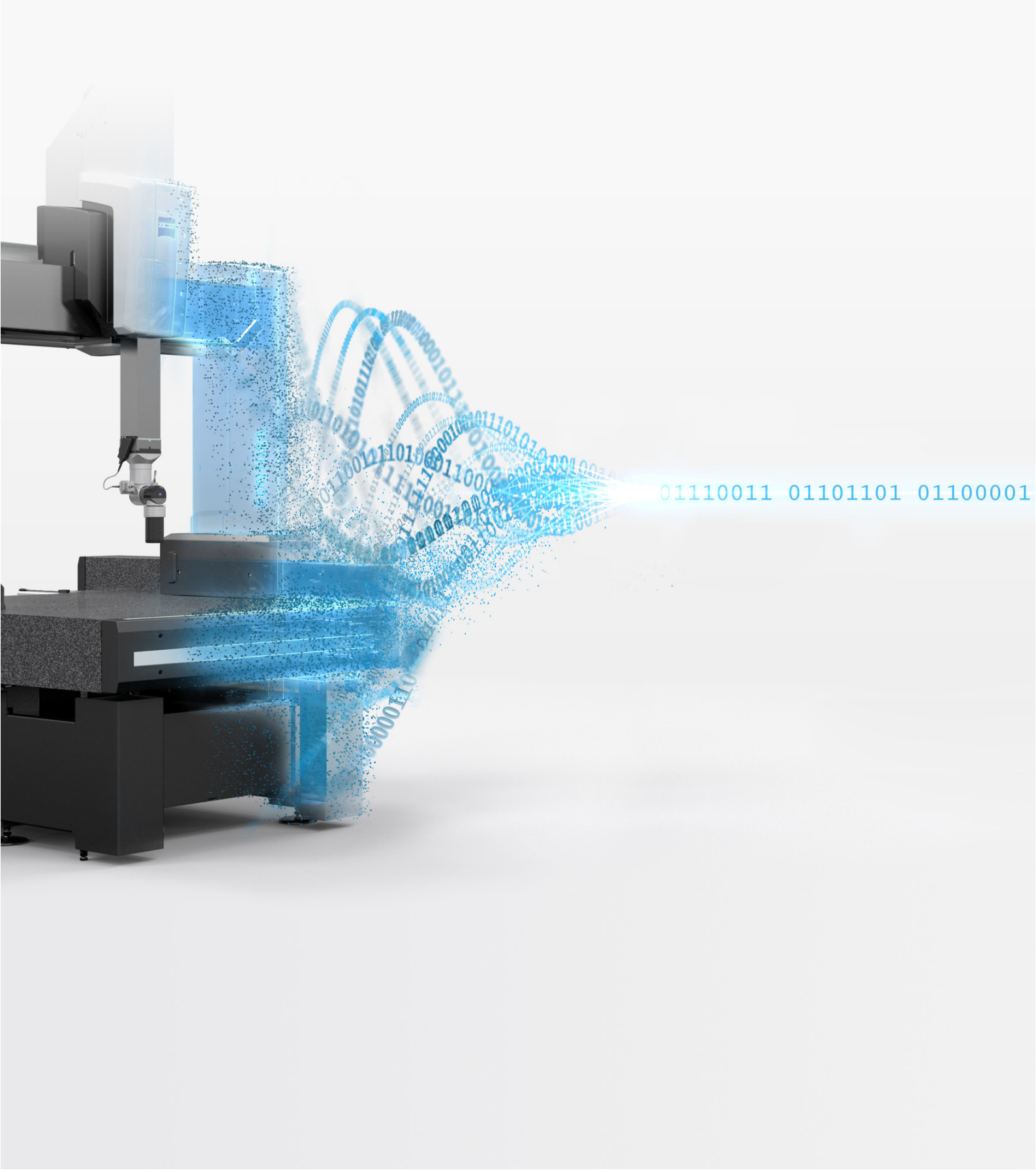
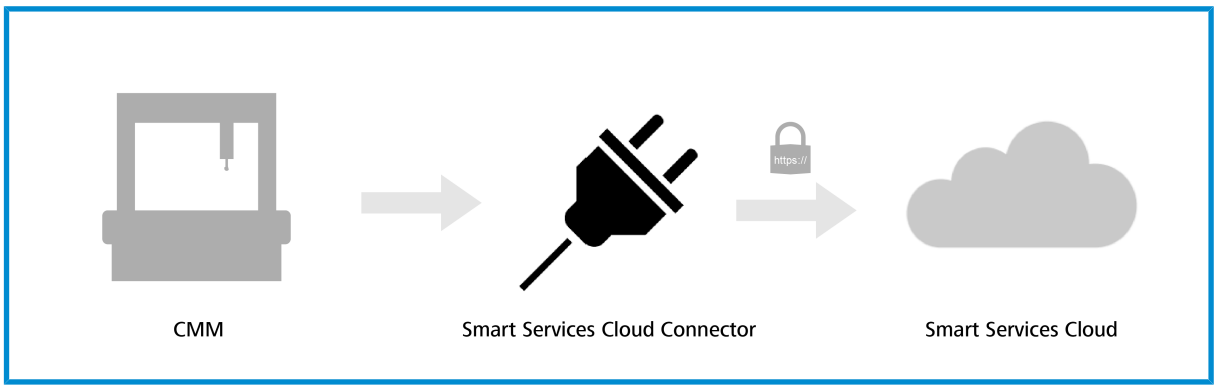


ZEISS Smart Services Cloud Connector

Technical description

Introduction

The **Smart Services Cloud Connector** (hereinafter also referred to as **Cloud Connector**) enables you to use the **Smart Services Dashboard** for monitoring ZEISS coordinate measuring machines (CMMs). It establishes a connection between the CMM computer and the **Smart Services Cloud**:



The **Cloud Connector** here acts as an IoT Device Client which registers the CMM in the **Smart Services Cloud** and establishes the connection.

