Harnessing Azure Synapse Analytics Serverless SQL Pools with Power BI Dataflows

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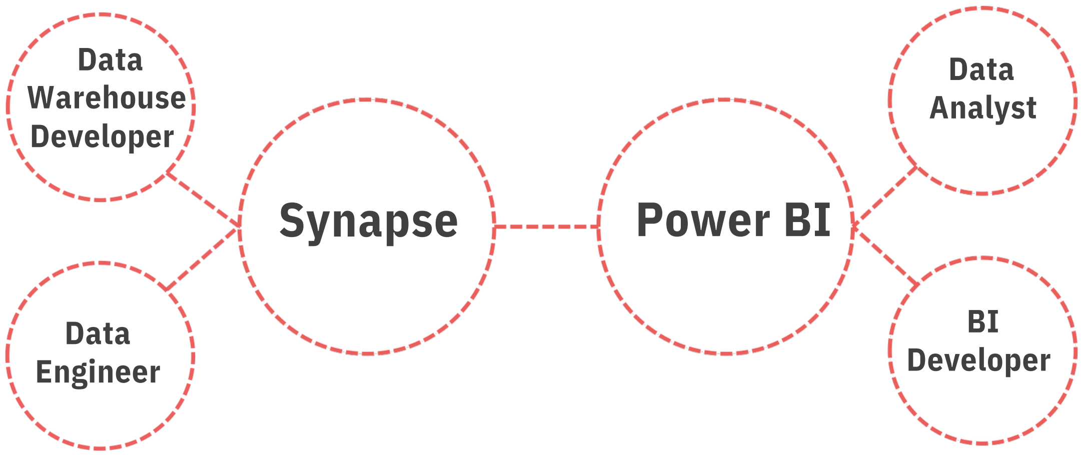
Who is this for?

Azure Synapse Analytics and Power BI have different role profiles. However, there is cross-over in terms of features available in Synapse such as Power BI integration.
Depending on the organisation size and data team maturity, the following roles may be carried out by dedicated teams or role-played amongst individuals.



Data Warehouse Developer

- Building Data Warehouse solutions using Synapse Analytics

Data Engineer

- Extracting, Loading and Transforming data from many sources

Business Intelligence Developer

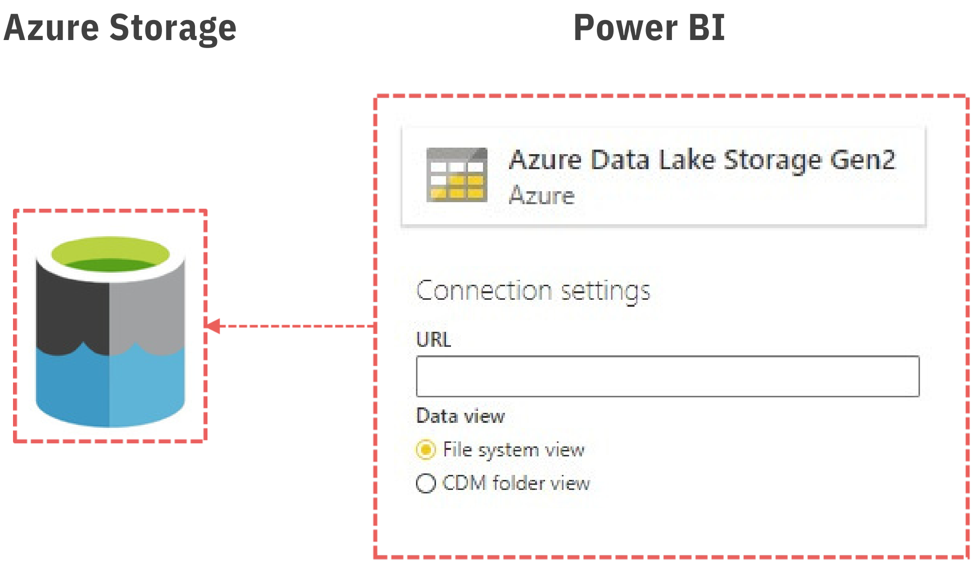
- Creating centralised data sets and data models with metrics

Data Analyst

- Creating analyses including reports and dashboards

Why are we connecting Power BI to Synapse?

Power BI already has a native Azure Data Lake Gen2 connector...why would we want to connect to Synapse Analytics and use the Serverless SQL engine?



Azure Data Lake Storage Gen2
Azure

Connection settings

URL

Data view

(● File system view) ○ CDM folder view

- “Out of the box” connector readily available.
- Power BI can connect to any level in the Azure Data Lake Gen2 folder hierarchy.
- Power BI can recursively load all file data located within the folder hierarchy.
- Can perform better than Serverless for small source datasets < 1GB.

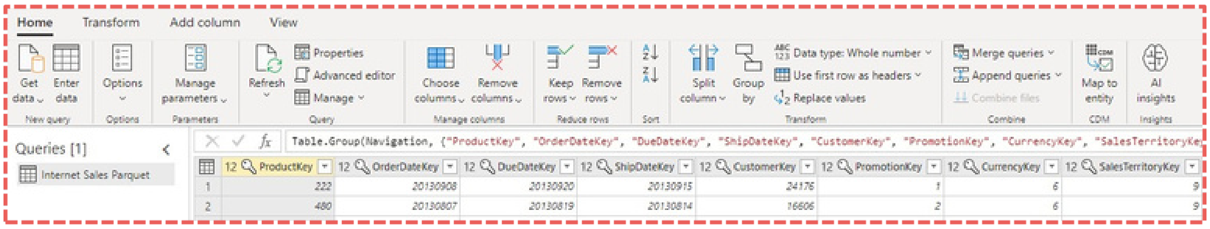
However...

- If the size of the data grows or required transformations affect performance...Serverless SQL can take the heavy-lifting away from Power BI. The best gains will be aggregation transformations in which the data is being reduced in size from the source into Power BI.

Power BI Dataflows

A Power Query basedfeature in the Power BI Service which enables:

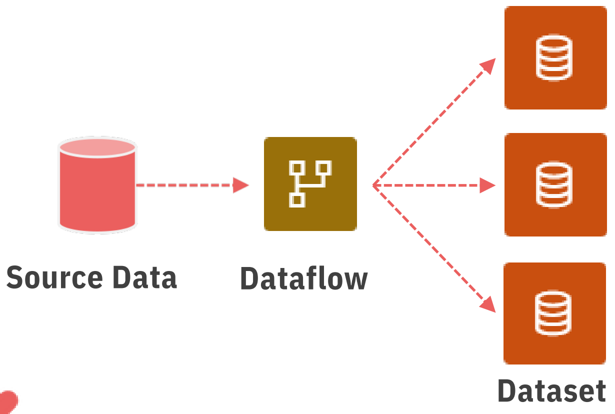
- Connecting to a variety of data sources including SQL Databases and Data Lake Storage
- Cleansingand Transforming the data to suit requirements
- Mapping to common business entities using the Common Data Model
- Creating a centralised repository of data ready for using in Power BI Datasets



```
Table.Group(Navigation, {"ProductKey", "OrderDateKey", "DueDateKey", "ShipDateKey", "CustomerKey", "PromotionKey", "CurrencyKey", "SalesTerritoryKe
```

	ProductKey	OrderDateKey	DueDateKey	ShipDateKey	CustomerKey	PromotionKey	CurrencyKey	SalesTerritoryKey
1	222	20130908	20130920	20130915	24176	1	6	9
2	480	20130807	20130819	20130814	16606	2	6	9

Dataflows reduce the number of times a data source is queried for data and reduces duplication of transformation logic.

