Azure Data Integration Pipelines

In Production

Paul Andrew | Technical Architect in Azure CoE

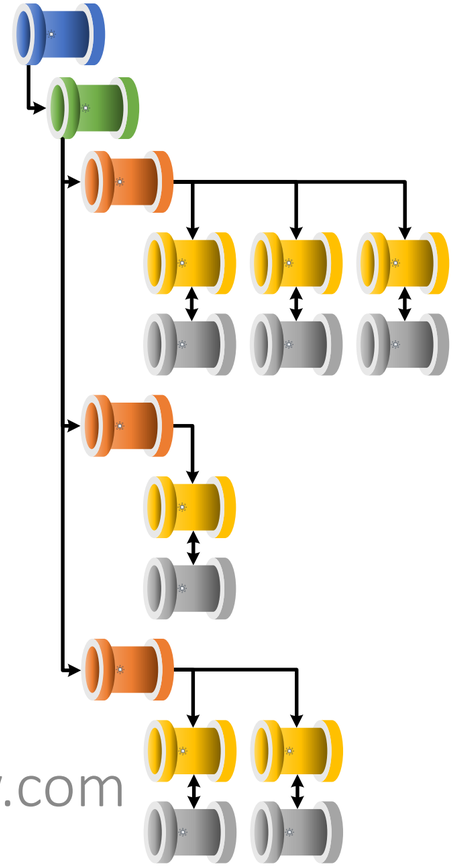
Microsoft Most Valuable Professional

avanade

@MrPaulAndrew

In/MrPaulAndrew

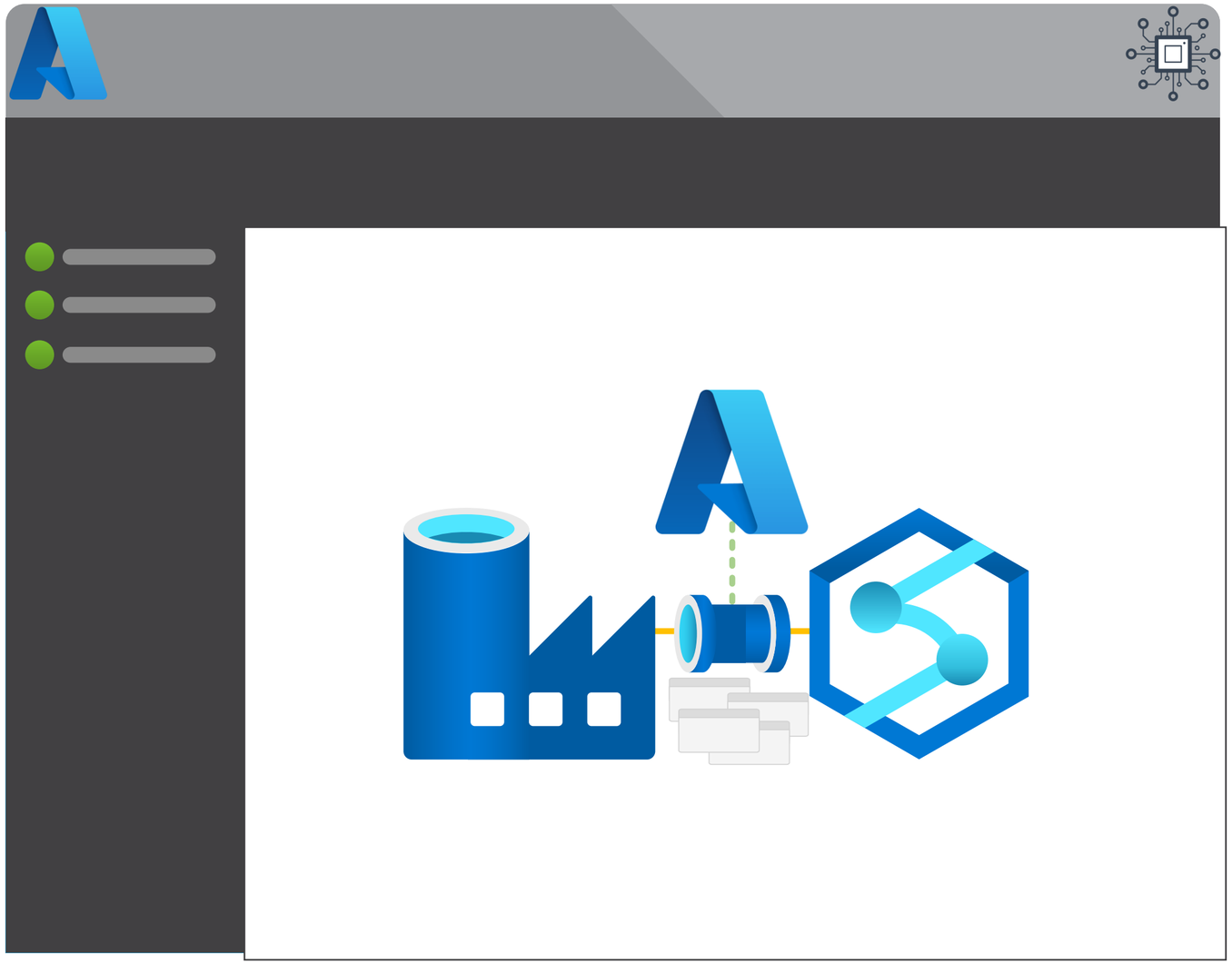
MrPaulAndrew.com



Agenda

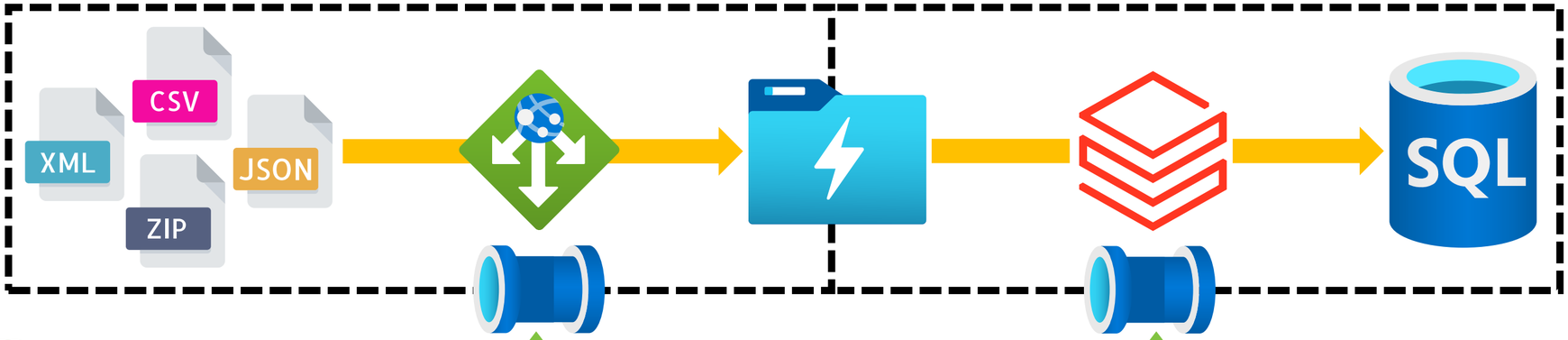
- Data Integration Pipelines – A Quick Overview
- Scaled Out Design Patterns
- Metadata Driven Framework
- Testing
- Source Code – A Quick Overview
- Enterprise Deployments
- VNet Integration
- Best Practice

Data Integration Pipelines – A Quick Overview

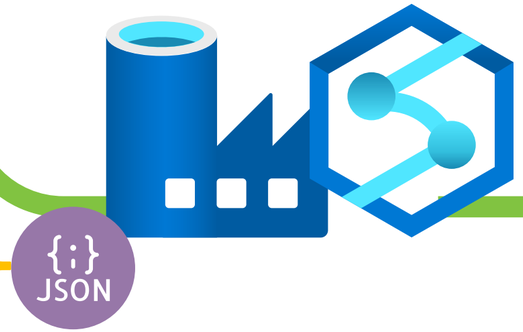


Integration Pipelines as Data Engineers

Control Flow



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



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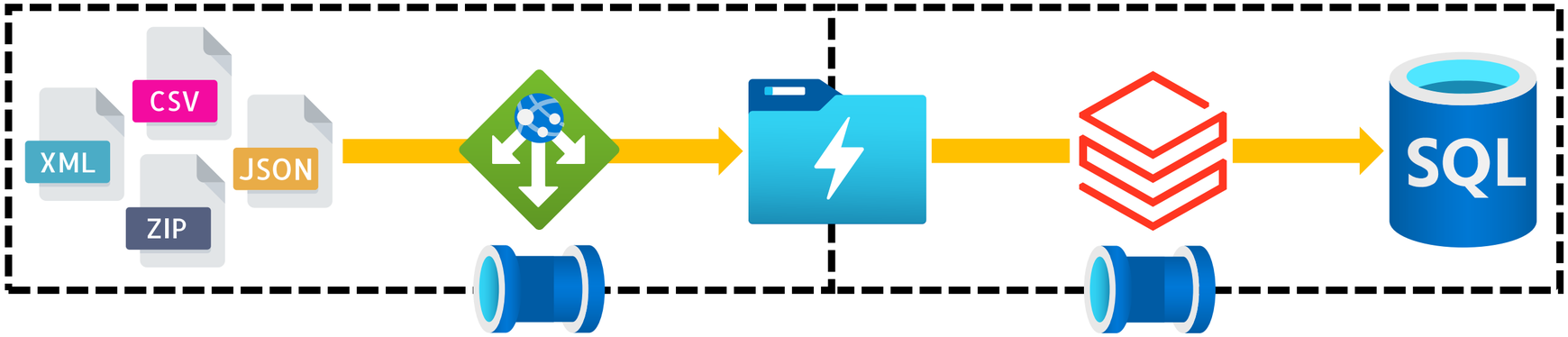
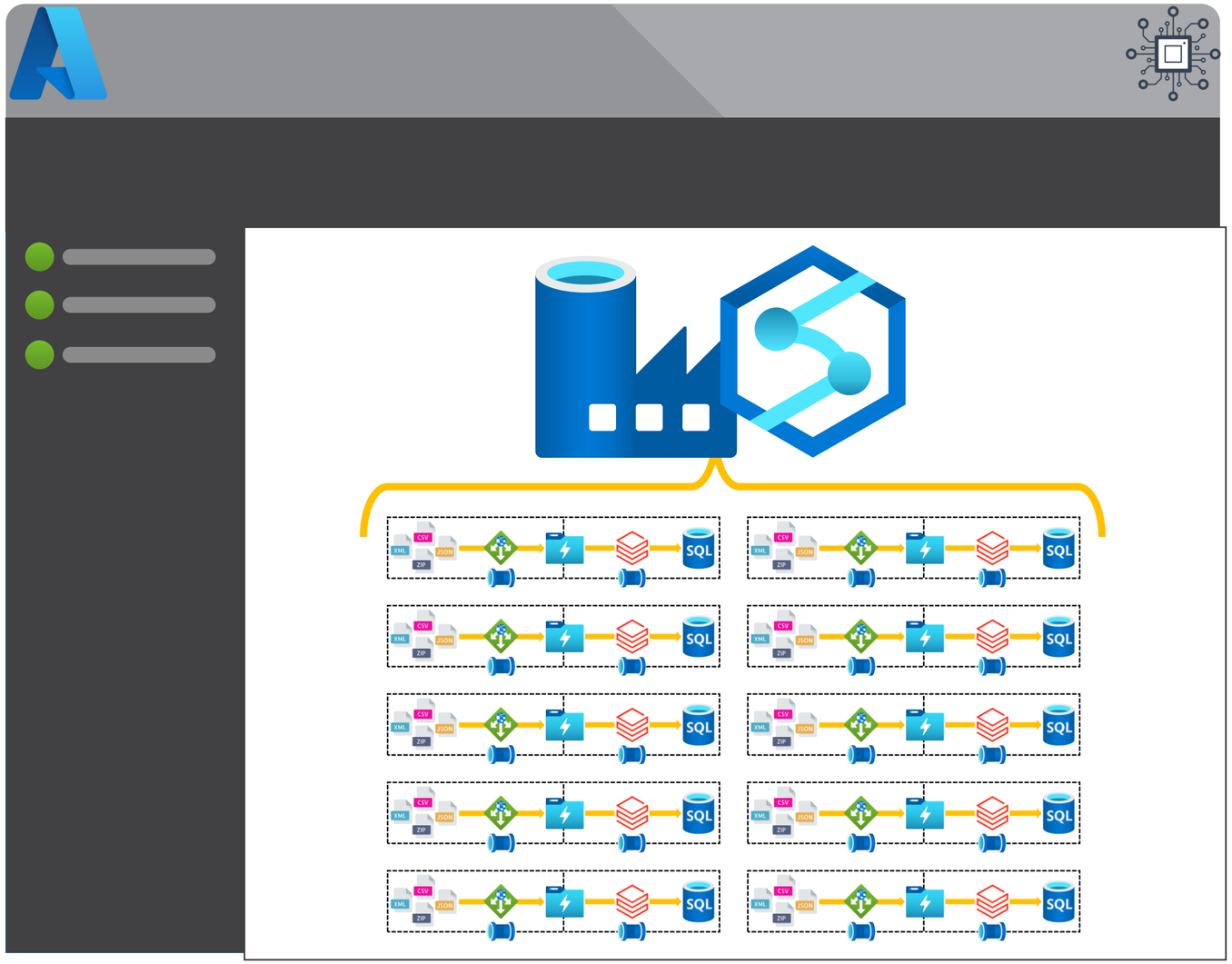
Integration Pipelines as Data Engineers

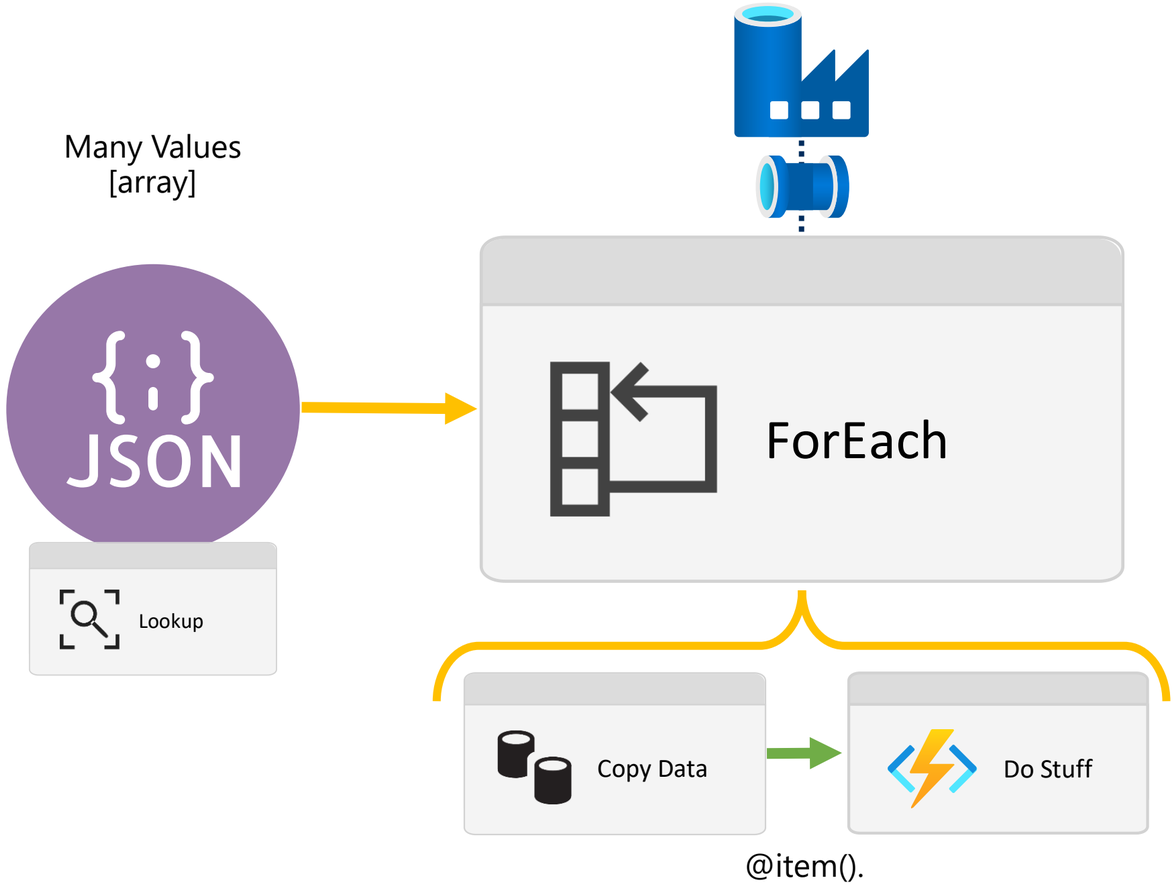


Scaled Out Design Patterns



For Each Activity

Scaling Out Control Flow Activities



IsSequential: true

[array]

[0]
[1]
[2]
[3]
[i]

[array]

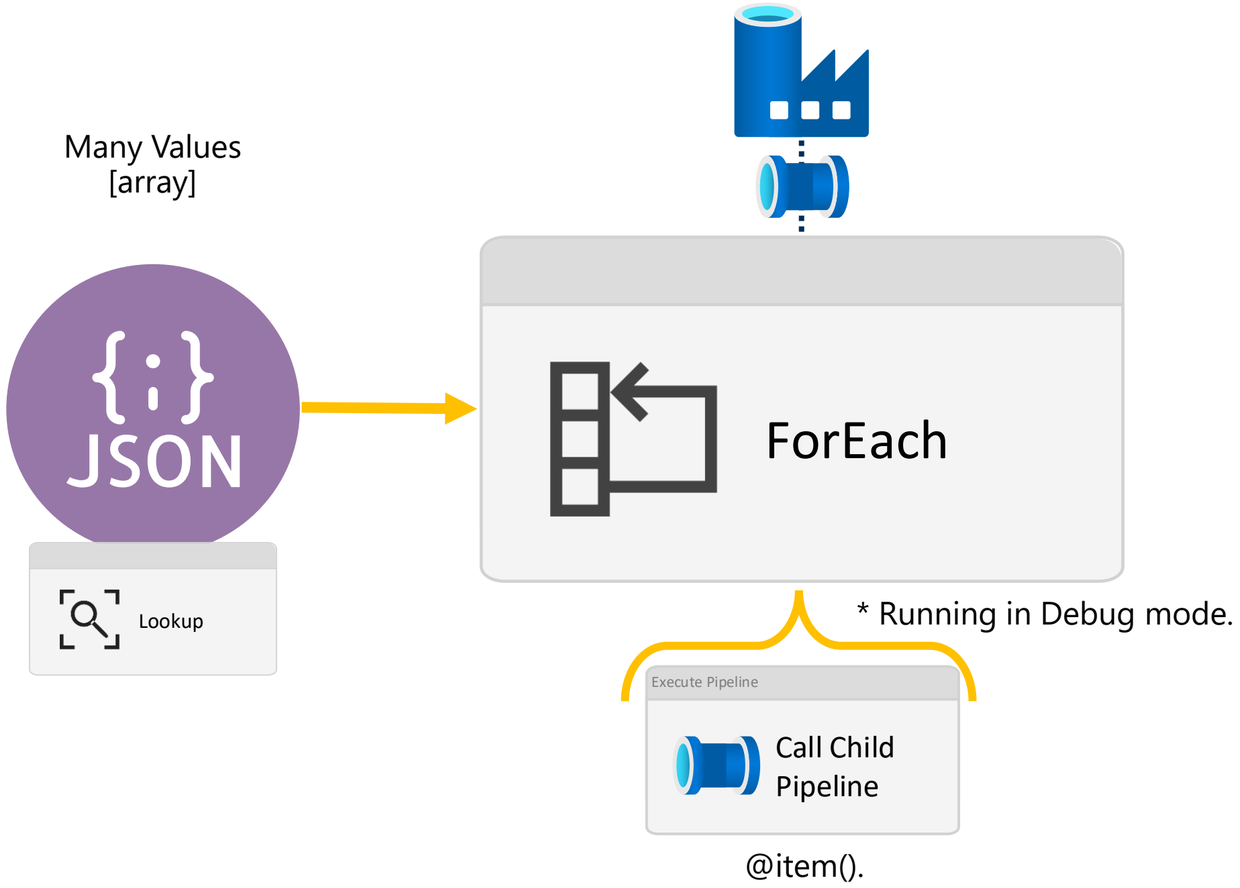
[0] [1] [2] [3] [4] [5] [6] [i]

