

FMS OPC UA CLIENT DRIVER

NEW FOR FMS 5.3.0

SETUP AND CONFIGURATION

TECHNICAL BULLETIN TCC-135
(9/28/2023) REVISION E

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Intent

The purpose of this document is to detail the setup and use of the new FMS OPC UA (Unified Architecture) Client driver introduced in FMS 5.3.2. **This document does not apply for FMS OPC UA Client version 5.3.1.**



Overview

There are many monitoring devices that FMS does not have drivers written for; therefore, FMS is unable to gather data from these devices. However, there is a communications standard, OPC UA (Unified Architecture), that allows two devices/software to communicate with each other without either one needing to know prior information about the other. An OPC UA Server can share its data with an OPC UA Client or Server.

- FMS 5.3.2 introduces the OPC Foundation certified OPC UA Client, meaning FMS can connect to an OPC UA Server and collect data, much like any other Sample Point.
- FMS OPC UA Client can only connect to an OPC UA Server. In other words, it cannot connect to an OPC Classic Server. If a connection to an OPC Classic Server is needed, an OPC Gateway Server should be used.
- FMS OPC UA Client driver has been fully tested using PostGreSQL, MySQL, and MSSQL through ODBC.
- User should have a basic understanding of OPC UA and FMS.

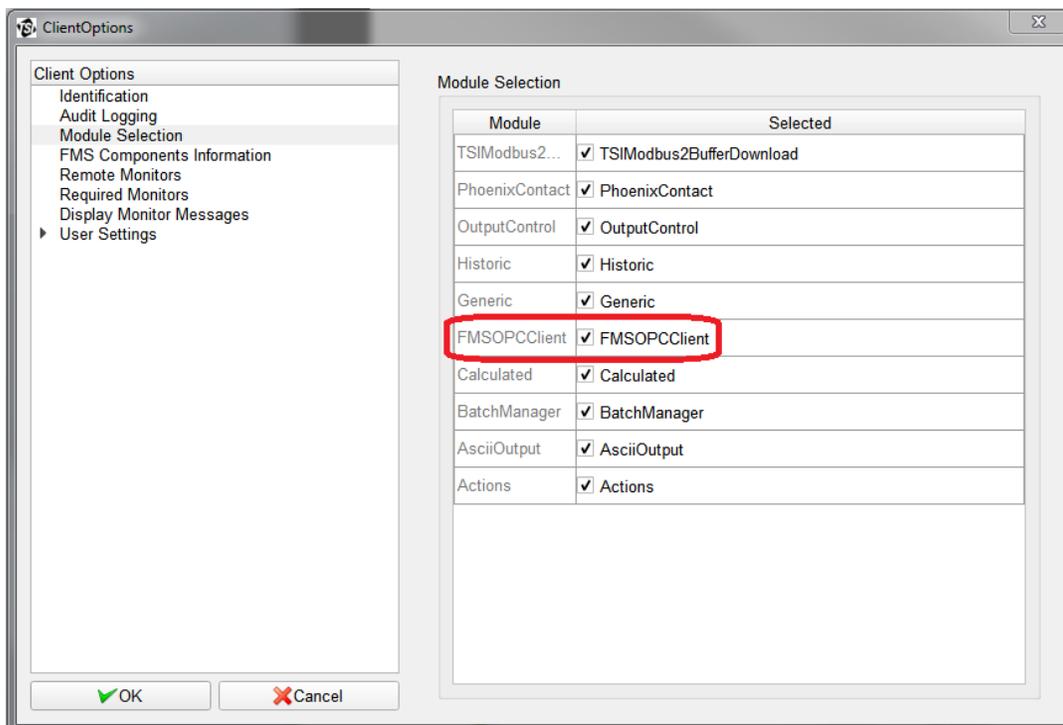
Setup and Configuration

Setup and configuration is the same for both Pharmaceutical and Semiconductor (Standard) mode.

