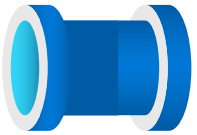
A Introduction to Azure Data Factory

Integration Pipelines 

Paul Andrew | Technical Architect in Azure CoE

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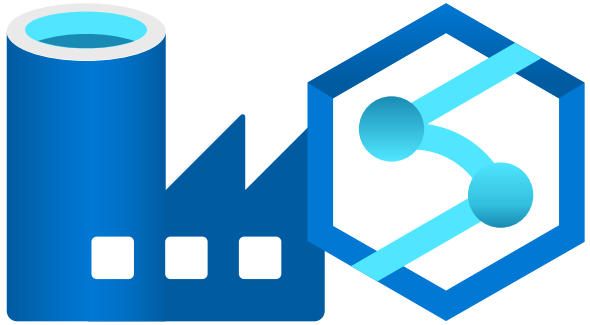
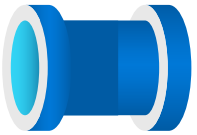
@MrPaulAndrew In/MrPaulAndrew MrPaulAndrew.com



A Introduction to Azure ~~Data Factory~~

Integration Pipelines 

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Go deeper on a topic...

https://mrpaulandrew.com

https://github.com/mrpaulandrew

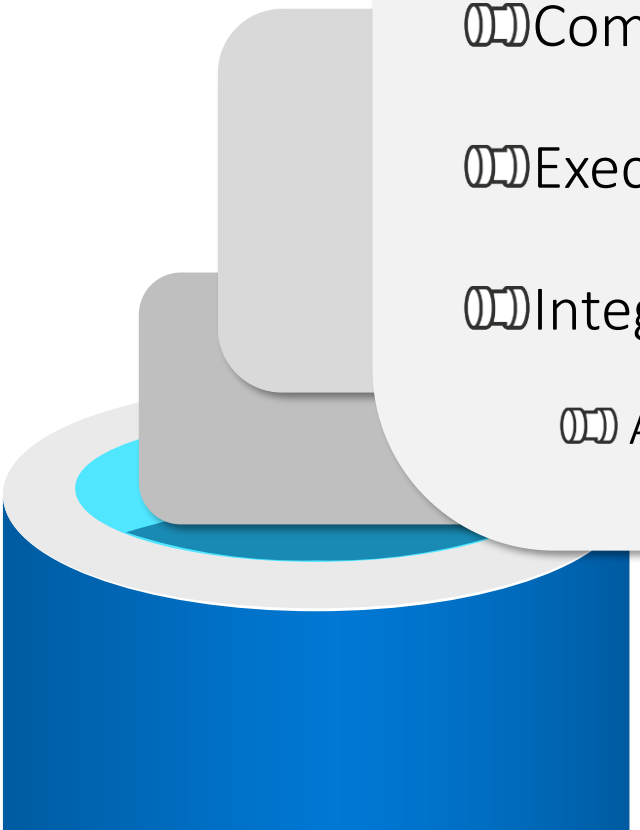
CommunityEvents

Demo code, content and slides from various community events.

{Event/Location}-{Month}-{Year}

Agenda

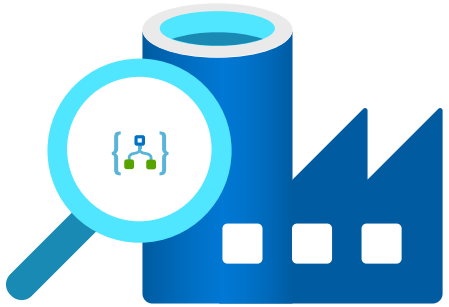
- What is it and why use it?
- Data Factory Components
- Common Activities
- Execution Dependencies
- Integration Runtimes
  - Azure/Hosted/SSIS
- Data Factory Data Flows
- Source Control
- Deployments
- Monitoring & Logging
- Conclusions



Azure Data Factory –

What is it?

Why use it?

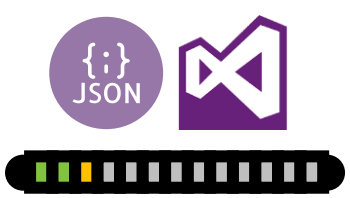


A Quick History Lesson

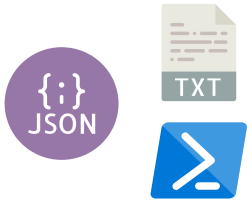
v1
July
2016

v2
Sept
2017

Oct
2020



Time Slices
VS2015 Projects



Notepad
Development

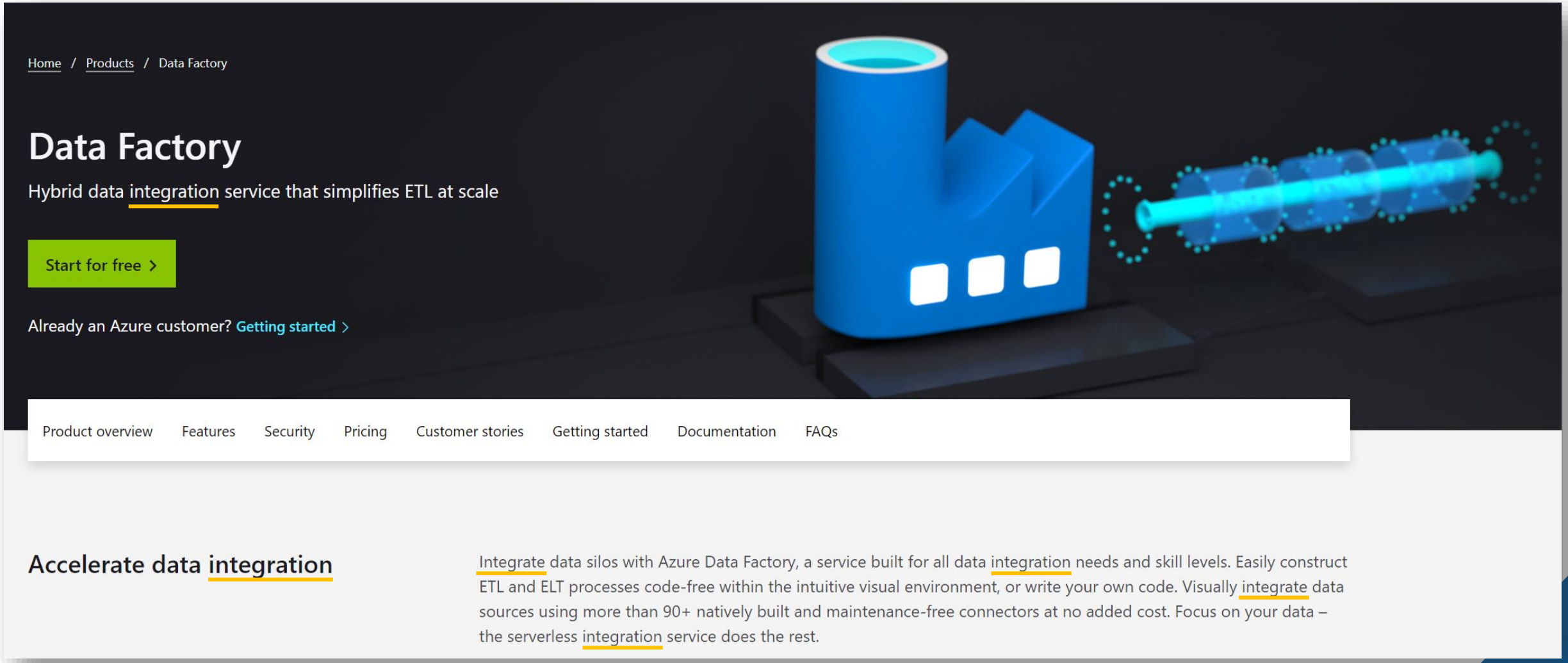
New UI

Source
Control

Data
Flows

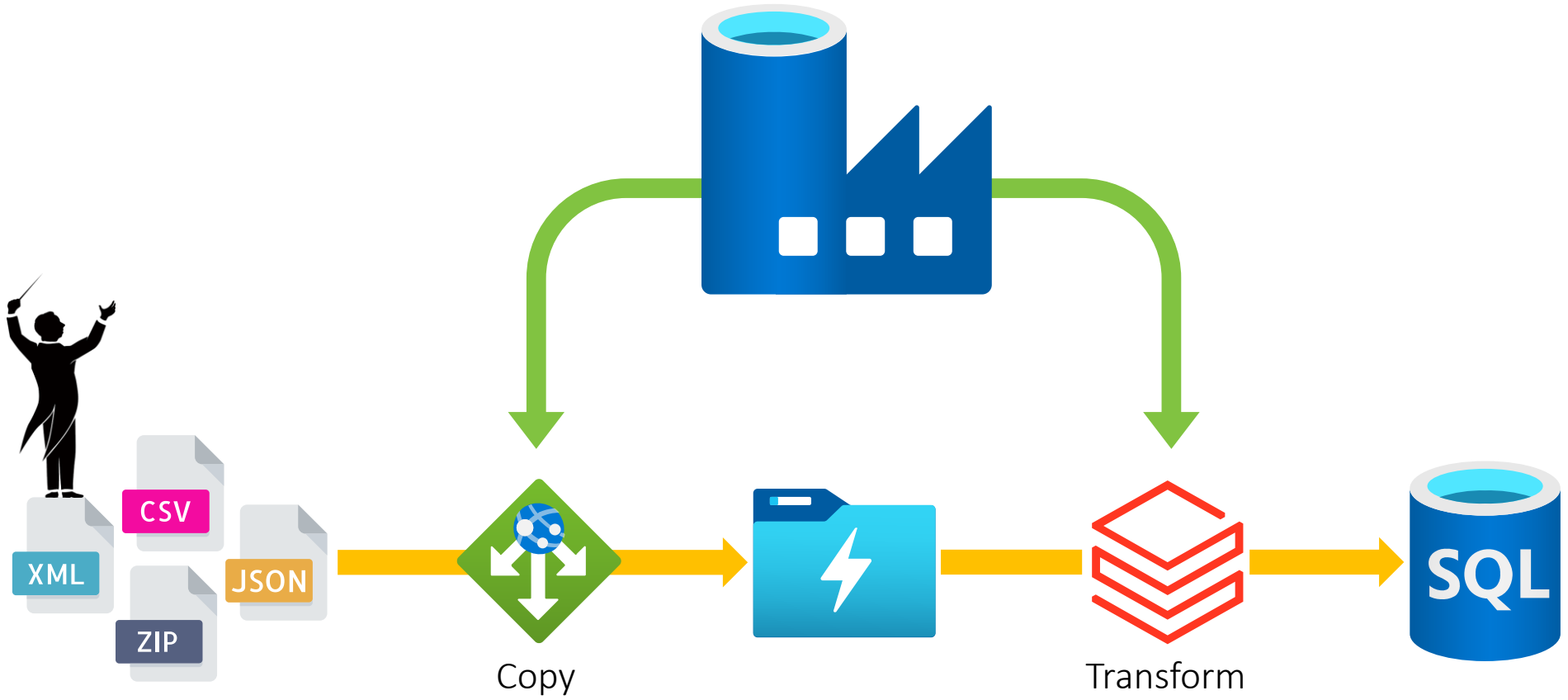
Private
Endpoints

What is Azure Data Factory (ADF)?

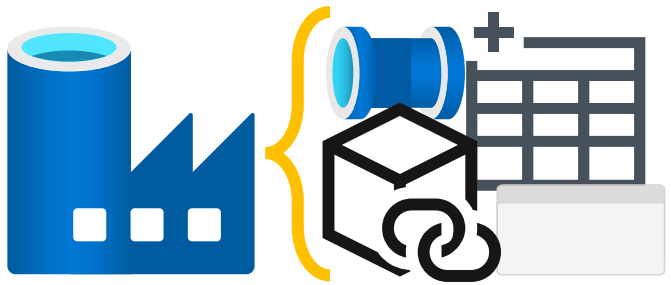


https://azure.microsoft.com/en-gb/services/data-factory

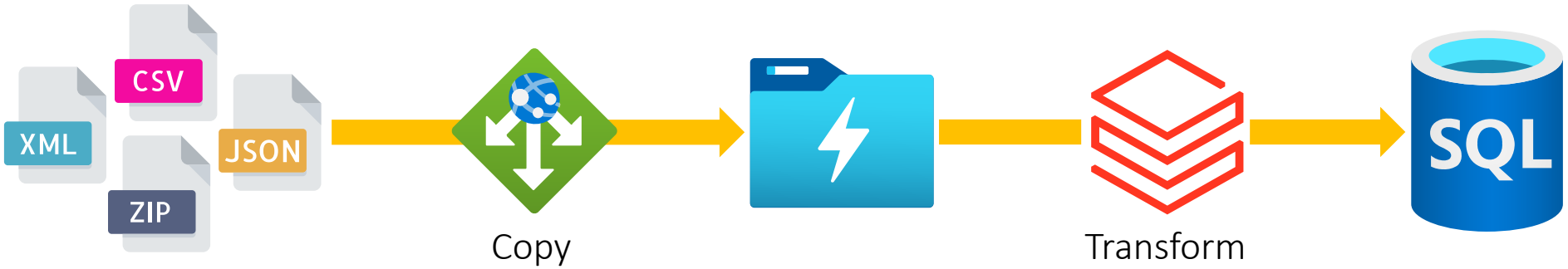
What is Azure Data Factory (ADF)?



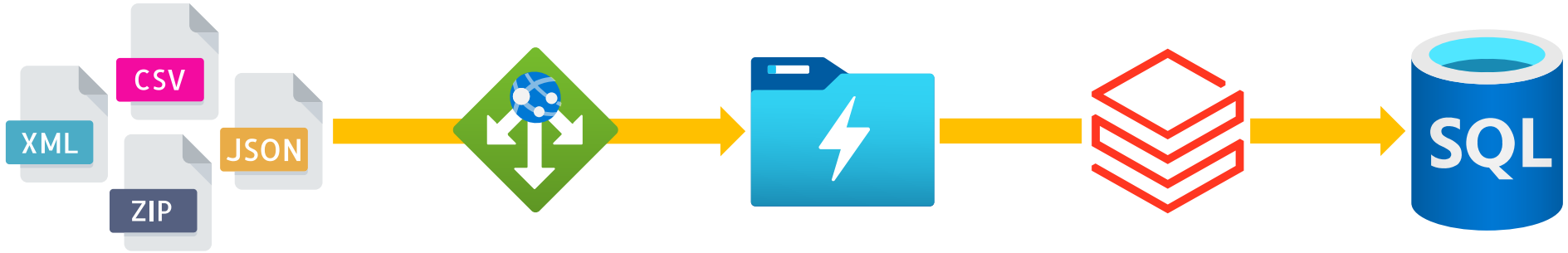
Data Factory Components



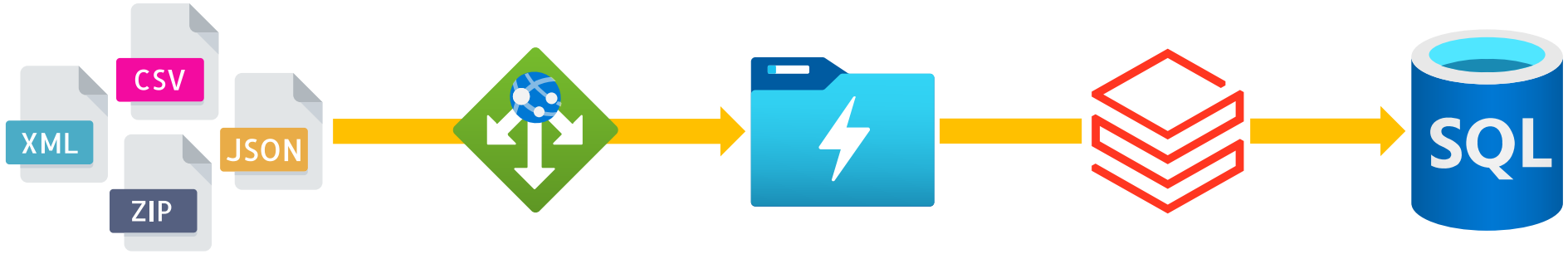
Data Factory Components



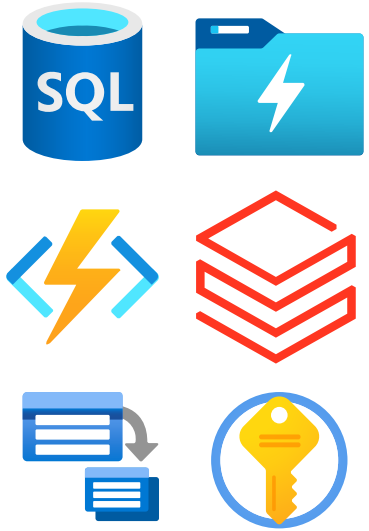
Data Factory Components



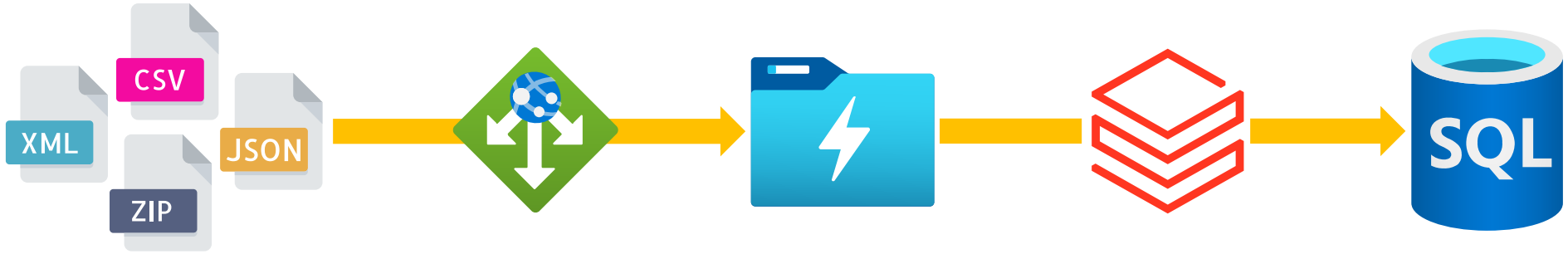
Data Factory Components



1 **Linked Services** – What to interact with and how?



Data Factory Components

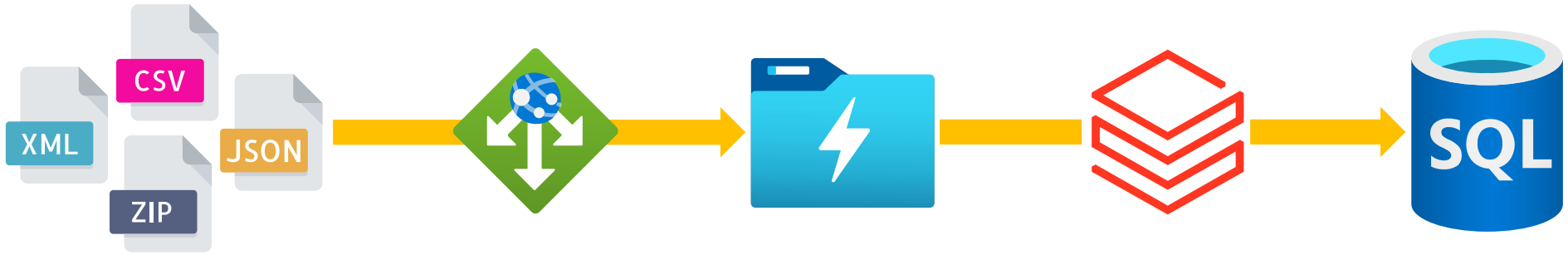


1. **Linked Services**
2. **Datasets** – Where is my data? What format? What file path/table do I need?

[dbo].[SalesOrders]

/RAW/Orders/2018/01/01/SalesOrders.csv

Data Factory Components



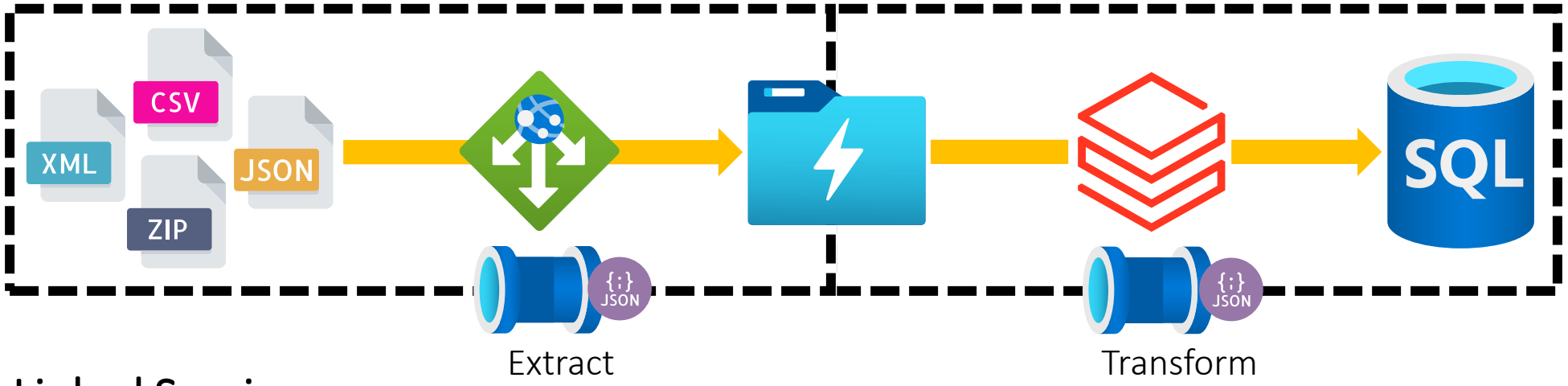
1. **Linked Services**
2. **Datasets**
3. **Activities** – What do we want to happen when we invoke a Linked Service?
   With what conditions?

JSON

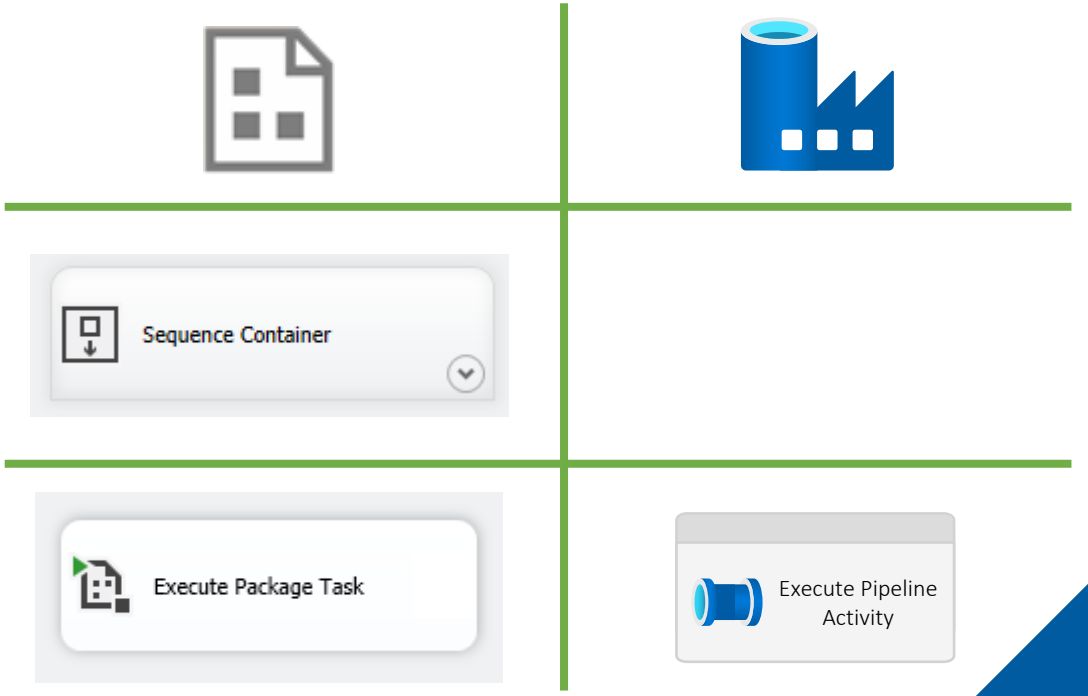
Databricks Notebook Activity

notebookPath: */Playground/Playing*
baseParameters: *Testing*
libraries[jar]: dbfs:/lib1.jar
linkedServiceName: *BricksOfData01*

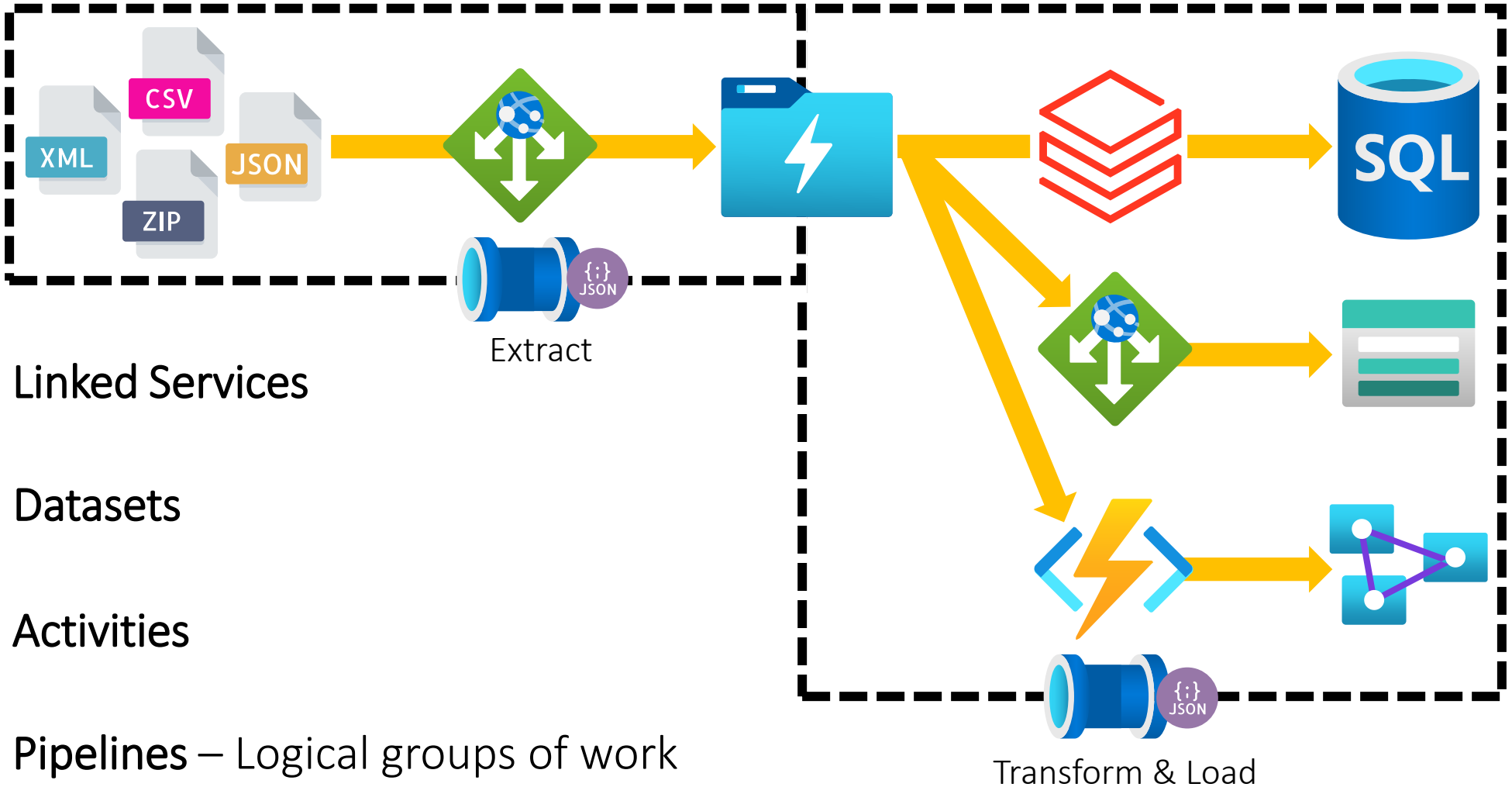
Data Factory Components



1. **Linked Services**
2. **Datasets**
3. **Activities**
4. **Pipelines** – Logical groups of work that can be executed.

