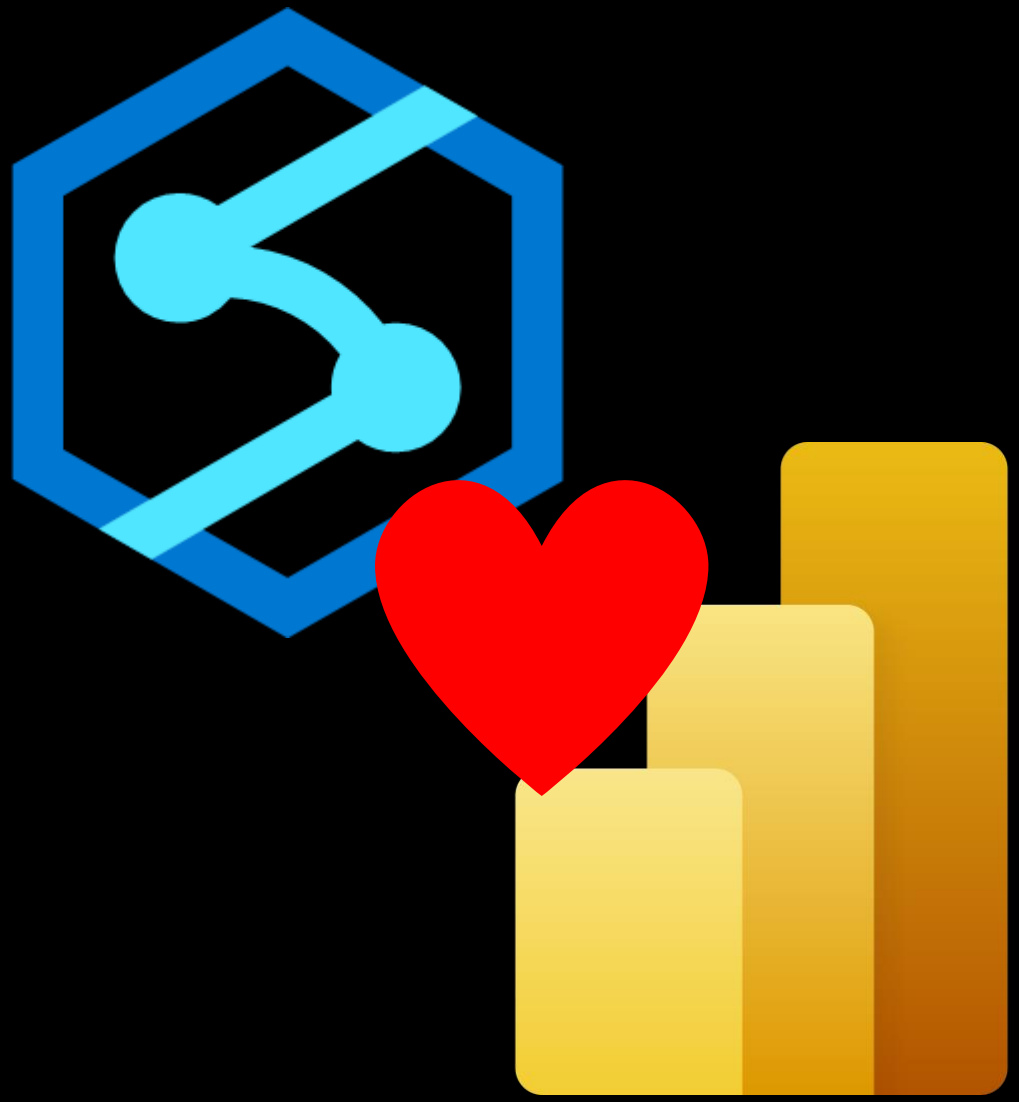
Analytics at scale with Power BI and Azure Synapse



Premium sponsors

Fellowmind

KONICA MINOLTA | NEXTAGENDA
ACHIEVE MORE WITH YOUR DATA
DIGITAL WORKPLACE SOLUTIONS FROM KONICA MINOLTA

kapacity

unit it

BUSINESS INNOVATION
BUSINESS INFORMATION
BUSINESS INTELLIGENCE

POWER BI SENTINEL™
Governance, Disaster Recovery and Auditing for Power BI

[stoltze][it]

Initiate

Standard sponsors

CatMan® Solution

RELATE IT

Dave Ruijter

Solution Architect Data & Analytics
Blue Rocket Data Consulting & Solutions

dave@blue-rocket.it

@DaveRuijter

linkedin.com/in/DaveRuijter

ModernData.ai

BLUE ROCKET DATA CONSULTING & SOLUTIONS

Data-Marc.com

Marc Lelijveld

Data & Analytics consultant
Macaw Netherlands

Microsoft Power Platform
FASTTRACK RECOGNIZED SOLUTION ARCHITECT
2022

Microsoft® Most Valuable Professional

Microsoft MCT

marc.lelijveld@outlook.com
@MarcLelijveld
linkedin.com/in/MarcLelijveld
Data-Marc.com

BLUE ROCKET DATA CONSULTING & SOLUTIONS

Data-Marc.com


Kahoot!

Break times

Tea and coffee available all day

- 10:30 to 11:00 Refreshments with snacks
- 12:30 to 13:30 Lunch
- 15:30 to 16:00 Afternoon break with snacks

Agenda

- Challenges
- Deep Dive
- Lunch
- Hybrid Tables & Incremental Refresh
- Refresh Challenges & Orchestration
- Backup & Restore
- Scaling
- Monitoring
- Wrap-up

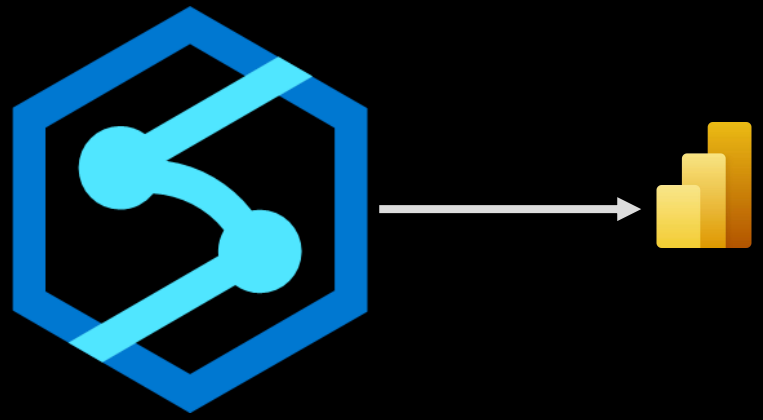
After this session

Design and implement	Orchestrate	Performance	Cost
Better design and implement complex data models, including hybrid tables, aggregations, and combined storage modes (import, DirectQuery , dual).	Orchestrate the end-to-end data processing, with a pipeline chain from data ingest in the data lake house to the incremental Power BI dataset refresh.	Use different techniques to identify performance bottlenecks in your solutions and how to solve those ("does it fold"?).	Implement a cost-efficient solution, that still meets the scalability demands.

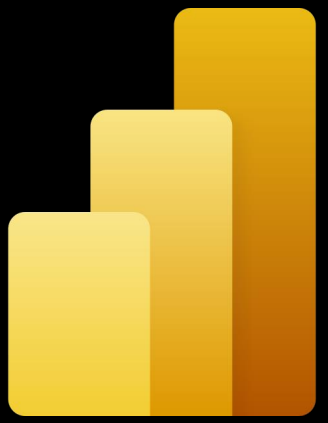
Solution challenges

two separate worlds

Data Platform



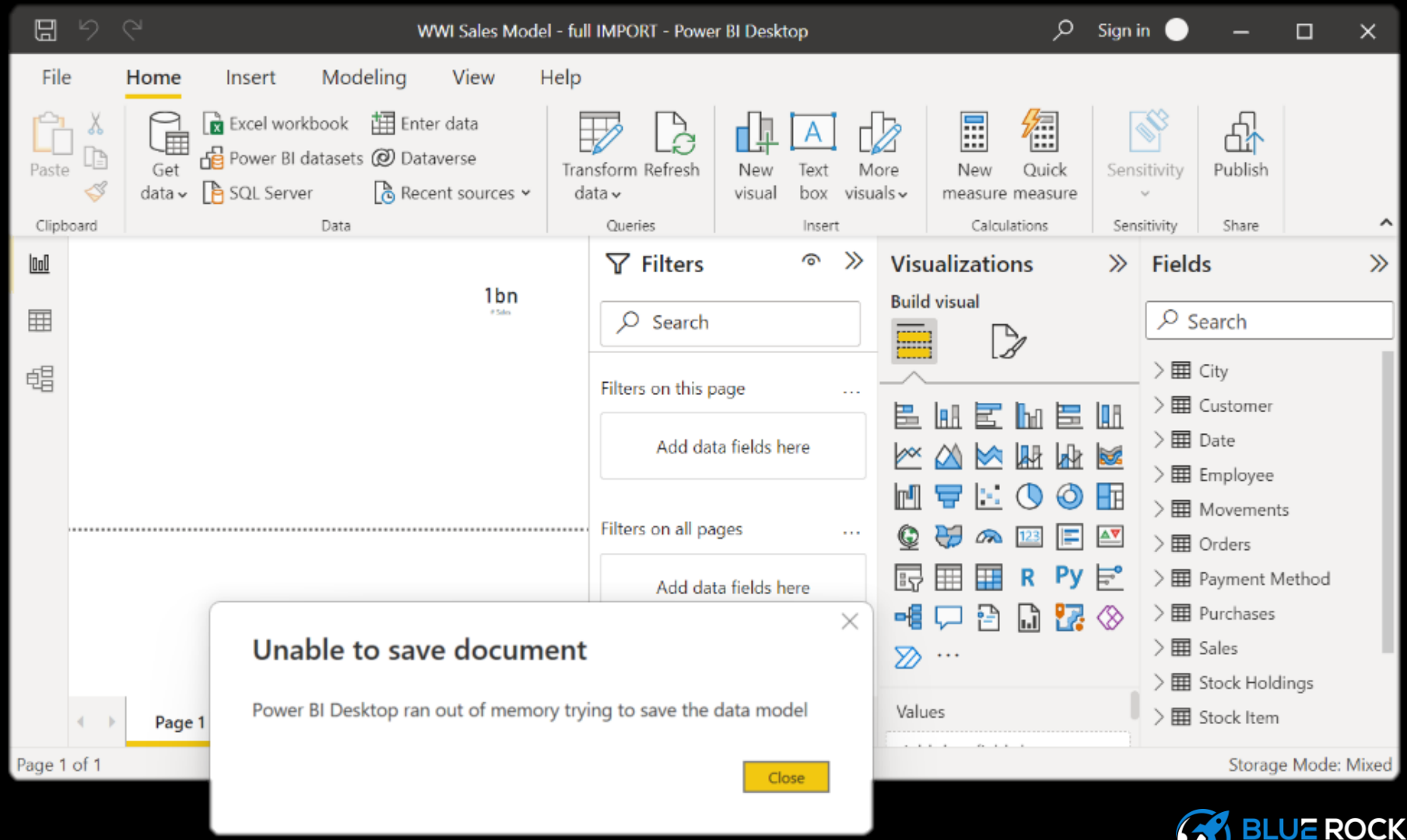
Power BI



Data Platform Solution Challenges

- Power BI report can't handle the volume of data
- Showing near real-time data in Power BI report

Power BI report can't handle the volume



BLUE ROCKET DATA CONSULTING & SOLUTIONS

Data-Marc.com

Demo

Power BI report can't handle the volume of data

Should I put everything on DirectQuery instead?

DirectQuery limitations

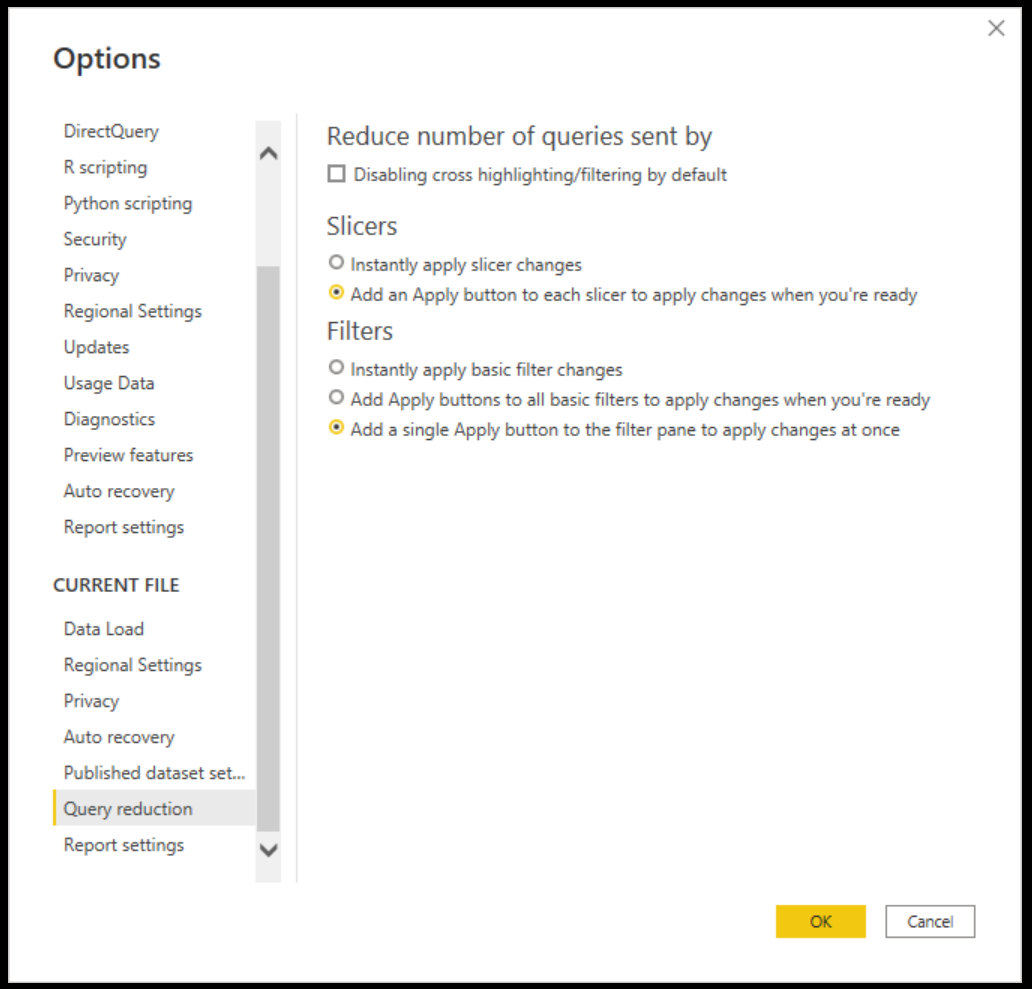
- Limited Power Query capabilities
- DirectQuery != streaming / live! Front-end still caches data
- No built-in date hierarchy (year/quarter/month/day)
- Lowest granularity data is seconds (no milliseconds)
- No parent-child support in DAX with *PATH()*
- Slower end user performance
- 1M row per query
- DAX limitations, only simple calculations possible

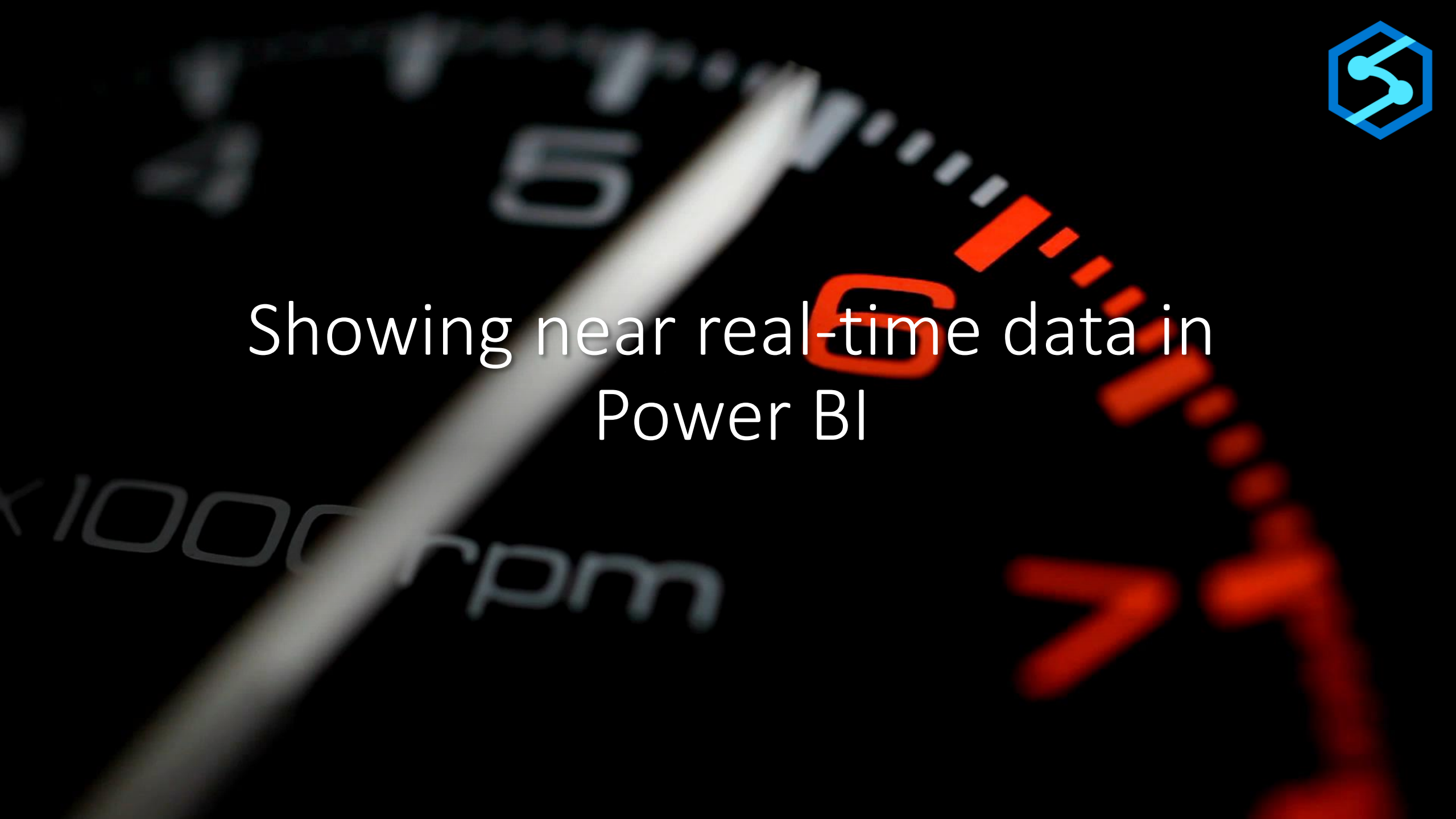
DirectQuery query reduction

Consider requesting to click **Apply** before queries are executed to the source

Applies to

- Slicers
- Filters (filter pane)





Showing near real-time data in Power BI

Showing near real-time data in Power BI

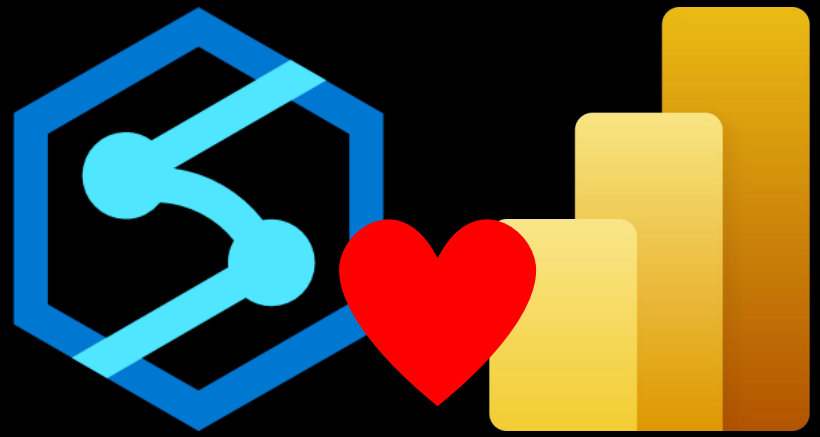
- Refresh takes to long
- Poor end-user performance on DirectQuery
- Streaming datasets only allow one table
- Potentially queries are not foldable, therefore incremental refresh does not work (depending on source)

Demo

Showing near real-time data in Power BI report

Data Platform Solution ~~Challenges~~

- Optimize Power BI model
- Use Aggregations
- Use Hybrid Table



Power BI Solution Challenges

- Loading data from various sources (flat files, databases, APIs)
- Some sources are manually maintained (like mapping tables)
- Data stored on decentralized storages, like SharePoint pages.
- Data from source systems are exported, rather than connected to analytical systems
- Store historical data in Power BI for trend analysis

WIDE WORLD IMPORTERS

OrderDate

Last | 1 | Select

No filters applied

Product Category

All

CountryRegion

- Canada
- United Kingdom
- United States

StateProvince, City

- Alberta
- Arizona
- British Columbia
- Brunswick

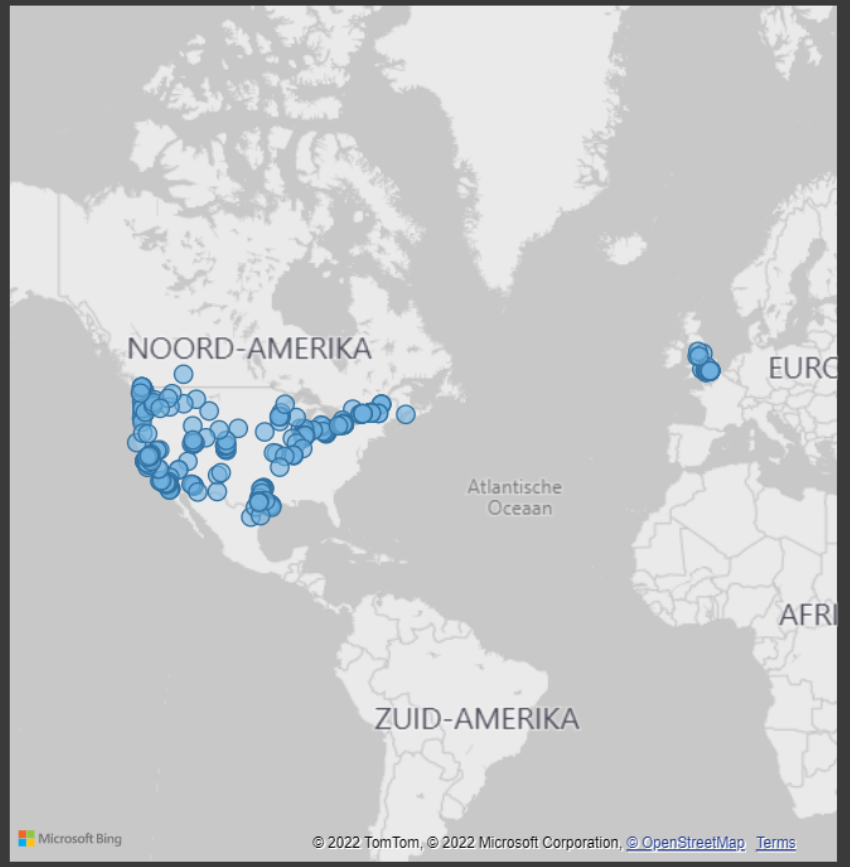
$708,69K
$ Sales

2.087
Order quantity

32
Orders

Product Category	# Order quantity	$ Sales	%GT $ Sales	$ Price Avg per product
Touring Bikes	252	$220.655,38	31,14%	$875,62
Road Bikes	222	$183.130,30	25,84%	$824,91
Mountain Bikes	209	$170.825,89	24,10%	$817,35
Mountain Frames	128	$54.949,60	7,75%	$429,29
Road Frames	60	$24.346,58	3,44%	$405,78
Touring Frames	39	$19.066,26	2,69%	$488,88
Jerseys	230	$7.017,88	0,99%	$30,51
Vests	121	$4.309,90	0,61%	$35,62
Cranksets	22	$3.968,87	0,56%	$180,40
Shorts	80	$3.299,80	0,47%	$41,25
Pedals	84	$2.996,50	0,42%	$35,67
Helmets	124	$2.523,88	0,36%	$20,35
Bike Racks	32	$2.304,00	0,33%	$72,00
Hydration Packs	50	$1.649,70	0,23%	$32,99
Bottom Brackets	22	$1.320,17	0,19%	$60,01
Derailleurs	21	$1.296,63	0,18%	$61,74
Handlebars	27	$1.192,97	0,17%	$44,18
Saddles	39	$1.010,30	0,14%	$25,91
Gloves	57	$837,56	0,12%	$14,69
Brakes	13	$830,70	0,12%	$63,90
Socks	66	$345,21	0,05%	$5,23
Caps	52	$277,36	0,04%	$5,33
Cleaners	55	$251,88	0,04%	$4,58
Total	**2.087**	**$708.690,15**	**100,00%**	**$339,57**

$ Sales by PostalCode

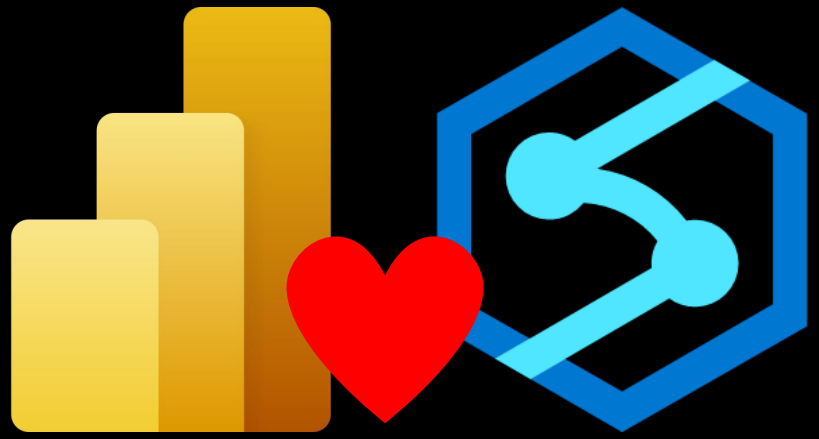


BLUE ROCKET DATA CONSULTING & SOLUTIONS

Data-Marc.com

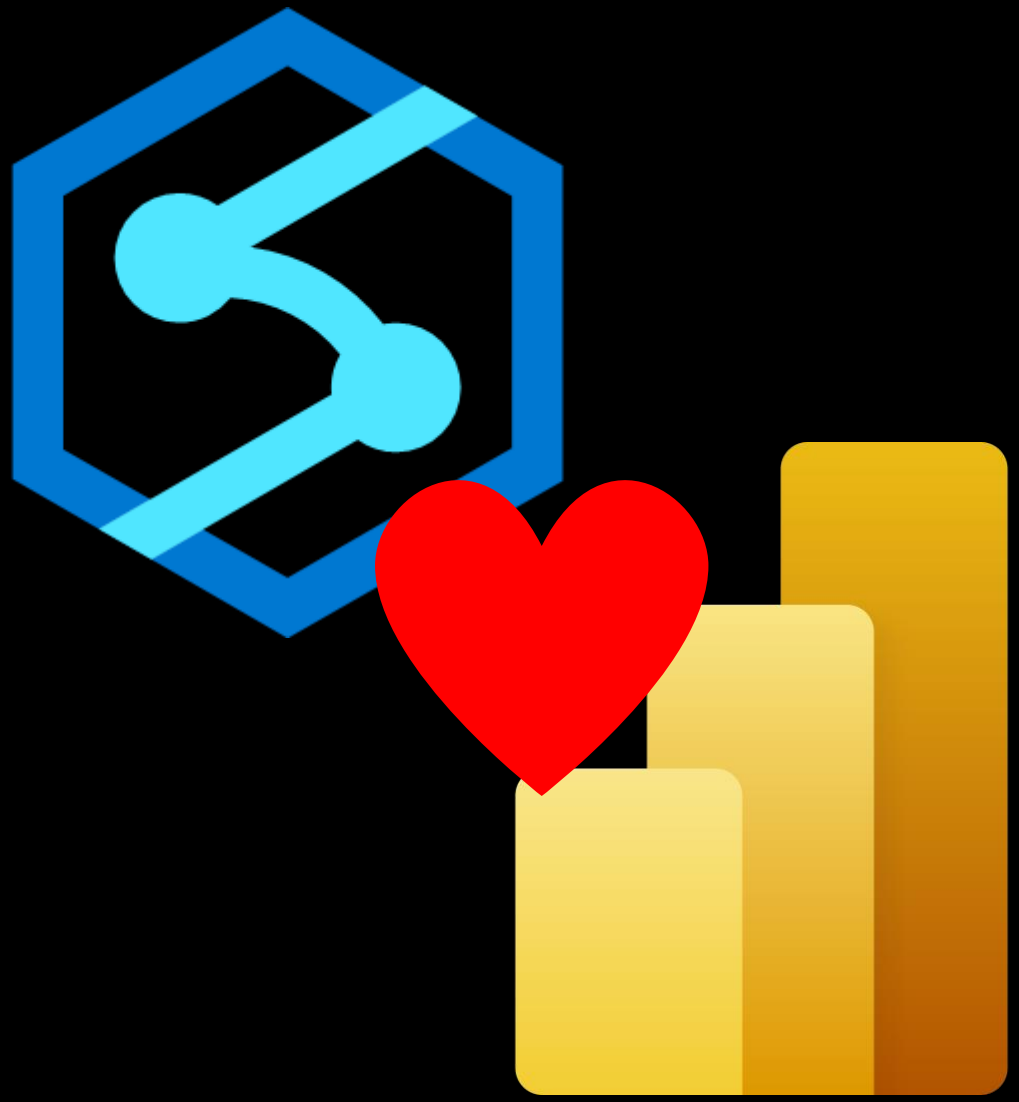
Power BI Solution ~~Challenges~~

- Use Synapse Analytics to ingest into a data lakehouse
- Use Layered approach: Bronze, Silver & Gold



