OPC UA Access to S7-1200 PLC via modeled OPC UA Server Interface

UaExpert / STEP 7 V16

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1 Introduction

1.1 Overview

Starting point

OPC UA communication is supported on S7-1200 CPUs with firmware version 4.4 or higher. The CPU enables data access by supporting configuration as an OPC UA Server.

For access by OPC UA Clients, the OPC UA Server stores the released PLC tags and other information in the form of nodes. These nodes are interconnected and form a network. A network of nodes is also called an address space.

The S7-1200 OPC UA Server does not support the standard SIMATIC server interface. The PLC tags are stored in the SIMATIC address space S7-1200 OPC UA Servers made visible to OPC UA Clients via a modeled S7-1200 OPC UA Server interface.

Requirement

During production, an S7-1200 CPU is used to monitor and control the conveyor system and conveyor belts. The S7-1200 CPU checks the actual speed of the conveyor belt, "actualSpeed", at regular intervals and compares it with a predefined value, "setPointSpeed".

- If the actual speed is greater than the predefined value, the speed "actualSpeed" is reduced to the value "setPointSpeed".

- If the actual speed is less than the predefined value, the speed "actualSpeed" is increased to the value "setPointSpeed".

The OPC UA Client "UaExpert" queries this data ("actualSpeed", "setPointSpeed") as well as the state of the conveyor belt "isActive". The S7-1200 CPU forwards this data via the SIMATIC S7-1200 OPC UA Server. The data is displayed in the OPC UA Client.

The following figure provides an overview of the automation task.

Figure 1-1
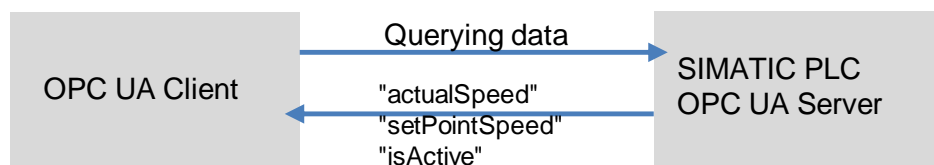
1.2 Principle of Operation

In this example, the OPC UA Client "UaExpert" communicates directly with the SIMATIC S7-1200 OPC UA Server. Client and server are connected via Ethernet and communicate with OPC UA over TCP/IP.
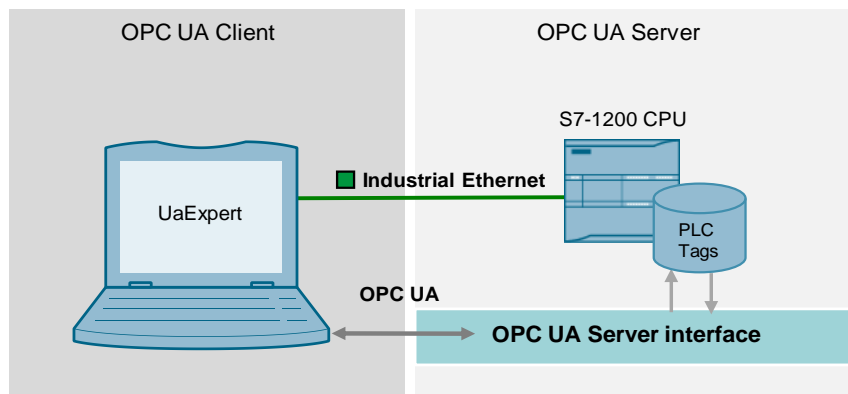
To approve the OPC UA Client for read and write access to certain PLC tags of the S7-1200 CPU, these variables must be enabled for OPC UA.
The PLC tags are made known to the S7-1200 CPU for the OPC UA Client via the S7-1200 OPC UA Server interface modeled in the TIA Portal V16.

Diagram

The following Figure shows the most important components of the solution:

Figure 1-2

Implemented functions

The following functions are implemented in the application example:

- Configuration of the SIMATIC S7-1200 OPC UA Server (Section 2.1.2).

- Modeling of the S7-1200 OPC UA Server interface for accessing the OPC UA Clients to certain PLC tags (Section 2.1.3).

- Display of the data in the OPC UA Client "UaExpert" (Section 4).

Note	You can use the "Companion Specification" server interface type to load internally created information models, such as those created in SiOME.
	An application example for the definition of OPC UA information models using SiOME can be found in SIOS under \4\.

1.3 Components Used

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

Table 1-1

Components	Quantity	Article number	Note
CPU 1215C DC/DC/DC, from firmware V4.4	1	6ES7215-1AG40-0XB0	A different S7-1200 CPU with firmware version V4.4 onward from the SIMATIC product range can also be used as an alternative.
Power supply PM1207	1	6EP1332-1SH71	Alternatively, a different power supply can be used.
TIA Portal V16	1	6ES7822-0AA06-0YA5	TIA Portal V16
UaExpert	1	Download \3\	OPC UA Client

Note This application example can also be used as a basis for modeling the OPC UA Server interface of an S7-1500 CPU from V2.6.

This application example consists of the following components:

Table 1-2

Components	File name	Note
Project	"109781701_S7_1200_OPC_UA_Server_ PROJ_V10.zip"	This zipped file contains the V16 project.
Documentation	"109781701_S7_1200_OPC_UA_Server_ DOCU_V10_en.pdf	This document

2 Configuration and Project Engineering

Note	The project engineering of the S7 station and the configuration of the SIMATIC S7-1200 OPC UA Server are completely implemented in the project.

This section shows you how to create a project with a SIMATIC S7-1200 CPU.

2.1.1 Configuring the S7 Station

1. Create a new STEP 7 project.
2. Configure the S7 station:

   CPU 1215C DC/DC/DC, V4.4
   Note:
   A different S7-1200 CPU, V4.4 from the SIMATIC product range can also be used as an alternative.
3. Create a new global data block with the tags to which the OPC UA client is to have read and write access.

