UBIQUBE

Developer Guide

MSactivator

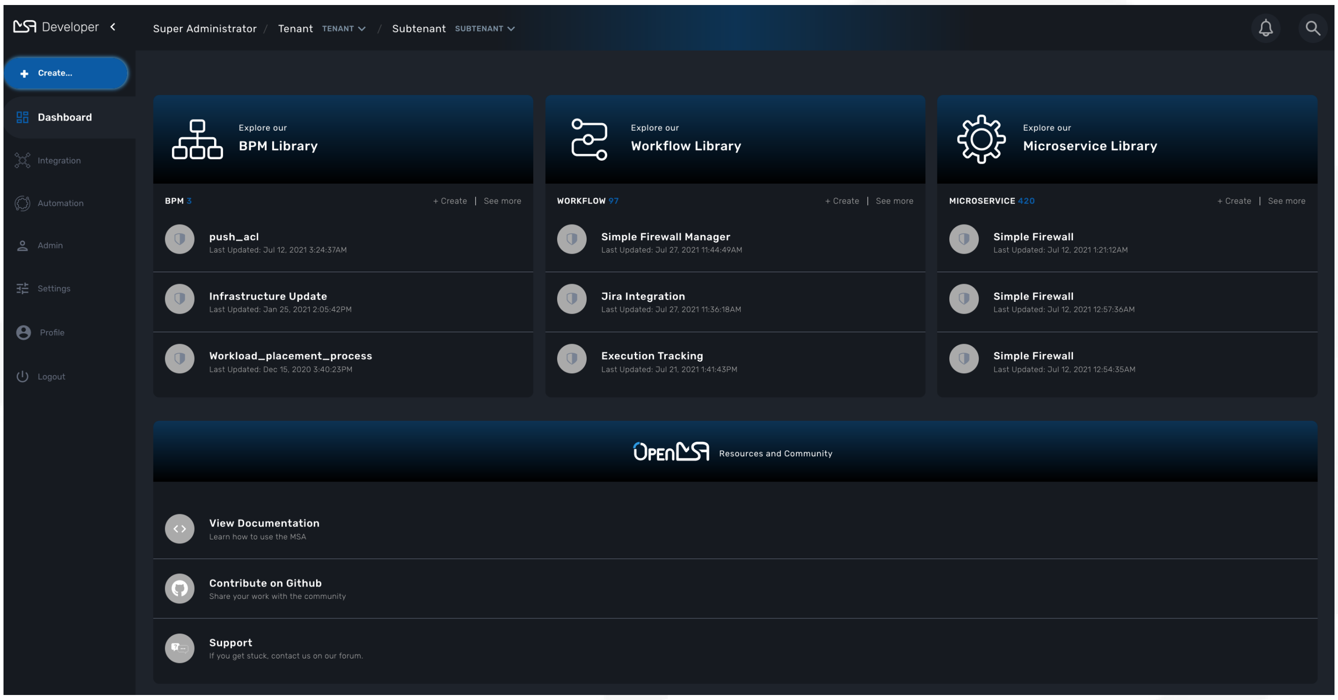
Table of Contents

This documentation contains a set of tutorials and examples to help you get familiar with the MSactivator™ as a development platform.

Developer Portal

The developer portal provides the tools to design, develop and test automated and integrated processes.

Developer dashboard



push_acl
Last Updated: Jul 12, 2021 3:24:37AM

Infrastructure Update
Last Updated: Jan 25, 2021 2:05:42PM

Workload_placement_process
Last Updated: Dec 15, 2020 3:40:23PM

Simple Firewall Manager
Last Updated: Jul 27, 2021 11:44:49AM

Jira Integration
Last Updated: Jul 27, 2021 11:36:18AM

Execution Tracking
Last Updated: Jul 21, 2021 1:41:43PM

Simple Firewall
Last Updated: Jul 12, 2021 1:21:12AM

Simple Firewall
Last Updated: Jul 12, 2021 12:57:36AM

Simple Firewall
Last Updated: Jul 12, 2021 12:54:35AM

View Documentation
Learn how to use the MSA

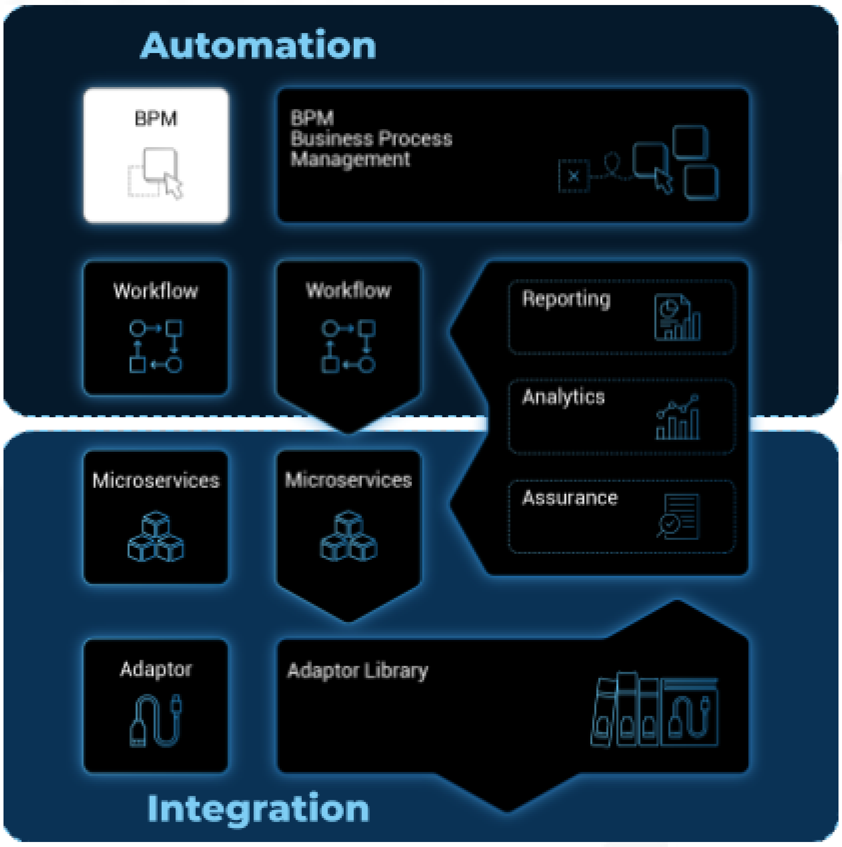
Contribute on Github
Share your work with the community

Support
If you get stuck, contact us on our forum.

After connecting to the developer portal you will see the 3 swimlanes for the automation and integration provided by the MSactivator™.

You can either start creating new libraries or view and edit the existing ones.

BPM Editor



The **BPM editor** is a web based UI for designing BPM processes.

Overview

The MSactivator™ provides a web based user interface editor for designing BPM (Business Process Model).

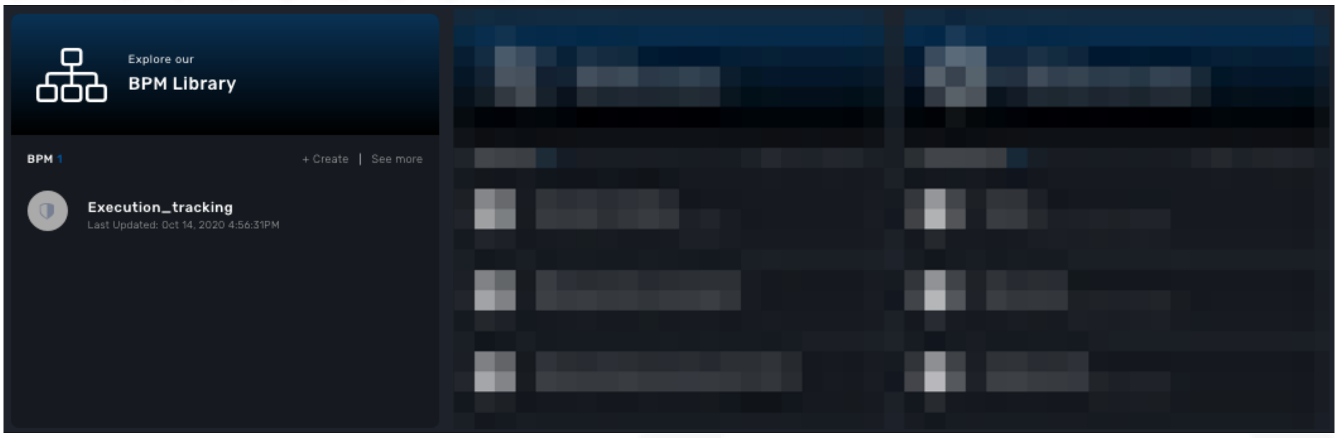
BPM are sitting at the top of the automation layer and the editor will allow you to create BPM in a codeless way.

BPM design

To create a new BPM from the developer portal, click on "+ Create" from the swimlane "BPM Library."

You can also browse through the existing BPM by clicking on "See more".

BPM library swimlane

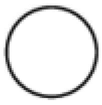


you need to select a sub-tenant to see the BPM.

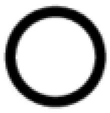
BPMN elements

The MSactivator™ BPM engine supports the following BPMN elements:

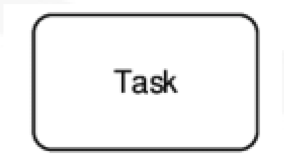
indicates the beginning of the BPM process



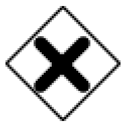
indicates the end of the BPM process



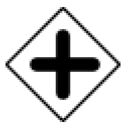
an executable task that can run workflow processes



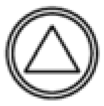
an exclusive decision gateway (XOR)



a parallel gateway (AND)



a user break point



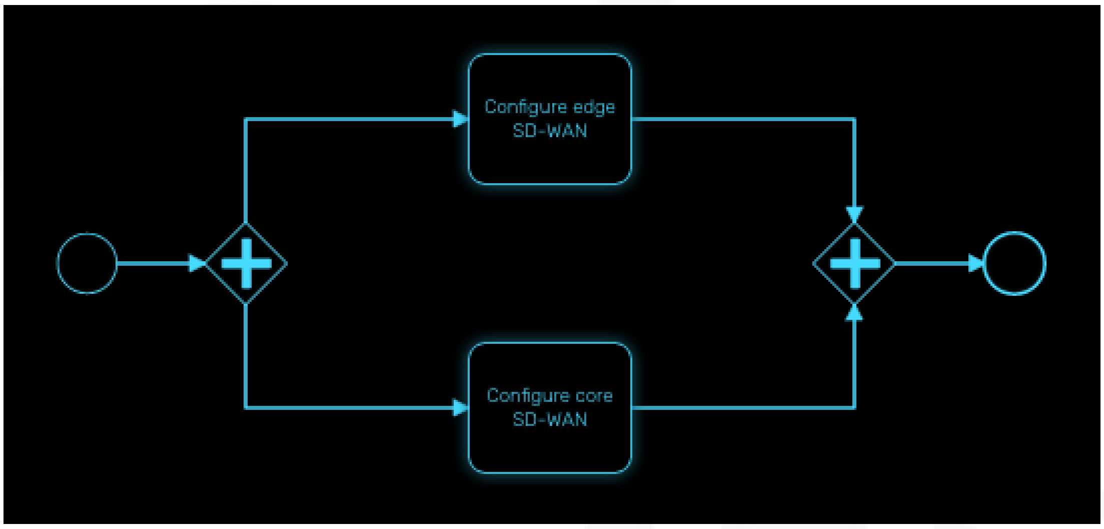
Bear in mind that a gateway is not a task! You have to determine facts and needs before reaching a gateway.

Parallel gateway (AND)

Gateways can also be used to model concurrency in a process.

The most straightforward gateway to introduce concurrency in a process model is the Parallel Gateway, which allows forking into multiple paths of execution or joining multiple incoming paths of execution.

Parallel gateway

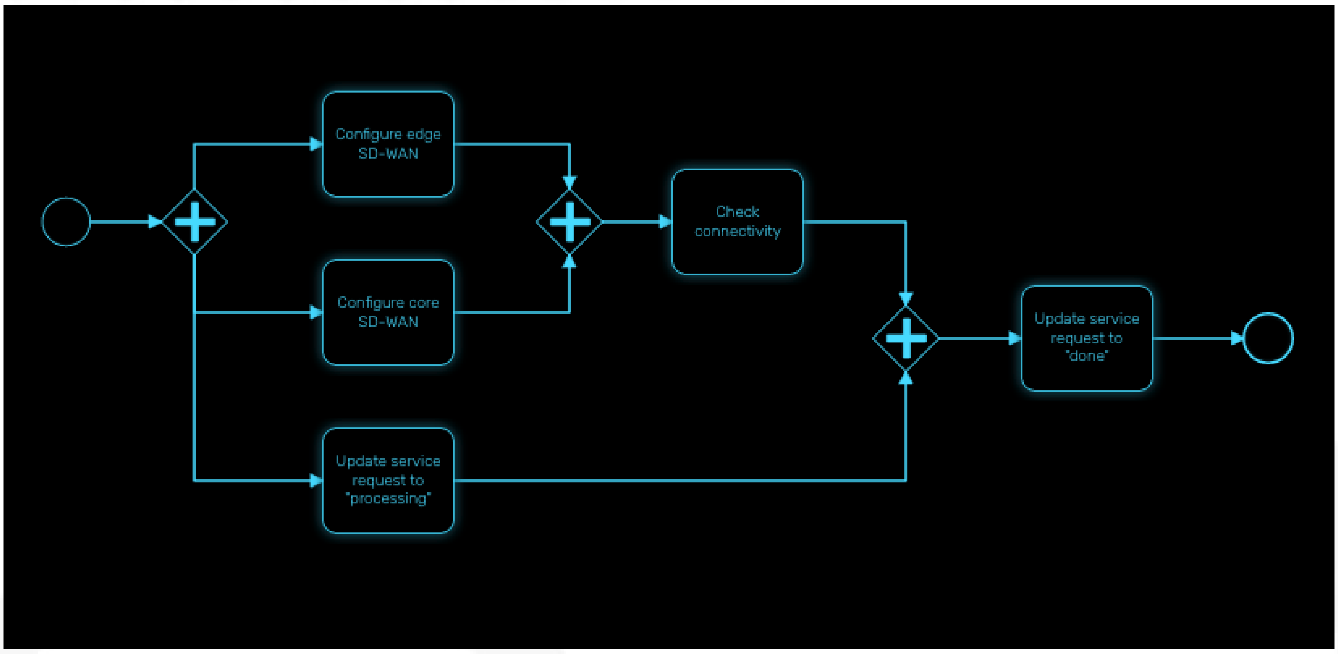


The functionality of the parallel gateway is based on the incoming and outgoing sequence flow(s):

- fork: all outgoing sequence flows are followed in parallel, creating one concurrent execution for each sequence flow.
- join: all concurrent executions arriving at the parallel gateway wait at the gateway until an execution has arrived for each of the incoming sequence flows. Then the process continues past the joining gateway.

Note that a parallel gateway does not need to be 'balanced' (i.e., a matching number of incoming/outgoing sequence flows for corresponding parallel gateways). A parallel gateway will simply wait for all incoming sequence flows and create a concurrent path of execution for each outgoing sequence flow, not influenced by other constructs in the process model. So, the following process is legal in MSactivator™:

Unbalanced parallel gateway

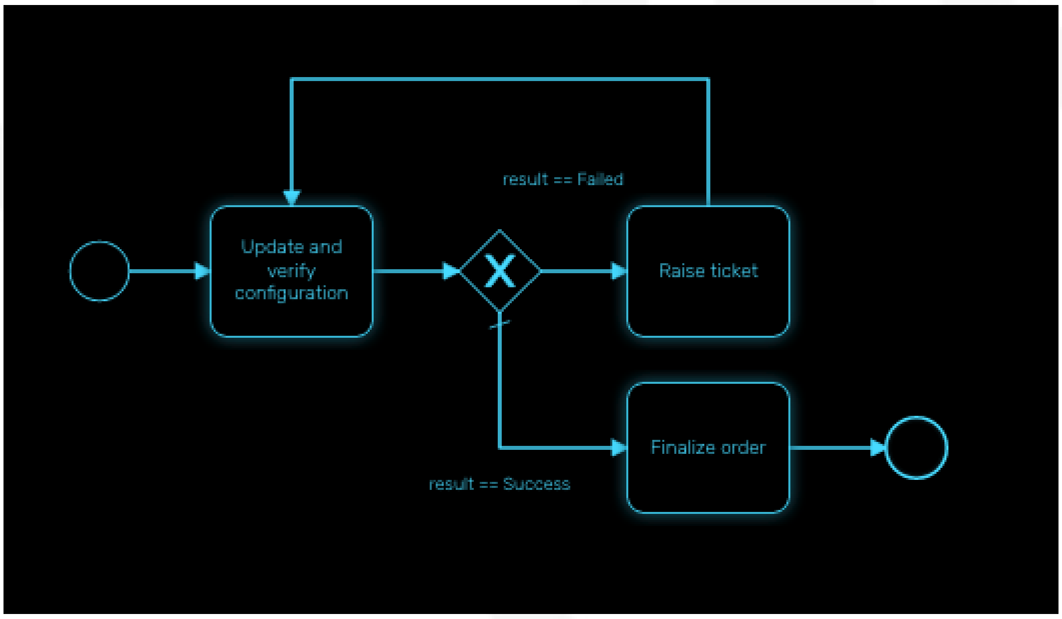

Configure edge SD-WAN
Configure core SD-WAN
Update service request to "processing"
Check connectivity
Update service request to "done"

Decision gateway (XOR)

The XOR gateway will let you model a decision in the process.

When the execution arrives at this decision gateway, all outgoing sequence flows are evaluated in the order in which they have been defined. The sequence flow whose condition evaluates to 'true' is selected for continuing the process.

XOR decision gateway

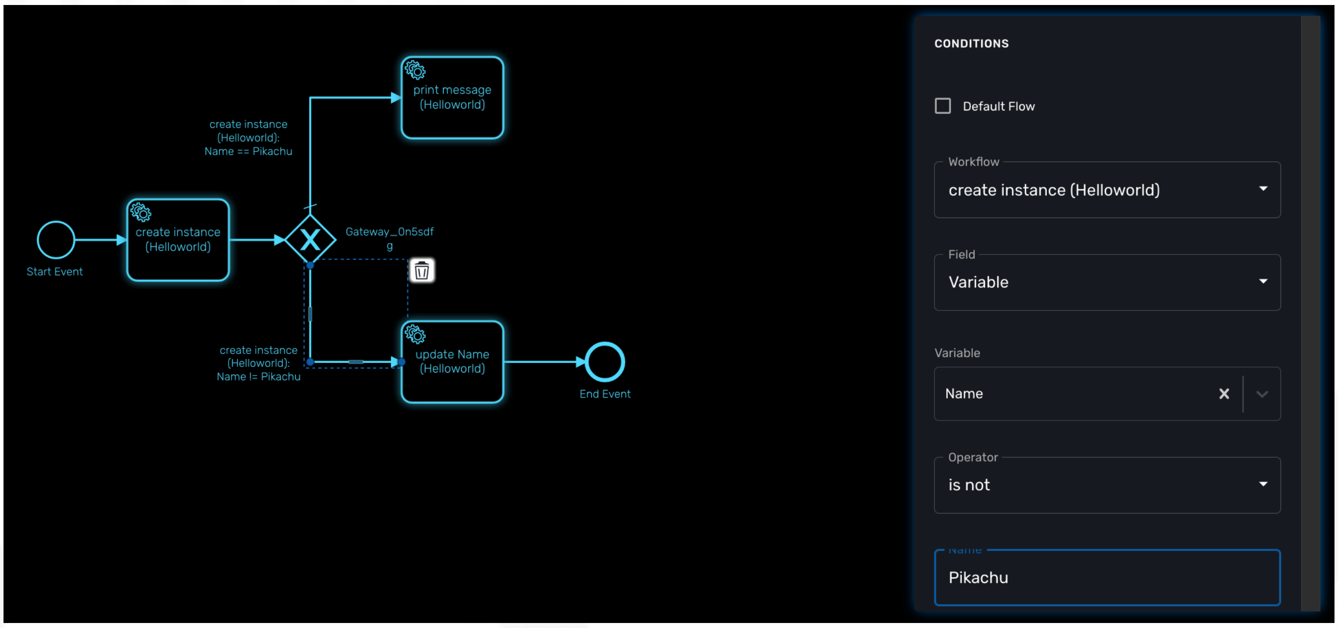


To configure the gateway, you need to select the outbound link from the gateway, choose the inbound task and configure the condition to transition to the next BPM task.

Configure a decision gateway

To configure a decision gateway, you need to configure each of its outbound links and select one of the outbound link to be the default flow.

Configure a decision gateway


print message (Helloworld)
create instance (Helloworld): Name == Pikachu
Start Event
create instance (Helloworld)
Gateway_0n5sdfg
create instance (Helloworld): Name != Pikachu
update Name (Helloworld)
End Event

CONDITIONS

Default Flow

Workflow: create instance (Helloworld)

Field: Variable

Variable: Name

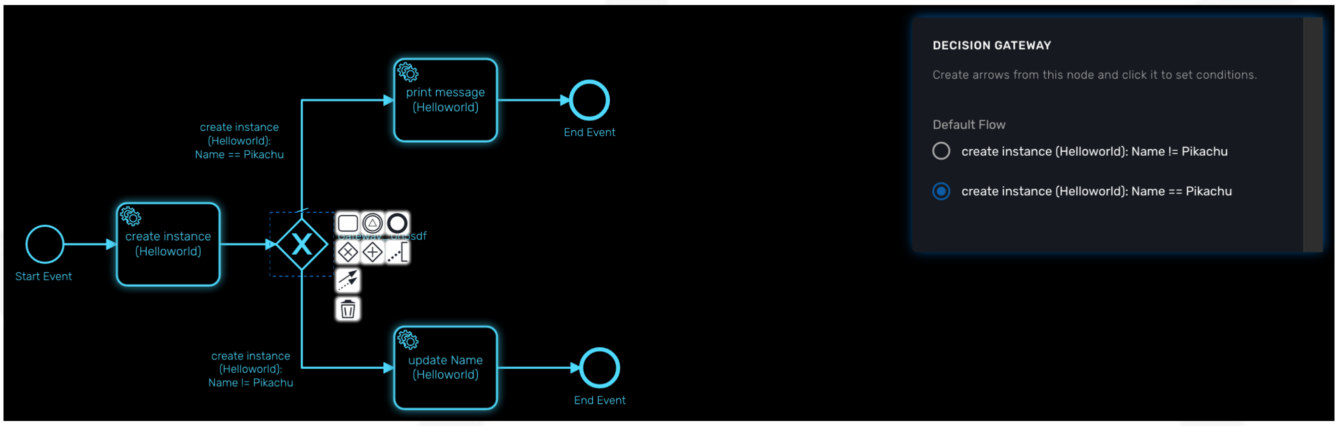
Operator: is not

Name: Pikachu

Default flow

Click on the decision gateway ans select the default flow of the process when there is not suitable condition based on the result of the inbound task.

Configure the default flow


print message (Helloworld)
End Event
create instance (Helloworld): Name == Pikachu
Start Event
create instance (Helloworld)
create instance (Helloworld): Name != Pikachu
update Name (Helloworld)
End Event

DECISION GATEWAY

Create arrows from this node and click it to set conditions.

Default Flow

create instance (Helloworld): Name != Pikachu [✓ create instance (Helloworld): Name == Pikachu]

Workflow

For each outbound link, select the inbound workflow that will be used as the condition source for the link.

Field

Select the field to use to test the condition. Field can be "Variable" or "Result Status".

With "Variable", you can choose one of the workflow variable and test its value for the decision.

With "Result Status", the decision will depend on the execution status of the workflow.

Design a BPM process

Create a new BPM

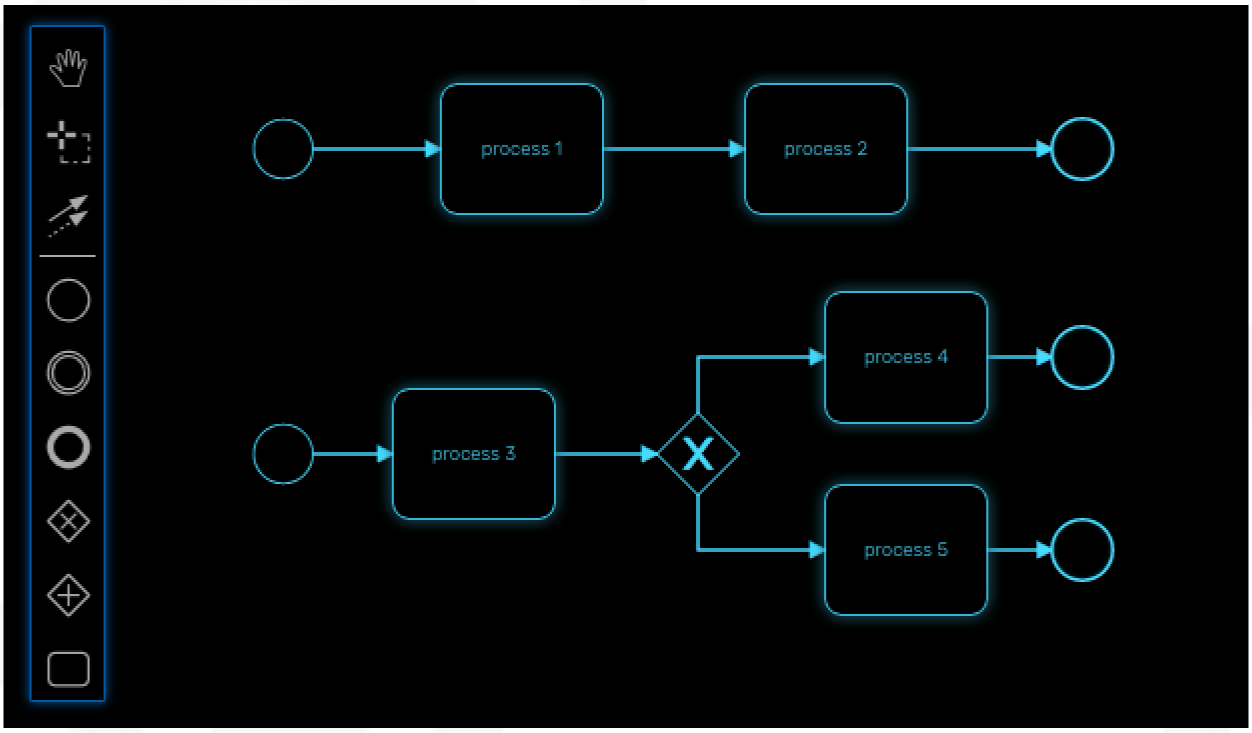
Click on "Create" to create a new BPM editor.

Use your mouse to add tasks and link them together.

A BPM process must have a StartEvent and an EndEvent.

Only one executable BPM process can be specified in a BPM definition.

Multiple process definition in a single BPM is not supported



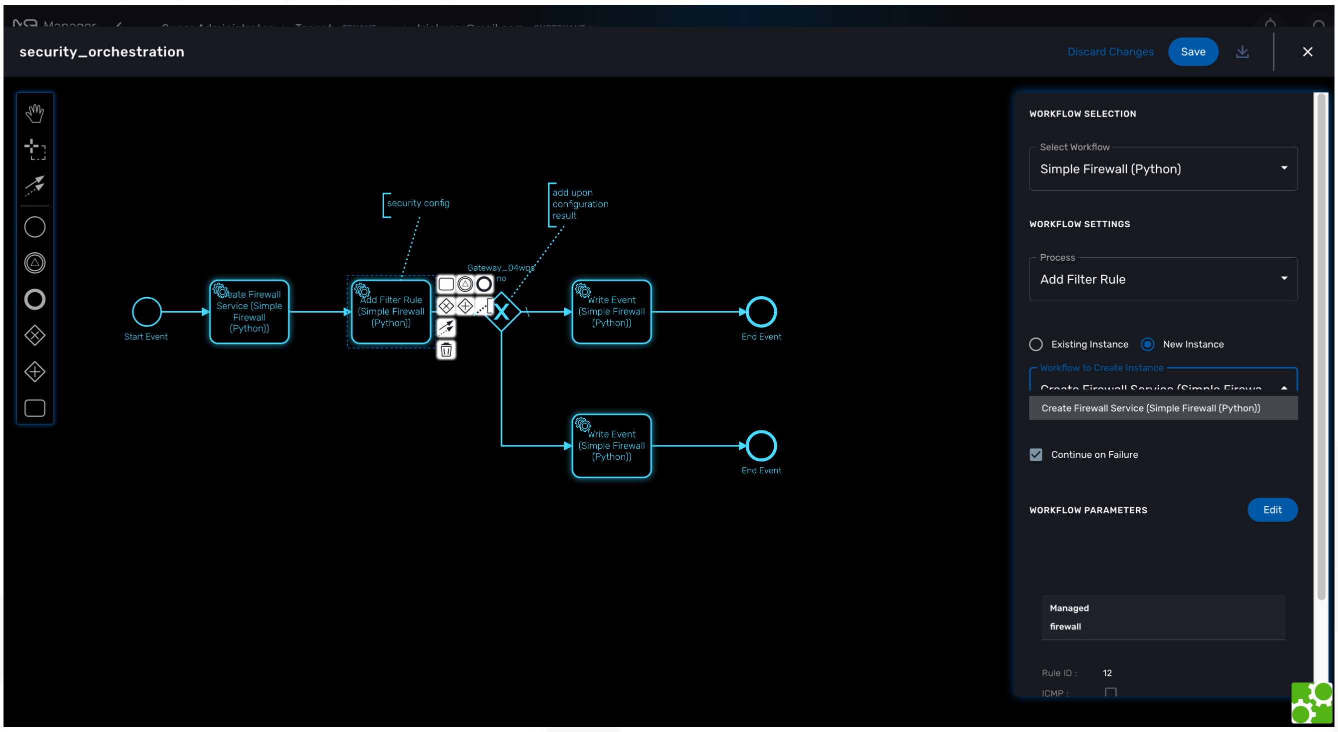
You can save your BPM at anytime and edit it later. When you save you BPM, you need to select a sub-tenant.

A BPM is associated to a single sub-tenant.

Connecting workflows and processes

Select an executable task to see the list of workflows (based on the sub-tenant selected), then select a process and provide its input parameters.

Configure a BPM task with workflow and processes


security_orchestration
Discard Changes
Save
security config
add upon configuration result
Gateway_04wq
no
Start Event
Create Firewall Service (Simple Firewall (Python))
Add Filter Rule (Simple Firewall (Python))
Write Event (Simple Firewall (Python))
End Event
Write Event (Simple Firewall (Python))
End Event
Edit

WORKFLOW SELECTION

Select Workflow: Simple Firewall (Python)

WORKFLOW SETTINGS

Process: Add Filter Rule

Existing Instance [✓ New Instance]

Workflow to Create Instance: Create Firewall Service (Simple Firewall (Python))

[✓ Continue on Failure]

WORKFLOW PARAMETERS

Managed firewall

Rule ID : 12

ICMP :

If the process you select in a BPM task is a "UPDATE" process (see Workflow design for more details), you'll have the possibility to select either an existing Workflow instance or use a new instance created by one of the previous BPM task.

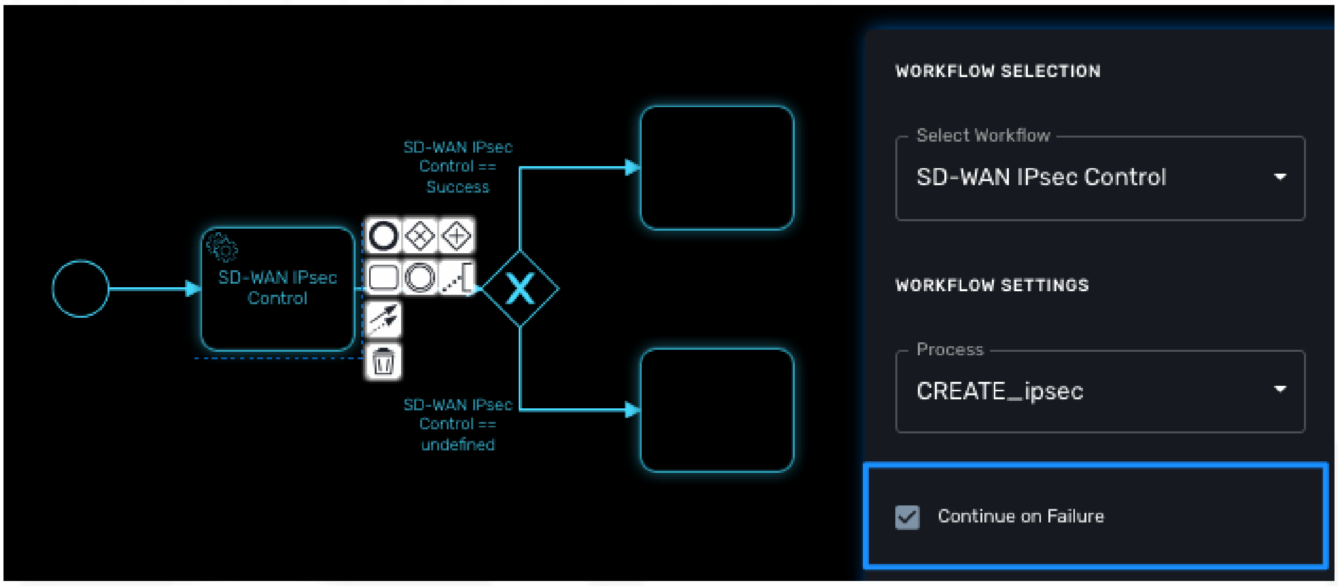
This is extremely useful for BPM designers for chaining tasks together.

Execution flow control

By default, the BPM execution will stop whenever the associated workflow process execution fails but you may need to make sure that the BPM continues to execute despite the failure. This is typically the case when there is a decision gateway where execution is routed based on the status of the process execution.

To allow the BPM process to continue executing after a workflow process execution fails, you need to edit the BPM task and check "Continue on Failure."

Control the execution flow


SD-WAN IPsec Control == Success
SD-WAN IPsec Control
SD-WAN IPsec Control == undefined

WORKFLOW SELECTION

Select Workflow: SD-WAN IPsec Control

WORKFLOW SETTINGS

Process: CREATE_ipsec

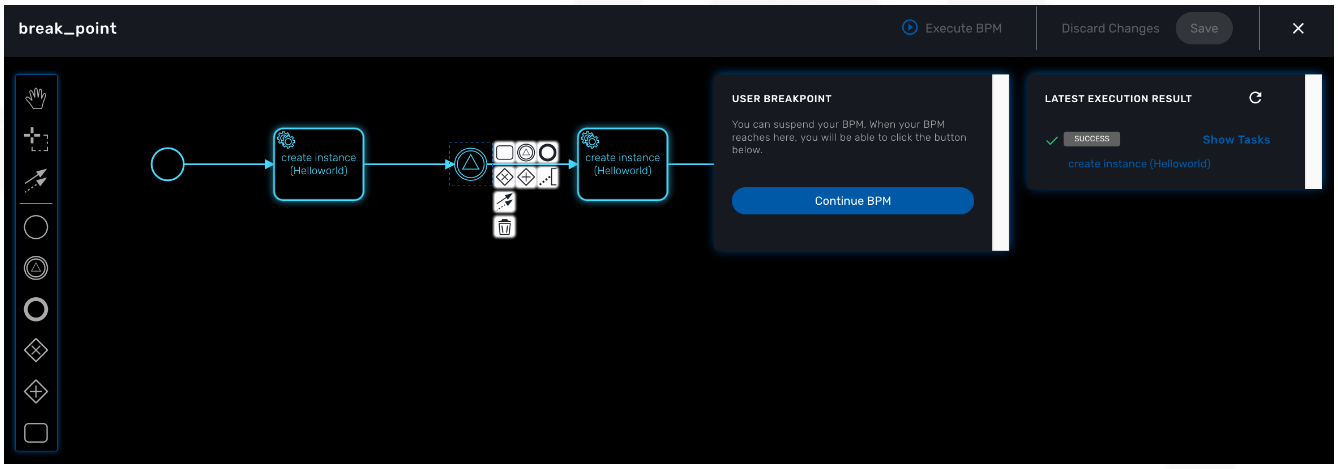
☑ Continue on Failure

Execution breakpoint

With the execution breakpoint you can create pauses in the BPM flow execution. The BPM process will run, stop and wait for the user to select the breakpoint symbol and click "Continue BPM" to resume it’s execution.

Breakpoints can be used for debugging a complex BPM process without triggering all the workflow and doing a step by step execution. It can also be used to organise a complex BPM into several part and allow for manual validation of each intermediate steps.

Resume the execution flow from the user breakpoint



USER BREAKPOINT

You can suspend your BPM. When your BPM reaches here, you will be able to click the button below.

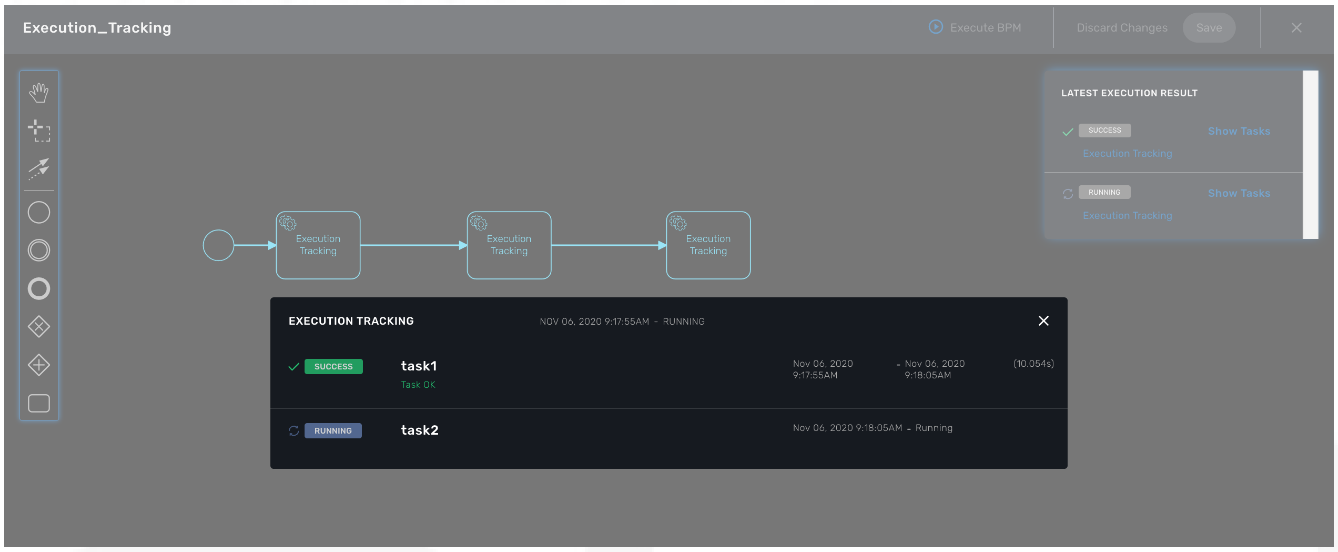
LATEST EXECUTION RESULT

✓ SUCCESS create instance (Helloworld)

Execution tracking

The BPM engine will start executing the BPM tasks one by one and the status of the current workflow process execution will be updated live in the view "LATEST EXECUTION RESULT" while the detail of the process execution will be displayed.

Execution tracking



LATEST EXECUTION RESULT

✓ SUCCESS Show Tasks
Execution Tracking

RUNNING Show Tasks
Execution Tracking

EXECUTION TRACKING NOV 06, 2020 9:17:55AM - RUNNING

✓ SUCCESS task1 Task OK Nov 06, 2020 9:17:55AM - Nov 06, 2020 9:18:05AM (10.054s)

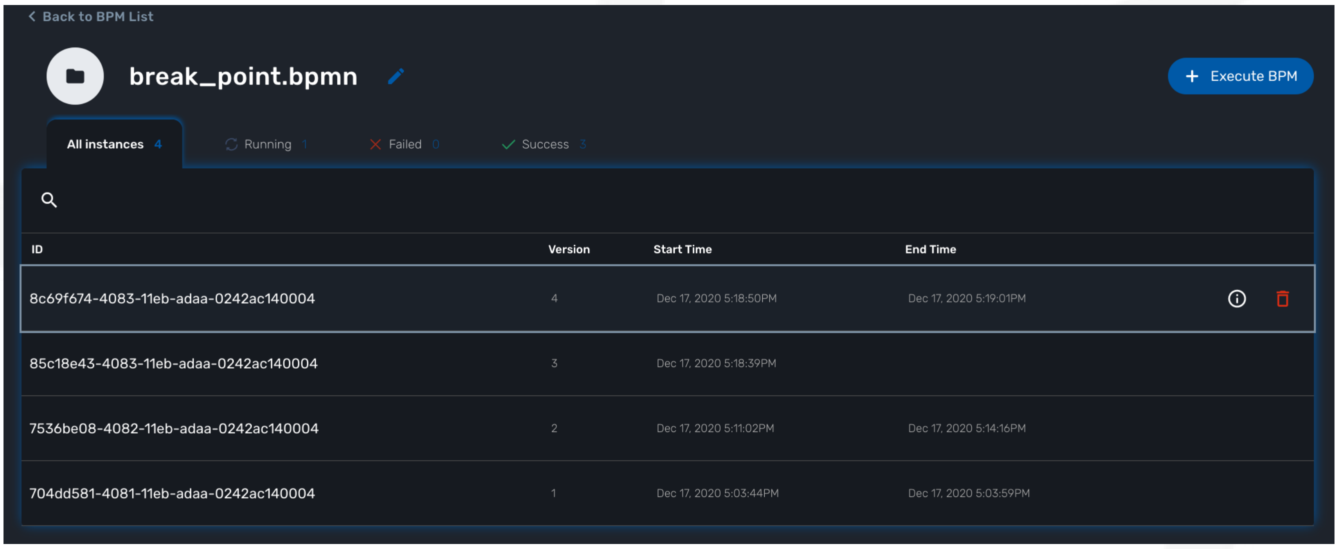
RUNNING task2 Nov 06, 2020 9:18:05AM - Running

BPM instances management

BPM are associated to a subtenant in a way which is very similar to workflows, you can manage the instances of BPM executions.

For instance, if you executed a BPM with a breakpoint, you don't need to leave the BPM execution screen open. You can trigger the execution, close the screen and later, select the instance and open it.

BPM instances management



ID	Version	Start Time	End Time
8c69f674-4083-11eb-adaa-0242ac140004	4	Dec 17, 2020 5:18:50PM	Dec 17, 2020 5:19:01PM
85c18e43-4083-11eb-adaa-0242ac140004	3	Dec 17, 2020 5:18:39PM	
7536be08-4082-11eb-adaa-0242ac140004	2	Dec 17, 2020 5:11:02PM	Dec 17, 2020 5:14:16PM
704dd581-4081-11eb-adaa-0242ac140004	1	Dec 17, 2020 5:03:44PM	Dec 17, 2020 5:03:59PM

Getting Started Developing BPM

The BPM (Business Process Modeling) will allow you to design your processes to automate and then execute these processes.

Uses of BPMN

Business Process modeling is used to communicate a wide variety of information to a wide variety of audiences. BPMN is designed to cover many types of modeling and allows the creation of end-to-end Business Processes.

The structural elements of BPMN allow the viewer to be able to easily differentiate between sections of a BPMN Diagram.

The MSactivator™ provides the support for executable BPM Processes.

With the BPM design console, you can design your BPM and connect the BPM elements to Workflows.

The MSactivator™ provides a partial support of the BPMN 2.0 specification and you will be able to use Event and Activities.

Start Event and End Event

will let you specify the beginning and the end of the process execution.

Activities: Tasks

Integration Task will allow you to specify the flow of execution of your BPM.

Text Annotation

Use text annotation to add some description to your BPM elements.

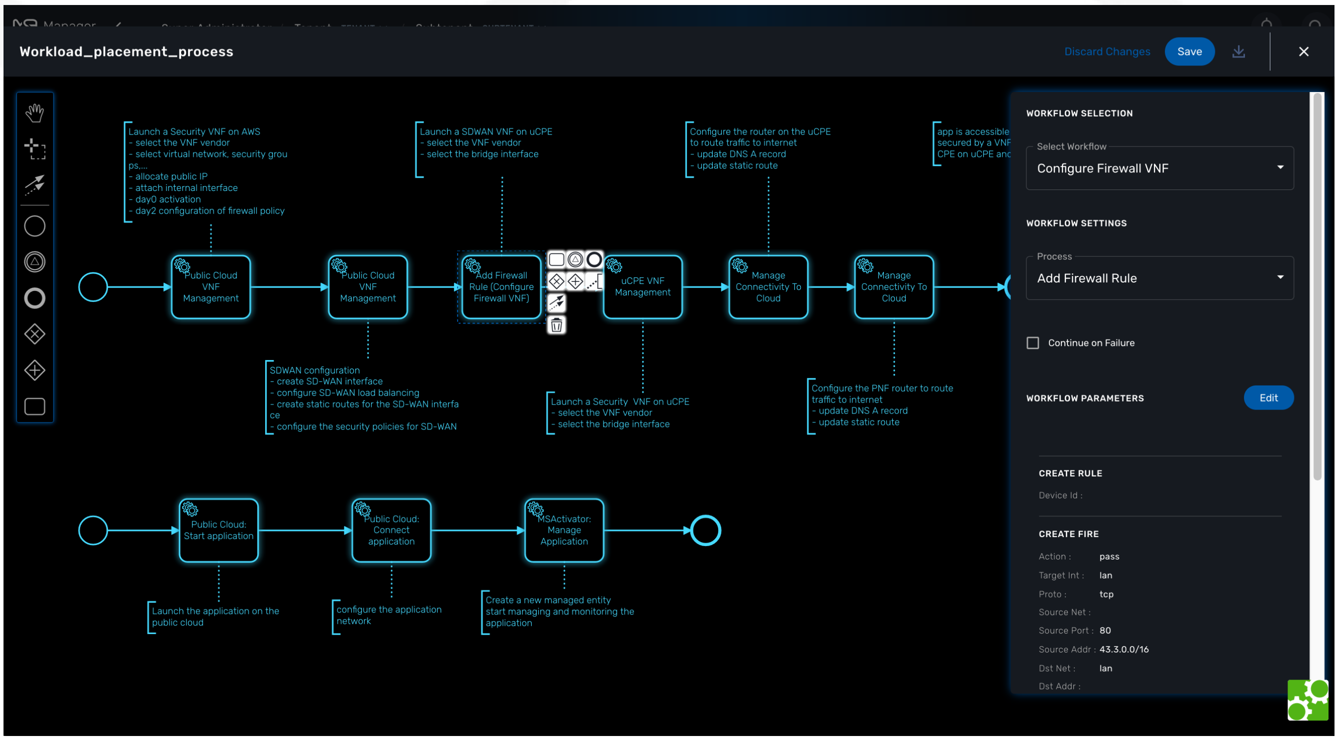
Gateway and Intermediate Event

Not supported yes

Example

The BPM below is made of 1 start event, 5 integration task and an end event.

Each integration task calls a workflow from the workflows that are associated to the current customer.


Workload_placement_process
Discard Changes
Save
Public Cloud VNF Management
Public Cloud VNF Management
Add Firewall Rule (Configure Firewall VNF)
uCPE VNF Management
Manage Connectivity To Cloud
Manage Connectivity To Cloud
Public Cloud: Start application
Public Cloud: Connect application
MSActivator: Manage Application
Edit

Launch a Security VNF on AWS
- select the VNF vendor
- select virtual network, security grou ps,...
- allocate public IP
- attach internal interface
- day0 activation
- day2 configuration of firewall policy

Launch a SDWAN VNF on uCPE
- select the VNF vendor
- select the bridge interface

Configure the router on the uCPE to route traffic to internet
- update DNS A record
- update static route

app is accessible secured by a VNF CPE on uCPE and

SDWAN configuration
- create SD-WAN interface
- configure SD-WAN load balancing
- create static routes for the SD-WAN interfa ce
- configure the security policies for SD-WAN

Launch a Security VNF on uCPE
- select the VNF vendor
- select the bridge interface

Configure the PNF router to route traffic to internet
- update DNS A record
- update static route

Launch the application on the public cloud

configure the application network

Create a new managed entity
start managing and monitoring the application

WORKFLOW SELECTION

Select Workflow: Configure Firewall VNF

WORKFLOW SETTINGS

Process: Add Firewall Rule

☐ Continue on Failure

WORKFLOW PARAMETERS

CREATE RULE

Device Id :

CREATE FIRE

Action :	pass
Target Int :	lan
Proto :	tcp
Source Net :	
Source Port :	80
Source Addr :	43.3.0.0/16
Dst Net :	lan
Dst Addr :	

Create or Edit a BPM

To create a new BPM you need to select "Automation" on the left menu. This will list any BPM available for the current customer.

You can either edit a BPM or create a new one from this screen. Use you mouse to add elements and link them together.

For each task, you need to select a workflow and one of the process from that workflow. The BPM editor will list all the processes defined in a workflow and when the process is selected it will list the variables that are defined in the tasks by the function `list_args`.

you should only select workflow processes with the type CREATE.

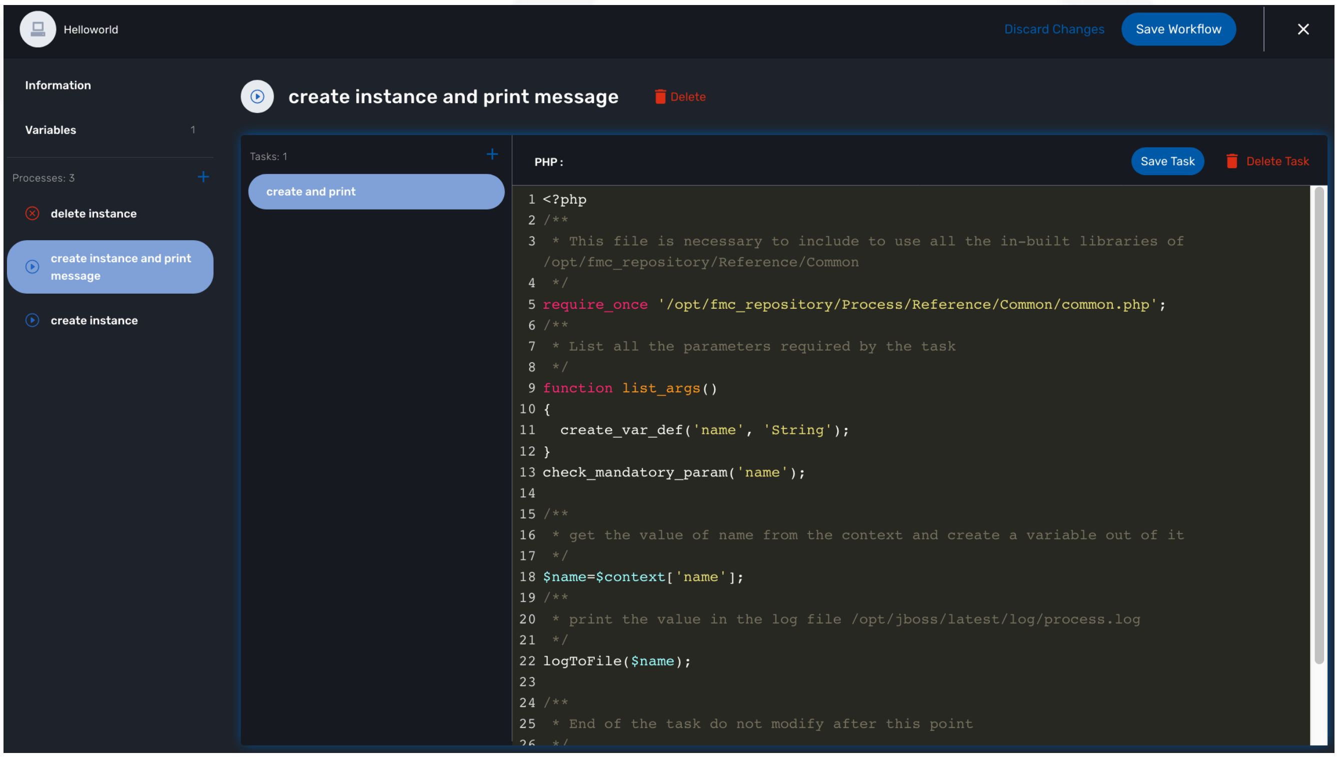
You can save your BPM design anytime and edit it later. The BPM files are stored in the repository under `/opt/fmc_repository/Datafiles/<TENANT ID>/<CUSTOMER ID>/bpmn`

The Helloworld BPM

This tutorial will show you, in a simple way how to create a new BPM and call a Workflow.

It is using the Helloworld example wich is detailed in this documentation: Getting Started Developing Workflows.

As stated above, the BPM tasks can only call Workflow process with the type CREATE. Before creating the BPM, you need to add a new process to the Helloworld workflow and make sure its type is CREATE. This process can have a single task and you can reuse the PHP code from the Helloworld tutorial.

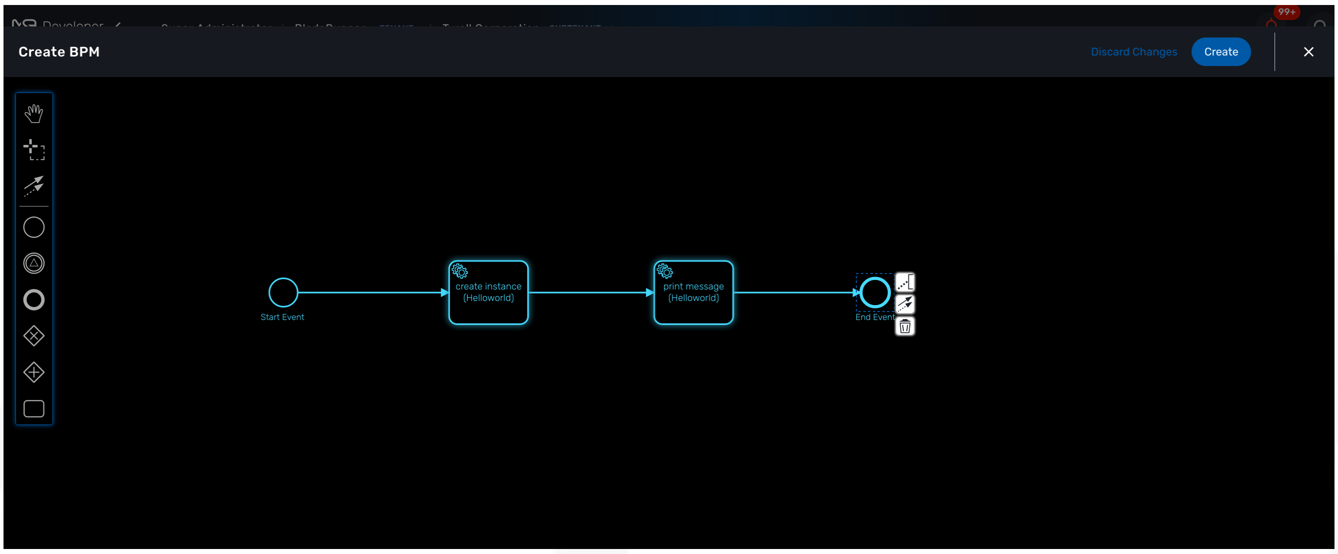


```php
<?php
/**
 * This file is necessary to include to use all the in-built libraries of
/opt/fmc_repository/Reference/Common
 */
require_once '/opt/fmc_repository/Process/Reference/Common/common.php';
/**
 * List all the parameters required by the task
 */
function list_args()
{
  create_var_def('name', 'String');
}
check_mandatory_param('name');

/**
 * get the value of name from the context and create a variable out of it
 */
$name=$context['name'];
/**
 * print the value in the log file /opt/jboss/latest/log/process.log
 */
logToFile($name);

/**
 * End of the task do not modify after this point
 */
```

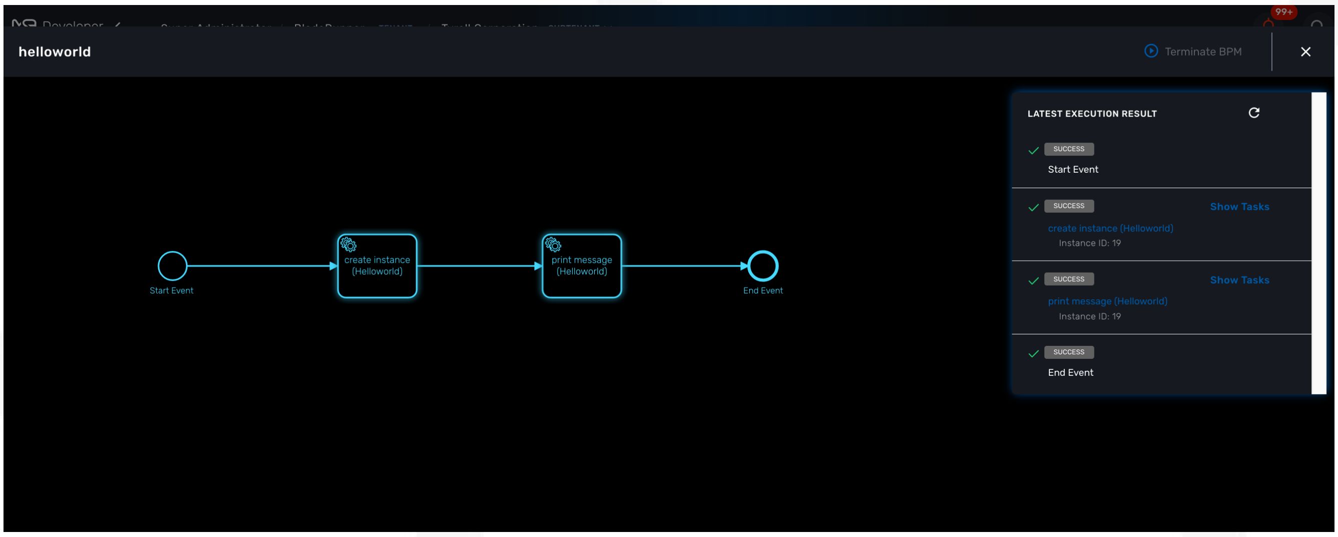
Once this is done, go to the "BPM" section under "Automation" and click on "+ Create BPM".

Add a Task Activity and an End Event.

