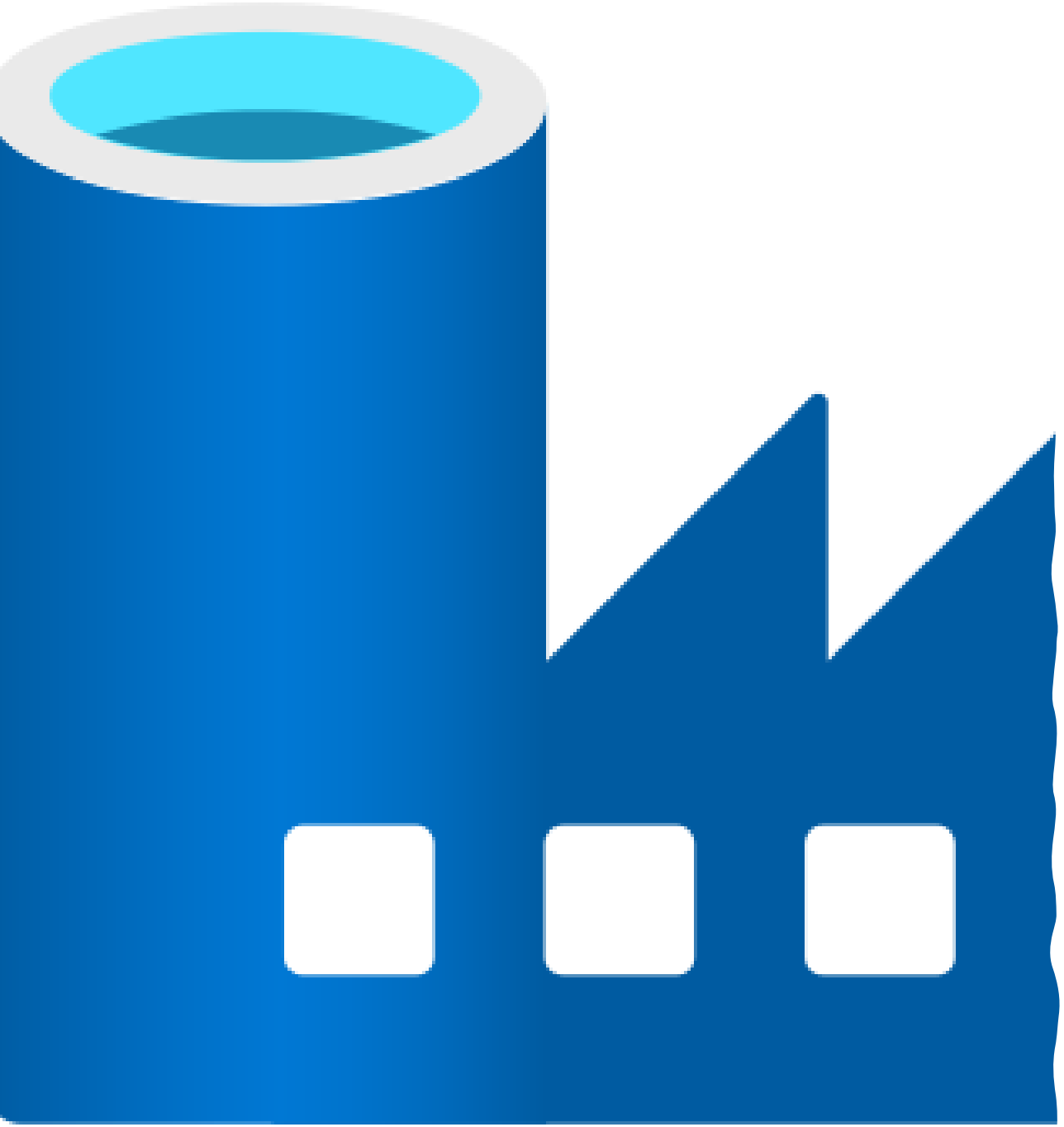


Azure Data Factory

Course Structure

Overview

Environment Set-up

Ingestion

Ingestion - Blob

Ingestion - HTTP

Transformation

Data Flow 1

Data Flow 2

Load

Load to ADLS

Load to Sql Db

Visualization

Power BI

Orchestration

Monitoring

Overview

Azure Data Factory (ADF)

Azure storage solutions

Azure SQL Database

Azure Blob Storage

Azure Data Lake Storage Gen2

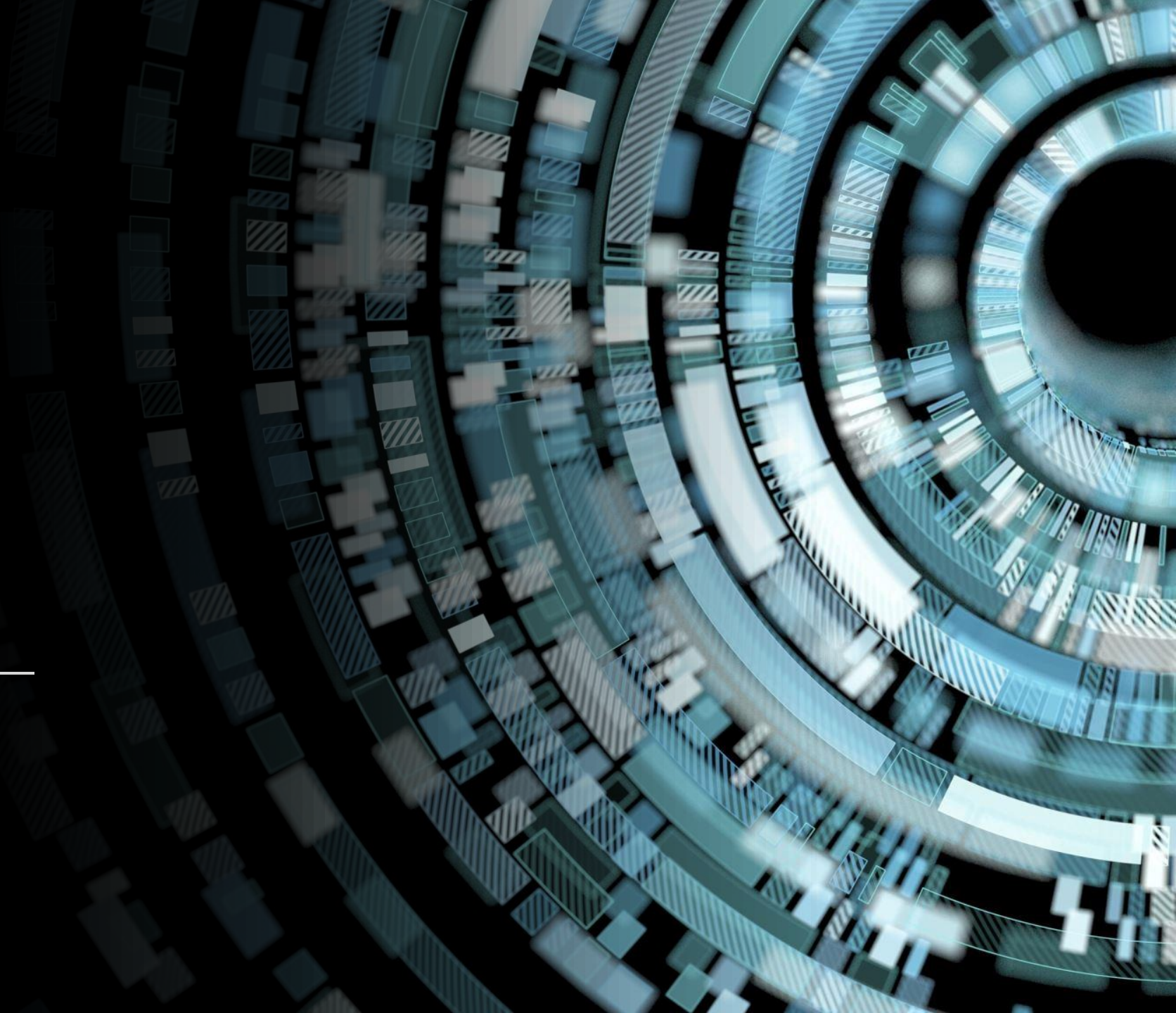
Other Bigdata Solutions

(continued as part of other modules)

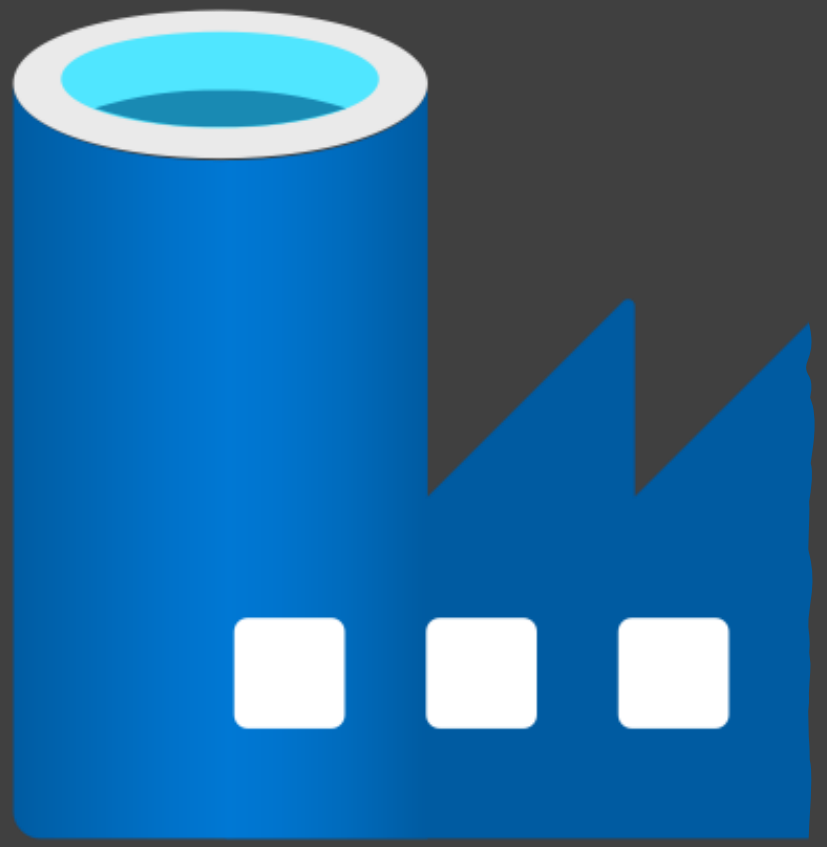
Azure Databricks

Power BI

Azure Data Factory Overview

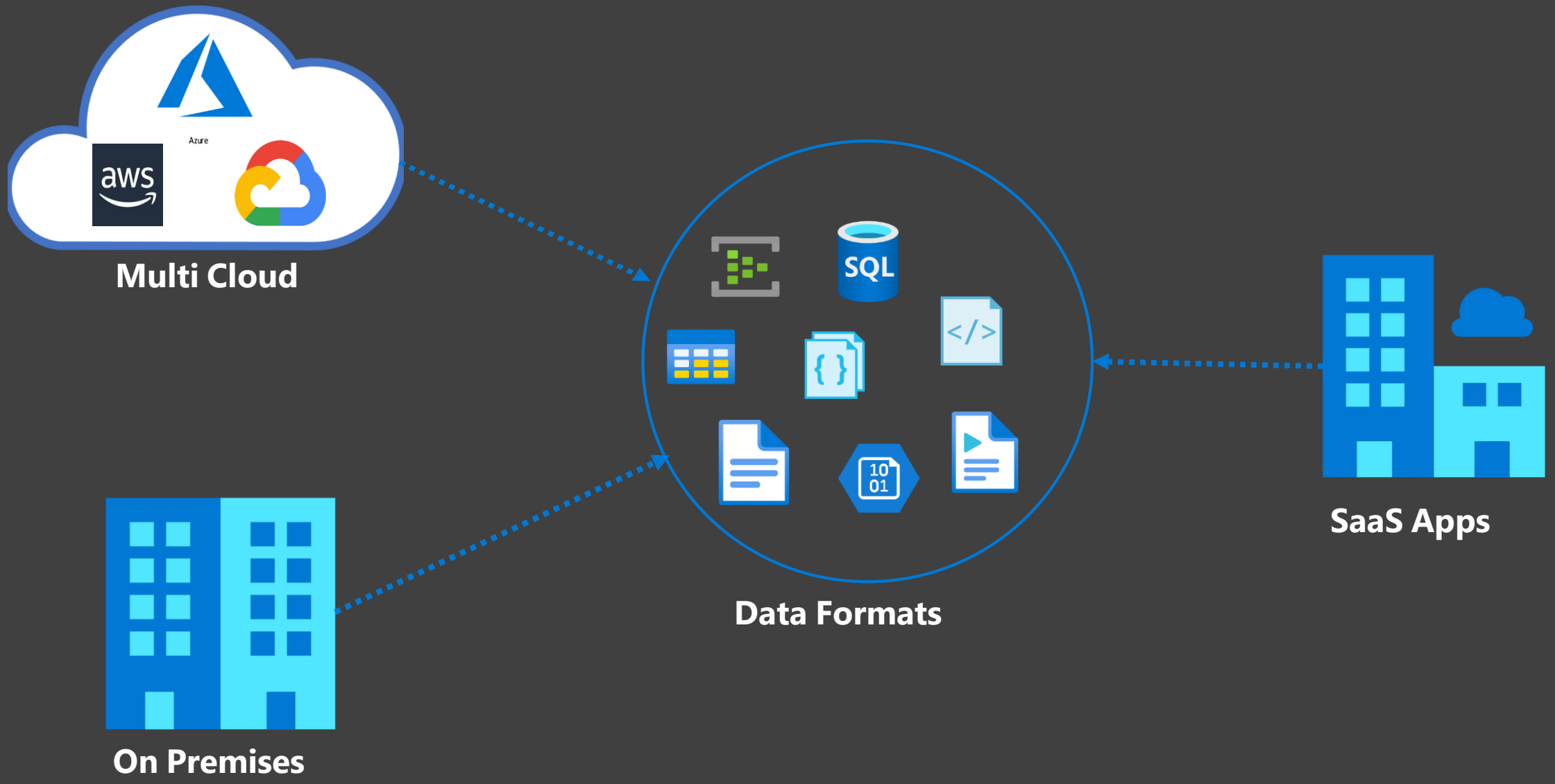


What is Azure Data Factory?

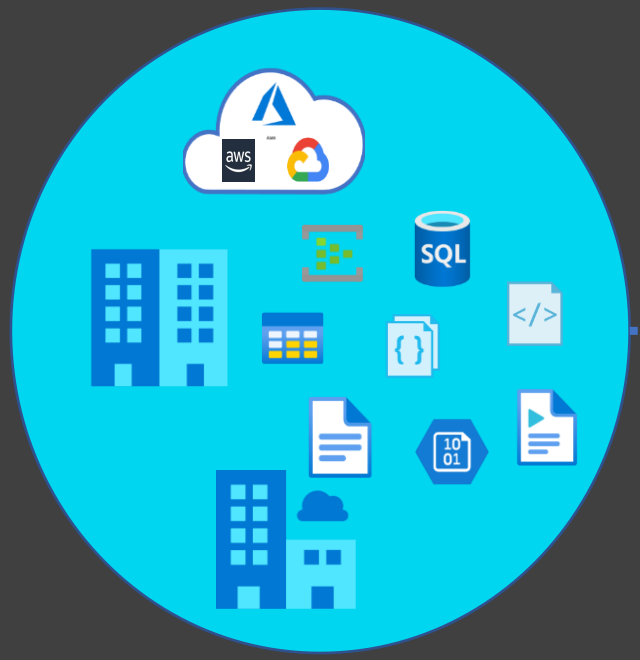


A fully managed, serverless data integration solution for ingesting, preparing and transforming all your data at scale.

