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# **MORPH.pro** **SMARTUNIFIER**

## **SMARTUNIFIER User Manual**

*Release 1.7.0*

**Amorph Systems GmbH**

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**Integrate perfectly your  
Production-IT using**

**SMARTUNIFIER**  
ADVANCED IT-INTEGRATION PLATFORM

**AMORPH.pro**  
**SMARTUNIFIER**

## ABOUT SMARTUNIFIER

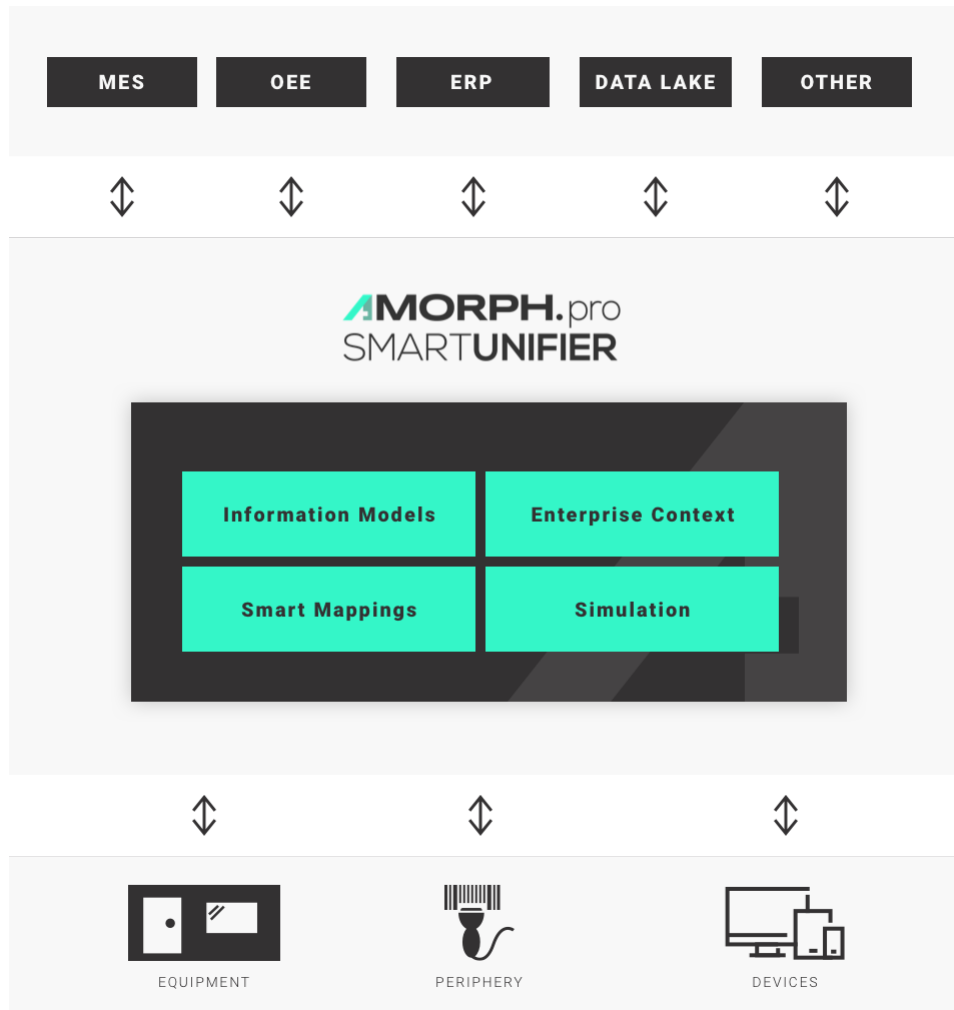
You are new to SMARTUNIFIER?

- Learn about the *SMARTUNIFIER* connectivity platform
- Learn about the *connectivity use cases* you can address with SMARTUNIFIER
- Check out the supported *connectivity endpoints and data formats*

### 1.1 What is SMARTUNIFIER

SMARTUNIFIER represents a powerful but very easy to use decentralized industrial connectivity platform for interconnecting all industrial devices and IT systems including equipment, peripheral devices, sensors/actors, MES, ERP as well as cloud-based IT systems.

SMARTUNIFIER is the tool of choice for transforming data into real value and for providing seamless IT interconnectivity within production facilities.



## 1.2 What does SMARTUNIFIER do

- SMARTUNIFIER provides an easy way to collect data from any *Data Source* and is able to transmit this data to any *Data Target*.
- Data Sources and Data Targets (commonly referred to as Communication Partners) in this respect may be any piece of equipment, device or IT system, communicating typically via cable or Wi-Fi and using a specific protocol like e.g., OPC-UA, file-based, database, message bus.
- With SMARTUNIFIER several Communication Partners can be connected simultaneously.
- With SMARTUNIFIER it is possible to communicate unidirectional or bidirectional to each Communication Partner. i.e., messages and events can be sent and received at the same time.
- SMARTUNIFIER can translate and transform data to any format and protocol that is required by a certain Data Target. This includes different pre-configured protocols and formats, e.g., OPC-UA, file-based, database, message bus, web services and many direct PLC connections. In case a certain protocol or format is currently not available it can be easily added to



**SMARTUNIFIER.**

- By applying so called *Information Models*, SMARTUNIFIER enables the same view to data regardless of the protocol or format being used to physically connect an equipment, device or IT system.
- A big advantage of SMARTUNIFIER is, that in many cases there is no need for coding when providing interfaces between different Communication Partners – providing a new interface is just drag and drop of data objects between data source(s) and destination(s).

## 1.3 Important Use Cases with SMARTUNIFIER

SMARTUNIFIER enables an easy and very efficient realization of many use cases that are crucial for gaining Industry 4.0 Excellence.

In the following subchapters some of the most important SMARTUNIFIER Use Cases are described. These give a comprehensive overview of the advanced SMARTUNIFIER Features.

### 1.3.1 Anything-To-Anywhere IT Interface

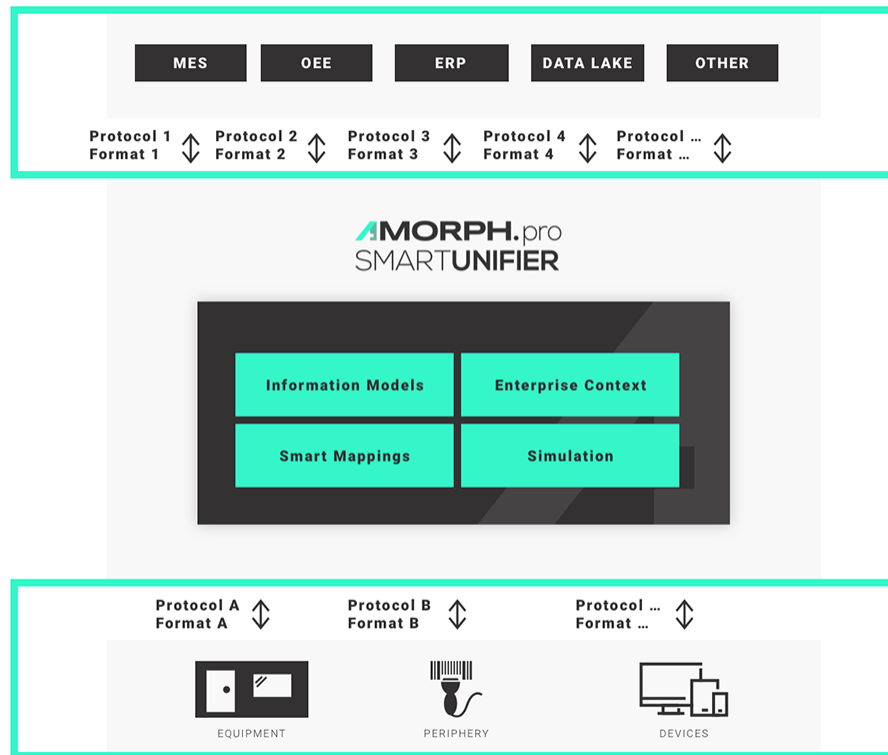
**Easy, fast and flexible bi-directional interconnection of multiple IT systems and equipment within a production facility.**

Interconnecting heterogeneous shop floor equipment and devices with IT systems and interconnecting different IT systems with each other is a central requirement for a successful transition to modern Industry 4.0 IT landscapes.

SMARTUNIFIER offers the unique capability to easily interconnect equipment and devices by allowing

- any number of parallel high-speed *Communication Channels* between equipment, devices and IT systems
- high-speed translation between different communication protocols and formats by applying configurable and reusable *Information Models* and *Smart Mappings*
- flexible integration of equipment periphery
- easy integration of enterprise-specific information (e.g., equipment -location/-name/-type/-capabilities) via configurable Enterprise Context
- riskless simulation of interfaces and communication scenarios

Results from renowned reference customers have shown that average equipment integration efforts and **cost can be reduced by up to 90%** using the SMARTUNIFIER and its advanced technologies to perform powerful IT integration by configuration instead of tedious interface programming.



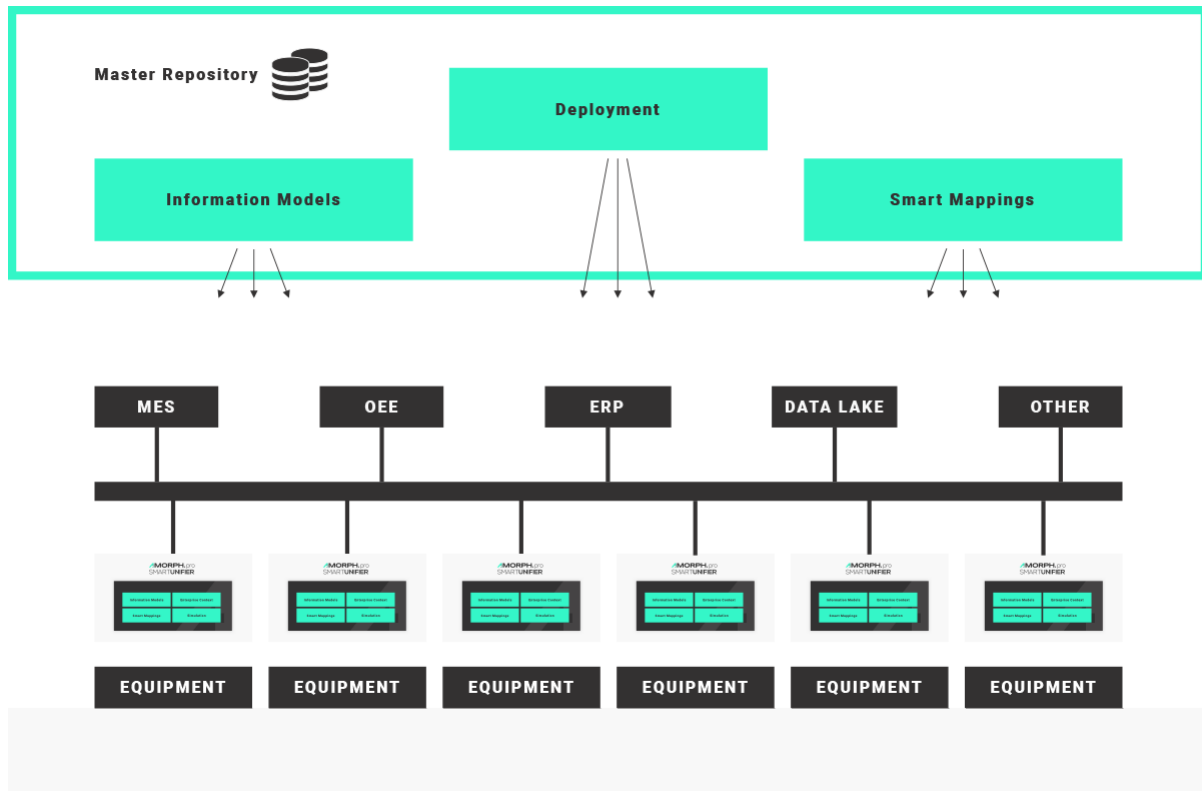
### 1.3.2 Reusable Interfaces and Interface Models

**Reuse interface configurations multiple times with minimum effort.**

When running an IT network with a higher number of installed SMARTUNIFIER *Instances*, all previously created interface configurations (Information Models and Smart Mappings) can be reused easily and shared across the whole installation. This way similar equipment types are integrated using the same connection and translation logic.

Changes and updates of interface configurations can be deployed from a centrally accessible Master Repository, eliminating the need to touch and update each equipment or device individually.

Summarized, SMARTUNIFIER allows a highly comfortable and effective management of very small to very large IT communication environments, creating minimum overhead and letting you reach your main goal: Excellent Manufacturing with a full Industry 4.0 IT infrastructure.



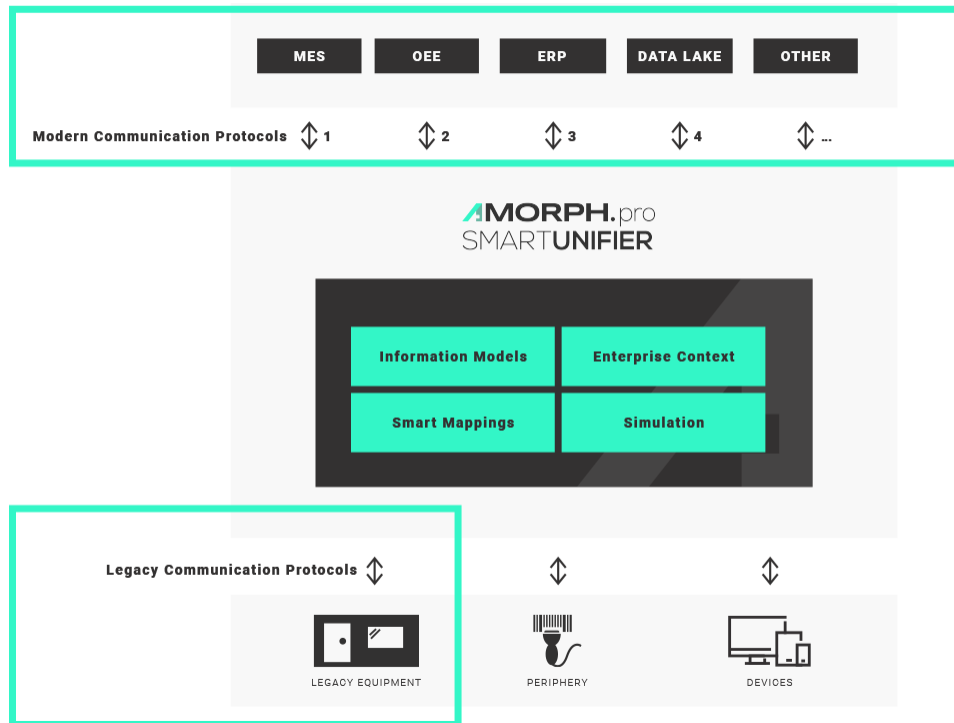
### 1.3.3 Integrate Legacy Equipment

**Fast adaptation of legacy communication protocols and formats to modern enterprise standards.**

By applying SMARTUNIFIER configurable protocol translation (Smart Mappings), modern communication standards like OPC-UA or XML over message bus are fully supported.

SMARTUNIFIER allows a smooth migration from existing communication protocols and formats (e.g., between existing equipment and MES) to new Industry 4.0 standards.

This unique capability of SMARTUNIFIER is realized by simply using existing communication channels simultaneously with newly introduced channels. When finishing the migration, the old channels can be switched off without any risk.

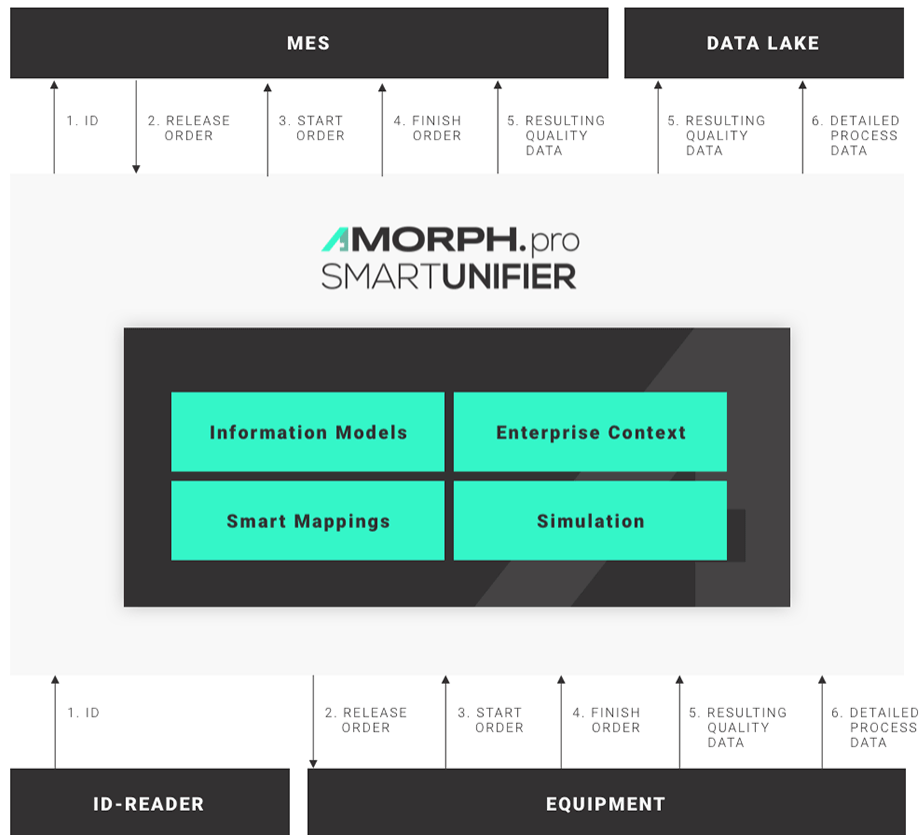


### 1.3.4 Implement Fab Communication Scenario

**Easily implement complete fab communication sequences that cover multiple steps.**

With SMARTUNIFIER it is not only possible to give access to simple equipment or device data and to provide „some data to MES and Cloud“, but also with SMARTUNIFIER complete communication scenarios between equipment to upper-level IT systems can be easily implemented.

The communication scenarios can cover all steps from identification, validation, order start as well as sending results and process data from equipment to MES or Cloud. Of course, it is also possible to provide any parameter data (recipes) from MES or SCADA to equipment.



### 1.3.5 Provide Base for Remote Maintenance and Health Monitoring

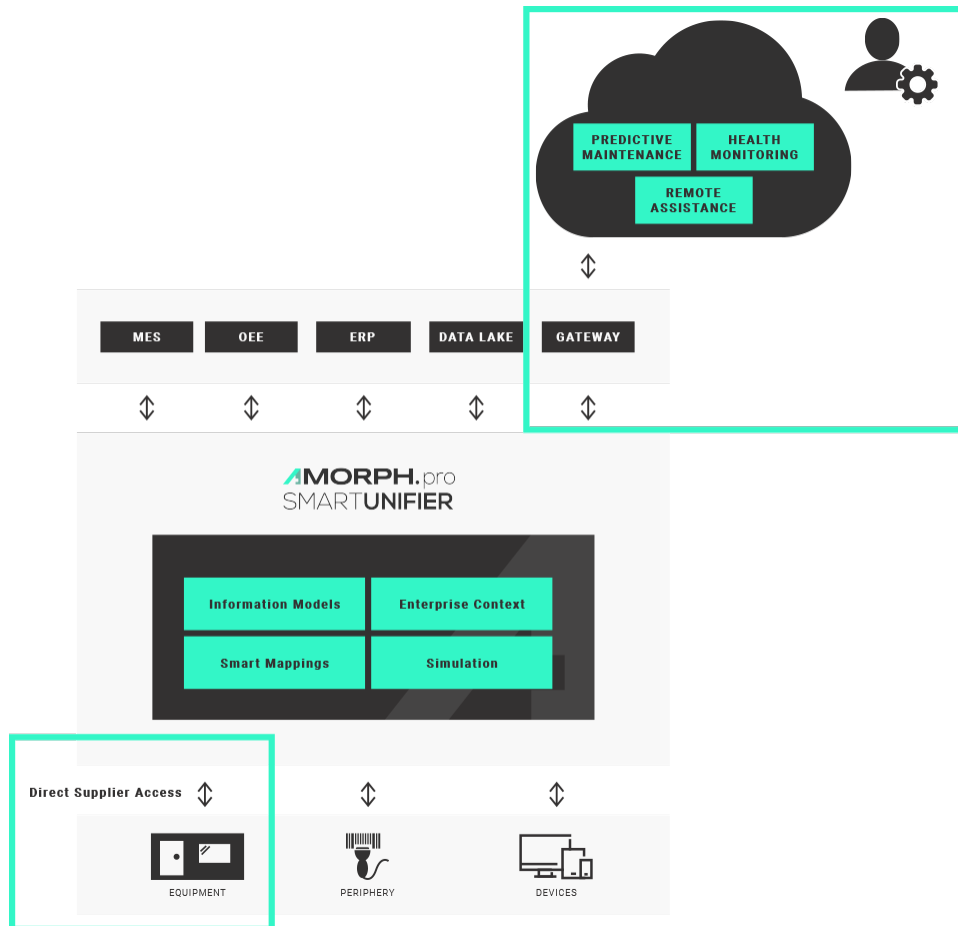
**Establish new services and business models by giving secured multi-channel access to equipment and device data in real-time.**

Production equipment can be integrated with SMARTUNIFIER to provide direct access for equipment suppliers or maintenance service providers to relevant equipment data (e.g., equipment status, equipment key parameters) via an equipment supplier's cloud infrastructure.

This way, new innovative business models for equipment suppliers are supported by building the base for "Production as a Service" offerings and remote predictive maintenance.

Also, further advanced business use cases with SMARTUNIFIER are possible, e.i., by implementing real-time equipment monitoring capabilities in a cloud environment.

Another SMARTUNIFIER use case is to give Remote Assistance to equipment suppliers to achieve production optimization and to ensure the most efficient usage of equipment resources for customers.



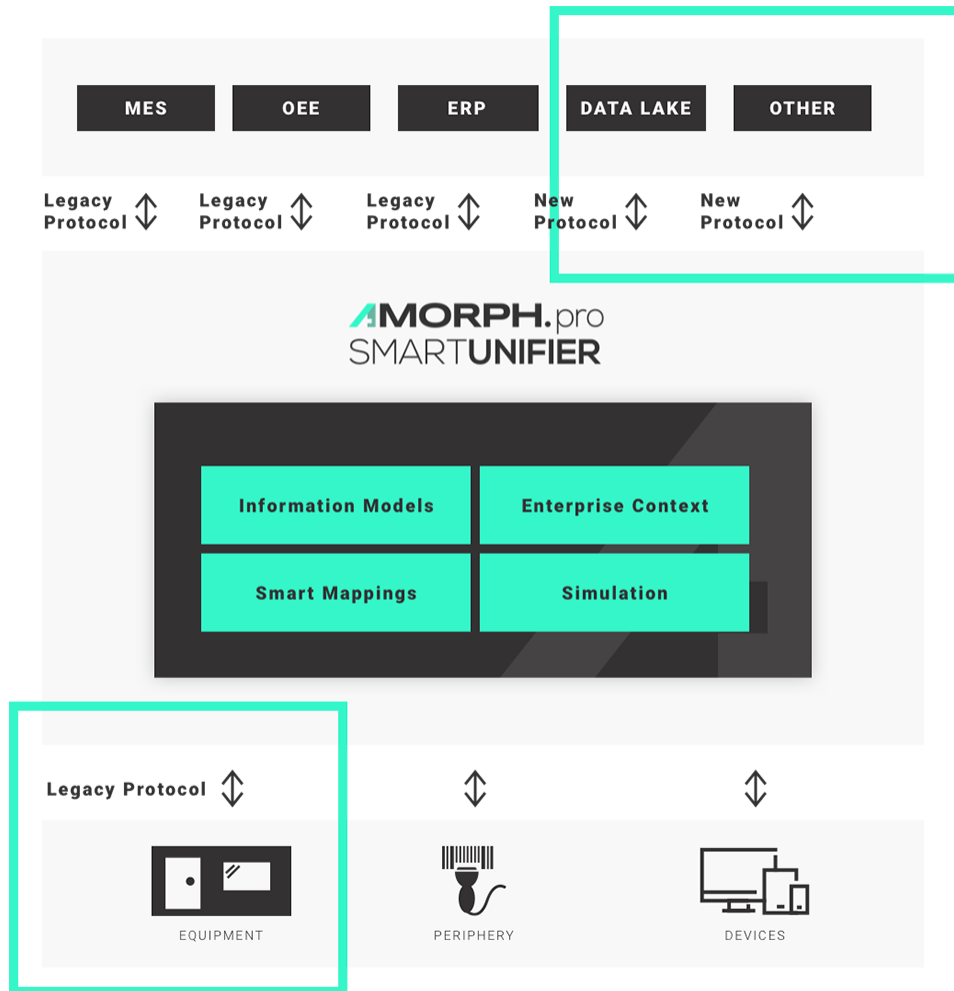
### 1.3.6 Migrate to Industry 4.0

**Migrate step by step to modern communication standards and apply enterprise-wide semantics to data.**

A key feature of SMARTUNIFIER is to open an easy way to integrate new IT systems using modern communication protocols. This is realized by simply adding additional communication channels to the existing legacy channels.

Another feature of SMARTUNIFIER in this respect is, that all existing IT systems with their legacy protocols and formats can still be operated in parallel with the newly established IT systems (e.g., Data Lake, Advanced Analytics, Cloud).

This way, it is possible to step by step introduce modern communication standards and incrementally migrate to a state-of-the-art Industry 4.0 IT architecture, but still keep the existing IT infrastructure fully operable.



### 1.3.7 Allow Unlimited Scalability

**Rely on unlimited scalability from single equipment and devices to whole facilities.**

SMARTUNIFIER is the first industrial connectivity platform that allows nearly unlimited virtually scalability in terms of number of connected equipment and devices. The SMARTUNIFIER platform can be applied for integrating one single equipment or device, but with SMARTUNIFIER hundreds or even thousands of equipment and devices within whole facilities can be integrated to upper-level systems or into the Cloud.

This is because SMARTUNIFIER is not a traditional middleware having a central limiting message bus. Nor does SMARTUNIFIER contain any central performance and latency limiting database for providing its communication features.

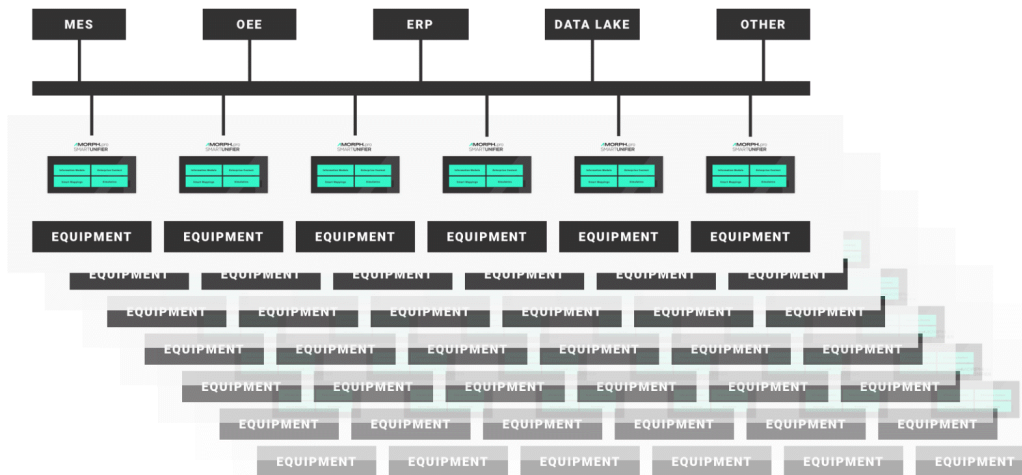
SMARTUNIFIER works as a distributed environment. Using advanced technologies of distributed computing is the key for enormous scalability.

In a large installation a high number of SMARTUNIFIER Instances, each with low software footprint, provide the required communication capabilities. These single instances can be deployed to any location within an enterprise IT network – on a server, on an equipment PC, within the Cloud.

Nevertheless, the configuration of all SMARTUNIFIER Instances can be managed centrally:

- central configuration of Information Models and Smart Mappings
- central Operations Monitoring of installed SMARTUNIFIER Instances.

Thus, SMARTUNIFIER is an essential piece of Industry 4.0 for any manufacturing enterprise – allowing fab-wide and enterprise-wide management of production communication and IT integration infrastructure.

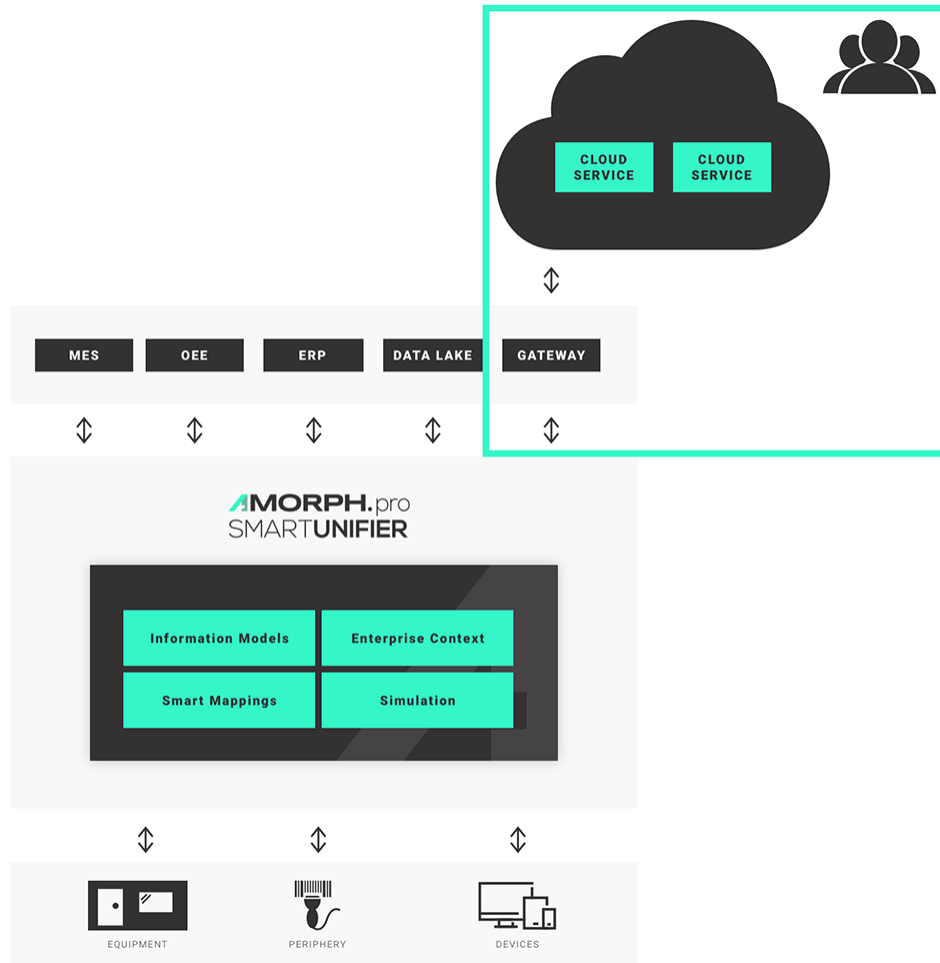


### 1.3.8 Enable Internet of Things

**Out-of-the-box connections between equipment, devices and other IT systems to Cloud infrastructures.**

By acting as a translator between equipment and any IOT device precise and secured access of data consumers is possible. The easy connection to any Cloud based infrastructure is also possible (e.g., AWS, Azure).





## 1.4 Connectivity Endpoints and Data Formats

SMARTUNIFIER provides comprehensive connectivity support for a variety of equipment, devices and IT systems. This includes many different pre-configured communication protocols and formats. e.g., OPC-UA, file-based, database, message bus, Webservices and direct PLC connections. Pre-configured interfaces are available also for many standard software applications. A number of these connectivity endpoints / communication protocols require a first time customization from Amorph Systems for a specific customer connectivity use case. Please contact Amorph Systems for detailed information.

### 1.4.1 Connectivity Endpoints / Communication Protocols

The following connectivity endpoints / communication protocols are supported by SMARTUNIFIER.

Table 1: Connectivity Endpoints

Format	Description
ADLink OpenSplice	Connectivity to ADLink OpenSplice middleware via Data Distribution Service (DDS)
AMQP	Interface to AMQP Message Broker via Active MQ
AODB	Interface to various Airport Operational Database (AODB) Systems that support standard communications via e.g., HTTP, REST, SQL
Apache Active MQ	Interface to Active MQ Message Broker
AWS Elastic Container Service (ECS)	Interface to applications running in AWS ECS
AWS Elastic Compute Cloud (EC2)	Interface to applications running in AWS EC2
AWS IoT	Interface to AWS IoT
AWS IoT Greengrass	Interface to AWS IoT Greengrass via MQTT
AWS IoT Sitewise	Interface to AWS IoT SiteWise via OPC-UA
AWS CloudWatch	Interface to CloudWatch
AWS DynamoDB	Interface to AWS DynamoDB
AWS S3	Interface to AWS S3
AWS SNS	Interface to AWS Simple Notification Service (SNS)
AWS SES	Interface to AWS Simple Email Service (SES)
Barcode Reader	Connectivity to any TCP/IP based barcode reader (or other identification system)
Beckhoff	Interface to Beckhoff PLC via Beckhoff OPC-UA Server
CNC	Connectivity to various CNC controllers (e.g., ABB, Fanuc, Heidenhain, Heller, Sinumerik, Traub, W&T Wiesemann & Theis)
DDS	Connectivity to Data Distribution Service (DDS)
EUROMAP	Connectivity of injection moulding machines via files
File	Read and Write files from arbitrary directories using File Consumer / File Tailer
FIWARE	Interface to FIWARE IoT
FTP	Upload and Download files to/from FTP servers
Flink	Interface to Apache Flink to enable real-time streaming
HTTP	Send request to HTTP servers
HTTPS	Send request to HTTPS servers
InfluxDB	Interface to InfluxDB
IBM MQ	Interface to IBM MQ Message Broker
In-Memory	Communication via local machine
ISO-on-TCP	(RFC1006) Connectivity of S7 automation devices with any communication partner
JDBC	Access databases through SQL and JDBC (refer to SQL Databases)

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Table 1 – continued from previous page

Format	Description
JMS	Send and receive messages to/from a JMS Queue or Topic using plain JMS
Kafka	Interface to Apache Kafka to enable real-time streaming
MES	Interface to a Manufacturing Execution System (MES) that support standard communications via e.g., HTTP, REST, SQL
Modbus-TCP	Communication via Modbus TCP Server / TCP Client
Microsoft Azure (IoT Hub)	Interface to Microsoft Azure Iot Hub via MQTT
MTConnect	Communication Interface to MTConnect compliant agent applications
MQTT	Connectivity by implementing MQTT Client
NoSQL Databases	Cassandra, MongoDB, Hbase
OEE	Interface to various Overall Equipment Efficiency (OEE) Applications that support standard communications via e.g., HTTP, REST, SQL
OPC-UA Client	Connectivity by deploying one or multiple OPC-UA Client instances per SMARTUNIFIER Communication Instances
OPC-UA Server	Connectivity by deploying one or multiple OPC-UA Server instances per SMARTUNIFIER Communication Instances
PLC	Connectivity to various PLCs (e.g., Allen-Bradley, B&R, FANUC, General Electric (GE), Hilscher, Honeywell, Krauss Maffei, Mitsubishi, Toshiba, Wago) via TCP/IP
PM	Interface to a various Predictive Maintenance Systems that support standard communications via e.g., HTTP, REST, SQL
REST	Communication via REST using REST Server / REST Client (Web-services)
SAP MII	Interface to SAP MII
SAP RFC	Interface to SAP via remote function call (RFC)
SAP Netweaver	Interface to SAP Netweaver via HTTP
SCADA	Interface to various SCADA Systems that support standard communications via e.g., HTTP, REST, SQL
SECS/GEM	Communication with semiconductor or photovoltaic equipment using SECS/GEM interface protocol for equipment-to-host data communications (TCP/IP).
Siemens Industrial Edge	Deployment of SMARTUNIFIER Communication Instances via Siemens Industrial Edge Platform
Siemens MindSphere (REST)	Interface to MindSphere via REST
Siemens MindSphere (MQTT)	Interface to MindSphere via MQTT
Siemens S7 PLC/TCP	Interface to Siemens S7 1500 / 1200 / 400 / 300 via TCP protocol
Siemens S7 PLC/OPC-UA	Interface to Siemens S7 1500 / 1200 via OPC-UA protocol
Smart Devices	Interface to various Smart Devices (e.g., Smart Phones, Tablets) that support standard communications via e.g., HTTP, REST, SQL
SOAP	Communication via SOAP (Webservices)

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Table 1 – continued from previous page

Format	Description
Splunk	Interface to Splunk via HTTP Event Collector
Splunk	Interface to Splunk via Metrics Interface
SQL Databases	Interface to any SQL-based database like e.g., DB2, HSQLDB, MariaDB, MSSQL, OracleDB, PostgreSQL, SQLServer and others
TCP	Communication from/to any (binary) TCP based protocol
SFTP	Upload and Download files to/from SFTP servers
UDP	Communication from/to any (binary) UDP based protocol
VANTIQ	Interface to VANTIQ
VIPA Speed 7	Interface to VIPA Speed 7 PLC
WAGO PLC/IP	Connectivity to WAGO PLCs via OPC-UA
Websocket	Interface to Websocket Server (TCP/IP)

**Note:** In case a customer requires to connect to other endpoints (e.g., computing devices, PLCs) not listed in the table, please contact Amorph Systems.

## 1.4.2 Data Formats

The following data formats can be used in conjunction with the above defined connectivity endpoints. The possible formats for a certain connectivity endpoint may be restricted based on the selected communication protocol. For detailed information please contact Amorph Systems.

Table 2: Data Formats

Format	Description
Binary	Handling of any binary communication format (e.g., fixed/variable lengths fields, headers/footers)
CSV	Handle CSV (Comma separated values) payloads
JSON	Encode and decode JSON formats
TEXT	Handling of any text-based communication format
XML	Encode and decode XML formats

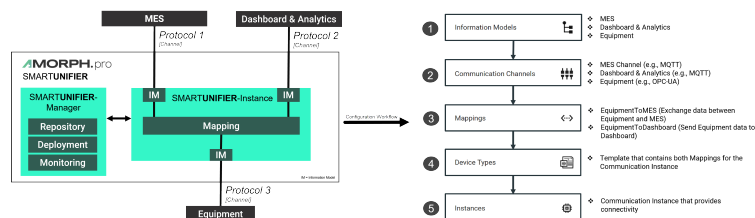
**Note:** In case a customer requires another data format not listed in the table, please contact Amorph Systems.

## HOW TO INTEGRATE WITH SMARTUNIFIER

Each integration scenario follows the same workflow, which consists out of 5 steps:

1. *Information Models* - describe and visualize communication related data using hierarchical tree structures
2. *Communication Channels* - describe and configure the protocols needed for the scenario
3. *Mappings* - define when and how to exchange/transform data between Information Models
4. *Device Types* - define templates for Instances
5. *Instances* - define applications that provide the connectivity

Below you can see an example of integration scenario and the necessary steps to establish connectivity with SMARTUNIFIER:



## 2.1 Information Models

### 2.1.1 What are Information Models

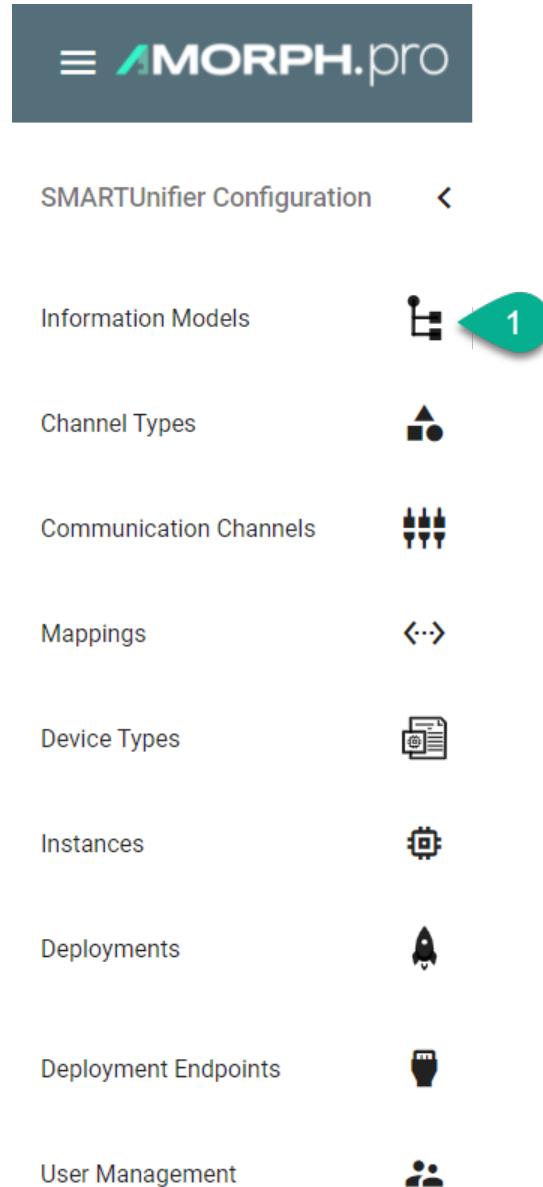
Within the SMARTUNIFIER an Information Model describes the communication related data that is available for a device or IT system. One device or one IT system therefore is represented by one Information Model. An Information Model consists of so-called *Node Types*. Information Models are build up in a hierarchical tree structure, i.e., elements within the Information Model can contain further elements. This is required to model the data structure of devices as naturally as possible.

The kind of *Node Types* to be used depends on the protocol of the device or IT system. Before creating the Information Model take a look in the chapter *Communication Channels* to see which *Node Types* the Channel you want to use is supporting.

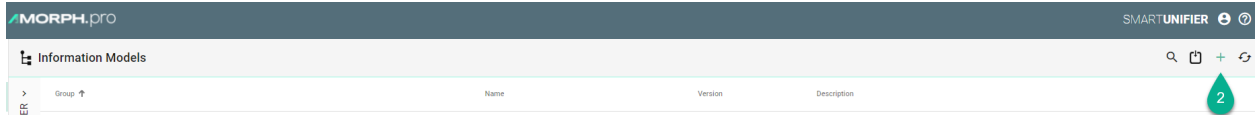
## 2.1.2 How to create a new Information Model

Follow the steps described below to create an Information Model:

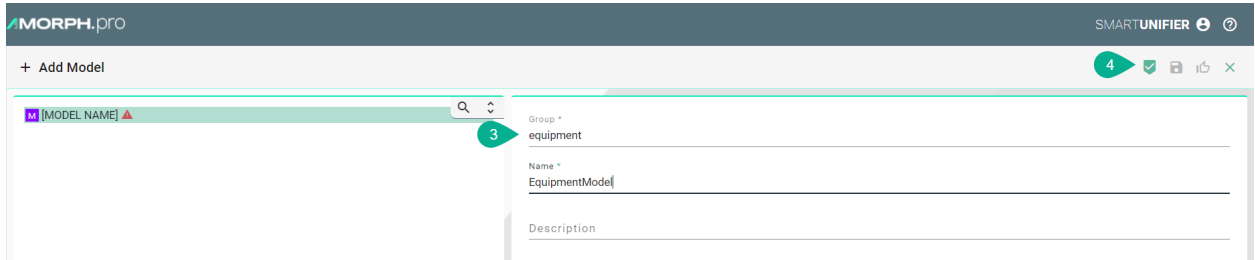
- Select the SMARTUNIFIER Information Model Perspective (1).



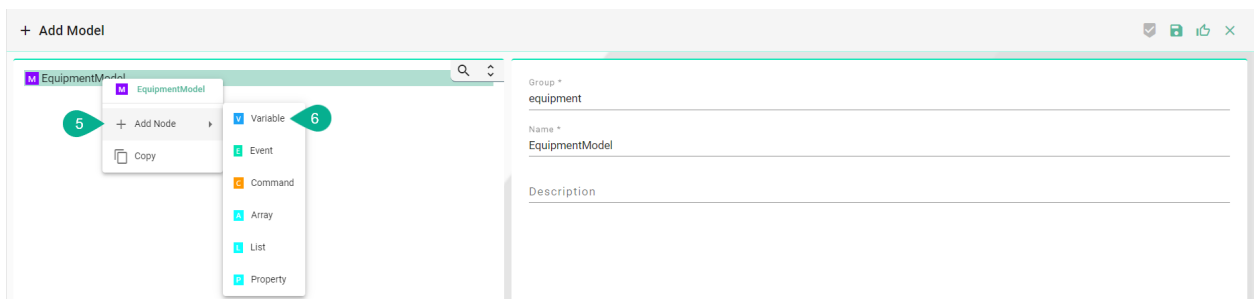
- You are presented with the following screen containing a list view of existing Information Models.
- In order to add a new Information Model, select the “Add Model” button at the top right corner (2).



- On the following screen provide the following mandatory information: Group and Name (3).
- The “Apply” button at the top right corner is enabled after all mandatory fields are filled in. Click the button to generate a new Information Model (4).
- The newly created Information Model is now visible as a node on the left side of the screen.



- After the root model node is created, a new Information Model can be built up using definition types.
- Perform a right click on the root model node and select “Add Node” (5). Select a Definition Type from the dialog (6).



### 2.1.3 Node Types

Model node types are elements within an Information Model. Model node types are variables, properties, events, commands and also collections such as arrays and lists. Each model node type has a Data Type that defines whether the model node type is a predefined data type or a custom data type.

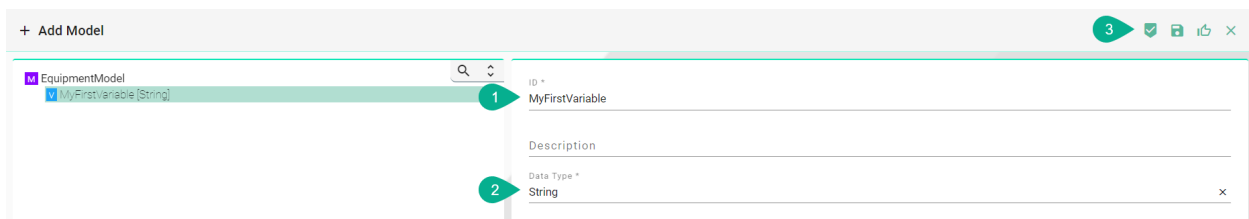
#### Variables

##### What are Variables

Variables are used to represent values. Within SMARTUNIFIER different types of Variables are defined. They differ in the kind of data that they represent and whether they contain other Variables. For example, a file Object may be defined that contains a stream of bytes. The stream of bytes may be defined as a Data Variable that is an array of bytes. Properties may be used to expose the creation time and owner of the file Object.

##### How to create a Variable

- Enter an ID (1)
- Enter a Data Type (2)
- Click the “Apply” button (3)



#### Properties

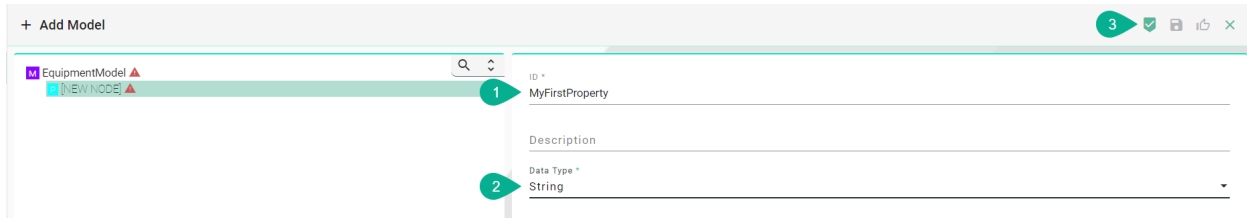
##### What are Properties

Properties are working similar to *Variables*. Properties can be used for XML attributes when XML-files are subject to be processed by SMARTUNIFIER, although XML elements are still represented by Variables in the *Information Model*.



## How to create a Property

- Enter an ID (1)
- Enter a Data Type (2)
- Click the “Apply” button (3)



## Events

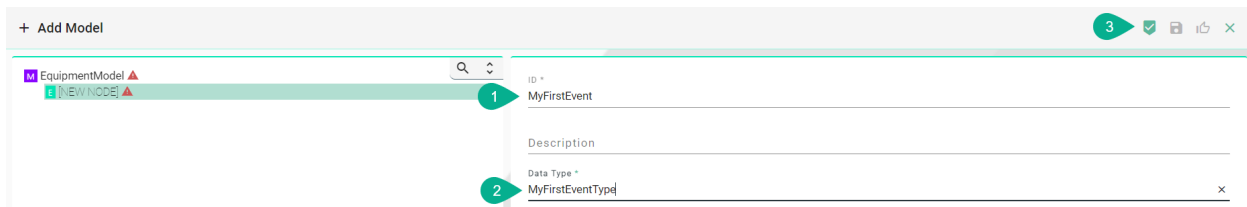
### What are Events

SMARTUNIFIER is an event-driven software. In this context an event is an action or occurrence recognized by SMARTUNIFIER, often originating asynchronously from an external *data source* (e.g., equipment, device), that may be handled by the SMARTUNIFIER. Computer events can be generated or *triggered* by external IT systems (e.g., received via a *Communication Channel*), by the SMARTUNIFIER itself (e.g., timer event) or in other ways (e.g., time triggered event). Typically, events are handled asynchronously with the program flow. The SMARTUNIFIER software can also trigger its own set of events into the event loop, e.g., to communicate the completion of a task. Each event defined in an *Information Model* has an event type.

An event type consists of one or multiple simple or structured variables. Clients subscribe to such events to receive notifications of event occurrences.

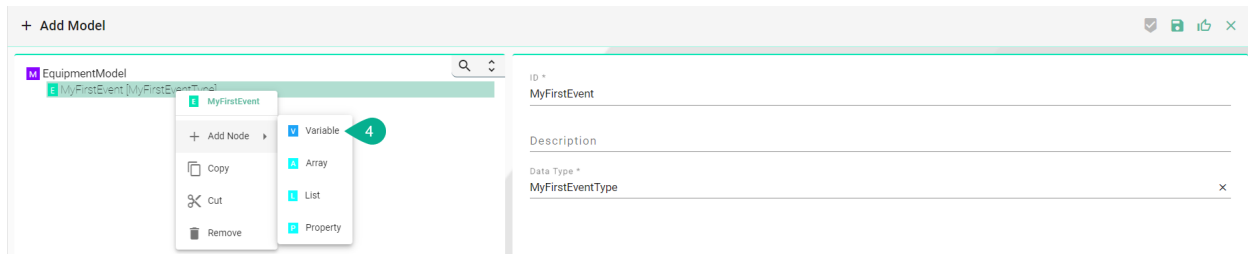
### How to create an Event

- Enter an ID (1)
- Enter a Data Type for the Event. e.g., “MyFirstEventType” (2)
- Click the “Apply” button (3)

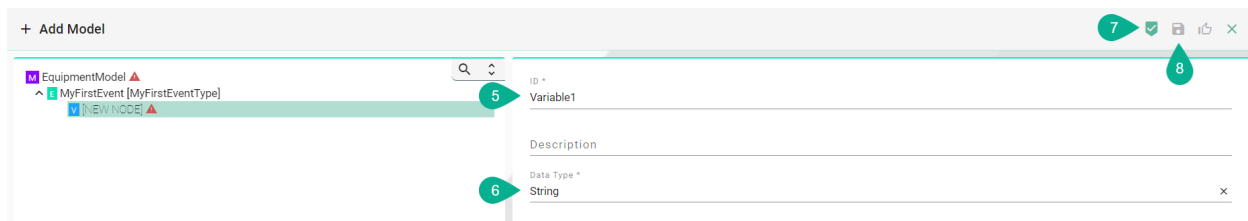


Within the Event *Variables*, *Arrays* or *Lists* can be added. Follow the steps below to add a Variable:

- Right click the Event node, select “Add Node” and choose a Definition Type (4)



- Enter an ID (5)
- Enter a Data Type (6)
- Click the apply button (7)
- Click the “Save” button at the top right corner (8) to save the Information Model



## Commands

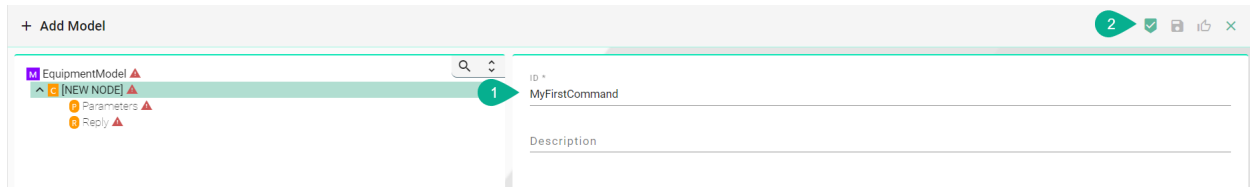
### What are Commands

Commands are functions, whose scope is bound by an owning *Information Model*, like the methods of a class in object-oriented programming. Commands within an Information Model are typically invoked by an external IT system (e.g., an equipment) that triggers the command. In addition, commands of a target Information Model (e.g., an MES) can be triggered by the SMARTUNIFIER through a *Mapping*. A command contains one or multiple simple or structured *Variables*. Also a command has a return parameter that likewise can be a simple or complex *data type*.

The lifetime of the command invocation instance begins when the client calls the command and ends when the result is returned. While commands may affect the state of the owning model, they have no explicit state of their own. In this sense, they are stateless. Each command defined in an Information Model has a command type

## How to create a Command

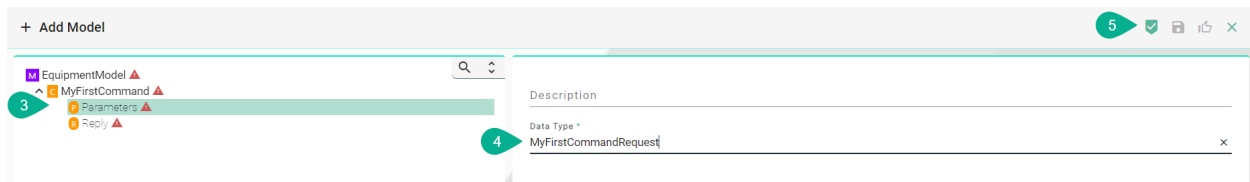
- Enter an ID (1)
- Click the “Apply” button (2)



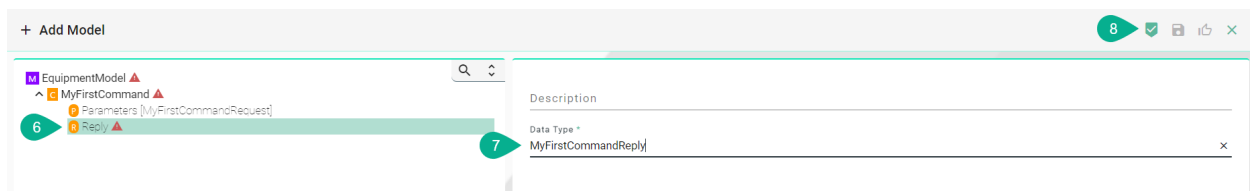
The main two parts of a Command are the Request, referred to as Parameters within the SMARTUNIFIER, and the Reply. *Variables*, *Arrays* and *Lists* can be added to both of these command parts.

Follow the steps below to add a Variable to Parameters:

- Select the Parameters node from the tree (3)
- Enter a Data Type (4)
- Click the “Apply” button (5)

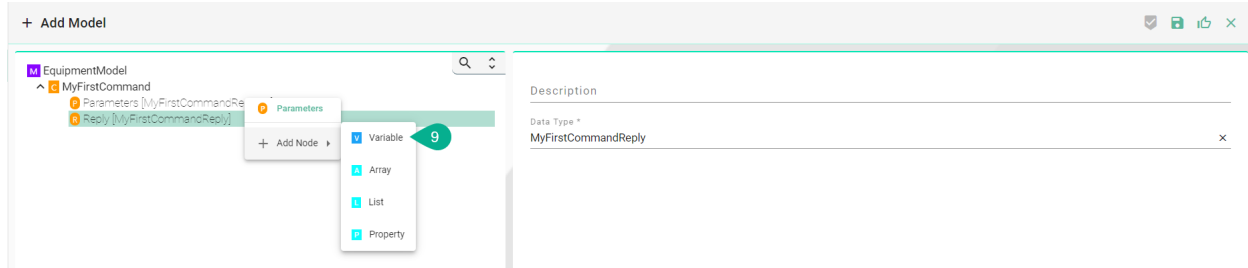


- Select the Reply node from the tree (6)
- Enter a Data Type (7)
- Click the “Apply” button (8)

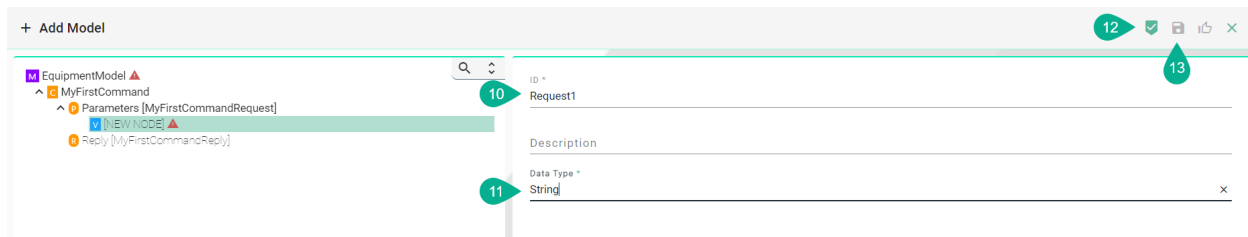


Follow the steps below to add nodes under the Parameter and Reply node:

- Right click the Parameter node, select “Add Node” and choose a Definition Type (9)



- Enter an ID (10)
- Enter a Data Type (11)
- Click the “Apply” button (12)
- Click the “Save” button (13) to save the Information Model



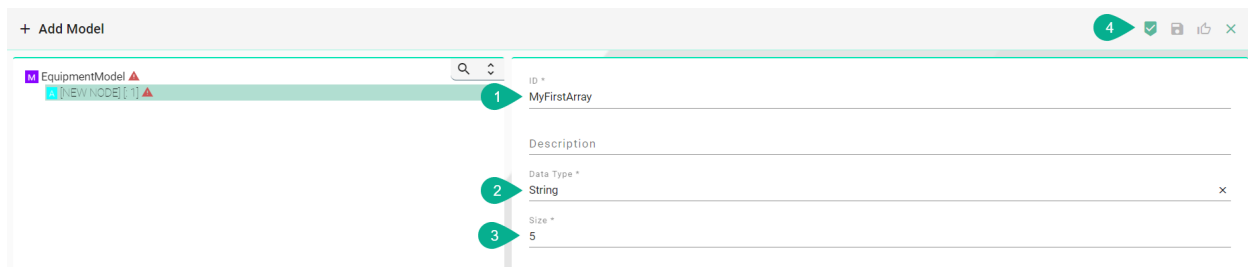
## Arrays

### What are Arrays

Arrays allow to hold a fixed size collection of elements, which have all the same data type. The size of the array must be defined in the configuration of the Information Model.

### How to create an Array

- Enter an ID (1)
- Select a Data Type for the Array by clicking the Data Type Drop-Down (2)
- Enter the size of the Array (3)
- Click the “Apply” button (4)



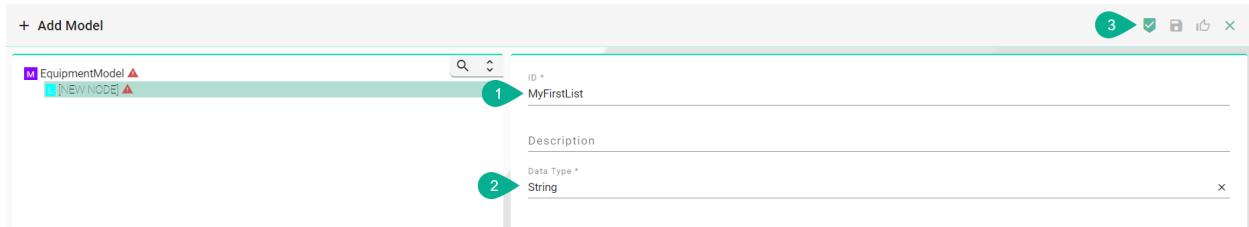
## Lists

### What are Lists

Lists allow to hold a collection of elements (*Variables*), which can each have different data types.

### How to create a List

- Enter an ID (1)
- Enter a Data Type for the List. E.g., “String” (2)
- Click the “Apply” button (3)



### 2.1.4 Data Types

There are two kinds of Data Types:

- Predefined Types e.g., String, Integer, Boolean and more. (**Note:** Only available for the definition types - Variables, Properties, Arrays, Lists)
- Custom Types

### How to create a Variable as a Simple Type

- Add a new Variable, enter an ID and select a primary data type for the Data Type e.g., “String” (1)

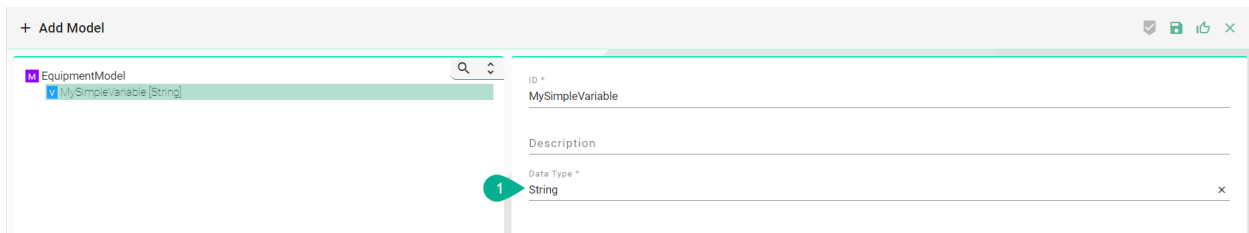


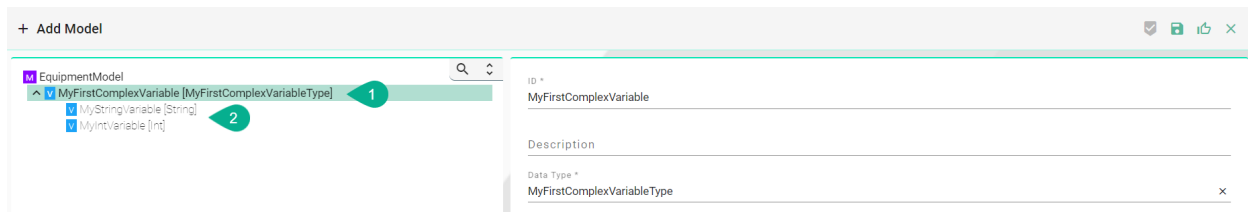
Table 1: Predefined Data Types

Type	Definition
Boolean	true or false
Byte	8 bit signed value (-27 to 27-1)
Int	32 bit signed value (-231 to 231-1)
String	Sequence of characters
Char	16 bit unsigned Unicode character (0 to 216-1)
Double	64 bit IEEE 754 double-precision float
Float	32 bit IEEE 754 single-precision float
Long	64 bit signed value (-263 to 263-1)
Short	16-bit signed integer
Array	Mutable, indexed collections of values.
List	Class for immutable linked lists representing ordered collections of elements.
LocalDate	Immutable date-time object that represents a date, often viewed as year-month-day.
LocalDate-Time	Immutable date-time object that represents a date-time, often viewed as year-month-day-hour-minute-second.
LocalTime	Immutable date-time object that represents a time, often viewed as hour-minute-second.
OffsetDate-Time	Immutable representation of a date-time with an offset.

