SIEMENS

Edge

Edge app
IIH Configurator for Industrial Edge V1.5

Application Manual

11/2022; V1.5
A5E51424386-AE

Legal information

Warning notice system

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

⚠ DANGER

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

⚠ WARNING

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

⚠ CAUTION

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

NOTICE

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

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

Qualified Personnel

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

Proper use of Siemens products

Note the following:

⚠ WARNING

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

Trademarks

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

Disclaimer of Liability

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

Siemens AG
Digital Industries
Postfach 48 48
90026 NÜRNBERG
GERMANY

A5E51424386-AE
Ⓟ 11/2022 Subject to change

Table of contents

Legal information

1

1.1 Security information

Security information

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

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

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

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

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

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

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

https://www.siemens.com/cert (https://www.siemens.com/cert).

1.2 Security Information for Industrial Edge Apps

Security information (assumptions/constraints) for Industrial Edge Apps is as follows:

- Only authorized internal operators will have access to Industrial Edge Device within a secure network using VPN connection.
- Perimeter firewall configuration responsibility lies with the end customer.
- The security guidelines for usage of USB Flash Drives in the shop floor area are applied accordingly.
- Creating users with appropriate access rights upon commissioning is the responsibility of the operator.

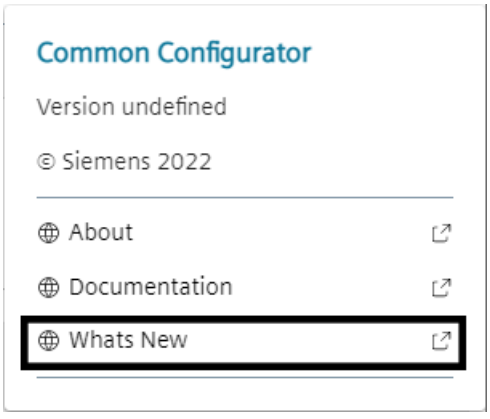
- The customer is responsible for configuring the application on the basis of the system requirements and technical capabilities of the documented App according to the Installation / User Manual such that the automation system performance is not impacted.
- The system is installed in an environment ensuring that physical access is limited to authorized maintenance personnel only. Managing unauthorized attachment of removable devices is the responsibility of the operator.
- The platform including hardware, firmware and operating system is securely configured and maintained by the operator.
- The operator is capable of protecting the environment from malware infection.
- Centralized IT security components (Active Directory, Centralized IT Logging Server) are provided and well secured by the operator and are trustworthy.
- The operator personnel accessing the system is well trained in the usage of the system and general information security aspects like password handling, removable media, etc.
- The operator is responsible for the CIA (Confidentiality, Integrity and Availability) of data stored outside the Industrial Edge Device.
- The operator is responsible for configuring the CPUs with appropriate read/write access levels (legitimization), and for configuring the Industrial Edge Apps using appropriate passwords for data collection from CPUs.
- The customer takes care about the time synchronization of Industrial Edge Management and Industrial Edge Device.

What's new in the IIH Configurator? 2

2.1 Overview

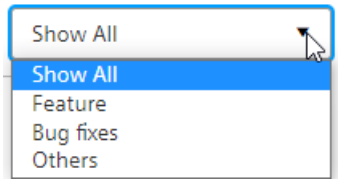
Description

All information on "What's new" can also be found in the IIH Configurator at:



Filtering

Use the filter to specifically view the information from "What's new":



2.2 What's new in IIH V1.5

All important innovations of the IIH Configurator are summarized here. For more details on the individual topics, refer to the documentation.

Bug fixes

- Assignment error when S7+ connector tags of multiple CPUs were assigned has been corrected.
- Problems loading models when using the Siemens Information Model Kit and PackML-based models have been corrected.

- Corrected connection problems (missing first update and missing time stamp) when using the Softing edgePlug connector.
- Problems preventing the asset model from being correctly loaded in the "Organize data" tab even though the asset model is available in the "Provide information" tab have been corrected.
- Problems loading models with PackML-based models have been corrected.
- Multiple bug fixes throughout the IIH Configurator
- Bug fix for companion models not being correctly loaded under certain circumstances.
- Highlighting of the asset selection

"Get data" tab

1. With the "Backup & Restore" option, you can back up and restore the configuration of the connectors in the IIH Configurator.
2. Improvements when importing tags:
   – Merging data points with the same data source is supported.
   – Overwriting data points with the existing data points.
   – Validation and modification options for specifying the right IP address when there are multiple IP addresses.
3. Showing or hiding columns:
   – You can show or hide the columns on the tag details page for each connector.
   – The selected columns are retained based on the individual connector configuration.
4. Support for additional file function extensions according to the connector specification:
   – You may upload various files (configuration files, certificate files, etc.).
   – You can upload multiple files.
5. Option to download log files:
   – You can download the log files that are displayed on the connector overview page. The log files can be used to analyze or debug connector-related problems.

"Organize data" tab

1. Data type validation is supported during assignment. This allows the tag data type to be validated with the data type of the OPC UA / asset model variables during the assignment. You can find additional information here: Assigning tags to a model (Page 50)
2. Live syntax validation is supported for the transformation rules. This allows the user to validate the syntax of the transformation rule and valid operands and operators before a rule is applied to a tag.
   You can find more information on supported operands and operators and the syntax of the transformation rules here: Transforming data (Page 51)
3. You can import and export the settings and information in the "Organize data" tab. This allows you to export the current status for a specific combination of model and namespace and work on it offline in order to complete the assignment and import it back in the "Organize data" tab. Note: Only Json format is supported.
   You can find additional information here: Importing and exporting data models (Page 54)

"Provide information" tab

1. Data definition: Option for onboarding a selection of nodes of instance models.
2. IIH Configurator: Backup & Restore
   You can find additional information here:
   Data backup (Page 93)
   Restoring data (Page 95)
3. GraphQ editor: Support for extended query conditions ("or" and "not") and various improvements to increase user friendliness.
   You can find additional information here: Query options with GraphQL in IIH and Altair (reading, writing, notifications and filtering). (Page 73)
4. Provide information: Option for retaining the page status after navigating away and back.

IIH Core V1.5.0

1. Asset models that were created in Data Service <V1.4 can now be migrated to the IIH Core. This enables access also via an OPC UA server. They are also available for configuration using the IIH Configurator, for example in order to be assigned new tags, selectively synchronized with the MindSphere, etc.
2. IIH OPC UA server: Supports subscription of events received from OPC UA servers connected to the IIH Core.
3. IIH OPC UA server: Gets OPC UA methods of the connected OPC UA servers. This enables a method in the connected OPC UA server to be called via the IIH OPC UA server.
4. IIH GraphQL API: Reading (querying), writing (mutation) and subscription of OPC UA variables of the connected OPC UA servers is now available using the IIH GraphQL API.
5. Supports the browsing and selection of certain OPC UA nodes for subscription of live values in connected OPC UA servers before they are loaded into the IIH aggregation server.

"Backup data" tab

1. Automatic integration from standalone Data Service to IIH mode is supported. When switching to IIH mode, the data already configured is retained.
   You can find more information on integration here: Integrating Data Service into the IIH (Page 57)
2. Changing models in IIH mode
   All APIs from the Data Service work in both modes (standalone or IIH).
   Apps that access APIs that change the model now also work with the Data Service in IIH mode.
3. Full-screen view for user interface dialogs
   The configuration of assets, aspects and variables has been improved by combining all configurations of each of these objects in a full-screen view. Now you find all configurations on this object in one place.
   You can find additional information here: Setting data retention for an individual variable (Page 60)
4. Enabling/disabling data retention of a variable
   Data retention can be temporarily disabled for individual variables. Each variable has a check box that indicates whether it is currently storing new values. In IIH mode, this is directly linked to the archive flag of the IIH Configurator.

See also

Backing up and restoring data (Page 93)

2.3 What's new in IIH V1.4?

All important innovations of the IIH Configurator are summarized here. For more details on the individual topics, refer to the documentation.

"Get data" tab

- Global import option for SIMATIC S7+ Connector
- Support for different acquisition cycles for Connectivity Suite Connectors to publish data to IE Databus
  - 100 milliseconds
  - 250 milliseconds
  - 500 milliseconds
  - 1 second
  - 2 seconds
  - 5 seconds
  - 10 seconds
- The configuration of the PROFINET IO Connector is supported.

- Usability improvements
  - Registry service availability is displayed
  - Connectors availability is displayed
  - Databus APP availability is displayed
- The size of the columns can be adjusted in the detail view and when importing tags.
- Compatibility with the IIH - Databus Gateway V1.2.1410
  The IIH Configurator V1.4 is compatible with the CS Databus Gateway V1.2.1407. Therefore you have to update both, IIH Configurator and CS Databus Gateway, to the versions specified.
- Connection status on the overview page
  The connection status of all configured data sources and log messages are now displayed separately. The list of data sources is displayed in a separate section with the current connection status.
- Improved look and feel for all "Get data" pages
- Number of configured tags
  Due to system limitations, the number of configurable tags is limited to 32,000. This number includes all tags configured together in different connectors.

"Organize data" tab

- Views based on filter options
  Supported filter options:
  - Creating/modifying/deleting assignments or applying the transformation rule from the filtered view.
  - Deploy new configuration from the filtered view.
  - Deleting and using filters
- Searching asset variables in the selected namespace
  The search option allows you to find OPC UA objects, variables, asset variables, tag names and rule names within a selected namespace. Additionally, the mapping can be performed/the transformation rule can be applied, and the mapping to the search results can be changed or deleted.
- MindSphere synchronization option in the "Mapping & Transformation" tab
  Activate the MindSphere synchronization per variable.
  Note: The MindSphere synchronization option is only available if you have selected the asset model and data retention.

"Provide information" tab

- New user interface for loading companion specifications
  It will show if and when a companion specification is missing, and guide you through a workflow to load it.
  - Load companion specification
  - Missing companion specifications are displayed
  - Status of the companion specifications is displayed
  - Companion specifications are displayed
  - Companion specifications with missing dependencies are displayed and you are prompted to load them.
  - Status history for loading phases of companion specifications is displayed
  - Conversion statistics and browsing status are displayed
  - Improvements in server URL and namespace validation
- Notification Center
  Shared service for viewing notifications and messages with a drop-down menu for viewing their history and support for asynchronous execution of tasks/processes in the background.
  - Messages remain visible
  - No overlapping of popover notifications and messages
  - Info messages are deleted after the navigation
  - Messages remain visible when you move the cursor over them
  - User-friendly descriptive message texts

  Improved user experience for managing MindSphere connections
  Displaying connectivity, editing existing connections, and providing credentials to developers
  - You can edit the MDSP parent node.
  - The MDSP connection is updated automatically.
  - You can reset the MDSP connection.
  - You can collect the credentials of the app.
- Visualized editor for creating filter functions for GraphQL queries
  - New user interface for filtering GraphQL queries
  - Integrated Altair user interface
  - Condition editor is available
  - The filter editor can be resized.
  - Field validation for filter functions
- Support for additional user interface languages
  - Spanish
  - Chinese

"Store data" tab

1. System info dashboard
2. Connectivity Suite compatibility
3. IIH integration
4. Major performance improvements
5. Precalculated aggregations
6. User interface for mobile devices
7. Keyboard optimizations

Settings

Configuring IE Databus credentials:

You can configure the Databus Service name and credentials in the settings to allow the IIH to access the IE Databus Topics data.

IIH Core V1.4.0

1. Selectively creating, deleting and renaming asset models when synchronizing from IIH on Edge to MindSphere.
2. Detailed status (e.g. model status) and statistics (e.g. loading times) of the loaded OPC UA models are provided in the IIH Core.
3. Support for S7-OPC UA models, only for limited (< 2,000 nodes) quantity structures.
4. Companion specifications management in IIH Core (load, view and delete).
5. Performance improvements
   - Faster deletion of OPC UA models.
   - Faster creation, update and deletion of asset models.
   - Total memory and CPU footprint optimization when handling OPC UA models.
6. [Only for experts] Contextualized access to historical data via SPARQL REST endpoint in IIHCore.

CS Registry Service

- Reduced storage capacity requirement

CS Databus Gateway

- Multiple connectors are supported in parallel (incl. new configuration file format)
- Performance improvements (faster JSON generation)
- In the metadata, "Sample Rate Information" is supported (e.g. for the Audio Connector)
- Improved application protocol

- Reduced storage capacity requirement
- The information "application name" was added to the IE metadata message.
- Improved IE metadata message
- Improvement of the (re)connection behavior

Bug fixes

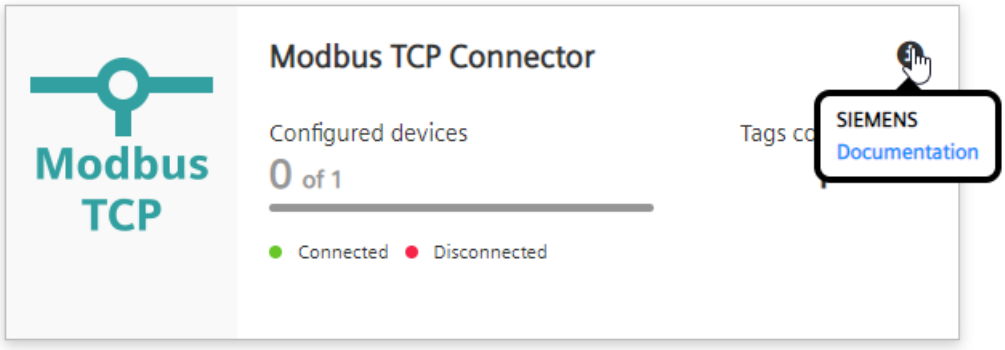
Bug ID: 1291856: There are new checks and messages when adding the same namespaces with a different server URL.

2.4 What's new in IIH V1.2?

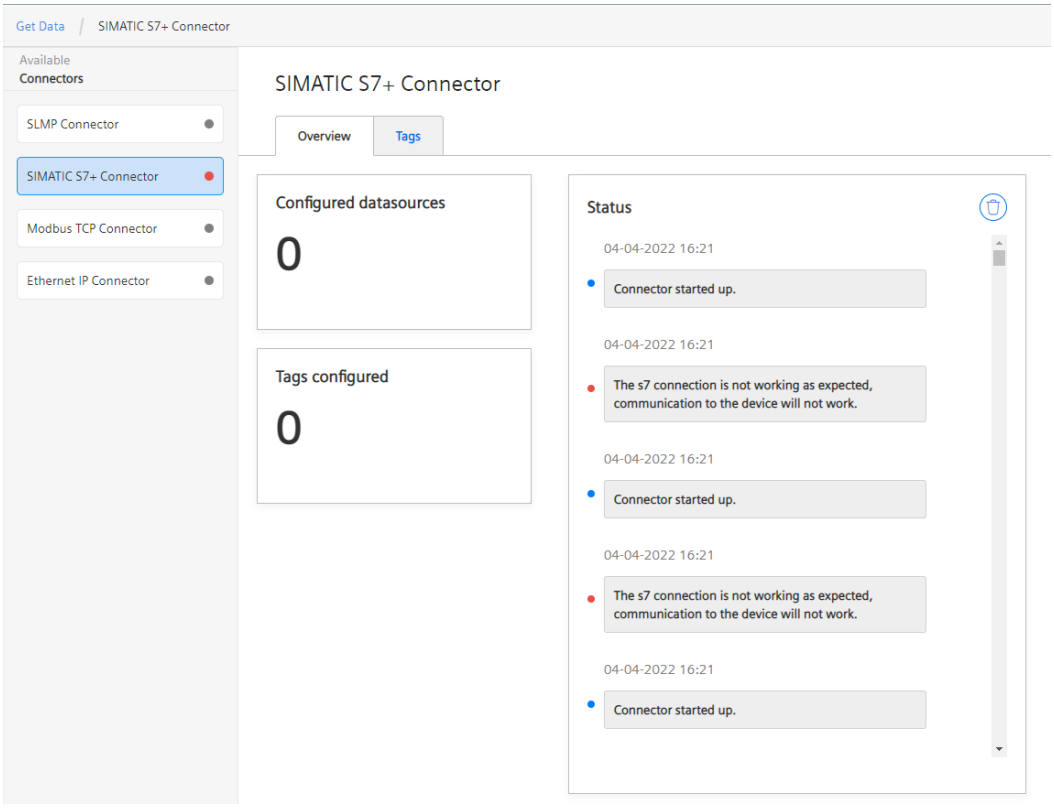
All important innovations of the IIH Configurator are summarized here. For more details on the individual topics, refer to the documentation.

"Get data" tab

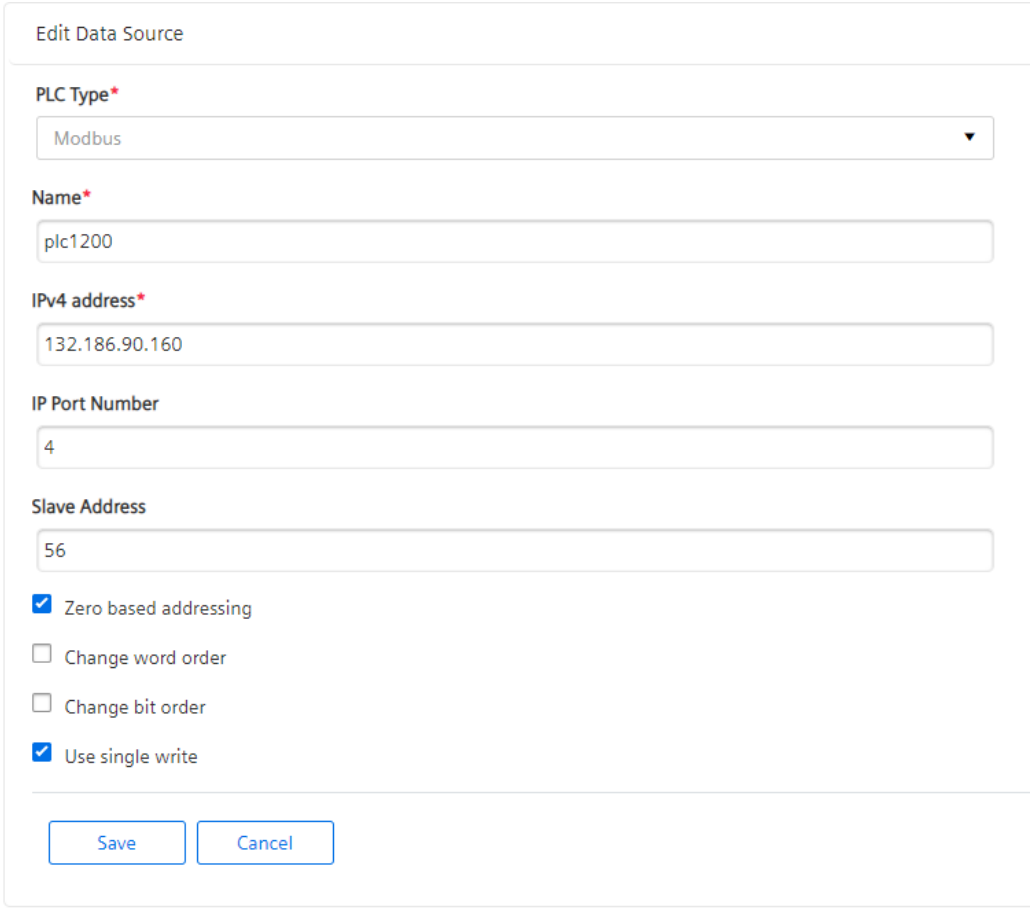
- Additional information about the connectors
  Information on the provider and a link to the documentation in Siemens Industry Online Support are now available:



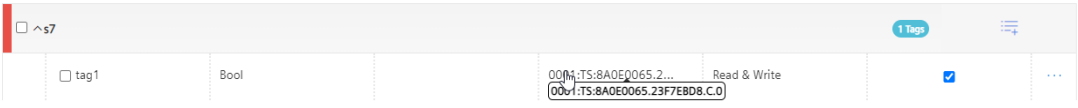
- Connection status log
  You can now view the connection status log on the connector configuration overview page. This option is only available for Connectivity Suite connectors:



- Usability improvements
  All mandatory fields are marked with an asterisk. The asterisks have been implemented accordingly in all forms:



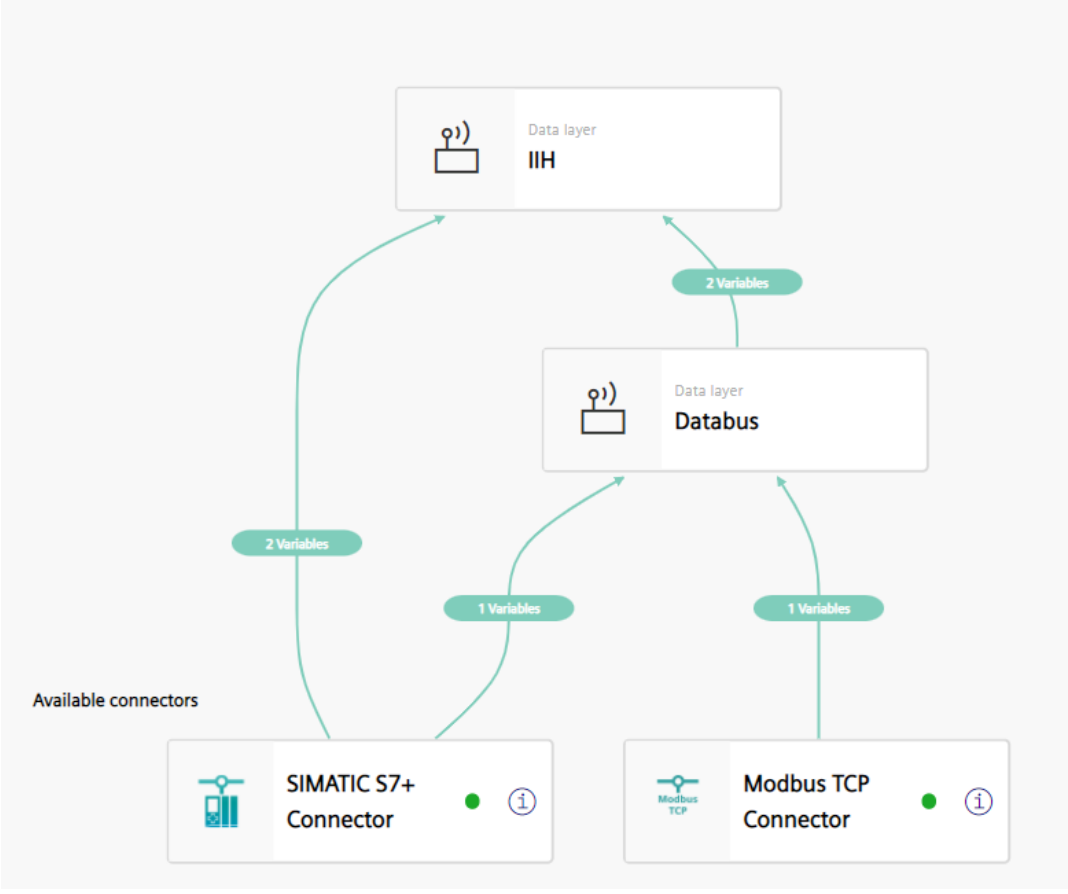
  Improved usability for importing tags for all supported connectors that support this option. There is now a filter that enables you to select the tags you want. Due to an improvement in handling duplicate and invalid tags, it is now easier to select and import valid tags after importing. A tooltip for all fields shows you the complete text in each case:



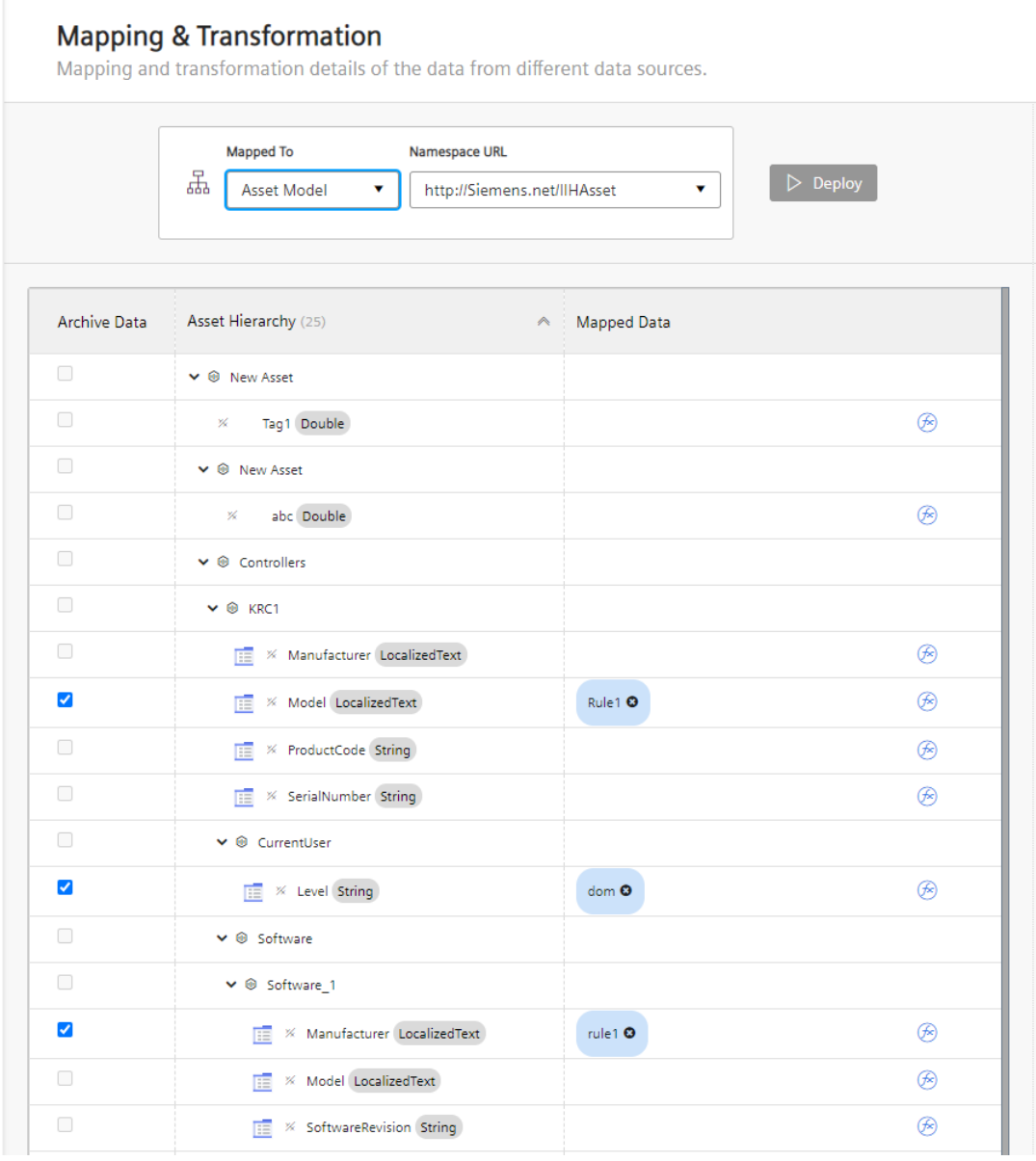
- Icon during loading
  An icon is displayed while the tags are being imported: "Data is being loaded"

"Organize data" tab

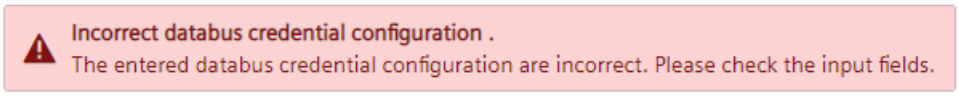
- Overview of the flow of assigned data streams
  You can view an overview of the data streams from the connectors to the IIH and its configurations:



- Assigning tags and preprocessing expressions in the asset model
  You can assign tags to variables in the asset model and create and assign expressions for preprocessing tags:

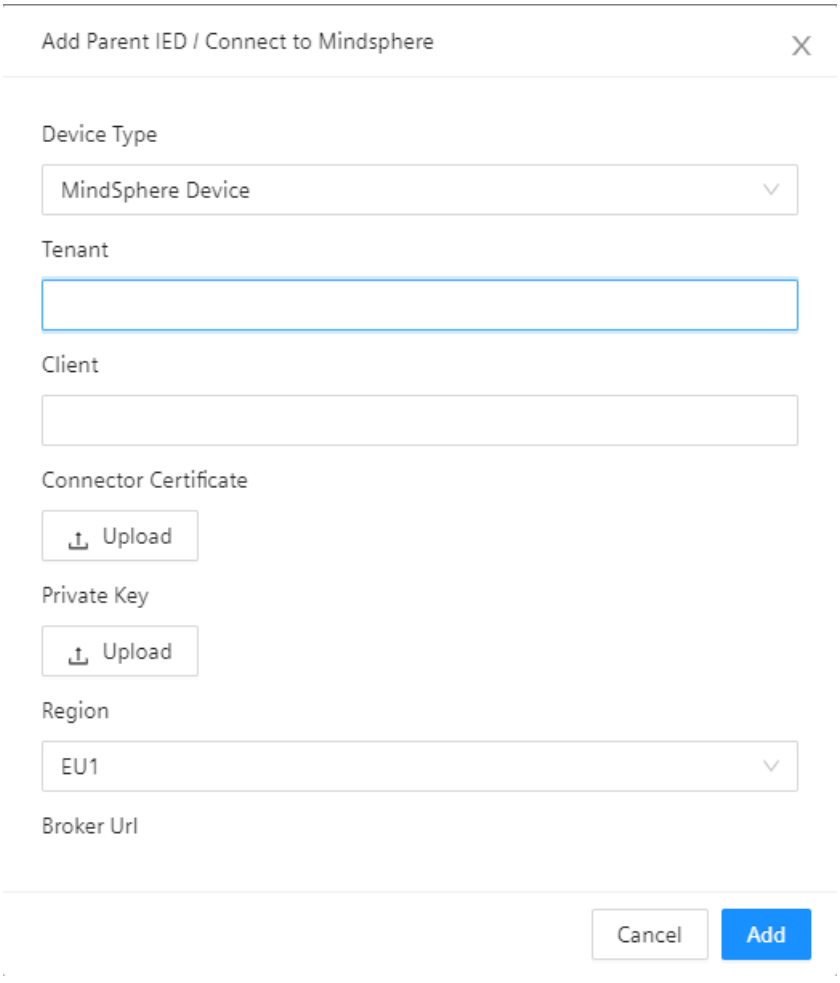


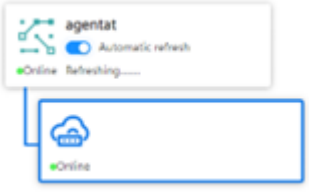
- Usability improvements
  Notification events provide feedback when errors/exceptions occur during the execution of the workflow.



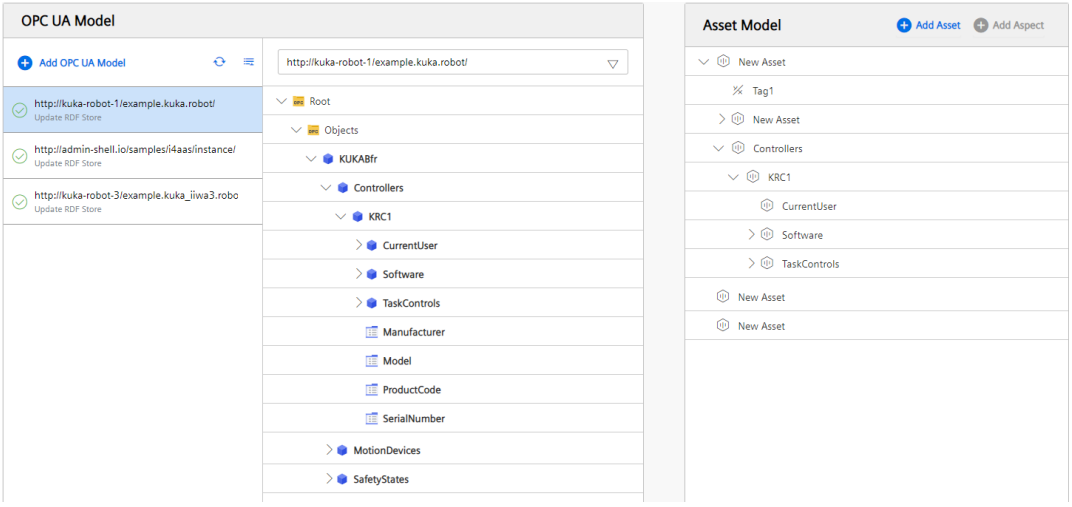
"Provide information" tab

- Setting up a connection to MindSphere
  You can set up a connection to a MindSphere instance. Currently, only a single tenant (MindSphere instance) is supported:

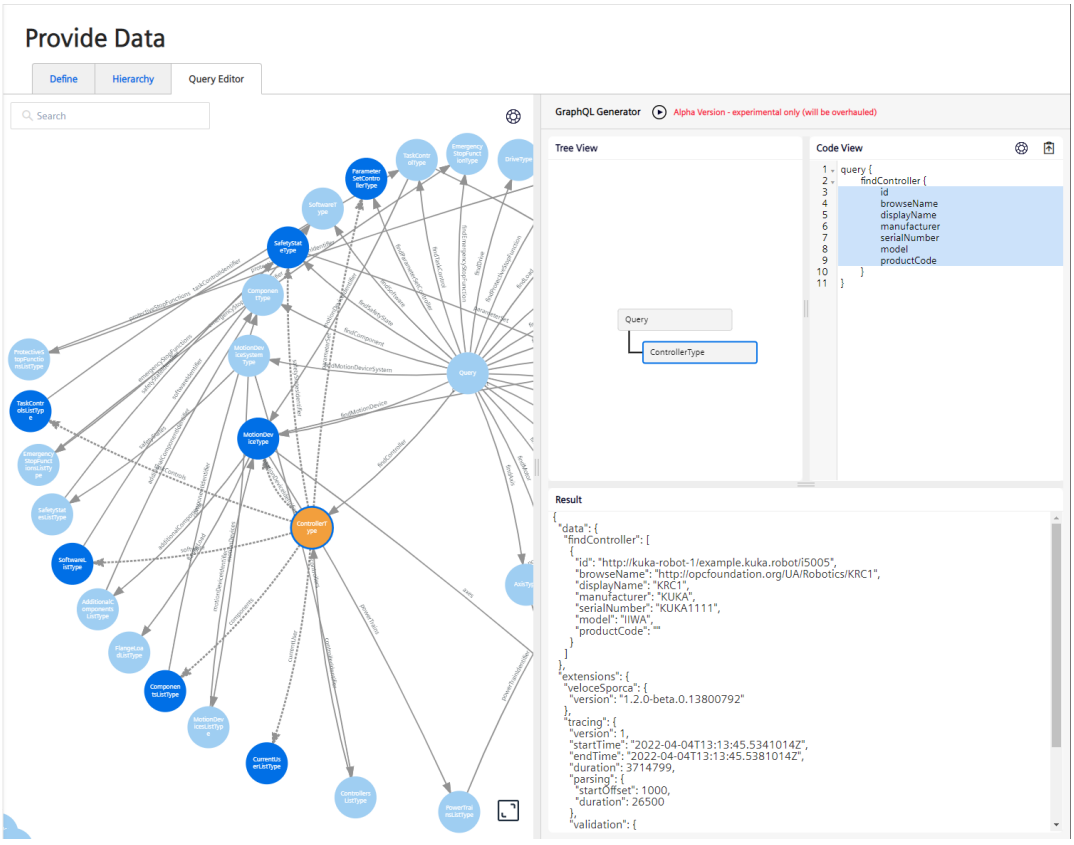


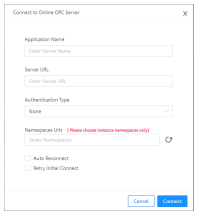


- Improved view and usability of the OPC UA model including performance improvements:

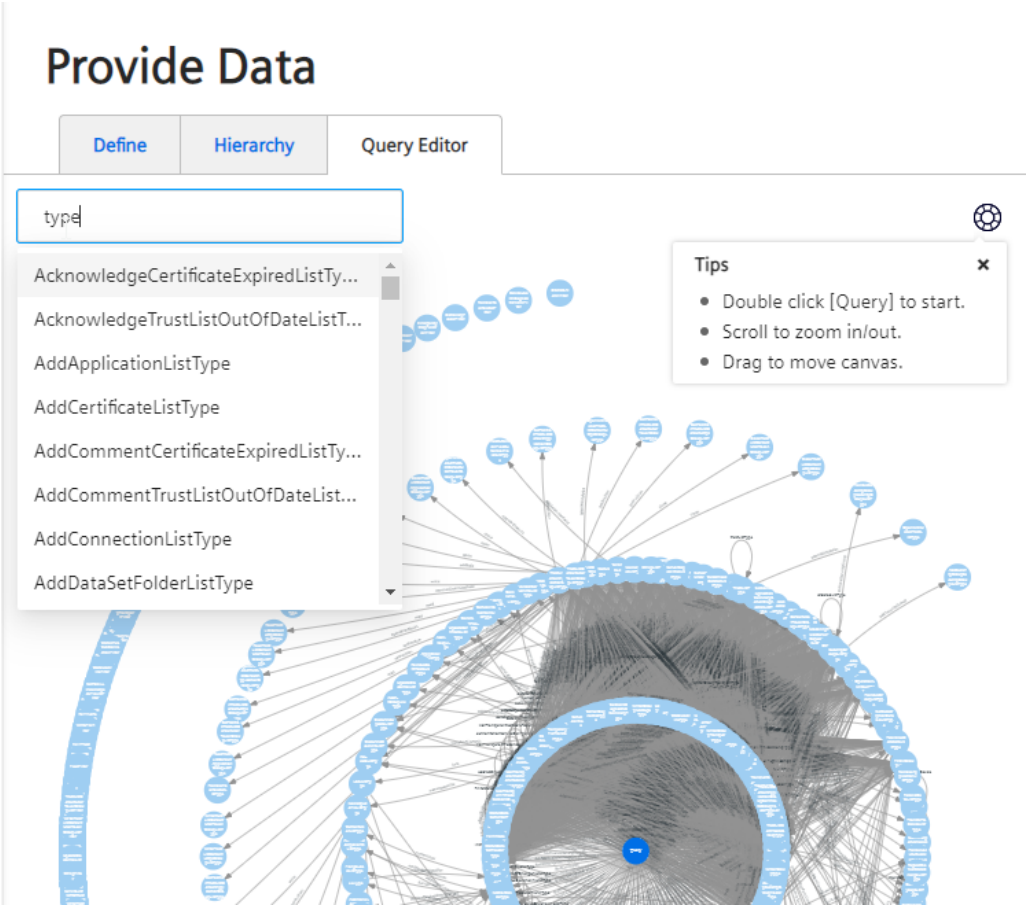


- Resizable operator panels with Responsive UI
  All operator panels are now resizable with Responsive UI and content is adapted accordingly:





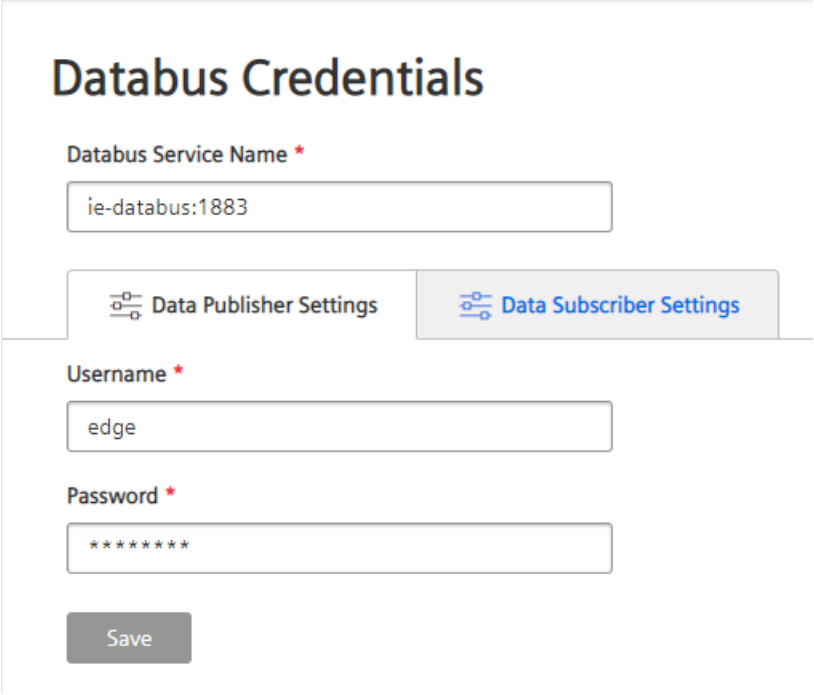
- When connecting to the OPC UA server, filter out base URLs based on namespace options
  Base URLs are filtered out if a selected base URL is not valid. This prevents the system from entering a faulty state:
- Search for keywords in the query editor
  You can search for any keywords that appear anywhere in the node names:



Settings

Configuring IE Databus credentials

You can configure the Databus service name and credentials in the settings to allow the IIH to access the IE Databus Topics data:



IIH Core V1.2.0

- Synchronizing asset models from Edge to MindSphere is now available as MVP:
  You can configure the connection to MindSphere in the IIH Configurator and go to MindSphere apps, such as Performance Insight, Fleet Manager, etc., to use the asset models that automatically appear once they have been created in IIH Core on the Edge.
- GraphQL API is available to query information in IIH Core:
  With the API, there are now also filters (such as equal to, contains, greater than, etc.) that can be applied to process objects (such as axles, motors, drive trains, etc.) to find only the relevant information.
- Applying mappings and preprocessing expressions in the asset model
  You can assign data to the asset model and assign preprocessing expressions in the IIH Configurator.
- Stability improvements when loading and deleting OPC UA models.

Bug fixes

Bug ID 1284321: The request to retrieve the instance is in the query state if adding the namespace failed. This request to retrieve the instance should be terminated after adding the namespace fails; otherwise, resources for the backend will be wasted.

Bug ID 1291734: The error message is not parsed and displayed correctly if the specified server URL is incorrect. The user cannot see the error messages properly.

Bug ID 1288344: The text label for the namespace field should be globalized so that the user can understand the label correctly.

Bug ID 1288439: The progress bar for deleting some models disappears when multiple models are deleted in succession - users can now see the progress at any time.

Bug ID 1190388: Before the fix, tags of data type Bool were ignored if the live values were assigned to the corresponding variables of the OPC UA model that were assigned in the UI. This fix enables the inclusion of Boolean data types in the mapping engine in IIH Core.

Installing IIH Configurator

3

3.1 System requirements

Note the following system requirements for the installation of the Edge Apps.

Software requirements

The following Internet browsers are required:

- Google Chrome

The apps are available in the Industrial Edge Marketplace. From there, you can transfer the latest version of the app to your Industrial Edge Management (IEM) and then install it on your Industrial Edge Device (IED):

App/Component	Description	Source
IIH Core	The IIH Core only needs to be installed, but not configured.	Industrial Edge Marketplace
IIH Registry Service (Connectivity Suite)	Creates the connection between the individual components.	
IIH Configurator	You need this if, for example, you want to configure the CPUs and data streams with it. You can also load the configuration as a file.	
Databus Gateway (Connectivity Suite)	Optional: You need this if you want to publish the values of the data points in the IE Databus.	
IE Databus	Optional: You need this if you want to publish the data in the IE Databus.	
Connectors	In order for the desired connector to be displayed in the "Available connectors" tab, it must be installed on the IED.	
Data Service	If you want to use the data retention for assets and variables in the IIH, the standalone Data Service must be installed on the IED and integrated into the IIH.	

Note

Installation of the apps

All apps must be installed on the same IED.

Note

Installation of multiple connectors

The IE Databus Gateway supports parallel use of multiple connectors of the Connectivity Suite, including third-party connectors.

Hardware requirements

- A device on which Industrial Edge Management (IEM) is running.
- An Industrial Edge Management-compatible Industrial Edge Device (IED):
  - IED Model: e.g. SIMATIC IPC 227E Nanobox, SIMATIC IPC 427E, IPC127E and IPC827E
  - Hard disk: At least 10 GB available
  - RAM: 2 GB available RAM
- The Edge device must be integrated on the Industrial Edge Management.

IEM, IED, and web browsers must be synchronous in the UTC time zone.

