

# Exercise 10

*Mediate a service interaction using an ESB to convert from an inbound REST call into an existing SOAP call.*

## Prior Knowledge

Basic understanding HTTP verbs, REST architecture, SOAP and XML

## Objectives

Understand the basic ESB flow, create a flow using the ESB tooling in Eclipse, upload to the ESB using Eclipse Remote Server model, mediate between REST and SOAP.

## Software Requirements

(see separate document for installation of these)

- Java Development Kit 8
- Apache Maven 3.3.9 or later
- WSO2 Developer Studio 3.8.0
- Tomcat / Docker
- WSO2 ESB 4.9.0

## Overview

In this lab, we are going to take a WSDL/SOAP payment service, which is *very* loosely modeled on a real SOAP API (Barclaycard SmartPay

<https://www.barclaycard.co.uk/business/accepting-payments/website-payments/web-developer-resources/smartpay#tabbox1>).

Our aim is to convert this into a simpler HTTP/JSON interface. We probably won't get as far as any RESTful concepts as we won't have the opportunity to add resources, HATEOAS, etc. But will look at how those could be added with more time.



1. Before we install the ESB we need to host some services to interact with. To do this we are going to use a payment server running in Docker.

```
sudo docker pull pizak/pay  
sudo docker run -d -p 8888:8080 pizak/pay
```

This offers the docker based service (which is a WAR file running in Tomcat) at port 8888.

2. We are also going to intercept all the messages between the ESB and the backend using mitmdump:

```
mitmdump --port 8080 -dd --reverse http://localhost:8888
```

This puts the port back to 8080, but lets us see all the traffic to the backend.

3. Check that it is running:

Browse: <http://localhost:8080/pay/services/paymentSOAP?wsdl>

4. Now start up the WSO2 ESB:

```
cd ~/servers/wso2esb-4.9.0/  
bin/wso2server.sh
```

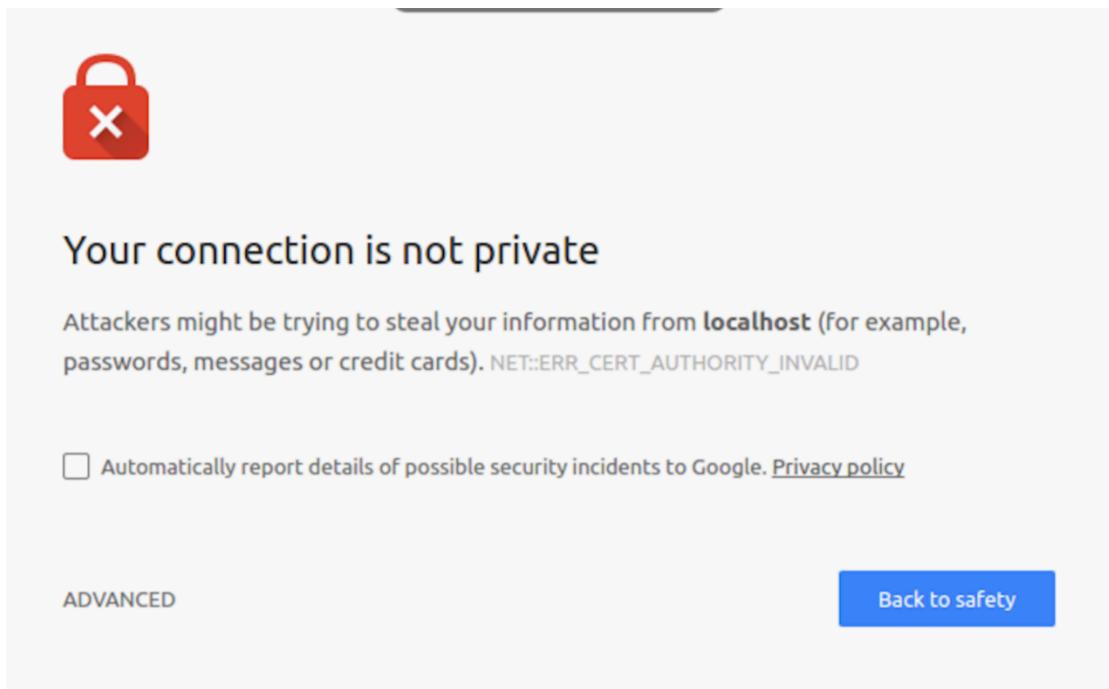
5. You should see something like:

```
oxsoa@oxsoa:~/servers/wso2esb-4.9.0$ bin/wso2server.sh  
JAVA_HOME environment variable is set to /usr/lib/jvm/java-8-openjdk-amd64/  
CARBON_HOME environment variable is set to /home/oxsoa/servers/wso2esb-4.9.0  
OpenJDK 64-Bit Server VM warning: ignoring option MaxPermSize=256m; support was removed  
in 8.0  
[2016-06-03 15:57:18,998]  INFO - CarbonCoreActivator Starting WSO2 Carbon...  
[2016-06-03 15:57:18,997]  INFO - CarbonCoreActivator Operating System : Linux 4.4.0-22-  
generic, amd64  
[2016-06-03 15:57:18,998]  INFO - CarbonCoreActivator Java Home      :  
/usr/lib/jvm/java-8-openjdk-amd64/jre  
[2016-06-03 15:57:18,998]  INFO - CarbonCoreActivator Java Version   : 1.8.0_91  
[2016-06-03 15:57:18,998]  INFO - CarbonCoreActivator Java VM       : OpenJDK 64-BIT  
Server VM 25.91-b14,Oracle Corporation  
[2016-06-03 15:57:18,998]  INFO - CarbonCoreActivator Carbon Home    :  
/home/oxsoa/servers/wso2esb-4.9.0  
...
```

6. Start up a browser and go to <https://localhost:9444>

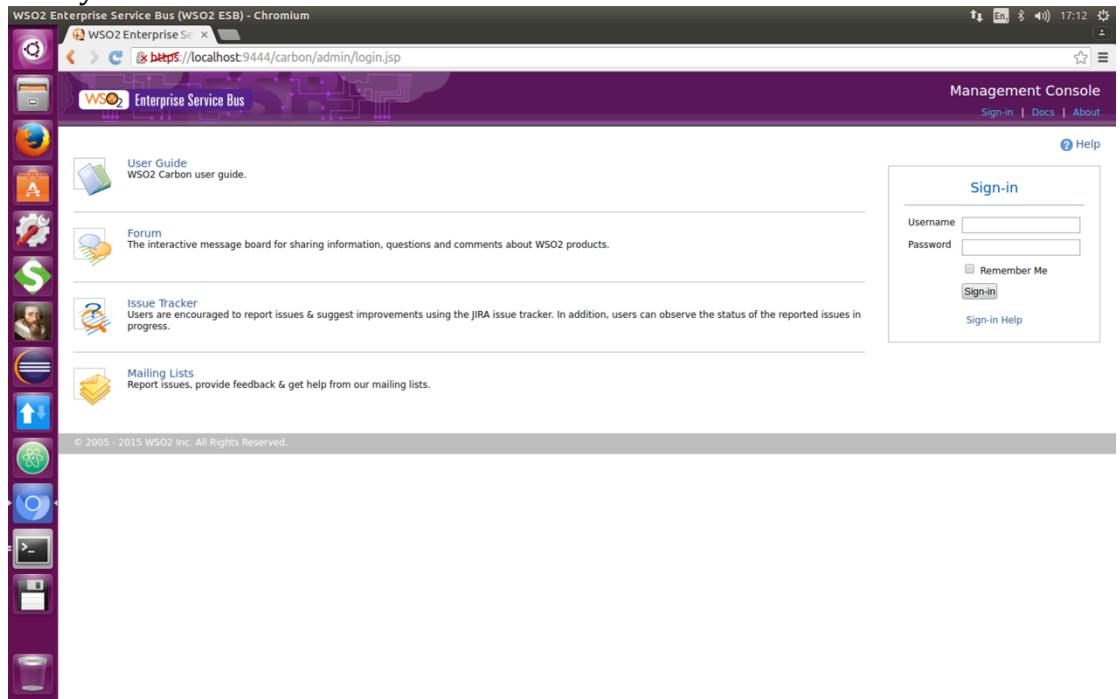
7. You may see a page like this:





*If you do, click on Advanced and Proceed to localhost*

8. Now you should see this screen:



9. Log in with the userid/password: **admin/admin**



10. You should see a Web console like this:

WSO2 Enterprise Service Bus Home

Welcome to the WSO2 Enterprise Service Bus Management Console

**Server**

Host	172.17.0.1
Server URL	local://services/
Server Start Time	2016-06-03 15:57:12
System Up Time	0 day(s) 1 hr(s) 34 min(s) 13 sec(s)
Version	4.9.0
Repository Location	file:/home/oxsoa/servers/wso2esb-4.9.0/repository/deployment/server/

**Operating System**

OS Name	Linux
OS Version	4.4.0-22-generic

**Operating System User**

Country	GB
Home	/home/oxsoa
Name	oxsoa
Timezone	Europe/London

**Java VM**

Java Home	/usr/lib/jvm/java-8-openjdk-amd64/jre
Java Runtime Name	OpenJDK Runtime Environment

11. Click on Services->List in the left hand menu. You should see something like this:

Home > Manage > Services > List

Help

Deployed Services

3 active services. 3 deployed service group(s).