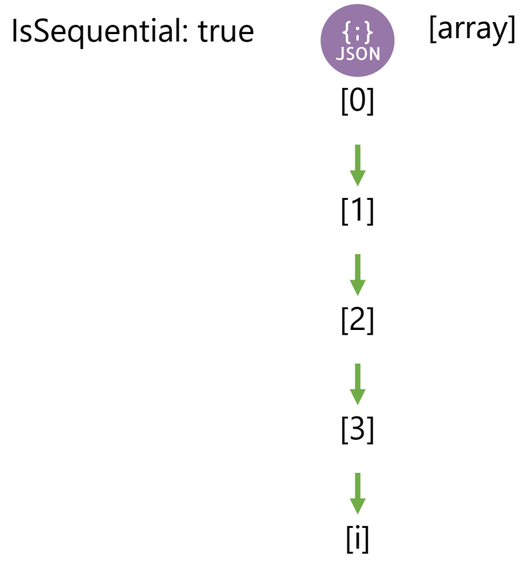
Batch Count Default: 20

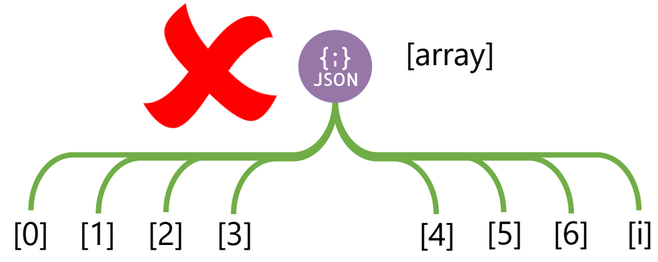
Batch Count Max: 50

For Each Activity

Scaling Out Control Flow Activities



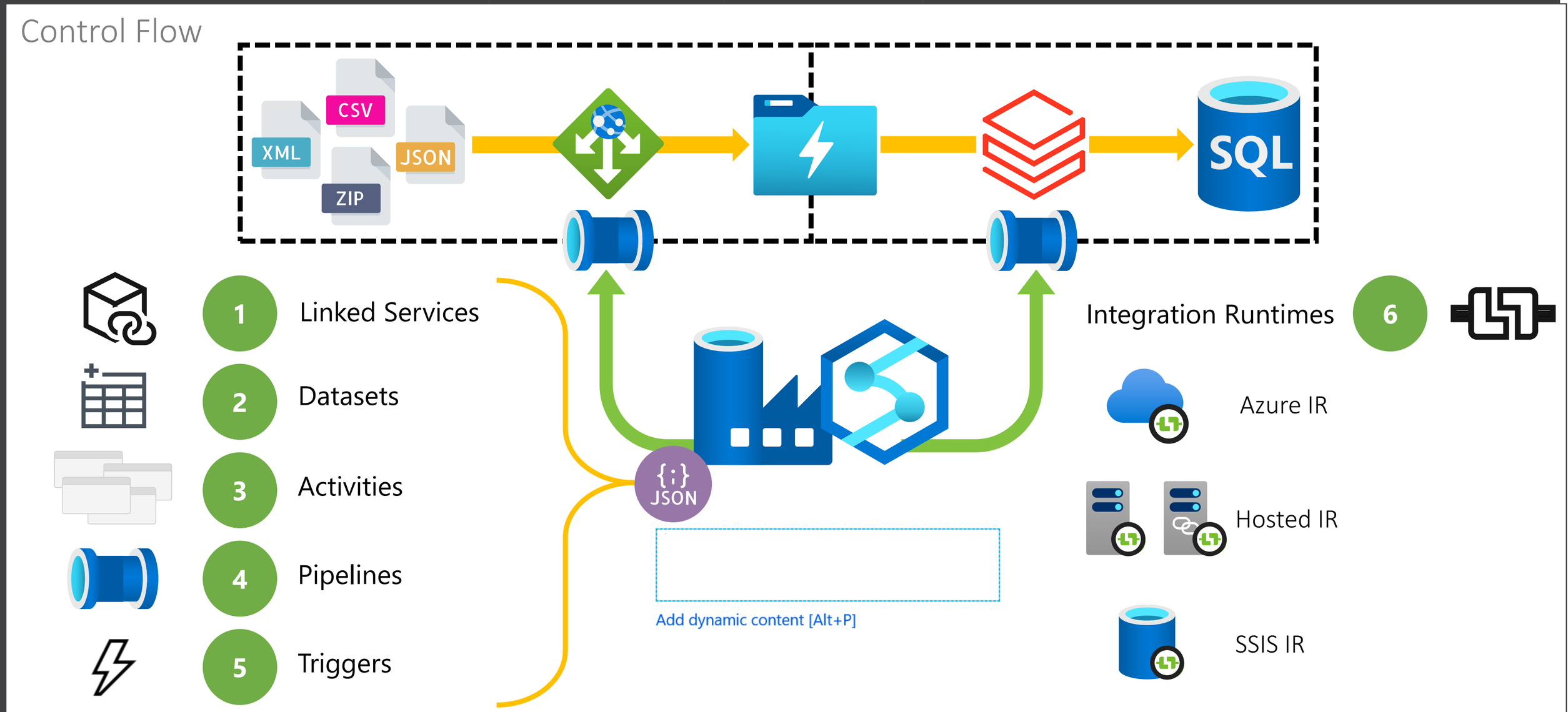




Batch Count Default: 20

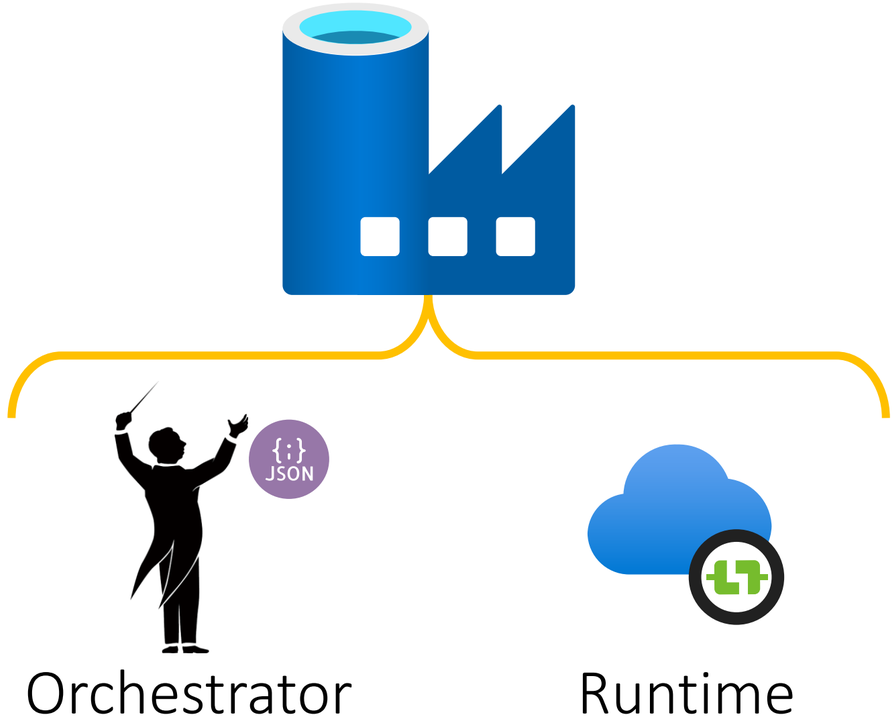
Batch Count Max: 50

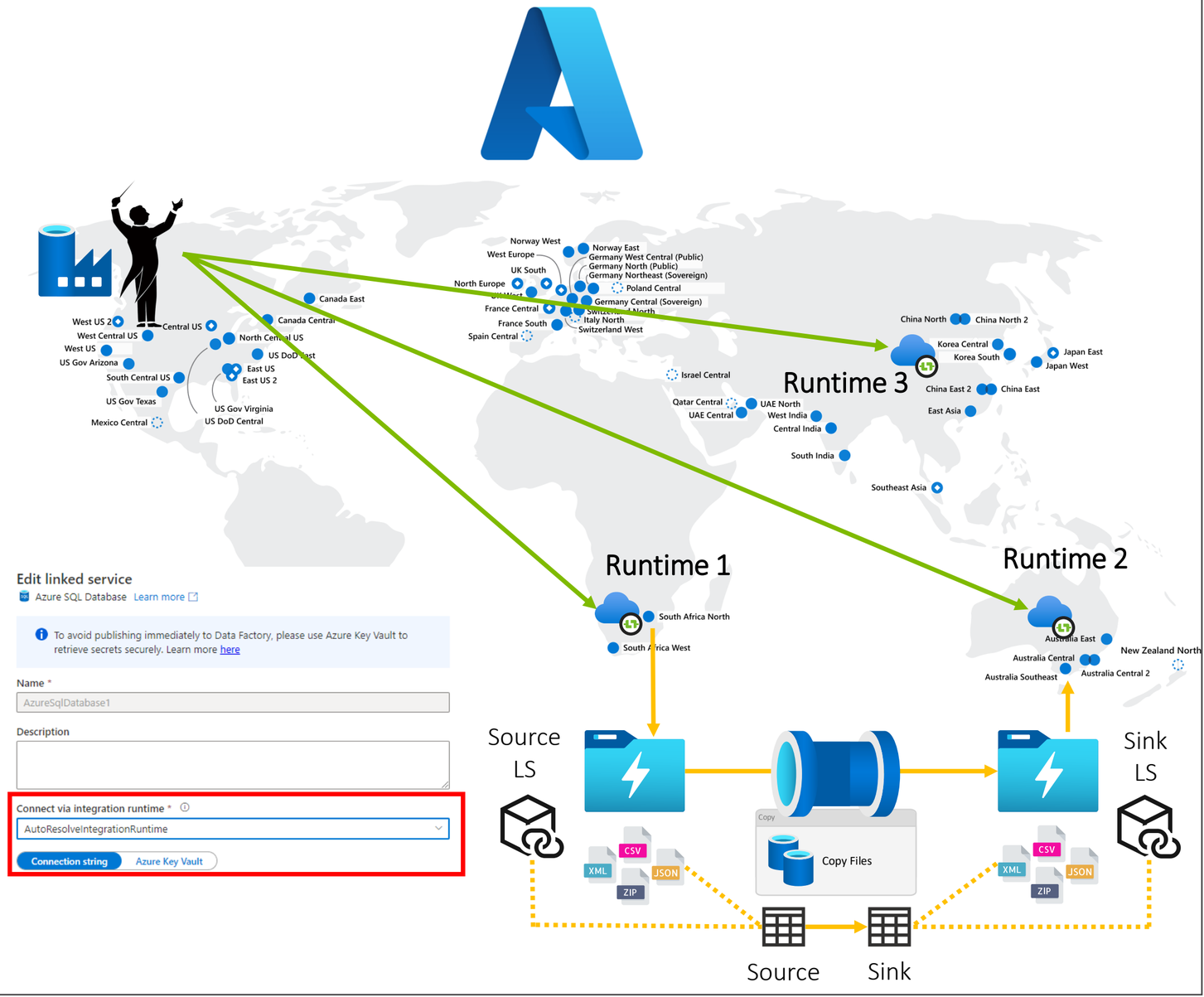
Integration Pipelines as Data Engineers



Azure Integration Runtime

Azure Integration Runtime

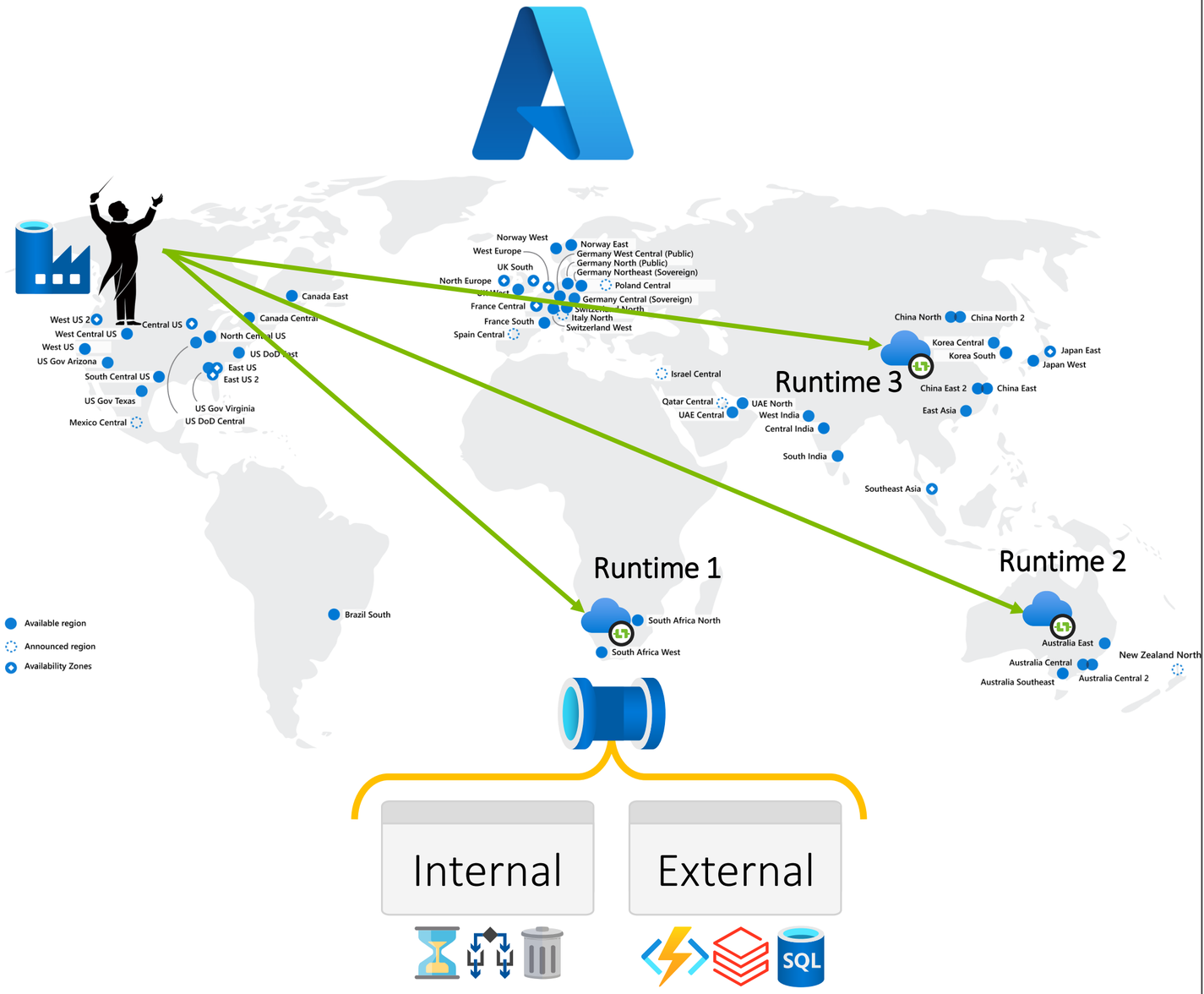




Azure Integration Runtime

Internal vs External Activities

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



Concurrency – Pipelines vs Activities

Per Subscription, per IR Region

10,000

Internal 1,000

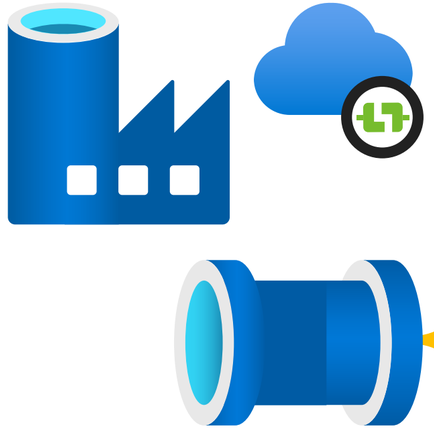
External 3,000

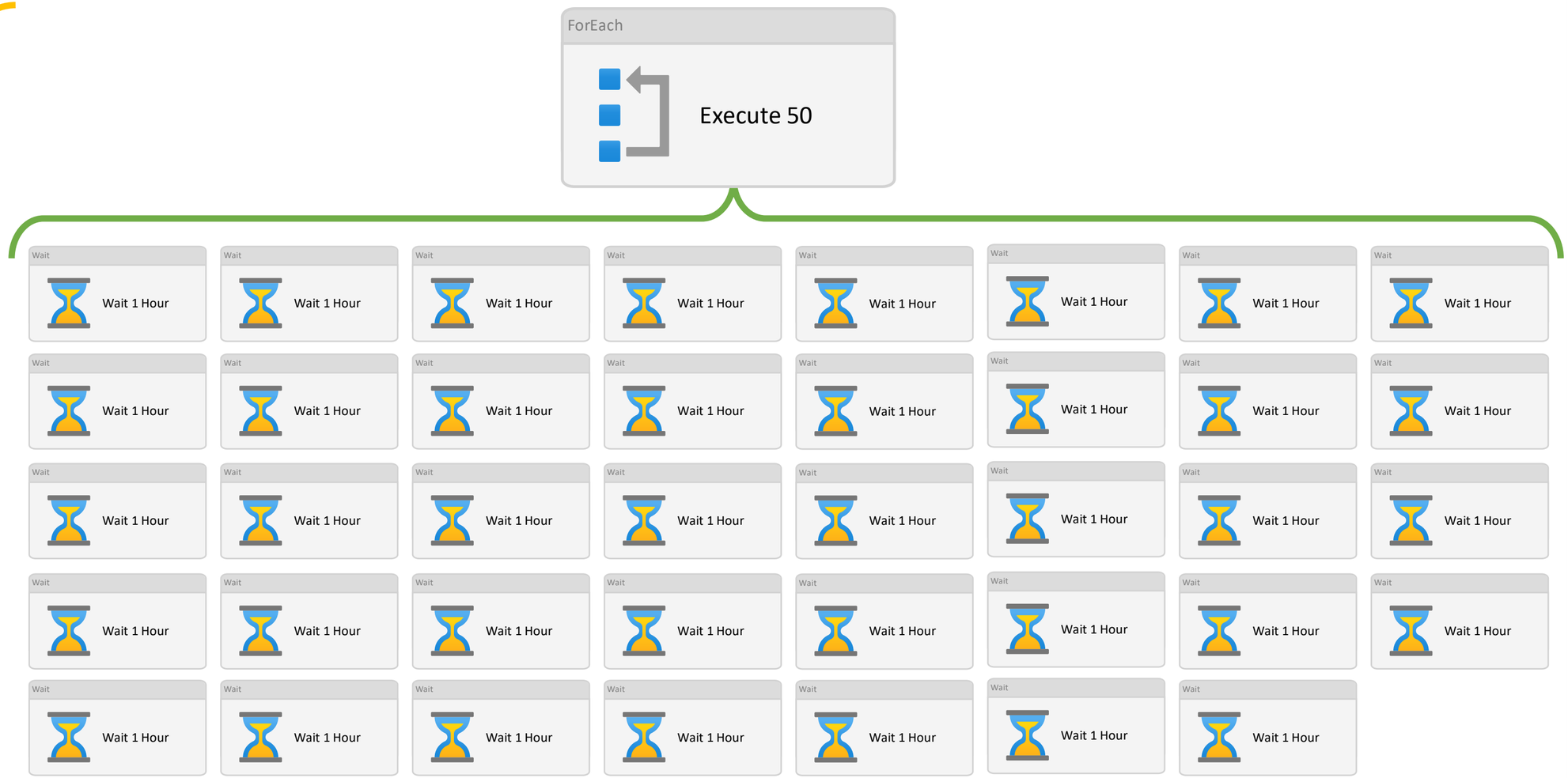
https://mrpaulandrew.com/2020/01/29/azure-data-factory-resource-limitations/

https://docs.microsoft.com/en-us/azure/azure-resource-manager/management/azure-subscription-service-limits#azure-data-factory-limits

Concurrency – Pipelines vs Activities

Example 1

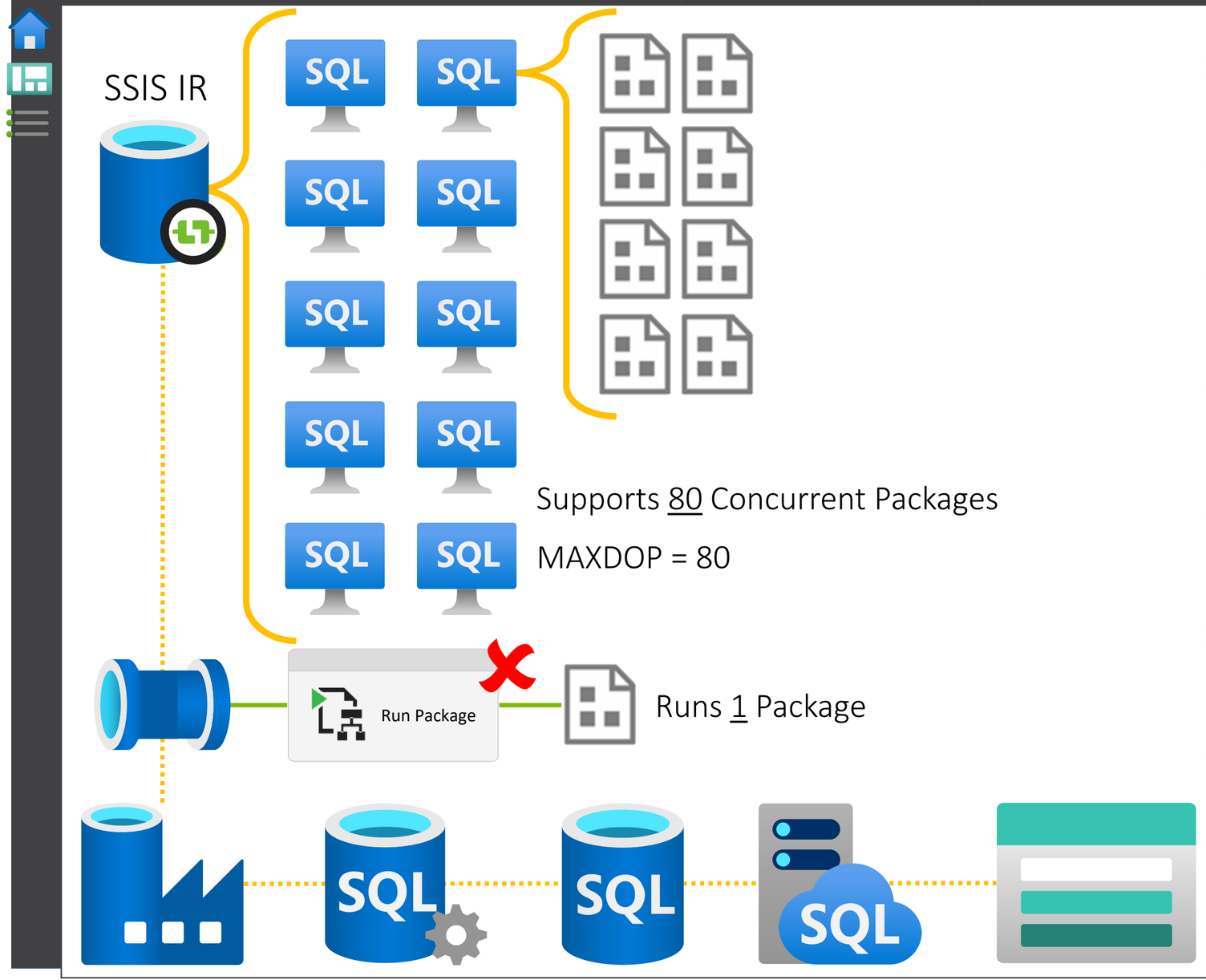


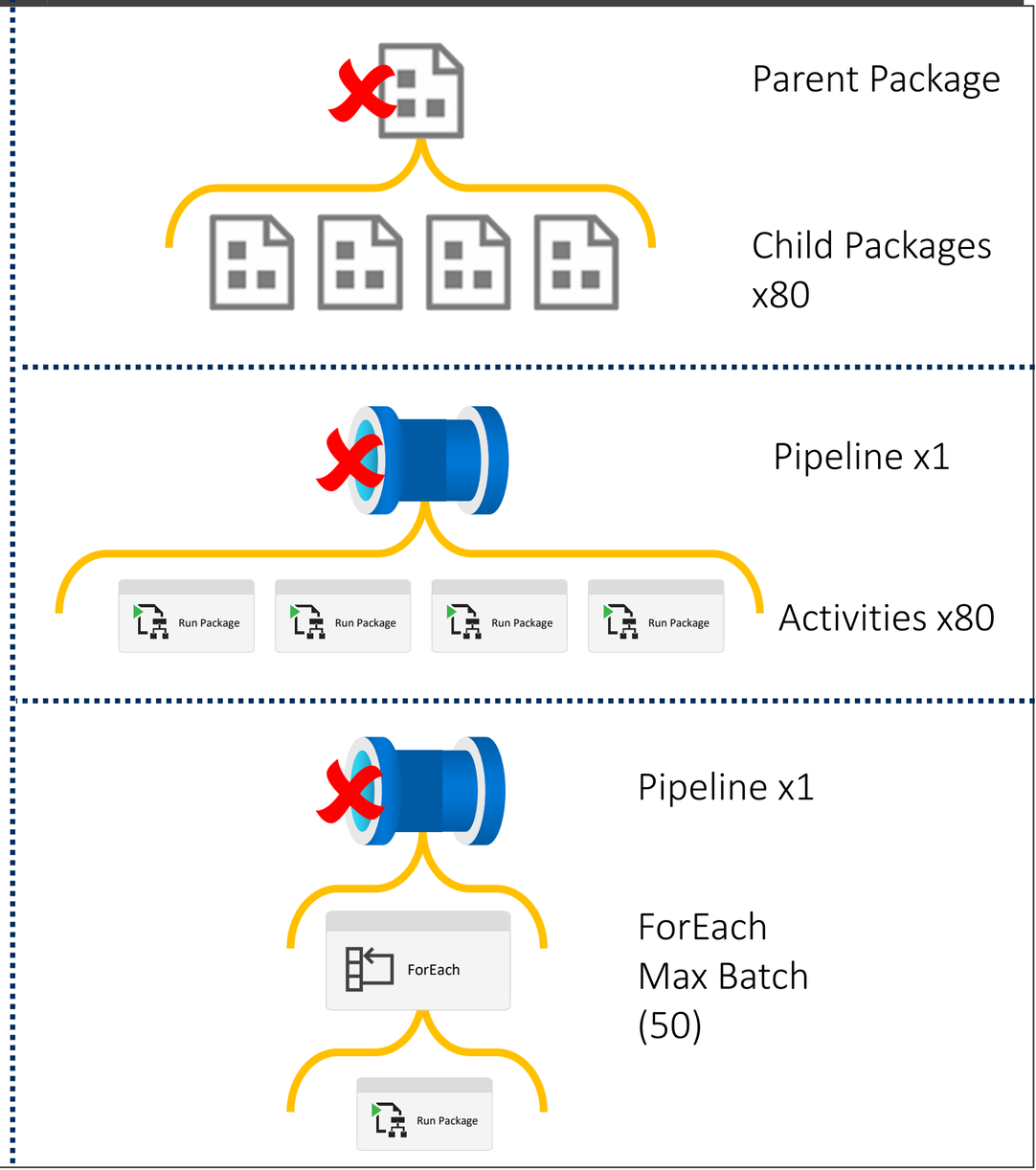


1	1	1		50		39		1951
IR	Pipeline	ForEach	+ (	Batches	X	Wait Activities	) =	Concurrent Activities

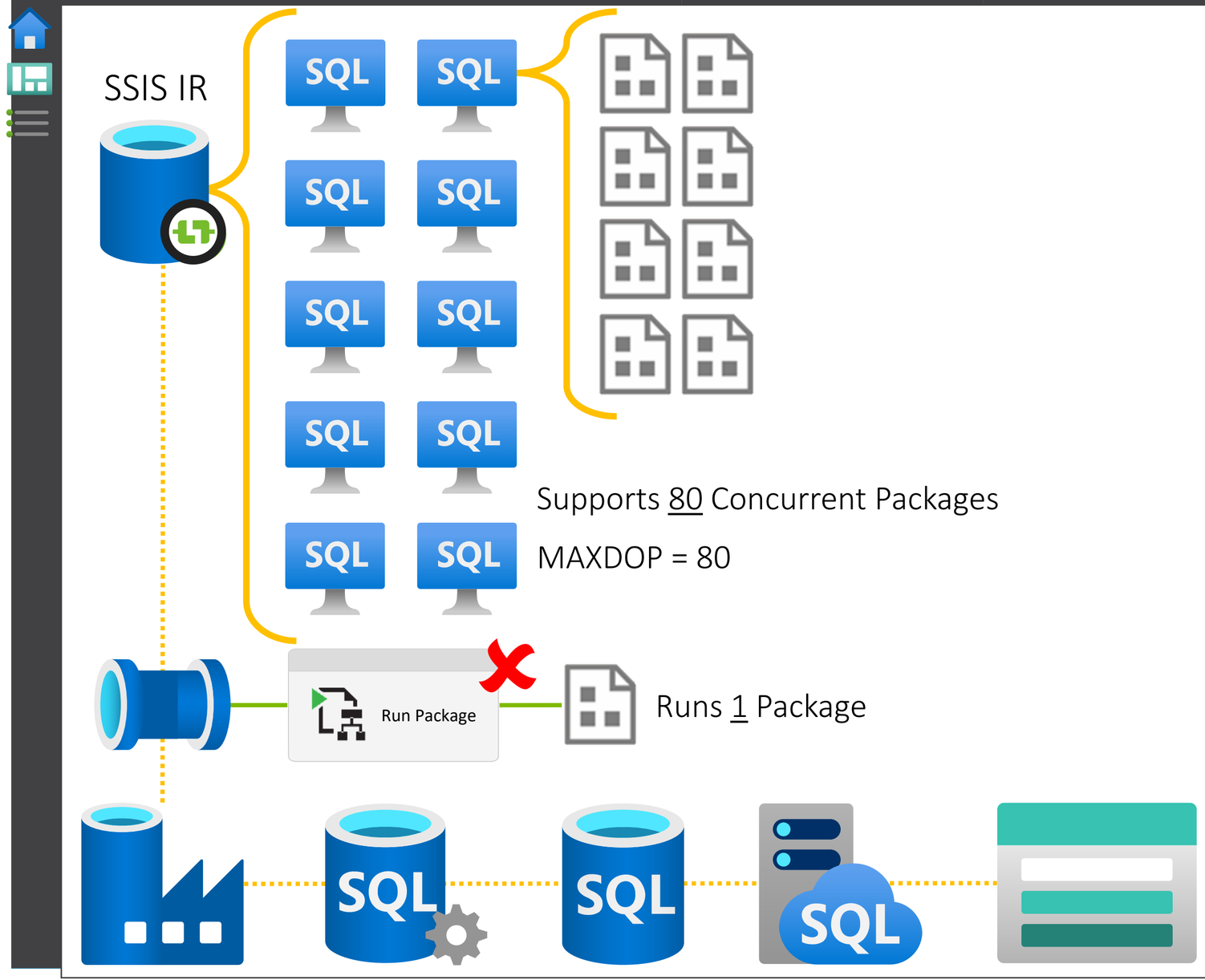

DEMO

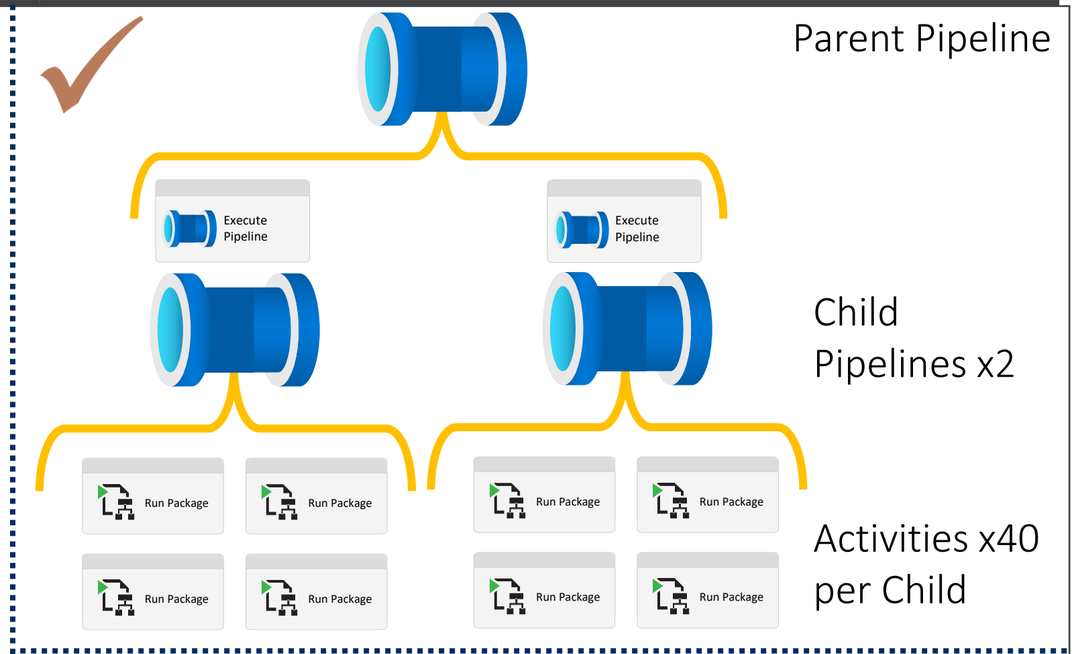
Problem: Using All Of The SSIS IR Compute

