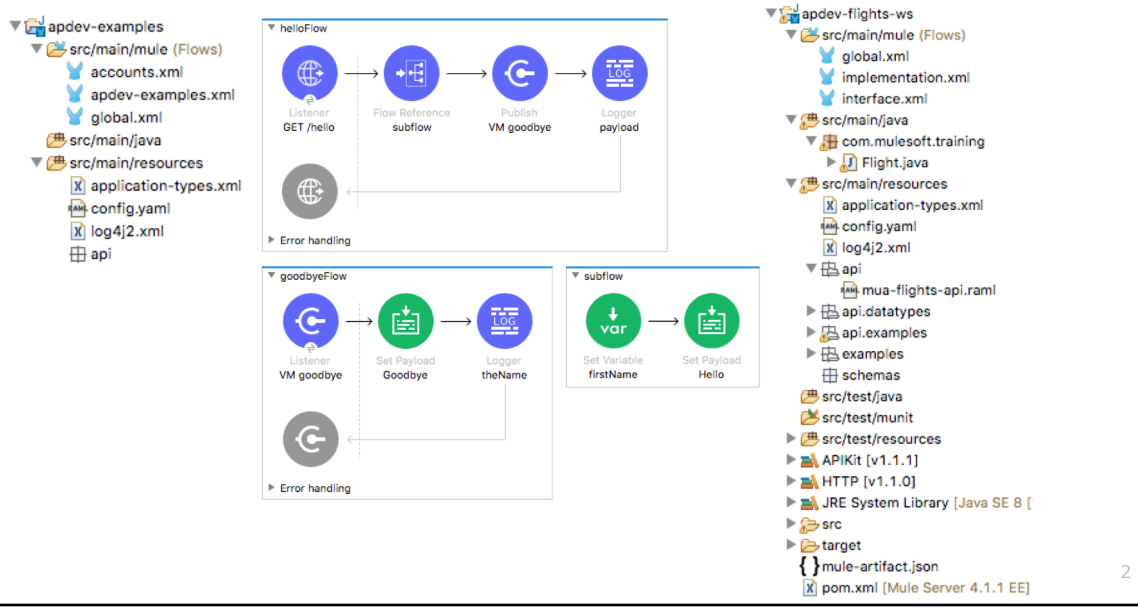
Module 7: Structuring Mule Applications

Goal



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

- Create applications composed of multiple flows and subflows
- Pass messages between flows using asynchronous queues
- Encapsulate global elements in separate configuration files
- Specify application properties in a separate properties file and use them in the application
- Describe the purpose of each file and folder in a Mule project
- Define and manage application metadata

Encapsulating processors into separate flows and subflows

Break up flows into separate flows and subflows

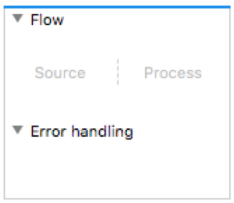
MuleSoft

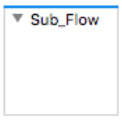
- Makes the graphical view more intuitive
  - You don't want long flows that go off the screen
- Makes XML code easier to read
- Enables code reuse
- Provides separation between an interface and implementation
  - We already saw this
- Makes them easier to test

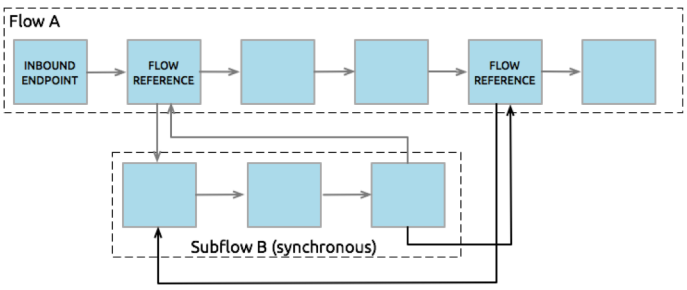
Flows vs subflows

MuleSoft

- **Flows** can have their own error handling strategy, **subflows** cannot
- Flows without event sources are sometimes called **private** flows
- Subflows are executed exactly as if the processors were still in the calling flow



