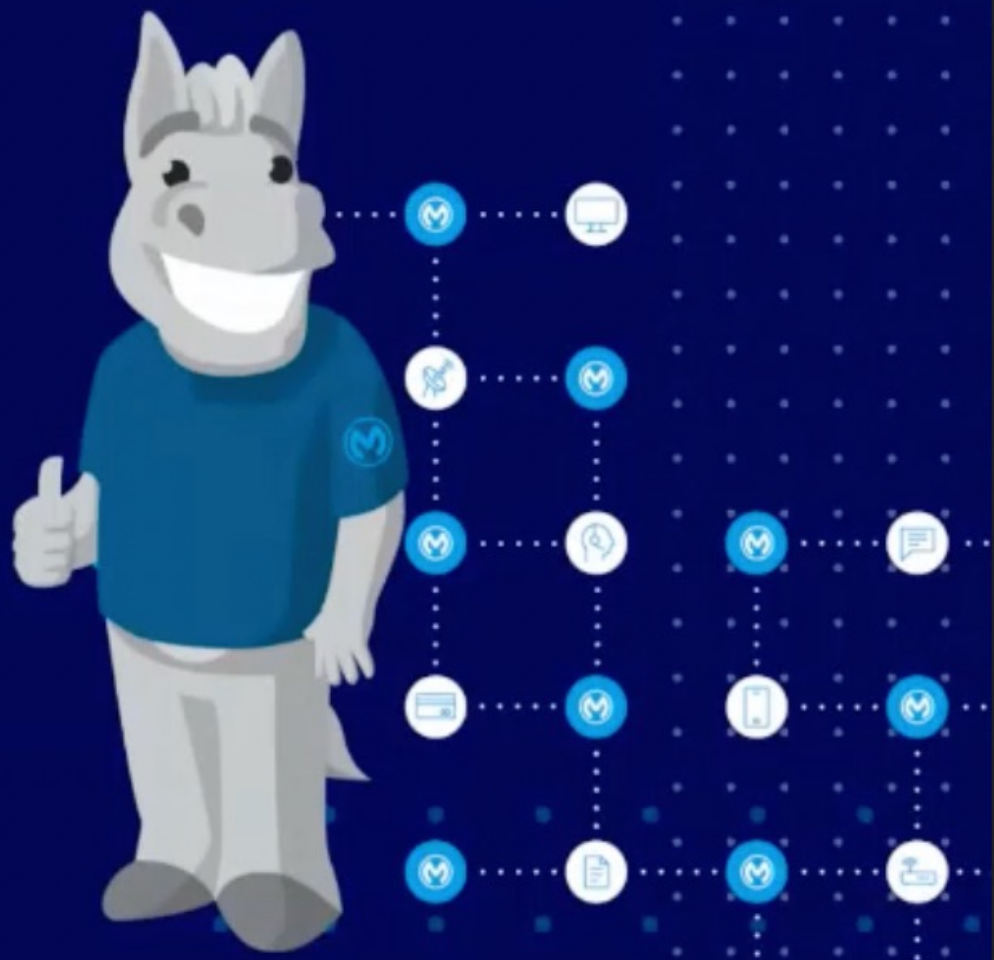
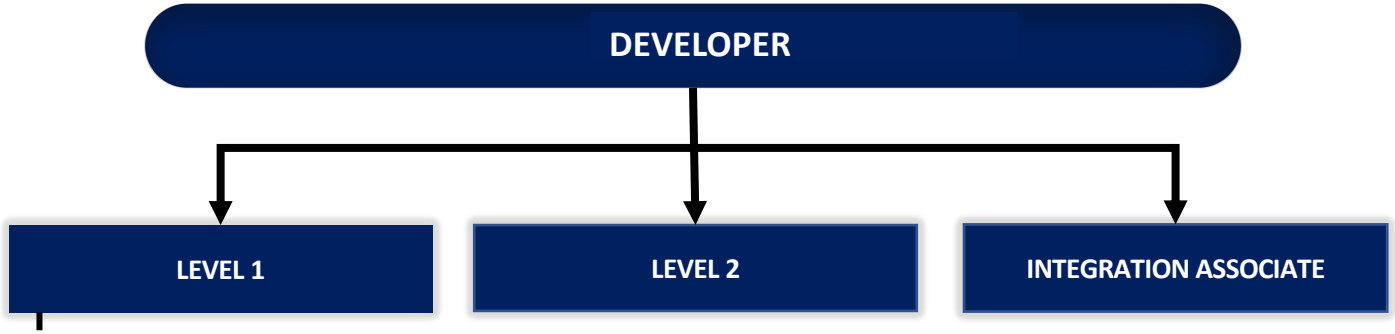
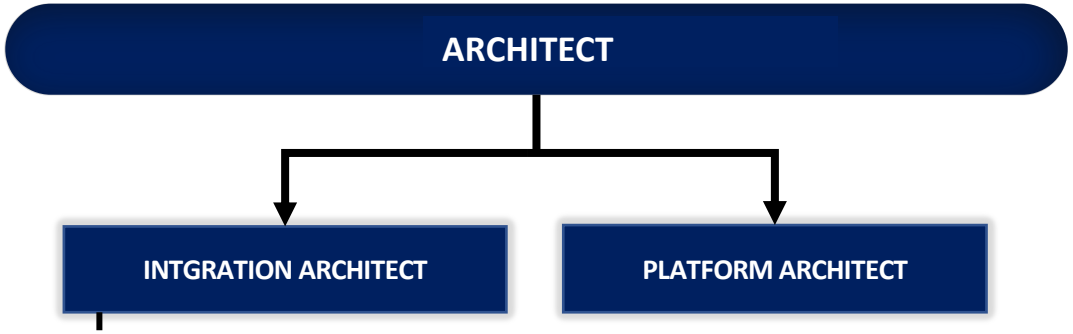
Chinna’s MuleSoft course



MuleSoft learning path

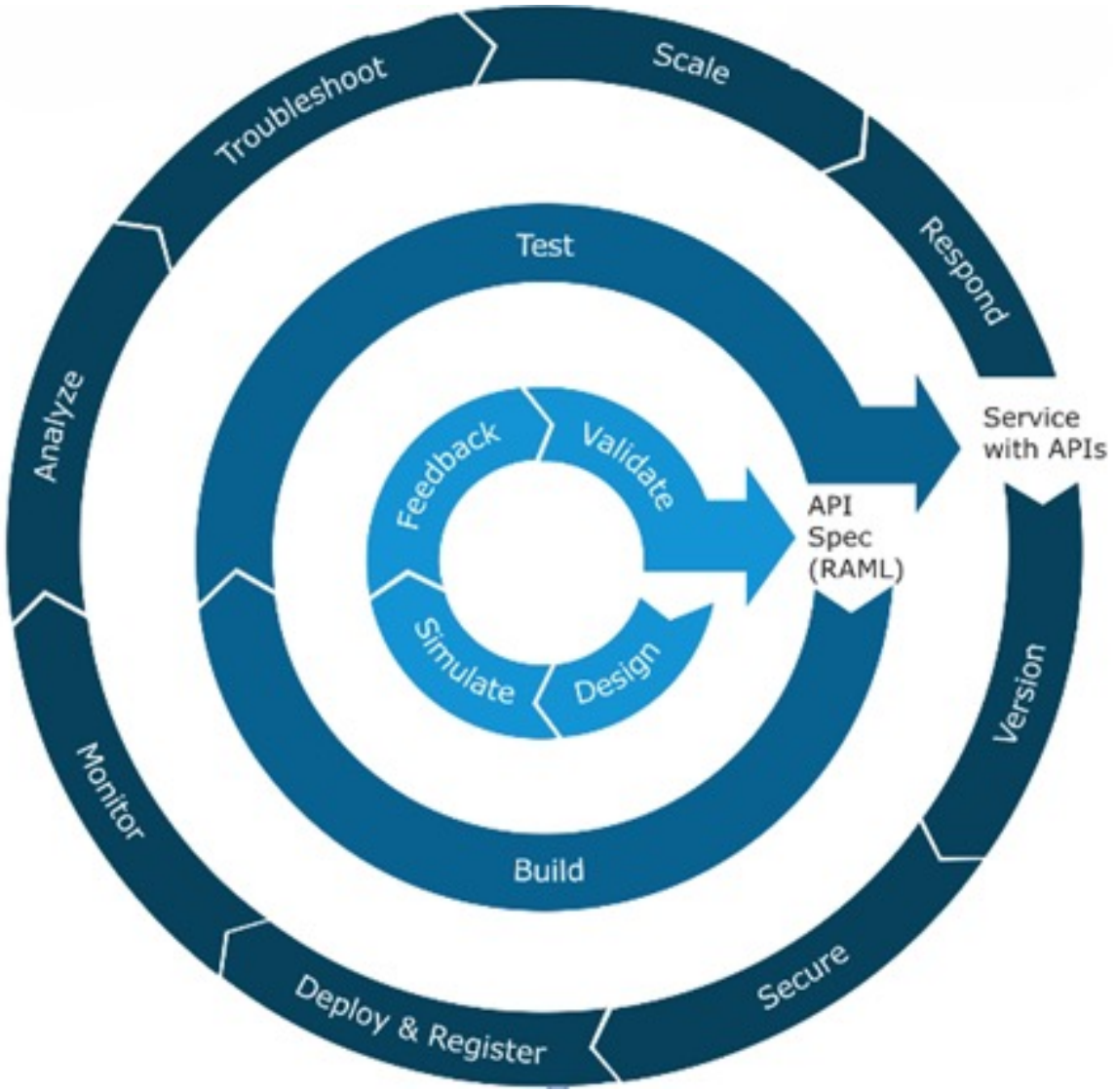


- Anypoint platform
  - Access management to deal with platform administration area's
  - Design API's using RAML or OAS
  - Dealing artifacts over exchange.
  - Cloud runtime to deploy mule applications.
  - API management. deploy mule apps.
  - Analytics management on deployed applications.
- Mule ESB integrations development using anypoint studio
- Dataweave language for transformations & enrichments
- MUnit to develop test cases driven development
- DevOps with mule
- Hands on real time project



- Integration architectural concepts
- Platform architectural concepts

Mule API life cycle



Setting up your computer

- Java installation & environment variables
- Maven installation & environment variables
- Setup Anypoint studio
- Postman installation

Web services

- **Web service : A web service is a program which runs in server and whose results are sharable over network/integration to make data transfer between applications.**
- **The types of web services are of two types SOAP and REST.**
- **SOAP services are legacy approach, and the development of SOAP services is very less comparing to REST.**
- **REST services are latest and called as REST API’s.**
- **The percentage of development of REST is 95% and SOAP is 5%**

How rest service can be accessed

- Before implementation of REST services, we should understand about a URL that we usually interact every day because we interact with REST API using URL.
    - http-protocol://host:port/base-path/sub-path
    - Example: http://localhost:8081/customer-sapi/customers
    - Example: http://mule-dev-customer-sapi.cloudhub.io/customer-sapi/customers
    - Example: https://mule-dev-customer-sapi.cloudhub.io/customer-sapi/customers

- HTTP Method : GET, POST, PUT, DELETE etc.
    - Example: GET https://mule-dev-customer-sapi.cloudhub.io/customer-sapi/customers
    - Example: POST https://mule-dev-customer-sapi.cloudhub.io/customer-sapi/customers
    - Example: PUT https://mule-dev-customer-sapi.cloudhub.io/customer-sapi/customers
    - Example: DELETE https://mule-dev-customer-sapi.cloudhub.io/customer-sapi/customers

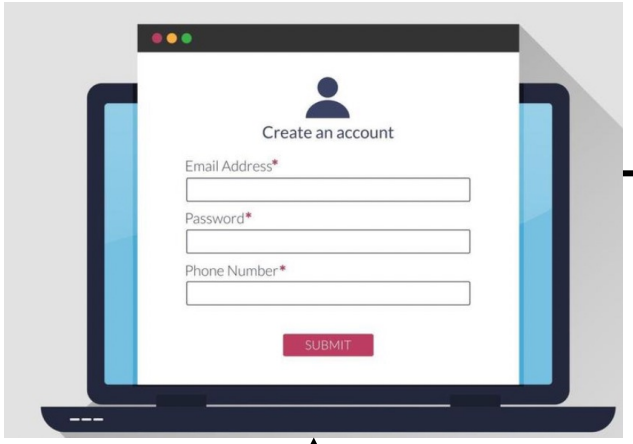
How request & response data passed over REST request

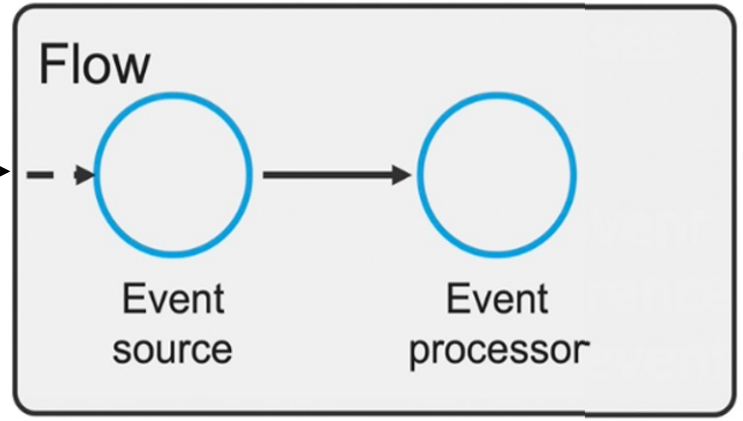
request headers

- Headers
- URI params
- Query params
- Etc.

request body

- JSON payload
- XML payload





Example: 200, OK. 400, Bad Request. 500 Server Error. etc.

response headers

- http response status code, status message

response body

- JSON payload
- XML payload

Process request and sends back response

Use case development of session : hello-mule-api

Rest configuration	Example
HTTP method	GET
Protocol	HTTP
Host	localhost
Port	8081
Base path	hello-mule-api
Sub path	hello-mule
URL	http://localhost:8081/hello-mule-api/hello-mule

Mule events

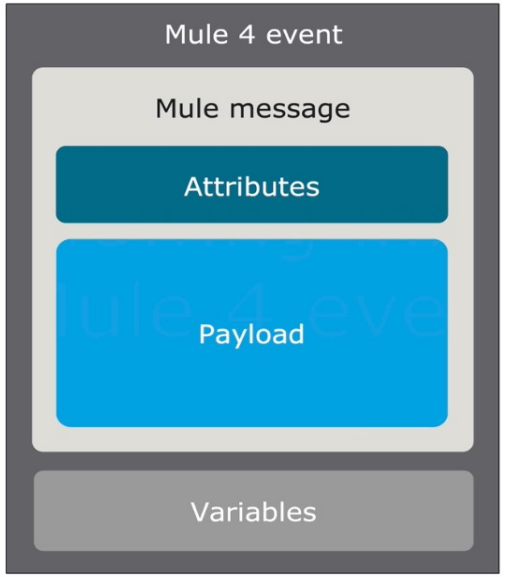
request headers

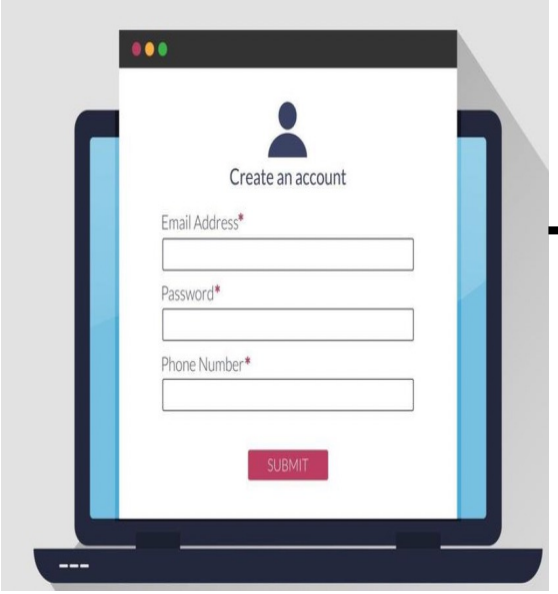
- Headers
- URI params
- Query params
- Etc.

