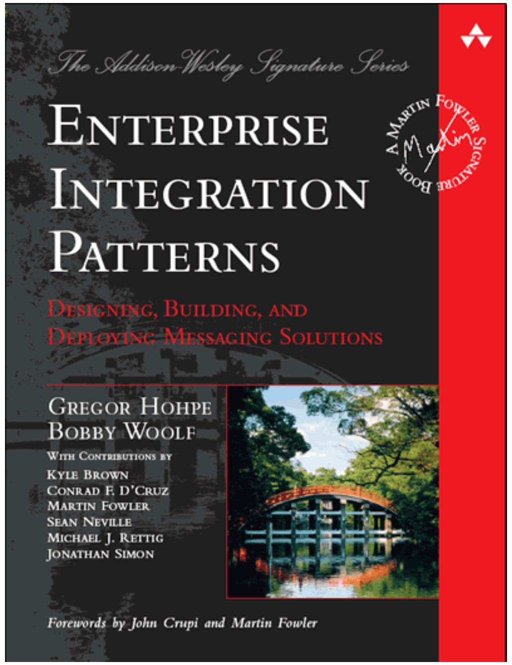
Enterprise Application Integration

Lesson 3
Anypoint and Mule
Tips

Hanzehogeschool Groningen
University of Applied Sciences

Mind map for this EAI course



The Addison-Wesley Signature Series

ENTERPRISE INTEGRATION PATTERNS

DESIGNING, BUILDING, AND DEPLOYING MESSAGING SOLUTIONS

A Martin Fowler Signature Book

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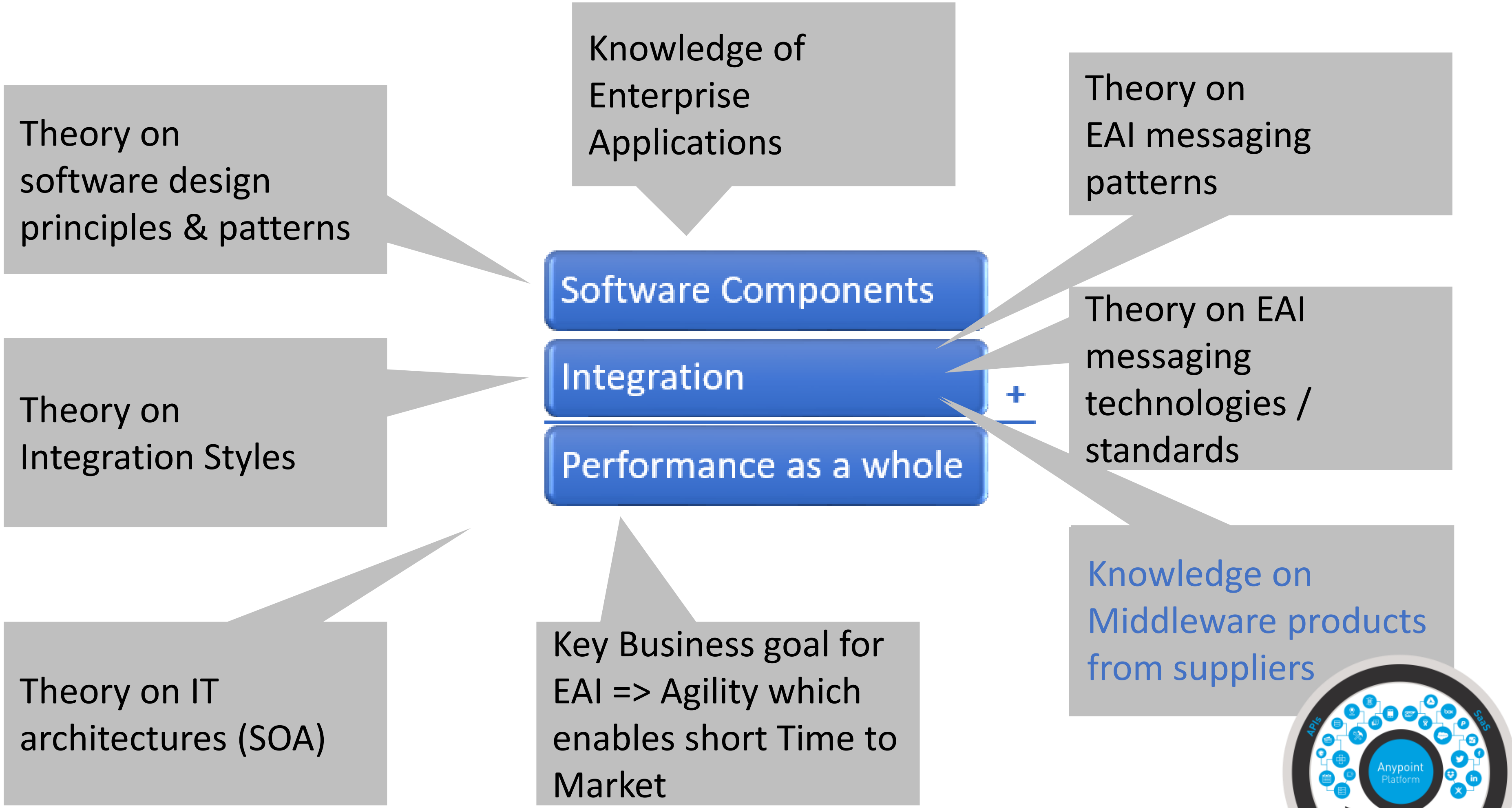
Forewords by John Crupi and Martin Fowler



Knowledge of Enterprise Applications

Theory on software design principles & patterns

Theory on EAI messaging patterns

Software Components

Integration

Performance as a whole

+

Theory on Integration Styles

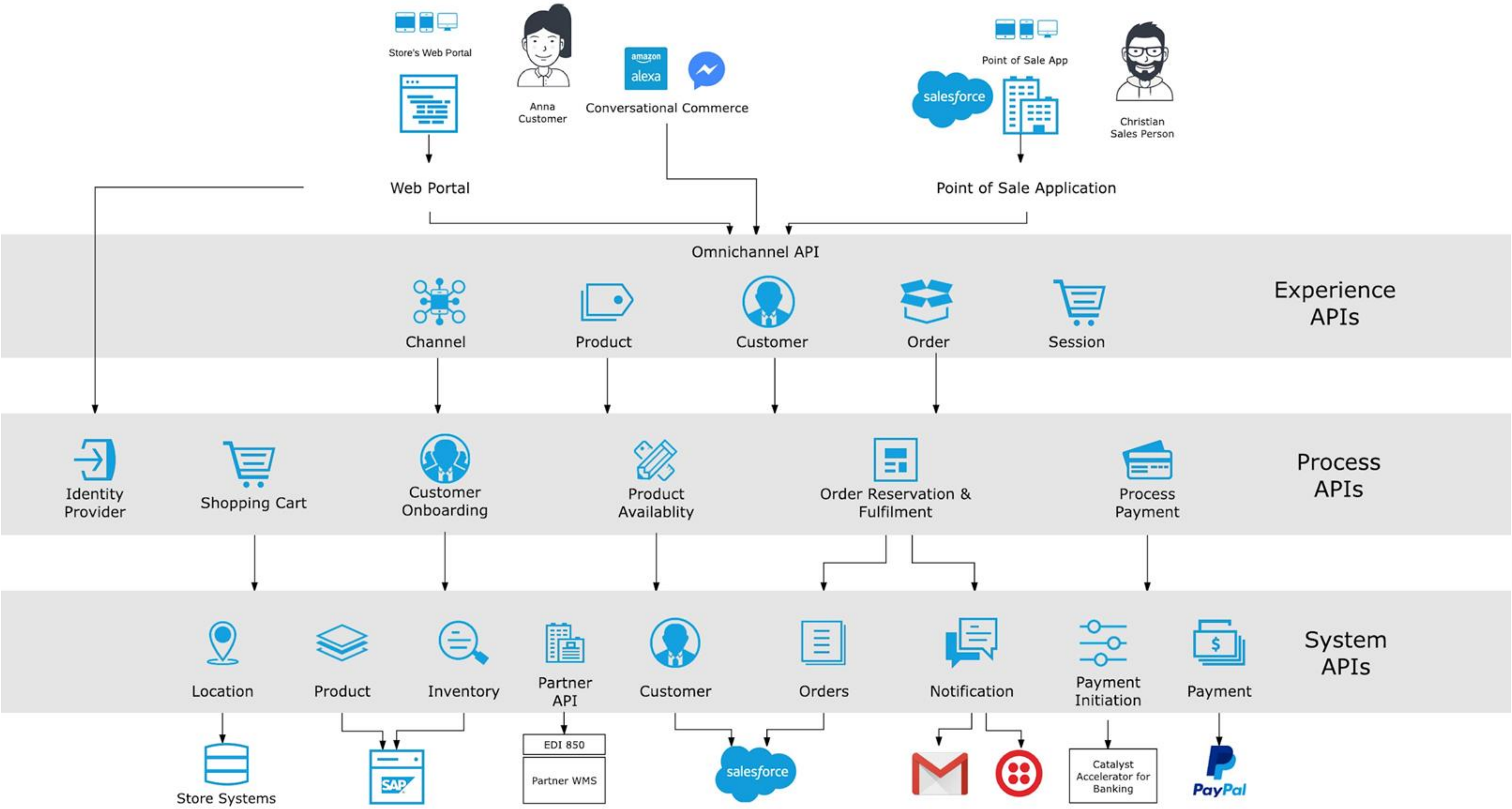
Theory on EAI messaging technologies / standards

Theory on IT architectures (SOA)

Key Business goal for EAI => Agility which enables short Time to Market

Knowledge on Middleware products from suppliers

Example of integrated business applications /distributed systems



Store's Web Portal

Anna
Customer

Conversational Commerce

Point of Sale App

Christian
Sales Person

Web Portal

Point of Sale Application

Omnichannel API

Experience APIs

Channel

Product

Customer

Order

Session

Process APIs

Identity Provider

Shopping Cart

Customer Onboarding

Product Availablity

Order Reservation & Fulfilment

Process Payment

System APIs

Location

Product

Inventory

Partner API

Customer

Orders

Notification

Payment Initiation

Payment

Store Systems

EDI 850

Partner WMS

Catalyst Accelerator for Banking

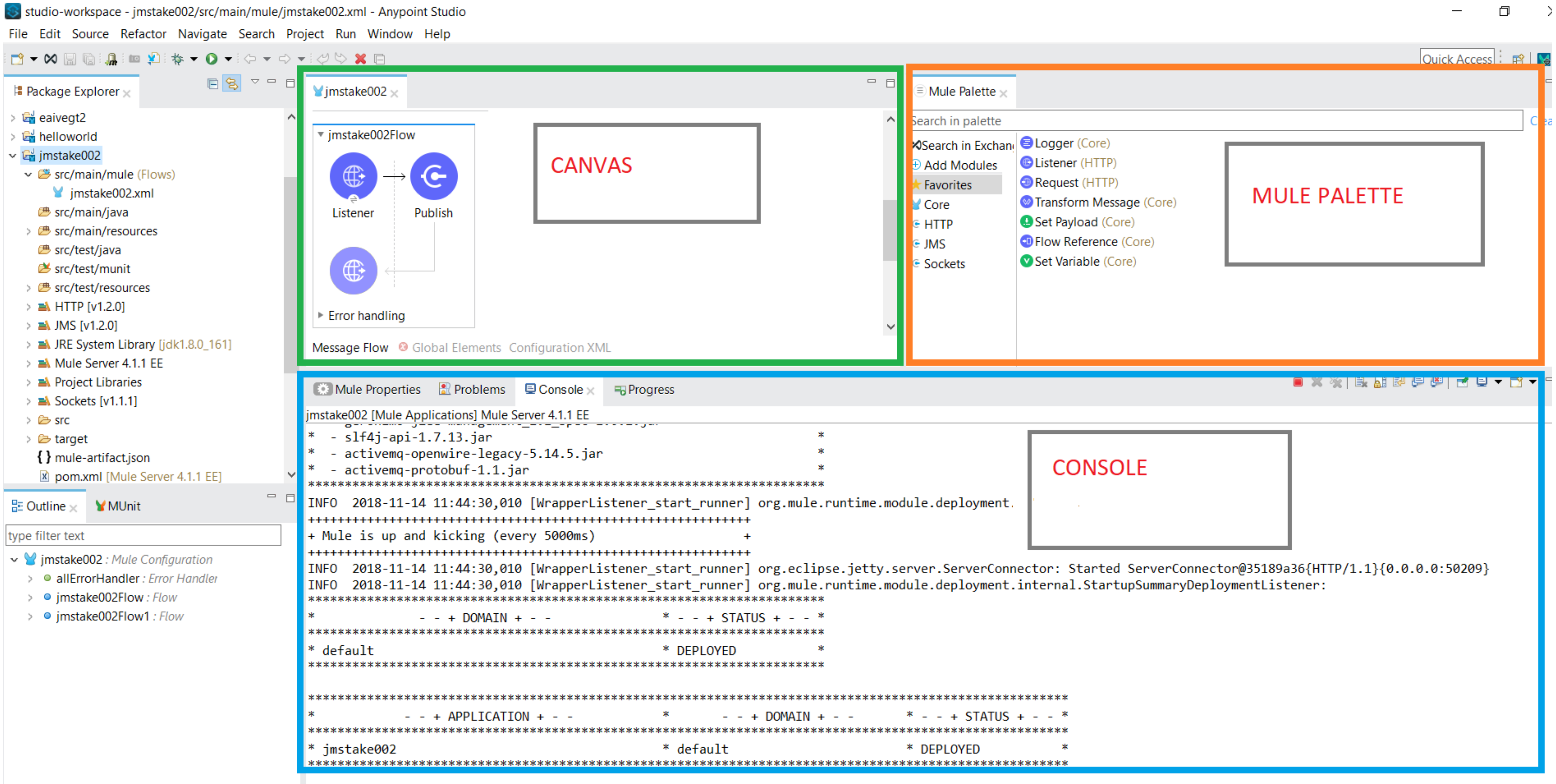
Getting started with Anypoint Studio

Anypoint
Platform
APIs
SaaS
SOA

- Mulesoft is the supplier of Anypoint Studio.
- Because it serves the implementation of several Integration Styles this product belongs to the software category Hybrid Integration Platform.
- It is an implementation of an Enterprise Service Bus Architecture (ESB).