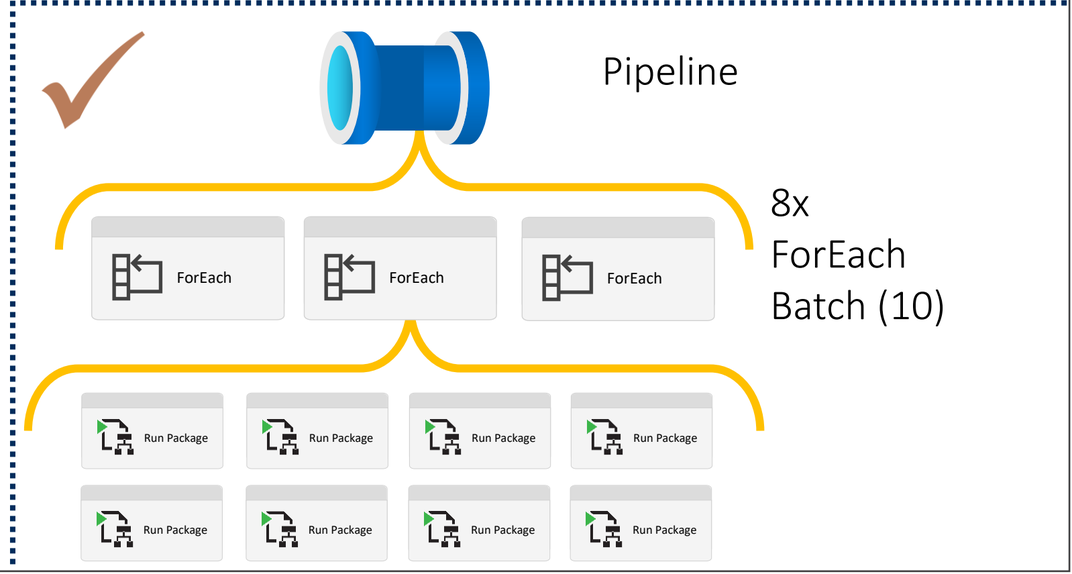




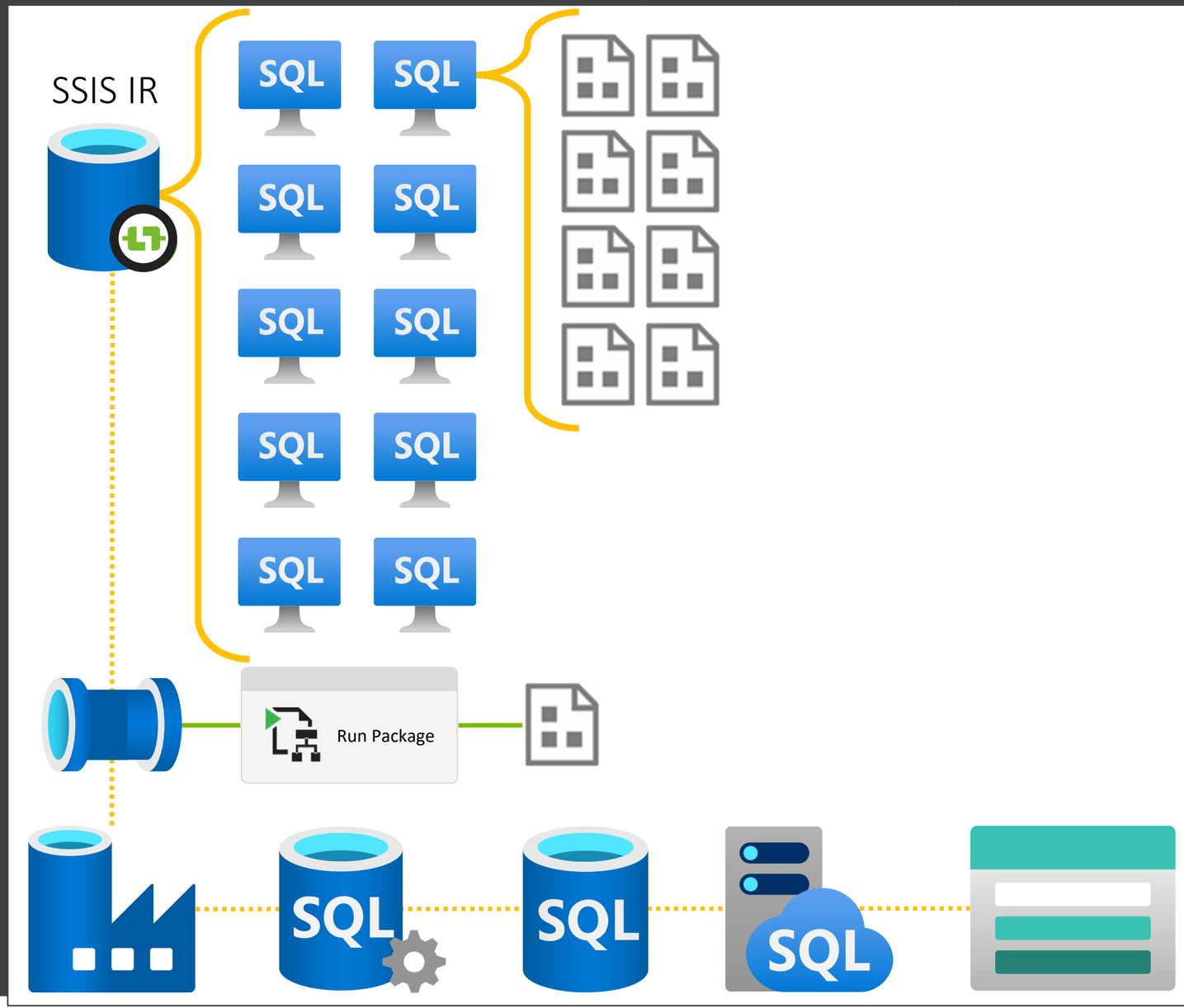
Solution 1 & 2: Static Pipelines



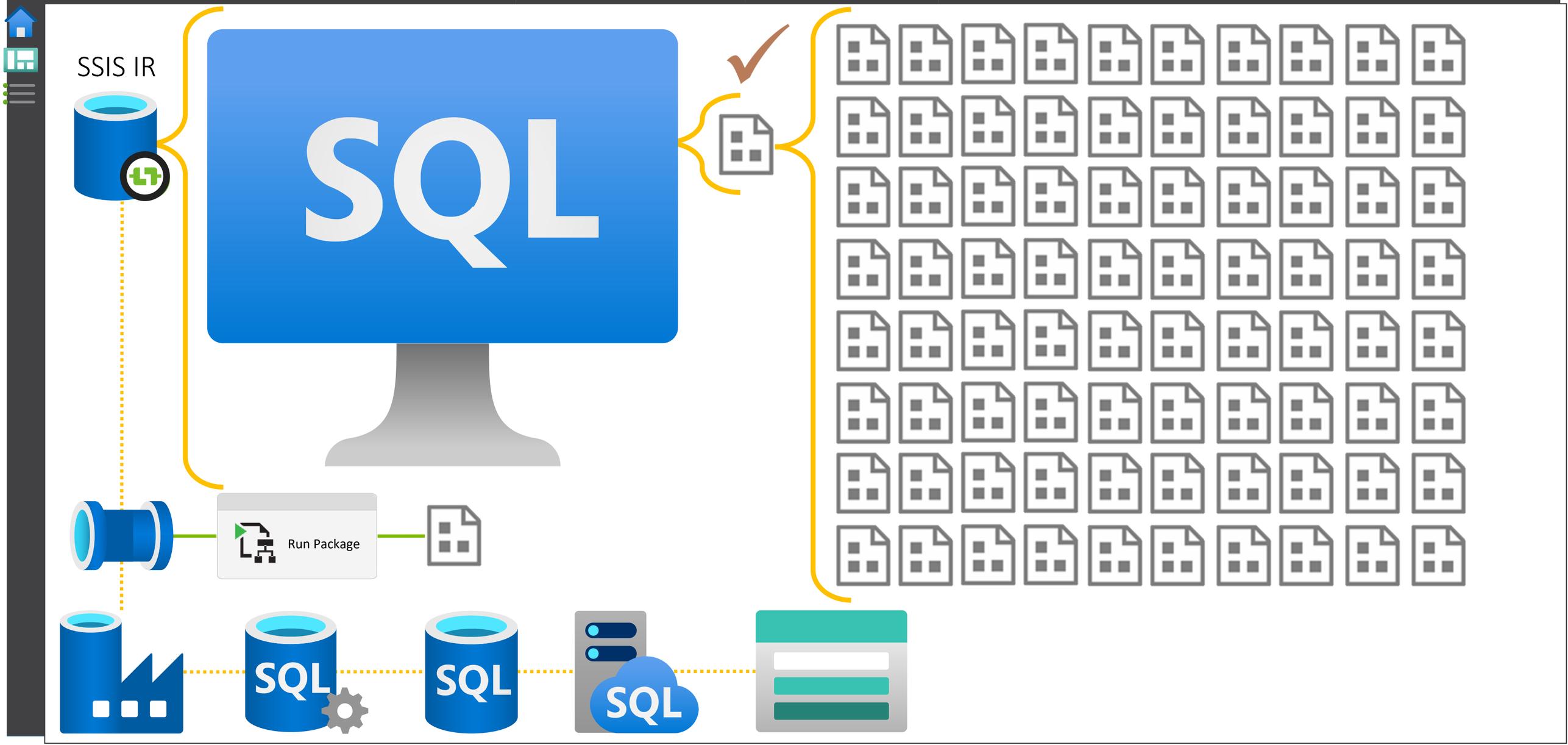




Solution 1 & 2: Static Pipelines

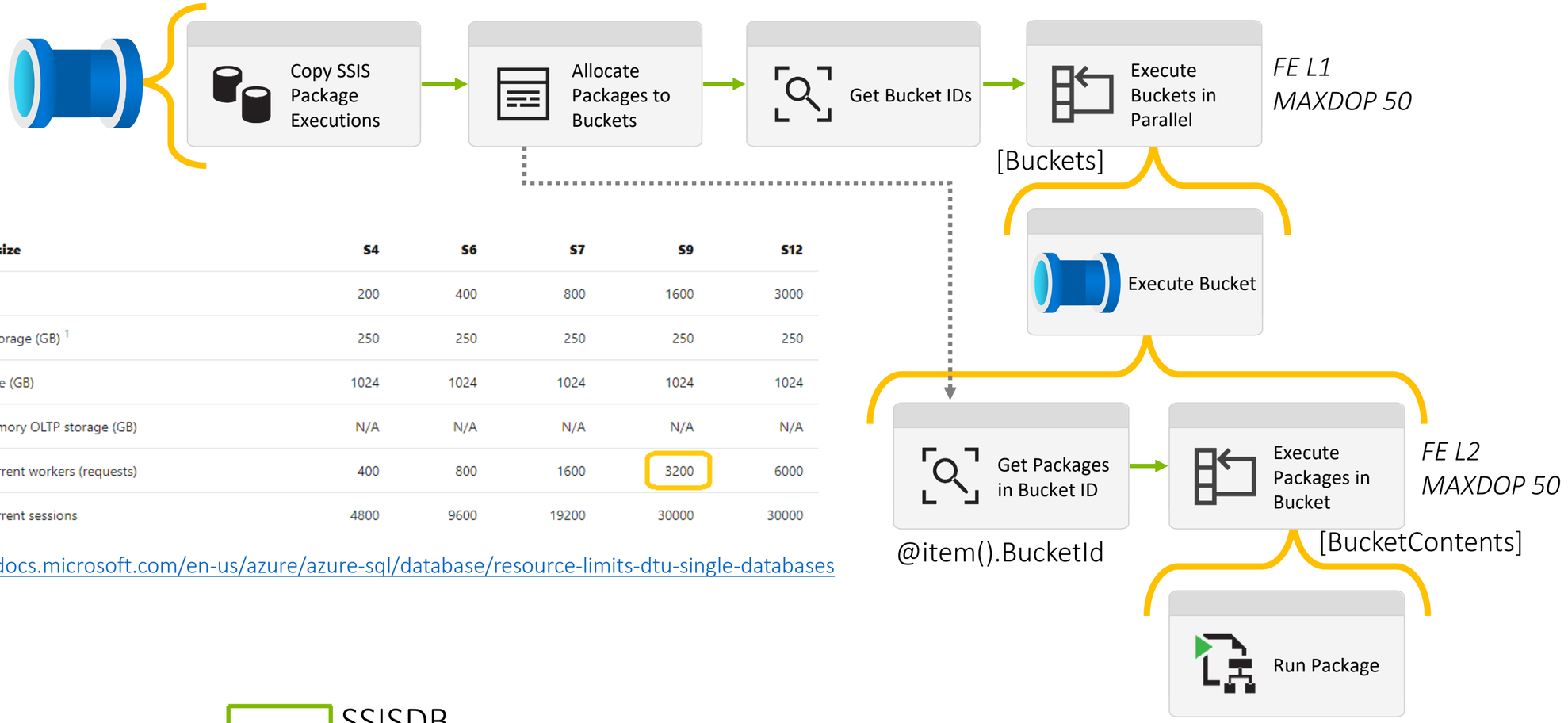


Solution 3: Packages Refactored on a Single Node IR



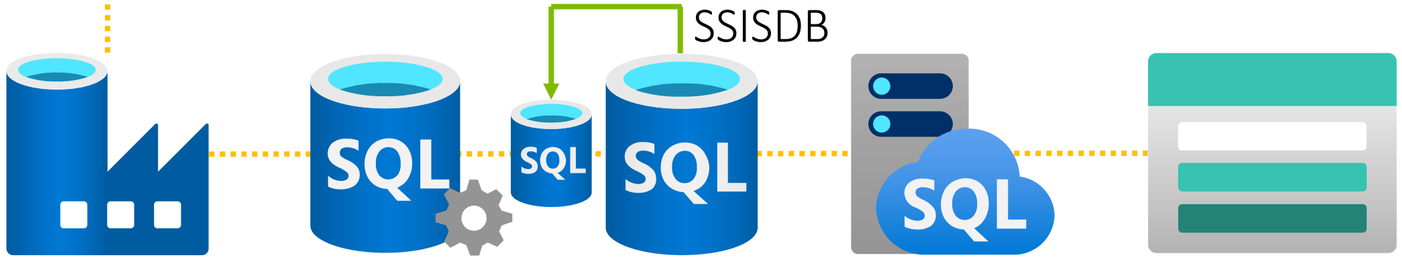
Solution 4: Nested ForEach Activities & Bucket Metadata

SSIS IR



Compute size	S4	S6	S7	S9	S12
Max DTUs	200	400	800	1600	3000
Included storage (GB) [1]	250	250	250	250	250
Max storage (GB)	1024	1024	1024	1024	1024
Max in-memory OLTP storage (GB)	N/A	N/A	N/A	N/A	N/A
Max concurrent workers (requests)	400	800	1600	3200	6000
Max concurrent sessions	4800	9600	19200	30000	30000

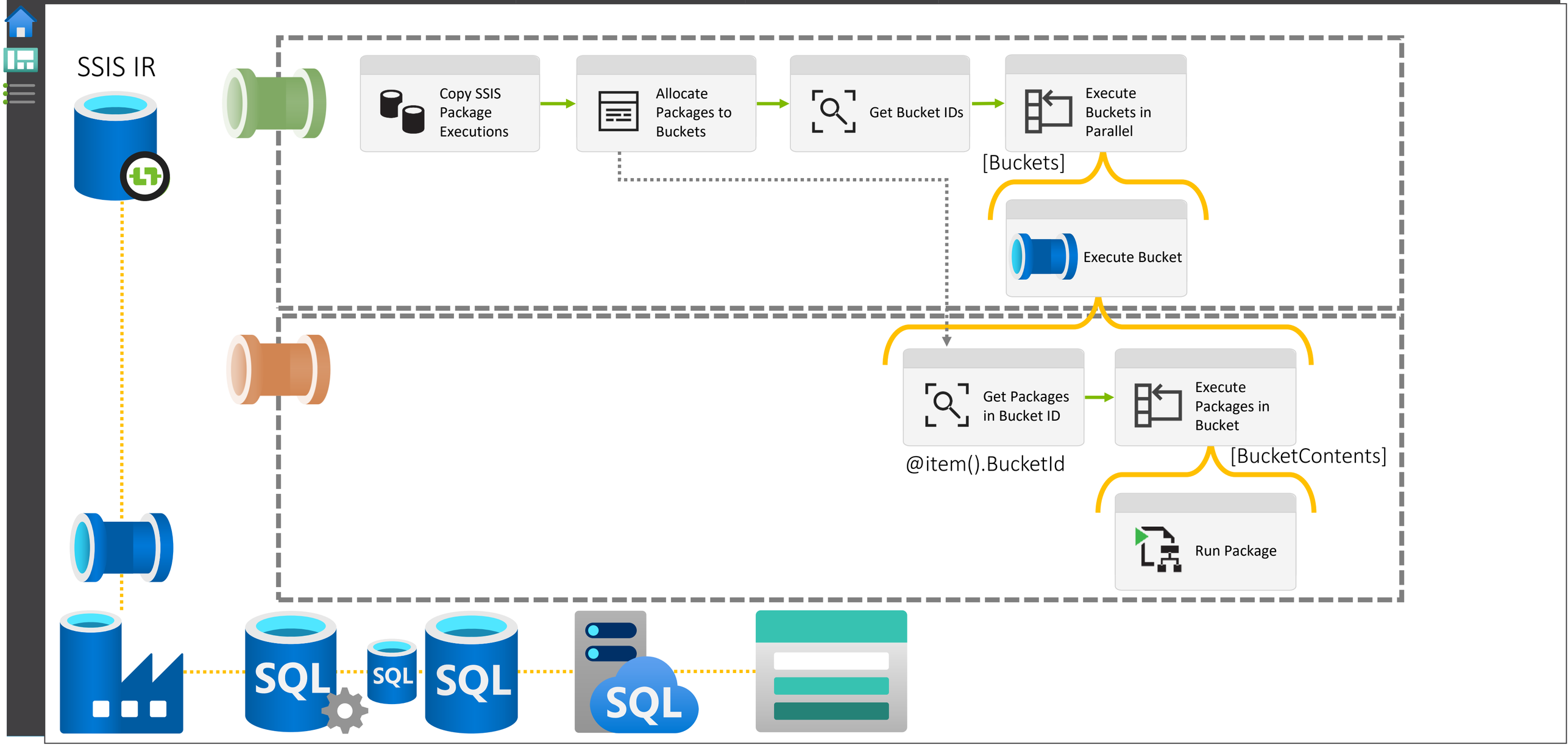
https://docs.microsoft.com/en-us/azure/azure-sql/database/resource-limits-dtu-single-databases



