FIWARE-Bosun: Cloto

Release

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Contents

Introduction

Bosun is the reference implementation (GEri) of FIWARE Policy Manager GE, and its component Cloto provides a REST API to create rules associated to servers, subscribe to Context Broker to get information about resources consumption of those servers, and launch actions described in rules when conditions are met.

Policy Manager provides the basic management of cloud resources based on rules, as well as management of the corresponding resources within the FIWARE Cloud instance like actions based on physical monitoring or infrastructure, security monitoring of resources and services or whatever that could be defined by facts, actions and rules. Policy Manager is a easy rule engine designed to be used in the OpenStack ecosystem and, of course, inside the FIWARE Cloud.

IMPORTANT NOTE: This GE reference implementation product is only of interest to potential FIWARE instance providers and therefore has been used to build the basic FIWARE platform core infrastructure of FIWARE Lab. If you are an application developer, you don't need to create a complete FIWARE instance locally in order to start building applications based on FIWARE. You may rely on instances of FIWARE GEris linked to the Data/Media Context Management, the IoT Services Enablement and the Advanced Web-based User Interface chapters, or some GEris of the Applications/Services Ecosystem and Delivery Framework chapter (WireCloud) as well as the Security chapter (Access Control). Those instances are either global instances or instances you can create on FIWARE Lab, but also instances you may create by downloading, installing and configuring the corresponding software in your own premises.

Bosun Policy Manager REST API source code can be found here.

CHAPTER 2

Documentation

GitHub's README provides a good documentation summary, and the following cover more advanced topics:

2.1 User & Programmers Guide

2.1.1 Introduction

Welcome the User and Programmer Guide for the Policy Manager Generic Enabler. The online documents are being continuously updated and improved, and so will be the most appropriate place to get the most up to date information on using this interface.

Background and Detail

This User and Programmers Guide relates to the Policy Manager GE which is part of the Cloud Hosting Chapter. Please find more information about this Generic Enabler in the following Open Specification.

2.1.2 User Guide

The Policy Manager GE is a backend component, without user interface. Therefore there is no need to provide a user guide. The Cloud Portal can be used for Web-based interaction (but it is not part of this GE).

2.1.3 Programmer Guide

Policy Manager API is based upon HTTP and therefore all devices, which can handle HTTP traffic, are possible clients.

Accessing Policy Manager from the CLI

To invoke the REST API use the curl program. Curl [1] is a client to get documents/files from or send documents to a server, using any of the supported protocols (HTTP, HTTPS, FTP, LDAP, FILE, etc.) and therefore is also suitable for Policy Manager API. Use either the curl command line tool or libcurl from within your own programs in C. Curl is free and open software that compiles and runs under a wide variety of operating systems.

In order to make a probe of the different functionalities related to the Policy Manager, we make a list of several operations to make a probe of the execution of these GEis.

1. Get a valid token for the tenant that we have (It is not a Policy Manager operation but a IdM operation).

Due to all operations of the Policy Manager are using the security mechanism which is used in the rest of the cloud component, it is needed to provide a security token in order to continue with the rest of operations.

```
curl -d '{"auth": {"tenantName": $TENANT, "passwordCredentials":{"username": $USERNAME,
"password": $PASSWORD}}}' -H "Content-type: application/json"
-H "Accept: application/xml"  http://130.206.80.100:35357/v2.0/tokens
```

Both $TENANT (Project), $USERNAME and $PASSWORD must be values previously created in the OpenStack Keystone. The IP address 10.95.171.115 and the Port 35357 are the data of our internal installation of IdM, if you planned to execute it you must changed it by the corresponding IP and Port of the FIWARE Keystone or IdM IP and Port addresses.

We obtained two data from the previous sentence:

- X-Auth-Token

```
<token expires="2012-10-25T16:35:42Z" id="a9a861db6276414094bc1567f664084d">
```

- Tenant-Id

```
<tenant enabled="true" id="c907498615b7456a9513500fe24101e0" name=$TENANT>
```

2. Get tenant information

This is the first real operation about our GEi, by which we can obtain the information about the Policy Manager, together with the information about the window size fixed for the execution of the GEi. For more information about the window size and its meaning.

```
curl -v -H 'X-Auth-Token: a9a861db6276414094bc1567f664084d'
-X GET http://130.206.81.71:8000/v1.0/c907498615b7456a9513500fe24101e0
```

This operation will return the information regarding the tenant details of the execution of the Policy Manager

```
< HTTP/1.0 200 OK
< Date: Wed, 09 Apr 2014 08:25:17 GMT
< Server: WSGIServer/0.1 Python/2.6.6
< Content-Type: text/html; charset=utf-8
{
    "owner": "Telefonica I+D",
    "doc": "https://forge.fi-ware.org/plugins/mediawiki/wiki/fi-ware-private/index.php/
                                                        FIWARE.OpenSpecification.Details.Cloud.PolicyManager'
    "runningfrom": "14/04/09 07:45:22",
    "version": 1.0,
    "windowsize": 5
}
```

3. Create a rule for a server

This operation allows to create a specific rule associate to a server:

```
curl -v -H 'X-Auth-Token: 86e096cd4de5490296fd647e21b7f0b4'
-X POST http://130.206.81.71:8000/v1.0/6571e3422ad84f7d828ce2f30373b3d4/servers
/32c23ac4-230d-42b6-81f2-db9bd7e5b790/rules/
-d '{"action": {"actionName": "notify-scale", "operation": "scaleUp"}, "name": "ScaleUpRule",
"condition": { "cpu": { "value": 98, "operand": "greater" },
"mem": { "value": 95, "operand": "greater equal"}}}'
```

The result of this operation is the following content:

```
< HTTP/1.0 200 OK
< Date: Wed, 09 Apr 2014 10:14:11 GMT
< Server: WSGIServer/0.1 Python/2.6.6
< Content-Type: text/html; charset=utf-8
{
    "serverId": "32c23ac4-230d-42b6-81f2-db9bd7e5b790",
    "ruleId": "68edb416-bfc6-11e3-a8b9-fa163e202949"
}
```

4. Subscribe the server to the rule

Through this operation we can subscribe a rule to be monitored in order to evaluate the rule to be processed.

```
curl -v -H 'X-Auth-Token: a9a861db6276414094bc1567f664084d'
-X POST http://130.206.81.71:8000/v1.0/6571e3422ad84f7d828ce2f30373b3d4/servers
/32c23ac4-230d-42b6-81f2-db9bd7e5b790/subscription
-d '{ "ruleId": "ruleid", "url": "URL to notify any action" }'
```

An the expected result is the following.

```
< HTTP/1.0 200 OK
< Date: Wed, 09 Apr 2014 10:16:11 GMT
< Server: WSGIServer/0.1 Python/2.6.6
< Content-Type: text/html; charset=utf-8
{
    "serverId": "32c23ac4-230d-42b6-81f2-db9bd7e5b790",
    "subscriptionId": "6f231936-bfce-11e3-9a13-fa163e202949"
}
```

5. Manual simulation of data transmission to the server

This operation simulate the operation that the context broker used to send data to the Policy Manager, the normal execution of this process will be automatically once that the Policy Manager subscribes a rule to a specific server. The operation is related to fiware-facts component and it has the following appearance:

```
curl -v -H "Content-Type: application/json"
-X POST http://127.0.0.1:5000/v1.0/6571e3422ad84f7d828ce2f30373b3d4/servers/serverI1
-d '{
"contextResponses": [
    {
        "contextElement": {
           "attributes": [
                {
                    "value": "0.12",
                    "name": "usedMemPct",
                    "type": "string"
                },
                {
                    "value": "0.14",
                    "name": "cpuLoadPct",
                    "type": "string"
                },
                {
                    "value": "0.856240",
                    "name": "freeSpacePct",
                    "type": "string"
                },
                {
                    "value": "0.8122",
                    "name": "netLoadPct",
                    "type": "string"
                }
            ],
            "id": "Trento:193.205.211.69",
            "isPattern": "false",
            "type": "host"
        },
        "statusCode": {
            "code": "200",
            "reasonPhrase": "OK"
        }
    }]
}'
```

Which produces the following result after the execution:

```
* About to connect() to 127.0.0.1 port 5000 (#0)
*   Trying 127.0.0.1...
* Adding handle: conn: 0x7fa2e2804000
* Adding handle: send: 0
* Adding handle: recv: 0
* Curl_addHandleToPipeline: length: 1
* - Conn 0 (0x7fa2e2804000) send_pipe: 1, recv_pipe: 0
* Connected to 127.0.0.1 (127.0.0.1) port 5000 (#0)
> POST /v1.0/33/servers/44 HTTP/1.1
> User-Agent: curl/7.30.0
> Host: 127.0.0.1:5000
> Accept: */*
> Content-Type: application/json
> Content-Length: 1110
> Expect: 100-continue
>
< HTTP/1.1 100 Continue
< HTTP/1.1 200 OK
< Content-Type: text/html; charset=utf-8
< Content-Length: 0
< Date: Wed, 09 Apr 2014 00:11:49 GMT
<
* Connection #0 to host 127.0.0.1 left intact
```

6. Unsubscribe the previous rule

In order to stop the process to evaluate rules, it is needed to unsubscribe the activated rule. We can do it with the following operation:

```
curl -v -H 'X-Auth-Token: a9a861db6276414094bc1567f664084d'
-X DELETE http://130.206.81.71:8000/v1.0/6571e3422ad84f7d828ce2f30373b3d4/servers
/serverI1/subscription/SubscriptionId
```

```
< HTTP/1.0 200 OK
< Date: Wed, 09 Apr 2014 10:16:59 GMT
< Server: WSGIServer/0.1 Python/2.6.6
< Content-Type: text/html; charset=utf-8
```

Accessing Policy Manager from a browser

To send HTTP requests to Policy Manager using a browser, you may use:

- Chrome browser [2] with the Simple REST Client plugin [3]
- Firefox RESTClient add-on [4].

2.2 Installation & Administration Guide

2.2.1 Policy Manager Installation

This guide tries to define the procedure to install the Policy Manager in a machine, including its requirements and possible troubleshooting that we could find during the installation. We have to talk about two applications deployed in a Django server.

Requirements

In order to execute the Policy Manager, it is needed to have previously installed the following software of framework in the machine:

- Rule engine dependencies:
  - Python 2.7.6 [1]
  - PyClips 1.0 [2]
  - RabbitMQ 3.3.0 [3]
  - MySQL 5.6.14 or above [4]
- Facts engine dependencies:
  - Python 2.7.6 [1]
  - Redis 2.8.8 [5]

Rule engine installation

There is no need to configure any special options in django server. Run as default mode.

Step 1: Install python

If you do not have python installed by default, please, follow instructions for your Operating System in the official page: https://www.python.org/download/releases/2.7.6/

Step 2: Install pyclips

Download pyclips from http://sourceforge.net/projects/pyclips/files/pyclips/pyclips-1.0

To install pyclips execute this following commands:

```
$ tar -xvf pyclips-1.0.X.Y.tar.gz
$ cd pyclips
$ python setup.py build
$ su -c "python setup.py install"
```

Maybe you need to execute these commands using sudo.

If everything was OK, you should not receive any error.

Step 3: Install RabbitMQ

To install RabbitMQ Server, it is better to refer official installation page and follow instructions for the Operating System you use: http://www.rabbitmq.com/download.html

After installation, you should start RabbitMQ. Note that you only need one instance of RabbitMQ and It could be installed in a different server than fiware-facts or Rule Engine.

Step 4: Install MySQL

To install MySQL Server, it is better to refer official installation page and follow instructions for the Operating System you use: http://dev.mysql.com/downloads/mysql/

You will need four packages:

```
mysql-server
mysql-client
mysql-shared
mysql-devel
```

After installation, you should create a user, create database called 'cloto' and give all privileges to the user for this database. The name of that database could be different but should be configured in the config file of fiware-facts and fiware-cloto.

To add a user to the server, please follow official documentation: http://dev.mysql.com/doc/refman/5.5/en/adding-users.html

Step 5: Download and execute the Rule Engine server

1. Installing fiware-cloto

Install the component by executing the following instruction:

```
sudo pip install fiware-cloto
```

It should show something like the following:

```
Installing collected packages: fiware-cloto
    Running setup.py install for fiware-cloto
Successfully installed fiware-cloto
Cleaning up...
```

2. Configuring Rule engine

Before starting the rule engine, you should edit settings file and add it to the default folder located in `/etc/fiware.d/fiware-cloto.cfg`

In addition, user could have a copy of this file in other location and pass its location to the server in running execution defining an environment variable called CLOTO_SETTINGS_FILE.