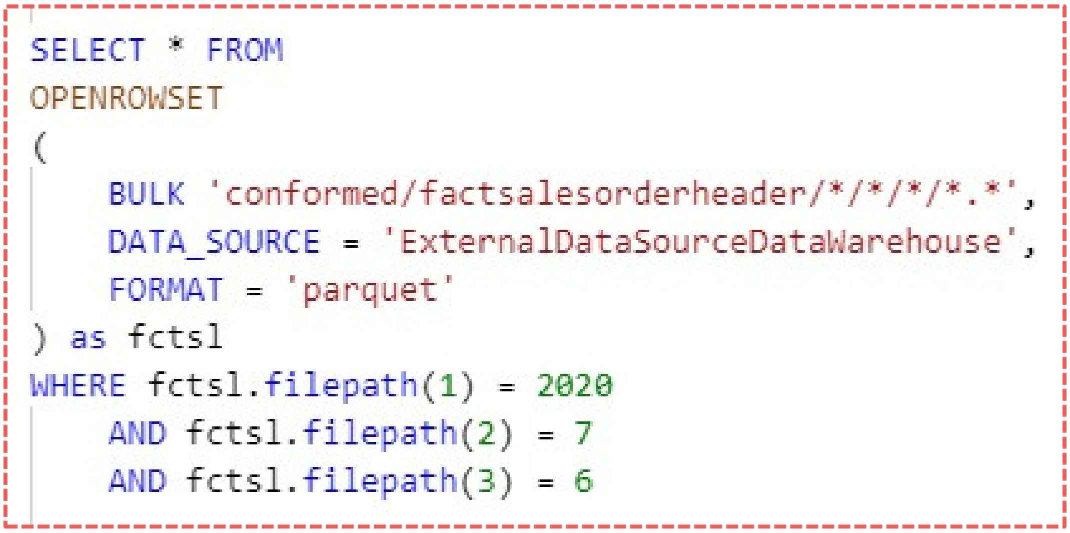


In this example, a single Dataflow connects to and loads data from a data source, reducing the number of times the data source is queried. The Datasets then use the single Dataflow.

Azure Synapse Analytics Serverless SQL Pools

Azure Synapse Analytics Serverless SQL is a cloud analytics platform to read and write data in Azure Storage and Azure Data Lake Gen2.

Serverless SQL is built around the ability to query file data "in place"using T-SQL without copying data to internal storage.



```sql
SELECT * FROM
OPENROWSET
(
    BULK 'conformed/factsalesorderheader/*/*/*/*.*',
    DATA_SOURCE = 'ExternalDataSourceDataWarehouse',
    FORMAT = 'parquet'
) as fctsl
WHERE fctsl.filepath(1) = 2020
    AND fctsl.filepath(2) = 7
    AND fctsl.filepath(3) = 6
```

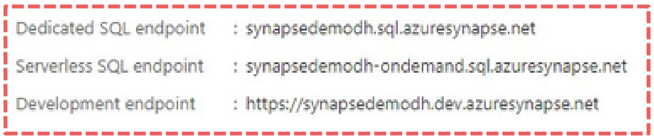
In the example above, T-SQL is used to SELECT all the data from every file that exists in the specified folder structure. The filepath() function is used to specify which folders to read data from, therefore eliminating any folders not required.

Serverless SQL includes the ability to write the results of a SELECT queryto external data lake storage for later retrieval or use in a data solution..

Serverless SQL exposes a standard SQL endpoint which allows SQL Client tools, Business Intelligence software and many other tools to connect and pass-through SQL commands and browse supported objects.

Serverless SQL Pools and Dataflows together

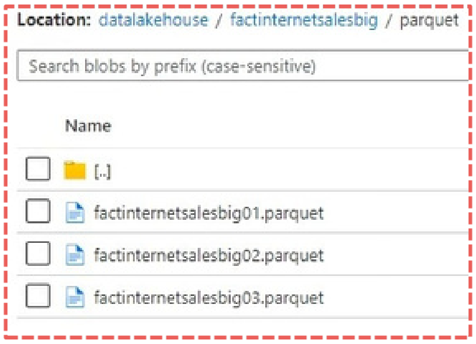
Power BI can connect to the Serverless SQL endpoint just like any SQL database. Connections can be made from Power BI Desktop and Power BI Service.



Dedicated SQL endpoint	: synapsedemodh.sql.azuresynapse.net
Serverless SQL endpoint	: synapsedemodh-ondemand.sql.azuresynapse.net
Development endpoint	: https://synapsedemodh.dev.azuresynapse.net

SQL endpoint visible via the Azure Portal

Source data in Storage / Data Lake

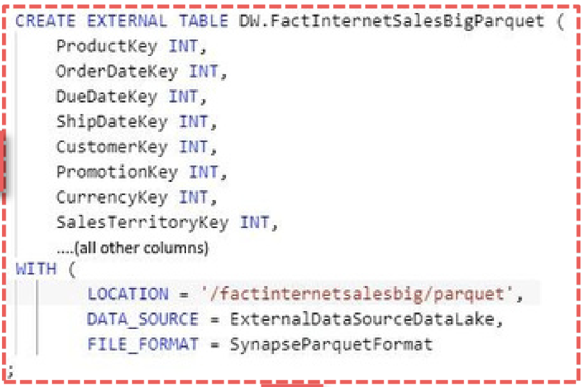


Location: datalakehouse / factinternetsalesbig / parquet

Search blobs by prefix (case-sensitive)

Name
[..]
factinternetsalesbig01.parquet
factinternetsalesbig02.parquet
factinternetsalesbig03.parquet

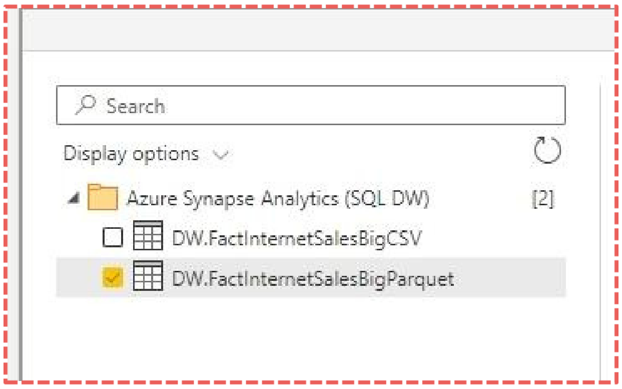
Create table to read data



```
CREATE EXTERNAL TABLE DW.FactInternetSalesBigParquet (
    ProductKey INT,
    OrderDateKey INT,
    DueDateKey INT,
    ShipDateKey INT,
    CustomerKey INT,
    PromotionKey INT,
    CurrencyKey INT,
    SalesTerritoryKey INT,
    ....(all other columns)
WITH (
        LOCATION = '/factinternetsalesbig/parquet',
        DATA_SOURCE = ExternalDataSourceDataLake,
        FILE_FORMAT = SynapseParquetFormat
;
```

If you have CSV, Parquet orJSON files in Storage, SQL Serverless can connect and perform data processing.
You can create a Power BI Dataflow and use Serverless SQL as a data source.
SQL is pushed down to SQL Serverless due to Power Query's Query Folding feature.