  Anypoint Studio supports amongst others :
  - Asynchronous messaging
  - File transfer
  - Streaming

Anypoint Studio Workspace



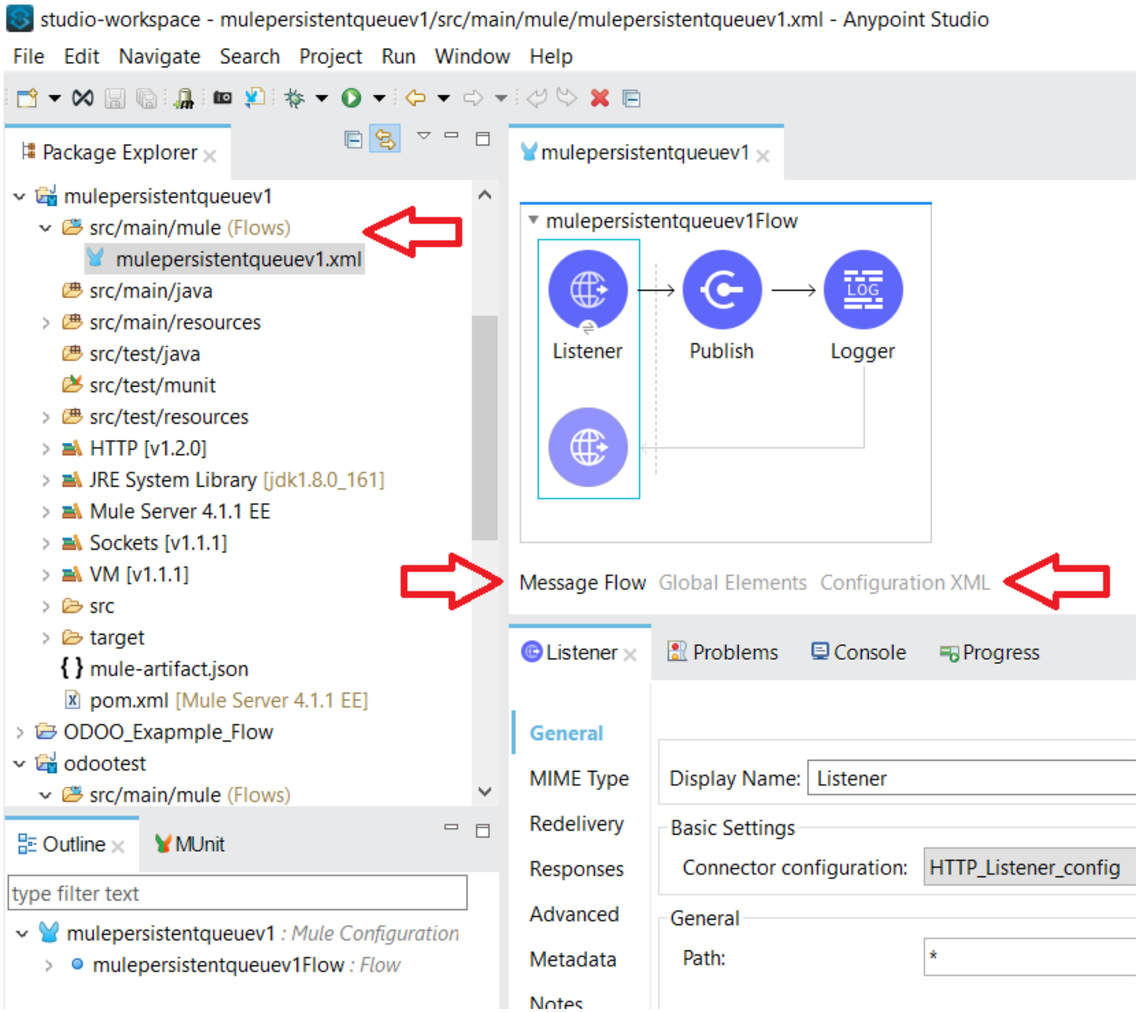
jmstake002 [Mule Applications] Mule Server 4.1.1 EE

```
*  - slf4j-api-1.7.13.jar                                              *
*  - activemq-openwire-legacy-5.14.5.jar                               *
*  - activemq-protobuf-1.1.jar                                         *
***********************************************************************
INFO  2018-11-14 11:44:30,010 [WrapperListener_start_runner] org.mule.runtime.module.deployment.
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
+ Mule is up and kicking (every 5000ms)                     +
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
INFO  2018-11-14 11:44:30,010 [WrapperListener_start_runner] org.eclipse.jetty.server.ServerConnector: Started ServerConnector@35189a36{HTTP/1.1}{0.0.0.0:50209}
INFO  2018-11-14 11:44:30,010 [WrapperListener_start_runner] org.mule.runtime.module.deployment.internal.StartupSummaryDeploymentListener:
***********************************************************************
*              - - + DOMAIN + - -               * - - + STATUS + - - *
***********************************************************************
* default                                       * DEPLOYED           *
***********************************************************************

*********************************************************************************************************
*             - - + APPLICATION + - -           *        - - + DOMAIN + - -       * - - + STATUS + - - *
*********************************************************************************************************
* jmstake002                                    * default                         * DEPLOYED           *
*********************************************************************************************************
```

Anypoint Studio Basics
Mule app and Flows

- The Canvas in the workspace shows the message flows of a Mule App.
- Drag components from the palette to the canvas. This will automatically update the configuration xml for the flows in the Mule app.
- The bottom window shows the configuration details per component.



General

Display Name: Listener

Basic Settings

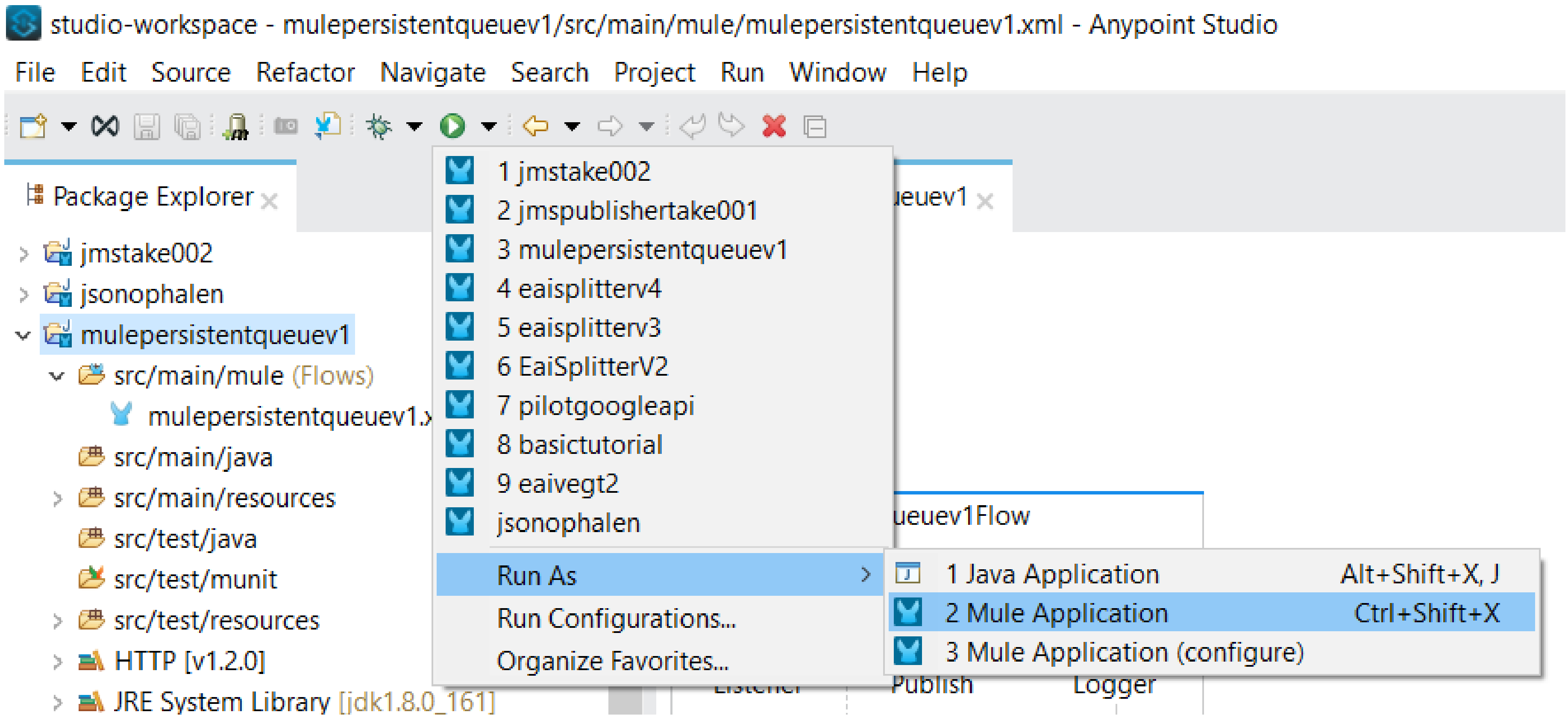
Connector configuration: HTTP_Listener_config