You can find the reference file here. You should copy this file into default folder and complete all empty keys.

```
[openstack]
# OPENSTACK information about KEYSTONE to validate tokens received
OPENSTACK_URL: http://cloud.lab.fi-ware.org:4731/v2.0
ADM_USER:
ADM_PASS:
ADM_TENANT_ID:
ADM_TENANT_NAME:
USER_DOMAIN_NAME: Default
AUTH_API: v2.0

[policy_manager]
SECURITY_LEVEL: LOW
SETTINGS_TYPE: production
DEFAULT_WINDOW_SIZE: 5
MAX_WINDOW_SIZE: 10
LOGGING_PATH: /var/log/fiware-cloto

[context_broker]
CONTEXT_BROKER_URL: http://130.206.115.92:1026/v1
# Public IP of fiware-facts module
NOTIFICATION_URL: http://127.0.0.1:5000/v1.0
NOTIFICATION_TYPE: ONTIMEINTERVAL
NOTIFICATION_TIME: PT5S

[rabbitmq]
# URL Where RabbitMQ is listening (no port needed, it uses default port)
RABBITMQ_URL: localhost

[mysql]
DB_CHARSET: utf8
DB_HOST: localhost
DB_NAME: cloto
DB_USER:
DB_PASSWD:

[django]
DEBUG: False
DATABASE_ENGINE: django.db.backends.mysql
ALLOWED_HOSTS: ['127.0.0.1', 'localhost']
### Must be a unique generated value. keep that key safe.
SECRET_KEY: TestingKey+faeogfjksrjgpjaspigjiopsjgvopjsopgvj

[logging]
level: INFO
```

You should also modify `ALLOWED_HOSTS` parameter adding the hosts you want to be accesible from outside, your IP address, the domain name, etc. An example could be like this:

```
ALLOWED_HOSTS: ['127.0.0.1', 'localhost', 'policymanager.host.com','80.71.123.2’]
```

Finally, ensure that you create a folder for logs `/var/log/fiware-cloto/` (by default), with the right permissions to write in that folder.

```
mkdir -m /var/log/fiware-cloto
```

In 2.5.0 release we added a new parameter called `SECURITY_LEVEL`. This parameter could have three values: `[HIGH | MEDIUM | LOW]` Depending of API version it will store user tokens in memory assuming that a token will be valid for a time period. After this expiration time, token is going to be verified with against keystone.

```
Using v3:
 LOW: user token should be verified after 1h
 MEDIUM: User token should be verified after 30min
 HIGH: user token should be verified after each request

Using v2.0:
 LOW: user tokens should be verified after 24h
 MEDIUM: user token should be verified after 6h
 HIGH: user token should be verified after each request
```

3. Starting the server

To run fiware-cloto, just execute:

```
$ gunicorn fiware_cloto.cloto.wsgi -b $IP
```

Where $IP is a valid network interface assigned with a public address. If you execute the command with `127.0.0.1` fiware-cloto won't be accessible from outside.

To stop fiware-cloto, you can stop gunicorn server, or kill it

NOTE: if you want to see gunicorn log if something is going wrong, you could execute the command before adding `--log-file=-` at the end of the command. This option will show the logs in your prompt (standard stderr). If you want to store the log into a file just write `--log-file=<log file name>`.

Facts installation

Step 1: Install python

The process will be the same that be see in the previous section.

Step 2: Install Redis

Download, extract and compile Redis with:

```
$ wget http://download.redis.io/releases/redis-2.8.8.tar.gz
$ tar xzf redis-2.8.8.tar.gz
$ cd redis-2.8.8
$ make
```

The binaries that are now compiled are available in the src directory. Run Redis with:

```
$ src/redis-server
```

It execute the redis server on port 6379.

You can interact with Redis using the built-in client:

```
$ src/redis-cli
redis> set foo bar
OK
redis> get foo
"bar"
```

Step 3: Install MySQL

The process is the same as process seen in the previous section. If fiware-facts is being installed in the same system as fiware-cloto, you could omit this step.

Step 4: Download and execute the facts engine server

1. Installing fiware-facts

Using pip Install the component by executing the following instruction:

```
pip install fiware-facts
```

This operation will install the component in your python site-packages folder.

It should shown the following information when it is executed:

```
Installing collected packages: fiware-facts
  Running setup.py install for fiware-facts

Successfully installed fiware-facts
Cleaning up...
```

2. Configuring fiware-facts

The configuration used by fiware-facts component is read from the configuration file located at `/etc/fiware.d/fiware-facts.cfg`

MySQL cloto configuration must be filled before starting fiware-facts component, user and password are empty by default. You can copy the default configuration file `facts_conf/fiware_facts.cfg` to the folder defined for your OS, and complete data about cloto MySQL configuration (user and password).

In addition, user could have a copy of this file in other location and pass its location to the server in running execution defining an environment variable called FACTS_SETTINGS_FILE.

Options that user could define:

```
[common]
 brokerPort: 5000       # Port listening fiware-facts
 clotoPort:  8000       # Port listening fiware-cloto
 redisPort:  6379       # Port listening redis-server
 redisHost:  localhost  # Address of redis-server
 rabbitMQ:   localhost  # Address of RabbitMQ server
 cloto:      127.0.0.1  # Address of fiware-cloto

[mysql]
 host: localhost        # address of mysql that fiware-cloto is using
 user:                  # mysql user
 password:              # mysql password

[logger_root]
 level: INFO            # Logging level (DEBUG, INFO, WARNING, ERROR, CRITICAL)
```

Finally, ensure that you create a folder for logs `/var/log/fiware-facts/` (by default), with the right permissions to write in that folder.

```
mkdir -m /var/log/fiware-facts
```

3. Starting the server

Execute command:

```
gunicorn facts.server:app -b $IP:5000
```

Where $IP should be the IP assigned to the network interface that should be listening (ej. 192.168.1.33)

You can also execute the server with a different settings file providing an environment variable with the location of the file:

```
gunicorn facts.server:app -b $IP:5000
--env FACTS_SETTINGS_FILE=/home/user/fiware-facts.cfg
```

NOTE: if you want to see gunicorn log if something is going wrong, you could execute the command before adding `--log-file=-` at the end of the command. This option will show the logs in your prompt (standard stderr). If you want to store the log into a file just write `--log-file=<log file name>`.

When you execute the server you can see some information about the server:

```
2015-09-24 16:30:10,845 INFO policymanager.facts policymanager.facts 1.7.0

2015-09-24 16:30:10,846 INFO policymanager.facts Running in stand alone mode
2015-09-24 16:30:10,846 INFO policymanager.facts Port: 5000
2015-09-24 16:30:10,846 INFO policymanager.facts PID: 19472

2015-09-24 16:30:10,846 INFO policymanager.facts
                                                  https://github.com/telefonicaid/fiware-facts



2015-09-24 16:30:10,896 INFO policymanager.facts Waiting for windowsizes
```

2.2.2 Sanity check procedures

The Sanity Check Procedures are the steps that a System Administrator will take to verify that an installation is ready to be tested. This is therefore a preliminary set of tests to ensure that obvious or basic malfunctioning is fixed before proceeding to unit tests, integration tests and user validation.

End to End testing

Although one End to End testing must be associated to the Integration Test, we can show here a quick testing to check that everything is up and running. For this purpose we send a request to our API in order to test the credentials that we have from then and obtain a valid token to work with.

In order to make a probe of the different functionalities related to the Policy Manager, we start with the obtention of a valid token for a registered user. Due to all operations of the Policy Manager are using the security mechanism which is used in the rest of the cloud component, it is needed to provide a security token in order to continue with the rest of operations. For this operation we need to execute the following curl sentence.

```
curl -d '{"auth": {"tenantName": $TENANT,
"passwordCredentials":{"username": $USERNAME, "password": $PASSWORD}}}'
-H "Content-type: application/json" -H "Accept: application/xml"
http://130.206.80.100:35357/v2.0/tokens
```

Both $TENANT (Project), $USERNAME and $PASSWORD must be values previously created in the OpenStack Keystone. The IP address 10.95.171.115 and the Port 35357 are the data of our internal installation of IdM, if you planned to execute it you must changed it by the corresponding IP and Port of the FIWARE Keystone or IdM IP and Port addresses.

We obtained two data from the previous sentence:

- X-Auth-Token

```
<token expires="2012-10-25T16:35:42Z" id="a9a861db6276414094bc1567f664084d">
```

- Tenant-Id

```
<tenant enabled="true" id="c907498615b7456a9513500fe24101e0" name=$TENANT>
```

After it, we can check if the Policy Manager is up and running with a single instruction which is used to return the information of the status of the processes together with the queue size.

```
curl -v -H 'X-Auth-Token: a9a861db6276414094bc1567f664084d'
-X GET http://130.206.81.71:8000/v1.0/c907498615b7456a9513500fe24101e0
```

This operation will return the information regarding the tenant details of the execution of the Policy Manager

```
< HTTP/1.0 200 OK
< Date: Wed, 09 Apr 2014 08:25:17 GMT
< Server: WSGIServer/0.1 Python/2.6.6
< Content-Type: text/html; charset=utf-8
{
    "owner": "Telefonica I+D",
    "doc": "https://forge.fi-ware.org/plugins/mediawiki/wiki/fi-ware-private/index.php/
                                 FIWARE.OpenSpecification.Details.Cloud.PolicyManager",
    "runningfrom": "14/04/09 07:45:22",
    "version": 1.0,
    "windowsize": 5
}
```

For more details to use this GE, please refer to the User & Programmers Guide.

List of Running Processes

Due to the Policy Manager basically is running over the python process, the list of processes must be only the python and redis in case of the facts engine. If we execute the following command:

```
ps -ewf | grep 'redis\|Python' | grep -v grep
```

It should show something similar to the following:

```
UID   PID  PPID   C   STIME     TTY       TIME   CMD
501  5287   343   0  9:42PM ttys001    0:02.49   ./redis-server *:6379
501  5604   353   0  9:40AM ttys002    0:00.20 /Library/Frameworks/Python.framework/
Versions/2.7/Resources/Python.app/Contents/MacOS/Python facts.py
```

Where you can see the Redis server, and the run process to launch the Python program.

In case of the rule engine node, if we execute the following command:

```
ps -ewf | grep 'rabbitmq-server\|python' | grep -v grep
```

It should show something similar to the following:

```
UID        PID  PPID  C    SZ   RSS PSR STIME TTY          TIME CMD
root      1584     1  0 15:31 ?        00:00:00 /bin/sh /etc/rc3.d/
S80rabbitmq-server start
root      1587  1584  0 15:31 ?        00:00:00 /bin/bash -c ulimit -S -c 0
>/dev/null 2>&1 ; /usr/sbin/rabbitmq-server
```

```
root      1589  1587  0 15:31 ?        00:00:00 /bin/sh /usr/sbin/rabbitmq-server
root      1603  1589  0 15:31 ?        00:00:00 su rabbitmq -s /bin/sh -c
/usr/lib/rabbitmq/bin/rabbitmq-server
root      2038  2011  0 15:32 ?        00:00:01 python cloto/environmentManager.py
root      2039  2011  1 15:32 ?        00:00:38 /usr/bin/python manage.py
runserver 172.30.1.119:8000
```

where we can see the rabbitmq process, the run process to launch the Python program and the clips program.