Better together

Data platform deep dive



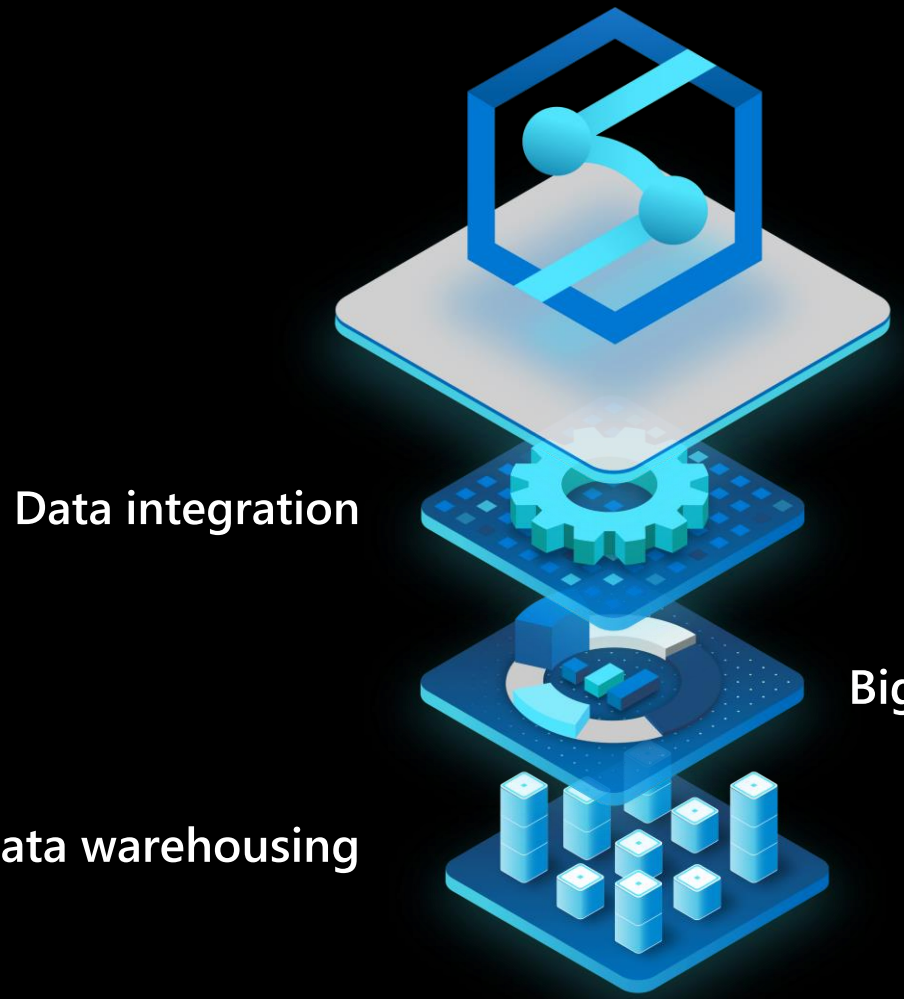
Improvement areas

- Ingesting data from APIs using Synapse Analytics
- Store (historical!) data in the delta lakehouse architecture

Azure Synapse Analytics

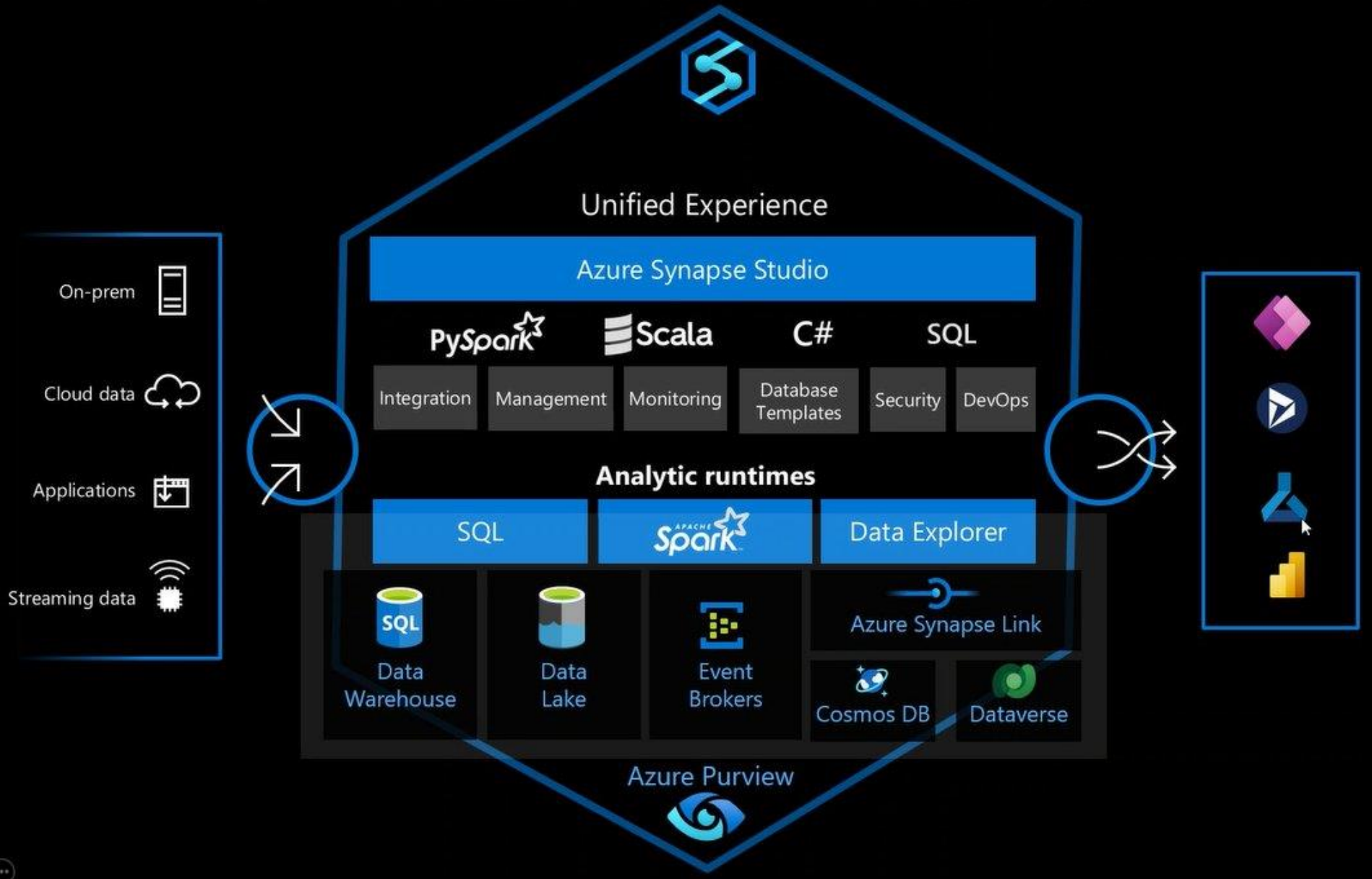
The first unified, cloud native platform for converged analytics

Azure Synapse is the only unified platform for analytics, blending big data, data warehousing, and data integration into a single cloud native service for end-to-end analytics at cloud scale.



Azure Synapse Analytics

The first unified, cloud native platform for converged analytics



Ingesting data from APIs using Synapse Analytics

- Pipeline (same as ADF)
- Data Flow (same as ADF) *not to be confused with dataflows in PBI*
- Spark Notebook (4 languages available)
- Wrangling Dataflows (Same as ADF)

Hybrid data integration

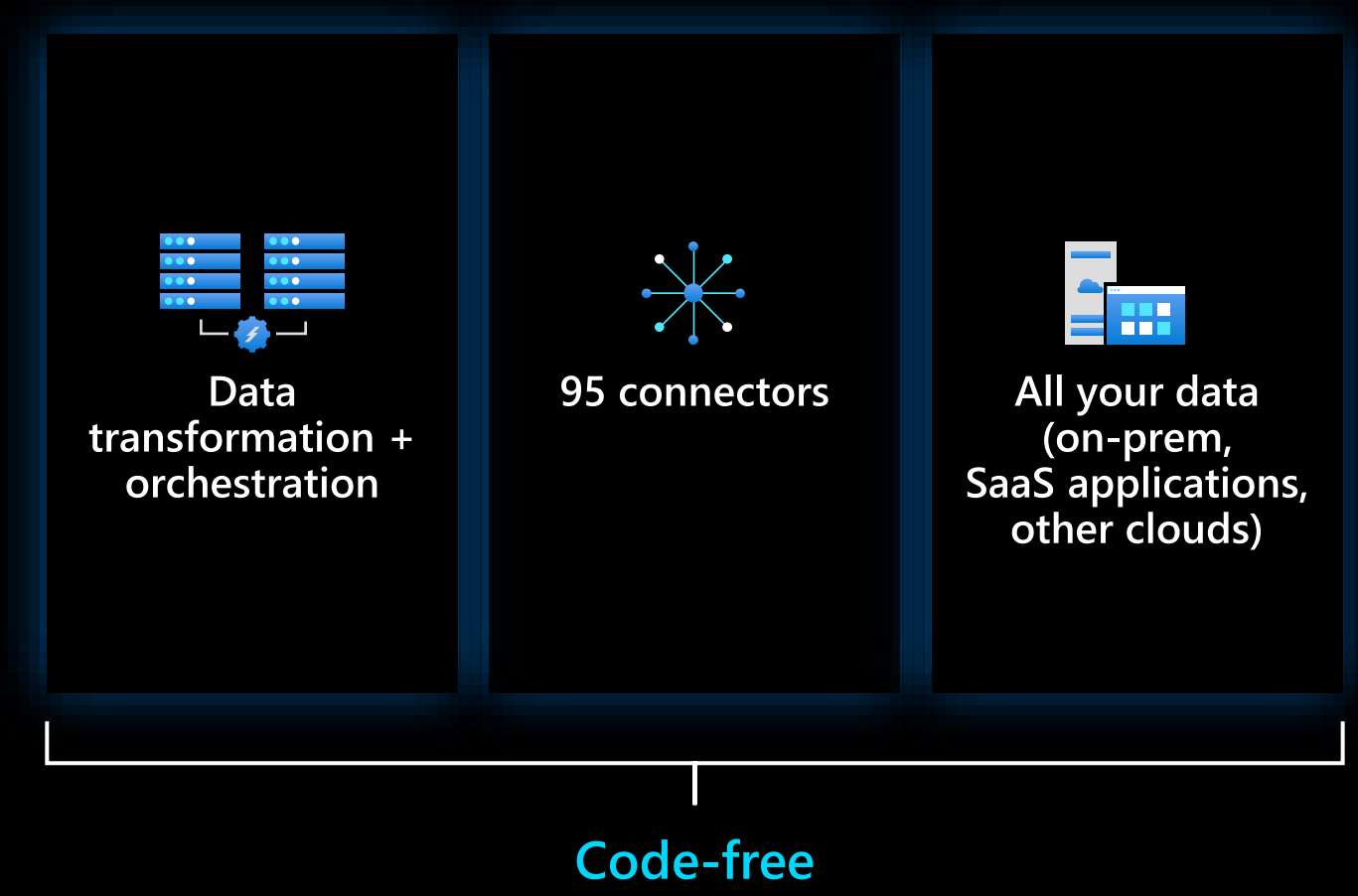
Cloud native ETL/ELT

95+ connectors available

Secure connectivity to on-premise data sources, other clouds, and SaaS applications

Code-first and low/no code design interfaces

Schedule and Event based triggering



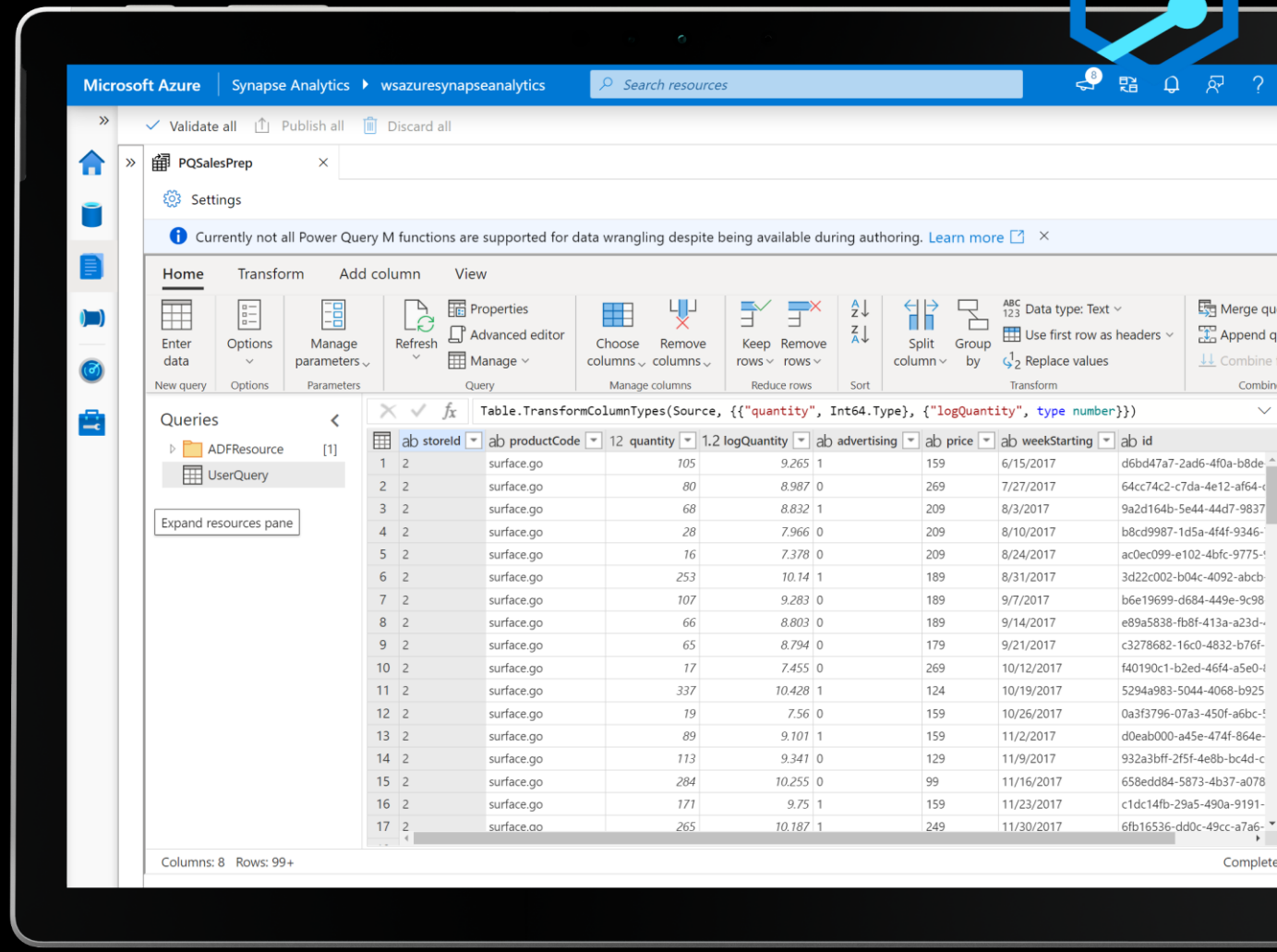
Code-free data wrangling

No/low-code data transformation

Excel-like interface is familiar to users

Transform data to desired shape completely visually

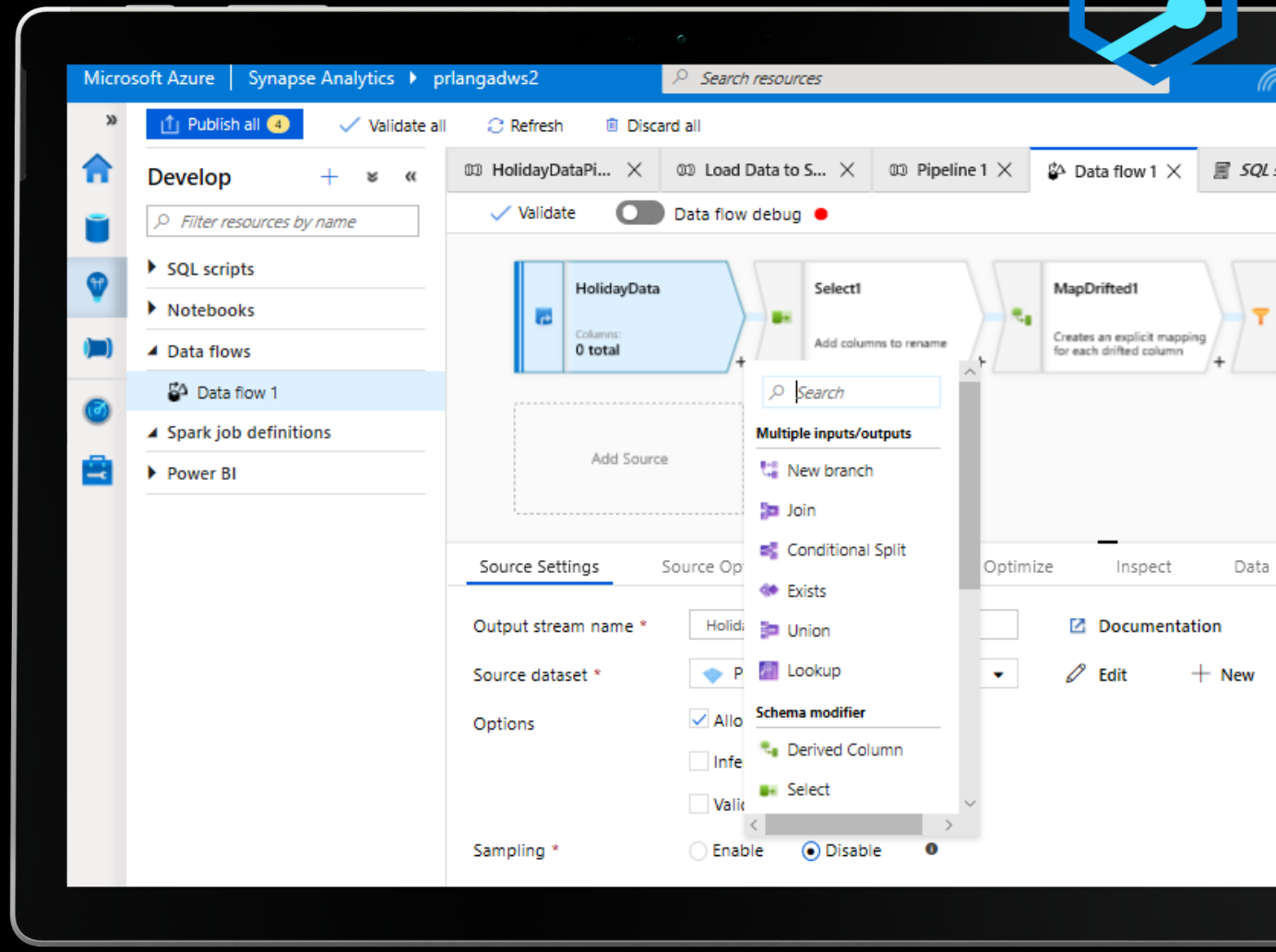
Operationalize into pipelines



Hybrid data integration

Data Flows

not to be confused with dataflows in Power BI



Demo API ingest

Store (historical!) data in the lake

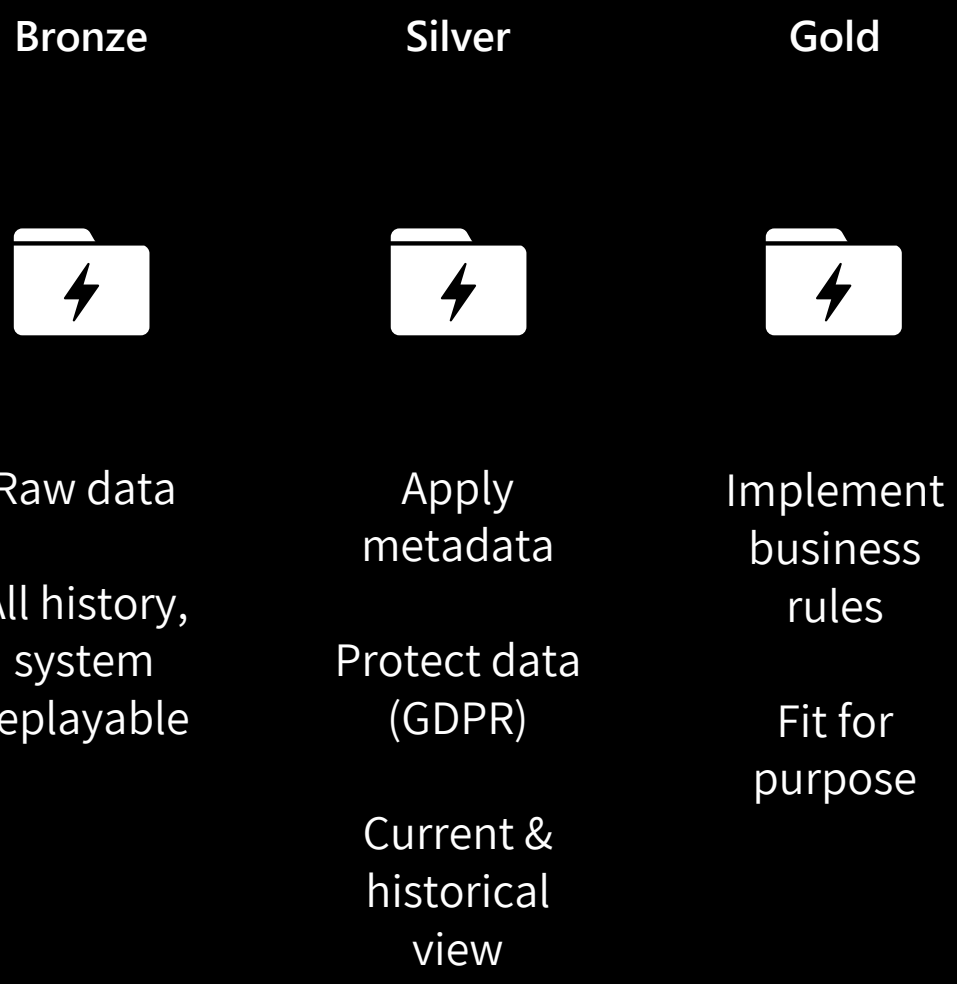
- The Layered approach: Bronze, Silver & Gold

- Keep original raw data, build up history -> **bronze**
- Cleanse and refine data, standard file format -> **silver**
- Aggregate, prepare, transform, merge, make start schema -> **gold**

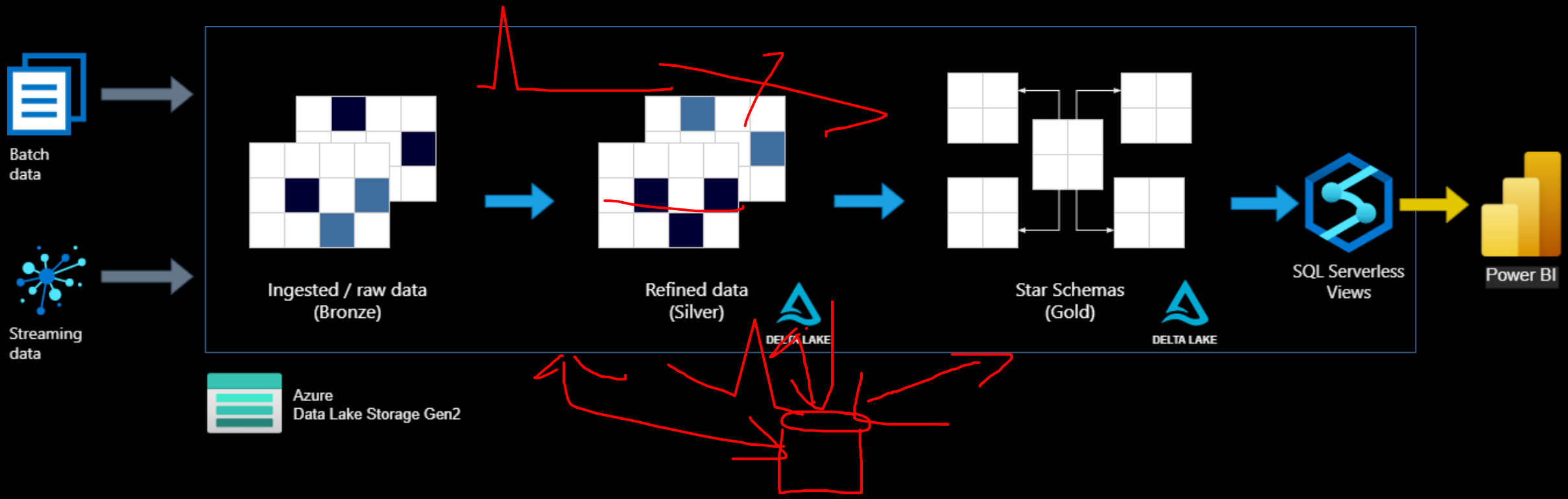
Store (historical!) data in the lake

- The Layered approach:
  Bronze, Silver & Gold

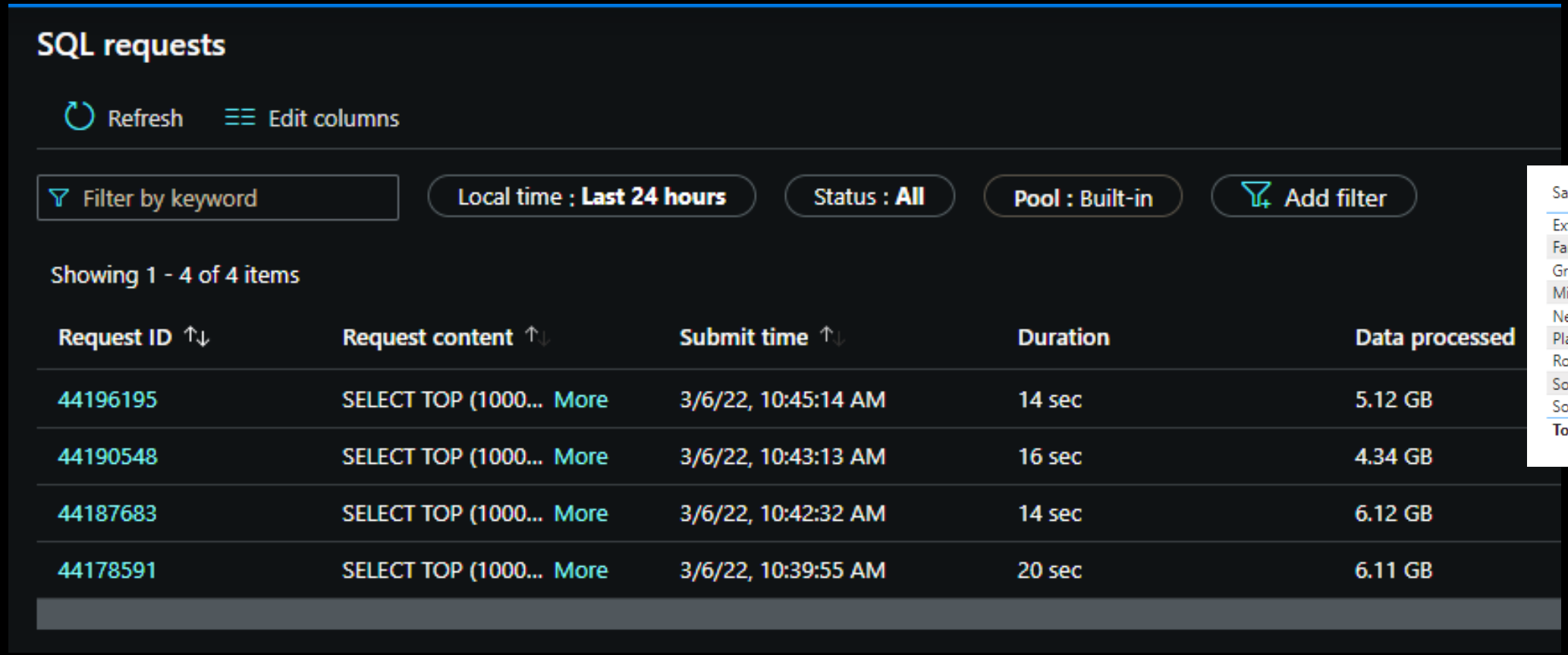
- Keep original raw data, build up history -> **bronze**
- Cleanse and refine data, standard file format -> **silver**
- Aggregate, prepare, transform, merge, make start schema -> **gold**



Using Delta Lakehouse with layered approach



Warm-up time of Serverless SQL pools



Sales Territory	$ Sales
External	$12,540,565,587.63
Far West	$130,724,597,536.11
Great Lakes	$137,062,180,086.18
Mideast	$170,472,095,945.05
New England	$58,853,530,841.09
Plains	$154,405,133,753.92
Rocky Mountain	$72,387,209,160.70
Southeast	$258,110,199,285.25
Southwest	$141,628,285,606.20
Total	**$1,136,183,797,802.13**

Best practices for serverless SQL pools

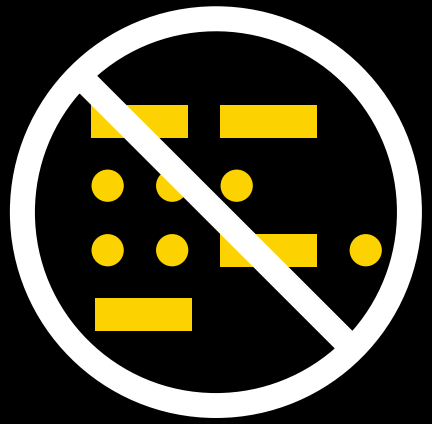
- Azure AD Pass-through Authentication performance <= shared access signature credentials
- Colocate
- Same region
- Convert large CSV and JSON files to Parquet
- Try to optimize storage layout by using partitioning and keeping your files in the range between 100 MB and 10 GB
- Use appropriate data types (smallest, integer-based, varchar)
- Use filename and filepath functions to target specific partitions

Demo Data Platform
Lakehouse architecture

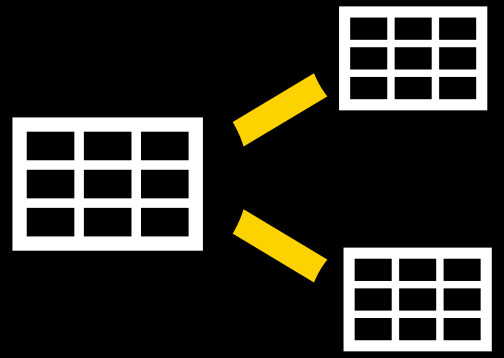
What about Datamarts?

