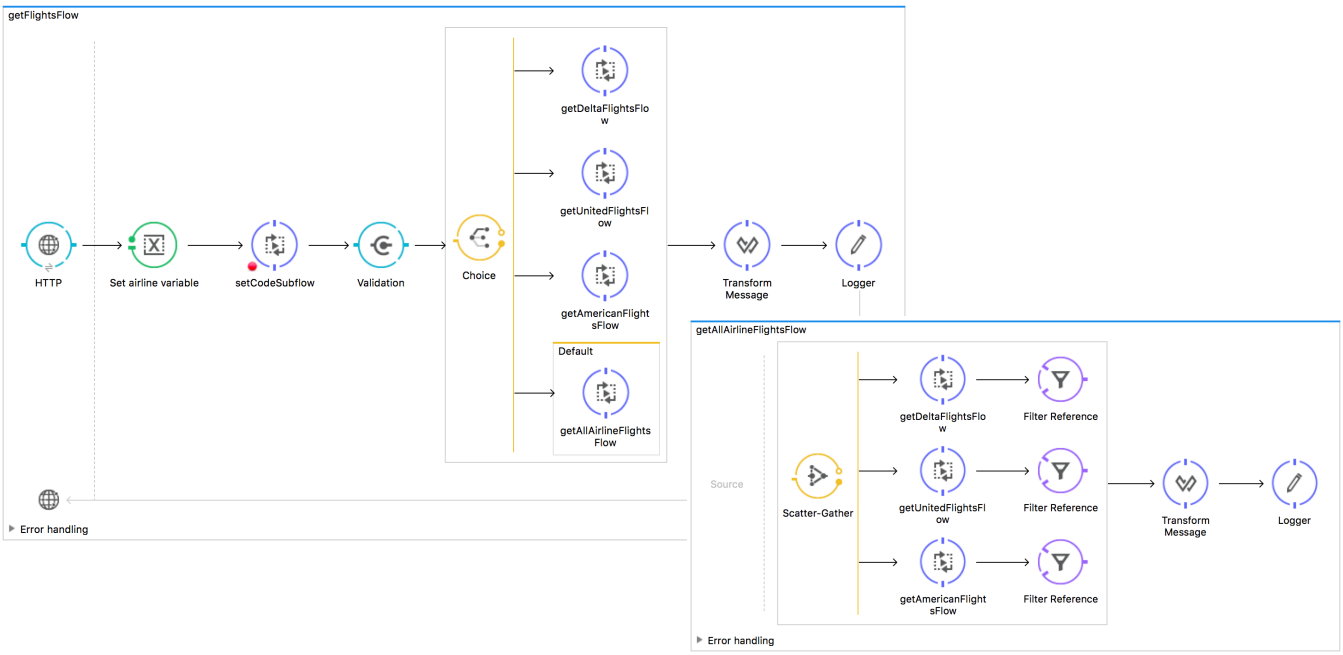
Module 10: Controlling Message Flow



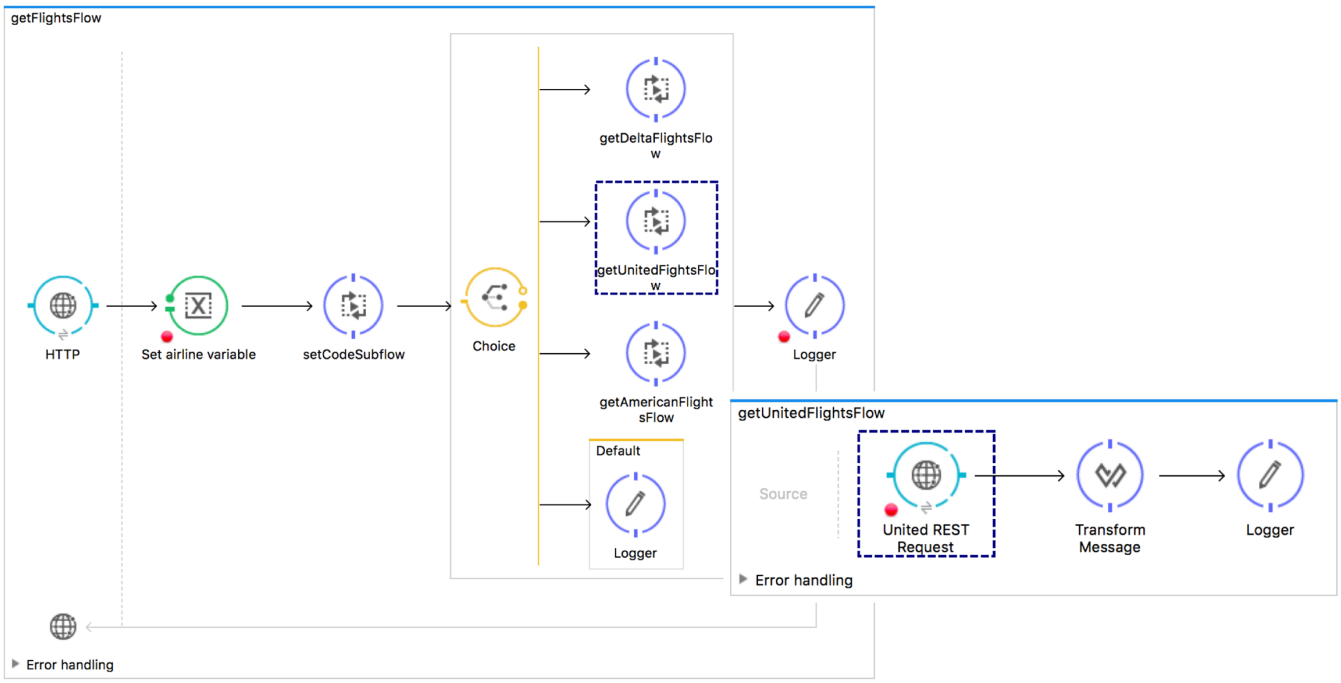
At the end of this module, you should be able to:

- Route messages based on conditions.
- Multicast messages.
- Filter messages.
- Validate messages.

Walkthrough 10-1: Route messages based on conditions

In this walkthrough, you modify getFlightsFlow to route messages to either the United, Delta, or American flows based on the value of an airline query parameter. You will:

- Use a Choice router.
- Set the router paths.



Look at possible airline values specified in the API

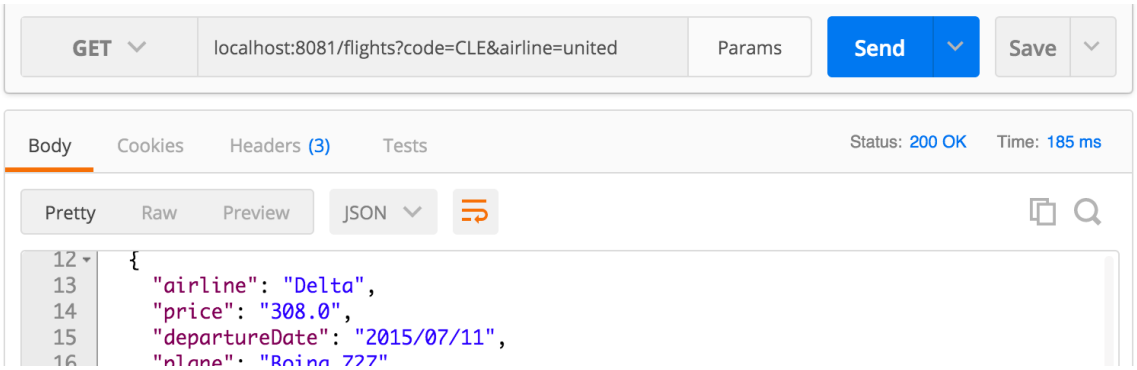
1. Return to the apdev-flights-ws project in Anypoint Studio.
2. Open mua-flights-api.raml.
3. Locate the airline query parameter and its possible values.

```
/flights:
  get:
    displayName: Get flights
    queryParameters:
      code:
        displayName: Destination airport code
        required: false
        enum: [SFO, LAX, PDX, CLE, PDF]
      airline:
        displayName: Airline
        required: false
        enum: [united, delta, american]
```

4. Run the project.

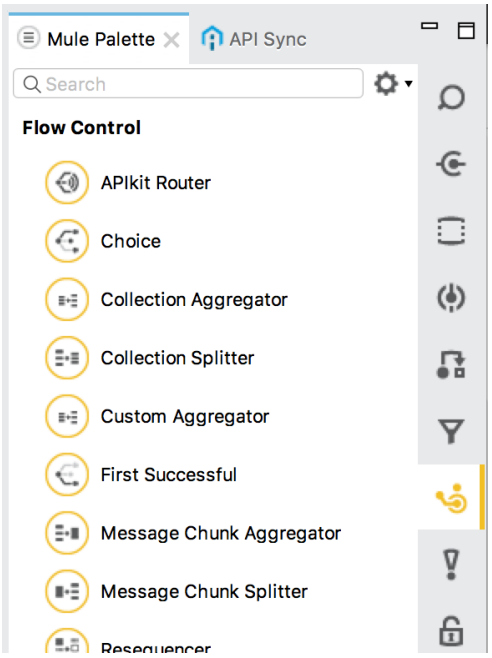
Test the application

5. In Postman, make a request to http://localhost:8081/flights?code=CLE; you should see only Delta flights to CLE.
6. Add a query parameter called airline and set it equal to united.
7. Send the request again; you should still only see the Delta flights.



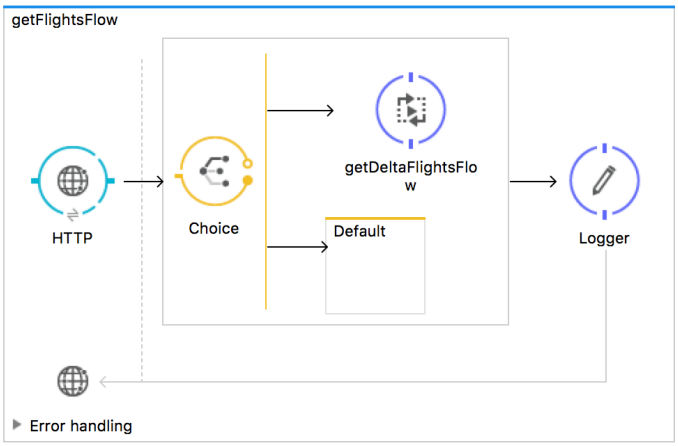
Browse the flow control elements in the Mule Palette

8. Return to implementation.xml in Anypoint Studio.
9. In the Mule Palette, select the Flow Control tab.
10. View the available flow control processors.

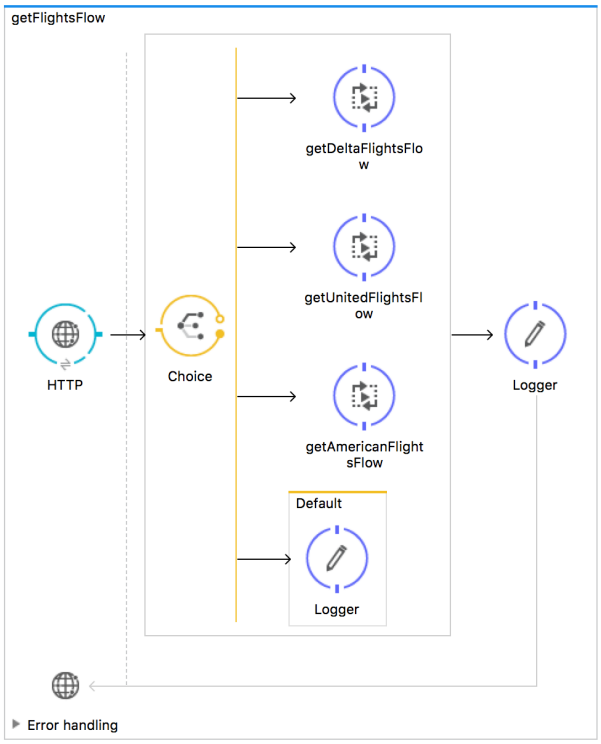


Add a Choice router

11. Drag a Choice flow control element from the Mule Palette and drop it in getFlightsFlow before getDeltaFlightsFlow.
12. Drag the getDeltaFlightsFlow flow reference into the router.



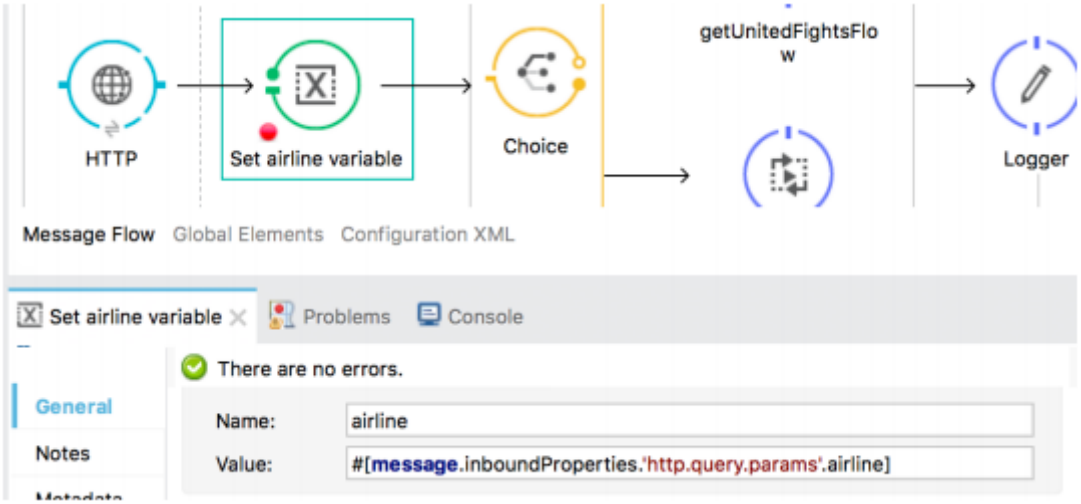
13. Add two additional Flow Reference components to the Choice router.
14. In the Properties view for the first flow reference, set the flow name to getUnitedFlightsFlow.
15. In the Properties view for the second flow reference, set the flow name to getAmericanFlightsFlow.
16. Drag a Logger component from the Mule Palette and drop it in the default branch.



Store the airline query parameter in a flow variable

17. Add a Variable transformer before the Choice router.
18. Change its display name to Set airline variable.
19. Set the flow variable name to airline and set it equal to a query parameter called airline.

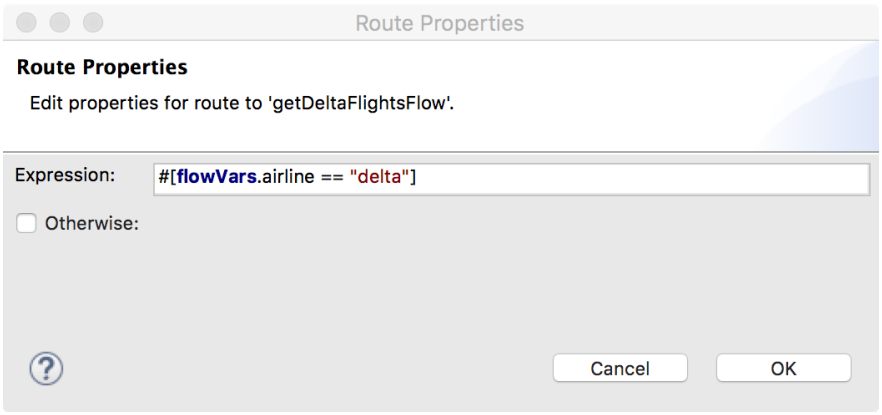
```
#[message.inboundProperties.'http.query.params'.airline]
```



Configure the Choice router

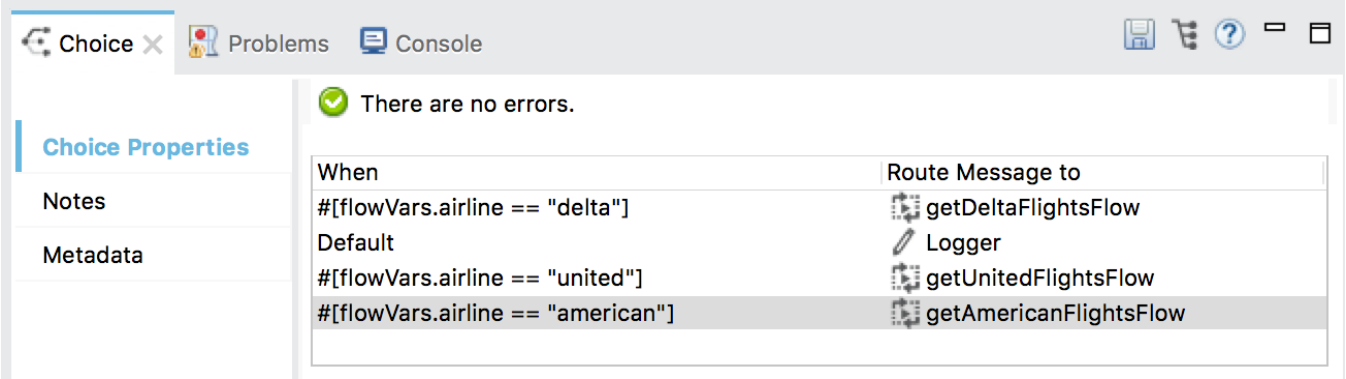
20. In the Choice properties view, double-click the getDeltaFlightsFlow route.
21. In the Route Properties dialog box, set the expression to true if the airline flow variable is equal to delta and click OK.

```
#[flowVars.airline == "delta"]
```



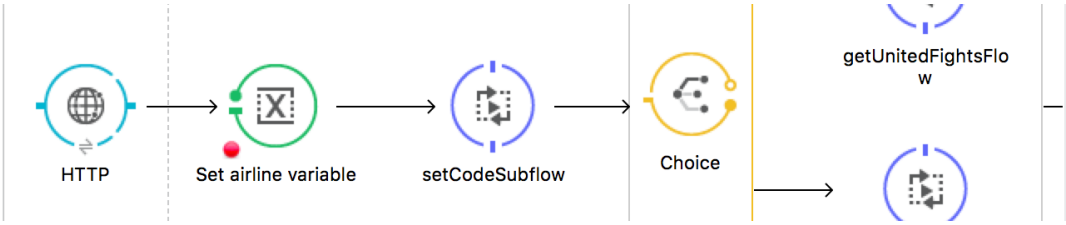
22. Set a similar expression for the United route, routing to it when flowVars.airline is equal to united.

