**Spatial Analyzer OPC UA Client**

1. **Configuration Files**

In C:\Program Files (x86)\New River Kinematics\SpatialAnalyzer 2025.3.0724.2 (alpha)\x64

* SpatialAnalyzer.config.xml
* NRKOpcUaClientCSDLL.runtimeconfig.json

1. **Certificates**

A certificate with a name of the form:

SpatialAnalyzer [993FEBC5D559797D7E4B77634B58D3DD3910B4E3].der

will be created and stored in the application certificate store path as defined in the configuration file “SpatialAnalyzer.config.xml”. This is currently specified as:

C:\ProgramData\OPC Foundation\pki\own\certs

1. **Logs**

When an instance of spatial analyzer is instantiated, trace and diagnostic logging begins to the following files:

C:\Users\<User>\AppData\Local\Hexagon\OPC UA\SpatialAnalyzer\OPC UA Client Log.txt

C:\ProgramData\OPC Foundation\Logs\ NRKOpcUaClient.SpatialAnalyzer.log.txt

The second file in this list is specified in the “SpatialAnalyzer.config.xml” file under the “TraceConfiguration” entry.

1. **Configuration**

An auto run MP script can be specified and enabled to run on startup.

* The directory to serve as a repository for MP scripts specified without full path specification can be defined and will be stored to the registry if the auto run mode is set to “**Auto Run On Application Start**”. If the auto run mode is set to “**Auto Run On Document Load**”, then the registry entry for this directory will not be modified and this directory will be set from the entry stored with the job file.
* The MP script file to be run with or without full path specification can be defined and will be stored to the registry if the auto run mode is set to “**Auto Run On Application Start**”. If the auto run mode is set to “**Auto Run On Document Load**”, then the registry entry for this file will not be modified and this file will be set from the entry stored with the job file.
* Auto run behavior:
  + “**Disable Auto Run**” will prevent any auto run MP from executing.
  + “**Auto Run On Application Start**” will use the registry entries to determine which MP script is to be run and then execute it upon application start.
  + “**Auto Run On Document Load**” will use the entries stored with the job file to determine which MP script is to be run and execute it when the job file has been loaded.

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AI-generated content may be incorrect.

1. **MP Commands**

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This connects SA to the specified OPC UA server. There is only one SA OPC UA client interface within the context of an instance of SA and once a connection has been established, it will persist until it is explicitly disconnected or the application terminates. Currently, this connection can only be explicitly disconnected via the MP command “Disconnect from OPC UA Server”.

A0 – The URL end point for the OPC UA server

A1 – The time interval allowed to elapse per OPC UA client/server transaction before an error is declared and the transaction is terminated on error.

A2 - The time interval allowed to elapse for OPC UA client inactivity before the session times out.

A3 - This will set the enabled state for the SA heartbeat. If TRUE the heatbeat will toggle between TRUE and FALSE at the specified interval.

A4 - The OPC UA server node to which the SA heartbeat is to be written.

A5 - The time interval between SA heartbeat updates.

A6 - The maximum number of successive failed attempts to write the SA heartbeat to the server before the SA heartbeat is deactivated.



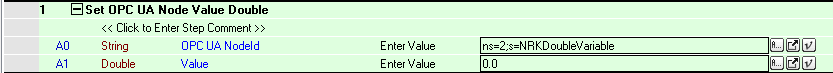
This disconnects SA from any current OPC UA server connection.



This will activate a diagnostic display that will provide information regarding OPC UA data exchange between SA and the OPC UA server.

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This will write the specified value to the specified OPC UA server node.

A0 - The OPC UA server node to be updated.

A1 - The value to be written to the OPC UA server node.

Note that if the target node is not a double type, then an error will occur.

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AI-generated content may be incorrect.

This will read the value from the specified OPC UA server node.

A0 - The OPC UA server node to be read.

A1 - The returned value.

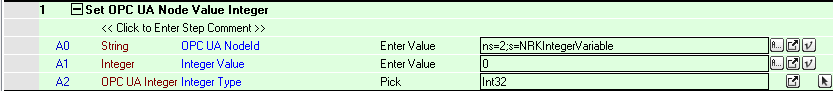
A2 - The status code for the returned value – non-zero values are BAD results.

A3 - The source timestamp for the returned value. The timestamp specific to when the source generated this value.

A4 - A finer resolution source timestamp for the returned value specific to when the source generated this value.

A5 - The server timestamp for the returned value. The timestamp specific to when the server last processed or updated this value from the source.

A6 - A finer resolution server timestamp for the returned value specific to when the source last processed or updated this value from the source.



This will write the specified value to the specified OPC UA server node.

