Azure Data Explorer - The New Star in your Data Platform

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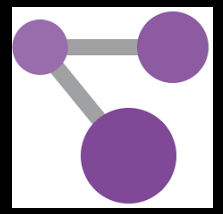
Agenda

- What exactly is Azure Data Explorer?
- A brief introduction to KQL
- Data Explorer – the hidden treasure of Azure analytic tools?
- Data Explorer in an IoT scenario
- Data Explorer with Synapse Link
- Graph Databases with Data Explorer

What exactly is Azure Data Explorer?

Azure Data Explorer

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Azure Data Explorer

- Columnar
  - very good compression
- Append-Only
- Elastic scale
- Low latency ingestion (200 Mb/s per node)
- Fully managed
  - indexed by default

Azure Data Explorer

- Developed by Microsoft engineers in Israel to handle Azure's need for fast log and telemetry analytics
- Released as Application Insights in 2016
- Data Explorer went GA 2019

Azure Data Explorer

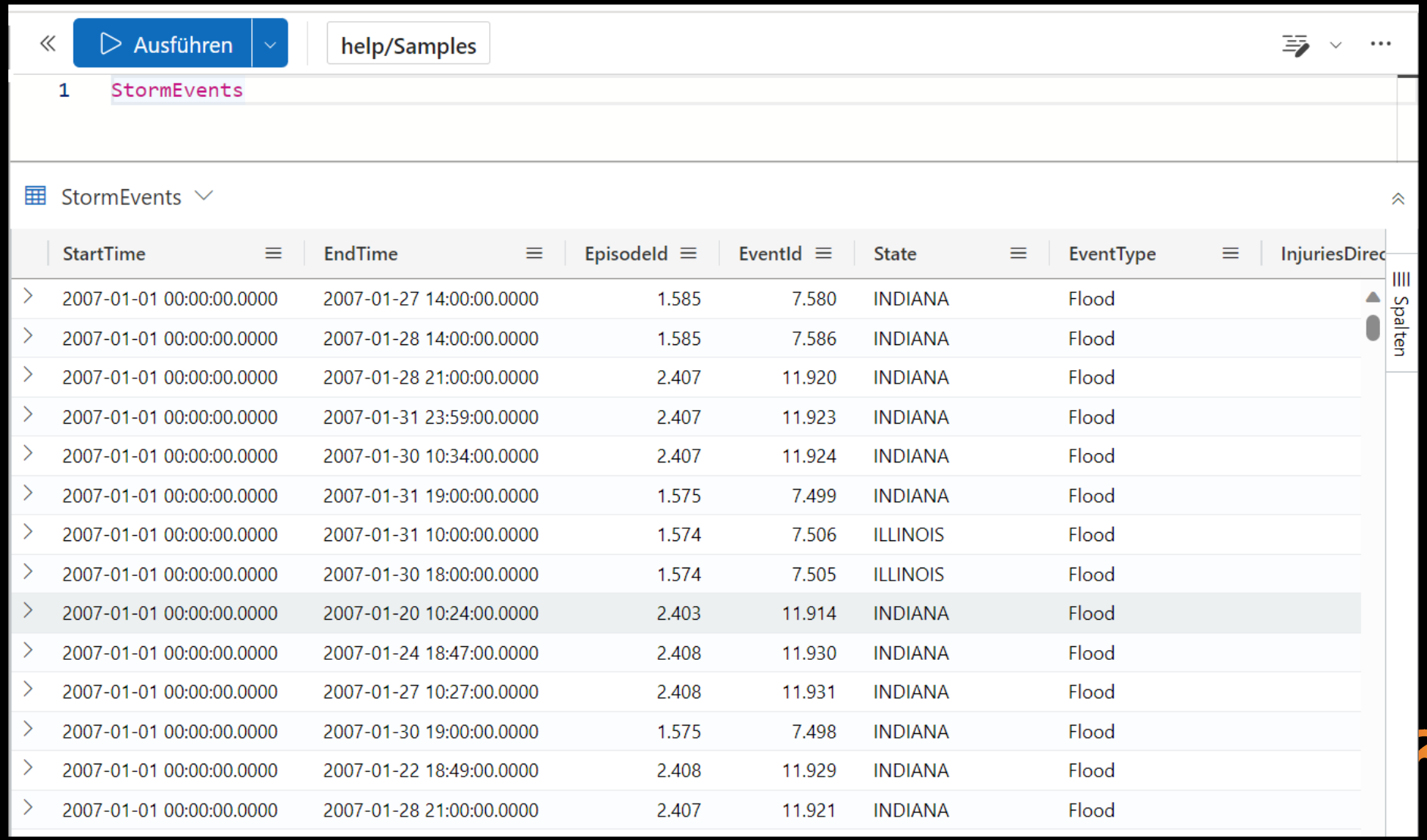
- RDBMS-like with databases, schemas & tables
- Powerful time series database
- Zero constraints
- Can be queried with SQL
- Better yet – the native language

Intro to KQL

- Kusto Query Language

No, Kusto – not Cousteau!

name of the table = SELECT *



StartTime	EndTime	EpisodeId	EventId	State	EventType	InjuriesDirec
2007-01-01 00:00:00.0000	2007-01-27 14:00:00.0000	1.585	7.580	INDIANA	Flood	
2007-01-01 00:00:00.0000	2007-01-28 14:00:00.0000	1.585	7.586	INDIANA	Flood	
2007-01-01 00:00:00.0000	2007-01-28 21:00:00.0000	2.407	11.920	INDIANA	Flood	
2007-01-01 00:00:00.0000	2007-01-31 23:59:00.0000	2.407	11.923	INDIANA	Flood	
2007-01-01 00:00:00.0000	2007-01-30 10:34:00.0000	2.407	11.924	INDIANA	Flood	
2007-01-01 00:00:00.0000	2007-01-31 19:00:00.0000	1.575	7.499	INDIANA	Flood	
2007-01-01 00:00:00.0000	2007-01-31 10:00:00.0000	1.574	7.506	ILLINOIS	Flood	
2007-01-01 00:00:00.0000	2007-01-30 18:00:00.0000	1.574	7.505	ILLINOIS	Flood	
2007-01-01 00:00:00.0000	2007-01-20 10:24:00.0000	2.403	11.914	INDIANA	Flood	
2007-01-01 00:00:00.0000	2007-01-24 18:47:00.0000	2.408	11.930	INDIANA	Flood	
2007-01-01 00:00:00.0000	2007-01-27 10:27:00.0000	2.408	11.931	INDIANA	Flood	
2007-01-01 00:00:00.0000	2007-01-30 19:00:00.0000	1.575	7.498	INDIANA	Flood	
2007-01-01 00:00:00.0000	2007-01-22 18:49:00.0000	2.408	11.929	INDIANA	Flood	
2007-01-01 00:00:00.0000	2007-01-28 21:00:00.0000	2.407	11.921	INDIANA	Flood	

aggregation, sampling, ordering

```
1  Trips
2  | count
```

Tabelle 1

Count
1.547.471.776

Ausführen | help/Samples

```
2  FHV_Trips
3  | summarize count() by bin (pickup_datetime, 1d)
```

Tabelle 1

pickup_datetime	count_
2015-01-01 00:00:00.0000	77.789
2015-01-02 00:00:00.0000	61.832
2015-01-03 00:00:00.0000	81.955
2015-01-04 00:00:00.0000	62.691
2015-01-05 00:00:00.0000	71.063
2015-01-06 00:00:00.0000	81.722
2015-01-07 00:00:00.0000	93.090
2015-01-08 00:00:00.0000	103.978
2015-01-09 00:00:00.0000	100.710
2015-01-10 00:00:00.0000	103.838
2015-01-11 00:00:00.0000	80.717
2015-01-12 00:00:00.0000	87.703
2015-01-13 00:00:00.0000	94.221
2015-01-14 00:00:00.0000	94.558
2015-01-15 00:00:00.0000	100.055
2015-01-16 00:00:00.0000	105.375

Ausführen | help/Samples

```
1  FHV_Trips
2  | order by pickup_datetime desc
3  | take 100
```

Tabelle 1 100

Dispatching_bas...	pickup_datetime	dropoff_datetime	Pickup_location...	Dropoff_locatio...	Shared_Ride_Fl...
B02510	2018-06-30 23:59:59...	2018-07-01 00:09:56...	89	133	
B02884	2018-06-30 23:59:59...	2018-07-01 00:25:38...	36	7	
B02871	2018-06-30 23:59:59...	2018-07-01 00:20:30...	255	97	true
B01145	2018-06-30 23:59:59...	2018-07-01 01:10:12...		265	
B02864	2018-06-30 23:59:59...	2018-07-01 00:17:11...	65	79	
B00647	2018-06-30 23:59:59...	2018-07-01 00:13:59...		265	
B02887	2018-06-30 23:59:59...	2018-07-01 00:06:49...	129	82	
B02764	2018-06-30 23:59:59...	2018-07-01 00:18:04...	255	37	
B02395	2018-06-30 23:59:59...	2018-07-01 00:12:43...	244	166	
B02510	2018-06-30 23:59:59...	2018-07-01 00:19:35...	40	145	
B02764	2018-06-30 23:59:59...	2018-07-01 00:33:52...	41	218	

filtering

```
1  FHV_Trips
2  | where Dropoff_location_ID == 1
3  | take 100
```

Tabelle 1 — 100

Dispatching_bas...	pickup_datetime	dropoff_datetime	Pickup_location...	Dropoff_locatio...	Shared_Ride_Fl...
B02884	2017-07-11 15:03:51...	2017-07-11 16:16:59...	162	1	
B02877	2017-07-11 15:18:15...	2017-07-11 16:00:10...	144	1	
B02877	2017-07-11 15:19:24...	2017-07-11 16:00:49...	114	1	
B02871	2017-07-11 16:05:43...	2017-07-11 16:58:43...	162	1	
B02871	2017-07-11 16:19:42...	2017-07-11 17:01:52...	158	1	
B02866	2017-07-11 16:35:23...	2017-07-11 17:44:18...	162	1	
B02764	2017-07-11 17:04:16...	2017-07-11 18:24:48...	75	1	
B02765	2017-07-11 17:08:49...	2017-07-11 18:49:24...	234	1	
B02884	2017-09-03 18:01:53...	2017-09-03 18:31:35...	13	1	
B02882	2017-09-03 18:02:42...	2017-09-03 18:48:35...	225	1	
B02884	2017-09-03 18:03:05...	2017-09-03 20:12:52...	248	1	
B02617	2017-09-03 18:05:54...	2017-09-03 18:29:18...	48	1	
B02879	2017-09-03 18:08:51...	2017-09-03 18:37:36...	230	1	

```
1  FHV_Trips
2  | where Dropoff_location_ID == 1
3  | take 100
4  | project Dispatching_base_num, pickup_datetime, dropoff_datetime, Pickup_location_ID
```