23. Set a similar expression for the American route, routing to it when flowVars.airline is equal to american.

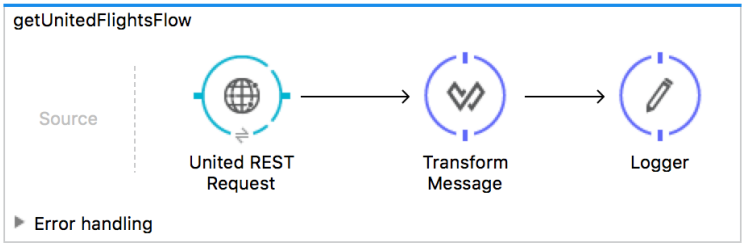


Route all requests through the router

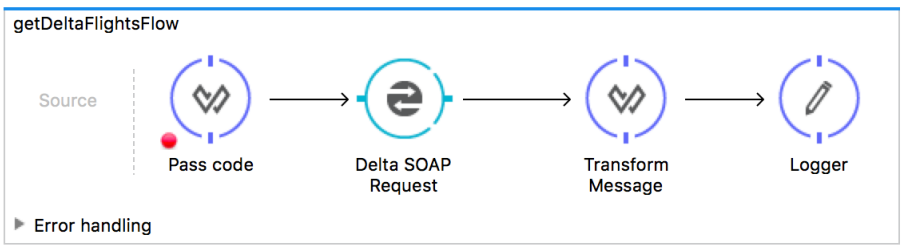
24. From getUnitedFlightsFlow, drag the setCodeSubflow flow reference into getFlightsFlow before the choice router.



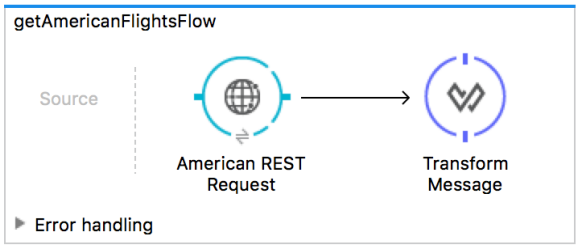
25. In getUnitedFlightsFlow, delete the HTTP Listener endpoint.



26. In getDeltaFlightsFlow, delete the HTTP Listener endpoint and the setCodeSubflow flow reference.

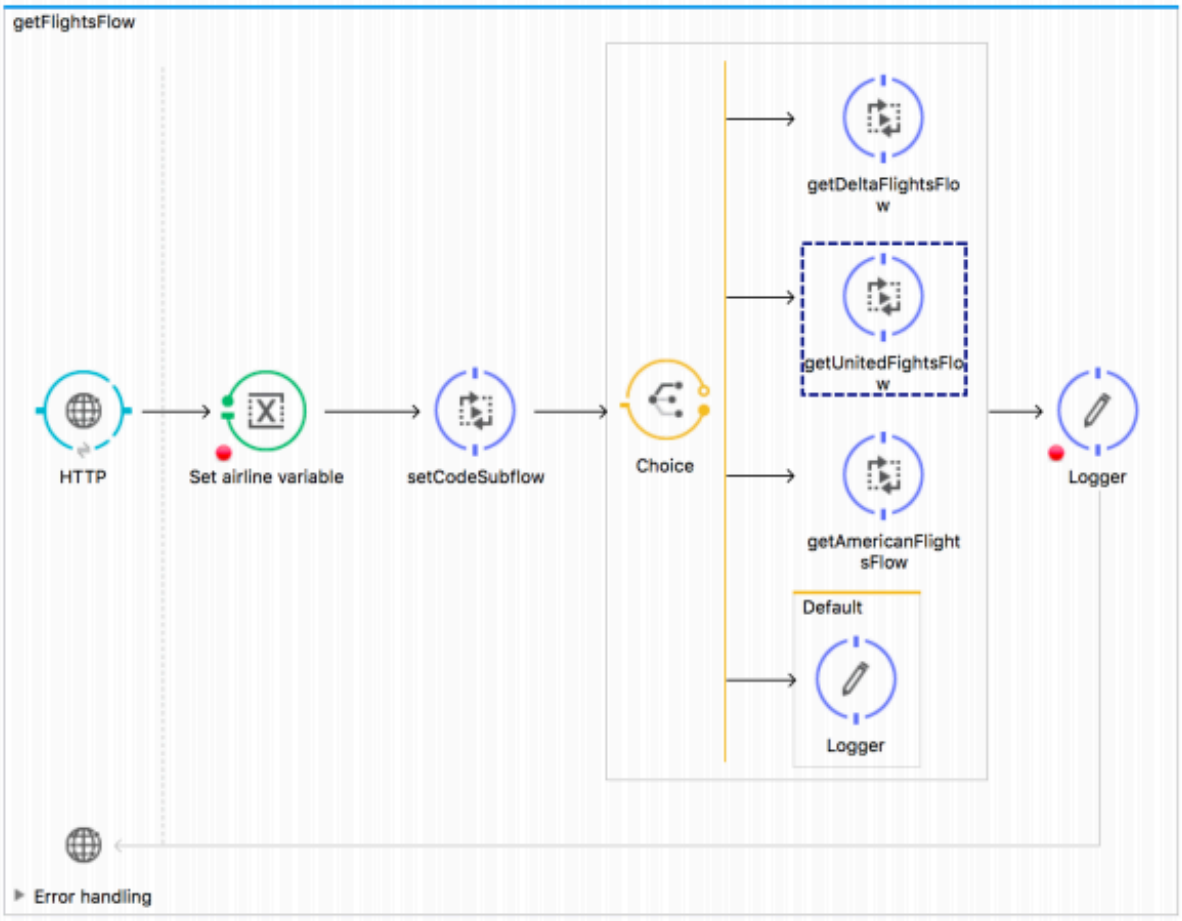


27. In getAmericanFlightsFlow, delete the HTTP Listener endpoint and the setCodeSubflow flow reference.

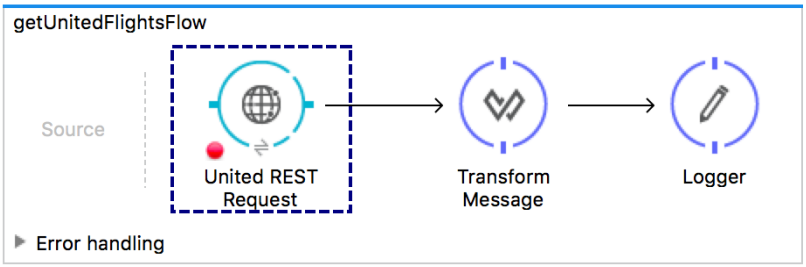


Test the application

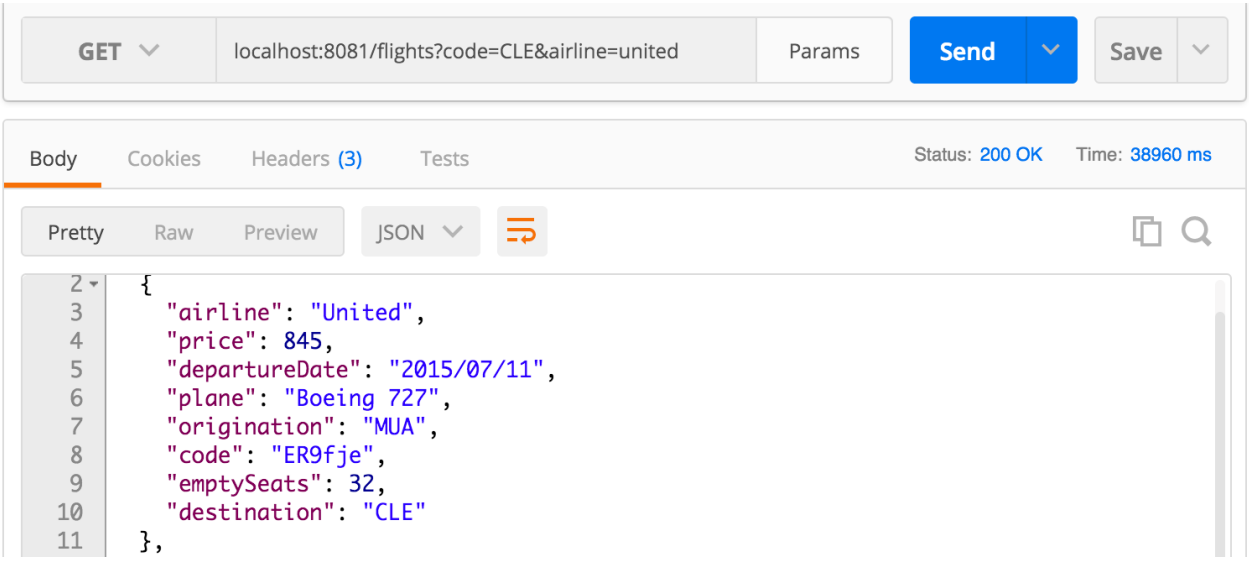
28. In getFlightsFlow, make sure there is a breakpoint on one of the processors before the Choice router.
29. Debug the project.
30. In Postman, make the same request to http://localhost:8081/flights?code=CLE&airline=united.
31. In the Mule Debugger, step through the application; you should see the Choice router pass the message to the United branch.



32. Step through the rest of the application; you should see the message passed to getUnitedFlightsFlow and then back to getFlightsFlow.

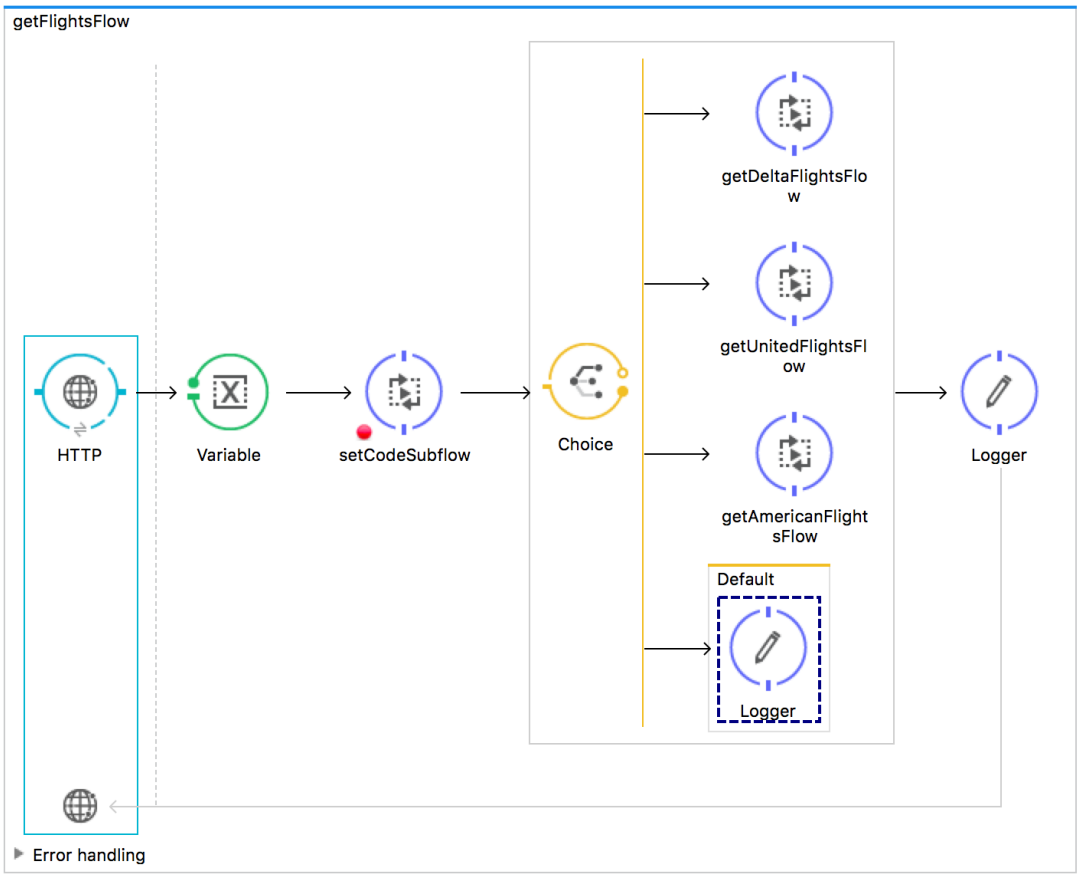


33. Return to Postman; you should see only United flights to CLE returned.

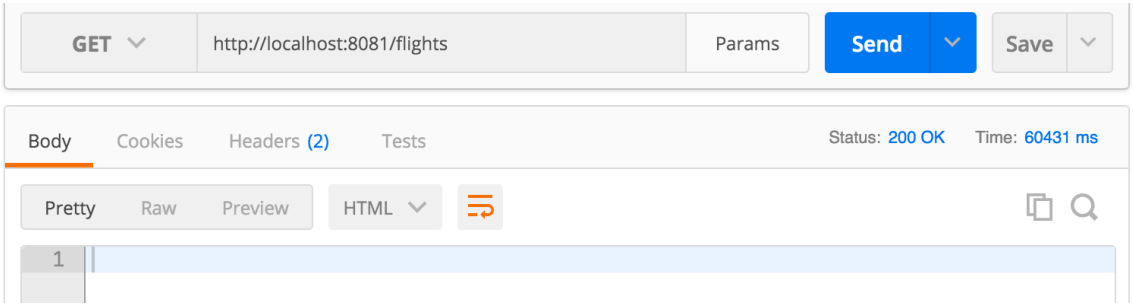


34. Change the airline to delta and the code to LAX.
35. Send the request.
36. Step through the application; the message should be routed to the Delta branch.
37. Return to Postman; you should see only Delta flights to LAX are returned.

38. In Postman, remove both parameters and make a request to http://localhost:8081/flights.
39. In the Mule Debugger, step through the application; you should see the Choice router pass the message to the default branch.



40. Click the Resume button.
41. Return to Postman; no flights are returned.



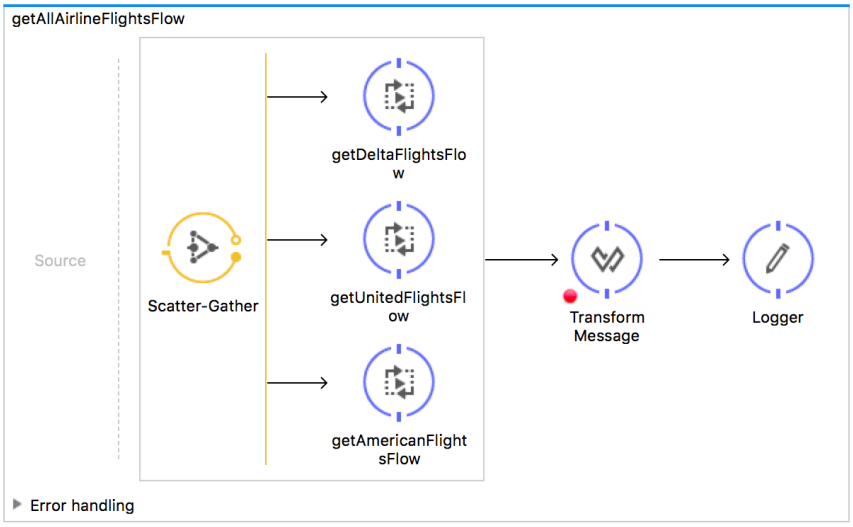
Note: If the next walkthrough, you will change this behavior so that if no airline is specified, flights for all airlines will be returned.

42. Return to Anypoint Studio, stop the project, and switch to the Mule Design perspective.

Walkthrough 10-2: Multicast a message

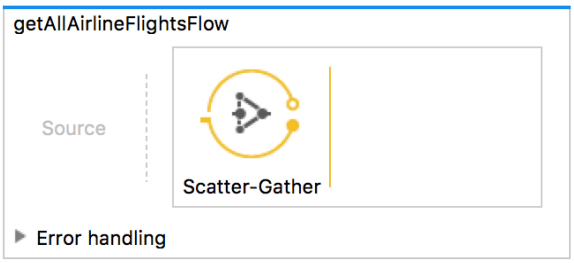
In this walkthrough, you create a flow that calls each of the three airline services and combines the results. You will:

- Use a Scatter-Gather router to concurrently call all three flight services.
- Use DataWeave to flatten multiple collections into one collection.
- Use DataWeave to sort the flights by price and return them as JSON.
- (Optional) Modify the airline flows to use DataWeave to each return a Java collection of Flight objects.



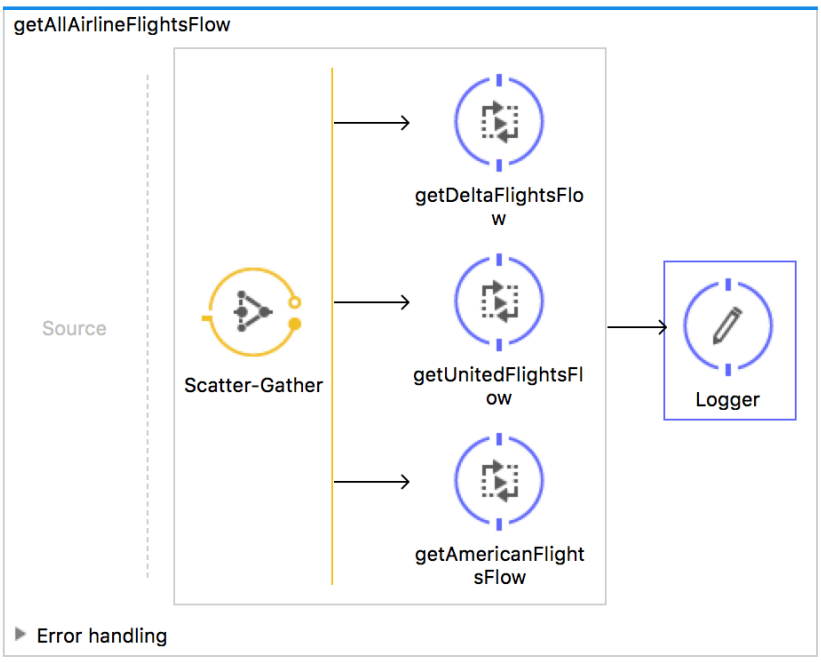
Create a flow to use a router to call all three airline services

1. Return to implementation.xml.
2. Drag a Scatter-Gather flow control element from the Mule Palette and drop it at the bottom of the canvas.
3. Change the name of the flow to getAllAirlineFlightsFlow.