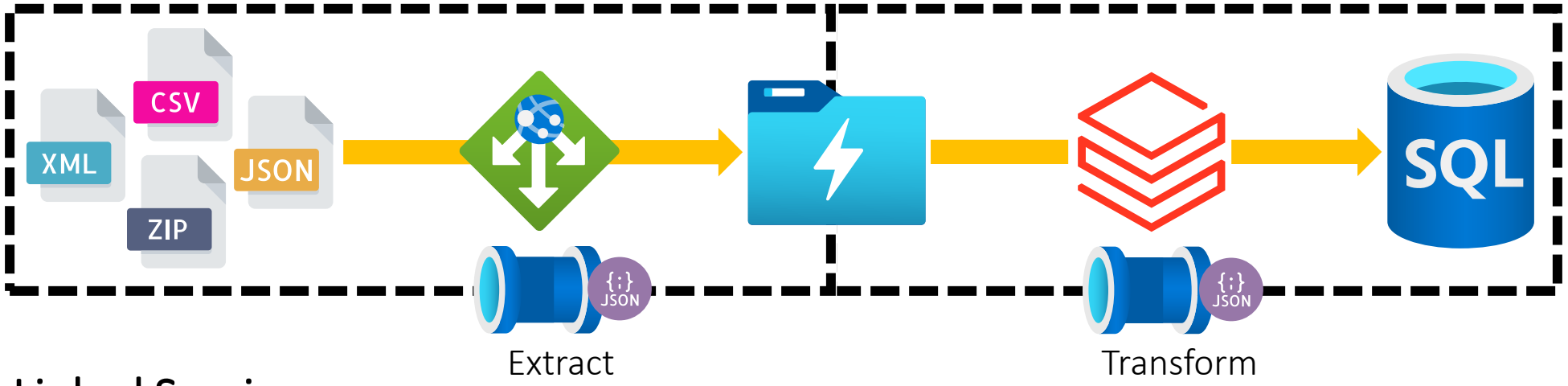


Data Factory Components

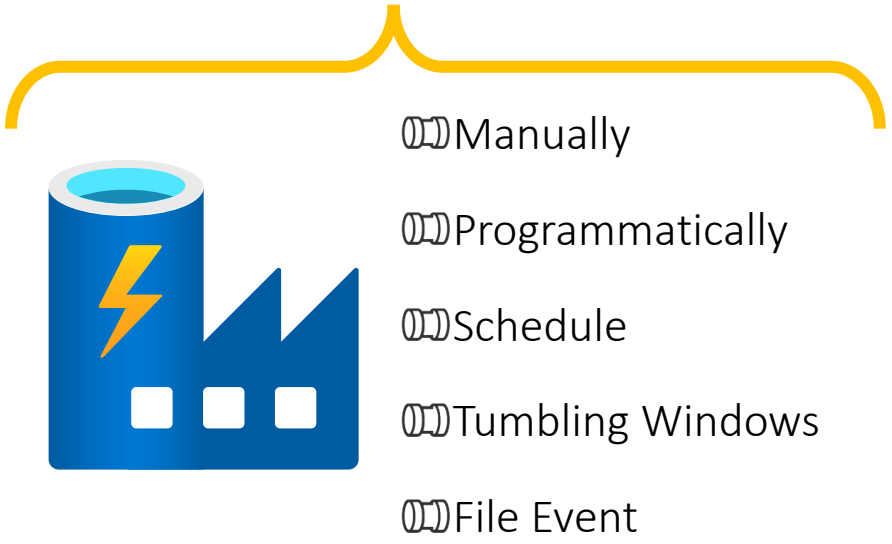


1. **Linked Services**
2. **Datasets**
3. **Activities**
4. **Pipelines** – Logical groups of work that can be executed.

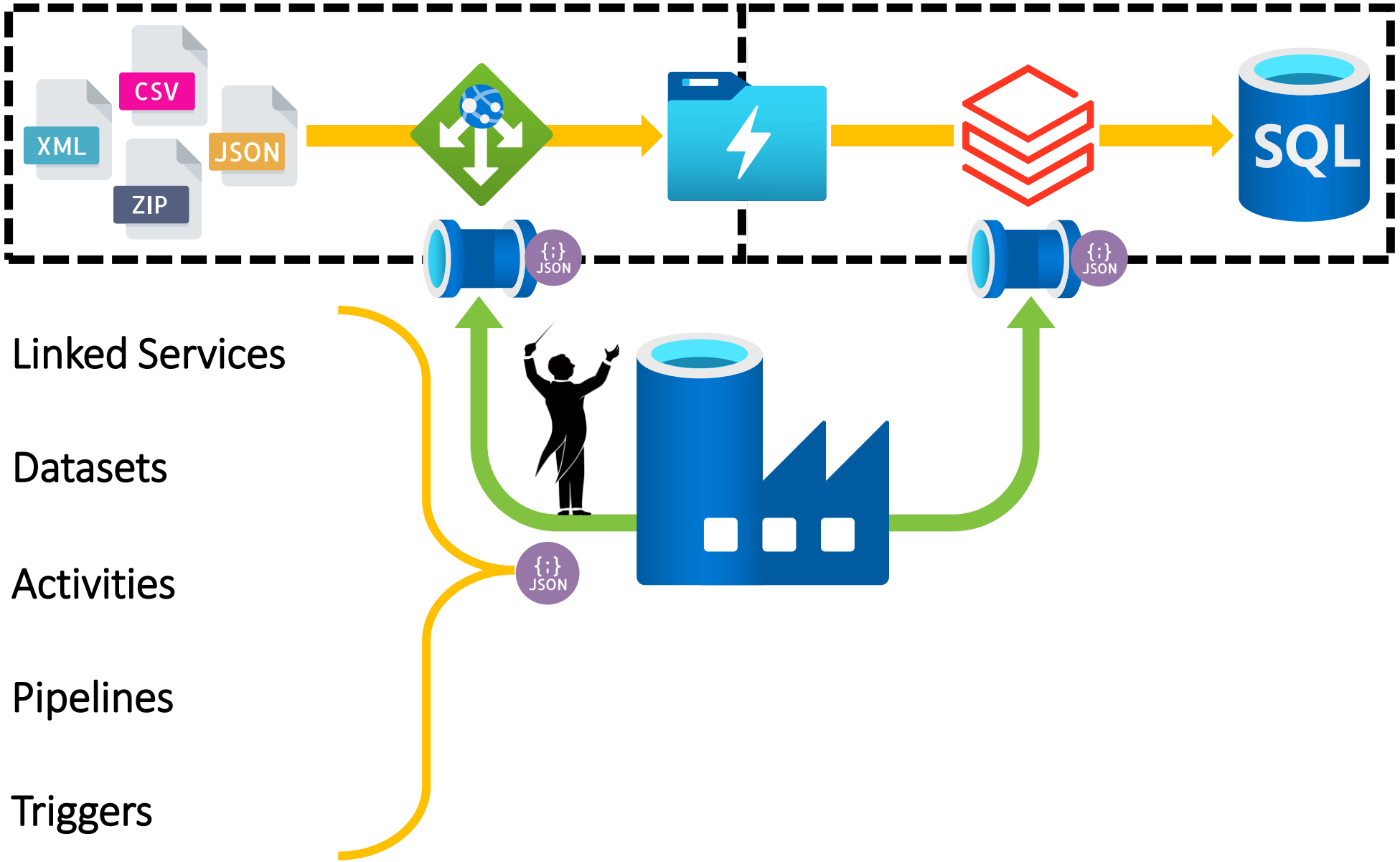
Data Factory Components



1. **Linked Services**
2. **Datasets**
3. **Activities**
4. **Pipelines**
5. **Triggers** – Telling our when pipelines to run.

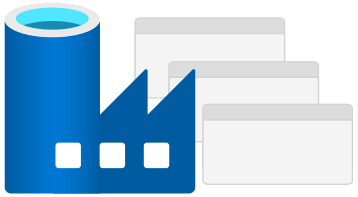


Data Factory Components

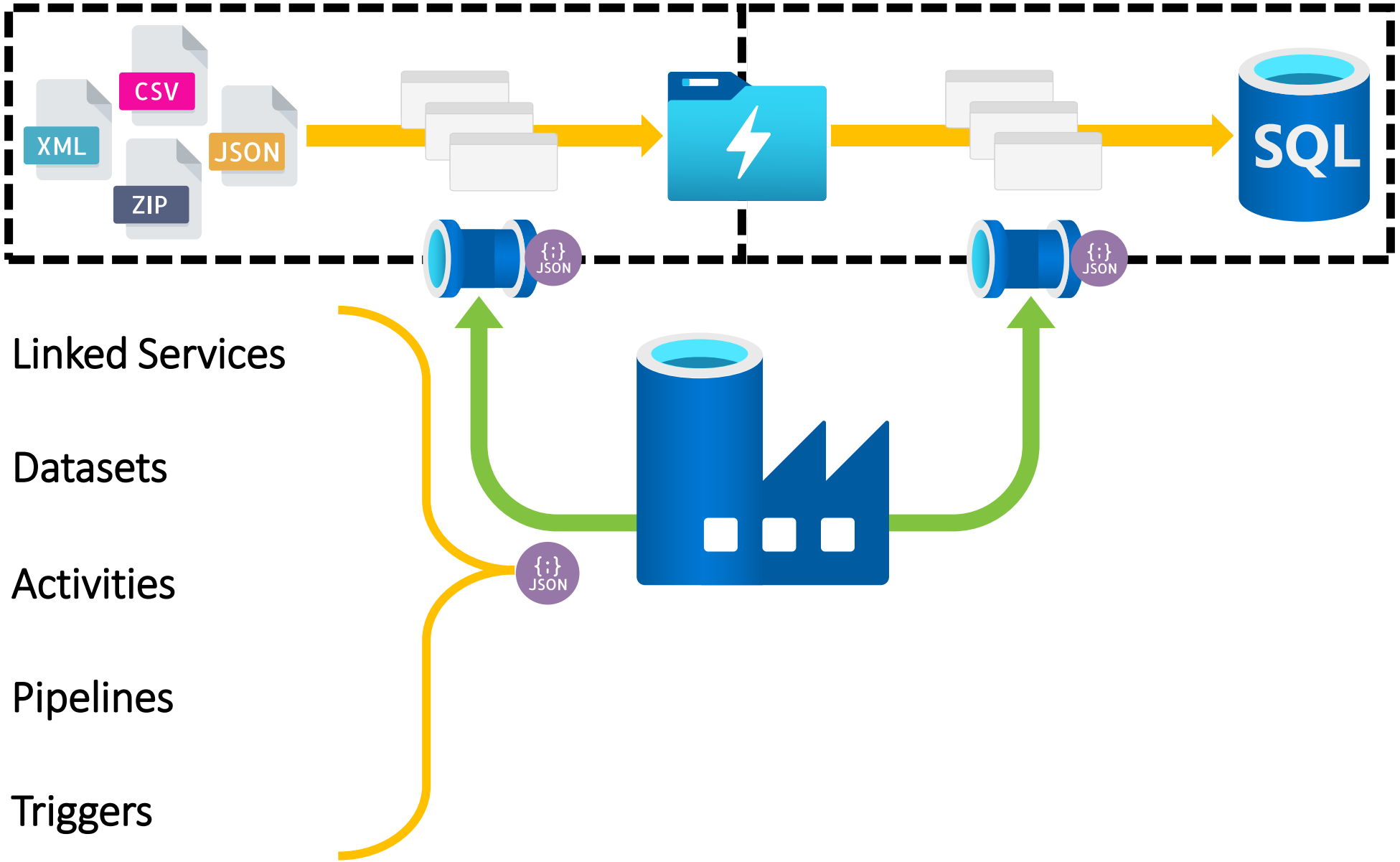


Common Activities

```
SELECT TOP 5
    [ActivityName],
    [Inputs],
    [Outputs],
    [Details]
FROM
    [metadata].[AdfActivities]
WHERE
    [Notes] = 'Pauls Favourites';
```

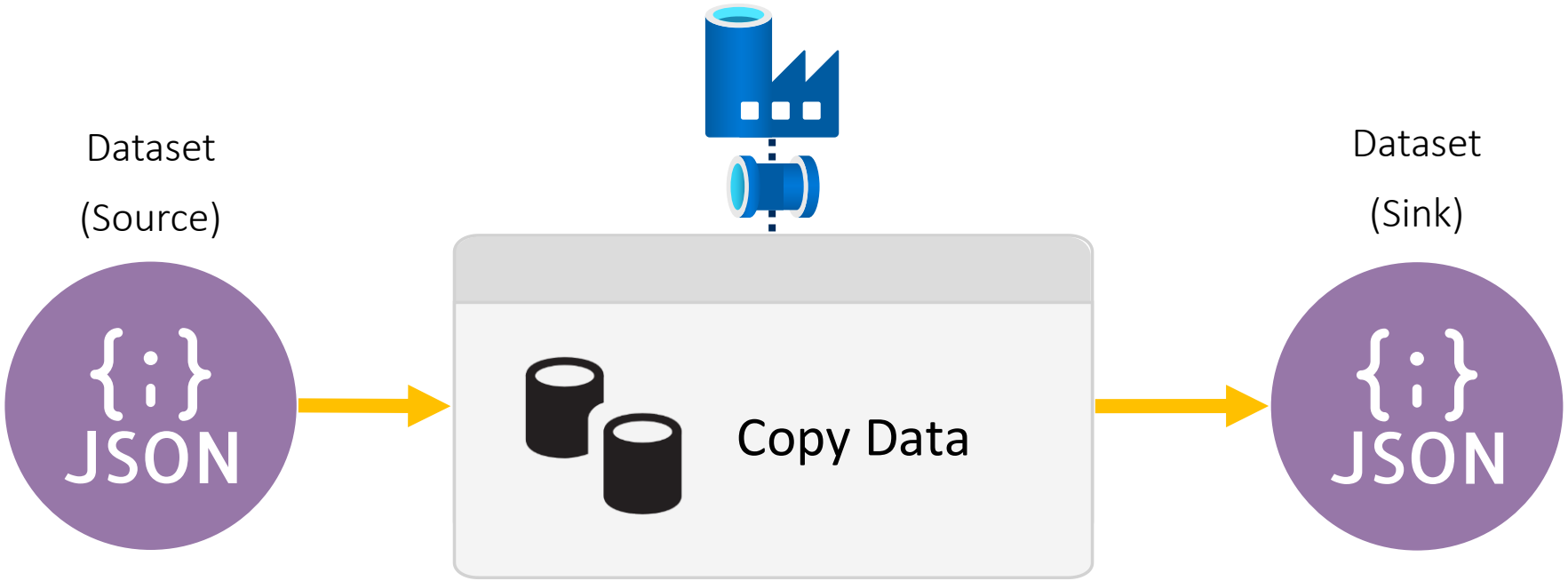


Data Factory Common Activities



1. Linked Services
2. Datasets
3. Activities
4. Pipelines
5. Triggers

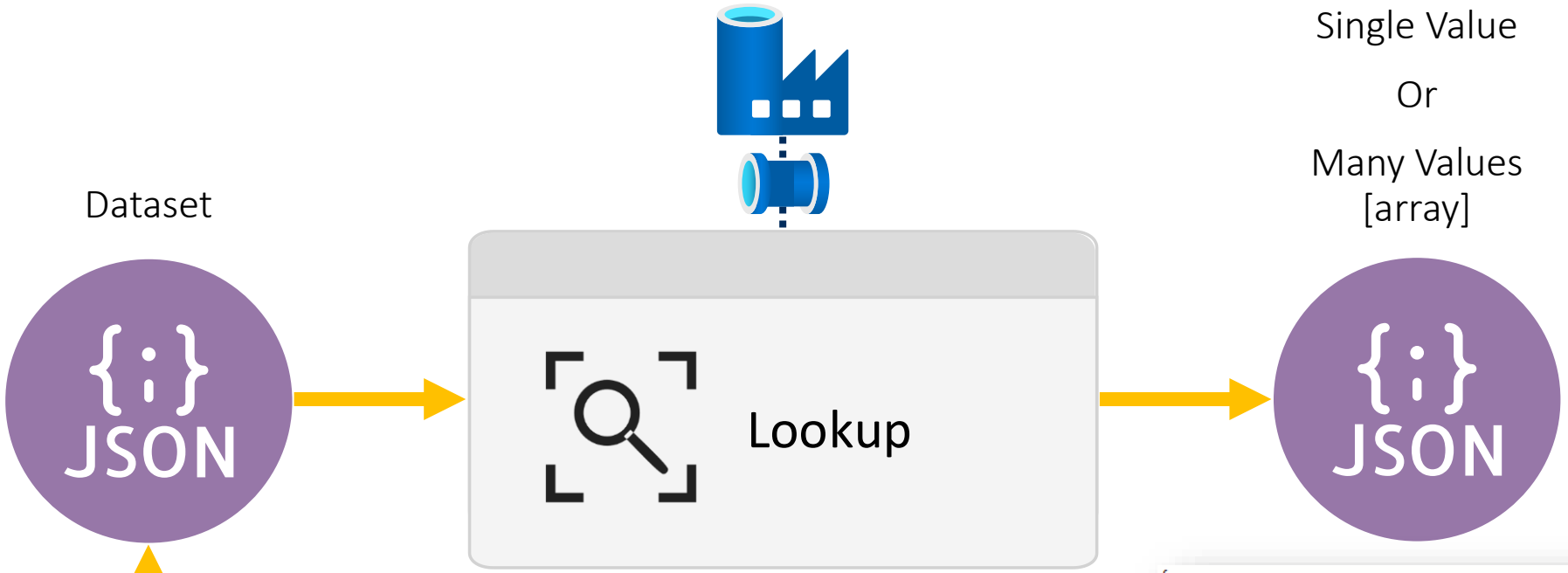
Copy



- Auto Scaling
- Transactional Restarts
- Handle Zip Compression
- Attribute Mapping and Schema Drift
- Handle Failed Rows
- Add Custom Attributes
- Parse Excel & JSON Files

Lookup

Get value to support other control flow activities

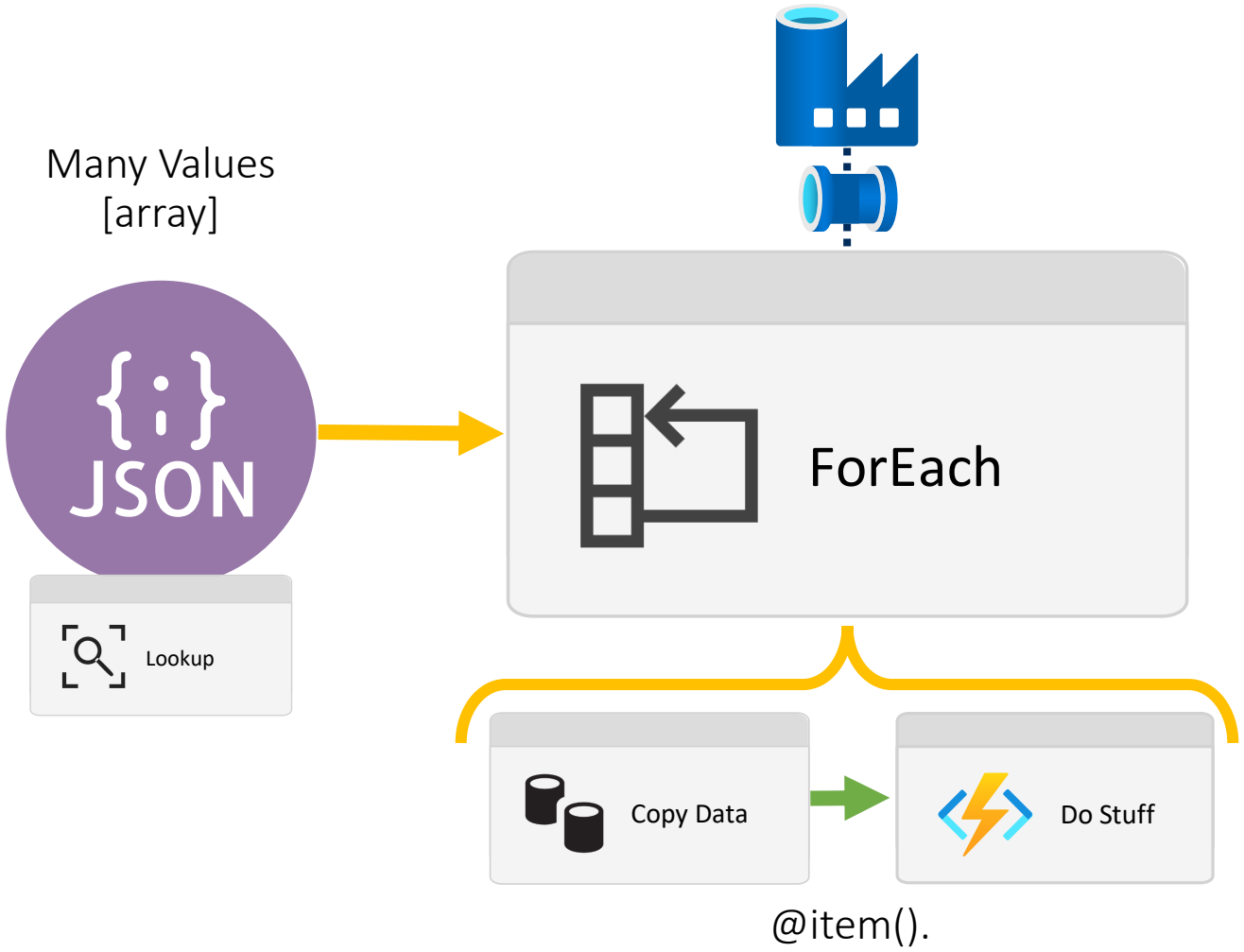



```
{
    "count": 3,
    "value": [
        {
            "SourceDIR": "ADFRoot\\ForUpload\\People\\",
            "TargetDIR": "RAW",
            "FileName": "Address.csv"
        },
        {
            "SourceDIR": "ADFRoot\\ForUpload\\People\\",
            "TargetDIR": "RAW",
            "FileName": "Gender.csv"
        },
        {
            "SourceDIR": "ADFRoot\\ForUpload\\People\\",
            "TargetDIR": "RAW",
            "FileName": "Ids.csv"
        }
    ]
}
```

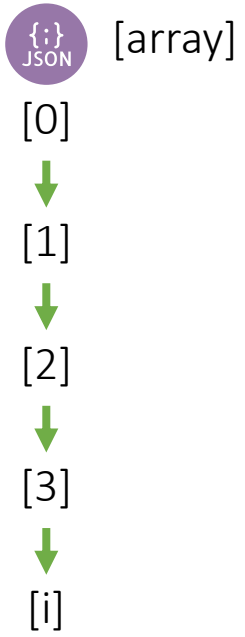
https://docs.microsoft.com/en-us/azure/data-factory/control-flow-lookup-activity