3.2 Buying an app

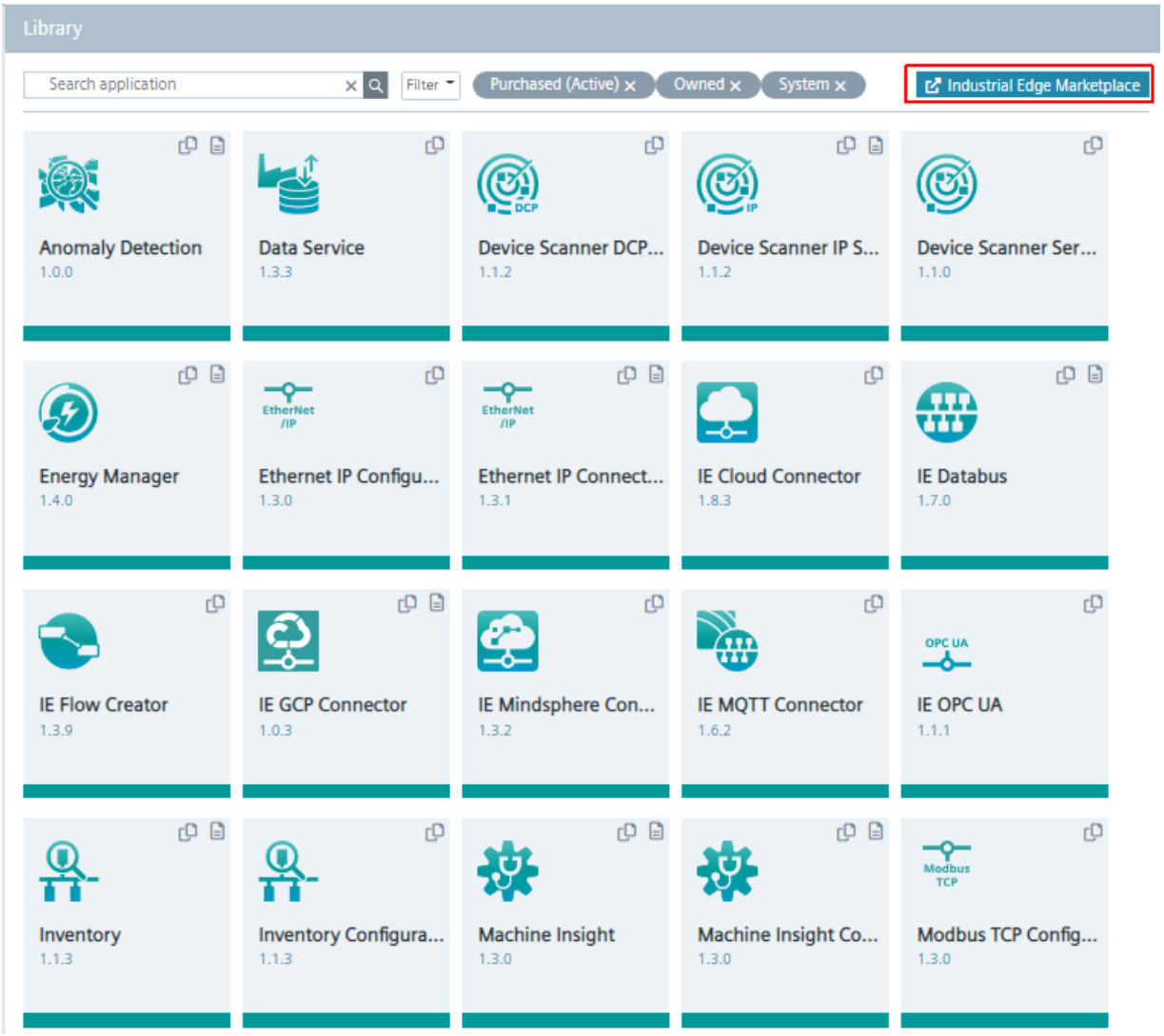
You can use the IE Marketplace to purchase an app or app license. To purchase an app, you need an access code. You will receive this access code from your regional Siemens contact.

Requirement

You have received the access code from your regional Siemens contact.

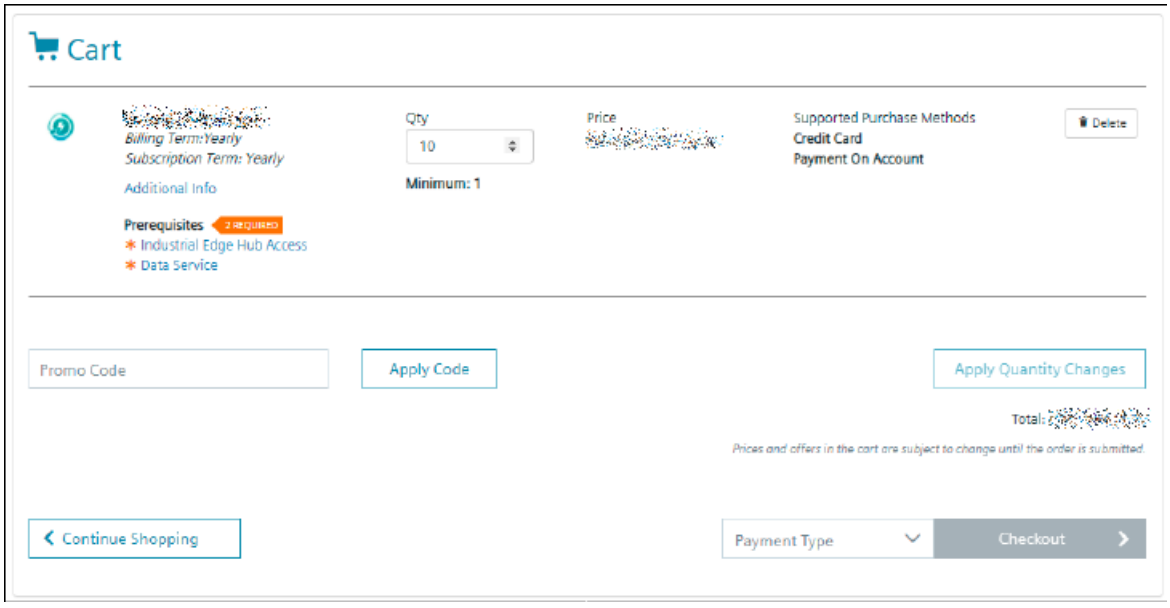
Procedure

1. In the "Library" screen of IE Hub, click "Industrial Edge Marketplace".

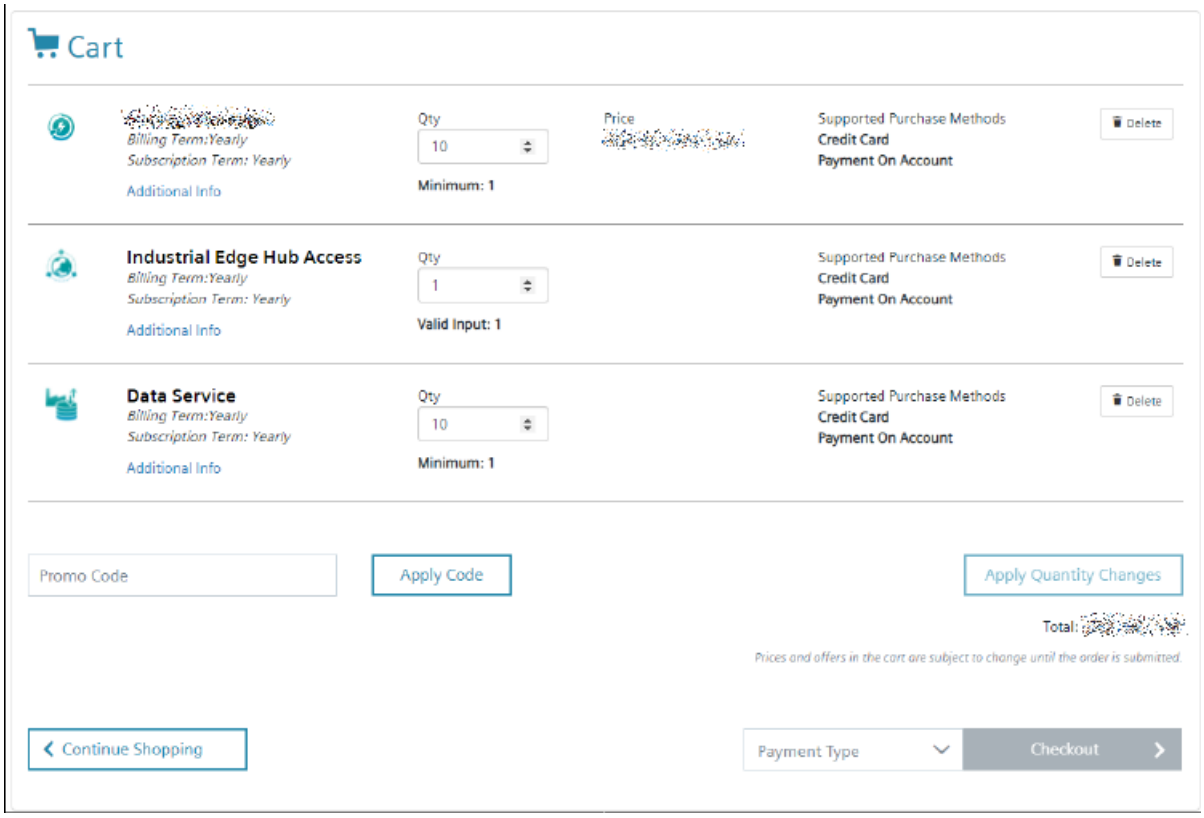


2. Click "Manufacturing & Process Industries".
   The Industrial Edge Marketplace opens.
3. Click the tile of the app you want to buy.
   The app description and details are displayed.
   On the left side you can see all the prerequisites and requirements to run this app in the IEM.
   You can purchase all the products you require in one transaction.
4. Enter the number of licenses required in the "Quantity" input field.
5. Enter the received access code in the "Access code" input field.

6. Click "Add to Cart".
   The shopping cart is displayed.



7. Add other products that are required to use the app to the shopping cart.
   To do this, click on the corresponding links under "Prerequisites" and add all the desired products to the shopping cart in the same way.

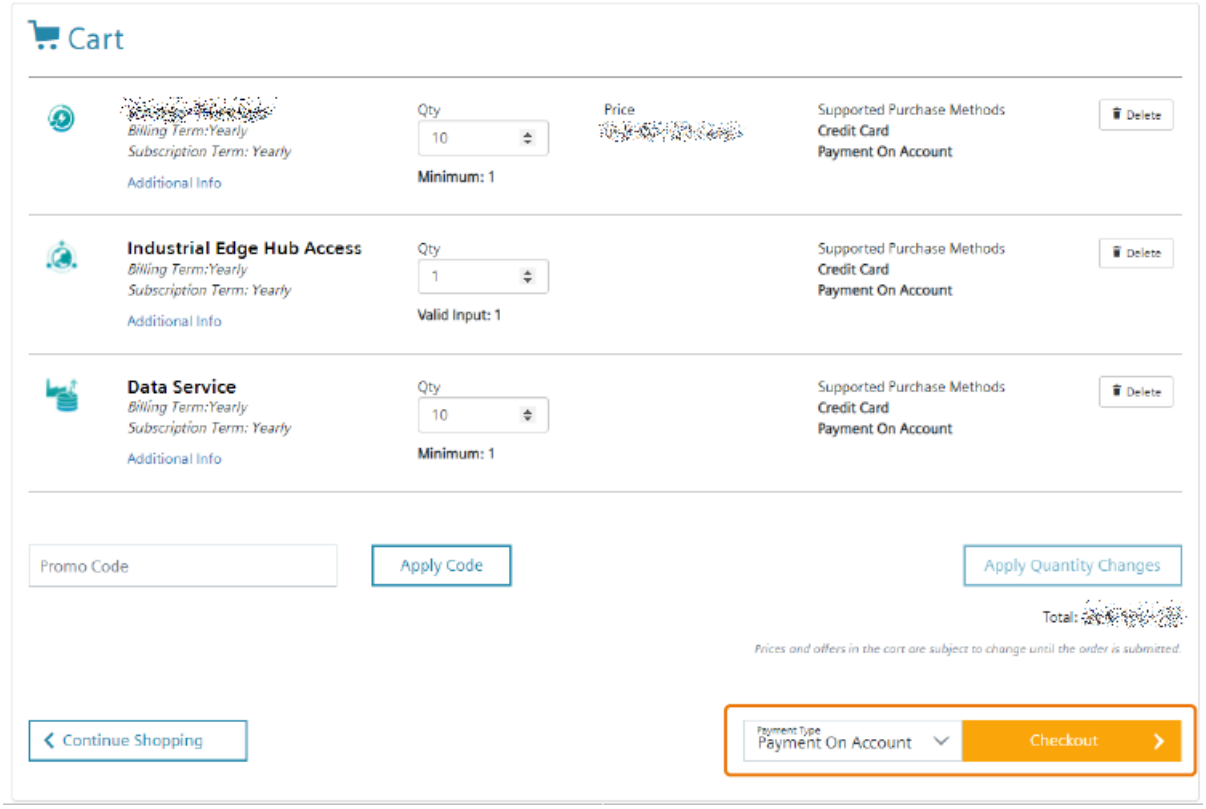


8. Select your preferred payment type from the "Payment type" drop-down list.
   Only "Credit Card" payment method is available for third-party apps.
9. Check again the information provided.

   Note

   You can edit the number of licenses again. Then click "Apply Quantity Changes".

10. Click "Checkout" and follow the instructions on the screen.



After you purchase the app, it appears in the "Library" section of IE Hub. From here, you can copy the app to your IEM instances. The number of licenses, the license itself and other details are displayed under "Licenses". If necessary, you can purchase additional licenses of the app in question from this location.

Introduction

4

4.1 Introduction to IIH

Description

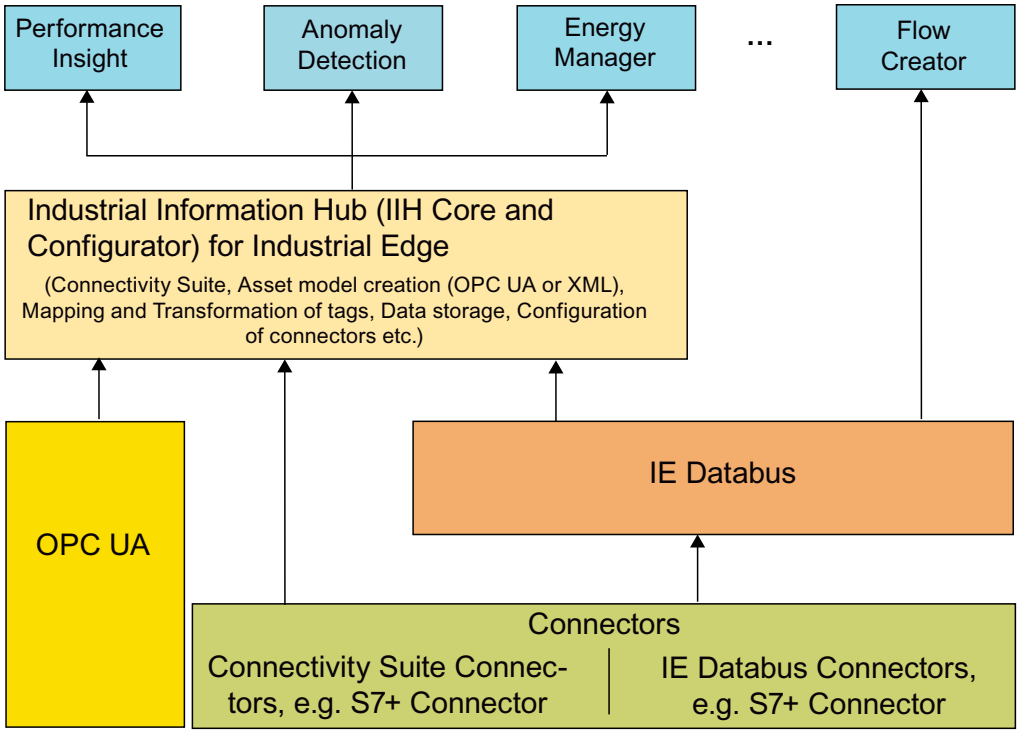
With the IIH (Core and Configurator), you can configure each of your connectors and send the data seamlessly to the different integration layers. You can either publish the data of OPC UA models directly in the IIH (Industrial Information Hub) or you can publish the data of the connectors directly or via the IE Databus in the IIH and then assign them to the variables in the OPC UA-based asset model.

The Connectivity Suite offers a standardized path for data exchange, as well as the configuration of different data sources.

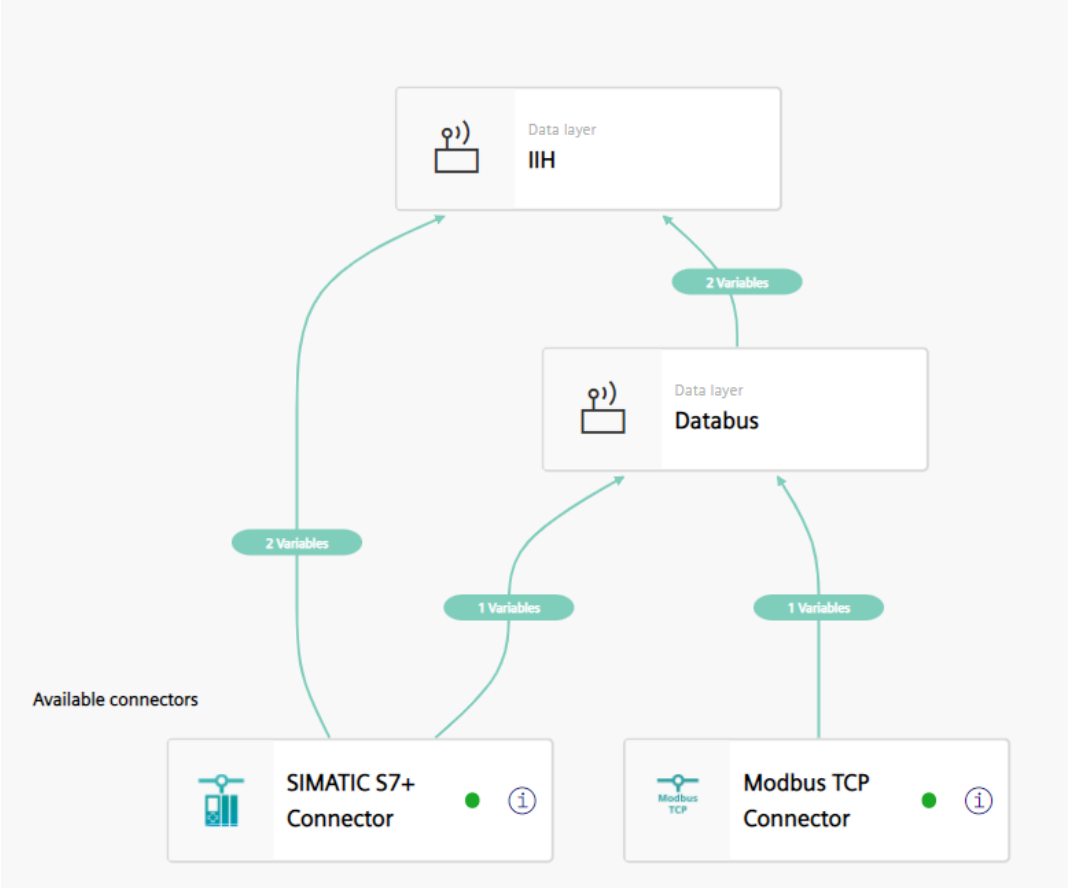
The IIH offers you the option of automatically converting the data points from a device into a semantic data model (Knowledge Graph). This data model can then be queried via GraphQL queries in order to find the data again. Both the current values and the historical time series are available in the Knowledge Graph. This function is available via SPARQL endpoint for experts.

You can find more information about the Knowledge Graph here: AUTOHOTSPOT

Data streams in the IIH



Data streams in the IIH



The left data stream shows the data flow from a Connectivity Suite connector (SIMATIC S7+ connector) directly into the IIH. The center and right data streams show the data flow from the connector through the IE Databus into the IIH. Both options are available for the Connectivity Suite connectors:

4.2 Validity of the documentation

Description

The "IIH Configurator for Industrial Edge" documentation is valid for installing the app on an IED.

4.3 Overview of additional documentation

Overview

The following documents supplement this description:

Documentation	Main contents
Industrial Edge Marketplace (https://www.dex.siemens.com/?selected=edge)	Platform for the purchase of app licenses
Industrial Edge Hub (https://iehub.eu1.edge.siemens.cloud)	This page describes the functions of the Siemens Industrial Edge platform and the functionalities of the Edge Management System. Under "Documents" you will find all documentation on the IE platform.
System overview (https://new.siemens.com/global/en/products/automation/topic-areas/industrial-edge/production-machines.html)	This page provides an overview of all Edge solutions.
Industrial Edge in 10 minutes (https://cache.industry.siemens.com/dl/dl-media/991/109772991/att_1010695/v1/109772991_V16_Highlights_V2_web/start.htm#!/en/12329)	Web Based Training: Integrate IT in the production with Siemens Industrial Edge
IE Databus (https://support.industry.siemens.com/cs/ww/en/view/109805958)	IE Databus documentation

4.4 Change user interface language

Description

You can change the user interface language in the settings. The following languages are available:

- German
- English
- Spanish
- Chinese

Procedure

To change the language, follow these steps:

1. Open the tab "Settings > Language".
2. Select the desired language.
3. Click "Save".

Get data (Southbound) 5

5.1 Overview

You have 3 different options to configure the data streams Southbound:

1. Via the Connectivity Suite
   All Connectivity Suite connectors, such as the SIMATIC S7+ Connector, can publish the data of the devices, such as an S7-1500 CPU, directly in the Configurator.
2. About OPC UA models
   OPC UA data can be published either directly from the OPC UA server (online, e.g. S7-1500 CPU OPC UA server) or via an XML file containing the OPC UA data (offline) in the IIH Configurator.
   No connectors are needed for the online variant.
3. Via the IE Databus
   All data provided by Connectivity Suite connectors or other connectors can or must be published in the IE Databus as well. Mandatory for all non-Connectivity Suite connectors.

You then map the published data points to the OPC UA-based asset model, even if the data is published via connectors and the IE Databus. For this purpose, upload a virtual OPC UA model (via an XML NodeSet file).

In the asset model, you activate the data retention of the variables. You can use the collected data as a calculation basis for your Industrial Edge Apps, such as Performance Insight, or via Open APIs in your own apps.

Note

Number of tags

A maximum of 32,000 tags can be configured across all connectors.

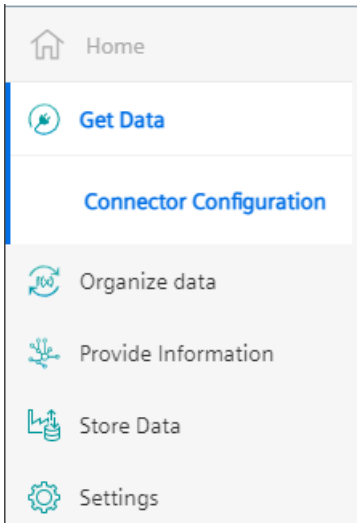
5.2 Configuring data streams via Connectivity Suite connectors

Description

Using Connectivity Suite connectors, such as a SIMATIC S7+ Connector, you can make the data streams available directly in the IIH Configurator.