Click on the task, select the Helloworld workflow, then from the list of process, select the new CREATE process. Provide a value for the parameter name and save the BPM



To test your BPM, click on it’s name from the list of BPM and click on "Execute BPM".



LATEST EXECUTION RESULT

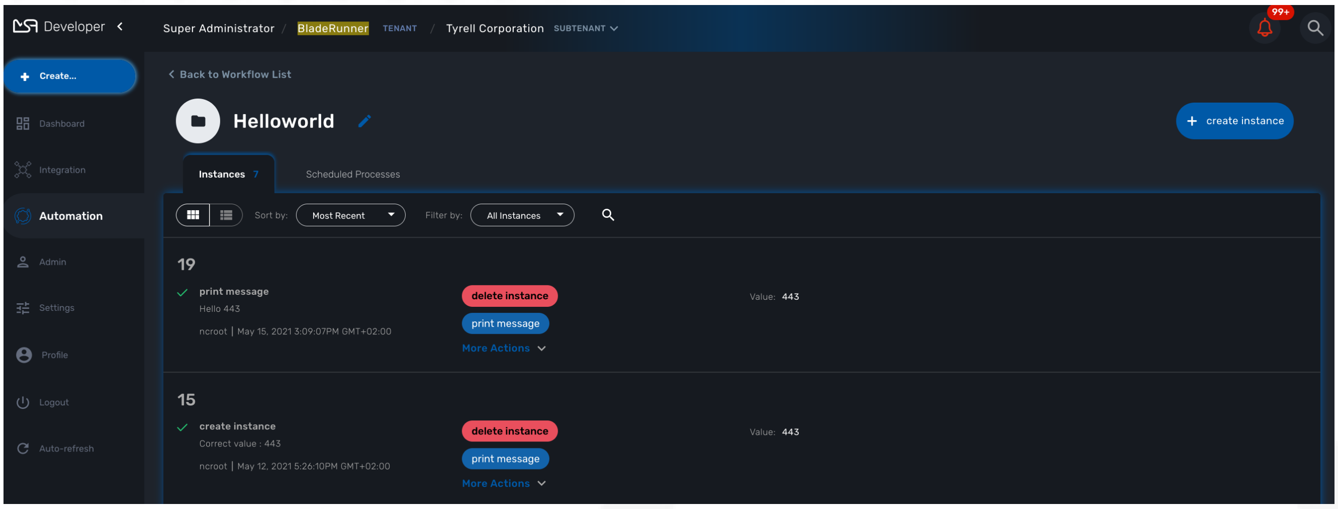
SUCCESS
Start Event

SUCCESS Show Tasks
create instance (Helloworld)
Instance ID: 19

SUCCESS Show Tasks
print message (Helloworld)
Instance ID: 19

SUCCESS
End Event

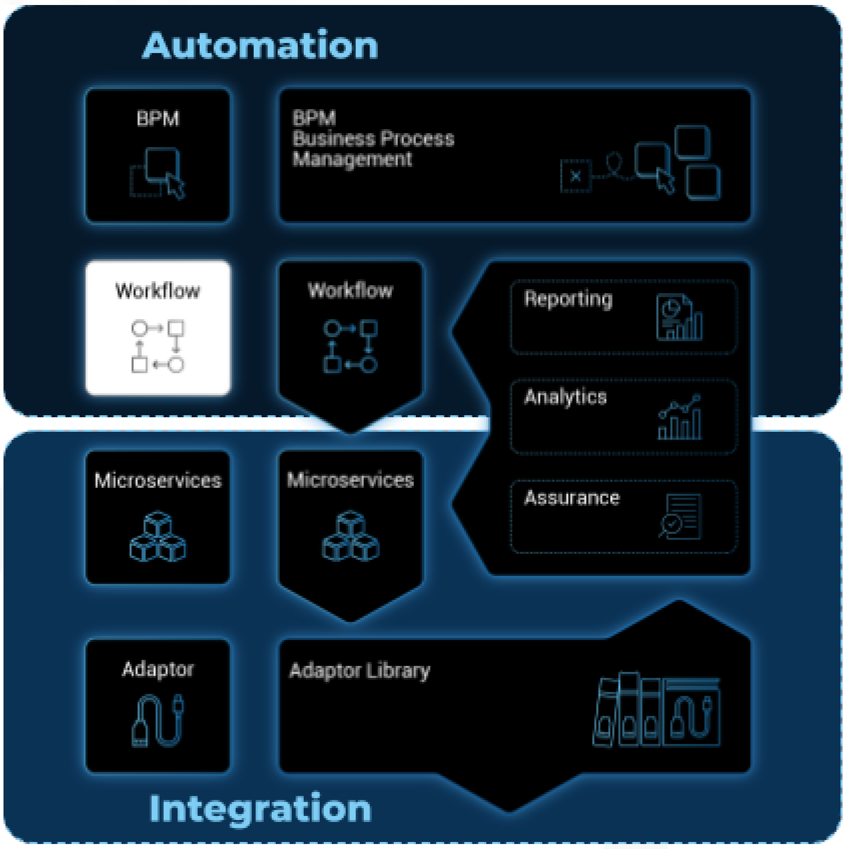
You can check that the workflow process was executed and the message is visible in the processes execution status.



19
print message
Hello 443
ncroot | May 15, 2021 3:09:07PM GMT+02:00
delete instance
print message
More Actions
Value: 443

15
create instance
Correct value : 443
ncroot | May 12, 2021 5:26:10PM GMT+02:00
delete instance
print message
More Actions
Value: 443

Workflow Editor



The **workflow editor** is a web based UI tool for designing, developing, testing and releasing automation workflows.

Overview

With the workflow editor, you can create new workflows or edit existing workflows.

This document explains how to use the editor to design workflows and implement them in PHP or in Python.

The Workflow designer and execution engine are located in the architecture layer, between the BPM and the Microservice.

Workflow overview

A workflow is a automation entity that can be used to automate all sorts of simple to complex processes.

A workflow is defined by

- a set of variables that can be used to hold the state of a workflow instance;
- a set of processes made out of tasks. This is where the execution is coded.

The tasks are scripts that can be implemented either in PHP or in Python.

The lifecycle of a workflow

There are 3 main types of workflow processes:

CREATE

execute an automated process and create a new instance of the workflows.

UPDATE

execute an automated process that will (but it’s not mandatory) update the state of the process.

DELETE

execute an automated process that will also remove the instance of the workflow.

> a delete process can be assigned to the trash icon of the workflow instances. By default, the thrash icon action will only delete the workflow instance without executing any specific process.

Execution status

The status a normal process execution is defined by the implementation of the tasks and it’s the responsibility of the developer to handle the termination status. As a developer, you have 3 statuses, defined by constants in PHP or Python, that you can use in your task to define the condition for transiting from a task to the next one.

- ENDED: the execution was successful, the next task will be executed and if it was the last task, the process will be marked as "Success".
- WARNING: the execution was successful but some warning were raised, the next task will be executed and if it was the last task, the process status will be displayed as "Warning".
- FAILED: the execution failed, the process execution will stop at the current task and the process status will be noted as "Failed".

> these documentations to get more details and code samples on this topic: PHP SDK and Python SDK

How to persist the state of a workflow instance

The variables are used to define the current state of a workflow instance, this state is maintained in a context which is persisted in the database.

For each workflow instance, the variable and their values are stored in the database in a context. This context is accessible in read-write mode anytime in the process tasks, in order to store a value of a variable or read a value from a variable.

Example:

in Python: read a value from the context

```
context = Variables.task_call()
my_name = context['name']
```

set a value in the context

```
context['name'] = my_name
```

Example:

in PHP: read a value from the context

```
$my_name = $context['name'];
```

set a value in the context

```
$context['name'] = $my_name;
```

The context is persisted in the database and its value is updated after each task execution.

This is how variable values can be passed, during the execution of a process, from one task to another.

by default, the variables that are declared a persisted in the context but you can also create local variables in the tasks and store them in the context.

Editor Overview

To create a new workflow, connect to the developer portal and click "+ Create" on the workflow library swimlane.

Workflow information

Provide the information related to the workflow:

- Workflow Name: the name of the workflow
- Description: a description of the workflow
- Delete process: the delete process to associate to the workflow instance trash icon.
- Workflow variable name: default to service_id (see below for more detail about this field)
- Workflow language: PHP or PYTHON (this cannot be edited)

Workflow variables

Use "+ Create Variable" to add a variable to this workflow.

A variable can be used to store data in the context of the workflow instance and it can also be used to generate the user input fields when executing a process from the UI.

It is possible to define a variable for "internal" use and decide to keep is hidden from the end-user.

A variable has a name, a type and a display name

This documentation will give you more details on the variables and the various types available.

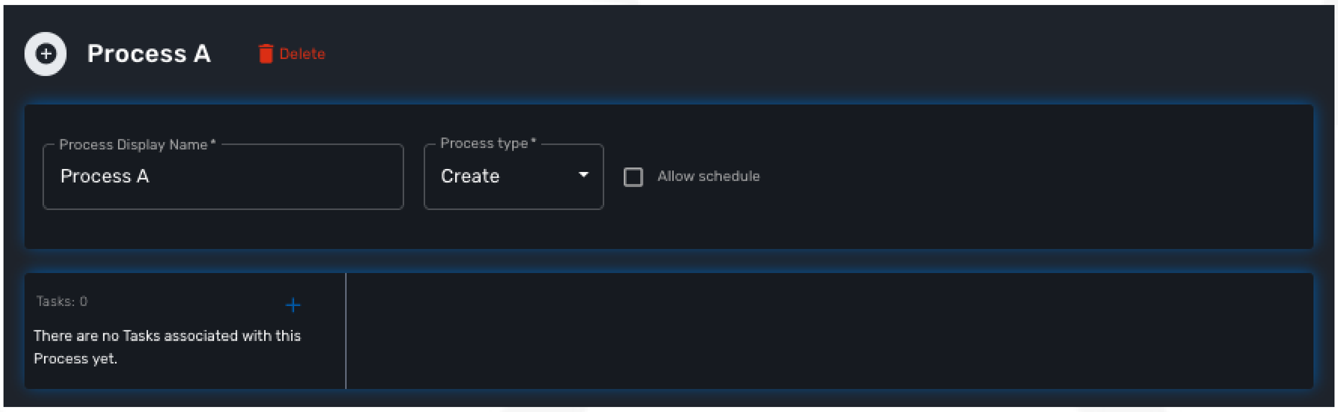
Workflow processes

A workflow can have as many processes as needed. The processes provide the "public" functions exposed by a workflow either with the UI or the REST API.

To create a process, click on the "+" and provide a name and a type (CREATE, UPDATE or DELETE).

the other types listed in the UI are not supported yet.

A new process



Process Display Name * Process A

Process type * Create

Tasks: 0

There are no Tasks associated with this Process yet.

Process scheduling

Scheduling of process execution can be authorize when defining a process by checking "Allow scheduling" on the process definition screen.

When scheduling is allowed, the user execute the process either the usual way by clicking "Run" or use "Schedule" to configure the process execution scheduling.

Tasks

The tasks are the smallest execution unit of a workflow.

A process can have as many tasks as needed and although it’s possible to implement a process with a single task, splitting the overall process execution into smaller tasks will ease the code maintenance and the execution monitoring.

Depending on the workflow language selected when creating the workflow, the task should be implemented either in Python or in PHP.

When creating a new task, the UI will populate the code editor with a pre-defined code template that you can use to start coding your tasks.

PHP template

```
<?php

require_once '/opt/fmc_repository/Process/Reference/Common/common.php';
①

function list_args()
②
{
  create_var_def('var_name', 'String');
  create_var_def('var_name2', 'Integer');
}

check_mandatory_param('var_name');
③

/**
 * $context => workflow context variable one per Instance
 * ENTER YOUR CODE HERE
 */
$context['var_name2'] = $context['var_name2'] + 1;
④

if ($context['var_name2'] % 2 === 0) {
⑤
    $ret = prepare_json_response(FAILED, 'Task Failed', $context, true);
    echo "$ret\n";
    exit;
}

task_success('Task OK');   // or task_error('Task FAILED');
⑥
?>
```

① include the php SDK libraries.

② function to list all the parameters required by the task and that should also be rendered as user input field.

③ function to check whether all the mandatory parameters are present in user input.

④ assign a variable with a modified value from another variable.

⑤ task execution status will depend on the value of a variable

⑥ end of the task.

Python template

```
from msa_sdk.variables import Variables     ①
from msa_sdk.msa_api import MSA_API


dev_var = Variables()
dev_var.add('var_name', var_type='String')          ②
dev_var.add('var_name2', var_type='Integer')


context = Variables.task_call(dev_var)
context['var_name2'] = int(context['var_name2']) + 1   ③

ret = MSA_API.process_content('ENDED', 'Task OK', context, True)
print(ret)          ④
```

① include the php SDK libraries.

② list all the parameters required by the task and that should also be rendered as user input field.

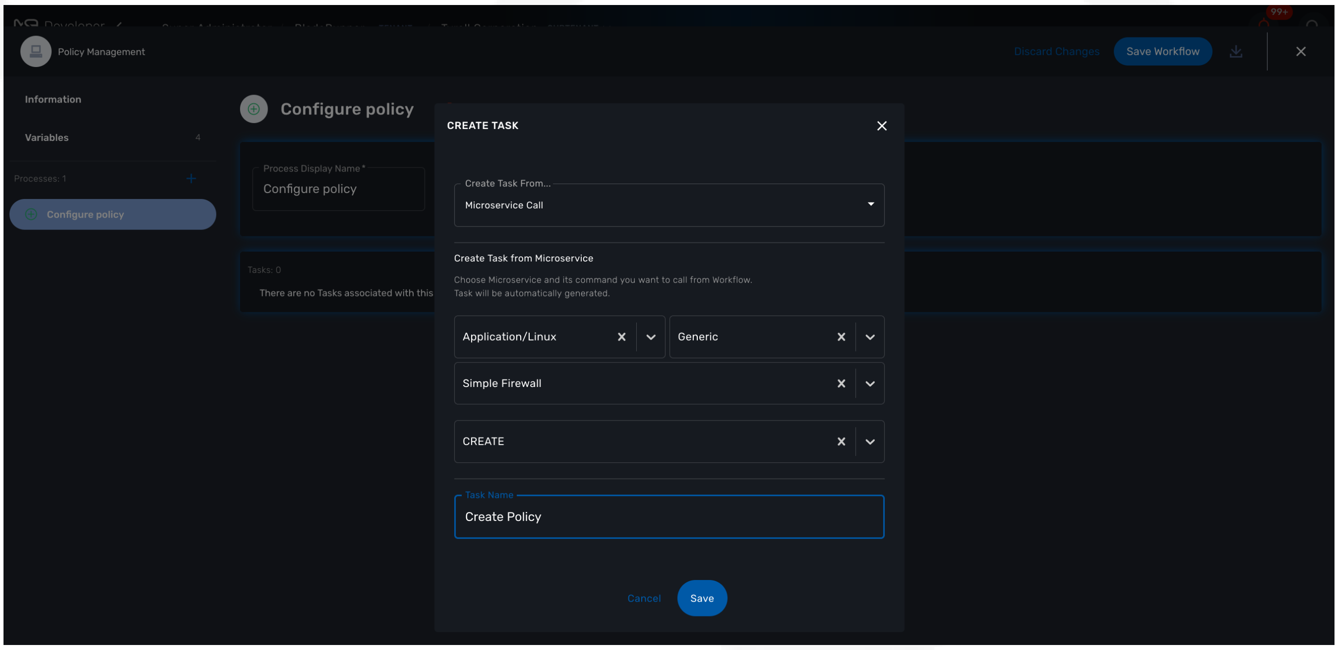
③ update the current context with another value read from the context.

④ end of the task.

Microservice to Task code generation

When you create a task you have the possibility to create a simple task pre-coded with on of the template above but you can also choose to create a task from a Microservice call.

If you select the second option, you'll have the possibility to select a Microservice and one for it's function to generate a task with all the code to execute this microservice auto-generated.



Process Display Name *
Configure policy

There are no Tasks associated with this

Create Task From...
Microservice Call

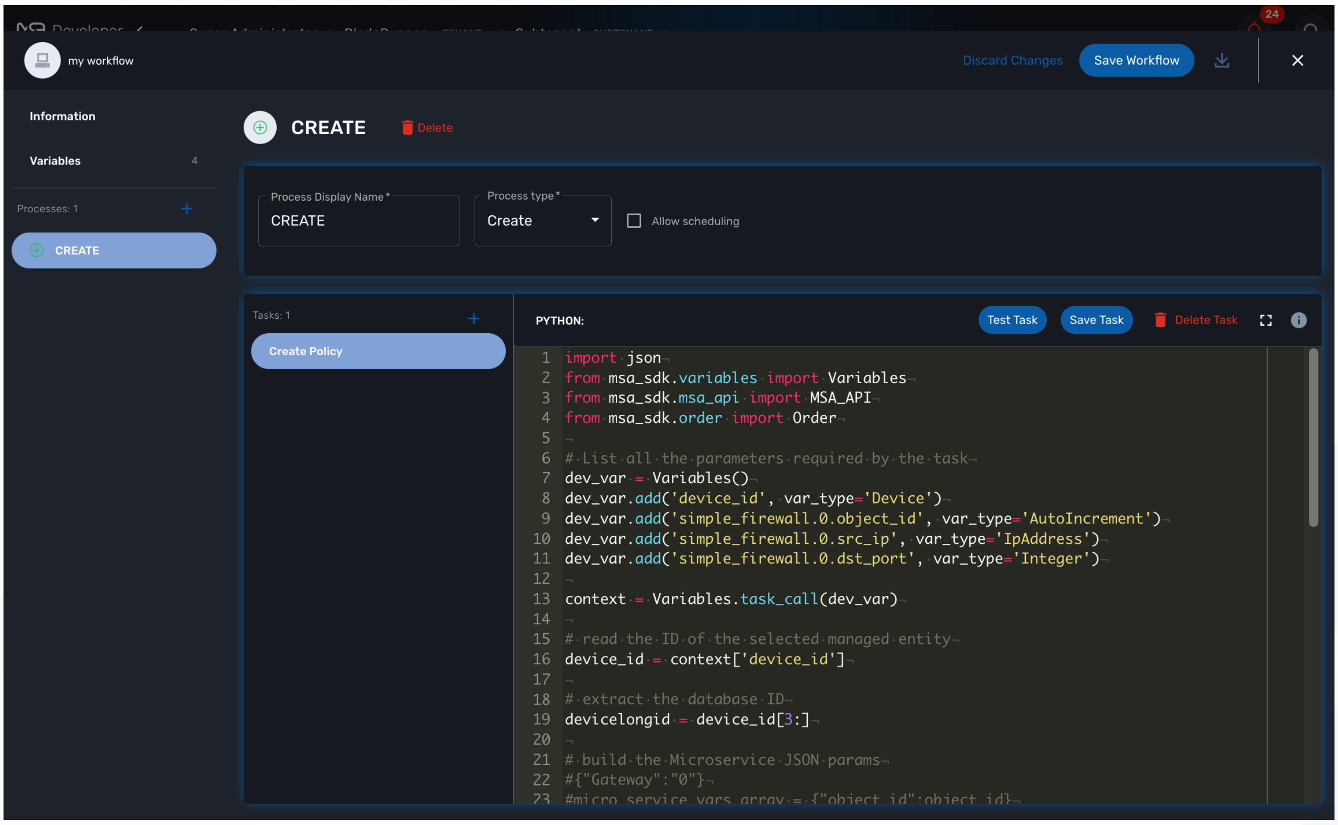
Create Task from Microservice

Choose Microservice and its command you want to call from Workflow.
Task will be automatically generated.

Application/Linux
Generic
Simple Firewall
CREATE

Task Name
Create Policy

The code of the task is automatically generated.



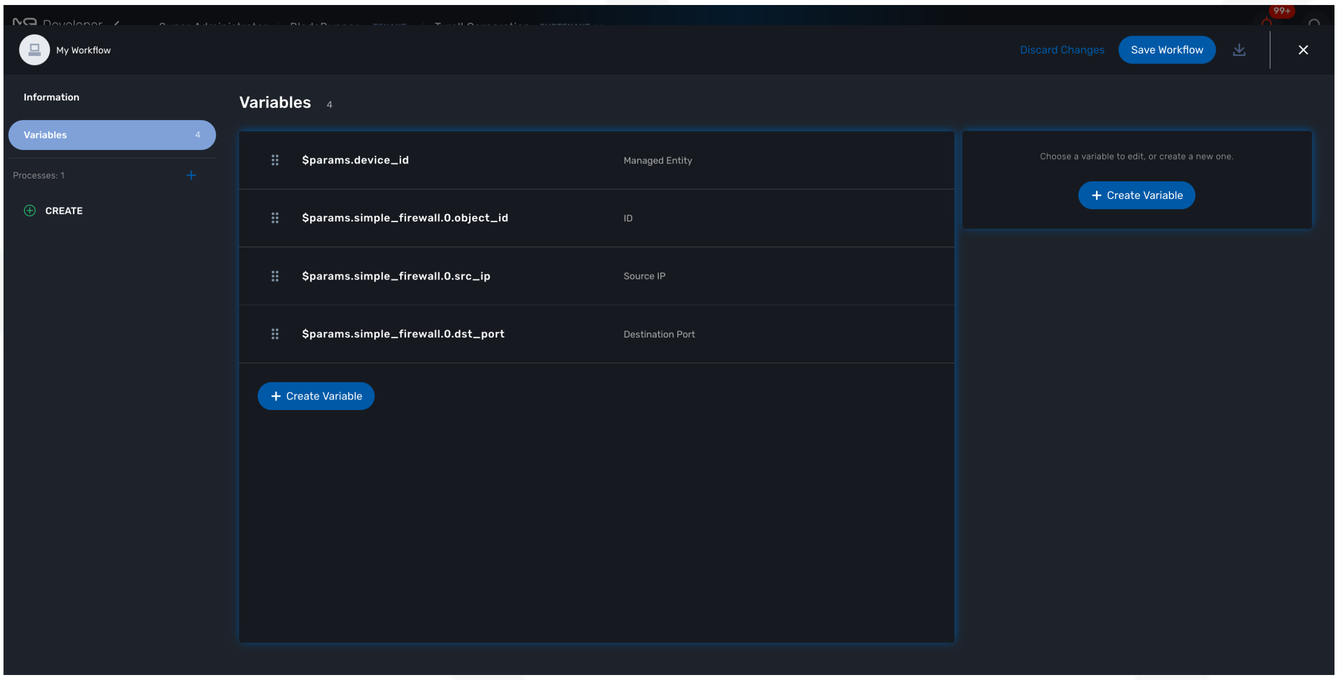
CREATE

Process Display Name * CREATE
Process type * Create
Allow scheduling

PYTHON:

```python
import json
from msa_sdk.variables import Variables
from msa_sdk.msa_api import MSA_API
from msa_sdk.order import Order

# List all the parameters required by the task
dev_var = Variables()
dev_var.add('device_id', var_type='Device')
dev_var.add('simple_firewall.0.object_id', var_type='AutoIncrement')
dev_var.add('simple_firewall.0.src_ip', var_type='IpAddress')
dev_var.add('simple_firewall.0.dst_port', var_type='Integer')

context = Variables.task_call(dev_var)

# read the ID of the selected managed entity
device_id = context['device_id']

# extract the database ID
devicelongid = device_id[3:]

# build the Microservice JSON params
#{"Gateway":"0"}
#micro_service_vars_array = {"object_id":object_id}
```

The variables related to the microservice are added.



Variables 4

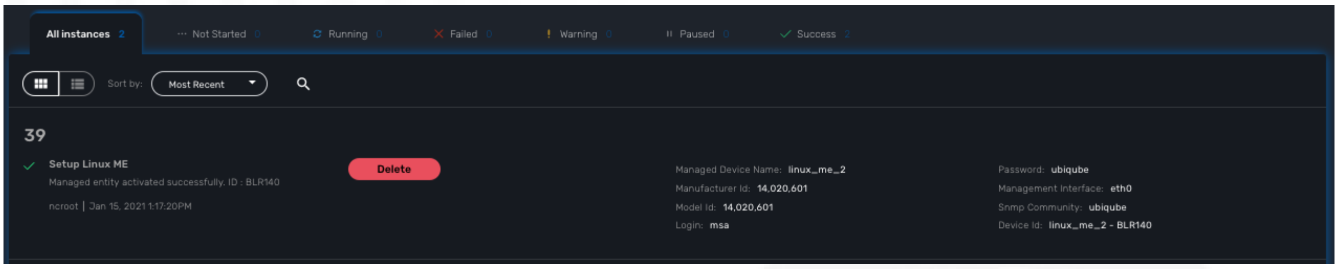
$params.device_id	Managed Entity
$params.simple_firewall.0.object_id	ID
$params.simple_firewall.0.src_ip	Source IP
$params.simple_firewall.0.dst_port	Destination Port

Logging and troubleshooting

You can add debugging information to help you with your development and also provide useful information for troubleshooting task in production.

The log files are generated per workflow instance in the container `msa_api` under `/opt/wildfly/logs/processLog/`. The log files are formatted as `process-XX.log` where XX is the workflow instance ID.

39 is the workflow instance ID

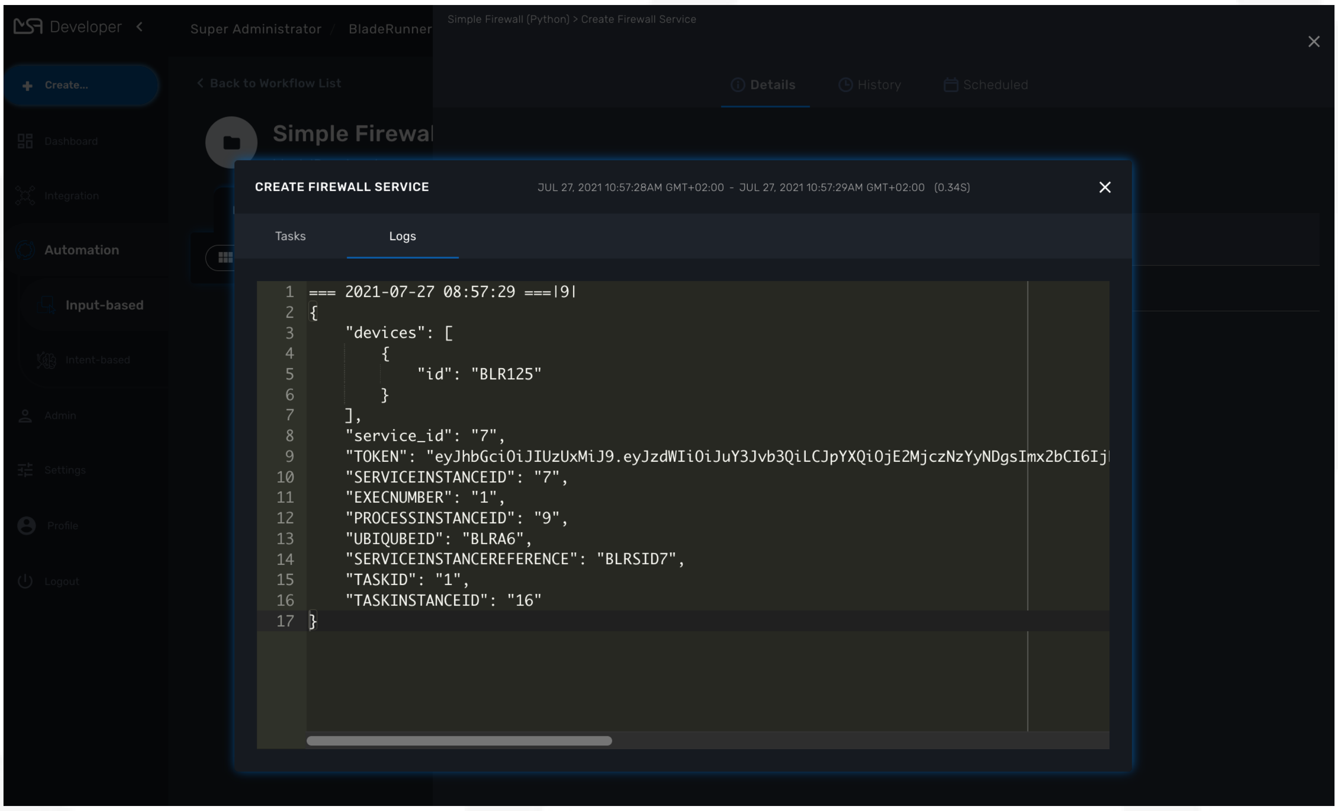


39

Setup Linux ME
Managed entity activated successfully. ID : BLR140
ncroot | Jan 15, 2021 1:17:20PM

Managed Device Name: linux_me_2
Manufacturer Id: 14,020,601
Model Id: 14,020,601
Login: msa
Password: ubiqube
Management Interface: eth0
Snmp Community: ubiqube
Device Id: linux_me_2 - BLR140

You can monitor the logs of a process by opening the logs tab in the process execution view.



```
=== 2021-07-27 08:57:29 ===|9|
{
    "devices": [
        {
            "id": "BLR125"
        }
    ],
    "service_id": "7",
    "TOKEN": "eyJhbGciOiJIUzUxMiJ9.eyJzdWIiOiJuY3Jvb3QiLCJpYXQiOjE2MjczNzYyNDgsImx2bCI6Ij
    "SERVICEINSTANCEID": "7",
    "EXECNUMBER": "1",
    "PROCESSINSTANCEID": "9",
    "UBIQUBEID": "BLRA6",
    "SERVICEINSTANCEREFERENCE": "BLRSID7",
    "TASKID": "1",
    "TASKINSTANCEID": "16"
}
```

You can also monitor the logs of a process with the CLI command below

Monitor the process execution logs

```
docker-compose exec msa-api tail -F  /opt/wildfly/logs/processLog/process-XX.log
```

Log a message in PHP

```
require_once '/opt/fmc_repository/Process/Reference/Common/common.php';

logToFile("a message");
```

Log a message in Python

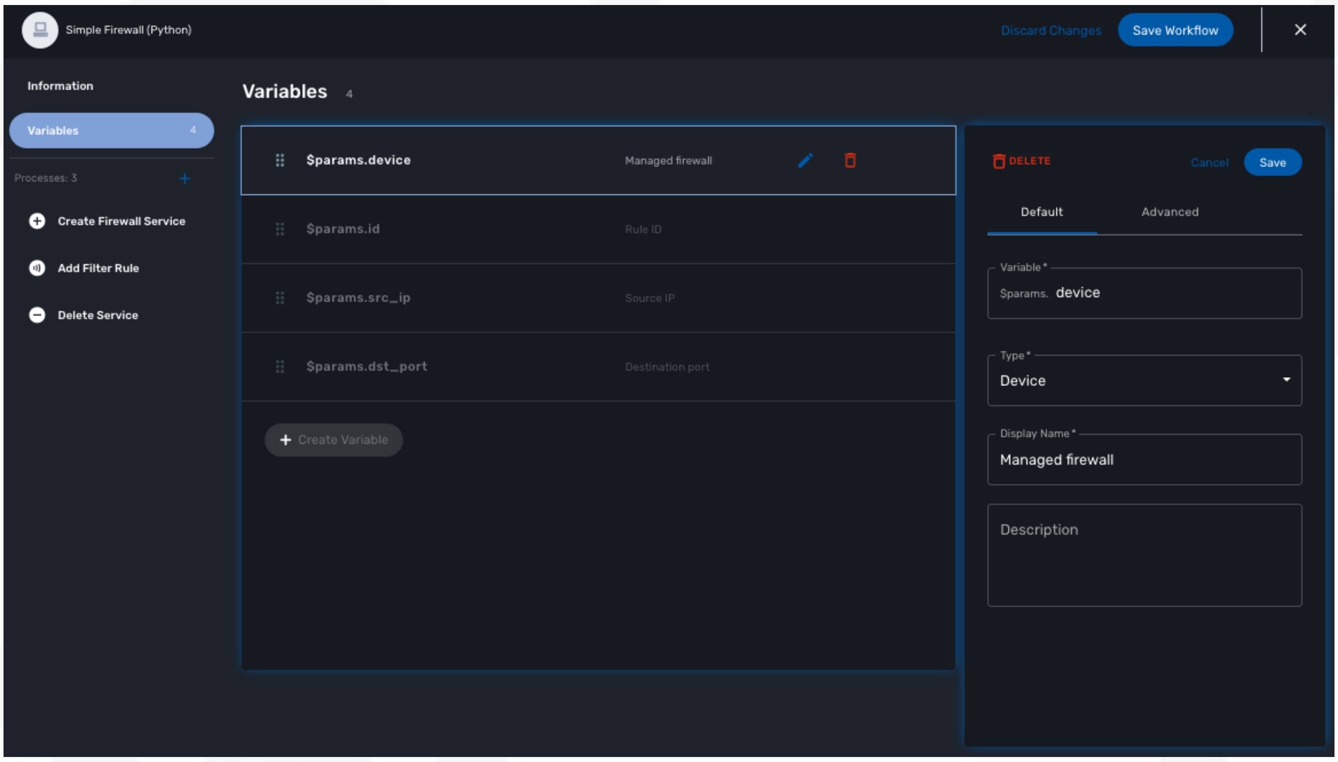
```
from msa_sdk.variables import Variables
from msa_sdk import util

dev_var = Variables()
```

```
context = Variables.task_call(dev_var)
process_id = context['SERVICEINSTANCEID']

util.log_to_process_file(process_id, 'a message')
```

Workflow Variables

Variables are used to hold the parameters to pass to a workflow process. For instance, the port and IP address to block in a firewall policy.

Workflow variable section



$params.device	Managed firewall
$params.id	Rule ID
$params.src_ip	Source IP
$params.dst_port	Destination port

Variable * $params. device

Type * Device

Display Name * Managed firewall

Description

All variables are referenced with the prefix `$params` which is automatically set in the variable editor screen and when a variable has to be referenced in one of the workflow functions, you need to use the syntax `{$params.your_variable}` (see below for more examples).

By default the type of a variable is String but other types are supported such as Integer, Boolean, Password, IpAddress, Microservice Reference,...

Overview

Variables are used to hold the parameters to pass to a workflow process. For instance, the port and IP address to block in a firewall policy.

Variables can also be used to display user information that is not necessarily meant to be used for configuring the managed entity.

Setting variables is done from the section "Variables" on the workflow editor screen.

The type of a variable will affect the way the workflow end user form will be rendered.

For instance, the type boolean will render the variable with true/false radio buttons.

Default settings

When creating or editing a variable, there are some information that need to be provided in the "Default" section.

Variable

Name of the variable to use in the implementation of the workflow or when calling the REST API.

Type

The type of the variable should be one from the list below

String

The default type for a variable, it will accepts any value and the UI renders it as a input field without any specifc validation with regards to the value set.

Boolean

This data type accepts a value of true or false, the UI will render it as a checkbox.

Integer

This data type represents a numerical value, the UI will render it as an input field restricted to integer.

Code

This type allows to render a variable as a textfield with the possibility to select a code language (default is simple text) for syntax highlighting

Password

> not supported yet

This data type represents a multi-character value that is hidden from plain sight (i.e. the value is represented as asterisks instead of clear text).

IPv4 address and mask, IPv6 mask

> not supported yet

This data type will enforce data validation against IP address formats.

Composite

The variable type composite provide ways to add control over the behavior of the workflow user form.

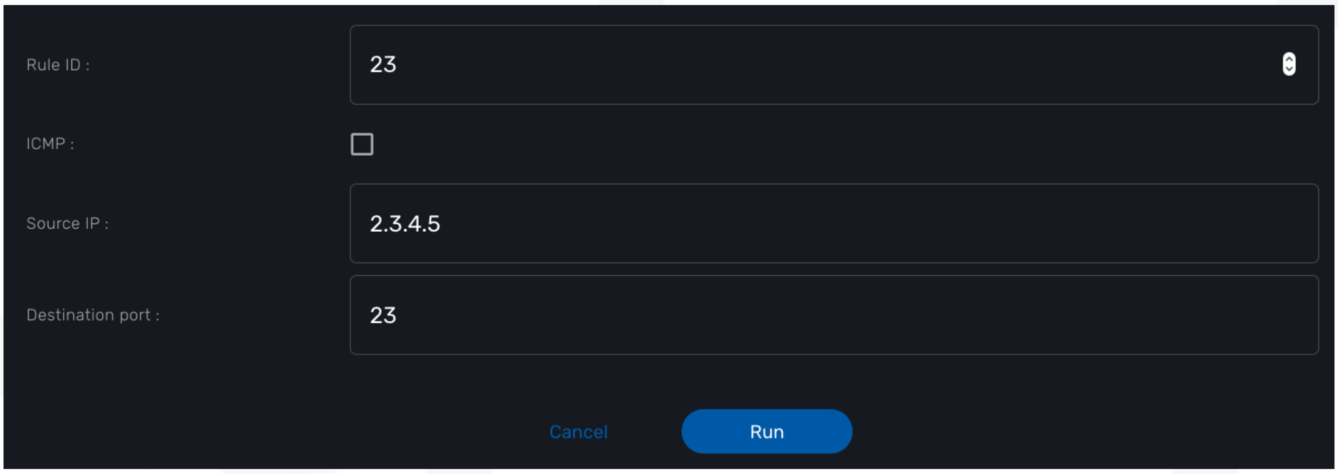
It can be used, for instance, to show/hide parts of the form based on the value of another component of the form.

Let’s take a simple example to illustrate the use of the composite type with a simple workflow for managing firewall policy.

The workflow allows the user to create a firewall policy to block a source IP address and a destination port but the user may also need to select the protocol TCP, UDP or ICMP and in the case of ICMP, the destination port is not relevant. We need to build a workflow UI where the user will have to provide the source IP and destination port when the protocol is TC or UDP and only the source IP when the protocol is ICMP.

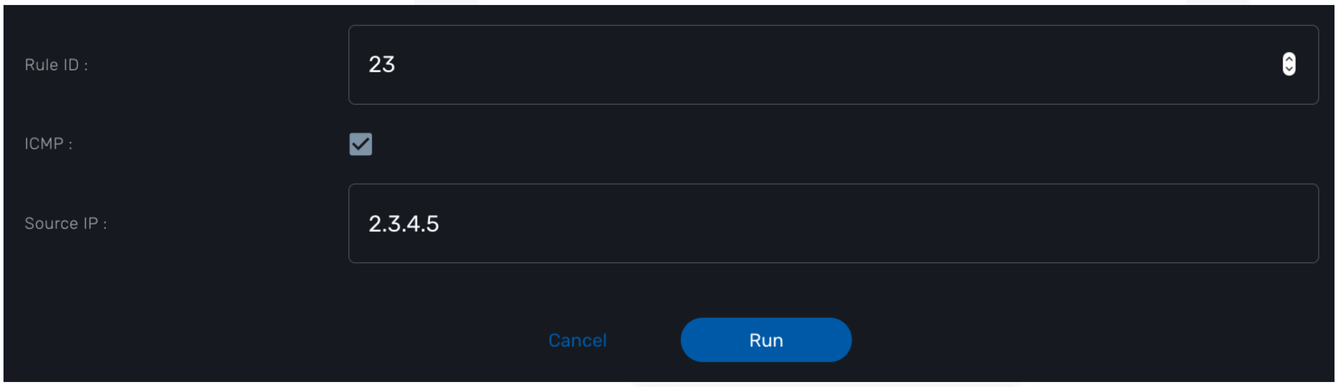
In this example, the variable "dst_port" for the destination port should be typed as a composite because it’s behavior when rendered as a user web form will depend on the other variable "protocol".

When the user choose TCP or UDP



Rule ID :	23
ICMP :	☐
Source IP :	2.3.4.5
Destination port :	23

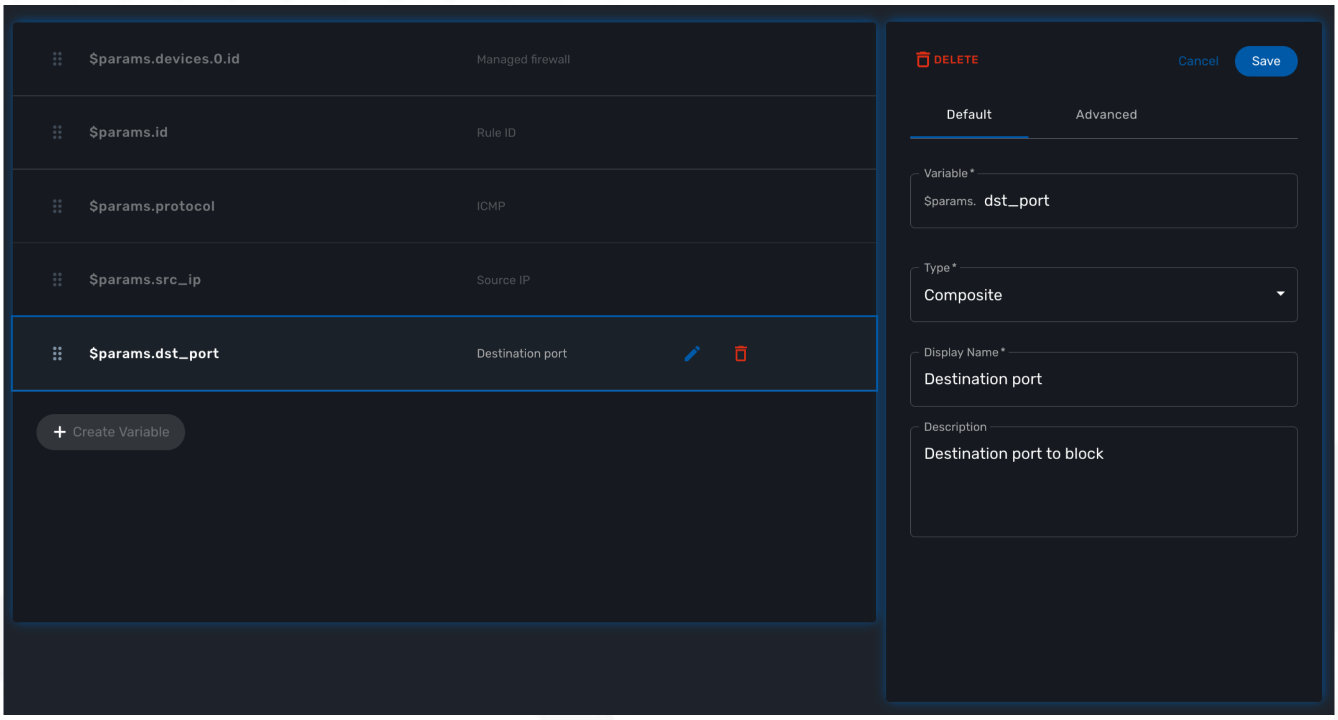
When the user selects ICMP



Rule ID :	23
ICMP :	☑
Source IP :	2.3.4.5

To implement this behavior, set the type of "dst_port" variable to "Composite".

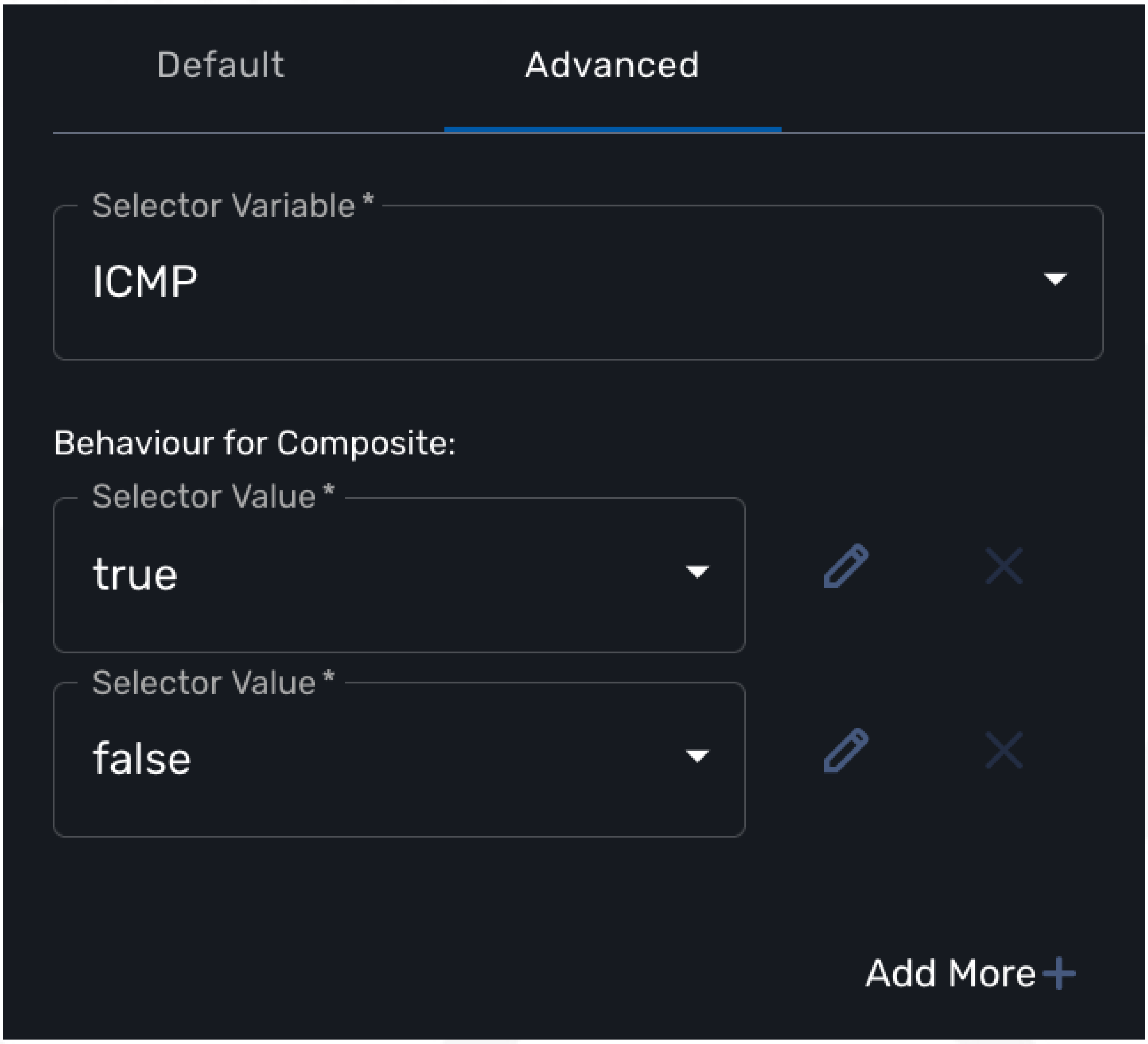
dst_port type is "Composite"


$params.devices.0.id	Managed firewall
$params.id	Rule ID
$params.protocol	ICMP
$params.src_ip	Source IP
$params.dst_port	Destination port

Variable *: $params. dst_port
Type *: Composite
Display Name *: Destination port
Description: Destination port to block

In the advanced parameter tab, first choose the "Selector Variable" and select the protocol (note that the list shows the display name, not the actual name of the variable)

Then configure the "Behavior for the Composite". The selector is a boolean so you can only have 2 types of behavior, one for true and one for false.



Selector Variable *
ICMP

Behaviour for Composite:

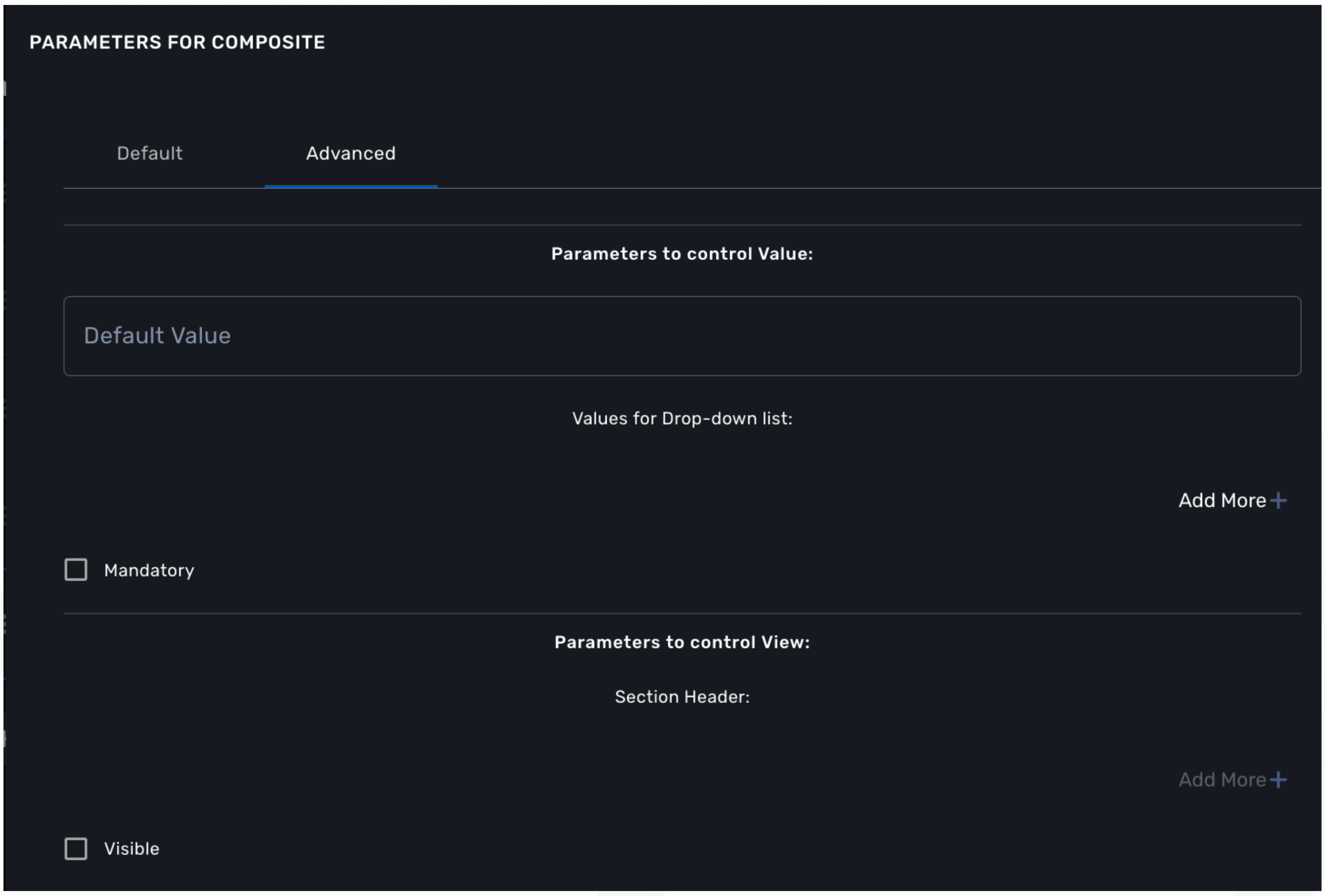
Selector Value *
true

Selector Value *
false

Each behavior can be configured by editing it with the pencil icon.

In our case, if the selector is set to true (when the user selects ICMP), the variable "dst_port" should be hidden: uncheck the attribute "Visible" in the advanced parameters for composite.

Hide the destination port when ICMP is checked


PARAMETERS FOR COMPOSITE

Default | Advanced

Parameters to control Value:

Default Value

Values for Drop-down list:

Add More +

☐ Mandatory

Parameters to control View:

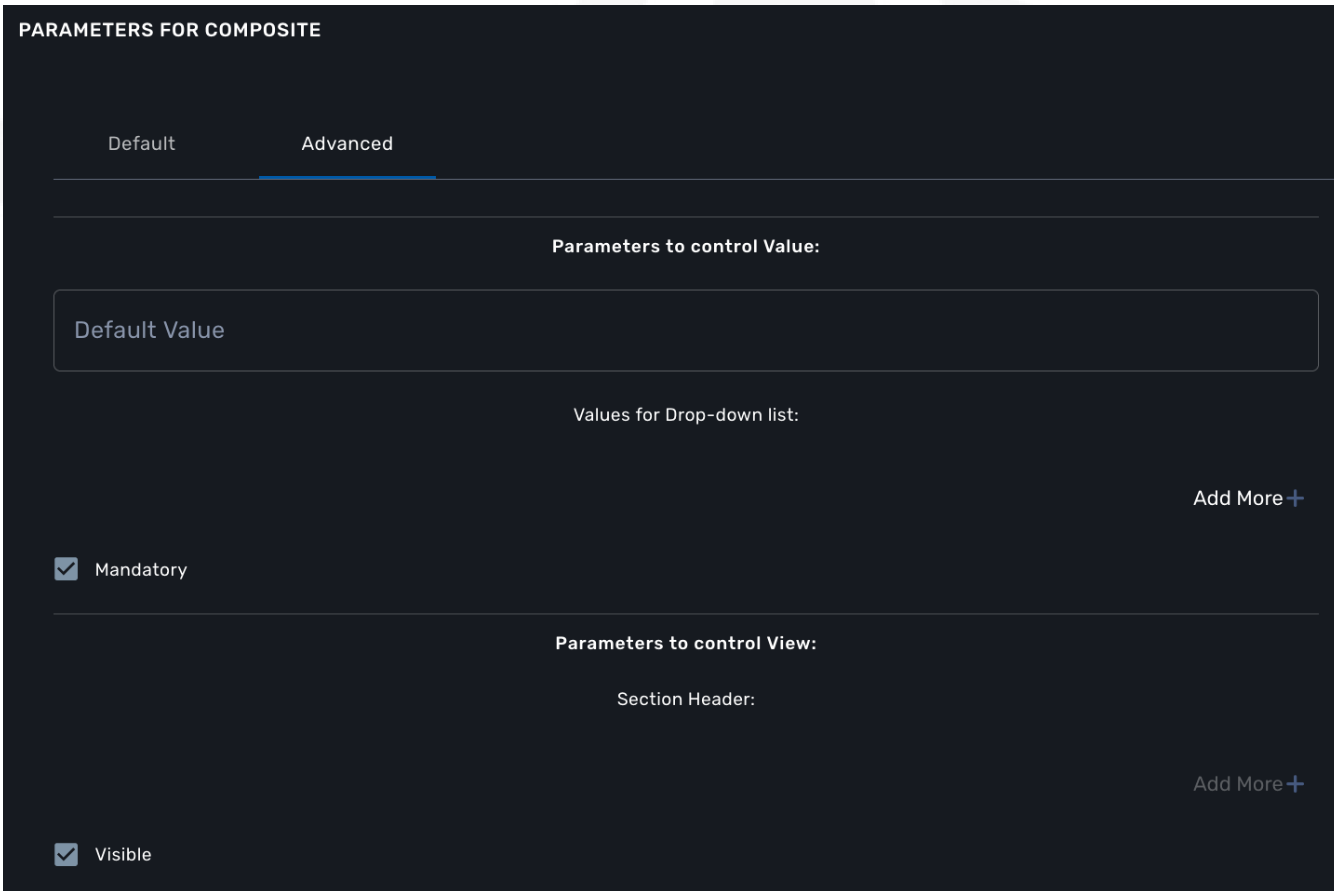
Section Header:

Add More +

☐ Visible

And when the selector is set to false, the variable "dst_port" should be visible and mandatory.

Show the destination port when ICMP is not checked


PARAMETERS FOR COMPOSITE

Default | Advanced

Parameters to control Value:

Default Value

Values for Drop-down list:

Add More +

☑ Mandatory

Parameters to control View:

Section Header:

Add More +

☑ Visible

Link

not supported yet

This type is useful if you wat to display a URL in the user form, for instance to link to some documentation on a web server. It is usually used in read-only mode with the URL set as the default value of the variable

File

not supported yet

This type is useful for allowing a user to select a file.

Auto Increment

This type is used to maintain an incremental counter in within the instances of a workflow for a managed entity. This is useful for managing the object_id.

Table 1. Specific advanced parameters

Increment	an integer to define the increment step
Start Increment	the initial value for the variable
Workflows sharing the same increment	a list of workflows that are also using the same variable and need to share a common value.

Device

This type is used to allow the user to select a managed entity and pass its identifier to the implementation of the workflow.

In the task implementation you need to list the variables with "Device" for the type

PHP

```php
function list_args()
{
  create_var_def('my_device');
}
```

Python

```python
from msa_sdk.variables import Variables

TaskVariables = Variables()

TaskVariables.add('my_device')
```

List of managed entities

A very common use of the type `Device` is for automating configuration (or any other automated action) over a list of managed entities.

You can do that by creating a array variable with the type `Device` and loop through the array in the task.

Sample task to list managed entities (Python)

```
from msa_sdk.variables import Variables
from msa_sdk.msa_api import MSA_API
from msa_sdk import util

dev_var = Variables()
dev_var.add('me_list.0.id')                                     ①

context = Variables.task_call(dev_var)
process_id = context['SERVICEINSTANCEID']                       ②

me_list = context['me_list']                                    ③

for me_id in me_list:                                           ④
    util.log_to_process_file(process_id, me_id['id'])           ⑤

ret = MSA_API.process_content('ENDED', 'Task OK', context, True)
print(ret)
```

① declare the the array variable to be displayed in UI

② read the current process ID

③ read the list of managed entities selected by the user on the UI

④ loop through the list and print each managed entity ID in the process log file

⑤ print the managed entity identifier in the process log file

Sample code to list managed entities (PHP)

```
function list_args()
{
  create_var_def('devices.0.id');
}

// read the ID of the selected managed entity
$devices = $context['devices'];

foreach ($devices as $device) {
  $device_id = $device['id'];

  logToFile("update device $device_id");
}
```

Subtenant

This type will allow the user to select a subtenant and use the subtenant ID from the workflow instance context in the task.

