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CTS™ Xenon™ Electroporation System OPC-UA

USER GUIDE

for use with Xenon™ Firmware Version 1.0.6 or greater

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Revision A

For Research Use or Manufacturing of Cell, Gene, or Tissue- Based Products.

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A	7 June 2024	New document for CTS™ Xenon™ Electroporation System OPC-UA.

The information in this guide is subject to change without notice.

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Contents

1 Product information

IMPORTANT! Before using this product, read and understand the information in the "Safety" appendix in this document.

Introduction

There are requirements where the Xenon™ instrument will need to be monitored and controlled by a Supervisory Control and Data Acquisition (SCADA) system. The Emerson DeltaV™ system is one of the SCADA system which will be used here to perform these operations targeted for clinical and commercial manufacturing. These monitoring and controls will include the following:

Monitoring

1. Run status
2. Instrument status
3. Protocol details
4. Instrument sensors

Controls

1. Select protocol index
2. Set multi-shot volume
3. Set multi-shot tbc temperature
4. Run single-shot protocol
5. Run sample extraction fro multi-shot
6. Pause, Resume or Abort extraction
7. Run multi-shot protocol
8. Pause, Resume or Abort run

Locking

1. To initiate any control commands

Each Xenon™ instrument will have a OPC-UA server installed together in the package for a client server based communication to perform data exchange with DeltaV™ System OPC Unified Architecture (OPC-UA) is a machine to machine protocol communication for industrial automation developed by the OPC Foundation.

Architecture

The following component diagram describes the communication within sub components of the Xenon™ instrument and to the external OPC client (DeltaV).
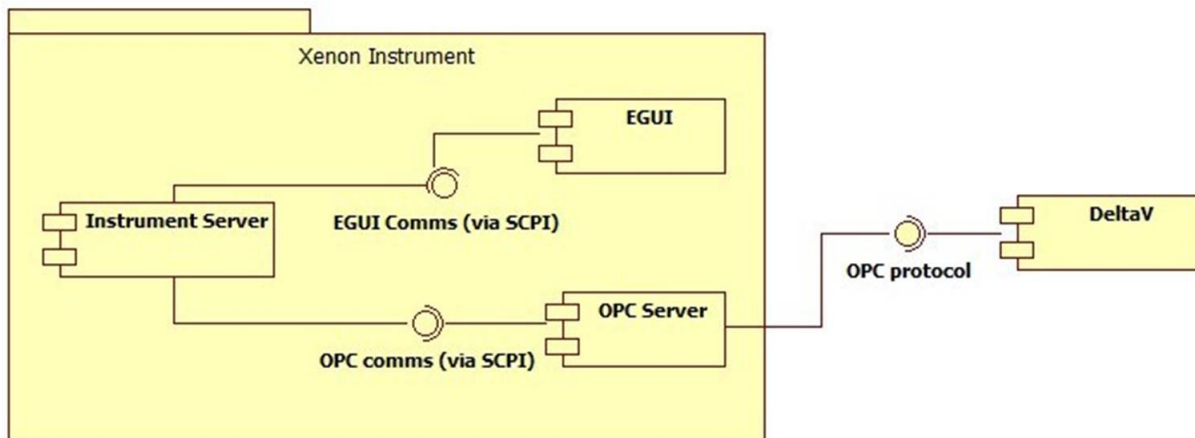
The instrument server will be the main interface performing back end logic to support both eGUI and OPC server interactions. The DeltaV™ system will establish login authentication and communication exchange with the OPC server that is a part of the Xenon™ instrument.

The communication between the Xenon™ instrument and DeltaV™ system will be the following:

1. The DeltaV™ system will send the commands (Controls) to the OPC server and the OPC server will in turn relay these commands to the instrument server.

2. The instrument server will send statuses (Monitoring) to OPC server and the OPC server will in turn relay these statuses to the DeltaV™ system.
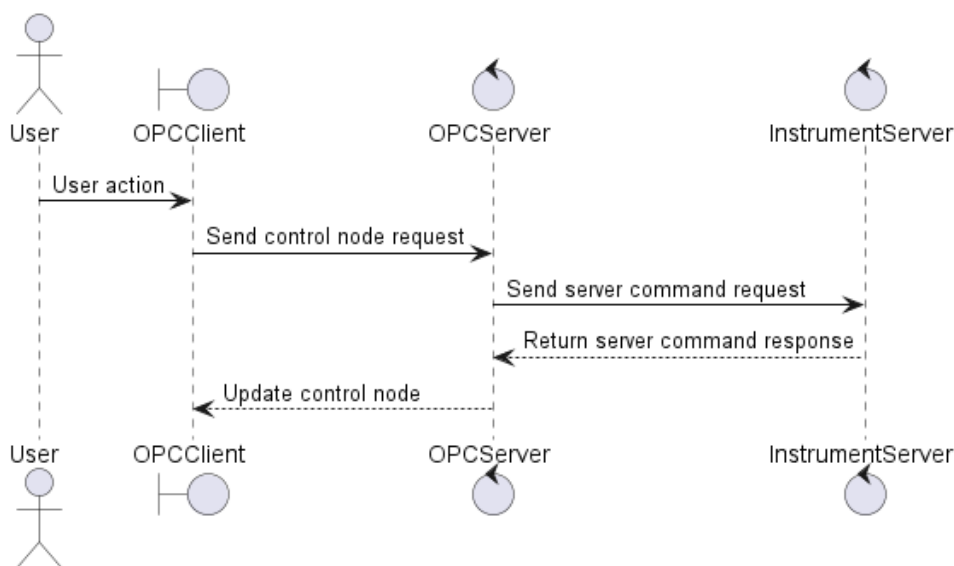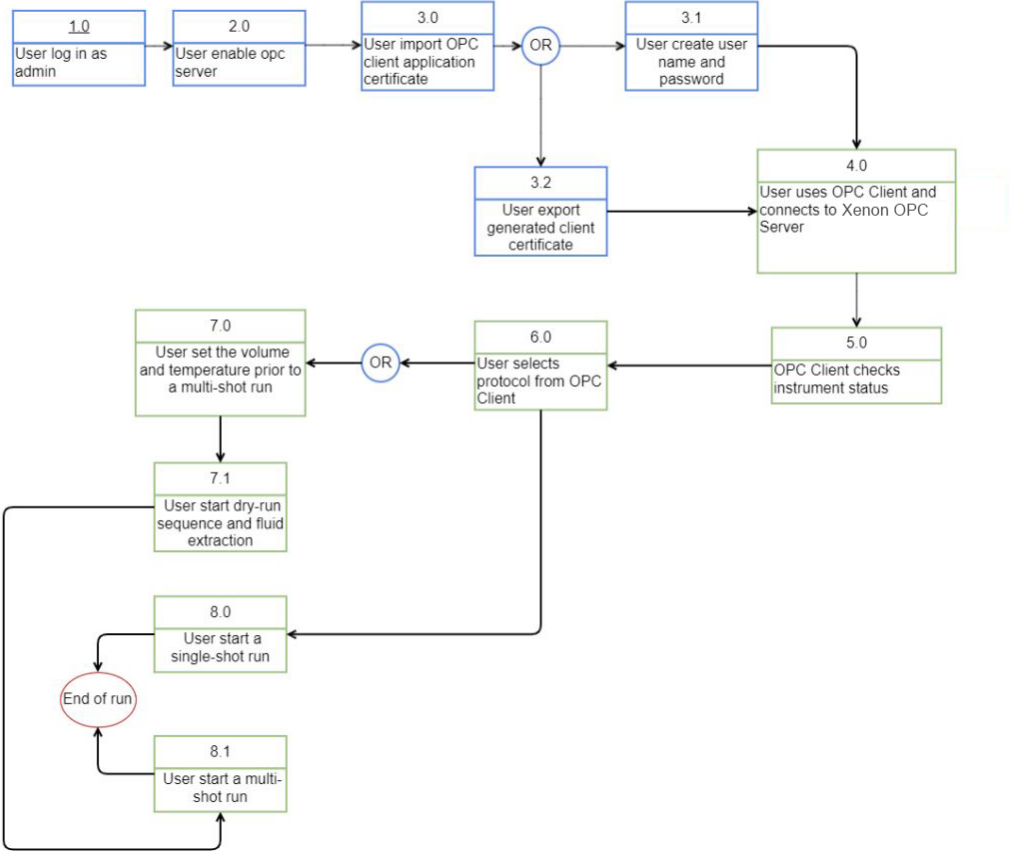
Figure 1   Flow chart diagram describing the process to start a run
Blue - user actions from eGUI; Green - user actions from OPC client/SCADA system

2 Enable OPC on Xenon™ instrument

The OPC mode can be enabled from the instrument eGUI directly via the settings page. The following diagrams replicate the steps to enable OPC mode.

UX workflow to enable OPC and retrieve OPC client credentials for authentication

1. The user selects **OPC Mode** from the settings page.

Chapter 2 Enable OPC on Xenon™ instrument
UX workflow to enable OPC and retrieve OPC client credentials for authentication