Service Type	ALL	Service	Delete			
Select all in this page	Select none					
Services						
echo	axis2	Unsecured	WSDL1.1	WSDL2.0	Try this service	Download
Version	axis2	Unsecured	WSDL1.1	WSDL2.0	Try this service	Download
wso2carbon-sts	sts	Unsecured	WSDL1.1	WSDL2.0		

Select all in this page | Select none

Delete

12. To see if the basic "echo" service is working click on "Try this service" next to echo.



13. You will see a “test” client. (If you don’t Chrome may have blocked a popup, in which case you need to enable popups on this site).

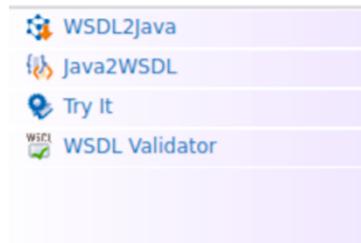
```
<body>
<echoString xmlns:ns="http://echo.services.core.carbon">
<!--0 to 1 occurrence-->
<in>Hello Paul</in>
</echoString>
</body>
```

```
<ns:echoStringResponse xmlns:ns="http://echo.services.core.carbon">
<return>Hello Paul</return>
</ns:echoStringResponse>
```

Select the **echoString** operation, modify the XML (**replace the ?**) and click **Send**. If it didn't work, you might have an odd network setup with VMWare. Try changing the URL to use 127.0.0.1.

14. Close that tab and now click on the Tools tab on the far left.

15. You should see some new options:



Click on Try It

Now enter the URL of our payment service WSDL (<http://localhost:8080/pay/services/paymentSOAP?wsdl>) and click TryIt. Make sure that there isn't another PopUp Blocked moment.



16. This is very like SOAP UI except built into the system. Try both the ping and the authorise methods and see how they work. You should see things like this:

The screenshot shows a web-based SOAP client interface. At the top, there's a header with a warning about cross-domain browser restrictions and a link to try an alternate http:// endpoint. Below this is a section titled '- authorise'. The 'Request' pane contains an XML document with various fields like card number, expiration date, and merchant ID. The 'Response' pane shows the XML response from the server, which includes a reference ID and a result code. Buttons for 'Send', 'Horizontal', and 'Vertical' are at the bottom.

```
<?xml version="1.0"?>
<soapenv:Envelope xmlns:soapenv="http://schemas.xmlsoap.org/soap/envelope/" xmlns:p="http://freo.me/payment/">
<soapenv:Header>
<wsse:Security soapenv:mustUnderstand="1" xmlns:wsse="http://schemas.xmlsoap.org/ws/2002/12/secext">
<wsse:UsernameToken wsse:mustUnderstand="1">
<wsse:Name>ping</wsse:Name>
<wsse:PasswordType>http://schemas.xmlsoap.org/ws/2002/12/secext/PasswordText</wsse:PasswordType>
</wsse:UsernameToken>
</wsse:Security>
</soapenv:Header>
<soapenv:Body>
<p:authorise xmlns:p="http://freo.me/payment/">
<!--Exactly 1 occurrence-->
<card xmlns="http://freo.me/payment/">
<!--Exactly 1 occurrence-->
<xsd:cardnumber xmlns:xsd="http://freo.me/payment/">455995088931</xsd:cardnumber>
<!--Exactly 1 occurrence-->
<xsd:postcode xmlns:xsd="http://freo.me/payment/">P0108PA</xsd:postcode>
<!--Exactly 1 occurrence-->
<xsd:name xmlns:xsd="http://freo.me/payment/">P Z FREMANTEL</xsd:name>
<!--Exactly 1 occurrence-->
<xsd:expiryMonth xmlns:xsd="http://freo.me/payment/">5</xsd:expiryMonth>
<!--Exactly 1 occurrence-->
<xsd:expiryYear xmlns:xsd="http://freo.me/payment/">18</xsd:expiryYear>
<!--Exactly 1 occurrence-->
<xsd:cvc xmlns:xsd="http://freo.me/payment/">111</xsd:cvc>
<!--Exactly 1 occurrence-->
<xsd:merchant xmlns:xsd="http://freo.me/payment/">A1234</xsd:merchant>
<!--Exactly 1 occurrence-->
<xsd:reference xmlns:xsd="http://freo.me/payment/">F000</xsd:reference>
<!--Exactly 1 occurrence-->
<xsd:amount xmlns:xsd="http://freo.me/payment/">17.80</xsd:amount>
</p:authorise>
</body>
</soapenv:Body>
</soapenv:Envelope>
```

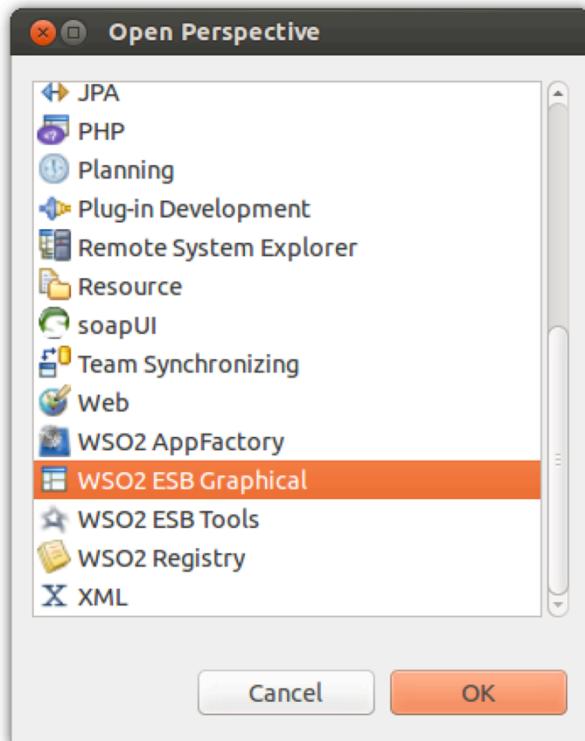
```
<?xml version="1.0"?>
<authoriseResponse xmlns="http://freo.me/payment/">
<reference>2a75b481-88d0-422b-94da-aeedfd1d8e6</reference>
<resultCode>0</resultCode>
<refusalReason>OK</refusalReason>
</authoriseResponse>
```

17. Close that tab to get back to the main console.

18. We are first going to create a simple RESTful API that bridges the ping service. We want the parameter to be grabbed from the URL using a URL template, and then transformed into an XML document, sent to the SOAP service, and then we will grab the response from the XML and transform into a JSON payload.

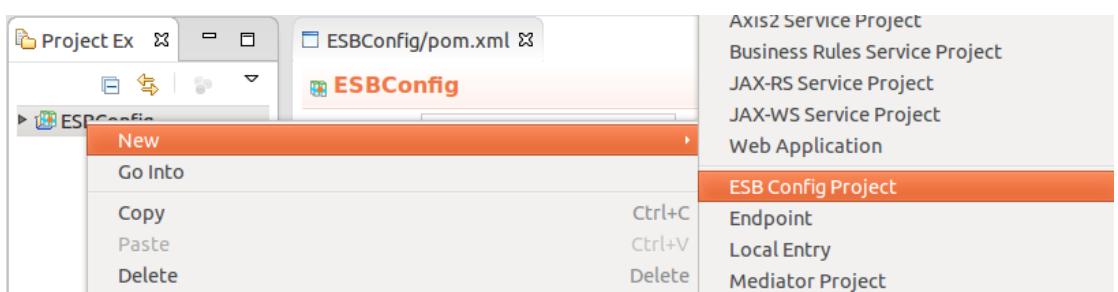


19. In Eclipse, first open the WSO2 ESB graphical perspective:  
**Window->Open Perspective->Other:**

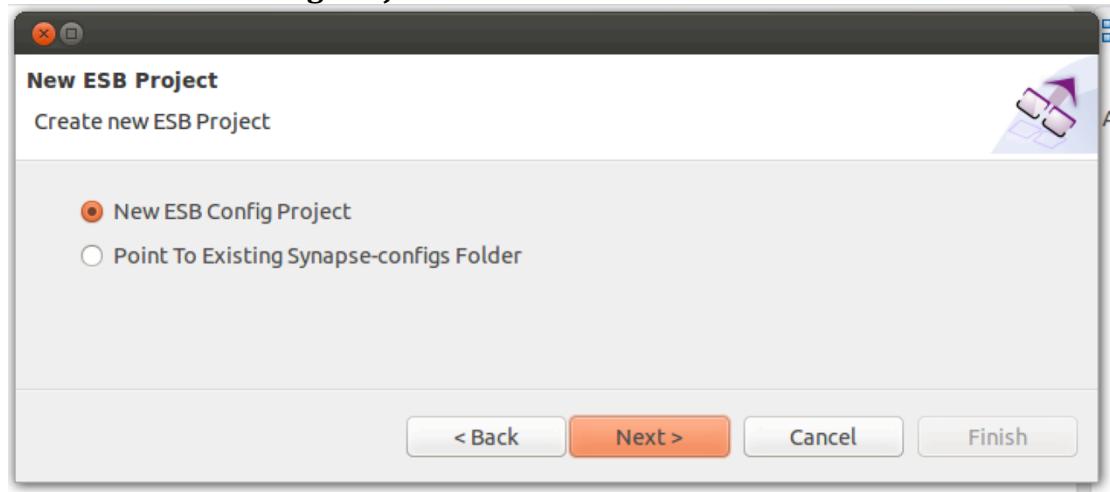


20. Now create a “Composite Application Project”:  
**File -> New -> Composite Application Project**  
Call it **ESBConfig** and click **Finish**.