What are Datamarts?

Self service relational database capabilities without IT involvement



No-code experience for data ingestion, preparation and transformation



Build semantic models in a holistic cloud experience

What is it NOT?

Replacement for Power BI datasets

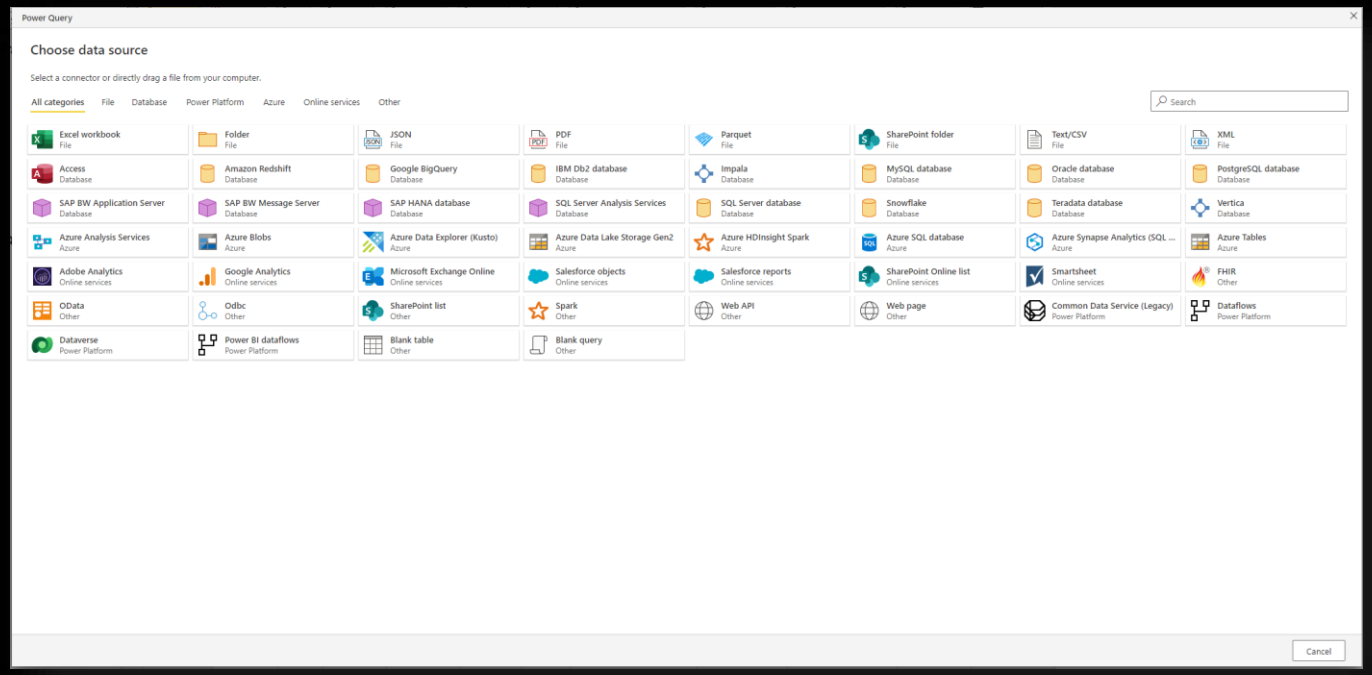
Replacement for Power BI dataflows

Replacement for Power BI Desktop

Replacement your data platform / DWH

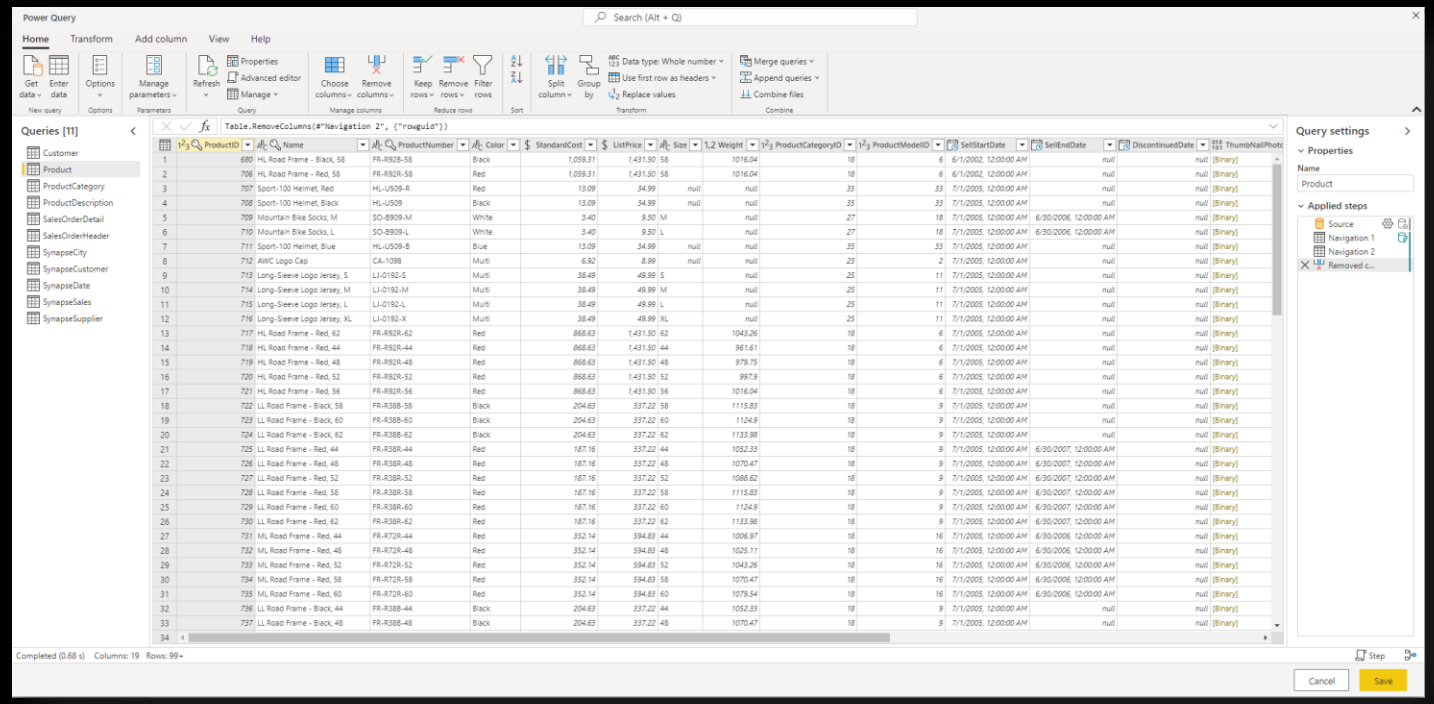
Datamarts or dataflows?

Ingest new sources, all the Power Query connectors are available!



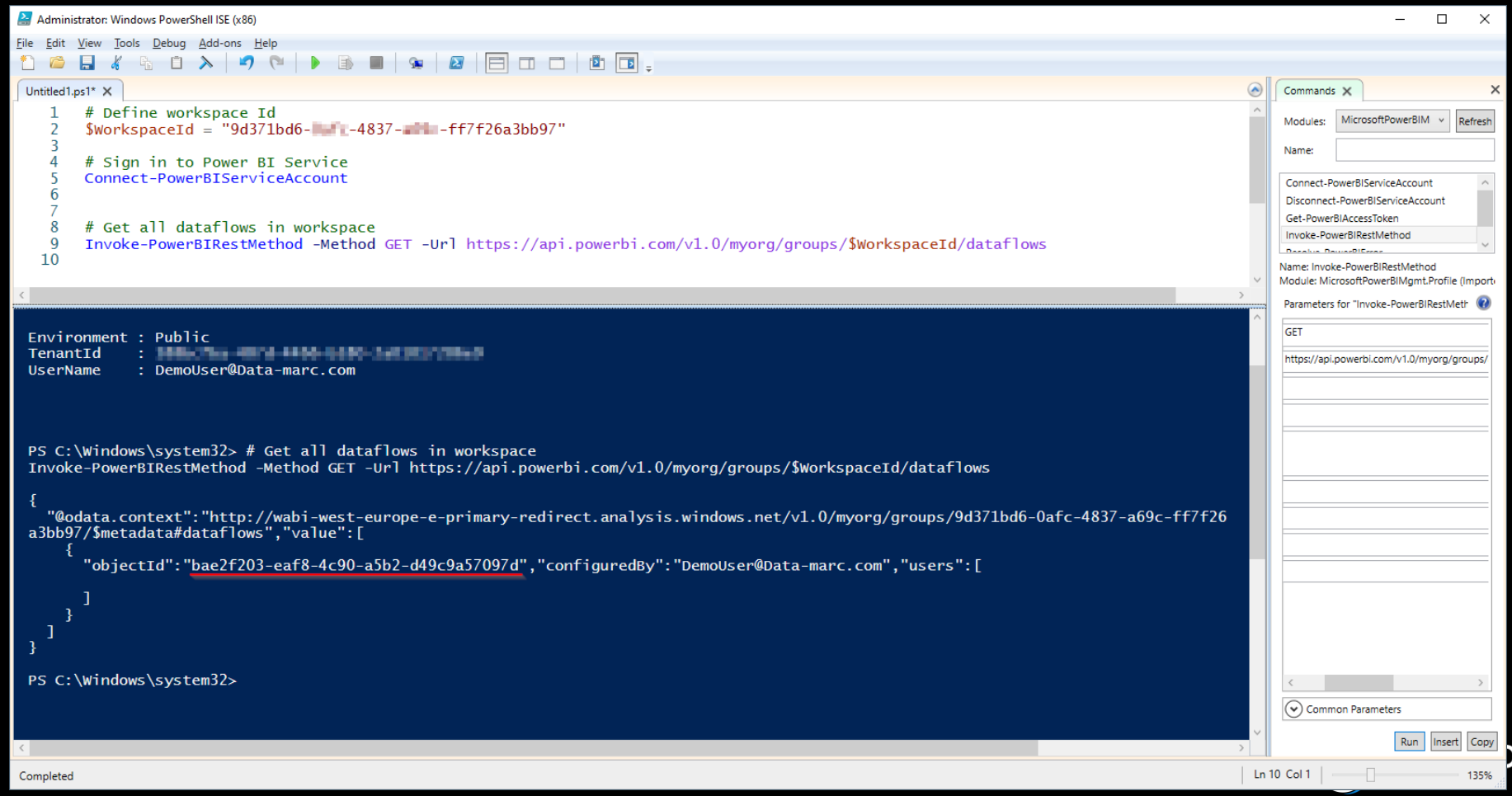
Datamarts or dataflows?

The web-based experience we all know from dataflows to transform data. But now data is loaded in a fully managed Azure SQL Database.



Magic uncovered?

Each table, is first saved as dataflow before being part of the Datamart.



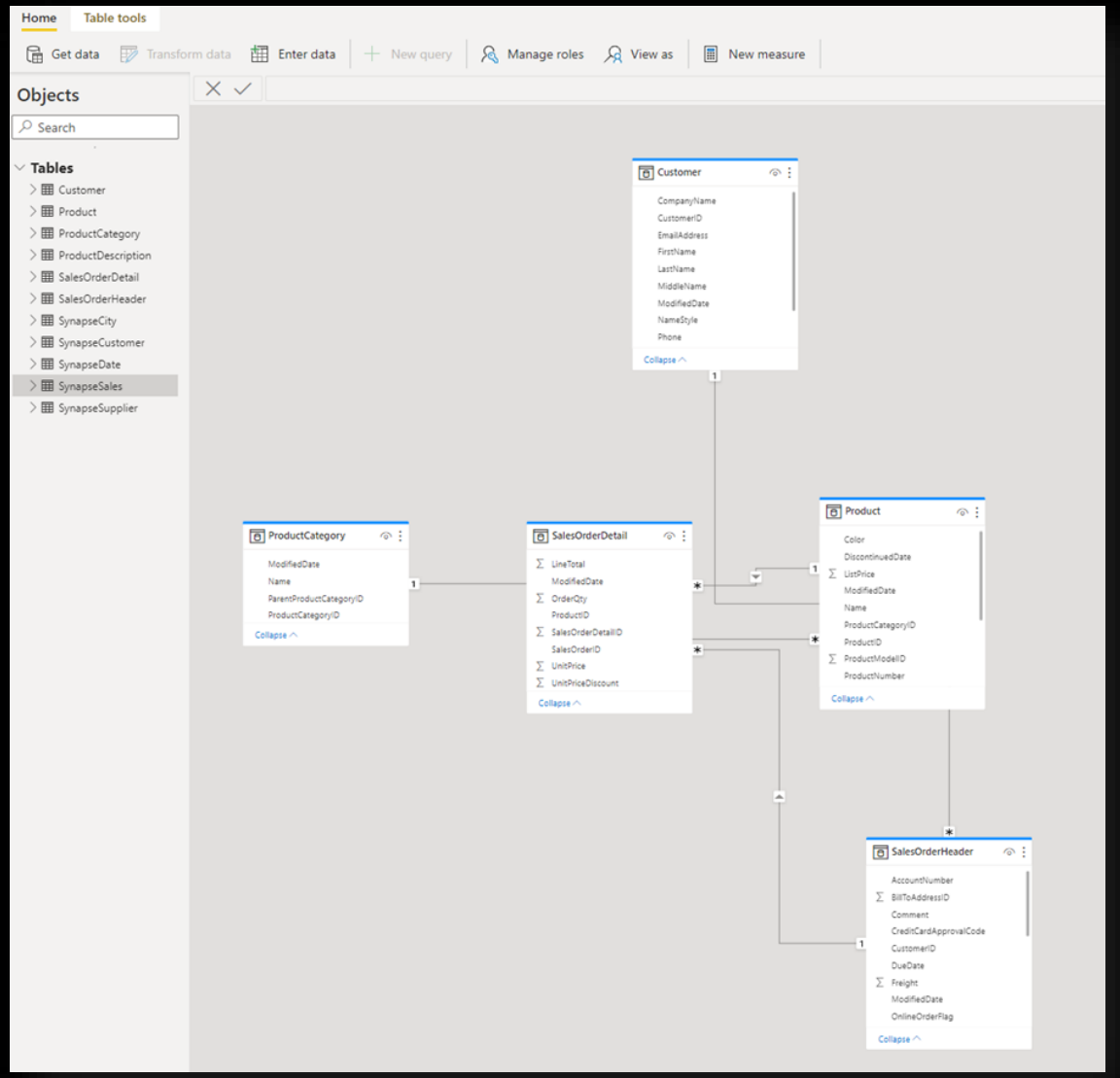
Magic uncovered?

Sources of the dataflows listed easily

```
PS C:\Windows\system32> # Get all dataflows in workspace
$ListDataflows = Invoke-PowerBIRestMethod -Method GET -Url https://api.powerbi.com/v1.0/myorg/groups/$WorkspaceId/dataflows | ConvertFrom-Json
$ListDataflows.value

objectId                             configuredBy          users
--------                             ------------          -----
bae2f203-[redacted]-a5b2-d49c9a57097d DemoUser@Data-marc.com {}



PS C:\Windows\system32> # Get Dataflow sources
$DataFlowObjectId = $ListDataflows.value.objectId
Invoke-PowerBIRestMethod -Method GET -Url https://api.powerbi.com/v1.0/myorg/groups/$WorkspaceId/dataflows/$DataFlowObjectId/datasources

{
  "@odata.context":"http://wabi-west-europe-e-primary-redirect.analysis.windows.net/v1.0/myorg/groups/9d371bd6-[redacted]-a69c-ff7f26a3bb97/$meta
data#datasources","value":[
    {
      "datasourceType":"Sql","connectionDetails":{
        "server":"[redacted].database.windows.net"
      },"datasourceId":"02bacc67-4570-4c7c-a801-2d47ae9a209c","gatewayId":"c1d863df-d137-453e-9504-0d1d99268906"
    },{
      "datasourceType":"Sql","connectionDetails":{
        "server":"[redacted].database.windows.net","database":"PowerBICheatSheet"
      },"datasourceId":"dc69e506-3d08-4f50-ba5f-daf90eb1f700","gatewayId":"c1d863df-d137-453e-9504-0d1d99268906"
    },{
      "datasourceType":"Sql","connectionDetails":{
        "server":"[redacted]-ondemand.sql.azuresynapse.net"
      },"datasourceId":"318de039-d12b-48f7-b676-963f2e077a75","gatewayId":"c1d863df-d137-453e-9504-0d1d99268906"
    },{
      "datasourceType":"Sql","connectionDetails":{
        "server":"[redacted]-ondemand.sql.azuresynapse.net ","database":"lake"
      },"datasourceId":"104ee253-d4d0-4692-90d1-283dfd905642","gatewayId":"c1d863df-d137-453e-9504-0d1d99268906"
    }
```

Modeling experience

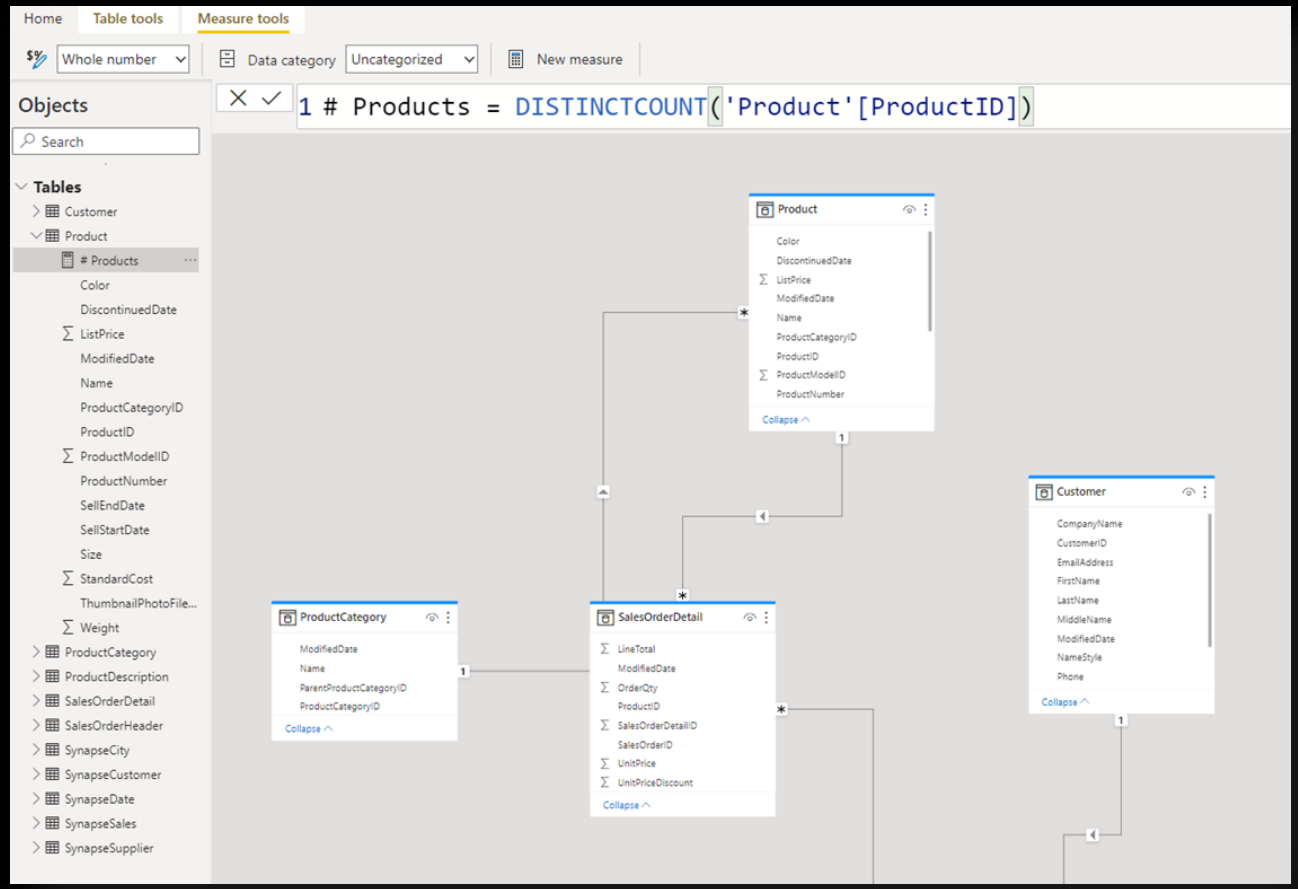
Modeling experience in the service, which allows you to build new relationships, define measure and more!



Measures

Datamarts allow you to build measures directly, as part of the modeling experience.

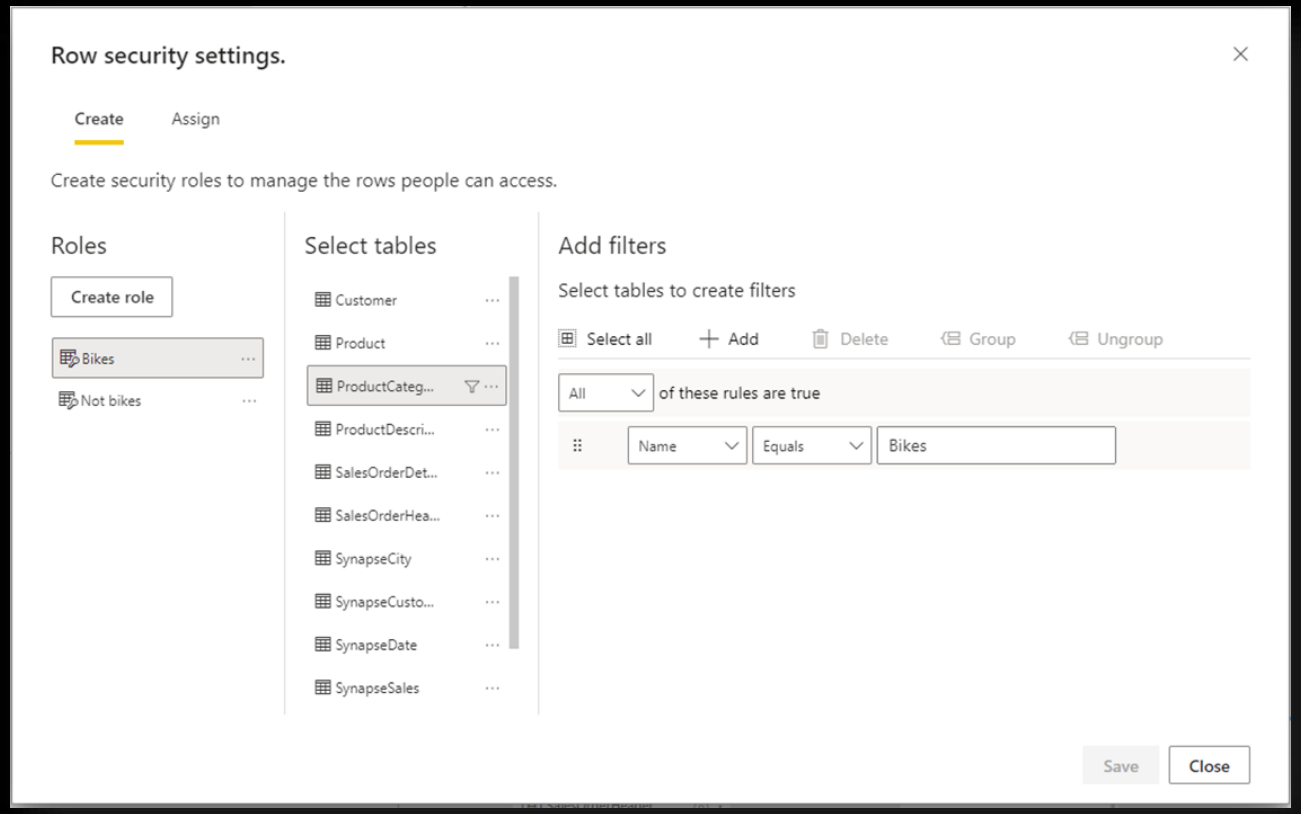
Measures results cannot be displayed inside the datamart.



Security

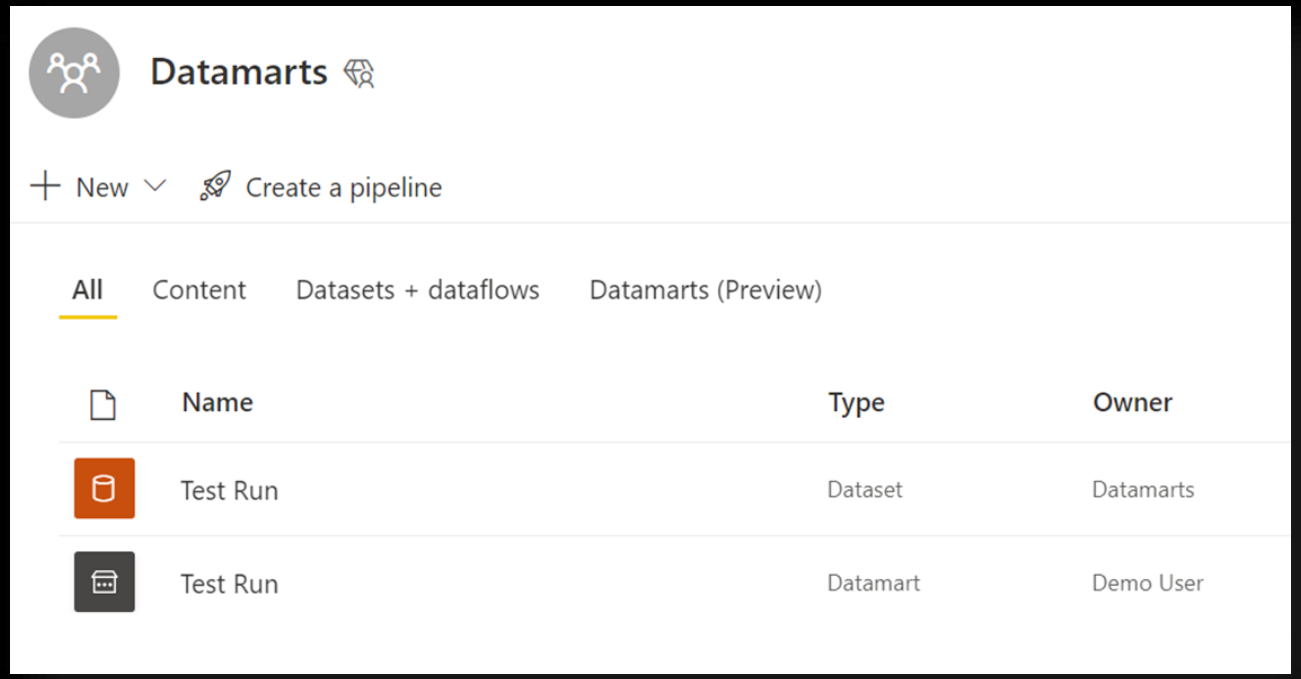
Simplified experience to setup row level security, without the need to understand DAX.

Object level security is not possible (yet?).



