

## Mule 4 - Training for Absolute Beginners

### ➤MODULE 1: Introduction to Mule

#### What is MuleSoft? :

➤MuleSoft is an Integration and API Platform that helps us to :

- Build and consume Web-services (RESTful & Soap )
- Helps to connect different systems (Integration)
- Perform Scheduler / Batch Jobs
- Ability to deploy applications on- Clouduhub/ On-prem



Important Info

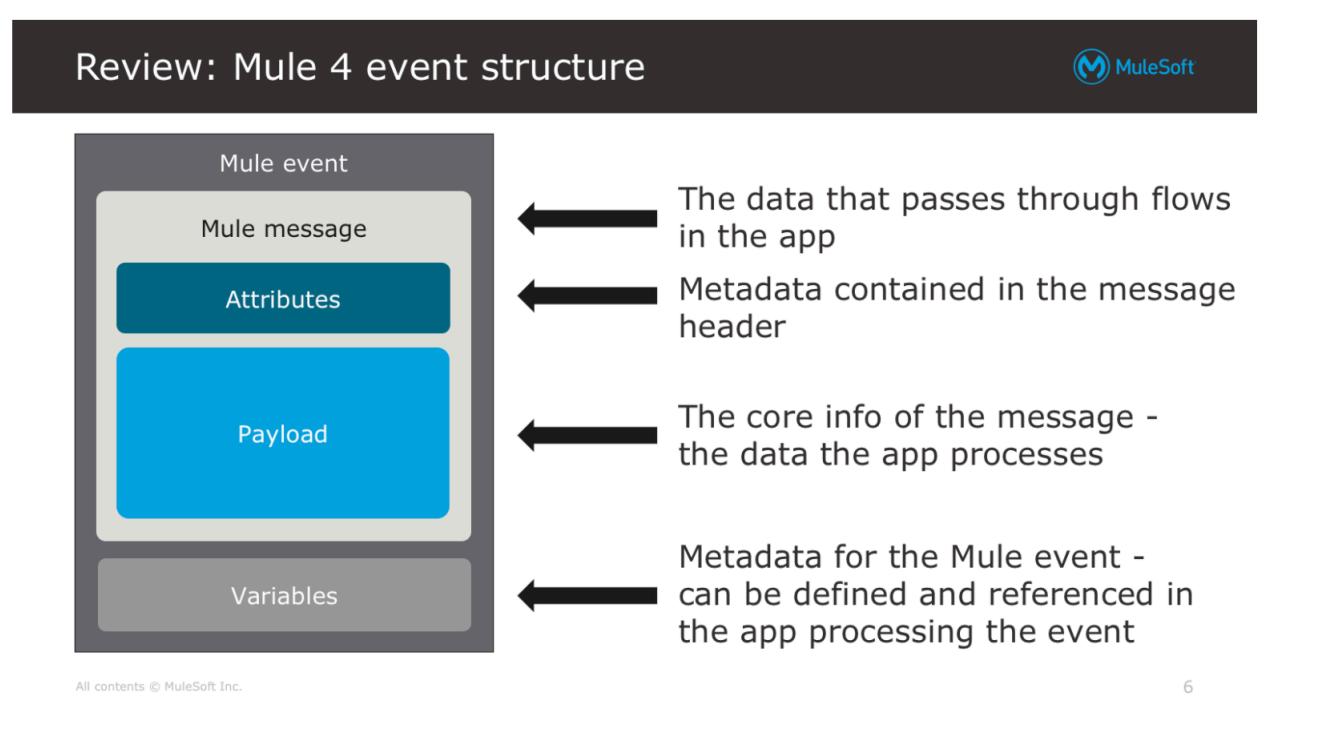
#### API -Led Connectivity Approach:

API Led connectivity approach is a widely successful approach in building API's. The concept of System - Process - Experience API's has been achieved to build reusable assets and highly secured.

In a simple way —>

- **System API's:** Are API's built to connect through underlying systems (Any system which contains the raw data).
- **Process API's:** Process API's are built to compose or combine two or more System API's to do any kind of transformation or to implement any kind of business logic.
- **Experience API's:** These are API's which are a kind of a wrapper either to Process API's (if present ) or to System API's, so that client/consumers will not have exposure or contact with direct Raw Data. (Secure purpose).

## Mule Message Structure.



**Mule Event = Mule Message (payload and attributes) + Variables**

Important Info

**Payload:** It's the actual message content. The payload can be overridden

**Attributes:** These provide metadata such as queryParams, file size etc. These are immutable (cannot be changed)

**Variables:** These are which you can store some kind of data or information and can be used across the application as long as you connect the flows with flow-ref

## One of The Differences between Mule 4 and Mule 3:

**In Mule 4 we have attributes wherein Mule 3 we have inbound properties**

**Eg:** To access a query Param say “name”

**Mule 3:** message.inboundProperties.queryParams.name

**Mule 4:** attributes.queryParams.name

Mule 4 has only one kind of variable called “variable” wherein in Mule 3 we used to have 3 kinds of variables.

Eg:

**Mule 3 :** flowVars.name , sessionVars.role , recordVars.company

**Mule 4 :** vars.name , vars.role , vars.company (it will act accordingly)

## Flow , Sub-flow and Private Flow:

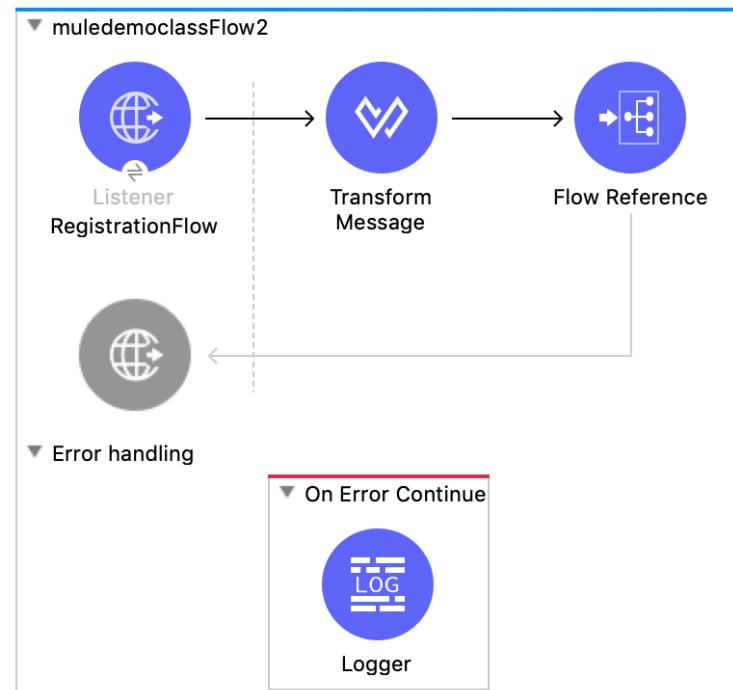
An app can consist of a single flow, or it can break up processing into discrete flows and subflows that you add to the app and connect together. Mule apps in production environments typically use multiple flows and subflows to divide the app into functional modules or for error-handling purposes.

You can connect and trigger their execution with Flow Reference components or by using the DataWeave lookup function within expressions and transformations. The function passes the current event to another flow for further event processing. You can think of a Flow Reference as a function call that accepts an event as input and then returns the modified event.

### Flow:

A flow has “**Source** “ Part and “**Process**” Part and “**Error handling**” Part

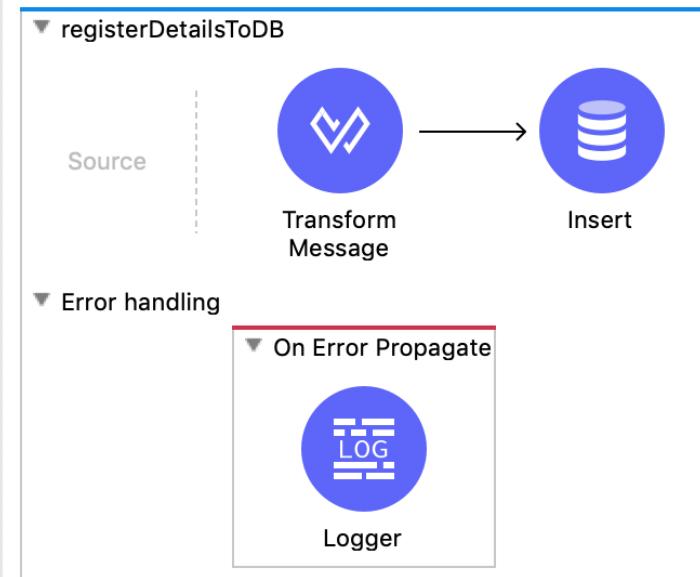
And you will **definitely need to put something in Source**



### Private Flow:

A flow has “**Source**” Part and “**Process**” Part and “**Error handling**” Part

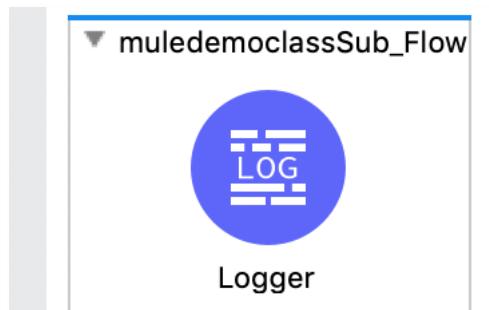
It is called a private flow when you **don't keep anything in Source**. It will be executed only if some other flow calls using flow-ref



### Sub-flow:

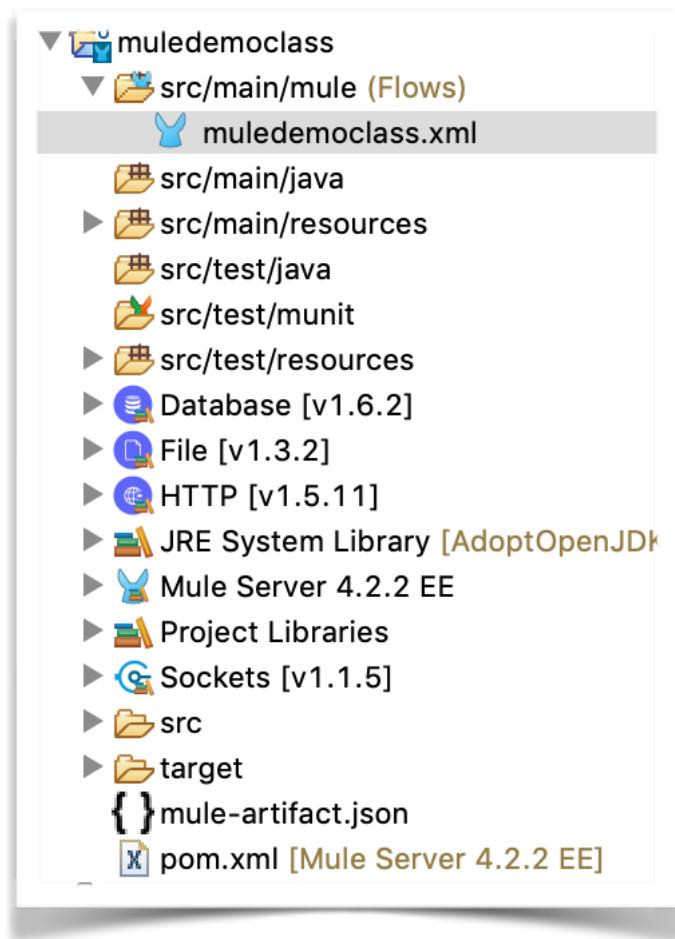
A sub-flow do not have a “Source” Part and don't have an “Error Handling part”

It just has “Process” Part.t will be executed only if some other flow calls using flow-ref



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## Mule Project Structure:



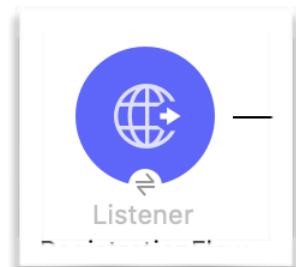
When you create a Mule Project, the folder structure looks like above

- Every project in Mule is Mavenized I.e, we use pom.xml to download all dependencies that are needed.
- All the Mule Application files are placed under **src/main/mule**
- Any other files can be placed under **src/main/resources** or **src/test/resources** based on the need
- mule-artifact.json by default has “minMuleVersion”. We have **Mule Pallet** where we find connectors
- The Mule application has 3 tabs.
  - Message flow (graphical view)
  - Global Elements (contains all config details)
  - configuration xml (the xml version of graphical view)

## Connectors:

### ● HTTP Listener :

- **Mandatory Config Details required:** host, port , path
- **Default:** Accepts all kinds of Methods if nothing is specified



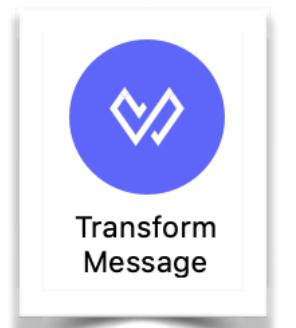
### ● Set Payload :

- **Mandatory Config Details required:** value  
eg : #["Hello World"] or #[payload] or #[attributes.queryParams.name]
- **Default :** #[payload]



### ● Transform Message:

- **Mandatory Config Details required:** Should have something written. You can set a payload, variable or attribute using Transform message. You can set Multiple variables along with the payload. The best practice is to define output type
- **Default :** output application/java - - - { }



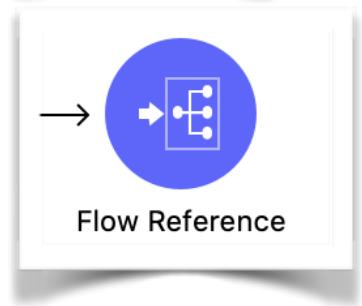
### ● Logger :

- **Mandatory Config Details required:** Nothing is mandatory here. You can set anything in the "message" field
- **Default:** empty message



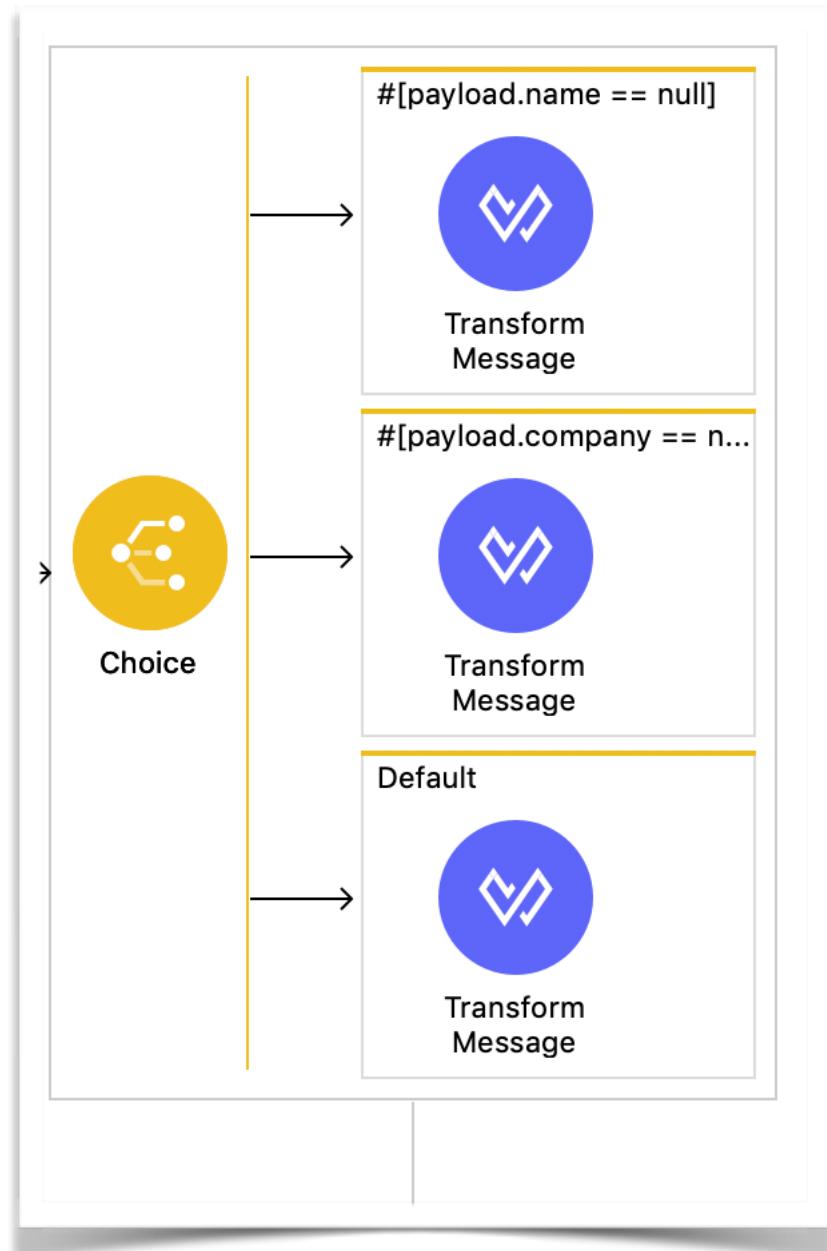
### ● Flow-ref :

- **Mandatory Config Details required:** flow name to be called. All names are present in the drop-down list
- **Default:** empty but it fails to deploy if you don't give any flow name from the drop-down



## ● Choice :

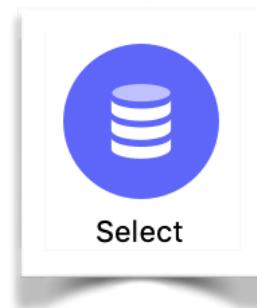
- **Mandatory Config Details required:** Expression is mandatory which checks some validation. The result of the expression should be either true or false nothing else.
- **Expression: empty but you can't keep empty expression, it will not deploy your application**
- **Remember:** If the first condition is satisfied, then it will not go to other blocks. It will execute the first satisfied condition block and continue further



## ● Database :

- Mandatory Config Details required:

- Driver
- Host
- Port
- User
- Password
- Database/service-name(instance)
- SQL Query text

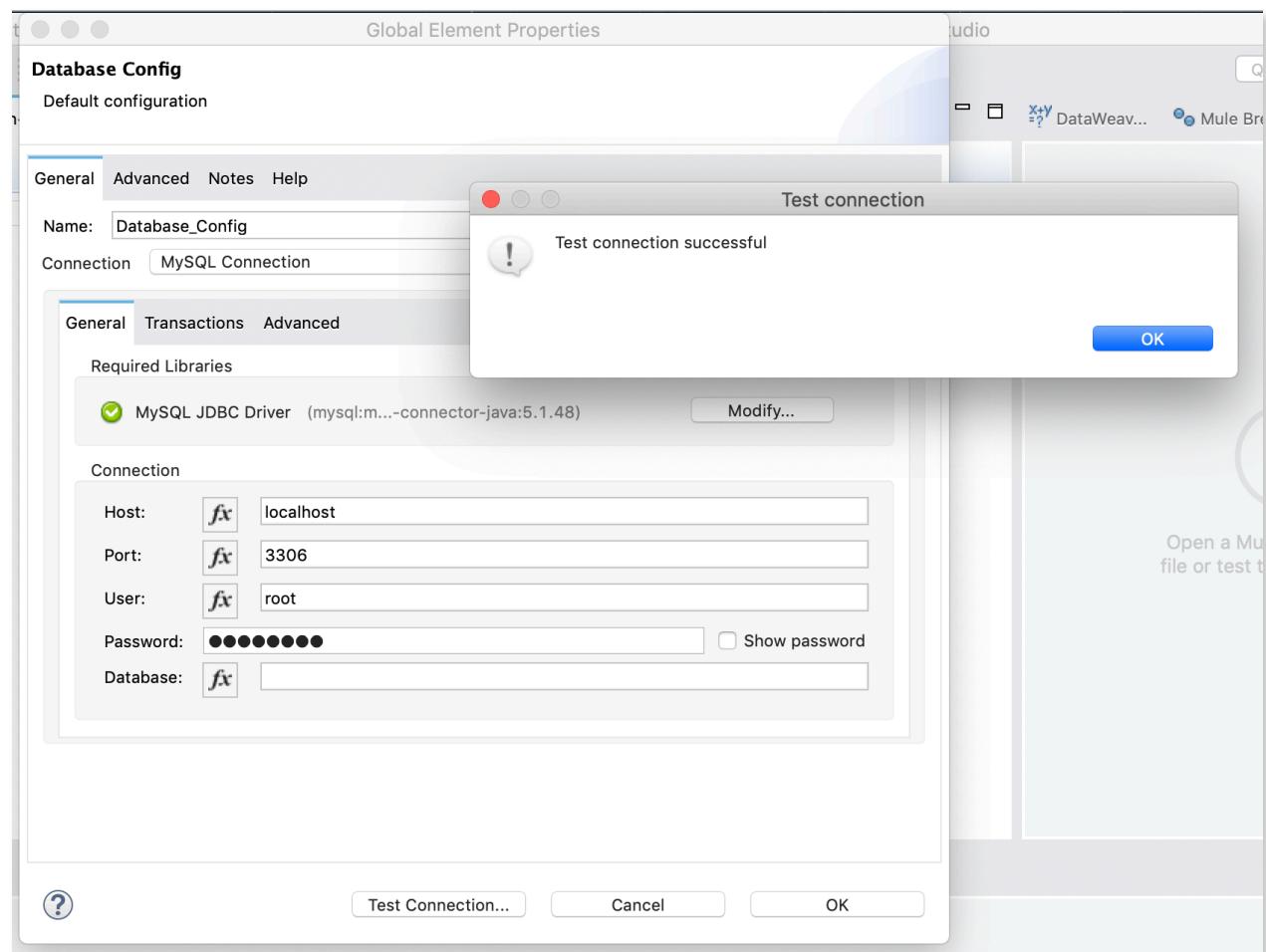


Select

- Default: empty but you can't keep empty expression, it will not deploy your application

- Remember: In Mule 3, we used to have one Database connector and we will be selecting the kind of operation that we want. Like

Important Info



- Select, update, delete, insert etc. But in Mule 4, we have separate connectors for each operation. You can test the connection if you want to check if connection is successful.

The **Output of Database is Array (applications/java)**.

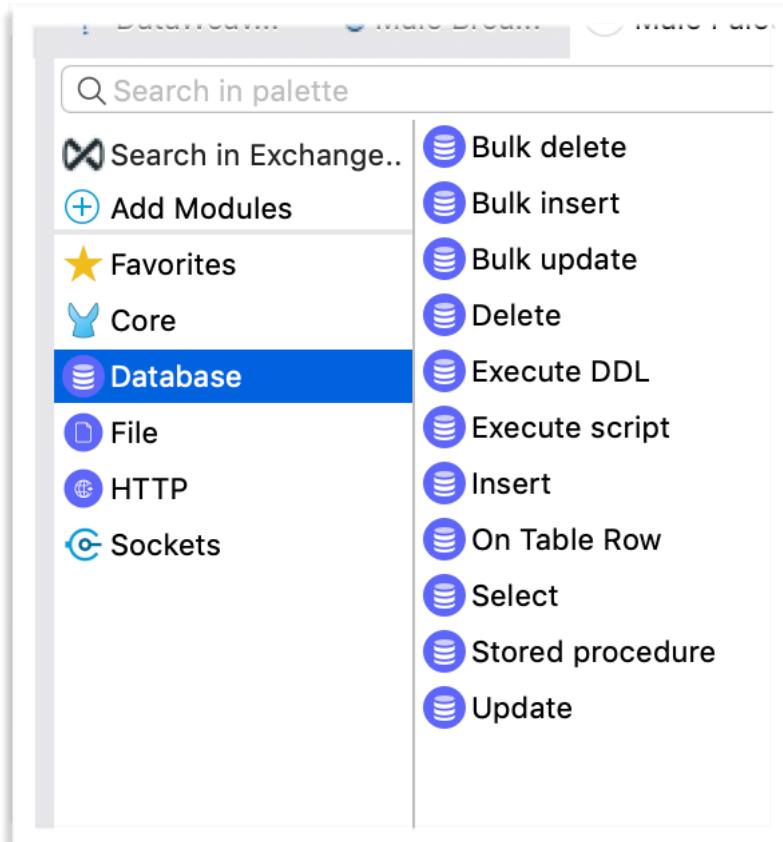
Convert to other Data Types like json , csv, xml or any to Display or return response to the caller. Because you cannot print an Object. If you want to use internal purpose there is no need to do the conversion.

### Sample Output from Select Database connector :

**Array of Objects:**

```
[  
  {  
    "name" : "Sravan",  
    "id"   : 2  
  },  
  {  
    "name" : "Lingam",  
    "id"   : 3  
  }  
]
```

### Operations :

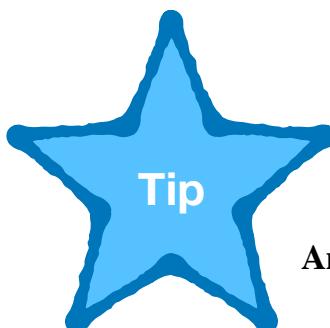


## The Power of Transform Message - Preview Mode :

Refer to: <https://www.linkedin.com/pulse/dataweave-20-part-2-power-transform-message-preview-sravan-lingam/>

```

1%dw 2.0
2output application/json
3---
4now() as Date as String {format: 'yyyy-MMM-dd'}
5
6|
7
  
```



### Do you know?

How to Identify an Object and an Array?

