# SIEMENS

# SINUMERIK

# SINUMERIK 840Dsl/828D SINUMERIK Access MyMachine / OPC UA

**Configuration Manual** 

### Preface

Introduction	1
Safety notes	2
Setting up of OPC UA server	3
Customer Specific Object Model (CSOM)	4
User administration	5
Functionality	6
Diagnostics	7
Update of OPC UA server	8
Technical data	9
Exceptions: 828D / V4.5	10
Trouble shooting	11

Valid for:

OPC UA server Version 3.0 SP1

### Legal information

### Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

### 

indicates that death or severe personal injury will result if proper precautions are not taken.

#### 

indicates that death or severe personal injury may result if proper precautions are not taken.

### 

indicates that minor personal injury can result if proper precautions are not taken.

### NOTICE

indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

### **Qualified Personnel**

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

### Proper use of Siemens products

Note the following:

### 

Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

### Trademarks

All names identified by <sup>®</sup> are registered trademarks of Siemens AG. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

### **Disclaimer of Liability**

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

# Preface

### SINUMERIK documentation

The SINUMERIK documentation is organized into the following categories:

- General documentation/catalogs
- User documentation
- Manufacturer/service documentation

### Additional information

You can find information on the following topics at the following address (<u>https://support.industry.siemens.com/cs/document/108464614/</u>):

- Ordering documentation/overview of documentation
- Additional links to download documents
- Using documentation online (find and search in manuals/information)

If you have any questions regarding the technical documentation (e.g. suggestions, corrections), please send an e-mail to the following address (mailto:docu.motioncontrol@siemens.com).

### mySupport/Documentation

At the following address (<u>https://support.industry.siemens.com/My/ww/en/documentation</u>), you can find information on how to create your own individual documentation based on Siemens' content, and adapt it for your own machine documentation.

### Training

At the following address (<u>http://www.siemens.com/sitrain</u>), you can find information about SITRAIN (Siemens training on products, systems and solutions for automation and drives).

### FAQs

You can find Frequently Asked Questions in the Service&Support pages under Product Support (<u>https://support.industry.siemens.com/cs/de/en/ps/faq</u>).

### SINUMERIK

You can find information about SINUMERIK at the following address (<u>http://www.siemens.com/</u> sinumerik).

### Target group

This document addresses commissioning engineers, machine tool manufacturers, planners and plant operating companies. The document provides detailed information that commissioning engineers require to setup the SINUMERIK Access MyMachine / OPC UA software.

### **Benefits**

The Configuration Manual instructs the target group on how to use/configure the software correctly.

#### Standard scope

This documentation describes the functionality of the standard scope. Additions or revisions made by the machine manufacturer are documented by the machine manufacturer.

Other functions not described in this documentation might be executable in the control system. This does not, however, represent an obligation to supply such functions with a new control system or when servicing.

For the sake of simplicity, this documentation does not contain all detailed information about all types of the product and cannot cover every conceivable case of installation, operation, or maintenance.

#### Note regarding the General Data Protection Regulation

Siemens observes standard data protection principles, in particular the principle of privacy by design. That means that this product does not process / store any personal data, only technical functional data (e.g. time stamps). If a user links this data with other data (e.g. a shift schedule) or stores personal data on the same storage medium (e.g. hard drive) and thus establishes a link to a person or persons, then the user is responsible for ensuring compliance with the relevant data protection regulations.

### **Technical Support**

Country-specific telephone numbers for technical support are provided in the Internet at the following address (<u>https://support.industry.siemens.com/cs/sc/2090/</u>) in the "Contact" area.

# Table of contents

	Preface		3
1	Introducti	on	9
	1.1 1.1.1	General description SINUMERIK OPC UA server	9 9
	1.2	Features	10
	1.3	System setup	11
	1.4	Compatibility of OPC UA server version and CNC software versions	12
	1.5	Reference to OPC UA specification	13
2	Safety no	tes	15
	2.1 2.1.1 2.1.2 2.1.3	Fundamental safety instructions General safety instructions Warranty and liability for application examples Industrial security	15 15 15 16
3	Setting ur		10
5	3 1		
	3.1		19 20
	3.3	Commissioning	20
	3.4 3.4.1 3.4.2 3.4.3 3.4.3.1 3.4.3.2	Certificate handling Overview Server certificates Client certificates Trusted certificates Rejected certificates	
	3.5	Testing the connection	35
4	Customer	r Specific Object Model (CSOM)	41
	4.1	Overview	41
	4.2	Functionalities	42
	4.3 4.3.1 4.3.2 4.3.3 4.3.3.1 4.3.3.2 4.3.3.3 4.3.3.4 4.3.2	Workflow for using CSOM in the SINUMERIK OPC UA server Overview Exporting SINUMERIK model from OPC UA server as OPC UA XML Creating a CSOM with SiOME Overview Importing SINUMERIK model (XML) Modeling own object model Exporting CSOM (XML)	
	4.3.3.5	маррину иата турез	55

	4.3.3.6 4.3.3.7	Modeling rules Access control with CSOM	55 56
	4.3.4 4.3.5	Converting the CSOM from XML to binary Importing the CSOM into the SINUMERIK OPC UA server	57 58
	4.4 4.4.1	CSOM dialog in SINUMERIK Operate Overview	60
	4.4.2	OPC UA model dialog	61
	4.4.3	Adding model	62
	4.4.4	Deleting OPC UA model	64
	4.4.5	Activating / Deactivating OPC UA model and SINUMERIK namespace	66
5	User admi	nistration	69
	5.1	Overview	69
	5.2	User management	70
	5.3	Access rights management	71
	5.4	List of access rights	72
6	Functional	ity	75
	6.1	Overview	75
	6.2	Address space model	76
	6.3	Variable access	78
	6.3.1	Variable paths for NC access operations	78
	6.3.2	Variable paths for GUD access operations	79
	6.3.3	Variable paths for PLC access operations	80
	6.3.4	Variable paths for machine and setting data	
	6.3.5	Variable paths for 1:N configuration (only target system PCU)	
	6.3.6	Finding of OPC UA variables	
	6.3.7	Monitored items	87
	6.4	Alarms	88
	6.4.1	Overview	88
	6.4.2	Subscribe / unsubscribe to alarms	
	6.4.3	Sequence description of alarms	90
	6.4.4	SINUMERIK Alarm object	
	6.4.4.1	Description	
	6.4.4.2	UPC UA event messages and alarms	
	6.4.5	CDC LLA language of alarms	
	6.4.5.1		
	0.4.5.2	SINUMERIA language specification.	
	0.4.3.3	OPC LIA alarma and conditions constraints	
	0.4.0 6.4.7	OPC UA alarms and conditions client	
	0.4.7 6.4.8	OPC UA alarms and conditions client	
	0.4.0		100
	0.0 651	Cherriew	102
	652	Overview Proroquisitos	102
	653	r rereguisites Standard file system sunnort	103
	6531	File transfer with standard methods	105
	6532	File transfer exceeding 16 MR between client and server	103
	0.0.0.2	The adherer exceeding to the between onent and server	

	6.5.3.3	Comfort methods for file transfer < 16 MB	
	6.6 6.6.1 6.6.2 6.6.3 6.6.4	Select Overview Description Input and output arguments Example call	
	6.7 6.7.1 6.7.2 6.7.3 6.7.4 6.7.5	Tool management Description CreateTool DeleteTool. CreateCuttingEdge DeleteCuttingEdge	
7	Diagnostic	28	
	7.1	Overview	
	7.2	Diagnostics screen	
	7.3	OPC UA server version	
8	Update of	OPC UA server	
	8.1	Overview	
	8.2	Compatibility	
	8.3 8.3.1 8.3.2	Installation of OPC UA server Installation/Upgrade on a PCU/IPC Installation/Upgrade a PPU/NCU	
9	Technical	data	
10	Exceptions	s: 828D / V4.5	
	10.1	Starting of configuration dialog	
	10.2	Update of OPC UA server	
11	Trouble sh	nooting	
	11.1	Frequently asked questions (FAQs)	
	11.2	Reference to OPC UA error code	
	Index		

# Introduction

### 1.1 General description

### Uniform standard for data exchange

"Industrie 4.0" stands for the intensive utilization, evaluation and analysis of data from the production in IT systems of the enterprise level. PLC programs today already record a wide range of data at the production and process level (pressure values, temperatures and counter readings) and make them available to systems at the enterprise level, for example, to increase the product quality. With Industry 4.0, the data exchange between the production and enterprise levels will increase much faster in the future. However, prerequisite for the success of "Industrie 4.0" is a uniform standard for data exchange.

The **OPC UA (Unified Architecture)** standard is particularly suitable for data exchange across different levels as it is independent from specific operating systems, has secure transfer procedures and better semantic description of the data. OPC UA not only makes data available, but also provides information about the data (e.g. data types). This enables machine-interpretable access to the data.

### 1.1.1 SINUMERIK OPC UA server

The SINUMERIK OPC UA server offers a communication interface with manufacturer independent standard. The information on SINUMERIK controls can be exchanged with an OPC UA client using this communication interface.

The client is not part of SINUMERIK and is either part of standard software or can be developed as part of individual software. For this purpose a stack for downloading is provided by the OPC foundation.

Some manufacturers provide a software development kit, which can be used to develop an OPC UA client.

### 1.2 Features

### 1.2 Features

The SINUMERIK OPC UA server provides the possibility to communicate with SINUMERIK via OPC UA. The following functionalities of the OPC UA specification are supported by the server:

- Read, write and subscribe to SINUMERIK variables (NC, PLC) (see chapter Variable access (Page 78))
- Transfer of part programs (see chapter File system (Page 102))
- Support for File and Folder Objects
- Event based provision of SINUMERIK alarms and messages from HMI, NC and PLC (see chapter Alarms (Page 88))
- Methods for selection of part programs from the NC file system and external memory (see chapter Select (Page 111)) and methods for tool management (see chapter Tool management (Page 115))
- Multi language support for the alarm and warning messages.
- The OPC UA server supports customer specific object models (see chapter Customer Specific Object Model (CSOM) (Page 41))

### Security settings

The server provides the possibility to communicate in an unencrypted or encrypted way. The following options are possible:

- None
- 128 Bit Sign (Basic128Rsa15)
- 128 Bit Sign & Encrypt (Basic128Rsa15)
- 256 Bit Sign (Basic256Sha256)
- 256 Bit Sign (Basic256)
- 256 Bit Sign & Encrypt (Basic256Sha256)
- 256 Bit Sign & Encrypt (Basic256)

### NOTICE

### Security risk of no or low encryption

During operational process, an encrypted communication must always be used for security reasons.

Furthermore, the SINUMERIK OPC UA server provides the possibility of user administration, which allows to assign access rights for each user individually (see chapter User administration (Page 69)).

### See also

Certificate handling (Page 26)

### 1.3 System setup

### Accessibility of the server

The accessibility of the server varies in the particular SINUMERIK systems. The following table shows the dependencies of the SINUMERIK systems:

SINUMERIK systems	Accessibility			
SINUMERIK 828D	After successful licen	After successful licensing and activation the OPC UA server is accessible via the X130 interface.		
SINUMERIK 840D sl	The OPC UA server r this reason, system so a PCU / IPC with Win	needs SINUMERIK Operate and runs on the same place as SINUMERIK Operate. For etup depends on whether a Thin Client is used (SINUMERIK Operate runs on NCU) or ndows operating system.		
	Thin Client	If a Thin Client is used, the OPC UA server is accessible after successful licensing and activation via X120 and X130 interface of the NCU.		
	PCU / IPC	If a PCU / IPC is used, the OPC UA server is accessible after successful licensing and activation via "eth1" and "eth2" interface of the PCU / IPC. In this case the OPC UA server is neither accessible via "eth3" interface of the PCU/IPC nor the X120 or X130 interface of the NCU.		

### Application scenario



Figure 1-1 Application scenario

1.4 Compatibility of OPC UA server version and CNC software versions

### 1.4 Compatibility of OPC UA server version and CNC software versions

The latest OPC UA server version is compatible to several CNC software versions. Below you will find the CNC software versions have been tested successfully with the OPC UA server versions:

CNC software version	OPC UA version
4.5	V2.2 and V3.0 SP1
4.07 - SP2SP5	V2.2 and V3.0 SP1
4.08 - SP2SP3	V2.2 and V3.0 SP1
4.92 and 4.92 - HF2	V3.0 SP1

1.5 Reference to OPC UA specification

# 1.5 Reference to OPC UA specification

The SINUMERIK OPC UA server matches the specification of the OPC foundation (<u>https://opcfoundation.org/</u>) V1.0.3.

1.5 Reference to OPC UA specification

# Safety notes

### 2.1 Fundamental safety instructions

### 2.1.1 General safety instructions

### 🔨 WARNING

### Danger to life if the safety instructions and residual risks are not observed

If the safety instructions and residual risks in the associated hardware documentation are not observed, accidents involving severe injuries or death can occur.

- Observe the safety instructions given in the hardware documentation.
- Consider the residual risks for the risk evaluation.

### 

### Malfunctions of the machine as a result of incorrect or changed parameter settings

As a result of incorrect or changed parameterization, machines can malfunction, which in turn can lead to injuries or death.

- Protect the parameterization against unauthorized access.
- Handle possible malfunctions by taking suitable measures, e.g. emergency stop or emergency off.

### 2.1.2 Warranty and liability for application examples

Application examples are not binding and do not claim to be complete regarding configuration, equipment or any eventuality which may arise. Application examples do not represent specific customer solutions, but are only intended to provide support for typical tasks.

As the user you yourself are responsible for ensuring that the products described are operated correctly. Application examples do not relieve you of your responsibility for safe handling when using, installing, operating and maintaining the equipment.

2.1 Fundamental safety instructions

### 2.1.3 Industrial security

#### Note

### Industrial security

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, systems, machines and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Products and solutions from Siemens constitute one element of such a concept.

Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. Such systems, machines and components should only be connected to an enterprise network or the Internet if and to the extent such a connection is necessary and only when appropriate security measures (e.g. using firewalls and/or network segmentation) are in place.

For additional information on industrial security measures that can be implemented, please visit:

Industrial security (https://www.siemens.com/industrialsecurity)

Siemens' products and solutions undergo continuous development to make them more secure. Siemens strongly recommends that product updates are applied as soon as they become available, and that only the latest product versions are used. Use of product versions that are no longer supported, and failure to apply the latest updates may increase customer's exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed at:

Industrial security (https://www.siemens.com/industrialsecurity)

Further information is provided on the Internet:

Industrial Security Configuration Manual (<u>https://support.industry.siemens.com/cs/ww/en/view/108862708</u>)

### \Lambda WARNING

### Unsafe operating states resulting from software manipulation

Software manipulations, e.g. viruses, Trojans, or worms, can cause unsafe operating states in your system that may lead to death, serious injury, and property damage.

- Keep the software up to date.
- Incorporate the automation and drive components into a holistic, state-of-the-art industrial security concept for the installation or machine.
- Make sure that you include all installed products into the holistic industrial security concept.
- Protect files stored on exchangeable storage media from malicious software by with suitable protection measures, e.g. virus scanners.
- On completion of commissioning, check all security-related settings.
- Protect the drive against unauthorized changes by activating the "Know-how protection" converter function.

### 2.2 OPC UA security notes

### NOTICE

OPC UA provides read/write access on data in SINUMERIK. This access might also affect security relevant data.

• You can limit this access on SINUMERIK data by individual read and write permission. Please refer to chapter User administration (Page 69), especially chapter List of access rights (Page 72).

# Setting up of OPC UA server

### 3.1 Prerequisites

### NOTICE

#### Protection against security risks

To protect industrial plants and systems comprehensively against cyber attacks, measures must be applied simultaneously at all levels (from the operational level up to the field level, from access control to copy protection). Therefore, before setting up of the OPC UA server, apply the "Defense in Depth" protection concept in order to avoid security risks in your environment.

Ensure that you do not connect the company network to the internet without suitable protective measures.

You will find **further information** on the Defense-in-Depth concept, suitable protective measures and Industrial Security in general in the Configuration Manual Industrial Security (<u>https://support.industry.siemens.com/cs/de/en/view/108862708</u>).

### Prerequisites

- OPC UA server requires SINUMERIK Operate.
- OPC UA server requires an OPC UA license (6FC5800-0AP67-0YBO).
- Make sure that the HMI time is set correctly, since this is a prerequisite for encrypted communication.

3.2 Option OPC UA

## 3.2 Option OPC UA

### Setting the option

1. Set the "Access MyMachine / OPC UA" option via the "Startup > Licenses" operating area.

			01/29/14 11:31 AM
Licensing: All options			Overview
Option	Set	Licensed 🗅	
6FC5800-0AP61-0YB0 SINUMERIK Operate runtime OD easy screen			All
6FC5800-0AP64-0YB0			options
SINUMERIK Operate runtime OA solution partner			Missing
SINIIMERIK Operate runtime OG net			lic./ont
6FC5800-0AP66-0YB0			and ob a
Access MyMachine /OPC UA			Search
6FC5800-0AP67-0YB0			bearon
6FC5800-0AS00-0YB0			Beset
Machining package 5 axis, add. Function 7th axis 6FC5800-0AS01-0YB0			(po)
Collision Avoidance (machine,workspace) 6FC5800-0AS02-0YB0			Exp. license requirement
Advanced Surface 6FC5800-0AS07-0YB0			Set entide
Monitoring for max. tool speed / acceleration 6FC5800-0AS08-0YB0			acc. lic.
Spline interpolation			"
6FC5800-0H516-0YB0			Back
Setup Li- archive censes & Wet- work OPs	Safety Su	vivel	

Figure 3-1 Setting the option

### Checking the HMI time

Make sure that the HMI time is set correctly, since this is a prerequisite for encrypted communication.

### Note

The certificate needed for secure OPC UA communication is automatically created during the first run-up. The start date of the validity period of the certificate is set to the current date. The validity period is 20 years.

If the SINUMERIK system time is subsequently changed, so that it lies outside the validity period, the secure OPC UA communication does not function (BadCertificateTimeInvalid).

The certificate can also be changed manually, as decribed in chapter Certificate handling (Page 26).

### Executing the OPC UA configuration dialog

1. Start the OPC UA configuration dialog via the operating area "Startup > Network".

### Note

### Different startup behaviour with 828D / V4.5

The control 828D with CNC software version V4.5 has a different startup behaviour of the configuration dialog (see chapter Starting of configuration dialog (Page 136)).

2. Press the "OPC UA" softkey.

3. Press the "Setting" softkey. The Settings dialog will appear. Then press the "Change" softkey. Make the necessary settings for connection, authentication and activation.

Settings of the OPC UA Server			Status
Connection settings			
Company network:		172.18.28.133	Contrast.
Systems network:		192.168.214.1	Setting
Service network:		192.168.215.1	
TCP port:	4840	)	Certificates
Message encryption			
None:	$\checkmark$		Model
128 bit:	$\checkmark$	(Basic128Rsa15)	
256 bit:	$\checkmark$	(Basic256, Basic256Sha256)	
Authentication			
Admin User:	Opcl	JaClient	
Password:	***1	****	Change
Confirm password:	***	****	
Allow anonymous access:			
Accept certificates automatically:	$\checkmark$		
Activation			"
Activate OPC UA:			Back
Changes become effective after restart of OPERATE, port changes after control on/o	off.		
archive renses to work OPs 🔼 Sa	fety	Swivel data	>

Figure 3-2 Settings of OPC UA server (with changes)

Group	Setting	Description	
Connection set- tings	<ul> <li>Company network</li> <li>Systems network (machine network)</li> <li>Service network</li> </ul>	<ul> <li>The available network connections (IP address) on a specific target system (828D, 840D sl, PCU, IPC) are shown. The available networks options vary depending on your target system.</li> <li>Company network</li> <li>Systems network (machine network)</li> <li>Service network.</li> <li>For example, since IPC is considered as PCU there will be only two networks (company and systems (machine) network) displayed.</li> <li>It is possible to activate or deactivate an interface from OPC LIA server point of view.</li> </ul>	
		OPC UA server point of vi	ew.
	TCP Port	TCP port at which the OP ble.	C UA server should be availa-
		Standard configuration: 48	340
		Note!	
		The port must also be ope this happens automatically be opened manually in the	n in the firewall. For PPU/NCU y. With PCU/IPC the port must e firewall.
	Message encryption	It can be chosen which se fered from the server	curity endpoints should be of-
		Setting	Standard configuration
		None	Deactivated
		128 bit	Activated
		256 bit	Activated

Group	Setting	Description
Authentication	Admin User	User name of the administrator. The administrator can add or delete users and assign or delete user authorizations.
	Password	Password of the administrator.
	Confirm Password	Enter the password again for confirmation.
	Allow anonymous ac-	Standard configuration: Deactivated
	cess	Anonymous access is only recommended for commis- sioning.
	Accept certificates au-	Standard configuration: Activated
	tomatically	If this option is set, all client certificates are automatically accepted. For manual acceptance, please refer to chap- ter Certificate handling.
Activation	Activate OPC UA	Place the checkmark to activate OPC UA and remove the checkmark to deactivate it.