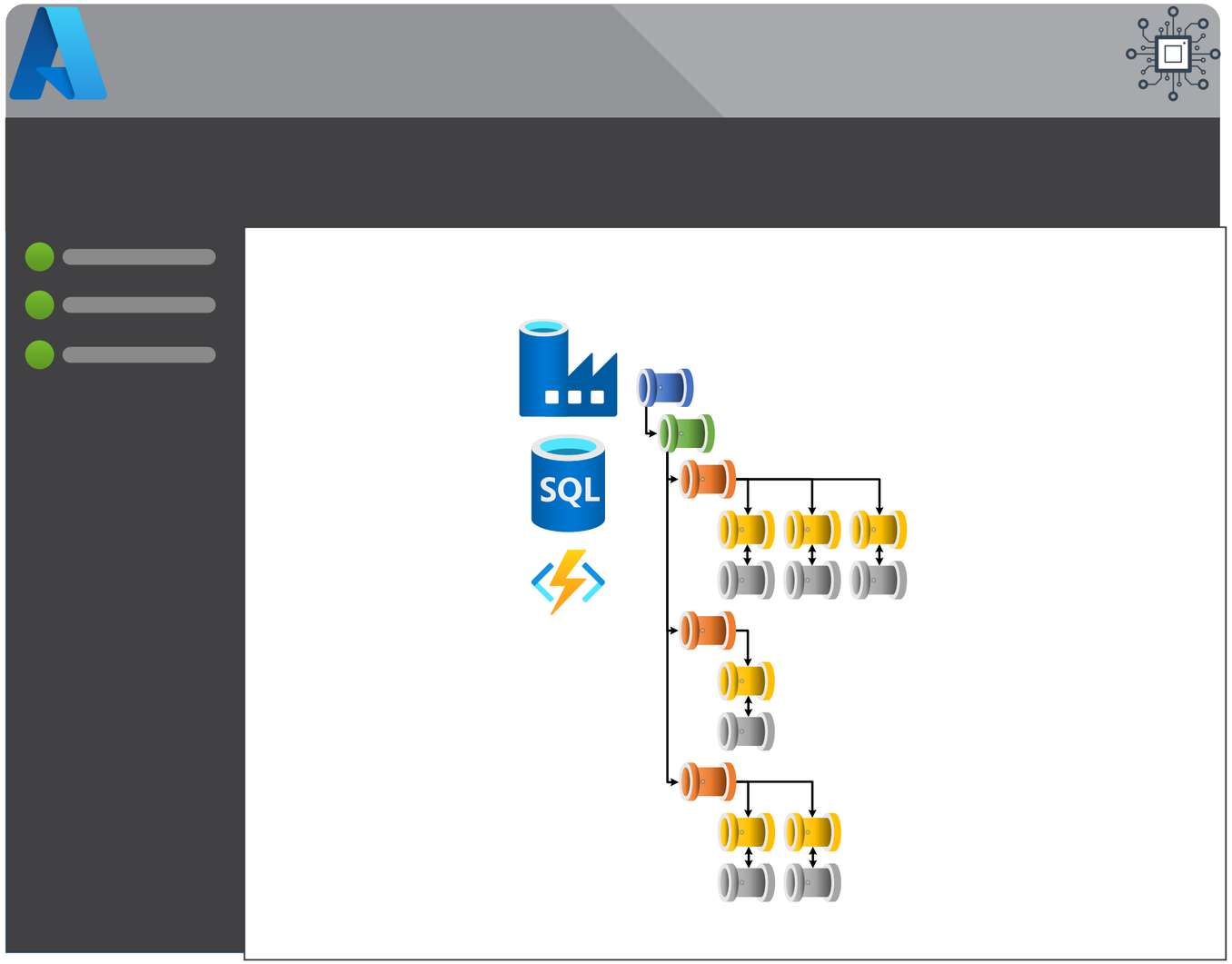
(FE L1) x (FE L2) = NEW MAXDOP

50 x 50 = 2500

Solution 4: Nested ForEach Activities & Bucket Metadata

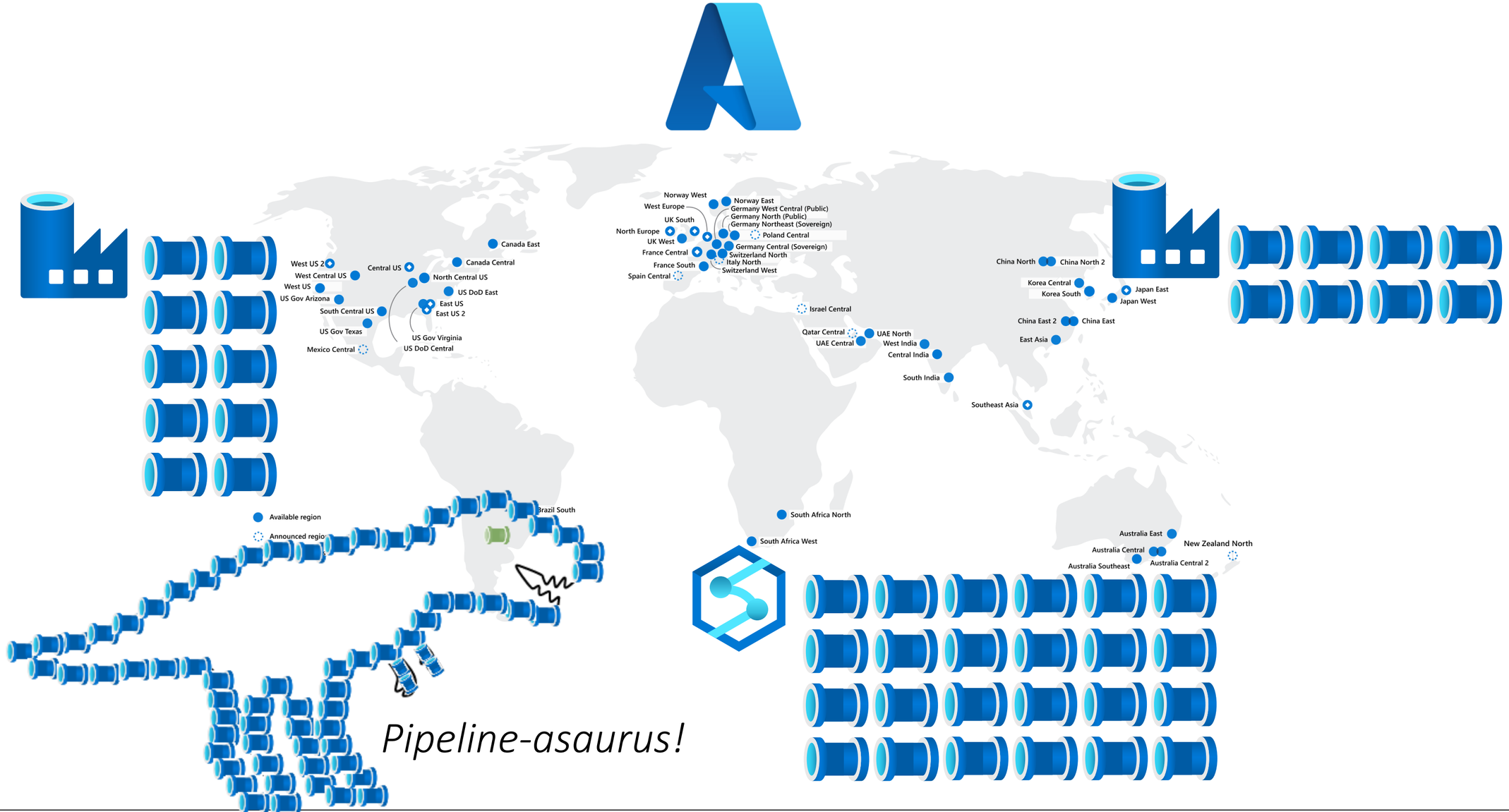


Metadata Driven Framework

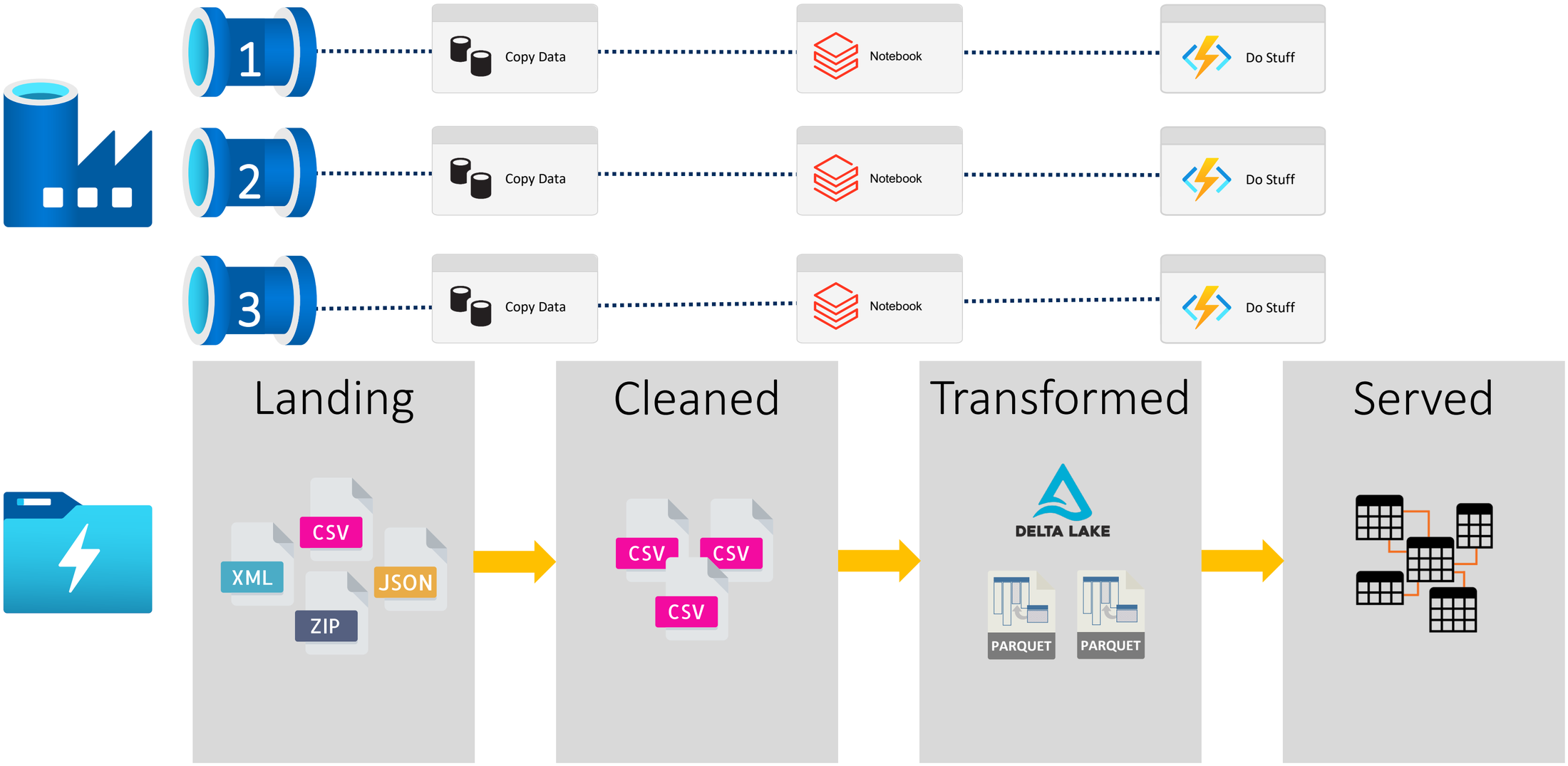


Problem

How should we structure and trigger our Integration Pipelines?



Problem


1
Copy Data
Notebook
Do Stuff
2
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3
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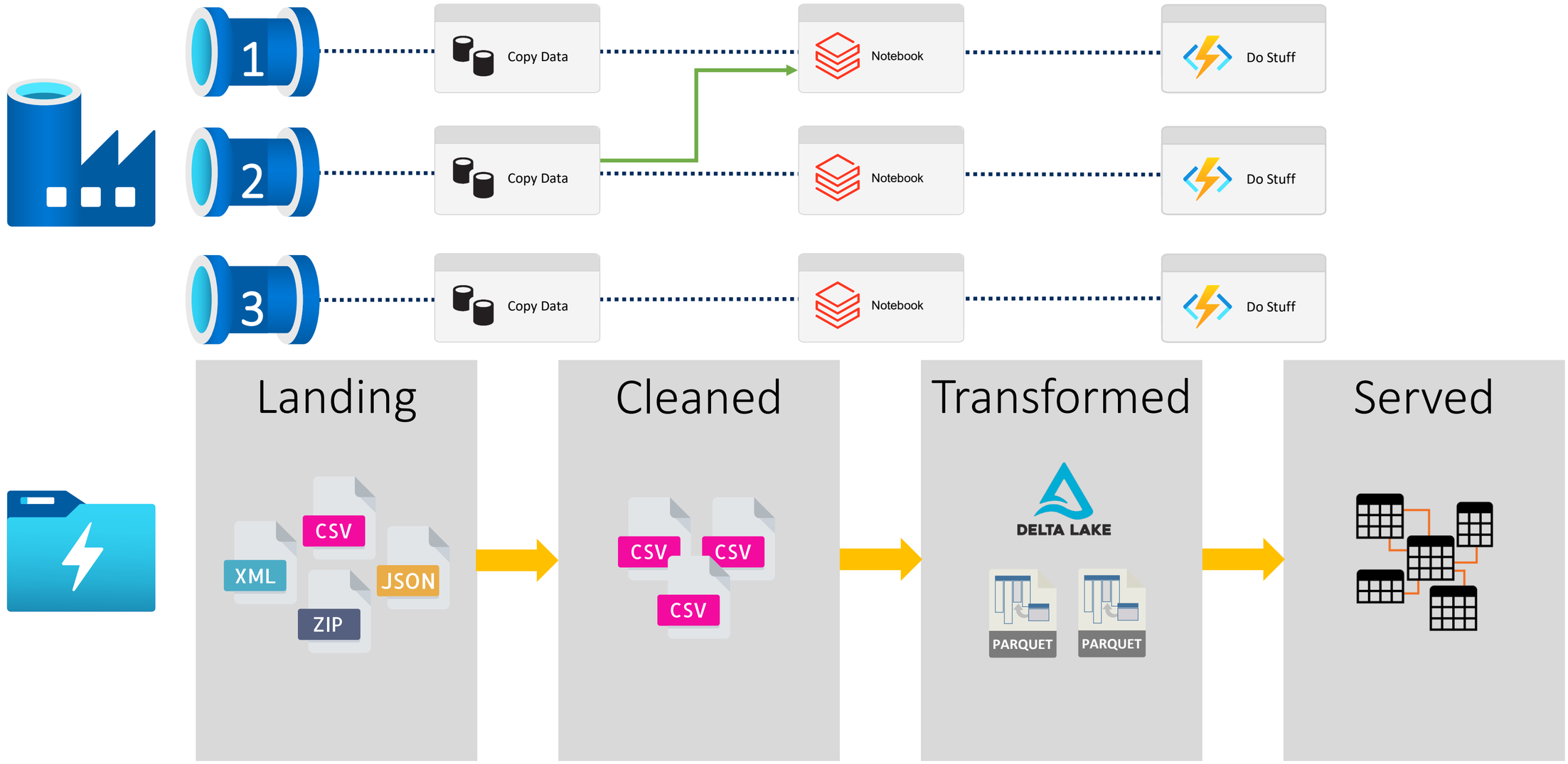
DELTA LAKE
PARQUET
PARQUET
Served

Problem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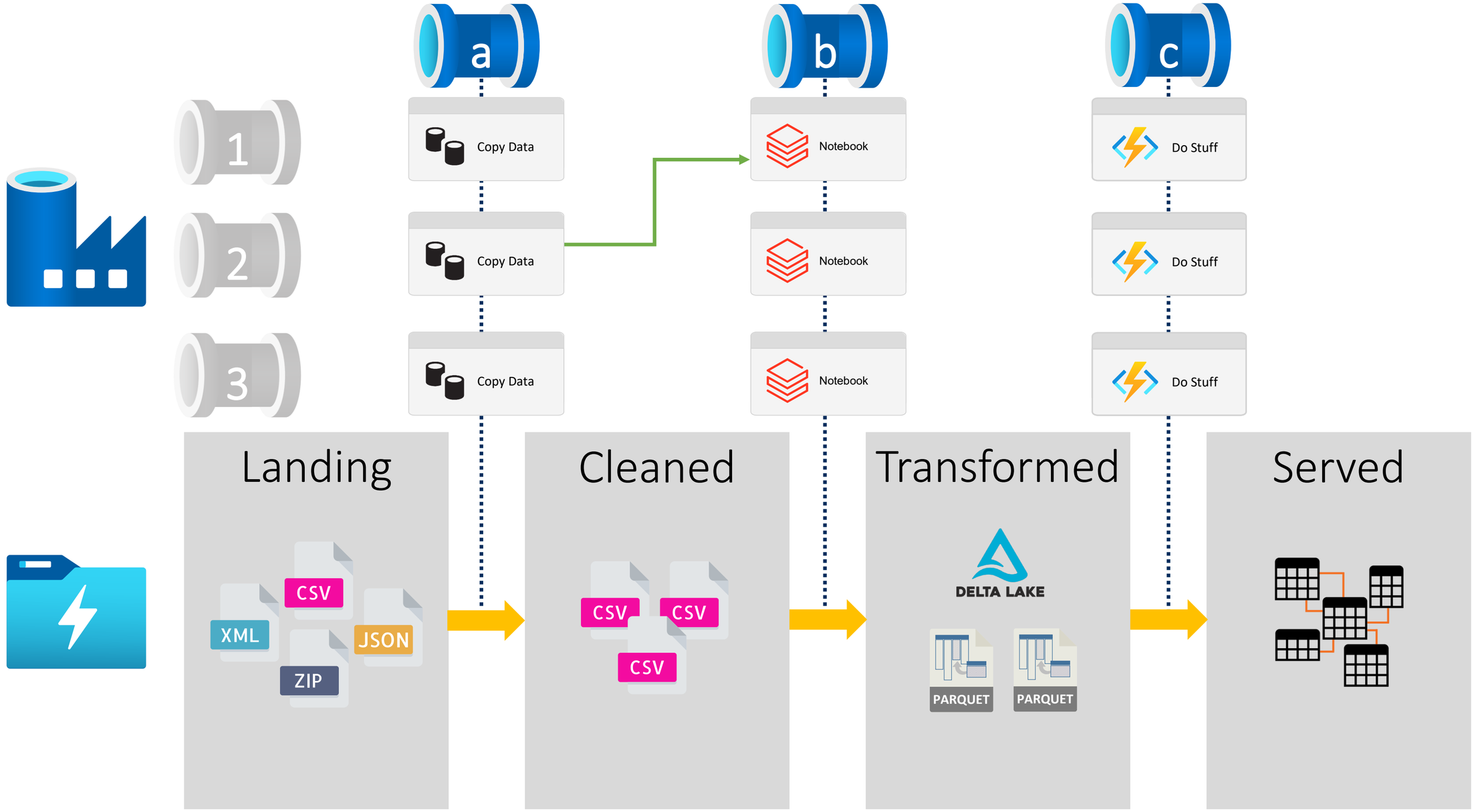
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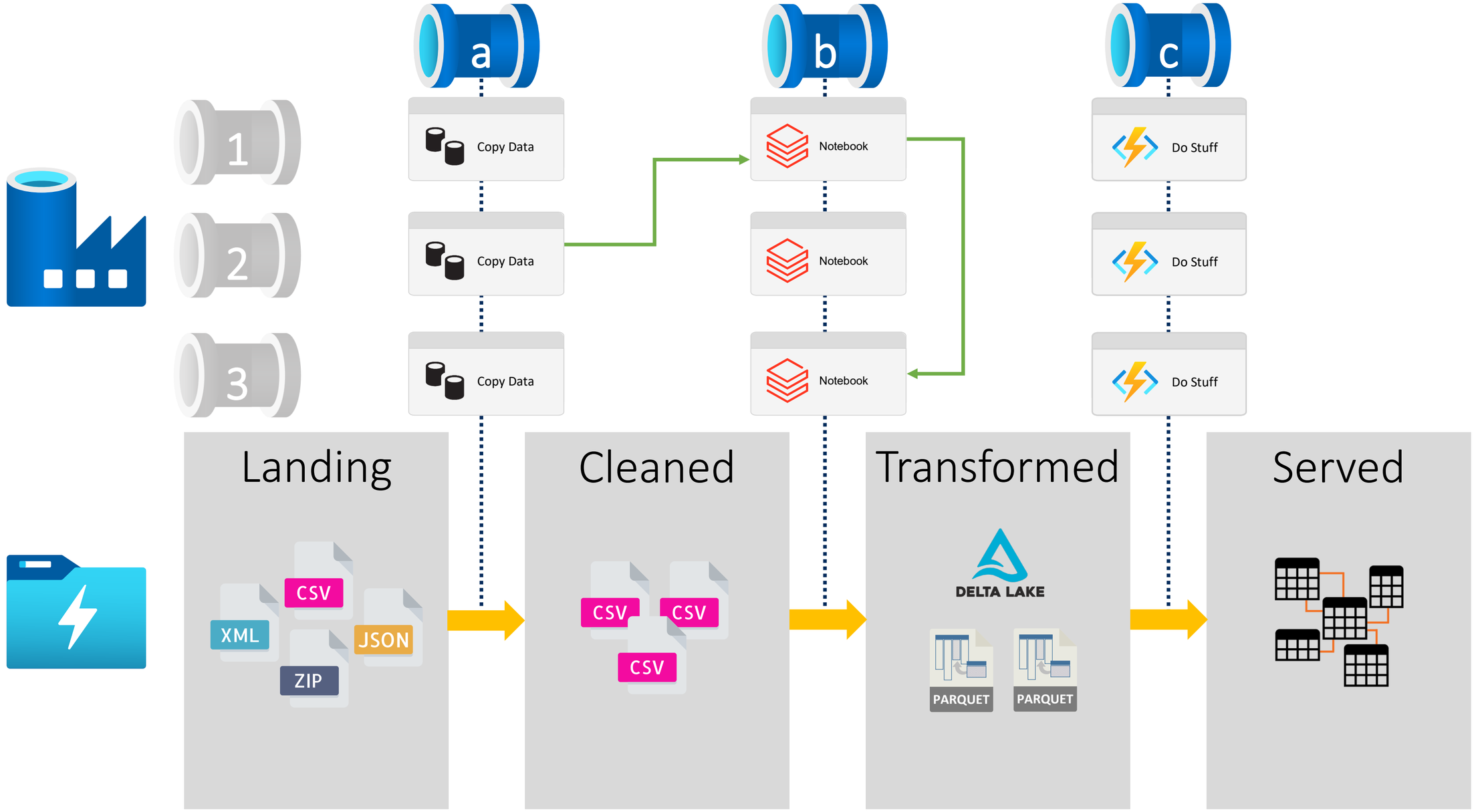
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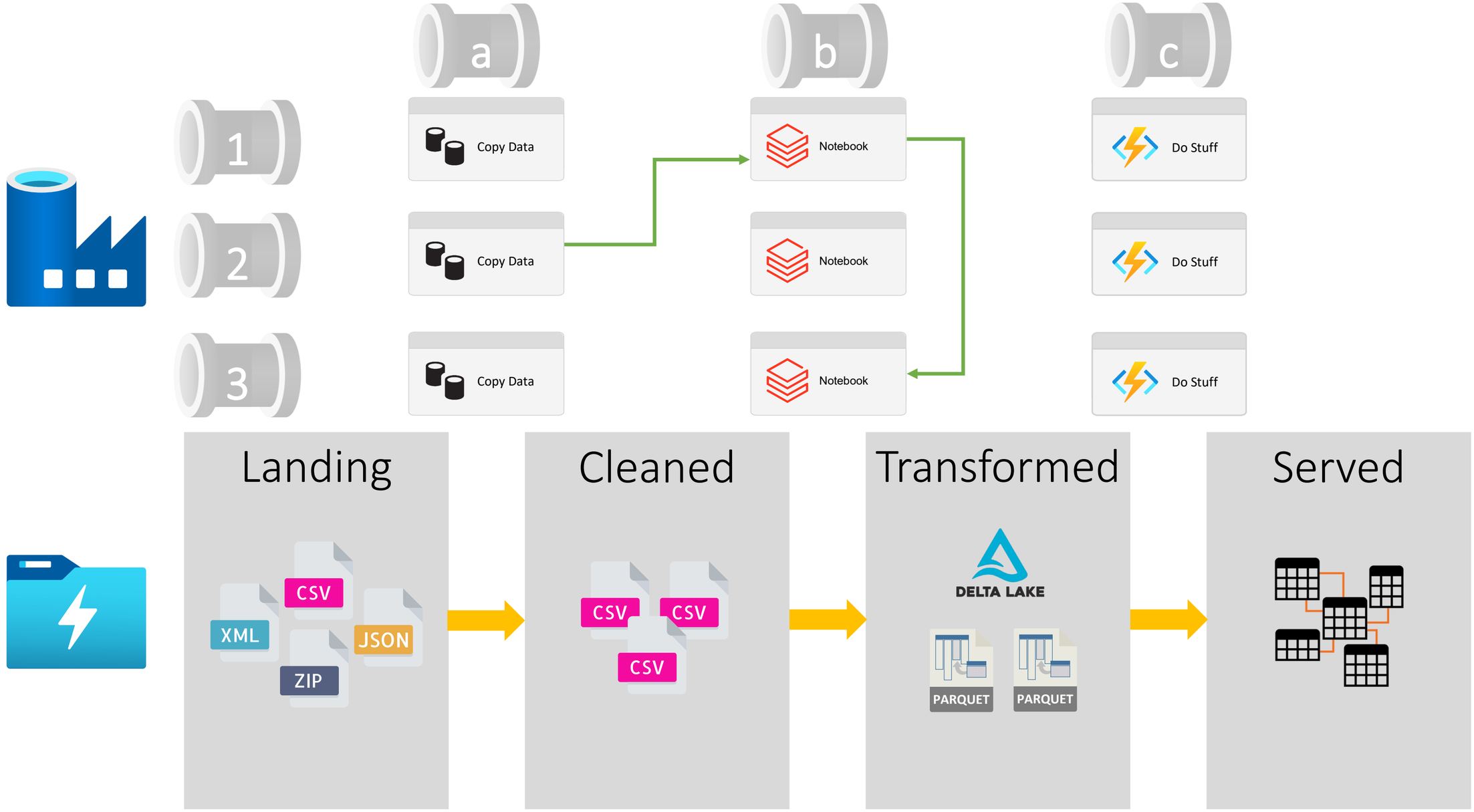
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DELTA LAKE
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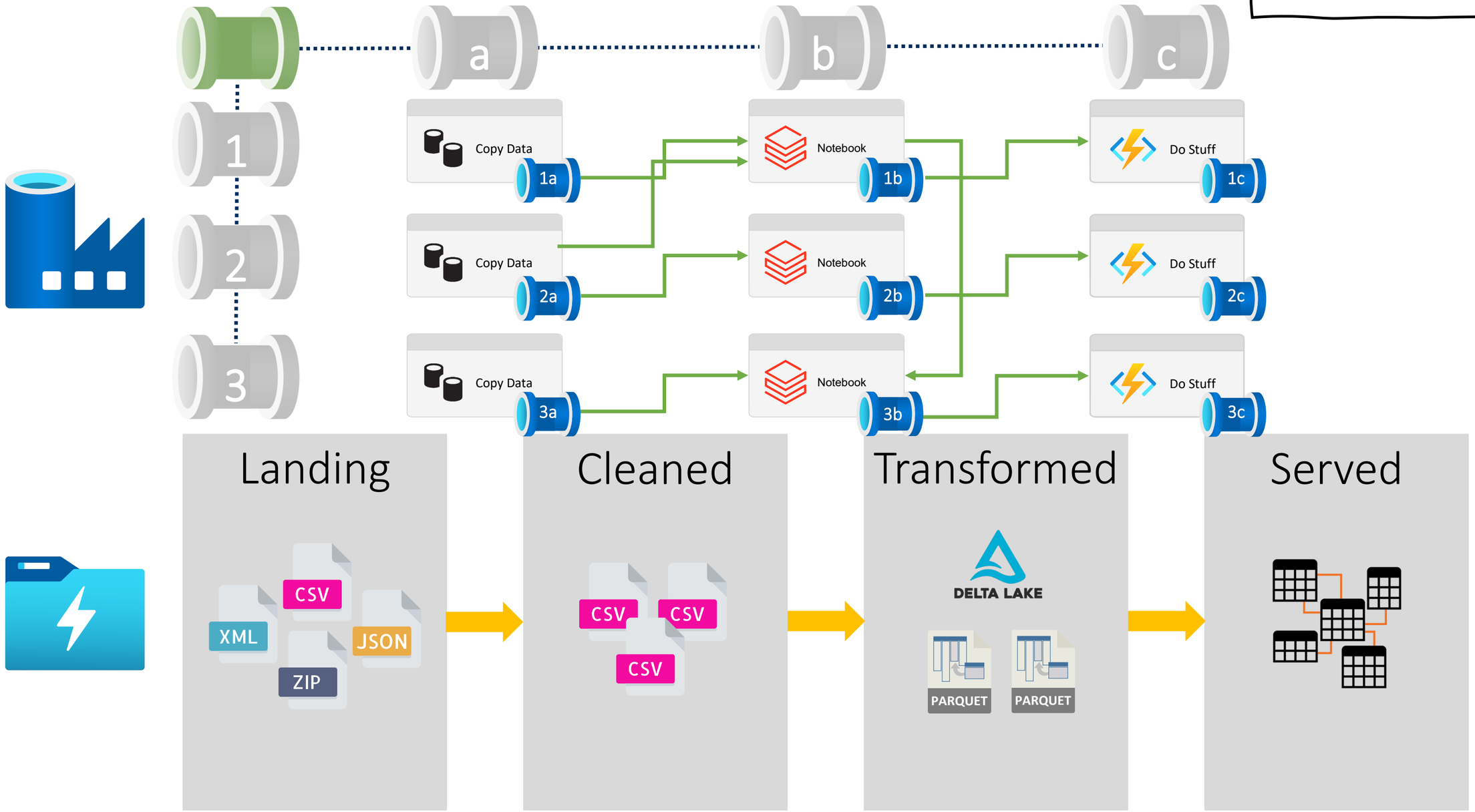
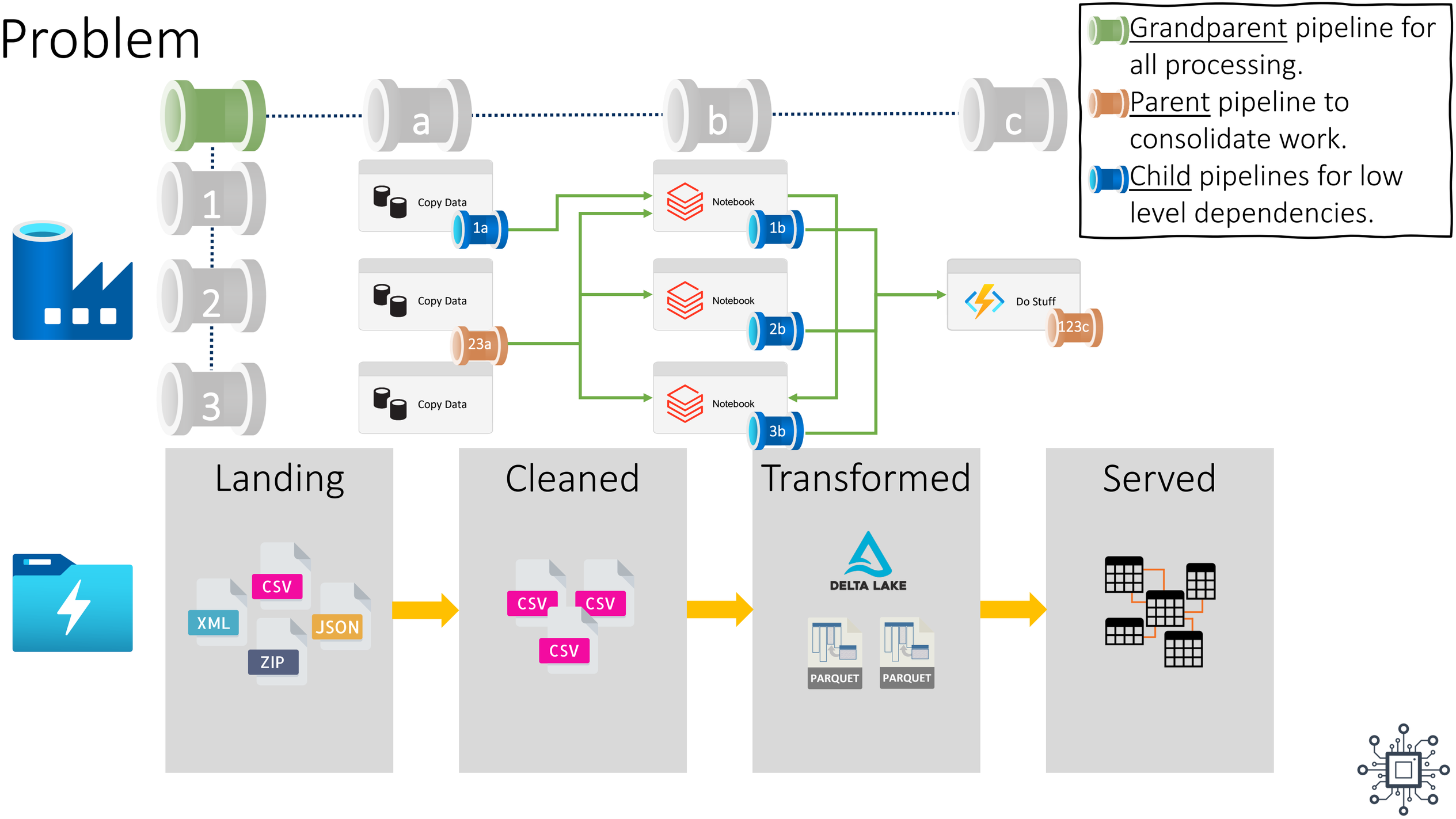
PARQUET
Served