General

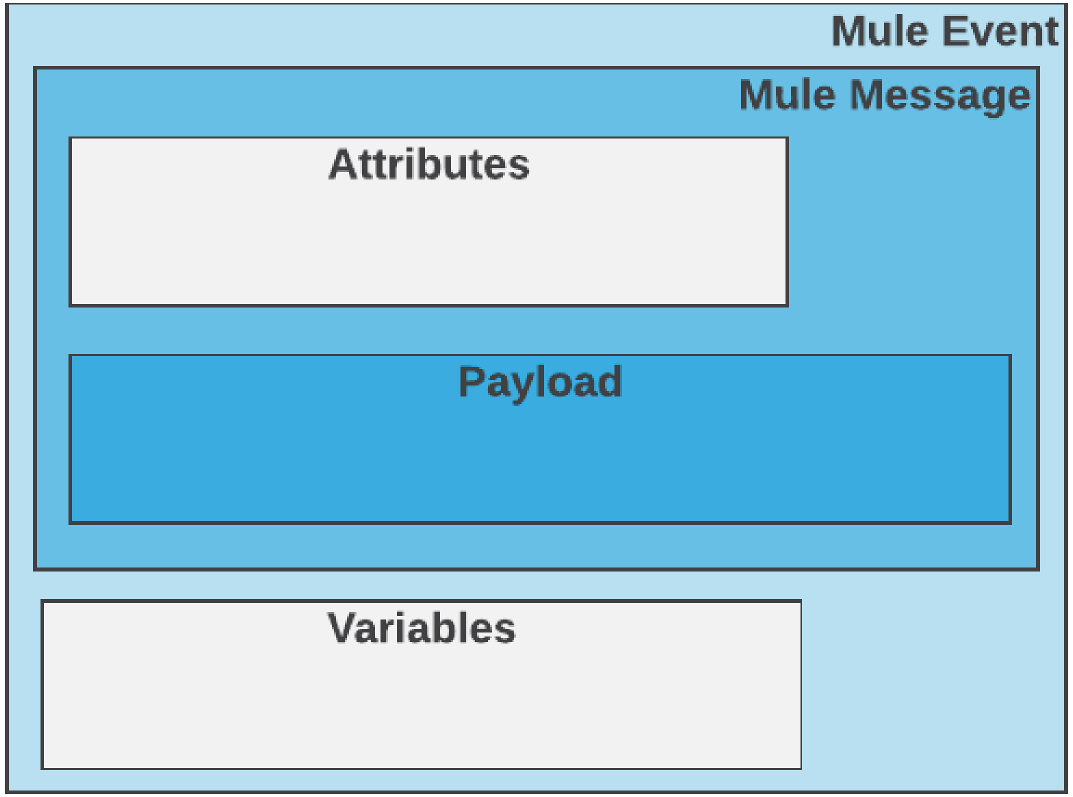
Path: *

Anypoint Studio Basics

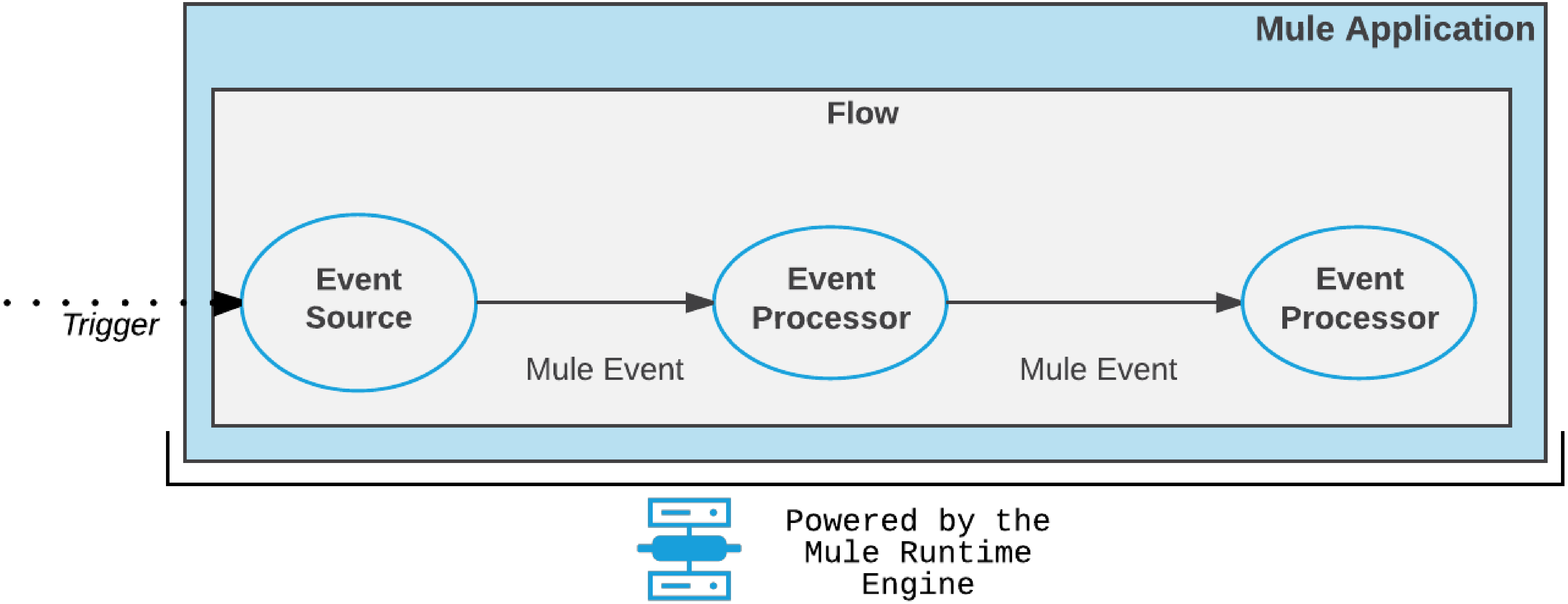
Run it as Mule Application



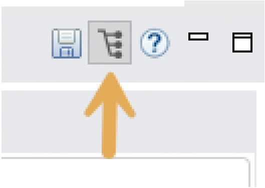
Mule Event structure

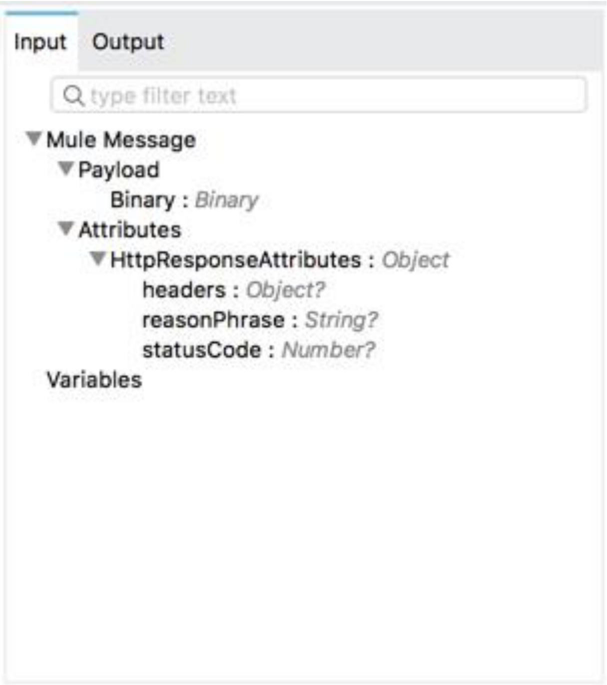


Components in a Flow serve as Mule Event Processors

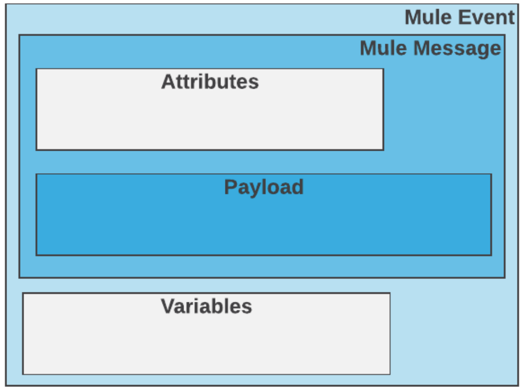


The Data Sense explorer shows the data structure of the Mule Event etc.





```
▼ Mule Message
    ▼ Payload
        Binary : Binary
    ▼ Attributes
        ▼ HttpResponseAttributes : Object
            headers : Object?
            reasonPhrase : String?
            statusCode : Number?
  Variables
```