Simple :

An Object is always enclosed with {} and contains key-value pair

Eg: { "name" : "Sravan" } — Valid ✓

{ "name" : "Sravan" , "id" : "2" } — Valid ✓

{ "Sravan" } — InValid X      { "name" : "Sravan" , "2" } — InValid X

An Array is always enclosed with [ ] and contains only values Eg:

[ "Sravan" , "2" , "MuleSoft" ] — Valid ✓

{ "name" : [ "Sravan" , "Lingam" ] } — Valid ✓

[ "name" : "Sravan" ] — InValid X

## Building Simple RESTful Application to print “Hello World” :

**Step 1:** Create a new project . File —> New —> Mule Project

**Step 2:** Drag and Drop a Flow from Mule Pallet

**Step 3:** In “Source” part of Flow , drag and drop HTTP Listener and enter basic config details (Refer to Connectors section ) like host, port, and path. (remember base path and normal path are different )

**Step 4:** Drag and Drop Set-payload or Transform Message component , both hold same value . And type “Hello World” in value.

**Step 5:** Place a logger component to print your message in console

**Step 6:** Right click on Canvas and click Deploy application

**Step 7:** Goto Postman and create url and deploy . URL can be frame like below:

**<Protocol> :// <host>:<port> /<basePath>/<path>**

In our case : Protocol : http , port : 8081 , basePath : “blank” , path : test

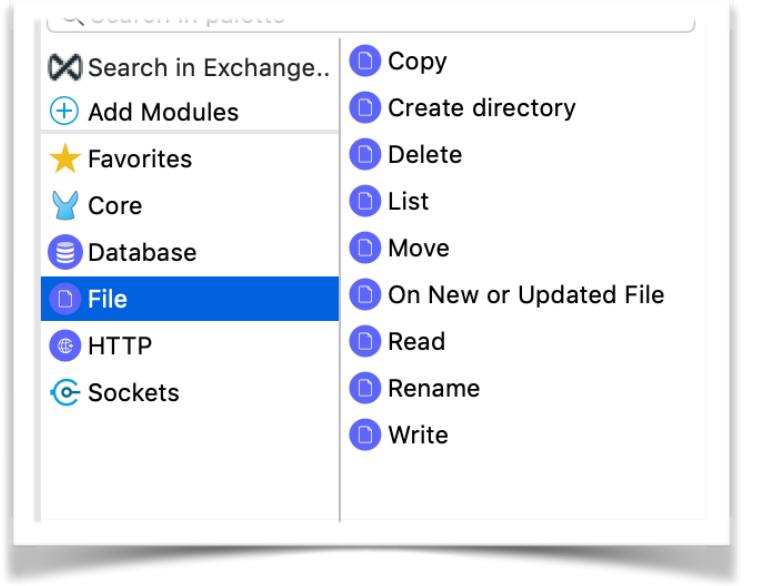
URL : **http://localhost:8081/test**

## ● File :

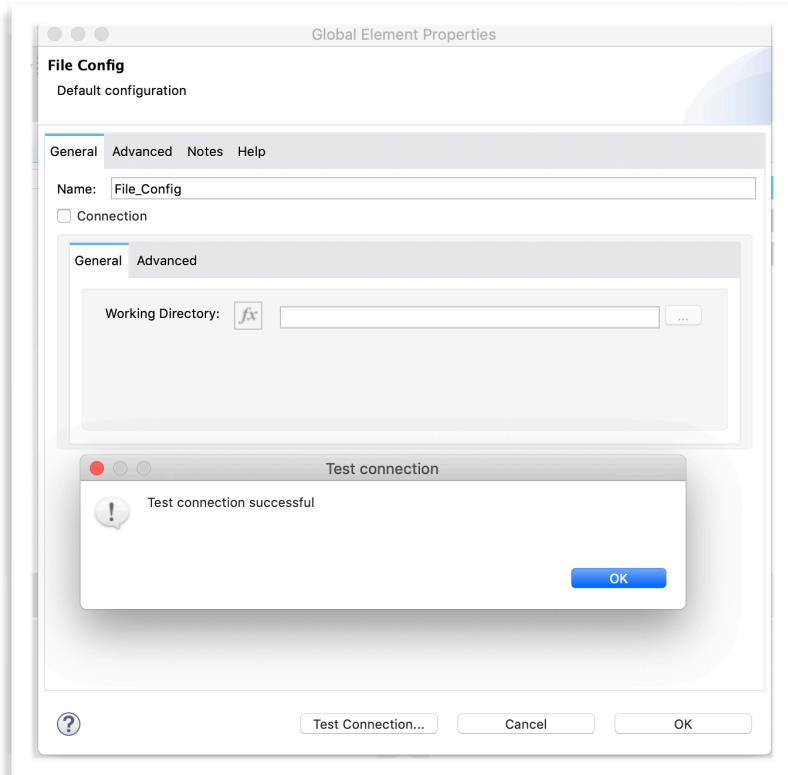
- **Mandatory Config Details required:** Only configuration which has one value that needs to be set I.e, Working Directory. You can leave empty too. But You have to create a Configuration for sure.



## ● Operations:



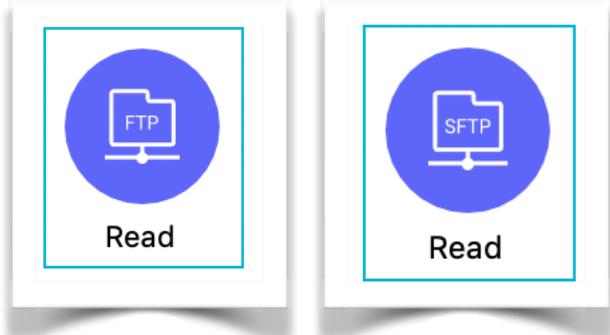
## Test Connection:



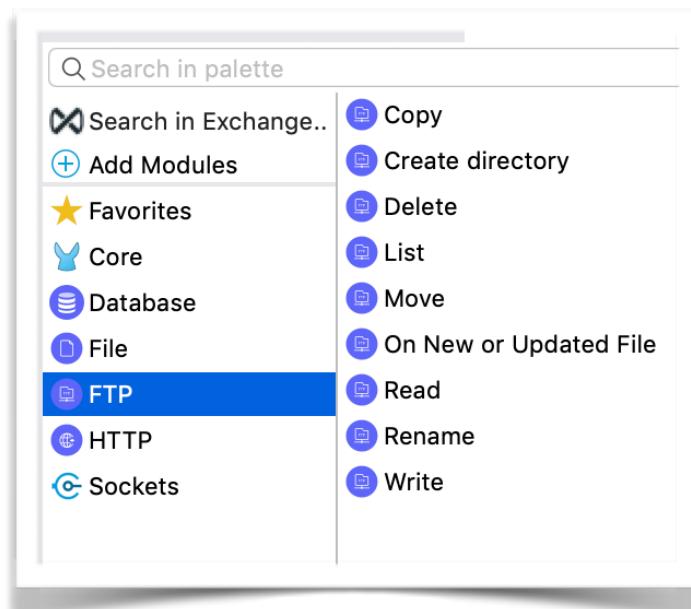
## ● FTP / SFTP :

- **FTP, SFTP are one and same except that SFTP uses secured protocol. The way we connect, the operations are all same. The operations and the way it works is same for File,FTP and SFTP .**

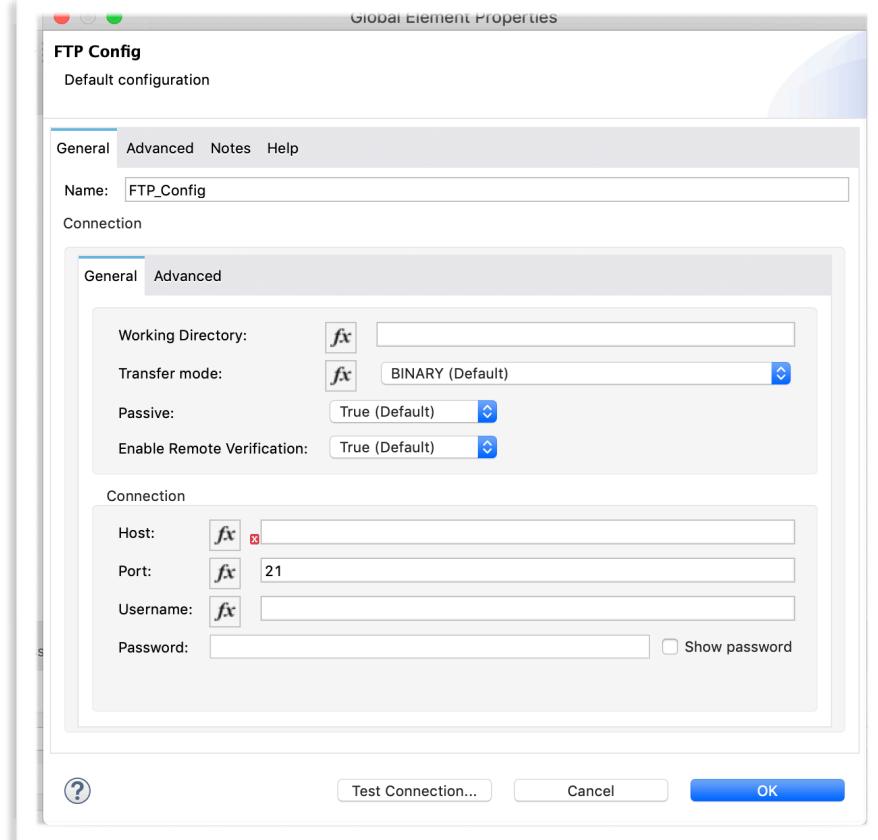
- **Mandatory Config Details required:** Host, port , username and password



## ● Operations:

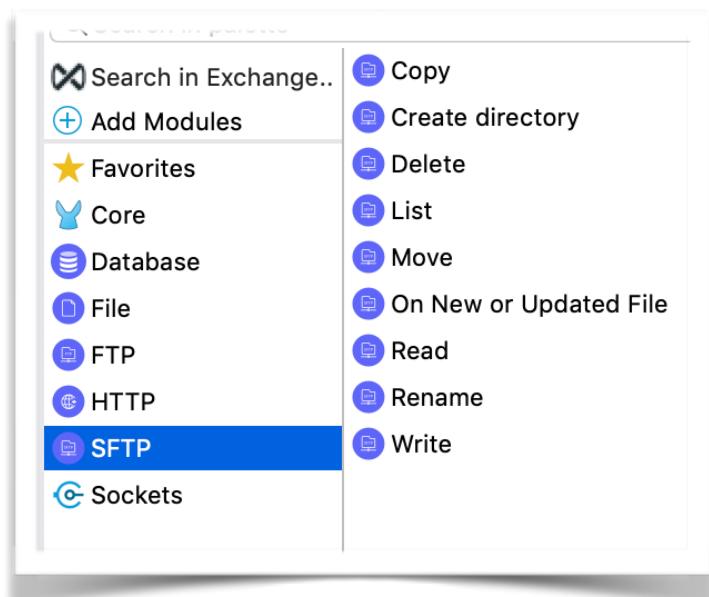


## FTP Config:

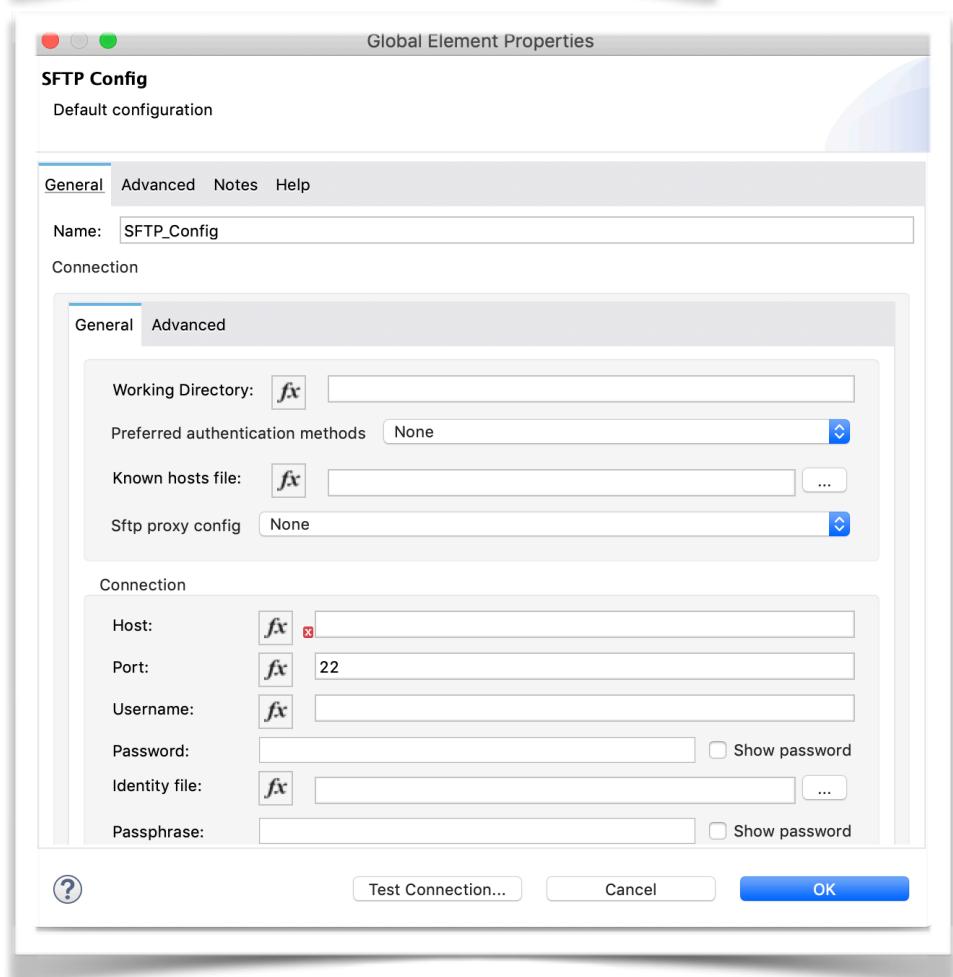


## SFTP:

- Operations:



## SFTP Config:

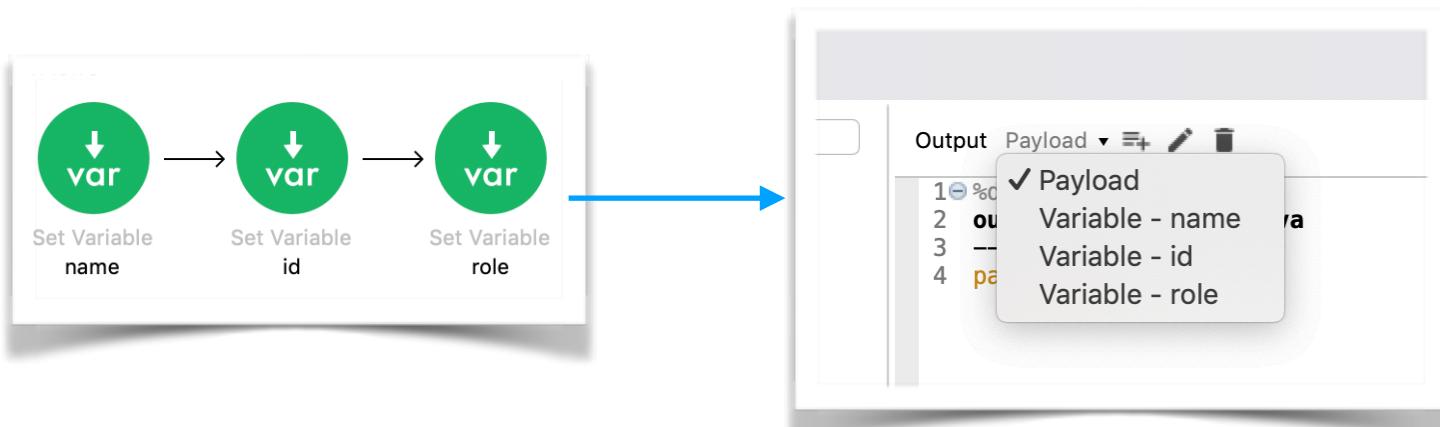


If you have observed above : File,FTP and SFTP operations, all are same because the functionality remains same. Only difference is File is on local, FTP and SFTP are on Server.



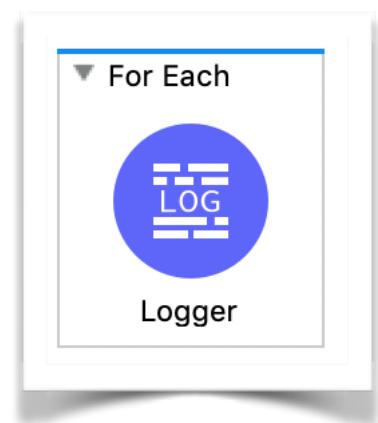
### Do you know?

We can set **multiple variables** , **Multiple Attributes including payload** in Single Transform Message. So that you can avoid having multiple "Set variable" components in a flow.



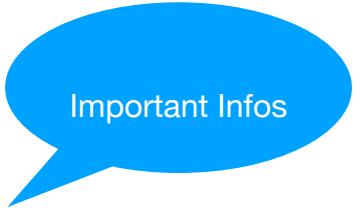
### ● For Each :

- **Mandatory Config Details required:** nothing
- **Default :** By default if you don't mention anything in "Collection" Tab, it takes payload as collection. Batch size=1
- **Remember:** Input collection for For-each must be always an Arrays



There are no errors.

Display Name:	For Each
<b>Settings</b>	
Collection:	<input type="text" value="fx"/>
Counter Variable Name:	<input type="text" value="counter"/>
Batch Size:	<input type="text" value="1"/>
Root Message Variable Name:	<input type="text" value="rootMessage"/>

Important Infos**Note:**

- 1) The payload value After For-each Loop is always the payload value that is present just before For each.
- 2) Everything is a payload of single object once it enters For-each loop . Even though if your “collection “ is vars or payload. As For-each iterates over every single record of “collection” . The payload value is always single object inside for-each loop
- 3) Input for For-each is payload by default if nothing is mentioned in “Collection” and it should be array.
- 4) You cannot keep empty For-each loop. It will fail to deploy if there’s empty for-each
- 5) If one record is failed in the process, then For-each will stop processing the rest of the records. For eg: You have an array of 5 . And 1st two records are processed and somehow 3rd record has failed to due to various reasons . Then your 4th and 5th records will not be processed
- 6) If you want to process all records even if there are failures in individual records. Then you must use “Try” block and use“On-Error-Continue” to handle individual errors and process to next record.
- 7) You can keep payload or any variable value inside “Collection” tab . But it should definitely be an array

**HTTP STATUS CODES :**

HTTP response status codes indicate whether a specific HTTP request has been successfully completed. Responses are grouped in five classes:

- Informational responses (100–199),
- Successful responses (200–299),
- Redirects (300–399),
- Client errors (400–499),
- and Server errors (500–599).

Every Request that is made by client/consumer but receive some response along with a Status Code.

So whenever you build a Web-service (either RESTful or SOAP) please make sure that you set appropriate Status code.

Frequently Used Status codes:

- **200** OK
- **201** Created
- **202** Accepted
- **400** Bad Request
- **401** Unauthorized
- **402** Payment Required
- **403** Forbidden
- **404** Not Found
- **405** Method Not Allowed
- **406** Not Acceptable
- **409** Conflict
- **415** Unsupported Media Type
- **500** Internal Server Error
- **501** Not Implemented
- **502** Bad Gateway
- **503** Service Unavailable
- **504** Gateway Timeout

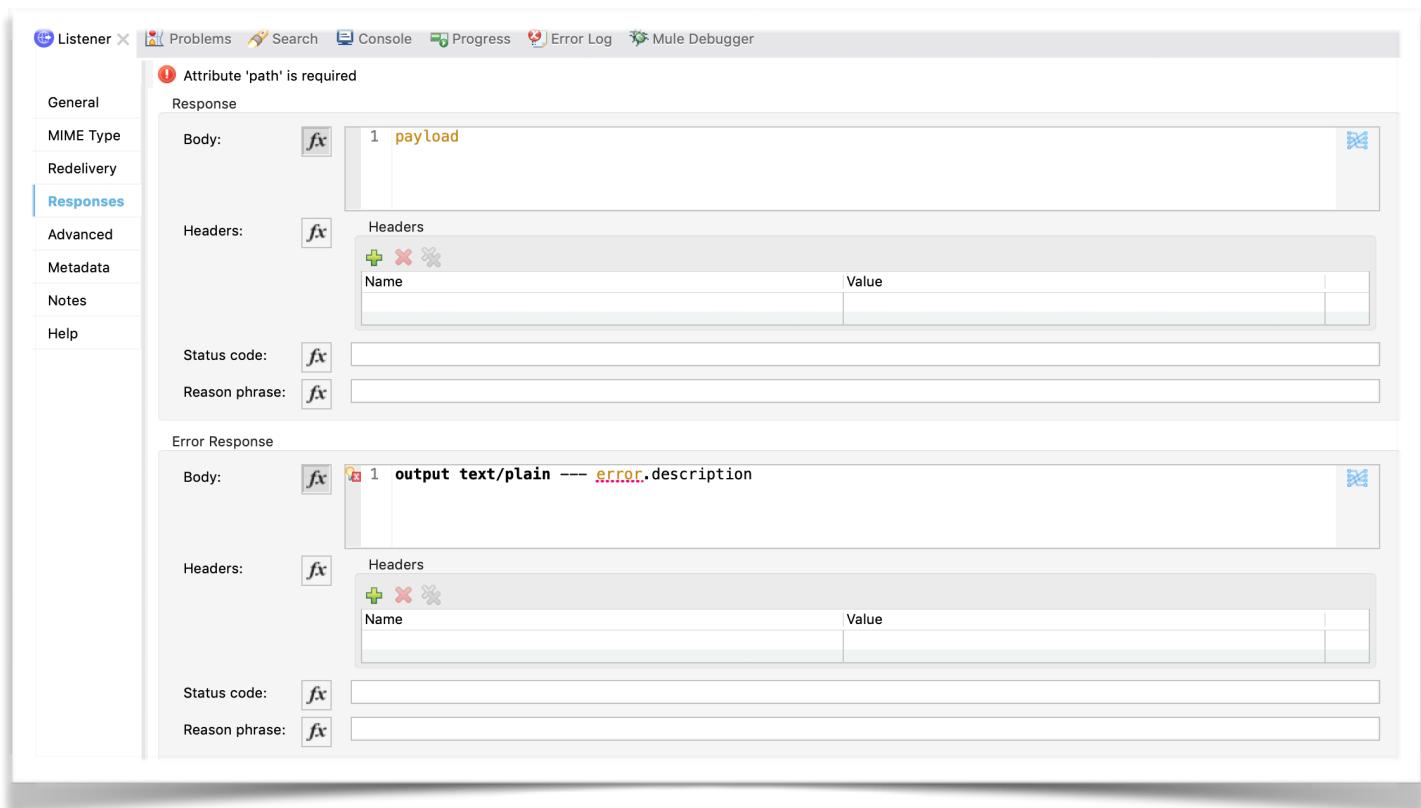
## How To Set HTTP Status Code in Mule Applications ?

HTTP Listener place a very important role in setting output response on both the Body and Status code.

We shall check how the Responses Tab of Http Listener looks like by default.

Please Note: Below HTTP Listener is which manually dragged and drop by developer.

The Http Listener generated using RAML will be having different values in Responses Tab



You can see there are 2 divisions:

- 1) **Response** - Which has Body and Status code. (Body is set to payload by default and can be changed if required. By default Status code is empty, i.e, default status code is 200) . Used for success scenarios
- 2) **Error Response** - Which has Body and Status code. (Body is set to error.description by default and can be changed if required. By default Status code is empty, i.e, default status code is 500) . Used for failure scenarios

If you want to set any status code manually. You can define any variable name in place of Status Code (Both in Response and Error Response tabs) and **make sure that Status code value is set with Same Variable name**

**Eg:** If you give Status code value as `vars.HttpStatus`. Then you have to set this variable at the end of each process whenever you require to change other than 200 (for success) or 500(for failure)

**Note:** Mostly All RESTful Applications use RAML to generate basic flows. So no need to manually give names in Http Listener. Because by default the Status codes are named as `vars.HttpStatus`.

If you forget to set status code value somewhere , then it will show 200 for success and 500 if any failure is present.