This document provides a technical overview of the **Cloud Connector** and its method of operation (↘ *Chapter 1: Architecture & technical description [Seite 6]*) and deals with security aspects (↘ *Chapter 2 Security considerations [Seite 8]*).

Chapters ↘ *3 [Seite 9]*, ↘ *4 [Seite 13]*, and ↘ *5 [Seite 16]* describe the steps required to install, repair, and uninstall the **Cloud Connector**.

Furthermore, useful installation tools as well as management and analysis of the **Cloud Connector** are described (in ↘ *Chapter 6: Operating system tools [Seite 17]*) and frequently asked questions are answered in ↘ *Chapter 7 [Seite 23]*.

If you have any further questions, you will find the necessary contact data on the reverse side/last page of this document.

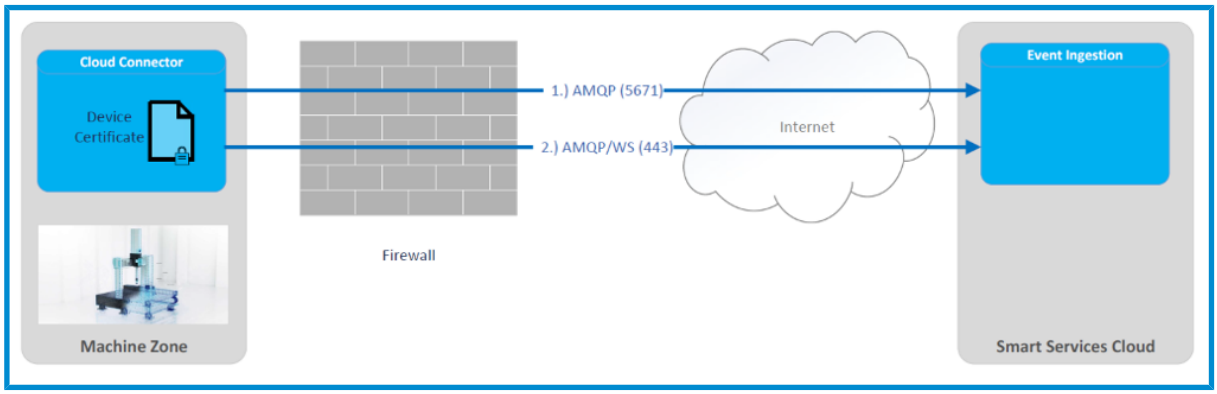
Table of Contents

1 Architecture & technical description

Technically speaking, the **Cloud Connector** is a local Windows service on the user's computer which receives defined CMM events from the CMM Agent via Microsoft Message Queuing and transmits them to the **Smart Services Cloud** in a secure manner. The use of message queues also makes it possible to bridge over brief connection disruptions without any data loss.

The **Smart Services Cloud** is the backend solution implemented on the basis of Microsoft Azure for **ZEISS Smart Services** functionalities such as e.g. the **Smart Services Dashboard**. It is operated according to international standards (e.g. ISO 27001, HIPAA, FedRAMP, SOC1 and SOC2) which are certified and audited by Microsoft data centers located in Europe.

1.1 System overview



1.1.1 Communication

The **Cloud Connector** exclusively uses the AMQP protocol for communication with the **Smart Services Cloud**. All communication is here encrypted using TLS. For use in different network topologies, the **Cloud Connector** utilizes a fallback mechanism with a maximum requirement of two open ports on the firewall:

In a first step, the **Cloud Connector** tries to connect to the **Smart Services Cloud** via port 5671 by AMQP via TCP. If no connection can be made via this port, the Cloud Connector uses port 443 by AMQP via Secure WebSockets.

This behavior enables the implementation of different scenarios and gives the user complete control only through corresponding configuration of the firewall. If port 5671 is used, the data traffic is separated from any other components which communicate externally via port 443 and is clearly attributable to the **Cloud Connector**. If this is not desired, the **Cloud Connector** can be operated in its own network by using port 443 with the minimum number of exactly one port activated.

The **Cloud Connector** also supports communication via proxy server.

1.1.2 Certificates

The identity of the CMMs is ensured via CMM certificates issued by Carl Zeiss Industrielle Messtechnik GmbH. The **Cloud Connector** can register itself in the **Smart Services Cloud** only with a valid CMM certificate. Each certificate is uniquely assigned to only one CMM and therefore represents a kind of ID. Technically speaking, the CMM certificate has stored the CMM serial number as a common name (CN).

For this purpose, the CMM certificate is stored in the Microsoft Windows certificate store of the CMM computer and is used by the **Cloud Connector** for registration and provisioning.

1.1.3 Logging

The **Cloud Connector** writes detailed information to log files. The transmitted events as well as information on the status of the **Cloud Connector** can be monitored herein. With a default configuration, the log files are saved to the preset storage location in a rolling system. This path can be set individually in the configuration file of the **Cloud Connector**. The corresponding section is:

```
"logger": {
"LogLevel": "Info",
"FileName": "${specialfolder:folder=CommonDocuments}/ZEISS/Smart Services Cloud
Connector/logs/log.txt",
"Format": "${longdate} | ${level:uppercase=true} | ${logger} | ${message} ${excep-
tion:format=toString,Data:maxInnerExceptionLevel=10}",
"AmountOfLogsToKeep": 10
},
```

Here, the storage location can be set via the Property FileName and the number of old log files to be kept and not overwritten can be set via AmountOfLogsToKeep. The format of the logged information should not be changed, since data which is required for analyses may otherwise be missing.