Problem

Only 40 Activities per Pipeline.



Problem


Grandparent pipeline for all processing.
Parent pipeline to consolidate work.
Child pipelines for low level dependencies.
a
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2
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1a
Copy Data
23a
Copy Data
Notebook
1b
Notebook
2b
Notebook
3b
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123c
Landing
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Cleaned
CSV
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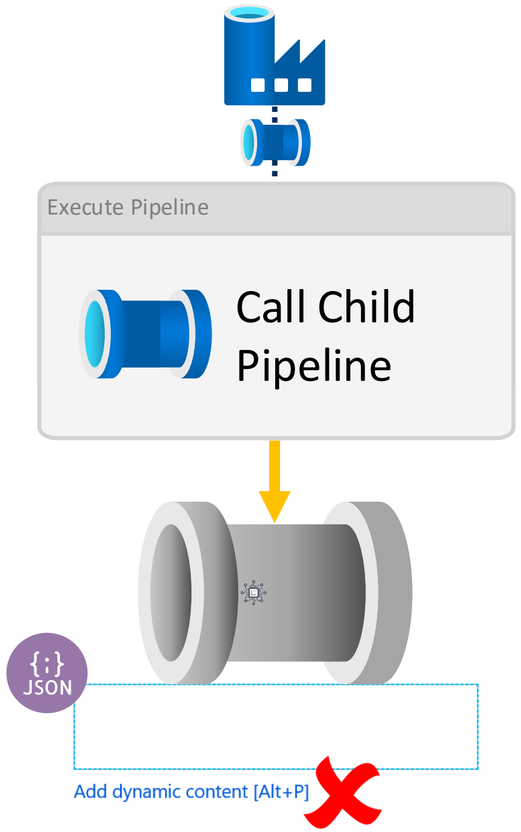
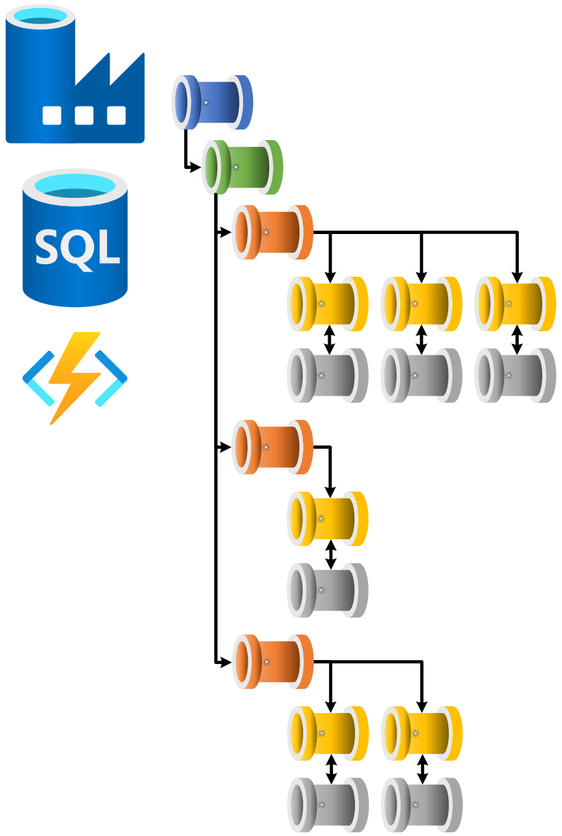
CSV
Transformed
DELTA LAKE
PARQUET
PARQUET
Served

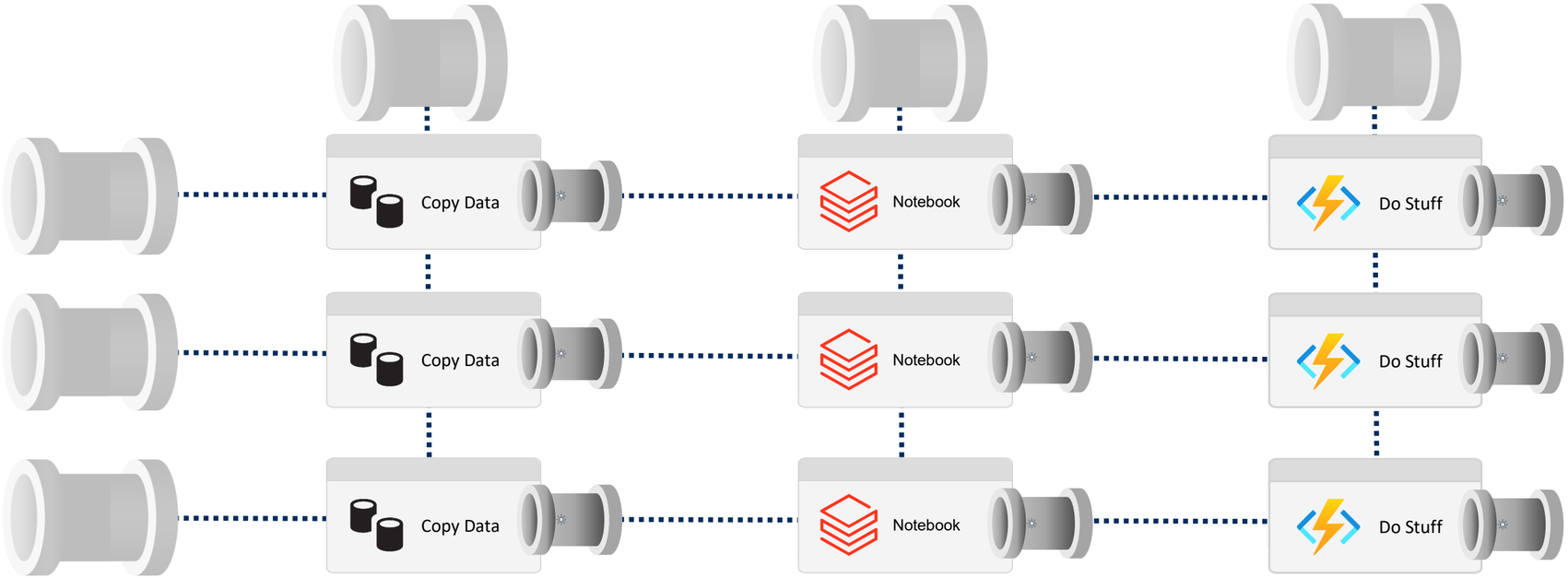
Solution

Use Metadata to Drive Integration Pipeline execution





Solution

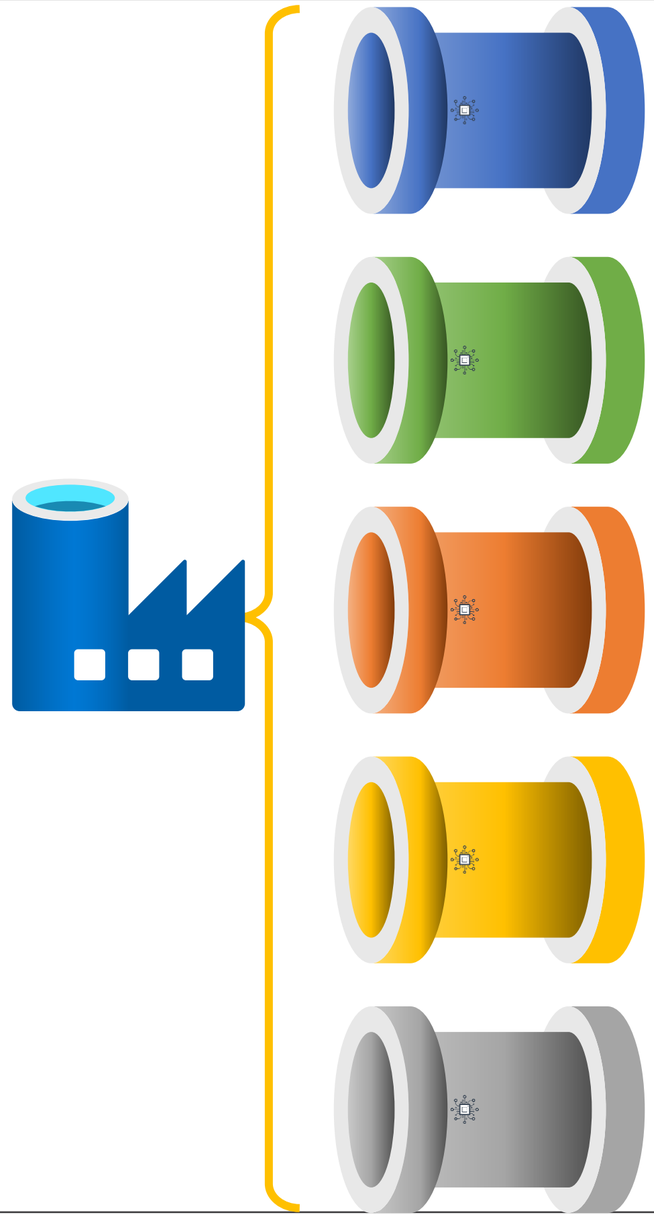


Stages
1
2
3

Pipelines
a
b
c
d
e
f
g
h
i

Stage	Pipeline
1	a
1	b
1	c
2	d
2	e
3	f
3	g
3	h
3	i

Framework Pipeline Hierarchy



- Grandparent

Role: Optional level platform setup, for example, scale up/out compute services ready for the framework to run.

- Parent

Role: Execution run wrapper for batches and execution stage iterator.

- Child

Role: Scale out triggering of worker pipelines within the execution stage(s).

- Infant

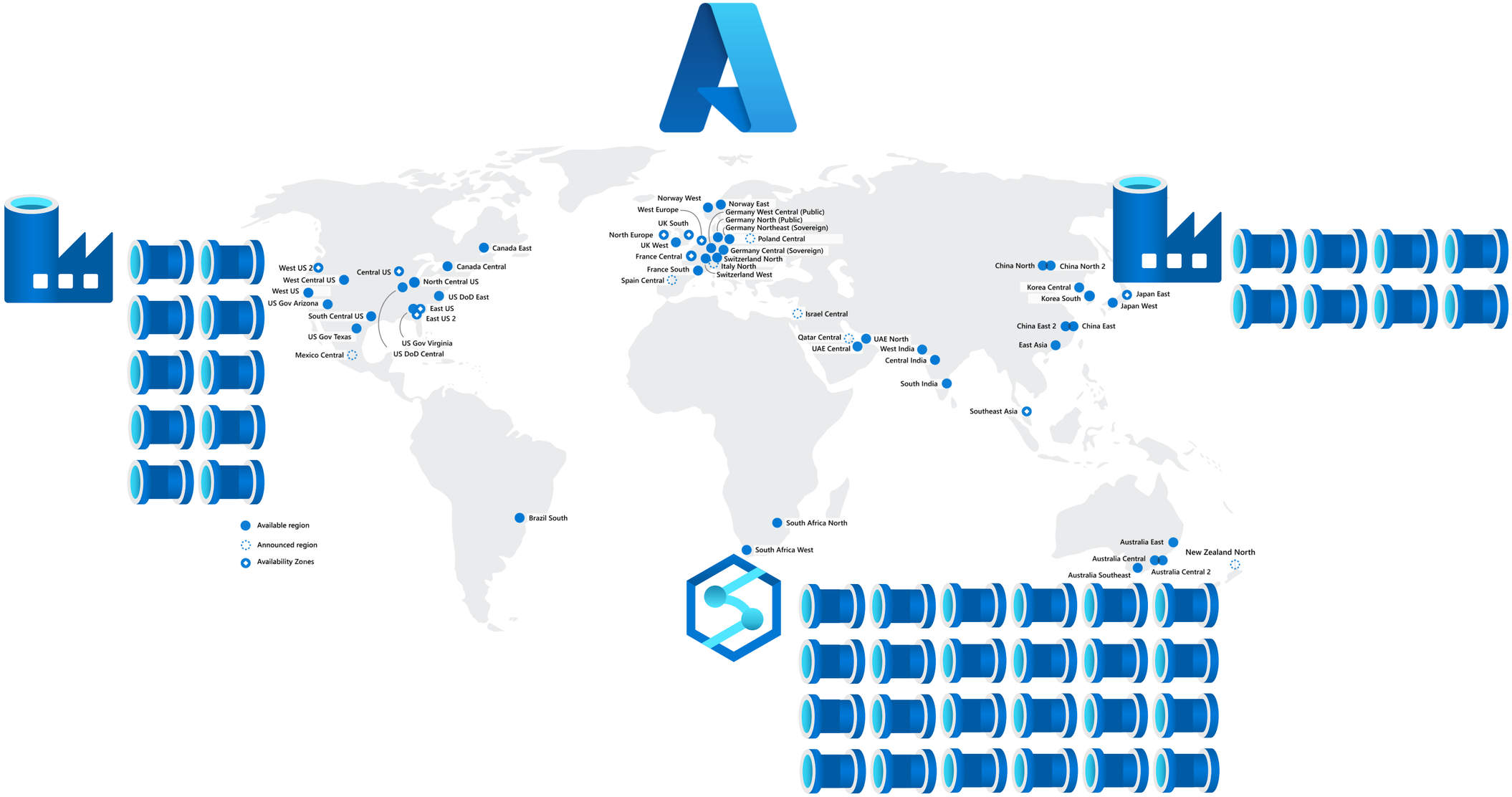
Role: Worker validator, executor, monitor and reporting of the outcome for the single worker pipeline.

- Worker

Role: Anything specific to the process needing to be performed.

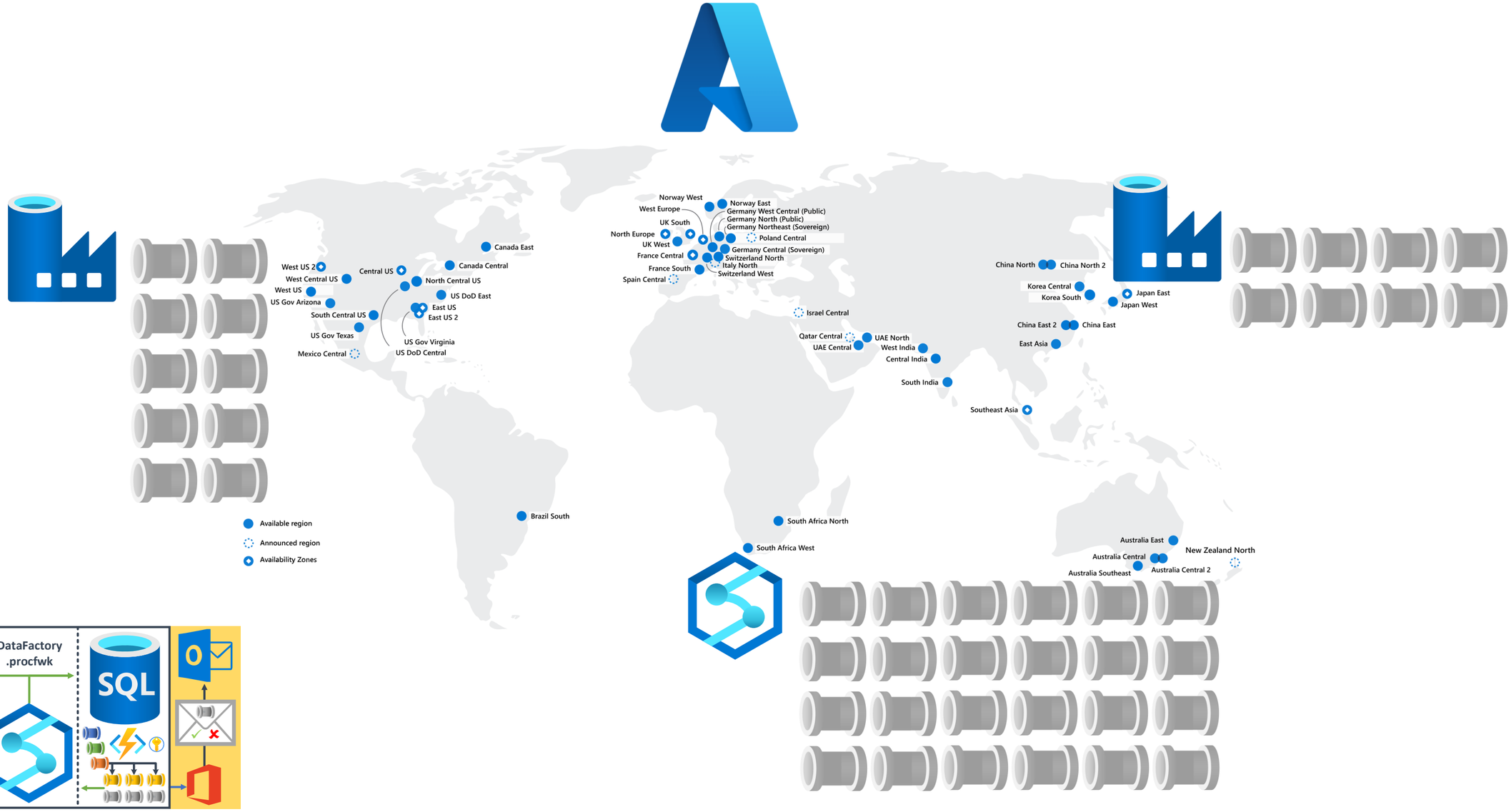
Problem

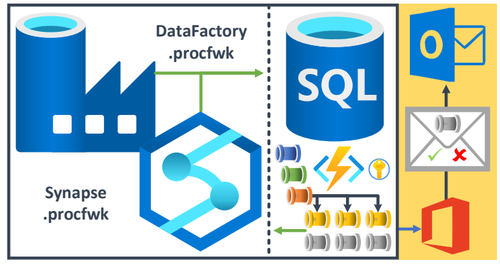
How should we structure and trigger our Integration Pipelines?