Note	• To enable read access for a tag via OPC UA, you must check the box "Accessible from OPC UA". • To enable write access for a tag via OPC UA, you must check the box "writeable from OPC UA". • To configure a tag for OPC UA, you must check the box "Visible in HMI Engineering".

## 2.1.2 Activating the SIMATIC S7-1200 OPC UA Server

As the default setting, the OPC UA Server of the S7-1200 CPU is not enabled for security reasons: OPC UA Clients have neither read nor write access to the

S7-1200 CPU.

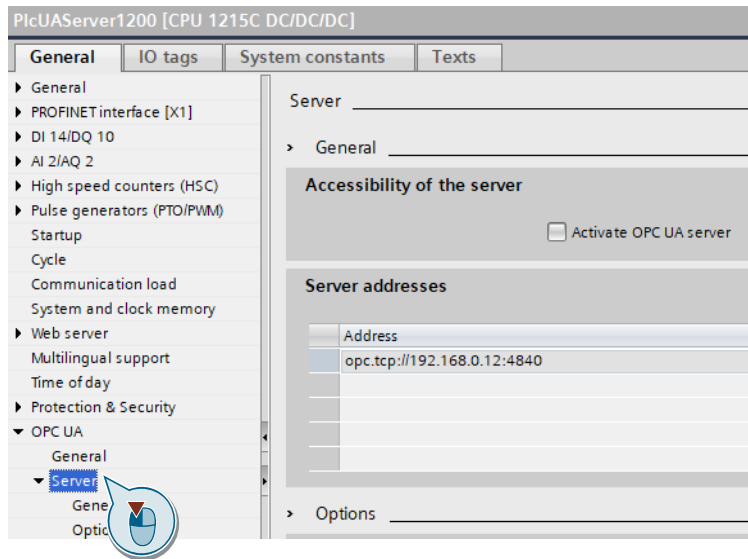To activate the OPC UA Server of the S7-1200 CPU, proceed as follows:

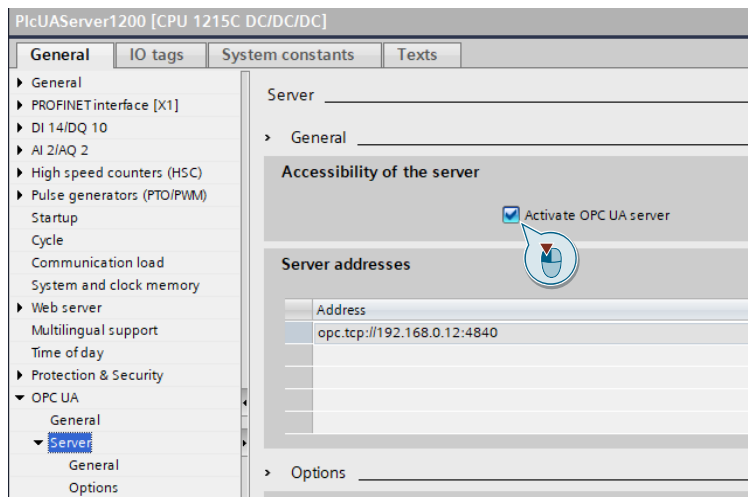1. Go to "Devices & Networks" of the configured S7 station.
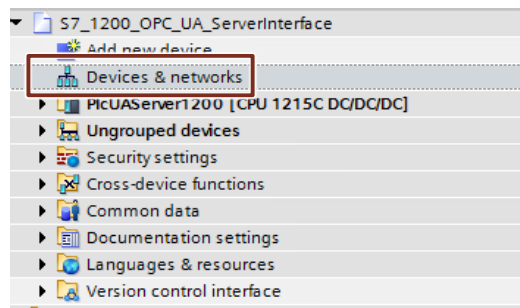
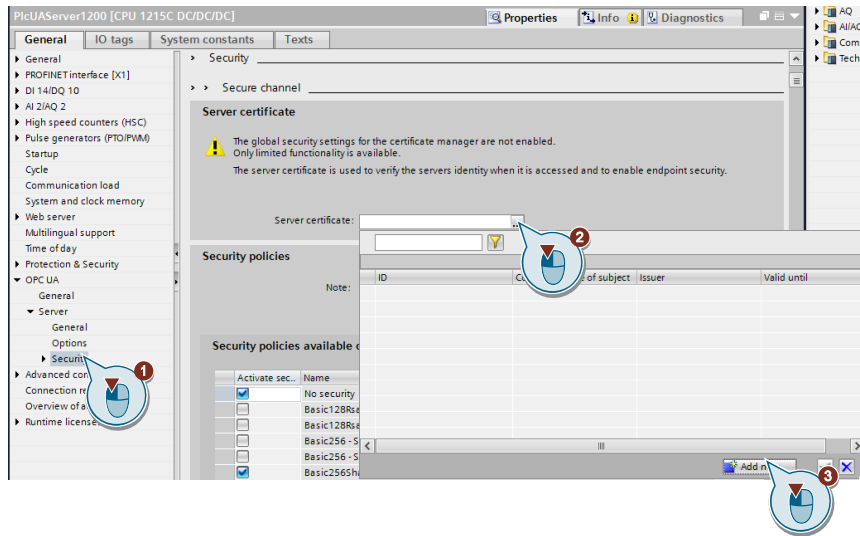2. Select the S7-1200 CPU. Click the CPU icon in the Network View.
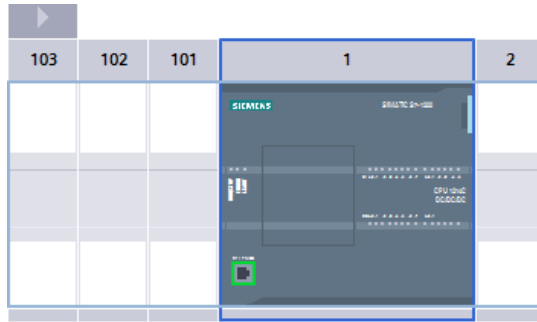
3. Click "OPC UA > Server" in the properties of the CPU.