request body

- JSON payload
- XML payload

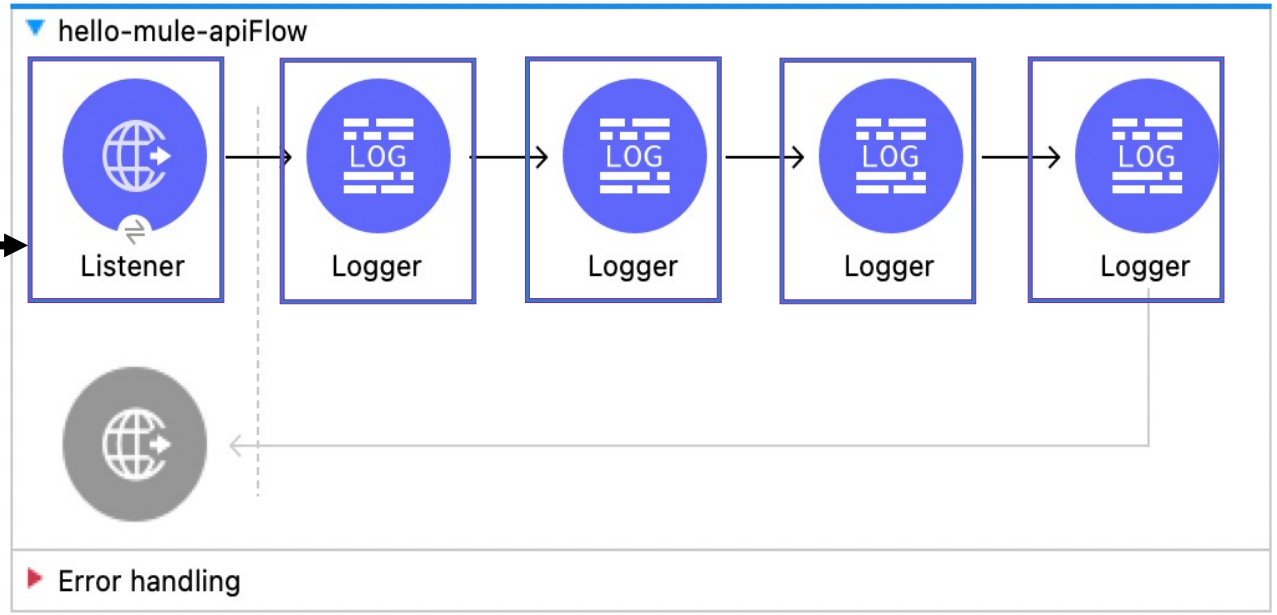
Mule event message





Mule event

Mule event source **Mule event processors**



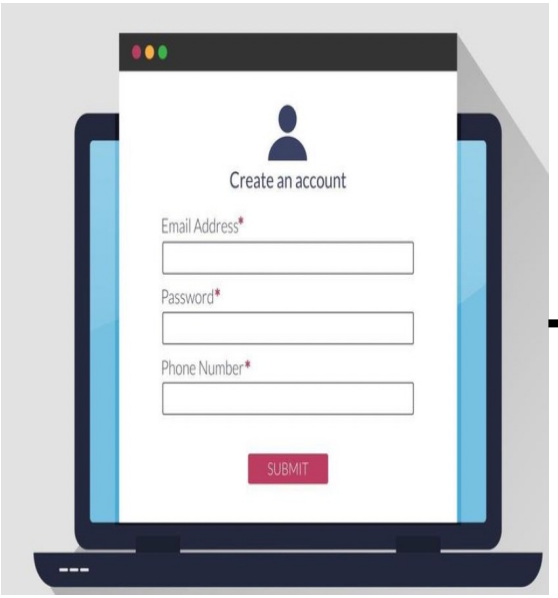
Mule message structure

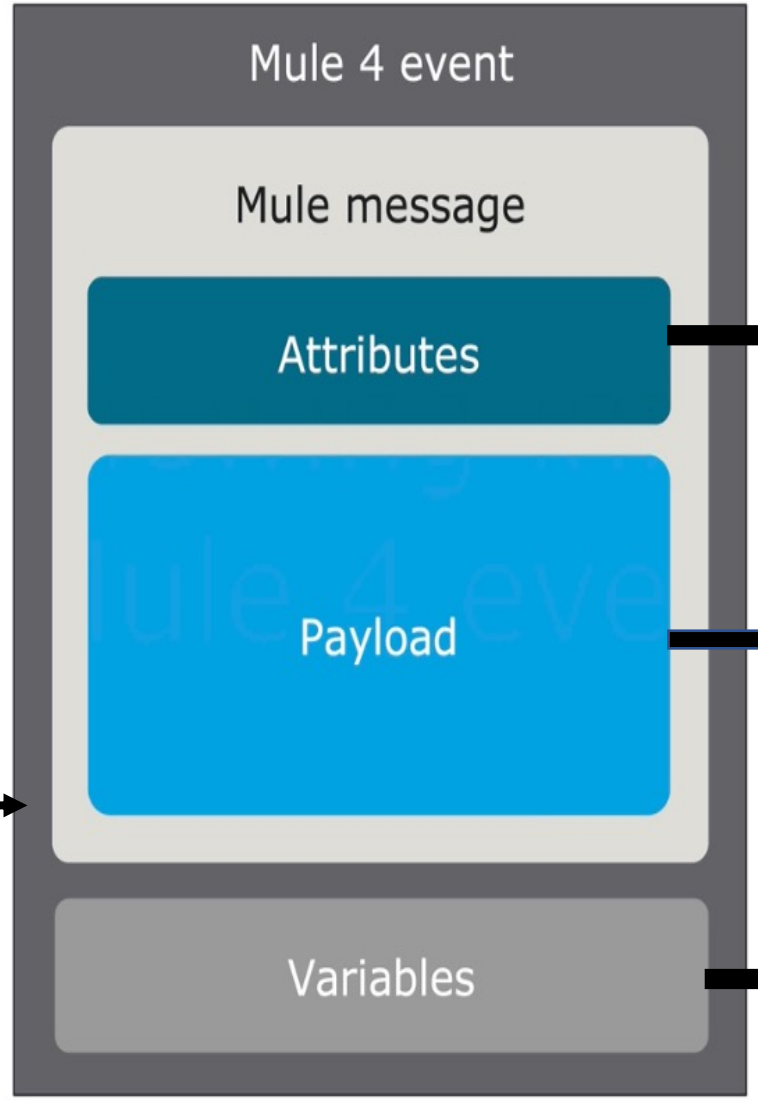
request headers

- Headers
- URI params
- Query params
- Etc.

request body

- JSON payload
- XML payload





attributes.headers.'Content-Type'

attributes.uriParams.fieldName

attributes.queryParams.fieldName

payload.fieldName

vars.variablename

create-employee rest service

- **URL:** http://localhost:8091/emp-sapi/create-employee (POST)

HTTP request body:

```
{
  "employeeID": 100,
  "employeeName": "Chinna",
  "employeeStatus": "A"
}
```

HTTP response header: 200, success

HTTP response body:

```
{
  "status": 200,
  "message": “Success”
}
```

update-employee rest service

- **URL:** http://localhost:8091/emp-sapi/update-employee (PUT)

HTTP request body:

```
<?xml version="1.0" encoding="UTF-8"?>
<employee>
        <employeeID>333</employeeID>
        <employeeStatus>A</employeeStatus>
</employee>
```

HTTP response body: HTTP response header: 200, OK

```
<?xml version="1.0" encoding="UTF-8"?>
<response>
        <status>200</status>
        <message>success</message>
</response>
```

get-employee rest service

- **URL:** http://localhost:8091/emp-sapi/get-employee?employeeID=100 (GET)

  HTTP response header: 200, OK

  HTTP response body:

```
{
  “employeeID”: 100,
  “employeeName”: “Chinna”,
  “employeeStatus”: “A”
}
```

get-employees rest service

- **URL:** http://localhost:8091/emp-sapi/get-employees (GET)

HTTP response header: 200, OK

HTTP response body:


```
[
    {
        “employeeID”: 100,
        “employeeName”: “Chinna”,
        “employeeStatus”: “A”
    },
    {
        “employeeID”: 101,
        “employeeName”: “John”,
        “employeeStatus”: “A”
    }
]
```

delete-employee rest service

- **URL:** http://localhost:8091/emp-sapi/delete-employee/101/John (DELETE)

HTTP response header: 200, OK

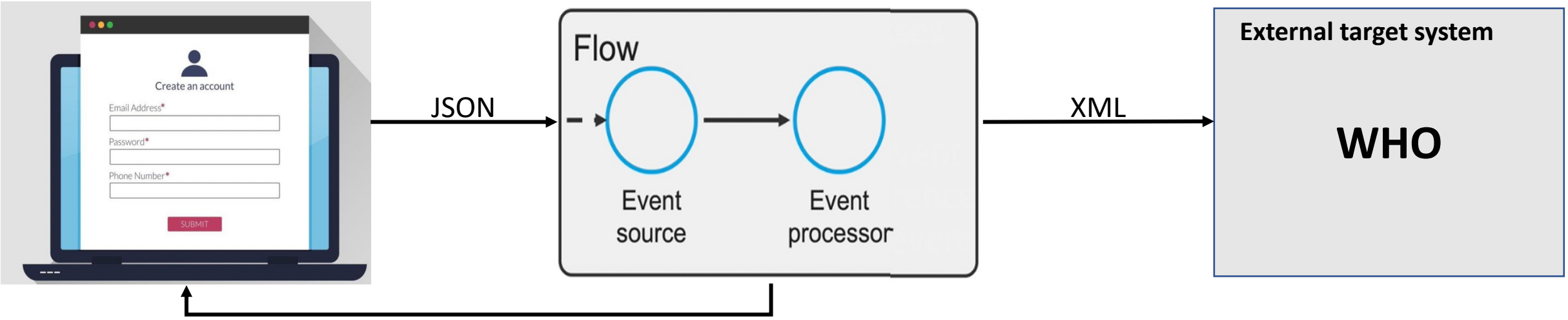
HTTP response body:

```
{
    “status”: 200,
    “message”: “Success”
}
```

ESB standards

ESB integration tool: A integration tool called as ESB tool when it provides below features.

- Components to orchestrate integrations
- Transformations
- Enrichments



Transformations & Enrichments – Mule components & Transform message connector

Dataweave logic

JSON

```
{
	"source": "DPC Hospital",
	"caseType": "positive",
	"firstName": "John",
	"lastName": "Nixon",
	"phone": "541-754-3010",
	"email": "john@gmail.com",
	"dateOfBirth": "1989-04-26",
	"nationalID": "209-49-6193",
	"nationalIDType": "SSN",
	"address": {
		"streetAddress": "1600 Pennsylvania Avenue",
		"city": "Dallas",
		"state": "TX",
		"postal": "20500",
		"country": "USA"
	}
}
```

XML

```
<?xml version="1.0" encoding="UTF-8"?>
<COVID_CASE>
  <FIRST_NAME>John</FIRST_NAME>
  <LAST_NAME>Nixon</LAST_NAME>
  <PHONE>541-754-3010</PHONE>
  <EMAIL>john@gmail.com</EMAIL>
  <DATE_OF_BIRTH>1989-04-26</DATE_OF_BIRTH>
  <COUNTRY>usa</COUNTRY>
</COVID_CASE>
```

Dataweave logic

JSON

```
{
	"source": "DPC Hospital",
	"caseType": "positive",
	"firstName": "John",
	"lastName": "Nixon",
	"phone": "541-754-3010",
	"email": "john@gmail.com",
	"dateOfBirth": "1989-04-26",
	"nationalID": "209-49-6193",
	"nationalIDType": "SSN",
	"address": {
		"streetAddress": "1600 Pennsylvania Avenue",
		"city": "Dallas",
		"state": "TX",
		"postal": "20500",
		"country": "USA"
	}
}
```

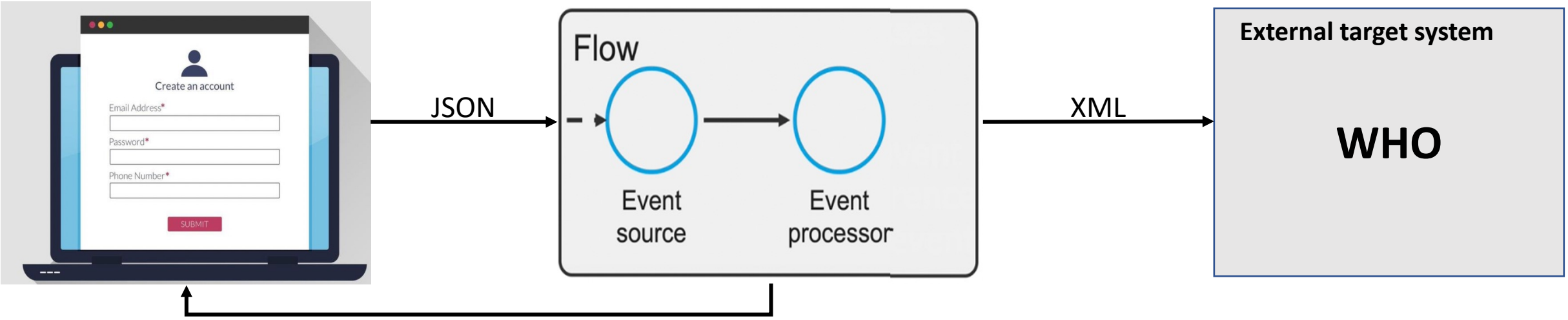
DW

```
%dw 2.0
output application/xml
---
{
COVID_CASE: {
    FIRST_NAME: payload.firstName,
    LAST_NAME: payload.lastName,
    PHONE: payload.phone,
    EMAIL: payload.email,
    DATE_OF_BIRTH:
    payload.dateOfBirth,
    COUNTRY: payload.address.country
  }
}
```

DataWeave Introduction

ESB integration tool: A integration tool called as ESB tool when it provides below features.

- Components to orchestrate integrations
- Transformations
- Enrichments



Transformations & Enrichments – Mule components & Transform message connector using **DataWeave** language

DataWeave selectors

DataWeave selectors: To extract the fields from mule message structure.