Tabelle 1

Dispatching_base_num	pickup_datetime	dropoff_datetime	Pickup_location_ID
B02884	2017-07-11 15:03:51.0000	2017-07-11 16:16:59.0000	162
B02877	2017-07-11 15:18:15.0000	2017-07-11 16:00:10.0000	144
B02877	2017-07-11 15:19:24.0000	2017-07-11 16:00:49.0000	114
B02871	2017-07-11 16:05:43.0000	2017-07-11 16:58:43.0000	162
B02871	2017-07-11 16:19:42.0000	2017-07-11 17:01:52.0000	158
B02866	2017-07-11 16:35:23.0000	2017-07-11 17:44:18.0000	162
B02764	2017-07-11 17:04:16.0000	2017-07-11 18:24:48.0000	75
B02765	2017-07-11 17:08:49.0000	2017-07-11 18:49:24.0000	234
B02884	2017-09-03 18:01:53.0000	2017-09-03 18:31:35.0000	13
B02882	2017-09-03 18:02:42.0000	2017-09-03 18:48:35.0000	225

joins

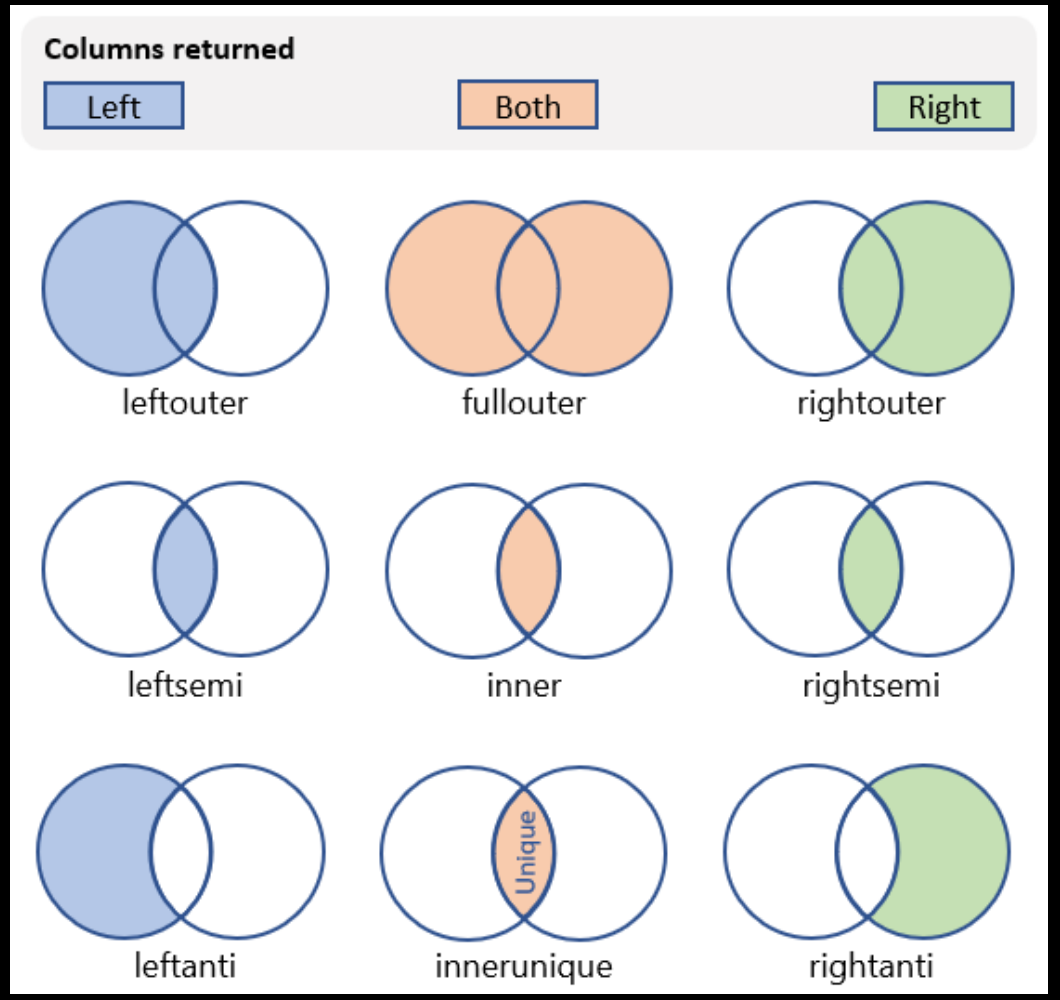
```
1  StormEvents
2  | join kind=inner PopulationData on $left.State == $right.State
3  | project StartTime, EndTime, State, EventType, Population
4  | limit 15
```

Tabelle 1 ✓ 15 ···

StartTime	EndTime	State	EventType	Population
2007-09-18 20:00:00.0000	2007-09-19 18:00:00.0000	FLORIDA	Heavy Rain	21.711.200
2007-09-20 21:57:00.0000	2007-09-20 22:05:00.0000	FLORIDA	Tornado	21.711.200
2007-12-11 21:45:00.0000	2007-12-12 16:45:00.0000	KANSAS	Flood	2.915.270
2007-12-13 09:02:00.0000	2007-12-13 10:30:00.0000	KENTUCKY	Flood	4.474.190
2007-12-20 07:50:00.0000	2007-12-20 07:53:00.0000	MISSISSIPPI	Thunderstorm Wind	2.971.280
2007-12-20 08:47:00.0000	2007-12-20 08:48:00.0000	MISSISSIPPI	Thunderstorm Wind	2.971.280
2007-12-20 10:32:00.0000	2007-12-20 10:36:00.0000	MISSISSIPPI	Tornado	2.971.280
2007-12-23 06:02:00.0000	2007-12-23 06:07:00.0000	OHIO	Thunderstorm Wind	11.701.900
2007-12-23 06:36:00.0000	2007-12-23 06:41:00.0000	OHIO	Thunderstorm Wind	11.701.900
2007-12-23 06:38:00.0000	2007-12-23 06:43:00.0000	OHIO	Thunderstorm Wind	11.701.900
2007-12-23 07:14:00.0000	2007-12-23 07:19:00.0000	OHIO	Thunderstorm Wind	11.701.900
2007-12-28 02:03:00.0000	2007-12-28 02:11:00.0000	MISSISSIPPI	Hail	2.971.280
2007-12-28 02:47:00.0000	2007-12-28 03:05:00.0000	MISSISSIPPI	Hail	2.971.280
2007-12-28 03:05:00.0000	2007-12-28 03:16:00.0000	MISSISSIPPI	Hail	2.971.280
2007-12-30 16:00:00.0000	2007-12-30 16:05:00.0000	GEORGIA	Thunderstorm Wind	10.723.700

joins

- different join types
  - innerunique (default) → only first match is included (like the SSIS lookup component)
  - inner
  - leftouter, rightouter
  - fullouter
  - leftanti, rightanti
  - leftsemi, rightsemi

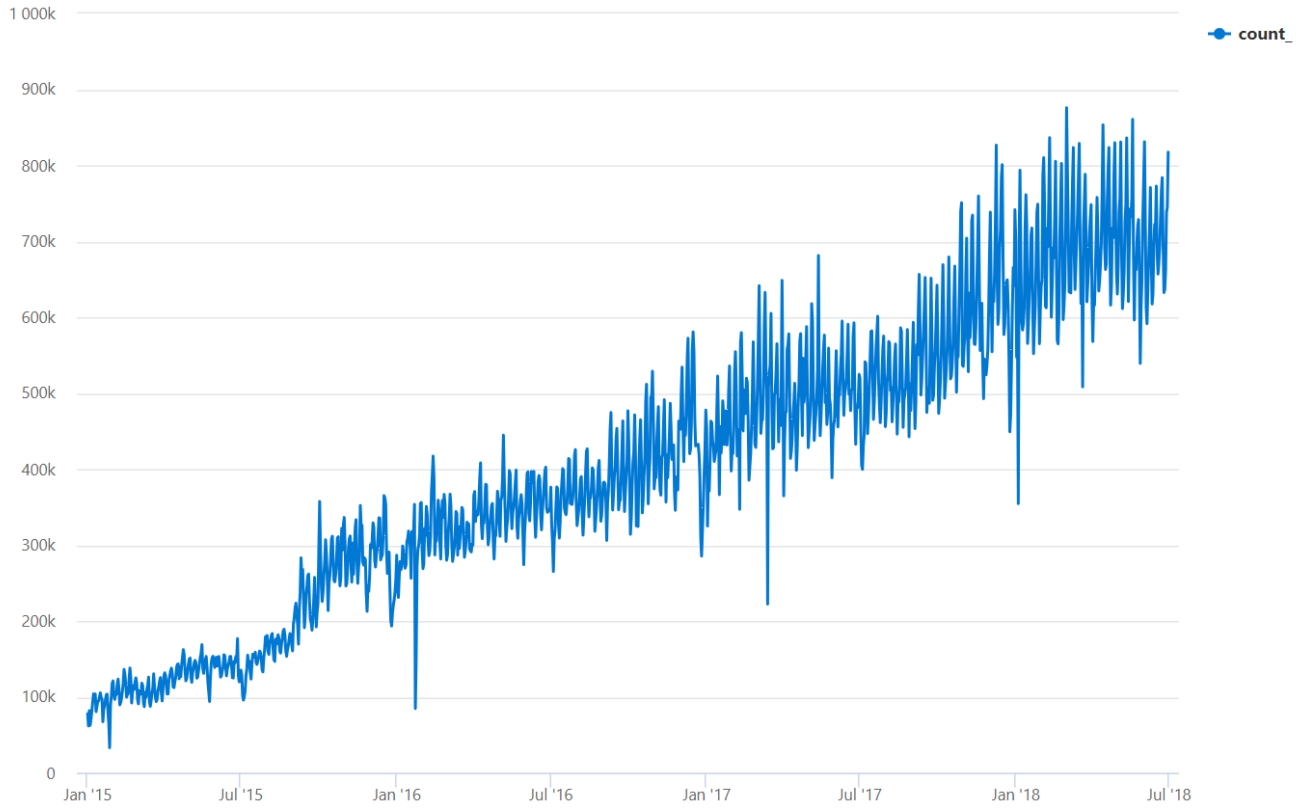


plotting

Ausführen | help/Samples

```
1  FHV_Trips
2  | summarize count() by bin (pickup_datetime, 1d)
3  | render timechart
```

Tabelle 1 | Visual | Statistik | UTC | Abgeschlossen (1.350 s) | 1.277 Datensätze



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time series

```
1  FHV_Trips
2  | make-series trips=count() default=0 on pickup_datetime step 1d
```