The source code below will let the user select a subtenant and display the subtenant ID on the execution console

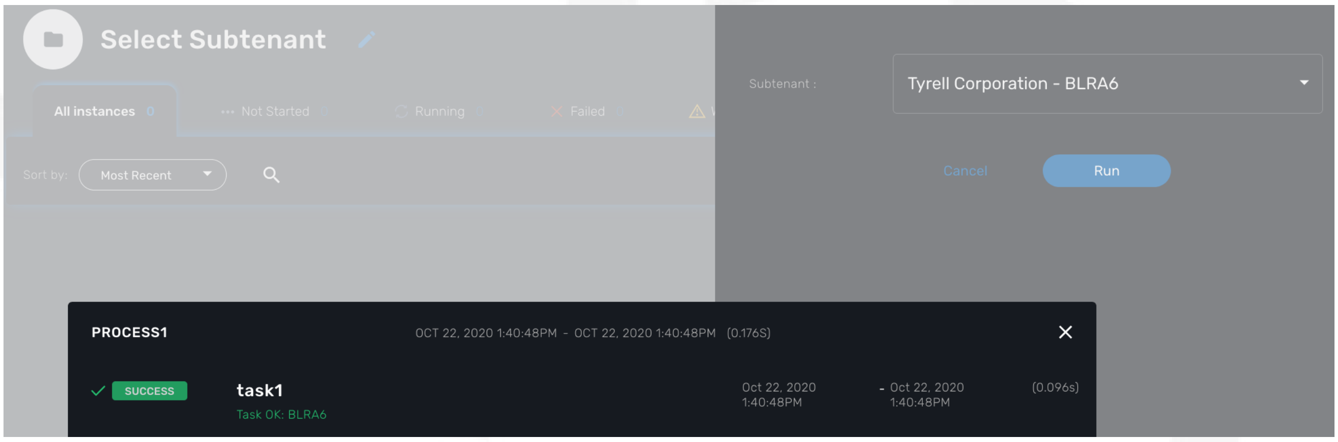
Sample task to create a UI to select a subtenant

```
<?php
require_once '/opt/fmc_repository/Process/Reference/Common/common.php';

function list_args()
{
  create_var_def('subtenant');                ①
}

$subtenant = $context['subtenant'];           ②

task_success('Task OK: '.$subtenant);         ③
?>
```

① declare the variable subtenant to be displayed in the user form

② read the variable value from the context

③ print the value on the execution console



Subtenant : Tyrell Corporation - BLRA6

```
PROCESS1        OCT 22, 2020 1:40:48PM - OCT 22, 2020 1:40:48PM (0.176S)

SUCCESS  task1                Oct 22, 2020    - Oct 22, 2020    (0.096s)
         Task OK: BLRA6       1:40:48PM         1:40:48PM
```

List of subtenant

If you need to select multiple subtenants, you have to create an array variable with the type `Customer`.

With the variable `$params.subtenants.0.id` typed as `Customer`, the code below will ask for the user to select 1 or more subtenant, print the identifier of each one in the process log file and display the number of subtenant selected on the UI.

Sample task to list the subtenant

```
<?php
```

```
require_once '/opt/fmc_repository/Process/Reference/Common/common.php';

function list_args()
{
  create_var_def('subtenants.0.id');
}

$subtenants = $context['subtenants'];

foreach ($subtenants as $subtenant) {          ①
  logToFile("subtenant: ".$subtenant['id']);    ②
}

task_success('Task OK: '.sizeof($subtenants )." subtenant selected");
?>
```

① loop through the list of subtenants

② log the value in the process log file

the code for iterating over an array of managed entities is very similar

Microservice reference

This type is key when integrating workflows and microservices.

It allows you to import and use the microservice instance data from a managed entity in your automation code.

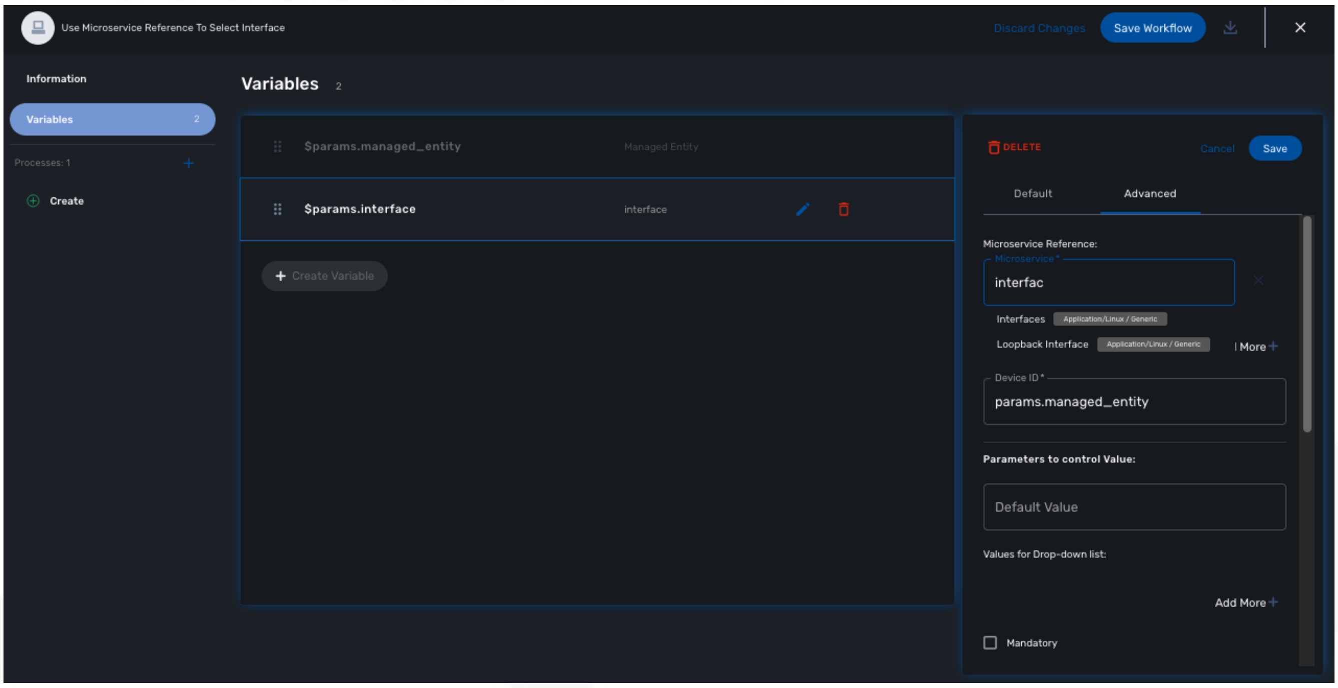
To use this type you need 2 variables:

1. a variable with the type `Managed Entity` to select the managed entity to get the data from
2. a variable with the type `Microservice Reference` to select the microservice that will pull the data

When creating a variable typed `Microservice Reference` you need to select the `Managed Entity` variable to use and the microservice that will act as the data source.

the microservice must be attached to the managed entity with a deployment setting in order for the microservice reference to work.

In the example below, the variable `$params.interface` is typed as `Microservice Reference`. In the "Advanced" tab, the field "Microservice Reference" references one or several microservice and the field "Device ID" references a managed entity.



Variables 2

$params.managed_entity	Managed Entity
$params.interface	interface

Microservice Reference:

Microservice * interfac

Interfaces Application/Linux / Generic

Loopback Interface Application/Linux / Generic

More +

Device ID * params.managed_entity

Parameters to control Value:

Default Value

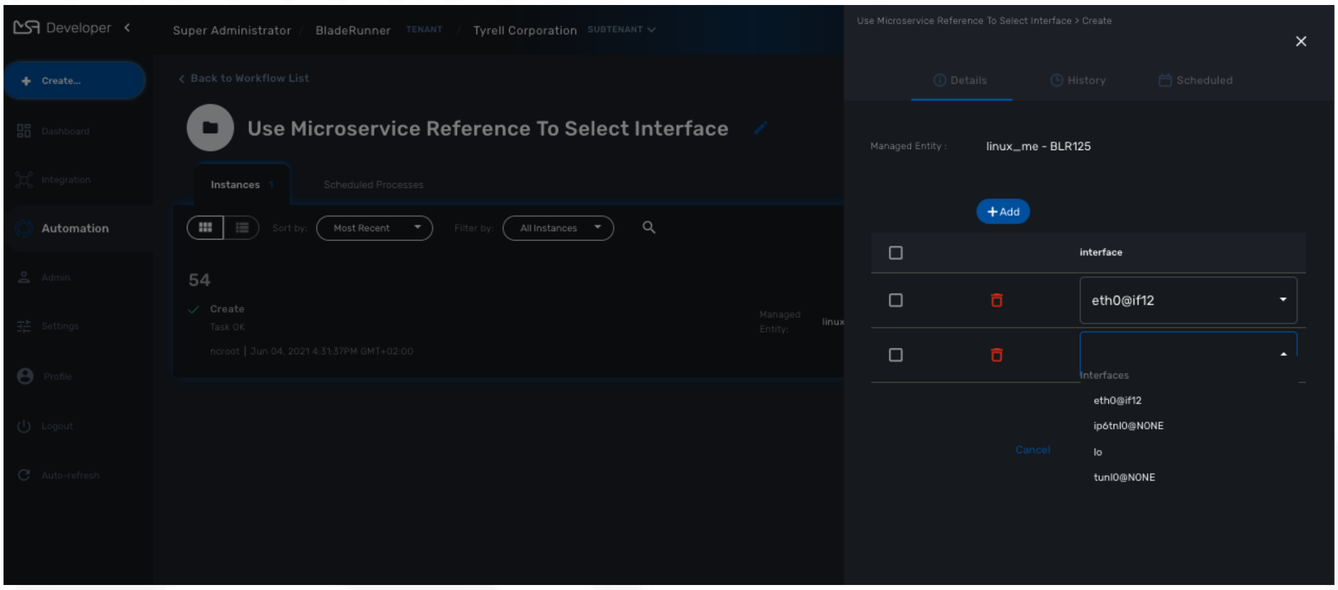
Values for Drop-down list:

Mandatory

Sample Python task to create the UI to select a managed entity and select a microservice instance from this managed entity

```
from msa_sdk.variables import Variables
from msa_sdk.msa_api import MSA_API

dev_var = Variables()
dev_var.add('managed_entity')
dev_var.add('interface.0.name')

context = Variables.task_call(dev_var)

ret = MSA_API.process_content('ENDED', 'Task OK', context, True)

print(ret)
```

It also possible to use an array to select multiple values from the microservice



Managed Entity : linux_me - BLR125

interface
eth0@if12

Interfaces
- eth0@if12
- ip6tnl0@NONE
- lo
- tunl0@NONE

Sample PHP task to select multiple values from the microservice instance

```
from msa_sdk.variables import Variables
from msa_sdk.msa_api import MSA_API

dev_var = Variables()
dev_var.add('managed_entity', var_type='Device')
dev_var.add('interface.0.name', var_type='OBMFRef') ①

context = Variables.task_call(dev_var)

ret = MSA_API.process_content('ENDED', 'Task OK', context, True)

print(ret)
```

① Use a variable array to allow multiple value selection

Workflow reference

This type is useful for referencing a workflow from another one.

Display Name

The display value for the variable name.

Description

An optional description of this variable.

Advanced settings

Depending on the selected type, some advanced parameters may be differ.

Setting	Description
Default Value	the default value that will be used when creating a new workflow instance
Values for Drop-down	a list of possible value the user can choose from
Mandatory	a value has to be provided for this variable
Read only variable	the value cannot be edited
Section Header	group some variables in the workflow console (see below).
Show only in edit view	hide the variable from the workflow console

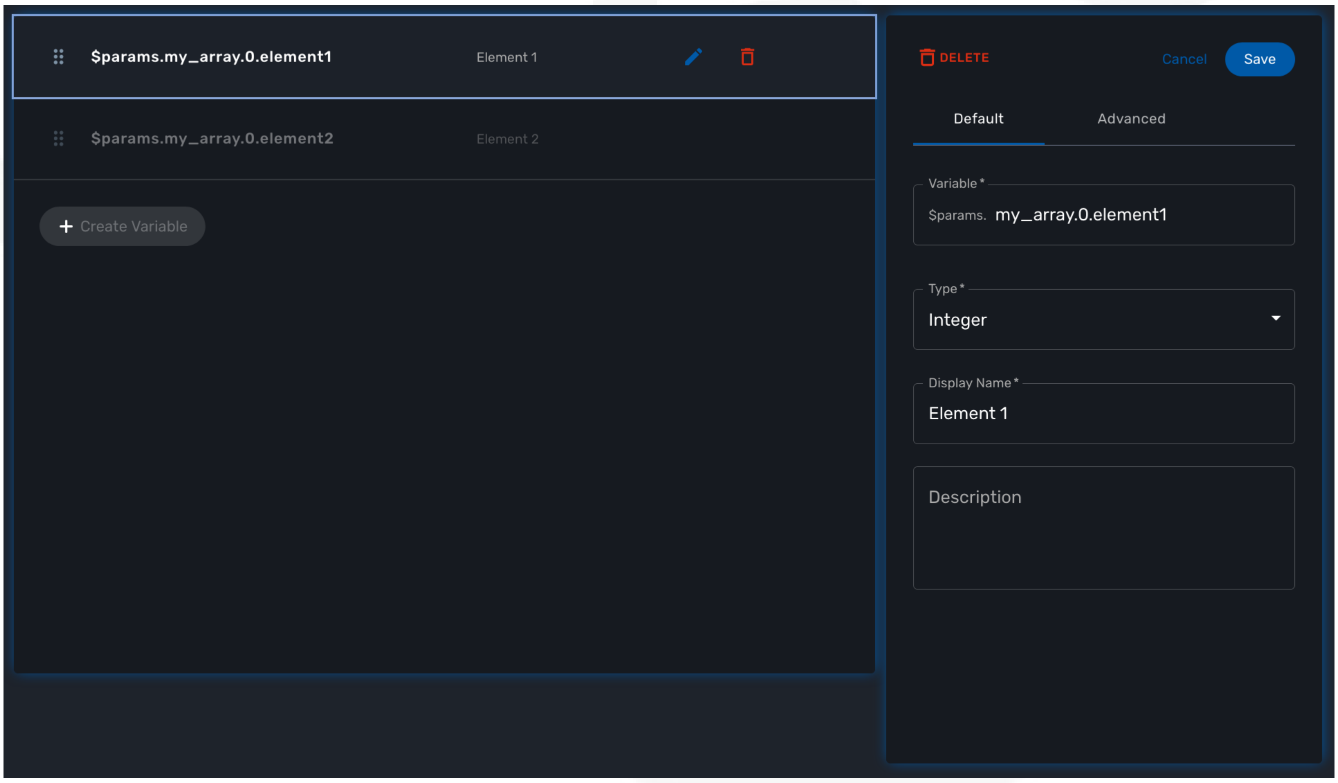
Array settings

When you are dealing with variable arrays, these options will let you control the possible actions a user can have over the array.

Variable arrays

To create a variable array, you need to follow a precise naming convention: `$params.<ARRAY NAME>.0.<ELEMENT NAME>`. The 0, is the separator that will allow the UI and the configuration engine that this variable is an array.

Variable array with 2 elements



Variable * $params. my_array.0.element1
Type * Integer
Display Name * Element 1
Description

Getting Started Developing Workflows in PHP

Overview

This tutorial walks you through the design and development of your first workflow.

Workflows can be used to automate a wide variety of tasks and processes, such as:

- Service configuration chaining
- VNF lifecycle management
- Configuration audit and verification
- Automated customer on-boarding
- …

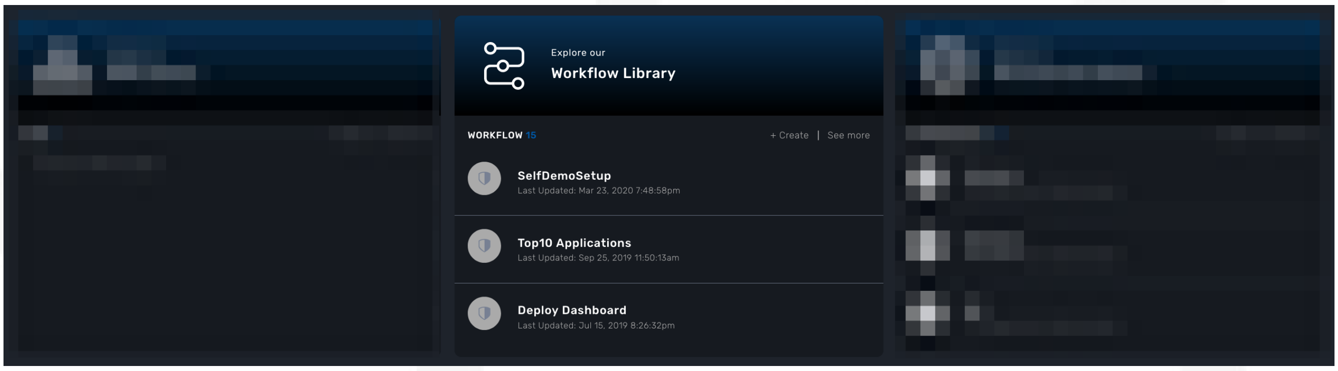
The "Helloworld" Workflow

As an example, we'll use the "Helloworld" workflow. The "Helloworld" workflow will print a name as IN parameter and will display a message to the user ("Hello NAME").

This workflow is composed of 3 processes: one to create the new instance of the workflow, one to enter the name and print it, and one to delete the instance.

Create a new Workflow

From the Developer dashboard click on "+ Create"

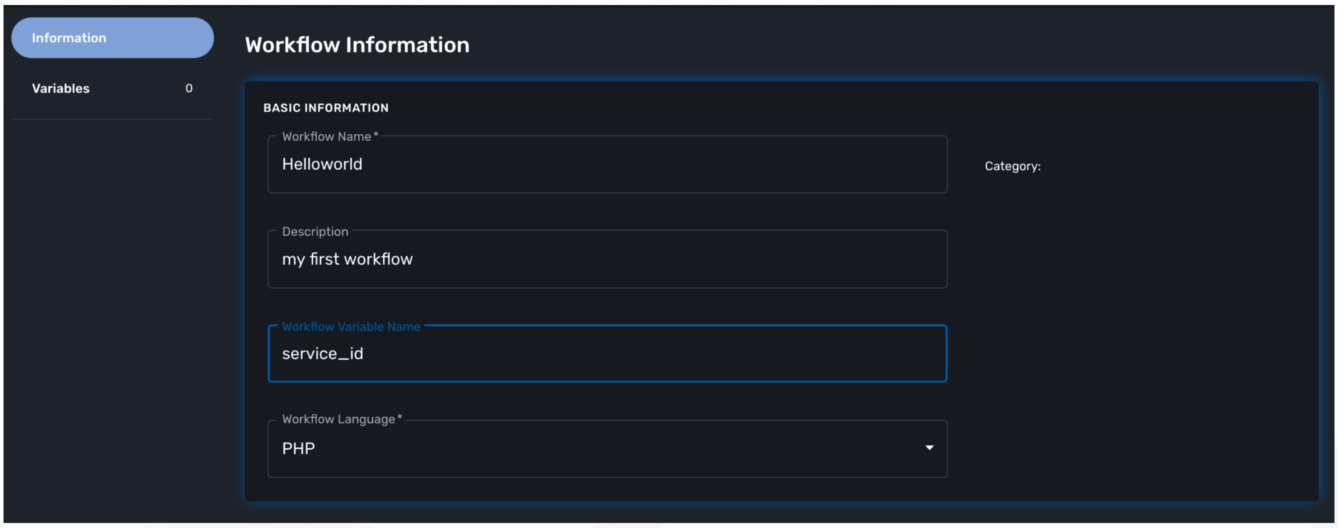


SelfDemoSetup
Last Updated: Mar 23, 2020 7:48:58pm

Top10 Applications
Last Updated: Sep 25, 2019 11:50:13am

Deploy Dashboard
Last Updated: Jul 15, 2019 8:26:32pm

In the tab "Information", set a name, a description and set the Workflow variable name to service_id and save your workflow.



Workflow Information

BASIC INFORMATION

Workflow Name *: Helloworld

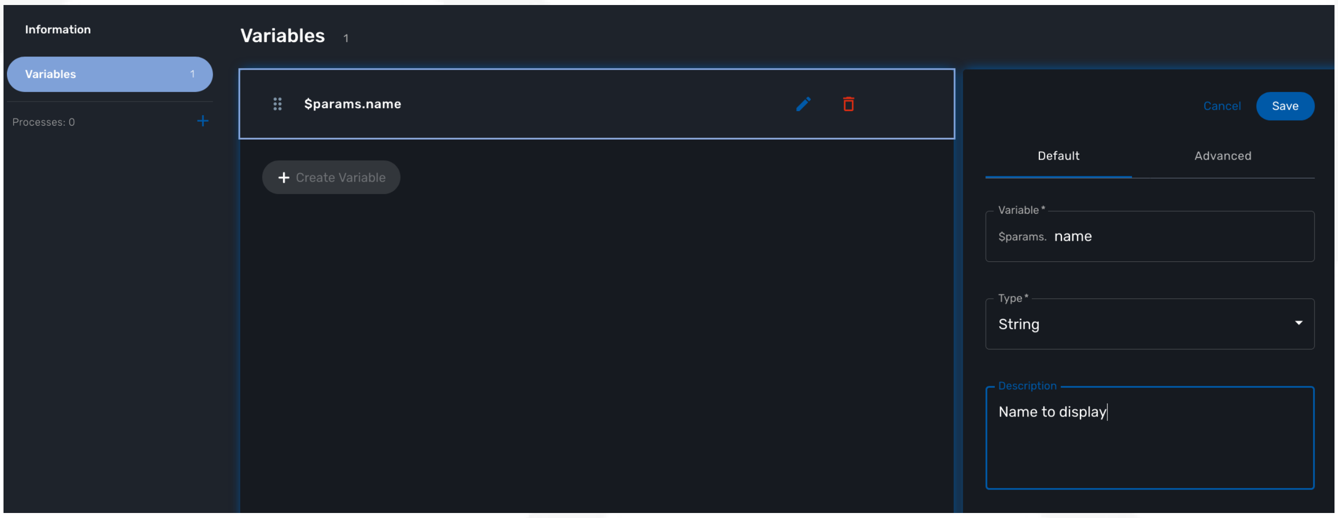
Category:

Description: my first workflow

Workflow Variable Name: service_id

Workflow Language *: PHP

Create a variable "Name" in the tab "Variable".



Variables 1

$params.name

Variable *: $params. name

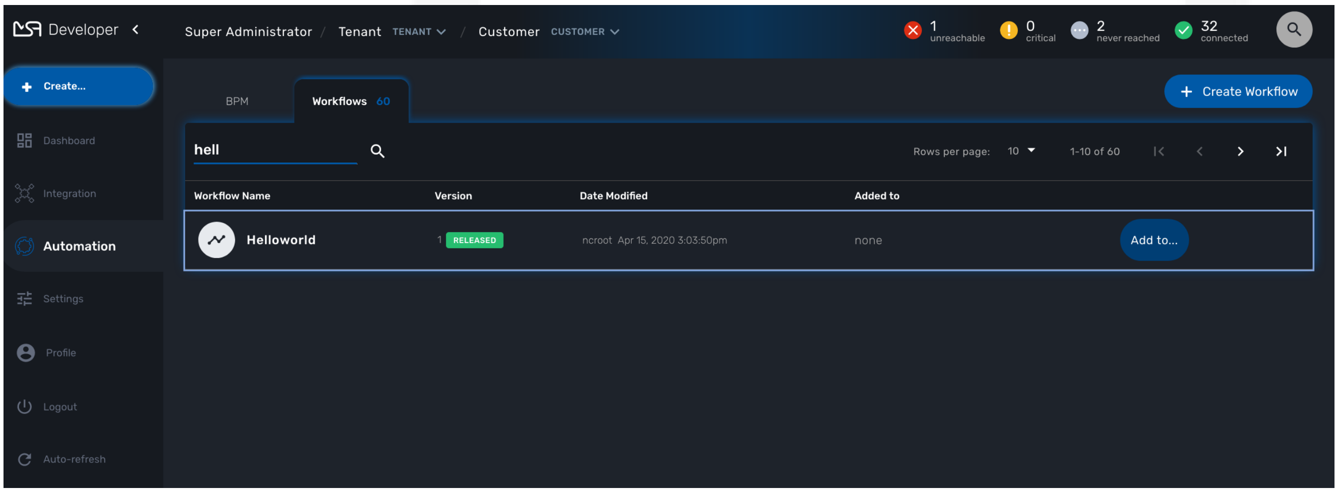
Type *: String

Description: Name to display

To start testing your workflow, you need to associate it to a customer. Make sure that you have no tenant selected, go to the "Automation" section, you should see your workflow in the list.

You can use the magnifier to search for it.

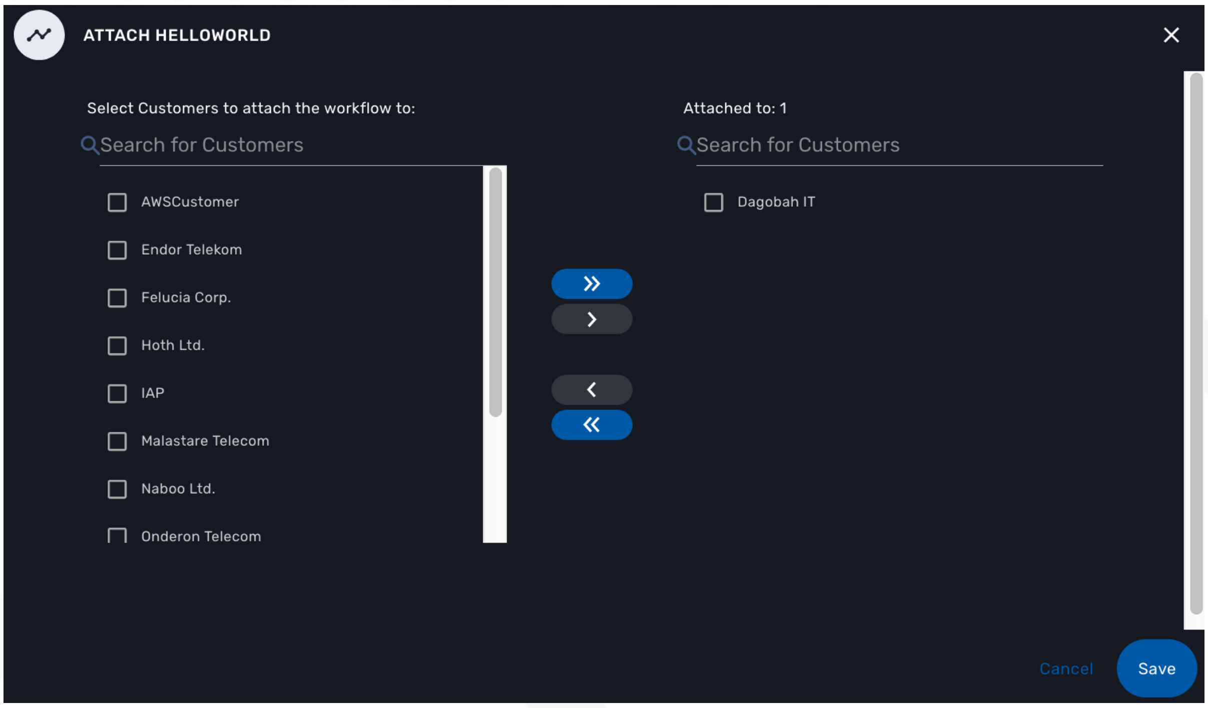
Use the link "Add to.." to associate the workflow to a customer.



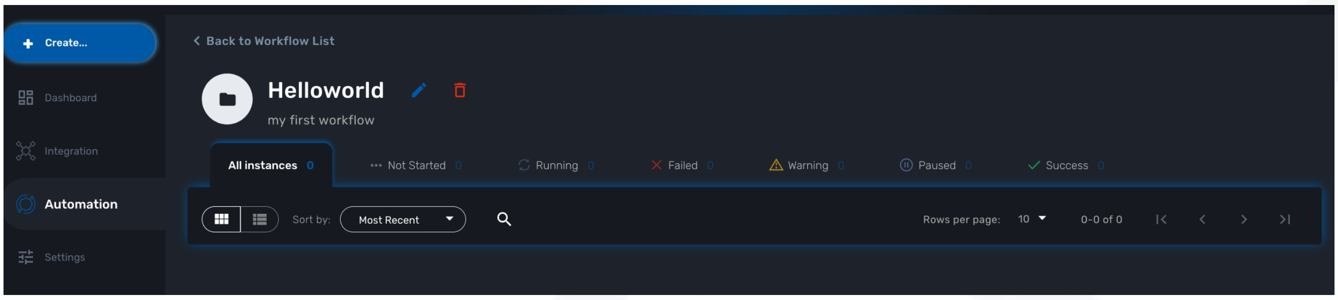
hell

Workflow Name	Version	Date Modified	Added to	
Helloworld	1 RELEASED	ncroot Apr 15, 2020 3:03:50pm	none	Add to...

Select the customer to use for designing and testing the workflow.



Once done, you can select your customer, list its workflows and edit it with the pencil icon.



Create the Processes

The "create instance" Process

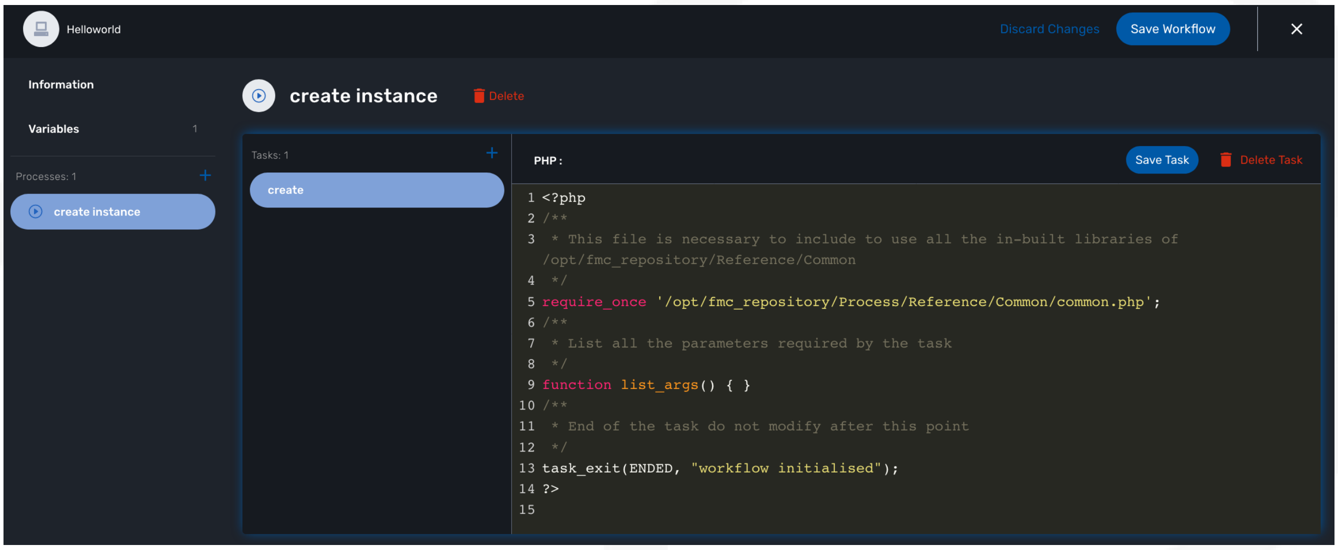
In order to be used, every Workflow should be instantiated first. This is the role of the process with the type "Create".

even though for most use cases, a single "CREATE" process is sufficient, it is possible to have several "CREATE" processes to support various ways of creating the Workflow instance (You can relate that to having several object constructor in an OOP language such as Java).

For this tutorial you will create one process named "create instance" and add one task to this process. This task will simply display a message to the process execution console.

```
<?php
/**
 * This file is necessary to include to use all the in-built libraries of
/opt/fmc_repository/Reference/Common
 */
require_once '/opt/fmc_repository/Process/Reference/Common/common.php';
```

```
/**
 * List all the parameters required by the task
 */
function list_args() { }
/**
 * End of the task do not modify after this point
 */
task_exit(ENDED, "workflow initialised");
?>
```



```
<?php
/**
 * This file is necessary to include to use all the in-built libraries of
/opt/fmc_repository/Reference/Common
 */
require_once '/opt/fmc_repository/Process/Reference/Common/common.php';
/**
 * List all the parameters required by the task
 */
function list_args() { }
/**
 * End of the task do not modify after this point
 */
task_exit(ENDED, "workflow initialised");
?>
```

Once done, save the Workflow.

The "delete instance" Process

Follow the same steps as in the "create instance" process, but make sure that the type of the process is set to "DELETE", instead of "CREATE".

In our case, we only need the instance to be deleted, therefore we don’t need a Task to be added to this Process but in a real world use case, your DELETE process will probably take care of removing or cleaning up some parts of your managed system.

The "print message" Process

For the print process, use the process type "UPDATE". It will take one parameter that will be used to print your message. Use the code below to create a task that will read the name from the user form and print it in the live console.

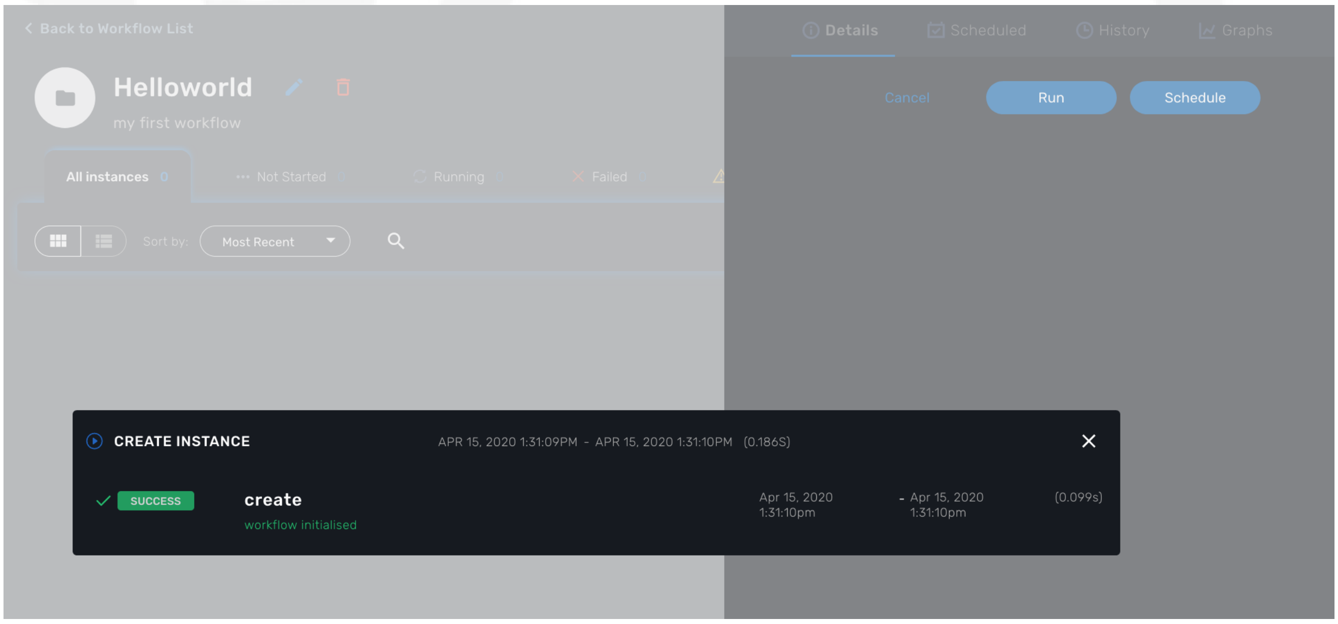
```
<?php
/**
 * This file is necessary to include to use all the in-built libraries of
/opt/fmc_repository/Reference/Common
 */
require_once '/opt/fmc_repository/Process/Reference/Common/common.php';
/**
```

```
 * List all the parameters required by the task
 */
function list_args()
{
  create_var_def('name', 'String');
}
check_mandatory_param('name');

/**
 * get the value of name from the context and create a variable out of it
 */
$name=$context['name'];
/**
 * print the value in the log file /opt/jboss/latest/log/process.log
 */
logToFile($name);

/**
 * End of the task do not modify after this point
 */
task_exit(ENDED, "Hello " . $name);

?>
```

Test the Workflow

Before you can test the workflow and execute some processes, you need to attach the workflow to your current subtenant.

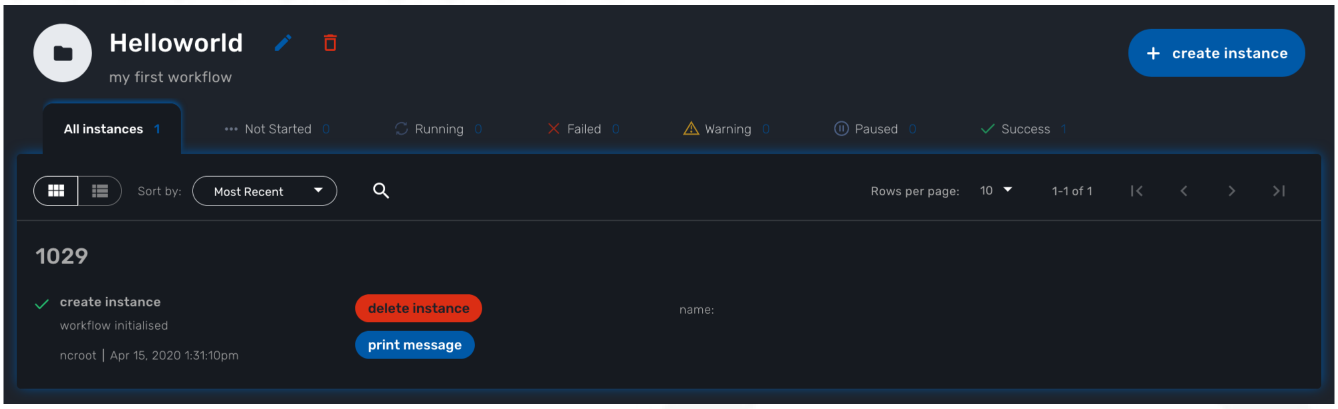
Use the "+ create instance" action to execute the "create instance" process and create a new instance of your workflow.



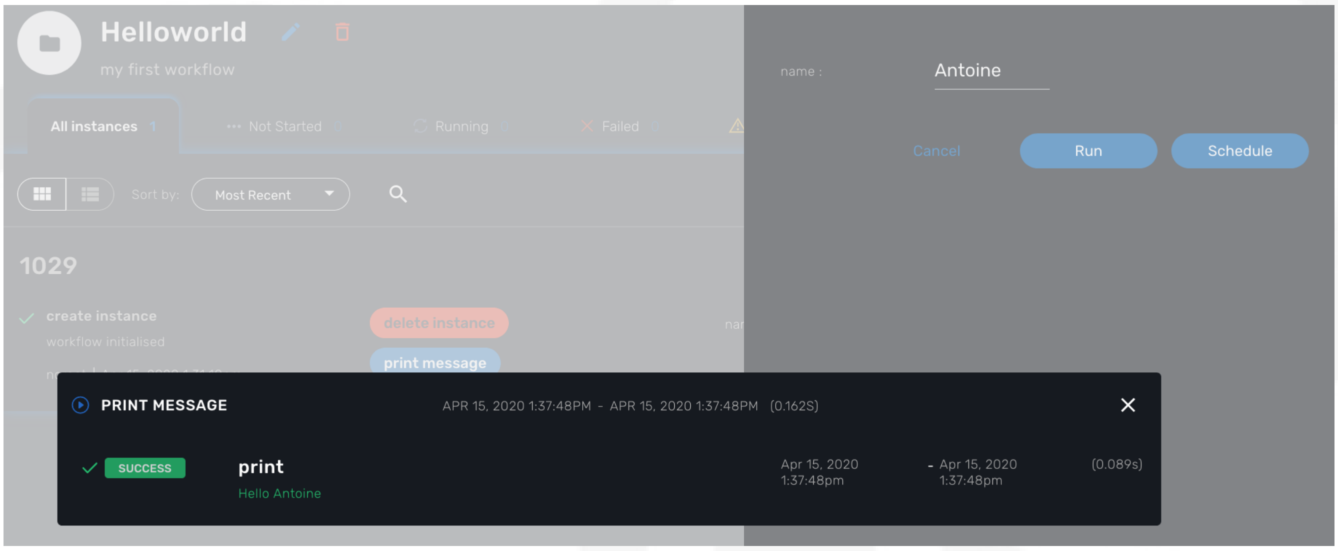
CREATE INSTANCE APR 15, 2020 1:31:09PM - APR 15, 2020 1:31:10PM (0.186S)

SUCCESS create workflow initialised Apr 15, 2020 1:31:10pm - Apr 15, 2020 1:31:10pm (0.099s)

A new instance is available and you can execute the process "print message".



The process "print message" will start executing and will executes the tasks sequentially.



The name will be displayed in the task execution status popup, below the name of the task.

Getting Started Developing Workflows in Python

Overview

This tutorial walks you through the design and development of your first workflow in Python. This tutorial is similar to the Helloworld example in PHP

Workflows can be used to automate a wide variety of tasks and processes, such as:

- Service configuration chaining
- VNF lifecycle management
- Configuration audit and verification
- Automated customer on-boarding
- ...

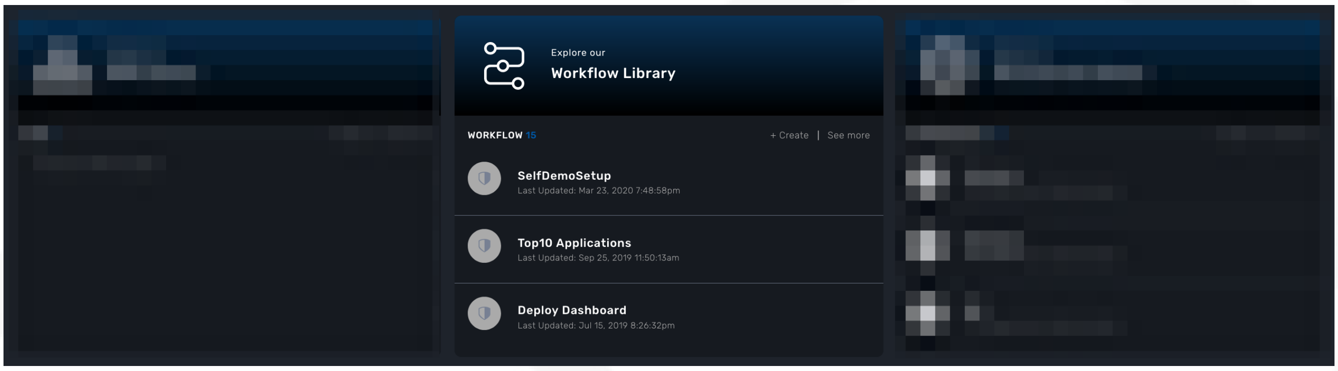
The "Hello world" Workflow

As an example, we'll use the "Helloworld" workflow. The "Helloworld" workflow will print a name as IN parameter and will display a message to the user ("Hello NAME").

This workflow is composed of 3 processes: one to create the new instance of the workflow, one to enter the name and print it, and one to delete the instance.

Create a New Workflow

From the Developer dashboard click on "+ Create"

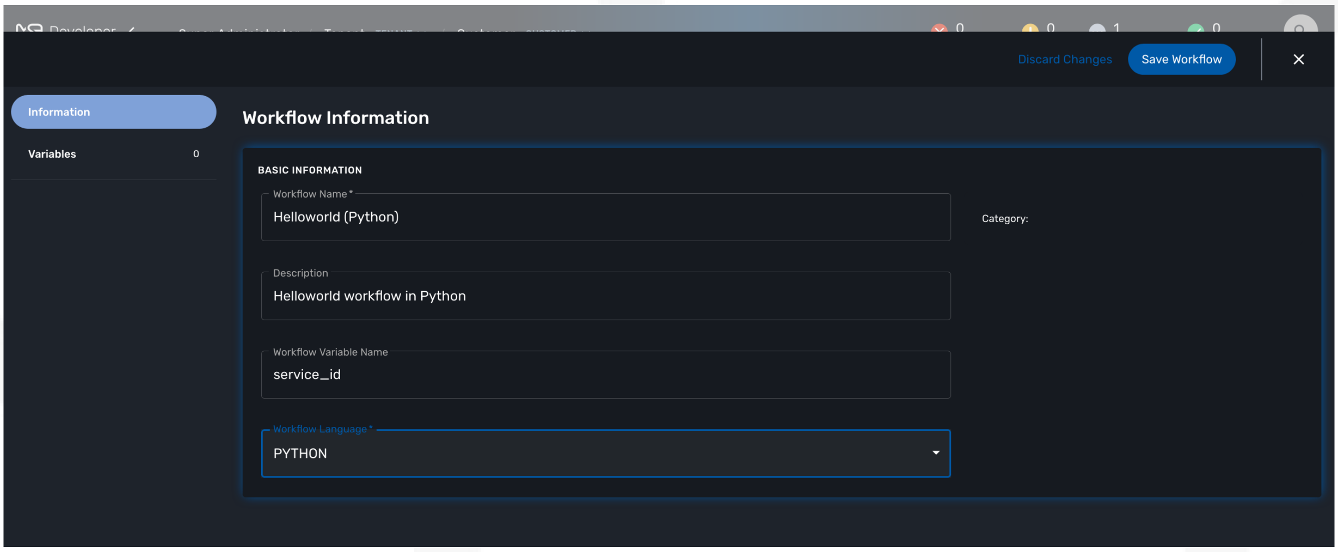


SelfDemoSetup
Last Updated: Mar 23, 2020 7:48:58pm

Top10 Applications
Last Updated: Sep 25, 2019 11:50:13am

Deploy Dashboard
Last Updated: Jul 15, 2019 8:26:32pm

In the tab "Information", set a name, a description and set the Workflow variable name to service_id and save your workflow.



Workflow Information

BASIC INFORMATION

Workflow Name*: Helloworld (Python)

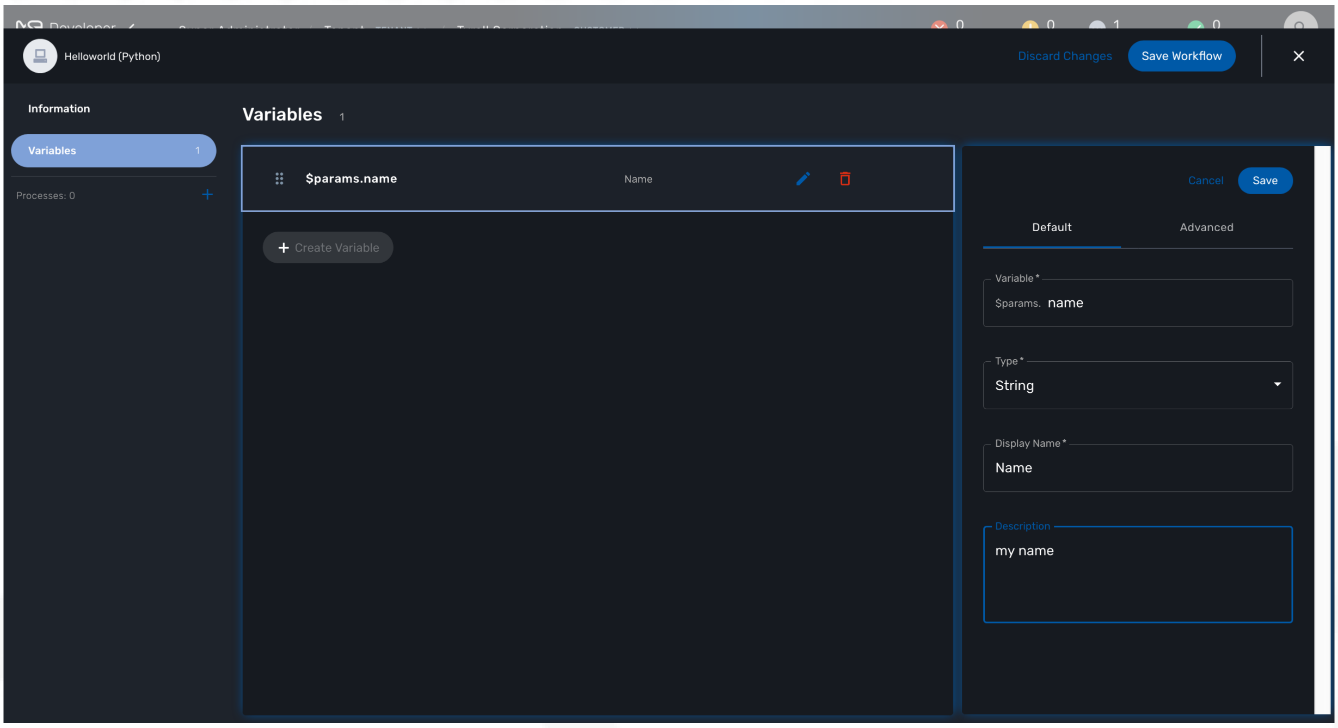
Category:

Description: Helloworld workflow in Python

Workflow Variable Name: service_id

Workflow Language*: PYTHON

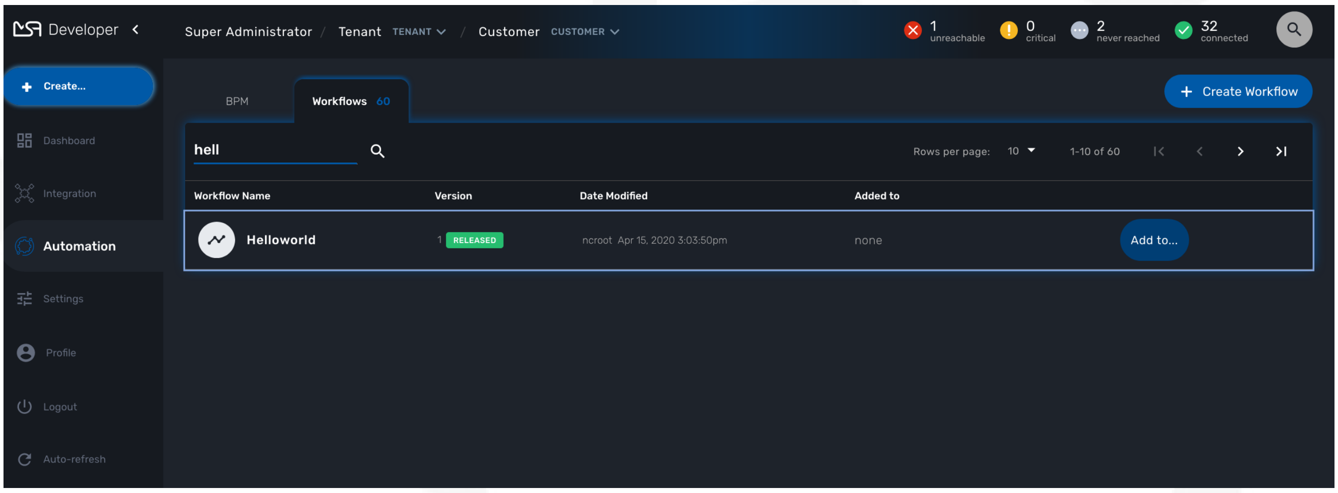
Create a variable "Name" in the tab "Variable".



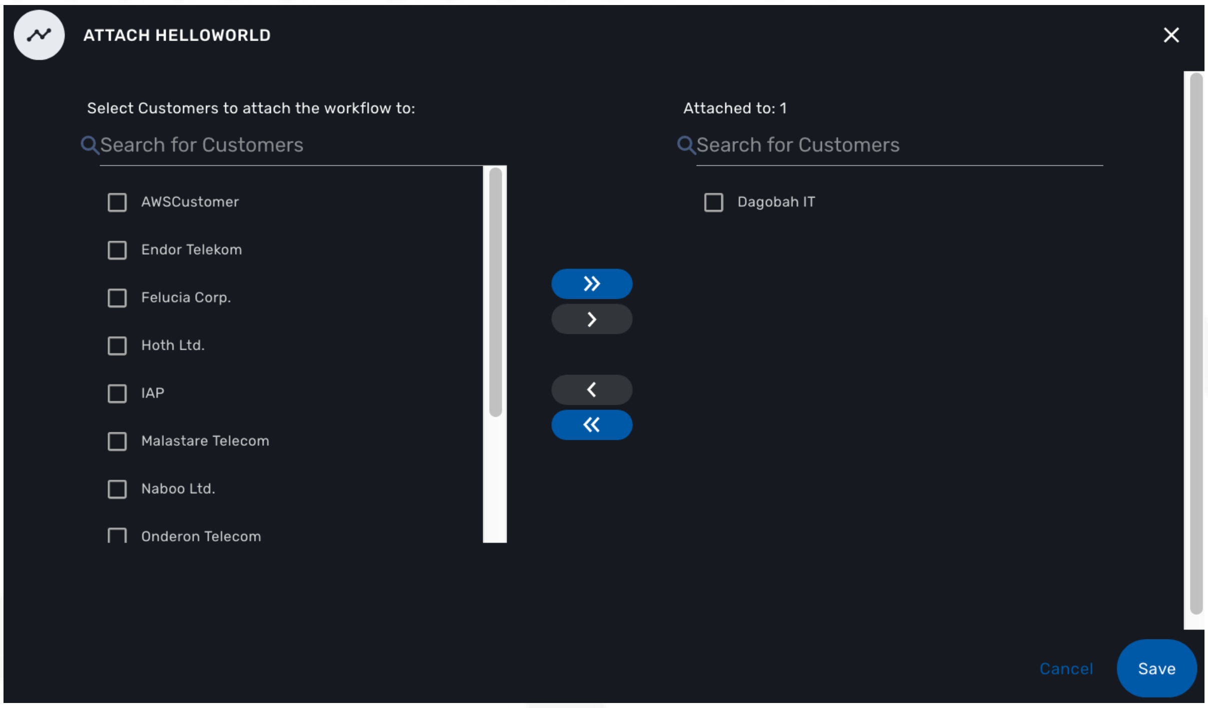
To start testing your workflow, you need to associate it to a customer. Make sure that you have no tenant selected, go to the "Automation" section, you should see your workflow in the list.

You can use the magnifier to search for it.

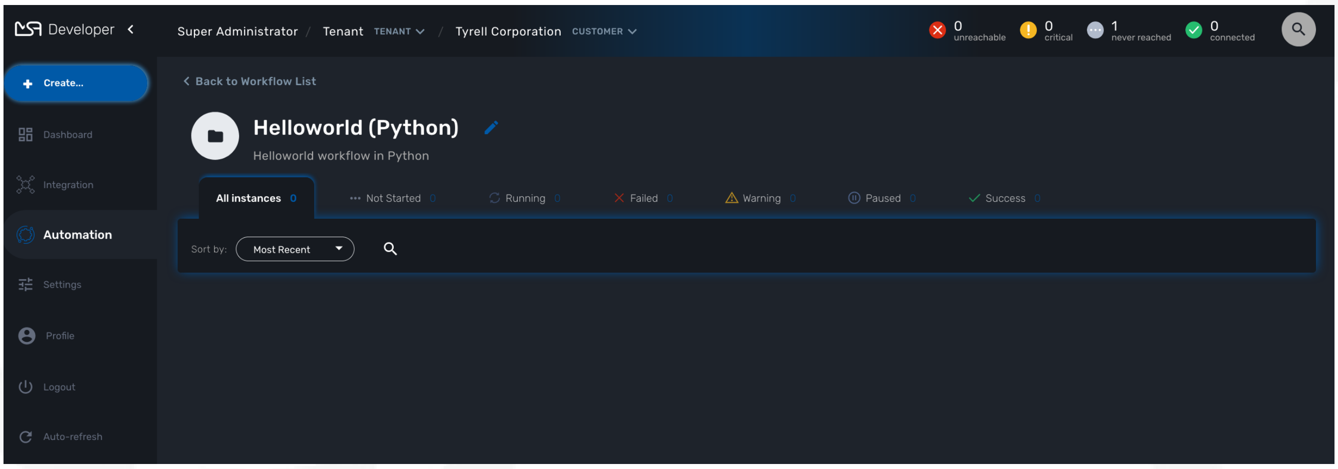
Use the link "Add to.." to associate the workflow to a customer.



Select the customer to use for designing and testing the workflow.



Once done, you can select your customer, list its workflows and edit it with the pencil icon.



Create the Processes

The "create instance" Process

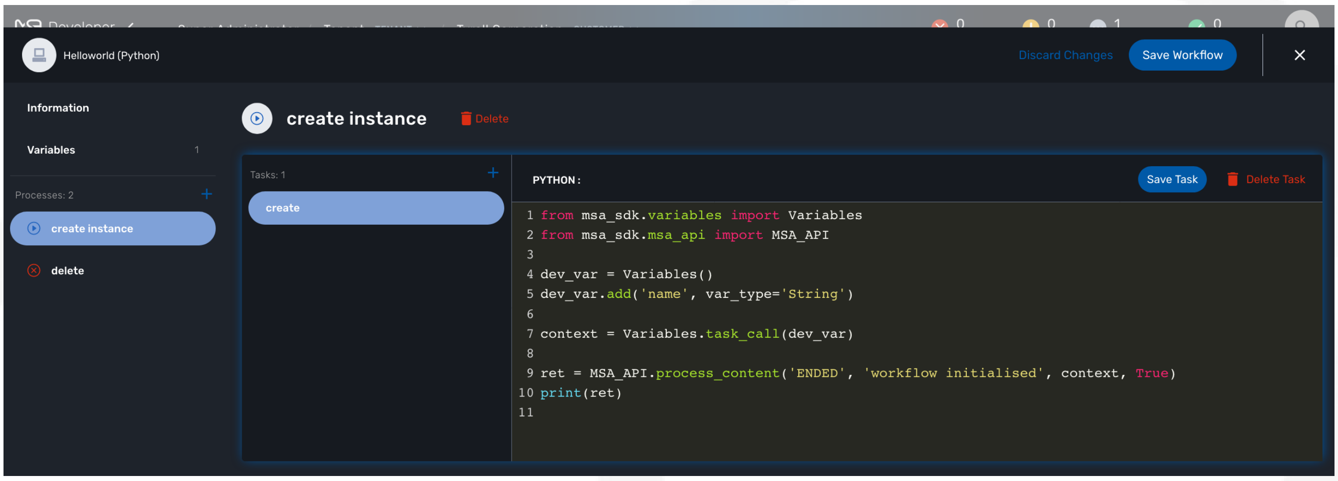
In order to be used, every Workflow should be instantiated first. This is the role of the process with the type "Create".

> even though for most use cases, a single "CREATE" process is sufficient, it is possible to have several "CREATE" processes to support various ways of creating the Workflow instance (You can relate that to having several object constructor in an OOP language such as Java).

For this tutorial you will create one process named "create instance" and add one task to this process. This task will simply display a message to the process execution console.

```
from msa_sdk.variables import Variables
from msa_sdk.msa_api import MSA_API
```

```
dev_var = Variables()
dev_var.add('name', var_type='String')

context = Variables.task_call(dev_var)

ret = MSA_API.process_content('ENDED', 'workflow initialized', context, True)
print(ret)
```



```
from msa_sdk.variables import Variables
from msa_sdk.msa_api import MSA_API

dev_var = Variables()
dev_var.add('name', var_type='String')

context = Variables.task_call(dev_var)

ret = MSA_API.process_content('ENDED', 'workflow initialised', context, True)
print(ret)
```

Once done, save the Workflow.