### NOTICE

### Security risk due to data manipulation and data sniffing

Anonymous access can be a security risk. Anonymous access should therefore be strictly limited to commissioning.

• For normal operation authentication via username and password or based on certificates should be used (see chapter Certificate handling).

### NOTICE

### Security risk due to data manipulation and data sniffing

If no message encryption to the client is established, there will be a security risk of data manipulation and data sniffing. It is therefore highly recommended to establish a message encryption to the client.

• Use the highest possible encryption standard (256 bit) to ensure a secure message transfer.

#### Note

### Assigning secure passwords

Observe the following rules when creating new passwords:

- When assigning new passwords, ensure that you do not assign passwords that can be guessed, e.g. simple words, key combinations that can be easily guessed, etc.
- Passwords must always contain a combination of upper-case and lower-case letters as well as numbers and special characters. Passwords must comprise at least eight characters. The server does not support passwords comprising less than eight characters. PINS must comprise an arbitrary sequence of digits.
- Wherever possible and where it is supported by the IT systems, a password must always have a character sequence as complex as possible.

The German Federal Office for IT Security (BSI) (<u>https://www.bsi.bund.de/SharedDocs/</u> <u>Downloads/DE/BSI/Grundschutz/International/GSK\_15\_EL\_EN\_Draft.pdf?</u> <u>\_blob=publicationFile&v=2</u>) provides additional rules for creating secure passwords.

Programs are available that can help you to manage your passwords. Using these programs, you can encrypt, save and manage your passwords and secret numbers – and also create secure passwords.

### Note

If you want to change the password later, you can do this via the OPC UA method "ChangeMyPassword" or in the SINUMERIK Operate screen.

				86/11/18 12:52 PM
Settings of the OPC U	A Server			
Connection setti	ngs			
Company	ı network:	✓ 146.254.44.	.157	
Systems	network:	<b>192.168.21</b> 4	4.1	
Service r	network:	192.168.21	5.1	
TCP port	:	48401		
Message	Safetu not	e		
Authentication	Please observe that you o firewall when activating th	pen a port in the e OPC UA service	115) isic256Sha256)	
Passuor	t:	****	-	
Confirm r	a.	****		
Allou an	nomone accese.			
Accent c	ertificates automaticallu:			Capad
Activation	or anoutos datomatioany.			Galicer
Activate	OPC UA:			
		-		0K

4. Then choose "OK". If you enter a port for the first time, you will receive a safety note.

Figure 3-3 Security message for opening the TCP port

### Note

### Port opening on IPC

On first startup of OPC UA server a windows message will appear, asking the user to confirm the opening of the port.

5. If settings are all done, restart is necessary to activate the new settings. Perform a hardware restart on the target systems NCU and PPU. A restart of the SINUMERIK Operate is necessary on the PCU 50/IPC.

3.4 Certificate handling

### 3.4 Certificate handling

### 3.4.1 Overview

To establish a secure connection between an OPC UA server and a client it is necessary to exchange and trust the certificate of the other communication partner. The exchange is normally done automatically at the first connection attempt between client and server. Nevertheless, there is also the possibility to exchange the certificates manually before the other communication partner is available, e. g for preparing an easy commissioning.

For trusting the certificates there are two possibilities within the server:

- Automatic trusting of new certificates
   If "Accept certificates automatically" is activated in the commissioning dialog, new client
   certificates are trusted automatically and there is no manual interaction necessary to
   establish a secure connection.
   This is the most comfortable option, but less secure than the manual trusting, since all
   certificates will be trusted.
- Manual trusting of certificates (recommended)
   If "Accept certificates automatically" is deactivated in the commissioning dialog the certificates must be trusted manually to establish a secure connection.
   This allows the administrator of the OPC UA server to manually decide, which client can establish a secure connection to the OPC UA server

To have a comfortable way to handle certificates, the OPC UA dialog offers a certificate section, which can be found under the softkey "Certificates".

OPC UA diagnostics			5	C
Server IPs	172.17.80.203:4840		_	`
Server status	192.168.215.1:4840			
Connected clients	URIs		i	ែ
			Sta	tus
			Set	ting
			Certif	icates
			Mo	del 🔪
Subscription load		8%		<
Current access level: Man	ufacturer		Ba	ck
archiv	p LI- Net- be 2 censes work	Safety		>
Figure 3-4 Soft	kev Certificates			

### Operations

The Certificate dialog allows the following operations:

- Server certificate
  - Renewal of the server certificate
  - Export of the current server certificate
- Client certificates
  - List of the current trusted certificates
  - List of the rejected client certificates
  - Manual import of a client certificate
  - Deletion of a client certificate
  - Trust a rejected client certificate

3.4 Certificate handling

### 3.4.2 Server certificates

### Overview

SIEMENS		SINUMERIK OPERATE 06/05/1 10:51 AI	₩ 300 m	
OPC UA certificate m	anagement		Server	
Certificate				
uaservercert.der			Trusted	
		-	Rejected	(1
<u>.</u>				
Certificate Details				
Field	Value	<u>^</u>	Renew	2
Version	U3			
Serial no.	5b 16 69 93		Export	3
lssuer	/C=DE/ST=Bavaria/L=Erlang	en/O=Siemens AG/OU=DF/C		e e
Valid from	06/04/2018 - 10:44:35am	0		
Valid to	05/31/2038 - 10:44:35am			
Subject	/C=DE/ST=Bavaria/L=Erlang	en/O=Siemens AG/OU=DF/C		
Public key	30 82 01 0a 02 82 01 01 00 b	9 6b 6a a4 4f be bd 2f db 83 💌		
			Back	(4
J Setup 🔒 I	i- nses 📅 Wet- 🛅 OPs 🙆	Safety 2		
		· · · ·		
		(5)		

- ① The name of the OPC UA server certificate is shown in the upper part of the screen.
- 2 You can renew the server certificates.
- ③ You can export the server certificate to a configured device.
- ④ You can leave the OPC UA dialogs.
- (5) The details of the server certificate are shown in the lower part of the screen. You can scroll down to see further certificate attributes.

Figure 3-5 Server Certificate

### Renewing server certificates

The server certification can be renewed at any timy. With the renewal the following things can be specified by the administrator:

Expiration date of the certificate / validity in years

#### Note

Before using this dialog make sure that the date and the time of SINUMERIK Operate is set correctly, as the certificate will be valid from the current date in SINUMERIK Operate at the time of renewal.

· Decision if IP address and/or host name should be mentioned in the server certificate

#### Note

Many clients will need the IP address in the certificate for validation. If the server will be addressed by hostname (e. g. because the IP address of the OPC UA server changes frequently due to a dynamic assignment by a DHCP server), it is recommended only to include the host name in the certificate. Because otherwise the certificate must be renewed and exchanged with every change of the IP address.

To renew a server certificate, proceed as follows:

1. Press the softkey "Renew".

A pop-up screen will appear that offers two ways of selecting a time period:

- Select the number of years, the server certificate will be valid
- Specify a precise date, the server certificate will expire

Specify also whether the IP address and/or the host name should be written in the server certificate.

Renew server certificate			
• Years valid			5
O Expiry date	Year:		2023
	Month:		11
	Day:		20
Subject Alternative Name includes:			
		✓IP address:	
		☑DNS name:	

Figure 3-6 Renew server certificate

Pressing the softkey "Cancel" will ignore all input and return to the "Server" dialog. Pressing the softkey "Ok" will save the input to the system, the currently valid certificate will be deleted and with the next start of SINUMERIK Operate the new certificate gets created.

### 3.4 Certificate handling

### Exporting server certificates

For an offline preparation of the connection to the server, you can export the server certificate. After that the certificate can be imported and trusted on the client side.

1. Press the softkey "Export".

A pop-up screen will appear showing the USB device to export to. You can navigate to a location on the USB device to export the OPC UA server certificate.

Pressing the softkey "Cancel" will ignore all input and return to the "Server" dialog. Pressing the softkey "Ok" will export the certificate.

### 3.4.3 Client certificates

3.4.3.1 Trusted certificates

### Overview



- ① The trusted certificates are listed in the upper part of the screen. You can select a certificate using the arrow keys (cursor up/ cursor down).
- ② You can delete the trusted certificates.
- ③ You can import a certificate from an USB device.
- ④ You can leave the OPC UA dialogs.
- (5) The certificate details are shown in the lower part of the screen. To set the focus on the lower part of the screen the softkey "next window" on the keyboard is used.
- Figure 3-7 Trusted Certificate

3.4 Certificate handling

### **Deleting trusted certificates**

1. To manually delete a client certificate select a certificate in the trusted list and press the softkey "Delete".

A pop-up screen will appear asking you for confirmation of deletion:



Figure 3-8 Delete certificate

Pressing the softkey "Cancel" will do no action and return to "Trusted" dialog. Pressing the softkey "Ok" will delete the selected certificate.

#### Note

After the deletion of the client certificate a connection with OPC UA server can no longer be established by the client of the corresponding certificate.

### Importing certificates

To prepare a connection a client certificate can be imported before actually establishing a connection. With the import the certificate is automatically trusted.

 Press the softkey "Import". A pop-up screen will appear showing the USB device to import from. You can navigate to a location on the USB device to import a certificate to a trusted folder. Pressing the softkey "Cancel" will ignore all input and return to the "Trusted" dialog. Pressing the softkey "Ok" will import the certificate.

### Note

Keep in mind, that only certificates with the file extension "\*.der" are accepted.

#### Note

To use a certificate for authentication it is necessary to create a user with the method "AddCertificateUser" first.

### 3.4.3.2 Rejected certificates

### Overview

SIEMENS		IK OPERATE 86/85/18	× 336	
OPC UA certificate m	anagement		Server	
Certificate		1		(1
			Trusted	
			Rejected	
<u>.</u>				
Certificate Details				
Field	Value	^	Delete	(2
Version	U3			
Serial no.	5b 16 69 40		Trust	3
lssuer	/C=DE/ST=Bavaria/L=Nuremberg/O=Sieme	ens AG/OU=DF/		e
Valid from	06/04/2018 - 10:43:12am			
Valid to	06/04/2023 - 10:43:12am	1.1.1		
Subject	/C=DE/ST=Bavaria/L=Nuremberg/O=Sieme	ens AG/OU=DF/		
Public key	30 82 01 0a 02 82 01 01 00 f1 b1 2c 8f 0b 8	6 23 11 b9 fe f <sub> </sub> 👱		
9 89		>	Back	(4
I Setup archive	Li- enses 료 Net- anses work 🖸 OPs 🙆 Safety			
		 (5)		

- ① The rejected certificates are listed in the upper part of the screen. You can select a certificate using the arrow keys (cursor up/ cursor down).
- 2 You can delete the selected certificate.
- ③ You can trust the selected certificate.
- ④ You can leave the OPC UA dialogs.
- (5) The certificate details are shown in the lower part of the screen. To set the focus on the lower part of the screen the softkey "next window" on the keyboard is used.
- Figure 3-9 Rejected Certificate

3.4 Certificate handling

### Deleting rejected certificates

1. To manually delete a client certificate, select the certificate in the rejected list and press the softkey "Delete".

A pop-up screen will appear asking you for confirmation of deletion:



Figure 3-10 Delete certificate

Pressing the softkey "Cancel" will do no action and return to the previous dialog. Pressing the softkey "Ok" will delete the selected certificate.

### Trusting rejected certificates

If the setting "Accept certificates automatically" is deactivated, certificates automatically transferred by a client with the first connection attempt will be treated as untrusted and need to be trusted manually before the connection can be established. In this case, the server will report an error (BadSecurityChecksFailed) on initial connection attempt.

1. To manually trust a client certificate, select the certificate in the rejected list and press the softkey "Trust".

A pop-up screen will appear asking for confirmation of trusting the certificate.

Trust certificate otto.der?

Figure 3-11 Trust certificate

Pressing the softkey "Cancel" will return to the "Rejected" dialog. Pressing the softkey "Ok" will trust the certificate and move it to the trusted folder.

### 3.5 Testing the connection

### Requirement

To test the connection, you can use the "Sample Applications" of the OPC Foundation (<u>https://opcfoundation.org/developer-tools/specifications-unified-architecture/opc-unified-architecture-for-cnc-systems/</u>) under "Developer Tools/Developer Kits/Unified Architecture". It is necessary to register with the OPC Foundation for this.

### Note

There are two ways to establish the connection:

- Connection without security
- Connection with the security policy "Basic128Rsa15" respectively "Basic256" and the security mode "SignAndEncrypt"

SIEMENS always recommends setting up a connection with security, as only in this way the confidentiality of the data transmitted can be ensured.

### Installation

The "Sample Applications" additionally install a service with the name "OPC UA Local Discovery Server". If you want to locally test the OPC UA connection, i.e. an installation directly on the PCU 50/IPC, you must deactivate this service.

### Note

If the service "OPC UA Local Discovery Server" is active, the OPC UA server cannot be started correctly, because it blocks the needed TCP port 4840.

This service has no influence if the "Sample Applications" are installed on a PC in the network. Deactivation is then not necessary.

### 3.5 Testing the connection

Services					- 6	×
File Action View	Help					
	🗟 📓 🖬 🖿 🖬 💷 🕬					
Services (Local)	Services (Local)					
	OPC UA Local Discovery Server	Name	Description	Status	Startup Type	^
	Description: The Local Discovery Server allows UA clients to discover UA servers running on the local machine.	MiniWeb     Multimedia Class Scheduler     Met.Tcp Port Sharing Service     NetJogon	MiniWeb W Enables rela Provides abi Maintains a	Started	Disabled Automatic Disabled Manual	
OPC UA Local Discovery Server Properties	(Local Computer)	Network Access Protection Age	The Networ	Started	Manual	
General Log On Recovery Dependence	ies	Network List Service     Network Location Awareness	Identifies th	Started	Manual Automatic	-
Service name: UALDS		Network Store Interface Service	This service	Started	Automatic	
Display name: OPC UA Local Discover	y Server	Offline Files	The Offline	Started	Automatic	
Description: The Local Discovery Se discover UA servers run Path to executable: C:\Program Files (x86)\Common Files\OPF Startup tys: Disabled Help me configure service startup options. Service status: Stopped Start Stop You can specify the start parameters that a from here.	Prove allows UA clients to ining on the local machine.	CPC UA Local Discovery Server	The Local D This service PCU-Base 5 PCU-Base 5 Supervises i PCU-Base I	Started Started Started Started	Disabled Manual Automatic Automatic Automatic Automatic	
ОК	Cancel Apply					

Figure 3-12 Deactivating the "OPC UA Local Discovery Server" service on PCU 50/IPC
## Procedure

1. Start the OPC UA "Sample client".

ex UA Sample Client	- • • ×
File Task Discovery Help	
F O U N D A T I O N United Architecture demonstration app	
opc.tcp://192.168.10.234.4840 - [SignAndEncrypt Basic256 Binary]	Connect
00:00:00	

Figure 3-13 Sample Client main window

- 2. Select the "New" entry from the drop-down list. The "Discover Servers" window opens.
- 3. Now enter the IPv4 address of the target system and click the "Discover" button.

	K Discover Servers					
0 U N D nified Architecture	Host Name 192.168.10.2	234			✓ Discover	Leam mo
New>	Name	Type	Host	URI		Connect
	ок				Cancel	

Figure 3-14 Discover servers

- 4. The SINUMERIK OPC UA server appears in the list. Select the server and confirm with "OK".
- 5. Return to the main window and click the "Connect" button.

### 3.5 Testing the connection

6. To establish a simple connection without security, configure the following settings. After clicking "OK", enter the administrator user assigned when OPC UA was set up and the administrator password. Confirm your settings by clicking "OK".

K Server Configuration			×
opc.tcp [192.168.10.234:4840] - None - None - Binary	Protocol	opc.tcp [192.168.10.234:4840]	
opc.tcp [192.168.10.234:4840] - SignAndEncrypt - Basic128Rsa15 - Bina opc.tcp [192.168.10.234:4840] - SignAndEncrypt - Basic256 - Binary	Security Mode	None	
	Security Policy	None	
	Message Encoding	Binary	
	Application Name	Sinumerik OPC UA	
	Application Type	Server	
	Application URI	um:192.168.10.234:miniweb	
	Product URI	http://automation.slemens.com	
	Transport Profile URI	http://opcfoundation.org/UA-Profile/Transport/uatcp-uasc-	Jat
	Gateway Server URI		
	Discovery Profile URI		
	User Security Policies	Anonymous, UserName	
· · · · · · · · · · · · · · · · · · ·	SecurityLevel	0	
Configuration options are up to date.   Warning: Selected Endpoint has no	security.		
ОК	Refresh	Cancel	

Figure 3-15 Server configuration

Copen Session	
Session Name	MySession 1
Authentication Mode	UserName 🔹
User Name	OpcUaClient 👻
Password	
ОК	Cancel

Figure 3-16 User Identity

7. Confirm the prompt asking if you want to trust the transferred certificate with "Yes".

UA Sample Client
Certificate could not validated: BadCertificateUntrusted Subject: CN=WINDOWS-63R82L4, E=opcua@siemens.com, OU=Industry, O=Siemens AG, L=Erlangen, S=Bavaria, C=DE Issue: Self-signed Valid From: 02.01.2017 11:15:42 Valid To: 03.01.2047 11:15:42 Thumbprint: 5ABFE622CA3B78AD130431EBF8DB457BC903FE69 Accept anyways?
Yes <u>N</u> o

Figure 3-17 Certificate

The connection to the SINUMERIK OPC UA server is now established and the available address space is displayed.

I UA Sample Client	- 0 <b>- X</b> -
File Task Discovery Help	
OPC UA Technology Sample     www.opcfoundation.org     UN D A T I D N     Unified Architecture demonstration app	
opc.tcp://192.168.10.234:4840 - [None:None:Binary]	<ul> <li>Connect</li> </ul>
MySession 1  Objects  Objects  Objects  Snumerik  Avis  Avis  GUD  Hmi  Methods  Nok  Random  SEA  TEA  Tool  Tool	
Create a subscription to see notifications	
opc.tcp://192.168.10.234:4840 (None) UABinary Server Status: Running 2017-01-04 12:14:13 0/0	.:

Figure 3-18 Address space of the SINUMERIK OPC UA server

8. Now navigate to a nodeID (e.g. R-parameter at Sinumerik > Channel > Parameter > R) and right click the corresponding entry. You can now test various functions:

## 3.5 Testing the connection

- E.g. read, write, setup monitoring

K UA Sample Client		- 0 <mark>- X</mark>
File Task Discovery Help		
F 0 U N D A T I 0 N Unified Architecture demonstration app	OPC UA Technology Sample www.cocfoundation.org UA Sample Client	Learn more
opc.top://192.168.10.234:4840 - [None:N	(one Einary	<ul> <li>Connect</li> </ul>
	GeometricAvis     GeometricAvis     GrindingFrame     Grindi	E
	Prote View Attributes      Proto Read      Proto Seare History Read      Write      Selec Write	
Create a subscription to see notification	Bistory Update Subscribe	
opc.tcp://192.168.10.234:4840 (None)	UABinary Server Status: Running 2017-01-04 12:15:18 0/0	

Figure 3-19 NodeID "Sinumerik > Channel > Parameter > R"

- The attributes of a NodeID can be queried via the entry "View Attributes". One of these attributes is the "Value", which provides the corresponding value of R1.