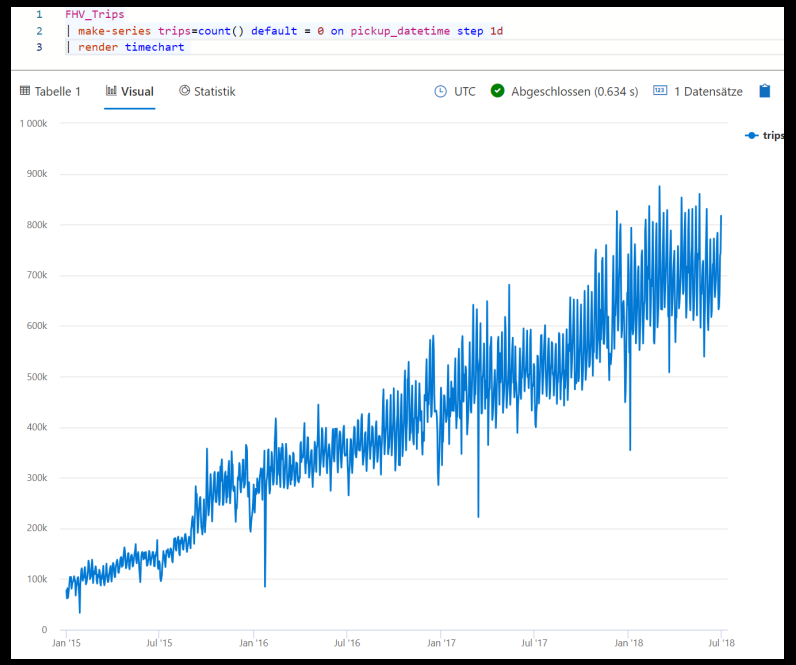
Tabelle 1 | Visuelles Element hinzufügen | Statistik | Suchen | UTC | Abgeschlossen (0.784 s) | 1 Datensätze

trips	pickup_datetime
[77789,61832,81955,62691,71063,81722,93090,103978,100710,103838,80717,87703,942...	["2015-01-01T00:00:00.0000000Z","2015-01-02T00:00:00.0000000Z","2015-01-03T00:0...

```
1  FHV_Trips
2  | make-series trips=count() default = 0 on pickup_datetime step 1d
3  | project series_stats(trips)
```

Tabelle 1 | Visuelles Element hinzufügen | Statistik | Suchen | UTC | Abgeschlossen (2.121 s) | 1 Datensätze

series_stats_trips_min	series_stats_trips_min_idx	series_stats_trips_max	series_stats_trips_max_idx	series_stats_trips_avg	series_stats_trip...
33.171	26	875.723	1.156	402.744,36256851995	191.777,52216295246



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time series

- you can also
  - calculate moving averages
  - apply linear regression
  - detect patterns
  - forecast
  - …

expand JSON

```
1  Covid19_map2
2  | take 10
```

Tabelle 1

AreaInfo	Location	Confirmed	Active
{"Alpha3CountryCode":null,"IsInternational":false,"CovidTrac...		{"ReportDate":null,"Change":1009572,"Source":null,"Value":1...	{"ReportDate":nu
{"Alpha3CountryCode":"USA","IsInternational":false,"CovidTr...		{"ReportDate":null,"Change":42778,"Source":null,"Value":318...	
{"Alpha3CountryCode":"USA","IsInternational":false,"CovidTr...		{"ReportDate":null,"Change":3827,"Source":null,"Value":3718...	
{"Alpha3CountryCode":"USA","IsInternational":false,"CovidTr...		{"ReportDate":null,"Change":883,"Source":null,"Value":12296...	
{"Alpha3CountryCode":"USA","IsInternational":false,"CovidTr...		{"ReportDate":null,"Change":0,"Source":null,"Value":297215}	
{"Alpha3CountryCode":"USA","IsInternational":false,"CovidTr...		{"ReportDate":null,"Change":315,"Source":null,"Value":294779}	
{"Alpha3CountryCode":"USA","IsInternational":false,"CovidTr...		{"ReportDate":null,"Change":562,"Source":null,"Value":274875}	
{"Alpha3CountryCode":"USA","IsInternational":false,"CovidTr...		{"ReportDate":null,"Change":200,"Source":null,"Value":268962}	
{"Alpha3CountryCode":"USA","IsInternational":false,"CovidT...		{"ReportDate":null,"Change":309,"Source":null,"Value":117081}	
{"Alpha3CountryCode":"USA","IsInternational":false,"CovidTr...		{"ReportDate":null,"Change":95,"Source":null,"Value":107859}	

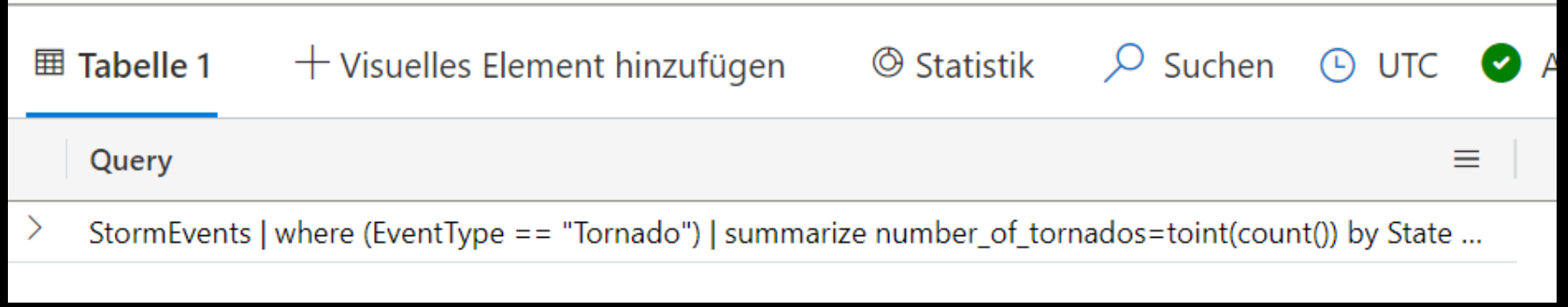
```
1  Covid19_map2
2  | project LastUpdated, AreaInfo
3  | mv-expand AreaInfo
4  | extend CountryName = tostring(AreaInfo.CountryName)
5  | project-away AreaInfo
6  | where CountryName <> ''
7  | take 100
```

Tabelle 1

LastUpdated	CountryName
2021-04-19 12:40:26.4950	Worldwide
2021-04-19 12:40:26.4950	United States
2021-04-19 12:40:26.4950	United States
2021-04-19 12:40:26.4950	United States
2021-04-19 12:40:26.4950	United States
2021-04-19 12:40:26.4950	United States
2021-04-19 12:40:26.4950	United States
2021-04-19 12:40:26.4950	United States
2021-04-19 12:40:26.4950	United States
2021-04-19 12:40:26.4950	United States
2021-04-19 12:40:26.4950	United States
2021-04-19 12:40:26.4950	United States
2021-04-19 12:40:26.4950	United States

Kusto is too hard?

```
1  Explain
2  SELECT State, count(*) as number_of_tornados from StormEvents
3  where EventType = 'Tornado'
4  Group by State
5
6  StormEvents
7  | where (EventType == "Tornado")
8  | summarize number_of_tornados=toint(count()) by State
9  | project State, number_of_tornados
```



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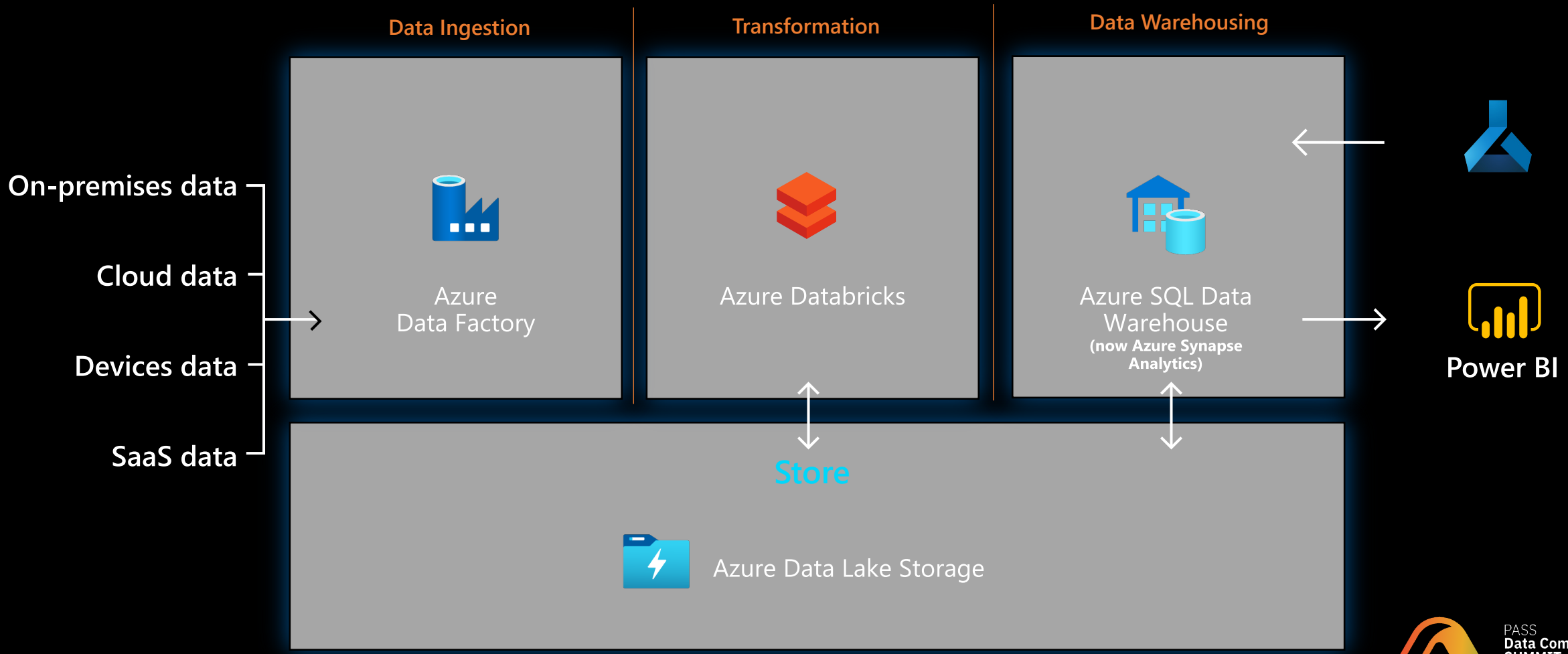
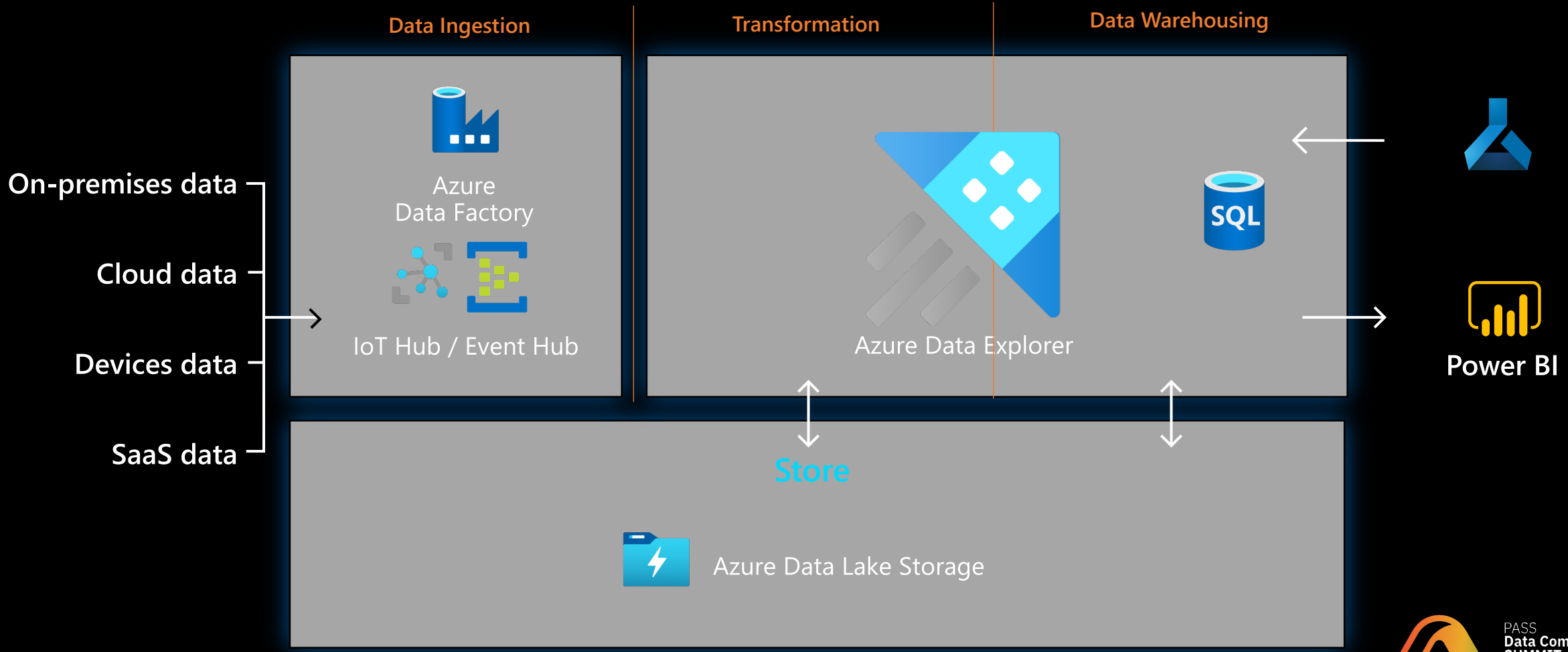
Data Explorer – the new star in your data platform?