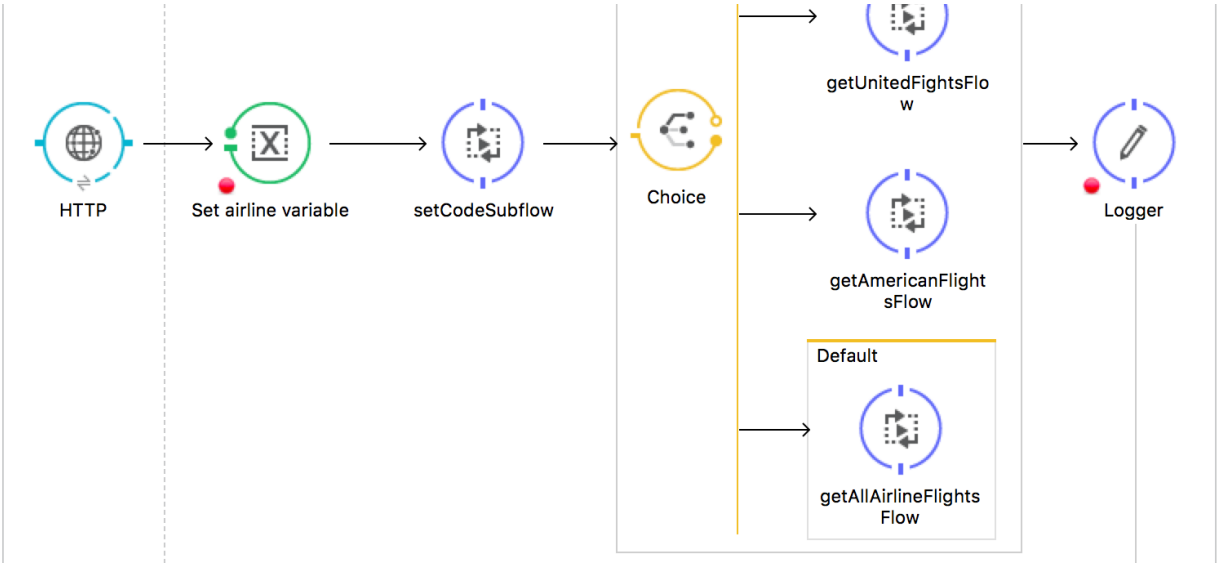
4. Drag three Flow Reference components into the Scatter-Gather router.
5. Using the Properties view, set the flow name of the first Flow Reference to getDeltaFlightsFlow.

6. Set the flow name of the second Flow Reference to getUnitedFlightsFlow.
7. Set the flow name of the third Flow Reference to getAmericanFlightsFlow.
8. Add a Logger after the router.



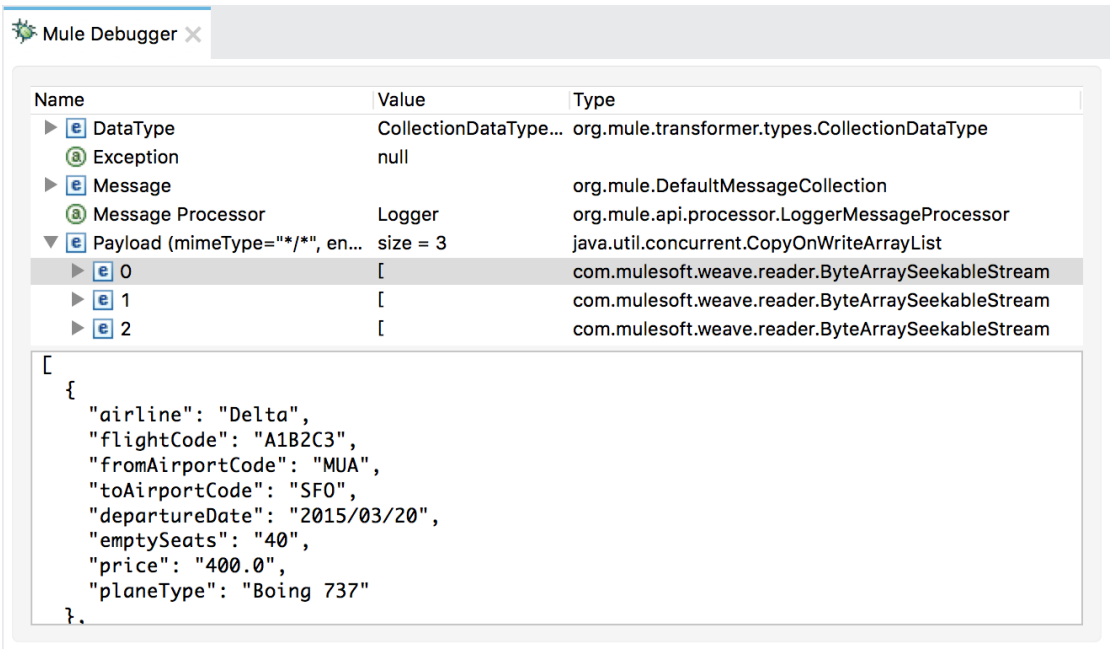
Call this flow if no airline is specified

9. Return to getFlightsFlow at the top of the canvas.
10. Delete the Logger in the default branch.
11. Add a Flow Reference to the default branch and set its flow name to getAllAirlineFlightsFlow.



Test the application

12. Debug the project.
13. In Postman, make the same request to http://localhost/flights.
14. In the Mule Debugger, step through the application to the default branch of the Choice router, then into the Scatter-Gather, and then into each of the airline flows.
15. Stop at the Logger back in getFlightsFlow and look at the payload.



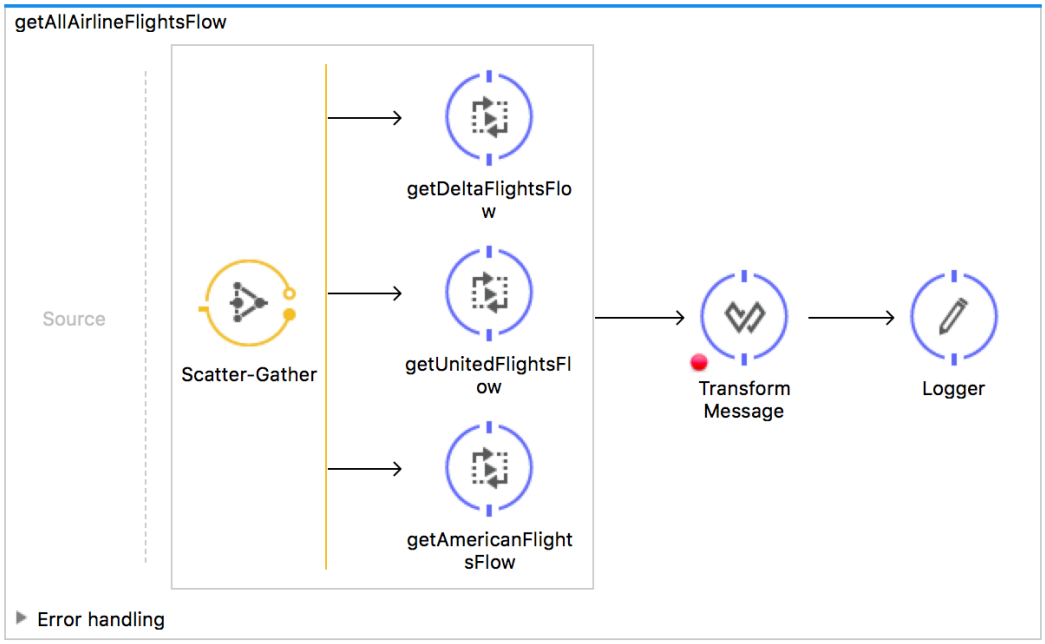
Note: You get three different DataWeave stream objects. You want to combine the three collections and then sort them by price and return them as JSON. Because the airline flight flows were written first and already return JSON, you can just flatten the collections into one and then order by price. More typically, however, you would have each of the airline flows return data of a common canonical format – in this case, a collection of Flight Java objects – and then flatten, order, and transform that data to the JSON specified by the API.

16. Click the Resume button.
17. Stop the project.

Flatten the combined results

18. Return to getAllAirlineFlightsFlow in the Mule Design pespective.

19. Add a Transform Message component before the Logger.



20. In the Properties view, set the DataWeave expression to flatten the payload.

```
flatten payload
```

```
1 %dw 1.0
2 %output application/java
3 ---
4 flatten payload
```

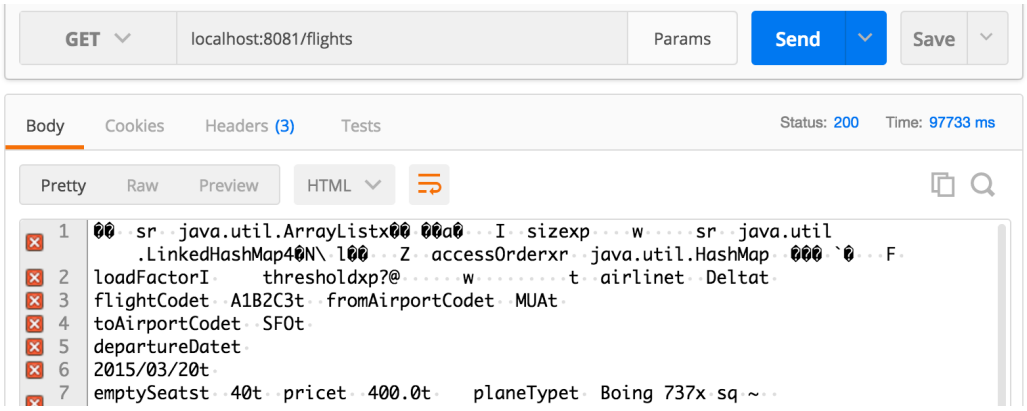
Note: You will learn about DataWeave operators in the later module Writing DataWeave Transformations.

Test the application

21. Save the file to redeploy the application.
22. In Postman, make the same request to http://localhost:8081/flights.

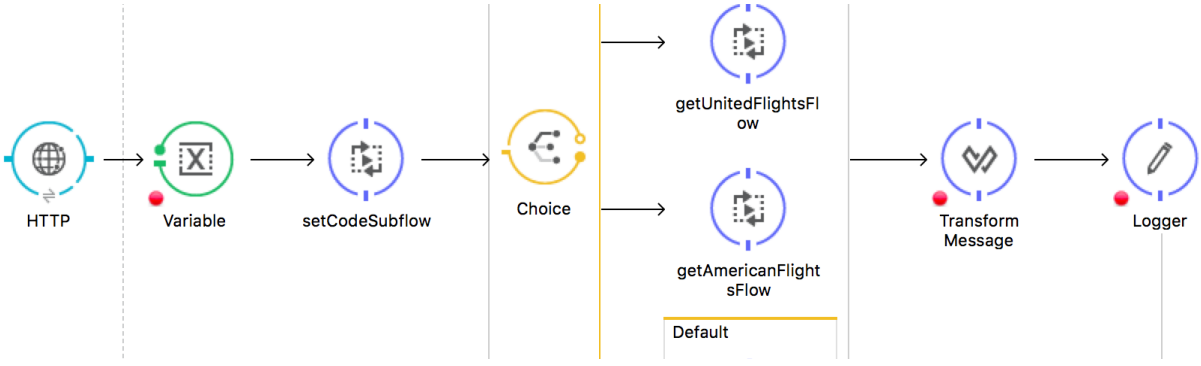
23. In the Mule Debugger, step through the application to the Logger after the Choice router; you should see the payload is now one ArrayList of HashMaps.

24. Step through the rest of the application and stop the project.
25. In Postman, you should get a representation of Java objects returned.

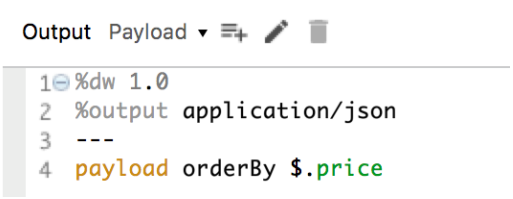


Return the data as JSON and sort by price

26. Return to getFlightsFlow in the Mule Design perspective.
27. Add a Transform Message component after the Choice router.



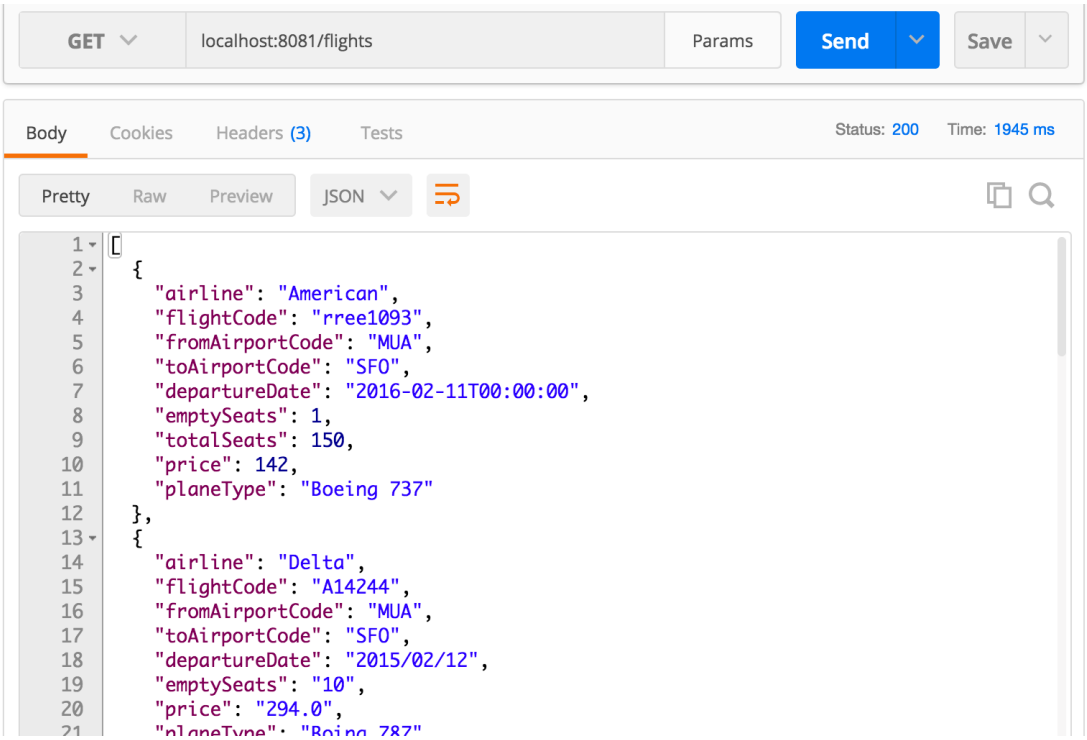
28. In the Transform Message properties view, change the output to application/json.
29. Change the transformation expression to order the payload by price.



Note: You will learn about DataWeave operators in the next module, Writing DataWeave Transformations.

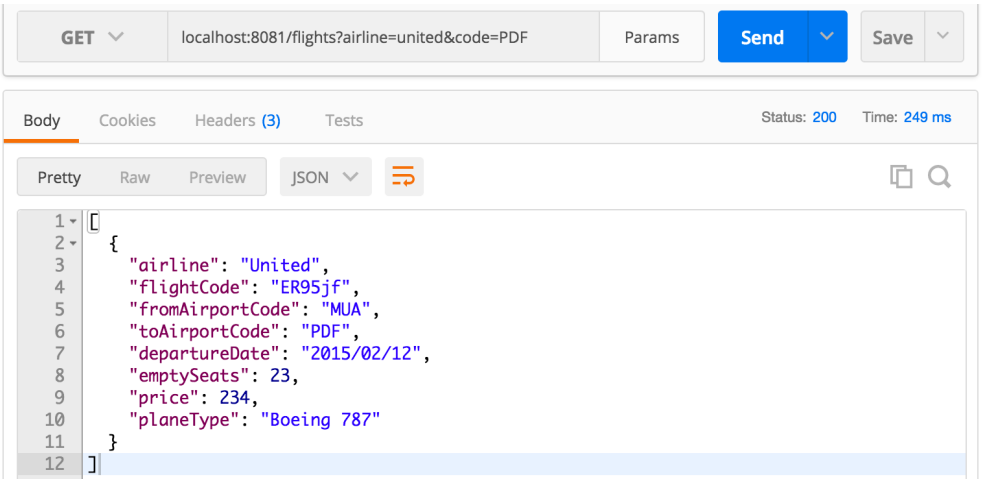
Test the application

30. Run the project.
31. In Postman, send the same request to http://localhost:8081/flights; you should get all the flights to SFO returned and they should be sorted by price.

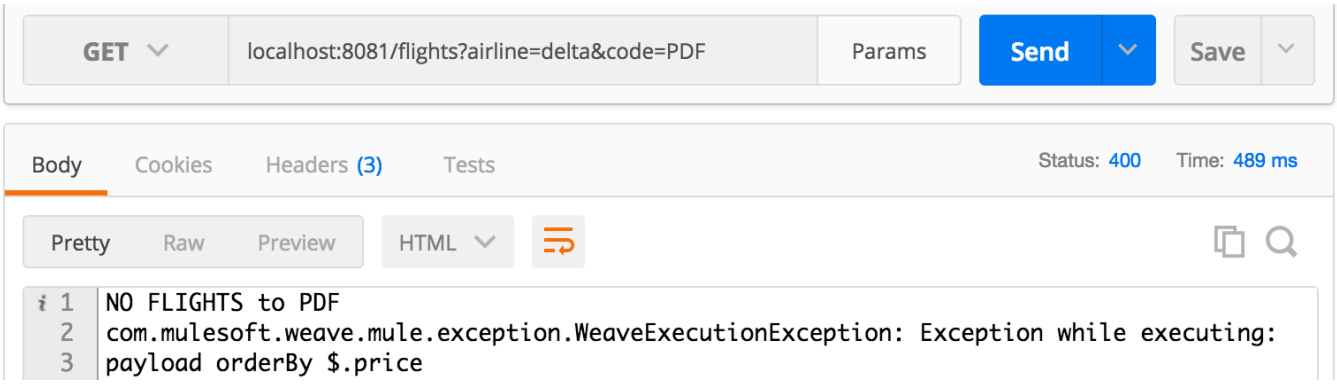


32. Add an airline parameter equal to united and send the request: http://localhost:8081/flights?airline=united; you should get united flights to SFO sorted by price.

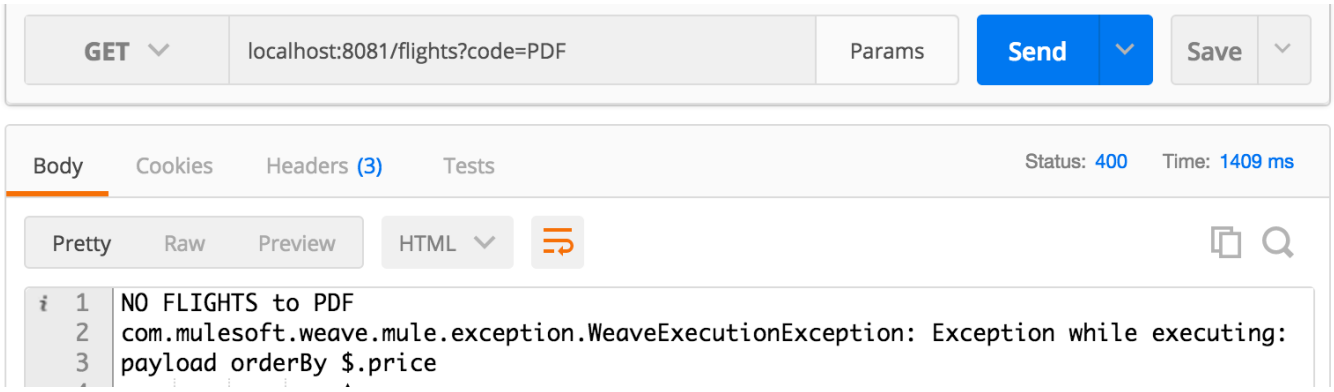
33. Add a code parameter equal to PDF and send the request: http://localhost:8081/flights?airline=united&code=PDF; you should get one united flight to PDF.