K View Node Attributes		<b>X</b>
Field	Value	
Has Type Definition   Nodeld  NodeClass  Browse Name  DisplayName  Write Mask  UserWrite Mask	BaseDataVariableType ns=2:s=/Channel/Parameter/R Variable 2:/Channel/Parameter/R R R variables 0 0	
	1	
- Data Type	Double	
	Scalar	
- AccessLevel	Readable   Writeable	
UserAccessLevel	Readable   Writeable	-
- Minimum Sampling Interval	50	
Refresh		Cancel

Figure 3-20 Viewing node attributes

# **Customer Specific Object Model (CSOM)**

# 4.1 Overview

#### What is a Customer Specific Object Model (CSOM)?

The primary objective of the OPC UA address space is to provide a standard way for servers to represent objects to clients. The OPC UA object model has been designed to meet this objective. It defines objects in terms of variables and methods. It also allows relationships to other objects to be expressed.

A **C**ustomer **S**pecific **O**bject **M**odel allows a specific view of the OPC UA server to meet the requirements in a customer-specific project. For this purpose, you can specify all required OPC UA nodes in an XML file.

You can use several tools to create your own Object Model. In this manual, all processes and examples are explained on the base of the tool **SiOME** (Siemens OPC UA Modeling Editor).

#### SiOME

With the help of SiOME, a tool for implementing Customer Specific Object Models or OPC UA companion specifications, you can design information models / address spaces for your OPC UA server and can create new types and instances of OPC UA nodes.

You can also use SiOME to map OPC UA variables to SINUMERIK variables.

Download link and explanations about SIOME are available here (<u>https://support.industry.siemens.com/cs/de/en/view/109755133</u>).

4.2 Functionalities

# 4.2 Functionalities

#### What is possible with a CSOM?

Possible application scenarios for a CSOM could be the following:

- Implementation of an own Information model
- Modifying of an own information model:
  - structure
  - display name
  - browse name
  - description

## What is not possible?

- Change of data types
- Create a new variable which is not part of the SINUMERIK address space

## Quantity structure of CSOM

Feature	Value
Maximum number of binary files	1
Maximum number of CSOM namespaces	7
Maximum number of nodes in CSOM	10.000

## 4.3.1 Overview

In order to use a Customer Specific Object Model (CSOM), it is necessary to follow a certain workflow procedure.

The following chapter provides an overview about the necessary process steps. Every process step will also be covered in greater detail.

### CSOM process workflow

The CSOM workflow consists of the following steps:

- 1. Exporting SINUMERIK model from OPC UA server as OPC UA XML (Page 43) with SINUMERIK Access MyMachine /P2P.
- 2. Creating a CSOM with SiOME (Page 45).
- 3. Converting the CSOM from XML to binary (Page 57) with SINUMERIK Access MyMachine /P2P.
- 4. Importing the CSOM into the SINUMERIK OPC UA server (Page 58) with SINUMERIK Operate.

## 4.3.2 Exporting SINUMERIK model from OPC UA server as OPC UA XML

SiOME offers the possibility to map variables using drag and drop. In order to provide this usability, SiOME needs to know the SINUMERIK address space of the machine, where the CSOM should be implemented.

Since the address space depends on machine configuration, this address space has to be exported after commissioning of the machine using "SINUMERIK Access MyMachine /P2P".

SINUMERIK Access MyMachine /P2P is reading SINUMERIK address space via OPC UA browse functionality and providing an XML file to be imported into SiOME.

#### Prerequisites

For exporting SINUMERIK OPC UA model, it is necessary to have SinuReadAll access right.

#### SINUMERIK Access MyMachine /P2P

SINUMERIK Integrate Access MyMachine /P2P (MLFB 6FC5860-7YC00-0YA0) supports the commissioning of machines with SINUMERIK Operate (software version 2.6 and higher) using a standard Windows PC. Its scope of functions includes the exchange of files between the service PC and the control as well as operation of the HMI user interface. EasyScreen texts, alarm texts, tool management texts and other texts can be edited easily.

## Exporting SINUMERIK OPC UA model as OPC UA XML

The following graphic shows the process of exporting the target system address space as OPC UA XML.



Figure 4-1 Exporting SINUMERIK OPC UA model as OPC UA XML

#### Procedure

- 1. Open the application "SINUMERIK Access MyMachine /P2P".
- 2. Click on "Tools > Sinumerik Opcua Server Tools > Opcua Server Model Export". A popup window appears.

AMM Opcua Se	rver Model Export	>	<
Server IP:			
Server Port:			
User name:			
Password:			
Output File:			
	Start	Cancel	
			0%
Status:			

Figure 4-2 Opcua Server Model Export

- 3. Enter the IP address and the port of the OPC UA server as well as the username and password to access the server. Then specify where the output file should be saved to.
- 4. Click "Start" button to generate the xml file. The generated XML file is saved to the specified location.

The generated XML file can then be imported into SiOME tool.

## 4.3.3 Creating a CSOM with SiOME

## 4.3.3.1 Overview

SiOME is a free of charge tool from SIEMENS that allows to easily create an OPC UA object model and map the object either to SINUMERIK or SIMATIC S7-1500 variables.

The following chapter shows the engineering workflow for a CSOM with SINUMERIK and SiOME.

This process itself has 3 sub steps:

- 1. Importing SINUMERIK model (XML) (Page 45)
- 2. Modeling own object model (Page 48)
- 3. Exporting CSOM (XML) (Page 54)



Figure 4-3 Creating a CSOM with SiOME

These 3 sub steps are explained further in the below sections with one application example.

## 4.3.3.2 Importing SINUMERIK model (XML)

#### Prerequisite

Exported SINUMERIK model (XML) file from SINUMERIK Access MyMachine /P2P.

#### Procedure

- 1. Open the SiOME application.
- 2. Click the 💽 icon in "SINUMERIK" tab to import the SINUMERIK model (XML) as shown in the below image.

siemens OPC UA Modeling Editor 0.7.0-sinumerik					- 🗆 ×
= SIEMENS			SiOME - OP	C UA Mo	deling Editor
Information model 🛛 🗩 offline 🛃 🗈 🕞 🖉		SINUMERIK			Attributes 🗴
V DPC Root					
Objects					
OP¢ Types					
op¢ Views					
Peferences	Nameon	2000			ng O Show all
References	Namespa	aces		Loggi	show all
	▼	A Modeling Editor Project		≔ Loggin	g started for SiOME 0.7.0-sir
	🔻 🗖 Nar	nespaces		i≡ Added	Opc.Ua.NodeSet2.xml Version
	ð i	0: http://opcfoundation.org/UA/			

Figure 4-4 SiOME dashboard page

3. A "Open" dialog box appears. Select the exported SINUMERIK model (XML) file and then click "Open".

#### Result

SINUMERIK tab shows the SINUMERIK browse tree as shown in the below image:

SINUMERIK			
▼ SinumerikModel.xml			
🔻 📴 Sinumerik			
<ul> <li>OPC Axis</li> </ul>			
<ul> <li>OPC Bag</li> </ul>			
<ul> <li>OPC Channel</li> </ul>			
<ul> <li>DriveVsa</li> </ul>			
GUD			
OPC Hmi			
► OPC NCK			
Pic			
OPC Random			
EA DPC SEA			
► OPC TEA			
<ul> <li>OPC Tool</li> </ul>			

Figure 4-5 SINUMERIK tab with SINUMERIK browse tree

## 4.3.3.3 Modeling own object model

#### Creating new namespace

To create a new namespace, follow the below steps:

1. Right-click on "Namespaces" in "Namespaces" tab and then click on "Add Namespace".

Namespaces	-t- ×
OPC UA Modeling Editor Project	
diamespaces       Add Namespace         diamespaces       Add Namespace	rikServer
Figure 4-6 Namespaces tab	

2. The "Add Namespace" popup window appears. Enter a name in the "Namespace URI" field and then click "Ok".

New Namespace	
Namespace URI * MyNamespace	
Version 1.00	
PublicationDate 2019-06-29T00:00:00Z	Ċ

Figure 4-7 Add Namespace popup window

## Result

The new namespace is added.

Ν	lar	nes	paces
۲	≞	OPC	UA Modeling Editor Project
	•		Vamespaces
		0	0: http://opcfoundation.org/UA/
		₿	1: urn:ncu1.local:SiemensAG:SinumerikServer
		0	2: SinumerikVarProvider
		G	3: MyNamespace

Figure 4-8 Namespace added

#### Creating new object

To create a new namespace, follow the below steps:

1. Right-click on "Objects" node in "Information model" tab and then click on "Add Instance".



Figure 4-9 Information model tab

2. The "Add Instance" popup window appears. Enter a name in the "Name" field.

Name	MyMachine	
NodeClass	Object	•
Namespace	MyNamespace	•
ReferenceType	Organizes	•
TypeDefinition	BaseObjectType	•

Figure 4-10 Add Instance popup window

3. Verify that newly added namespace is selected in the "Namespace" row and then click "Ok".

#### Result

The new instance is added under "Objects" node.

Information model	offline 🛓 🛨 🕞 🍼 Show all 🔹
V OP¢ Root	
▼ OP¢ Objects	
🔰 MyMachine	
<ul> <li>Server</li> </ul>	
► OPC Types	
OP¢ Views	
Figure 4-11 New insta	ance added

### Adding a new instance for a variable

To add a new instance for a variable, follow the below steps:

1. Under "Objects" node, right-click on "MyMachine" node and then click on "Add Instance".



Figure 4-12 Adding a new instance for a variable

2. The "Add Instance" popup window appears. Enter a name in the "Name" field.

- 3. Select "Variable" from the "NodeClass" drop-down list.
- 4. Select "Double" from the "DataType" drop-down list and then click "Ok".

Name	PositionX	
NodeClass	Variable	*
Namespace	MyNamespace	•
ReferenceType	Organizes	•
TypeDefinition	BaseDataVariableType	•
DataType	Double	-

Figure 4-13 Add Instance popup for a variable

## Result

The new instance is added for a variable under "MyMachine" node.

Information model	offline 🛃 🗶 🕞 🕞 👉 Show all 🔻
V OPC Root	
▼ OP¢ Objects	
🔻 📦 MyMachine	
- PositionX	
<ul> <li>Server</li> </ul>	
► OP¢ Types	
OP¢ Views	

Figure 4-14 New Instance added under a variable

#### Mapping to SINUMERIK data

To map to SINUMERIK data, follow the below steps:

1. Move the slider to right, to activate the mapping table as shown in the below image.

Information model	offline 🛨 🗈 🕒 🖉 Show all 🔻	
V OPC Root		
▼ Objects		
🔻 📦 MyMachine		
- PositionX		
<ul> <li>Server</li> </ul>		
► OPC Types		
OP¢ Views		

Figure 4-15 Mapping table slider

 The slider turns green in color and the mapping table is visible. Drag and drop the variable from the "SINUMERIK" tab to the variable "PositionX" in the "Information model" tab as shown in the below image.

Information model	🌔 offline 🛃 主 🕞 🔍 🛹 Show all 🔻	SINUMERIK	
V OPC Root		actFeedRate	-
▼ OP¢ Objects		actFeedRateIpo	
🔻 🏮 MyMachine	<i>→</i>	- actincrVal	
- PositionX	+ <b>•</b>	actProgPos	
<ul> <li>Server</li> </ul>		actProgPosBKS	
<ul> <li>OPC Types</li> </ul>		actToolBasePos	
OPC Views		actToolBasePosBasic	
		actToolBasePosBasicDiam	_
		actToolBasePosDiam	
		- actToolBasPosBN	
		actToolBasPosBNDiam	

Figure 4-16 Mapping SINUMERIK variable

The variable is added in the mapping table in the "Information model" tab.

Information model	offline 🛃 🛨 🖪 🤍 👉 Show all 🔻	SINUMERIK	
V OPC Root		actFeedRate	-
▼ OP¢ Objects		actFeedRateIpo	
🔻 🏮 MyMachine	→	actincrVal	
- PositionX	→ ✓ F ns=2;s=/Channel/GeometricAxis/actToolBasePos	actProgPos	
<ul> <li>Server</li> </ul>		actProgPosBKS	
OPC Types		actToolBasePos	
OP¢ Views		actToolBasePosBasic	
		actToolBasePosBasicDiam	
		actToolBasePosDiam	
		actToolBasPosBN	
		actToolBasPosBNDiam	

Figure 4-17 SINUMERIK variable added in mapping table

3. Add the correct axis index

Information model	offline 🛨 🛨 🕒 🥌 Show all 🔻	SINUMERIK	
V OPC Root		actFeedRate	-
▼ Objects		actFeedRatelpo	
🔻 📦 MyMachine	<i>→</i>	- actincrVal	
- PositionX	→ ✓ ns=2;s=/Channel/GeometricAxis/actToolBasePc [[u1,1]	actProgPos	
<ul> <li>Server</li> </ul>		actProgPosBKS	
<ul> <li>OP¢ Types</li> </ul>		actToolBasePos	
OP¢ Views		actToolBasePosBasic	
		actToolBasePosBasicDiam	
		actToolBasePosDiam	
		actToolBasPosBN	
		actToolBasPosBNDiam	
Figure 4-18 Ad	ding axis index		

## 4.3.3.4 Exporting CSOM (XML)

To export the CSOM (XML) to your local machine, follow the below steps:

1. Click the **1** icon in the "SINUMERIK" tab as shown in the below image.

Information model	offline 👤 主 🖬 🖜 🖈 Show all 🔻
V OPC Root	
▼ Objects	
🔻 📦 MyMachine	<i>→</i>
- PositionX	→ ✓ ns=2;s=/Channel/GeometricAxis/actToolBasePos[u1,1]
<ul> <li>Server</li> </ul>	
OP¢ Types	
OP¢ Views	

Figure 4-19 Exporting the CSOM

 The "Export XML" popup appears. Select the "MyNamespace" check-box and then click "Ok".

Sele	ct namespace
	http://opcfoundation.org/UA/
	urn:ncu1.local:SiemensAG:SinumerikServer
	SinumerikVarProvider
/	MyNamespace
l Ir	nclude mappings

Figure 4-20 Export XML popup

 A "Save as" dialog box appears. Select the location to save the exported CSOM (XML) file and then click "Save".

For further steps, continue with the chapter Converting the CSOM from XML to binary (Page 57).

For a more detailed description of SiOME, refer to Industry Online Support (<u>https://support.industry.siemens.com/cs/de/en/view/109755133</u>). You can find a function manual, download link, further explanations and applications examples on modeling and mapping.

Additional information on data types, modeling rules and necessary user access rights for the modeling process are explained in the following chapters:

- Mapping data types (Page 55)
- Modeling rules (Page 55)
- Access control with CSOM (Page 56)

#### 4.3.3.5 Mapping data types

#### Mapping data types

The table below shows the compatible SINUMERIK data type for each OPC UA data type.

Assign the data types as shown below (SINUMERIK data type – OPC UA data type). Other assignments are not permitted. You are responsible for the rule-compliant selection and assignment of the data types.

You may find further information on mapping of OPC UA data types in the document "OPC UA Information Model for IEC 61131-3".

SINUMERIK data type	OPC UA data type
Bool	Boolean
Character	Byte
Byte	Byte
Word	UInt16
Short Integer	SByte
Doubleword	UInt32
Long Integer	Int64
Float	Float
Real	Float
Double	Double
String	String

Table 4-1 Mapping of data types

#### 4.3.3.6 Modeling rules

Following are the rules while modeling the exported SINUMERIK model (XML) with SiOME:

- The exported SINUMERIK Model (XML) should not be used in the "Information Model" window as a base for model creation.
- No new nodes should be added under the below namespaces:
  - 0: http://opcfoundation.org/UA/
  - 1: urn:ncu1.local:SiemensAG:SinumerikServer
  - 2: SinumerikVarProvider

- Up to 10.000 nodes (over all CSOM namespaces) can be modeled within the OPC UA server.
- Total namespaces should not be more than 10 (Including the above namespaces).
- First three namespaces 0, 1 and 2 should not be edited, deleted or change in order.
- Additional namespaces should have an index of 3 or higher.
- In SiOME, when a new node is created with a "ValueRank" set to "Dimension" then the value attribute of the node should be initialized by clicking on the "Value" in the "Attribute" window.

#### Note

If customer model is not shown in the browse tree, then refer to the error logs under the folder (..\user\sinumerik\hmi\log\opcua).

#### 4.3.3.7 Access control with CSOM

For the CSOM, the customer has the follwoing possibilities to provide access rights for variables:

- 1. In SiOME, the CSOM Access level can be defined.
- 2. In addition, the OPC UA administrator has two new access rights:
  - CsomReadx
  - CsomWritex

To read a variable within a CSOM namespace the OPC UA administrator has to provide the user with the access right "CsomReadx" while "x" stands for the namespace index.

For example, to read a variable out of namespace 3, the user only needs to get the access right "CsomRead3". No other access rights are needed. The same is valid for "CsomWritex".

The following table gives an overview about the interaction between CSOM access level and access rights of target device. A variable that is read only by access rights of target device can not be written by OPC UA, even if the OPC UA access write is read/write (3).

CSOM AccessLevel	CSOM namespace rights	Rights of target device	Result
1 = Read	No access	Read / Write	No access
	Read	Read / Write	Read
	Write	Read / Write	No access
	Read / Write	Read / Write	Read

Table 4-2 Access table

CSOM AccessLevel	CSOM namespace rights	Rights of target device	Result
2 = Write	No access	Read / Write	No access
	Read	Read / Write	No access
	Write	Read	No access
	Write	Read / Write	Write
	Read / Write	Read	No access
	Read / Write	Read / Write	Write
3 = Read/Write	No access	Read / Write	No access
	Read	Read / Write	Read
	Write	Read	No access
	Write	Read / Write	Write
	Read / Write	Read	Read
	Read / Write	Read / Write	Read / Write

## 4.3.4 Converting the CSOM from XML to binary

The exported CSOM (XML) from SiOME needs to be converted to a binary format that can be read by SINUMERIK OPC UA server. The converted binary file has a more compact format and is therefore controller optimized. For this conversion process SINUMERIK Access MyMachine/ P2P is used.

The following graphic shows the process of converting the CSOM (XML) to binary format.



Figure 4-21 Converting the CSOM from XML to binary

## Procedure

- 1. Open the application "SINUMERIK Access MyMachine /P2P".
- Click "Tools > Sinumerik Opcua Server Tools > Model Binary Converter". A popup window appears.

MM Model Binary Converter		×
Input XML File:		
Output BIN File:		
Start	Cancel	
		0%
Status:		

Figure 4-22 Model Binary Converter

- 3. Select the location of the XML file under "Input XML File" and specify the location to save the binary file under "Output BIN File".
- 4. Click "Start" button to generate the binary file. The generated binary file will be saved to the specified location.

## Result

Imported CSOM XML file is converted to binary format.

## 4.3.5 Importing the CSOM into the SINUMERIK OPC UA server

After converting the CSOM (XML) to a binary format, it can be imported to the SINUMERIK OPC UA server.

The following graphic shows the process of importing the CSOM (binary format) to SINUMERIK OPC UA server.