### How to create a Variable as a Custom Type

- Add a new Variable, enter an ID and enter a custom name for the Data Type e.g., “MyFirstComplexVariableType” (1)
- Select the Custom Variable - “MyFirstComplexVariableType” - and add a new Variable underneath it (2)

**Note:** Model *Node Types* with custom data types can be easily duplicated throughout the Information Model by selecting the same custom data type for a new model node type.



Data Types for Properties, Arrays and Lists can be defined as shown above for Variables.

## 2.2 Communication Channels

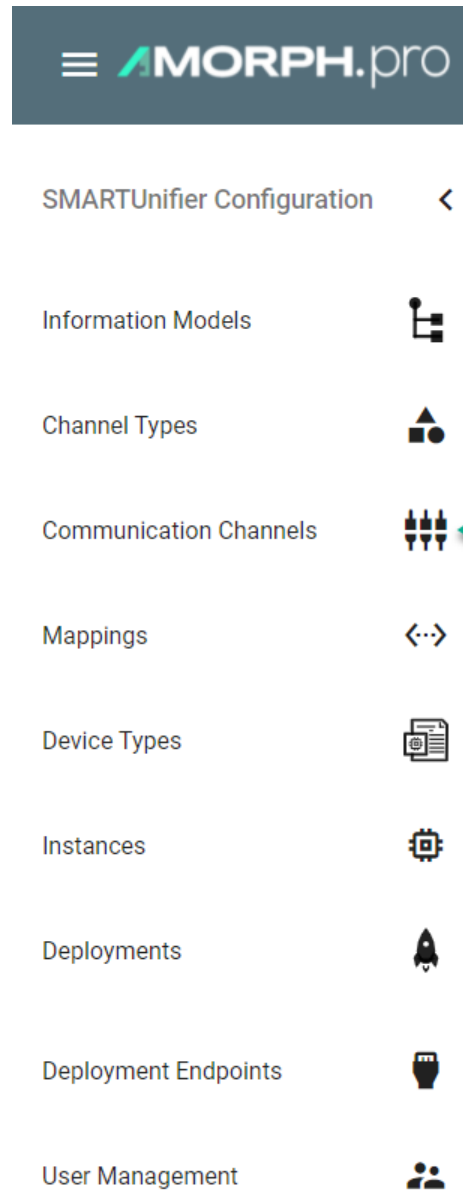
### 2.2.1 What are Channels

*Communication Channel* or simply Channel refers to a transmission medium. A Channel is used to convey information from one or several senders (or transmitters). Communicating data from one location to another requires a pathway or medium. These pathways are called Communication Channels, and the information is transmitted with the help of communication protocols. Each *Information Model* can have one Channel or many, and each model can choose which Channels it subscribes to. The information is transmitted through the Communication Channels in both directions: from the external system to the SMARTUNIFIER application and vice versa.

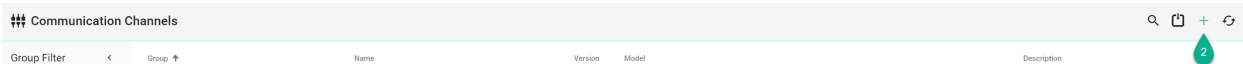
### 2.2.2 How to create a new Channel

Follow the steps below to create a new Channel:

- Go to the Communication Channels perspective by clicking the “Communication Channels” button (1)



- To create a new Channel, select the “Add Channel” button at the top right corner **(2)**



- The creation of a Communication Channel is split up into two parts. First enter basic information about the new Communication Channel
  - Fill in the information for the Channel identifier such as: Group, Name and Version. Description is optional **(3)**
  - Besides that, associate the Channel with an Information Model **(4)**
  - Select the type this Channel represents from the Drop-Down **(5)**. A list of available Channel Types and a description of how to configure each of them can be found below



- Click the “Save” button (6) to save the Channel

The screenshot shows a web interface for adding a communication channel. The form is titled "Add Communication Channel". It contains the following fields:

- Group \***: demo (indicated by a green circle with the number 3)
- Name \***: EquipmentChannel
- Description**: (empty)
- Model \***: demo.EquipmentModel.latest (indicated by a green circle with the number 4)
- Channel type \***: File reader (CSV) (indicated by a green circle with the number 5)

A green circle with the number 6 is positioned over the "Save" button in the top right corner of the form.

### 2.2.3 Channel Types and Configuration

There are several Channel Types available with SMARTUNIFIER. The supported Communication Channel Types are listed in the chapter *Connectivity Endpoints / Communication Protocols*. If a specific Communicating Channel Type is not available in this product version, please contact Amorph Systems. In many cases the provision of a specific Communication Channel Type can be provided as extension to the standard product.

The configuration of the Communication Channels can be done on Channel, *Device Type* and *Instance* level.

**Note:** Important to note is that the configuration of a Channel can be overwritten accordingly. For example: The configuration done in the Communication Channel view can be changed in the Device Type or Instance view.

The following paragraphs lay out the configuration process of selected Channel Types. If the Channel Type you want to use is not described, please contact Amorph Systems for configuration guidance.

#### File-based

##### File Reader

#### Characteristics

- File Reader monitors a specified folder - the so-called input folder
- If a file is inserted the following actions take place:
  - The *Trigger* of the specified *Rule* in the Mapping is activated
  - Thus, the Rule is executed
- After successful execution of the rule the file is moved into a so-called output folder
- In case of an exception the file is moved into an error folder

## Supported File Formats:

- CSV
- JSON
- XML

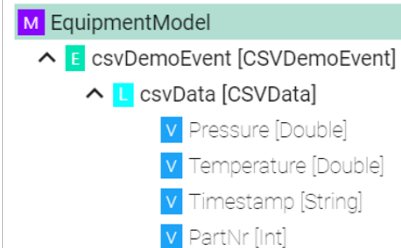
## Information Model Requirements

The first Node after the root node **M** must be of type Event **E**.

### CSV

- The node after the Event must be of type *List* **L** - multiple lines, each representing a data record.
- Fields, which are separated by commas, are represented by the Node Type *Variable* **V**. Note that the order of fields in the CSV file must match the order of Variables in the Information Model.

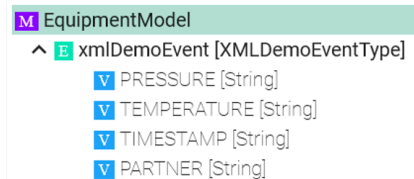
```
1 Pressure, Temperature, Timestamp, PartNr
2 17.5, 20, 2020.06.11-06:56:31, 0001
3 18.9, 22, 2020.06.11-07:56:31, 0002
```



### XML

- Elements of the XML file are represented by the Node Type Variable **V**.
- Attributes of the XML file are represented by the Node Type *Property* **P**. In order to assign attributes to elements in the Information Model, the element Node Type **V** must be a *Custom Data Type*.

```
1 <?xml version="1.0"?>
2 <DATA>
3   <PRESSURE>17.6</PRESSURE>
4   <TEMPERATURE>25</TEMPERATURE>
5   <TIMESTAMP>2020.06.11-07:56:31</TIMESTAMP>
6   <PARTNR>0001</PARTNR>
7 </DATA>
```



## How to use File Reader with CSV

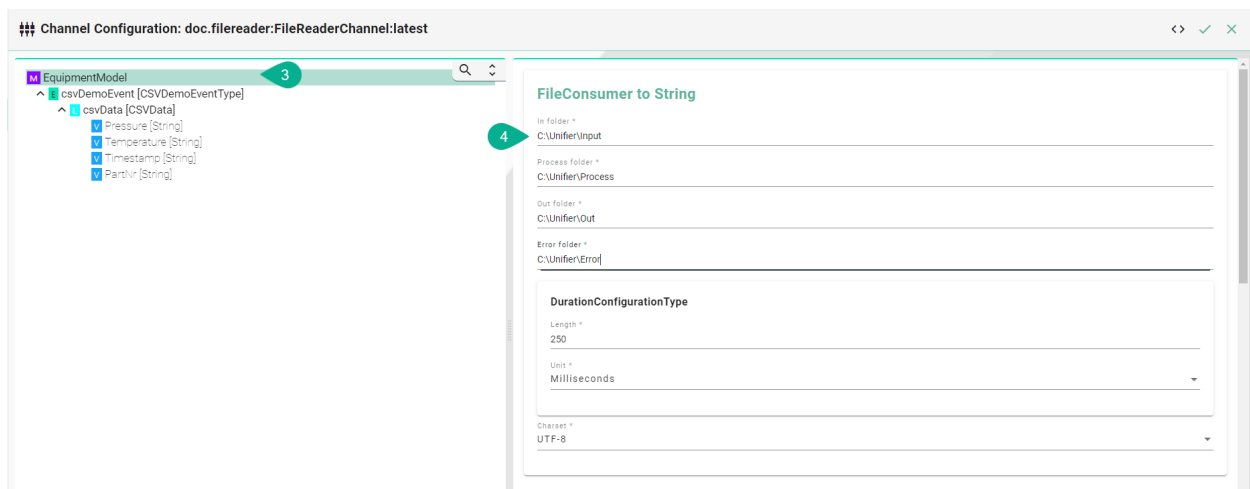
1. Select **File reader (CSV)** from the Drop-Down.
2. Click the **Configure** button.



3. **Make sure** the root model node is selected to configure the File Consumer to String as well as the CSV String to Model.

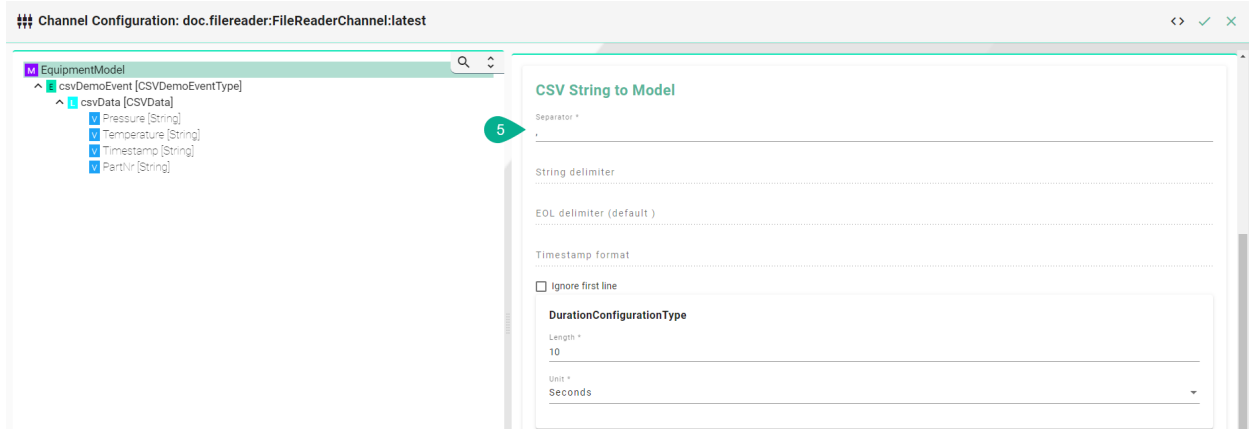
#### 4. File Consumer to String - Configuration

- Enter a path for the input folder - **In Folder**
- Enter a path for the process folder - **Process Folder**
- Enter a path for the output folder - **Out Folder**
- Enter a path for the error folder - **Error Folder**
- Specify the **Polling interval** and select the **Unit**
- Select the **CharSet** according to the file in use



#### 5. CSV Consumer to Model - Configuration

- Enter the **Separator** which is used in the CSV-file
- If needed, set **String delimiter**, **EOL delimiter** and the **Timestamp format**
- If the CSV file contains a header enable **Ignore first line**
- Specify the **Polling interval** and select the **Unit**



6. Specify the Event used by selecting the **event node** in the tree on the left side

---

**Note:** The entries of a CSV-File can only be mapped directly to an Event object and its parameters.

---

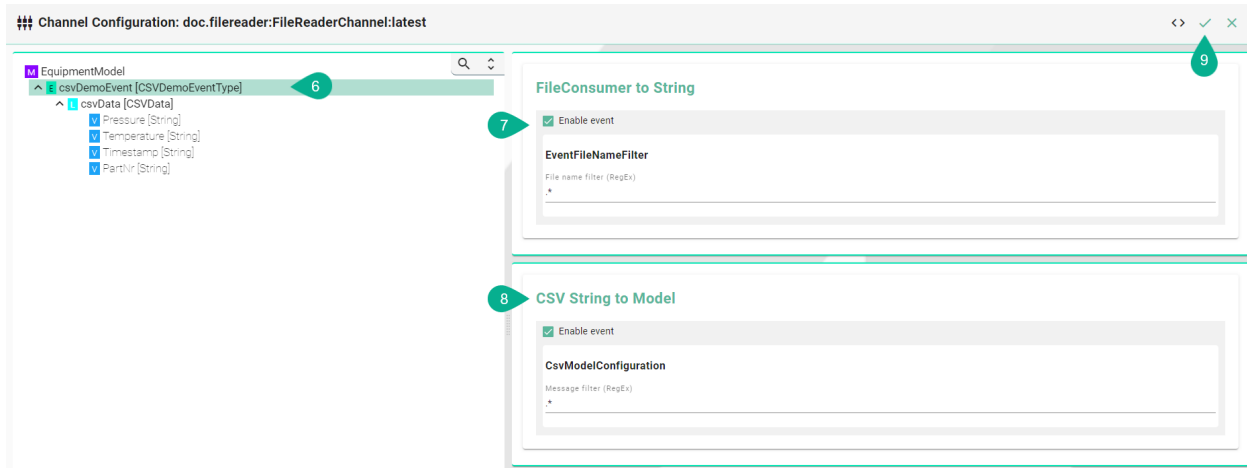
#### 7. File Consumer to String - Configuration

- Enable the **Event** checkbox for the **File Name Filter**
- Enter a **Regular expression** in order to determine which file is to be processed in the input folder

#### 8. Csv String to Model - Configuration

- Enable the **Event** checkbox for the **Csv Model Configuration**
- Start of processing
  - If the entire content of the file is processed on this event enter a wildcard in the **RegEx** field
  - If the processing starts at a specific line enter a regular expression in the **RegEx** field to identify the line

9. Click the **Apply** button, then the **Close** button and save the Channel by clicking the **Save** button



### Description of configuration properties:

Property	Description	Example
Separator	Separator type, used in the csv file	, , ;
Delimiter	Values that have an additional delimiter like “Date”, “Time”	”
Eol Delimiter	Defining Carriage return and/or Line Feed	\r, \n
Timestamp format	Format of the timestamp	YYYY-MM-DD HH:mm:ss
ignoreFirstLine	Delay between checks of the file for new content in milliseconds	true, false
TailFromEnd	Set to true to tail from the end of the file, false to tail from the beginning of the file	true, false
InFolder	Path leading to the Input Folder	C:\FileConsumer\In
OutFolder	Path of a node in the Information Model	C:\FileConsumer\Out
ErrorFolder	Regular Expression for the message filter used in the implementation	C:\FileConsumer\Error
CharSet	Encoding of the file in use	UTF-8, UTF-8 BOM, etc
ProcessFolder	Regular Expression for the message filter used in the implementation	C:\FileConsumer\Process

## File Tailer

### Characteristics

- File Tailer monitors a given file in a given location.
- Data is processed line by line.
- Note that the File Tailer does not support the definition type **List** in the *Information Model*.

### Supported File Formats:

- CSV

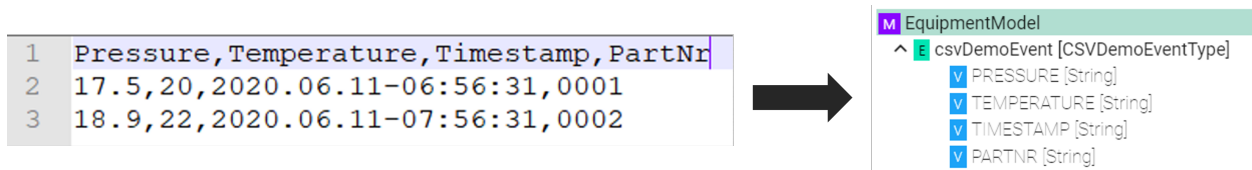
- JSON
- XML

### Information Model Requirements

The first Node after the root node **M** must be of type Event **E**.

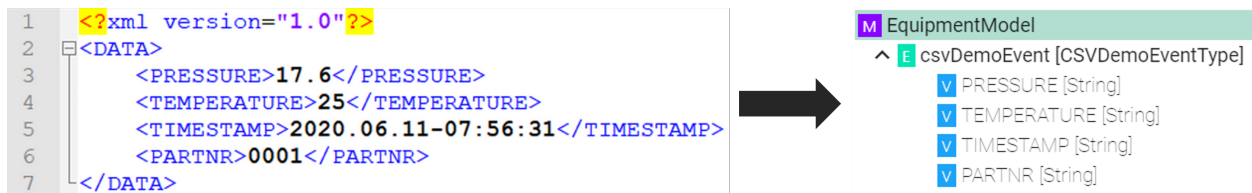
### CSV

- Fields, which are separated by commas, are represented by the Node Type *Variable* **V**. Note that the order of fields in the CSV file must match the order of Variables in the Information Model.



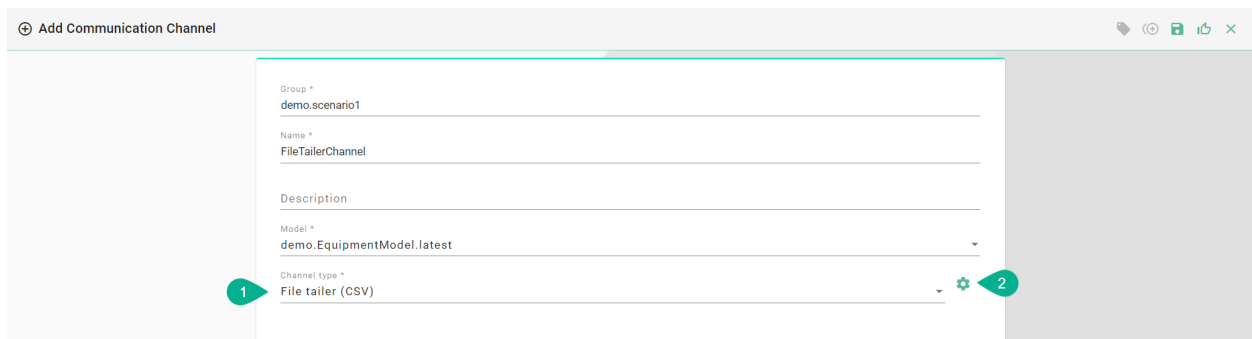
### XML

- Elements of the XML file are represented by the Node Type Variable **V**.
- Attributes of the XML file are represented by the Node Type *Property* **P**. In order to assign attributes to elements in the Information Model, the element Node Type **V** must be a *Custom Data Type*.



### How to configure the File Tailer (CSV) Channel

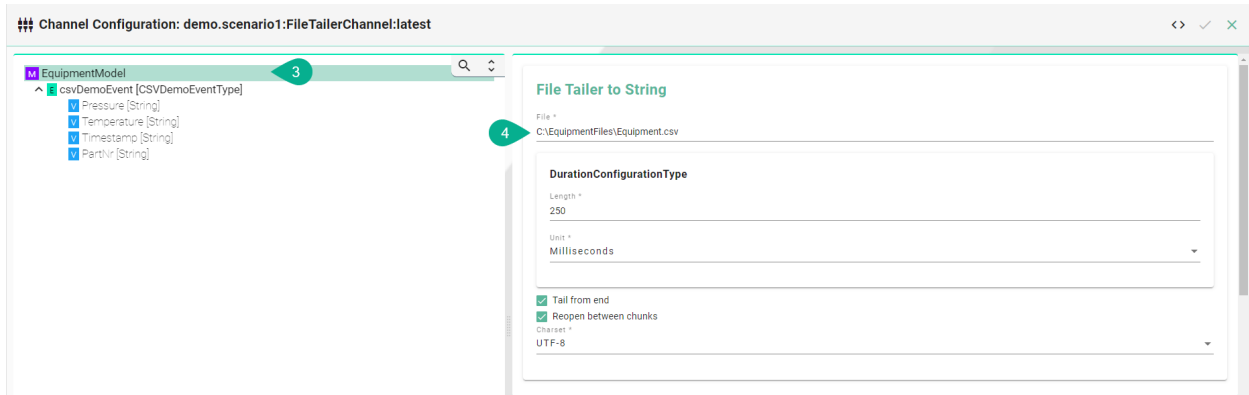
1. Select **File tailer (CSV)** from the Drop-Down.
2. Click the **Configure** button.



3. **Make sure** the root model node is selected to be able to configure the File Tailer to String and CSV String to Model.

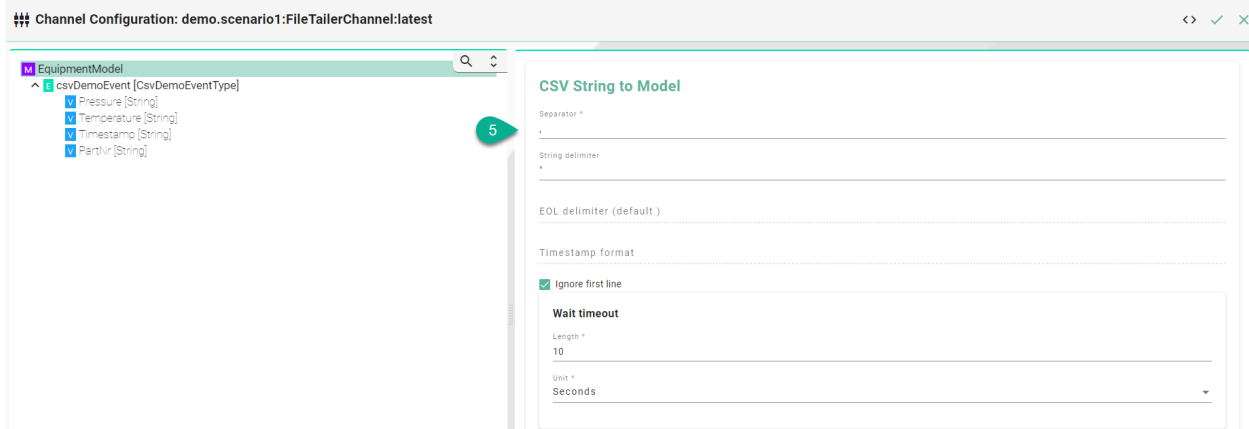
#### 4. File Tailer to String - Configuration:

- Enter the **File path** for the CSV-file on your machine
- Specify the **Polling interval** and select the **Unit**
- Enable **Tail from end** if you want to pick up always the last line of the file
- Enable **Reopen between chunks** if the file should be closed and reopened between chunks
- Select the **Charset** according to the file in use



#### 5. CSV String to Model - Configuration:

- Enter the **Separator** which is used in the CSV-file as well as the **String delimiter**
- Input the **Eol delimiter** and the **Timestamp format** if one is used.
- If the CSV file contains a header enable **Ignore first line**
- Input the **Polling interval** and select the **Unit**

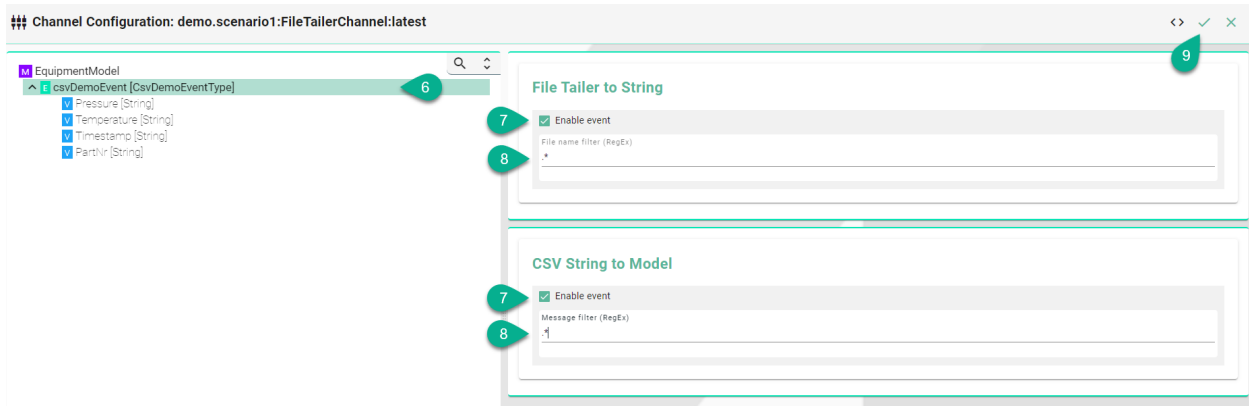


6. Select the **event node** in the tree on the left side.

**Note:** The entries of a CSV-File can only be *mapped* directly to an *Event* object and its parameters.

7. Check the **Routes checkbox**.

8. Enter a **Regular expression** for the message filter.
9. Click the **Apply** button, then the **Close** button and save the Channel by clicking the **Save** button on the upper right corner.



**Description of configuration properties:**

Property	Description	Example
Separator	Separator type, used in the csv file	, , ;
Delimiter	Values that have an additional delimiter like “Date”, “Time”	”
Eol Delimiter	Defining Carriage return and/or Line Feed	\r, \n
Timestamp format	Format of the timestamp	YYYY-MM-DD HH:mm:ss
File	Path to the csv file	C:\test.csv
Delay Millis	Delay between checks of the file for new content in milliseconds	250
TailFromEnd	Set to true to tail from the end of the file, false to tail from the beginning of the file	true, false
ReopenBetweenChunks	If true, close and reopen the file between reading chunks	true, false
routes	Path of a node in the Information Model	true, false
messageFilter-RegEx	Regular Expression for the message filter used in the implementation	.*

**Databases**

**InfluxDB**

**Characteristics - InfluxDB**

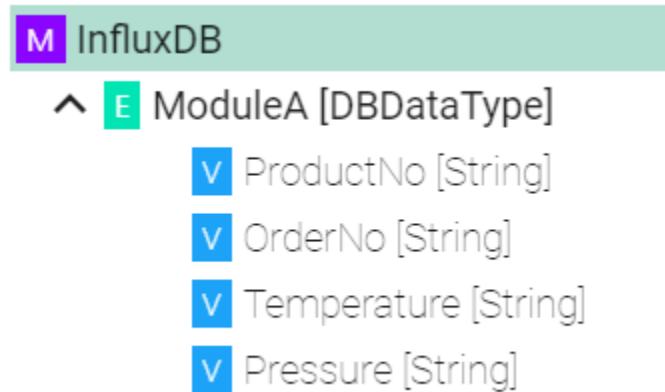
In case of a time series data use case where you need to ingest data in a fast and efficient way you can use [InfluxDB](#).

**Information Model Requirements**

**Inserts using Events**

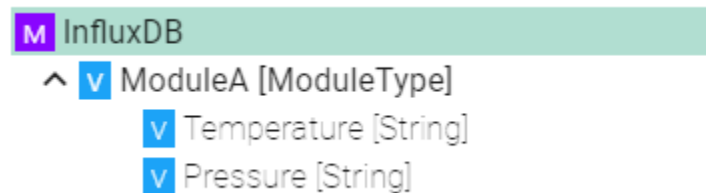


- The node after the root model in this case is of the type *Event* **E** which represent a database table.
- *Fields* are represented by *Variables* **V**.

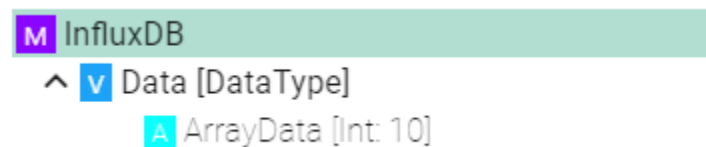


### Inserts using Custom Data Types

- Complex *Variables* **V** (ModuleA) represents *Measurements*
- *Variables* **V** underneath within the complex variable (Temperature) represents *Fields*



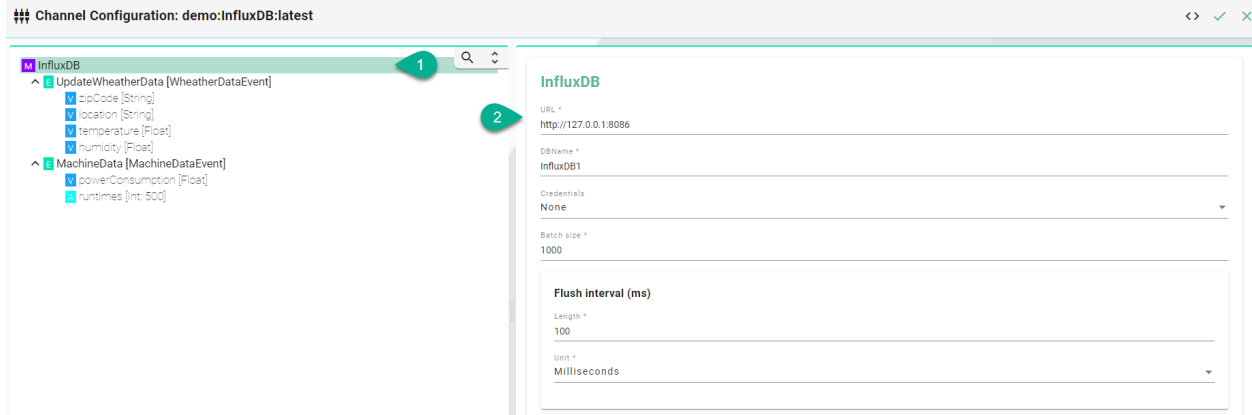
- Arrays **A** can be used to set use an index



### How to configure InfluxDB

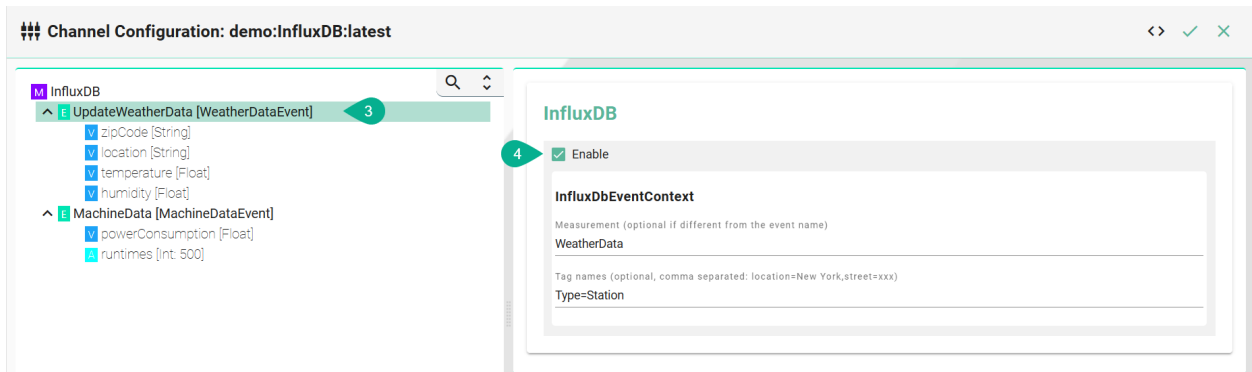
1. Select the **root model node** in the tree on the left.
2. Configure the InfluxDB.
  - Enter the **URL** to the database
  - Enter the **Database name**
  - Enter the database **Username** and **Password** or select it from the Credentials Manager

- Enter the **Batch size** - writes data in batches to minimize network overhead when writing data to InfluxDB
- Enter the **Flush interval** and select the **Unit** - if data should be written every 10 seconds enter a flush interval of 10000ms



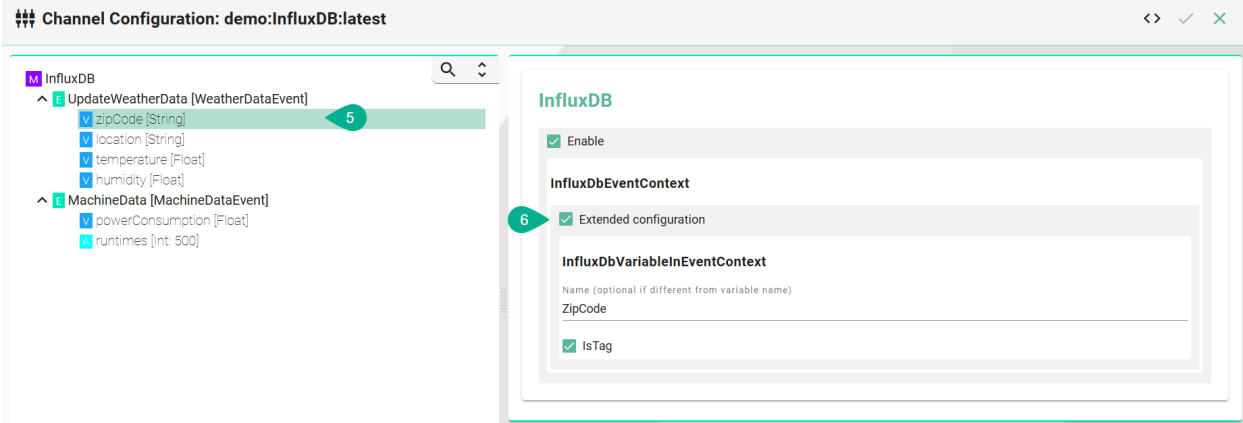
## Event Configuration

3. Select the event node
4. Enable the checkbox to configure the event
  - Enter the **Measurement** - if it differs from the event name
  - Enter **Tags** - comma separated



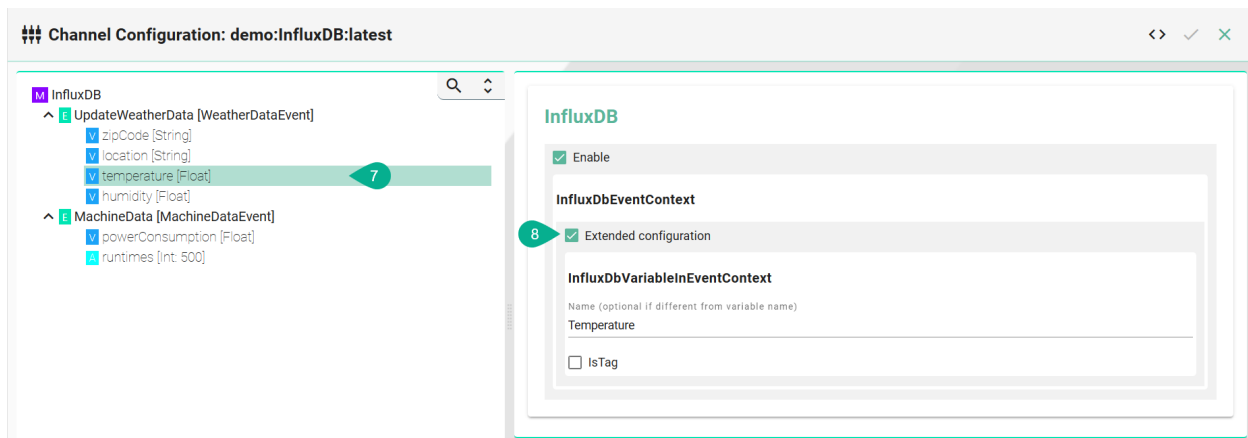
## Configuration of Tags

5. Select the variable which should be a **Tag**
6. Enable **Extended configuration**
  - Enter a **Name** - if it differs from the variable name
  - Enable the checkbox **IsTag**



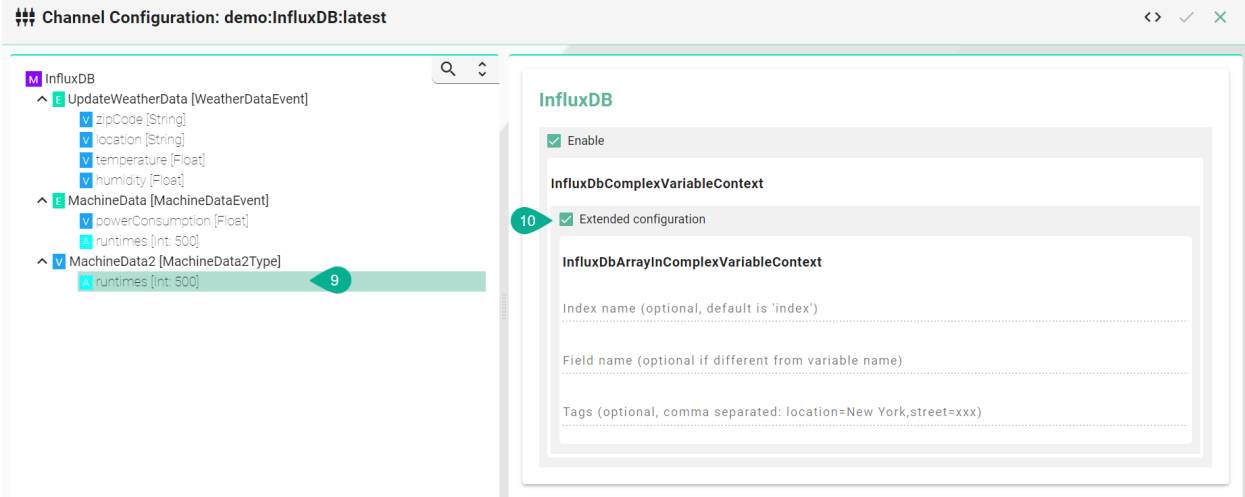
### Configuration of fields

7. Select the variable which should be a **field**
8. Enable **Extended configuration**
  - Enter a **Name** - if it differs from the variable name
  - Leave the checkbox **IsTag** disabled



### Array Configuration

9. Select the Array
10. To configure the Array select **Extended Configuration**
  - (Optional) Enter an **Index** name
  - (Optional) Enter a **Field** name if the event node name differs from the actual name in InfluxDB.
  - (Optional) Enter **Tags** separated by commas e.g., (location=NewYork, street=xxx)



**Description of configuration properties:**

Property	Description	Example
URL	Database URL and port	http://127.0.0.1:8086
DB Name	Database name	InfluxDB
Credentials	Database credentials	None
Batch size	Data written in batches	1000
Flush interval	Interval to write data	10
Measurement	Name of the measurement stored in influxdb	WeatherData
Tag names	Optional tag to be added to the measurement	Type=Station

**SQL Database**

**Characteristics - SQL Database**

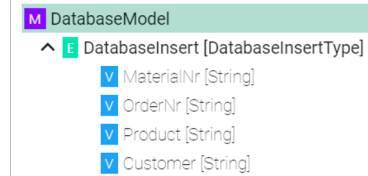
- The SQL Channel can be configured for the following two scenarios:
  - Inserting data
  - Updating data
  - Retrieving data
- When inserting values into the database please **note** that “infinity” values are converted automatically into “null” values.

**Information Model Requirements**

**Insert/Update**

- The node after the root model node must be of type *Event* **E** which represent a database table.
- In case of relational databases: Tables which are dependent on each other require a *List* **L**.
- Columns of databases are represented by *Variables* **V**.

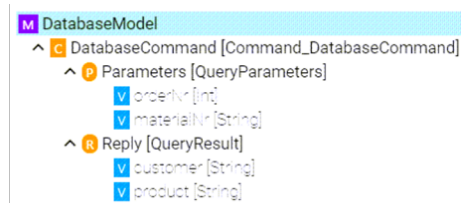
* MATERIAL_Nr	ORDER_Nr	PRODUCT	CUSTOMER
1 HS787FSTC	121	AXY_200	DemoCompany1
2 HS787FSTC	123	AXY_150	DemoCompany2
3 HS777FSTC	120	AXY_100	DemoCompany1
4 HS767FSTC	123	AXY_200	DemoCompany1



## Select

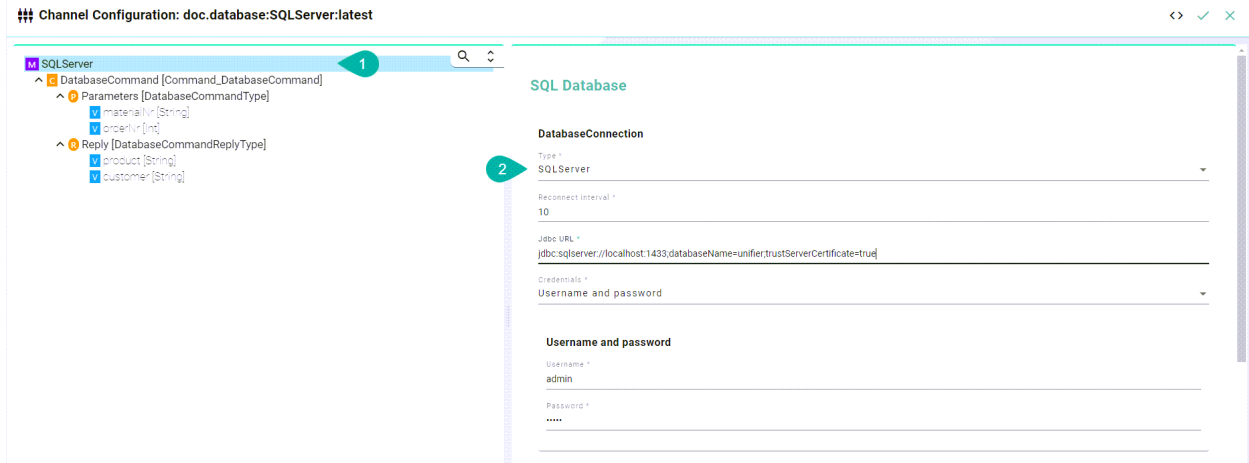
- The **Command** **C** defines that after a request is made, a reply with a result is expected.
- Parameters **P** within a Command represent a collection of query parameter - query parameters are defined as Variables **V**.
- Reply **R** within a Command represents the result of the Command - results are defined as Variables **V**.

* MATERIAL_Nr	ORDER_Nr	PRODUCT	CUSTOMER
1 HS787FSTC	121	AXY_200	DemoCompany1
2 HS787FSTC	123	AXY_150	DemoCompany2
3 HS777FSTC	120	AXY_100	DemoCompany1
4 HS767FSTC	123	AXY_200	DemoCompany1



## How to configure the SQL-Database

1. Select the **root model node** in the tree on the left.
2. Configure the database connection
  - Select the **Database type**.
  - Specify a **Reconnection interval**.
  - Enter the **database connection URL** for the specific database type.
    - **DB2**: jdbc:db2:server:port/database
    - **HSQldb**: jdbc:hsqldb:file:databaseFileName;properties
    - **ORACLE**: jdbc:oracle:thin:prodHost:port:sid
    - **PostgreSQL**: jdbc:postgresql://host:port/database
    - **SQLServer**: jdbc:sqlserver://[serverName[\instanceName][:portNumber]][:property=value[:property=value]]
    - **MariaDB**: jdbc:(mysql|mariadb):[replication:|loadbalance:|sequential:|aurora:]/<host>[:<portnumber>]/[database][?<key1>=<value1>[&<key2>=<value2>]]
  - Enter the database **Username** and **Password** or select it from the Credentials Manager.



**Description of configuration properties:**

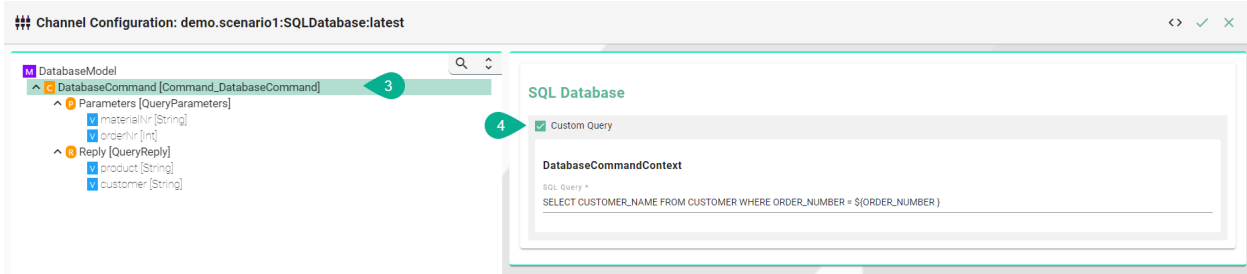
Property	Description	Example
<b>Type</b>	Type of the database	MariaDB, SQLServer, ORACLE, HSQLDB, DB2, PostgreSQL
<b>ReconnectInterval</b>	Time to reconnect if connection fails	10 (in milliseconds)
<b>JdbcUrl</b>	Url to connect to database	<ul style="list-style-type: none"> <li>• jdbc:sqlserver://localhost:1433; databaseName=unifier; trustServerCertificate=true</li> <li>• jdbc:mariadb://localhost:3306/unifier?connectTimeout=5000</li> <li>• jdbc:db2://127.0.0.1:50000/TESTDB</li> <li>• jdbc:hsqldb:file:\protect\T1\textdollardbFileName; shutdown=true</li> <li>• jdbc:oracle:thin:@localhost:1521/MYCDB</li> <li>• jdbc:postgresql://127.0.0.1:5432/postgres</li> </ul>
<b>Username and password</b>	Credentials of the database	

**Note:** The configuration of specific *information model nodes* differs whether you want to perform an **insert** or an **select** statement on the database. Inserting data into the database requires an

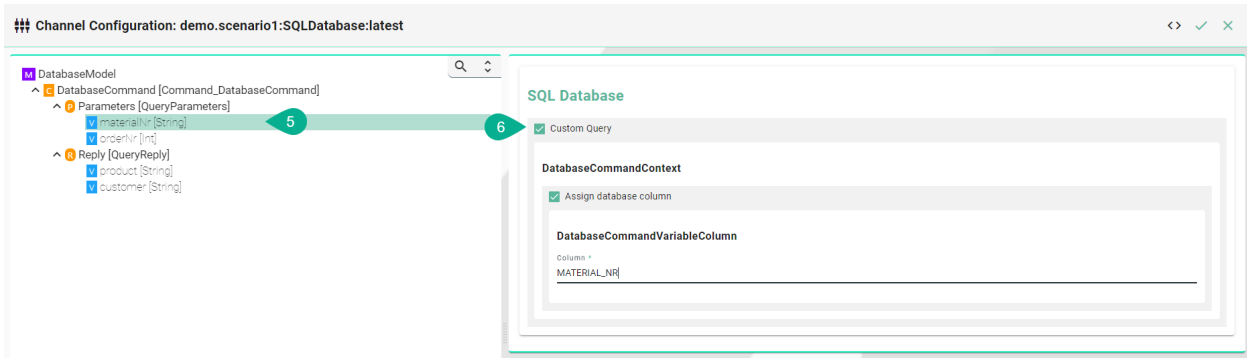
**event node** whereas selecting data requires a **command node** in the *Information Model*.

## Select Statement

3. Select the **command node** in the tree on the left.
4. Check the **Custom Query** checkbox and enter the **SQL Query**.

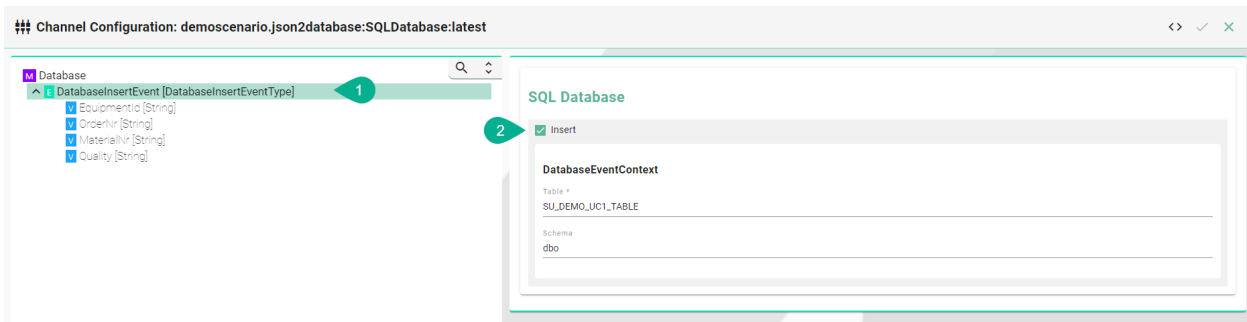


5. Each variable under *Parameters* and *Reply* needs to be assigned to a database column. Select the **variable node** under *Parameters* and in the tree select what needs to be configured.
6. Check the **Assign database column** checkbox and enter the **Column name** as it is defined in the used database.



## Insert Statement

1. Select the **event node** in the tree on the left.
2. Check the **Insert** checkbox and enter the **Table name**. If required enter a **Schema name**.



## Protocols

### MQTT

#### Characteristics - MQTT

MQTT is an OASIS standard messaging protocol for the Internet of Things (IoT). To learn more about the standard visit the [MQTT website](#).

#### Information Model Requirements

- The first Node after the root node **M** must be of type *Event* **E**.
- The following Node Types can be used under the Event Node:
  - *Variables* **V** with a *Simple Data Type* represents the key-value pairs.
  - *Variables* **V** with a *Custom Data Type* represent objects that can contain key-value pairs.
  - With *Lists* **L** you can aggregate multiple variables.
- In case of publishing a topic, the Information Model determines the structure of the payload.
- In case of subscribing to a topic make sure that the Information Model structure matches the payload.

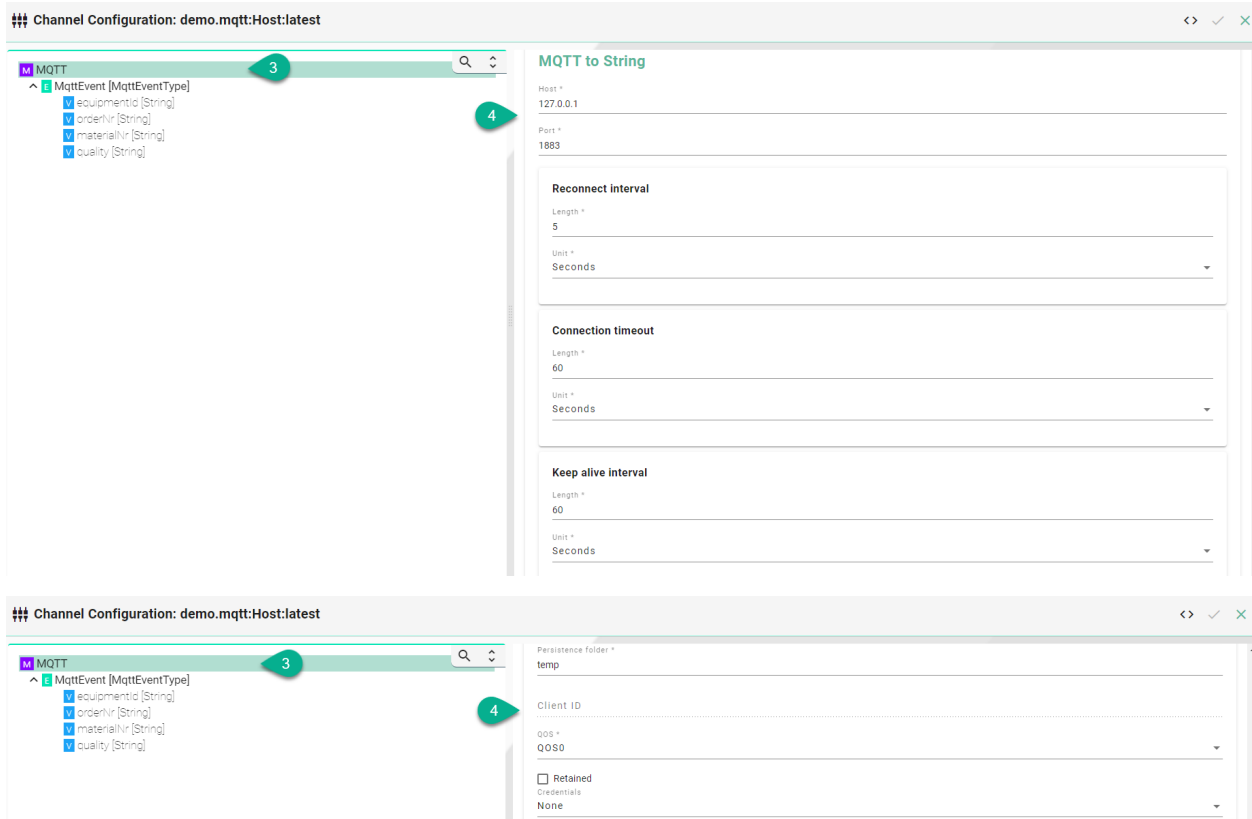
#### Configuration - MQTT Channel

1. Select the **MQTT (JSON)** as Channel Type.
2. Click the **Configure** button.

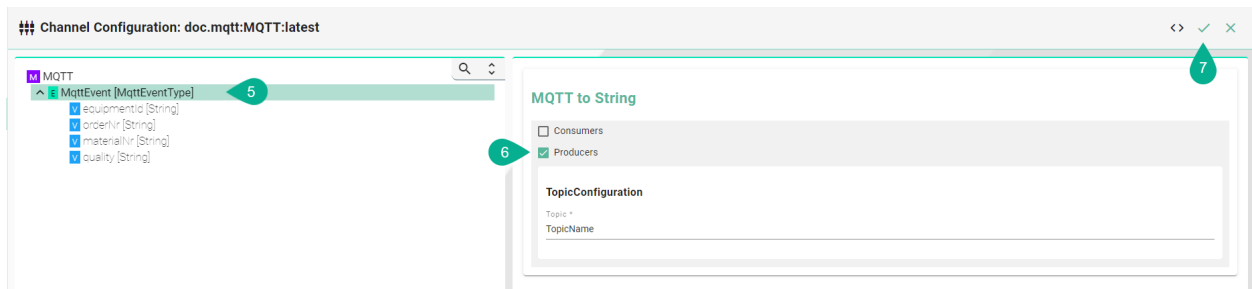
3. Select the **root model node**
4. Configure the MQTT To String configuration:
  - Enter **Host** and **Port** of the MQTT Broker used
  - If required, adjust the default values for **Reconnect interval**, **Connection timeout**, **Keep alive interval** and the **Unit** for each
  - Specify a path to a folder on your local machine. The **temp** directory inside the *SMARTUNIFIER Manager* can be used as well.



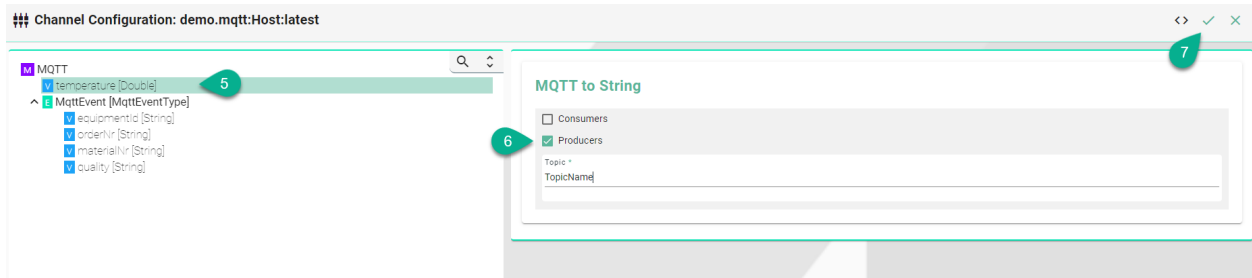
- (Optional) Specify a **Client ID**
- Set the **Quality of Service (QoS)**
- (Optional) Enable **Retained** if required
- Select **Username and password** in order to manually enter the credentials or select **Username and password credentials reference** to add it from the Credentials Manager. If there are no credentials needed (e.g., test.mosquitto.org) select **None**.



5. Select the **event node** in the tree on the left.
6. Enable either **Producer** or **Consumer** depending on the use case and enter a **Topic name**.
7. Click the **Apply** button.



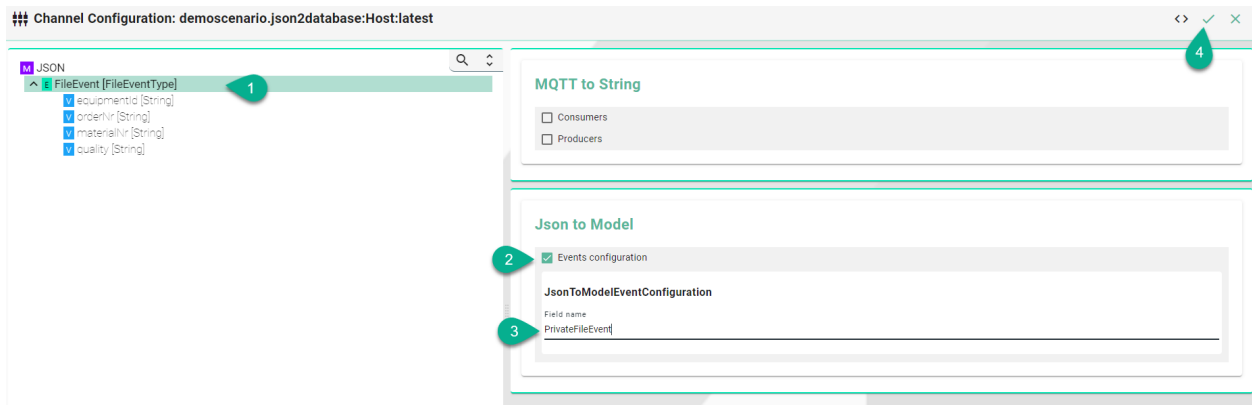
The **Producer** or **Consumer** option can be enabled for a **Variable node**.



## Json To Model Event Configuration

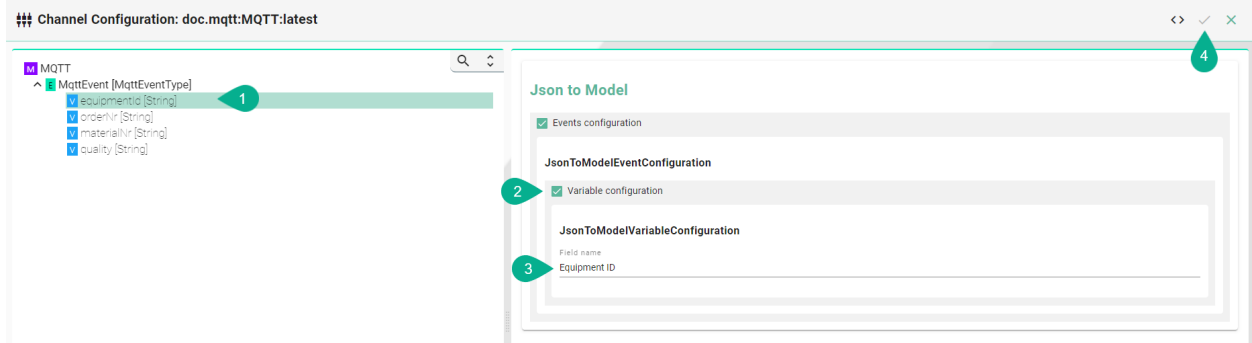
This configuration is used when some keywords or reserved words can't be used in the Information Model.

1. Select the **event node** in the tree on the left.
2. Check the box for the **Events configuration**.
3. Input the **Field name**, representing the reserved word.
4. Click on the **Apply** button.



## Json To Model Variable Configuration

1. Select a **variable** in the tree on the left.
2. Check the box for the **Variable configuration**.
3. Input the **Field name**, representing the reserved word.
4. Click on the **Apply** button.



## Certificates

Encrypted connection using TLS security is supported. Follow the steps below to encrypt the connection.

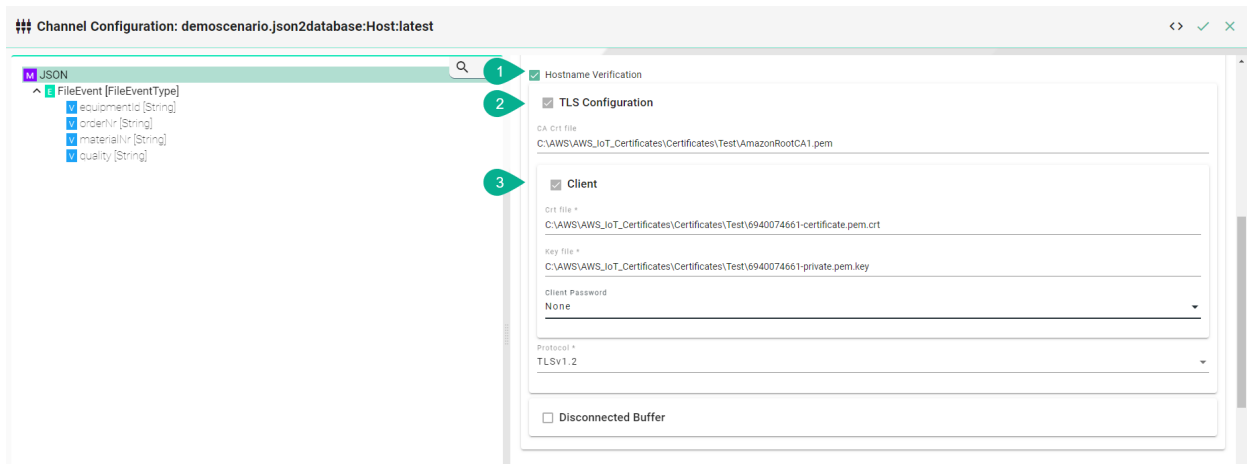
1. Enable **Hostname Verification** (optional)
2. Enable the **Tls Configuration** checkbox
  - Enter the **path** to the **CA (certificate authority) certificate** of the CA that has signed the server certificate

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**Note:** Make sure the CA certificate is valid.