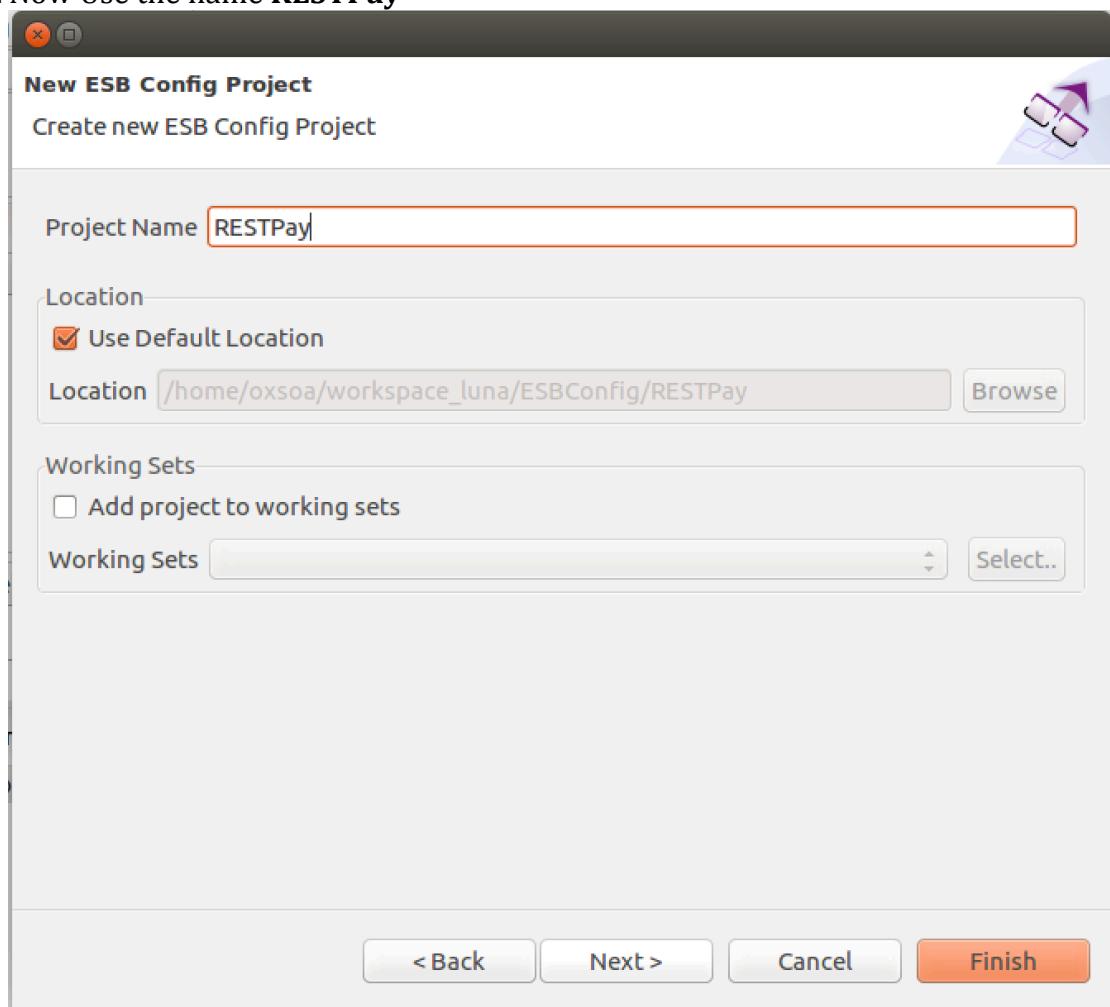
21. Now **right click on the new project** and choose **New->ESB Config Project**