Typical data platform in Azure



Azure Data Explorer



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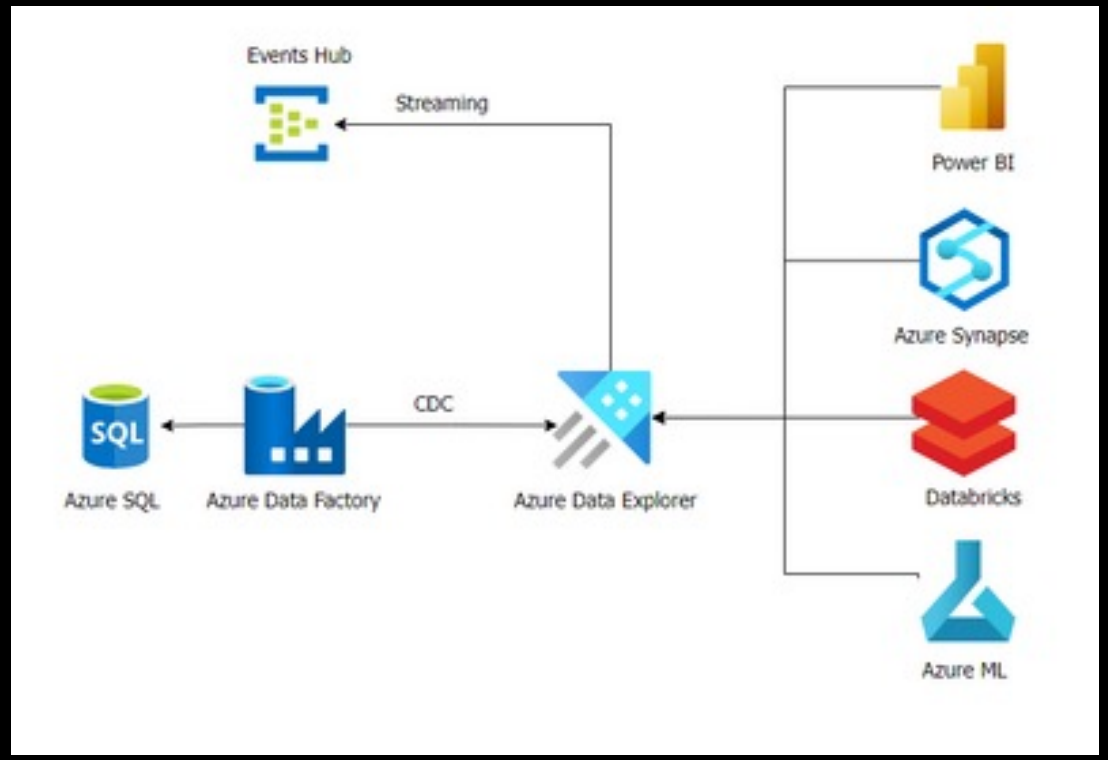
The benefits of Data Explorer

- Auto-ingest from event hubs
- Receive CDC & batch from Data Factory
- Continuous Export
- External Tables
- Materialized views
- Policies and retention to mimic SQL DB



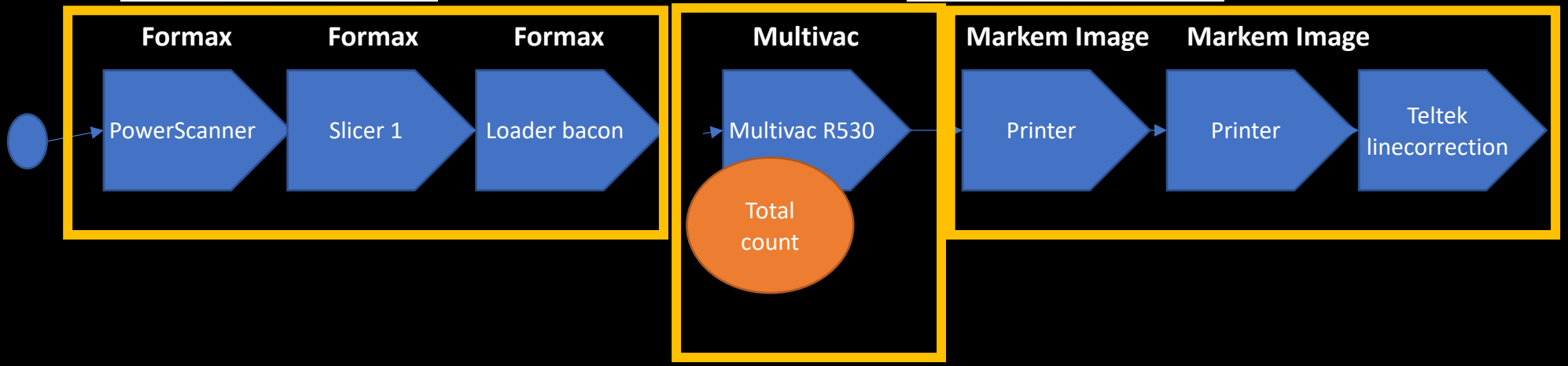
Demo

Azure Data Explorer in an IoT scenario

Overall Equipment Efficiency

OEE identifies the percentage of manufacturing time that is truly productive.

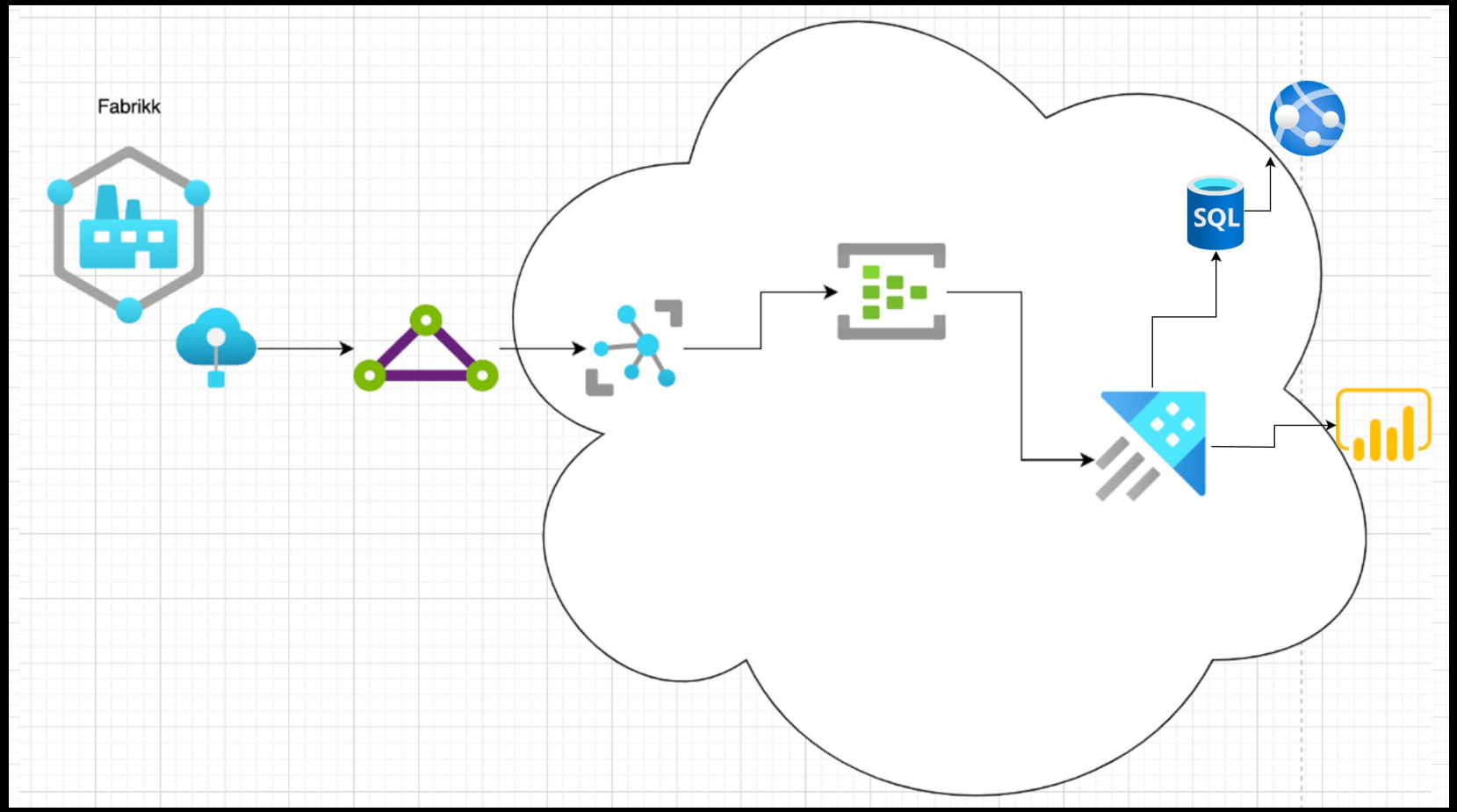
100% is theoretical potential – if no failures, no breaks, no downtime



Solution

- Counter connected
- Simple counter – 1,2,3,4…
- Stop if same number repeated
- > 1 minute defined as stop
- Query collating timeseries, identifying stops – however…
- Customer demand for export every 2 minutes to webapp
- What if stop lasts longer?