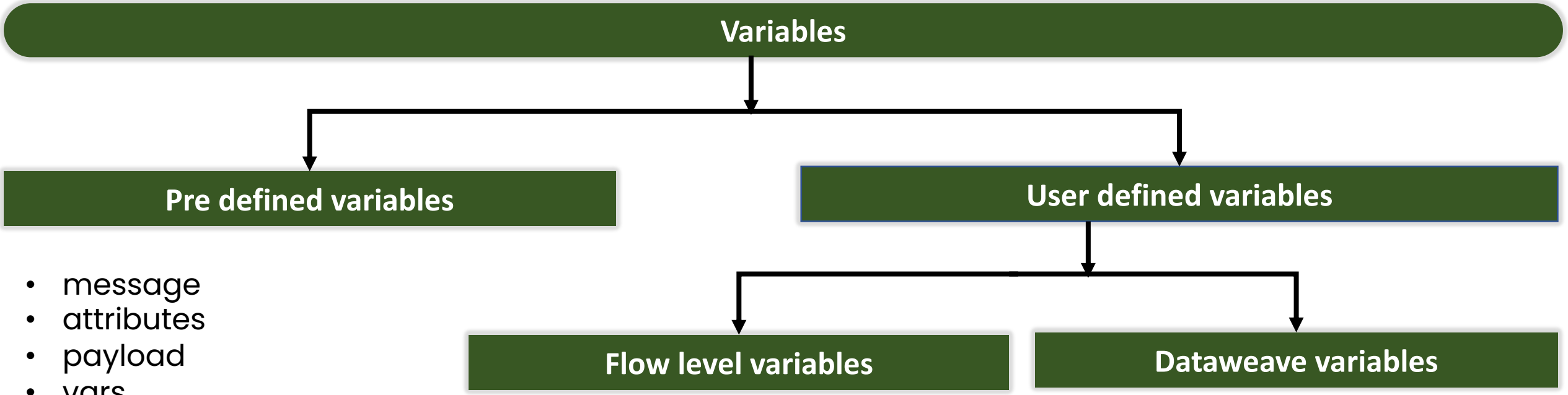
Selector	Syntax
Single-value	.keyName
Multi-value	.*keyName
Index	[<index>]
XML attribute	.@keyName
Range	[<index> to <index>]
Filter	[?(boolean_expression)]
Namespace	keyName.#
Descendants	..keyName
Dynamic	payload[(nameExpression)]
Key-value pair	.&keyName
Key present	keyName?, keyName.@type?
Assert present	keyName!
Metadata	.^someMetadata

Mule data types

Data types: Mule supports below datatypes.

Data type	Example
String	"hello world"
Number	123
VeryBigNumber	123412341341234123412341234123
FloatingPointNumber	123.456
Boolean	**true**
Date	2018-12-07
Time	11:55:56
DateTime	2018-10-01T23:57:59-03:00
LocalDateTime	2018-10-01T23:57:59-03:00
Array	[1, 2, 3, 5, 8]
MixedArray	[1, 2, "blah”]
Object	{ ”caseID": ”267" }

Types of variables



- message
- attributes
- payload
- vars
- error
- app
- flow
- mule
- server

- The scope of variables are application level

- The scope of variable is flow level

- The scope of variable is dw level

Type coercion

Type coercion: The process of changing field value from one type to other type

- Types can be coerced from one type to other using the ‘as’ operator
- Input : {“caseID”: “667”}
- Type coercion from string to number : payload.caseID as Number

Arithmetic Operators

DataWeave supports the most common mathematical operators:

Operator	Description
+	For addition.
-	For subtraction.
*	For multiplication.
/	For division.

Equality and Relational Operators

DataWeave supports the following equality and relational operators:

Operator	Description
<	For less than.
>	For greater than.
<=	For less than or equal to.
>=	For greater than or equal to.
==	For equal to.
~=	Equality operator that tries to coerce one value to the type of the other when the types are different.

Logical Operators

DataWeave supports the following logical operators:

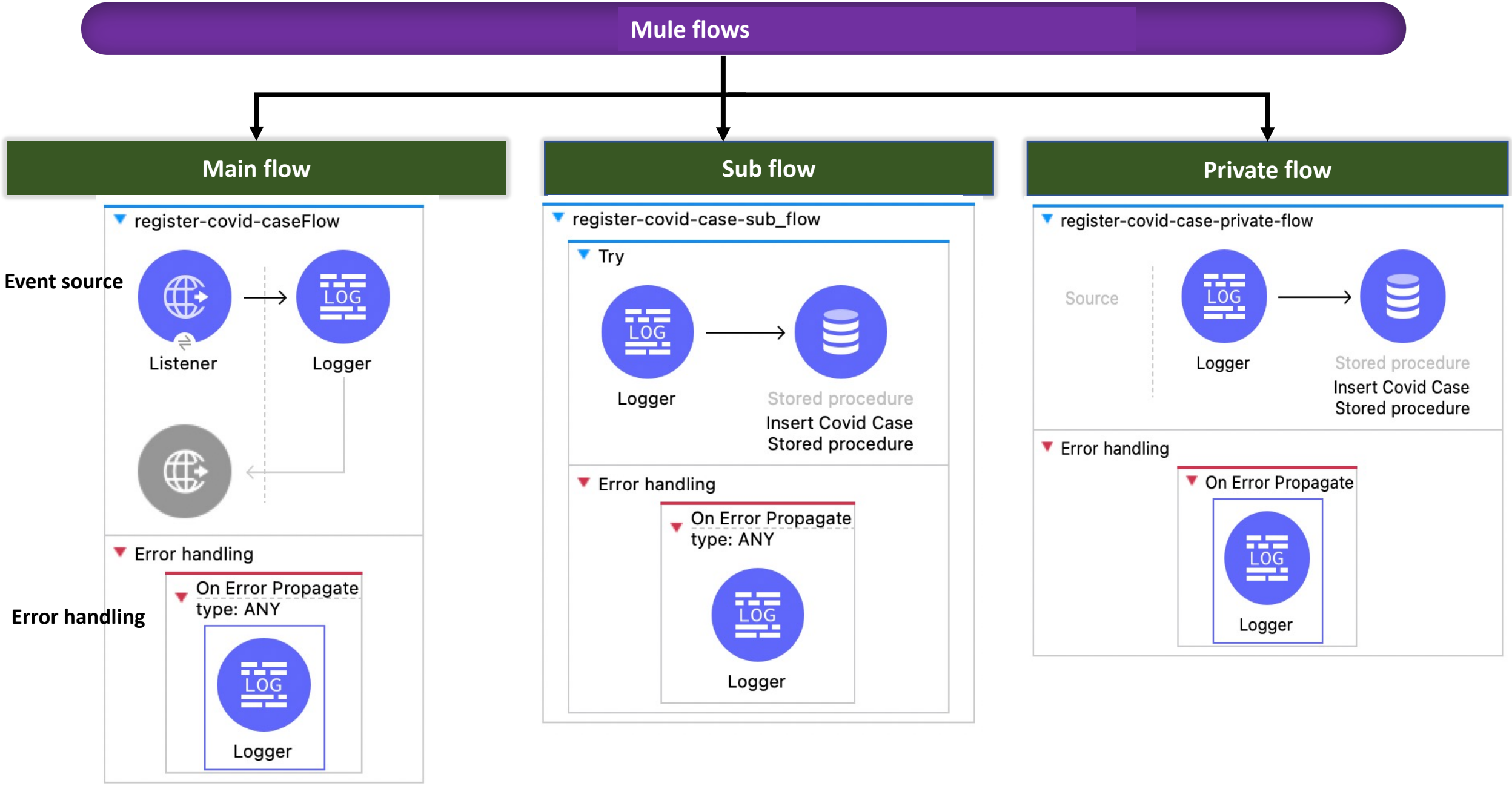
Operator	Description
not	Negates the result of the input. See also, !.
!	Negates the result of the input.
and	Returns true if the result of all inputs is true, false if not.
or	Returns true if the result of any input is true, false if not.

Prepend, Append, and Remove Operators

DataWeave supports operators for appending and prepending items within an array:

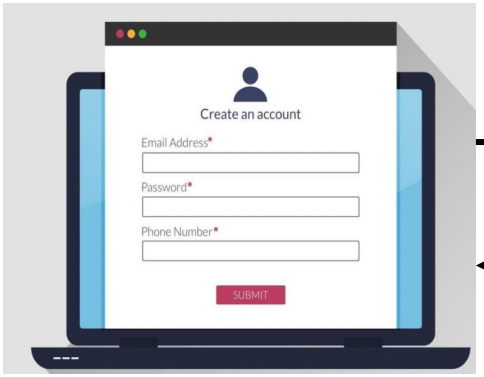
Operator	Description
>>	Prepends data on the left-hand side of the operator to items in the array on the right-hand side. For example, 1 >> [2] results in [1, 2], prepending 1 to 2 in the array.
<<	Appends data on the right-hand side of the operator to items in the array on the left-hand side. For example, [1] << 2 results in [1, 2], appending 2 to 1 in the array.
+	Appends data on the right-hand side of the operator to items in the array on the left-hand side. For example, [1] + 2 results in [1, 2], appending 2 to 1 in the array. The array is always on the left-hand side of the operator.
-	Removes a specified element of any supported type from an array.

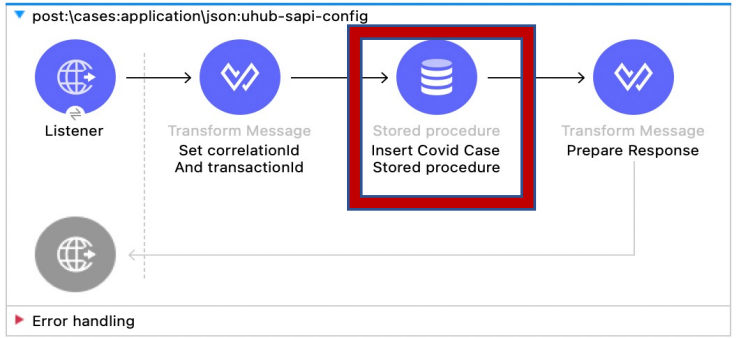
Types of mule flows



Error handling

- **Error handling: The process of handling errors in flow and responding back user friendly messages instead of system error messages is known as error handling.**





response headers

500, Server error

response body

Could not obtain connection from data source

response headers

503, Service unavailable

response body


```
{
  "code":503,
  "message":"Service unavailable",
  "description":"The service is temporarily not available",
  "dateTime":"2024-05-31T06:18:02Z",
  "transactionId":"48n32920-69ne-47b4-907d-fa15869f3c4d"
}
```

Error handling

Description

It is an important component of Mule error which will give description about the problem. Its expression is as follows:

```
#[error.description]
```

Type

The **`Type`** component of Mule error is used to characterize the problem. It also allows routing within an error handler. Its expression is as follows:

```
#[error.errorType]
```

Cause

The **`Cause`** component of Mule error gives the underlying java throwable that causes the failure. Its expression is as follows:

```
#[error.cause]
```

Message

The **`Message`** component of Mule error shows an optional message regarding the error. Its expression is as follows:

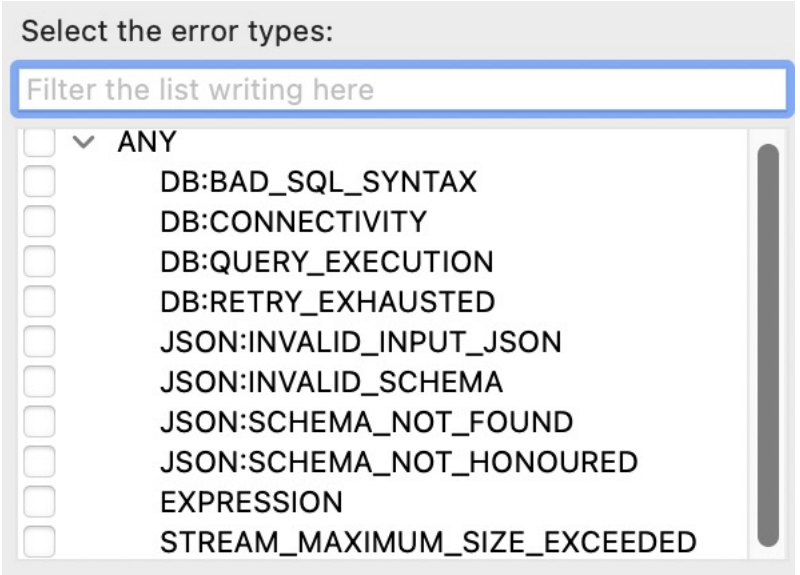
```
#[error.errorMessage]
```

Child Errors

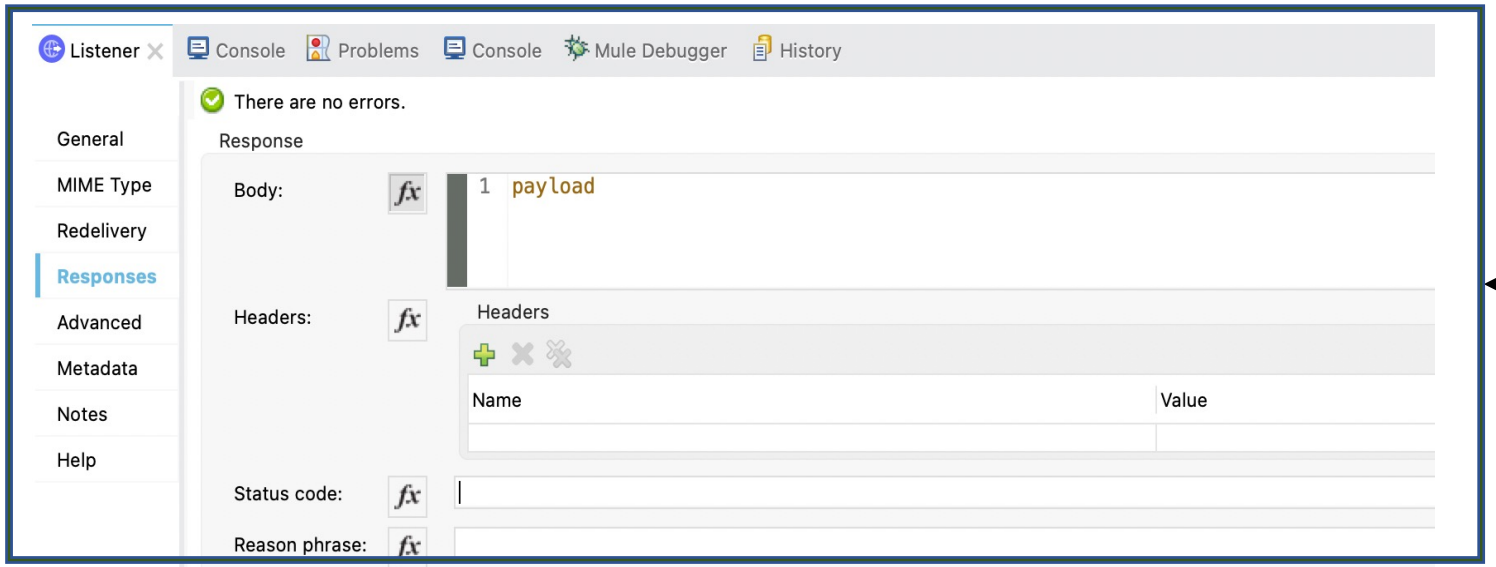
The **`Child Errors`** component of Mule error gives an optional collection of inner errors. These inner errors are mainly used by elements like Scatter-Gather to provide aggregated route errors. Its expression is as follows:

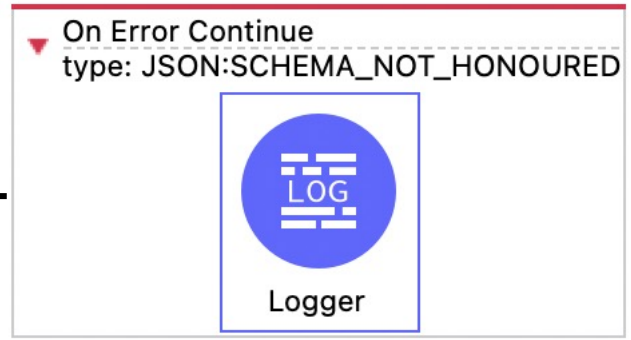
```
#[error.childErrors]
```

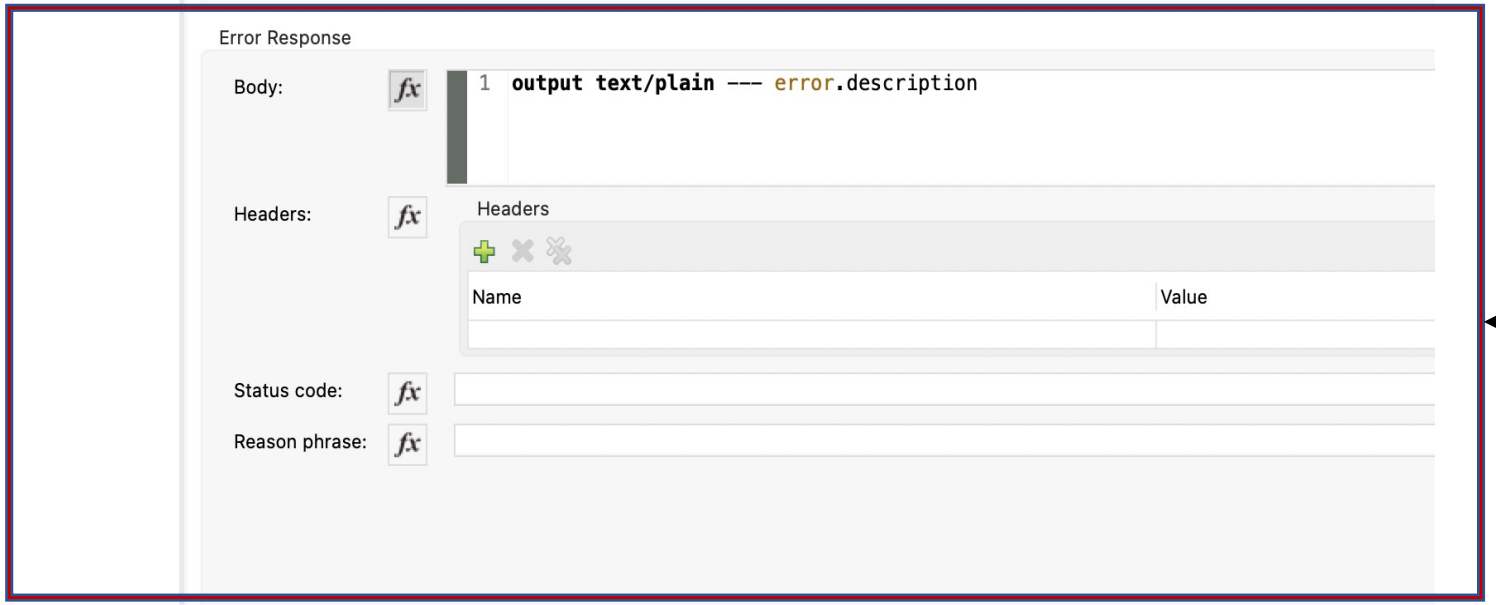
NAMESPACE:IDENTIFIER

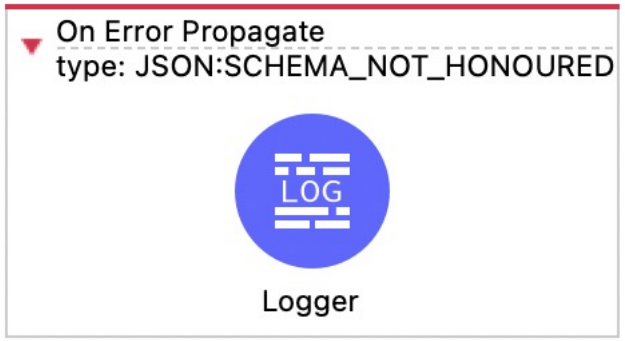


On error propagate vs on error continue



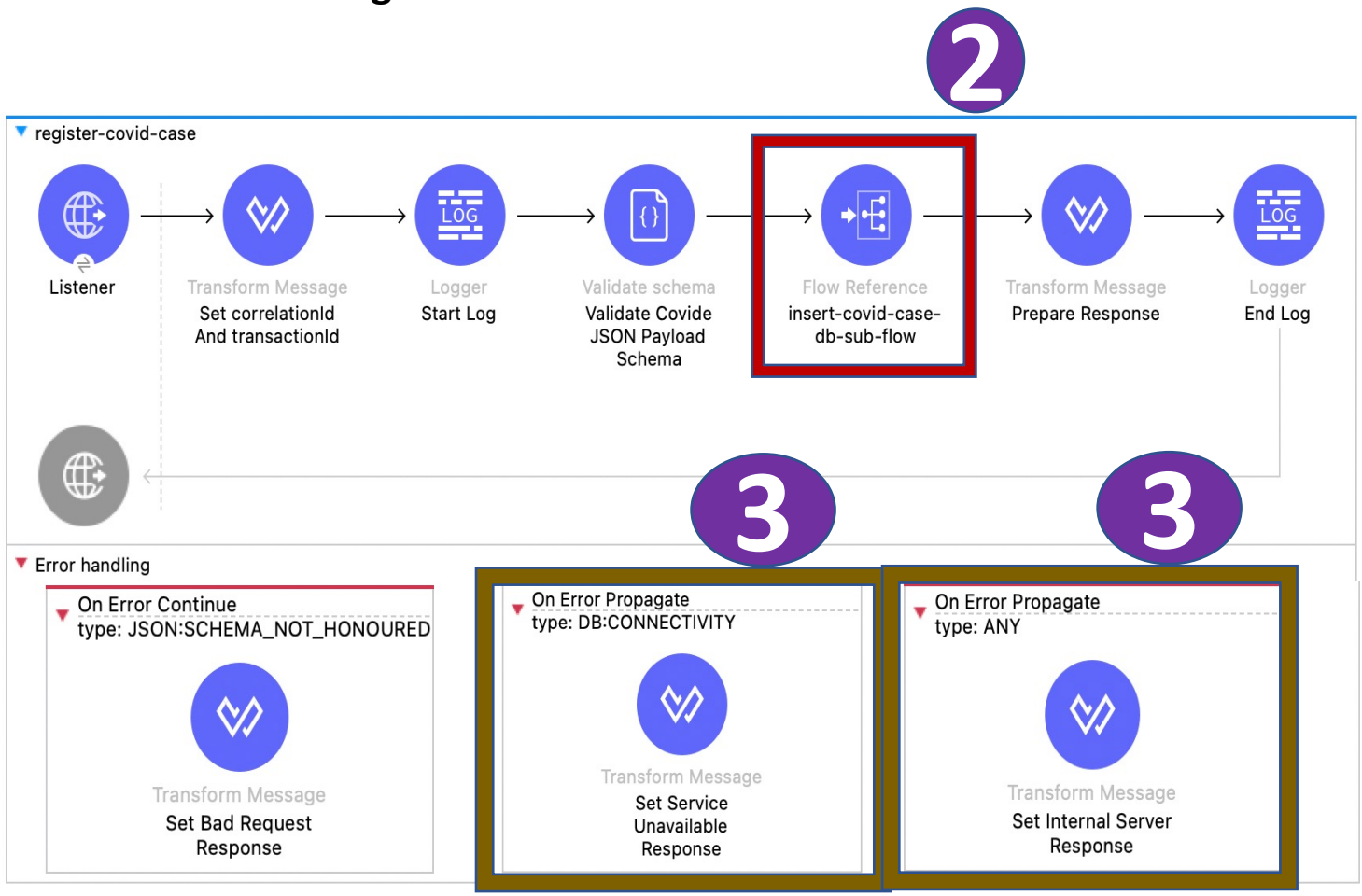


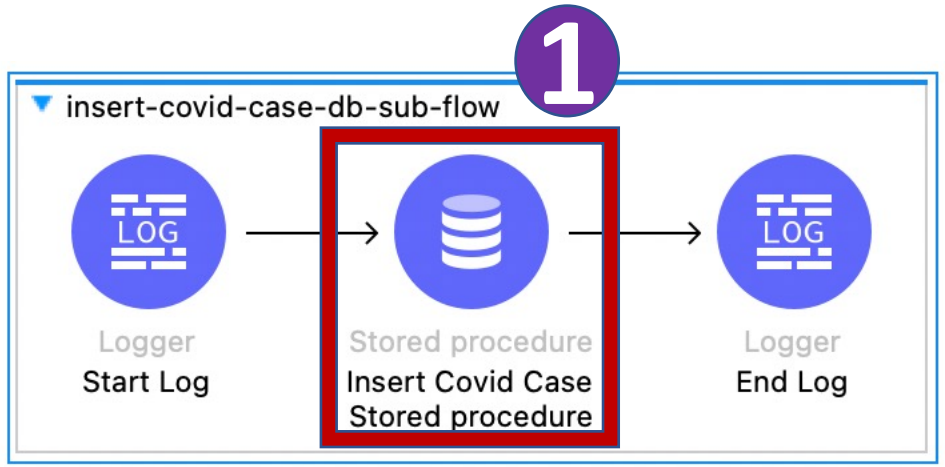




Error handling b/w parent flow & sub flow

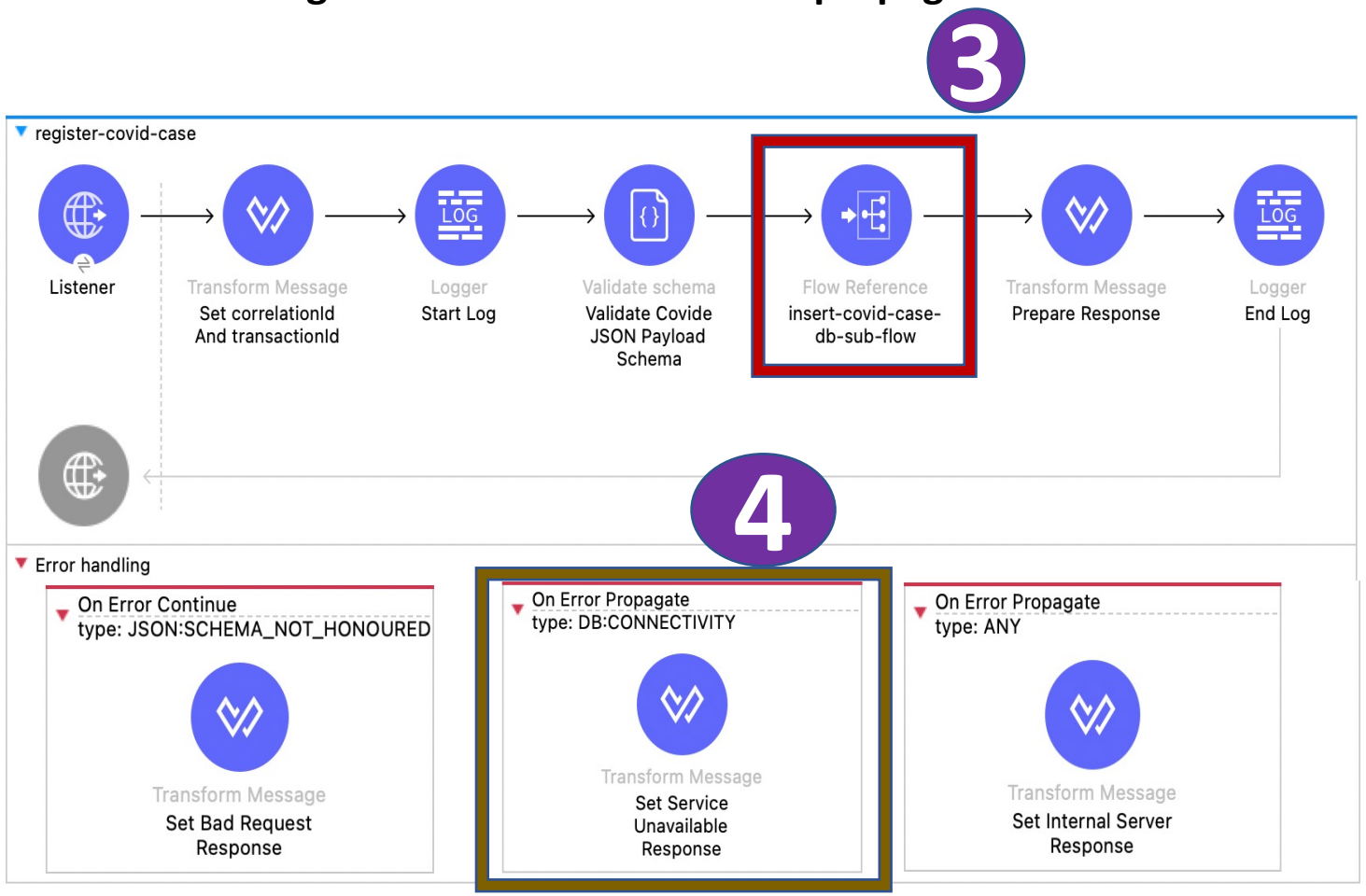