Notes

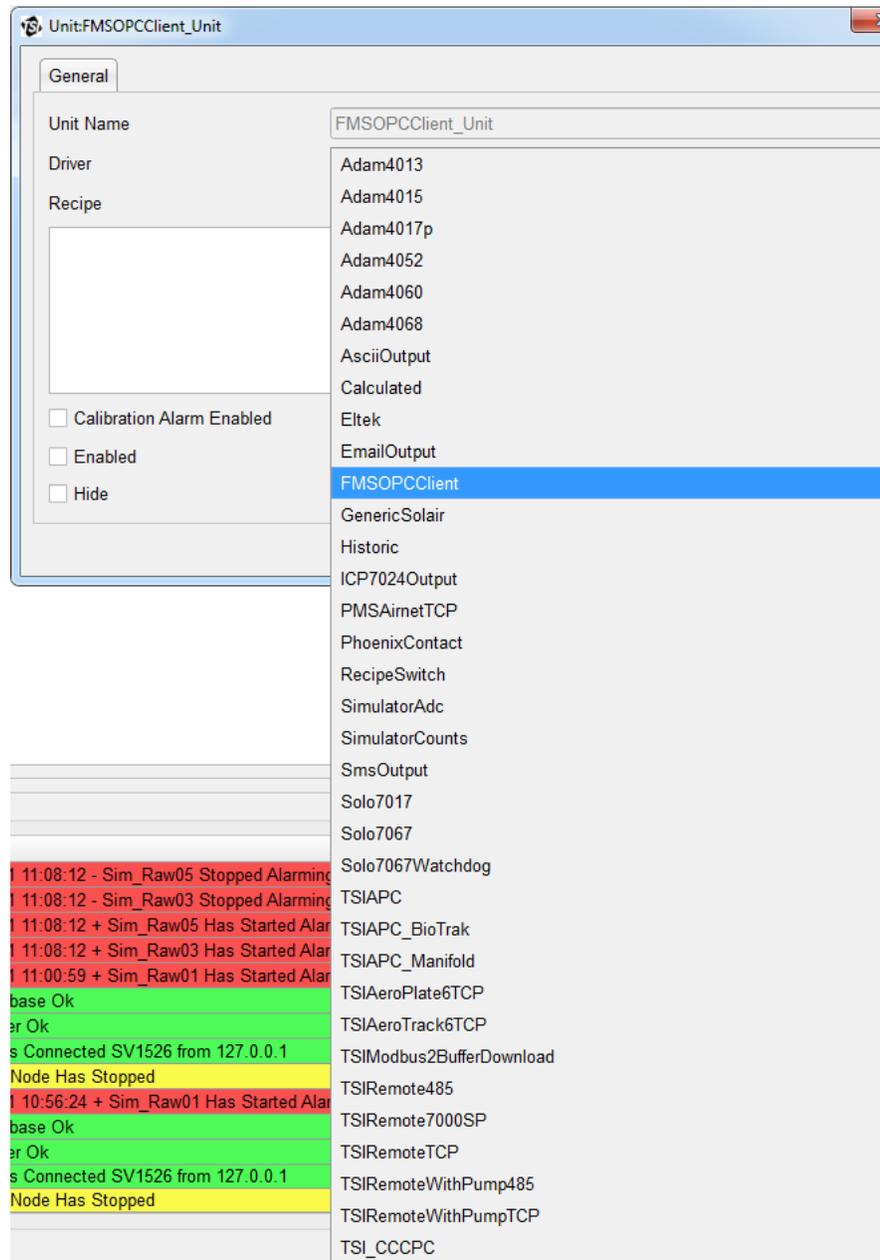
Normally, to monitor a device, FMS requires three components: Communication, Unit, and Sample Point. However, with FMS OPC UA Client, only the Unit and Sample Point are needed for configuration. The FMS OPC UA Client driver is named "FMSOPCClient."

By default, the FMS OPC UA Client driver module is disabled. If the FMS OPC UA Client driver is not selectable in the driver drop-down menu of a Unit configuration, make sure the FMS OPC UA Client module is checked under **Client Options** → **Module Selection** → **FMSOPCClient**.



Unit Configuration

1. Start by creating a new FMS OPC UA Client Unit. Select **FMSOPCClient** from the Driver drop-down list.
2. Check the **Enabled** check box and select the **OK** button to close the dialog.
3. Re-open the Unit properties window and navigate to the Driver tab. This is where the connection parameters to the OPC UA Server are configured.