Auto-generated dataset

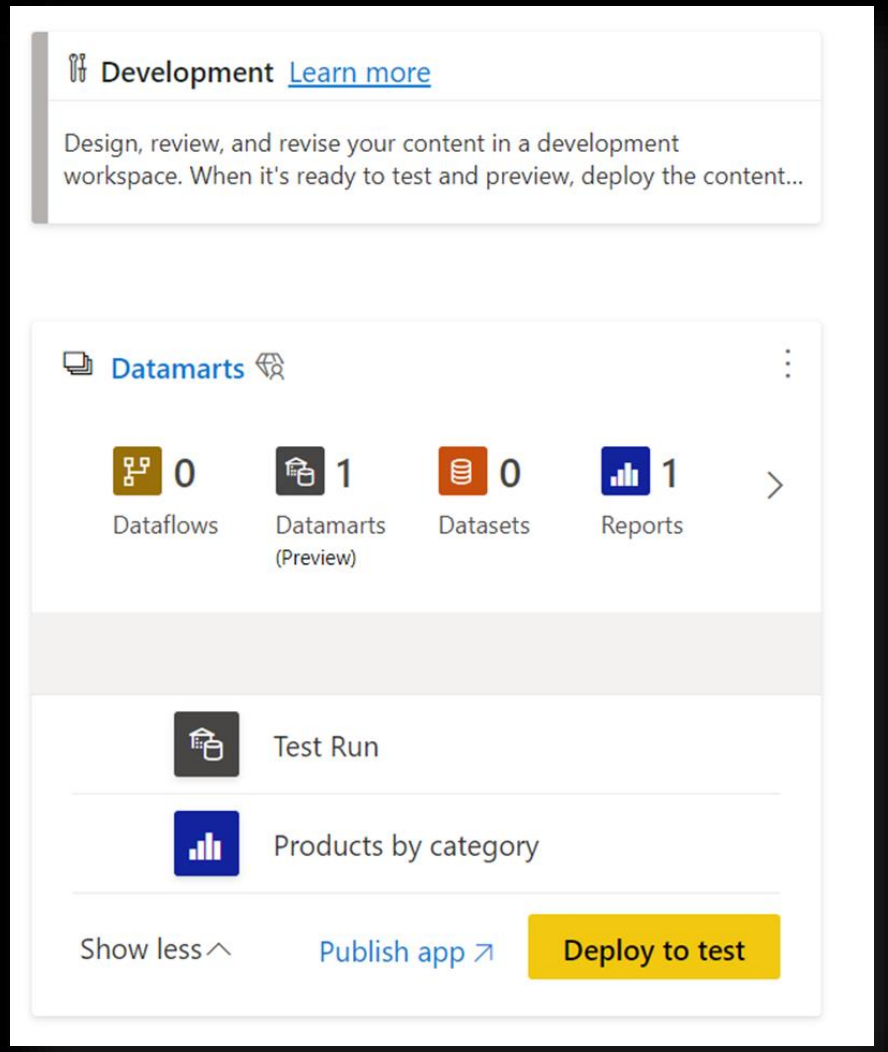
A Power BI dataset is automatically generated in the same workspace, using a DirectQuery connection to your datamart.



ALM for datamarts

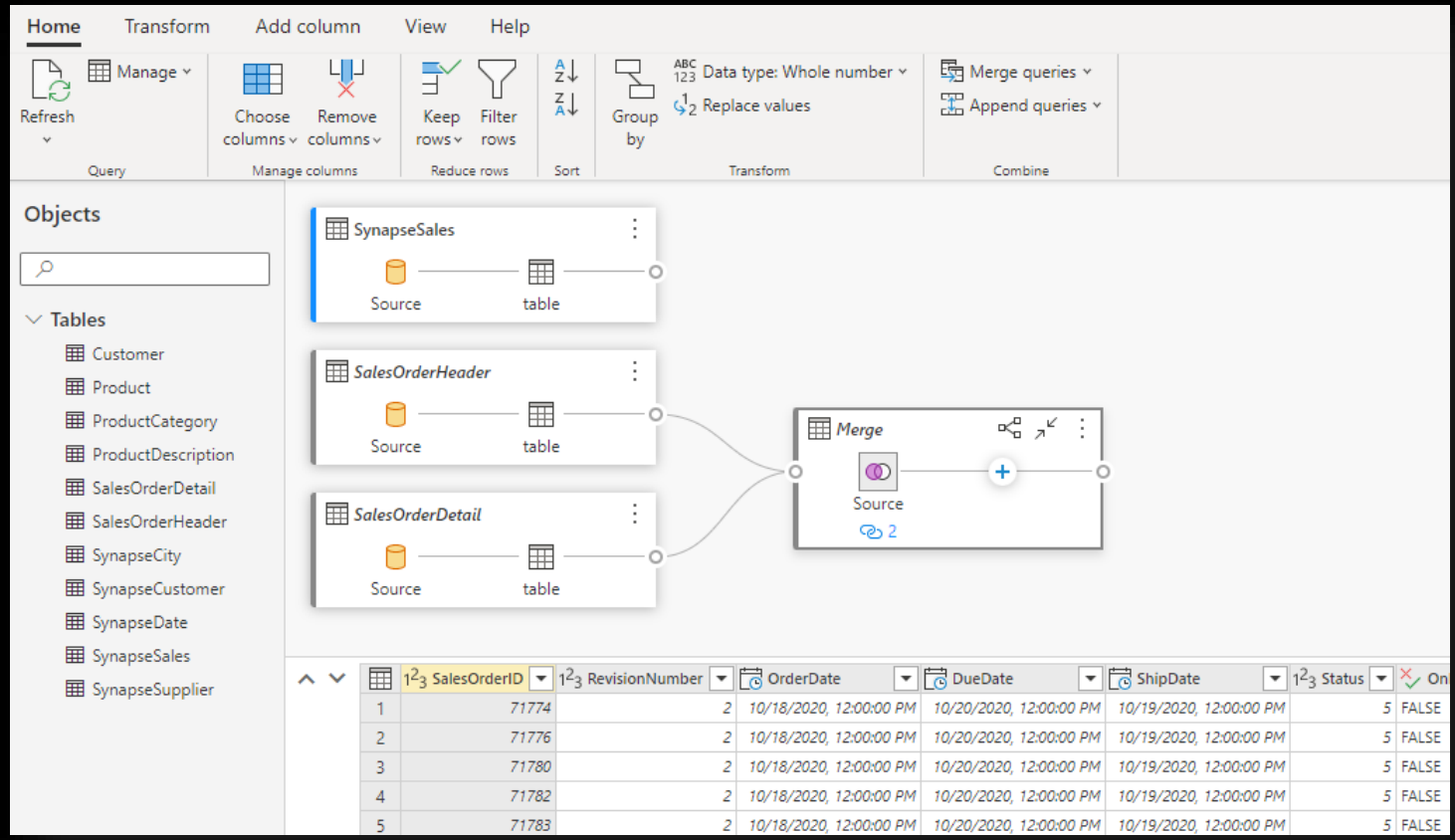
Datamarts can be deployed to different stages using Power BI deployment pipelines.

Notice the auto-generated dataset is not visible in the pipeline.



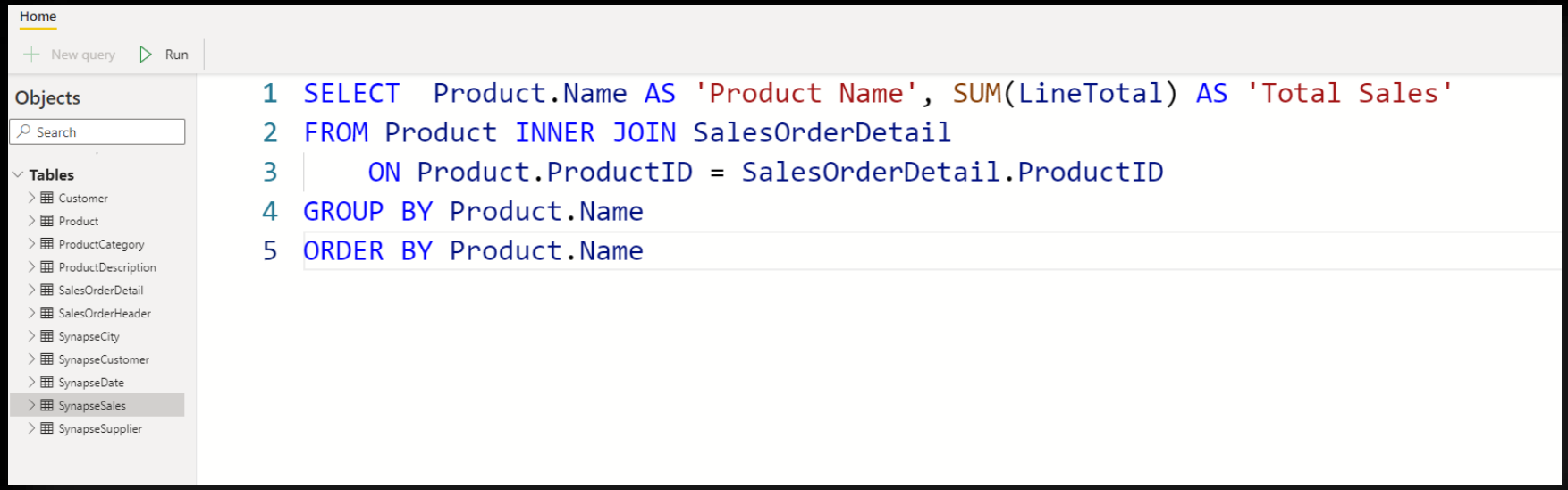
Query experience

Ad-hoc M-queries (PowerQuery) in a visual experience.



Query experience

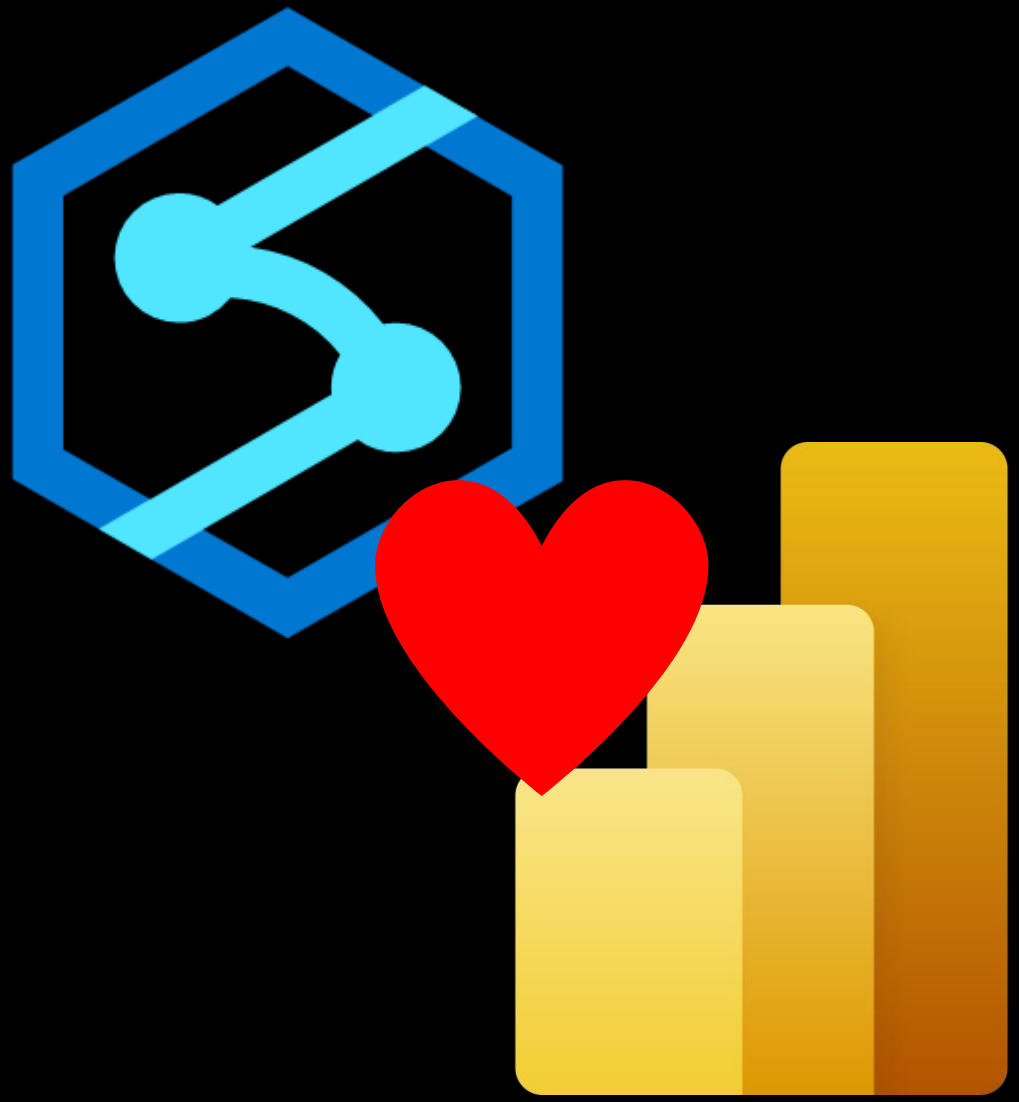
Write on-demand SQL queries in the same datamart interface.



Datamarts

Better together

Power BI deep dive

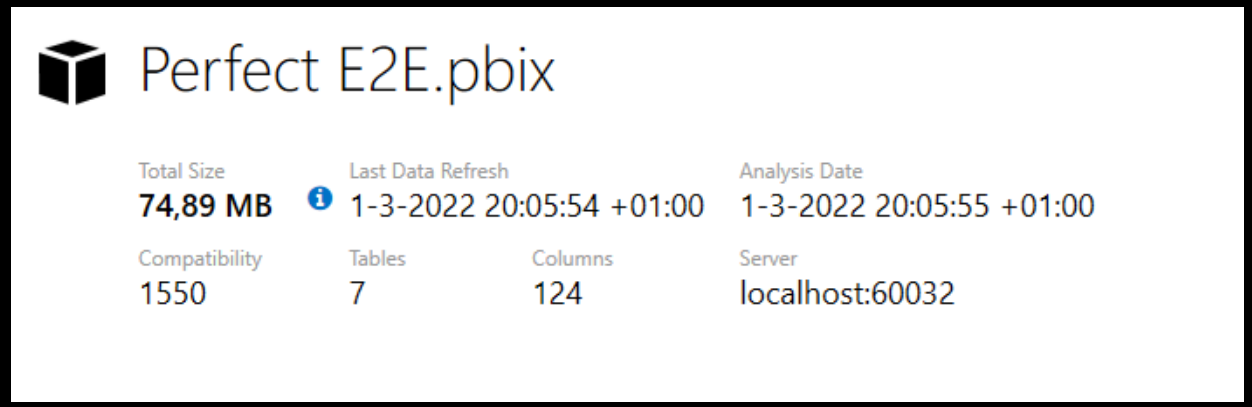


Improvement areas

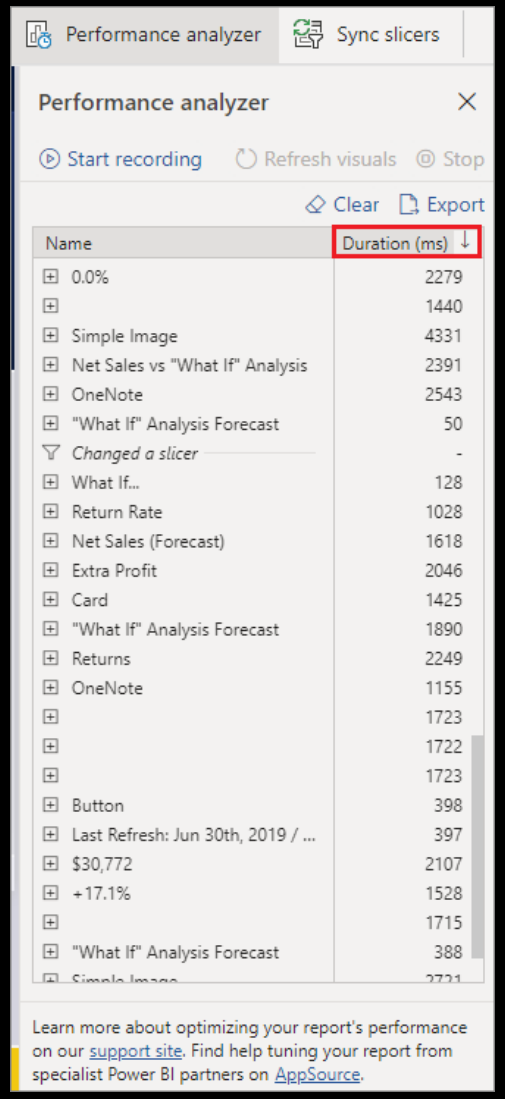
- Data model
- Query Folding
- Aggregations
- Storage modes
- Hybrid tables

But before we start changing our solution, let's measure…

- Refresh durations
- Model Size
- Vertipaq Analyzer
- Performance Analyzer
- Query folding applied?



Performance analyzer in Power BI Desktop



- DAX Query
- Visual Display
- Other
  - Preparing queries
  - Waiting for other visuals to complete
  - Other background processes

Vertipaq analyzer

See where your data volume is

Log Results History **VertiPaq Analyzer**

Tables
Columns
Relationships
Partitions
Summary

Name	Cardinality	Total Size	Data	Dictionary	Hier Size	Encoding	Data Type	RI Violations	User Hier Size	Rel Size	% Table	% DB	Columns	Partitions	Segments	Pageable	Re
fact_sales	95.698.437	3.550.478.095	1.593.067.7...	1.623.142.9...	333.924.200	Many	-	-	0	343.152		93,49%	23	37	1.058	1.012	
dim_product	702.325	148.212.536	11.674.288	120.676.304	15.861.896	Many	-	5	0	48		3,90%	29	1	29	28	
fact_orders	786.607	31.441.169	8.799.896	19.509.521	2.906.040	Many	-	-	0	225.712		0,83%	20	8	160	152	
fact_sales_delivery	835.125	19.332.293	12.489.752	5.919.589	790.408	Many	-	-	0	132.544		0,51%	26	8	208	200	
dim_calendar	1.126	15.136.510	29.064	15.065.662	41.784	Many	-	13	0	0		0,40%	39	1	39	38	
fact_sales_consumer...	355.266	11.410.007	4.168.504	6.912.887	304.448	Many	-	-	0	24.168		0,30%	28	8	224	216	
fact_sales_budget_w...	292.939	5.205.688	2.160.552	2.172.840	870.632	Many	-	-	0	1.664		0,14%	22	8	176	168	
fact_sales_hd_budg...	436.324	4.052.572	994.688	2.688.172	366.240	Many	-	-	0	3.472		0,11%	12	8	96	88	
fact_ga_product_vie...	537.616	3.287.830	1.575.408	1.281.262	327.008	Many	-	-	0	104.152		0,09%	7	8	56	48	
dim_product_ecateg...	39	2.133.436	64	2.132.956	416	Many	-	2	0	0		0,06%	4	1	4	3	
fact_sales_budget_d...	257.436	1.770.948	1.005.456	193.980	570.520	Many	-	-	0	992		0,05%	12	8	96	88	
dim_store	1.045	1.692.785	19.744	1.614.505	58.528	Many	-	4	0	8		0,04%	31	1	31	30	
dim_countries	8	1.065.912	8	1.065.824	80	Many	-	4	0	0		0,03%	2	1	2	1	
fact_store_traffic	284.585	898.358	774.544	87.422	34.144	Many	-	-	0	2.248		0,02%	5	8	40	32	
fact_ga_sessions	325.171	800.778	570.200	160.906	65.440	Many	-	-	0	4.232		0,02%	6	8	48	40	
fact_ecommerce_bu...	37.944	449.848	204.440	133.104	111.872	Many	-	-	0	432		0,01%	11	8	88	80	
fact_ecommerce_for...	4.464	318.524	16.120	268.396	33.600	Many	-	-	0	408		0,01%	10	8	80	72	
fact_sales_budget_d...	30.132	221.814	103.048	103.646	15.048	Many	-	-	0	72		0,01%	14	8	112	104	

Log Results History **VertiPaq Analyzer**

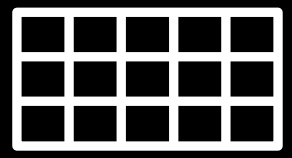
- Tables
- Columns
- Relationships
- Partitions
- Summary

Name	Cardinality	Total Size	Data	Dictionary	Hier Size	Encoding	Data Type	RI Violations	User Hier Size	Rel Size	% Table	% DB	Co
fact_sales	**95.698.437**	**3.550.478.095**	**1.593.067.7...**	**1.623.142.9...**	**333.924.200**	**Many**	**-**	**-**	**0**	**343.152**		**93,49%**	
transaction_id	35.848.228	2.097.266.232	378.951.376	1.431.529.016	286.785.840	HASH	Double	-	-	-	59,08%	55,22%	
receipt_number	2.889.572	391.942.672	380.384.240	136	11.558.296	VALUE	Int64	-	-	-	11,04%	10,32%	
product_id	127.796	217.518.748	213.841.864	2.654.500	1.022.384	HASH	Int64	-	-	-	6,13%	5,73%	
[redacted]	2.147.941	188.167.733	76.707.760	94.276.437	17.183.536	HASH	String	-	-	-	5,30%	4,95%	
gross_margin	29.248	149.055.816	147.460.408	1.361.408	234.000	HASH	Double	-	-	-	4,20%	3,92%	
store_id	745	114.206.090	114.169.472	30.650	5.968	HASH	String	-	-	-	3,22%	3,01%	
order_id	1.517.113	92.295.229	24.397.824	55.760.493	12.136.912	HASH	String	-	-	-	2,60%	2,43%	
net_revenue	21.058	63.140.880	61.728.376	1.244.024	168.480	HASH	Double	-	-	-	1,78%	1,66%	
gross_revenue	21.783	62.888.240	61.456.240	1.257.728	174.272	HASH	Double	-	-	-	1,77%	1,66%	
vat_amount	9.281	59.433.856	58.744.256	615.344	74.256	HASH	Double	-	-	-	1,67%	1,56%	
customer_email_id	558.750	51.952.377	13.888.256	33.594.105	4.470.016	HASH	String	-	-	-	1,46%	1,37%	
gross_total_markdown	10.958	28.449.208	27.723.848	637.680	87.680	HASH	Double	-	-	-	0,80%	0,75%	
transaction_date	355	21.011.840	20.989.424	19.568	2.848	HASH	DateTime	-	-	-	0,59%	0,55%	
product_line_number	887	5.982.752	5.955.408	20.240	7.104	HASH	Int64	-	-	-	0,17%	0,16%	
vat_percentage	1.094	4.264.760	4.212.584	43.408	8.768	HASH	Double	-	-	-	0,12%	0,11%	
delivery_method	4	888.426	871.024	17.354	48	HASH	String	-	-	-	0,03%	0,02%	
loyalty_indicator	2	791.592	790.216	1.344	32	HASH	Boolean	-	-	-	0,02%	0,02%	
quantity	429	300.192	286.376	10.376	3.440	HASH	Int64	-	-	-	0,01%	0,01%	
sales_channel	3	276.956	259.824	17.100	32	HASH	String	-	-	-	0,01%	0,01%	
country_id	8	179.128	161.720	17.328	80	HASH	String	-	-	-	0,01%	0,00%	
return_code	20	85.060	67.384	17.500	176	HASH	String	-	-	-	0,00%	0,00%	
transaction_indicator	3	37.020	19.904	17.084	32	HASH	String	-	-	-	0,00%	0,00%	

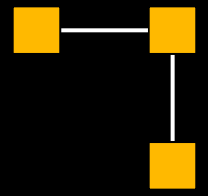
Performance & Vertipaq Analyzer

Care about the data model!

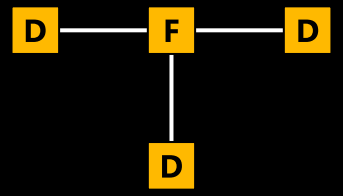
Dimensional



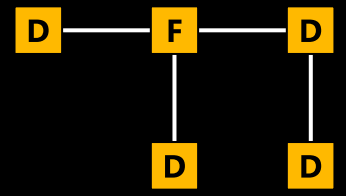
Flat



Normalized
(n^{th} normal form)



Star

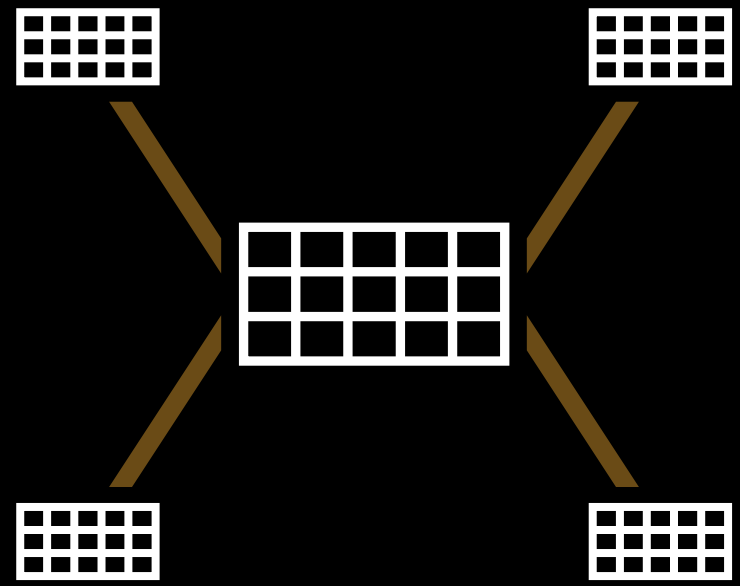


Snowflake

Star schema all the things!

Facts

- Contains numerical information about a business process or items to be aggregated
- Aggregations provide totals, averages, etc.
  Power BI implements these using Measures
- Usefulness limited without context
  Context is provided by dimensions that slice the data



Dimensions

- Contains descriptive information that define how a fact should roll up.
- Examples: Date, Month, Customer, Geography, Product, Payment type.
- Without dimensions there is no context.
- Also called: Lookup table on steroids.

Care about the data model

	Flat table	Normalized	Star schema	Snowflake
Performance for analytics	Low	Medium	High	High
Development effort	Low	High	High	High
Query volume and complexity	Low volume Low complexity	High volume Low complexity	Low volume High complexity	Low volume High complexity
Intended for	No database	CRM / ERP / Applications	Analytical systems / data warehouses	Analytical systems / data warehouses
Compression	Row	Row	Column	Column

Aggregations

Benefits

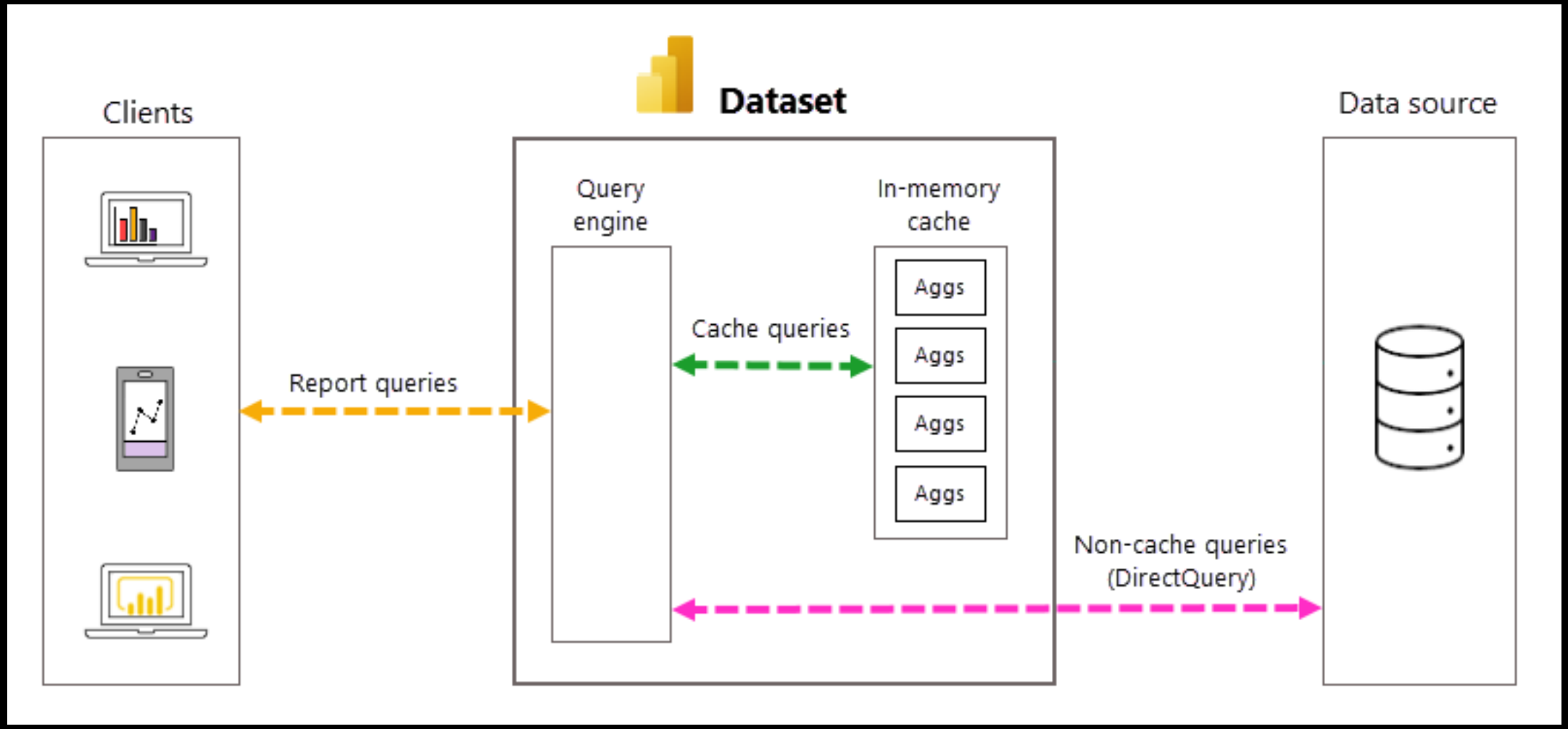
- Report visualizations are faster
- Balanced architecture by combining DirectQuery and Import storage modes

Store data at a higher level of granularity than the original table

The following aggregations are available:
count, groupby, max, min, sum, and count table rows

- Aggregated data is stored in-memory (imported), details are accessed through DirectQuery
- You can create the aggregated table in the
  Data Transformations (Power Query) or in your source (preferred)

Aggregations



Aggregations

Aggregation, that hit based on relationships, require *regular* relationships.