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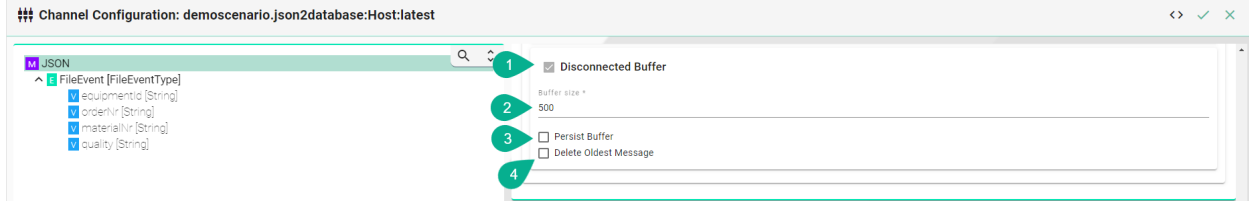
3. Enable the **Client** checkbox
  - Enter the **path** to the **Client certificate**. The client certificate identifies the client just like the server certificate identifies the server.
  - Enter the **path** to the **Private client key**.
  - If applicable select to enter a **Password** or to add from the **Credentials Manager**.
  - Select the **Protocol** from the Drop-Down.



## Disconnected Buffer

In case the connection is lost, messages can be buffered offline when the Disconnected Buffer is enabled. Follow the steps below to enable the DisconnectedBuffer.

1. Enable the **Disconnected Buffer** checkbox.
2. Set the **Buffer size** - defines the number of messages being hold e.g., 5000.
3. (Optional) Enable **Persist Buffer**.
4. (Optional) Enable **Delete Oldest Message**.



**Description of configuration properties:**



Property	Description	Example
host	URL of the MQTT Broker.	test.mosquitto.org
port	Port of the MQTT Broker.	1883
reconnectInterval	Time interval to reconnect to the MQTT Broker after loss of connection in seconds	5
connection-Timeout	Time interval the connection times out in seconds	60
keepAliveInterval	Time the session persists in seconds	60
persistence-Folder	Path to a folder for the persistence store of the MQTT	temp
clientId	Identifies an MQTT client which connects to an MQTT Broker	MyClientID
username	Client username	Username
password	Client password	Password
hostnameVerification	Hostname Verification	true, false
tls	Encryption	true, false
producers	Data producer	true, false
consumer	Data consumer	true, false
protocol	TLS protocol version	TLSv1.1, TLSv1.2
disconnected-Buffer	Offline buffering of data	true, false
bufferSize	Amount of message allowed in the buffer	5000
persistBuffer	Buffer persistence	true, false
deleteOldestMessage	Delete oldest message in buffer	true, false

## Modbus

### Characteristics - Modbus


MODBUS is an application-layer messaging protocol, positioned at level 7 of the OSI model. It provides client/server communication between devices connected on different types of buses or networks. To learn more about the standard visit the [MODBUS website](#).

### Information Model Requirements

- The following Node Types can be used to model a register:
  - Variables  with a *Simple Data Type*.
  - Variables  with a *Custom Data Type*.

### Configuration - Modbus

1. Select **Modbus/Tcp Client** as Channel Type.
2. Click the **Configure** button.



⊕ Add Communication Channel

Group \*  
demo.modbus

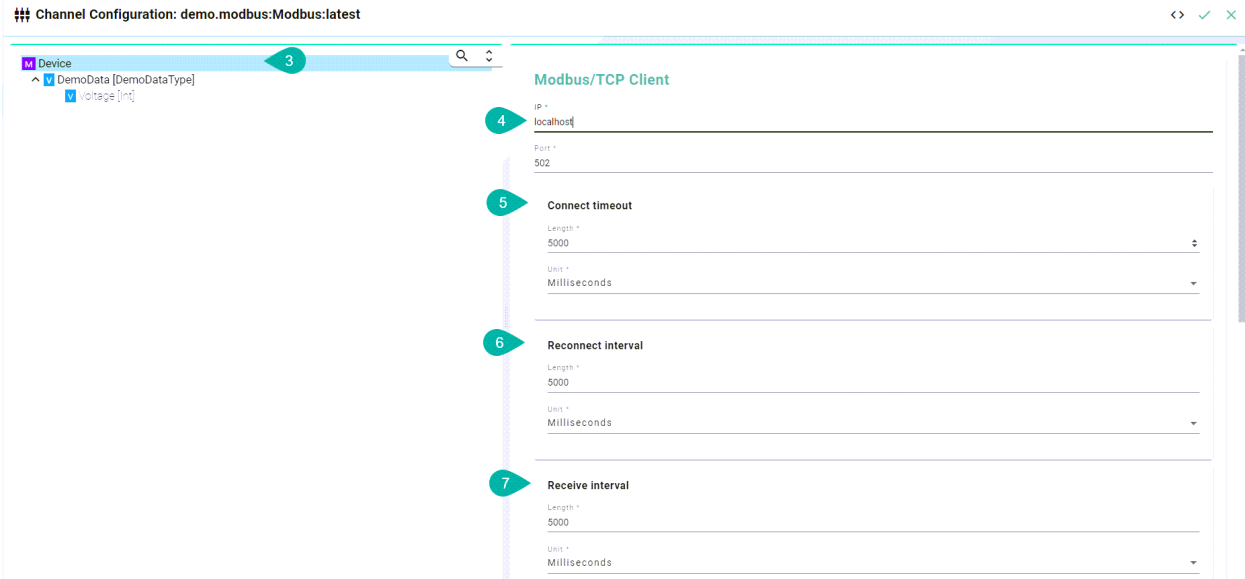
Name \*  
Modbus

Description

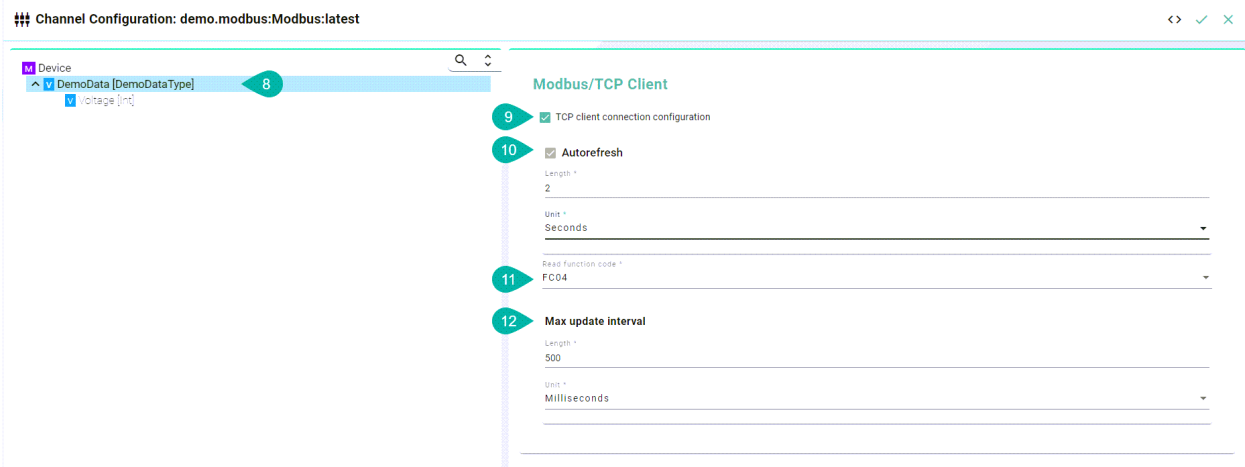
Model \*  
demo.modbus.Device.latest

Channel type \*  
Modbus Tcp Client

3. Make sure the root model node is selected to configure the Modbus/TCP Client
4. Enter the **IP** address and the **port**
5. (Optional) Change the **Connect interval** if needed
6. (Optional) Change the **Reconnect interval** if needed
7. (Optional) Change the **Receive interval** if needed



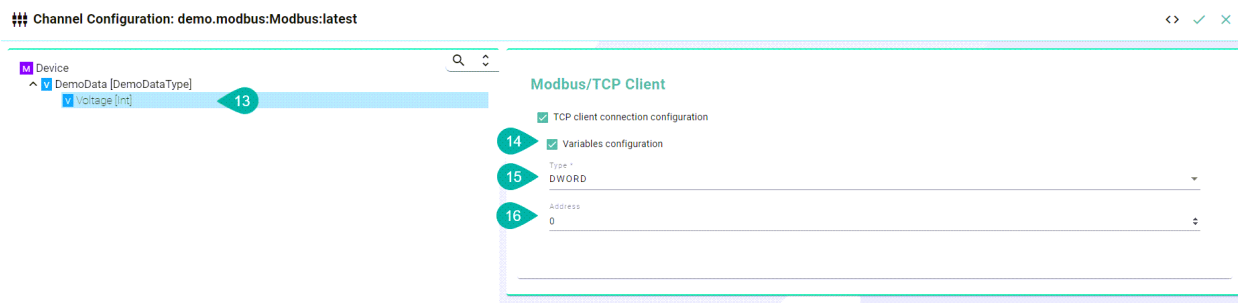
8. Select the complex variable node
9. Enable the checkbox **TCP Client connection configuration**
10. (Optional) Enable **Autorefresh** to specify the retrieval rate
11. Select the **Function Code**
12. (Optional) Change the **Max update interval** if needed



13. Select the complex variable node
14. Enable the checkbox **Variables configuration**
15. Select the **Data type**
16. (Optional) Enter the **register address**

**Note:** If **address** is left empty, SMARTUNIFIER assumes that the Information Model structure is

in line with the register addresses.



Description of data type format:

Data Type	Size	Range
BYTE, USINT, UInt8	8 Bit	0 - 255
WORD, UINT, UInt16	16 Bit	0 - 65.535
DWORD, UDINT, UInt32	32 Bit	0 - 4.294.967.295
LWORD, ULINT, UInt64	64 Bit	0 - 2 <sup>64</sup> -1
SINT, Int8	8 Bit	-128 - 127
INT, Int16	16 Bit	-32.768 - 32.767
DINT, Int32	32 Bit	-2.147.483.648 - 2.147.483.647
LINT, Int64	64 Bit	-2 <sup>63</sup> - 2 <sup>63</sup> -1
REAL, Float32	32 Bit	-3,402823e+38 - 3,402823e+38
LREAL, Float64	64 Bit	-1,7976931348623158e+308 - 1,7976931348623158e+308

Description of configuration properties:



Property	Description	Example
IP	Client IP	localhost
Port	Client port	502
Connection timeout	Time interval the connection times out	60
Reconnect interval	Time interval to reconnect to the client after loss of connection	5
Receive interval	TCP/IP receive timeout	50
Autorefresh	Automatic polling of Modbus server	2
Read function code	Function code used for reading variables from a modbus server	FC04
Max update interval	Minimum time between requests to the Modbus server (if autorefresh is not used)	60
Variable configuration Type	Format of variable	DWORD
Variable configuration Address	Address of the variable on the modbus server	0

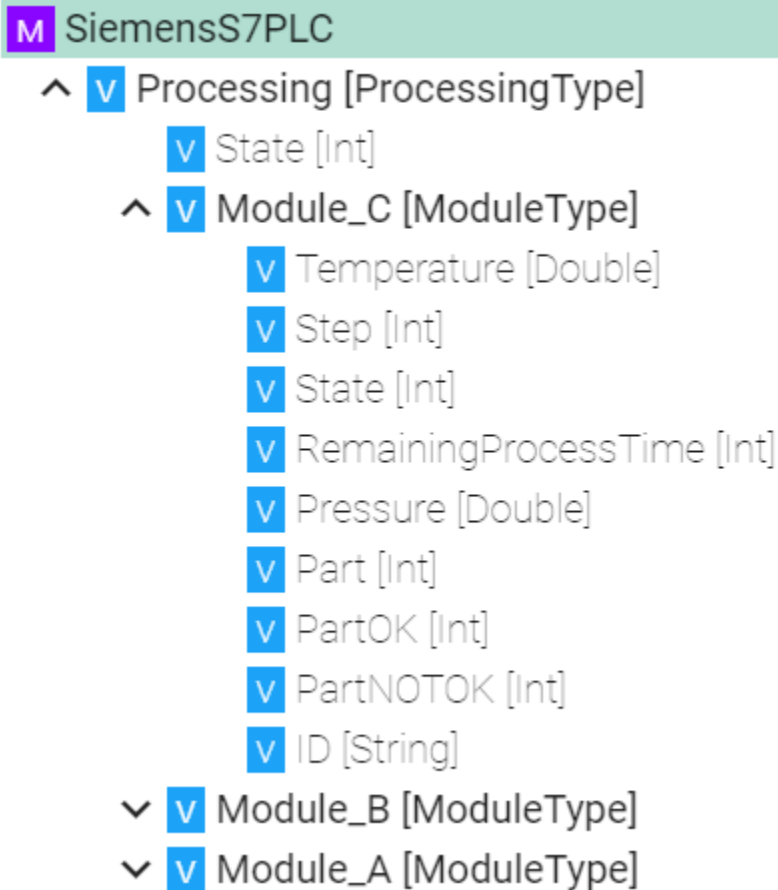
## OPC-UA

### Characteristics - OPC-UA

OPC (Open Platform Communications) enables access to machines, devices and other systems in a standardized way. To learn more about the standard visit the [OPC-UA website](#).

### Information Model Requirements

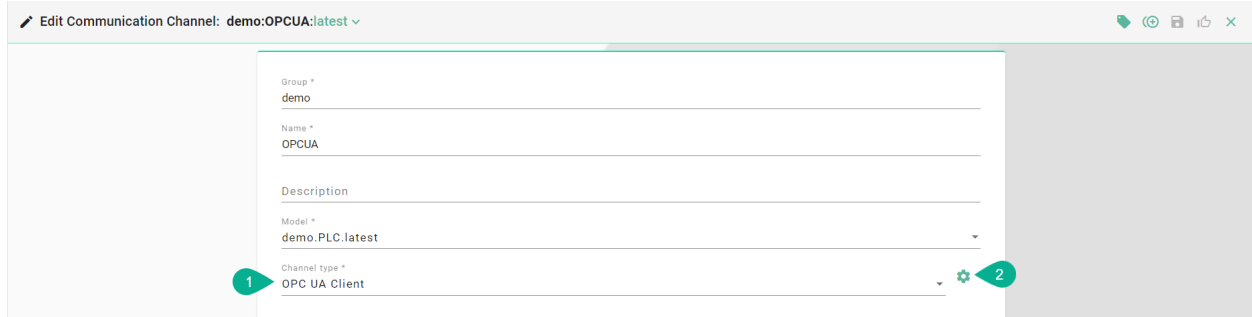
- The following Node Types can be used to model data structures:
  - Variables  with a *Simple Data Type*.
  - Variables  with a *Custom Data Type*.



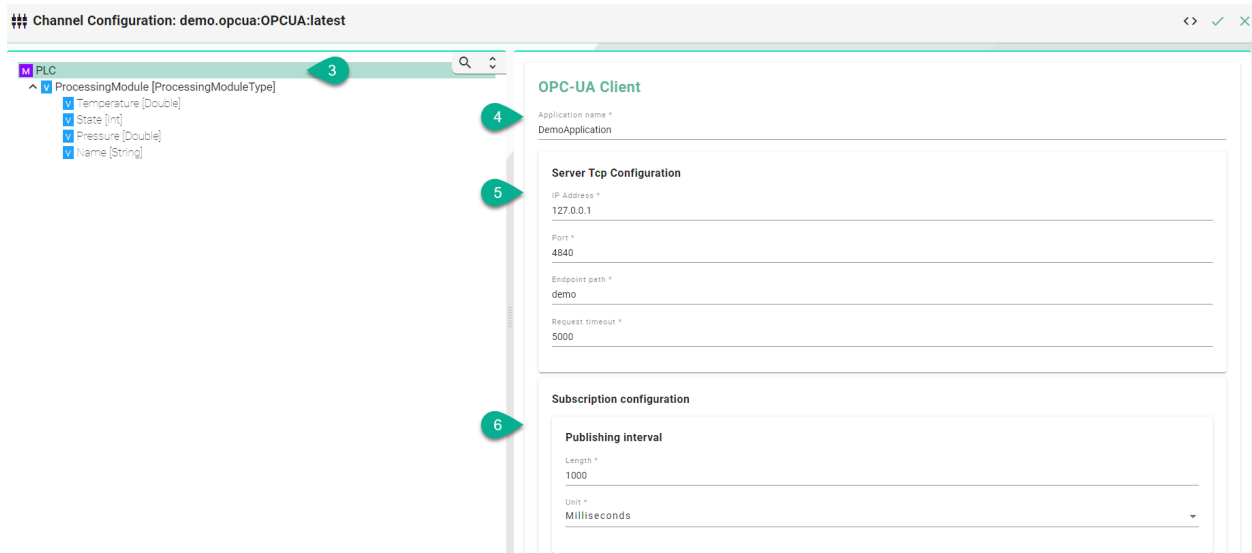


## Configuration - OPC-UA Client

1. Select **OPC-UA Client** as Channel Type.
2. Click the **Configure** button.

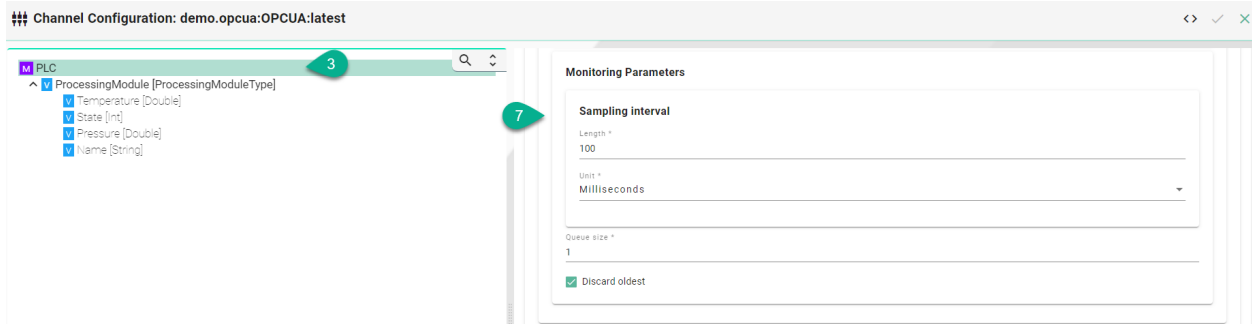


3. **Make sure** the root model node is selected to configure the OPC-UA Client
4. Enter an **Application name**
5. Configure the serverTcpConfiguration
  - Enter an **Ip Address**
  - Enter the **Port**
  - Define an **Endpoint**
  - Set a **Request timeout**
6. Configure the defaultSubscriptionAttribute
  - Define a **Publishing interval** and select the **Unit**

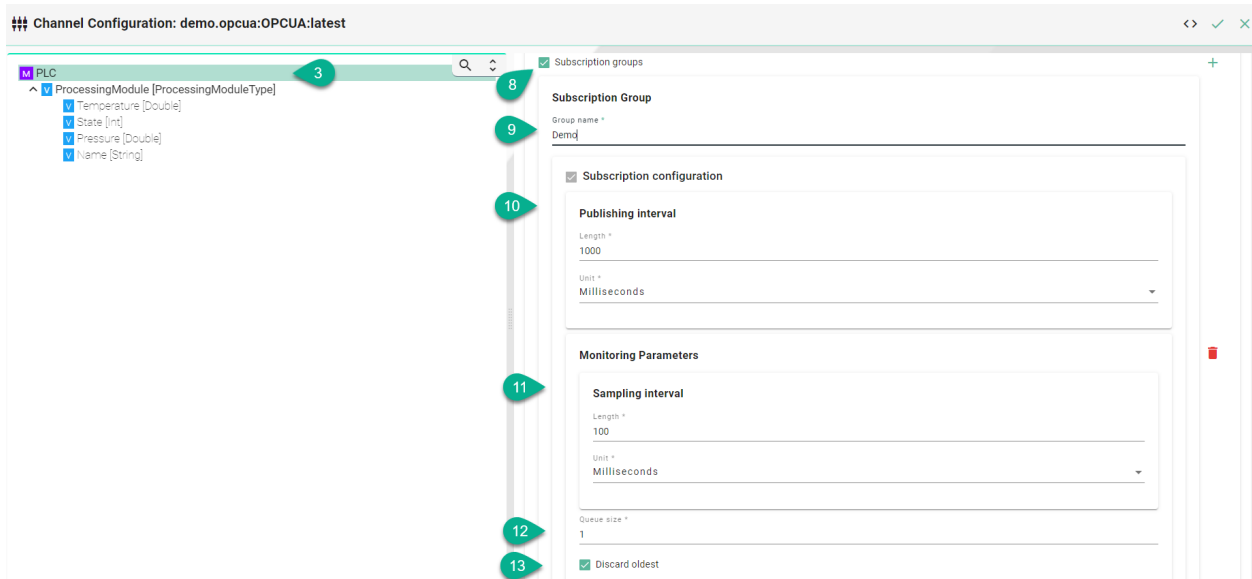


7. Configure monitoringParameters
  - Set a **Sampling interval** and the **Unit**

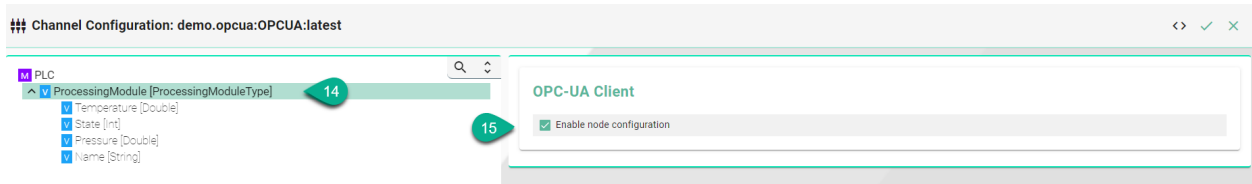
- Enter a **Queue size**
- Enable **Discard oldest** depending on the use case



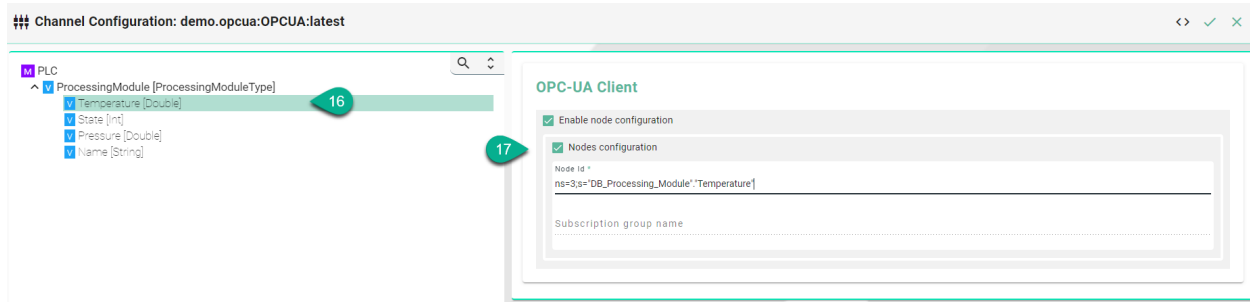
8. Enable **Subscription Groups** depending on the use case
9. Input the **Group name**
10. Define a **Publishing interval** and select the **Unit**
11. Set a **Sampling interval** and the **Unit**
12. Enter a **Queue size**
13. Enable **Discard oldest** depending on the use case



14. Select the complex variable node.
15. Enable the Node configuration



16. Assign OPC-UA data block variables to corresponding variables in the Information Model by selecting the variable in the tree
17. Assign data block
  - Enable the **Nodes configuration** checkbox
  - Enter the **Node Id**



#### Description of configuration properties:

Property	Description	Example
IP Address	Client IP	127.0.0.1
Port	Client port	4840
Endpoint path	Service name at the server endpoint	demo
Publishing interval	Interval in which Notification Messages are sent	1
Sampling interval	Sampling interval of monitored items	10
Queue size	Max number of messages stored in the publish queue	1
Node id	Id of the item	s='DB_Processing_Module'

## REST

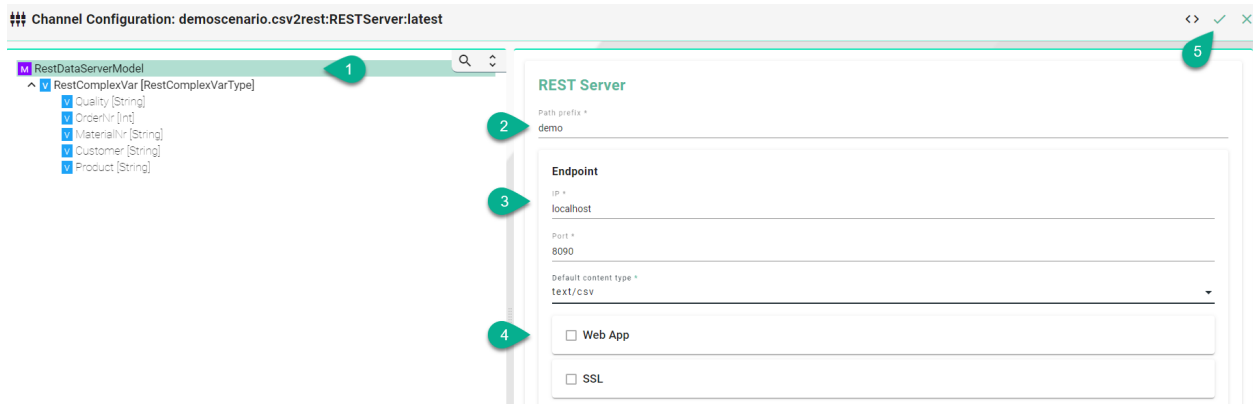
### Characteristics - REST

Representational state transfer (REST) is a software architectural style that describes a uniform interface between decoupled components in the Internet in a Client-Server architecture. To learn more about the standard visit the [REST section in Wikipedia website](#).

## Configuration - REST Server

The following sample configuration shows how variables can be made accessible over a REST server.

1. Select the **root model node** in the tree on the left.
2. Enter a **path prefix**.
3. Configure the *REST Server* endpoint.
  - Enter the **IP**.
  - Enter the **port**.
  - Enter the **Content-Type**.
4. Check the **webapp** checkbox and provide the **WAR-file** if you want to host an application.
5. Click the **Apply** button and save the Channel by clicking the **Save** button on the upper right corner.



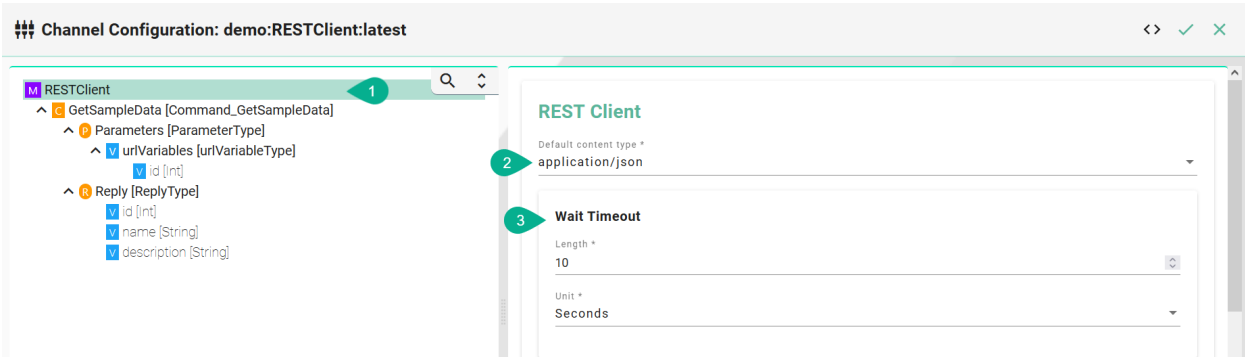
### Description of configuration properties:

Property	Description	Example
pathPrefix	Prefix for the URL	e.g., demo
Port	Port of the REST server	e.g., 9002, 9000, ...
IP	IP address of the REST server	http://localhost
DefaultContent-type	Is used to indicate the media type of the resource	application/json, application/xml, text/html, text/csv
webapp	Possibility to host an application	true, false

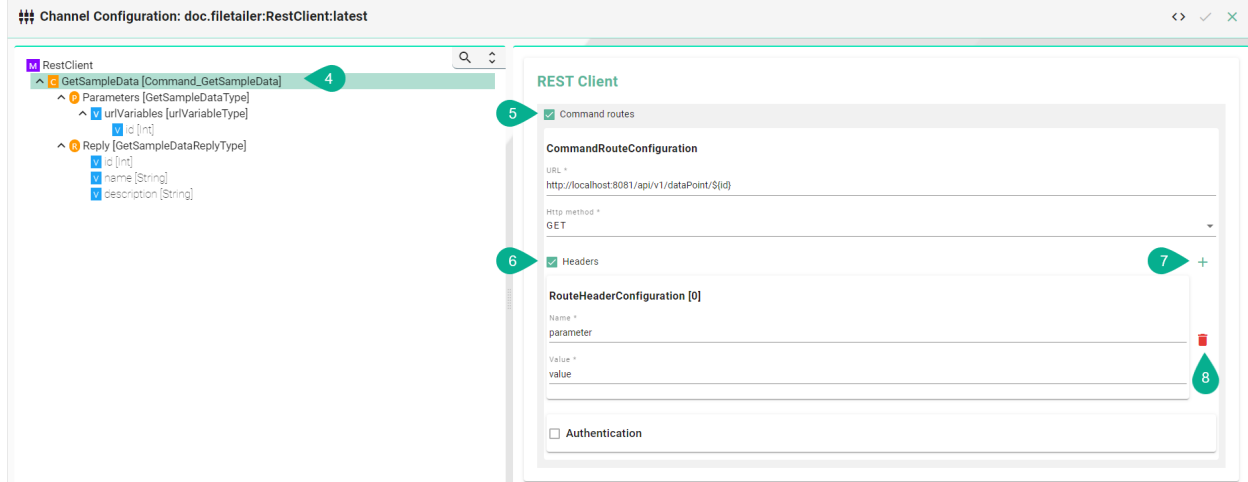
## Configuration - REST Client

The following sample configuration shows a GET request using url parameters.

1. Select the **root model node** in the tree on the left
2. Select the **content type** - defines the media type of the associated representation
3. Set the **wait timeout**

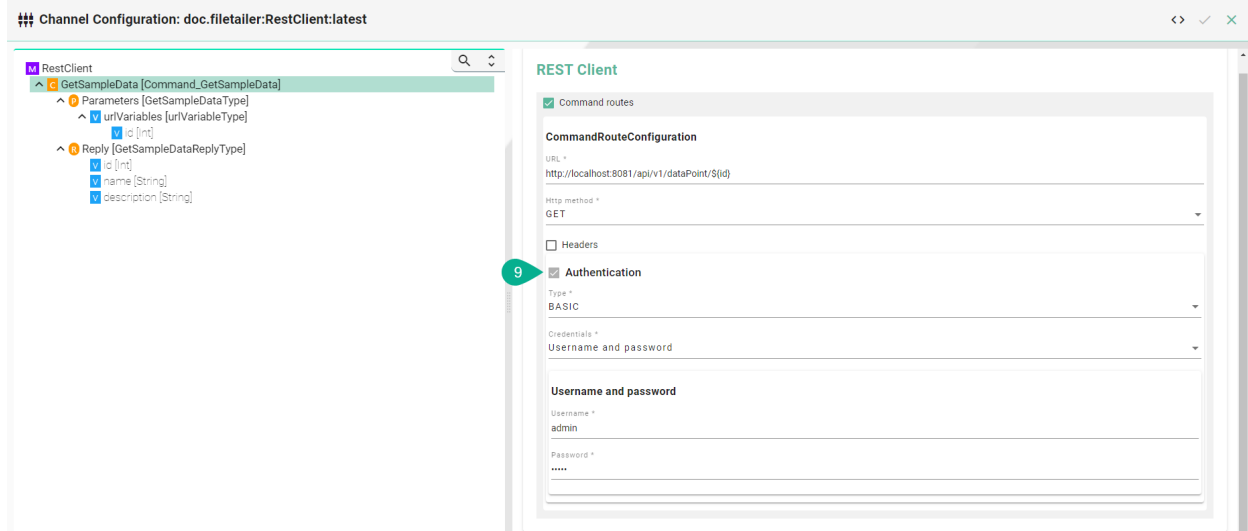


4. Select the **Command** node
5. Enable the **Command routes** checkbox for the configuration of the following fields:
  - Enter the **URL** - If URL parameters are used then add each parameter in the following syntax `${id}`
  - Select the **HTTP method**.
6. (Optional - Headers) Enable the checkbox **Headers** for the configuration of the following fields:
  - Enter the name of the header
  - Enter the value
7. (Optional - Headers) You can add multiple header entries by clicking the **Add** button
8. (Optional - Headers) Headers can be deleted by clicking the **delete** button

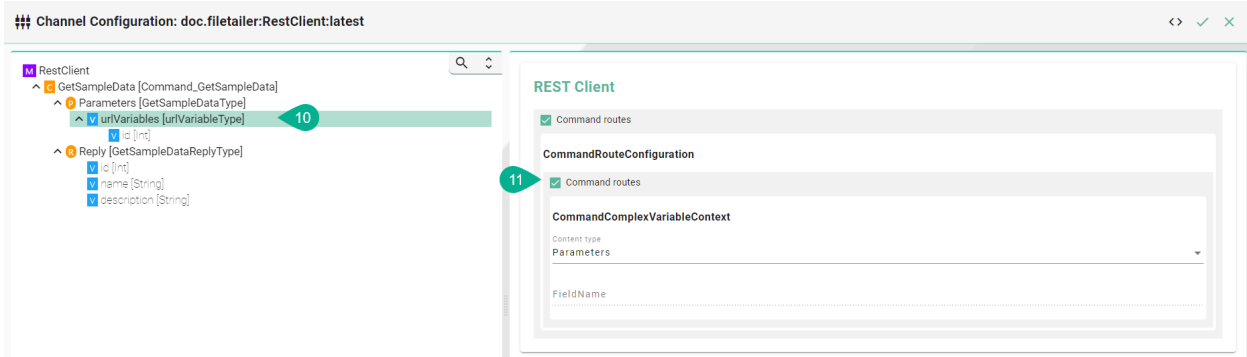


9. (Optional - Authentication) Enable the checkbox **Authentication** for the configuration of the following fields:

- Select the **Type** of the Authentication
- Enter the **Username** and **Password** or select it from the Credentials Manager



1. (Optional - URL Parameters) Select a custom variable and enable the **command routes** checkbox
2. (Optional - URL Parameters) Enable the **command routes** for the configuration of the following fields:
  - Select the **Content Type**
  - (Optional) Enter a **Field Name** in case the *Information Model Node* is not matching the REST API



**Description of configuration properties:**

Property	Description	Example
URL	URL of the REST API.	http://localhost:8081/api/v1/dataPoint/\${id}
HttpMethod	HTTP method for the action performed by the Client.	GET, POST, PUT
HeaderName and Header Value	To provide server and client with additional information	Retry-After: 12
Default Content Type	Is used to indicate the media type of the resource.	application/json
RouteHeaderConfiguration	Headers represent the meta-data associated with the API request	Name, Value
Authentication Type	Type of the Authentication	Basic, Digest, Kerberos, NTLM, SPNEGO
Content Type of Parameter Nodes	Type of the Parameter	Parameters, Body, Header, None
Field Name	For non-matching Information Model nodes and API spelling	String
WaitTimeoutDuration	Timeout in seconds until request is failing	10

**SECS/GEM**

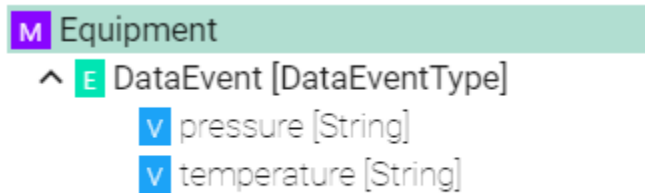
**Characteristics - SECS/GEM**

The SECS/GEM is the semiconductor’s equipment interface protocol for equipment-to-host data communications. In an automated fab, the interface can start and stop equipment processing, collect measurement data, change variables and select recipes for products. To learn more about the standard visit the [SECS/GEM section in Wikipedia website](#).

**Information Model Requirements**

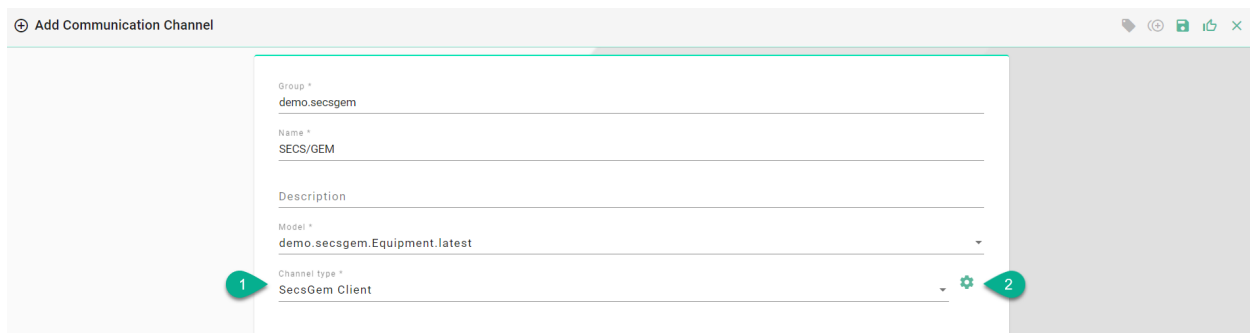
- The first Node after the root node **M** can be of type *Event* **E**, *Command* **C** or *Variable* **V**
- The following Node Types can be used under the Event Node:

- Variables **V** with a *Simple Data Type* represents the key-value pairs.
- Variables **V** with a *Custom Data Type* represent objects that can contain key-value pairs.



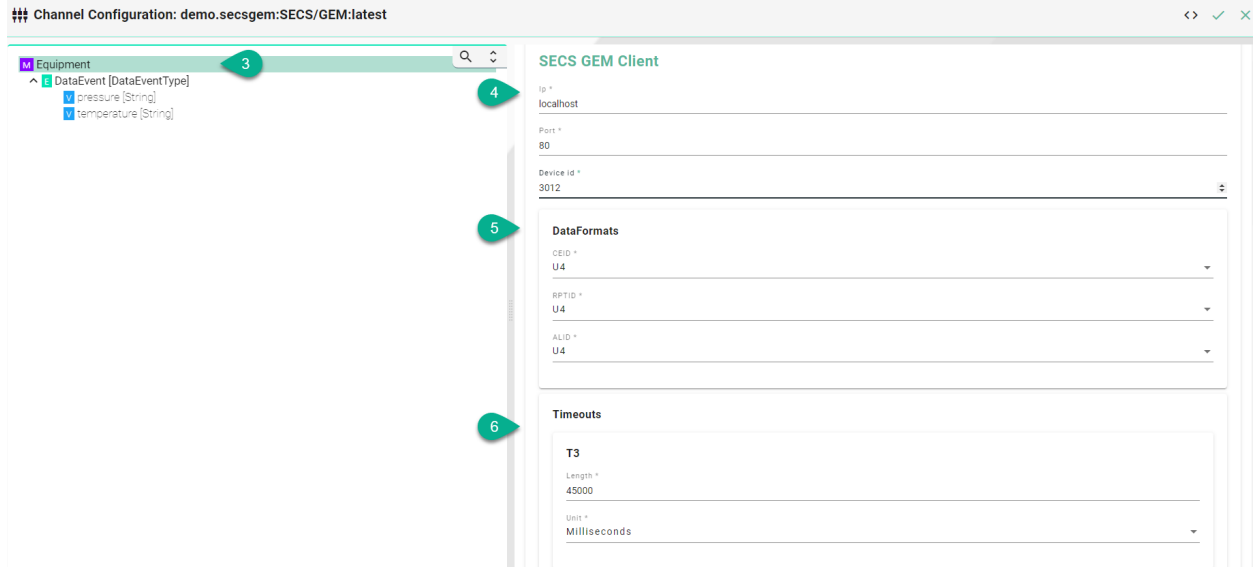
### Configuration - SECS/GEM Client

1. Select **Secs Gem Client** as Channel Type.
2. Click the **Configure** button.



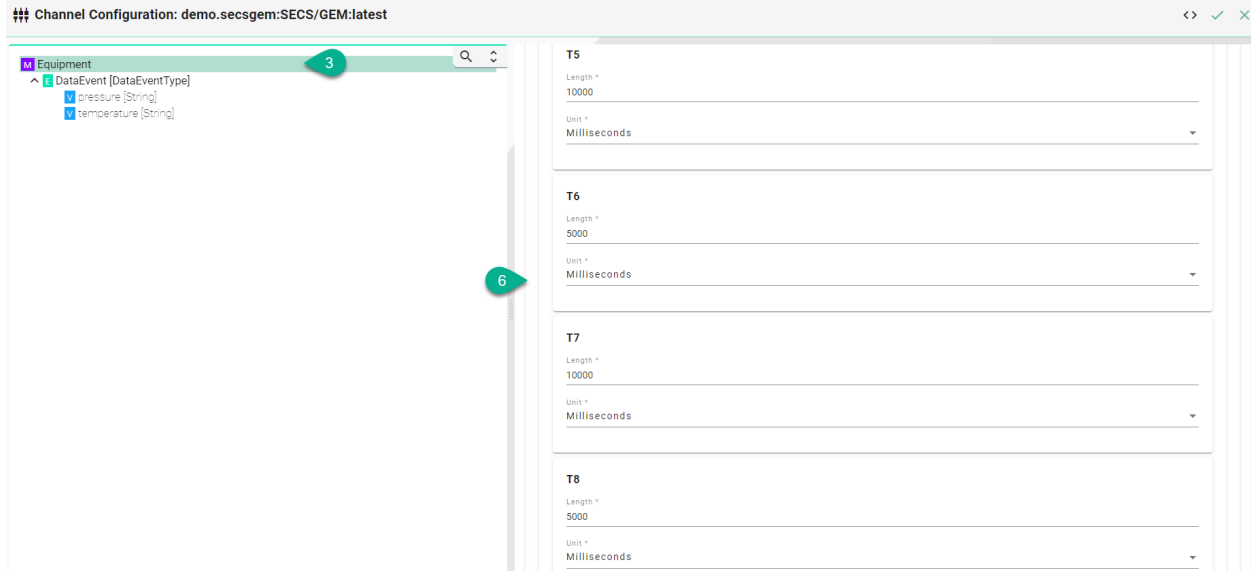
3. **Make sure** the root model node is selected to configure the SECS/GEM Client
4. Enter the device configuration:
  - input the equipment-to-host **Ip** address
  - type in the TCP **Port** for the communication
  - input the **Device Id**
5. Enter the **Data Formats**
  - Input **CEID** - format for event Ids
  - Enter **RPTID** - format for report Ids
  - Input **ALID** - format for alarm Ids





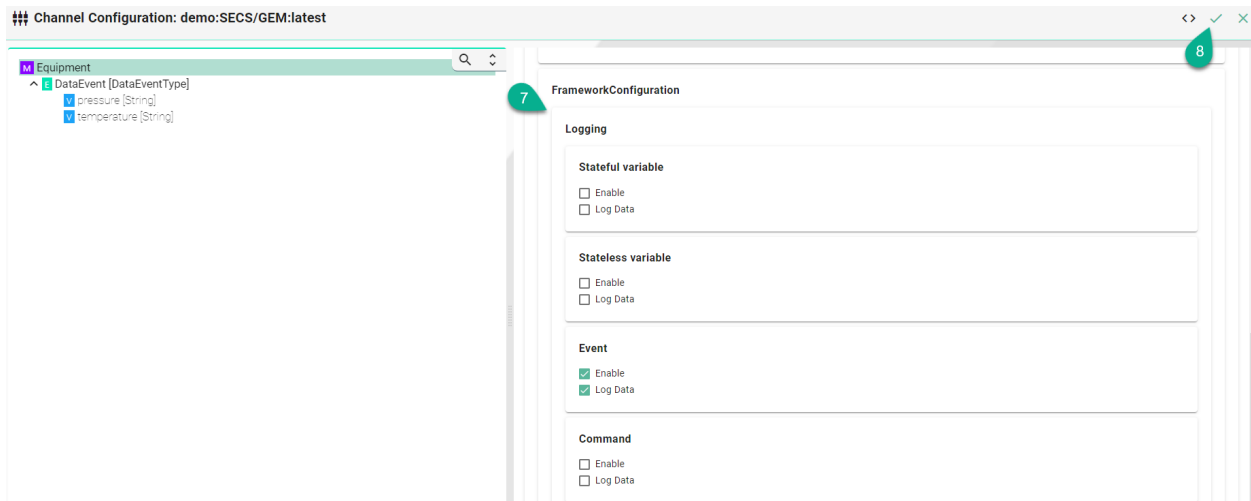
#### 6. Input timeout for:

- **T3** - Reply Timeout in the HSMS protocol.
- **T5** - Connect Separation Timeout in the HSMS protocol used to prevent excessive TCP/IP connect activity by providing a minimum time between the breaking, by an entity, of a TCP/IP connection or a failed attempt to establish one, and the attempt, by that same entity, to initiate a new TCP/IP connection.
- **T6** - Control Timeout in the HSMS protocol which defines the maximum time an HSMS control transaction can remain open before a communications failure is considered to have occurred. A transaction is considered open from the time the initiator sends the required request message until the response message is received.
- **T7** - Connection Idle Timeout in the HSMS protocol which defines the maximum amount of time which may transpire between the formation of a TCP/IP connection and the use of that connection for HSMS communications before a communications failure is considered to have occurred.
- **T8** - Network Intercharacter Timeout in the HSMS protocol which defines the maximum amount of time which may transpire between the receipt of any two successive bytes of a complete HSMS message before a communications failure is considered to have occurred.



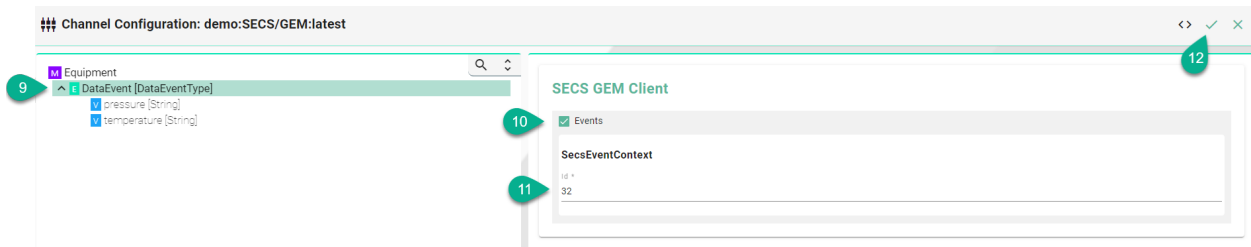
7. Select the logging type for the required Node Types:

- Check the **Enable** box
- Check the **Log Data** box



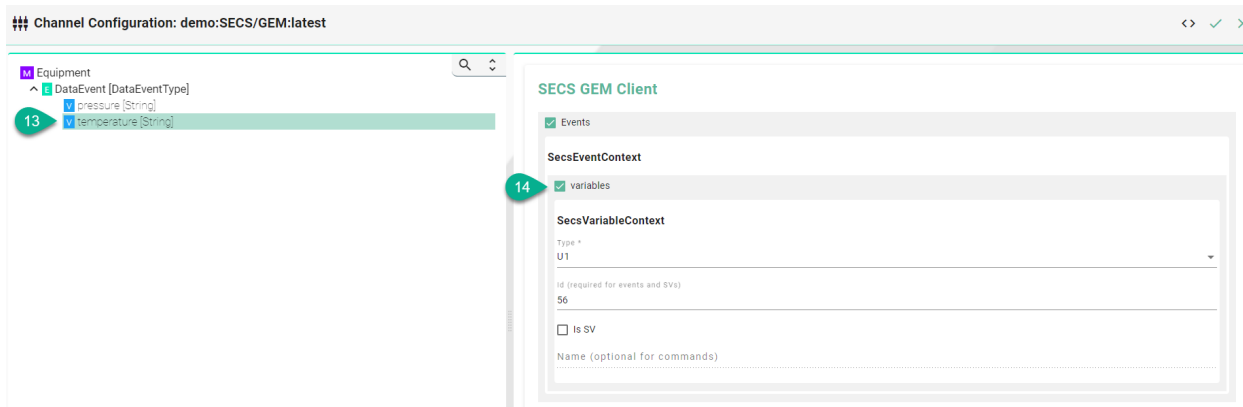
8. Click on the **Apply** button

9. Select the **Event** node to configure the event context



10. Click to check the **Events** box

11. Enter the event context **Id** which will trigger the event in the Information Model
12. Click on the **Apply** button
13. Select the variable in the tree



14. Click to check the **variables** box and configure the Secs variable context
  - select the variable **Type**
  - enter the variable **Id**
  - click the **Is SV** box to check if the variable is a SV
  - input the variable **Name**

**Description of configuration properties:**

Property	Description	Example
Ip	IP address of the Equipment	http://localhost
Port	TCP port for the communication	5000
Device Id	Id of the equipment	NJ-300
CEID	Format for event Ids	U4
RPTID	Format for report Ids	U4
ALID	Format for alarm Ids	U4
Timeouts	Time interval the connection times out in milliseconds	45000
T3	Reply timeout in the HSMS protocol	10000
T5	Connect Separation Timeout in the HSMS protocol	5000
T6	Control Timeout in the HSMS protocol	10000
T7	Connection Idle Timeout in the HSMS protocol	5000
T8	Network Intercharacter Timeout in the HSMS protocol	10000
Id	Id of the equipment event which will trigger the event	E32
Type	Type of variable	U1
Id	Variable Id	V56
Type	Commands - Type of the message	S2F41
Id	Commands Id	C33
RCMD	Name of command if it is different from the command Id	C1

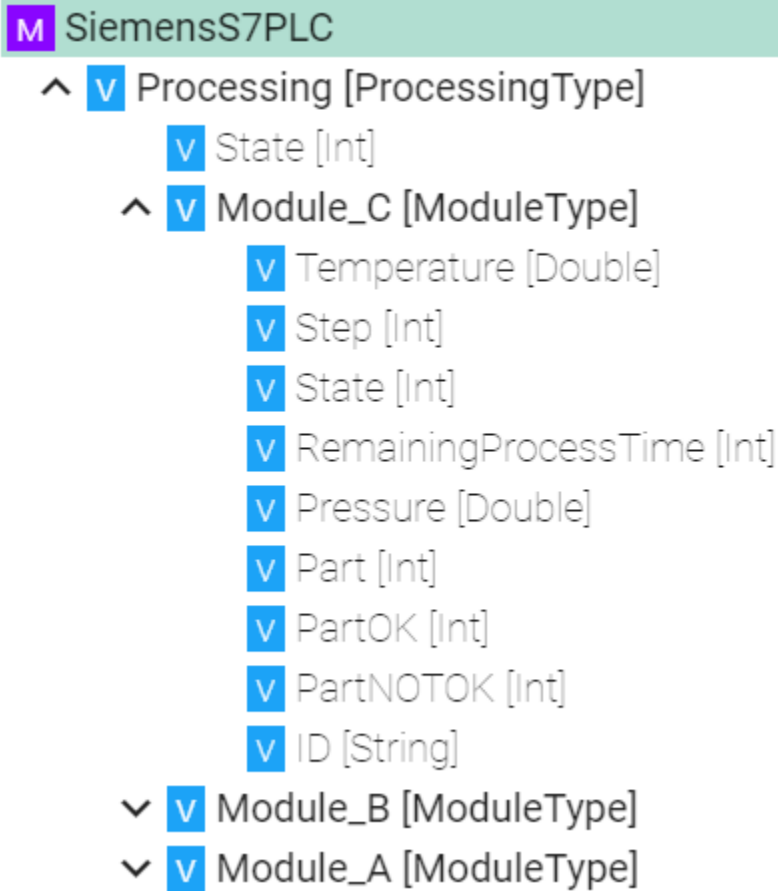
## AWS SiteWise IoT

### Characteristics - AWS IoT SiteWise

The AWS IoT SiteWise Channel enables you to send data directly to assets measurements via the [AWS IoT SiteWise API](#).

#### Information Model Requirements

- The first Node after the root node **M** can be of type *Event* **E** or *Variable* **V**.
- The following Node Types can be used under the Event Node or Variable Node:
  - *Variables* **V** with a *Simple Data Type* represent measurements.
  - *Variables* **V** with a *Custom Data Type* represent asset models.
- The following measurement data types can be used when creating a variable of a *Simple Data Type*:
  - String
  - Int
  - Double
  - Boolean



---

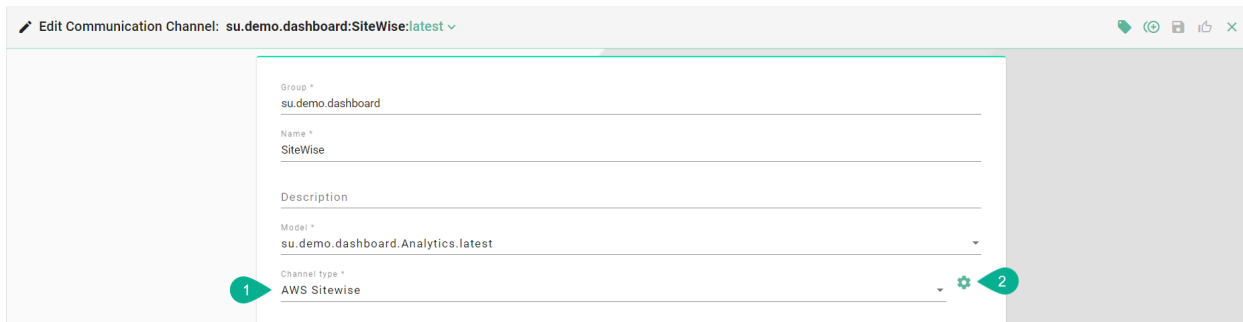
**Note:** Make sure that the Information Model is available in the AWS IoT SiteWise service. You can use the AWS SiteWise extension in order to export an SMARTUNIFIER Information Model to AWS IoT SiteWise.

---

### Configuration - AWS IoT SiteWise

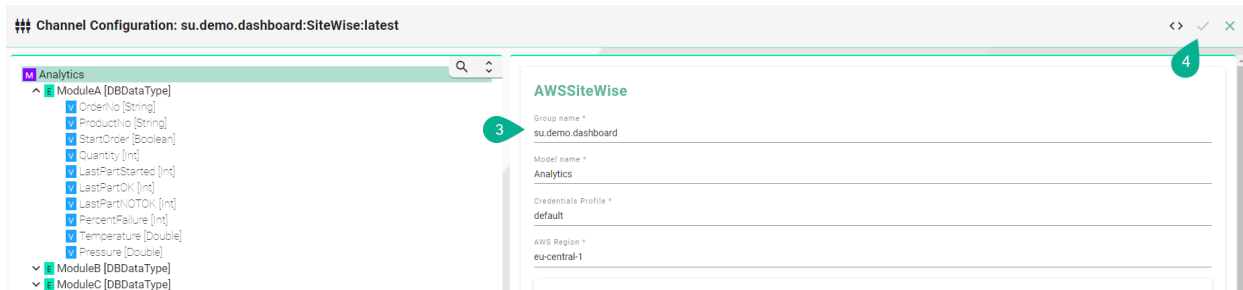
The following sample configuration shows how a AWS IoT SiteWise Channel is created.

1. Select **AWS Sitewise** as Channel Type.
2. Click the **Configure** button.



3. Enter the SiteWise configuration:

- Enter the group of the *Information Model*
- Enter the name of the *Information Model*
- Enter the profile from the credential file that should be used
- Enter the region of the AWS Iot SiteWise service you are using



Description of configuration properties:

Property	Description	Example
Group name	Information Model group name	demo
Model name	Information Model name	Analytics
Credentials Profile	Profile from the credential file	default
AWS Region	Region of the AWS Iot SiteWise service	eu-central-1

## 2.2.4 General Configurations

These configurations apply for all Communication Channel Types.

### Framework Configuration

The Framework Configuration enables insights into data handled by *Mapping Rules*. If enabled, logs will be generated once Rules are triggered and executed. These logs are visible then by default in the **INFO Log Level** as well as in the *Log Viewer*.

The following Framework Logging Configurations are available:

- Stateful Variable
- Stateless Variable
- *Event*
- Command

For each configuration there are two ways to use logging:

- **Enable:** Logs out information about the *Node Type* that was executed by the Rule.
- **Log Data:** Logs out in JSON-format the actual data of the *Node Type* that was executed by a Rule.

#### FrameworkConfiguration

**Logging**

**Stateful variable**

Enable

Log Data

**Stateless variable**

Enable

Log Data

**Event**

Enable

Log Data

**Command**

Enable

Log Data

## Event Logging

To use the Event Logging enable the checkbox **EventLogging** and for more detailed logging **Event-DataLogging**.

### EventLogging

- EnableLogging
- EnableDataLogging

## Event Logging Output

```
[INFO ] - EventDefinition - Received Event: /Model/bcdbbfd3-cdbe-4ade-8a73-
↪3788e6815c46/Event/ReleaseOrder
```

## Event Data Logging Output

```
[INFO ] - EventDefinition - Received Event: /Model/bcdbbfd3-cdbe-4ade-8a73-
↪3788e6815c46/Event/ReleaseOrder={"Quantity":10,"ProductNumber":"Mv5","OrderNumber":
↪"Ord154","EquipmentId":"4-SWC2"}
```

## 2.3 Mappings

### 2.3.1 What are Mappings

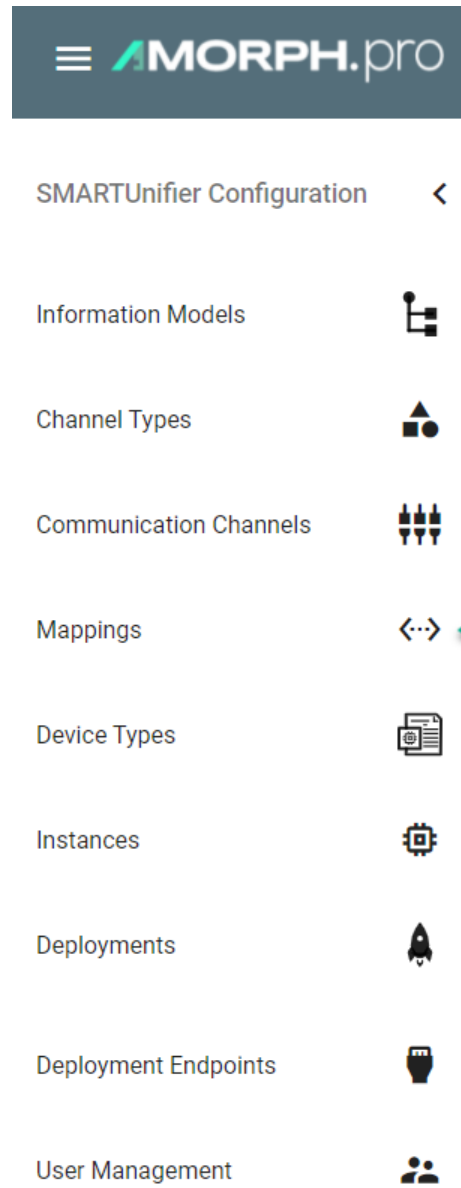
Mappings represent the SMARTUNIFIER component that define when and how to exchange/transform data between two or multiple *Information Models*. In other words, it is acting as a translator between the different Information Models. One Mapping consists of one or multiple Rules. A Rule contains a Trigger, which defines when the exchange/transformation takes place, and a list of actions that are defining how the exchange/transformation is done.

### 2.3.2 How to create a new Mapping

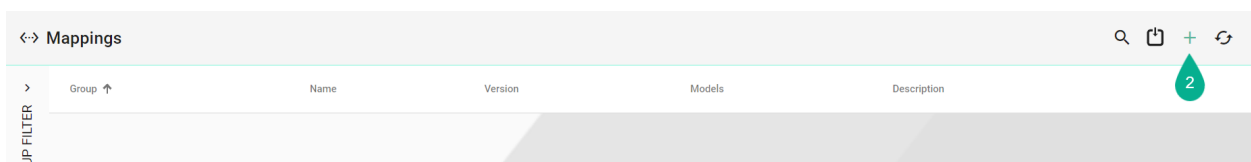
Follow the steps below to create a new Mapping definition:

- Go the Mappings perspective by clicking the “Mappings” button (1)





- Following screen containing a list view of existing Mappings is displayed
- In order to add a new Mapping, select the “Add Mapping” button at the top right corner (2)



- On the following screen provide the following mandatory information: Group, Name, Version and a Description which is optional (3)
- Click the “Add Model” button (4)
- Select the Information Model for this Mapping and enter a name for it (5)

- “Remove Model” button (6) removes the Model
- After all mandatory fields are filled in, the “Save” button at the top right corner is enabled. Click the button to submit the new *Mapping* (7)
- The newly created Mapping is now visible in the list view

The screenshot shows the 'Add Mapping' interface. The 'Configuration' section includes:

- Group: demoscenario.csv2rest (3)
- Name: CSVToREST
- Description: (empty)
- Models (4):
 

Short name	Information model identifier *
csv (5)	demoscenario.csv2rest:CsvDataModel:latest
rest	demoscenario.csv2rest:RestDataModel:latest (6)

The 'Rules' section is currently empty. A 'Save' button (7) is located at the top right of the 'Rules' pane.

### 2.3.3 How to create Rules

Follow the steps described below to create *Rules*:

- Select the “Edit” button (1).

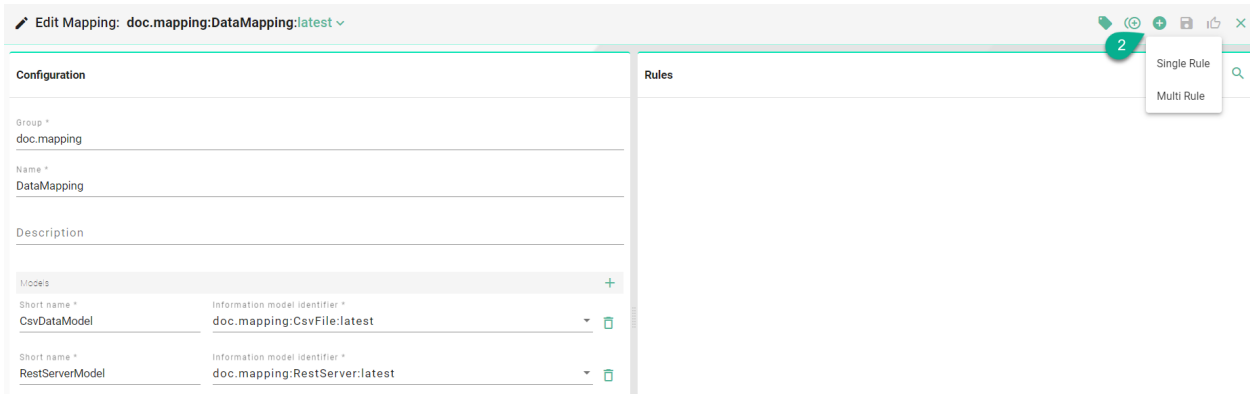
The screenshot shows the 'Mappings' list view. The table contains the following data:

Group ↑	Name	Models	Description
doc.mapping	DataMapping	DataModel, DataModel	

An 'Edit' button (1) is located at the top right of the table row.