34. Change the airline to delta and send the request: http://localhost:8081/flights?airline=delta&code=PDF; you should the message that there are not flights to PDF – which is correct.



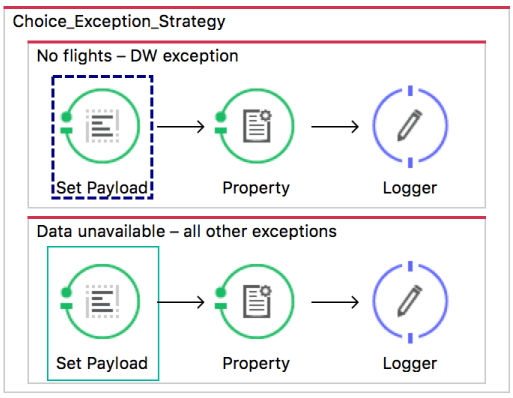
35. Remove the airline parameter and send the request: http://localhost:8081/flights?code=PDF; you should get the one United flight to PDF, but instead you get the message that there are no flights.



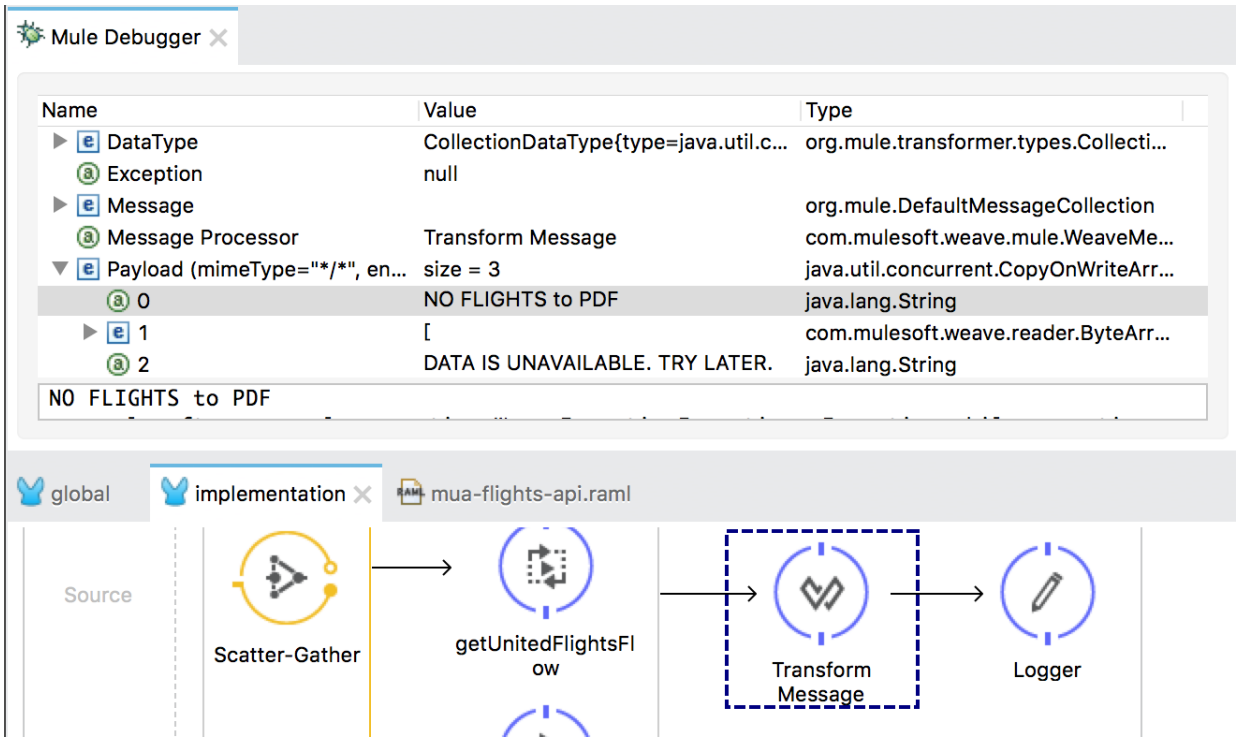
36. Return to Anypoint Studio and stop the project.

Debug the application

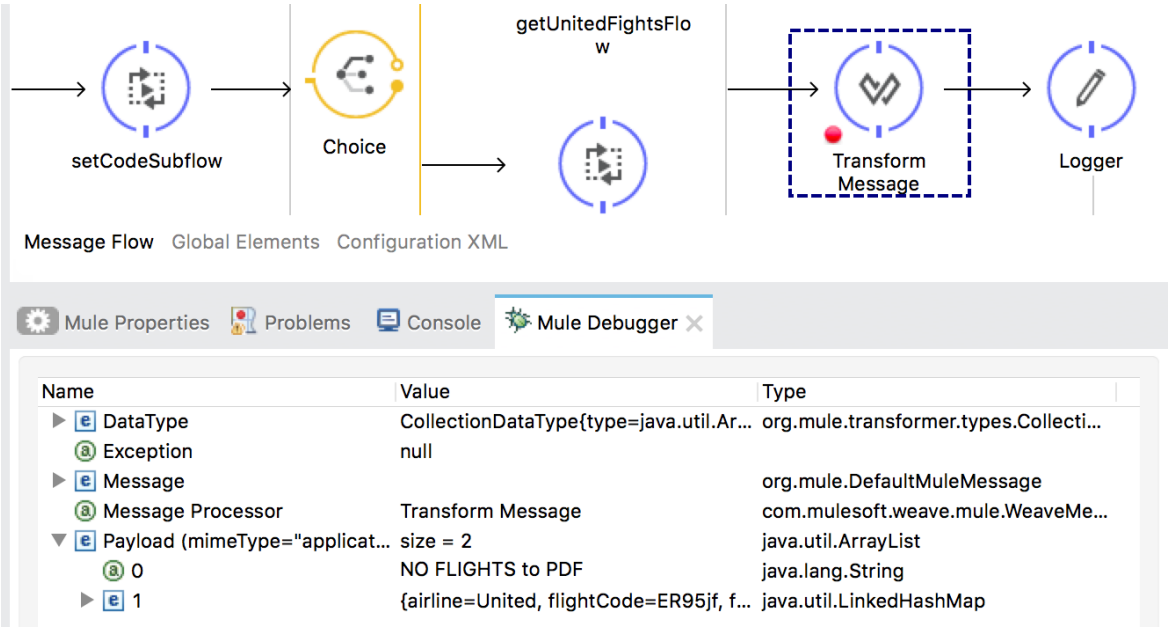
37. Debug the project.
38. In Postman, send the same request to http://localhost:8081/flights?code=PDF.
39. In the Mule Debugger, step through the application until an exception is thrown – and handled by the default global exception handler.



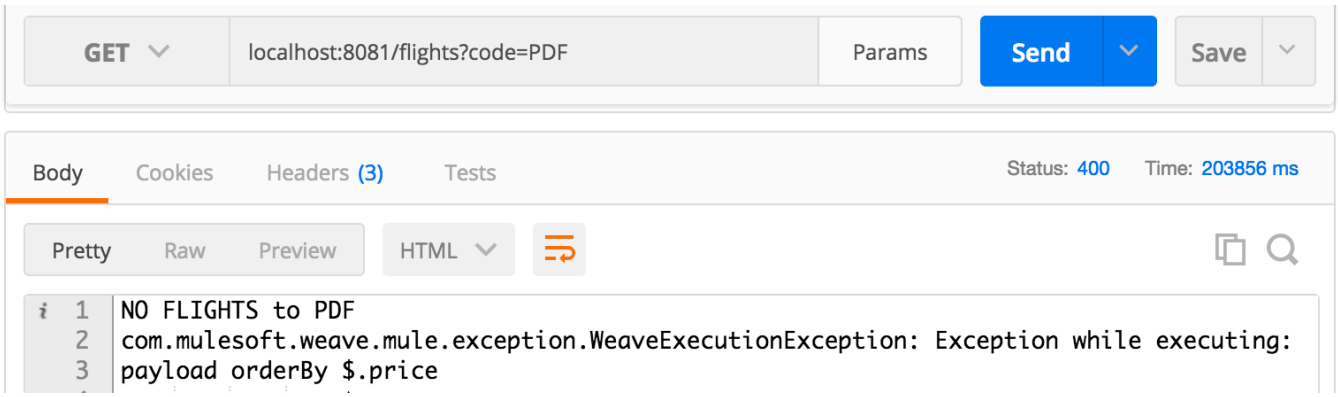
40. Continue to step through the application until you reach the Transform Message component in getAllAirlineFlightsFlow; you should see different types of objects returned.



41. Step to the Transform Message component in getFlightsFlow; you should see the payload still contains the error message in addition to the valid flight results to PDF.



42. Step to the end of the application; you should not get the United results to PDF.



Note: You could write a custom aggregation strategy for the Scatter-Gather router with Java to handle this situation, but instead you will use the simpler approach of filtering out the exception messages in the next walkthrough.

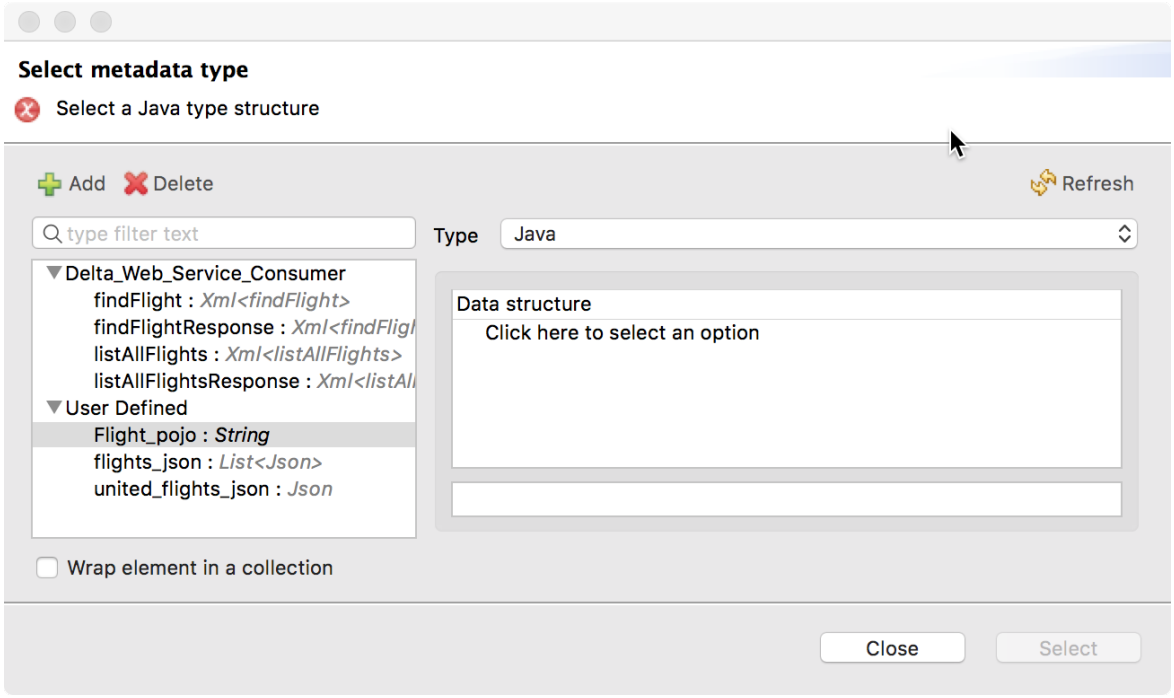
43. Return to Anypoint Studio, stop the project, and switch to the Mule Design perspective.

(Optional) Modify the airline flows to return Java Flight objects instead of JSON

Note: The rest of the walkthrough is optional. It contains steps to modify each of the airline flows to return data of a common canonical format – in this case, a collection of Flight Java objects.

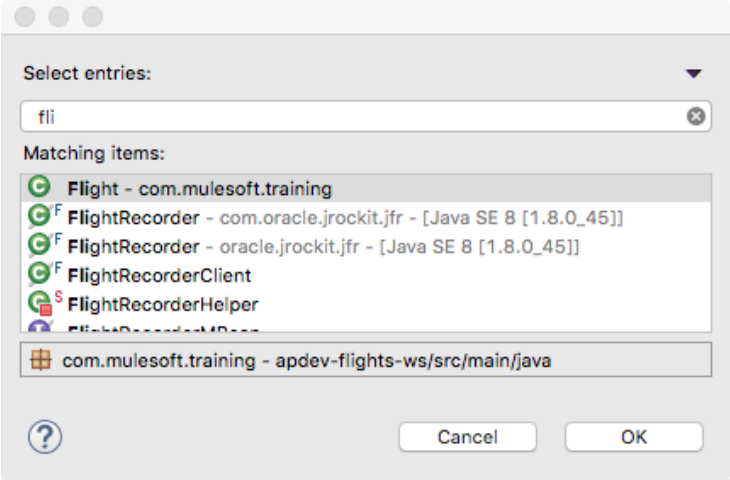
Change the United airline flows to return Java Flight objects instead of JSON

44. Return to getUnitedFlightsFlow in implementation.xml.
45. In the Transform Message properties view, right-click List <Json> in the output section and select Clear Metadata.
46. Click the Define metadata link.
47. In the Select metadata type dialog box, click the Add button.
48. In the Create new type dialog box, set the name to Flight_pojo and click Create type.
49. In the Select metadata type dialog box, change the type to Java.
50. In the Data structure section, click the Click here to select an option link.

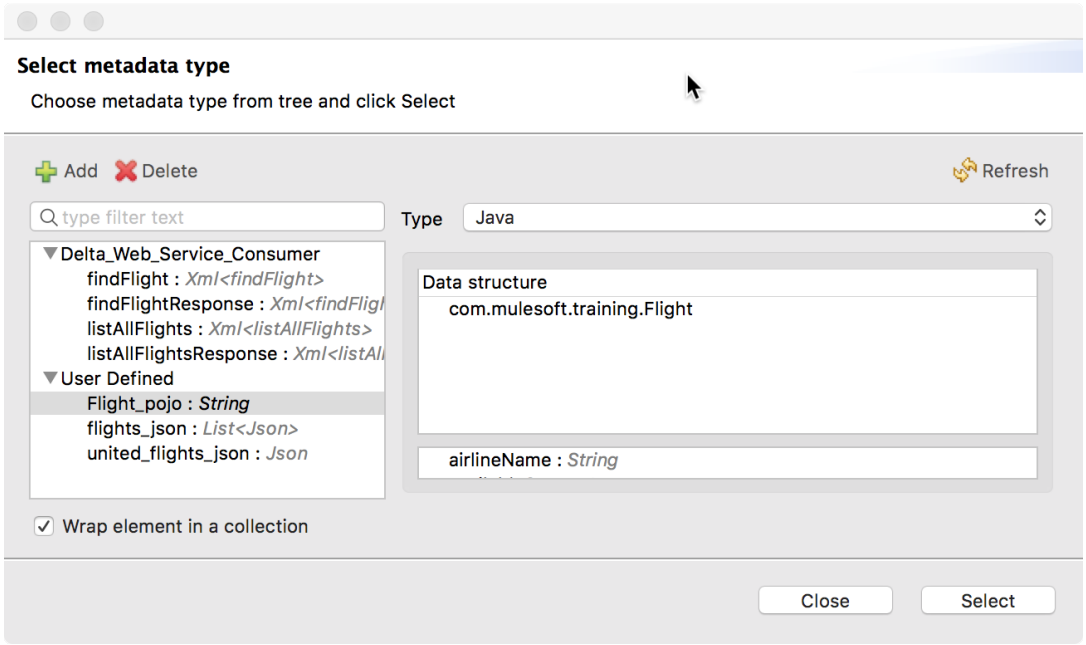


51. In the drop-down menu that appears, select Java object.

52. In the dialog box that opens, type fli and then in the list of classes that appears, select Flight – com.mulesoft.training.com.

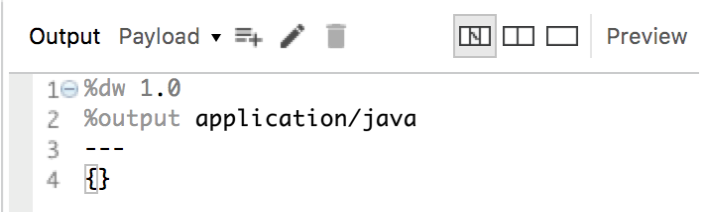


53. Click OK.
54. In the Select metadata type dialog box, select Wrap element in a collection in the lower-left corner.

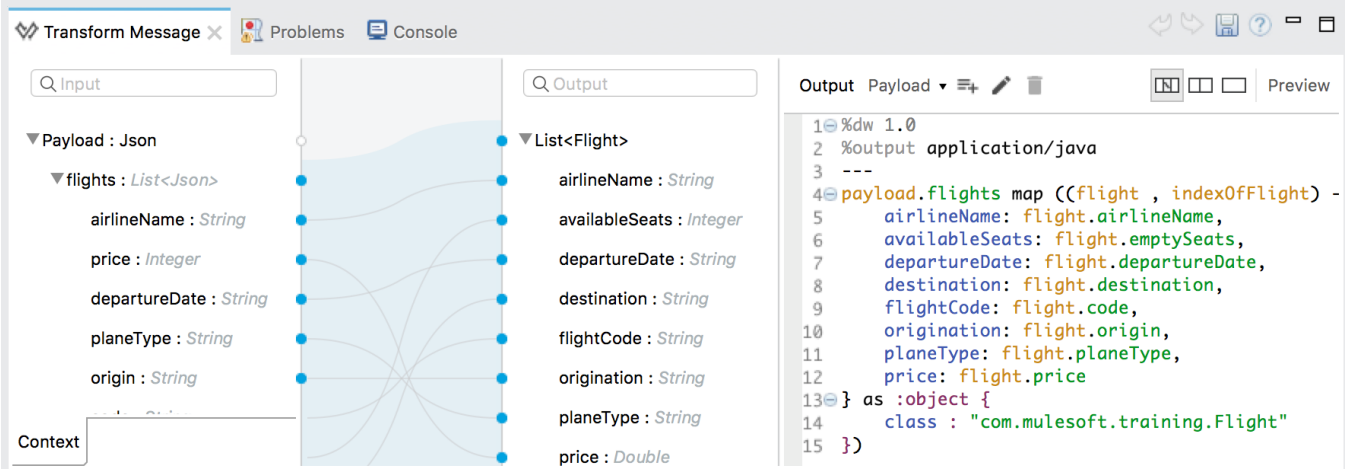


55. Click Select.

56. In the Transform Message properties view, replace the current transformation expression with an empty object.



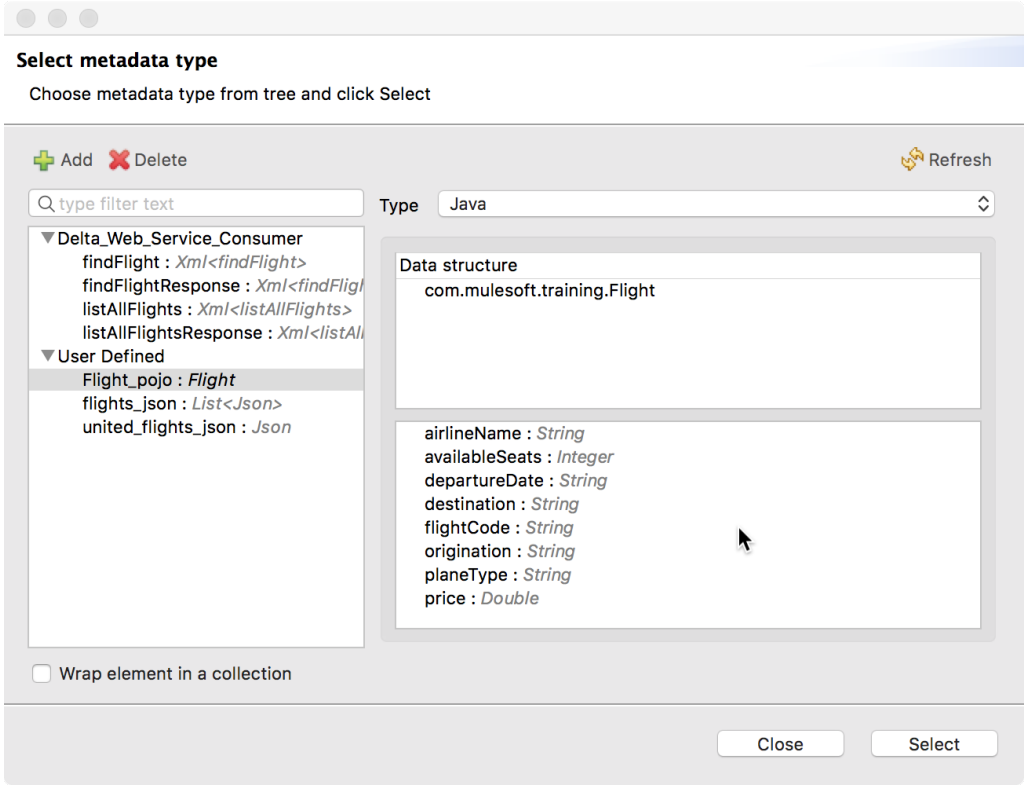
57. Use the graphical editor to map the fields appropriately.