4. Enter the address of the OPC UA Server in the “OPC UA Server URL” field. This must be the full URL of the server, i.e., “opc.tcp://192.168.1.5:51210/UA/SampleServer.”

Notes

Only UA-TCP UA-SC Binary Profile is implemented in FMS [i.e., SOAP-HTTP is currently not implemented (http[s])]. OPC UA Discovery service is not implemented.

If FMS is unable to connect to the OPC UA Server, there may be a networking issue. The end user’s IT department should be consulted to ensure there are no networking blockades between FMS and the OPC UA Server.

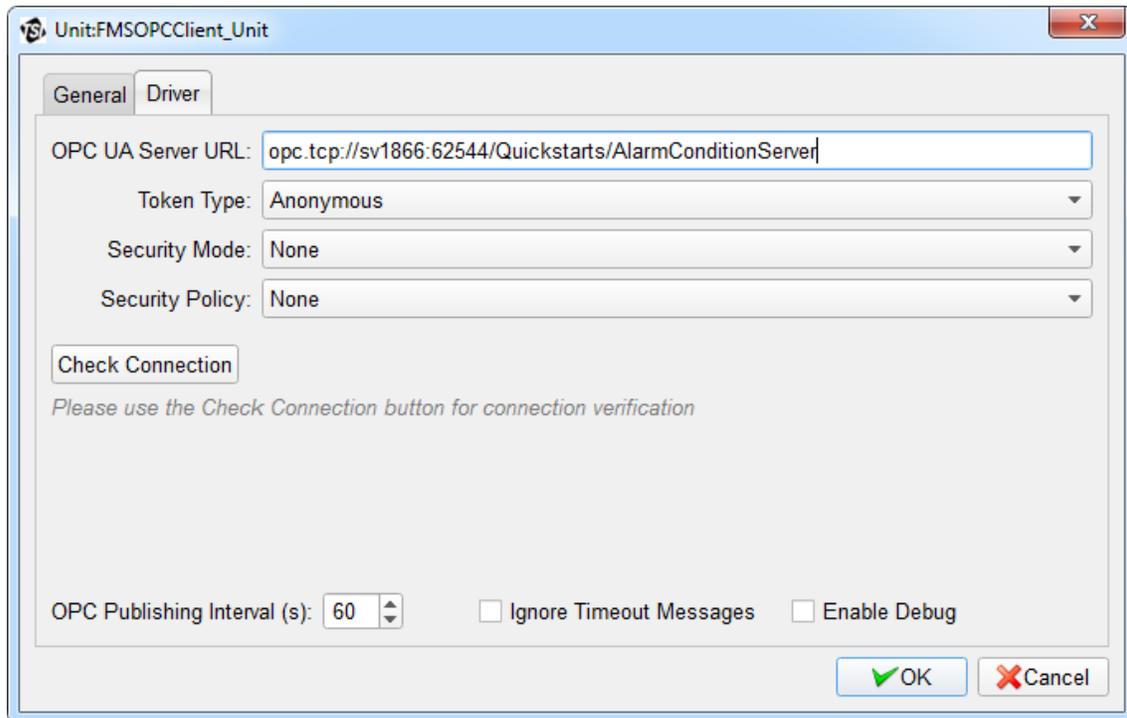
5. Select either **Anonymous** or **User Name** as the Token Type. Typically the “User Name” will be a Windows® username and password.

6. Because both of these options are unencrypted, “Security Mode” and “Security Policy” option is “None”.

Note

Only Anonymous and User Name authentications are currently implemented in FMS. SSL Certificate will be implemented in the future.

7. Click the **Check Connection** button to ensure a valid connection to the OPC UA Server can be established. A status message will be displayed below the button.