Connect to table in Power BI Dataflow

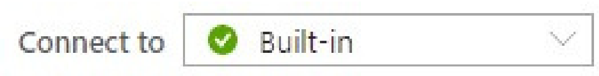


Azure Synapse Analytics (SQL DW) [2]
- ☐ DW.FactInternetSalesBigCSV
- ✓ DW.FactInternetSalesBigParquet

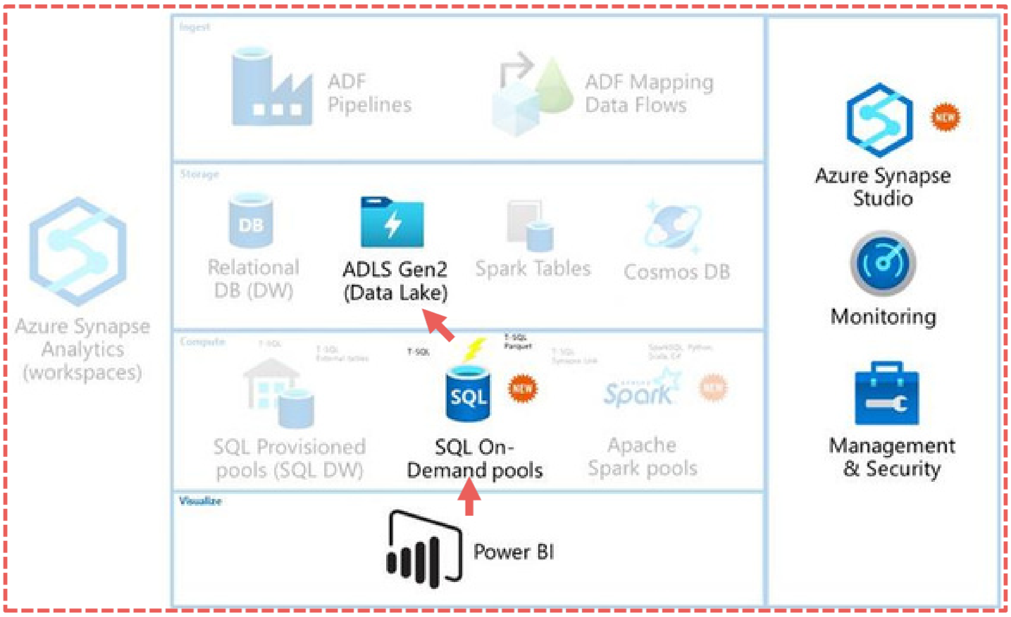
Azure Synapse Analytics

In this scenario Serverless SQL is being used as an intermediate service by Power BI Dataflows for data processing and transformation.

When an Azure Synapse Analytics resource is created, a Serverless SQL Pool is created automaticallyand is available immediately for use.



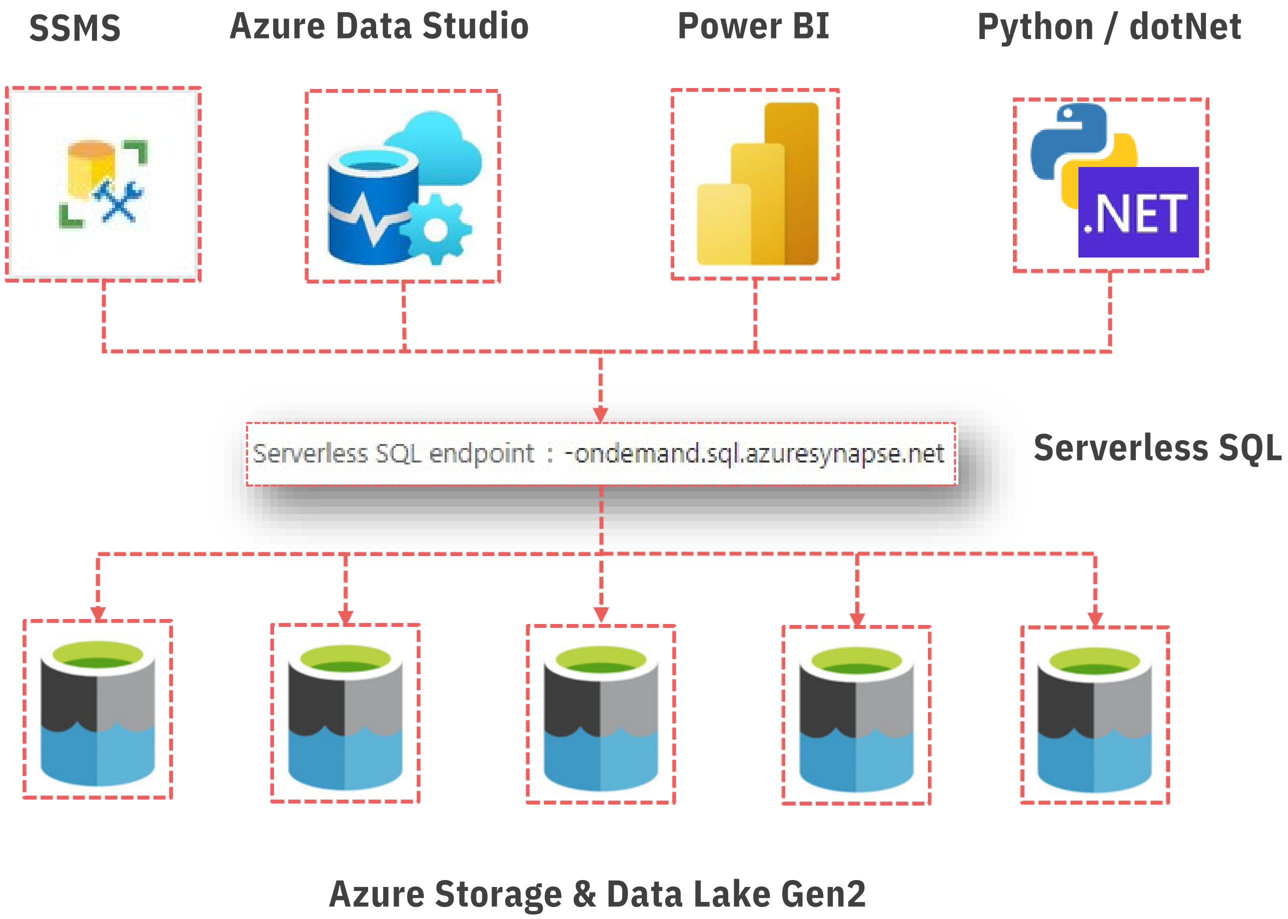
"Built-in" Serverless SQL pool available as soon as Azure Synapse Analytics resource is created.