The Data Problem



The Data Problem



Data Sources

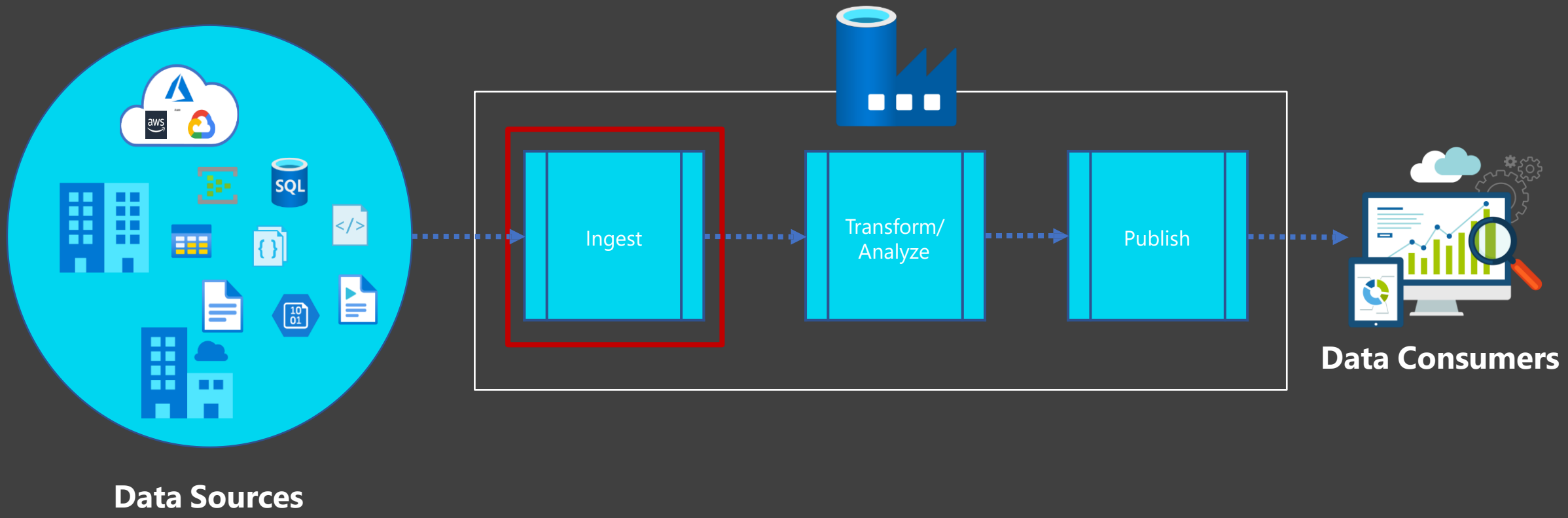
Ingest

Transform/
Analyze

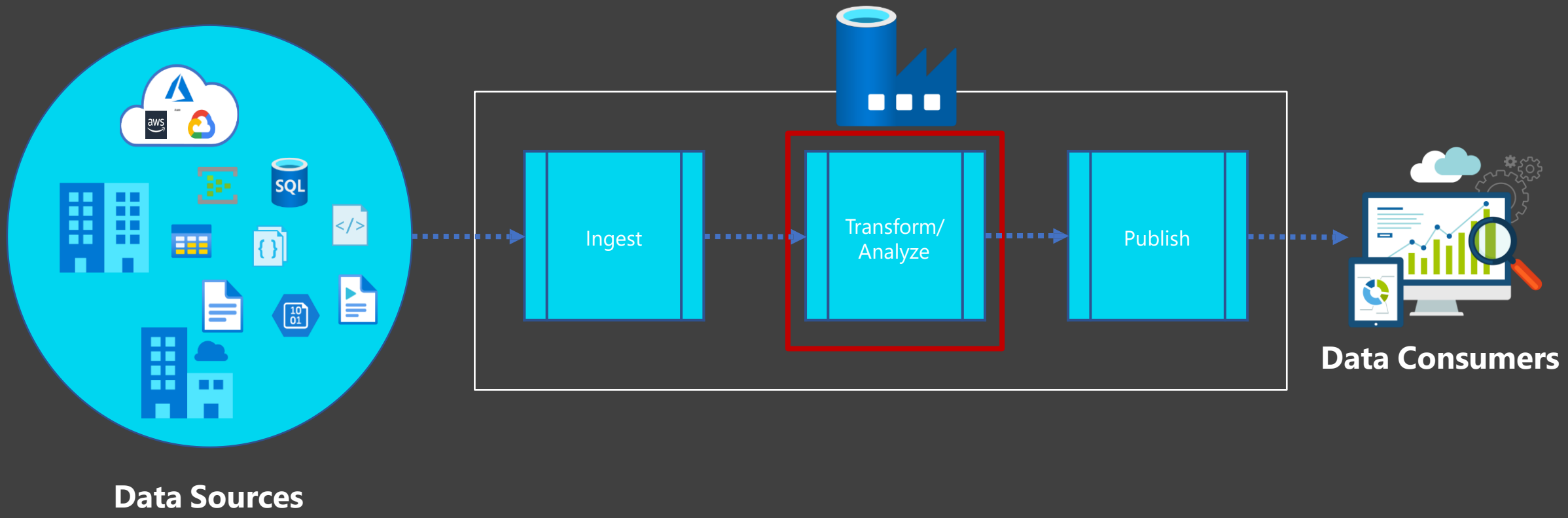
Publish

Data Consumers

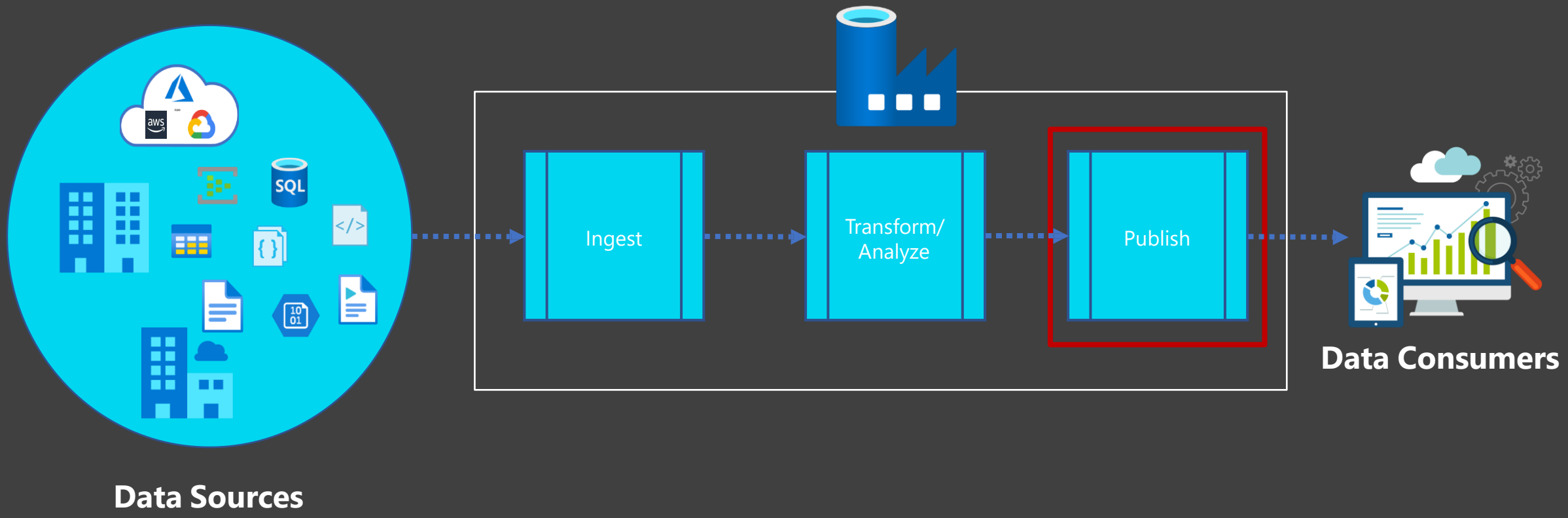
The Data Problem



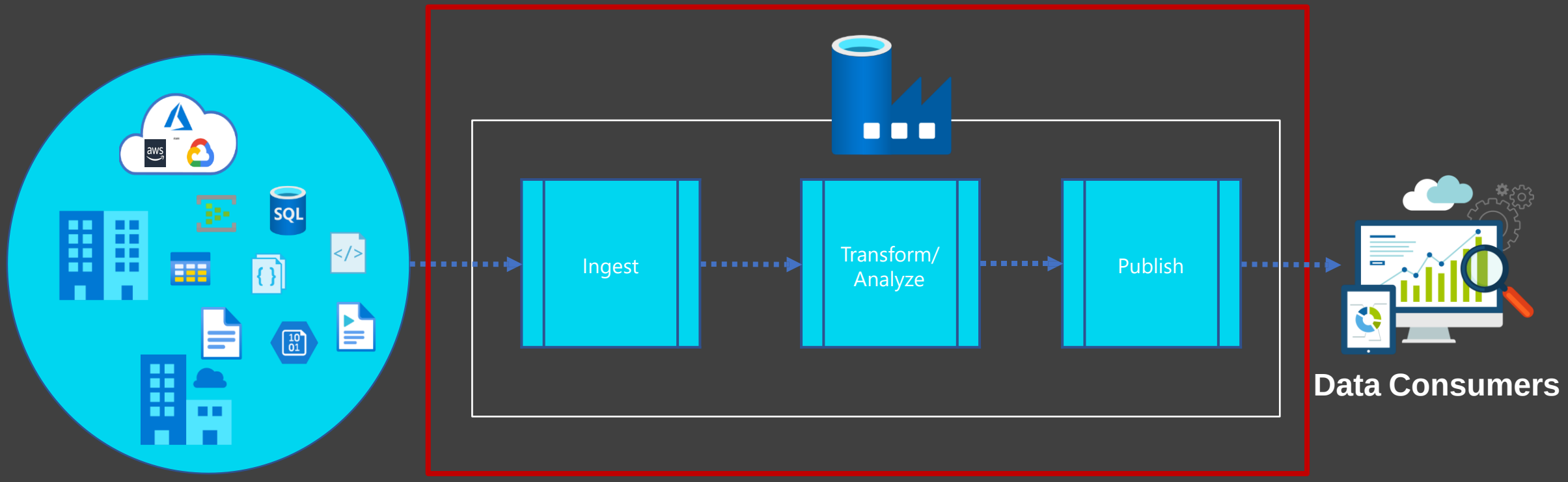
The Data Problem



The Data Problem



The Data Problem



What is Azure Data Factory?

- Fully Managed Service
- Serverless
- Data Integration Service
- Data Transformation Service
- Data Orchestration Service

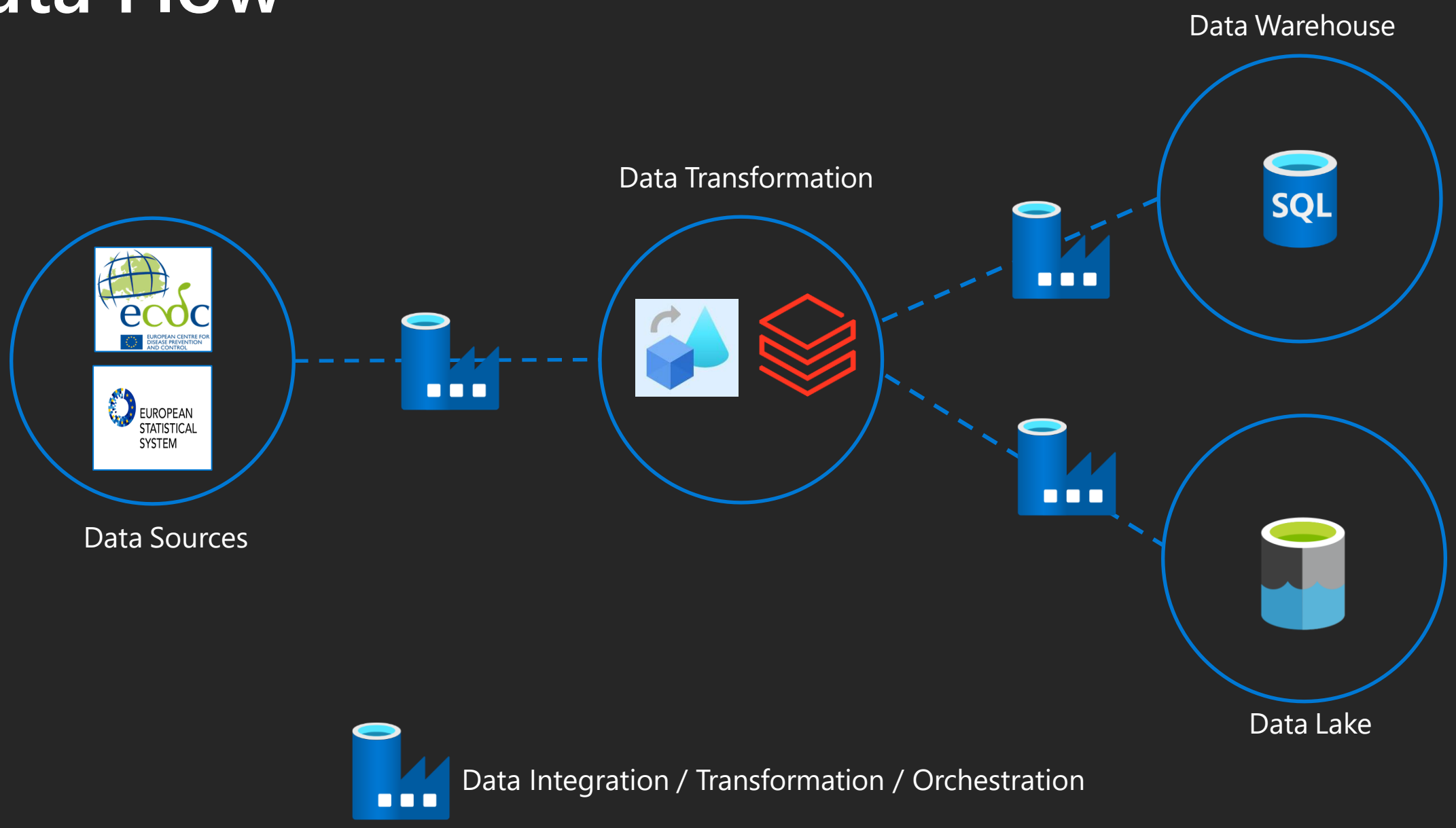
A fully managed, serverless data integration solution for ingesting, preparing and transforming all of your data at scale.

What Azure Data Factory Is Not

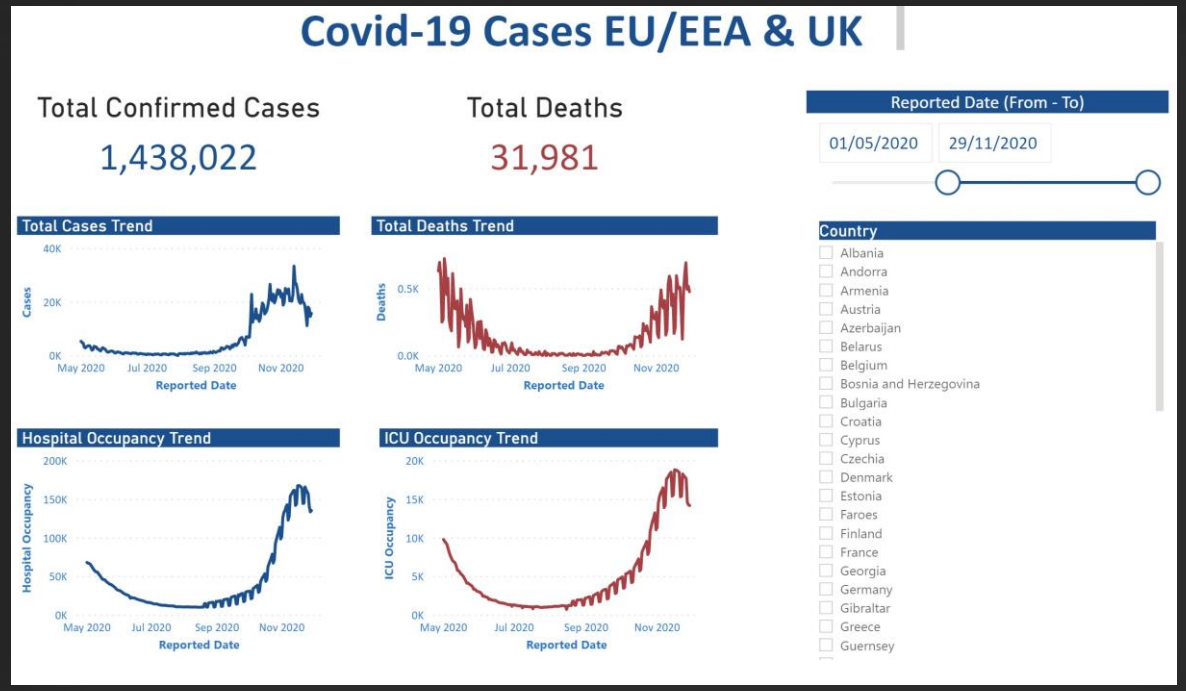
- Data Migration Tool
- Data Streaming Service
- Suitable for Complex Data Transformations
- Data Storage Service

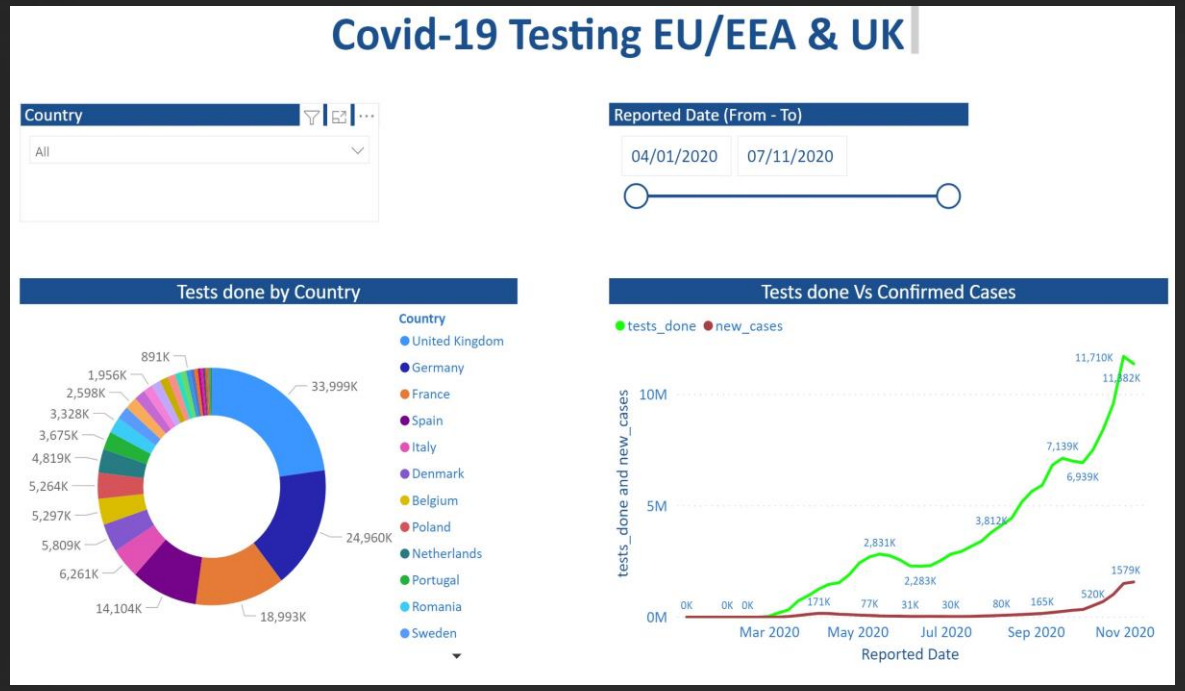
Project Overview

Data Flow

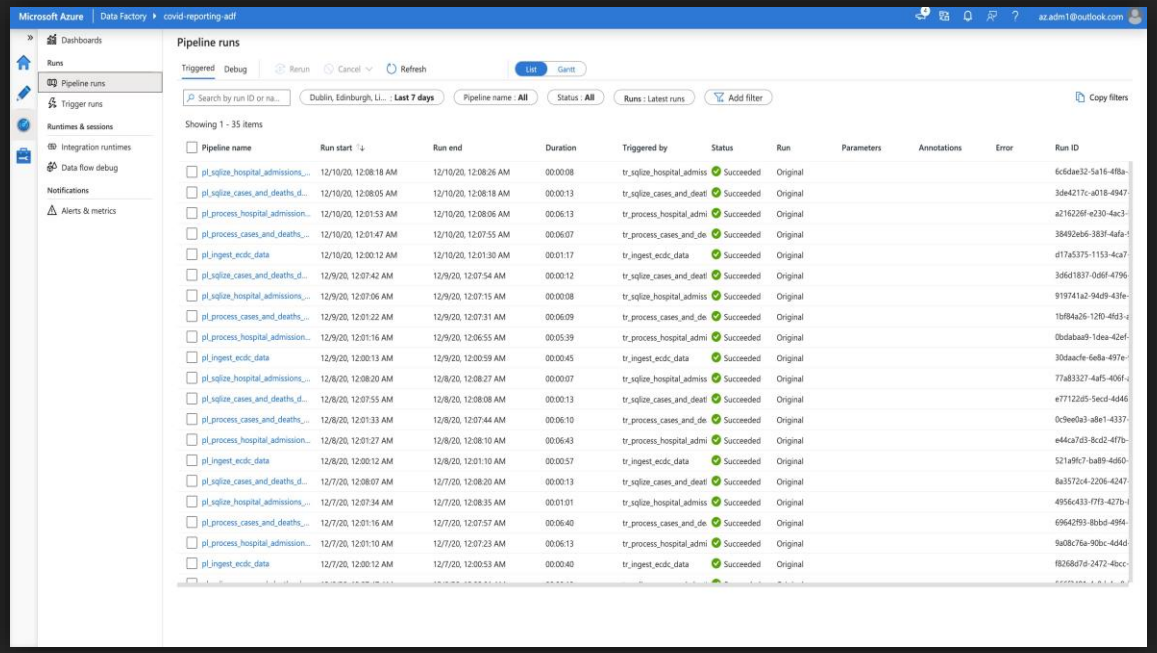

Data Warehouse
Data Transformation
SQL
ecdc
EUROPEAN CENTRE FOR DISEASE PREVENTION AND CONTROL
EUROPEAN STATISTICAL SYSTEM
Data Sources
Data Lake
Data Integration / Transformation / Orchestration