1. No error handling sub flow

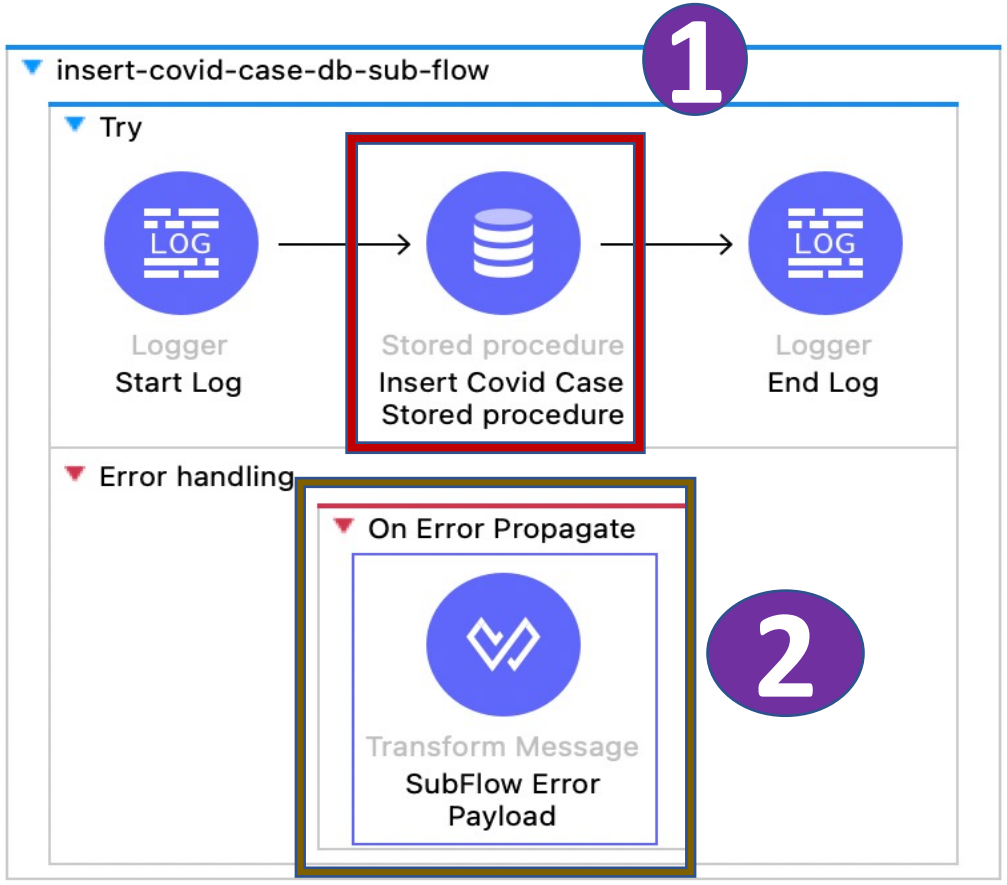




Error handling b/w parent flow & sub flow

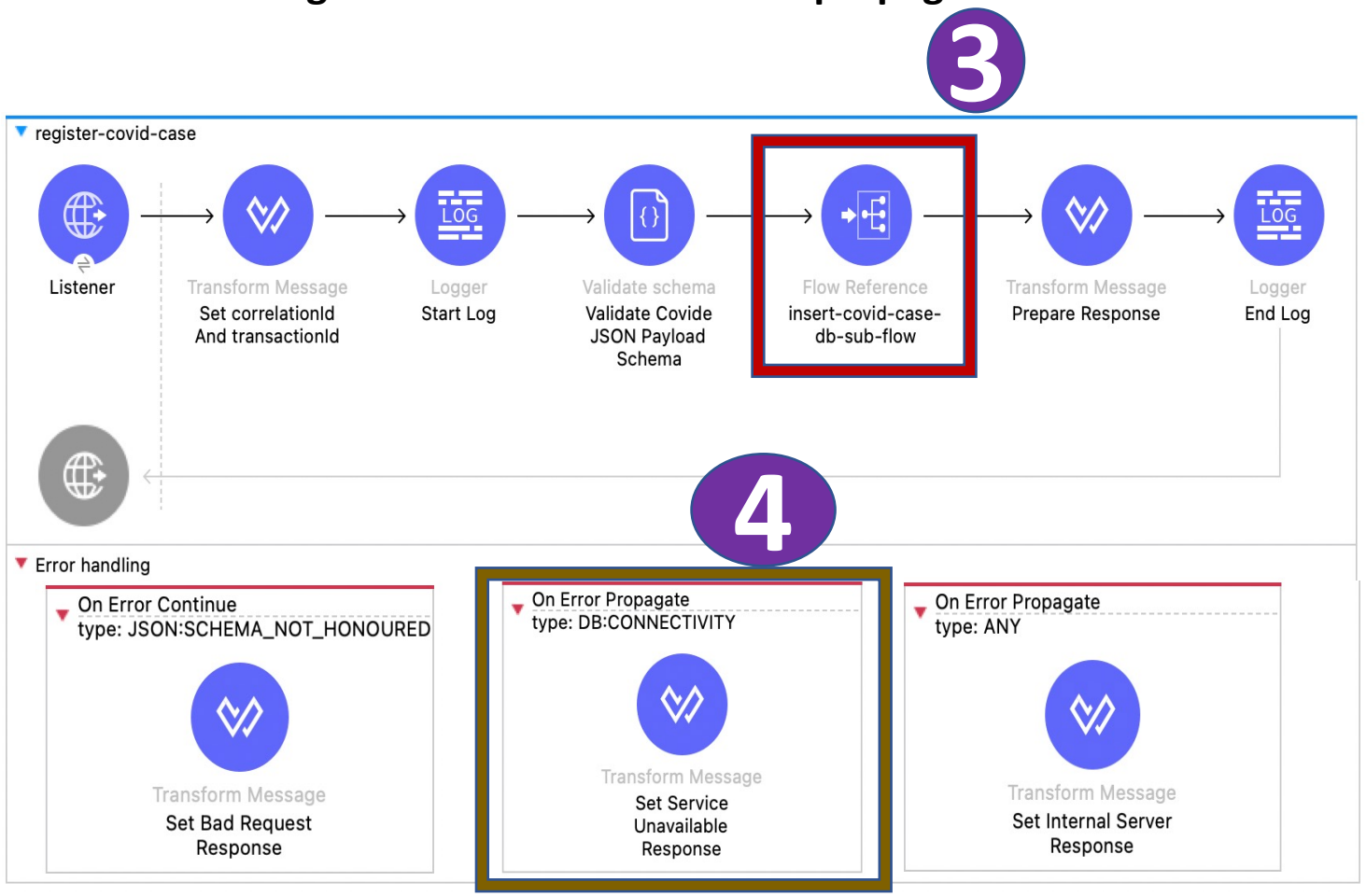
2. Error handling in sub flow with on-error-propagate

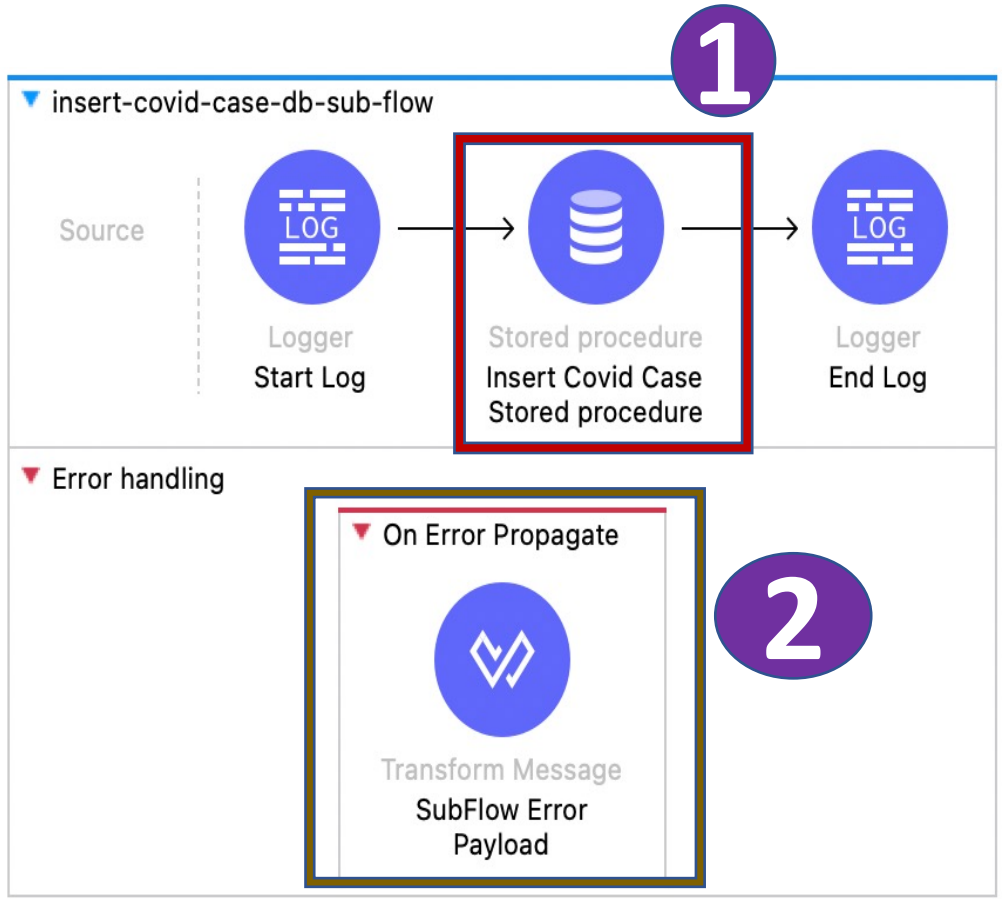




Error handling b/w parent flow & sub flow

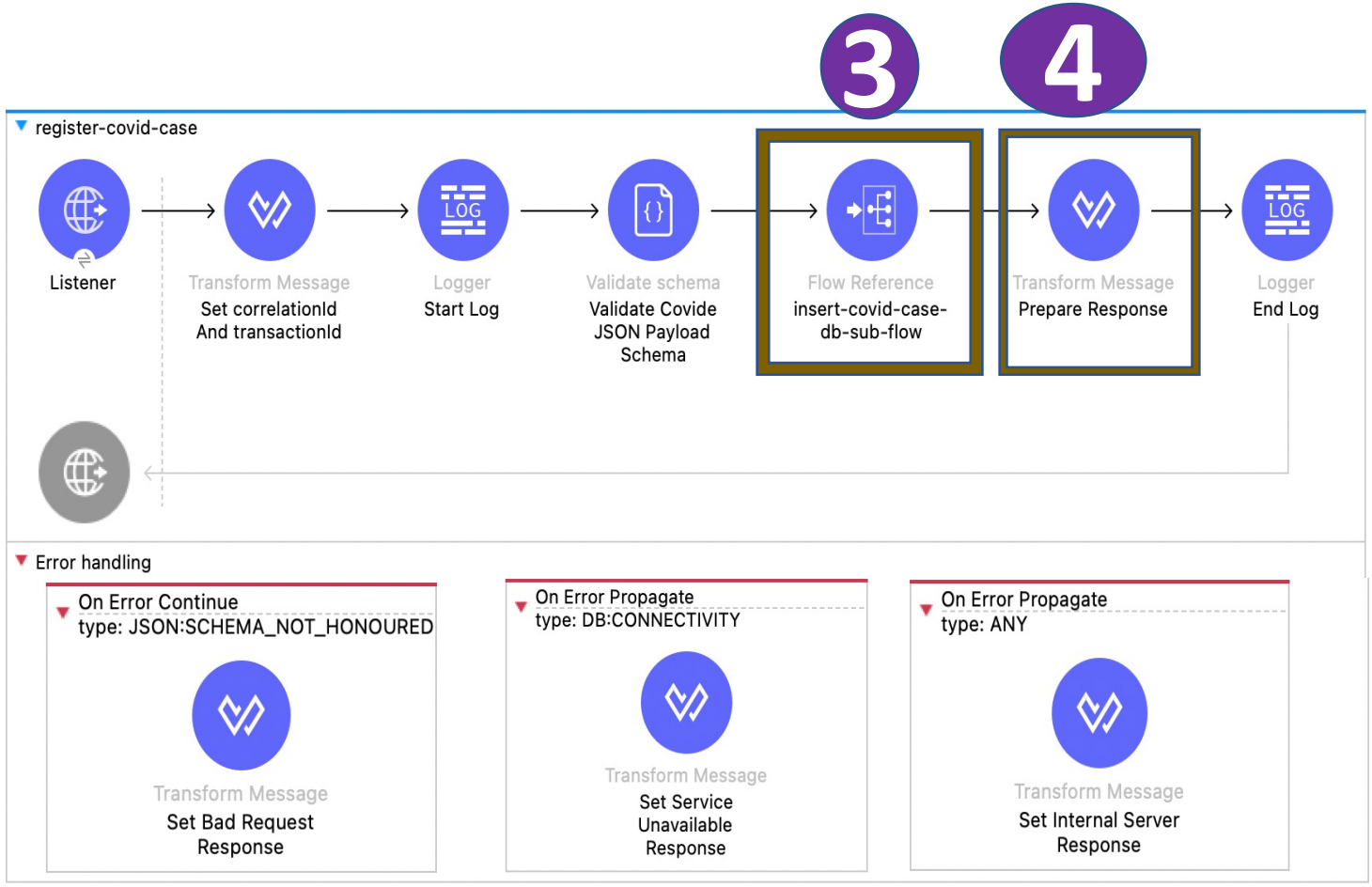
2. Error handling in sub flow with on-error-propagate