2
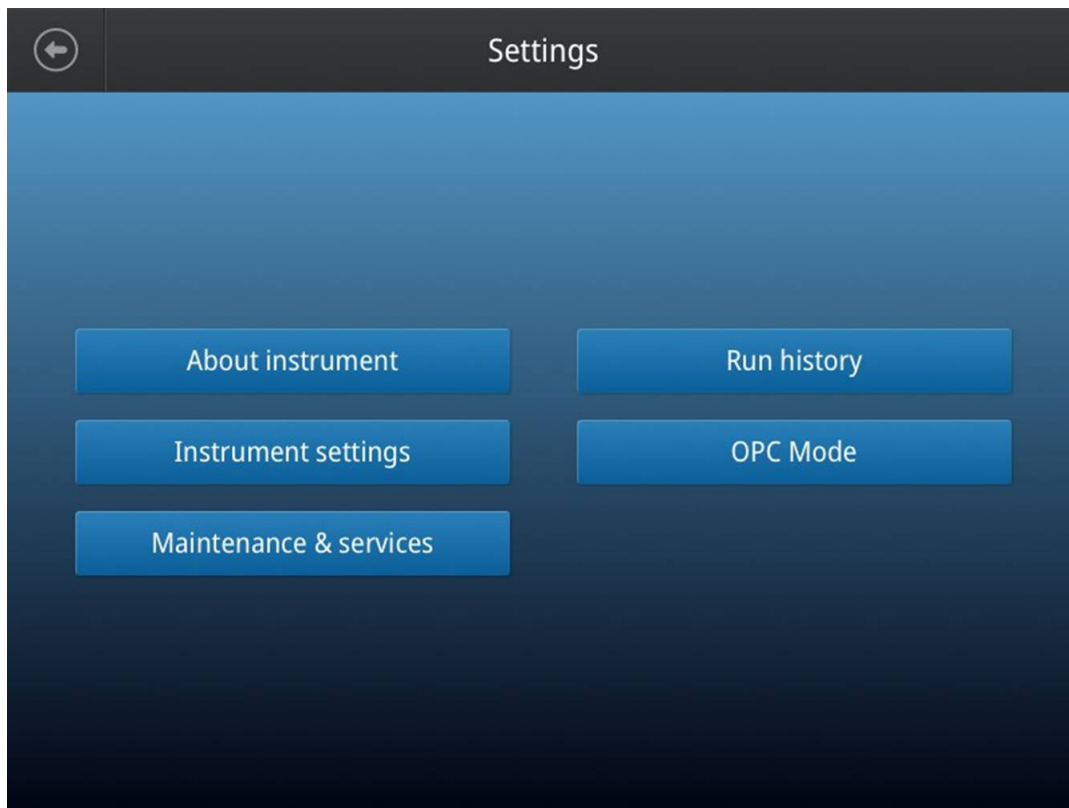
2. User will have to configure OPC initial settings if it is a first time user. As shown on the screen, the user will have the option to enable/disable the OPC server and also allow/disallow control functions from the OPC server.
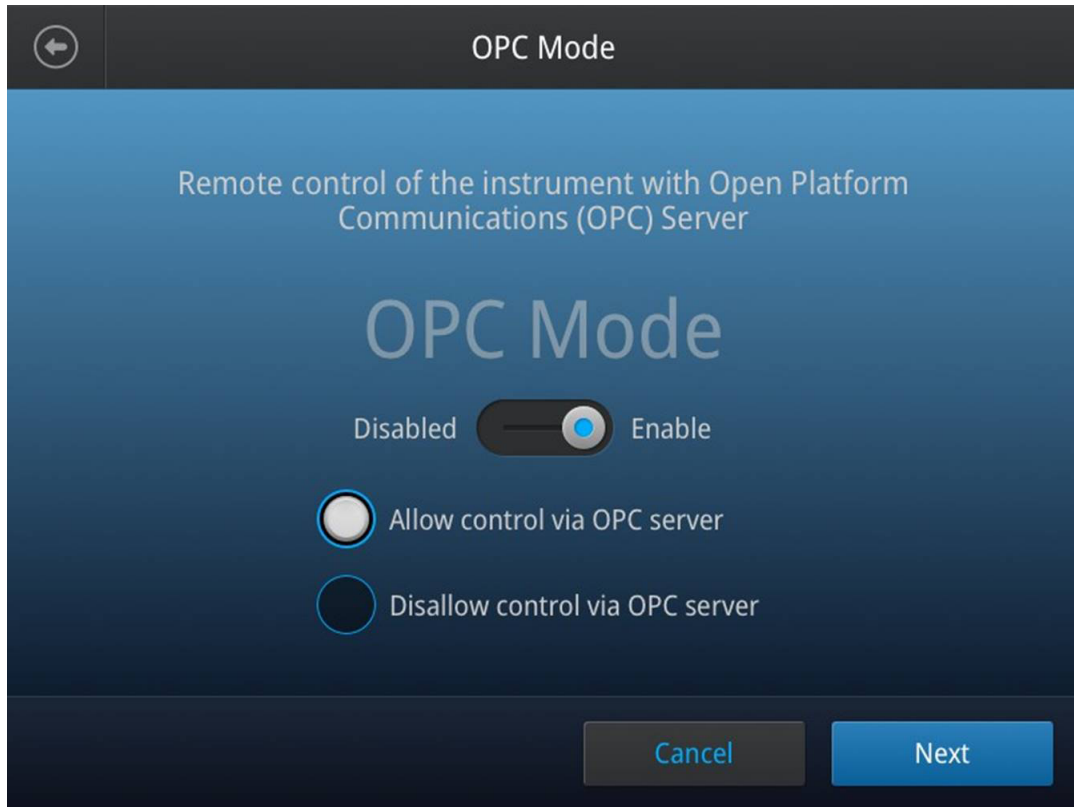
3. There are 2 available option for OPC client authentication. The user can either select authentication via SSL certificate or username and password. Also, the OPC endpoint url port number can be edited here, e.g. `opc.tcp://<ip-address>:<port>/ThermoFisher`.
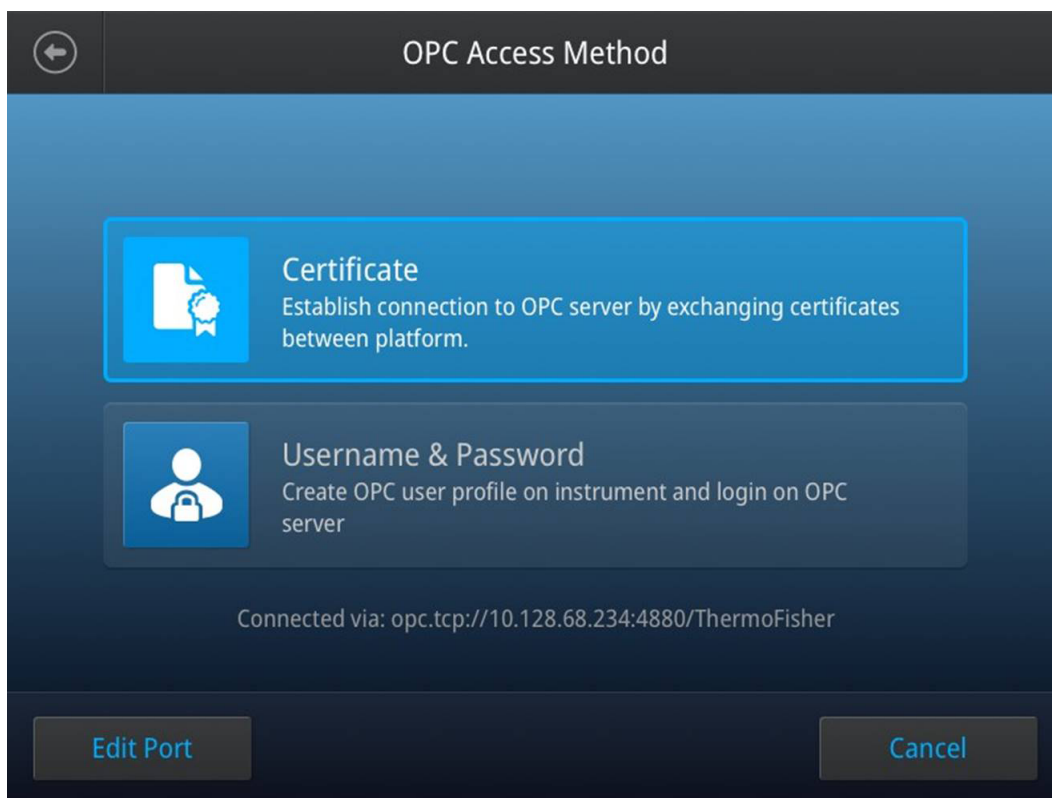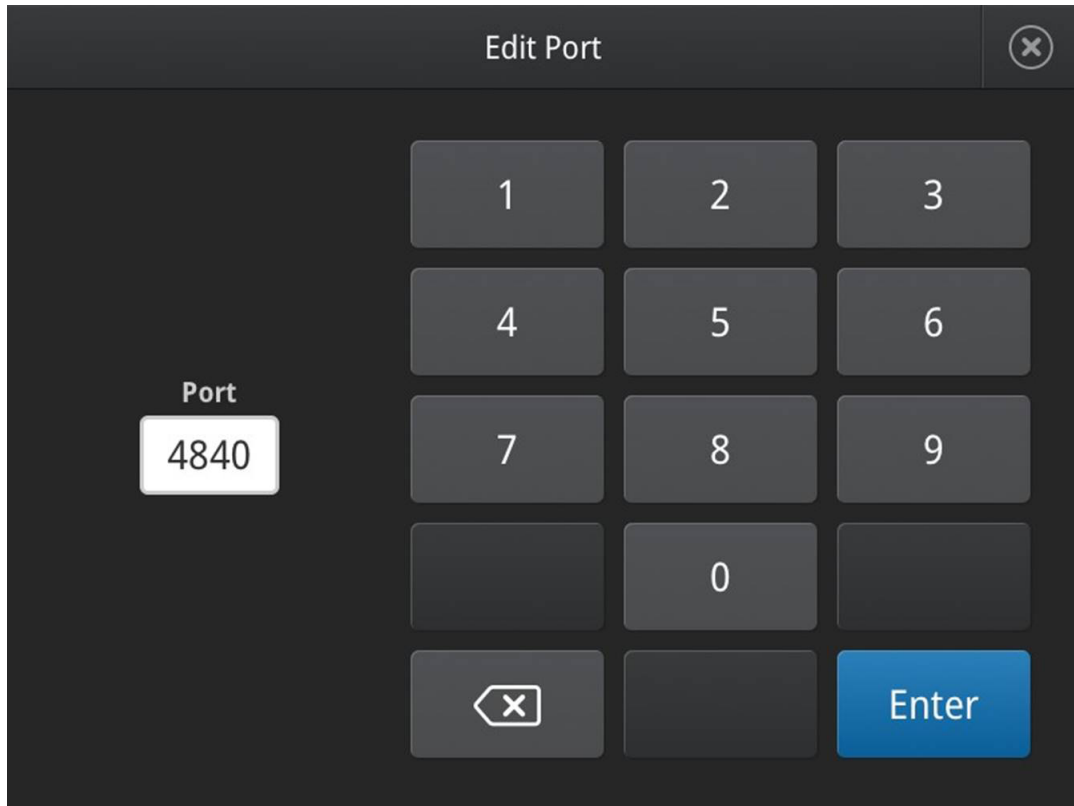
SSL certificate

The user will have to perform the following steps to setup login credential via SSL certificate.

1. Import OPC client application certificate into the USB drive.

2. Plug in USB drive into the instrument.

3. Select **Import certificate**. This will put the applicant certificate into the OPC server trust store.
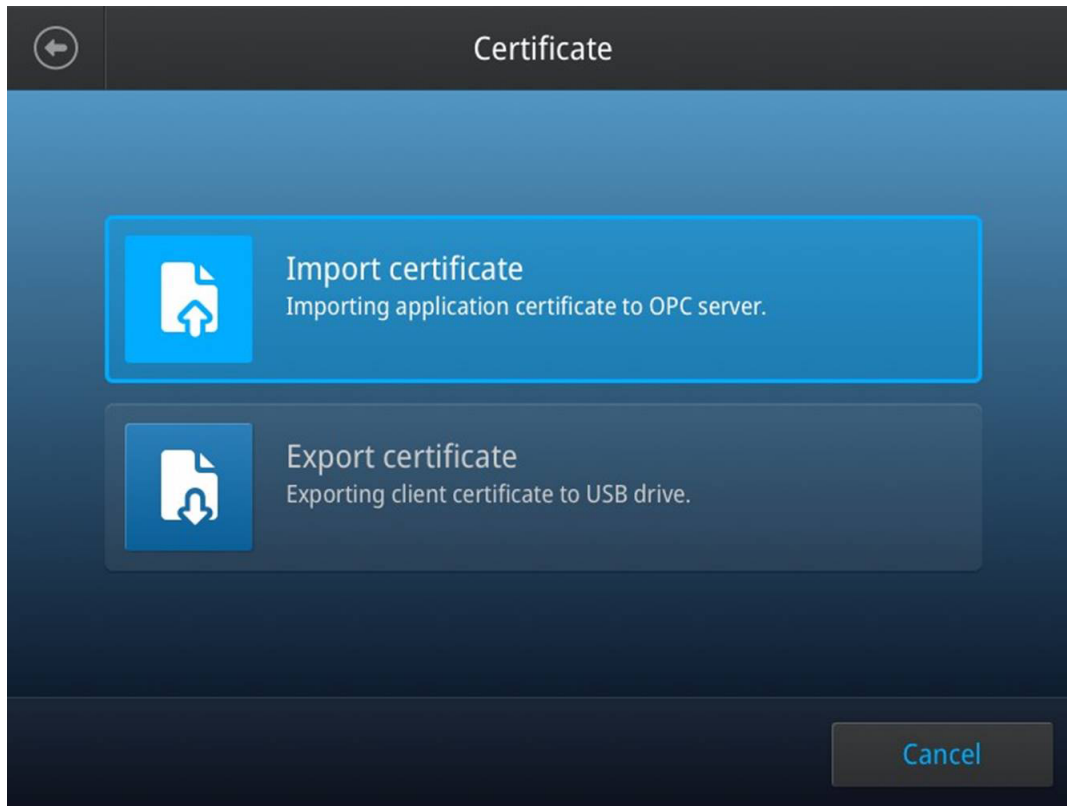
Chapter 2 Enable OPC on Xenon™ instrument
UX workflow to enable OPC and retrieve OPC client credentials for authentication

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4. Select the correct application certificate to import from the USB directory.

Chapter 2 Enable OPC on Xenon™ instrument
UX workflow to enable OPC and retrieve OPC client credentials for authentication

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5. Once import is done, select **Export certificate**.

    This will generate a client certificate into the USB drive and also place this client certificate into the OPC server trust store. Internally, the client certificate will be trusted by the OPC-UA server.