The "delete instance" Process

Follow the same steps as in the "create instance" process, but make sure that the type of the process is set to "DELETE", instead of "CREATE".

In our case, we only need the instance to be deleted, therefore we don’t need a Task to be added to this Process but in a real world use case, your DELETE process will probably take care of removing or cleaning up some parts of your managed system.

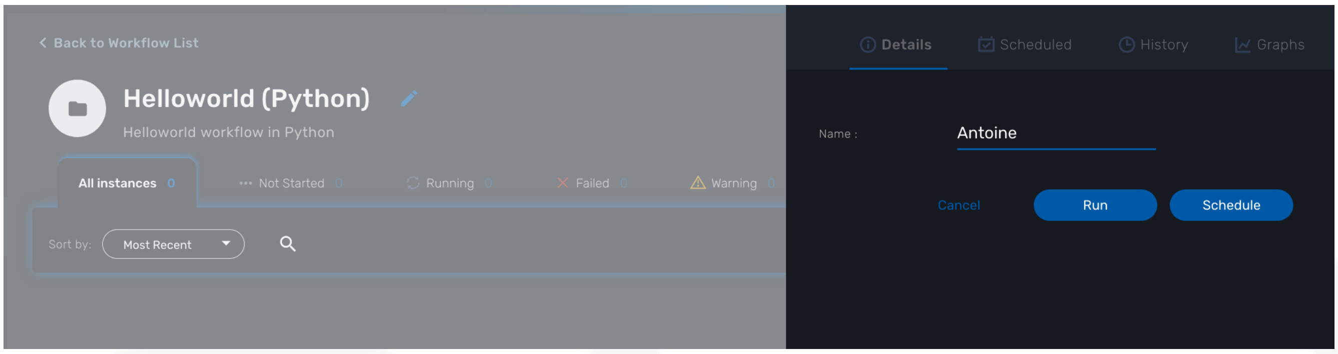
The "print message" Process

For the print process, use the process type "UPDATE". It will take one parameter that will be used to print your message. Use the code below to create a task that will read the name from the user form and print it in the live console.

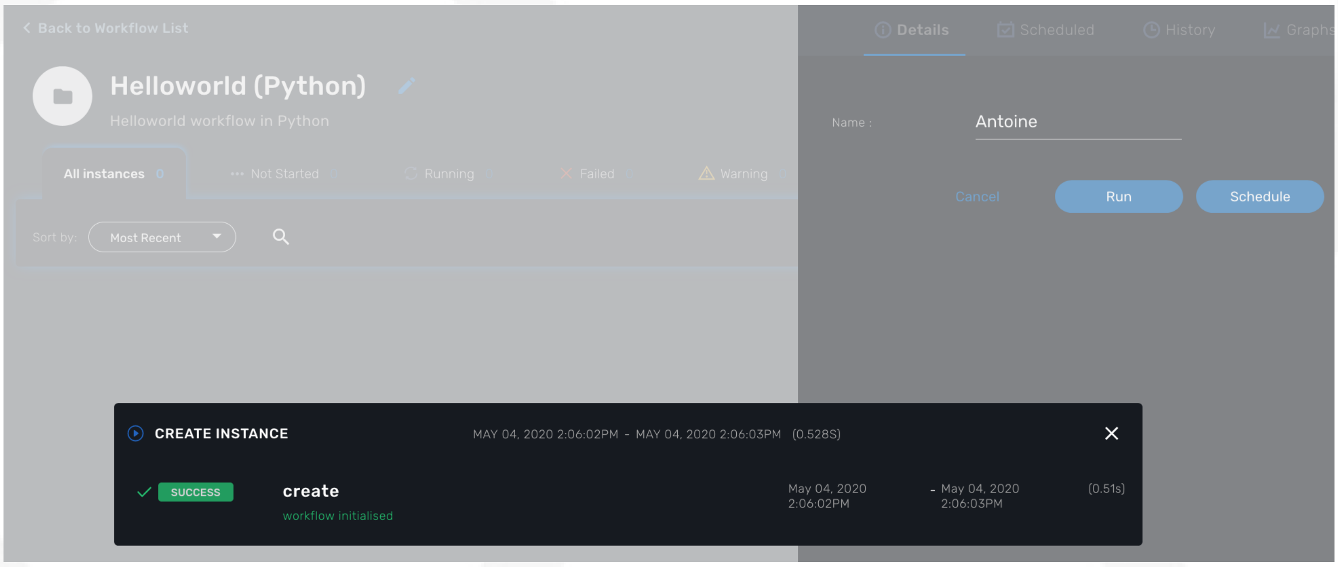
```
from msa_sdk.variables import Variables
from msa_sdk.msa_api import MSA_API

context = Variables.task_call()
my_name = context['name']

ret = MSA_API.process_content('ENDED', f'Hello {my_name}', context, True)
print(ret)
```

Test the Workflow

Use the "+ create instance" action to execute the "create instance" process and create a new instance of your workflow.

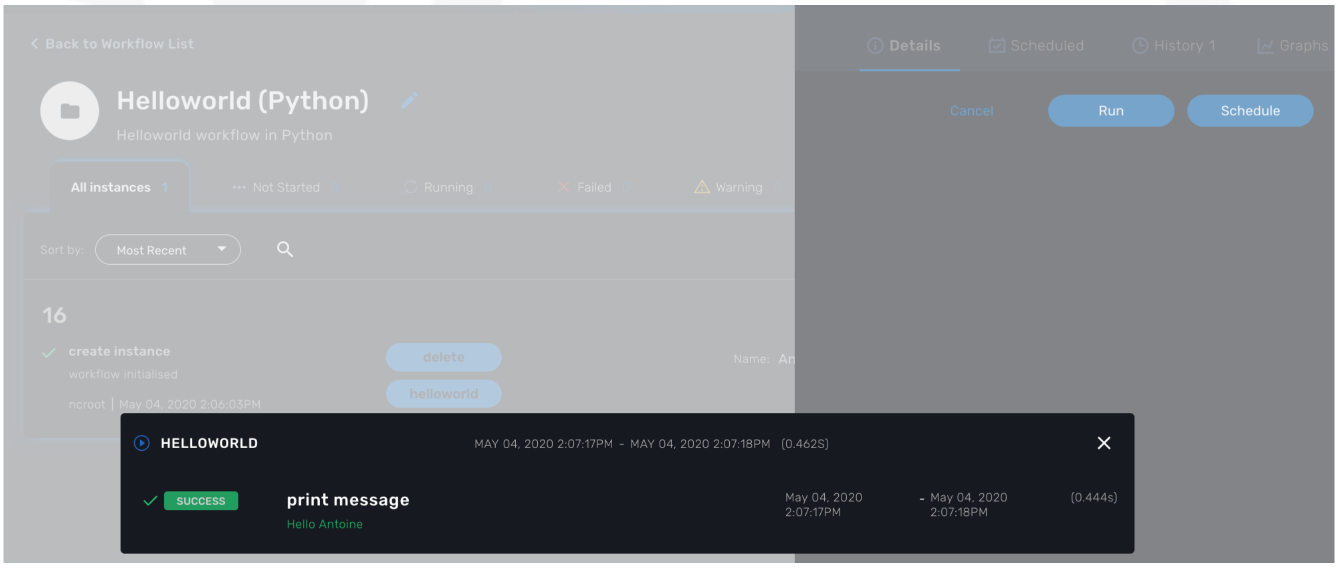


A new instance is available and you can execute the process "print message".


CREATE INSTANCE MAY 04, 2020 2:06:02PM - MAY 04, 2020 2:06:03PM (0.528S)

SUCCESS create
workflow initialised
May 04, 2020 2:06:02PM - May 04, 2020 2:06:03PM (0.51s)

The process "print message" will start executing and will executes the tasks sequentially.


HELLOWORLD MAY 04, 2020 2:07:17PM - MAY 04, 2020 2:07:18PM (0.462S)

SUCCESS print message
Hello Antoine
May 04, 2020 2:07:17PM - May 04, 2020 2:07:18PM (0.444s)

The name will be displayed in the task execution status popup, below the name of the task.

Python SDK

The MSactivator™ provides a support for Python SDK dedicated to developing automation workflows.

Overview

This SDK provides a set of functions to call the MSactivator™ REST API and automate action on the MSactivator™ such as create and activate managed entities, call microservice functions, call processes from other workflows...

The SDK API documentation is available online on your MSactivator™ instance at: https://localhost/msa_sdk

Contribution

The sources of the SDK is available on Github.

Code samples

Sample implementation of a SDK function.

This code sample is an example of the implementation of a Python SDK function to create a new managed entity.

```
class Device(MSA_API):

    self.api_path = "/device"

    def create(self):
        self.action = 'Create device'
        self.path = '{}/v2/{}'.format(self.api_path, self.customer_id)      ①

        data = {"manufacturerId": self.manufacturer_id,
                "modelId": self.model_id,
                "managementAddress": self.management_address,
                "reporting": self.reporting,
                "useNat": self.use_nat,
                "logEnabled": self.log_enabled,
                "logMoreEnabled": self.log_more_enabled,
                "managementInterface": self.management_interface,
                "mailAlerting": self.mail_alerting,
                "passwordAdmin": self.password_admin,
                "externalReference": self.device_external,
                "login": self.login,
                "name": self.name,
                "password": self.password,
                "id": 0,
                "snmpCommunity": self.snmp_community}
        if self.management_port:
            data["managementPort"] = self.management_port

        self.call_post(data)                                                    ②
        self.fail = not self.response.ok
        if self.response.ok:
            self.device_id = json.loads(self.content)['id']

        return json.loads(self.content)
```

① the REST API to call

② post the data to the REST API

Sample call of a function in a workflow task.

```
from msa_sdk.device import Device
from msa_sdk.variables import Variables
import json

dev_var = Variables()                                    ①

dev_var.add('customer_id')
dev_var.add('managed_device_name')
dev_var.add('manufacturer_id')
dev_var.add('model_id')
dev_var.add('device_ip_address')
dev_var.add('login')
dev_var.add('password')
dev_var.add('password_admin')

context = Variables.task_call(dev_var)

new_device = Device(context['customer_id'], context['managed_device_name'], context
['manufacturer_id'],context['model_id'], context['login'], context['password'],
context['password_admin'],context['device_ip_address'])

new_device.create()                                      ②

context['device_id'] = new_device.device_id              ③

print(new_device.process_content('ENDED', 'Task OK', context, False))
```

① define the parameters to pass to the API

② create the new managed entity

③ store the ID of the new managed entity in the workflow instance context

Microservice functions

Call a microservice CREATE/UPDATE/DELETE function

```
from msa_sdk.variables import Variables
from msa_sdk.msa_api import MSA_API
from msa_sdk.order import Order
from msa_sdk.orchestration import Orchestration
from msa_sdk import util
import json

me_id = context['me'][3:]                                    ①

micro_service_vars_array = {                                 ②
                            "object_id": "12.1.1.1",
                            "mask": "255.255.255.0",
                            "gateway": "10.10.1.254"
                           }
object_id = "null"
route = {"routing": {object_id: micro_service_vars_array}}  ③
try:
  ms_order = Order(me_id)
  ms_order.command_execute('CREATE', route)                  ④
except Exception as e:
  ret = MSA_API.process_content('FAILED', f'CREATE ERROR: {str(e)}', context, True)
  print(ret)
```

① Read the ID of the managed entity from the context, assuming the variable 'me' type is Device

② Build the Microservice JSON params for the CREATE operation of the microservice.

③ The value of the key should match the Microservice file name (stripped of the .xml file extension)

④ Call the CREATE for simple_firewall MS for each device (use UPDATE or DELETE for the other operations)

The function `command_execute` is defined in order.py

Call a microservice CREATE on multiple managed entities

```
from msa_sdk.variables import Variables
from msa_sdk.msa_api import MSA_API
from msa_sdk.order import Order
from msa_sdk import util

dev_var = Variables()
dev_var.add('object_id')
dev_var.add('service')
dev_var.add('src_ip')
dev_var.add('src_itf')
dev_var.add('dst_ip')
dev_var.add('dst_itf')
dev_var.add('firewalls.0.id')     ①
dev_var = Variables()

context = Variables.task_call(dev_var)

object_id = context['object_id']

micro_service_vars_array = {"object_id": context['object_id'],
                            "src_ip": context['src_ip'],
                            "src_mask": '255.255.255.255',
                            "dst_ip": context['dst_ip'],
                            "dst_mask": '255.255.255.255',
                            "src_itf": context['src_itf'],
                            "dst_itf": context['dst_itf'],
                            "action": 'deny',
                            "service": context['service']
                            }

simple_firewall = {"simple_firewall": {object_id: micro_service_vars_array}}

firewalls = context['firewalls']
for firewall in firewalls:
  devicelongid = firewall['id'][-3:]
  try:
    order = Order(devicelongid)
    order.command_execute('CREATE', simple_firewall)
  except Exception as e:
    ret = MSA_API.process_content('FAILED', f'CREATE ERROR: {str(e)}', context, True)
    print(ret)

ret = MSA_API.process_content('ENDED',
                            f'IPTABLES RULE INITIALIZED',
                            context, True)

print(ret)
```

① use a variable array typed as a Managed Entity

Call a microservice IMPORT function

```
from msa_sdk.variables import Variables
from msa_sdk.msa_api import MSA_API
from msa_sdk.order import Order
from msa_sdk.orchestration import Orchestration
from msa_sdk import util
import json

try:
  order = Order(me_id)                                ①
  order.command_execute('IMPORT', {"routing":"0"})    ②
  order.command_objects_instances("routing")                    ③
  ms_instances = json.loads(order.content)                      ④

except Exception as e:
  ret = MSA_API.process_content('FAILED', f'IMPORT ERROR: {str(e)}', context, True)
  print(ret)
```

① initialize an Order object

② execute the IMPORT of a microservice defined in a file routing.xml

③ get the microservice instances

④ store the instance in a variable to further reuse

Getting more Examples

You will find many examples of Workflows in https://github.com/openmsa/Workflows

How to create you libraries of functions

When developing a workflow you will probably have de define some functions that will be used in multiple tasks.

In order to avoid code duplication and ease the maintenance of your workflow one option is to create a `common` folder at the same level as your other task folder and create a python file `common.py` where the shared functions will be defined.

```
my_workflow
  |- my_workflow.xml
  |- common
    |- common.py
  |- process_1
    |- task1.py
```

`common.py` will contain the python code and can also import the Python SDK as well as other Python modules

```
from msa_sdk.variables import Variables
from msa_sdk.msa_api import MSA_API
from msa_sdk import util
from msa_sdk.order import Order
from datetime import datetime
import time
import json
import typing
import copy
import requests
import ipaddress
import re
import pandas as Pandas

dev_var = Variables()
context = Variables.task_call(dev_var)

# Function: to convert
def printTable(myDict):                    ①
  df = Pandas.DataFrame.from_records(myDict)
  return df.to_string()
```

① a function that can be used in a task

In the task implementation you need to add the following lines to import this common library

```
import os
import os.path
import sys
from pathlib import Path
from msa_sdk.variables import Variables
from msa_sdk.msa_api import MSA_API
currentdir = os.path.dirname(os.path.realpath(__file__))      ①
parentdir = os.path.dirname(currentdir)
sys.path.append(parentdir)
from common.common import *

dev_var = Variables()
context = Variables.task_call(dev_var)

if data:
  result = printTable(data)                                   ②
  context['result'] = result

ret = MSA_API.process_content('ENDED', 'DONE', context, True)

print(ret)
```

① include the path of `common` in the modules

② call the method defined in the common library

How to extend the SDK

Create a custom library of scripts

You can extend the SDK by adding your own scripts in the MSactivator™. The scripts have to be added in the container `msa_dev`, under the directory `/opt/fmc_repository/Process/PythonReference/custom`

In a workflow task, you can use the code below to import your custom scripts

```
import custom.myfile
```

or

```
from custom.myfile import SOME_METHOD
```

You can create a git repository under `/opt/fmc_repository/Process/PythonReference/custom` with `git init` and set a `remote` to a remote repository to ease the management and versioning of your custom SDK library

Install additional Python modules

To install an additional Python package you need to log into the `msa_dev` container and execute

```
python3 -m pip install \
  --install-option="--install-lib=/opt/fmc_repository/Process/PythonReference" PACKAGE
①
```

① PACKAGE is the name of the Python package to install

To list the packages that are installed

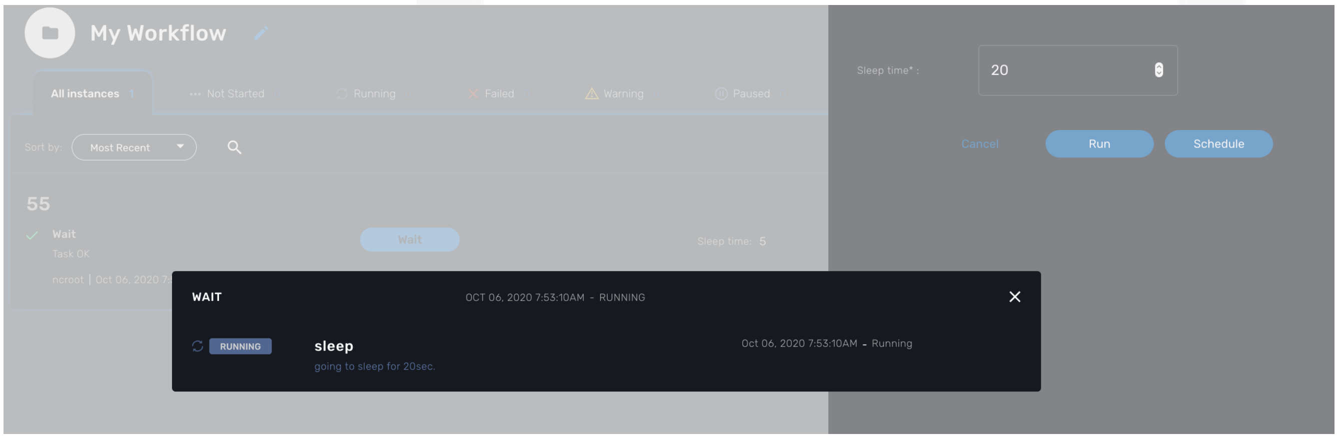
```
python3 -m pip list
```

Miscellaneous

Output messages to the process execution UI

When a task runs, it is often useful to be able to provide real time message update on the UI.

Output message from a task to the user interface



Sleep time* : 20

55
Wait
Task OK
ncroot | Oct 06, 2020 7:
Wait
Sleep time: 5

WAIT   OCT 06, 2020 7:53:10AM - RUNNING

RUNNING sleep
going to sleep for 20sec.
Oct 06, 2020 7:53:10AM - Running

The code sample below shows how to do it.

```
from msa_sdk.orchestration import Orchestration
from msa_sdk.msa_api import MSA_API
import time

Orchestration = Orchestration(context['UBIQUBEID'])
async_update_list = (context['PROCESSINSTANCEID'],
                     context['TASKID'],
                     context['EXECNUMBER'])                      ①


Orchestration.update_asynchronous_task_details(*async_update_list,
                                               'going to sleep')  ②
time.sleep(2)                                                    ③
Orchestration.update_asynchronous_task_details(*async_update_list,
                                               'wake up')        ④
```

① creates an array with the information about current process and task

② update the UI with a message

③ execute some code

④ update the UI with another message

Write debug message in the process log file

To write debugging messages in the process execution log file (msa-api container, under /opt/wildfly/logs) you can use the function `log_to_process_file`

```
from msa_sdk import util

dev_var = Variables()
context = Variables.task_call(dev_var)

process_id = context['SERVICEINSTANCEID']      ①

util.log_to_process_file(process_id, 'a debug message')
```

① read the current process ID from the context

Contributing

Help us improve the SDK: fork https://github.com/openmsa/python-sdk and submit your changes with a Pull Request

PHP SDK

The MSactivator™ provides a support for PHP SDK dedicated to developing automation workflows.

Overview

This SDK provides a set of functions that can be used to call the MSactivator™ REST API and automate actions on the MSactivator™ such as create and activate managed entities, call microservice function, call processes from other workflows…

Where to find the source code of the SDK?

The SDK functions are implemented in a set of PHP files stored in the MSactivator™ container msa_dev under `/opt/fmc_repository/Process/Reference/Common/Library`

The PHP files are organised by API topic and contains the functions that are calling the REST API.

These functions can be called directly when implementing the tasks of the workflow processes.

Code samples

Sample implementation of a SDK PHP function

The source code below shows the implementation of one of the functions provided by the SDK.

```
/**
 * Create Subtenant
①
 * curl -u ncroot:ubiqube  -H "Content-Type: application/json" \
 *   -XPOST 'http://ip_address/ubi-api-
rest/customer/{prefix}?name={name}&reference={reference}' -d '
    {
        "name": "contactName",
        "firstName": "contactFirstName",
        "address": {
            "streetName1": "sn1",
            "streetName2": "sn2",
            "streetName3": "sn3",
            "city": "city123",
            "zipCode": "zip123",
            "country": "Country098",
            "fax": "1233",
            "email": "contact @ company.com",
            "phone": "123"
        }

    }
 */
function _customer_create ($operator_prefix,
                            $customer_name,
                            $external_reference = "",
                            $contact_details = "{}") {
②
```

```
    $msa_rest_api = "customer/{$operator_prefix}?name={$customer_name}&reference=
{$external_reference}";
    $curl_cmd = create_msa_operation_request(OP_POST, $msa_rest_api,
$contact_details);           ③
    $response = perform_curl_operation($curl_cmd, "CREATE CUSTOMER");
④
    $response = json_decode($response, true);
    if ($response['wo_status'] !== ENDED) {
⑤
        $response = json_encode($response);
        return $response;
    }
    $response = prepare_json_response(ENDED, ENDED_SUCCESSFULLY, $response
['wo_newparams']['response_body']);
    return $response;
}
```

① A description of the function and an sample call of the matching REST API

② The function of the SDK always starts with _

③ Call a SDK helper function to build the curl request

④ Call a SDK helper function to execute the curl request

⑤ Call a SDK helper function (defined in utility.php) to format a response with proper status, comment and response payload

Sample call of a SDK function in a workflow task.

```
// Create subtenant
logToFile("Creating subtenant:\n");

$customer_contact_details_array = array();
①
$customer_contact_details_array['firstName'] = $customer_contact_first_name;
$customer_contact_details_array['name'] = $customer_contact_name;
if (isset($context['email_recipient']) && $context['email_recipient']){
  $address = array('email' => $context['email_recipient']);
  $customer_contact_details_array['address'] = $address;
}

$customer_contact_details_json = json_encode($customer_contact_details_array);
②

// Call function to create customer
$response = _customer_create ($operator_prefix, $customer_name,
$customer_ext_reference,
                                $customer_contact_details_json);
③

$response = json_decode($response, true);
```

```
④
if ($response['wo_status'] !== ENDED) {
⑤
    $response = json_encode($response);
    echo $response;
    exit;
}
logToFile(debug_dump($response['wo_newparams'], "RESPONSE\n"));
⑥
```

① Build the array with the customer contact details. This parameter is defaulted by an empty array

② Encode the array into it's json representation

③ Call the SDK function

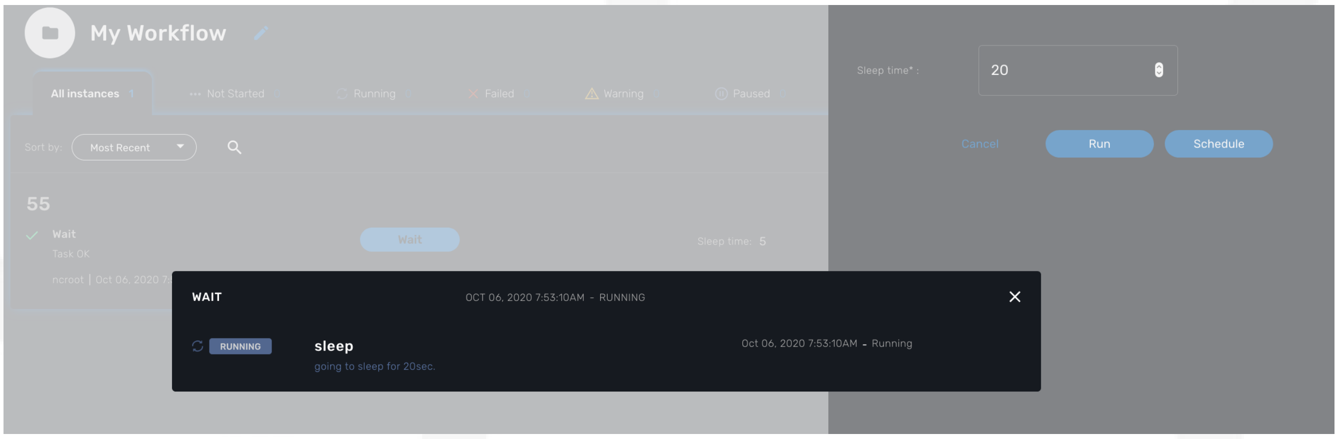
④ Get the JSON response as an array

⑤ If the call to the function failed, echo the response and exit the task

⑥ If the call was successful continue the task execution

Output messages to the process execution UI

When a task runs, it is often useful to be able to provide real time message update on the UI.



Sleep time* : 20

55
Wait
Task OK
ncroot | Oct 06, 2020
Sleep time: 5

WAIT   OCT 06, 2020 7:53:10AM - RUNNING

RUNNING   sleep   Oct 06, 2020 7:53:10AM - Running
going to sleep for 20sec.

The code sample below shows how to do it.

```
$PROCESSINSTANCEID = $context['PROCESSINSTANCEID'];
$EXECNUMBER = $context['EXECNUMBER'];
$TASKID = $context['TASKID'];
$process_params = array('PROCESSINSTANCEID' => $PROCESSINSTANCEID,
①
                        'EXECNUMBER' => $EXECNUMBER,
                        'TASKID' => $TASKID);

update_asynchronous_task_details($process_params,
                                "going to sleep for ".$context['sleep']. "sec.");
②
sleep($context['sleep']);
③
```

```
update_asynchronous_task_details($process_params, "wakeup");
④
```

① creates an array with the information about current process and task

② update the UI with a message

③ execute some code

④ update the UI with another message

Microservice functions

Call a microservice CREATE/UPDATE/DELETE function

```
$micro_service_vars_array = array ();                         ①
$micro_service_vars_array ['object_id'] = $context ['id'];     ②

$micro_service_vars_array ['src_ip'] = $context ['src_ip'];
$micro_service_vars_array ['src_mask'] = $context ['src_mask'];

$micro_service_vars_array ['dst_ip'] = $context ['dst_ip'];
$micro_service_vars_array ['dst_mask'] = $context ['dst_mask'];

$micro_service_vars_array ['service'] = $context ['service'];
$micro_service_vars_array ['action'] = $context ['action'];

$object_id = $context ['id'];

$simple_firewall = array (
        'simple_firewall' => array (                          ③
                $object_id => $micro_service_vars_array
        )
);

$response = execute_command_and_verify_response ( $managed_entity_id, CMD_CREATE,
$simple_firewall, "CREATE simple_firewall" ); ④
```

① Build the Microservice JSON params for the CREATE operation of the microservice.

② Assign the values passed to the workflow process to the array of parameters of the Microservice.

③ The value of the key should match the Microservice file name (stripped of the .xml file extension)

④ Call the CREATE for simple_firewall MS for each device (use CMD_UPDATE or CMD_DELETE for the other operations)

The function `execute_command_and_verify_response` is defined in msa_common.php

Synchronize the managed entity configuration

The code sample below uses a PHP function from the SDK to trigger this operation by calling the

IMPORT function of a microservice

```
$response = synchronize_objects_and_verify_response($managed_entity_id);  ①
```

① The variable $managed_entity_id is the database ID of the managed entity

Useful functions

Here is a list of some of the most commonly used functions.

Managed entities

Managed entity creation

```
function _device_create ($customer_id, $device_name, $manufacturer_id,
                        $model_id, $login, $password, $password_admin,
                        $management_address, $device_external_reference = "",
                        $log_enabled = "true", $log_more_enabled = "true",
                        $mail_alerting = "true", $reporting = "false", $snmp_community
= SNMP_COMMUNITY_DEFAULT, $managementInterface = "")
```

location: device_rest.php

if you need to set the hostname or update the credentials you can use some dedicated functions from device_rest.php

Managed entity activation

```
function _device_do_initial_provisioning_by_id ($device_id)
```

location: device_rest.php

Managed Entity Deletion

```
function _device_delete ($device_id) {
```

location: device_rest.php

Tenant and Subtenant

Tenant creation

```
function _operator_create ($operator_prefix, $name)
```

location: operator_rest.php

Subtenant creation

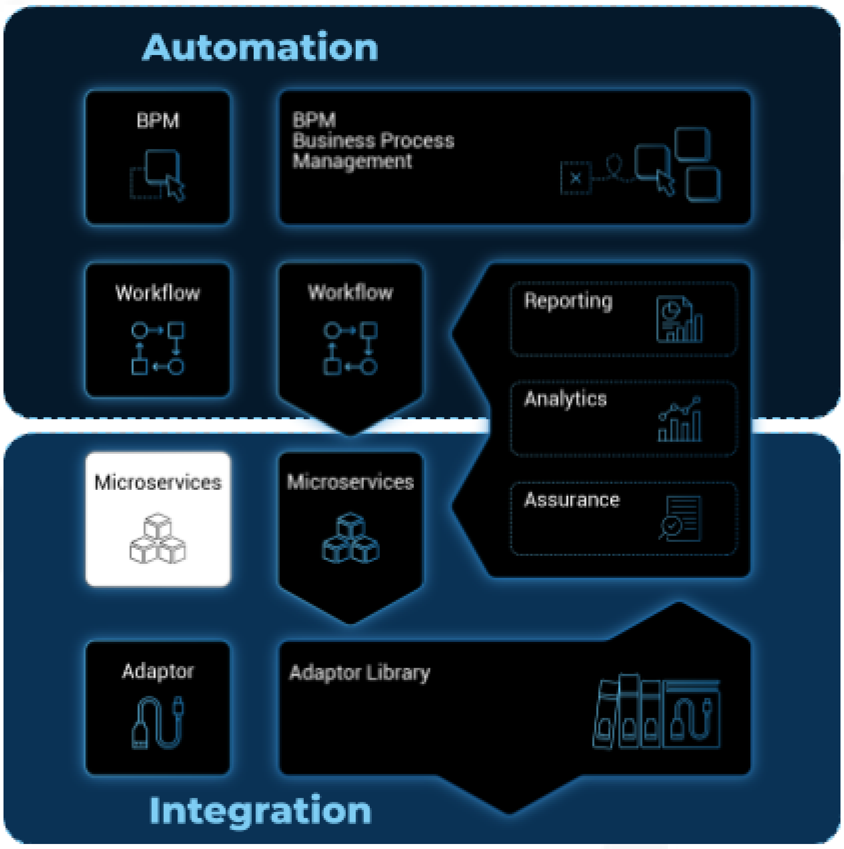
```
function _customer_create ($operator_prefix, $customer_name, $external_reference = "",
$contact_details = "{}")
```

location: customer_rest.php

Getting more Examples

You will find many examples of Workflows in https://github.com/openmsa/Workflows

Microservice Editor

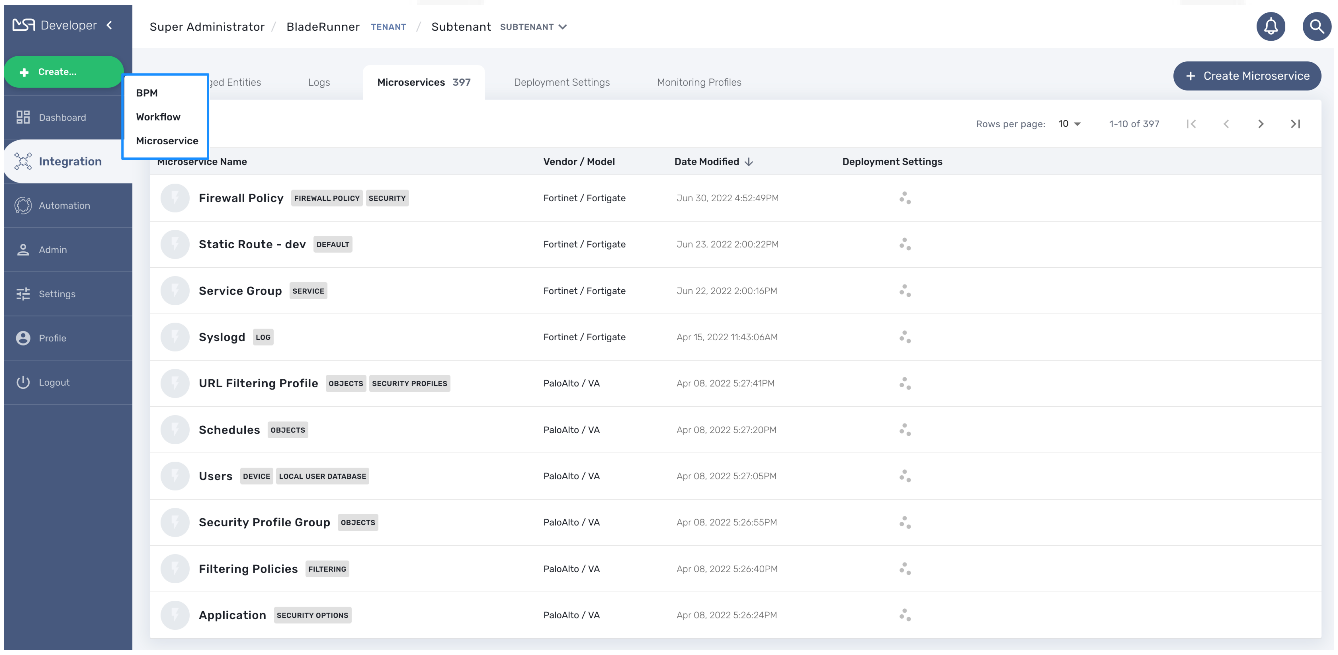


The **microservice editor** is a web based UI tool for designing, developing, testing and releasing microservices.

Microservice editor

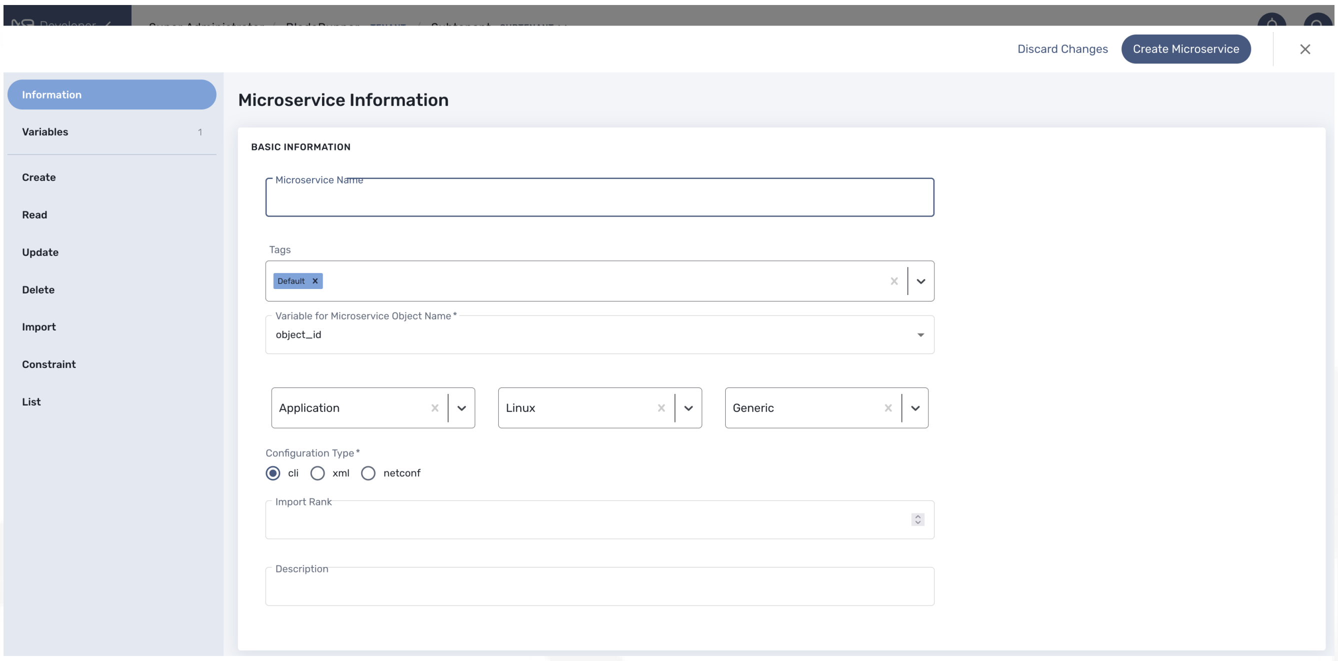
Overview

From the developer portal, click on "Create Microservice" to create the microservice.



Microservice Name	Vendor / Model	Date Modified	Deployment Settings
Firewall Policy FIREWALL POLICY SECURITY	Fortinet / Fortigate	Jun 30, 2022 4:52:49PM	
Static Route - dev DEFAULT	Fortinet / Fortigate	Jun 23, 2022 2:00:22PM	
Service Group SERVICE	Fortinet / Fortigate	Jun 22, 2022 2:00:16PM	
Syslogd LOG	Fortinet / Fortigate	Apr 15, 2022 11:43:06AM	
URL Filtering Profile OBJECTS SECURITY PROFILES	PaloAlto / VA	Apr 08, 2022 5:27:41PM	
Schedules OBJECTS	PaloAlto / VA	Apr 08, 2022 5:27:20PM	
Users DEVICE LOCAL USER DATABASE	PaloAlto / VA	Apr 08, 2022 5:27:05PM	
Security Profile Group OBJECTS	PaloAlto / VA	Apr 08, 2022 5:26:55PM	
Filtering Policies FILTERING	PaloAlto / VA	Apr 08, 2022 5:26:40PM	
Application SECURITY OPTIONS	PaloAlto / VA	Apr 08, 2022 5:26:24PM	

The microservice console is composed of a vertical menu on the left and a main screen



Information

Microservices are vendor specific, the implementations of the functions to create, update, delete or import a managed entity configuration will depend on the managed entity, the type of remote management interface, the format of the configuration, how it is structured,...

Vendor and model

Select the correct vendor/model information. This will be used by the deployment settings to filter the microservice that are eligible for selection.

Configuration Type

It is also important to select the proper configuration type:

- cli: for managed entities such as Linux, Cisco IOS, Fortigate,...
- xml: for managed entities with a REST management API (both XML and JSON API are supported)
- netconf: for managed entities that support Netconf as the management API

The editor UI will adjust based on the configuration type and this setting cannot be changed once the microservice is created.

Import rank

The import rank is needed to control in which order the execution of the import functions of your microservices will be executed when you click on "Synchronize with Managed Entity" from the managed entity tab "configure".

Setting correct import rank is important when you have dependencies between your microservices.

Microservice dependencies are created by leveraging the variable type "Microservice Reference" (see documentation about microservice variables).

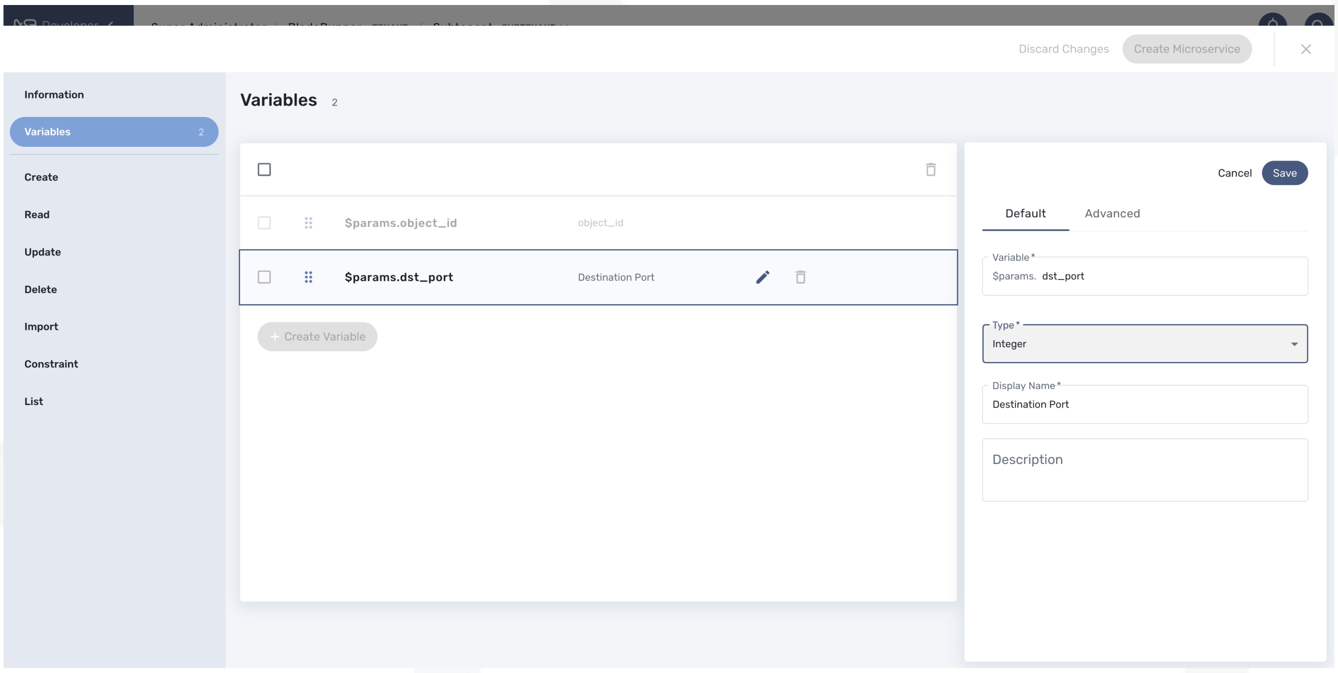
Once created, you can search for your microservice in the list and attach it to a deployment setting, you can also edit it or delete it.

The easiest way to design a microservice is to use a managed entity dedicated to testing and follow in a code-test-fix development cycle. This documentation uses the Linux Managed Entity provided by the mini lab.

Variables

Variable are usually defined to hold the parameters to be passed to the microservice. For instance, the port and IP to block for a firewall policy. Variables can also be used to display user information that is not meant to be used for configuring the managed entity.

Setting variables is done from the section "Variables" on the microservice editor screen.



$params.object_id	object_id
$params.dst_port	Destination Port

Variable*: $params. dst_port
Type*: Integer
Display Name*: Destination Port
Description

When you create a new microservice, the variable object_id, which is mandatory, will be set and cannot be deleted. It can be edited to set it’s type and other advanced properties.

All variables are referenced with the prefix `$param` which is automatically set in the variable editor screen and when a variable has to be referenced in one of the microservice function, you need to use the syntax `{$param.your_variable}` (see below for more examples)

By default the type of a variable is String but other types are supported such as Integer, Boolean, Password, IpAddress, ObjectRef,…

Usage of the {$object_id} variable

The `{$object_id}` is a reserved variable used to reference objects into the database and used as variable name in Smarty in the template resolution.

When the parameters are passed to the engine you give:

```
{"interface":{"Interface-Service-engine0/0":{"ip_address":"1.2.3.4"}}}
```

The variables values are:

```
{$object_id} => "Interface-Service-engine0/0"
{$params.ip_address} => "1.2.3.4"
```

Functions

From the left menu of the microservice editor there is a list of functions to implement. While none of the functions are mandatory, at least one of 'Create', 'Update', 'Delete' or 'Import' has to be implemented in oder to have a microservice that can actually do something.

In order to provide a full lifecycle management of a service on a managed entity, the 4 functions above have to be implemented.

The function 'Read', 'List' are optional and while it’s possible to implement them, you’ll have to rely on the REST API to execute them.

The function 'Constraint' allow the implementation of custom constraints to be verified before the managed entity is actually configured.

Create

The Create function takes care of configuring a new service in the managed entity. For example, a new static route if the managed entity is a router.

This functions is implemented either in PHP Smarty template language for CLI microservice (see "Microservice Template with PHP Smarty" for more details) or as a REST API call for XML microservice.

When this function is implemented, a button "+ Add Row" will appear in the tab "Configure" of the managed entity that uses this microservice.

Example

This example is a Samrty template that will take the parameters entered in the user form and generate a configuration.

```
config router static
edit {$params.object_id}
set dst {$params.ip_dest} {$params.mask}
set gateway {$params.gw}
set device {$params.interface}
{if empty($params.comment)}
unset comment
```

```
{else}
set comment "{$params.comment}"
{/if}
next
end
```

Update

The Update function takes care of updating an existing service in the managed entity.

Delete

The Delete function takes care of deleting an existing service in the managed entity.

Example

This example generate a conf based on the instance parameters as store in the database.

```
config router static
delete "{$routing.$object_id.object_id}"
end
```

Import

The role of the Import function is to import the actual configuration of the managed entity into the MSactivator™ database.

The implementation of the Import is either based on a set of regular expressions or a set of XPath expressions that build a parser that will extract the values of the variables.

The Import is made of 3 parts:

- the command to run on the device for CLI command based device or the REST API to call.
- the configuration parser, implemented with a set of regular expressions or XPath expressions. Only the microservice identifier extractor is mandatory.
- a set of optional post import operations implemented in Smarty language (https://www.smarty.net/).

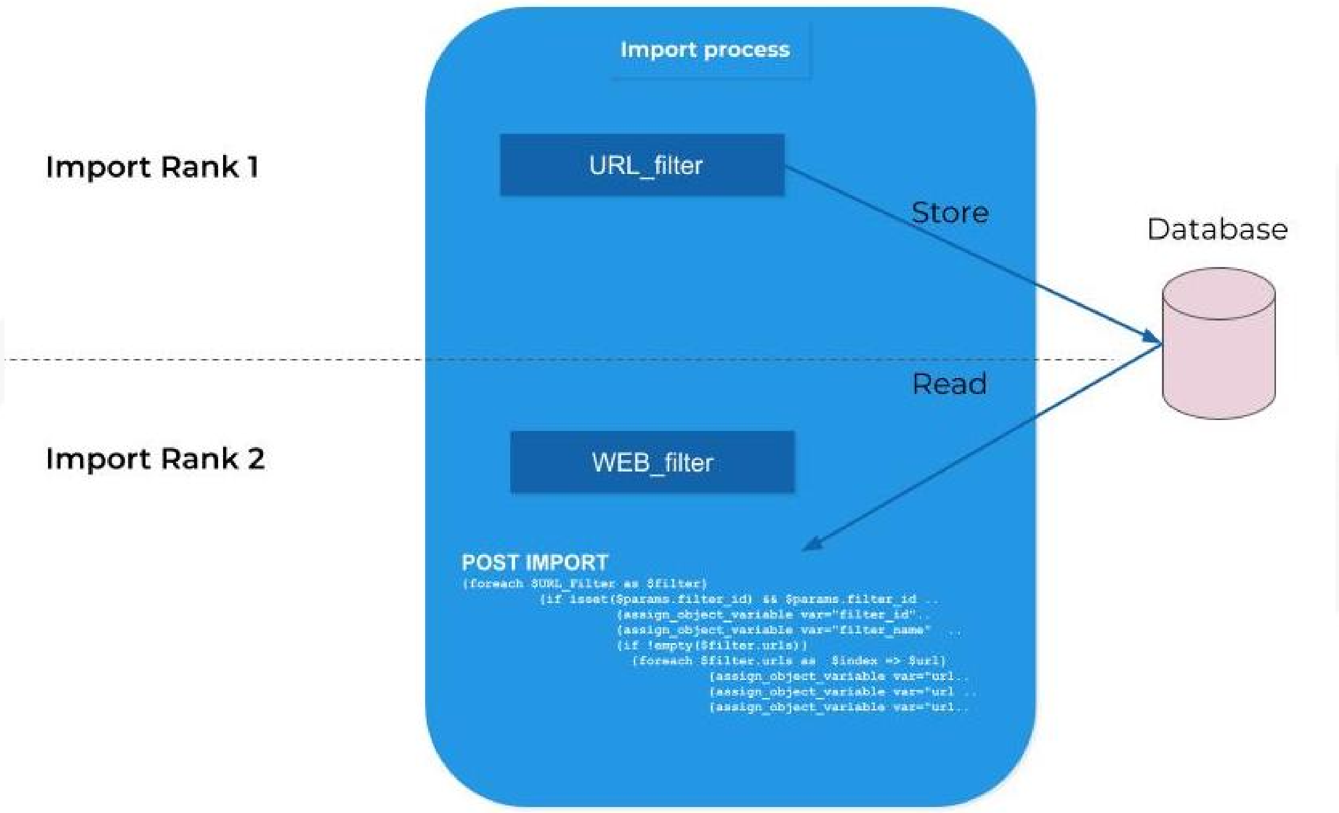
Post-import

This example shows how to use the post import section of a microservice in order to fulfill one of it's variable with data coming from other microservice instances already imported in MSactivator™ database.

This example is based on Fortigate configuration example, more precisely on the web filtering configuration sub-part.

This first relies on the ability to define an import rank in the microservice definition. In our example the microservice Web_Filter(.xml) will need the instances of the microservice

URL_Filter(.xml) to be imported first in order to have relevant information. So Web_Filter microservice as an import rand higher than URL_Filter, so that during the import import/synchronize process, URL_Filter microservice will be imported first in MSactivator™ database so they can be read during the post import of Web_Filter microservice in order to enrich the instance with detailed values/info.



```
{foreach $URL_Filter as $filter}
          {if isset($params.filter_id) && $params.filter_id ..
                    {assign_object_variable var="filter_id"..
                    {assign_object_variable var="filter_name"  ..
                    {if !empty($filter.urls)}
                      {foreach $filter.urls as  $index => $url}
                                {assign_object_variable var="url..
                                {assign_object_variable var="url ..
                                {assign_object_variable var="url..
```

Instead of displaying/proposing to enter meaningless numbers as identifier of URL filtering rules, the post import , the Web filtering microservice will display the URL filter details gathered during the post import. In order to read the MS instance, the syntax is simply based on the microservice definition file name.

In the below Web_Filter post import example, by using the foreach loop on the variable $URL_Filter, we can seek MSactivator™ microservice database instance.

```
{foreach $URL_Filter as $filter}
    {if isset($params.filter_id) && $params.filter_id == $filter.object_id}
        {assign_object_variable var="filter_id" value=$filter.object_id}
        {assign_object_variable var="filter_name" value=$filter.filter_name}
        {if !empty($filter.urls)}
          {foreach $filter.urls as  $index => $url}
              {assign_object_variable var="urlfilter.{$index}.url_id" value=$url
.url_id}
              {assign_object_variable var="urlfilter.{$index}.url" value=$url.url}
              {assign_object_variable var="urlfilter.{$index}.action" value=$url
.action}
              {assign_object_variable var="urlfilter.{$index}.type" value=$url.type}
              {/foreach}
        {/if}
        {break}
    {/if}
{/foreach}
```

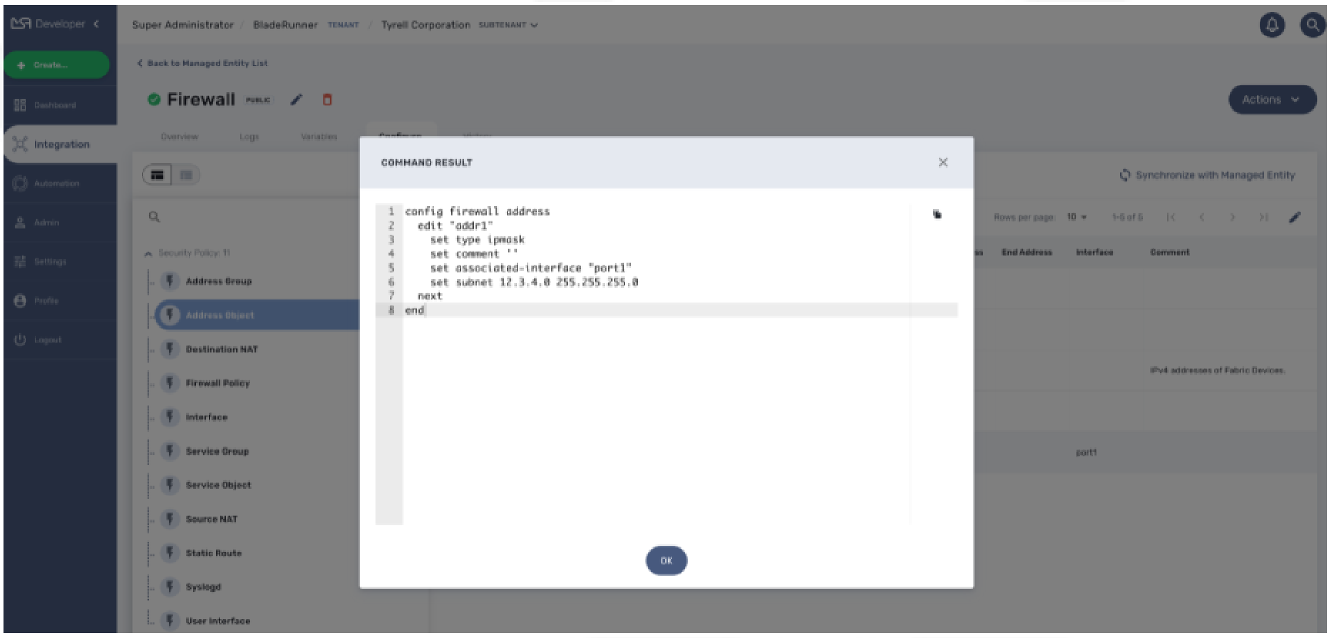
Read

The Read function can be implemented to allow the user or the API to generate a text file based on a Smarty template and the microservice instance variables store in the database.

Example

This example generate a text based on a template and the microservice instance variables values as stored in the database

```
config router static
edit {$routing.$object_id.object_id}
set dst {$routing.$object_id.ip_dest} {$params.mask}
set gateway {$routing.$object_id.gw}
set device {$routing.$object_id.interface}
{if empty($routing.$object_id.comment)}
unset comment
{else}
set comment "{$routing.$object_id.comment}"
{/if}
next
end
```



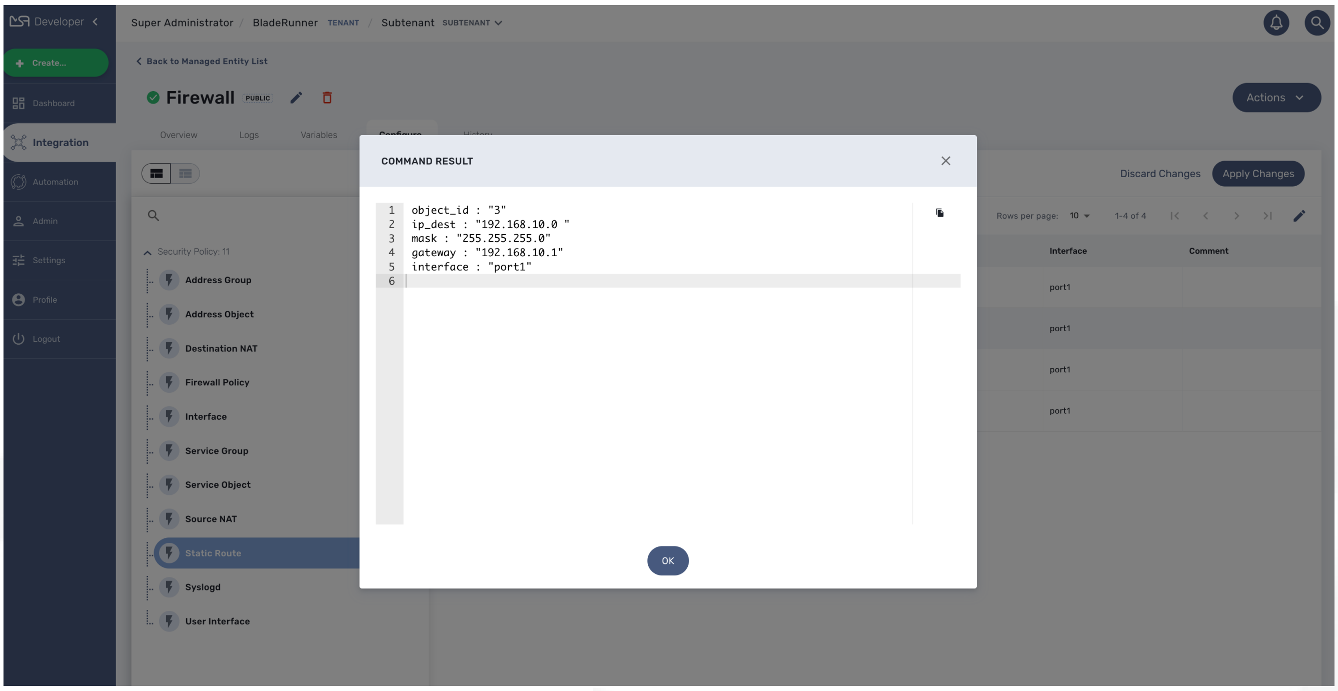
Developer
Super Administrator / BladeRunner TENANT / Tyrell Corporation SUBTENANT
Firewall
Actions
Integration
COMMAND RESULT
OK

```
config firewall address
  edit "addr1"
    set type ipmask
    set comment ''
    set associated-interface "port1"
    set subnet 12.3.4.0 255.255.255.0
  next
end
```

Another template could be:

```
object_id : "{$routing.$object_id.object_id}"
ip_dest : "{$routing.$object_id.ip_dest} "
mask : "{$params.mask}"
```

```
  gateway : "{$routing.$object_id.gw}"
  interface : "{$routing.$object_id.interface}"
```



```
object_id : "3"
ip_dest : "192.168.10.0 "
mask : "255.255.255.0"
gateway : "192.168.10.1"
interface : "port1"
```

Constraint

In most cases, the constraint definition is straight forward when defining a microservice variable. Based on the type of the variable, the UI will check if the provided value is consistent with the type. For example if the type is "IP Address", the format of the value should be an IP address.

