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S7-1200 OPC UA server

S7-1200 CPUs

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Table of content

1	Introduction	4
2	Interesting information about the OPC UA server of the S7-1200 CPUs	4
2.1	1.1 The OPC UA server of the S7-1200 CPUs	4
2.1.1	Basics on the OPC UA server of the S7-1200 CPU	4
2.1.2	Node classes and address space	4
2.1.3	See also.....	5
2.2	End points of the OPC UA servers.....	6
2.2.1	Different security settings	6
2.2.2	Structure of end points	6
2.3	Information provided by the OPC UA server.....	7
2.4	Display of the information of the OPC UA server.....	8
2.5	Behavior of the OPC UA server in operation	8
2.5.1	OPC UA server in operation.....	8
2.5.2	Loading of the CPU with running OPC UA server	8
2.5.3	Reading out the CPU operating mode over OPC UA server	9
3	Configuring the OPC UA server	10
3.1	Enabling the OPC UA server	10
3.1.1	Requirement.....	10
3.1.2	Commissioning an OPC UA server	10
3.1.3	Settings remain stored	10
3.1.4	Application name	10
3.2	Access to the OPC UA server	11
3.2.1	Server addresses	11
3.2.2	Dynamic IP addresses	11
3.2.3	Standard SIMATIC server interface not for S7-1200	12
3.3	Additional OPC UA server settings	12
3.3.1	OPC UA server settings	12
3.4	License for OPC UA	12
3.4.1	Runtime licenses	12
4	OPC UA server interface configuration	13
4.1	What is a server interface?.....	13
4.1.1	Definition.....	13
4.1.2	Injection molding machine as an example for companion specification.....	13
4.1.3	Additional Information on handling server interfaces	14
5	Configuring access to PLC tags	15
5.1	Managing write and read rights	15
5.1.1	Enabling PLC tags and DB tags for OPC UA	15
5.1.2	Removing write rights.....	15
5.1.3	Removing write and read rights	15
5.1.4	Visible in HMI engineering.....	16
5.1.5	Rules	16
5.2	"MinimumSamplingInterval" attribute	16
5.2.1	Sampling of tags.....	16

1 Introduction

This document is an updated description of the OPC UA server of the S7-1200 from the TIA Portal V16 information system.

2 Interesting information about the OPC UA server of the S7-1200 CPUs

2.1 1.1 The OPC UA server of the S7-1200 CPUs

The S7-1200 CPUs as of firmware V4.4 are equipped with an OPC UA server. This also includes the versions S7-1200FC in addition to the standard S7-1200C CPUs. Convention: "S7-1200 CPU" also includes the above-mentioned CPU variants.

2.1.1 Basics on the OPC UA server of the S7-1200 CPU

Access to the OPC UA server of the CPU is possible over the PROFINET interfaces of the S7-1200 CPU.

For access by clients, the server saves the enabled PLC tags and other information in the form of nodes (see chapter 3). These nodes are interconnected and form a network. OPC UA nodes form access points into this network (well-known nodes) that enable OPC UA clients to navigate to subordinated nodes.

2.1.2 Node classes and address space

OPC UA servers provide information in the form of nodes. A node can be, for example, an object, a tag, or a property.