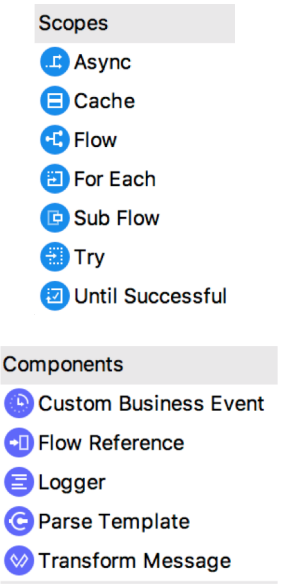




Creating flows and subflows

MuleSoft

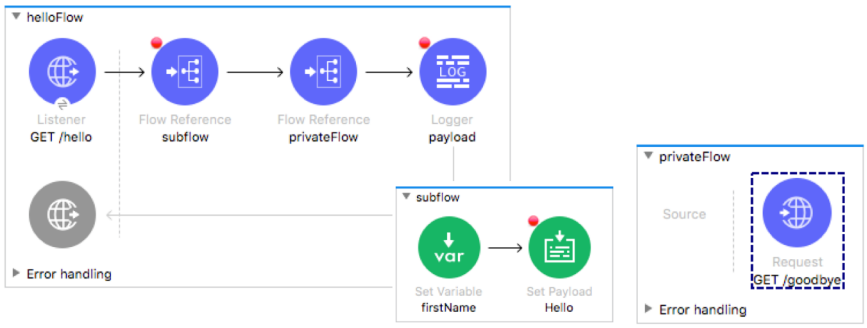
- Several methods
  - Add a new scope: Flow or Sub Flow
  - Drag any event processor to the canvas – creates a flow
  - Right-click processor(s) in canvas and select Extract to
- Use Flow Reference component to pass events to other flows or subflows
- Variables persist through all flows unless the event crosses a transport boundary
  - We saw this in the last module



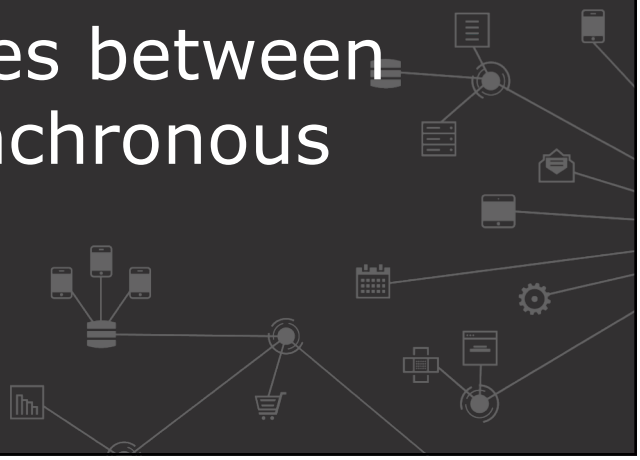
Walkthrough 7-1: Create and reference subflows and private flows

MuleSoft

- Extract processors into separate subflows and private flows
- Use the Flow Reference component to reference other flows
- Explore event data persistence through subflows and private flows



Passing messages between flows using asynchronous queues

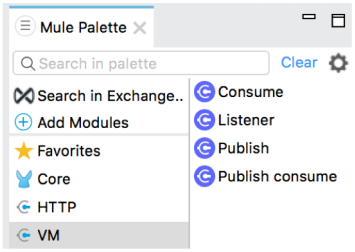


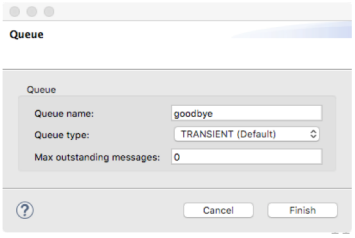
Passing messages between flows using asynchronous queues