		OPC UA Models Add					5	C
Import Binary Customer Model e.g USB	Import Binary	Pro UN Floads: Bid     Filename Namespace     Simmerik Simmerik     C///RET_SHORE     C//RET_SHORE     C//RET_SHORE		Verzion Date 1.80 Lan 1970 80-98-98 55 thiotal 82/25/19 12-85-98 PM 7540 85/15/19 2-55-66 PM 7552 85/25/19 11-53-59 PM		Activated 88 AM 6 PM 36 AM 32 PM	i i	(* 1
	- E CSOMRight E newbin - RUString.bi //USB:	s.bin in trace, bin	1678 8 1264 4135	07/12/19 2:40:3 04/25/19 11:20: 05/16/19 10:57: 05/16/10 2:23:5	6 PM 22 AM 22 AM 5 DM Free: 3.7 GB	Ca	× ncel	

Figure 4-23 Importing the CSOM into the SINUMERIK OPC UA server

### Procedure

1. Copy the binary file either to an USB/Networkshare or - alternatively - transfer the file via AMM directly to the control (addon\sinumerik\hmi\opcua\models).

Note

If models folder is not present, then create a folder name models.

- 2. Press the softkey "Add Model" in the OPC UA model dialog and select the saved binary file.
- Press the softkey "OK". The model is visible in the OPC UA model dialog.
- 4. Then press the softkey "Change" and activate the customer specific model.
- 5. Restart the OPC UA server by restarting SINUMERIK OPC UA server.

#### Result

The CSOM is now accessible in SINUMERIK Operate.

#### Note

For accessing data via an OPC UA client, it is necessary to have appropriate access rights (see chapter List of access rights (Page 72)).

4.4 CSOM dialog in SINUMERIK Operate

# 4.4 CSOM dialog in SINUMERIK Operate

### 4.4.1 Overview

To have a comfortable way to work with a customer specific object model, the OPC UA dialog offers a special section, which can be found under the softkey "Model".

OPC UA diagnostics		K		C
Server IPs	172.17.80.203:4840 192.168.215.1:4840			
Server status	OK			
Connected clients	URIS	i	i	0
			Stat	us
			Setti	ing
		Ce	er tifi	cates
			Moo	iel 🔪
Subscription load	8%		"	
Current access level: Manufact	rer		Bac	:k
Setup archive	censes work Safety			>

Figure 4-24 Softkey Model

The SINUMERIK Operate dialog has the following functionality:

- Import of CSOM binary file from USB/Networkshare or via AMM
- Display the filename of the selected binary file
- Deleting the selected binary file
- Activate the selected binary file
- Deactivate the actual binary file

#### Note

The changes are visible only after restarting the OPC UA server.

# 4.4.2 OPC UA model dialog

## Overview

Press the "Model" softkey to get the below screen.

OPC UA Models					50	
Filename	Namespace	Version	Date	Activated		
Sinumerik	Sinumerik	1.00	1 Jan 1970 00:00:00			
ReadUrite_Model.bin	CSOM_ReadWrite	1.00	11 Jun 2019 02:15:14			
					1 🔍	
						0
					Add Model	(2)
						õ
					Delete Model	(3)
					Change	4
					<b>«</b>	
					Back	
The Column						
Setup o	Net-					

① The OPC UA model dialog shows the activated CSOM and also displays the following information:

- Filename of the CSOM
- The namespace of the CSOM
- The version of the CSOM
- The date of the import
- Status of activation
- 2 You can add new CSOM
- ③ You can delete the CSOM
- ④ You can change the CSOM by selecting from the drop down list and also it can be activated/ deactivated

#### See also

Adding model (Page 62) Activating / Deactivating OPC UA model and SINUMERIK namespace (Page 66) Deleting OPC UA model (Page 64) 4.4 CSOM dialog in SINUMERIK Operate

## 4.4.3 Adding model

#### Note

This option can be seen with user access rights, but you can add models with only manufacturer's rights.

C

0

« Back

>

## Procedure

- OPC UA Models 5 Filename Namespace Version Date Activated Sinumerik Sinumerik 1.00 1 Jan 1970 00:00:00 [ i Add Model
- 1. To add a customer specific object model press the softkey "Add Model".

Figure 4-25 Softkey Add Model

Setup archive

The "Add Model" popup screen appears.

Li-censes

2. Select the binary file from either USB/Networkshare.

Net-work

đ.

OPC UR Mo	iels Hdd						5	C
Filename	Namespace	Version	Dat	te		Activated		•
Sinumerik	Sinumerik	1.00	1 Ja	an 1970 00:00	:00		[1111]	
	Add Model						i	Ō
₽₿//	Net_share:							
	USB:							
• 🖻	System Volume Information			02/26/19	12:03:08 AM			
	CSOM_ArrString_V4.bin	75	40	05/15/19	2:54:06 PM			
	CSOM_Automation.bin	76	32	05/20/19	11:53:36 AM			
- 🗎	CSOM_ReadWrite_V6.bin	50	39	05/15/19	12:16:32 PM		1	
- 🗎	CSOMRights.bin	16	78	07/12/19	2:40:36 PM			
- 🗎	newbin		0	04/25/19	11:20:22 AM		1	
	RWString.bin	12	64	05/16/19	10:57:22 AM			
	To at String Orrou hin	11	JE	AE/16/10	2-27-56 DM	a: 3.7 GB		
//030	9				1160	c. J./ GD	-	_
							Can	cel
-								
							0	ĸ
	I al con home of con-			1	1	2	2	

🙆 Safety

Figure 4-26 OPC UA Models Add

Pressing the softkey "Cancel" will do no action and return to "OPC UA Models" screen. Pressing the softkey "OK" will add the binary file.

4.4 CSOM dialog in SINUMERIK Operate

# 4.4.4 Deleting OPC UA model

### Note

This option can be seen with user access rights, but you can delete models with only manufacturer's rights.

## Procedure

- QPC UA Models 5 C Namespace Filename Version Date Activated Sinumerik Sinumerik 1.00 1 Jan 1970 00:00:00 [ CSOM\_ReadWrite\_V6.bin SiemensMilling 1.00 15 May 2019 06:46:31 i 0 Add Model Delete Model Change « Back Li-censes Setup archive Net-work Safety > đ.
- 1. To delete a customer specific object model press the softkey "Delete Model".

Figure 4-27 Softkey Delete Model

2. Select the model you want to delete from the CSOM drop-down list and then click "OK".

OPC UA Models Delete				5	C
Nom de fichier	Espace de noms	Version Date	Activé		
Sinumerik	Sinumerik	1.00 1 Jan 1970 00:00:00		[:::::	
CSOM_ReadWrite_V6.bin	SiemensMilling	1.00 15 May 2019 06:46:31	<ul> <li>Image: A set of the set of the</li></ul>		
CSOM_ArrString_V4.bin				ĺ	$\Box$
CSOM_Automation.bin					
CSOM_ReadWrite_V6.bin					
CSUMRights.bin					
					/
				7	<
				Abar	ndon
				<b>v</b>	1
				0	ĸ
Archive o	Licen- Béseau	Safetu			>
-1 MES   -1	ces is nescau				-

Figure 4-28 OPC UA Models Delete

A pop-up screen will appear asking you for confirmation of deletion:

## 4.4 CSOM dialog in SINUMERIK Operate



Pressing the softkey "OK" will delete the customer model.

## 4.4.5 Activating / Deactivating OPC UA model and SINUMERIK namespace

#### Note

This option can be seen with user access rights, but you can change models with only manufacturer's rights.

## Procedure

1. Press the softkey "Change".

QPC UA Models				5	C
QPC UA Models Filename Sinumerik CSOM_ReadUrite_V6.bin	Namespace Sinumerik SiemensMilling	Version Date 1.00 1 Jan 1970 00:00:00 1.00 15 May 2019 06:46:31	Activated	i Add f Delete	Todel Model
				Ba	K ack
I Setup archive	Li- censes Ret- work	Safety			>

Figure 4-30 Softkey Change

- 2. The following screen appears where you can perform the following functions:
  - Selecting the CSOM file from the drop-down list.
  - Activating the CSOM file by selecting the check box.
  - Deactivating the CSOM file by clearing the check box.
  - Activating the SINUMERIK namespace by selecting the check box.
  - Deactivating the SINUMERIK namespace by clearing the check box.

OPC UA Models Select				5	C
Filename	Namespace	Version Date	Activated		
Sinumerik	Sinumerik	1.00 1 Jan 1970 00:00:00		[1001	
CSOM_ReadUrite_V6.bin	SiemensMilling	1.00 15 May 2019 06:46:31			
CSOM_ArrString_V4.bin				i	0
CSOM_Automation.bin					
COMPights hip					
	1				
					_
				-	
				>	<
				Can	icel
				×	
				0	ĸ
T Setup	Li- <u>P</u> Net-	Cofety			~
🚽 archive	censes work	Salety			-

Figure 4-31 OPC UA Models Select

4.4 CSOM dialog in SINUMERIK Operate

Pressing the softkey "Cancel" will do no action and return to "OPC UA Models" screen. Pressing the softkey "OK" will apply the changes.

# User administration

# 5.1 Overview

The admin can add/delete users and access rights via OPC UA methods provided by the server. Therefore a connection with a generic client must be established, using the admin credentials.

Users and access rights can then be assigned using the following OPC UA server methods:

- Add users (AddUser, AddCertificateUser)
- Delete users (DeleteUser)
- List users (GetUserList)
- Change password (ChangeMyPassword)
- Give access rights (GiveUserAccess)
- Remove access rights (DeleteUserAccess)
- List access rights (GetMyAccessRights, GetUserAccessRights)

#### NOTICE

#### Misuse of access rights

As an administrator, you are fully responsible for the administration of users and their access rights. Any error in the administration process can lead to the misuse of access rights.

#### Note

#### Anonymous connection

You can also establish an anonymous connection during commissioning, if this setting is active, but the methods will not be available (feedback: "BadRequestNotAllowed").

#### Note

#### Anonymous user

Anonymous users don't have any access (Read/Write) rights after installation. As an administrator, you have to set these access rights explicitly.

#### Note

#### Administrator has only read rights

Note that the administrator has only read rights per default. Other rights need to be set explicitly.

#### Note

You can only add or remove users or access rights if you are connected as administrator. If you call the methods with a different user, you will receive the message "BadInvalidArgument".

5.2 User management

# 5.2 User management

A new user created with the "AddUser" or "AddCertficateUser" function has no access rights at all. The user administrator has the responsibility for the user management and the associated access rights. All users must use a secure password.

 Table 5-1
 Methods for user administration

Method	Description		
AddUser	Creates a new user for accessing OPC UA.		
	Input arguments:		
	UserName	User Name	
	Initially, the password of the new user is the user name. It should then be changed using the method "ChangeMyPassword".		
AddCertificateUser	Creates a new user for accessing OPC UA via certificate authentication.		
	Input arguments:		
	UserName	user, certificate is issued to	
	CertficateData	Certificate(.der) as byte string	
DeleteUser	Deletes a user who was added previously using the method "AddUser" and "AddCertificateUser".		
	Input arguments:		
	UserName	User Name	
	The administrator user, created when OPC UA was set up, cannot be deleted.		
GetUserList	The administrator can read the list of all users.		
	Input arguments:		
	-	List of users	
ChangeMyPassword	Changes the password for the connected user.		
	Input arguments:		
	OldPwd	Current password	
	NewPwd1	New password	
	NewPwd2	New password (security prompt)	
	Important!		
	Whereas the methods "AddUser", "DeleteUser", "GiveUserAccess" and "DeleteUserAccess" can only be called up if the user is connected as the administrator, the user must connect as the corresponding user in order to change the password.		

# 5.3 Access rights management

After setting up the OPC UA components, the administrator user has read access to all data ("SinuReadAll") but no write access. These access rights must be set explicitly.

The administrator can also add the user access rights for individual PLC DBs.

Method	Description		
GetMyAccessRights	The currently connected user can read	ly <b>connected</b> user can read his access rights.	
	Input Arguments:		
	-	Rights	
GetUserAccessRights	The administrator can read the access rights of another user.		
	Input Arguments:		
	User name	Rights	
DeleteUserAccess	Deletes the specified access rights for a user.		
	Input Arguments:		
	User	A user whose access rights are to be deleted	
	Realm	The access rights to be deleted as a string. If a user wants to delete several access rights, they must be separated by a semicolon.	
For all possible realm strings, see chapter List of access rights (Page 72).			
Example:			
DeleteUserAccess("John","PlcReadDB100")			
Admin wants to delete read rights of user "John" for PLC data block DB100.			

Table 5-2 Methods for user administration

#### Major access rights versus minor access rights

A possibility to reset all user access rights is to use the general OPC UA access rights behaviour that by deleting a major access right all minor access rights will be deleted too. So if you have granted several read rights for special users to read certain data blocks beforehand, you can reset all of these access rights by deleting "SinuReadAll".

5.4 List of access rights

# 5.4 List of access rights

Below is the list of access rights a user is assigned:
#### Table 5-3 List of access rights

Method	Description				
GiveUserAccess	Sets the specified access rights for combination.	a user. The access rights below can be combined in any			
	Input Arguments:				
	User	User name which is to given the access rights			
	Realm	The access rights to be set as a string. If a user wants to set several access rights, they must be separated by a semicolon.			
	Some possible realm strings are:	Some possible realm strings are:			
	"StateRead"	Status data - NC, channel, axis, read access			
	"StateWrite"	Status data - NC, channel, axis, write access			
	"FrameRead"	Zero offsets, read access			
	"FrameWrite"	Zero offsets, write access			
	"SeaRead"	Setting data, read access			
	"SeaWrite"	Setting data, write access			
	"TeaRead"	Machine data, read access			
	"TeaWrite"	Machine data, write access			
	"ToolRead"	Tool and magazine data, read access			
	"ToolWrite"	Tool and magazine data, write access, Tool management methods			
	"DriveRead"	Drive data, read access			
	"DriveWrite"	Drive data, write access			
	"GudRead"	User data, read access			
	"GudWrite"	User data, write access			
	"FsRead"	File system, read access			
	"FsWrite"	File system, write access			
	"PlcRead"	PLC, read access			
	"PlcWrite"	PLC, write access			
	"AlarmRead"	Allows to subscribe to alarms			
	"RandomRead"	Random, read access			
	"RandomWrite"	Random, write access			
	"SinuReadAll"	All of the read access operations mentioned			
	"SinuWriteAll"	All of the write access operations mentioned			
	"ApWrite"	Allows to call method "Select"			
	"PlcReadDBx"	PLC DB read access (x indicates the DB num- ber)			
	"PlcWriteDBx"	PLC DB write access (x indicates the DB num- ber)			
	"CsomReadx"	CSOM read access (x indicates the name- space number, possible numbers: 3-9) <sup>1</sup>			
	"CsomWritex"	CSOM write access (x indicates the name- space number, possible numbers: 3-9) <sup>1</sup>			
	Examples:				

### 5.4 List of access rights

Method	Description	
	<ul> <li>GiveUserAccess ("MyUser", "GudRead; PlcWrite") Sets the read access for user data for the "MyUser" user and sets the write access for the PLC.</li> </ul>	
	<ul> <li>GiveUserAccess ("John", "PlcReadDB100")</li> <li>Admin gives read rights to user "John" for PLC data block DB100.</li> </ul>	

1) CSOM read and write access rights is sufficient to access the CSOM namespace. It overwrites all the other user rights. Therefore, no other additional rights are needed for reading or writing in CSOM address space (for example, PLC read access rights is not needed to read the PLC data in CSOM).

## 6.1 Overview

#### Overview

The OPC UA server provides the possibility to communicate with SINUMERIK via OPC UA. The following functionalities of the OPC UA specification are supported by the server:

- Data Access: Read, write and subscribe to SINUMERIK variables (NC, PLC)
- Alarms & Conditions:

Event based provision of SINUMERIK alarms and messages from HMI, NC and PLC

• Methods:

User management, file transfer, tool management and program selection

This chapter describes the address space of the OPC UA server and gives further information how to address some SINUMERIK specific values. Especially since a lot of SINUMERIK values are stored in arrays or matrices.

Furthermore you can find description on the SINUMERIK alarm object and how to get the alarms from the server.

At the end of this chapter explanation on how users can transfer files from or to the server using the SINUMERIK file system.

6.2 Address space model

## 6.2 Address space model

### Address space model

If the OPC UA server is browsed, the available address space is mapped under the "Sinumerik" node.

Global User Data (GUD) can be found under the "/Sinumerik/GUD" node.

The PLC blocks (inputs, outputs, bit memory, data blocks) can be found under the "/Sinumerik/ Plc" node.

Machine data can be found under the node "/Sinumerik/TEA".

Setting data can be found under the node "/Sinumerik/SEA".

Observe the following while browsing:

 In the address space of the NC, the displayed variables always represent only the first parameter of the corresponding unit.

Example:

The R parameters can be found under "Sinumerik > Channel > Parameter > R". The corresponding identifier is called "/Channel/Parameter/R", which is finally mapped to "/ Channel/Parameter/R[u1, 1]". If you want to access other parameters, you need to specify the corresponding index in brackets, e. g. "/Channel/Parameter/R[u2,56]".

• In the address space of the PLC, the displayed variables represent the access format that has to be extended accordingly.

Example:

The variable "/Plc/MB" is in the address space and is mapped to "/Plc/MB0". For accessing further bytes this variable must be extended by the appropriate byte number, e.g. "/Plc/MB6".

• The address space of the NC also contains variables that are not available in a corresponding machine configuration. These variables return "BadAttributeIdInvalid" as value.

Functionality

6.2 Address space model

<pre>     file Server         Sinumerik         Axis         State         State</pre>	Objects
<pre> i Sinumerik     Axis     Bag     State     Axis     Axis     State     Axis     Axis     State     Axis     State     Axis     Axis     State     Axis     Axis     State     Axis     Axis     State     Axis     Axis     Axis     State     Axis     Axis     Axis     State     Axis     Axis     Axis     State     Axis     Axi</pre>	
<pre>Figure 6-1 Browsing</pre>	Sinumerik
Figure 6-1 Browsing	Avie
Figure 6-1 Browsing	
Figure 6-1 Browsing	Bag
Figure 6-1 Browsing	i⊒+⊡ State
Figure 6-1 Browsing	i
<pre>Figure 6-1 Browsing</pre>	
<pre>Gub Gub Gub Gub Gub Gub Gub Gub Gub Gub</pre>	
<pre>Guber State Guber State G</pre>	n - On Mode
<pre>Figure 6-1</pre> <pre> PreadyActive Pre</pre>	
Figure 6-1 Browsing	+ readyActive
Gub Gub Gub Gub Gub Gub Gub Gub	i autoJogState
Image: Sector of the sector	□ Channel
Image: System         Image: GUD         Image: GUD_CH1         Image: GUD_	
GUD GUD_NC1 GUD_CH1	
GUD_NC1 GUD_CH1 GUD	
GuD_CH1 Gud_CH	GUD NC1
Image: Second	GUD CH1
Image: Second	El
Image: Mainless         Image: Nok         Image: Pic         Image: Clock	Methods
Image: Pic         Image: Clock	Nok
Image: Clock	
Cubok  Cubok	
C C C C C C C C C C C C C C	
Image: Connect_state	
Connect_state	
Image: Second	
Image: Second	
Image: Second	
Image: Second	
Image: Second	in the second se
Image: Second	
Image: Second	
Image: Constraint of the second se	
Image: Constraint of the second se	
Q Q Q Q Q Q Q Q Q Q Q Q Q Q	
Image: Constraint of the second state of the second sta	
QW QD DB1 DB1.DBX DB1.DBB DB1.DBB DB1.DBB DB1.DBB DB1.DBB DB1.DBB DB1.DBD DB1.DBD DB2 DB3 DB4 DB5 DB7 DB1 DB1 DB1 DB1 DB1 DB1 DB1 DB1	
Image: Constraint of the second state of the second sta	
Image: Second system       DB1         Image: Second system       DB1.DBX         Image: Second system       DB1.DBB         Image: Second system       DB1.DBD         Image: Second system       DB1.DBD         Image: Second system       DB1.DBD         Image: Second system       DB1.DBD         Image: Second system       DB2         Image: Second system       DB3         Image: Second system       DB4         Image: Second system       DB7         Image: Second system       DB10         Image: Second system       Image: Second system         Image: Second system       DB10         Image: Second system       Image: Second system         Image: Second system       Image: Second system <td< th=""><th>T QD</th></td<>	T QD
Image: Construction of the second	
Image: Spin Sbort         Image: Spin Sbort <t< th=""><th></th></t<>	
Image: Second	
Image: Constraint of the second se	
Image: Constraint of the second se	
Image: Constraint of the second se	i ⊕+⊂ DB1.DBD
Image: Bigure 6-1     Browsing	i ⊕ → □ DB2
Figure 6-1 Browsing	
Figure 6-1 Browsing	
Figure 6-1 Browsing	
Figure 6-1 Browsing	DB7
Figure 6-1 Browsing	
Figure 6-1 Browsing	
Figure 6-1 Browsing	
	Figure 6-1 Browsing

6.3 Variable access

## 6.3 Variable access

## 6.3.1 Variable paths for NC access operations

Note

You have to pay attention to the correct upper-case and lower-case of the "nodeID". The respective identifier of the "nodeID" provides information on the correct notation.