Overall Equipment Efficiency

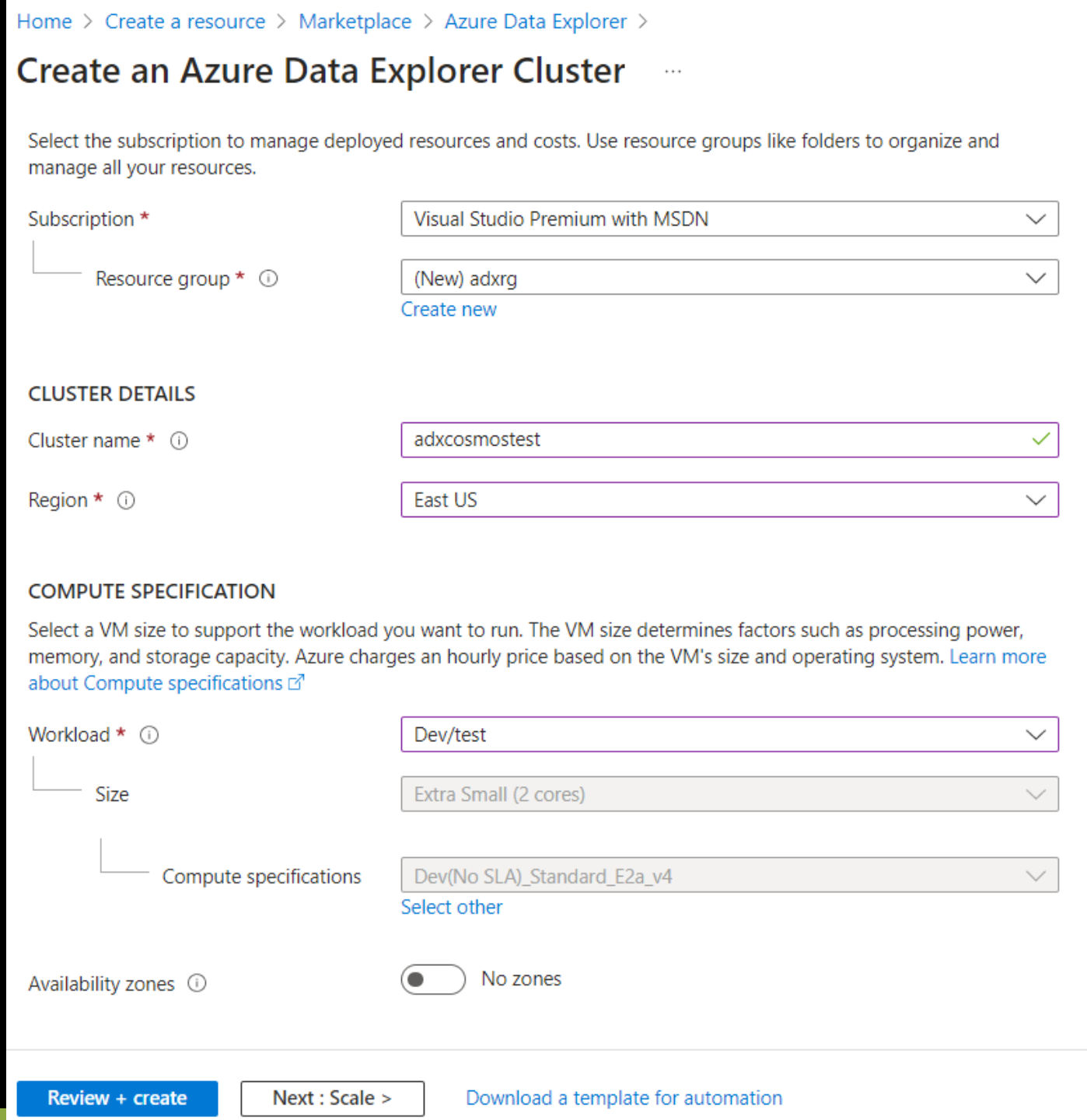


Azure Synapse Link from Azure Cosmos DB to ADX

- (spoiler: it has nothing to do with Synapse)