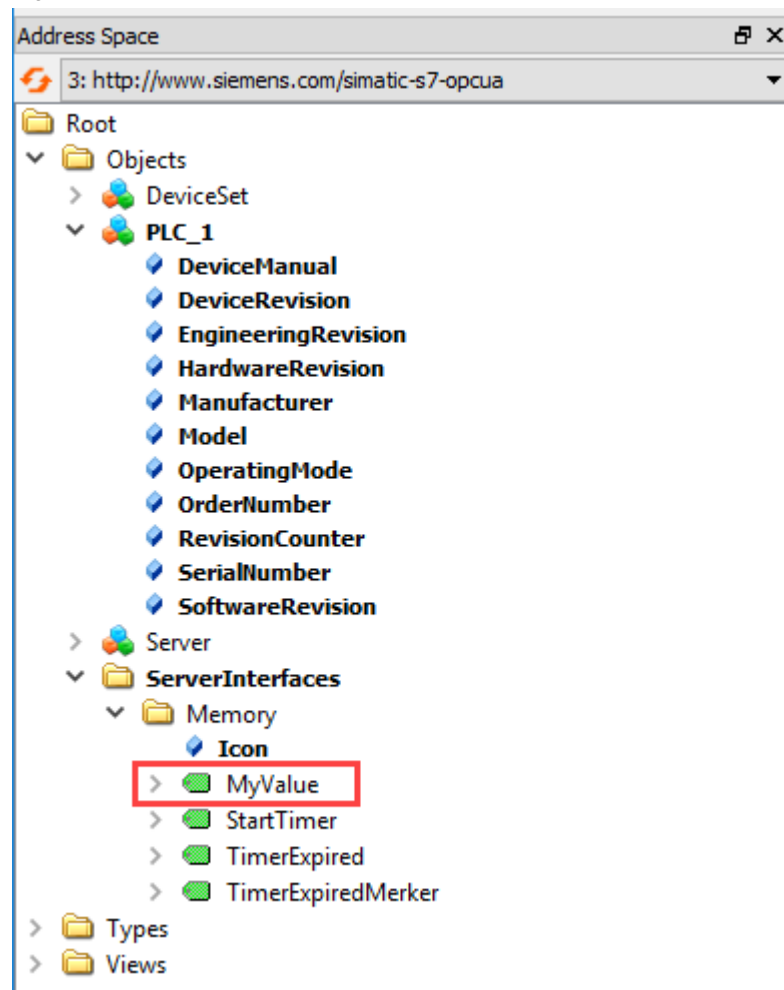
A network of nodes is also called an address space. Starting from the root, all nodes can be reached in the address space.

The nodes are linked over references, for example, the reference "HasComponent", which represents a hierarchical relationship between a node and its subordinate nodes. With their references, the nodes form a network that can, for example, take the form of a tree.

If you want to make PLC tags visible to OPC UA clients in the address space of the OPC UA server of the S7-1200 CPU, the you create either a server interface of type "Companion Specification" or simply of the type "Interface".

[Figure 2-1](#) shows the address space of the OPC UA server of an S7-1200 CPU.

Figure 2-1 Extract from the "UaExpert" from Unified Automation



The "MyValue" tag is selected in the figure above.
This tag is located below the "Memory" server interface node.

2.1.3 See also

Documentation for S7-1200 automation system
(<https://support.industry.siemens.com/cs/ww/en/view/109772940>)

2.2 End points of the OPC UA servers

The end points of the OPC UA servers define the security level for a connection. Depending on the application or desired security level, you must configure the connection accordingly at the end point.

2.2.1 Different security settings

Before establishing a secure connection, OPC UA clients ask the server with which security settings connections are possible. The server returns a list with all the security settings (end points) that the server allows.

2.2.2 Structure of end points

End points consist of the following components:

- Identifier for OPC: "opc.tcp"
- IP address: 192.168.178.151 (in the example)
- Port number for OPC UA: 4840 (standard port)
The port number can be configured.
- Security setting for messages (Message Security Mode):
 - None
 - Sign
 - SignAndEncrypt.
- Encryption and hash procedures (Security Policy):
 - None
 - Basic128Rsa15
 - Basic256
 - Basic256Sha256 (in the example)

[Figure 2-2](#) shows the "UA Sample Client" of the OPC Foundation.

The client has established a secure connection to the OPC UA server to the end point "opc.tcp://192.168.178.151:4840 - [SignAndEncrypt: Basic256Sha256:Binary]". The security settings "SignAndEncrypt:Basic256Sha256" are contained in the end point.