Below are screenshot examples of messages after the “Check Connection” button is pressed:

Check Connection

Wed Jul 27 07:27:50 2016: OPC Server connection successful, Good

Check Connection

Wed Jul 27 07:28:31 2016: FMSOPCCClientUnit::connectToServer failed to get end points from server,BadNotSupported error, session is null

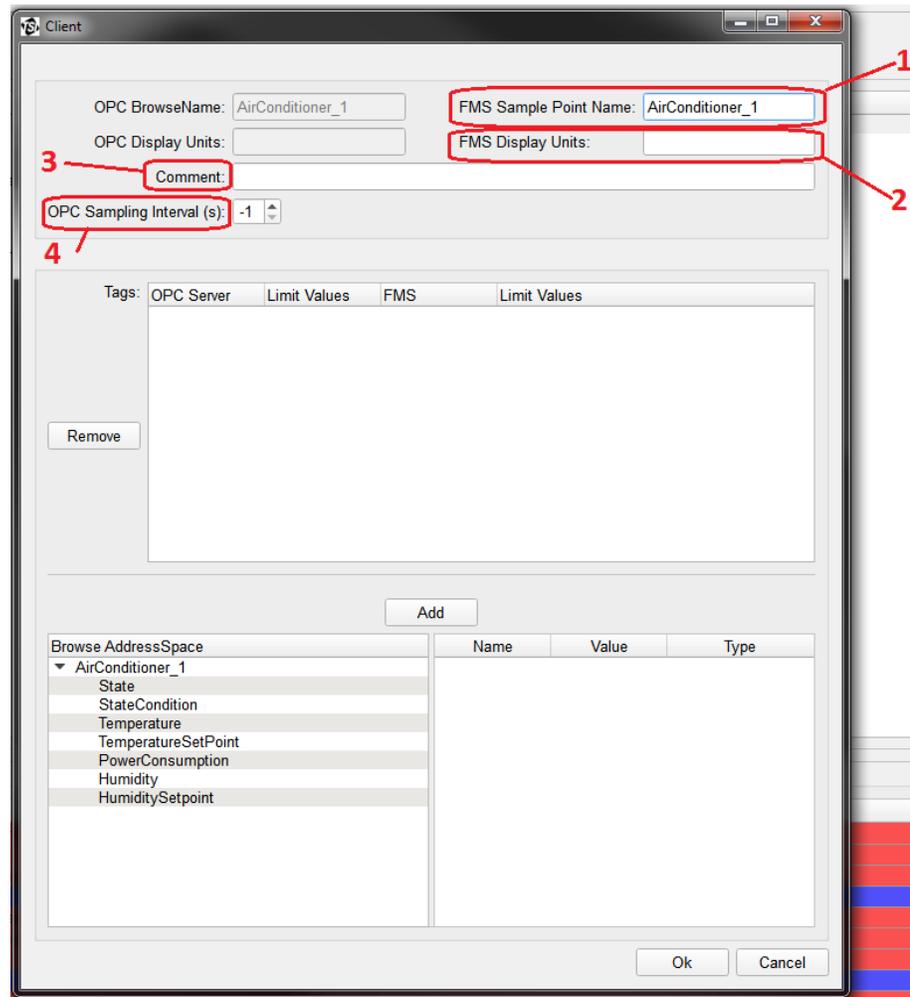
8. The “**OPC Publishing Interval**” is how often the OPC UA Server should push data to FMS.
9. The “**Ignore Timeout Messages**” prevents the unit from failure mode due to publishing interval timeout from OPC UA Server.

Notes

The OPC UA Server can change this value upon connection. If so, a message will be posted to the Alarm Log.

① “**FMS Sample Point Name**” will be the name of the FMS Sample Point. Initially, it matches the name of the OPC UA Node. Once the **Ok** button is pressed on this page, the Sample Point name cannot be changed.

② “**FMS Display Units**” are the display units that will appear on the graphs and status of the Sample Point. Leaving this field empty is permitted; however, graphs will not work. This field can be set/changed at a later date.



③ If the OPC UA Node has comments, the “**Comment**” field will be populated. This is the same field as the comments of the FMS Sample Point. This field can be changed at a later date.