Network interfaces Up & Open

Taking into account the results of the ps commands in the previous section, we take the PID in order to know the information about the network interfaces up & open. To check the ports in use and listening, execute the command:

```
lsof -i | grep "$PID1\|$PID2"
```

Where $PID1 and $PID2 are the PIDs of Python and Redis server obtained at the ps command described before, in the previous case 5287 (redis-server) and 5604 (Python). The expected results must be something similar to the following:

```
COMMAND    PID USER    FD  TYPE             DEVICE SIZE/OFF NODE NAME
redis-ser 5287  fla    4u  IPv6 0x8a557b63682bb0ef      0t0  TCP *:6379 (LISTEN)
redis-ser 5287  fla    5u  IPv4 0x8a557b636a696637      0t0  TCP *:6379 (LISTEN)
redis-ser 5287  fla    6u  IPv6 0x8a557b63682b9fef      0t0  TCP localhost:6379->
localhost:56046 (ESTABLISHED)
Python    5604  fla    7u  IPv6 0x8a557b63682bacaf      0t0  TCP localhost:56046->
localhost:6379 (ESTABLISHED)
Python    5604  fla    9u  IPv4 0x8a557b6369c90637      0t0  TCP *:commplex-main
(LISTEN)
```

In case of rule engine, the result will we the following:

```
COMMAND    PID USER    FD  TYPE             DEVICE SIZE/OFF NODE NAME
python    2039       root    3u  IPv4  13290      0t0  UDP *:12027
python    2039       root    4u  IPv4  13347      0t0  TCP policymanager.novalocal
:irdmi (LISTEN)
python    2044       root    3u  IPv6  13354      0t0  TCP localhost:38391->localhost
:amqp (ESTABLISHED)
```

Databases

The last step in the sanity check, once that we have identified the processes and ports is to check the database that have to be up and accept queries. For the first one, if we execute the following commands inside the code of the rule engine server:

```
$ mysql -u user -p
```

Where user is the administration user defined for cloto database. The previous command should ask you for the password and after that show you:

```
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 155286
Server version: 5.6.14 MySQL Community Server (GPL)

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Oracle is a registered trademark of Oracle Corporation and/or its
affiliates. Other names may be trademarks of their respective
```

```
owners.

Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.
mysql>
```

In order to show the different tables contained in this database, we should execute the following commands with the result that we show here:

```
mysql> SHOW TABLES FROM cloto;
+----------------------------+
| Tables_in_cloto            |
+----------------------------+
| auth_group                 |
| auth_group_permissions     |
| auth_permission            |
| auth_user                  |
| auth_user_groups           |
| auth_user_user_permissions |
| cloto_entity               |
| cloto_entity_specificrules |
| cloto_entity_subscription  |
| cloto_rule                 |
| cloto_serverinfo           |
| cloto_specificrule         |
| cloto_subscription         |
| cloto_tenantinfo           |
| django_content_type        |
| django_session             |
| django_site                |
+----------------------------+
```

Now, we can execute a simple test query in order to check the content of the table:

```
mysql> select * from cloto.cloto_serverinfo;
```

It should return with the following information:

```
+----+----------------+---------+---------------------+--------+
| id | owner          | version | runningfrom         | doc    |
+----+----------------+---------+---------------------+--------+
|  1 | Telefonica I+D |       1 | 2014-10-02 14:04:41 | {file} |
+----+----------------+---------+---------------------+--------+
```

Where {file} is the path to the OpenSpecification file whose value is https://forge.fi-ware.org/plugins/mediawiki/wiki/fi-ware-private/index.php/FIWARE.OpenSpecification.Details.Cloud.PolicyManager

2.2.3 Diagnosis Procedures

The Diagnosis Procedures are the first steps that a System Administrator will take to locate the source of an error in a GE. Once the nature of the error is identified with these tests, the system admin will very often have to resort to more concrete and specific testing to pinpoint the exact point of error and a possible solution. Such specific testing is out of the scope of this section.

Resource availability

The resource availability in the node should be at least 2Gb of RAM and 8GB of Hard disk in order to prevent enabler's bad performance in both nodes. This means that bellow these thresholds the enabler is likely to experience problems or bad performance.

Remote Service Access

We have internally two components to connect, the Rule engine component and the facts engine component. After that two internals component, we should connect with the the IdM GE. An administrator to verify that such links are available will use this information.

The first step is to check that the facts engine is up and running, for this purpose we can execute the following curl command, which is a simple GET operation:

```
root@fiware:~# curl http://$IP:$PORT/v1.0
```

The variable will be the IP direction in which we have installed the facts engine. This request should return the status of the server if it is working properly:

```
{"fiware-facts":"Up and running..."}
```

In order to check the connectivity between the rule engine and the IdM GE, due to it must obtain a valid token and tenant for a user and organization with the following curl commands:

```
root@fiware:~# curl
-d '{"auth": {"tenantName": "<MY_ORG_NAME>",
"passwordCredentials":{"username": "<MY_USERNAME>", "password": "<MY_PASS>"}}}'
-H "Content-type: application/json" -H "Accept: application/xml"
http://<KEYSTONE_HOST>:<KEYSTONE_PORT>/v2.0/tokens
```

The will be the name of my Organization/Tenant/Project predefined in the IdM GE (aka Keystone). The and variables will be the user name and password predefined in the IdM GE and finally the and variables will be the IP direction and port in which we can find the IdM GE (aka Keystone). This request should return one valid token for the user credentials together with more information in a xml format:

```
<?xml version="1.0" encoding="UTF-8"?>
<access xmlns="http://docs.openstack.org/identity/api/v2.0">
  <token expires="2012-06-30T15:12:16Z" id="9624f3e042a64b4f980a83afbbb95cd2">
    <tenant enabled="true" id="30c60771b6d144d2861b21e442f0bef9" name="FIWARE">
      <description>FIWARE Cloud Chapter demo project</description>
    </tenant>
  </token>
  <serviceCatalog>
  ...
  </serviceCatalog>
  <user username="fla" id="b988ec50efec4aa4a8ac5089adddbaf9" name="fla">
    <role id="32b6e1e715f14f1dafde24b26cfca310" name="Member"/>
  </user>
</access>
```

With this information (extracting the token id), we can perform a GET operation to the rule engine in order to get the information related to the window size associated to a tenant. For this purpose we can execute the following curl commands:

```
curl -v -H 'X-Auth-Token: a9a861db6276414094bc1567f664084d'
-X GET "http://<Rule Engine HOST>:8000/v1.0/c8da25c7a373473f8e8945f5b0da8217"
```

The variable will be the IP direction in which we have installed the Rule engine API functionality. This request should return the valid info for this tenant in the following json response structure:

```
{
    "owner": "Telefonica I+D",
    "doc": "https://forge.fi-ware.org/plugins/mediawiki/wiki/fi-ware-private/index.php
                                /FIWARE.OpenSpecification.Details.Cloud.PolicyManager",
    "runningfrom": "14/04/11 12:32:29",
    "version": "1.0",
    "windowsize": 5
}
```

Resource consumption

State the amount of resources that are abnormally high or low. This applies to RAM, CPU and I/O. For this purpose we have differentiated between:

- Low usage, in which we check the resources that the JBoss or Tomcat requires in order to load the IaaS SM.
- High usage, in which we send 100 concurrent accesses to the Claudia and OpenStack API.

The results were obtained with a top command execution over the following machine configuration:

Table 2.1: Machine Info

Machine	Rule Engine Node	Facts Engine Node
Type Machine	Virtual Machine	Virtual Machine
CPU	1 core @ 2,4Ghz	Intel(R) Xeon(R) CPU X5650 Dual Core @ 2.67GHz
RAM	2GB	2GB
HDD	20GB	20GB
Operating System	CentOS 6.3	CentOS 6.3

The results of requirements both RAM, CPU and I/O to HDD in case of Rule engine node is shown in the following table:

Table 2.2: Resource Consumption (in JBoss node)

Characteristic	Low Usage	High Usage
RAM	1,2GB ~ 70%	1,4GB ~ 83,5%
CPU	1,3% of a 2400MHz	95% of a 2400MHZ
I/O HDD	6GB	6GB

And the results of requirements both RAM, CPU and I/O to HDD in case of Tomcat node is shown in the following table:

Table 2.3: Resource Consumption (in Tomcat node)

Characteristic	Low Usage	High Usage
RAM	1,2GB ~ 63%	1,5GB ~ 78%
CPU	0,8% of a 2400MHz	90% of a 2400MHZ
I/O HDD	6GB	6GB

I/O flows

The rule engine application is hearing from port 8000 and the Fact-Gen application (by default) is hearing in the port 5000. Please refer to the installation process in order to know exactly which was the port selected.

2.3 Architecture Description

2.3.1 Legal Notice

Please check the following Legal Notice to understand the rights to use these specifications.

2.3.2 Overview

This specification describes the Policy Manager GE, which is a key enabler to scalability and to manage the cloud resources based on defined policies or rules.

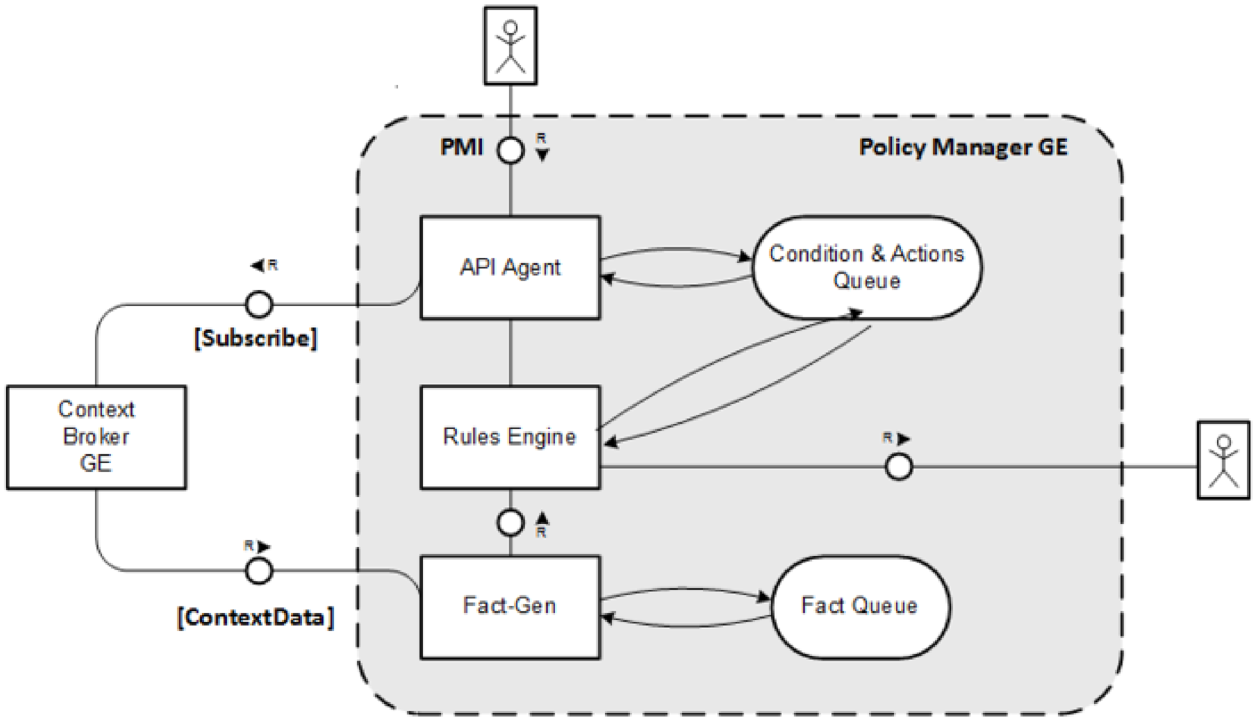
The Policy Manager GE provides the basic management of cloud resources based on rules, as well as management of the corresponding resources within the FIWARE Cloud Instance like actions based on physical monitoring or infrastructure, security monitoring of resources and services or whatever that could be defined by a facts, actions and rules.

The baseline for the Policy Manager GE is PyCLIPS, which is a module to interface CLIPS expert system and python language. The reason to take PyCLIPS is to extend the OpenStack ecosystem with a expert system written in the same language that the rest of the OpenStack services. Hence, Policy Manager offers the decision-making ability, independently of the type of resource (physical/virtual resources, network, service or whatever), able to solve complex problems within the Cloud field by reasoning about the knowledge base, represented by facts and rules.

The main functionality that the Policy Manager GE provides is:

- Management of scalability rules. It is possible to manage rules whose target is not to scale and this is also included in the main functionality of component.
- Management of different facts related to virtual machines and other facts in order to launch actions from the rules whose conditions are met.