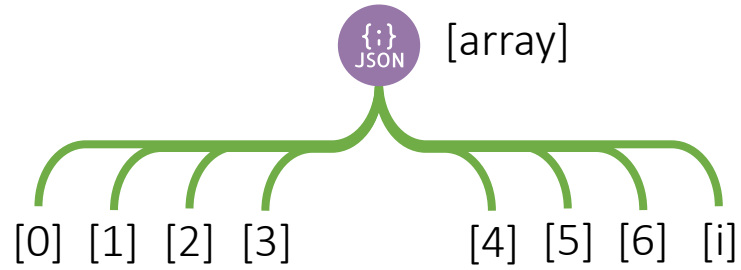
ForEach

Scaling Out Control Flow Activities



IsSequential: true



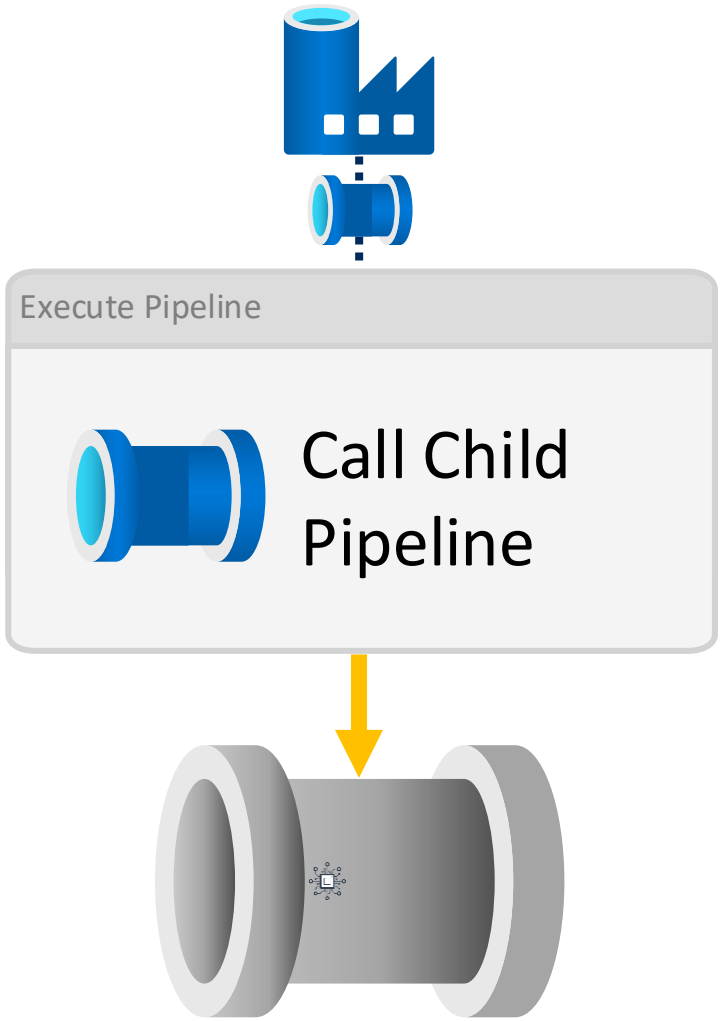


Batch Count Default: 20

Batch Count Max: 50

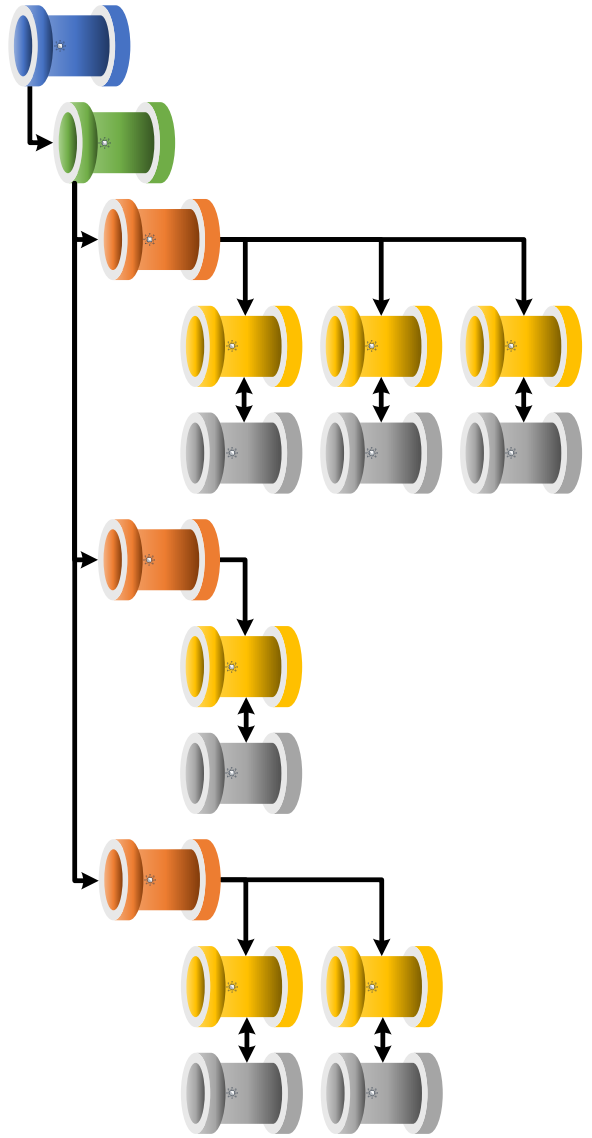
https://docs.microsoft.com/en-us/azure/data-factory/control-flow-for-each-activity

Execute Pipeline



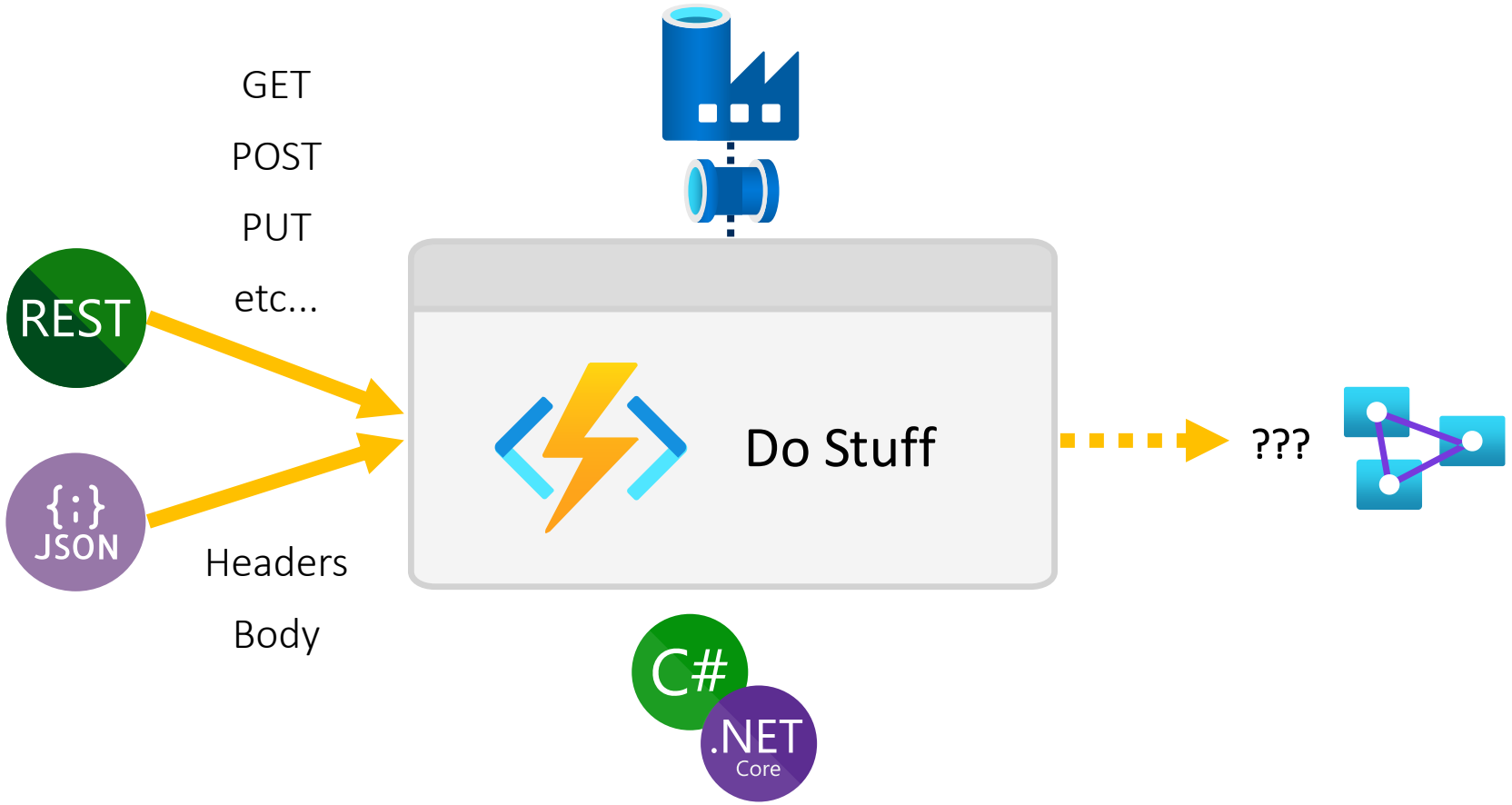
Pipeline Hierarchies Generation Control

https://mrpaulandrew.com/2019/09/25/azure-data-factory-pipeline-hierarchies-generation-control



Azure Function

Extend Data Factory with Rest Calls



Web

HTTP Do Stuff

Web Hook

Do Stuff

Custom

Extend Data Factory with Custom Code

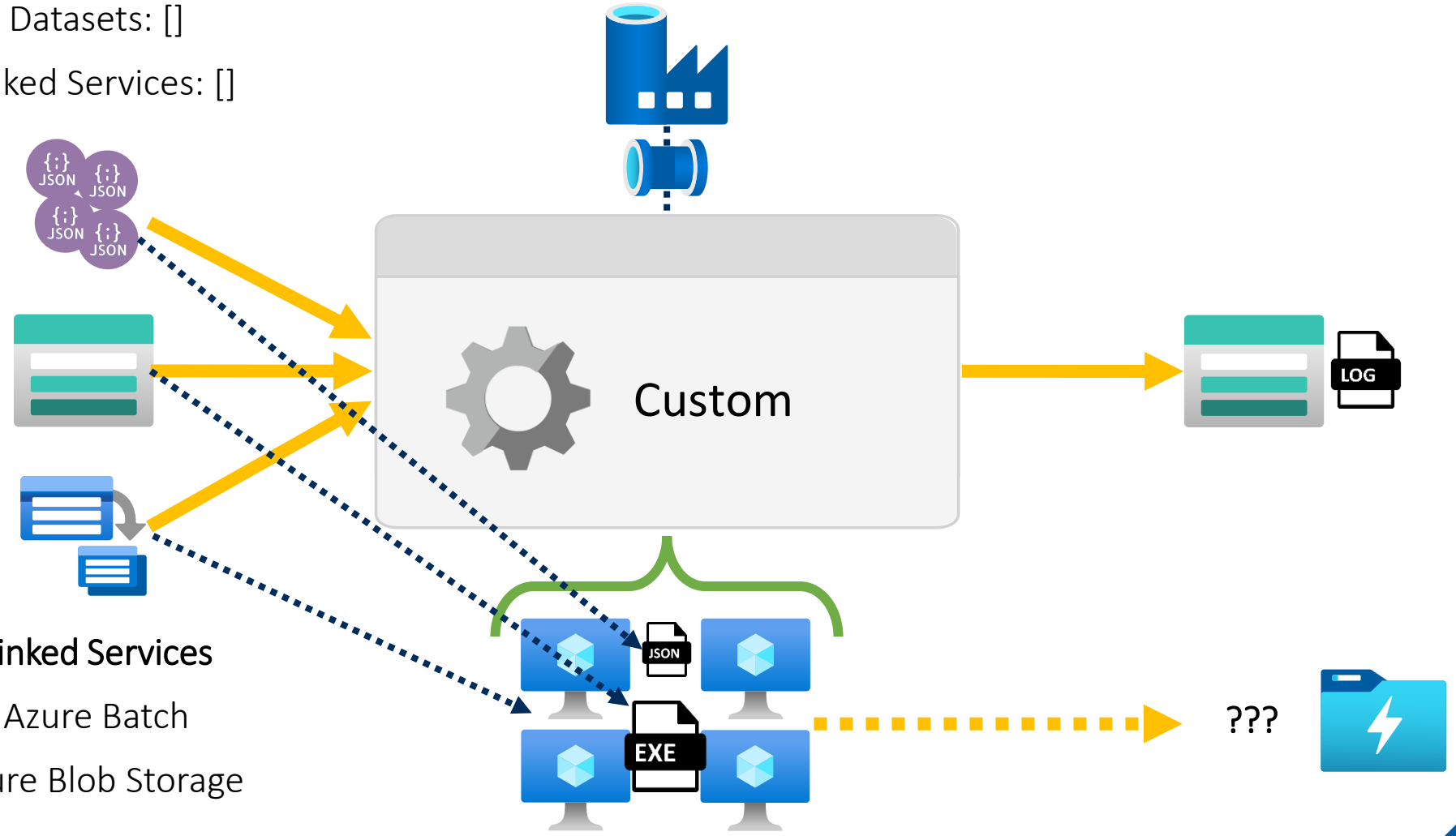
Creating a Custom Activity

https://mrpaulandrew.com/2018/11/12/creating-an-azure-data-factory-v2-custom-activity/

References Objects

Datasets: []

Linked Services: []

