

Power BI – Day 6

April 2018

Insights & Data



Power BI Security



Power BI Security

Power BI Service is built on Azure

Based on 2 Clusters – Web Front End (**WFE** – for initial authentication) and the Back End

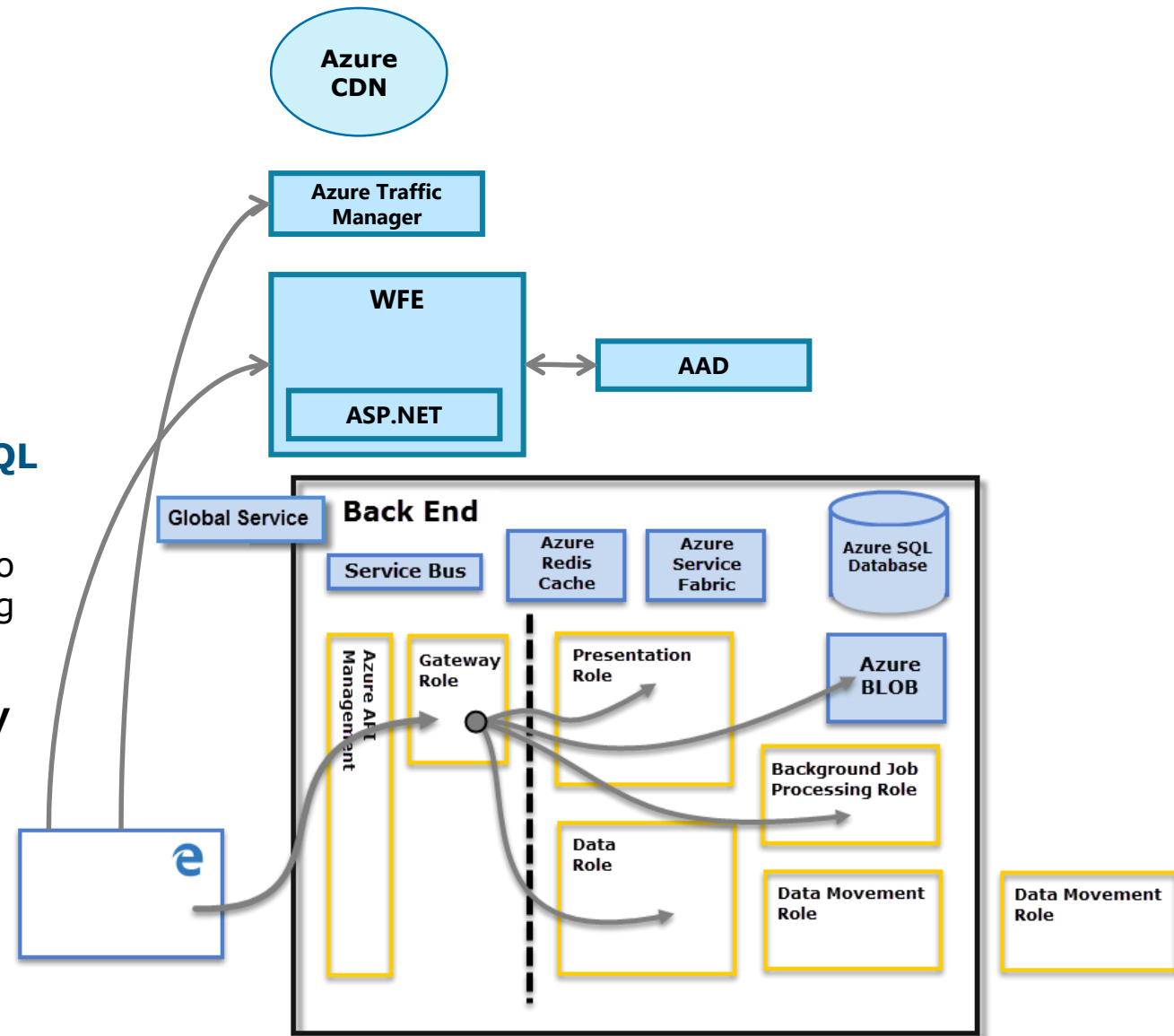
Uses Azure Active Directory (**AAD**) to store/manage user interactions.