The Policy Manager needs interaction with the user who provides the specification of the rules and actions that compound the knowledge system following a CLIPS language format. The facts are received from any producer of information that monitors the different resources of the cloud system. Context Broker GE, like publish/subscribe/notify system, interacts with the Policy Manager GE to suscribe to the information (facts) of Virtual Machines or whatever in order to get updated usage status of resources (e.g. cpu, memory, or disk) or resources that we want to monitor. These facts are used by the inference engine to deduce new facts based on the rules or infer new actions to take by third parties.



Policy Manager architecture specification

Target Usage

The Policy Manager GE is an expert system that provides independent server in the OpenStack ecosystem which evaluates the current state of the knowledge-base, applied the pertinent rules and infers new knowledge into the knowledge-base. Currently, the actions are designed to scale up and down Virtual Machines according to facts received from them (memory, cpu, disk or whatever). There are more kind of usage for these rules and is the user who defines conditions and actions he wants for. It is the user when specify the rule and actions who specify which is the use that we want to give to this GE.

2.3.3 Main concepts

Following the above FMC diagram of the Policy Manager, in this section we introduce the main concepts related to this GE through the definition of their interfaces and components and finally an example of their use.

Basic Concepts

The Policy Manager manages a set of rules which throws actions when certain conditions are activated when some facts are received. These rules can be associated with a specific virtual machine or be a general rule that affects the entire system. The key concepts, components and interfaces associated to the Policy Manager GE and visible to the cloud user, are described in the following subsections.

Entities

The main entities managed by the Policy Manager are as follows:

- **Rules**. They represent the policy that will be used to infer new facts or actions based on the facts received from the Context Broker GE. Usually, rules are some type of statement of the form: if then . The if part is the rule premise or antecedent, and the then part is the consequent. The rule fires when the if part is determined to be true or false. They are compound of 2 types of rules:
  - **General Rules**. They represent a global policy to be considered regardless specific virtual machines. Each rule is compound of a name to identify it and the condition and action which is fired. GeneralRules entities are represented as RuleModel.
  - **Specific Rules**. They represent a policy associated to a specific virtual machine. SpecificRules entities are represented as SpecificRuleModel.
- **Information**. It represent the information about the Policy Manager API and tenant information. Tenant information contains the window size, a modificable value for manage the minimal number of measures to consider a real fact for Rules Engine.
- **Facts**. They represent the measurement of the cloud resources and will be used to infer new facts or actions. an average of measures from a virtual machine trough the Context Broker GE. The are the base of the reasoning process.
- **Actions**, They are the output of the knowledge system related to a sense input and the are the implementation of the response rule or consequent.

Interfaces

The Policy Manager GE is currently composed of two main interfaces:

- **The Policy Manager interface (PMI)** is the exposed REST interface that implements all features of the Policy Manager exposed to the users. The PMI allows to define new rules an actions together with the activation of a specific rule asociated to a resource. Besides, this interface allow to get the information about this GE (url documentation, windows size, owner and time of the last server start). Besides, the PMI implements the NGSI-10 interface in order to receive the facts provided by Context Broker (notification of the context data) related to a virtual server.
- **Context Broker Manager Interface (NGSI)** is invoked in order to subscribe the Policy Manager to a specific monitoring resource. See NGSI-10 Open RESTful API Specification for more details.

Architecture Components

The Policy Manager includes a data repository which keeps the rules stored and information about the server, tenants.

- **API-Agent (PMI)** is responsible of offering a RESTful interface to the Policy Manager GE users. It triggers the appropriate manager to handle the request.
  - **InfoManager**, is responsible for the management of general information about the server running and specific tenant information like the window size.
  - **RuleManager**, is responsible for the management of all related with general rules and rules for specified virtual machines.
- **Rules Engine**. Is responsible for handling when a condition is satisfied based on the facts received and launch the associated actions.
  - **RuleEngineManager**, provides management for access the rule engine based on CLIPS, adding the new facts to the Rule Engine and check rule conditions.

    - **DbManager**, provides connection to the Data Base.

- **Fact-Gen**, provides the mechanisms to insert facts into the rule Engine from context data received.
    - **FactGenManager**, is responsible for the management of all related with data context build facts from this data.
- **Condition & Actions Queue**, which contains all the rules and actions that can be managed by Policy Manager, including the window size for each tenant.
- **Facts Queue**, which represents the actual instantiation of resources for a specific resource. For each element in the inventory (called *-Instance), there is an equivalent in the catalogue. This queue is implemented with a list on a data structure server in order to obtain a rapid response of the system.

Example Scenario

The Policy Manager GE is involved in three different phases:

- Management of the rules provided by users.
- Populate rule engine with facts collected from the data context.
- Management of rules status at runtime.

Rules Management

The management of rules involves several operations to prepare the scalability system working. First of all, the rules have to be defined. The definition of a rule includes the specification of the actions to be launched, the conditions that must be inferred and a descriptive name so user can easily recognize the rule. This rule can also be specified for a single virtual machine.

Secondly, to get facts, it must subscribe the virtual machine to Context Broker GE in order to receive notifications of the resources status. Context Broker GE updates the context of each virtual machined to which we are subscribed and the Policy Manager stores this information in a Queue system in order to get a stable monitored value without temporal oscillation of the signal.

Finally, the rules can be deleted or redefined. When a rule is deleted, Policy Manager unsubscribe the virtual machine from Context Broker if rule is a Specific Rule.

Collecting data

The Context Broker has subscribed a number of virtual machines. Each virtual machine publishes the status of its resources in the Context Broker GE and Policy Manager receives this notifications. After that, Policy Manager is in charge of build facts and insert them into de Rule Engine. When we receive a number of Facts equal to the window size, the Policy Manager calculates the arithmetic mean of the data and insert its value into the Rule Engine. Finally, Policy Manager discards the oldest value in the queue.

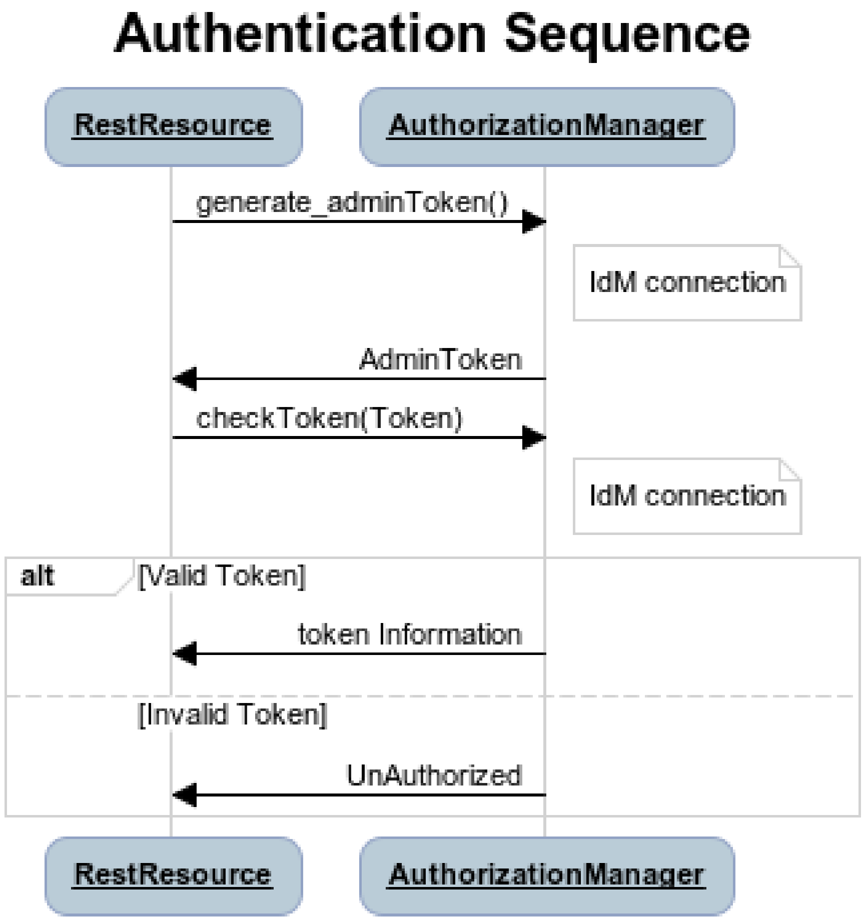
Runtime Management

During the runtime of an application, the Policy Manager can detect if a rule condition is inferred and is in charge of launch actions associated with, this action will be communicated to the users that was subscribed to this specific rule.

2.3.4 Main Interactions

The following pictures depicts some interactions between the Policy Manager, the Cloud Portal as main user in a typical scenario. For more details about the Open REST API of this GE, please refer to the Open Spec API specification.

First of all, every interaction need Authentication sequence before starting. Authentication sequence follows like this:



1. If Policy Manager have requested an administration Token before it will use this token to validate the future token received from the Cloud Portal.
2. If an existing administration token has expired or it is the first initialization, the Policy Manager requests a new administration Token from IdM in order to validate the future token received from the Cloud Portal through **generate_adminToken()** interface.
   (a) The IdM returns a valid administration token that will be used to check the *Token* received from the Cloud Portal requested message through the **checkToken(Token)** interface.
   (b) The IdM could return 2 options:
      i. If the *Token* is valid, the IdM returns the information related to this token.
      ii. If the *Token* is invalid, the IdM returns the message of unauthorized token.

The next interactions gets information about the Policy Manager server:

1. The User through Cloud Portal or CLI sends a GET operation to request information about the Policy Manager through **getInformation()**.

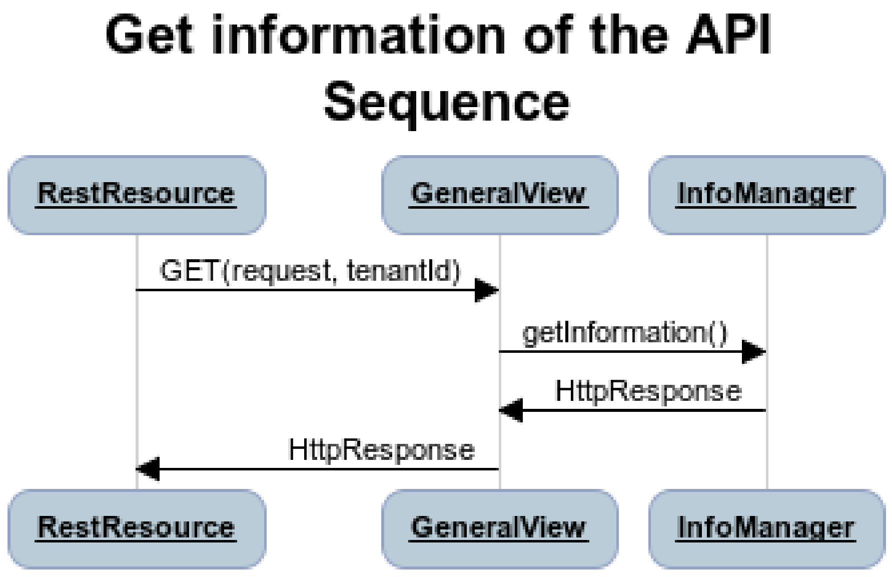


Fig. 2.1: Get Information sequence

2. The InfoManager returns the information related to the Policy Manager GE associated to this tenant.
   (a) Owner of the GEi.
   (b) Time and date of the last wake up of the Policy Manager GE.
   (c) URL of the open specification specification.
   (d) Window size of the facts stabilization queue.

Following, you can see request to update the window size.

1. The User through Cloud Portal or CLI sends a PUT message to the Policy Manager GE to update the window size of the tenantId through the **updateWindowSize()** message.
2. The Policy Manager returns a message with the information associated to this tenantId in order to confirm that the change was made.

Next, you can see the interactions to create general or specific rule sequence

1. The User through Cloud Portal or CLI requests a POST operation to create a new general/specific rule to the Policy Manager.
   (a) In case of general one, the **create_general_rule()** interface is used, with params *tenantId*, the OpenStack identification of the tenant, and the rule description.
   (b) In case of specific one, the **create_specific_rule()** interface is used, with params *tenantId*, the OpenStack identification of the tenant, the *serverId*, the OpenStack identification of the server, and the rule description.
2. The Rule Manager returns the new ruleModel associated to the new requested rule and the Policy Manager returns the respense to the user.
   (a) If something was wrong, due to incorrect representation of the rule, a *HttpResponseServerError* is returned in order to inform to the user that something was wrong.