- We do not needto provision a Dedicated SQL Pool
- We do not need to provision Spark pools
- We do not need to integrate Power BI workspaces
- We do not need to create pipelines

Connecting to the Serverless SQL endpoint

As Serverless SQL exposes a SQL endpoint, there are many options in terms of connecting from various software.


SSMS
Azure Data Studio
Power BI
Python / dotNet
.NET
Serverless SQL endpoint : -ondemand.sql.azuresynapse.net
Serverless SQL
Azure Storage & Data Lake Gen2

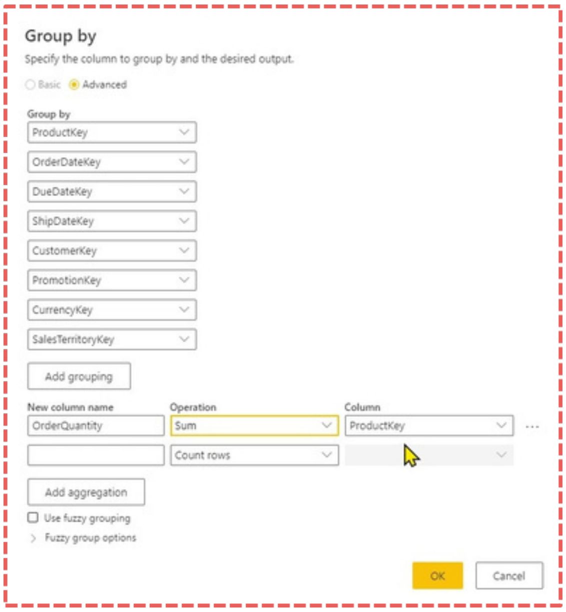
In the context of using with Power BI, a Data Analyst/BI Developer could connect to Serverless SQL via a SQL client tool to perform ad-hoc analysis before creating a Power BI artifact.

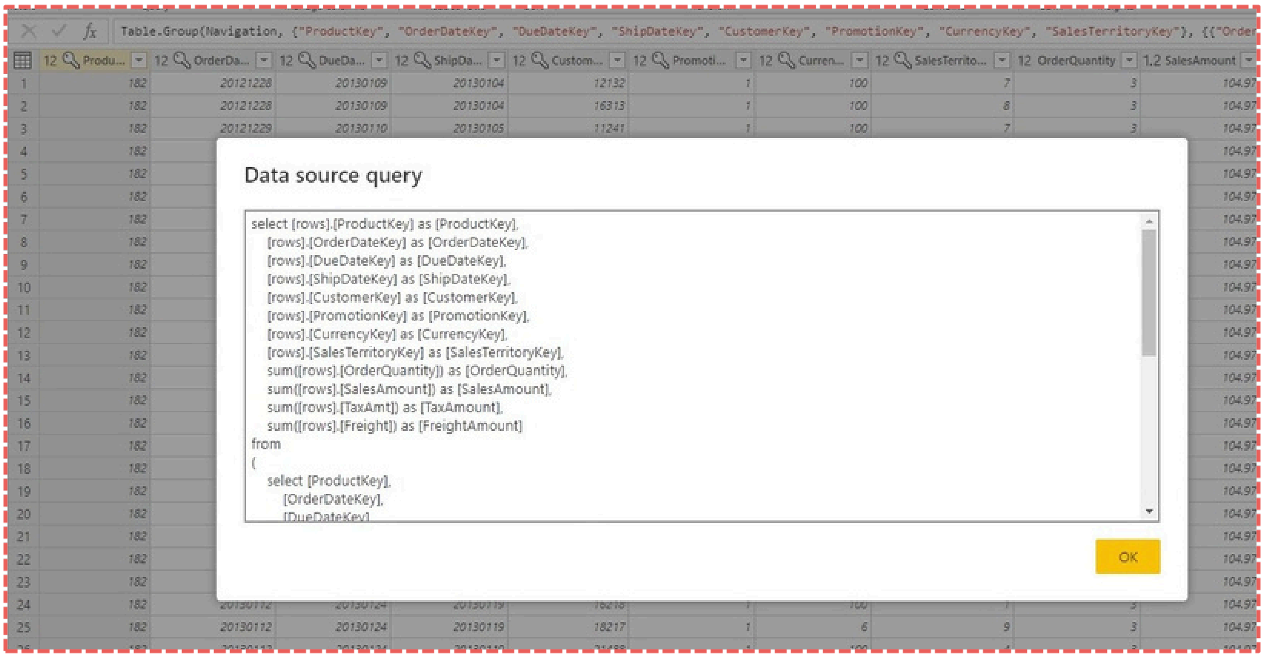
Power BI Query Folding

When transformations are applied to the dataset and can be "folded", the logic to perform the transformations is passed to the data source. In this scenarios, Serverless SQL will receive a SQL statement.

In this example, the GROUP BY transformation within the Dataflow is being used to aggregate and therefore reduce the incoming dataset size.

The SQL generated by the transformation will be sent to Serverless SQL.





```
Table.Group(Navigation, {"ProductKey", "OrderDateKey", "DueDateKey", "ShipDateKey", "CustomerKey", "PromotionKey", "CurrencyKey", "SalesTerritoryKey"}, {{"Order
```

	12 Produ...	12 OrderDa...	12 DueDa...	12 ShipDa...	12 Custom...	12 Promoti...	12 Curren...	12 SalesTerrito...	12 OrderQuantity	1.2 SalesAmount
1	182	20121228	20130109	20130104	12132	1	100	7	3	104.97
2	182	20121228	20130109	20130104	16313	1	100	8	3	104.97
3	182	20121229	20130110	20130105	11241	1	100	7	3	104.97
4	182									104.97
5	182									104.97
6	182									104.97
7	182									104.97
8	182									104.97
9	182									104.97
10	182									104.97
11	182									104.97
12	182									104.97
13	182									104.97
14	182									104.97
15	182									104.97
16	182									104.97
17	182									104.97
18	182									104.97
19	182									104.97
20	182									104.97
21	182									104.97
22	182									104.97
23	182									104.97
24	182	20130112	20130124	20130119	18216	1	100	1		104.97
25	182	20130112	20130124	20130119	18217	1	6	9	3	104.97

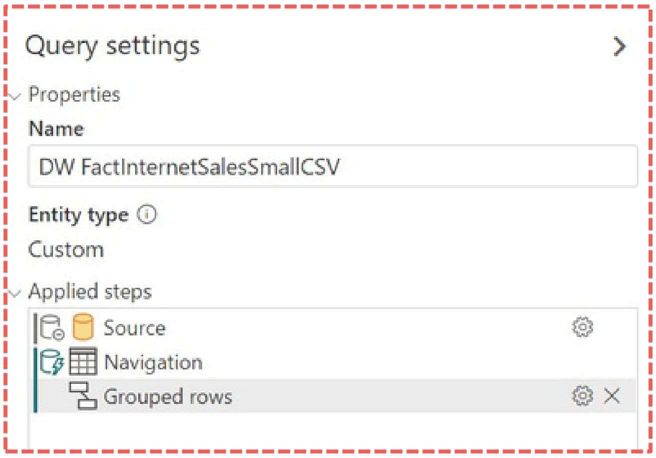
Data source query

```
select [rows].[ProductKey] as [ProductKey],
    [rows].[OrderDateKey] as [OrderDateKey],
    [rows].[DueDateKey] as [DueDateKey],
    [rows].[ShipDateKey] as [ShipDateKey],
    [rows].[CustomerKey] as [CustomerKey],
    [rows].[PromotionKey] as [PromotionKey],
    [rows].[CurrencyKey] as [CurrencyKey],
    [rows].[SalesTerritoryKey] as [SalesTerritoryKey],
    sum([rows].[OrderQuantity]) as [OrderQuantity],
    sum([rows].[SalesAmount]) as [SalesAmount],
    sum([rows].[TaxAmt]) as [TaxAmount],
    sum([rows].[Freight]) as [FreightAmount]
from
(
    select [ProductKey],
        [OrderDateKey],
        [DueDateKey]
```