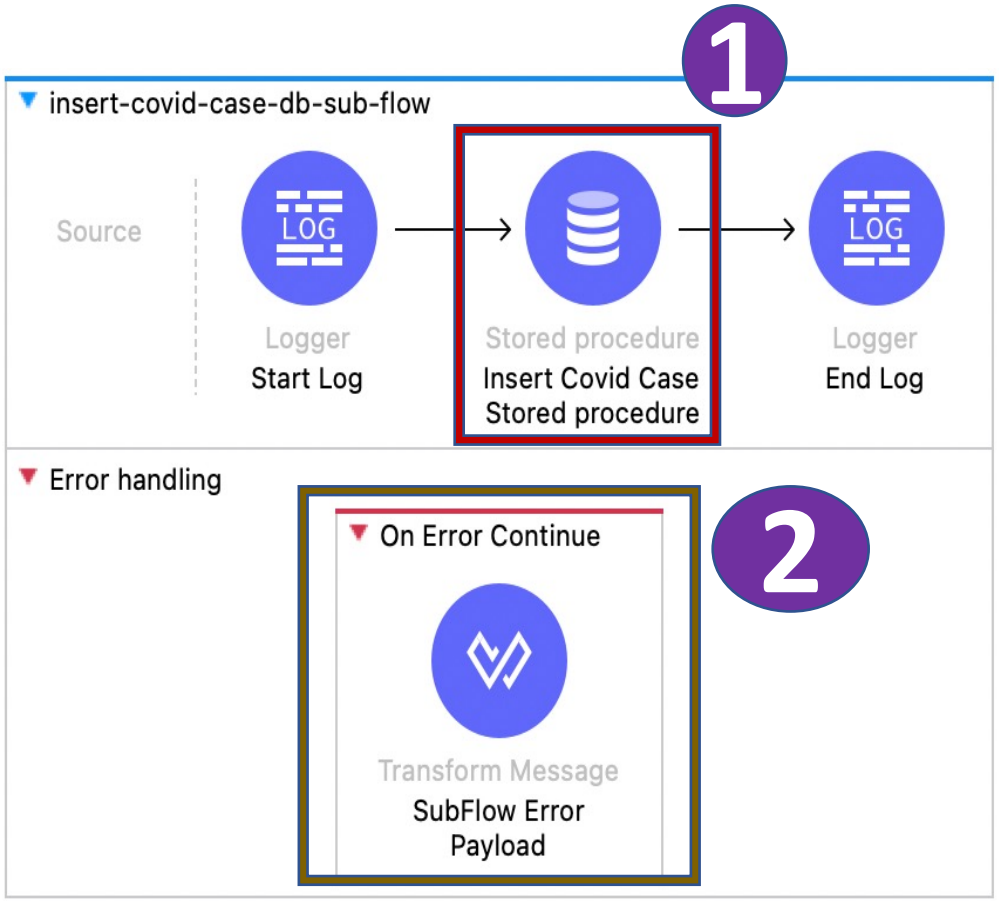




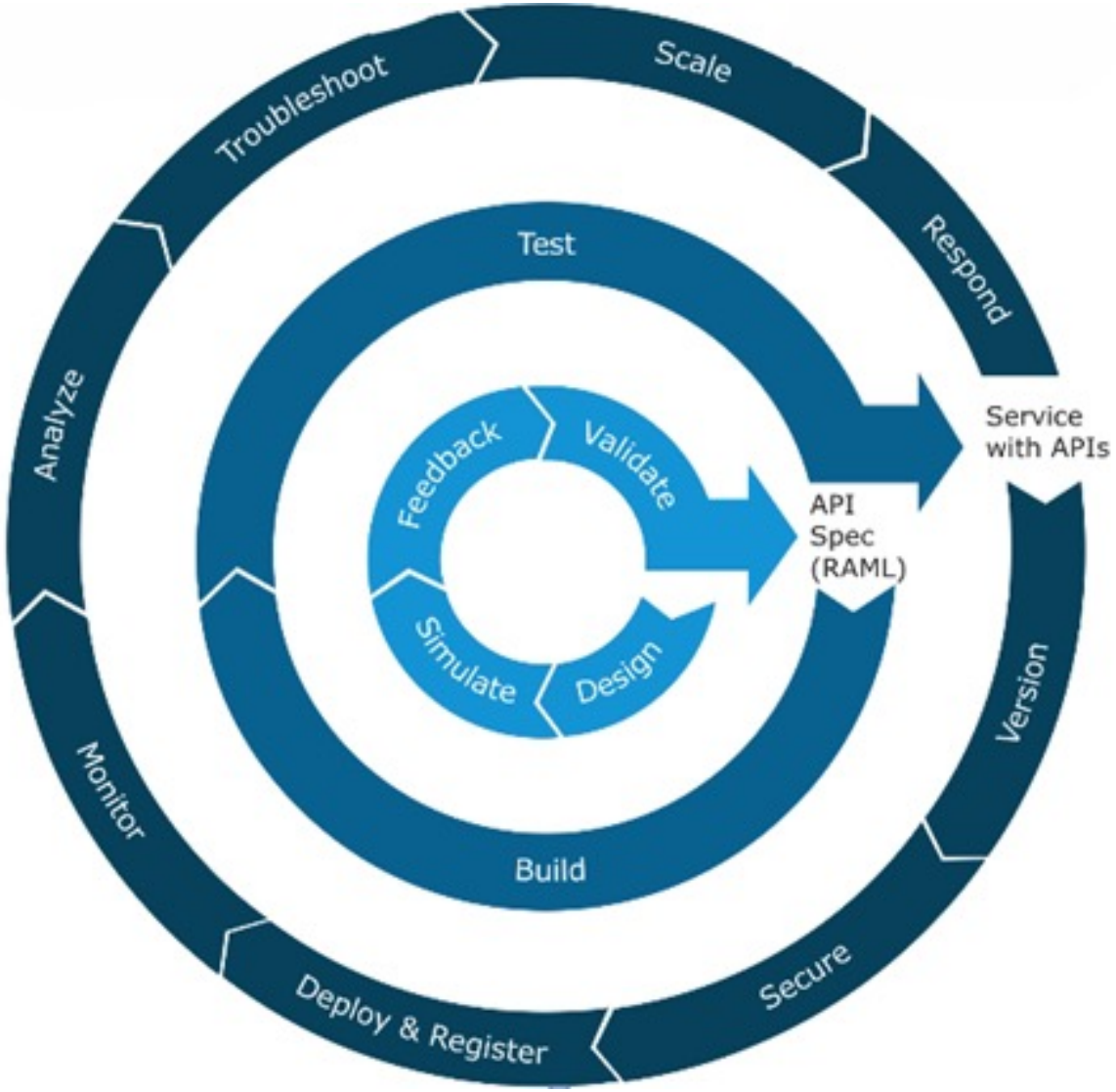
Error handling b/w parent flow & sub flow

3. Error handling in sub flow with on-error-continue





Mule API life cycle



DESIGN

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MUNIT TESTING

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MANUAL DEPLOYMENT

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CICD DEPLOYMENT

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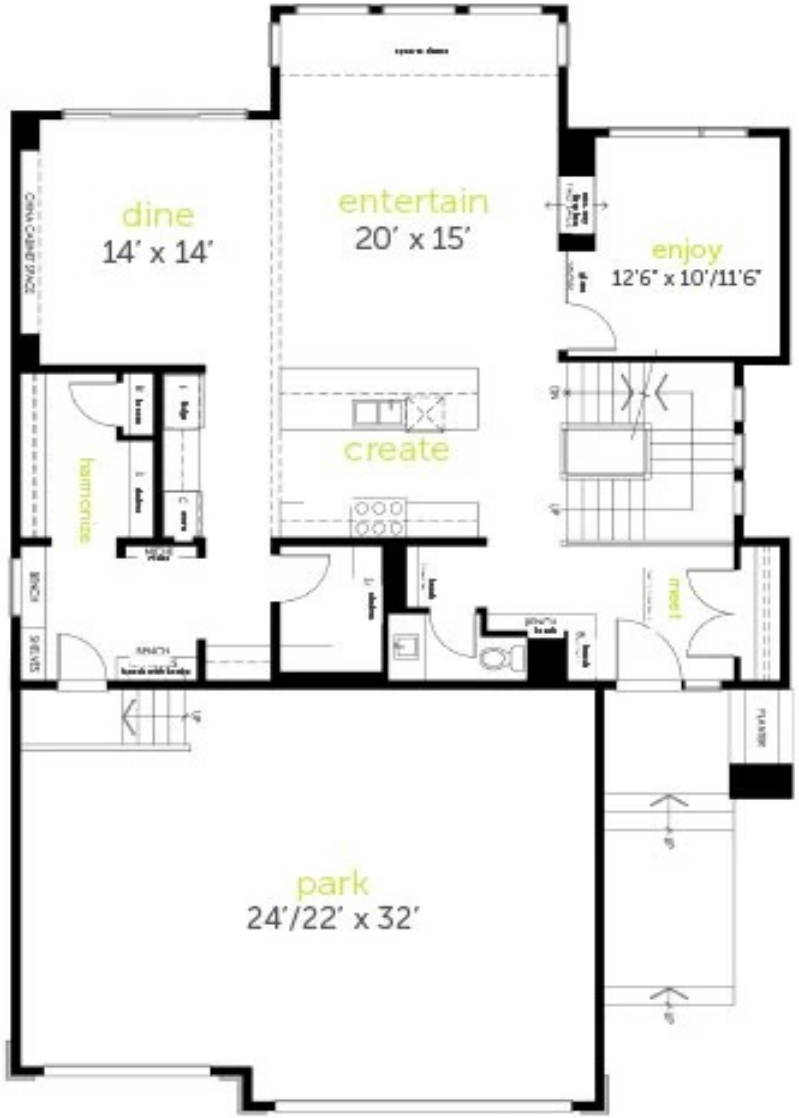
API MANAGEMENT

Designing API's

Designing API's

Mecca Main floor: 1407 sq.ft



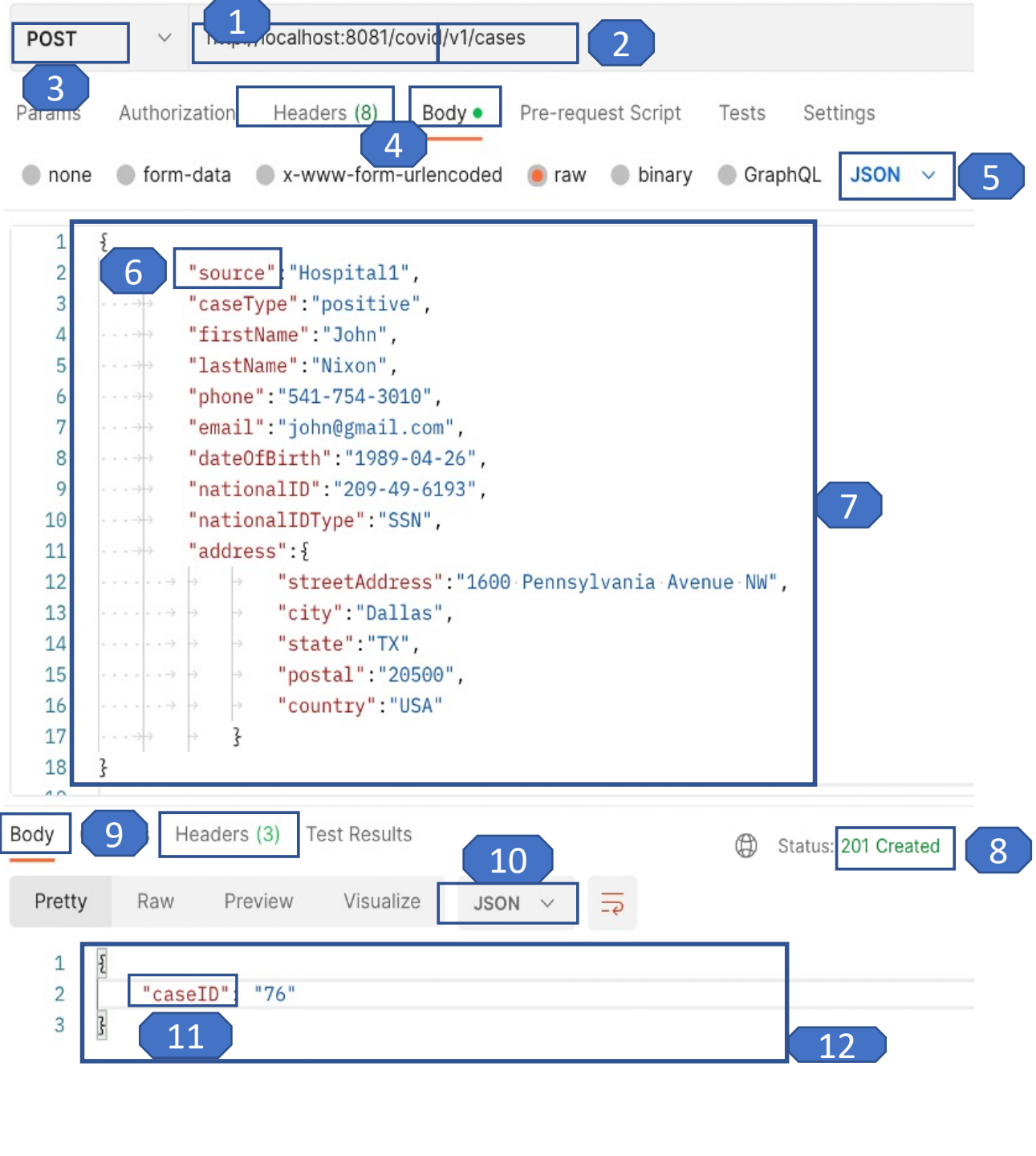
Aurora Main floor: 1445 sq.ft

Rest API

Base URI

Resource

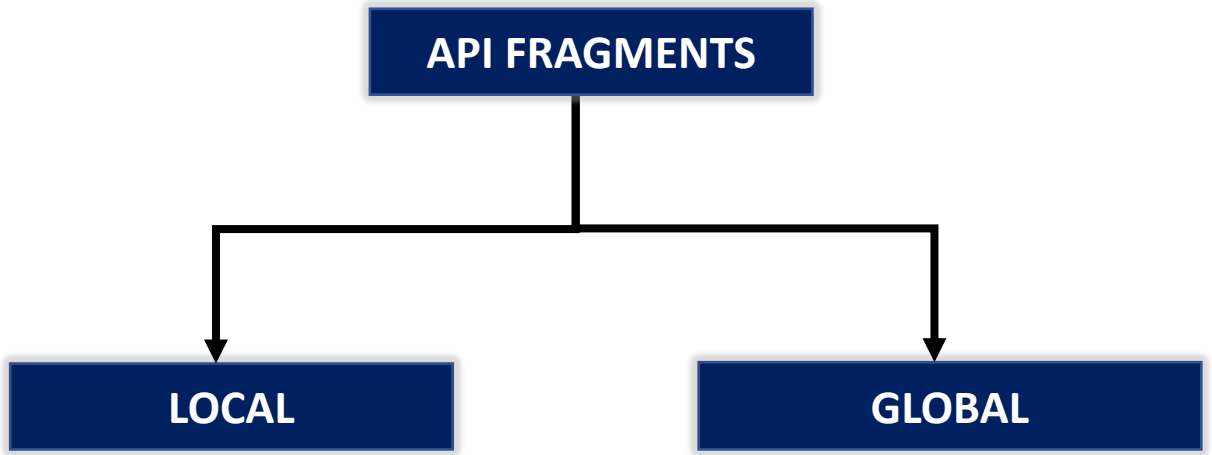
- REST API URL : http://localhost:8081/covid/v1/cases
- HTTP Method : GET, POST, PUT, DELETE etc.
- Input: headers, body
- Content type: application/json, application/xml etc.
- Response headers: 200, OK. 400, Bad Request. 500 Server Error. Etc
- Response body: application/json, application/xml etc.




```yaml
#%RAML 1.0
title: uhub-sapi
baseUri: http://localhost:8081/covid
/v1/cases:
  post:
    body:
      application/json:
        properties:
          source:
            type: string
            required: true
            example: "Hospital1"
          .
        example:
          {
            "source":"Hospital1",
            .
            .
          }
    responses:
      200:
        body:
          application/json:
            properties:
              caseID:
                type: string
                example: "76"
            example:
              {
                "caseID": "76"
              }
```

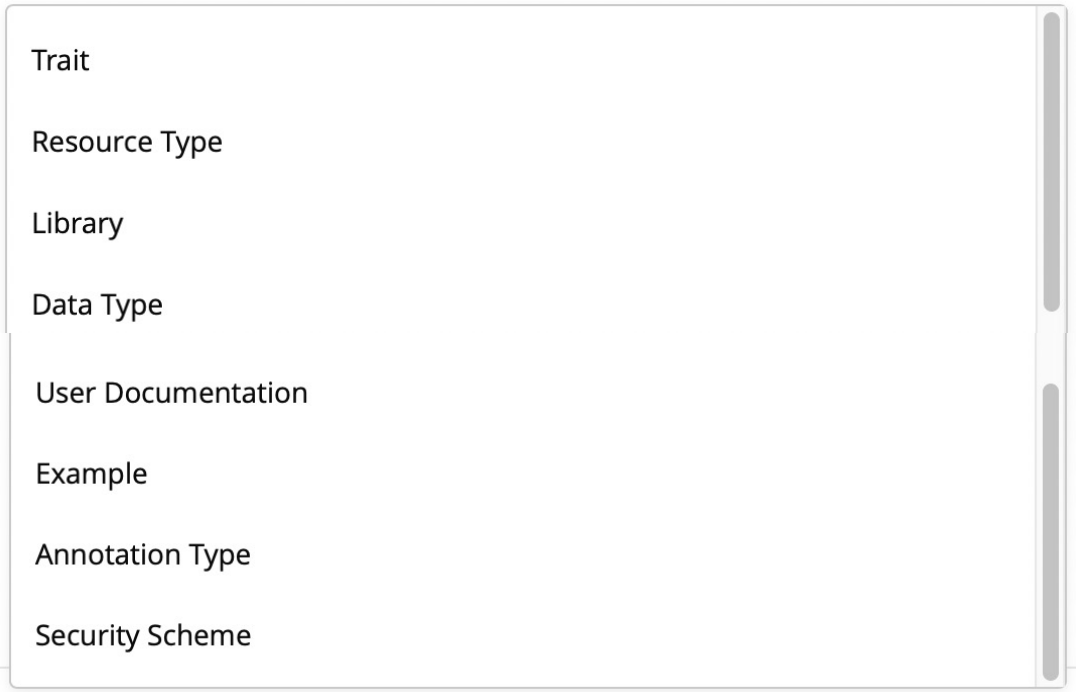
Fragments in RAML

Fragments : API fragments are reusable component of RAML to make the design and build of a reusable API even quicker and easier.