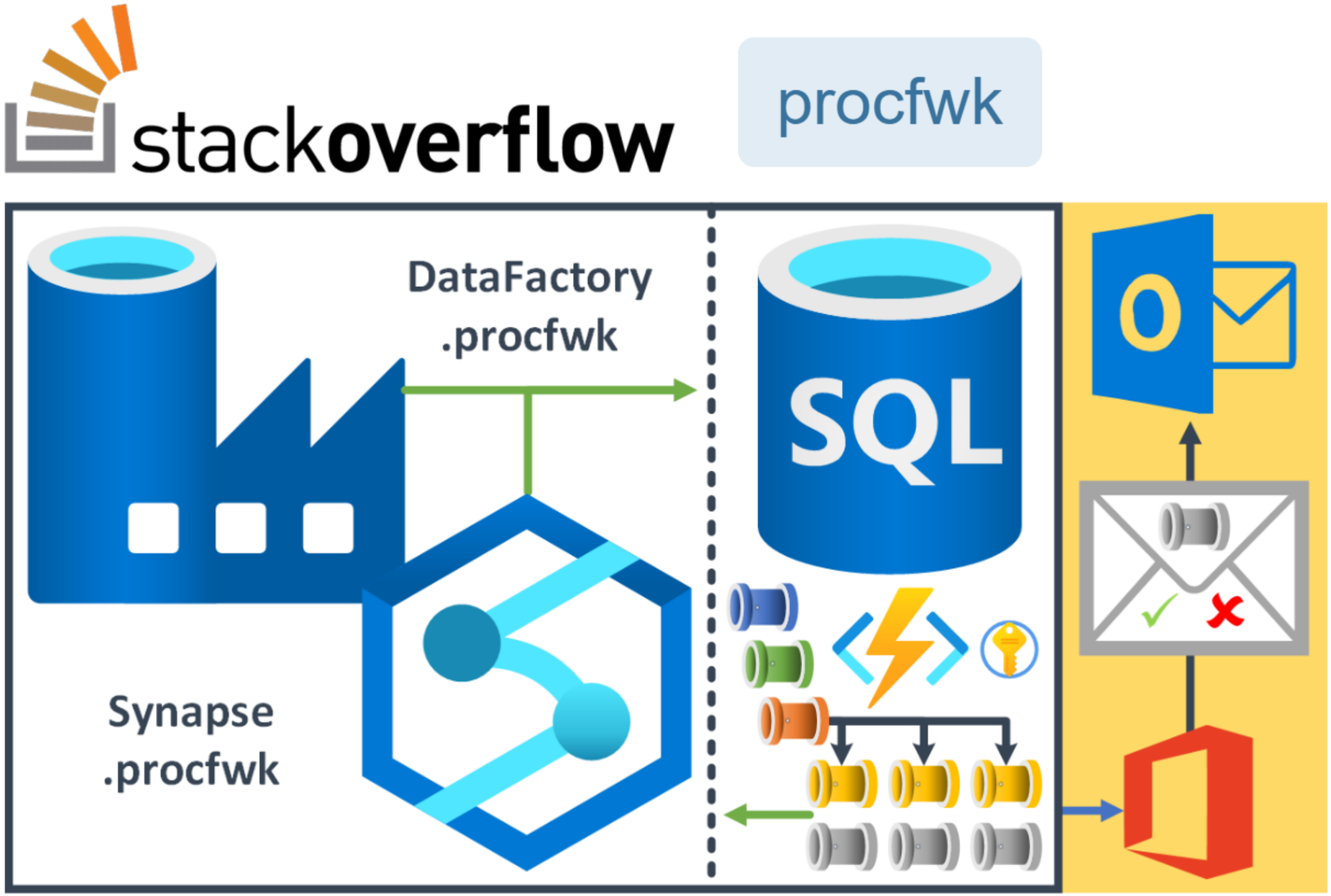
Solution

Use Metadata to Drive Integration Pipeline execution

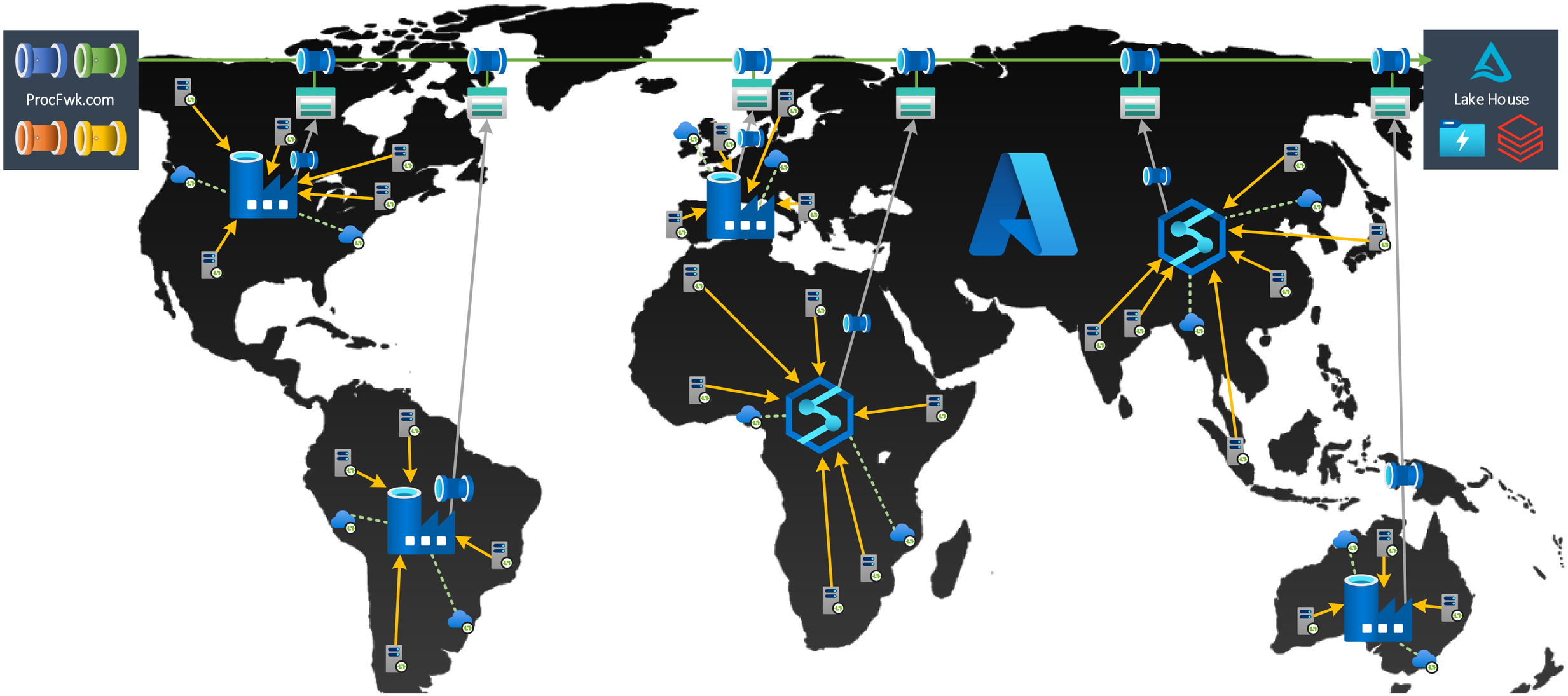




Introducing ProcFwk.com

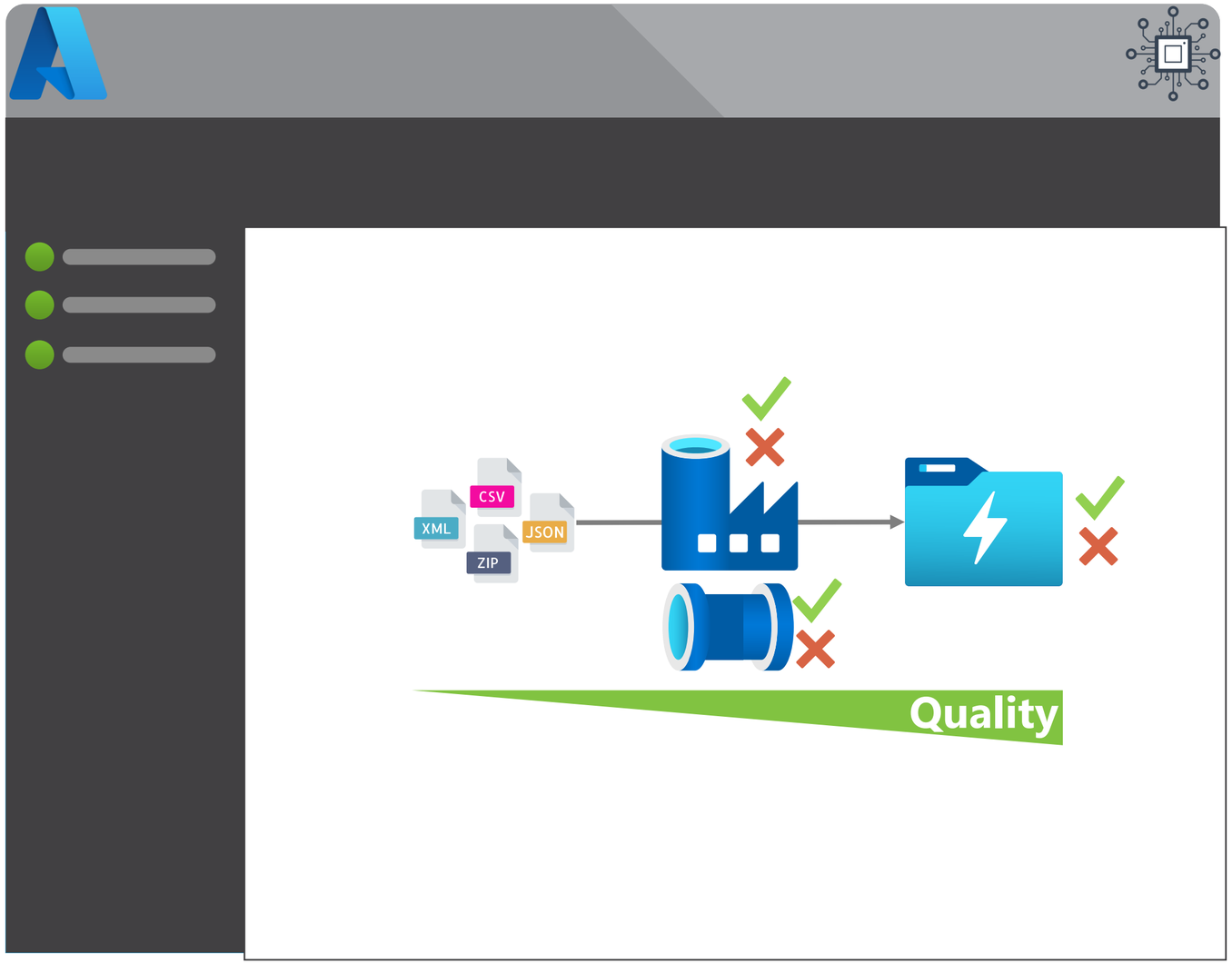


Hub & Spoke Integration Architecture



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

Testing



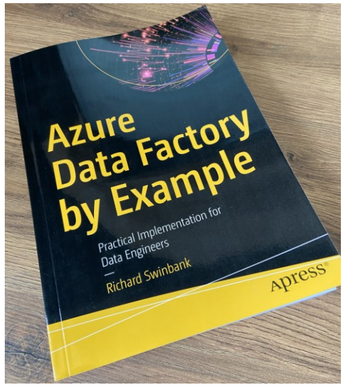
Types of Testing

Integration Tests - A test of a pipeline as-is, without eliminating any effects of external dependencies.

Functional Tests - An isolated test of whether the pipeline is doing things right – is the pipeline producing the desired result?

Unit Tests - An isolated test of whether the pipeline is doing the right things – do the pipeline's activities get executed in the way you expect?

Source: Richard Swinbank richardswinbank.net



ISBN-13978-1484270288

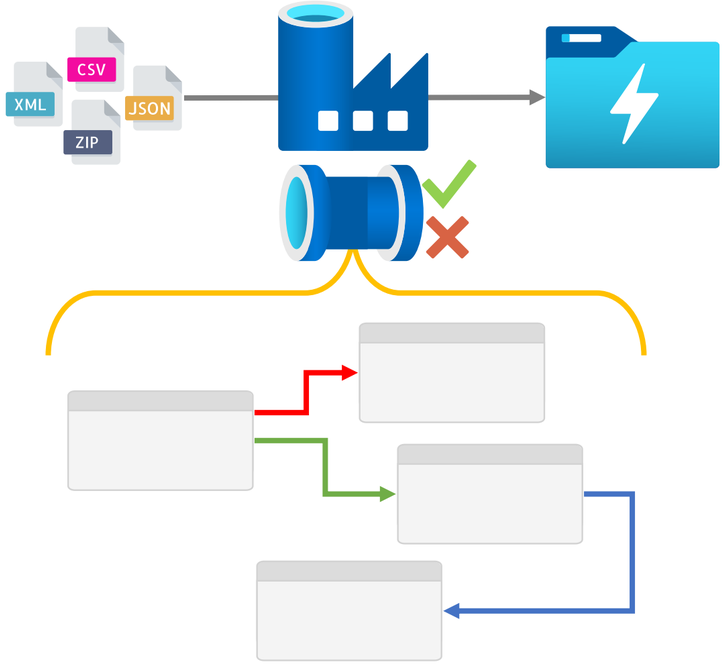
https://mrpaulandrew.com/2021/06/29/azure-data-factory-by-exampe-a-review-of-my-technical-review/

Types of Testing

What do they mean in our pipelines?

Integration Tests

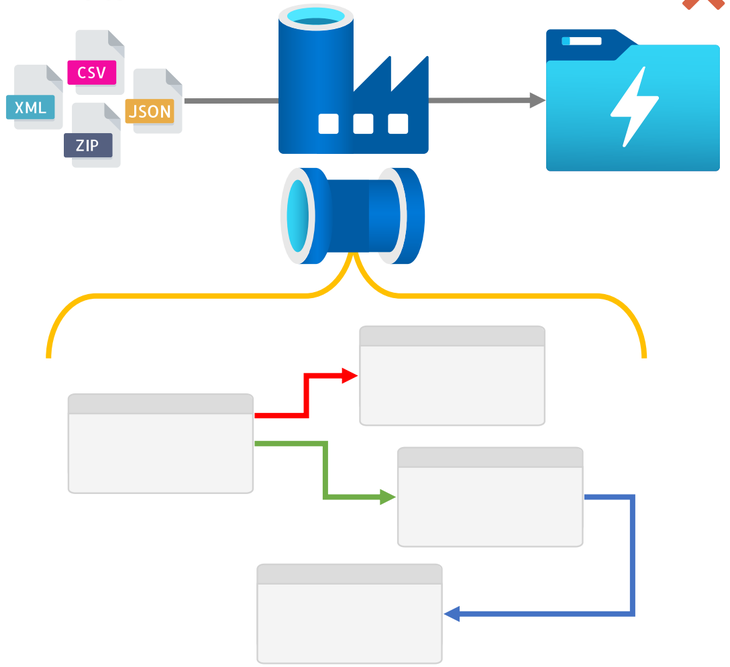
Simple Run Outcome



Functional Tests

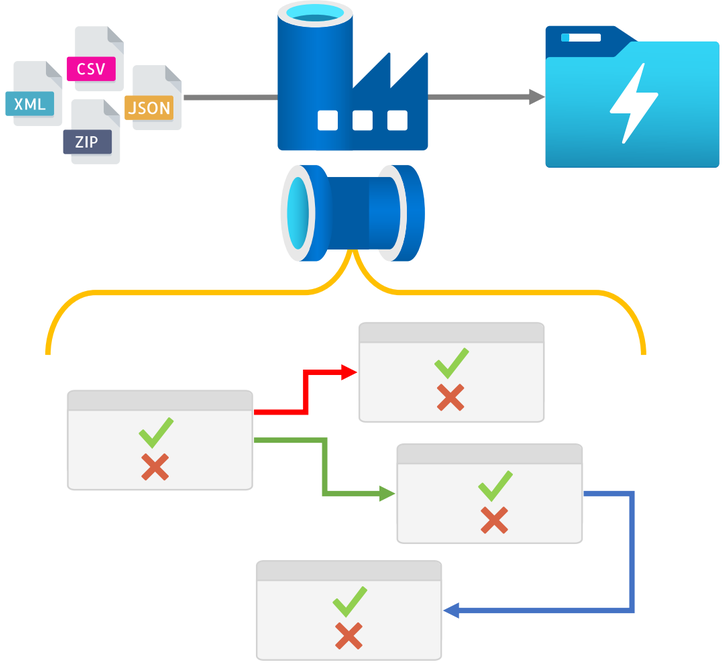
Sample Data

Specific Results



Unit Tests

Sample Data

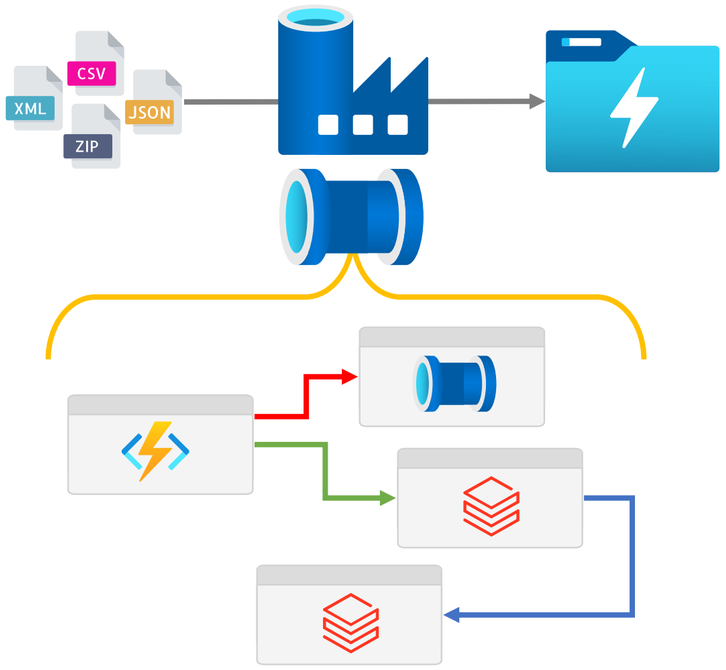


Specific Activity Inputs & Outputs

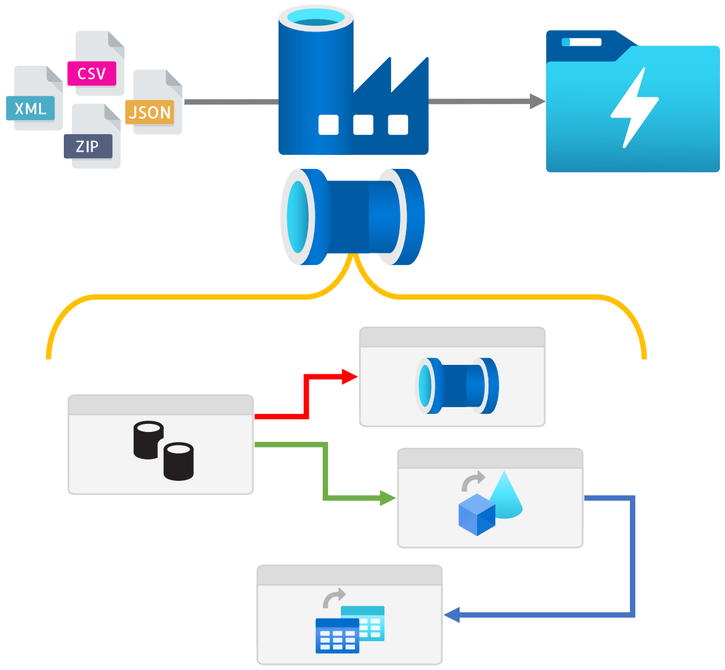
Types of Testing

Does it depend on external resources?