1.2 File locations

The **Cloud Connector** stores various artifacts at the following locations of the CMM computer:

Directory	Purpose	Storage location/default setting
Installation	Storage of the program files required for the **Cloud Connector**	C:\Program Files (x86)\ZEISS\Smart Services Cloud Connector\
Configuration	Storage of configuration files for the **Cloud Connector**: ■ preferences.json ■ serviceconfig.json	C:\Users\Public\Documents\ZEISS\Smart Services Cloud Connector\
Logging	Storage of log files written by the **Cloud Connector**: ■ log.txt ■ log.[0-9].txt	C:\Users\Public\Documents\ZEISS\Smart Services Cloud Connector\logs

2 Security considerations

The **Cloud Connector** ensures the operational security, confidentiality, and integrity of transmitted data through various measures. Security aspects are considered and regularly checked as part of the development process. However, measures to safeguard the network itself are considered to be part of the user's obligation to cooperate as part of normal operation.

The following points are relevant from an architectural point of view.

2.1 Encryption

Every communication link used by the **Cloud Connector** (see ↘ *Communication [Seite 6]*) is 256-bit encrypted at transport level by means of TLS 1.2 with the Advanced Encryption Standard (AES) (Secure AMQP protocol – AMQPS or WebSockets).

2.2 Minimized requirements for the network infrastructure

Any unnecessary complexity increases the security risk in software components. For this reason, and in order to be executable in the variously structured environments of the different companies using it, **Cloud Connector** has eliminated all unnecessary complexity. The requirements for the network infrastructure were minimized. So, in extreme cases, exactly one firewall port is opened for communication with the **Smart Services Cloud**. Since the default external communication port for encrypted http (443) is involved here, no changes in the firewall settings are required in many cases. Only outgoing connections are established by the **Cloud Connector**. No ports are to be opened for incoming communication.

2.3 Unique identification of the CMMs

In order to ensure the integrity and secure origin of the data, the CMMs are uniquely identified by CMM certificates issued by **ZEISS**. This prevents attack scenarios that contaminate the CMM data with false data. Therefore, only data that has been verified with a CMM certificate for this particular CMM can be transmitted to the **Smart Services Cloud**.

The certificates are generated via the **ZEISS**-internal private key infrastructure and made available to the user. These CMM certificates must be handled with appropriate care and confidentiality on the user's side.

2.4 Templates

Another point regarding the minimization of security gaps is the avoidance of own implementations of safety-relevant parts. For this purpose, the Device SDK provided by Microsoft is exclusively used for communication by the **Cloud Connector** as standard.

3 Installation

To facilitate its installation, the **Cloud Connector**, is provided as a Windows Installer package (msi) which must be executed with administrator rights, since the **Cloud Connector** is installed as a local Windows service and management of the CMM certificate also requires elevated permissions.

3.1 System requirements

The current version of the **Cloud Connector** can be downloaded via the Download portal:

↘*https://portal.zeiss.com/download-center/softwares/imt*

The only task of the **Cloud Connector** is to establish the communication link between the CMM computer and the **Smart Services Cloud**. The **Cloud Connector** receives the appropriate data from the CMM Agent via Windows Message Queuing. Therefore, the following system requirements must be met:

Category	Condition
CMM controller	C99 N/S/L/L2
Controller firmware	FW ≥ 24.00
Hardware	Existing network connection via port 5671 or port 443 to *.azure-devices-provisioning.net and *.azure-devices.net If a more specific configuration is required, restriction to zeiss-imt-cmmiot-dps-prod.azure-devices-provisioning.net, zeiss-imt-cmmiot-iothub-prod.azure-devices.net, and global.azure-devices-provisioning.net is possible. These could, however, change in the future.
Operating system	Windows 10 Build 1607 (Anniversary Update) .NET Framework 4.7.2
Software	Calypso ≥ 6.4.08 (2017) CMM Agent MSMQ (see ↘*https://docs.microsoft.com/en-us/previous-versions/windows/desktop/legacy/ms711472(v=vs.85)* and ↘*https://docs.microsoft.com/de-de/dotnet/framework/wcf/samples/installing-message-queuing-msmq* for installation)
Certificate	A CMM certificate issued by ZEISS IMT incl. a password for the private key

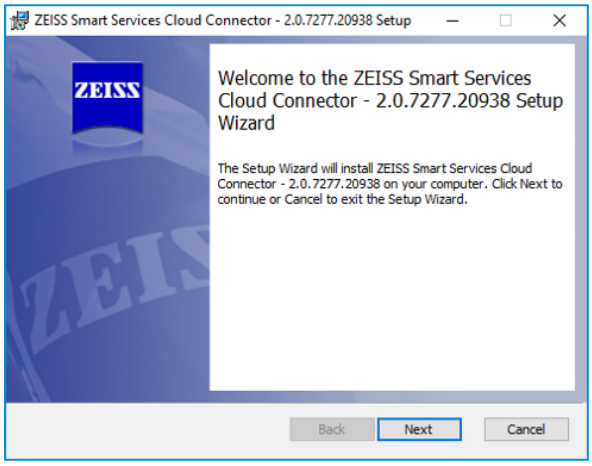
Note: Before installation, please make sure that the local time and time zone settings on the user's computer of the CMM are correct.

3.2 Installing the Cloud Connector

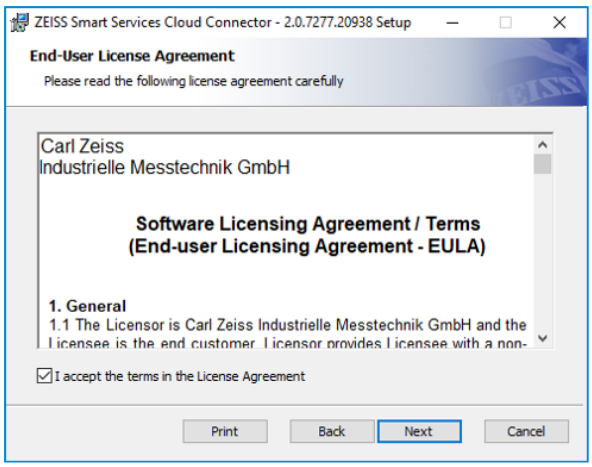
Please read the installation notes before installing the **Cloud Connector**.