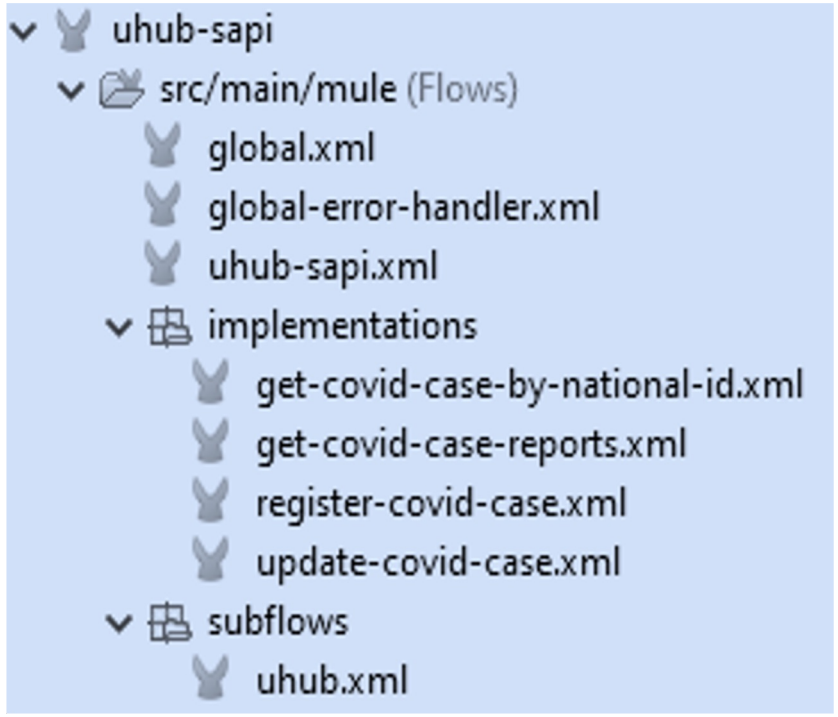


uhub-sapi

uhub-sapi
aws-sapi
who-sapi



Mule project naming standards and structure



Project name: kebab case (ex: uhub-sapi)

Flow and subflow names: kebab case (ex: register-covid-case)

Property file names: kebab case (ex: uhub-sapi-dev.yaml)

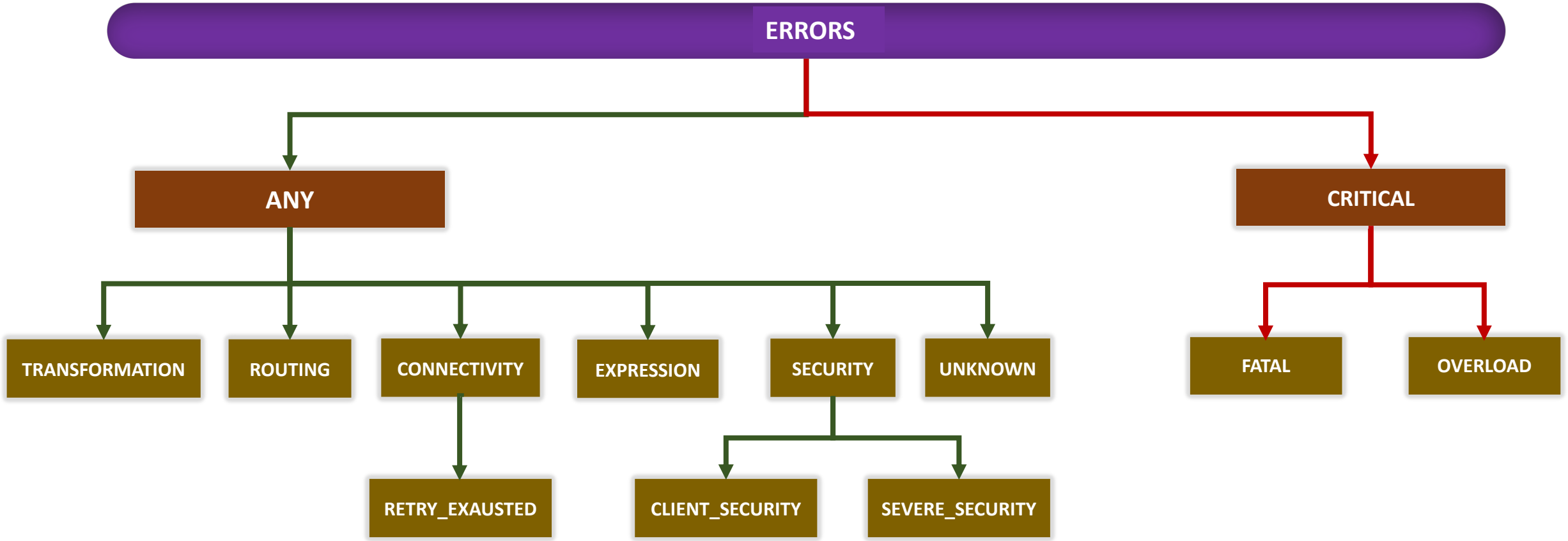
JSON/XML fields: Any on of below

- capital camel case: StreetAdress
- kebab case: street-address
- snake case: sreet_address
- camel case: streetAddress

Variable names: camel case (ex: covidCasePayload)

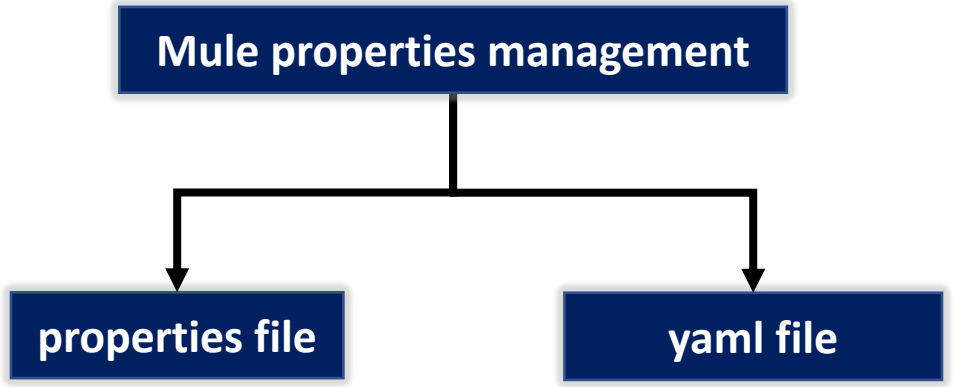
Connector names: Firstletter capital word with space b/w words (ex: Transform Message)

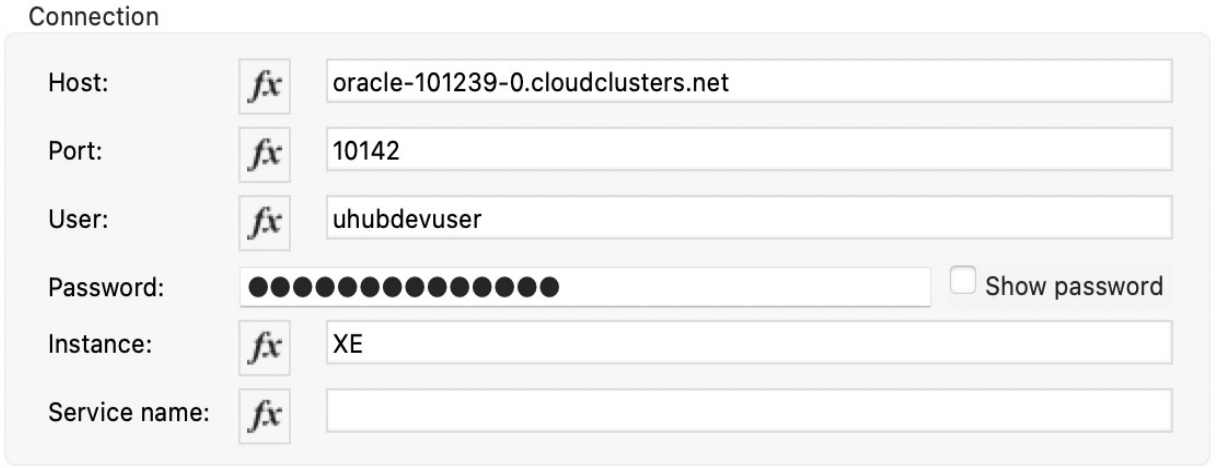
Mule error types



Mule properties management

Properties management : Externalizing properties from mule configuration help us in better code management and need not touch applications on configurations property changes.





1. Create property file or yaml file in src/main/resources.
2. Create “configuration properties” global element.
3. Use ${key} expression extract the property from property file or yaml file.
4. Use Mule::p(‘key’) dataweave script to extract in dataweave.

Mule properties – Secure configuration properties

Properties management : Externalizing properties from mule configuration help us in better code management and need not touch applications on configurations property changes.

1. Create property file or yaml file in src/main/resources.

2. Encrypt password property values:

   - Choose 16 digits encryption key : abcdef0123456789
   - Use algorithm and mode to encrypt password using above key.

3. Create secure configuration property global element.

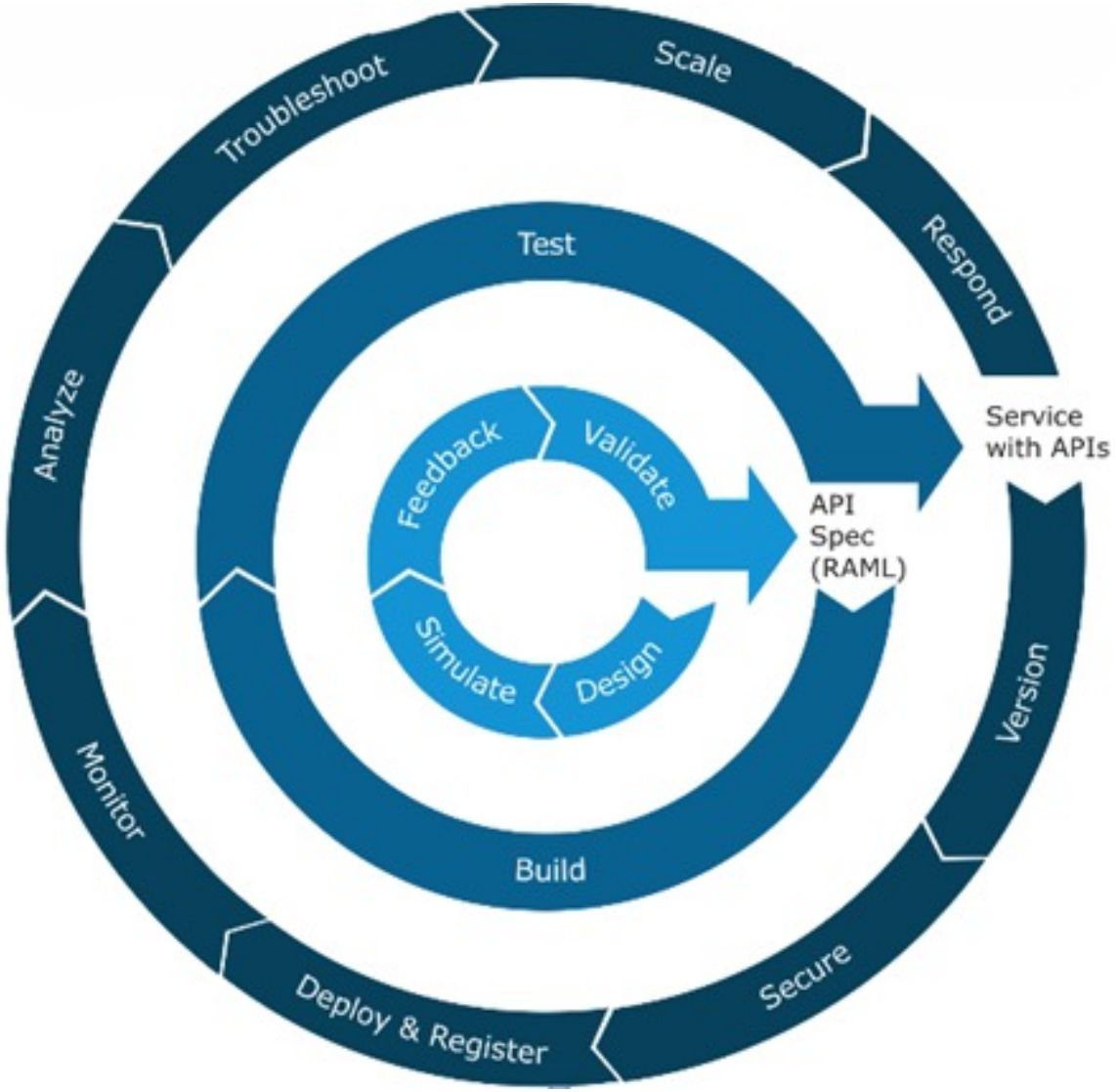
1. Use ${secure::key} expression extract the property from property file or yaml file.