Mule Event

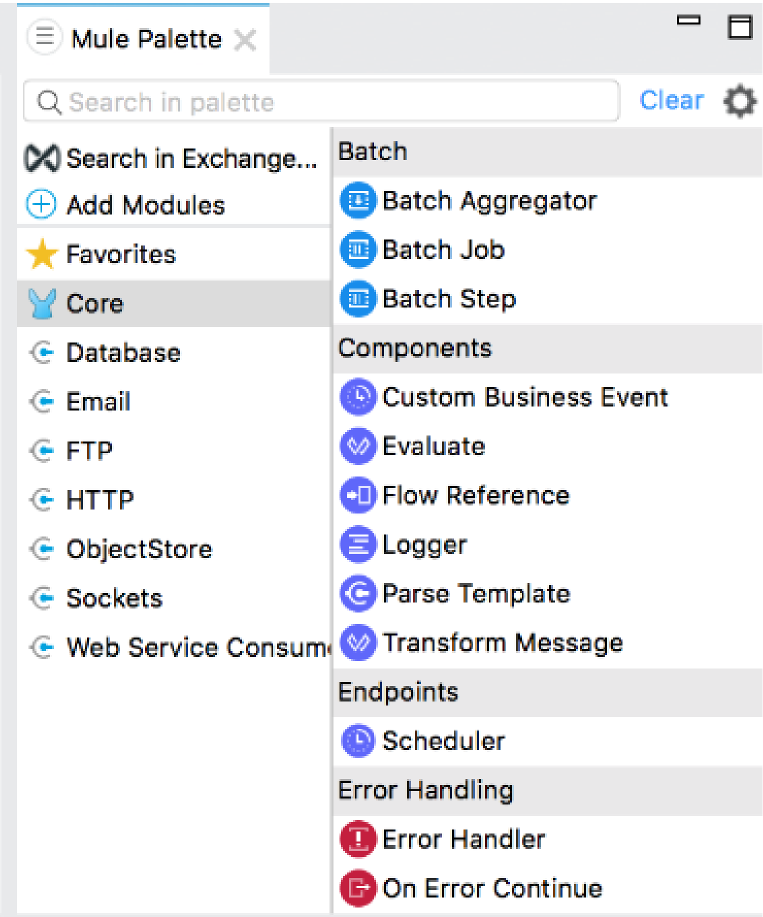
Mule Message

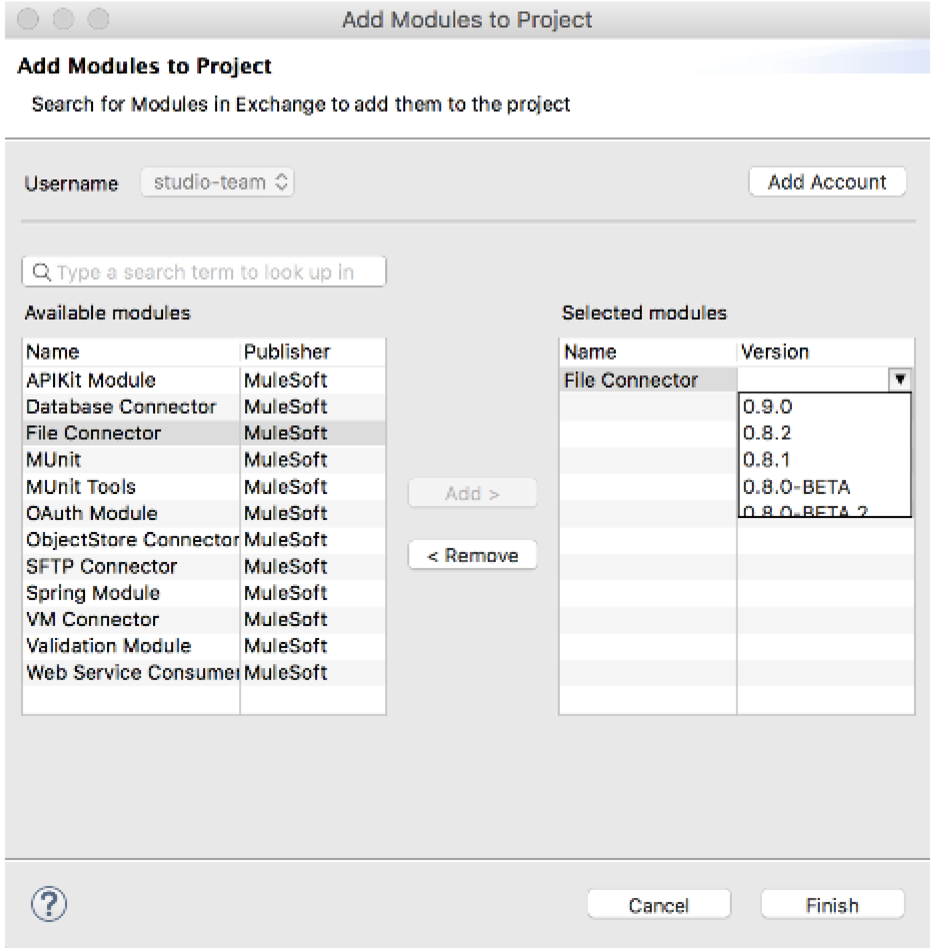
Attributes

Payload

Variables

Component Modules can be added in the Mule Palette





Add Modules to Project

Search for Modules in Exchange to add them to the project

Username: studio-team

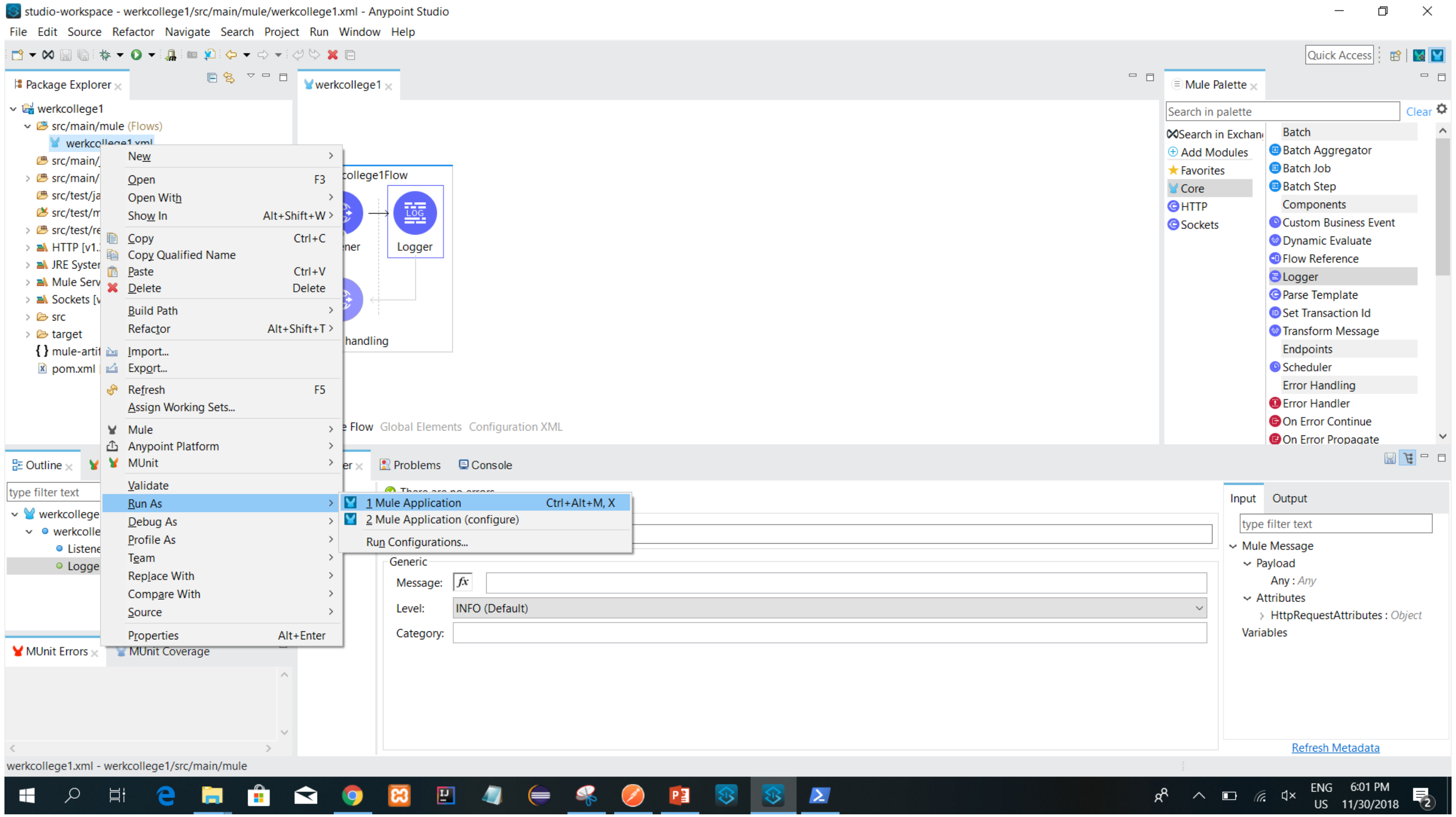
Available modules

Name	Publisher
APIKit Module	MuleSoft
Database Connector	MuleSoft
File Connector	MuleSoft
MUnit	MuleSoft
MUnit Tools	MuleSoft
OAuth Module	MuleSoft
ObjectStore Connector	MuleSoft
SFTP Connector	MuleSoft
Spring Module	MuleSoft
VM Connector	MuleSoft
Validation Module	MuleSoft
Web Service Consumer	MuleSoft

Selected modules

Name	Version
File Connector	0.9.0 0.8.2 0.8.1 0.8.0-BETA 0.8.0-BETA.2

Save & run as Mule Application



studio-workspace - werkcollege1/src/main/mule/werkcollege1.xml - Anypoint Studio

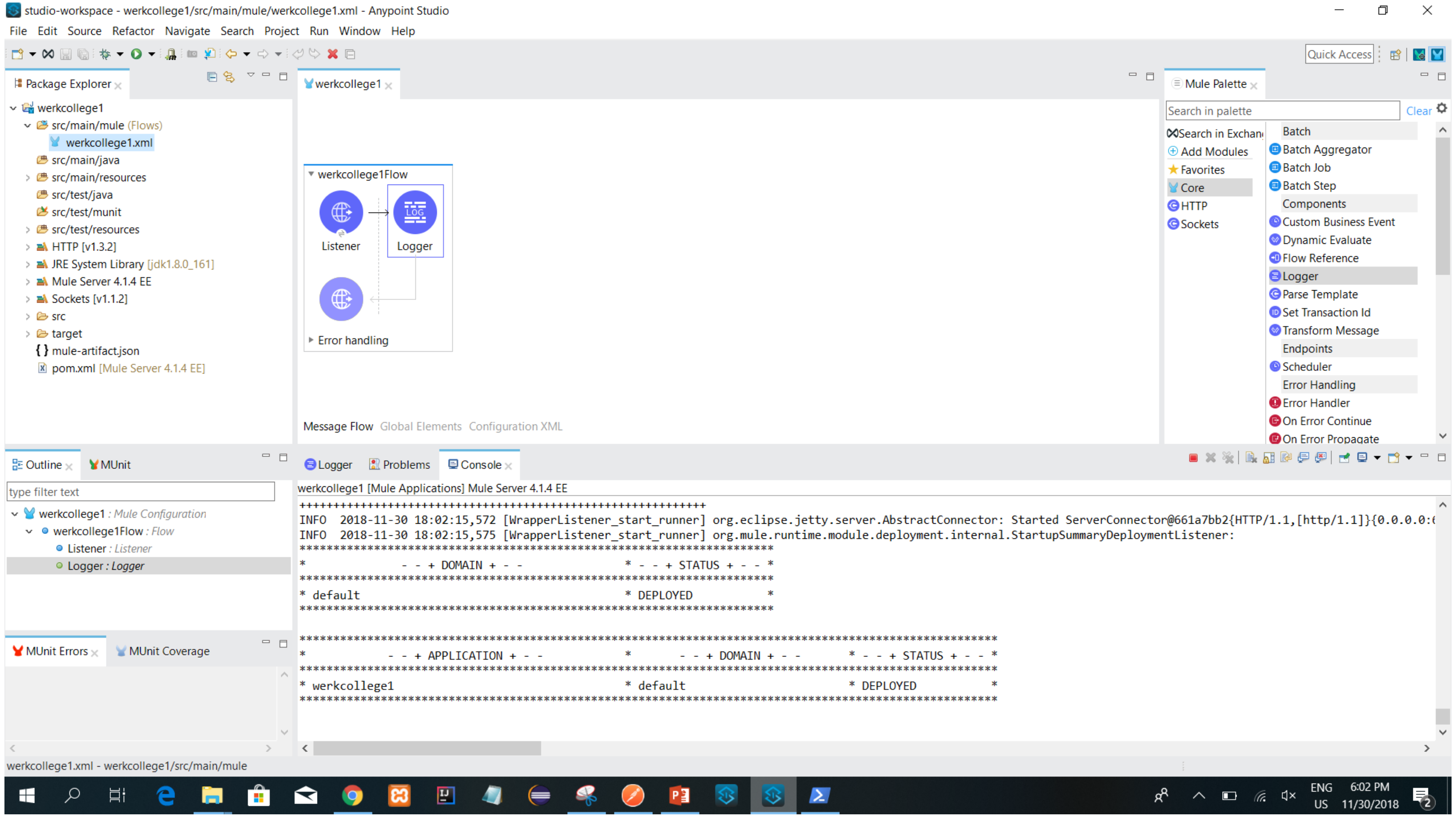
Message:

Level: INFO (Default)

Category:

werkcollege1.xml - werkcollege1/src/main/mule

Verify that both the Mule runtime and the Mule Application is Deployed

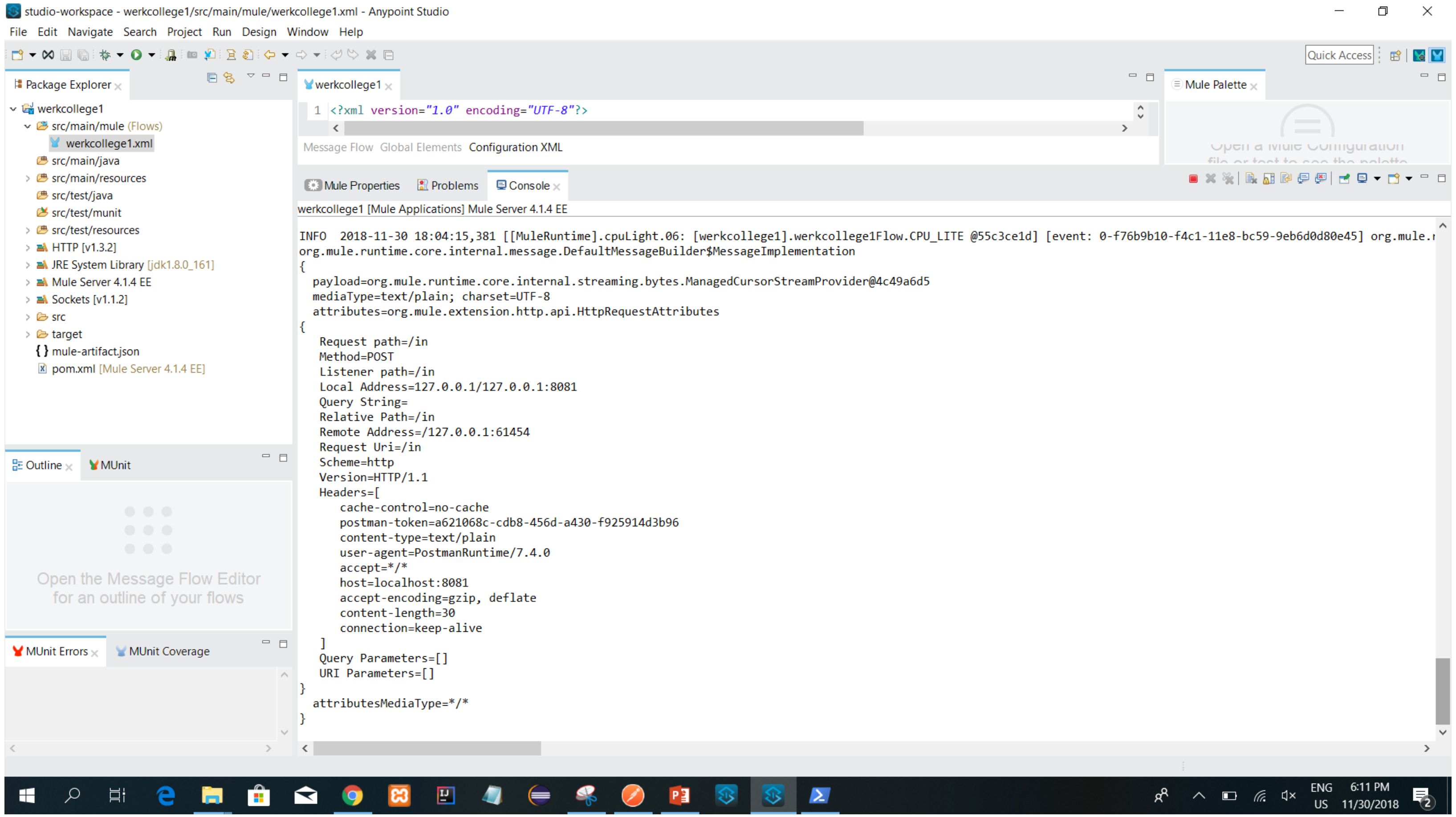


werkcollege1 [Mule Applications] Mule Server 4.1.4 EE

```
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
INFO  2018-11-30 18:02:15,572 [WrapperListener_start_runner] org.eclipse.jetty.server.AbstractConnector: Started ServerConnector@661a7bb2{HTTP/1.1,[http/1.1]}{0.0.0.0:
INFO  2018-11-30 18:02:15,575 [WrapperListener_start_runner] org.mule.runtime.module.deployment.internal.StartupSummaryDeploymentListener:
**********************************************************************
*              - - + DOMAIN + - -               * - - + STATUS + - - *
**********************************************************************
* default                                       * DEPLOYED           *
**********************************************************************

********************************************************************************************************
*            - - + APPLICATION + - -            *       - - + DOMAIN + - -        * - - + STATUS + - - *
********************************************************************************************************
* werkcollege1                                  * default                         * DEPLOYED           *
********************************************************************************************************
```

The logger component shows the message attributes. However the payload is not visible.