Power BI Query Folding

However, not all transformations with the Dataflow can be "folded" and therefore not pushed down to the source data engine. In this instance, a transformation within the Power BI Dataflow can cause the query to no longer "fold".

Within the Dataflow, there is an indicator to show whether the query is being folded. In this example the indicator is green, which shows that the query is being folded.



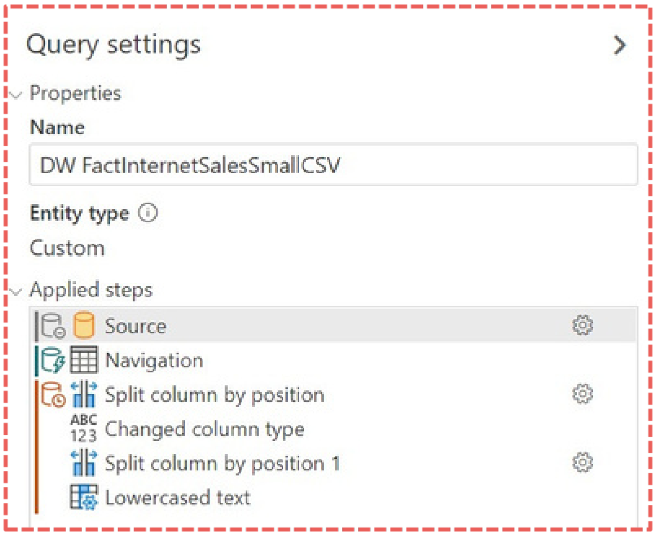
Query settings

Properties

Name: DW FactInternetSalesSmallCSV

Entity type: Custom

Applied steps
- Source
- Navigation
- Grouped rows



Query settings

Properties

Name: DW FactInternetSalesSmallCSV

Entity type: Custom

Applied steps
- Source
- Navigation
- Split column by position
- Changed column type
- Split column by position 1
- Lowercased text

In this example a split column by delimiter transformation has been applied to the data resulting in an orange indicator from that specific step. This shows that this new transformation is not being folded to Serverless SQL. It's important to note that the steps preceding this new step are still being folded to Serverless SQL. It's important to move any foldable transformations before any non-foldable transformations.

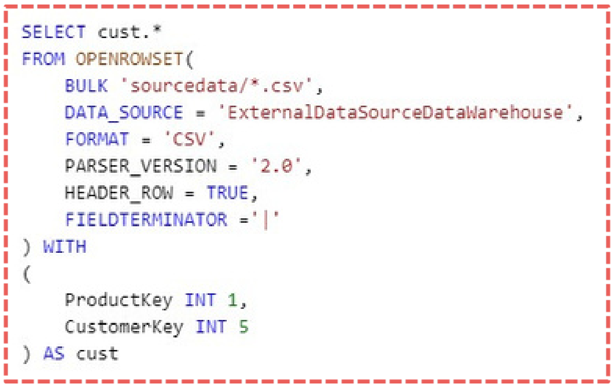
Supported File Formats

CSV, Parquetand JSONfile formats stored in Azure Storage and Azure Data Lake Gen2 are supported by Serverless SQL. The focus for the remainder of this guide will be CSVand Parquet.

CSV

A CSV(Comma-Separated File)is a text format file which is readable by a wide-range of text editors and data transformation tools.

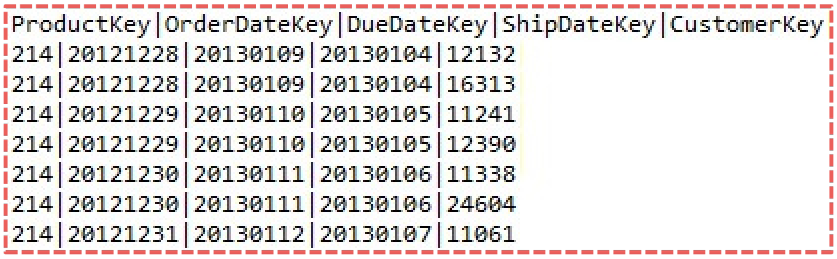
Serverless SQL will read the entire CSV file when a SQL query is issued regardless of any filter present. The filepath() andfilename() can be used to include or exclude certain folders and CSV files to reduce data processed.



```
SELECT cust.*
FROM OPENROWSET(
    BULK 'sourcedata/*.csv',
    DATA_SOURCE = 'ExternalDataSourceDataWarehouse',
    FORMAT = 'CSV',
    PARSER_VERSION = '2.0',
    HEADER_ROW = TRUE,
    FIELDTERMINATOR ='|'
) WITH
(
    ProductKey INT 1,
    CustomerKey INT 5
) AS cust
```

Within the SELECTstatement, a WITHkeyword can be used to select specific columns from the CSV using the ordinal position of the column.

Ordinal Position 1 Ordinal Position 2



```
ProductKey|OrderDateKey|DueDateKey|ShipDateKey|CustomerKey
214|20121228|20130109|20130104|12132
214|20121228|20130109|20130104|16313
214|20121229|20130110|20130105|11241
214|20121229|20130110|20130105|12390
214|20121230|20130111|20130106|11338
214|20121230|20130111|20130106|24604
214|20121231|20130112|20130107|11061
```

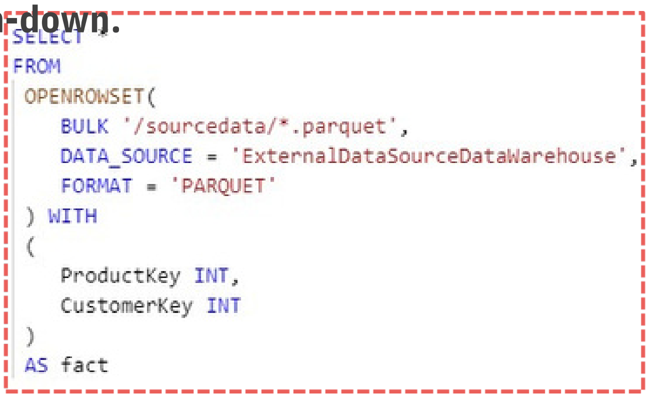
Supported File Formats

Parquet

A Parquet file is a columnar(columntore) based compressedfile format which contains the data itself plus the schema definition and statistics about the data.