### Examples:

#### 201:

POST http://localhost:8081/db

Status: 201 Created Time: 567 ms Size: 198 B

Body (Pretty):

```

1 [
2   [
3     "User Verynewgbit was registered Successfully"
4   ]
5 ]

```

#### 400:

POST http://localhost:8081/db

Status: 400 Bad Request Time: 40 ms Size: 238 B

Body (Pretty):

```

1 [
2   [
3     "Require username and password to Display detailsFor Object 1"
4   ]
5 ]

```

**404:**

The screenshot shows a Postman interface with a POST request to `http://localhost:8081/dbss`. The request body is a JSON object with fields: `customerName`, `custUsername`, `custPassword`, `custAddress1`, `custAddress2`, `custCity`, `custState`, and `custCountry`. The response status is 404 Not Found, indicating no listener for the endpoint.

**405:**

The screenshot shows a Postman interface with a GET request to `http://localhost:8081/db`. The request body is a JSON object with the same fields as the previous screenshot. The response status is 405 Method Not Allowed, indicating the method is not allowed for the endpoint.

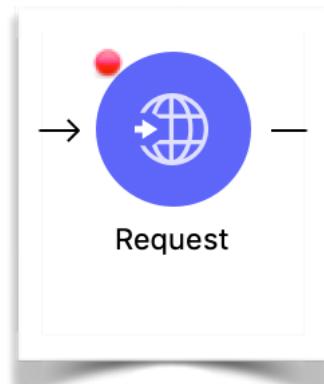
**409:**

The screenshot shows a Postman interface with a POST request to `http://localhost:8081/db`. The request body is identical to the previous ones. The response status is 409 Conflict, with a JSON response message: "User Verynewgbit Already Exist".

This we we follow the standards of HTTP Status codes

## ● Http Request :

- Http Request is used to call other web-services . It can be placed only in “Process” area of flow/private-flow/ sub-flow . We should make sure that we send all kind of proper inputs to Http Request component like URL,method, the input payload that the external web-service is expecting, various attributes like queryParams,headers etc



### ● Mandatory Config Details required:

- Protocol
- Method
- URL or Path : If you provide whole URL, then port base path are not required. But If you give path, then host, port ,path are necessary.

You can pass body ,headers ,Attributes ,QueryParams in respective tabs



1. In any case if an error coming from the web-service we are calling to be considered as success , then we have to make changes in Response Tab of Http Request and make use of **Success-status-code-validator**.

**Example:** If you are receiving 404 NOT FOUND error or any 400 series errors needs to be considered as success scenario instead of error .

In above case **200..499** states that all the response status codes pithing range 200 to 499 are need to be considered as Success

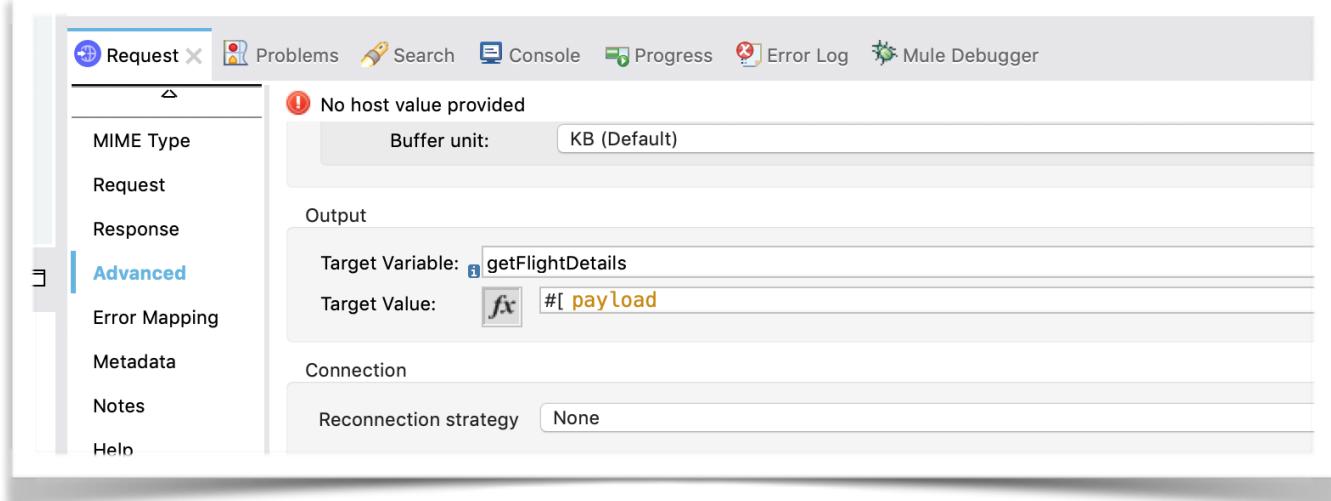
Same way, if you want to consider only one particular Status code as a failure and rest all Status codes as Success , then we make us of **Failure-Status-Code-Validator**

**2)** If you feel that the time taken to get response form external web-service is taking long than expected, then we can increase **Response Timeout Value** . Which is just about Response Validator configuration in Response Tab (Refer to above pic).

**3)** All Attributes and Payload just before Http Request are overridden by attributes and Payload that we received from external web-service via Http Request .

**4)** To check the status code coming form Http Request , we use #[attributes.statusCode]

**5)** If you still don't want to Override existing payload just before HTTP Request , we can give **Target Variable Name** which is in Advance Tab of Http Request , so that the output payload of web-service is stored in a variable that you have defined . From below picture , we can see that your payload is stored in variable named `getFlightDetails` and can be accessed across the applications using `vars.getFlightDetails`.



## ● Error Handling :

An exception occurs when an unexpected event happens while processing.

Exception handling is the process of responding to exceptions when a computer program runs.

**In Mule we can handle the message exception at different level.**

- –At Project level using **Default error handler**
- –At Project level using **Custom Global error handler**
- –At Flow level in exception handling using **On Error Continue** and **On Error Propagate, Raise Error**
- –With in Flow or at processor level using **try scope**

Whenever there is an error occurred in a Flow, an **error Object** is created . It contains many properties . Eg : **error.description , error.errorType** etc

errorType is combination of Namespace and Identifier :

Eg : **HTTP:UNAUTHORIZED**

Here :

**namespace = HTTP**

**Identifier = UNAUTHORIZED**

**Mule identifies based on error Type and then route to respective blocks that are placed in Error Handler.**

**Let's discuss what is On Error Propagate and On Error Continue in detail:**

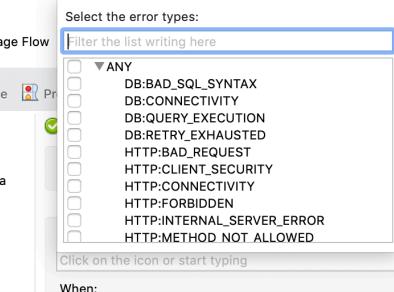
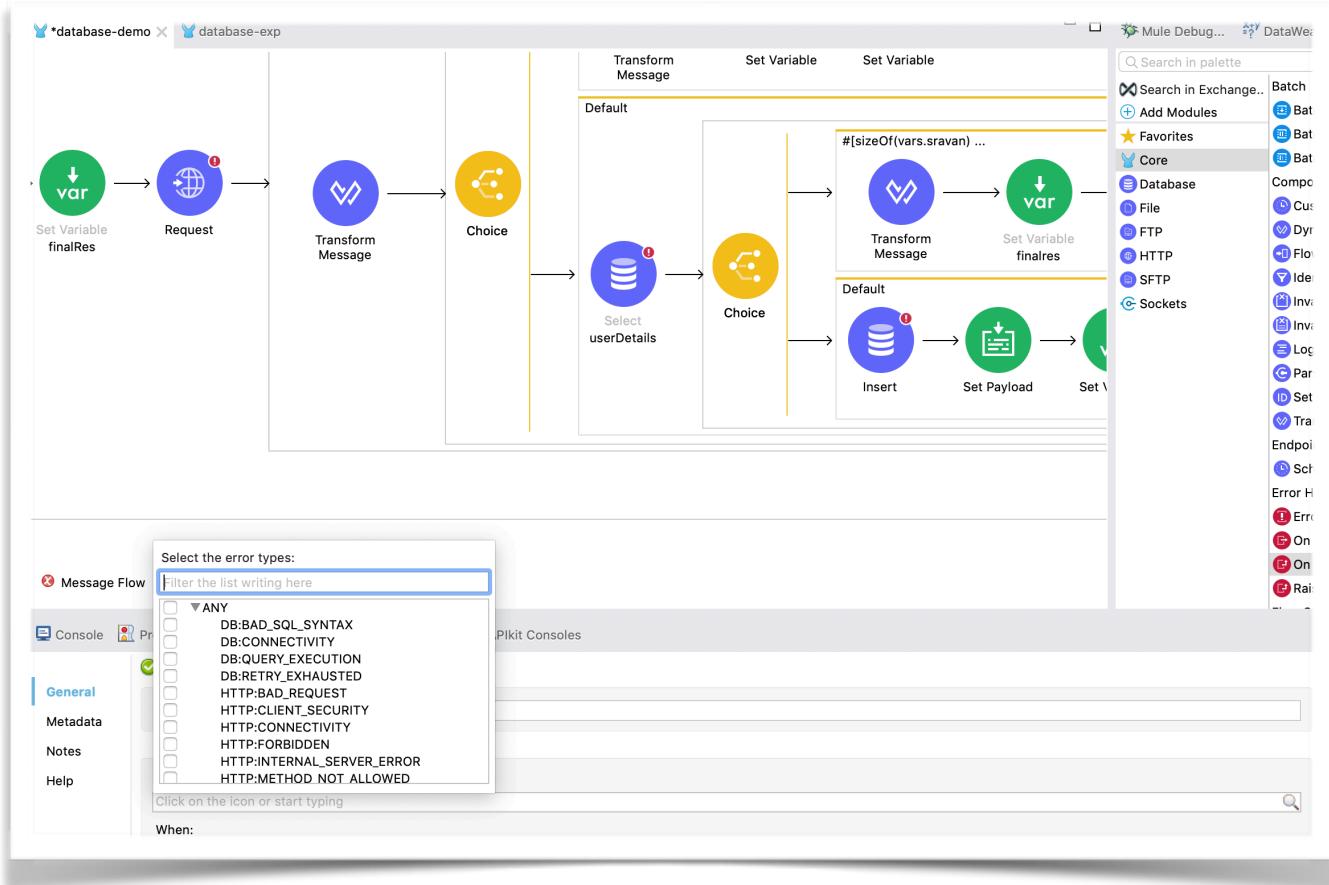
As we have discussed earlier about the differences between flow , sub-flow and private flow, Sub-Flow doesn't have Error Handling scope . So its just Flow and a Private flow where you can place On-Error-Propagate and On-Error-Continue inside Error-handling block.

As we discuss earlier , either it is Propagate or Continue, Mule Executes all the components within that block

We used to have many kinds of error-handling connectors in Mule 3 . But it was simplified in Mule 4

**Remember :** The error will route to error-handling only if it identifies that the errorType of that error is handled

Also Mule 4 has one excellent feature of Identifying the types of errors that can occur within that flow by looking at what kind of connectors are placed in that particular flow.



You can see above that as we have Http-Request and Database , it has all kind of error types which are expected to come in error scenarios . Even you can find EXPRESSION error type as we have some Dataweave syntaxes in the flow.

It will be very easy to learn Error-handling on how Error-Propagate or Error-Continue works . We shall follow some set of rules to identify the flow of process. That way we can determine what is the result payload statusCode

Before going to learn about rules. We must not forget that , RAML based generated Http Listener has Error Response Body as “payload” as Default but manually dragged and drop Http Listeners has **output text/plain - - - error.description** as default. So change accordingly to your business requirements .

## **RULES:**

### **When an error occurred in any Flow :**

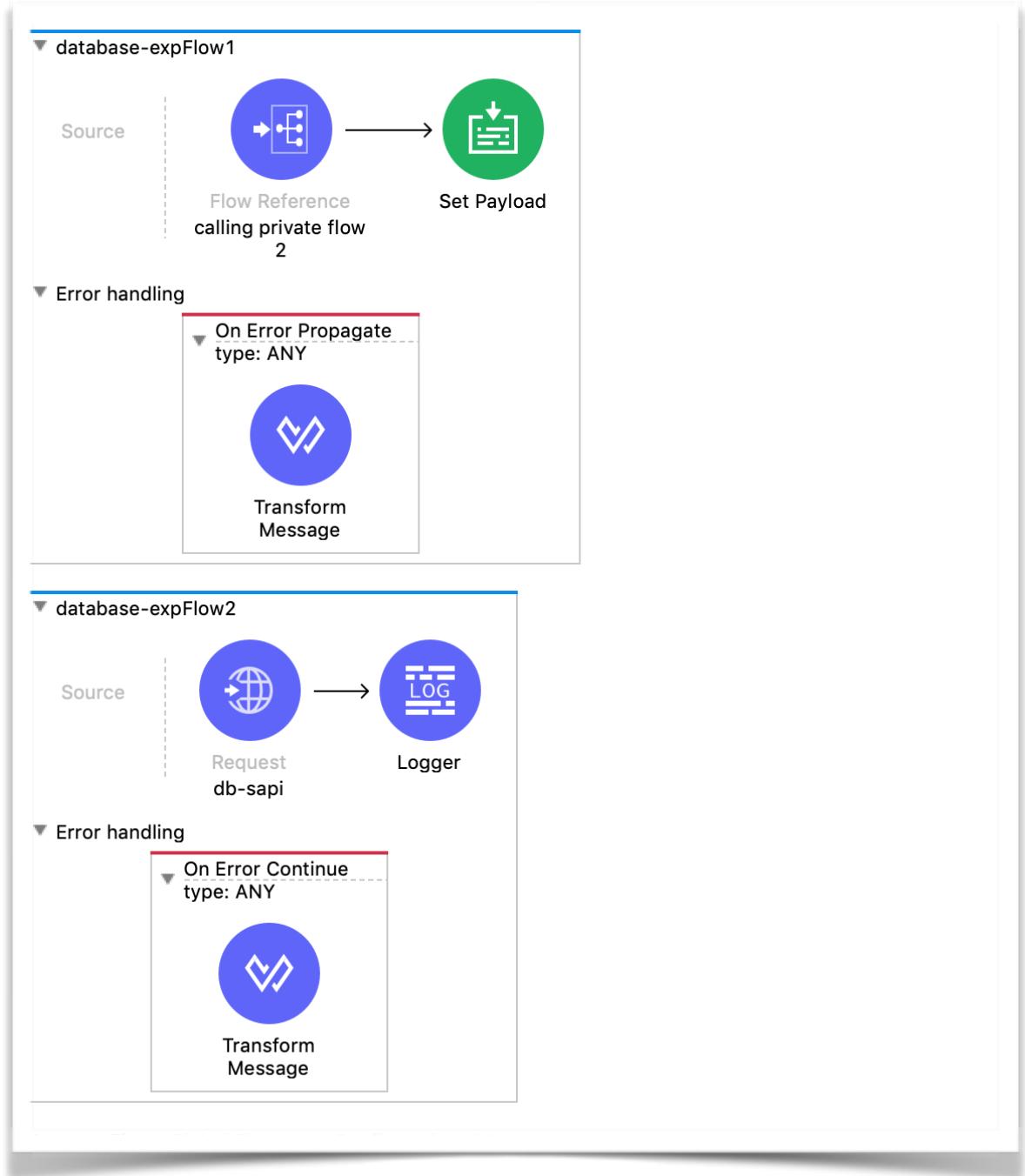
**Rule 1 :** See if anything is present in Error-Handling . Even if there are on-error-propagate and on-error-continue blocks, see that if that particular errorType is handled. If NOT, then Mule will use default Error Handling . Suppose if your flow is not called by any other flow , then it will display default value that is set in Error-Response and gives status code as 500 bad default if nothing is set manually. If your flow is called by any other flow, then it will RAISE as an error to the calling flow.

**Rule 2 :** If some Error Handling is present in that particular flow and errorType is handled (YES condition for RULE1) , then check whether it is On-Error-continue or On-Error-Propagate . In both the cases, **Mule will execute all components** within that block.

**Rule 3 :** After execution of all components . Now:

- If the error is handled using On-Error Propagate , it will raise an error back to the calling flow.
- If the error is handled using On-Error Continue , it will not raise an error back to the calling flow and continue to next processor after “flow-ref” and continues further process as it is. But it will not continue to other processors in the flow where error is handled.
- Suppose you have only single flow. Then On-error-propagate and On-error-Continue behaves same way, instead error-continues gives 200 status and error-propagate gives 500 status. Because as said , even if its error-continue, it will not go to next processor within the same flow.
- **Always remember , this point is very important. On-error-Continue will continue only to next processor of calling flow but not in the same flow .**

**If you observe below flows. Suppose your error is handled in 2nd private flow and if there is on-error-continue, it will not execute logger in private flow 2, instead it will go to Set payload of private flow 1 which is actually calling private flow 2**



If it is on-error-propagate , The error is raised back to the calling flow . And now flow Rule1 to Rule 3 again for that particular calling flow until final process is completed .

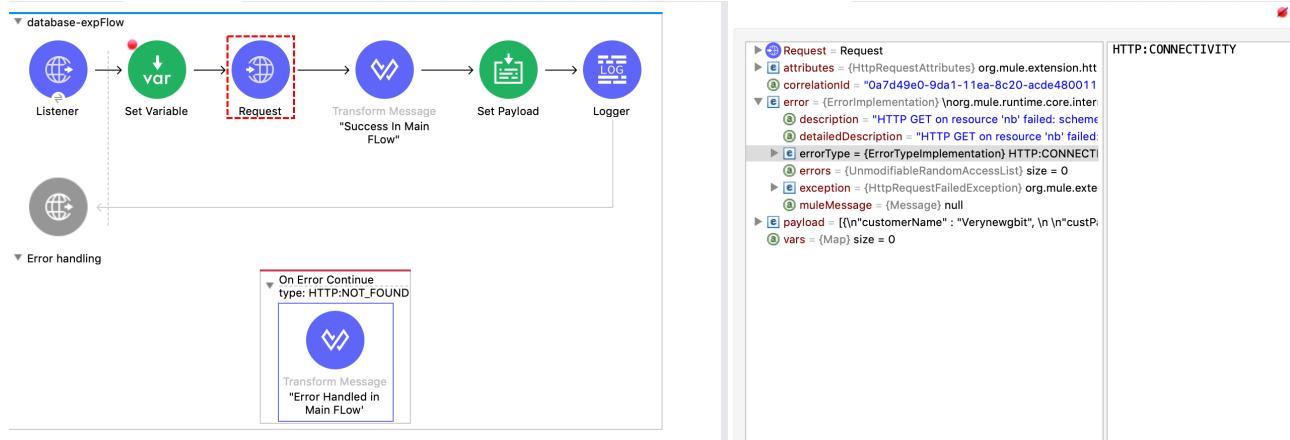
Simple tip is, whenever an error is raised back to calling flow, just go by the rules 1,2,3 again .

Let's See some examples and check what is the output and status code of each one.

Consider that in all cases , default value for response in Http Listener in Error Response is set to #[payload] and all cases below raise error for errorType : HTTP:CONNECTIVITY

**All cases have input payload as {name : "sravan lingam"}**

**Case 1:** Let us assume we have only one flow. Lets follow rules



**Rule1 :** There's something handled in Error-Handler. But errorType is not Matching with Handled errorType. So don't care whether it's error-continue or error-propagate. When errorType not matched, it will use default error handler by mule.

Actual errorType = HTTP:CONNECTIVITY

Handled errorType = HTTP:NOT\_FOUND

As both doesn't match and this is main flow and is not called by any flow,

It uses Mule's default error-handling.

It will print the payload whatever is coming from input just before Http Request with status code 500

**Final Response :**

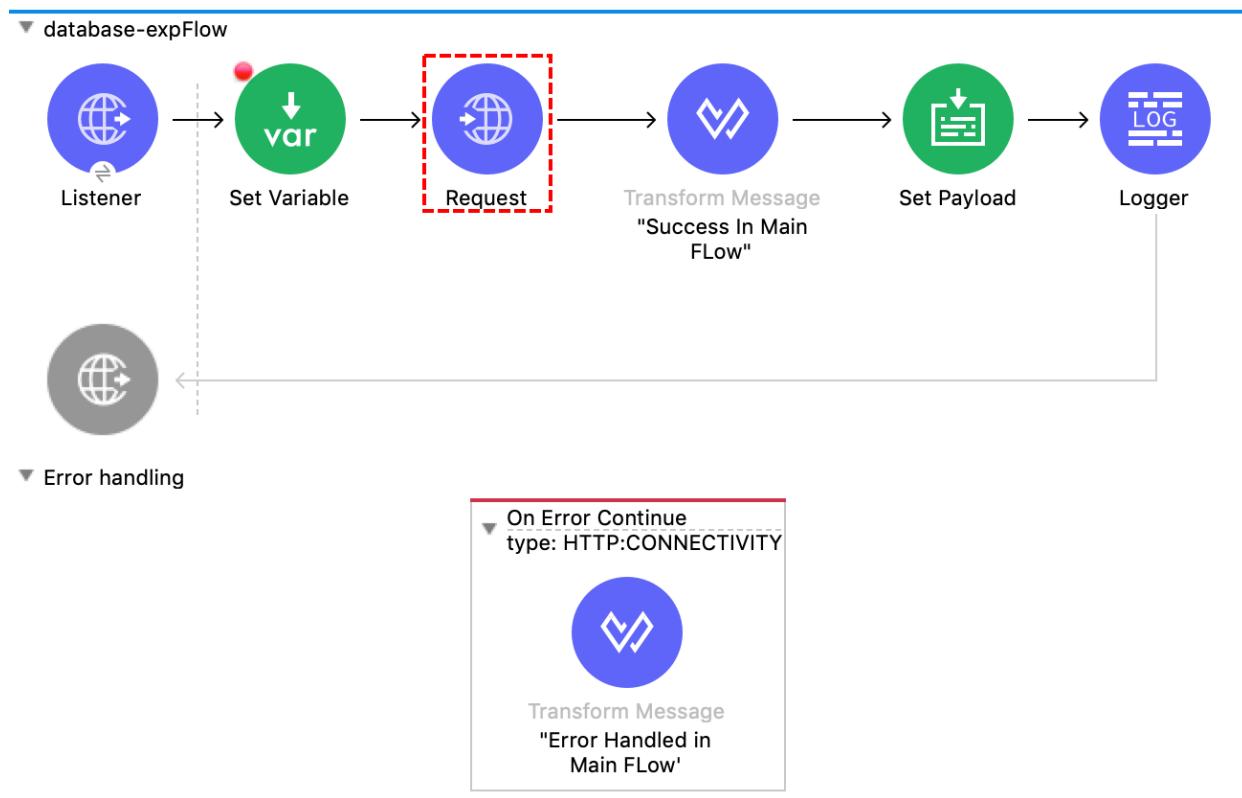
**Response Body :**

{name : "sravan lingam" }

**Response status code :**

500

**Case 2:** Let us assume we have only one flow. Lets follow rules



**Rule1 :** There's something handled in Error-Handler. And `errorType` is Matching with Handled `errorType`.

Actual `errorType` = **HTTP:CONNECTIVITY**

Handled `errorType` = **HTTP:CONNECTIVITY**

As both are matching and this is main flow and is not called by any flow,

**Rule 2 :** The flow is using **On-Error-Continue** . It executes all components in this block. In this block we are setting payload in Transform message with value “Error Handled in Main flow”

**Rule 3:** According to point b and c in Rule 3, As it is **On-error-continue** , and the current flow is not called by any other flow , it will execute processors in **Error-Continue** and end the process with 200 status

It will not execute the components after Http-Request as this is main flow

It will print the payload whatever is set in Transform Message in Error-Continue

**Final Response :**

**Response Body :**

“Error Handled in Main flow”

**Response status code :**

200

---

**Case 3:** If we use On-error-Propagate in Case 2 instead of On-error-Continue ,Every rule is same but as its On-error-propagate , it will raise an error back to caller with status code 500