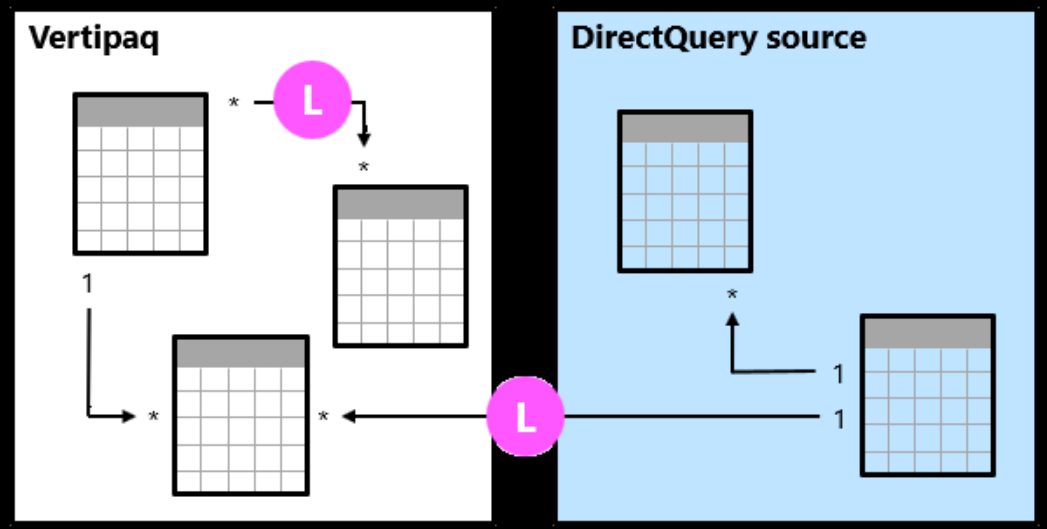
Regular relationships include the following storage mode combinations, where both tables are from a single source group:

Table on the many side	Table on the 1 side
Dual	Dual
Import	Import or Dual
DirectQuery	DirectQuery or Dual

Relationships and storage modes

A model relationship is *limited* when there's no guaranteed "one" side. It can be the case for three reasons:

- The relationship uses a Many-to-many cardinality type (even if one or both columns contain unique values)
- The storage mode combination is Import and DirectQuery
- The relationship is cross source group



Impact of limited relationships

Cross source group relationships have performance implications.

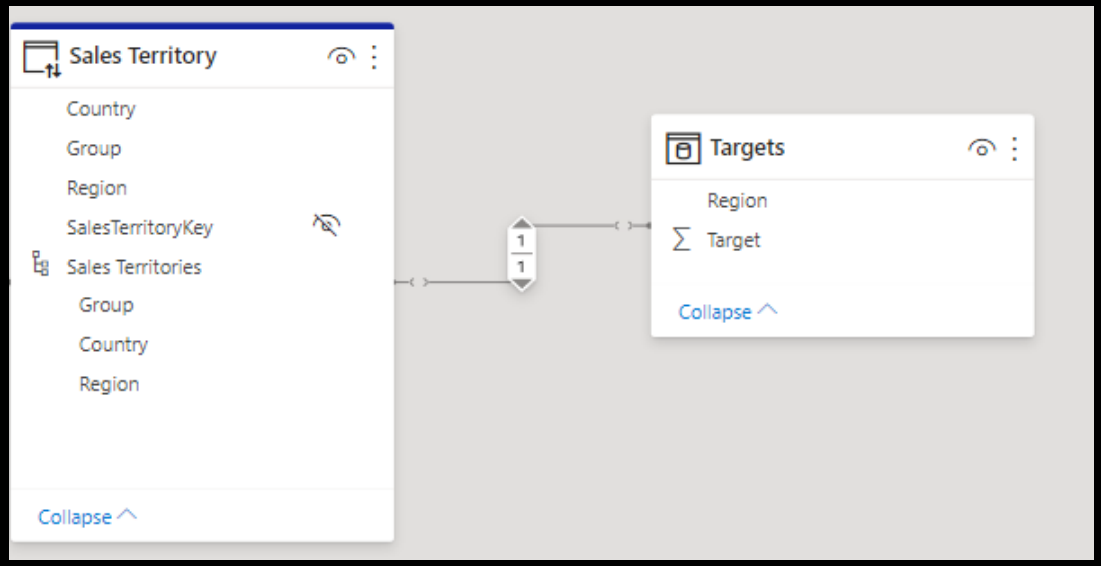
Limited optimalization: joins are done on-demand for DirectQuery.

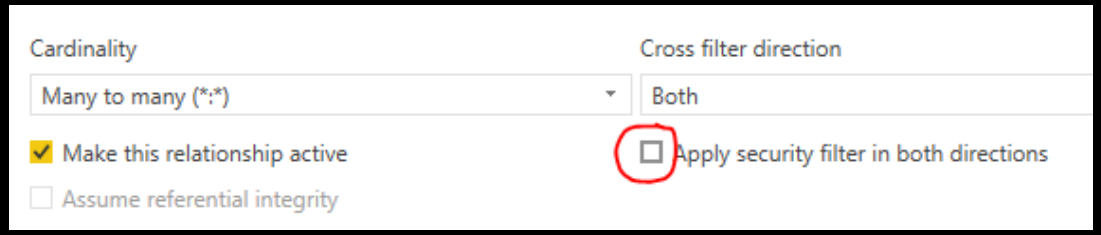
No blank rows: table joins are achieved by using INNER JOIN.

- Blank rows are not added for referential integrity violations

Additional restrictions:

- RELATED DAX function cannot be used to retrieve the ‘one’ side of the relationship
- Enforcing RLS requires you to check the following checkbox





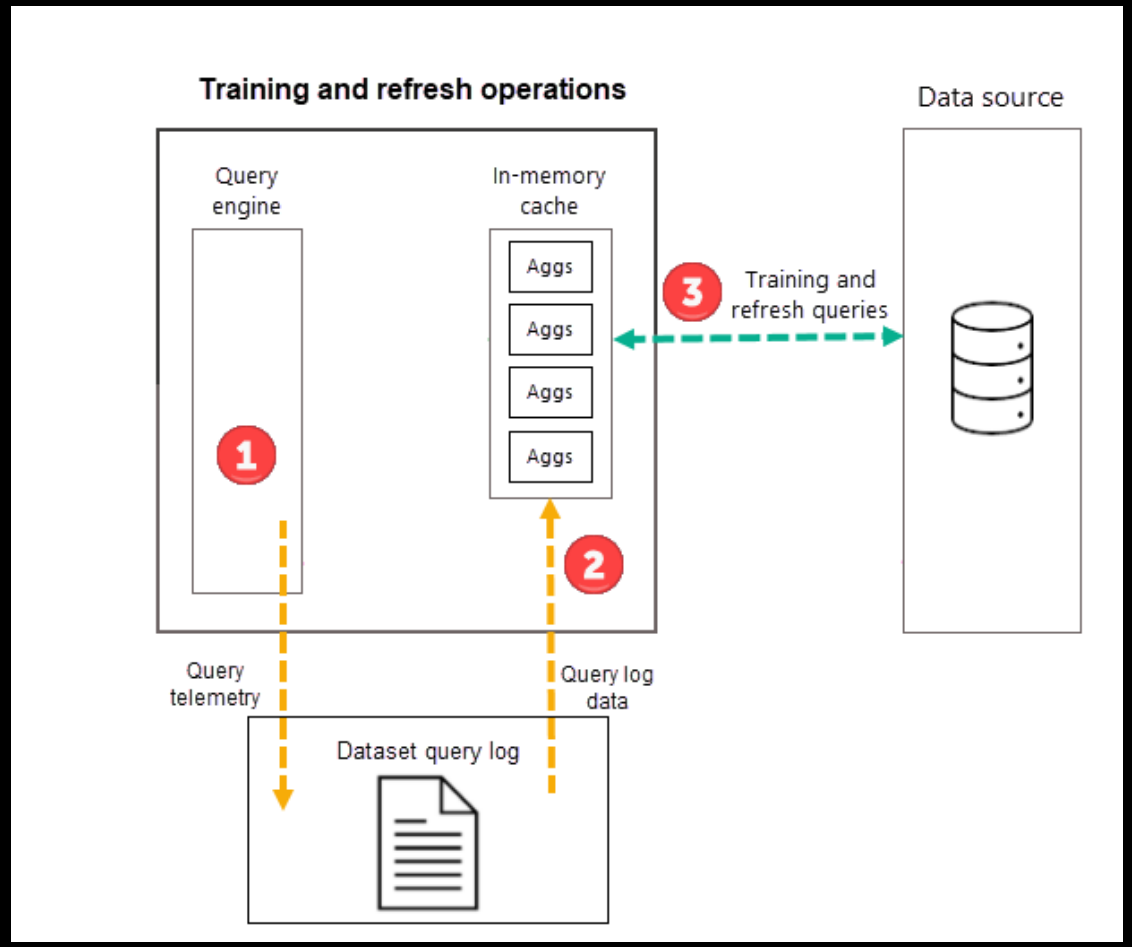
Automatic Aggregations

Power BI Premium per User, Premium Capacity and Embedded datasets

Automatic aggregations based on Query logs (7 days)

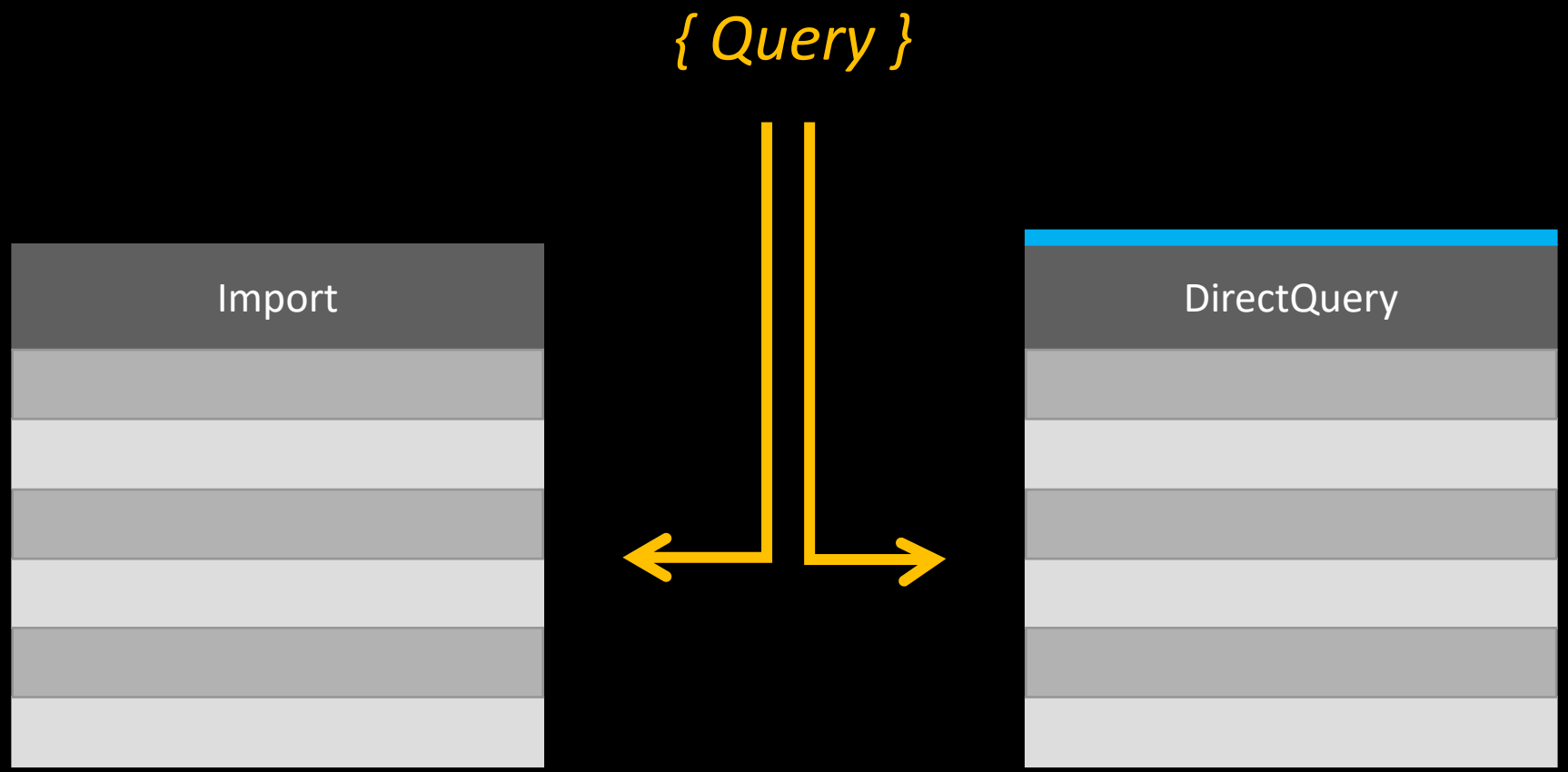
Supported sources:

- Azure SQL Database
- Azure Synapse Dedicated SQL pool
- Databricks
- Google BigQuery
- Snowflake
- Amazon Redshift



Aggregated data

Detailed data



Demo Aggregations

Query Folding

Generate SQL queries

Push queries back to the source

Improve performance in Power Query

Query folding – supported sources

- Relational data sources like SQL Server, Oracle…
- OData sources (SharePoint lists…)
- Active Directory
- Exchange
- …

Query folding – supported operations

- Filtering (both rows and columns)
- Joins
- Aggregation (Group By)
- Pivot and Unpivot
- Numeric Calculations
- Simple transformations (Uppercase / Lowercase)

Home
Data
Develop
Integrate
Monitor
Manage

Analytics pools
SQL pools
Apache Spark pools
Data Explorer pools (preview)

Activities
SQL requests
KQL requests
Apache Spark applications
Data flow debug

Integration
Pipeline runs
Trigger runs
Integration runtimes

SQL requests

Refresh | Edit columns

Filter by keyword | Local time : **Last 24 hours** | Status : **All** | **Pool** : Built-in | Add filter

Showing 1 - 94 of 94 items

Request ID	Request content	Submit time	Duration	Data processed	Submitter
11198235	*** Global stats qu... More	3/1/22, 9:56:40 PM	2 sec	10.00 MB	Marc@Data-marc.com
11198526	SELECT TOP (1000... More	3/1/22, 9:56:40 PM	4 sec	3.29 GB	Marc@Data-marc.com
11196299	SELECT TOP (1000... More	3/1/22, 9:56:09 PM	18 sec	6.64 GB	Marc@Data-marc.com
11033321	SELECT TOP (1000... More	3/1/22, 8:51:57 PM	3 sec	3.29 GB	Marc@Data-marc.com
11031891	*** Global stats qu... More	3/1/22, 8:51:36 PM	2 sec	10.00 MB	Marc@Data-marc.com
11032227	SELECT TOP (1000... More	3/1/22, 8:51:36 PM	5 sec	3.41 GB	Marc@Data-marc.com
11028238	*** Global stats qu... More	3/1/22, 8:51:00 PM	22 sec	1.85 GB	Marc@Data-marc.com
11029080	*** Global stats qu... More	3/1/22, 8:51:00 PM	30 sec	1.62 GB	Marc@Data-marc.com
11030543	*** Global stats qu... More	3/1/22, 8:51:00 PM	30 sec	10.00 MB	Marc@Data-marc.com
11030806	SELECT TOP (1000... More	3/1/22, 8:51:00 PM	36 sec	10.00 MB	Marc@Data-marc.com
11026584	*** Global stats qu... More	3/1/22, 8:50:57 PM	16 sec	351.00 MB	Marc@Data-marc.com
11025192	*** Global stats qu... More	3/1/22, 8:50:47 PM	2 sec	11.00 MB	Marc@Data-marc.com
11025794	SELECT TOP (3502)... More	3/1/22, 8:50:47 PM	3 sec	10.00 MB	Marc@Data-marc.com
11004240	select [_].[Custome... More	3/1/22, 8:44:08 PM	1 sec	10.00 MB	Marc@Data-marc.com
11004313	select [_].[Employe... More	3/1/22, 8:44:08 PM	1 sec	10.00 MB	Marc@Data-marc.com
11003771	select [rows].[Invoi... More	3/1/22, 8:44:05 PM	15 sec	37.47 GB	Marc@Data-marc.com
10988500	select top 1000 [ro... More	3/1/22, 8:38:51 PM	15 sec	37.41 GB	Marc@Data-marc.com
10987176	select top 1000 [ro... More	3/1/22, 8:38:33 PM	15 sec	37.41 GB	Marc@Data-marc.com
10982220	*** Global stats qu... More	3/1/22, 8:37:42 PM	7 sec	83.00 MB	Marc@Data-marc.com
10982965	*** Global stats qu... More	3/1/22, 8:37:42 PM	15 sec	910.00 MB	Marc@Data-marc.com

Home
Data
Develop
Integrate
Monitor
Manage

Analytics pools
SQL pools
Apache Spark pools
Data Explorer pools (preview)

Activities
SQL requests
KQL requests
Apache Spark applications
Data flow debug

Integration
Pipeline runs
Trigger runs
Integration runtimes

SQL requests

Refresh | Edit columns

Filter by keyword | Local time : **Last 24 hours** | Status : **All**

Showing 1 - 94 of 94 items

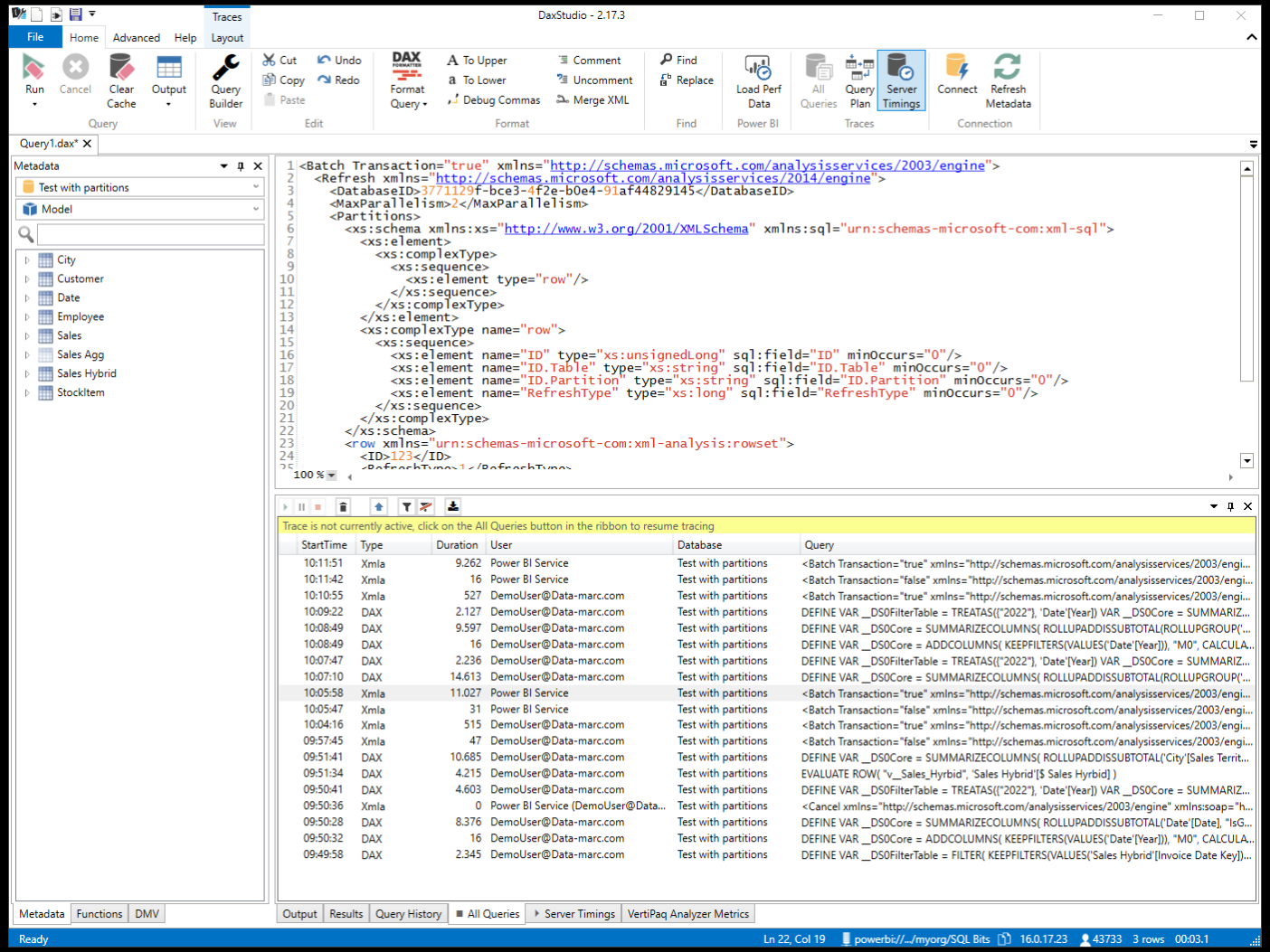
Request ID	Request content	Submit time
11198235	*** Global stats qu... More	3/1/22, 9:56:40 PM
11198526	SELECT TOP (1000... More	3/1/22, 9:56:40 PM
11196299	SELECT TOP (1000... More	3/1/22, 9:56:09 PM
11033321	SELECT TOP (1000... More	3/1/22, 8:51:57 PM
11031891	*** Global stats qu... More	3/1/22, 8:51:36 PM
11032227	SELECT TOP (1000... More	3/1/22, 8:51:36 PM
11028238	*** Global stats qu... More	3/1/22, 8:51:00 PM
11029080	*** Global stats qu... More	3/1/22, 8:51:00 PM
11030543	*** Global stats qu... More	3/1/22, 8:51:00 PM
11030806	SELECT TOP (1000... More	3/1/22, 8:51:00 PM
11026584	*** Global stats qu... More	3/1/22, 8:50:57 PM
11025192	*** Global stats qu... More	3/1/22, 8:50:47 PM
11025794	SELECT TOP (3502)... More	3/1/22, 8:50:47 PM
11004240	select [_].[Custome... More	3/1/22, 8:44:08 PM
11004313	select [_].[Employe... More	3/1/22, 8:44:08 PM
11003771	select [rows].[Invoi... More	3/1/22, 8:44:05 PM
10988500	select top 1000 [ro... More	3/1/22, 8:38:51 PM
10987176	select top 1000 [ro... More	3/1/22, 8:38:33 PM
10982220	*** Global stats qu... More	3/1/22, 8:37:42 PM
10982965	*** Global stats qu... More	3/1/22, 8:37:42 PM

Request content

11198526

```
SELECT
TOP (1000001) *
FROM
(

SELECT [t5].[Sales Territory],SUM([t4].[Profit])
 AS [a0]
FROM
((
select [_].[SaleKey] as [Sale Key],
    [_].[CityKey] as [City Key],
    [_].[CustomerKey] as [Customer Key],
    [_].[BillToCustomerKey] as [Bill To Customer Key],
    [_].[StockItemKey] as [Stock Item Key],
    [_].[InvoiceDateKey] as [Invoice Date Key],
    [_].[DeliveryDateKey] as [Delivery Date Key],
    [_].[SalespersonKey] as [Salesperson Key],
    [_].[WWIInvoiceID] as [WWIInvoice ID],
    [_].[Description] as [Description],
    [_].[Package] as [Package],
    [_].[Quantity] as [Quantity],
    [_].[UnitPrice] as [Unit Price],
    [_].[TaxRate] as [Tax Rate],
    [_].[TotalExcludingTax] as [Total Excluding Tax],
    [_].[TaxAmount] as [Tax Amount],
    [_].[Profit] as [Profit],
    [_].[TotalIncludingTax] as [Total Including Tax],
    [_].[TotalDryItems] as [Total Dry Items],
    [_].[TotalChillerItems] as [Total Chiller Items],
    [_].[LineageKey] as [Lineage Key]
from [sales_model].[Sales] as [_]
where [_].[InvoiceDateKey] >= convert(date, '2013-01-01') and [_].[InvoiceDateKey]
) AS [t4]

 INNER JOIN

(
select [_].[CityKey] as [City Key],
    [_].[WWICityID] as [WWICity ID],
    [_].[City] as [City],
```

DAX Studio trace

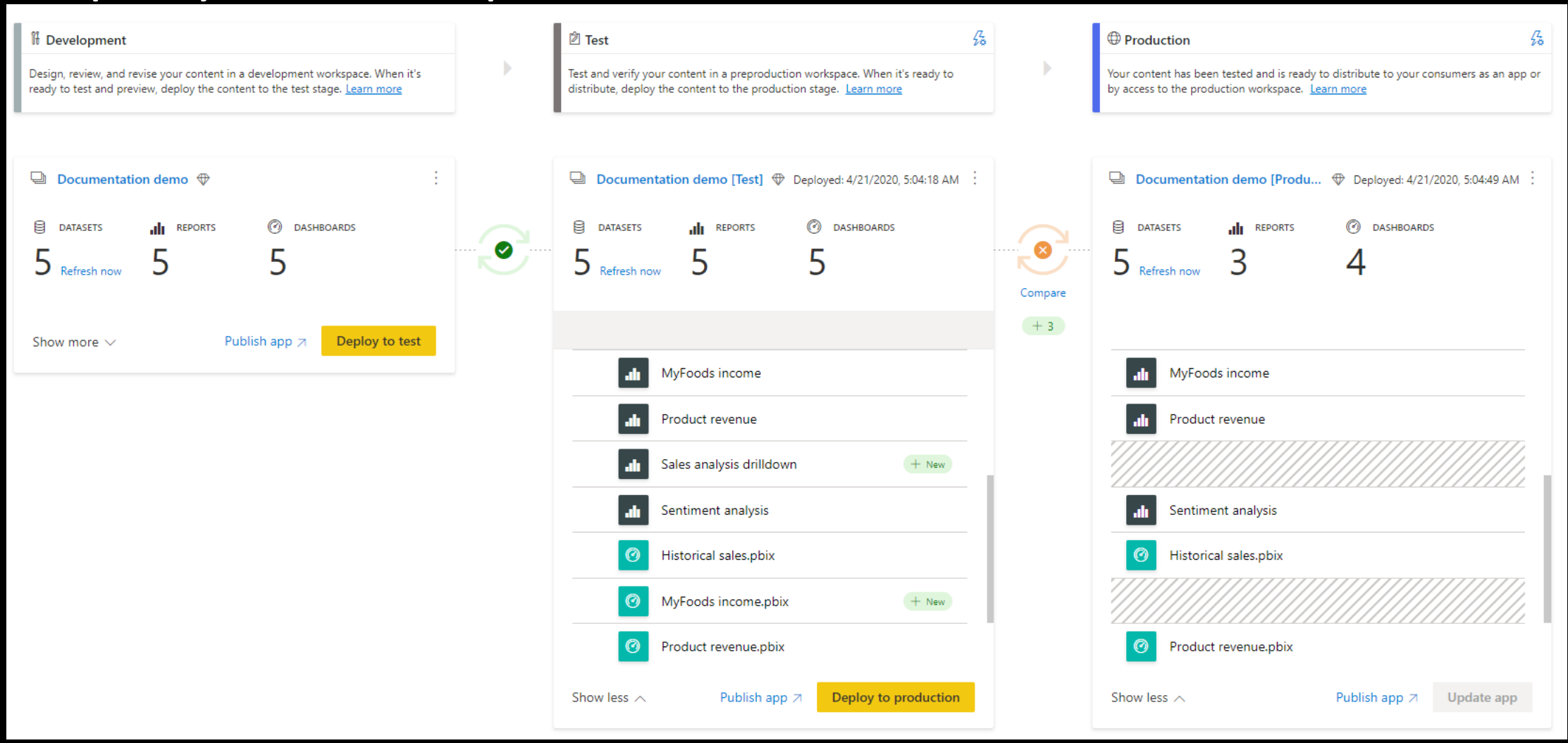


Demo Query Folding

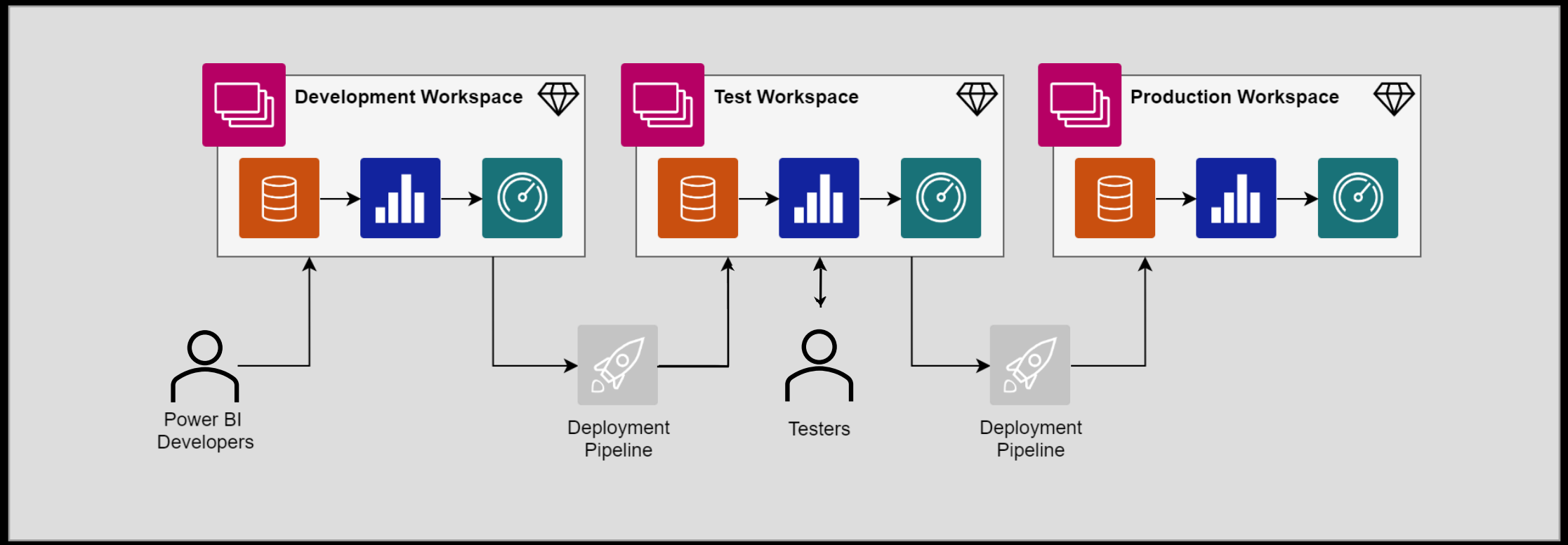
Premium specific features

- Paginated Reports
- Share with free users
  (P sku only! Not in A sku!)
- Auto-scale
- Support for larger dataset sizes
- 48x daily refresh
  (and Automatic Page Refresh)
- Extra dataflows features
- Enhanced embedding scenarios
- Bring your own key (BYOK)
- Hybrid tables
- Datamarts
- Multi-geo support
- XMLA endpoints
- Deployment Pipelines
- AI workloads