If you also want to make the data available in the IE Databus in addition, because you want to work with the IE Flow Creator, for example, then this is also possible.

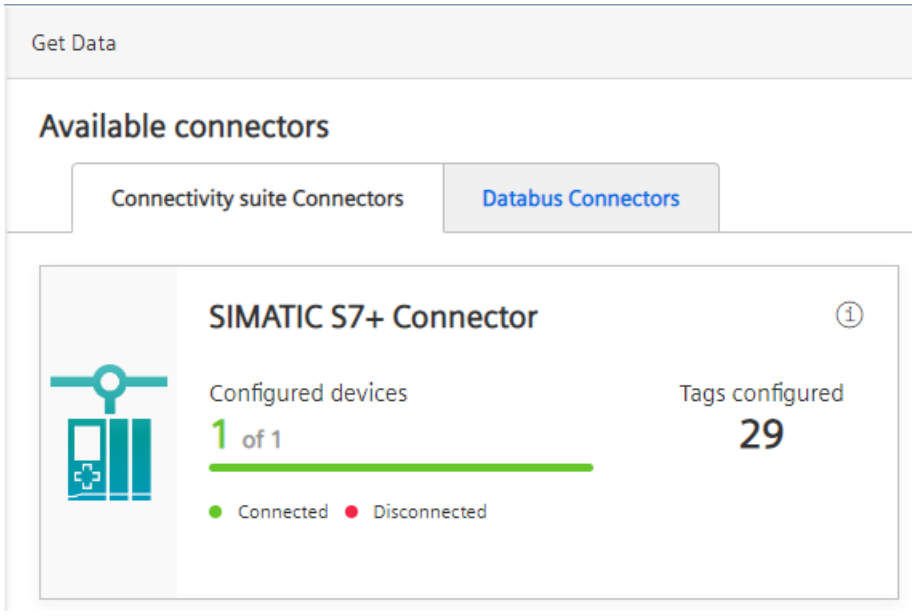
In the "Get Data" tab, you see all apps for which you have purchased licenses:



Connecting connectors

A detailed description of how to connect a connector can be found in the respective connector documentation.

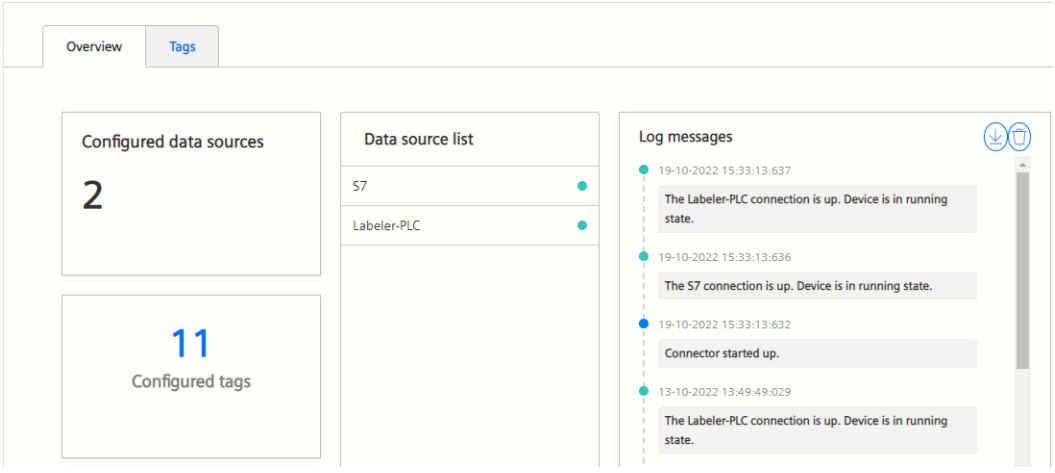
Click the ⓘ icon to open the documentation.



Connection status of the connectors

Click on the connector

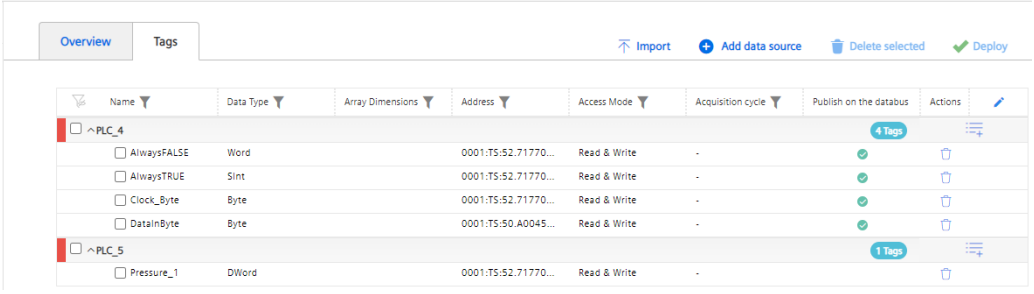
You can see the connection status of all configured data sources and the corresponding log messages:



Click the icon to download the log messages.

Adding data sources

In the "Tags" tab, you can add one or more data sources, such as audio devices, CPUs, etc., for each connector:



For Connectivity Suite connectors, the following acquisition cycles are available to publish the tags to the IE Databus:

- 100 milliseconds
- 250 milliseconds
- 500 milliseconds
- 1 second
- 2 seconds
- 5 seconds
- 10 seconds

Editing individual tags

To edit individual tags, follow these steps:

1. Double-click in the tag line.
2. Change the desired fields.
3. Click ✔ to apply the changes.

Editing multiple tags simultaneously

To be able to edit multiple tags at the same time, follow these steps:

1. Select all the tags you want to edit.
2. Click on the ✎ icon.
   An input field is displayed for each column.
3. For example, enter the value "1 second" in the "Acquisition cycle" column.
4. In the "Name" column, click all tags for which the acquisition cycle is to changed accordingly.
5. Click ✔ to apply the changes.

Filtering tags

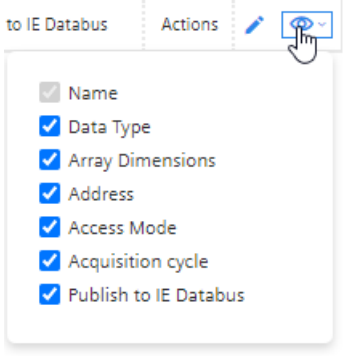
To filter the tags, follow these steps:

1. Click on the ▼ icon in the header.
2. Select the desired filter.
3. Only the filtered tags are displayed and the filter icon is highlighted in blue ▼.
   Any changes that you make in the filtered view, such as enabling/disabling data retention for variables, are applied to the filtered tags throughout the entire list.
4. To delete the filter, click the ▽ icon.

Showing and hiding columns

To show or hide columns, follow these steps:

1. Click on the 👁 icon.
2. Select the corresponding columns from the drop-down list:



Configuring data streams

For each data source, you can either manually create the tags that the connector transfers or directly query from a CPU. After you have created all tags, make the data available in the IIH Configurator by clicking "Deploy".

In the background, the IIH Configurator generates a configuration file (xxx_config.json) and sends it to the respective connector.

5.3 Configuring data streams via OPC UA

5.3.1 Load companion specification

Description

The companion specification defines how the address space of the OPC UA server is displayed and is essential for an OPC UA client. The companion specification defines the node, its types, methods and events which are available to the clients.

Note

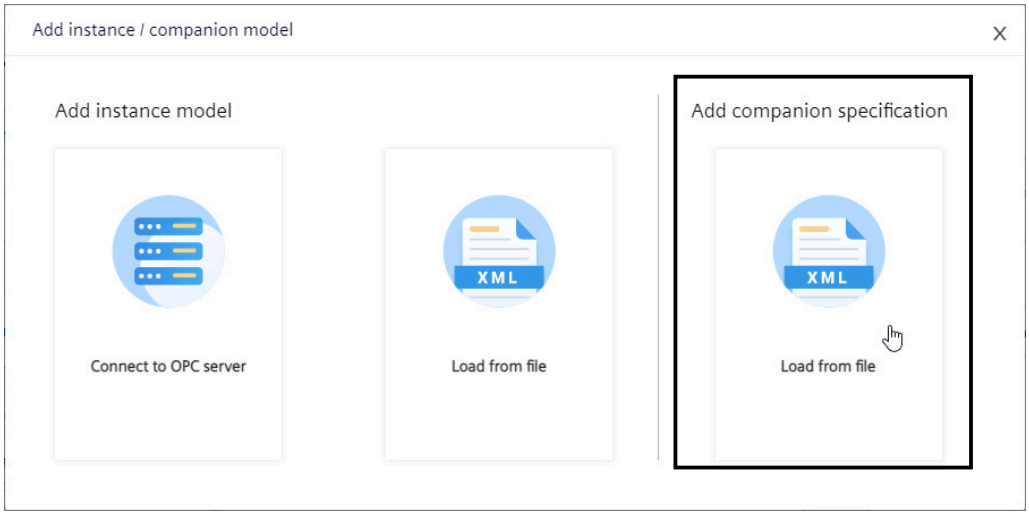
It is recommended to download the Companion specification right at the beginning to the IIH Configurator before you upload the OPC UA model.

For more information about the documentation and where to download the companion specifications, click here: OPC UA Foundation Companion Specs (https://github.com/OPCFoundation/UA-Nodeset)

Procedure

To load a companion specification, follow these steps:

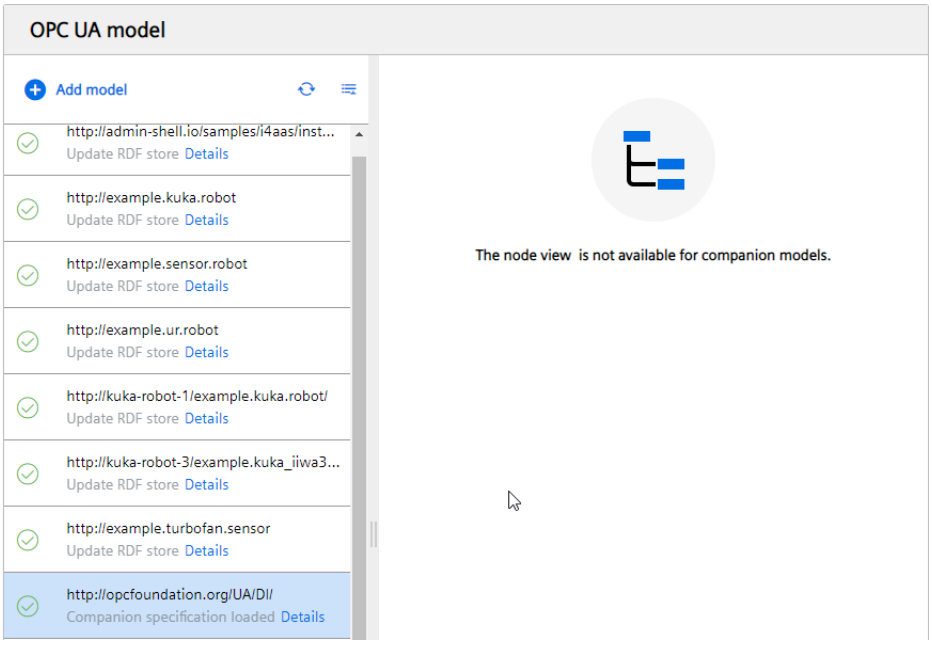
1. Open the "Provide information" tab and click "Add instance/companion model" under "Define".
2. Under "Add companion specification", click "Load from file":



3. Add the XML file using drag and drop.
4. Click "Load".

Result

The companion specification is displayed in the list of OPC UA models.



Click "Details" for more information about the specification.

Note

Error message: Missing companion specifications

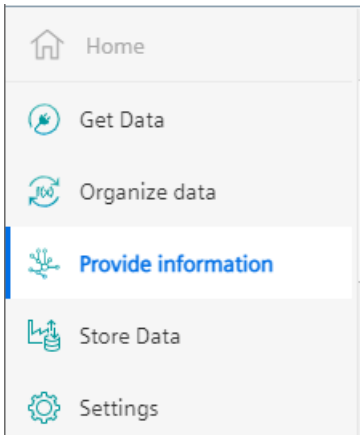
If companion specifications have not yet been loaded, an error message is displayed. The reason may be that a companion specification references another companion specification or you have loaded an OPC UA model that requires a missing companion specification.

5.3.2 Loading OPC UA model via OPC UA server

Description

For devices with an OPC UA server, such as a S7-1500 CPU with OPC UA server, you can connect the IIH Configurator directly to the OPC UA server and load the OPC UA model.

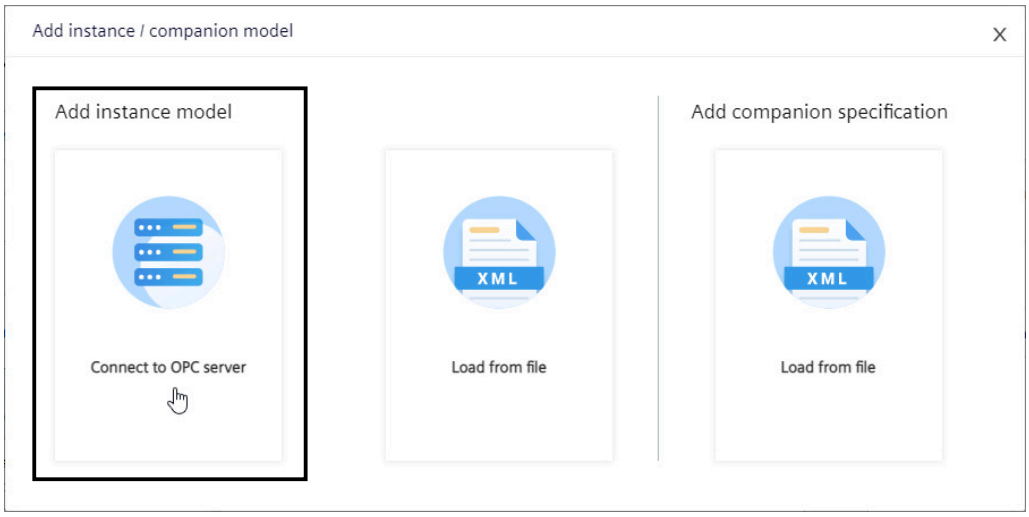
The connection of an OPC UA server has the great advantage that all relevant data points are supplied and can be used directly in the created asset model. No OPC UA connector is required.



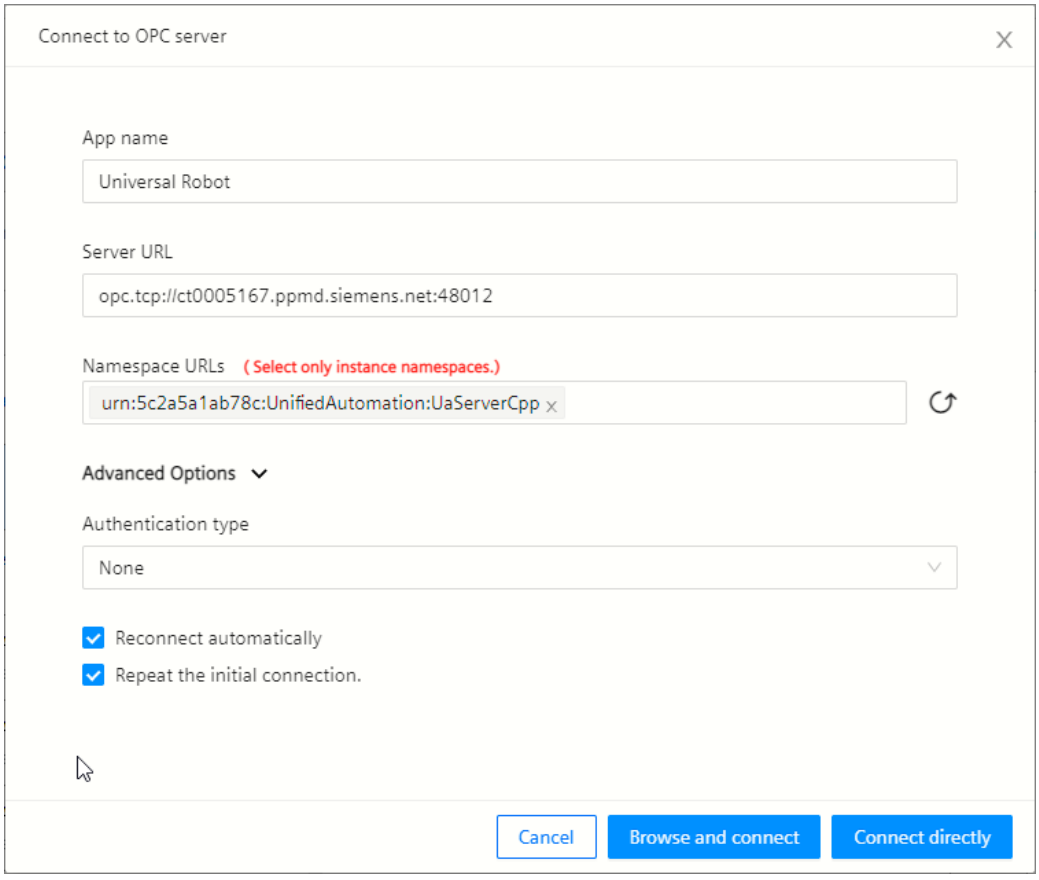
Procedure

To create an OPC UA model based on OPC UA server data, follow these steps:

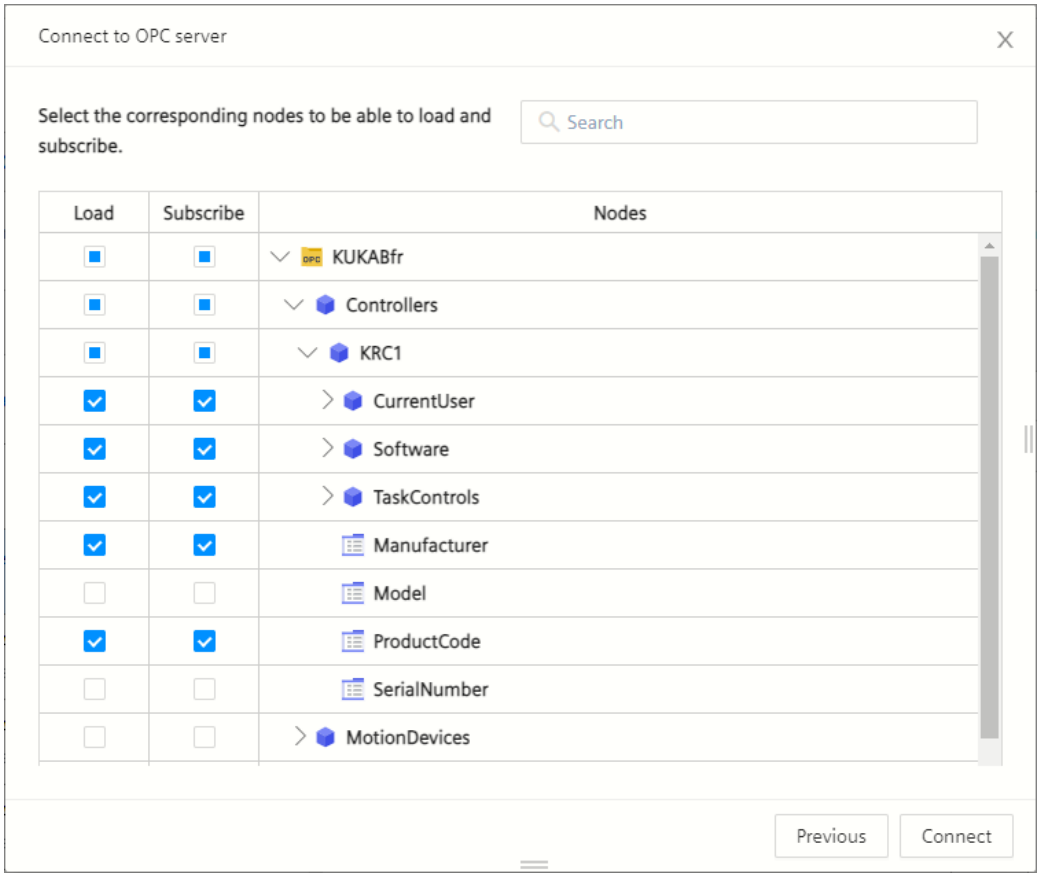
1. Open the "Provide information" tab and click "Add instance / companion model" under "Define":



2. Click "Connect to OPC server".
3. Enter the data for the OPC UA server, e.g.:



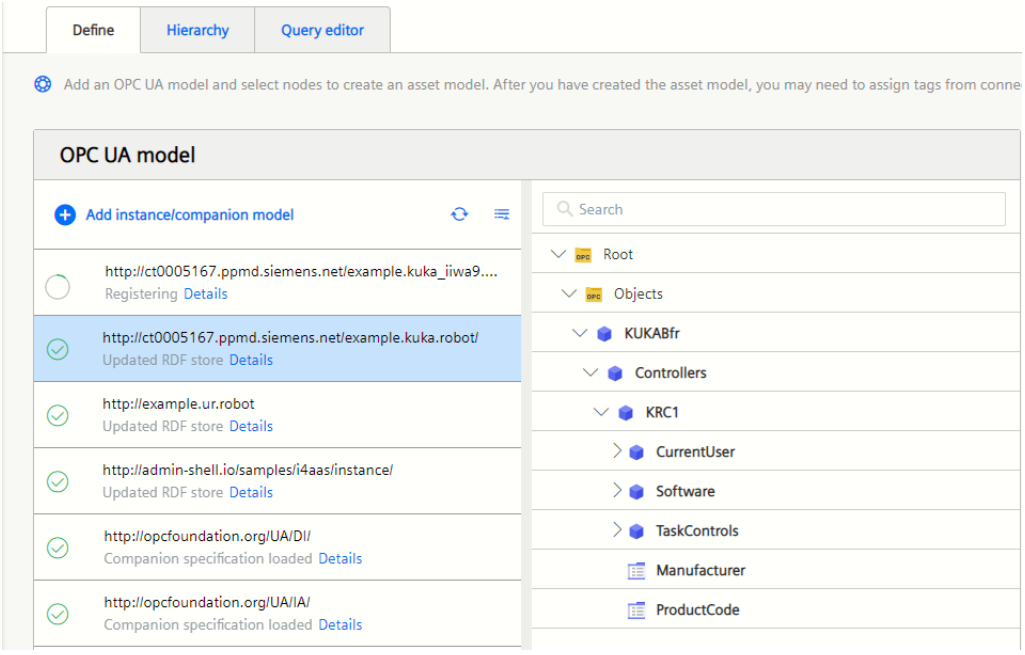
4. Click "Browse and connect" to select individual nodes already when adding the OPC UA model and to download and subscribe to them only:



5. Click "Connect".
6. Or: Click "Connect directly" to download the complete OPC UA model.

Result

The OPC UA model is displayed:



The OPC UA models and companion specifications are displayed in the left column. You can add or delete more OPC UA models.