Uses Azure Content Delivery Network (CDN) for effective delivery of static files and content to users

Data Storage Security - Uses **Azure BLOB** and **Azure SQL DB** for **data storage** and **metadata** respectively.

Uses **Azure Traffic Manager (ATM)** to direct user traffic to nearest datacenter using the DNS entry of the client making the connection

Only APIM (**Azure API Management Role**) and **Gateway Role** are accessible via public internet.

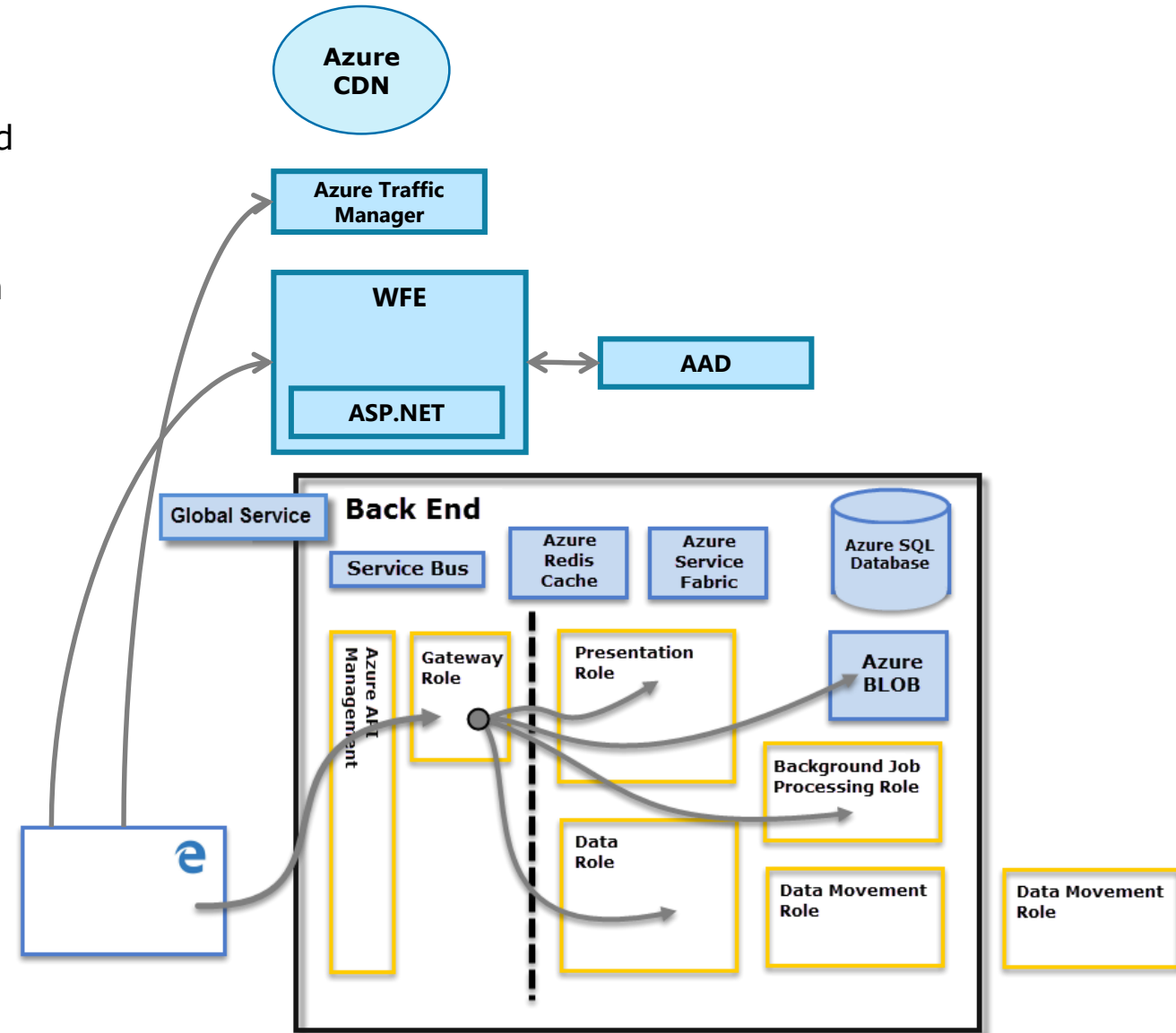




Power BI Security Contd..