NOTE

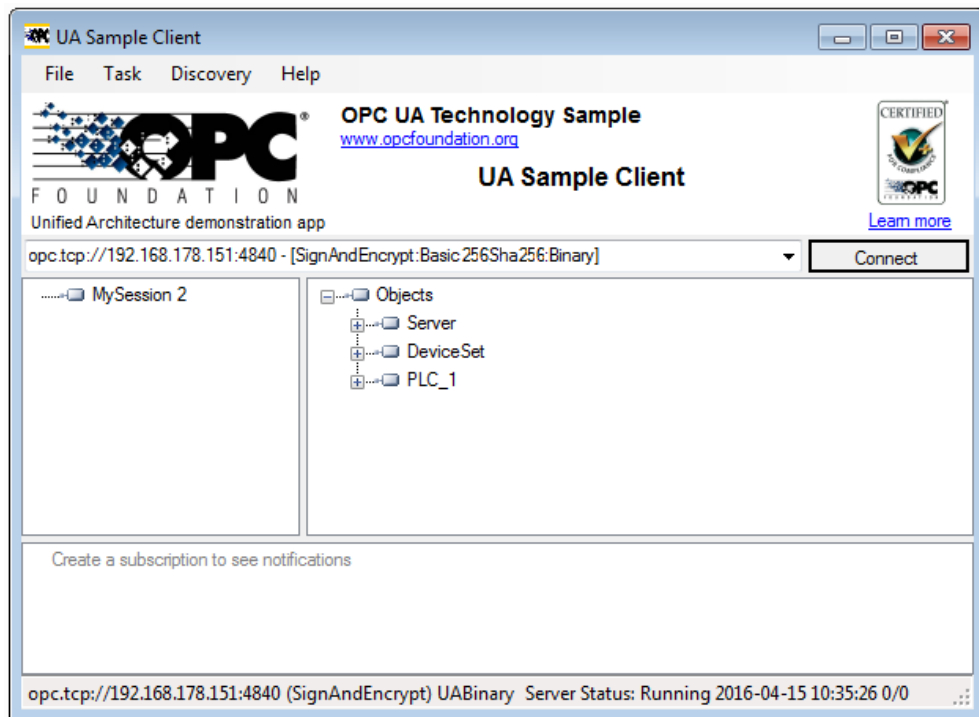
Select an end point with a security policy that is as strict as possible

- For the end points at the OPC UA server, activate only the most secure ones which a client still supports.
- Disable the less strict security policy at the OPC UA server.

Establishing a connection to the server (client side)

- To establish a connection to the server, select the appropriate security policy for the application.
- Use a Sha256 certificate for the most secure end points (Basic256Sha256) of the S7-1200 CPU OPC UA server.

Figure 2-2



A connection to a server end point is only established if the OPC UA client complies with the security policies of that end point.

The "[SIMATIC STEP 7 Basic/Professional V16 and SIMATIC WinCC V16](#)" manual, "Handling client and server certificates" section describes how to configure the security policy in the TIA Portal.

2.3 Information provided by the OPC UA server

OPC UA servers provide a wide range of information:

- The values of PLC tags and DB components which clients may access.
- The data types of these PLC tags and DB components.
You can find the data types supported by the OPC UA server of the S7-1200, in the documentation for the S7-1200 Automation System (<https://support.industry.siemens.com/cs/ww/en/ps/13685/man>).
- Information on the OPC UA server itself and on the CPU.

This gives clients an overview and allows them to read out specific information. Previous knowledge of the PLC program and the CPU data is not required. You do not need to ask the developer of the PLC program when PLC tags are to be read. All necessary information is stored on the server itself (for example, the data types of the PLC tags).

2.4 Display of the information of the OPC UA server

You have the following options:

- Online: You have all the available information displayed during the runtime of the OPC UA server. To do so, navigate (browse) the address space of the server.
- Offline: You export your configured server interfaces as XML files that are based on the XML schemes of the OPC Foundation.
- Offline with the Openness API: In your program, you use the API (Application Programming Interface) of the TIA Portal to access the function for exporting all PLC tags that can be read by OPC UA. This requires .NET Framework 4.0; see TIA Portal Openness, Automating SIMATIC projects with scripts (<https://support.industry.siemens.com/cs/ww/en/view/109477163>)
- If you already know the syntax and the PLC program, you can access the OPC UA server without first researching the information.

2.5 Behavior of the OPC UA server in operation

2.5.1 OPC UA server in operation

The OPC UA server of the S7-1200 CPU starts when you activate the server and download the project to the CPU.

Behavior in stop mode of CPU

An activated OPC UA server remains in operation even if the CPU switches to "STOP". The OPC UA server continues to respond to requests from OPC UA clients.

Server response in detail:

- If you request the values of PLC tags, you will get the values that were current before the CPU switched to or was set to "STOP".
- If you write values to the OPC UA server, the OPC UA server will accept those values.
However, the CPU will not process the values because the user program is not executed in "STOP" mode.
An OPC UA client can nonetheless read the values written at STOP from the OPC UA server of the CPU.