In some cases, though, the constraint is more complex and may depend on a combination of several conditions that can involve multiple variables.

For example, the 5 variables `params.av`, `params.webfilter`, `params.spamfilter`, `params.ips`, and `params.scanport` have the following dependencies:

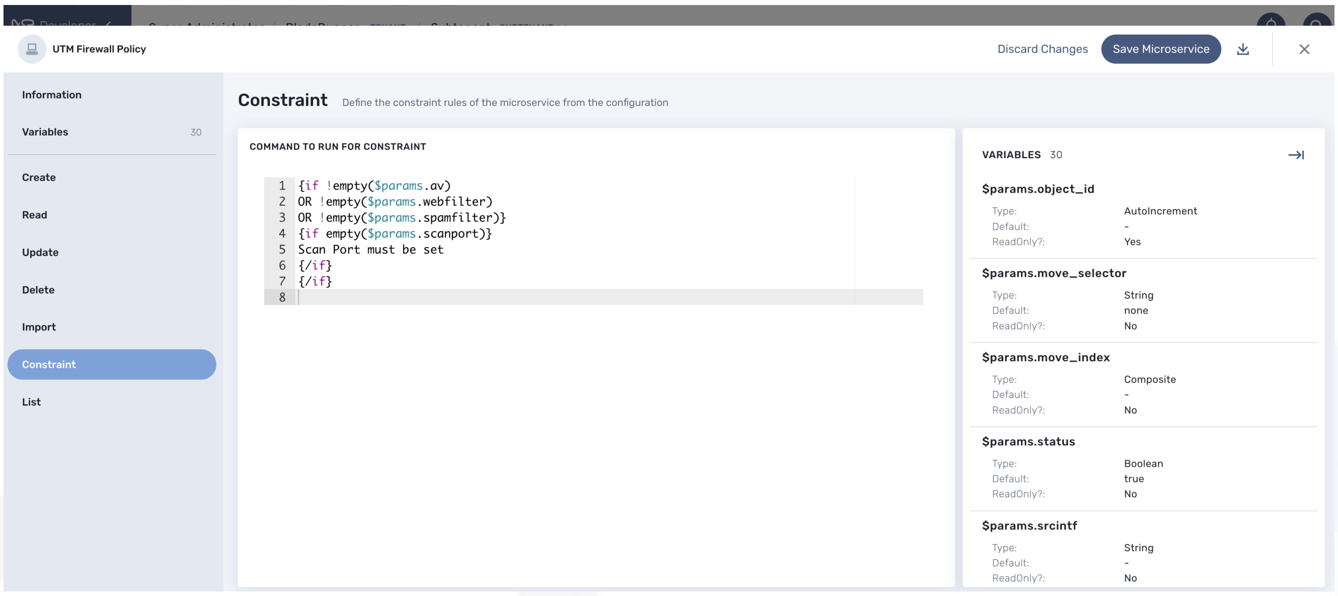
- if `params.av` is set then `params.scanport` must be set
- if `params.webfilter` is set then `params.scanport` must be set
- if `params.spamfilter` is set then `params.scanport` must be set
- if `params.ips` is set then `params.scanport` is not mandatory

To make things simpler, it is possible to add a custom constraint evaluation to the object definition.

The custom constraint is implemented as a smarty template:

```
{if !empty($params.av)
    OR !empty($params.webfilter)
    OR !empty($params.spamfilter)}
    {if empty($params.scanport)}
    Scan Port must be set
    {/if}
```

```
{/if}
```


UTM Firewall Policy

Discard Changes | Save Microservice

- Information
- Variables 30
- Create
- Read
- Update
- Delete
- Import
- Constraint
- List

Constraint Define the constraint rules of the microservice from the configuration

COMMAND TO RUN FOR CONSTRAINT

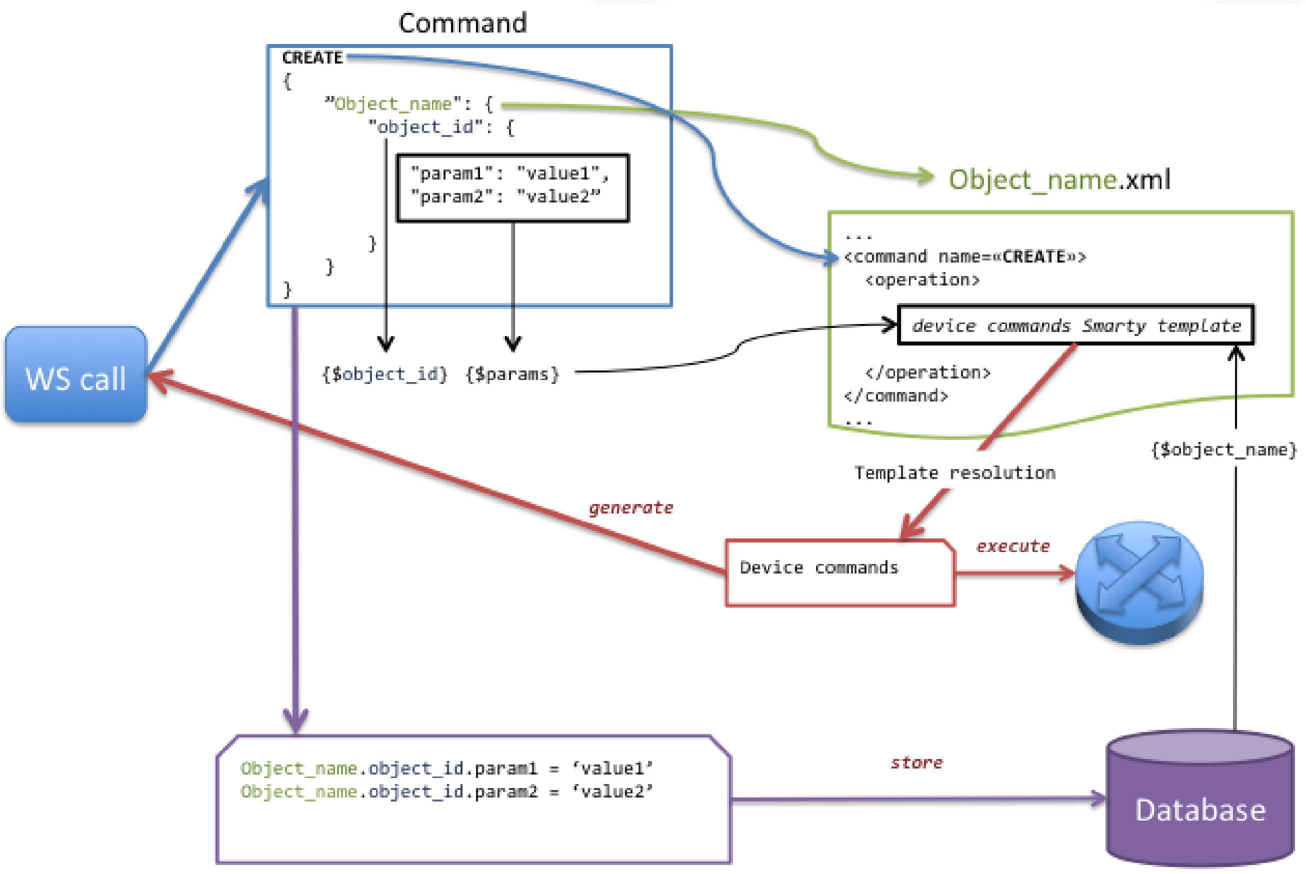
```
{if !empty($params.av)
OR !empty($params.webfilter)
OR !empty($params.spamfilter)}
{if empty($params.scanport)}
Scan Port must be set
{/if}
{/if}

```

VARIABLES 30

$params.object_id	
Type:	AutoIncrement
Default:	-
ReadOnly?:	Yes
$params.move_selector	
Type:	String
Default:	none
ReadOnly?:	No
$params.move_index	
Type:	Composite
Default:	-
ReadOnly?:	No
$params.status	
Type:	Boolean
Default:	true
ReadOnly?:	No
$params.srcintf	
Type:	String
Default:	-
ReadOnly?:	No

Create, Update or Delete Execution flow

The diagram below shows the flow of execution when one of the Create, Update or Delete function is executed by the REST API (directly or from the UI)



1. A command (CREATE here) is send via web service.
2. The microservice name is used to retrieve the associated XML definition file associated to the managed entity.

3. The command name is used to find the <command> section in the XML definition file.
4. The variables {$object_id} and {$params} are created to parse the template of the XML definition file.
5. Variables from the database are also created to parse the template of the XML definition file.
6. The template generates device commands used to perform the requested command on the object.
7. The device commands generated are returned to the web service call.
8. Optionally the device commands generated are applied to the managed entity.
9. Optionally the object extracted from the web service call is stored in the database.

XML Microservice Editor

Overview

XML microservice are used to manage entities that expose a REST API that return a response formatted in XML or for Adapter that are not supporting JSON microservice and JsonPath.

To create a XML microservice, you need to check XML for the configuration type when creating a new microservice

do not try to change the configuration type of an existing microservice as this is not supported.

The functions Create, Update and Delete

Create and Update

These functions will call the REST API design to create or update the managed entity configuration.

For instance, the REST API to create a new tenant is

HTTP Request: `/operator/{$prefix}`

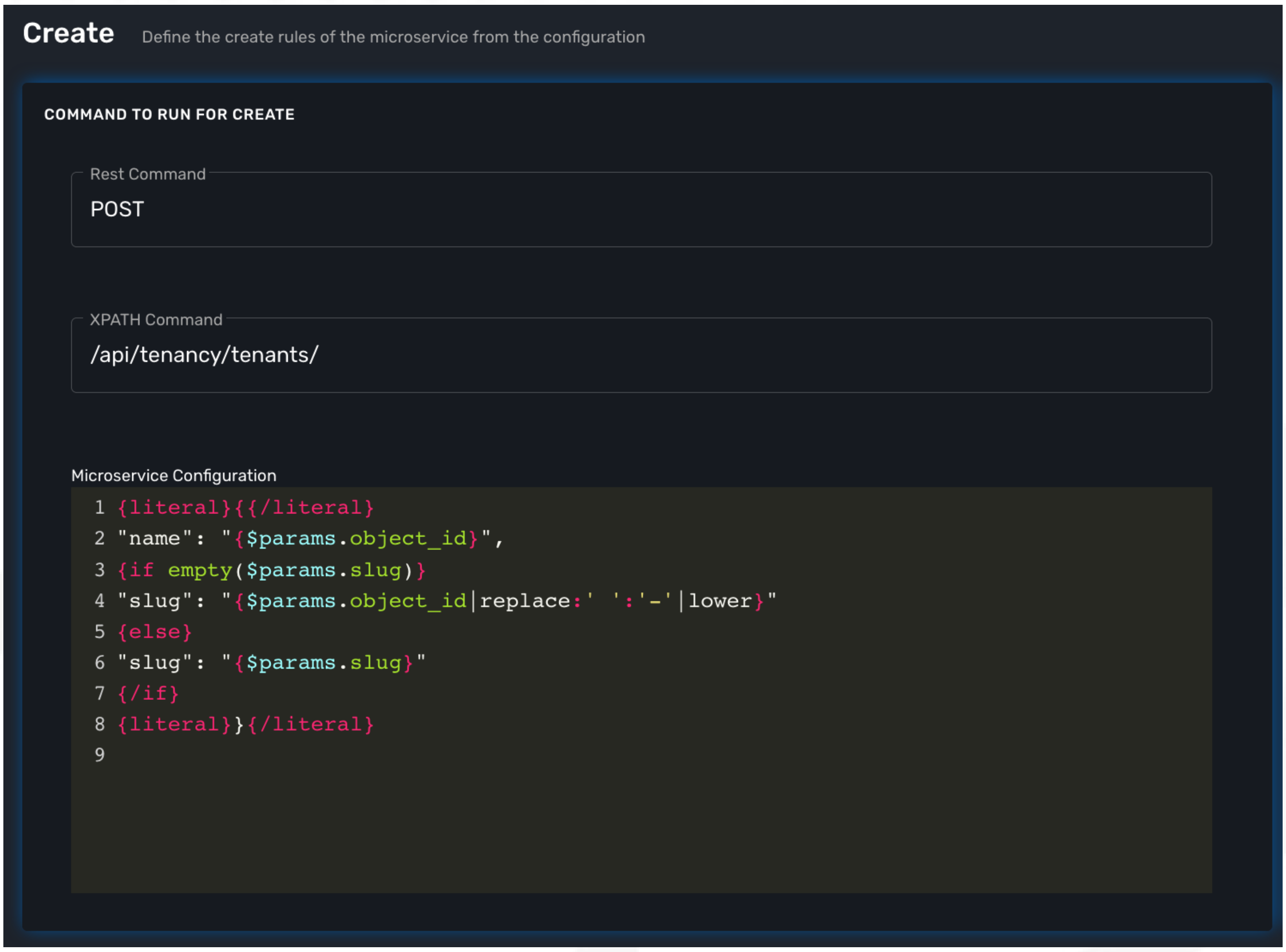
Method: `POST`

Parameter Name	Type	Description
name	String	the name of the tenant

Example:

```
POST /api/tenancy/tenants/
```

In case you need to pass in a JSON payload with the parameters, the microservice Create will look like this.


Create Define the create rules of the microservice from the configuration

COMMAND TO RUN FOR CREATE

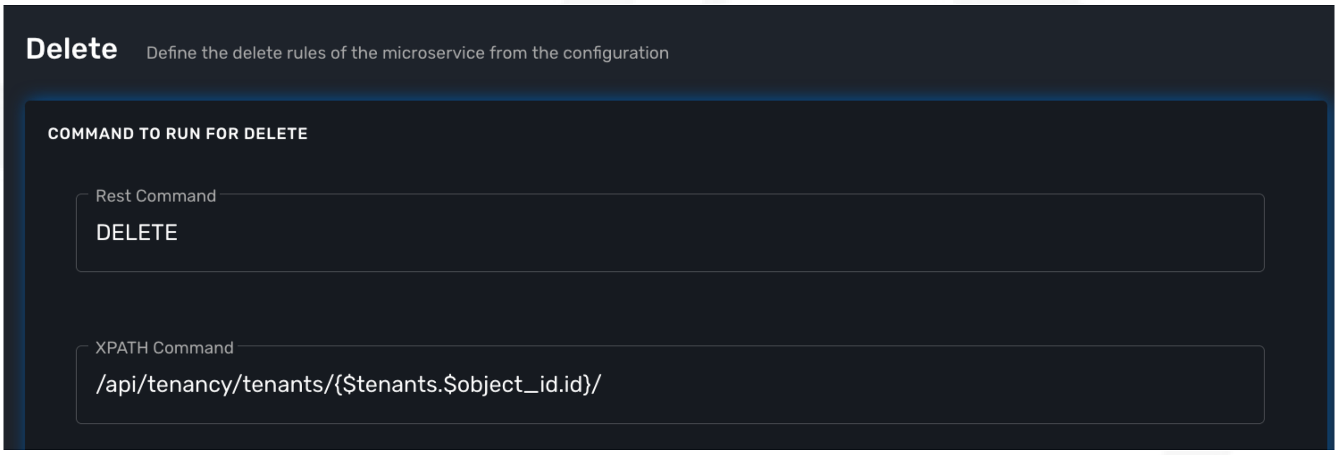
Rest Command: POST

XPATH Command: /api/tenancy/tenants/

Microservice Configuration

```
{literal}{{/literal}
"name": "{$params.object_id}",
{if empty($params.slug)}
"slug": "{$params.object_id|replace:' ':'-'|lower}"
{else}
"slug": "{$params.slug}"
{/if}
{literal}}{/literal}
```

Delete

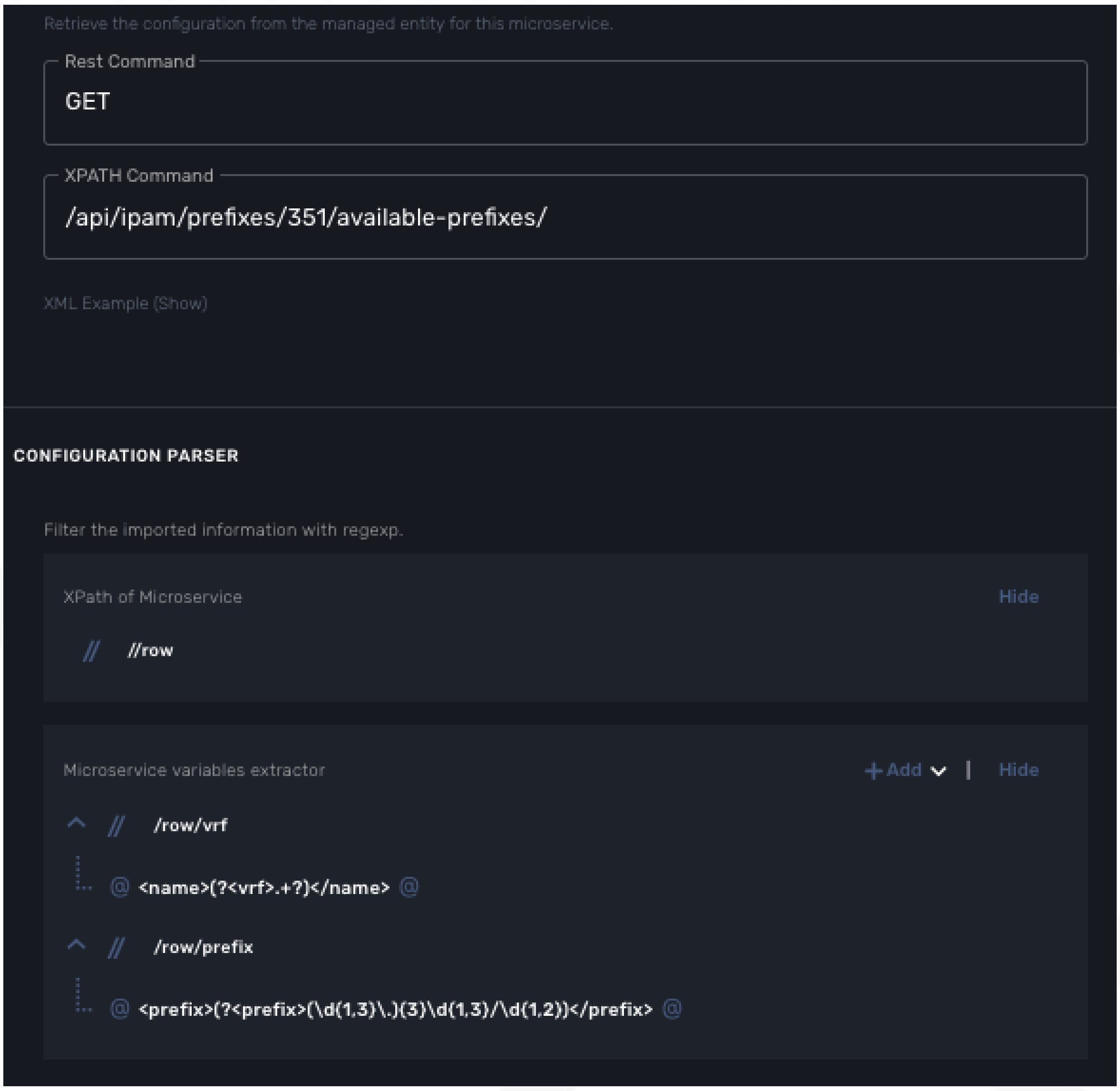

Delete Define the delete rules of the microservice from the configuration

COMMAND TO RUN FOR DELETE

Rest Command: DELETE

XPATH Command: /api/tenancy/tenants/{$tenants.$object_id.id}/

Import


Retrieve the configuration from the managed entity for this microservice.

Rest Command: GET

XPATH Command: /api/ipam/prefixes/351/available-prefixes/

XML Example (Show)

CONFIGURATION PARSER

Filter the imported information with regexp.

XPath of Microservice: //row

Microservice variables extractor

```
/row/vrf
  @ <name>(?<vrf>.+?)</name> @
/row/prefix
  @ <prefix>(?<prefix>(\d{1,3}\.){3}\d{1,3}/\d{1,2})</prefix> @
```

The main difference between the CLI and REST (Json/XML) Microservice definition is the implementation of the functions Create/Update/…

CLI Microservice definition is covered in the documentation about the CLI microservice editor.

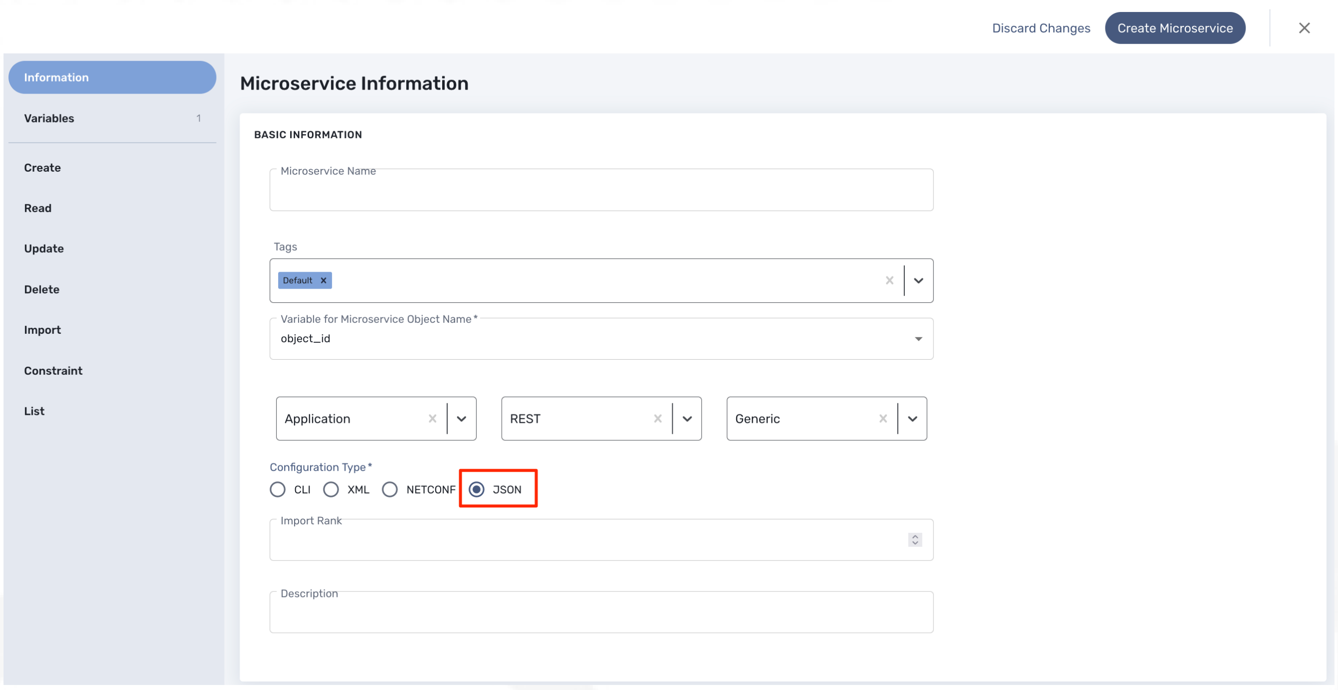
This documentation uses the Netbox REST adapter and the Netbox REST API to illustrate the design of XML Microservice.

JSON Microservice Editor

Overview

JSON microservice are used to manage entities that expose a REST API that returns a response formatted in JSON.

To create a JSON microservice, you need to check JSON for the configuration type when creating a new microservice.



Microservice Information

BASIC INFORMATION

Microservice Name	
Tags	Default
Variable for Microservice Object Name *	object_id
	Application
	REST
	Generic
Configuration Type *	CLI XML NETCONF [✓ JSON]
Import Rank	
Description	

do not try to change the configuration type of an existing microservice as this is not supported.

The functions Create, Update and Delete

Create and Update

These functions will call the REST API design to create or update the managed entity configuration.

For instance, the REST API to create a new tenant is

HTTP Request: `/operator/{$prefix}`

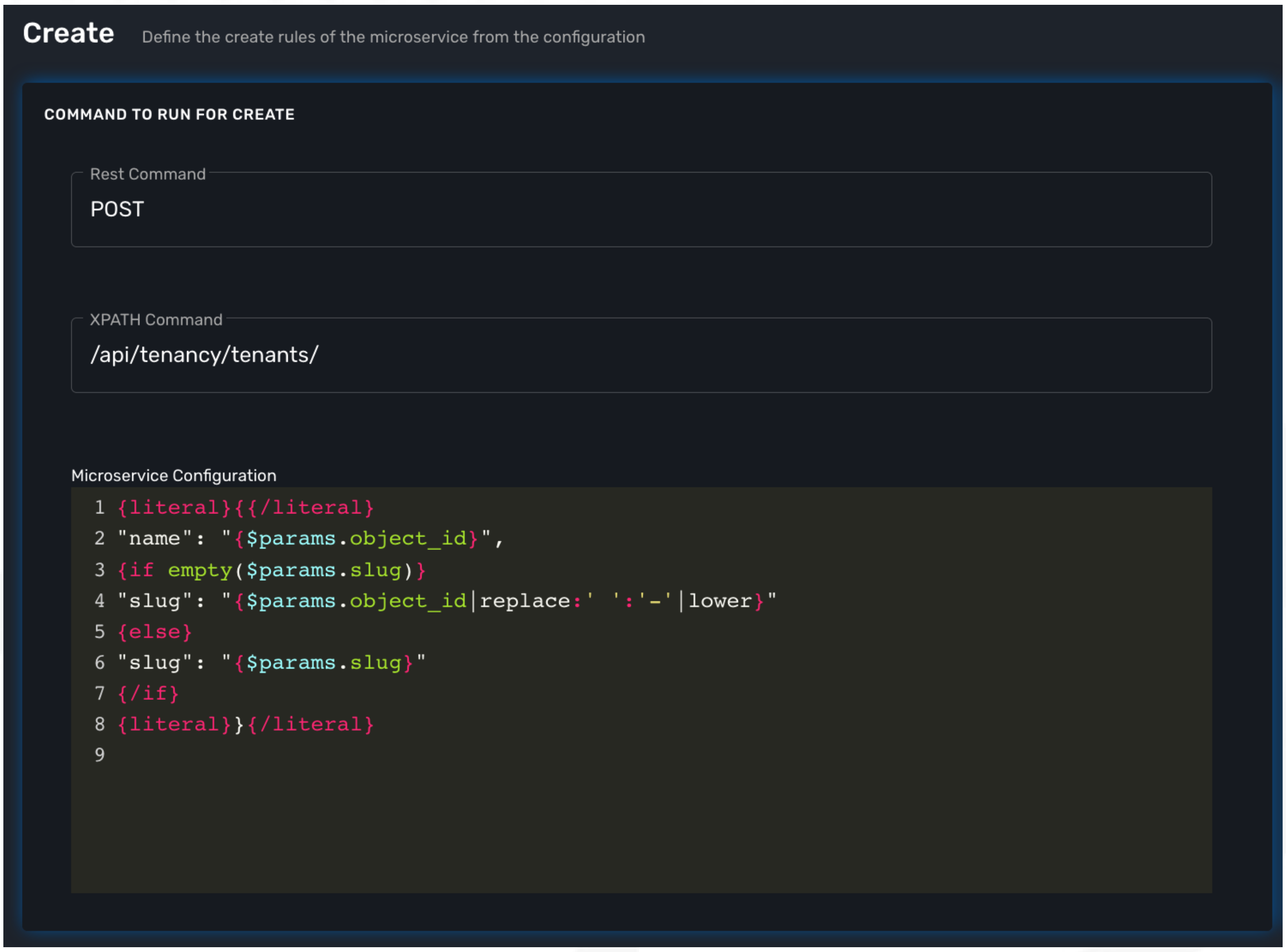
Method: `POST`

Parameter Name	Type	Description
name	String	the name of the tenant

Example:

```
POST /api/tenancy/tenants/
```

In case you need to pass in a JSON payload with the parameters, the microservice Create will look like this.


Create Define the create rules of the microservice from the configuration

COMMAND TO RUN FOR CREATE

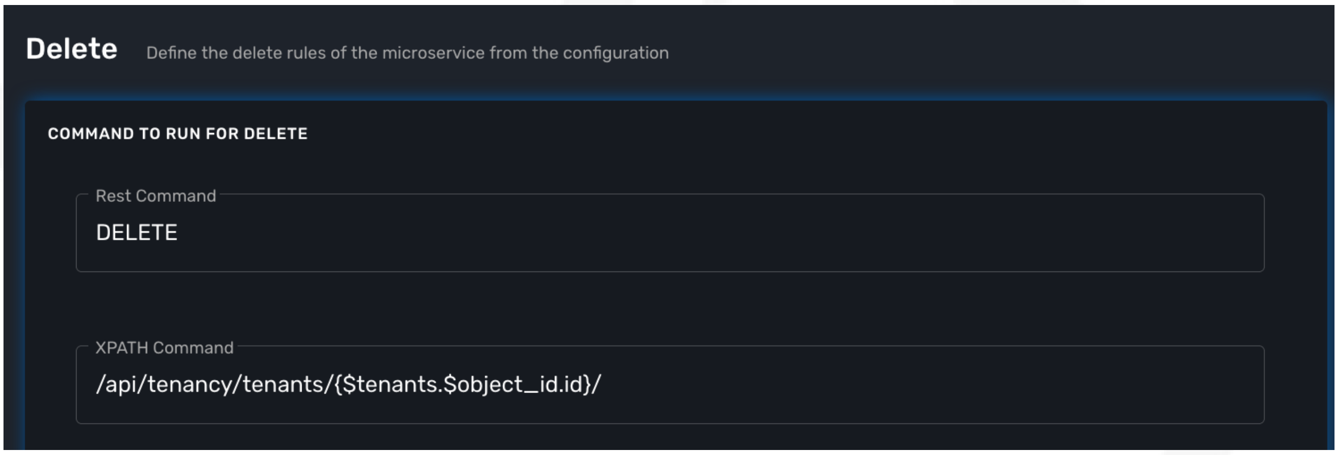
Rest Command: POST

XPATH Command: /api/tenancy/tenants/

Microservice Configuration

```
{literal}{{/literal}
"name": "{$params.object_id}",
{if empty($params.slug)}
"slug": "{$params.object_id|replace:' ':'-'|lower}"
{else}
"slug": "{$params.slug}"
{/if}
{literal}}{/literal}

```

Delete

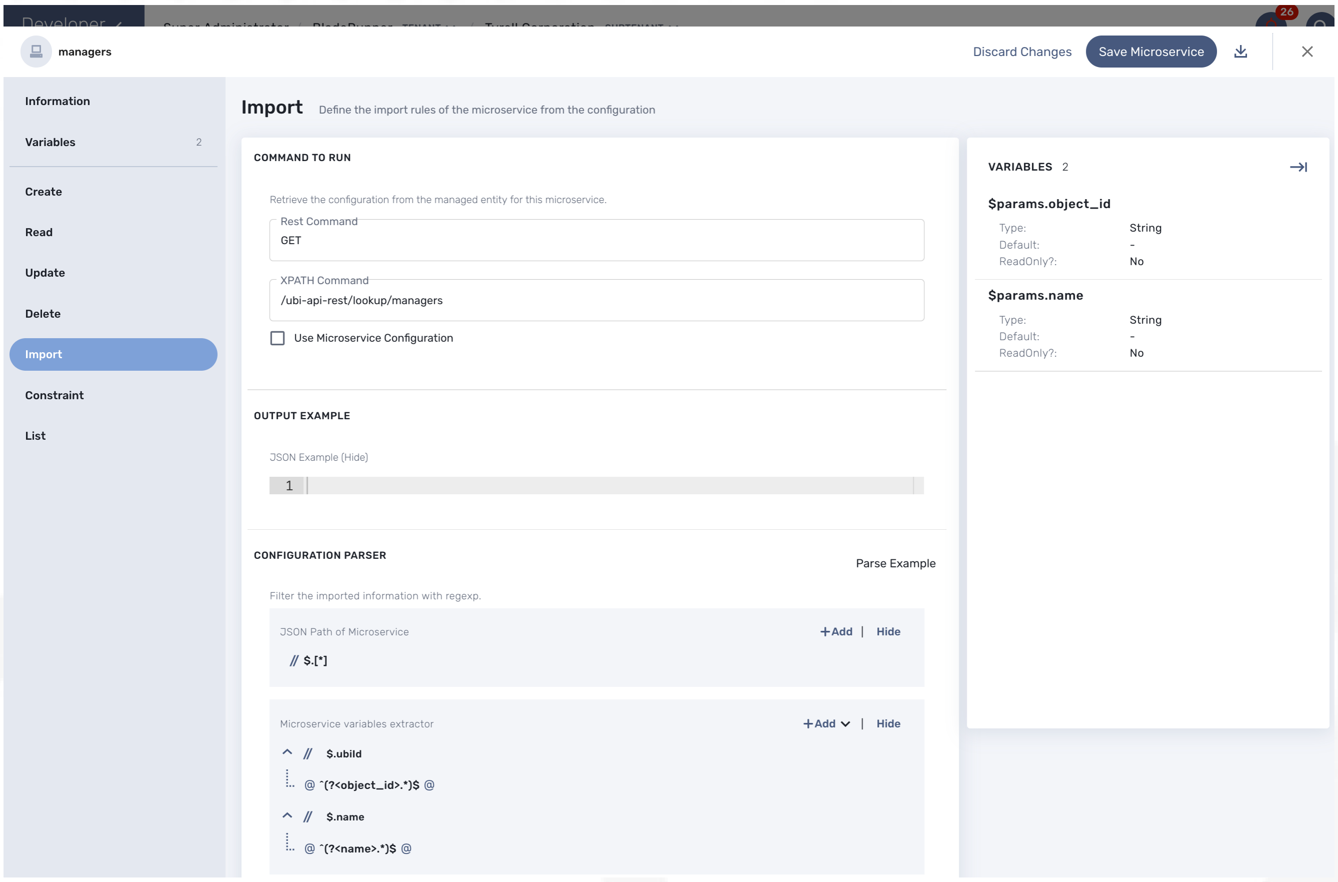

Delete Define the delete rules of the microservice from the configuration

COMMAND TO RUN FOR DELETE

Rest Command: DELETE

XPATH Command: /api/tenancy/tenants/{$tenants.$object_id.id}/

Import


managers

Import Define the import rules of the microservice from the configuration

COMMAND TO RUN

Retrieve the configuration from the managed entity for this microservice.

Rest Command: GET

XPATH Command: /ubi-api-rest/lookup/managers

Use Microservice Configuration

OUTPUT EXAMPLE

JSON Example (Hide)

CONFIGURATION PARSER

Parse Example

Filter the imported information with regexp.

JSON Path of Microservice +Add | Hide

// $.[*]

Microservice variables extractor +Add | Hide

// $.ubiId
@ ^(?<object_id>.*)$ @
// $.name
@ ^(?<name>.*)$ @

VARIABLES 2

$params.object_id

Type:	String
Default:	-
ReadOnly?:	No

$params.name

Type:	String
Default:	-
ReadOnly?:	No

The main difference between the CLI and REST (Json/XML) Microservice definition is the implementation of the functions Create/Update/…

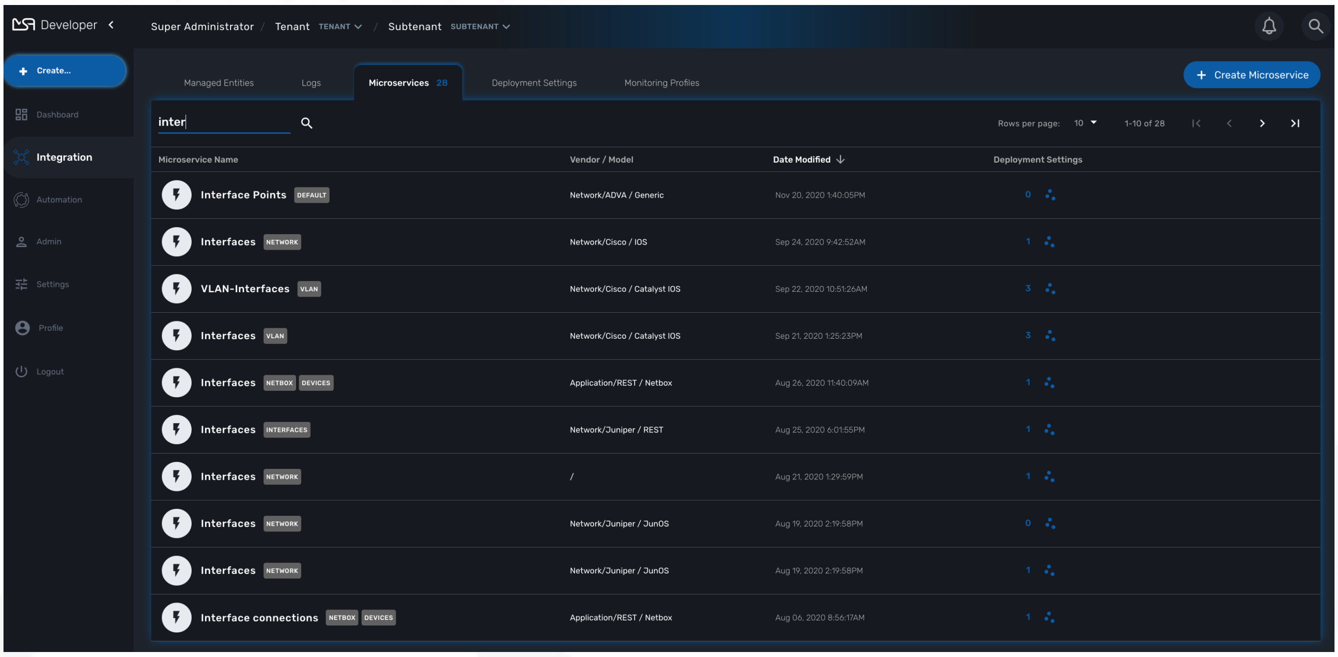
CLI Microservice definition is covered in the documentation about the CLI microservice editor.

This documentation uses the Netbox REST adapter and the Netbox REST API to illustrate the design of XML Microservice.

CLI Microservice Editor

You can use the the microservice editor UI to create or update a microservice.

To create or edit a microservice you can go to the "Integration" section and select the Microservice tab



Microservice Name	Vendor / Model	Date Modified	Deployment Settings
Interface Points DEFAULT	Network/ADVA / Generic	Nov 20, 2020 1:40:05PM	0
Interfaces NETWORK	Network/Cisco / IOS	Sep 24, 2020 9:42:52AM	1
VLAN-Interfaces VLAN	Network/Cisco / Catalyst IOS	Sep 22, 2020 10:51:26AM	3
Interfaces VLAN	Network/Cisco / Catalyst IOS	Sep 21, 2020 1:25:23PM	3
Interfaces NETBOX DEVICES	Application/REST / Netbox	Aug 26, 2020 11:40:09AM	1
Interfaces INTERFACES	Network/Juniper / REST	Aug 25, 2020 6:01:55PM	1
Interfaces NETWORK	/	Aug 21, 2020 1:29:59PM	1
Interfaces NETWORK	Network/Juniper / JunOS	Aug 19, 2020 2:19:58PM	0
Interfaces NETWORK	Network/Juniper / JunOS	Aug 19, 2020 2:19:58PM	1
Interface connections NETBOX DEVICES	Application/REST / Netbox	Aug 06, 2020 8:56:17AM	1

CLI microservice implementation

The Microservice API is made of several functions that can be implemented. It is not mandatory to implement all the functions, this will depend on your requirements and can be done incrementally.

The functions Create, Update and Delete

Create and Update

The CLI commands to create or delete an iptable rule to allow or block a port and an IP are:

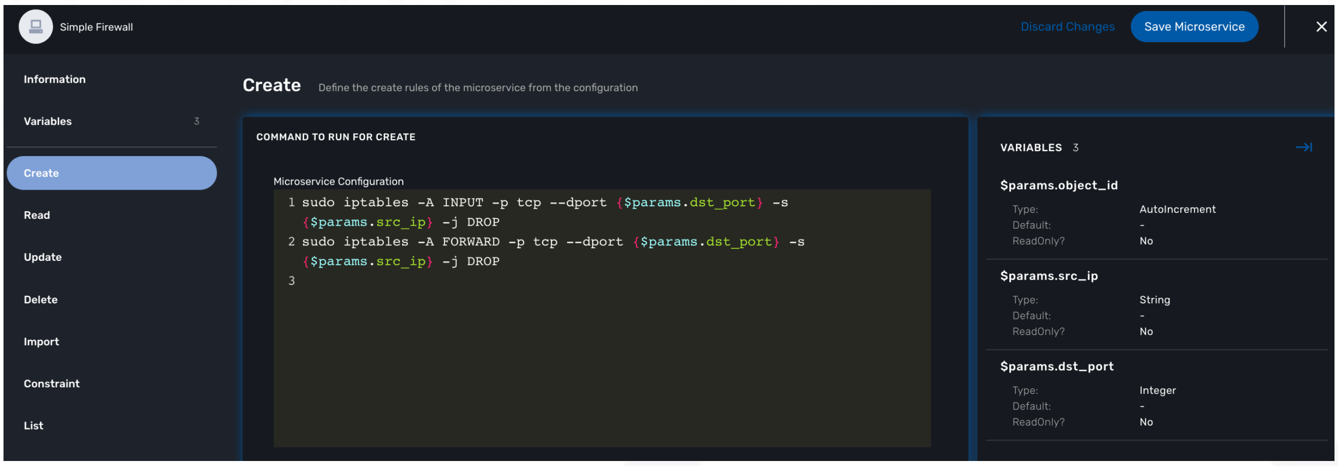
```
sudo iptables -A INPUT -p tcp --dport <PORT TO BLOCK> -s <IP TO BLOCK> -j DROP
sudo iptables -A FORWARD -p tcp --dport <PORT TO BLOCK> -s <IP TO BLOCK> -j DROP
```

this is how it would be implemented in the Create function of the Microservice

```
sudo iptables -A INPUT -p tcp --dport {$params.dst_port} -s {$params.src_ip} -j DROP
sudo iptables -A FORWARD -p tcp --dport {$params.dst_port} -s {$params.src_ip}  -j
DROP
```

As you can see the parameters are prefixed with `$params.` and this is the reason why the variable editor section will automatically add `$params.` to the variable.

The implementation of the Update will be similar and will of course depend on the CLI syntax.



Create Define the create rules of the microservice from the configuration

COMMAND TO RUN FOR CREATE

Microservice Configuration

```
sudo iptables -A INPUT -p tcp --dport {$params.dst_port} -s
{$params.src_ip} -j DROP
sudo iptables -A FORWARD -p tcp --dport {$params.dst_port} -s
{$params.src_ip} -j DROP
```

VARIABLES 3

$params.object_id
Type: AutoIncrement
Default: -
ReadOnly? No

$params.src_ip
Type: String
Default: -
ReadOnly? No

$params.dst_port
Type: Integer
Default: -
ReadOnly? No

Delete

The deletion of the iptables INPUT and FORWARD rules is executed with the CLI command below:

```
sudo iptables -D INPUT -p tcp --dport <PORT TO BLOCK>  -s <IP TO BLOCK>  -j DROP
sudo iptables -D FORWARD -p tcp --dport <PORT TO BLOCK>  -s <IP TO BLOCK>  -j DROP
```

This will be implemented as:

```
sudo iptables -D INPUT -p tcp --dport {$simple_firewall.$object_id.dst_port} -s
{$simple_firewall.$object_id.src_ip} -j DROP
sudo iptables -D FORWARD -p tcp --dport {$simple_firewall.$object_id.dst_port} -s
{$simple_firewall.$object_id.src_ip} -j DROP
```

The syntax {$simple_firewall.$object_id.dst_port} provides a way to access the Microservice variable values in the MSactivator™ configuration database.

The convention is as follow:

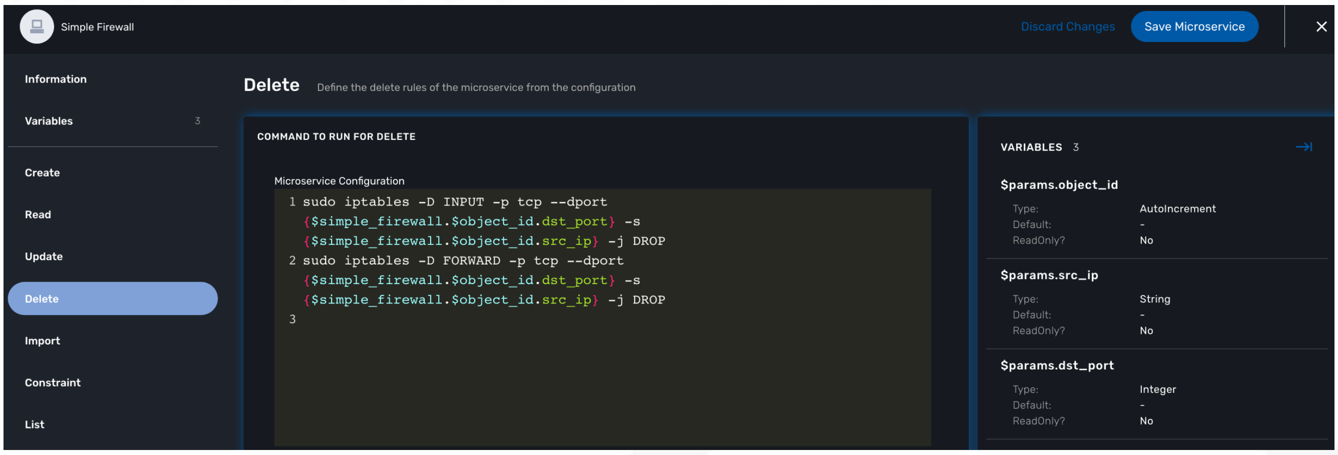
```
{$<MICROSERVICE NAME>.$object_id.<VARIABLE NAME>}
```

In our case:

- MICROSERVICE NAME ⇒ simple_firewall
- VARIABLE NAME ⇒ dst_port
- MICROSERVICE NAME is the name of the Microservice file without the .xml extension.

Example

simple_firewall.xml ⇒ simple_firewall



Delete Define the delete rules of the microservice from the configuration

COMMAND TO RUN FOR DELETE

Microservice Configuration

```
sudo iptables -D INPUT -p tcp --dport
  {$simple_firewall.$object_id.dst_port} -s
  {$simple_firewall.$object_id.src_ip} -j DROP
sudo iptables -D FORWARD -p tcp --dport
  {$simple_firewall.$object_id.dst_port} -s
  {$simple_firewall.$object_id.src_ip} -j DROP
```

VARIABLES 3

$params.object_id
Type: AutoIncrement
Default: -
ReadOnly? No

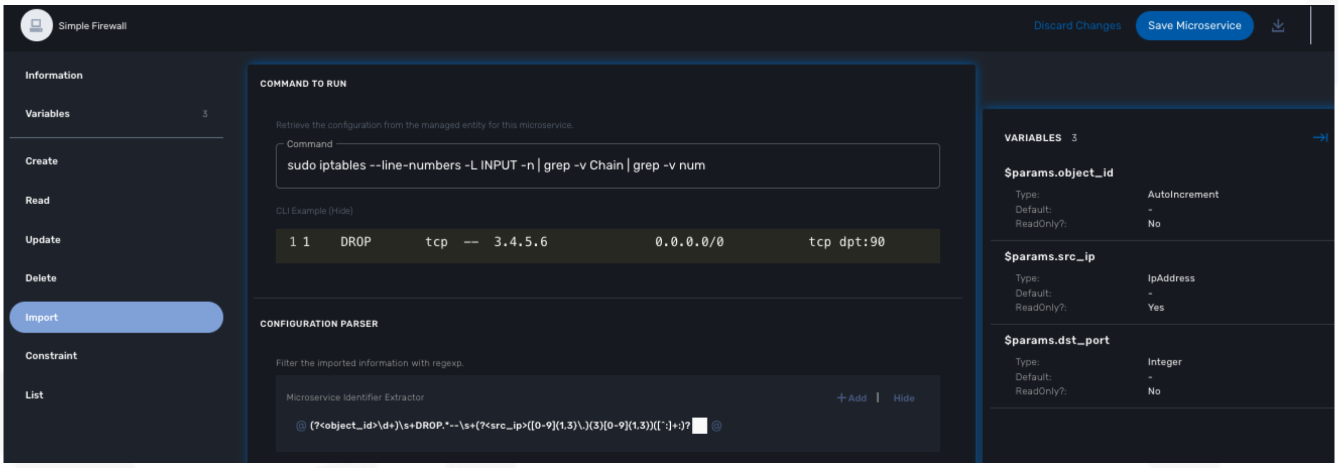
$params.src_ip
Type: String
Default: -
ReadOnly? No

$params.dst_port
Type: Integer
Default: -
ReadOnly? No

The function Import

This regex will extract the firewall parameter and store them in the database

```
@(?<object_id>\d+)    DROP      tcp  --  (?<src_ip>([0-9]{1,3}\.){3}[0-
9]{1,3})[^:]+:(?<dst_port>\d+)@
```



COMMAND TO RUN

Retrieve the configuration from the managed entity for this microservice.

Command

```
sudo iptables --line-numbers -L INPUT -n | grep -v Chain | grep -v num
```

CLI Example (Hide)

```
1 1    DROP      tcp  --  3.4.5.6              0.0.0.0/0           tcp dpt:90
```

CONFIGURATION PARSER

Filter the imported information with regexp.

Microservice Identifier Extractor

```
@ (?<object_id>\d+)\s+DROP.*--\s+(?<src_ip>([0-9]{1,3}\.){3}[0-9]{1,3})([^:]+:)? @
```

VARIABLES 3

$params.object_id
Type: AutoIncrement
Default: -
ReadOnly?: No

$params.src_ip
Type: IpAddress
Default: -
ReadOnly?: Yes

$params.dst_port
Type: Integer
Default: -
ReadOnly?: No

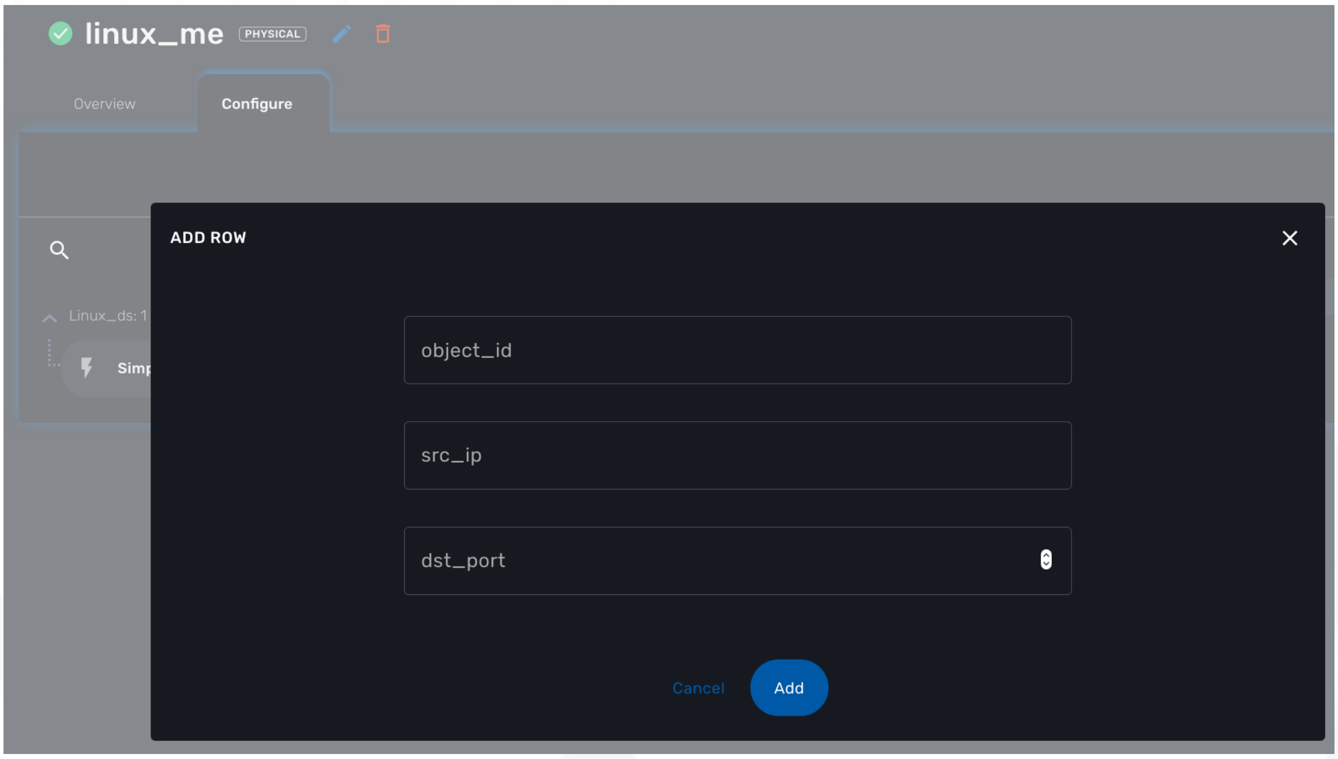
the variable `object_id` is a mandatory parameter and will be used to identify the Microservice instance in the database.

Testing the microservice

The Microservice is ready to be tested.

Make sure that you can add and delete a policy rule, that it's reflected on the Linux firewall, and that the parameters are also properly synchronised after a call to Create or Delete.

You can also add some iptables rules manually on the Linux CLI and run a configuration synchronization to make sure that your manual changes are properly imported.



Import function: tips and examples

Below you'll find some example of CLI based configuration and the regex that can be used to extract the variables.

These are only provided as example and you may have to modify them to match you needs.

To help with testing and validating your regular expression, there are many online tools. We, at UBiqube, usually use this one: https://regexr.com/3bhgg

Example 1 : Fortigate, get the syslogd3 config

CLI command: `how full-configuration log syslogd3 setting`

result:

```
config log syslogd3 setting
    set status enable
    set server "91.167.210.90"
    set mode udp
    set port 514
    set facility local7
    set source-ip ''
    set format default
end
```

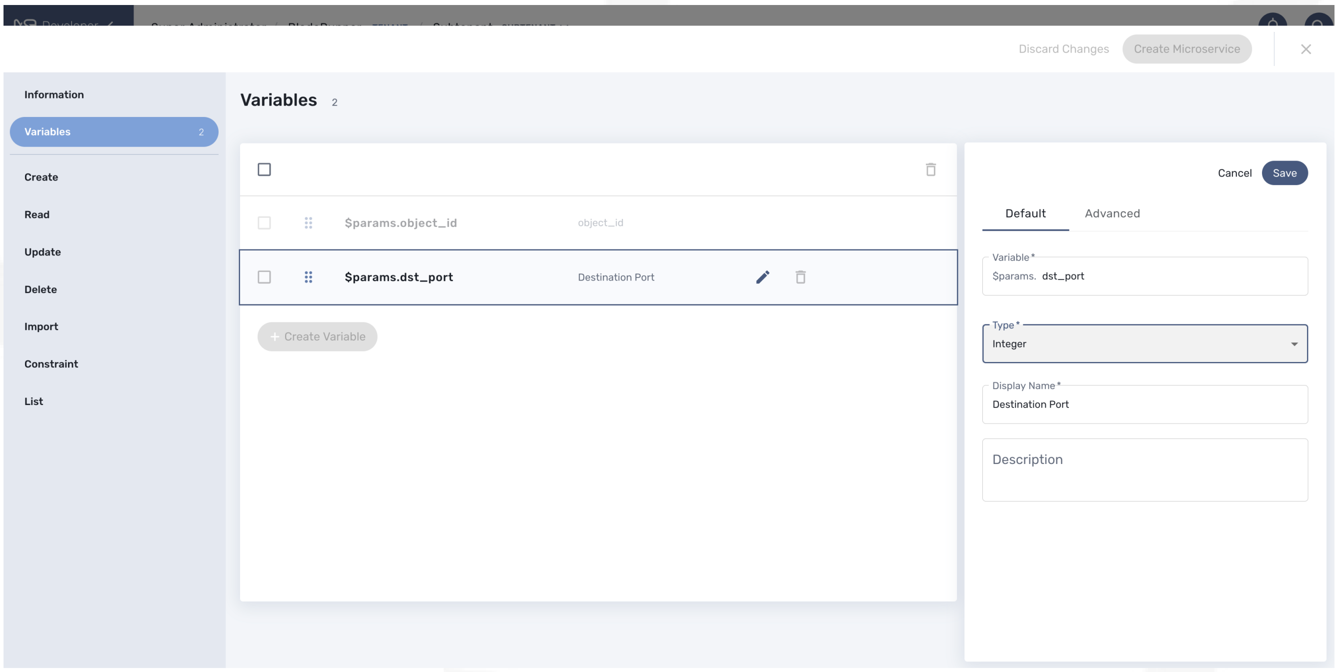
Here is the Import function implementation to extract the object_id, the status, the server IP and the port.

config	regex	instance key	value
config log syslogd3 setting	config log (?<object_id>\S+) setting	syslogd.syslogd3.object_id	syslogd3
set status enable	\s*set status (?<syslogd3_status>\S+)	syslogd.syslogd3.syslogd3_status	enable
set port 514	\s*set port (?<syslogd3_port>\d+)	syslogd.syslogd3.syslogd3_port	514
set server "91.167.210.90"	\s*set server "(?<syslogd3_server_ip>[^"]+)"	syslogd.syslogd3.syslogd3_server_ip	91.167.210.90

Microservice Variables

Variables are usually defined to hold the parameters to be passed to a microservice. For instance, the port and IP address variables to block for a firewall policy. Variables can also be used to display user information that is not meant to be used for configuring the managed entity.

Setting variables is done from the section "Variables" on the microservice editor screen.



$params.object_id	object_id
$params.dst_port	Destination Port

Variable* $params. dst_port

Type* Integer

Display Name* Destination Port

Description

When you create a new microservice, the variable object_id, which is mandatory, will be set and cannot be deleted. It can be edited to set its type and other advanced properties.

All variables are referenced with the prefix `$params` which is automatically set in the variable editor screen and when a variable has to be referenced in one of the microservice functions, you need to use the syntax `{$params.your_variable}` (see below for more examples).

By default the type of a variable is String but other types are supported such as Integer, Boolean, Password, IpAddress, ObjectRef,...