- Select the “Add Rule” button at the top right corner (2).
- Two options are available:
  - Single Rule
  - Multi Rule

**Note:** Make sure to select **single rule** if you want to build up a rule using the code editor!

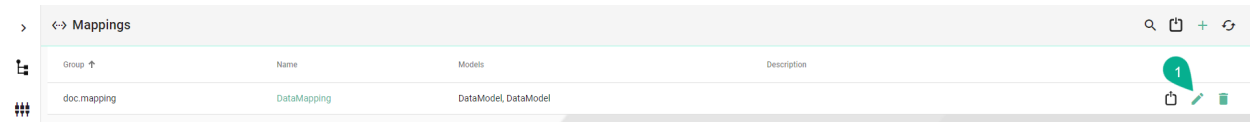


## Graphical

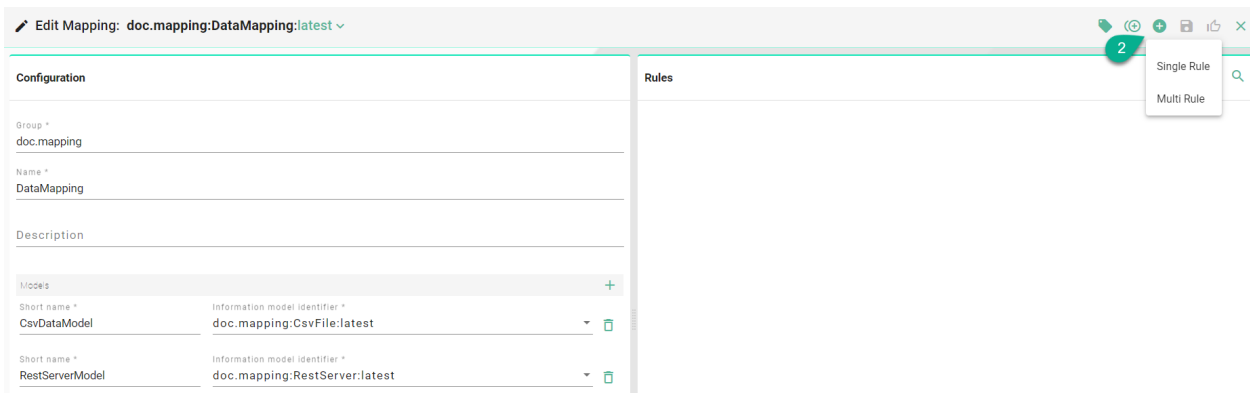
### How to create a Rule

Follow the steps described below to create *Rules*:

- Select the “Edit” button (1).



- Select the “Add Rule” button at the top right corner (2).
- Two options are available:
  - Single Rule
  - Multi Rule

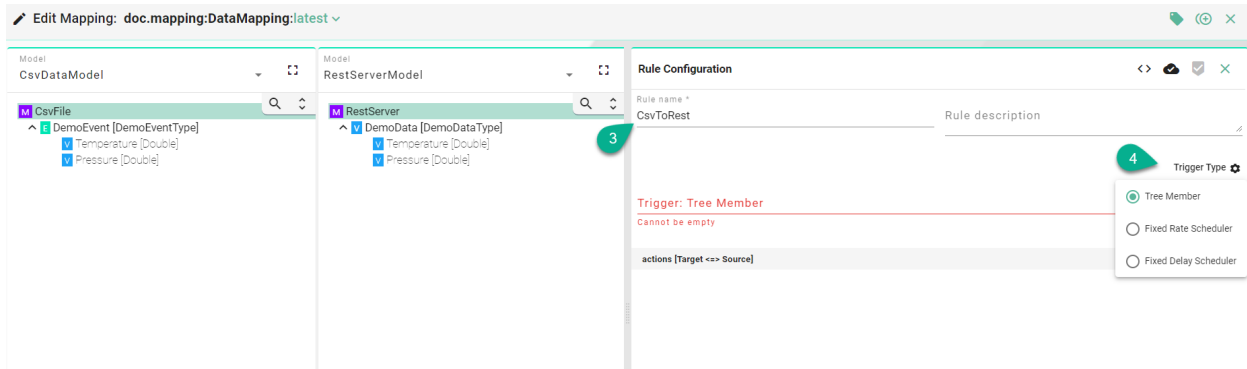


## Single Rule

- The following screenshot shows the Single Rule Editor. The Rule contains the following components: Name, Trigger and the Action with it's Source to Target assignments.

**Note:** The Single Rule includes only one Trigger.

- Enter “Rule name” (3).

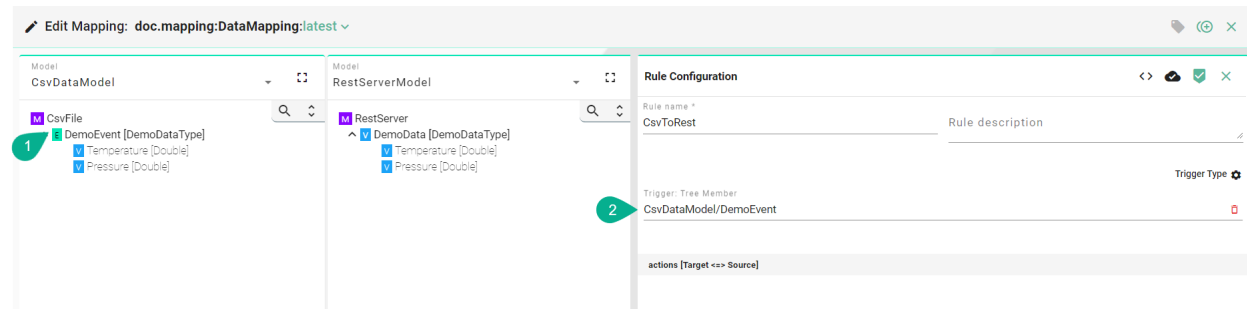


- Select the “Trigger Type” (4):
  - Tree Member - rule with an Information Model tree member as trigger
  - Fixed Rate Scheduler - rule with a time based trigger, using a Cron Expression
  - Fixed Delay Scheduler - rule based on a scheduled delay

## Trigger Types

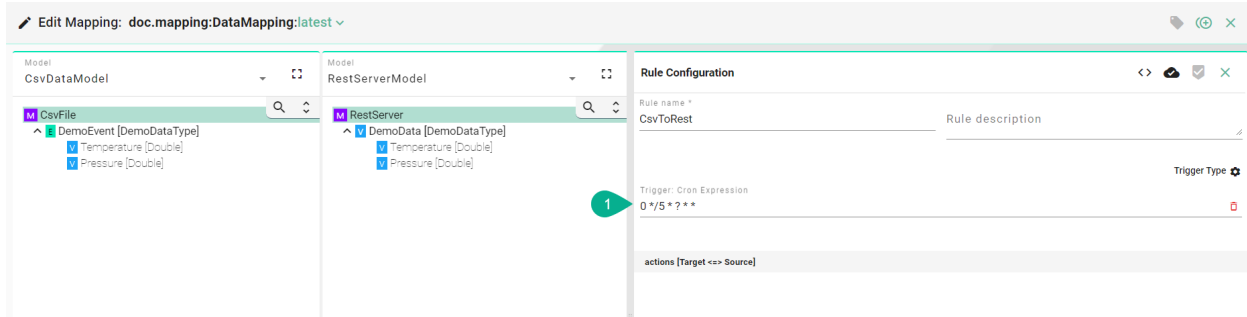
### Tree Member

- Drag and drop the *Trigger* from the model panes (1) into the trigger field (2).



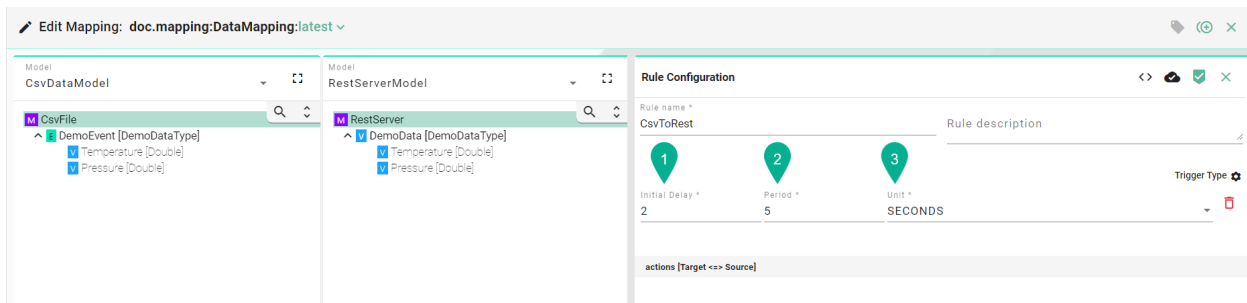
## Fixed Rate Scheduler

- Input a “Cron Expression” (1) to set the time based trigger. (E.g., `0 */5 * ? * *` meaning the trigger is set at every 5 minutes).



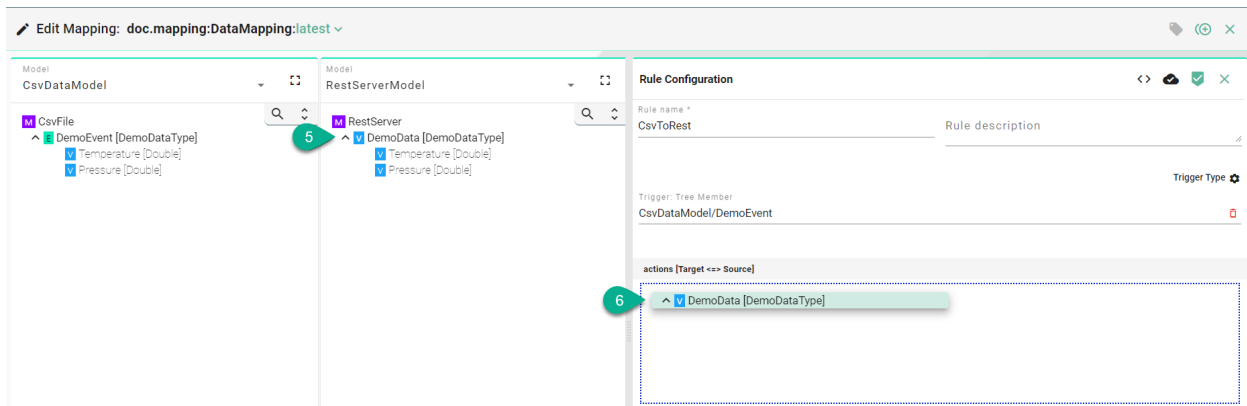
## Fixed Delay Scheduler

- Input the trigger “Initial start Delay” (1), the “Period” delay (2) and the “Unit” (3).



## Actions

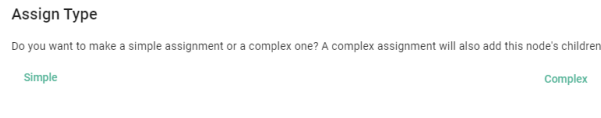
- Drag and drop the *Target* Information Model node (5) into the Target field (6).



A popup appears to select the assignment type:

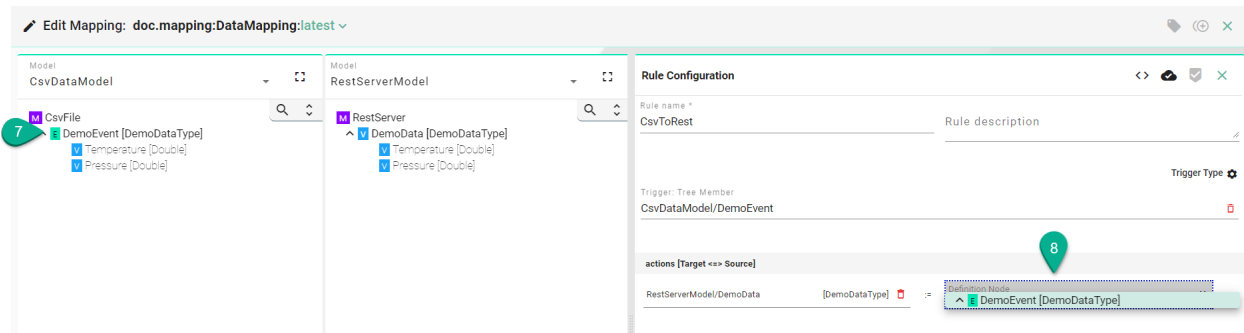
- Simple - the assignment is made at the Information Model node level

- Complex - the assignment is made at the Information Model node children's level



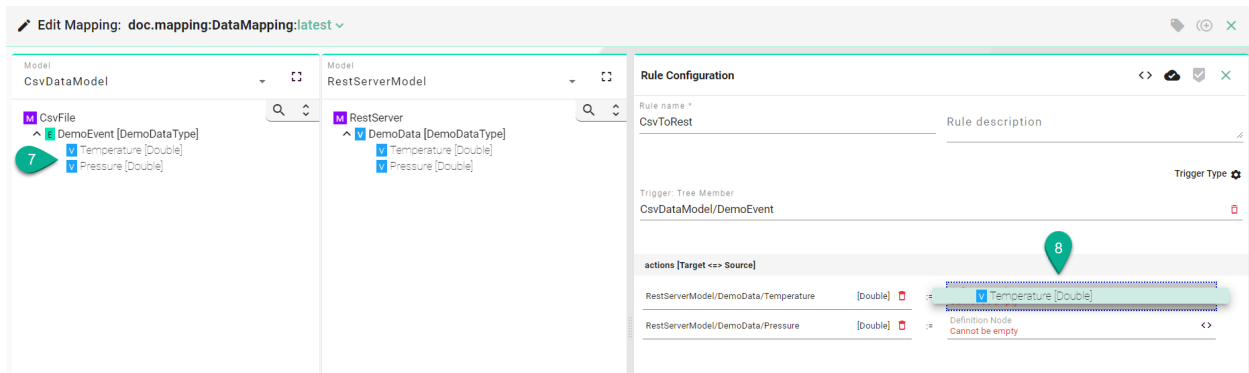
## Simple Assignment

- Drag and drop the *Source* Information Model node (7) into the Source field (8). The Source and the Target node data type must be matched one on one (e.g., DemoEventType to DemoEventType).

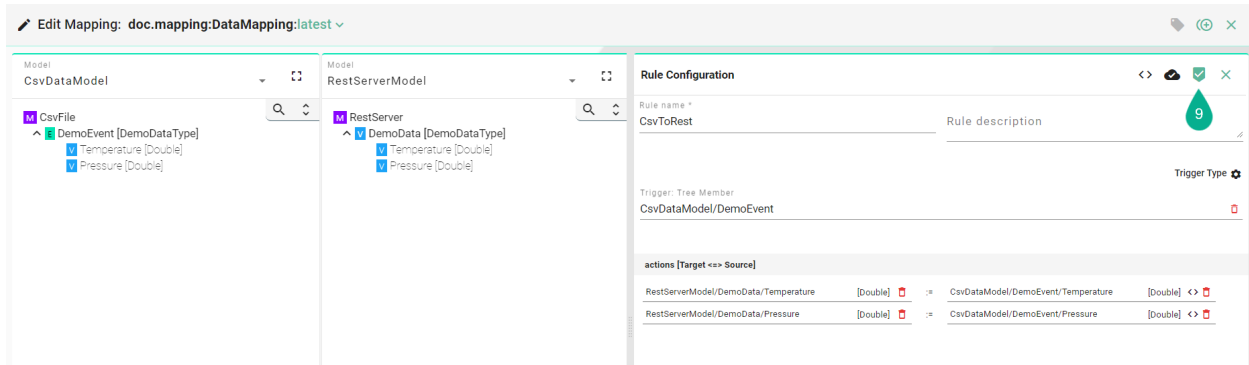


## Complex Assignment

- Drag and drop the *Source* Information Model node children's (7) one by one into the Source field (8). The Source and the Target information must be matched one on one (e.g., String to String).

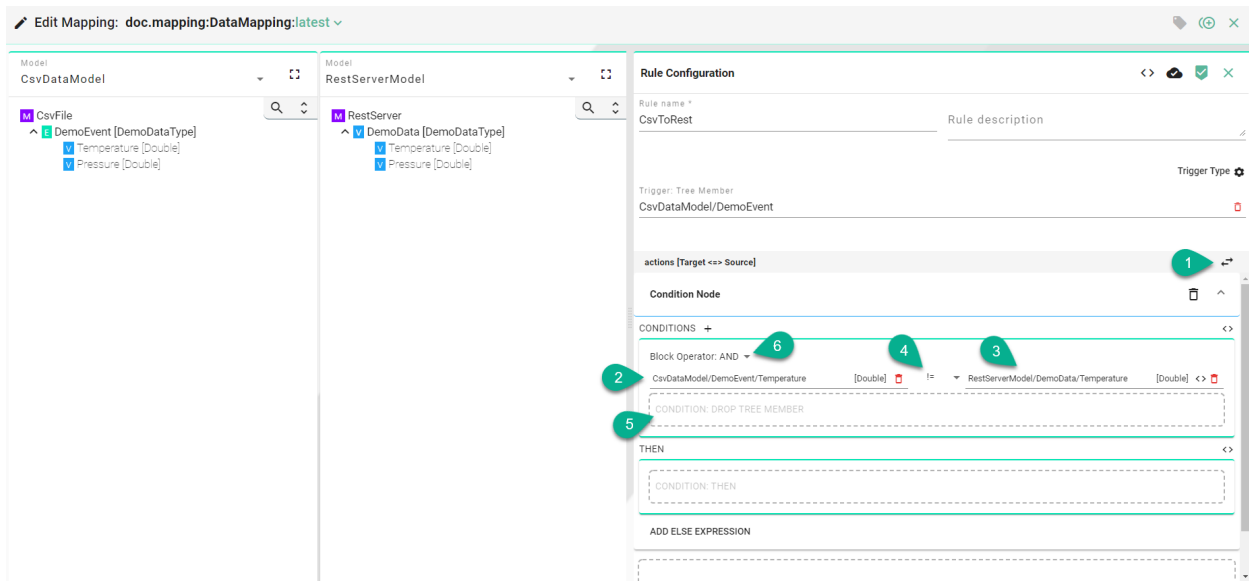


- After all mandatory fields have been filled out, select the “Apply” button (9) to save the newly created Rule.
- The Single Rule Editor is closed and the newly created Rule is displayed in the Rules List.
- Select the “Save” button placed in the upper right corner to save the Mapping.



## Actions with Conditions

- Click on the “Add condition block” button (1).
- Drag and drop a tree member (2) and (3).
- Select the condition operator (4).

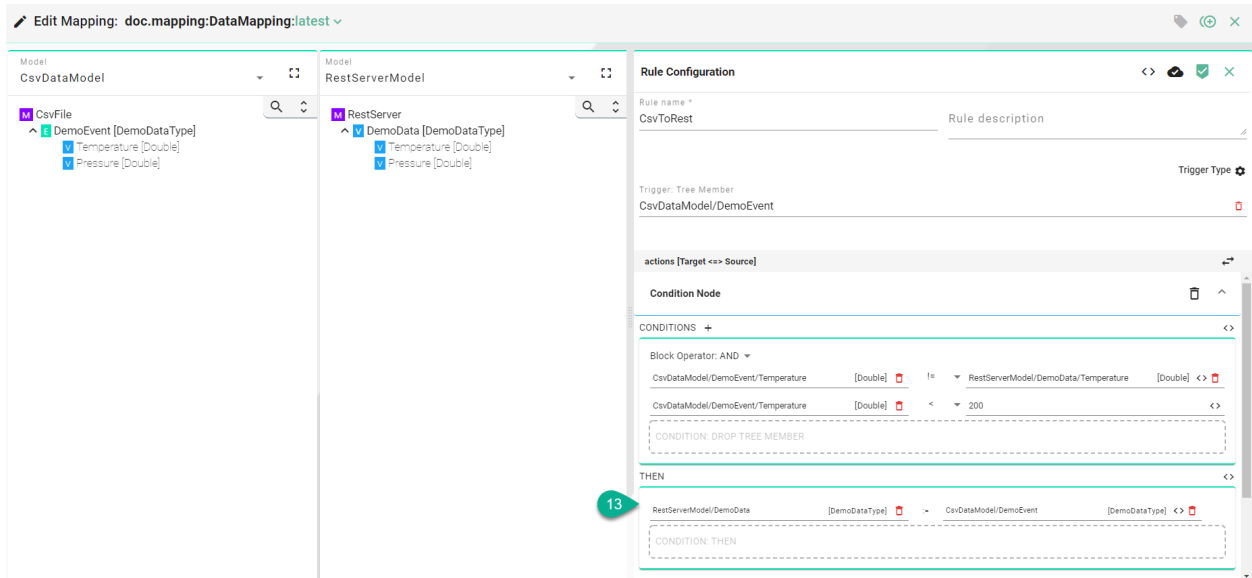


- To add multiple conditions (5) select the block operator (6).
- Click on the “Literal Node” button (7) to use as a definition node a value (e.g., Integer) instead of a tree member.
- Input a value (8).
- Select the condition operator (9).

- Click on the “Add Condition Block” button (10) to add a new one.
- Click on the “Delete Condition Block” button (11) to remove a condition block and select the “Delete” button (12) to remove the condition.

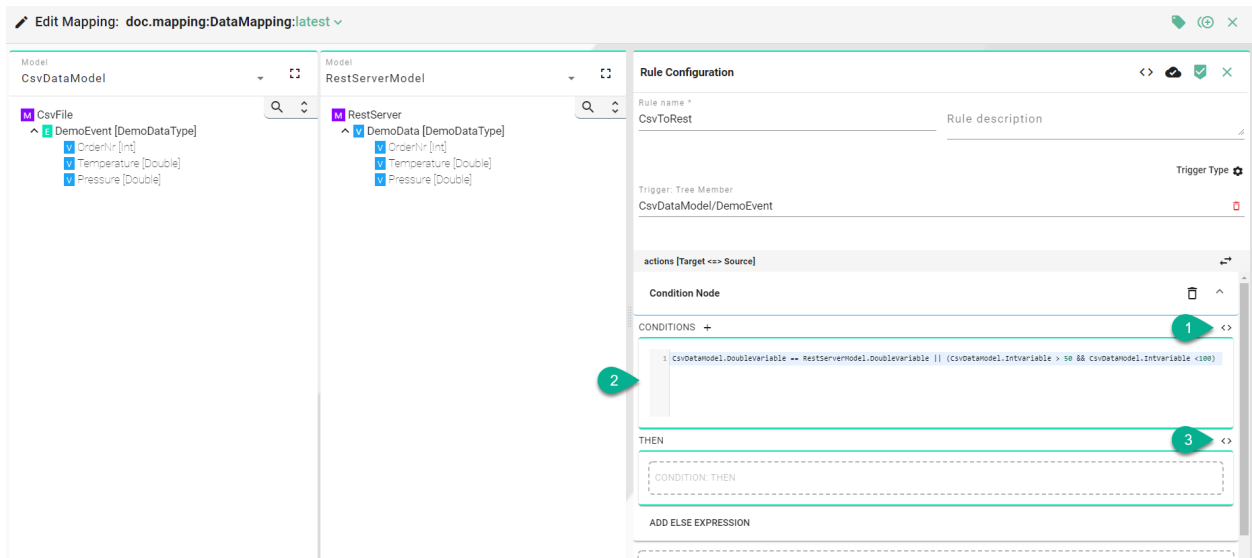
In the “THEN” (13) section, drag and drop the Target and Source Information Model nodes, using either the *simple* or the *complex* assignment.





### Actions with Custom Conditions

- Click on the “Source Code” button (1).
- Input code for a complex condition (2).



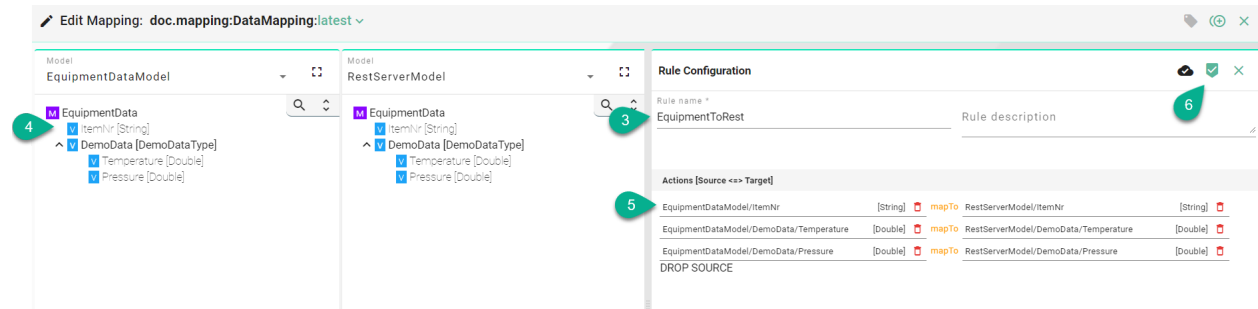
- For the “THEN” section use drag and drop or click the “Source Code” button (3) to input code.

## Multi Rule

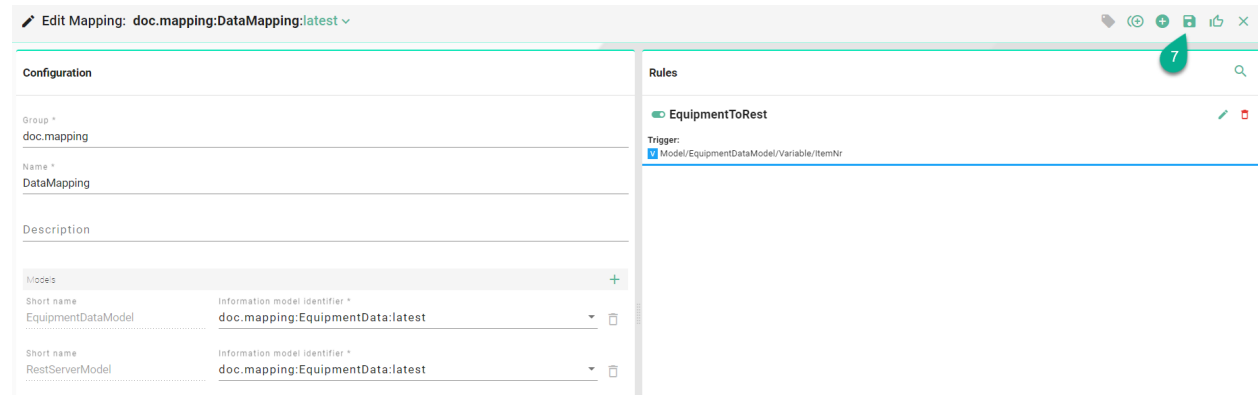
- The following screenshot shows the Multi Rule Editor. The Rule contains the following components: Name and the Actions with its Source to Target assignments.

**Note:** The Multi Rule configuration considers each Source as a Trigger.

- Enter “Rule name” (3).
- Drag and drop the *Source* Information Model nodes (4) one by one into the Source field (5).
- The Source and the Target information must be matched one on one (e.g., String to String). Allowed nodes for Source and Target: Simple Variables and Variables from a Complex Variable.
- After all mandatory fields have been filled out, select the “Apply” button (6) to save the newly created Rule.



- The Multi Rule Editor is closed and the newly created Rule is displayed in the Rules List.
- Select the “Save” button (7) placed in the upper right corner to save the Mapping.



## Code-based Rules

More complex scenarios, which are currently not supported by the graphical view can be implemented via the code editor in the [Scala](#) programming language. Similar to Mappings via drag and drop, there is no knowledge of the underlying communication protocol (e.g., MQTT, OPCUA, etc.) needed. Protocols are hidden behind the corresponding Information Models.

### Basics - Rule construct

A Rule is always starting with a *Trigger* (1). The Trigger can represent a *Variable*, an *Event* or a *Command*; within one of the selected *Information Models*. After the trigger call `mapTo` (2) and define the function body by adding curly braces (3). Depending on the Trigger declare the `TriggerInstance` (4). Depending on the type of the Trigger use the naming accordingly:

```

1 Trigger mapTo { TriggerData =>
2
3
4
5
}
```

The *Source* (5) is the content of the `TriggerInstance` (e.g., In case the Trigger is a Variable, then is the Source an Instance of that Variable) In order to assign the Source to the *Target*, add the `:=` operator (6). The Target can be any variable you want to map to (7).

```

Trigger mapTo { TriggerData =>
7 Target := Source
6
}
```

## Trigger Types

### Rule Scheduler

Rules can be scheduled to run continuously at a fixed rate. Instead of having an element of the Information Model defined as a Trigger the **fixedRateScheduler** method can be used. Therefore define the Trigger as the following: `_trigger.fixedRateScheduler(<Cron Expression>)` (line 2).

Listing 1: Scheduled Rule

```

1 def rule_ScheduleNode(): Unit = {
2   _trigger.fixedRateScheduler("0/1 * * * * ? *") mapTo(() => {
3     model1.StringVariable := model2.StringVariable
```

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```

4   })
5   }

```

## Same Type Assignments

When both target and source nodes are of the same data type the assignment of variables can be shortened:

Listing 2: Type Assignment with Events

```

1 event1 := event2

```

## Logging

Logging can be added in the Rule implementation by calling - **CommunicationLogger.log** (line 5)

Listing 3: Rule with Logging

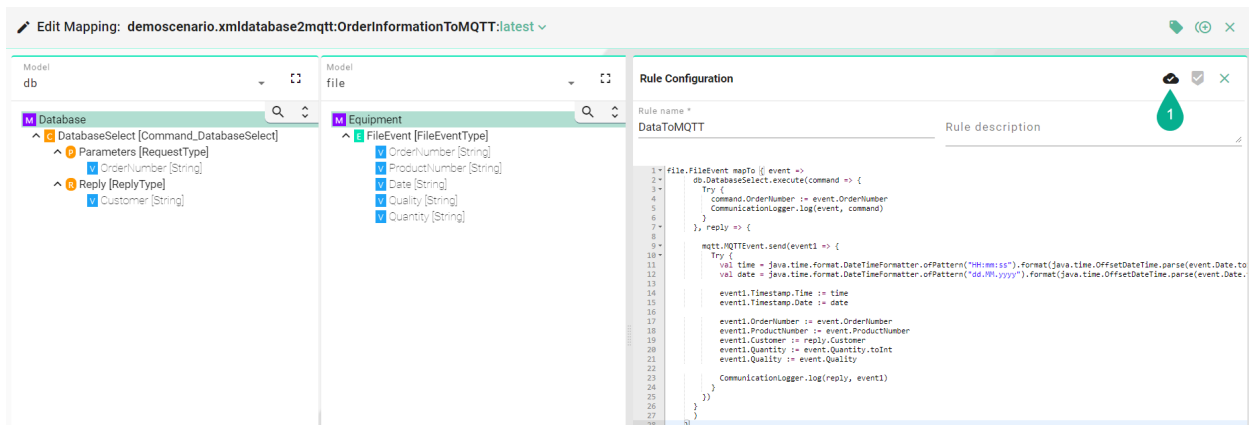
```

1 EquipmentModel.Alarm mapTo {variable =>
2   MesModel.EquipmentAlarm.send(event => {
3     Try {
4       event.EquipmentId := EnterpriseModel.EquipmentName
5       CommunicationLogger.log(variable, event)
6     }
7   })
8 }

```

## Compiling

You can compile the code for the selected Rule by clicking the “Compile” button (1) and check for compilation errors before saving the Rule.



## Examples

### Variable to Event Mapping

In this case the mapping of the Complex Variable *CurrentOrder* in the *EquipmentModel* and of a Simple Variable in the *EnterpriseModel* to the *EquipmentNewOrderStart* Event in the *MesModel* is described.

- Trigger: **EquipmentModel.StartNewOrderFlag** (line 1)
- TriggerInstance of **EquipmentModel.Alarm**: **variable** (line 1)
- Since values are assigned to an Event, call the function - *send*, on the *EquipmentNewOrderStartEvent* (line 2) and define the TriggerInstance - **event** (line 2).
- The Targets are defined by entering the path of the variables in the event - **event.EquipmentId** (line 4).

Listing 4: Rule - StartOrder - Variable/Event

```

1 EquipmentModel.Alarm mapTo {variable =>
2   MesModel.EquipmentAlarm.send(event => {
3     Try {
4       event.EquipmentId := EnterpriseModel.EquipmentName
5       event.OrderNr := EquipmentModel.CurrentOrder.OrderNr
6       event.MaterialID := EquipmentModel.CurrentMaterialID
7       event.AlarmInfo := EquipmentModel.AlarmInfo
8       CommunicationLogger.log(variable, event)
9     }
10  })
11 }
```

### Event to Variable Mapping

In this case the mapping of values inside the *TransferNewOrder* Event from the *MesModel* into variables from the *EquipmentModel* is described.

- The Trigger is defined by entering the path of the Event - **MesModel.TransferNewOrder** (line 1). Since an Event is used as Trigger, the TriggerInstance is named accordingly - **event** (line 1).
- In the function body provide the Complex Variable *NewOrder* and the Simple Variable *NewMESOrderFlag* with data from the *MesModels TransferNewOrder* Event.
- Targets are defined by entering the path of the variables like - **EquipmentModel.NewOrder.OrderNr** (line 3).
- In order to assign values to *OrderNr*, *MaterialNr* and *Quantity* of the Complex Variable *NewOrder*, enter the TriggerInstance event followed by the variable name of the *TransferNewOrder* Event - **event.OrderNr** (line 3).

- In this case it is also possible to provide the variable *NewMesOrderFlag* with a Boolean like - **true** (line 6).

Listing 5: Rule - TransferNewOrder - Event/Variable

```

1 MesModel.TransferNewOrder mapTo { event =>
2   Try {
3     EquipmentModel.NewOrder.OrderNr := event.OrderNr
4     EquipmentModel.NewOrder.MaterialNr := event.MaterialNr
5     EquipmentModel.NewOrder.Quantity := event.Quantity
6     EquipmentModel.NewMESOrderFlag := true
7   }
8 }

```

## Commands Mapping

The following scenario describes a Rule mapping incoming data from a file to *MQTT*. When the *FileEvent* is triggered - the rule executes first the *DatabaseCommand* to retrieve data from a database.

- Trigger is defined by entering the path of the Event - **file.FileEvent** (line 1). Since an Event is used as Trigger, the TriggerInstance should be named accordingly - **event** (line 1).
- Inside the function body execute a Command. The execution of a Command is defined by entering the path of the Command. At the end of the path, call the **execute** function (line 2). The TriggerInstance is named accordingly - **command** (line 4).
- The lines 4-6 show the first part of the Command. Here assign values from the source model to the Command Parameters.
- Since every Command has a Reply, we need to define the reply section - (line 8).
- In this case send out the data over MQTT after the data is retrieved from the database. In the reply function body, enter the path of the *MqttEvent*. Since this is the 2nd Event, the TriggerInstance can be named - **event1** (line 1).
- Inside the function body assign values from the *FileEvent* (line 11-13) as well as from the Reply (line 14-15) to the *MqttEvent*.

Listing 6: Rule - File2MqttWithDB - Event/Commands

```

1 file.FileEvent mapTo {event =>
2   database.DatabaseCommand.execute(command => {
3     Try {
4       command.orderNr := event.orderNr
5       command.materialNr := event.materialNr
6       CommunicationLogger.log(event, command)
7     }
8   }, reply => {

```

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```
9      mqtt.MqttEvent.send(event1 => {
10          Try {
11              event1.Quality := event.quality
12              event1.OrderNr := event.orderNr
13              event1.MaterialNr := event.materialNr
14              event1.Customer := reply.customer
15              event1.Product := reply.product
16              CommunicationLogger.log(reply, event1)
17          }
18      })
19  })
20 }
```

### Mapping with Lists

The following scenario describes a Rule that is mapping incoming data from a file to MQTT. The MQTT Model contains a List called *DataList*. **Note** that lists can only be mapped in the code view.

- Create a variable *listItem* that holds a reference of a *newItem* in the *DataList* (line 6)
- Call the variable from the *listItem* and assign the value from the file event (line 8)

Listing 7: Rule - FileToMQTT - Lists

```

1 csv.FileEvent mapTo { event =>
2
3     event.items.foreach { item =>
4         mqtt.MqttEvent.send(event1 => {
5             Try {
6                 val listItem = event1.DataList.newItem
7
8                 listItem.Timestamp := item.Timestamp
9                 listItem.Pressure := item.Alarmlevel
10
11                CommunicationLogger.log(event, event1)
12            }
13        })
14    }
15 }

```

## Target Source Combinations

A Rule is defined by its elements: Trigger, Target and Source. Each element is a *node* assigned from an *Information Model*.

The possible combinations between Target and Source are independent of the Trigger Type. There are two kinds of assignments:

### Simple

When Source and Target are of the same *data type* they can be directly assigned to one another.

### Sample Assignments:

The screenshot shows the 'Edit Mapping' interface for a rule named 'Simple'. On the left, two models, 'm1' and 'm2', are displayed. Both models have a tree view of nodes, with 'E2EEvent' selected in both. Red circles with numbers 1 and 2 highlight the 'E2EEvent' nodes in the models. On the right, the 'Rule Configuration' panel shows a 'Simple' rule with a trigger 'm1/E2EEvent' and an action 'm2/E2EEvent'. Red circles with numbers 1 and 2 highlight the 'E2EEvent' nodes in the action configuration.

Based on the combinations of a Rule elements, all the scenarios are listed in the table below.

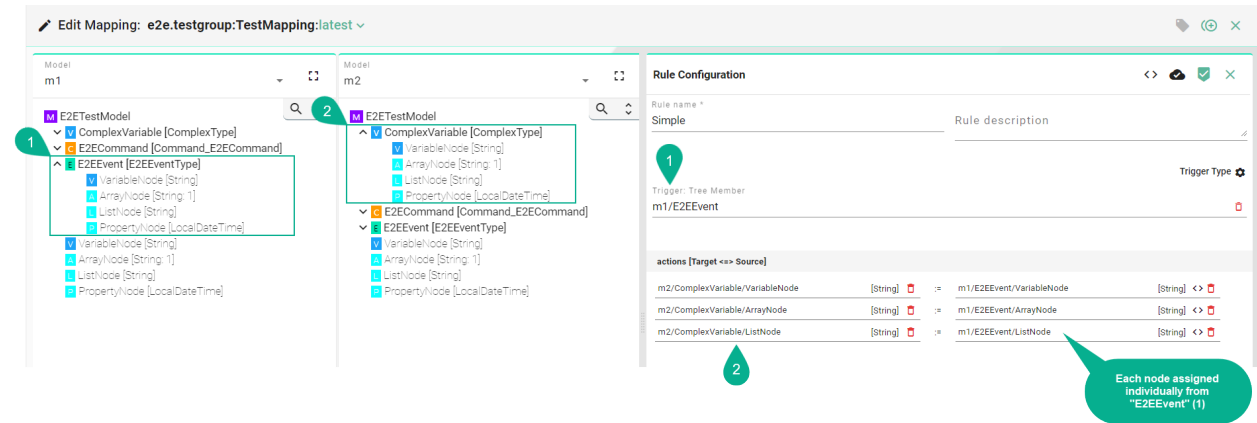


Trigger	Target	Source
Any Source <i>node</i>	Any Target <i>node</i>	Any Source <i>node</i>
Fixed Rate Scheduler		
Fixed Delay Scheduler		

### Complex

When Source and Target differ in the *data type* their children *nodes* have to be assigned individually.

### Sample Assignments:



Based on the combinations of a Rule elements, all the scenarios are listed in the table below.

Trigger	Target	Source
Variable of a custom type	Variable	Variable
		Variable of a custom type
		List
		Array
	Custom type Variable	Variable
		Variable of a custom type
		List
		Array
	Variable of a custom type	Variable
		Variable of a custom type
		List
		Array
Event	Variable	
	Variable of a custom type	
	List	
	Array	
Command	Variable	
	Variable of a custom type	
	List	

continues on next page

Table 2 – continued from previous page

Trigger	Target	Source	
	List	Array	
		Variable	
		Variable of a custom type	
		List	
	Array	Array	
		Variable	
		Variable of a custom type	
		List	
	Variable	Variable	Variable
			Variable of a custom type
			List
			Array
Custom type Variable		Variable	
		Variable of a custom type	
		List	
		Array	
Variable of a custom type		Variable	
		Variable of a custom type	
		List	
		Array	
Event		Variable	
		Variable of a custom type	
		List	
		Array	
Command		Variable	
		Variable of a custom type	
		List	
		Array	
List		Variable	
		Variable of a custom type	
		List	
		Array	
Array		Variable	
		Variable of a custom type	
		List	
		Array	
Property of a custom type	Variable	Variable	
		Variable of a custom type	
		List	
		Array	
	Custom type Variable	Variable	
		Variable of a custom type	
		List	
		Array	

continues on next page

Table 2 – continued from previous page

Trigger	Target	Source
	Variable of a custom type	Variable
		Variable of a custom type
		List
		Array
	Event	Variable
		Variable of a custom type
		List
		Array
	Command	Variable
		Variable of a custom type
		List
		Array
	List	Variable
		Variable of a custom type
		List
		Array
Array	Variable	
	Variable of a custom type	
	List	
	Array	
Property	Variable	Variable
		Variable of a custom type
		List
		Array
	Custom type Variable	Variable
		Variable of a custom type
		List
		Array
	Variable of a custom type	Variable
		Variable of a custom type
		List
		Array
	Event	Variable
		Variable of a custom type
		List
		Array
	Command	Variable
		Variable of a custom type
		List
		Array
	List	Variable
		Variable of a custom type
		List
		Array
	Array	Variable

continues on next page

Table 2 – continued from previous page

Trigger	Target	Source	
Command		Variable of a custom type	
		List	
		Array	
	Variable	Variable	Variable
			Variable of a custom type
			Variable of a Command
			List
			Array
		Custom type Variable	Variable
			Variable of a custom type
			Variable of a Command
			List
			Array
		Variable of a custom type	Variable
			Variable of a custom type
			Variable of a Command
			List
			Array
	Event	Event	Variable
			Variable of a custom type
			Variable of a Command
			List
			Array
	Command	Command	Variable
			Variable of a custom type
			Variable of a Command
			List
Array			
List	List	Variable	
		Variable of a custom type	
		Variable of a Command	
		List	
		Array	
Array	Array	Variable	
		Variable of a custom type	
		Variable of a Command	
		List	
		Array	
Event	Variable	Variable of a custom type	
		Variable of an Event	
		Variable	
		List	
		Array	
	Custom type Variable	Custom type Variable	Variable of a custom type
			Variable of an Event

continues on next page

Table 2 – continued from previous page

Trigger	Target	Source
		Variable
		List
		Array
	Variable of a custom type	Variable of a custom type
		Variable of an Event
		Variable
		List
		Array
	Event	Variable of a custom type
		Variable of an Event
		Variable
		List
		Array
	Command	Variable of a custom type
		Variable of an Event
		Variable
		List
		Array
	List	Variable
		Variable of a custom type
Variable of an Event		
List		
Array		
Array	Variable	
	Variable of a custom type	
	Variable of an Event	
	List	
	Array	

## 2.4 Device Types

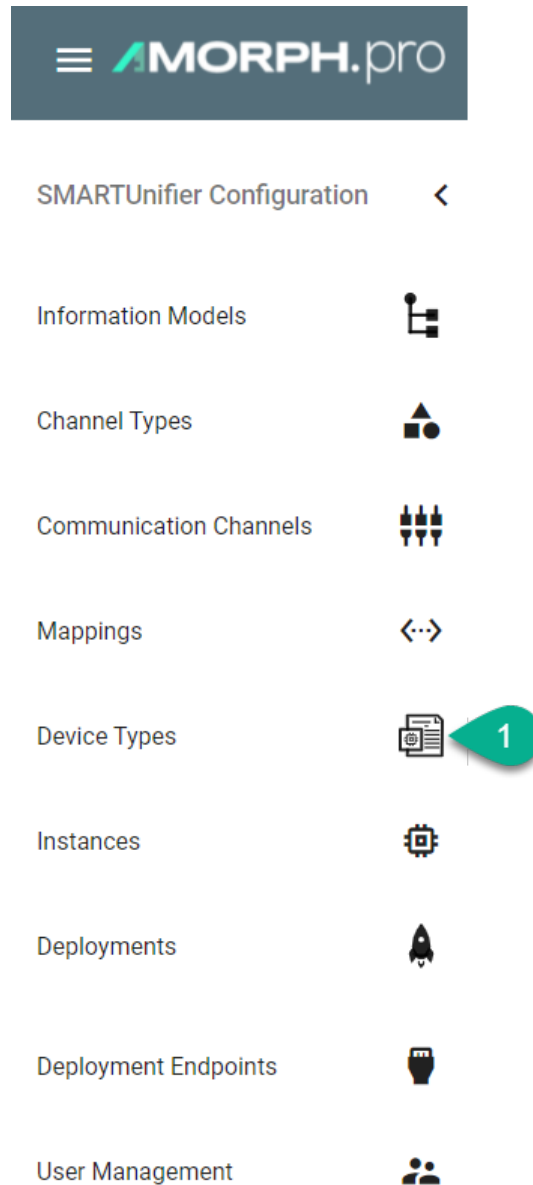
### 2.4.1 What are Device Types

With SMARTUNIFIER Device Types it is possible to have multiple Communication *Instances*, which share common configuration parameters. A Device Type contains one or multiple Mappings. Each Mapping contains one or multiple Information Models and its associated Communication Channel. Within a SMARTUNIFIER Device Type it is possible to over-write existing Communication Channel configurations. Device Types are especially important, when integrating several similar pieces of equipment or devices. In this case, the Device Type can be reused for all Instances (i.e., one instance represents one equipment).

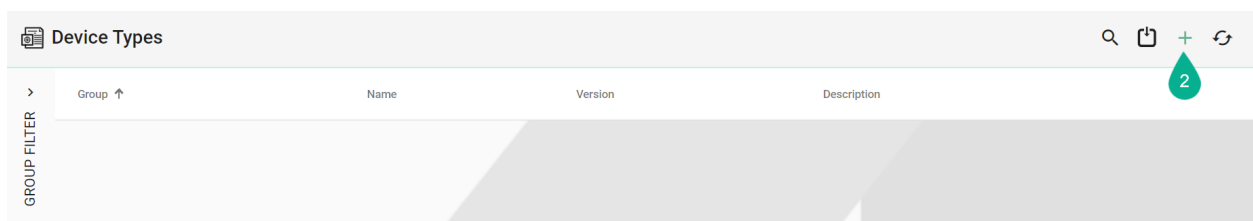
## 2.4.2 How to create a new Device Type

Follow the steps described below to create a SMARTUNIFIER Device Type.

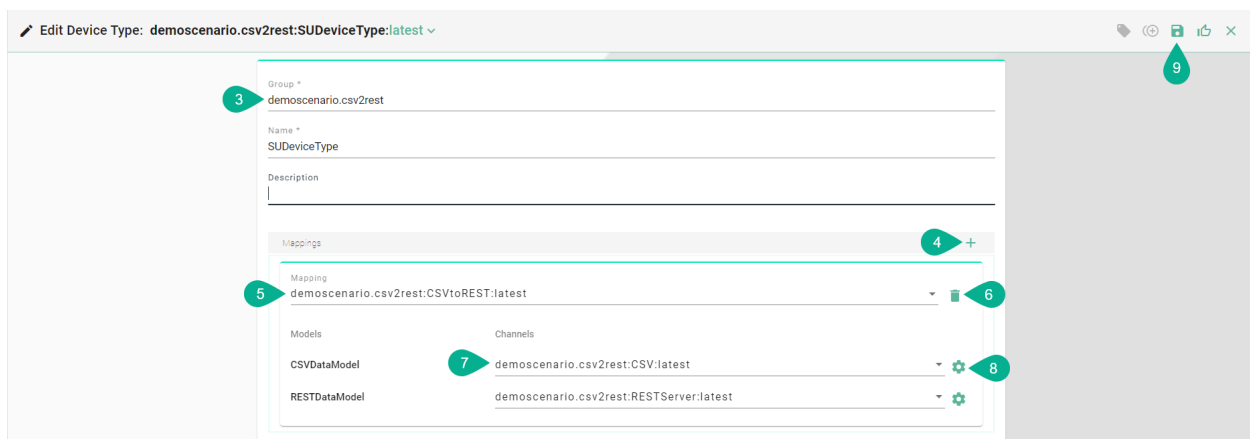
- Select the SMARTUNIFIER Device Type Perspective (1).



- Click on the “Add Device Type” button in the upper right corner (2).



- The creation of a Device Type is split up into two parts. First provide the basic information about the Device Type like the Group, the Name, and the Version. Optionally, provide a short description (3).
- In the next step provide one or multiple *Mappings* previously created. To do so click the “Add Mapping” button (4). After selecting a Mapping (5) the associated Information Models show up. In case the wrong Mapping was selected click the “Delete Mapping” button to remove the Mapping from the Device Type (6). Now select a *Communication Channel* for each *Information Model* from the Drop-Down (7).
- Similar to the Communication Channel view it is possible to change the configuration of the Channel within the Device Type view. In case of changes in the configuration click the “Configure” button (8). This action over-writes previous configurations.
- The new Device Type can be saved by clicking the “Save” button at the top right corner (9).



## 2.5 Communication Instances

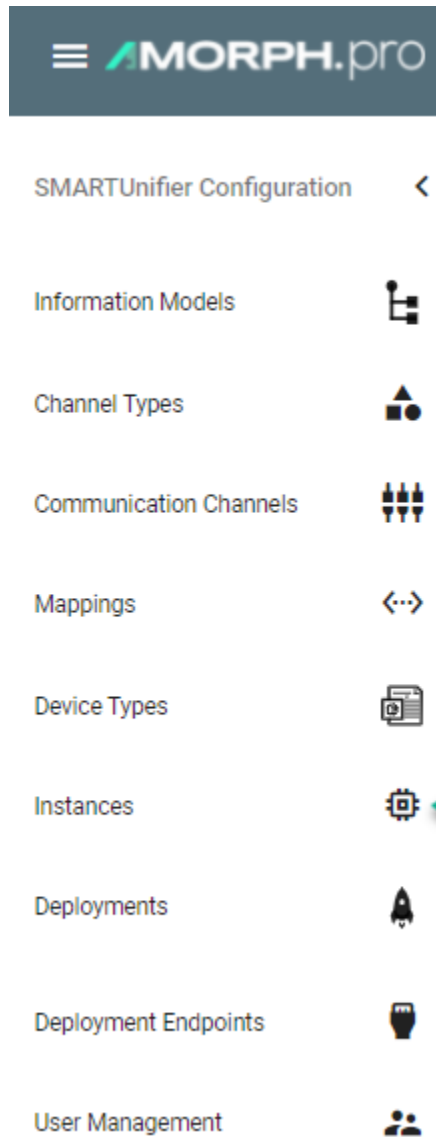
### 2.5.1 What are Instances

A SMARTUNIFIER Instance is a dynamically created application that can be deployed to any suitable IT resource (e.g., Equipment PC, Server, Cloud), and which provides the connectivity functionality configured. Therefore, a SMARTUNIFIER Instance uses one or multiple Mappings and selected Communication Channels from a previously defined *Device Type*.

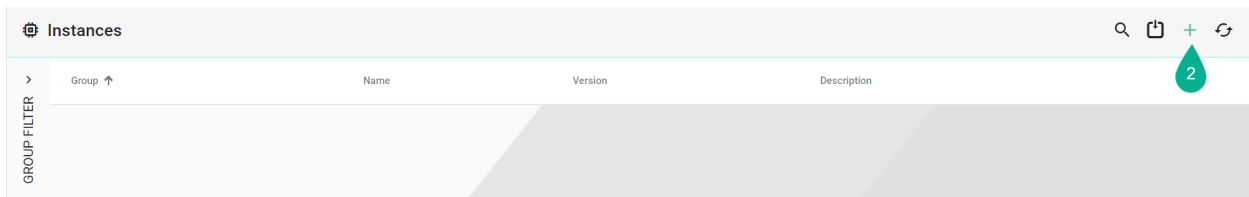
### 2.5.2 How to create a new Instance

Follow the steps described below to create a SMARTUNIFIER Instance.

- Select the SMARTUNIFIER Instances Perspective (1).



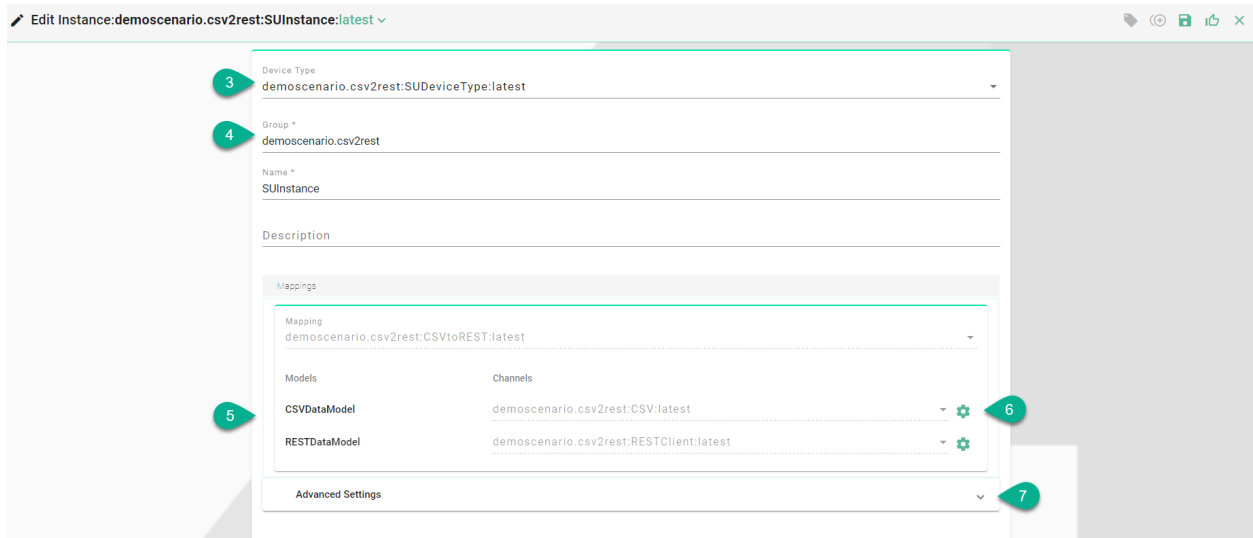
- Click on the “Add Instance” button from the upper right corner (2).



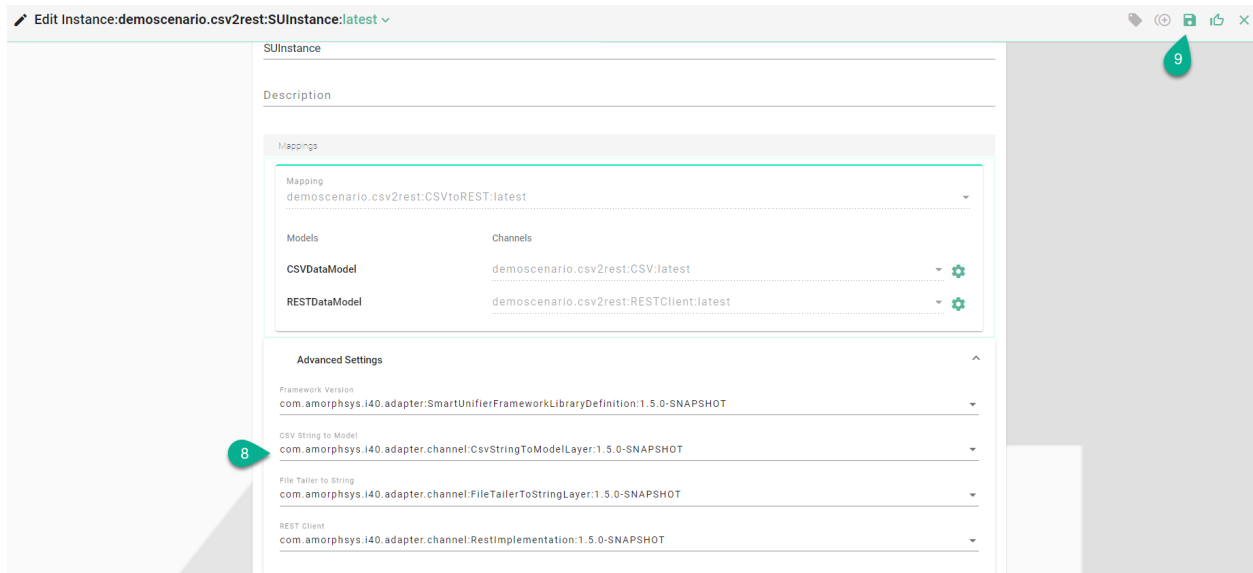
- Select a Device Type from the Drop-Down (3)
- The details for the Instance are automatically taken from the Device Type (4). However, Group, Name, Version and the Description can still be changed.
- The Mapping defined in the Device Type show up in the Mapping area (5).
- To change the existing configuration or if no configuration has been made yet, click the “Con-



figure” button (6)



- Expand the **Advanced Settings** option (7) to select the framework version (8) for the Communication Channels. Allows backwards compatibility for Communication Instances created with previous versions of SMARTUNIFIER.



- Save the SMARTUNIFIER Instance by clicking the “Save” button (9)
- In order to deploy, run and stop the Instance navigate to the *Deployment* perspective.

## CONFIGURATION COMPONENT MANAGEMENT

SMARTUNIFIER provides a comprehensive management of the configuration components:

- *Group Filter*
- *Component Version Control*
- *Operations*

In order to keep the SMARTUNIFIER configuration components organized take a look on *how to name the configuration components*.

### 3.1 Naming Convention

Each *Configuration Component* created with SMARTUNIFIER has defined a Group, a Name, and a Version.

We recommend the following naming convention for better comprehensibility.

**Group** Identifies the integration scenario across all integration scenarios within the *SMARTUNIFIER Manager*.

**Name** Is the name of each component, which is part of the integration scenario, such as: *Models, Channels, Mappings, Device Types, Instances* as well as *Deployment Endpoints*.

**Version** Defines the version of the component - Suggested format: 1.0.0 / 1.0.1 / 2.0.0.

### 3.2 Group Filter

With the Group Filter it is possible to restrict the number of components according to the substrings in the Group.

The Group Name contains substrings separated by a dot “.”. The Group Filter is then able to visualize the Group Names in a hierarchical structure.

The *Show All* filter enables the view of all components (1).

Group Filter	Group	Name	Description	
▼ Show All (1)				
▼ demo				
▼ scenario1				
▼ demoscenario				
▼ csv2rest				
▼ json2database				
▼ xmldatabase2mqtt				
	demoscenario.xmldatabase2mqtt	Database		🗑️ ✎️ 🗑️
	demoscenario.xmldatabase2mqtt	Equipment		🗑️ ✎️ 🗑️
	demoscenario.xmldatabase2mqtt	Host		🗑️ ✎️ 🗑️
	demoscenario.json2database	Database		🗑️ ✎️ 🗑️
	demoscenario.json2database	JSON		🗑️ ✎️ 🗑️
	demoscenario.csv2rest	CsvDataModel		🗑️ ✎️ 🗑️
	demoscenario.csv2rest	RestDataModel		🗑️ ✎️ 🗑️
	demo.scenario1	DatabaseModel		🗑️ ✎️ 🗑️
	demo	DBModel		🗑️ ✎️ 🗑️
	demo	EquipmentModel		🗑️ ✎️ 🗑️

In order to apply a filter, click one of the items in the Group Filter list (2). At the top of the table, the selected filter is visible (3).

Group Filter	Group	Name	Description	
Filtered by: csv2rest x (3)				
▼ Show All				
▼ demo				
▼ scenario1				
▼ demoscenario				
▼ csv2rest (2)				
▼ json2database				
▼ xmldatabase2mqtt				
	demoscenario.csv2rest	CsvDataModel		🗑️ ✎️ 🗑️
	demoscenario.csv2rest	RestDataModel		🗑️ ✎️ 🗑️

Removing the filter is possible by either clicking the selected item again, selecting the *Show All* option or by clicking the cross in the filter at the top of the table.

### 3.3 Component Version Control

Component Version Control enables users to version SMARTUNIFIER configuration components such as Information Models, Communication Channels, Mappings, Device Types and Communication Instances.

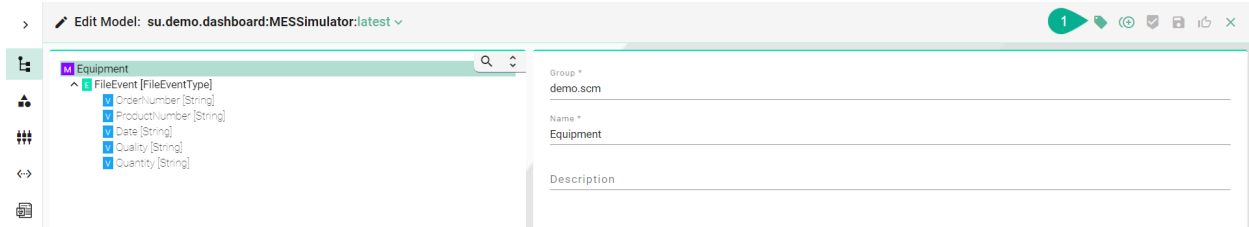
By default, SMARTUNIFIER is using the Component Version Control internally - therefore no configuration is needed. Another option is to point to an external version control system like [Gitea](#). In order to setup an external version control check out the SMARTUNIFIER Installation Guide.

**How it works:** SMARTUNIFIER creates a repository for each configuration component. Configuration components can be released using tags which reference a specific point in the Git history. After a tag has been created (equivalent to release of a configuration component) there will be no further history of commits/changes. This means that the configuration component can not be edited any further.

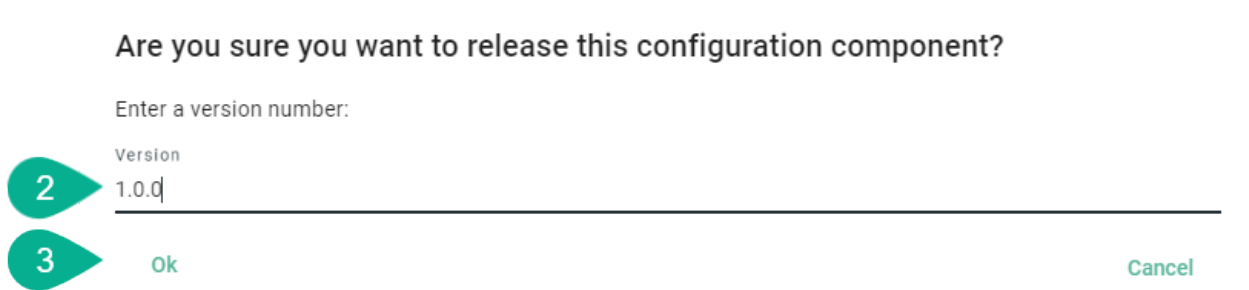
### 3.3.1 How to release configuration components

In order to release a configuration component follow the steps below:

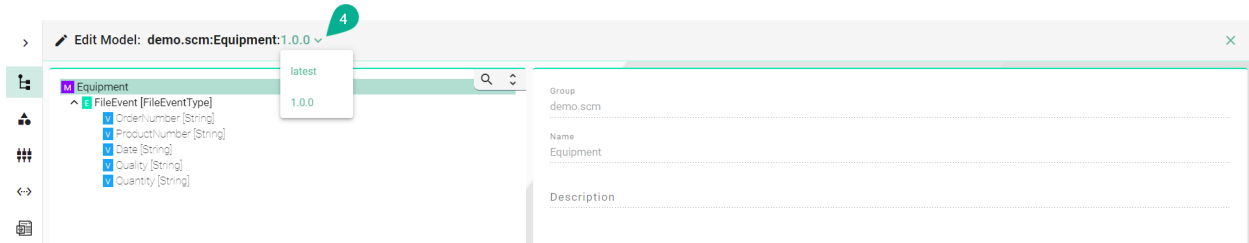
1. Go to an edit page of a configuration component and click the **release** button.