Procedure

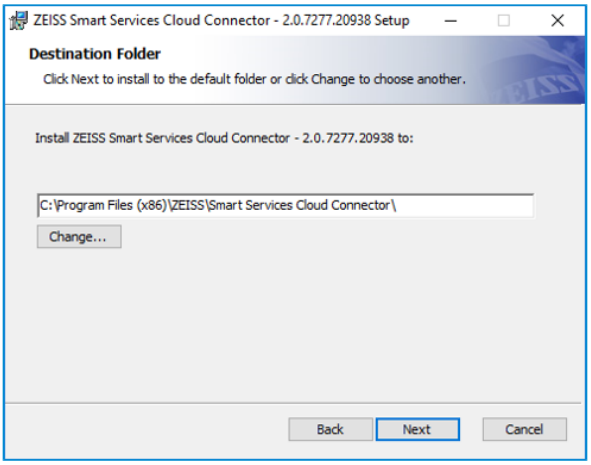
1 Start the setup of the **Cloud Connector**. **Note:** The current version of the Cloud Connector is displayed on the Welcome page.



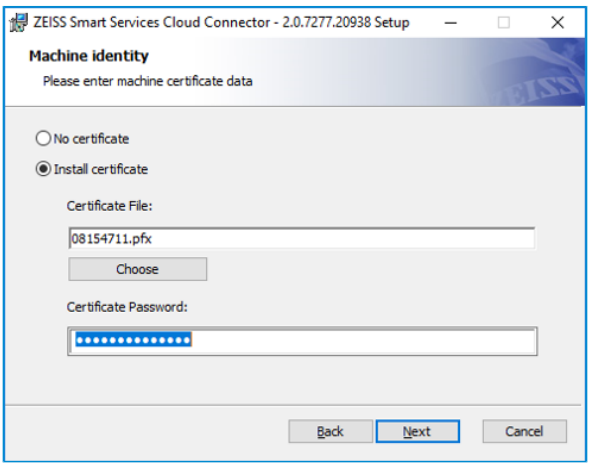
2 Accept the license conditions of the **Cloud Connector**.



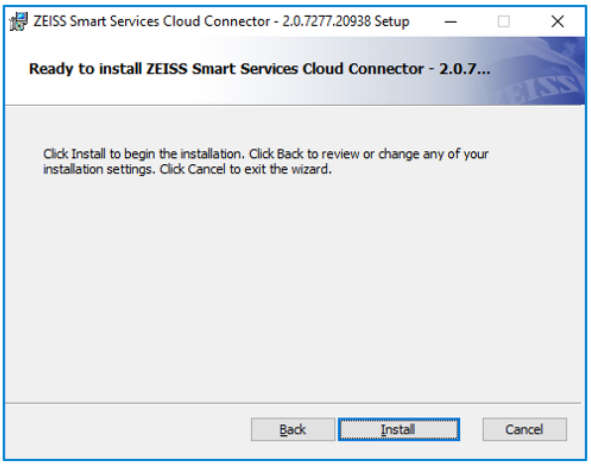
3 Select the desired installation path for the **Cloud Connector**.



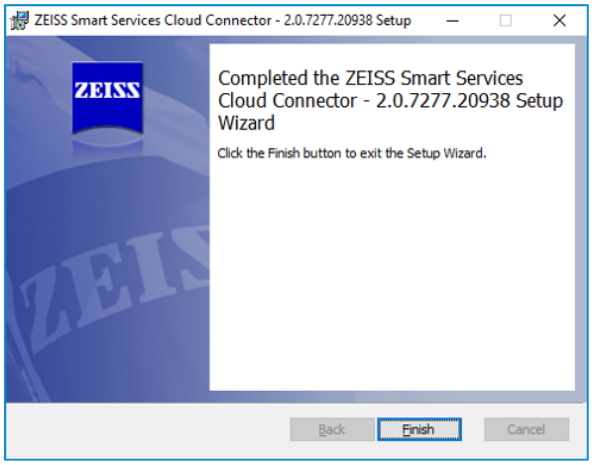
4 Optional: Upload the CMM certificate as a .pfx file if required. In addition to the certificate file, the password for the private key also is required. **Note:** The certificate is imported to the certificate store during the installation process.



5 Select **Install** to start the installation process.



6 After a successfully completed installation, the following message will appear. **Note:** If the installation is not completed successfully, it will automatically be rolled back.

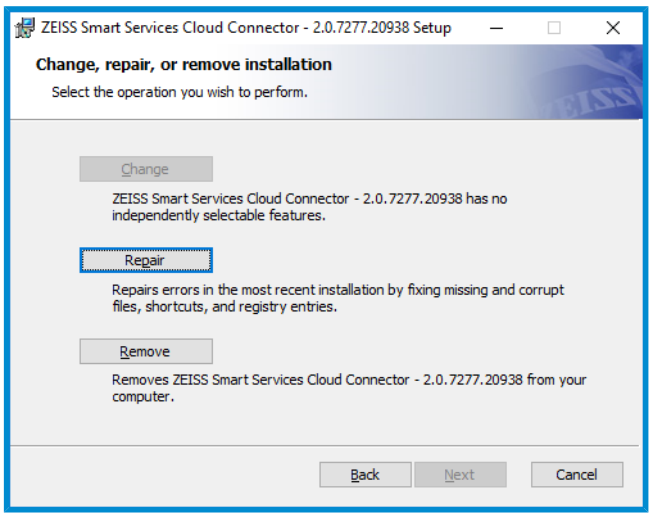


7 Finish the installation.

⇨ The installation process is complete.

