PART 3: Building Applications to Synchronize Data

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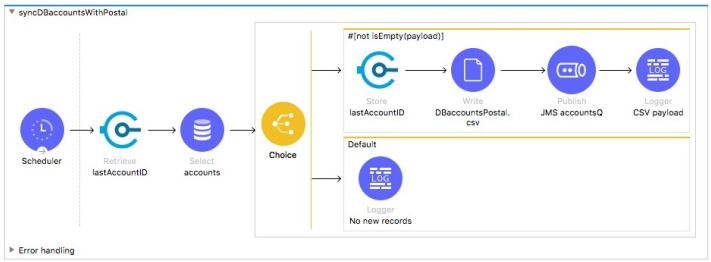
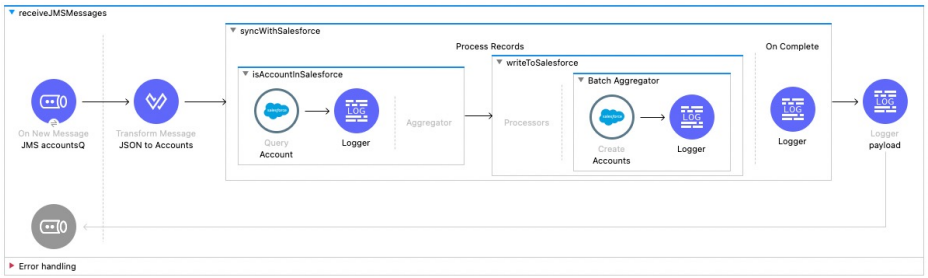
Goal





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2

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

- Trigger flows when files or database records are added or updated
- Schedule flows
- Persist and share data across flow executions
- Publish and consume JMS messages
- Process items in a collection sequentially
- Process records asynchronously in batches

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Module 12: Triggering flows

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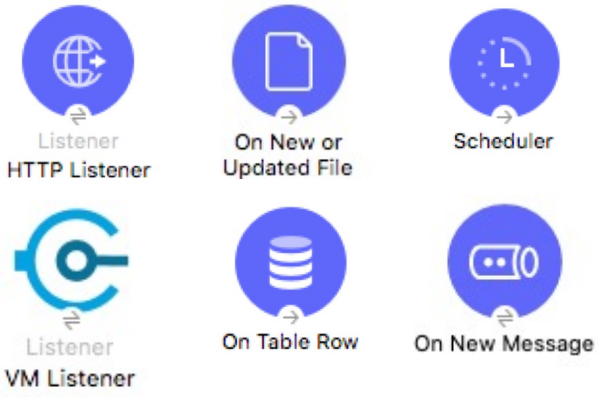
Goal

MuleSoft

How have we initiated flows so far?

In this module, we will learn new ways



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

MuleSoft

- Read and write files
- Trigger flows when files are added, created, or updated
- Trigger flows when new records are added to a database table
- Schedule flows to run at a certain time or frequency
- Persist and share data in flows using the Object Store
- Publish and consume JMS messages

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Reading and writing files

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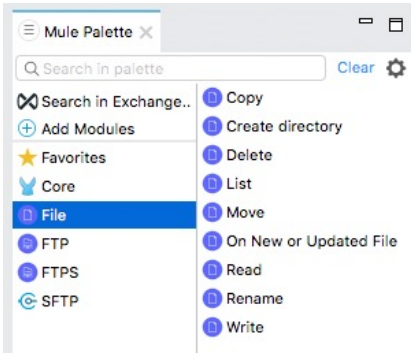
Reading and writing files

MuleSoft

- There are 4 connectors for working with files and folders
  - File (for locally mounted file system)
  - FTP
  - FTPS
  - SFTP
- All have the same set of operations and they behave almost identically
- Support for
  - File matching functionality
  - Locking files
  - Overwriting, appending, and generating new files



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Using the File connector

- Add the File module to the project
- Create a global element configuration
  - Not required but a best practice
  - Set the **working directory** that will be the root for every path used with the connector

- Use one of the connector operations and specify its properties

- On **CloudHub**, the connector can only be used with the /tmp folder
- On **Customer-hosted** Mule runtimes, the account running Mule must have read and/or write permissions on the specified directories
- *Be careful not to permanently delete or overwrite files*
  - Move or rename them after processing

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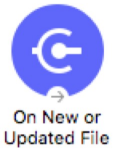
Trigger a flow when a new file is created or updated

- Use the **On New or Updated File** listener
  - Polls a directory for files that have been created or updated
  - One message is generated for each file that is found



- Multiple ways to ensure a file is new
  - Delete each file after it has been processed so all files in the next poll will be new
  - Move each file to a different directory after it has been processed
  - Rename a file after it has been processed and filter the files to be processed
  - Save and compare the file creation or modification times