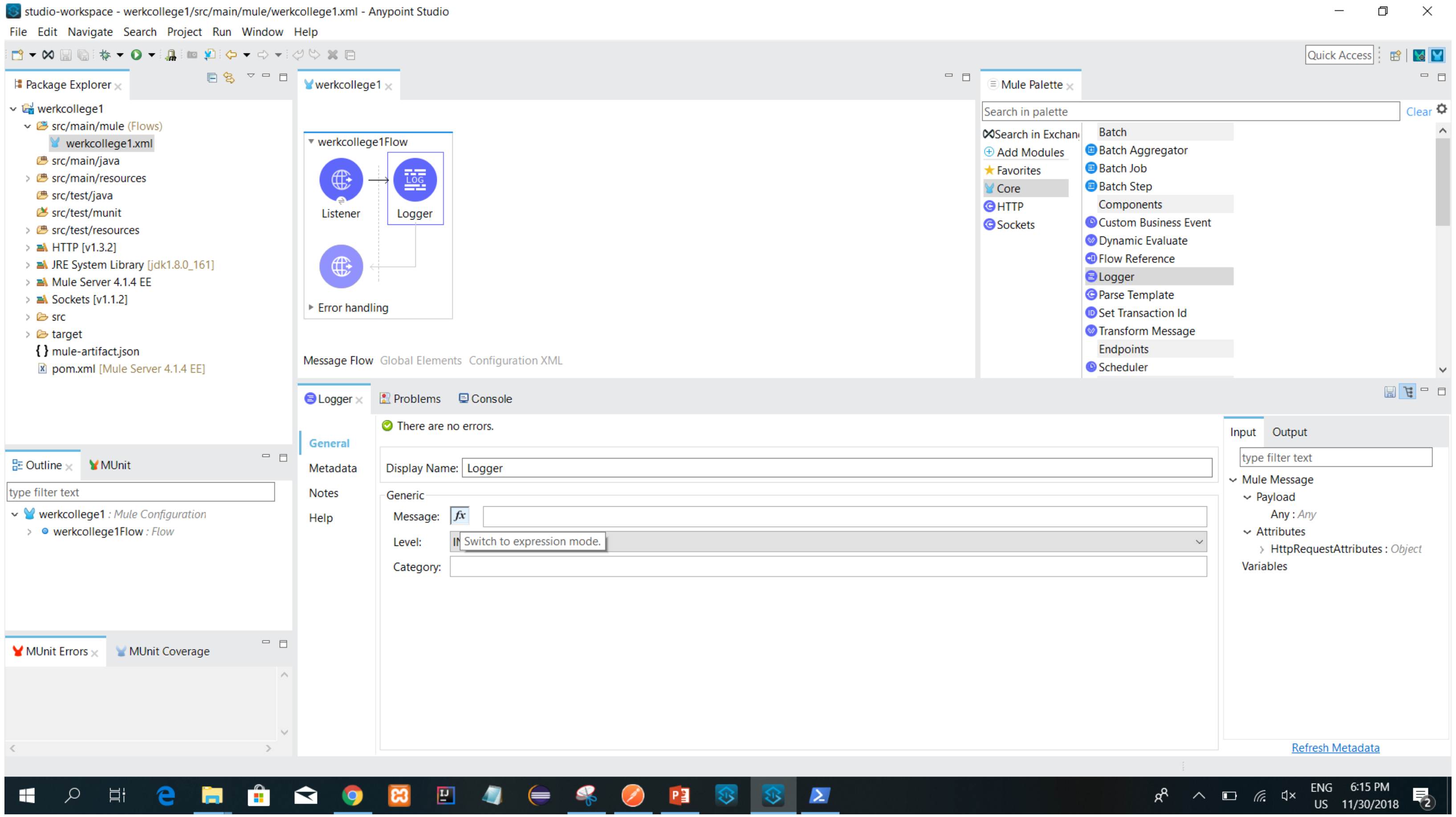


```
<?xml version="1.0" encoding="UTF-8"?>
```

werkcollege1 [Mule Applications] Mule Server 4.1.4 EE

```
INFO  2018-11-30 18:04:15,381 [[MuleRuntime].cpuLight.06: [werkcollege1].werkcollege1Flow.CPU_LITE @55c3ce1d] [event: 0-f76b9b10-f4c1-11e8-bc59-9eb6d0d80e45] org.mule.
org.mule.runtime.core.internal.message.DefaultMessageBuilder$MessageImplementation
{
  payload=org.mule.runtime.core.internal.streaming.bytes.ManagedCursorStreamProvider@4c49a6d5
  mediaType=text/plain; charset=UTF-8
  attributes=org.mule.extension.http.api.HttpRequestAttributes
{
   Request path=/in
   Method=POST
   Listener path=/in
   Local Address=127.0.0.1/127.0.0.1:8081
   Query String=
   Relative Path=/in
   Remote Address=/127.0.0.1:61454
   Request Uri=/in
   Scheme=http
   Version=HTTP/1.1
   Headers=[
      cache-control=no-cache
      postman-token=a621068c-cdb8-456d-a430-f925914d3b96
      content-type=text/plain
      user-agent=PostmanRuntime/7.4.0
      accept=*/*
      host=localhost:8081
      accept-encoding=gzip, deflate
      content-length=30
      connection=keep-alive
   ]
   Query Parameters=[]
   URI Parameters=[]
}
  attributesMediaType=*/*
}
```

Add a message in the Logger component



studio-workspace - werkcollege1/src/main/mule/werkcollege1.xml - Anypoint Studio

There are no errors.

Display Name: Logger

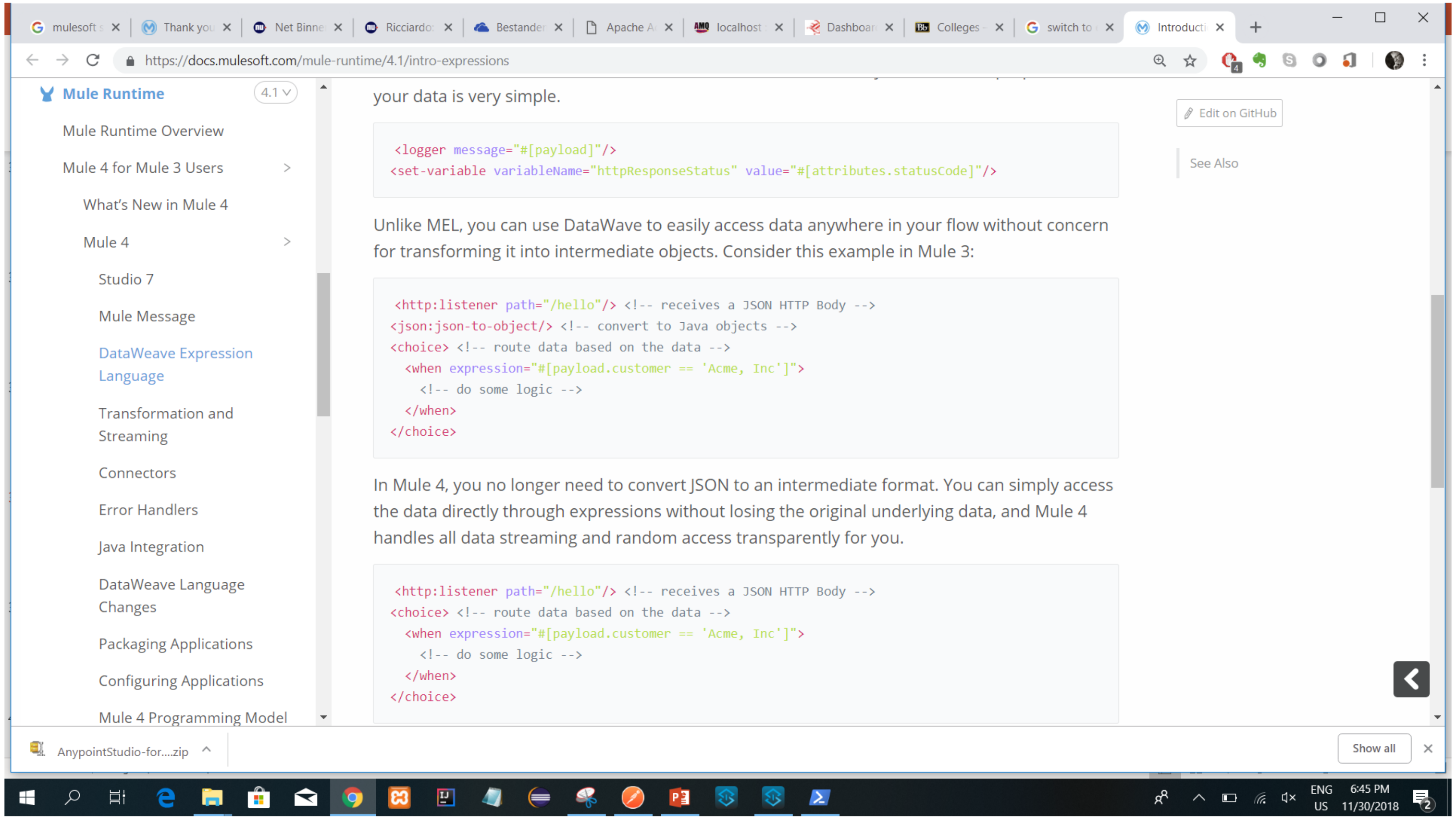
Generic

Message: *fx*

Level: Switch to expression mode.

Category:

https://docs.mulesoft.com/mule-runtime/4.1/intro-expressions



your data is very simple.

```
<logger message="#[payload]"/>
<set-variable variableName="httpResponseStatus" value="#[attributes.statusCode]"/>
```

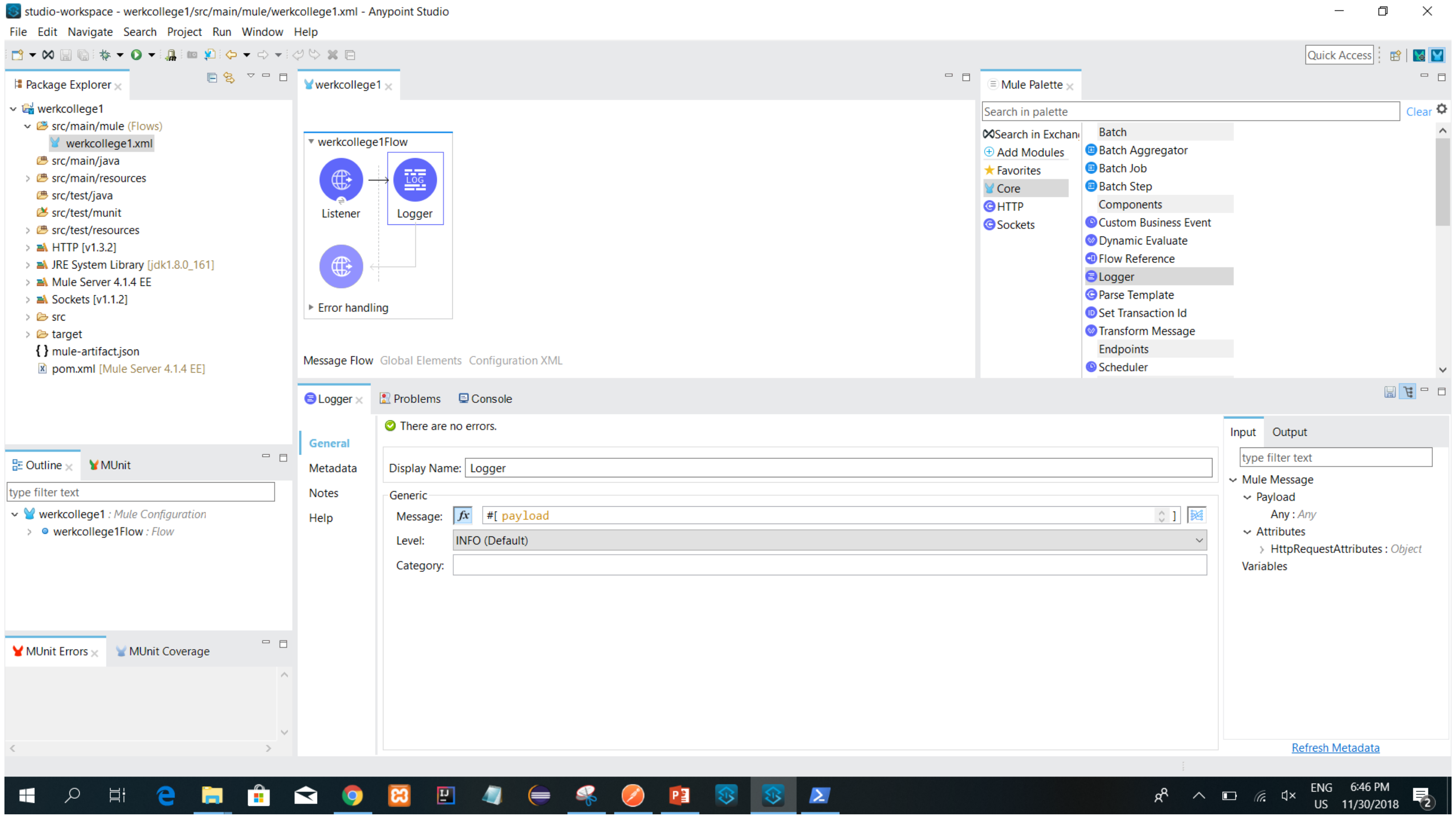
Unlike MEL, you can use DataWave to easily access data anywhere in your flow without concern for transforming it into intermediate objects. Consider this example in Mule 3:

```
<http:listener path="/hello"/> <!-- receives a JSON HTTP Body -->
<json:json-to-object/> <!-- convert to Java objects -->
<choice> <!-- route data based on the data -->
  <when expression="#[payload.customer == 'Acme, Inc']">
    <!-- do some logic -->
  </when>
</choice>
```

In Mule 4, you no longer need to convert JSON to an intermediate format. You can simply access the data directly through expressions without losing the original underlying data, and Mule 4 handles all data streaming and random access transparently for you.

```
<http:listener path="/hello"/> <!-- receives a JSON HTTP Body -->
<choice> <!-- route data based on the data -->
  <when expression="#[payload.customer == 'Acme, Inc']">
    <!-- do some logic -->
  </when>
</choice>
```

Assign the payload to the logger message and rerun everything.