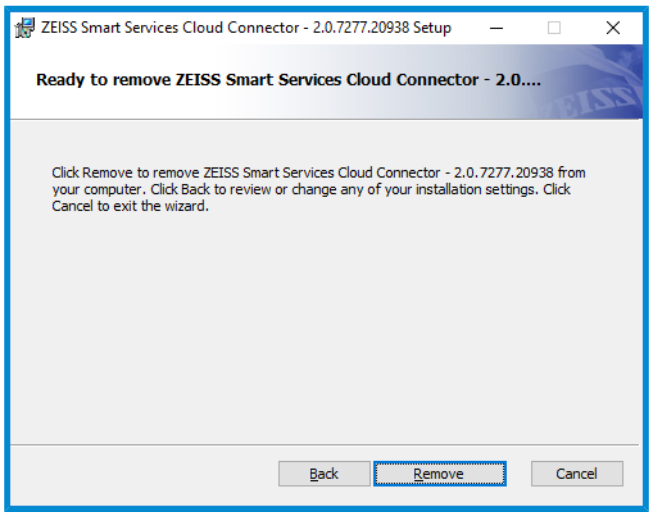
4 Repair and uninstallation

The **Smart Services Cloud Connector Installer** package also can be used for repair or uninstalling. When you start the Installer, it immediately recognizes that the service has already been installed and opens the view for selecting repair, installation or uninstallation.

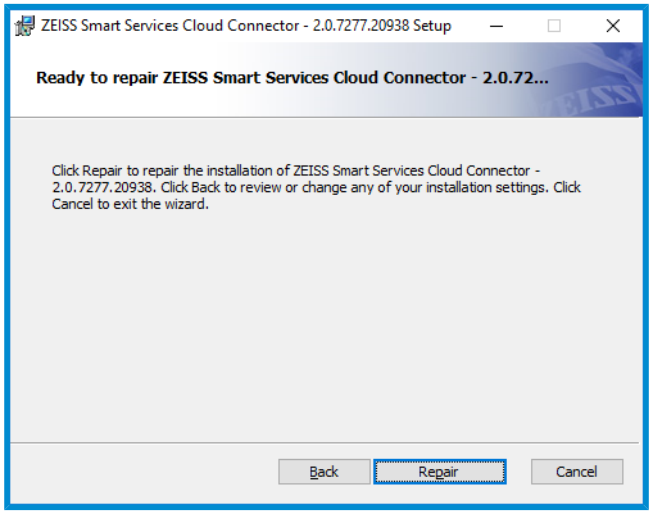


Selection of repair/uninstallation

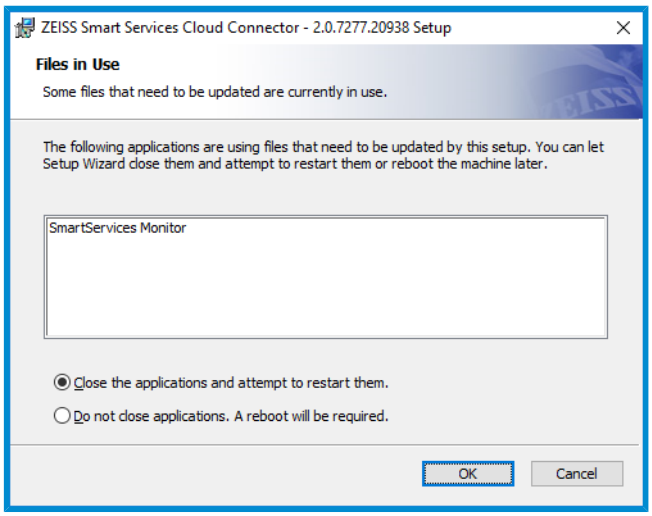
Depending on the action you select (uninstallation or repair), one of the following views then appears. After you confirm with Remove/Repair, the selected system changes will be made.



Selection of uninstallation



Selection of repair



Query on closing affected applications

5 Migration

If the CMM was already connected via the **MasterConnect System**, the installed Smart Services Service should be uninstalled first; then the **Cloud Connector** should be re-installed (see ↘ *Installing the Cloud Connector [Seite 9]*).

In addition, further clean-up work also can be performed optionally:

The Smart Services Service also required an entry in the hosts file of the operating system for communication with the **MasterConnect System**:

192.168.168.168 ckconnector.io

These are no longer required by **Cloud Connector** and can be removed.

In a default installation, the configuration and log files for the old Smart Services Service are located in the path:

C:\Users\Public\Documents\ZEISS\Smart Services Service

These are no longer required and can be removed. Any existing old certificates in the certificate store can be removed (see ↘ *Management of certificates [Seite 20]*).

6 Operating system tools

This chapter lists several tools which are available in Windows and can be used for the analysis of problem cases or for manual corrections. However, it should not generally be necessary to use most of these tools, since the **Cloud Connector** Installer installs the **Cloud Connector** in an immediately usable condition.

6.1 Windows Installer

The supplied Windows Installer package can easily be started in the usual manner for Microsoft Windows environments, i.e. by double-clicking in the mode with the graphic user interface. The installation can, however, be adapted to meet your own personal requirements using the `msiexec` command line tool.

In order to identify problems with the installation, a log file also can be written during the installation process:

*msiexec /i SmartServices.Installer.msi /l*v install.log*

The required information from the file on the CMM certificate and the certificate password can be transferred as command line parameters:

```
msiexec /i SmartServices.Installer.msi /l*v install.log CERT_FILEPATH="[Certificate filepath]" CERT_PASSWORD="[Certificate password]"
```

In addition, the Installer also uses the installation in the background (silent mode). Here, it is all the more important to have a log file written for the corresponding feedback and to transfer the parameters:

```
msiexec /qn /i SmartServices.Installer.msi /l*v install.log CERT_FILEPATH="[Certificate file path]" CERT_PASSWORD="[Certificate password]"
```

6.2 Management of Windows Services

Since the **Cloud Connector** is integrated as a Windows service, all of the available tools also can be used for management.