Overview

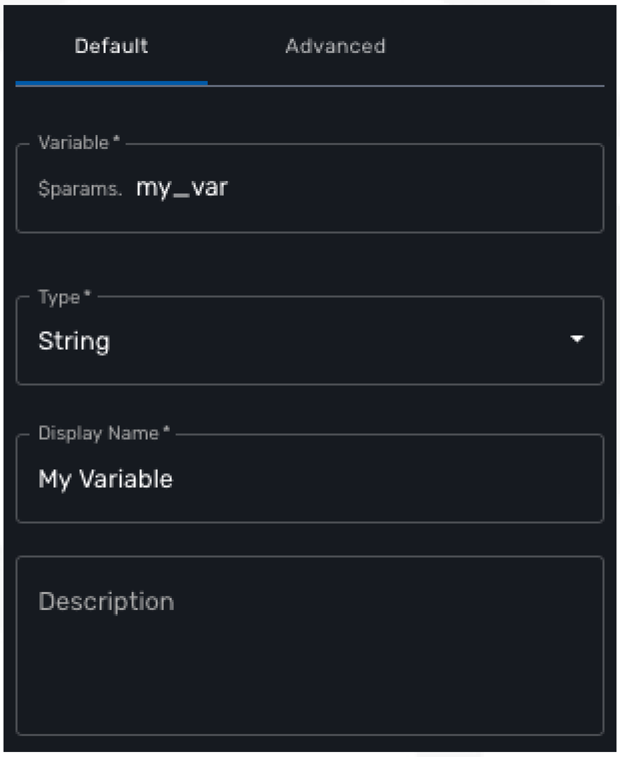
The variables are usually defined to hold the parameters to be passed to the microservice. For instance, the port and IP address variables to block for a firewall policy. Variables can also be used to display user information that is not meant to be used for configuring the managed entity.

Setting different types for variables will affect the way the microservice end user form, for creating or updating it, will render.

For instance, the type boolean will render the variable with true/false radio buttons.

Default settings

When creating or editing a variable, there are some information that need to be provided in the "Default" section.



Variable * $params. my_var

Type * String

Display Name * My Variable

Description

Variable

Name of the variable to use in the implementation of the microservice or when calling the REST API.

Type

The type of the variable should be one from the list below

String

The default type for a variable, it will accepts any value and the UI renders it as a input field without any specific validation with regards to the value set.

Boolean

Accepts a value of true or false, the UI will render it as a checkbox.

Integer

Represents a numerical value, the UI will render it as an input field restricted to integer.

Password

This data type represents a multi-character value that is hidden from plain sight (i.e. the value is represented as asterisks instead of clear text).

IP address and IP mask, IPv6 address

not supported yet

This data type will enforce data validation against IP address formats.

Composite

Provide the means to add control over the behavior of the microservice user form.

It can be used, for instance, to show/hide part of the form based on the value of another component of the form.

Link

Display a URL in the user form, for instance to link to some documentation on a web server.

It is usually used in read-only mode with the URL set as the default value of the variable

File

not supported yet

This type is useful for allowing a user to select a file.

Auto Increment

Maintains an incremental counter within the instances of a microservice for a managed entity. This is useful for managing the object_id.

Table 2. Specific advanced parameters

Increment	an integer to define the increment step
Start Increment	the initial value for the variable
Microservices sharing the same increment	a list of microservices that are also using the same variable and need to share a common value.

Device

This type is used to allow the user to select a managed entity and pass it’s identifier to the implementation of the microservice.

Index

not supported yet

Microservice Reference

Reference an other microservice from a microservice and use the referenced microservice variable value.

By default the value used from the referenced microservice is the object_id.

The referenced microservice should be configured in the "Advanced" section:

"Microservice Reference" field: enter the name of the microservice to reference. The form field will provide the list of possible microservice to choose from based on the the input value. It is possible to select more that one microservice in order to import values from different part of the configuration imported by the referenced microservice.

Filtering with remote and local variables

You can optionnaly controle the values that matches between the local microservice and the remote one (the one which is referenced).

This works as filtering: it searches the value for local variable and shows the rows which match to the remote.

This is useful if the values to be selected from the referenced microservices have to match the local variables.

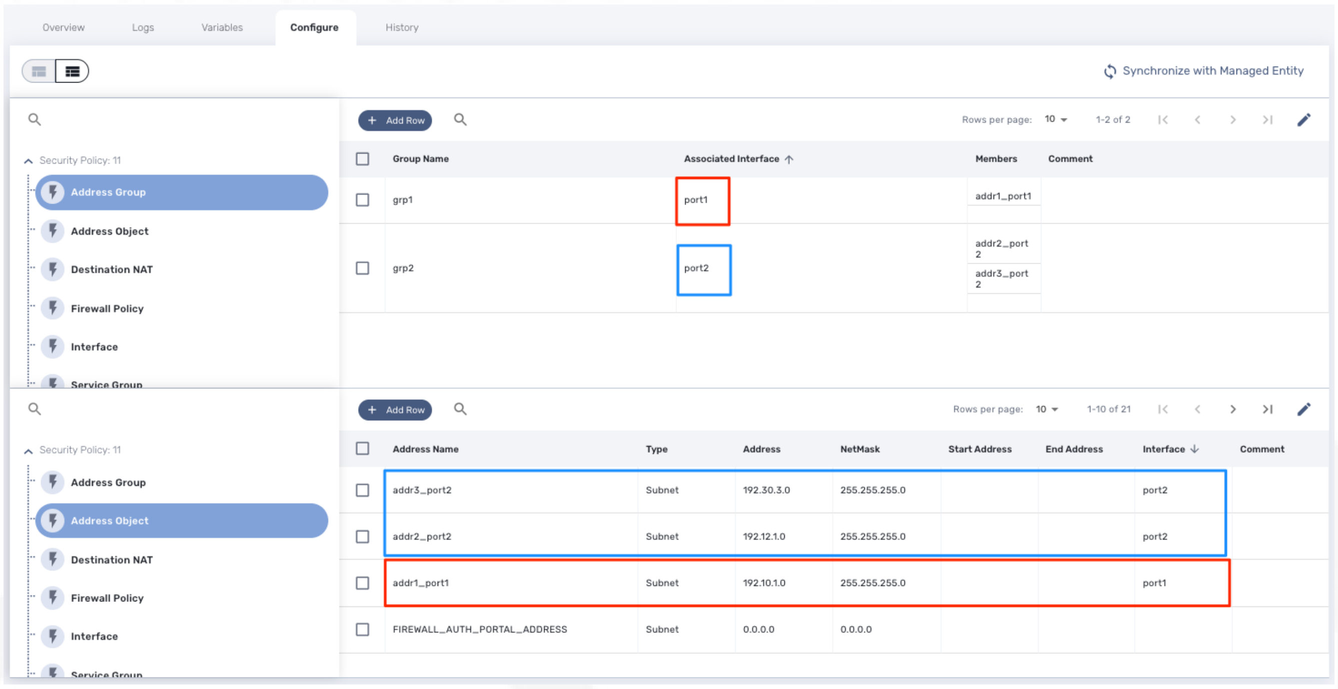
Example:

As an example, let’s consider 2 microservices, the first one to configure addresses and the second one to configure group of addresses. The group of addresses will be referencing the addresses.

An address is composed of an IP and a mask and is associated to an interface. A group of addresses will be composed to multiple addresses but the group of address is also associated to an interface.

In this use case, when a group of address is associated to an interface, each addresses selected must be associated to the same interface.

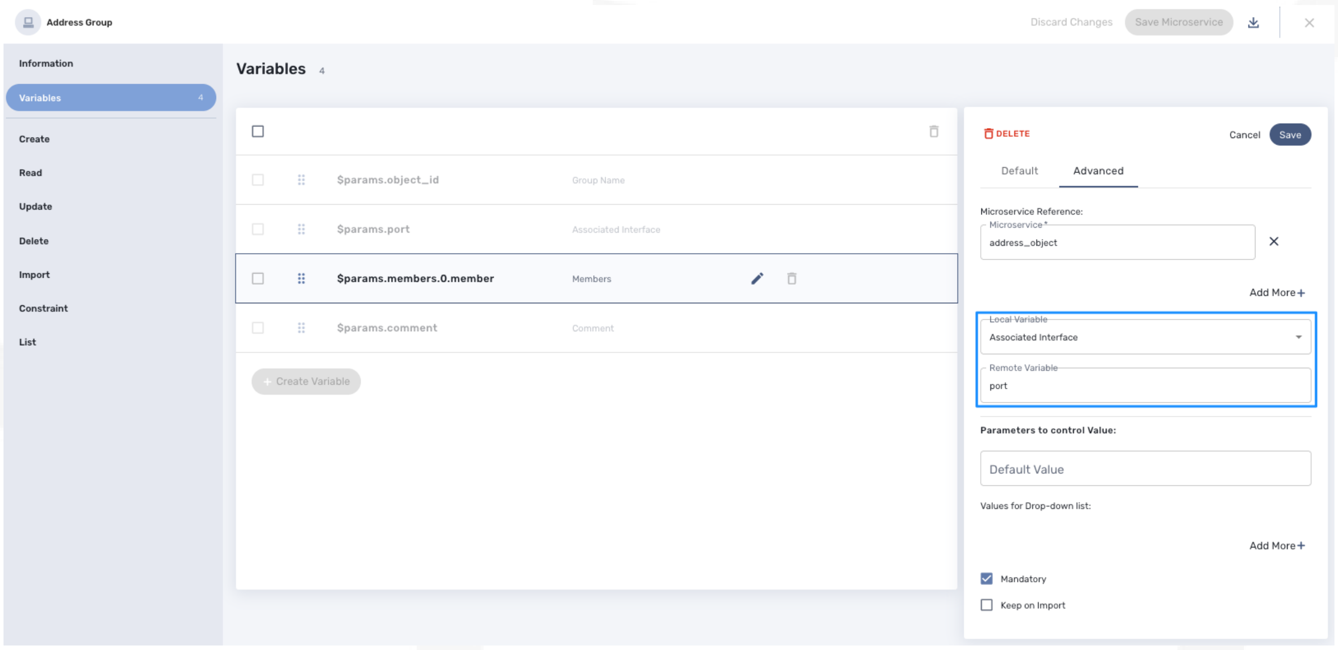
In the screenshot below we can see that "grp1" is associated to interface "port1" and "grp2" is associated to "port2"



Group Name	Associated Interface	Members	Comment
grp1	port1	addr1_port1	
grp2	port2	addr2_port2 addr3_port2	

Address Name	Type	Address	NetMask	Start Address	End Address	Interface	Comment
addr3_port2	Subnet	192.30.3.0	255.255.255.0			port2	
addr2_port2	Subnet	192.12.1.0	255.255.255.0			port2	
addr1_port1	Subnet	192.10.1.0	255.255.255.0			port1	
FIREWALL_AUTH_PORTAL_ADDRESS	Subnet	0.0.0.0	0.0.0.0				

The address group microservice variable "Member" is typed as a "Microservice Reference" that points to the address microservice:



$params.object_id	Group Name
$params.port	Associated Interface
$params.members.0.member	Members
$params.comment	Comment

Microservice Reference:
Microservice*: address_object

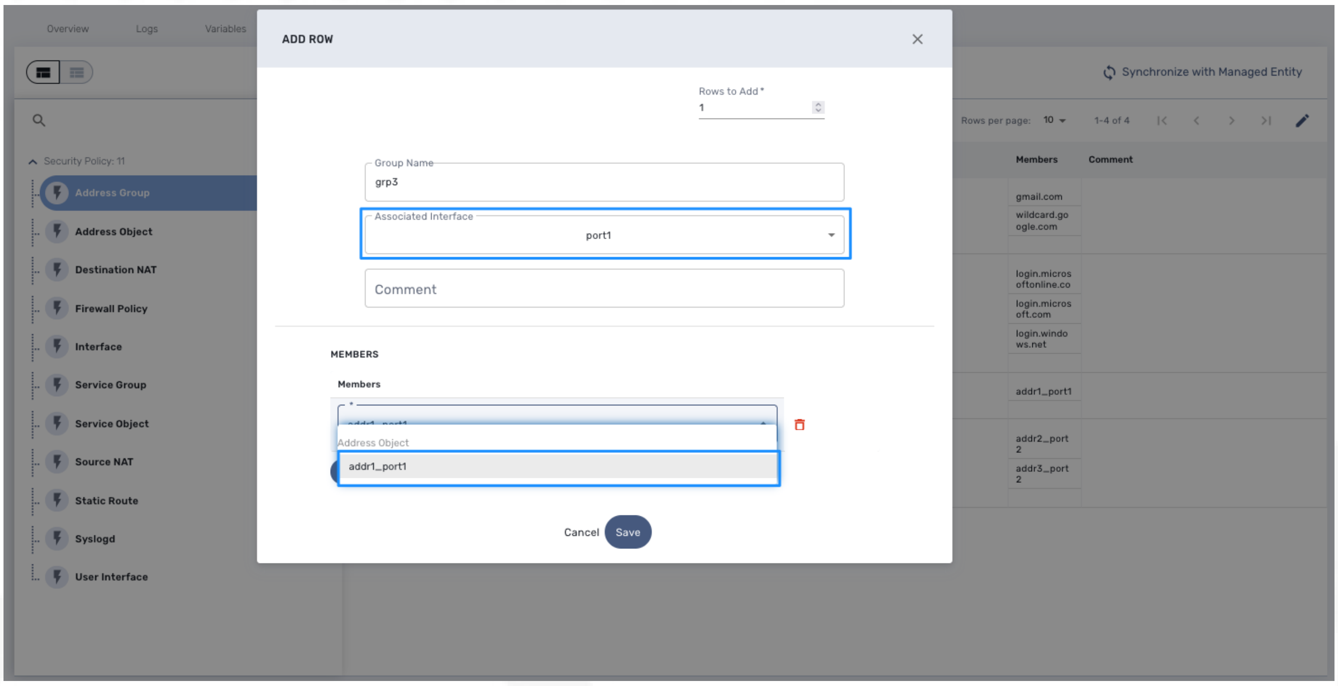
Local Variable: Associated Interface
Remote Variable: port

Parameters to control Value:
Default Value
Values for Drop-down list:

[✓] Mandatory
[ ] Keep on Import

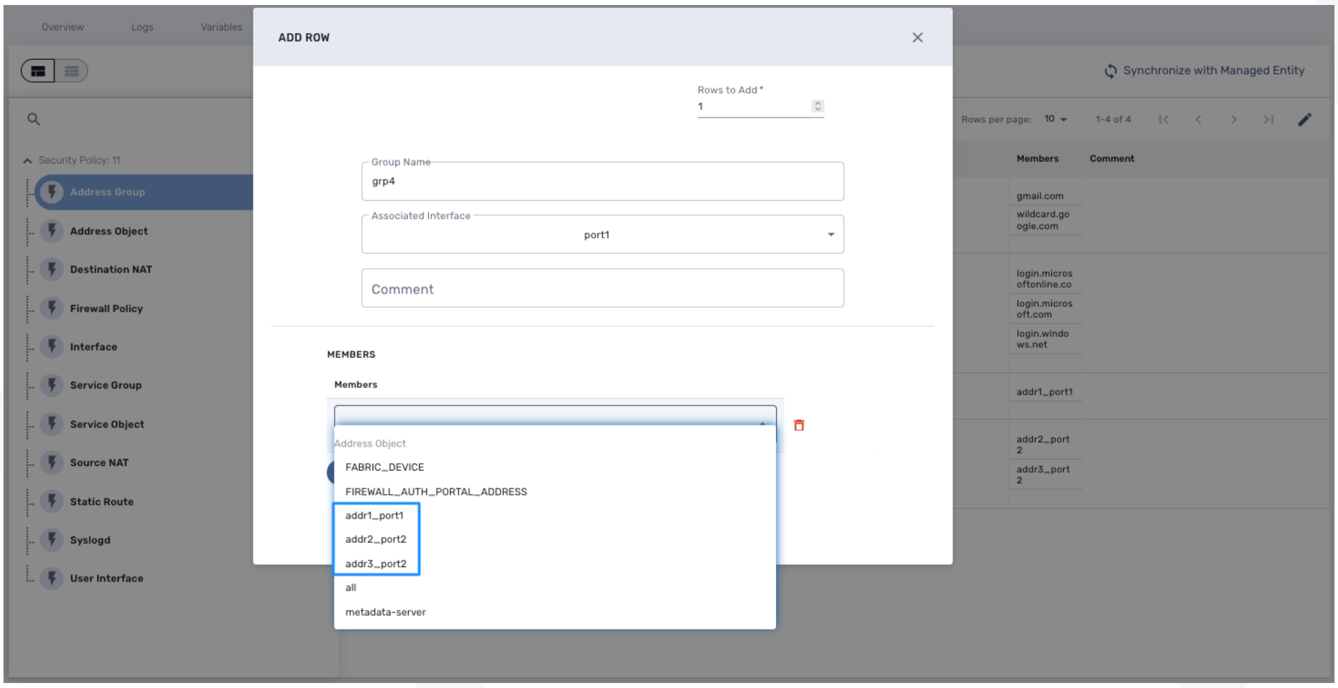
In this case, when creating an address group instance, the values available for the variable "$params.members.0.member" will be filtered so that the only one available are the ones with a match between the local variable value and the remote variable value.

If "port1" is selected for the "Associated Interface" then only "addr_port1" will be listed



Rows to Add *: 1
Group Name: grp3
Associated Interface: port1
Comment
Members: addr1_port1

If not filtering is used (by default):



Rows to Add *: 1
Group Name: grp4
Associated Interface: port1
Comment

Display Name

The display value for the variable name.

Description

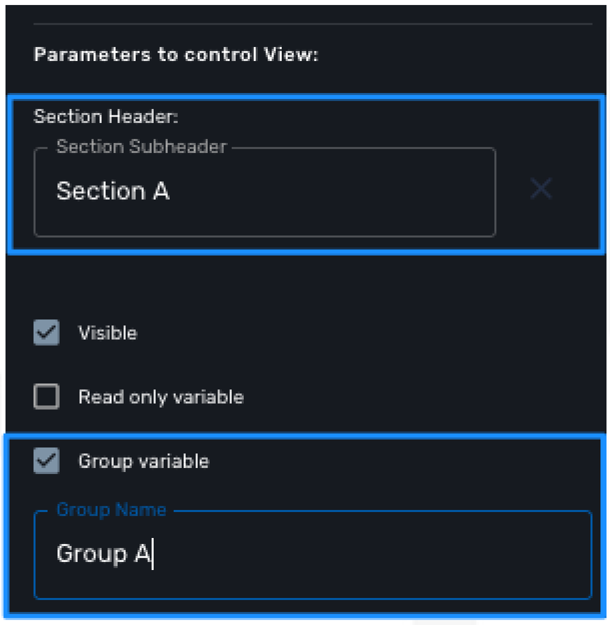
An optional description of this variable.

Advanced settings

Depending on the selected type, some advanced parameters may be differ.

Setting	Description
Default Value	the default value that will be used when creating a new microservice instance
Values for Drop-down	a list of possible value the user can choose from
Allow adding free value	available if some value(s) were provided for drop-down
Mandatory	a value has to be provided for this variable
Read only variable	the value cannot be edited
Section Header	group some variables in the microservice console (see below)
Group variable	group some variables in the auto-rendered UI for creating or editing a microservice (see below
Show only in edit view	hide the variable from the microservice console

Group Variables



Parameters to control View:

Section Header:

Section Subheader: Section A

✓ Visible

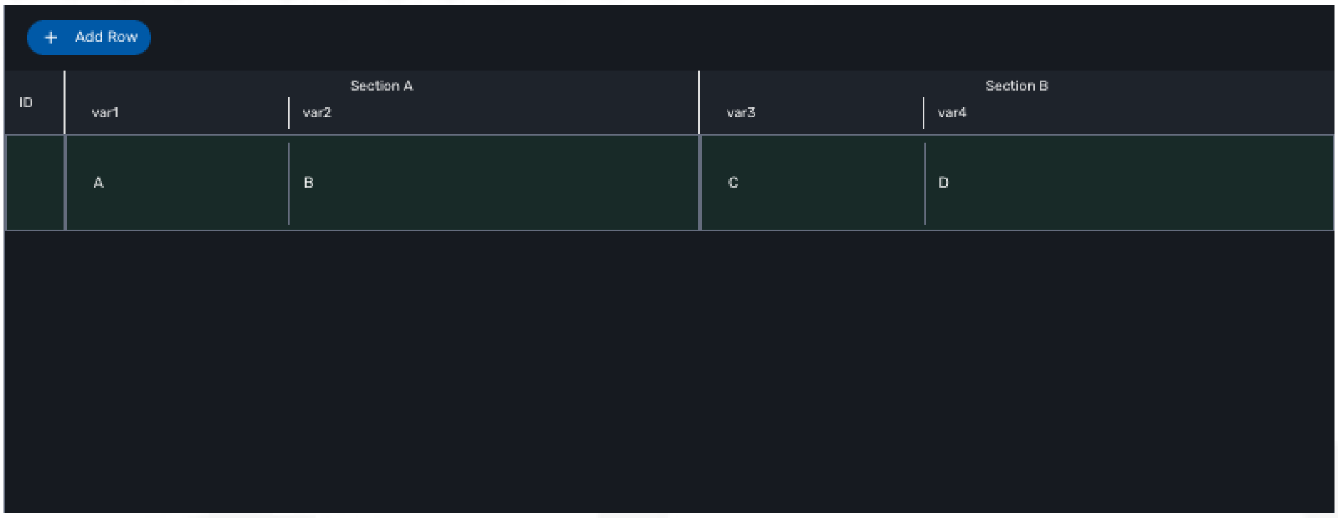
☐ Read only variable

✓ Group variable

Group Name: Group A

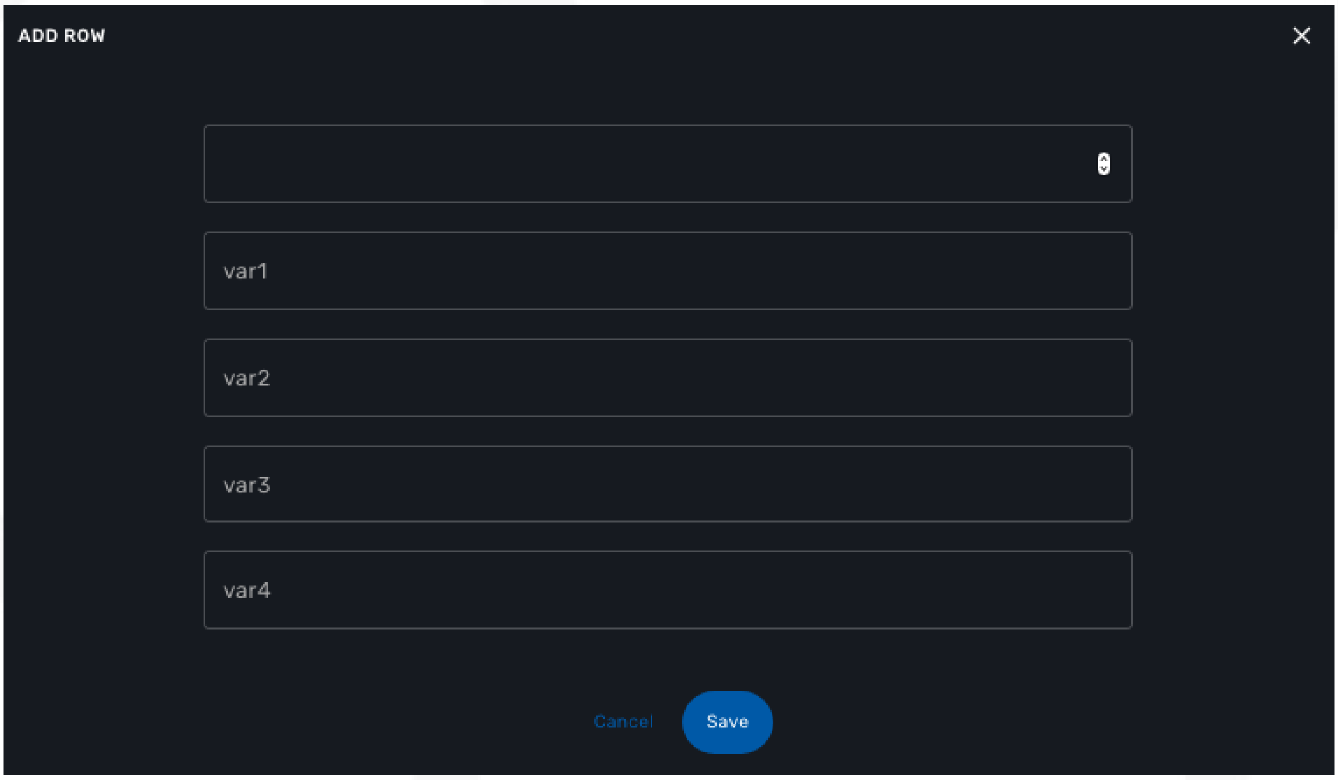
You can group the variables in the microservice console by setting a section header name. The UI will gather the columns under a common header

Section A and section B



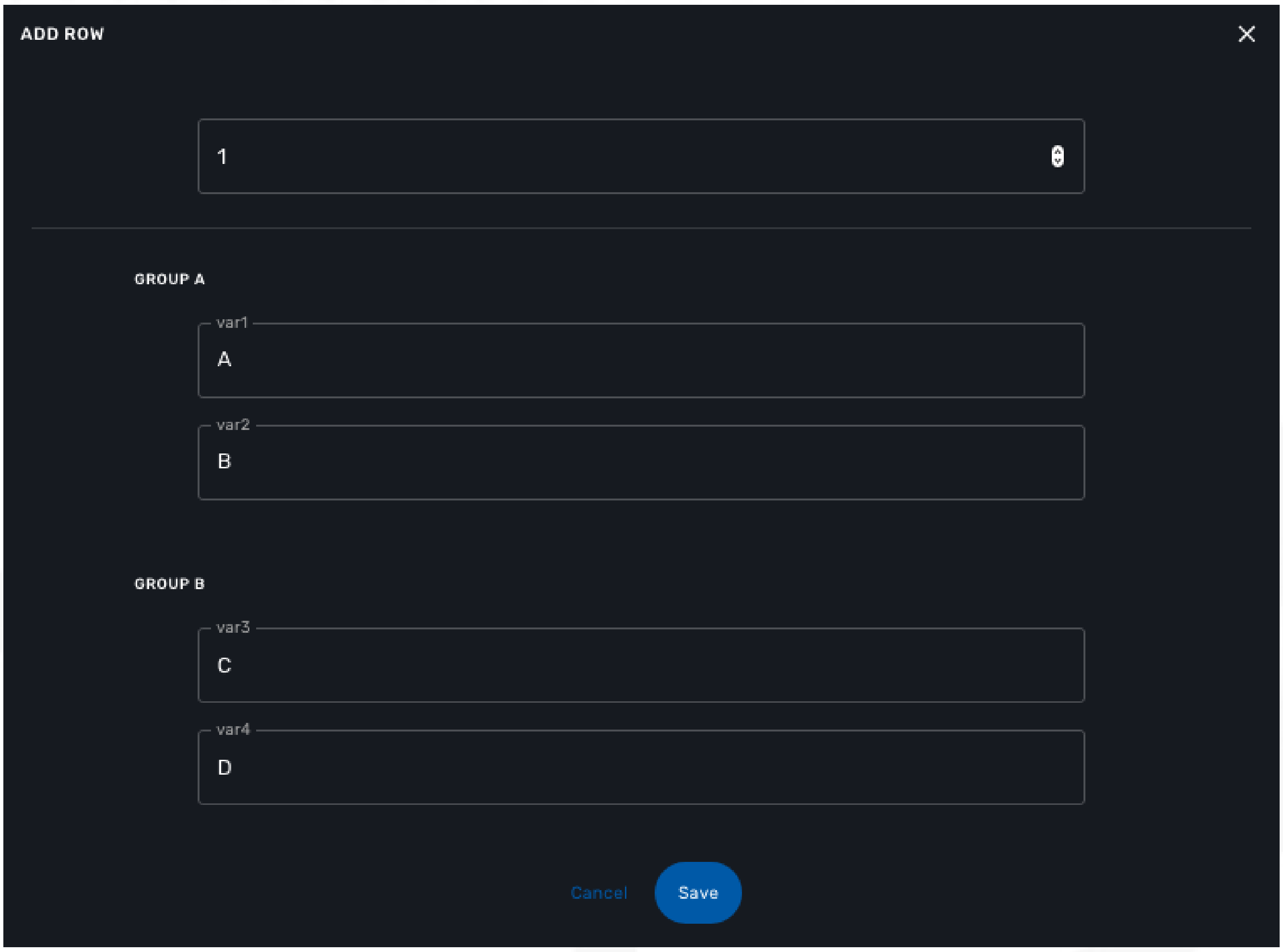
ID	Section A		Section B	
	var1	var2	var3	var4
	A	B	C	D

It is also possible to group variables to provide a better user experience when creating or editing a microservice and go from a flat view



To a more organized view

Group A and group B


ADD ROW

1

GROUP A

var1: A

var2: B

GROUP B

var3: C

var4: D

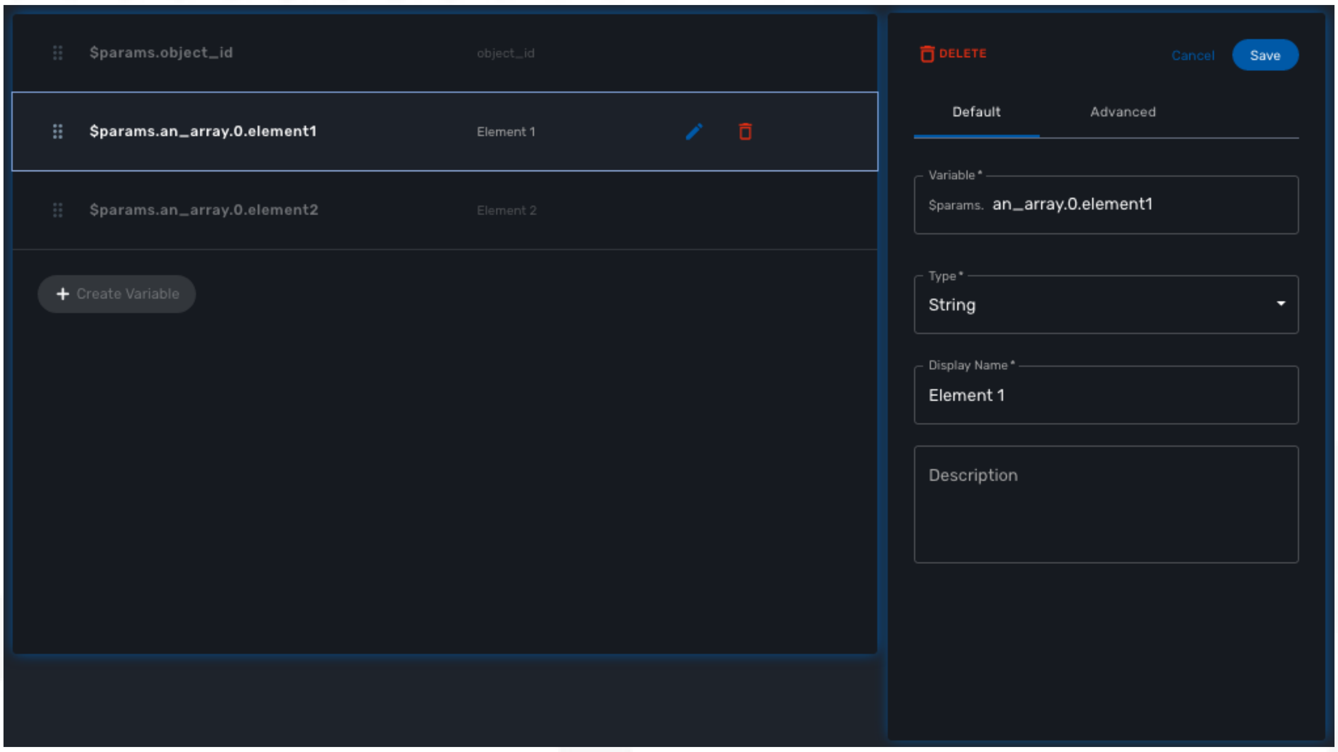
Array settings

When you are dealing with variable arrays, these options will let you control the possible actions a user can have over the array.

Variable arrays

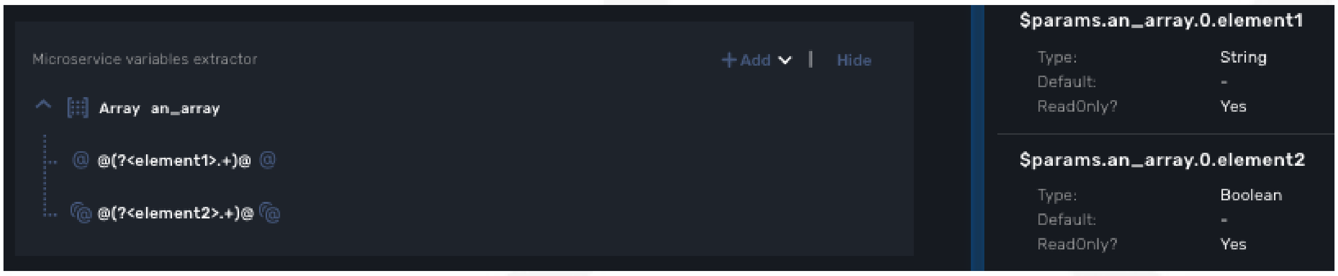
To create a variable array, you need to follow a precise naming convention: `$params.<ARRAY NAME>.0.<ELEMENT NAME>`. The 0, is the separator that will allow the UI and the configuration engine that this variable is an array.

a variable array with 2 elements



Variable *: $params. an_array.0.element1
Type *: String
Display Name *: Element 1
Description

This type of variables should be used when extracting configuration with an array variable extractor in the Import function of the microservice.



```
@(?<element1>.+)@
@(?<element2>.+)@
```

$params.an_array.0.element1
Type: String
Default: -
ReadOnly? Yes

$params.an_array.0.element2
Type: Boolean
Default: -
ReadOnly? Yes

Microservice Template with PHP Smarty

Smarty templates

The Smarty templates are used to generate output using variables and control structures like if/then/else conditional branches or for/each loops.

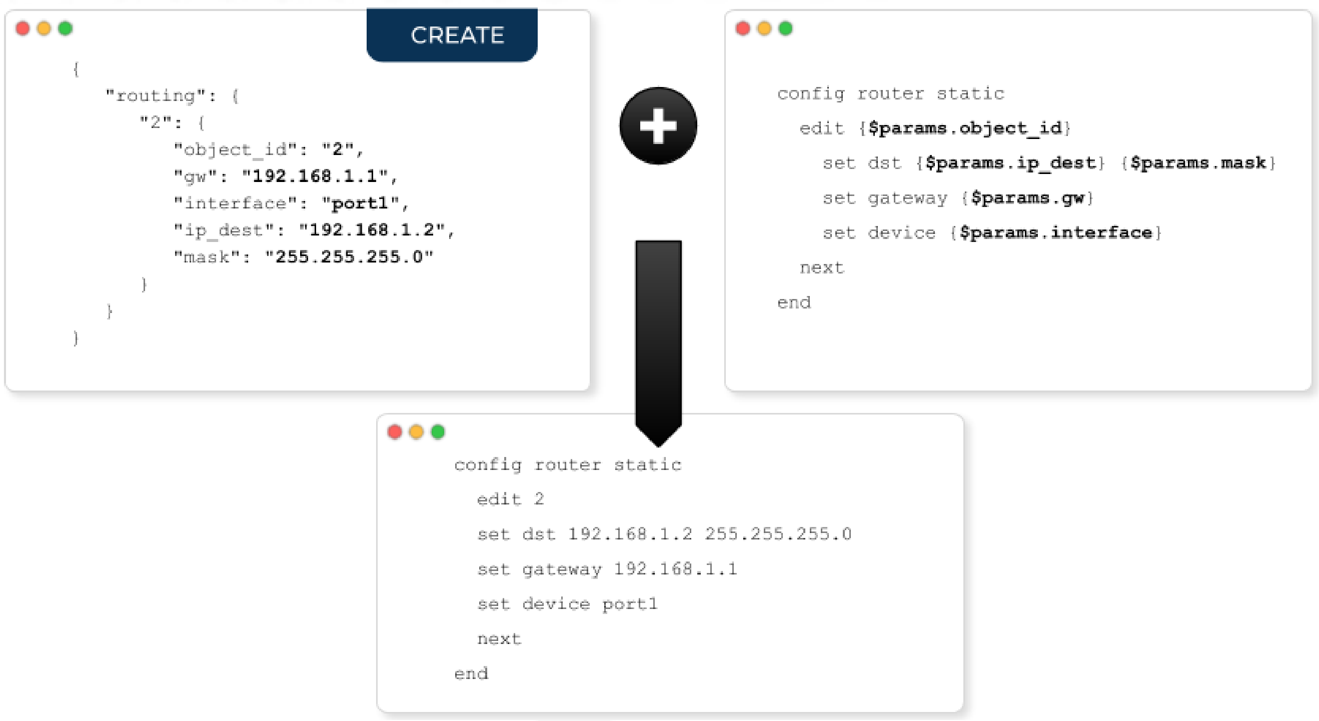
The output is used to configure the managed entities or retrieve data from the database.

Parameter substitution in microservice

Whether you are developing a CLI or and XML (REST) based microservice, the CoreEngine will rely on parameter substitution to generate the configuration or the call to the REST API.

The parameters, coming from the web UI or the REST API are passed to the template engine as a JSON payload.

For ClI microservices, the parameters, extracted from the JSON payload will be used to generate the piece of configuration to apply to the managed entity (this is the role of the adapter).

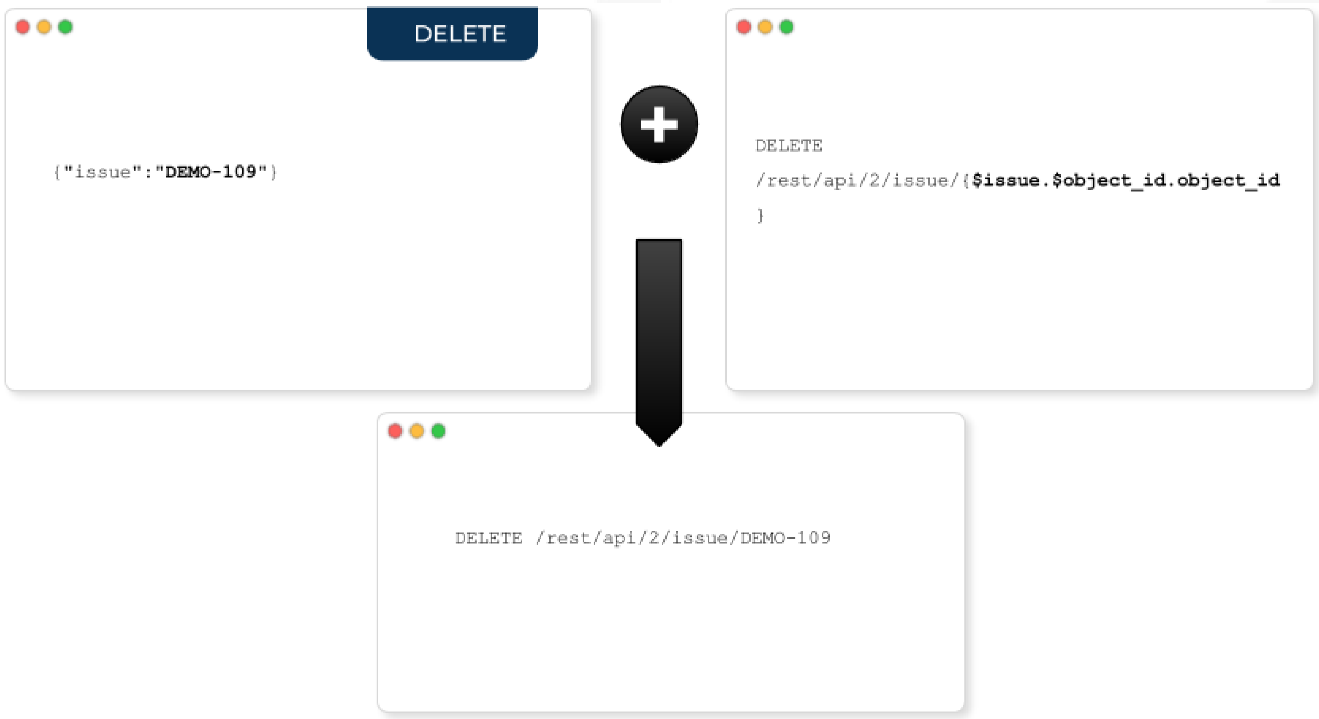


```
{
    "routing": {
        "2": {
            "object_id": "2",
            "gw": "192.168.1.1",
            "interface": "port1",
            "ip_dest": "192.168.1.2",
            "mask": "255.255.255.0"
        }
    }
}
```

```
config router static
  edit {$params.object_id}
    set dst {$params.ip_dest} {$params.mask}
    set gateway {$params.gw}
    set device {$params.interface}
  next
end
```

```
config router static
  edit 2
  set dst 192.168.1.2 255.255.255.0
  set gateway 192.168.1.1
  set device port1
  next
end
```

For XML/REST, the parameters are used to build the REST API call, either by updating the path and/or by updating the payload



```
{"issue":"DEMO-109"}
```

```
DELETE
/rest/api/2/issue/{$issue.$object_id.object_id
}
```

```
DELETE /rest/api/2/issue/DEMO-109
```

Variables

From database

For an object object_name, the instance instance_id can accessed with the syntax

```
{$object_name.instance_id}
```

Object fields can be accessed via

```
{$object_name.instance_id.field_name}
```

Array values can be accessed with the syntax

```
{$object_name.instance_id.array_name.array_index}
```

From parameters

Variables generated from parameters are accessed by using the syntax

```
{$params.name}
```

Special case of object_id

```
{$object_id}
```

can also be used. It corresponds to the object ID given in the JSON parameter object.

The {$object_id} variable can also be used to retrieve an object instance from the database.

```
{$object_name[$object_id|object_id]}
```

is the instance of object_name corresponding to the object ID given in parameters.

Smarty has a specific meaning for the '.' dot character, so it is not allowed in $object_id variable. In order to solve this issue, it is better to use {$params.object_id} instead of {$object_id} when generating the configuration.

In order to reference the value of another object, the Smarty modifier '|object_id' can be use.

Example:

```
v2.0/subnets/{$subnets[$params.object_id|object_id].uuid}
```

will fetch the uuid parameter of the 'subnets' object having $params.object_id id.

Control Structures

Control structures are used to generate output using complex data, like list of objects, or optional parts.

Conditionals

```
{if},{elseif},{else}
```

{if} statements in Smarty have much the same flexibility as PHP if statements, with a few added features for the template engine. Every {if} must be paired with a matching {/if}. {else} and {elseif} are also permitted. All PHP conditionals and functions are recognized, such as ||, or, &&, and, is_array(), etc.

The following is a list of recognized qualifiers, which must be separated from surrounding elements by spaces. Note that items listed in [brackets] are optional. PHP equivalents are shown where applicable.

Qualifier	Alternates	Syntax Example	Meaning	PHP Equivalent
==	eq	$a eq $b	equals	==
!=	ne, neq	$a neq $b	not equals	!=
>	gt	$a gt $b	greater than	>
<	lt	$a lt $b l	less than	<
>=	gte, ge	$a ge $b	greater than or equal	>=
⇐	lte, le	$a le $b	less than or equal	⇐
===		$a === 0	check for identity	===
!	not	not $a	negation (unary)	!
%	mod	$a mod $b	modulous	%
is [not] div by		$a is not div by 4	divisible by	$a % $b == 0
is [not] even		$a is not even	[not] an even number (unary)	$a % 2 == 0
is [not] even by		$a is not even by $b	grouping level [not] even	($a / $b) % 2 == 0
is [not] odd		$a is not odd	[not] an odd number (unary)	$a % 2 != 0
is [not] odd by		$a is not odd by $b	[not] an odd grouping	($a / $b) % 2 != 0

example

```
telephony-service
{if isset($params.ntp_server_ip_address) && $params.ntp_server_ip_address != ''}
 ntp-server {$params.ntp_server_ip_address}
{/if}
{if isset($params.maximum_ephones) && $params.maximum_ephones != ''}
 max-ephones {$params.maximum_ephones}
{/if}
{if isset($params.maximum_dial_numbers) && $params.maximum_dial_numbers != ''}
```

```
 max-dn {$params.maximum_dial_numbers}
{/if}
{if isset($params.source_ip_address) && $params.source_ip_address != ''}
 ip source-address {$params.source_ip_address} port {$params.source_port} {if
isset($params.secondary_ip_address) && $params.secondary_ip_address != ''} secondary
{$params.secondary_ip_address} {/if}
{/if}
```

Loops

```
{foreach},{foreachelse}
```

{foreach} is used to loop over an associative array as well a numerically-indexed array, unlike {section} which is for looping over numerically-indexed arrays only.

The syntax for {foreach} is much easier than {section}, but as a trade off it can only be used for a single array. Every {foreach} tag must be paired with a closing {/foreach} tag.

Attribute Name	Type	Required	Default	Description
from	array	Yes	n/a	The array you are looping through
item	string	Yes	n/a	The name of the variable that is the current element
key	string	No	n/a	The name of the variable that is the current key

- Required attributes are from and item.
- {foreach} loops can be nested.
- The from attribute, usually an array of values, determines the number of times {foreach} will loop.
- {foreachelse} is executed when there are no values in the from variable.

```
telephony-service
{foreach from=$params.tftp_load item=tftp}
 load {$tftp.phone_type} {$tftp.firmware_file_name}
{/foreach}
```

Sorting

Use the smarty function 'sortby_typed' to sort arrays by key.

'sortby_typed' take a list of comma separated keys with a type (int or string) for each one.

```
{foreach $params.access_list|@sortby_typed:"acl_seq_number:int" as $acl}    ①
    {$acl.acl_seq_number} {$acl.acl_rule} {$acl.acl_protocol} {$acl.acl_src}
{/foreach}
```

① sort by the key 'acl_seq_number' and convert the key values to integer

Variable assignment

Local variable

Under certain circumstances it is necessary to use a local temporary variable to generate the output.

```
{assign}
```

{assign} is used for assigning template variables during the execution of a template.

Attribute Name	Type	Required	Default	Description
var	string	Yes	n/a	The name of the variable being assigned
value	string	Yes	n/a	The value being assigned

```
!
{assign var='sdid' value=$SD->SDID}
{foreach from=$VOIP_PROFILE->SD_list.$sdid->MAIL_BOX_list item=mbox}
!
voicemail mailbox owner {$mbox->MBOX_USERNAME}
login pinless any-phone-number
end mailbox
{/foreach}
!
```

Microservice variable

It is also possible to assign a value to a microservice variable.

This is only possible in the post-import section.

```
{if isset($params.syslogd_server_ip) && $params.syslogd_server_ip != ""}
      {assign_object_variable var="_syslogd_server_ip" value="{$params
.syslogd_server_ip}"}  ①
{/if}
```

① assign the value of $params.syslogd_server_ip to $params._syslogd_server_ip

Common problems

The templates are extracted from the XML definition files, and evaluated with Smarty. Some behavior must be known prior to developing templates.

XML non supported characters

Templates within XML definition files must not contain characters like < or >. You'll get an error:

```
Bad format for local file due to XML parsing error.
```

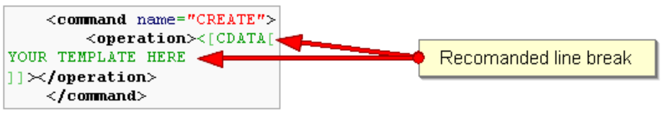
```
<command name="CREATE">
    <operation>
you can't "write" if ({$foo} < 1) in your templates
    </operation>
</command>
```

Templates must be embedded into a <[CDATA[ ]]> tag to avoid most of the problems of non-supported characters.

```
<command name="CREATE">
    <operation><[CDATA[
    you can "write" if ({$foo} < 1) in your templates
]]></operation>
</command>
```

Extra line break and space characters

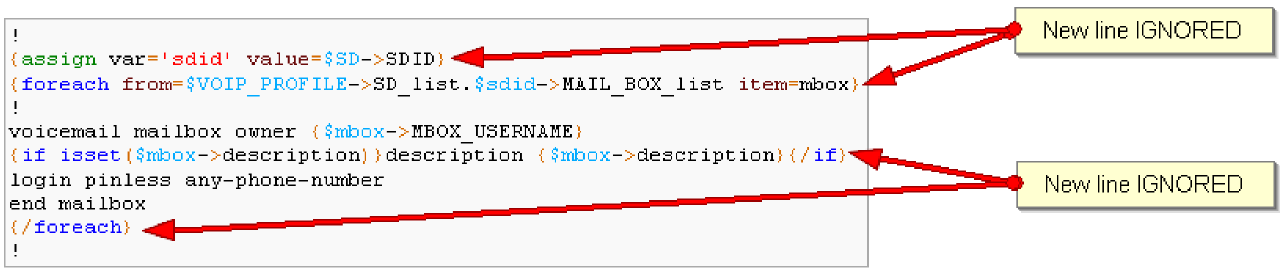
The templates reflects what is written within the <operation> and </operation> tags, that's why it is recommended to write



```
    <command name="CREATE">
        <operation><[CDATA[
YOUR TEMPLATE HERE
]]></operation>
    </command>
```

When a Smarty command like {if} {foreach}, or also an ending tag like {/if} {/foreach}, is immediately followed by a line break, then this line break is REMOVED by Smarty. This does NOT apply to variables.

example



```
!
{assign var='sdid' value=$SD->SDID}
{foreach from=$VOIP_PROFILE->SD_list.$sdid->MAIL_BOX_list item=mbox}
!
voicemail mailbox owner {$mbox->MBOX_USERNAME}
{if isset($mbox->description)}description {$mbox->description}{/if}
login pinless any-phone-number
end mailbox
{/foreach}
!
```

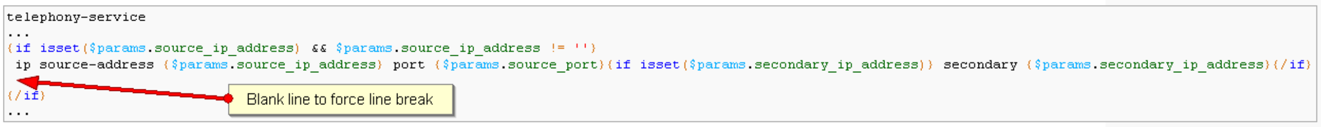
In this case the

```
{if} ... {/if}
```

The line should have been split.

```
!
{assign var='sdid' value=$SD->SDID}
{foreach from=$VOIP_PROFILE->SD_list.$sdid->MAIL_BOX_list item=mbox}
!
{if isset($mbox->description)}
 description {$mbox->description}
{/if}
voicemail mailbox owner {$mbox->MBOX_USERNAME}
login pinless any-phone-number
end mailbox
{/foreach}
!
```

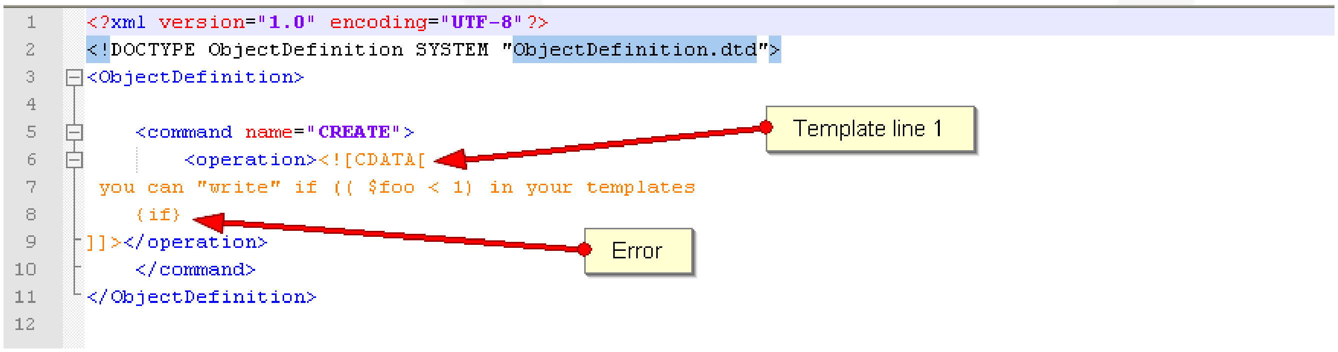
Sometimes the line cannot be split, the solution is to either add a space character at the end of the line, if it remains correct for the configuration, or add an extra new line (one line left blank).



```
telephony-service
...
{if isset($params.source_ip_address) && $params.source_ip_address != ''}
 ip source-address {$params.source_ip_address} port {$params.source_port}{if isset($params.secondary_ip_address)} secondary {$params.secondary_ip_address}{/if}

{/if}
...
```

Syntax errors

The Smarty syntax is very strict, for example an error in the template



```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE ObjectDefinition SYSTEM "ObjectDefinition.dtd">
<ObjectDefinition>

    <command name="CREATE">
        <operation><![CDATA[
 you can "write" if (( $foo < 1) in your templates
    {if}
]]></operation>
    </command>
</ObjectDefinition>

```

will return

```
Operation Failed
```

Currently, the only way to find the root cause is to check the file

```
/opt/sms/logs/smsd.log
```

An example of an error found in the log

```
2011/08/12:12:28:42:(D):smsd:ZTD66206:JSCALLCOMMAND:: Managing object test
2011/08/12:12:28:42:(D):smsd:ZTD66206:JSCALLCOMMAND:: compute file
/opt/fmc_repository/CommandDefinition/CISCO/MyTemplates/test.xml for key test
2011/08/12:12:28:42:(D):smsd:ZTD66206:JSCALLCOMMAND:: ELEMENT CREATE found
2011/08/12:12:28:42:(E):smsd:ZTD66206:JSCALLCOMMAND:: PHPERROR: [256] Smarty error:
[in var:2313098ec4aae945b1a201eb153cf778 line 3]: syntax error: 'if' statement
requires arguments (Smarty_Compiler.class.php, line 1270) error on line 1093 in file
/opt/sms/bin/php/smarty/Smarty.class.php
```

This indicates that in the file

```
CommandDefinition/CISCO/MyTemplates/test.xml
```

for the command

```
CREATE
```

an error occured in the 3rd line of the template

```
syntax error: 'if' statement requires arguments
```

Usage of the {$object_id} variable

The {$object_id} variable is used to reference objects into the database and is used as a variable name in Smarty in the template resolution.

When the parameters are passed to the engine the JSON payload is:

```
{"interface":{"Interface-Service-engine0/0":{"ip_address":"1.2.3.4"}}}
```

The variables values are:

- `{$object_id}` ⇒ "Interface-Service-engine0/0"

- `{$params.ip_address}` ⇒ "1.2.3.4"

When writing a template {$object_id} can be used in expressions like {$interface.$object_id.ip_address} to retrieve database values.

The CREATE template looks like:

```
<command name="CREATE">
    <operation>
    <![CDATA[
interface {$object_id}
{if isset($params.dot1qtrunk) && $params.dot1qtrunk == 'Yes'}
 switchport trunk encapsulation dot1q
 switchport mode trunk
{/if}
{if isset($params.vlan_id) && $params.vlan_id != ''}
 encapsulation dot1Q {$params.vlan_id}
{/if}
{if isset($params.ip_address) && $params.ip_address != ''}
 ip address {$params.ip_address} {$params.subnet_mask}
{/if}
{if $object_id|stristr:"Ethernet" && !$object_id|stristr:"."}
{if isset($params.enable_nbar) && $params.enable_nbar != '' && $params.enable_nbar ==
'Yes'}
 ip nbar protocol-discovery
{/if}
{if isset($params.enable_media_type) && $params.enable_media_type != '' &&
$params.enable_media_type == 'Yes'}
 max-reserved-bandwidth 100
 media-type sfp
{/if}
{if isset($params.description) && $params.description != ''}
 description {$params.description}
{/if}
...
no shutdown
!]]>
    </operation>
</command>
```

Skip the parsing of the `{$ }` structure

Normally, the `{$ }` structure is used in the microservices template to specify the variables to be parsed by the Smarty templating engine (ex: `{$parms.my_variable}`) but in some case, you might need this structure to be ignored by the parser because it is part of the actual configuration to build for the managed entity.

This is where you need to use the keywords `ldelim` (left delimiter)and `rdelim` (right delimiter).

For example consider the following pattern in the "Microservice Configuration" section of the REST based Microservice definitions:

```
"subUnit": "{$v_vni-0-0_WAN-1__unit}"
```

Here we want to use the '{' and '}' characters in their literal values and have to specify not to be parsed. We can do this by replacing '{' with '{ldelim}' and replacing '}' with '{rdelim}' and hence for the line mentioned above we have to change it as shown below:

```
"subUnit": "{ldelim}$v_vni-0-0_WAN-1__unit{rdelim}"
```

Getting Started with Microservices Design

Overview

This tutorial explores the design and development of a Microservice.

Microservices can be used to manage a wide variety of services on numerous types of devices, such as:

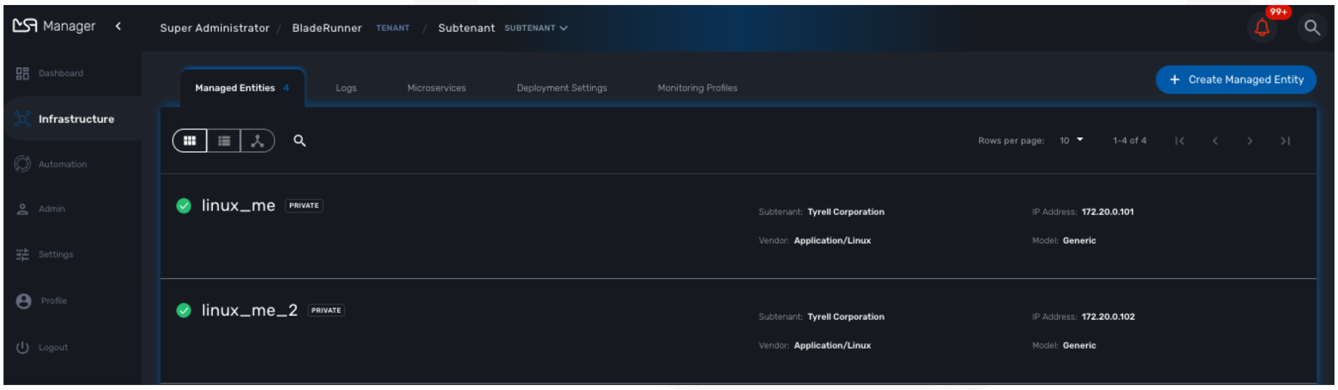
- network equipment (routers, switches, UTM, etc.)
- virtualization infrastructure managers (VMWare, AWS, Openstack, etc.)
- Linux servers

Lab setup

The first step in Microservice design and development is to have a device to manage.