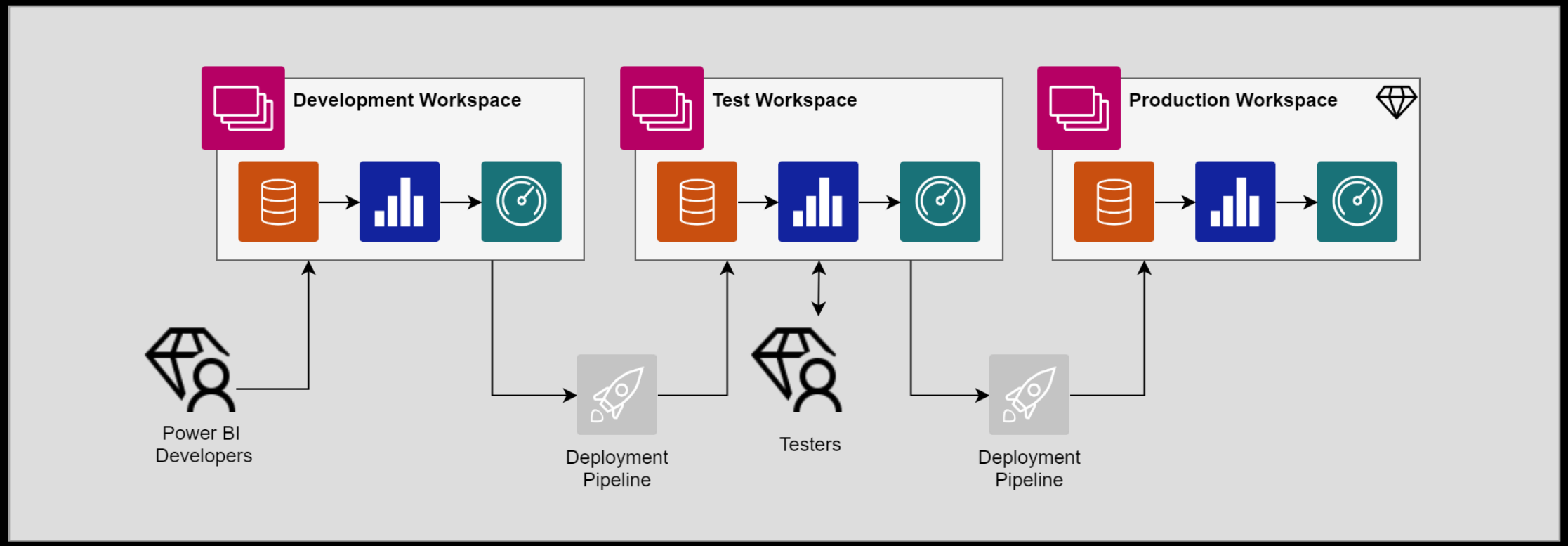
Deployment Pipelines



Lower capacity utilization with DTAP



Lower capacity utilization with DTAP



LUNCH BREAK

Hybrid tables & incremental refresh

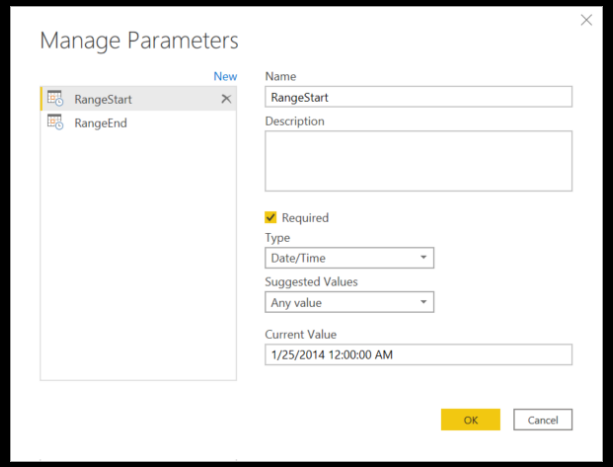
Incremental refresh

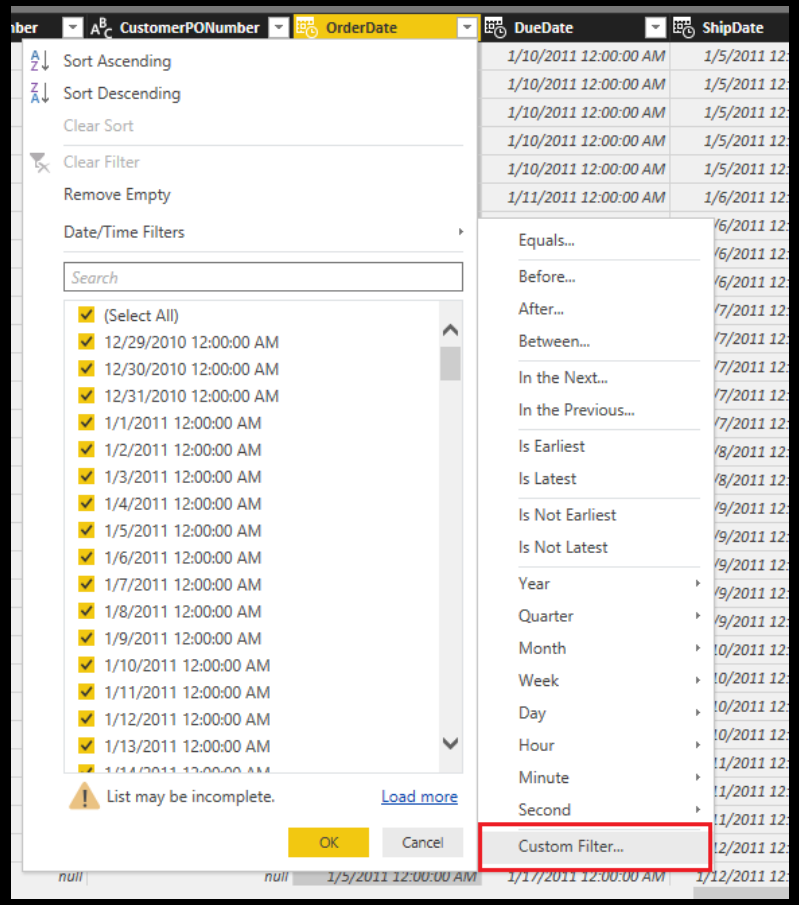
- Fewer refresh cycles for fast-changing data – DirectQuery mode gets the latest data updates as queries are processed without requiring a high refresh cadence.
- Refreshes are faster - Only the most recent data that has changed needs to be refreshed.
- Refreshes are more reliable - Long-running connections to volatile data sources aren't necessary. Queries to source data run faster, reducing potential for network problems to interfere.
- Resource consumption is reduced - Less data to refresh reduces overall consumption of memory and other resources in both Power BI and data source systems.
- Enables large datasets - Datasets with potentially billions of rows can grow without the need to fully refresh the entire dataset with each refresh operation.
- Easy setup - Incremental refresh policies are defined in Power BI Desktop with just a few tasks. When published, the service automatically applies those policies with each refresh.

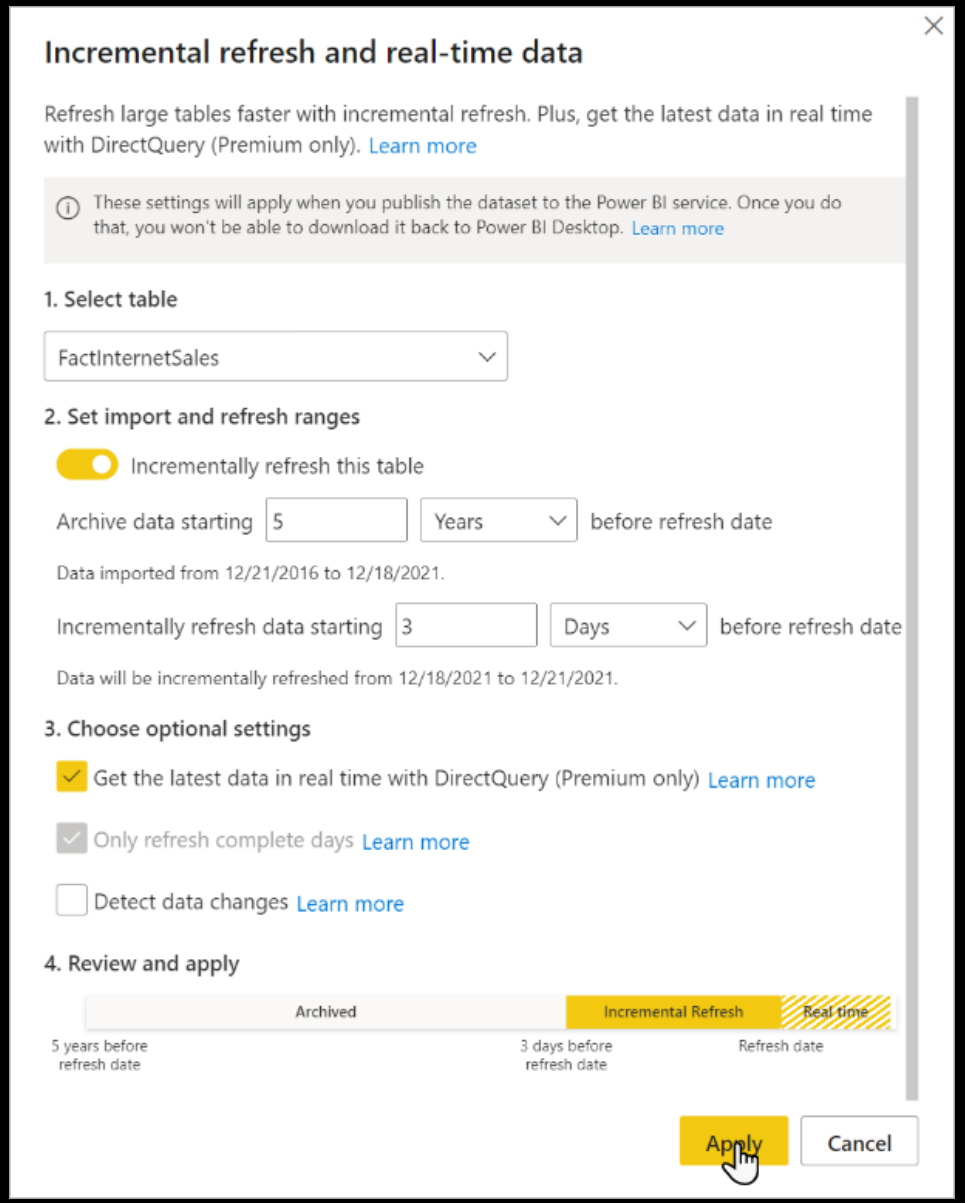
Incremental refresh

- Incremental refresh is supported for Power BI Premium, Premium per user, **Power BI Pro**, and Power BI Embedded datasets.
- Getting the latest data in **real time** with DirectQuery is **only supported for Power BI Premium**, Premium per user, and Power BI Embedded datasets.

Incremental refresh config





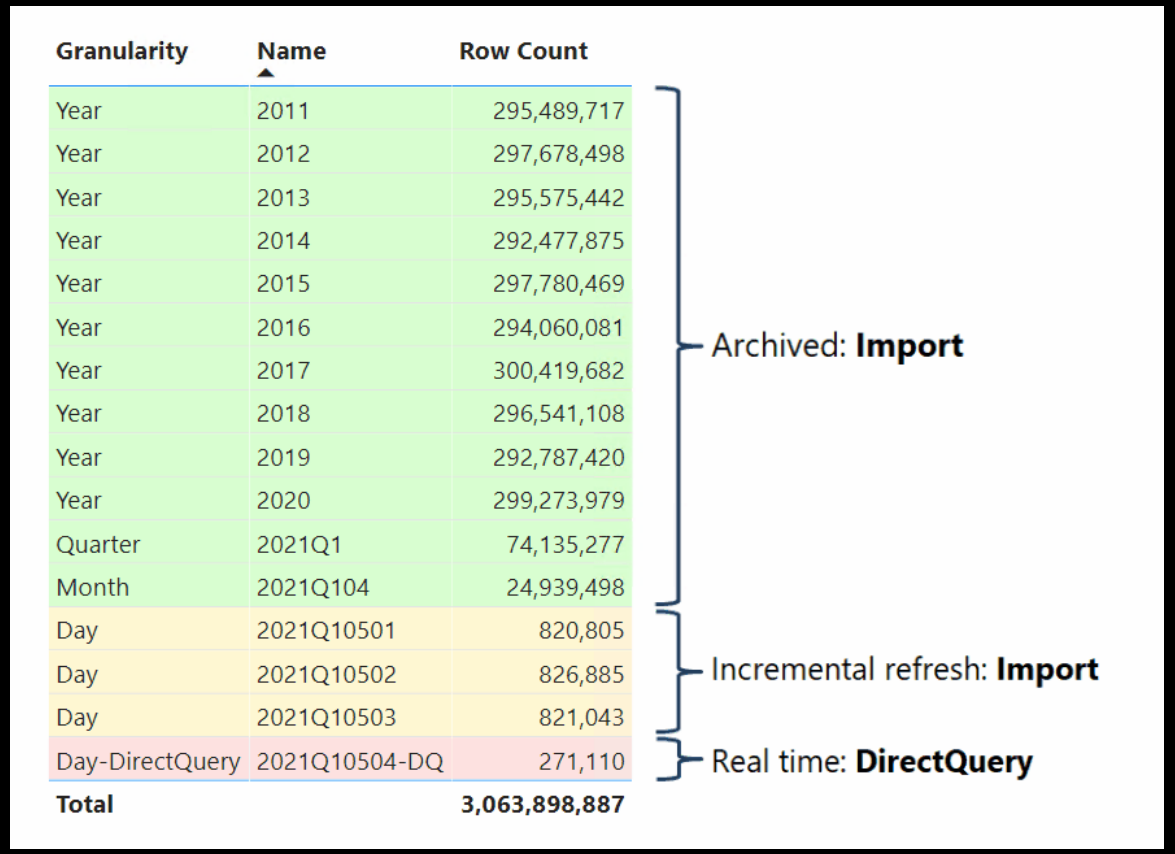


BLUE ROCKET DATA CONSULTING & SOLUTIONS

Data-Marc.com

Hybrid tables

- Live / Realtime data in Power BI
- Combines different storage modes on partition level in a single table
- Goes hand-in-hand with Incremental Refresh

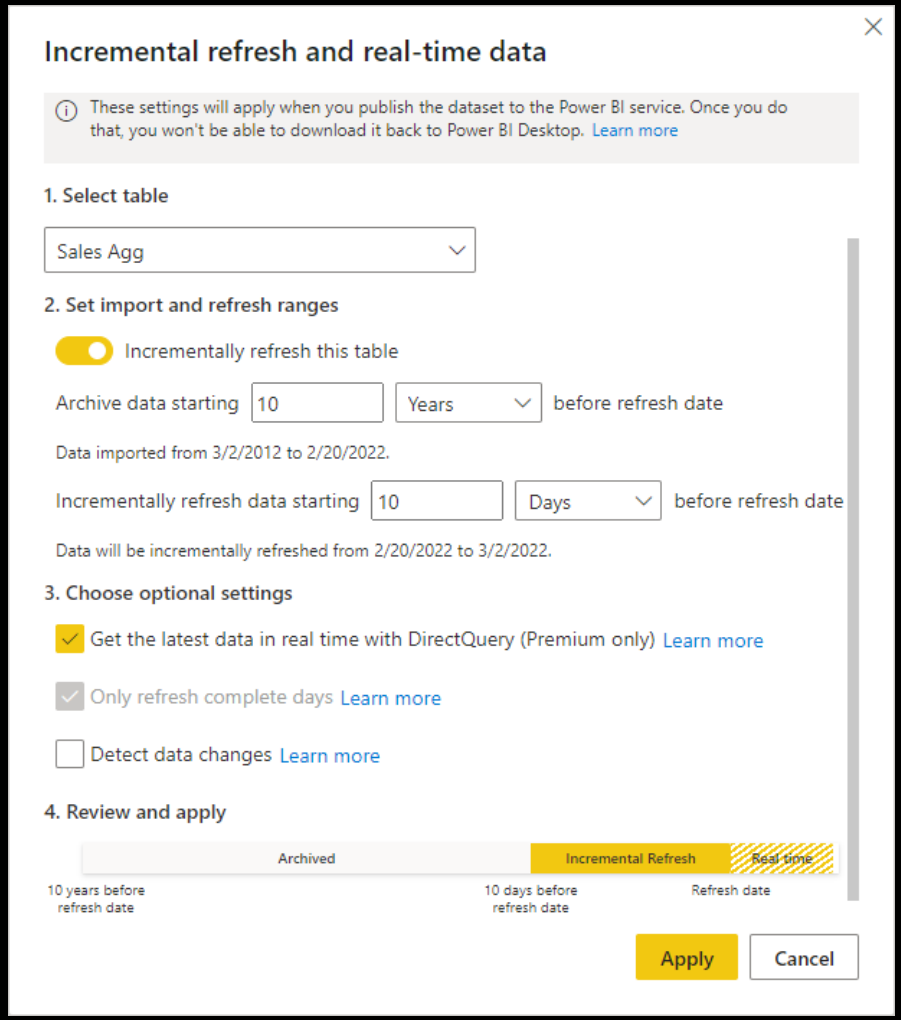


Granularity	Name	Row Count
Year	2011	295,489,717
Year	2012	297,678,498
Year	2013	295,575,442
Year	2014	292,477,875
Year	2015	297,780,469
Year	2016	294,060,081
Year	2017	300,419,682
Year	2018	296,541,108
Year	2019	292,787,420
Year	2020	299,273,979
Quarter	2021Q1	74,135,277
Month	2021Q104	24,939,498
Day	2021Q10501	820,805
Day	2021Q10502	826,885
Day	2021Q10503	821,043
Day-DirectQuery	2021Q10504-DQ	271,110
Total		**3,063,898,887**

Hybrid tables

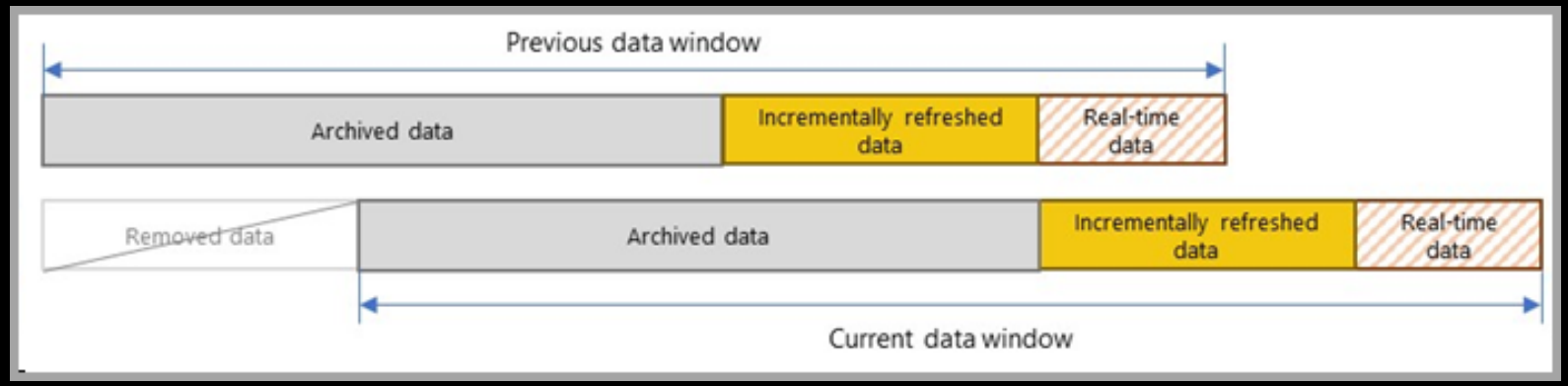
- Implementation with Incremental Refresh
- Customizable via 3rd party tooling like Tabular Editor

>> Limitation: Only 1 DQ partition per table allowed at the moment.



Hybrid tables – what challenge does it solve?

- Realtime scenarios without full tables on DQ mode
- No complex refresh mechanisms needed with partition refresh and queries over XMLA
- No more multiple tables and complex DAX to combine to achieve the same goal

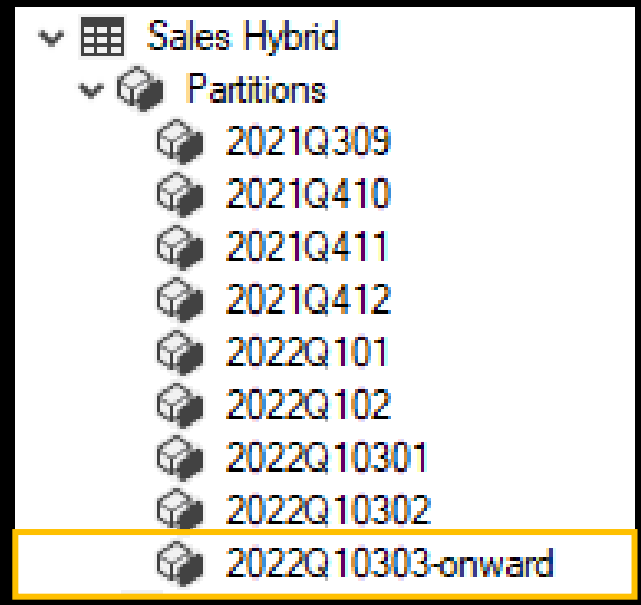


Hybrid tables – Keep in mind that…

- Premium feature
- DAX restrictions for DirectQuery apply
- Limited Power Query capabilities (due to DQ)
- Requires Large Dataset Format (storage) in workspace
- Performance hit on upstream data sources

Import

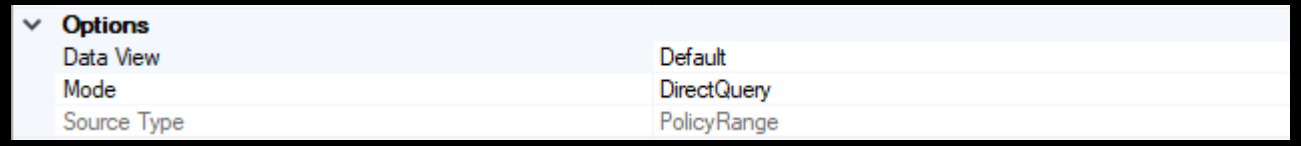
DirectQuery

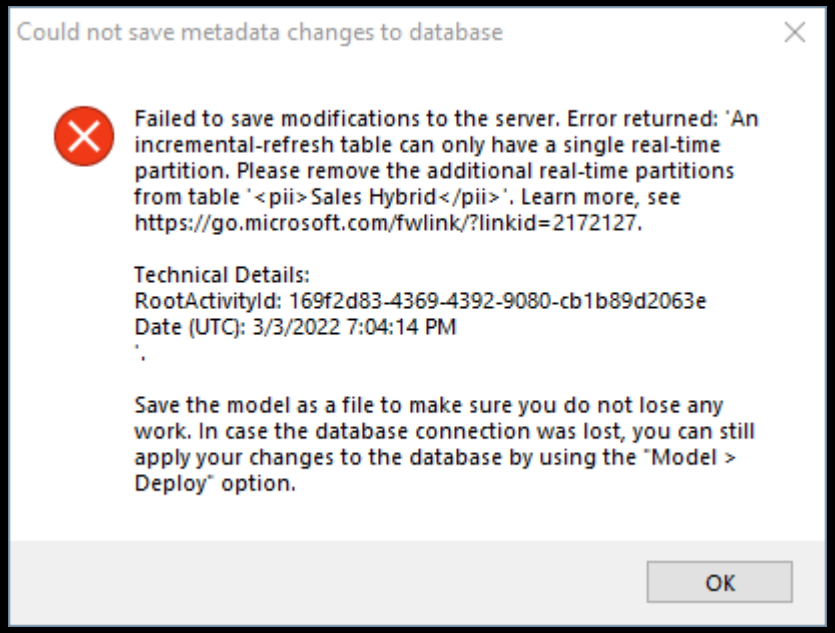


Demo Hybrid Tables
Latest data in real time

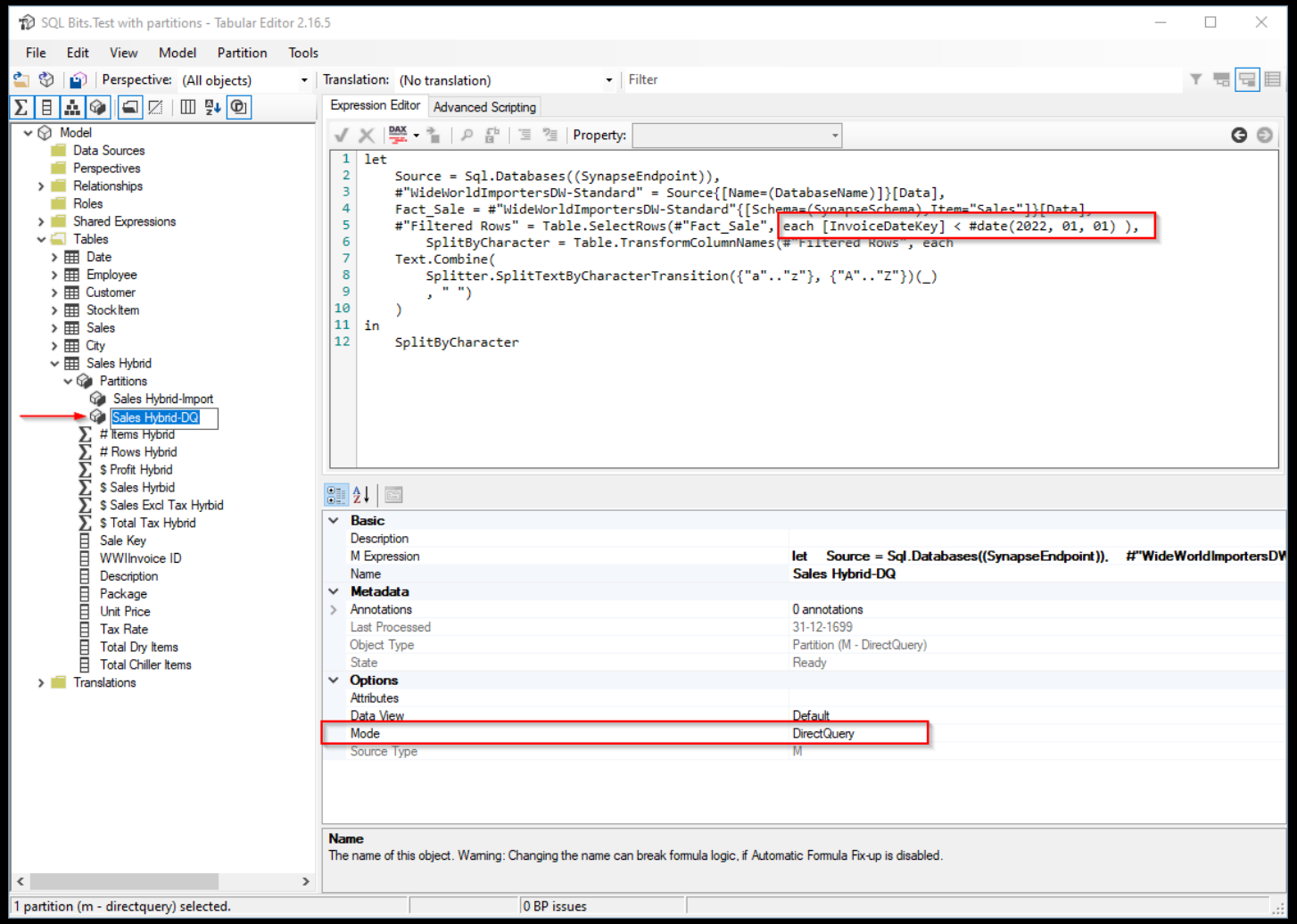
Can I change partition storage modes?