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UX workflow to enable OPC and retrieve OPC client credentials for authentication

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Chapter 2 Enable OPC on Xenon™ instrument
UX workflow to enable OPC and retrieve OPC client credentials for authentication

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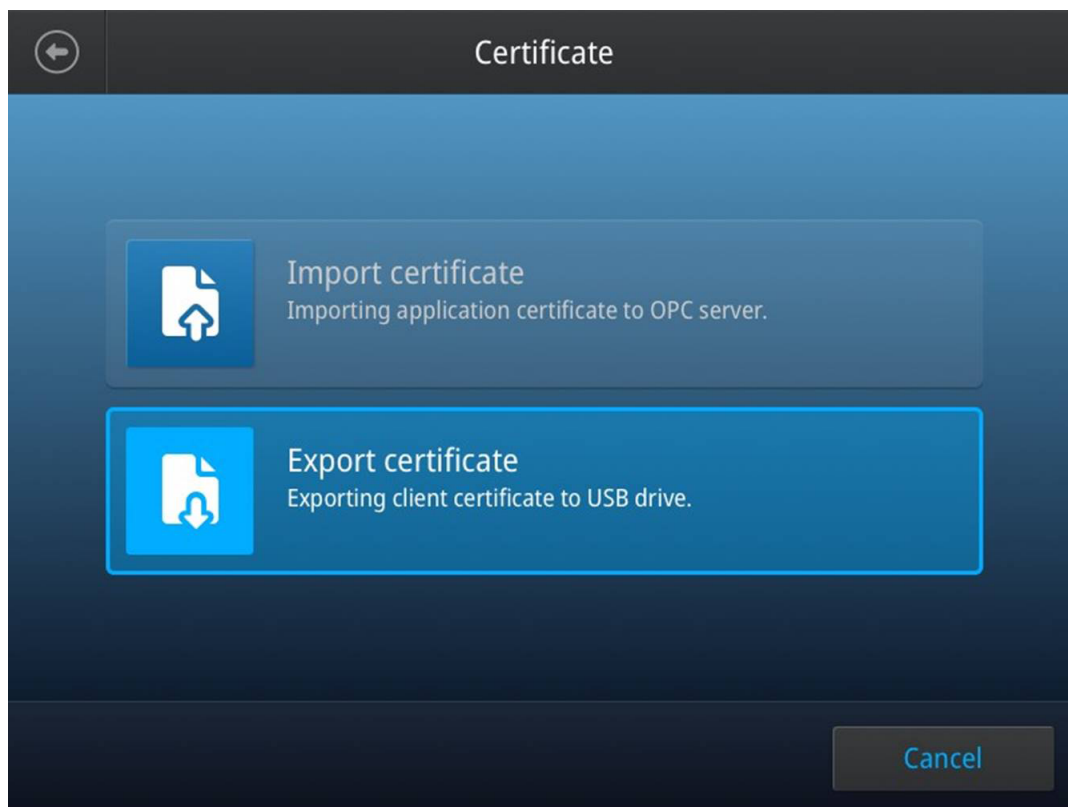
6. Once export is done, copy down the 6 alphanumeric password for the client certificate. This will be the password for authentication at the client side.

Username/password

The user will have to perform the following steps to setup username/password credential.

1. Import OPC client application certificate into USB drive.

2. Plug in USB drive into instrument.

Chapter 2 Enable OPC on Xenon™ instrument
UX workflow to enable OPC and retrieve OPC client credentials for authentication

2

3. First, the user will have to import the client application certificate. This will put the applicant certificate into the OPC server trust store.
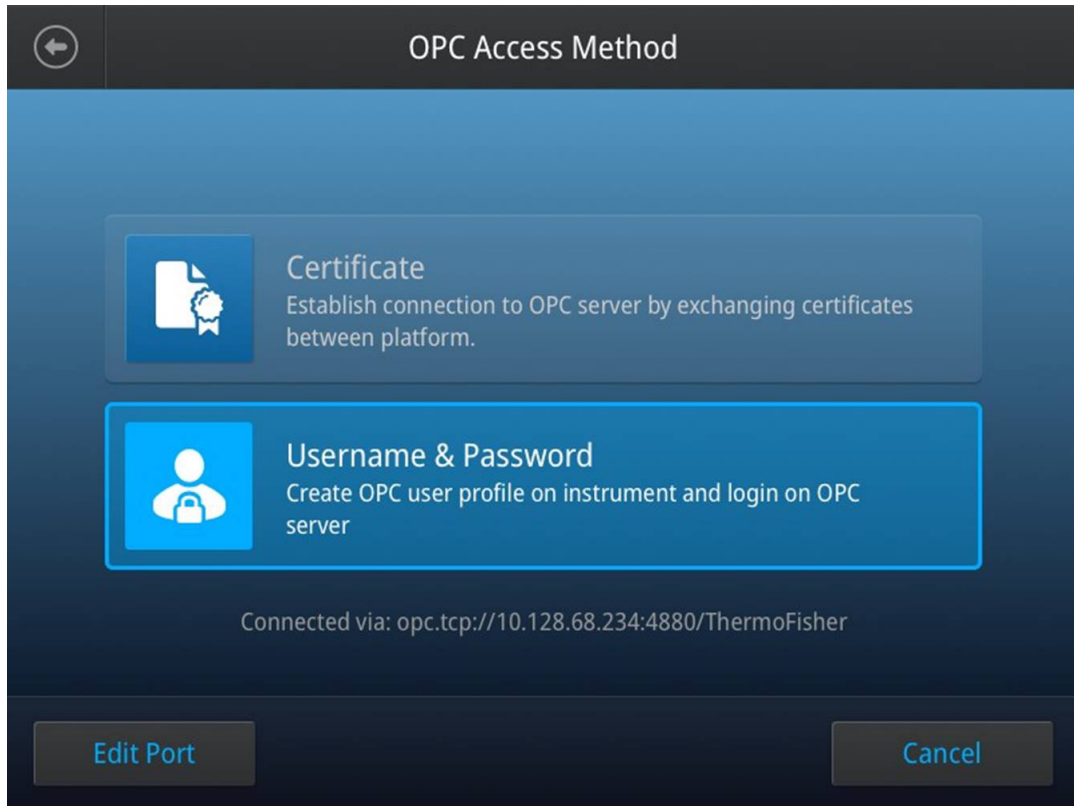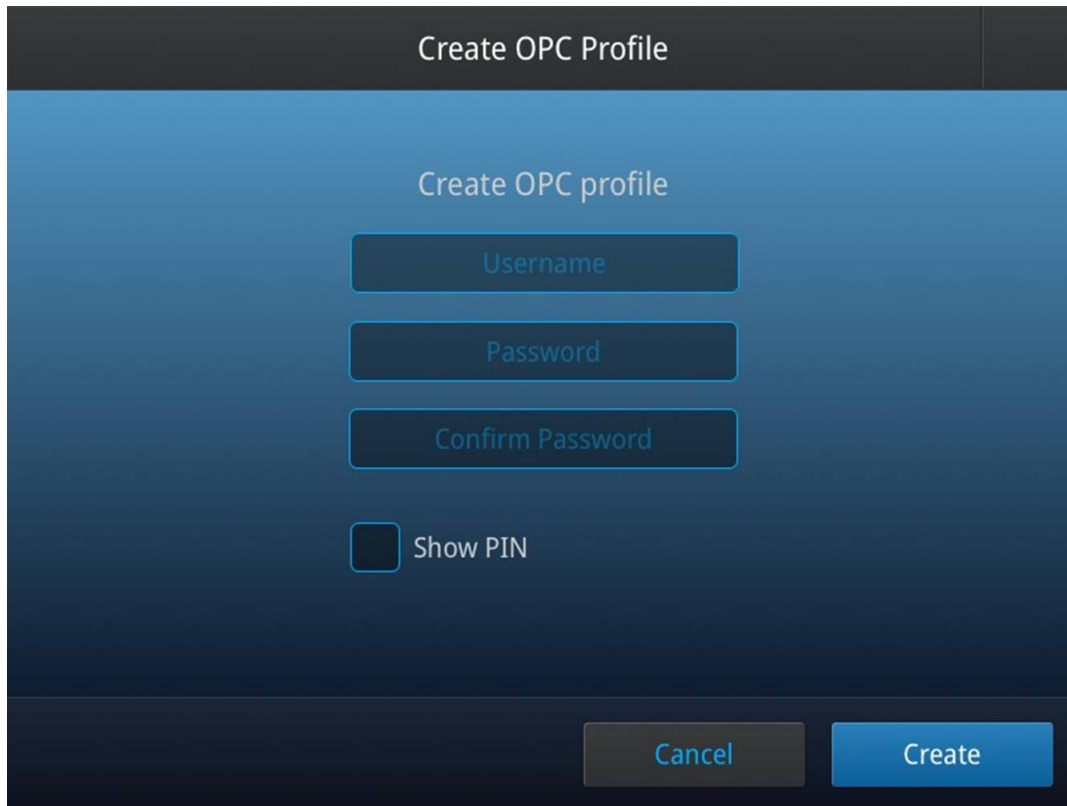
4. Select the correct application certificate to import from the USB directory.

Chapter 2 Enable OPC on Xenon™ instrument
UX workflow to enable OPC and retrieve OPC client credentials for authentication

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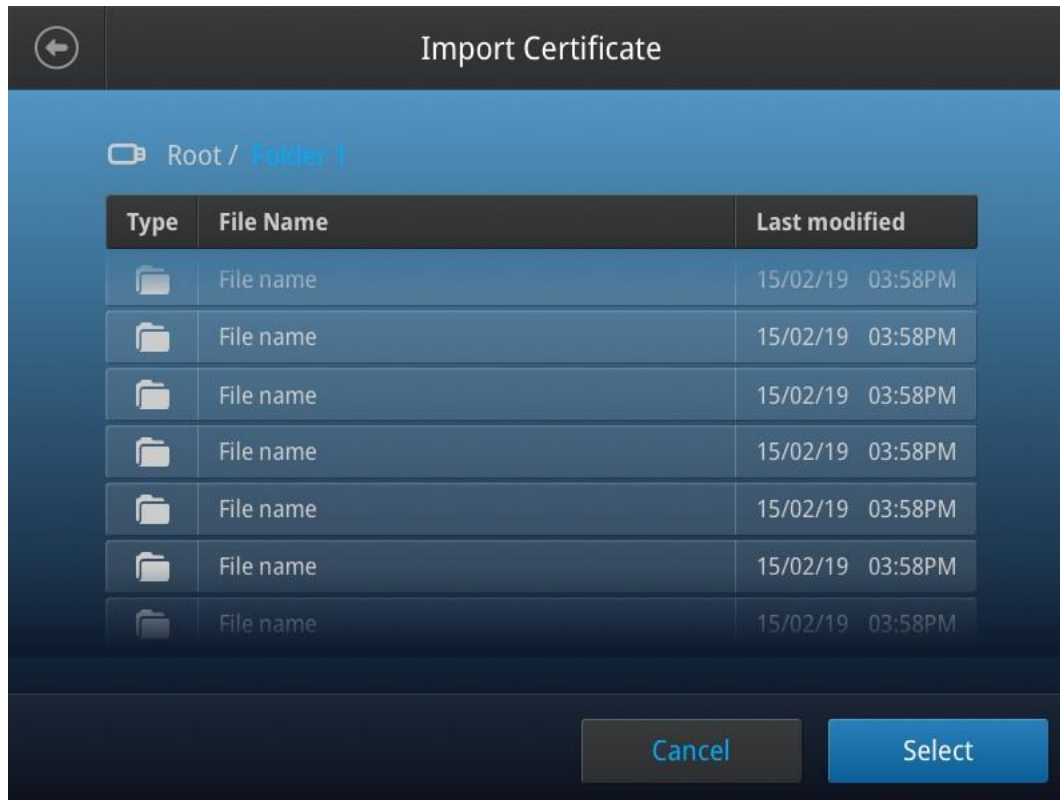
5. Once import is done, export the server public certificate out to the USB drive by pressing the export button.
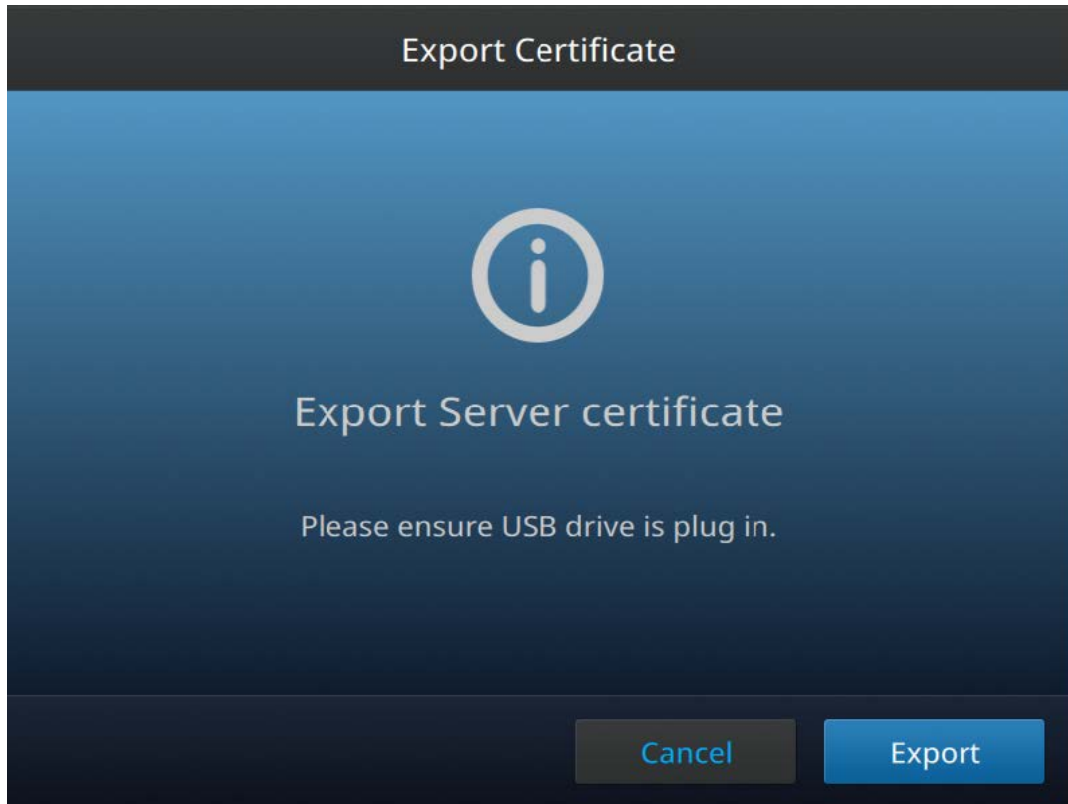
6. Once export is done, enter in the desired username and password.