There are no errors.

Display Name: Logger

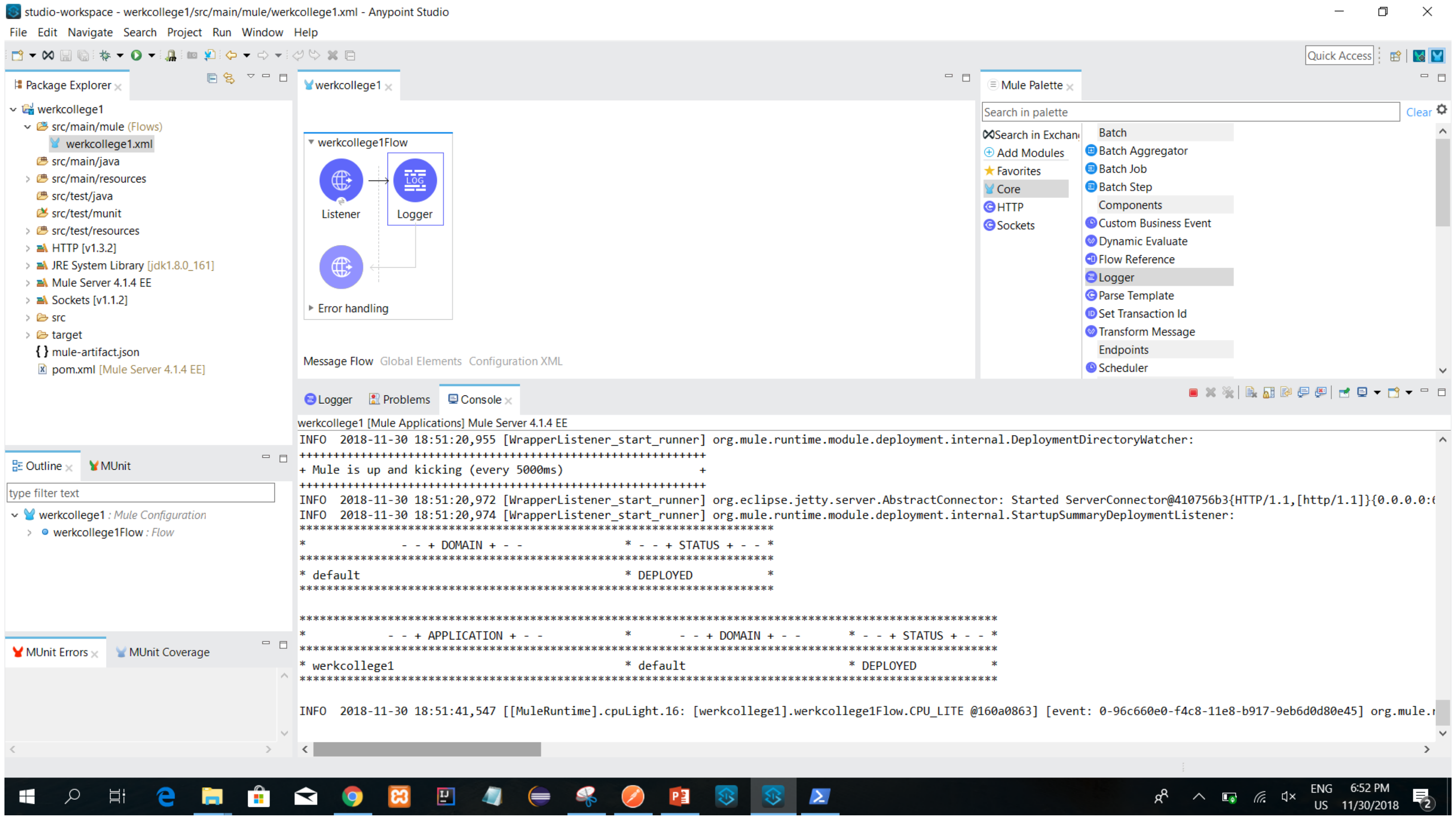
Generic

Message: #[payload]

Level: INFO (Default)

Category:

Now the logger shows the body content = payload



werkcollege1 [Mule Applications] Mule Server 4.1.4 EE

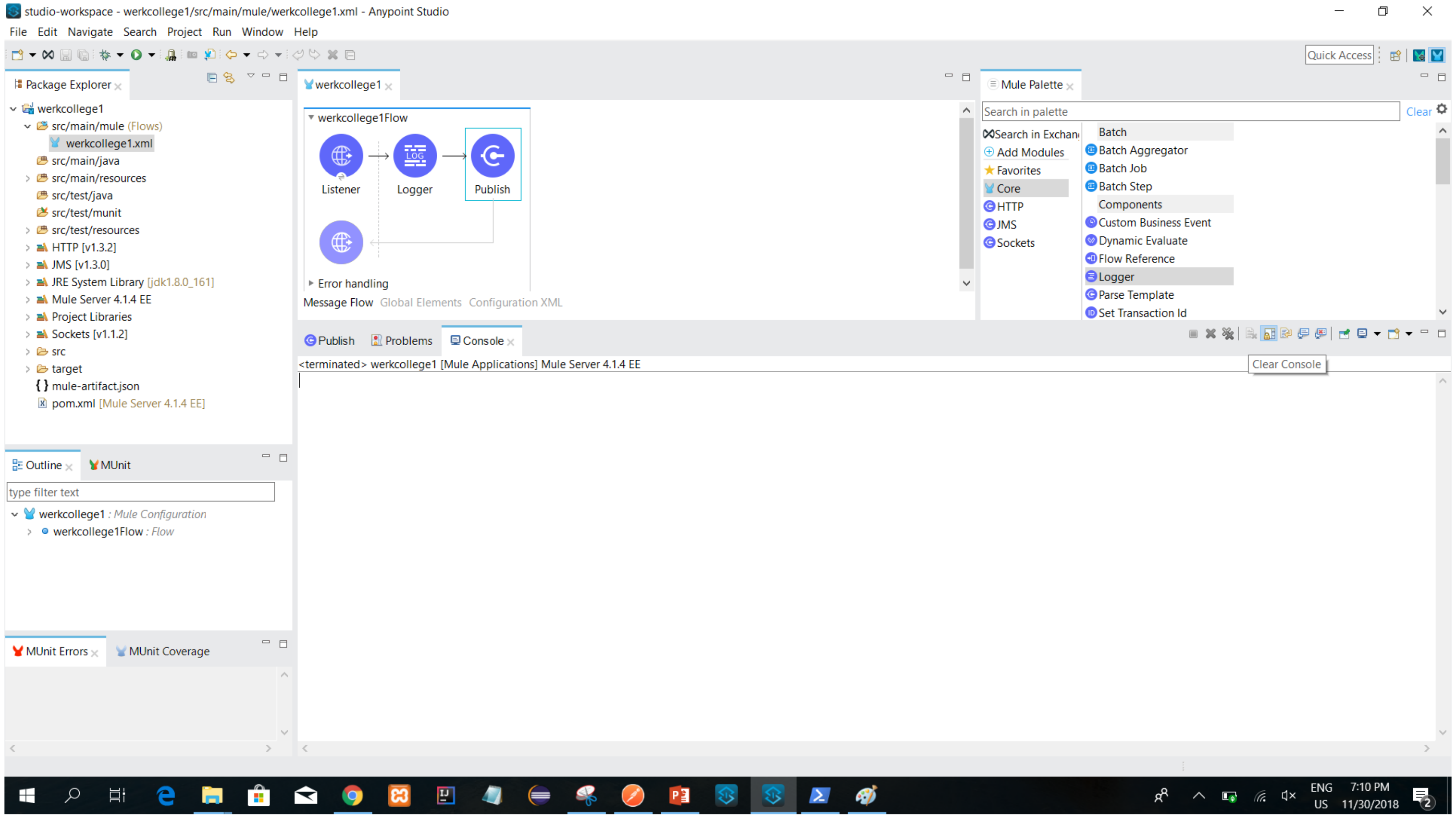
```
INFO  2018-11-30 18:51:20,955 [WrapperListener_start_runner] org.mule.runtime.module.deployment.internal.DeploymentDirectoryWatcher:
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
+ Mule is up and kicking (every 5000ms)                     +
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
INFO  2018-11-30 18:51:20,972 [WrapperListener_start_runner] org.eclipse.jetty.server.AbstractConnector: Started ServerConnector@410756b3{HTTP/1.1,[http/1.1]}{0.0.0.0:
INFO  2018-11-30 18:51:20,974 [WrapperListener_start_runner] org.mule.runtime.module.deployment.internal.StartupSummaryDeploymentListener:
**********************************************************************
*              - - + DOMAIN + - -               * - - + STATUS + - - *
**********************************************************************
* default                                       * DEPLOYED           *
**********************************************************************

*******************************************************************************************************
*            - - + APPLICATION + - -            *        - - + DOMAIN + - -       * - - + STATUS + - - *
*******************************************************************************************************
* werkcollege1                                  * default                         * DEPLOYED           *
*******************************************************************************************************

INFO  2018-11-30 18:51:41,547 [[MuleRuntime].cpuLight.16: [werkcollege1].werkcollege1Flow.CPU_LITE @160a0863] [event: 0-96c660e0-f4c8-11e8-b917-9eb6d0d80e45] org.mule.r
```

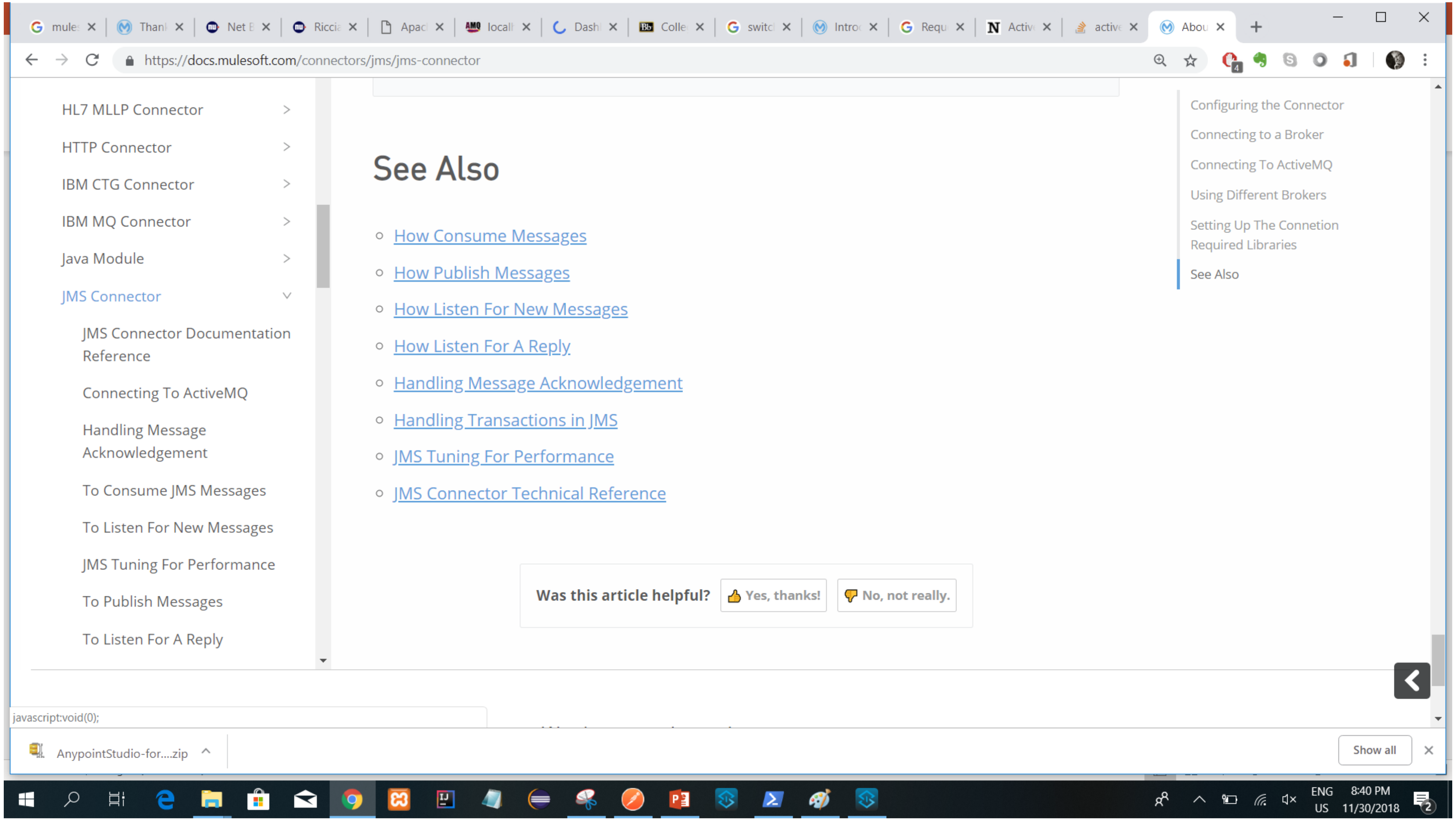
```
org.mule.runtime.core.internal.processor.LoggerMessageProcessor: Buslijn 15 vertrokken om 06:30
```