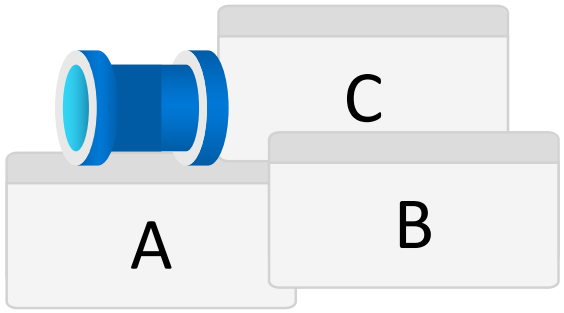


Linked Services

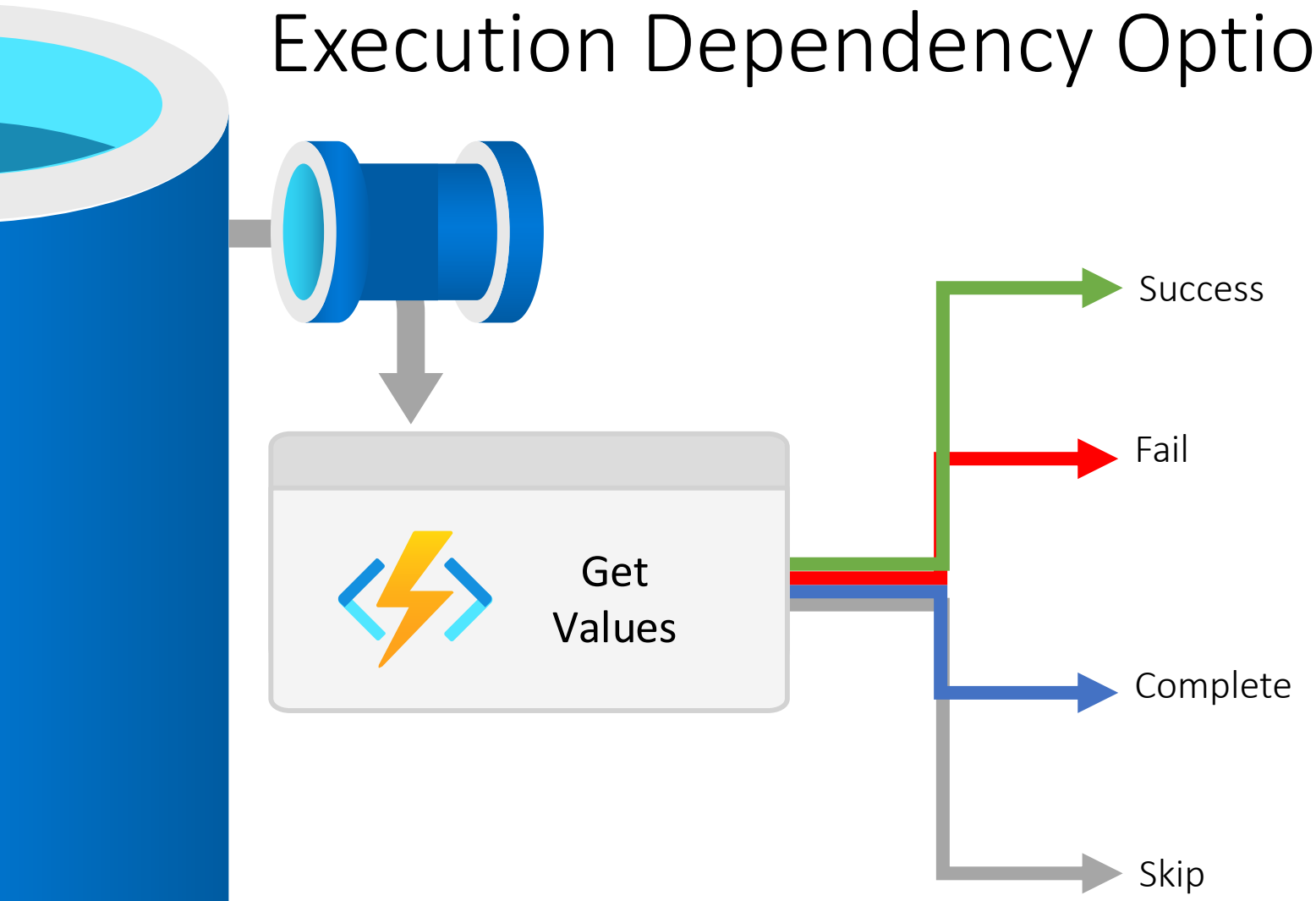
Azure Batch

Azure Blob Storage

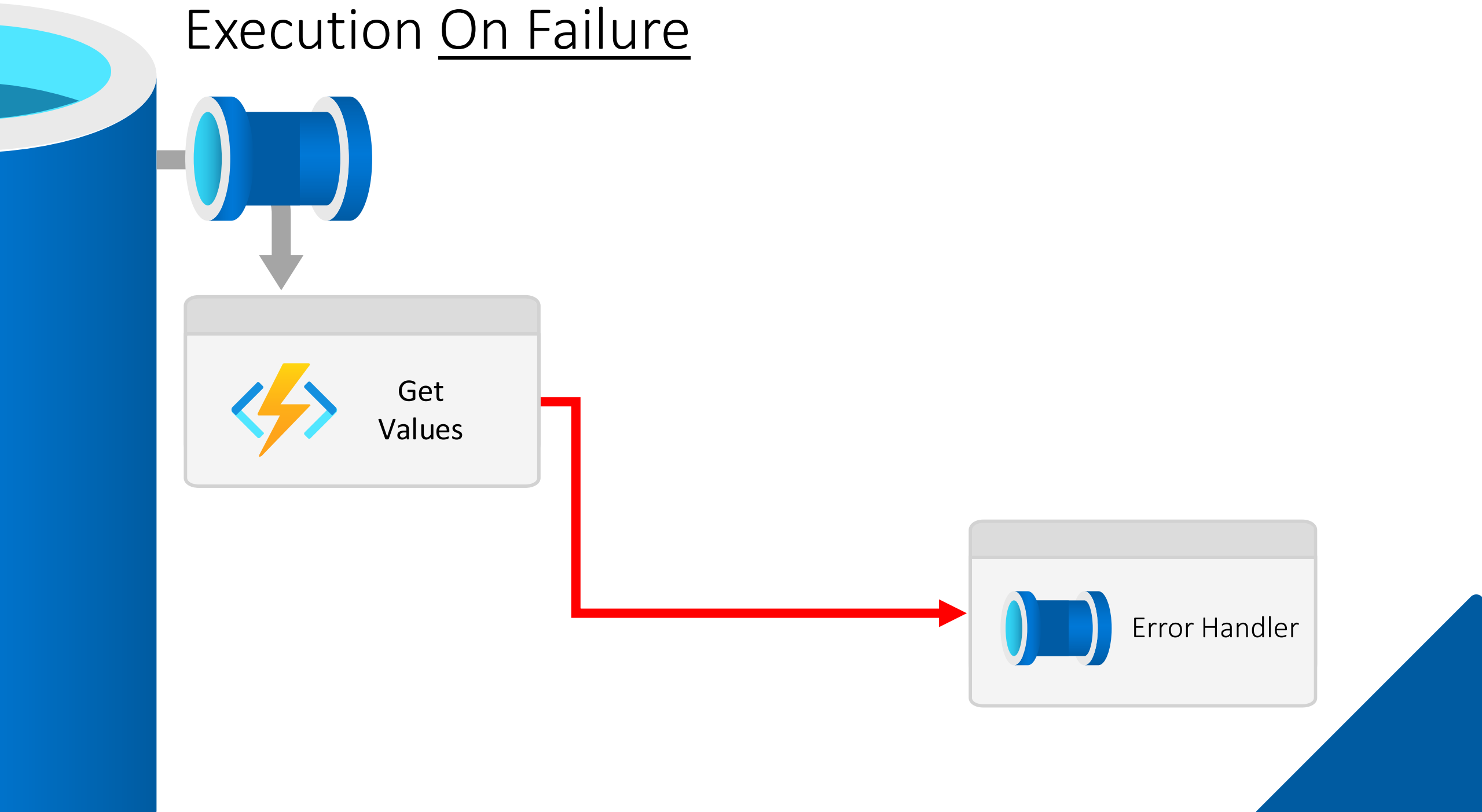
Execution Dependencies



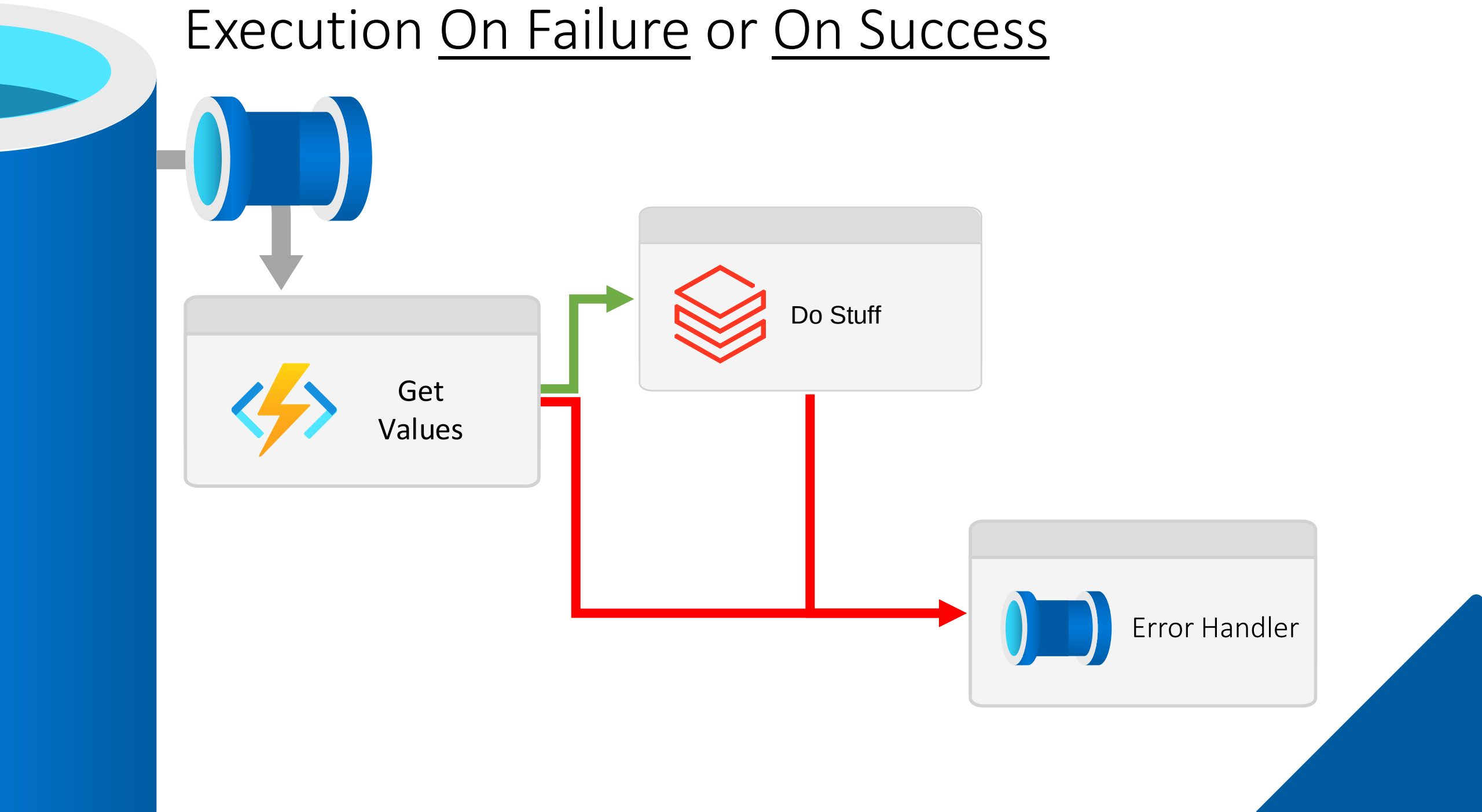
Execution Dependency Options



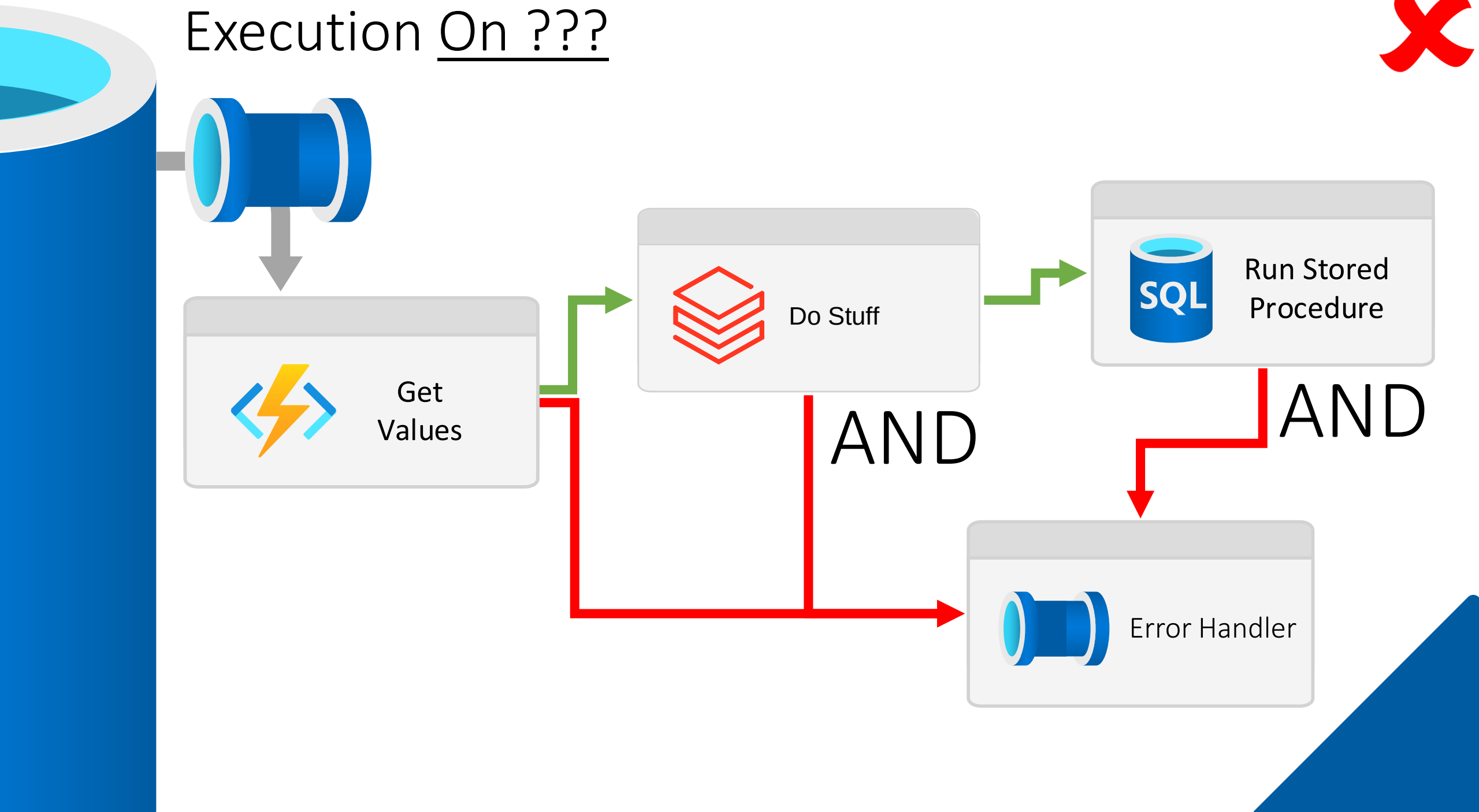
Execution On Failure



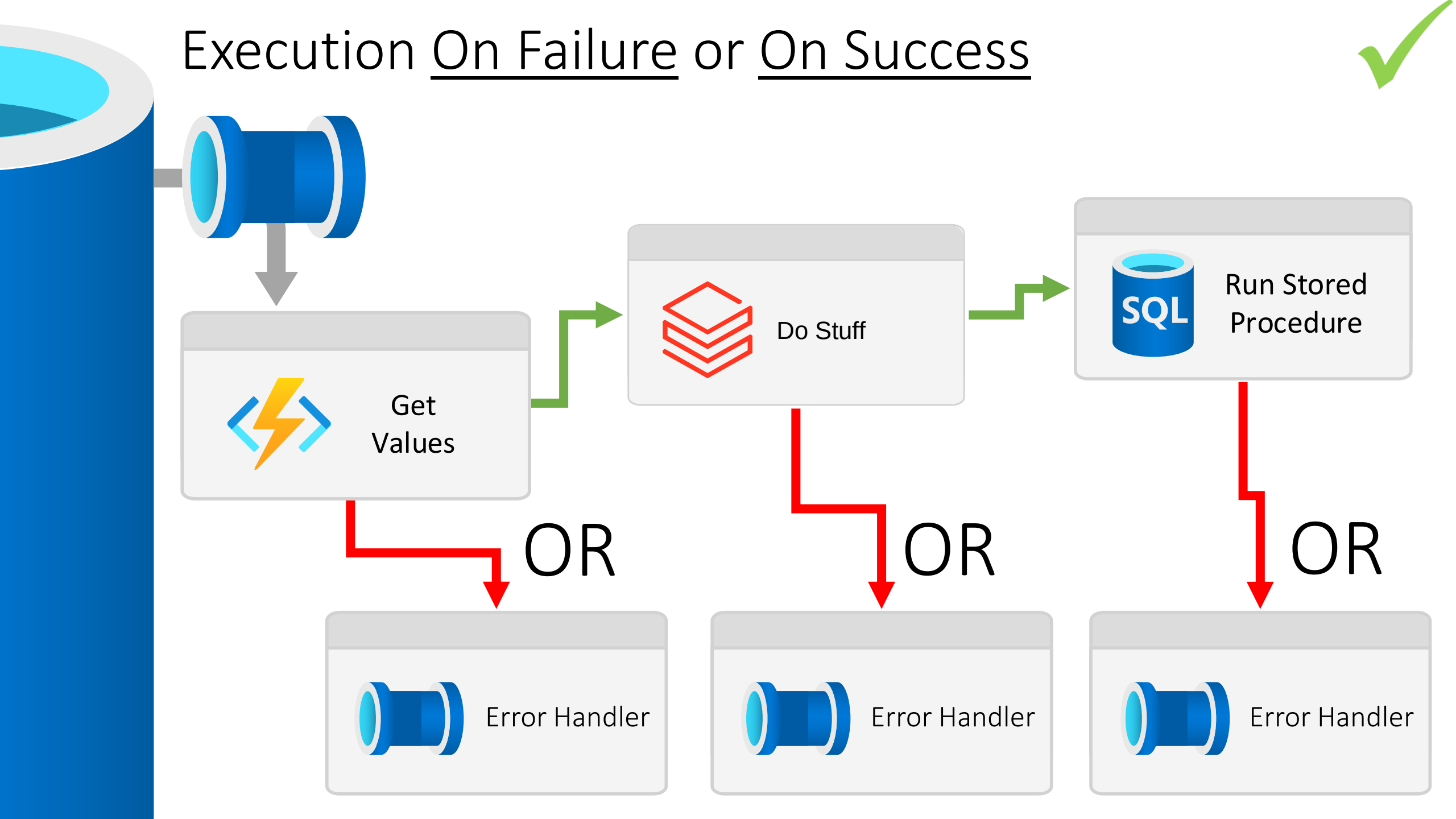
Execution On Failure or On Success



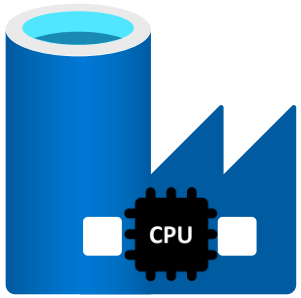
Execution On ???



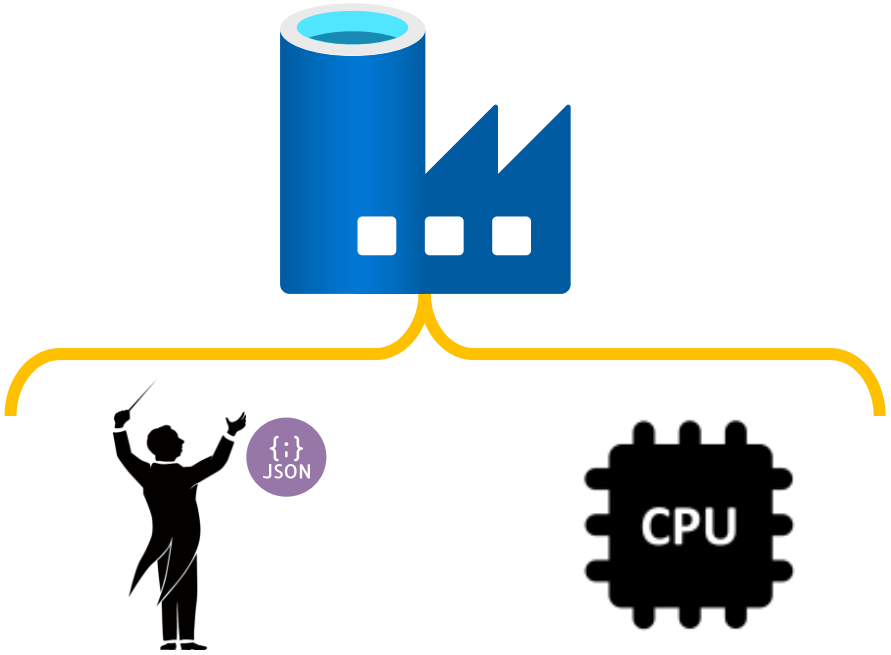
Execution On Failure or On Success



Integration Runtimes



What is an Integration Runtime?

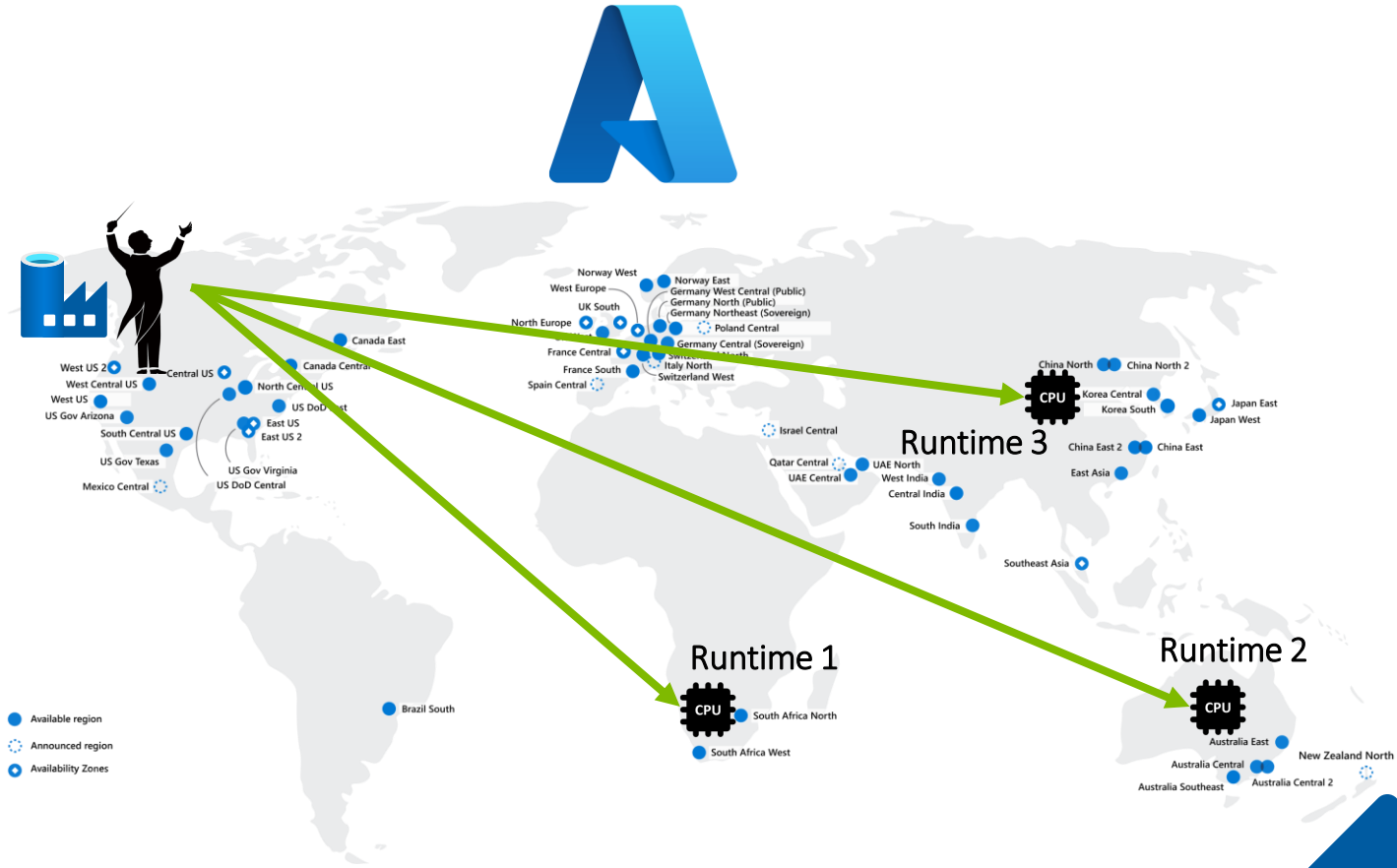


Orchestrator

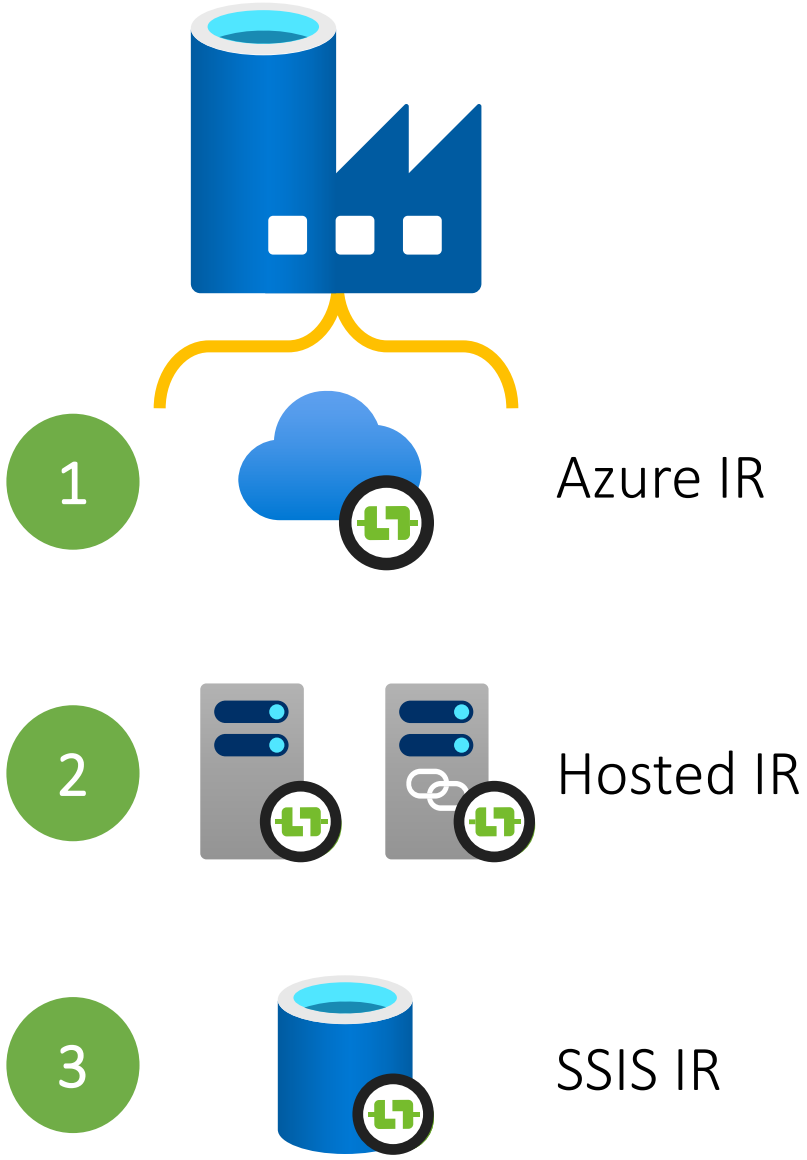
Fixed Region

Runtime

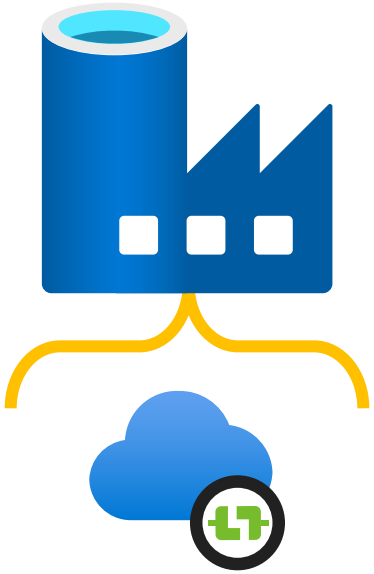
Flexible Location



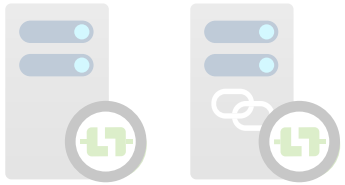
What can an Integration Runtime do?



Azure Integration Runtime



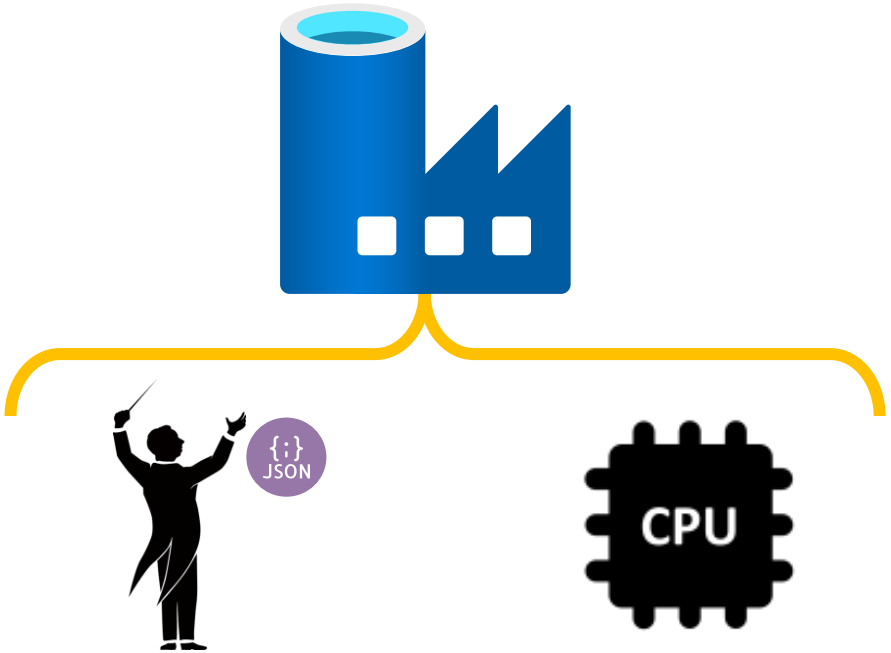
Azure IR



Hosted IR

SSIS IR

Azure Integration Runtime

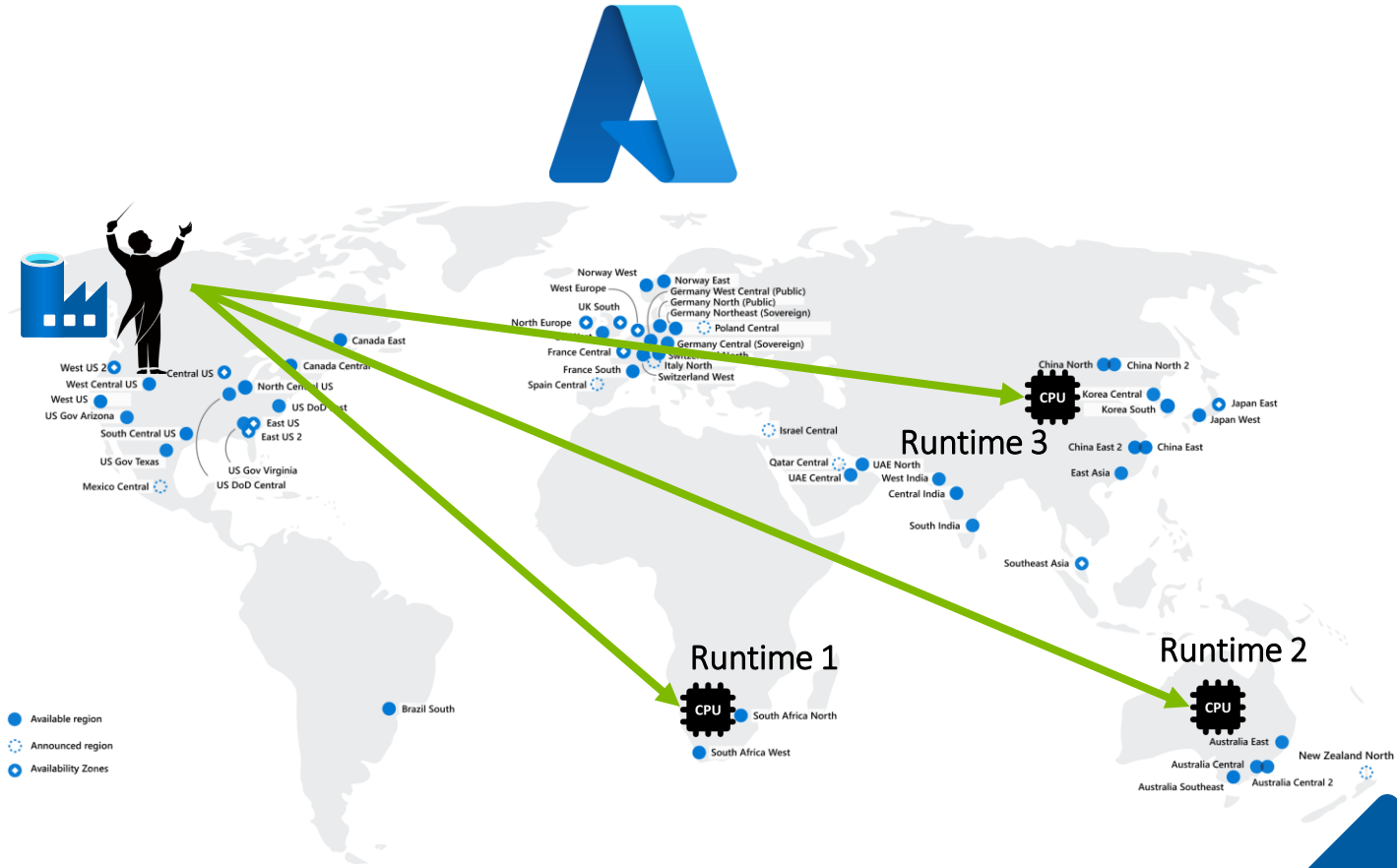


Orchestrator

Fixed Region

Runtime

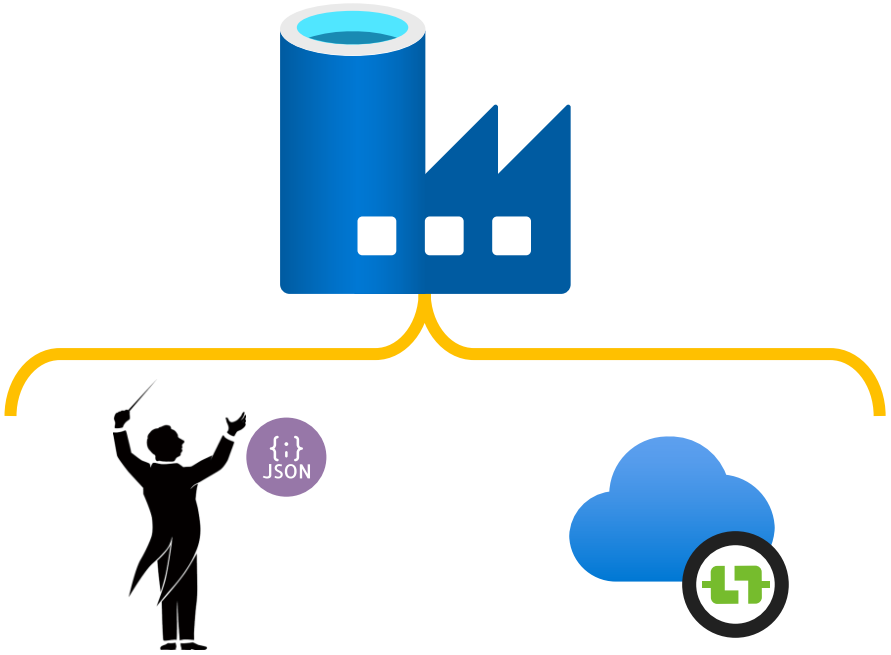
Flexible Location



Azure Integration Runtime

Internal vs External Activities

https://mrpaulandrew.com/2020/12/22/pipelines-understanding-internal-vs-external-activities/