The Service Management Console features a graphic user interface for Windows Services:

6.2.1 Starting/Stopping services

To start or stop services, proceed as follows:

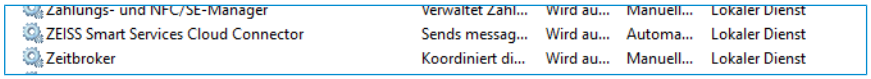
Procedure

1 Press *Windows* + *R*.

→ The **Run** window opens.

2 Enter services.msc.

→ The **Services** window in which the **ZEISS Smart Services Cloud Connector** service is displayed opens.



3 Start/Stop the service.

Optional procedure

1 Press *Windows* + *R*.

→ The **Run** window opens.

2 Enter cmd.

3 Enter `net start "Zeiss Smart Services Cloud Connector"` in the command line.

```
C:\>net start "Zeiss Smart Services Cloud Connector"
ZEISS Smart Services Cloud Connector wird gestartet.
ZEISS Smart Services Cloud Connector wurde erfolgreich gestartet.
```

4 Optional: Enter `net stop "Zeiss Smart Services Cloud Connector"` in the command line.

```
C:\>net stop "Zeiss Smart Services Cloud Connector"
ZEISS Smart Services Cloud Connector wird beendet.
ZEISS Smart Services Cloud Connector wurde erfolgreich beendet.
```

6.2.2 Determining the status of the service

To determine the current status of the service, proceed as follows:

Procedure

1 Open Windows PowerShell.

2 Enter `Get-Service -name 'Zeiss Smart Services Cloud Connector'`.

→ The current status of the service is displayed.

```
PS C:\> Get-Service -name 'Zeiss Smart Services Cloud Connector'

Status   Name               DisplayName
------   ----               -----------
Stopped  ZEISS Smart Ser... Zeiss Smart Services Cloud Connector
```

6.2.3 Determining the process ID of the service

To determine the process ID of the service, proceed as follows:

Procedure

1 Press *Windows* + *R*.

→ The **Run** window opens.

2 Enter cmd.

3 Enter `sc queryex "Zeiss Smart Services Cloud Connector"` in the command line.

→ The process ID of the service is displayed.

```
C:\>sc queryex "Zeiss Smart Services Cloud Connector"

SERVICE_NAME: Zeiss Smart Services Cloud Connector
        TYPE               : 10  WIN32_OWN_PROCESS
        STATE              : 4  RUNNING
                                (STOPPABLE, NOT_PAUSABLE, ACCEPTS_SHUTDOWN)
        WIN32_EXIT_CODE    : 0  (0x0)
        SERVICE_EXIT_CODE  : 0  (0x0)
        CHECKPOINT         : 0x0
        WAIT_HINT          : 0x0
        PID                : 31992
        FLAGS              :
```

6.2.4 Forced shutdown of a service

If a service can no longer be stopped, proceed as follows:

> **NOTE**
>
> It cannot be ensured that the service will be in a consistent state following a hard termination!

Procedure

1 Press *Windows* + *R*.

→ The **Run** window opens.

2 Enter cmd.

3 Enter `taskkill /pid 31992 /f` in the command line.

→ The service is stopped.

```
C:\>taskkill /pid 31992 /f
ERFOLGREICH: Der Prozess mit PID 31992 wurde beendet.
```

6.2.5 Uninstalling a service

If it is no longer possible to uninstall a service with the Installer package, proceed as follows:

> **NOTE**
>
> Use this procedure only in an extreme emergency, e.g. if uninstallation via the Installer package no longer functions properly.

Procedure

1 Press *Windows* + *R*.

→ The **Run** window opens.

2 Enter cmd.

3 Enter `sc delete "Zeiss Smart Services Cloud Connector"` in the command line.

→ The service is then uninstalled.

```
C:\>sc delete "Zeiss Smart Services Cloud Connector"
[SC] DeleteService ERFOLG
```

6.3 Management of certificates

Command line tools as well as tools with a graphic interface are available under Windows 10 for managing certificates in the Windows certificate store. It should not generally be necessary to use these tools, since the **Smart Services Cloud Connector Installer** imports the CMM certificate to the certificate store and sets the required rights.

6.3.1 Calling up an overview of installed certificates

To call up an overview of the installed certificates, proceed as follows:

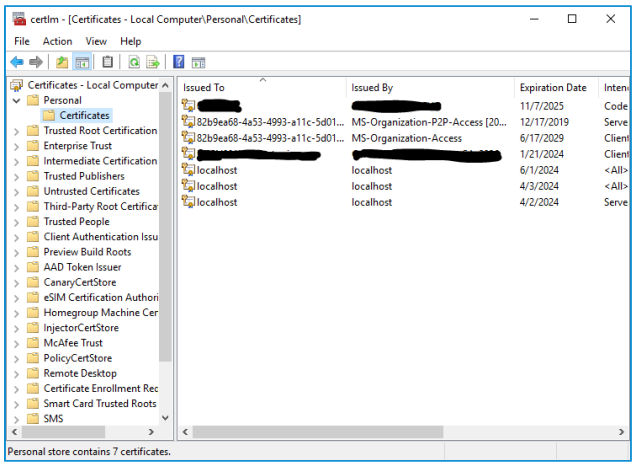
Procedure

1 Press *Windows* + *R*.

→ The **Run** window opens.