Serverless SQL will only read the columns and data necessary to support the SQL query issues as Parquet files support predicate push-down.

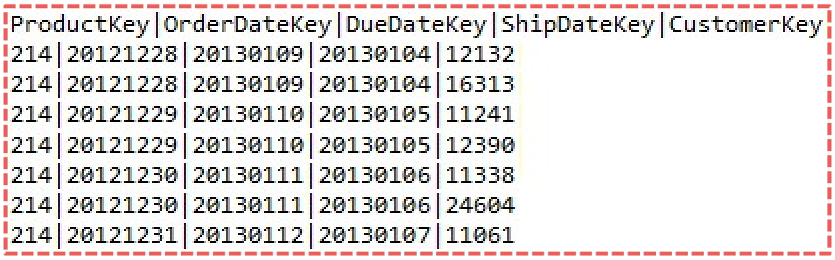
The filepath() andfilename() can be used to include or exclude certain folders and Parquet files to reduce data processed.



```
SELECT *
FROM
 OPENROWSET(
    BULK '/sourcedata/*.parquet',
    DATA_SOURCE = 'ExternalDataSourceDataWarehouse',
    FORMAT = 'PARQUET'
 ) WITH
 (
    ProductKey INT,
    CustomerKey INT
 )
 AS fact
```

Within the SELECTstatement, a WITHkeyword can be used to select specific columns from the CSV using the name of the column in the Parquet file.

Named Column   Named Column

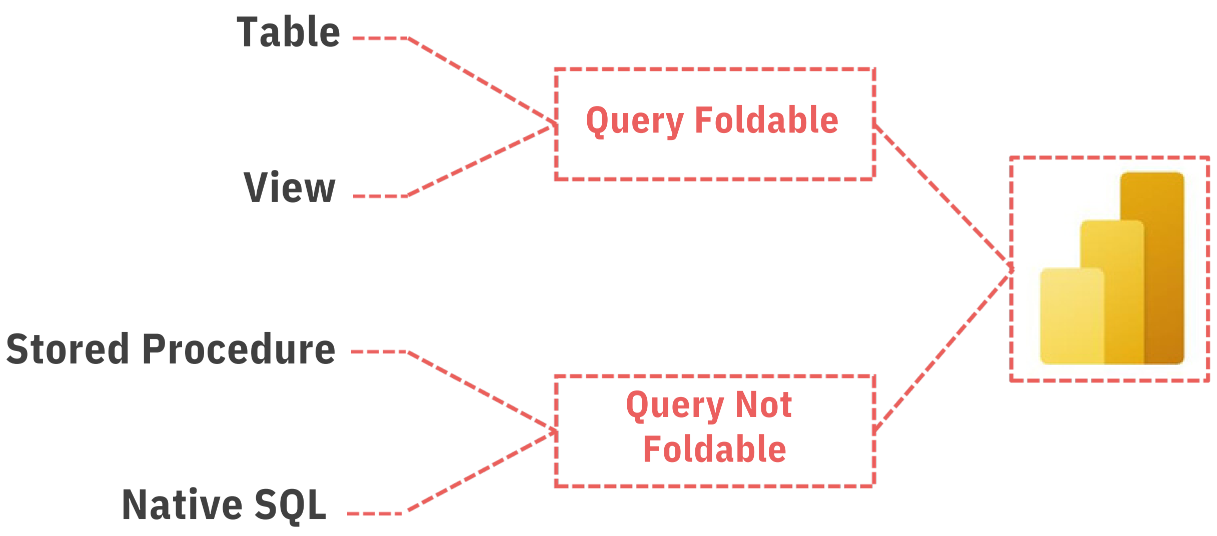


```
ProductKey|OrderDateKey|DueDateKey|ShipDateKey|CustomerKey
214|20121228|20130109|20130104|12132
214|20121228|20130109|20130104|16313
214|20121229|20130110|20130105|11241
214|20121229|20130110|20130105|12390
214|20121230|20130111|20130106|11338
214|20121230|20130111|20130106|24604
214|20121231|20130112|20130107|11061
```

Which SQL objects can Power BI connect to

The Serverless SQL engine exposes a SQL endpoint which will allow Power BI to connect and interact with the following supported objects:

Object	Notes
Table	An External Table which points to a folder location within Azure Storage / Data Lake Gen 2
View	A View which can point to specific folders locations within a Data Lake and also allow “partition pruning”
Stored Procedure	Conditional logic support but has limitations around “query folding”
Native SQL	A SQL statement can be written and used to retrieve data but has similar limitation to a stored procedure with regards to !query folding”

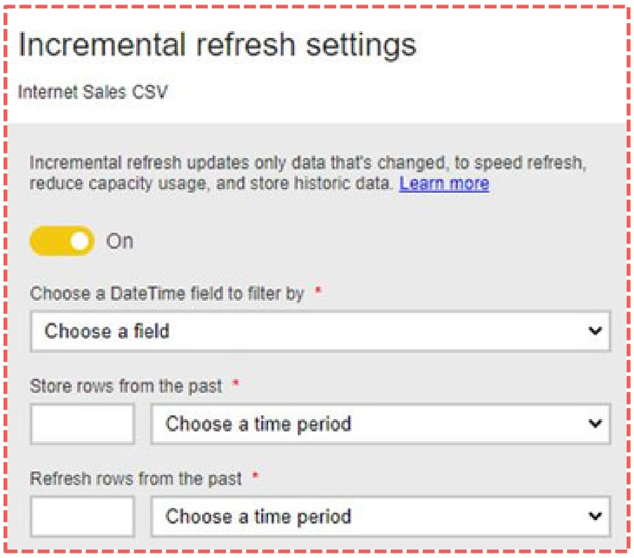


Dataflow Incremental Refresh

If there is a DateTimecolumn within the data then we are able to enable the Incremental Refresh (Premium feature in Dataflows) and Power BI Desktop (Pro feature).

External Tables: If using an external table as the data source, the refresh will scan all folders, sub-folders, and files referenced by the external table location.

Views: If using a View as the data source, we have the option of partition pruning (excluding folders not required) using the filepath()function within Serverless SQL.