Terminate the current process and clear the console



```
<terminated> werkcollege1 [Mule Applications] Mule Server 4.1.4 EE
```

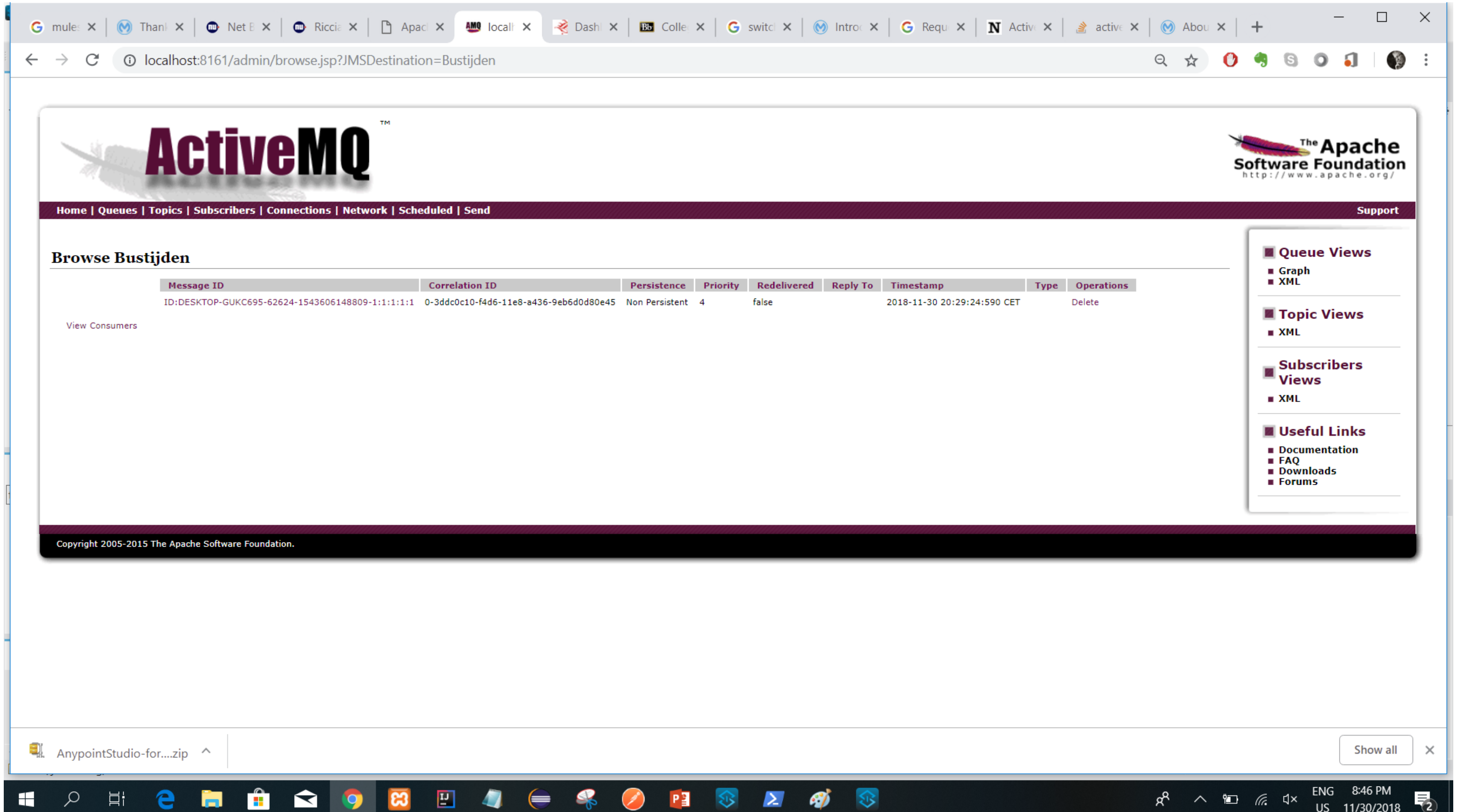
More JMS help info via : https://docs.mulesoft.com/connectors/jms/jms-connector



See Also

- How Consume Messages
- How Publish Messages
- How Listen For New Messages
- How Listen For A Reply
- Handling Message Acknowledgement
- Handling Transactions in JMS
- JMS Tuning For Performance
- JMS Connector Technical Reference

You can zoom in on the message of an ActiveMQ queue



localhost:8161/admin/browse.jsp?JMSDestination=Bustijden

ActiveMQ™

The Apache Software Foundation http://www.apache.org/

Home | Queues | Topics | Subscribers | Connections | Network | Scheduled | Send

Support

Browse Bustijden

Message ID	Correlation ID	Persistence	Priority	Redelivered	Reply To	Timestamp	Type	Operations
ID:DESKTOP-GUKC695-62624-1543606148809-1:1:1:1:1	0-3ddc0c10-f4d6-11e8-a436-9eb6d0d80e45	Non Persistent	4	false		2018-11-30 20:29:24:590 CET		Delete

View Consumers

Queue Views
- Graph
- XML

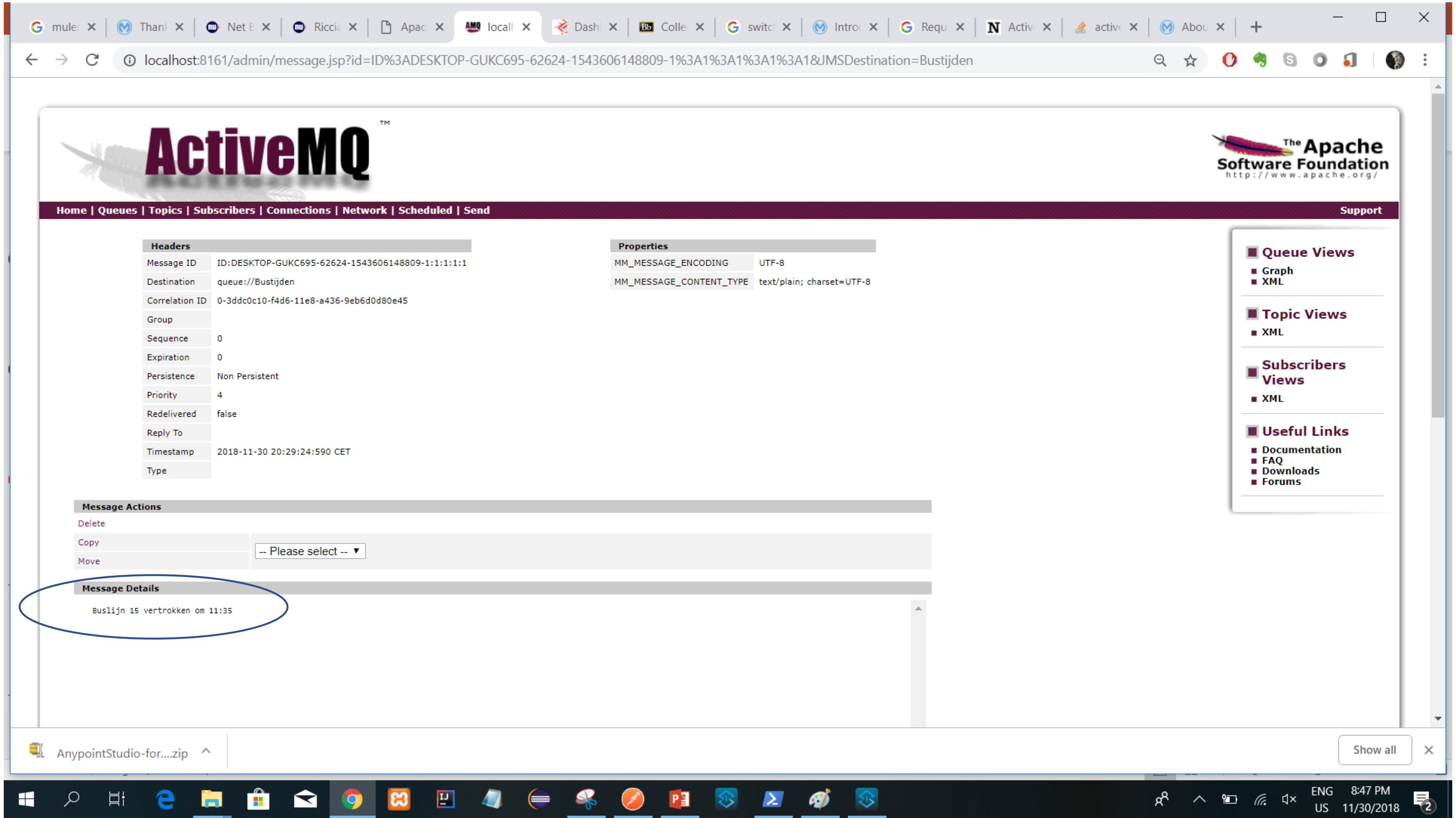
Topic Views
- XML

Subscribers Views
- XML

Useful Links
- Documentation
- FAQ
- Downloads
- Forums

Copyright 2005-2015 The Apache Software Foundation.

You can zoom in on the message of an ActiveMQ queue



mule
Than
Net E
Riccia
Apac
locall
Dash
Colle
switc
Intro
Requ
Activ
active
Abou
localhost:8161/admin/message.jsp?id=ID%3ADESKTOP-GUKC695-62624-1543606148809-1%3A1%3A1%3A1%3A1&JMSDestination=Bustijden
ActiveMQ™
The Apache Software Foundation
http://www.apache.org/
Home | Queues | Topics | Subscribers | Connections | Network | Scheduled | Send
Support
Queue Views
Graph
XML
Topic Views
XML
Subscribers Views
XML
Useful Links
Documentation
FAQ
Downloads
Forums
AnypointStudio-for....zip
Show all
ENG
US
8:47 PM
11/30/2018

Headers	
Message ID	ID:DESKTOP-GUKC695-62624-1543606148809-1:1:1:1:1
Destination	queue://Bustijden
Correlation ID	0-3ddc0c10-f4d6-11e8-a436-9eb6d0d80e45
Group	
Sequence	0
Expiration	0
Persistence	Non Persistent
Priority	4
Redelivered	false
Reply To	
Timestamp	2018-11-30 20:29:24:590 CET
Type	

Properties	
MM_MESSAGE_ENCODING	UTF-8
MM_MESSAGE_CONTENT_TYPE	text/plain; charset=UTF-8