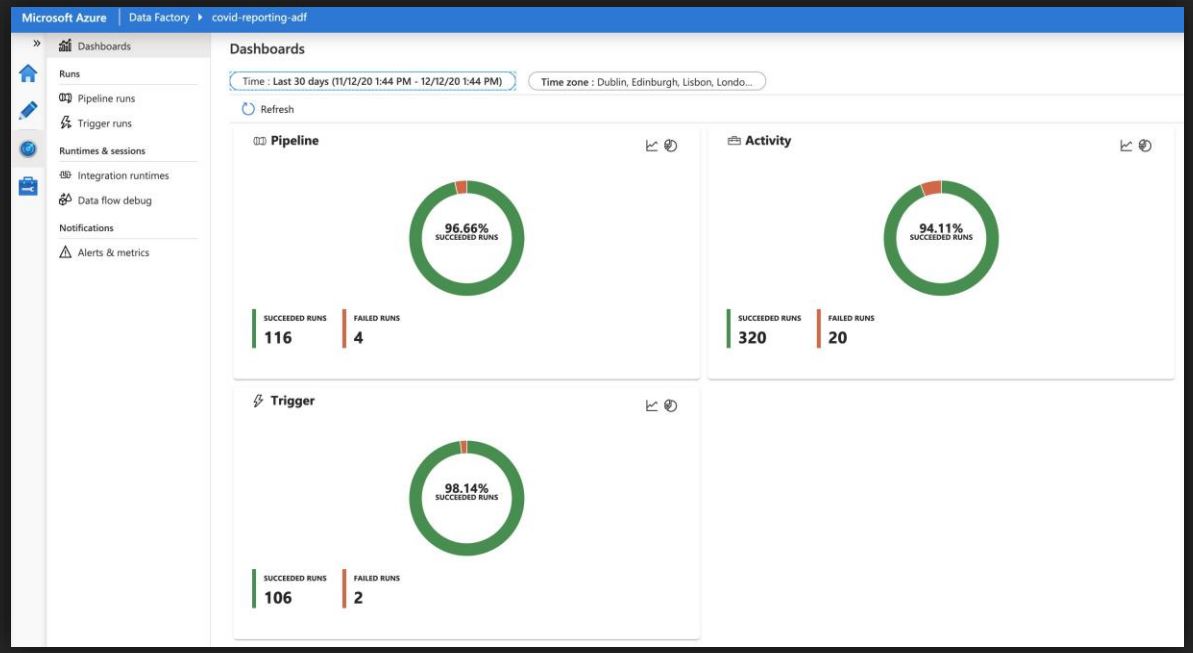
Covid-19 Sample Reporting



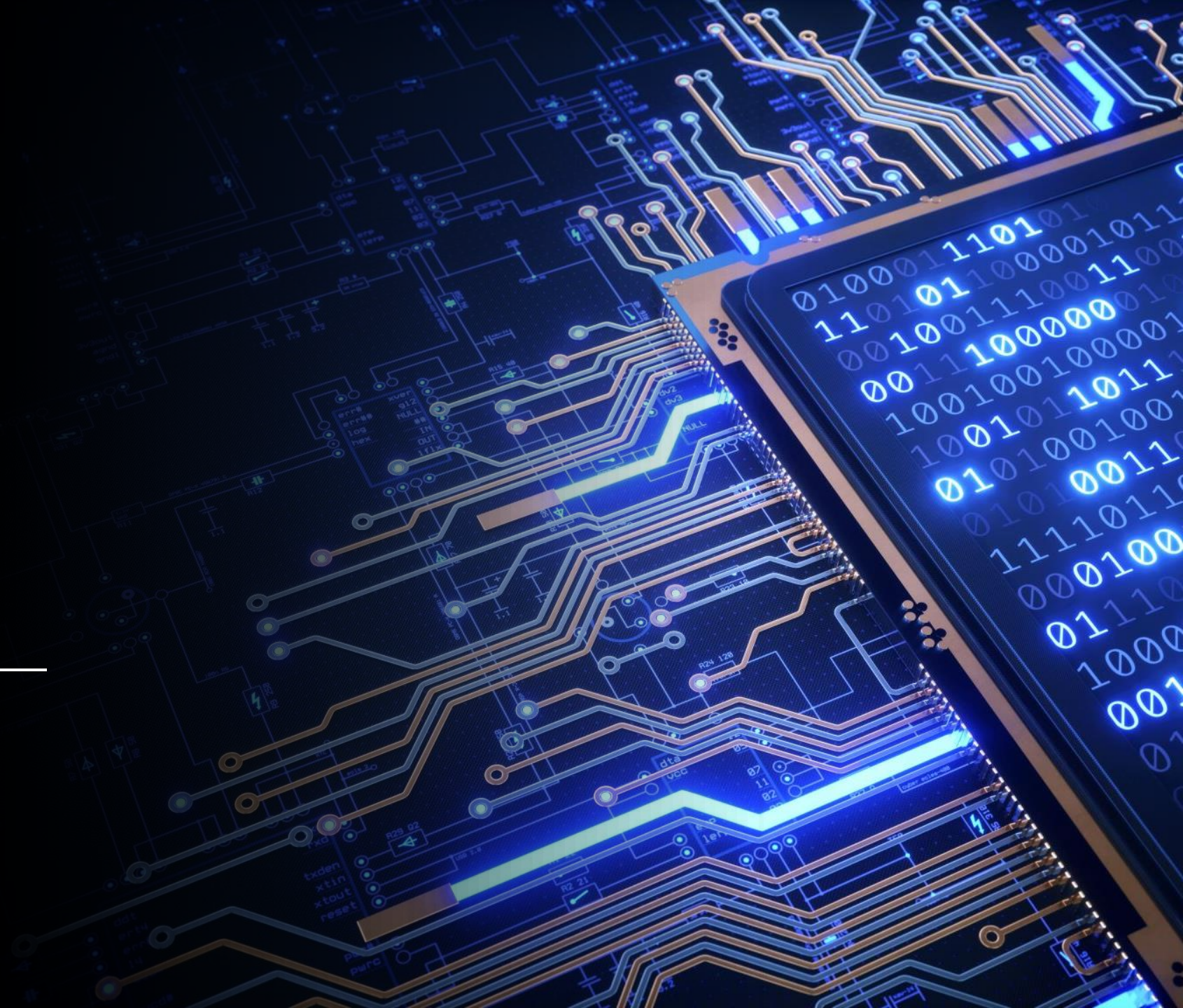


Data Pipeline Monitoring

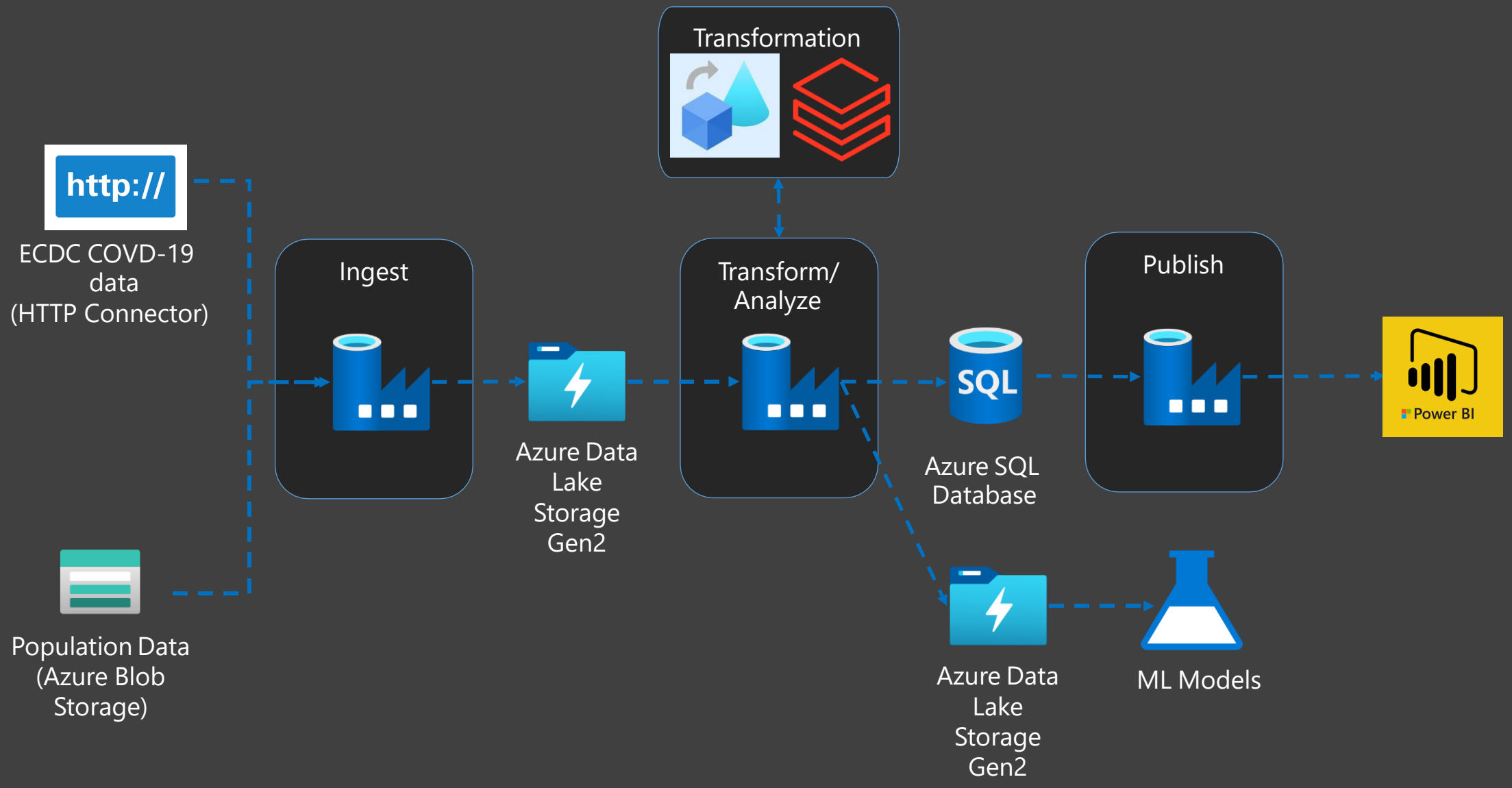




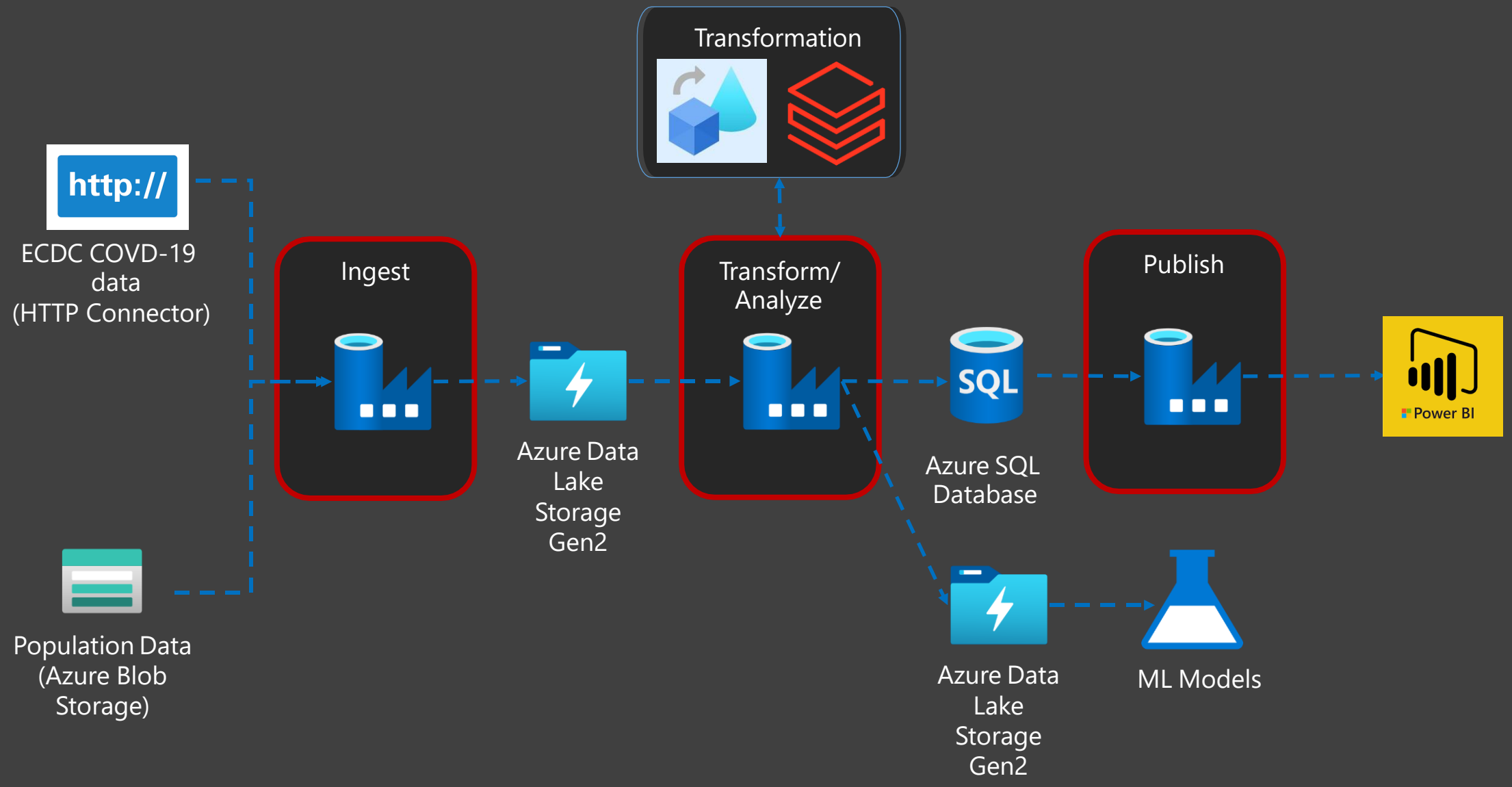
Solution Architecture



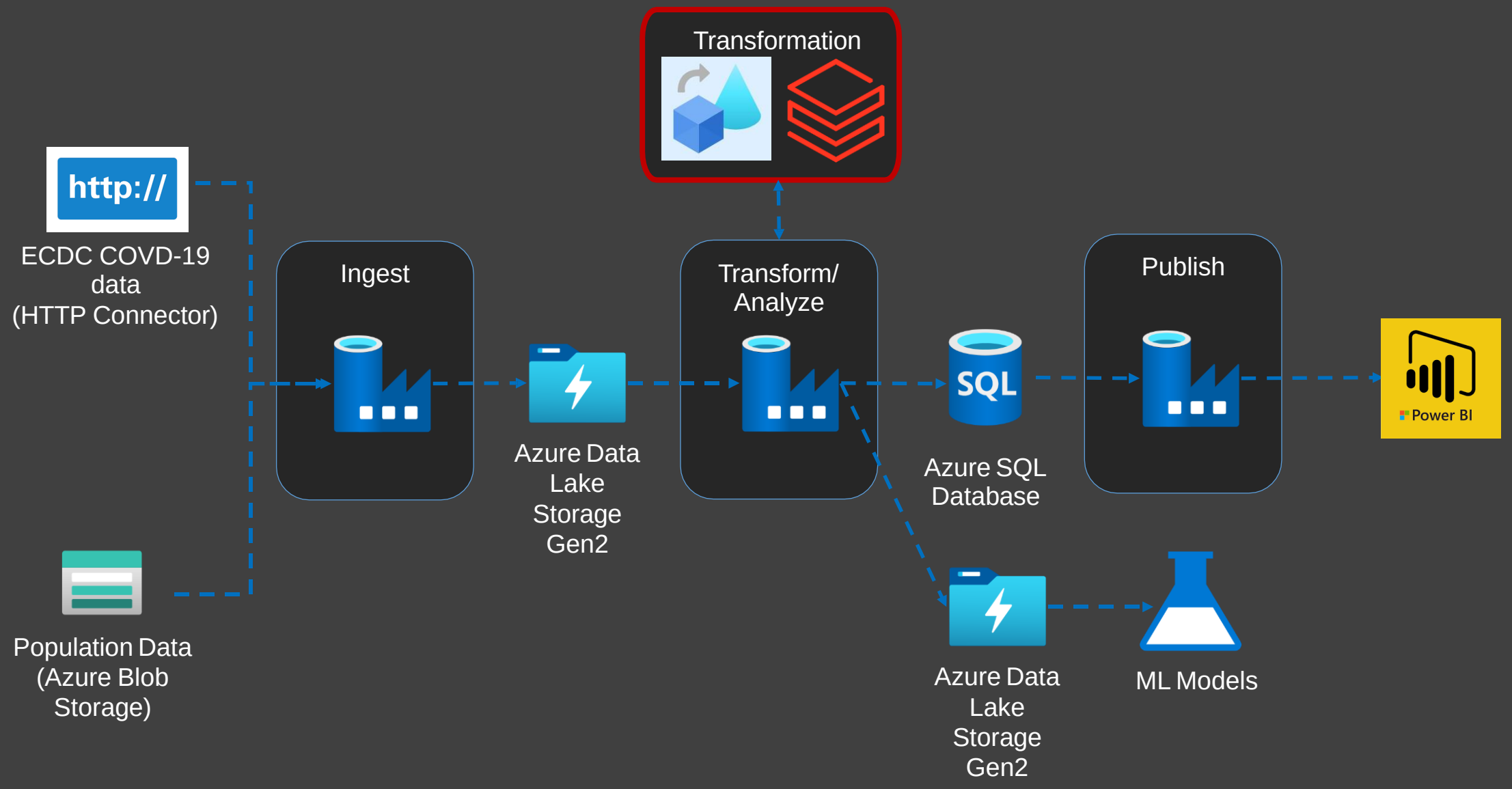
Solution Architecture



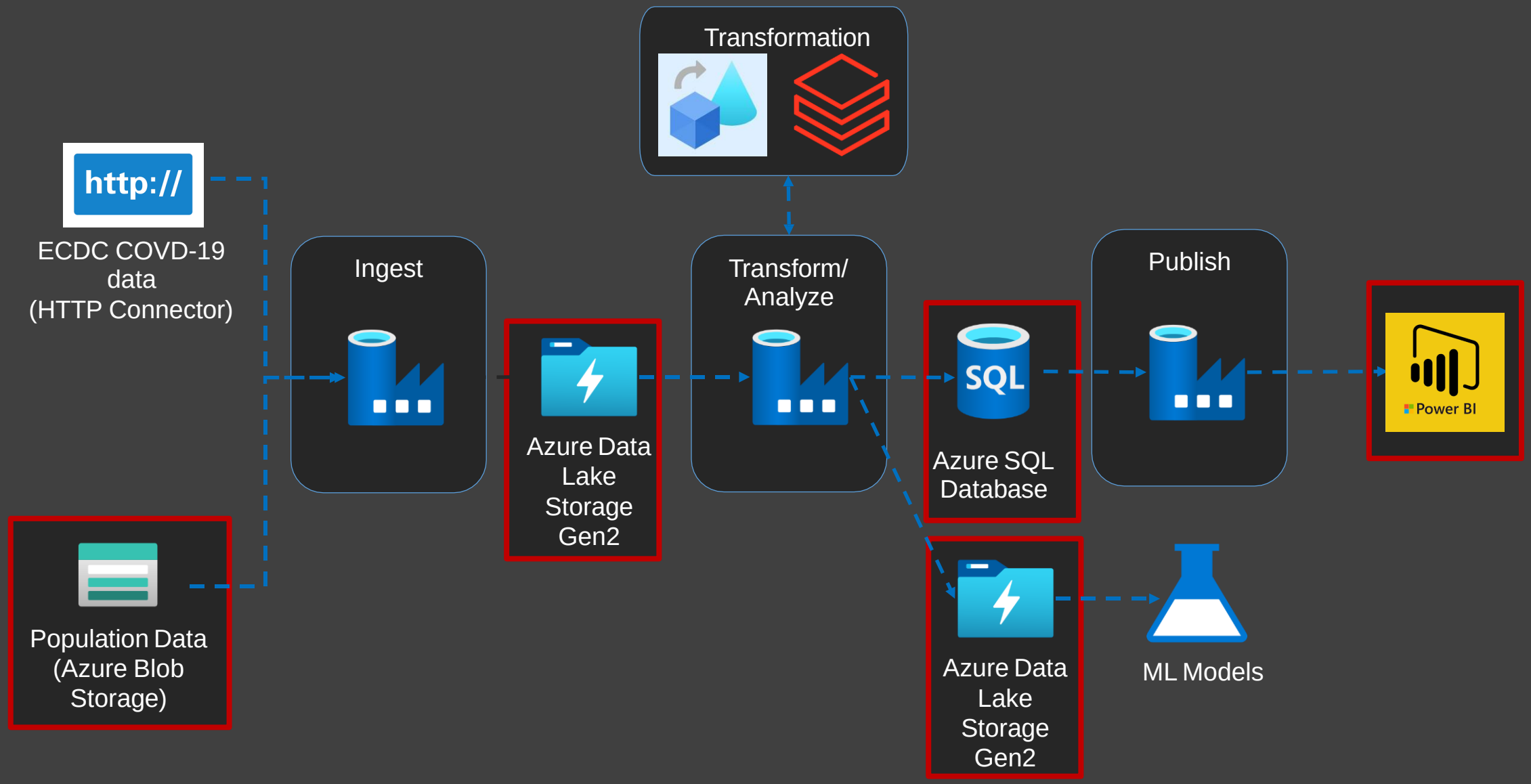
Solution Architecture



Solution Architecture



Solution Architecture



Detailed Solution Design

Data Sources

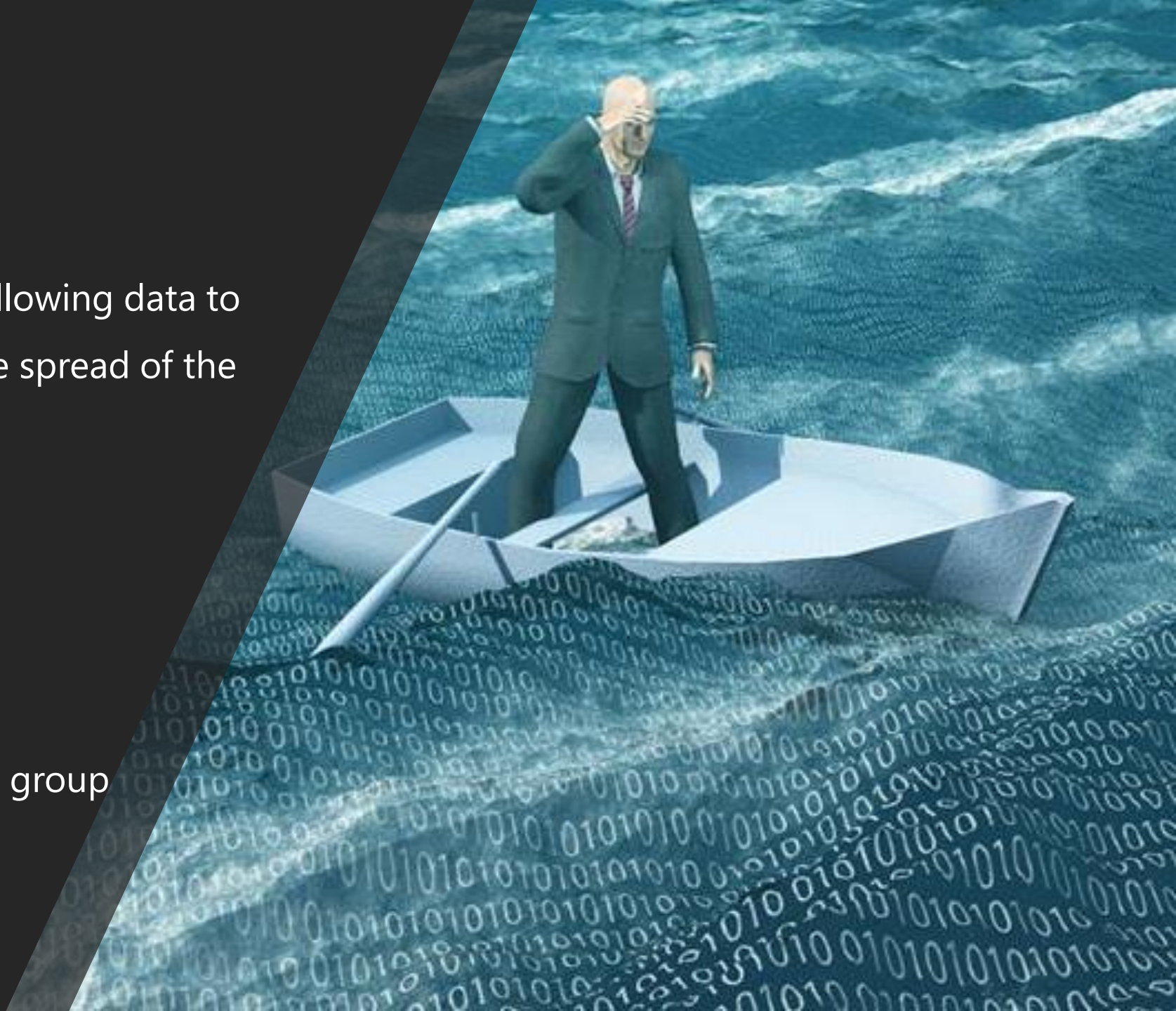
- ECDC Website
  - Confirmed cases
  - Mortality
  - Hospitalization/ ICU Cases
  - Testing Numbers

- Eurostat Website