- When using Flow Reference, events are passed synchronously between flows
- You may want to pass events asynchronously between flows to
  - Achieve higher levels of parallelism in specific stages of processing
  - Allow for more-specific tuning of areas within a flow's architecture
  - Distribute work across a cluster
  - Communicate with another application running in the same Mule domain
    - Domains will be explained later this module
  - Implement simple queueing that does not justify a full JMS broker
    - JMS is covered in Module 12
- This can be accomplished using the **VM connector**

Using the VM connector

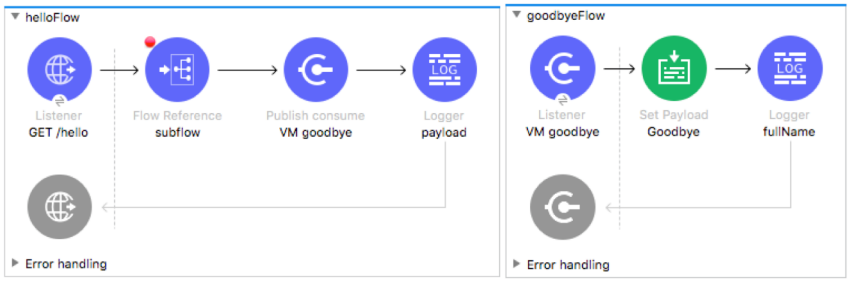
- Use the connector for intra and inter application communication through asynchronous queues
- Add the VM module to the project
- Configure a global element configuration
  - Specify a queue name and type
    - Queues can be transient or persistent
    - By default, the connector uses in-memory queues
    - **Transient** queues are faster, but are lost in the case of a system crash
    - **Persistent** queues are slower but reliable
- Use operations to publish and/or consume messages



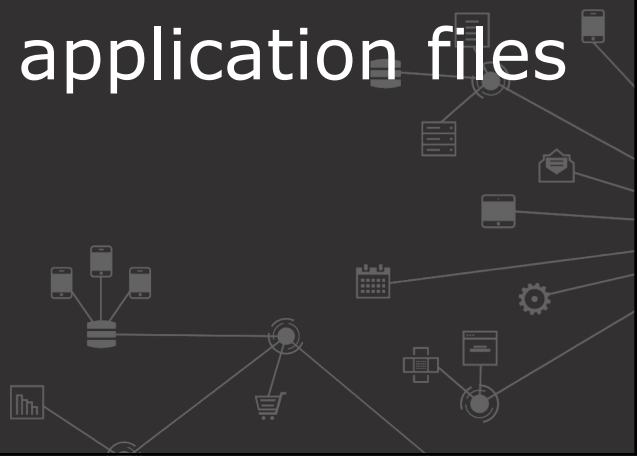


Walkthrough 7-2: Pass messages between flows using the VM connector

- Pass messages between flows using the VM connector
- Explore variable persistence with VM communication
- Publish content to a VM queue and then wait for a response
- Publish content to a VM queue without waiting for a response



Organizing Mule application files



Separating apps into multiple configuration files

MuleSoft

- Just as we separated flows into multiple flows, we also want to separate configuration files into multiple configuration files
- Monolithic files are difficult to read and maintain
- Separating an application into multiple configuration files makes code
  - Easier to read
  - Easier to work with
  - Easier to test
  - More maintainable

Encapsulating global elements in a configuration file

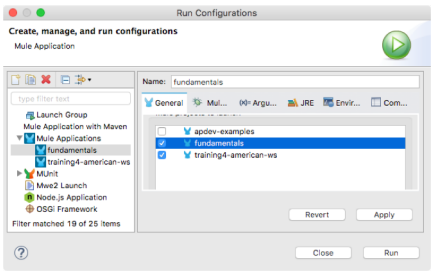
MuleSoft

- If you reference global elements in one file that are defined in various, unrelated files
  - It can be confusing
  - It makes it hard to find them
- A good solution is to put most global elements in one config file
  - All the rest of the files reference them
  - If a global element is specific to and only used in one file, it can make sense to keep it in that file