Chapter 2 Enable OPC on Xenon™ instrument
UX workflow to enable OPC and retrieve OPC client credentials for authentication

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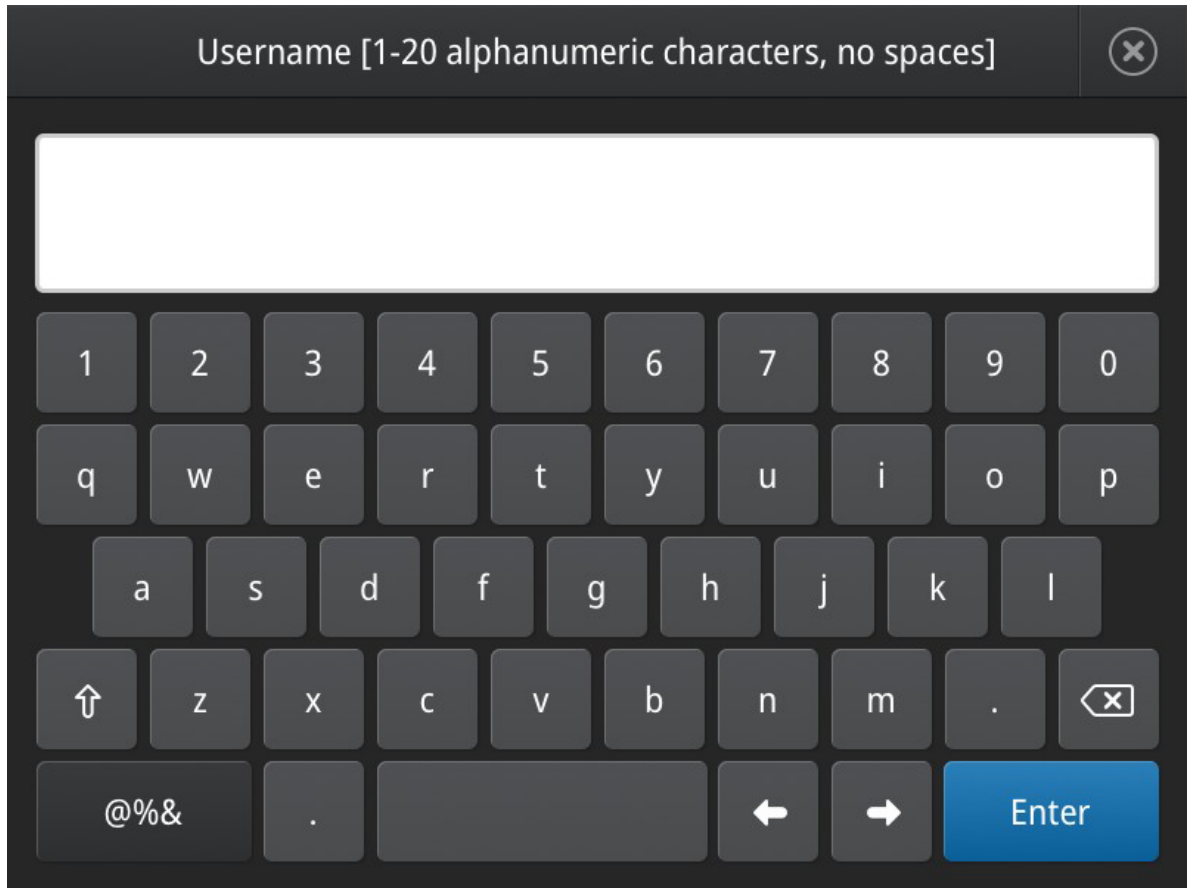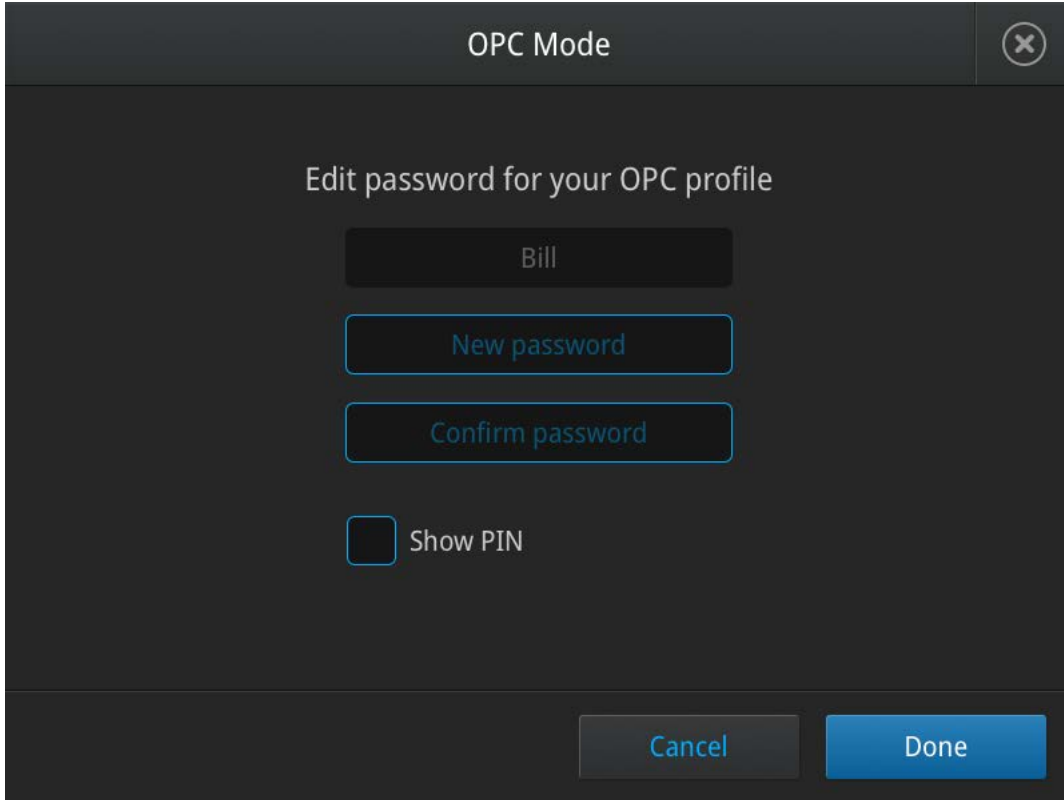
Once done, this will be the username/password for authentication at the client side.
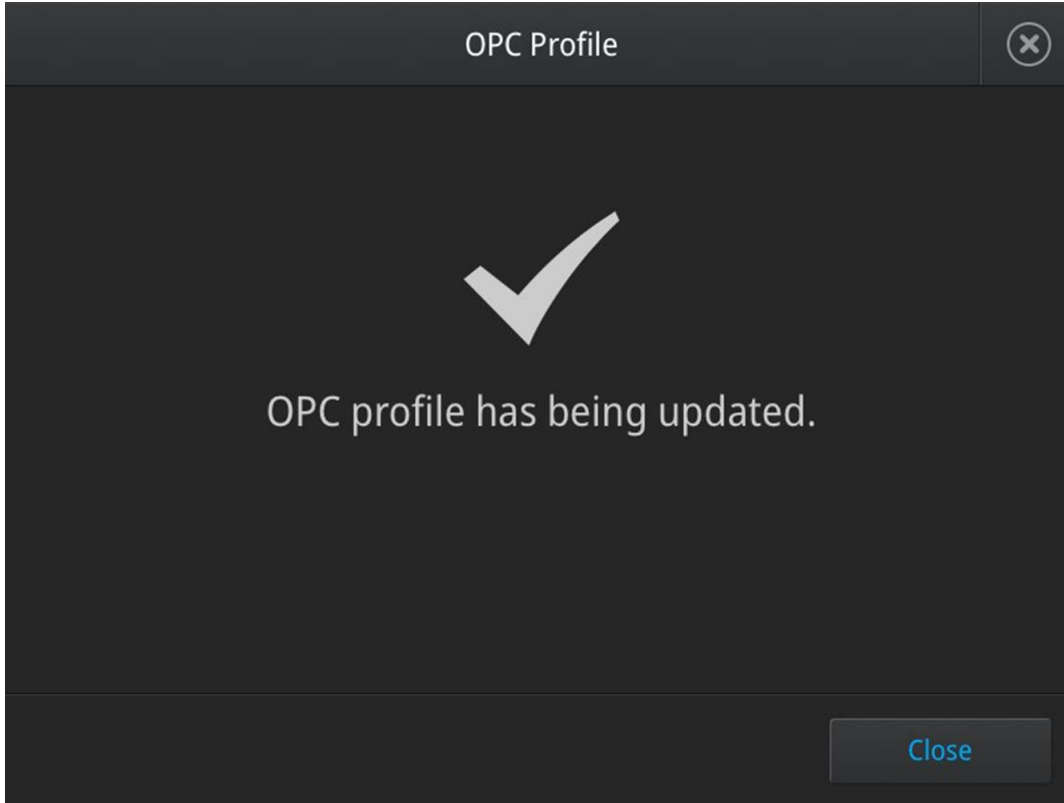
Modify OPC client password

The user will be able to modify the OPC client password after setting it up for the first time in the event that the password have been forgotten or there is a need to change due to security. Also, the user will be able to export the server certificate to a USB drive again by clicking on the **Export cert.** button

Chapter 2 Enable OPC on Xenon™ instrument
UX workflow to enable OPC and retrieve OPC client credentials for authentication

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Chapter 2 Enable OPC on Xenon™ instrument
Sequence diagram to enable OPC and retrieve OPC client credentials for authentication

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Sequence diagram to enable OPC and retrieve OPC client credentials for authentication

SSL certificate

The following sequence diagram describes the flow for user to retrieve the ssl certificate from the instrument.

1. The instrument server will generate the client ssl certificate and add it into the OPC server's trust store.

2. The user then exports the opc client application certification and imports it into the OPC server's trust store.

3. The user then exports the public certificate to a USB thumbdrive from the eGUI. The user may also export the OPC sever's public certificate if needed.