Afterward, you could see the interactions to get information about already created general rules:

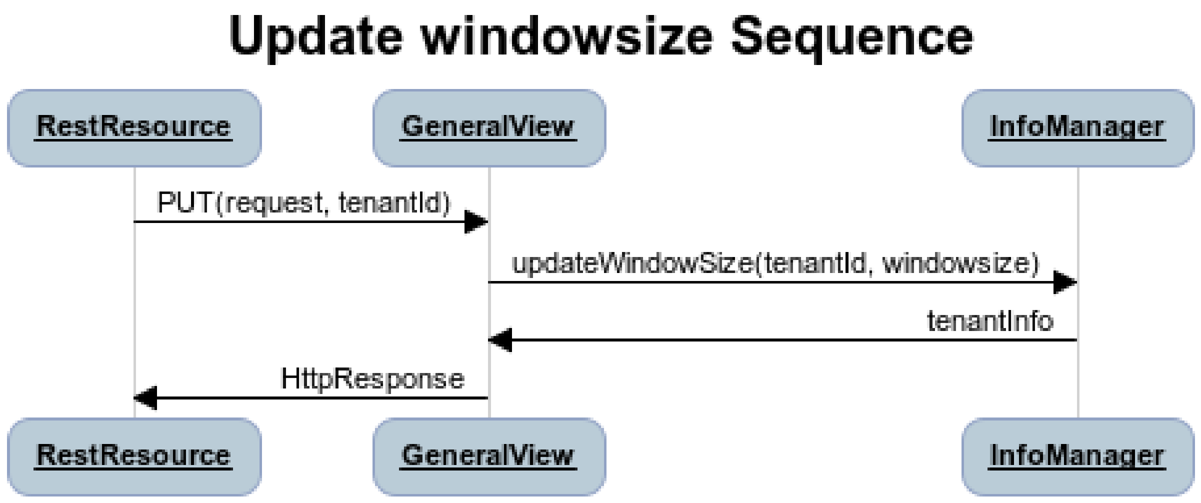


Fig. 2.2: Update Window Size sequence

1. The User through Cloud Portal or CLI requests a GET operation to the Policy Manager in order to receive all the general rules associated to a tenant through **get_all_rules()** interface with parameter *tenantId*
2. The Rule Manager component of the Policy Manager responses with the list of general rules.
3. If the tenant identify is wrong or whatever the Rule Manager responses a HttpResponseServerError.

Following, the interactions to get detailed information about getting general or specific rule sequence.

1. The User through Cloud Portal or CLI requests a GET operation to recover the rules.
   (a) If we decide to recover a general rule, the **get_rule()** interface should be used with *ruleId* parameter
   (b) Otherwise, if you decir to recover a specific rule, the **get_specific_rule()** interface should be used with the *ruleId* parameter.
2. The Rule Manager of the Policy Manager will return the ruleModel that it is stored in the Rule & Action Queue. If something was wrong, Policy Manager will return **HttpResponseServerError** to the user.

Next off, the interactions to delete general or specific rule.

1. The User through Cloud Portal or CLI requests the deletion of a general or specific rule to the Policy Manager with the identity of the tenant and rule.
   (a) The view sends the request to the RuleManager by calling the **delete_rule()** interface with identity of the rule as parameter of this interface to delete it.
   (b) Otherwise, if the rule is specific for a server, the views sends the request to the RuleManager by calling the **delete_specific_rule()** interface, with identity of the rule as parameter of this interface to delete it.
2. If the operation was ok, the RuleManager responses a *HttpResponse* with the ok message, by contrast, if something was wrong, it returns a *HttpResponseServerError* with the details of the problem.

Finally, the interactions to update a specific or general rule

1. The User through Cloud Portal or CLI requests the update of a general or specific rule to the Policy Manager with the identity of the tenant and rule.

