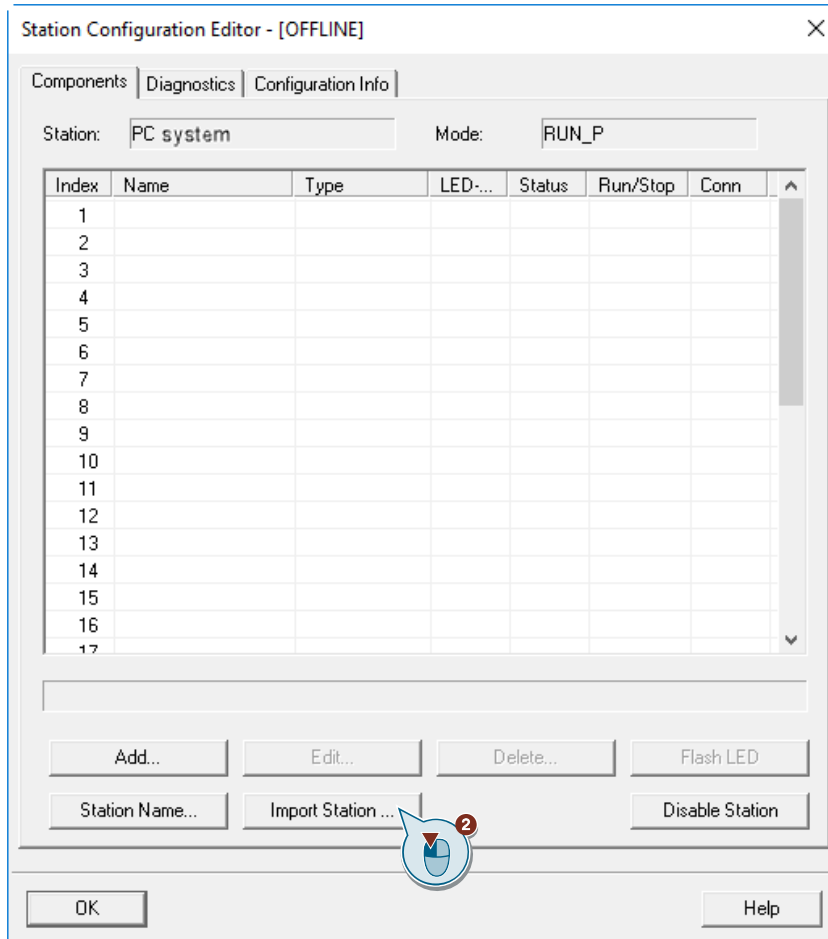
- The components are in "RUN" mode. This is shown with the icon in the "Run/Stop" column.
- The following status icon for the component shows that the configuration data have been loaded successfully.



- The component is present and configured in the current configuration of the PC station.
  - The component is ready for operation!
- The configured S7 connection is loaded. This is shown with the icon in the "Conn" column.

**XDB import: Importing XDB in the Station Configuration Editor**

1. Open the Station Configuration Editor.
2. Click "Import Station" to download the configuration data to the PC station.



Result:

The PC station configuration data have been loaded successfully.

Figure 2-16



- The station has the same name as in the component image that you generated in TIA Portal in the "Device view" for the PC station.
- The components are in "RUN" mode. This is shown with the icon in the "Run/Stop" column.
- The following status icon for the component shows that the configuration data have been loaded successfully.
  - The component is present and configured in the current configuration of the PC station.
  - The component is ready for operation!
- The configured S7 connection is loaded. This is shown with the icon in the "Conn" column.

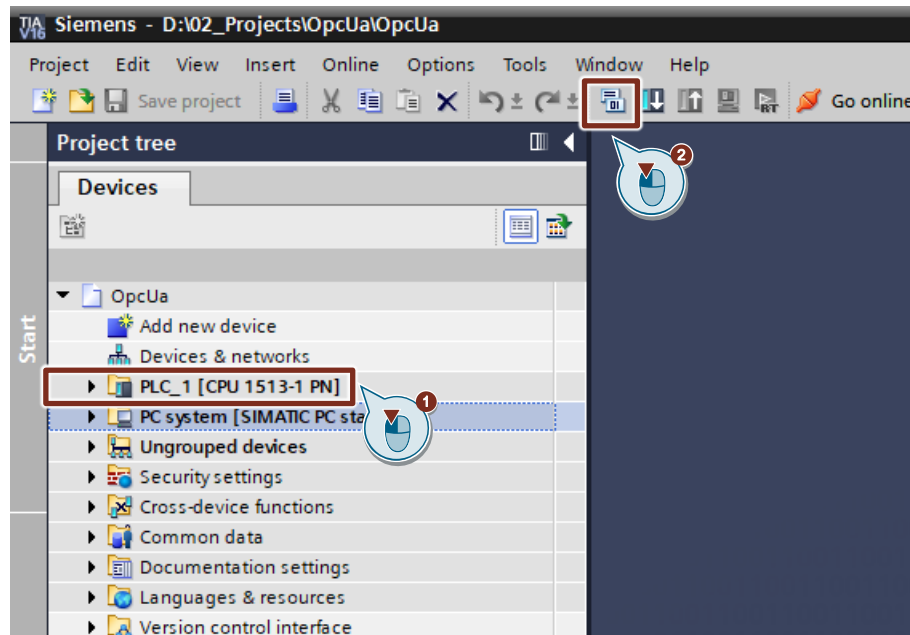
## 2.7.2 Load S7 CPU configuration data

### Requirements

- Engineering PC and S7 CPU are in the same subnet.
- You set the same IP address and subnet mask for the S7 CPU as you did in the hardware configuration (see chapter [2.2.2](#)).

### Compile

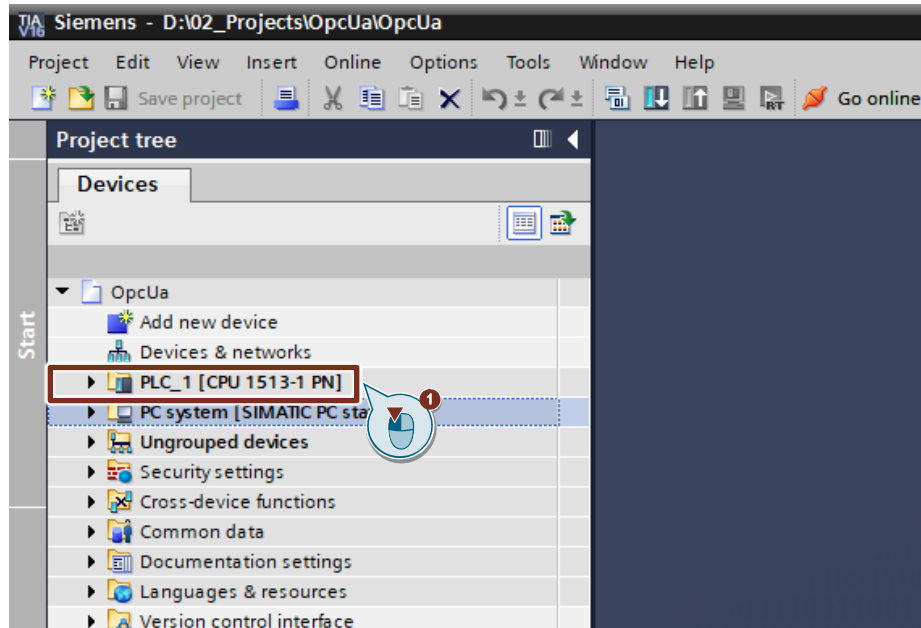
Figure 2-17



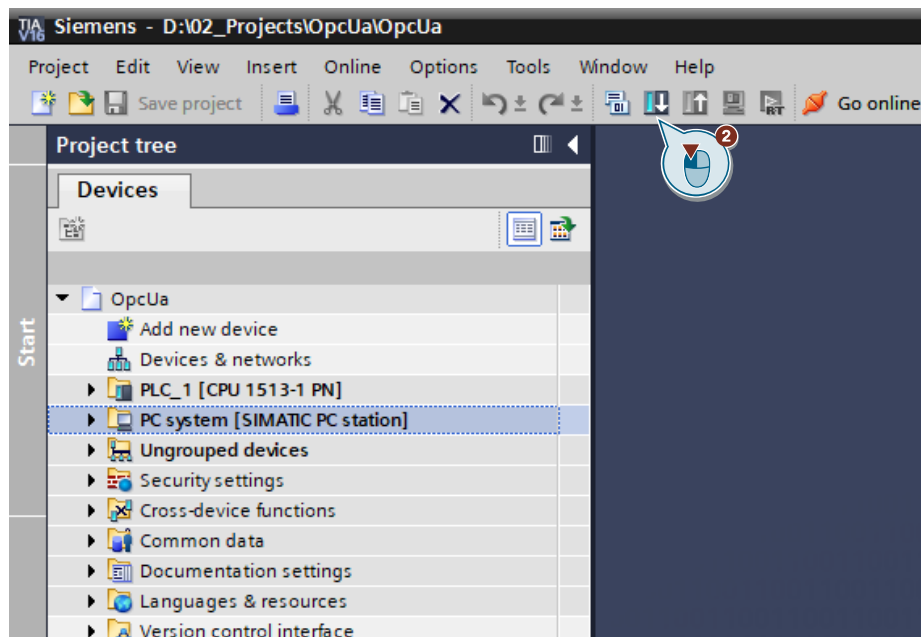
1. Select the S7 CPU in the "Project tree".
2. Click on the "Compile" button in the function bar.

### Downloading

1. Select the S7 CPU in the "Project tree".



2. Click on the "Download to device" button in the function bar.

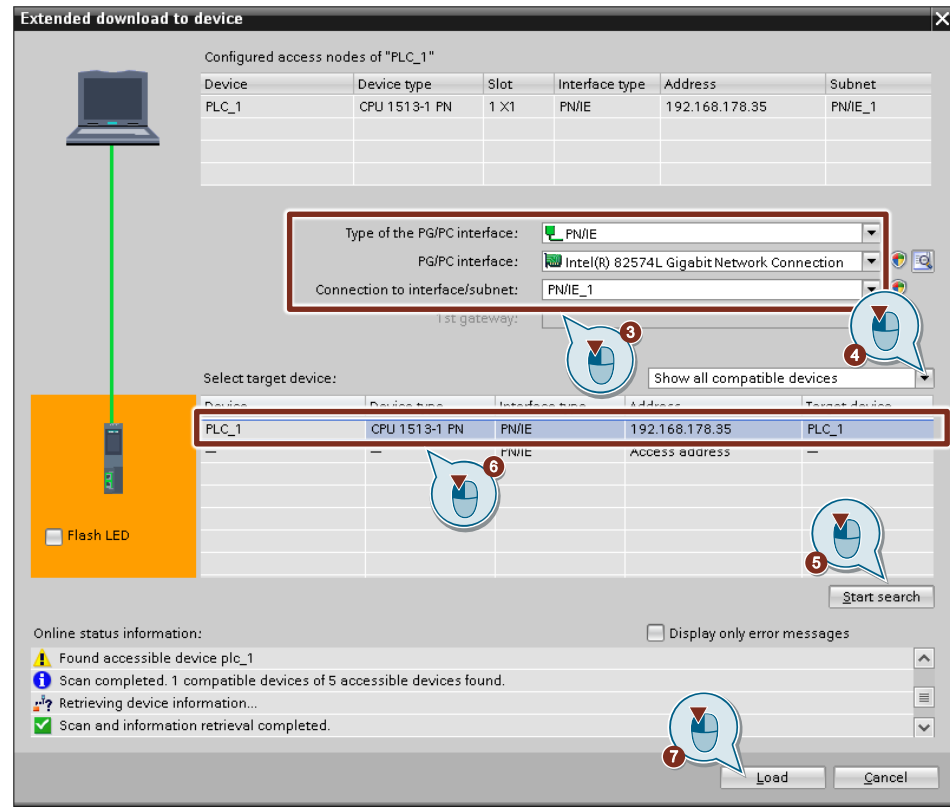




The "Extended download to device" or "Load preview" dialog opens automatically.

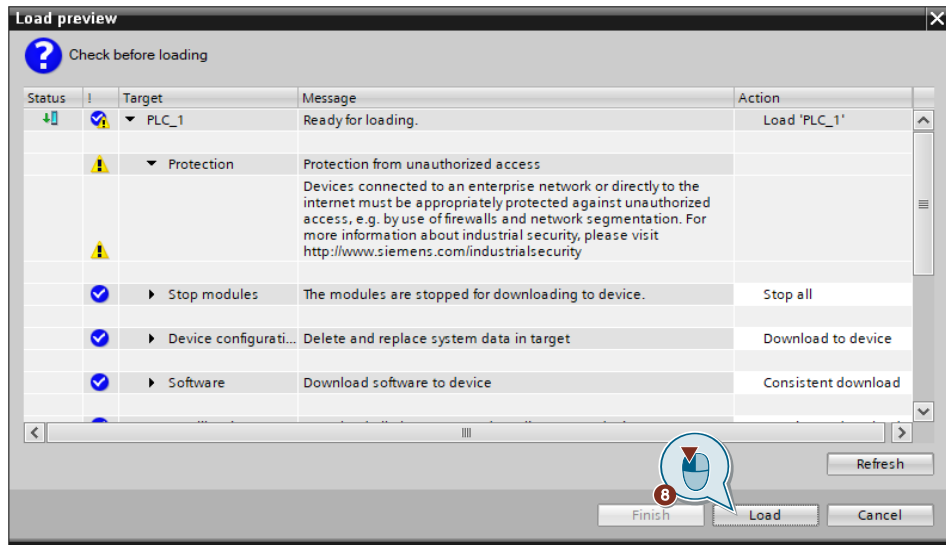
**Note**

The "Extended download to device" dialog is only opened automatically if the access path from the PG/PC to the S7 CPU has to be reset.