**Final Response :**

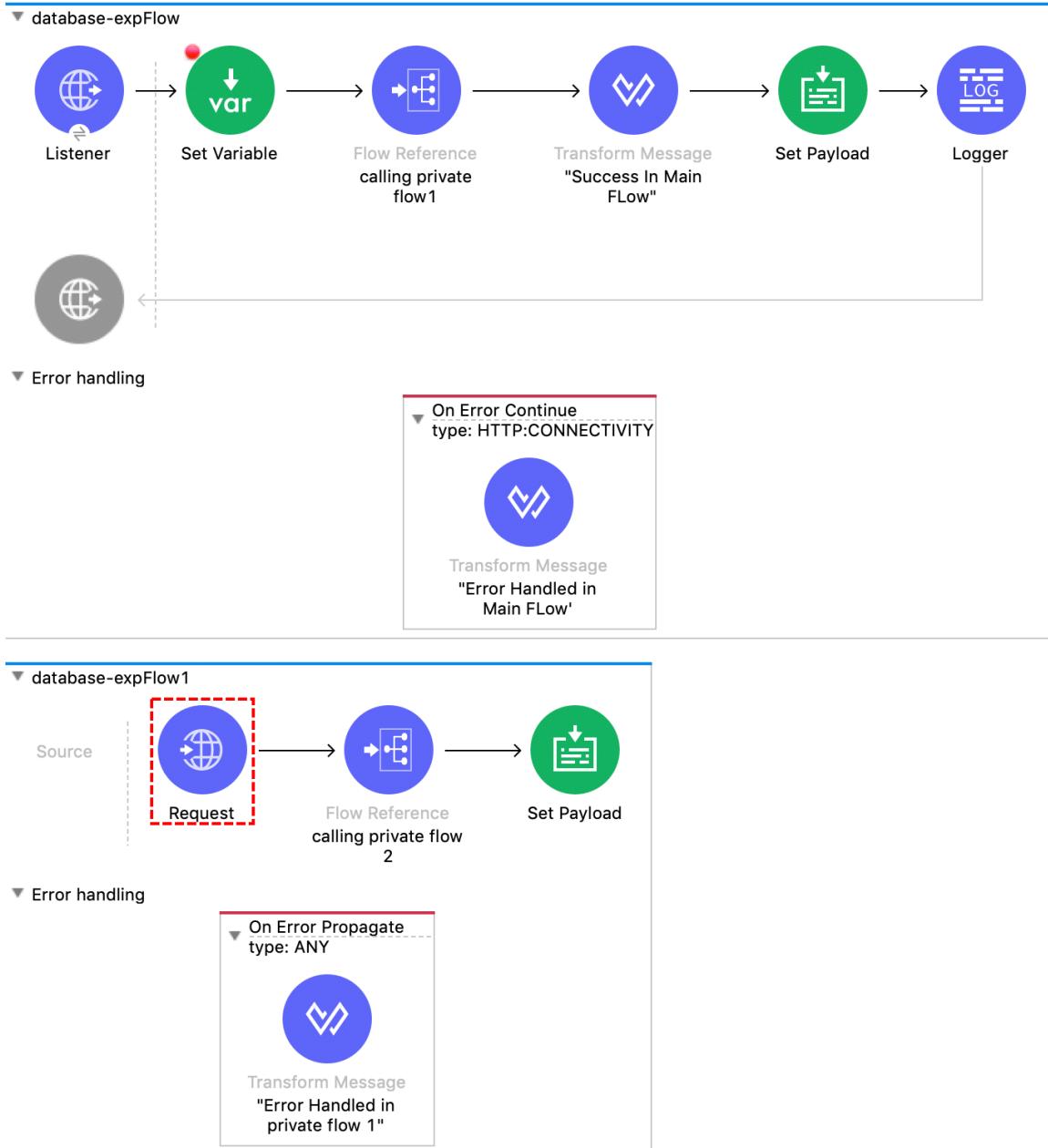
**Response Body :**

“Error Handled in Main flow”

**Response status code :**

500

---



**Case 4:** Let us assume we have 2 flows. Lets follow rules

**Rule1:** There's something handled in Error-Handler. And errorType is Matching with Handled errorType.

Actual errorType = HTTP:CONNECTIVITY

Handled errorType = ANY

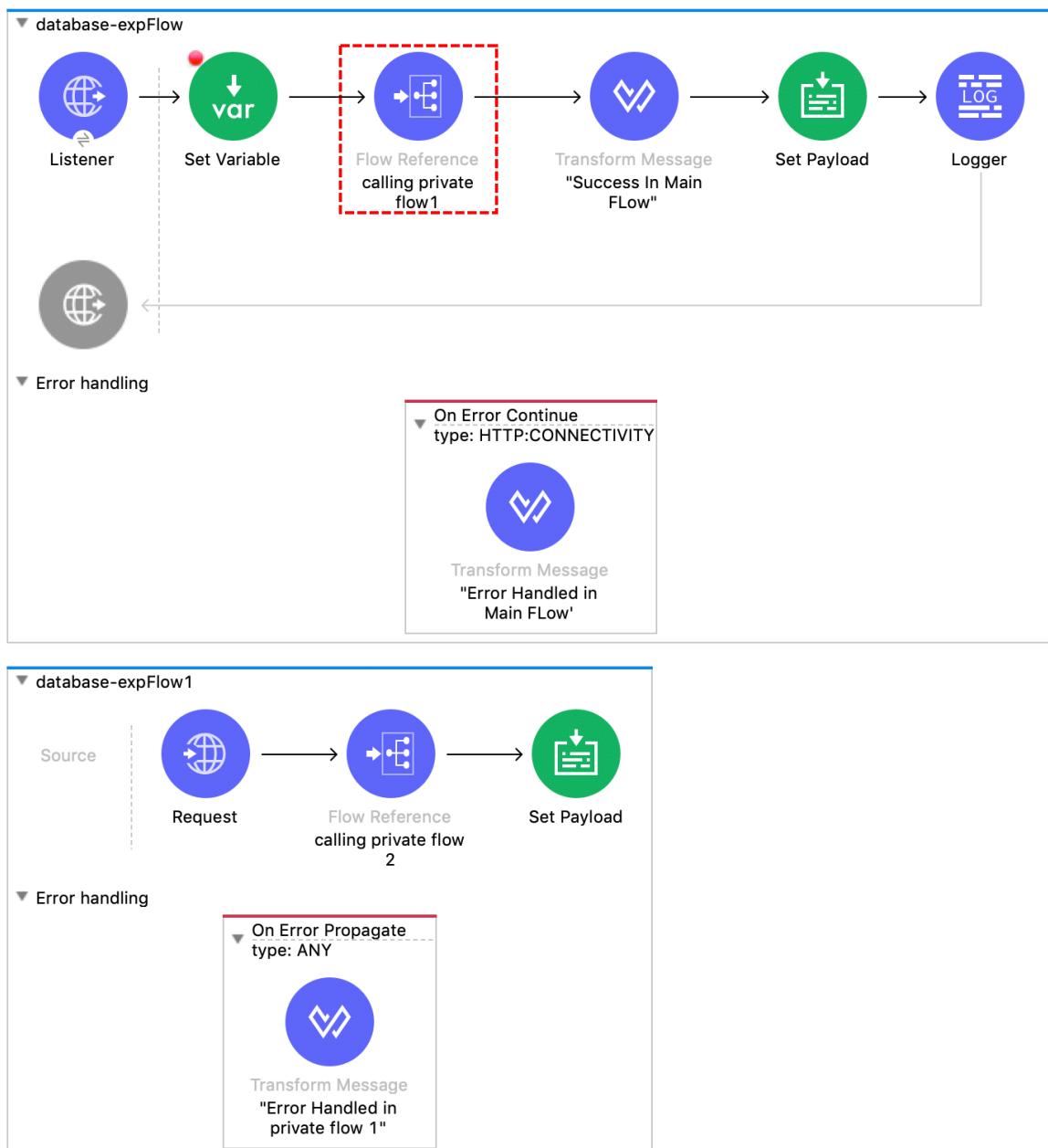
ANY can handle anything

**Rule 2 :** The flow which has error (private flow 1 in this case) is using On-Error-Propagate . It executes all components in this block. In this block we are setting payload in Transform message with value “Error Handled in Private Flow 1”

**Rule 3:** According to Rule 3, As it is On-error-propagate , and the current flow is called by main flow , it will execute processors in Error-Propagate and raise error back to calling flow which is main flow.

Now ball is in Main flow court.

Now repeat the rules again for Main flow :



This is how it raised back error to main flow

Repeat rules:

**Rule 1 :** Matching error type exists

**Rule 2 :** On-error continue , executes transform message with payload “Error handled in main flow”, will not go to other components after flow-ref. As it is On-error Continue, and no other flow is calling the current flow, it will display latest payload with 200 status

**Final Response :**

**Response Body :**

“Error Handled in Main flow”

**Response status code :**

200

---

**Case 5: Same as Case 4 except that error-continue is used in private flow 1**

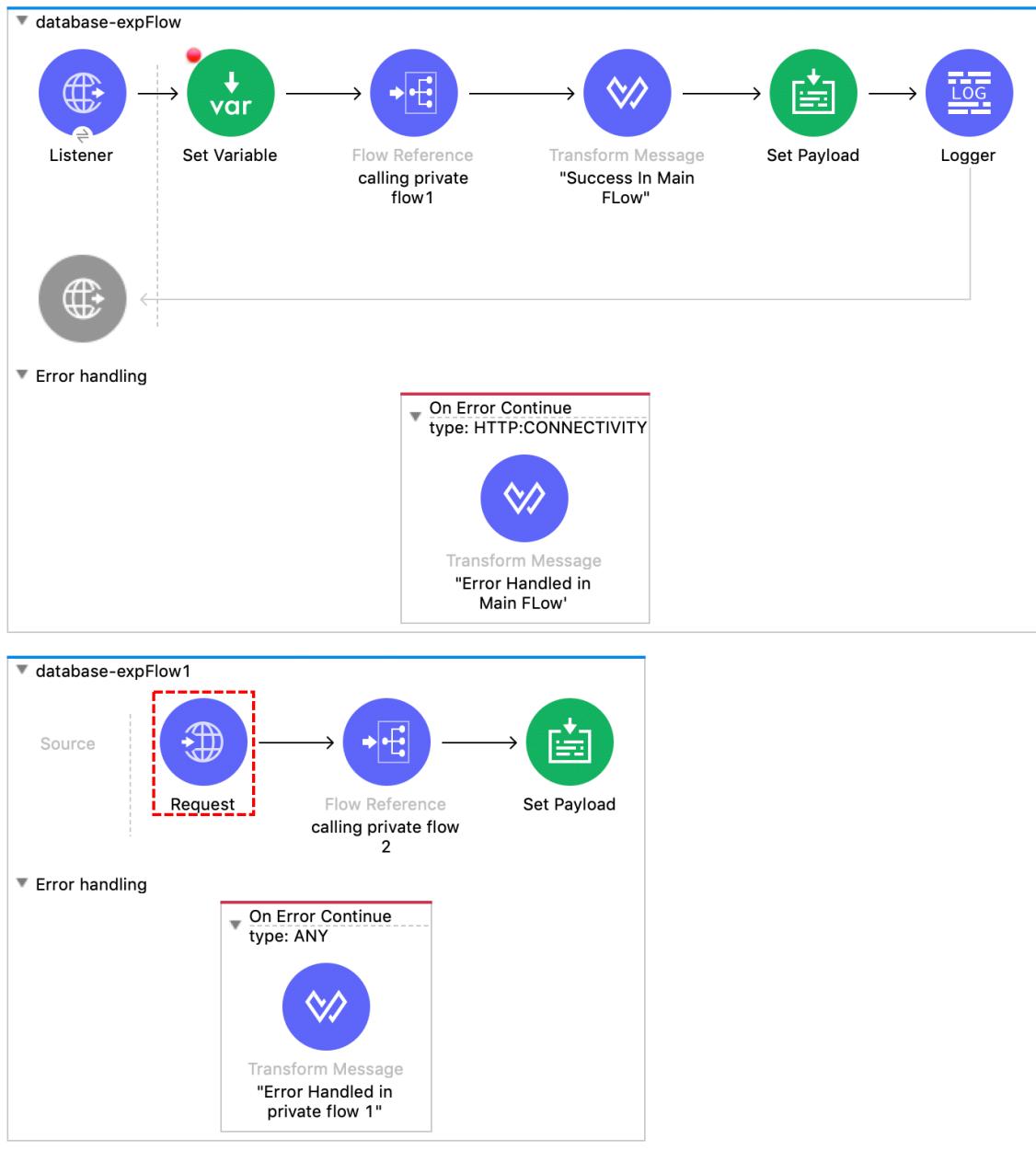
**Rule1** : There's something handled in Error-Handler. And errorType is Matching with Handled errorType.

Actual errorType = HTTP:CONNECTIVITY

Handled errorType = ANY

ANY can handle anything

**Rule 2 :** The flow which has error (private flow 1 in this case) is using On-Error-Continue. It executes all components in this block. In this block we are setting payload in Transform message with value “Error Handled in Private Flow 1”



**Rule 3:** According to Rule 3, As it is On-error-continue , and the current flow is called by main flow , it will execute processors in Error-continue ,doesn't raise as error and go back to calling flow which is main flow . It executes all components after flow-ref and final payload will be displayed with 200 .

### Final Response :

#### Response Body :

“Success in Main flow”

Response status code : 200

## Configuring Properties :

It is always a best practice to place all the values which are hardcoded in the Application in property files. This helps us by not touching our code if there are any changes in those values. We can just modify them in property files.

Also usually we have different configuration details for different environments for connecting to external systems. For eg : We have different host, password for Dev , Int , Stage and Prod environments . In that case we can have 3 property files for each environment which can handle the values based on the environment we deploy our application in.

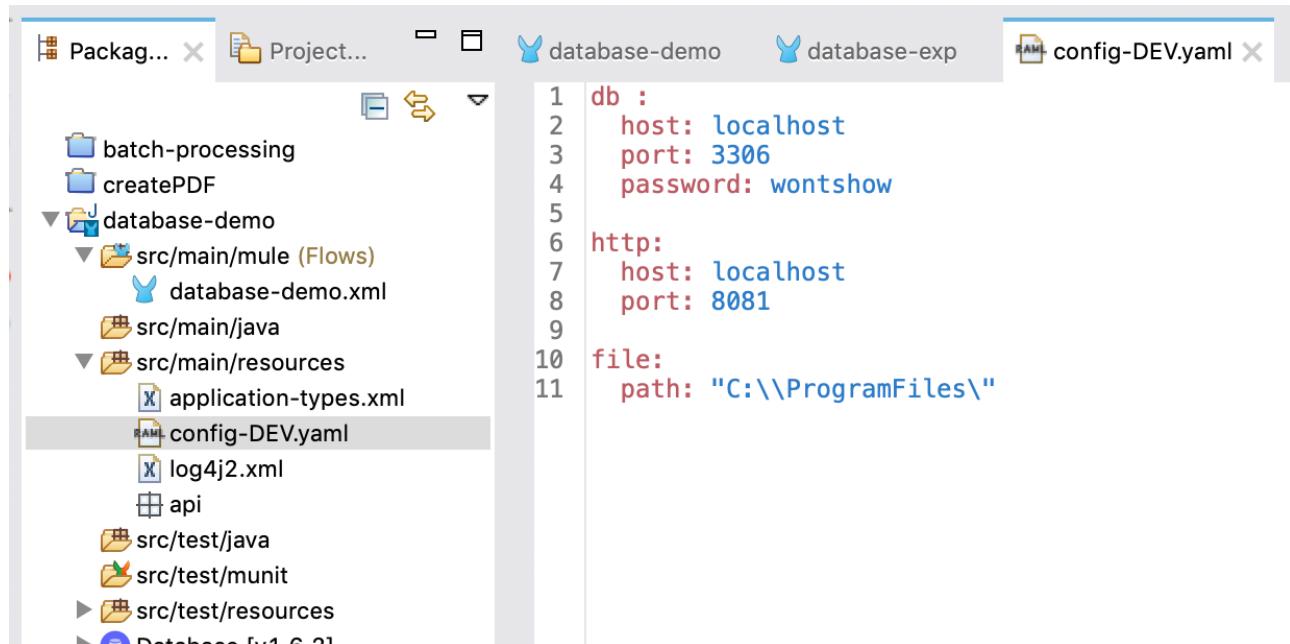
It's very simple. Have your key-value pairs in a property file and use them across your application using \${keyname} or if you want to use in some MEL , you p('keyname').

### Supported Files:

The Configuration Properties support both YAML configuration files (.yaml) and Properties configuration files (.properties). String is the only supported type in both file formats. Use the format that you find easier to read and edit.

Remember it's alway best practice to place these files in src/main/resources

### **YAML Sample :**



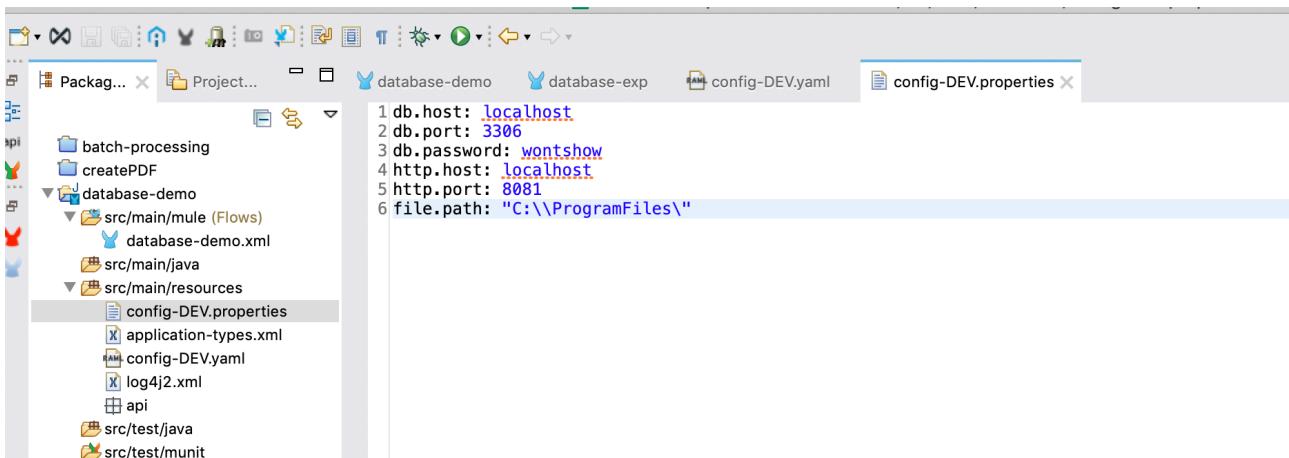
```

1 db :
2   host: localhost
3   port: 3306
4   password: wontshow
5
6 http:
7   host: localhost
8   port: 8081
9
10 file:
11   path: "C:\\ProgramFiles\\"

```

The screenshot shows the Anypoint Studio interface with the project 'database-demo' selected. The left sidebar displays the project structure under 'src/main/resources'. The 'config-DEV.yaml' file is open in the main editor area, showing its contents. The code uses YAML syntax to define configurations for database, http, and file paths.

## Properties Sample :

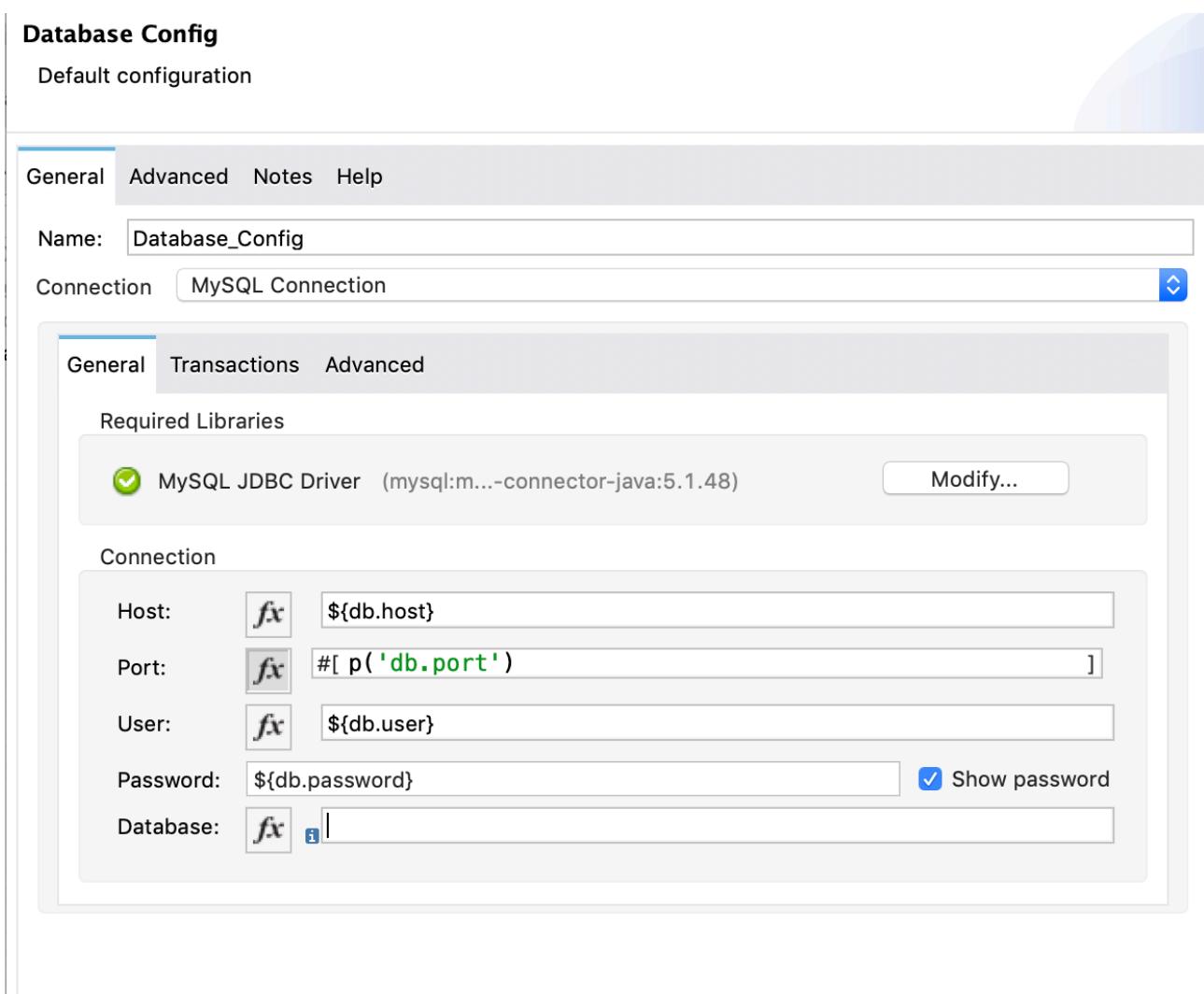


The screenshot shows the Mule Studio IDE interface. On the left is the Project Explorer, displaying a package named "Packag..." and a project named "database-demo". Inside "database-demo", there are several folders: "batch-processing", "createPDF", "database-demo" (which contains "src/main/mule (Flows)" with "database-demo.xml", "src/main/java", and "src/main/resources" which includes "config-DEV.properties"), "src/test/java", and "src/test/munit". On the right, the main editor window shows the content of "config-DEV.properties":

```
1 db.host: localhost
2 db.port: 3306
3 db.password: wontshow
4 http.host: localhost
5 http.port: 8081
6 file.path: "C:\\ProgramFiles\\\"
```

In both cases, we call these property values using \${keyname} or p('keyname')

Eg:



The screenshot shows the "Database Config" dialog in Anypoint Studio. At the top, it says "Default configuration". Below that is a toolbar with tabs: General (selected), Advanced, Notes, and Help. The "Name" field is set to "Database\_Config" and the "Connection" dropdown is set to "MySQL Connection".

The main area has three tabs: General (selected), Transactions, and Advanced.

**Required Libraries:** MySQL JDBC Driver (mysql:mysql-connector-java:5.1.48) with a "Modify..." button.

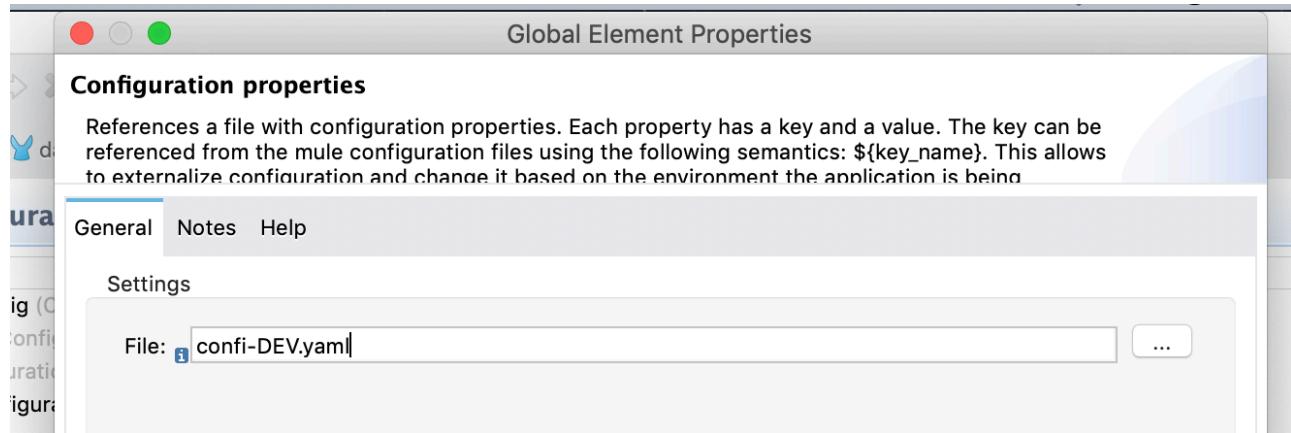
**Connection:**

Setting	Value
Host:	<input type="text"/> \${db.host}
Port:	<input type="text"/> #[ p('db.port') ]
User:	<input type="text"/> \${db.user}
Password:	<input type="text"/> \${db.password} <input checked="" type="checkbox"/> Show password
Database:	<input type="text"/> <input type="button"/>

If you observe in above pic , we use p('db.port') only if we have placeholder for MEL.