You cannot adjust tables with incremental refresh policies applied. However, there are other options to consider.

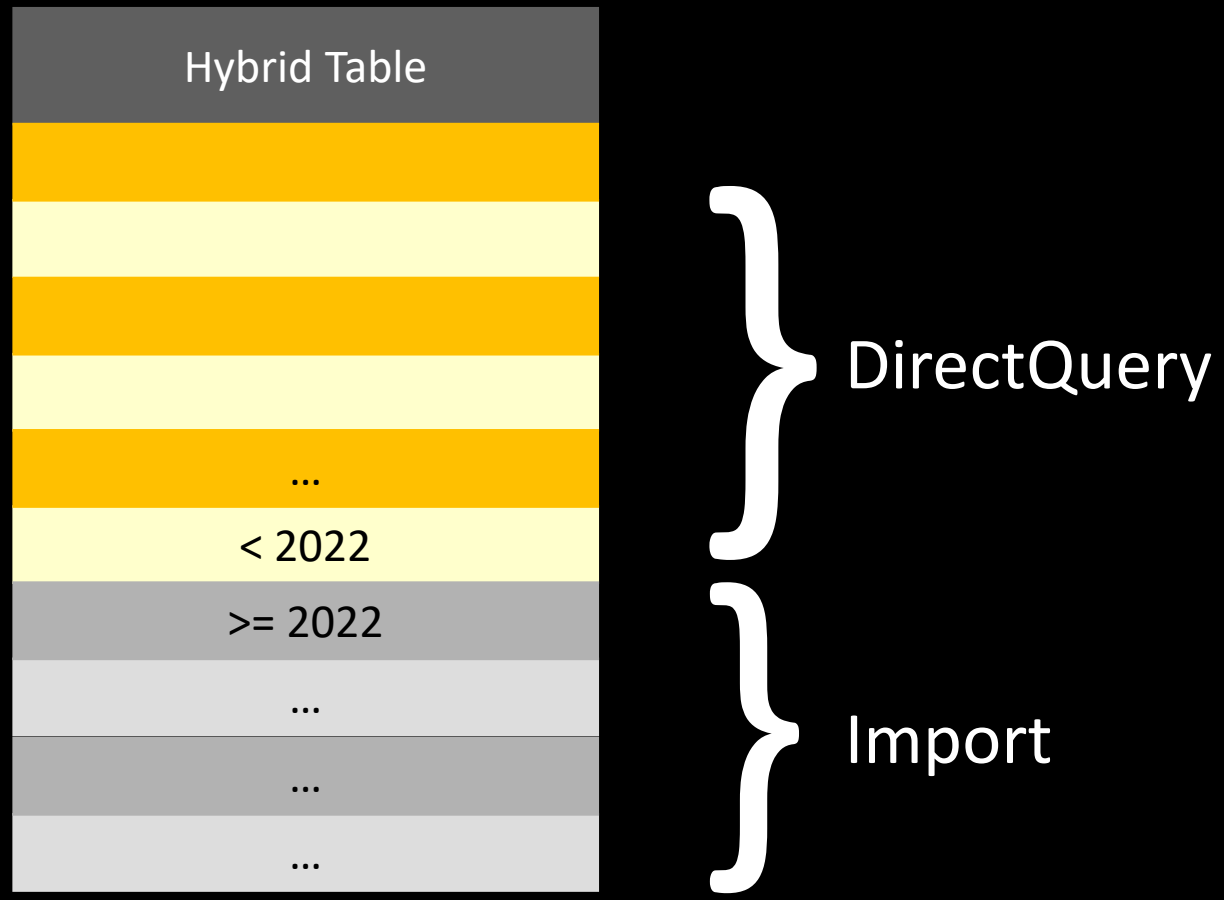




Manually setup partitioning



Create your own hybrid table setup, using 3rd party tooling like Tabular Editor



DirectQuery Partition definition

```
let
    Source = Sql.Databases((SynapseEndpoint)),
    #"WideWorldImportersDW-Standard" = Source{[Name=(DatabaseName)]}[Data],
    Fact_Sale = #"WideWorldImportersDW-
Standard"{[Schema=(SynapseSchema),Item="Sales"]}[Data],
    #"Filtered Rows" = Table.SelectRows(#"Fact_Sale", each
[InvoiceDateKey] < #date(2022, 01, 01) and
[InvoiceDateKey] >= #date(2013, 01, 01)),
        SplitByCharacter = Table.TransformColumnNames(#"Filtered Rows", each
    Text.Combine(
        Splitter.SplitTextByCharacterTransition({"a".."z"}, {"A".."Z"})(_)
        , " ")
    )
in
    SplitByCharacter
```

Import Partition definition

```
let
    Source = Sql.Databases((SynapseEndpoint)),
    #"WideWorldImportersDW-Standard" = Source{[Name=(DatabaseName)]}[Data],
    Fact_Sale = #"WideWorldImportersDW-
Standard"{[Schema=(SynapseSchema),Item="Sales"]}[Data],
    #"Filtered Rows" = Table.SelectRows(#"Fact_Sale", each
[InvoiceDateKey] >= #date(2022, 01, 01) and
[InvoiceDateKey] < #date(2022, 03, 31)),
        SplitByCharacter = Table.TransformColumnNames(#"Filtered Rows", each
    Text.Combine(
        Splitter.SplitTextByCharacterTransition({"a".."z"}, {"A".."Z"})(_)
        , " ")
    )
in
    SplitByCharacter
```

Demo Hybrid Tables
Historic data via DirectQuery

Refresh challenges

Refresh options

- Scheduled in the service
- Manual trigger
- Power Automate
- PowerShell
- API

Large datasets & high refresh rate

	Pro (shared capacity)	Premium (dedicated capacity)
Total storage size	10 GB	100 TB
Refresh rate	8/day	48/day
Max imported dataset size	1 GB	Depending on SKU size
Isolation with dedicated resources	✗	✓ [1]
Enterprise distribution to all users		
Apps & sharing	✗	✓ [2]
Email subscriptions	✗	✓
Embed APIs and controls	✗	✓ [3]
Power BI reports on-premises	✗	✓

[1] EM3 SKU or higher.
[2] Basic user consumption in apps includes viewing content in web and mobile; using Q&A, Quick Insights, and Cortana; and exporting to Excel, CSV, and PowerPoint.
[3] Embedded SKUs only allow consumption through embedded APIs and controls, NOT apps or email subscriptions.

Effective refreshing

Considerations

- Refreshing the entire model takes too long with high load on sources
- Can we only refresh certain tables?
- Can we only refresh certain partitions?
- Can we use DQ tables/partitions (Hybrid Tables)

What do we need?

- Enhanced refresh API
- XMLA Endpoints

Enhanced refresh API

- Specify the objects to refresh

POST
https://api.powerbi.com/v1.0/myorg/groups/f089354e-8366-4e18-aea3-4cb4a3a50b48/datasets/cfafbeb1-8037-4d0c-896e-a46fb27ff229/refreshes

```
{
   "type": "Full",
   "commitMode": "transactional",
   "maxParallelism": 2,
   "retryCount": 2,
   "objects": [
      {
         "table": "DimCustomer",
         "partition": "DimCustomer"
      },
      {
         "table": "DimDate"
      }
   ]
}
```

Demo Enhanced Refresh API

Central E2E orchestration

- Combine pipelines from Data Platform with Power BI
- Lowest latency between source and report
- Consider including backup operations for Power BI
- Incremental loading where possible

Demo end-2-end orchestration

Scaling

Scaling data platform

- Spark Cluster:
  - Use multiple cluster configs
  - Autoscale -> *It can take 1 to 5 minutes for a scaling operation to complete*
  - Dynamic allocation of executors
  - Automatic pause

Size	vCore	Memory
Small	4	32 GB
Medium	8	64 GB
Large	16	128 GB
XLarge	32	256 GB
XXLarge	64	512 GB
XXX Large (Isolated Compute)	80	504 GB

Scaling data platform

If you are unsure what size cluster to utilize, start with a Medium Spark pool with three nodes and the ability to scale to ten nodes. After executing your spark jobs, view the Apache Spark history server to check performance.

- There are a few areas to monitor:
  - **Disk Spillage** – If there are jobs where data spilled to disk, consider increasing the size of your Spark instance.
  - **Number of Tasks vs. Number of Executors** – Utilizing larger clusters can cause high Garbage Collection (GC). To prevent this, it is best to have less than 5 tasks executing per core when running Spark jobs. If you have exceeded this, consider scaling up your Spark instance.
  - **Executor Usage** – In the Diagnostics tab, the Executor Usage Graph will show you the executor usage over time. If executor usage is very low, consider scaling down your Spark instance.

Best practices for serverless views/pools

- Collocated/region (Azure Storage account vs Synapse)
- Convert large CSV and JSON files to ~~Parquet~~ Delta Tables
- Use appropriate data types
- Try to optimize storage layout by using partitioning and keeping your files in the range between 100 MB and 10 GB
- If you're filtering results by string column, try to use a BIN2_UTF8 collation
- Consider caching the results on the client side by using Power BI import mode
- Push wildcards to lower levels in the path

https://learn.microsoft.com/en-us/azure/synapse-analytics/sql/best-practices-serverless-sql-pool

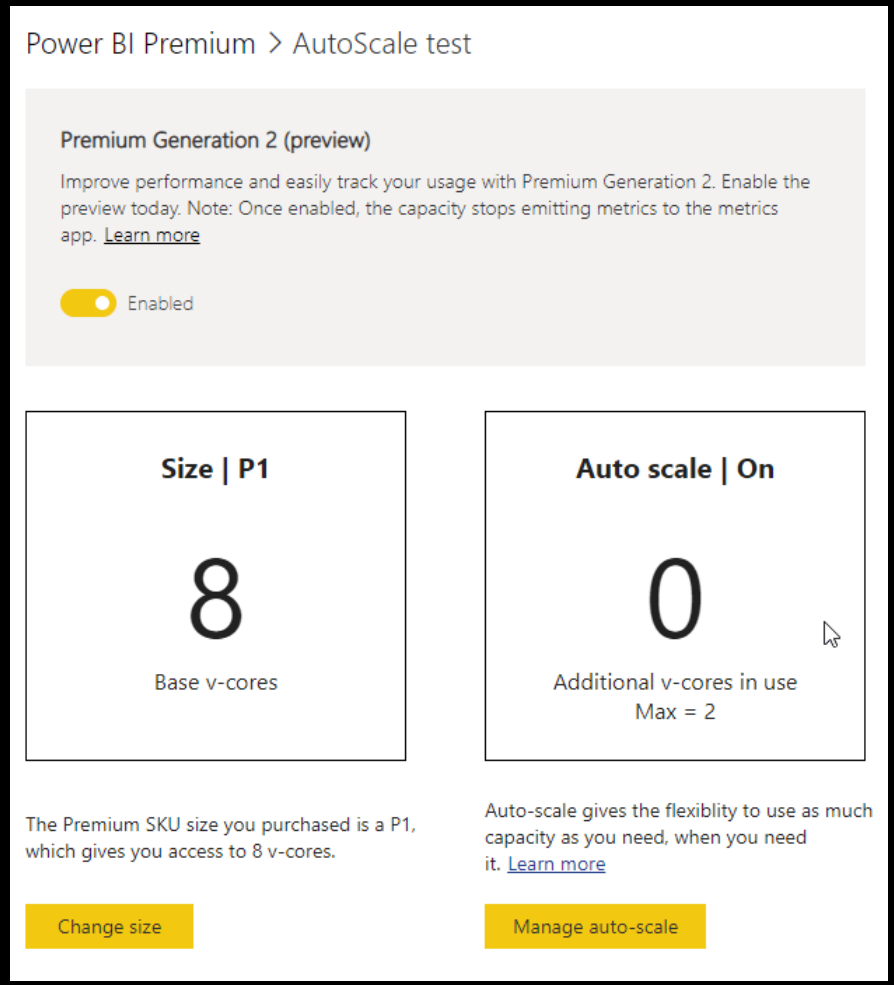
Auto-scale (gen2 only)

Auto-scale adds:

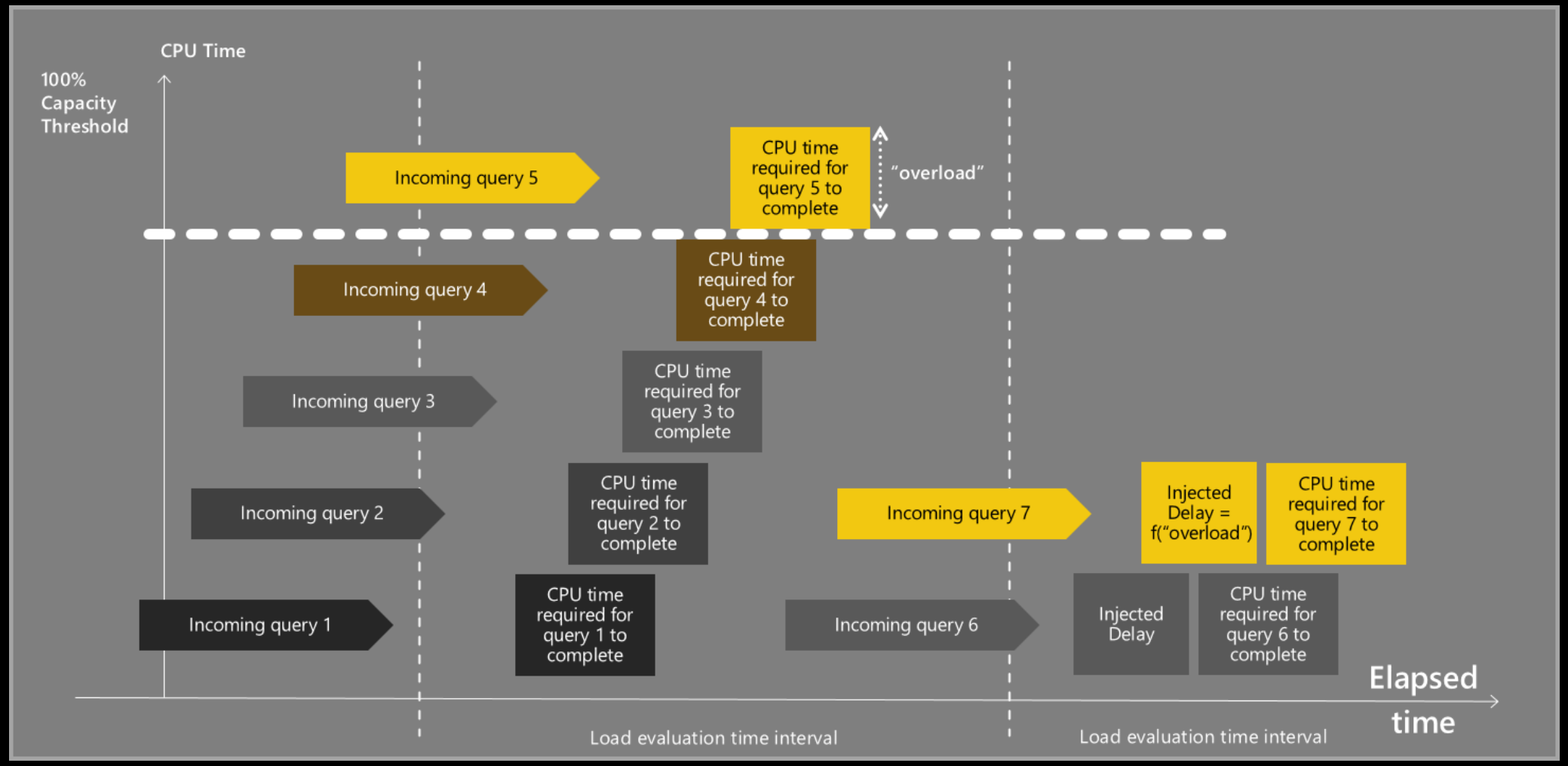
- Additional vCores
- Applies for at least 24h

Configured through

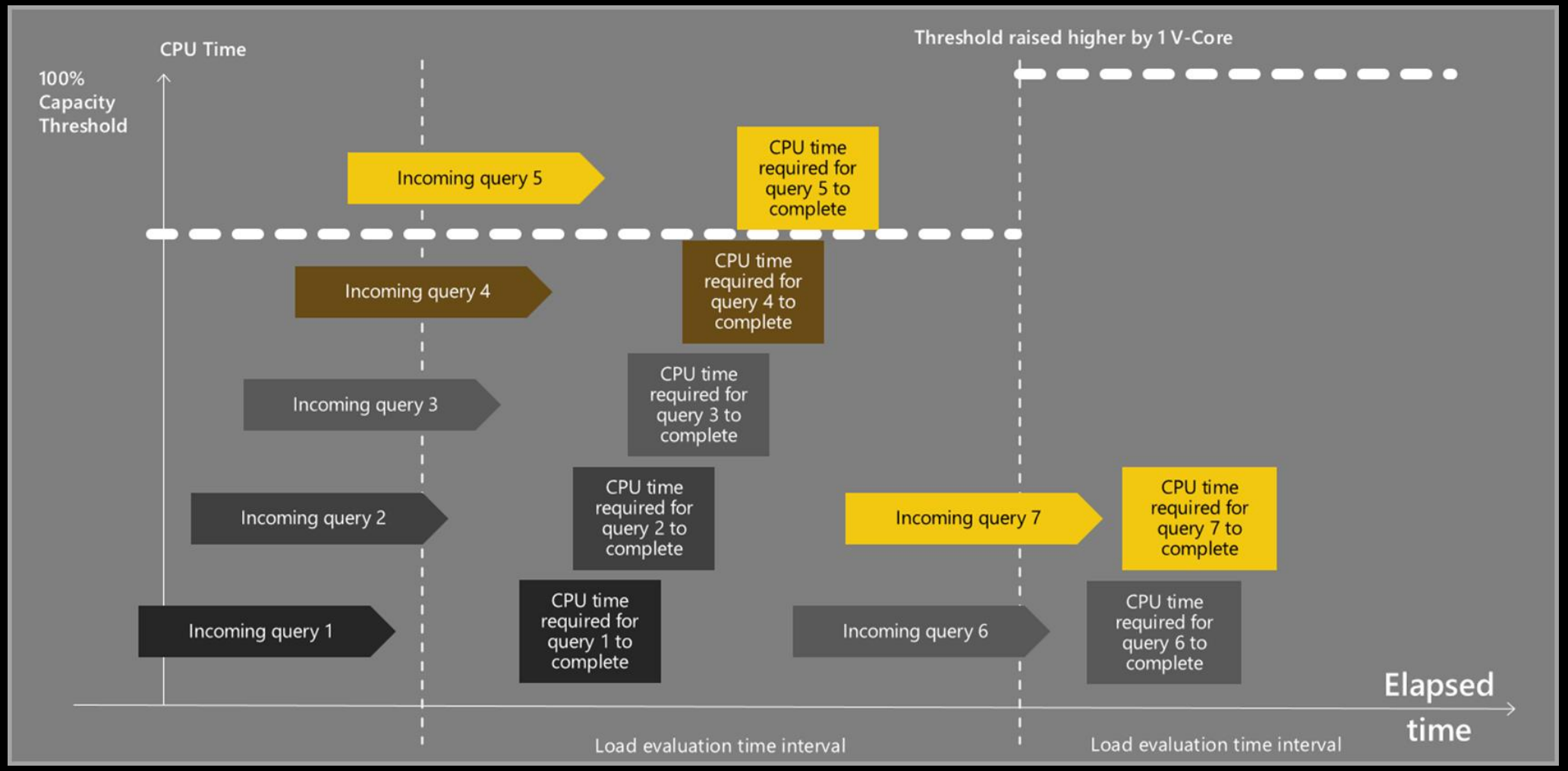
- Max. number of scalable vCores
- Azure subscription – Pay as you go



Power BI Premium – Auto scale



Power BI Premium – Auto scale

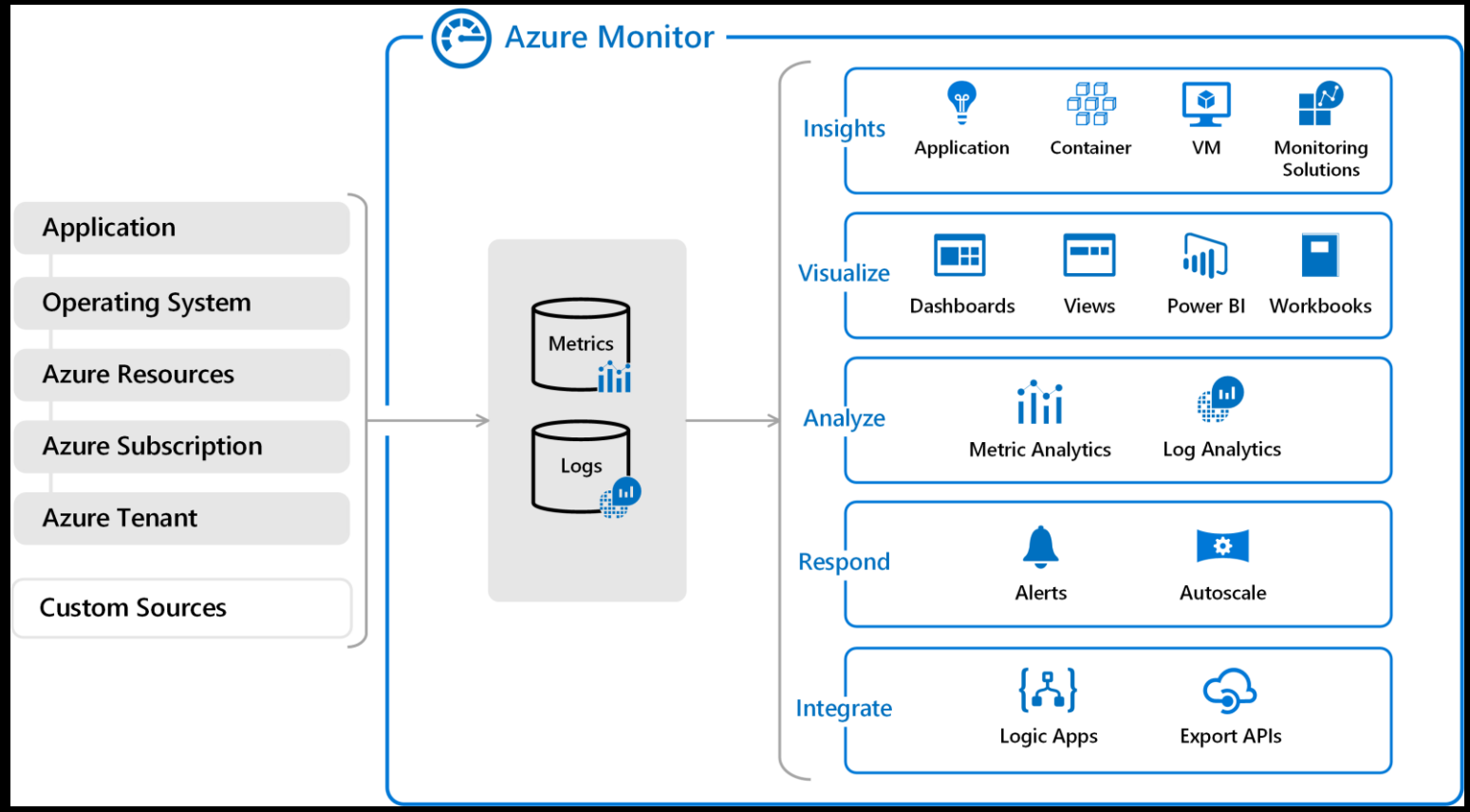


Monitoring

Data platform monitoring

Log Analytics Workspace / Azure Monitor

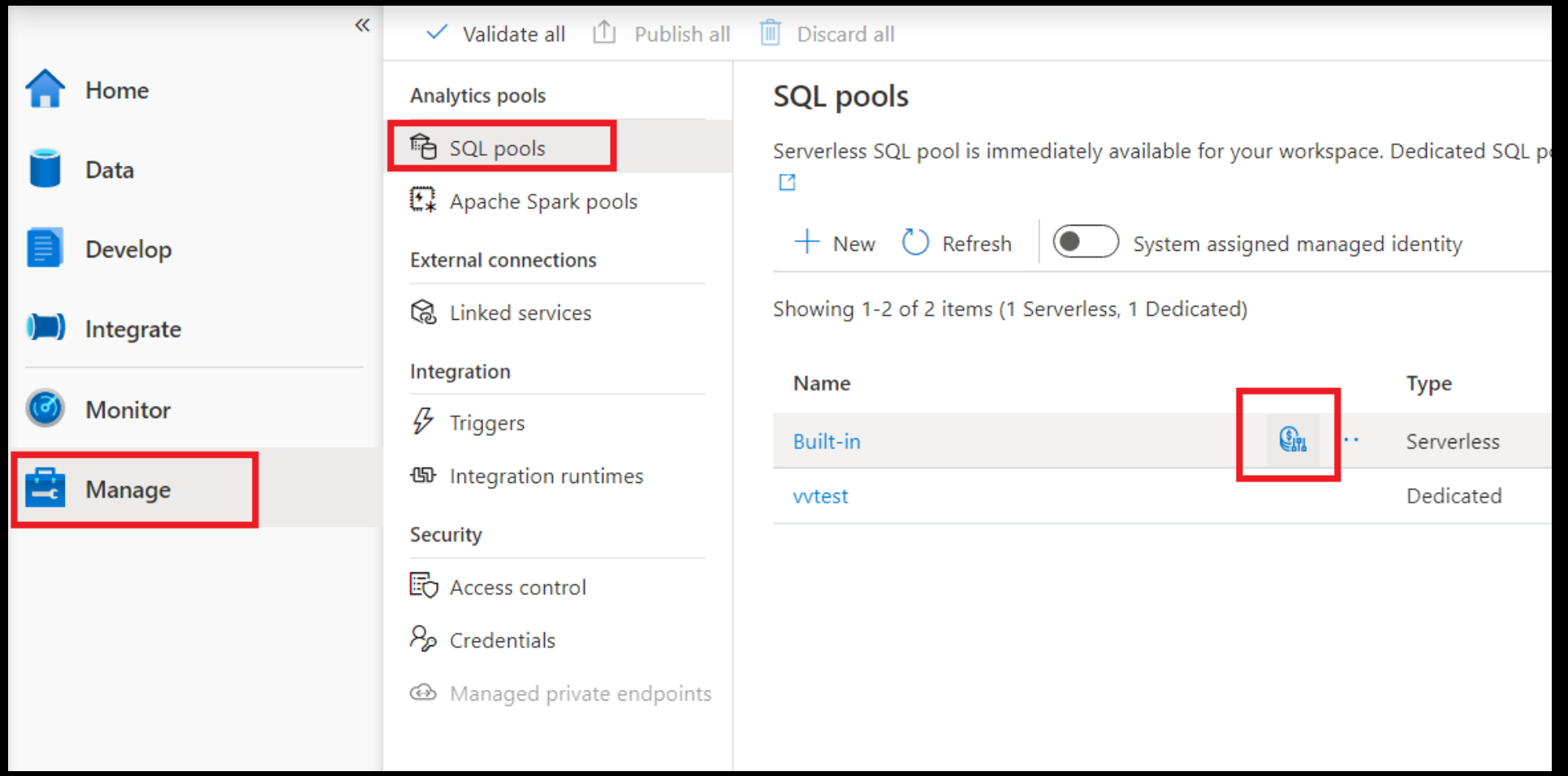
Azure Monitor delivers a comprehensive solution for collecting, analyzing, and acting on telemetry from your cloud and on-premises environments. It helps you understand how your applications are performing and proactively identifies issues affecting them and the resources they depend on.