4. The user then imports the public certificate for OPC client authentication to establish connection with OPC server.

Chapter 2 Enable OPC on Xenon™ instrument
Sequence diagram to enable OPC and retrieve OPC client credentials for authentication

2
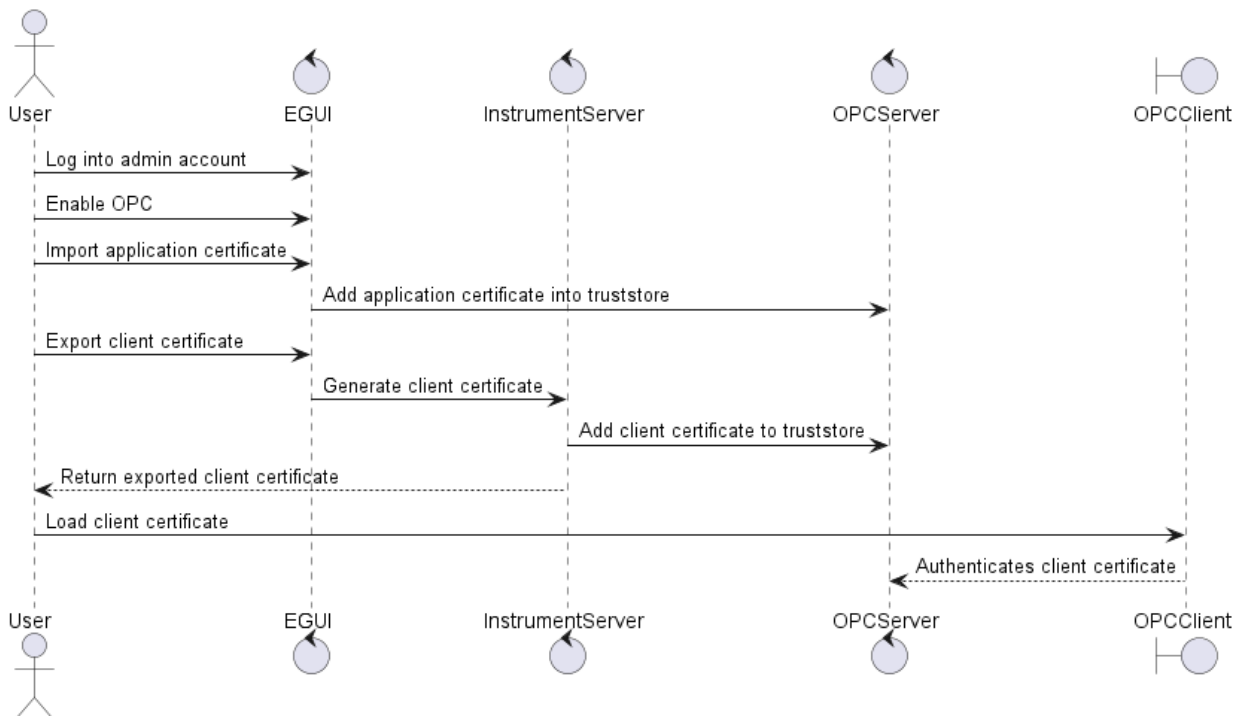
Username/password

1. The user then exports the OPC client application certification and import it into the OPC server's trust store.

2. The user may also export the OPC sever's public certificate if needed.

3. The user will input the desired username and password for the first time in the eGUI.

4. These credentials will be sent to the instrument server and then to the OPC server for storage.

   Note: The password will be hashed.

5. The user then uses these log in credentials for OPC client authentication to establish connection with OPC server.

Chapter 2 Enable OPC on Xenon™ instrument
Sequence diagram to enable OPC and retrieve OPC client credentials for authentication

2
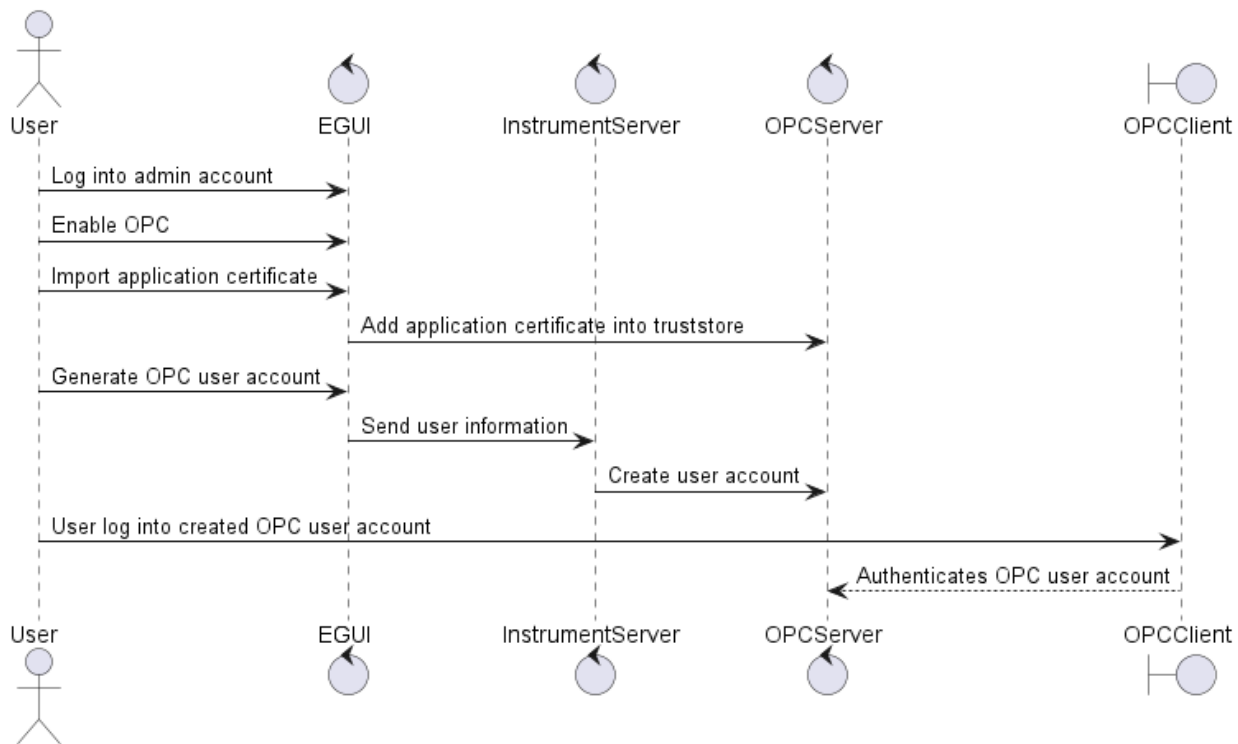
Sequence diagram to import and export protocols to the OPC server
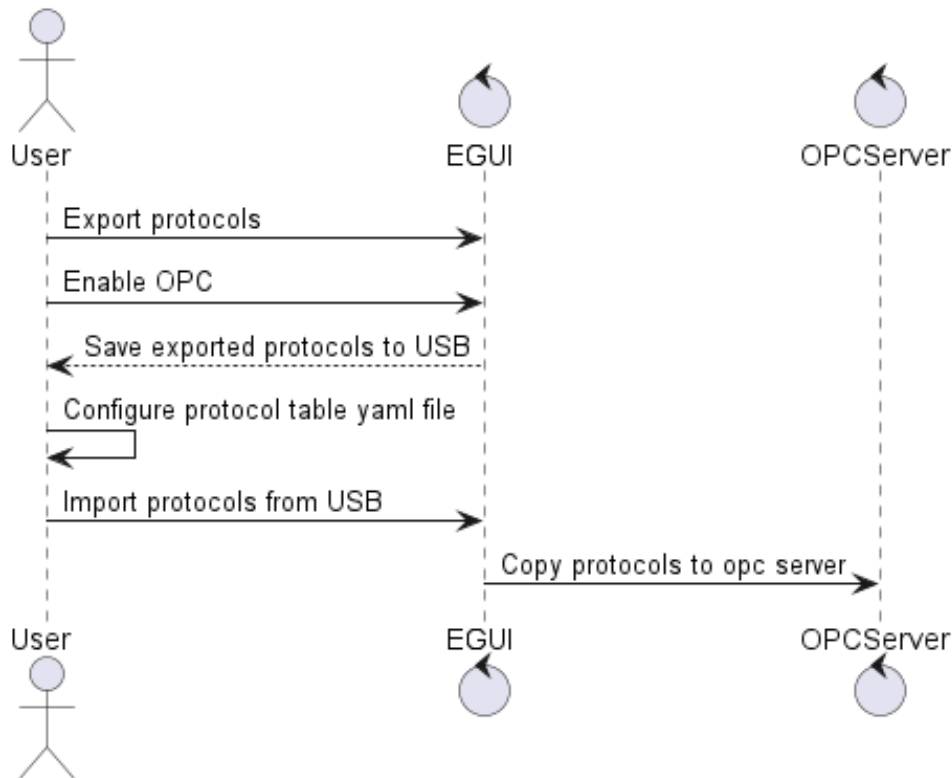
Steps to import protocol table

1. The user creates and exports the protocol in local mode to the USB drive. This will create /XenonProtocols folder in the root directory of the USB drive.

   Note: Refer to *CTS™ Xenon™ Electroporation System User Guide* (Pub. No. MAN0025488) to export the protocol to the usb.

2. The user creates a `protocoltable.yaml` file which must be in the same folder as the exported protocols in the root directory /XenonProtocols of the USB drive.

3. The XenonProtocols folder should look like this before importing it into the instrument.

The `protocoltable.yaml` file should map the protocols inside this folder with an integer ID.

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4. The user imports the protocol via the import/export settings from the OPC menu.
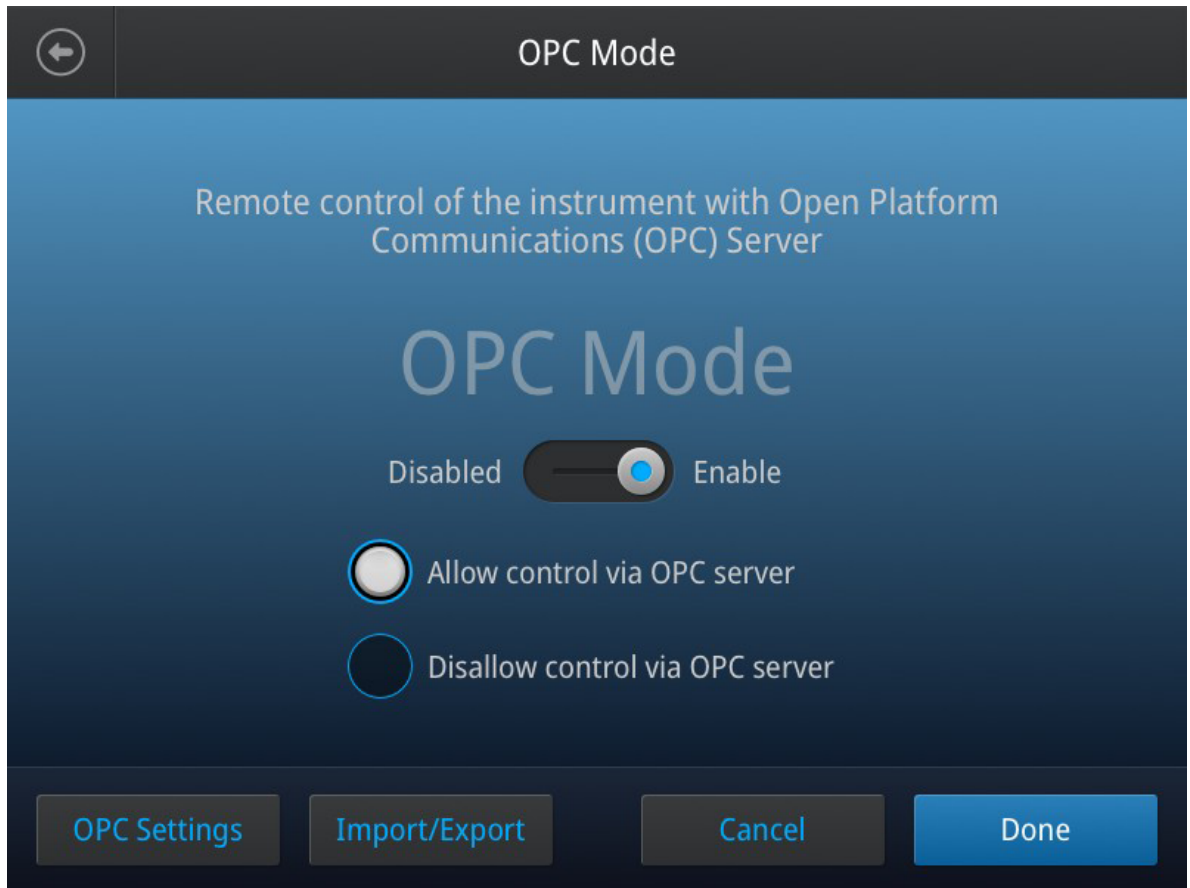
5. Key in the local administrator password for authentication.