#### Variable access

The variable paths for NC access are stored in the address space of the SINUMERIK Operate OPC UA server.

You can obtain **further information** from the List Manual for 840D sl and 828D "NC variables and interface signals" (<u>https://support.industry.siemens.com/cs/de/de/view/109748365/en</u>).

Attribute	Value
🖻 NodeId	NodeId
- NamespaceIndex	2
IdentifierType	String
Identifier	/Channel/Parameter/R
NodeClass	Variable
BrowseName	2, "/Channel/Parameter/R"
DisplayName	"en_us", "R"
Description	"en_us", "R"
WriteMask	0
UserWriteMask	0
📮 🖓 Value	
SourceTimestamp	1/30/2014 3:17:25.822 PM
ServerTimestamp	1/30/2014 3:17:25.822 PM
SourcePicoseconds	0
ServerPicoseconds	0
····· Value	66
🗇 DataType	Double
···· NamespaceIndex	0
IdentifierType	Numeric
Identifier	11
ValueRank	-1
····· ArrayDimensions	BadAttributeIdInvalid
AccessLevel	Readable, Writeable
UserAccessLevel	Readable, Writeable
MinimumSamplingInterval	50
····· Historizing	false

Figure 6-2 Identifier for R parameter

The displayed NC variables always represent only the first parameter of the corresponding NC data area (channel, TO area, mode group).

#### Example

Syntax of the R parameter is as follows: R[Channel, Parameter]

The R parameters are found under the identifier "/Channel/Parameter/R", which is eventually mapped to "/Channel/Parameter/R[u1, 1]". If you want to access other parameters, you must correspondingly extend the identifier, for example "/Channel/Parameter/R[u2, 56]".

Table 6-1 Examples of variable paths (NC access operations)

Variable path	Description	
/Channel/Parameter/R[u1,10]	R parameter 10 in channel 1	
/Channel/Parameter/R[u1,1,5]	R parameter array	
/Channel/Parameter/R[u1,1,#5]	R parameters 1 to 5 in channel 1	
/Channel/GeometricAxis/name[u2,3]	Name of the 3rd axis in channel 2	
/Channel/GeometricAxis/actToolBasePos[u1,3]	Position of the 3rd axis in channel 1	

#### Note

Please keep in mind that with array access only max 149 parameters are allowed in one access operation (for example /Channel/Parameter/R[u1, 1, #149]).

## 6.3.2 Variable paths for GUD access operations

GUD variables can be found in the OPC UA server under the "/Sinumerik/GUD" node.

The displayed GUD variables always represent only the first parameter (for GUD arrays) of the first NC channel (for channel-dependent GUD variables). If you want to access a different parameter of a GUD array or a different channel, you must extend the identifier accordingly for the NC access.

GUD arrays are 1-indexed for access, and access is always one-dimensional. This means, the index must be calculated for multi-dimensional arrays.

## Example 1: One-dimensional array, NC-global GUD array

"UGUD.DEF" file

DEF NCK INT ARRAY[2] M17

#### Access is performed as follows:

#### Example 2: Two-dimensional array, channel-dependent GUD array

#### "UGUD.DEF" file

DEF CHAN INT ABC[3,3] M17 6.3 Variable access

#### Access is performed as follows:

## 6.3.3 Variable paths for PLC access operations

PLC variables can be found in the OPC UA server under the "/Sinumerik/Plc" node.

In the address space of the PLC, the displayed variables represent the access format that has to be extended accordingly.

#### Example

Syntax of the PLC variable is as follows: "/PIc/MB"

This variable must be extended by the appropriate byte number, e.g. to "/Plc/MB6".

#### Note

On SINUMERIK 828D, you can only access the freely definable customer data blocks from DB9000.

## Access formats

The various access formats are shown in the following table. They need to be prefixed with "/ Plc/".

#### Note

The data type is converted during access with the OPC UA data access interface. Refer to the following table for the data type conversions.

#### Table 6-2 PLC syntax

Area	Address (IEC)	Permissible data types	OPC UA data type
Output image	Qx.y	BOOL	Boolean
Output image	QBx	<b>BYTE</b> , CHAR, STRING	UInt32 String
Output image	QWx	WORD, CHAR, INT,	UInt32 Int32

Area	Address (IEC)	Permissible data types	OPC UA data type
Output image	QDx	<b>DWORD</b> , DINT, REAL	UInt32 Int32 Double
Data block	DBz.DBXx.y	BOOL	Boolean
Data block	DBz.DBBx	BYTE, CHAR, STRING	UInt32 String
Data block	DBz.DBWx	WORD, CHAR, INT	UInt32 Int32
Data block	DBz.DBDx	DWORD, DINT, REAL	UInt32 Int32 Double
Input image	lx.y	BOOL	Boolean
Input image	IBx	<b>BYTE</b> , CHAR, STRING	UInt32 String
Input image	IWx	WORD, CHAR, INT	UInt32 Int32
Input image	IDx	DWORD, DINT, REAL	UInt32 Int32 Double
Bit memory	Mx.y	BOOL	Boolean
Bit memory	MBx	BYTE, CHAR, STRING	UInt32 String
Bit memory	MWx	WORD, CHAR, INT	UInt32 Int32
Bit memory	MDx	DWORD, DINT, REAL	UInt32 Int32 Double
Counters	Сх	-	Byte
Timers	Тх	-	UInt32
PLC time	Clock	-	UInt16

Notes regarding the table:

- "x" represents the byte offset; "y" the bit number in the byte and "z" the data block number.
- The data type in bold characters is the default data type and does not have to be specified. The specifications DB2.DBB5.BYTE and DB2.DBB5 are equivalent.
- Square brackets are used to access arrays, e.g. "/Plc/DB5.DBW2:[10]" (word array of length 10).
- Access to STRING arrays ("/Plc/DB123.DBB0:STRING[5]") is not supported.

#### Examples of variable paths (PLC access operations)

Table 6-3 Examples of variable paths (PLC access operations)

Variable path	Description
/Plc/M5.0	Memory bit 0 at byte offset 5
/Plc/DB5.DBW2	Word (16-bit) at byte offset 2 in data block 5

#### 6.3 Variable access

Variable path	Description
/Plc/DB8.DBB2:STRING	UTF8 string beginning at byte offset 2 in data block 8
/Plc/DB8.DBW2:[10]	Array of 10 words beginning at byte offset 2 in data block 8
/Plc/DB100.DBB1	Byte at byte offset 1 in data block 100
/Plc/DB2.DBD0:REAL[10]	Array of 10 double words (32-bit) beginning at byte offset 0 in data block 2, which are formatted as a floating-point number

#### Note

- Timers can only be read. A timer is active if it contains a value other than 0.
- If the data type CHAR or STRING is used in conjunction with a byte access, UTF8 characters are read, but if either data type is used in conjunction with a word access, UTF16 characters are read.
- Variables of the STRING type contain the maximum length in the first byte and the actual length in the second byte. When strings are written, the actual length is adapted accordingly. The maximum length is not changed.
- For the STRING data type in conjunction with a byte access (e.g. "/Plc/ DB99.DBB0:STRING"), the maximum string length is 255 characters. As a result of the UTF8 formatting, for some characters (e.g. for the "µ"), two bytes are required so that the maximum string length is correspondingly reduced.
- Only one-dimensional arrays are supported.

## 6.3.4 Variable paths for machine and setting data

The variable paths for machine and setting data are stored in the address space of the OPC UA server under the nodes "/Sinumerik/TEA" and "/Sinumerik/SEA". Pay attention to the correct upper-case and lower-case of the "nodeID". The respective identifier of the "nodeID" provides information on the correct notation.

The displayed machine and setting variables always represent only the first parameter of the corresponding data area (channel, axis).

Table 6-4	Examples of variable paths (machine and setting data)
-----------	---

Variable path	Description
/NC/_N_CH_TEA_ACX/\$MC_CHAN_NAME	Channel name of channel 1
/NC/_N_CH_TEA_ACX/\$MC_CHAN_NAME[u2]	Channel name of channel 2

Machine data arrays are 1-indexed for access.

## 6.3.5 Variable paths for 1:N configuration (only target system PCU)

By default, data is accessed on the NCU which is being viewed by SINUMERIK Operate. Switching to a different NCU in the SINUMERIK Operate results in a situation where the OPC UA server is also looking at the value of the now active NCU.

If the access is to be to a specific NCU, the Nodeld must be expanded with a prefix:

### /Random@<NCUName><NodeId> Examples of variable paths (1:N constellation)

## Examples of variable paths (1:N constellation)

Variable path	Description
/Random@NCU_1/Channel/Parameter/R[u1,10]	R parameter 10 in channel 1 of NCU_1R parameter 10 in channel 1 of NCU_2
Random@NCU_2/Channel/Parameter/R[u1,10]	
/Random@NCU_1/Plc/DB123.DBB0	Byte at byte offset 0 in data block 123 of NCU_1

#### Note

The NCU names are listed in the "MMC.ini" file.

Entry:

[GLOBAL]

NcddeMachineNames=NCU1,NCU2

🕞 mmc.ini - Editor
Datei Bearbeiten Format Ansicht 2
[Global]
NcddeMachineNames=net,NCU840D_1,NCU840D_2
NcddeDefaultMachineName=NCU840D_1
ADDRESSO=192.168.10.224,LINE=14,NAME=/NC,SAP=040d,PROFILE=CLT1CP_L4_INT
ADDRESS1=192.168.10.224,LINE=14,NAME=/PLC,SAP=0202,PROFILE=CLT1CP_L4_INT
ADDRESS2=192.168.10.224,LINE=14,NAME=/CP,SAP=0502,PROFILE=CLT1CP_L4_INT
ADDRESS10=192.168.10.224,LINE=14,NAME=/DRIVE_00_000,SAP=0201,SUBNET=0000-00000000:000,PROFILE=CLT1CP_L4_INT
ADDRESS11=192.168.10.224,LINE=14,NAME=/DRIVE_03_003,SAP=0900,PROFILE=CLT1CP_L4_INT
ADDRESS12=192.168.10.224,LINE=14,NAME=/DRIVE_03_010,SAP=0A00,PROFILE=CLT1CP_L4_INT
ADDRESS13=192.168.10.224,LINE=14,NAME=/DRIVE_03_011,SAP=0B00,PROFILE=CLT1CP_L4_INT
ADDRESS14=192.168.10.224,LINE=14,NAME=/DRIVE_03_012,SAP=0C00,PROFILE=CLT1CP_L4_INT
ADDRESS15=192.168.10.224,LINE=14,NAME=/DRIVE_03_013,SAP=0D00,PROFILE=CLT1CP_L4_INT
ADDRESS16=192.168.10.224,LINE=14,NAME=/DRIVE_03_014,SAP=0E00,PROFILE=CLT1CP_L4_INT
ADDRESS17=192.168.10.224,LINE=14,NAME=/DRIVE_03_015,SAP=0F00,PROFILE=CLT1CP_L4_INT
DECOMPTION AND A CONTRACT AND
ADDIEGOUTIS.100.10.222, HINET4, WAREFAC, SAFTO400, FROFILE-CDICF_14_MI
ADDRESSIEJS.100.10.227, HNEE-4, WARE-756, SAF-0602, FROFILE-CLIL_CF_14_INI
ADDRESS2-12.100.10.22/INE-14,WARE-//F/SAF-0302/ROFILE-011F_4_MI
ADDRESS[1_102] [20 10 222] INE 14 NAME / DATE 00 000 SAF 2001, SOME 1-0000 00000000, 000, FROME COMPLETE IN INTERCOMPANY AND
ADDRESSITES: 100:100.222, DIRE-14, WARE-/ARTY_05_05_05, ART-9500, FROTILE-011_07_14_INT
INDERSIZ-152.100.10.222/INTET4/MALE/DATE_0_101.041-000/REFIDE-CHIL-CF_LT_CF_LT_INT
ADDRESSIA-102 162 10 222 JINE 14 NUME / DRIVE 03 012 SAD-0000 ROTAL-CITL OF LA INT
ADDRESSITESE: 100:100:222, LINE-14, MARC-/MAYL_05_012; MAR-0000, PROTIEC-UIT_07_14_IMI
ADDRESSIG 92, 168, 10, 222, LINE 14, NAME /DRIVE 03, 014, SAP OF 00, PROFILE CLIL CP L4 INT
ADDRESS17=192, 168, 10, 222, LINE-14, MAME, /DEIVE 03, 015, SAPEDROO, PROFILE=CLI, CP L4, INT

Figure 6-3 NCU names with 1:N

6.3 Variable access

## 6.3.6 Finding of OPC UA variables

You can find **further information** on variable documentation in the list manualNC variables and interface signals (<u>https://support.industry.siemens.com/cs/de/de/view/109748365/en</u>)

## Example 1: Finding an OPC UA variable in the variable documentation

You want to find the variable "opMode" in folder "/Bag/State".



1. Refer to the document mentioned above. Search for "opMode".

namePhys				
Name of assigned physical spind	le, identical to "name" variable.			
-			String [32]	r
Multi-line: yes	Axis index	maxn	umGlobMachAxe	es
onModo				
opMode				
opMode Spindle mode				
opMode Spindle mode 0 = spindle mode				
opMode Spindle mode 0 = spindle mode 1 = oscillation mode (gear step ol	hangeover)			
opMode Spindle mode 0 = spindle mode 1 = ossilitation mode (gear step of 2 = positioning mode	hangeover)			
opMode Spindle mode D = spindle mode 1 = oscillation mode (gear step of 2 = positioning mode 3 = synchronous mode	hangeover)			

## Example 2: Finding an OPC UA variable occurring in different folders in the variable documentation

You want to find the variable "cuttEdgeParam" which occurs in the folder "/Channel/ Compensation" and "/Tool/Compensation".



6.3 Variable access

1. At the beginning of each chapter for variable sections, you find the information "OEM-MMC: LinkItem" specifying "/ToolCompensation/".

#### 3.7.2 Area T, Block TO : Tool edge data: Offset data

OEM-MMC: Linkitem /ToolCompensation/...

The data module TO is organized as a 2-dimensional variable array.

2. Refer to the document and search for "ChannelCompensation" and then navigate manually to the requested parameter "cuttEdgeParam".

cuttEdgeParam	\$TC_DPx[y,z]				
Compensation value parameters for a tool edge					
mm, inch or user-defined	0			Double	wr
Multi-line: Yes	(EdgeNo - 1) * num ParameterNo	CuttEdgeParams +	numCuttEdgeParam	is * numCuttEdges	

### Example 3: Finding a variable from documentation on OPC UA client

You want to find the variable "cuttEdgeParam" in the Tool edge data section.

1. At the beginning of each chapter of the variable documentation you find the information "OEM-MMC: LinkItem" specifying here "/ToolCompensation/".

#### 3.7.2 Area T, Block TO : Tool edge data: Offset data

OEM-MMC: Linkitem /ToolCompensation/...

The data module TO is organized as a 2-dimensional variable array.

2. Therefore you will find the variable "cuttEdgeParam" in the OPC UA Browse Tree in the folder "Tool", subfolder "Compensation".



## 6.3.7 Monitored items

An OPC UA client can subscribe to a selection of nodes of interest and let the server monitor these items. Only in case of changes, e.g. to their values, the server notifies the client about such changes. This mechanism reduces the amount of transferred data immensely. Besides the reduction of bandwidth this mechanism introduces further advantages and is the recommended mechanism to "read" information from a UA server.

A client can subscribe to different types of information provided by an OPC UA server. The purpose of a subscription is to group these sources of information, called monitored items, together, forming a piece of information called a notification.

A subscription consists of at least one monitored item, which has to be created within the context of a session and can be transferred to another session. To create a session, a secure channel between the client and the server has to be established.

There are two different types of "changes" a client can subscribe to when adding monitored items to the subscription:

- subscribe to data changes of Variable Values (Value attribute of a Variable)
- subscribe to Events of Objects (EventNotifier attribute of an Object)

### **Publish interval**

Clients define MonitoredItems to subscribe to data and Events. Each MonitoredItem identifies the item to be monitored and the Subscription to use to send Notifications. The item to be monitored may be any Node Attribute.

Notifications are data structures that describe the occurrence of data changes and Events. They are packaged into NotificationMessages for transfer to the Client. The Subscription periodically sends NotificationMessages at a user-specified publishing interval, and the cycle during which these messages are sent is called a publishing cycle." (see OPC UA Part 4 - Services 1.03 Specification.pdf (https://opcfoundation.org/))

## Sampling interval

Each MonitoredItem created by the Client is assigned a sampling interval that is either inherited from the publishing interval of the Subscription or that is defined specifically to override that rate. [...] The sampling interval indicates the fastest rate at which the server should sample its underlying source for data changes. (see OPC UA Part 4 - Services 1.03 Specification.pdf (https://opcfoundation.org/))

#### See also

Technical data (Page 133)

### 6.4.1 Overview

Any OPC UA client supporting Alarms & Conditions connected to the OPC UA server can subscribe to alarms to get the notifications of alarms.

All OPC UA Clients that have subscribed for SINUMERIK alarms will be provided with an alarm as soon as it becomes active. Also if the alarm becomes inactive, the status of the corresponding alarm/s will be updated automatically.

Alarms and Conditions support subscription of all the pending and active alarms of the SINUMERIK system. Part program messages are not supported as part of Alarms and Conditions, but can be received using data access. The OPC UA Server provides all alarms that will be provided by the SINUMERIK AlarmService:

- HMI alarms
- NCK alarms including drive alarms
- Diagnostic buffer alarms
- PLC alarms (FC10)
- Alarm\_S(Q) alarms (SFC17/18, PDiag, HiGraph, S7-Graph) with results of criteria analysis.

Multi language support for the alarms and warnings messages are supported and the required alarm language can be selected during session creation in OPC UA Client. If the desired language is not supported in the operate, the default English language is supported. The SINUMERIK Alarm object is of the "CNCAlarmType" which is defined in the Companion Specification "OPC UA Information Model for CNC Systems (<u>http://opcfoundation.org/UA/CNC/</u>)".

## 6.4.2 Subscribe / unsubscribe to alarms

## Subscribe to alarms

The SINUMERIK Alarm Event object is connected to the SINUMERIK node. To receive the alarms, an event subscription must be placed at the SINUMERIK node. The following example describes how to receive the alarms using the OPC UA Foundation Client:

1. Open the "Quickstart Alarm Condition Client".

Quickstart	Ala	rm Condition	Client						
File Serv	er	Conditions	View H	lelp	-				
		View Refresh			chnology Sample ation.org				
F O U N D Set Area Filter					rt Alarm Condition Client				
Unified Archite opc.tcp://172.	ctur 17.3	Conditi Minimu	on Type um Severity	, ,	ionServer				
Source Cor	ditic	Enable			Time	State	Message	Comment	
NCU Sys	tem(	Disable			23:59:59.999		25202   Axis MX1 waiting fo	r drive	
		Add Co	mment						
		Acknow	vledge						
		Confirm	n						
		Respon	d						
	l	Shelvin	9	•					



2. Click "Conditions > Set Area Filter...". The "Select Area" window appears.

🖳 Select Area	
⊡. Server Sinumerik	
ОК	Cancel

Figure 6-5 The Select Area Window

- 3. Select "Sinumerik".
- 4. Click "OK".