4. Activate the OPC UA Server of the CPU "Activate OPC UA Server".
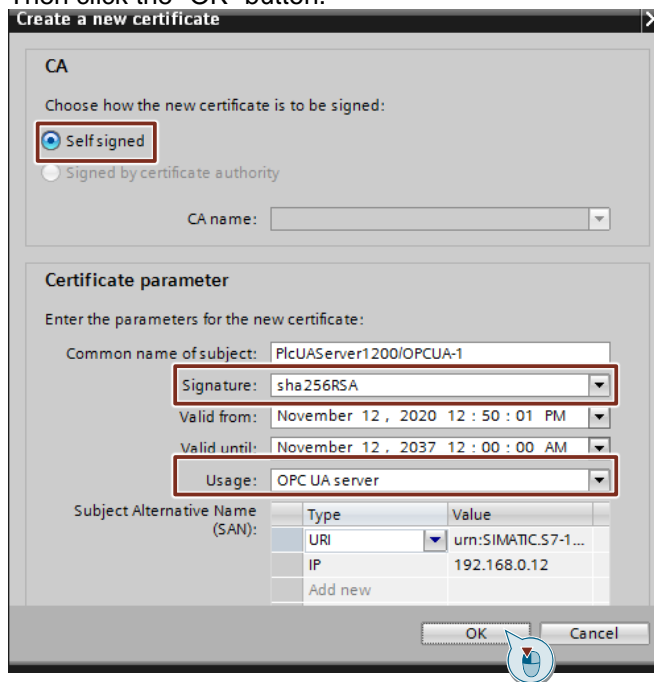
5. Navigate to the "Security> Server certificate" menu and create a new server certificate.
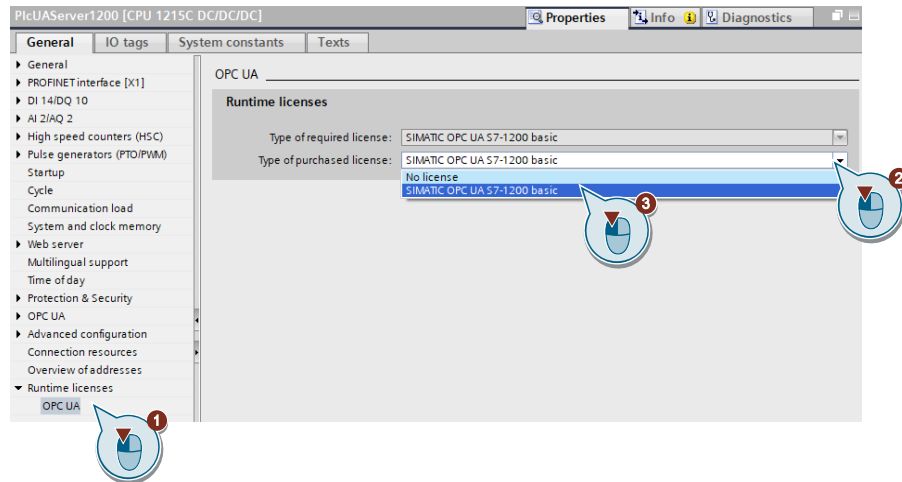
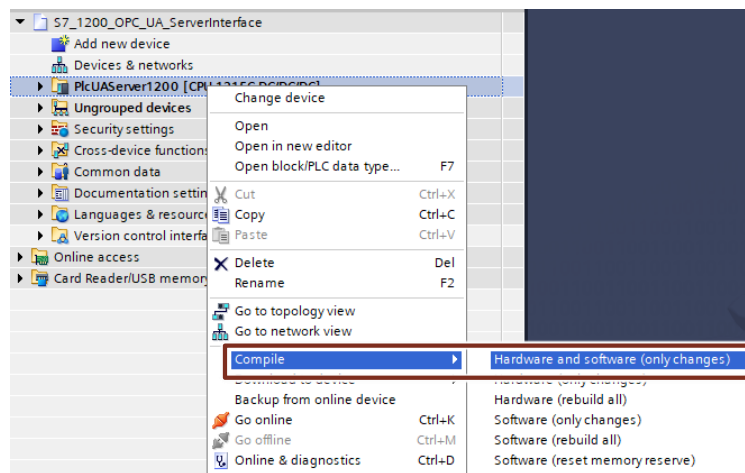

The "Create a new certificate" dialog appears.

6. Set the required parameters.
   Then click the "OK" button.

7. Switch to "Runtime licenses" and select your license from the drop-down menu.

8. Compile the hardware and software of the S7 station. To do this, right-click the device in the project navigation and select the menu "Compile > Hardware and software (only changes)".

Note	The OPC UA Server requires a certificate for activation. TIA Portal automatically generates a certificate when you activate the server. You can modify this certificate in the PLC properties.

Note	To run the OPC UA Server for the S7-1200 CPU, a Runtime license is required. The following licenses are available: • SIMATIC OPC UA S7-1200 Basic DVD 6ES7823-0BA00-2BA0 • SIMATIC OPC UA S7-1200 Basic DL 6ES7823-0BE00-2BA0

| Note	More information on the OPC UA Server for S7-1200 CPUs can be found at the link \5\.