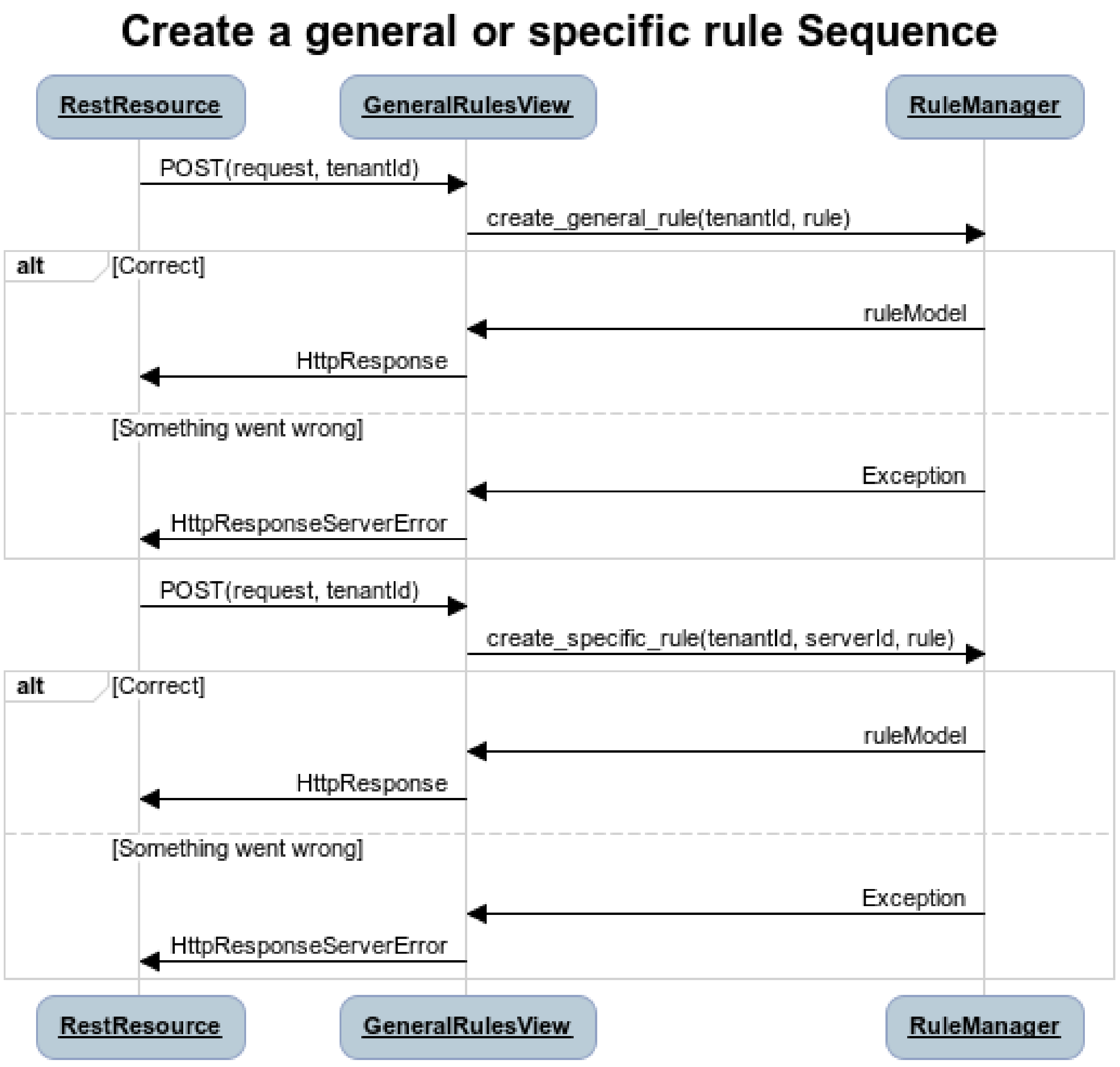


Fig. 2.3: Create general or specific rule sequence

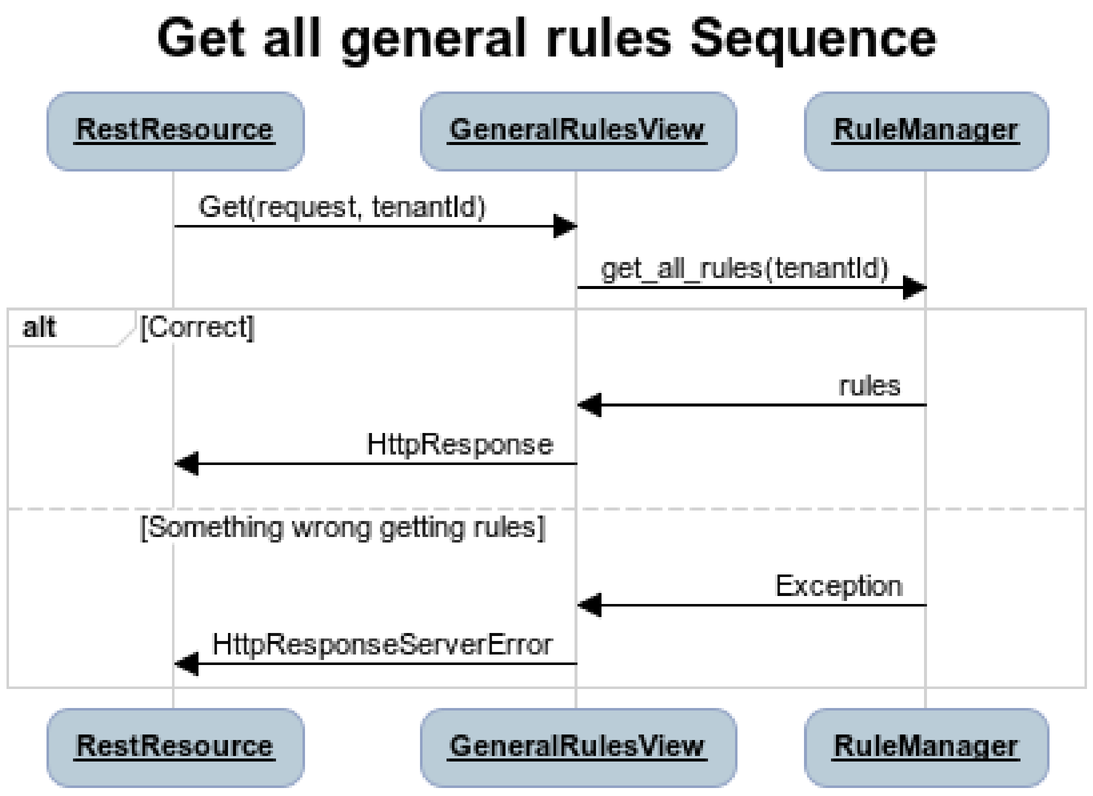


Fig. 2.4: Get all general rules sequence

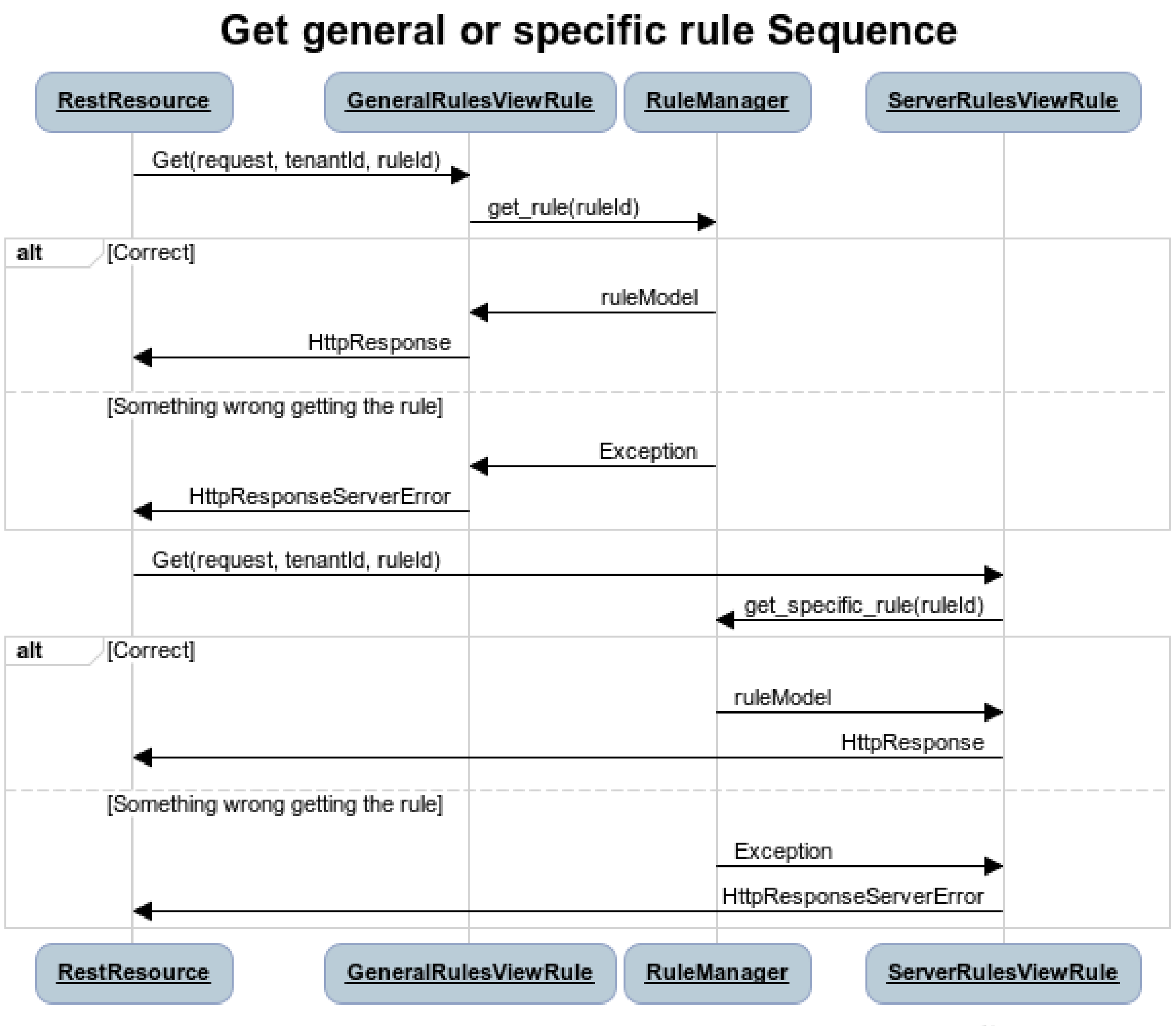


Fig. 2.5: Get general or specific rule sequence

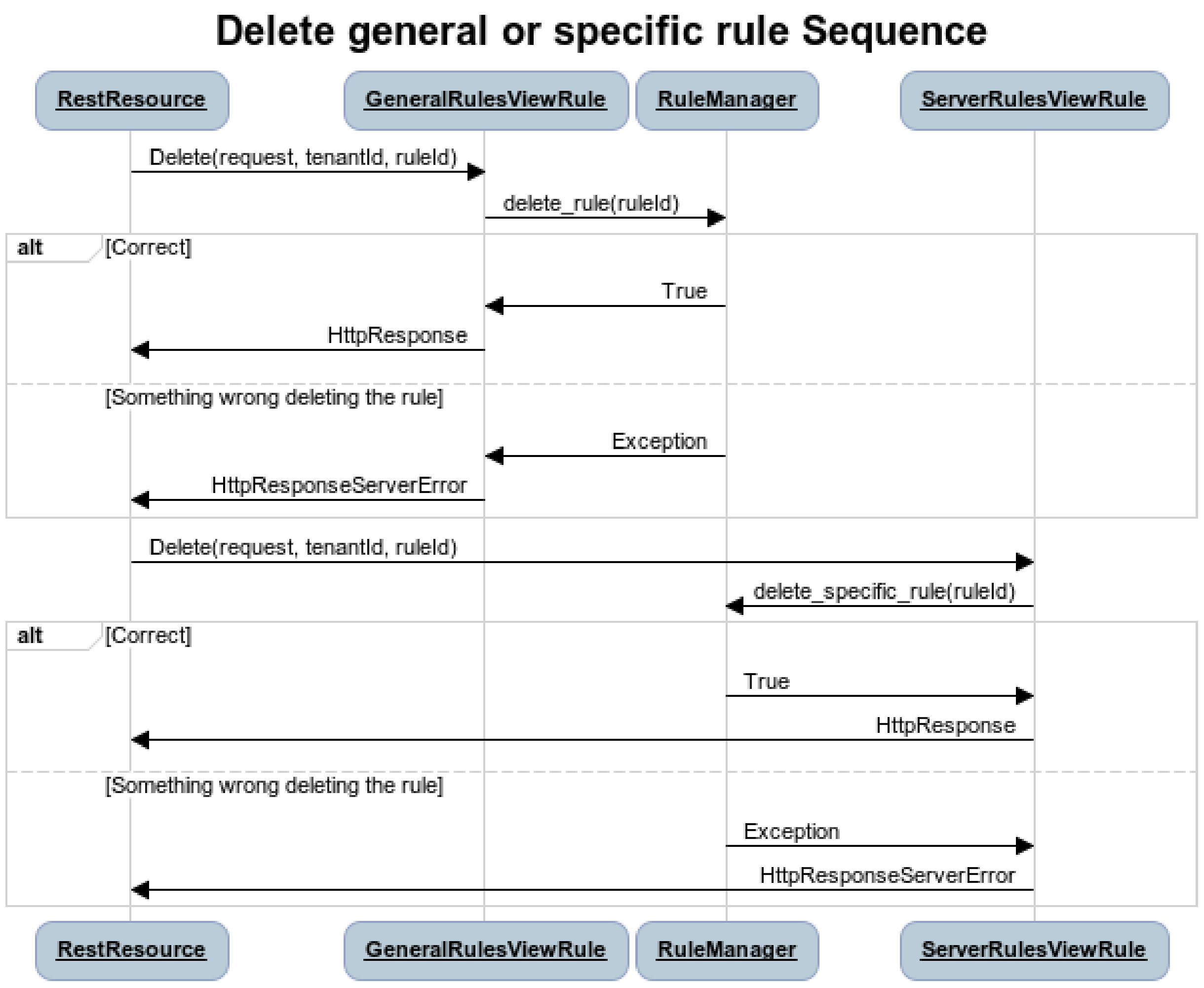


Fig. 2.6: Delete a general or specific rule sequence

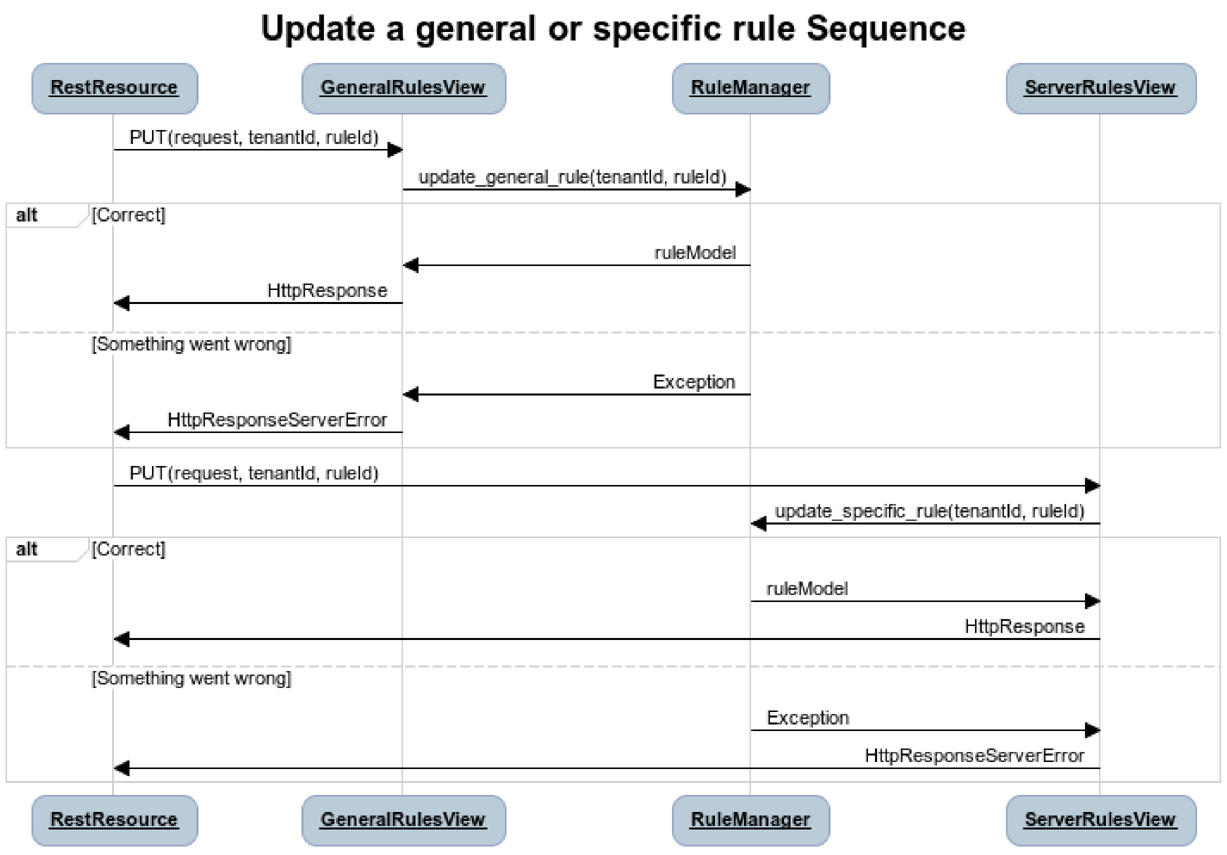


Fig. 2.7: Update a general or specific rule sequence

   (a) The view sends the request to the RuleManager by calling the **update_general_rule()** interface with identity of the tenant and rule as parameters of this interface to delete it.
   (b) Otherwise, if the rule is specific for a server, the views sends the request to the RuleManager by calling the **update_specific_rule()** interface, with identity of the tenant and rule as parameters of this interface to delete it.

2. If the operation was ok, the RuleManager responses with a new ruleModel class created and the API returns a *HttpResponse* with the ok message, by contrast, if something was wrong, it returns a *HttpResponseServerError* with the details of the problem.

2.3.5 Basic Design Principles

Design Principles

The Policy Manager GE has to support the following technical requirements:

- The condition to fire the rule could be formulated on several facts.
- The condition to fire the rule could be formulated on several interrelated facts (the values of certain variables in those facts match).
- User could add facts "in runtime" via API (without stop server).
- User could add rules "in runtime" via API (without stop server).
- That part of the implementation of the rule would:
  - Update facts.
  - Delete facts.
  - Create new facts.
- Actions can use variables used in the condition.
- Actions implementation can invoke REST APIs.
- Actions can send an email.
- The Policy Manager should be integrated into the OpenStack without any problem.
- The Policy Manager should interact with the IdM GE in order to offer authentication functionality to this GE.
- The Policy Manager should interact with the Context Broker GE in order to receive monitoring information from resources.

Resolution of Technical Issues

When applied to Policy Manager GE, the general design principles outlined at Cloud Hosting Architecture can be translated into the following key design goals:

- Rapid Elasticity, capabilities can be quickly elastically provisioned and released, in some cases automatically, to scale rapidly outward and inward commensurate with demand. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be appropriated in any quantity at any time.
- Availability, Policy Manager should be running all the time without interruption of the service due to the nature of itself.
- Reliability, Policy Manager should assure that the activations of rule was produce by correct inference based on facts received from a Context Broker GE.

- Safety, is the Policy Manager has any problem, it should continue working without any catastrophic consequences on the user(s) and the environment.
- Integrity, Policy Manager does not allow the alteration of the facts queue and/or rules and actions queue.
- Confidentiality, Policy Manager does not allow the access to facts, rules and actions associated to a specitic tenant.

Regarding the general design principles not covered by the Cloud Hosting Architecture, they can be translated into the following key design goals:

- REST based interfaces, for rules and facts.
- The Policy Manager GE keeps stored all rules provisioned for each user.
- The Policy Manager GE manage all facts and checks when actions should be fired.

2.4 Open RESTful API Specification

2.4.1 Introduction to the PMI Policy API

Please check the FIWARE Open Specifications Legal Notice to understand the rights to use FIWARE Open Specifications.