6. Select **Import**.
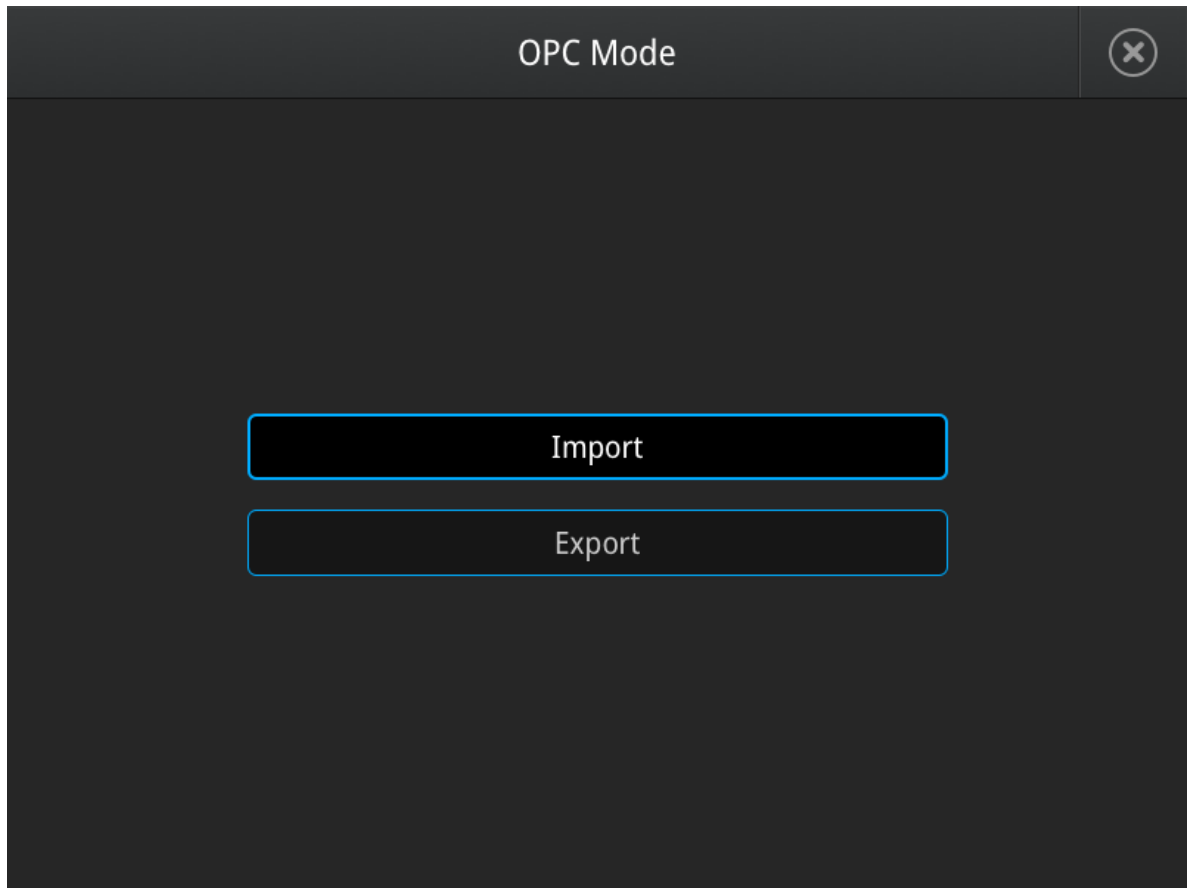
Confirm that all existing protocols in the OPC protocols in the instrument will be overwritten.

Note: If there is a need to retrieve the existing protocols, please select **Export** instead in the previous screen before this action.
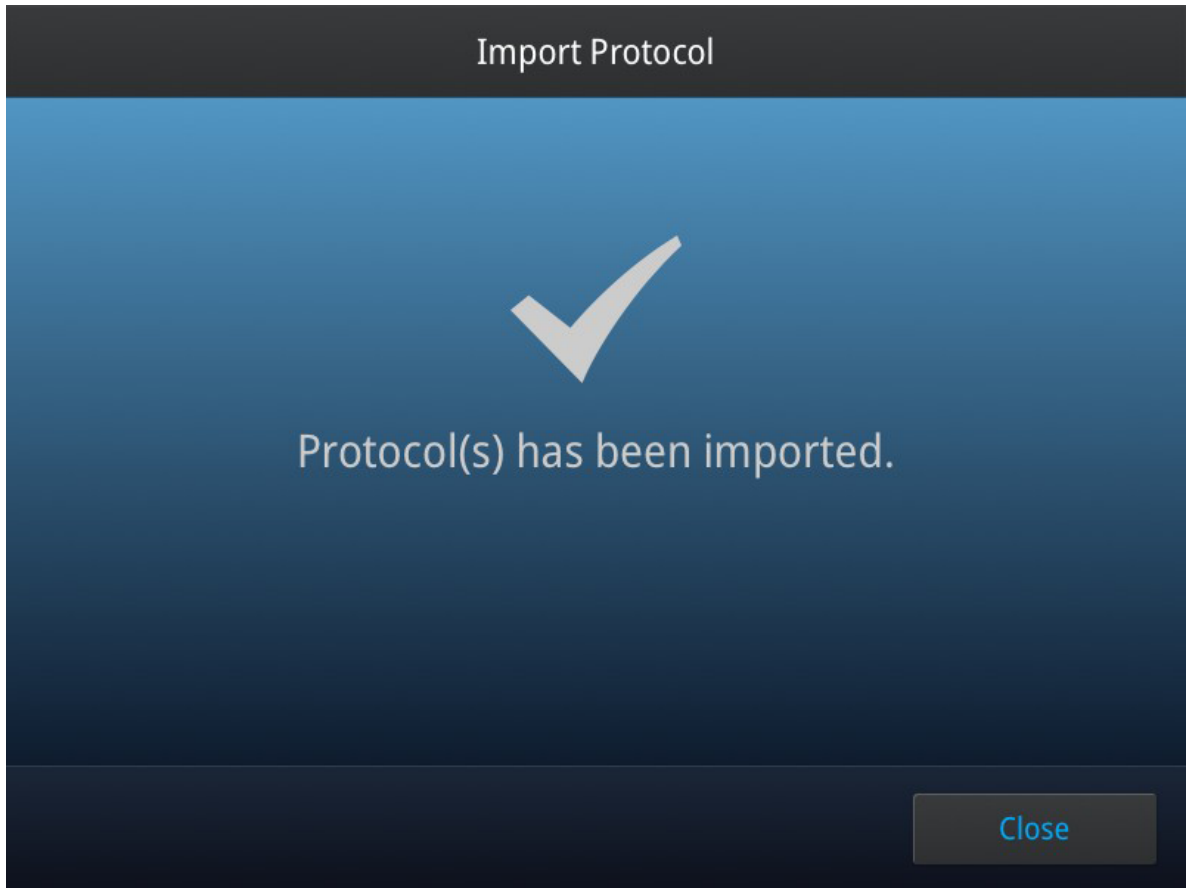
OPC Server State Diagram

STATES:

1. IDLE
2. EXTRACTION START
3. EXTRACTION PAUSE
4. EXTRACTION ABORT
5. EXTRACTION ERROR
6. EXRTRACTION FINISHED
7. RUN START
8. RUN PAUSE
9. RUN ABORT
10. RUN END
11. RUN ERROR

EXTRACTION

IDLE

EXTRACTION RESUME

Instrument return start

Resume

EXTRACTION START — Pause → EXTRACTION PAUSE — Abort → EXTRACTION ABORT

Abort

Instrument return finish

Instrument return error

EXTRACTION FINISH

EXTRACTION ERROR

Resume from error

Abort

Condition:
Selected protocol

Condition for MS:
1. Finish extraction
2. Set volume
3. Set temperature

RUN RESUME

Resume

RUN START (MS) — Pause → RUN PAUSE — Abort → RUN ABORT

Start

RUN START (SS)

Start

IDLE

Instrument return finish

Instrument return error

RUN END

RUN ERROR

Table 1 OPC server errors list

Item	Steps that result in error if fail	Steps that will show warning if fail
dry run	1. extractor tube detection: Tube not present at extraction pump. (Extractor tube is not inserted in properly) 2. drainer tube detection: Tube not present at drainer pump. (Drainer tube is not inserted in properly) 3. extractor lid close check: Extractor pump lid is not closed 4. filler lid close check: Filler pump lid is not closed 5. drainer lid close check: Drainer pump lid is not closed 6. filler pump move check: Unable to move filler pump to target position 7. drainer pump move check: Unable to move drainer pump to target position. 8. mixer cup move check: Unable to home cell mixer cup. 9. purger open/close check: Unable to open/close stop cock. 10. valve open/close check: Unable to move valve to open/close position. 11. epin open/close check: Unable to move electrode pin to open/close position 12. tbc start to 24.0 check: Many various reasons (need to refer to subsystem error) 13. capper home uncap/home check: Unable to move capper to uncap/home position.	1. extractor bubble sensor detection Unable to start fluid extraction. Liquid sensor active. 2. drainer bubble sensor detection Unable to start draining. Liquid sensor active.
extraction	1. Fluid initialisation check to determine if liquid is detected at extractor bubble sensor: Unable to detect fluid during extraction 2. Extraction pump move: Unable to move extractor to target position 3. Open purger: Unable to move purger during fluid extraction 4. Extraction pump move: Unable to move extractor to target position 5. Close purge: Unable to move purger during fluid extraction	—

OPC server purging sample retrieval

Purging

If run is aborted in the midst of a multi-shot run, the user can refer to MSRunDetails to determine if the current sample in the electroporation chamber have been electroprated. In the same manner, OPC client can be the one to determine if they were to show the notification prompt based on the node string or it will be entirely up to the user to determine themselves if they were to perform a manual purge. User is only able to purge if it is not running any protocol or extraction.

MSRunDetails = *Finished electroporation* means it has completed the electorporation.

Sample retrieval (at the end of the run)

User may perform sample retrieval at the end of the run if the run is either aborted by user or error. The amount of sample retrieval is predetermined by the number of cycles left in the multi-shot run with a buffer of +2 mL. e.g if there are 5 cycles left, the sample retrieval flow will perform 5 + 2 mL of shots. This predetermined sample retrieval can only be performed immediately at the end of the run. Once it is outside of the run flow, the user may have to perform sample retrieval based on the input in mL.

Sample retrieval (outside the run)

If the user wants to perform a sample retrieval outside the run, they may do so with input based on mL.

*hint: refer to controlling nodes to perform the above.

Information model
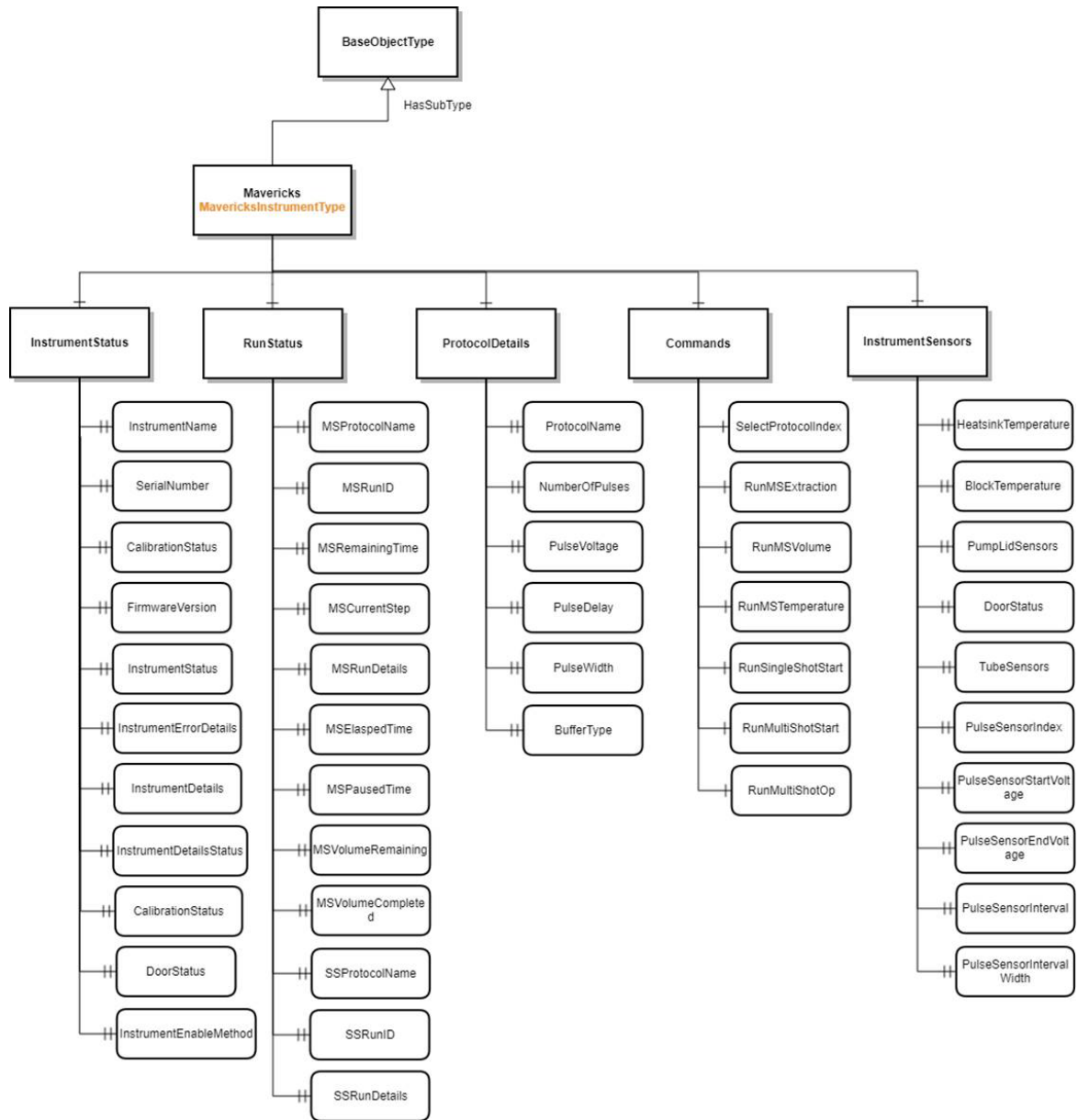
OPC interface is separated into 2 parts.