2.1.3 Modeling the S7-1200 OPC UA Server interface

OPC UA Clients have read and write access to PLC tags and DB tags if the tags are enabled for OPC UA.
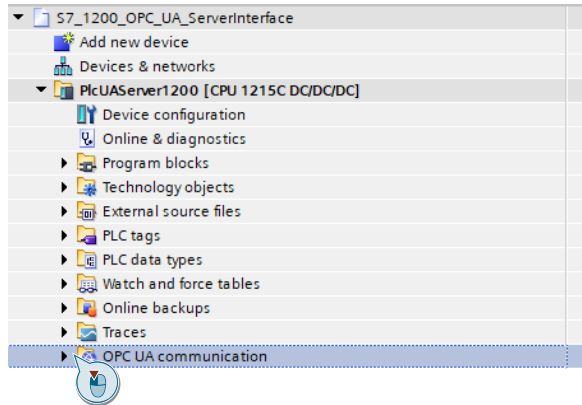
To do this, you must assign the PLC tags to S7-1200 CPUs as OPC UA nodes via an OPC UA Server interface for OPC UA Clients.

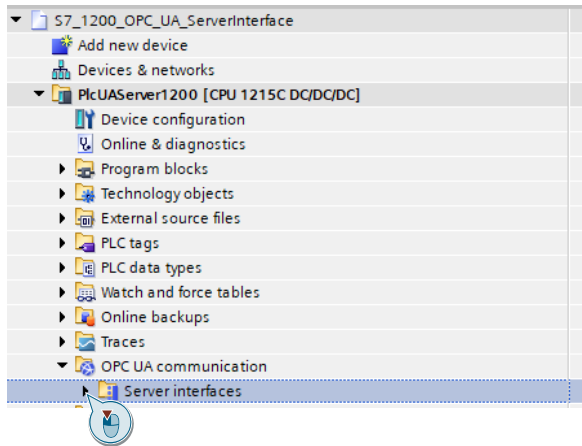To add an OPC UA Server interface, proceed as follows:

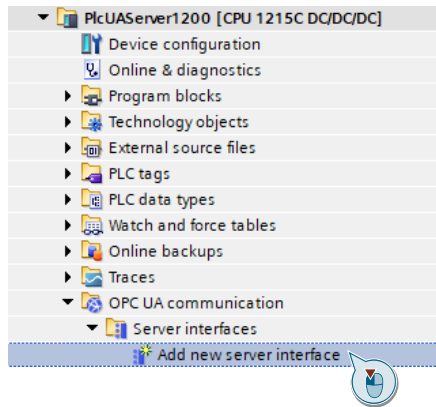1. In the project navigation, click "PlcUAServer1200".
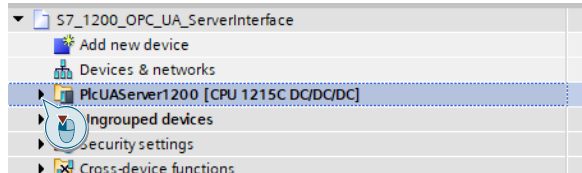
2. Select "OPC UA communication".
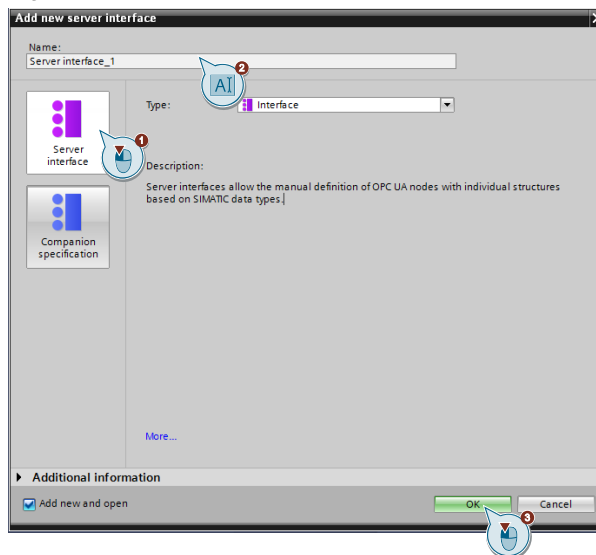

3. Select "Server interfaces".

4. Select "Add new server interface".

5. Select the server interface type "Server interface" to define the OPC UA nodes manually.

Figure 2-1

Note:

To load internally created information models, such as those created in SiOME, you must use the server interface type "Companion Specification".

6. Use drag & drop to assign the appropriate tags to the interface. Change access rights, Browse Name or Display Name if necessary.
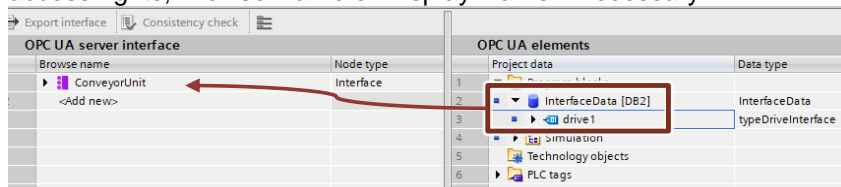
Note:

In an S7-1200 with firmware V4.4, no structured data types (structures and arrays) for OPC UA are possible.

7. Compile the hardware and software of the S7 station. To do this, right-click the device in the project navigation and select the menu "Compile > Hardware and software (only changes)".
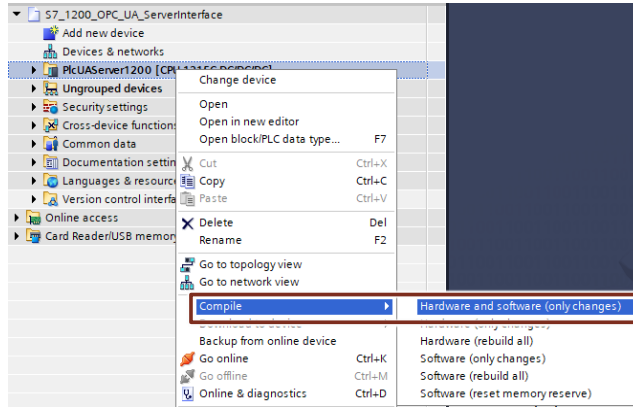
3 Installation and Commissioning
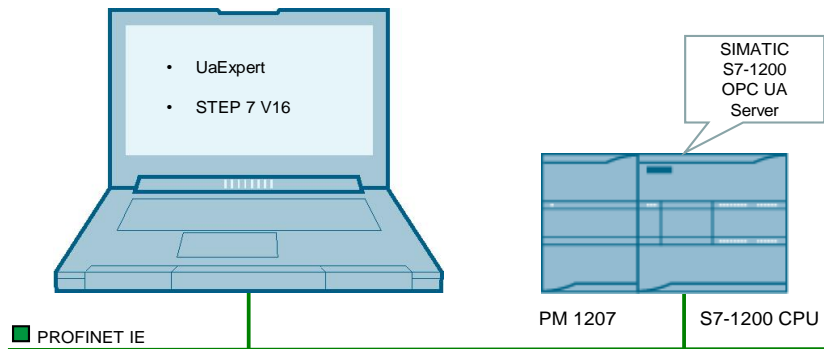
3.1 Hardware Setup