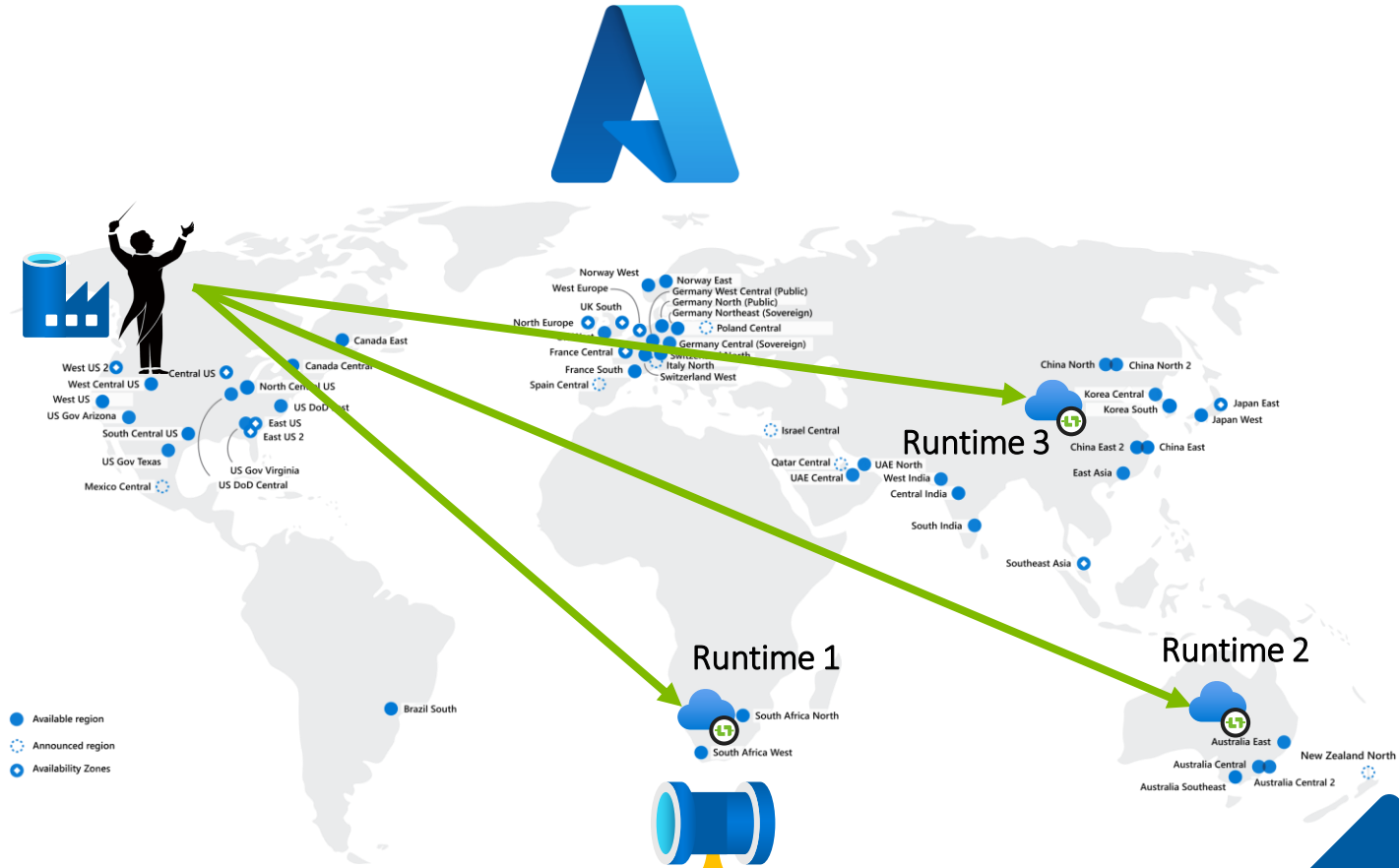
Orchestrator

Fixed Region

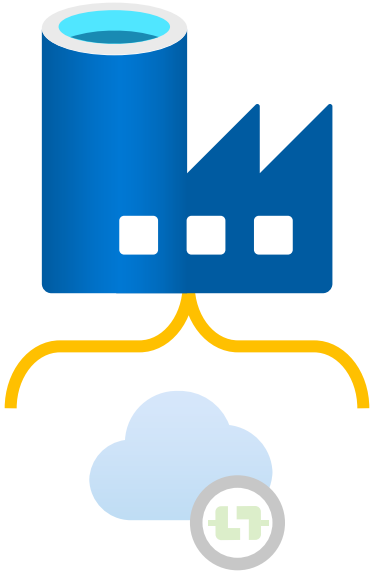
Runtime

Flexible Region

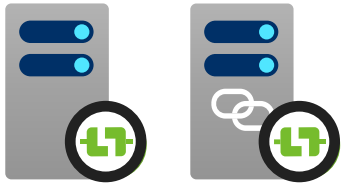
AutoResolveIntegrationRuntime



Hosted Integration Runtime



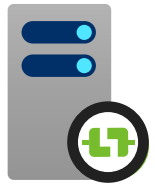
Azure IR



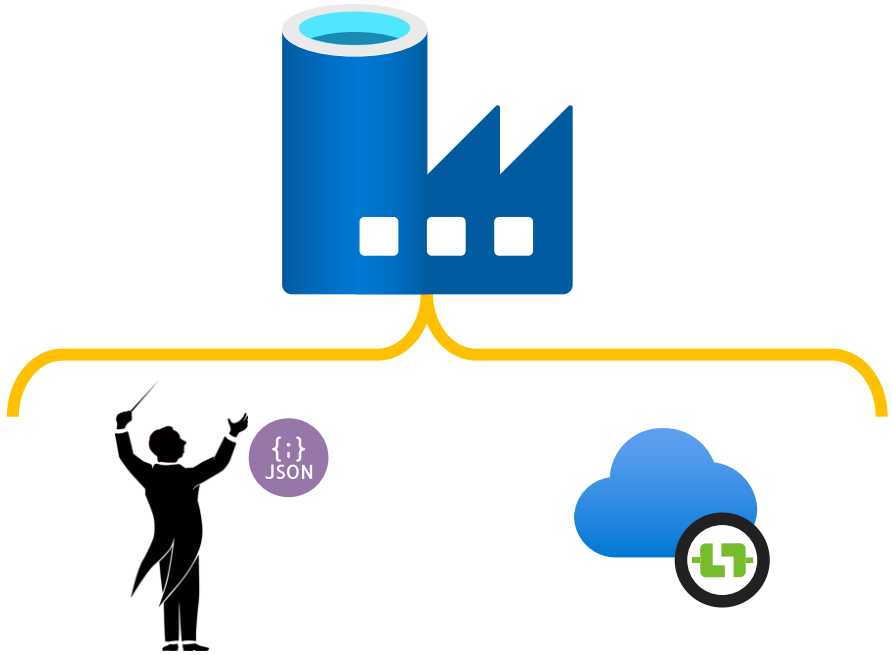
Hosted IR

SSIS IR

Hosted Integration Runtime



Runtime



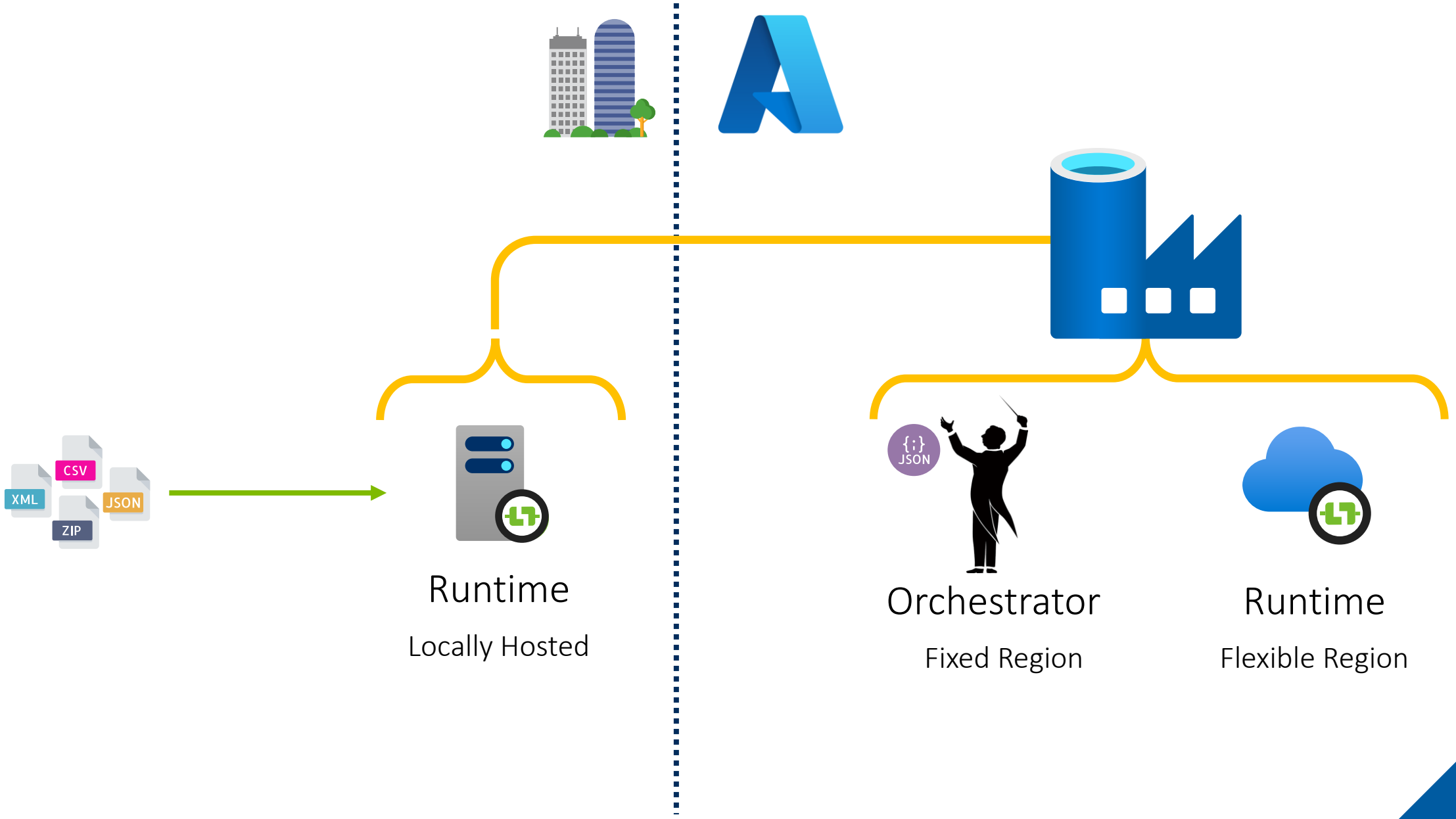
Orchestrator

Fixed Region

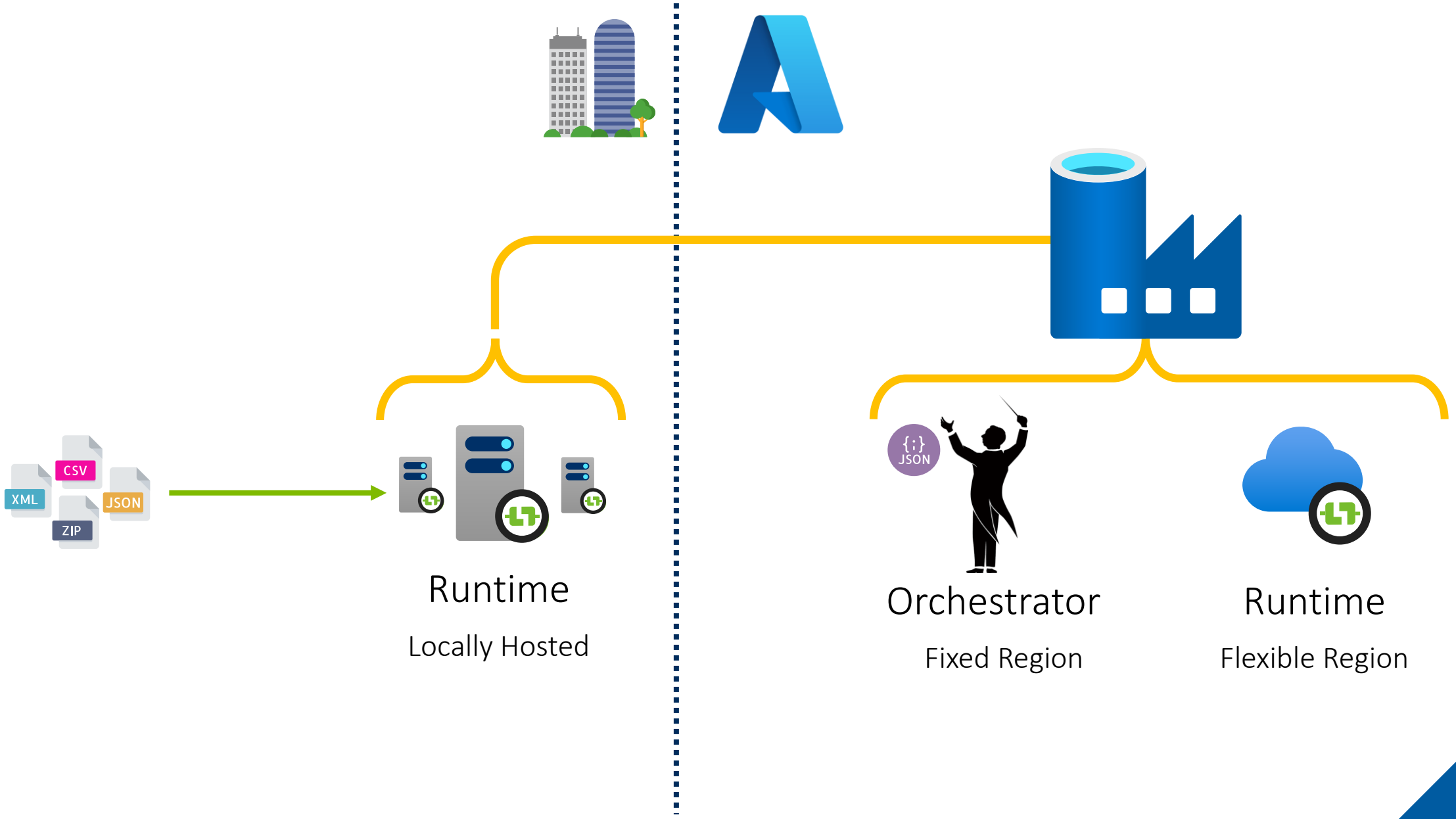
Runtime

Flexible Region

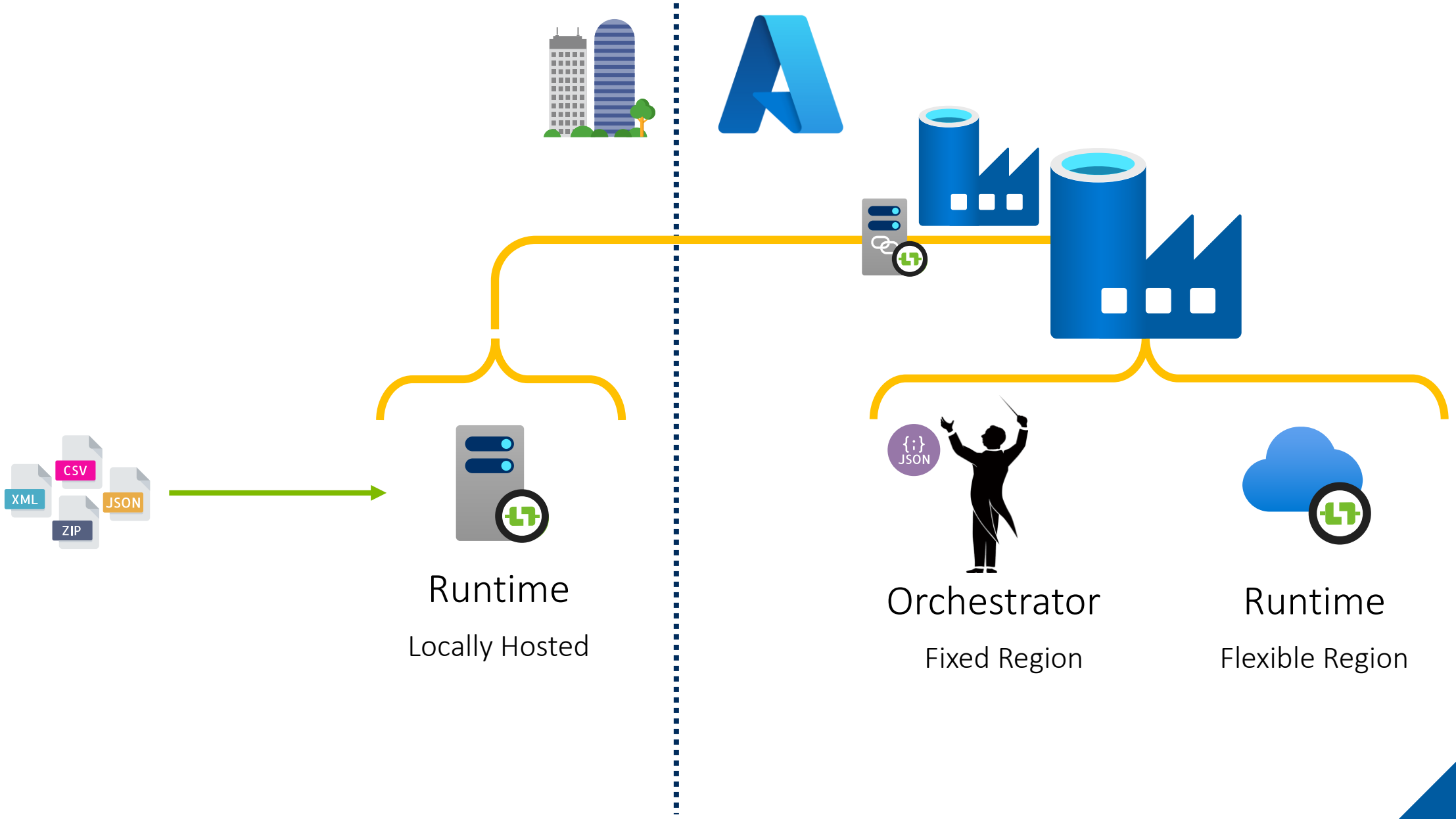
Hosted Integration Runtime



Hosted Integration Runtime – Secondary Nodes



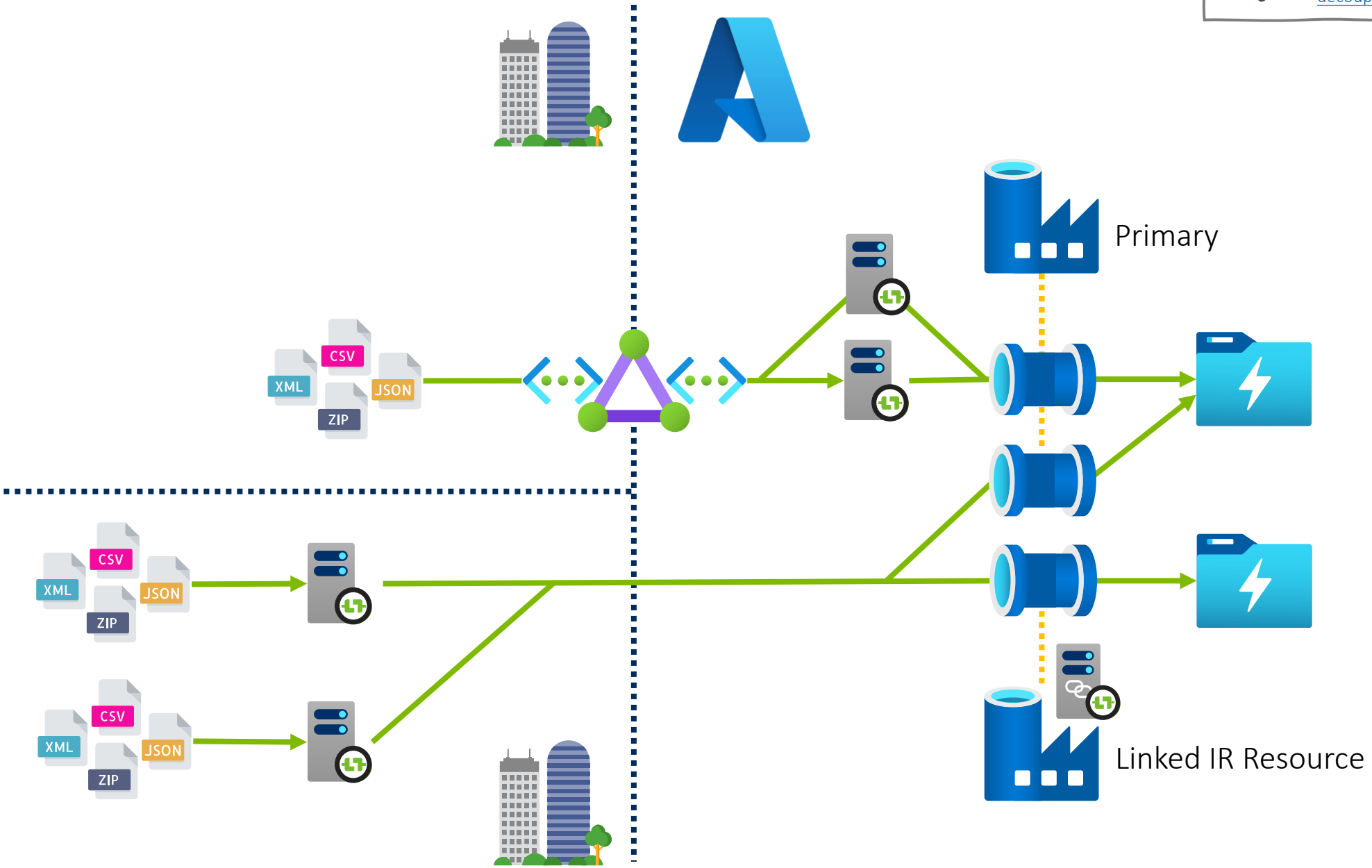
Hosted Integration Runtime – Linked



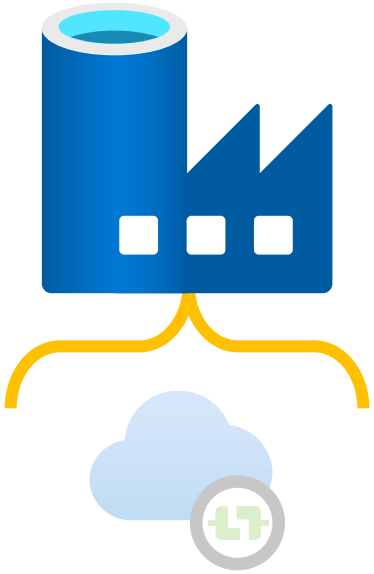
Hosted IR Advanced Patterns

Scaling Azure Data Integration Pipelines

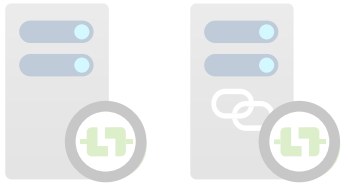
https://mrpaulandrew.com/2021/08/10/scaling-azure-data-integration-pipelines-decoupling-data-extract-and-transform/