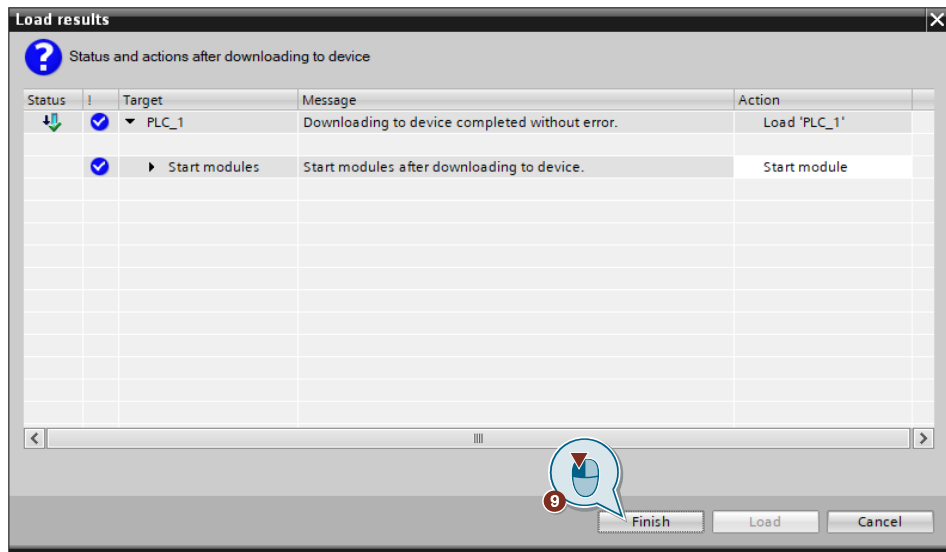
3. In the "Extended download to device" dialog, make the following settings to access the S7 CPU over TCP/IP:
  - Type of PG/PC interface: PN/IE
  - PG/PC interface: PG/PC network adapter
  - Connection to interface/subnet: Subnet of the S7 CPU, e.g. PN/IE\_1
4. Select the "Show all compatible devices" option.
5. Click the "Start search" button.
6. Select the S7 CPU as the target device.
7. Click "Load".  
The "Load preview" dialog window opens.

- Click the "Load" button to start the load process.



The "Load results" dialog opens.

- Click "Finish" to finish downloading.



## 3 Operation

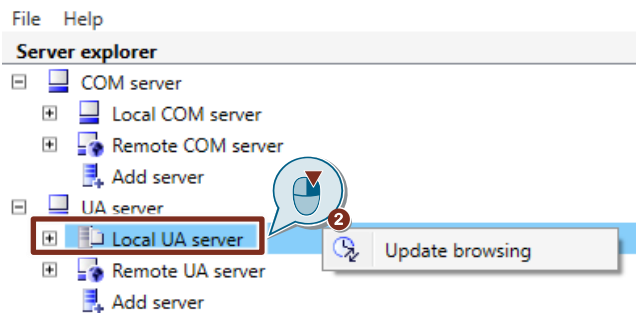
### 3.1 Establish SIMATIC S7 communication from the PC station to the S7 CPU

#### 3.1.1 Establishing an optimized S7 connection

The SIMATIC NET OPC server V12 or higher supports optimized S7 connections to S7-1500 CPUs and S7-1200 CPUs (firmware V4 or higher). You will need an OPC client in order to use read requests and write requests to access the data provided by the SIMATIC NET OPC UA server. In this example, "OPC Scout V10" from SIMATIC NET will be used as OPC client.

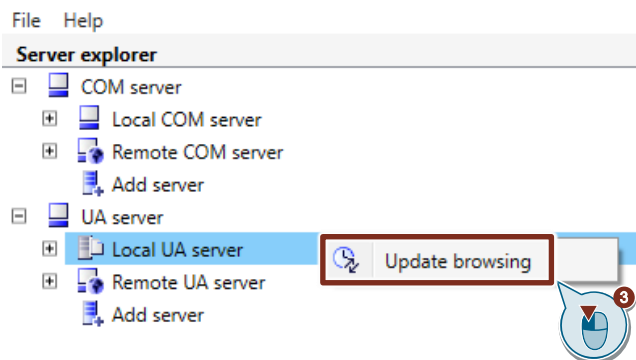
#### Establish connection to the S7OPT OPC UA server with OPC Scout V10

1. Start OPC Scout V10 from the Windows Start Menu item "Siemens Automation > OPC Scout V10".
2. In the "Server explorer" under "UA server", right-click "Local UA server".



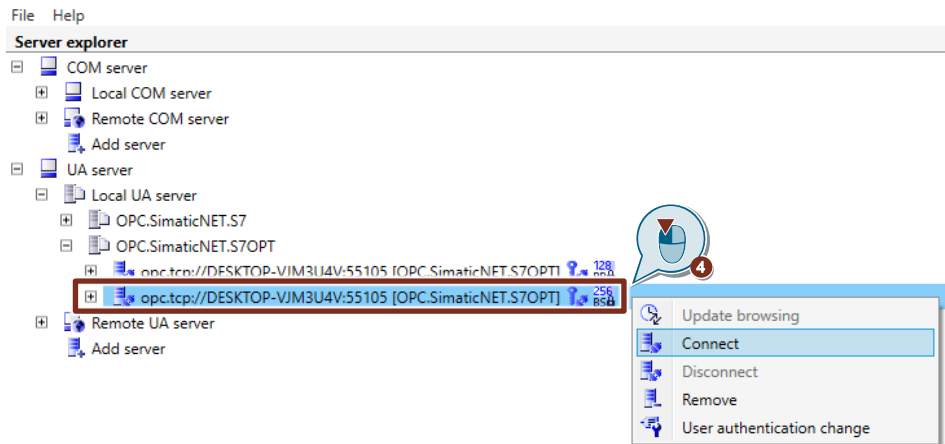
The context menu opens.

3. Click "Update browsing".



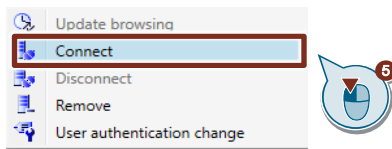
The enabled and available connections will be displayed.

- Under "UA server > Local UA server > OPC.SimaticNET.S7OPT", right-click the S7 connection to establish an optimized S7 connection form the SIMATIC NET OPC UA server to the S7 CPU.



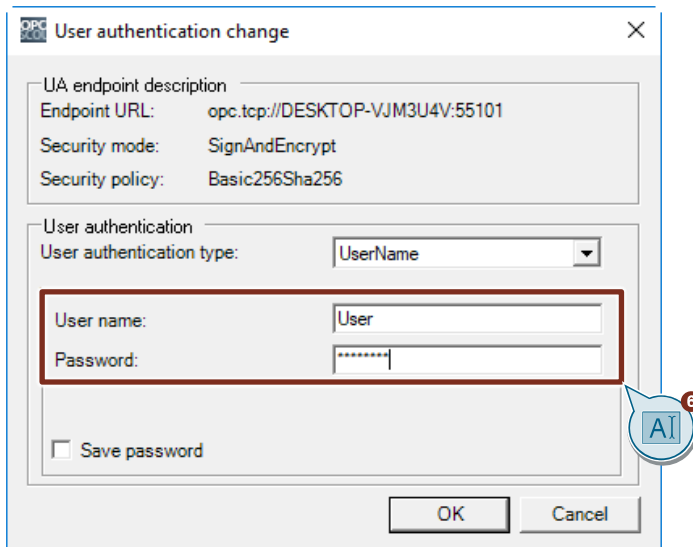
The context menu opens.

- Click "Connect".

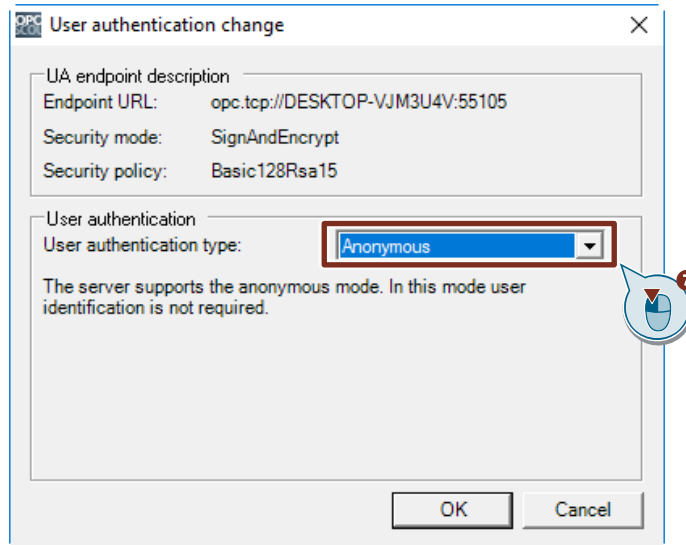


The "User authentication change" dialog opens.

- A user authentication with Windows login and password will be needed in order to establish the optimized S7 connection.



7. It is possible to log in anonymously if you enabled the option "Allow anonymous logins to the OPC UA server" in the "Communication settings".

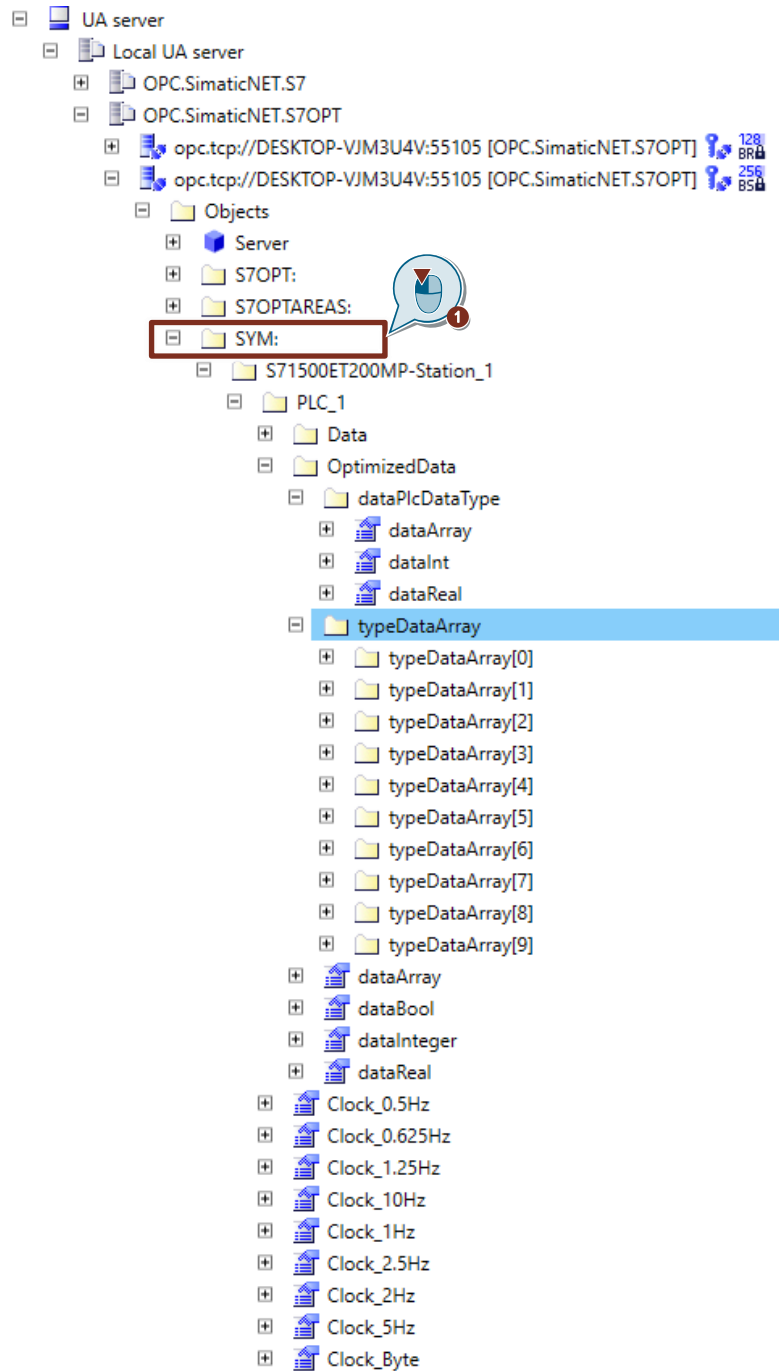


**Note**

Connect to the SIMATIC NET OPC UA server "OPC.SimaticNET.S7" to establish a standard S7 connection to an S7-300 CPU or S7-400 CPU.