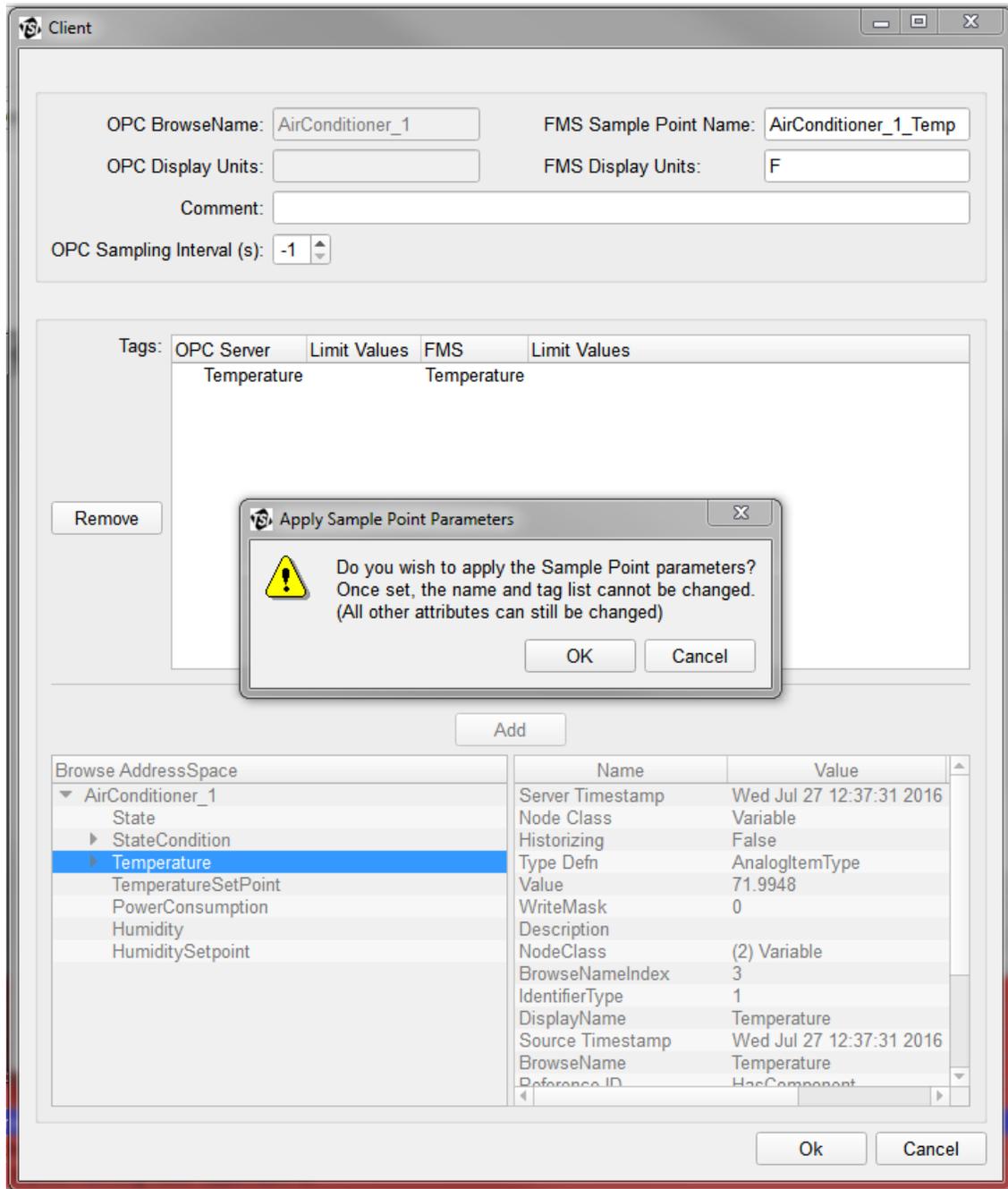
④ “**OPC Sampling Interval(s)**” is a request to the OPC UA Server of how often the OPC UA Server should attempt to get data from the instrument. This is equivalent to a Sample Period in FMS. This field can be changed at a later date.

Notes

The OPC UA Server can change this value upon connection. If so, a message will be posted to the Alarm Log. There are two special cases for this value.