## Select New ESB Config Project



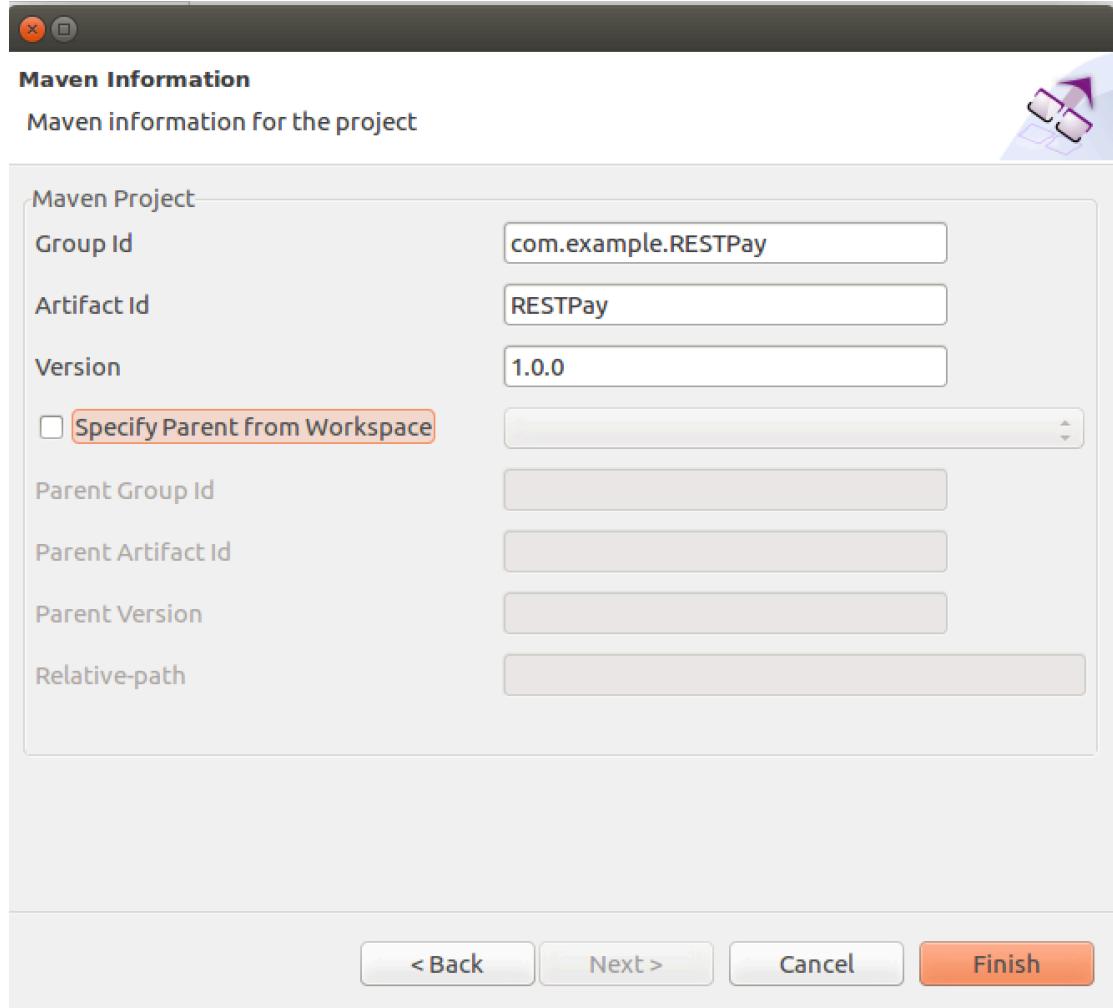
22. Now Use the name RESTPay



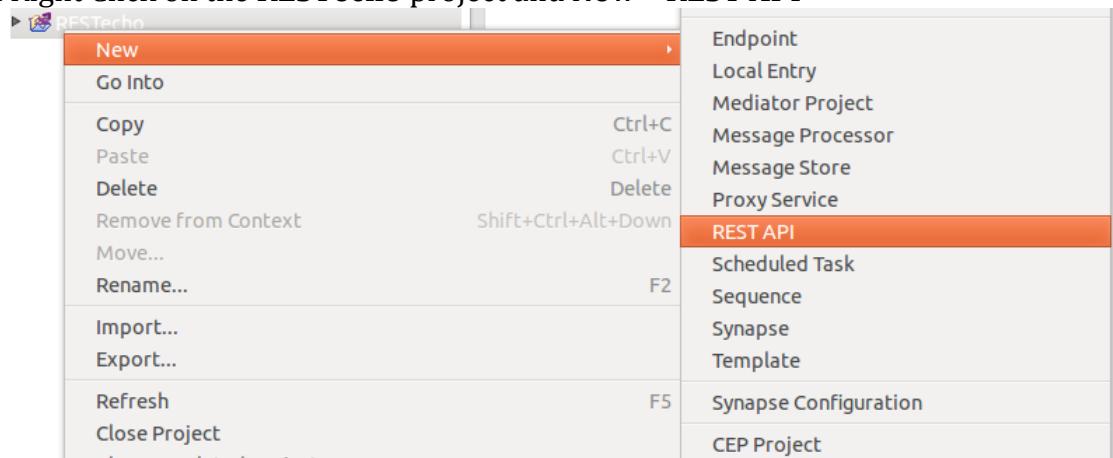
23. Click Next



24. Leave the Maven info the same:



25. Right Click on the RESTEcho project and New->**REST API**



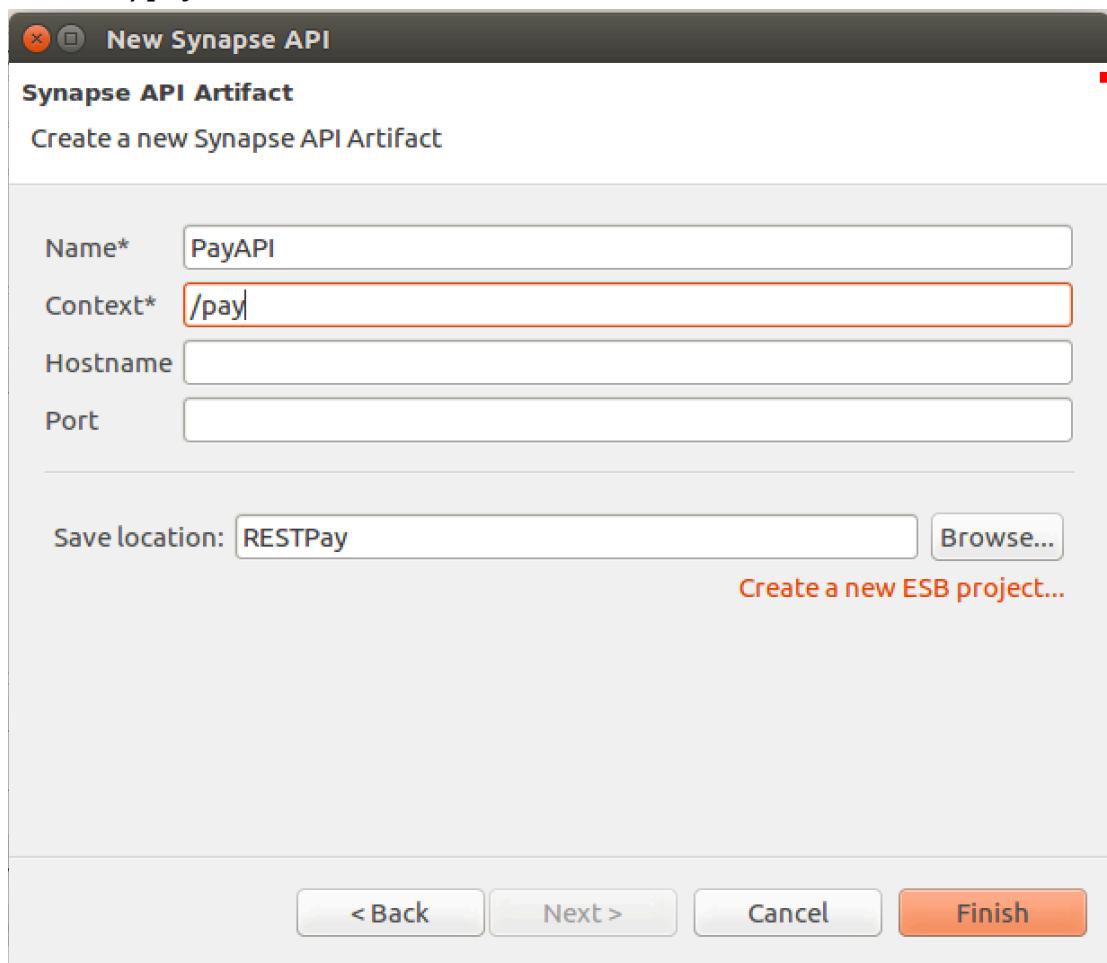
26. Select **Create a New API Artefact** and then **Next**.



27. Use:

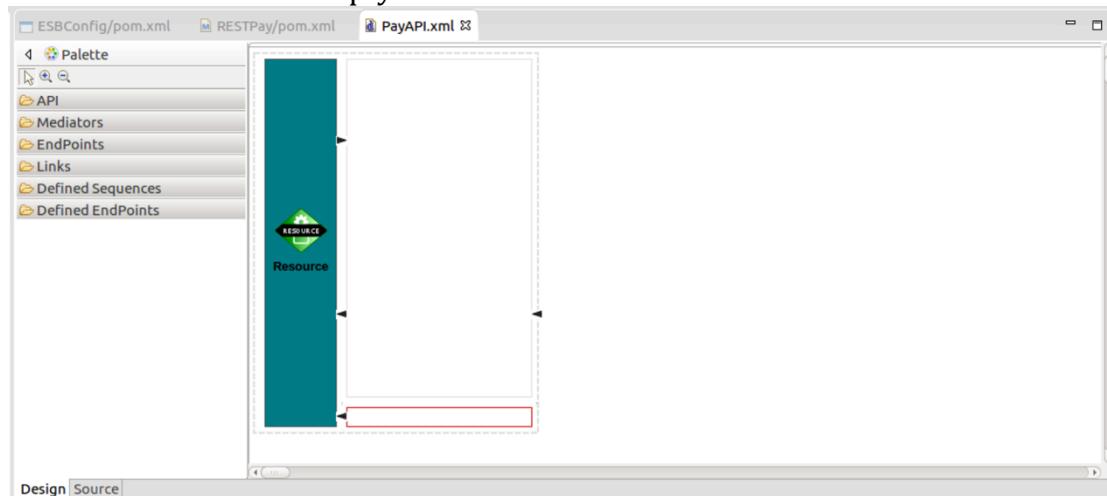
Name: **PayAPI**

Context: **/pay**

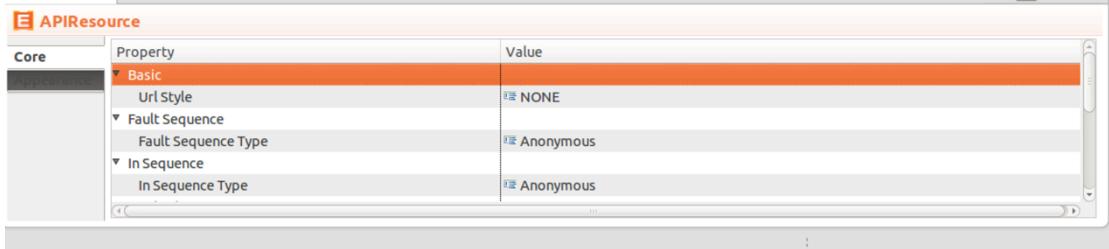


28. Finish

29. You should see a nice empty ESB flow like this:



30. First, we need to edit the properties of this resource. Click on the Resource icon, and look at the property editor box.



31. Change (or check) the following:

Url Style: **URI\_TEMPLATE** (then hit enter and the next box will appear)

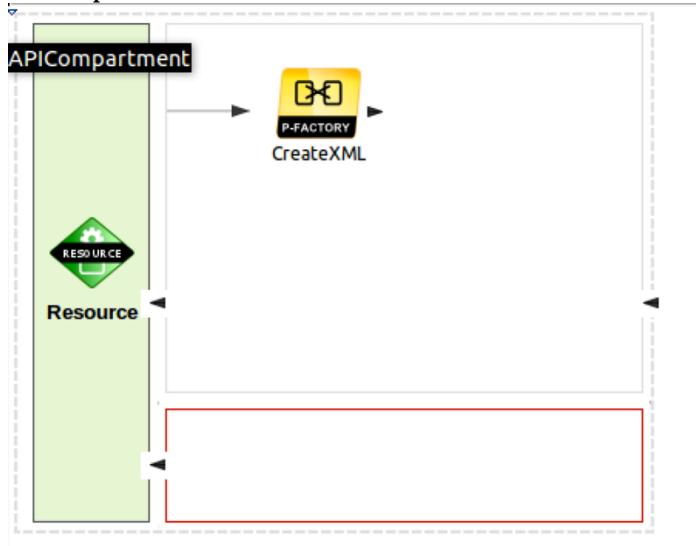
Uri Template: **/{input}**

Methods / Get: **True** (should already be this).