1. Monitoring: See "Monitoring" on page 39.
2. Controlling: See "Controlling" on page 47.

Sequence diagram for instrument status
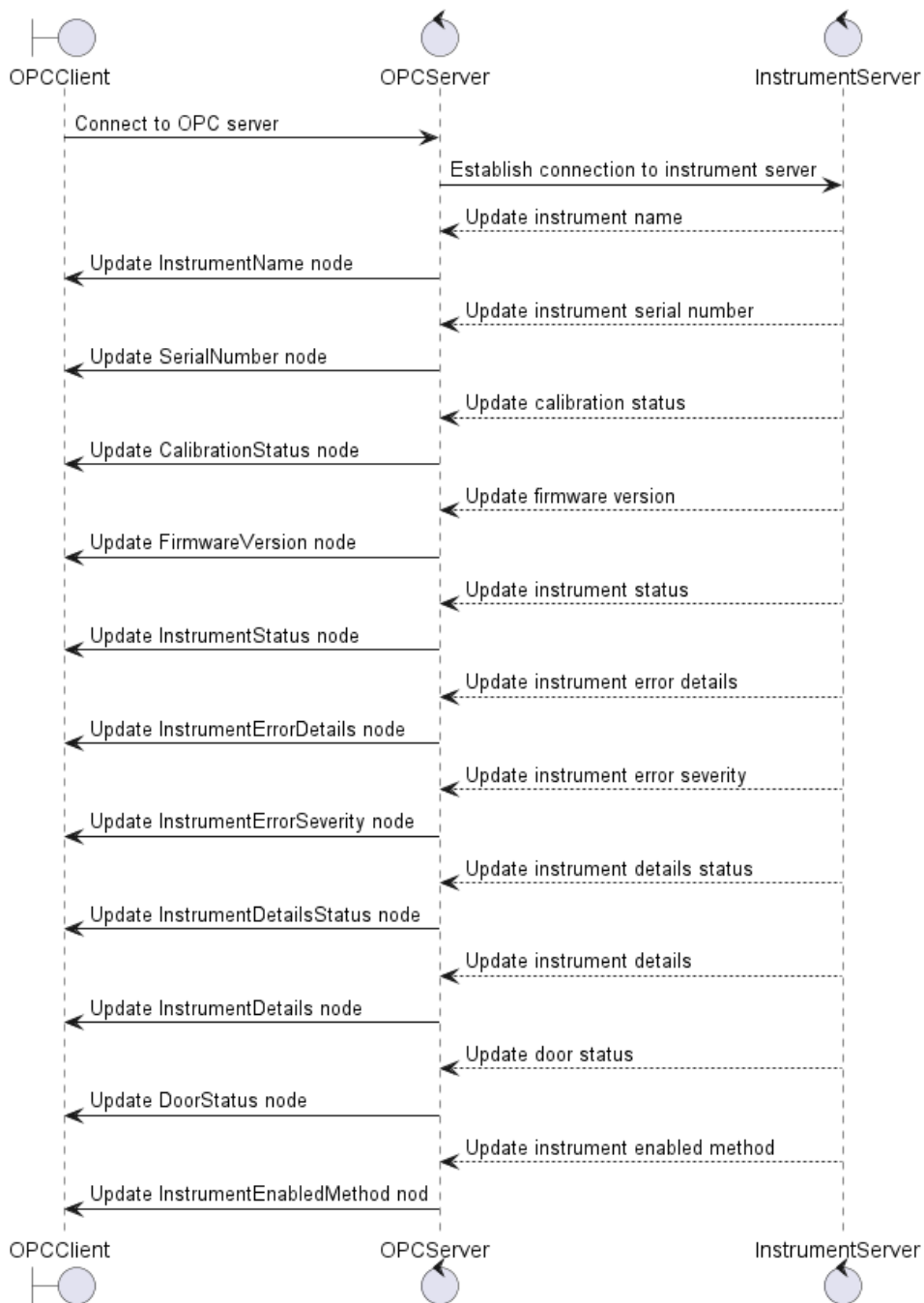
Run Status (Xenon™ instrument to OPC server)

The run status will only be updated if there is an existing run.

Monitoring

Instrument status (Xenon™ instrument to OPC server)

Variable	Type	Access	NodeId	Values/Description
InstrumentName	<String>	Read	18	The name of the instrument set by eGUI
SerialNumber	<String>	Read	19	The serial number of the instrument set during manufacturing
CalibrationStatus	<String>	Read	20	The last calibration status date set during manufacturing or if there is a change of parts which requires calibration
FirmwareVersion	<String>	Read	21	The firmware version of the instrument
InstrumentStatus	<String>	Read	22	The current instrument status • Idle • Running • Diagnostics • Error The instrument will not be able to perform any run if it is in *Error* state.
InstrumentErrorDetails	<String>	Read	23	This is the instrument error that comes directly from the instrument server itself when it encounters an error. It will be set to 'nil' if there is no error. The error will always be overwritten with the latest error. *hint: Error history should be managed from the OPC client.

Chapter 3

(continued)

Variable	Type	Access	NodeId	Values/Description
InstrumentErrorSeverity	\<Byte\>	Read	25	This is the instrument error severity of InstrumentErrorDetails 0 = Warning 1 = Recoverable 3 = Fatal The instrument will display fatal errors in the following situations: • subsystems fatal errors • error encountered in run but neither due to error from instrument nor user abort • any other error during self-test Other than the ones mentioned above, the instrument will usually display the error as warnings as there are times when it can be due to consumable or wrong usage from the user. The correct procedures to troubleshoot an error is always to: 1. re-run the protocol run 2. if error still persists after checking the consumable setups, perform a self-test 3. if all the self-tests pass the checks, reboot the instrument and continue the protocol run. 4. if it is still failing, please contact the field service engineer
InstrumentDetailsStatus	\<Boolean\>	Read	55	This is the instrument details status to determine if the controlling node command is a success. True = Success False = Not success

(continued)

Variable	Type	Access	NodeId	Values/Description
InstrumentDetails	<String>	Read	50	This is the instrument details when sending variable commands. Please refer to controlling nodes. Please refer to InstrumentDetailsStatus to determine if the command is sent correctly. Red text means that the command is not sent correctly while green means that it is successful. SelectProtocolIndex • Cannot find version number • Cannot find filename in id <id> • Cannot find id in filename <filename> • Something is wrong with the protocol table • Cannot find key id <id> in map • Unknown error: <reason> • Cannot select protocol because it is in incorrect state. Please unload and load the protocol again • Unable to find protocol index • Unable to find read <name> protocol • The protocol <name> contains invalid character(s)" • Unable to set <name> protocol • Found protocol index file <filename> RunMSExtraction • Cannot start extraction because instrument is not in idle state • Error encountered in dry run checks • Error encountered in dry runs • Error encountered in extraction • Starting dry run checks • Finished dry run checks • Starting fluid extraction • Finished fluid extraction • Error in pause extraction • Cannot pause extraction because extraction is not in progress • Paused extraction

(continued)

Variable	Type	Access	NodeId	Values/Description
InstrumentDetails	<String>	Read	50	• Error in resume extraction • Cannot resume extraction because instrument is not pause state • Resumed extraction
				• Error in abort extraction • Cannot abort extraction because extraction is not in progress • Aborted extraction
				• Cannot resume extraction from error • Finished fluid extraction
				• Error in skipping extraction • Cannot skip extraction because extraction is not in progress • Skipped extraction

(continued)

Variable	Type	Access	NodeId	Values/Description
InstrumentDetails	<String>	Read	50	RunMultiShotStart • Unloaded protocol • Please close the instrument door before the run • Please selected protocol before MS run • Please start extraction before running multi-shot • Please set volume to be within 5 to 25 mL • Please set temperature to be within 10 to 30 deg • Error encountered in getting run time estimate • Error encountered in multi-shot run - <reason> • Error encountered in run RunSingleShotStart: • Unloaded protocol • Please close the instrument door before the run • Please selected protocol before SS run • Error encounterd in singleshot run - <reason> • Error encountered in run RunMultiShotOp: • Cannot pause because there is no active run • Cannot resume because there is no active run or run is not paused • Cannot abort because there is no active run or run is not paused RunSamplePurge: • Error during sample purge • Unable to purge • Sample purge successful • Starting purge RunSampleRetrieval • Error in sample retrieval, <reason>
DoorStatus	<Boolean>	Read	0	The current instrument door status • False = Open • True = Close

(continued)

Variable	Type	Access	NodeId	Values/Description
InstrumentEnableMethod	<Boolean>	Read	24	To determine if OPC control function is enabled or disabled • False = Disabled • True = Enabled

Run status (Xenon™ instrument to OPC server)

The run status will only be updated if there is an existing run.

Variable	Type	Access	NodeId	Values/Description
MSProtocolName	<String>	Read	2	The protocol name of the current multi-shot run
MSRunID	<String>	Read	3	The run ID of the current multi-shot run
MSRemainingTime	<UInt16>	Read	4	The time remaining of the current multi-shot run in seconds
MSCurrentStep	<UInt16>	Read	5	The current steps of the multi-shot run
MSRunStatus	<String>	Read	6	The current multi-shot run status • Idle • Running • Pausing • Paused • Completing • Completed • Aborting • Aborted • Unknown *hint: Error state is removed, please refer to instrumenterrordetails to determine if it is a user or instrument abort error. Instrument abort error should have information on instrumenterrordetails

(continued)

Variable	Type	Access	NodeId	Values/Description
MSRunDetails	<String>	Read	7	The current multi-shot run details • Starting run • Started initializing run • Finished initializing run • Started filling sample to electroporation chamber • Finished filling sample to electroporation chamber • Started electroporation • Finished electroporation • Started draining sample from electroporation chamber • Finished draining sample from electroporation chamber • Ending run • Ended run • Aborting run • Pausing run • Paused run • Error • Aborted
MSElapsedTime	<UInt16>	Read	51	The elapsed time for a multi-shot run in seconds
MSPausedTime	<UInt16>	Read	52	The paused time for a multi-shot run in seconds if the run is paused
MSVolumeRemaining	<UInt16>	Read	53	The volume remaining for a multi-shot run in mL
MSVolumeCompleted	<UInt16>	Read	54	The volume completed for a multi-shot run in mL
SSProtocolName	<String>	Read	8	The protocol name of the current single-shot run
SSRunID	<String>	Read	9	The run ID of the current single-shot run
SSRunStatus	<String>	Read	10	The current single-shot run status Idle Running Completed Aborting Aborted Error Unknown
RetrievalStatus	<String>	Read	70	The current sample retrieval status Idle Running Completed Error
RetrievalTime	<UInt16>	Read	71	The current time left for sample retrieval in seconds
RetrievalVolume	<UInt16>	Read	72	The current volume for sample retrieval
RetrievalTotalVolume	<UInt16>	Read	73	The total volume for sample retrieval at the start

Protocol details

Variable	Type	Access	NodeId	Values/Description
ProtocolName	<String>	Read	44	The name of the selected protocol
NumberOfPulses	<UInt16>	Read	45	The number of pulses for the selected protocol
PulseVoltage	<UInt16>	Read	46	The pulse voltage for the selected protocol
PulseDelay	<UInt16>	Read	47	The pulse delay for the selected protocol
PulseWidth	<UInt16>	Read	48	The pulse width for the selected protocol
BufferType	<String>	Read	49	The buffer type for the selected protocol