A0 - The OPC UA server node to be updated.

A1 - The value to be written to the OPC UA server node.

A2 - The type of integer to be written. The choices are:

* Int16
* Int32
* Int63
* UInt16
* UInt32
* UInt64
* Boolean
* Byte

Note that if the target node is not the proper integer type, then an error will occur.

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AI-generated content may be incorrect.

This will read the value from the specified OPC UA server node.

A0 - The OPC UA server node to be read.

A1 - The returned value.

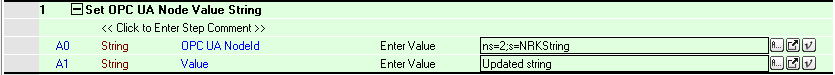
A2 - The status code for the returned value – non-zero values are BAD results.

A3 - The source timestamp for the returned value. The timestamp specific to when the source generated this value.

A4 - A finer resolution source timestamp for the returned value specific to when the source generated this value.

A5 - The server timestamp for the returned value. The timestamp specific to when the server last processed or updated this value from the source.

A6 - A finer resolution server timestamp for the returned value specific to when the source last processed or updated this value from the source.



This will write the specified value to the specified OPC UA server node.

A0 - The OPC UA server node to be updated.

A1 - The value to be written to the OPC UA server node.

Note that if the target node is not a string type, then an error will occur.

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AI-generated content may be incorrect.

This will read the value from the specified OPC UA server node.

A0 - The OPC UA server node to be read.

A1 - The returned value.

A2 - The status code for the returned value – non-zero values are BAD results.

A3 - The source timestamp for the returned value. The timestamp specific to when the source generated this value.

A4 - A finer resolution source timestamp for the returned value specific to when the source generated this value.

A5 - The server timestamp for the returned value. The timestamp specific to when the server last processed or updated this value from the source.

A6 - A finer resolution server timestamp for the returned value specific to when the source last processed or updated this value from the source.

**Subscription Services**

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This will subscribe to changes in the specified OPC UA server node. Whenever the specified node is updated, then a callback will be activated which will take actions as per the selected “Callback Action”. Note that subscriptions remain active subsequent to the completion of the MP that initializes them.

A0 - The OPC UA server node for the subscription.

A1 - The time interval at which the server will sample the node for changes.

A2 - The time interval at which the server will notify the client that a node has changed.

A3 - The callback action to be performed with a subscribed node changes.

A4 - The OPC UA server node providing argument data for the callback action to utilize.

Callback actions:

* “**MP Select**” – the subscribed OPC UA server node must be of string type and the associated callback for this node will retrieve the string from the cached results retained for the specified “Callback Argument NodeId” and set this string as the file name for an MP script that will be queued for launch.
* “**MP Load**” – the subscribed OPC UA server node must be of Boolean type and provided that the value for this node is set to TRUE, the associated callback for this node will load the MP script file previously specified by “MP Select”. If this file cannot be successfully loaded, then an “SA Error” status is set. The “Callback Argument NodeId” value is not used.
* “**MP Start**” – the subscribed OPC UA server node must be of Boolean type and provided that the value for this node is set to TRUE, the associated callback for this node will verify that there is no currently active MP, that an MP has been loaded, and then start the previously loaded MP. If the MP is not successfully started, then an “SA Error” status is set. . The “Callback Argument NodeId” value is not used.
* “**MP Abort**” – the subscribed OPC UA server node must be of Boolean type and provided that the value for this node is set to TRUE, the associated callback for this node will terminate any currently running MP. . The “Callback Argument NodeId” value is not used.
* “**PLC Heartbeat**” – the subscribed OPC UA server node must be of Boolean type. Currently, the associated callback for this node only outputs diagnostic updates to the diagnostic display. . The “Callback Argument NodeId” value is not used.



This will unsubscribe from the specified OPC UA server node.

A0 - The OPC UA server node for the subscription.



This will unsubscribe from all OPC UA server nodes.

**Notification Services**

SA has an MPOpcUaManager that provides a monitoring service that runs in a 500 Msec loop such that any enabled registered services can provide notification to the OPC UA server specific to the status of the monitored services. Note that the timer granularity of this service is 500 Msec.



Stops the monitoring service loop.

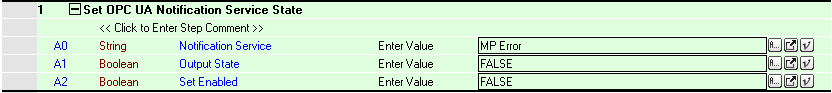
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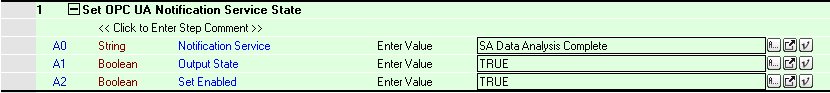
Registers a service for a monitored condition.