### Access the S7 tags in the S7 CPU via symbolic names

1. In the "Server explorer", navigate to "UA server > Local UA server > OPC.SimaticNET.S7OPT > opc.tcp://Computer name:55105 [OPC.SimaticNET.S7OPT] > Objects > SYM". A symbol table with the existing S7 tags will be displayed.



2. Drag and drop the desired S7 tags into the DA view of OPC Scout V10.

DA view 1 X

Monitoring ON    Generate values ON    Read    Write

ID	Display name	Type	Access
SYM: S71500ET200MP-Station_1.PLC_1.OptimizedData.dataPlcDataType.dataArray	dataArray	ubyte[]	RW
SYM: S71500ET200MP-Station_1.PLC_1.OptimizedData.dataPlcDataType.dataInt	dataInt	short	RW
SYM: S71500ET200MP-Station_1.PLC_1.OptimizedData.dataPlcDataType.dataReal	dataReal	float	RW
SYM: S71500ET200MP-Station_1.PLC_1.OptimizedData.typeDataArray.typeDataArray[0].dataArray	dataArray	ubyte[]	RW
SYM: S71500ET200MP-Station_1.PLC_1.OptimizedData.typeDataArray.typeDataArray[0].dataInt	dataInt	short	RW
SYM: S71500ET200MP-Station_1.PLC_1.OptimizedData.typeDataArray.typeDataArray[0].dataReal	dataReal	float	RW
SYM: S71500ET200MP-Station_1.PLC_1.OptimizedData.dataArray	dataArray	ubyte[]	RW
SYM: S71500ET200MP-Station_1.PLC_1.OptimizedData.dataInteger	dataInteger	short	RW
SYM: S71500ET200MP-Station_1.PLC_1.OptimizedData.dataReal	dataReal	float	RW
SYM: S71500ET200MP-Station_1.PLC_1.OptimizedData.dataBool	dataBool	bool	RW
SYM: S71500ET200MP-Station_1.PLC_1.Clock_1Hz	Clock_1Hz	bool	RW
	-		-

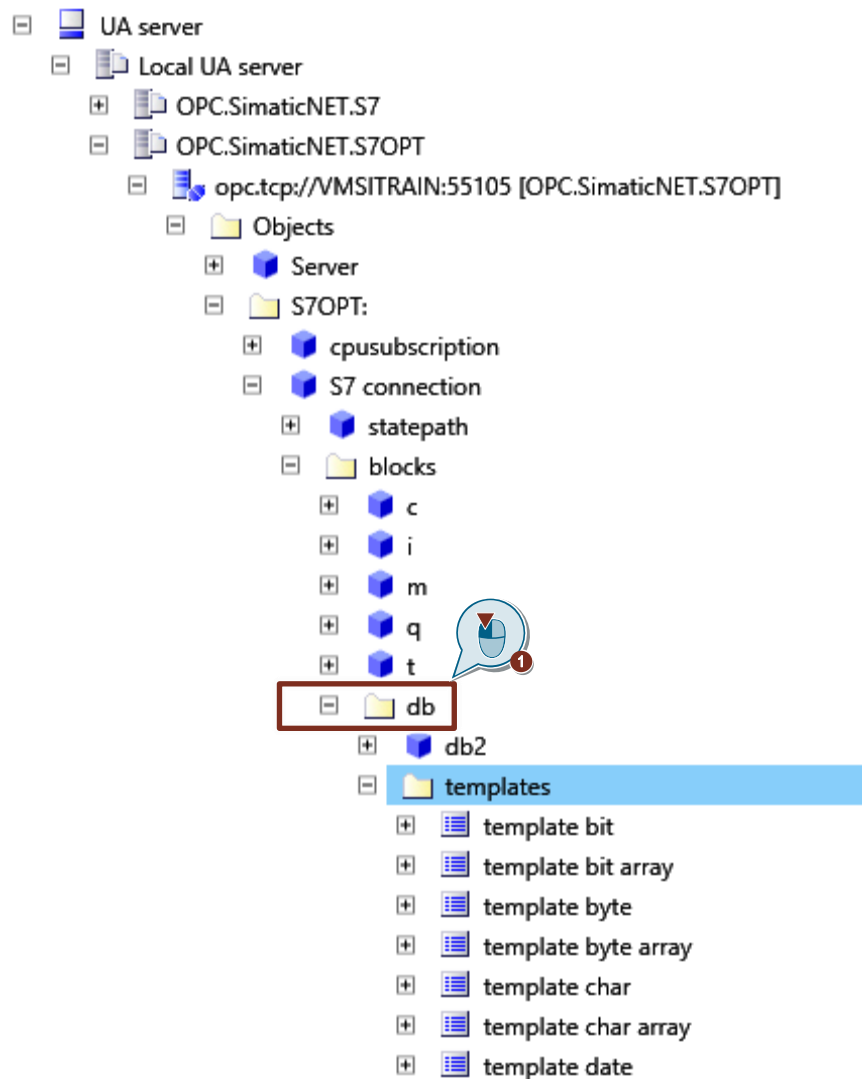
### Access the S7 tags in the S7 CPU via absolute address

When dealing with optimized data blocks, it is not possible to access the S7 tags using the absolute address. You will access the S7 tags in optimized data blocks using their symbolic names.

For the S7-1500 CPUs and S7-1200 CPUs, it is necessary to enable the function "Permit access with PUT/GET communication from remote partner" in order to access the S7 tags via the absolute address (see chapter [2.5.6](#)).

1. In the "Server explorer", navigate to "UA server > Local UA server > OPC.SimaticNET.S7OPT > opc.tcp://Computer name:55101 [OPC.SimaticNET.S7OPT] > Objects > S7OPT > connection name > blocks > db".

Here you will see templates for accessing the S7 tags in the S7 CPU via the absolute address.





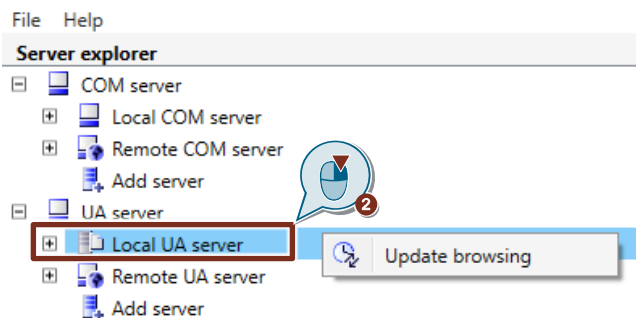


### 3.1.2 Establishing a standards S7 connection

The SIMATIC NET OPC server accesses the S7 tags in S7-300 CPUs and S7-400 CPUs via standard S7 connections. You will need an OPC client in order to use read requests and write requests to access the data provided by the SIMATIC NET OPC UA server. In this example, "OPC Scout V10" from SIMATIC NET will be used as OPC client.

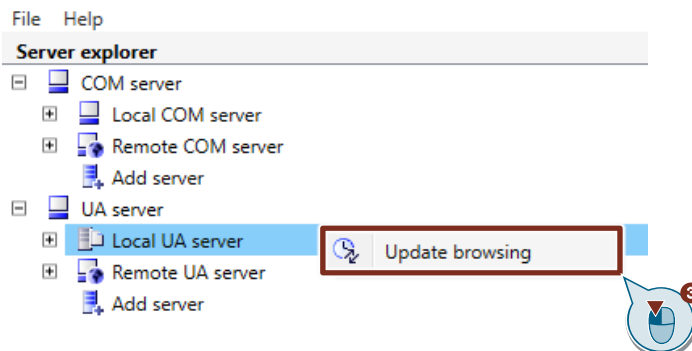
#### Establish connection to the S7 OPC UA server with OPC Scout V10

1. Start OPC Scout V10 from the Windows Start Menu item "Siemens Automation > OPC Scout V10".
2. In the "Server explorer" under "UA server", right-click "Local UA server".



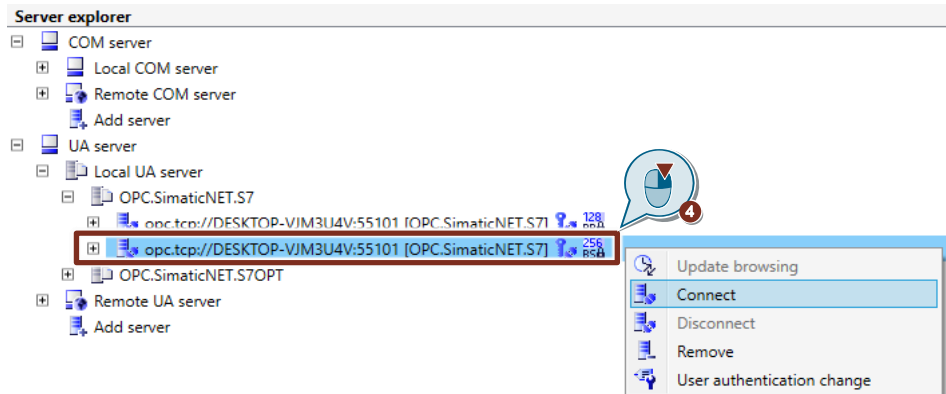
The context menu opens.

3. Click "Update browsing".



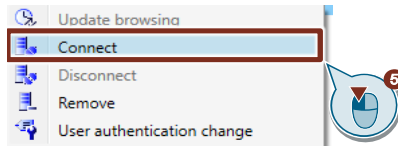
The enabled and available connections will be displayed.

- Under "UA server > Local UA server > OPC.SimaticNET.S7", right-click the S7 connection in order to establish an S7 connection from the SIMATIC NET OPC UA server to the S7 CPU.



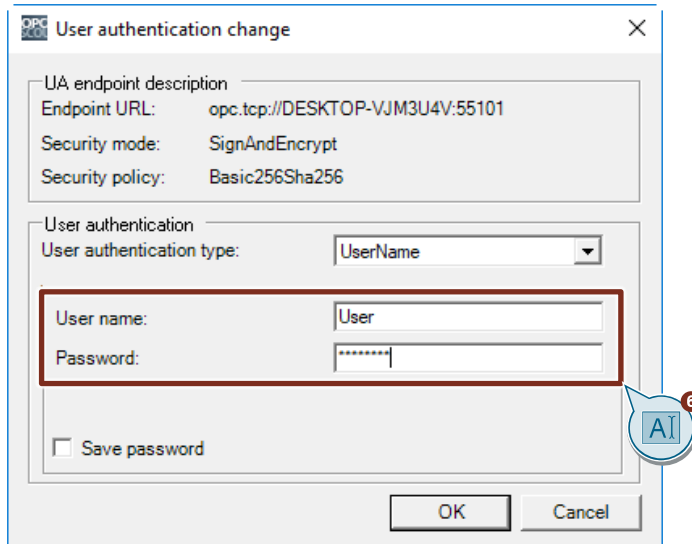
The context menu opens.

- Click "Connect".

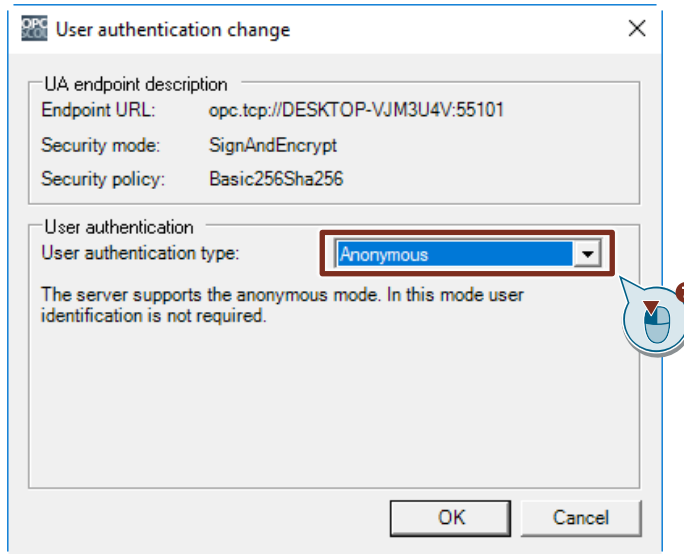


The "User authentication change" dialog opens.

- A user authentication with Windows login and password will be needed in order to establish the S7 connection.



7. It is possible to log in anonymously if you enabled the option "Allow anonymous logins to the OPC UA server" in the "Communication settings".