Incremental refresh settings

Internet Sales CSV

Incremental refresh updates only data that's changed, to speed refresh, reduce capacity usage, and store historic data. Learn more

On

Choose a DateTime field to filter by *

Choose a field

Store rows from the past *

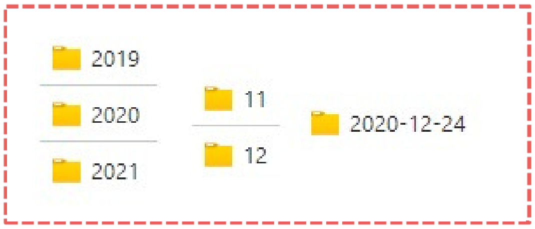
Choose a time period

Refresh rows from the past *

Choose a time period

The SELECT statement will pass the date through to the filepath function within the View and only read folders in the Data Lake that match the filter.

```
CREATE VIEW DW.vwFactInternetSales
AS
SELECT CAST(fct.filepath(1) AS DATETIME)
        AS FilePathDate,
ProductKey,
COUNT(*) AS TotalProductCount
FROM
OPENROWSET...
```

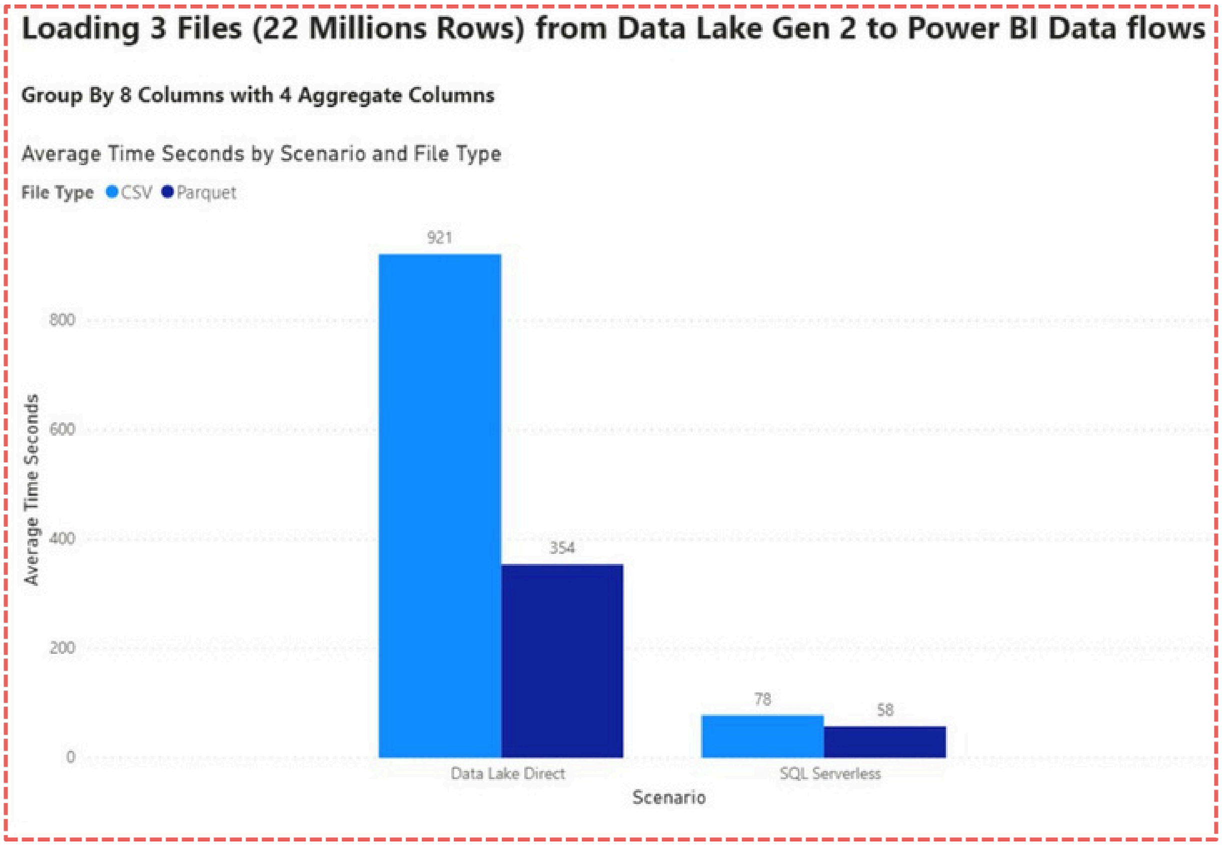


```
SELECT ProductKey,TotalProductCount
FROM DW.vwFactInternetSales
WHERE FilePathDate = '2020-12-24'
```

We create a folder structure in the Data Lake than can be read by the filepath() function.

Data Loading Performance Analysis

When comparing the performance of Serverless SQL and the Power BI native Data Lake connector, we can see an improvement in loading performance.



The data loading tests were carried out on CSVand Parquetdata.

Total CSV file size: 4.5 GB

Total Parquet file size: 1.5 GB

Pushing foldable transformations down to the Serverless SQL Pool can reduce the time taken to load Power BI Dataflows.

Considerations

Cost

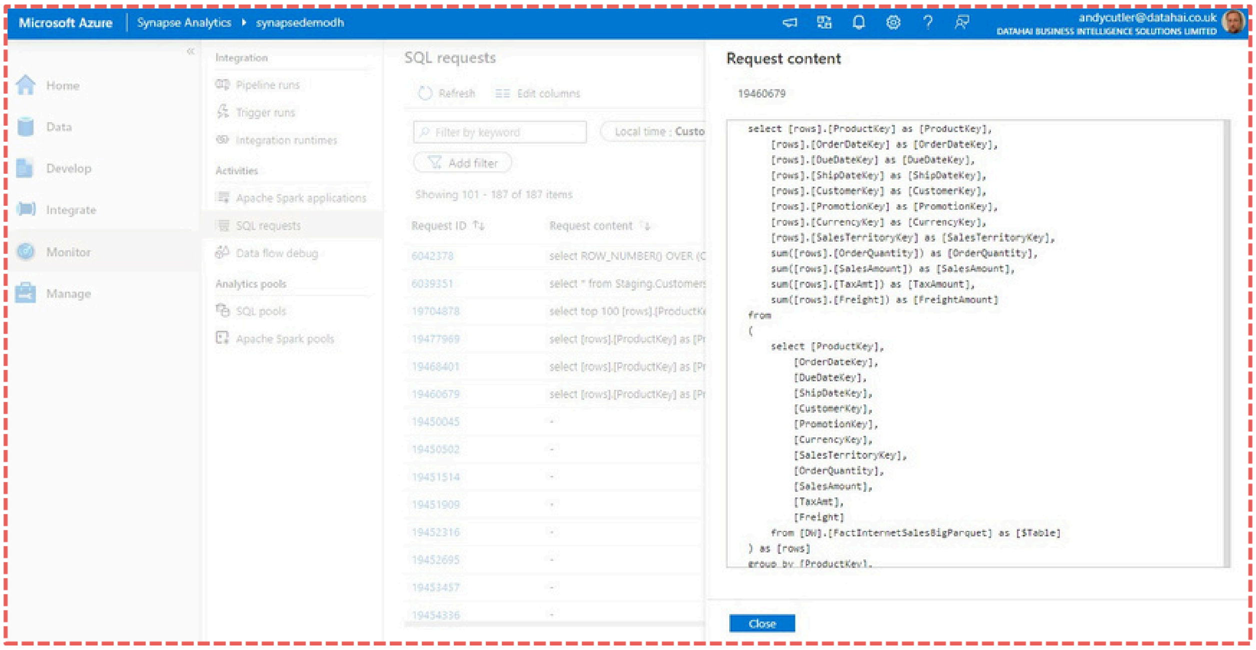
SQL Serverless does cost money!
£4.659 per 1 Terabyte (1TB) of Data Processed
When developing/testing, use a smaller file or set of smaller files
Data at rest does not necessarily translate directly into data processed

Infrastructure

Adds another service into a data architecture which will need managing
However, you can use Synapse Analytics SQL Serverless as a processing engine without any data warehousing

Serverless SQL Pools Monitoring

The SQL generated by Power BI can be seen in the Monitorarea of Synapse Analytics Studio.