  - Population by age

Data Lake

Data Lake to be built with the following data to aid Data Scientists to predict the spread of the virus/mortality

- Confirmed cases
- Mortality
- Hospitalization/ ICU Cases
- Testing Numbers
- Country's population by age group



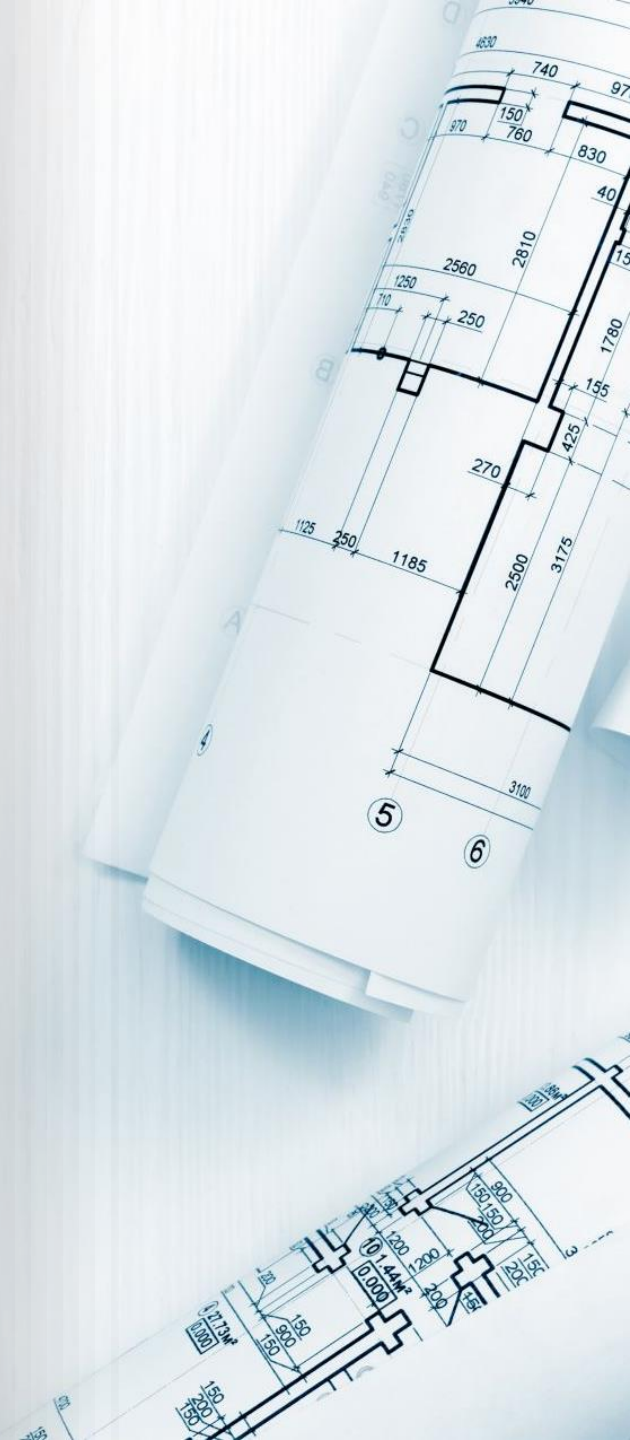
Data Warehouse

Data Warehouse to be built with the following data to aid Reporting on trends

- Confirmed cases
- Mortality rates
- Hospitalization / ICU Cases
- Testing Numbers

Environment set-up

- Azure Subscription
- Azure Data Factory
- Azure Blob Storage Account
- Azure Data Lake Storage Gen2
- Azure SQL Database
- Azure Databricks