SSIS Integration Runtime



Azure IR



Hosted IR

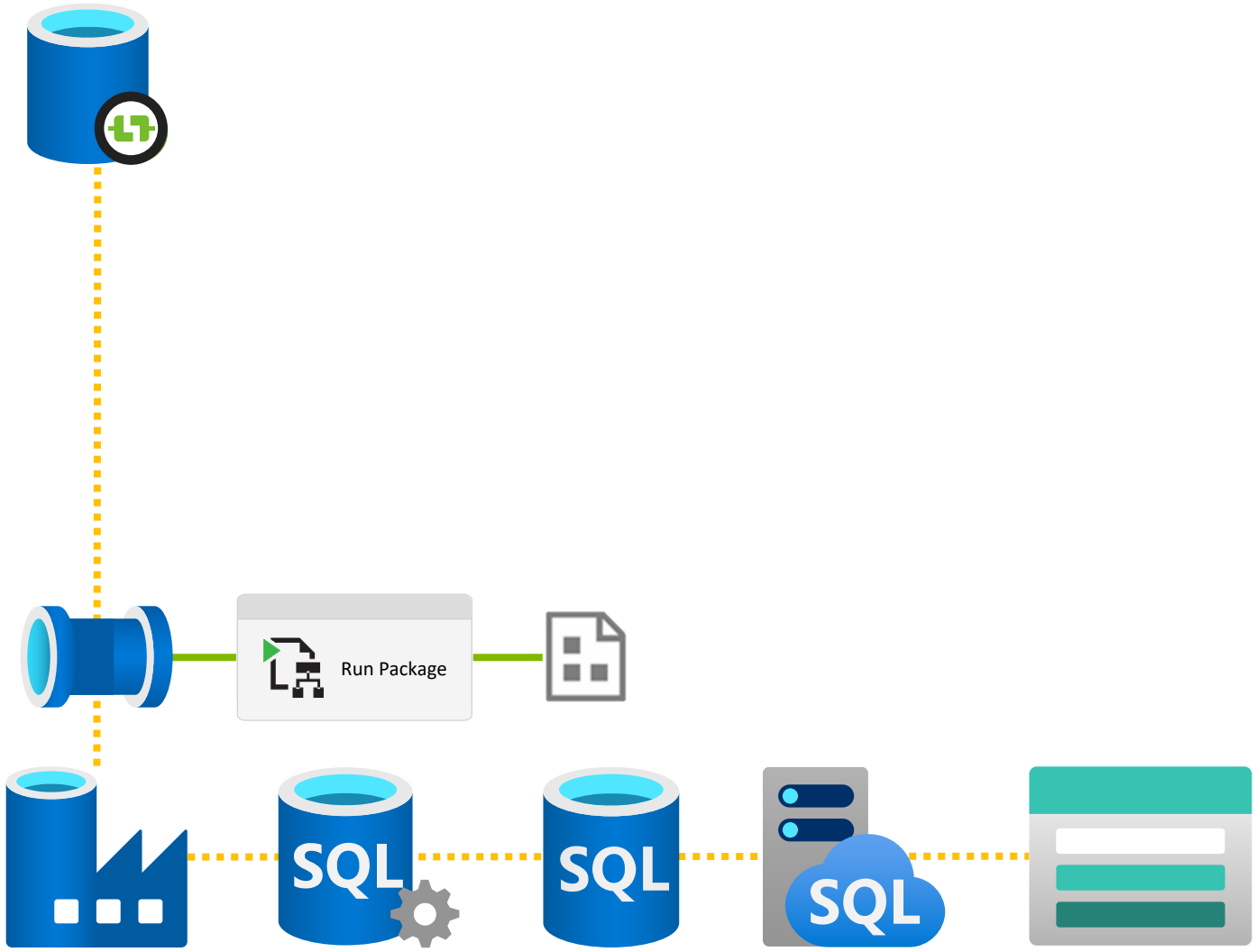
SSIS IR

Running an SSIS Package in Azure

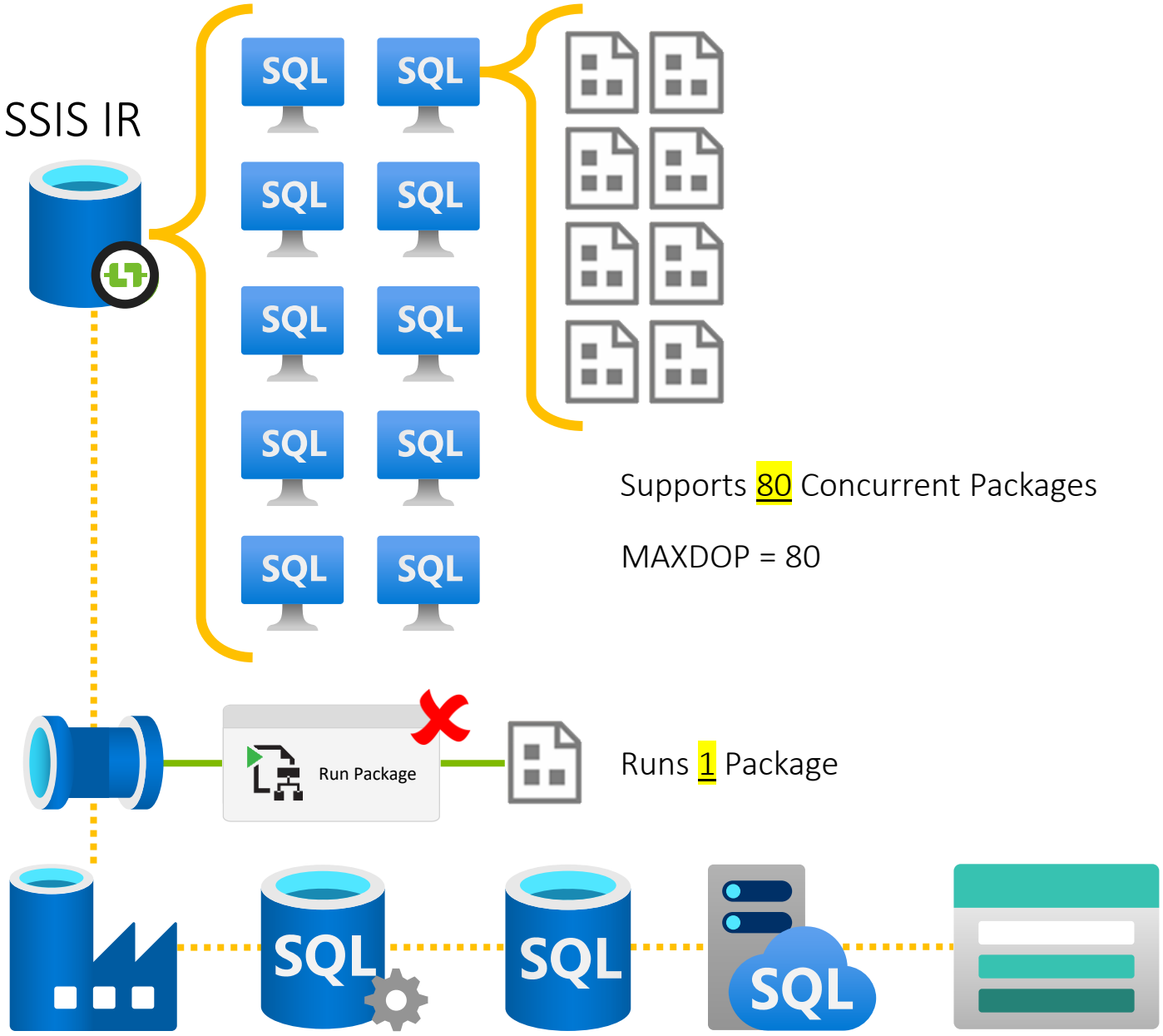
SSIS IR

Running an SSIS Package in Azure

SSIS IR

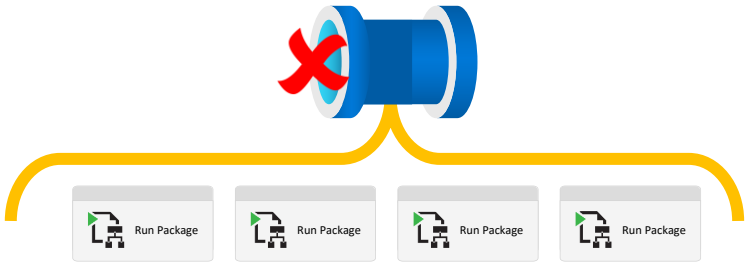


Problem: Using All Of The SSIS IR Compute



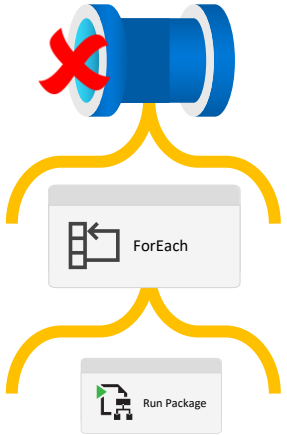
Parent Package

Child Packages x80



Pipeline x1

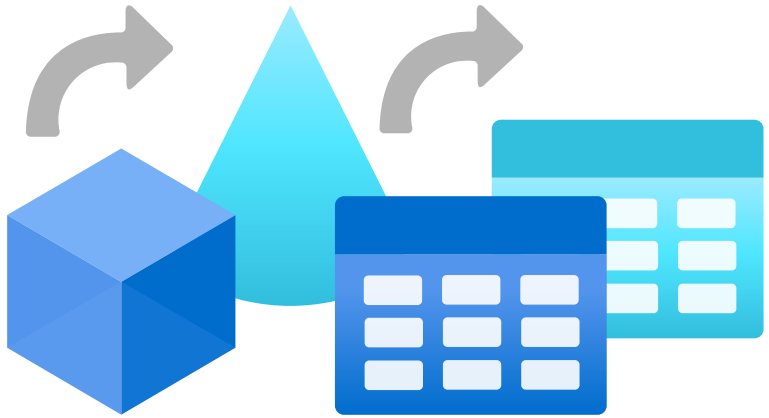
Activities x80



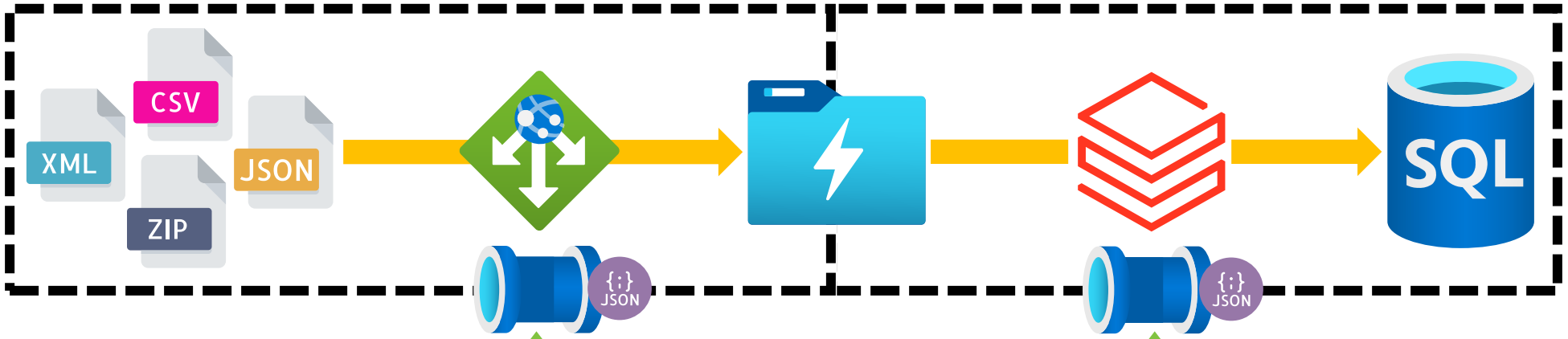
Pipeline x1

ForEach
Max Batch
(50)

Data Flows

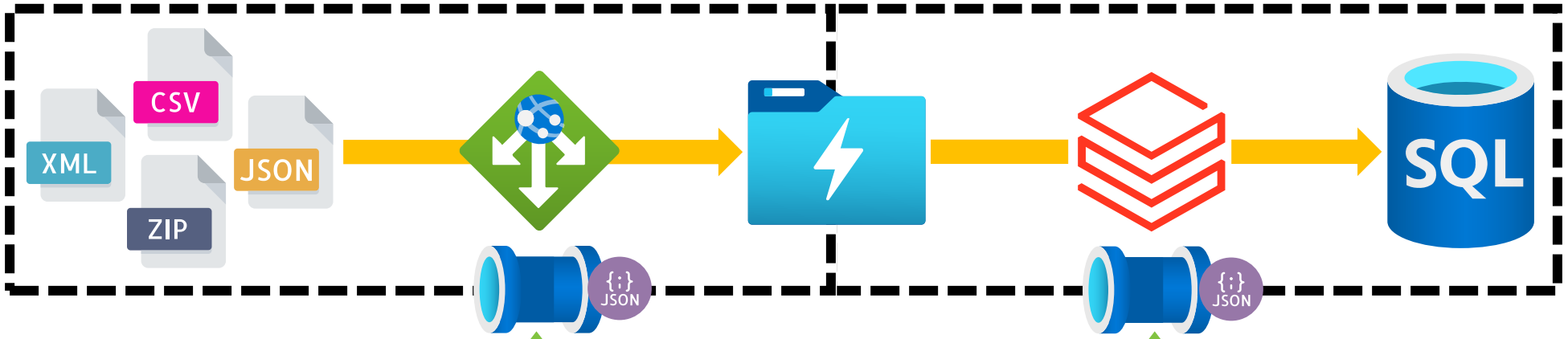


Integration Components

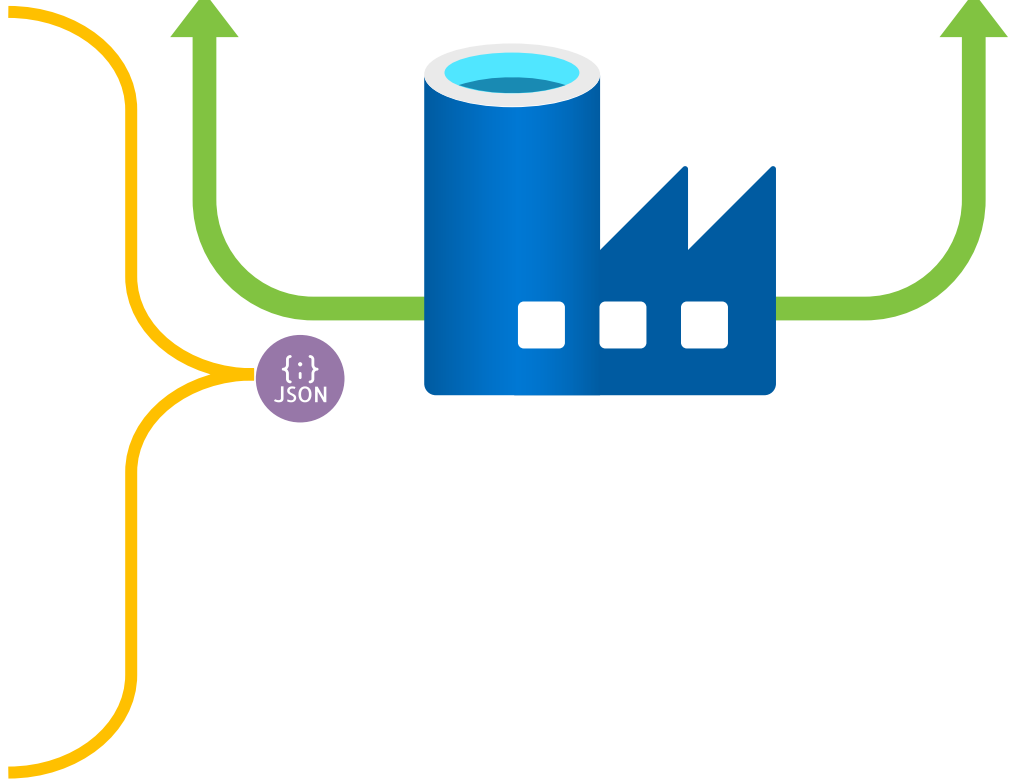


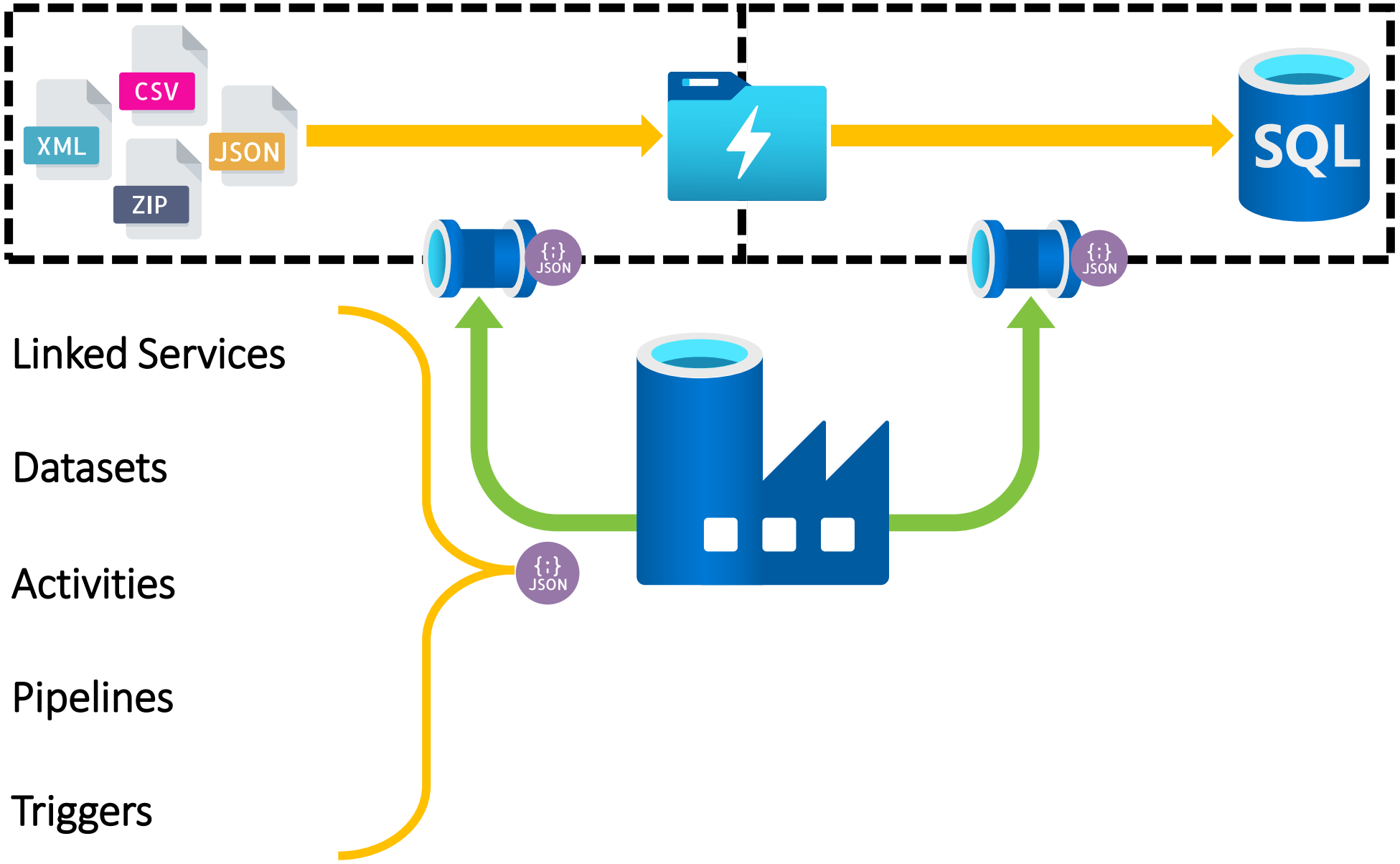
1. Linked Services
2. Datasets
3. Activities
4. Pipelines
5. Triggers

Integration Control Flow Components



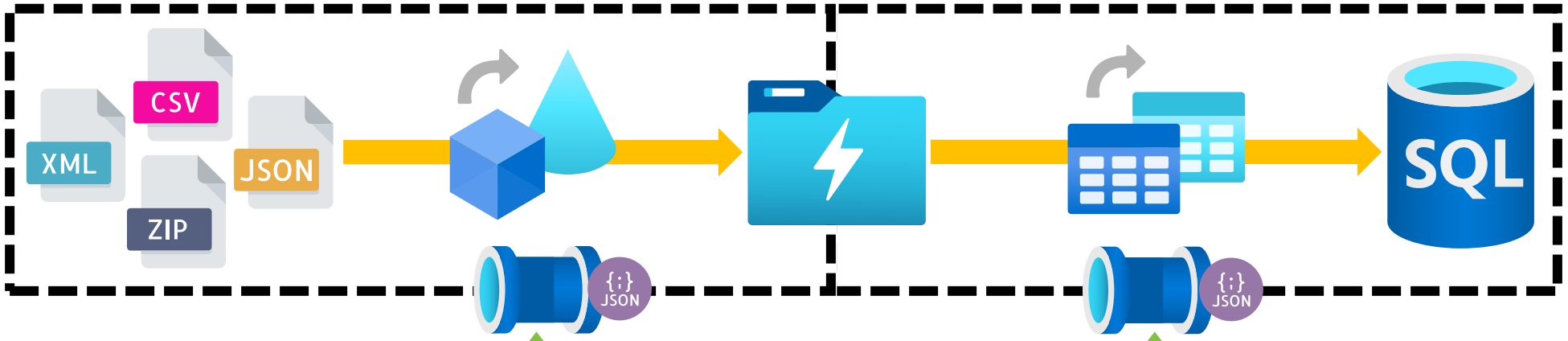
1. Linked Services
2. Datasets
3. Activities
4. Pipelines
5. Triggers



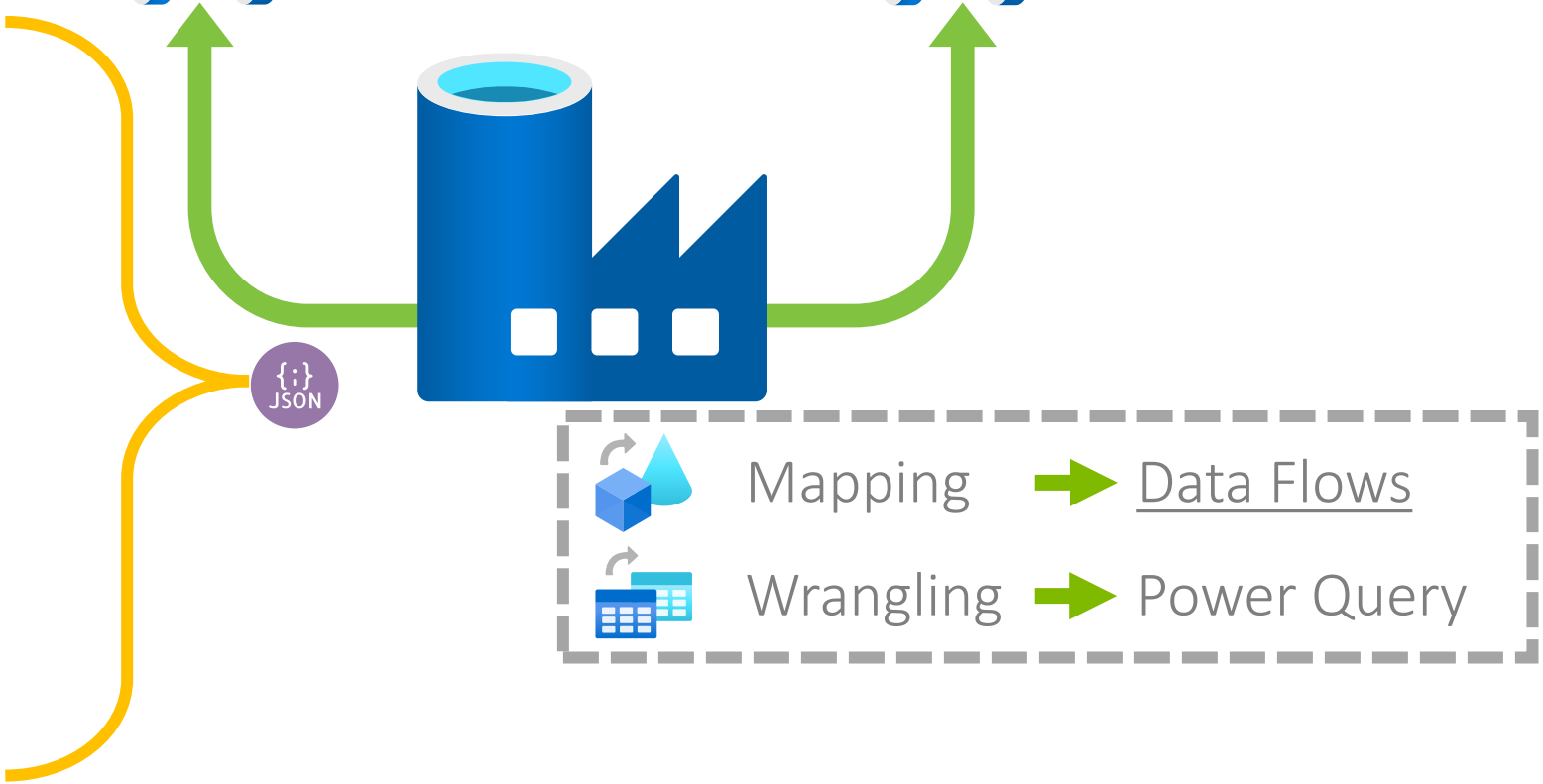


1. Linked Services
2. Datasets
3. Activities
4. Pipelines
5. Triggers

Integration Data Flow (Transformation) Activities



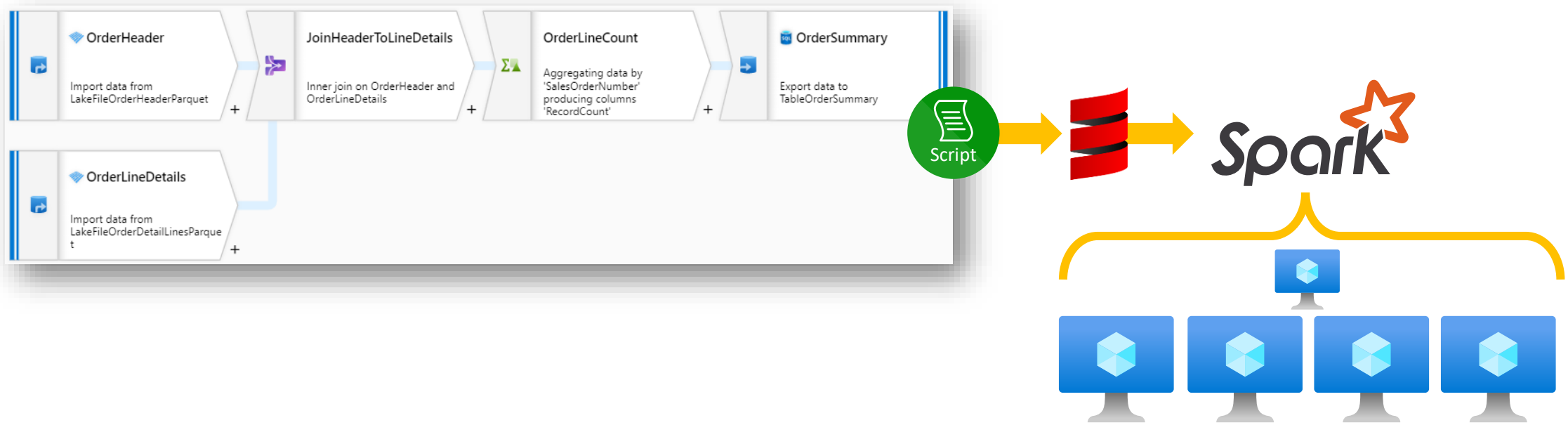
1. Linked Services
2. Datasets
3. Activities
4. Pipelines
5. Triggers



What is a ~~Mapping~~ Data Flow?

Control Flow

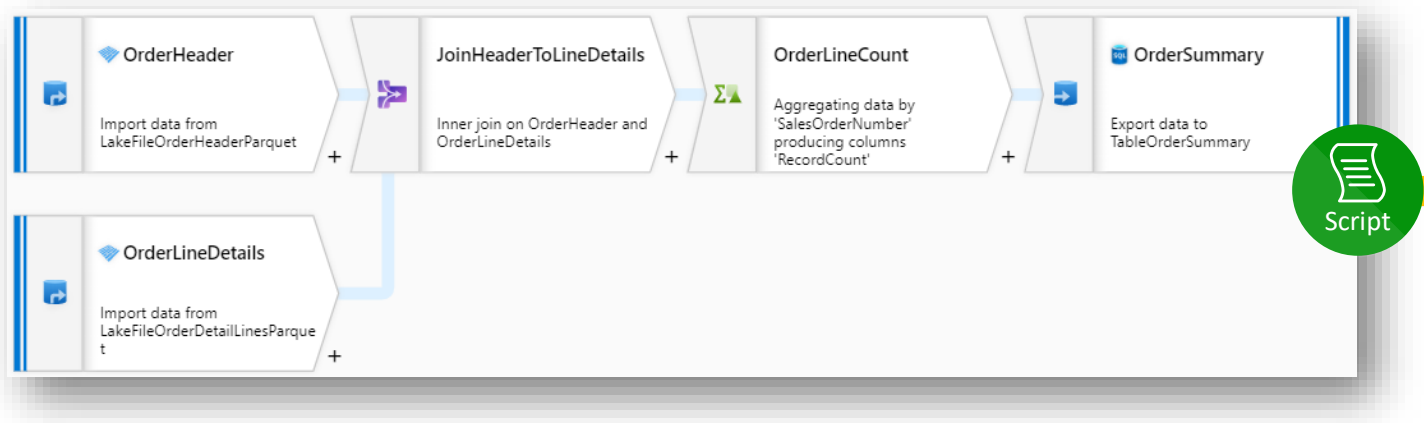
Data Flow

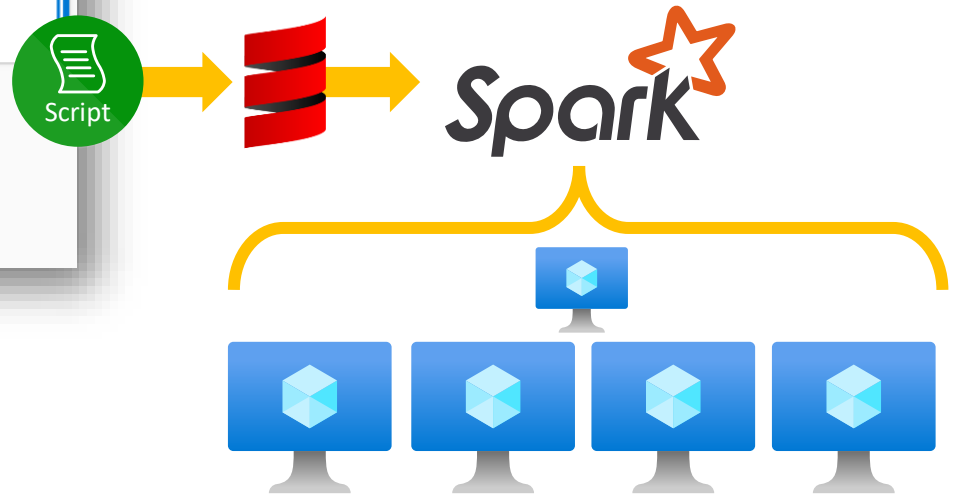


Q: What is a ~~Mapping~~ Data Flow?