User Authentication: Power BI uses login email id as effective username while connecting to data. The *effective name* is mapped to *User Principle Name* (UPN) and resolved to the associated Windows domain account, against which authentication is applied.

Data & Service Security: Data is encrypted at rest and in process ().





Row Level Security

Row Level Security (RLS) is used by Power BI to restrict data access for users.

Configure RLS on data models imported into Power BI or on datasets using Direct Query Mode.

How do I apply Row Level Security?

1. Define Roles and rules within Power BI Desktop
2. Validate the role in Power BI Desktop
3. Publish the report and use Power BI Service to manage security on the datasets.

DAX Introduction



Introduction... What is DAX?

- ❑ **D**ata **A**nalysis **E**xpression
- ❑ Language of Power BI, Power Pivot, SSAS Tabular
- ❑ Neither SQL nor MDX
- ❑ Functional language
- ❑ Simple & Straightforward yet difficult to fully use and understand



DAX Types

Numeric Types

- ❑ Integer
- ❑ Decimal (floating)
- ❑ Date (Datetime) - # of days after 30 Dec 1899
- ❑ Currency (money)
- ❑ TRUE / FALSE (Boolean)

Other Types

- ❑ String
- ❑ Binary Object



DAX Calculation Types

Calculated Columns

- ❑ Represents a single value per row
- ❑ Computed at time of creation/refresh
- ❑ Results are materialized and stored with the table
- ❑ Attached to a specific table
- ❑ Normally can only see the row they exist in
- ❑ Can be used in filters or values/results areas

Calculated Measures

- ❑ Represents a single value per data model
- ❑ Computed at run time
- ❑ Results are dynamic, based on filters
(This is called the filter context)
- ❑ Not attached to any table
- ❑ Sees all the data at once



DAX Functions

Aggregation

- ☐ SUM
- ☐ AVERAGE
- ☐ MIN
- ☐ MAX
- ☐ SUMX (and other X functions)

Counting

- ☐ COUNT
- ☐ COUNTA
- ☐ COUNTBLANK
- ☐ COUNTROWS
- ☐ DISTINCTCOUNT

Logical

- ☐ AND
- ☐ OR
- ☐ NOT
- ☐ IF
- ☐ IFERROR

Information

- ☐ ISBLANK
- ☐ ISNUMBER
- ☐ ISTEXT
- ☐ ISNONTEXT
- ☐ ISERROR
- ☐ PATH – *manage parent child hierarchy*

Text

- ☐ CONCATENATE
- ☐ REPLACE
- ☐ SEARCH
- ☐ UPPER
- ☐ FIXED



DAX Function...