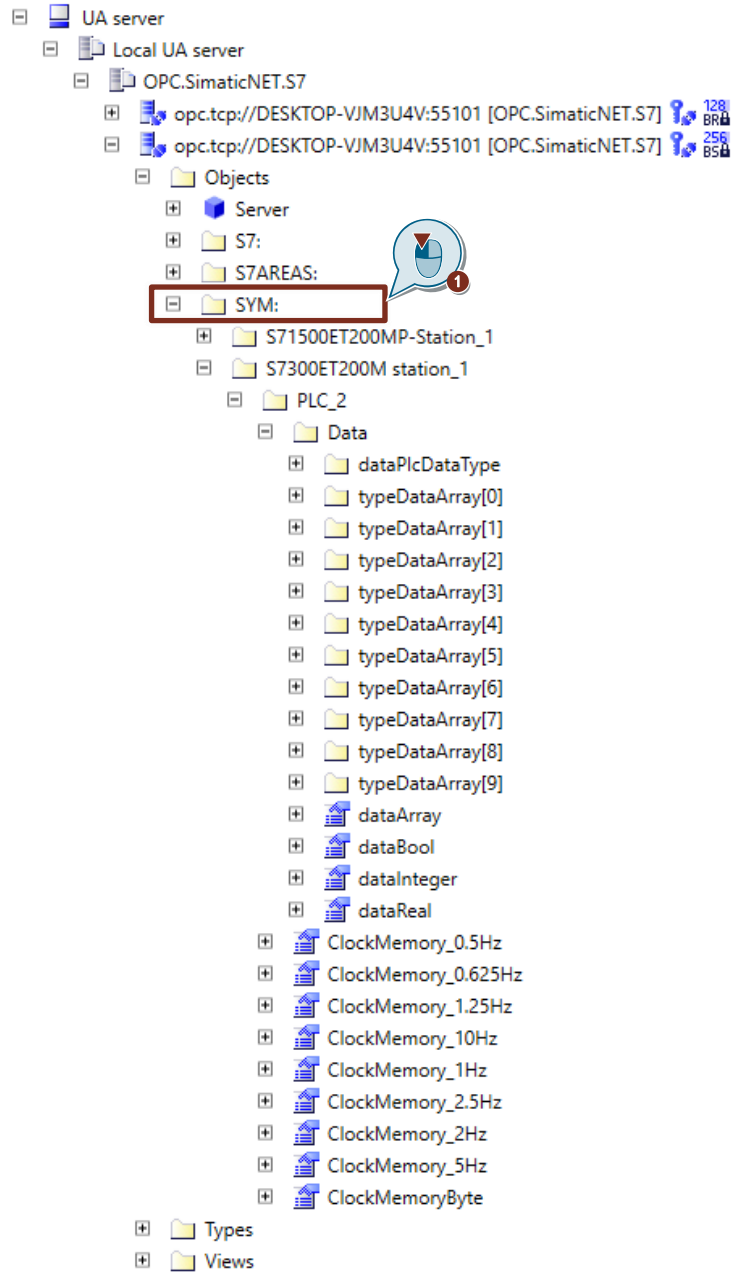


#### Note

Connect to the SIMATIC NET OPC UA server "OPC.SimaticNET.S7OPT" to establish an optimized S7 connection to an S7-1500 CPU or S7-1200 CPU (V4 onward).

**Access the S7 tags in the S7 CPU via symbolic names**

1. In the "Server explorer", navigate to "UA server > Local UA server > OPC.SimaticNET.S7 > opc.tcp://Computer name:55101 [OPC.SimaticNET.S7] > Objects > SYM".  
A symbol table with the existing S7 tags will be displayed.



2. Drag and drop the desired S7 tags into the DA view of OPC Scout V10.

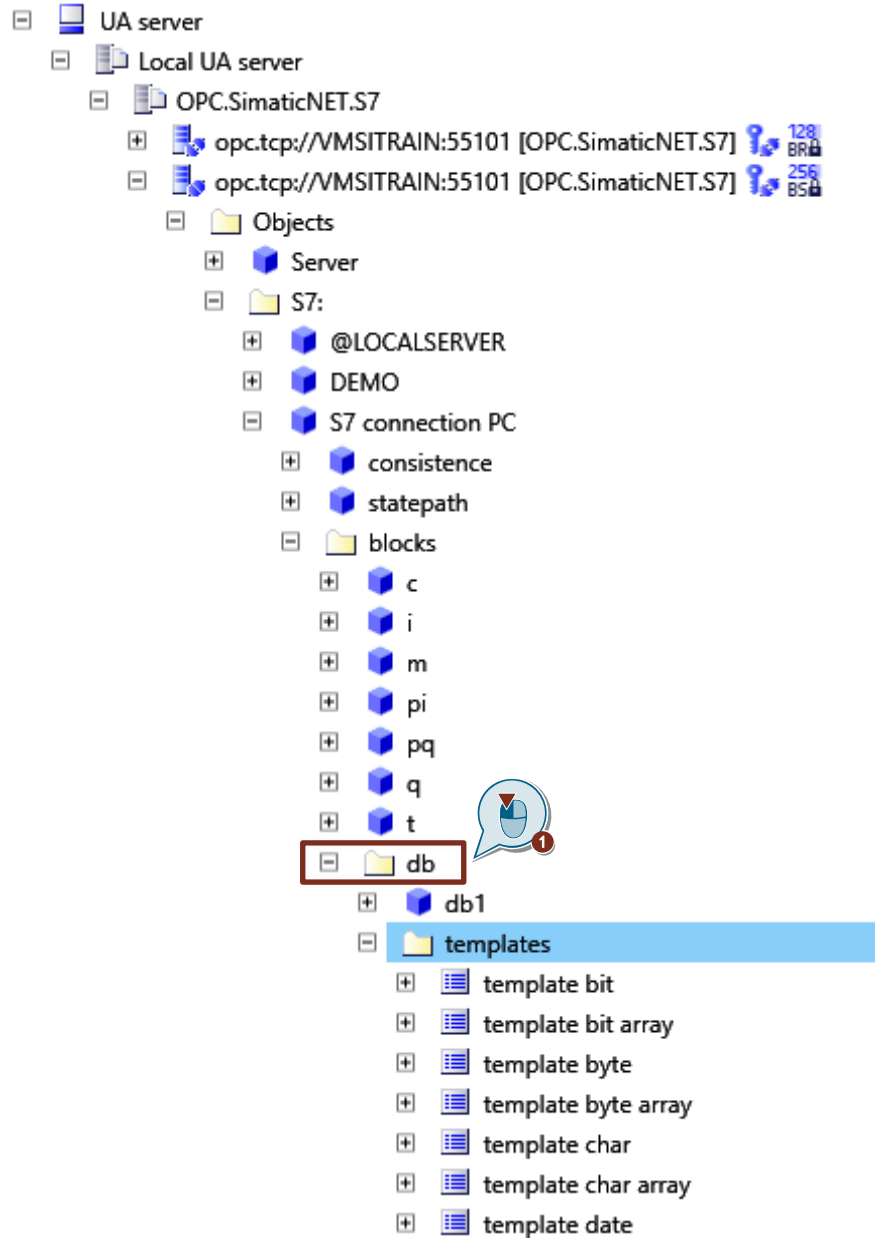
DA-Ansicht 1 X

Monitoring ON    Generate values ON    Read    Write

ID	Display name	Type	Access rights
SYM: S7300ET200M station_1.PLC_2.Data.dataArray	dataArray	ubyte[]	RW
SYM: S7300ET200M station_1.PLC_2.Data.dataInteger	dataInteger	short	RW
SYM: S7300ET200M station_1.PLC_2.Data.dataReal	dataReal	float	RW
SYM: S7300ET200M station_1.PLC_2.Data.dataBool	dataBool	bool	RW
SYM: S7300ET200M station_1.PLC_2.Data.dataPlcDataType.dataArray	dataArray	ubyte[]	RW
SYM: S7300ET200M station_1.PLC_2.Data.dataPlcDataType.dataInt	dataInt	short	RW
SYM: S7300ET200M station_1.PLC_2.Data.dataPlcDataType.dataReal	dataReal	float	RW
SYM: S7300ET200M station_1.PLC_2.Data.typeDataArray[0].dataArray	dataArray	ubyte[]	RW
SYM: S7300ET200M station_1.PLC_2.Data.typeDataArray[0].dataInt	dataInt	short	RW
SYM: S7300ET200M station_1.PLC_2.Data.typeDataArray[0].dataReal	dataReal	float	RW
SYM: S7300ET200M station_1.PLC_2.ClockMemory_1Hz	ClockMemory_1Hz	bool	RW
	-		-

**Access the S7 tags in the S7 CPU via absolute address**

1. In the "Server explorer", navigate to "UA server > Local UA server > OPC.SimaticNET.S7 > opc.tcp://Computer name:55101 [OPC.SimaticNET.S7] > Objects > S7 > connection name > blocks > db". Here you will see templates for accessing the S7 tags in the S7 CPU via the absolute address.



### 3 Operation

2. Drag and drop the desired templates for accessing the absolute addresses of the S7 tags into the DA view of OPC Scout V10.
3. Modify the templates according to your configuration. In this application example, the S7 tags are saved in DB1 "Data".

DA view 1 X

Monitoring ON    Generate values ON    Read    Write

ID	Display name	Type	Acc	Time stamp (UTC)	Value	Quality	Result
S7: S7 connection PC.db1.0,i	db1.0,i	short	RW			-	Connected
S7: S7 connection PC.db1.2,r	db1.2,r	float	RW			-	Connected
S7: S7 connection PC.db1.8,b,10	db1.8,b,10	ubyte[]	RW			-	Connected
S7: S7 connection PC.db1.6,x0	db1.6,x0	bool	RW			-	Connected
S7: S7 connection PC.db1.18,i	db1.18,i	short	RW			-	Connected
S7: S7 connection PC.db1.20,r	db1.20,r	float	RW			-	Connected
S7: S7 connection PC.db1.24,b,10	db1.24,b,10	ubyte[]	RW			-	Connected



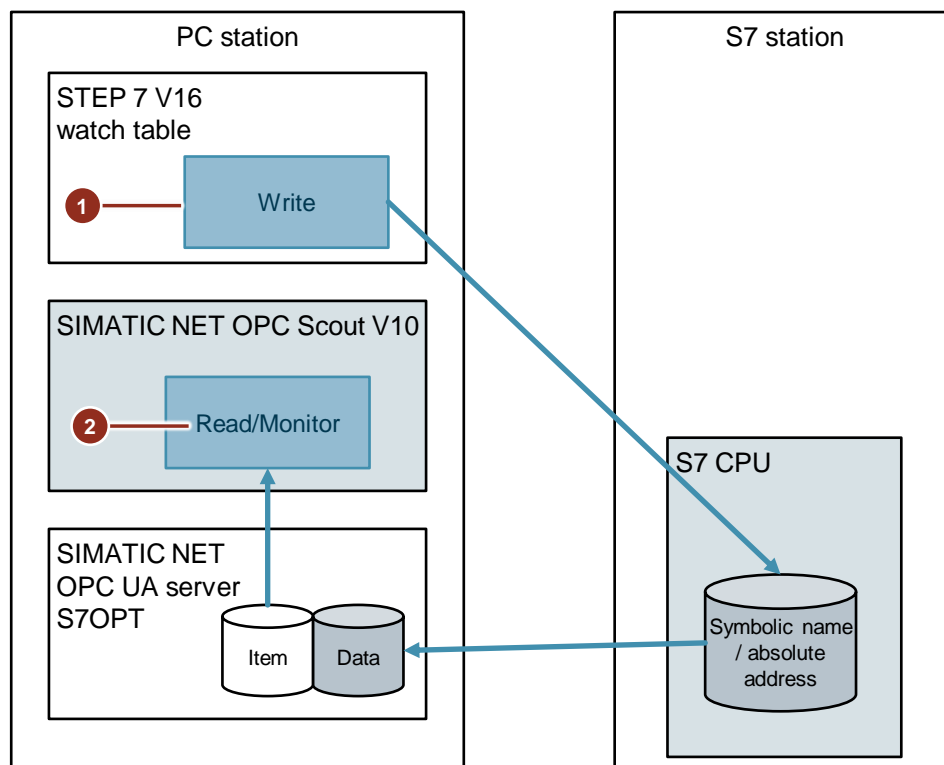
## 3.2 Reading and monitoring an S7 tag

### Requirements

- The connection from the PC station to the S7 CPU has been established (see chapter [3.1.2](#) and chapter [3.1.1](#)).
- You have created and opened a watch table in STEP 7 V16 (TIA Portal) that contains all the S7 tags that you wish to access using the SIMATIC NET OPC server via the symbolic names or the absolute address.