A0 - The notification event to be monitored.

* “**MP Command Ready**” – This will be set to FALSE and transmitted to the OPC UA server whenever an MP script starts and be set to TRUE and transmitted to the OPC UA server when the MP completes. It is expected that this will normally be initialized as enabled because it is being set from an MP and therefore the “**Initial Output State**” should be set to FALSE since an MP is obviously being executed. It is expected that this will be setup as a “**One Shot**” notification which means that it will transmit one update to the OPC UA server and then set its enabled state to FALSE.
* “**MP Busy**” – It is expected that this will normally be setup as a “**Timeout**” notification. At the start of each MP step, the timeout for this notification will be reset.
  + If the enable state for this notification was initially FALSE, then a reset will set the enabled state to TRUE and output the “**Initial Output State**” to the OPC UA server.
  + If the enable state is already TRUE, then the timer will reset but no output will be sent to the OPC UA server.
  + If a timeout for this notification occurs, then the inverse of “**Initial Output State**” is sent to the OPC UA server and the notification enabled state is set to FALSE.
  + If MP steps execute within the time interval specified by “**Update Interval**”, the notification will be reset to prevent any instances of “**MP Busy**” status as FALSE being sent to the OPC UA server.
  + Note that if the status does go to FALSE, it will reset back to TRUE with the initiation of the next MP step.
* “**MP Complete**” – This will be set to FALSE and transmitted to the OPC UA server whenever an MP script starts and be set to TRUE and transmitted to the OPC UA server when the MP completes. It is expected that this will normally be initialized as enabled because it is being set from an MP and therefore the “**Initial Output State**” should be set to FALSE since an MP is obviously being executed. It is expected that this will be setup as a “**One Shot**” notification which means that it will transmit one update to the OPC UA server and then set its enabled state to FALSE.
* “**MP Error**” – This will be set to an internal value of TRUE whenever an MP script starts. When the MP completes, the internal value of “**MP Error**” is output to the OPC UA server. This means that within a running MP script, an explicit call to “**Set OPC Notification Service Status**” as shown must be executed to set “**MP Error**” internal state to FALSE.



* “**SA Data Analysis Complete**” – This will only be output when explicitly executed as an MP step.



It is expected that this will be setup as a “**One Shot**” notification which means that it will transmit one update to the OPC UA server and then set its enabled state to FALSE.

* “**SA Error**” – This will be set to TRUE and output to the OPC UA server whenever:
  + Subscribed event “**MP Load**” callback fails to load selected MP specified by subscribed event “**MP Select**”.
  + Subscribed event “**MP Start**” callback fails to initiate execution of currently MP loaded by “**MP Load**”.

A1 - The target node on the OPC UA server to which the notification is to be written.

A2 - The initial internal state for this notification.

A3 - The interval timer mode:

* “**One Shot**” – if notification is enabled, then when an instance of the notification event occurs, the internal state for this notification is transmitted to the OPC UA server and the notification is then disabled.
* “**Pulse**” – if notification is enabled, then when an instance of the notification event occurs, the internal sate for this notification is output to the OPC UA server and then after the time interval specified by “**Update Interval**” has elapsed, the inverse of the internal state of this notification is output to the OPC UA server and the notification is then disabled.
* “**Periodic**” – if notification is enabled, then the internal state for this notification is output to the OPC UA server at time intervals specified by the “**Update Interval**”.
* “**Timeout**” – if notification is reset while it is disabled, the internal state of this notification is output to the OPC UA server, the notification is enabled, and a timeout is started with the timeout interval set as per the “**Update Interval**”. If the notification is periodically reset before the timeout interval elapses, then the timeout is restarted, and no further action occurs. If the notification is not reset within the timeout interval, then the inverse of the internal state is sent to the OPC UA server, and the notification is disabled.
* “**Heartbeat**” – if notification is enabled, then the internal state for this notification is output to the OPC UA server at time intervals specified by the “**Update Interval”** and then the internal state is toggled to its inverse.

A4 - The update interval utilized by the various timer modes.

A5 - If the notification is registered with this value set to TRUE, then an immediate notification will be posted to the OPC UA server if the OPC UA Notification Services are running.

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Registers a service for a monitored condition.

A0 - The notification event to be monitored. When this is set to “**MP Select Echo**”, when the subscription event “**MP Select**” occurs, then this notification is activated.