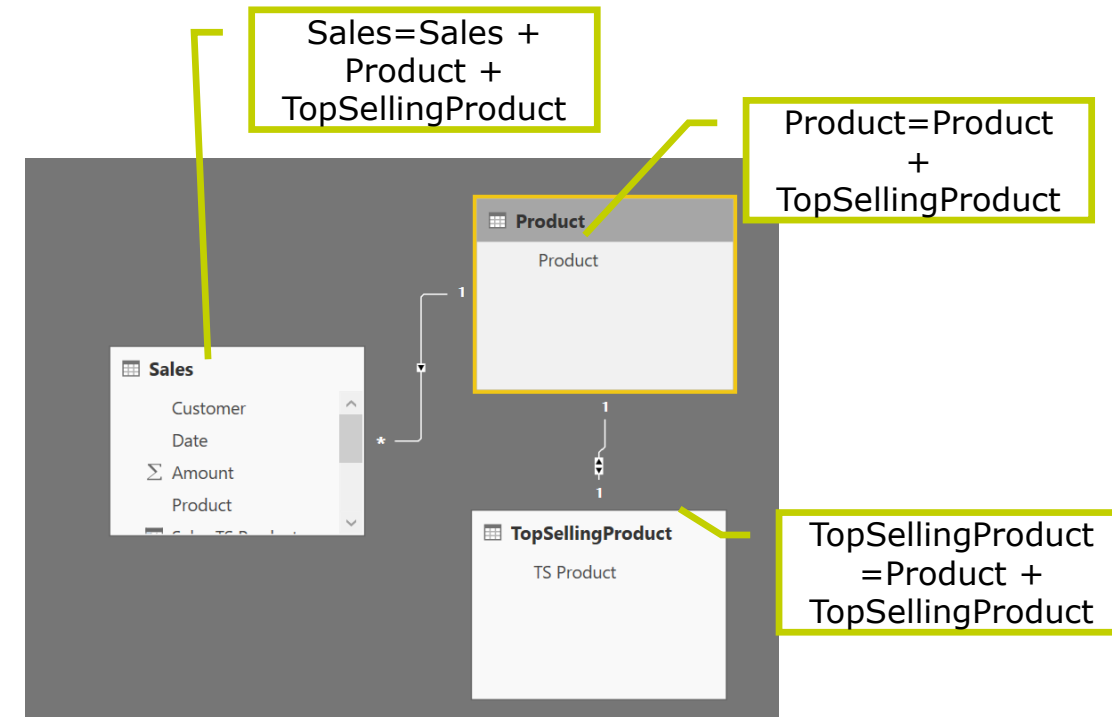
Date

- ☐ DATE
- ☐ HOUR
- ☐ NOW
- ☐ EOMONTH
- ☐ WEEKDAY
- ☐ YEAR



Expanded Tables in DAX

- ❑ Expanded Tables = Base Table +Columns of tables linked to Base Table using ***:1** or **1:1** relationship
- ❑ Similar to FULL / LEFT OUTER JOIN
- ❑ Relationship Concept



`Sales TS Product = RELATED(TopSellingProduct[TS Product])`



Variables in DAX Expressions

- ❑ Extremely powerful
- ❑ It can be defined anywhere in the DAX expression.
- ❑ Referring the variable again is from the cache model.

```
VariableDemoSalesMargin =
```

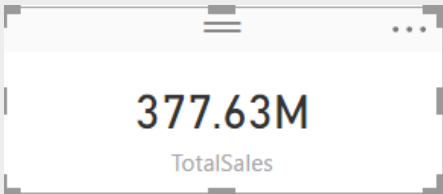
```
VAR TotalRevenue = SUM(bi_salesFact[Revenue])  
RETURN  
IF ([TotalSales] > 10000, [TotalSales]*0.2,  
TotalRevenue*0.1  
)
```



Evaluation Context

For which rows is the TotalSales evaluated?

```
TotalSales = SUM(bi_salesFact[Revenue])
```



| Category | TotalSales |
|--------------|-----------------------|
| Urban | 312,960,273.88 |
| Rural | 41,181,671.21 |
| Mix | 16,063,198.46 |
| Youth | 7,420,366.22 |
| Total | 377,625,509.78 |

Value computed depends on the context



Row Context & Filter Context

Row Context

RevenueMargin = SUMX(bi_salesFact,
bi_salesFact[Revenue]-bi_salesFact[Revenue]*0.1)

Defined by calculated column definition & various row iterator functions.

Filter Context

Set of filters applied to data model before evaluating DAX expression.