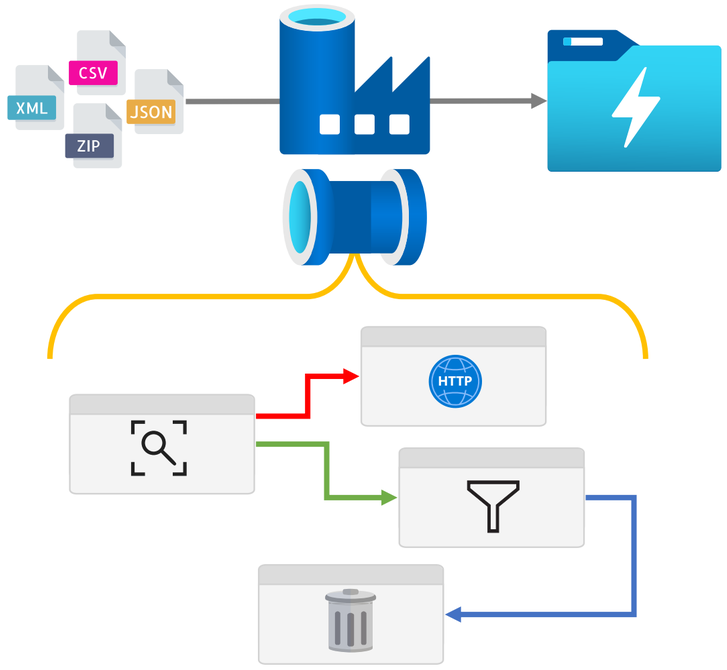
Integration Tests



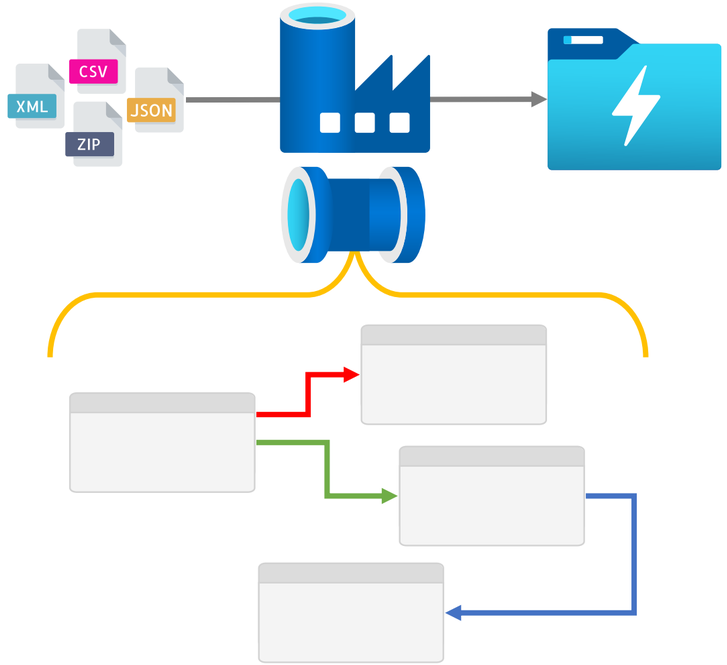
Functional Tests

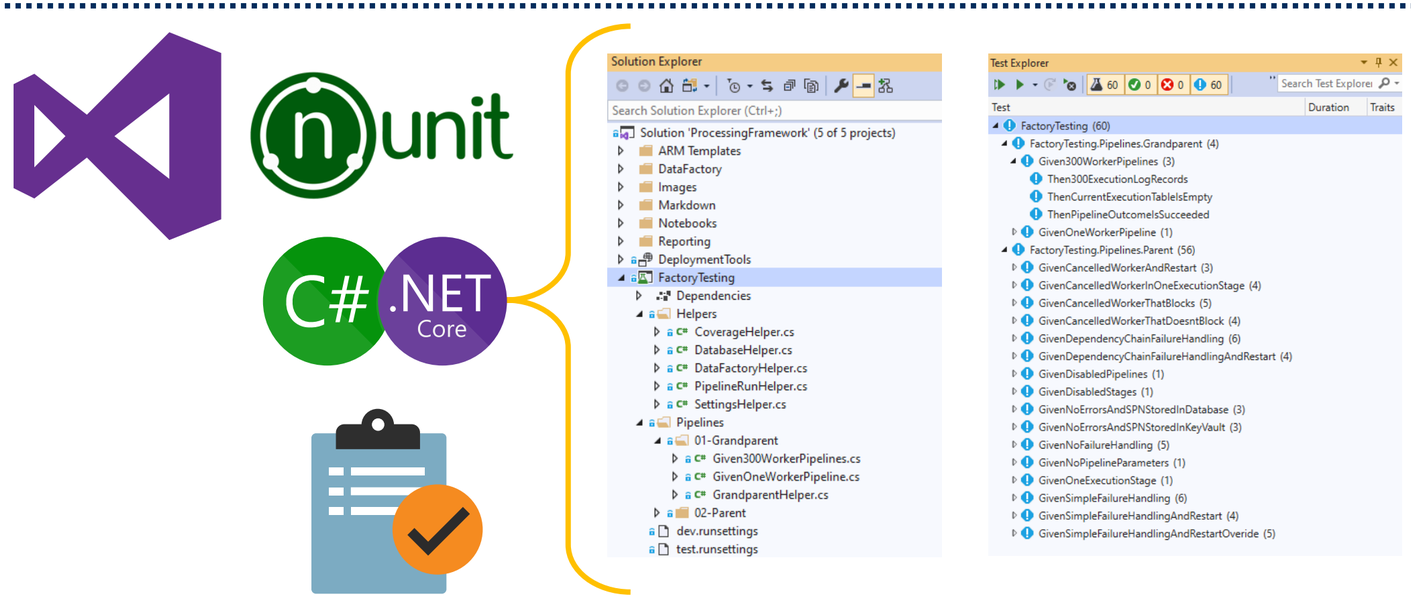


Unit Tests

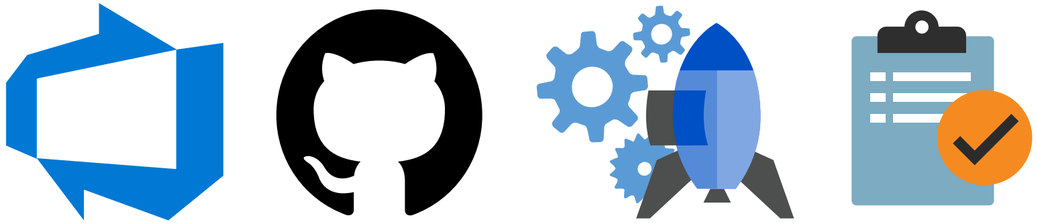


How To Run & Automate Tests



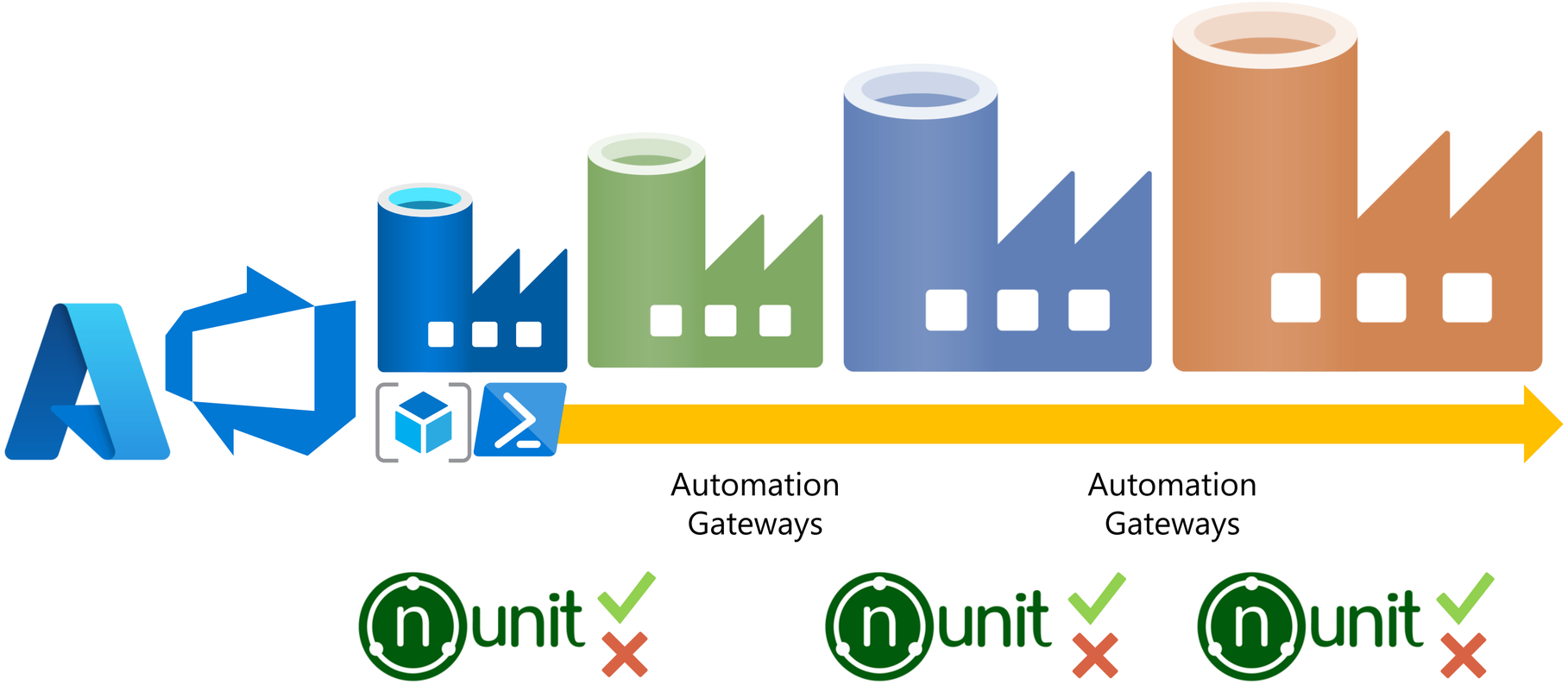


github.com/richardswinbank/community/tree/main/adf-testing-series



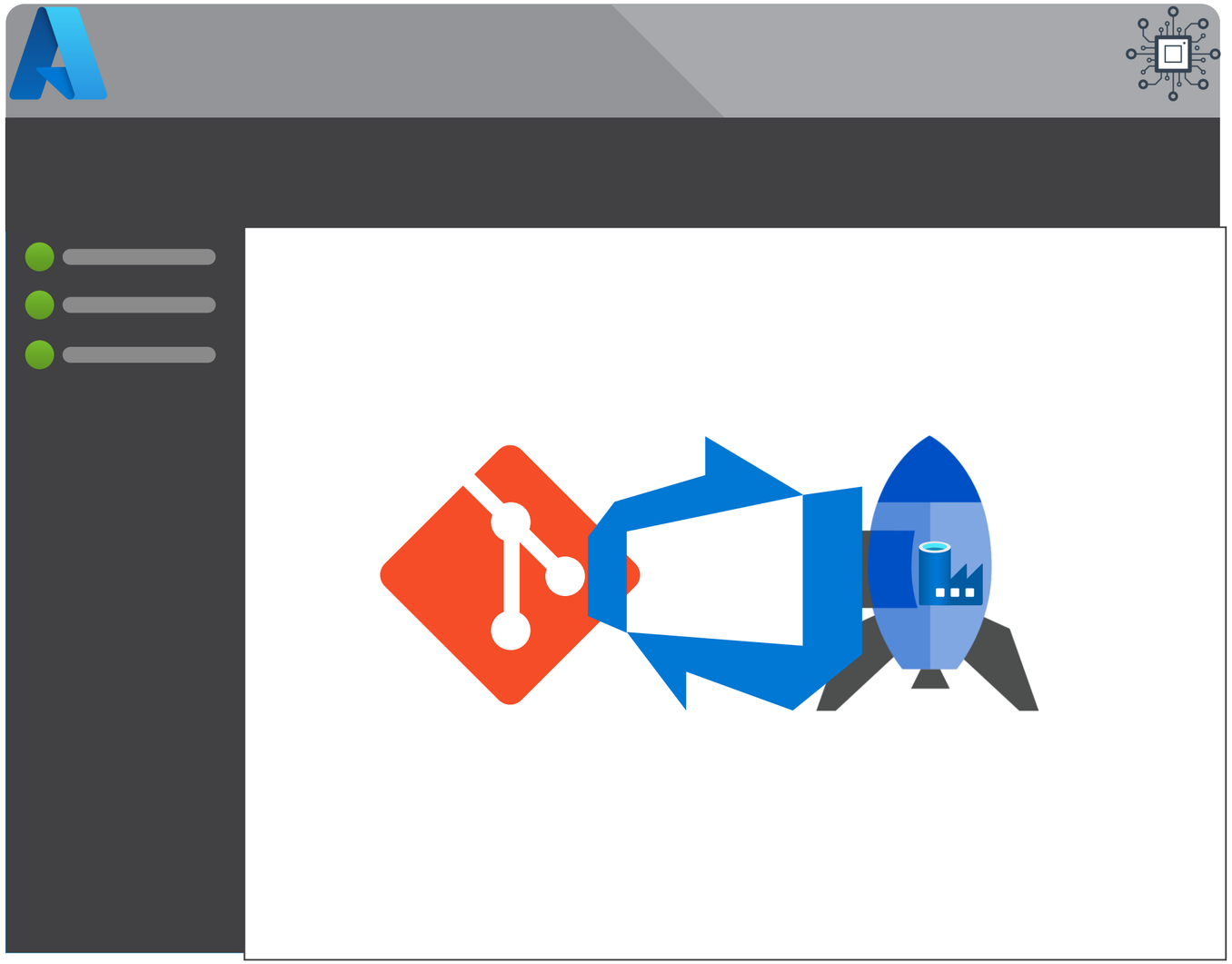
Testing Code vs Actual Code

Data Factory – Chicken vs Egg

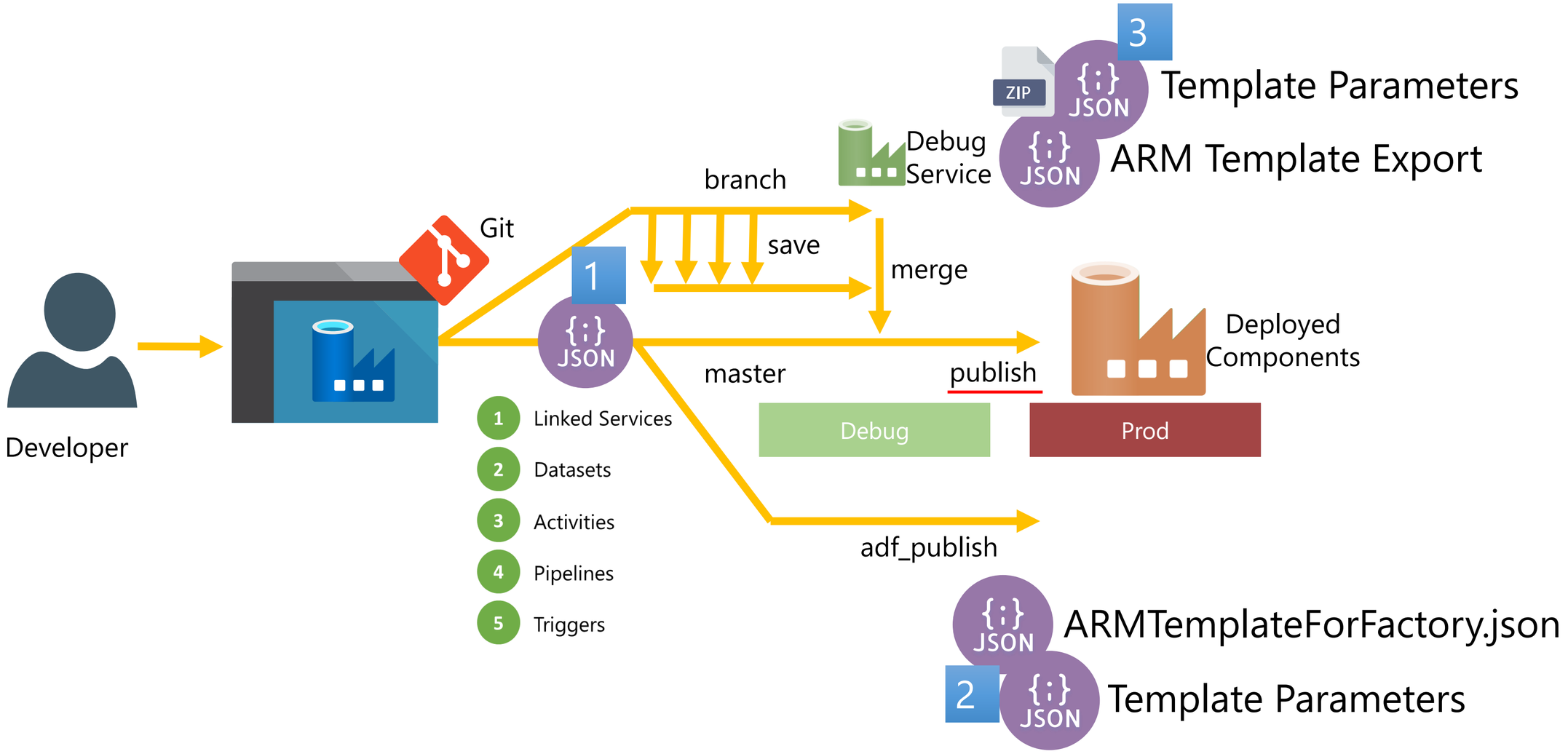


- Should automate this?
- When should testing scripts run?
- What if a test case fails?

CI/CD

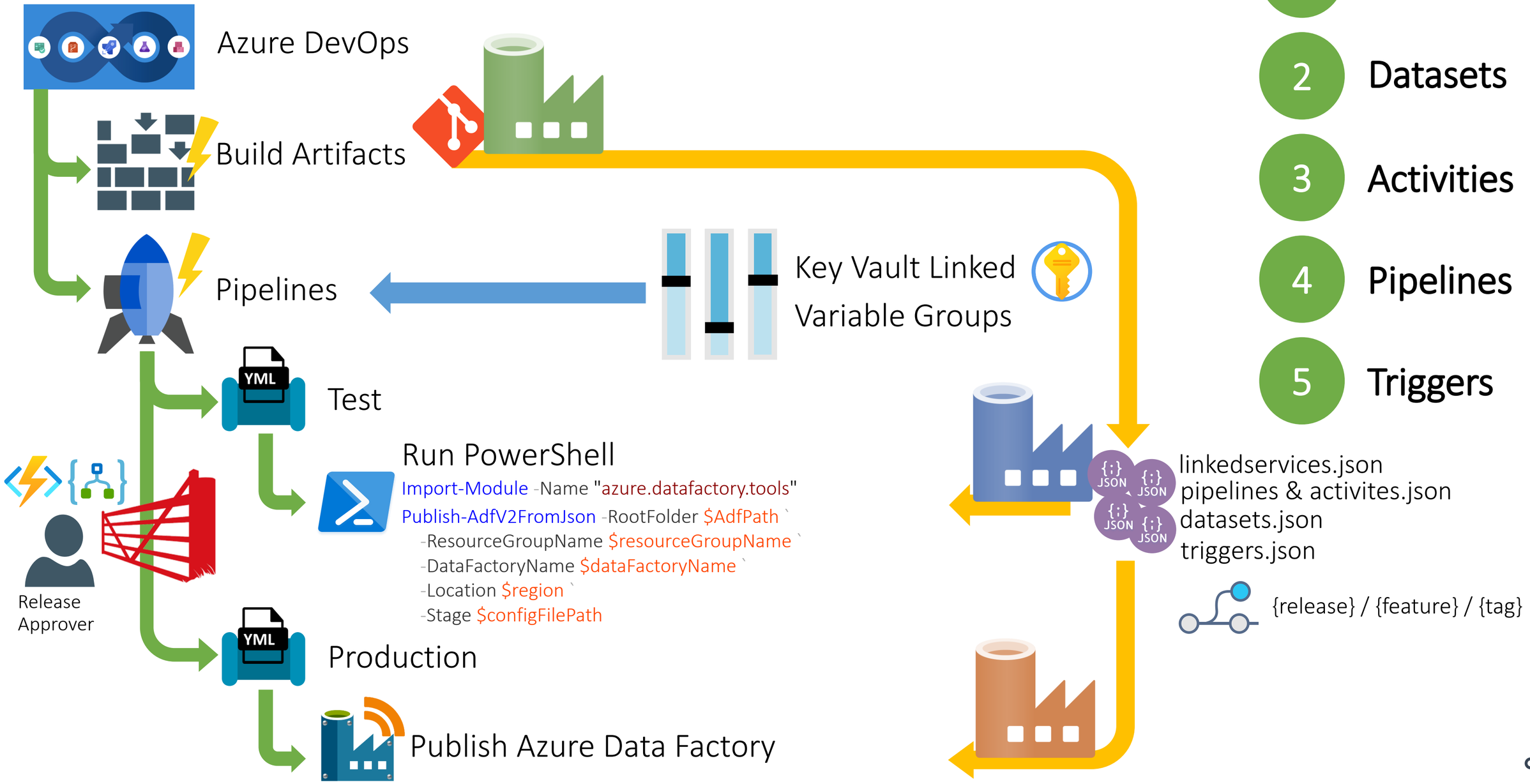


Getting Our ADF Source Code



Data Factory Continuous Delivery - Complex

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

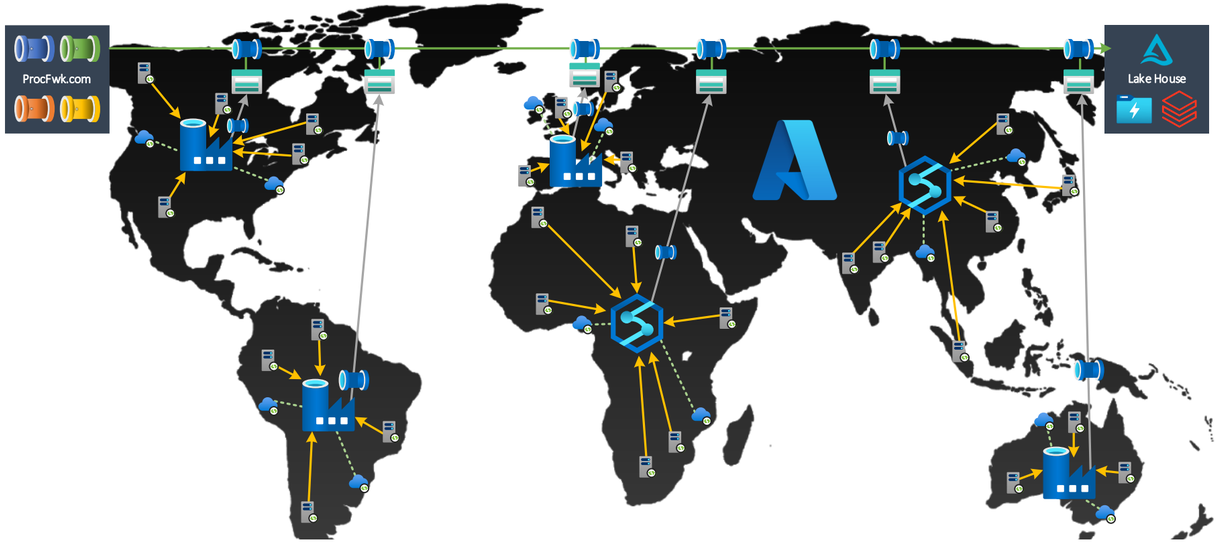
linkedservices.json

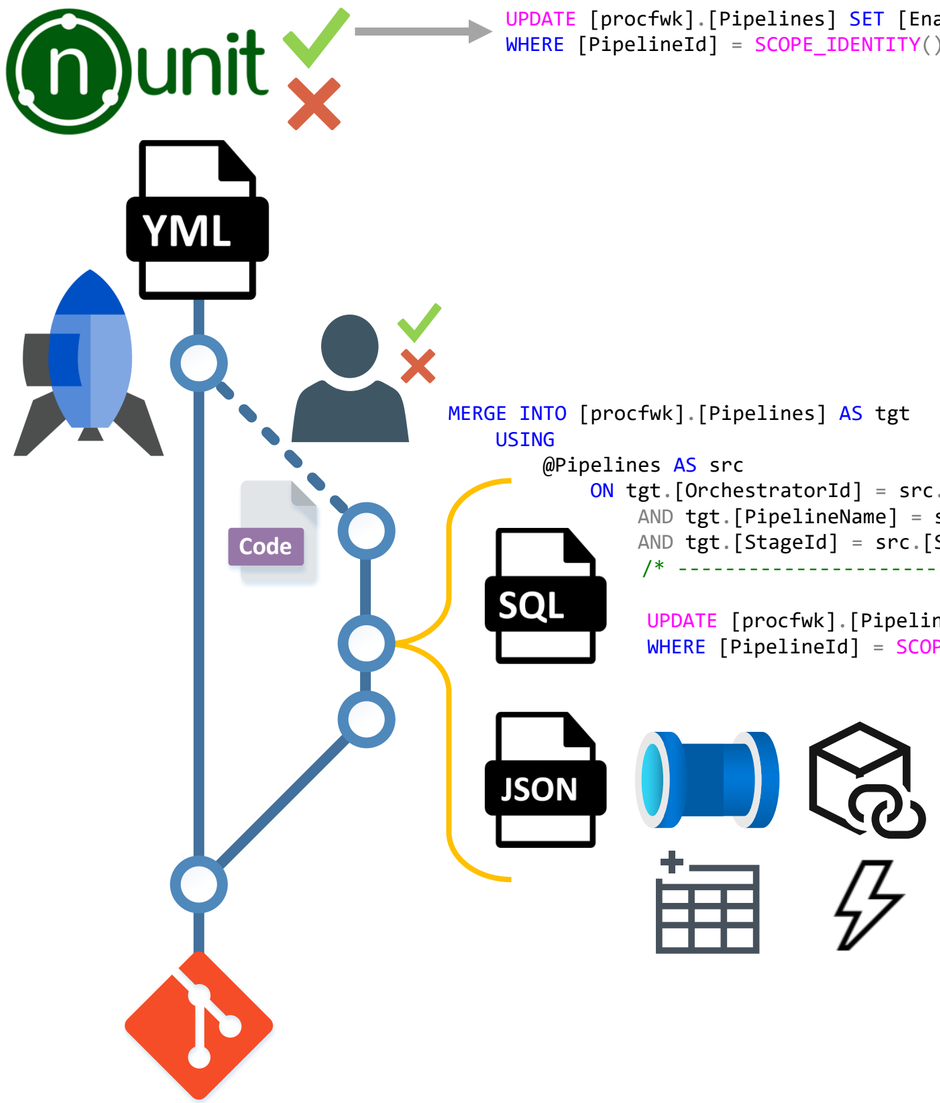
pipelines & activites.json

datasets.json

triggers.json

How Small Can Deployments Be?



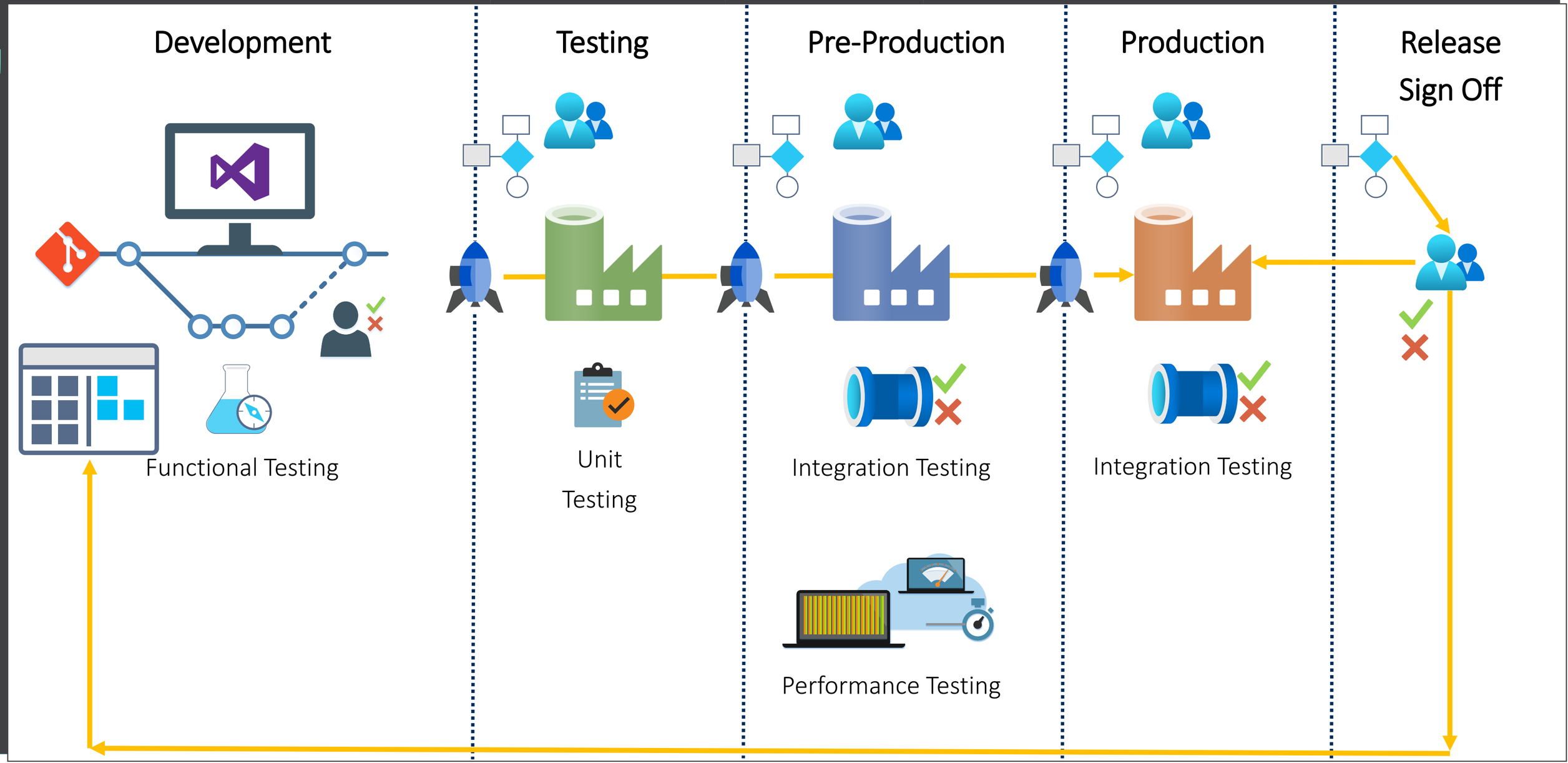



```
UPDATE [procfwk].[Pipelines] SET [Enabled] = 1
WHERE [PipelineId] = SCOPE_IDENTITY();
```

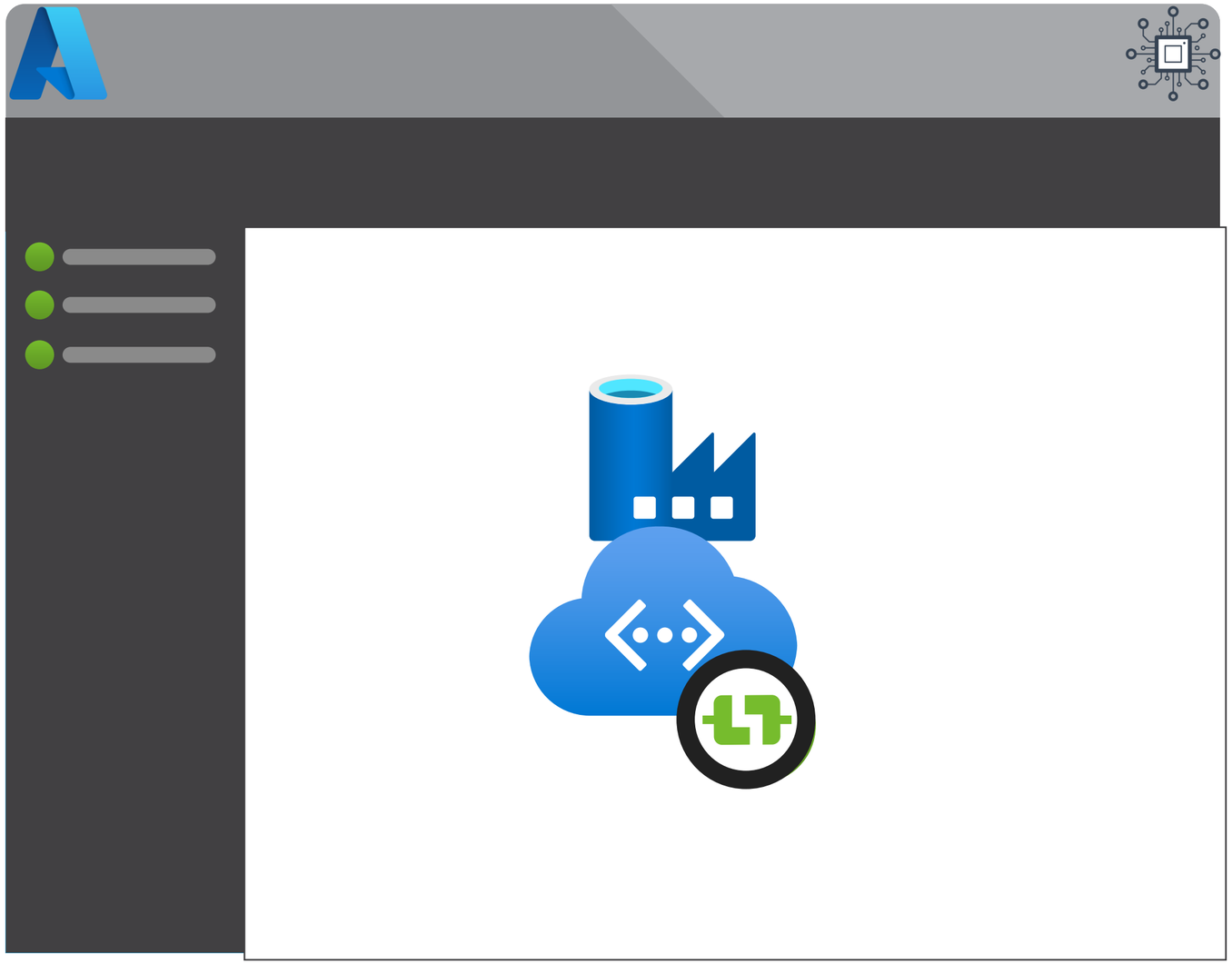
```
MERGE INTO [procfwk].[Pipelines] AS tgt
    USING
        @Pipelines AS src
            ON tgt.[OrchestratorId] = src.[OrchestratorId]
               AND tgt.[PipelineName] = src.[PipelineName]
               AND tgt.[StageId] = src.[StageId]
               /* ------------------------------------ */

               UPDATE [procfwk].[Pipelines] SET [Enabled] = 0
               WHERE [PipelineId] = SCOPE_IDENTITY();
```