### Overview

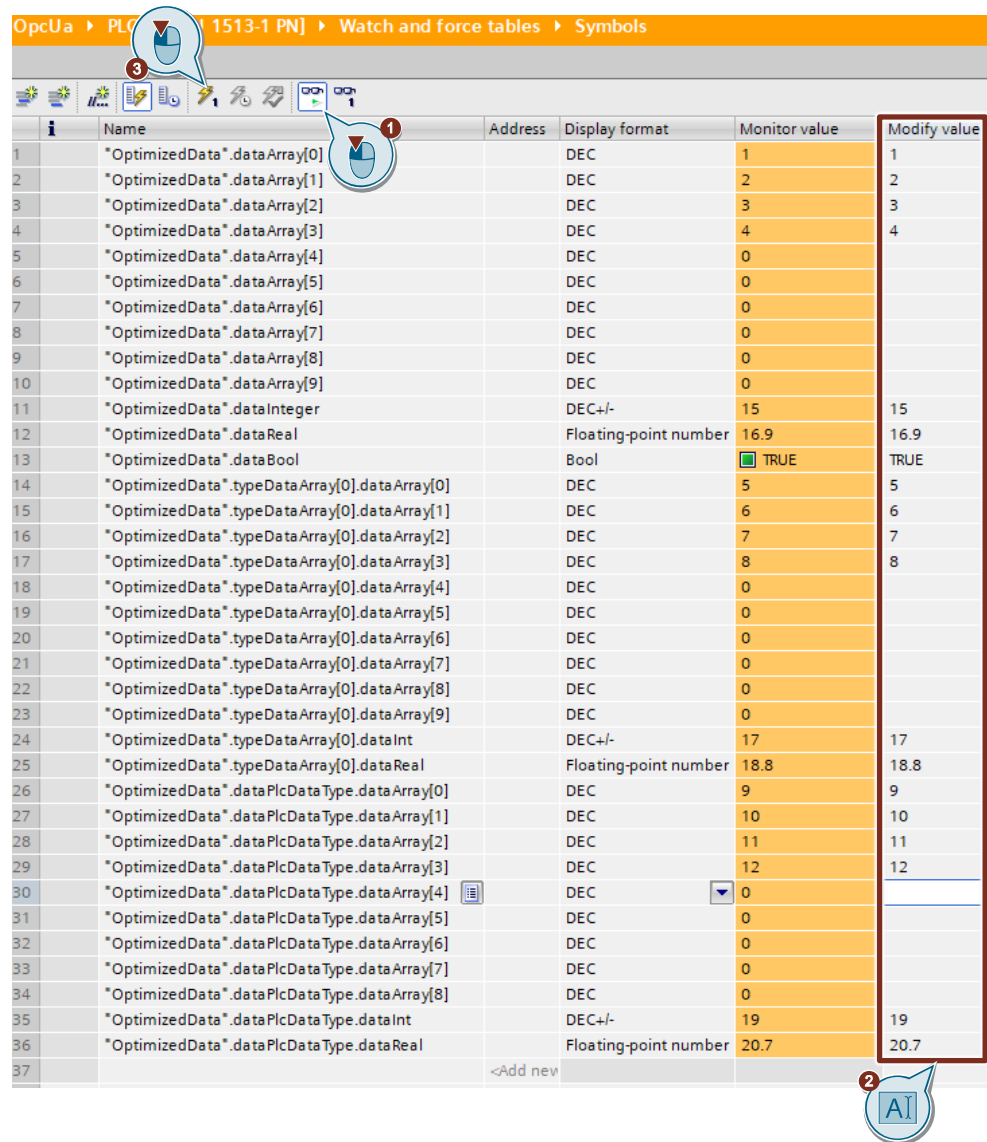
Figure 3-1



1. Write S7 tags in STEP 7 V16 (TIA Portal)
2. Read and monitor S7 tags in SIMATIC NET OPC Scout V10

## Writing in STEP 7 V16 (TIA Portal)

Figure 3-2



	Name	Address	Display format	Monitor value	Modify value
1	"OptimizedData".dataArray[0]		DEC	1	1
2	"OptimizedData".dataArray[1]		DEC	2	2
3	"OptimizedData".dataArray[2]		DEC	3	3
4	"OptimizedData".dataArray[3]		DEC	4	4
5	"OptimizedData".dataArray[4]		DEC	0	
6	"OptimizedData".dataArray[5]		DEC	0	
7	"OptimizedData".dataArray[6]		DEC	0	
8	"OptimizedData".dataArray[7]		DEC	0	
9	"OptimizedData".dataArray[8]		DEC	0	
10	"OptimizedData".dataArray[9]		DEC	0	
11	"OptimizedData".dataInteger		DEC+/-	15	15
12	"OptimizedData".dataReal		Floating-point number	16.9	16.9
13	"OptimizedData".dataBool		Bool	TRUE	TRUE
14	"OptimizedData".typeDataArray[0].dataArray[0]		DEC	5	5
15	"OptimizedData".typeDataArray[0].dataArray[1]		DEC	6	6
16	"OptimizedData".typeDataArray[0].dataArray[2]		DEC	7	7
17	"OptimizedData".typeDataArray[0].dataArray[3]		DEC	8	8
18	"OptimizedData".typeDataArray[0].dataArray[4]		DEC	0	
19	"OptimizedData".typeDataArray[0].dataArray[5]		DEC	0	
20	"OptimizedData".typeDataArray[0].dataArray[6]		DEC	0	
21	"OptimizedData".typeDataArray[0].dataArray[7]		DEC	0	
22	"OptimizedData".typeDataArray[0].dataArray[8]		DEC	0	
23	"OptimizedData".typeDataArray[0].dataArray[9]		DEC	0	
24	"OptimizedData".typeDataArray[0].dataInt		DEC+/-	17	17
25	"OptimizedData".typeDataArray[0].dataReal		Floating-point number	18.8	18.8
26	"OptimizedData".dataPlcData Type.dataArray[0]		DEC	9	9
27	"OptimizedData".dataPlcData Type.dataArray[1]		DEC	10	10
28	"OptimizedData".dataPlcData Type.dataArray[2]		DEC	11	11
29	"OptimizedData".dataPlcData Type.dataArray[3]		DEC	12	12
30	"OptimizedData".dataPlcData Type.dataArray[4]		DEC	0	
31	"OptimizedData".dataPlcData Type.dataArray[5]		DEC	0	
32	"OptimizedData".dataPlcData Type.dataArray[6]		DEC	0	
33	"OptimizedData".dataPlcData Type.dataArray[7]		DEC	0	
34	"OptimizedData".dataPlcData Type.dataArray[8]		DEC	0	
35	"OptimizedData".dataPlcData Type.dataInt		DEC+/-	19	19
36	"OptimizedData".dataPlcData Type.dataReal		Floating-point number	20.7	20.7
37		<Add new			

1. Click the "Monitor all" button.
2. In the "Modify value" column, enter values for the S7 tags.
3. Click the "Modify all selected values once and now." button.

**Result**

Figure 3-3

OpCua > PLC\_1 [CPU 1513-1 PN] > Watch and force tables > Symbols

	i	Name	Address	Display format	Monitor value	Modify value
1		*OptimizedData*.dataArray[0]		DEC	1	1
2		*OptimizedData*.dataArray[1]		DEC	2	2
3		*OptimizedData*.dataArray[2]		DEC	3	3
4		*OptimizedData*.dataArray[3]		DEC	4	4
5		*OptimizedData*.dataArray[4]		DEC	0	
6		*OptimizedData*.dataArray[5]		DEC	0	
7		*OptimizedData*.dataArray[6]		DEC	0	
8		*OptimizedData*.dataArray[7]		DEC	0	
9		*OptimizedData*.dataArray[8]		DEC	0	
10		*OptimizedData*.dataArray[9]		DEC	0	
11		*OptimizedData*.dataInteger		DEC+/-	15	15
12		*OptimizedData*.dataReal		Floating-point number	16.9	16.9
13		*OptimizedData*.dataBool		Bool	<input checked="" type="checkbox"/> TRUE	TRUE
14		*OptimizedData*.typeDataArray[0].dataArray[0]		DEC	5	5
15		*OptimizedData*.typeDataArray[0].dataArray[1]		DEC	6	6
16		*OptimizedData*.typeDataArray[0].dataArray[2]		DEC	7	7
17		*OptimizedData*.typeDataArray[0].dataArray[3]		DEC	8	8
18		*OptimizedData*.typeDataArray[0].dataArray[4]		DEC	0	
19		*OptimizedData*.typeDataArray[0].dataArray[5]		DEC	0	
20		*OptimizedData*.typeDataArray[0].dataArray[6]		DEC	0	
21		*OptimizedData*.typeDataArray[0].dataArray[7]		DEC	0	
22		*OptimizedData*.typeDataArray[0].dataArray[8]		DEC	0	
23		*OptimizedData*.typeDataArray[0].dataArray[9]		DEC	0	
24		*OptimizedData*.typeDataArray[0].dataInt		DEC+/-	17	17
25		*OptimizedData*.typeDataArray[0].dataReal		Floating-point number	18.8	18.8
26		*OptimizedData*.dataPlcDataType.dataArray[0]		DEC	9	9
27		*OptimizedData*.dataPlcDataType.dataArray[1]		DEC	10	10
28		*OptimizedData*.dataPlcDataType.dataArray[2]		DEC	11	11
29		*OptimizedData*.dataPlcDataType.dataArray[3]		DEC	12	12
30		*OptimizedData*.dataPlcDataType.dataArray[4]		DEC	0	
31		*OptimizedData*.dataPlcDataType.dataArray[5]		DEC	0	
32		*OptimizedData*.dataPlcDataType.dataArray[6]		DEC	0	
33		*OptimizedData*.dataPlcDataType.dataArray[7]		DEC	0	
34		*OptimizedData*.dataPlcDataType.dataArray[8]		DEC	0	
35		*OptimizedData*.dataPlcDataType.dataInt		DEC+/-	19	19
36		*OptimizedData*.dataPlcDataType.dataReal		Floating-point number	20.7	20.7
37				<Add new		

The S7 tags are written with the modify values. The values of the S7 tags are displayed in the "Monitor value" column.



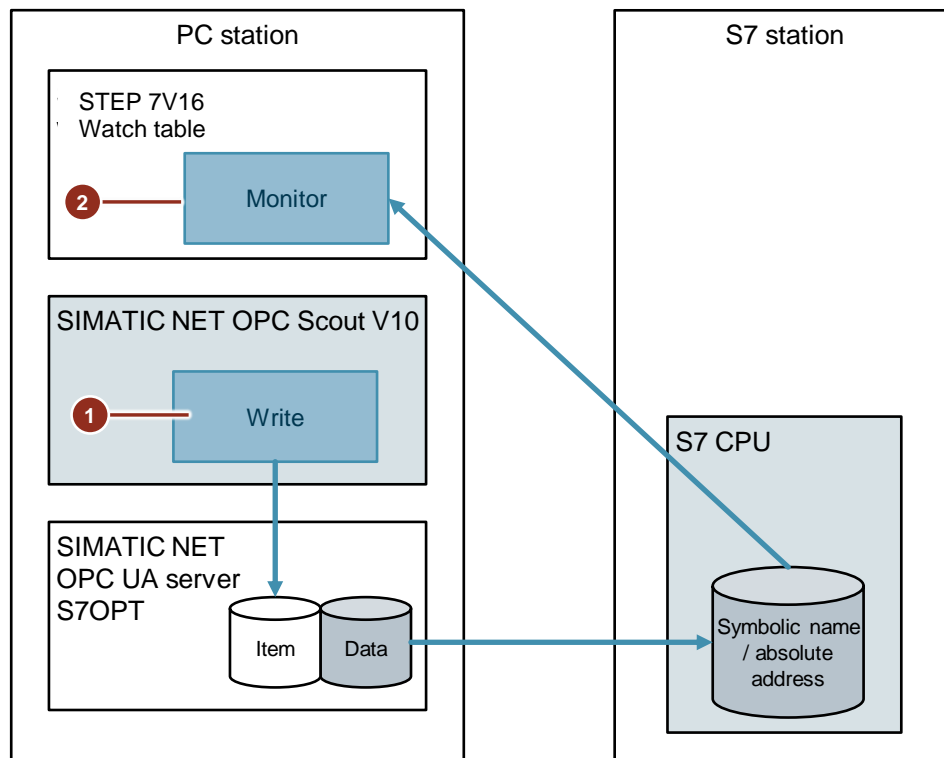
### 3.3 Writing S7 tags

#### Requirements

- The connection between the PC station and the S7 CPU has been established (see chapter [3.1.1](#) and chapter [3.1.2](#)).
- You have created and opened a watch table in STEP 7 V16 (TIA Portal) that contains all the S7 tags that you wish to access using the SIMATIC NET OPC server via the symbolic names or the absolute address.

#### Overview

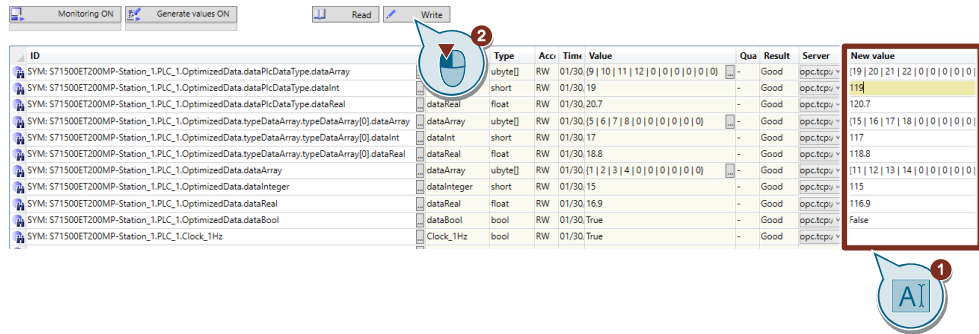
Figure 3-6



1. Write S7 tag in SIMATIC NET OPC Scout V10
2. Monitor S7 tag in STEP 7 V16 (TIA Portal)

### Writing with OPC Scout V10

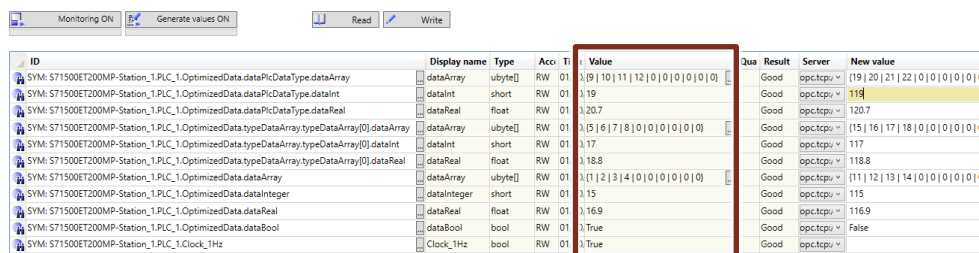
Figure 3-7



1. Click the "Monitoring ON" button to continuously monitor the values of the S7 tags.
2. In the DA view of OPC Scout V10, enter new values for the S7 tags in the "New Value" column.
3. Click the "Write" button to write the S7 tags with the new value.