CalcAmount = SUMX(
FILTER(Orders, Orders[Price] > 1), Orders[Amount])

| City | Channel | Color | Size | Quantity | Price |
|----------|----------|-------|-------|----------|-------|
| Paris | Store | Red | Large | 1 | 15 |
| Paris | Store | Red | Small | 2 | 13 |
| Toronto | Store | Green | Large | 4 | 11 |
| New York | Store | Green | Small | 8 | 9 |
| | Internet | Red | Large | 16 | 7 |
| | Internet | Red | Small | 32 | 5 |
| | Internet | Green | Large | 64 | 3 |
| | Internet | Green | Small | 120 | 1 |

| Channel | |
|-----------------|---|
| is Internet | |
| Filter Type | |
| Basic filtering | |
| Select All | |
| Internet | 4 |
| Store | 4 |

| Table Filtering | | | |
|-----------------|-------|-------|-------|
| Color | Large | Small | Total |
| Green | 192 | | 192 |
| Red | 112 | 160 | 272 |
| Total | 304 | 160 | 464 |



CALCULATE

- ❑ Modify filter context
- ❑ Filter and then apply Color = Green to get a table on which SUM can be applied

```
GreenQuantity := CALCULATE(SUM(Sales[Quantity]),  
Sales[Color]="Green")
```

```
GreenQuantity := CALCULATE(SUM(Sales[Quantity]),  
    FILTER(  
        ALL (Sales[Color]),  
        Sales[Color]="Green"  
    )  
)
```


SQL Profiler



SQL Server Profiler - [U...]

File Edit View Replay Tools Window Help

EventClass EventSubclass

| | |
|--------------------------|---------------------------|
| Execute MDX Script Begin | 2 - MDX Script Command |
| Execute MDX Script Begin | 2 - MDX Script Command |
| DAX Query Plan | 1 - DAX VertiPaq Logical |
| DAX Query Plan | 2 - DAX VertiPaq Physical |
| Query End | 3 - DAXQuery |
| DAX Query Plan | 1 - DAX VertiPaq Logical |
| DAX Query Plan | 2 - DAX VertiPaq Physical |
| Query End | 3 - DAXQuery |
| Session Initialize | |
| Query Begin | 3 - DAXQuery |
| Query Begin | 3 - DAXQuery |
| DAX Query Plan | 1 - DAX VertiPaq Logical |
| DAX Query Plan | 2 - DAX VertiPaq Physical |
| Query End | 3 - DAXQuery |
| DAX Query Plan | 1 - DAX VertiPaq Logical |
| Session Initialize | |
| Query Begin | 3 - DAXQuery |
| DAX Query Plan | 1 - DAX VertiPaq Logical |

Trace Properties

General Events Selection

Review selected events and event columns to trace. To see a complete list, select the "Show all events" and "Show all columns" options.

| Events | EventSubclass | TextData | ConnectionID | NTUserName | ApplicationName | IntegerData | StartTime | C |
|---|-------------------------------------|-------------------------------------|-------------------------------------|------------|-------------------------------------|-------------------------------------|-------------------------------------|---|
| <input type="checkbox"/> Calculation Evaluation Detailed Infor... | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | |
| <input checked="" type="checkbox"/> DAX Query Plan | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | |
| <input checked="" type="checkbox"/> DirectQuery Begin | | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | | | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | |
| <input checked="" type="checkbox"/> DirectQuery End | | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | | | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | |
| <input checked="" type="checkbox"/> Execute MDX Script Begin | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | | | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | |
| <input checked="" type="checkbox"/> Execute MDX Script Current | | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | | | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> | |
| <input type="checkbox"/> Execute MDX Script End | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | | | <input type="checkbox"/> | <input type="checkbox"/> | |
| <input type="checkbox"/> Execute MDX Script Error | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | | | | | |
| <input type="checkbox"/> Get Data From Aggregation | | <input type="checkbox"/> | <input type="checkbox"/> | | | | <input type="checkbox"/> | |
| <input type="checkbox"/> Get Data From Cache | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | | | | <input type="checkbox"/> | |
| <input type="checkbox"/> Query Cube Begin | | <input type="checkbox"/> | <input type="checkbox"/> | | | <input type="checkbox"/> | <input type="checkbox"/> | |
| <input type="checkbox"/> Query Cube End | | <input type="checkbox"/> | <input type="checkbox"/> | | | <input type="checkbox"/> | <input type="checkbox"/> | |

Query Cube Begin
Query cube Begin.