The alarms will be displayed on the screen.

#### 6.4 Alarms



Figure 6-6 Alarm List

#### Unsubscribe to alarms

- 1. Click "Conditions > Set Area Filter...". The "Select Area" window appears.
- 2. Right click on "Sinumerik" and select "Remove Monitored Item" to unsubscribe the server from the Quickstart Alarm Condition Client.

## 6.4.3 Sequence description of alarms

The OPC UA server automatically sends an object of the "CNCAlarmtype" to the OPC UA client containing the single alarm which has just been triggered.

The OPC UA server automatically resends an object of the "CNCAlarmtype" with the same content as when the corresponding alarm was triggered, except a change in the status.

To get all the active alarms, the client has to subscribe to the Sinumerik node.

## 6.4.4 SINUMERIK Alarm object

#### 6.4.4.1 Description

Every variable or object in the address space of an OPC UA server is called a node. Every node has a server unique node id, its symbolic name, addressing information inside the address model and some other attributes.

Events are by themselves not visible as nodes in the address space. They can only be received via objects. Not all objects can signal events. Whether an object can signal events is specified at the object by the EventNotifier attribute. Only objects where this attribute has been set can be specified in the Event Monitored Item and received in Clients Events.

The Server Object serves as root notifier, that is, its EventNotifier Attribute shall be set providing Events. However Server object will not be allowed to subscribe for the Events. Only the "Sinumerik" Object node is accessible and can subscribe to the events.

## 6.4.4.2 OPC UA event messages and alarms

#### Access to alarms

User access right is required to subscribe the Events of the Sinumerik object. User access right with access permission has to be set to "SinuReadAll" or "AlarmRead". The access right is provided using Method Call "GiveUserAccess" as shown below.

⊡ Objects	🚾 Call Me	thods.Give	UserAco	ess 🗖 🗖 💌
i⊒+⊐ Sinumerik	Name	DataType	Value	Description
i → □ Axis	- User	String		user
i Bag	- Realm	String		allowed values: \"StateRead\", \"StateWrite\", \"FrameRead\", \"Fr
🕂 ····· 💷 Channel	•			F .
i DriveVsa	This me	thad has as	ou drou di oo	en una ante
i File System	This me	unou nas no	output a	guments.
ia⊐ GUD				
i∰+⊡ Hmi	C-1			Cancel
i → → → Methods				Calicei
ia,⊒ AddUser				
AddCertificateUser				
ChangeMyPassword				
CopyFile To Server				
i → Delete User				
🕂 Delete User Access				
Get UserAccess Rights				
i ReadVar				
🚛 🛶 💷 WriteVar				
👳 🖙 💷 Filehandling				
i ToolManagement				

Figure 6-7 Alarm access rights

If the client does not have the access with "SinuReadAll "or "AlarmRead" and user tries to subscribe to the Events, server will return error code with "BadUserAccessDenied".

#### **Event types**

The SINUMERIK Alarm object is of the "CNCAlarmType" which is defined in the Companion Specification "OPC UA Information Model for CNC Systems (<u>http://opcfoundation.org/UA/CNC/</u>)".

The root of the derivation hierarchy is the BaseEventType. The types for Alarms and Conditions are available below the ConditionType. The Application-specific event types such as CncAlarmType can be derived. The CncAlarmType extends the DiscreteAlarmType.

An alarm is composed of various nested or parallel state machines. Monitoring can generally be enabled or disabled. If monitoring is enabled, the alarm can be active or otherwise inactive. Acknowledgment, confirm and comments of alarms is currently not supported.

The basic type for all condition objects is the condition type. It is derived from BaseEventType. All mechanisms for alarm processing work even without the condition objects are contained in the address space.

If a condition object changes one or several states, the server sends an event with the requested event fields to the client. So only the alarms, where a status change happens after the connection is established, will be sent. To receive all currently active alarms the refresh method can be used.

## CncAlarmType

The CncAlarmType, which is specified in the Companion Specification "OPC UA Information Model for CNC Systems" is derived from the DiscreteAlarmType, which is defined by the OPC Foundation.



Figure 6-8 OPC UA Information Model for CNC Systems

## Description of the CncAlarmType

Since the CncAlarmType is derived from a number of types as you can see in Figure 5-8, it does not only contain the three attributes AlarmIdentifier, AuxParameters and HelpSource, but also all the other attributes which are inherited from the objects.

## Attributes of BaseEventType

Attribute	Data type	Mapping with respect to SINU- MERIK	M/O	Description
EventId	String	Unique node id generated from SINUMERIK system.	M	EventId is generated by the server to uniquely identify a particular Event Notifi- cation.
				The EventId shall always be returned as value and the server is not allowed to return a StatusCode for the EventId indicating an error.
EventType	Nodeld	It is always set to 'CncAlarmType'.	М	The EventType shall always be returned as value and the server is not allowed to return a StatusCode for the EventType indicating an error.
SourceNode	Nodeld	Alarm source identifier provided by SINUMERIK system.	M	SourceNode identifies the Node that the Event originated from. If the Event is not specific to a Node, the Nodeld is set to null.
SourceName	String	Supported alarm source names are HMI, NCK, and PLC.	Μ	SourceName provides a description of the source of the Event. This could be the string-part of the DisplayName of the Event source using the default locale of the serv- er. If it is not possible for a CNC system to pro- vide this information in detail, the Source-
				Name should provide the main component responsible for this alarm (e.g. CNC, PLC, or even Channel).
Time	UtcTime	Alarm time stamp	M	Time provides the time of the Event occur- red. Once set, intermediate OPC UA serv- ers shall not alter the value.
ReceiveTime	UtcTime	Alarm time stamp of the server.	M	ReceiveTime provides the time the OPC UA server received the Event from the un- derlying device of another server.
Message	Localized Text	Reading attributes via (SLAE_EV_ATTR_MSG TEXT)	M	Alarm Message provides a human reada- ble and localizable text description of the Event.

## 6.4 Alarms

Attribute	Data type	Mapping with respect to SINU- MERIK	M/O	Description
Severity	UInt16	Reading attributes via (SLAE_EV_ATTR_SEVE RITY)	М	Severity of the event message. The range of values of the severity is from 1 to 1000, where 1000 corresponds to the highest se- verity.
LocalTime	TimeZoneDa- taType	Offset and the DaylightSavingl- nOffset flag	0	LocalTime is a structure containing the Off- set and the DaylightSavingInOffset flag. The Offset specifies the time difference (in minutes) between the Time Property and the time at the location in which the event was issued.
				If DaylightSavingInOffset is -
				TRUE: Standard/Daylight savings time (DST) at the originating location is in effect and Offset includes the DST correction.
				FALSE: The Offset does not include DST correction and DST may or may not have been in effect.

## Severity of Alarms

SINUMERIK systems use three severity levels (e.g. Information, Warning and Error). The table below shows the values at SINUMERIK system and its mapping in OPC UA server/client:

Severity Level	SINUMERIK System	OPC UA server/client
Information	0-1	1
Warning	2-999	500
Error	1000	1000

## Additional attributes of the ConditionType

Attribute	Data type	Mapping with respect to SINU- MERIK	M/O	Description
ConditionCla ssId	Nodeld	Unique node id (sum of alarm id and alarm instance)	М	String NodeID SystemConditionClassType
ConditionCla ssName	String	Set to "SystemConditionClas- sType"	М	SystemConditionClassType
ConditionNa me	String	Set to "SystemCondition".	М	ConditionName identifies the Condition in- stance that the Event originated from. It can be used together with the Source- Name in a user display to distinguish be- tween different Condition instances.
Retain	Boolean	True when the alarm is active. False otherwise.	M	Information whether or not the alarm shall be displayed. This is set to true by default.

Attribute	Data type	Mapping with respect to SINU- MERIK	M/O	Description
Quality	String	According to SINUMERIK quality attribute, below string will be set:	М	The quality provides information about the reliability of an alarm.
		• BAD		Possible values of SINUMERIK:
		• GOOD		AlarmQuality.QUALITY_BAD = 0
		UNCERTAIN		<pre>AlarmQuality.QUALITY_GOOD = 192 AlarmQuality.QUALITY_UNCERTAIN = 64</pre>
LastSeverity	UInt16	Reading attributes via(SLAE_EV_ATTR_SEVERITY)	M	LastSeverity provides the previous severity of the ConditionBranch. Initially this Varia- ble contains a zero value; it will return a value only after a severity change. The new severity is supplied via the Severity Prop- erty which is inherited from the BaseEvent- Type.
Branchld	Nodeld	Null	М	BranchId is Null for all Event Notifications that relate to the current state of the Condition instance.
Comment	LocalizedText	Null	М	The value of this Variable is set to null.
ClientUserId	String	Null	М	The value of this Variable is set to null.
Enable		Not supported	М	Servers do not expose Condition instances in the AddressSpace.
Disable		Not supported	М	Servers do not expose Condition instances in the AddressSpace.
AddComment		Not supported	М	Not supported and the result code should return Bad_MethodInvalid.
ConditionRe- freshMethod			None	When the method is called up, an event with the current state is triggered for the calling client for all conditions. Only those conditions are updated for which the Re- tain flag has been set.

## Additional attributes of the AcknowledgeableConditionType

Attribute	Data type	Mapping with respect to SINU- MERIK	M/O	Description
AckedState	Localized text	True / False	Μ	AckedState when FALSE indicates that the Condition instance requires acknowledge- ment for the reported Condition state. When the Condition instance is acknowl- edged, the AckedState is set to TRUE.
Confirmed- State	LocalizedText	True / False	0	ConfirmedState indicates whether it re- quires confirmation.
EnabledState	Localized text	True / False	М	Always set to true

#### 6.4 Alarms

Attribute	Data type	Mapping with respect to SINU- MERIK	M/O	Description
Acknowledge		Not supported	М	Not Supported and the return error code shall be Bad_MethodInvalid.
Confirm			0	The Confirm Method is used to confirm an Event Notifications for a Condition instance state where ConfirmedState is FALSE. Normally, the Nodeld of the object instance as the ObjectId is passed to the Call Serv- ice. However, some Servers do not expose Condition instances in the AddressSpace. Therefore all Servers shall also allow Cli- ents to call the Confirm Method by specify- ing ConditionId as the ObjectId. The Meth- od cannot be called with an ObjectId of the AcknowledgeableConditionType Node.

## Additional attributes of the CncAlarmType

The CNCAlarmType is defined in the VDW Companion Specification "OPC UA Information Model for CNC Systems".

Attribute	Data type	Mapping with respect to SINU- MERIK	M/O	Description
AlarmIdentifi- er	String	Unique Alarm id.	Μ	Unique alarm number. This mapped to Alarm ID.
AuxParame- ters	String	All available (out of 10) parame- ters will be displayed in '' separa- ted value.	М	10 Auxilliary parameter values provided by SINUMERIK system.

## 6.4.5 Language of alarms

## 6.4.5.1 OPC UA language specification

The OPC UA server has a built-in data type "LocalizedText" to store the language specific alarm text. This data type defines a structure containing a string in a locale-specific translation specified in the identifier for the locale. The elements are defined in the table below :-

Name	Туре	Description
LocalizedText	structure	
text	String	The localized text.
locale	LocaleId	The identifier for the locale (e.g. "en-US").

The "Localeld" is a simple data type that is specified as a string that is composed of a language component and a country/region component as specified by IEEE 754-1985 (<u>http://standards.ieee.org/findstds/interps/index.html</u>), IEEE Standard for Binary Floating-Point Arithmetic. The <country/region> component is always preceded by a hyphen.

The format of the Localeld string is shown below:

#### <language>[-<country/region>]

- <language> is the two letter ISO 639 code for a language
- <country/region> is the two letter ISO 3166 code for the country/region

For more information, refer to the specification OPC UA Part3 - Address Space Model 1.03 Specification.pdf

### 6.4.5.2 SINUMERIK language specification

The SINUMERIK system currently supports 31 languages which are mentioned below. These languages are identified by the 3-letter abbreviation that follows Microsoft conventions.

#### Note

In the list of languages that are mentioned, not every language is supported always.

## 6.4.5.3 Mapping of SINUMERIK LanguageID with OPC UA LocaleID

Mapping of the SINUMERIK LanguageID with the OPC UA specific LocaleId for each of the supported languages.

Language	SINUMERIK LanguageID	OPC UA Specific LocaleId
German - Germany	deu	de-DE
English - United Kingdom	eng	en-GB
Chinese (Simplified)	chs	zh-CHS
Chinese (Traditional)	cht	zh-CHT
Czech - Czech Republic	csy	cs-CZ
Danish – Denmark	dan	da-DK
Bulgarian - Bulgaria	bgr	bg-BG
Greek – Greece	ell	el-GR
Spanish – Spain	esp	es-ES
Finnish – Finland	fin	fi-Fl
French – France	fra	fr-FR
Hindi – India	hin	hi-IN
Croatian – Croatia	hrv	hr-HR
Hungarian – Hungary	hun	hu-HU
Indonesian – Indonesia	ind	id-ID
Italian – Italy	ita	it-IT
Japanese - Japan	jpn	ja-JP
Korean – Korea	kor	ko-KR
Malay – Malaysia	msl	ms-MY
Dutch - The Netherlands	nld	nl-NL
Polish – Poland	plk	pl-PL
Portuguese - Brazil	ptb	pt-BR

### 6.4 Alarms

Language	SINUMERIK LanguageID	OPC UA Specific LocaleId
Romanian - Romania	rom	ro-RO
Russian – Russia	rus	ru-RU
Slovak – Slovakia	sky	sk-SK
Slovenian – Slovenia	slv	sl-Sl
Swedish – Sweden	sve	sv-SE
Tamil – India	tam	ta-IN
Thai – Thailand	tha	th-TH
Turkish – Turkey	trk	tr-TR
Vietnamese - Vietnam	vit	vi-VN

In the above list "OPC UA Specific LocaleId" is used by the OPCU UA client to connect with the server.

## 6.4.6 OPC UA alarms and conditions constraints

Below are the features which are not supported in this version:

- Acknowledgements and confirmation of the alarms.
- Part program messages
- Only alarm text will be available in localized text. All other attributes will be available in English only.

## 6.4.7 OPC UA alarms and conditions client

## User interface

The figure and table below describes the user interface of the UaExpert client example with which the information of the namespace of an OPC UA server can be conveniently accessed.

roject & X	Data Access View Event View	0		
Project     Servers	Configuration	4		
SinumerikServer@ncu1.local     Documents     Data Access View     Event View     X	Serve/Object > SinumerikServer@ncv1.Jocal - Basic128Rsa15 - Sign (watcp-vasc-wabinary) / Sinumerik			
ddress Space 🛛 🕏 🗙				
🖸 No Highlight 🔹 👻				
Root     Objects				
> 🔥 Server				
<ul> <li>Sinumerik</li> <li>Durses</li> </ul>		Acciv		
> 🖸 Views	Events			
	Events Alarms Event History			
	Ø ∧ S ℝ			
	A         C         Time         Severity         Server(V)bject         Message         ConditionName         Active           △         △         6.0022309.01M         Blow         SimumeniSer	_		

① The Alarm window

2 Displays the received events with preconfigured event fields. The standard event fields are:

- In the Events tab: Time, ReceiveTime, Severity, SourceName, Message, EventType and SourceNode
- In the Alarms tab: AcknowledgeState, Time, Severity, SourceName, Message, ConditionName, ActiveState and Retain Flag
- ③ In the first column of the Alarm tab, a symbol indicates whether an event has already been Acknowledged. (red flag: unacknowledged, green checkmark: acknowledged)
- ④ The Alarm / Event Subscription View
- 5 Alarm / Event Instances:

The user needs to subscribe to these instances (by dragging or by configuring).

Figure 6-9 User interface UaExpert client

## 6.4.8 OPC UA multi-language alarms and conditions client

The OPC UA client must explicitly provide the OPC UA specific language "LocaleId" to change the alarm texts. Below is an example of changing the client language using OPC UA foundation stack client.

```
//Create and connect session
var preferredLocalesList = new List<String>();
preferredLocalesList.Insert(0, "de-DE");
Session mSession = Session.Create(
    ApplicationConfig,
    mEndpoint,
    true,
    "MySession",
    60000,
    UserIdentity,
    preferredLocalesList //preferred locale list
    );
```

Figure 6-10 OPC UA multi-language alarms and conditions client using OpcUa foundation .Net Client

In the case of UaExpert client proceed as follows:

- 1. Open the "Configure UaExpert" window under "Settings" Tab in the client
- 2. Provide the OPC UA specific "LocaleId" as value for the parameter "General.LocaleId".
- 3. Then connect to the server.

ilter:		
Parameter	Value	
General.ConnectTimeout	10000	
General. Disable Error. Certificate Issuer Revocation Unknown	false	
General.DisableError.CertificateIssuerTimeInvalid	false	
General.DisableError.CertificateRevocationUnknown	false	
General.DisableError.CertificateTimeInvalid	false	
General.DiscoveryTimeout	10000	
General.ForceSendClientCertificate	false	=
General.InternalServiceCallTimeout	5000	-
General.LocaleId	fr-FR	
General.LogLevel	ALL	
General.LogMaxEntries	1000	
General.LogShowDateWithTimestamps	true	
General.MaxBrowseNextCalls	1000	
General.MaxOperationsPerServiceCall	0	
General.MaxReferencesToReturn	100	
General.NoOfRecentFiles	5	

Figure 6-11 Client User Interface for changing Session Language

Language	OPC UA Specific LocaleId
German - Germany	de-DE
English - United Kingdom	en-GB
Chinese (Simplified)	zh-CHS
Chinese (Traditional)	zh-CHT
Czech - Czech Republic	cs-CZ
Danish – Denmark	da-DK
Bulgarian - Bulgaria	bg-BG
Greek – Greece	el-GR
Spanish – Spain	es-ES
Finnish – Finland	fi-Fl
French – France	fr-FR
Hindi – India	hi-IN
Croatian – Croatia	hr-HR
Hungarian – Hungary	hu-HU
Indonesian – Indonesia	id-ID
Italian – Italy	it-IT
Japanese - Japan	ja-JP
Korean – Korea	ko-KR
Malay – Malaysia	ms-MY
Dutch - The Netherlands	nl-NL
Polish – Poland	pl-PL
Portuguese - Brazil	pt-BR
Romanian - Romania	ro-RO
Russian – Russia	ru-RU
Slovak – Slovakia	sk-SK
Slovenian – Slovenia	sl-Sl
Swedish – Sweden	sv-SE
Tamil – India	ta-IN
Thai – Thailand	th-TH
Turkish – Turkey	tr-TR
Vietnamese - Vietnam	vi-VN

6.5 File system

## 6.5 File system

### 6.5.1 Overview

SINUMERIK OPC UA supports the standard OPC UA file and folder objects, which allows transfer of files as well as the manipulation of the file systems.

Furthermore, the server offers 2 comfort methods to copy NC part programs from the OPC UA client to the OPC UA server and vice versa. Due to the nature of the method this comfort methods are limited to a file size of 16 MB. For bigger files please use the file and folder objects as described in chapter File transfer exceeding 16 MB between client and server (Page 107).

## Operations

This allows an OPC UA client to use the following operations within the part of the SINUMERIK file system:

- 1. Create files/directories
- 2. Copy files/directories
- 3. Moving files/directories
- 4. Deleting files/directories
- 5. Renaming files/directories

#### File system

The standard OPC UA file system is placed in the SINUMERIK folder and the file structure of the NCU is as shown below:

- 1. Part Programs
- 2. Sub Programs
- 3. Work Pieces
- 4. NCExtend (External CF Card/internal CF Card)

#### Note

#### For 840D sl

For NCU, external CF Card/internal CF Card is supported.

For IPC/PCU, SSD/Harddisk is supported.

5. ExtendedDrives (USB/Networkshare)

#### Note

The ExtendedDrives folder will only be displayed if there are external drives available. Please keep in mind that a licence my be required to use these external drive.