Instrument sensors

Variable	Type	Access	NodeId	Values/Description
HeatsinkTemperature	<Float>	Read	17	Heatsink temperature
BlockTemperature	<Float>	Read	16	Thermal block temperature
PumpLidSensors	<Byte>	Read	13	Pump lid status, either open or close Bitwise value bit 1 = Extractor lid status (0 = open, 1 = close) bit 2 = Filler lid status (0 = open, 1 = close) bit 3 = Drainer lid status (0 = open, 1 = close)
TubeSensors	<Byte>	Read	15	Tube sensor status, either detected or not detected Bitwise value bit 1 = Extractor tube sensor status (0 = not inserted, 1 = inserted) bit 2 = Drainer tube sensor status (0 = not inserted, 1 = inserted)
PulseSensorIndex	Array[10] <Byte>	Read	57	Pulse index of the applied pulses, maximum up to 10 pulses • return 0 if not NA
PulseSensorStartVoltage	Array[10] <Float>	Read	58	Pulse start voltage of the pulse index • return 0 if not NA
PulseSensorEndVoltage	Array[10] <Float>	Read	59	Pulse end voltage of the pulse index • return 0 if not NA

(continued)

Variable	Type	Access	NodeId	Values/Description
PulseSensorInterval	Array[10] <UInt16>	Read	60	Pulse interval of the pulse index • return 0 if not NA
PulseSensorWidth	Array[10] <Byte>	Read	61	Pulse width of the pulse index • return 0 if not NA

Controlling

Commands

Table 2   Variables

Variable	Type	Access	NodeId	Values/Description
SelectProtocolIndex	<UInt32>	Read/Write	37	The selected protocol index. This will find the protocol details from the `protocoltable.yaml` file that is imported into the instrument. This will update variable node InstrumentDetails with either of the following: • Cannot find version number • Cannot find filename in id <id> • Cannot find id in filename <filename> • Something is wrong with the protocol table • Cannot find key id <id> in map • Unknown error: <reason> • Cannot select protocol because it is in incorrect state, please unload and load the protocol again • Unable to find protocol index • Unable to find read <name> protocol • The protocol <name> contains invalid character(s) • Unable to set <name> protocol • Found protocol index file <filename> reset = 0

Table 2   Variables *(continued)*

Variable	Type	Access	NodeId	Values/Description
RunMultiShotExtraction	<UInt16>	Read/Write	38	1= start 2 = pause 3 = resume 4 = abort 5 = resume from error 6 = skip This will update variable node InstrumentDetails with either of the following: • Cannot start extraction because instrument is not in idle state • Error encountered in dry run checks • Error encountered in dry runs • Error encountered in extraction • Starting dry run checks • Finished dry run checks • Starting fluid extraction • Finished fluid extraction
				• Error in pause extraction • Cannot pause extraction because extraction is not in progress • Paused extraction
				• Error in resume extraction • Cannot resume extraction because instrument is not pause state • Resumed extraction
				• Error in abort extraction • Cannot abort extraction because extraction is not in progress • Aborted extraction
				• Cannot resume extraction from error • Finished fluid extraction
				• Error in skipping extraction • Cannot skip extraction because extraction is not in progress • Skipped extraction reset = 0

Table 2 Variables *(continued)*

Variable	Type	Access	NodeId	Values/Description
RunMultiShotVolume	<UInt16>	Read/Write	39	Volume to run before the start of a multi-shot run reset = 0
RunMultiShotTemperature	<UInt16>	Read/Write	40	Temperature to set before the start of a multi-shot run reset = 0
RunSingleShotStart	<UInt16>	Read/Write	41	Prerequisite • Load protocol 0 = unload protocol 1 = start This will update variable node InstrumentDetails with either of the following: • Unloaded protocol • Please close the instrument door before the run • Please selected protocol before SS run • Error encounterd in singleshot run - <reason> • Error encountered in run reset = 99

Table 2   Variables *(continued)*

Variable	Type	Access	NodeId	Values/Description
RunMultiShotStart	<UInt16>	Read/Write	42	Prerequisite • Load protocol • Started extraction • Set volume and temperature 0 = unload protocol 1 = start This will update variable node InstrumentDetails with either of the following: • Unloaded protocol • Please close the instrument door before the run • Please selected protocol before MS run • Please start extraction before running multi-shot • Please set volume to be within 5 to 25 mL • Please set temperature to be within 10 to 30 deg • Error encountered in getting run time estimate • Error encountered in multi-shot run - <reason> • Error encountered in run reset = 99
RunMultiShotOp	<UInt16>	Read/Write	43	1 = Pause 2 = Resume 3 = Abort This will update variable node InstrumentDetails with either of the following: • Cannot pause because there is no active run • Cannot resume because there is no active run or run is not paused • Cannot abort because there is no active run or run is not paused reset = 0

Table 2 Variables *(continued)*

Variable	Type	Access	NodeId	Values/Description
ResetError	<UInt16>	Read/Write	67	1 = Reset error This will reset the following: • InstrumentErrorDetails "nil" • ErrorSeverity 0 • InstrumentDetails "nil" reset = 0
ResetRunStatus	<UInt16>	Read/Write	74	1 = Reset run status This will reset the following • MSRunStatus "Idle" • SSRunStatus "Idle" • RetrievalStatus "Idle" reset = 0
RunSamplePurge	<UInt16>	Read/Write	68	1 = purge This will perform a purge from the chamber to the output bag. There are various use case when the user may want to perform this. User will only be able to purge if the instrument is not currently running any protocols or extraction. e.g output tube length is longer than expected and thus there may still be some samples left in the tubing. This will update variable node InstrumentDetails with either of the following: • Error during sample purge • Unable to purge • Sample purge successful • Starting purge reset = 0
RunSampleRetrieval	<UInt16>	Read/Write	69	0 - auto (only can be performed at the end of the run) 1-25 = the amount to purge in mL This will update variable node InstrumentDetails with either of the following: • Error in sample retrieval, <reason> reset = 99

Sequence diagram to start single-shot run

(Run status will update accordingly when single-shot is started)
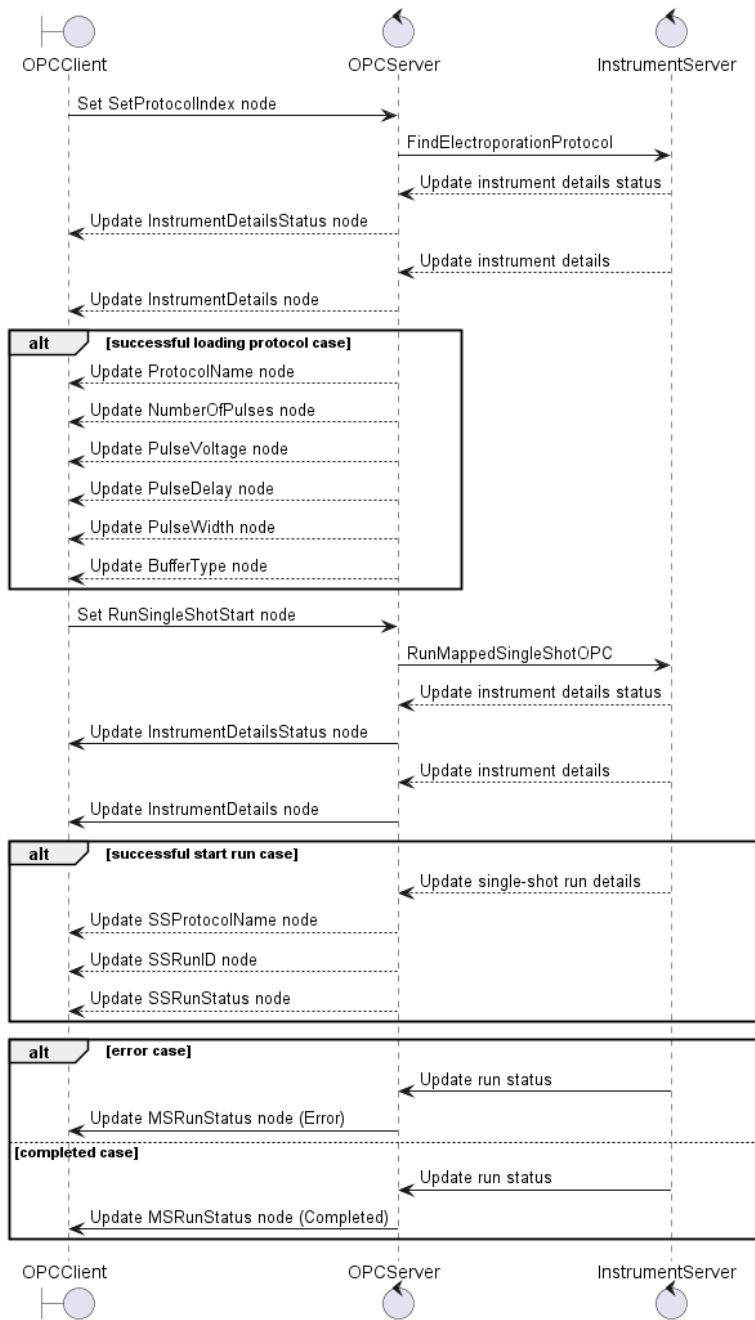
Sequence diagram to start multi-shot run

(Run status will update accordingly when multi-shot is started)

alt [successful start run case]

Update multi-shot run details

Update MSProtocolName node

Update MSRunID node

Update MSRunStatus node (Running)

Update MSRemainingTime node

Update MSCurrentStep node

Update MSRunDetails node

Update MSElapsedTime node

Update MSPausedTime node

Update MSVolumeRemaining node

Update MSVolumeCompleted node

alt [update pulsing information (after every step)]

Update pulse information

Update PulseSensorIndex node

Update PulseSensorStartVoltage node

Update PulseSensorEndVoltage node

Update PulseSensorInterval node

Update PulseSensorWidth node

alt [pause resume case]

Set MultiShotOp (1)

PauseProtocolFlowThrough

Update run status

Update MSRunStatus node (Paused)

Set MultiShotOp (2)

ResumeProtocolFlowThrough

Update run status

Update MSRunStatus node (Running)

[abort case]

Set MultiShotOp (1)

PauseProtocolFlowThrough

Update run status

Update MSRunStatus node (Paused)

Set MultiShotOp (3)

AbortRunFlowThrough

Update run status

Update MSRunStatus node (Aborted)

[error case]

Update run status

Update MSRunStatus node (Error)

[completed case]

Update run status

Update MSRunStatus node (Completed)

OPCClient   OPCServer   InstrumentServer

Locking

LockingServicesType

Variable	Type	Range	Access	Node Id	Values/Description
LockCommand	<UInt16>	1–4	Read/Write	62	This command will allow the user to initiate a lock in order to run any controlling command. 1 = InitLock 2 = RenewLock (not implemented) 3 = ExitLock 4 = BreakLock (not implemented)
Locked	<Boolean>		Read	63	false = not lock true = locked
LockingClient	<String>		Read	65	Currently this will be the session id of the locking client
LockingUser	<String>		Read	65	Currently not implemented as there is no user name from OPC-UA server
RemainingLockTime	<Duration> (build from Int64)		Read	66	Currently not implemented as there is no specific lock time

Change logs

Revisions 76 and above

- Added locking service (LockingServicesType)
- Added sample purge node (RunSamplePurge)
- Added sample retrieval node (RunSampleRetrieval)
- Added new nodes for sample retrieval details (RetrievalStatus, RetrievalTime, RetrievalVolume & RetrievalTotalVolume)
- Added run error reset node (ResetError)
- Added run status reset node (ResetRunStatus)
- Added error severity node (InstrumentErrorSeverity)
- Updated state diagram
- Updated reset node for controlling nodes (specific for DeltaV requirements)

Revisions 56

- Added new instrument sensor nodes.

1. Heatsink temperature
2. Thermal block temperature
3. Pump lid status
4. Tube sensor status
5. Pulse index
6. Pulse width
7. Pulse interval
8. Pulse start voltage
9. Pulse end voltage

B

Safety

> **WARNING! GENERAL SAFETY.** Using this product in a manner not specified in the user documentation may result in personal injury or damage to the instrument or device. Ensure that anyone using this product has received instructions in general safety practices for laboratories and the safety information provided in this document.
>
> - Before using an instrument or device, read and understand the safety information provided in the user documentation provided by the manufacturer of the instrument or device.
> - Before handling chemicals, read and understand all applicable Safety Data Sheets (SDSs) and use appropriate personal protective equipment (gloves, gowns, eye protection, and so on). To obtain SDSs, visit **thermofisher.com/support**.

C   Documentation and support

Customer and technical support

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- Worldwide contact telephone numbers
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    - Product FAQs
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- Order and web support
- Product documentation
    - User guides, manuals, and protocols
    - Certificates of Analysis
    - Safety Data Sheets (SDSs; also known as MSDSs)

  Note: For SDSs for reagents and chemicals from other manufacturers, contact the manufacturer.

Limited product warranty

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