This has said that this is modeling a GET resource with a URI template of:  
`http://hostname:port/pay/{input}`

32. There are lots of ways to create an XML payload to send to the SOAP service. For example, we could use XSLT, XQuery, or JavaScript. But the simplest way is a mediator called a PayloadFactory that simply populates the body with XML or JSON, and uses a template model to fill in parameters (e.g. \$1 is replaced by the first parameter).

Now expand the Mediators box, and choose the PayloadFactory mediator and drag it over to the upper half of the flow box. It will prompt you for a description. Use “CreateXML”:



Now edit the properties of the PayloadFactory.

The first thing is to make the right XML. We do this by pasting in a sample XML and replacing parts of it with the input parameter from the URL.

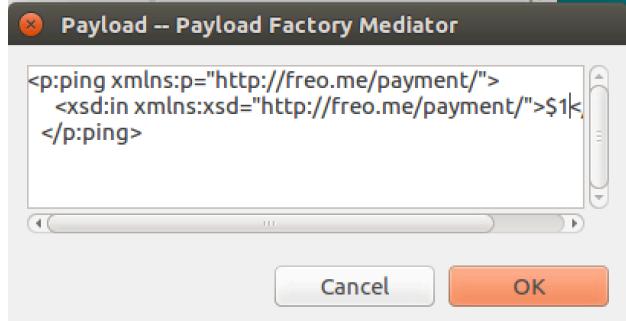


To get the sample XML I used **SOAPUI/Try It** against the paymentSOAP service. If you want to do that, please go ahead, otherwise you can enter it from here. I replaced the ? with a \$1 which will be augmented by an argument.

Choose Format (hit the little button, and then replace <inline/> with:

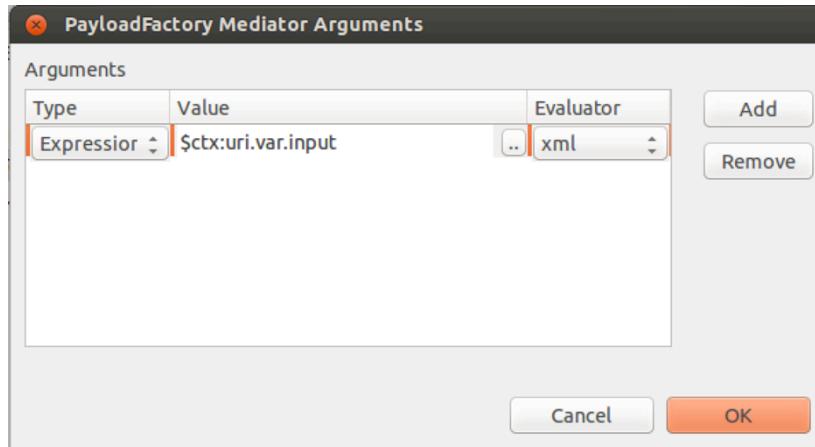
```
<p:ping xmlns:p="http://freo.me/payment">
```

33. <in>\$1</in>  
</p:echoString>



34. Now we need to grab the {input} data that came in the URI. We do this by clicking on the button by Args: Then click **Add**. Change the type to **Expression**, and then click the button to edit the expression value.  
Replace **/default/****expression** with **\$ctx:uri.var.input**

35. It should look like:



36.

37. Click **OK**

38.

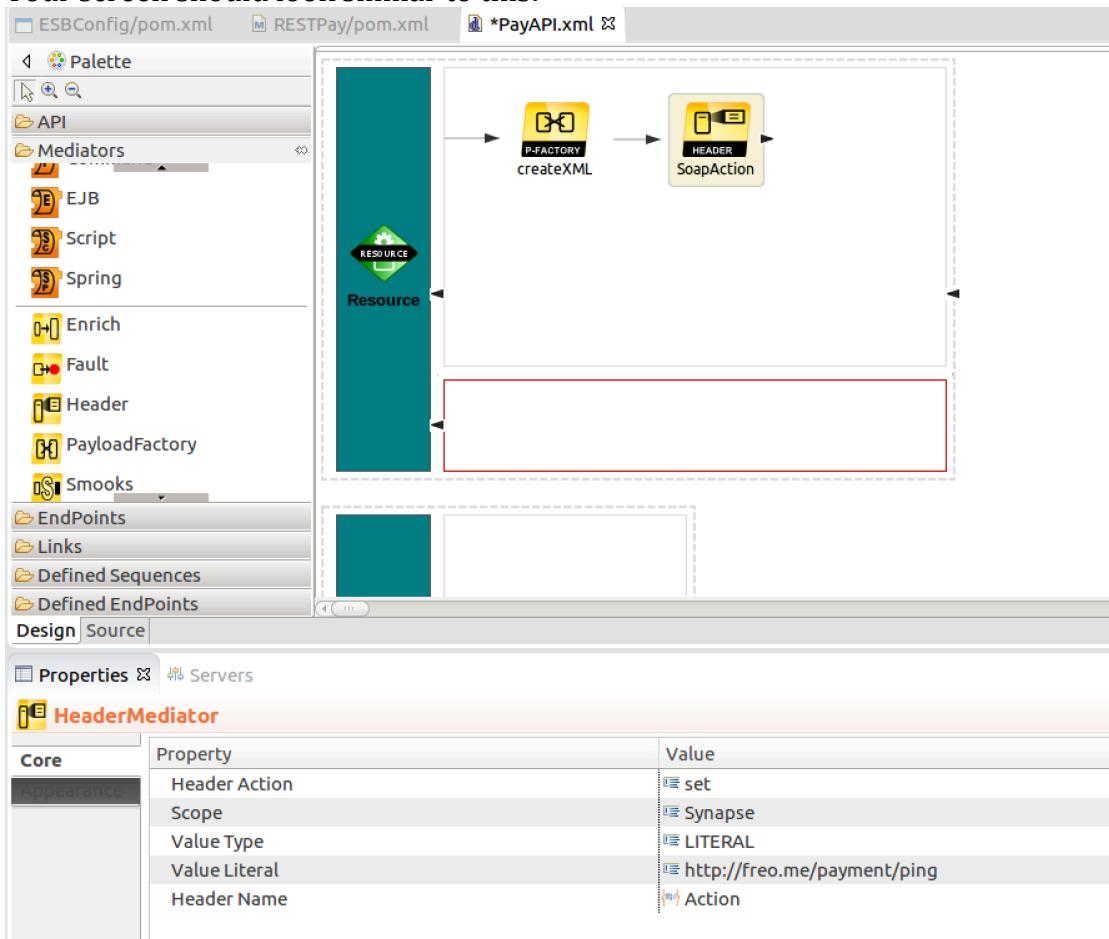
39. Because we are sending the message to a SOAP service, we need a SOAP Action header. We can add that with a **Header** mediator. Grab one of those and drop it to the right of the PayloadFactory. Give it a useful description (like **Add Soap Action**). Now set the properties as:

Value Literal: **http://freo.me/payment/ping**

Header Name: **Action**



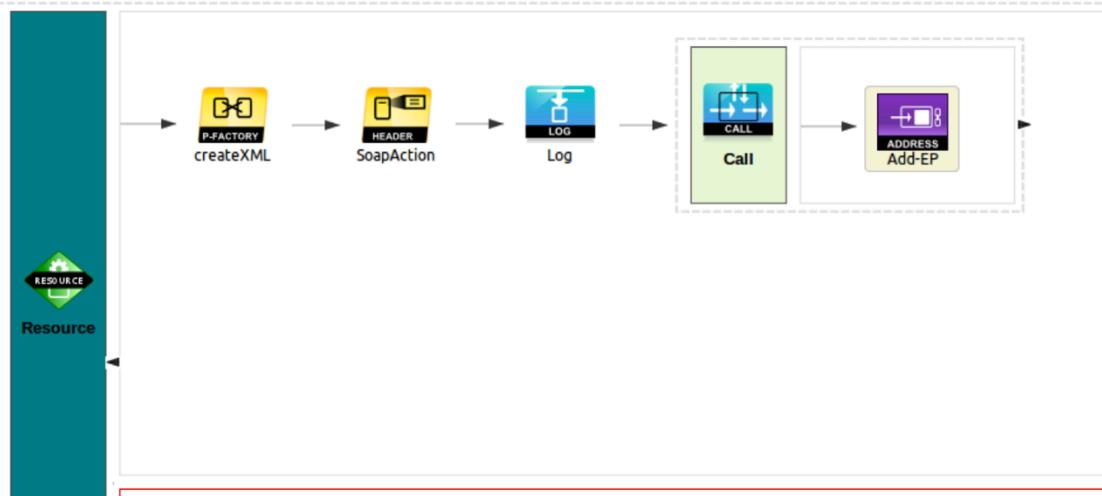
Your screen should look similar to this:



40. Now drop a Log mediator to the right, and set its log level to **FULL**.
41. We are now ready to send our SOAP message to the SOAP service. Drop a Call Mediator to the right. It will have an empty box inside the mediator.
- 42.
43. Open the Endpoints section on the left and drop an **Address Endpoint** into the empty box. Edit the description from Add-EP to echoSOAP.
- 44.
45. In the properties section, under **Basic -> Format**, change the URI from <http://www.example.org/service> to <http://localhost:8080/pay/services/paymentSOAP>
46. Scroll down the properties until you get to the Misc->Format, and set that to be **soap11**.