Control Flow

Data Flow

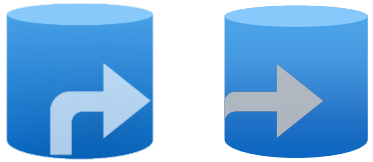




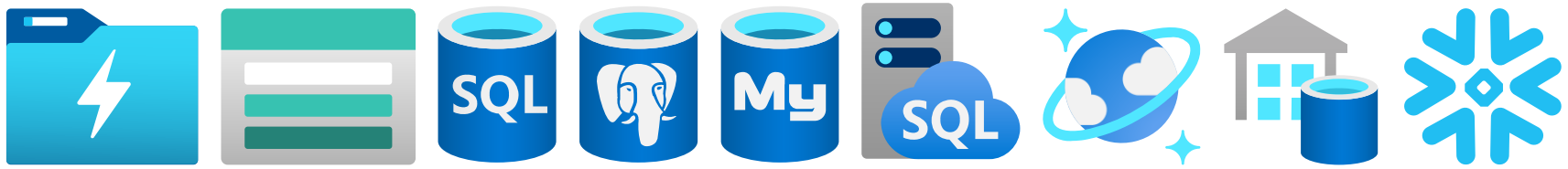
A: Graphic no low/low code data transformation tool that sits on top of Apache Spark.

Data Flows – Inputs & Outputs

Source & Sink



Linked Services

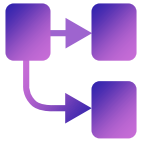


Source Types

Dataset

Inline

Data Flows – Transformations


New Branch

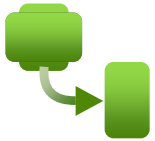

Join


Conditional Split


Exists


Union


Lookup


Derived Column


Select


Aggregate


Surrogate Key

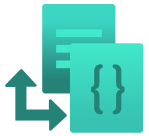

Pivot


Unpivot


Window


Rank


Flatten


Parse


Filter


Sort


Alter Row

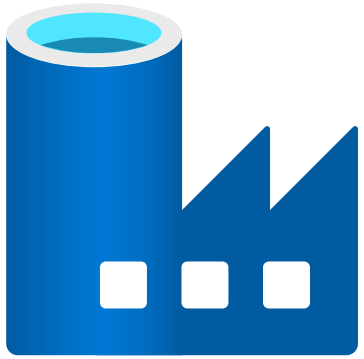
Key

Input & Output Modifiers

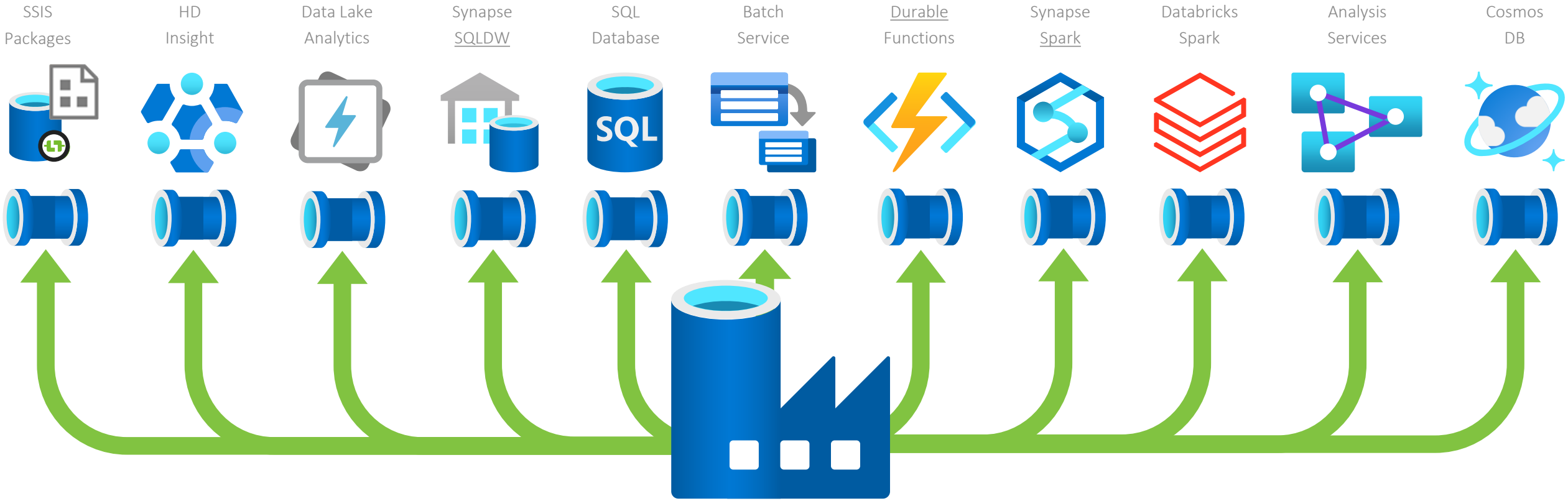
Schema Modifiers

Formatters

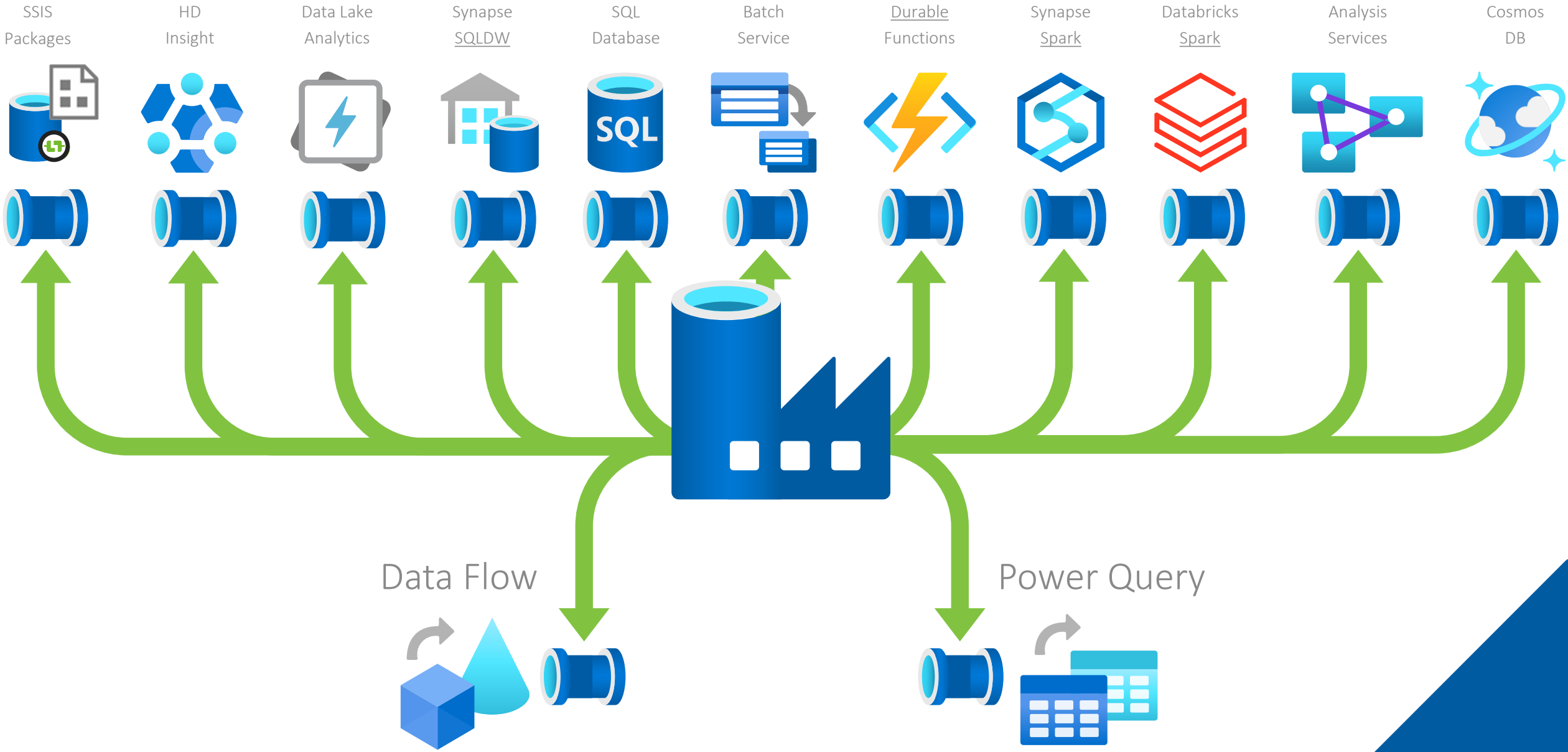
Row Modifiers



Other Data Transformation Services in Azure

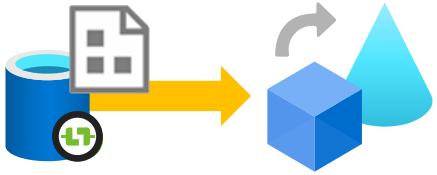


When Should We Use These Integration Pipeline Transformation Activities?

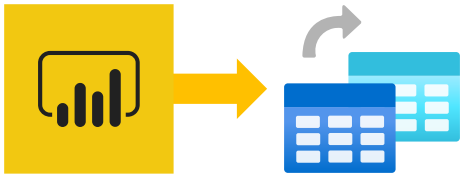


Use Cases

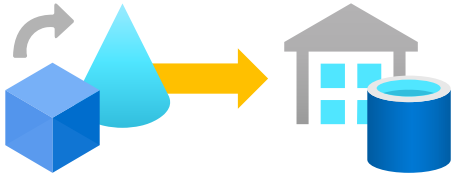
SSIS developers who are transferring existing skills to cloud native technologies have a very low barrier to entry and don't need to worry about distributed compute to get started.



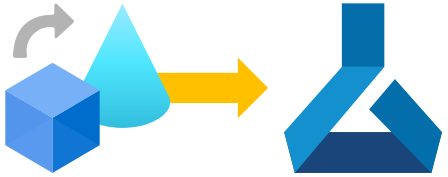
Data engineering made easy for the power users who has grown out of Power BI following a series of Data Lake exploration sessions.



Data insight teams needing to do rapid prototyping and data warehouse loading within a single Azure Resource making deployments simple and release cycles short.



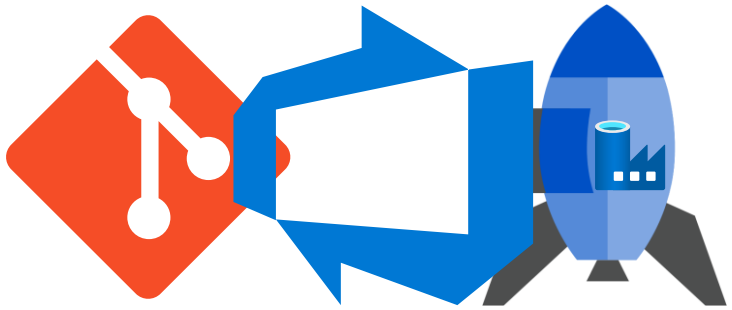
Simpler and quicker data wrangling for data scientists that want to quickly prepare multiple raw datasets ready for model training and testing, also with the ability to use large amounts of compute.

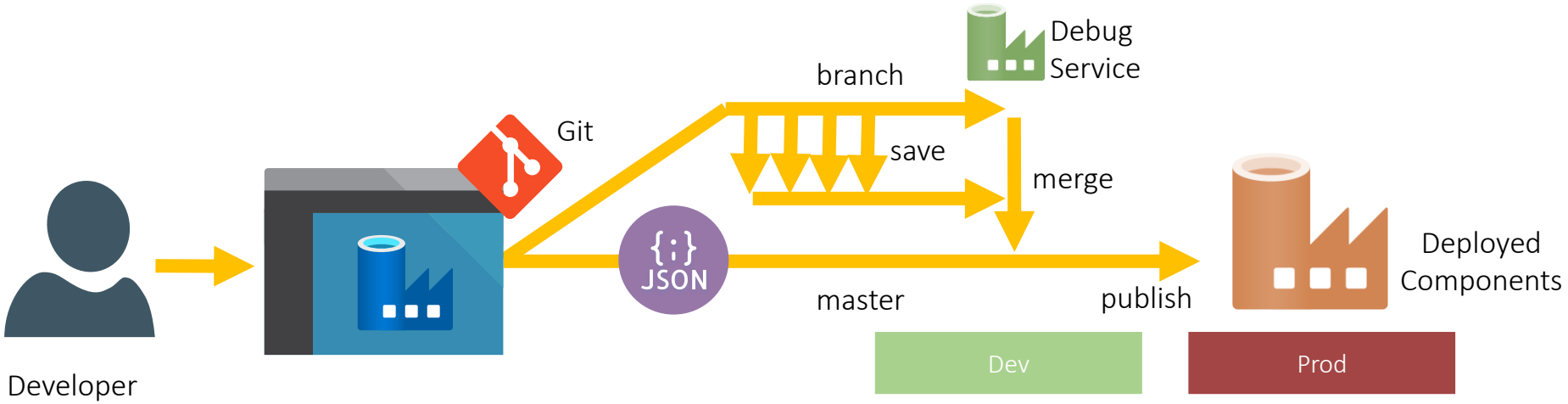


Data Flows used to deliver all data transformation workloads as part of a end to end cloud based data analytics/warehouse solution.

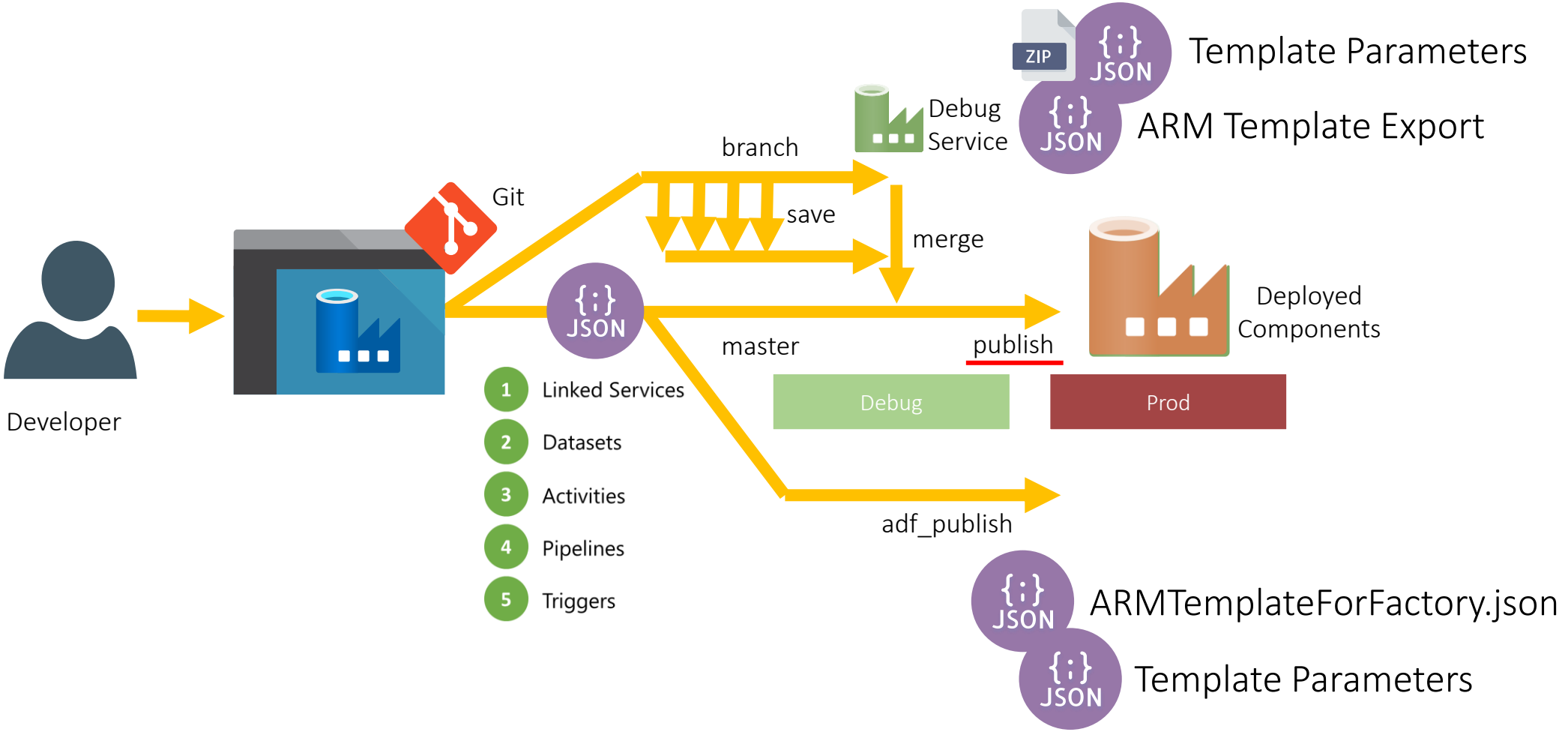
Data Flows script dynamically generated from external metadata and injected into like we once did with BIML for SSIS packages.

Source Control & Deployments



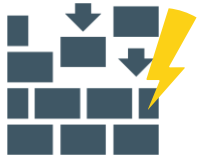

Debug
Service
branch
Git
save
merge
{;}
JSON
Deployed
Components
master
publish
Dev
Prod
Developer

Getting Our ADF Source Code



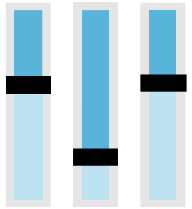
Data Factory Continuous Delivery

Azure DevOps



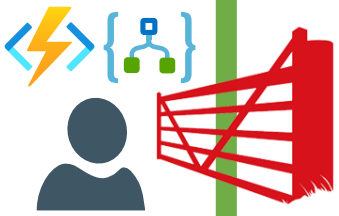
Build Artifacts

Releases



Scoped Variables

Test



Azure Resource Group Deployment

- Override Template Parameters

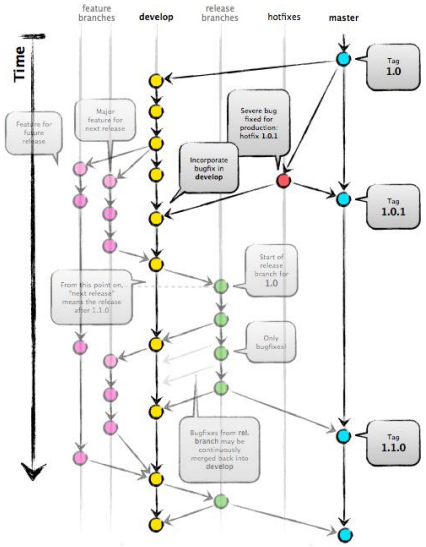
  -factoryName "$(DataFactory.Name)"

Release Approver

ARMTemplateForFactory.json

Production

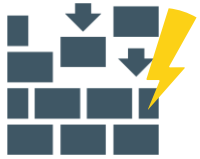
Azure Resource Group Deployment



Gitflow

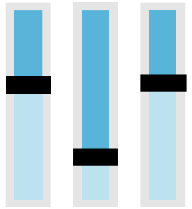
Data Factory Continuous Delivery - Simple

Azure DevOps



Build Artifacts

Releases



Scoped Variables

Test

Azure Resource Group Deployment

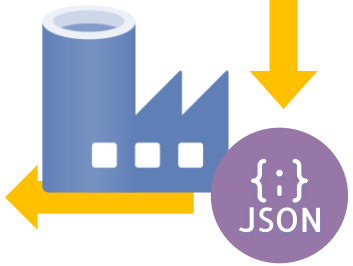
- Override Template Parameters

  -factoryName "$(DataFactory.Name)"

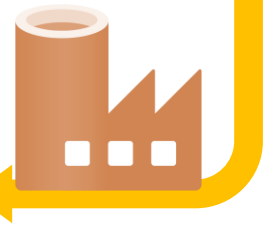
Release Approver

Production

Azure Resource Group Deployment



ARMTemplateForFactory.json

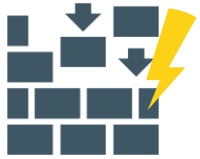


1. Linked Services
2. Datasets
3. Activities
4. Pipelines
5. Triggers

Data Factory Continuous Delivery - Simple

1 Linked Services

Azure DevOps

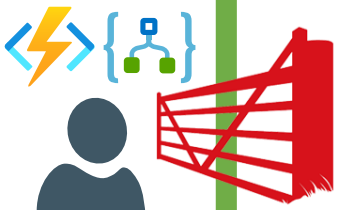


Build Artifacts

Releases

Scoped Variables

Test

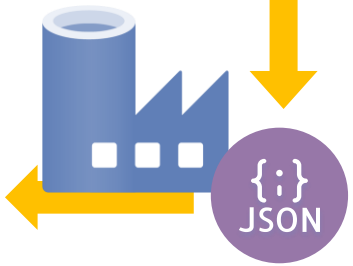


Release Approver

Azure Resource Group Deployment

- Override Template Parameters

  -factoryName "$(DataFactory.Name)"



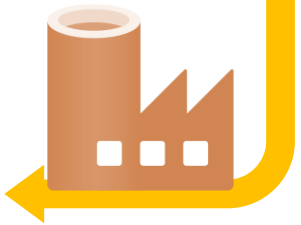
JSON

ARMTemplateForFactory.json

adf_publish

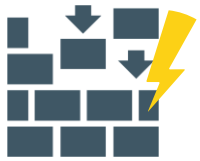
Production

Azure Resource Group Deployment

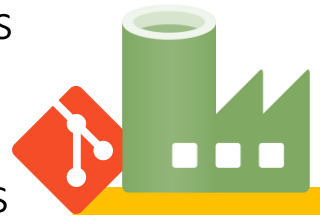


Data Factory Continuous Delivery - Complex

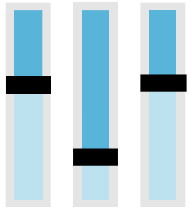
Azure DevOps



Build Artifacts



Pipelines



Key Vault Linked

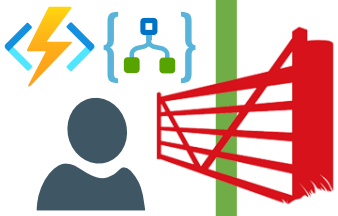
Variable Groups

YML

Test

Run PowerShell

```
Import-Module -Name "azure.datafactory.tools"
Publish-AdfV2FromJson -RootFolder $AdfPath `
  -ResourceGroupName $resourceGroupName `
  -DataFactoryName $dataFactoryName `
  -Location $region `
  -Stage $configFilePath
```

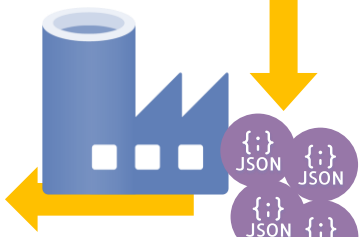


Release Approver

YML

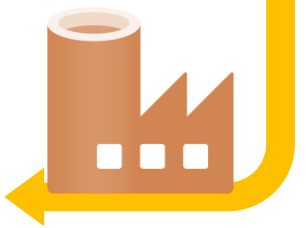
Production

Publish Azure Data Factory



linkedservices.json
pipelines & activites.json
datasets.json
triggers.json

{release} / {feature} / {tag}



1 Linked Services

2 Datasets

3 Activities

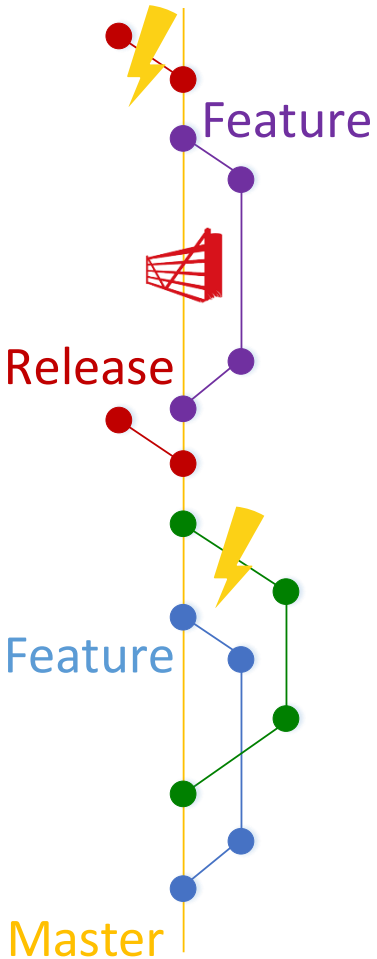
4 Pipelines

5 Triggers

https://www.powershellgallery.com/packages/azure.datafactory.tools

Data Factory DevOps Story Summary

What is your code branching strategy?



Which source control tool to use?

How many environments do we want?

What deployment method do we want to use?

What artifacts are we going to use?...

OR

How much control do you want?