#### Note

NCExtend and ExternalDrives option is supported for SINUMERIK Operate version 4.7 or later.



Figure 6-12 The file system

## 6.5.2 Prerequisites

The OPC UA server allows the OPC UA client to support the transfer of files between the client and the server.

As a user, you will require user access rights to access these files from the server. The access rights are provided using the "GiveUserAccess" method. The following access rights can be provided for the file system (also see chapter List of rights (Page 72)):

- FsRead for the standard file system methods like Open, GetPosition, Read as well as the CopyFileFromServer method.
- FsWrite for the standard file system methods like CreateDirecotry, CreateFile, Delete, MoveOrCopy, Write, SetPosition, Close as well as the CopyFileToServer method.

K UA Sample Client	
File Task Discovery Help	
F 0 U N D A T I 0 N Unified Architecture demonstration app	OPC UA Technology Sample www.opcfoundation.org UA Sample Client
opc.tcp://172.17.30.70:48030 - [SignAndEn	cryptBasic128Rsa15:Binary]
MySession 1	Objects     Server     Server     Sinumerik     P Axis     P Bag     P Channel     P FileSystem     P GUD     P Hmi     P ChangeMyPassword     P CopyFileFromServer     P InputArguments     P OutputArguments     P OutputArguments     P DeleteUser     P DeleteUser     P DeleteUser     P GetUserAccess     P GetUserAccess     P ReadVar     P WriteVar     P Nck     P SEA     P TEA     P Tool

Figure 6-13 Standard Method

## 6.5.3 Standard file system support

#### 6.5.3.1 File transfer with standard methods

The SINUMERIK OPC UA server supports the "FileType"/"FolderType" as described in the OPC UA Specification Part 5, which allows manipulating files and folders via OPC UA.

#### **Folder methods**

The folders, "Part Programs", "Sub Programs", "Work Pieces", "NCExtend", and "ExtendedDrives" are of the "FolderType", which contain the following methods:

Method/Attribute	Description
CreateDirectory	To create new folders under parent folder.
CreateFile	To create new file under parent folder.
Delete	To delete folder and file under parent folder.
MoveOrCopy	To copy or move files from source to destination within server filesystem.

You can create, delete, move or copy folders and files using the above methods. When you create a new folder using "CreateDirectory", a new node will be created with "FolderType" and name provided by the user in OPC UA client. This folder contains all methods and attributes specified in above table.

The node in the address space, under which the "CreateDirectory" method is called, is the "parent" node of the new folder node.

The folder methods exist under all folder type objects in the file system. Please note that you must always call the method under the direct parent node of the file or folder.

For the methods "Delete" and "MoveOrCopy" you must always provide the full identifier of the node to be moved, copied or deleted.

Whenever you create a new file using the method "CreateFile", a new node will be created with "FileType" with a user provided name. This file again contains all methods and attributes specified in the table above. The node in address space, under which the "CreateFile" method is called, is the "parent" node of the new file node. For specific information for the described methods, check the Typedefinition in the OPC UA Specification Part 5.

#### Examples for the usage of the folder methods

Use Case	Where to call	Input parameter
CreateDirectory	Method must be called under the node where the files should be created (e. g. "SINUMERIK/FileSystem/Part Pro- grams/")	Folder name
CreateFile	Method must be called under the node where the files should be created (e. g. "SINUMERIK/FileSystem/Part Pro- grams/")	Filename incl. file extension (e. g. 'My- PartProgram.mpf")

#### 6.5 File system

Use Case	Where to call	Input parameter
Delete	Method of the direct parent node of the file/folder to be deleted must be called (e. g. to delete a file located under "SIN- UMERIK/FileSystem/Part Programs/ Test" the method of the folder "Test" must be called)	Identifier of the file/folder (e.g. "SINU- MERIK/FileSystem/Part Programs/Test/ MyPartProgram.mpf")
MoveOrCopy	Method of the direct parent node of the file/folder to be moved or copied must be called (e. g. to move or copy a file loca- ted under 'SINUMERIK/FileSystem/ Part Programs/Test "the method of the	Identifier of the source file/folder as well as identifier of the target folder (e.g. Mover or copy the file "MyProgram.mpf" from the folder "Test" to the folder "Part Programs"
	folder "Test" must be called)	Source: "SINUMERIK/FileSystem/Part Programs/Test/MyPartProgram.mpf"
		Target: "SINUMERIK/FileSystem/Part Program/MyPartProgram.mpf")

### **File methods**

All files which are in the above mentioned folders will be of the "FileType" type and consist of the following methods and properties:

Method/Attribute	Description
Open	Opens the file either in read/write mode.
Read	Reads contents of the file.
Write	Writes data to the file. (if write permission is available)
Close	Closes the file. (succeeds if file is open)
GetPosition	Gets the position of current position of file pointer while file read/write operation.
SetPosition	Sets the position of current position of file pointer while file read/write operation.
OpenCount	Gives the number of file open instances.
Size	Gives the file size details.
UserWritable	Set to true if current user has access to modify the content of the file.
Writable	Set to false if the file is read only.

Whenever you create a new file using the method "CreateFile", a new node will be created with "FileType" type with a user provided name. This file again contains all methods and attributes specified in the table above. The node in address space, under which the "CreateFile" method is called, is the "parent" node of the new file node. For specific information for the described methods, check the type definition in the OPC UA Specification Part 5 Annex C.

## Note

#### No multiple extensions supported

The methods "CreateFile", "CopyFileToServer", "CopyFileFromServer" and "MoveOrCopy" will not support files with multiple extensions (i.e. test.mpf.mpf).

## 6.5.3.2 File transfer exceeding 16 MB between client and server

For file transfer, the OPC UA specification v1.0X, Part 5, Annex C offers the use of file and folder object methods.

## How can a file transfer be implemented in a client using the file and folder object methods?

The basic idea is to open a file and copy the content from location A to B and then close the file.

Therefore to copy a file from the SINUMERIK to an OPC UA client the client needs to do the following:

- Open the file on the SINUMERIK via the Open method,
- then pass the received handle to the Read method and operate on arrays of bytes,
- then close the file via the Close method.

For the other direction, the file has to be created on the SINUMERIK file system first, using the Create method.



Figure 6-14 File transfer from server to client using standard file system methods

### 6.5 File system



Figure 6-15 File transfer to server from client using standard file system methods

## 6.5.3.3 Comfort methods for file transfer < 16 MB

In addition to the standard file system, two additional methods are provided to transfer files from server to client and vice versa.

#### Note

With these methods, you will be able to transfer maximum of 16 MB by default, depending on the client settings. As the maximum ByteString and message size depends on the server and client-side stack limit. For file transfer more than 16 MB, it is recommended to use OPC UA standard file transfer methods.
Functionality

6.5 File system



Figure 6-16 Methods for the file transfer

6.5 File system

### Procedure and Example

- 1. CopyFileFromServer:
  - Allows copying file from SINUMERIK OPC UA server to client location.
  - The user shall provide the name of the file with full path to be copied.
  - On completion of the file transfer, an appropriate message will be displayed.

Туре	Data type	Argument	Description
Input parameter	string	SourceFile	Name of the file need to be copied with abso- lute path.
Output parameter	ByteString	Data	Raw file data

- 2. CopyFileToServer:
  - Allows copying a client file to a specified SINUMERIK NC memory location.
  - The user shall select the file to be transferred and specify the location on server.

Туре	Data type	Argument	Description
Input parameter	string	TargetFilename	Target file name with absolute path
Input parameter	ByteString	Data	Raw file Data
Input parameter	Boolean Overwrite	Overwrite	True: Overwrite the file if already exists. False: File will not be overwrit- ten.

For example:

The complete path of the files can be provided as below:

- Sinumerik/FileSystem/Part Program/partprg.mpf
- Sinumerik/FileSystem/Sub Program/subprg.spf
- Sinumerik/FileSystem/Work Pieces/wrkprg.wpf
- Sinumerik/FileSystem/NCExtend/Program.mpf
- Sinumerik/FileSystem/ExtendedDrives/USBdrive/Q3.mpf

6.6 Select

# 6.6 Select

### 6.6.1 Overview

The "Select" method is provided under "Methods > Filehandling" in the address space, which allows the selecting of a part program from the NC file system. You can call this method and select the file to be executed by providing the node identifier of the file in address space and the channel number.

By calling this method, you can only select the program for execution and not start the execution of the program itself.



#### 6.6 Select

### 6.6.2 Description

You are allowed to select the part program file for execution from the NC file system and external memory, which includes "local drive", "USB" and "network share". As part of the file system feature, the NC file system is exposed in the OPC UA address space.

There are two input values to be provided to call the "Select" method.

- Node identifier of the file to be selected for execution.
- Channel number.

Each part program file on the file system is associated with a node identifier in the OPC UA address space and is provided as the input. Only one part program can be selected for a channel. An error will be displayed otherwise.

 🛠 Call Filehandli	ing.Select					
Name	DataTy	pe	Value	Description		
Source Nodel     Grannel Numb	d Nodeld ber Ulnt32	l i	=0 0	Part program to be selected Channel in which the part p	l for processing rogram is selected	d
Name	DataType	Value	e De	scription		
- Status Code	UInt32	0	Re	sult of the requested action		
Call					[	Cancel

Status code is an output parameter which indicates the error code in case of failures.

### 6.6.3 Input and output arguments

Signature of the method "Select" is as follows:

Select (
[in] string SourceFileNodeId,
[in] int32 ChannelNumber,
[out] int32 Status Code)

Argument	Description
SourceFileNodeId	Represents the node identifier of the file with absolute path (which is selected for execution).
Channel Number	A number which represents the channel to be used while pro- gram execution.

### Prerequisites

- Channel to be used during program execution must be in the state "Reset".
- User with "ApWrite" access right can call "Select" method. If the user does not have the access "ApWrite" and tries to call "Select" method, it fails and server will return with OpcUa status "BadUserAccessDenied".

#### Note

The access right for the user is provided using the "GiveUserAccess" method.

### Status Code of the method call

The following table gives details on values and description on the status of the "Select" method call. As part of output argument, the result code (value) is displayed in the OPC UA client.

Status Code (value)	Description
0	Successful
1	Channel does not exist
2	Part Program cannot be found
3	Channel is not in Reset
4	Target rejected requested action.

#### Note

### No file restriction

Notice that a file with any extension is allowed to be selected through OPC UA "Select" method. OPC UA does not restrict selecting files with any file extension.

Joblists cannot be selected.

### **OPC UA Status**

The following table gives details on values and description of the OPC UA method call status:

Result	Description
Succeeded	Method is executed with success/failure.
OpcUa_BadInvalidArgument	Invalid inputs are provided.
OpcUa_BadUserAccessDenied	User does not have permission to invoke the method.

6.6 Select

## 6.6.4 Example call

### Procedure

- 1. Look for the NodeID of the particular part program you want to select (for example "NC\_PROG1.MPF").
- 2. Navigate in the "File System" node until you reach the particular file.

Garage Create Directory	View Node Attrib	utes	
	Field	Value	Status
⊕ Delete	HasTypeDefinition	BaseObjectType	Good
	Contract Nodeld	ns=2;s=Sinumerik/FileSystem/Part Program/NC_PROG1.MPF	Good
G4TEST.MPF	- NodeClass	Object	Good
	- Browse Name	2:NC_PROG1.MPF	Good
	- DisplayName	NC_PROG1.MPF	Good
NC_PROGABCD.MPF	+ Description		Good
TESTMPF.MPF	- Write Mask	0	Good
	- UserWriteMask	0	Good
X1.MPF	- Event Notifier	No Access	Good
X2.MPF	- Value		BadNodeldUnknown
Work Pieces	OpenCount	0	Good
	Size	11	Good
notifications	Writable	True	Good
	UserWritable	True	Good

Figure 6-17 Finding of NodelD

3. Specify the NodelD and the channel number in the call of the method.

🕷 Call Filehandling.Select						
Name	DataT	ype Va	alue	Description		
Source Node     Channel Nun	eld Nodelo nber Ulnt32	l i=( 0	D	Part program to be selected Channel in which the part p	d for process program is se	sing elected
Name	DataType	Value	De	scription		
Status Code	UInt32	0	Re	sult of the requested action		
Call						Cancel

Figure 6-18 Arguments of select method

The particular part program will be selected.

# 6.7 Tool management

### 6.7.1 Description

The OPC UA server supports the creation and deletion of tools and cutting edges. The methods for this operation can be found under "Sinumerik > Methods > ToolManagement" folder. Following are the four methods present in "ToolManagement" folder:

- CreateTool
- DeleteTool
- CreateCuttingEdge
- DeleteCuttingEdge



#### **Example calls**

For example calls of the provided methods, please refer to the shown screenshots of OpcFoundation Client.

#### 6.7 Tool management

### Prerequisites

User with "ToolWrite" access right can call "ToolManagement" methods. If the user does not have the access "ToolWrite" and tries to call "ToolManagement" methods, it fails and server will return with OpcUa status "**BadUserAccessDenied**".

#### Note

The access right for the user is provided using the "GiveUserAccess" method.

### 6.7.2 CreateTool

The "CreateTool" method is used to create a new tool with a special T-number in Tool List section of the SINUMERIK, and appears under the folder "Methods/ToolManagement". The CreateTool method does not contain the settings of tool parameters. The tool parameters e.g.: tool type, cutting edge date etc. are set via data access functions.

The CreateTool method has two input parameters and one output parameter.

```
Signature:
CreateTool(
[in] string ToolArea
[in] string ToolNumber
[out] Uint32 StatusCode
)
```

Call ToolManagement.CreateTool				
Name	DataType	Value	Description	
- Tool Area - Tool Number	String String		Input parameter to enter tool area Input parameter to enter tool number	
Name	DataType	Value	Description	
- Status Code	UInt32	0	Result of the requested action	
Call				Cancel

The following table will give details about the parameters of the method:

Туре	Parameters	Description
Input	Tool Area	Input parameter to enter tool area.
Input	Tool Number	5 digit number given to the created tool.
		For range of number please refer to 828D or 840D sl documentation respectively.
Output	Status Code	A number which gives a feedback if the method was executed success- fully or not.

The method returns a value which indicates whether the creation was successful or not. If the creation was not successful the return value will give information about the reason of the failure.

### Status code

The status code is the result of the requested action which is a number as shown in the table below:

Reason
OK.
Tool area does not exist.
Tool number out of range.(Reason wrong parameter)
Tool number exists already.
Maximum number of tools reached.

### Method Result Codes

Result	Description
Succeeded	Method executed with success/failure reason.
BadInvalidArgument	Arguments provided are not correct.
BadUserAccessDenied	"ToolWrite" access is not provided.

### 6.7.3 DeleteTool

The "DeleteTool" method is used to delete an existing tool in Tool List section of the SINUMERIK, and appears under the folder "Methods/ToolManagement".

The method deletes the tool with all cutting edges in all data blocks where it is saved.

DeleteTool(
[in] string ToolArea
[in] string ToolNumber

Functionality

6.7 Tool management

[out] Uint32 StatusCode					
)					
Call ToolMan	agement.D	)eleteTo	ool		
Name	DataType	Value	Description		
- Tool Area - Tool Number	String String		Input parameter to enter tool ar Input parameter to enter tool nu	rea umber	
Name	DataType	Value	Description		
- Status Code	UInt32	0	Result of the requested action		
Call					Cancel

The following table will give details about the Parameters of the method:

Туре	Parameters	Description
Input	Tool Area	Input parameter for the end user to enter tool area.
Input	ToolNumber	5 digit number which is to be de- leted.
		For range of number please refer to 828D or 840D sl documenta- tion respectively.
Output	StatusCode	A number which gives a feed- back if the method was executed successfully or not.

The method returns a value which indicates whether the delete was successful or not. If the delete was not successful the return value will give information about the reason of the failure.

### Status code

If the deletion of the tool was not successful the return value will give information about the reason of the failure which are explained in the table below.

StatusCode	Description
0	OK.
1	Tool area does not exist.
2	Tool number out of range.(Reason wrong parameter)
3	Tool does not exist.
6	Tool active.(Reason tool in use)

#### Method Result Codes

The Result return "Succeeded" when the method is correctly executed and the *StatusCode* gives the reason of Success/Failure.

It returns "BadInvalidArgument", if inputs are not according to OPC UA standards.

Result	Description
Succeeded	Method executed with success/failure reason.
BadInvalidArgument	Arguments provided are not correct.
BadUserAccessDenied	"ToolWrite" access is not provided.

### 6.7.4 CreateCuttingEdge

The "CreateCutting Edge" method is used to create a new cutting edge of an existing tool in "Tool List" section of the SINUMERIK. The next superior free D number will be created.

The "CreateCuttingEdge" method appears under the folder "Methods/ToolManagement". This method does not contain the settings of cutting edge parameters.

The CreateCuttingEdge method has two inputs and two output parameters.

```
Signature:
CreateCuttingEdge(
[in] string ToolArea
[in] string ToolNumber
[out] Uint32 DNumber
[out] Uint32 StatusCode
)
```

Name	DataType	Value	Description		
- Tool Area	String		Input parameter to enter tool ar	ea	
- Tool Number	String		Input parameter to enter tool nu	umber	
Name	DataType	Value	Description		
- DNumber	UInt32	0	Cutting edge number		
- Status Code	UInt32	0	Result of the requested action		

The following table will give details about the parameters of the method:

Туре	Parameters	Description
Input	Tool Area	Input parameter to enter tool area.
Input	Tool Number	5 digit number which is to be de- leted.
		For range of number please refer to 828D or 840D sl documenta- tion respectively.

#### Functionality

#### 6.7 Tool management

Туре	Parameters	Description
Output	DNumber	Cutting Edge Number of the tool.
Output	Status Code	A number which gives a feed- back if the method was executed successfully or not.

The method returns a value which indicates whether the creation was successful or not. If the creation was successful the DNumber under which the new cutting edge was created will be returned. If the creation was not successful the return value will give information about the reason of the failure.

### Status code

The status code is the result of the requested action and is represented by a number, as shown in the table below:

Status Code	Reason
0	OK.
2	Tool number out of range.
4	Maximum cutting edges reached no more cutting edges.
5	There is no tool for which edge can be created. (Reason wrong tool area or tool number)

### Method Result Codes

Result	Description
Succeeded	Method executed with success/failure reason.
BadInvalidArgument	Arguments provided are not correct.
BadUserAccessDenied	"ToolWrite" access is not provided.

### 6.7.5 DeleteCuttingEdge

The "DeleteCuttingEdge" is used to delete a cutting edge of an existing tool in "Tool List" section of the SINUMERIK. This method appears under the folder "Methods/ ToolManagement".

The DeleteCuttingEdge method has three input and one output parameters.

Signature:

- DeleteCuttingEdge(
- [in] string ToolArea
- [in] string ToolNumber
- [in] string CuttingEdgeNumber
- [out] Uint32 StatusCode

Call ToolManagement.DeleteCuttingEdge \* Name DataType Value Description Ξ - Tool Area String Input parameter to enter tool area - Tool Number String Input parameter to enter tool number - Cutting Edge Number String Input parameter to enter cutting edge number DataType Value Description Name - Status Code UInt 32 0 Result of the requested action Call Cancel

Following table will give details about the Parameters of the method:

Туре	Parameters	Description
Input	Tool Area	Input parameter to enter tool area.
Input	Tool Number	Tool number of an existing tool whose cutting edge is to be de- leted.
Input	Cutting Edge Number	5 digit number which is to be de- leted.
		For range of number please refer to 828D or 840D sl documenta- tion respectively.
Output	Status Code	A number which gives a feed- back if the method was executed successfully or not.

The method should return a value which indicates whether the delete was successful or not. If the delete was not successful the return value should give information about the reason of the failure.

### Status code

)

The status code is the result of the requested action which is a number as shown in the table below:

Status Code	Reason
0	ОК
2	Tool number out of range.
4	Cutting edge does not exist.
5	There is no tool for which edge can be deleted (Reason wrong tool area or tool number)
6	Tool active. (Reason tool in use)
7	The first cutting edge cannot be deleted.