1. Enter a **version number**.
2. Click **Ok** to confirm.



4. Open the version drop-down to change between **latest** and other **tags**.



**Note:** Once a configuration component is released you can no longer edit the current tag. If changes are necessary select **latest**. Once you finished editing the final version you can repeat the release process as described above.

## 3.4 Operations

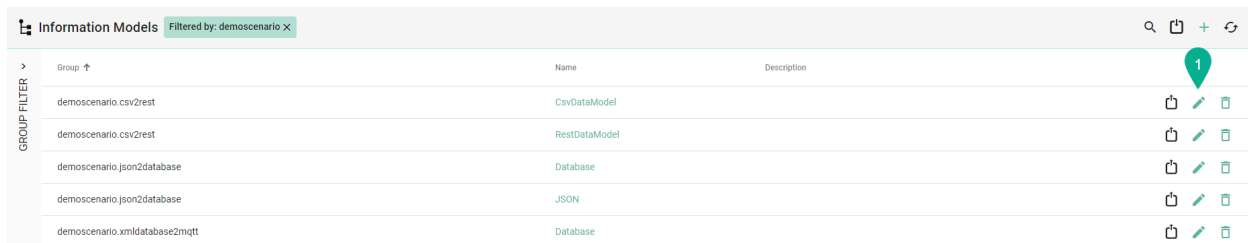
### 3.4.1 Add

The option to add/create a new component is described in the Instance Setup chapter, for each type:

- *Information Models*
- *Communication Channels*
- *Mappings*
- *Device Types*
- *Instances*
- *Deployments*
- *Deployment Endpoints*

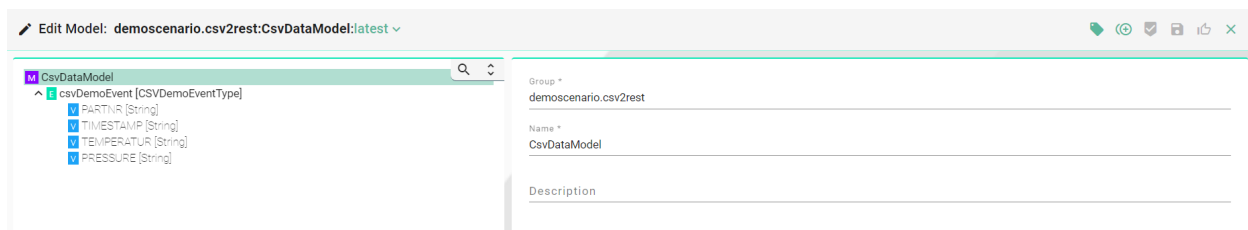
### 3.4.2 Edit

A component can be edited by clicking the **Edit** button (1).



GROUP FILTER	Group ↑	Name	Description	
	demoscenario.csv2rest	CsvDataModel		📄 ✎ 🗑️
	demoscenario.csv2rest	RestDataModel		📄 ✎ 🗑️
	demoscenario.json2database	Database		📄 ✎ 🗑️
	demoscenario.json2database	JSON		📄 ✎ 🗑️
	demoscenario.xml2database2mqtt	Database		📄 ✎ 🗑️

The component is opened in the edit mode.



Edit Model: demoscenario.csv2rest:CsvDataModel:latest

Group \*  
demoscenario.csv2rest

Name \*  
CsvDataModel

Description

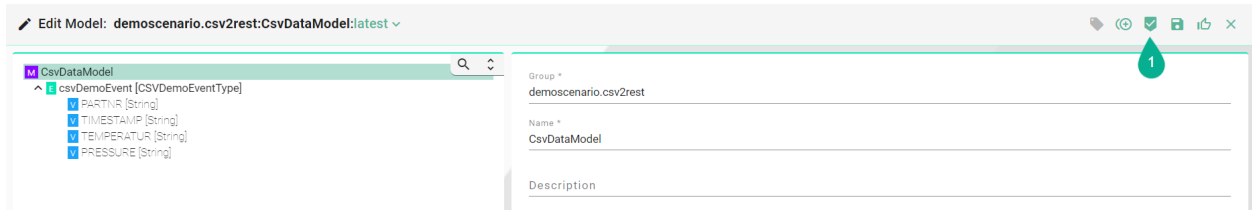
In the edit mode, the following operations are available:

- Clone
- Apply
- Save
- Save and Close

- Close

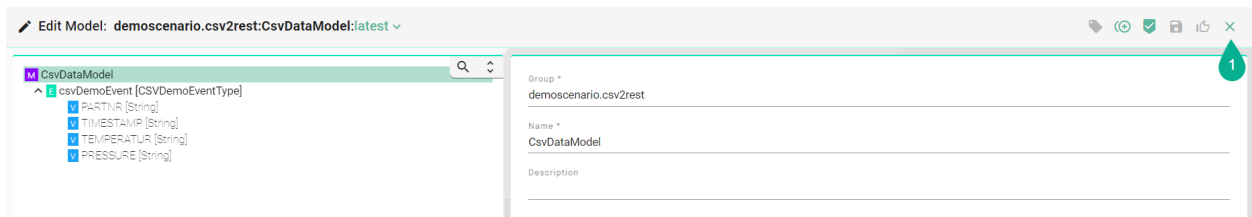
### 3.4.3 Apply

In the edit mode, after a new data input the **Apply** button (1) must be selected to validate/compile data.



### 3.4.4 Exit Editing

The user can exit the edit mode by clicking on the **Close** button (1).



If the data is not saved, a pop-up appears and the user can select the **Cancel** button (2) to return to the edit mode and save the data or select the **Leave** button (3) to exit without saving.

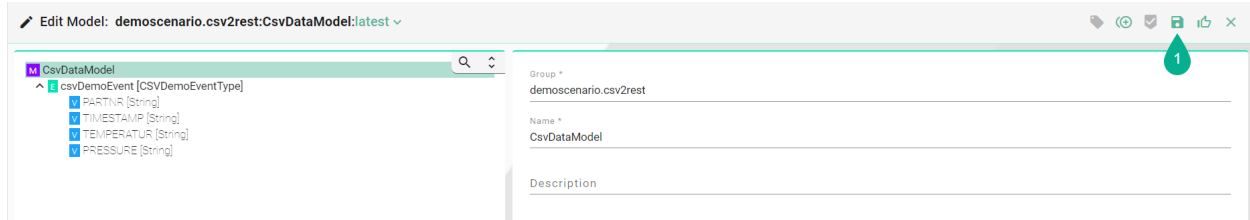
## Unsaved data

There are unsaved changes on this page. Are you sure you want to leave?

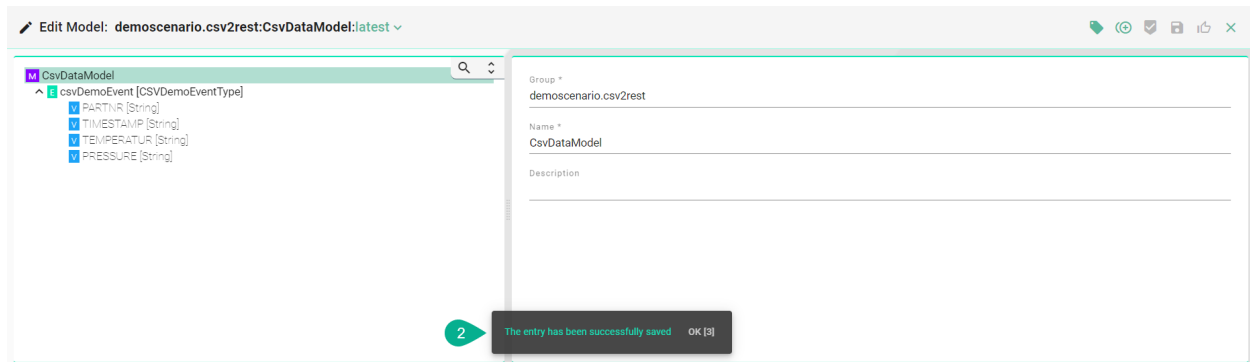


### 3.4.5 Save

In the Edit Mode, after applying the input data, the user can save the changes by clicking on the **Save** button (1).

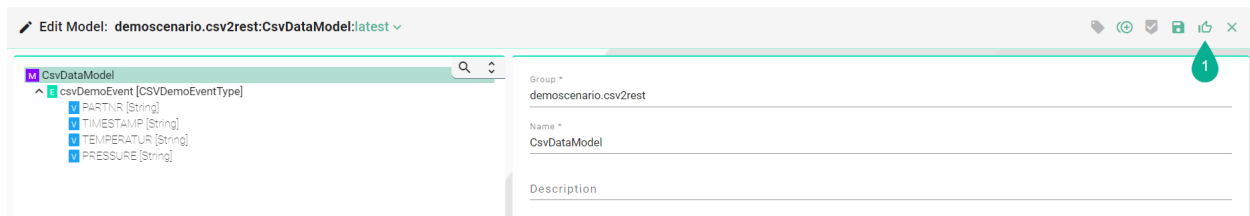


A confirmation message appears (2). The edit mode remains active.



### 3.4.6 Save and Close

When editing a component, after applying the input data, the user can save the changes and exit the edit mode by clicking on the **Save and Close** button (1).



A confirmation message appears (2). The view mode is active.

Information Models Filtered by: demoscenario x

Group	Name	Description	
demoscenario.csv2rest	CsvDataModel		
demoscenario.csv2rest	RestDataModel		
demoscenario.json2database	Database		
demoscenario.json2database	JSON		
demoscenario.xmldatabase2mqtt	Database		
demoscenario.xmldatabase2mqtt	Equipment		
demoscenario.xmldatabase2mqtt	Host		

The entry has been successfully saved OK [1]

### 3.4.7 Search

The Search option allows the user to filter results by different criteria:

- Name
- Version
- Description

The search is not key sensitive and it works as a partial search, displaying all the results matching with the searched characters.

To search for a component, select the **Search** button (1) from the upper right corner.

Information Models

Group Filter	Group	Name	Description	
Show All	demoscenario.xmldatabase2mqtt	Database		
demo	demoscenario.xmldatabase2mqtt	Equipment		
scenario1	demoscenario.xmldatabase2mqtt	Host		

Enter a search term (2).

CSV

Group Filter	Group	Name	Description	
Show All	demoscenario.csv2rest	CsvDataModel		
demo	demoscenario.csv2rest	RestDataModel		

To cancel the search click on the **Close Search** button (3).

CSV

Group Filter	Group	Name	Description	
Show All	demoscenario.csv2rest	CsvDataModel		
demo	demoscenario.csv2rest	RestDataModel		



### 3.4.8 Sort

The information in the view mode can be sorted ascending or descending for each column:

- Group
- Name
- Version
- Description

To sort the information from a column click on the column header (1). An arrow icon will indicate if the components are sorted ascending or descending.

Group Filter	Group	Name ↑	Description	
▼ Show All				
▼ demo				
▼ scenario1				
▼ demoscenario				
▼ csv2rest	demoscenario.csv2rest	CsvDataModel		🗑️ ✎️ 📄
▼ json2database	demoscenario.json2database	Database		🗑️ ✎️ 📄
▼ xmlidatabase2mqtt	demoscenario.xmlidatabase2mqtt	Database		🗑️ ✎️ 📄
▼ xmlidatabase2mqtt	demoscenario.xmlidatabase2mqtt	Equipment		🗑️ ✎️ 📄
▼ xmlidatabase2mqtt	demoscenario.xmlidatabase2mqtt	Host		🗑️ ✎️ 📄
▼ json2database	demoscenario.json2database	JSON		🗑️ ✎️ 📄
▼ csv2rest	demoscenario.csv2rest	RestDataModel		🗑️ ✎️ 📄

In the view mode on the right of each component, the following operations are available:

- Export
- Edit
- Delete

### 3.4.9 Reload

This option reloads the components from the repository by selecting the **Reload** button (1) from the upper right.

Group Filter	Group ↓	Name	Description	
▼ Show All				
▼ demo				
▼ scenario1				
▼ demoscenario				
▼ csv2rest	demoscenario.xmlidatabase2mqtt	Database		🗑️ ✎️ 📄
▼ json2database	demoscenario.xmlidatabase2mqtt	Equipment		🗑️ ✎️ 📄
▼ xmlidatabase2mqtt	demoscenario.xmlidatabase2mqtt	Host		🗑️ ✎️ 📄

### 3.4.10 Import

This option allows the user to add to the scenario a new created or an exported component.

Before importing an exported component, open the JSON file and delete the component **id** (1) - when importing the database will generate a universally unique identifier (uuid). Also, copy (2) and paste (3) the **version** in the **info** section, as shown bellow.



```

1  {
2    "info": {
3      "identifier": {
4        "id": "8b6bc3f2-192d-4870-8bad-b7c2f5e191b9",
5        "version": "latest"
6      },
7      "externalIdentifier": {
8        "name": "CsvDataModel",
9        "group": "demoscenario.csv2rest"
10     },
11     "externalDescriptor": {
12       "description": ""
13     }
14   },
15   "members": [{
16     "id": "csvDemoEvent",
17     "description": "",
18     "definitionType": "Event",
19     "typeName": "CSVDemoEventType"
20   }
21 ],
22   "types": {
23     "CSVDemoEventType": {
24       "id": "CSVDemoEventType",
25       "members": [{
26         "id": "PARTNR",
27         "description": "",
28         "definitionType": "Variable",
29         "typeName": "String"
30       }, {
31         "id": "TIMESTAMP",
32         "description": "",
33         "definitionType": "Variable",
34         "typeName": "String"
35       }, {
36         "id": "TEMPERATUR",
37         "description": "",
38         "definitionType": "Variable",
39         "typeName": "String"
40       }, {
41         "id": "PRESSURE",
42         "description": "",
43         "definitionType": "Variable",
44         "typeName": "String"
45       }
46     ],
47     "category": "model",
48     "type": "StructuredVariable"
49   }
50 },
51 "rawModelString": "",
52 "ignoreCompileErrors": false
53 }

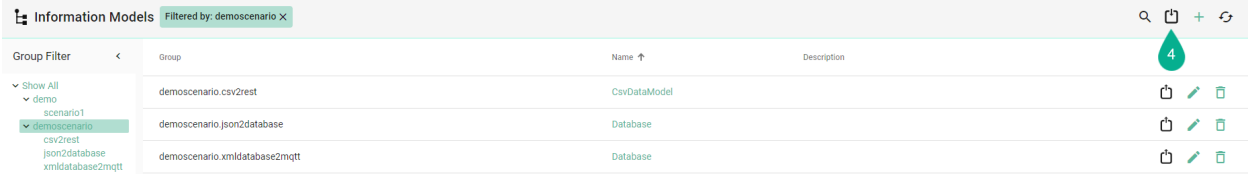
```

```

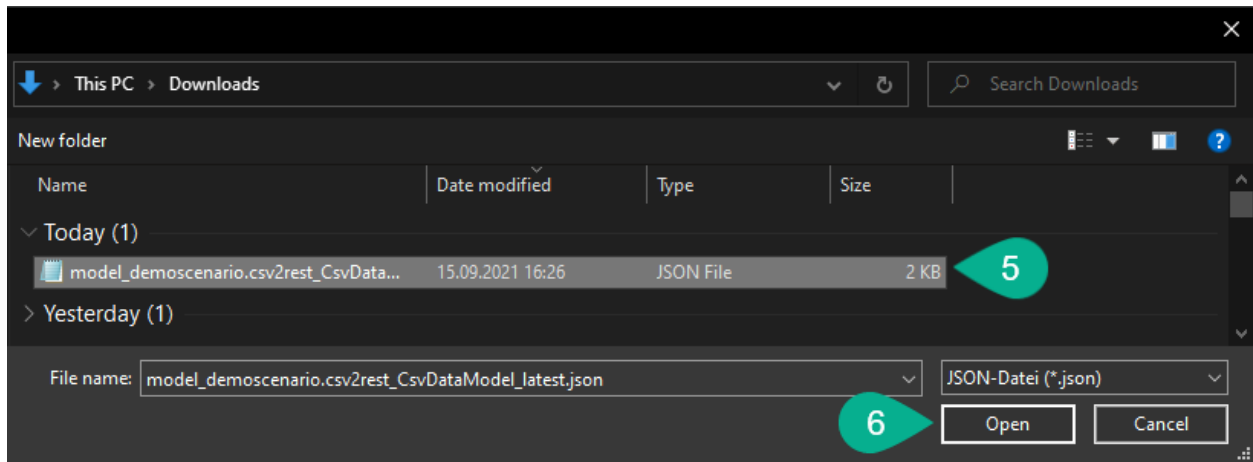
1  {
2    "info": {
3      "identifier": {
4        "id": "",
5        "version": "latest"
6      },
7      "externalIdentifier": {
8        "name": "CsvDataModel2",
9        "group": "demoscenario.csv2rest"
10     },
11     "externalDescriptor": {
12       "description": " "
13     },
14     "version": "latest"
15   },
16   "members": [{
17     "id": "csvDemoEvent",
18     "description": "",
19     "definitionType": "Event",
20     "typeName": "CSVDemoEventType"
21   }
22 ],
23   "types": {
24     "CSVDemoEventType": {
25       "id": "CSVDemoEventType",
26       "members": [{
27         "id": "PARTNR",
28         "description": "",
29         "definitionType": "Variable",
30         "typeName": "String"
31       }, {
32         "id": "TIMESTAMP",
33         "description": "",
34         "definitionType": "Variable",
35         "typeName": "String"
36       }, {
37         "id": "TEMPERATUR",
38         "description": "",
39         "definitionType": "Variable",
40         "typeName": "String"
41       }, {
42         "id": "PRESSURE",
43         "description": "",
44         "definitionType": "Variable",
45         "typeName": "String"
46       }
47     ],
48     "category": "model",
49     "type": "StructuredVariable"
50   }
51 },
52 "rawModelString": "",
53 "ignoreCompileErrors": false
54 }

```

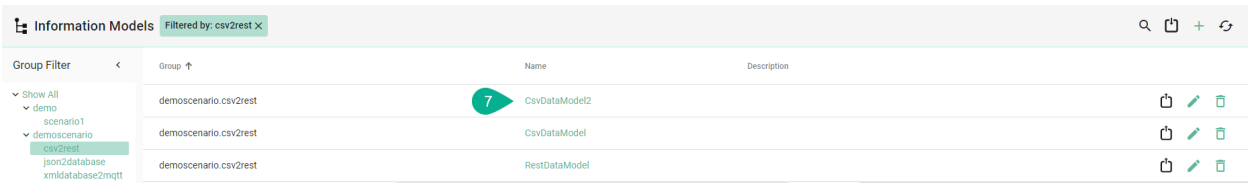
To import, select the **Import** button (4) from the upper right.



A pop-up window appears. Chose the file (5) and select the **Open** button (6).



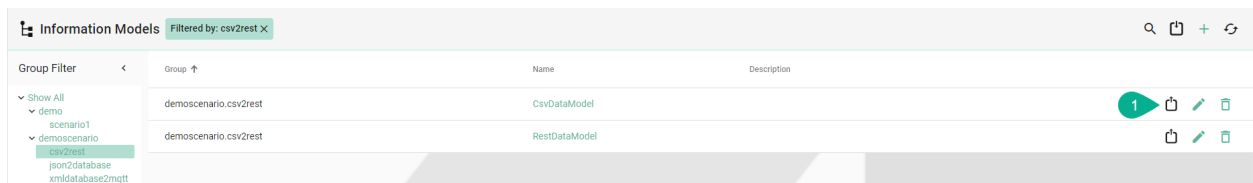
The imported component is now listed (7).



### 3.4.11 Export

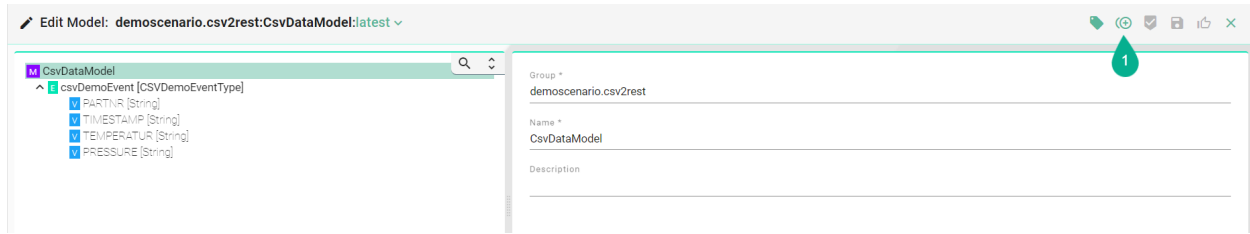
The user has the option to export a component to the local machine.

First, click on the **Export** button (1).



### 3.4.12 Clone

A component can be cloned from the edit mode, by selecting the **Clone** button. (1).



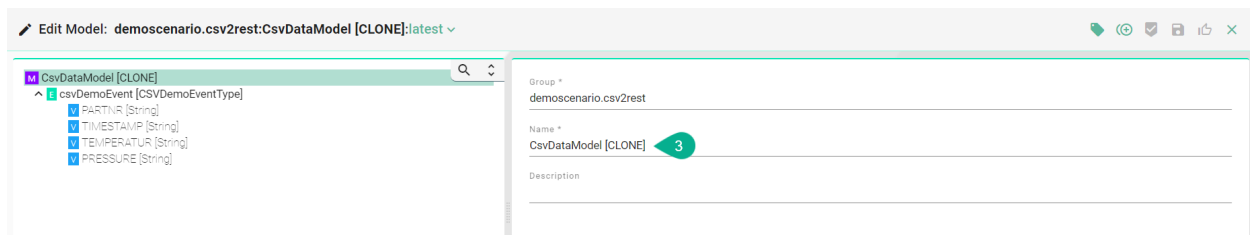
A pop-up appears, click on the **Ok** button (2).

**Are you sure you want to clone this configuration component?**

A clone of this entry will be created and you will be redirected to the edit for of the new entry



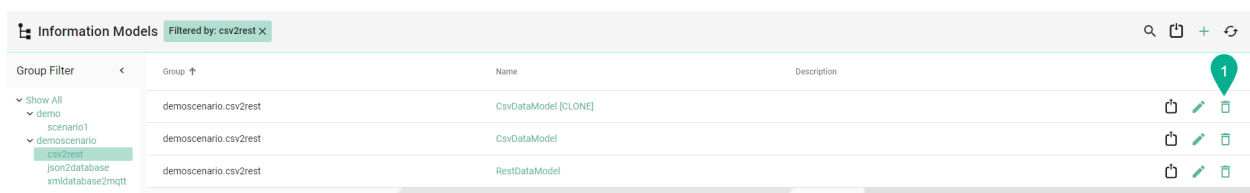
The cloned component is visible, in edit mode, requiring to input a valid name (4)



**Note:** The Clone operation is not available for the Deployment component.

### 3.4.13 Delete

A component can be deleted by clicking the **Delete** button (1).



Select **Delete** on the confirmation dialog (2).

## Delete Model

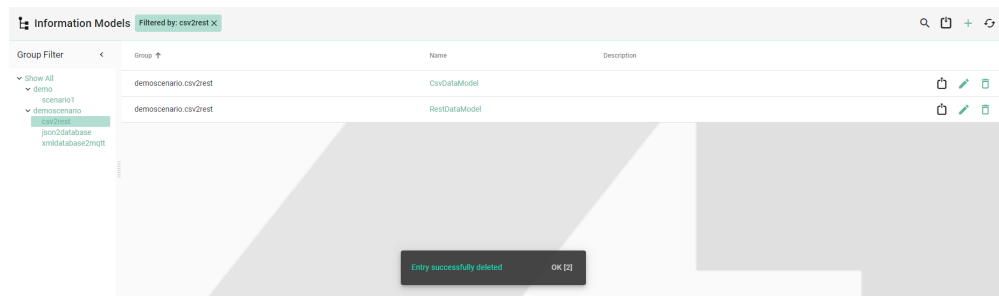
Are you sure you want to delete this Information Model?

Cancel

Delete

2

The component is deleted.

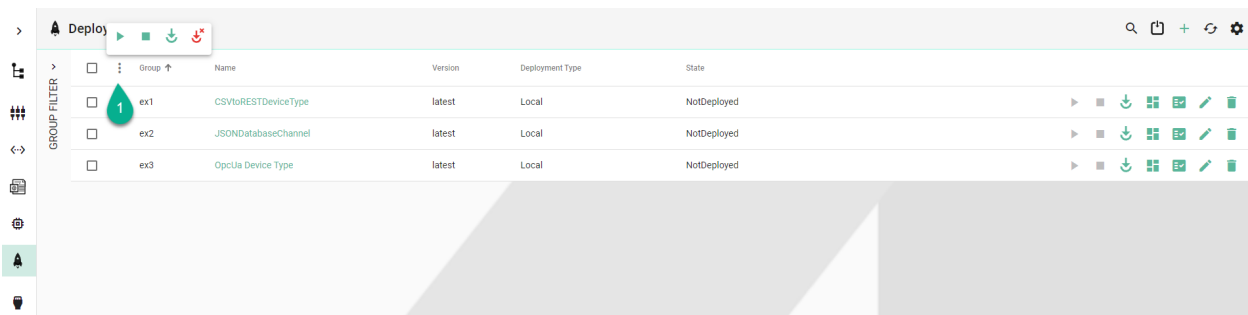


### 3.4.14 Bulk Action

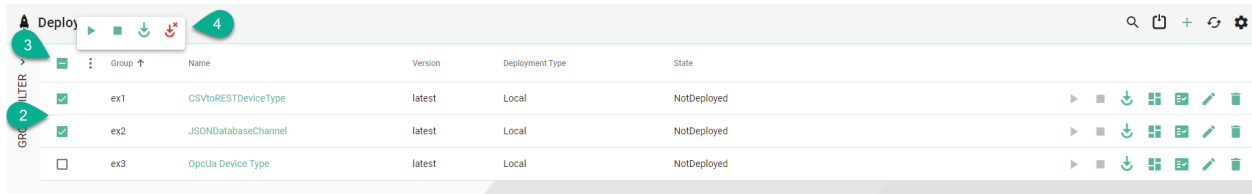
This operation is available only for the **Deployment**.

Click on the **ellipsis menu** button (1) to see the available bulk operations:

- Start
- Stop
- Deploy
- Undeploy



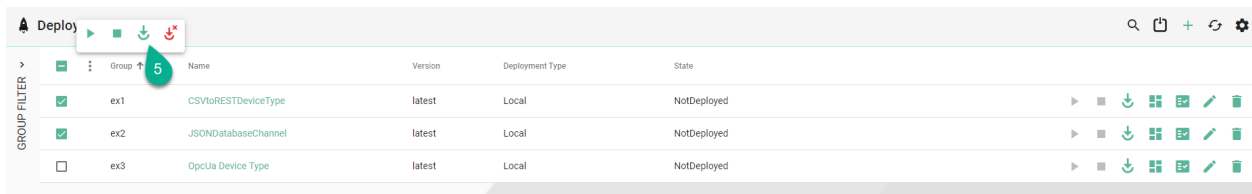
To get started, check the boxes for specific Deployment Instances (2) or the box to select all (3). The bulk operations popup appears (4).



For the Deployment Instance there is a defined action order:

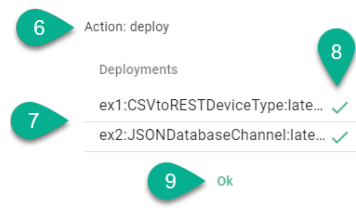
- Deploy, Start, Stop, Start, Stop... Undeploy

In this example the selected Instances should be deployed (5).



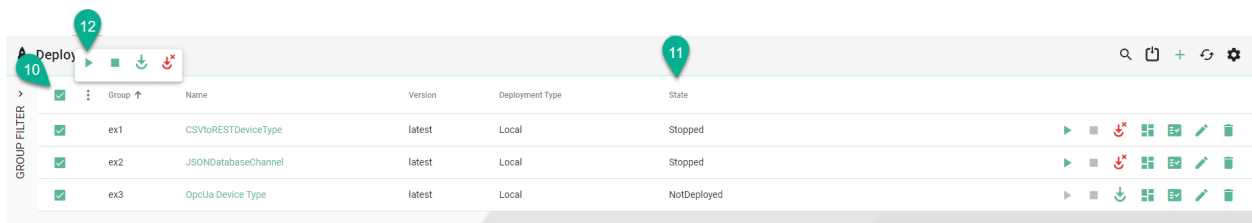
A status popup appears, displaying the following information:

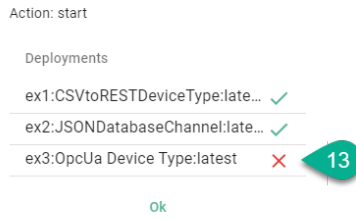
- Performed action (6)
- The Instances included in the bulk action (7)
- The status of the action (8)



Click the **Ok** button (9) to close the popup.

When the selected Instances (10) are in different states (11), the bulk action (12) will only affect Instances with the compatible state (13).





---

**Note:** Protected Instances will not work using bulk actions.

---



## DEPLOYMENT

SMARTUNIFIER supports the *deployment* of Instances on several computing environments:

- *Local* - on the same environment the SMARTUNIFIER Manager is running on
- *Docker* - on containerized environments
- *SSH* - remote on Linux machine
- *Fargate* - on the AWS Cloud using fully managed service AWS Fargate

Learn how to *operate* and *monitor* your SMARTUNIFIER Instances.

Learn about *notifications*.

Learn about additional *deployment options*.

### 4.1 What is a Deployment

With the SMARTUNIFIER Deployment capability you can deploy your SMARTUNIFIER *Communication Instances* to any IT resource (e.g., Equipment PC, Server, Cloud) suitable to execute SMARTUNIFIER Instances.

Depending on the Deployment Type a Deployment Endpoint must be initially created. For deployments on a local computer, no Deployment Endpoint needs to be set.

Currently, the following Deployment Endpoints are supported:

- *Local*: Deployment of a SMARTUNIFIER Communication Instance to your local computer where the SMARTUNIFIER Manager is running on.
- *Docker*: Deployment of a SMARTUNIFIER Communication Instance in containerized environments.
- *AWS*: Deployment of a SMARTUNIFIER Communication Instance on the AWS Cloud using AWS Fargate.
- *SSH*: Deployment of a SMARTUNIFIER Communication Instance on a Linux machine.

SMARTUNIFIER Communication Instance can be encrypted prior the deployment by enabling the encryption option. You learn how to do so in the chapters of the specific deployment options.

**Getting started:**

- Select your environment and create the Deployment:
  - *Local*
  - *Docker*
  - *Fargate*
  - *SSH*
- Learn how to *operate* an Deployment.
- Learn how to *monitor* an Deployment.

## 4.2 Deploy Locally

SMARTUNIFIER Communication Instances can be deployed on the IT-resource where the SMARTUNIFIER Manager is running on (e.g., a computer, a server or the AWS Cloud).

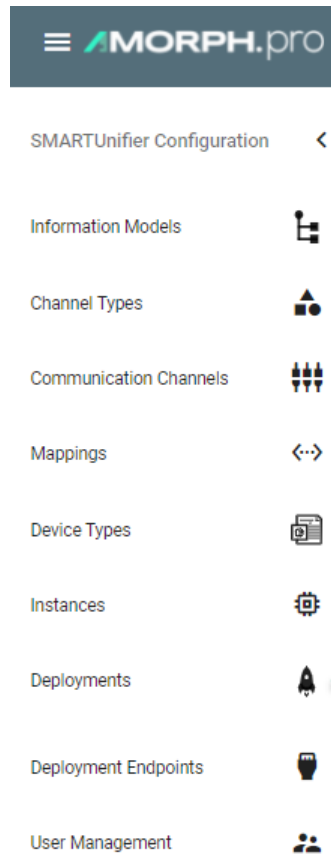
---

**Note:** Before deploying a Local Communication Instance make sure to create and **Start** a *Local Deployment Endpoint*. The Deployment Endpoint specifies the location where you want the Instance to run.

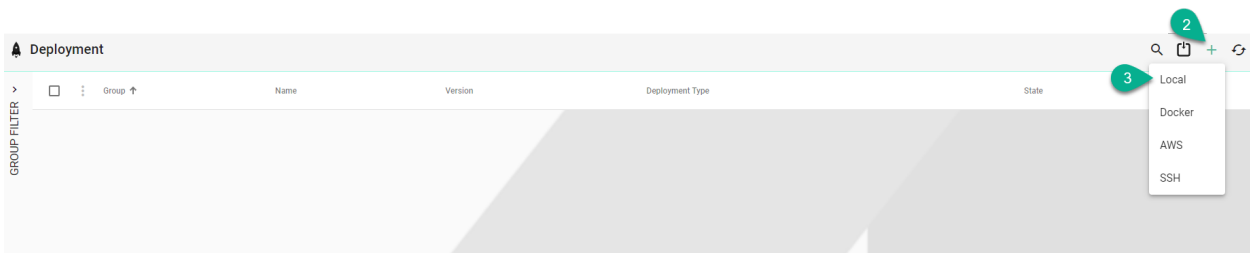
---

Follow the steps described below in order to deploy a Communication Instance locally:

- Select the SMARTUNIFIER Deployment perspective (1).



- Click on the **Add Deployment** button (2).
- Select the Deployment Type **Local** from the pop-up (3).



- In the Add Deployment view a set of configuration parameters is required (4)
  - Select the SMARTUNIFIER Communication Instance to be used in the Deployment.
  - Select the **Local Endpoint**.
  - Select the *log file level*. We recommend the log level of type *Info* in case of a normal deployment scenario.
  - (Optional) Enable *Encryption*.
  - (Optional) Enable *Protection*.
  - (Optional) Add *VM Arguments*.

- When all mandatory fields are filled click the **Save** button (5).

When the Instance is deployed, its configuration will be copied in the **Deployment folder** defined in the *Local Deployment Endpoint configuration*.

---

**Note:** The Instance configuration folder can be copied to another location and started, but the Instance will not be monitored by the SMARTUNIFIER Manager.

---

### 4.3 Deploy with Docker

---

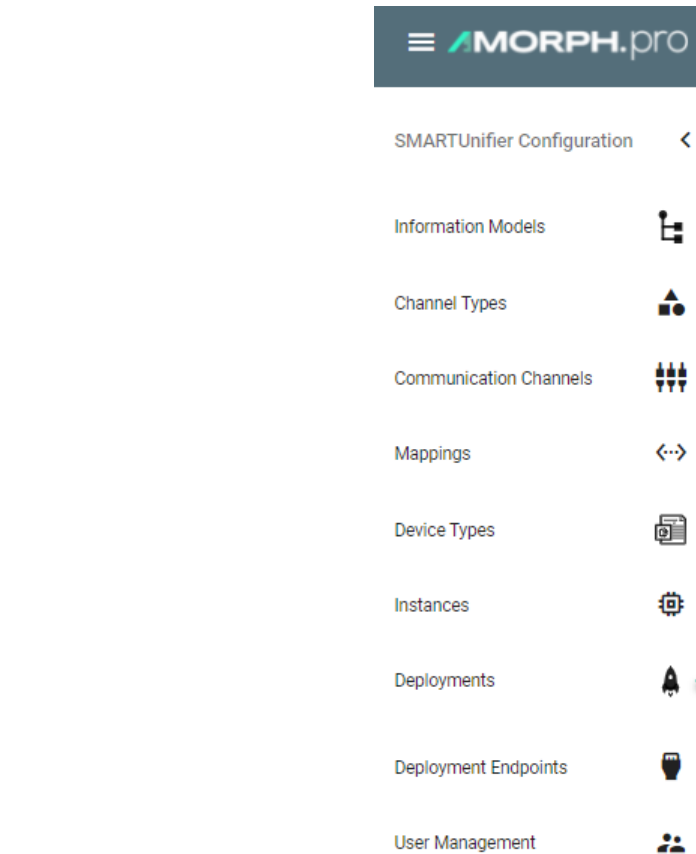
**Note:** Before deploying a Communication Instance with Docker make sure to add a *Docker Java Image* and to create and **Start** a *Docker Deployment Endpoint*. The Deployment Endpoint specifies the location where you want the container to run.

---

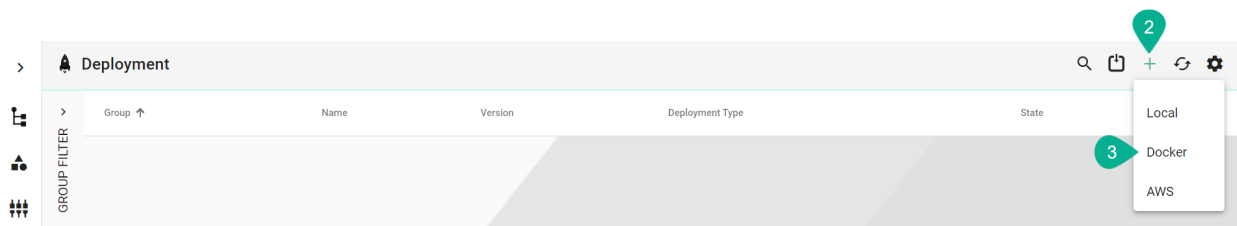
SMARTUNIFIER Communication Instances can be deployed on any location that has an existing Docker environment in place.

Follow the steps described below to deploy a Communication Instance inside a Docker container:

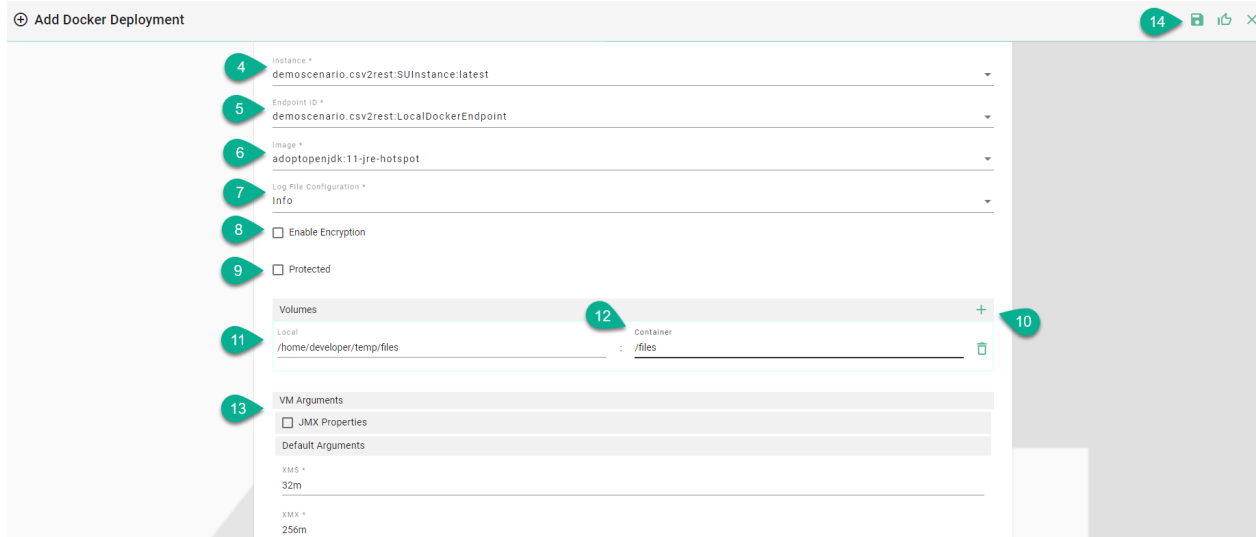
- Select the SMARTUNIFIER Deployment perspective (1).



- Click on the “Add Deployment” button (2).
- Select the Deployment Type **Docker** from the pop-up (3).



- Select the SMARTUNIFIER Communication Instance to be used in the Deployment (4).
- Select the Docker Endpoint ID created in the *Docker section* from the Drop-Down menu (5).
- Select the Image added in the *Docker Java Image Manager* from the Drop-Down menu (6).
- Select the *log file level* (7). We recommend the log level of type *Info* in case of a normal deployment scenario.
- (Optional) Enable *Encryption* (8)
- (Optional) Enable *Protection* (9)



- (Optional) Add Volumes to store persisting data that can be used by the Docker container (10).
  - Enter the local path of the directory or the name of an existing volume (11)
  - Enter the mount path inside the container (12)
- (Optional) Add *VM Arguments* (13)
- When all mandatory fields are filled click the “Save” button (14).

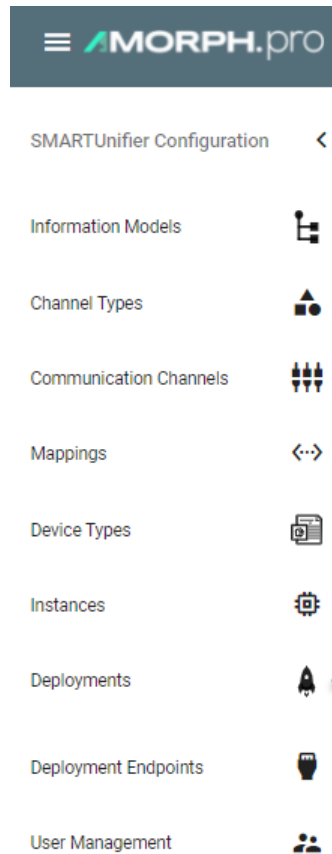
## 4.4 Deploy with SSH

**Note:** Before deploying a Communication Instance with SSH make sure to create and **Start** a *SSH Deployment Endpoint*. The Deployment Endpoint specifies the location where you want the Instance to run.

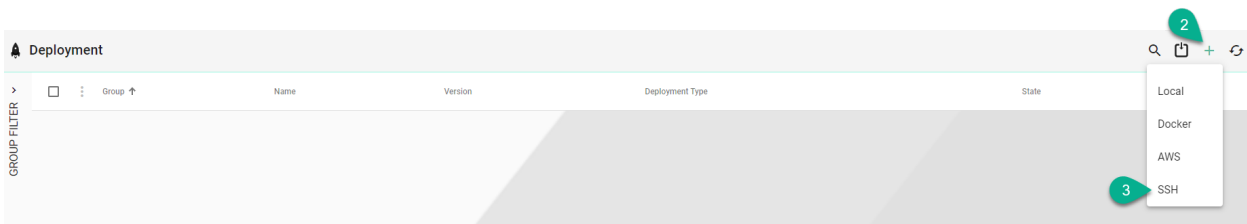
SMARTUNIFIER Communication Instances can be remotely deployed on any Linux machine by using the Secure Socket Shell protocol.

Follow the steps described below to deploy a Communication Instance using the SSH protocol:

- Select the SMARTUNIFIER Deployment perspective (1).



- Click on the “Add Deployment” button (2).
- Select the Deployment Type **SSH** from the pop-up (3).



- In the “Add Deployment” view a set of configuration parameters is required (4)
- Select the SMARTUNIFIER Communication Instance to be used in the Deployment.
- Select the SSH Endpoint ID created in the *SSH section* from the Drop-Down menu.
- Select the *log file level*. We recommend the log level of type *Info* in case of a normal deployment scenario.
- (Optional) Enable *Encryption*.
- (Optional) Enable *Protection*.
- (Optional) Add *VM Arguments*.

- When all mandatory fields are filled click the “Save and Close” button (5).

## 4.5 Deploy with AWS Fargate

SMARTUNIFIER supports the deployment of Communication Instances on Amazon Web Services (AWS) using AWS Fargate. Using AWS Fargate removes the operational overhead of managing servers by paying only for the resources actually used.

To deploy your SMARTUNIFIER Instances using AWS Fargate an AWS Account is required.

Before deploying a SMARTUNIFIER-Instance using AWS Fargate please refer to the *Prerequisites* section and make sure all requirements your Account needs to fulfill are met.

### 4.5.1 Prerequisites

#### Specialized Knowledge

Before deploying and operating SMARTUNIFIER Instances using AWS Fargate, it is recommended that you become familiar with the following AWS services. (If you are new to AWS, see [Getting Started with AWS](#))

- [Amazon Elastic Container Service \(ECS\)](#)
- [Amazon Virtual Private Cloud \(VPC\)](#)
- [Amazon CloudWatch](#)

You should also be familiar with the used Communication Channel and its capabilities of the deployed SMARTUNIFIER Instance.



## AWS Resources

For the deployment of SMARTUNIFIER Instances on AWS Fargate the following resources are required:

### Amazon S3 - Bucket

SMARTUNIFIER is using an Amazon S3 Bucket to upload Instances in an archive file format. We recommend to [create a private Bucket](#) dedicated for the SMARTUNIFIER.

### AWS VPC and Subnets

In order for SMARTUNIFIER to deploy Instances your AWS account a [VPC and Subnets](#) are needed. Please note that the Default VPC should not be used.

### Amazon ECS - Cluster

SMARTUNIFIER is using AWS Fargate for the deployment of Instances on the AWS Cloud. Therefore an ECS Cluster is required. We recommend to [create one Cluster](#) dedicated for SMARTUNIFIER deployed Instances.

### AWS ECR - Repository

SMARTUNIFIER is using an AWS ECR repository in order to push Docker Images, which is created by an AWS CodeBuild project. We recommend to [create one repository](#) dedicated for SMARTUNIFIER Instance images.

### IAM - User

SMARTUNIFIER complies with the [security best practices in IAM](#) and does not need root privileges. We recommend to [create one user](#) dedicated for SMARTUNIFIER. The IAM user follows the general rule of least privileges and allows only policies needed for the deployment of SMARTUNIFIER Instances.

Create the IAM user by following the steps described in the AWS IAM documentation [the IAM dashboard](#). The IAM user for SMARTUNIFIER must use the AWS access type **programmatic access**.

Attach the following permission:

Policy ARN	Description
<i>arn:aws:iam::aws:policy/AmazonS3FullAccess</i>	Provides full access to all buckets via the AWS Management Console.
<i>arn:aws:iam::aws:policy/AWSCodeBuildAdminAccess</i>	Provides full access to AWS CodeBuild via the AWS Management Console. Also attach AmazonS3ReadOnlyAccess to provide access to download build artifacts, and attach IAMFullAccess to create and manage the service role for CodeBuild.
<i>arn:aws:iam::aws:policy/AmazonEC2ContainerRegistryFullAccess</i>	Provides administrative access to Amazon ECR resources.
<i>arn:aws:iam::aws:policy/AmazonECS_FullAccess</i>	Provides administrative access to Amazon ECS resources and enables ECS features through access to other AWS service resources, including VPCs, Auto Scaling groups, and CloudFormation stacks.
<i>arn:aws:iam::aws:policy/CloudWatchFullAccess</i>	Provides full access to CloudWatch.

### Programmatic system credentials

SMARTUNIFIER needs the set up of a [credential profile](#) in order to deploy Instances on AWS Fargate. We recommend to [create a new access key](#) after 90 days.

Listing 1: Credentials Profile

```
[default]
aws_access_key_id = your_access_key_id
aws_secret_access_key = your_secret_access_key
```

### IAM Role - AWS CodeBuild Service Role

CodeBuild requires a service to interact with dependent AWS services:

- Access to Amazon S3 to retrieve SMARTUNIFIER Instance artifacts - such as libraries and configuration files.
- Access to AWS ECR to push the container image in the specified repository

Create the following [IAM Role](#) via the AWS console.

Listing 2: AWS CodeBuild Service Role

```

{
  "Version": "2012-10-17",
  "Statement": [
    {
      "Sid": "CloudWatchLogsPolicy",
      "Effect": "Allow",
      "Action": [
        "logs:CreateLogGroup",
        "logs:CreateLogStream",
        "logs:PutLogEvents"
      ],
      "Resource": [
        "*"
      ]
    },
    {
      "Sid": "CodeCommitPolicy",
      "Effect": "Allow",
      "Action": [
        "codecommit:GitPull"
      ],
      "Resource": [
        "*"
      ]
    },
    {
      "Sid": "S3GetObjectPolicy",
      "Effect": "Allow",
      "Action": [
        "s3:GetObject",
        "s3:GetObjectVersion"
      ],
      "Resource": [
        "*"
      ]
    },
    {
      "Sid": "S3PutObjectPolicy",
      "Effect": "Allow",
      "Action": [
        "s3:PutObject"
      ],
      "Resource": [
        "*"
      ]
    }
  ]
}

```

(continues on next page)

(continued from previous page)

```

    ]
  },
  {
    "Sid": "ECRPullPolicy",
    "Effect": "Allow",
    "Action": [
      "ecr:BatchCheckLayerAvailability",
      "ecr:GetDownloadUrlForLayer",
      "ecr:BatchGetImage"
    ],
    "Resource": [
      "*"
    ]
  },
  {
    "Sid": "ECRAuthPolicy",
    "Effect": "Allow",
    "Action": [
      "ecr:GetAuthorizationToken"
    ],
    "Resource": [
      "*"
    ]
  },
  {
    "Sid": "S3BucketIdentity",
    "Effect": "Allow",
    "Action": [
      "s3:GetBucketAcl",
      "s3:GetBucketLocation"
    ],
    "Resource": "*"
  }
]
}

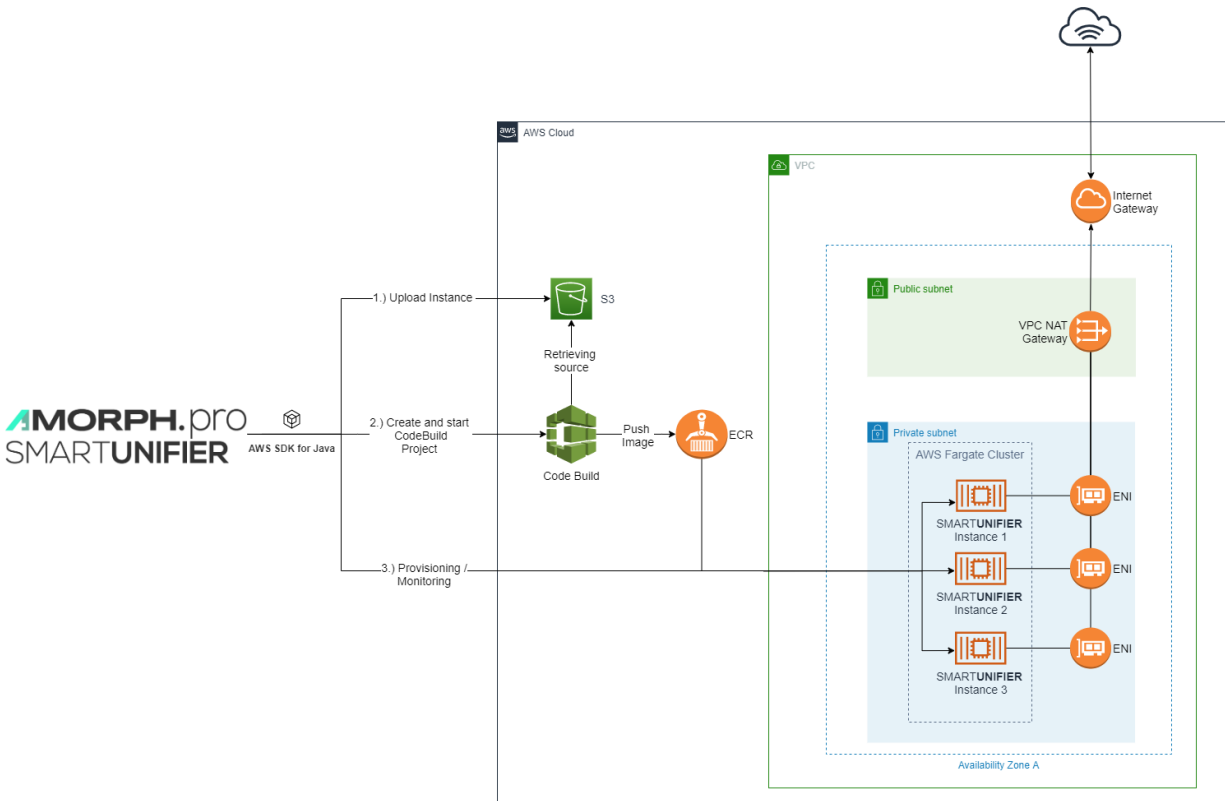
```

## 4.5.2 Architecture

The deployment of SMARTUNIFIER-Instances on AWS Cloud is handled by the SMARTUNIFIER Manager. The Manager can run on any On-Premise location such as, server environments and Industrial PCs; however, in order to deploy Instances on AWS an internet connection is required. To run SMARTUNIFIER Manager on AWS Cloud please see the SMARTUNIFIER Installation Manual.

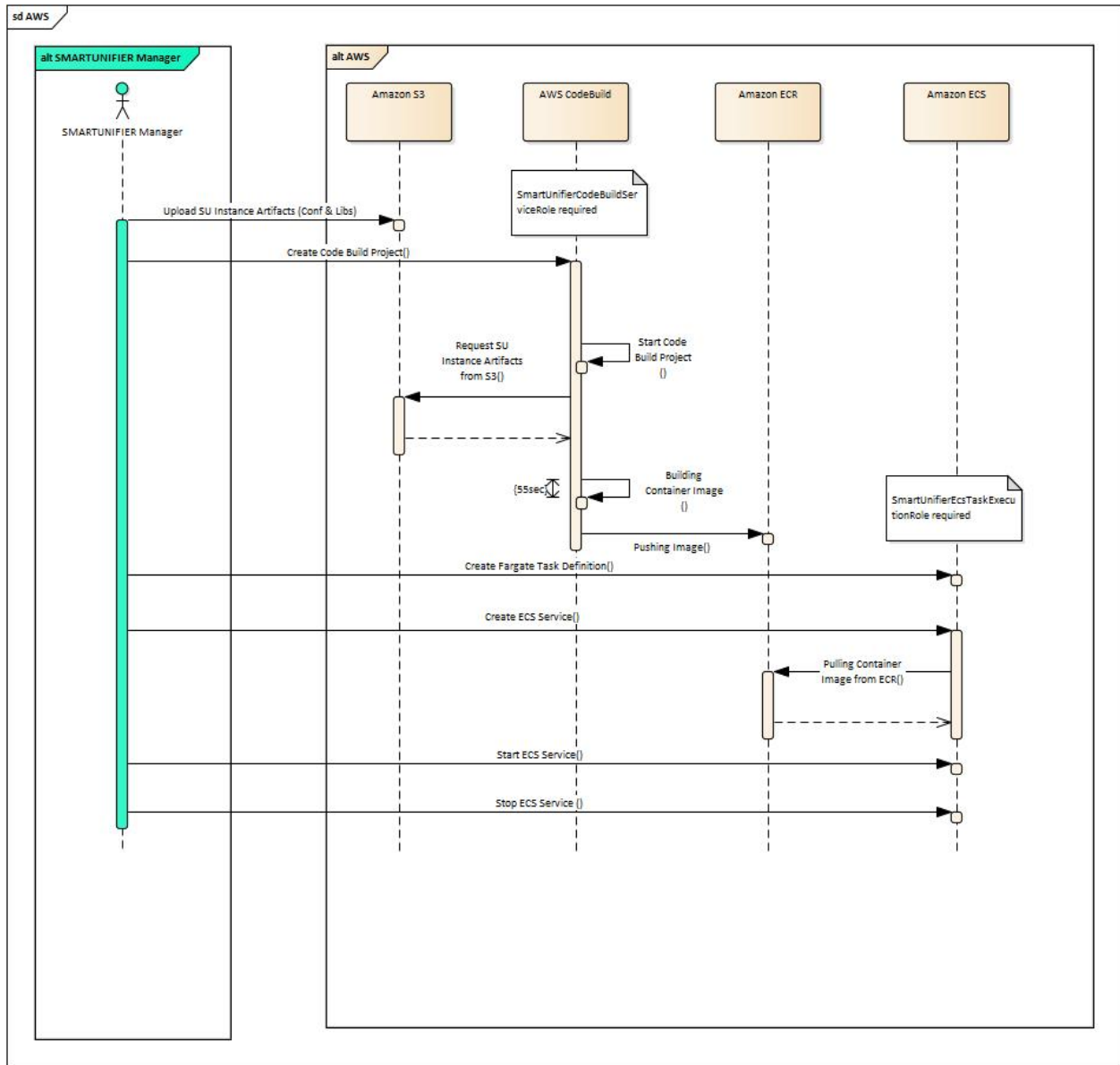
SMARTUNIFIER is using the [AWS SDK for Java](#) to make deployments of Instances to [AWS Fargate](#). Following AWS Services are used during the deployment process:

- AWS Simple Storage Service (Amazon S3) (Mandatory).
- AWS CodeBuild (Mandatory).
- AWS Elastic Container Registry (Mandatory).
- AWS Elastic Container Service (Mandatory).
- AWS Fargate (Mandatory).
- Amazon CloudWatch (Optional).



## Sequence of events

1. Upload of the SMARTUNIFIER Instance as an archive file format to Amazon S3.
2. Creation and automatic triggering of an AWS CodeBuild project.
3. The AWS CodeBuild project uses the archive file from the specified Amazon S3 Bucket in order to build a Docker Image for the particular SMARTUNIFIER Instance.
4. When finished, AWS CodeBuild pushes the Image to a specified ECR Repository.
5. Is the Image available on the ECR Repository a Fargate Task Definition is created as well as an ECS Service which is using the Task Definition.
6. By default, the Task is not started directly. Starting and Stopping of tasks can be done via the SMARTUNIFIER Manager or the AWS Console.



### 4.5.3 Planning the Deployment

#### Task Sizing

Each SMARTUNIFIER Instance runs as java byte code, thus having a low footprint. We recommend using the following guideline for Task Sizing.

**Note:** Please note that AWS Fargate is pricing based on the vCPU and memory resources, which are specified during the set up.

CPU	Memory Values	Instance (Number of Mappings)	Workload of Map-pings)
0.25 vCPU	0.5GB, 1GB, and 2GB	<= 5	
0.5 vCPU	Min. 1GB and Max. 4GB, in 1GB increments	> 6	

#### 4.5.4 Deployment Steps

##### Expected Time

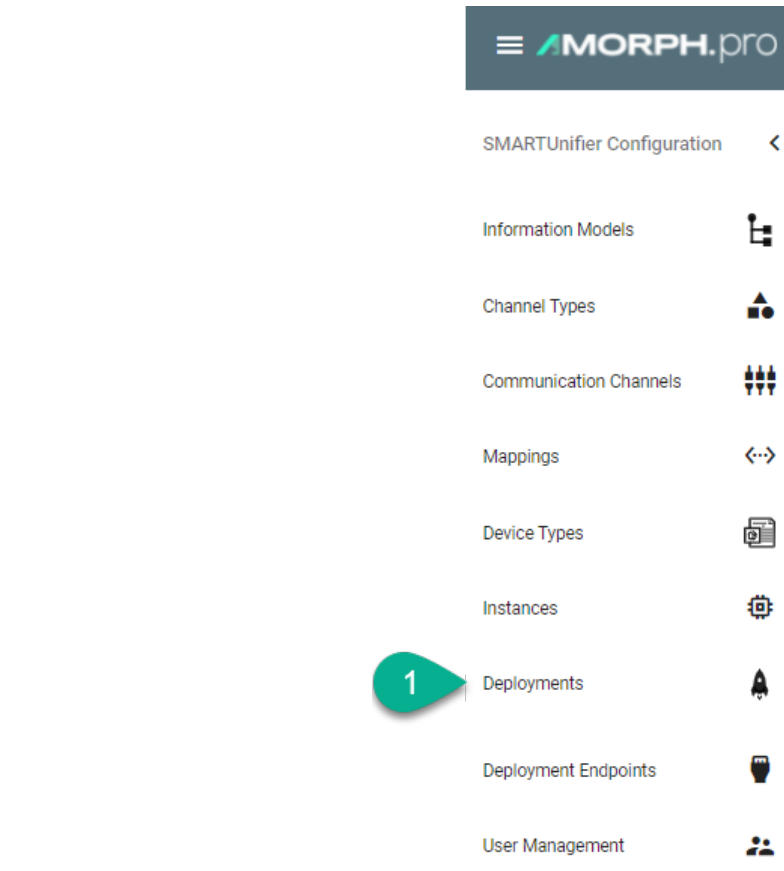
- Deployment of an SMARTUNIFIER Instance on AWS Fargate (Existing AWS Resources) - expected deployment time: **3-5 min**
- Deployment of an SMARTUNIFIER Instance on AWS Fargate (Creation of needed AWS Resources required) - expected deployment time: **20-30 min** (Please note that this is a one time setup of the customers AWS cloud infrastructure)

##### Deployment of the SMARTUNIFIER Instance

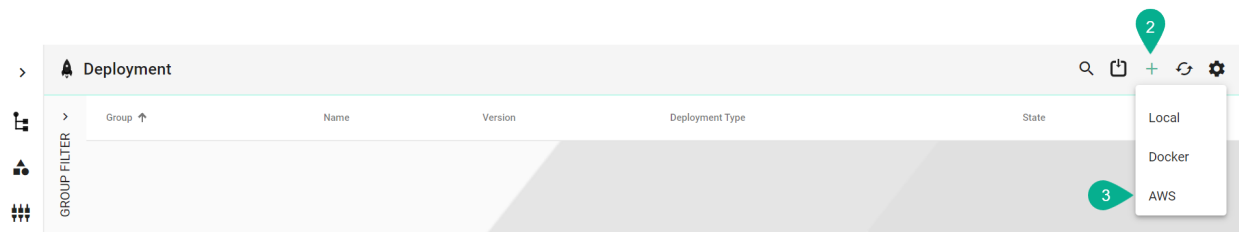
If you have not already created and **Started** an AWS Deployment Endpoint please refer to chapter: [AWS Endpoint](#).

Follow the steps described below to deploy a SMARTUNIFIER Instance on AWS Fargate:

- Select the SMARTUNIFIER Deployment perspective (1).