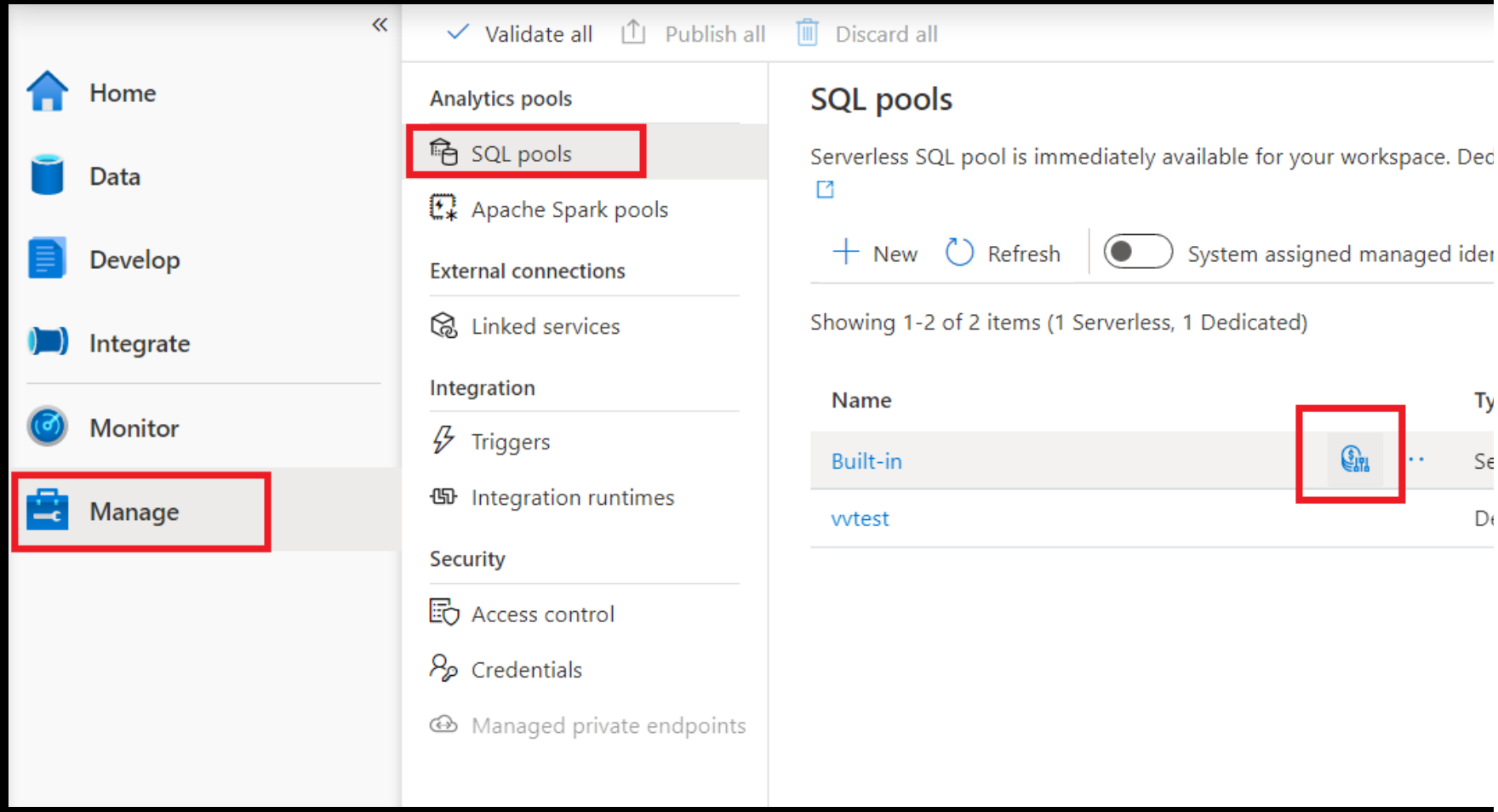
Scenarios

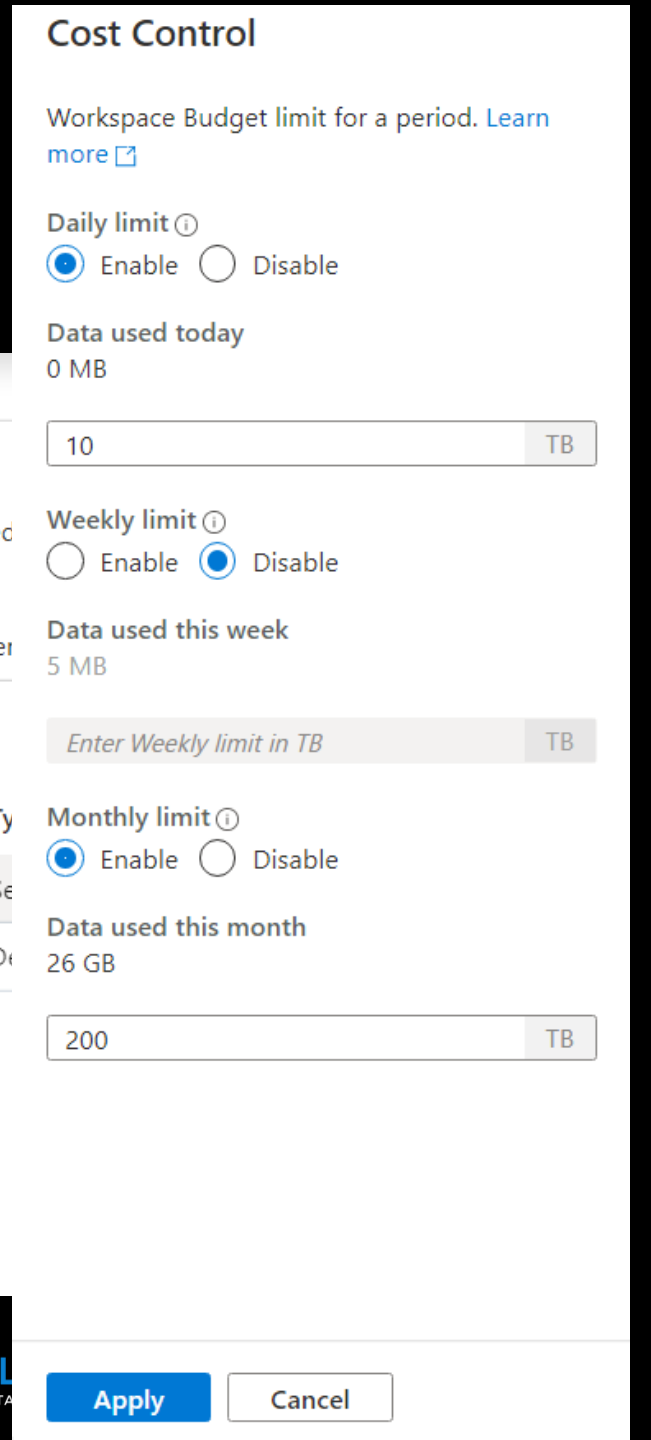
- Pipelines:
  - Identify (unusual) long durations
  - Identify unusual amount of runs
  - Trend analysis for durations
- Spark cluster:
  - Analyse utilization of driver and worker nodes
- SQL Serverless:
  - Data scanned by DirectQuery & import to datasets
- Storage:
  - Analyse trend in amount of data stored
  - Analyse trend in amount/duration of reads and writes
- Cost:
  - Analyse Resource Costs

Azure Synapse serverless SQL pool



Azure Synapse serverless SQL pool





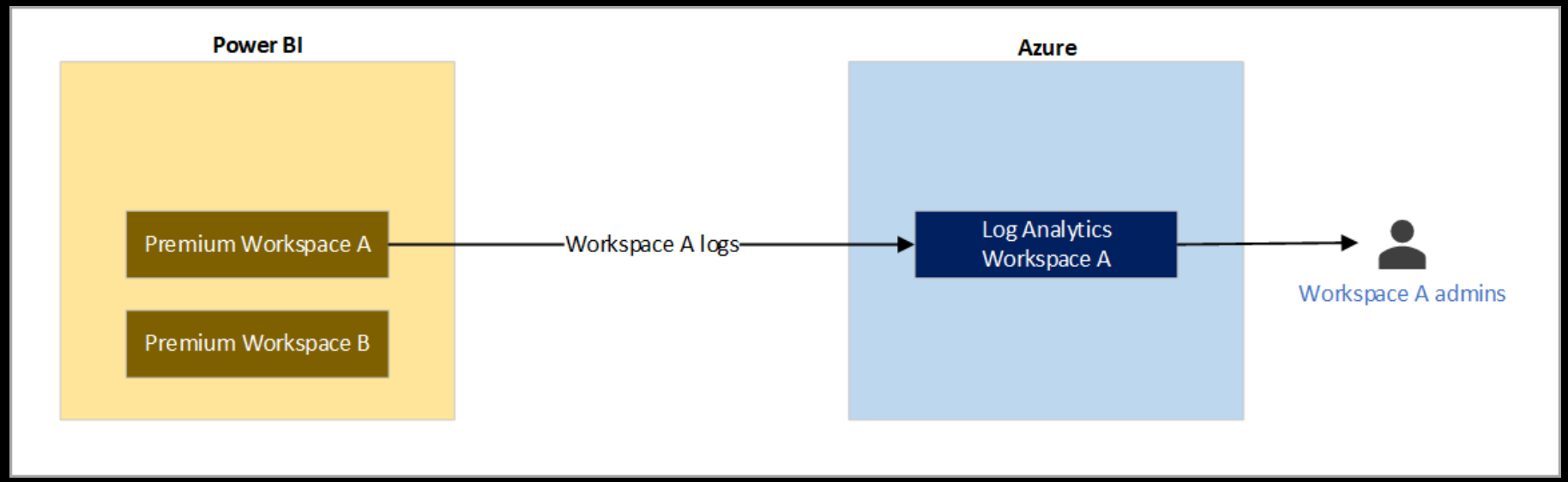
Azure Synapse monitoring

Pipeline runs
Spark cluster
Log Analytics

Power BI monitoring

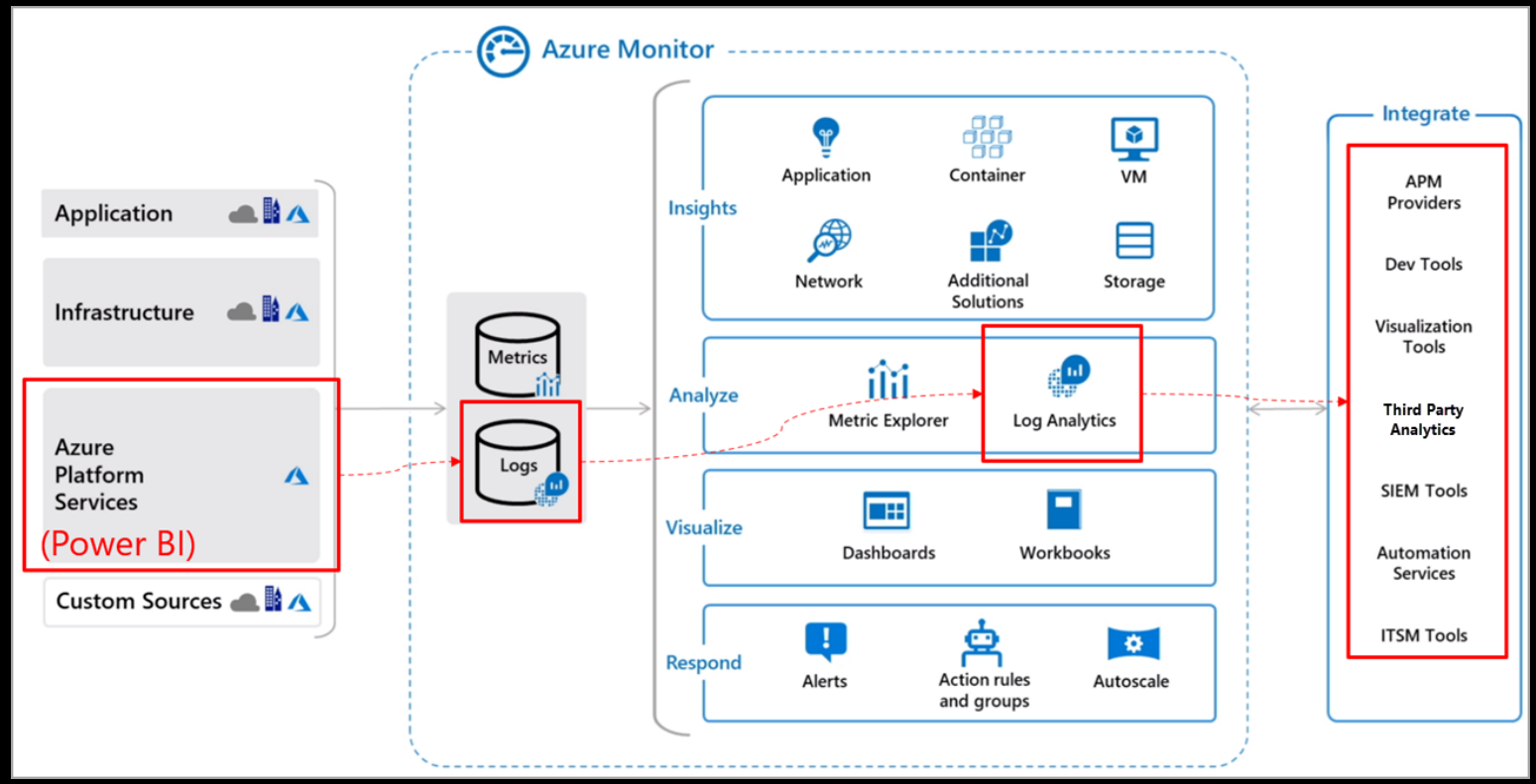
Power BI Azure Log Analytics (ALA) integration

Configure Azure Monitor integration on Power BI workspace level to allow workspace administrators to collect, analyze and act on telemetry data. PBI integration with ALA exposes events from the Analysis Services engine.



Log Analytics Workspace / Azure Monitor

Azure Monitor delivers a comprehensive solution for collecting, analyzing, and acting on telemetry from your cloud and on-premises environments. It helps you understand how your applications are performing and proactively identifies issues affecting them and the resources they depend on.



Scenarios

- Identify high or unusual engine activity by capacity / ws / user
- Analyze query performance
- Analyze dataset refresh durations and engine operations
- Investigate impact of custom operations via Premium XMLA

Example KQLs

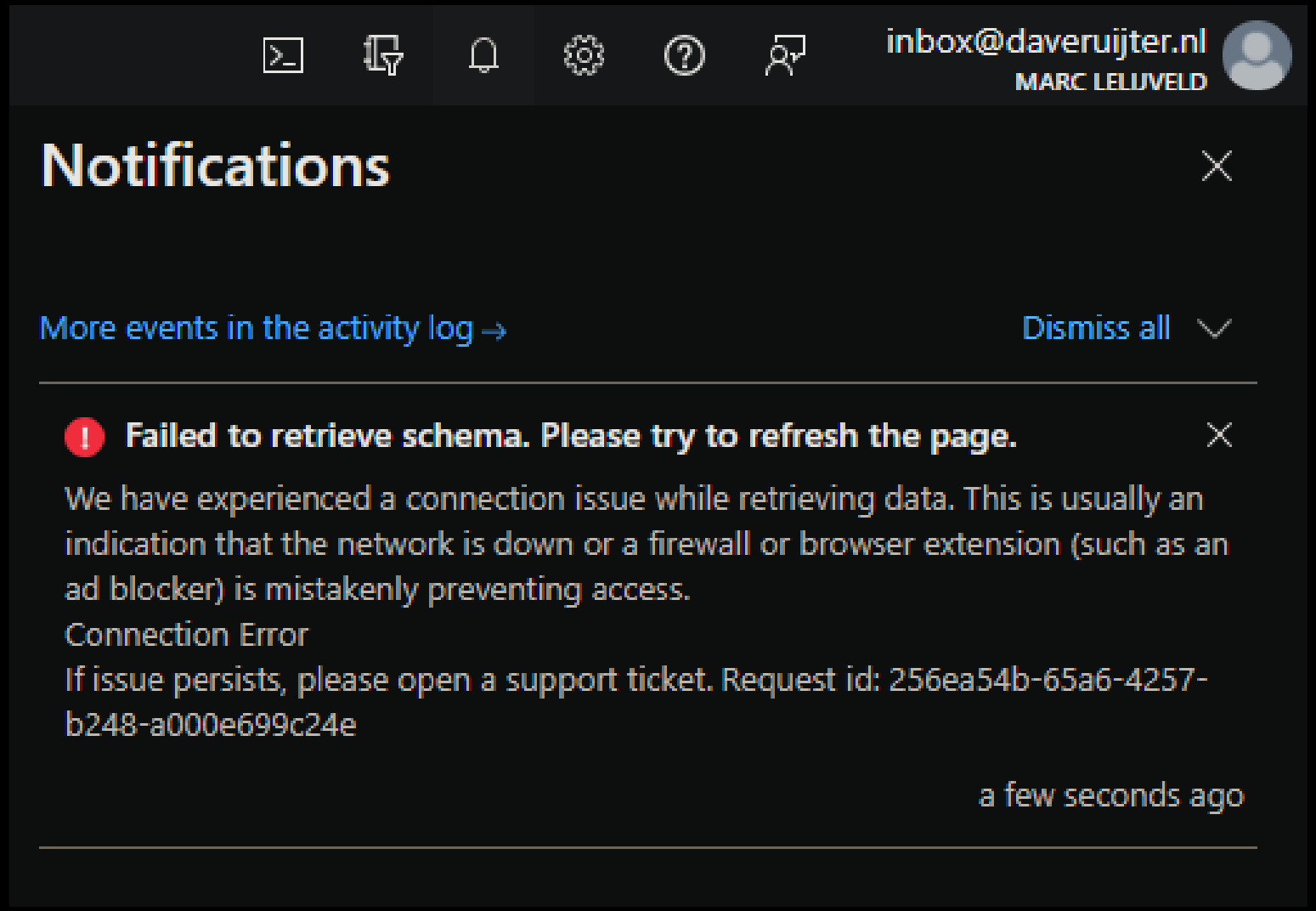
```
// log count per day for last 30d
PowerBIDatasetsWorkspace
| where TimeGenerated > ago(30d)
| summarize count() by format_datetime(
TimeGenerated, 'yyyy-MM-dd')
```

```
// average query duration by day for last 30d
PowerBIDatasetsWorkspace
| where TimeGenerated > ago(30d)
| where OperationName == 'QueryEnd'
| summarize avg(DurationMs) by
format_datetime(TimeGenerated, 'yyyy-MM-dd’)
```

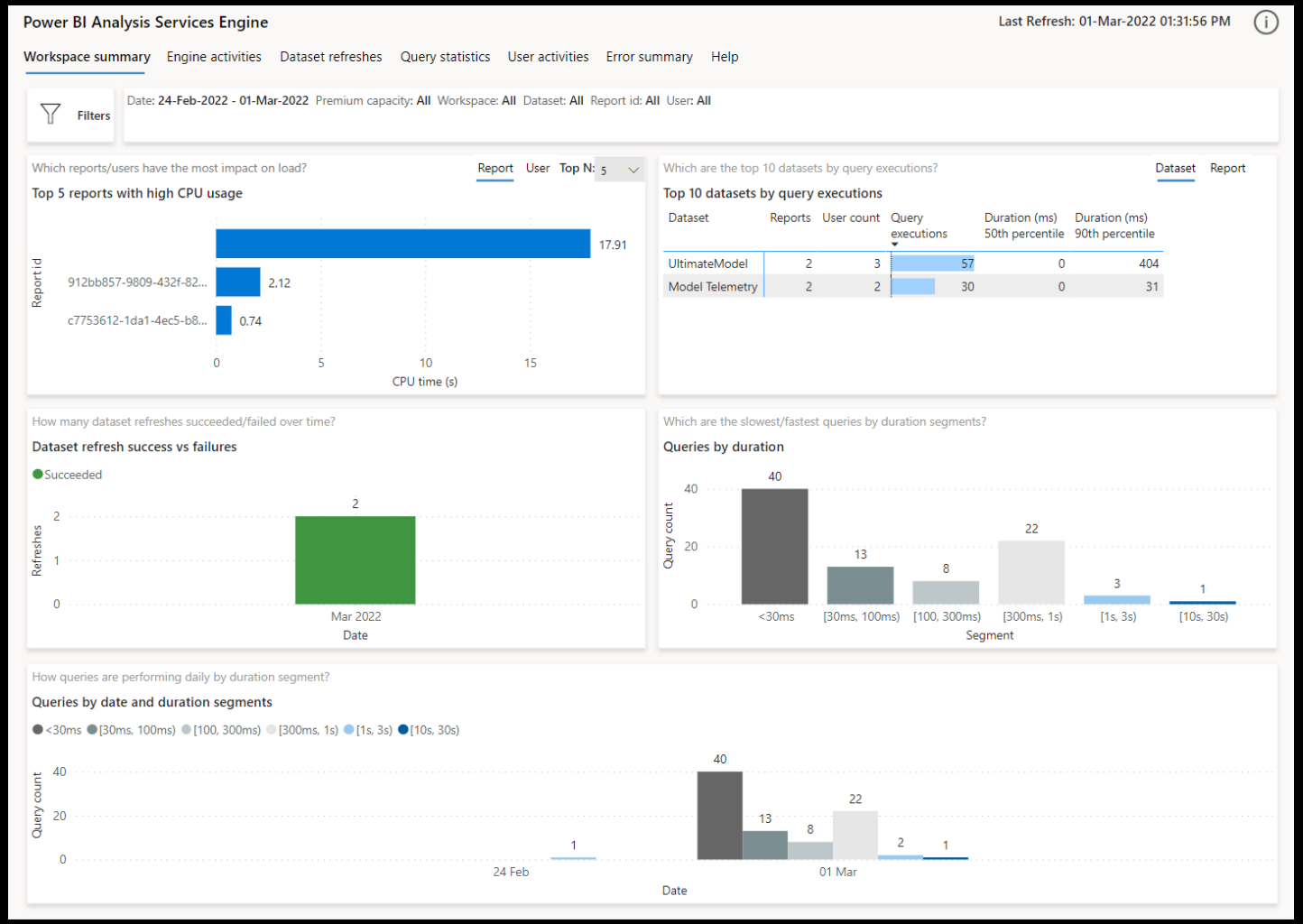
```
//query duration percentiles for a single day in 1 hour bins
PowerBIDatasetsWorkspace
| where TimeGenerated >= todatetime('2021-04-28') and
TimeGenerated <= todatetime('2021-04-29')
| where OperationName == 'QueryEnd'
| summarize percentiles(DurationMs, 0.5, 0.9) by
bin(TimeGenerated, 1h)
```

```
// refresh durations by workspace and dataset for last 7d
PowerBIDatasetsWorkspace
| where TimeGenerated > ago(30d)
| where OperationName == 'CommandEnd'
| where ExecutingUser contains 'system'
| where EventText contains 'refresh'
| project WorkspaceName, DatasetName = ArtifactName,
DurationMs
```

Ad-blocker?

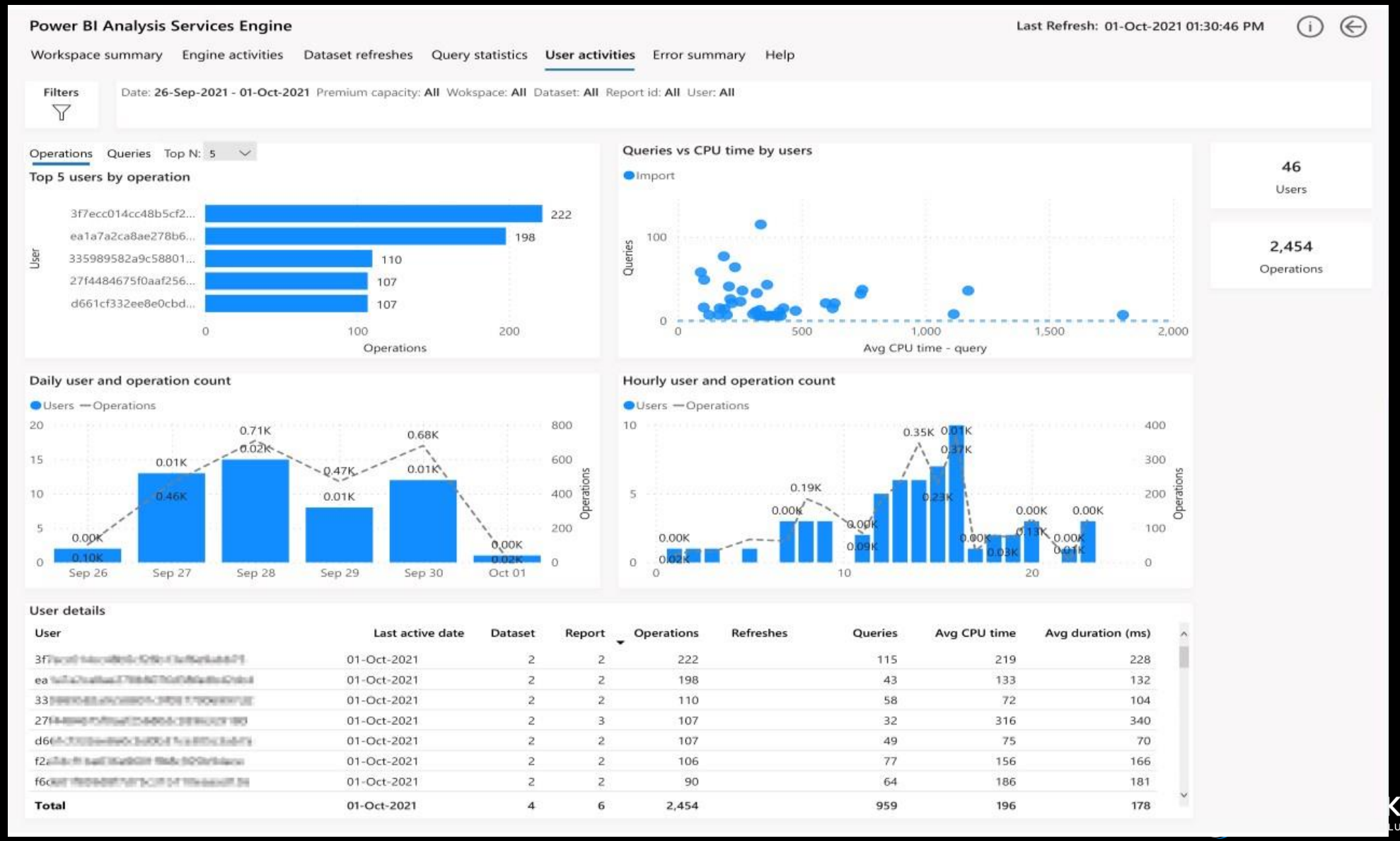

inbox@daveruijter.nl
MARC LELIJVELD
Notifications
More events in the activity log →
Dismiss all
Failed to retrieve schema. Please try to refresh the page.
We have experienced a connection issue while retrieving data. This is usually an indication that the network is down or a firewall or browser extension (such as an ad blocker) is mistakenly preventing access.
Connection Error
If issue persists, please open a support ticket. Request id: 256ea54b-65a6-4257-b248-a000e699c24e
a few seconds ago

Template report to get insights



- Workspace summary
- Engine activities
- Dataset refreshes
- Query statistics
- Error summary

Power BI Analysis Services Engine



GitHub location for .pbit

https://github.com/microsoft/PowerBI-LogAnalytics-Template-Reports

Customizations

- Visual ID
- Report Name

Demo Log Analytics Integration

SQL Database	S3 DTUs	$88.91
Azure Synapse Analytics	vCore	$63.06
Azure Synapse Analytics	Standard Data Processed	$14.69
Azure Synapse Analytics	Standard LRS Data Stored	$13.63
Azure Synapse Analytics	Azure Hosted IR Data Movement	$7.6
Storage	S10 Disks	$3.62
SQL Database	B DTU	$2.96
Storage	Hot LRS Data Stored	$2.51
Storage	Hot Read Operations	$1.03
Storage	Hot Iterative Read Operations	$0.62
Storage	Hot Write Operations	$0.43
Storage	Hot Other Operations	$0.39
Storage	Hot LRS Data Stored	$0.2
Azure Synapse Analytics	Standard ZRS Data Stored	$0.11
Azure Synapse Analytics	Azure Hosted IR Orchestration Activity Run	$0.09
Log Analytics	Pay-as-you-go Data Ingestion	$0.05
Log Analytics	Pay-as-you-go Data Retention	$0
Storage	Hot LRS Index	$0
Azure Synapse Analytics	Azure Hosted IR Pipeline Activity	$0
Azure Synapse Analytics	Azure Hosted IR External Pipeline Activity	$0
Bandwidth	Standard Data Transfer Out	$0
Storage	Hot Other Operations	$0
Storage	All Other Operations	$0
Storage	Hot Write Operations	$0
Storage	LRS List and Create Container Operations	$0
Storage	Hot Read Operations	$0
Storage	Delete Operations	$0
Storage	Cool LRS Data Stored	$0
Bandwidth	Standard Data Transfer In	$0
Storage	Batch Write Operations	$0
Storage	LRS Data Stored	$0

Wrap-up

Design and implement	Orchestrate	Performance	Cost
Better design and implement complex data models, including hybrid tables, aggregations, and combined storage modes (import, DirectQuery , dual).	Orchestrate the end-to-end data processing, with a pipeline chain from data ingest in the data lake house to the incremental Power BI dataset refresh.	Use different techniques to identify performance bottlenecks in your solutions and how to solve those ("does it fold"?).	Implement a cost-efficient solution, that still meets the scalability demands.

Any bonus questions?

Please provide us feedback!