2. Use Mule::p('secure::key') dataweave script to extract in dataweave.

```yaml
http:
  port: "8081"

db:
  uhub:
    host: "oracle-101239-0.cloudclusters.net"
    port: "10142"
    username: "uhubdevuser"
    password: "uhubdevuser123"
    service: "XE"
```

Mule API life cycle



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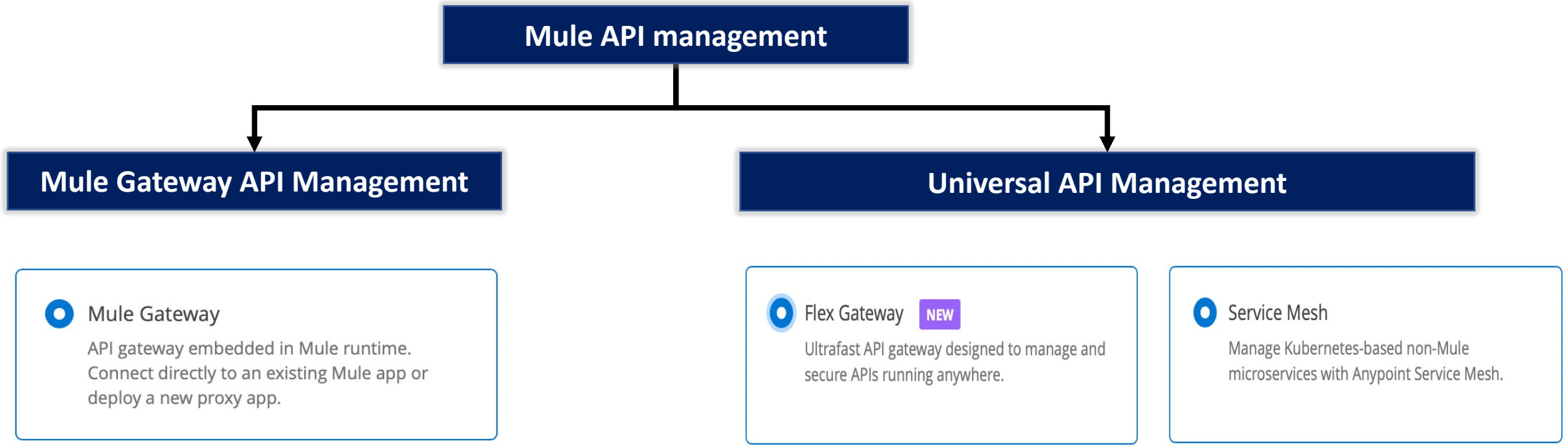
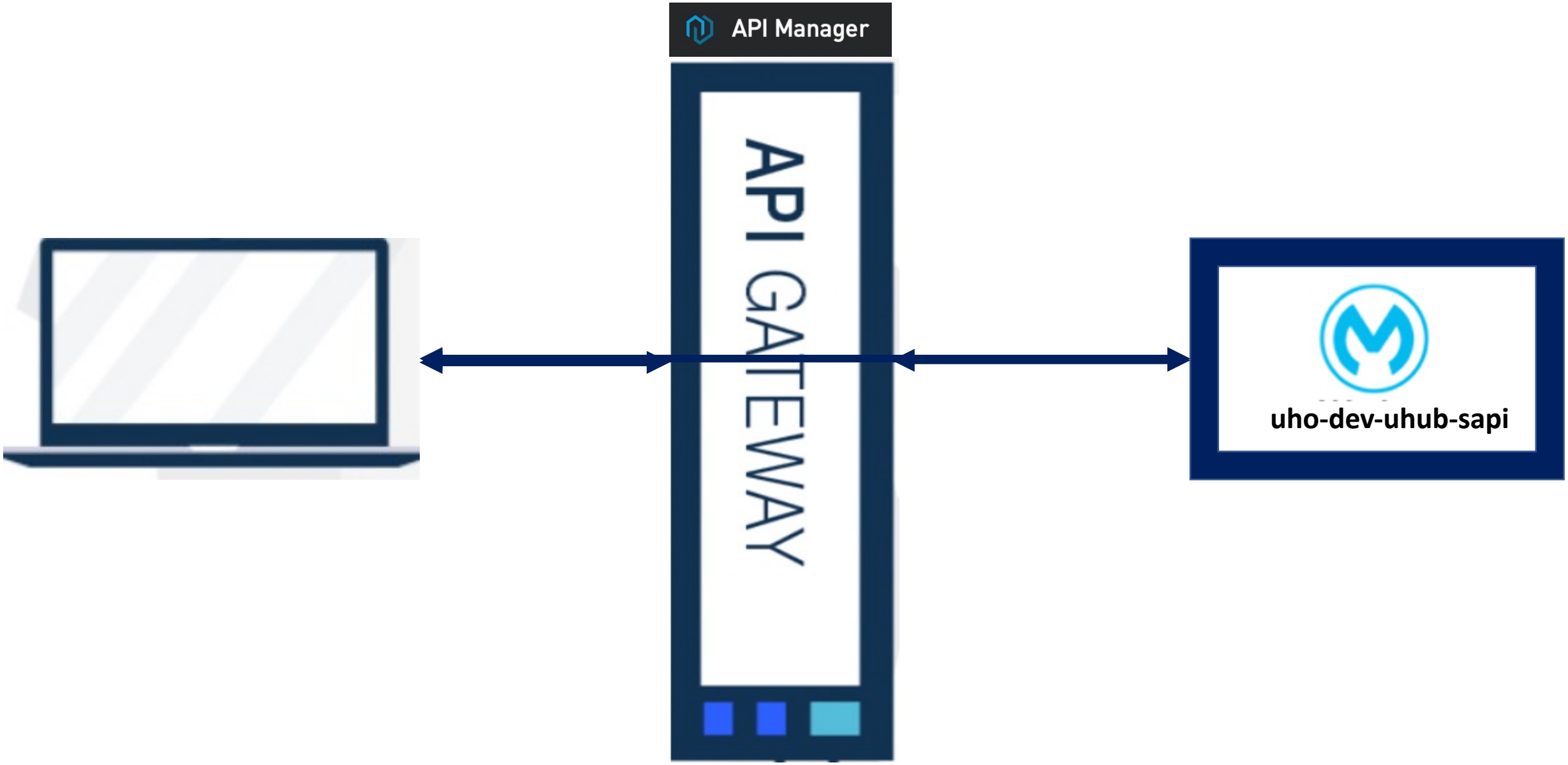
API MANAGEMENT

Mule API management

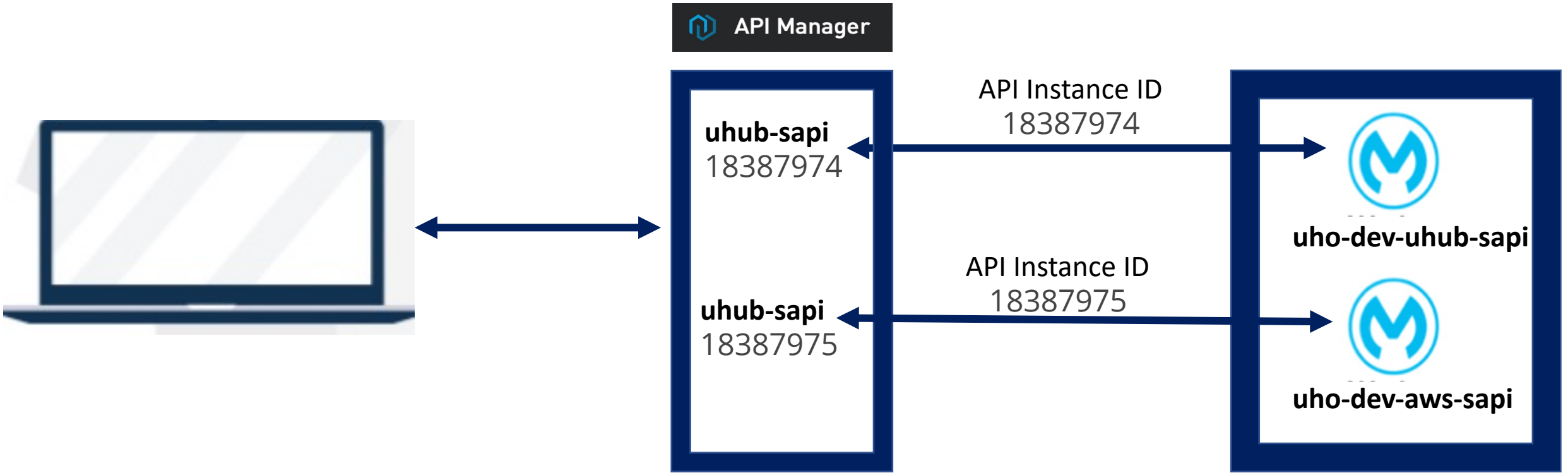
API management : API Management is the process of designing, publishing, documenting, analyzing, versioning, securing and managing API users, traffic, SLAs.



Mule API management



Auto discovery



1. Create auto discovery global element using API instance id.

2. Provide below runtime properties:

   - Organization business group client_id
   - Organization business group client_secret

Client id enforcement policy

The Client ID Enforcement policy restricts access to a protected resource by allowing requests only from registered client applications. The policy ensures that the client credentials sent on each request have been approved to consume the API.

1. Register client app on API in exchange.

2. Specifies from where in the request to extract the values:

    - HTTP Basic Authentication Header: Requires credentials as part of the authorization header. The application consuming the API must use the basic authentication scheme to send the credentials in the requests.

    - Custom Expression: Accepts an expression each for client_id and client_secret in. the headers, indicating where to extract the credentials from the request.

Rate limiting policy

The Rate Limiting policy enables you to limit the number of requests that an API can accept within a time window. The API rejects any request that exceeds this limit. You can configure multiple limits with window sizes ranging from milliseconds to years.

1. Apply configuration to all API method & resources

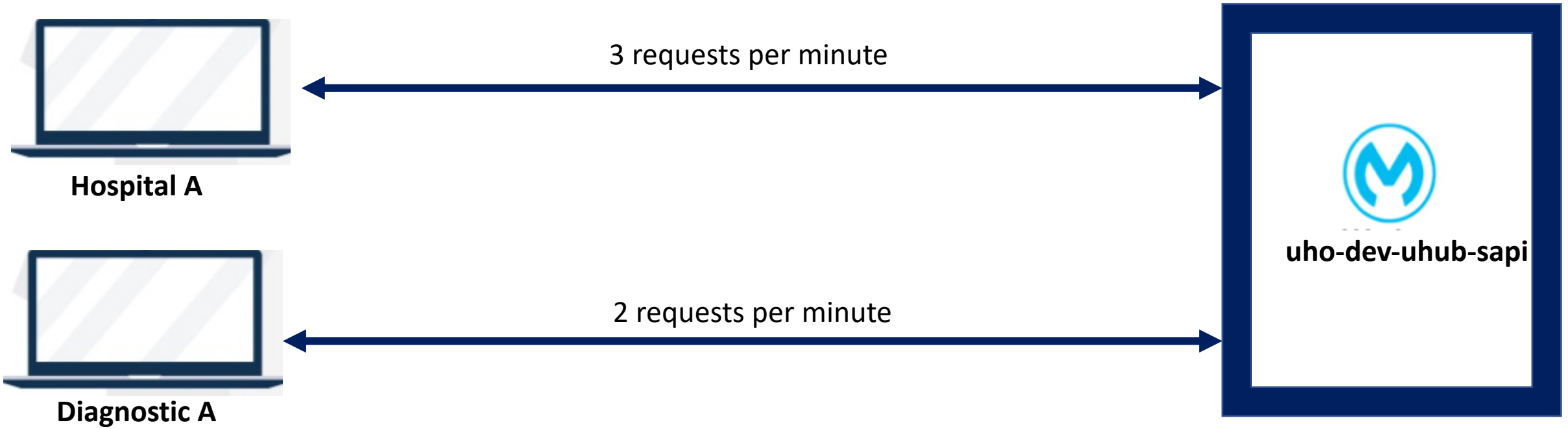
2. Apply configuration to specific API method & resources

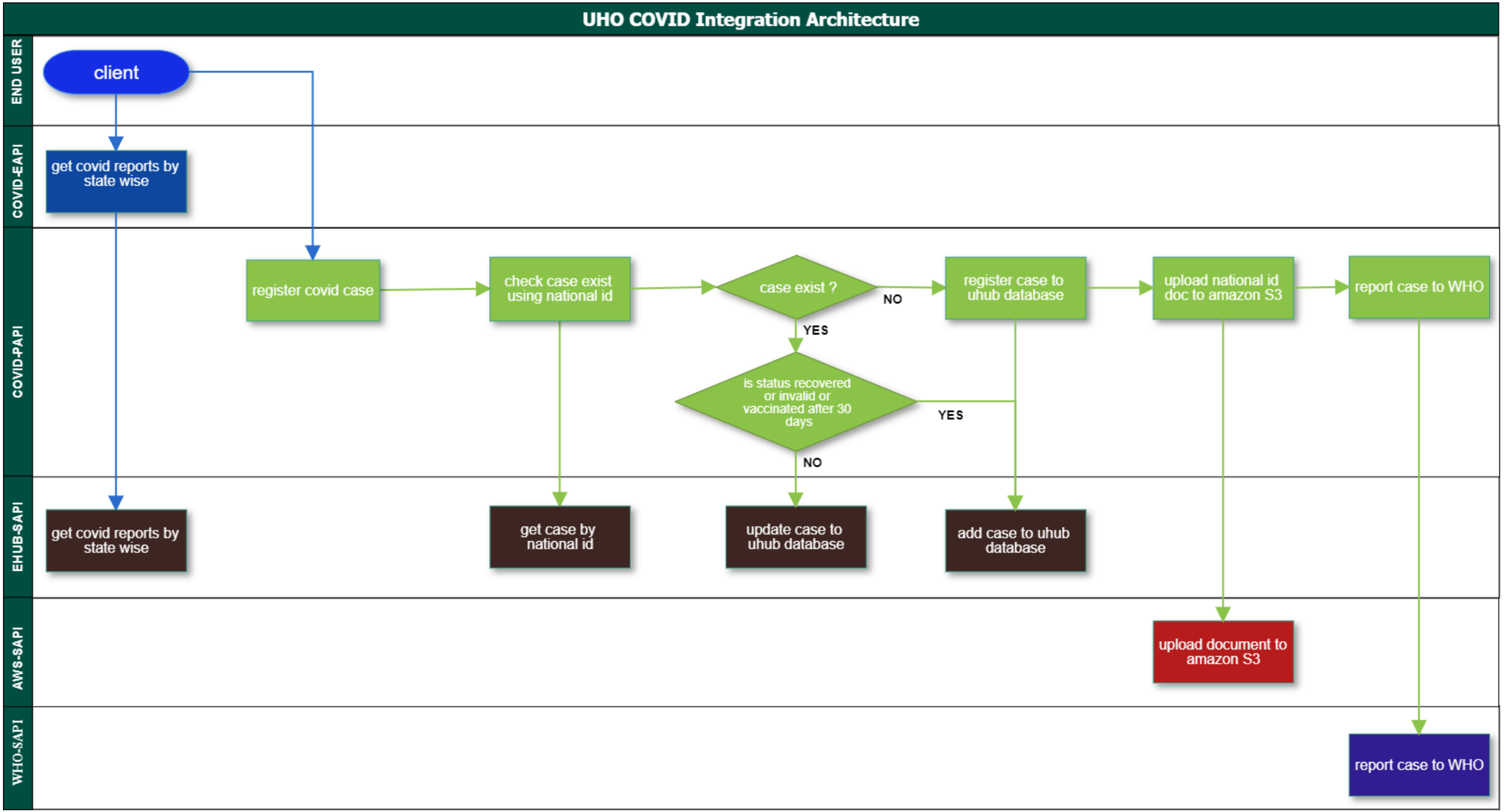
Rate limiting – SLA based policy

The Rate Limiting policy is combination of rate limiting and client id enforcement that enables you to limit the number of requests specified by the level of access granted to the requesting application. The API rejects any request that exceeds this limit. You can configure multiple limits with window sizes ranging from milliseconds to years.

1. Apply configuration to all API method & resources

2. Apply configuration to specific API method & resources




UHO COVID Integration Architecture
END USER
client
COVID-EAPI
get covid reports by state wise
COVID-PAPI
register covid case
check case exist using national id
case exist ?
NO
YES
register case to uhub database
upload national id doc to amazon S3
report case to WHO
is status recovered or invalid or vaccinated after 30 days
YES
NO
EHUB-SAPI
get covid reports by state wise
get case by national id
update case to uhub database
add case to uhub database
AWS-SAPI
upload document to amazon S3
WHO-SAPI
report case to WHO

THANK YOU

HAPPY LEARNING ☺