Creating multiple applications

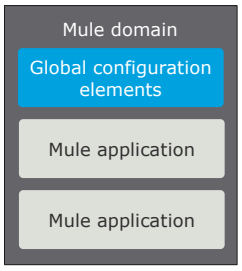
MuleSoft

- You are also not going to want all your flows in one application/project
- Separate functionality into multiple applications to
  - Allow managing and monitoring of them as separate entities
  - Use different, incompatible JAR files
- Run more than one application at a time in Anypoint Studio by creating a run configuration



Sharing global elements between applications

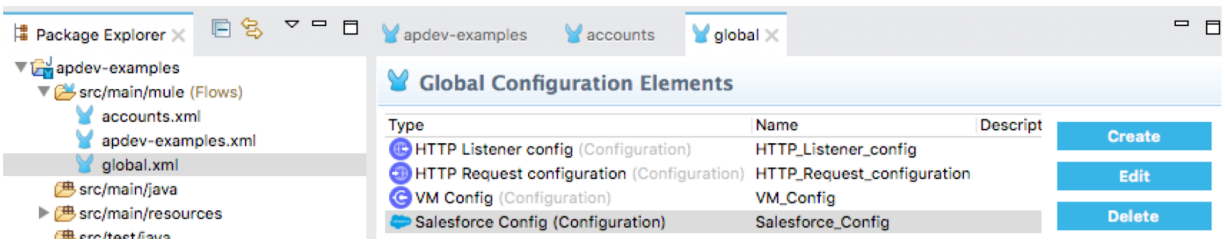
- **A domain project** can be used to share global configuration elements between applications, which lets you
  - Ensure consistency between applications upon any changes, as the configuration is only set in one place
  - Expose multiple services within the domain on the same port
  - Share the connection to persistent storage (Module 12)
  - Call flows in other applications using the VM connector



- Only available for customer-hosted Mule runtimes, not on CloudHub
- The general process
  - Create a Mule Domain Project and associate Mule applications with a domain
  - Add global element configurations to the domain project

Walkthrough 7-3: Encapsulate global elements in a separate configuration file

- Create a new configuration file with an endpoint that uses an existing global element
- Create a configuration file global.xml for just global elements
- Move the existing global elements to global.xml
- Create a new global element in global.xml and configure a new connector to use it



Organizing and parameterizing application properties

Application properties

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- Provide an easier way to manage connector properties, credentials, and other configurations
- Replace static values
- Are defined in a configuration file
  - Either in a .yaml file or a .properties file
- Are implemented using property placeholders
- Can be encrypted
- Can be overridden by system properties when deploying to different environments

Defining application properties

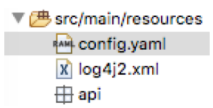
- Create a YAML properties file in the src/main/resources folder

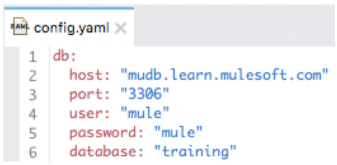
  `config.yaml`

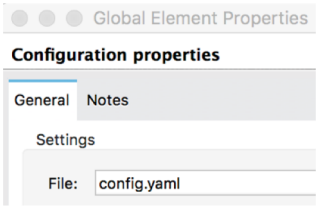
- Define properties in the hierarchical YAML file

```
db:
  port: "3306 "
  user: "mule"
```