(wherever you see fx) . Or else you can you any way to access values.

You can access these values only if you have “Configuration Properties” configured.



You can go to Global-elements —> Create —> search for Configuration properties

Or

Use below xml tag in mule config file:

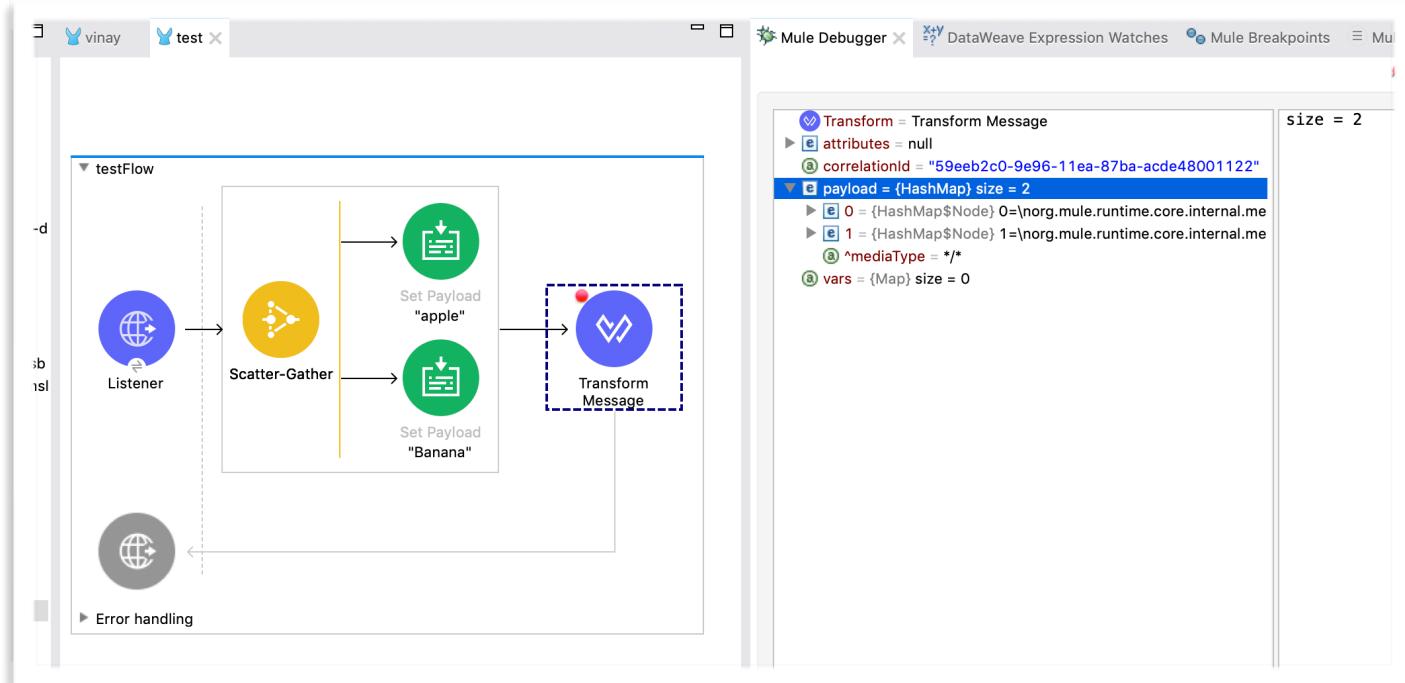
```
<configuration-properties doc:name="Configuration properties"  
doc:id="96988409-1412-4e11-a697-3aa1f600d923" file="config-DEV.yaml" />
```

Note: If you miss any property value in property file and if such property key is accessed in Mule App, then the application fails while deploying saying that so and so property value is missing .

## ● Scatter - Gather :

Scatter Gather sends the request message to multiple targets concurrently , it collects responses from various targets and aggregate them to single message.

- The output type Scatter Gather is Object. application/java
- It executes routes concurrently instead of sequentially . But wait till all targets executes
- Output payload is combination of all targets. And each target output has payload+attributes.

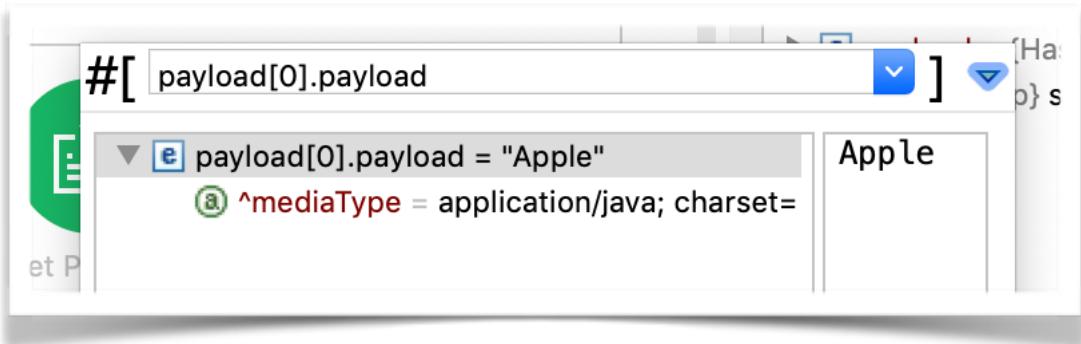


## Result —

```

1  {
2    "0": {
3      "inboundAttachmentNames": [],
4      "exceptionPayload": null,
5      "inboundPropertyNames": [],
6      "outboundAttachmentNames": [],
7      "payload": "Apple",
8      "outboundPropertyNames": [],
9      "attributes": {...}
10     },
11     "1": {
12       "inboundAttachmentNames": [],
13       "exceptionPayload": null,
14       "inboundPropertyNames": [],
15       "outboundAttachmentNames": [],
16       "payload": "Banana",
17       "outboundPropertyNames": [],
18       "attributes": {...}
19     }
20   }
21 }
```

If you want to access only payload value, access like below:



**Note:** If any of the targets fail inside scatter-gather , it will fail whole process.

So its always best practice to wrap every target within Try-Block with On-Error-Continue ,So that you can handle the errors and complete the process successfully .

## ● Validation :

Validation component will verify the content of message whether it matches the specified criteria.

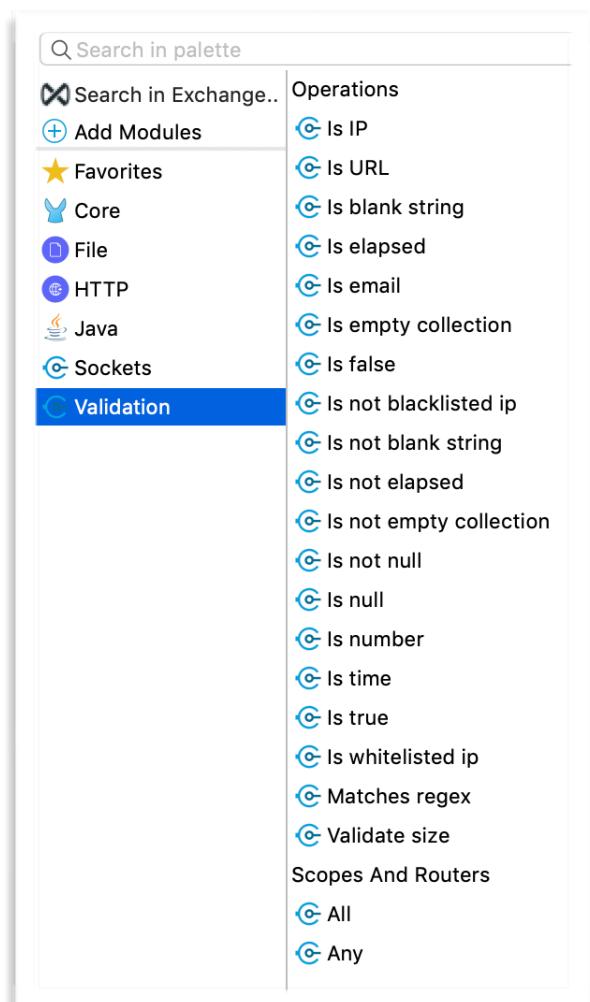
### Examples:

```
<validation:is-not-blank-string
value="#[payload]" message="The username
cannot be blank"/>
```

```
<validation:is-not-null
value="#[payload]" message="Null is
not a valid value"/>
```

```
<validation:is-true
expression="#[vars.username ==
"sravan"]"/>
```

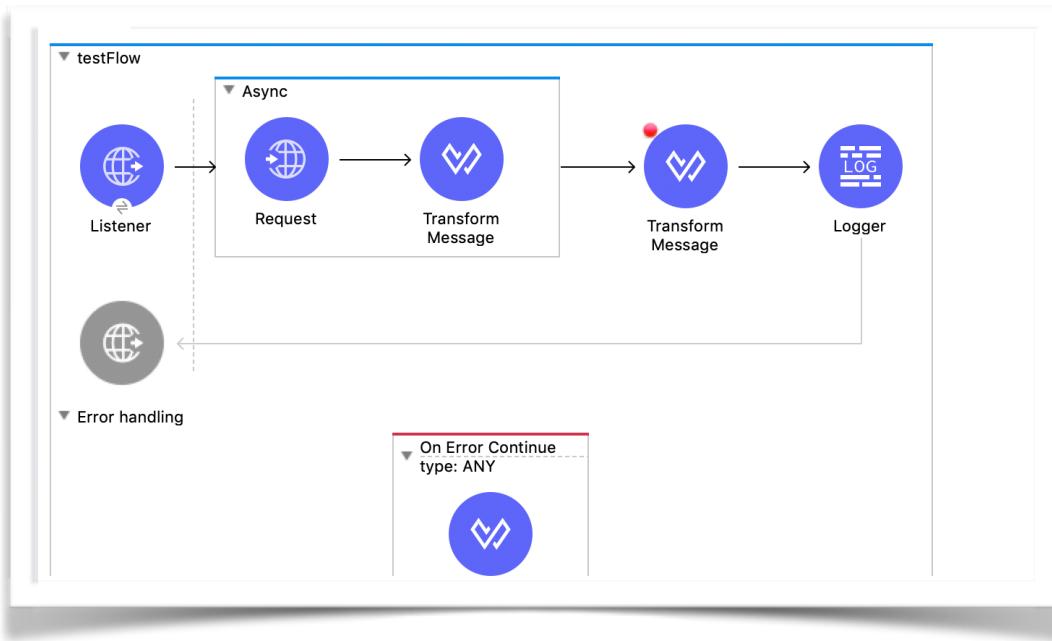
**It will proceed to further connector if the conditions are matched. Else , it will raise an error.**



- **Async :**

Async block process the request simultaneously with the main flow instead of waiting for the process within Async block to complete.

Usually Async will be used for time-consuming operations. Async scope doesn't inherit exception strategy of main flow.



- Until-successful :

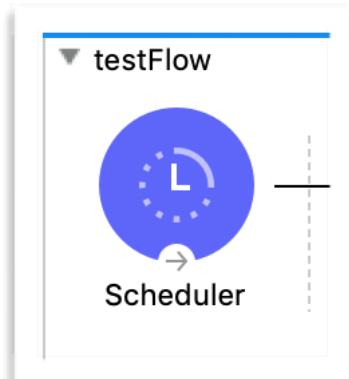
If a component within the Until-successful fails to connect or produce a successful result, Until Successful retries the failed task until all configured retries are exhausted. If a retry succeeds, the scope proceeds to the next component. If the final retry does not succeed, Until Successful produces an error. The error Type for this Until-successful is MULE:RETRY EXHAUSTED .



## ● Scheduler:

The Scheduler component enables you to trigger a flow when a time-based condition is met. You can configure it to be triggered at a regular interval like to start a flow every 5 seconds or give it a more flexible cron expression like your flow must start at 2PM IST during weekdays

Scheduler Should be placed only Source part of the flow.



Expression	Behavior
1/2 * * * *	Run every 2 seconds of the day, every day.
?	
0 15 10 ? *	Run at 10:15 a.m., every day. 0 15 10 * * ? * and 0 15 10 * * ? produce the same effect.
0 15 10 * * ? 2019	Run at 10:15 a.m., every day during the year 2019.
0 * 14 *	Run every minute starting at 2pm and ending at 2:59pm, every day.
* ?	
0 0/5 14 *	Run every 5 minutes starting at 2pm and ending at 2:55pm, every day
* ?	
1 1 1 1,7 *	Run the first second of the first minute of the first hour, on the first and seventh day, every month.
?	

Note that the Scheduler component also supports Quartz Scheduler special characters:

- \*: All values.
- ?: No specific value.
- -: Range of values, for example, 1-3.
- ,: Additional values, for example, 1,7.
- /: Incremental values, for example, 1/7.
- L: Last day of the week or month, or last specific day of the month (such as 6L for the last Saturday of the month).
- W: Weekday, which is valid in the month and day-of-the-week fields.
- #: Nth day of the month. For example, #3 is the third day of the month.

If you are still not sure about cron expressions you can generate them with available online cron generators. Eg: <http://www.cronmaker.com/>

## ● EMAIL:

Email connector helps in sending and receiving emails via standard email protocols.

It does following operations :

- Retrieving emails from POP3 mailboxes
- Retrieving, deleting, and storing emails from IMAP mailboxes
- Sending emails over the SMTP protocol
- Supporting secure connections for all protocols over Transport Layer Security (TLS)



Eg: If you want to send a mail via GMAIL, refer to following steps:

**Step 1 :** Select SMTP connection

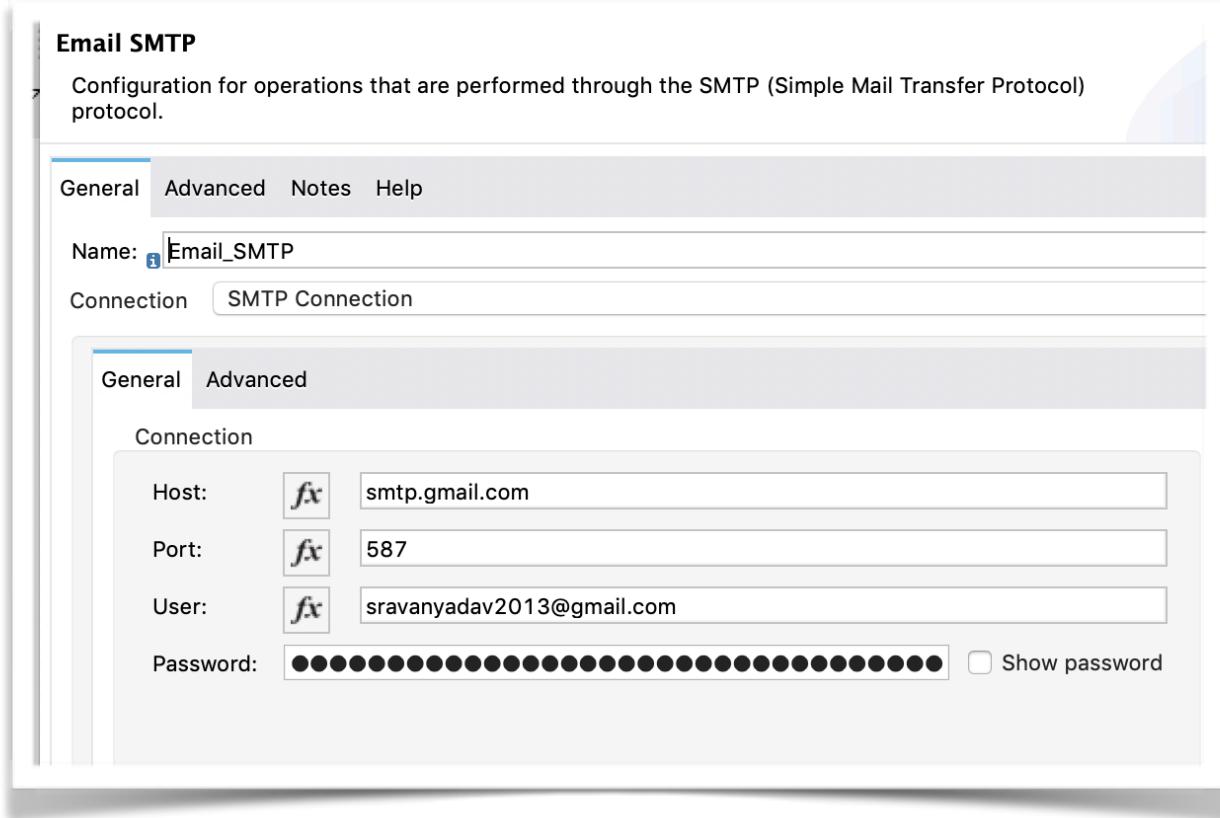
**Step 2 :** Give the configuration details as below

host = smtp.gmail.com

Port = 587

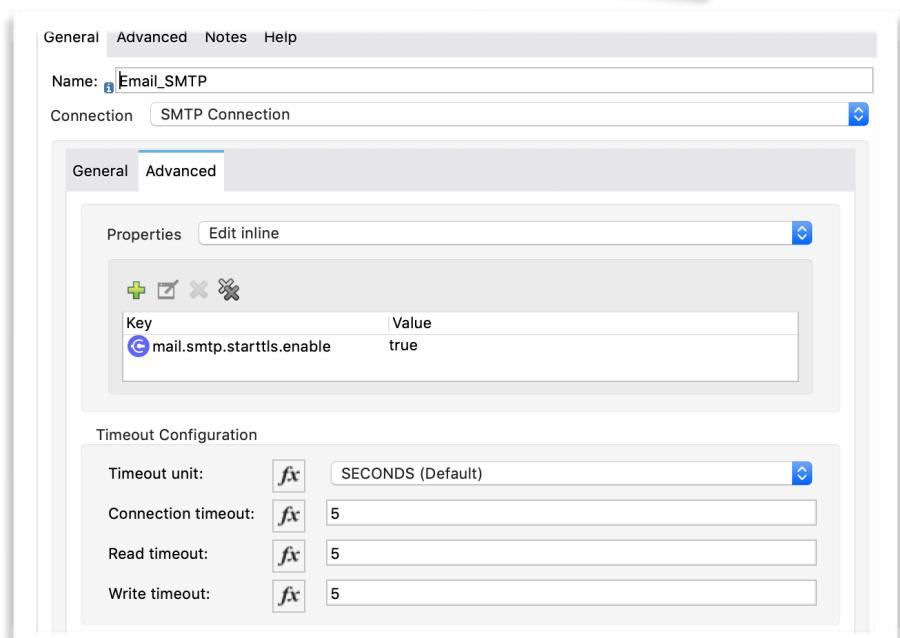
user = your gmail id

password = gmail account password



**Step 3:** Additionally add the property in Advanced Tab

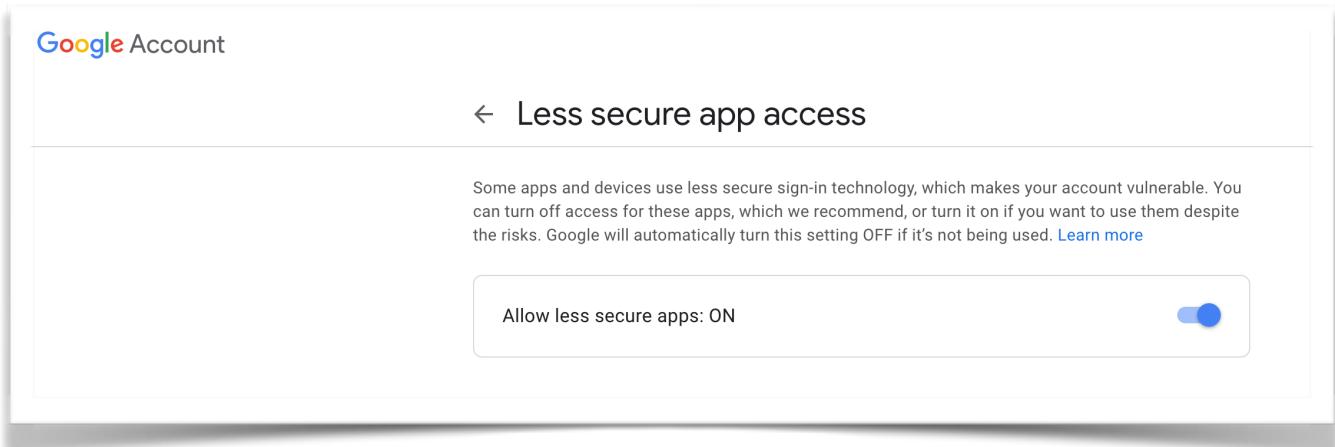
**mail.smtp.starttls.enable : true**



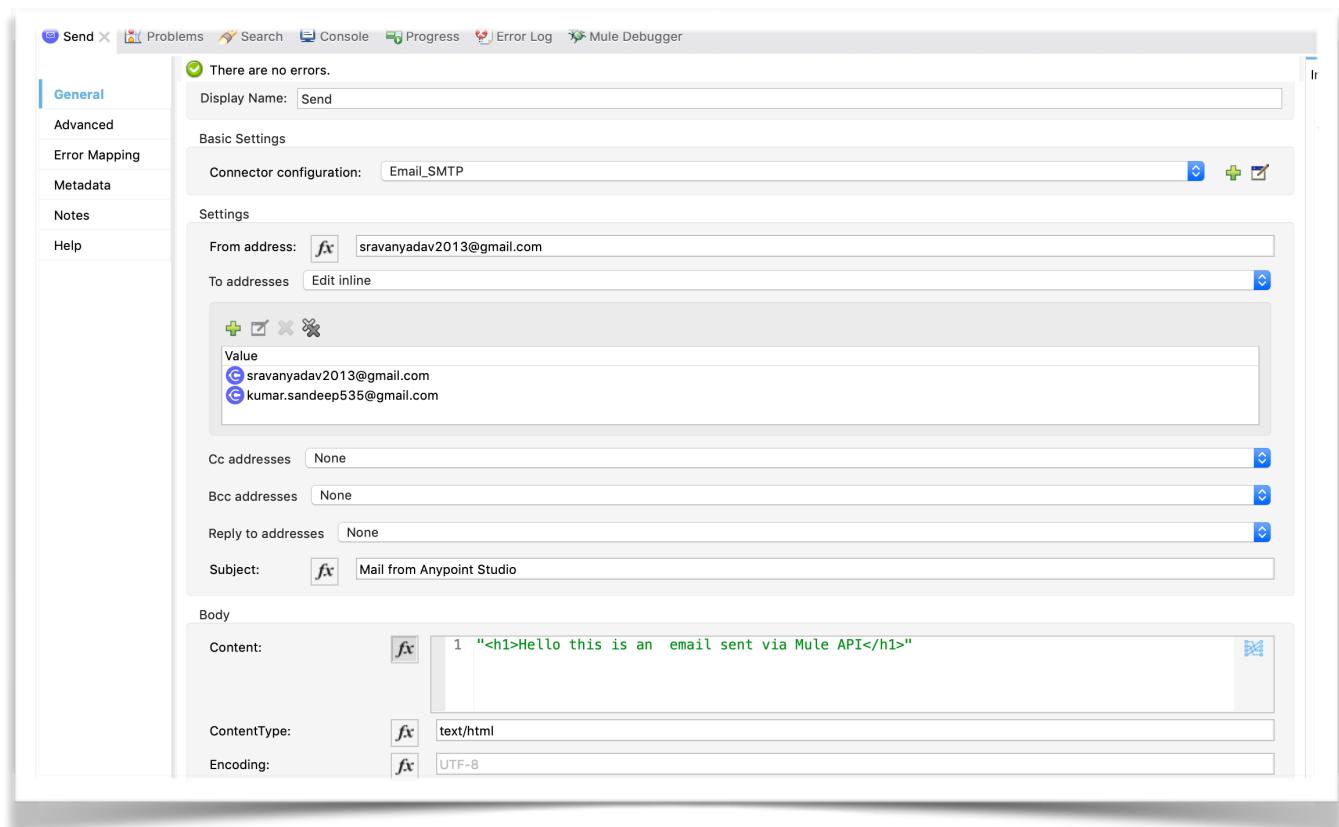
**Step 4:** Go to your Google Settings for lessSecureApps and enable it . If we don't do this , we won't be able to send a mail via external sources.