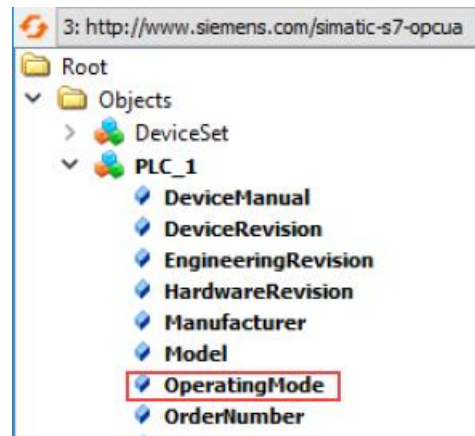
2.5.2 Loading of the CPU with running OPC UA server

During loading in RUN, the OPC UA Server of the S7-1200 CPU is generally stopped and restarted.

2.5.3 Reading out the CPU operating mode over OPC UA server

The OPC UA server allows you to read out the CPU mode, see [Figure 2-3](#):

Figure 2-3



3 Configuring the OPC UA server

3.1 Enabling the OPC UA server

3.1.1 Requirement

- If you use certificates for secured communication, e.g. HTTPS, Secure OUC, OPC UA, make sure that the modules involved have the current time of day and the current date. Otherwise, the modules evaluate the used certificates as invalid and secure communication does not work.
- You have acquired a runtime license for the operation of the OPC UA functions.

3.1.2 Commissioning an OPC UA server

By default, the OPC UA server of the CPU is not enabled for reasons of security: OPC UA clients have neither write nor read access to the S7-1200 CPU.

Follow these steps to activate the OPC UA server of the CPU:

1. Select the CPU. Click on the CPU symbol (for example in the network view).
2. Click "OPC UA > Server" in the properties of the CPU.
3. Activate the OPC UA server of the CPU.
4. Confirm the security notes.
5. Go to the CPU properties, select "Runtime licenses" and set the runtime license acquired for the OPC UA server.
6. Compile the project.
7. Download the project to the CPU.

The OPC UA server of CPU now starts.

3.1.3 Settings remain stored

If you have already enabled the server and assigned the parameters, those parameter assignments are not lost if the server is then disabled. The settings are saved as before and are available when you enable the server again.

3.1.4 Application name

The application name is the name of the OPC UA application and applies in principle to the server and the client of a CPU. S7-1200 CPUs currently have only one OPC UA server. The name is displayed under "OPC UA > General":

- The default for the application name is:
"SIMATIC.S7-1200.OPC-UA.Application:PLC_1".
- The default consists of "SIMATIC.S7-1200.OPC-UA.Application:" and the name of the CPU selected under "General > Product information > Name", in this case "PLC_1".
- The OPC UA server uses this application name to identify itself to a communication partner (OPC UA client), for example, when an OPC UA client uses the discovery service to detect accessible servers.
- The displayed application name uses the OPC UA client of the CPU when connecting to an OPC UA Server. This means that the CPU enters this application name automatically as "ApplicationName" for the instruction "OPC-UA_Connect" (tag of type "OPC-UA_SessionConnectInfo" at the

parameter "SessionConnectInfo" of the instruction "OPC_UA_Connect"). When you program the instruction "OPC_UA_Connect" you must therefore assign an empty string to the "ApplicationName". You can use the application name, for example, to identify the client and its sessions (SessionNames) for diagnostic purposes.

If you have activated the server, you can also use a different name that is meaningful in your project and that fulfills the requirements of your project, e.g. for worldwide uniqueness.

Changing the application name

To change the application name, follow these steps:

1. Select the CPU. Click on the CPU symbol (for example in the network view).
2. Click "OPC UA > General" in the properties of the CPU.
3. Enter a meaningful name.

Please note that the application name is also entered on the certificate (Subject Alternative Name) and you may have to generate an existing certificate again after changing the application name.

See also

Chapter [3.4](#)

3.2 Access to the OPC UA server

3.2.1 Server addresses

The OPC UA server of the S7-1200 CPU can be reached over the integrated PROFINET interface of the CPU (firmware V4.4 and higher).