- Create a Configuration properties global element







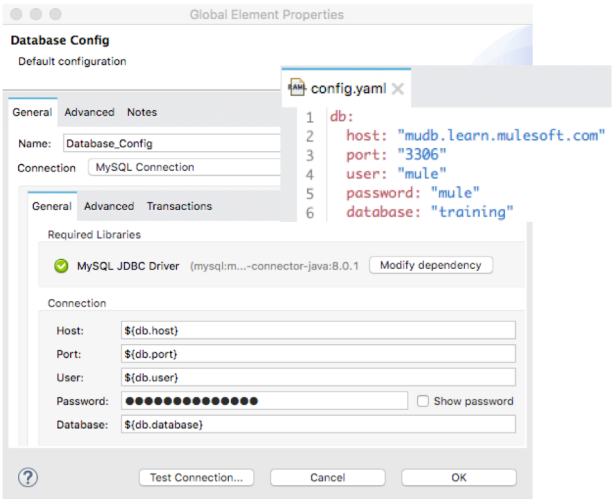
Using application properties

- In global element configurations and event processors

  `${db.port}`

- In DataWeave expressions

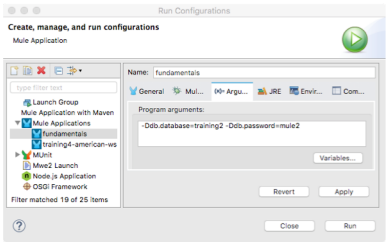
  `{port: p('db.port')}`



Overriding property values in different environments

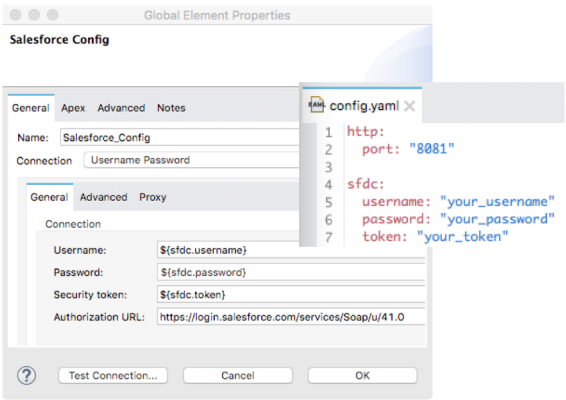
- Use **system properties** to override property values when deploying an application to a different environment (like dev, qa, production),
- Set system properties (JVM parameters) from
  - Anypoint Studio
    in Run > Run Configurations > Arguments
  - The command line for a standalone Mule instance

```
mule -M-Ddb.database=training2 -M-Ddb.password=mule2
```



Walkthrough 7-4: Use property placeholders in connectors

- Create a YAML properties file for an application
- Configure an application to use a properties file
- Define and use HTTP and Salesforce connector properties

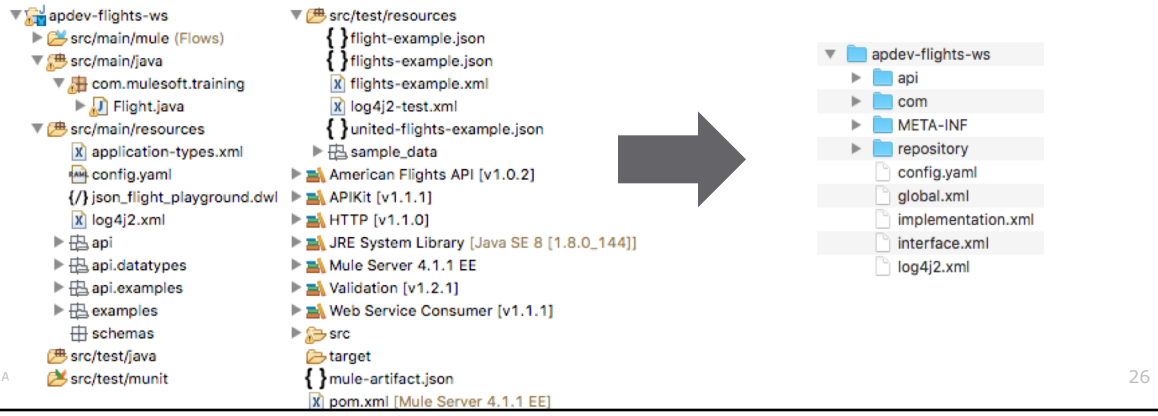


Organizing Mule project files

Examining the folder structure for a Mule project

MuleSoft

- The names of folders indicate what they should contain
- src/test folders should contain files only needed at development time
  - Like schema and example files for metadata types, sample data for transformations
  - They are not included in the application JAR when it is packaged