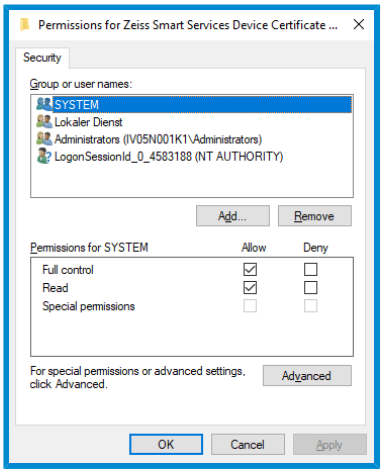
2 Enter `certlm.msc`.

→ The local certificate store is displayed.



6.3.2 CMM certificate for Cloud Connector

The CMM certificate for the **Cloud Connector** is saved in the certificate store of the local CMM. Using the management console (see ↘ *Calling up an overview of installed certificates [Seite 20]*), you can import certificates (*Right-click - All tasks - Import*), view the details of a certificate (*Right-click - Open*), or delete certificates (*Right-click - Delete*), whereby the latter-most function is possible only with administrator rights. This tool also can be used to check and change the access rights on the private key of the certificate (*Right-click - All tasks - Manage private keys*). It is important here that local services have full access to the **Cloud Connector** CMM certificate.



Alternatively, certificate details also can be imported and output via the command line by entering `certutil`. In order to obtain an overview of the respective certificates, the corresponding name of the certificate store (my) also must be specified:

```
certutil -store my
```

The output then lists the installed certificates in the following form:

```
  Anbieter = Microsoft RSA SChannel Cryptographic Provider
Der private Schlüssel ist NICHT exportierbar
Verschlüsselungstest wurde durchgeführt

================ Zertifikat 1 ================
Seriennummer: 01
Aussteller: CN=SmartServices DEV
 Nicht vor: 07.11.2019 06:27
 Nicht nach: 07.11.2025 08:27
Antragsteller: CN=08154711
Kein Stammzertifikat
Zertifikathash(sha1): c1de191b5cf4a44beb70623b71d417801c74dd91
  Schlüsselcontainer = {B039423C-8058-44B5-ABC5-6CAAE0FF0880}
  Eindeutiger Containername: 09bd0f9fa592e71016d7a242d901c2cf_cf96acf0-fc2d-4f7e-96b7-453f0d1fd74a
  Anbieter = Microsoft Strong Cryptographic Provider
Das Testen der Signature wurde erfolgreich abgeschlossen

================ Zertifikat 2 ================
Seriennummer: 43a7b019ad19b38e45390d2954d5ebeb
Aussteller: CN=localhost
 Nicht vor: 03.06.2019 09:26
 Nicht nach: 01.06.2024 09:26
Antragsteller: CN=localhost
Signatur stimmt mit dem öffentlichen Schlüssel überein.
Stammzertifikat: Antragsteller stimmt mit Aussteller überein
Zertifikathash(sha1): a800e12e19ab2badf72235c7c9656b9a3b2b21f8
```

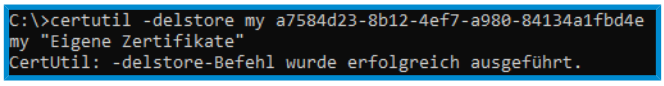
In order to display specific CMM certificates corresponding to a given common name (in this context, corresponding to the serial number of the CMM), only the respective CN needs to be specified:

```
certutil -store my 08154711
```

```
C:\>certutil -store my 08154711
my "Eigene Zertifikate"
================ Zertifikat 1 ================
Seriennummer: 01
Aussteller: CN=SmartServices DEV
 Nicht vor: 07.11.2019 06:27
 Nicht nach: 07.11.2025 08:27
Antragsteller: CN=08154711
Kein Stammzertifikat
Zertifikathash(sha1): c1de191b5cf4a44beb70623b71d417801c74dd91
  Schlüsselcontainer = {B039423C-8058-44B5-ABC5-6CAAE0FF0880}
  Eindeutiger Containername: 09bd0f9fa592e71016d7a242d901c2cf_cf96acf0-fc2d-4f7e-96b7-453f0d1fd74a
  Anbieter = Microsoft Strong Cryptographic Provider
Das Testen der Signature wurde erfolgreich abgeschlossen
CertUtil: -store-Befehl wurde erfolgreich ausgeführt.
```

In order to delete a specific certificate, the name of the certificate store and the common name (CN) of the certificate to be deleted must be specified:

```
certutil -delstore my a7584d23-8b12-4ef7-a980-84134a1fbd4e
```



7 Troubleshooting

7.1 Installation problems

If any problems arise during the installation process and the installation is canceled, detailed information can be collected by starting the installation package with logging activated:

Procedure

1 Press *Windows* + *R*.

→ The **Run** window opens.

2 Enter `cmd`.

3 Navigate to the directory where the installation package is stored.

4 Start the installation with logging: `msiexec /i SmartServices.Installer.msi /l*v in-stall.log`

⇨ All installation activities are then logged in the install.log file located in the corresponding directory. This file needs to be handed over to ZEISS Service for analysis purposes if necessary.

Note: If the installation is aborted or rolled back without a cause being found in the installation log, this may be due to the certificate file path being too long. Therefore, the certificate should not be stored too deep in the directory tree.

7.2 Errors not in the log file

In order to analyze errors which do not show up in the log files, indications of their cause also can be obtained from the event viewer.