- -1: indicates to match the FMS Unit’s Publishing Interval.
- 0: indicates to the OPC UA Server that it should collect data as fast as the instrument will allow.
- Sampling Interval cannot be greater than the unit’s Publishing Interval.

5. Continue to browse the Address Space until the desired node is found that should be monitored. Either right-click or push the **Add** button to add the Node as the FMS Sample Point Tag.
 - At this time, FMS OPC Sample Points are limited to one tag.
 - OPC UA Node Value or DataType must be able to be converted to a number in order for it to qualify as an FMS tag. An error message will appear if otherwise. Some examples of DataTypes that are not able to be converted to numbers are datetime stamps, arrays, multi-state values, and strings. The Value and DataType Node will be displayed in the lower right hand window.
6. Once everything is set, select the **OK** button.



Notes

The FMS Sample Point Name and the tag cannot be changed after this point. This is consistent behavior with all other FMS Sample Points. If either of these attributes needs to be changed, and the Sample Point was created but not yet saved to disk, simply delete the Sample Point and start over. However, if a change is needed but the configuration has already been saved to disk and the same Sample Point name must be used, perform the following steps.

- First delete the existing Sample Point and restart Monitor.
- Go into the database and remove or rename the Sample Point's table.
- Start Monitor and re-create the Sample Point.

7. After the Sample Point has been configured, the Driver tab will now be different. The Driver tab will contain static text fields that pertain to the Sample Point's OPC configuration. The following can still be changed:
 - a. **"OPC Sampling Interval"** is a request to the OPC UA Server of how often the OPC UA Server should attempt to get data from the instrument. This is equivalent to a Sample Period in FMS.
 - b. **"TimeStamp"** is the preferred timestamp used to log data into the database. If **"Source"** is selected, FMS will prioritize the timestamps by Source, Server, and system time. If **"Server"** is selected, FMS will prioritize the timestamps by Server, Source, and system time. **"Server"** can be particularly useful if the OPC UA Server does not provide a Source timestamp. In all cases, FMS will log all possible timestamps in the Sample Point's metadata table.

The screenshot shows a software window titled "Sample Point: AirConditioner_1" with a close button in the top right corner. The window has five tabs: "General", "SPC", "Recipe", "Alarms", and "Driver", with "Driver" currently selected. The main content area is titled "Sample Point parameters on the OPC Server" and contains the following fields:

- OPC Server BrowsePath:
- OPC BrowseName:
- OPC Display Units:
- OPC Sampling Interval: with up and down arrow buttons.
- TimeStamp: with a dropdown arrow.

At the bottom right of the window, there are two buttons: "OK" with a green checkmark icon and "Cancel" with a red X icon.

Additional Configuration Information

OPC UA Events and Alarms

1. Any OPC UA Events that were received on the FMS Sample Point level will be logged in the Event Log (e.g., an FMS Sample Point was created on the OPC UA AirConditioner_1 level; any message that comes from AirConditioner_1 will be logged in the Event Log).
2. FMS uses its own Alarm and Warning values; therefore, the OPC UA Alarms will be ignored. However, if the Tag has Alarms configured on the OPC UA Server, FMS will import these values. These values can be changed at a later date.
3. It is possible to create an FMS OPC Sample Point with no tags. If so, an “N/A” tag will be created. This could be useful if events are wanted to be logged from the OPC UA Server, but the sub nodes of the Sample Point node do not have any data.

Inconsistent Publishing Interval Value Changes

It is possible that not all Nodes on the OPC UA Server have new values on each Publishing Interval. FMS has a timeout timer, and if enough time passed where no Sample Point associated with the unit has received new values, the Unit and Sample Points will go into failure. In general, it is not recommended to monitor an OPC UA Node which has inconsistent readings. However, if it is desired, use the following steps for implementation. Create a Sample Point that has consistent readings. Then with the same Unit, create the inconsistent reading Sample Points. The consistent reading Sample Point will prevent the other Sample Point's associated with the same Unit from going into a timeout failure.