Section 1.3 lists the required hardware components.

CAUTION	**Observe the setup guidelines for S7-1200. Please read the corresponding device manual \6\.**

CAUTION	**Only switch on the power supply after you have completed and checked the assembly!**

The following graphic shows the hardware setup of the application.

Figure 3-1

The following table provides an overview of all IP addresses used in this example. Assignment of static IP addresses is assumed.

Table 3-1

Components	IP address	Description
CPU 1215C DC/DC/DC	192.168.0.12	S7-1200 CPU with OPC UA Server
Programming computer	192.168.0.10	• UaExpert • STEP 7 V16

The subnet mask in all network components is 255.255.255.0.

3.2 Installing Hardware and Software Components

To load the hardware and software components, proceed as follows:

1. Install the hardware and software components (Table 1-1) according to the description in the operating manuals of the respective components.
2. Connect the hardware components as shown in Figure 1-2.
3. Unzip the file "109781701_S7_1200_OPC_UA_Server_PROJ _V10.zip":

3.3 Downloading the S7-1200 Configuration

Proceed as follows to load the S7-1200 configuration:

1. Start TIA Portal V16.
2. Open the project "S7_1200_OPC_UA_ServerInterface".
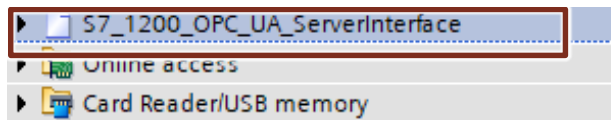
3. Connect the Ethernet jack of the programming computer with the Ethernet jack of the S7-1200 CPU.
4. Download the configuration "PlcUAServer1200". To do this, right-click the device in the project navigation and select the menu "Download to device > Hardware and software (only changes)".

Figure 3-2
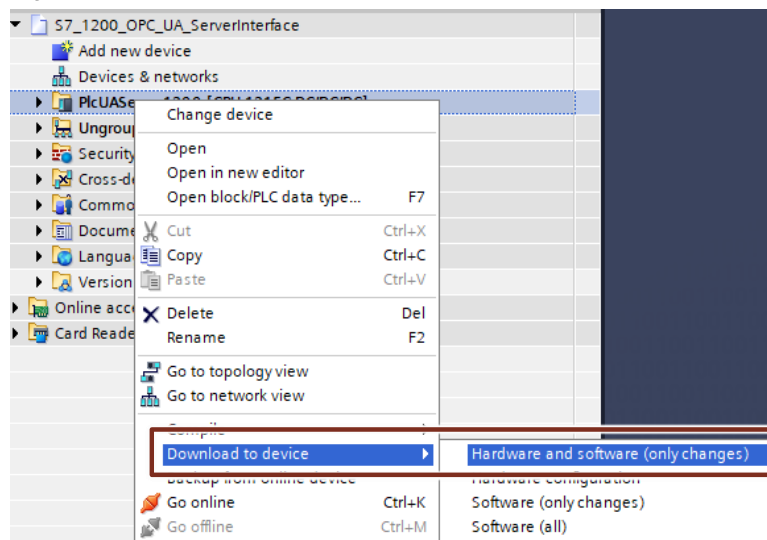
4 Operation

Introduction

This section will show you how to use the functions of the application example described above.

Reading the data via the OPC UA Client "UaExpert"

The following is required to use the OPC UA Client "UaExpert":

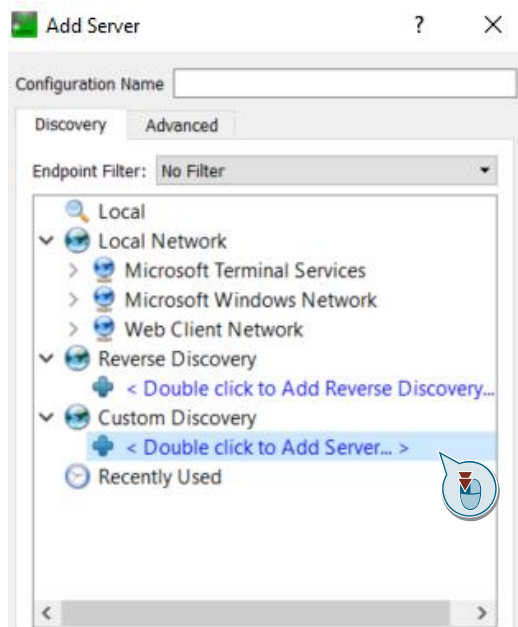- "UaExpert" is installed on your PC.
- OPC UA Server is activated in "PlcUAServer1200" (Section 2).
- The STEP 7 project is loaded into the controller (Section 3.3).