### Result

Figure 3-8

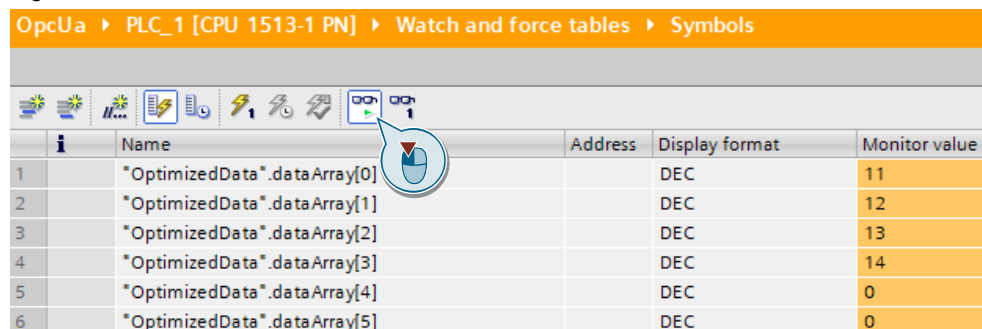


The written values are displayed in the "Value" column.

### Monitoring in STEP 7 V16 (TIA Portal)

Click the "Monitor all" button.

Figure 3-9



**Result**

Figure 3-10

OpcUa ▶ PLC\_1 [CPU 1513-1 PN] ▶ Watch and force tables ▶ Symbols

	i	Name	Address	Display format	Monitor value
1		*OptimizedData*.dataArray[0]		DEC	11
2		*OptimizedData*.dataArray[1]		DEC	12
3		*OptimizedData*.dataArray[2]		DEC	13
4		*OptimizedData*.dataArray[3]		DEC	14
5		*OptimizedData*.dataArray[4]		DEC	0
6		*OptimizedData*.dataArray[5]		DEC	0
7		*OptimizedData*.dataArray[6]		DEC	0
8		*OptimizedData*.dataArray[7]		DEC	0
9		*OptimizedData*.dataArray[8]		DEC	0
10		*OptimizedData*.dataArray[9]		DEC	0
11		*OptimizedData*.dataInteger		DEC+/-	115
12		*OptimizedData*.dataReal		Floating-point number	116.9
13		*OptimizedData*.dataBool		Bool	<input type="checkbox"/> FALSE
14		*OptimizedData*.typeDataArray[0].dataArray[0]		DEC	15
15		*OptimizedData*.typeDataArray[0].dataArray[1]		DEC	16
16		*OptimizedData*.typeDataArray[0].dataArray[2]		DEC	17
17		*OptimizedData*.typeDataArray[0].dataArray[3]		DEC	18
18		*OptimizedData*.typeDataArray[0].dataArray[4]		DEC	0
19		*OptimizedData*.typeDataArray[0].dataArray[5]		DEC	0
20		*OptimizedData*.typeDataArray[0].dataArray[6]		DEC	0
21		*OptimizedData*.typeDataArray[0].dataArray[7]		DEC	0
22		*OptimizedData*.typeDataArray[0].dataArray[8]		DEC	0
23		*OptimizedData*.typeDataArray[0].dataArray[9]		DEC	0
24		*OptimizedData*.typeDataArray[0].dataInt		DEC+/-	117
25		*OptimizedData*.typeDataArray[0].dataReal		Floating-point number	118.8
26		*OptimizedData*.dataPlcDataType.dataArray[0]		DEC	19
27		*OptimizedData*.dataPlcDataType.dataArray[1]		DEC	20
28		*OptimizedData*.dataPlcDataType.dataArray[2]		DEC	21
29		*OptimizedData*.dataPlcDataType.dataArray[3]		DEC	22
30		*OptimizedData*.dataPlcDataType.dataArray[4]		DEC	0
31		*OptimizedData*.dataPlcDataType.dataArray[5]		DEC	0
32		*OptimizedData*.dataPlcDataType.dataArray[6]		DEC	0
33		*OptimizedData*.dataPlcDataType.dataArray[7]		DEC	0
34		*OptimizedData*.dataPlcDataType.dataArray[8]		DEC	0
35		*OptimizedData*.dataPlcDataType.dataInt		DEC+/-	119
36		*OptimizedData*.dataPlcDataType.dataReal		Floating-point number	120.7
37			<Add new		

The values of the S7 tags are displayed in the "Monitor value" column.

## 4 Useful information

### 4.1 SIMATIC NET OPC server

#### 4.1.1 S7 OPC UA server

The S7 OPC UA server supports S7 communication via Industrial Ethernet and PROFIBUS.

#### Connection type

The S7 OPC UA server supports the following connection type:

- Standard S7 connection (see chapter [4.5.2](#)).

#### Communication services

The S7 OPC UA server supports the following communication services:

Table 4-1

Communication service	Description
Variable services	Functions for reading and writing one or more S7 tags.
Buffer-oriented services	Program-controlled transfer of larger blocks of data.
Block services	Transfer of a loadable data range to and from S7.
Server functionality	The PC can be used as a server for data buffers and data blocks.
S7 password function	Setting a password for access to protected blocks.
OPC UA events, conditions and alarms	Processing of S7 messages and S7 diagnostic events.
History data on OPC UA	Access to history S7 data tags that are archived in a database for up to 360 hours.

#### Note

The S7 OPC UA server communication services listed in [Table 4-1](#) are available for Industrial Ethernet and PROFIBUS.



### 4.1.2 S7OPT OPC UA server

The S7OPT OPC UA server supports S7 communication via Industrial Ethernet with S7-1200 (V4 onward) and S7-1500.

#### Connection type

The S7OPT OPC UA server supports the following connection type:

- Optimized S7 connection (see chapter [4.5.1](#)).

#### Communication services

The S7OPT OPC UA server supports the following communication services:

Table 4-2

Communication service	Description
Variable services	Functions for reading and writing one or more S7 tags via standard access and access to optimized data blocks.
OPC UA events, conditions and alarms	Processing of PLC messages.
History data on OPC UA	Access to history S7OPT data tags that are archived in a database for up to 360 hours.
S7 CPU protection level concept	Setting a password for secured connection establishment and access to the S7-1200 and S7-1500 stations.

#### Note

The S7OPT OPC UA server communication services listed in [Table 4-2](#) are only available for Industrial Ethernet.

### 4.1.3 SR OPC UA server

The SR OPC UA server makes it possible to use open communication services (SEND/RECEIVE) via Industrial Ethernet with OPC UA. The SR OPC UA server is authorized for communication with S7 devices. In addition, it also enables the user to communicate with external devices.

#### Connection type

The SR OPC UA server supports the following connection types:

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

#### Type of connection

The type of SR connection methods that is possible via an SR connection is set in STEP 7. The connection can either:

- only Fetch
- only Write
- only Send/Receive

#### Communication services

The SR OPC UA server supports the following communication services:

Table 4-3

Communication service	Description
Variable services	<p>Reading and writing of data tags for S5 data blocks and ranges (S5-compatible communication) requires that a Fetch or Write connection first be configured.</p> <p>The data tags on a Fetch connection are only read. On a Write connection, the data tags are written only. If a communication partner's data blocks must not only be read but also written, then you must configure two corresponding connections which will be managed fully independently by the OPC UA server.</p>
Buffer-oriented service	<p>Buffer-oriented services allow program-controlled transfer of larger blocks of data. These services are also known as SEND/RECEIVE services. Data transfer with the OPC UA server is implemented with tags:</p> <ul style="list-style-type: none"> <li>• Tags that receive blocks of data</li> <li>• Tags that send blocks of data</li> </ul> <p>A default size for the blocks of data is specified in the configuration. When sending tags, the length can be restricted. Partial access within the blocks of data is possible.</p>

### 4.1.4 DP OPC UA server

The DP OPC UA server supports DP master class 1. The DP master class 1 performs cyclic communication to the DP slaves.

The DP OPC UA server supports the DP slave function DP-V0.

#### Process tags for the DP master with OPC UA

The DP OPC UA server for DP master mode offers process tags for the following services:

- Services for the master class 1 access and monitoring of DP inputs and outputs
- Sync/Freeze: Acyclic sending of control telegrams to slave groups
- Fast Logic for:
  - CP 5613 A2 and CP 5614 A2 (only DP master):  
Automatic monitoring of slave data
  - CP 5623 and CP5624 (only DP master):  
Automatic monitoring of slave data
- Diagnostic tags: Evaluation of static diagnostic information

#### Process tags for the DP slave with OPC UA

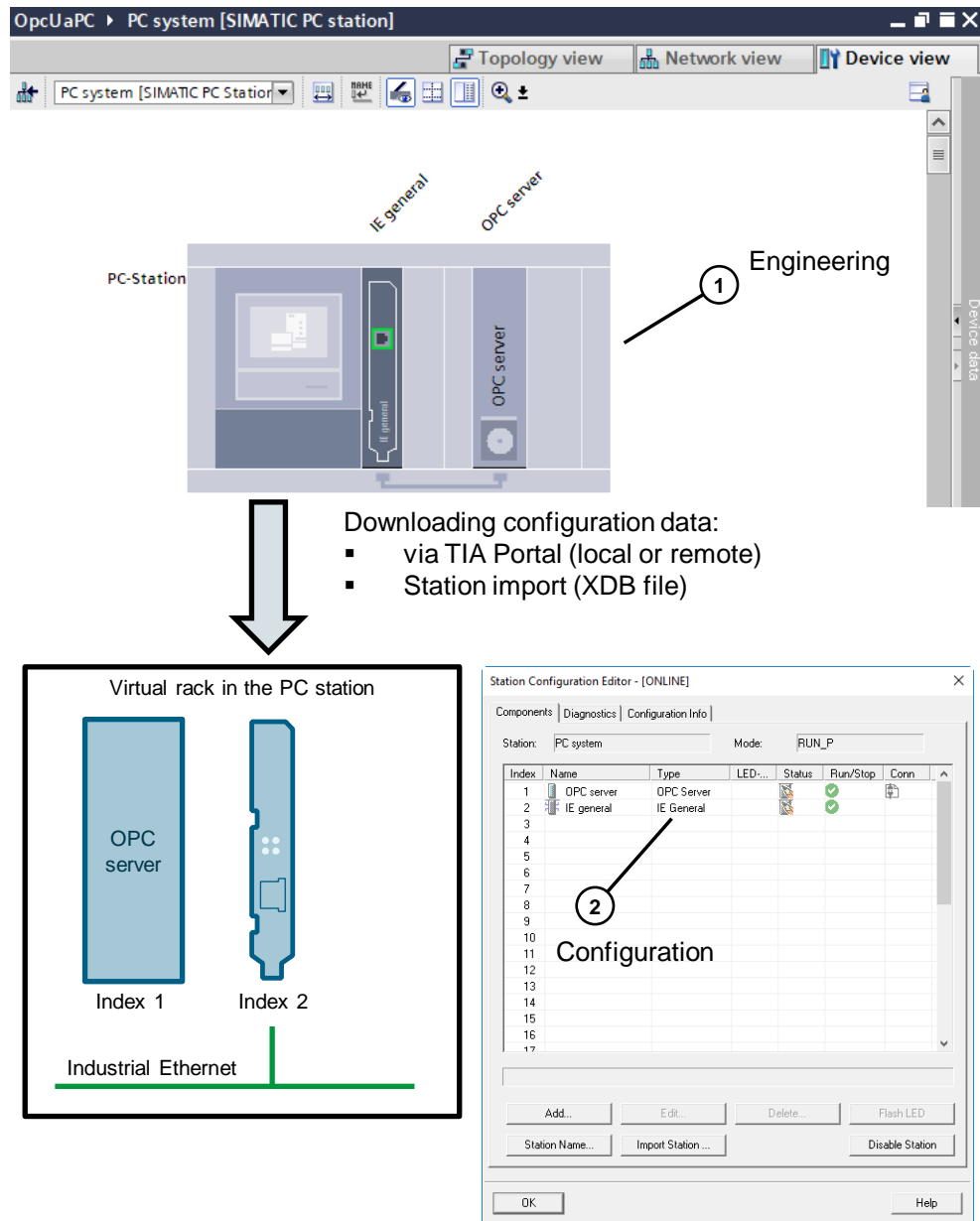
The DP OPC UA server for DP slave mode offers process tags for the following services:

- Tag services for access to local slave data, access to the inputs and outputs of the slave
- Diagnostic tags: Evaluation of static diagnostic information of the slave

## 4.2 Configuring a PC station

### Overview

Figure 4-1



### Engineering

In TIA Portal you will configure the PC station with the necessary components:

- Network adapter: e.g. "IE General"
- User application, e.g. "OPC Server"

Set all necessary addresses and parameters, such as IP address and subnet mask for the network adapter.