PMI Policy API

The PMI Policy API is a RESTful, resource-oriented API accessed via HTTP/HTTPS that uses JSON-based representations for information interchange that provide functionalities to the Policy Manager GE. This document describes the FIWARE-specific features extension, which allows cloud user to extend the basic functionalities offered by Policy Manager GE in order to cope with elasticity management.

Intended Audience

This specification is intended for both software developers and Cloud Providers. For the former, this document provides a full specification of how to interoperate with Cloud Platforms that implements PMI API. For the latter, this specification indicates the interface to be provided in order to create policies and actions associated the facts received from cloud resources (currently associated to servers but not only oriented to them). To use this information, the reader should first have a general understanding of the Policy Manager Generic Enabler and also be familiar with:

- RESTful web services
- HTTP/1.1 (RFC2616)
- JSON data serialization formats.

API Change History

This version of the PMI Policy API Guide replaces and obsoletes all previous versions. The most recent changes are described in the table below:

Revision Date	Changes Summary
Oct 17, 2012	First version of the PMI Policy API.

How to Read This Document

In the whole document the assumption is taken that the reader is familiarized with REST architecture style. Along the document, some special notations are applied to differentiate some special words or concepts. The following list summarizes these special notations.

- A **bold**, mono-spaced font is used to represent code or logical entities, e.g., HTTP method (GET, PUT, POST, DELETE).
- An *italic* font is used to represent document titles or some other kind of special text, e.g., *URI*.
- The variables are represented between brackets, e.g. {id} and in italic font. When the reader find it, can change it by any value.

For a description of some terms used along this document, see [1].

Additional Resources

You can download the most current version of this document from the FIWARE API specification selecting **PDF Version** from the Toolbox menu (left side), which will generate the file to download it. For more details about the **Policy Manager** that this API is based upon, please refer to FIWARE Cloud Hosting.

2.4.2 General PMI Policy API Information

Resources Summary

A graphical diagram, including the different Uniform Resource Names (URNs) that can be used in the API, is shown here. The URL is http://{serverRoot}:{serverPort}.

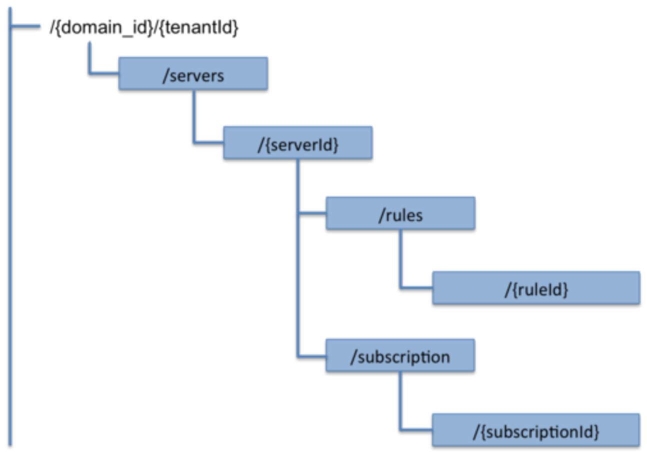


Fig. 2.8: Policy_Manager_open_specification_diagram_v1.png

Policy Manager Open RESTful API resource summary

Authentication

Each HTTP request against the **PMI** requires the inclusion of specific authentication credentials. The specific implementation of this API supports OAuth v2.0 authentication schemes and will be determined by the specific provider that implements this GE and Interface. Please contact with it to determine the best way to authenticate against this API. Remember that some authentication schemes may require that the API operate using SSL over HTTP (HTTPS).

Representation Format

The PMI Policy API resources are represented by hypertext that allows each resource to reference other related resources. More concisely, JSON format are used for resource representation and URLs are used for referencing other resources by default. The request format is specified using the Content-Type header and is required for operations that have a request body. The response format can be specified in requests using either the Accept header with values application/json or adding a .json extension to the request URI. In the following examples we can see the different options in order to represent format.

POST /v1.0/d3fdddc6324c439780a6fd963a9fa148/servers/15520fa6dc914f97bd1e54f8e1444d41 HTTP/1.1
Host: servers.api.openstack.org
Content-Type: application/json
Accept: application/json
X-Auth-Token: eaaafd18-0fed-4b3a-81b4-663c99ec1cbb

POST /v1.0/d3fdddc6324c439780a6fd963a9fa148/servers/15520fa6dc914f97bd1e54f8e1444d41.json HTTP/1.1
Host: servers.api.openstack.org
Content-Type: application/json
X-Auth-Token: eaaafd18-0fed-4b3a-81b4-663c99ec1cbb

Representation Transport

Resource representation is transmitted between client and server by using HTTP 1.1 protocol, as defined by IETF RFC-2616. Each time an HTTP request contains payload, a Content-Type header shall be used to specify the MIME type of wrapped representation. In addition, both client and server may use as many HTTP headers as they consider necessary.

Resource Identification

API consumer must indicate the resource identifier while invoking a GET, PUT, POST or DELETE operation. PMI Policy API combines both identification and location by terms of URL. Each invocation provides the URL of the target resource along the verb and any required input data. That URL is used to identify unambiguously the resource. For HTTP transport, this is made using the mechanisms described by HTTP protocol specification as defined by IETF RFC-2616.

PMI Policy API does not enforce any determined URL pattern to identify its resources. Anyway the SM Policy API follows the HATEOAS principle (Hypermedia As The Engine Of Application State). This means that resource representation contains the URLs of the related resources (e.g., book representation contains hyperlinks to its chapters; chapter representation contains hyperlinks to its pages...). API consumer obtains the server representation as its following point, which in turn provides hyperlinks that directly or indirectly take to other resources like scalability rules.

Some PMI Policy API entities provide an instance identifier property (instance ID). This property is used to identify unambiguously the entity but not the REST resource used to manage it, which is identified by its URL as described above. It is common that most implementations make use of instance ID to compose the URL (e.g., the book with instance ID 1492 could be represented by resource http://.../book/1492), but such an assumption should not be taken by API consumer to obtain the resource URL from its instance ID.

Links and References

Resources often lead to refer to other resources. In those cases, we have to provide an ID or an URL to a remote resource. see OpenStack Compute Developer Guide on their application to infrastructural resources.

Limits

n.a.

Rate Limits

n.a.

Absolute Limits

n.a.

Determining Limits Programmatically

n.a.

Versions

This section shows the version of this API. You can see the historical change of the API at the beginning of this document. Currently, the version of this API is the 1.0.

Extensions

n.a.

Faults

n.a.

2.4.3 API Operations

In this section we go in depth for each operation. These operations were described in the Policy Manager Architectural description. The FI-WARE programmer guide will also provide examples of how to use this API. The specify operations of this extensions are related to the management of scalability rules.

General Operations

This section has the general operations related to this service.

Get the information of the API

Verb	URI	Description
GET	/{tenantId}/	Get information about this current API.

Normal Response Code(s): 200 (Ok)

Error Response Code(s): identityFault (400, 500, …), badRequest (400), unauthorized (401), forbidden (403), badMethod (405), serviceUnavailable (503)

This operation does not require a request body and lists the information of the current version of the API. The following examples show a JSON response for the API operation:

Response:

```
{
    "owner": "TELEFONICA I+D",
    "windowsize": <windows_size>,
    "version": "<API_version>",
    "runningfrom": "<last_launch_date>
    "doc": "<URL_DOCUMENTATION>"
}
```

The descriptions of the returned values are the following:

- **owner** is the key whose value is the company name that develops this API. Its value is fixed to "Telefonica I+D".
- **windowsize** is the key that represents the window size () to stabilize the values of the measures probes to checking rules and taking actions. This value is very important due to allow resolving false positives that could launch the action to scaling up and down a server.
- **version** is the key whose value is the version () of the API currently in execution.
- **runningfrom** is the key whose value is the date of the last launch () of the service. This value takes the ISO 8601 an example of this value 2013-10-04 20:32:17.
- **doc** is the key whose value is the link to this API specification.

Update the window size

Verb	URI	Description
PUT	/{tenantId}/	Update the window size of the service.

Normal Response Code(s): 200 (Ok)

Error Response Code(s): identityFault (400, 500, …), badRequest (400), unauthorized (401), forbidden (403), badMethod (405), serviceUnavailable (503)

This call updates the window size of the service in order to change the stabilization window size to be applied to the monitoring data received from the Monitoring GE. The request is in JSON format and the response has no body.

Request:

```
{
    "windowsize": <windows_size>
}
```

Where **windowsize** is the key whose value is the size of the windows to stabilized the values of the measures probes to checking rules and taking actions. This value is very important due to allow resolving false values that could launch the action to scaling up and down a server.

Response:

```
{
    "windowsize": <windows_size>
}
```

Servers

This section has the operations related to the subscription to the platform together with the rules associated to the servers to be analyzed by the rules engine.

Get the list of all servers' rules

Verb	URI	Description
GET	/{tenantId}/servers	Get the list of all servers registered in the platform.

Normal Response Code(s): 200 (Ok)

Error Response Code(s): identityFault (400, 500, …), badRequest (400), unauthorized (401), forbidden (403), badMethod (405), serviceUnavailable (503)

Returns a list of servers with their rules. There is no body in the request and the response is the following one:

Response:

```
{
    "servers": [
         {
             "serverId": "<serverId>",
             "rules": [
                {
                     "condition": <CONDITION_DESCRIPTION>,
                     "action": <ACTION_ON_SERVER>,
                     "ruleId": "<RULE_ID>"
                },
                {
                     "condition": <CONDITION_DESCRIPTION>,
                     "action": <ACTION_ON_SERVER>,
                     "ruleId": "<RULE_ID>"
                }
             ]
         },
         {
             "serverId": "<serverId>",
             "rules": [
                {
                     "condition": <CONDITION_DESCRIPTION>,
                     "action": <ACTION_ON_SERVER>,
                     "ruleId": "<RULE_ID>"
                },
                {
                     "condition": <CONDITION_DESCRIPTION>,
                     "action": <ACTION_ON_SERVER>,
                     "ruleId": "<RULE_ID>"
                }
            ]
        }
    ]
}
```

The values that you receive are the following:

- **serverId** is the key whose value specifies the server ID in the URI, following the OpenStack ID format. An example of it is the id 52415800-8b69-11e0-9b19-734f6af67565.
- **condition** is the key whose value is the description of the scalability rule associated to this server. It could be one or more than one. You can find an example condition at the end of this document.
- **action** is the key whose value represents the action to take over the server. Its values are up and down.
- **ruleId** is the key that represents the id of the rule, following the OpenStack Id format (e.g. 52415800-8b69-11e0-9b19-734f6f006e54).

Get the list of all rules of a server

Verb	URI	Description
GET	/*{tenantId}*/servers/*{serverId}*	Get all rules related to specified server.

Normal Response Code(s): 200 (Ok)

Error Response Code(s): identityFault (400, 500, …), badRequest (400), unauthorized (401), forbidden (403), badMethod (405), serviceUnavailable (503)

This operation returns the list of elasticity rules associated with a server identified with its *{serverId}*. This operation does not require a body and the response is in JSON format.

Response:

```
{
    "serverId": "<serverId>",
    "rules": [
                {
                    "name": <NAME>,
                    "condition": <CONDITION_DESCRIPTION>,
                    "action": <ACTION_ON_SERVER>,
                    "ruleId": "<RULE_ID>"
                },
                {
                    "name": <NAME>,
                    "condition": <CONDITION_DESCRIPTION>,
                    "action": <ACTION_ON_SERVER>,
                    "ruleId": "<RULE_ID>"
                }
    ]
}
```

The values that you receive are the following:

- **serverId** is the key whose value specifies the server ID in the URI, following the OpenStack ID format. An example of it is the id 52415800-8b69-11e0-9b19-734f6af67565.
- **condition** is the key whose value is the description of the scalability rule associated to this server. It could be one or more than one and the format of this rule is the following:
- **action** is the key whose value represents the action to take over the server. Its values are up and down.

- **ruleId** is the key that represents the id of the rule, following the OpenStack Id format (e.g. 52415800-8b69-11e0-9b19-734f6f006e54).

Update the context of a server

Verb	URI	Description
POST	/*{tenantId}*/servers/*{serverId}*	Update Context of a specific server.