This tutorial assumes you have a properly configured, running MSactivator™.

If you have followed the quickstart guide you should have a running MSactivator™ with a Linux managed entity, created and activated.



linux_me PRIVATE
Subtenant: Tyrell Corporation
Vendor: Application/Linux
IP Address: 172.20.0.101
Model: Generic

linux_me_2 PRIVATE
Subtenant: Tyrell Corporation
Vendor: Application/Linux
IP Address: 172.20.0.102
Model: Generic

Microservice design

As a first example of Microservices, we will start with managing this Linux Managed Entity.

On Linux, the CLI command to list the users is: `cat /etc/passwd`.

To create a new user use the command: `useradd`

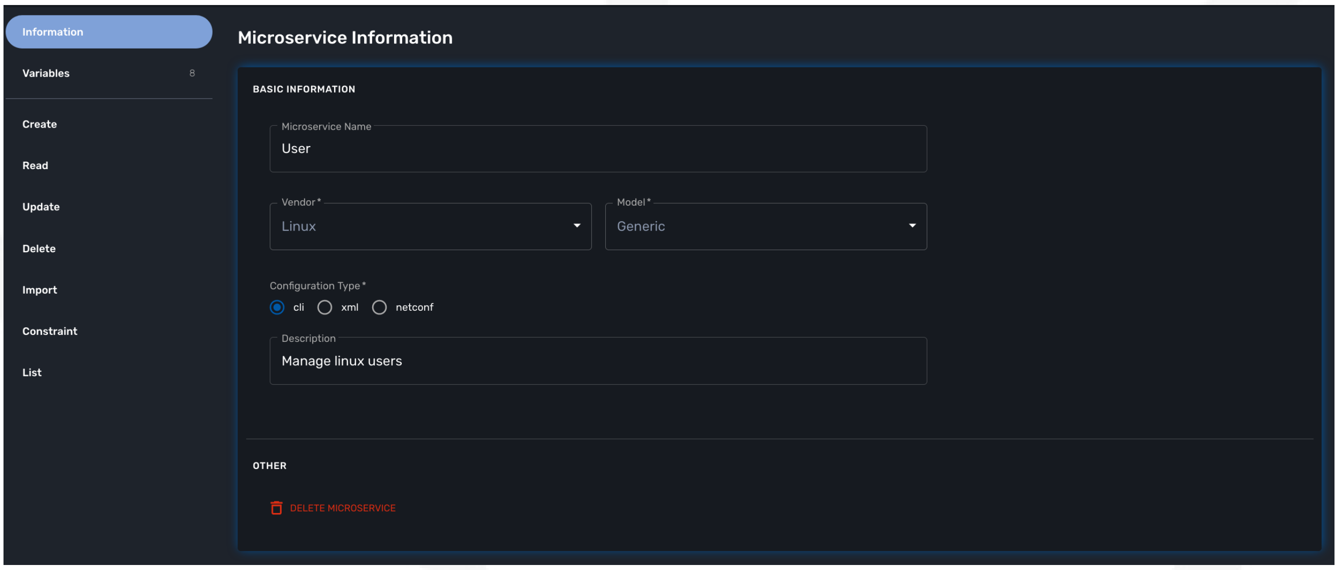
and to delete a user use the command: `userdel`.

```
[root@managed-linux ~]# cat /etc/passwd
root:x:0:0:root:/root:/bin/bash
bin:x:1:1:bin:/bin:/sbin/nologin
...
sshd:x:74:74:Privilege-separated SSH:/var/empty/sshd:/sbin/nologin
oprofile:x:16:16:Special user account to be used by
OProfile:/home/oprofile:/sbin/nologin
tcpdump:x:72:72::/:/sbin/nologin
```

The list of users in /etc/passwd contains the system users that we want to exclude from the scope of the Microservice. We will cover this later in this tutorial.

Create a new microservice

Click on the "Integration" from the left menu, select the tab "Microservices" and click on "Create Microservice"



Microservice Information

BASIC INFORMATION

Microservice Name: User

Vendor*: Linux

Model*: Generic

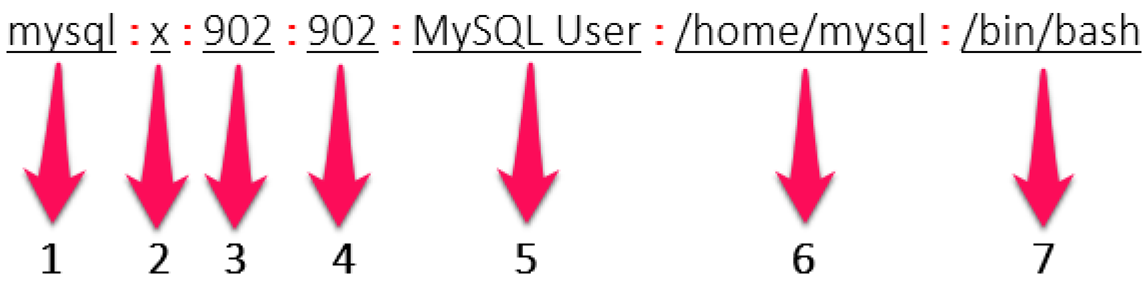
Configuration Type*: [✓ cli] xml netconf

Description: Manage linux users

OTHER

Import the users with the IMPORT function

The result of the CLI command `cat /etc/passwd` is composed of a line with the format:


mysql : x : 902 : 902 : MySQL User : /home/mysql : /bin/bash
1
2
3
4
5
6
7

1. Username: Used when user logs in. It should be between 1 and 32 characters in length.
2. Password: An "x" character indicates that an encrypted password is stored in /etc/shadow file. Please note that you need to use the passwd command to compute the hash of a password typed at the CLI, or to store/update the hash of the password in /etc/shadow file.
3. User ID (UID): Each user must be assigned a user ID (UID). UID 0 (zero) is reserved for root. UIDs 1-99 are reserved for other predefined accounts. UIDs 100-999 are reserved by the system for administrative and system accounts/groups.
4. Group ID (GID): The primary group ID (stored in /etc/group file)
5. User ID Info: The comment field. This allows you to add extra information about the users, such as user's full name, phone number etc. This field is used by finger command.
6. Home Directory: The absolute path to the directory the user will be in when they log in. If this directory does not exists then users directory becomes /.
7. Command/Shell: The absolute path of a command or shell (/bin/bash). Typically, this is a shell. Please note that it does not have to be a shell.

Now let's build the IMPORT function with the parsers to extract the information listed above.

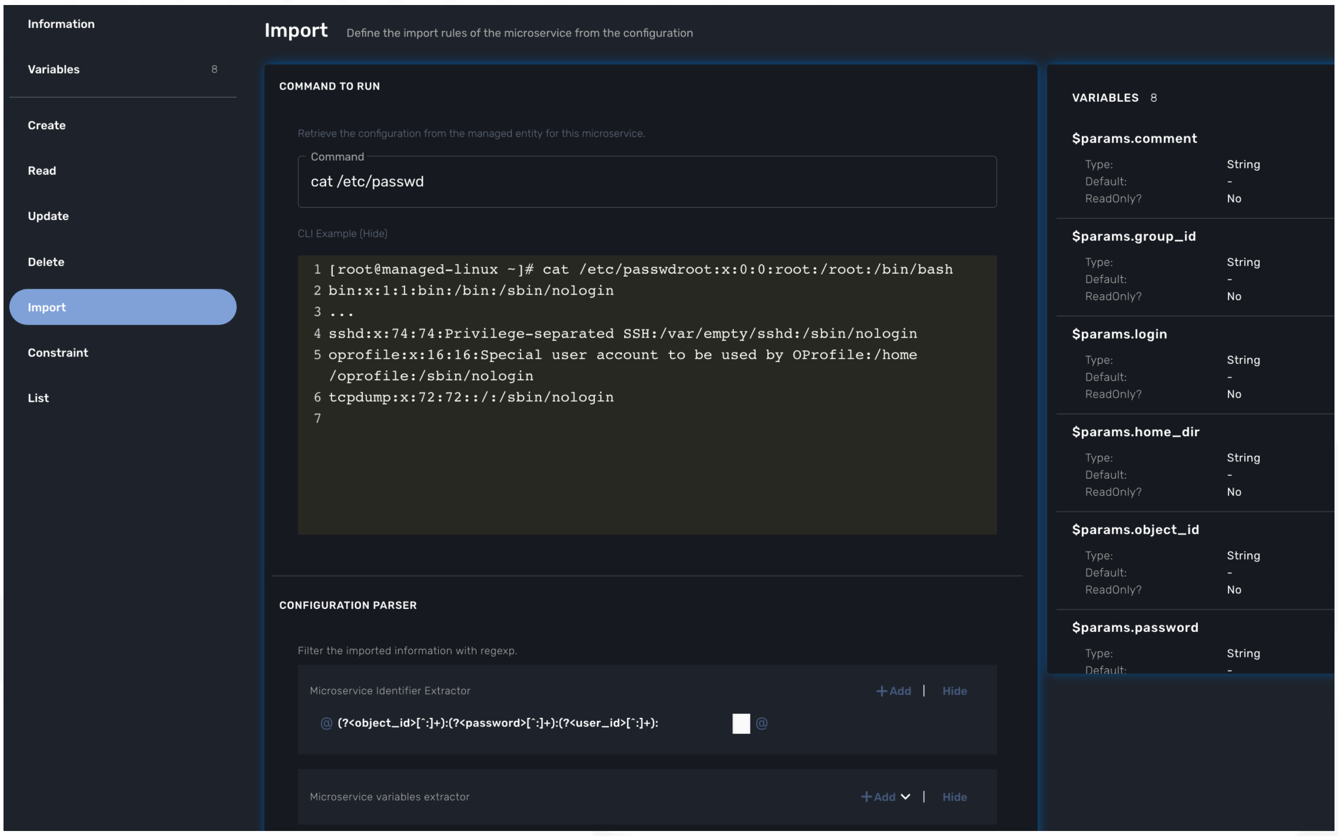
Firstly, we have to decide how the Microservice ID (the mandatory variable name "object_id") will be extracted. In this case, since the username is unique on Linux, the obvious choice is to use the username field as the object_id.

The regular expression to extract the fields from the result of `cat /etc/passwd` is:

```
@(?<object_id>[^:]+):(?<password>[^:]+):(?<user_id>[^:]+):(?<group_id>[^:]+):(?<commen
t>[^:]*):(?<home_dir>[^:]+):(?<shell>[^:]+)@
```

it may be useful to use an online regular expression tester when developing and testing regular expressions. One such online tester can be found here: http://lumadis.be/regex/test_regex.php (see reference below)

Once validated, this regular expression can be used in the field "Micro service identifier extractor" of the IMPORT function builder:



Import Define the import rules of the microservice from the configuration

COMMAND TO RUN

Retrieve the configuration from the managed entity for this microservice.

Command: cat /etc/passwd

CLI Example (Hide)

```
[root@managed-linux ~]# cat /etc/passwdroot:x:0:0:root:/root:/bin/bash
bin:x:1:1:bin:/bin:/sbin/nologin
...
sshd:x:74:74:Privilege-separated SSH:/var/empty/sshd:/sbin/nologin
oprofile:x:16:16:Special user account to be used by OProfile:/home
/oprofile:/sbin/nologin
tcpdump:x:72:72::/:/sbin/nologin
```

CONFIGURATION PARSER

Filter the imported information with regexp.

Microservice Identifier Extractor

```
@ (?<object_id>[^:]+):(?<password>[^:]+):(?<user_id>[^:]+):  @
```

Microservice variables extractor

VARIABLES 8

$params.comment	Type:	String
	Default:	-
	ReadOnly?	No
$params.group_id	Type:	String
	Default:	-
	ReadOnly?	No
$params.login	Type:	String
	Default:	-
	ReadOnly?	No
$params.home_dir	Type:	String
	Default:	-
	ReadOnly?	No
$params.object_id	Type:	String
	Default:	-
	ReadOnly?	No
$params.password	Type:	String
	Default:	-

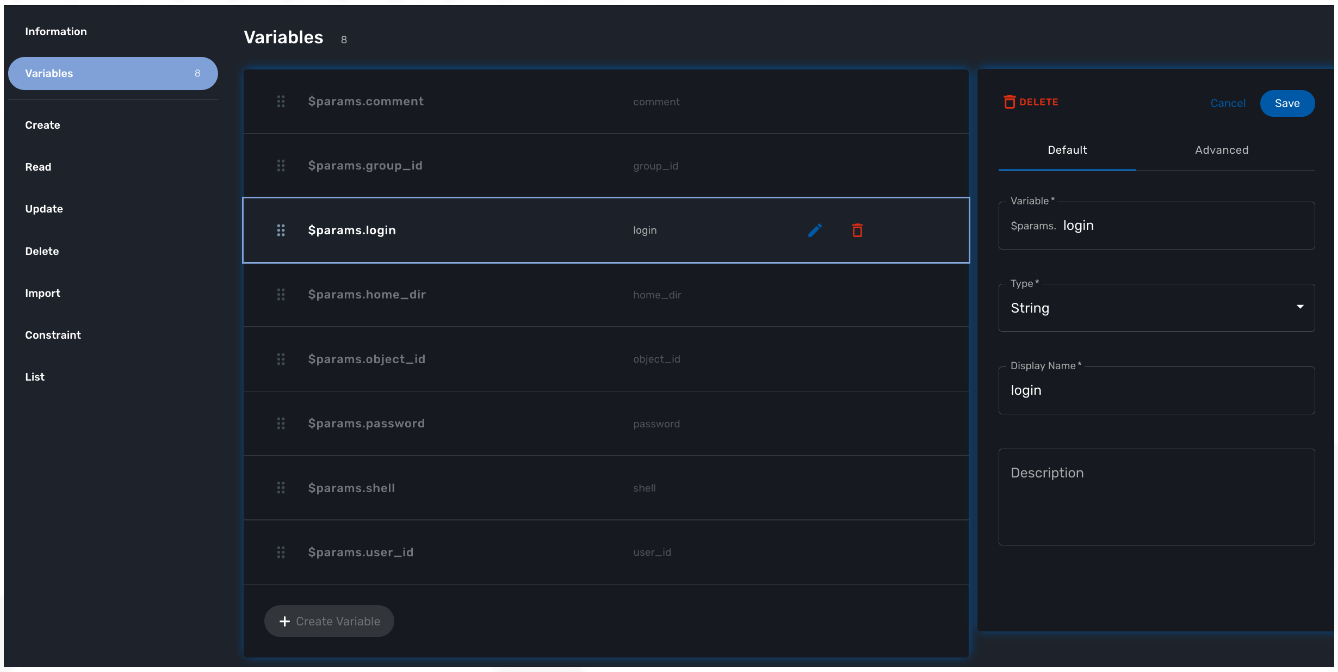
the variables such as object_id, password, have to be created in the variable section of the Microservice.

Variable creation

Variable are user to store the Microservice instance state in the database.

To create a variable, you need to go to the "Variables" section in the left menu and click "Create Variable".

When refering to a variable in the Create/Update or Delete functions, you will always have to prefix them by `$params.` (see below). This is why the UI to create the variable is showing the string "$params."



$params.comment	comment
$params.group_id	group_id
$params.login	login
$params.home_dir	home_dir
$params.object_id	object_id
$params.password	password
$params.shell	shell
$params.user_id	user_id

Variable * : $params. login
Type * : String
Display Name * : login
Description

For more detail on Microservice variables and type, you can go to the documentation about the microservice editor

Run the first test

In order to use your microservice, you need to associate it to a managed entity with a deployment setting and use the synchronization button from the microservice console under the tab "Configure".

Save your work, run the synchronization, and view at the result.

Add and remove users with the CREATE and DELETE functions

On Linux, the CLI command to add a user is:

```
useradd -m -d HOME_DIR -c COMMENT -p PASSWORD LOGIN
```

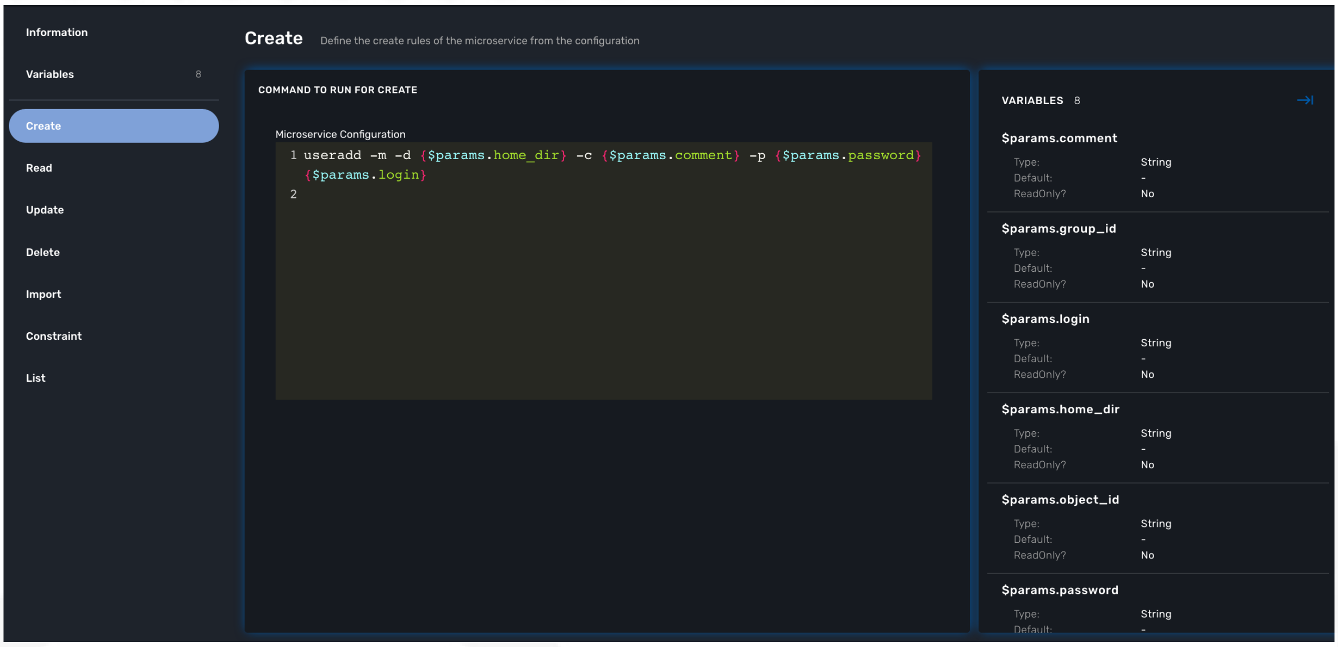
and to delete a user is:

```
userdel -f -r  LOGIN
```

Since it is possible to set the password as a parameter of the user creation, you need to modify the definition of the variable "password" and make it visible and mandatory (but only in the edit view).

You are now ready to implement the CREATE:

```
useradd -m -d {$params.home_dir} -c "{$params.comment}" -p {$params.password} {
$params.object_id}
```



Create Define the create rules of the microservice from the configuration

COMMAND TO RUN FOR CREATE

Microservice Configuration

```
useradd -m -d {$params.home_dir} -c {$params.comment} -p {$params.password}
  {$params.login}
```

VARIABLES 8

$params.comment	
Type:	String
Default:	-
ReadOnly?	No
$params.group_id	
Type:	String
Default:	-
ReadOnly?	No
$params.login	
Type:	String
Default:	-
ReadOnly?	No
$params.home_dir	
Type:	String
Default:	-
ReadOnly?	No
$params.object_id	
Type:	String
Default:	-
ReadOnly?	No
$params.password	
Type:	String
Default:	-

and the DELETE:

```
userdel -f -r {$users.$object_id.object_id}
```

the use of the syntax {$users.$object_id.object_id} in the implementation of the DELETE.

$users is the name of the Microservice definition file as created in the repository: users.xml. This syntax is used to get values from the MSactivator™ database, where Microservice instances are stored. The syntax has to be used when implementing a DELETE because the DELETE must delete the entry from the database AND remove the configuration from the device (in this case we want to delete a user).

Going further

With this simple implementation you can manage users on a Linux system, but there are some additional use cases that you may want to address:

- Is it possible to ignore the system users when importing (for example: bin, daemon, adm,…)?
- What if no comment is provided?
- What if no home dir is provided?

How to ignore the system users

In order to ignore system users during the import, you have to find criteria to help differentiate system users from the users created by the system admin. You can chose to ignore all users that do not have the home directory under /home. The regular expression would then look like:

```
@(?[^:]+):(?[^:]+):(?[^:]+):(?[^:]+):(?[^:]*):(?/home/.+):(?[^:]+)@
```

This regular expression will exclude all users that do not have a home directory under /home, but the system users below will still be imported:

`oprofile:x:16:16:Special user account used by OProfile: /home/oprofile:/sbin/nologin`

Since the shell is not part of the parameters that we have exposed in the creation form, you can decide to import the user that have /bin/bash as shell:

```
@(?[^:]+):(?[^:]+):(?[^:]+):(?[^:]+):(?[^:]*):(?/home/.+):/bin/bash@
```

In this case, the variable shell is no longer needed, so you can remove it from the list of the variables. You also have to update the CREATE function to make sure that the home dir will always be under /home, and you have to make sure that the variable home_dir is read only.

```
useradd -m -d /home/{$params.object_id} -c "{$params.comment}" -p {$params.password}
{$params.object_id}
```

How to handle optional empty variables

The comment is an optional parameter, so you need to make sure that the execution of the CLI command `useradd` will not fail if no comment is passed as a parameter.

This can be achieved with a bit of scripting in the CREATE function:

```
{if empty($params.comment)}
useradd -m -d /home/{$params.object_id} -p {$params.password} {$params.object_id}
{else}
useradd -m -d /home/{$params.object_id} -c "{$params.comment}" -p {$params.password}
{$params.object_id}
{/if}
```

Getting the sources

The source of this tutorial is available on GitHub at https://github.com/openmsa

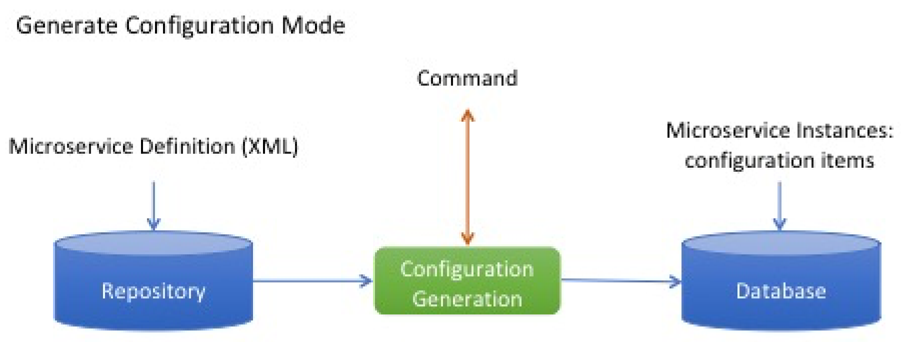
Microservice Order Command REST API

Type of Execution

Generate Configuration

This execution type is used to preview the configuration to be generated, before storing it in the database or applying it to the device.

The configuration generated by the command is returned to the caller, no other action is performed.


Generate Configuration Mode
Command
Microservice Definition (XML)
Microservice Instances: configuration items
Repository
Configuration Generation
Database

REST API syntax

```
POST /ordercommand/get/configuration/{deviceId}/{commandName}
body : microservice parameters formatted as JSON
```

- deviceId is the ID (long) of the device to manage.
- commandName is the command to apply to the device.
- objectParameters are the JSON formatted list of objects and attributes.

Example

The call below is using the Microservice vlan.xml to do simple VLAN management on a Cisco Catalyst IOS

```
curl -u ncroot:NCROOT_PWD  -XPOST http://MSA_IP/ubi-api-
rest/ordercommand/get/configuration/311/UPDATE -d '{
    "vlan": {
        "4001": {
            "name": "MyVlan4001",
            "ports": "Fa0\/11",
            "object_id": "4001",
            "status": "active"
        }
    }
}'
```

Where:

MSA_IP is the IP address of MSactivator™.

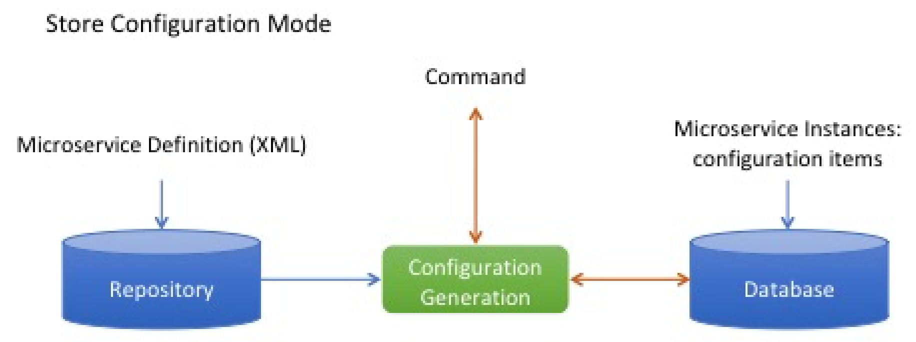
This will return:

```
{
    "commandId": 0,
    "message": "vlan 4002\nname MyVlan4002\n",
    "status": "OK"
}
```

Store Configuration

This execution type is used to store the configuration objects in the database.

The configuration generated by the command is returned to the caller, and the generated objects are stored in the database.



Web service syntax:

```
PUT /ordercommand/store/configuration/{deviceId}/{commandName}
body : microservice parameters formatted as JSON
```

- deviceId is the ID (long) of the device to manage
- commandName is the command to apply to the device
- objectParameters are the JSON formatted list of objects and attributes.

Example

The call below is using the Microservice vlan.xml to do simple VLAN management on a Cisco Catalyst IOS

```
curl -u ncroot:NCROOT_PWD  -XPUT http://MSA_IP/ubi-api-
rest/ordercommand/store/configuration/311/CREATE -d '{
    "vlan": {
        "4020": {
            "name": "MyVlan4020",
            "ports": "Fa0\/11",
            "object_id": "4020",
            "status": "active"
        }
    }
}'
```

Where:

NCROOT_PWD is the password to the MSactivator™.

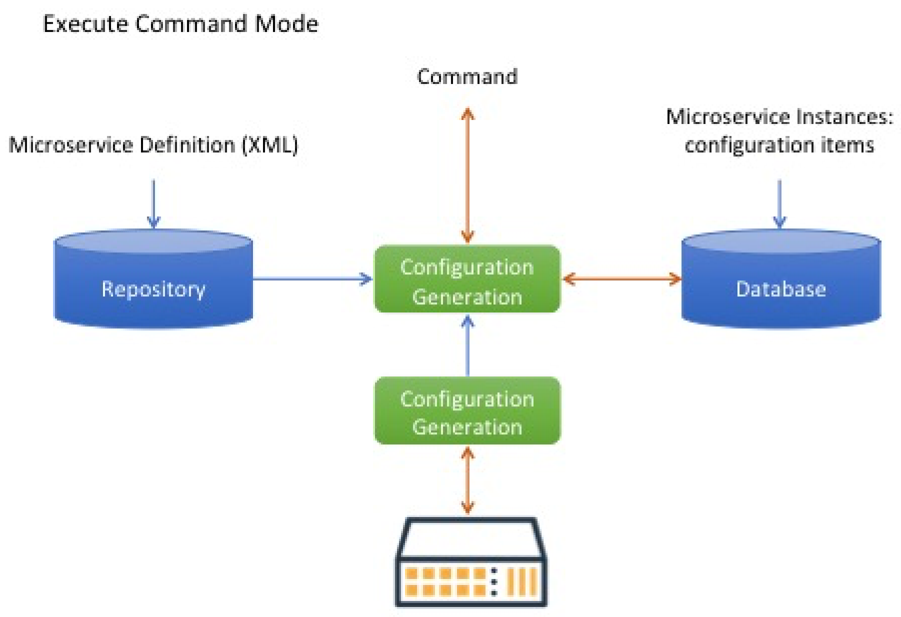
It will return:

```
{
    "commandId": 0,
    "message": "vlan 4020\nname MyVlan4020\n",
    "status": "OK"
}
```

Execute Command

This execution type is used to store the configuration in the database and apply it to the device.

The configuration generated by the command is returned to the caller, the actions are also performed in the database and on the device.



Executing Commands

Use the following method to trigger OrderCommand (Microservices) methods present at the following URL:

```
http://MSA_IP/ubi-api-rest/ordercommand/execute/{deviceId}/{commandName}
```

- {deviceId}: is the device sequence number or the numeric part of the MSactivator™ Device ID
- {commandName}: can take one of the following values: — UPDATE — IMPORT — CREATE — DELETE

Example

```
curl -u ncroot:NCROOT_PWD  -XPUT http://MSA_IP/ubi-api-
rest/ordercommand/execute/311/CREATE -d '{
    "vlan": {
        "4020": {
            "name": "MyVlan4020",
            "ports": "Fa0\/11",
            "object_id": "4020",
            "status": "active"
        }
    }
}'
```

As shown above, the http body contains what's called "object parameters" in general.

Root Element

The root element of the JSON body is the Microservice definition identifier. Here, the first JSON element refers to the Microservice definition name.

In the example above it is `syslogd`. This is the same string that is used when creating a Microservice definition in the Microservices builder. Hence, in the above case the Microservice was named: `syslogd.xml`.

Microservice Instance JSON Object

The JSON element at the next level is the object_id of the Microservice instance, in the above case it is: `SyslogConf`.

the object_id is also passed as an instance variable.

Microservice Instance Variables

The third level of JSON elements is the instance variables, represented in a standard name-value pair.

In this case the value of the variable {commandName} is IMPORT (import operation of Microservice) and the http response body will contain the list of Microservice instances.

As an example, let's say we have three instances of `syslogd` Microservices on the device, with instance names:

- SyslogConf
- MSASyslogConf
- NMSSyslogconf

The response of the import will be the following JSON object, that will be part of the http response:

```
{
    "syslogd": {
        "SyslogConf": {
            "object_id": "SyslogConf",
            "syslogd3_status": "enable",
            "syslogd3_port": "514",
            "syslogd3_server_ip": "1.2.2.3"
        },
        "MSASyslogConf": {
            "object_id": "MSASyslogConf",
            "syslogd3_status": "enable",
            "syslogd3_port": "514",
            "syslogd3_server_ip": "2.3.4.5"
        },
        "NMSSyslogconf": {
            "object_id": "NMSSyslogconf",
            "syslogd3_status": "disable",
            "syslogd3_port": "514",
            "syslogd3_server_ip": "7.6.5.4"
        }
    }
}
```

Getting the Sources

The sources of this tutorial are available on GitHub at https://github.com/openmsa/Microservices/tree/master/CISCO/CATALYST_IOS/VLAN

In order to use the Microservice for VLAN management, you need to use vlan.xml and interface.xml because the vlan.xml Microservice references the interface.xml Microservice.

Microservice Order Stack Management API

Overview

This documentation describes the order stack management API.

This REST API is also used internally by the MSactivator™ portal.

Each API is described below with the REST call, a textual description, the parameters and a section 'detail'. The 'detail' section provides some insight into the inner workings of the API. For instance, what is the database table impacted or what CoreEngine API command is being used.

The detail on the CoreEngine API command is very important because it is directly related to the adaptor implementation for a specific vendor.

API description

Add an order to the Stack

```
curl --location -s -k -H "Authorization: Bearer TOKEN" -XPUT http://MSA_IP/ubi-api-
rest/orderstack/command/{deviceId}/{commandName} -d {objectParameters}
```

Description

Adds a command in the stack and returns the ID of the order in the stack.

Parameters

- deviceId: the database identifier of the managed device, for example: 123.
- commandName: possible values are CREATE UPDATE IMPORT DELETE
- objectParameters: in JSON format, for example:

```
'{
"interface" : {
   "port2" : {
       "ip" : "1.2.4.5",
       "object_id" : "port2",
       "mask" : "255.255.255.0"
         }
     }
}'
```

Detail

Write into database (redsms.sd_crud_object).

Generate the configuration from the stack

```
curl --location -s -k -H "Authorization: Bearer TOKEN" -XGET http://MSA_IP/ubi-api-
rest/orderstack/configuration/{deviceId}
```

Description

Generates the configuration based on the stacked orders for a device.

Parameters

- deviceId: the database identifier of the managed device, for example: 123.

Detail

loop on commands in the stack call SMS verb end loop

The SMS verb is equivalent to the following CLI command command:

```
sms -e JSCALLCOMMAND -i 'deviceId commandName 0' -c 'objectParameters'
```

with the CLI command above the parameter 0 is used along with commands such as CREATE, UPDATE or DELETE and generate configuration without access to the database or the device

Generates the configuration and store the configuration from the stack

```
curl --location -s -k -H "Authorization: Bearer TOKEN -XPUT http://MSA_IP/ubi-api-
rest/orderstack/configuration/{deviceId}
```

Description

Generates the configuration based on the stacked orders for a device and stores the configuration items in the database.

Parameters

- deviceId: the database identifier of the managed device, for example: 123.

Detail

```
loop on commands in the stack
  call SMS verb
  write in database (redsms.sd_crud_object)
end loop
```

The SMS verb is equivalent to the following command: `sms -e JSCALLCOMMAND -i 'deviceId commandName 1' -c 'objectParameters'`

In the CLI command above the parameter 1 is used along with commands such as CREATE, UPDATE or DELETE and generate the configuration and stores the configuration items in the database.

The device configuration is not impacted.

Generate the configuration from the stack and apply to the device

```
curl --location -s -k -H "Authorization: Bearer TOKEN -XPOST http://MSA_IP/ubi-api-
rest/orderstack/execute/{deviceId}
```

Description

Generates the configuration based on the stacked orders for a device and stores the configuration items in the database and executes all the commands on the device.

Parameters

- deviceId: the database identifier of the managed device, for example: 123.

Detail

```
loop on commands in the stack
  call SMS verb
  write in database (table redsms.sd_crud_object)
  execute command on the device
end loop
```

The SMS verb is equivalent to the following command: sms -e JSCALLCOMMAND -i 'deviceId commandName 2' -c 'objectParameters'

with the CLI command above, the parameter 2 is used along with commands such as CREATE, UPDATE or DELETE which will generate the configuration, store the configuration items in the database and apply the configuration to the device.

List the orders in the stack

```
curl --location -s -k -H "Authorization: Bearer TOKEN -XGET http://MSA_IP/ubi-api-
rest/orderstack/{deviceId}
```

Description

Lists the stacked orders for a device.

Parameters

- deviceId: the database identifier of the managed device, for example: 123.

Detail

Read from the database (table redsms.sd_crud_object).

Get the detail of a stack command

```
curl --location -s -k -H "Authorization: Bearer TOKEN -XGET http://MSA_IP/ubi-api-
rest/orderstack/command/{deviceId}/{commandId}
```

Description

Gets the detail of a stack command based on its identifier in the stack.

Parameters

- deviceId: the database identifier of the managed device, for example: 123.
- commandId: the identifier of the command in the stack.

Detail

Read in database (redsms.sd_crud_object).

Clear the stack

```
curl --location -s -k -H "Authorization: Bearer TOKEN" -XDELETE http://MSA_IP/ubi-api-
rest/orderstack/{deviceId}
```

Description

Clears the stack for a device.

Parameters

- deviceId: the database identifier of the managed device, for example: 123.

Detail

Remove in database (redsms.sd_crud_object)

Delete a command from the stack

```
curl --location -s -k -H "Authorization: Bearer TOKEN" -XDELETE http://MSA_IP/ubi-api-
rest/orderstack/command/{deviceId}/{commandId}
```

Description

Deletes a command from the stack based on the command ID.

Parameters

- deviceId: the database identifier of the managed device, for example: 123.
- commandId: the identifier of the command in the stack.

Detail

Remove in database (redsms.sd_crud_object).

Apply the configuration for a device

```
curl --location -s -k -H "Authorization: Bearer TOKEN" -XPUT http://MSA_IP/ubi-api-
rest/device/push_configuration/{deviceId} -d {configuration}
```

Description

Perform a push configuration for a device.

Parameters

- deviceId: the database identifier of the managed device, for example: 123.
- configuration: the configuration in JSON format.

Example

```
{
    "configuration": "config system interface\nedit port1\nset ip 192.168.1.10
255.255.255.0\nend"
}
```

Detail

Applies the configuration to the device.

Get the status of the API push_configuration

```
curl --location -s -k -H "Authorization: Bearer TOKEN  -X GET http://MSA_IP/ubi-api-rest/device/push_configuration/status/{deviceId}
```

Description

Gets the status of the push configuration from the device.

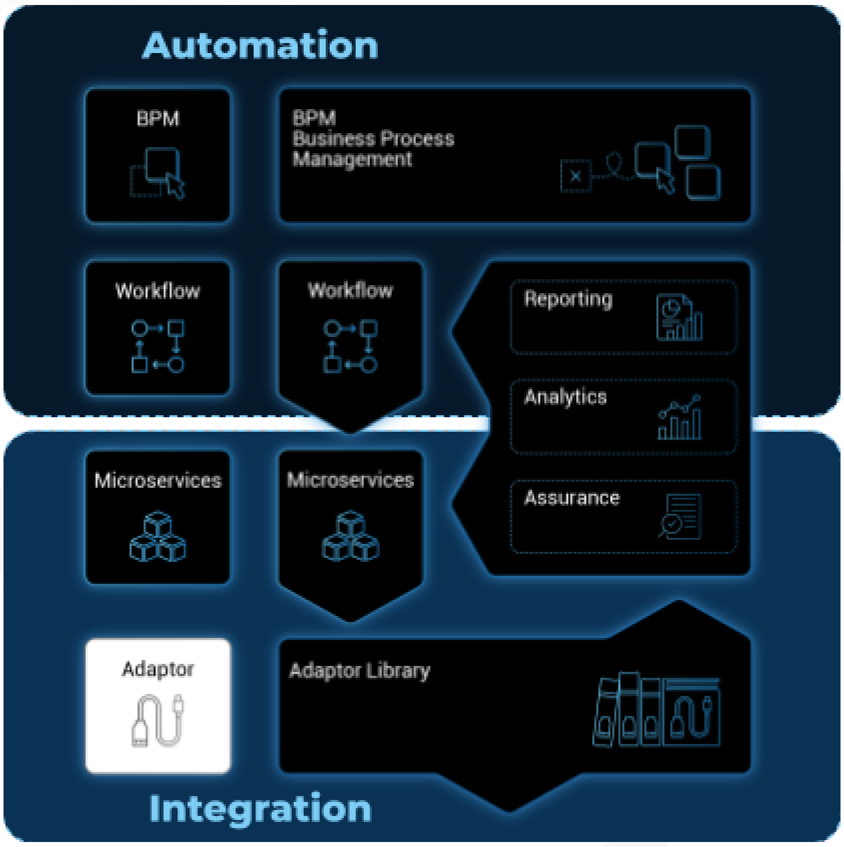
Parameters

deviceId: the database identifier of the managed device, for example: 123.

Detail

Read the status from the database.

Adapter Development



The **adapters** are the "drivers" that allow the main MSactivator™'s engine to seamlessly communicate with the Managed Entities for configuration assurance, event collection, et cetera.

Overview

The adapters are designed per vendor because they need to address the specifics of each vendor especially when the Managed Entitie does not provide a REST management API.

The MSactivator™ provides a library of device adaptors ready to use.

The libraries are implemented in PHP which makes extension and customization easy.

How to find, install, activate the adapters

The Adapters are packaged in the MSactivator™, in the "msa_dev" container, under `/opt/devops/Openmsa_Adapters` which is a git repository configured to point to github.

```
$ sudo docker-compose exec msa-dev bash
```

Many other Adapters are available on the Adapters Github repository

The installation of an Adapter is covered in this documentation: How to install an Adapter

REST Generic adapter

The REST Generic adapter, available on Github will allow you to integrate most vendors that exposes a REST management interface API.

This adapter is included in the mini lab.

If you need to create a new vendor based on the REST Generic adapter, you can follow this guide in the next section

How to create a new vendor based on an existing adapter

Overview

Some adapters were designed to be generic in order to have little dependencies with a specific vendor.

This is the case for the REST and the Linux adapters.

- The REST Generic adapter will let you quickly integrate a new managed entity with a REST based management API
- The Linux Generic can be used for any Linux distribution or vendor model based on Linux

but you may want to also have the vendor name and entity model both appear in the list of supported vendor instead of REST/Generic or Linux/Generic.

Doing so will allow you to filter the microservice and deployment setting based on the vendor name and model name.

This will ease the organization of your integration files.

How to do it

Let’s assume that you want to add vendorA / modelX to the list of supported vendors.

You will need an access to the MSactivator™ CLI of the msa_dev container.

```
sudo docker-compose exec msa-dev bash
```

use `msa_dev` for MSactivator™ version 2.6 or older.

Create the new model in the Adapters github repository

If you followed the quickstart guide to install your instance of MSactivator™ the image msa_dev contains a clone of github.com/openmsa/Adapters

We are going to create the new model in this local repository. Using a git repository has several advantages such as using a working branch to track your changes and revert them if needed or contributing to the community by creating a pull request to submit your code.

Go to the repository

```
cd /opt/devops/OpenMSA_Adapters/
```

Go to the adapter definition directory and create a new folder for your new vendor model. By convention the folder name should be defined as <vendor name>_<model name>

```
cd adapters
mkdir -p vendorA_modelX/conf
cd vendorA_modelX/conf
```

You need to create 2 configuration files to define this new model:

- device.properties : define the adapter properties for UI display (msa-ui)
- sms_router.conf : define the adapter config for the Core Engine (msa-sms)

In the github repository you will find lot of doc and example about these files

device.properties

```
# VendorA / ModelX            ①
manufacturer.id = 18082020    ②
manufacturer.name = VendorA
model.id = 18082020           ③
model.name = ModelX

obsolete = false
```

① any comment you find useful.

② select a unique, numeric ID. Your current date it a good choice.

③ same as above.

the model ID and the manufacturer ID don’t have to be identical and you can have several models for the same vendor by using different model ID

sms_router.conf

```
# VendorA / ModelX              ①
model       18082020:18082020   ②
path        rest_generic        ③
```

① any comment you find useful.

② format: <manufacturer.id>:<model.id>.

③ the path to an existing adapter code (example: rest_generic or linux_generics).

Update file owner

```
chown -R ncuser.ncuser /opt/devops/OpenMSA_Adapters/adapters/vendorA_modelX
```

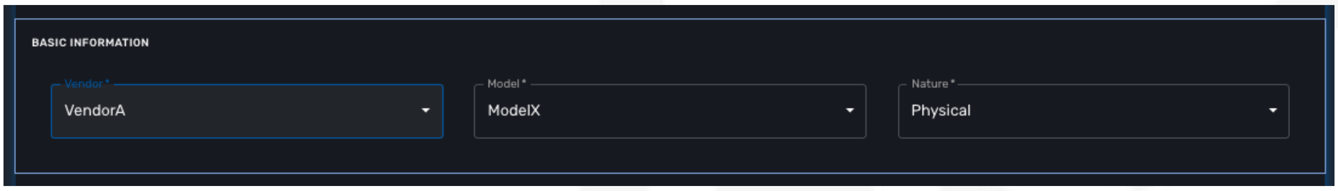
Install and activate the new vendor

Exit the docker container msa-dev and restart the API container and the CoreEngine service

```
$ sudo docker-compose restart msa-api
$ sudo docker-compose restart msa-sms
```

Verify your new vendor is available

Once the services have restart, you can connect to the UI to check that a new vendor/model is listed when you create a new managed entity.


BASIC INFORMATION

Vendor *: VendorA

Model *: ModelX

Nature *: Physical

First, verify that you can create a new managed entity and try to activate it.

During the activation, you can monitor the logs of smsd daemon from the Core Engine and check that the adapter code being used is the one from rest_generic (or any other you may have set in sms_router.conf above)

Login to the CoreEngine container

```
$docker-compose exec msa-sms bash
```

Set the configuration log level to DEBUG

```
# tstsms SETLOGLEVEL 255 255
```

Monitor the logs with tail

```
# tail -F /opt/sms/logs/smsd.log
```

It should output something similar to that. You can verify that the managed entity activation is relying on the adapter code specified in sms_router.conf

```
2020/08/18:14:39:09:(I):smsd:BLR129:JSAPROVISIONING:: analysing verb JSAPROVISIONING
arg BLR129
2020/08/18:14:39:09:(D):smsd:BLR129:JSAPROVISIONING::   arg: 1.2.3.4 aa aa
2020/08/18:14:39:09:(D):smsd:BLR129:JSAPROVISIONING:: SMSSQL_GetSD current node name
is msa, sdid = BLR129
2020/08/18:14:39:09:(D):smsd:BLR129:JSAPROVISIONING:: Alloc SDINFO for BLR129
2020/08/18:14:39:09:(D):smsd:BLR129:JSAPROVISIONING:: RUN script
/opt/sms/bin/php/rest_generic/do_provisioning.php
2020/08/18:14:39:09:(D):smsd:BLR129:JSAPROVISIONING:: LOAD_ONCE
/opt/sms/bin/php/rest_generic/adaptor.php
2020/08/18:14:39:09:(D):smsd:BLR129:JSAPROVISIONING:: LOAD_ONCE
/opt/sms/bin/php/rest_generic/rest_generic_connect.php
2020/08/18:14:39:09:(D):smsd:BLR129:JSAPROVISIONING:: LOAD_ONCE
/opt/sms/bin/php/rest_generic/rest_generic_apply_conf.php
2020/08/18:14:39:09:(D):smsd:BLR129:JSAPROVISIONING:: LOAD_ONCE
/opt/sms/bin/php/rest_generic/rest_generic_connect.php
2020/08/18:14:39:09:(D):smsd:BLR129:JSAPROVISIONING:: LOAD_ONCE
/opt/sms/bin/php/rest_generic/provisioning_stages.php

...

2020/08/18:14:39:09:(D):smsd:BLR129:JSAPROVISIONING:: script
/opt/sms/bin/php/rest_generic/do_provisioning.php executed in 0.105652 seconds
2020/08/18:14:39:09:(D):smsd:BLR129:JSAPROVISIONING:: free SDINFO for BLR129
2020/08/18:14:39:09:(I):smsd:BLR129:JSAPROVISIONING:: ends OK
```

Adapter SDK

The Adapter SDK is composed of a set of PHP scripts that implement an API This API exposes functions such as:

1. Asset management
2. Status polling
3. SshConnection
4. Provisioning
5. Update conf
6. Backup conf
7. Microservice commands (CREATE, READ, UPDATE, DELETE, IMPORT)
8. …

Custom commands

It is possible to implement new custom commands that will be callable from the MSactivator™ API (verb JSACMD MY_COMMAND).

Status polling

The MSactivator™ CoreEngine daemon in charge of polling the device for availability is `polld`.

```
Logs: /opt/sms/logs/sms_polld.log
```

By default, polling is using `ping`, and for scalability and performance reasons the polling mechanism is implemented in the C programming language. This allows the MSactivator™ to poll several hundreds of managed entities per minute. For the devices that don't support `ping`, or in case the polling has to be customized, it is possible to implement a custom polling in a php script:

```
/opt/sms/bin/polld/<model>_polld.php
```

Custom polling example:

On Stormshield the connection to the device is tested as shown below

```
try
{
  global $sms_sd_ctx;
  netasq_connect();
  netasq_disconnect();
}
catch (Exception $e)
{
  netasq_disconnect();
  return $e->getCode();
}
return SMS_OK;
```

Asset management

The MSactivator™ CoreEngine can connect on a managed entity to fetch a set of predefined assets such as:

1. Firmware
2. Memory
3. CPU
4. …

The specific model script retrieves information (via CLI, snmp, REST calls…) into an array. The array is then passed to a specific callback in order to store the information in the database.

```
sms_polld_set_asset_in_sd($sd_poll_elt, $asset);
```

Custom asset management

It is also possible to extract custom assets. They will be stored in the database as a list of key values.

The asset mngt module uses regular expressions to extract the asset from the configuration.

These values are stored in a database that keeps the asset history.

The asset script is device specific and is located in:

```
/opt/sms/bin/polld/<model>_mgmt.php
```

Example on fortigate

Regexp:

```
$get_system_status_asset_patterns = array(
    'firmware'    => '@Version:\s+(?<firmware>.*)@',
    'av_version'  => '@Virus-DB:\s+(?<av_version>.*)@',
    'ips_version' => '@IPS-DB:\s+(?<ips_version>.*)@',
    'serial'      => '@Serial-Number:\s+(?<serial>.*)@',
    'license'     => '@License Status: (?<license>.*)@',
);
```

The regexp is executed against the result of the CLI : `get system status`.

Example on cisco

Regexp:

```
$show_ver_asset_patterns = array(
  'serial' => '@Processor board ID (?<serial>\S*)@',
  'license' => '@oftware \((?<license>[^\)]*)\)@',
  'firmware' => '@\), Version (?<firmware>[^,]*),@',
  'model' => '@^(?<model>[^(]*) \(.*with \d+K/\d+K bytes of memory@',
  'cpu' => '@^.* \((?<cpu>[^\)]*)\) processor@',
  'memory' => '@with (?<memory>\d*K/\d*K bytes) of memory@',
  );
```

The regexp is executed against the result of the CLI `show version`.

Configuration management

Dialog with the managed entity

The following PHP scripts have to be created in the `/opt/sms/bin/php/<model>/` directory.

This set of PHP scripts manages the dialog between the {produt_name} and the managed entity.

adaptor.php

Provides access to the device for device connection and configuration update.

device_connect.php

Manages the connection to the device (SSH, or REST, for example).

Microservice based configuration

PHP scripts to configure a device using objects:

<model>_command.php

Manages the OBMF specificities for the device.

device_configuration.php

Manages the main configuration methods for the managed entity (only update_conf() is used for objects).

Template based configuration

PHP scripts to configure a device using templates:

do_update_conf.php

Generates and applies a configuration.

This task is also called automatically when the router configuration changes.

device_configuration.php

update_conf() should be enhanced to support configuration templates.

Provisioning

PHP scripts to do the initial provisioning of the device:

do_provisioning.php

Generates and applies the initial configuration on the device. This is an asynchronous task, so a script must be provided to give an update on progress.

provisioning_stages.php

Describes all the provisioning stages. This is used to store the provisioning status into the database.

prov_lock.php

Provisioning action to lock the database for this device during the provisioning.

prov_init_conn.php

This is the initial connection test.

prov_dns_update.php

Add the device to the MSA local DNS.

prov_unlock.php

Provisioning action to unlock the database for this device during the provisioning.

Other Features

do_get_running_conf.php

Called by GUI (menu Monitoring → Get the running configuration).

do_staging.php

Generate the staging configuration for the device (menu General → Staging).

do_backup_conf.php

Generate a backup of the device configuration.

do_restore_conf.php

Restore a configuration backup on the device.

do_update_firmware.php

Update the firmware of a device.

If a script is not present, the corresponding operation on the MSactivator™ will give the "Function not supported by the device" error.

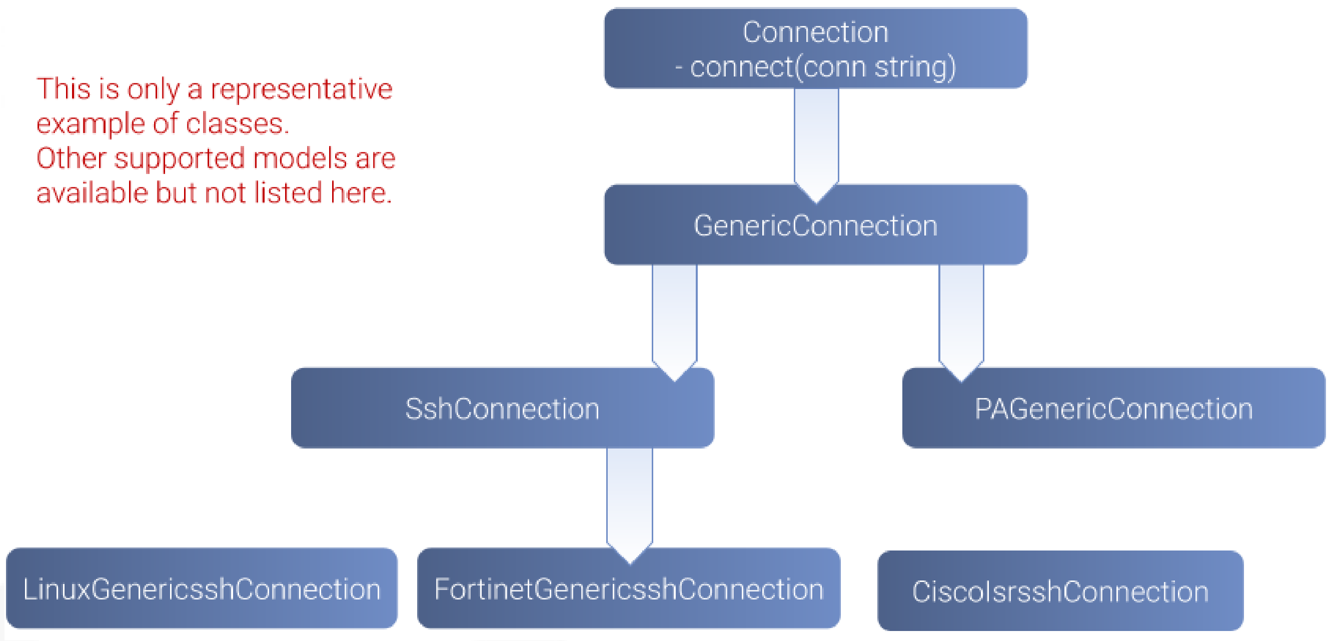
Connectivity to the Devices

For the managed entities that expose a remote CLI based management interface the adapter API requires the implementation of a class that extends SshConnection.

SshConnection connection is defined in `/opt/sms/bin/php/smsd/ssh_connection.php`

SshConnection extends GenericConnection defined in `/opt/sms/bin/php/smsd/generic_connection.php`

SshConnection extends GenericConnection defined in `/opt/sms/bin/php/smsd/generic_connection.php`


This is only a representative example of classes.
Other supported models are available but not listed here.
Connection
- connect(conn string)
GenericConnection
SshConnection
PAGenericConnection
LinuxGenericsshConnection
FortinetGenericsshConnection
CiscoIsrsshConnection

The class Connection

/opt/sms/bin/php/smsd/connection.php

This class is always overridden by a generic connection. It defines functions such as the "get" and "set" attributes such as the prompt, the device IP (sd_ip_config) ...

The function `connect` It defines the main connect functions `public function connect($connectString)`.

This function uses the PHP function `proc_open` to execute the connect command and opens file pointers for IO. The disconnect closes the IO file pointers and leaves a clean state.

Other function

`sendexpectone` for sending a command to a device and getting the result back.

```
public function sendexpectone($origin, $cmd, $prompt='lire dans sdctx', $delay =
EXPECT_DELAY, $display_error = true)
```

Example (in Fortinet adaptor)

```
$buffer = sendexpectone(__FILE__ . ':' . __LINE__, $this, 'get system status', '\#');
```

The class GenericConnection

/opt/sms/bin/php/smsd/connection.php

This class implements a constructor that initiates a class attribute.

Device information is read by calling the function `get_network_profile()`.

get_network_profile is defined for each device in a PHP file located in:

```
/opt/sms/spool/php_db_data/<device_id>.php
```

This PHP file is an “image” of the device configuration as stored in the database.

This design allows a quick and easy access to device configurations such as IP, credentials, interface name, SNMP community, customer ID …

The class SshConnection

/opt/sms/bin/php/smsd/ssh_connection.php

It implements the function `do_connect()` that uses the function `connect()` from the class Connection:

```
parent::connect("ssh □p 22 -o StrictHostKeyChecking=no⋯
```

It uses the function `expect()` to check that SSH connectivity is OK (by checking that the result contains “Permanently added”).

The class SshKeyConnection

/opt/sms/bin/php/smsd/ssh_connection.php

Allows public/private keys via SSH authentication with the device.

Example

Fortiweb WAF on AWS requires this kind of authentication.

Other examples

LinuxGenericsshConnection

```
/opt/sms/bin/php/linux_generic/linux_generic_connect.php
```

Used in `do_update_conf.php`

```
$ret = linux_generic_connect();
```

Implementation of ‘Update Configuration’

Base operation for implementing:

1. The initial provisioning
2. The template-based configuration
3. The Microservice CREATE/UPDATE/DELETE operation

Implemented by `do_update_conf.php`

Can be called directly by the MSactivator™ CoreEngine API, it is an asynchronous process, its status can be monitored.

Managed entity activation (initial provisioning)

The MSactivator™ executes a set of steps to activate the device.

The steps can be customized to do additional operations.

Default steps:

Defined in `provisioning_stages.php`

```
$provisioning_stages = array(
0 => array('name' => 'Lock Provisioning',      'prog' => 'prov_lock'),
1 => array('name' => 'Initial Connection',     'prog' => 'prov_init_conn'),
2 => array('name' => 'Initial Configuration', 'prog' => 'prov_init_conf'),
3 => array('name' => 'DNS Update',             'prog' => 'prov_dns_update'),
4 => array('name' => 'Unlock Provisioning',    'prog' => 'prov_unlock'),
5 => array('name' => 'Save Configuration',     'prog' => 'prov_save_conf'),
)
```

Configuration backup/restore

do_backup_conf.php

Based on the verb GETSDCONF (see save_router_conf.sh) which is implemented by do_get_sd_conf.php for each device.

do_restore_conf.php

The implementation will vary depending on the vendor.

Example

Fortinet uses TFTP and CLI `execute restore config tftp`. Cisco ISR first tries to SCP to flash and to TFTP and then reboots.

Connectivity fallback mechanism

By default, the device adaptor uses secure protocols to communicate with the devices (SSH or TFTP).

When these protocols fail (the device doesn't support them or firewall restrictions – which might be unlikely), there is a fallback mechanism to protocols such as Telnet or TFTP.

Example

in `cisco_isr_connect.php`

Microservice implementation

The implementation of the functions CREATE/READ/UPDATE/DELETE/IMPORT is specific to the vendor.

this is especially true for the IMPORT.