### Configuration

Using the "Station Configuration Editor" you will insert the components into the virtual slots of the PC station and assign addresses and parameters to them.

To allow communication between the components in the PC station and to receive project engineering data, each component is assigned a unique identification number. The identification number for components in a PC station is the index. In much the same way as the slot of a module in an S7 CPU, the index corresponds to a virtual slot in a PC station.

## 4.3 "Station Configuration Editor"

Using the "Station Configuration Editor" you have access to the component management of the "Stationmanager" in the PC station.

You need the "Station Configuration Editor" for the initial configuration and project engineering as well as maintenance of a PC station.

The "Station Configuration Editor" is the user interface for Station Manager.

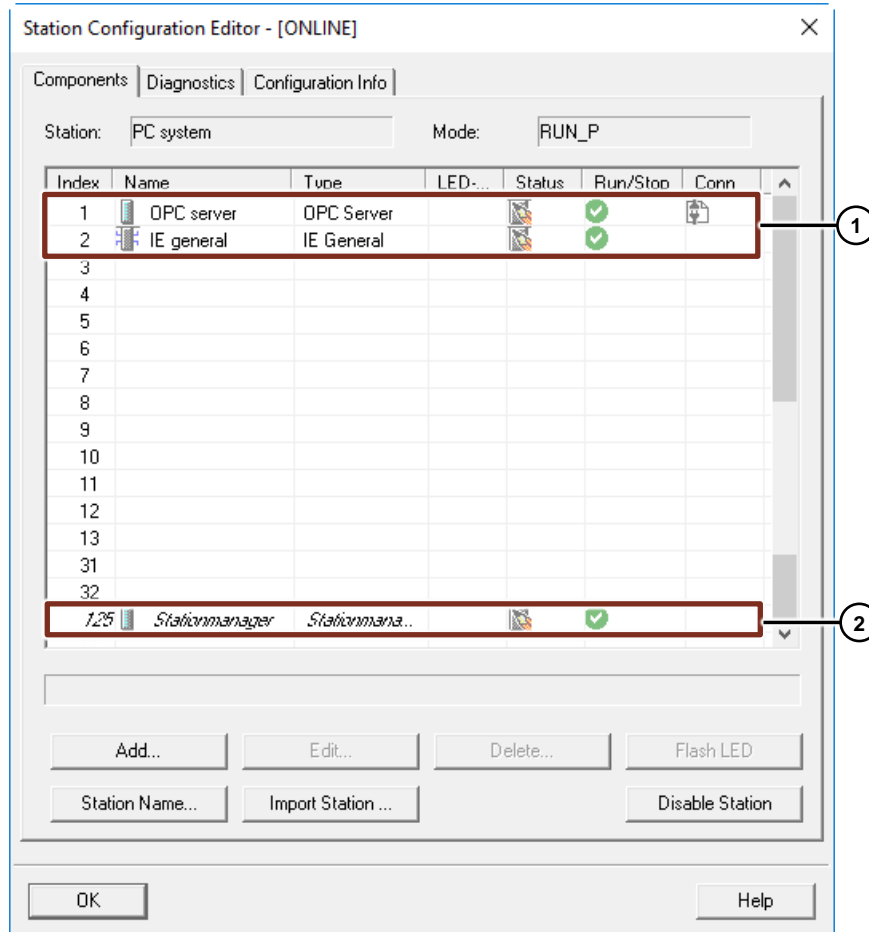
#### Note

The "Station Configuration Editor" is always available and running on the PC station where you installed the "SIMATIC NET PC Software".

### 4.3.1 Overview

The following figure shows the layout of the "Station Configuration Editor".

Figure 4-2



1. **Components:**  
The components are the modules and the applications involved in communications in the PC station. These components require configuration and project engineering data.
  2. **Station Manager:**  
The Station Manager holds the configuration and project engineering data for the components in the component management (database).
- Apart from component configuration, the "Station Configuration Editor" can also be used for diagnostic purposes.

### 4.3.2 Application area and use cases

#### Initial configuration (commissioning)

When a component is put into operation for the first time, an initial configuration is necessary. This initial configuration is performed for all newly installed components. The initial configuration sets an index (the "virtual slot number") of the component.

After initial configuration of the components, the PC station is prepared to receive the project engineering data. This step can be compared to inserting the components into the rack of an S7 station.

#### Project engineering and maintenance

Changes in the project engineering and configuration data can be downloaded to the PC station from TIA Portal (local and remote). As an alternative, it is possible to transfer data using an XDB file.

Using the "Station Configuration Editor", you can check the effects in the "Components" tab. The "Diagnostics" tab provides you with information on the operating state at all times.

### 4.3.3 "Components" tab

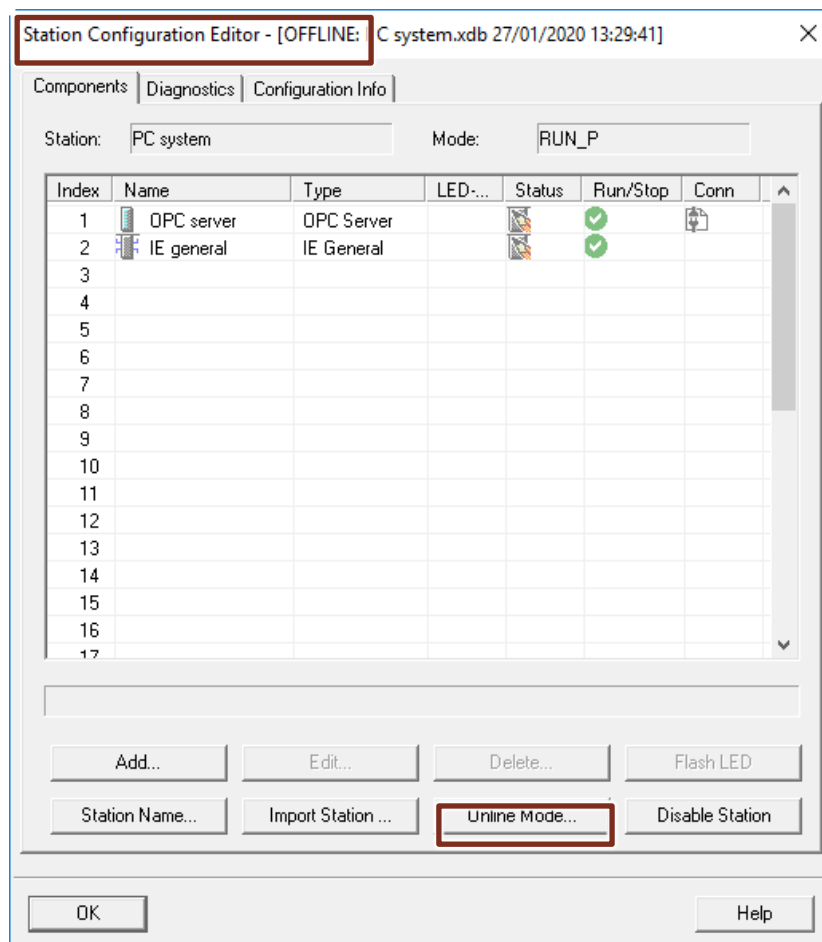
In the "Components" tab, you will find the essential functions for configuring a PC station.

- Assigning the station name
- Creating new components
- Applying the component configuration and project engineering data
- Checks and diagnostics
- Setting the operating mode

The current mode is displayed in the title bar of the "Station Configuration Editor".

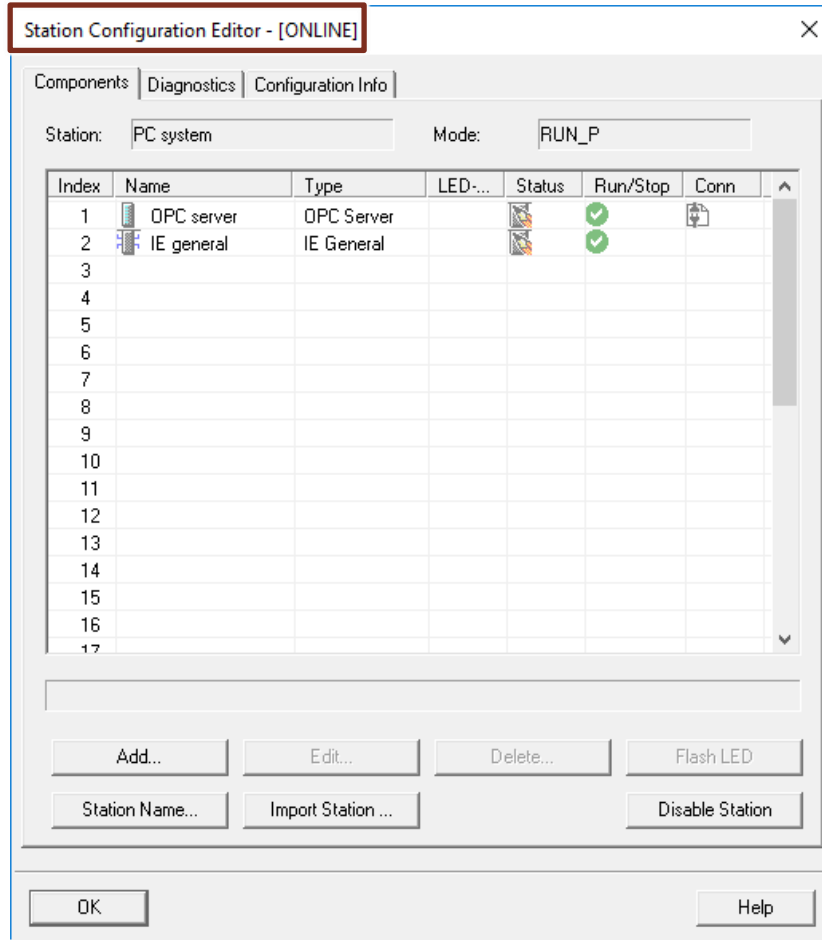
- Offline mode

In offline mode, you can make changes to the configuration only by entering them directly or by importing the station (XDB file). The "Online Mode" button is visible and operable to reach the online mode.



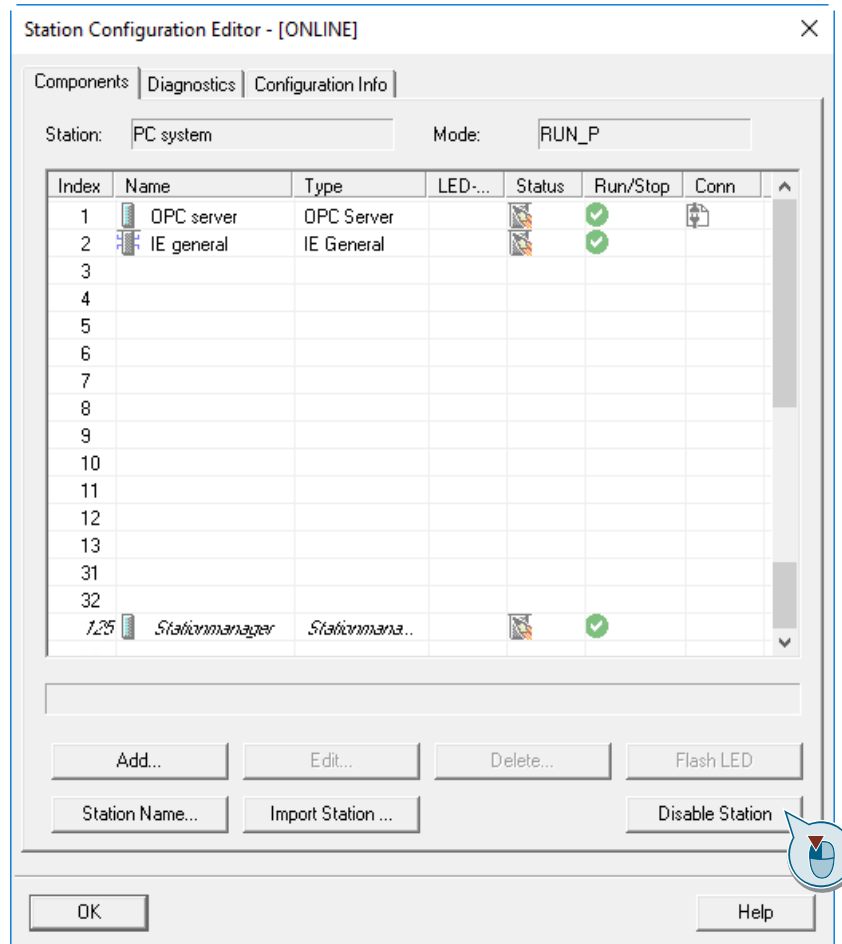


- Online mode  
In online mode, you have the ability to download project engineering data directly to the PC station using TIA Portal. You can perform an XDB import at any time. You can also specify (as an option) whether you want the "offline mode" to be set following the import.