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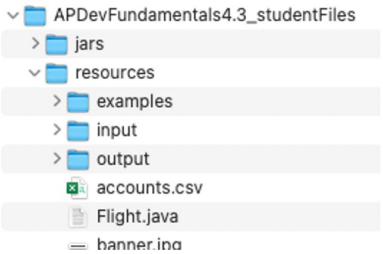
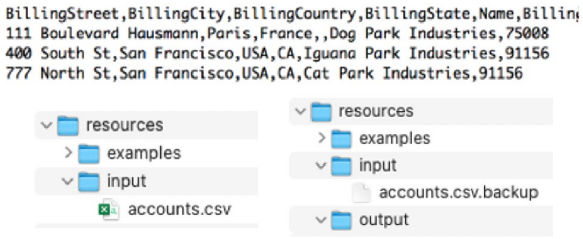
Walkthrough 12-1: Trigger a flow when a new file is added to a directory

MuleSoft

- Add and configure a File listener to watch an input directory
- Restrict the type of file read
- Rename and move the processed files





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Synchronizing data with watermarks

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Synchronizing data from one system to another

MuleSoft

- The general process
  - The first time, you need to sync all the data
  - After that, you only need to sync the new data
  - Requires a field with ordered values to identify processed items
- How do you determine what is new and needs to be synced?
  - On the first sync, store the highest field value for any item in the data set
  - On later syncs, retrieve that value and compare the value of each item and see if it is larger
- The field with ordered values is often a
  - Record ID
  - Creation or modification timestamp

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Introducing watermarks

MuleSoft

- The timestamp or ID that is stored each sync and then retrieved and compared against in the next sync is called a **watermark**
- Where did the name come from?
  - After a flood, one might record how high the water got by marking the level on a wall
  - Similarly, for data, we want to look at the last value - how "high" it was in the last sync

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Types of watermarking in Mule

MuleSoft

- **Automatic**
  - The saving, retrieving, and comparing is automatically handled for you
  - Available for several connector listeners
    - On New or Updated File
    - On Table Row
  - Restricted in how you can specify what items/records are retrieved
- **Manual**
  - You handle saving, retrieving, and comparing the watermark
  - More flexible in that you specify exactly what records you want retrieved

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Using listeners with automatic watermarking

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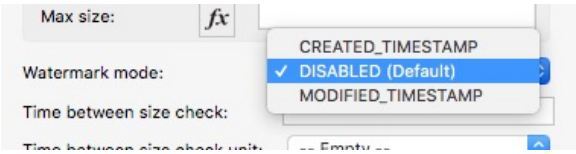
Using automatic watermarking with files

MuleSoft

- There is a watermarking option for the **On New and Updated File** operation for the family of file connectors

- There are two watermarking modes
  - CREATED_TIMESTAMP
  - MODIFIED_TIMESTAMP



- This can be used for one of the ways introduced last section to ensure a file is new
  - Other options: Delete, move, filter
  - **Save and compare the file creation or modification times**

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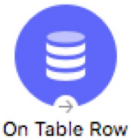
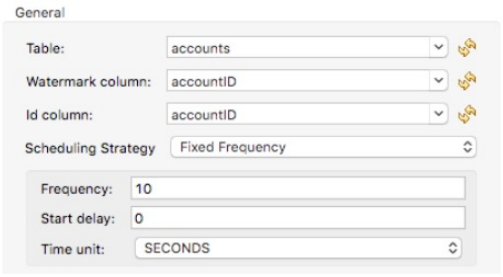
Triggering a flow for each row in a database table

MuleSoft

- The Database connector has an **On Table Row** operation that is triggered for every row in a table



- The operation can handle
  - Generating the query
  - Watermarking
  - Idempotency across concurrent requests



- You can specify one, both, or neither of
  - Watermark column
  - Id column

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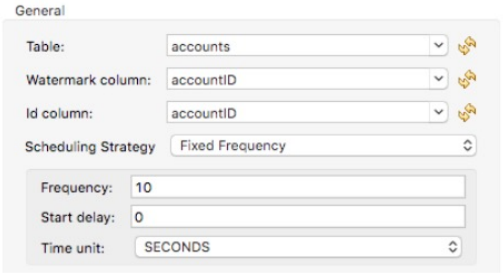
Using automatic watermarking with database tables

MuleSoft

- When a watermark column is specified, this query is automatically generated and used

  SELECT * FROM table
  WHERE table_column > :watermark

- On each poll, the component will go through all the retrieved rows and store the maximum value obtained