Change the American flow to return Java Flight objects instead of JSON

58. Return to getAmericanFlightsFlow.
59. In the Transform Message properties view, right-click List <Json> in the output section and select Clear Metadata.
60. Click the Define metadata link.
61. In the Select metadata type dialog box, select Flight_pojo.

62. Select the Wrap element in a collection checkbox in the lower-left corner.

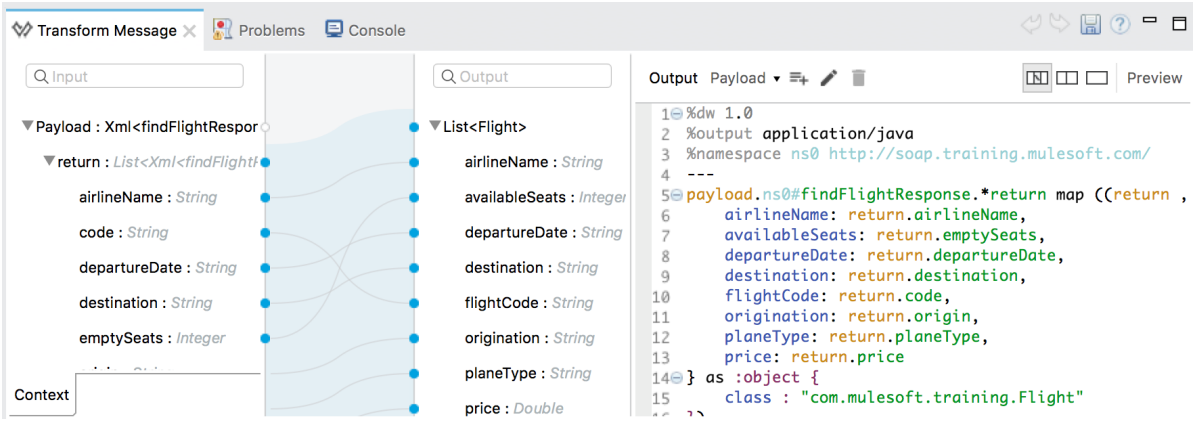


63. Click Select.
64. In the Transform Message properties view, replace the current transformation expression with an empty object.
65. Use the graphical editor to map the fields appropriately.
66. In the output section of the graphical editor, double-click airlineName; the field should be added to the DataWeave expression.
67. Set its value to "American".

```
%dw 1.0
%output application/java
---
payload map ((payload01 , indexOfPayload01) -> {
    airlineName: "American",
    availableSeats: payload01.emptySeats,
    departureDate: payload01.departureDate,
    destination: payload01.destination,
    flightCode: payload01.code,
    origination: payload01.origin,
    planeType: payload01.plane.type,
    price: payload01.price
} as :object {
    class : "com.mulesoft.training.Flight"
})
```

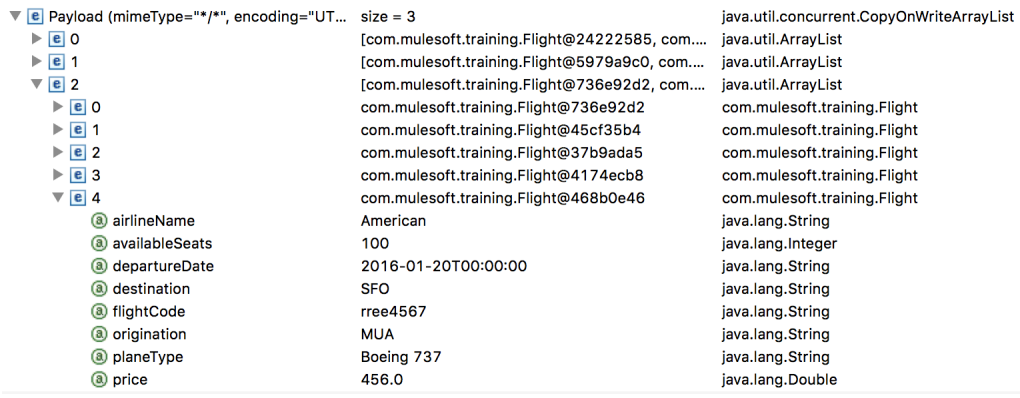
Change the Delta flow to return Java Flight objects instead of JSON

68. Return to getDeltaFlightsFlow.
69. In the Transform Message Properties view for the component after the Delta SOAP Request, right-click List <Json> in the output section and select Clear Metadata.
70. Click the Define metadata link.
71. In the Select metadata type dialog box, select Flight_pojo.
72. Select the Wrap element in a collection checkbox in the lower-left corner.
73. Click Select.
74. In the Transform Message properties view, replace the current transformation expression with an empty object.
75. Use the graphical editor to map the fields appropriately.

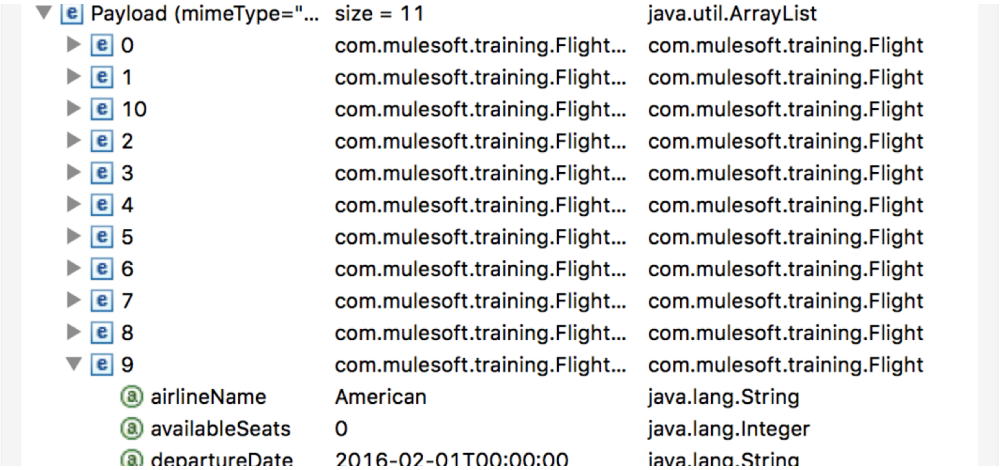


Test the application

76. Debug the project.
77. In Postman, remove the parameters and send a request to http://localhost:8081/flights.
78. In the Mule Debugger, step through the application to the Transform Message component in getAllAirlineFilghtsFlow; the payload should be a collection of three ArrayLists of Flight objects.



79. Step to the Logger; the payload should now be one ArrayList of Flight objects.

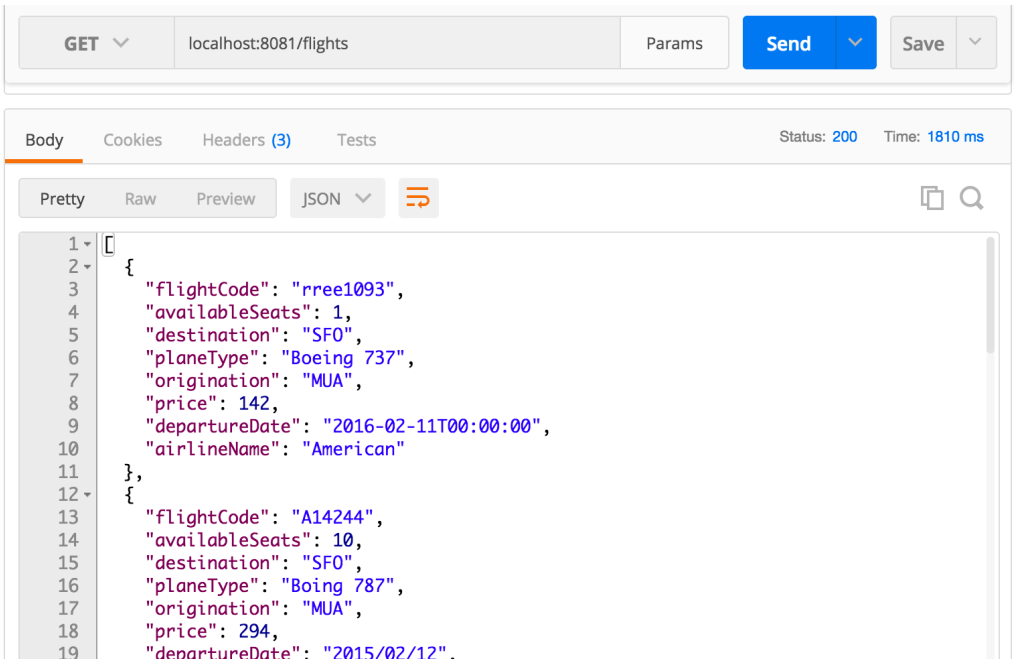


80. Step through to the end of the application.

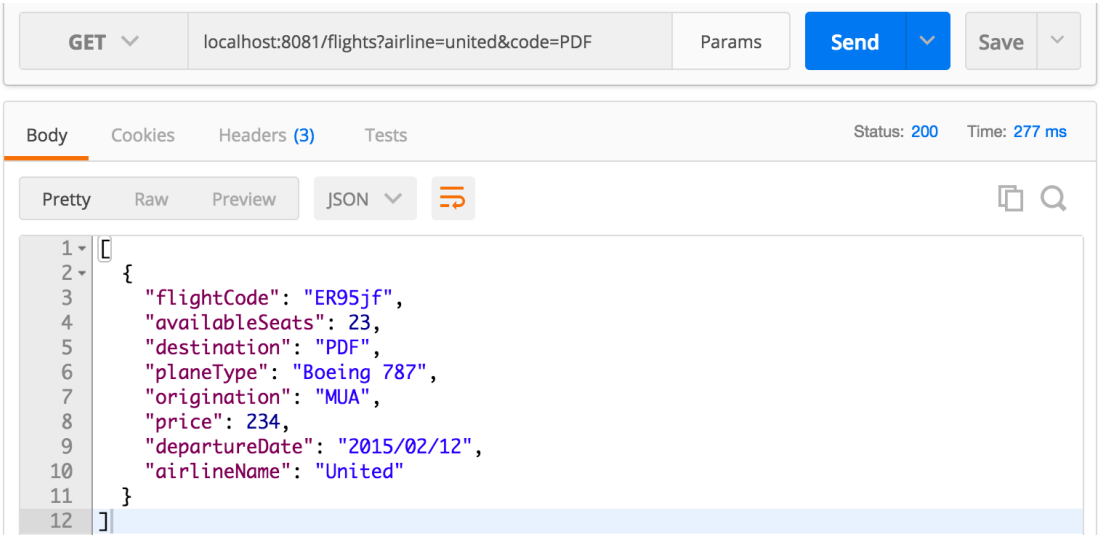
Test the application

Note: You completed the rest of the walkthrough steps already before modifying the airline flows to return collections of Flight objects. You are repeating them as a lead in to the next walkthrough.

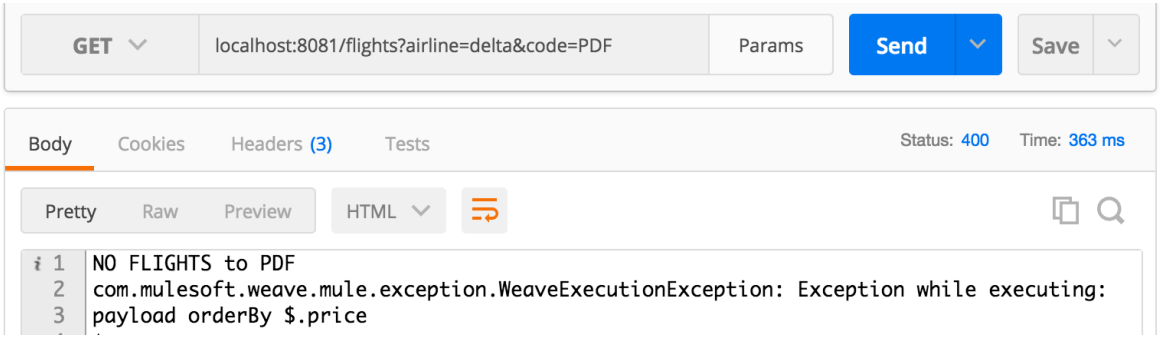
81. Run the project.
82. In Postman, send the same request to http://localhost:8081/flights; you should get all the flights to SFO returned and they should be sorted by price.



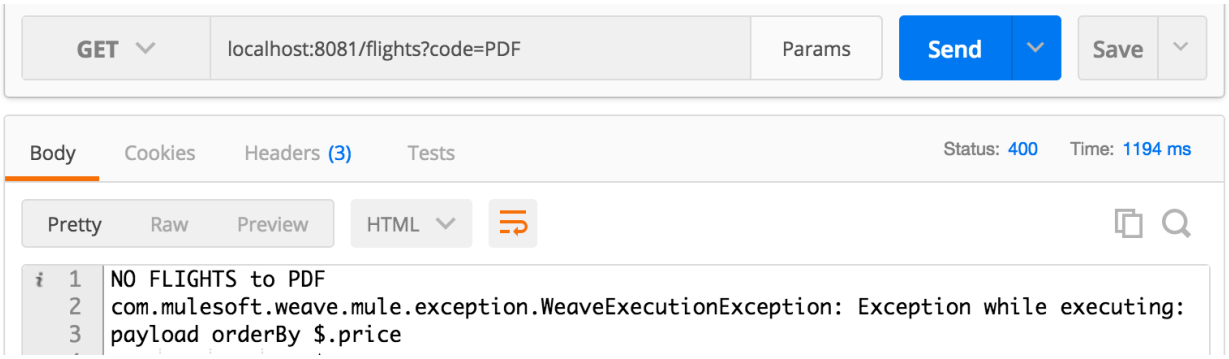
83. Add an airline parameter equal to united and send the request: http://localhost:8081/flights?airline=united; you should get united flights to SFO sorted by price.
84. Add a code parameter equal to PDF and send the request: http://localhost:8081/flights?airline=united&code=PDF; you should get one united flight to PDF.



85. Change the airline to delta and send the request: http://localhost:8081/flights?airline=delta&code=PDF; you should the message that there are not flights to PDF – which is correct.



86. Remove the airline parameter and send the request: http://localhost:8081/flights?code=PDF; you should get the one United flight to PDF, but instead you get the message that there are no flights.

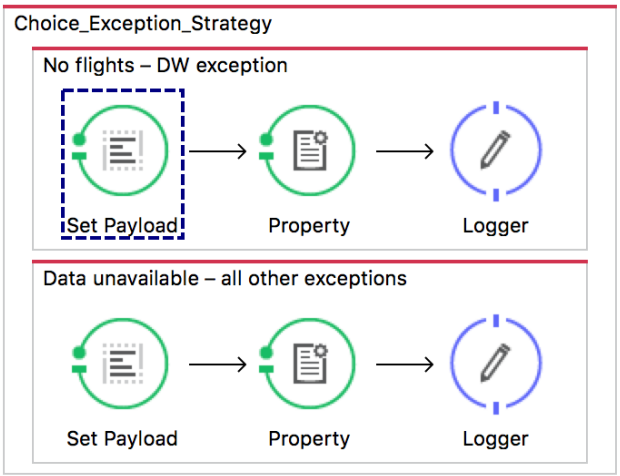


87. Return to Anypoint Studio and stop the project.

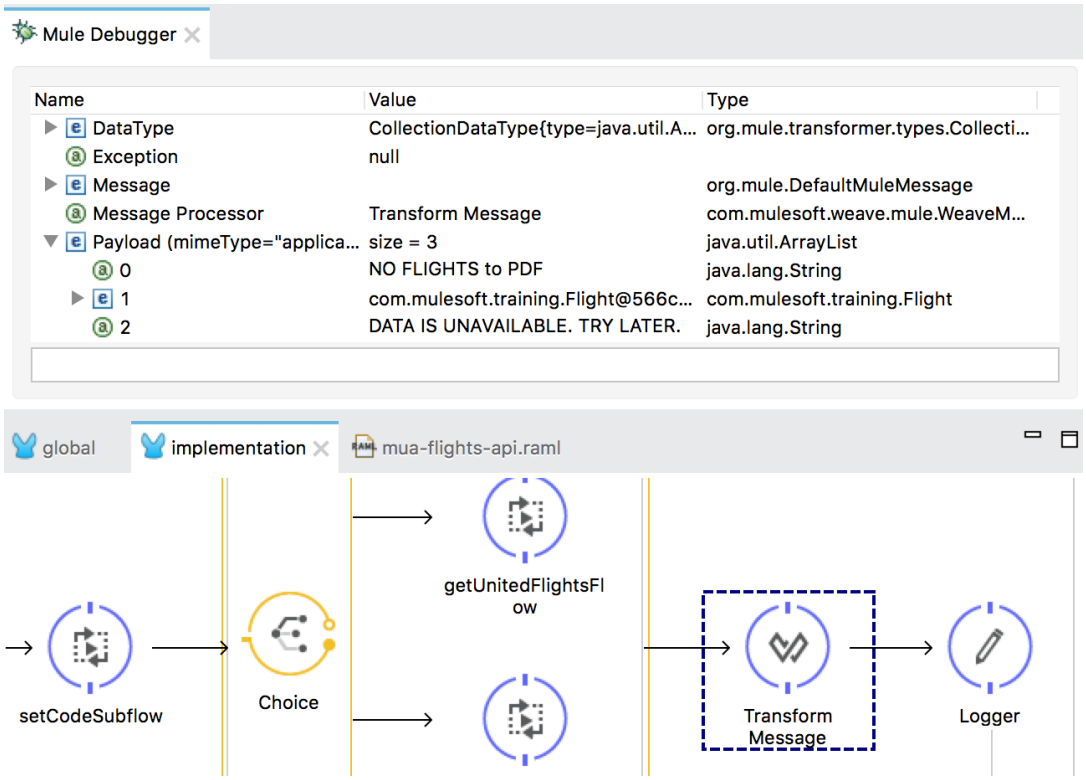
Debug the application

88. Debug the project.
89. In Postman, send the same request to http://localhost:8081/flights?code=PDF.
90. In the Mule Debugger, step through the Delta flow throws an exception that is handled by the default global exception handler.