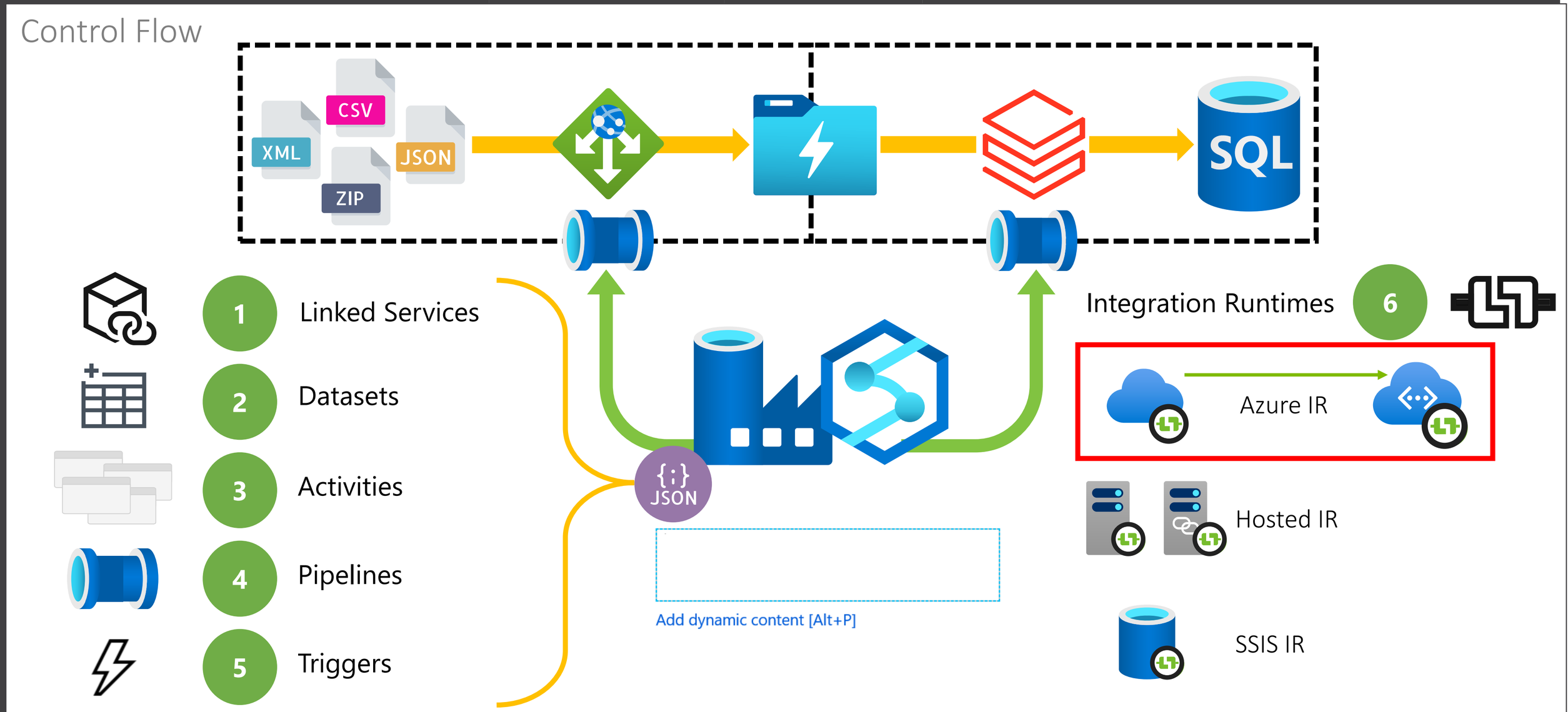
Deployment Life Cycle & Gateway



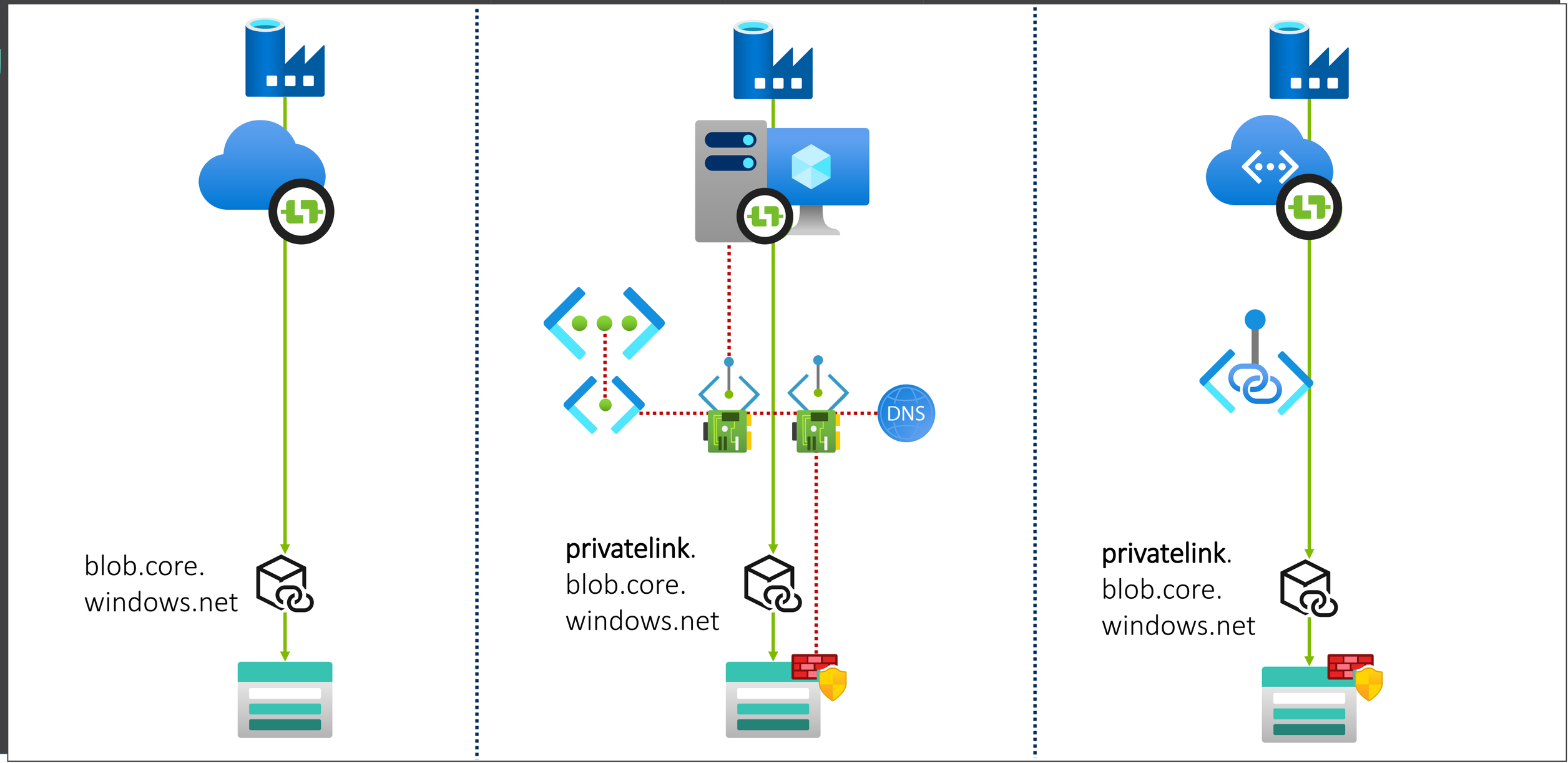
VNet Integration



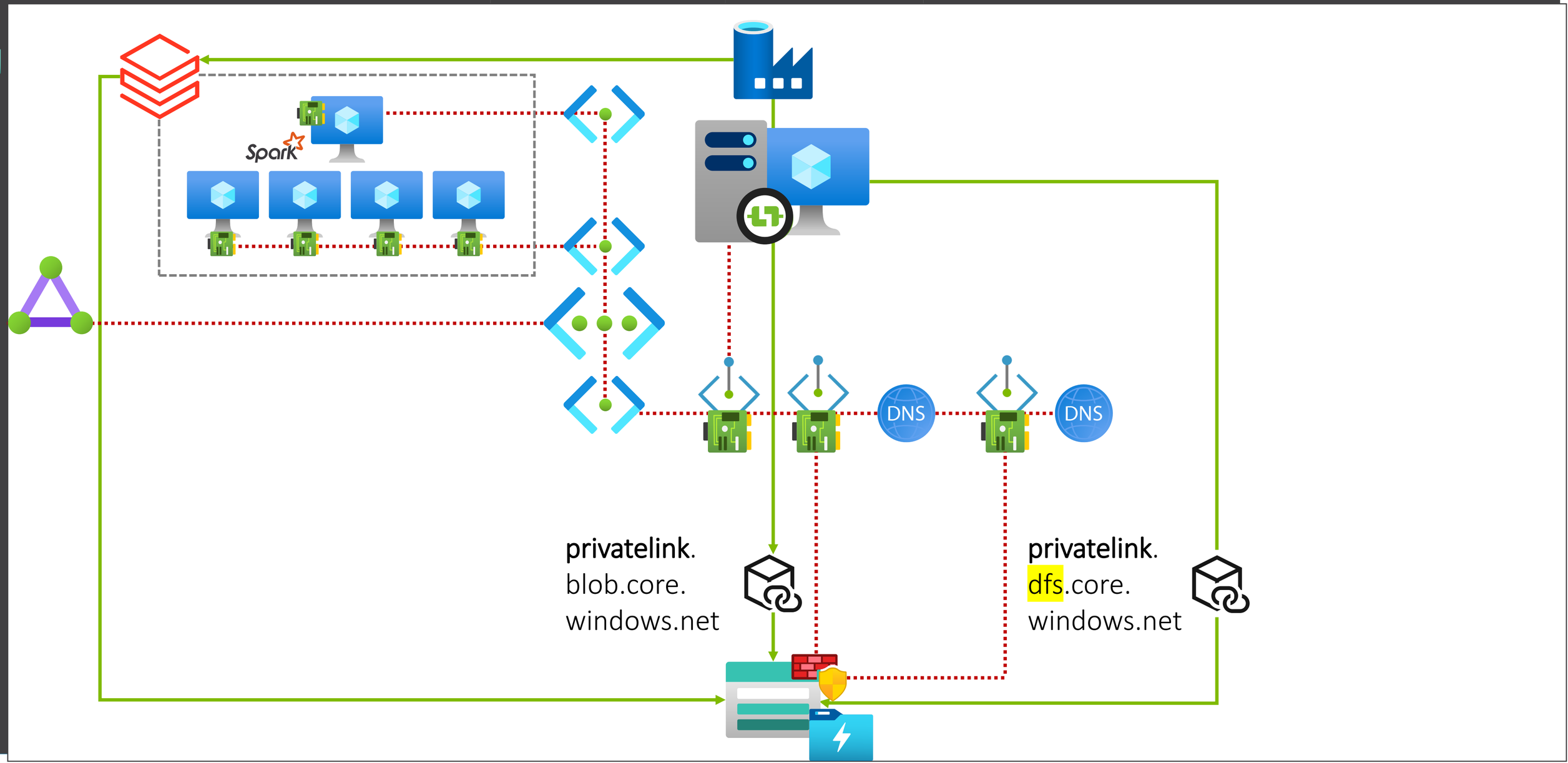
Integration Pipelines as Data Engineers



Managed vs Unmanaged Connections

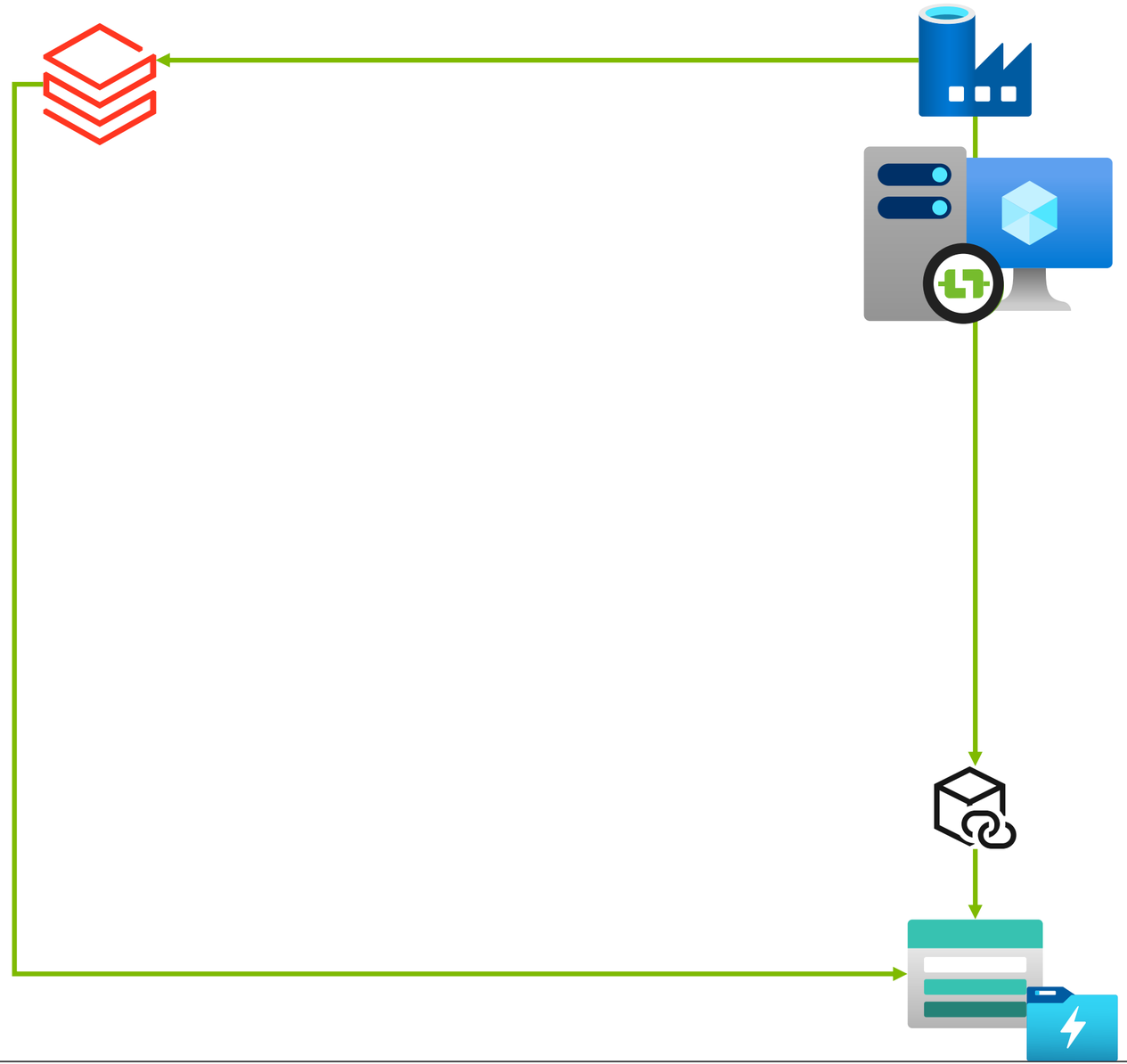


Further VNet Connections

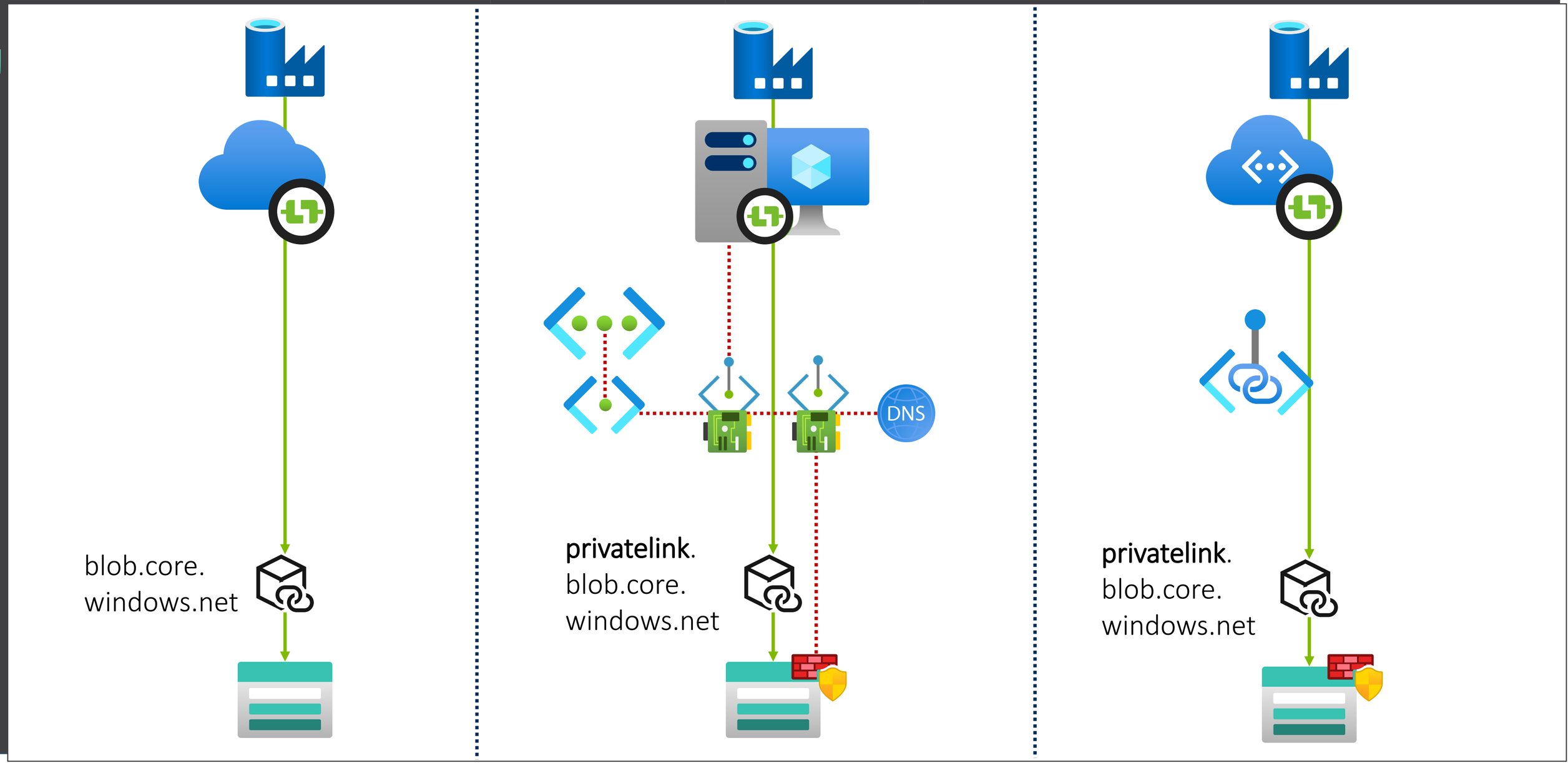


Further ~~VNet~~ Connections

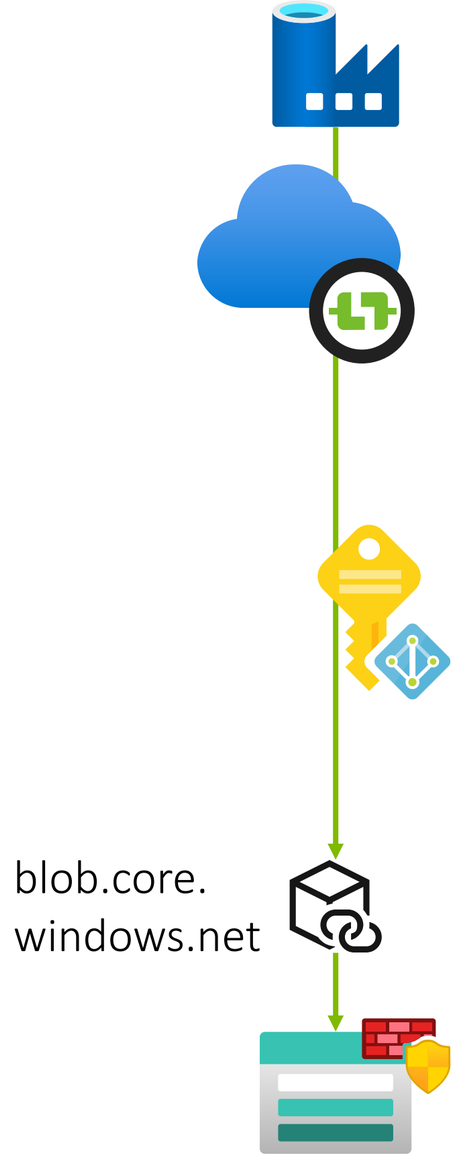
For a Data Engineer



Managed vs Unmanaged Connections



Public Connections

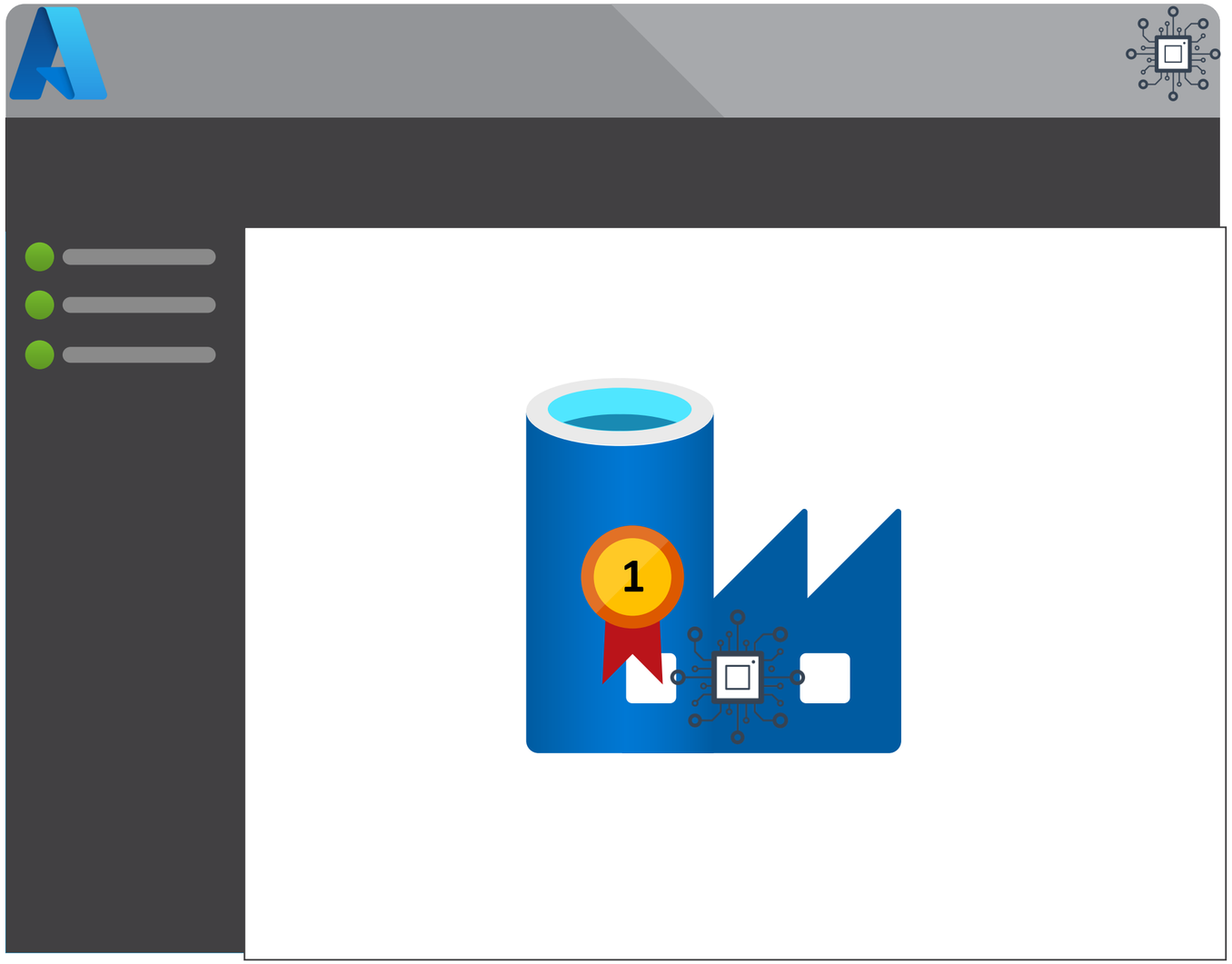


** Trusted access based on system-assigned managed identity.*

Microsoft.DataFactory/factories

https://docs.microsoft.com/en-us/azure/storage/common/storage-network-security?tabs=azure-portal

Best Practice



Key Points

- Environment Setup & Developer Debugging
- Deployments
- Automated Testing
- Naming Conventions
- Pipeline Hierarchies
- Pipeline & Activity Descriptions
- Factory Component Folders
- Linked Service Security via Azure Key Vault
- 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
- Service Limitations
- Using Pipeline Templates
- Documentation

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

Thank you for listening…

Paul Andrew

Microsoft Most Valuable Professional

avanade

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LinkedIn: In/mrpaulandrew

GitHub: github.com/mrpaulandrew