To read the data via the OPC UA Client "UaExpert", proceed as follows:

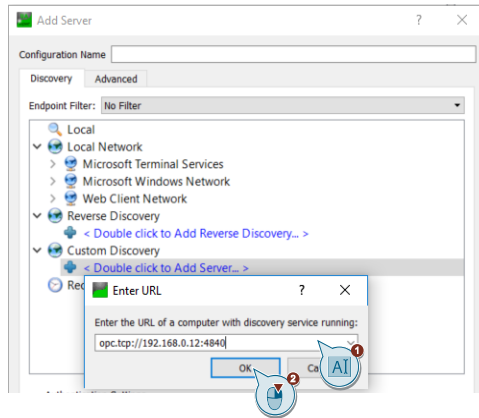1. Start "UaExpert" and click the "Add Server" button.
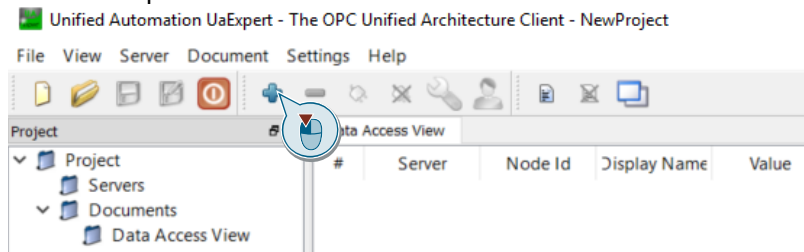
2. In the dialog, double-click "< Double click to Add Server... >" in the "Custom Discovery" list area.

3. In the following dialog, enter the URL and the port of the OPC UA Server of the S7-1200 CPU (e.g. opc.tcp://192.168.0.12:4840) and then click "OK".

4. Select an endpoint of the OPC UA Server to which you want to establish a connection (e.g.: SIMATIC.S7-1200.OPC-UA.Application:PlcUAServer1200-None -None).
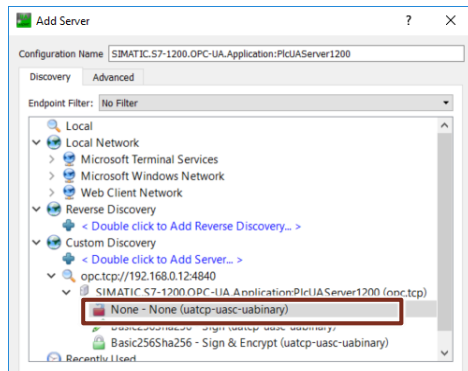
Note:
Since no users are stored in this application example, the "Anonymous" field is activated under "Authentication Settings".
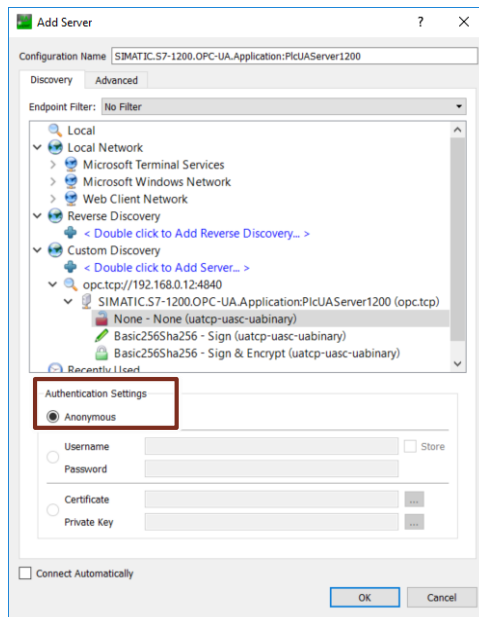
5. Set the "Connect Automatically" checkbox and then confirm with "OK".
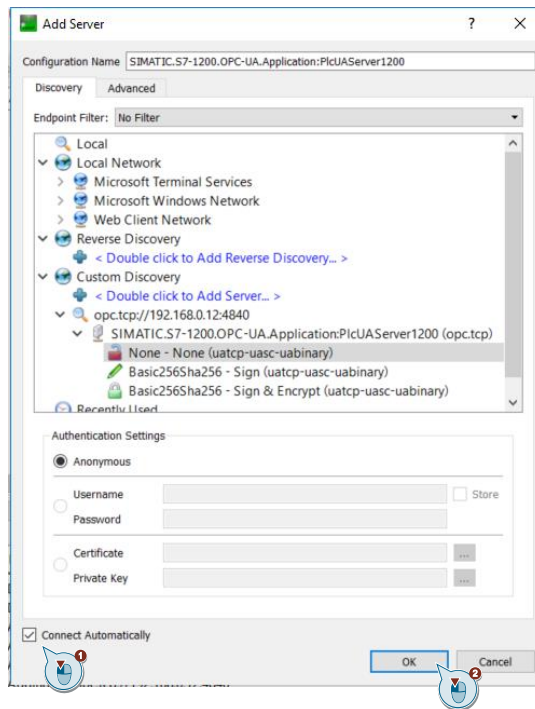
6. In the following dialog, accept the server certificate by setting the checkbox "Accept the server certificate temporarily for this session".
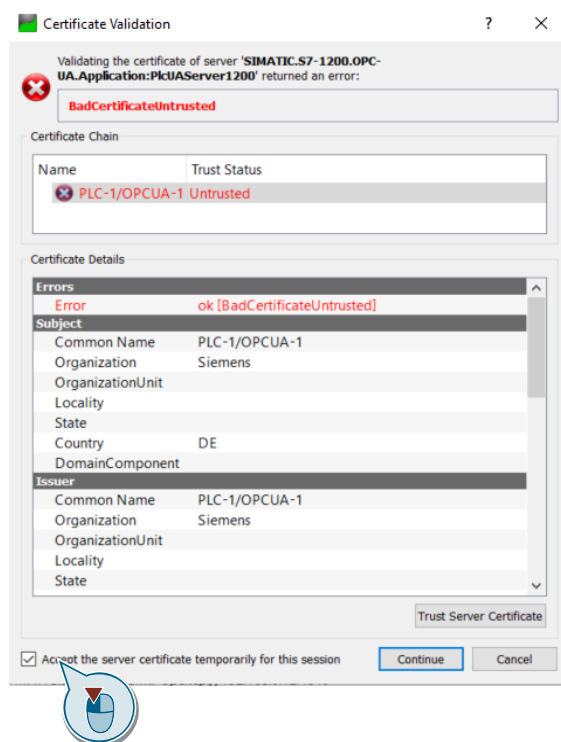
The certificate is not stored in the trusted list of "UAExpert".