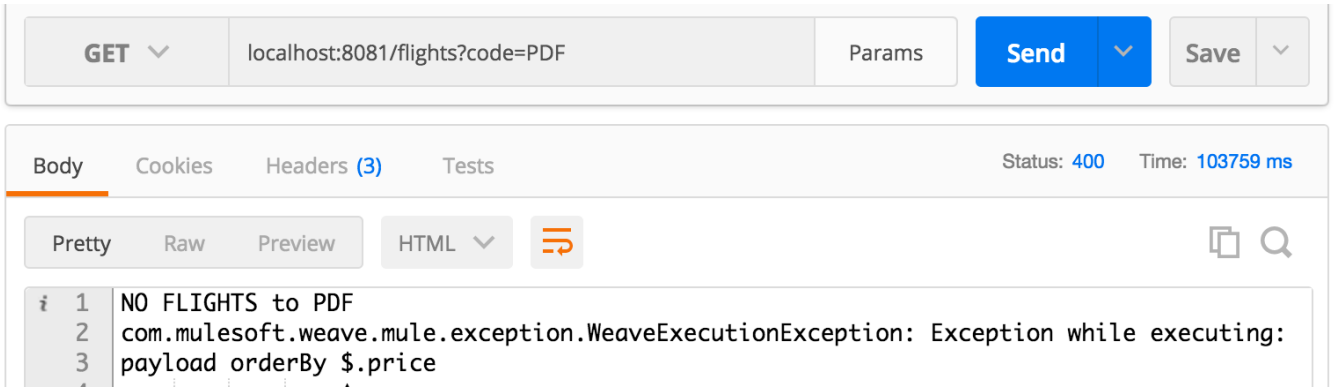
    Note: The American flow also throws an exception that is handled by this choice exception strategy.



91. Continue to step through the application until you reach the Transform Message component in getFlightsFlow; you should see the payload still contains the error messages in addition to the valid flight results to PDF.



92. Step to the end of the application; you should not get the United results to PDF.



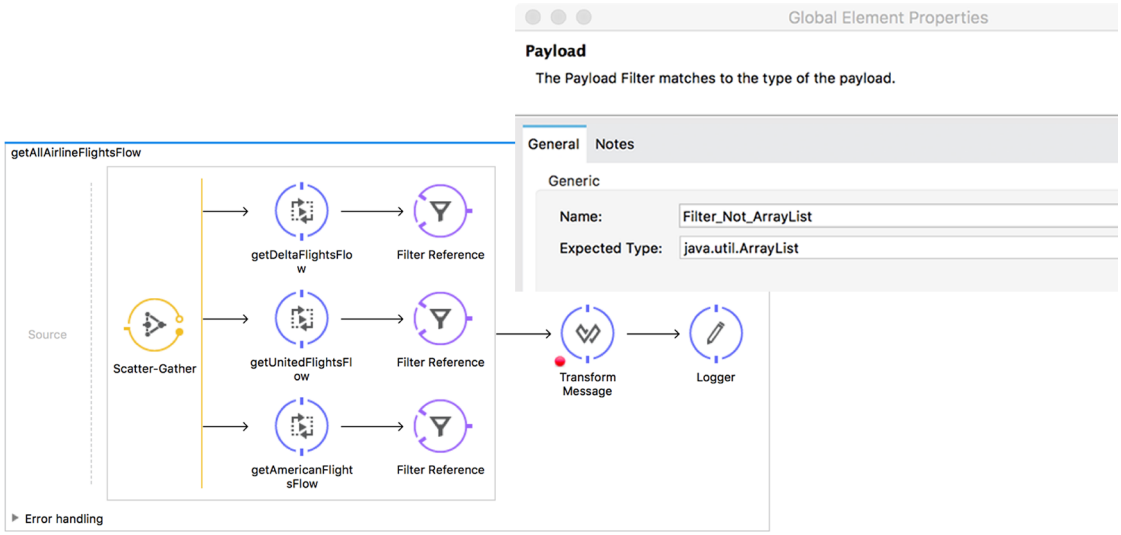
Note: You could write a custom aggregation strategy for the Scatter-Gather router with Java to handle this situation, but instead you will use the simpler approach of filtering out the exception messages in the next walkthrough.

93. Return to Anypoint Studio, stop the project, and switch perspectives.

Walkthrough 10-3: Filter messages

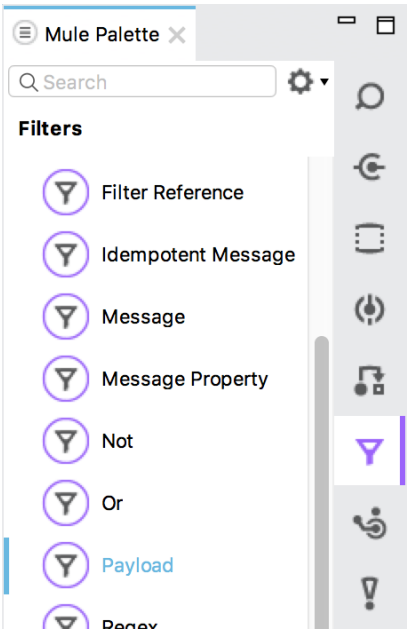
In this walkthrough, you filter the results in the multicast to ensure they are ArrayLists and not exception strings. You will:

- Use the Payload filter.
- Create and use a global filter.



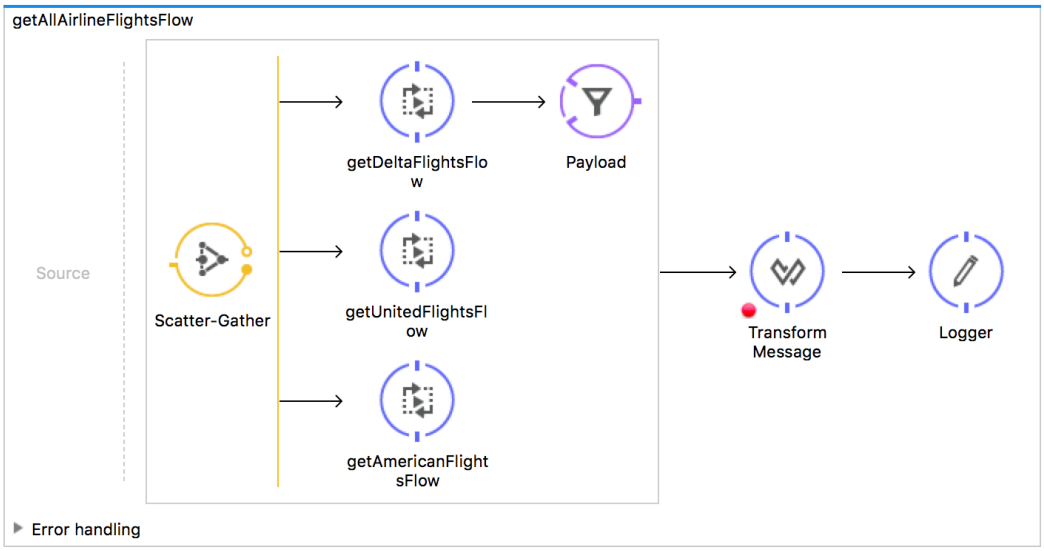
Browse the filter elements in the Mule Palette

1. In the Mule Palette, select the Filters tab.
2. View the available filters.

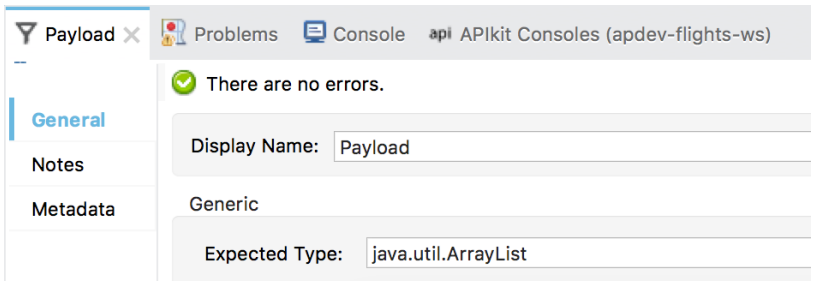


Add a filter

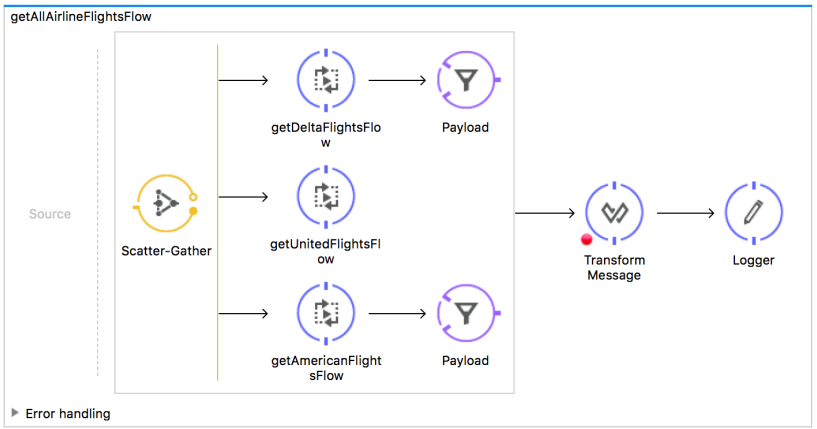
3. Return to getAllAirlineFlightsFlow.
4. Drag out a Payload filter from the Mule Palette and drop it after the getDeltaFlightsFlow reference in the Scatter-Gather.



5. In the Payload properties view, set the expected type to java.util.ArrayList.

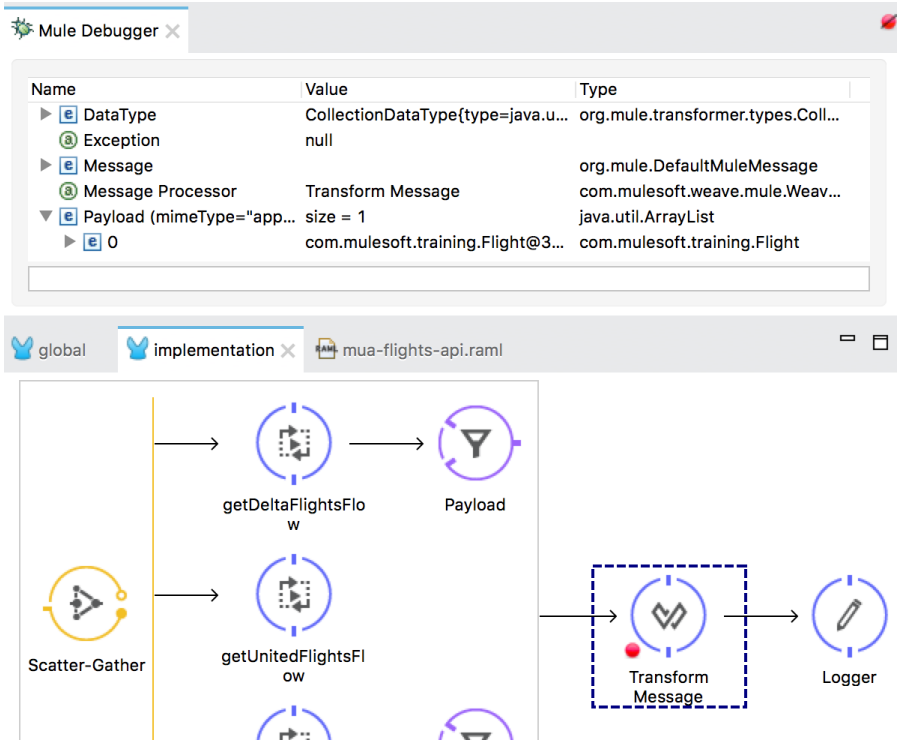


6. Add a Payload filter after the getAmericanFlightsFlow reference and set its expected type to java.util.ArrayList.

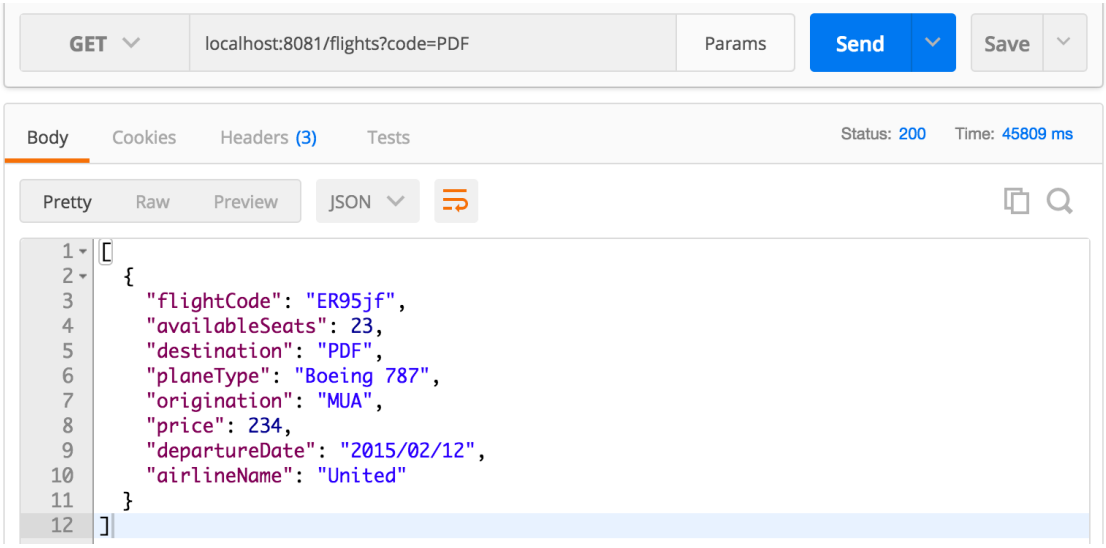


Test the application

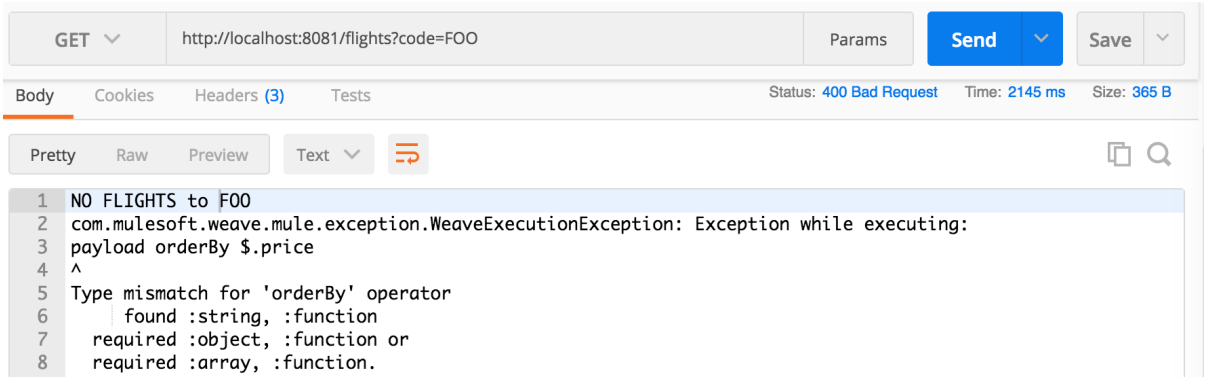
7. Debug the project.
8. In Postman, make the same request to PDF and all airlines.
9. In the Mule Debugger, step to the Transform Message component after the Scatter-Gather; this time you should see the payload does not contain the error strings.



10. Step to the end of the application.
11. In Postman, view the response; you should see the United results to PDF.

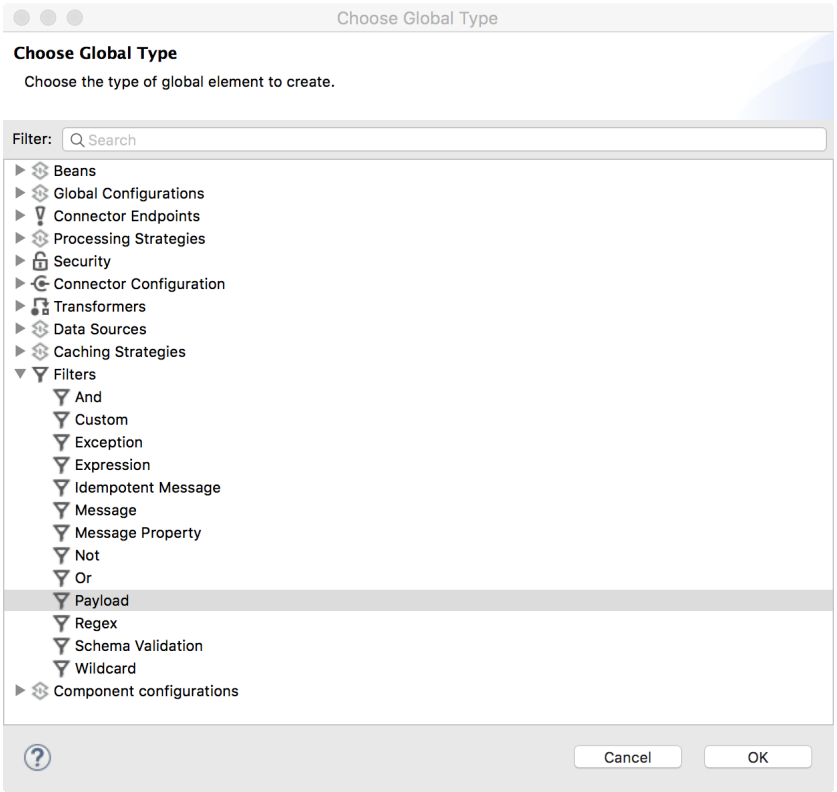


12. Change the code parameter to FOO and send the request.
13. Click Resume until you step through to the end of the application.
14. In Postman, view the response; you should see an error message.