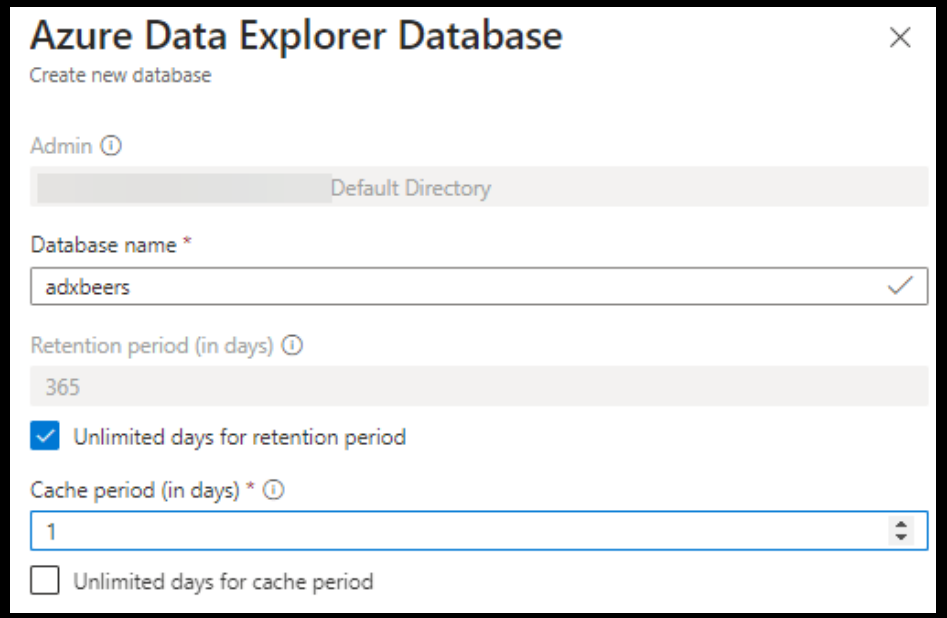
Synapse Link

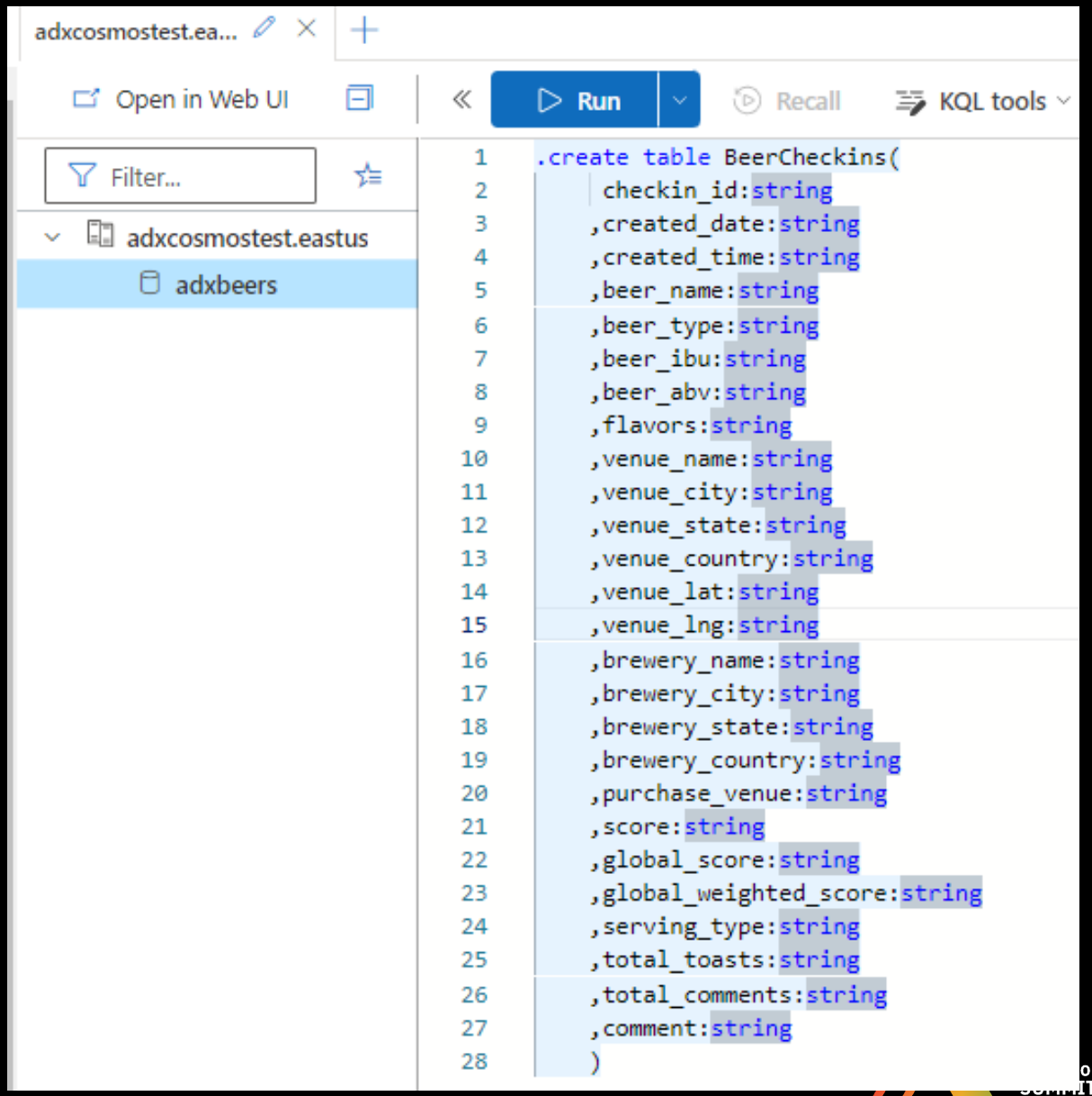
Create a cluster & database



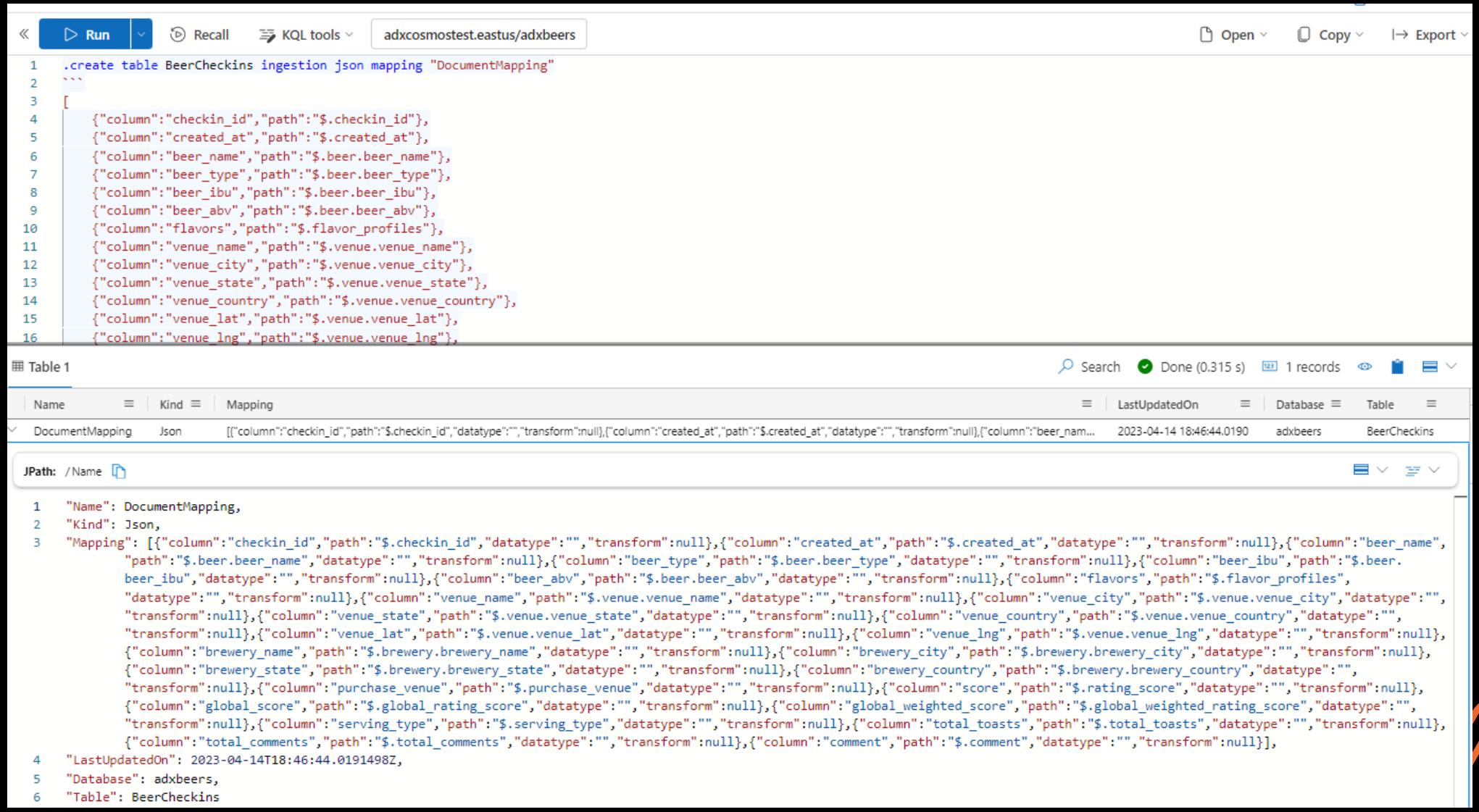
Waiting for the ADX cluster to start…

Synapse Link





Synapse Link



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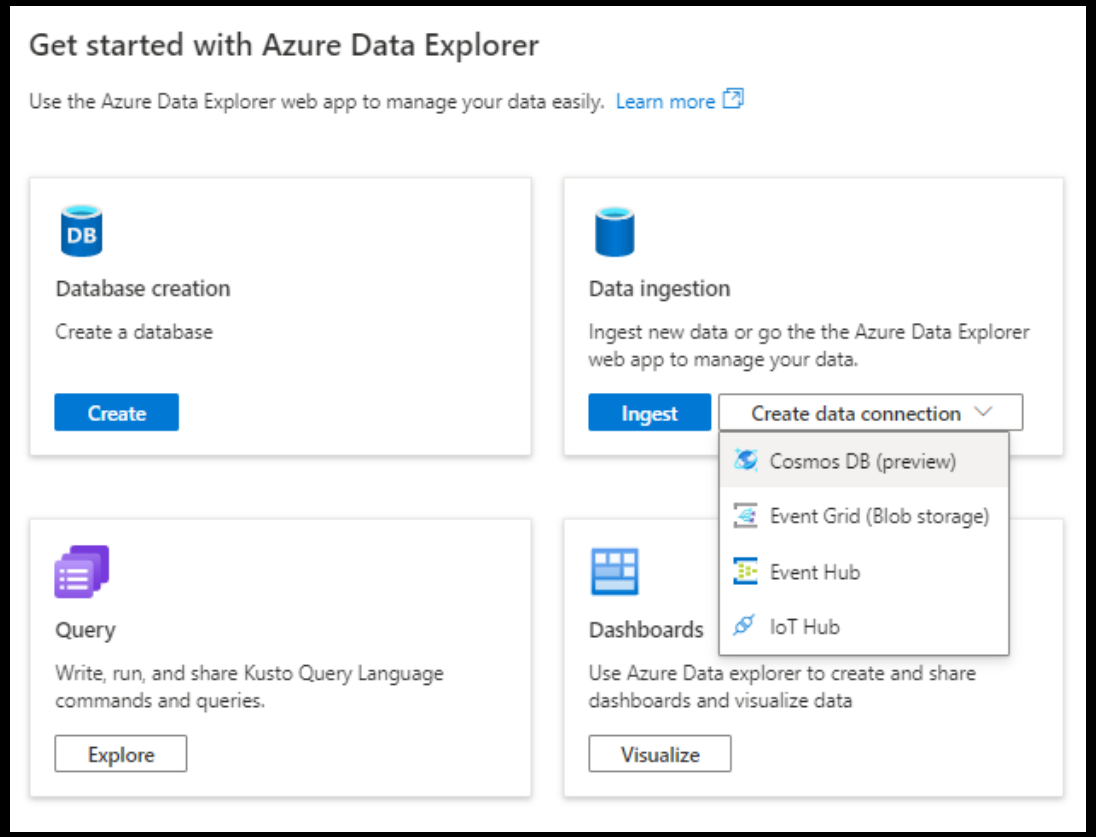
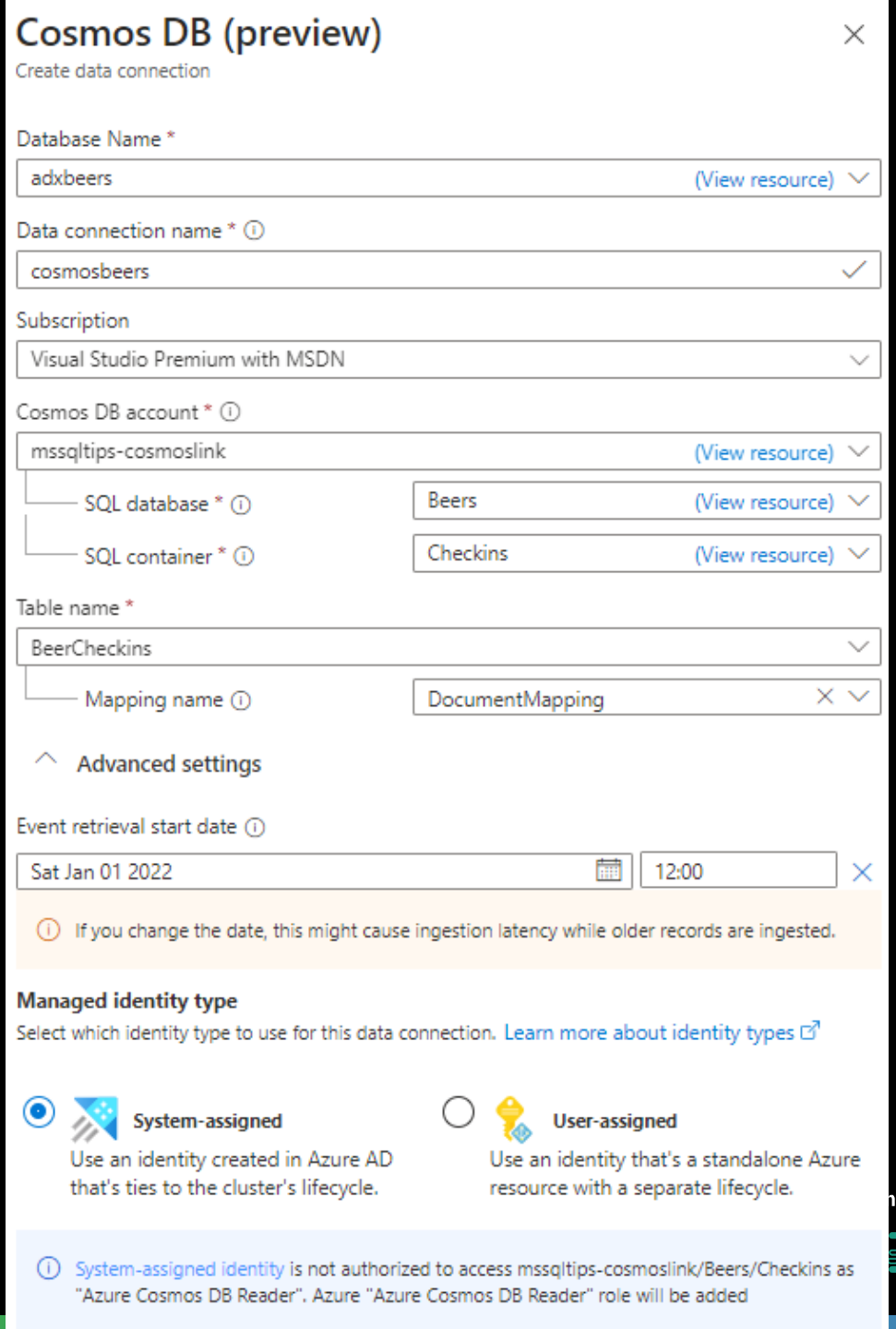
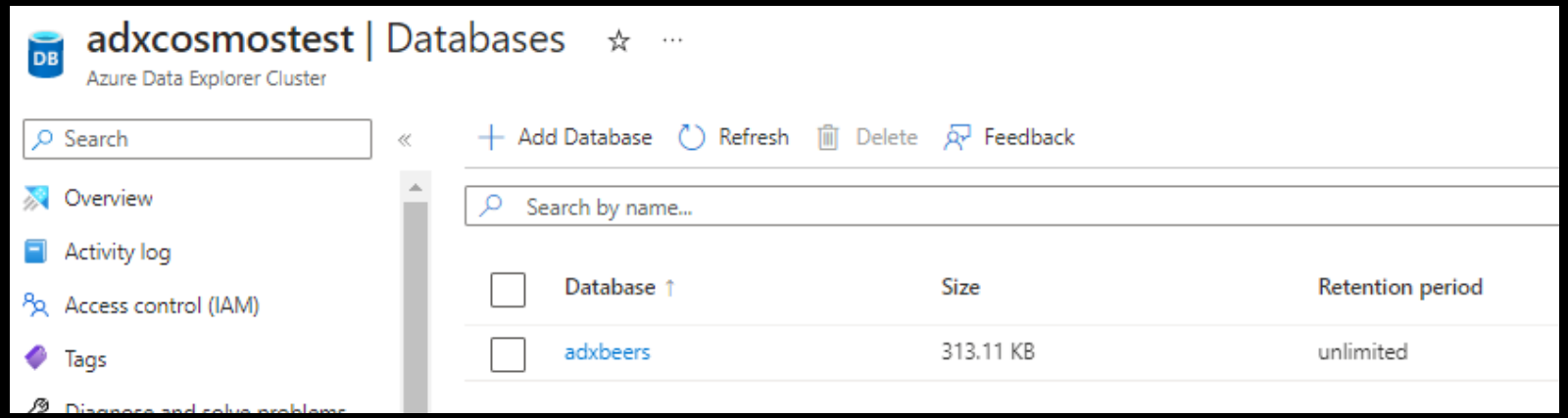
Synapse Link