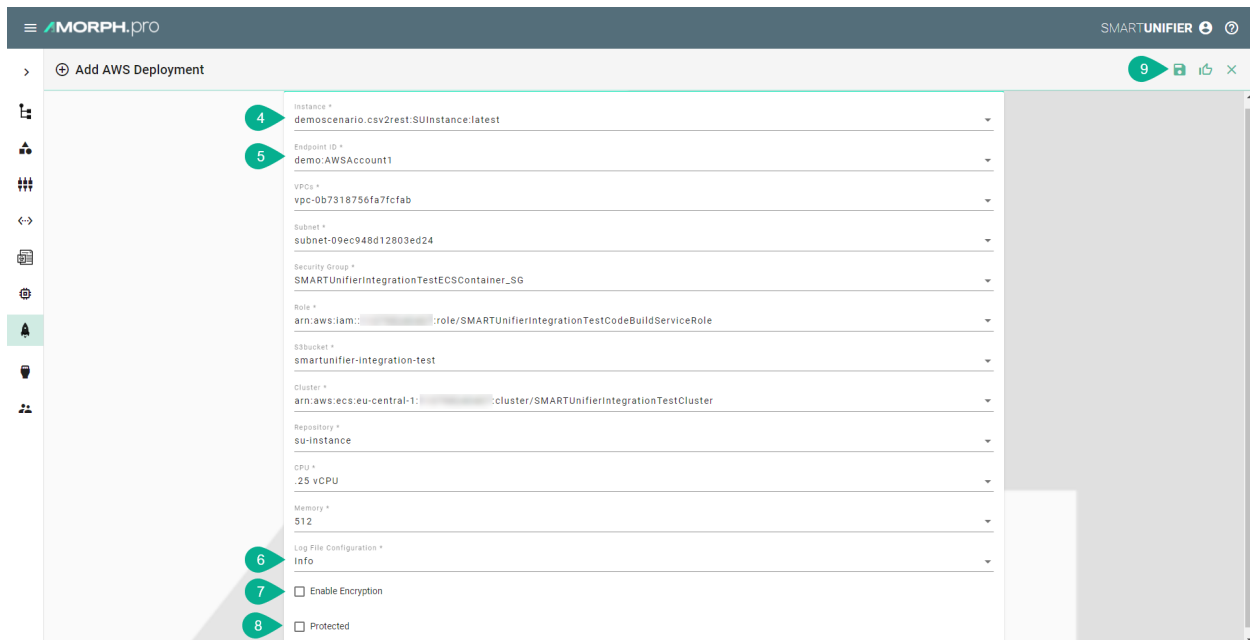
- Click the “Add” button (2).
- Select AWS (3).



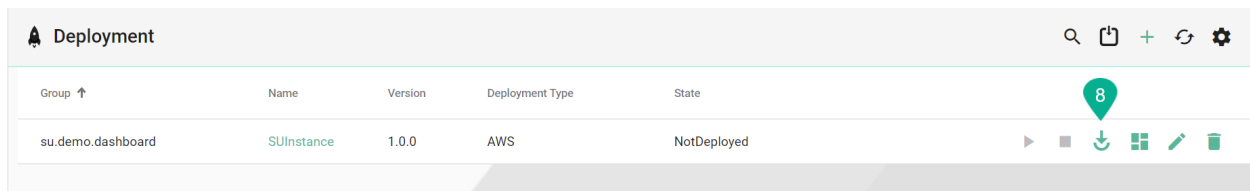
- Select the SMARTUNIFIER Instance you want to deploy (4):
- Select your AWS account in form of a Deployment Endpoint created *previously* (5) and configure the following parameters:
  - Select the **VPC** in which you want to deploy the SMARTUNIFIER Instance.
  - Select a **Subnet** within the VPC.
  - Select a **Security Group**.
  - Select a **IAM Role** for AWS CodeBuild.
    - \* AWS CodeBuild needs a service role so that it can interact with dependent AWS services on behalf of SMARTUNIFIER.



- Select a **S3 Bucket**.
- Select a **ECS Cluster** in which the Instance should be deployed.
- Select an **ECR Repository**.
  - \* The AWS CodeBuild project, which is created and triggered by SMARTUNIFIER, pushes an Image to the provided Amazon ECR Repository.
- Select the *Task's* - **CPU**.
- Select the *Task's* - **Memory**.
- Select the *log file level* (6).
- (Optional) Enable *Encryption* (7)
- (Optional) Enable *Protection* (8)
- Save the Deployment by clicking the “Save” button (9).



- Go back to the list view by clicking the “Close” button and deploy your SMARTUNIFIER Instance by clicking the “Deploy” button (8).



- You can start and stop the Instance using SMARTUNIFIER by clicking the “Start”/”Stop” button or using the AWS Console.

## Monitoring

Once deployed and started, the SMARTUNIFIER Instance logs can be accessed via Amazon CloudWatch.

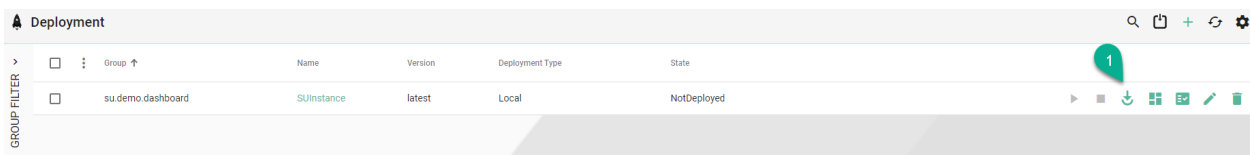
In order to access log files follow the steps below:

- Go to the Amazon CloudWatch Service via the Console.
- Select **Log groups** from the menu on the left.
- Select **awslogs-testinstance** and select a log Stream.

## 4.6 How to Deploy, Run and Operate a Deployed Instance

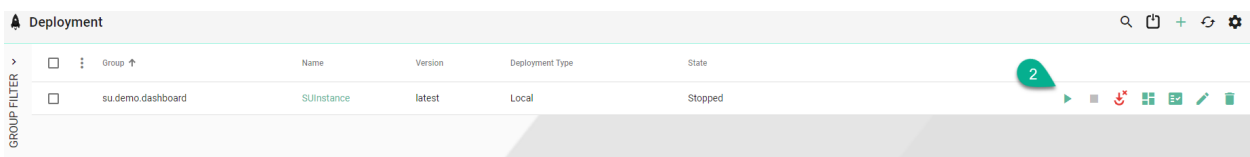
### 4.6.1 How to Deploy an Instance

- In order to start the Instance, click first the “Deploy” button (1). A message is shown, that confirms the successful deployment of the Instance.



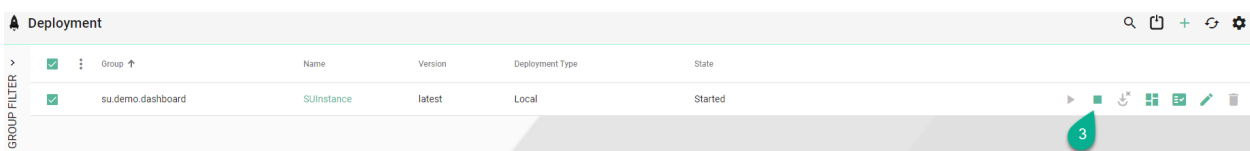
### 4.6.2 How to Run an Instance

- After successfully deploying the Instance, the state changes from *NotDeployed* to *Stopped*. You can now click the enabled “Start” button (2). The Instance state will change to *Started*. A message is shown, that confirms the successful start of the Instance.



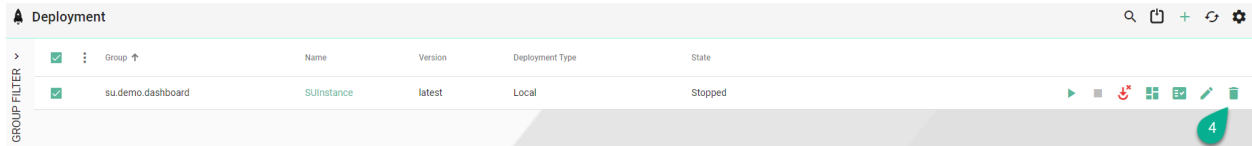
### 4.6.3 How to Stop an Instance

- To stop the Instance, click the “Stop” button (3).



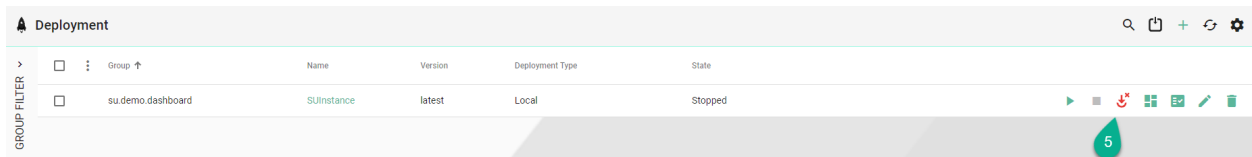
#### 4.6.4 How to Delete a Deployment of an Instance

- Click on the “Delete” button to delete the Deployment for a specific Instance (4). This is only possible if the Instance is in the state *Stopped*.

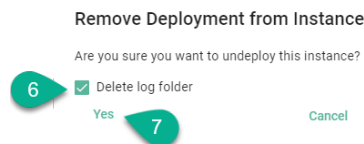


#### 4.6.5 How to Un-deploy an Instance

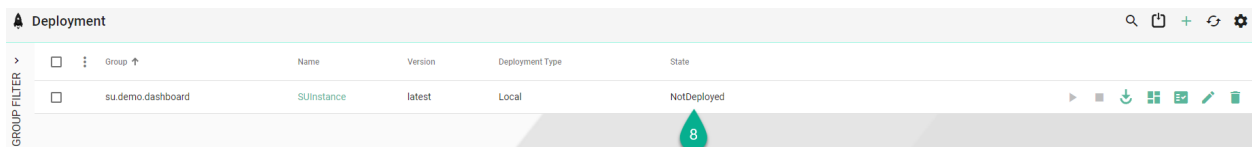
- In order to un-deploy an Instance, **make sure** that the Instance is not running. If necessary *stop the Instance*.
- Click on the “Undeploy” button in the upper right corner (5).



- A popup appears, uncheck the box (6) to keep the log folder and click on the **Yes** button (7) to confirm.

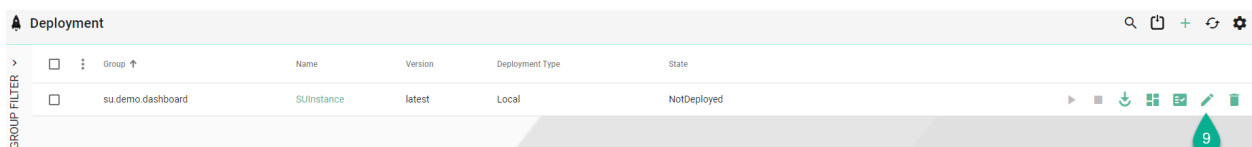


- The Instance state changes to *NotDeployed* (8) and the Deployment can be edited. Please **note** that the Instance associated with the Deployment cannot be changed.



#### 4.6.6 How to Edit a Deployment of an Instance

- Click on the “Edit” button to perform changes to the Deployment (9). It is only possible to edit a Deployment if the Instance is not deployed. In case the Instance is deployed, only the details of the Deployment can be viewed.



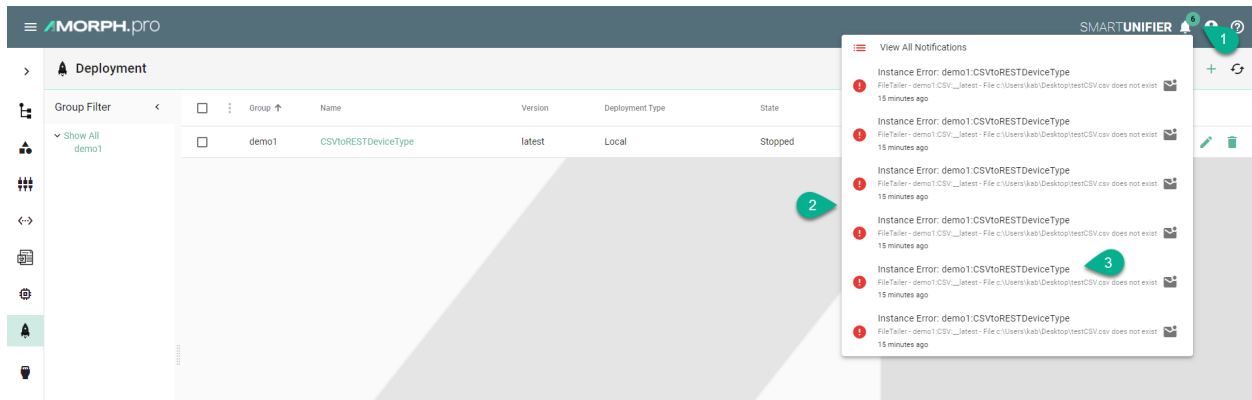
## 4.7 Notifications

SMARTUNIFIER comes with an integrated notification system, which helps to gain insights when a deployed Communication Instance is started or running and errors appear.

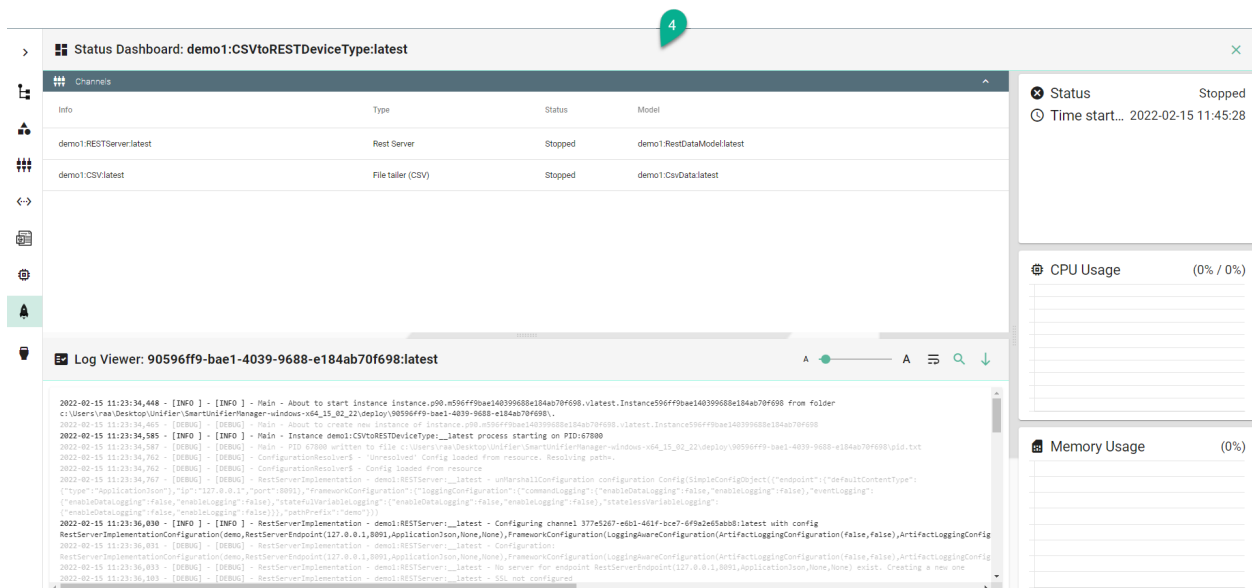
### 4.7.1 How to access Notifications

When a deployed Communication Instance is started or running and errors appear, the number of errors will be displayed near the **Notifications** button (1).

Click on the Notifications button and the **Notifications List** (2) will display all the Instance errors.

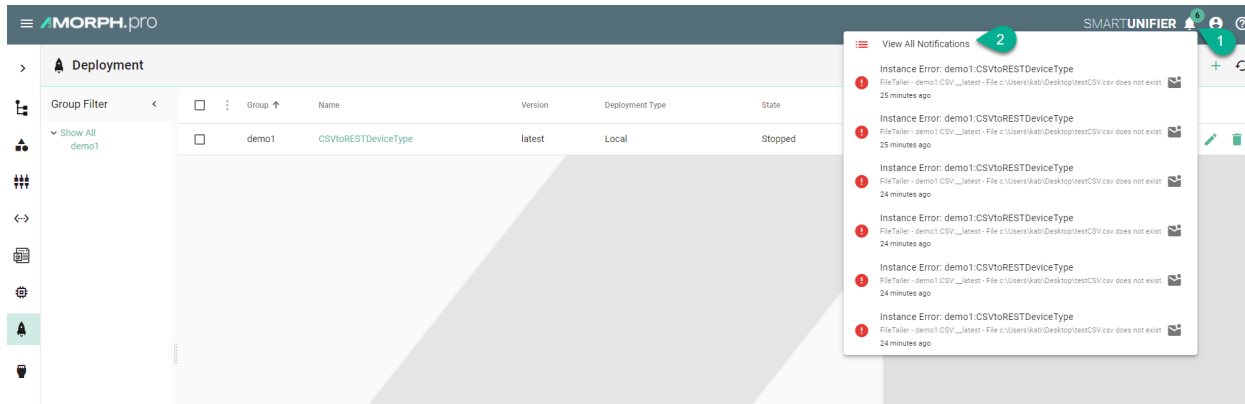


Select a notification (3) from the list and the **Dashboard** (4) will appear and display additional information.

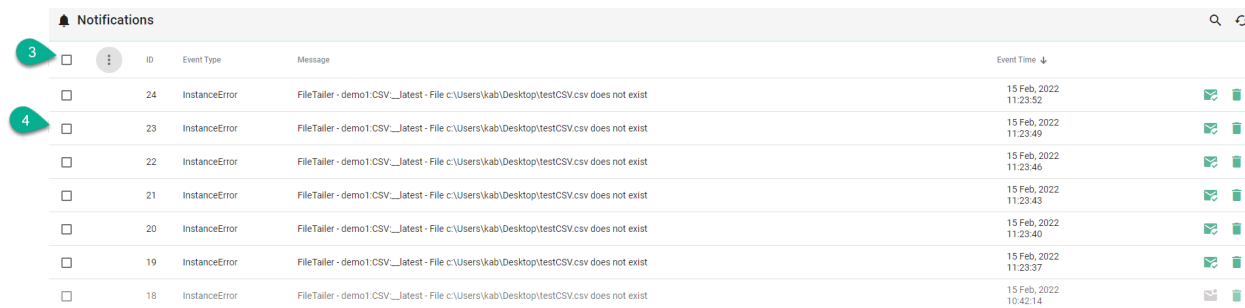


### 4.7.2 How to manage Notifications

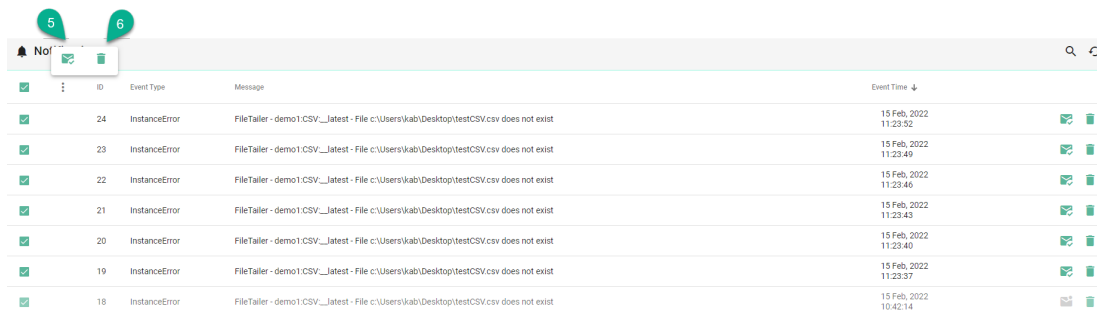
In order to manage the notifications click on the **Notifications** button (1) and select the **View All Notifications** option (2).



The Notifications Manager displays all the notifications. Select all (3) or specific notifications (4).



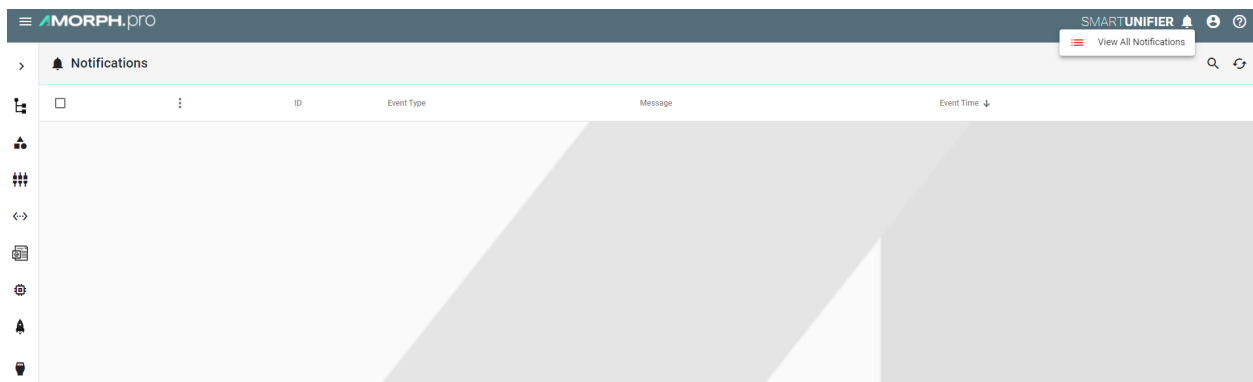
After selection a pop-up appears providing two options.



Click on the **Dismiss** button (5) to remove the selected notifications from the Notifications List. The selected notifications will still be available in the Notifications Manager.

ID	Event Type	Message	Event Time
24	InstanceError	FileTailer - demo1.CSV__latest - File c:\Users\kabi\Desktop\testCSV.csv does not exist	15 Feb, 2022 11:23:52
23	InstanceError	FileTailer - demo1.CSV__latest - File c:\Users\kabi\Desktop\testCSV.csv does not exist	15 Feb, 2022 11:23:49
22	InstanceError	FileTailer - demo1.CSV__latest - File c:\Users\kabi\Desktop\testCSV.csv does not exist	15 Feb, 2022 11:23:46
21	InstanceError	FileTailer - demo1.CSV__latest - File c:\Users\kabi\Desktop\testCSV.csv does not exist	15 Feb, 2022 11:23:43
20	InstanceError	FileTailer - demo1.CSV__latest - File c:\Users\kabi\Desktop\testCSV.csv does not exist	15 Feb, 2022 11:23:40
19	InstanceError	FileTailer - demo1.CSV__latest - File c:\Users\kabi\Desktop\testCSV.csv does not exist	15 Feb, 2022 11:23:37
18	InstanceError	FileTailer - demo1.CSV__latest - File c:\Users\kabi\Desktop\testCSV.csv does not exist	15 Feb, 2022 10:42:14

To remove the selected notifications from the Notifications List and the Manager, click on the **Delete** button (6).



## 4.8 How to monitor a deployed Instance

### 4.8.1 Log Viewer

SMARTUNIFIER comes with an integrated log viewer, which helps to gain insights in deployed and running Communication Instance.

The log viewer will show the details of logs based on the level defined throughout the creation of the deployment.

#### Log Levels

**TRACE** The most fine-grained information only used in rare cases where full visibility of what is happening inside a Communication Instance.

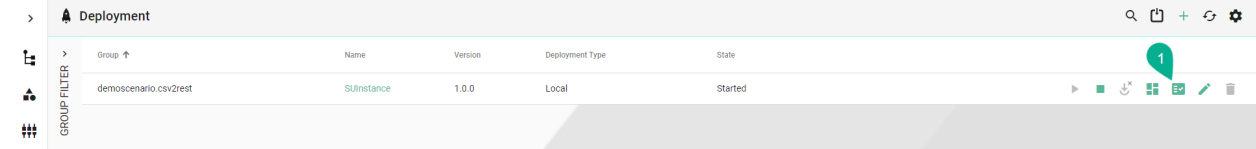
**DEBUG** Less granular compared to the TRACE level, but more than needed in a production environment. The DEBUG log level should be used for troubleshooting an faulty Communication Instance or when running a Communication Instance inside a test environment.

**INFO** Is the standard log level used for a standard deployment of a Communication Instance.

**WARNING** Log level that indicates that something unexpected happened inside a Communication Instance that might cause problems for the course of communication.

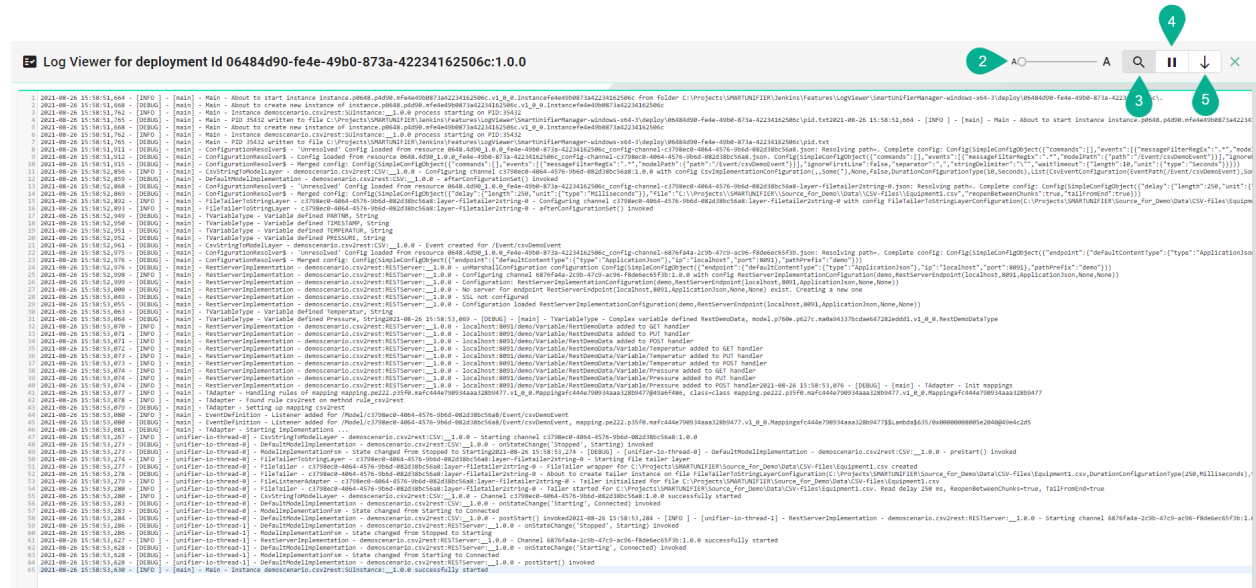
## Log Viewer operation

Logs can be accessed by clicking the “Log” button (1).



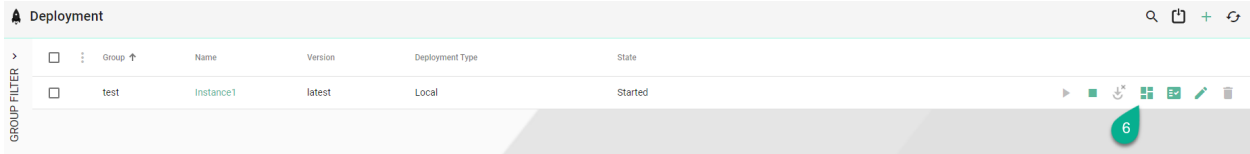
Log Viewer comes with the following features:

- Font size adjustability (2)
- Searching, based on a regular expression (Regex) (3)
- Start/Stop to “freeze” the current logging in order to investigate already printed log lines (4)
- Follow Tail, to skip through to the latest log line (5)

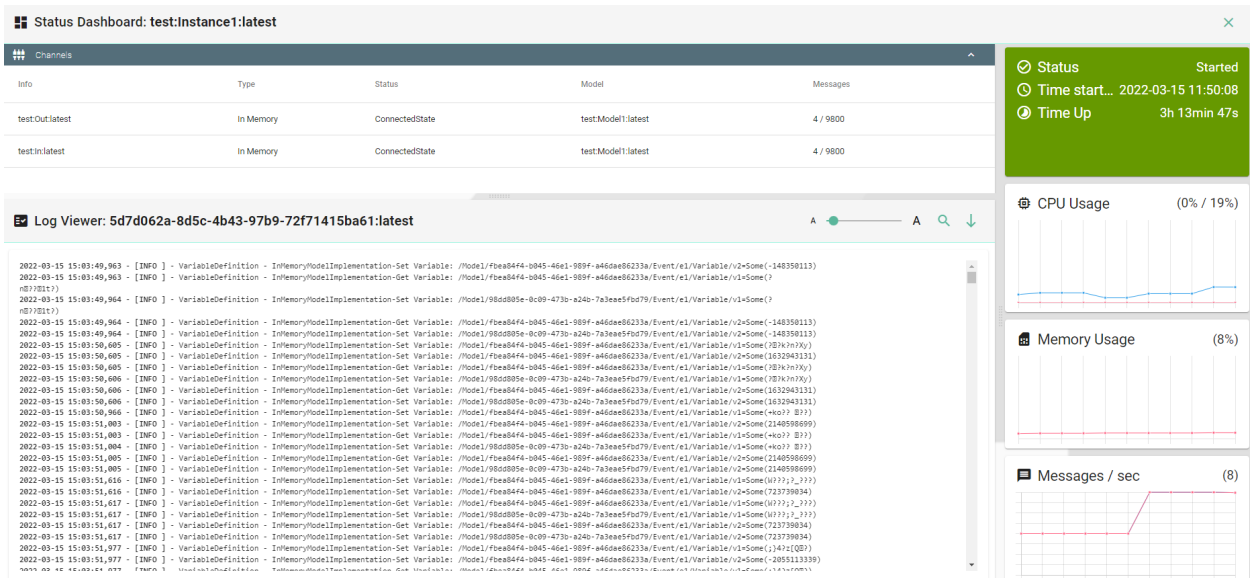


## 4.8.2 Dashboard

- In order to monitor an Instance, access the Dashboard view by clicking the “Dashboard” button (6).
- If the Instance is in the state NotDeployed the Dashboard cannot be accessed.



- The Dashboard provides the following information:
  - Channels associated with the Instance
  - Log Viewer
  - Status of the Instance
  - Start time of the Instance
  - Instance Time Up
  - CPU Usage of the Instance
  - Memory Usage of the Instance
  - Sent and received messages



## 4.9 Additional Options

### 4.9.1 Encryption of Communication Instances

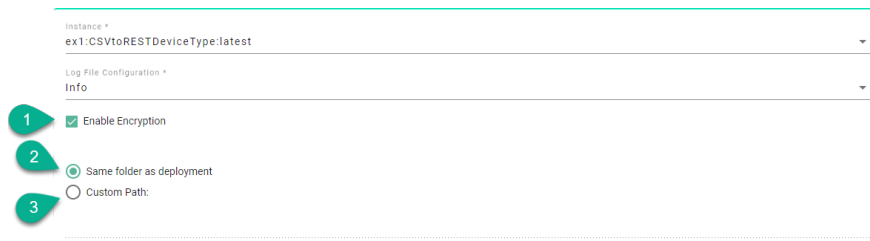
This feature provides the possibility to encrypt the configuration files of Communication Channels used by the Instance, which may contain credentials to access a database or external services. The encryption method used is Advanced Encryption Standard (AES).

The encryption is available for all deployment options, by following the steps below:

- Check the **Enable Encryption** box (1).



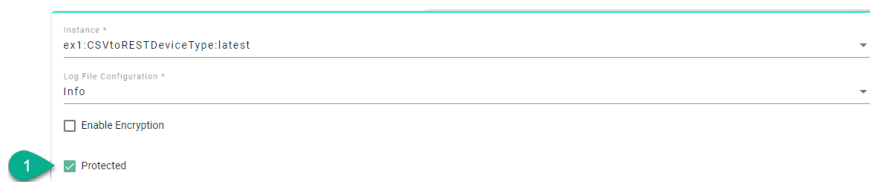
- A symmetrical key (cfg.key) is generated and can be saved in the same folder as the deployment (2) or check the **Custom Path** option (3) to save the key into a secured location.



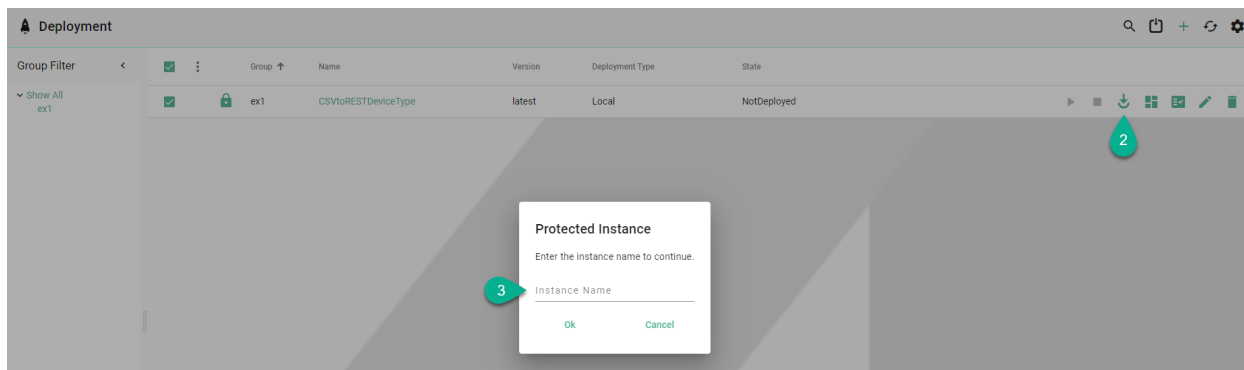
## 4.9.2 Protect Communication Instances

This feature provides an additional protection when performing an Instance action (e.g., deploy, undeploy, start, stop).

The protection is available for all deployment options, by checking the **Protected** box (1).



Now the Instance is protected, meaning that when the user performs an action like Deploy (2), a popup appears requiring to input the Instance name (3).



**Note:** Protected Instances will not work with Bulk actions.

### 4.9.3 VM Arguments

This feature provides the possibility to configure the Java Virtual Machine (JVM). In some cases, when dealing with larger files when using the File Reader Communication Channel (large XML file), it might be necessary to increase the **XXM** in order to avoid running into a *java.lang.OutOfMemoryError* - exception.

VM Arguments can be configured when deploying an Communication Instance locally or on Docker, by following the steps below:

- Check the **JMX Properties** box (1) to expand the Java Management Extensions parameters and input the **JMX Host Name** and **Port** (2).
- Check the authentication method (3).
- Update the **XMS** value (4), minimal heap size, representing the amount of memory used by the JVM to start with.
- Update the **XXM** value (5), maximal heap size, representing the maximum amount of memory that JVM will be able to use.

- By default, the **Heap Dump On Out Of Memory Error** option is checked, providing an analysis file for debugging.
- Additional JVM arguments can be added by selecting the **add Arg** button (6) and input the argument (7). For example, to debug memory issues or application performance, the Garbage Collection logging can be enabled in JVM, as seen below.

Instance \*  
ex1:CSVtoRESTDeviceType:latest

Log File Configuration \*  
Info

Enable Encryption

Protected

VM Arguments

JMX Properties

JMX Host Name \*  
localhost

JMX Port \*  
1280

JMX Authenticate

Authenticate

Local Only

Use SSL

Default Arguments

XMS \*  
32m

XMx \*  
256m

Heap Dump On Out Of Memory Error

Additional 6 +

argument 7

-XX:+PrintGCDetails 8

- An additional argument can be deleted by clicking on the **delete Arg** button (8).

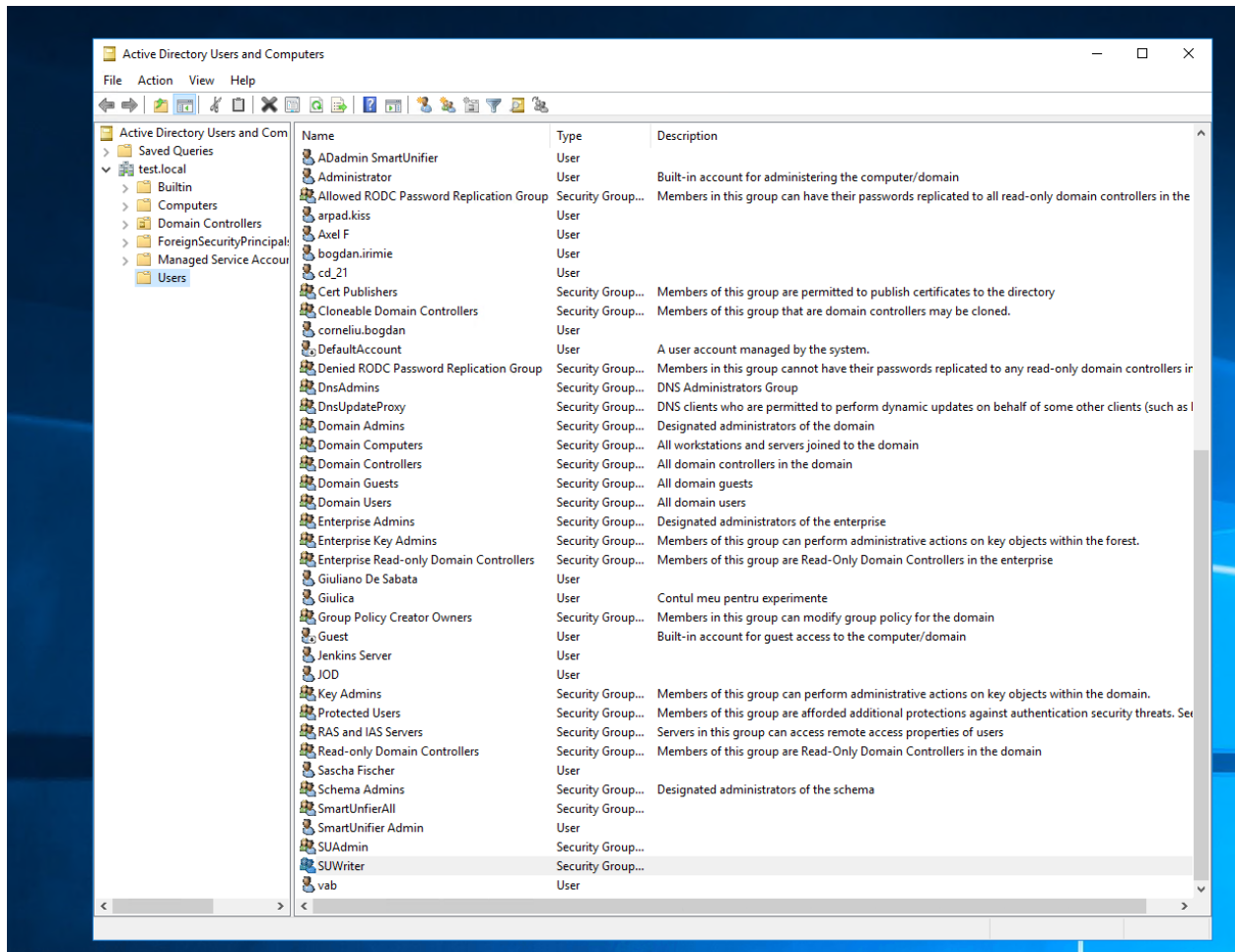
## ADMINISTRATION

Learn how to:

- Integrate an *Active Directory*
- *Backup* and *Restore* the Repository
- Manage *Communication Channel Types*
- Manage *Docker Java Images*
- Create *Deployment Endpoints*
- Manage *Credentials*
- Manage *User Accounts*
- Manage *Logging Configurations*
- Use *Extensions*

### 5.1 Active Directory Integration (ADI)

SMARTUNIFIER supports Windows Active Directory (AD). System administrators can use the Active Directory to add/remove users, groups, and resources quickly and efficiently through one dashboard.



### 5.1.1 AD Group Mapping

An user from AD must be added to a group that acts as a role. The role determines what permissions are assigned to the user.

The mapping between the AD groups and the SMARTUNIFIER roles is defined in the **application.conf** file from the **conf** folder.

```

application.conf x
1 # https://www.playframework.com/documentation/latest/Configuration
2 include "default.conf"
3 apiPrefix = adapter
4
5 play = {
6   server = {
7     http.port = 9000
8     http.address = "0.0.0.0"
9
10    #http.port=disabled
11    #https.port=9443
12    #https.keyStore.path="path_to_keystore"
13    #https.keyStore.password="keystore_password"
14   }
15   http.secret.key = "ChangeMySecret"
16 }
17 authentication {
18   activedirectory {
19     host = "192.168.0.132",
20     port = 389,
21     baseDN = "DC=test,DC=local",
22     useSSL = false,
23     user = "jenkins@test.local",
24     password = "Aiurea05",
25     groupmapping = {
26       Administrator = "SUAdmin",
27       Writer = "SUWriter",
28       Reader = "SmartUnifierAll"
29     }
30   }
31 }
32 unifiermanager {
33   tempFolder = "temp"
34   compiler {
35     scala {
36       javaHome = "jre"
37     }
38   }
39   management {
40     dontDeleteWorkspace = true
41   }
42 }
43 model {
44   loadCodeFromScalaFile = false
45 }
46 deployment {
47   javaHome = "jre"
48   local = {
49     deploymentFolder = "deploy"
50     softRefreshInterval = 2000
51     hardRefreshInterval = 5
52     logStatusInterval = 30
53     monitorLogs = true
54   }
55   docker {
56     baseimage {
57       autcreate = false
58       jreImage = "adoptopenjdk/11-jre-hotspot"
59     }
60   }
61 }

```

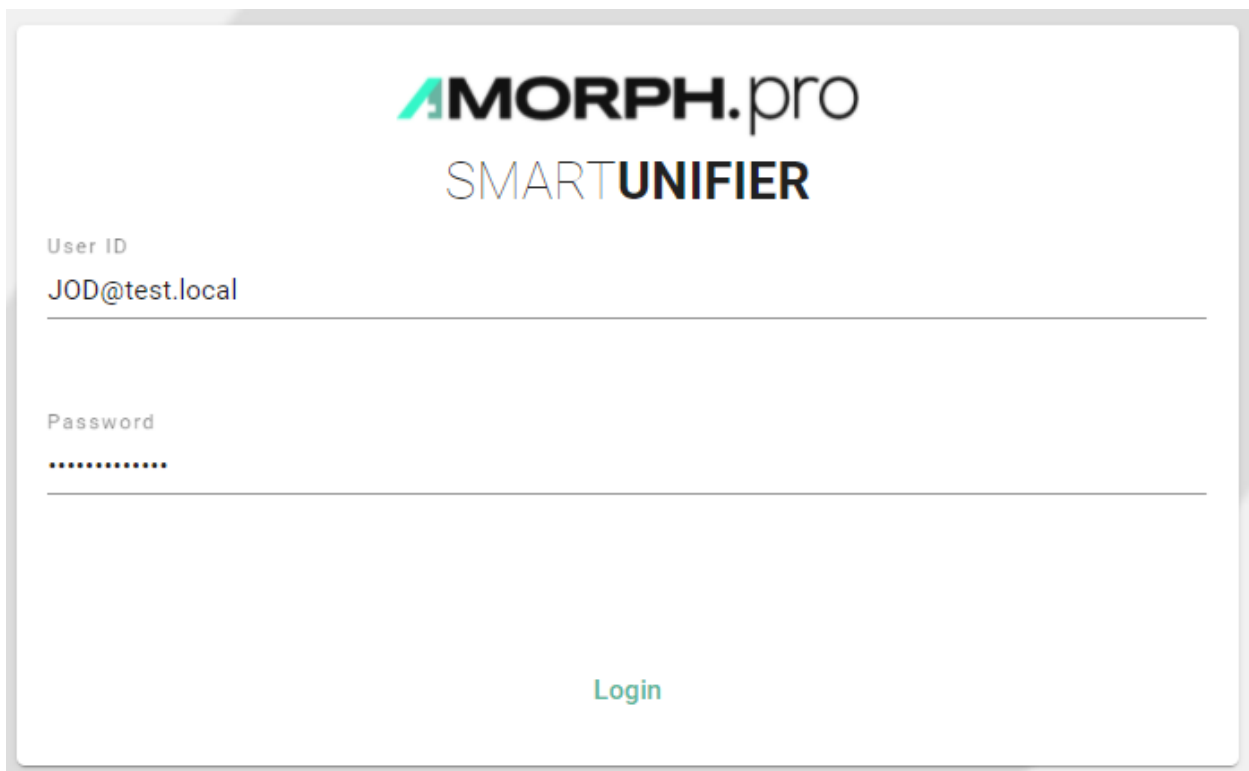
As seen above (1) in the left side are the SMARTUNIFIER roles and in the right side, between the quotation marks are the AD groups.

**The SMARTUNIFIER roles are predefined:**

- Administrator - global permission
- Writer - limited permission, write and read access
- Reader - limited permission, read access

A user from an AD group will have permission based on the mapping of the AD group to a predefined SMARTUNIFIER role.

After all the above configuration is done, the user can login to the SMARTUNIFIER with the **User logon name** and the **Password** defined in AD.



AMORPH.pro  
SMARTUNIFIER

User ID  
JOD@test.local

Password  
.....

Login

## 5.2 Backup and Restore

SMARTUNIFIER provides the possibility to manually backup and restore the repository. The repository represents a central location in which all the configuration components are stored:

- Information Models
- Communication Channels
- Mappings
- Node Types

- Instances

### 5.2.1 How to access

To access the Backup or the Restore option, click on the **Account** icon (1), go to the **Administrative** option (2) and select the **Backup** perspective (3) or the **Restore** perspective (4).



**Note:** The Backup and the Restore features can only be accessed by user accounts with an administrator role assigned. Also keep in mind that the same SMARTUNIFIER Manager version must be used.

### 5.2.2 Backup

The Backup feature provides the possibility to create a copy of the configuration components to store elsewhere, so that it can be used to restore the last used after a data loss event occurs.

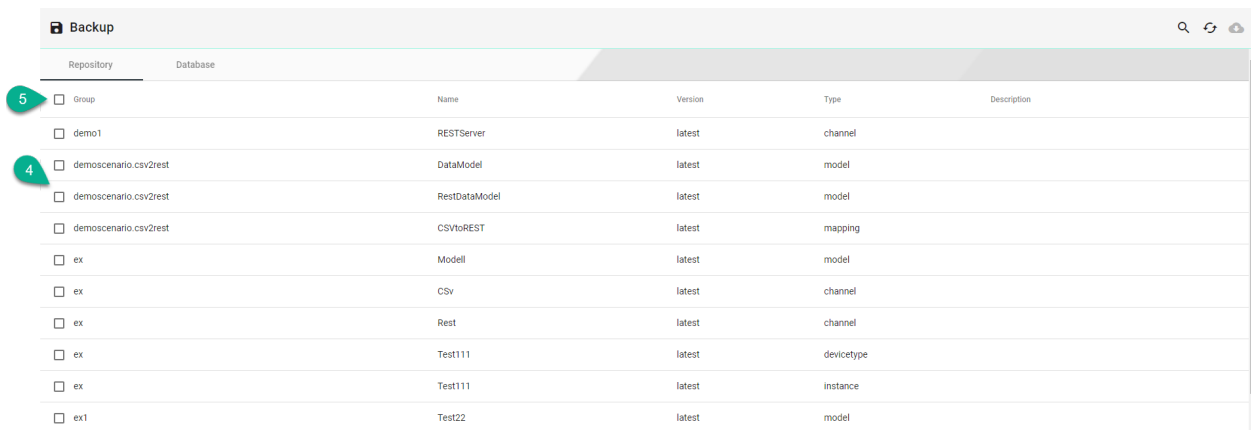
Follow the steps described below to create a backup of the repository:

- Select the **Account** icon (1), go to the **Administrative** section (2) and select the **Backup** option (3).

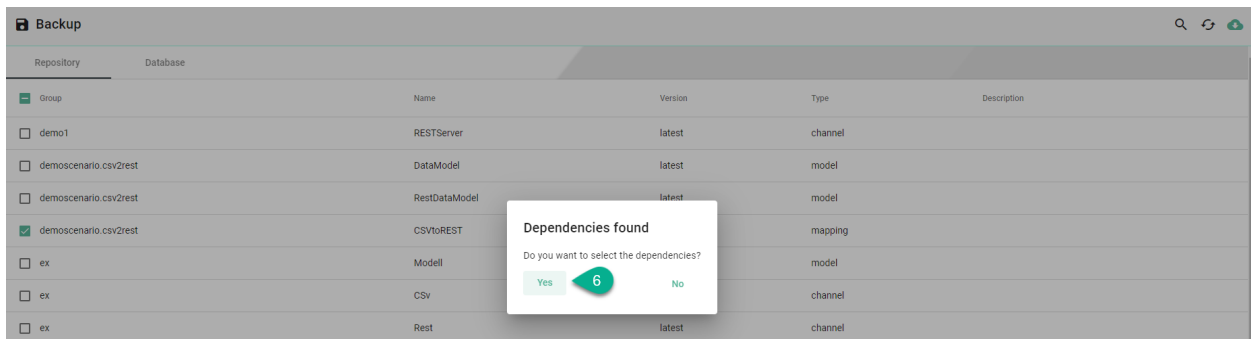




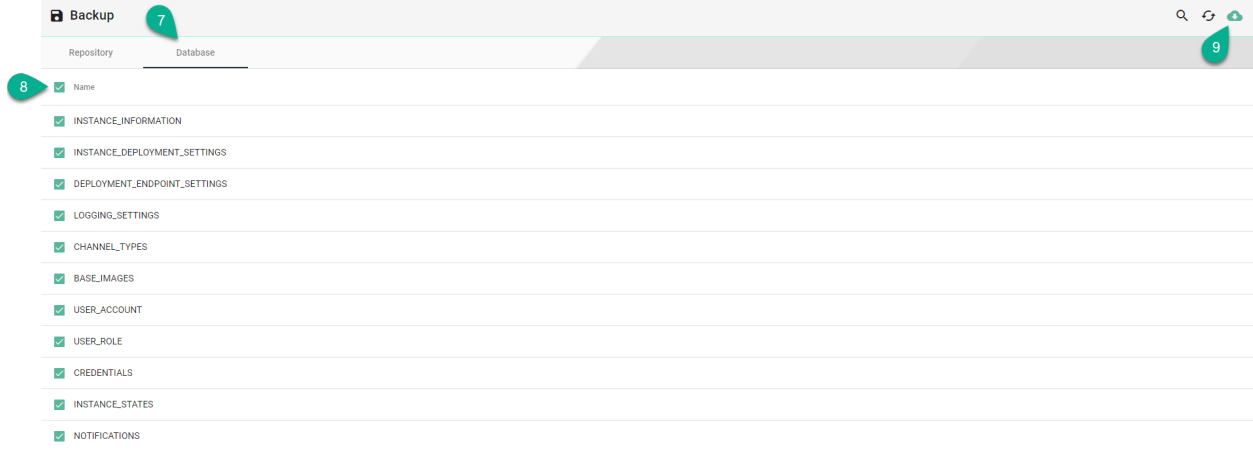
- The configuration components (Repository) are visible. Check the boxes (4) to select what to backup or check the top box (5) to select all.



- When the selected component has dependencies, a pop-up will appear and click on the Yes button (6) to select all the dependencies.



- Click on the **Database** tab (7) and select the desired tables (8) for backup.



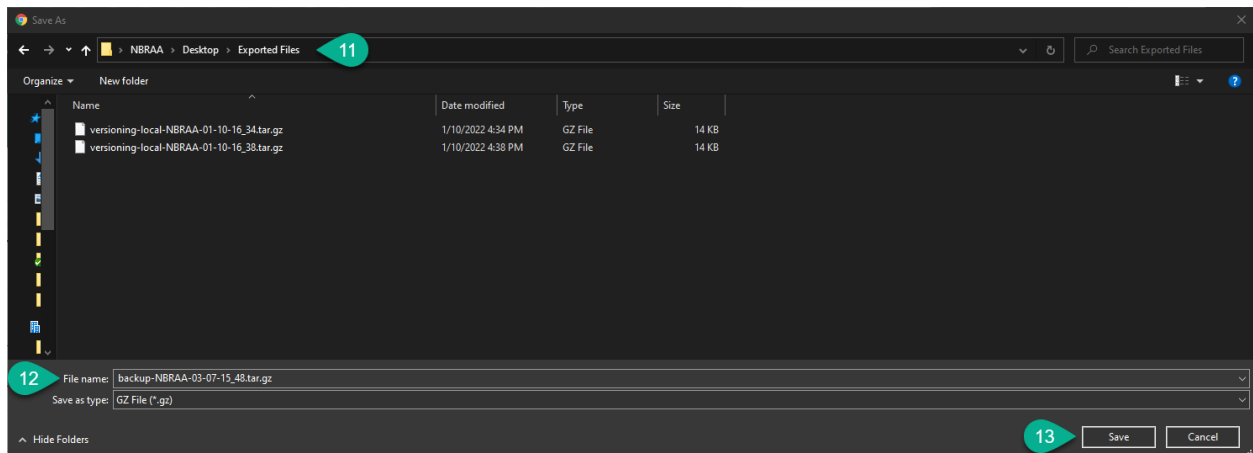
- After the desired components are selected, click on the **Backup** button (9). Click on the **Yes** button (10) to confirm.

## Backup Repository?

Are you sure you want to backup the Unifier Repository? This might take a long time based on the size of the repository



- Choose the path (11) and the name (12) to save the repository **TAR** file then click on the **Save** button (13) to finish.



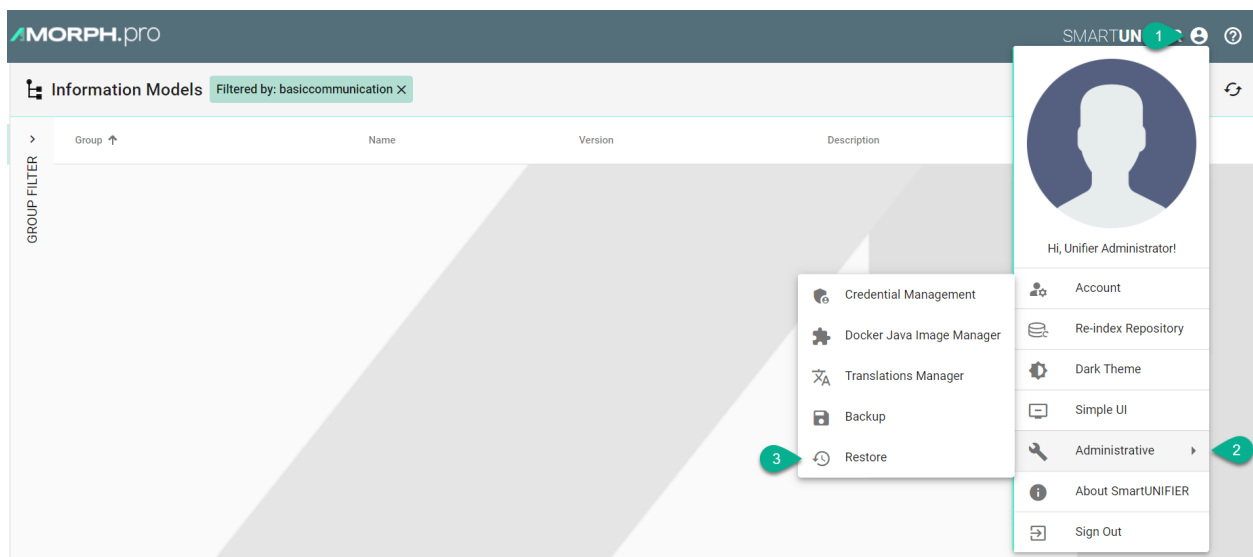
### 5.2.3 Restore

The Restore feature allows to copy the SMARTUNIFIER configuration components from a backup to the original location.

**Note:** When restoring, the existing configuration components will be overwritten by with the selected configuration components from the backup if the name match!

Follow the steps described below to restore the SMARTUNIFIER repository:

- Select the **Account** icon (1), go to the **Administrative** section (2) and select the **Restore** option (3).



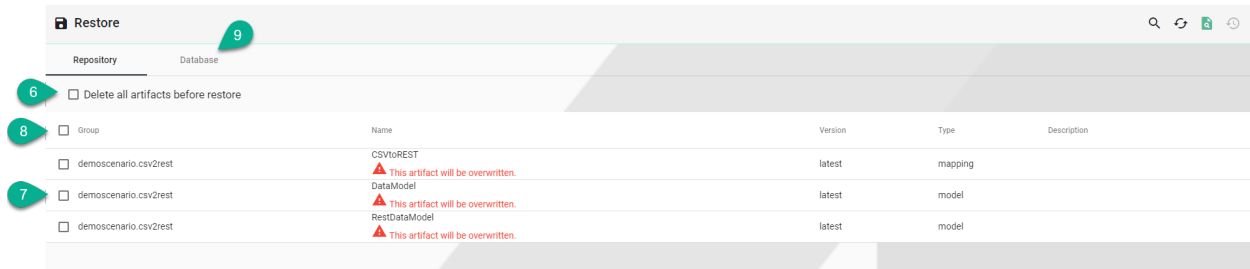
- A pop-up appears, choose the **TAR** file to restore (4) and select the **Yes** button (5) to confirm.

### Restore Repository?

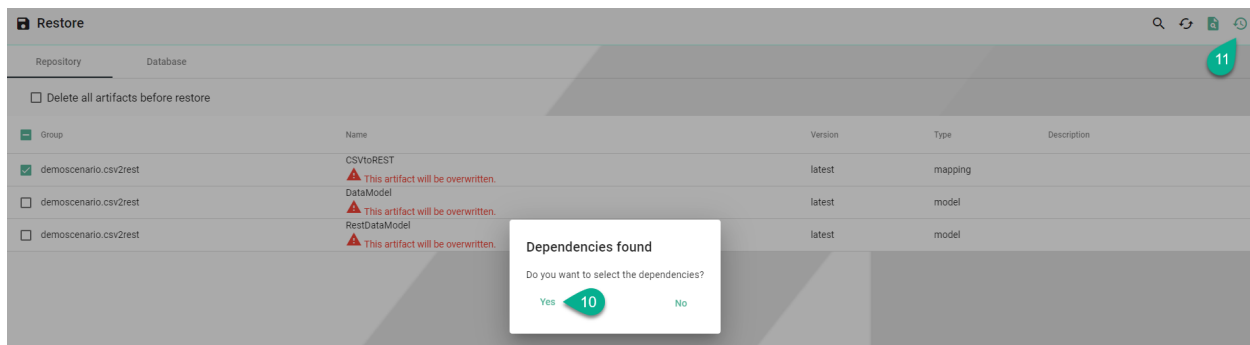
Are you sure you want to restore a Unifier Repository? All existing data will be overwritten!



- The backup configuration components (Repository) are visible.
- If needed, check the box (6) to delete all existing components, before restoring.
- Check the boxes (7) to select what to restore or check the top box (8) to select all. Do the same for **Database** tab (9) if needed.



- If a component from the current configuration (if any) has the same name as one from the backup, it will be overwritten.
- When the selected component has dependencies, a pop-up will appear and click on the **Yes** button (10) to select all the dependencies.



- After the desired components are selected, click on the **Restore** button (11).
- The configuration components are uploading and all existing data will be overwritten!
- The uploading progress is displayed, including errors, if any.

```

INFO: Restored 1 mapping source control repositories
INFO: Restored 1 model source control repositories
INFO: Creating workspace for demoscenario.csv2rest:DataModel:latest
INFO: Building demoscenario.csv2rest:DataModel:latest..
INFO: Publishing demoscenario.csv2rest:DataModel:latest..
INFO: Success
INFO: Creating workspace for demoscenario.csv2rest:CSVtoREST:latest
INFO: Building demoscenario.csv2rest:CSVtoREST:latest..
INFO: Publishing demoscenario.csv2rest:CSVtoREST:latest..
INFO: ***** SUMMARY *****
INFO: model demoscenario.csv2rest:DataModel:latest successfully released
INFO: mapping demoscenario.csv2rest:CSVtoREST:latest successfully released

```

12 Close

- Click on the **Close** button to finish (12).

## 5.2.4 Manager Backup

In order to backup SMARTUNIFIER Manager make a copy of the SMARTUNIFIER installation package.

Before the backup make sure to remove the following directories:

- temp
- workspace
- log
- deploy

Name	Date modified	Type	Size
bin	31.08.2021 07:10	File folder	
conf	07.09.2021 17:16	File folder	
jre	31.08.2021 07:10	File folder	
keystore	07.09.2021 17:16	File folder	
lib	31.08.2021 07:10	File folder	
licenses	31.08.2021 07:10	File folder	
log	07.09.2021 17:16	File folder	
manual	31.08.2021 07:10	File folder	
repository	31.08.2021 07:10	File folder	
scala	31.08.2021 07:10	File folder	
versioning	07.09.2021 17:16	File folder	
UnifierManager.bat	31.08.2021 07:10	Windows Batch File	1 KB

## 5.3 Channel Types Manager

By default, the Channel Types Manager displays all *Channels* included in your current version of SMARTUNIFIER.

*Communication Channels* that should be used within the configuration of a SMARTUNIFIER Communication Instance have to exist in the Channel Types Manager. How to add new Channel Types is shown in the *section below*.

### 5.3.1 How to access

Follow the steps bellow to access the Channel Types Manager:

- Click on the **Account** icon (1) and select the **Advanced UI** (2).



- Click on the **Channel Types** button (3) to open the Channel Types perspective.



- The main view of the Channel Types is visible.

Group	Name	Version	Description
com.amorphsys.unifier.channel	Sql Database	1.0.0	
com.amorphsys.unifier.channel	InfluxDB	1.0.0	
com.amorphsys.unifier.channel	In Memory	1.0.0	
com.amorphsys.unifier.channel	Iso-On-Tcp Client	1.0.0	
com.amorphsys.unifier.channel	Modbus Tcp Client	1.0.0	
com.amorphsys.unifier.channel	OPC UA Server	1.0.0	
com.amorphsys.unifier.channel	OPC UA Client	1.0.0	
com.amorphsys.unifier.channel	Rest Server	1.0.0	
com.amorphsys.unifier.channel	Rest Client	1.0.0	
com.amorphsys.unifier.channel	SecsGem Client	1.0.0	
com.amorphsys.unifier.channel	Websocket client (JSON)	1.0.0	
com.amorphsys.unifier.channel	Websocket client (XML)	1.0.0	
com.amorphsys.unifier.channel	Websocket client (CSV)	1.0.0	
com.amorphsys.unifier.channel	SFTP file writer (JSON)	1.0.0	
com.amorphsys.unifier.channel	SFTP file writer (XML)	1.0.0	

**Note:** The Channel Types Manager can only be accessed by user accounts with an administrator role assigned.

### 5.3.2 About Layers

Implementations of SMARTUNIFIER Communication Channels consist of one and up to three so-called layers.

The target of layers is to transform data from Information Models into the respective data format of the specific protocol used in case the data traffic is outgoing from a SMARTUNIFIER Communication Instance. The same principle applies when data is incoming.