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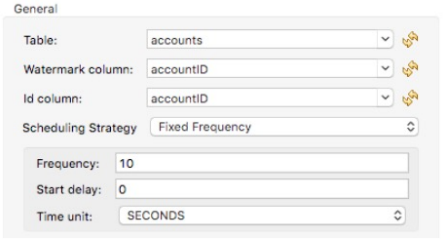
Handling idempotency across concurrent requests

MuleSoft

- **A new poll can be executed before the watermark is updated if**
  - The poll interval is small
  - The amount of rows is big
  - Processing one single row takes too much time

- **To avoid a record being processed more than once**
  - Specify an ID column
    - A unique identifier for the row
  - The listener will make sure the row is not processed again if
    - It has already been retrieved and
    - Processing of it hasn't finished yet



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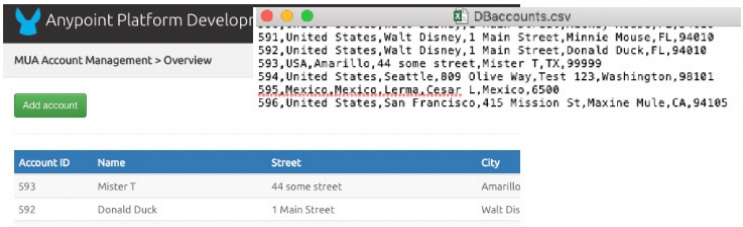
Walkthrough 12-2: Trigger a flow when a new record is added to a database & use automatic watermarking

MuleSoft

- Add and configure a Database listener to check a table on a set frequency for new records
- Use the listener's automatic watermarking to track the ID of the latest record retrieved and trigger the flow whenever a new record is added
- Output new records to a CSV file
- Use a form to add a new account to the table and see the CSV updated



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Using manual watermarking and scheduling flows

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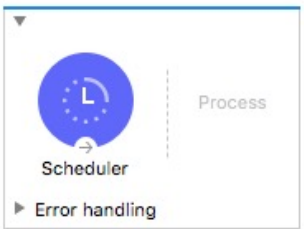
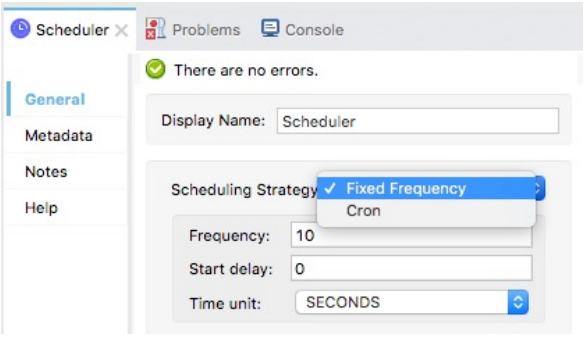
Handling watermarking manually

- The general process
  - Schedule when a flow should be executed
  - Give the watermark a default value
  - On the first sync
    - Determine a new watermark value
    - Store the watermark value so it available in the future to other flow executions
  - On later syncs
    - Retrieve the watermark from storage
    - Check if each item in the data set should be retrieved based on the watermark value

Triggering flows at a certain time or frequency

- Some connector event sources use a scheduling strategy to trigger a flow
  - Like On New or Updated File and On Table Row
- To trigger **any** flow at **any** time, use the **Scheduler** event source





Two types of scheduling strategies

MuleSoft

- **Fixed frequency**
  - The default is to poll every 1000 milliseconds
- **Cron**
  - A standard for describing time and date information
  - Can specify either
    - An event to occur just once at a certain time
    - A recurring event on some frequency

0 15 10 ? * *	Poll at 10:15am every day
0 15 10 * * ? 2018	Poll at 10:15pm every day in 2018
1 1 1 1 1,6 ?	Poll the first day of January and June every year in the first second of the first minute of the first hour

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Persisting data across executions of flows

MuleSoft

- Use the **Object Store** component to store simple key-value pairs
  - The component was designed to store
    - Synchronization information like watermarks
    - Temporal information like access tokens
    - User information
  - Retrieved values can be accessed through storage in a target variable
    - This storage causes the component to output the same message as the one received
- Each Mule application has an Object Store that is
  - Available without any setup or configuration
  - Persistent
    - Saved to file for embedded Mule and standalone Mule runtime
    - Saved to data storage for CloudHub
    - Saved to shared distributed memory for clustered Mule runtimes