For more information about the OPC UA models, click "Details".

Create your asset model now: Creating an asset model (Page 49)

5.3.3 Loading an OPC UA model via XML file

Description

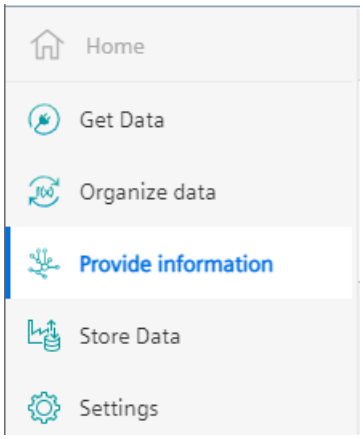
If you want to use the OPC UA model of a device that does not have an OPC UA server, which means that no direct connection to the device is possible, import the OPC UA model as an XML file.

Later, map the tags from one or more connectors to the variables of this OPC UA model so that the data points can be transferred.

Note

It is recommended to download the Companion specification right at the beginning to the IIH Configurator before you upload the OPC UA model.

You can use SiOME, for example, to create an XML file: Siemens OPC UA Modeling Editor (SiOME) (https://support.industry.siemens.com/cs/ww/en/view/109755133)



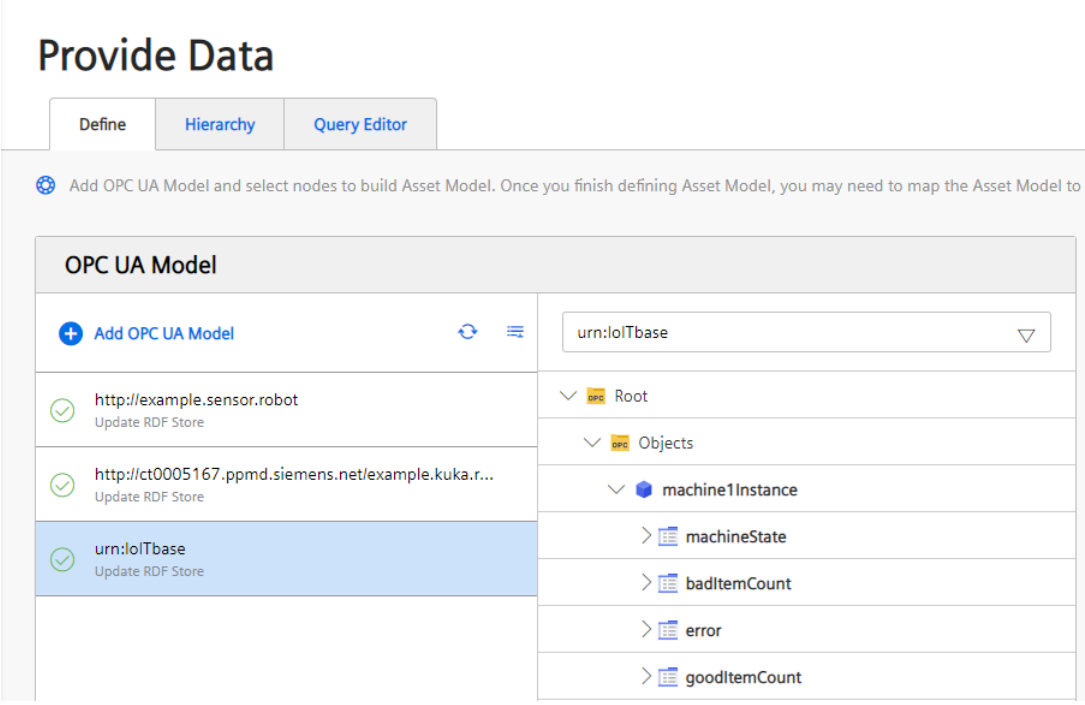
Procedure

To upload an OPC UA XML file, follow these steps:

1. Open the "Provide information" tab and click "Add instance model" under "Define".
2. Select "Load from file".
3. Add the XML file using drag and drop.
4. Click "Load".
5. Select the matching namespace.
6. Click "Validate".

Result

The OPC UA model is displayed:



The OPC UA models are displayed in the left column. You can add or delete more OPC UA models.

For more information about the OPC UA models, click "Details".

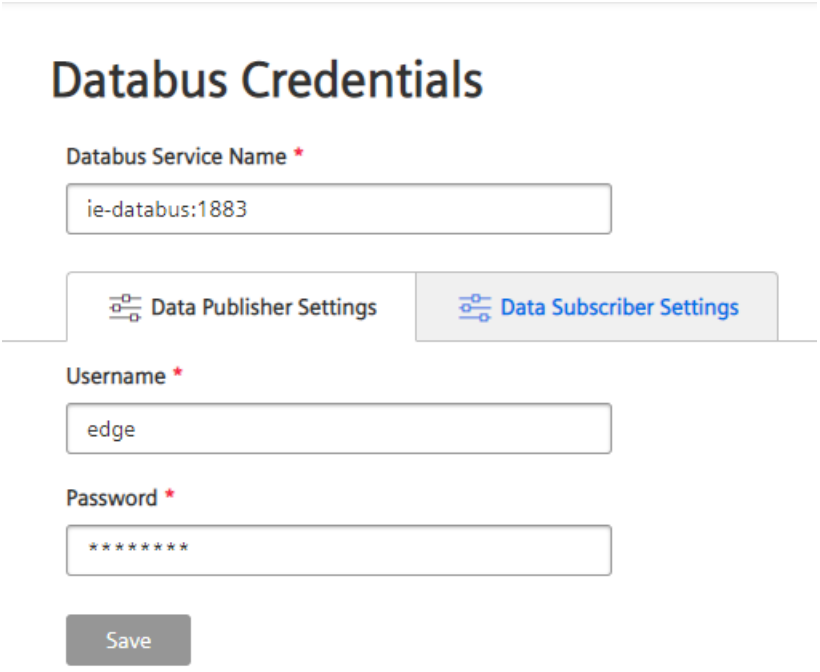
Create your asset model now: Creating an asset model (Page 49)

5.4 Publishing data streams in the IE Databus

Description

To publish the data in the IE Databus, you must enter the connection data in the "Settings > Databus Credentials" tab.

Here you configure the Databus credentials and then specify these credentials in the connector configuration:



- Data Publisher Settings: For connecting connectors
- Data Subscriber Settings: Read access for the IIH Configurator and internal services to the Databus data

Note

User name and password

The user name and password must be configured in the MQTT broker, or in the IE Databus, with the access rights (read/write) and then entered in the corresponding connector and in the IIH respectively.

5.5 Exporting and importing connector configuration

Description

You can export the configurations of all connectors (Connectivity Suite and Databus connectors), including all created tags.

Procedure

To export the configuration of the connectors, follow the steps below:

1. In the "Get data" tab, click the "Export" button in the top right corner.

Result

The "download.json" file is generated and downloaded.

Organizing data (in the IIH)

6

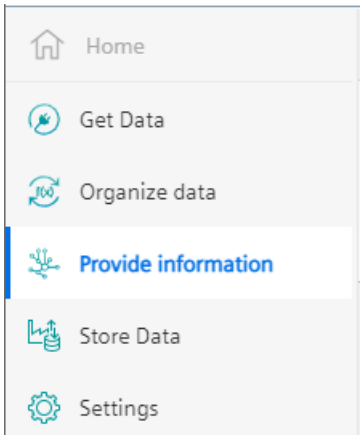
6.1 Deploy data

6.1.1 Creating an asset model

Description

You create the asset model based on an OPC UA model. This enables you to specifically filter only the information from the OPC UA model that you actually need for your project.

In this way, you can access your data quickly and assign the live signals to the assets, even multiple times.

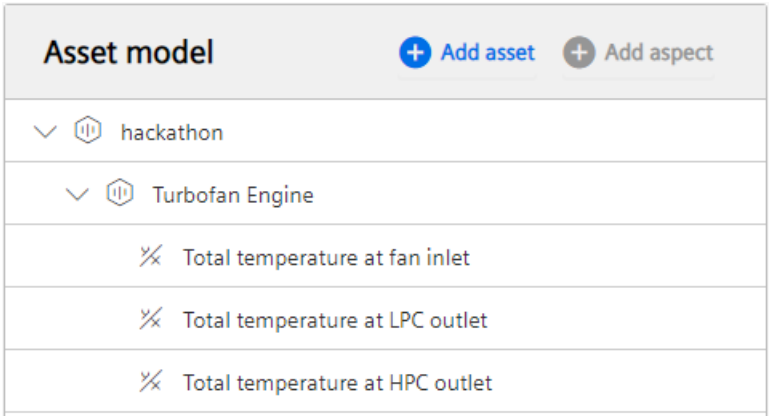


Procedure

To create an asset model, follow these steps:

1. Open the "Provide Information" tab.
2. Select the desired OPC UA model or add a new model.
3. Add assets and aspects in the asset model on the right side.
4. Drag the variables from the OPC UA model to the corresponding locations in the asset model.

Result

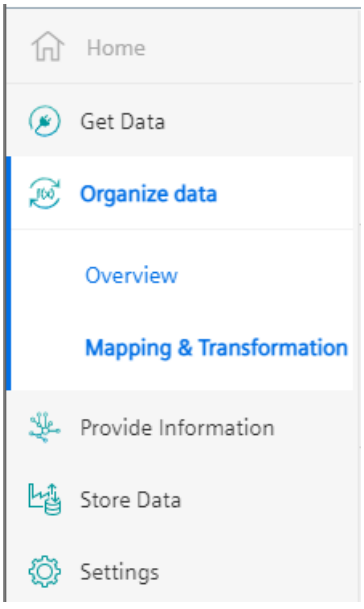


In the "Store data" tab you can activate data retention for the asset model.

6.1.2 Assigning tags to a model

Description

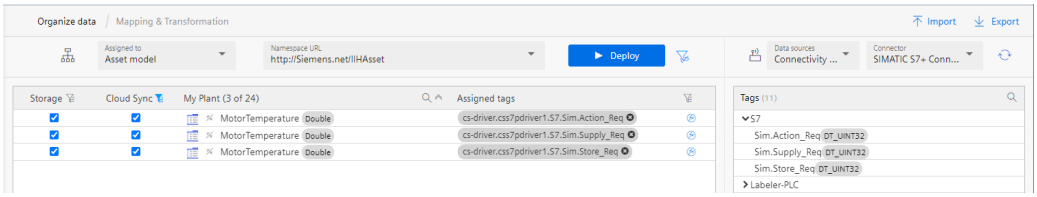
Assign the tags transmitted by a connector (Connectivity Suite or IE Databus) to the variables in the OPC UA-based asset model or an OPC UA model.



Procedure

To assign the tags, proceed as follows:

1. Select the asset model, for example:



2. Select the desired connector from the list of "Data Sources“ (Data sources).
3. Drag and drop the tag from the connector to the desired variable of the asset or OPC UA model.
   The compatibility of the tag data type is checked immediately with the data type of the asset or OPC UA model variable.
4. In the "Storage" column, you can select data retention for each variable as soon as you have mapped a tag.
5. If you have activated the data retention, you can also activate the synchronization to the MindSphere per variable.
6. Click "Deploy".

6.1.3 Transforming data

Description

In the rule editor of the IIH Configurator you can create the transformation rules with pre-defined operators. A transformation rule can consist of the following elements:

- Tags from the data source
- Process tags
- Constants

A **Data Source** is referenced by the name of the data source from which the data is downloaded into the "Mapping & Transformation" directory (e. g. either Connectivity Suite or Data bus connectors). A data source consists of a source type, source ID, connection name and tag name.

TagNames examples: sourceType.sourceId.connectionName.tagName

1. `cs-driver.css7pdriver1.PLC_3.AlwaysTRUE`
2. `databus.mbtcp1.turbofan.sensor1`

A **Connector ID** is referenced by the name of the southbound connector from which the data is called (e.g. SIMATIC S7+ CONNECTOR).

A **process tag** consists of the name of the CPU, followed by a dot, followed by a tag name (e.g. "plc.tagname").

A **constant** can be:

- An integer
  A number must only be used decimally, for example 4711.
- A floating-point number
  A floating-point number is a digit sequence, followed by a dot, followed by a sequence of numbers
- TRUE or FALSE

Note

Observe case-sensitivity

Note that the entry is case-sensitive for variables and operators.

A blue background in the data model indicates that a formula for data transformation has been stored.

Example: (('turbofan.sensor4' + 'PLC_4.AlwaysFALSE') * 'PLC_4.DataInByte'/'PLC_5.Pressure_1' + 10)

List of all supported operators

An unary operator can be placed in front of a primary or (partial) expression.

The following unary operators are supported:

Operator	Description	Notes
!	Multiplication of all positive numbers less than or equal to	
Factorial	Number	

The following binary operators are supported (from the highest to the lowest priority):

Operator	Description	Notes
* / %	Multiplication Division Modulo	Mathematical operators
+ -	Addition Subtraction	
< > <= >=	Relational operators	Relational operators have a higher priority than equality operators, in contrast to IEC 6113-1.
== !=	Equality operators	Equality operators have a lower priority than relational operators, in contrast to IEC 6113-1.
^	Bit-wise Exclusive Or	of the C languages

Operator	Description	Notes
and	logical AND	
Or	logical OR	

The following ternary operators are supported:

Operator	Description	Notes
? :	Conditional operator	The priority of the ternary operators is lower than that of all other operators.

All listed operators can be combined with any process tags and constants (as long as the data types fit). The sequence of the operations can be changed by using brackets: In the expression (x+y)*z the sub-expression x+y is calculated first and then the result is multiplied by z.

For Boolean values you can either use the texts representations TRUE and FALSE or the numerical values 0 and 1. A numerical calculation with a result of the data type BOOL must be evaluated either as 0 or 1. Any other value leads to an evaluation error.

Conditional evaluations can be made with the ternary operator. The general syntax is <condition> ? <true case> : <false case> :

if the result of the sub-expression <condition> is TRUE (or unequal to 0), then the result is the value of the sub-expression <true case>. Otherwise the result is the value of <false case>.

Examples for transformation rules

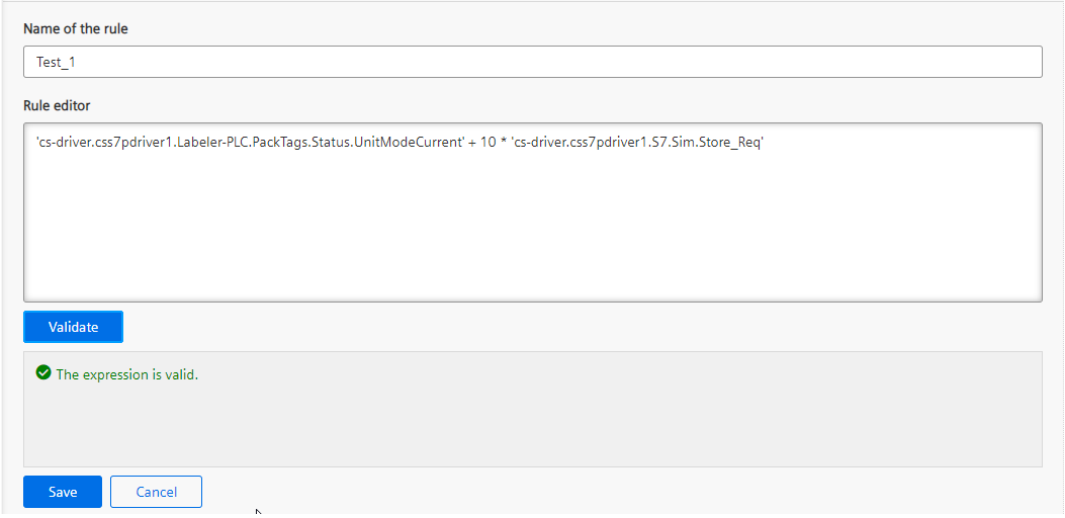
- a > b ? x + 1 : 0
  If the actual value of the variables a is greater than the actual value of the variables b, the value of the assigned variables is set to the result of the evaluation of x+1.
  Otherwise if a is smaller or equal to b, the value of the assigned variables is set to 0.
- a > b ? 1 : x + y
  If the actual value of the variables a is greater than the actual value of the variables b, the value of the assigned variables is set to 1. Otherwise the value of the assigned variables is set to the result of the evaluation of x+y.
- (a > b ? 1 : x) + y
  If the actual value of the variables a is greater than the actual value of the variables b, the value of the assigned variables is set to 1+y. Otherwise the value of the assigned variables is set to the result of the evaluation of x+y.

Procedure

To transform an assigned tag, follow these steps:

1. Either click the icon next to the variable or drag another tag onto the tag to be transformed.
   The window for the creation of the transformation rule is opened.
2. Assign a name for the transformation rule.
3. Create the transformation rule in the rule editor.

4. Click "Validate" (Validate) to validate the syntax of the transformation rule, the operands and operators immediately.

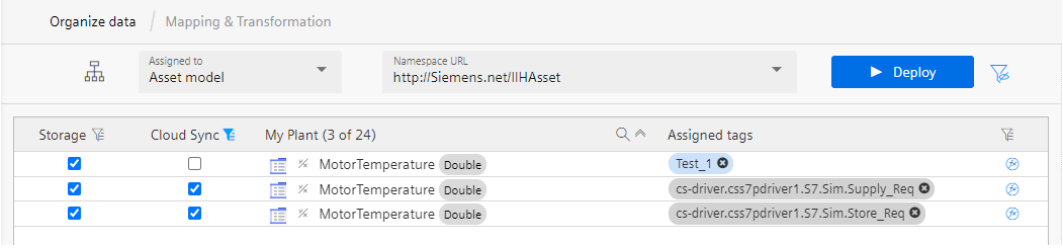


   The tag must be enclosed in single quotes.

5. Click "Save".

Result

As soon as the transformation rule has been created, the tag is replaced by the formula highlighted in blue:



6.1.4 Importing and exporting data models

Description

You can export the current state for a specific combination of data model and namespace and work on it offline in order to complete the assignment and import it again in the IIH Configurator.

Note: Only Json format is supported. It is recommended to only reimport the "model_data.json" file.

A file (download_mnt.zip) is created and exported. The .zip file contains the two .json files:

- datasources_data.json
  The file contains a list of all configured tags of the connectors, both Connectivity Suite as well as Databus connectors.
- model_data.json
  The file contains the data model information (Asset / OPC UA model) for the selected model and the namespace.

Procedure

To export the information, follow the steps below:

1. Open the "Organize data > Mapping & Transformation" tab.
2. Click the "Export" button in the top right corner.

6.1.5 Filtering tags

Description

You can filter the tags according to the following criteria in the "Mapping & Preprocessing" tab:

- Data retention activated/deactivated
- MindSphere Sync activated/deactivated
- Tag assigned/not assigned

Any changes that you make in the filtered view, such as enabling/disabling data retention for variables, are applied to the filtered tags throughout the entire list.

You can also deploy the changes from the filtered view.

Procedure

To filter the tags, follow these steps:

1. Click on the icon in the header.
2. Select the desired filter.

Result

Only the filtered tags are displayed and the filter icon is highlighted in blue.

To delete the filter, click the icon next to the "Deploy" button.

6.1.6 Search tags

Description

Using the search function you can find OPC UA objects, variables, asset variables, tags and preprocessing rules within the selected namespace.

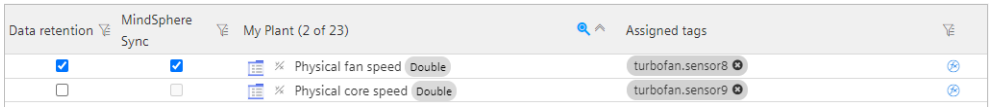
Procedure

To search for an object, follow these steps:

1. Click on the magnifying glass in the header.
2. Enter the search query.

Result

The desired selection is displayed and the magnifying glass is highlighted in blue:



You can also make changes and assignments in the filtered view.

6.2 Setting up data retention

6.2.1 Overview

Description

The standalone Data Service can be integrated into the IIH Configurator. All APIs/interfaces are hereby retained.

After integration into the IIH, set the data retention of the variables in the "Store data" tab.

You can find more information on integration here: Integrating Data Service into the IIH (Page 57)

You can find more information about the APIs of the Data Service here: Data Service OpenAPI specification (Page 62)

Activating data retention

You can set data retention for the following variables:

- Variables of MQTT connectors
- Variables of Connectivity Suite connectors

- REST API variables
- OPC UA variables (supported as of V1.6)

6.2.2 Integrating Data Service into the IIH

Note

Integration Data Service V1.5 in the IIH Configurator

Based on version 1.5, all data, assets and variables of the Data Service are automatically migrated to the IIH Configurator without data loss.

Description

You can integrate the standalone Data Service with its own user interface into the IIH Configurator and use it there.

You can do the integration starting from the Data Service or from the IIH Configurator.

⚠ WARNING

Data is lost with version 1.4

You can already integrate the Data Service into the IIH Configurator with V1.4. However, all data of the Data Service are then lost.

⚠ CAUTION

Undo integration

The integration cannot be undone and after the integration no data/variables independent of the IIH Configurator can be saved in the Data Service.

Requirement

The following apps must also be installed on the IED:

- IIH Configurator
- IIH Core

The green check mark indicates that all necessary apps are installed on the IED:

✓ IIH available

Procedure starting from the Data Service

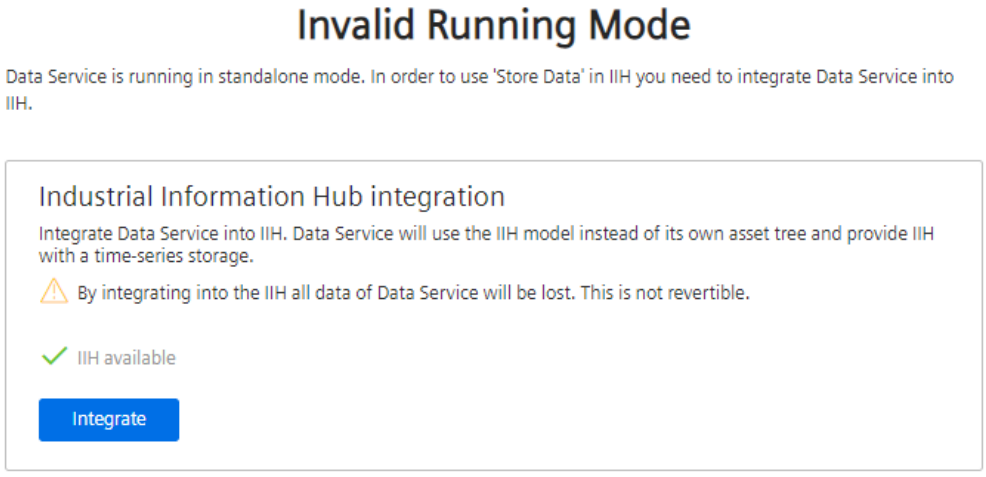
To integrate the Data Service into the IIH Configurator, follow these steps:

1. Open the "Settings".
2. Click "Integrate".

Procedure starting from the IIH Configurator

To integrate the Data Service into the IIH Configurator, follow these steps:

1. Open the "Store data" tab.
   If the Data Service is not yet integrated, you see the following window:



2. Click "Integrate".

Result

The Data Service is now integrated in the IIH Configurator. The integrated Data Service no longer has its own user interface. Switch to the IIH Configurator to create new connectors, assets and variables. You set the data retention in the IIH Configurator in the "Store data" tab.