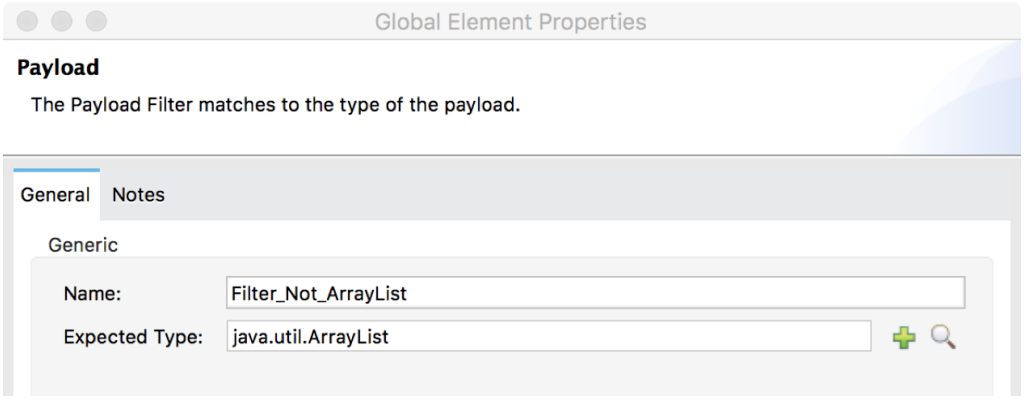


Create a global filter

15. Return to getAllAirlineFlightsFlow in the Mule Design perspective.
16. Delete the Payload filters.
17. Return to global.xml.
18. Switch to the Global Elements view and click Create.
19. In the Choose Global Type dialog box, select Filters > Payload and click OK.

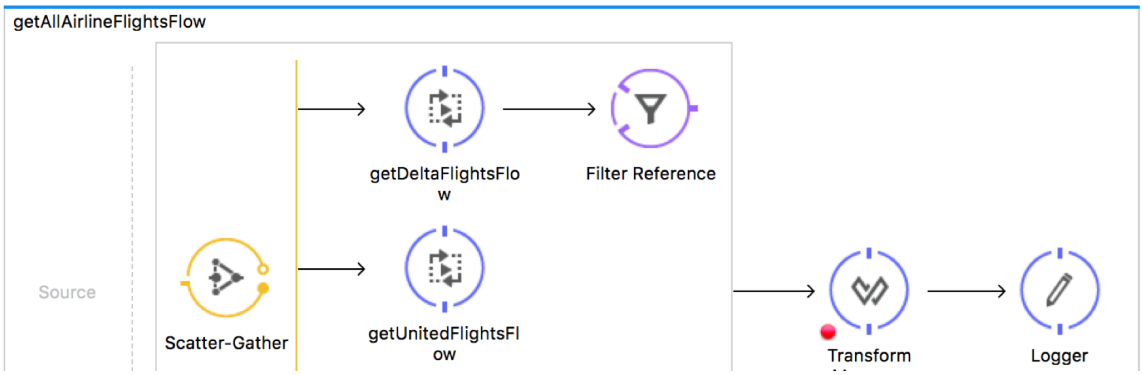


20. In the Global Elements dialog box, set the name to Filter_Not_ArrayList.
21. Set the expected type to java.util.ArrayList and click OK.

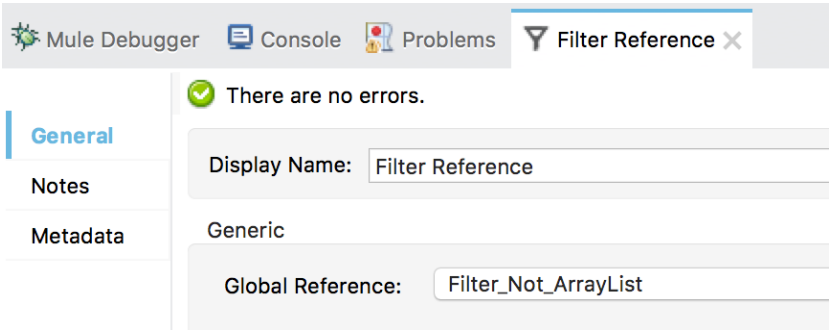


Use the global filter

22. Return to getAllAirlineFlightsFlow in implementation.xml.
23. Drag a Filter Reference from the Mule Palette and drop it after getDeltaFlightsFlow in the Scatter-Gather.

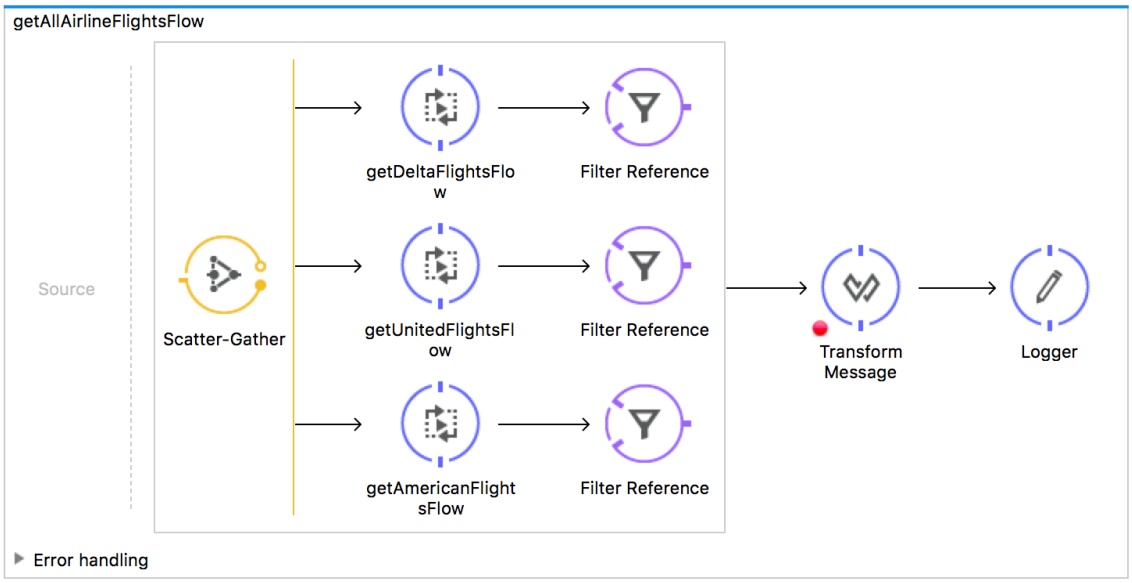


24. In the Filter Reference properties view, set the global reference to Filter_Not_ArrayList.



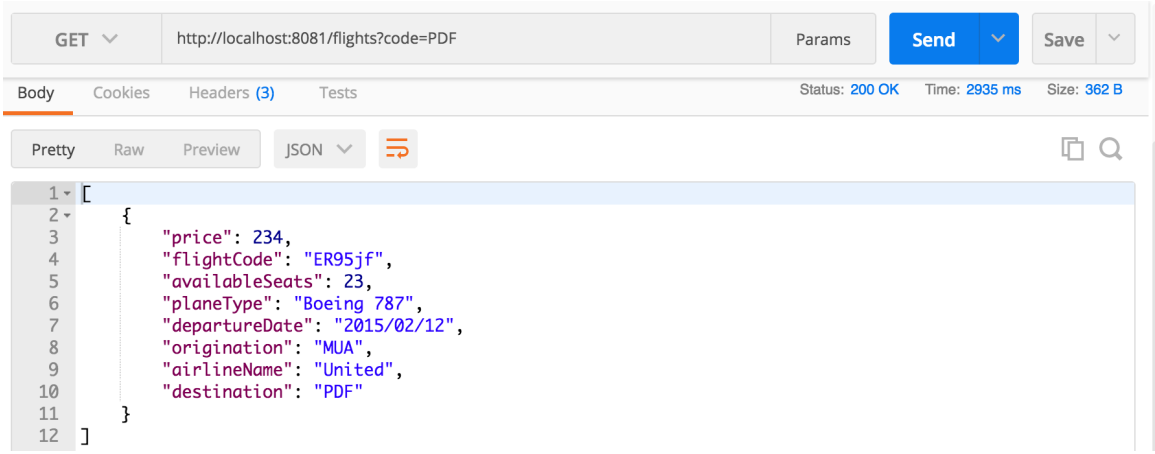
25. Add a Filter Reference after getUnitedFlightsFlow.
26. In the Filter Reference properties view, set the global reference to Filter_Not_ArrayList.
27. Add a Filter Reference after getAmericanFlightsFlow.

28. In the Filter Reference properties view, set the global reference to Filter_Not_ArrayList.

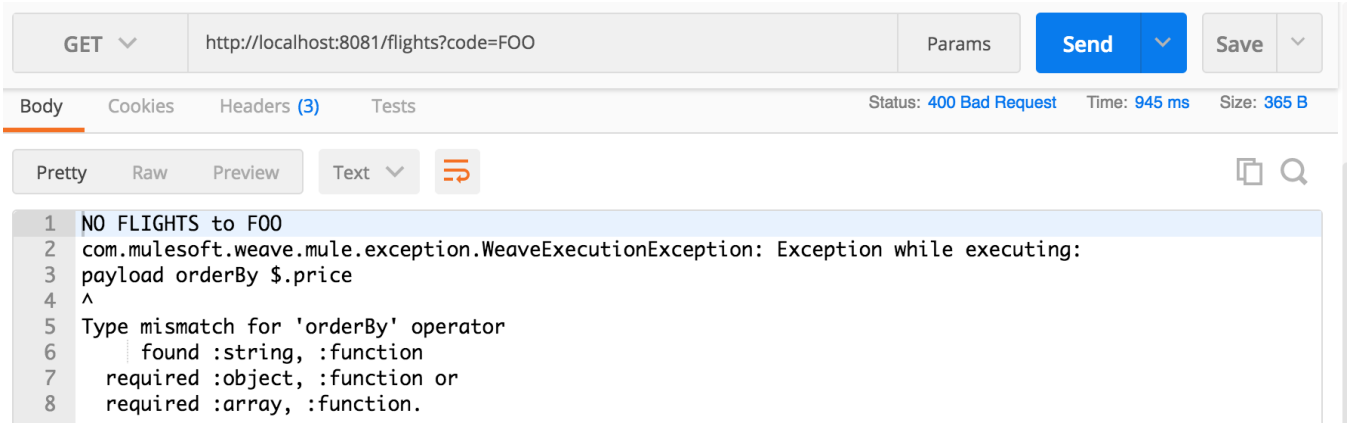


Test the application

29. Debug the project.
30. In Postman, make the same request to http://localhost:8081/flights?code=PDF; you should still get the one United flight.



31. In Postman, make a request to http://localhost:8081/flights?code=FOO; you should correctly get the message that there are no flights to FOO.

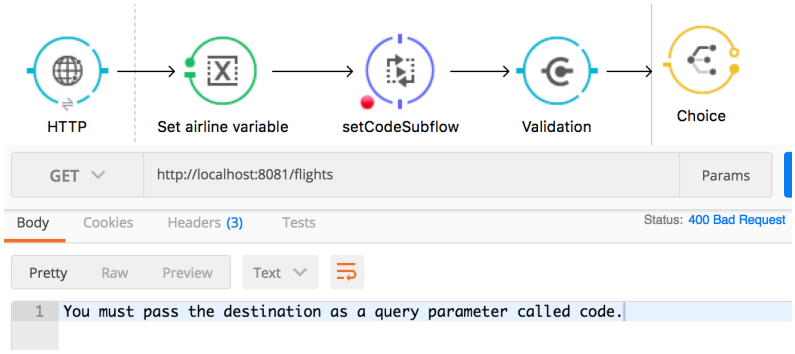


32. Return to Anypoint Studio and stop the project.

Walkthrough 10-4: Validate messages

In this walkthrough, you modify the application to require a destination code be sent to it as a query parameter and then use a validator to make sure a value is sent and to throw an exception if it is not. You will:

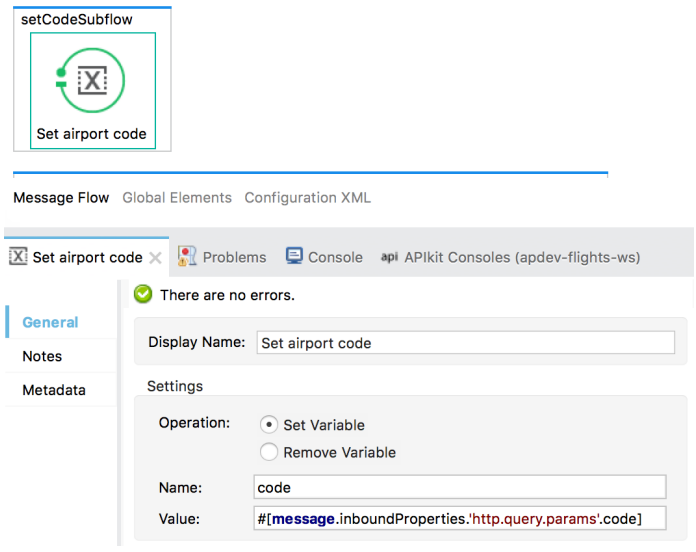
- Require a destination code to be passed to the application as a query parameter.
- Use the Validation component to throw an exception if the query parameter is not set.
- Catch the exception in the global exception strategy and return an appropriate message.



Require a destination code to be specified

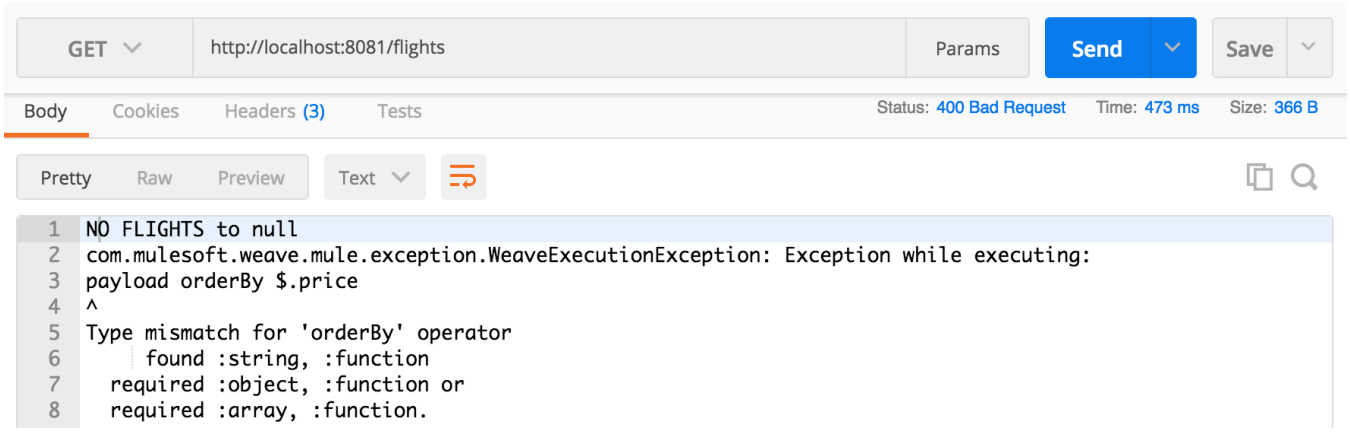
1. Return to getFlightsFlow and locate the setCodeSubflow flow reference.
2. Locate the setCodeSubflow subflow and review the value set for the code flow variable.
3. Delete the ternary expression and instead just set the flow variable to the value of the code query parameter.

```
#[message.inboundProperties.'http.query.params'.code]
```



Test the application

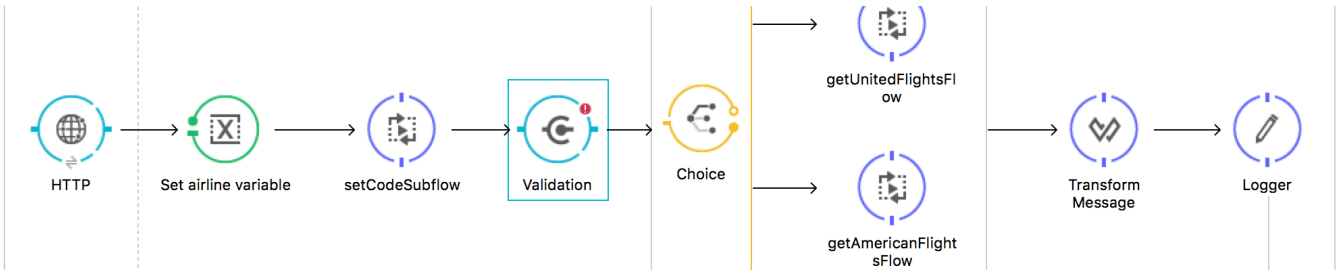
4. Run the project.
5. In Postman, make a request to http://localhost:8081/flights; you should get an incorrect message that there are no flights to null.



6. Return to Anypoint Studio and stop the project.

Add a validator

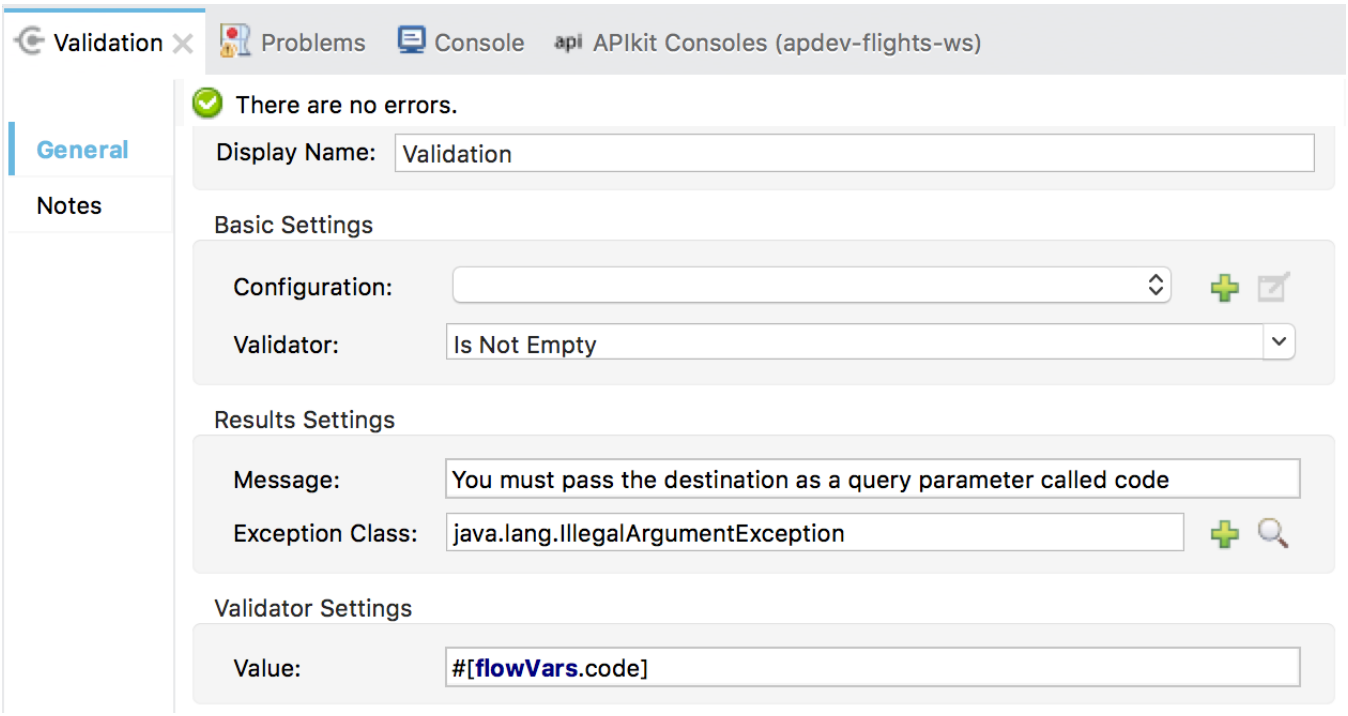
7. Return to getFlightsFlow.
8. Drag out a Validation component from the Mule Palette and drop it after the setCodeSubflow flow reference.