Message Actions

Delete

Copy

Move

-- Please select --

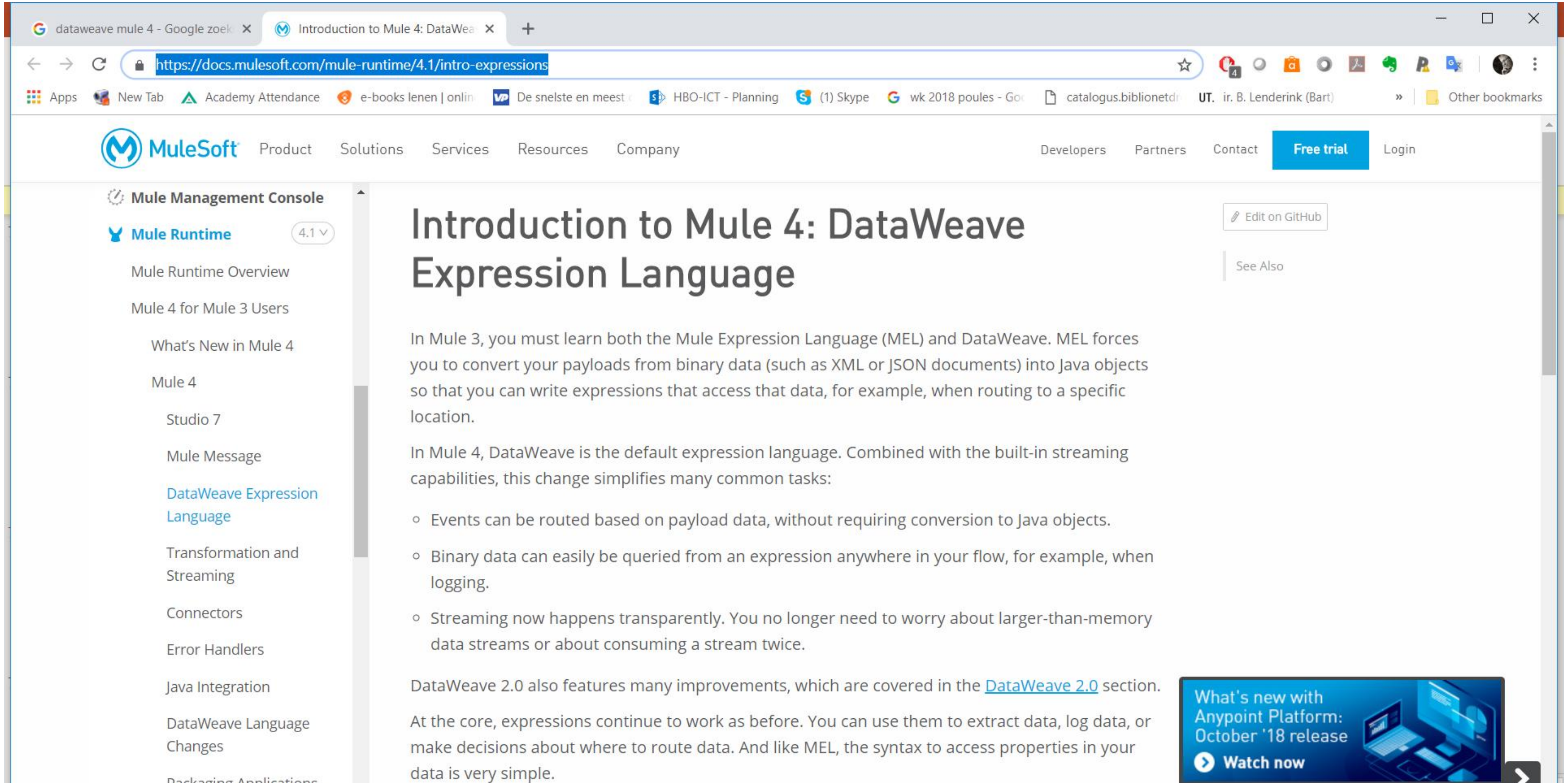
Message Details

```
Buslijn 15 vertrokken om 11:35
```

It is important to understand Dataweave.

https://docs.mulesoft.com/mule-runtime/4.1/intro-expressions

https://docs.mulesoft.com/mule-runtime/4.1/dataweave



Introduction to Mule 4: DataWeave Expression Language

In Mule 3, you must learn both the Mule Expression Language (MEL) and DataWeave. MEL forces you to convert your payloads from binary data (such as XML or JSON documents) into Java objects so that you can write expressions that access that data, for example, when routing to a specific location.

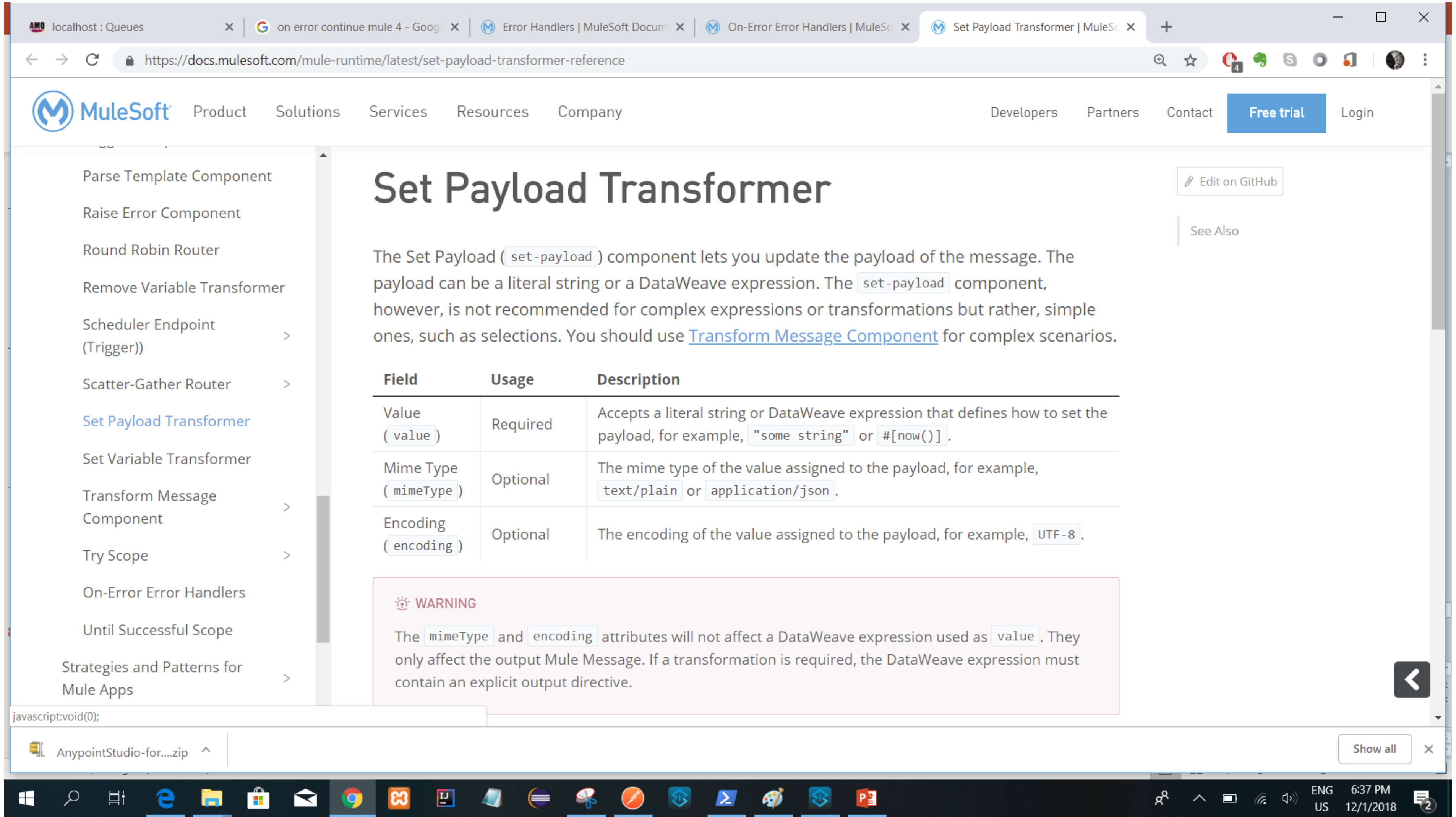
In Mule 4, DataWeave is the default expression language. Combined with the built-in streaming capabilities, this change simplifies many common tasks:

- Events can be routed based on payload data, without requiring conversion to Java objects.
- Binary data can easily be queried from an expression anywhere in your flow, for example, when logging.
- Streaming now happens transparently. You no longer need to worry about larger-than-memory data streams or about consuming a stream twice.

DataWeave 2.0 also features many improvements, which are covered in the DataWeave 2.0 section.

At the core, expressions continue to work as before. You can use them to extract data, log data, or make decisions about where to route data. And like MEL, the syntax to access properties in your data is very simple.

Help text



Set Payload Transformer

The Set Payload (`set-payload`) component lets you update the payload of the message. The payload can be a literal string or a DataWeave expression. The `set-payload` component, however, is not recommended for complex expressions or transformations but rather, simple ones, such as selections. You should use Transform Message Component for complex scenarios.

Field	Usage	Description
Value (`value`)	Required	Accepts a literal string or DataWeave expression that defines how to set the payload, for example, `"some string"` or `#[now()]`.
Mime Type (`mimeType`)	Optional	The mime type of the value assigned to the payload, for example, `text/plain` or `application/json`.
Encoding (`encoding`)	Optional	The encoding of the value assigned to the payload, for example, `UTF-8`.

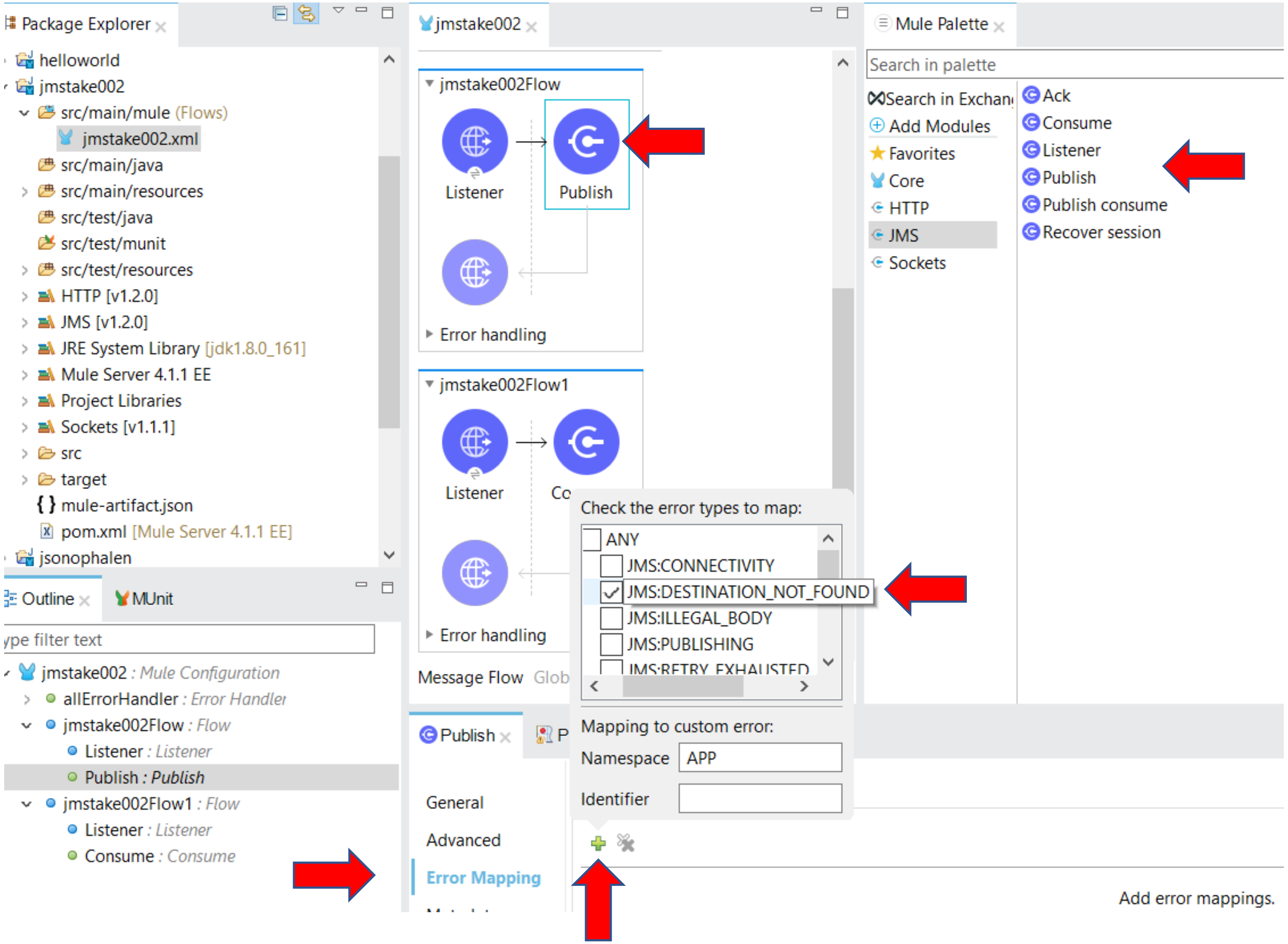
WARNING

The `mimeType` and `encoding` attributes will not affect a DataWeave expression used as `value`. They only affect the output Mule Message. If a transformation is required, the DataWeave expression must contain an explicit output directive.

Anypoint Studio Basics

Error processing

- In this example, the Publish component from JMS is part of a flow.
- clicking the plus sign in the Error Mapping Tab results in a pop up with all the catchable messages.



Check the error types to map:

☐ ANY
☐ JMS:CONNECTIVITY
☑ JMS:DESTINATION_NOT_FOUND
☐ JMS:ILLEGAL_BODY
☐ JMS:PUBLISHING
☐ JMS:RETRY_EXHAUSTED

Mapping to custom error:

Namespace APP

Identifier

Anypoint Studio Basics
Mind this!

In the message flows the payload is passed on from a component to the next component.

However:

1. Components can change the payload.
2. When an error is not processed by the Error Handling Block(s) the flow stops and the error message(s) will replace the payload.
3. When you add an http-Listener-component to a flow to receive a request, then a Reply component is automatically inserted as the last component of the flow. The payload of this last component is sent as the http body content.