Your diagram should look like:



47. After the Call/Endpoint, drop another Log mediator. Call it Logback, and again set the logging level to FULL.

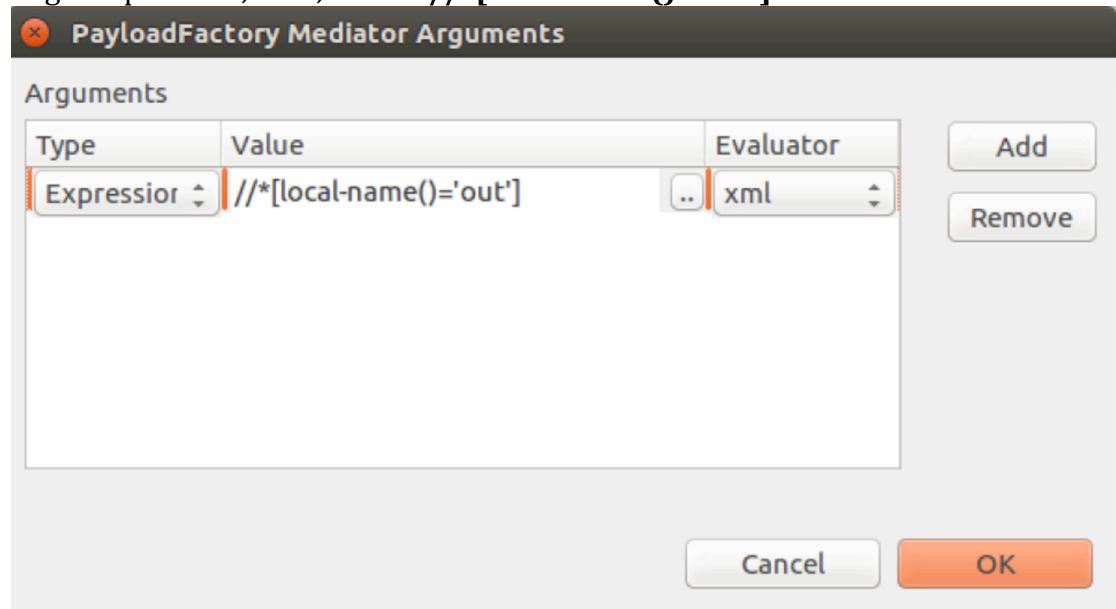
48. To the right of that drop another PayloadFactory, and change its description to **toJSON**.

49. Set its properties as follows:

Media Type: JSON

Format: { "return": "\$1" }

Args: Expression, XML, value - //\*[local-name()='out']



50. This is an XPath expression that finds any element called <out> in any namespace and grabs the value of it.

51. Now drag a Respond Mediator right of the Payload mediator.

52. You have now created an ESB API that will:

- a. Listen at GET /pay/{input}
- b. Extract the {input} value
- c. Construct an XML message
- d. Using the input parameter
- e. Send this as SOAP11 to our server endpoint ping method
- f. Send the response back to the client as JSON

53. Before deploying this in the ESB, take a look at the XML configuration behind this configuration. Click on the Source tab (bottom left corner of the API design pane). Your XML should look like this:

```
<?xml version="1.0" encoding="UTF-8"?>
<api context="/pay" name="PayAPI" xmlns="http://ws.apache.org/ns/synapse">
    <resource methods="GET" protocol="http" uri-template="/{input}">
        <inSequence>
            <payloadFactory description="createXML" media-type="xml">
                <format>
                    <p:ping xmlns:p="http://freo.me/payment/">
                        <p:in>$1</p:in>
                    </p:ping>
                </format>
                <args>
                    <arg evaluator="xml" expression="$ctx:uri.var.input"/>
                </args>
            </payloadFactory>
            <header description="SoapAction" name="Action" scope="default" value="http://freo.me/payment/ping"/>
            <log level="full"/>
            <call>
                <endpoint>
                    <address format="soap11" trace="disable" uri="http://localhost:8080/pay/services/paymentSOAP"/>
                </endpoint>
            </call>
            <log description="logback" level="full"/>
            <payloadFactory description="toJSON" media-type="json">
                <format>{ return: $1 }</format>
                <args>
                    <arg evaluator="xml" expression="//out"/>
                </args>
            </payloadFactory>
            <respond description="respond"/>
        </inSequence>
        <outSequence/>
        <faultSequence/>
    </resource>
</api>
```

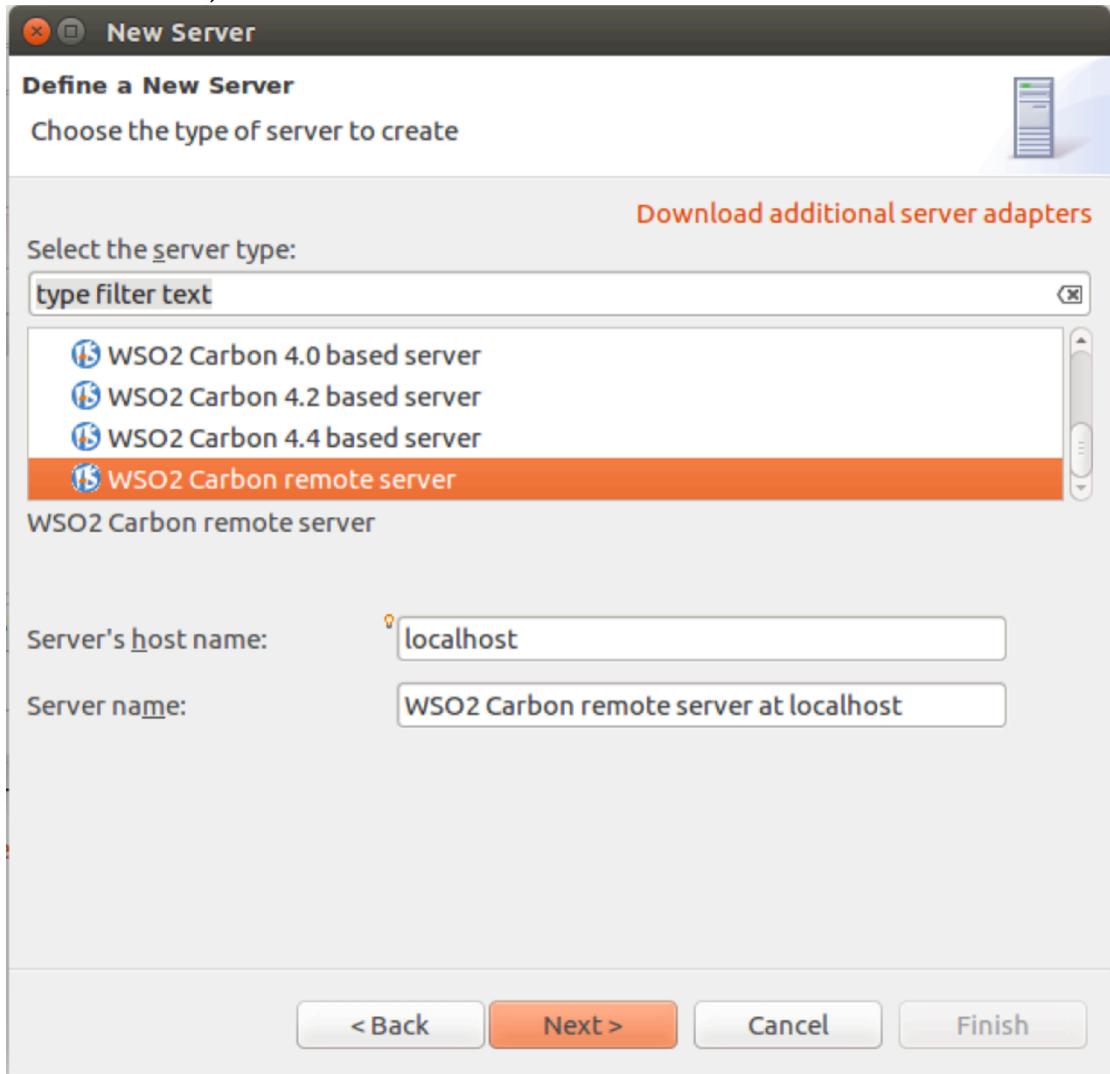
This XML is available at

<https://gist.github.com/pzfereo/af29a037a5aa333fc1dc02075775231d>

Firstly, we are defining an API, which is a collection of resource definitions (in the REST style). Each resource is actually implemented by a sequence of flow logic. In this case, we are looking for a GET and mapping it to a simple flow with some mediators. First we create an XML payload, then we send that to an endpoint.