**Note : This is not valid for Gmail accounts using 2-way authentication**

<https://myaccount.google.com/lesssecureapps?pli=1>



**Step 5:** Now, final step is to give From address ,to address ,subject along with content . You can also send Attachment by converting them to base64



## MUNITS

As we all know that MUnit is a testing framework which helps us to build automated Tests for our API's.

In short , MUnit's helps us to cross check whether our flows are running as expected!

When we say as expected , it includes both Success and Failure scenarios.

This article helps you to create the Test cases and give an idea on how to Mock The Processors and build and run test cases successfully.

Before getting started , lets see what all versions i have used to create and Run these MUnits:

- Anypoint Studio - 7.4 version
- Mule Runtime - 4.2.2 version
- MUnit Version - 2.2.1 version

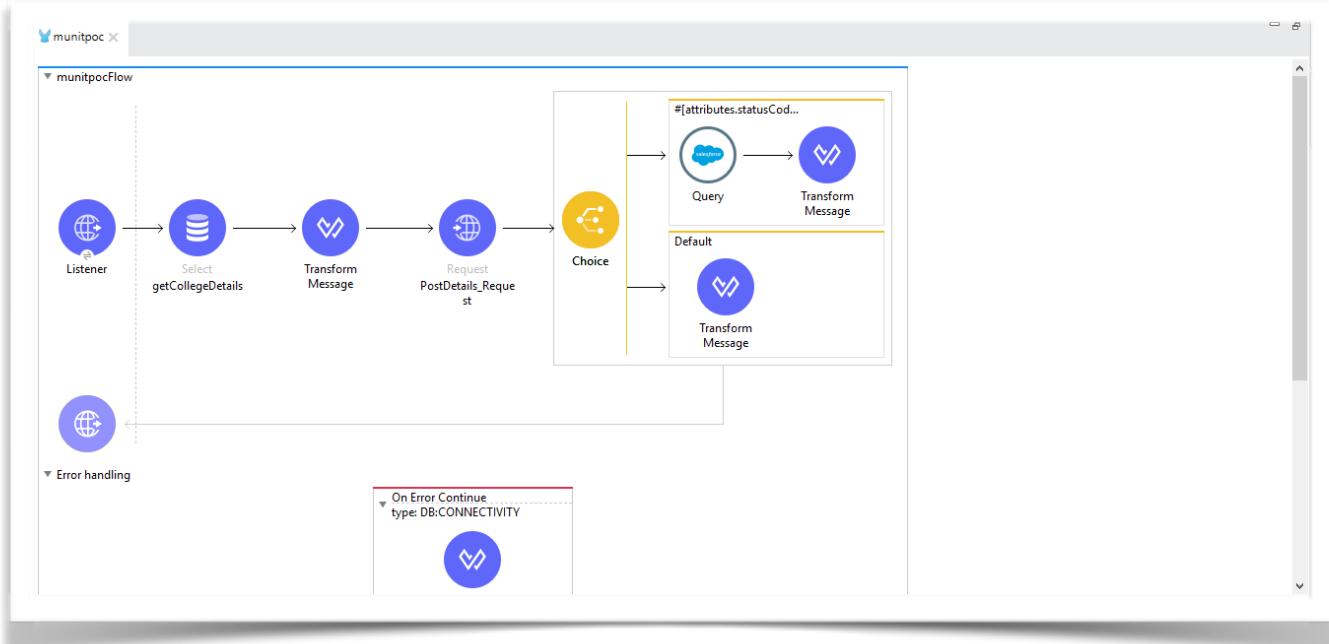
**Let's go step-by-step :**

### 1) Configuring pom.xml :

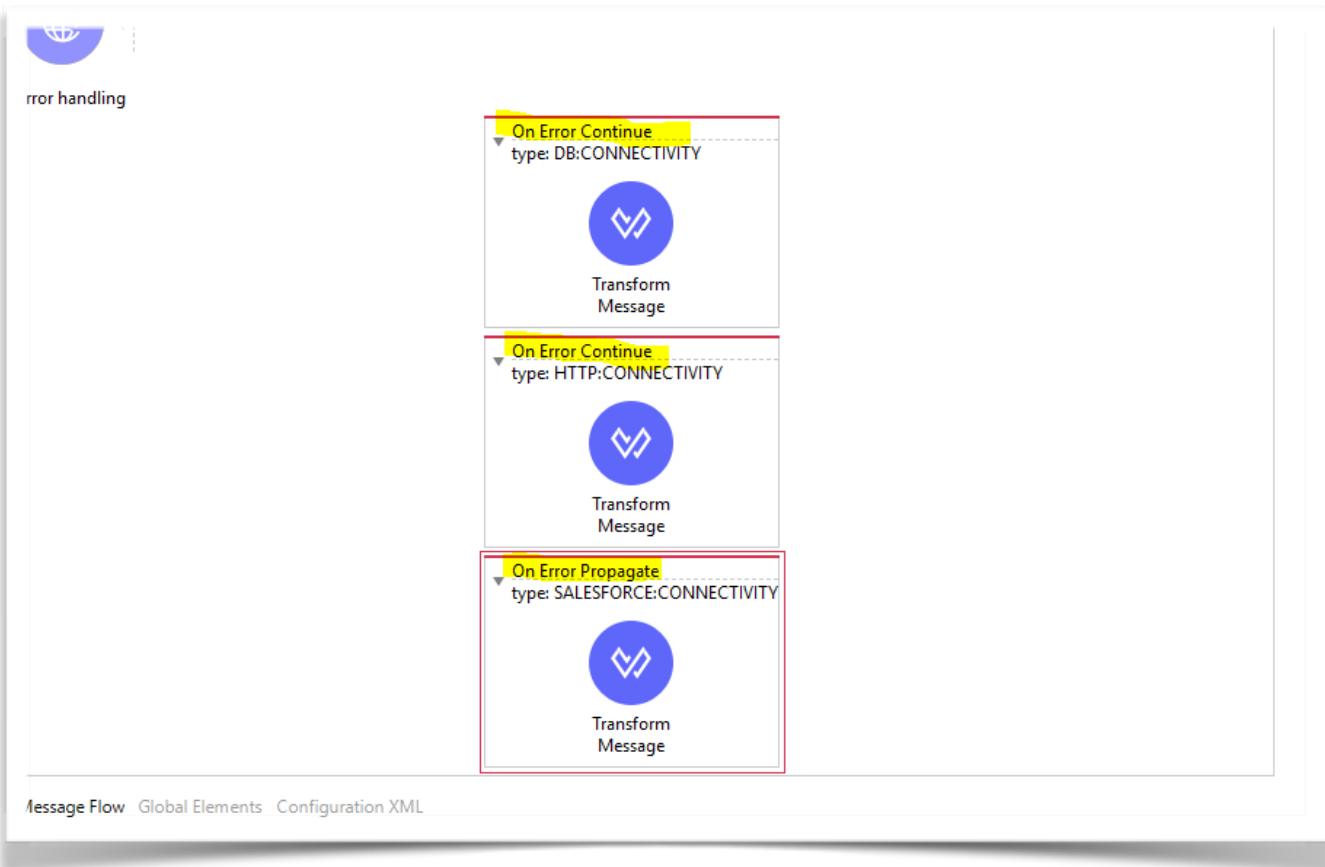
Whenever you right click on the project--> New -> MUnit Test, the dependencies, <plugin> are automatically loaded into pom. But still have a cross check if you have following things in plate before creating MUnits. Check below pom if you have everything as expected.

### 2) Check the processors which needs Mocking :

Lets have a Mule flow where you have a functionality which includes Database, Http Requester and Salesforce connectors embedded in it!



Also let us have the errors handled. In this scenario we are using both Error Continue & Error Propagate so that i will show you why and how we need to handle MUnits separately for both Error scenarios.



## What is Mocking?

Mocking, the word itself describes that we need to Mock the processor with some dummy payload . Simply , we are not actually connecting to the external systems. We are trying to show that "this would be the payload/attribute" when we actually connect. So we would be setting sample or dummy payload for that particular processor without actually connecting to it.

Now What?

Come on let's check what all external systems that we are connecting to ,in this flow

- Database
- Http Requester
- Salesforce

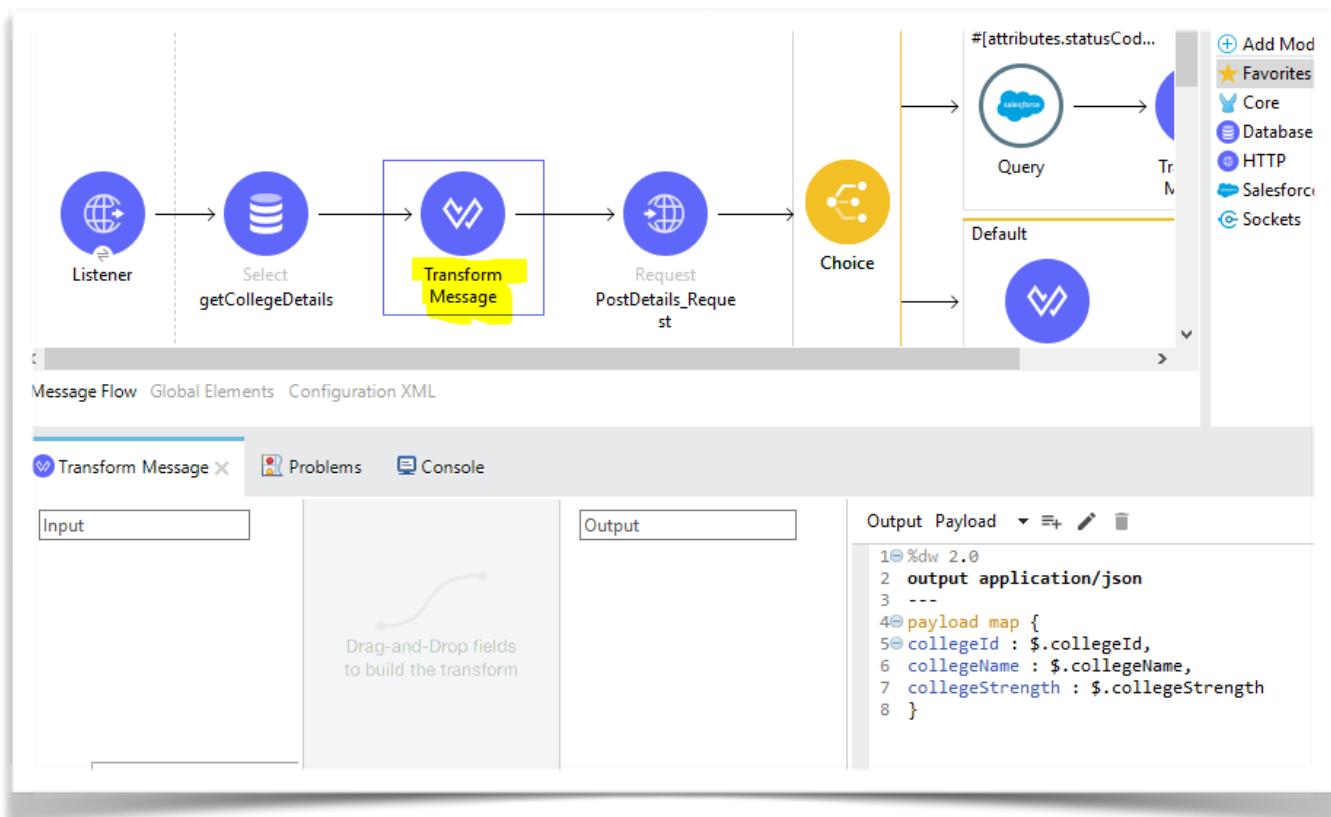
The best practice on how to give Mock payload/attributes is, check what are the processors placed after these external connectors.

In the current flow ,

Lets first check what is there After:

### a) Database:

We have a transform Message after Database . And this contains below transformation:



We can see that some payload is mapped with collegeId,collegeName,collegeStrength

So Mock the DB with some payload which is an array of data which contains above fields. You can see the Mocking section

### b) Http Requester:

We have a choice router after Http requester :

We can see that we are routing based on **attributes.statusCode** .

So Mock the Http requester with attribute containing statusCode . You can see the Mocking section

### c)Salesforce:

We have a Transform message after Salesforce connector . As of now , we are not making use of any kind of payload that is coming out of Salesforce . But still you need to mock

something .because if you are not mocking with some payload or attributes, then your test case will actually try to connect to Salesforce and get data.To make you understand, i have used this scenario . You can see the Mocking section.

### Now are we done?

No. What about error scenarios?

In this flow, we have divided handling of errors for each of the external connectors. We have used Error Continue for DB & Http Connectors and Error Propagate for Salesforce Connector.

I said previously that we are not actually connecting to external systems, then how can we get an error? How to get this test case tested?

There is answer for that!

As we are mocking Payload and attributes , we can also mock the connector to generate an error using **Type Id**.

We shall see how further.

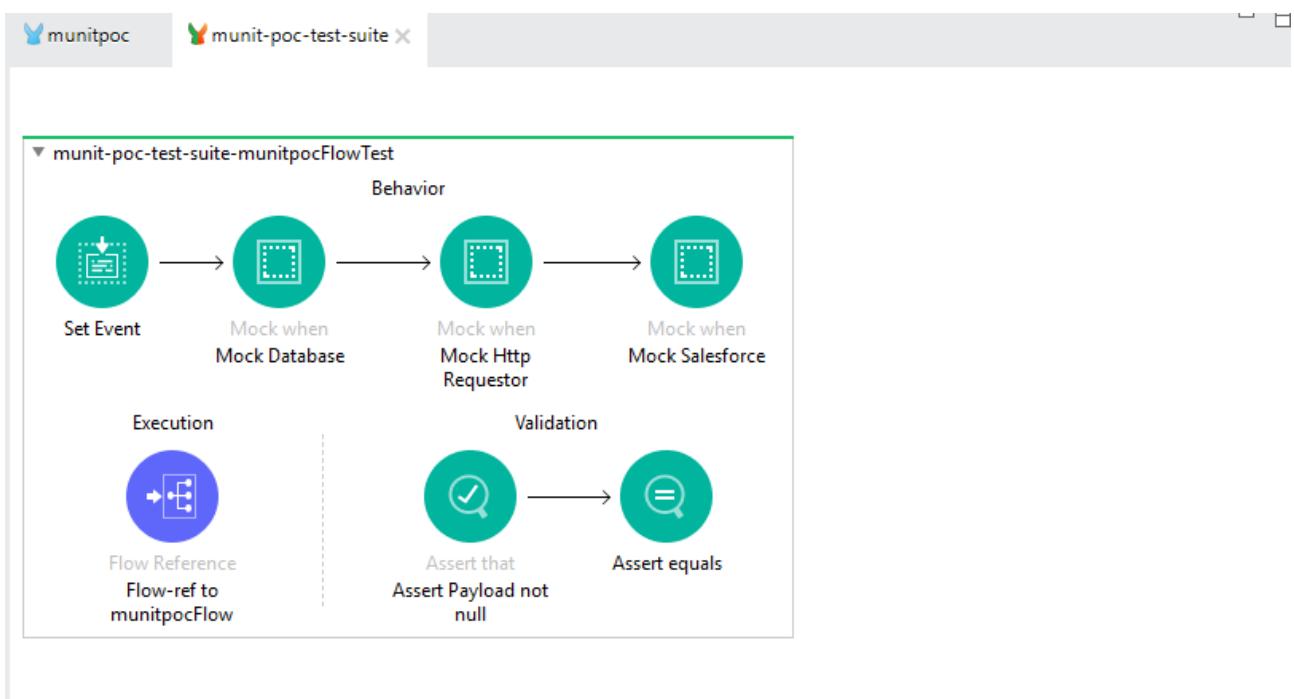
That's all! we are good to write the test cases :)

### 3) Writing Munit's :

In this project am writing 5 test cases for 100% coverage. Will show you few and rest you can understand from the code am going to share!

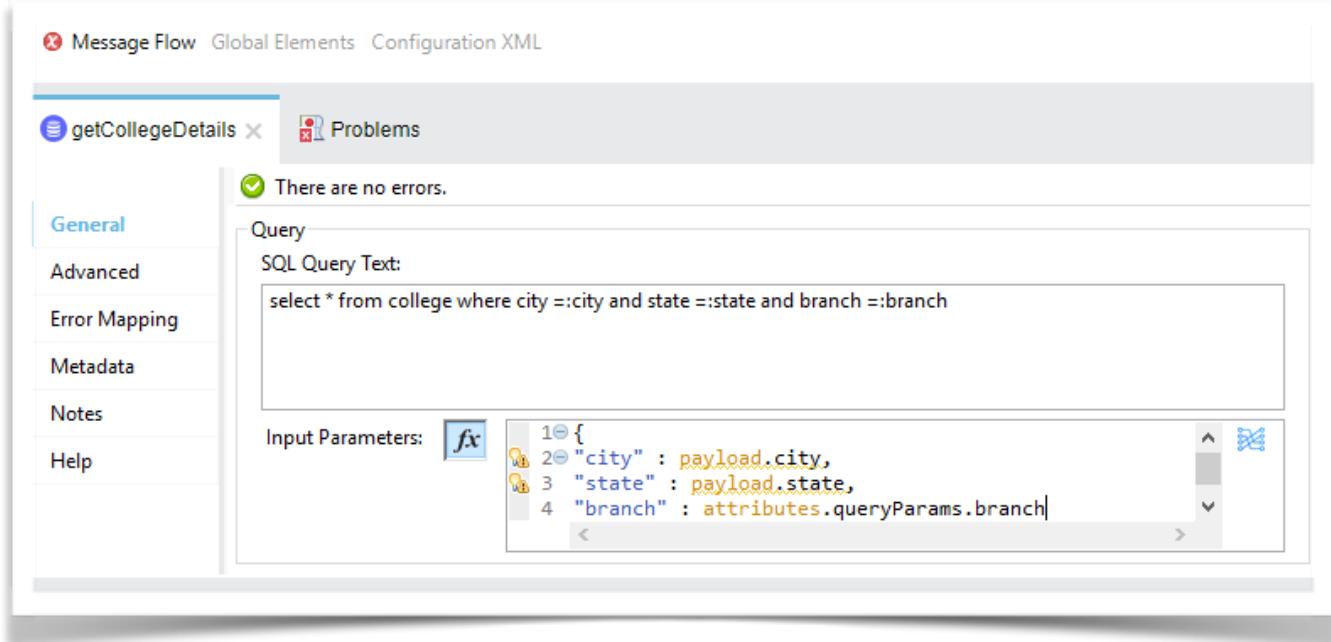
#### a) Writing a Test case for success scenario :

For having a success scenario, keep the things in mind that i mentioned what needs to be mocked in Step 2.



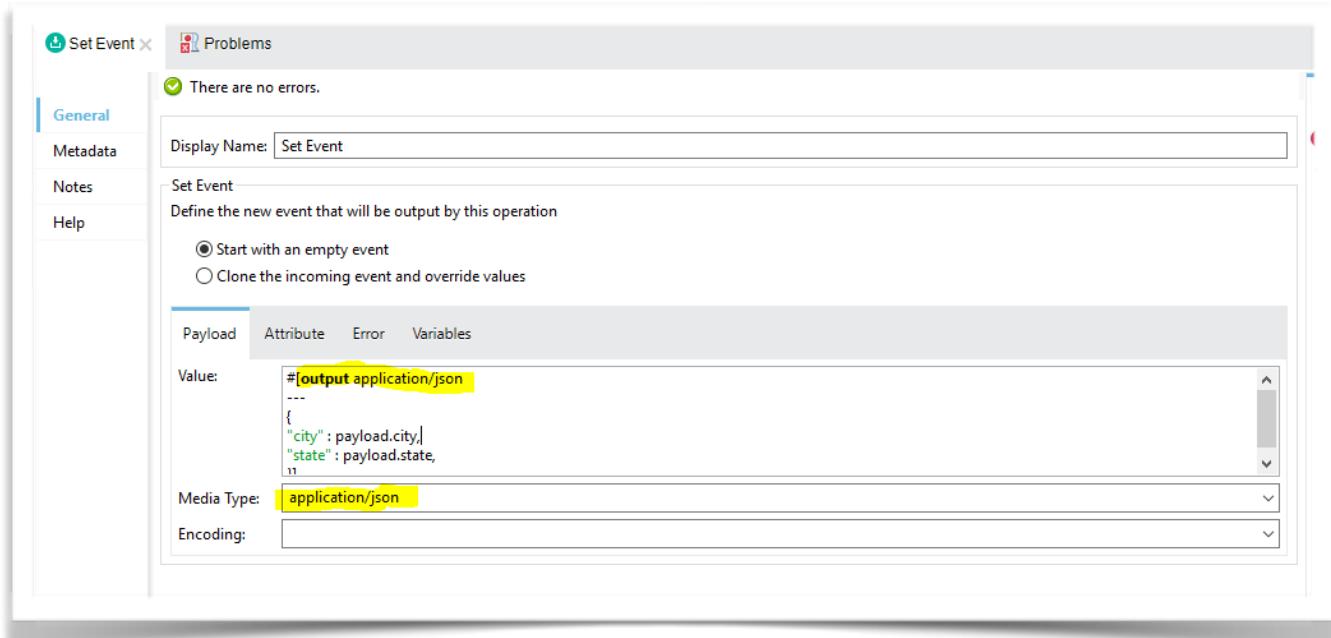
Generally when we run an application , we use postman to run the end-point and send some body if that is a POST method. But Munit's we dont need anything to be run externally using any browser. But still your listener needs get some Data that it is actually expecting. In short, Set Event is something that we pass as how we pass data through postman or any browser.

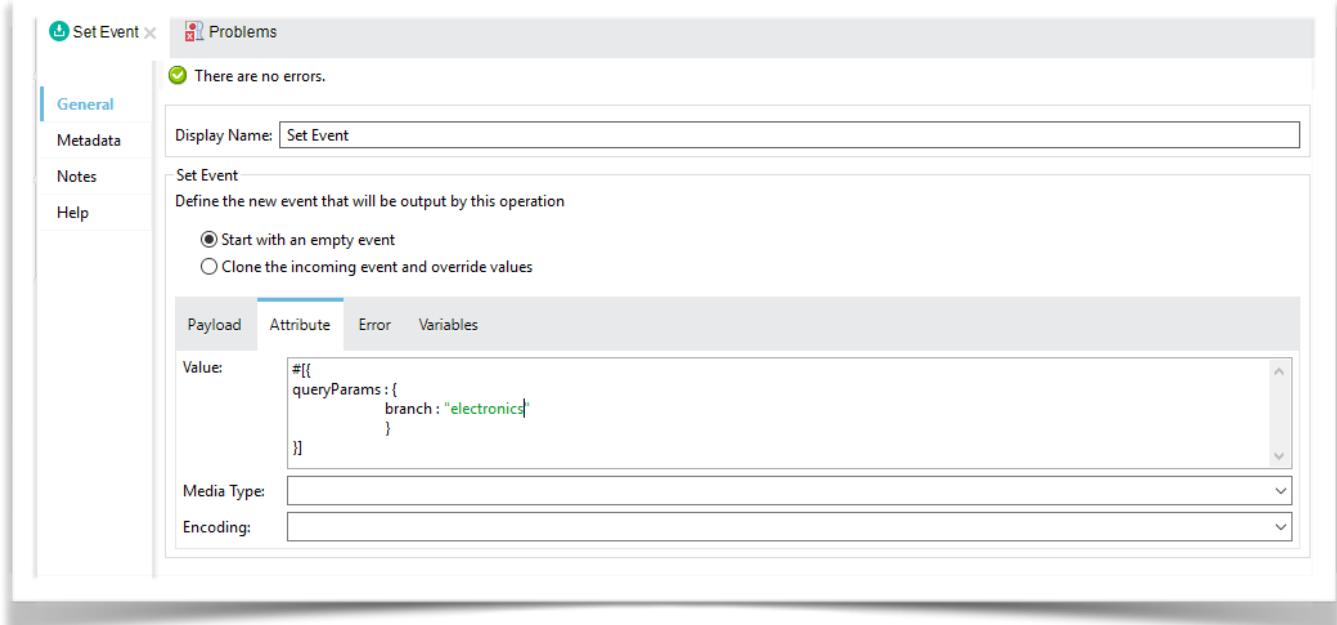
You can see in Database there is a where clause for the query :



so from above image you can see , we need city and state which is coming from payload and branch coming from query parameters.