Creating Azure Free Account

Creating Azure Data Factory

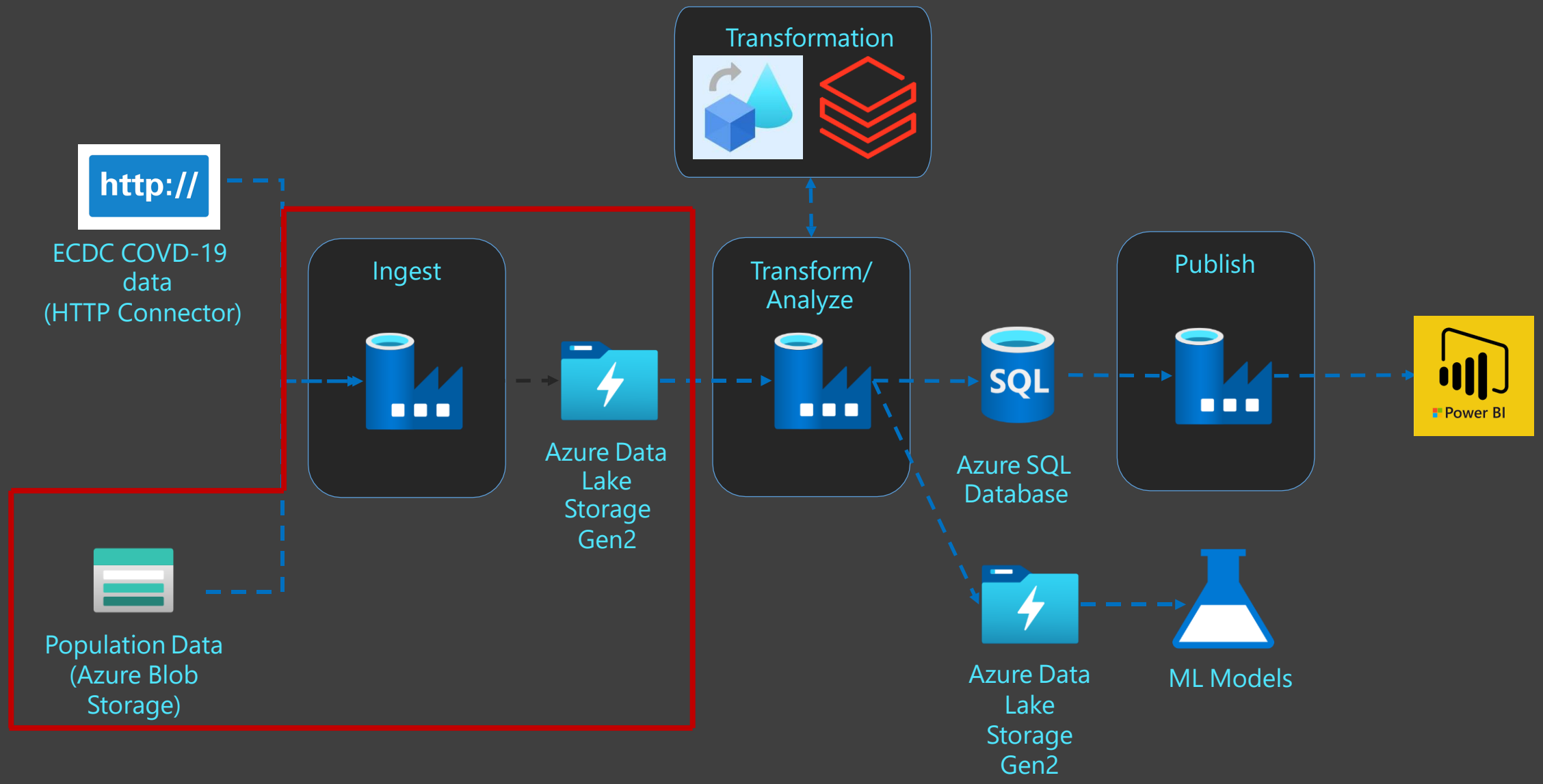
Creating Azure Storage Account

Creating Azure Data Lake Gen2

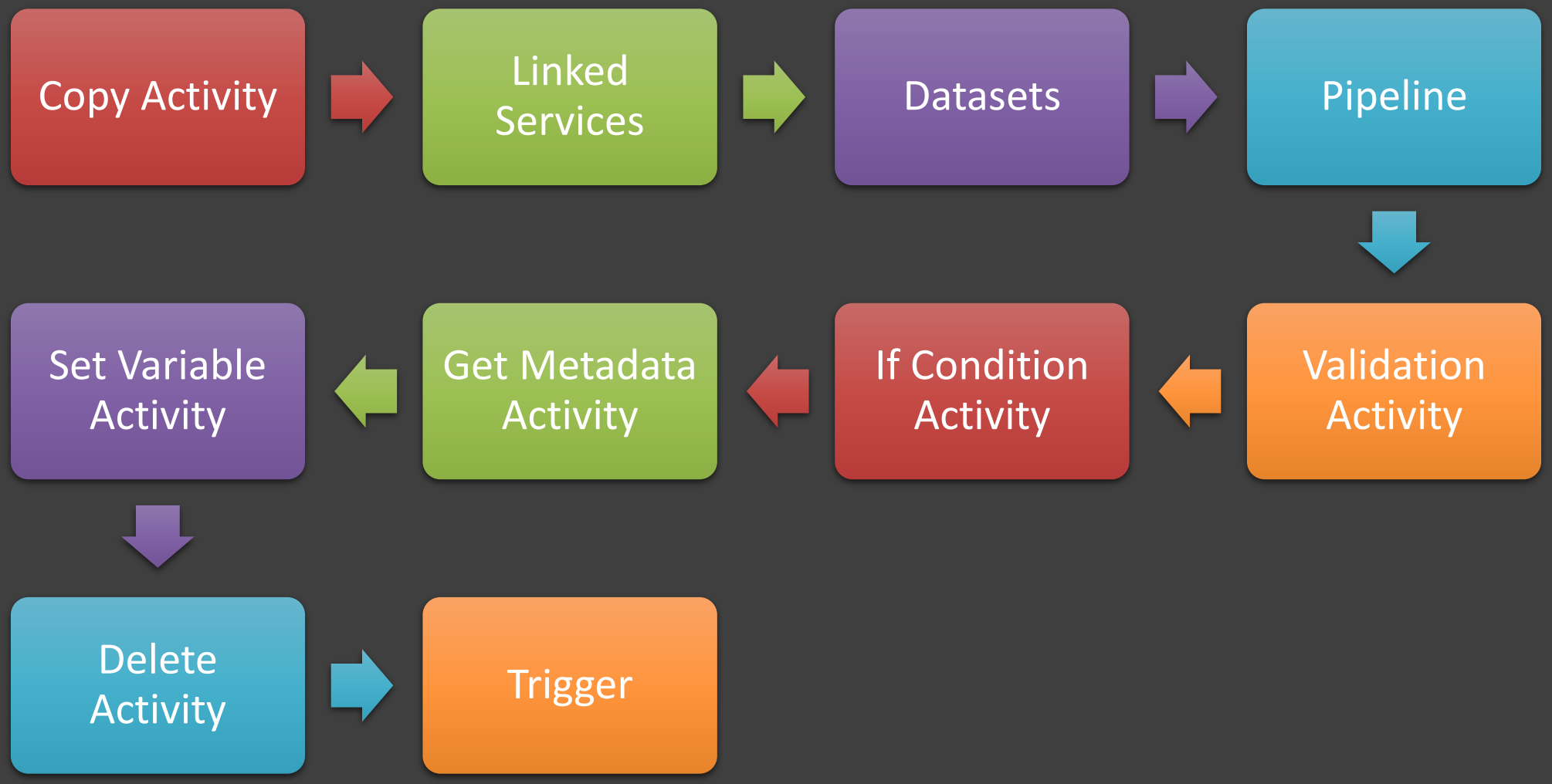
Creating Azure SQL Database

Data Ingestion

Population Dataset Ingestion



Population Dataset Ingestion



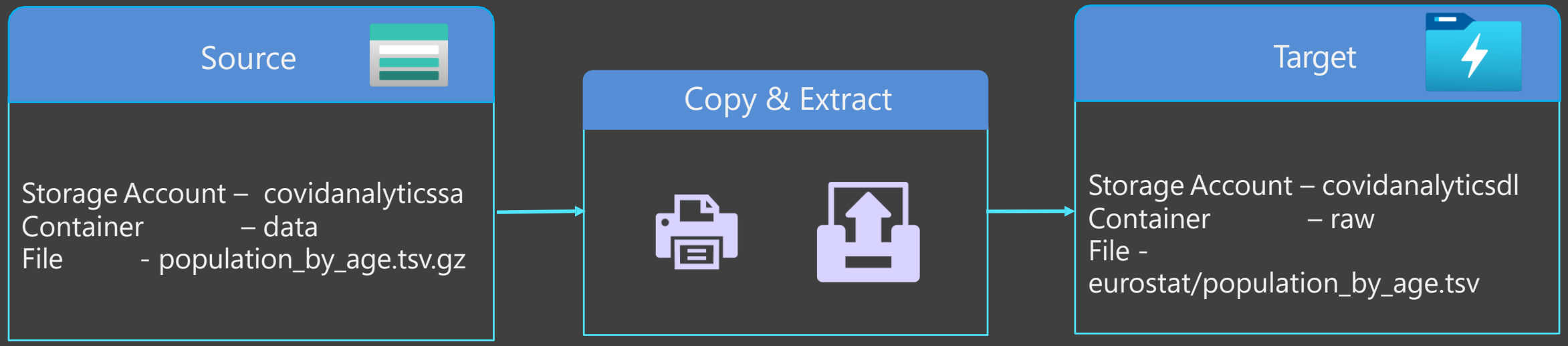
Copy Activity

Azure Blob Storage → Azure Data Lake

Copy Activity

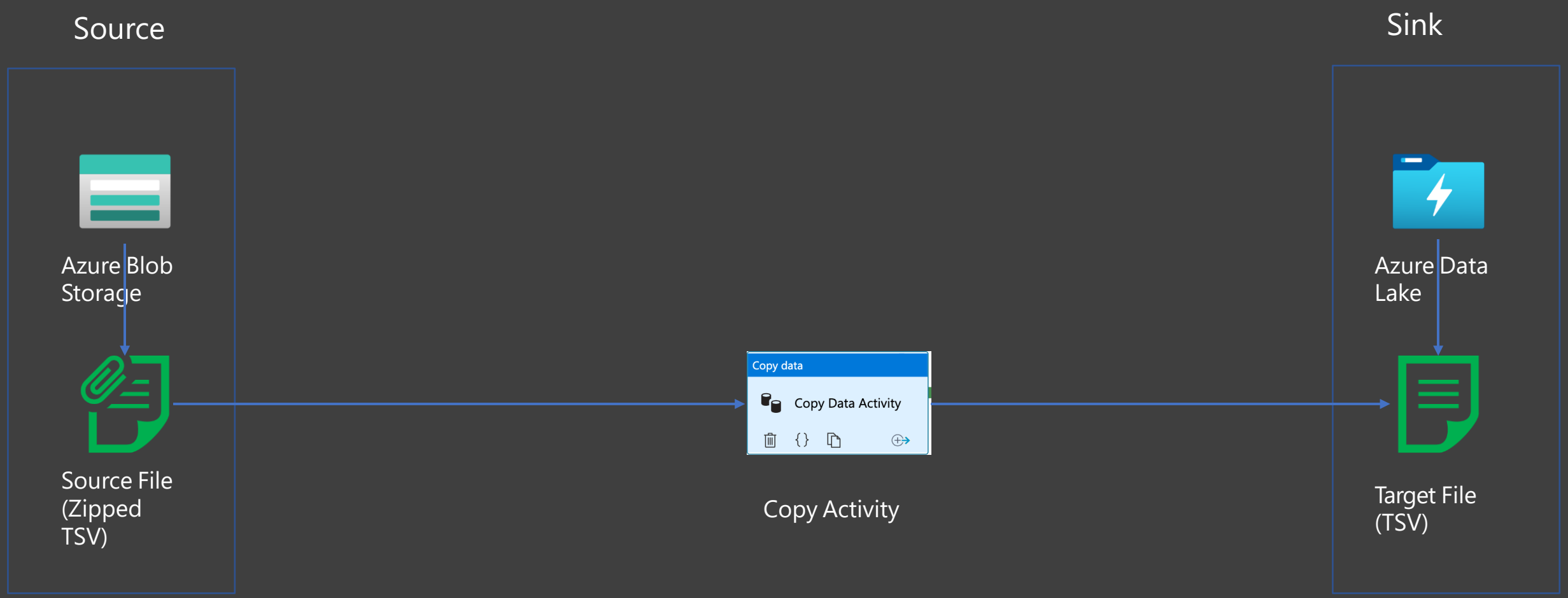
Ingest “population by age” for all EU Countries into the Data Lake to support the machine learning models to predict increase in Covid-19 mortality rates

Copy Activity

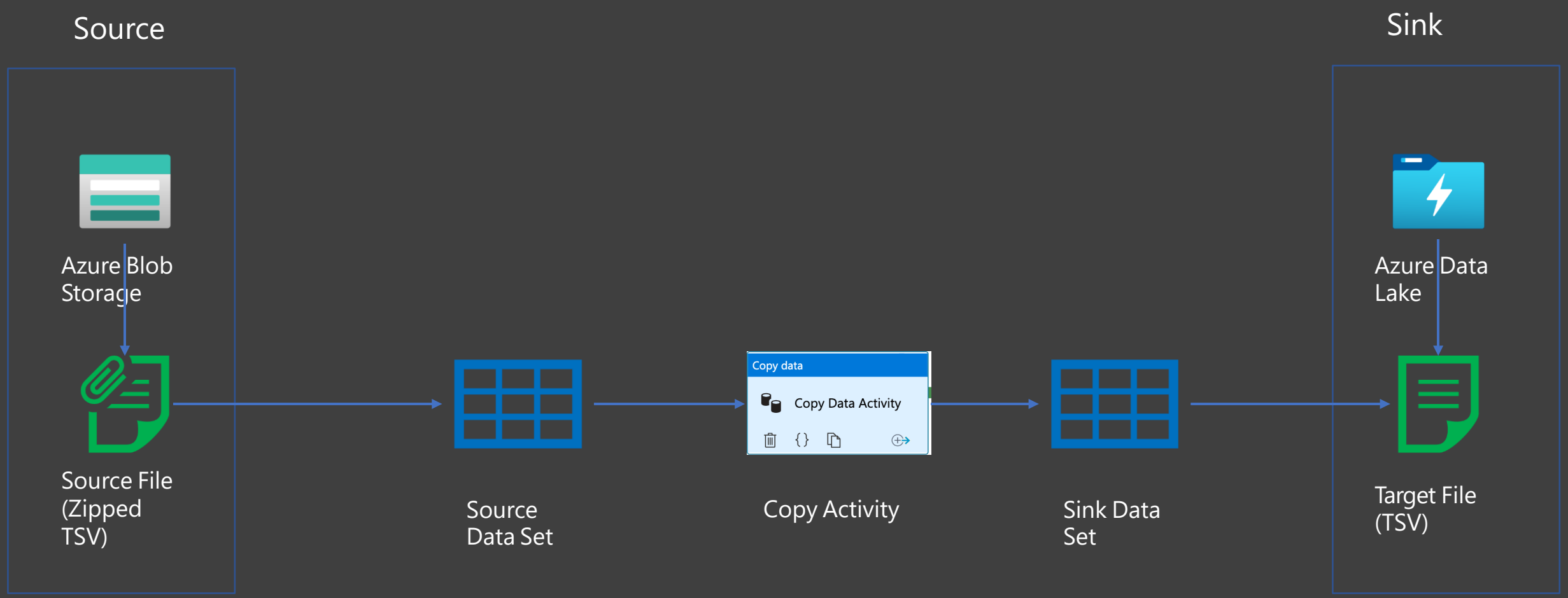


Data Sourced from - https://ec.europa.eu/eurostat/tgm/table.do?tab=table&plugin=1&language=en&pcode=tps00010

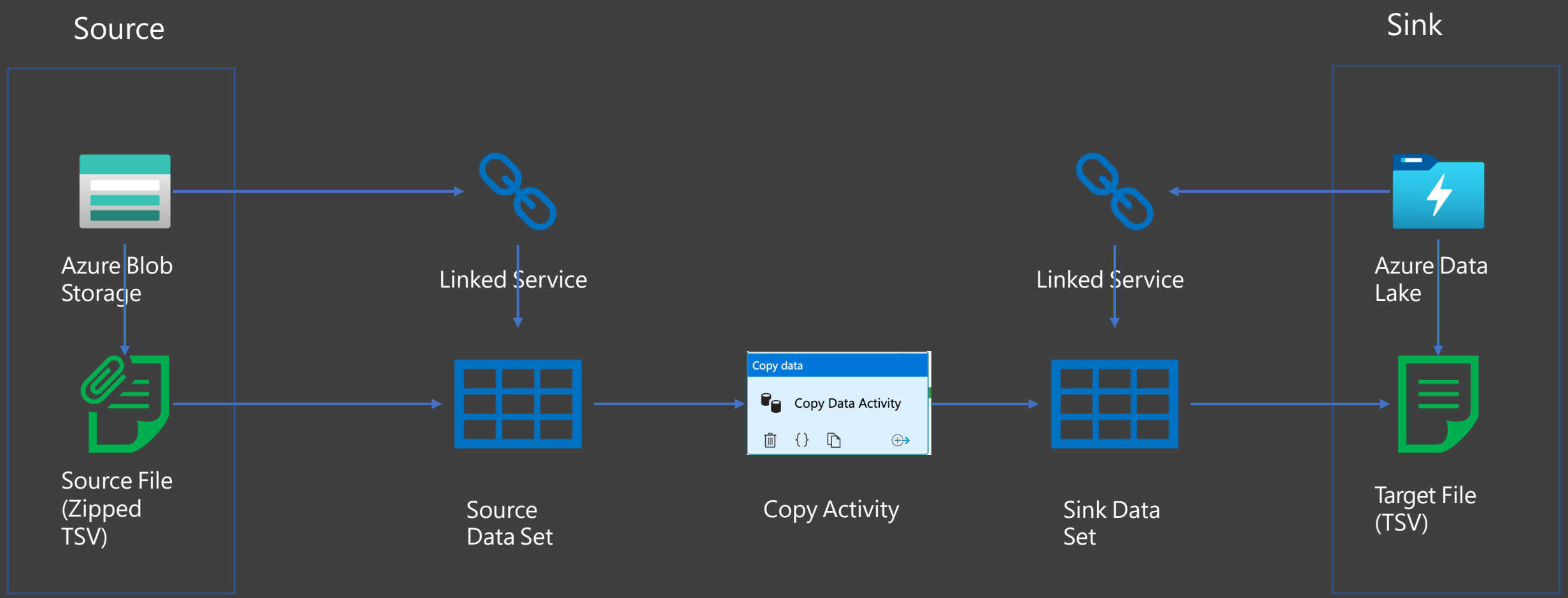
Copy Activity



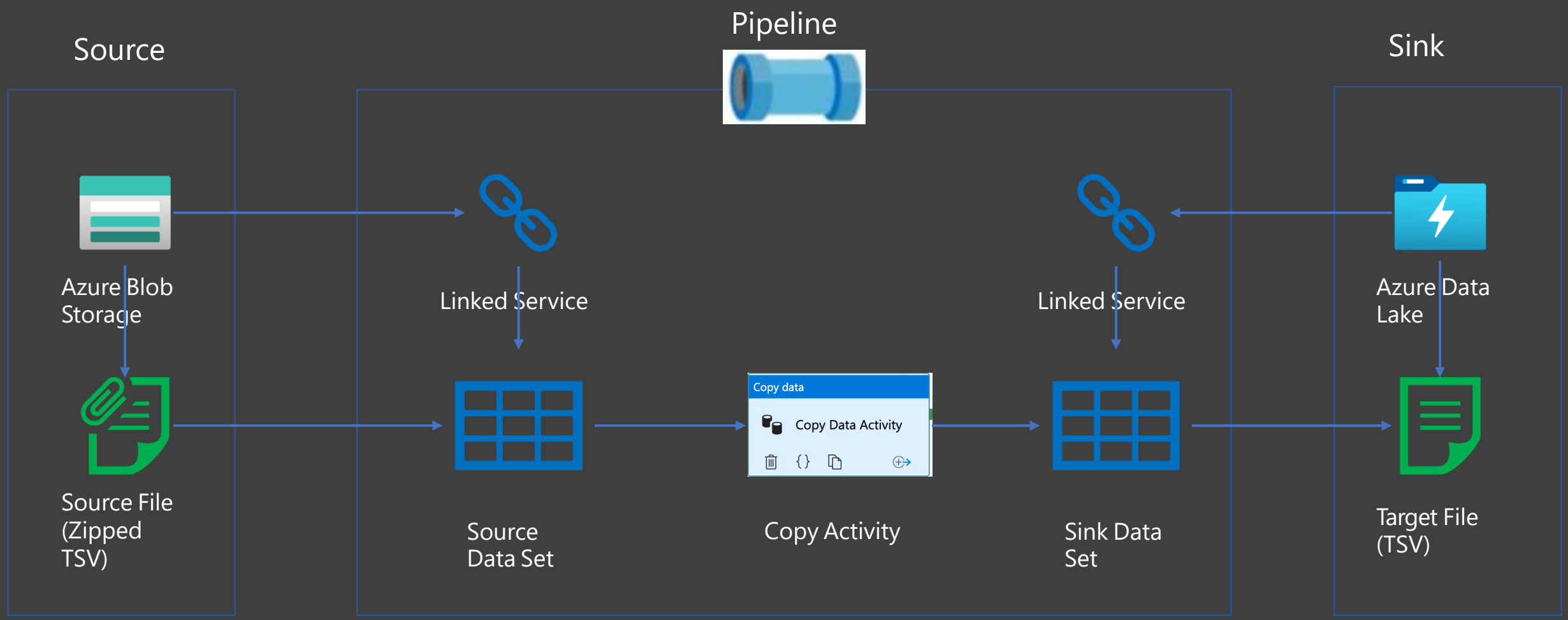
Copy Activity



Copy Activity

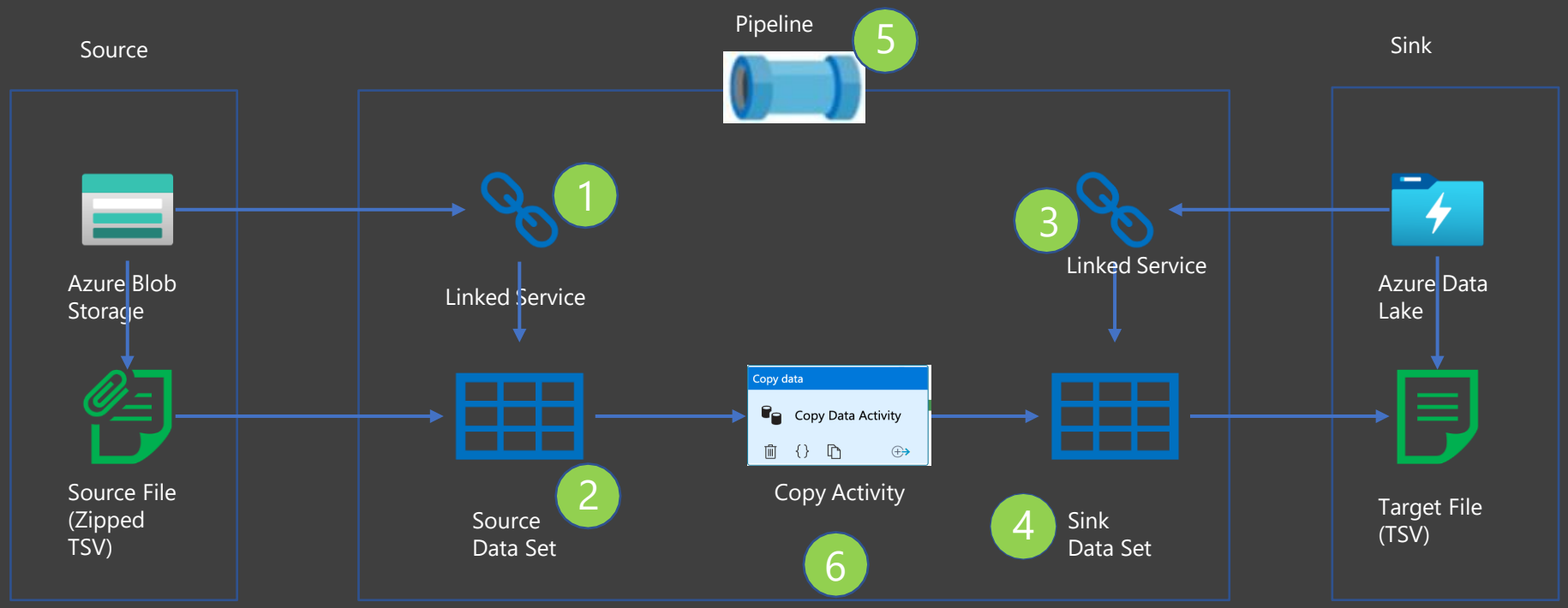


Copy Activity



Copy Activity
From Azure Blob Storage

Copy Activity



Storage Account: covidanalyticssa
Container: data
File: population_by_age.tsv.gz

Storage Account: covidanalyticsdl
Container: raw
File: eurostat/eu/population_by_age.tsv