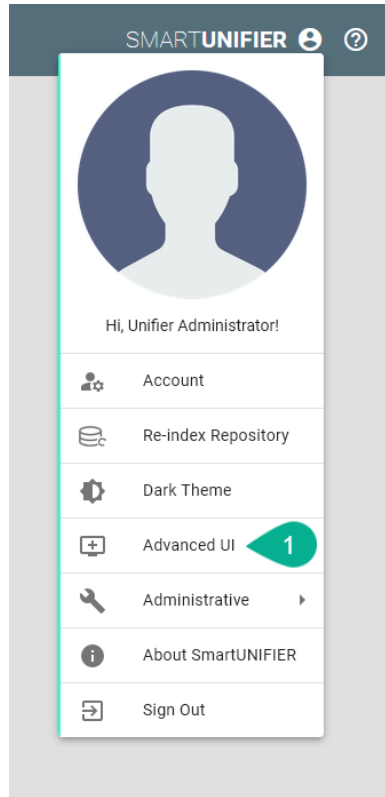
As an example for such a layer stack you can see below the layer stack for the *MQTT Communication Channel*:

- Data that is incoming from a Device is transformed into a String behind the scene.
- The String is then converted into a JSON Object.
- Finally, the JSON is used to assign data to the assigned Information Model.

### 5.3.3 How to create a new Channel Type

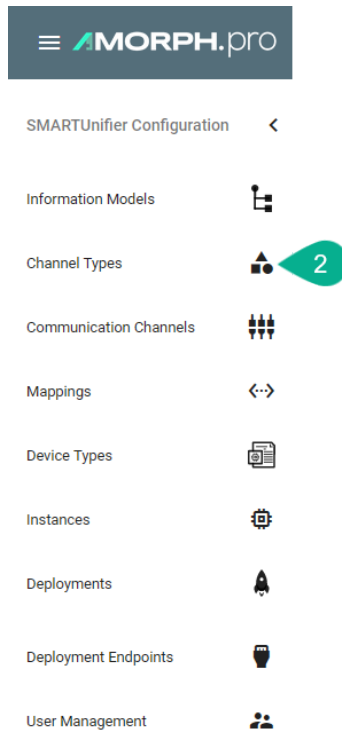
Follow the steps below to create a new Channel Type:

1. Open the SMARTUNIFIER menu and select **Advanced UI**.

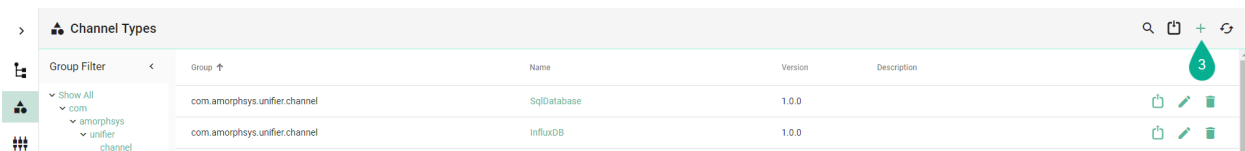


2. Go to the Channel Types perspective by clicking the **Channel Types** button.





3. Click on the **Add** button in the upper right corner.



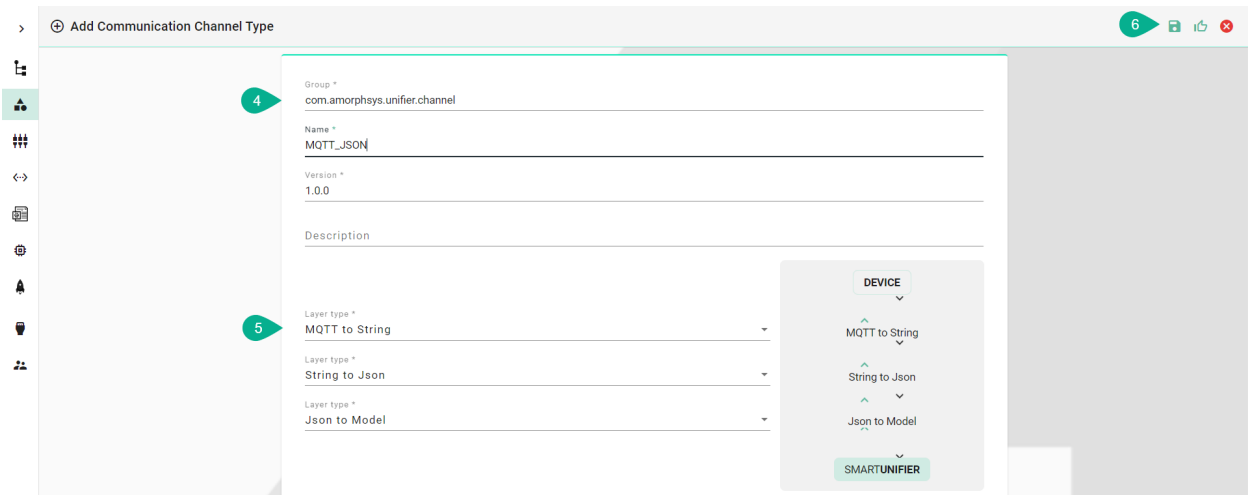
4. Enter some descriptive information:

- Enter a **group**
- Enter the **name** of the Channel
- Enter a **version**

5. Next, define the layer stack of the new Channel Type:

- Select a layer with the **Layer type** drop-down menu.
- In case the selected layer has more layers dependent on itself, select again another layer with the **Layer type** drop-down menu showing up below.

6. To save the Communication Channel Type select the **Save** button.



## 5.4 Docker Java Image Manager

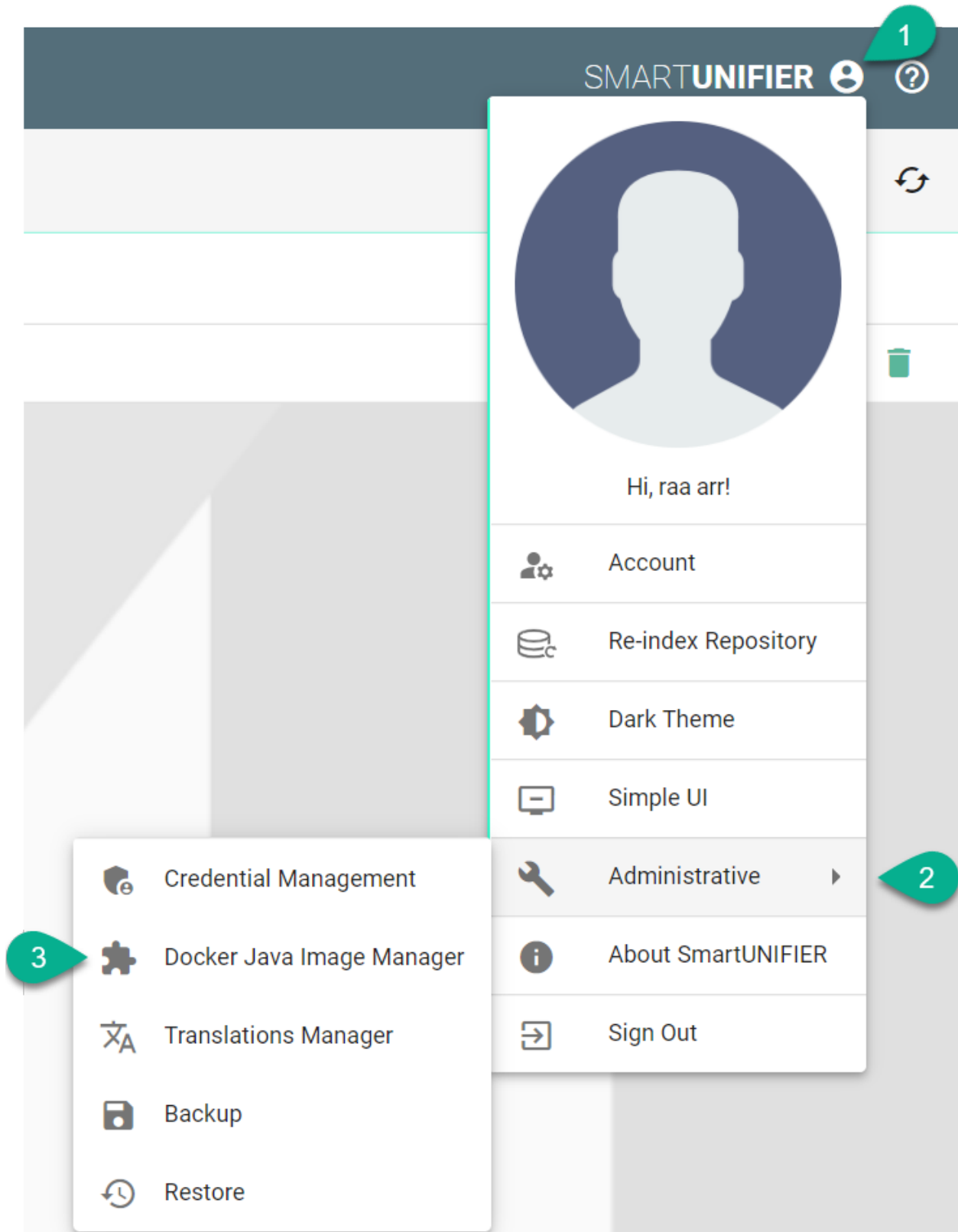
SMARTUNIFIER supports the Deployment of Instances using Docker Containers using different Java base images. With the Docker Java Images Manager, the user can create and maintain different versions of Docker Java images.

This feature can only be accessed by a user with the administrator role.

### 5.4.1 How to access

Follow the steps bellow to access the Docker Java Image Manager:

- Click on the **Account** icon (1), go to **Administrative** section (2) and select the **Docker Java Image Manager** option (3).



- The Docker Java Image Manager is visible.

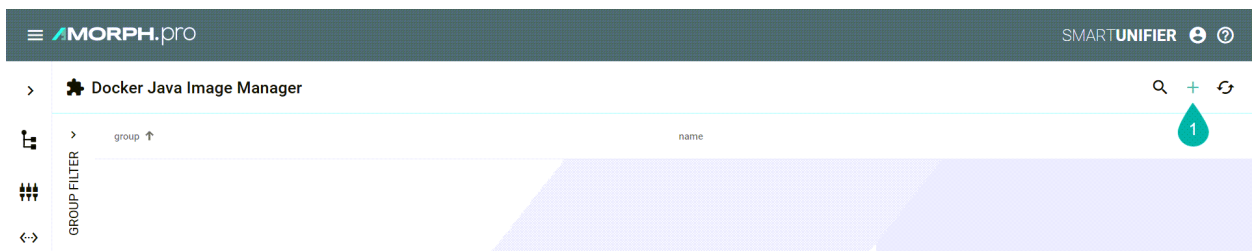


**Note:** The Docker Java Image Manager can only be accessed by user accounts with an administrator role assigned.

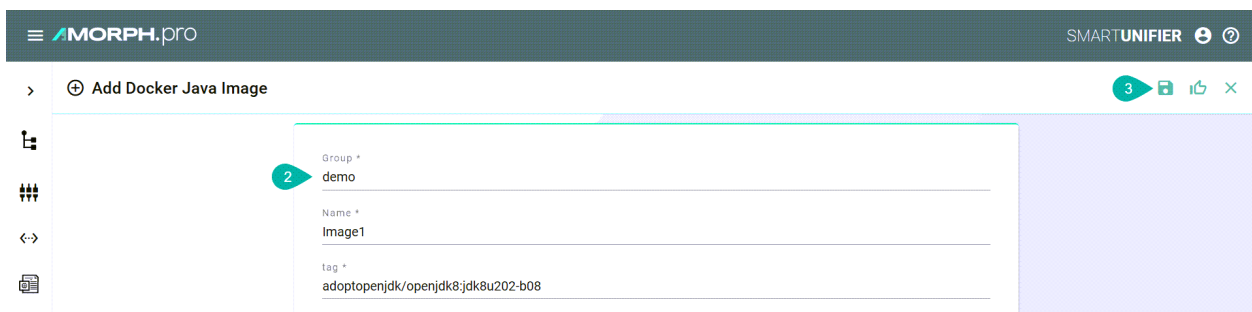
## 5.4.2 Add a New Docker Java Image

Follow the steps described below to add a new Docker Java image:

- Click on the **Add** button (1).

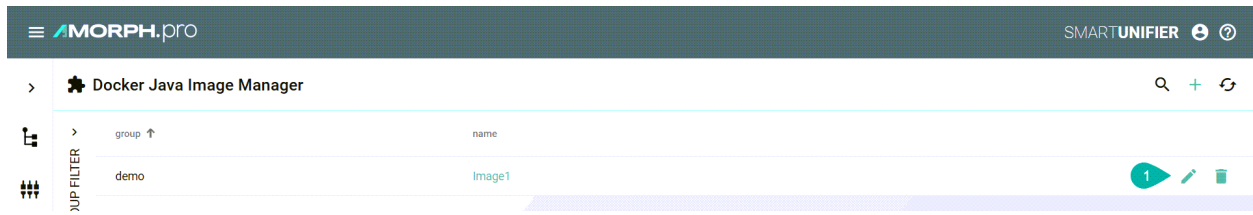


- In the *Add Docker Java Image* view, a set of configuration parameters is required (2): \* Provide a **Group** and a **Name** \* Provide a **tag** e.g., adoptopenjdk/openjdk8:jdk8u202-b08
- After all mandatory fields are filled in, click the **Save** button (3).



### 5.4.3 Edit a Docker Java Image

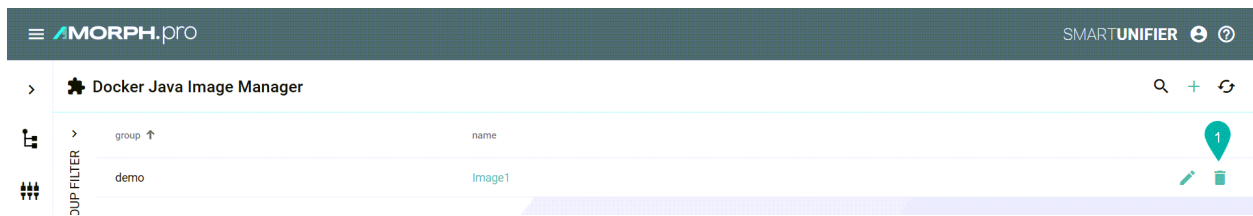
To edit a Docker Java image, select the **Edit** button (1).



The Docker Java image is in the Edit Mode, the configuration parameters can be edited and then save the session by selecting the **Save** button.

### 5.4.4 Delete a Docker Java Image

To delete a Docker Java image, select the **Delete** button (1).



A pop-up confirmation appears, select the **Delete** button.

## 5.5 Deployment Endpoints

### 5.5.1 What are Deployment Endpoints

Deployment Endpoints are used to identify the location of a Deployment (i.e., the definition where an Instance is executed). With the Deployment Endpoints, you can create and maintain those locations. This feature can only be accessed by a user with the administrator role.

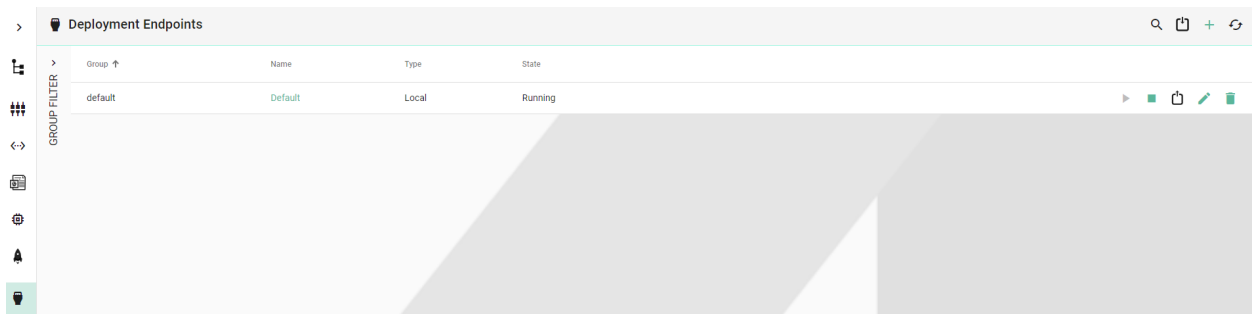
### 5.5.2 How to access

Follow the steps bellow to access the Deployment Endpoints:

- Click on the **Deployment Endpoints** button (1) to open the Deployment Endpoints perspective.



- The main view of the Deployment Endpoints is visible.



**Note:** The Deployment Endpoints can only be accessed by user accounts with an administrator role assigned.

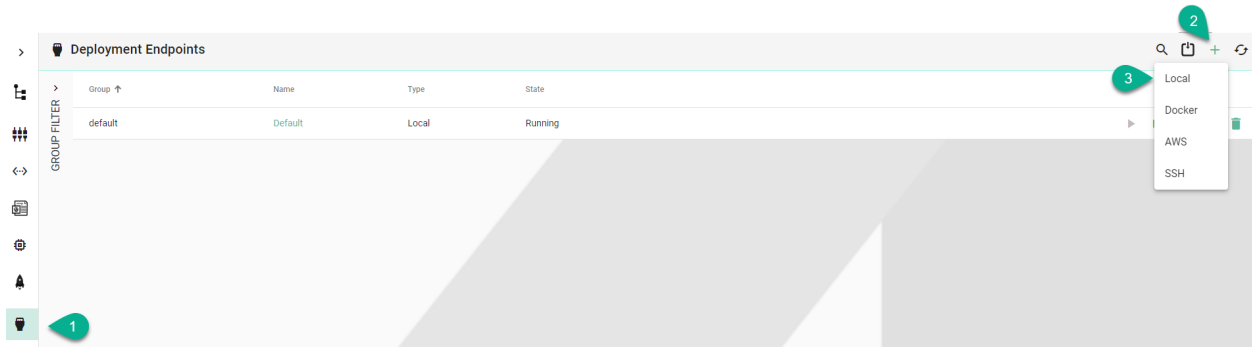
### 5.5.3 Deployment Endpoints Types

#### Local

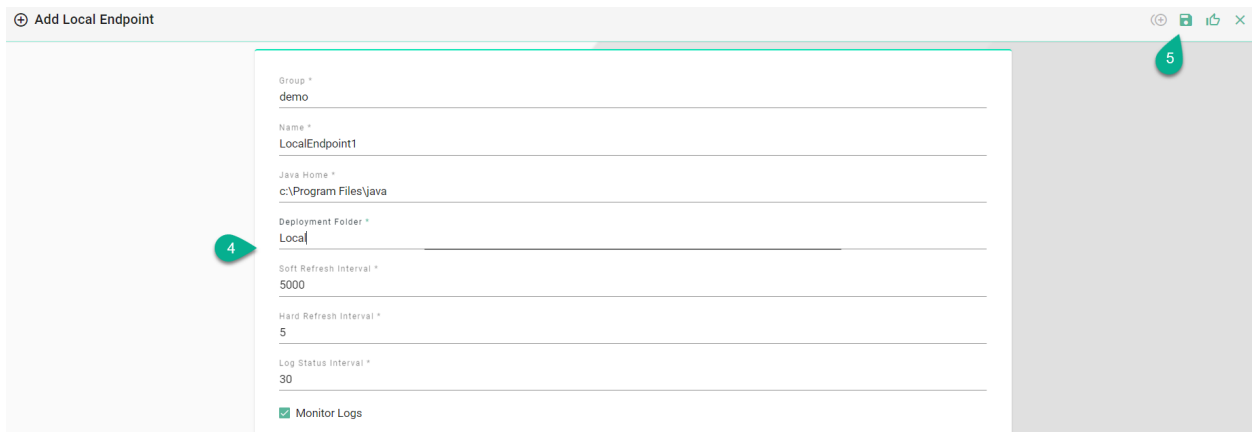
SMARTUNIFIER supports Endpoint for Local Deployment. A **Default Local Endpoint** is preconfigured.

Follow the steps described below to create a Local Deployment Endpoint:

- Navigate to the SMARTUNIFIER Deployment Endpoints perspective (1).
- Click on the **Add Endpoint** button (2).
- Select the Deployment Type **Local** from the pop-up (3).



- In the **Add Endpoint** view a set of configuration parameters is required (4)
  - Provide a **Group** and a **Name**
  - Input the path for **Java**
  - Provide the **Deployment Folder**
  - Configure the **Soft/Hard Refresh Interval** and the **Log Status Interval** (in milliseconds)
  - Enable **Monitor Logs** (optionally)

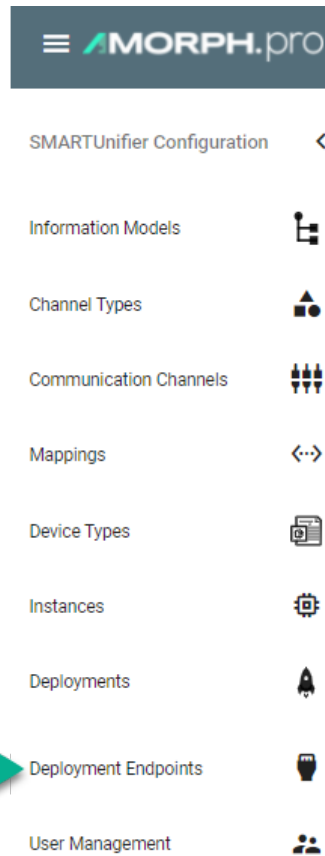


- After all mandatory fields are filled in, click the **Save** button (5).

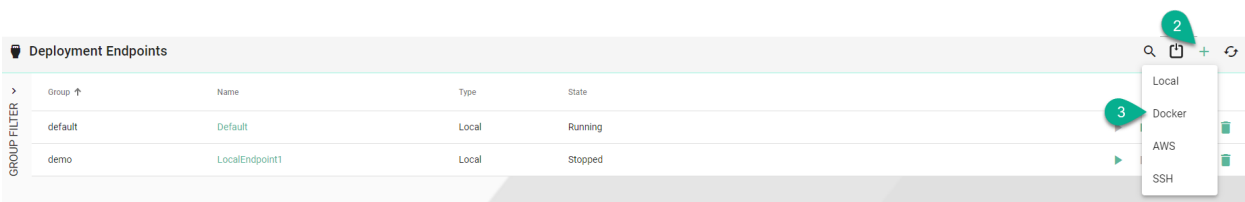
## Docker

SMARTUNIFIER supports the Deployment of Instances using Docker Containers. Before creating a new Deployment for an Instance using Docker, install Docker on your device and open up the [Docker Remote API Interface](#). If you want to learn more about Docker and how to install it, visit the [Docker Website](#). When your Docker Daemon is up and running you must provide a Docker endpoint.

- Navigate to the SMARTUNIFIER Deployment Endpoints perspective (1).



- Click on the **Add Endpoint** button (2).
- Select the Deployment Type **Docker** from the pop-up (3).



- In the **Add Endpoint** view a set of configuration parameters is required (4)
  - Provide a **Group** and a **Name**
  - Provide **URL**. Depending on your use case choose between the **unix** e.g., `unix:///var/run/docker.sock` or the **tcp** e.g., `tcp://127.0.0.1:2375` **protocol**.
  - If needed, enable **TLS** by enabling the checkbox
- After all mandatory fields are filled in, click the **Save** button (5).



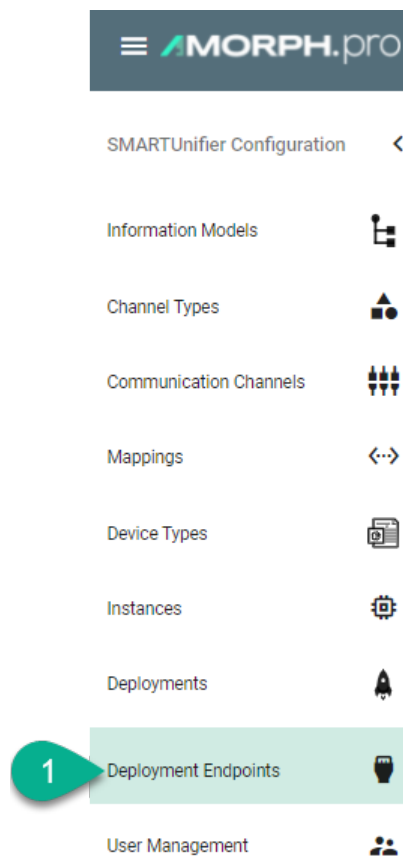


## AWS

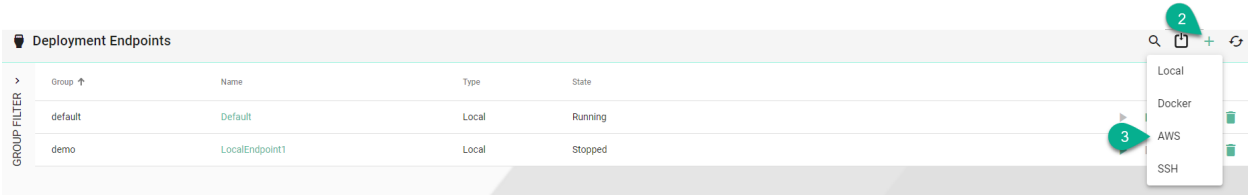
Before deploying a SMARTUNIFIER Instance on AWS Fargate you need to create an AWS Deployment Endpoint. The AWS Deployment Endpoint specifies, which AWS account should be used for the deployment.

Follow the steps described below to create an AWS Deployment Endpoint:

- Select the SMARTUNIFIER Deployment Endpoints perspective (1).

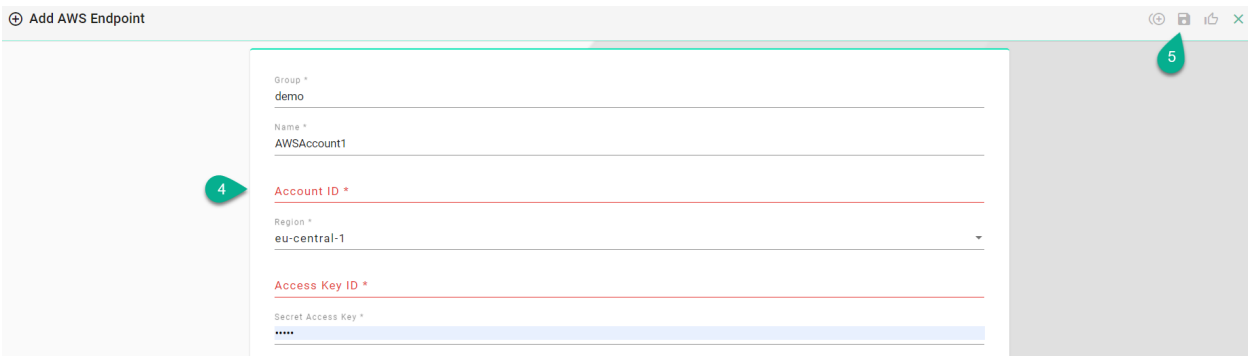


- Click the **Add** button (2).
- Select the Deployment Type **AWS** from the pop-up (3).



GROUP FILTER	Group ↑	Name	Type	State
	default	Default	Local	Running
	demo	LocalEndpoint1	Local	Stopped

- Configure your AWS account by entering the following parameters (4):
  - Enter a **Group** and a **Name**.
  - Enter your **AWS Account ID**.
  - Select the **Region**.
  - Enter the **Access Key ID** and the **Secret Access Key** that allows SMARTUNIFIER to connect to your AWS account.
- Save the new Endpoint by clicking the **Save** button (5):



⊕ Add AWS Endpoint

Group \*  
demo

Name \*  
AWSAccount1

Account ID \*

Region \*  
eu-central-1

Access Key ID \*

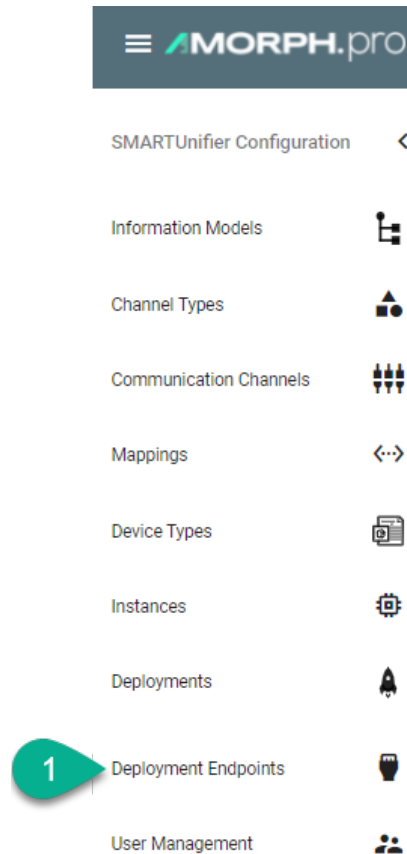
Secret Access Key \*  
\*\*\*\*\*

Save

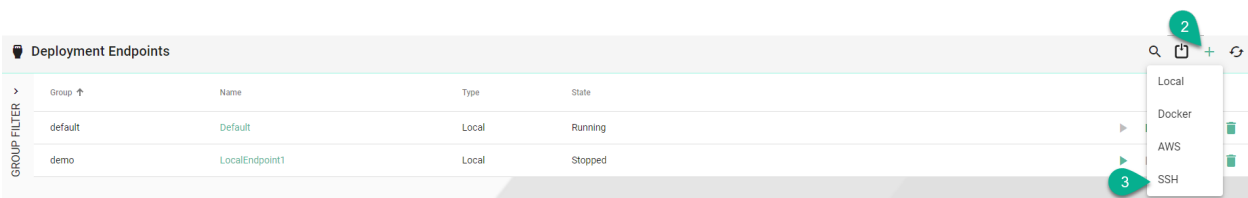
## SSH

SMARTUNIFIER supports the Deployment of Instances using SSH protocol.

- Navigate to the SMARTUNIFIER Deployment Endpoints perspective (1).



- Click on the **Add Endpoint** button (2).
- Select the Deployment Type **SSH** from the pop-up (3).



- In the **Add Endpoint** view a set of configuration parameters is required (4)
  - Provide a **Group** and a **Name** .
  - Provide the VM **Hostname**. The default used port is **22**.
  - Provide the **Username** and the **Password** .
  - If needed, input **Private Key** for secured connections.
  - Provide the **Java Home** path.
  - Provide the **Deployment Folder** path.
- After all mandatory fields are filled in, click the **Save and Close** button (5).

⊕ Add SSH Endpoint

Group \*  
demo

Name \*  
VM1

Hostname \*  
192.168.56.101

Port \*  
22

Username \*  
ubuntu

Password  
\*\*\*\*\*

Private Key

Connect Timeout \*  
5000

Java Home \*  
usr/lib/jvm/java-11-openjdk-amd64/

Deployment Folder \*  
/opt/amorph/smartunifier/deploy/

Soft Refresh Interval \*  
5000

Hard Refresh Interval \*  
5

### 5.5.4 Deployment Endpoints States

A Deployment Endpoint can have the following states:

- **Stopped** - The Stop command has been sent and the Deployment Endpoint is stopped
- **Starting** - The Start command has been sent
- **Running** - Deployment Endpoint is up and running
- **Failure** - The Start command has been sent and the Deployment Endpoint has failed to start

Deployment Endpoints

Group Filter	Group	Name	Type	State	
▼ Show All default demo	default	Default	Local	Running	▶ ■ 🔄 🗑️
	demo	DockerE1	Docker	Stopped	▶ ■ 🔄 🗑️
	demo	SSHE2	SSH	Failure	▶ ■ 🔄 🗑️

For the **Failure** state, hover over it (1) and a pop-up will display the error (2).

Deployment Endpoints

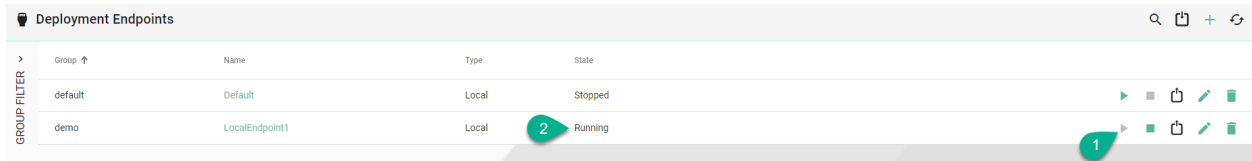
GROUP FILTER	Group	Name	Type	State	
>	default	Default	Local	Running	▶ ■ 🔄 🗑️
	demo	DockerE1	Docker	Stopped	▶ ■ 🔄 🗑️
	demo	SSHE2	SSH	Failure	▶ ■ 🔄 🗑️

Failed to create ssh client for 192.168.56.101.22

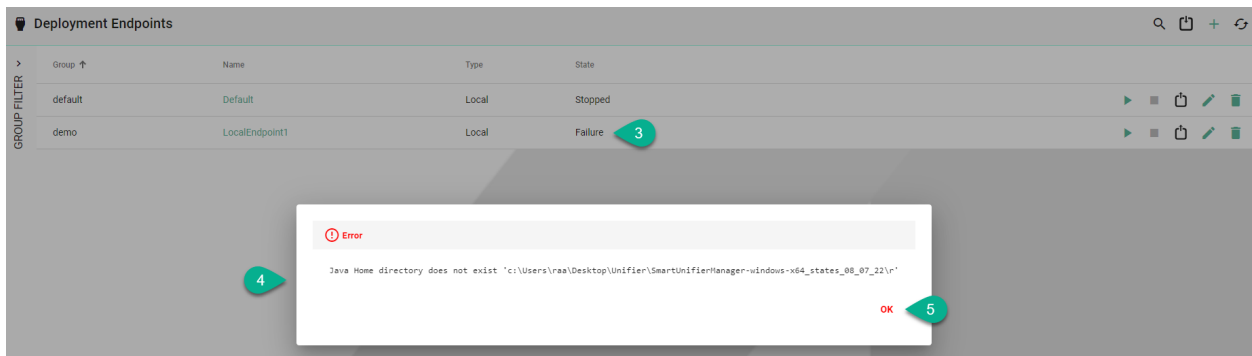
## 5.5.5 Deployment Endpoints Operations

### Start Endpoint

After a Deployment Endpoint is created, its default state is Stopped. To start it, click on the **Start** button (1). The state will change into **Starting** and if it succeeds, the state becomes **Running** (2).



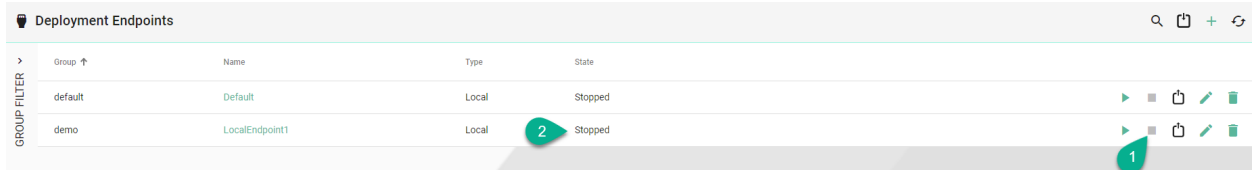
If the Deployment Endpoint fails to start, the state changes into **Failure** (3) and an error message will be displayed (4).



Click on the **OK** button (5) to close the error message.

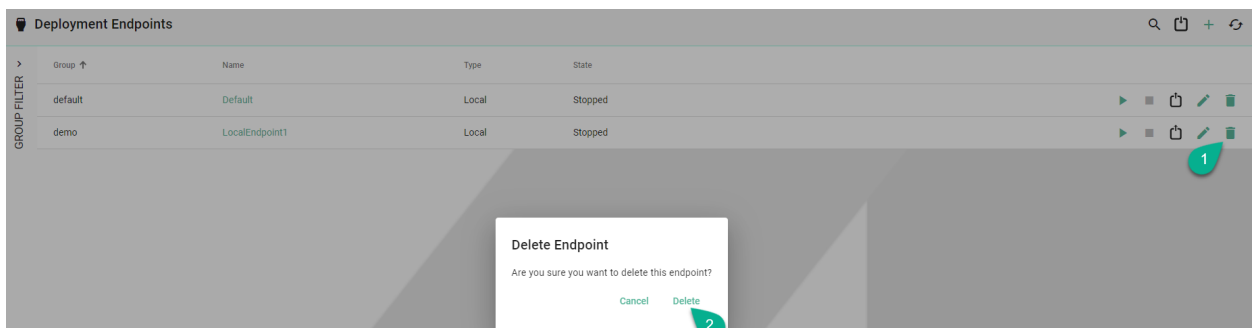
### Stop Endpoint

To stop a Deployment Endpoint, click on the **Stop** button (1) and the state will change accordingly (2).



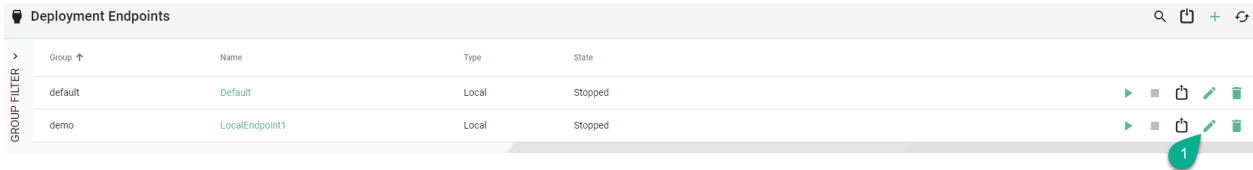
### Delete Endpoint

To remove a Deployment Endpoint, click on the **Delete** button (1) and confirm the action (2).



## Edit Endpoint

To edit a Deployment Endpoint, click on the **Edit** button (1).



In the Deployment Endpoint edit view update the configuration (2) and click on the **Save** button (3).



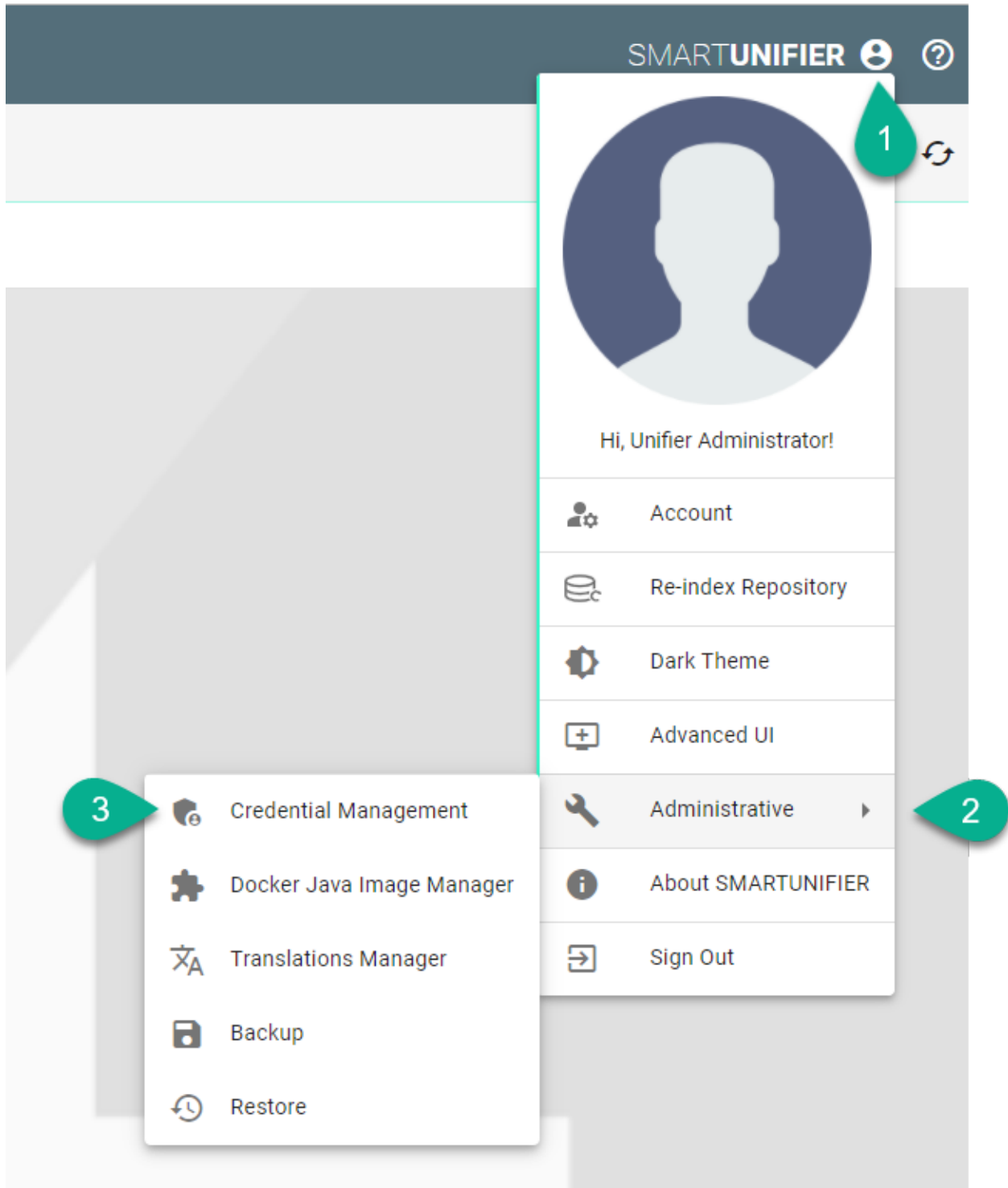
## 5.6 Credential Management

Within the Credential Manager the user can store and manage the credentials needed for the Communication Channel configuration (e.g., password for certificates, username and password for SQL Server).

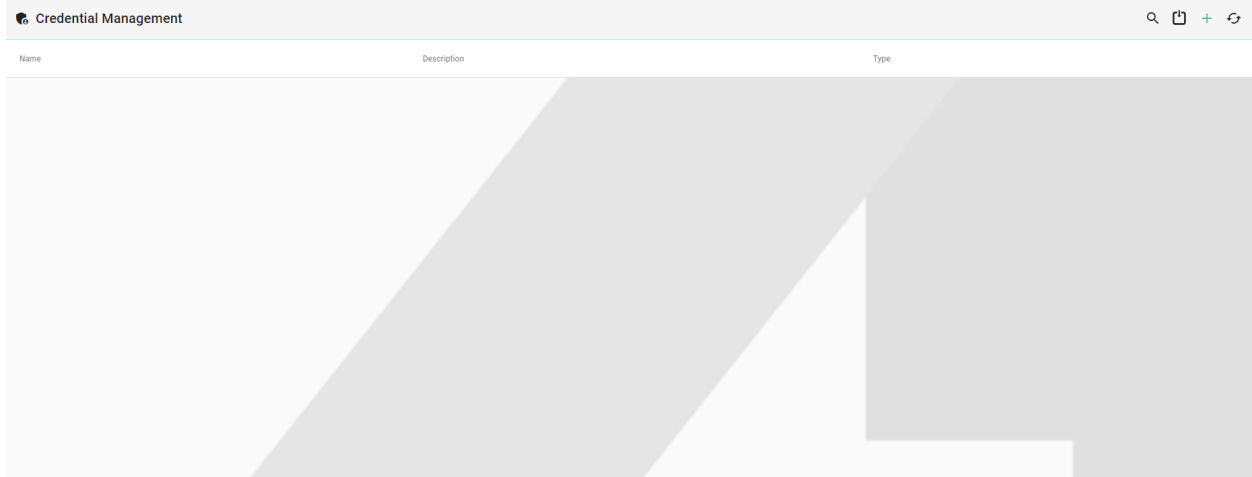
### 5.6.1 How to access

Follow the steps bellow to access the Credential Management:

- Click on the **Account** icon (1), go to **Administrative** section (2) and select the **Credential Management** option (3).



- The Credential Management is visible.

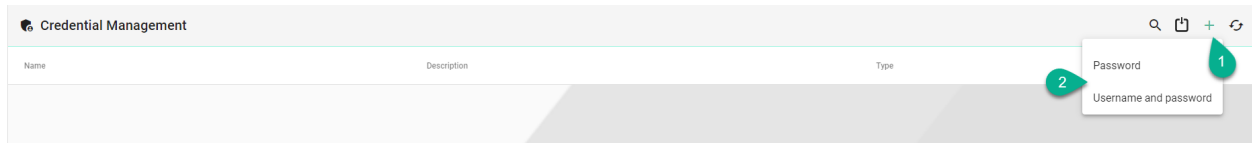


**Note:** The Credential Management can only be accessed by user accounts with an administrator role assigned.

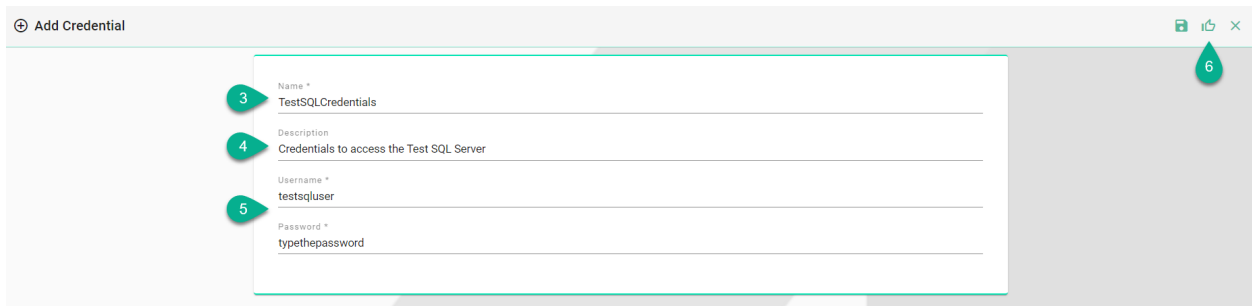
## 5.6.2 Add Credentials

Follow the steps described below to add credentials:

- Click on the **Add** button (1).
- Select an option (2) Password or Username and Password.





- Type a name for Credentials (3).
- Add description (4) (optional).
- Input the Username and Password (5).






- Click on the **Save and Close** button (6).



Credential Management			🔍 📄 + ↻
Name	Description	Type	
TestSQLCredentials	Credentials to access the Test SQL Server	UserNameAndPassword	 

### 5.6.3 Edit Credentials

To edit the credentials, select the **Edit** button (1).




Credential Management			🔍 📄 + ↻
Name	Description	Type	
TestSQLCredentials	Credentials to access the Test SQL Server	UserNameAndPassword	  

The Edit Mode is visible, the configuration can be edited (2) and then save the session by selecting the **Save and Close** button (3).

Edit Credential: TestSQLCredentials		📄 🔄 ✕
	<p>Name *</p> <input type="text" value="TestSQLCredentials"/>	
	<p>Description</p> <input type="text" value="Credentials to access the Test SQL Server"/>	
	<p>Username *</p> <input type="text" value="testsqluser"/>	
	<p>Password *</p> <input type="password" value="typethepassword"/>	

### 5.6.4 Delete Credentials


To delete credentials, select the **Delete** button (1).

Credential Management			🔍 📄 + ↻
Name	Description	Type	
TestSQLCredentials	Credentials to access the Test SQL Server	UserNameAndPassword	  

A pop-up confirmation appears, select the **Delete** button (2).

**Delete credential**

Are you sure you want to delete this credential?

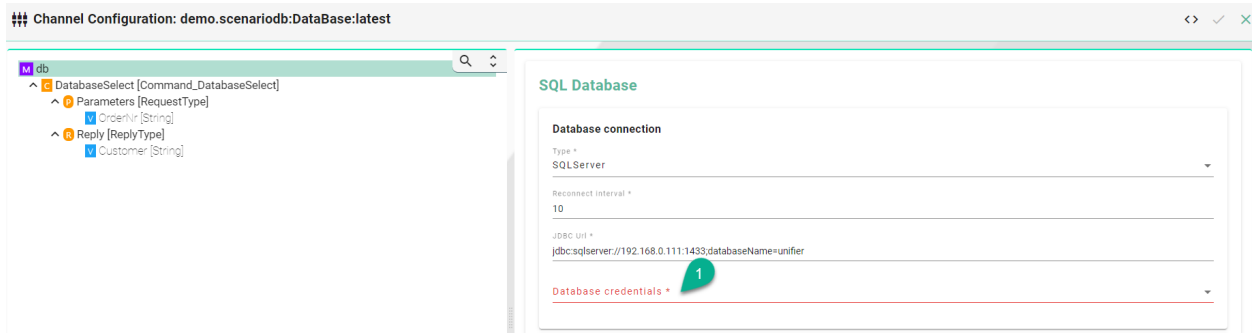


## 5.6.5 Using Credential Manager when configuring the Communication Channels

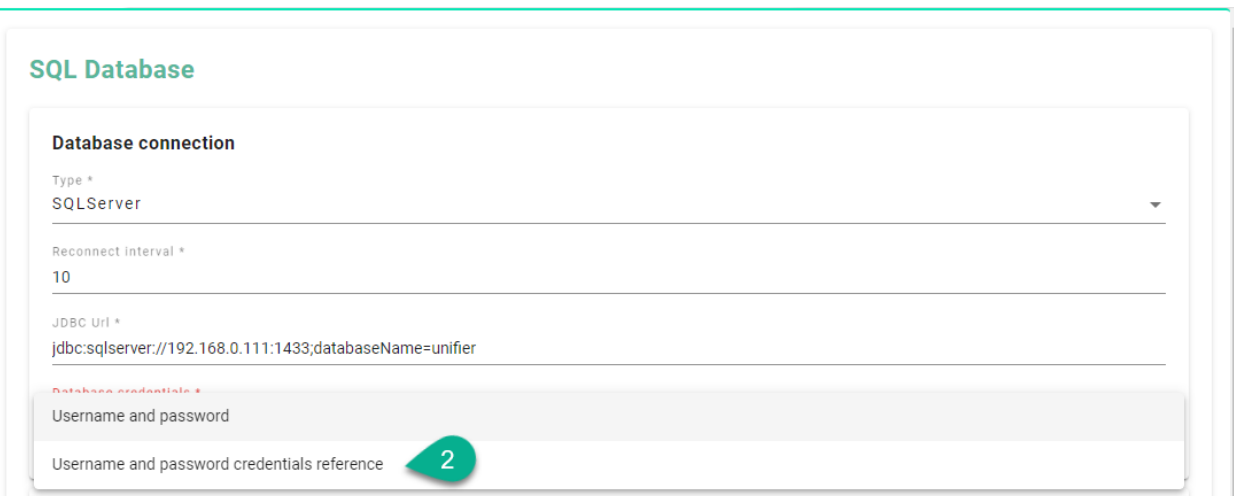
When configuring the Communication Channels, the user has the option to manually input the credentials or to select one from the Credential Manager.

Example of Database Communication Channel configuration:

- Click on the **Database credentials** field (1).



- Select the **Username and password credentials reference** option (2).



- Click on the **Credentials Manager Selector** option (3).

### SQL Database

**Database connection**

Type \*  
SQLServer

Reconnect interval \*  
10

JDBC Url \*  
jdbc:sqlserver://192.168.0.111:1433;databaseName=unifier

Database credentials \*  
Username and password credentials reference

**Username and password credentials reference**

Credentials Manager Selector **3**

- Select one of the credentials from the list (4).

### SQL Database

**Database connection**

Type \*  
SQLServer

Reconnect Interval \*  
10

JDBC Url \*  
jdbc:sqlserver://192.168.0.111:1433;databaseName=unifier

Database credentials \*  
Username and password credentials reference

**Username and password credentials reference**

Credentials Manager Selector

+ Add credentials

TestSQLCredentials **4**

raa

- If the credentials are not saved in the Credentials Manager, click on the **Add credentials** option (5).

### SQL Database

**Database connection**

Type \*  
SQLServer

Reconnect Interval \*  
10

JDBC Uri \*  
jdbc:sqlserver://192.168.0.111:1433;databaseName=unifier

Database credentials \*  
Username and password credentials reference

**Username and password credentials reference**

*Credentials Manager Selector*

+ Add credentials **5**

TestSQLCredentials

raa

- Input the credentials details **(6)** and click on the **Save and Close** button **(7)**.

**+ Add Credential** 📄 🔄 ✕

**6**

Name \*  
DevSQLCredentials

Description  
Credentials to access the Dev SQL Server

Username \*  
devsqluser

Password \*  
typethepassword

**7**

- The new credentials are saved and added into the configuration **(8)**.

## SQL Database

### Database connection

Type \*

SQLServer

Reconnect interval \*

10

JDBC URL \*

jdbc:sqlserver://192.168.0.111:1433;databaseName=unifier

Database credentials \*

Username and password credentials reference

### Username and password credentials reference

Credentials Manager Selector

DevSQLCredentials

8

## 5.7 User Management

### 5.7.1 About User Management

Within the User Management the administrator can create users accounts, assign permissions as well as activate or deactivate user accounts.

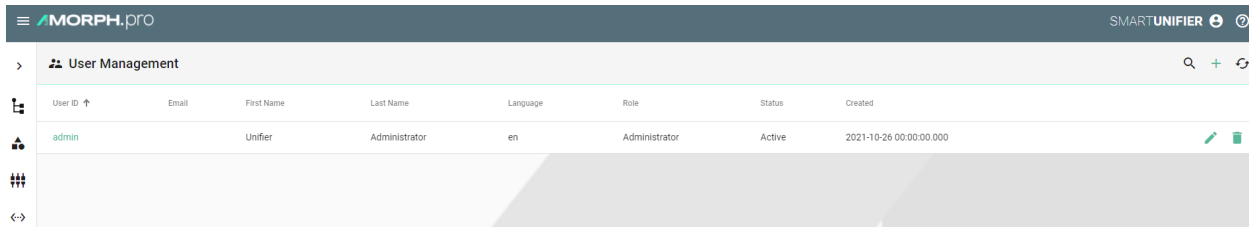
### 5.7.2 How to access

Follow the steps bellow to access the User Management:

- Click on the **Account** icon (1), go to the **Administrative** option (2) and select the **User Management** perspective (3).



- The User Management main view is visible.



**Note:** The User Management can only be accessed by user accounts with an administrator role assigned.

### 5.7.3 Add a new user

This procedure describes how to create a new user account.

- Select the SMARTUNIFIER User Management perspective (1).



- Click the “Add User” button (2).

**User Management** 2 + ↻

User ID	Email	First Name	Last Name	Language	Role	Status	Created
admin		Unifier	Admin	en	Administrator	Active	2020-07-13 00:00:00.000

- In the “Add User” view provide the following information (3):
  - Provide a **user id, first and last name**
  - Optionally, provide an e-mail address
  - Set a preferred language for the *SMARTUNIFIER Manager*.
- The role defines the permission of the user. It is mandatory to assign a role for the user. The following roles are available for use in the SMARTUNIFIER.
  - **Administrator**: Full read and write access for the SMARTUNIFIER Configuration and Administration.
  - **Reader**: Only read access for the SMARTUNIFIER Configuration
  - **Writer**: Read and write access for the SMARTUNIFIER Configuration
- Choose the account status: Active or Inactive.
  - **Active**: User account is activated and ready to use.
  - **Inactive**: User account is deactivated and cannot be used until it is activated again.
- Set an initial password for the first login of the new user.
- After all mandatory fields are filled in, click the “Save” button (4).

**Add User**

User ID \*  
JohnDoe2

Email

First Name \*  
John

Last Name \*  
Doe

Language \*  
English

Role: Writer   
 Administrator   
 Reader   
 Writer

Status: Active   
 Inactive

Credentials  
 Password \*  
 .....  
 8 / 30

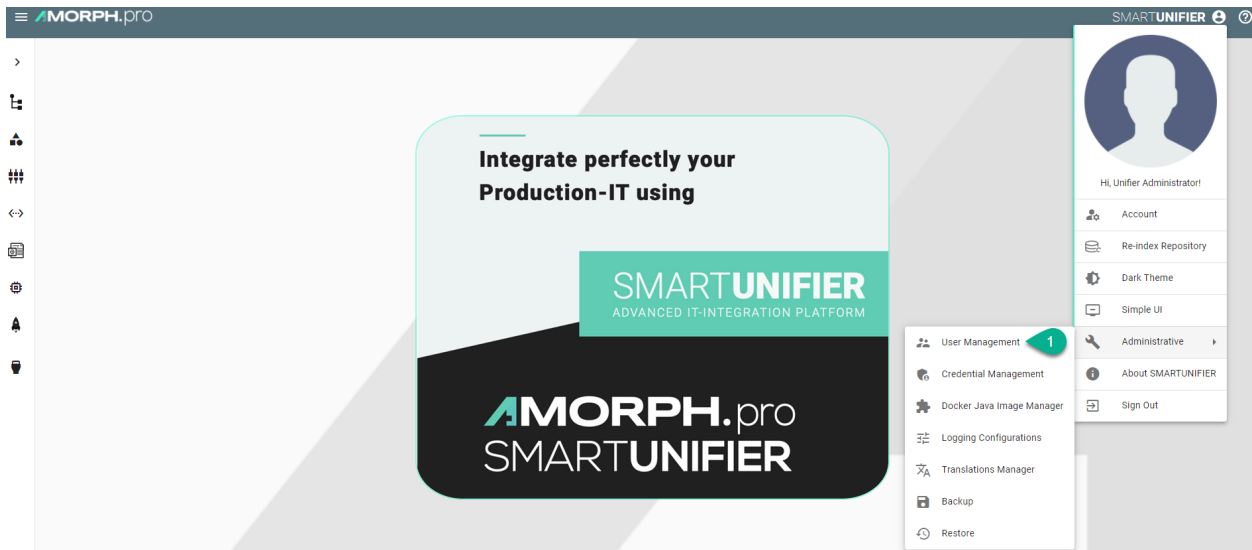
- ✓ contains at least one lower character
- ✓ contains at least one upper character
- ✓ contains at least one digit character
- ✓ contains at least one special character
- ✓ contains at least 4 characters

Confirm password \*  
 .....

### 5.7.4 Edit a user

This procedure describes how to edit an existing user account.

- Select the SMARTUNIFIER User Management perspective (1).



- Click the “Edit” button (2).

**User Management**

User ID ↑	Email	First Name	Last Name	Language	Role	Status	Created
JohnDoe2		John	Doe	en	Reader	Active	2021-03-26 00:00:00.000
admin		Unifier	Administrator	en	Administrator	Active	2021-03-26 00:00:00.000

In the “Edit” view the user account can be redefined (3).



- update the user details: user id, first and last name, email address
- change the language
- edit the user permission: Administrator, Writer or Reader
- **activate** or **inactivate** the user account
- change the password

- After editing, click the “Save” button (4).

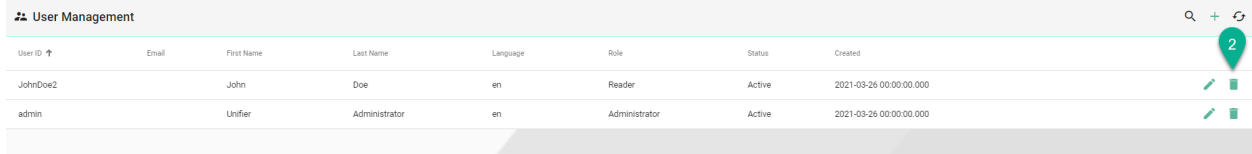
### 5.7.5 Delete a user

This procedure describes how to delete a user account.

- Select the SMARTUNIFIER User Management perspective (1).

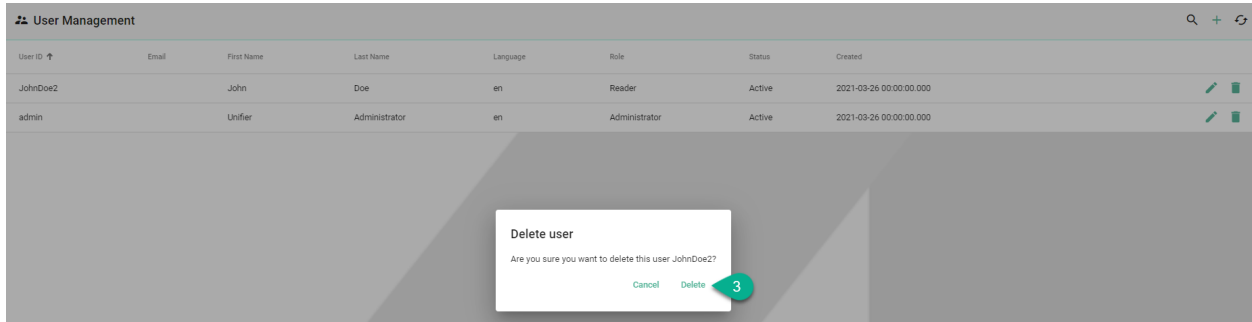


- Click the “Delete” button (2).

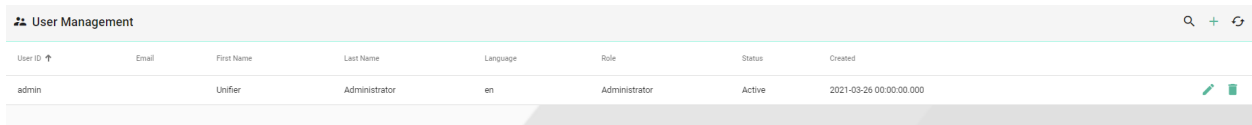


User ID	Email	First Name	Last Name	Language	Role	Status	Created
JohnDoe2		John	Doe	en	Reader	Active	2021-03-26 00:00:00.000
admin		Unifier	Administrator	en	Administrator	Active	2021-03-26 00:00:00.000

Confirm by selecting the “Delete” button (3).



The user account is deleted and no more visible in the SMARTUNIFIER User Management perspective.



User ID	Email	First Name	Last Name	Language	Role	Status	Created
admin		Unifier	Administrator	en	Administrator	Active	2021-03-26 00:00:00.000

## 5.8 Logging Configurations

Log files in SMARTUNIFIER are generated using the [log4j framework](#). The Logging Configuration features enables to create new *log Levels* configurations that can be selected when deploying a Communication Instance.

### 5.8.1 How to access

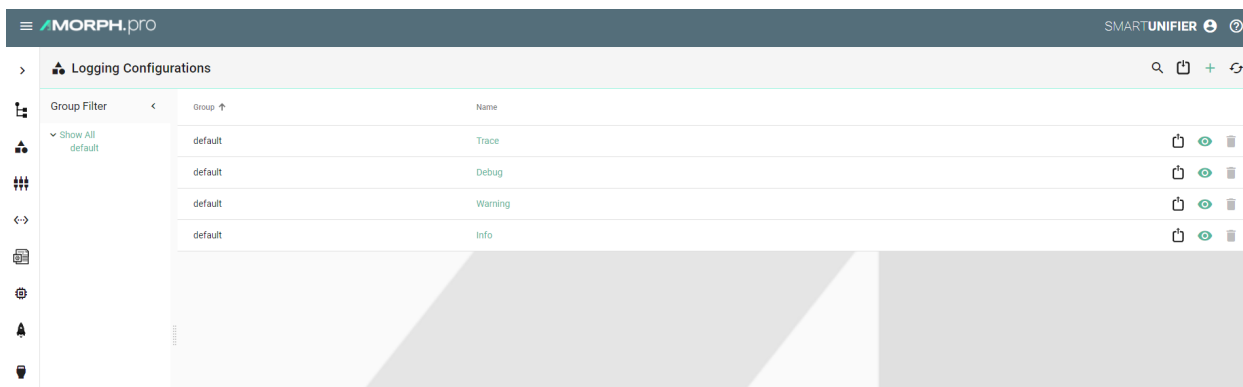
Follow the steps below to access the feature:

- Click on the **Account** icon (1), go to the **Administrative** option (2) and select the **Logging Configurations** perspective (3).