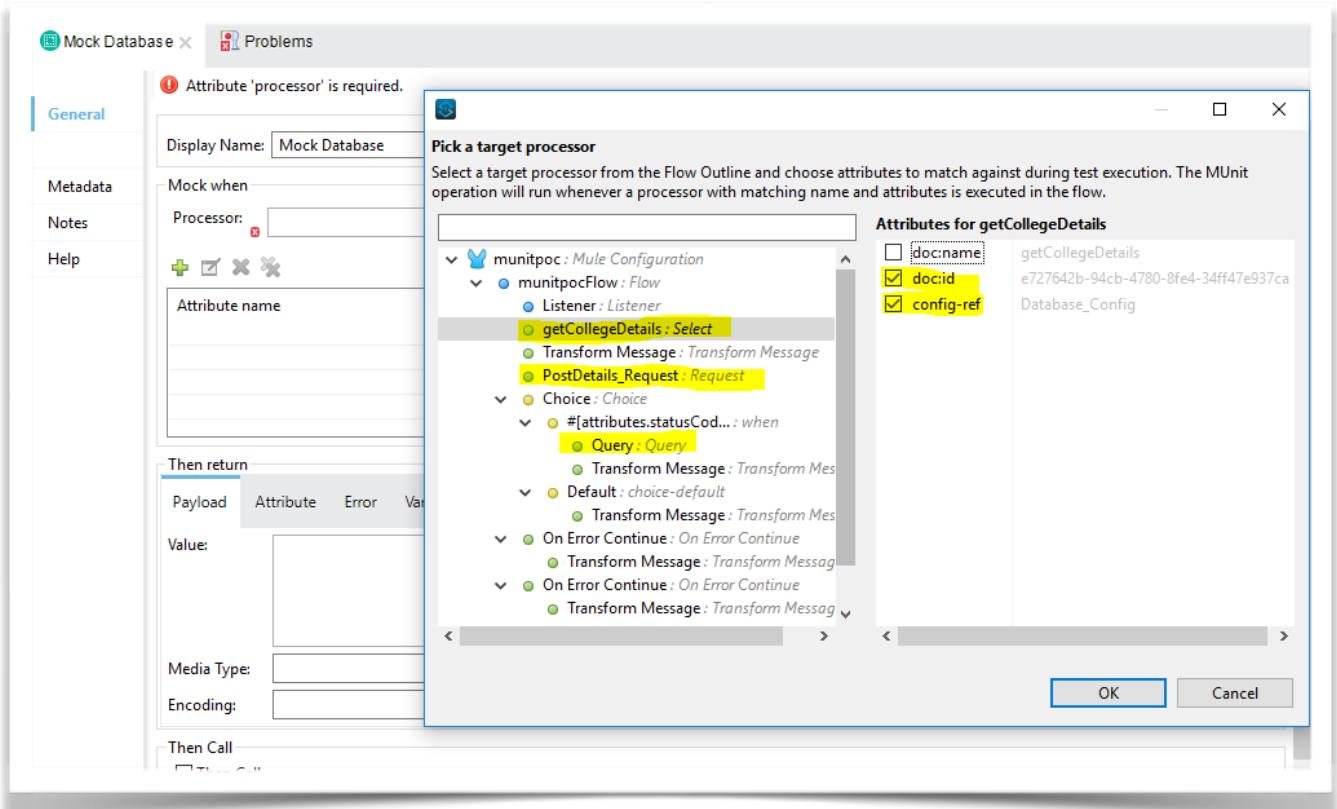
So we need to set them using **Set Event**





## Mocking Connectors:

Mule 4.2.2 version made Munits to write very easy .Drag and drop Mock When connector. Click on pick processor (this option is not available in version 4.1.x , still you can manually write doc:name and config-ref for identification of processor). Pick your processor which you want to mock. Then select the values like config-ref,doc:name or whatever you want so that the processor is identified uniquely.



Same way if you want to mock attributes. Set as below:

### Mock Attributes

The screenshot shows the 'Mock Http Requestor' configuration dialog. In the 'General' tab, the 'Display Name' is set to 'Mock Http Requestor'. Under 'Mock when', the 'Processor' is selected as 'http:request'. In the 'Attribute' section, there are two entries: 'doc:id' with value 'bbc32c46-0434-4b2c-b5e9-524c68676ef3' and 'config-ref' with value 'HTTP\_Request\_configuration'. In the 'Then return' section, the 'Attribute' tab is selected, showing a payload template: '#[{ statusCode : 200 }]'.

Similarly for Error Scenarios. Mock errors as below:

The screenshot shows the 'Mock when' configuration dialog. The 'Display Name' is set to 'Mock DB for failure connectivity'. Under 'Mock when', the 'Processor' is selected as 'db:select'. In the 'Attribute' section, there are two entries: 'doc:id' with value 'e727642b-94cb-4780-8fe4-34ff47e937ca' and 'config-ref' with value 'Database\_Config'. In the 'Error' section, the 'Type' field is set to 'DB:CONNECTIVITY'.

You can have full code at the end of this article.

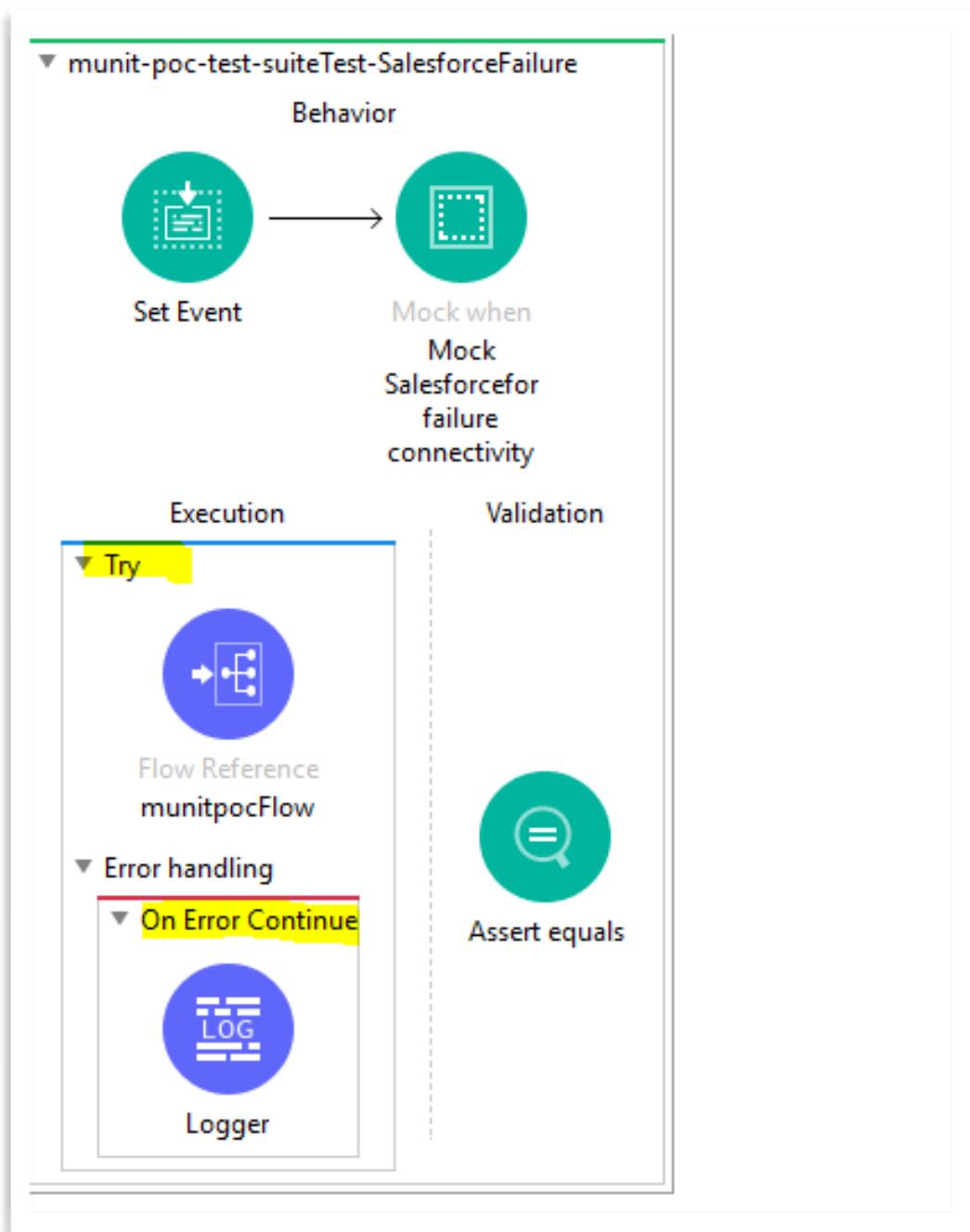
Now finally Use Assert cases to test if the value coming from flow is as expected.

That's it . Your Munit's are done!

Pretty simple!!

### Things to Take care:

- 1) Whenever you are using Error Propagate Please make sure you are wrapping the flow-ref in execution within Try block and use error-continue . Because we are aware that when we use error-propagate , it throws an error to calling person(in this case flow-ref). see below image:



- 2) See the connectors properly and check what is the data that is required to mock.
- 3) Give proper Asserts to run Test case with success status.
- 4) You can ignore any flows or files using <ignoreFlows> <ignoreFiles>(refer to pom.xml). But keep one thing in mind. **The Coverage Percentage that shows in HTML page is including the excluded files and flows.** So don't worry when you see that you have ignored some files/flows and still see that % coverage is not growing. The excluded flows and actual percentage can be seen in console when you run the application. Once the % of coverage is covered as you have mentioned in pom, the application starts deploying. If not, the build will fail.
- 5) Final thing, to run application including test cases, Go To Windows -> preferences -> maven and remove "-DskipMunitTests" . So that Munits are not Skipped.
- 6) Last But not least, **NEVER EVER USE** doc:id as your identification factor for pick processor. doc:id changes whenever you cut/copy/paste. Also **DO NOT CHANGE** your doc:name / config-ref names after you have written MUnits. If at all there is a need in changing the names, make sure that you change them in MUnits as well

## Deployments

We have various kinds of deployments options. Let's go over a little description of each deployment. We will cover CloudHub and On-prem deployments in this documentation .

### ★ CloudHub Deployments :

CloudHub is an Integration Platform as a Service (iPaaS) that allows you to deploy your applications through Runtime Manager. The total Infrastructure is managed and controlled by MuleSoft cloudhub.

### ★ Hybrid / On-Prem Deployments :

These deployments can be managed to deploy your applications through Runtime manager to your Customer hosted infrastructure. Here the total infrastructure should be managed by customer hosted environment .

### ★ Anypoint Runtime Fabric Deployments :

Runtime Fabric is a container service. It runs on a customer hosted Infrastructure like AWS, Azure or any other VM's(Virtual Machines). Anypoint RTF has built in scripts for AWS and Azure infra related deployments to reduce the effort .

### ★ Anypoint Platform Private Cloud Edition :

This is totally managed and controlled by customer. Usually if your customer has strict regulatory or compliance requirements that limits us to use cloud solutions . Then we go for this option

Let's see how we can deploy our application via CloudHub and On-prem.

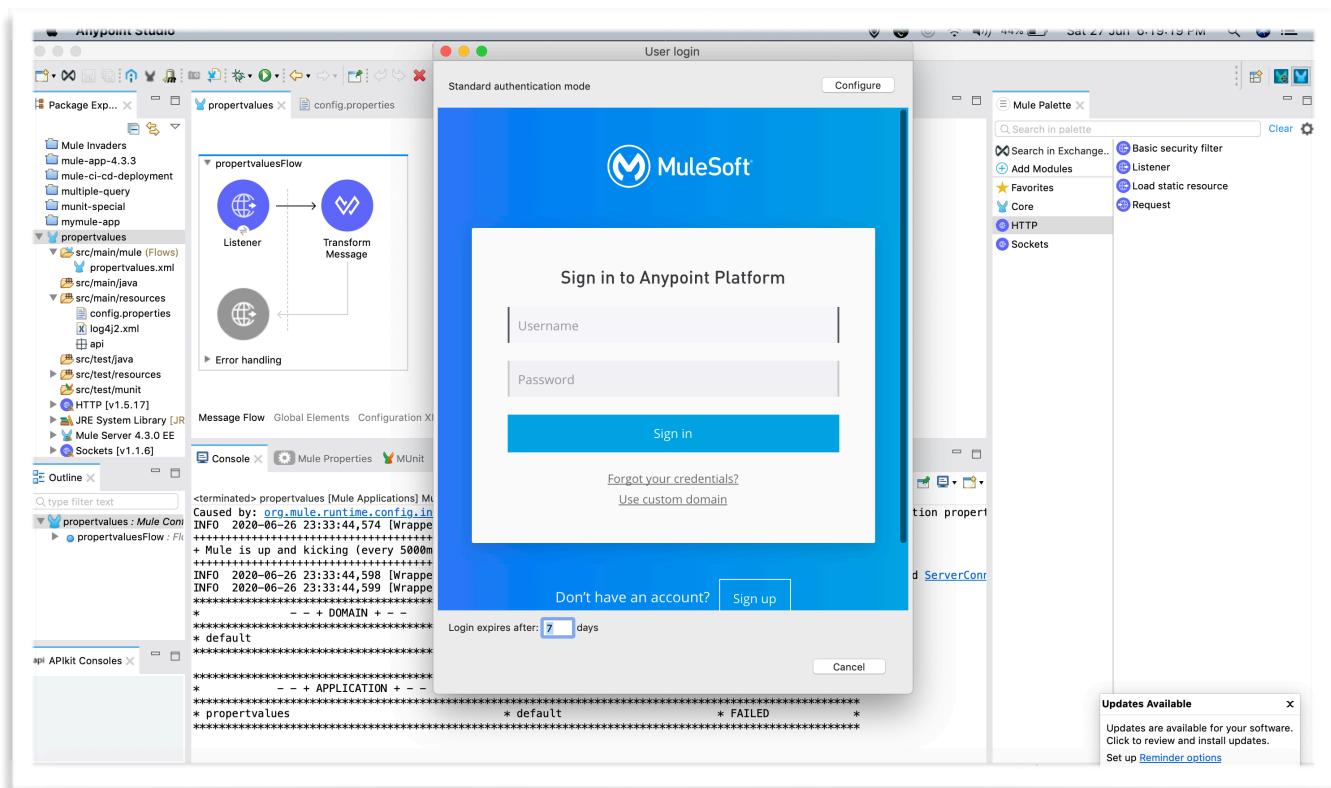
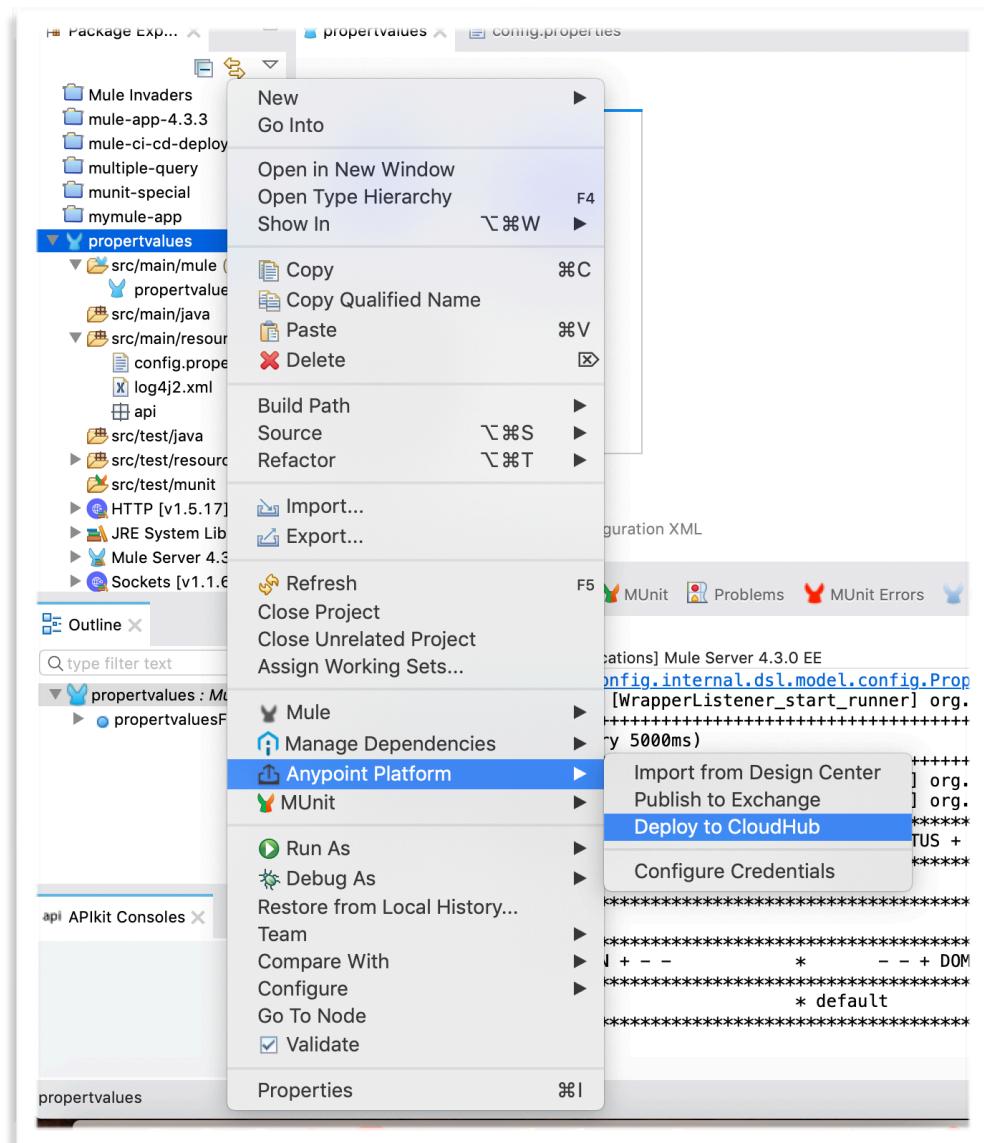
You can use CI/CD process to deploy your applications .

### Deploying via CloudHub :

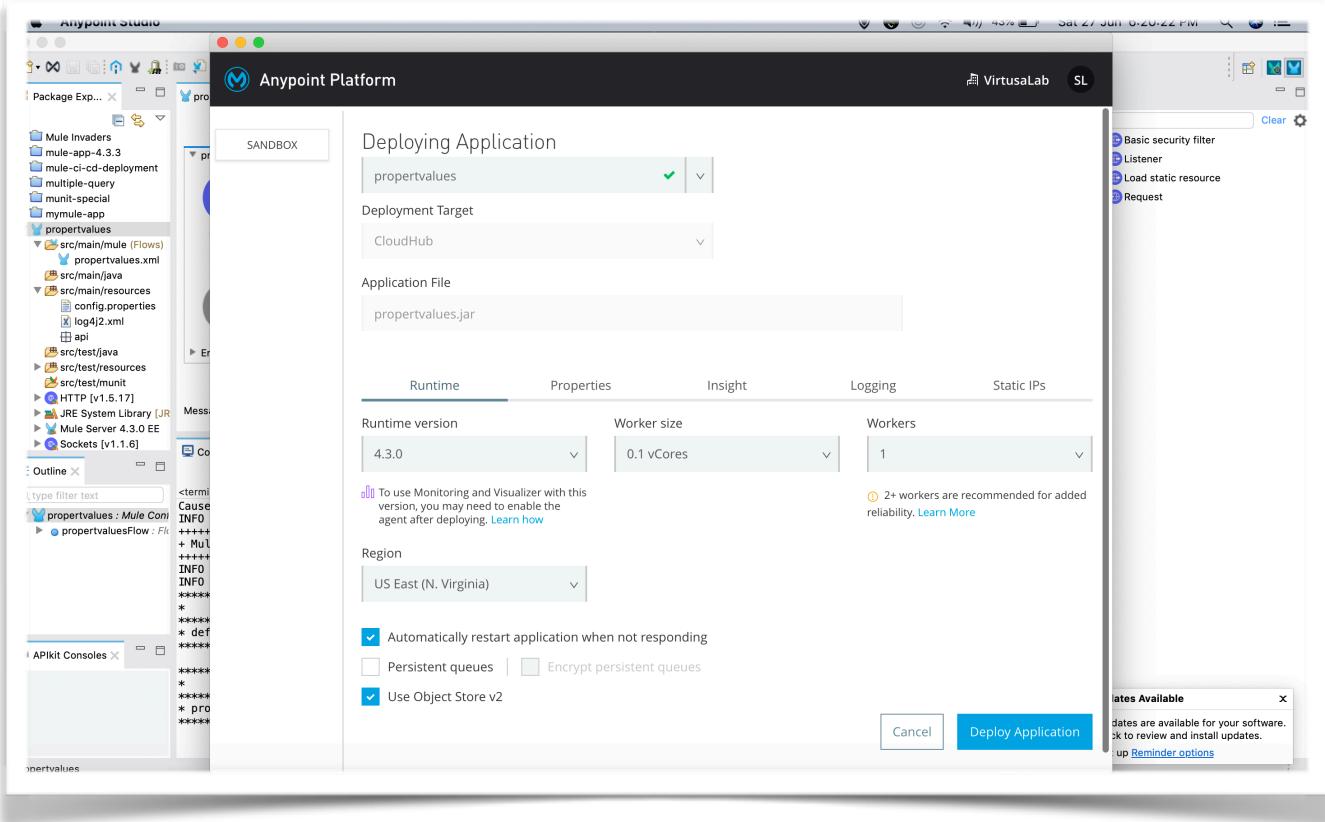
But for manual deployment , we have 2 ways. Either deploy through Anypoint Studio directly or login to Anypoint platform and deploy through Runtime Manager.

### Deploying from Anypoint Studio :

**Step 1 :** Once your coding is done , right-click on project —> Anypoint Platform —> Deploy to CloudHub. You have to login to Anypoint platform with your credentials in Studio.



**Step 2 :** Now After login from studio. Runtime Manager's Deploy Application screen will be prompted. By default the application name is set to whatever name you have given in your project . You can change it if you want.



**Step 3 :** Click on “Deploy Application “ . That’s it your application will be build and deploy at a time!

### Deploying from Anypoint Platform :

To perform this step, first you need to run your application on your local, so that the jar file is created under “target” folder of your project.

- ✓ Now Goto Anypoint Platform —> Runtime Manager—>Choose your environment
- ✓ Click on Deploy Application —> Give the application name and Deployment Target as “CloudHub” and click on Choose File —>Upload file —> Select the jar file which is generated in target folder —> Choose your Runtime option and then click on Deploy Application . It’s done!

**Note :** The worker size and workers can be increased based on your application size and performance.



**Note :** Default http and https ports for cloudbuild deployments are 8081 and 8082 respectively . So its always better to define \${http.port} or \${https.port} and leave the host name as is to default .

## Deploying via On-prem :

If you opt for On-prem deployment , then you need to setup Mule Server on your environment . For this , you have to download Mule Standalone Server.

Download from : <https://www.mulesoft.com/lp/dl/mule-esb-enterprise>

As we saw two ways in deploying the applications via cloudbus , we have 2 ways here as well.

### Deploying Applications directly via “apps” folder :

**Step 1 :** Once you download the Mule Standalone server, extract it . Now open command prompt (if your system is running on windows) or terminal (if using MacOS). Go to bin folder path of Mule Standalone Server and run **mule.bat**

**You can now see that your Mule Server is up and running , and is ready to deploy your applications**

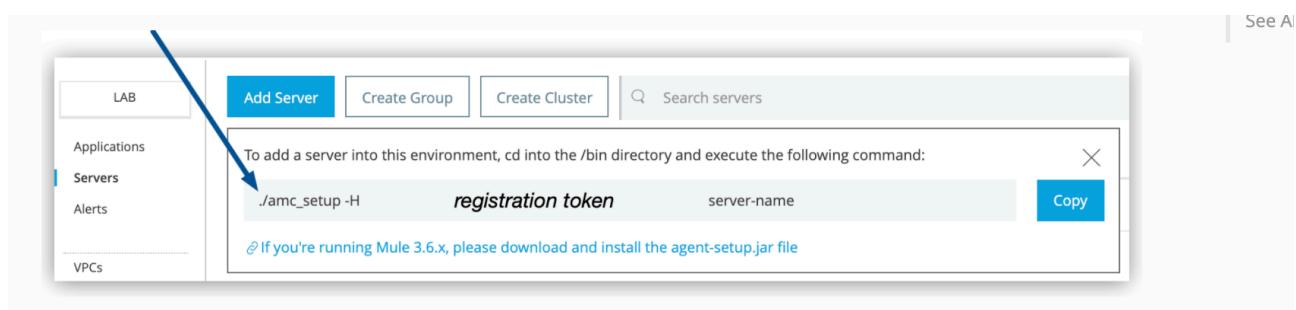
### **Step 2:**

- ✓ Now it's very easy to deploy your application on on-prem. Just copy paste the jar file that is generated in your “target” folder into “apps” folder of Mule Standalone Server .
- ✓ This will automatically start deploying your application . You can check that in command prompt or terminal.
- ✓ Once it's deployed , you can see an anchor text file created with the project name in “apps” folder.
- ✓ If at all you want to delete any application , simply delete this text file in apps folder.

### Deploying Applications directly via Runtime Manager:

**Step 1:** Login to Anypoint platform . Goto Runtime Manager —> Choose environment —> click on Servers.

**Step 2 :** Now Click on add server . You can see a command where you can copy it and run on our customer hosted environment.