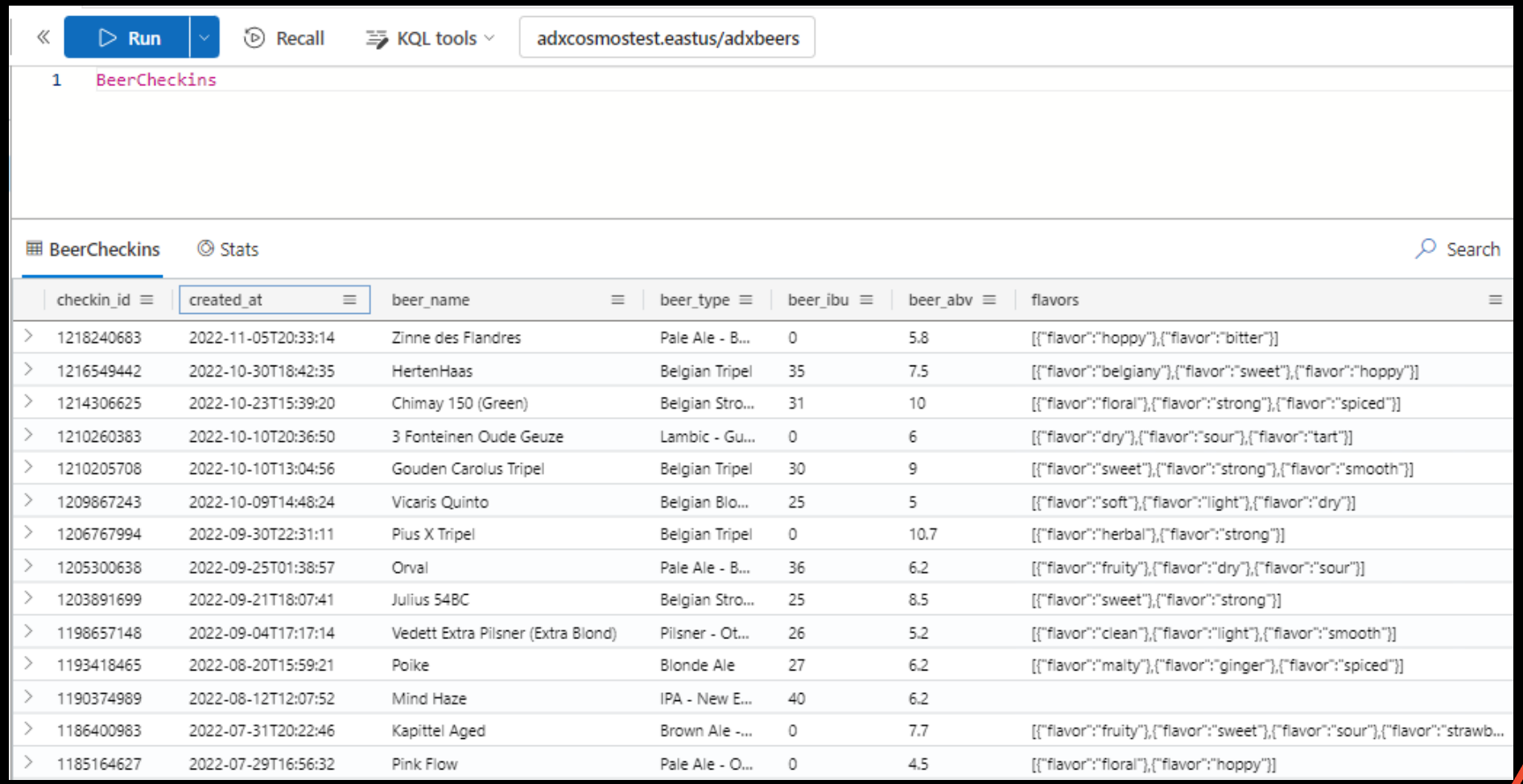
Synapse Link

data will be imported from the specified start date using Azure Cosmos DB change feed



when it’s imported, you can query it with KQL

profit!