For Example: Monitoring a Furnace. The Furnace has two readings, Temperature and State. The Temperature has consistent readings (e.g., every 30 seconds); however, the State only produces a reading when the Furnace is turned on or off. If only one Sample Point was created for the Furnace, and the Sample Point was monitoring the State, the Unit will go into a timeout failure. However, if two Sample Points are created for the Furnace Unit (1 for Temperature and 1 for State), the Unit will not go into failure as long as the Temperature produces consistent readings.

Recommended Maximum Number of Sample Points per Unit

It is possible to have many FMS OPC Sample Points associated with a single Unit, and is the recommended configuration. It is considered OPC UA best practices to **only have one Unit per publishing interval to any given server**. An FMS OPC UA Unit corresponds to one subscription to the OPC UA Server. While most OPC UA Servers allow more than one subscription, additional subscriptions can produce unnecessary overhead on the server.

Status and Metadata (Additional Information) for Sample Periods

The Status window of an FMS OPC Sample Point works much the same way as any other Sample Point with the exception of metadata. Normally with FMS, on each Sample Period, each tag will have a value: the state of the entire Sample Period, timestamp, and any message as appropriate. However, with OPC UA, some additional information is available. To access this information, open an OPC Sample Point's inspect window from the Status page. Right-click on a Sample Period and select **Display Metadata** to open a new table. This entire table contains more information for a single Sample Period. Information can include real-time or historical data reading, quality of the value, the value, which timestamp was used, and all of the available timestamps. There are usually three timestamps in an FMS OPC Sample Point.

- Source Timestamp: The timestamp from the instrument.
- Server Timestamp: The timestamp of when the OPC UA Server received the value.
- FMS System Timestamp: The timestamp of the computer when the value was inserted into the database.

By default, FMS will try to use the Source timestamp first. If unavailable, the Server and next the FMS timestamp. Source and Server timestamp priority can be configured in the Sample Point's configuration.

p_id	title	description	f_id
501109	Type	Real time (non historizing) data	140267
501110	Value	Value(Double) = 72.0335;	140267
501111	Quality	0: Good	140267
501112	Timestamp used	Source Timestamp	140267
501113	FMS System Timestamp	2016-08-05T13:27:45Z	140267
501114	Source Timestamp	2016-08-05T13:27:09Z	140267
501115	Server Timestamp	2016-08-05T13:27:09Z	140267

05-08-2016 13:27:09	Ok	72.03
05-08-2016 13:26:59	Ok	71.97
05-08-2016 13:26:49	Ok	72.10
05-08-2016 13:26:39	Ok	72.03
05-08-2016 13:26:29	Ok	71.97
05-08-2016 13:26:19	Ok	72.10
05-08-2016 13:26:09	Ok	72.03

Certificate Usage

The PKI store contains many folders that contain the certificates required to operate the FMS OPC UA Server.

- **All Certificates** contains certificates and private keys which are created by “create_fms_store.bat” during the creation of the FMS OPC UA Server application instance certificate.
- **Batches** contains files used during the creation of the FMS OPC UA Server application instance certificate.
- **Cert** contains the FMS OPC UA Server application instance certificate.
- **CRL** contains the FMS OPC UA Server certificate revocation list.
- **Issuer** contains any OPC UA Client issued certificates.
- **Private** contains the FMS OPC UA Server application instance private key.
- **Rejected** contains the FMS OPC UA Server rejected OPC UA Client certificates.
- **Trusted** contains the FMS OPC UA Server trusted OPC UA Client certificates.

Troubleshooting

Some Unit Connection Errors and Causes

BadUserAccessDenied	The given User Name or password is not found on the OPC UA Server
BadDisconnect	The specified Server URL cannot be found
BadNoMatch	The Server does not support the selected Token Type
BadCertificateUntrusted	The OPC UA Server certificate must be copied to the FMS PKI Store trusted folder

Customizable Clients Parameters Settings

Parameter	Default	Description
LifetimeCount	3	Maximum Lifetime count of the Subscription. The life time count defines how many times the publish interval expires without having a connection to the client to deliver data. If the life time count reaches maxKeepAliveCount , the subscription will automatically terminate. OPCUA Spec: The life-time count shall be a minimum of three times the keep keep-alive count.
MaxKeepAliveCount	1	Maximum of the Subscription Keep Alive counter. Requested maximum keep-alive count. When the publishing timer has expired this number of times without requiring any NotificationMessage to be sent, the Subscription sends a keep-alive Message to the Client.