CREATE/READ/UPDATE/DELETE are using the functions to apply conf, this is similar to the configuration update.

IMPORT needs to be aware of the device configuration structure.

It is necessary to provide a unified GUI to build the import but with devices that have different data models.

for REST based managed entities, the IMPORT is usually generic since the response is formatted in XML or JSON (cf. rest_generic)

The MSactivator™ CoreEngine API

As well as named verbs, these commands can be used to interact directly with the MSactivator™ CoreEngine from the CLI.

The can also be executed with a REST API:

HTTP Request: `/sms/verb/{verb}/{deviceId}`

Method: `POST`

Parameter Name	Type	Description
verb	String	the command (JSAPROVISIONING, JSCHECKPROVISIONING, JSAUPDATECONF,...)
deviceId	String	the database ID of the managed entity

COMMAND	
JSAPROVISIONING	Initial provisioning
JSCHECKPROVISIONING	Check initial provisioning status
JSAUPDATECONF	Update configuration
JSSTAGING	Staging
JSGETSDCONF	Get router running configuration
JSGETCONF	Get router generated

The verbs are associated to specific PHP do_<verb>.php:

Example

```
tstsms JSGETSDCONF UBI132
```

This will retrieve the running configuration of the device and use the implementation of `do_get_running_conf.php`.

Operation status feedback

During operations done by the MSactivator™ CoreEngine, especially the asynchronous ones, the status of the ongoing operation can be set for the user by the PHP scripts. How to update the status depends on the operation.

Initial Provisioning

Set provisioning status for a provisioning stage.

```
sms_bd_set_provstatus($sms_csp, $sms_sd_info, $stage, $status, $ret, $next_status,
$additionalmsg)
```

Configuration Update

Set the update status of the configuration update of an equipment.

```
sms_set_status_update($sms_csp, $sdid, $error_code, $status, $e->getMessage())
```

This has covered various aspects of Adapter development. If you have further questions, please contact info@ubiqube.com for more information.

Import / Export Librairies

Overview

MSactivator™ provide the possibility to use git version control system to handle the libraries (BPM, workflows and microservices) stored in the local libraries repositories under `/opt/fmc_repository` in the container msa_dev.

Local libraries repositories overview

The libraries are stored in the location below

- **BPM**: /opt/fmc_repository/Bpmn/bpmns
- **Workflow**: /opt/fmc_repository/Process/workflows
- **Microservice**: /opt/fmc_repository/CommandDefinition/microservices

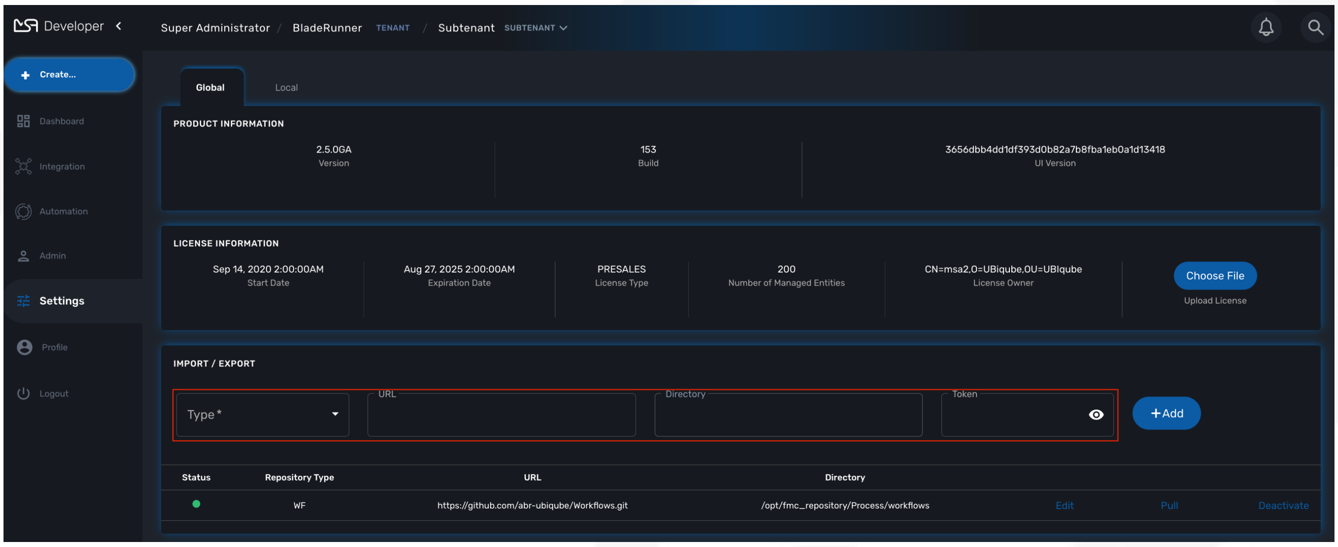
Configuration

By default the MSactivator™ doesn't have any git repository configured.

To configure the git repositories, log into the **Developer** portal and click on "Settings" in the left menu.

Use the "IMPORT / EXPORT" form to configure the repositories. You can choose which type of libraries (BPM, workflow or microservice) you want to be managed by a remote git repository.

Git repository settings



PRODUCT INFORMATION

2.5.0GA	153	3656dbb4dd1df393d0b82a7b8fba1eb0a1d13418
Version	Build	UI Version

LICENSE INFORMATION

Sep 14, 2020 2:00:00AM	Aug 27, 2025 2:00:00AM	PRESALES	200	CN=msa2,O=UBiqube,OU=UBIqube	Choose File
Start Date	Expiration Date	License Type	Number of Managed Entities	License Owner	Upload License

IMPORT / EXPORT

Type * | URL | Directory | Token | +Add

Status	Repository Type	URL	Directory			
●	WF	https://github.com/abr-ubiqube/Workflows.git	/opt/fmc_repository/Process/workflows	Edit	Pull	Deactivate

Prerequisites

The remote gite repository must exist and accessible with SSH, the default branch must be set to `master`

Add a repository

MSactivator™ supports one repository per type of libraries. Select the type of repository and provide the git remote URL (only SSH is supported), the git username and password and click "+Add".

The MSactivator™ will clone the repository under one of the locations described above and set the status to green.

How it works

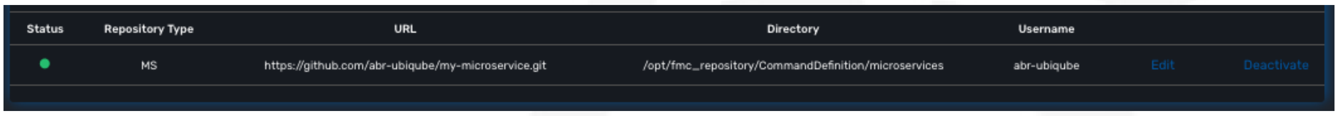
The CLI commands extracts below are taken from the container msa_dev, under /opt/fmc_repository/CommandDefinition/microservices.

To connect to the container msa_dev, use `docker-compose exec msa-dev bash` from where the docker-compose file is located.

initial state: no git repository configured

```
[root@msa_dev microservices]# ls -la
total 4
drwxr-xr-x 3 ncuser ncuser   18 Dec 15 11:59 .
drwxr-xr-x 3 ncuser ncuser 4096 Dec 15 13:49 ..
drwxr-xr-x 7 ncuser ncuser  135 Dec 15 15:17 .git

[root@msa_dev microservices]# git status
On branch master
nothing to commit, working tree clean

[root@msa_dev microservices]# git remote -v
[root@msa_dev microservices]#
```

new repository configured in settings



Status	Repository Type	URL	Directory	Username		
●	MS	https://github.com/abr-ubiqube/my-microservice.git	/opt/fmc_repository/CommandDefinition/microservices	abr-ubiqube	Edit	Deactivate

you need at least one file in the git repository before you can configure it in the UI. We recommend that you add an empty file like README.md. On github you have the option to do that automatically when you create a new repository

status of the git repository

```
[root@msa_dev microservices]# git status
On branch master
Your branch is up to date with 'origin/master'.

nothing to commit, working tree clean

[root@msa_dev microservices]# git remote -v
origin  https://github.com/abr-ubiqube/my-microservice.git (fetch)
origin  https://github.com/abr-ubiqube/my-microservice.git (push)
```

create a new microservice (Integration → Microservices)

```
[root@msa_dev microservices]# git status
On branch master
```

```
Your branch is up to date with 'origin/master'.

nothing to commit, working tree clean

[root@msa_dev microservices]# git lg
* 750f29a - 15-12-2020 15:46:10 - Updating microservice on  - ncroot <jboss> (18 hours
ago)
* 7cc1d81 - 15-12-2020 15:43:39 - Updating microservice on  - ncroot <jboss> (18 hours
ago)
* e73a455 - 15-12-2020 15:41:10 - Updating microservice on  - ncroot <jboss> (18 hours
ago)
* 5290a81 - Initial commit with existing files <jboss> (18 hours ago)
```

Every updates on the libraries are committed and pushed to the remote upstream.

You can use git CLI commands to view the differences between 2 commits (`git diff`) and also to revert your changes (`git reset`)

Git repository management rules

New git repository

- Files already exists in local repo
    - No files exists upstream
        - There won’t be any conflict and git should be configured successfully.
        - Local files should now be available in upstream.
- Some files exists upstream
    - It will synchronize files with the remote.
        - If no conflict, then local files will be pushed upstream. Also, upstream files will be available locally.
        - If there is a conflict, error message will be thrown and git will not be configured. And sync will not happen.
- No files exists in the local repo
    - No files exists upstream
        - No conflict, git should be configured successfully.PASSED
    - Some files exists upstream
        - There will be no conflict, and upstream files will be available locally and git will be configured successfully.

REST API

The MSactivator™ provides a support for REST API. These API can be used by third-party service, application or script to manage your MSactivator™ instance.

Enabling REST API support

The API is enabled by default. No additional configuration is required.

Authentication

When making requests to MSactivator™ using the REST API, you will need:

- A valid admin username and password (so that a token can be generated and an authenticated session can be established).
- Appropriate access permissions for the requested resource (controlled by admin profile)

Using curl, you may save the authentication information as a HTTP header to allow subsequent requests to be accepted automatically.

authentication request

```
curl -H 'Content-Type: application/json' -XPOST -k https://<MSA IP or FQDN>/ubi-api-
rest/auth/token -d '{"username":"username", "password":"user password"}'
```

authentication response

```
{
    "token":
"eyJhbGciOiJIUzUxMiJ9.eyJzdWIiOiJuY3Jvb3QiLCJpYXQiOjE2NTUxOTQ3MzMsImx2bCI6IjEiLCJleHAi
OjE2NTUxOTgzMzN9.kVl5XuqbSnGI59k0dlHmhB9xmPsixS3X24yQ4oWD-S9GgcBWw7X-
DAb_S5oqwd0h3R64i_Custn8GeFt34Yzow",  ①
    "message": "authenticated",
    "authenticated": "true",
    "userDetails": {
        "id": 1,
        "baseRole": {
            "id": 1,
            "name": "Super Administrateur"
        },
        "externalReference": "NCLG1",
        "login": "ncroot",
        "operator": {
            "id": 1,
            "abonnes": [],
            "baseUrl": null,
            "isPartner": false,
            "name": "UBIqube",
            "prefix": "NCL",
            "address": {
                "city": "",
                "country": "",
                "fax": "",
                "mail": "",
                "phone": "",
                "streetName1": "",
                "streetName2": "",
                "streetName3": "",
                "zipCode": ""
            },
            "customersCount": 0,
            "adminsCount": 0,
            "managersCount": 0,
            "externalReference": ""
        },
        "acteurId": 1,
        "address": {
            "city": "",
            "country": "",
            "fax": null,
            "mail": "ncroot@msactivator.com",
            "phone": "",
            "streetName1": "",
            "streetName2": "",
            "streetName3": "",
            "zipCode": ""
        },
        "delegationProfileId": 0,
        "userType": 2,
        "delegations": null,
        "delegationsPerCustomer": {},
        "netceloId": {
            "ubiID": "NCLG1",
            "thePrefix": "NCL",
            "id": 1,
            "customerPrefix": "NCL"
        },
        "isExternalAuth": false,
        "activationKey": "",
        "ccla": false,
        "isActive": true,
        "passwordUpdateDate": "",
        "attachedCustomerIds": null,
        "firstname": "",
        "attachedOperatorIds": null,
        "manageAllUsers": true,
        "name": "ncroot",
        "sort": "NAME",
        "ldapAuthentication": false,
        "delegationProfilePerCustomer": {}
    }
}
```

① auth TOKEN

Use the token from the auth response in the Authorization Bearer header to call the MSactivator™ REST API.

```
curl -H 'Accept: application/json' -H "Authorization: Bearer TOKEN" -XGET 'http://<MSA
IP or FQDN>/ubi-api-rest/user/customer-by-manager-id/1
```

Format

MSactivator™ API uses the JSON format.

Example API commands

For the full list of available commands, see the MSactivator™ API guide on your MSactivator™ instance: http://<MSA IP or FQDN>/swagger

User login

HTTP Request: `/ubi-api-rest/auth/token`

Method: `POST`

Parameter Name	Type	Description
username	String	User name
password	String	Password

Example:

```
{
    "username": "test",
    "password": "test1234567890"
}
```

Response:

```
{
    "token": "<TOKEN>",     ①
    "message": "authenticated",
    "authenticated": "true",
    "userDetails": {
        "id": 18,

        ... ②

        "externalReference": "UBIG18",
        "login": "test",
        "firstname": "",
        "manageAllUsers": true,
        "name": "test",
        "sort": "NAME",
        "ldapAuthentication": false,
        "delegationProfilePerCustomer": {}
    }
}
```

① the authentication token to use in the HTTP header of the REST API calls

② the JSON response has been shortened for this documentation

Ping an IP address from the CoreEngine

HTTP Request: `/ubi-api-rest/device/ping/{$ip_address}`

Method: `GET`

Parameter Name	Type	Description
ip_address	String	The IP address to ping

Example:

```
/ubi-api-rest/device/ping/127.0.0.1
```

Response:

```
{
    "status": "OK",
    "rawJSONResult": "{\"sms_status\":\"OK\",\"sms_code\":\"\",\"sms_message\":\"---
127.0.0.1 ping statistics ---\\n5 packets transmitted, 5 received, 0% packet loss,
time 3999ms\\nrtt min/avg/max/mdev = 0.031/0.036/0.043/0.006 ms\"}",
    "message": "--- 127.0.0.1 ping statistics ---\n5 packets transmitted, 5 received,
0% packet loss, time 3999ms\nrtt min/avg/max/mdev = 0.031/0.036/0.043/0.006 ms"
}
```

Call microservice functions

HTTP Request: `/ubi-api-rest/ordercommand/execute/{device_id}/{command_name}`

Method: `POST`

Parameter Name	Type	Description
device_id	Long	The database identifier of the Managed Entity
command_name	String	One of CREATE, UPDATE, DELETE
body	String	the payload with the microservice parameters

Example:

```
/ubi-api-rest/ordercommand/execute/156/CREATE
```

```
{
    "simple_firewall": {
        "789": {
            "object_id": "789",
            "src_ip": "7.8.3.0",
            "src_mask": "255.255.255.0",
            "dst_ip": "8.8.3.0",
            "dst_mask": "255.255.255.0",
            "service": "http",
            "action": "deny"
        }
    }
}
```

Response:

```
{
    "commandId": 0,
    "status": "OK",
    "message": "access-list 789 extended deny object http 7.8.3.0 255.255.255.0
8.8.3.0 255.255.255.0 log\n"
}
```

Configuration variables

HTTP Request: `/variables/{deviceId}/{name}`

Method: `GET`

Parameter Name	Type	Description
deviceId	Long	Id of device (Number format) has to be higher than 0, Example = 3453
name	String	Name of the variable, Example = var1

Configuration

HTTP Request: `/system-admin/v1/msa_vars`

Method: `POST`

Body:

```
[
  {
    "name": "string",
    "lastUpdate": "string",
    "comment": "string",
    "value": "string"
  }
]
```

Workflow

HTTP Request: `orchestration/service/execute/{ubiqubeId}`

Method: `POST`

Parameter Name	Type	Description
ubiqubeId	String	Id of the subtenant. A combination of the tenant prefix and the subtenant database ID. Example UBI123.
serviceName	String	Relative path of the workflow
processName	String	Relative path of the process

Body:

the payload JSON contains the parameter to pass to the process thus depends on the variables of the workflow

```
[
  {
    "name": "string",
    "lastUpdate": "string",
    "comment": "string",
    "value": "string"
  }
]
```

Example: call the process "Create Instance" of the worklflow "Helloworld"

This workflow is part of the MSActivator mini-lab and maintained in a github repository.

```
POST

/ubi-api-
rest/orchestration/service/execute/BLRA7?serviceName=Process/Tutorials/Helloworld/Hell
oworld&processName=Process/Helloworld/Process_create_instance

{"name":"jack"}
```

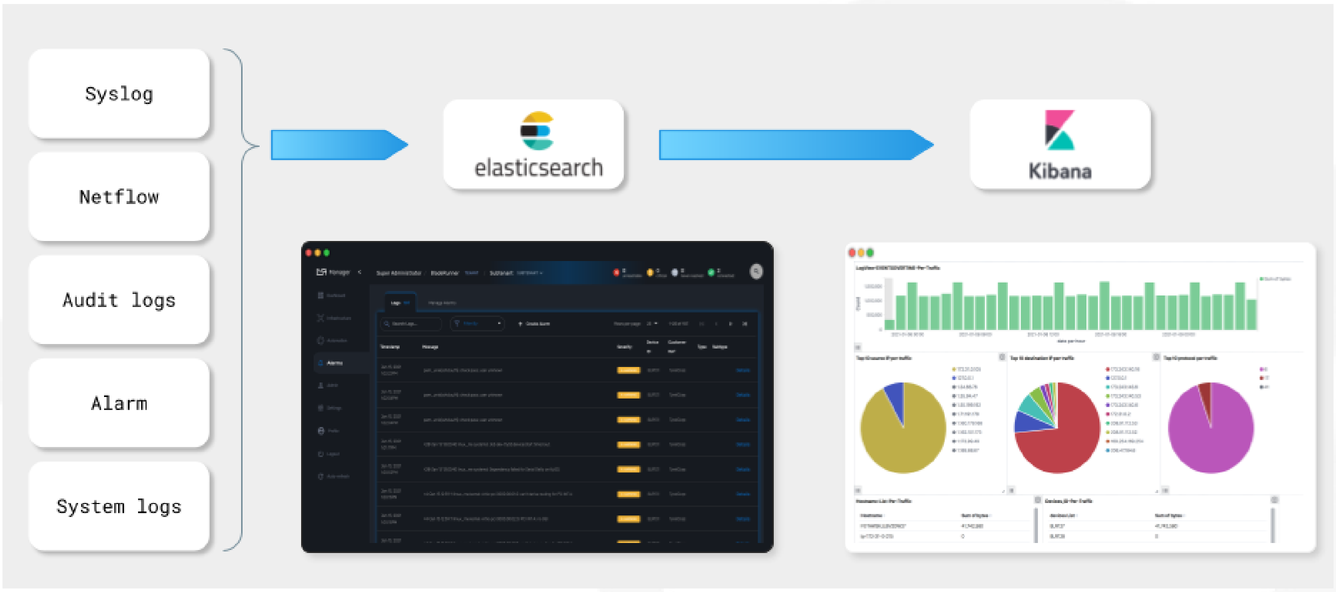
Dashboard design

The MSactivator™ integrate both Elasticsearch and Kibana to provide log analysis and event visualization.

Overview

To visualize the events stored in Elasticsearch, you can use some of the dashaboard that are packaged in the MSactivator™, but you can also design your own dashboards.

event processing flow in elasticsearch and kibana

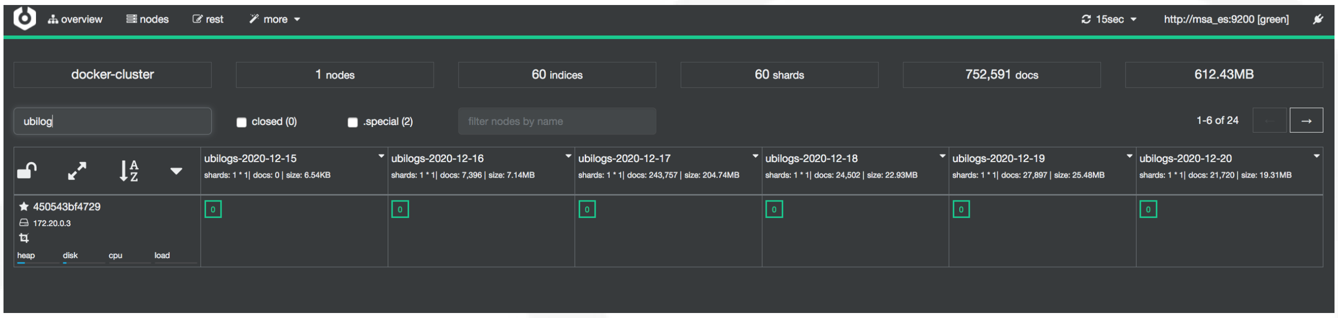


Create a dashboard

To create a dashboard, you can either reuse on of the existing visualization provided in the MSactivator™ or you can create your own.

Let's create a simple visualization to show in a histogram the number of events collected and indexed in ubilogs-* in Elasticsearch.

Cerebro on http://MSA_IP:9000 showing ubilogs indexes



docker-cluster	1 nodes	60 indices	60 shards	752,591 docs	612.43MB

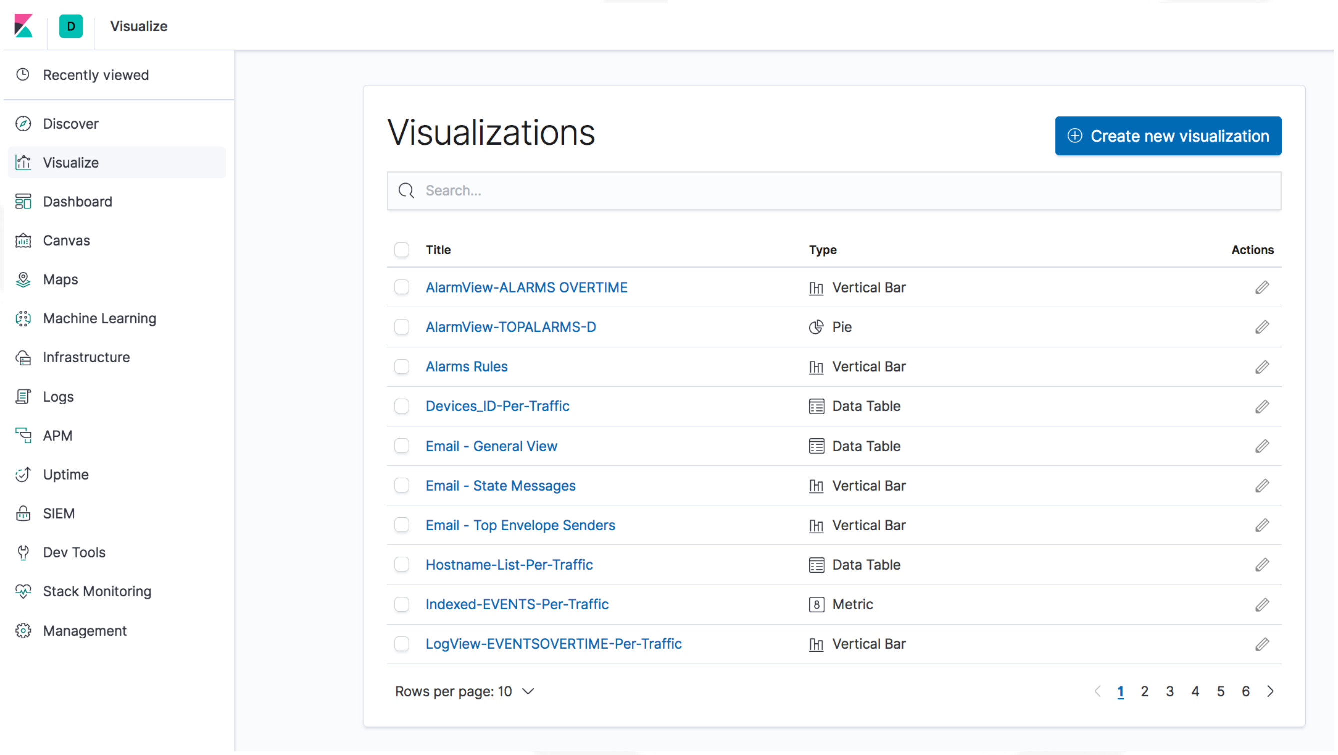
ubilog | closed (0) | .special (2) | filter nodes by name | 1-6 of 24

	ubilogs-2020-12-15	ubilogs-2020-12-16	ubilogs-2020-12-17	ubilogs-2020-12-18	ubilogs-2020-12-19	ubilogs-2020-12-20
	shards: 1 * 1| docs: 0 | size: 6.54KB	shards: 1 * 1| docs: 7,396 | size: 7.14MB	shards: 1 * 1| docs: 243,757 | size: 204.74MB	shards: 1 * 1| docs: 24,502 | size: 22.93MB	shards: 1 * 1| docs: 27,897 | size: 25.48MB	shards: 1 * 1| docs: 21,720 | size: 19.31MB
450543bf4729 172.20.0.3 heap disk cpu load	0	0	0	0	0	0

Create a visualization

Open Kibana on http://MSA_IP:5601 and select "Visualize" on the left menu.

visualizations available



Title	Type	Actions
AlarmView-ALARMS OVERTIME	Vertical Bar	
AlarmView-TOPALARMS-D	Pie	
Alarms Rules	Vertical Bar	
Devices_ID-Per-Traffic	Data Table	
Email - General View	Data Table	
Email - State Messages	Vertical Bar	
Email - Top Envelope Senders	Vertical Bar	
Hostname-List-Per-Traffic	Data Table	
Indexed-EVENTS-Per-Traffic	Metric	
LogView-EVENTSOVERTIME-Per-Traffic	Vertical Bar	

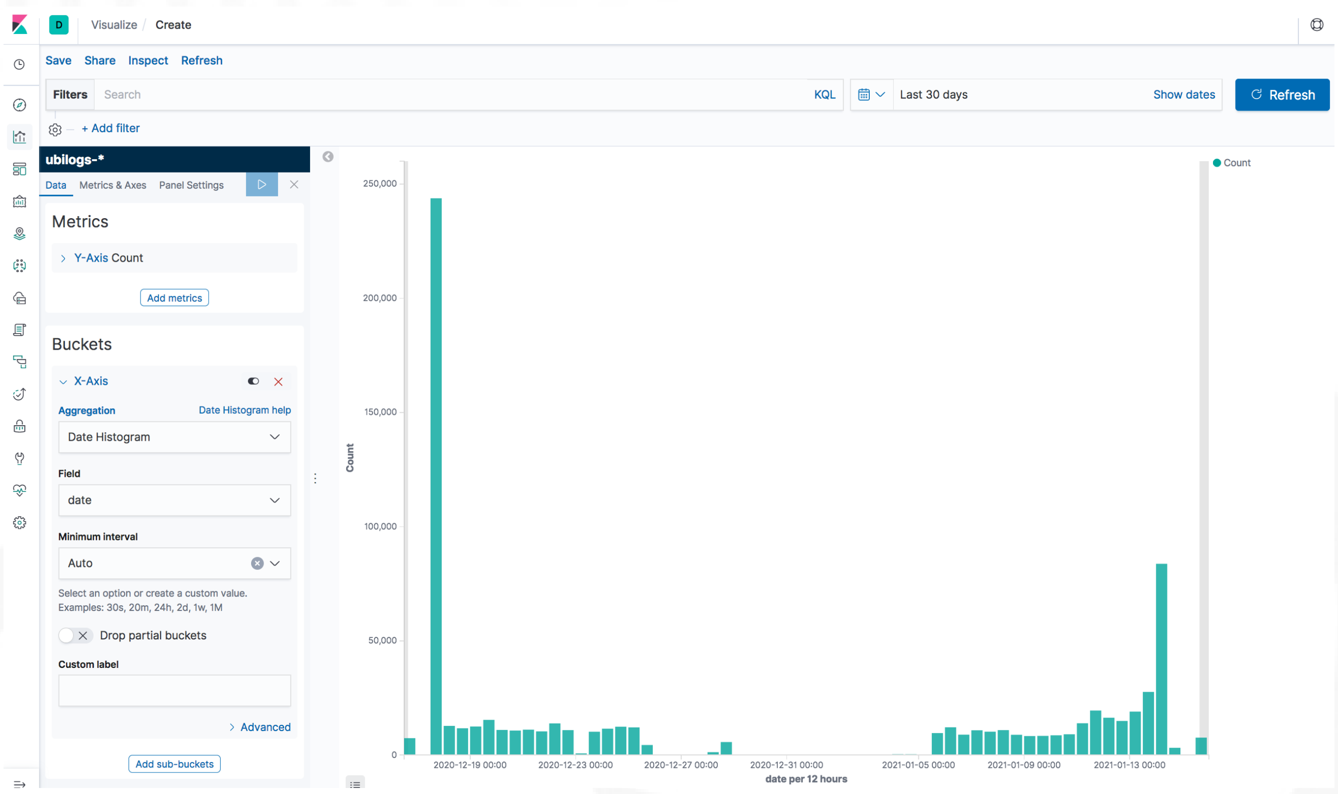
Rows per page: 10   1 2 3 4 5 6

Click on "+ Create new visualization", select "Vertical Bar" and choose ubilogs-* as the source.

In the configuration panel, select "X-Axis" as the bucket type and "Date Histogram" for the aggregation. The field for aggregation should be automatically set to "Date".

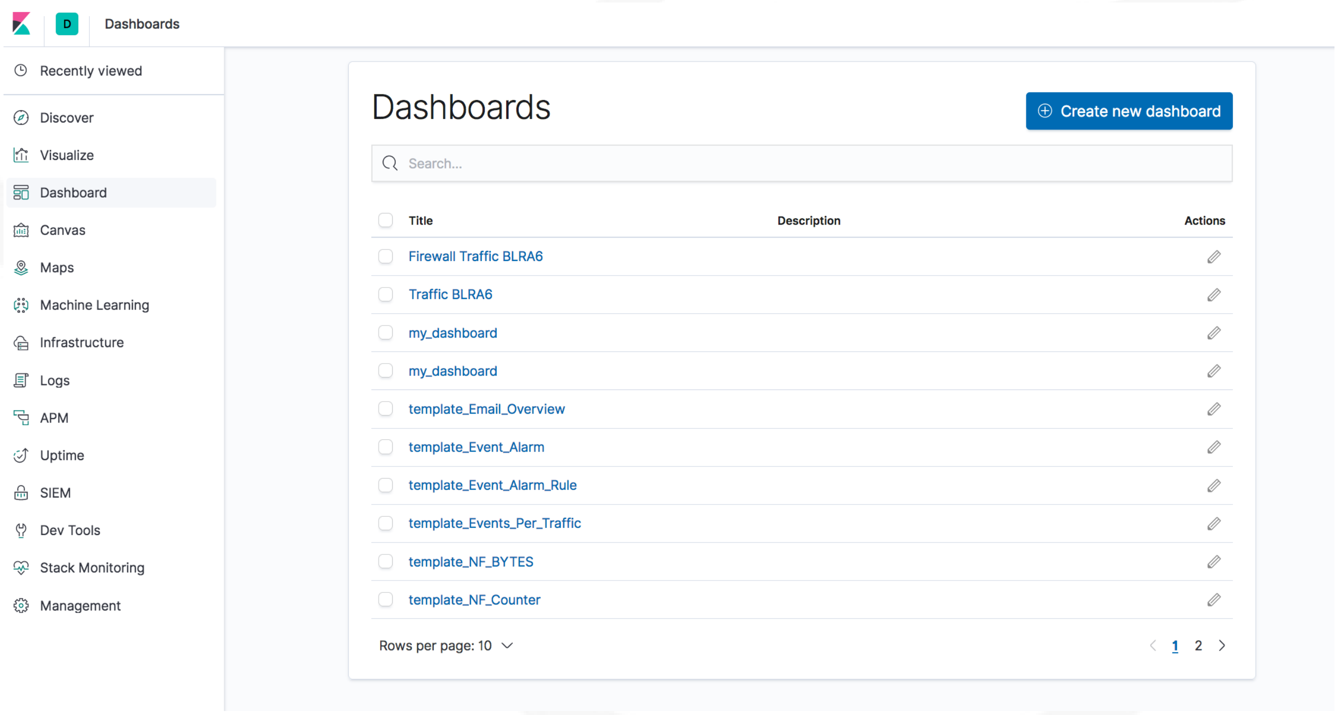
Click on the button "Apply Change" on the top right of the panel.

new visualization created



Save the visualization and browse to the dashboards

list of dashboards



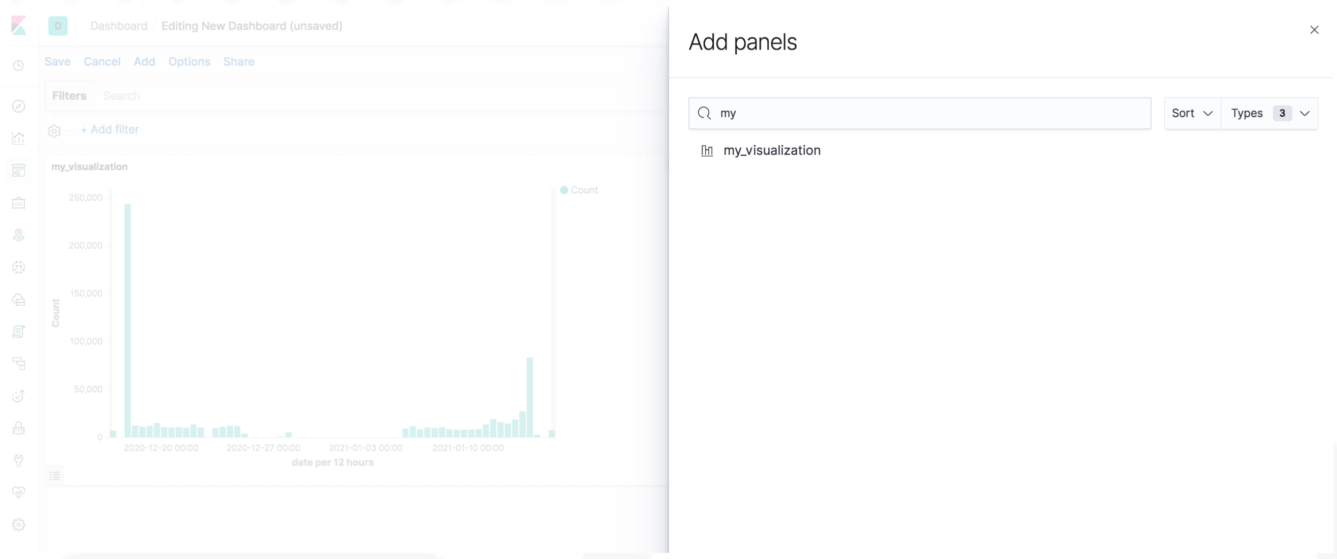
Dashboards

Title	Description	Actions
Firewall Traffic BLRA6		
Traffic BLRA6		
my_dashboard		
my_dashboard		
template_Email_Overview		
template_Event_Alarm		
template_Event_Alarm_Rule		
template_Events_Per_Traffic		
template_NF_BYTES		
template_NF_Counter		

Create a dashboard

Click on "+ Create new dashboard" to create a new dashboard and click "Add" to list the visualizations and select yours.

new visualization added

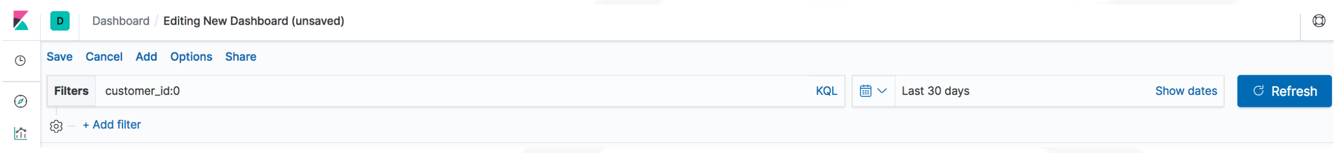


On the same dashboard, add another predefined visualization named "timeFilter". This will add a simple time range selector widget to your dashboard.

Set the subtenant filter

The dashboard is meant to be deployed for a subtenant by the workflow "Deploy Dashboard", the workflow will inject the subtenant ID in the dashboard. For this to happen you have to add a filter "customer_id:0" to your dashboard.

dummy filter for the dashboard template

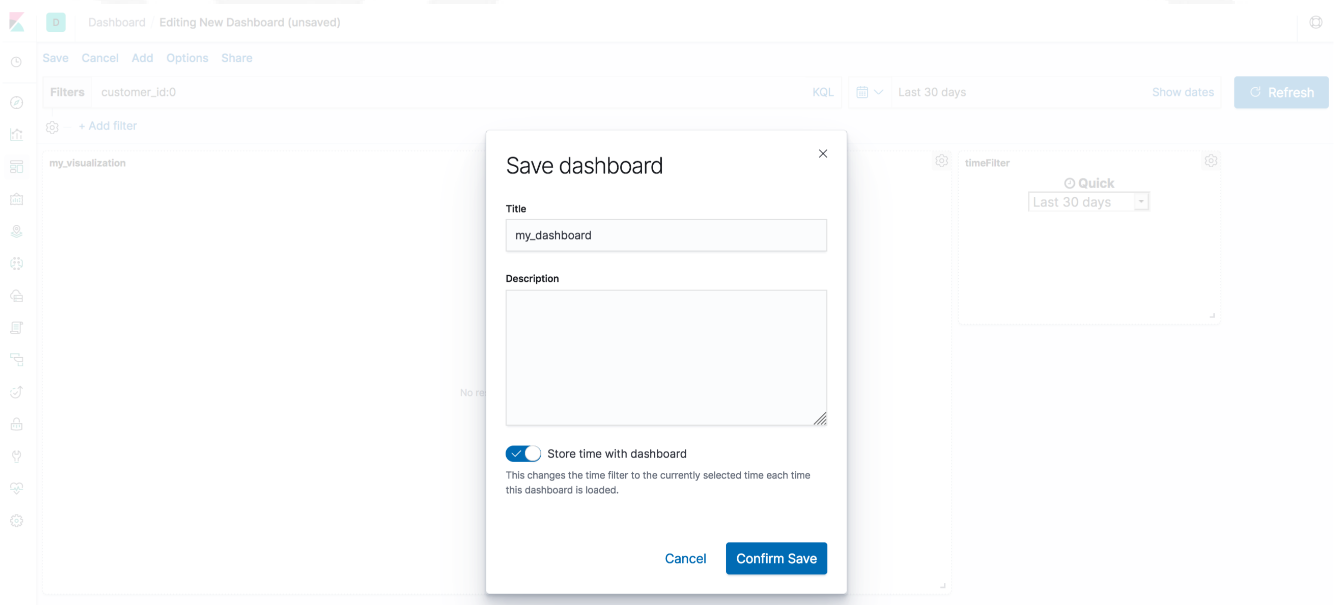


Dashboard / Editing New Dashboard (unsaved)

Filters: customer_id:0

Save the dashboard

save the dashboard with "Store time with dashboard"



Save dashboard

Title: my_dashboard

Description:

Store time with dashboard: on

This changes the time filter to the currently selected time each time this dashboard is loaded.

Update the reference and name of the dashboard

By default Kibana saves the dashboard with a UID to identify it but here is how to update your dashbaord and give it a human readable name that you can use in the deployment workflow.

Step 1: export the dashboard

From Kibana management, go to "Saved Objects" and select your dashboard, export is as an ndjson file. Leave the option "Include related object" off.

Step 2: edit the ndjson file

With your favorite text editor, edit the file and update the properties "title" and "id". Both properties should be set to the same value starting with "template_".

Example

```
"id":"template_my_dashboard"
"title":"template_my_dashboard"
```

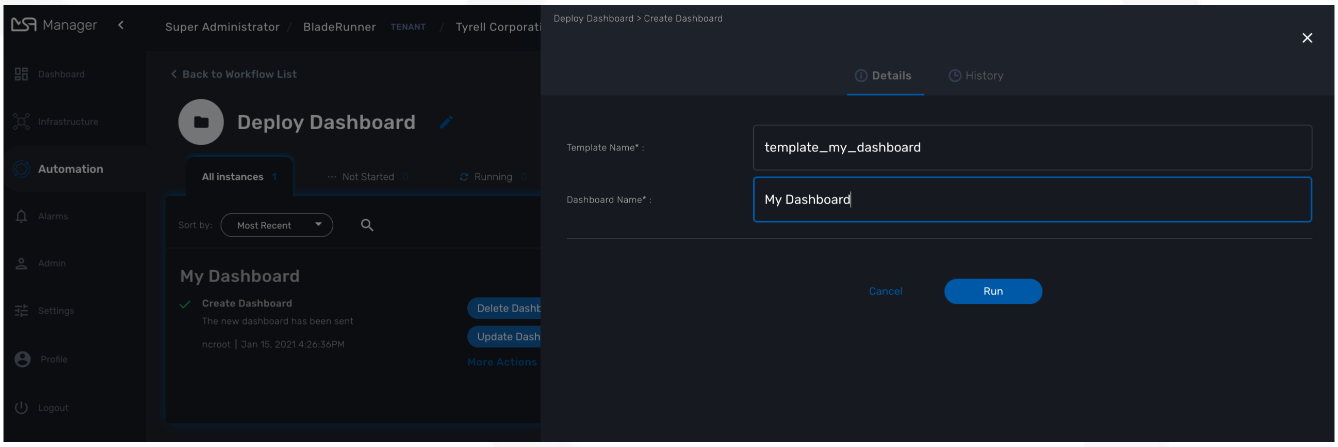
Step 3: import the dashboard

Step 4: deploy the dashboard with the selected name

On the MSactivator™ UI, select your subtenant, make sure the workflow "Deploy Dashboard" is attached and click "+ Create Dashboard".

Set the template name to name you used in the ndjson file and provide a name of your choice for the Dashboard.

deploy the dashboard



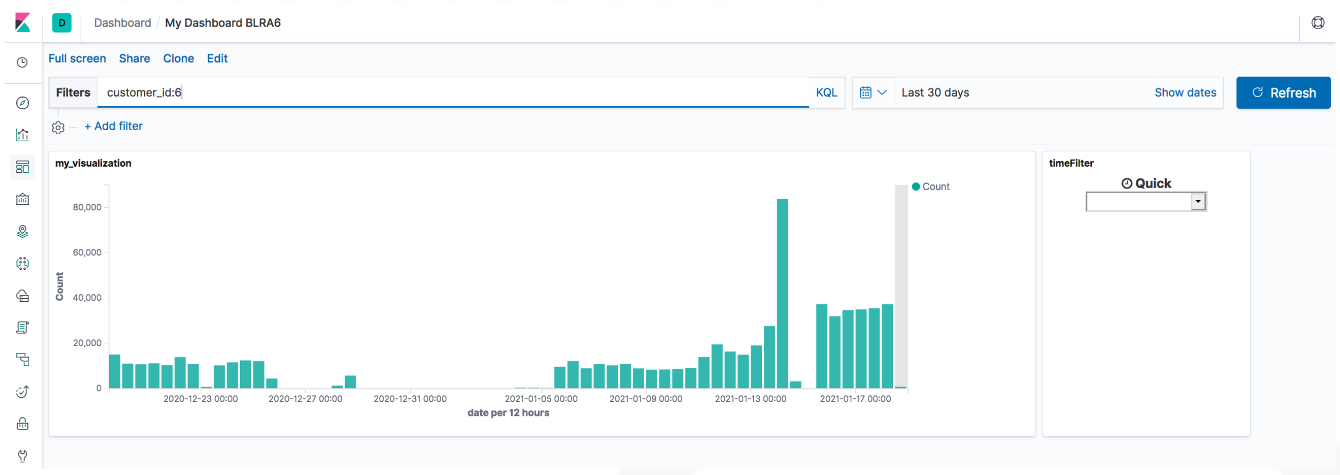
Template Name* : template_my_dashboard

Dashboard Name* : My Dashboard

Execute the process and use the URL provided in the process execution status to open your custom dashboard.

you need to edit the URL to use the proper IP address of your MSactivator™

dashboard deployed in Kibana



Dashboard / My Dashboard BLRA6
Full screen
Share
Clone
Edit
Filters
customer_id:6
KQL
Last 30 days
Show dates
Refresh
+ Add filter
my_visualization
Count
80,000
60,000
40,000
20,000
0
2020-12-23 00:00
2020-12-27 00:00
2020-12-31 00:00
2021-01-05 00:00
2021-01-09 00:00
2021-01-13 00:00
2021-01-17 00:00
date per 12 hours
timeFilter
Quick

DevOps best practice guide

The MSactivator™ is a platform for designing and developing network and security automation applications.

The community applications (Microservices, Workflows and Adaptors) are available on GitHub

These applications are located in dedicated GitHub repositories and can be forked and/or cloned from GitHub to your MSactivator™ development platform.

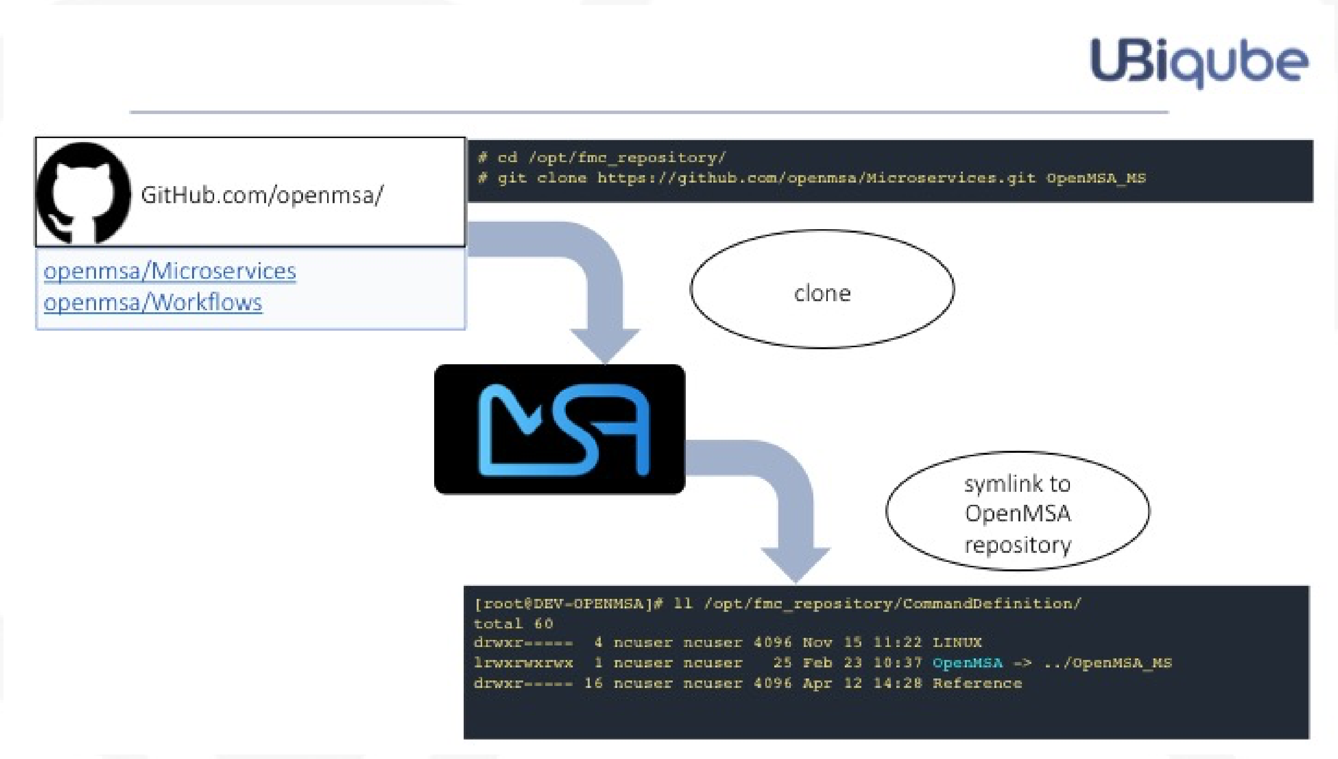
This page explains in detail how to do this and the associated best practices.

How to install the microservices and the workflows

Overview

As a DevOps engineer, the first step to getting familiar with the MSactivator™ community code is to:

- Retrieve the code from GitHub
- Install the code on the OpenMSA platform
- Utilize the microservices and the workflows



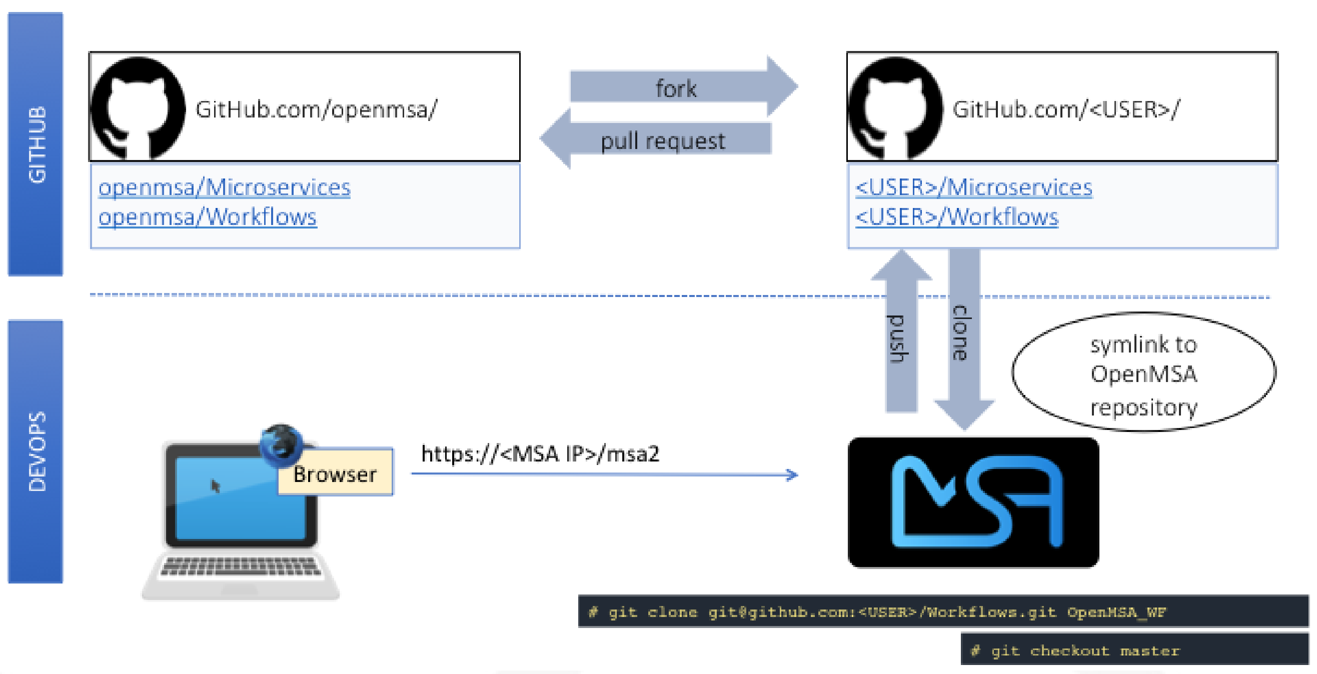
```
# cd /opt/fmc_repository/
# git clone https://github.com/openmsa/Microservices.git OpenMSA_MS
```

```
[root@DEV-OPENMSA]# ll /opt/fmc_repository/CommandDefinition/
total 60
drwxr-----  4 ncuser ncuser 4096 Nov 15 11:22 LINUX
lrwxrwxrwx  1 ncuser ncuser   25 Feb 23 10:37 OpenMSA -> ../OpenMSA_MS
drwxr----- 16 ncuser ncuser 4096 Apr 12 14:28 Reference
```

How to design/develop and contribute to the community

As a microservice or workflow designer you'll have the opportunity to contribute to the community source code.

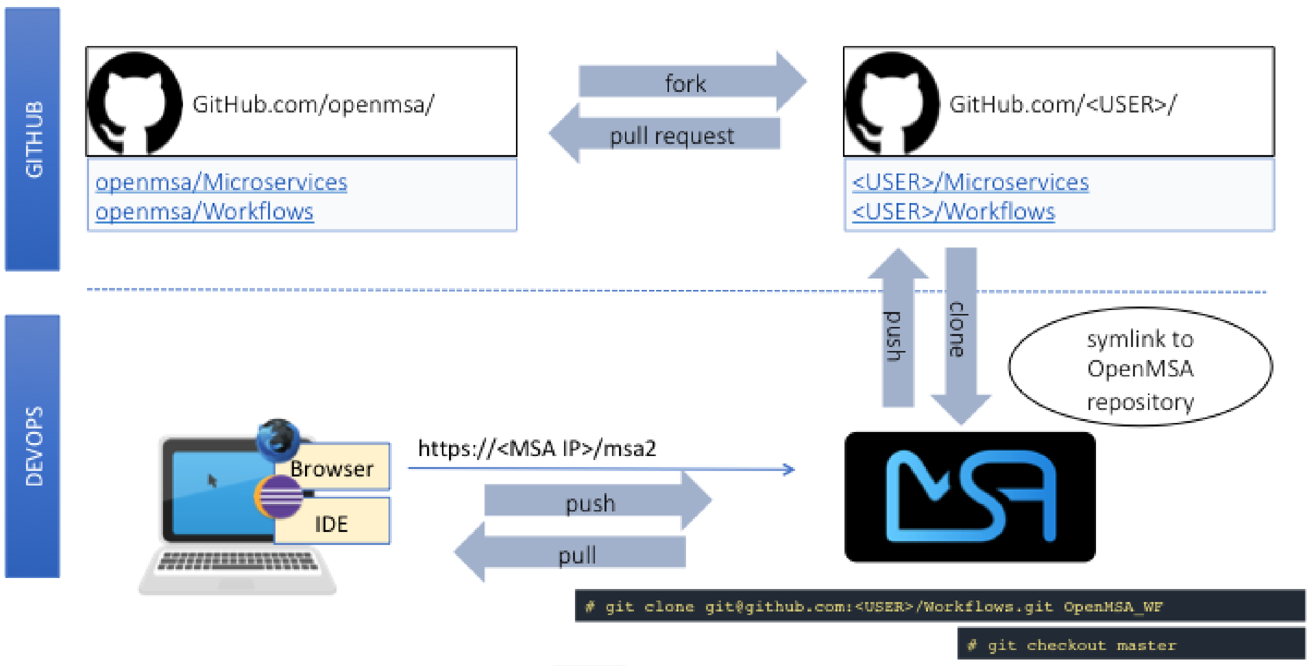
The easiest way is to utilize MSactivator™ as the design tool. This is the most typical and recommended method.



```
# git clone git@github.com:<USER>/Workflows.git OpenMSA_WF
```

```
# git checkout master
```

1. Fork the OpenMSA repository into your GitHub account.
2. Clone the repository from your personal GitHub account to your OpenMSA DevOps platform.
3. Utilize your favorite browser to use/design/test/update Workflows and Microservices.
4. Push the changes to your GitHub account.
5. Contribute by submitting pull requests to the OpenMSA community.
6. It is possible to use your favorite IDE to ease development of Workflow tasks or Device Adaptors that are in PHP language.



This procedure adds a set of push/pull steps to sync the code from your PC with your MSactivator™ DevOps platform.

Design or edit code on your PC and IDE, such as Eclipse or a simple editor with PHP syntax highlighting, then push to the MSactivator™ platform to use it live.

Default installation for the libraries.

When you install the MSactivator™ with the quickstart a selected list of libraries (microservices, workflows and adapters) are installed by default.

The installation is done by the script `install_libraries.sh` installed in the docker container msa_dev.

Standard libraries installation

Next, we'll see where the adapters, microservices and workflows are installed, and some of the specific facts about this installation that you need to be aware of when installing your own libraries.

Adapters

The Github repository for the adapters is located under `/opt/devops/OpenMSA_Adapters`. By default, the git remote is

```
# git remote -v
origin  https://github.com/openmsa/Adapters.git (fetch)
origin  https://github.com/openmsa/Adapters.git (push)
```

and the branch points to master

```
# git branch
* master
```

If you are planning to add your adapter or update an existing one, you need to add a remote to point to your own fork of the Github repository and create a dedicated branch.

When you are ready with you development, you can commit and push your changes to your remote with the new remote and use the branch as the upstream branch. You will then be able to create a pull request on OpenMSA repository and start contributing to the community code.

Learning about creating and installing new adapters is addressed in the adapter development documentation.

Microservices

The Github repository for the microservices is located under `/opt/fmc_repository/OpenMSA_MS`.

In a similar way to the adapters above, the remote is set to https://github.com/openmsa/Microservices.git and the default branch is master.

You can add your own remote and push your working branch to your fork.

The installation of the microservices is done under `/opt/fmc_repository/CommandDefinition/` and is based on symbolic links to the git repo.

```
# ls -la | grep LINUX
lrwxrwxrwx  1 ncuser ncuser   25 Sep 24 09:02 .meta_LINUX -> ../OpenMSA_MS/.meta_LINUX
① ②
lrwxrwxrwx  1 ncuser ncuser   19 Sep 24 09:02 LINUX -> ../OpenMSA_MS/LINUX ②
```

① A symlink as to be created to the meta file

② you need to set `ncuser` as the user and group for all the files under `/opt/fmc_repository/CommandDefinition/` otherwise the microservices won't be listed or editable on the UI.

Workflows

The Github repository for the workflows is located under `/opt/fmc_repository/OpenMSA_MS`.

In a similar way to the microservices above, the remote is set to https://github.com/openmsa/Workflows.git and the default branch is master.

The installation of the microservices is done under `/opt/fmc_repository/Process/` and is based on symbolic links to the git repo.

```
# ls -la | grep Topology
```

```
lrwxrwxrwx  1 ncuser ncuser   28 Sep 24 09:02 .meta_Topology ->
../OpenMSA_WF/.meta_Topology
lrwxrwxrwx  1 ncuser ncuser   22 Sep 24 09:02 Topology -> ../OpenMSA_WF/Topology
```

when creating the symlinks to the workflow, you need to make sure to keep the consistency with the paths defined in the workflow definition file.