Note:

To permanently add the certificate to the "UaExpert" trusted list, you must select "Trust Server Certificate".

7. Then click "Continue".
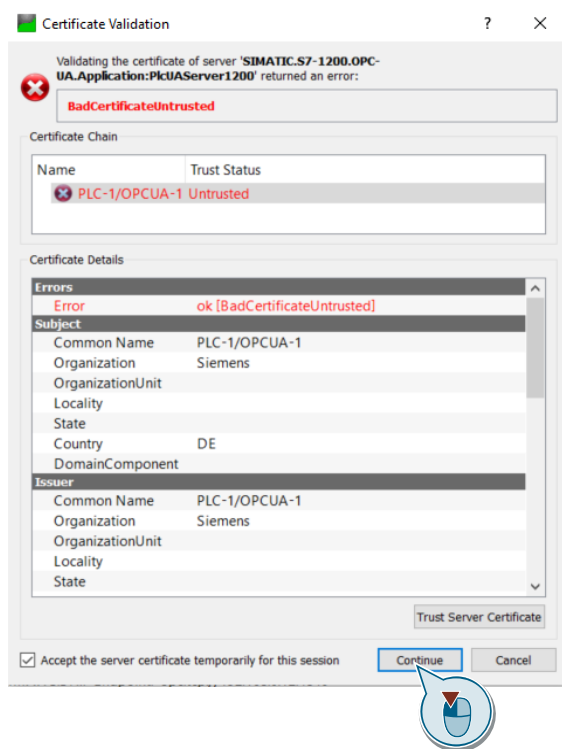
You are now connected to the OPC UA Server of the "PlcUAServer1200".

8. Navigate to "Root > Objects > ServerInterfaces > ConveryorUnit > drive1" in the "Address Space" of the server and drag & drop the tags "actualSpeed", "isActive", and "setPointSpeed" into the "Data Access View" area.
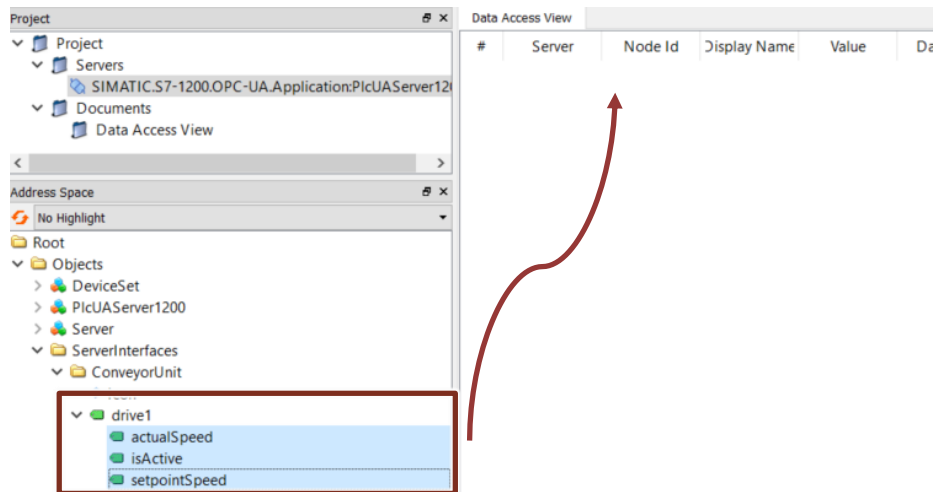
Note:
Here you only see the OPC UA nodes that you have configured in the project engineering of the OPC UA Server interface (see Section 2.1.3, step 5).

9. Open OB1 in your project and switch it to the online view.

10. Enter the desired value via the "setPointSpeed" input (e.g. "10").
    You receive the current speed at the "actualSpeed" output.

11. You can observe the data in the "Data Access View" area in the "Value" column.
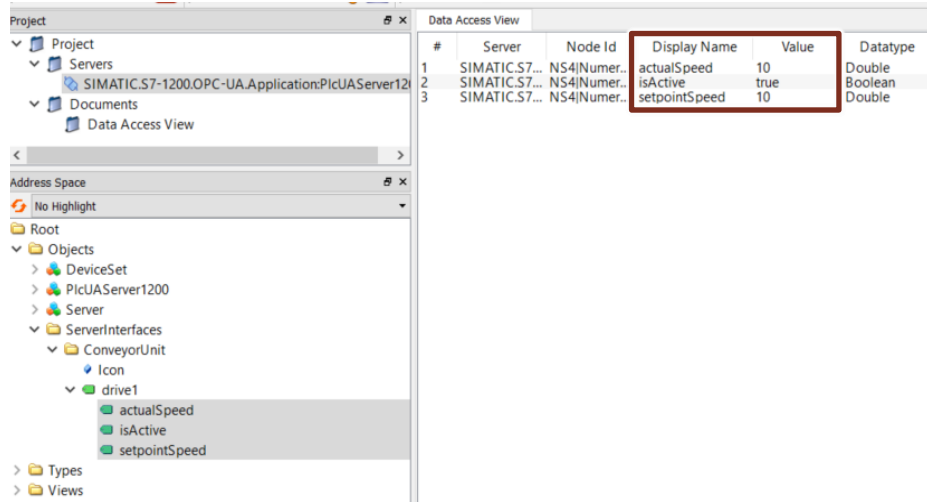
5 STEP 7 V16 Project Description

5.1.1 Overview

Introduction

The STEP 7 V16 project contains

- the user program for the S7 CPU with the "SimulatedDrive" function block
- the configuration of the SIMATIC S7-1200 OPC UA Server
- the modeling of the SIMATIC S7-1200 OPC UA Server interface

Diagram

The following graphic shows the program structure of the whole STEP 7 V16 project.