Configure the validator

9. In the Validation properties view, set the validator to Is Not Empty.
10. Set the value to #[flowVars.code].
11. Set the message to You must pass the destination as a query parameter called code.
12. Set the Exception class to java.lang.IllegalArgumentException.

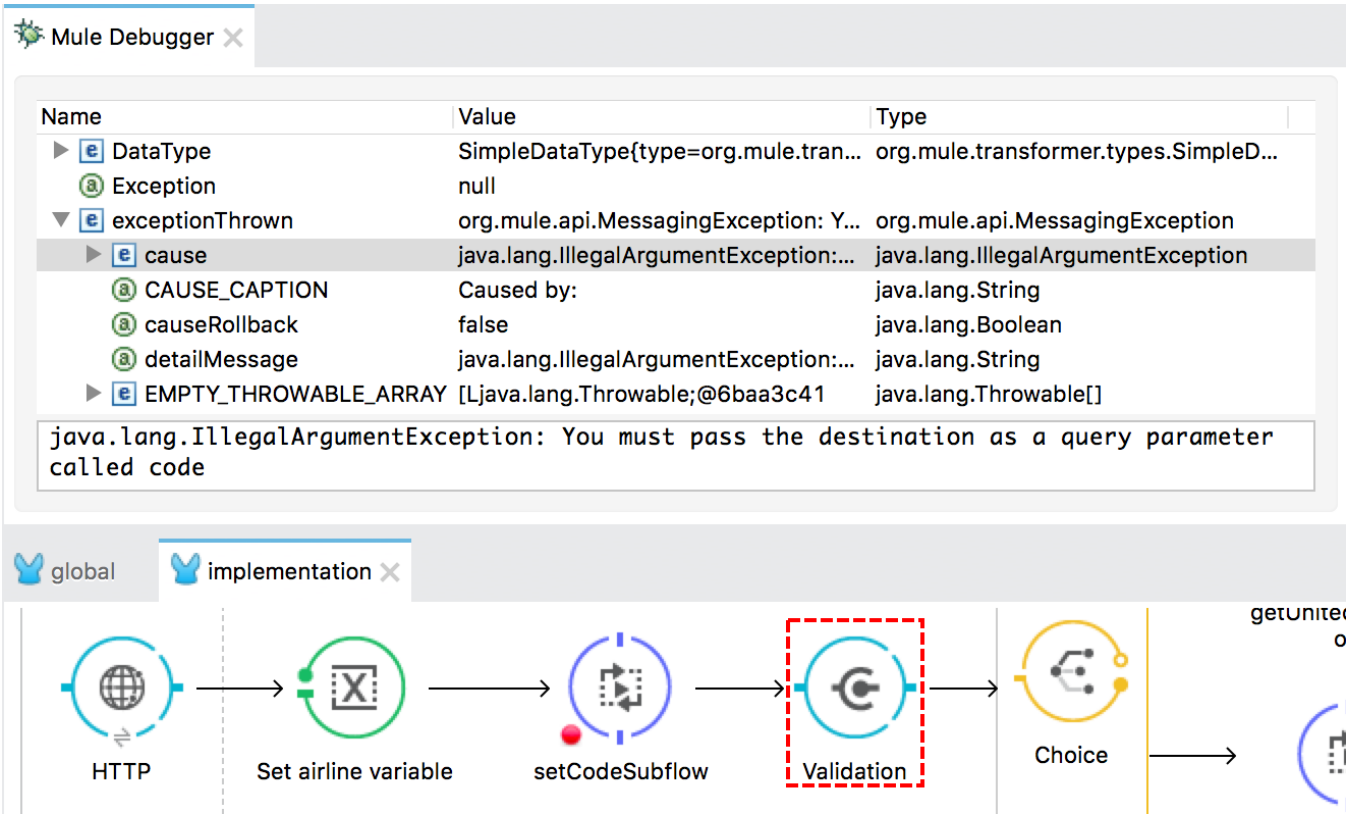
    Note: If you do not set an exception type, it will default to be of type org.mule.extension.validation.api.ValidationException.



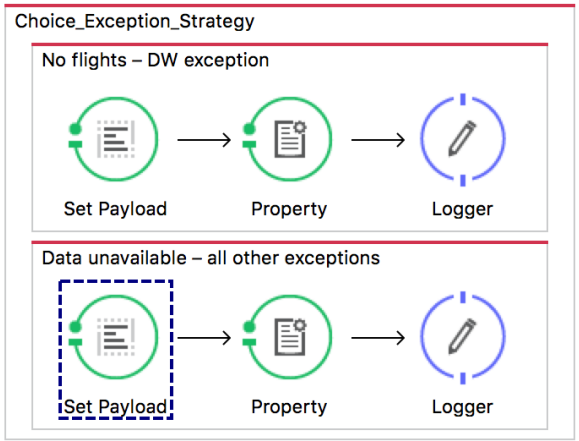
Test the application

13. Place a breakpoint on the setCodeSubflow flow reference.
14. Debug the project.
15. In Postman, make the same request to http://localhost:8081/flights.

16. In the Mule Debugger, step to the Validation component and look at the exception it throws.



17. Step again; you should move into the Data unavailable catch exception strategy in global.xml.

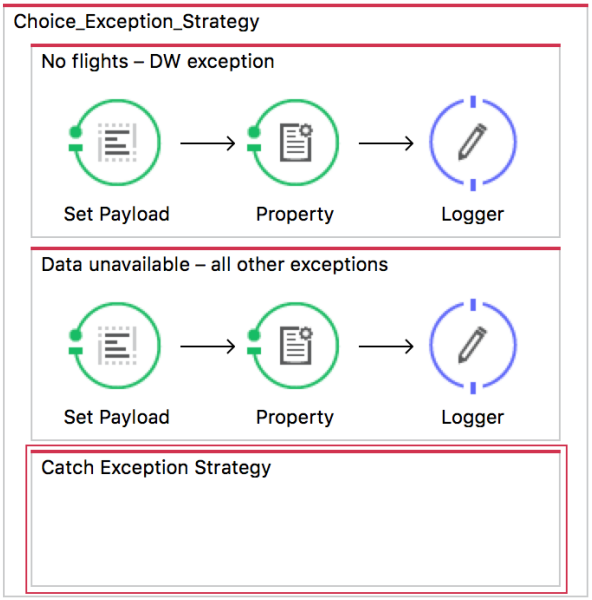


18. Step to the end of the application.

Add a catch exception strategy

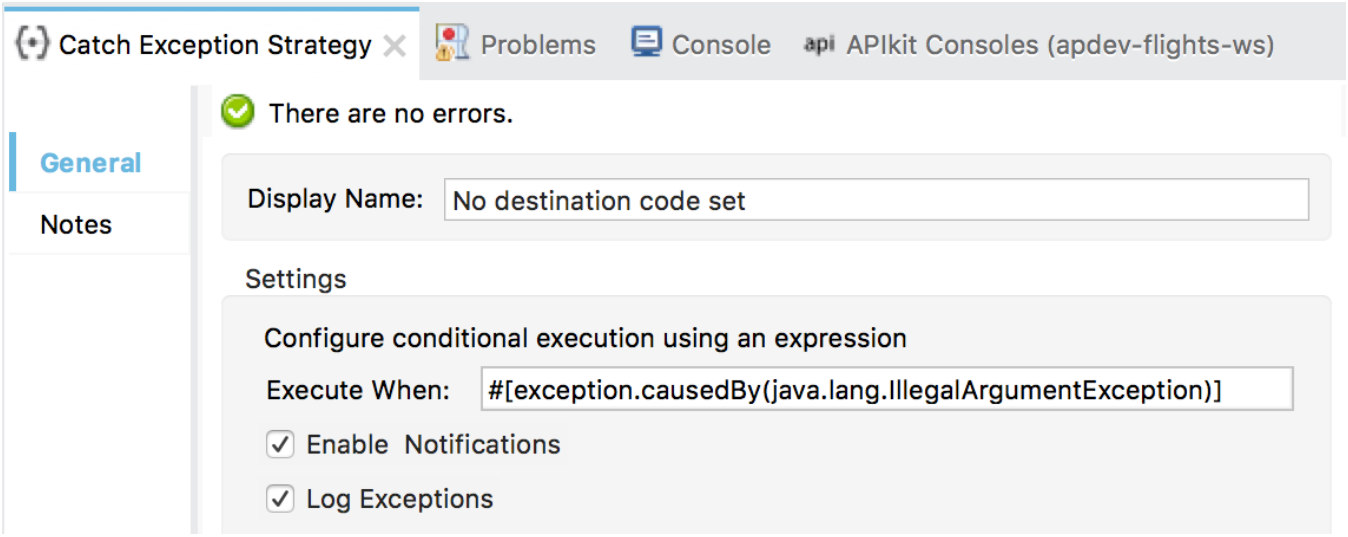
19. Return to global.xml.

20. Drag a Catch Exception Strategy form the Mule Palette and drop it in the choice exception strategy.

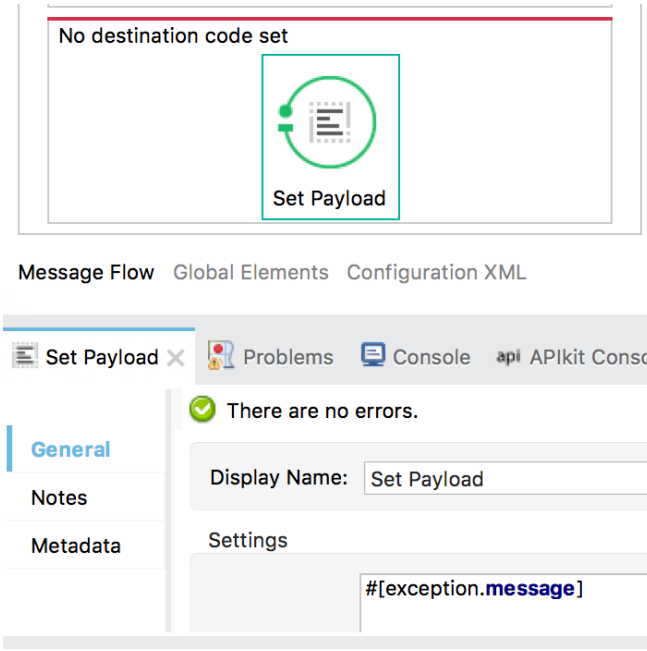


21. In the Properties view for this catch strategy, set the display name to No destination code set.
22. Specify to execute this catch strategy when the exception is of type java.util.IllegalArgumentException.

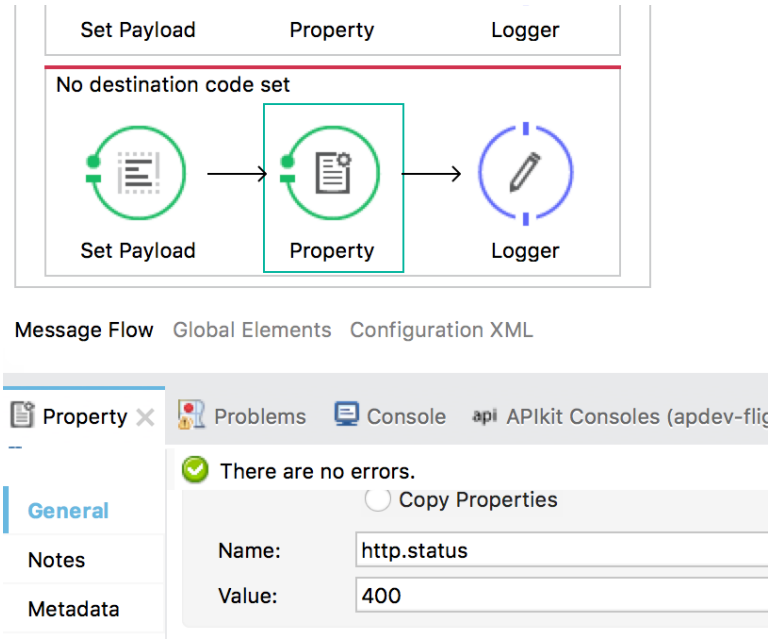
```
#[exception.causedBy(java.lang.IllegalArgumentException)]
```



23. Add a Set Payload transformer to the catch strategy and set the value to the message property of the exception.



24. Add a Property transformer and set a property with the name http.status and a value of 400.
25. Add a Logger component.



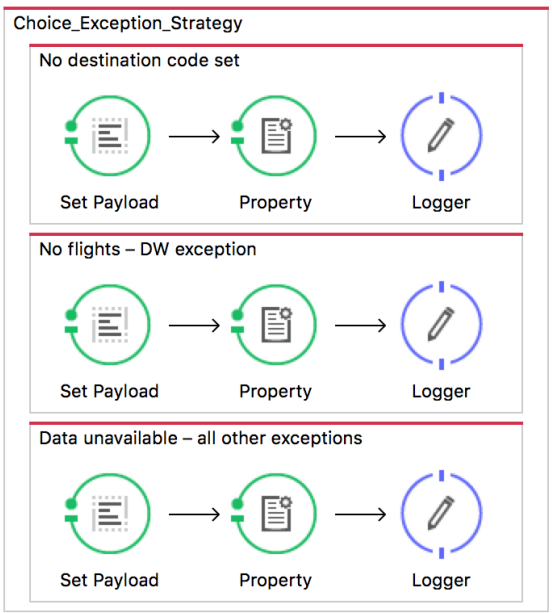
26. Switch to the Configuration XML view.

27. Move this catch exception strategy so it is the first strategy in the choice exception strategy.

```
*global   implementation

22
23      <choice-exception-strategy name="Choice_Exception_Strategy">
24          <catch-exception-strategy when="#[exception.causedBy(java.lang.IllegalArgumentEx
25              <set-payload value="#[exception.message]" doc:name="Set Payload"/>
26              <set-property propertyName="http.status" value="400" doc:name="Property"/>
27              <logger level="INFO" doc:name="Logger"/>
28          </catch-exception-strategy>
29          <catch-exception-strategy when="#[exception.causeMatches('com.mulesoft.weave.*')
30              <set-payload value="NO FLIGHTS to #[flowVars.code +  '\n' + exception]" doc:
31              <set-property propertyName="http.status" value="400" doc:name="Property"/>
32              <logger level="INFO" doc:name="Logger"/>
33          </catch-exception-strategy>
34      <catch-exception-strategy doc:name="Data unavailable &#8211; all other exceptions">
35          <set-payload value="DATA IS UNAVAILABLE. TRY LATER. #['\n' + exception] " doc:na
36          <set-property propertyName="http.status" value="500" doc:name="Property"/>
37          <logger level="INFO" doc:name="Logger"/>
38      </catch-exception-strategy>
39
40      </choice-exception-strategy>
```

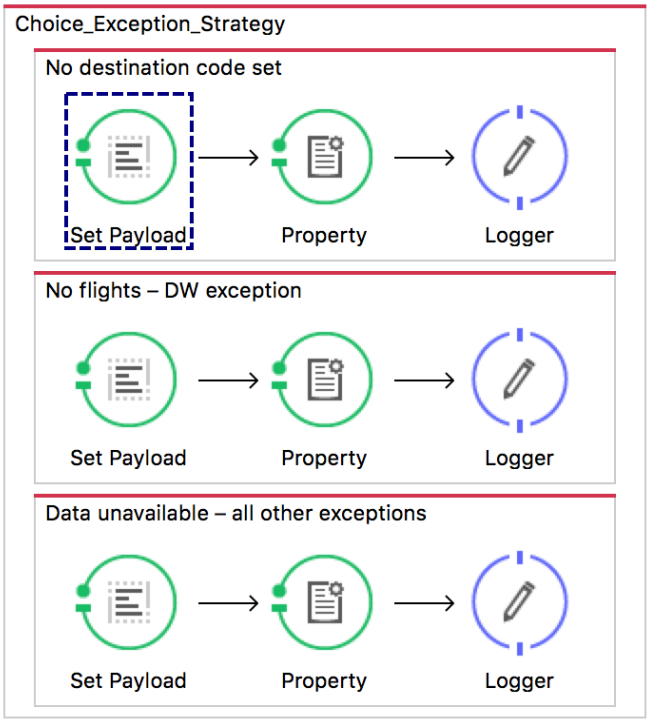
28. Return to the Message Flow view; the default catch exception strategy should now be at the bottom.



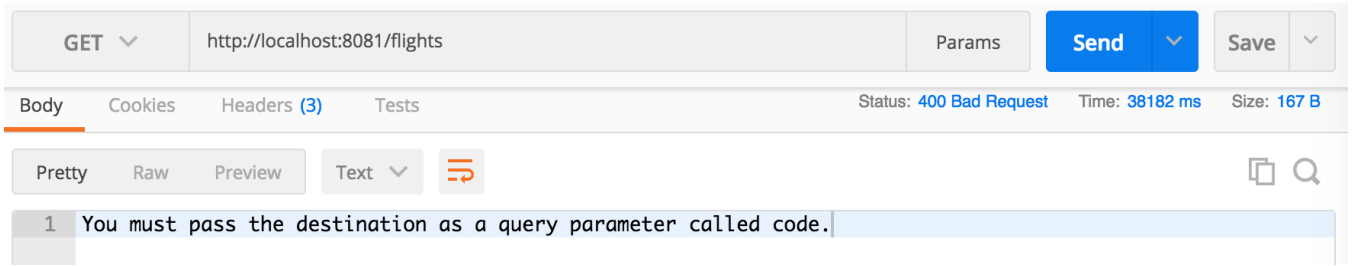
Test the application

29. Debug the project.
30. In Postman, make the same request to http://localhost:8081/flights.

31. In the Mule Debugger, step past the Validation component into the exception strategy; this time, you should move into the No destination code set strategy.



32. Step to the end of the application.
33. In Postman, you should see the You must pass the destination as a code query parameter message.



34. Return to Anypoint Studio, stop the project, and switch perspectives.
35. Close the project.