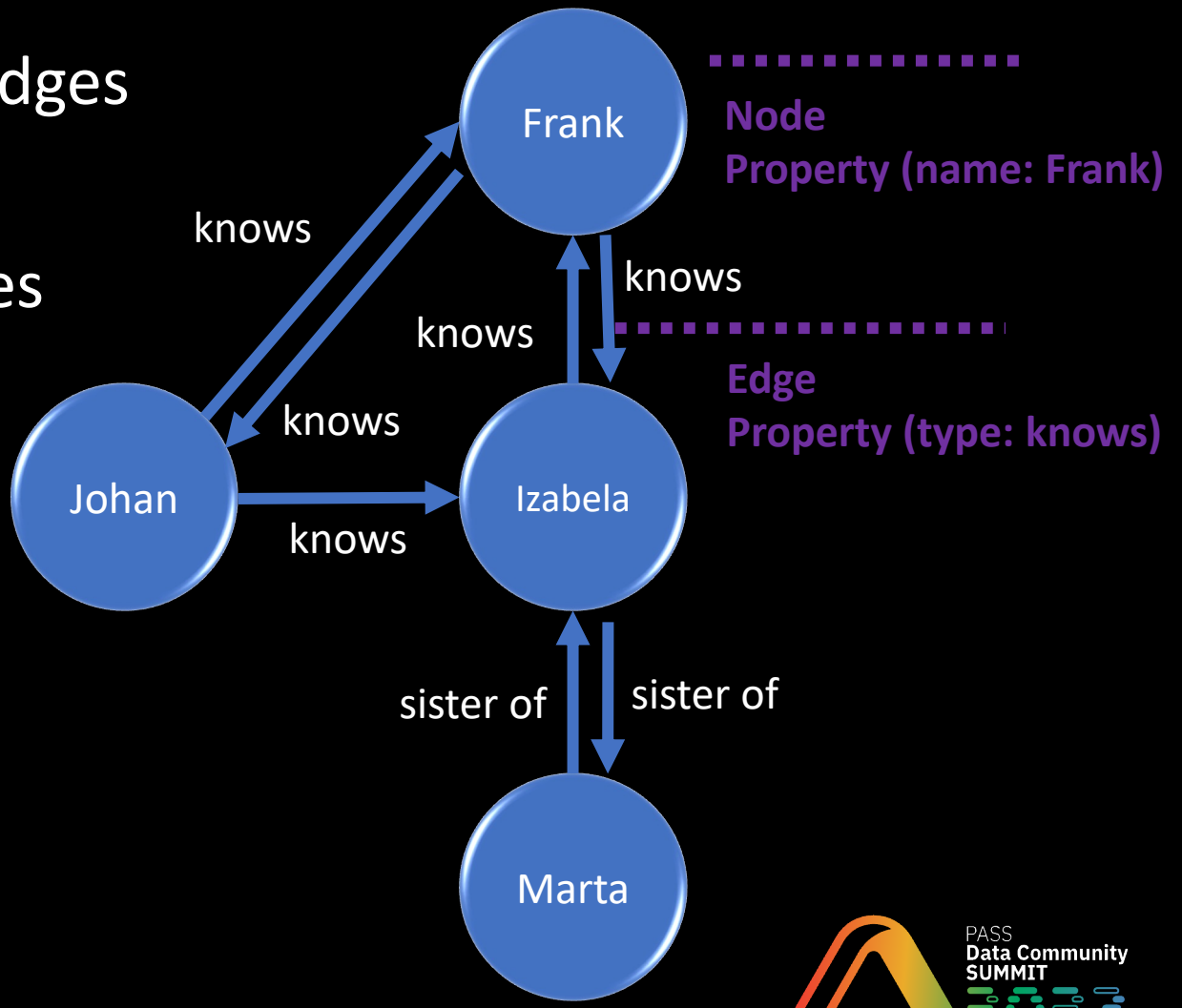


checkin_id	created_at	beer_name	beer_type	beer_ibu	beer_abv	flavors
1218240683	2022-11-05T20:33:14	Zinne des Flandres	Pale Ale - B...	0	5.8	[{"flavor":"hoppy"},{"flavor":"bitter"}]
1216549442	2022-10-30T18:42:35	HertenHaas	Belgian Tripel	35	7.5	[{"flavor":"belgiany"},{"flavor":"sweet"},{"flavor":"hoppy"}]
1214306625	2022-10-23T15:39:20	Chimay 150 (Green)	Belgian Stro...	31	10	[{"flavor":"floral"},{"flavor":"strong"},{"flavor":"spiced"}]
1210260383	2022-10-10T20:36:50	3 Fonteinen Oude Geuze	Lambic - Gu...	0	6	[{"flavor":"dry"},{"flavor":"sour"},{"flavor":"tart"}]
1210205708	2022-10-10T13:04:56	Gouden Carolus Tripel	Belgian Tripel	30	9	[{"flavor":"sweet"},{"flavor":"strong"},{"flavor":"smooth"}]
1209867243	2022-10-09T14:48:24	Vicaris Quinto	Belgian Blo...	25	5	[{"flavor":"soft"},{"flavor":"light"},{"flavor":"dry"}]
1206767994	2022-09-30T22:31:11	Pius X Tripel	Belgian Tripel	0	10.7	[{"flavor":"herbal"},{"flavor":"strong"}]
1205300638	2022-09-25T01:38:57	Orval	Pale Ale - B...	36	6.2	[{"flavor":"fruity"},{"flavor":"dry"},{"flavor":"sour"}]
1203891699	2022-09-21T18:07:41	Julius 54BC	Belgian Stro...	25	8.5	[{"flavor":"sweet"},{"flavor":"strong"}]
1198657148	2022-09-04T17:17:14	Vedett Extra Pilsner (Extra Blond)	Pilsner - Ot...	26	5.2	[{"flavor":"clean"},{"flavor":"light"},{"flavor":"smooth"}]
1193418465	2022-08-20T15:59:21	Poike	Blonde Ale	27	6.2	[{"flavor":"malty"},{"flavor":"ginger"},{"flavor":"spiced"}]
1190374989	2022-08-12T12:07:52	Mind Haze	IPA - New E...	40	6.2	
1186400983	2022-07-31T20:22:46	Kapittel Aged	Brown Ale -...	0	7.7	[{"flavor":"fruity"},{"flavor":"sweet"},{"flavor":"sour"},{"flavor":"strawb...
1185164627	2022-07-29T16:56:32	Pink Flow	Pale Ale - O...	0	4.5	[{"flavor":"floral"},{"flavor":"hoppy"}]

Graph Databases with Data Explorer

What is a graph database?

- Graph compromises of nodes and edges
- edges connect nodes
- edges and nodes can have properties
- data is differently stored than in a relational database:
  - Each node has a pointer to its direct neighbour
  - no need to index or join anything
  - easier and faster to traverse graph



Why graph database?

Useful for:

- complex and dynamic data
- network relationships
- hierachical relationships
- many-to-many relationships

Examples:

- social networks
- reccomendation systems
- connected assets
- knowledge graphs

queries can use graph structure and meaning => complex and powerful queries:

- finding paths
- finding patterns
- finding shortest distances
- finding communities
- finding centrallity measures

Why graph semantics in KQL?

KQL does not support recursive joins:

- explicitly define traversals → use make-graph operator to define hops of variable length.

- Useful when relationship distance or depth is not fixed

- find all resources that are connected in a graph or find all places that you can reach from a source

Time-aware graphs

- unique feature of graph semantics in KQL → allow user to model graph data as series of graph manipulation events over time
- examine how graph evolves over time
  - changes of network or properties over time
  - how anomalies happen
  - use time series queries to discover
    - trends
    - patterns
    - outliers
  - analyze changes in
    - network density
    - centrality
    - modularity

Examples for use of Graph Queries

- Time-based queries:
  - analyze evolution of graph over time
    (changes of network or property values)
- Geospatial Analysis:
  - spatial distribution or proximity of nodes and edges
    (how distance or location effects relationships)
- Machine learning queries:
  - apply various algorithms to graph data
    (clustering, classification, anomaly detection)

make-graph

- simple intuitive syntax
- works well with existing KQL features
- mix graph queries with other queries
  - time-based queries
  - machine learning queries
  - location-based queries
  - => more advanced and powerful data analytics
- KQL semantics → speed and scale of KQL mixed with flexibility and expressiveness of graph queries

Supported Graph Operators

Operator	Description
make-graph	Builds a graph from tabular data.
graph-match	Searches for patterns in a graph.
graph-merge	Merges two graphs into a single new graph.
graph-to-table	Builds nodes or edges tables from a graph.

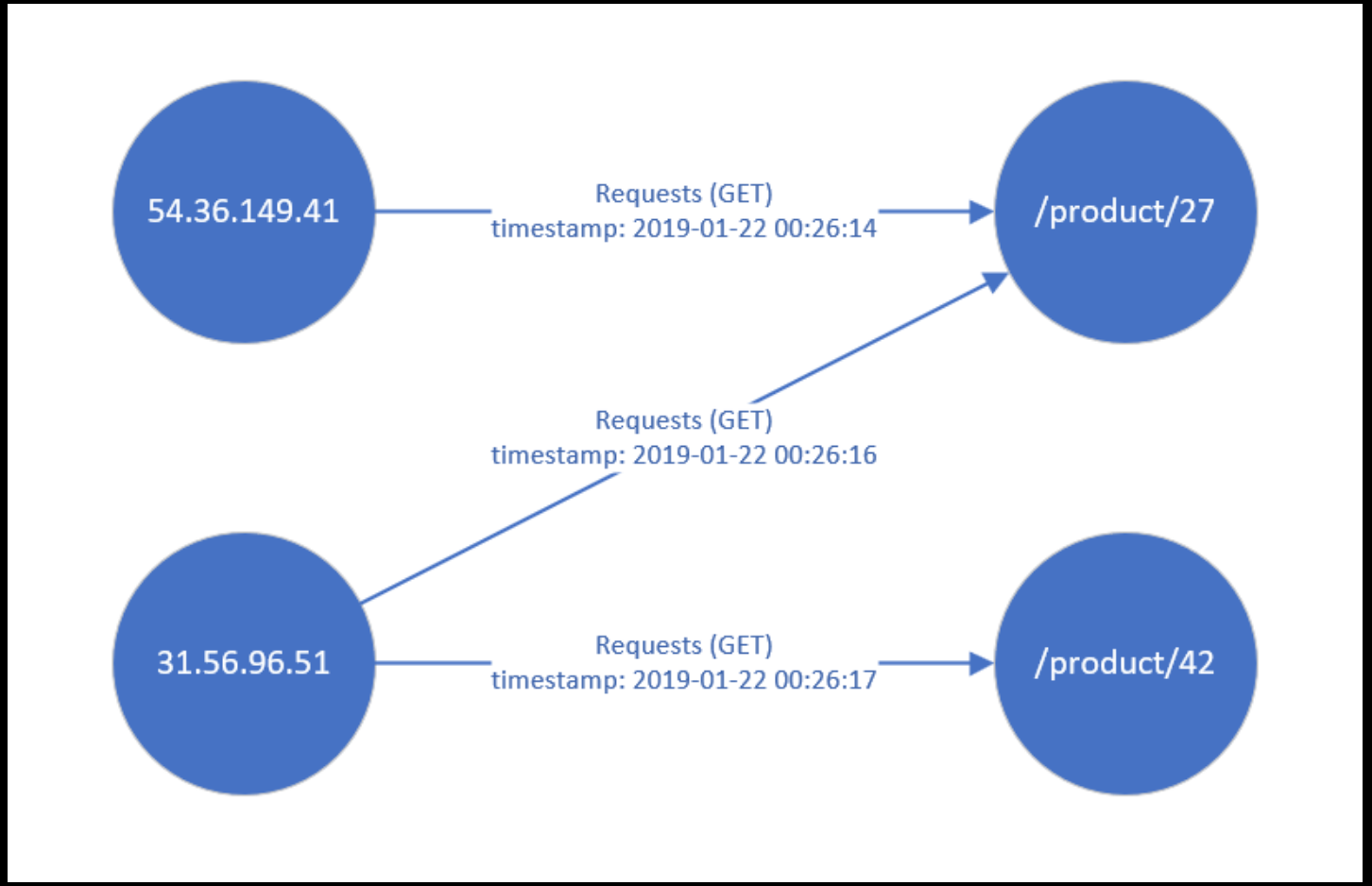
- Graph is transient object
- Build when query is run and deceased when query is finished
- Persist a graph → transform back to tabular form and then stored as edges or nodes table

Limits and reccomenations

- graph is build in memory on the fly → performance cost for building the graph
- limit the size of the graph by only including necessary data
- building graphs with 10 Mio objects (edges and nodes) at max
- Query limitations:
  Query limits - Azure Data Explorer | Microsoft Learn

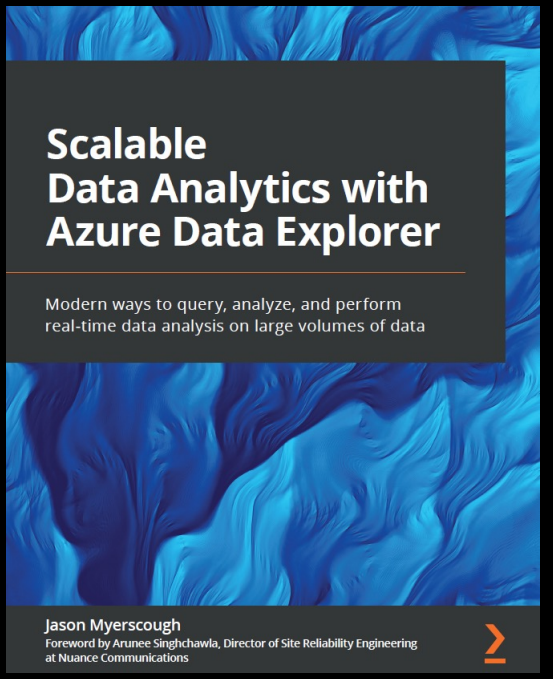
Demo

Scenario 2



Resources

- ADX in a day – GitHub
- Kusto Detective Agency
- The Most Powerful Azure Service You've Never Heard Of – SQLBits
- Get started with Real-Time Analytics in Microsoft Fabric – Microsoft Learn
- Start for free with ADX
- Building a Data Lakehouse using Azure Data Explorer



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GitHub

Community Person

Co-organizer – Data Moshpit
On the board of PASS Deutschland e.V.
Chapter Lead of PASS RG Münsterland

When not geeking out over new tech

Listening to Metal
Doing some decent BBQ
Going on "Adventures" with my 6y old daughter

Johan Ludvig Brattås

Director, Deloitte

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GitHub

Chronic volunteer

Co-organizer – DataSaturday Oslo
President – MDPUG Oslo
Frequent voulenteer in general

When not geeking out over new tech

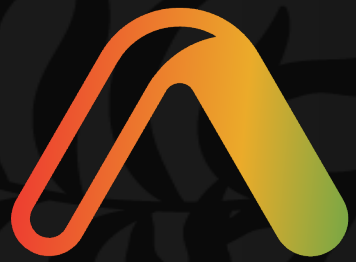
Teaching coeliacs how to bake gluten free
Baking
Hiking
Gardening

Session evaluation

Your feedback is important to us

Evaluate this session at:

www.PASSDataCommunitySummit.com/evaluation



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