The server address is available in the area "OPC UA > Server > General" of the CPU parameters and shows the IP address of the PROFINET interface in form of a URL in the following format:

Example of a URL (Uniform Resource Locator) that can be used to set up connections to the OPC UA server of the CPU:

```
"opc.tcp://192.168.178.151:4840"
```

The URL is structured as follows:

- Protocol identifier "opc.tcp://"
- IP address: 192.168.178.151
The IP address at which the OPC UA server can be accessed from the Ethernet subnet 192.168.178.
- TCP Port number (Default): 4840 (standard port)
The port number can be changed under "OPC > UA > Server > Port".

3.2.2 Dynamic IP addresses

If the IP address of the PROFINET interface has not been specified yet, the placeholder "<ynamically>" is displayed in the "Server addresses" area.

In this case, the IP address of this PROFINET interface must be set later on the device.

3.2.3 Standard SIMATIC server interface not for S7-1200

The option "Activate standard SIMATIC server interface" is not available for the OPC UA server of the S7-1200 CPU.

You must add server interfaces using the "OPC UA communication" entry in the project tree. These server interfaces make the PLC tags enabled for OPC UA visible for OPC UA clients.

3.3 Additional OPC UA server settings

3.3.1 OPC UA server settings

In principle, the OPC UA server of the S7-1200 CPU offers the same settings as a S7-1500 CPU; only some options are not available with the OPC UA server of the S7-1200 CPU. Value ranges are restricted.

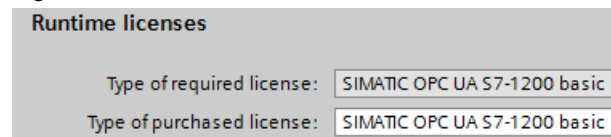
3.4 License for OPC UA

3.4.1 Runtime licenses

A "Basic" type license is required to run the OPC UA server of the S7-1200 CPU.

The required license type is displayed under "Properties > General > Runtime licenses > OPC-UA > Type of required license".

Figure 3-1



To confirm purchase of the license, follow these steps:

1. Click "Runtime licenses > OPC UA" in the properties of the CPU.
2. Select the license from the "Type of purchased license" drop-down list.

4 OPC UA server interface configuration

4.1 What is a server interface?

4.1.1 Definition

A server interface combines nodes of an OPC UA address space of a CPU into a unit, so that a specific view on this CPU is provided for OPC UA clients.

Each server interface defines one or more namespaces in the OPC UA server of the CPU.

STEP 7 (TIA Portal) differentiates between the following types of server interfaces:

- Companion specification
- User-defined server interface

Companion specification

For this type of server interface, you use a Companion Specification created by a workgroup, for example.

The workgroup is typically composed of members of the OPC Foundation and another industry organization who have jointly specified an OPC UA information model for a specific purpose (for example, for data exchange with RFID devices or with injection molding machines).

This information model is realized in the form of OPC UA nodes in the address space of an OPC UA server. OPC UA clients can access these OPC UA nodes.

You can also use the server interface type "Companion specification", for example, to download company-internal information models, e.g. in SiOME.

If you implement a certain companion specification in your project, you apply the specifications of this companion specification into your project as server interface.

For "Companion specification"-type server interfaces, you can import multiple namespaces which the Companion specification uses.

User-defined server interface:

For this type of server interface, you combine OPC UA nodes of an OPC UA server into a unit.

To do this, use the specifications for your project or the requirements for your machine or your plant as a basis.

4.1.2 Injection molding machine as an example for companion specification

A server interface of the type "Companion specification", for example, contains the following elements:

- OPC UA nodes which you can write with an OPC UA client to receive information about this injection molding machine (in readable PLC tags)
- OPC UA nodes which you can write with an OPC UA client to transfer values to the injection molding machine (in writable PLC tags)

This server interface enables a default view of a CPU, which can be used to control an injection molding machine.

For injection molding machines, the companion specification "Euromap" defines a whole series of OPC UA nodes which you can combine in a server interface.

Other OPC UA nodes of the CPU are not included in this server interface. This provides a better overview.

4.1.3 Additional Information on handling server interfaces

Creation, export and loading of server interfaces is exactly the same as for the S7-1500 CPUs.