**Step 3:** Goto command prompt or terminal , goto bin folder path of Mule Standalone server and paste the command that you copied in Step 2 .

You can give a proper server name which you would like to give. Remove ./ and run the command

**Step 4:**

You can see that “Mule Agent configured successfully” is prompted on screen  
Basically what we have done is , we are creating a connection between our on-prem server to Runtime manager. So basically we need a Mule agent to mediate.

**Step 5:**

Simple, If you want to deploy the application ,  
Go to Runtime Manager —> Choose environment —>Deploy new application —> Select the Deployment target shown in drop down list with your server name —> Choose file from local (jar file) and Click on Deploy Application .

**Step 6 :**

That's it your application is successfully deployed on on-prem. You can also check in “apps” folder that anchor text file is created. If at all you want to delete the app, we can delete that particular anchor text file.



**Note : There's no Default http and https ports for on-prem deployments . You can define your own ports which is valid for your infrastructure .**

**Also if you want multiple servers. (Like workers in cloudbuild deployments)**

**Have a copy of Mule Standalone servers with different names and follow Step 2,3,4 to create multiple servers.**

This is how you deploy your applications both in CloudHub and On-prem

## Managing Applications by applying Policies:



**Note :** Anypoint Platform's API Manager policies can only be applied to the applications which are deployed only on CloudHub. For other mode of deployments , you need to have other ways of applying policies .

This Documentation shows you how to apply policies via Anypoint Platform's API manager.

Again , we have 2 ways to apply policies :

- ▶ **Creating Proxy API's**
- ▶ **Without Creating Proxy API's**

The main difference between two of them is either :

Using API id in Auto Discovery of your “actual” application

or

Mule itself will create a Proxy application on top of your “actual” application which has api auto discovery.

We shall see how in detail:

- ▶ **Without Creating Proxy API's :**

This way of Deploying application to invoke policies needs 2 Things:

- API id generated in API Manager and used in global element “Auto Discovery” of your application .
- Need Anypoint platforms client id and secret .We can get them from “Access Management” Under Environments Tabs —> Choose the environment in which your application is getting deployed. Use them in Runtime properties while deploying the application in below way

anypoint.platform.client\_id : xxxxxxxxxxxxxxxx

anypoint.platform.client\_secret : xxxxxxxxxxxxxxxx

With help of these 2 things, we can see in API Manager , the status of API will turn from “Unregistered” to “Active”

**Step 1 :** Design a RAML , Publish to exchange. After that import the RAML to anypoint Studio and generate the flows.

**Step 2 :** Go to API Manager , Click on Manage API and choose “Manage API from Exchange”

The screenshot shows the API Manager dashboard. On the left, there's a sidebar with 'Sandbox' selected. In the center, under 'API Administration (Sandbox)', there's a 'Manage API' button with a dropdown arrow. A sub-menu is open, showing 'Manage API from Exchange' which is highlighted with a blue border. Other options in the sub-menu include 'Manage an existing Exchange asset', 'Create new API' (with a sub-note about uploading RAML/OAS/SOAP), and 'Import' (with a sub-note about importing an exported API configuration zip file). To the right of the sub-menu, there are tabs for 'All', 'Favorites', and 'Active'. Below the sub-menu, there are sections for 'Status' and 'Client Applications'. At the bottom, there are filters for 'Active' and a page number '2'.

**Step 3 :** Select your API , And select the Managing type as “Basic Endpoint” . Don’t forget to check the box “Mule version: Check this box if you are managing this API in Mule 4 or above.” Click on Save ,

This is a configuration dialog for managing an API from Exchange. It has several input fields:

- API name: BankDetails
- Asset type: RAML/OAS
- API version: 1.0
- Asset version: 1.0.1
- Managing type: A radio button group where 'Basic Endpoint' is selected (indicated by a blue outline).
- Mule version: A checkbox with the text "Check this box if you are managing this API in Mule 4 or above."

At the bottom right of the dialog, there is a 'Save' button.

## BankDetails 1.0

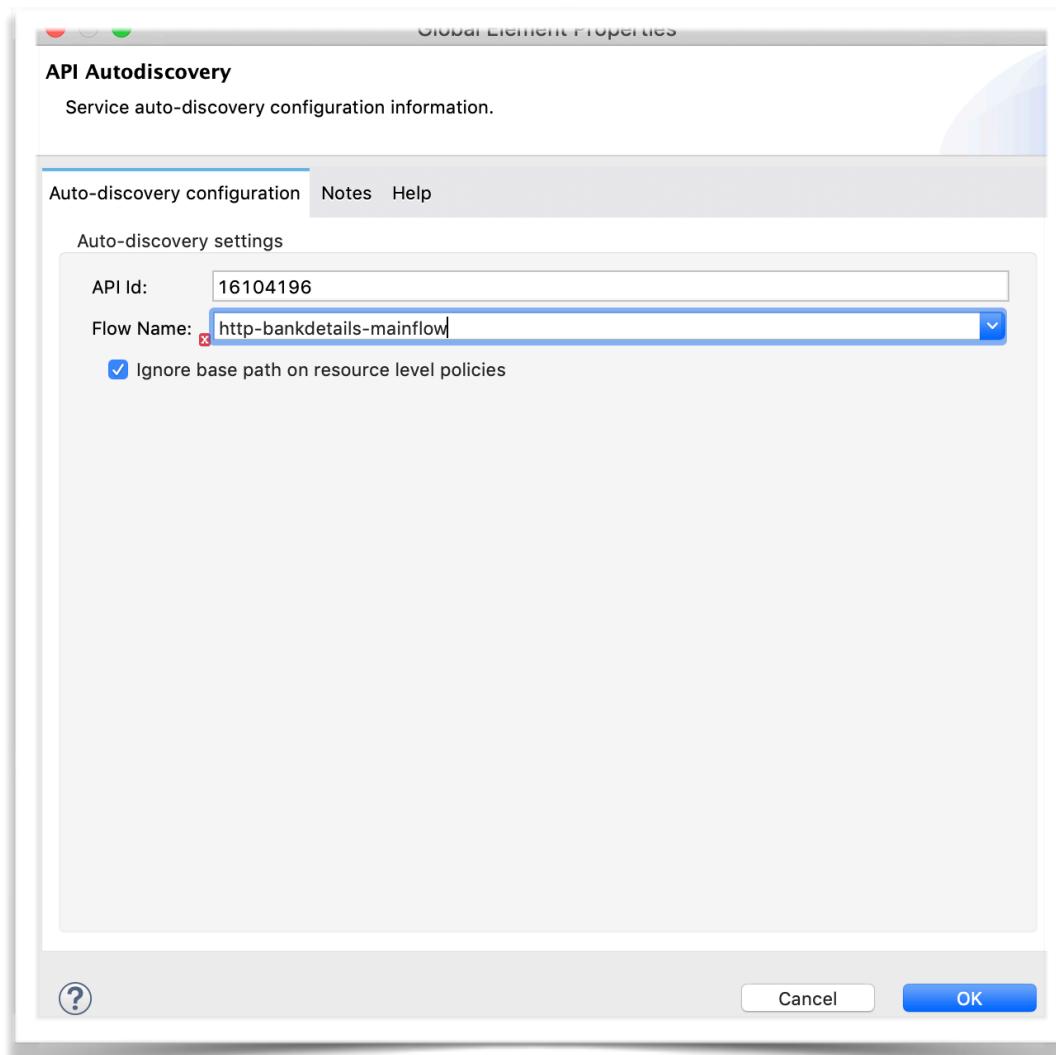
API Status: Unregistered Asset Version: 1.0.1 Latest Type: RAML/OAS

Implementation URL: <https://anypoint.mulesoft.com/mockng/api/v1/links/ce3468bd-ef91-486f-8f99-46b50662e4ba/>

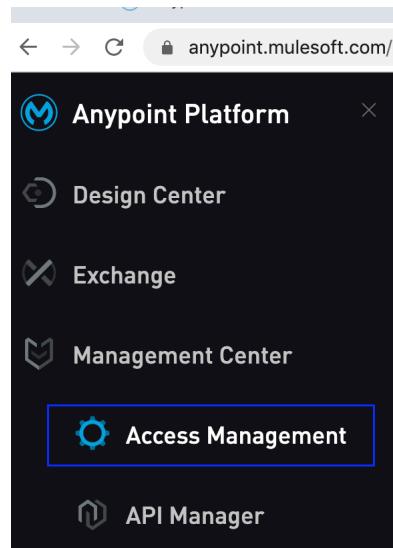
[+ Add consumer endpoint](#)

<b>API Instance</b> ⓘ	<b>Autodiscovery</b> ⓘ
ID: 16104196	API Name: groupId:a654c73127954739b04623033293e9... <a href="#">Edit</a>
Label: <a href="#">+ Add a label</a>	API Version: 1.0:16104196

**Step 4 :** Go to the Application in Anypoint Studio, Create a Global Element Auto Discovery and Add API id and choose the flow name (usually Main flow where the request is listened )



**Step 5:** Go to Access Management.( Only Owner of the account can have access and can view this option. If you are not seeing this, that means you need to request the owner of Anypoint platform account) . Choose environments Tab and select your env. Get your client id and secret



A screenshot of the 'Access Management' interface. The left sidebar shows 'Environments' selected. The main area displays an 'Environments' table with a single row for 'Sandbox'. A modal window titled 'Edit environment' is open over the table, showing fields for 'Name' (Sandbox), 'Client ID' (b6f2698f73da4d889c40d5352aa9005d), and 'Client Secret' (redacted). Buttons for 'Delete Environment', 'Cancel', and 'Update' are at the bottom of the modal.

**Step 6 :** Go to Runtime Manager , Add Runtime properties like below and deploy.

The screenshot shows the Mule Runtime Manager interface. On the left, there's a sidebar with options like Applications, Dashboard, Insight, Logs, Object Store, Queues, Schedules, and Settings. The Applications option is selected. In the main area, the application 'my-first-application' is chosen. The 'Properties' tab is active. Two runtime properties are listed: 'anypoint.client\_secret' and 'anypoint.client\_id'. Both of these values have been redacted with large blue rectangular bars.

Now your API in API manager status will turn to **Active** and you can start applying policies. By going to Policies —> Apply New Policy.

No Need to Restart the application once policy is applied. It will reflect within seconds automatically . Even if you add one or more policies at later point of time, no restart of application is required.

#### ► Creating Proxy API's:

In above method, we have seen lot of manual process required like getting API id , clientid,secret , placing in Application and in Runtime properties. To avoid all these, we can go for 2nd approach of create a Proxy application .

This Proxy application is nothing but a kind of Wrapper to your main Application . So now for each application we will have 2 apps in Runtime Manager.

1) Your Actual Application

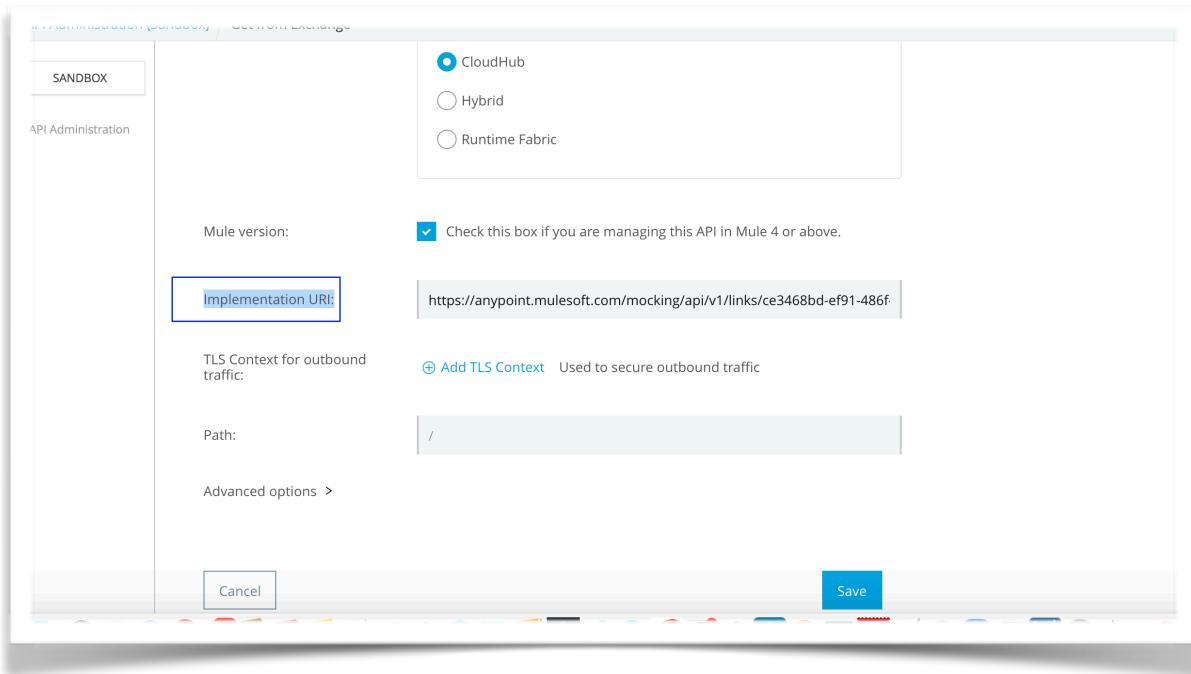
2) Your proxy Application that is deployed which has api id, client id , secret everything within it. No manual effort required to deploy. It's deployed from API manager.

**Step 1 :** Design a RAML , Publish to exchange. After that import the RAML to anypoint Studio and generate the flows.

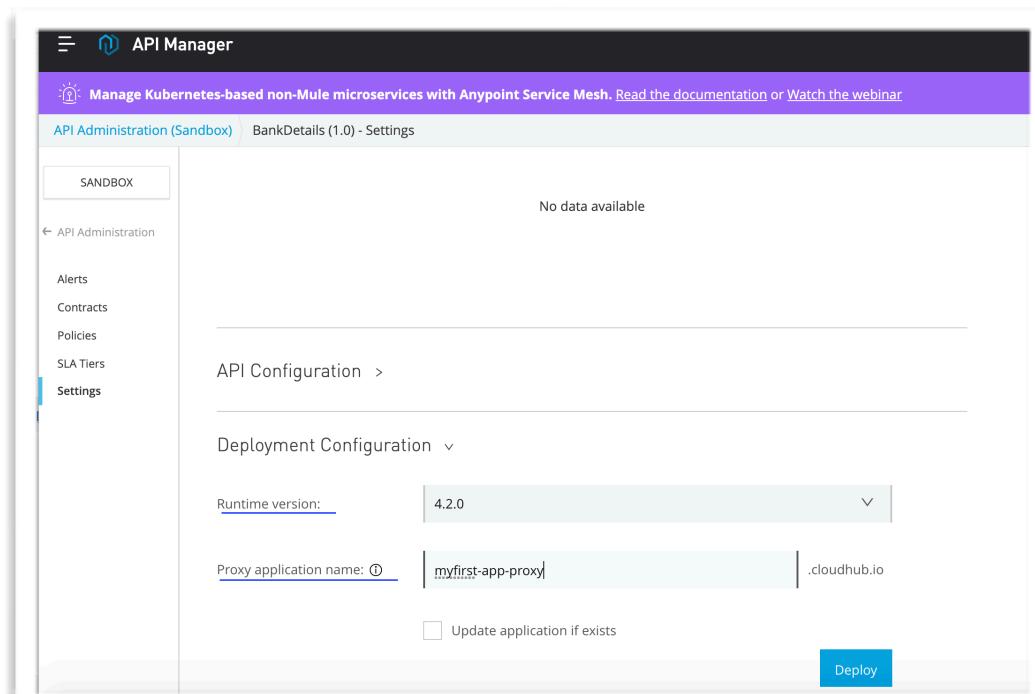
**Step 2 :** Go to API Manager , Click on Manage API and choose “Manage API from Exchange”

**Step 3:** Select your API , And select the Managing type as “Endpoint with Proxy” . Don’t forget to check the box “Mule version: Check this box if you are managing this API in Mule 4 or above.” Click on Save ,

**Step 4 :** Give your Implementation URL of your actual application that is deployed. Make sure you give your path till /api as all RAML generated flows has a common base path as /api  
Eg : <http://myfirstapp.cloudhub.io/api>  
Once done, click on save



**Step 5 :** Now on the screen, you can see Deployment Configuration . Choose runtime and name of proxy app you want to give and click on deploy. The Application will be deployed in Runtime Manager.



**Step 6 :** Now edit the Consumer end point in API Manager with your proxy endpoint. So that all the requests will hit proxy application . Basically your implementation url is your actual endpoint and Consumer endpoint is Proxy endpoint. So client hits proxy endpoint which in-turn is routed to implementation url

The screenshot shows the Mule API Manager interface. The top navigation bar has a purple banner with the text "Manage Kubernetes-based non-Mule microservices with Anypoint Service Mesh. Read the documentation or Watch the webinar". Below the banner, the main header says "API Administration (Sandbox)" and "searchDetails (1.0) - Settings". On the left, there's a sidebar with links: SANDBOX, API Administration, Alerts, Contracts, Policies, SLA Tiers, and Settings (which is currently selected). The main content area displays the "searchDetails" API version 1.0. It shows the API Status as Active, Asset Version as 1.0.0 (Latest), and Type as RAML/OAS. The Implementation URL is listed as <http://searchdetails.us-e1.cloudhub.io/api>. The Consumer endpoint is listed as <http://search-details-proxy.us-e1.cloudhub.io/> with an edit icon. Below that, the Mule runtime version is 4.2.2-20200709. Under the "API Instance" section, the ID is 16095790 and the API ID is 16095790. There's also a "Label: NO Lable" field with an edit icon. The "Autodiscovery" section shows the same information. Under the "Proxy" section, the Proxy Application is listed as "search-details-proxy" and the Proxy URL is <search-details-proxy.us-e1.cloudhub.io>.

You can see client id and secret values are picked automatically and placed in Runtime properties. As well as you can download the jar of the proxy app and import it in any point studio where you can see API Id is automatically configured and the HTTP request will route to your main APP. So you have to provide the endpoint of the Proxy app to consumers/clients so that they don't have access to your main App. The policies are applied to your proxy app. But the thing here is, we need additional vCore and workers to deploy our proxy app. So according to your requirements, you can choose which method you want to follow to apply policies for your cloud hub Apps.

### Pros and Cons :

#### **Without Proxy Application :**

- You will save a vCore and worker .
- As a developer You need to know client id / Secret unless the deployment is managed by CI/CD process.
- Manually you need to create global element to invoke Auto discovery
- You will expose your actual endpoint to client/Consumer.
- Use case : If your apis are used within organisation , within Intranet , you can choose this option where we can share the endpoints directly. This saves vCores

#### **With Proxy Application :**

- You will need additional vCore and worker for each proxy app you deploy.
- As a developer You need not know client id as it is managed internally.
- No need of manual process of using api id or using client id / secret
- You will expose your proxy endpoint over actual endpoint to client/Consumer.
- Use case : If your apis are used outside of your organisation , you can choose this option where we can share the endpoints of proxy app instead of actual endpoint. More secured

### Applying Policies using API MANAGER(for only Cloud-hub apps):

#### Simple :

#### After the Deployment to cloudbhub :

Apply policies to the applications in a simpler way.

If you have Proxy App , then apply policies to Proxy application , else apply for root app.

Note we apply policies for HTTP Services ONLY.

Now after you see the status as ACTIVE in API Manager, Now we are ready to apply policies.

Go to Policies Tab of that particular Application —> click on Add New Policy (you can apply more than one) —> Choose your policy and click Apply.

That's it, no need to restart your application to get policies appended. It will be appended in few seconds.



**Note :** If your API is not showing ACTIVE in API Manager, that means , either the api ID is mismatched that you have given in your code and the value in API Manager, or The Anypoint platform credentials are wrong. When Status is “Un Registered “ That means , your policies are not appended. But still application works without having Policies appended.

For On-prem Apps, you have to have a different kind of mechanism within code to apply policies , as API Manager policies are applicable only for Cloudbhub deployed Apps.

## DATAWEAVE

Dataweave is a MuleSoft Expression Language that helps us to do various actions like accessing Data, Transforming Data. Mule 4 version of Runtime Uses Dataweave 2.0 version.

The syntaxes are very simple and it is very powerful to access, modify or transform data. You can do a lot of things with Dataweave!

This Documentation covers very little and basic info. You can still search online for various syntaxes that we use.

### **What is DataWeave capable of?**

- Transform from one format to another . Eg: JSON to XML, XML to CSV etc.
- We can access any specific field inside a payload. Eg: payload.name
- Basically all kinds of Extraction and Transformation

As Part of this Cook Book, I limit the scope of the operators used. You can still refer to the official MuleSoft Documentation for a wide variety of examples.

Reference Doc: <https://docs.mulesoft.com/dataweave/2.4/dw-core>

Operator	Can be applied on input which is/are	Output Type	Used for
map	Only On Arrays	Array	Array of Object
mapObject	Only On Objects	Object	Output is an Object
reduce	On Arrays	Single value or an Object	To reduce into the given expression
pluck	On Objects	Array	Same as mapObject , only difference is the output is returned as array instead of Object
flatten	On Arrays	Single set of Array	Turns into set of subarrays to single array

DataWeave is a vast topic. So please refer to this video and Hands-on practice is a must.

**Video Link :**



## Design An API Specification using RAML

An API Specification provides an understanding of how an API behaves.

Like :

- ◆ What kind of request does API accept?
- ◆ What kind of response did it return?
- ◆ What are Mandatory fields / Data Types etc..

For a detailed explanation, refer to the below video.



**Watch the sessions step by step and have good hands-on practice to become a developer in 30days!**

[https://www.youtube.com/playlist?list=PL61bQcdxsK6\\_1tb0BbAtAOX\\_SdtvgQlxV](https://www.youtube.com/playlist?list=PL61bQcdxsK6_1tb0BbAtAOX_SdtvgQlxV)

**Please excuse me if you see any false information and try to reach out to me by email.**

## How to get Certified?

This is another common question I frequently encounter. There are no shortcuts! Practice is the only way to get certified.

There is a free Self Placed in the official MuleSoft Training Portal

**DEVELOPMENT COURSES : ANYPOINT STUDIO**

**Anypoint Platform Development: Fundamentals**

5 days | Self-paced (Free) | Instructor-led | Level 1

Get started with Anypoint Platform with hands-on experience building APIs and integrations.

**Anypoint Platform Development: Mule 4 for Mule 3 Users**

3 days | Self-paced (Free) | Instructor-led | Level 1

Uplevel your skills from Mule 3 to Mule 4 with hands-on experience with Studio 7 and Mule 4.

- ❖ Create an Account @ [training.mulesoft.com](https://training.mulesoft.com)
- ❖ Enrol on the course mentioned above.
- ❖ Complete the course, DIY exercises and the quiz for each section.
- ❖ Upon successful completion of the course, **you will be awarded 2 free Attempts for MCD Level 1 examination**, Which means, it's absolutely free if the course is completed 100%

So, don't miss this great opportunity!

**P.S:** This information is valid as of 20th of Dec, 2021 and may change in future!

Apart from the official training, The **MuleSoft TechZone** videos for Absolute Beginners has a detailed explanation of the concepts.

### **Topics that you have to concentrate more on :**

For-Each, Batch Scope, RAML , DataWeave (especially XML transformations are tricky), Error Handling, property file values, API led connectivity, Scatter Gather and other misc topics

## MuleSoft TechZone Plan for you to become a MuleSoft developer in 30days!!!!

- ❖ Spend 3 hours a Day.
- ❖ 1.5 hours watching the videos and 1.5 hours practising!
- ❖ Complete all the assignments including the Final Project to get good hands-on experience
- ❖ Join our Telegram group to get doubts clarified! (link is mentioned in the above Contact Information).
- ❖ Only One Mantra “Practice Practice and Practice”!
- ❖ **Playlist of 10 sessions:** [https://www.youtube.com/playlist?list=PL61bQcdxsK6\\_1tb0BbAtAOX\\_SdtvgQlxV](https://www.youtube.com/playlist?list=PL61bQcdxsK6_1tb0BbAtAOX_SdtvgQlxV)

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YouTube : <https://www.youtube.com/channel/UCCA2pYQqFvUJnIewJpwmPyA>

Website : <http://sravanlingam.com/>

Facebook : <https://www.facebook.com/MuleSoftTechZone/>

Twitter : <https://twitter.com/mulesofttz>

Instagram : <https://www.instagram.com/mulesofttechzone/>

Telegram : [t.me/MuleSoftForAB](https://t.me/MuleSoftForAB)

## Thank you!

Once Again, I thank each and everyone for their love and support in my professional journey. I hope that this Developer cookbook will help beginners to get started with MuleSoft Journey!  
If at all if you find any typos / false information, don't hesitate to reach out to me!  
Wish you all Good luck and Happy Learning!

Yours truly,  
Sravan Lingam