Parameter	Default	Description
MaxNotificationsPerPublish	0	<p>Maximum number of notifications for each publish response.</p> <p>MaxNotificationsPerPublish specifies the maximum number of notifications that the Client wishes to receive in a single Publish response. A value of zero indicates that there is no limit.</p> <p>The server may send fewer notifications in one message if its own limit is lower</p>
DataChangeTrigger	1	<p>Specifies the conditions under which a data change notification should be reported by the OPC UA Server. It has the following values:</p> <p>Value of 0 means: OPC UA Client get Data if the Status Code changed have changed on the OPC UA Server.</p> <p>Value of 1 means: OPC UA Client get Data if either the StatusCode or the value have change on the OPC UA Server. The Deadband filter can be used in addition for filtering value changes</p> <p>Value 2 means: OPC UA Client get Data if either StatusCode, value or the SourceTimestamp have changed on the OPC UA Server. If a Deadband filter is specified, this trigger has the same behavior as of a Value 0</p>
DeadbandType	0	<p>Value 0 means: no Deadband filtering.</p> <p>Value 1 means: Absolute Deadband. A notification is generated if the absolute value of the difference between the last cached value and the current value is greater than the deadband value.</p> <p>Value 2 means: Percent Deadband. Only valid for AnalogItems with an EURange property. A notification is generated if the absolute value of the difference between the last cached value and the current value is greater than value percent of the EURange.</p>

Parameter	Default	Description
DeadbandValue	0	<p>A deadband is the range that tag value can vary until it is logged. Applying a deadband to tags is useful for filtering out inconsequential data, which conserves network and machine resources while reducing the data footprint.</p> <p>Value 0 means: Absolute Deadband. When a new value is received from the OPC server, it must differ from the previously logged value by more than the specified amount. If it did not increase or decrease by more than the specified value, the value gets discarded.</p> <p>Value 1 means: Percent Deadband. Percent deadband means the deadband range is equal to a percentage of the incoming value. Most OPC UA Servers do not support percent deadbanding.</p>

Helpful Hints

Historical Data

1. In the case where FMS Monitor goes down or loses connection to the OPC UA Server for a period of time, when the connection is re-established and the first data is received from the OPC UA Server, FMS will request historical data from the OPC UA Server for the time that was lost.
2. Not all OPC UA Servers have historical data capabilities. In this case, a request will still be made but no historical data will be received.
3. FMS will request up to the last 3000 Sample Periods worth of data.
4. FMS will not request historical data during a recipe change.

Failures

1. In the case of an OPC UA Subscription or Monitored Item error, FMS will fail the Sample Point or Unit and post the error message.
2. If FMS does not receive any new values after a timeout period that is calculated based off of the Unit's Publishing Interval, all of the Sample Point's associated with the Unit will go into a timeout failure.

Miscellaneous

1. An FMS OPC Unit represents a single session and subscription to an OPC UA Server.
2. An FMS OPC Sample Point represents a Monitored Item to an OPC UA Server. Each tag in the Sample Point is also a Monitored Item.
3. There is no limit to the number of FMS OPC UA Sample Points per FMS OPC UA Unit. However, considerations should be made to the limitations of FMS and the server. FMS has been tested with hundreds of Sample Points for a single Unit; however, this may not be the case with all servers as each client-server overhead interactions can be different depending on the systems.

Revision History

Revision	Released	Description
A	19 August 2016	First Released
B	22 Sept 2016	Added: Sample Point Configuration, Step 7 Revised: Maximum Sample Points per unit section with OPC recommendation. Revised: Miscellaneous 3.
C	23 Sept 2017	Updated screen in unit configuration Added: Unit Configuration, Step 9
D	9 April 2020	Revised for FMS 5.5.1 SU130. <ul style="list-style-type: none">• Added Certificate Usage Section.• Added Troubleshooting section
E	01 October 2023	Added Customizable Clients Parameters Settings Section.

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