54. In order to test this we need to tell the Eclipse environment about our ESB server.
55. You can check the server is running (in a minute) by browsing <https://localhost:9444/>. You will need to Proceed past the security warning because by default the server is using a self-signed certificate. The default credentials are **admin/admin**.
56. To add this server to Eclipse, do File->New->Other->Server. Then scroll down to WSO2, and select **WSO2 Carbon remote server**.



57. Click **Next**.
58. Set the servers URL to be <https://localhost:9444/>. Test the connection and the credentials. Click **Finish**.
59. You need to make sure the RESTecho ESB config is part of the Composite Application Project. Open up the ESBConfig project and it will open the



**pom.xml**. Make sure the RESTecho Artifact is checked:

\*ESBConfig/pom.xml RESTPay/pom.xml PayAPI.xml

**ESBConfig**

Group Id	com.example.ESBConfig
Artifact Id	ESBConfig
Version	1.0.0
Description	ESBConfig

**Dependencies**

Artifact	Server Role	Version
RESTPay	-	1.0.0

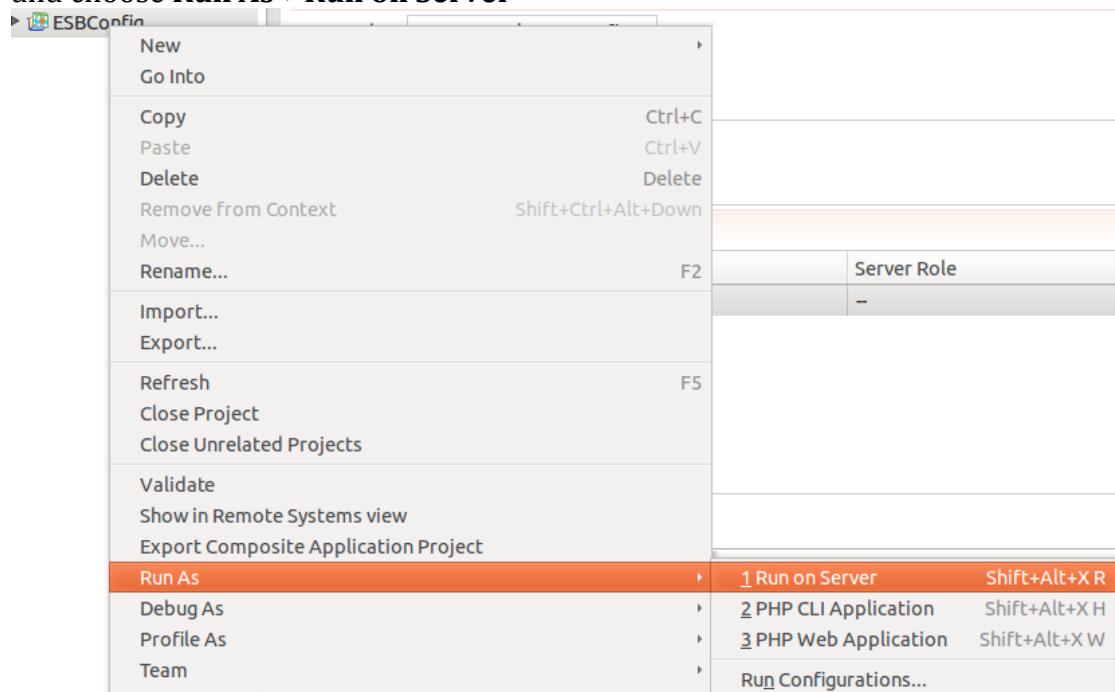
Select All Deselect All

Design Source

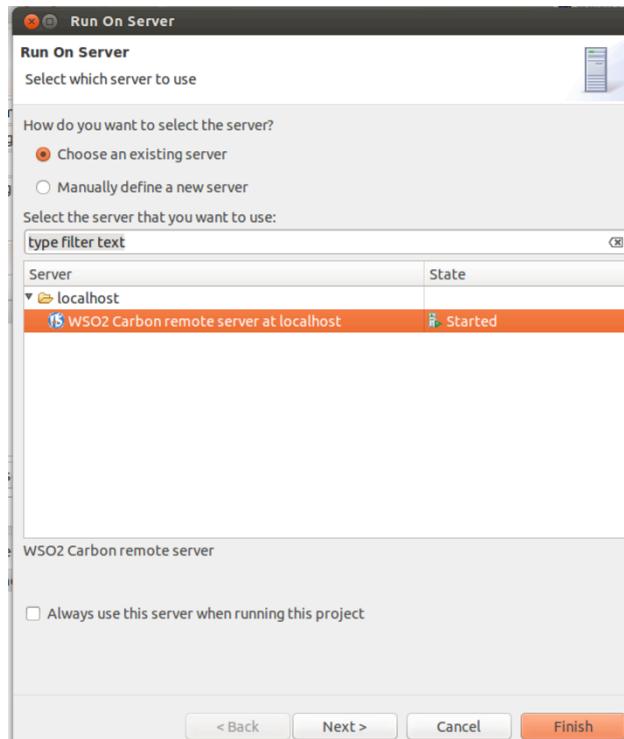
**SAVE**



60. Now you should be able to run the ESBConfig project on the server. You may need to restart Eclipse. To do this right-click on the ESBConfig project and choose Run As->Run on Server

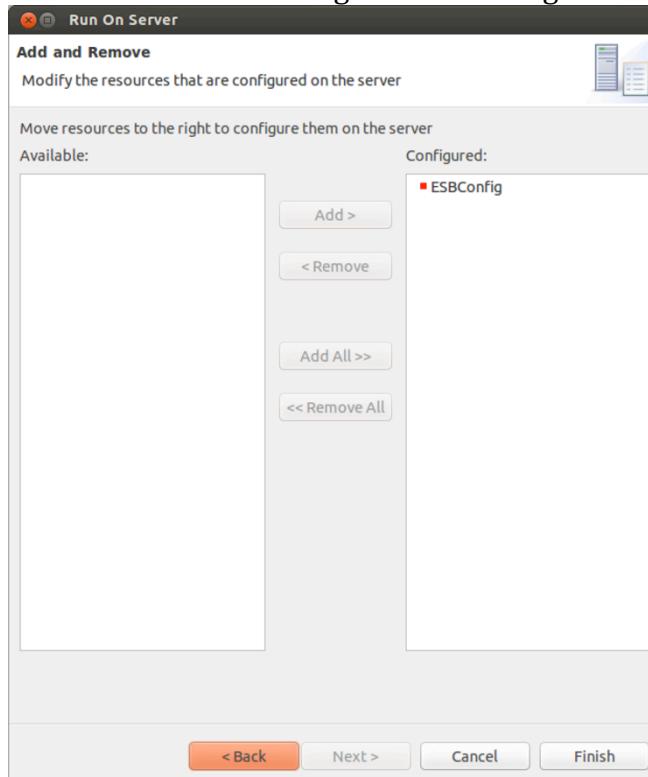


61. Make sure the Carbon Server is selected:



Click Next

62. Make sure the ESBConfig is in the Configured section:



63. Click **Finish**.

64. You might need to wait a second to see it deployed. If you look at your ESB terminal window where the server is running you should see something like:

```
[2016-06-03 18:54:09,090] INFO - CarbonAuthenticationUtil 'admin@carbon.super [-1234]' logged in at [2016-06-03 18:54:09,090+0100]
[2016-06-03 18:54:11,502] INFO - ApplicationManager Deploying Carbon Application : ESBConfig_1.0.0.car...
[2016-06-03 18:54:11,548] INFO - API Initializing API: PayAPI
[2016-06-03 18:54:11,550] INFO - APIDeployer API named 'PayAPI' has been deployed from file : /home/oxsoa/servers/wso2esb-4.9.0/tmp/carbonapps/-1234/1464976451503ESBConfig_1.0.0.car/PayAPI_1.0.0/PayAPI-1.0.0.xml
[2016-06-03 18:54:11,550] INFO - ApplicationManager Successfully Deployed Carbon Application : ESBConfig_1.0.0 [super-tenant]
```

65. You can browse to the admin console and see if an API is visible in the API section.

Home > Manage > Service Bus > APIs Help

**Deployed APIs**

[Add API](#)

Available defined APIs in the Synapse Configuration : 1

Select all in this page | Select none

Select	API Name	API Invocation URL	Action
<input type="checkbox"/>	PayAPI	http://172.17.0.1:8281/pay	