Figure 5-1
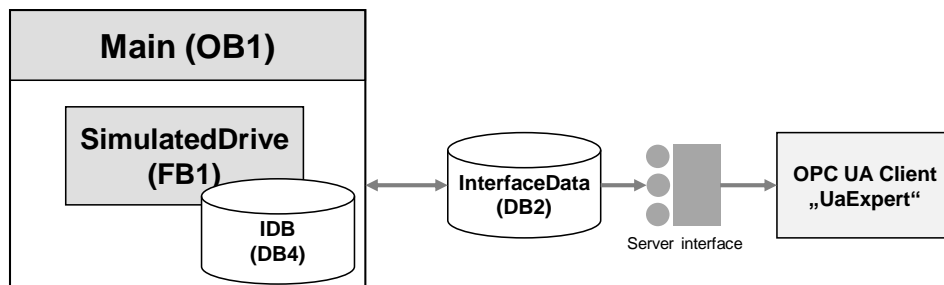
Program blocks

The user program for the SIMATIC S7-1200 CPU consists of the following elements:

Table 5-1

Element	Symbolic name	Description
OB1	Main	In OB1, the function block "SimulatedDrive" including the corresponding instance data block is called cyclically.
FB1	SimulatedDrive	The function block "SimulatedDrive" contains the functions implemented in this example.
DB2	InterfaceData	Global data block for storing the data.
DB4	InstSimulatedDrive	Instance data block of the "SimulatedDrive" function block.

5.1.2 The "SimulatedDrive" Function Block

Function

The function block "SimulatedDrive" checks the current speed of the conveyor belt "actualSpeed" at regular intervals and compares it with a predefined value "setPointSpeed".

- If the actual speed is greater than the predefined value, the speed "actualSpeed" is reduced to the value "setpointSpeed".

- If the actual speed is less than the predefined value, the speed "actualSpeed" is increased to the value "setpointSpeed".

Parameter

The Figure and table below show the call interface of the function block "SimulatedDrive".

Figure 5-2
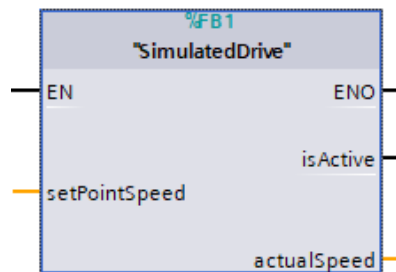
Table 5-2

<table>
<tr><th></th><th>Icon</th><th>Data type</th><th>Description</th></tr>
<tr><td rowspan="2">INPUT</td><td>EN</td><td>BOOL</td><td>Enable input. Only in FDP and LAD</td></tr>
<tr><td>setPointSpeed</td><td>LREAL</td><td>Predefined value with which the speed of the conveyor belt is compared at regular intervals.</td></tr>
<tr><td rowspan="3">OUTPUT</td><td>ENO</td><td>BOOL</td><td>Enable output. Only in FDP and LAD</td></tr>
<tr><td>isActive</td><td>BOOL</td><td>State of the conveyor belt.</td></tr>
<tr><td>actualSpeed</td><td>LREAL</td><td>Indicates the current speed of the conveyor belt:

• If the actual speed is greater than the predefined value, the speed "actualSpeed" is reduced to the value "setPointSpeed".

• If the actual speed is less than the predefined value, the speed "actualSpeed" is increased to the value "setPointSpeed".</td></tr>
</table>

5.1.3 The "InterfaceData" Global Data Block

The "InterfaceData" data block contains the data for communication between the SIMATIC S7-1200 OPC UA Server and the OPC UA Client:

- isActive
- actualSpeed
- setpointSpeed

Figure 5-3

		Name	Data type	Start value	Retain	Accessible f...
1		▼ Static			☐	☐
2	▪	▼ drive1	"typeDriveInterface"		☐	☑
3	▪	isActive	Bool	false	☐	☑
4	▪	actualSpeed	LReal	0.0	☐	☑
5	▪	setpointSpeed	LReal	0.0	☐	☑

Note	The PLC tags used for communication between the SIMATIC S7-1200 OPC UA Server and the OPC UA Client must be declared as accessible for OPC UA ("Accessible from HMI/OPC UA/Web API").

6 Appendix

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support.industry.siemens.com/cs/ww/en/sc/2067

6.2 Industry Mall

The Siemens Industry Mall is the platform on which the entire siemens Industry product portfolio is accessible. From the selection of products to the order and the delivery tracking, the Industry Mall enables the complete purchasing processing – directly and independently of time and location:
mall.industry.siemens.com

6.3 Links and literature

Table 6-1

No.	Subject
\1\	Siemens Industry Online Support https://support.industry.siemens.com
\2\	Link to the article page of the application example https://support.industry.siemens.com/cs/ww/en/view/109781701
\3\	Link to the download of the UaExpert tool https://www.unified-automation.com/products/development-tools/uaexpert.html
\4\	Siemens OPC UA Modeling Editor (SiOME) for the implementation of OPC UA Companion specifications https://support.industry.siemens.com/cs/ww/en/view/109755133
\5\	OPC UA Server for S7-1200 CPUs https://support.industry.siemens.com/cs/ww/en/view/109775168
\6\	SIMATIC S7 S7-1200 Programmable controller https://support.industry.siemens.com/cs/ww/en/view/109772940

6.4 Change documentation

Table 6-2

Version	Date	Change
V1.0	11/2020	First edition