1. ls_asa_covidreportingsa
2. ds_population_raw_gz
3. ls_adls_covidreportingdl
4. ds_population_raw_tsv
5. pl_ingest_population_data
6. Copy Population Data

Handling Real World Scenarios

Scenario 1

Execute Copy Activity when the file becomes available

Scenario 2

Execute Copy Activity only if file contents are as expected

Scenario 3

Delete the source file on successful copy

Scheduling Pipeline Execution

Triggers

Schedule Trigger

Tumbling Window Trigger

Event Trigger

Schedule Trigger

- Runs on a calendar/ Clock
- Supports periodic and specific times
- Trigger to Pipeline is Many to Many
- Can only be scheduled for a future time to start

Tumbling Window Trigger

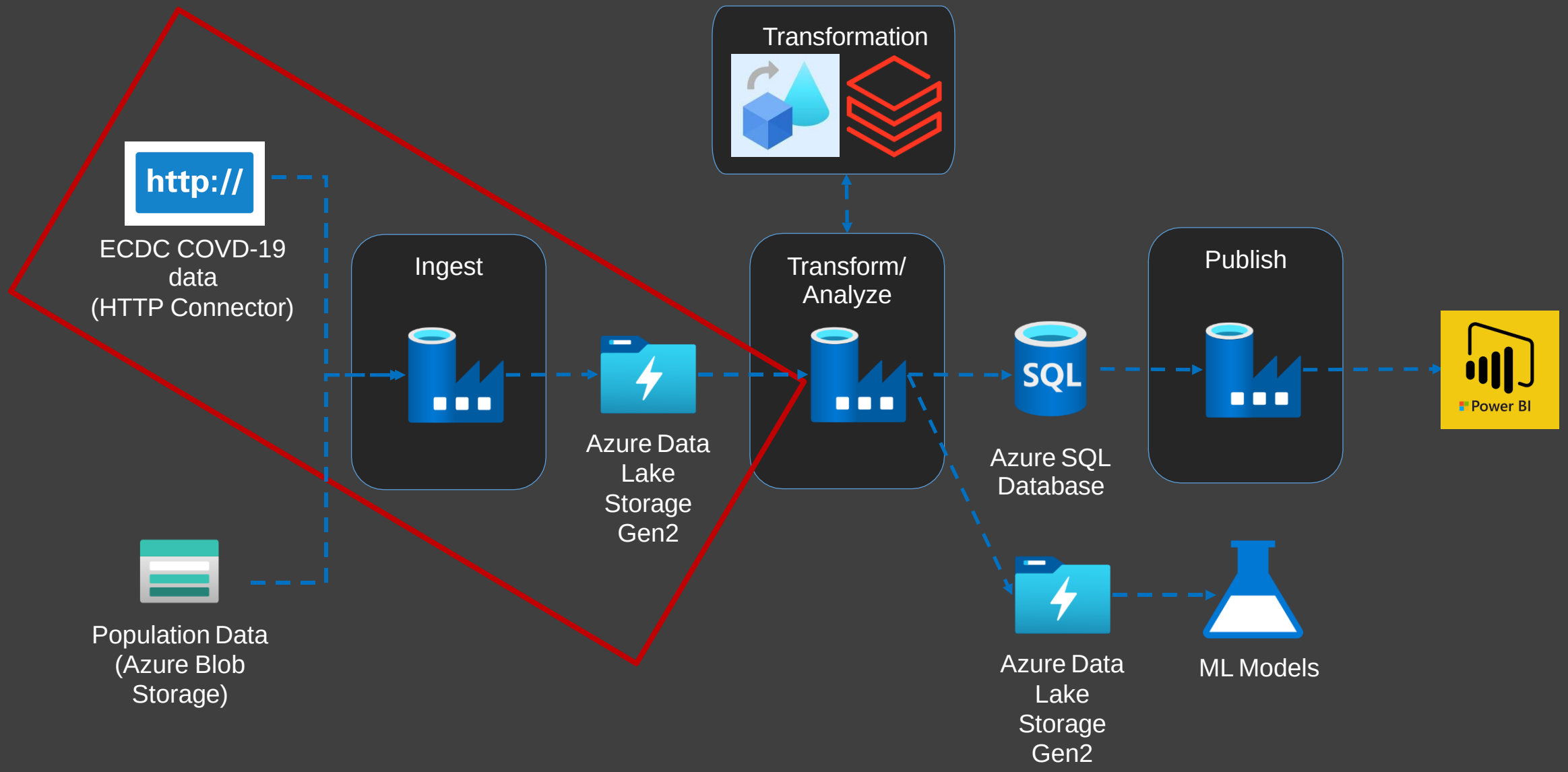
- Runs at periodic intervals
- Windows are fixed sized, non-overlapping
- Can be scheduled for the past windows/slices
- Trigger to Pipeline is one to one

Storage Events Trigger

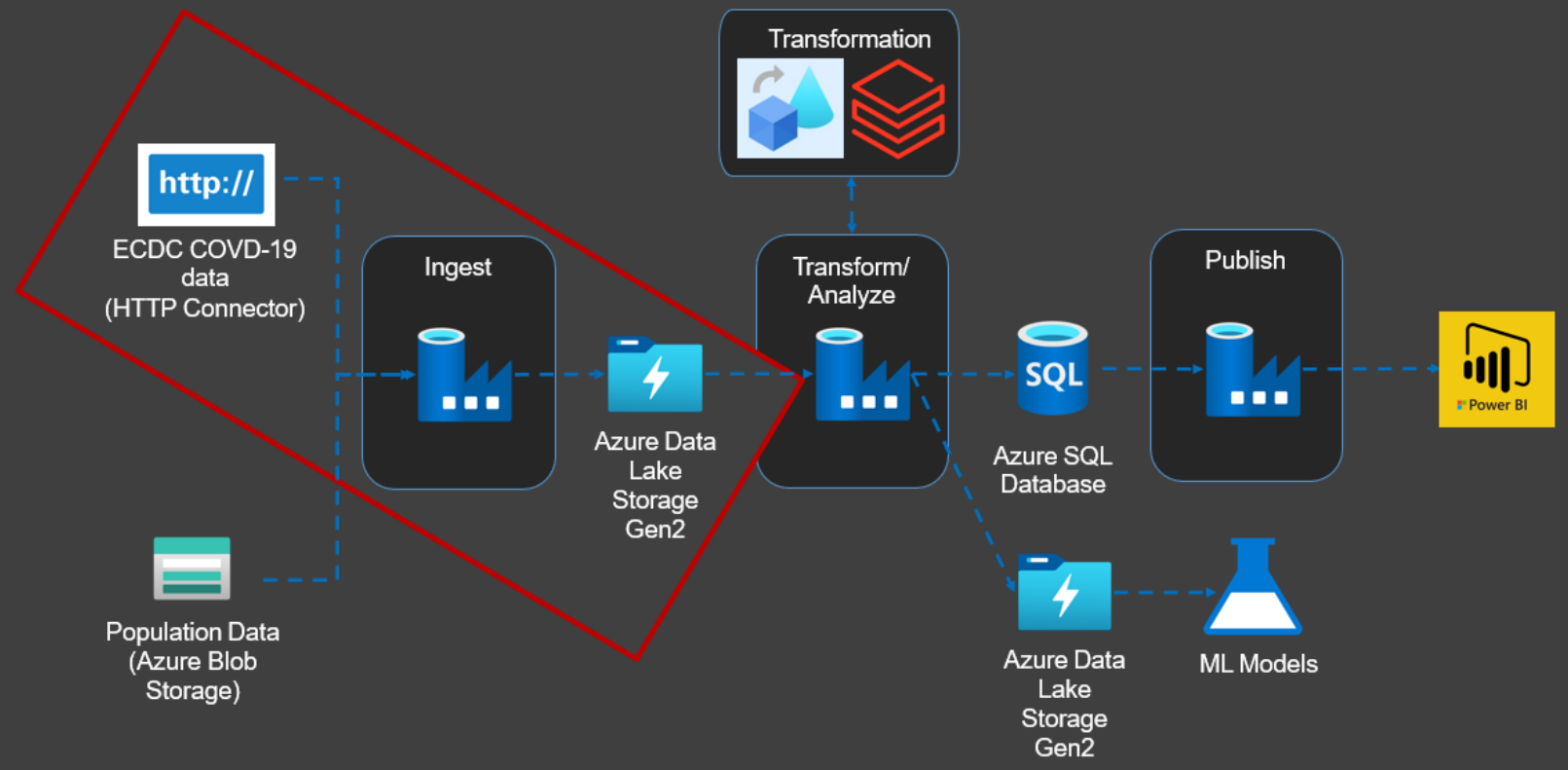
- Runs in response to events
- Events can be creation or deletion of Blobs/Files
- Trigger to Pipeline is Many to Many

Data Ingestion - Module Overview (ECDC Data)

Data Ingestion – ECDC Data



Data Ingestion – ECDC Data



- ECDC Data Overview
- Create Initial Pipeline
- Pipeline Variables
- Pipeline Parameters
- Lookup Activity
- For Each Activity
- Linked Service Parameters
- Metadata driven pipeline

Data Ingestion – ECDC Data

HTTP → Azure Data Lake

Data Ingestion Requirements

- Covid-19 new cases and deaths by Country
- Covid-19 Hospital admissions & ICU cases
- Covid-19 Testing Numbers
- Country Response to Covid-19

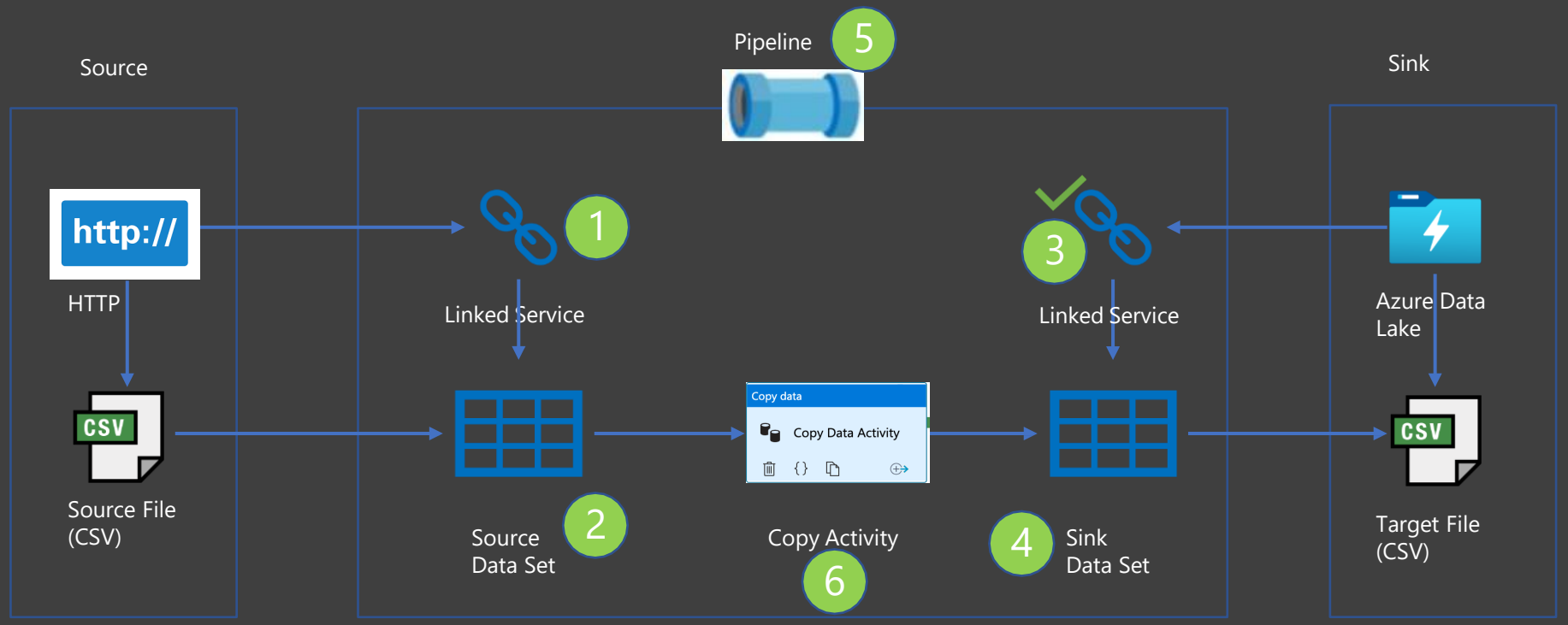
URL - https://www.ecdc.europa.eu/en/covid-19/data

Data Ingestion

Case & Deaths Data

URL - https://www.ecdc.europa.eu/en/publications-data/data-national-14-day-notification-rate-covid-19

Copy Activity – Case & Deaths Data

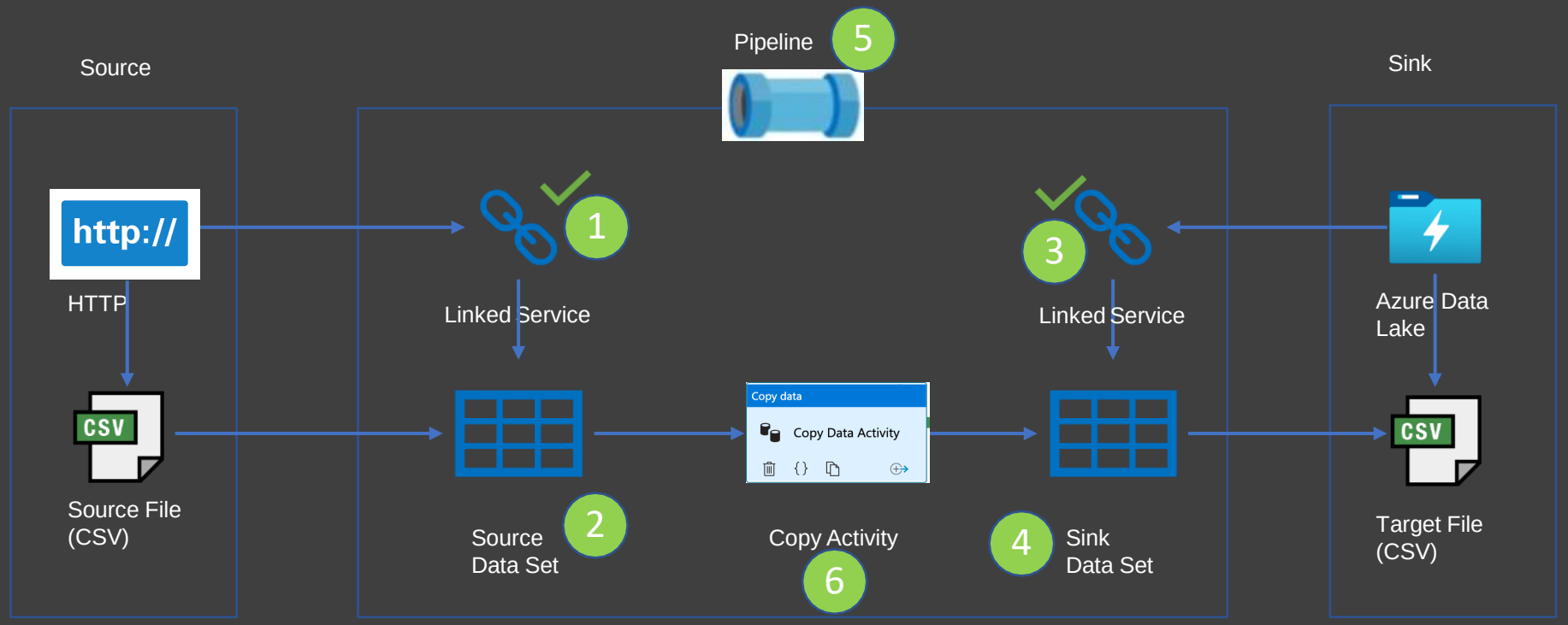


1. ls_http_ecdc
2. ds_cases_deaths_raw_csv_http
3. ls_adls_covidreportingdl ✓
4. ds_cases_deaths_raw_csv_dl
5. pl_ingest_cases_deaths_data
6. Copy Cases And Deaths Data

URL: https://opendata.ecdc.europa.eu/covid19/nationalcasedeath/csv/data.csv

Storage Account: covidreportingdl
Container: raw
File: ecdc/cases_deaths.csv

Copy Activity – Hospital Admission Data



1. ls_http_ecdc ✓
2. ds_hospital_admissions_raw_csv_http
3. ls_adls_covidreportingdl ✓
4. ds_hospital_admissions_raw_csv_dl
5. pl_ingest_hospital_admissions_data
6. Copy Hospital Admissions Data

URL: https://opendata.ecdc.europa.eu/covid19/hospitalicuadmissionrates/csv/data.csv

Storage Account: covidreportingdl
Container: raw
File: ecdc/hospital_admissions.csv

Parameters & Variables

Parameters are external values passed into pipelines, datasets or linked services. The value cannot be changed inside a pipeline.