You must observe the following restrictions for S7-1200 CPUs:

- A S7-1200 CPU does not support methods.
There is no reaction during an attempt to assign a function block of the "OPC UA elements" column to a method in the OPC UA server interface with drag & drop.
- Structured data types, such as the OPC UA data types DateTime, NodeId and QualifiedName, are not supported.
STEP 7 creates an error during the attempt to assign a tag with a structured data type of the "OPC UA elements" column to a corresponding element of the server interface.

Copying server interfaces of an S7-1500 CPU

If you have created server interfaces for an S7-1500 CPU, you can copy these server interfaces to the "OPC UA communication" area of an S7-1200 CPU.

If the server interface contains elements that are not supported, as described above, a compilation of the configuration or the consistency check is canceled with errors.

5 Configuring access to PLC tags

5.1 Managing write and read rights

5.1.1 Enabling PLC tags and DB tags for OPC UA

OPC UA clients can have read and write access to PLC tags and DB tags if the tags are enabled for OPC UA (default setting).

For enabled tags, the following check boxes are activated:

- "Accessible from HMI/OPC UA"
- "Writable from HMI/OPC UA"
- "Visible in HMI engineering"

Figure 5-1

MyDB				
Name	Data type	Accessible from HMI/OPC UA	Writable from HMI/OPC UA	Visible in HMI engineering
MyDB[0]	Int	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

You can change the default setting in the settings of the TIA Portal: Command "Settings > PLC programming > General" in "Options" menu. You will find the corresponding options in the "Block interface/data block elements" area.

In addition, with S7-1200 CPUs you must make the PLC tags known as OPC UA nodes for OPC UA clients via a server interface ("OPC UA communication" area in the project tree). Alternatively, you can use a Companion Specification with mapping to PLC tags.

5.1.2 Removing write rights

If you want to write-protect a tag, deselect the "Writable from HMI/OPC UA" option for that tag. This removes the write right for the OPC UA clients and HMI devices.

Result

Only read access by OPC UA clients and HMI devices is possible. OPC UA clients cannot assign values to this tag and therefore cannot influence execution of the S7 program.

For S7-1200 CPUs it is sufficient to remove the mapping of the corresponding PLC tags from the server interface.

5.1.3 Removing write and read rights

To write-protect and read-protect a tag, disable the "Accessible from HMI/OPC UA" option for that tag (checkbox not selected). This makes the OPC UA server remove the tag from its address space. OPC UA clients can no longer see this CPU tag.

Result

OPC UA clients and HMI devices can neither read nor write the tag.

5.1.4 Visible in HMI engineering

The option "Visible in HMI Engineering" applies to Siemens engineering tools. If you disable the option "Visible in HMI Engineering" (check mark not set), you can no longer configure the tag in WinCC (TIA Portal).

The option does not have any effect on OPC UA.

5.1.5 Rules

- Only allow read access to PLC tags and tags of data blocks in STEP 7 if this is necessary for communication with other systems (controllers, embedded systems or MES).
You should not enable other PLC tags.
- Only allow write access over OPC UA if write rights are genuinely necessary for specific PLC tags and tags of data blocks.
- If you have reset the "Accessible from HMI/OPC UA" option for all elements of a data block, the data block for an OPC UA client is no longer visible in the address space of the OPC UA server of the S7-1200 CPU.
- You can also prevent access to an entire data block centrally, as with S7-1500 CPUs. This setting "overrules" the settings for the components in the DB editor.

5.2 "MinimumSamplingInterval" attribute

5.2.1 Sampling of tags

In addition to "Value", "DataType" and "AccessLevel", you can also set the "MinimumSamplingInterval" attribute for a tag in the XML file that represents the server address space.

The attribute specifies how fast the server can sample the tag value.

The value can be set in a range from 100 ms to 10 s. The default value is 1000 ms.

The sampling frequency is limited to the sampling interval defined by the OPC UA client.

The OPC UA server of the S7-1200 CPU handles the values for "MinimumSamplingInterval" attribute as follows:

- Negative values and values greater than 4294967 are set to -1. This means:
The minimum sampling rate is indeterminate. The server does not specify how fast the tag value is sampled.
- Decimal numbers are rounded to three decimal places.