The API remains unchanged by the integration into the IIH Configurator, thus apps based on it, such as Performance Insight or the Notifier, continue to function as usual.

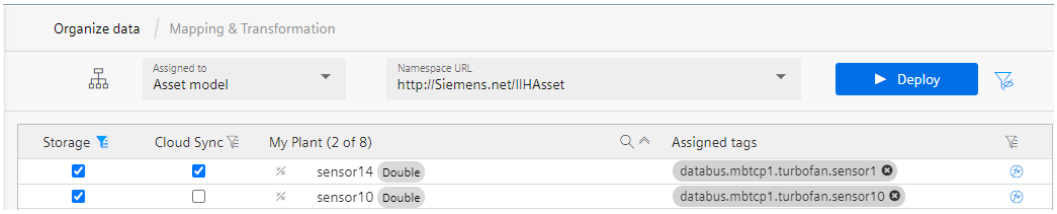
6.2.3 Setting data retention for an asset

Description

You can set the data retention period for an asset and all variables it contains or for individual variables. The data is deleted from the memory after this time.

Requirement

In the "Organize data > Mapping & Transformation" tab, you have assigned the corresponding tags to the variables, set the check mark in the "Data retention" column and deployed the model:



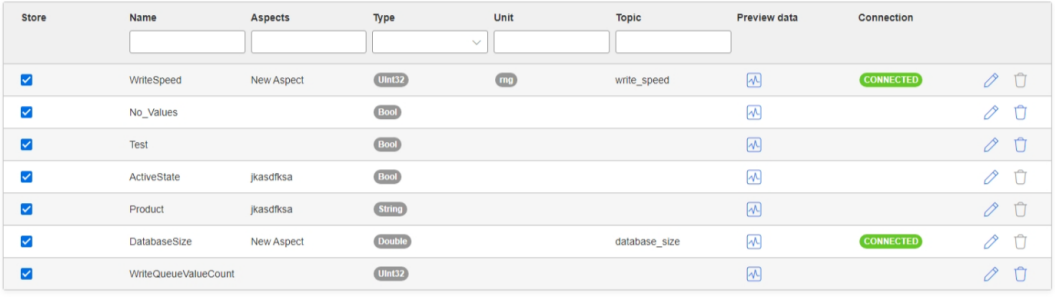
Procedure

To set the time period for the data retention of an asset, follow these steps:

1. Open the "Save data" tab.
2. Select the corresponding asset in the hierarchy.
3. In the detail view, click on the limit specification in the second row. As long as no data retention has been set, the specification is "No limit".
4. Select a period for the data retention.
5. Click "Save".

Result

The limit information in the detail view is changed. In the example below to "30 Days" (30 days).



Variables for which data retention active have the status CONNECTED.

To deactivate the data retention per tag, remove the check mark in the respective line without losing the settings of the data retention.

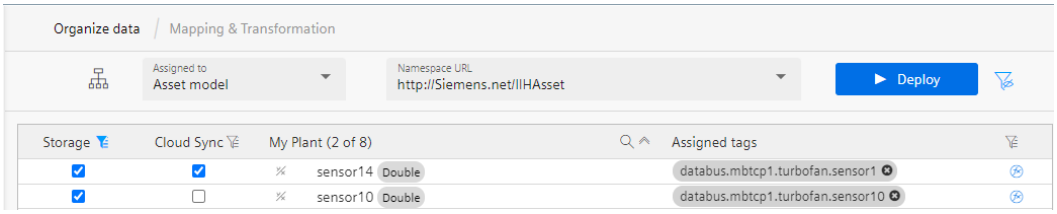
6.2.4 Setting data retention for an individual variable

Description

If you do not want to use the data retention period that you have set on the asset for individual variables, you can set a separate time period for each individual variable.

Requirement

- In the "Organize data > Mapping & Transformation" tab, you have assigned the corresponding tags to the variables.
- You have set the check mark per variable in the "Storage" column:

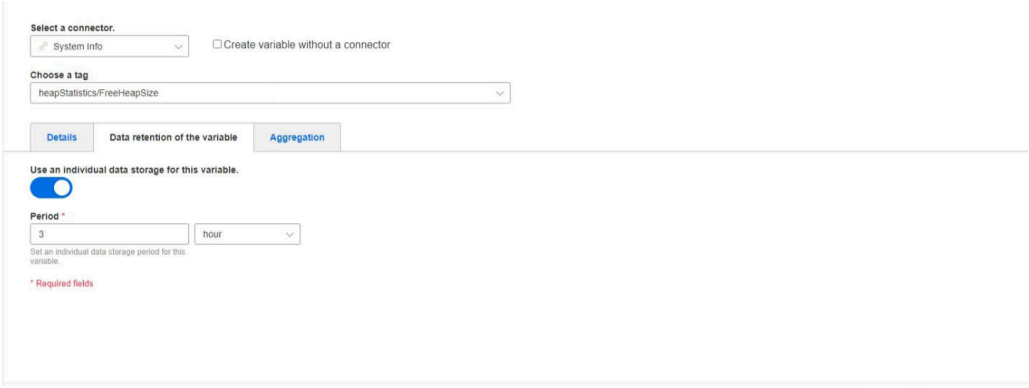


- You have deployed the data model.

Procedure

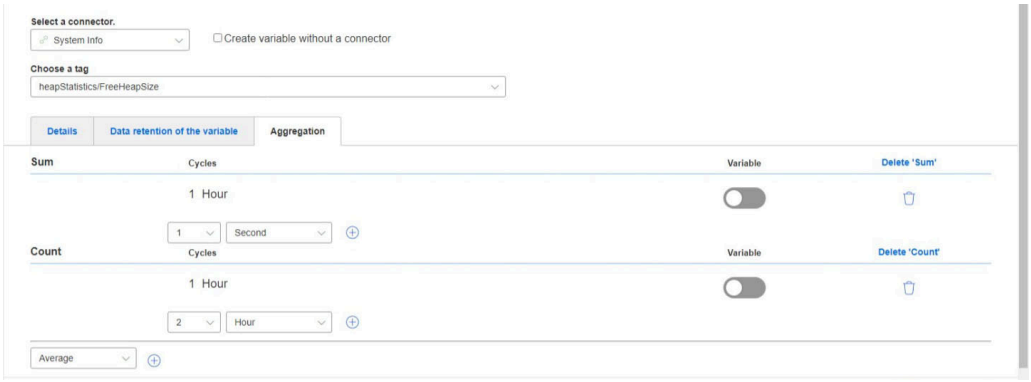
To set the data retention for an individual variable, follow these steps:

1. Open the "Save data" tab.
2. In the detail view, click on the icon in the row of the corresponding variable. The "Edit variable" dialog box opens:



3. Enable the "Use an individual data retention for this variable" function.
4. Set the desired period for the data retention of the variable.

5. Select one or more aggregations as required:



Note

Improving performance

Pre-calculated aggregations are taken into account when querying the data. This decisively shortens the duration of the query. For example, the Aggregations API queries the last month with aggregation "Sum".

For this purpose, aggregation is calculated from the raw data as required (at 1 ms cycle = 2,628,000,000 data points). However, if pre-calculated aggregations have been configured on the variable, the aggregation can be calculated from these (e.g. 1 h aggregation configured = 730 data points).

The following aggregations are available:

- Sum
- Count
- Average
- Min
- Max
- First
- Last
- Counter
- Timer
- TimeWeightedAverage
- StandardDeviation
- Variance

6. Click "Edit variable".

6.2.5 Data Service OpenAPI specification

Description

The Data Service OpenAPI specification is a standard for describing REST-compliant programming interfaces (API). With the OpenAPI, you can connect your user-developed app to the Data Service and access the interfaces of the Data Service.

You can find the routes for the Data Service by clicking the ⓘ icon in the title bar under "API Documentation".

The routes remain stable or compatible for at least 1 year. When a route is changed in such a way that existing interfaces have to be adapted (breaking change), this is announced in the OpenAPI specification in the description of the route (deprecated). You have one year to adapt your routes accordingly.

Requirement

The OpenAPI of the Data Service is available in the Industrial Edge Device-wide Docker network "proxy-redirect".

To communicate with the OpenAPI from the Data Service, an app must define this "external" network with the "bridge" driver:

```
networks:
  proxy-redirect:
    external:
     name: proxy-redirect
    driver: bridge
```

Depending on the environment, the Data Service is available there under this URL:

Edge Box: http://edgeappdataservice:4203

Industrial Edge App Publisher

You can find additional information on how to integrate your custom-developed app in Industrial Edge Management here: Industrial Edge App Publisher (https://support.industry.siemens.com/cs/us/en/view/109780392)

Procedure

To set up a connection to the OpenAPI of the Data Service, follow these steps:

1. You can retrieve information, for example, by calling the "getTimeSeries" method.
2. Additional routes can be found in the OpenAPI specification.

Note

Quality of values

If the quality is GOOD or UNCERTAIN, then the values are taken fully into account in the app.

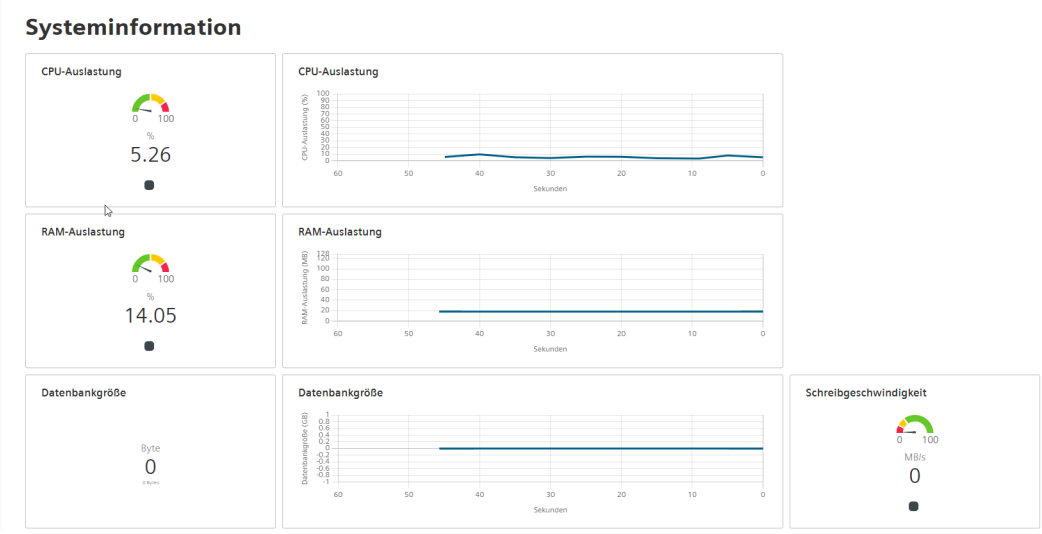
What does it mean if the value has the quality BAD:

- This value is not taken into account when calculating KPIs, for example, in Performance Insight or Energy Manager.
- The value is also saved when the raw data is saved in an app.

6.2.6 Display system information

Description

In the System Information dashboard, you can view various information provided by the System Info connector, such as CPU load, RAM usage, database size and write speed:



Procedure

To display the system information, follow these steps:

1. Open the "Settings". (In the standalone Data Service)
   -or-.
2. In the navigation, click on "Save data > Configuration". (In the integrated Data Service in the IIH)
3. Click "System information".

6.3 Querying OPC UA data via Aggregating server

Description

You can use the Aggregating server to display the view of the OPC UA data in the IIH Configurator. This means that you can search for the causes of errors and see the current status of the IIH core.

For OPC UA-specific use cases, you also need direct access to the OPC UA server.

To connect to the Aggregating server, you can use, for example, UA Expert via port 62520, or you can use the GraphQL API endpoint, which provides appropriate query capabilities.

An application example for reading out data via the OPC UA client "UaExpert" can be found here: Reading out data via the OPC UA client "UaExpert" (https://support.industry.siemens.com/cs/ww/en/view/109781701)

Credentials for the Aggregating server

Default user name: iihcore

Default password: iihcore

Default SecurityPolicy: Basic256Sha256

Default SecurityMode: SignAndEncrypt

Publishing data in MindSphere (Northbound) 7

7.1 Overview

Description

You can synchronize the variables of the Asset model with Mindsphere. In the process all assets, variables and aspect names are created automatically in MindSphere and the time series real-time data are synchronized (per second). Changes and the deletion of objects is synchronized directly in the MindSphere, if the "Cloud Sync" function was activated.

7.2 Synchronizing variables with a MindSphere

Description

You can specify by means of a variable whether you want to synchronize the data in the MindSphere. The assets, variables and aspect names are automatically created in the MindSphere.

Note

Cloud Connector

With this function, a Cloud Connector is no longer required.

Procedure

To select the data for MindSphere synchronization, follow these steps:

1. Open the "Data management > Mapping & Preprocessing" tab.
2. Select the data model (Asset or OPC UA model).
3. Assign the desired tags to the variables in the data model.
4. Enable the "Data retention" and "Cloud Sync" columns for the variables that you want to synchronize into MindSphere.

   Note

   Requirement for synchronization into MindSphere

   Only those variables can be synchronized into MindSphere for which data retention is activated.

5. Click "Deploy".

Result

The variables are created in MindSphere and the real-time data of the time series data are synchronized (per second). Changes to the variables, such as a name change, or the deletion of variables are also synchronized directly into MindSphere.

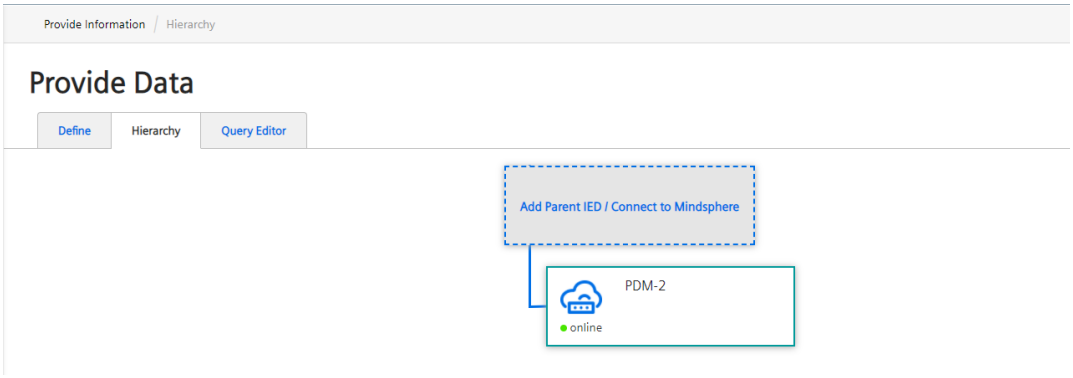
NOTICE
Move variables from one asset to another one If you assign variables on an IED from one asset to another asset, this shift is not synchronized with the MindSphere. In this case, we recommend that you delete the variables and create them again on the corresponding asset.

7.3 Setting up and terminating a connection to MindSphere

Description

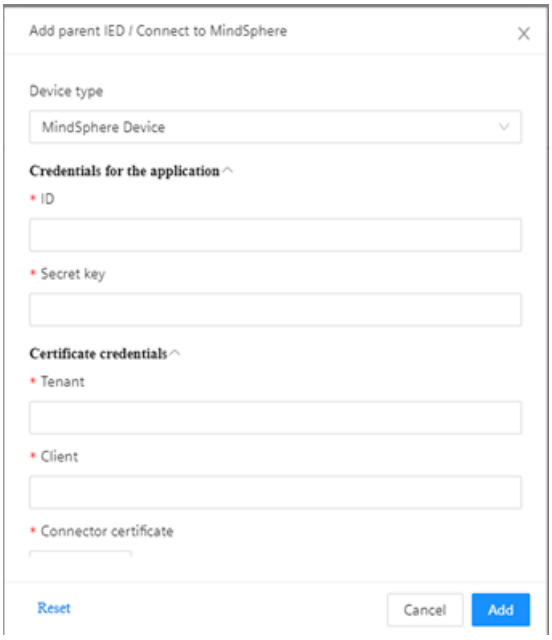
To set up a connection to MindSphere, follow these steps:

1. Open a web browser, such as Google Chrome, and enter the following URL to access the IIH Core API portal directly on your Industrial Edge Device (IED):
   `<your-ied-url>/common-configurator/get-data/connector-configuration`
2. Open the "Provide Information > Hierarchy" tab:



3. Click "Add Parent IED / Connect to Mindsphere".

4. Enter the following data to create and upload the certificate for MindSphere:



If there is no certificate for the selected tenant yet, then you need to create an appropriate certificate first.
A detailed description of how to create a Connector certificate can be found here:
Managing CA Certificates (https://developer.mindsphere.io/howto/howto-managing-ca-certificates.html)
MindSphere MQTT Broker (https://developer.mindsphere.io/concepts/concept-mindsphere-mqtt-broker.html)

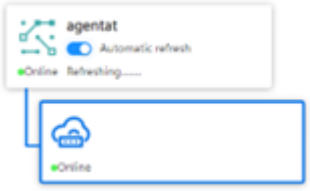
- Device type: MindSphere device
- Credentials for the application:
  The App ID and Secret Key are the app credentials required when an app like the IIH requires interaction with REST APIs from MindSphere. A MindSphere Tenant Administrator must create an app and create app credentials for their IIH Core instance. These credentials must then be used here at this point. Also ensure that the app credentials created have the **mdsp:core:Admin3rdPartyTechUser** role to update the asset model in MindSphere. For more information on app credentials for API apps, refer to the Developer documentation: Application Credentials for API applications (https://documentation.mindsphere.io/MindSphere/apps/operator-cockpit/application-credentials-for-API-applications.html)
  This is the recommended method for interacting with MindSphere REST APIs. Alternatively, the MindSphere Tenant Administrator can use the technical usage token (id/secret key) for his tenant instead of creating a dedicated app. You can find additional information here: Token Management Service (https://documentation.mindsphere.io/MindSphere/apis/exchange-tokenmanager/api-tokenmanager-samples.html)
- Tenant: MindSphere tenant name of the MindSphere account, for example, wccdev
- Client: CN Name (common name) used to create the certificate, e.g. test. The name must match the client ID.
- Connector certificate: Upload created certificate, for example, test-cert.pem

Region: for example, EU1

5. Upload the created certificate.
6. Click "Add".

Result

The connection to MindSphere has been established and is displayed as follows:



To ensure that the connection to MindSphere is automatically refreshed every 5 seconds, you can enable the "Automatic refresh" option.

If you move the cursor over the parent IED, you can edit and delete it.

7.4 Synchronizing the configuration of one IED to further IEDs and in the MindSphere

Description

The IIH Configurator allows you to synchronize all data, such as the asset hierarchy, current data and stored data, from one IEDs to a further IED and to load the data to MindSphere.

This way you can create a network and access the tags of all synchronized IEDs (e.g. per machine) from one IED at the highest level (in the example below IED #0, for example, one server per factory). In addition, the data can be transferred centrally from one location to the MindSphere.

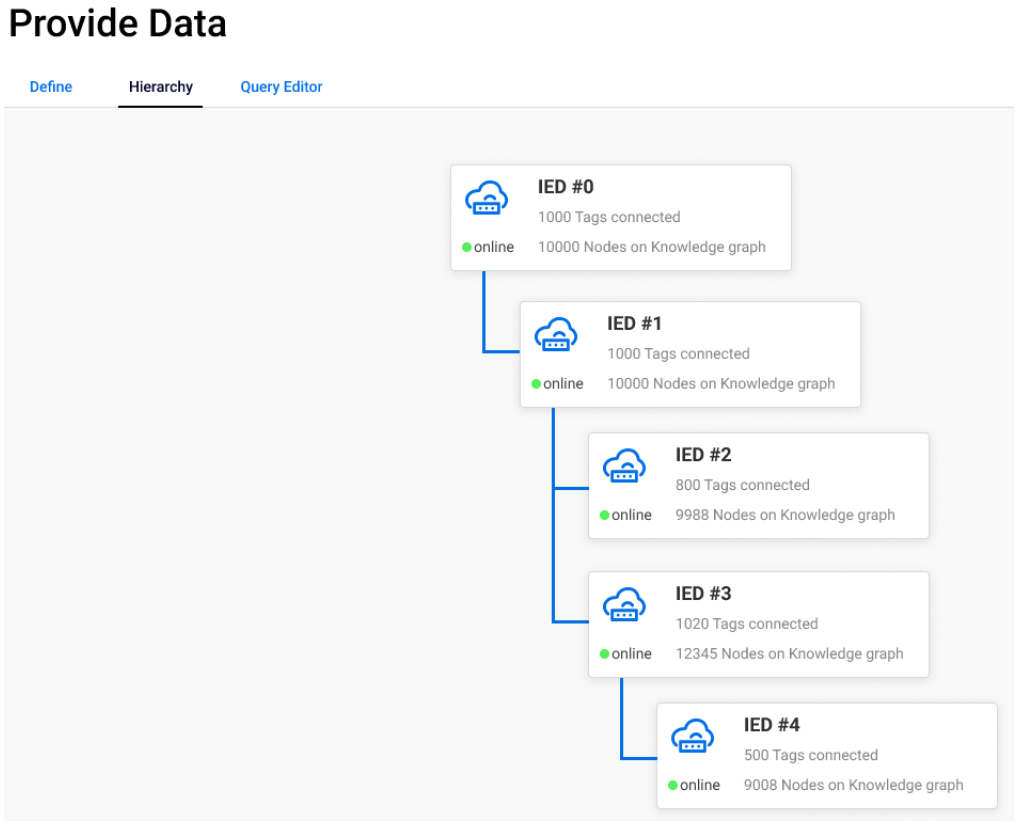
Procedure

To synchronize the settings to another IED, follow these steps:

1. Open the "Provide information > Hierarchy" tab.
2. Click "Add Parent IED/Connect to MindSphere" and enter the connection data of the IED.