Variables are internal values set inside a pipeline. The value can be changed inside the pipeline using Set Variable or Append Variable Activity

Differences

Source

https://opendata.ecdc.europa.eu/covid19/nationalcasedeath/csv/data.csv
https://opendata.ecdc.europa.eu/covid19/hospitalicuadmissionrates/csv/data.csv
https://opendata.ecdc.europa.eu/covid19/testing/csv/data.csv
https://www.ecdc.europa.eu/sites/default/files/documents/response_graphs_data_2021-08-26.csv

Sink

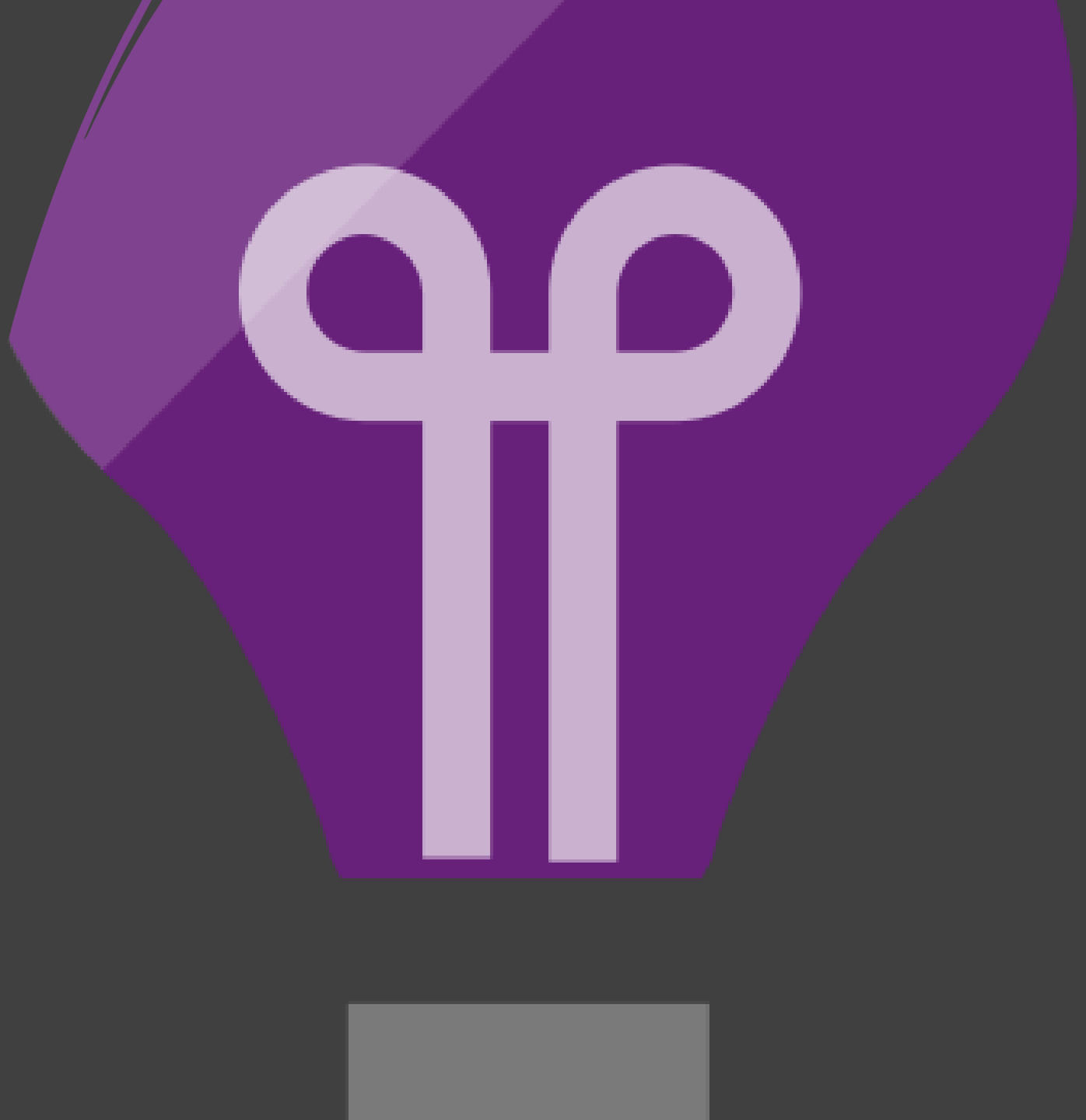
raw/ecdc/case_distribution.csv
raw/ecdc/hospital_admission.csv
raw/ecdc/testing.csv
raw/ecdc/country_response.csv

Scenario 1

Use Variables to Parameterize the Pipeline

Scenario 2

Use Pipeline Parameters to make the Pipeline generic

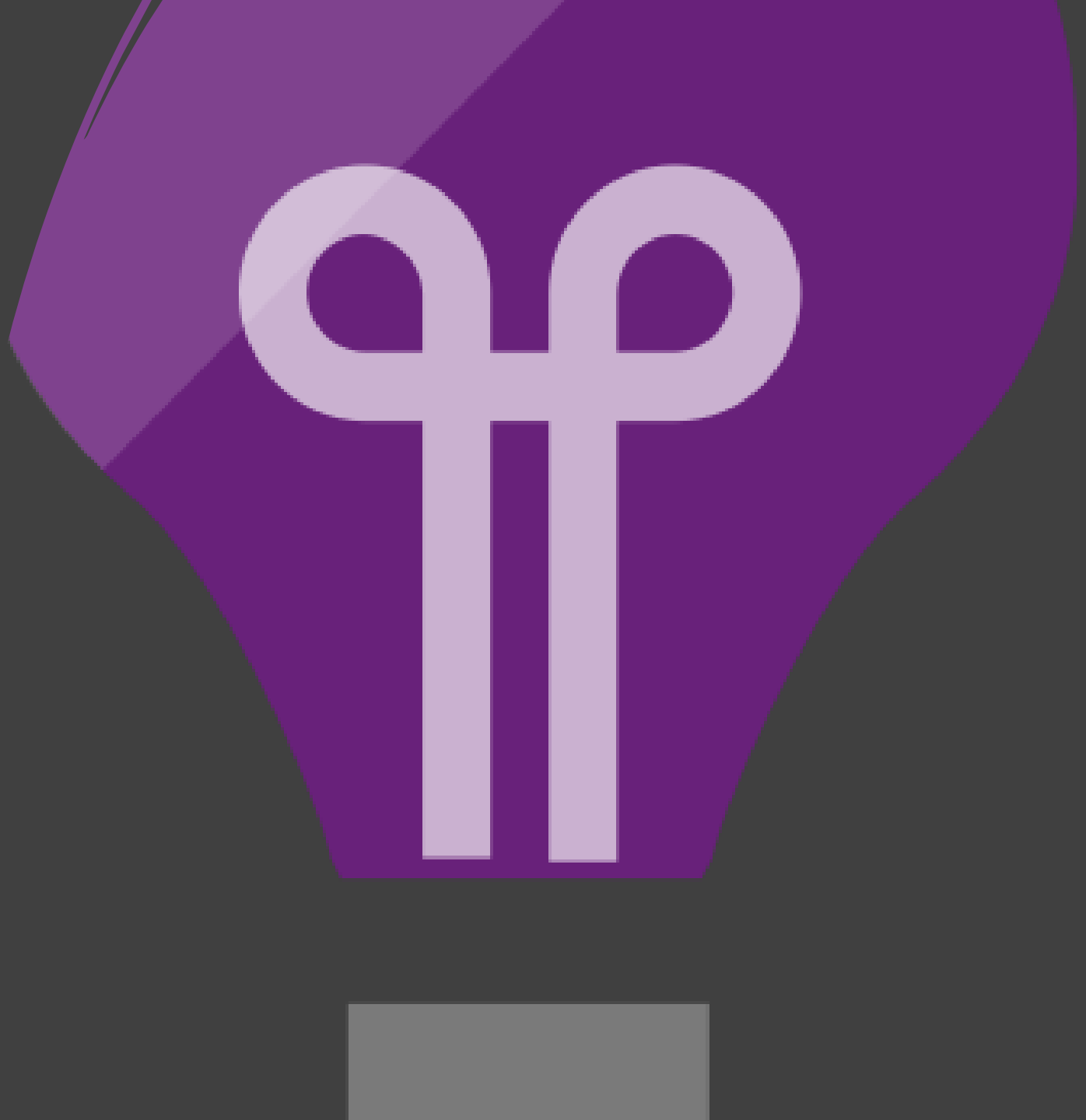


Scenario 3

Schedule the Pipeline and pass Trigger Parameters

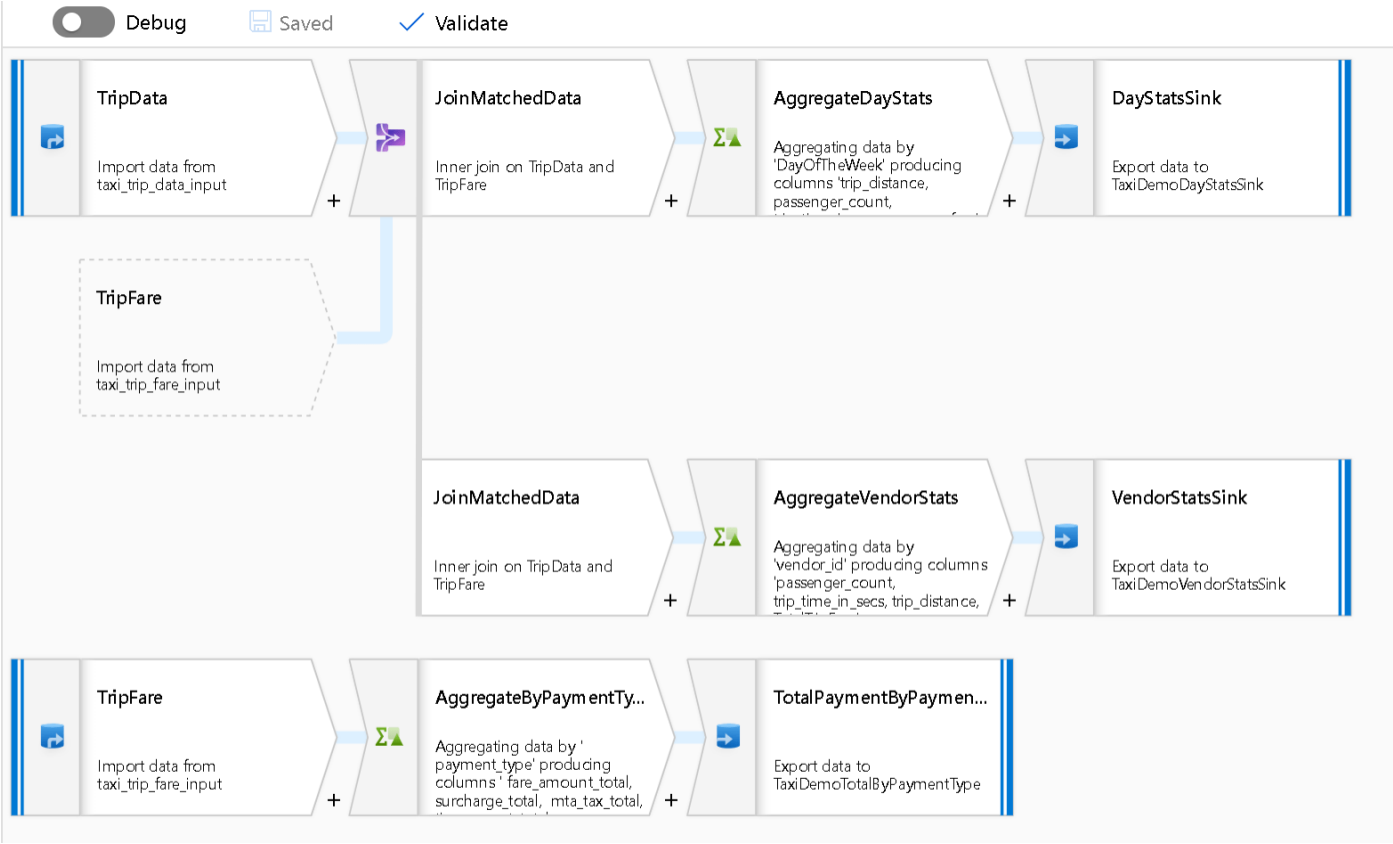
Scenario 4

Use a config file and further optimize the pipeline design

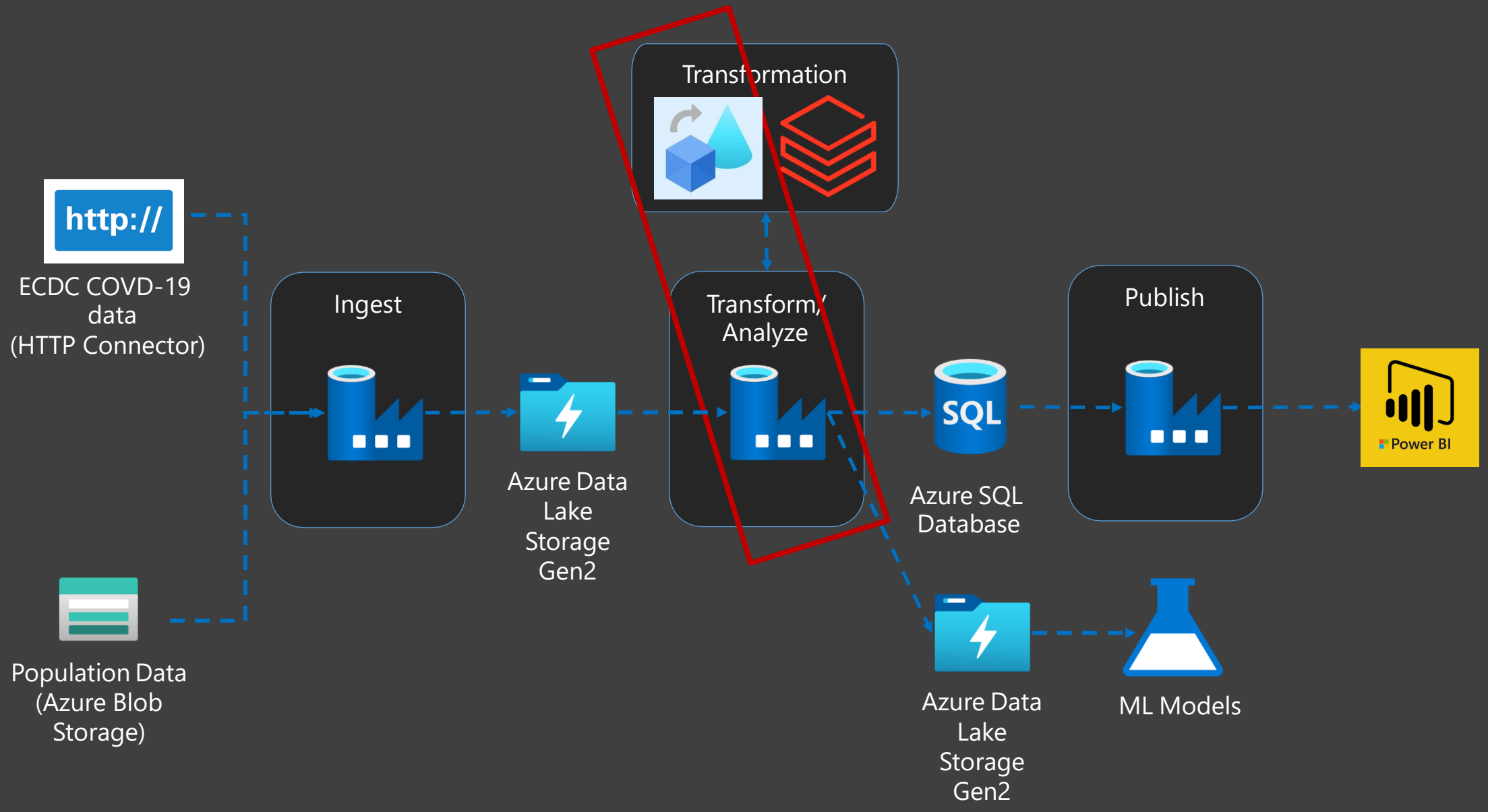


Data Flows

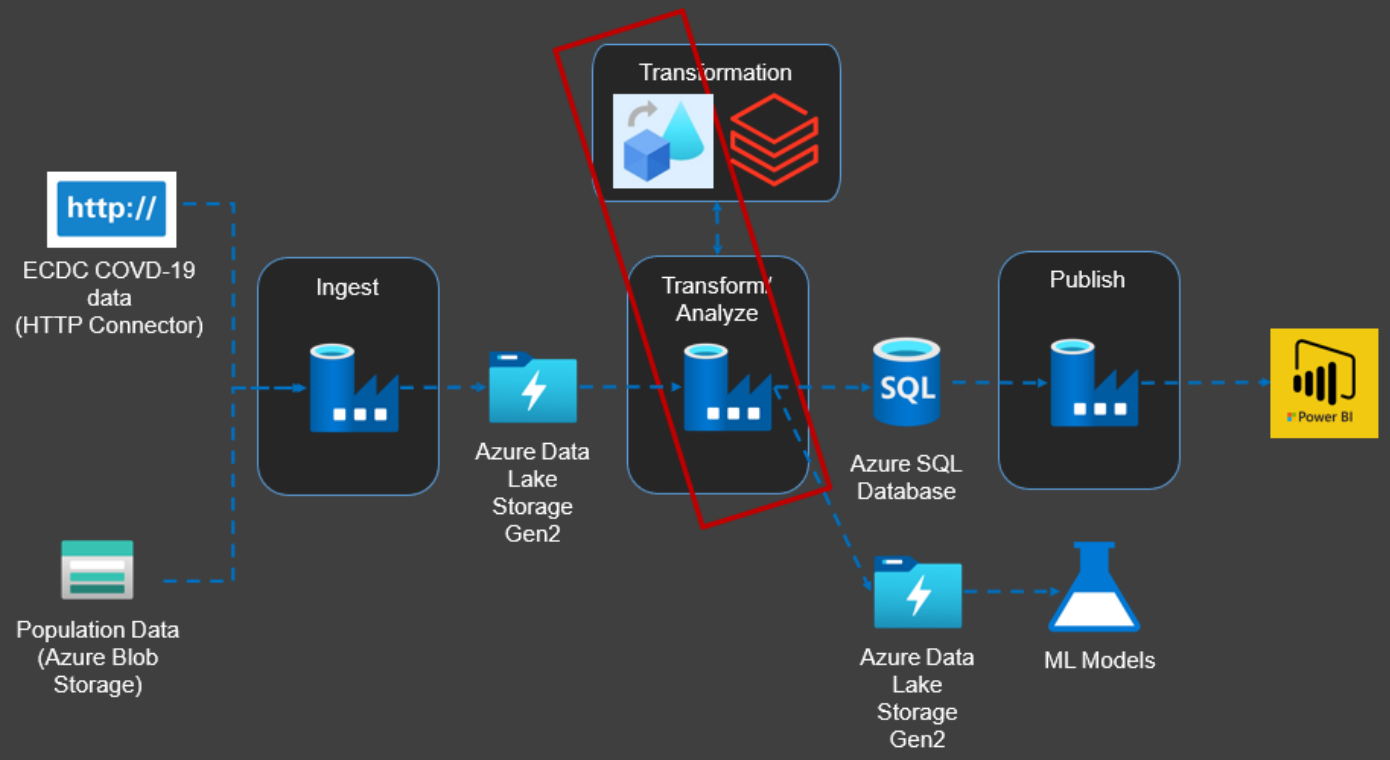
Cases & Deaths File



Data Flow – Cases & Deaths Data



Data Flow – Cases & Deaths Data



- Data Flow Overview
- Requirements
- Source Transformation
- Filter Transformation
- Select Transformation
- Pivot Transformation
- Lookup Transformation
- Sink Transformation
- Create Pipeline