Select all in this page | Select none

66. Now try the API by browsing <http://localhost:8281/pay/test>  
You should see something like:



67. Check the ESB terminal window and you should see the log messages from the log mediators:

```
[2016-06-03 19:19:40,919] INFO - LogMediator To: /pay/test, WSAction: http://freo.me/payment/ping, SOAPAction: http://freo.me/payment/ping, MessageID: urn:uuid:164b0197-2962-4d37-a413-aae8ec8feb46, Direction: request, Envelope: <?xml version='1.0' encoding='utf-8'?><soapenv:Envelope xmlns:soapenv="http://www.w3.org/2003/05/soap-envelope"><soapenv:Body><p:ping xmlns:p="http://freo.me/payment/"><p:in></p:in></p:ping></soapenv:Body></soapenv:Envelope>[2016-06-03 19:19:40,989] INFO - LogMediator To: http://www.w3.org/2005/08/addressing/anonymous, WSAction: , SOAPAction: , MessageID: urn:uuid:7e928fa1-d062-4eb6-a5db-08f53b8d1daa, Direction: request, Envelope: <?xml version='1.0' encoding='utf-8'?><soap:Envelope xmlns:soap="http://schemas.xmlsoap.org/soap/envelope/"><soap:Body><pingResponse xmlns="http://freo.me/payment/"><out>test</out></pingResponse></soap:Body></soap:Envelope>
```

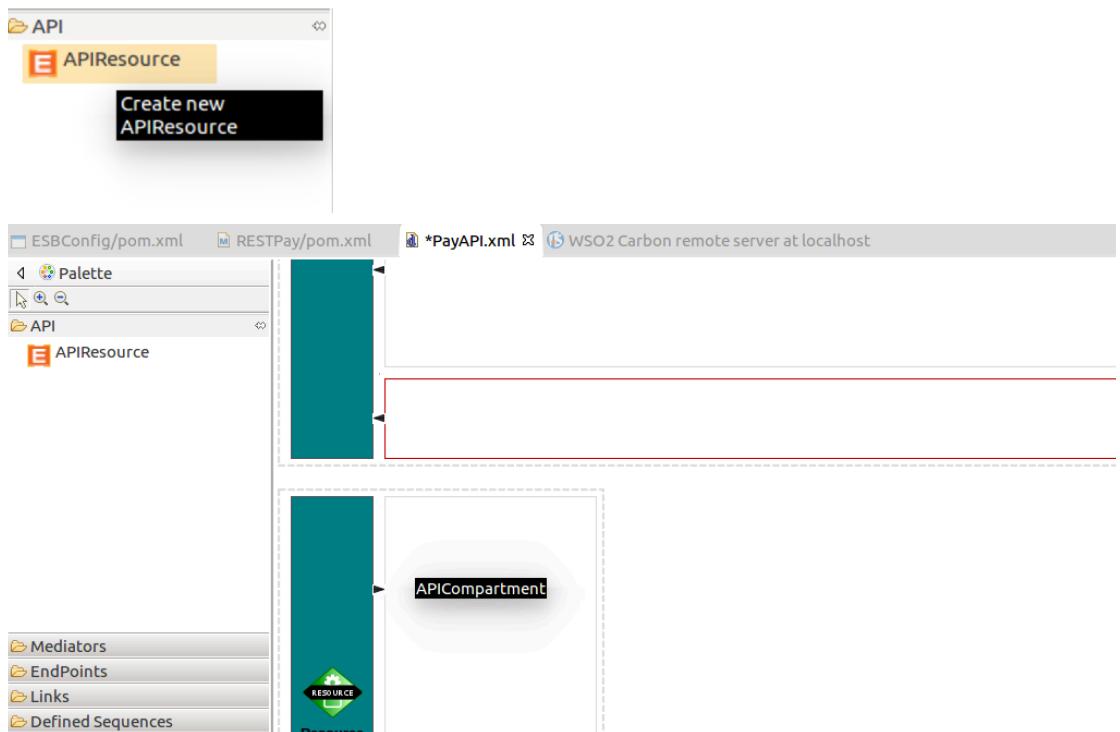
68. Also check out the mitmdump window.

I know that seemed like a lot of bother to get to a simple end, but in fact, we have now set up to do the next stage!

69. Ok. So that was the ping service! But we really want to do is the actual Payment Service.

70. Go back to the Eclipse editor.

71. In the same API, add a new resource underneath the GET resource. Drag it to underneath.



72. Set up the properties on the resource:

URL style: **NONE**

Methods: **POST - True**

Property	Value
Basic	
Url Style	<input checked="" type="checkbox"/> NONE
Protocol	<input checked="" type="checkbox"/> http
Fault Sequence	
Fault Sequence Type	<input checked="" type="checkbox"/> Anonymous
In Sequence	
In Sequence Type	<input checked="" type="checkbox"/> Anonymous
Methods	
Get	<input checked="" type="checkbox"/> false
Post	<input checked="" type="checkbox"/> true
Put	<input checked="" type="checkbox"/> false
Delete	<input checked="" type="checkbox"/> false
Options	<input checked="" type="checkbox"/> false
Head	<input checked="" type="checkbox"/> false
Patch	<input checked="" type="checkbox"/> false
Out Sequence	
Out Sequence Type	<input checked="" type="checkbox"/> Anonymous

73. We need the same flow of mediators:

PayloadFactory -> Header -> Log -> Call (Address) -> Log ->  
PayLoadFactory -> Respond

74. Basically, do the same unless it is different! If you prefer XML, once you have created the API Resource, you could cut and paste the XML and make the right edits to that. Or you can use the GUI.

75. The differences this time are:

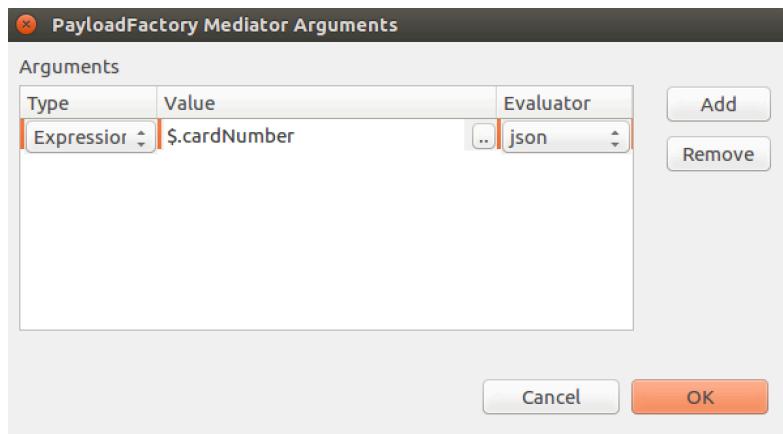
**First PayloadFactory:**

Firstly, the format of the XML is much more complex!

```
<p:authorise xmlns:p="http://freo.me/payment/">
  <p:card>
    <p:cardnumber>$1</p:cardnumber>
    <p:postcode>$2</p:postcode>
    <p:name>$3</p:name>
    <p:expiryMonth>$4</p:expiryMonth>
    <p:expiryYear>$5</p:expiryYear>
    <p:cvc>$6</p:cvc>
  </p:card>
  <p:merchant>$7</p:merchant>
  <p:reference>$8</p:reference>
  <p:amount>$9</p:amount>
</p:authorise>
```



Secondly, the arguments are not extracted from the URI, but from the JSON body of the message, using JSONPath. These are defined like this:



Here is the proposed incoming JSON:

```
{
  "cardNumber": "4544950403888999",
  "postcode": "PO107XA",
  "name": "P Z FREMANTLE",
  "month": 6,
  "year": 2017,
  "cvc": "999",
  "merchant": "A0001",
  "reference": "test",
  "amount": 11.11
}
```

Hint: You might prefer to edit the XML source of the API design rather than use the UI as its quicker! I quite often create one argument with the GUI and then cut and paste the XML.

**The Header mediator** needs a different SOAPAction. It should be:  
<http://freo.me/payment/authorise>

### The address endpoint is the same

The JSON response format in the second PayloadFactory should be adjusted to something useful like:

```
{"authcode": "$1", "reference": "$2", "refusalreason": "$3"}
```

The same model for extracting the responses from the XML SOAP response will work for the results, but we need to extract three arguments. In XML this looks like:

```
<arg evaluator="xml" expression="//*[local-name()='authcode']"/>
<arg evaluator="xml" expression="//*[local-name()='reference']"/>
<arg evaluator="xml" expression="//*[local-name()='refusalreason']"/>
```





76. Your overall XML should look like this Gist here:

<https://gist.github.com/pzfreo/7a73491eb2b513707b779434b21a3d86>

77. You can try the API out by sending a JSON POST using Advanced Rest Client.

The JSON to try is here:

<https://gist.github.com/pzfreo/3340dc7a6cb6f3ab53916cdedb6fff4e>

78. There are lots of ESB samples you can look at here:

<http://docs.wso2.org/display/ESB490/Samples>

79. Extension:

What should the HTTP return code be if the payment is not authorised by the payment service? Can you find a way of acting on the returncode value of the response to produce different flows in the ESB?

80. Big extension!

The WSO2 ESB stores its configurations in <ESB>/repository/\*

See if you can make a docker build for the ESB and a docker compose that joins the payment XML and the ESB into a single easy deployment.