- Logging Configurations main view is visible, as seen below.
- There are four predefined log4j configurations that can be used as template when creating a new log level.

**Note:** The predefined log4j configurations can not be edited or deleted.

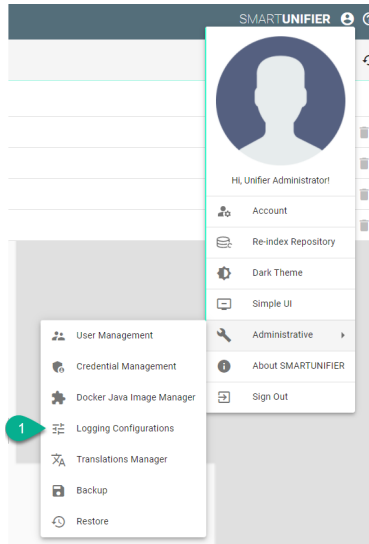


**Note:** This feature can be only used by users with the administration role.

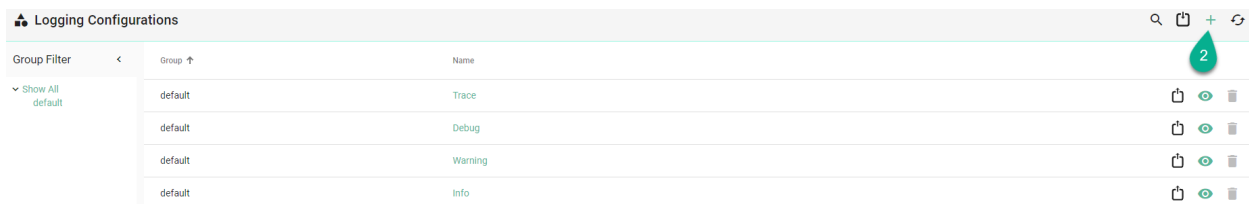
## 5.8.2 Add a new logging file

Follow the steps below to add a new log4j configuration file:

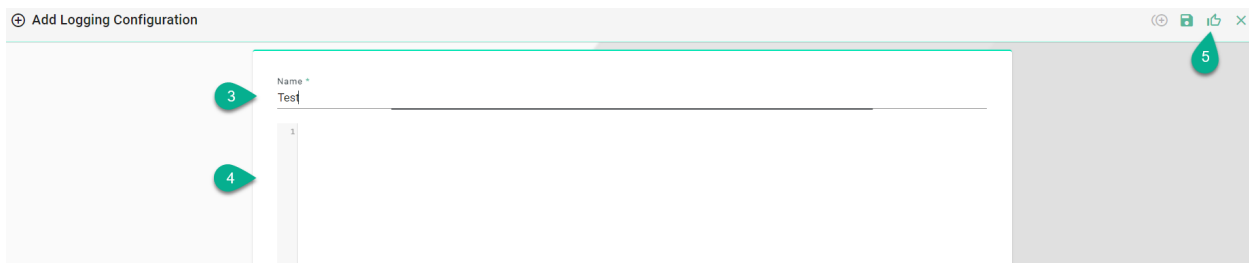
- Select the **Logging Configurations** perspective (1).



- Click on the “Add” button (2).



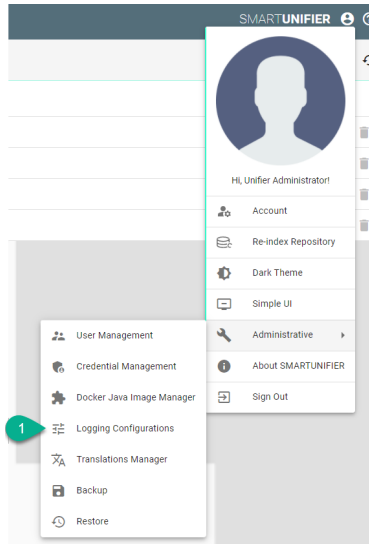
- Input the file **Name** (3) and the configuration (4).
- Click on the **Save and Close** button to exit (5).



### 5.8.3 Edit a logging file

Follow the steps below to edit a log4j configuration file:

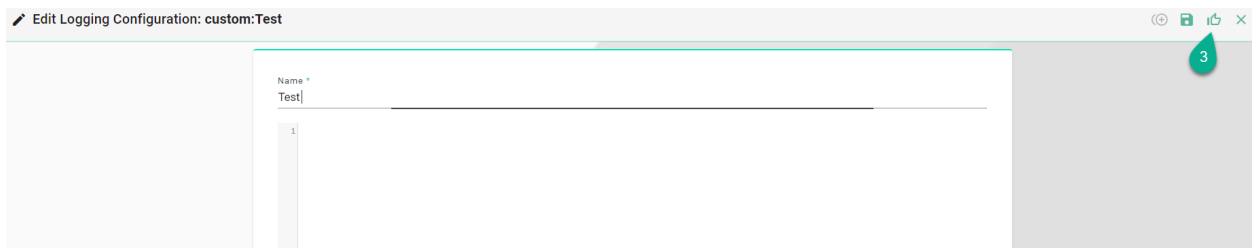
- Select the **Logging Configurations** perspective (1).



- Click on the “Edit” button (2).



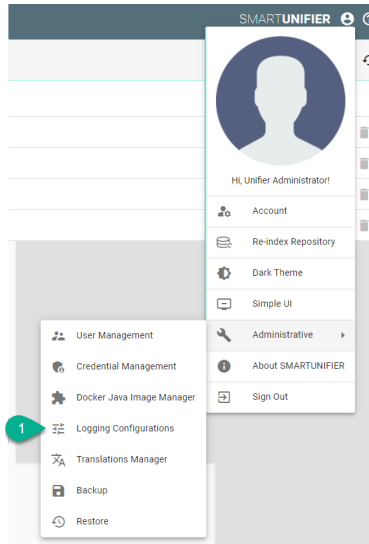
- Edit and click on the **Save and Close** button to exit (3).



## 5.8.4 Delete a logging file

Follow the steps below to delete a log4j configuration file:

- Select the **Logging Configurations** perspective (1).



- Click on the “Delete” button (2).

Logging Configurations			Search	Refresh	+	Refresh
Group Filter	Group	Name				
<ul style="list-style-type: none"> <li>Show All</li> <li>custom</li> <li>default</li> </ul>	custom	Test				2
	default	Trace				
	default	Debug				
	default	Warning				
	default	Info				

- To confirm, click on the **Delete** button (3).

### Delete Logging Configuration

Are you sure you want to delete this Logging Configuration?

Cancel Delete

3

## 5.9 Extensions

**Note:** Please contact Amorph Systems for guidance on how to enable and use extensions.

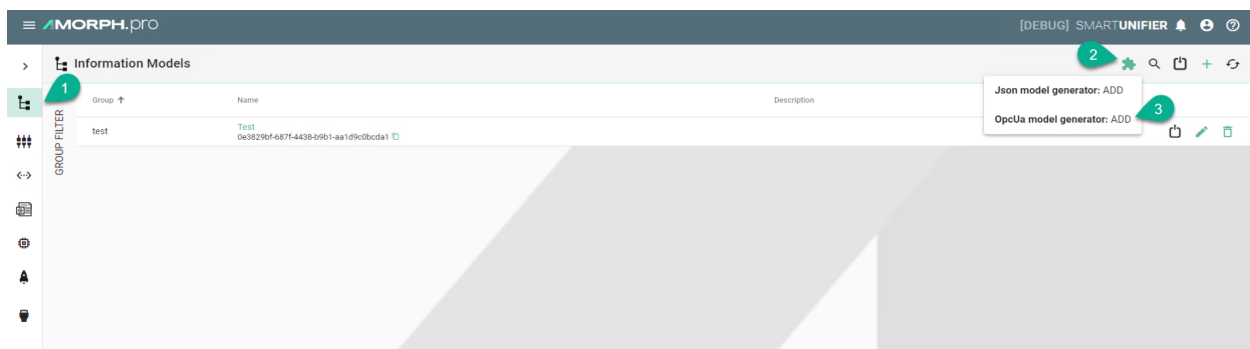
### 5.9.1 OpcUa Model Import

SMARTUNIFIER provides the possibility to generate an OpcUa Information Model using a XML-file or connecting to the OpcUa server.

#### Create a new Information Model (OPCUA)

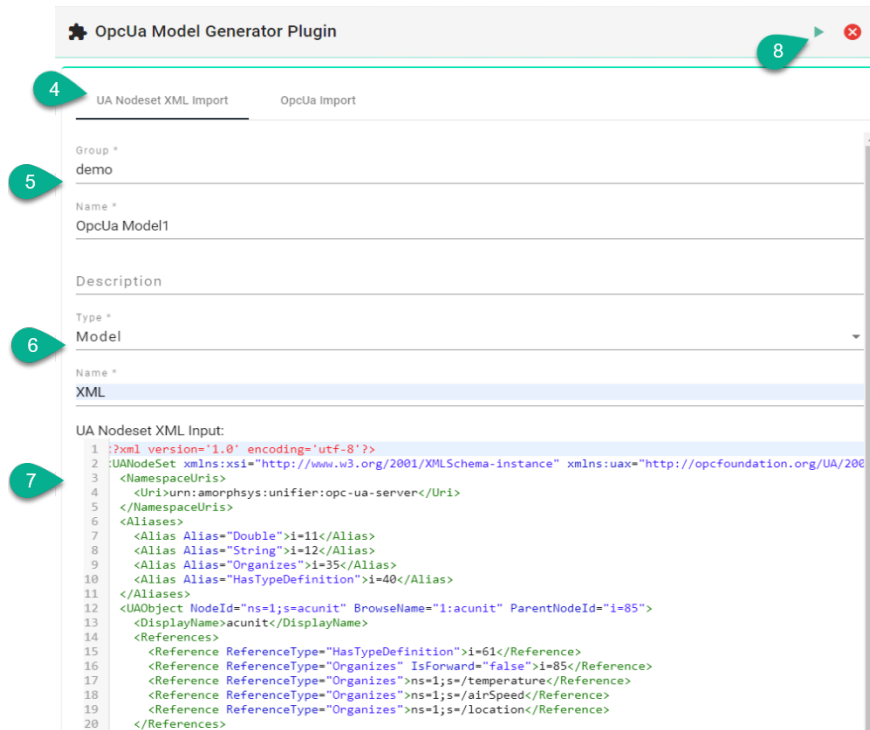
Follow the steps described below to generate an Information Model:

- Select the SMARTUNIFIER Information Model Perspective (1).
- Click on the **Extensions** button (2).
- Select the **OpcUa model generator: ADD** option (3).

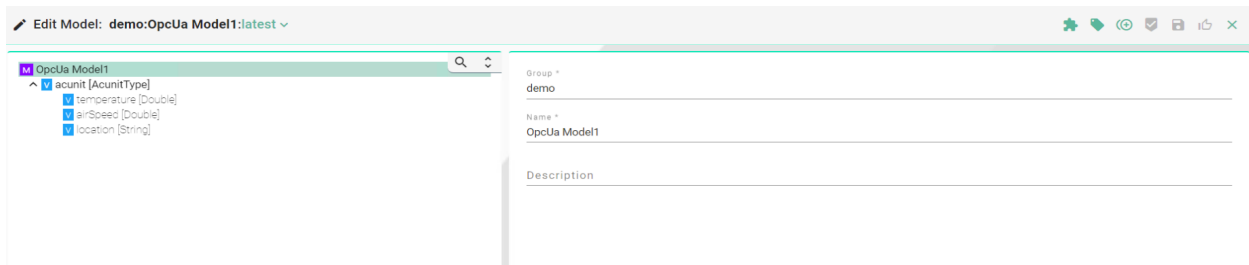


#### OpcUa Nodeset XML Import

- Select the **UA Nodeset XML Import** option (4).
- Provide the following mandatory information: **Group** and **Name** (5).
- Select the type of the **Information Model Node** and provide a **Name** (6) :
  - **Model** - the OpcUa data is converted inside the root model node
  - **Event** - the OpcUa data is converted inside an Event node type
  - **Variable** - the OpcUa data is converted inside a Variable node type
- Paste the content from the XML file (7).
- To finish, click on the **Save** Button (8).



- The Information Model is generated.



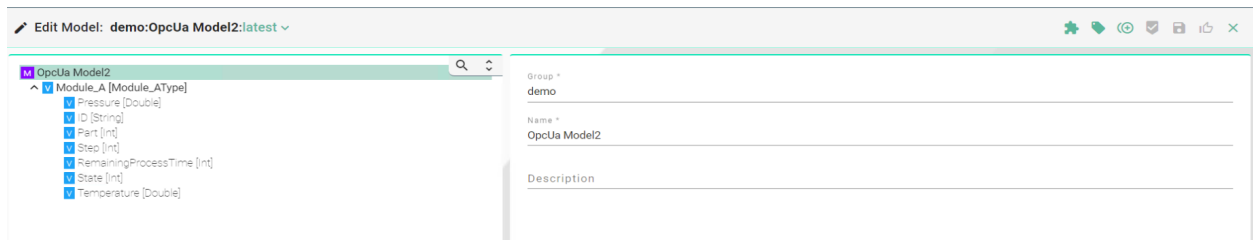
## OpcUa Direct Import

- Select the **OpcUa Import** option (4).
- Provide the following mandatory information: **Group** and **Name** (5).
- Input the **Namespace Index** (6).
- Click on the **Add identifier name** button and provide an **Identifier Name** (7).
- Provide the server details (8):
  - **Security Policy**
  - **IP address**
  - **TCP port**
  - **Endpoint path**



- To finish, click on the **Save Button (9)**.

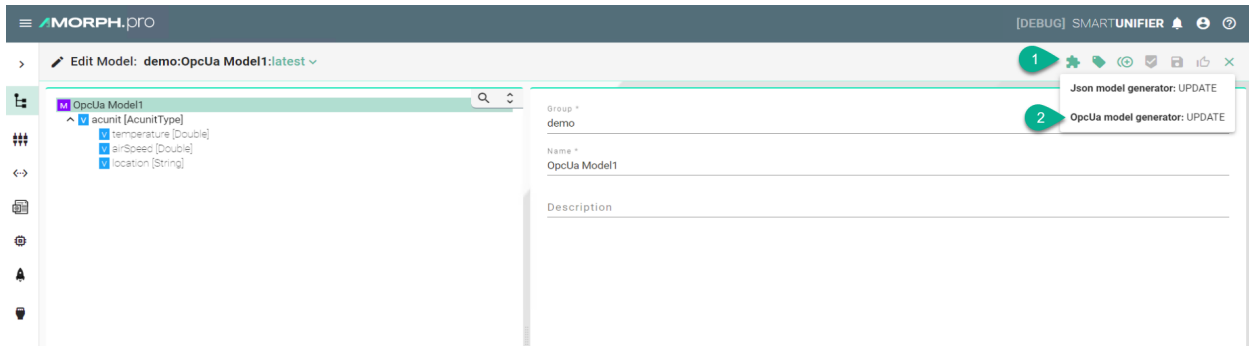
- The Information Model is generated.



## Update an existing Information Model (OPCUA)

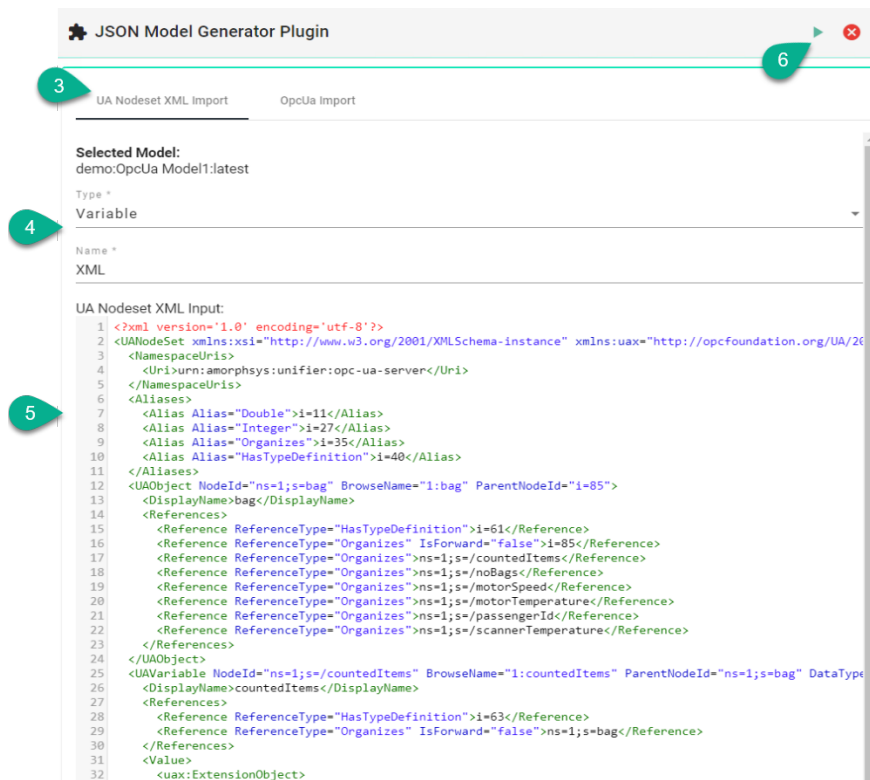
Follow the steps described below to update an Information Model:

- Open an Information Model to edit and click on the **Extensions** button (1).
- Select the **OpcUa model generator: UPDATE** option (2).



## OpcUa Nodest XML Import (Update)

- Select the **UA Nodest XML Import** option (3).
- Update the **Type** and the **Name** (4).
- Paste the updated content from a XML-file (5).
- To finish, click on the **Save** button (6).



## OpcUa Direct Import (Update)

- Select the **OpcUa Import** option (3).
- Input the **Namespace Index** (4).
- Click on the **Add identifier name** button and provide an **Identifier Name** (5).
- Provide the server details (6):
  - **Security Policy**
  - **IP address**
  - **TCP port**
  - **Endpoint path**
- To finish, click on the **Save Button** (7).

The screenshot shows the 'JSON Model Generator Plugin' window with the 'OpcUa Import' tab selected. The form contains the following fields and values:

- Selected Model:** demo:OpcUa Model1:latest
- Namespace Index \***: 2
- Identifier Name** (with a '+' button): Module\_B
- Security Policy \***: None
- IP address \***: 192.168.4.12
- TCP port \***: 9999
- Endpoint path \***: server

Numbered callouts indicate the following steps: 3 points to the 'OpcUa Import' tab; 4 points to the 'Namespace Index' field; 5 points to the '+' button next to the 'Identifier Name' field; 6 points to the 'IP address' field; and 7 points to the 'Save' button (represented by a play icon) in the top right corner.

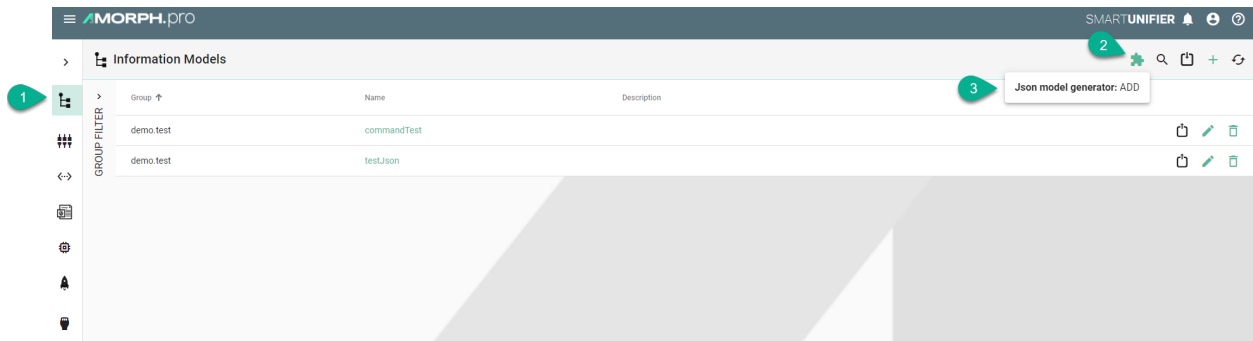
## 5.9.2 JSON Model Import

SMARTUNIFIER provides the possibility to generate an Information Model using a JSON-file.

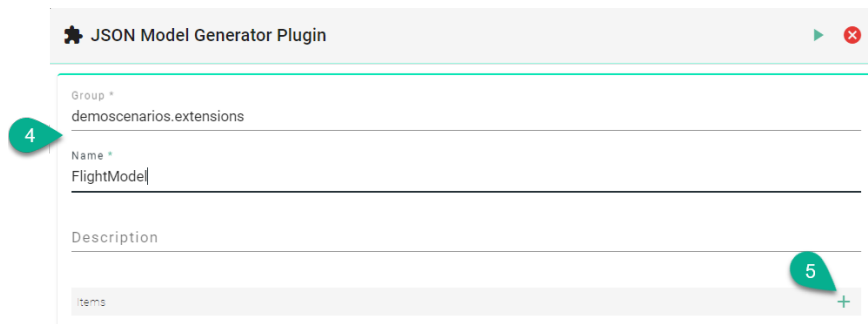
### Create a new Information Model (JSON)

Follow the steps described below to generate an Information Model:

- Select the SMARTUNIFIER Information Model Perspective (1).
- Click on the **Extensions** button (2).
- Select the **Json model generator: ADD** option (3).



- Provide the following mandatory information: **Group** and **Name** (4).
- Click on the **Add item** button (5).

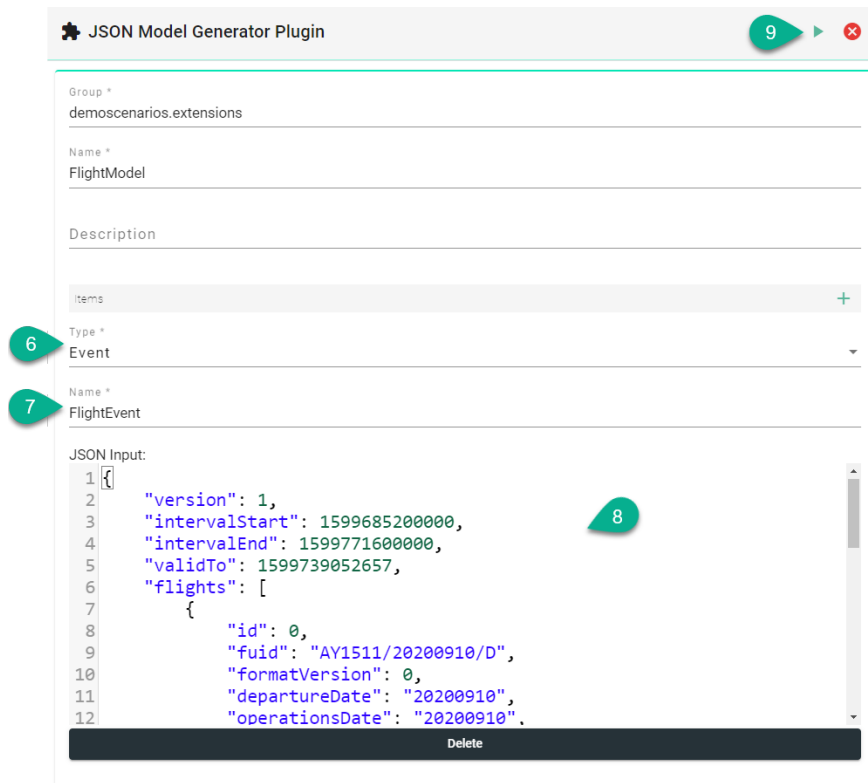


- Select the type of the **Information Model Node** (6):
  - **Model** - the Json data is converted inside the root model node

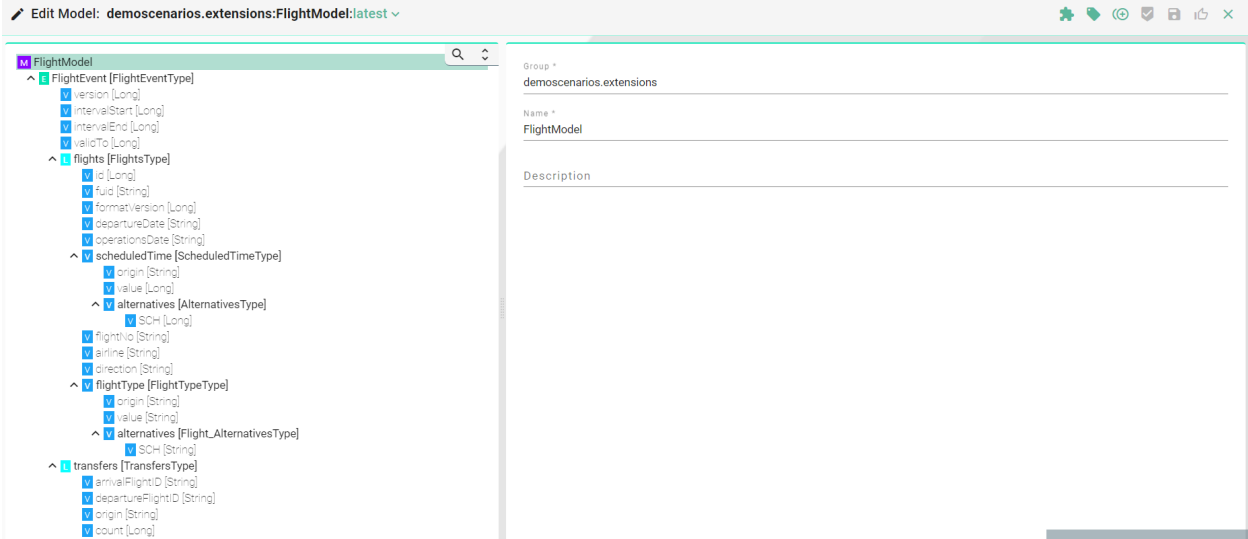
- **Event** - the Json data is converted inside an Event node type
- **Variable** - the Json data is converted inside a Variable node type
- **Command** - the Json data is converted inside a Command node type
- Enter a **Name** (7).
- Paste the content from a Json file (8).

**Note:** Make sure to copy the JSON object { }.

- To finish, click on the **Save** Button (9).



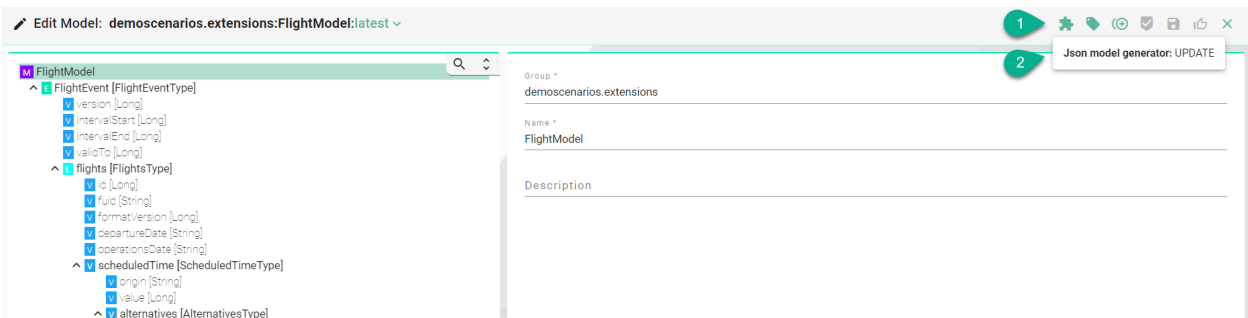
- The Information Model is generated.



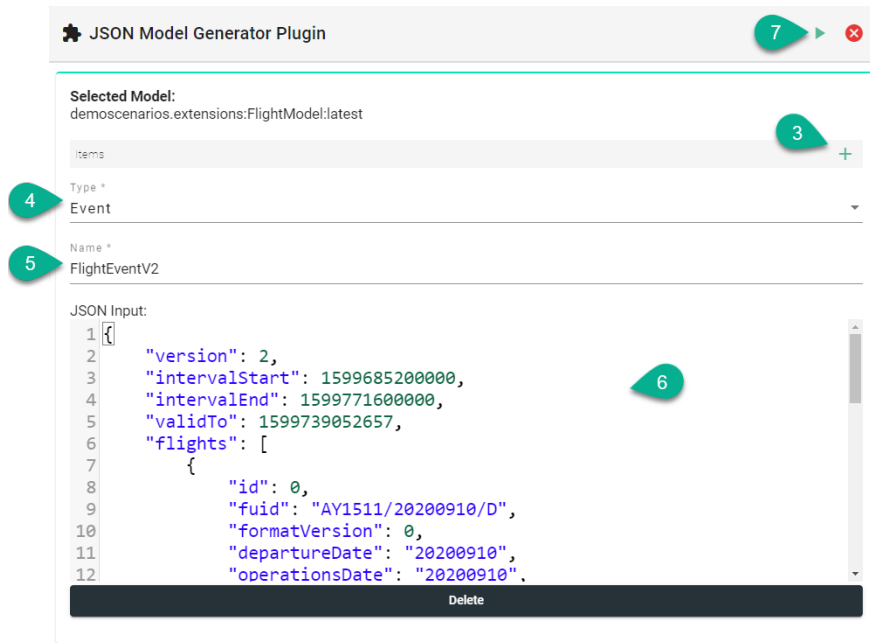
## Update an existing Information Model (JSON)

Follow the steps described below to update an Information Model:

- Open an Information Model to edit and click on the **Extensions** button (1).
- Select the **Json model generator: UPDATE** option (2).



- Click on the **Add item** button (3).
- Update the **Type** (4) and the **Name** (5).
- Paste the updated content from a Json-file (6).
- To finish, click on the **Save** button (7).



### 5.9.3 AWS IoT SiteWise Model Export

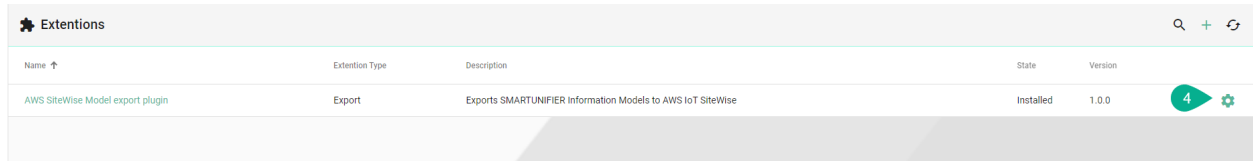
This extension allows you to export an SMARTUNIFIER Information Model to AWS IoT SiteWise.

#### How to access

To access the AWS IoT SiteWise extension, click on the Account icon (1), go to the Administrative option (2) and select the Extensions (3).



Then select the **configuration** button of the (4)



Name ↑	Extension Type	Description	State	Version
AWS SiteWise Model export plugin	Export	Exports SMARTUNIFIER Information Models to AWS IoT SiteWise	Installed	1.0.0

## How to export Information to AWS IoT SiteWise

We recommend to [have one user](#) dedicated for SMARTUNIFIER.

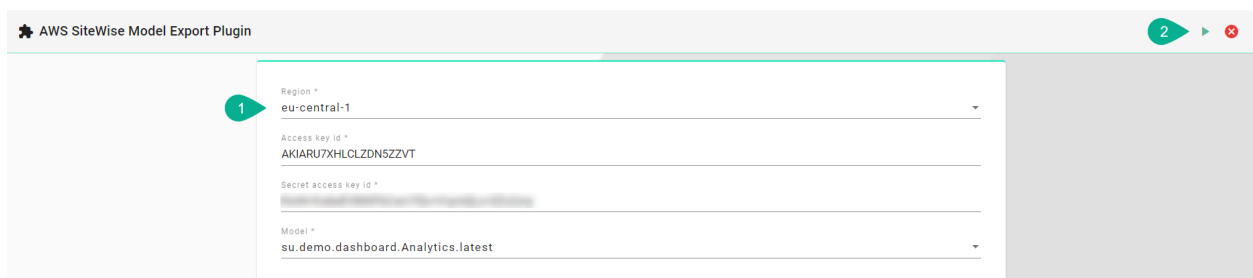
Attach the following permission:

Policy ARN	Description
<i>arn:aws:iam::aws:policy/AWSIoTSiteWiseFullAccess</i>	Provides full access to IoT SiteWise.

If you do not have already an access key available you have to create a new access key. We recommend to [create a new access key](#) after 90 days.

Follow the steps described below to export a the SMARTUNIFIER Information Model:

- Configuration of the extension (1):
  - Select the [region](#) of the AWS Iot SiteWise service you are using
  - Enter the **access key id** and the **secret access key id**
  - Select the **Information Model** you want to export
- Click on the **Run** button to execute the export (2)





## GETTING HELP

Having trouble? We would like to help!

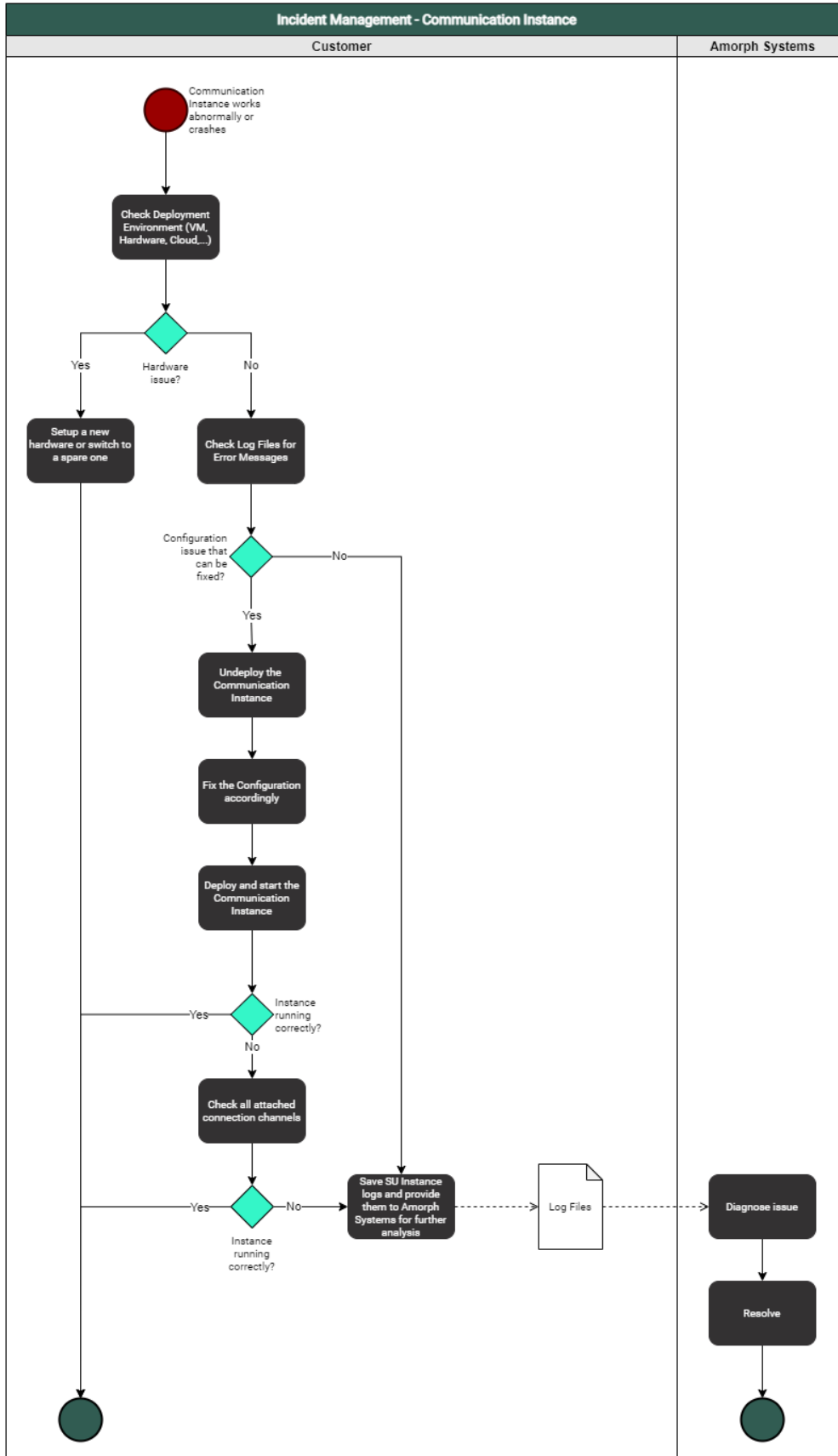
- In case of malfunctioning SU Instances check out the *Troubleshooting* section
- Try the *FAQ* - it's got answers to regularly asked questions
- Check out the *Glossary* if some terminology is not clear

### 6.1 Troubleshooting

#### 6.1.1 Communication Instances

Determine if there is an issue with the deployment environment (VM, Cloud, other Hardware) where the Communication *Instance* is operated on.

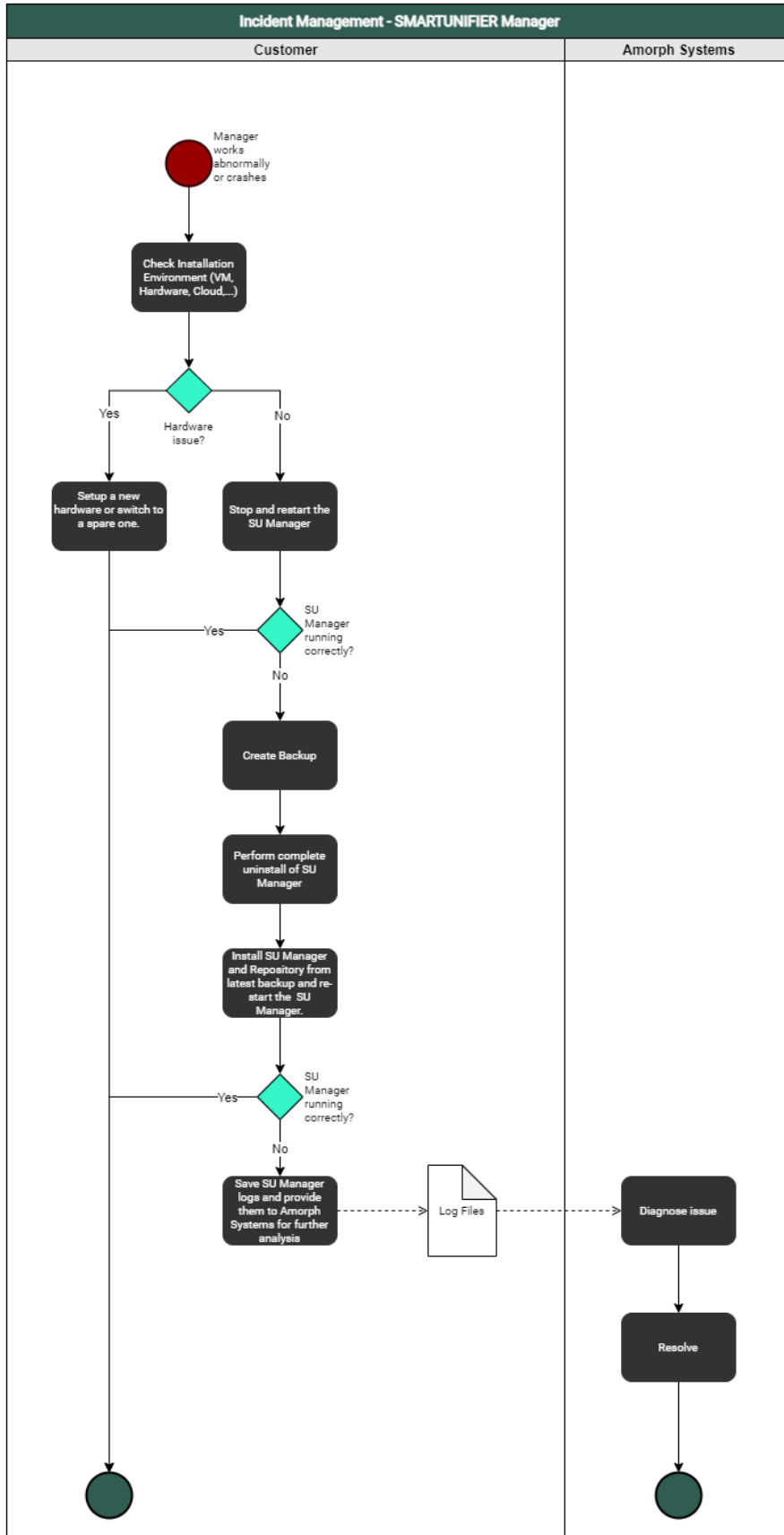
- In case of a HW problem setup a new HW (or switch to a spare HW). Ensure to place the correct security certificates on the new HW. Perform a new *deployment* of a new SU Instance with *SU Manager* on the new HW.
- In case, the HW is operating correctly navigate to the log file of the deployed instance `./SmartUnifierManager/deploy/<deployment-id>` and check for error messages.
  - If there is a configuration issue which can be fixed:
    - \* Undeploy the Communication Instance
    - \* Fix the configuration issue accordingly
    - \* *Deploy* and start the Communication Instance
  - If there is a configuration issue which can not be fixed save the log files and contact Amorph Systems through the [Support Portal](#) for further assistance



### 6.1.2 SMARTUNIFIER Manager

Determine if it is a HW problem on the HW where SMARTUNIFIER Manager is operated.

- In case of a HW problem, setup a new HW or switch to a spare HW. Perform installation of SU Manager and Repository from latest backup and re-start the Manager on the new HW.
- In case HW is operating correctly stop and restart the Manager
- If the Manager is still not running correctly:
  - Create a Backup
  - Perform a complete uninstall of the Manager
  - Install the Manager with the Repository from the latest backup and start the Manager
- If the Manager is still not working navigate to `./SmartUnifierManager/log` and save the log files (debug.log and info.log) and contact Amorph Systems through the [Support Portal](#) for further assistance



## 6.2 FAQ

### Does SMARTUNIFIER provide caching/buffering of data?

Yes, SMARTUNIFIER is capable of supporting caching of messages using file buffer (Spool) for message transfer to external middleware like MQTT. This functionality can be provided as part of a SMARTUNIFIER Communication Channel and dependent on the used communication protocol of the respective channel.

### Is it possible to set different buffering options for different channels?

Yes, each communication channel of SMARTUNIFIER can provide a different buffer size and further options.

### Does SMARTUNIFIER enable data pre-processing, cleansing, filtering and optimization of data?

Yes, this is a core feature of SMARTUNIFIER. SMARTUNIFIER provides powerful capabilities for any kind data preprocessing, cleansing, filtering and optimization. The capabilities of SMARTUNIFIER in this respect range from simple calculations, unit conversions, type conversions and reformatting up to arbitrary processing algorithms of any complexity.

### Does SMARTUNIFIER enable data aggregation?

Yes, SMARTUNIFIER enables data aggregation and reformatting with any level of complexity.

### Does SMARTUNIFIER provide short term data historian features?

Yes, historic telemetric data (of variable time horizons; size limited by used HW) can be monitored by usage of SMARTUNIFIER's logs which can record all communication activities of a SMARTUNIFIER Instance incl. telemetric data. SMARTUNIFIER's Log data can afterwards be forwarded by usage of a dedicated Communication Channel to any (and also multiple) upper-level monitoring or analytics system. Alternatively SMARTUNIFIER's Logs can be accessed directly by any external IT application (remote access to HW device is required).

Yes, SMARTUNIFIER can create any number of OPC-UA Servers and/or Clients within just one Communication Instance.

**Does SMARTUNIFIER support standard number of connections to OPC-UA Clients?**

Yes, SMARTUNIFIER supports a virtually unlimited number of client connections per OPC-UA Server. Physically the number of connections is limited by number of subscriptions per session, number of data objects and size per subscription as well as by HW and network constraints. SMARTUNIFIER allows to operate multiple OPC-UA Servers and/or OPC-UA Clients within each single SMARTUNIFIER instance for northbound and/or southbound communication.

**Does SMARTUNIFIER support brokering to MQTT Server?**

Yes, SMARTUNIFIER supports any number of MQTT connections. One single SMARTUNIFIER Instance can connect to one or multiple MQTT brokers (e.g., for different target systems) and is able to communicate bi-directional.

**Which southbound protocols are offered with SMARTUNIFIER?**

SMARTUNIFIER supports many protocols like e.g.,

- Siemens S7, S7-2
- OPC-UA
- Beckhoff
- MQTT
- Modbus-TCP
- file-based (different formats like CSV, XML, JSON, any binary format)
- SQL

... and many more to come continuously. Specific protocols can be provided based on customer request. Therefore please contact Amorph Systems ([www.amorphsys.com](http://www.amorphsys.com)).

**Does SMARTUNIFIER enable pre-aggregation of additional sensor data and/or more devices (rule based), for e.g., temperature monitoring?**

Yes, SMARTUNIFIER allows to connect any number of telemetric data sources to a SMARTUNIFIER Instance. Rule-based pre-aggregation and pre-processing of additional sensor data is supported with any level of complexity. This ranges from simple pre aggregation/pre-processing up to complex utilization of advanced AI or ML algorithms.

### Does SMARTUNIFIER support processing of active cloud commands? (e.g., System Manager AWS / AWS Agent)

Yes, SMARTUNIFIER provides a RESTful API to execute Shell Commands (e.g., Start/Stop Instance, etc.). Thus, active cloud commands are supported. In addition, also commands from other external IT-Systems (e.g., MES, ERP, AWS Systems Manager etc.) are possible. Furthermore if required SMARTUNIFIER can be fully executed and operated within Cloud Environments (e.g., within AWS Cloud).

### Which northbound protocols are supported by SMARTUNIFIER?

SMARTUNIFIER supports many northbound protocols, like e.g.,

- OPC-UA
- MQTT
- WebSphere
- HTTP / REST
- any file based protocol
- SQL/any database
- Splunk
- Vantiq

... and many more to come continuously. Specific protocols can be provided based on customer request. Therefore, please contact Amorph Systems ([www.amorphsys.com](http://www.amorphsys.com)).

### Does SMARTUNIFIER support international naming standards (example: EUROMAP 77, PackML)?

Yes, SMARTUNIFIER is specifically designed to strongly support the incorporation of international standards (e.g., EUROMAP 77, 82, 83, 84, AutomationML, PackML, DFQ, SEMI SECS/GEM etc.) as well as company standards, by offering the capability to be able to build up specific SMARTUNIFIER Information Models complying with these standards and incorporating full data semantics. There will be a one-time effort to implement such a standard in SMARTUNIFIER as a respective Information Model and afterwards this Standard can be used for any communication across the whole customer IT Infrastructure. Also this includes flexible mapping from legacy protocols to new standard protocol and vice versa.

**Does SMARTUNIFIER offer the ability to integrate with other systems and applications through REST Server APIs and Web Services for Operational purpose?**

Yes, SMARTUNIFIER features a REST API for operational purpose (e.g., instance start/stop service, configuration etc.)

**Does SMARTUNIFIER offer a way to realize a flexible, configurable dataflow?**

Yes, SMARTUNIFIER features a configurable and highly performant rule-based engine (SmartMappings) based on different northbound and/or southbound input sources for realizing any dataflow (workflow) that is required in industrial environments. This covers communication sequences for identification, processing start, processing execution, processing end, results data provision as well as detailed process data provision. Also commands from any upper-level IT-System can be processed and further transmitted to the production equipment (e.g., recipe management, NC program transfer etc.) External data flow engines / visualization apps (e.g., Node-Red, Grafana) can be connected.

**Does SMARTUNIFIER enable Central Software Management?**

Yes, all Information Models, Mappings and Deployment Features can be managed centrally. Furthermore, SMARTUNIFIER features an easy to use REST API for operational purpose (e.g., instance start/stop service, configuration etc.).

**Does SMARTUNIFIER enable Container Deployment?**

Yes, SMARTUNIFIER operation and deployment is fully based on Container-Technology (Docker). SMARTUNIFIER Manager and Instances can be operated and deployed inside Docker Containers to any End Point within the network running Docker environment.

**Which Operating System SMARTUNIFIER is supporting?**

SMARTUNIFIER runs on Windows, Linux, Mac and other OS supporting Java RT and Docker.

**Does SMARTUNIFIER support onPrem Edge-Analytics?**

Yes, SMARTUNIFIER can be connected to any Edge-Analytics System SMARTUNIFIER Logs can provide detailed information about all communication activities. These log data can either be provided by a dedicated Communication Channel to any upper level Analytics System (in any required format) or can be made locally accessible to any agent running locally on the HW.



**Does SMARTUNIFIER support DevOps CI/CD Pipeline for installations and update?**

Yes, SMARTUNIFIER supports remote installation/update of Software from SMARTUNIFIER Manager via Docker Registry SMARTUNIFIER Instances (running in Docker Containers) can be updated, monitored and controlled remotely. Docker registry is also accessible from external systems if required.

**Does SMARTUNIFIER enable Software Scalability?**

Yes, SMARTUNIFIER can scale from connection of one single equipment/device to virtually any number of equipment/devices by means of its decentralized architecture.

**Does SMARTUNIFIER support the architecture of distributed systems?**

Yes, SMARTUNIFIER itself is a fully distributed and scalable IT system. With this architecture SMARTUNIFIER is able to collaborate in any small or large IT environment. SMARTUNIFIER is open to reliably collaborate in large sites.

**Does SMARTUNIFIER provide the ability to directly communicate with other Devices or IT-Systems through standard protocols and also supports Load-Balancing?**

Yes, SMARTUNIFIER can communicate with any other Devices or IT-Systems and also address load balancers for optimized feeding of data to any message brokers or data forwarder.

**Does SMARTUNIFIER provide the ability for data to be ingested as a consolidated batch (File Transfer)?**

Yes, SMARTUNIFIER can use any file in any format as input source and also as output destination.

**Does SMARTUNIFIER provide the ability to create custom connectors to ingest data from arbitrary sources?**

Yes, the capability to be able to realize custom connectors for any data source is one of the core elements of SMARTUNIFIER's architecture.

**Is SMARTUNIFIER able to push operational data to an Edge-Gateway?**

Yes, SMARTUNIFIER can receive operational data from any device or IT-System and push it to an Edge-GW. E.g., OPC-UA, MQTT and HTTP/REST are supported. Also, many other protocols can be used therefore.

**Does SMARTUNIFIER provide Software Monitoring?**

Yes, each SMARTUNIFIER Instance creates detailed logs that document every communication activity. These logs can be made accessible to any external system e.g., by a dedicated monitoring communication channel. Moreover, SMARTUNIFIER Manager comes with a built-in Monitoring Dashboard that allows monitoring of the distributed SMARTUNIFIER Instances.

**Does SMARTUNIFIER support Monitoring integration?**

Yes, this is possible; Each SMARTUNIFIER Instance creates detailed logs that document every communication activity. These logs can be made accessible to any external system e.g., by a dedicated monitoring communication channel. In addition, SMARTUNIFIER is able to send any kind of monitoring message (e.g., based on status changes or other events (e.g., time triggered) to any (or multiple) upper level monitoring system in any required format.

**Does SMARTUNIFIER provide certificate handling?**

Yes, SMARTUNIFIER can handle certificates and establish state-of-the-art secured connections (e.g., TLS, secured MQTT, secured OPC-UA, etc.).

**Is it possible with SMARTUNIFIER to limit access to data?**

Yes, SMARTUNIFIER Instances work on independent Windows/Linux computer units. Data may be stored temporarily on these HW devices as logs or for buffer (cache) purposes. This temporary data can be protected by assigning the HW with appropriate access rights and user roles.

**Does SMARTUNIFIER support services for security supervision and security monitoring?**

Yes, SMARTUNIFIER creates detailed logs regarding all communication activities (and other activities) it performs. With SMARTUNIFIER it is possible to integrate with any external security supervision/monitoring system (e.g., Splunk) and provide on-line log files (in any required format) to these systems by usage of a dedicated monitoring communication channel.

**Does SMARTUNIFIER support End-to-End transport encryption (to Northbound and Southbound)?**

Yes, SMARTUNIFIER can support End-to-End transport encryption for southbound and northbound communication channels.

**Does SMARTUNIFIER enforce secure individual authentication for all users?**

Yes, SMARTUNIFIER supports individual user authentication.

**Does SMARTUNIFIER support Windows Active Directory (AD)?**

Yes, SMARTUNIFIER supports *Windows Active Directory*.

**Does SMARTUNIFIER support a (configurable) secure remote access?**

Yes, Secure remote access to SMARTUNIFIER Manager and SMARTUNIFIER Instances is possible by standard Windows or Linux tools (e.g., SSH).

**Can SMARTUNIFIER protect unsecured Shop Floor devices from office network through isolation?**

Yes, a SMARTUNIFIER Instance can be deployed locally near an equipment/device and map any unsecured equipment/device interface into a secured protocol (e.g., OPC-UA, MQTT). This way “unsecured data streams” coming from an equipment/device can be transferred to any northbound system in a secured way (isolation of the equipment/device). The same principle can be also applied when sending control parameters (e.g., screwer params, NC programs, recipes, ...) or commands from a northbound system to the equipment/device.

**Does SMARTUNIFIER support malware protection concepts (e.g., support of standard Anti-Virus Software)?**

Yes, SMARTUNIFIER works with any standard malware protection software incl. McAfee, NOD and many others.

**Is SMARTUNIFIER secure by design (e.g., secure coding guidelines, use of open source code, pen-testing)?**

SMARTUNIFIER was developed according to state-of-the-art coding principles and on request we are willing to let perform any checks, verifications, pen testing as required to validate the software. Especially for realizing communication channels and implementing protocols, state-of-the-art Open Source Libraries are used and constantly updated to the newest versions available.

**Does SMARTUNIFIER support a range of transmission/infrastructure protocols (e.g., IPV4/IPv6)?**

Yes, with SMARTUNIFIER (depending on used HW) IP4/IP6 are supported.

- LAN: Up to 4x Gbit Ethernet Intel i211
- Wireless LAN: 802.11ac dual antenna + BT 4.2
- Cellular communication: LTE/WCDMA/GSM/GNSS

USB: Up to 8 ports, 2x USB 3.0, Up to 6x USB 2.0

- RS232 serial port

Also other transmission/infrastructure protocols can be supported on request but may require additional HW.

**Does SMARTUNIFIER provide the ability to handle intermittent connectivity of sources (data/event redelivery and failure modes)?**

Yes, intermittent connectivity of sources can be handled by SMARTUNIFIER Communication Channels. Based on rules, data/event redelivery can take place, failure modes can be activated, and escalation procedures to northbound systems can be triggered.

**Does SMARTUNIFIER reduce unnecessary traffic on shop floor network to protect device interfaces from traffic overload?**

Yes, a SMARTUNIFIER instance can be deployed locally nearby the equipment on any suitable HW device. The SMARTUNIFIER instance can then be configured to communicate to the connected southbound equipment/devices by using a separate physical network port and this way isolate the device from unnecessary traffic coming from the northbound network.

**Does SMARTUNIFIER support low Latency between Southbound and Northbound Interfaces?**

Yes, SMARTUNIFIER provides high performance / low latency by its distributed architecture consisting out of small SMARTUNIFIER Instances (i.e., no central bottlenecks like e.g., a middleware broker/database). Furthermore, SMARTUNIFIER features an integrated compiler that creates native Bytecode for the interfaces to be executed within the SMARTUNIFIER Instances. This makes the SMARTUNIFIER highly performant, since no slow scripting language nor any slow interpreter is used to provide the connectivity functionality.

**Is it possible with SMARTUNIFIER to ensure a consistent setting of time stamps for events (NTP)?**

Yes, this is possible.

**Is it possible to use UNICODE for operational data?**

Yes, it is possible to use UNICODE with SMARTUNIFIER (e.g., for OPC-UA).

**Is stability of SMARTUNIFIER s API given? Is the API stable across releases?**

Yes, SMARTUNIFIER is a standard product from Amorph Systems. Interface stability is given and stable across new product releases. Furthermore, interfaces are versioned and under controlled release management (i.e., different versions of interface, Information, Models and Mappings can be maintained and deployed in a controlled mode).

**Which tools for development, deployment and error analysis can be used with SMARTUNIFIER ?**

For extension, deployment and error analysis of SMARTUNIFIER (e.g., development of new Information Models, pre-processing, aggregation etc.) widely-used and accepted state-of-the-art development environments and powerful standard tools may be used, e.g., Eclipse, Maven/sbt, Jenkins, Docker. For Error Analyses detailed logs created by SMARTUNIFIER can be used and analysed with any analytics tools.

**What is the cost model of SMARTUNIFIER ?**

Please refer to Amorph Systems ([www.amorphsys.com](http://www.amorphsys.com)) for prices for SMARTUNIFIER . In general, the following policies apply:

- SMARTUNIFIER Manager is free of charge
- For SMARTUNIFIER Instances a yearly license fee is charged

**Does Amorph Systems offer reliable support for SMARTUNIFIER ?**

For many years, Amorph Systems is providing first class support and intensive care to all of its customers. This covers all products and solutions that were delivered and operated in Industrial Areas as well as in Air Traffic Industry. For customer references please refer to Amorph Systems ([www.amorphsys.com](http://www.amorphsys.com)).

### What support levels (SLAs) are supported?

Different levels of services (8x5, 8x7 up to 24x7) are available upon request from Amorph Systems ([www.amorphsys.com](http://www.amorphsys.com)).

### Does SMARTUNIFIER support multiple languages?

Yes, SMARTUNIFIER can support multiple languages. Currently the GUI is available in English and German language. In case more languages are required, please contact Amorph Systems ([www.amorphsys.com](http://www.amorphsys.com))

### Does Amorph Systems provide relevant training capabilities for operating SMARTUNIFIER and for engineering of Information Models and Mappings?

Yes, SMARTUNIFIER is a simple to use standard product and was specifically designed as a powerful tool to enable the end customers themselves to provide seamless equipment/device as well as IT-Systems interconnectivity within their industrial environments.

Therefore, Amorph Systems trains customers to configure, deploy and operate SMARTUNIFIER in their environments. Moreover, we can give advanced trainings, so that the customers can also implement new interfaces, new channels, new, Information Models and new Mappings on their own.

## 6.3 Glossary

**Arrays** An Array (as an Information Model Node Type) is a container object that holds a fixed number of values of a single type.

**Configuration Components** Configuration Components are Information Models, Communication Channels, Mappings, Device Type and Communication Instances, used to realize an integration scenario.

**Commands** Commands (as an Information Model Node Type) are functions like the methods of a class in object-oriented programming. The scope of a Command is bounded to the Information Model it belongs.

**Communication Channels** Communication Channels or simply Channels, refer to a transmission medium. A Channel is used to convey information from one or several senders (or transmitters). Communicating data from one location to another requires some form of pathway or medium. These pathways are called Communication Channels, and the information is transmitted with the help of communication protocols. Each Information Model has one or many Channels, and each Information Model can choose which Channel it subscribes to. The information is transmitted through the Communication Channels in both directions: from the external system to the SMARTUNIFIER application and vice versa.

**Custom Types** Custom Data types are defined by the user for a Node Type.

**Data Types** Each Node Type has a Data Type. Data Types can be either a Simple Type or a Custom Type - depending on the Node Type.

**Deployments** With the SMARTUNIFIER Deployment capability Instances can be deployed to any IT resource (e.g., Equipment PC, Server, Cloud) suitable to execute a SMARTUNIFIER Instance.

**Deployment Endpoints** Deployment Endpoints are used to identify the location of a Deployment (e.g., AWS Fargate, Docker)

**Device Types** Device Type contains one or multiple Mappings. Each Mapping contains one or multiple Information Models and its associated Communication Channel. Within a SMARTUNIFIER Device Type it is possible to overwrite existing Communication Channel configurations. Device Types are especially important, when having to connect several similar equipment or devices that share the same communication parameters. In these cases it is sufficient to define only one Device Type and the settings of this Device Type can be reused across all Instances.

**Events** Events (as an Information Model Node Type) represent an action or occurrence recognized by SMARTUNIFIER, often originating asynchronously from an external data source (e.g., equipment, device). Computer events can be generated or triggered by external IT systems (e.g., received via a Communication Channel), by the SMARTUNIFIER itself (e.g., timer event) or in other ways (e.g., time triggered event).

**File Consumer** This Communication Channels offers the capability to read-in files (e.g., CSV, XML, and JSON). The File Consumer monitors an input folder that is specified in the configuration.

**File Tailer** This Communication Channels offers the capability to read-in files (e.g., CSV, XML, and JSON). The File Tailer monitors a specific file, which is specified in the configuration.

**InfluxDB** This Channel offers connectivity to an InfluxDB. InfluxDB is an open-source time series database.

**Information Models** Information Model describes the communication related data, which is available for a device or IT system. Each device or IT system is represented by an Information Model.

**Instances** An Instance represents an application that handles the connectivity. Instances can be deployed to any suitable IT resource (e.g., Equipment PC, Server, Cloud), and provide the connectivity functionality configured. Therefore, a SMARTUNIFIER Instance uses one or multiple Mappings and selected Communication Channels from a previously defined Device Type.

**Lists** A List (as an Information Model Node Type) representing collections of Node Types (e.g., Variables, Properties, Arrays, and other Lists).

**Mappings** Mapping represents the SMARTUNIFIER component that is defining when and how to exchange/transform data between two or multiple Information Models. In other words it is acting as a translator between the different Information Models. One Mapping consists of one or multiple Rules.

**MQTT** This Communication Channel offers the capability to send data using the messaging protocol MQTT. MQTT is a lightweight publish/subscribe messaging transport for connecting remote devices with minimal network bandwidth.

**Node Types** Node Types are elements within an Information Model. Node Types are Variables, Properties, Events, Commands and also collections such as Arrays and Lists. Each Node Type has a Data Type that defines if the Node Type is a predefined Data Type or a custom Data Type.

**OPC-UA** Is a machine to machine communication protocol for industrial automation.

**Predefined Types** Predefined Data Types (e.g., String, Integer, Double, etc.) are available for the definition types - Variables, Properties, Arrays, Lists (e.g., String, Integer, Boolean).

**Properties** Properties (as an Information Model Node Type) are used to represent XML attributes.

**REST Client** This Communication Channels offers the capability to consume and operate with resources exposed by REST Servers.

**REST Server** This Communication Channels offers the capability to provide resources employing the HTTP communication protocol.

**Rules** A Rule contains a Trigger that defines when the exchange/transformation takes place and a list of actions that are defining how the exchange/transformation is done.

**Manager** The Web application SMARTUNIFIER Manager is used to create and monitor SMARTUNIFIER Instances.

**Source** In the Mapping sources are Node Types that are mapped to targets.

**SQL DB** This Communication Channel offers the capability to connect to a SQL Databases (e.g., MariaDB, SQLServer, PostgreSQL, ORACLE, HSQLDB, and DB2).

**Target** In the Mapping targets are Node Types that receive data assigned from a source.

**Trigger** The Trigger defines when the exchange/transformation data between two or multiple Information Models takes place.

**User Management** User Management allows the administrator to create users accounts, to assign permissions as well as to activate or to deactivate the user accounts.

**Variables** Variables (as an Information Model Node Type) are used to represent values.