Data Flows

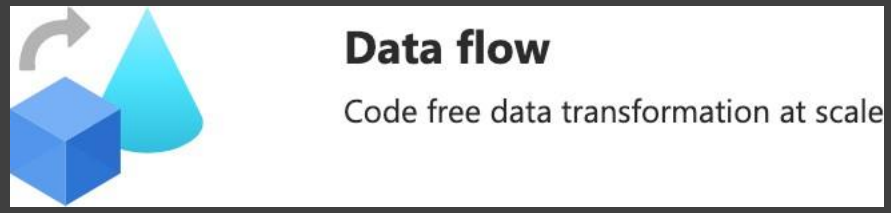
Data Flows

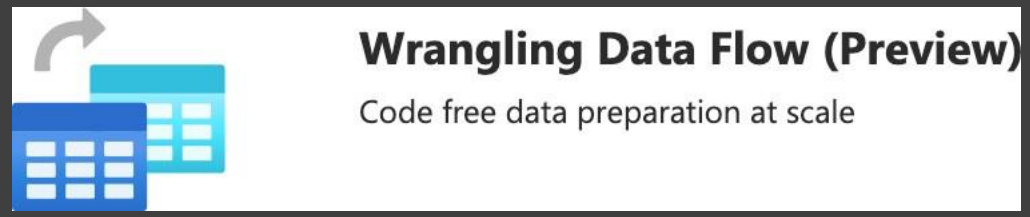
Features

- Code free data transformations
- Executed on Data Factory managed Spark clusters
- Benefits from Data factory scheduling and monitoring capabilities.

Data Flows

Types





Data Flows

Limitations

- Only available in some regions

  https://docs.microsoft.com/en-us/azure/data-factory/concepts-data-flow- overview#available-regions

- Limited set of connectors available

  https://docs.microsoft.com/en-us/azure/data-factory/data-flow-source#supported- sources

- Not suitable for very complex logic

Data Flows

Transform Cases & Deaths Data

Transform Cases & Deaths Data

Raw File from ECDC

Column Name
country
country_code
~~continent~~
population
indicator
daily_count
date
~~rate_14_day~~
source

Europe Only

Transformed File

Column Name
country
country_code_2_digit(Lookup)
country_code_3_digit
population
cases_count
deaths_count
reported_date
source

Transform Cases & Deaths Data

Raw File from ECDC

Column Name
country
country_code
~~continent~~
population
indicator
daily_count
date
~~rate_14_day~~
source

Europe Only

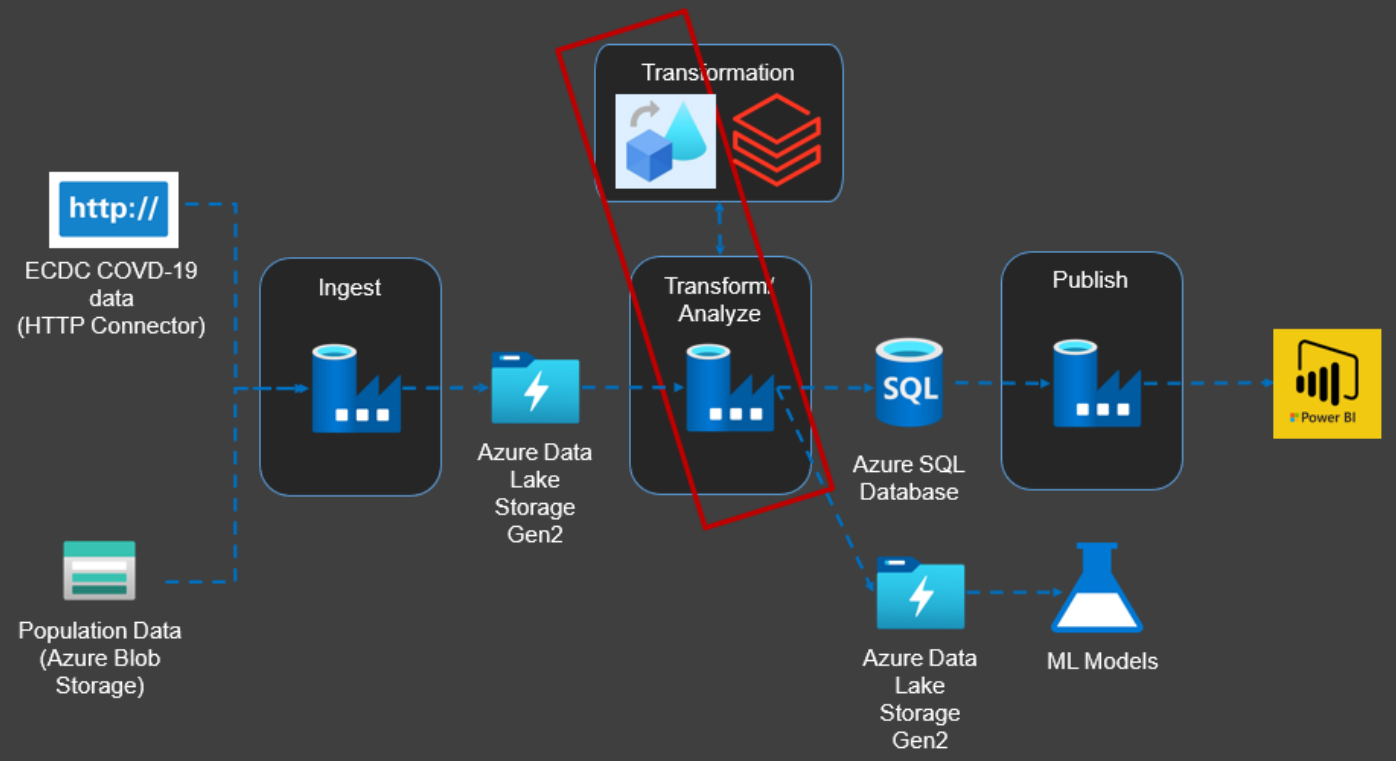
Transformed File

Column Name
country
country_code_2_digit(Lookup)
country_code_3_digit
population
cases_count
deaths_count
reported_date(Rename)
source

Hospital Admissions File

Data Flow 2

Data Flow – Hospital Admission Data



- Requirement
- Source Transformation
- Select Transformation
- Lookup Transformation
- Pivot Transformation
- Sink Transformation
- Conditional Split Transformation
- Derived Column Transformation
- Aggregate Transformation
- Sort Transformation
- Join Transformation
- Create Pipeline

Hospital Admissions Data

Hospital Admissions Data

Raw File from ECDC

Column Name
country
indicator
date
year_week
value
source
~~url~~

Transformed Daily File

Column Name
country
country_code_2_digit(Lookup)
country_code_3_digit(Lookup)
Population(Lookup)
reported_date
hospital_occupancy_count
icu_occupancy_count
source

Transformed Weekly File

Column Name
country
country_code_2_digit(Lookup)
country_code_3_digit(Lookup)
population(Lookup)
reported_year_week(transformed)
reported_week_start_date(Lookup)
reported_week_end_date(Lookup)
new_hospital_occupancy_count
new_icu_occupancy_count
Source

Hospital Admissions Data

Raw File from ECDC

Column Name
country
indicator
date
year_week
value
source
~~url~~

Transformed Daily File

Column Name
country
country_code_2_digit(Lookup)
country_code_3_digit(Lookup)
Population(Lookup)
reported_date
hospital_occupancy_count
icu_occupancy_count
source

Transformed Weekly File

Column Name
country
country_code_2_digit(Lookup)
country_code_3_digit(Lookup)
population(Lookup)
reported_year_week(transformed)
reported_week_start_date(Lookup)
reported_week_end_date(Lookup)
new_hospital_occupancy_count
new_icu_occupancy_count
Source

Source Transformation

Assignment

Select Transformation

Assignment

- Remove url
- Rename date to reported_date
- Rename year_week to reported_year_week

Lookup Transformation

Assignment

- Lookup country file
- Select only required fields (i.e. remove additional fields from lookup)

Pivot Transformation

Assignment

Hospital Admissions Data

Raw File from ECDC

Column Name
country
indicator
date
year_week
value
source
~~url~~

Transformed Daily File

Column Name
country
country_code_2_digit(Lookup)
country_code_3_digit(Lookup)
Population(Lookup)
reported_date
hospital_occupancy_count
icu_occupancy_count
source

Transformed Weekly File

Column Name
country
country_code_2_digit(Lookup)
country_code_3_digit(Lookup)
population(Lookup)
reported_year_week(transformed)
reported_week_start_date(Lookup)
reported_week_end_date(Lookup)
new_hospital_occupancy_count
new_icu_occupancy_count
Source

Hospital Admissions Data

Raw File from ECDC

Column Name
country
indicator
date
year_week
value
source
~~url~~

Transformed Daily File

Column Name
country
country_code_2_digit(Lookup)
country_code_3_digit(Lookup)
Population(Lookup)
reported_date
hospital_occupancy_count
icu_occupancy_count
source

Transformed Weekly File

Column Name
country
country_code_2_digit(Lookup)
country_code_3_digit(Lookup)
population(Lookup)
reported_year_week(transformed)
reported_week_start_date(Lookup)
reported_week_end_date(Lookup)
new_hospital_occupancy_count
new_icu_occupancy_count
Source

Select & Sink Transformation

Assignment

Hospital Admissions Data

Raw File from ECDC

Column Name
country
indicator
date
year_week
value
source
~~url~~

Transformed Daily File

Column Name
country
country_code_2_digit(Lookup)
country_code_3_digit(Lookup)
Population(Lookup)
reported_date
hospital_occupancy_count
icu_occupancy_count
source

Transformed Weekly File

Column Name
country
country_code_2_digit(Lookup)
country_code_3_digit(Lookup)
population(Lookup)
reported_year_week(transformed)
reported_week_start_date(Lookup)
reported_week_end_date(Lookup)
new_hospital_occupancy_count
new_icu_occupancy_count
Source

Hospital Admissions Data

Raw File from ECDC

Column Name
country
indicator
date
year_week
value
source
~~url~~

Transformed Daily File

Column Name
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country_code_3_digit(Lookup)
Population(Lookup)
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icu_occupancy_count
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Transformed Weekly File

Column Name
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country_code_3_digit(Lookup)
population(Lookup)
reported_year_week(transformed)
reported_week_start_date(Lookup)
reported_week_end_date(Lookup)
new_hospital_occupancy_count
new_icu_occupancy_count
Source

Data Flow Execution

Assignment

Data Orchestration

Data Orchestration Requirements

- Pipeline executions are full automated
- Pipelines run at regular intervals or on an event occurring
- Activities only run once the upstream dependency has been satisfied
- Easier to monitor for execution progress and issues

Data Factory Capability

- Dependency between activities inside a pipeline
- Dependency between pipelines within a parent pipeline
- Dependency between triggers [Only tumbling window triggers]
- Custom-made Solution

Data Orchestration

Option 1 – Parent Pipeline

Data Orchestration

Option 2 – Trigger Dependency

Azure Data Factory - Monitoring

Azure Data Factory - Monitoring

- What to Monitor
- Data Factory
- Monitoring Creating
- Alerts
- Recovery From Failure
- Reporting on Metrics
- Azure Monitor
- Introduction Log Analytics

Monitoring

What do we want to monitor

- Azure Data Factory Resource
- Integration runtime
- Trigger runs
- Pipeline runs
- Activity runs

Data Factory Monitor

- Ability to monitor status of pipeline/ triggers
- Can be used to re-run failed pipelines/ triggers
- Ability to send alerts from base level metrics
- Provides base level metrics and logs
- Pipeline runs are stored only for 45 days

Azure Monitor

- Ability to route the diagnostic data to other storage solutions
- Provides richer diagnostic data
- Ability to write complex queries and custom reporting
- Ability to report across multiple data factories

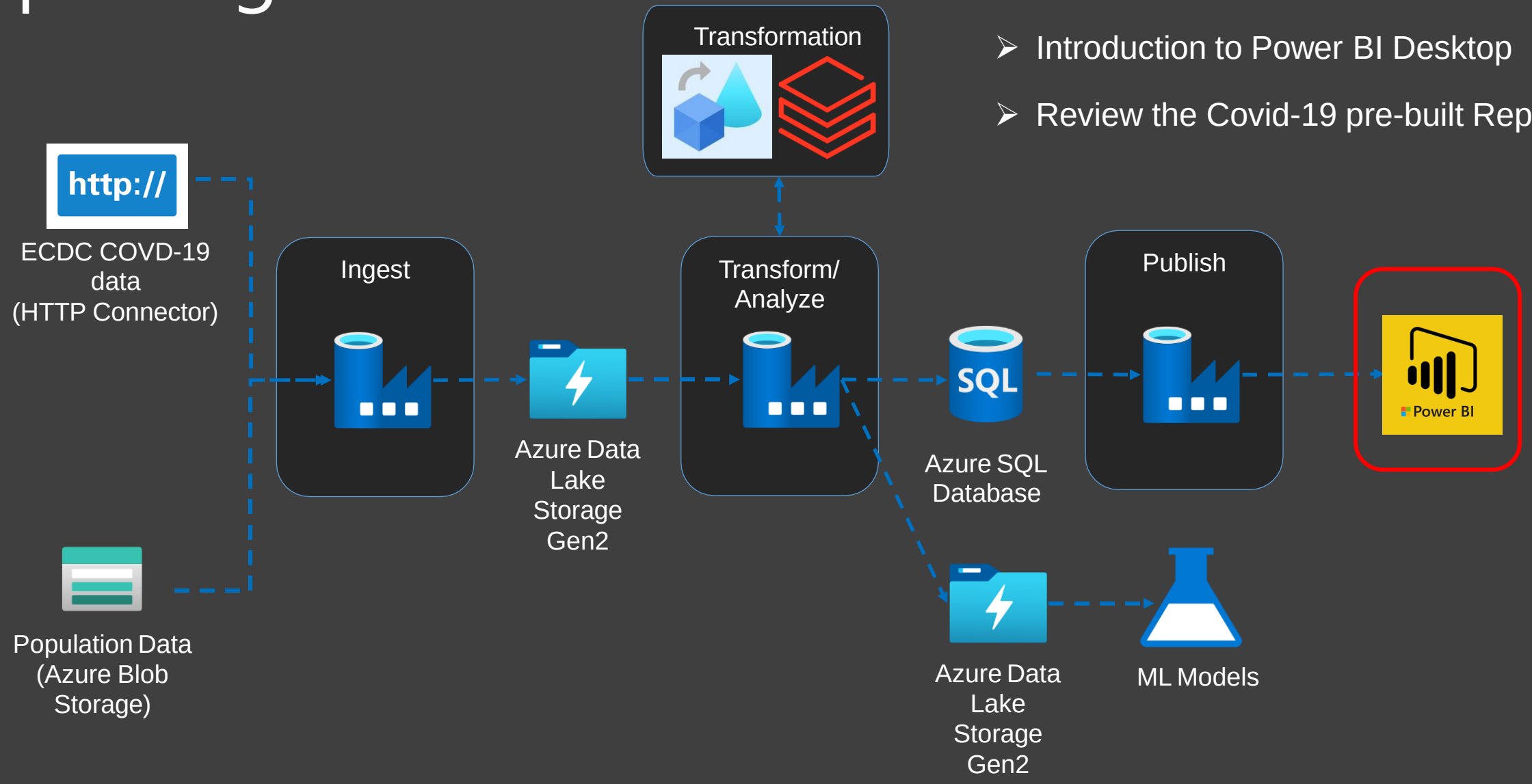
Data Factory Monitor

Azure Monitor

Reporting via Power BI

Reporting via Power BI

- Introduction to Power BI Desktop
- Review the Covid-19 pre-built Report



Power BI Desktop Overview