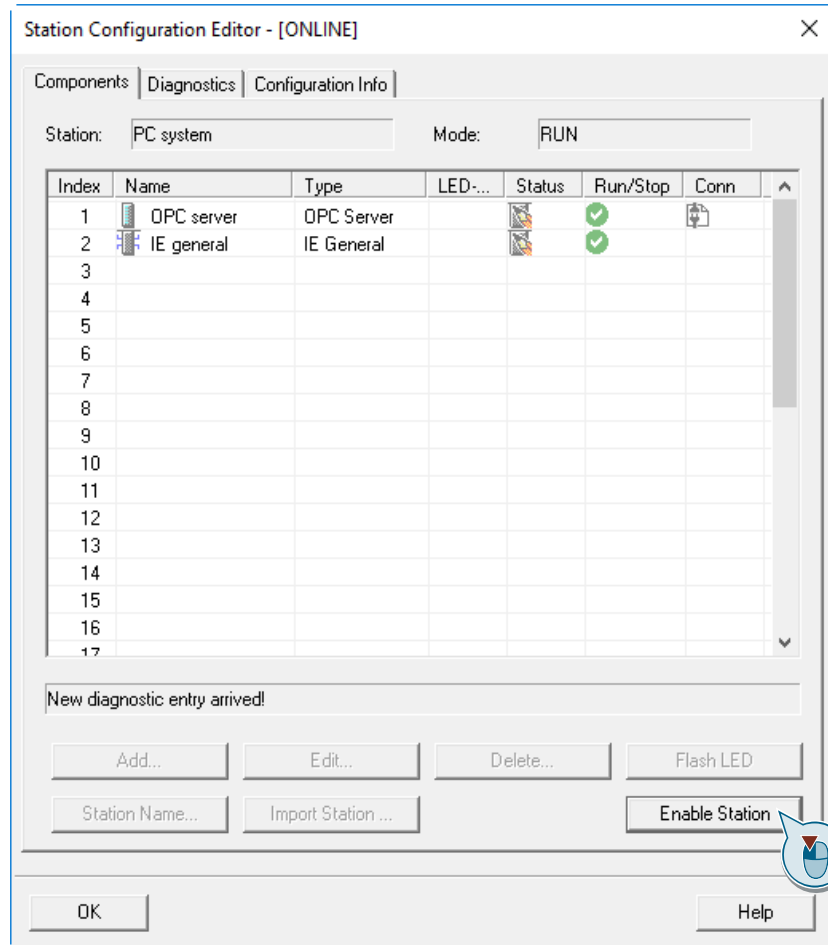


## 4 Useful information

- Disable and enable station:  
As an administrator you have the ability to secure the PC station's configuration data against changes.
  - Click the "Disable Station" button to lock the PC station.



- Click the "Enable Station" button to unlock.



It is not possible to change the configuration data while the station is locked. The following functions are locked:

- Station import (XDB file)
- Downloading the PC station via TIA Portal (local or remote)
- Modifying the PC station in the "Station Configuration Editor"

The current status is displayed in the "Mode" field.

- RUN: The PC station is disabled for changes.
- RUN\_P: The PC station is enabled for changes.

## 4.4 Data blocks

STEP 7 (TIA Portal) offers data blocks with the following access options for S7-1500 and S7-1200 automation systems:

- Data blocks with optimized access
- Data blocks with standard access

The S7-300 and S7-400 automation systems only support data blocks with standard access.

### 4.4.1 Data blocks with optimized access

Data blocks with optimized access have no predefined structure. In the declaration, the data elements contain no fixed address within the data block but rather a symbolic name. The elements are arranged in the block's available storage space so that no gaps in the storage occur. This achieves optimal utilization of the storage space.

The tags in this data block are identified by their symbolic names. Enter the symbolic names of the tags in order to address them.

Optimized block access has the following advantages:

- Increase your engineering efficiency using purely symbolic addressing.
- Achieve higher performance in your automation system from optimized block access.

### 4.4.2 Data blocks with standard access

Data blocks with standard access have a fixed structure. In the declaration, the data elements contain a fixed address within the data block as well as a symbolic name. The address is shown in the "Offset" column.

The tags in this data block can be addressed symbolically and absolutely.

## 4.5 Connection types

### 4.5.1 Optimized S7 connections

From version V12 onward, the SIMATIC NET OPC UA server can access optimized data blocks of the S7-1200 CPU (firmware V4 or higher) and of the S7-1500 CPU. Optimized data blocks no longer use absolute addresses. It is only possible to access the tags using their symbolic names. This makes optimized data blocks more generic, which reduces the possible sources of errors.

The optimized data blocks are located in the namespace of the SIMATIC NET OPC UA server in the "SYM" folder of the S7-1500 station or S7-1200 station.

Optimized data blocks are accessed over the network using the new "S7Opt" protocol.

The default setting makes all S7 connections to S7-1200 CPUs (firmware V4 or higher) and S7-1500 CPUs optimized S7 connections. S7 connections to S7-1200 CPUs and S7-1500 CPUs are configured in the same manner as with the S7-300 CPUs and S7-400 CPUs. However, there are restrictions:

- Optimized S7 connections and optimized data blocks can only be used via OPC UA. DCOM-based OPC clients cannot access optimized data blocks.
- The SIMATIC NET software must be V12 or higher.
- Smaller quantity structure for CP1613 A2 Only 40 optimized S7 connections are possible for this CP.

### 4.5.2 Standard S7 connections

The S7-300 CPUs and S7-400 CPUs only support data blocks with standard access. Using the absolute address or the symbolic name, it is possible to access the tags of a data block with standard access.

The symbols of the data block with standard access are located in the namespace of the SIMATIC NET OPC UA server in the "SYM" folder of the S7-300 station or S7-400 station.

Network access to data blocks with standard access is made via the "S7" protocol.

## 4.6 Syntax for access to absolute addresses

The following figure shows the syntax structure in the OPC client for access to the NodeId of the node, which is required in order to access the absolute addresses of the S7 tags.

Figure 4-3

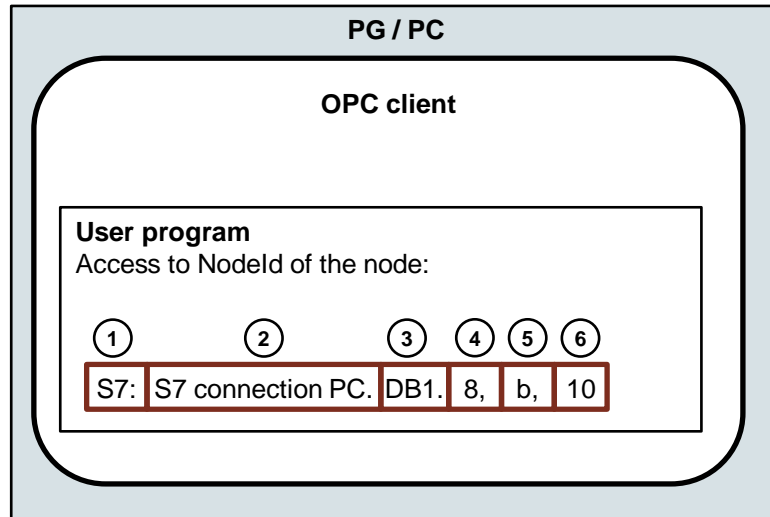


Table 4-4

No.	Description	Value
1.	Protocol	S7
2.	Connection name	S7 connection PC
3.	Object	DB
4.	Start address	8
5.	Data type	b (bytes)
6.	Quantity	10

## 4.7 OPC UA protocols

At the lowest level, the communications protocol of OPC UA is TCP-based and can therefore be used cross-platform even on embedded systems. A secure, encrypted transmission is required in all cases.

According to the standard, the following protocol options are available on the OPC UA interface:

- Simple XML/SOAP with "HTTP" via port 80 or with "HTTPS" via port 443.
- Binary TCP via port 4840 and other ports, such as port 55101 to port 55105 if other servers are involved.

The protocol can be selected using the URL address of the OPC UA server on the OPC UA user interface. You have the following two options available.

- OPC UA XML web services by specifying a URL, for example:
  - <http://<hostname>:80>
  - <https://<hostname>:443>
- Pure (native) binary TCP protocol by specifying:
  - `opc.tcp://<hostname>:4840`

### 4.7.1 XML Web services

XML can be used very easily with common development environments for OPC UA applications.

The firewall is usually already set to enable port 80 for HTTP and port 443 for HTTPS or these ports can be enabled easily in it. This means that Internet access is usually possible for the use of XML Web services without extra configuration.

### 4.7.2 Pure (native) binary TCP protocol

In OPC UA, the "OPC UA native binary" protocol has the highest transmission speed because data is transmitted compressed and little packaging information needs to be used. It requires the least additional effort. For example, no XML parser is required as is necessary for SOAP and HTTP.

The format is standardized down to the binary level. This stabilizes the data exchange between the OPC UA client and server since there are no degrees of freedom (such as blanks or comments in XML) present.

The specially defined TCP port 4840 is used for communication in the "OPC UA native binary" protocol, while SIMATIC NET OPC server still uses port 55101 to port 55105, depending on the protocol. These ports can be enabled or disabled in a firewall.

## 4.8 Structure of the namespace for OPC UA

The name space of OPC UA no longer consists of just folders, items and properties. It is a network of nodes with additional information and links.

The nodes are used both for the user data (instances) and for other information such as type descriptions of data (types). The nodes of OPC UA can be subdivided as follows:

- **Types**  
These are the node types specified in the OPC UA specification and, where necessary, by the relevant vendor, which are explicitly defined with respect to their properties and attributes. There are four basic types as follows:
  - ObjectTypes
  - VariableTypes
  - ReferenceTypes
  - DataTypes

The types serve as the type description for the instances.

- **Instances**  
These are the instances of the objects of your real project. Depending on the type of node, they obtain their properties by referencing the various types.

The root of your OPC UA server organizes both the types and the instances. This organizing includes the definition of additional nodes.

A node can have the following properties:

- Attributes that can be read
- Methods that can be called
- Events that can be signaled

Many standard nodes are defined in the OPC UA specification. Other node types may be added by specific manufacturers. The namespace is shown as a tree structure in OPC Scout V10.

## 4.9 Scanning the OPC UA namespace

The "Browse" and "Read" services are available for scanning the OPC UA namespace.

The response returns the requested value (reference, property or attribute).

### 4.9.1 "Browse"

This service is used to obtain the references (links) of a node.

### 4.9.2 "Read"

This service is used to obtain one or more attributes of one or more nodes.



## 4.10 Reading and writing attribute values of nodes

The two services "Read" and "Write" are available to read and write the attribute values of nodes.

### 4.10.1 "Read"

This service is used to obtain one or more attributes of one or more nodes. With structured attribute values, whose elements are indexed as in an array, clients can read the entire set of indexed values, and they can read specific ranges or individual elements.

How up to date the values are is decided by the "maxAge" parameter.

### 4.10.2 "Write"

This service is used to write values to one or more attributes of one or more nodes. With structured attribute values, whose elements are indexed as in an array, clients can write the entire set of indexed values, and they can write specific areas or individual elements.

The service request remains pending until the values have been written or until it is recognized that the values cannot be written.

Access for "Read" and "Write" uses the NodeId of the node or nodes. The NodeId is the identifier of a node in the namespace of OPC UA.

## 5 Appendix

### 5.1 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, application examples and videos – all information is accessible with just a few mouse clicks:

<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. Please send queries to Technical Support via Web form:

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- 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 web page:

<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 iOS and Android:

<https://support.industry.siemens.com/cs/ww/en/sc/2067>

## 5.2 Links and literature

Table 5-1

No.	Subject
\1\	Siemens Industry Online Support <a href="https://support.industry.siemens.com">https://support.industry.siemens.com</a>
\2\	Link to the article page of the application example <a href="https://support.industry.siemens.com/cs/ww/en/view/67295801">https://support.industry.siemens.com/cs/ww/en/view/67295801</a>
\3\	SIMATIC NET PC Software Industrial Communication with PG/PC Volume 1 - Basics (system manual) <a href="https://support.industry.siemens.com/cs/ww/en/view/77376110">https://support.industry.siemens.com/cs/ww/en/view/77376110</a>
\4\	SIMATIC NET: PC software Industrial Communication with PG/PC Volume 2 - Interfaces <a href="https://support.industry.siemens.com/cs/ww/en/view/77378184">https://support.industry.siemens.com/cs/ww/en/view/77378184</a>
\5\	SIMATIC NET: PC software Commissioning PC Stations - Manual and Quick Start <a href="https://support.industry.siemens.com/cs/ww/en/view/77377601">https://support.industry.siemens.com/cs/ww/en/view/77377601</a>

## 5.3 Change documentation

Table 5-2

Version	Date	Change
V1.0	05/2014	First version
V2.0	06/2020	Complete revision