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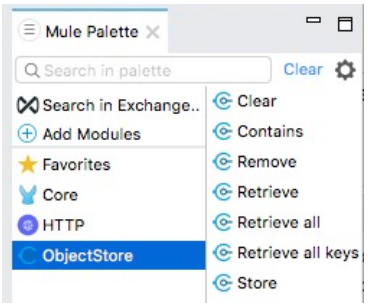
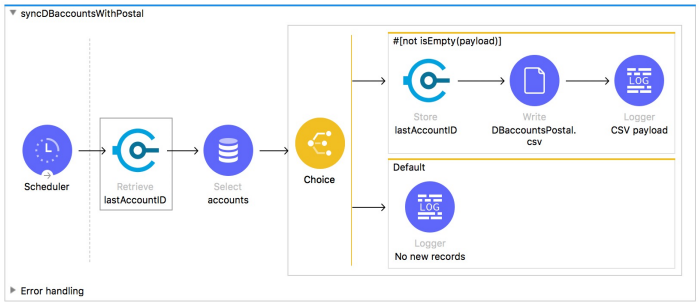
Using the Object Store connector for watermarking

- Add the ObjectStore module to the project
- Use the **Retrieve** operation to retrieve a watermark value and to assign a default value for the first poll
- Use the watermark value in a processor to retrieve the desired items
  - Like in a database query for records in a table
- Use the **Store** operation to determine and store a watermark value



Walkthrough 12-3: Schedule a flow and use manual watermarking

- Use the Scheduler component to create a new flow that executes at a specific frequency
- Retrieve accounts with a specific postal code from the accounts table
- Use the Object Store component to store the ID of the latest record and then use it to only retrieve new records



Publishing and consuming JMS messages

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Java Messaging Service (JMS)

MuleSoft

- Is a widely-used API for enabling applications to communicate through the exchange of messages
- Simplifies application development by providing a standard interface for creating, sending, and receiving messages
- Supports two messaging models
  - **Queues**: PTP (point-to-point or 1:1)
    - A sender sends messages to a queue & a single receiver pulls the message off the queue
    - The receiver does not need to be listening to the queue at the time the message is sent
  - **Topics**: Pub-Sub (publish/subscribe or 1:many)
    - A publisher sends a message to a topic & all active subscribers receive the message
    - Subscribers not actively listening will miss the published message (unless messages are made durable)

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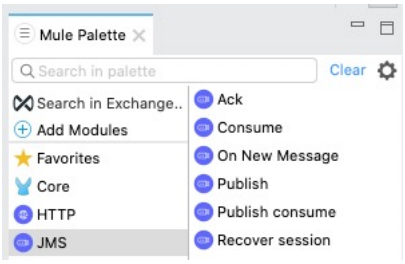
Using the JMS connector

- Add the JMS module to the project
- Configure a global element configuration
  - By default, it is set up with a finely tuned set of values for both for publishing and consuming messages
  - Typically, you just need to configure which connection should be used
- Use operations to publish and/or consume messages to destinations



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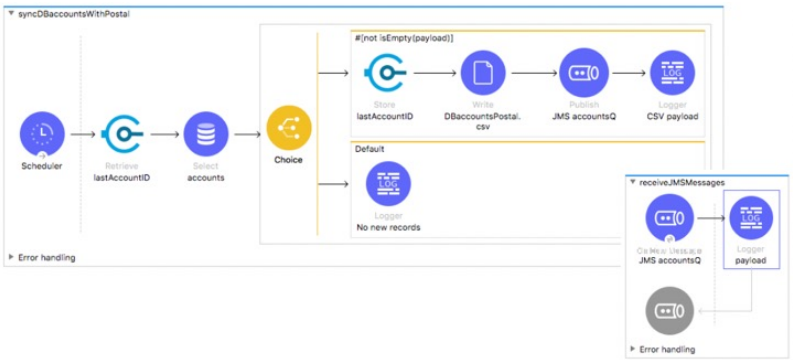
Walkthrough 12-4: Publish and listen for JMS messages

- Add and configure a JMS connector for ActiveMQ (that uses an in-memory broker)
- Send messages to a JMS queue
- Listen for and process messages from a JMS queue



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Summary

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Summary

MuleSoft

- Use **watermarks** to synchronize data across data stores
  - Use either **manual** or the **automatic** watermarking available for some connectors
- Use the family of **File**, **FTP**, **FTPS**, and **SFTP** connectors to work with files and folders
- Use the **On New or Updated File** listener to trigger flows when files are added, created, or updated
  - Use the connector's **automatic watermarking** to determine if a file is new based on a creation or modification timestamp
- Use the **On Table Row** listener when new records are added to a database table
  - Use the connector's **automatic watermarking** to determine if the record is new

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Summary

MuleSoft

- Use the **Scheduler** component to schedule flows to run at a certain time or frequency
  - Use a watermark to keep a persistent variable between scheduling events
- Use the **Object Store** connector to persist and share a watermark (or other data) across flow executions
- Use the **JMS** connector to publish and consume messages
  - Connect to any JMS messaging service that implements the JMS spec