Result

You have created a higher-level IED and applied the settings of the IIH Configurator to the higher-level IED. This eliminates the need to configure the settings again manually on additional IEDs:



Querying information with GraphQL

8

8.1 Introduction to GraphQL

Description

Related information can be extracted from the OPC UA model and automatically converted into a semantic data model (Knowledge Graph) and displayed. Using the GraphQL query language, you can query information from this data model and display it hierarchically.

Both the current values and the historical time series data are available in the data model via the REST API SparQL.

As a stateless query language, GraphQL allows you to define the exact structure of the data needed. This parameter assignment avoids transmission of unnecessarily large amounts of data with each request – quite unlike many other REST API interfaces. GraphQL supports reading, writing and subscribing to data changes (real-time updates).

You can find more information on the query language GraphQL here: GraphQL.org Foundation (https://graphql.org/)

You have two options to query information or data from the data model.

You can start the query directly in IIH (visual approach) or in expert mode via Altair (purely textual approach).

The "Expert mode" button takes you to the Altair user interface. Altair's GraphQL user interface automatically converts OPC UA-based ontologies into an accessible GraphQL object API with filtering capabilities. The GraphQL API consists of several functions, including:

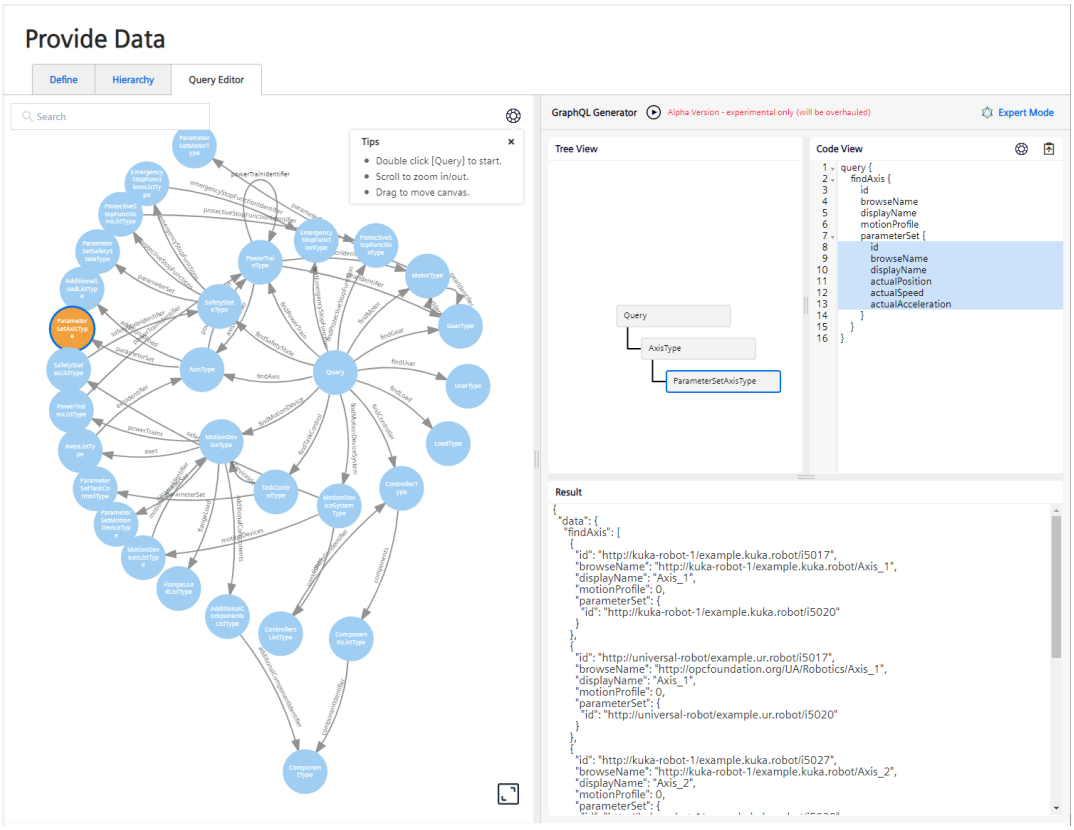
- Hierarchical retrieval of objects
- Hierarchical filtering of objects
- Filtering with alternatives (And/Or)

Procedure in the IIH

Requirement:

In order for a visual data model to be displayed to you in the query editor, you must have added an OPC UA model in the "Provide data" tab under "Define".

In IIH, you can create the query structure by double-clicking the respective query levels from the inside out starting at "Query" in the visual data model:



To query information in IIH, proceed as follows:

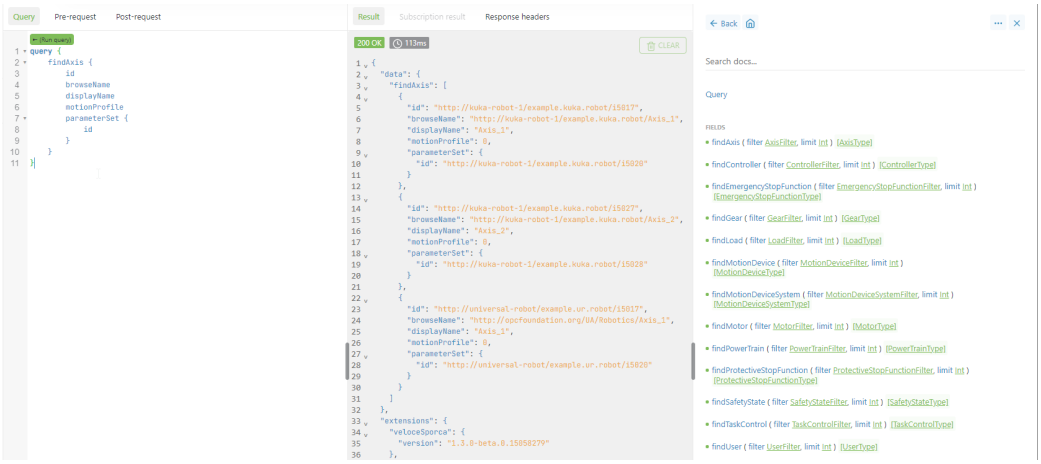
1. Click on the "Provide information > Deploy data > Query editor" tab.
2. In the visual data model, click "Query".
   The next possible level of information that you can query is shown in dark blue.
3. Search for the desired node at the next level of information and double-click the corresponding node.
   The query hierarchy is displayed in the "Tree view" window, and the corresponding associated code is displayed in the "Code View".
4. Click "Execute" to the right of "GraphQL Generator" to start the query.
5. The result is stored in the "Result" window.

Procedure via Altair

Requirement:

You must have added an OPC UA model in the "Provide data" tab under "Define".

You can interactively perform GraphQL queries using Altair. It provides Intellisense for possible query options and the "Docs" button allows you to view a complete list of possible query options. Queries can be programmed in the left pane and the results appear in the center pane.



To query information via Altair, proceed as follows:

1. Click on the "Provide information > Deploy data > Query editor" tab.
2. Click "Expert mode" at the top right.
   The "<IP address>/iih-core-config/ui/altair" page opens.
3. Enter the query structure in the "Query" window.
4. Click "Run query".

8.2 Query options with GraphQL in IIH and Altair (reading, writing, notifications and filtering).

8.2.1 Reading information (query)

Description

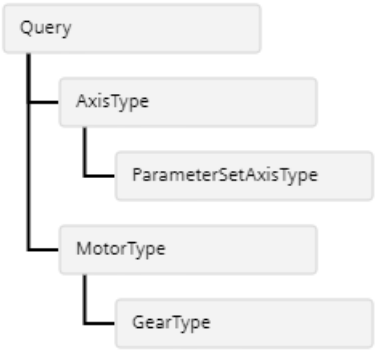
You can use the code examples in IIH as well as in Altair.

Querying object information hierarchically

In the result of the query, the interrelationships of the information are output in a parent-child structure of the objects.

In this example, a robot has a power train, which in turn has a motor with a gearbox and an axis with a certain parameter set. This type of relationship can be retrieved using GraphQL:

Visual representation in the Tree View:



Code example

```
query {
    findAxis {
        id
        browseName
        displayName
        motionProfile
        parameterSet {
            id
            browseName
            displayName
            actualPosition
            actualSpeed
            actualAcceleration
        }
    }
    findMotor {
        id
        browseName
        displayName
        manufacturer
        productCode
        model
        serialNumber
        gearIdentifier {
            id
            browseName
            displayName
            productCode
            model
            manufacturer
            serialNumber
            gearRatio
            pitch
        }
    }
}
```

Result:

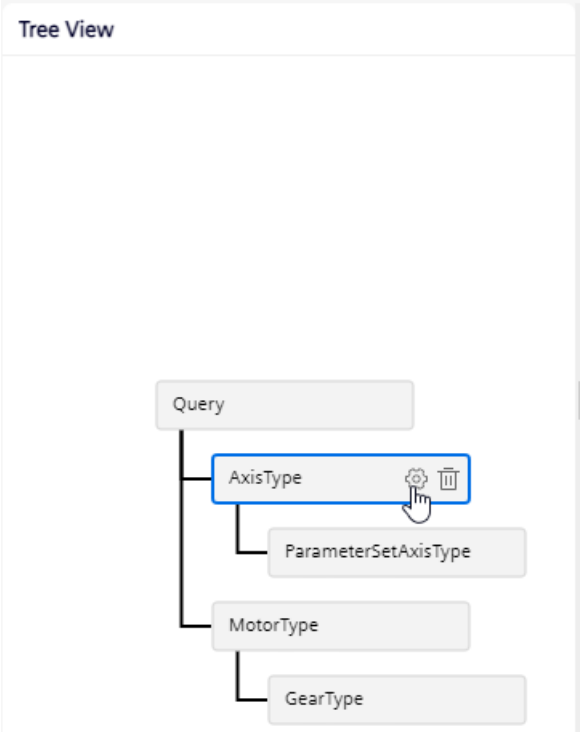
Result


```
{
 "data": {
  "findAxis": [
   {
    "id": "http://kuka-robot-1/example.kuka.robot/i5017",
    "browseName": "http://kuka-robot-1/example.kuka.robot/Axis_1",
    "displayName": "Axis_1",
    "motionProfile": 0,
    "parameterSet": {
     "id": "http://kuka-robot-1/example.kuka.robot/i5020",
     "browseName": "http://opcfoundation.org/UA/DI/ParameterSet",
     "displayName": "ParameterSet",
     "actualPosition": 24.66086998333264,
     "actualSpeed": null,
     "actualAcceleration": null
    }
   },
   {
    "id": "http://kuka-robot-1/example.kuka.robot/i5027",
    "browseName": "http://kuka-robot-1/example.kuka.robot/Axis_2",
    "displayName": "Axis_2",
    "motionProfile": 0,
    "parameterSet": {
     "id": "http://kuka-robot-1/example.kuka.robot/i5028",
     "browseName": "http://opcfoundation.org/UA/DI/ParameterSet",
     "displayName": "ParameterSet",
     "actualPosition": 12.654074711098371,
     "actualSpeed": null,
     "actualAcceleration": null
    }
   },
   {
    "id": "http://kuka-robot-1/example.kuka.robot/i5017",
    "browseName": "http://kuka-robot-1/example.kuka.robot/Axis_1",
    "displayName": "Axis_1",
    "motionProfile": 0,
    "parameterSet": {
     "id": "http://kuka-robot-1/example.kuka.robot/i5020",
     "browseName": "http://opcfoundation.org/UA/DI/ParameterSet",
     "displayName": "ParameterSet",
     "actualPosition": 18.77489977924847,
     "actualSpeed": null,
     "actualAcceleration": null
    }
   },
```

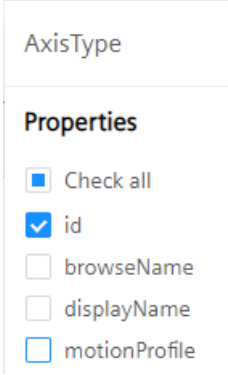

If the OPC UA model contains several axes and motors, as in this example, the result can become very extensive. Therefore, you can deselect parameters, for example, so that they are no longer included in the query.

Selecting/deselecting parameters for query result

In IIH, you can deselect individual parameters by clicking on the ⚙ symbol to the right of "AxisType" or "MotorType" in the "Tree View", for example:



And deselect the corresponding parameters:



Or you can delete the corresponding code lines in the Code View (IIH or Altair).

Then click ▶ "Execute".

Result:

Result


```
{
 "data": {
  "findAxis": [
   {
    "id": "http://kuka-robot-1/example.kuka.robot/i5017",
    "displayName": "Axis_1",
    "motionProfile": 0,
    "parameterSet": {
     "id": "http://kuka-robot-1/example.kuka.robot/i5020"
    }
   },
   {
    "id": "http://kuka-robot-1/example.kuka.robot/i5027",
    "displayName": "Axis_2",
    "motionProfile": 0,
    "parameterSet": {
     "id": "http://kuka-robot-1/example.kuka.robot/i5028"
    }
   },
   {
    "id": "http://universal-robot/example.ur.robot/i5017",
    "displayName": "Axis_1",
    "motionProfile": 0,
    "parameterSet": {
     "id": "http://universal-robot/example.ur.robot/i5020"
    }
   }
  ],
  "findMotor": [
   {
    "id": "http://kuka-robot-1/example.kuka.robot/i5021",
    "browseName": "http://kuka-robot-1/example.kuka.robot/Motor_1",
    "gearIdentifier": [
     {
      "id": "http://kuka-robot-1/example.kuka.robot/i5024",
      "displayName": "Gear_1"
     }
    ]
   },
   {
    "id": "http://kuka-robot-1/example.kuka.robot/i5025",
    "browseName": "http://kuka-robot-1/example.kuka.robot/Motor_2",
    "gearIdentifier": [
     {
      "id": "http://kuka-robot-1/example.kuka.robot/i5029",
      "displayName": "Gear_2"
     }
```


Only the selected parameter information is output per axis and motor.

8.2.2 Filtering information

Hierarchical filtering of objects

The filtering approach follows the same general syntax as the object retrieval syntax. It is possible to filter by more than one object. The objects can have different basic data types, such as String, Numeric, Boolean. The filter can be applied only at the beginning of the object retrieval query and only to the top-level object. The list of top-level objects is filtered in this way.

Only the child object of top-level objects can be the first level of the filter; its child object in the hierarchy can be used in later levels.

You can also filter with create alternatives (and/or).

Filter operators

Literal objects are the only ones to which a filter operator can be applied. The operator types available for each literal type vary. Below are the operator types of various data types:

- String
  - Equal to; eq
  - Contains
- Floating point numbers (float)/Numbers (integer)
  - Equal to; eq
  - Less than; lt
  - Greater than; gt
- Bool
  - Equal to; eq

Explanation:

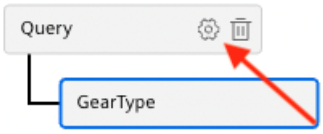
- eq: The 'equal to' operator; searchItem = ProvidedValue
- contains: This is the 'Search' operator for substrings; the searchItem contains the substring ProvidedValue.
- lt: This is the 'less than' operator applied to numerical data types; searchItem < ProvidedValue
- gt: This is the 'greater than' operator applied to numerical data types; searchItem > ProvidedValue

Filtering Information in the IIH

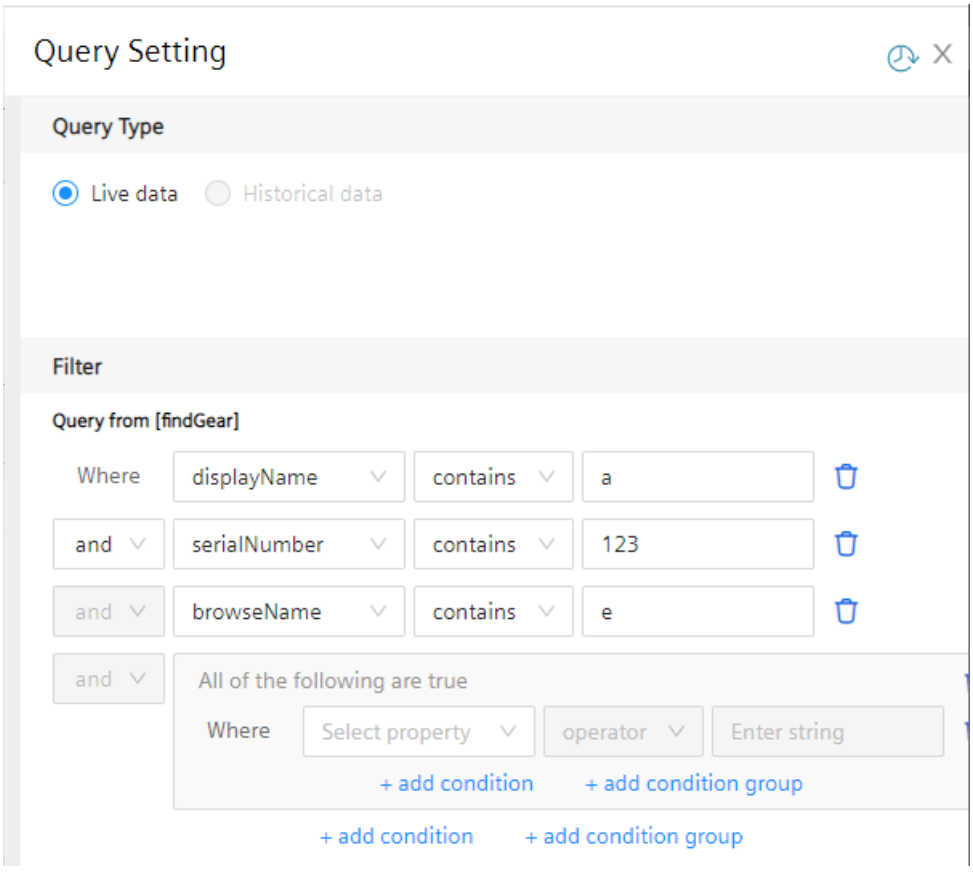
To filter the queries by particular information, follow these steps:

1. Open the IIH Configurator.
2. Open the query editor in the "Provide information" tab.
3. Double-click the "Query" object.
4. Search for the desired node and double-click the node(s) in each case in the query editor. The nodes are displayed in the tree view.

5. Move the cursor over the "Query" node and click on the icon Settings:



In the settings, you can select the query type and set the filter for each child object:



6. Click "Validate".

Filtering Information via Altair

To filter the queries by particular information, follow these steps:

1. Open the IIH Configurator.
2. Open the query editor in the "Provide information" tab and click on "Expert mode".

Filtering objects hierarchically

The GraphQL API also allows hierarchical filtering of objects. The filtering approach follows the same general syntax as the object retrieval syntax. It is possible to filter by more than one object. The objects can have different basic data types, such as String, Numeric, Boolean.

The filter can be applied only at the beginning of the object retrieval query and only to the top-level object. The list of top-level objects is filtered in this way.

Only the child object of top-level objects can be the first level of the filter; its child object in the hierarchy can be used in later levels.

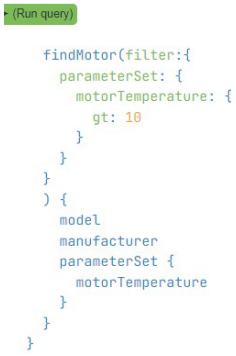
The filter format is as follows:

```
{
    TopLevelQuery(filter:
    {
        Level1Child1: {
            Level2Child1: {
                literalMember1 {
                    filterOperator: Value
                }
            }
        }
    }
     {
         Level1Child1 {
               Level2Child1 {
                      literalMember1
                }
          }
 }
```

You can see an example of such a query with filters here:

```
{
  findMotor(filter:{
    parameterSet: {
      motorTemperature: {
        gt: 10
      }
    }
  }
  ) {
    model
    manufacturer
    parameterSet {
      motorTemperature
    }
  }
}
```

The example has the following result:


(Run query)
findMotor(filter:{
parameterSet: {
motorTemperature: {
gt: 10
}
}
}) {
model
manufacturer
parameterSet {
motorTemperature
}
}
}


200 OK
130ms
CLEAR
{
"data": {
"findMotor": [
{
"model": "",
"manufacturer": "",
"parameterSet": {
"motorTemperature": 20.533769607543945
}
},
{
"model": "",
"manufacturer": "",
"parameterSet": {
"motorTemperature": 20.533769607543945
}
}
]
},
"extensions": {
"veloceSporca": {
"version": "1.2.0-beta.0.13620580"
},
"tracing": {

Filtering multiple nodes

Filter queries can apply the filter operator to multiple nodes in the filter structure hierarchy. This allows for complex filter queries that specify the definition of nodes which satisfy such conditions:

```
{
  findMotionDeviceSystem (filter: {
    controllers : {
      controllerIdentifier: {
        manufacturer: {
          contains: "KUKA"
        }
        software: {
          softwareIdentifier: {
            softwareRevision: {
              contains: "1.5"
            }
          }
        }
      }
    }
  }) {
    motionDevices {
      id
      motionDeviceIdentifier {
        powerTrains {
          id
          powerTrainIdentifier {
            id
            motorIdentifier {
              id
              parameterSet {
                motorTemperature
              }
            }
          }
        }
      }
    }
  }
}
```

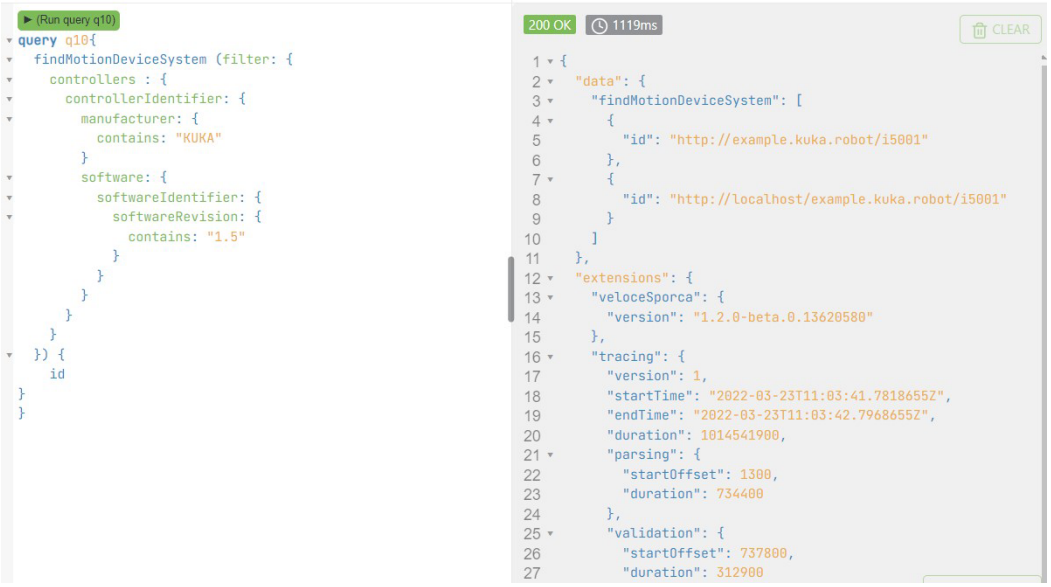
The example has the following result:

The query retrieval structure may be different from the filter structure.