ARMTemplate ForFactory.json

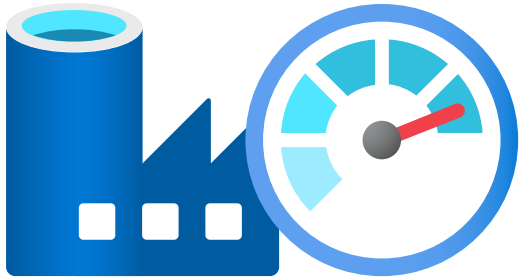
linkedservices.json

pipelines & activites.json

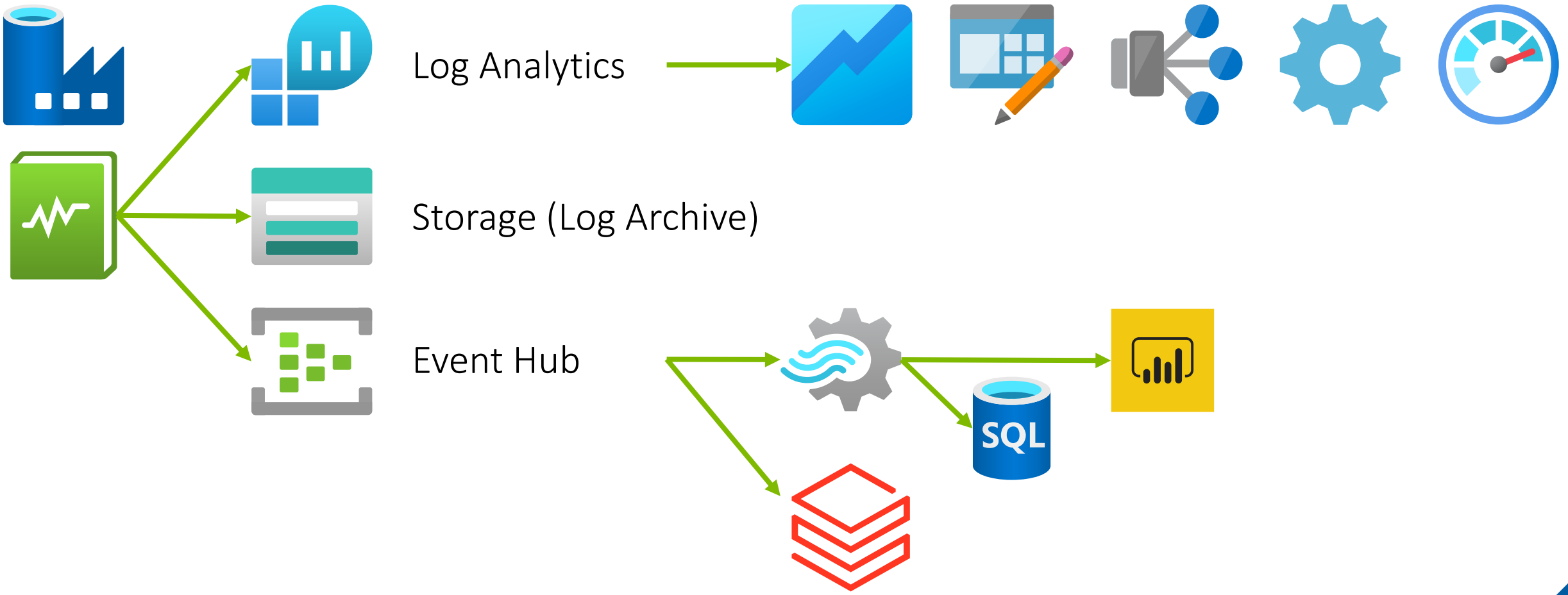
datasets.json

triggers.json

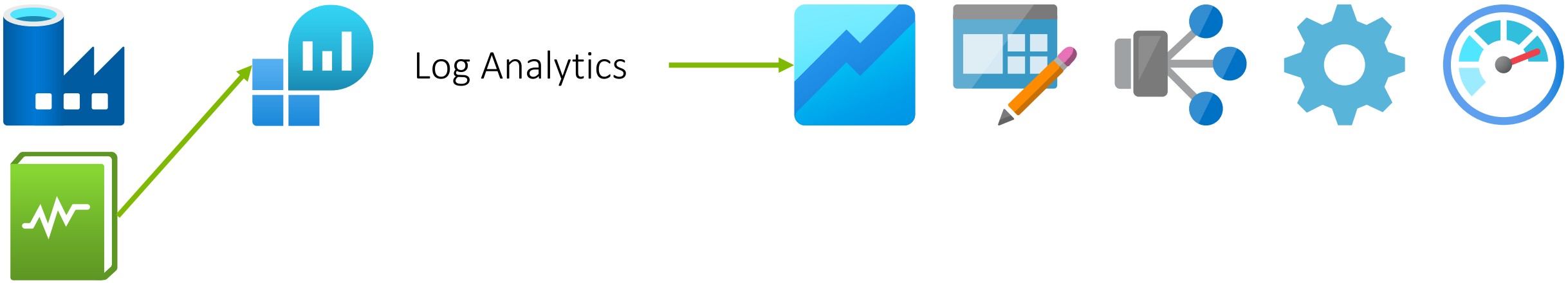
Monitoring & Logging



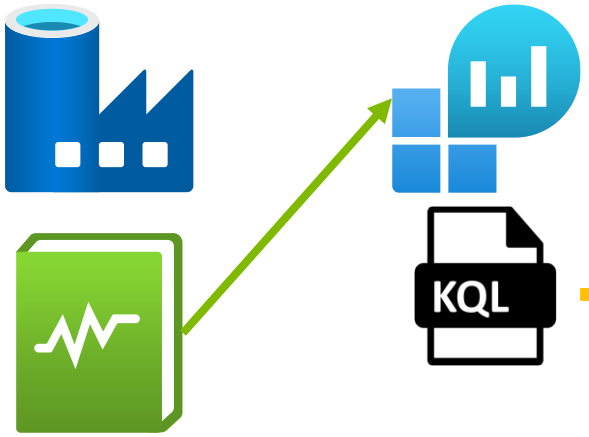
Diagnostic Settings



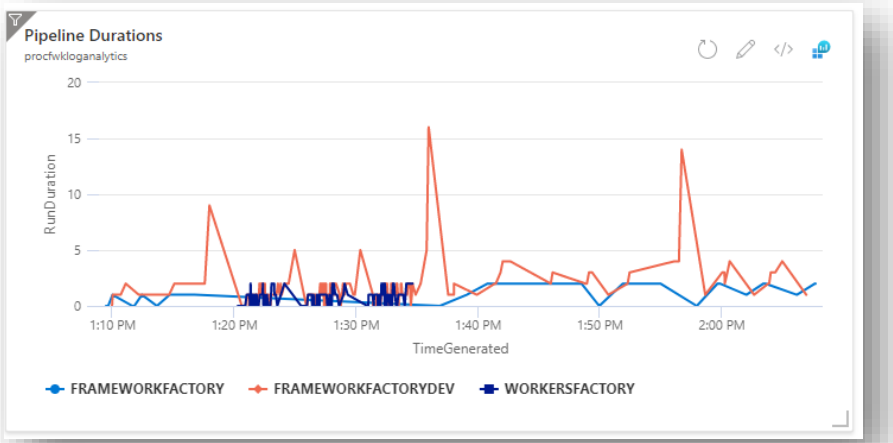
Diagnostic Settings

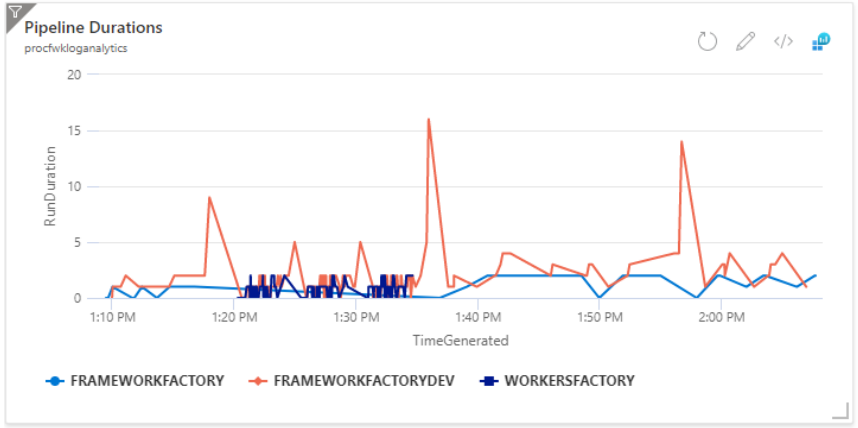


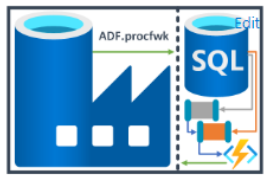
Using Log Analytics




```
ADFPipelineRunDurations
 | project
          TimeGenerated,
          Start,
          End,
          ['DataFactory'] = substring(ResourceId, 121, 100),
          Status,
          PipelineName,
          Parameters,
          ["RunDuration"] = datetime_diff('Minute', End, Start)
 | where
          TimeGenerated > ago(1h)
          and Status !in ('InProgress','Queued','Cancelling')
```




Pipeline Durations
procfwkloganalytics
20
15
10
5
0
RunDuration
1:10 PM
1:20 PM
1:30 PM
1:40 PM
1:50 PM
2:00 PM
TimeGenerated
FRAMEWORKFACTORY
FRAMEWORKFACTORYDEV
WORKERSFACTORY



Edit

Resources and Content

Edit

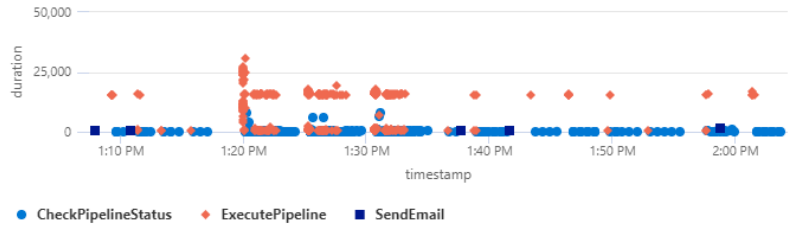
	Blogs	mrpaulandrew.com/ADF.procfwk
	GitHub	github.com/mrpaulandrew/ADF.procfwk
	Twitter	#ADFprocfwk

FrameworkSupportF...
Function App

Running

Function Call Durations

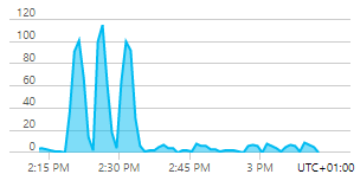
ProcFwkAppInsights



ProcFwkAppInsights
Application Insights

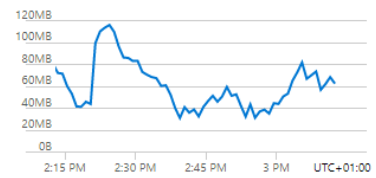
procfwkloganalytics
Workspace

Server requests



Server requests (Count)
procfwkappinsights
1.06 k

Memory working set



Memory working set (Sum)
frameworksupportfunctions
62.09 MB

FrameworkFactor...
Data factory

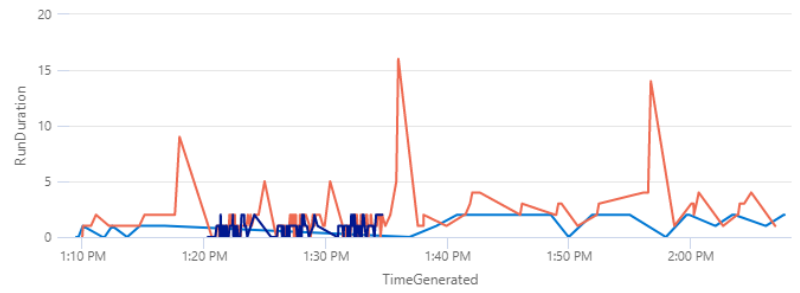
FrameworkFactor...
Data factory

FrameworkFactor...
Data factory

WorkersFactory
Data factory

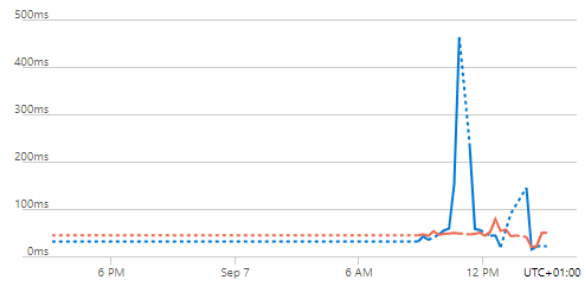
Pipeline Durations

procfwkloganalytics



FrameworkKeys
Key vault

Average latency

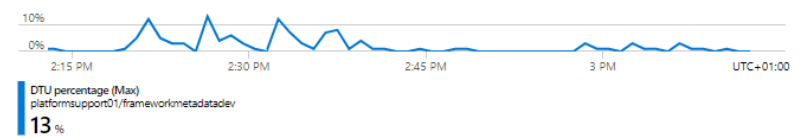


auxiliary
frameworkkeys
45.45 ms

secret
frameworkkeys
33.57 ms

FrameworkMetadat...
SQL database
Online

Compute utilization



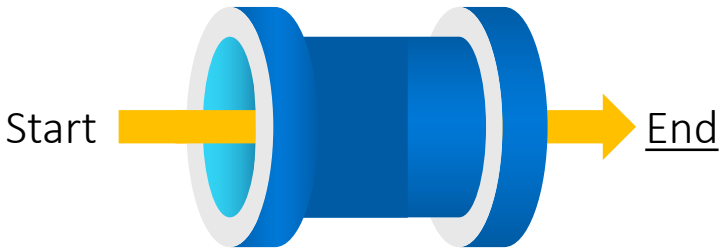
DTU percentage (Max)
platformsupport01/frameworkmetadatadev
13 %

Resources

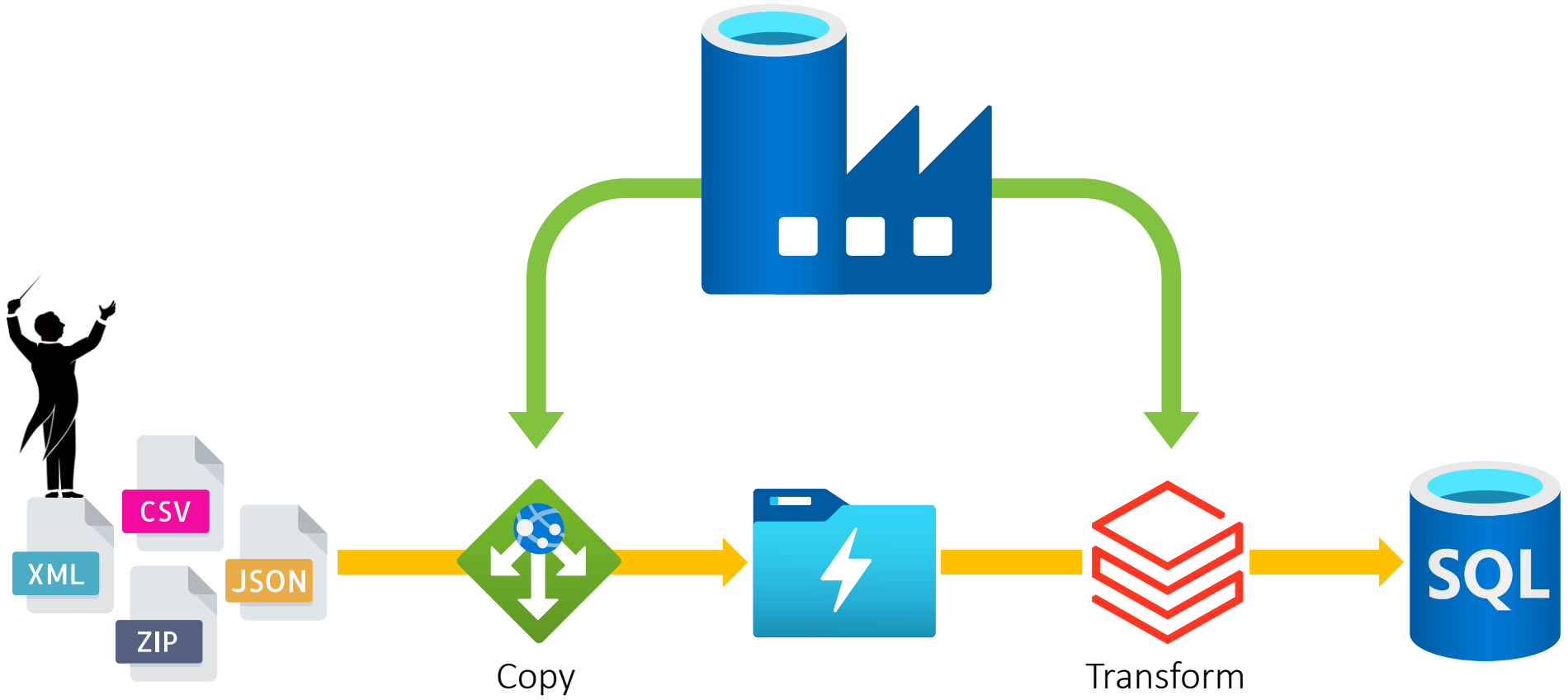
ADF.procfwk

- ProcFwkLogAnalytics
- FrameworkFactory
- FrameworkFactoryDev
- FrameworkKeys
- platformsupport01
- FrameworkMetadataDev (pl...
- frameworksupportstore
- frameworkstorage01
- FrameworkSupportFunctions
- FrameworkFactoryTest
- WorkersFactory
- frameworkonsynapse
- UKSouthPlan
- FrameworkMetadataTest (pl...
- ProcFwkAppInsights
- 9a4fe00e-39d9-4ec8-8f88-5...
- frameworkdatalake01
- sqlvaexht4i7t63enw

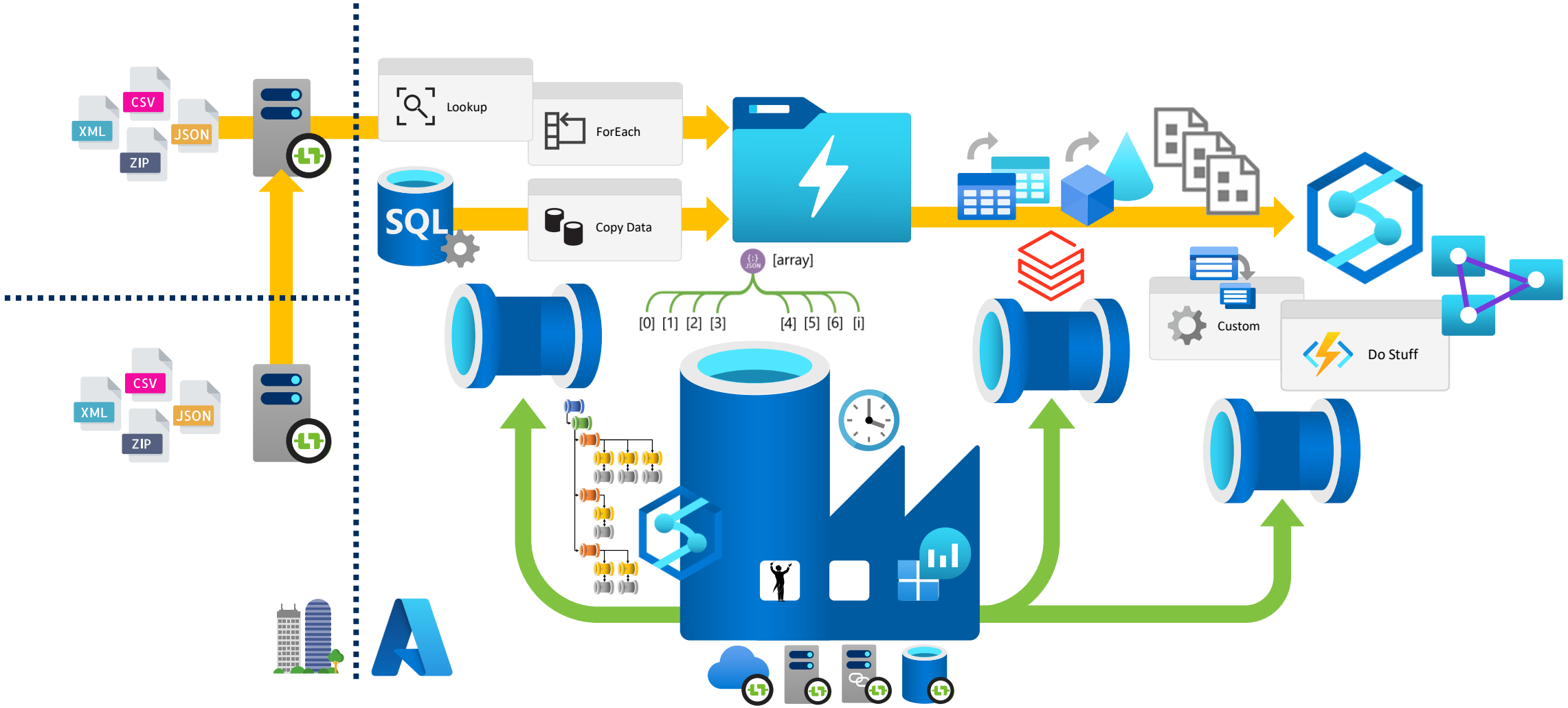
Conclusions



What is Azure Data Factory (ADF)?



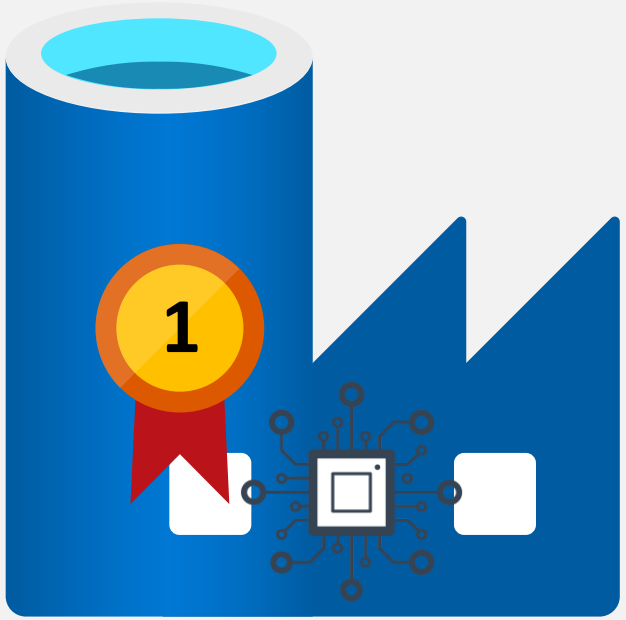
What are Azure ~~Data Factory~~ Integration Pipelines?



1. A complete Microsoft Azure integration tool.
2. Orchestrator of our Control Flow operations – with scale out Activities.
3. Orchestrator of our Data Flow transformations – using cloud native services.
4. The scheduler of solutions – using a variety of Pipeline Triggers and dynamic frameworks.

What Next?

Best Practices for Implementing Azure Data Factory



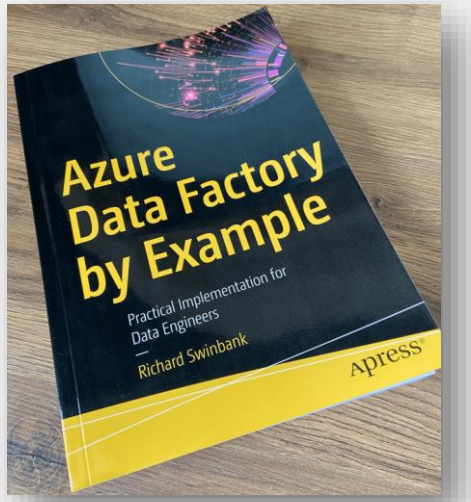
- Environment Setup
- Multiple Data Factory Instance's
- Deployments
- Automated Testing
- Naming Conventions
- Pipeline Hierarchies
- Pipeline & Activity Descriptions
- Annotations
- Factory Component Folders
- Linked Service Security via Azure Key Vault
- Security Custom Roles
- Dynamic Linked Services
- Generic Datasets
- Metadata Driven Processing
- Parallel Execution
- Hosted Integration Runtimes
- Azure Integration Runtimes
- Wider Platform Orchestration
- Custom Error Handler Paths
- Monitoring via Log Analytics
- Timeouts & Retry
- Service Limitations
- Using Templates
- Documentation

Best Practices for Implementing ADF

https://mrpaulandrew.com/2019/12/18/best-practices-for-implementing-azure-data-factory/

What Next?

Azure Data Factory by Example



Author: Richard Swinbank @RichardSwinbank

Technical Reviewer: Paul Andrew

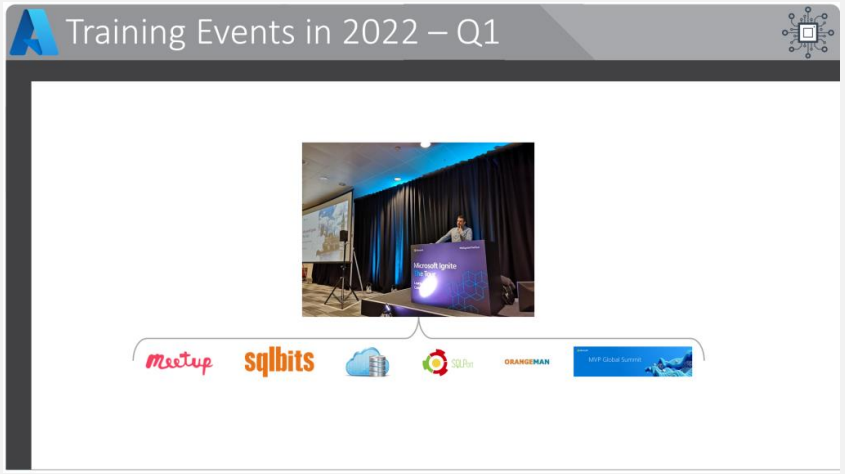
ISBN-13978-1484270288

What Next?

More Azure Data Platform Training and Sessions With Me!

2022 – Q1 Training & Speaking

https://mrpaulandrew.com/2021/12/14/training-events-and-speaking-in-2022-q1/



Thank you for listening…

Paul Andrew

Blog: mrpaulandrew.com
YouTube: c/mrpaulandrew
Email: paul@mrpaulandrew.com

Twitter: @mrpaulandrew
LinkedIn: In/mrpaulandrew

GitHub: github.com/mrpaulandrew /CommunityEvents /ContentCollateral