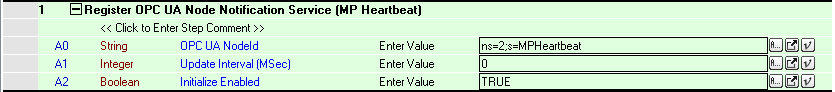
A1 - The target node on the OPC UA server to which the notification is to be written.

A2 - The is the initial internally stored filename for the MP script to be loaded when an “**MP Load**” subscription event occurs. It is expected that this will be replaced by a filename provided by an “**MP Select**” subscription event/

A3 - The interval timer mode is expected to normally be set to “**One Shot**” for a “String” node notification although other timer modes are permissible.

A4 - The update interval utilized by the various timer modes.

A5 - If the notification is registered with this value set to TRUE, then an immediate notification will be posted to the OPC UA server if the OPC UA Notification Services are running. For “**MP Select Echo**”, it is expected that this value will normally be set to FALSE.



The monitored condition for this notification is that of a running MP. Whenever an MP is started, the “**MP Heartbeat**” notification is enabled and will remain enabled until the MP completes.

A0 - The target node on the OPC UA server to which the notification is to be written.

A1 - The update interval utilized by the heartbeat timer. At each update, the internal state of this notification is output to the OPC UA server and then toggled.

A2 - The initial internal state for this notification. Since this is being set within the context of an MP script, it is expected that this value would normally be set to TRUE.

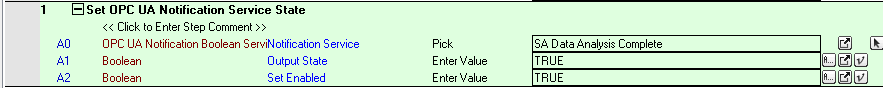


Removes specified notification service from the list of registered services.

A0 - The service to be unregistered.



Removes all notification services from the list of registered services.

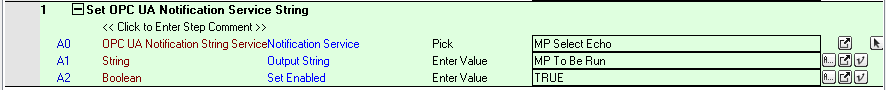


This facilitates the setting of the internal state of selected notifications.

A0 - The service for which the internal value is to be updated.

A1 - The internal state to be set for this notification.

A2 - If set to TRUE, then this notification will set this notification for immediate transmission to the OPC UA server. If set to FALSE, then the internal state will be updated but this notification will not be sent to the OPC UA server until the notification is enabled.



This facilitates the setting of the internal string data of selected notifications.

A0 - The service for which the internal value is to be updated.

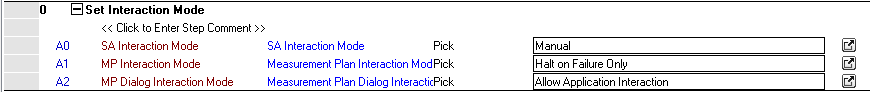
A1 - The internal string to be set for this notification.

A2 - If set to TRUE, then this notification will set this notification for immediate transmission to the OPC UA server. If set to FALSE, then the internal state will be updated but this notification will not be sent to the OPC UA server until the notification is enabled.



A0 - The service for which the timeout is to be reset.

1. **Example Initialization MP Script**



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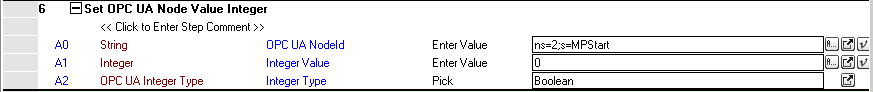
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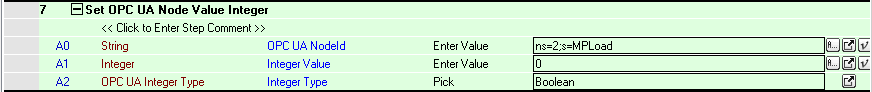


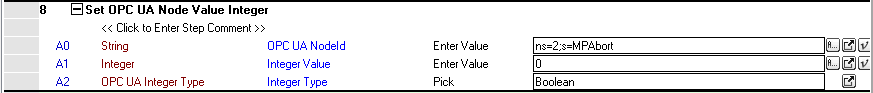


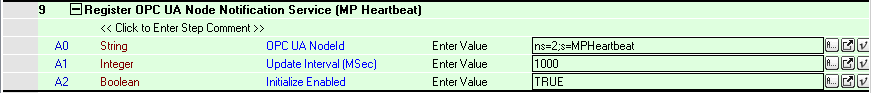












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A close-up of a computer screen

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