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In Mule 4, Mule applications are Maven projects

MuleSoft

- **Maven** is a tool for building and managing any Java-based project that provides
  - A standard way to build projects
  - A clear definition of what a project consists of
  - An easy way to publish project information
  - A way to share JARs across several projects

- Maven manages a project's build, reporting, and documentation from a central piece of information – the **project object model (POM)**
- A Maven build produces one or more **artifacts**, like a compiled JAR
  - Each artifact has a group ID (usually a reversed domain name, like com.example.foo), an artifact ID (just a name), and a version string

The POM (Project Object Model)

MuleSoft

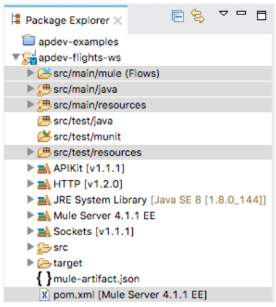
- Is an XML file that contains info about the project and configuration details used by Maven to build the project including
  - Project info like its version, description, developers, and more
  - Project dependencies
  - The plugins or goals that can be executed

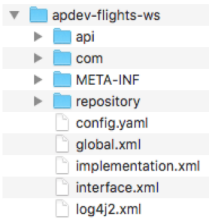
pom.xml

```
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<project xmlns="http://maven.apache.org/POM/4.0.0" xmlns:xsi="http:/
    <modelVersion>4.0.0</modelVersion>
    <groupId>com.mulesoft</groupId>
    <artifactId>apdev-flights-ws</artifactId>
    <version>1.0.0-SNAPSHOT</version>
    <packaging>mule-application</packaging>
    <name>apdev-flights-ws</name>

    <properties>

    <build>

    <dependencies>
        <dependency>
            <groupId>org.mule.modules</groupId>
            <artifactId>mule-apikit-module</artifactId>
            <version>1.1.1</version>
            <classifier>mule-plugin</classifier>
        </dependency>
    <dependency>
            <groupId>74922056-9245-48e0-99df-a8141d1d3e9f</groupId>
            <artifactId>american4-flights-api</artifactId>
            <version>1.0.2</version>
            <classifier>mule-plugin</classifier>
        </dependency>
    <dependency>
            <groupId>org.mule.connectors</groupId>
            <artifactId>mule-http-connector</artifactId>
```

Walkthrough 7-5: Create a well-organized Mule project

- Create a project with a new RAML file that is added to Anypoint Platform
- Review the project's configuration and properties files
- Create an application properties file and a global configuration file
- Add Java files and test resource files to the project
- Create and examine the contents of a deployable archive for the project

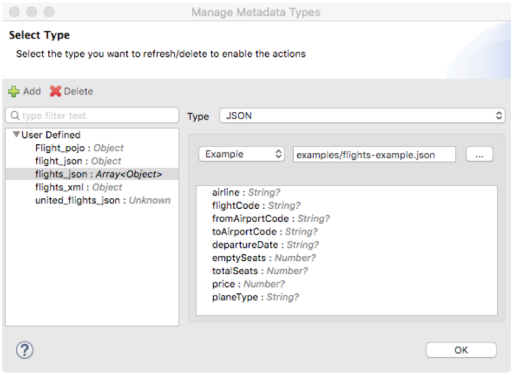




Managing metadata for a project

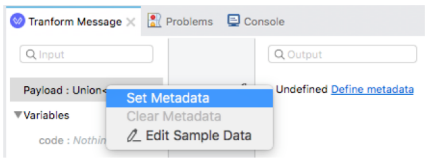
Defining metadata

- It is often beneficial to define metadata for an application
  - For the output structures required for transformations
    - You did this in Module 4 when transforming database output to JSON defined in the API
  - For the output of operations that can connect to data sources of different structures
    - Like the HTTP Request connector
  - For the output of connectors that are not DataSense enabled
    - And do not automatically provide metadata about the expected input and output