6.7 Tool management

## Method Result Codes

Result	Description
Succeeded	Method executed with success/failure reason.
BadInvalidArgument	Arguments provided are not correct.
BadUserAccessDenied	"ToolWrite" access is not provided.

# **Diagnostics**

# 7.1 Overview

#### Overview

The OPC UA server offers a variety of diagnostics information, as described in the OPC UA Standard Part 5 - "Information Model", Chapter 6.

This diagnostics information can be found under the Server Node:



Figure 7-1 Diagnostics Information - Server Node

7.2 Diagnostics screen

# 7.2 Diagnostics screen

### Requirement

#### Note

To show the correct status of OPC UA server you must have at least one type of message encryption (128 bit or 256 bit) enabled.

#### **Diagnostics screen**

Additional to the server diagnostic information available via OPC UA, there is a SINUMERIK Operate screen, which shows the actual status of the OPC UA server.

To open the diagnostics screen, select the operating area "Startup > Network" in SINUMERIK Operate, then press the "OPC UA" softkey. The OPC UA status screen is the first screen to be displayed.

OPC UA diagnostics		5	C
Server IPs	172.17.80.203:4840 192.168.215.1:4840		
Server status	OK		
Connected clients	URIs	i	$\overline{\mathbf{O}}$
		Sta	tus
		Set	ung
		Certif	icates
		Mo	del 🕨
Subscription load	8%	4	(
Current access level: Manufact	urer	Ba	ck
Setup archive	Li- Net- censes work Safety		>
Figure 7-2 Diagnos	tics		

Value	Description	Further explanation
Server IPs	Server IPs and ports of the company network, systems network or service network where the OPC UA server is accessible	
Server status	Possible status of the server:	There are too many sessions used
	Ok (server up and running)	by other clients. External clients are
	• Not activated (OPC UA server deactivated)	828D and 10 sessions with 840D sl.
	<ul> <li>No connection can be set up (error within the OPC UA server)</li> </ul>	The session limitation is 6 and 11, respectively, to have one more ses-
	• No more sessions possible. All sessions are in use by other clients. The status screen cannot create a session.	sion for the status client.
Connected cli-	Clients which are connected to the server	
ents	Example:	
	MD1EXMQC: remote PC of the client	
	<ul> <li>SiemensAG:OpcUaTestsApp: URN of the application of the remote PC</li> </ul>	
	• 10788 Session ID	
	OpcUaTestConsole: Session Name	
Subscription load	Utilized capacity of the OPC UA server regard- ing possible subscriptions (see chapter Techni- cal data (Page 133)), not the overall load.	

7.3 OPC UA server version

# 7.3 OPC UA server version

### **OPC UA server version**

OPC UA server version and OPC UA dialog version information can be found in SINUMERIK OPERATE version screen.

- 1. Open SINUMERIK OPERATE and choose operating area "Diagnostics". Press the softkey "Version".
- 2. Select "System extensions" and press softkey "Details".

SIEMENS		SINUMERIK OPER	ATE 11/13/17	$\bigtriangleup$	.→ AUTO
CHAN1 Version dat	ta			l nah	nnk
SINUMERIK 840D si	- 840DSL-72			Logi	JUIL
Name	Actual version	1	arget version		
CNC software	U04.07 + SP 04 + HF 01				
Basic PLC program	04.05.07				
System extensions					
OEM applications					
User					
Hardware					
R					
**				Deta	ails
				C.e.	
				530	le l
Target/actual compa	arison is being executed		· . • •		
Alarm 🔊	Mes- 🗠 Alarm NC/PLC	P_Remot	e	VB LL	reinn
$\square$ list $\square$	sages   💻 log 🛛 🖵 variab.	RCS diag.			131011

Figure 7-3 Version data

#### Diagnostics

7.3 OPC UA server version

SIEMEN	IS		SINUMERIK OPERATE	11/13/17 🔽 2:02 PM 🕂	$\bigtriangleup$	<b>→</b> AUTO
CHAN1 Ve	rsion data /Syst	tem extensions			Loab	ook
Name	Actual version	Target version				,
opcua	02.00.00.00				_	-
sinintclient	03.00.06.00					
0						
~					Det	ails
					_	
					5a	
					_<	< l
Target/actu	al comparison is	being executed		••• >	Ва	CK
Alarm list	Mes- sages	Alarm NC/PLC log variab.	RCS diag.		<mark>V</mark> ≝ ∪	ersion

Figure 7-4 Version data / system extensions

The OPC UA entry is found.

3. Select the entry and press "Details" again to show more detailed information on OPC UA components.

### Diagnostics

7.3 OPC UA server version

# Update of OPC UA server

# 8.1 Overview

### Compatibility

This version of OPC UA server is supported by SINUMERIK 840D sI and SINUMERIK 828D. An update process is possible with the following SINUMERIK software versions:

- Software line 4.5: with versions  $\geq$  V4.5 SP4.
- Software line 4.7: with versions  $\geq$  V4.7 SP2.
- Software line 4.8: with versions  $\geq$  V4.8 SP1.

### SINUMERIK Create MyConfig (CMC)

The necessary update (CMC) file can be provided by your regional SIEMENS office.

8.2 Compatibility

# 8.2 Compatibility

### Compatibility

Below are the compatibility issues of OPC UA:

- Password The Password length has changed to min. 8 characters.
- User rights
  - The behavior in setting "SinuReadAll" and "SinuWriteAll" is different from previous versions.
  - Different from previous version is that removing the right "SinuReadAll" will remove all read rights. In previous versions additionally added read rights have not been deleted with removing "SinuReadAll".
     Same applies to "SinuWriteAll".

#### Note

If you face any other compatibility issues or for further details, refer to hotline (<u>https://support.industry.siemens.com/cs/sc/2090/</u>).

# 8.3 Installation of OPC UA server

### Requirements

The installation procedure of the OPC UA server varies depending whether a PCU or a PPU/ NCU is being used. The following operating systems are required:

- PCU Base and SINUMERIK Operate on Windows 7 / Windows 10 systems
- SINUMERIK Operate on NCU840D (embedded).

Below are the instructions for both options:

### See also

Update of OPC UA server (Page 137)

## 8.3.1 Installation/Upgrade on a PCU/IPC

- 1. Load OPC UA software (OpcUaDeployWindows\_XXX.XXX.exe) on USB stick.
- 2. Start PCU in the service mode.
- 3. Insert USB stick in USB port of operator panel.
- 4. Start Windows Explorer.
- 5. Navigate to .exe file and execute it.
- 6. Follow the installation instructions.
- 7. After successful installation, restart the PCU.

### Note

If OPC UA was active before the installation, users and access rights are being preserved.

# 8.3.2 Installation/Upgrade a PPU/NCU

### Note

### Different installation procedure for 828D / V4.5

Please not that the server update procedure for 828D with CNC software version V4.5 varies from the standard process below (see chapterUpdate of OPC UA server (Page 137)).

- 1. Load OPC UA software (OpcUaDeployLinux\_XXX.XXX.usz) on USB stick.
- 2. Insert USB stick in USB port of NCU/PPU.
- 3. Switch off NCU/PPU and switch it on again.

#### 8.3 Installation of OPC UA server

- 4. Follow the installation instructions.
- 5. After successful installation, restart the NCU/PPU.

### Note

If OPC UA was active before the installation, users and access rights are being preserved.

# **Technical data**

### Technical data

Description	Value		
Number of sessions <sup>1)</sup>	828D	5	
	840 D sl	10	
Number of subscriptions <sup>2)</sup>	828D	5	
	840D sl	10	
Maximum samples / second	828D	500 1/s	
	840D sl	1000 1/s	
Min. sampling interval	100 ms		
Sampling intervals	{100, 250, 500, 1000, 2500, 5000} ms		
Min. publishing interval	100 ms		
Publishing intervals	{100, 250, 500, 1000, 25	00, 5000} ms	
Max. number of users	20		
Max. lifetime interval (LifeTime Count)	3600000 s		
Session timeout	60 s		
Max. monitored items queue size (Subscription Queue size)	10000		

1) Session = Connection of a client to a server

2) Subscription = In an existing session a subscription is a functionality for monitoring data items.

#### Calculating maximum subscription load

The maximum number of monitored items (Page 87) depends on the update time of the subscriptions. Therefore the max. number of monitored items can be calculated as down below.

The maximum subscription load is calculated from the load imposed to the system by the sample rate of all monitored items from all subscriptions of all active sessions.

Max number of monitored items = Systemload / Updates per second

Updates per second = 1 / Sampling rate (in seconds)

Systemload SINUMERIK 840D sl = 1000 items/s

Systemload SINUMERIK 828D = 500 items/s

# Exceptions: 828D / V4.5

The following chapter describes the exceptions regarding 828D control with CNC software version V4.5.

10.1 Starting of configuration dialog

# 10.1 Starting of configuration dialog

Because of certain prerequisites of OPERATE V4.5 and 828D, it was not possible to implement the startup of the OPC UA configuration dialog the same way as in OPC UA standard software releases. Therefore you reach the OPC UA configuration dialog via a different way:

### Executing the OPC UA configuration dialog

1. Press "menu select". The operating area will appear.



2. Press the softkey ">". The second operating area will appear.



Figure 10-2 Operating area

3. Press the softkey "OPC UA". The settings dialog will appear.

#### Note

The operating of the settings dialog is explained in chapter Commissioning (Page 21).

# 10.2 Update of OPC UA server

The update procedure for 828D with CNC software version V4.5 varies from the standard update procedure described in chapter Installation of OPC UA server (Page 131).

### Prerequisite

A .tgz file (e. g.: hmi\_sl\_opcua\_02.02.00.007.tgz) is provided on an USB stick.

### Installation of OPC UA server

- 1. Power on the control.
- 2. Go to "Startup menu" (press "Select" button when a message appears on the screen).

Startup menu					
• Norn	nal starti	up	1110176		
O Belo	ad saved	l user d	ata		
			-		
O Delet	e user fi	les			
1111111111					
- Contractivity					

Figure 10-3 Startup menu

3. Press key "^", then 2<sup>nd</sup> horizontal softkey, then 2<sup>nd</sup> vertical softkey to get to extended "startup menu".

	Startup menu	
	Normal startup	
0	Reload saved user data	
0	Install software update/backup	
0	Create software backup	
0	NCK default data	
0	Drive default data	
C	PLC default data	
0	HMI default data	
C	Factory settings	
C	Delete OEM files	
	Delete user files	
	PLC-Stop	

Figure 10-4 Extended startup menu

4. Plug in the USB drive with the provided .tgz file at the front of the 828D control.

10.2 Update of OPC UA server

5. Select "Install software update/backup".

Startup menu	
O Normal startup	
O Reload saved user data	
Install software update/backup	
O Create software backup	
O NCK default data	
O Drive default data	
O PLC default data	
O HMI default data	
Factory settings	
Delete OEM files	
O Delete user files	
O PLC-Stop	

Figure 10-5 Install software update/backup

6. Confirm the popup message with "Yes".



Figure 10-6 Confirmation message

7. Select the package to install. The OPC UA dialogs will become available after power off/on.

# **Trouble shooting**

# 11.1 Frequently asked questions (FAQs)

Торіс	Question	Possible solution
Setting dialog is not dis- played correctly	The OPC UA setting dialog will not be dis- played correctly after installation or not to that extent as described in documentation. What can I do?	<ul> <li>Possibly the SINUMERIK operating area "Setting" has already been extended by OEM dialogs (function: slsudialog_oem xml). This may cause incorrect functioning of the OPC UA setting dialog in software versions &lt; 4.8 SP2.</li> <li>Please contact your regional SIEMENS office or the technical support (https:// support.industry.siemens.com/cs/sc/ 2090/).</li> </ul>
OPC UA client has no con- nection	In spite of correct commissioning my OPC UA client cannot connect. What can I do?	<ul> <li>If no connection is possible, though you have operated the commissioning of the OPC UA server thoroughly, it is recommended to restore factory settings of the OPC UA server.</li> <li>Proceed as follows:</li> <li>Deactivate OPC UA in the setting dialog</li> <li>Switch off PCU/NCU/PPU and on again</li> <li>Activate OPC UA again in the setting dialog</li> <li>Switch off PCU/NCU/PPU and on again</li> <li>Switch off PCU/NCU/PPU and on again</li> </ul>
	The server cannot be found by the client. What can I do?	<ul> <li>Check whether the IP address of the networking dialog is compatible to those of the OPC UA dialog.</li> <li>If the IP addresses are not compatible, press "Change" in the OPC UA setting dialog. The new addresses will be directly transferred into the setting dialog.</li> <li>Confirm with "Ok" and restart the SINUMERIK.</li> <li>The connection the server should function properly now.</li> </ul>
	The OPC UA server status shows OK but the client is not able to connect. What can I do?	<ul> <li>Reboot the control in order to activate all necessary firewall settings (e.g.: port number changed).</li> </ul>
OPC UA client cannot con- nect as certificate user	<ul> <li>Certificate user is created</li> <li>Certificate for certificate user is trusted</li> <li>OPC UA client cannot connect as certificate user</li> </ul>	Please check date and time of the target sys- tem. In case the target system time is not within the period of validity (valid from – valid to) of the client certificate, the connection gets refused (BadIdentityTokenRejected).

### Trouble shooting

11.1 Frequently asked questions (FAQs)

# File Sysytem

Торіс	Question	Possible solution
File System	How to use "CreateDirectory" method?	The OPC UA server can create a folder with any extension or with no extensions in the USB drive, network share, and local drive. However in the NC drive, we can create an extension with "DIR" only.
	How to use "CreateFile" method?	The "CreateFile" method is used to create a new file. The created file can be written using the "Write" method of the FileType. The OPC UA server can create file without extension in the USB drive, network share, and local drive but not in the NC memory.
	How to use "Delete" method?	<ul> <li>The "Delete" method is used to delete a file/directory. The OPC UA server will not allow to delete the file if the file is opened for the file operation. You must close the file handle to delete the file. In case of directory, all the file and directory objects below the directory to delete are deleted recursively.</li> <li>A file which is selected for execution or a folder which contains the selected file are not allowed to be moved. However if the file is moved there is a possibility that an empty file will be created.</li> </ul>
	How to use "MoveOrCopy " method?	<ul> <li>The "MoveOrCopy" method is used to move or copy a file/directory to another directory or to rename a file/directory.</li> <li>The OPC UA server can move any file or folder without extension in the USB drive, network share, and local drive but not in the NC memory. In the NC memory, a folder with the extension "DIR" can only be allowed to be moved to the NC memory.</li> <li>The OPC UA server will not allow to move the folder if the file is opened for the file operation.</li> <li>A file which is selected for execution or a folder which contains the selected file, are not allowed to be moved. However if the file is moved there is a possibility that an empty file will be created.</li> </ul>
	How to use "Open " method?	When a client opens a file, it gets a file handle that is valid while the session is open. Clients shall use the "Close" meth- od to release the handle when they do not need access to the file anymore. Clients can open the same file several times for read.
	How to use "Read " method?	The "Read" method is used to read a part of the file starting from the current file position. The file position is advanced by the number of bytes read. The data contains the returned data

## 11.1 Frequently asked questions (FAQs)

Topic	Question	Possible solution
		of the file. If the ByteString is empty, it indicates that the end of the file is reached.
	How to use "Write " method?	The "Write" method is used to write a part of the file, starting from the current file position. The file position is advanced by the number of bytes written. When the client session is closed, all the open file handled will be closed for the respective ses- sion. In this scenario, if there is any existing file opened with write mode or append mode, the current data will be lost.
	How to use "Close " method?	The "Close" method is used to close a file represented by a FileType. When a client closes a file, the handle becomes invalid.
	How to use "GetPostion " method?	The "GetPosition" method is used to provide the current posi- tion of the file handle. If a "Read" or "Write" method is called, it starts at that position.
	How to use "SetPosition " method?	The "SetPosition" method is used to set the current position of the file handle. If a "Read" or "Write" method is called, it starts at that position. If the position is higher than the file size, the position is set to the end of the file.
	Does OPC UA standard file system support 1:N constellation?	No, only the default machine name is mapped (target system PCU only).

11.2 Reference to OPC UA error code

# 11.2 Reference to OPC UA error code

You can find all relevant information on error codes at Github (<u>https://github.com/</u> <u>OPCFoundation/UA-Nodeset/blob/master/DotNet/Opc.Ua.StatusCodes.cs</u>).

### **Technical Support**

Country-specific telephone numbers for technical support are provided in the Internet at the following address (<u>https://support.industry.siemens.com/cs/sc/2090/</u>) in the "Contact" area.

# Index

# Α

Accessibility, 11 AddCertificateUser, 70 Address space, 76 GUD, 76 machine data, 76 PLC blocks, 76 setting data, 76 AddUser, 70 Alarms CnCAlarmType, 92 Event types, 91 sequence, 90 subscribe, 89 unsubscribe, 90 Application scenario, 11

# В

Browsing, 76

# С

ChangeMyPassword, 70 Checking the time, 21 Client, 9 Close method. 106 CopyFileFromServer method, 110 CopyFileToServer method, 110 Create tool, 116 Method Result Codes, 116 Parameters, 116 Status code, 116 CreateCutting Edge, 119 Method Result Codes, 119 Parameters, 119 Status code, 119 CreateDirectory method, 105 CreateFile method, 105 CSOM, 41 Exporting, 43

Importing, 57, 58 Modeling with SiOME, 45 process, 43 workflow, 43 Customer Specific Object Model, 41

# D

Data types, 80 Delete method, 105 DeleteCuttingEdge, 120 Method Result Codes, 120 Parameters, 120 Status code, 120 DeleteTool. 117 Method Result Codes, 117 Parameters, 117 Status code, 117 DeleteUser, 70 DeleteUserAccess, 71 Deleting rejected certificates, 34 trusted certificates. 32 development kit, 9

# Ε

Encryption, 10 Exporting server certificates, 30

# F

File access rights, 103 Functionalities, 10

# G

GetMyAccessRights, 71 GetPosition method, 106 GetUserAccessRights, 71 GetUserList, 70 GiveUserAccess, 73

### I

Importing trusted certificates, 32 Industry 4.0, 9

## L

Language identifier, 97 License, 20 LocalizedText, 96

### Μ

Max. lifetime interval (LifeTime Count), 133 Max. monitored items queue size (Subscription Queue size), 133 Max. number of users, 133 Maximum samples / second, 133 Method Close, 106 CopyFileFromServer, 110 CopyFileToServer, 110 CreateDirectory, 105 CreateFile, 105 Delete, 105 GetPosition, 106 MoveOrCopy, 105 OpenCount. 106 Read, 106 SetPosition, 106 Size, 106 UserWritable, 106 Writable, 106 Write, 106 Min. publishing interval, 133 Min. sampling interval, 133 Monitored items, 87 **MoveOrCopy** method, 105

# Ν

Number of sessions, 133 Number of subscriptions, 133

# 0

OPC UA standard, 9

Open method, 106 OpenCount method, 106

# Ρ

PCU / IPC, 11 Publish interval, 87 Publishing intervals, 133

# R

Read method, 106 Rejected certificates deleting, 34 trusting, 34 Renewing Server certificates, 29

# S

Sampling interval, 87 Sampling intervals, 133 Security settings, 10 Select Status code, 113 Server certificates exporting, 30 renewing, 29 Session timeout, 133 SetPosition method. 106 SINUMERIK supported languages, 97 SINUMERIK 828D, 11 SINUMERIK 840D sl. 11 SINUMERIK Access MyMachine/ P2P, 43 SINUMERIK OPC UA server, 9 SINUMERIK systems, 11 SiOME, 41 download, 41 Size method, 106 Supported Languages SINUMERIK, 97
## Т

Thin Client, 11 Trusted certificates deleting, 32 importing, 32 Trusting rejected certificates, 34

## U

UaExpert client, 99 User administration, 10 UserWritable method, 106

## V

Variable paths, 78

## W

Writable method, 106 Write method, 106