The query retrieval structure provides the server with the data points that must be retrieved. This retrieval request may be completely different from the filter structure. This allows complex filter queries that return only one data point:

```
{
  findMotionDeviceSystem (filter: {
    controllers : {
      controllerIdentifier: {
        manufacturer: {
          contains: "KUKA"
        }
        software: {
          softwareIdentifier: {
            softwareRevision: {
              contains: "1.5"
            }
          }
        }
      }
    }
  }) {
    id
}
}
```

The example has the following result:



8.2.3 Code examples for filtering

Description

You can use the code examples in IIH as well as in Altair.

```
query demo5 {
  findMotor(filter: {parameterSet: {motorTemperature: {gt: 10 lt: 30}}} limit: 2) {
    targetName:id
    browseName
    parameterSet {
      motorTemperature
    }
}
}
// filter by "greater than", "less than" and a threshold of 2.
```

```
query demo {
  findMotor(filter: {browseName: {contains: "_2"}}) {
    targetName:id
    browseName
    parameterSet {
      motorTemperature
    }
}
}
// filter by all motors with the ending "_2" in the "browseName".
```

```
query demo4 {
  findMotor {
    targetName:id
    browseName
    parameterSet {
      motorTemperature
    }
}
}
```

```
# motorName != "Motor_2"

query demo1{
  findMotor(filter: {
    not: {displayName: {eq: "Motor_2"}}
  }) {
    displayName
    parameterSet {
      motorTemperature
    }
  }
}
// When filtering, motors with the "displayName" => "Motor_2" should be excluded.
```

```
# trainName == "PowerTrain_1" || motorName == "Motor_1"

query demo2 {
  findPowerTrain(filter: {
    or: [
      {and: [
        {motorIdentifier: {browseName: {contains: "Motor_1"}}}
      ]}
      {displayName: {eq: "PowerTrain_1"}}
      {motorIdentifier: {displayName: {eq: "Motor_1"}}}
    ]
  }) {
    displayName
    motorIdentifier {
      displayName
      parameterSet {
        motorTemperature
      }
    }
  }
}
```

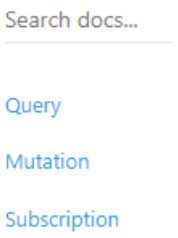
```
# (machine == UR3 && motorTemp > 20) || (machine == KUKAfr && motorName != Motor_1)

query demo3{
  findMotionDeviceSystem(filter: {
        or: [
      {and: [
        {displayName: {eq: "UR3"}}
        {motionDevices: {motionDeviceIdentifier: {powerTrains: {powerTrainIdentifier:
{motorIdentifier: {parameterSet: {motorTemperature: {gt: 10}}}}}}}}
      ]}
      {and: [
        {displayName: {eq: "KUKABfr"}}
        {motionDevices: {motionDeviceIdentifier: {powerTrains: {powerTrainIdentifier:
{motorIdentifier: {not: {displayName: {eq: "Motor_1"}}}}}}}}
      ]}
    ]
  }) {
    displayName
    motionDevices {
      displayName
      motionDeviceIdentifier {
        displayName
        powerTrains {
          displayName
          powerTrainIdentifier {
            displayName
            motorIdentifier{
              displayName
              parameterSet{
                motorTemperature
              }
            }
          }
        }
      }
    }
  }
}
```

8.2.4 Writing information (Mutation)

Description

Writing (modification) works only on variable nodes that are allowed to be modified (AccessLevel = 3). You must activate the write function on the respective node to be able to write values. This option is displayed to you in Altair only if the S7/S7+ connector or the OPC UA server model contains writeable nodes.



This function is available in Altair or other REST API clients.

The following data types are currently supported:

- All numeric data types (integers, floating-point numbers (float, double), etc.)
- Boolean values
- Strings

Note

LocalizedText or other structured data types

Currently, variables of the type "LocalizedText" or other structured data types cannot be written.

Procedure

To write values to variables, follow these steps:

1. Open the IIH Configurator.
2. Connect a SIMATIC S7/S7+ connector or a corresponding OPC UA server to the IIH providing nodes with write access.
3. Wait until the namespace is fully integrated (updated RDF store).
4. In the "Provide information > Query editor" tab, click the "Expert mode" button.
5. Update "Docs" by clicking "Reload Docs".
6. In the editor on the right, in addition to the query options on "Query", "Mutation" and "Subscription" are displayed.
7. You see the following write command under "Mutation":

8. Move the mouse over the write command and right-click on "ADD QUERY".
   The following query is displayed in the left editor:

```
▶ (Run mutation)
mutation {
  writeVariable(
    nodeId: { namespaceUri: "string", identifier: "string" }
    value: "string"
  ) {
    namespaceUri
    identifier
    identifierType
    value
    timestamp
    timestampString
    statusCode
  }
}
```

9. Update the "nodeId" parameter so that it points to the right OPC UA node, and enter the value as a string.
   Example:

```
mutation {
  writeVariable(
    nodeId: { namespaceUri: "http://localhost/
example.kuka.robot/", identifier: "6024" }
    value: "New Name"
  ) {
    namespaceUri
    identifier
    identifierType
    value
    timestamp
    timestampString
    statusCode
   }
}
```

Note

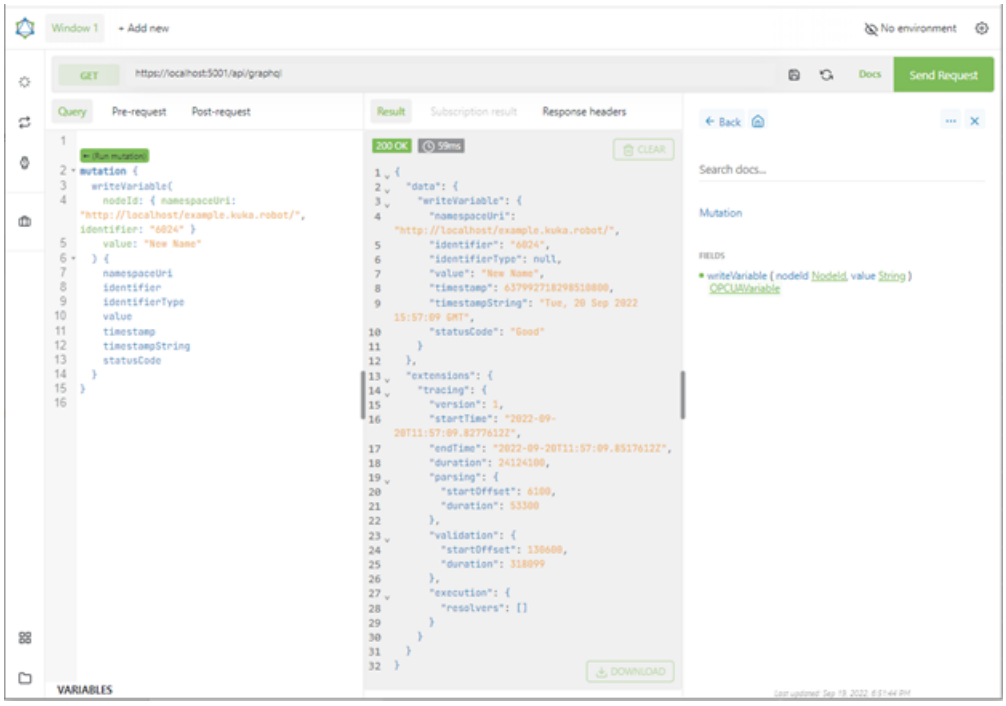
String data type

For all data types, the data must be converted to strings.

10. Click "Run mutation".

Result

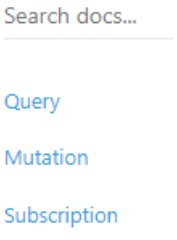
The value at the node is changed accordingly:



8.2.5 Send notifications in the event of value changes on the OPC UA Aggregation Server (subscription)

Description

The Subscription function serves as notification if there are value changes on the OPC UA Aggregation Server. This is implemented by using the GraphQL subscription function over websockets. Subscription works for all variable nodes.

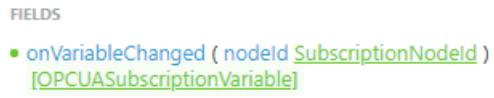


This function is available in IIH and Altair.

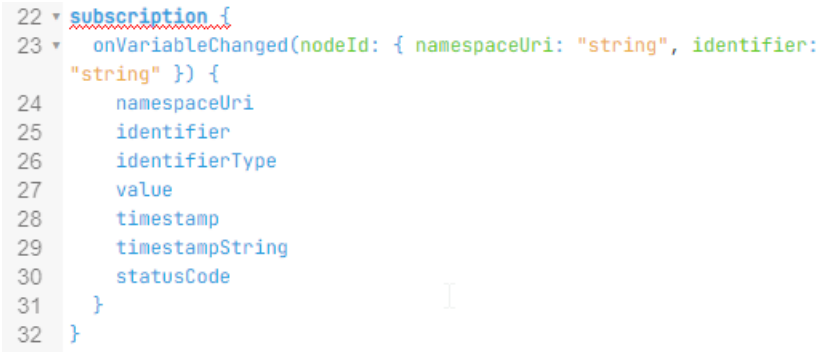
Procedure

To create subscriptions, proceed as follows:

1. Open the IIH Configurator.
2. In the "Provide information > Query editor" tab, click the "Expert mode" button.
3. Update "Docs" by clicking "Reload Docs".
4. In the editor on the right, in addition to the query options on "Query", "Mutation" and "Subscription" are displayed.
5. You see the following command under "Subscription":



6. Move the mouse over the subscription and right-click on "ADD QUERY".
The following query is displayed in the left editor:



7. Update the parameter "nodeId" in such a way that it points to the right OPC UA node, and enter the value as a string.
Example:

```
subscription {
  onVariableChanged(
    nodeId: { namespaceUri: "http://localhost/
example.kuka.robot/", identifier: "6024" }
    ) {
    namespaceUri
    identifier
    identifierType
    value
    timestamp
    timestampString
    statusCode
   }
}
```

Note

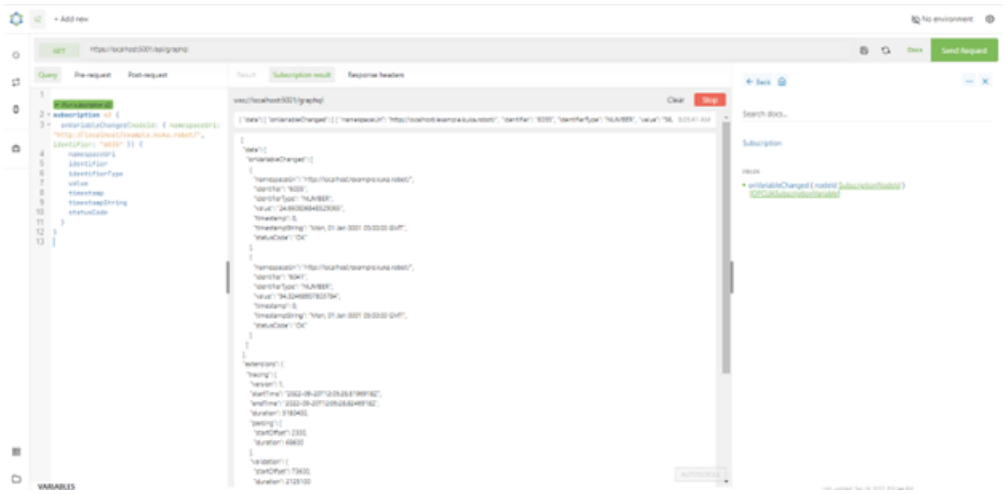
String data type

For all data types, the data must be converted to strings.

8. Click "Run subscription".

Result

The following value changes are displayed:



Backing up and restoring data

9

9.1 Data backup

Description

You can save the configuration data and time series data in the IIH Configurator (connector connections, asset models, variables, aspects, etc.) and restore it to another IED, for example, or create a data backup of your configuration.

Note

Restore data backup

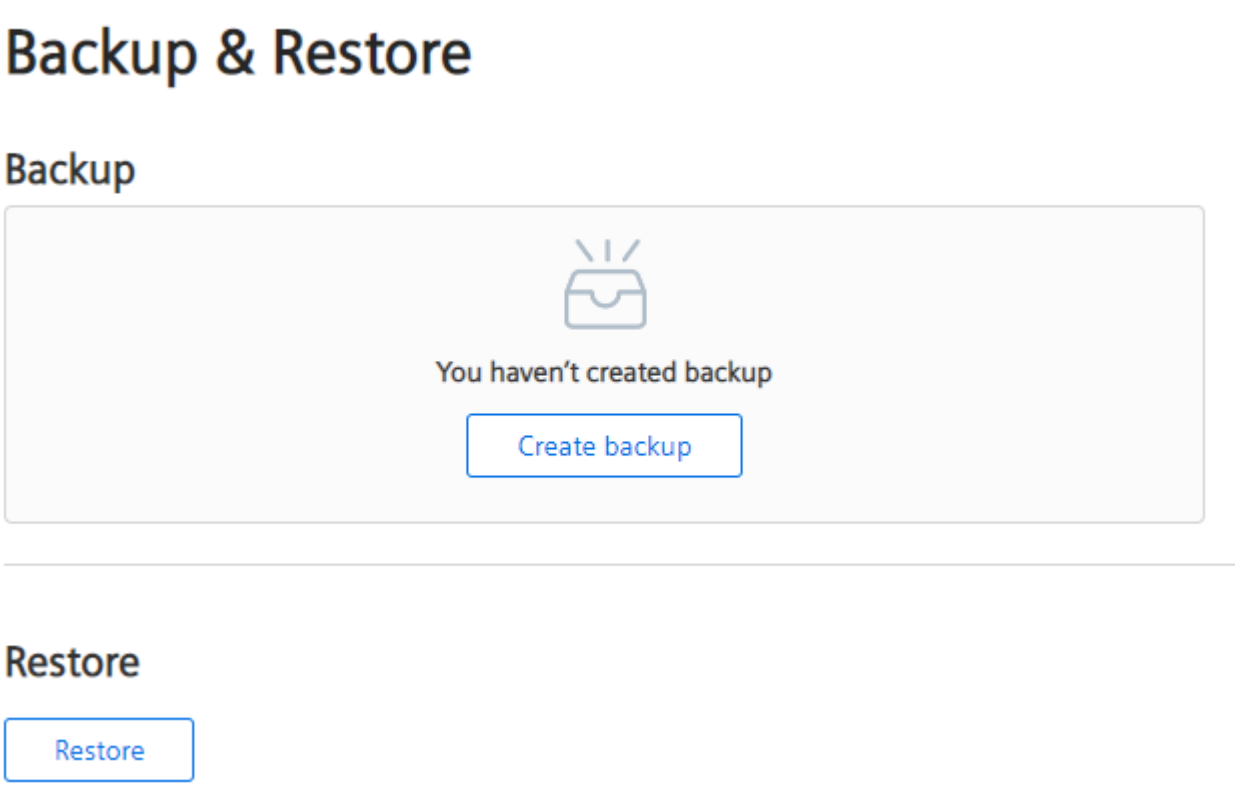
When you restore a data backup of your data, only the data that was included at the time of the last data backup is restored. Recent changes made in the IIH Configurator after the time of the last data backup are lost when the data backup is restored.

For this reason, we recommend making regular data backups.

Procedure

Proceed as follows to back up the data:

1. In the navigation bar, click "Settings > Backup & Restore".
2. Click "Create backup":



3. To track the creation process of the files, you can enable the developer tools in the browser (F12 or Ctrl + Shift + I) and open the "Network" tab.

9.2 Restoring data

Description

You can restore a data backup of your configuration or the time series data, or you can fill several other IEDs with the configuration of the IIH Configurator, for example, and therefore do not have to set up any new configurations.

Note

Restore data backup

When you restore a data backup of your data, only the data that was included at the time of the last data backup is restored. Recent changes made in the IIH Configurator after the time of the last data backup are lost when the data backup is restored.

For this reason, we recommend making regular data backups.

Requirement

Existing files:

- .tgz file

Procedure

To upload or restore the configuration data, follow these steps:

1. In the navigation bar, click "Settings > Backup & Restore".
2. Click "Restore".
3. Drag & drop the desired file (.tgz) into the window.

   Note

   Data is overwritten

   When you confirm the dialog window, the old data is overwritten.

4. Click "Confirm".

Result

The configuration is restored.

Improving performance

10

Description

With the following configuration examples, we can ensure the highest possible performance of the Data Service app:

Note

Validity

This information applies only to retaining the data and reading historical data. It does not apply to reading the live data.

Write performance

The Data Service app supports 5,000 changes per second. Changes means that a write operation takes place in the database. In the worst case, only one value is written per write operation.

The following scenarios are therefor possible:

- 5,000 variables with a write cycle of 1 s (5,000 * 1,000/1,000 = 5,000 changes)
- 500 variables with a write cycle of 100 ms (500 * 1,000/100 = 5,000 changes)
- 50 variables with a write cycle of 10 ms (50 * 1,000/10 = 5,000 changes)
- etc.

If the values are sent from the adapter in packets, more data can be processed. For example, an adapter sends the values of a variable in packets of 1,000 every second. This means that there is only one write operation per second.

Read performance

The read performance is influenced by many factors. Two examples provide a guide value here:

A variable with a 1 ms write cycle is to be queried over one hour. 1 ms in 1 h = 3.6 million values.

- Aggregated query (e.g. average) = 10 seconds load time
- Raw data query = 30 seconds load time

Database (dashboard configuration in Performance Insight)		
4 counter variables in 1 second resolution		
Widget 1: Chart (diagram)	3 counter variables	No aggregation
Widget 2: Chart (diagram)	3 counter variables	Aggregation: Average
Widget 3: Gauge (pointer diagram)	1st counter variable	Aggregation: Average

Database (dashboard configuration in Performance Insight)		
Widget 4: Value	2nd counter variable	Aggregation: Average
Widget 5: Heatmap	3rd counter variable	No aggregation

The test runs were performed on a Unified Comfort Panel (UCP) instead (with the minimum hardware equipment).

Load times of the database		
Loading 1 day	10:70 s	777,600 data points
Loading 1 week	58.00 s	5,443,200 data points

Impact of parameters on the test:

Time period		
1 day	10:70 s	777,600 data points
2 days	19:21 s	1,555,200 data points
3 days	28:99 s	2,332,800 data points
4 days	37:09 s	3,110,400 data points
5 days	50:57 s	3,888,000 data points
6 days	61:01 s	4,665,600 data points
7 days	68:00 s	5,443,200 data points
=> Linear influence		

Calculation time period (1 day)		
10 min	11:83 s	777,600 data points
20 min	10:41 s	
30 min	11.03 s	
40 min	11.46 s	
50 min	11.84 s	
60 min	11.68 s	
= has no effect		

Variable cycle (1 day)		
1 s	11.50 s	777,600 data points
2 s	8.50 s	388,800 data points
3 s	4.30 s	259,200 data points
4 s	4.09 s	194,400 data points
5 s	4.23 s	155,520 data points
6 s	3.12 s	129,600 data points
7 s	3.01 s	111,086 data points

Variable cycle (1 day)		
8 s	2.52 s	97,200 data points
=> Linear influence		

Aggregation (1 day, all requests use only one specific aggregation)		
Average	3.28 s	777,600 data points
Min	2 s	
Max	2.5 s	
Sum	4 s	
Last	2 s	
Counter	70 s	
Timer	62 s	
=> no influence of the aggregations in the database => major influence of the aggregations in the program code		

Calculation example for data consumption 11

Description

You can calculate how many GB of memory are required for which data points.

Note

Validity

This information applies only to retaining the data and reading historical data. It does not apply to reading the live data.

Calculation formula

The calculation formula is made up as follows:

DBSize = Number of variables * ValuePerVariable * Data type size

The data type size results from the addition of:

- Time stamp 8 bytes
- Quality code 2 bytes
- Value
  - Bool 1 byte
  - (U)Int8 1 byte
  - (U)Int16 2 bytes
  - (U)Int32 4 bytes
  - (U)Int64 8 bytes
  - Float 4 bytes
  - Double 8 bytes
  - String, depending on length and contained characters: 1 byte (single character) to 4 bytes (UTF-8) per character

Example

5 millisecond cycle -> 200 values per second

8 hours of storage time -> 200 * (60 * 60 * 8) = 5,760,000 values per variable (5.76 million)

90 Int32 variables -> 14 * 5,760,000 * 90 = 7,257,600,000 bytes = 6,921 MB = 6,759 GB

Known problems

12

IED Proxy changes

Changes to an IED proxy will cause all apps to be manually restarted.

Download OPC UA model based on selected nodes

If you use the new "Browse and connect" function when loading an OPC UA model, it is currently only possible to undo the subscription for these loaded nodes on this basis.

It is not possible to delete the loaded nodes from this view. If you want to delete nodes, connect directly to the OPC UA server.

Parallel use of the IIH Configurator on an IED

The IIH Configurator can only be opened by one user at a time on an IED.

File size (IPC 227E)

For performance reasons, OPC UA Nodeset XML files that you can upload in the "Provide data > Add OPC UA Model" tab should not be larger than 5 MB.

Mapping & Transformation of tags with namespaces

It is recommended to use mapping and transformation of tags from connectors (based on IE Databus and Connectivity Suite) with namespaces mapped to static virtual namespaces.

Mapping and conversion (Mapping & Transformation) to physical namespaces is allowed but not recommended.

Delete companion specifications

It is not possible to delete a companion specification if it was not loaded successfully, in such cases as missing dependencies that could not be loaded due to an error.

Compatibility with the IIH - Databus Gateway V1.2.1410

The IIH Configurator V1.4 is compatible with the CS Databus Gateway V1.2.1407. Therefore you have to update both, IIH Configurator and CS Databus Gateway, to the versions specified.

Number of configured tags

Due to system limitations, the number of configurable tags is limited to 32,000. This number includes all tags configured together in different connectors.

Data retention

Currently only data from IE Databus, Connectivity Suite connectors and REST API variables can be stored.

No data of OPC UA models can be stored.