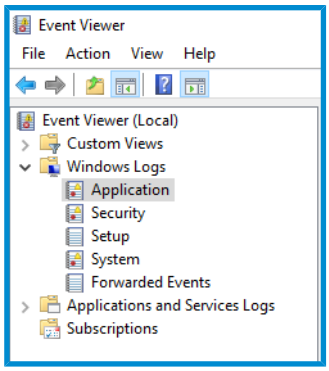
Procedure

1 Press *Windows* + *R*.

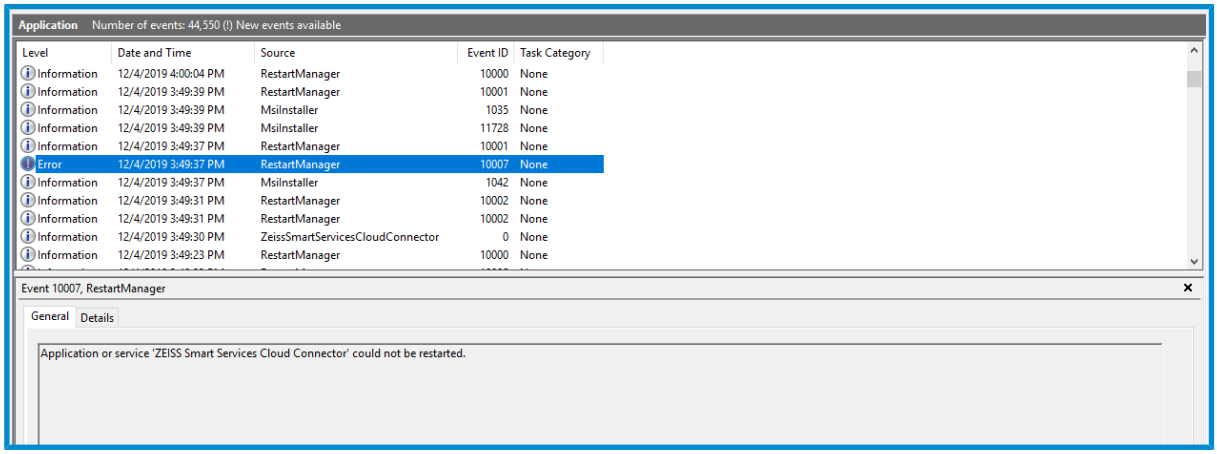
→ The **Run** window opens.

2 Enter `eventvwr`.

⇨ The corresponding warnings and errors are listed under **Windows Logs** in the category **Application**.



The causes of errors can be analyzed via the event details.



7.3 Network configuration

If successful connection between the Smart Services Cloud Connector and the cloud cannot be established despite possibly necessary firewall unlocking, this may be because name resolution (DNS) is not possible on the corresponding PC. You can use the `nslookup` command to check this.

Procedure

1 Press *Windows* + *R*.

→ The **Run** window opens.

2 Enter `nslookup` global.azure-devices-provisioning.net.

⇨ This should allow the address to be resolved and a message similar to the following ones will be displayed:

Non-authorizing response:

Name: idsu-prod-am-001-su.westeurope.cloudapp.azure.com

Address: 23.100.8.130

Aliases: global.azure-devices-provisioning.net; id-prod-global-endpoint.trafficmanager.net

The same test has to be performed for both addresses: zeiss-imt-cmmiot-iothub-prod.azure-devices.net and zeiss-imt-cm-miot-dps-prod.azure-devices-provisioning.net.

7.4 Cloud Connector cannot be uninstalled

If an installation procedure is canceled or the msi package is no longer present in the operating system, it may no longer be possible to uninstall the **Cloud Connector**. In this case, you can nevertheless try to uninstall the **Cloud Connector** using the troubleshooting tool provided by Microsoft. A consistent status can then be established once again via re-installation. This tool is available under the following link:

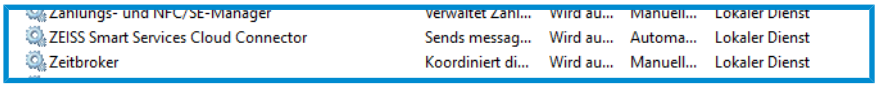
↘*https://support.microsoft.com/de-de/help/17588/windows-fix-problems-that-block-programs-being-installed-or-removed*

7.5 Removing CMM certificates manually

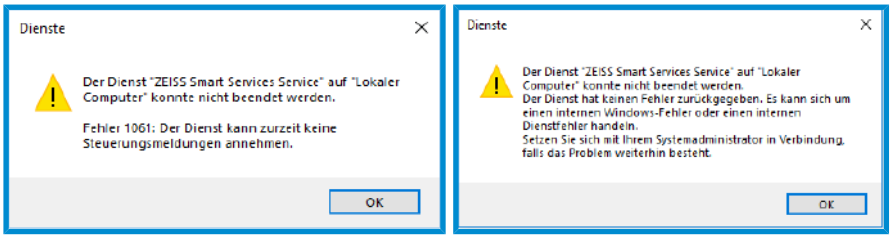
The **Cloud Connector** certificates are saved in the Microsoft Windows certificate store and also can be removed there (see ↘ *Management of certificates [Seite 20]*).

7.6 Service cannot be stopped

In its normal state, the **Cloud Connector** can be started/stopped via the Smart Services Monitor or in the Services Management (services.msc) via the context menu (see ↘ *Starting/Stopping services [Seite 17]*):



If the service cannot be stopped by selecting Exit in the context menu and e.g. one of the following error messages is displayed, a forced shutdown of the service is necessary (see ↘ *Forced shutdown of a service [Seite 19]*).




```
sc queryex "Zeiss Smart Services Service"

SERVICE_NAME: Zeiss Smart Services Service
TYPE : 10 WIN32_OWN_PROCESS
STATE : 4 RUNNING
(STOPPABLE, NOT_PAUSABLE, ACCEPTS_SHUTDOWN)
WIN32_EXIT_CODE : 0 (0x0)
SERVICE_EXIT_CODE : 0 (0x0)
CHECKPOINT : 0x0
```

```
WAIT_HINT : 0x0
PID : 3932
FLAGS :

taskkill /PID 3932 /F
```

Notes

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