Request ID	Request content
6042378	select ROW_NUMBER() OVER (C
6039351	select * from Staging.Customers
19704878	select top 100 [rows].[ProductK
19477969	select [rows].[ProductKey] as [Pr
19468401	select [rows].[ProductKey] as [Pr
19460679	select [rows].[ProductKey] as [Pr
19450045	-
19450502	-
19451514	-
19451909	-
19452316	-
19452695	-
19453457	-
19454336	-

19460679

```
select [rows].[ProductKey] as [ProductKey],
    [rows].[OrderDateKey] as [OrderDateKey],
    [rows].[DueDateKey] as [DueDateKey],
    [rows].[ShipDateKey] as [ShipDateKey],
    [rows].[CustomerKey] as [CustomerKey],
    [rows].[PromotionKey] as [PromotionKey],
    [rows].[CurrencyKey] as [CurrencyKey],
    [rows].[SalesTerritoryKey] as [SalesTerritoryKey],
    sum([rows].[OrderQuantity]) as [OrderQuantity],
    sum([rows].[SalesAmount]) as [SalesAmount],
    sum([rows].[TaxAmt]) as [TaxAmount],
    sum([rows].[Freight]) as [FreightAmount]
from
(
    select [ProductKey],
        [OrderDateKey],
        [DueDateKey],
        [ShipDateKey],
        [CustomerKey],
        [PromotionKey],
        [CurrencyKey],
        [SalesTerritoryKey],
        [OrderQuantity],
        [SalesAmount],
        [TaxAmt],
        [Freight]
    from [DW].[FactInternetSalesBigParquet] as [$Table]
) as [rows]
group by [ProductKey],
```

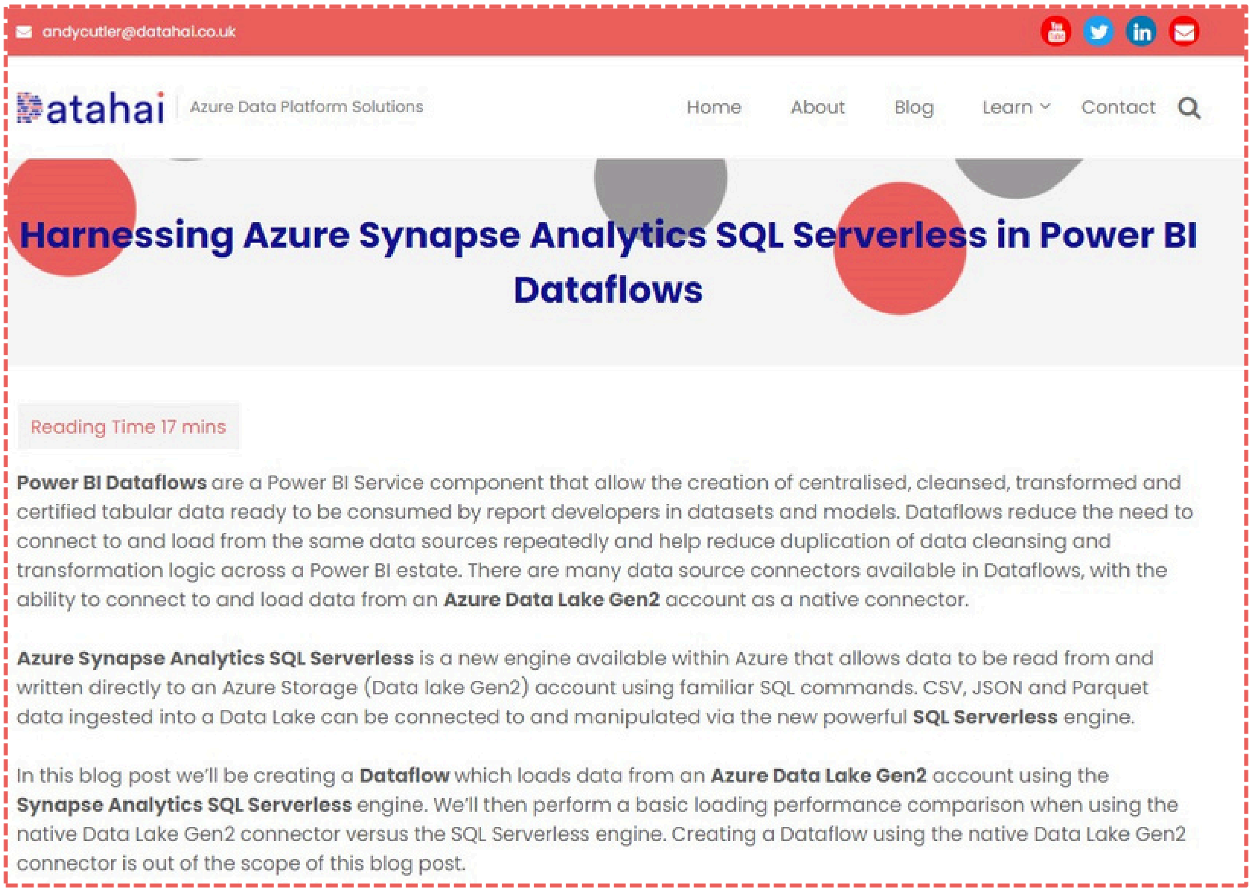
The statistics include the query time and also the Data Processed amount, which is a vital statistic as this is how Serverless SQL’s cost model is based on. Keep track of this metric to ensure costs are tracked.
Synapse Studio includes the capability to limit the amount of data processed per day, week, and month by using the Cost Management feature available in the Manage area.

Further Reading

The following links will take you through the technical implementation of Synapse Analytics and connecting with Power BI.

Getting Started with Azure Synapse Analytics SQL Serverless

Harnessing Azure Synapse Analytics SQL Serverless in Power BI Dataflows



Harnessing Azure Synapse Analytics SQL Serverless in Power BI Dataflows

Reading Time 17 mins

Power BI Dataflows are a Power BI Service component that allow the creation of centralised, cleansed, transformed and certified tabular data ready to be consumed by report developers in datasets and models. Dataflows reduce the need to connect to and load from the same data sources repeatedly and help reduce duplication of data cleansing and transformation logic across a Power BI estate. There are many data source connectors available in Dataflows, with the ability to connect to and load data from an **Azure Data Lake Gen2** account as a native connector.

Azure Synapse Analytics SQL Serverless is a new engine available within Azure that allows data to be read from and written directly to an Azure Storage (Data lake Gen2) account using familiar SQL commands. CSV, JSON and Parquet data ingested into a Data Lake can be connected to and manipulated via the new powerful **SQL Serverless** engine.

In this blog post we'll be creating a **Dataflow** which loads data from an **Azure Data Lake Gen2** account using the **Synapse Analytics SQL Serverless** engine. We'll then perform a basic loading performance comparison when using the native Data Lake Gen2 connector versus the SQL Serverless engine. Creating a Dataflow using the native Data Lake Gen2 connector is out of the scope of this blog post.