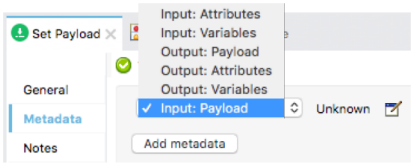


Ways to access the Metadata Editor

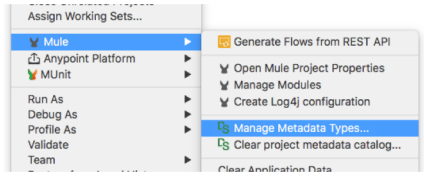
- From the Transform Message component



- From the Metadata tab in the properties view for most event processors

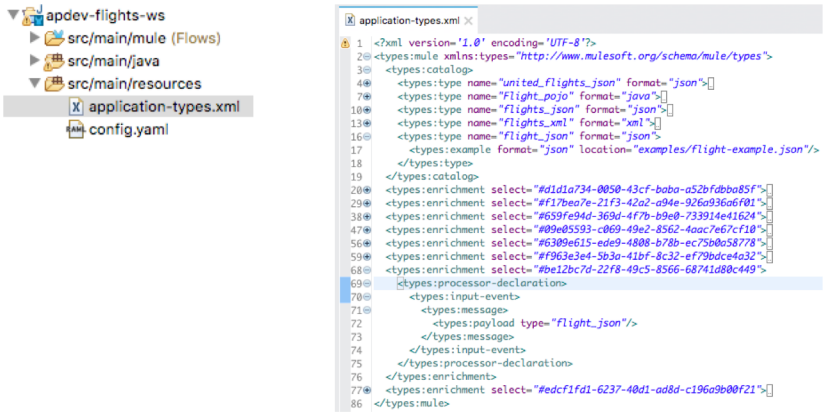


- From a project's menu in the Package Explorer



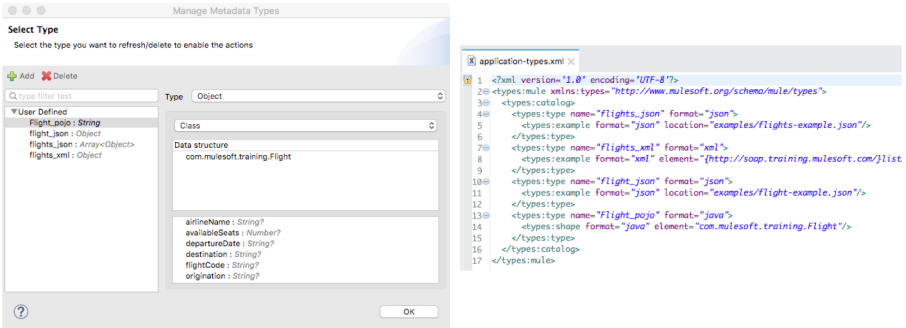
Where is metadata stored?

- In application-types.xml in src/main/resources



Walkthrough 7-6: Manage metadata for a project

- Review existing metadata for the training-american-ws project
- Define new metadata to be used in transformations in the new apdev-flights-ws project
- Manage metadata



Summary

Summary

MuleSoft

- Separate functionality into **multiple applications** to allow managing and monitoring of them as separate entities
- Mule applications are **Maven** projects
  - A project's **POM** is used by Maven to build, report upon, and document a project
  - Maven builds an artifact (a Mule deployable archive JAR) from multiple dependencies (module JARs)
- Separate application functionality into **multiple configuration files** for easier development and maintenance
  - Encapsulate **global elements** into their own separate configuration file
- Share resources between applications by creating a **shared domain**

Summary

MuleSoft

- Define **application properties** in a YAML file and reference them as ${prop}
- Application **metadata** is stored in application-types.xml
- Create applications composed of multiple **flows** and **subflows** for better readability, maintenance, and reusability
- Use **Flow Reference** to calls flows synchronously
- Use the **VM connector** to pass messages between flows using asynchronous queues