Normal Response Code(s): 200 (Ok)

Error Response Code(s): identityFault (400, 500, ...), badRequest (400), unauthorized (401), forbidden (403), badMethod (405), serviceUnavailable (503)

This operation updates the context related to a specific server, identified with its *serverId*. The context information contains the description of the CPU, Memory, Disk and/or Network usages. This message follows the NGSI-10 information model but using JSON format and the response has no body.

Request:

```
{
    "subscriptionId": "<SubscriptionId>",
    "originator": "http://localhost/test",
    "contextResponses": [
        {
            "contextElement": {
                "type": "Server",
                "isPattern": "false",
                "id": "<ServerId>",
                "attributes": [
                    {
                        "name": "CPU",
                        "type": "Probe",
                        "value": "0.75",
                    },
                    {
                        "name": "Memory",
                        "type": "Probe",
                        "value": "0.83",
                    },
                    {
                        "name": "Disk",
                        "type": "Probe",
                        "value": "0.83",
                    },
                    {
                        "name": "Network",
                        "type": "Probe",
                        "value": "0.83",
                    }
                ],
            },
            "statusCode": {
                "code": "200",
                "reasonPhrase": "Ok",
                "details": "a message"
            }
        }
    ]
}
```

The values that you receive are the following:

- **SubscriptionId**, is the identifier of a subscription process following the id schemas of OpenStack.
- **type**, is the element type, in our case, it is always "Server".
- **isPattern**, is used to define some type of pattern in order to search the information in the list of attributes. In our case, this attribute is not used and is always fixed to "false".
- **id**, is the id of a server, the same id of ServerId of OpenStack.
- **attributes**, this is a list of attributes:
  - **type** is the type of attribute, for our case, this key has always the value "Probe".
  - **value**, is the value of the attribute expressed in percentage.
  - **name** is the name of the attribute. In our case, this key takes one of the following values:
    - **CPU**, amount of used CPU of a server.
    - **Memory**, amount of used Memory of the same server.
    - **Disk**, amount of used disk (HDD) of the same server.
    - **Network**, amount of used network interface of the same server.
- **statusCode**, in NGSI-10 this key shows the information that the system should return when it receives this message. Currently, our implementation does not take into consideration this information but have to be defined following the standard. Its values are always the same in that case how you can see in the previous example.

Elasticity rules

Create a new elasticity rule

Verb	URI	Description
POST	/{tenantId}/servers/{serverId}/rules	Create a new rule associated to the server.

Normal Response Code(s): 200 (Ok)

Error Response Code(s): identityFault (400, 500, …), badRequest (400), unauthorized (401), forbidden (403), badMethod (405), serviceUnavailable (503)

This operation creates a new elasticity rules associated to a server, which is identified by {serverId}. The request specifies the rule to be activated and the action associated to it (increase or decrease the number of servers). The response returns a 200 Ok message together with the id of the new rule created.

Request:

```
{
   "name": <NAME>,
   "condition": <CONDITION_DESCRIPTION>,
   "action": <ACTION_ON_SERVER>
}
```

The values that you receive are the following:

- **name** is the key whose value represents the name of the rule.

- **condition** is the key whose value is the description of the scalability rule associated to this server. It could be one or more than one and the format of this rule is the following:
- **action** is the key whose value represents the action to take over the server. Its values are up and down.

Response:

```
{
   "serverId": <serverId>,
   "ruleId": <RULE_ID>
}
```

The values that you receive are the following:

- **serverId** is the key whose value specifies the server ID in the URI, following the OpenStack ID format. An example of it is the id 52415800-8b69-11e0-9b19-734f6af67565.
- **ruleId** is the key that represents the id of the rule, following the OpenStack Id format (e.g. 52415800-8b69-11e0-9b19-734f6f006e54).

Update an elasticity rule

Verb	URI	Description
PUT	/{tenantId}/servers/{serverId}/rules/{ruleId}	Update an elasticity rule.

Normal Response Code(s): 200 (Ok)

Error Response Code(s): identityFault (400, 500, …), badRequest (400), unauthorized (401), forbidden (403), badMethod (405), serviceUnavailable (503)

This operation allows to update the rule condition, the action or both or a specific server identified by its {serverId} and a specific rule identified by its {ruleId}. This operation requires a request context and the response has no body on it.

Request:

```
{
   "name": <NAME>,
   "condition": <CONDITION_DESCRIPTION>,
   "action": <ACTION_ON_SERVER>
}
```

Where:

- **name** is the key whose value represents the name of the rule.
- **condition** is the key whose value is the description of the scalability rule associated to this server. It could be one or more than one and the format of this rule is the following:
- **action** is the key whose value represents the action to take over the server. Its values are up and down.

Response:

```
{
   "name": <NAME>,
   "condition": <CONDITION_DESCRIPTION>,
   "action": <ACTION_ON_SERVER>
}
```

Delete an elasticity rule

Verb	URI	Description
DELETE	/{tenantId}/servers/{serverId}/rules/{ruleId}	Delete an elasticity rule.

Normal Response Code(s): 200 (Ok)

Error Response Code(s): identityFault (400, 500, …), badRequest (400), unauthorized (401), forbidden (403), badMethod (405), serviceUnavailable (503)

This operation deletes a specific rule, identified by its {ruleId}, within a server, identified by its {serverId}. This operation does not require a request body and response body. The response is a 200 Ok if it was deleted without any problem or error message in other case.

Get an elasticity rule

Verb	URI	Description
GET	/{tenantId}/servers/{serverId}/rules/{ruleId}	Get an elasticity rule.

Normal Response Code(s): 200 (Ok)

Error Response Code(s): identityFault (400, 500, …), badRequest (400), unauthorized (401), forbidden (403), badMethod (405), serviceUnavailable (503)

This operation gets a specific rule, identified by its {ruleId}, within a server, identified by its {serverId}. This operation does not require a request body and response body is in JSON format.

Response:

```
{
   "name": <NAME>,
   "condition": <CONDITION_DESCRIPTION>,
   "action": <ACTION_ON_SERVER>,
   "ruleId": "<RULE_ID>"
}
```

Where:

- **name** is the key whose value represents the name of the rule.
- **condition** is the key whose value is the description of the scalability rule associated to this server. It could be one or more than one and the format of this rule is the following:
- **action** is the key whose value represents the action to take over the server. Its values are up and down.
- **ruleId** is the key that represents the id of the rule, following the OpenStack Id format (e.g. 52415800-8b69-11e0-9b19-734f6f006e54).

Subscription to rules

Create a new subscription

Verb	URI	Description
POST	/{tenantId}/servers/{serverId}/subscription/	Create a new subscription for the server.

Normal Response Code(s): 200 (Ok)

Error Response Code(s): identityFault (400, 500, …), badRequest (400), unauthorized (401), forbidden (403), badMethod (405), serviceUnavailable (503)

This operation creates a new subcription rules associated to a rule, which is identified by {ruleId}. The request specifies the rule to be activated and the action associated to it (increase or decrease the number of servers). The response returns a 200 Ok message together with the id of the new subscription created.

Request:

```
{
   "ruleId": <RULE_ID>,
   "url": <URL_TO_NOTIFY>,
}
```

The values that you receive are the following:

- **ruleId** is the key whose value identifies the rule associated to this server.
- **url** is the key whose value is the url to notify the action when the rule is fired.

Response:

```
{
   "subscriptionId": <SUBSCRIPTION_ID>
}
```

The values that you receive are the following:

- **subscriptionId** is the key that represents the id of the subscription, following the OpenStack Id format (e.g. 52415800-8b69-11e0-9b19-734f6f006e54).

Delete a subscription

Verb	URI	Description
DELETE	/{tenantId}/servers/{serverId}/subscription/{subscriptionId}	Delete a subscription.

Normal Response Code(s): 200 (Ok)

Error Response Code(s): identityFault (400, 500, ...), badRequest (400), unauthorized (401), forbidden (403), badMethod (405), serviceUnavailable (503)

This operation deletes a subscription, identified by its {subscriptionId}, within a server, identified by its {serverId}. This operation does not require a request body and response body. The response is a 200 Ok if it was deleted without any problem or error message in other case.

Get a subscription

Verb	URI	Description
GET	/{tenantId}/servers/{serverId}/subscription/subscriptionId}	Get a subscription.

Normal Response Code(s): 200 (Ok)

Error Response Code(s): identityFault (400, 500, ...), badRequest (400), unauthorized (401), forbidden (403), badMethod (405), serviceUnavailable (503)

This operation gets a subscription, identified by its {subscriptionId}, within a server, identified by its {serverId}. This operation does not require a request body and response body is in JSON format.

Response:

```
{
   "subscriptionId": <SUBSCRIPTION_ID>,
   "url": <URL_TO_NOTIFY>,
   "serverId": <SERVER_ID>,
   "ruleId": "<RULE_ID>"
}
```

Where:

- **subscriptionId** is the key that represents the id of the subscription, following the OpenStack Id format (e.g. 52415800-8b69-11e0-9b19-734f6f006e54).
- **url** is the key whose value is the url to notify the action when the rule is fired.
- **serverId** is the key whose value specifies the server ID in the URI, following the OpenStack ID format. An example of it is the id 52415800-8b69-11e0-9b19-734f6af67565.
- **ruleId** is the key that represents the id of the rule, following the OpenStack Id format (e.g. 52415800-8b69-11e0-9b19-734f6f006e54).

2.4.4 Elasticity Rules

In this section we explain how it is represented an elasticity rule.

Rules Engine

Rules are described using JSON, and contain information about CPU and Memory, Disk and Network usage, in first instance.

Conditions

Conditions are represented as JSON format as a compound of attributes representing server measures with a value and an operator.

Attributes are:

- cpu
- mem
- hdd
- net

Supported operators are:

- greater
- greater equal
- less
- less equal

```
"condition": {
            "cpu": {
                    "value": 98.3,
                    "operand": "greater"
            },
            "mem": {
                    "value": 95,
                    "operand": "greater equal"
            },
            "hdd": {
                    "value": 95,
                    "operand": "greater equal"
            },
            "net": {
                    "value": 95,
                    "operand": "greater equal"
            }
    }
```

Actions

There are two types of actions:

- notify-scale: with two different options
- scaleUp

```
"action": {
      "actionName": "notify-scale",
      "operation": "scaleUp"
},
```

- scaleDown

```
"action": {
      "actionName": "notify-scale",
      "operation": "scaleDown"
},
```

These actions send a meessage with the following format:

```
{"action": <ACTION_NAME>,
 "serverId": <SERVER_ID>}
```

Where:

- **ACTION_NAME** is the name of the action (scaleUp or Scale Down).
- **SERVER_ID** is the key whose value specifies the server ID that fulfills the condition, following the OpenStack ID format. An example of it is the id 52415800-8b69-11e0-9b19-734f6af67565.
- notify-email

```
"action": {
      "actionName": "notify-email",
      "email": “name@host.com”,
      "body": “Example body”
},
```

This action send a meessage with the following format:

```
{"action": "notify-email",
 "serverId": <SERVER_ID>,
 "email": <EMAIL>,
 "description": <DESCRIPTION>}
```

Where:

- **SERVER_ID** is the key whose value specifies the server ID that fulfills the contidion, following the OpenStack ID format. An example of it is the id 52415800-8b69-11e0-9b19-734f6af67565.
- **EMAIL** is the email address where the message should be sent.
- **DESCRIPTION** is the body of the email which contains the detail that the creator of the rule wanted to inform.

Example Rule

The rule is compound of three parts, name, conditions and actions. In this case, the name will be “AlertCPU”

Every fact is like “(server (server-id 12345-abcd)(cpu 50)(mem 33)(hdd 66)(net 66))”

In this case, the condition defined expects all server with cpu usage more than 98.3, memory usage 95, hdd space used 95 and network usage 95.

Actions will create an HTTP POST notification to an url specified on every subscription to this rule. In this case the notification will be that server should be scaled up because CPU usage is greater than limit.

This is the rule as is expected to:

```
{
    "action": {
          "actionName": "notify-scale",
          "operation": "scaleUp"
    },
    "name": "AlertCPU",
    "condition": {
           "cpu": {
                  "value": 98.3,
                  "operand": "greater"
           },
           "mem": {
                  "value": 95,
                  "operand": "greater equal"
           },
           "hdd": {
                  "value": 95,
                  "operand": "greater equal"
           },
           "net": {
                  "value": 95,
                  "operand": "greater equal"
           }
   }
}
```