ConnectionID (no filters applied)
Unique connection ID.

☒ Show all events
☒ Show all columns

Column Filters...
Organize Columns...

Run Cancel Help

Trace is paused.

Ln 212, Col 5 Rows: 272

Add Security to Model using DAX



Manage roles

Roles

UrbanCategory

Create Delete

Tables

bi_date

bi_product

bi_salesFact

Table filter DAX expression

[category] = "Urban"

Filter the data that this role can see by entering a DAX filter expression that returns a True/False value. For example: [Entity ID] = "Value"

Save Cancel

Role Manager

Specify the roles for the tabular project. Roles define a group of users with a set of permissions on the Analysis Services database.

| Name | Permissions | Description |
|---------|----------------|-------------|
| Admin | Administrator | |
| Read | Read | |
| Process | Read and Pr... | |
| TestSBU | Read | |

New Copy Delete

Details - TestSBU

Row Filters Members

Specify DAX expressions that return Boolean values. Only rows that match the specified filters are visible to users in this role.

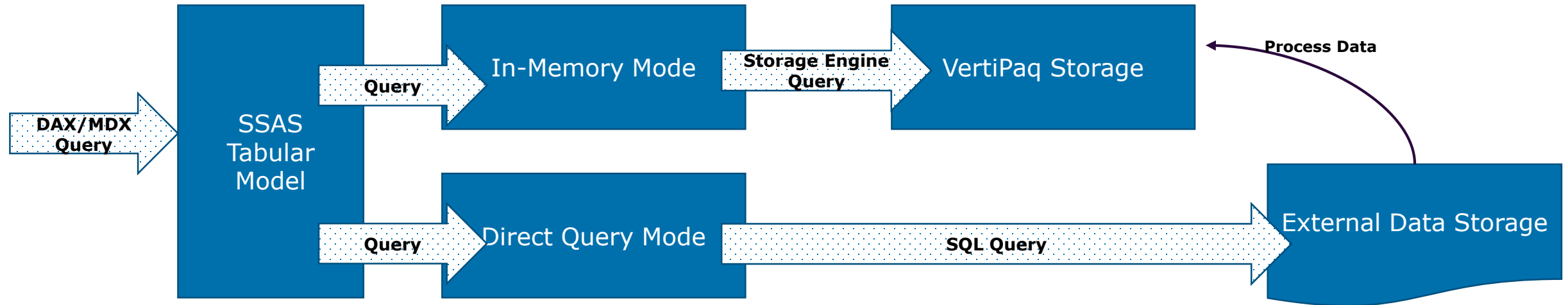
| Table | DAX Filter |
|------------------------|--|
| Currency | |
| Currency Rate | |
| Journal | |
| Local Account HZ | |
| Project Classes | |
| Parent Production Unit | = 'Parent Production Unit'[Hierarchy_Level_Type]="SBU" |
| PnL Label | |
| PnL Table | |

OK Cancel

DAX Internals



VertiPaq Engine in DAX



Official name of the engine on top of which DAX runs is “xVelocity in-memory Analytical Engine”

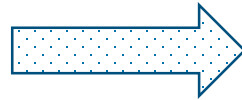
Power BI runs a special instance of AS Instance

During processing, the engine reads the data source & transforms it in the internal VertiPaq data structure.

Columnar DB



| City | Channel | Color | Size | Quantity | Price |
|----------|----------|-------|-------|----------|-------|
| Paris | Store | Red | Large | 1 | 15 |
| Paris | Store | Red | Small | 2 | 13 |
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| New York | Store | Green | Small | 8 | 9 |
| | Internet | Red | Large | 16 | 7 |
| | Internet | Red | Small | 32 | 5 |
| | Internet | Green | Large | 64 | 3 |



| City | Channel | Color | Size | Quantity | Price |
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| Toronto | Store | Green | Large | 4 | 11 |
| New York | Store | Green | Small | 8 | 9 |
| | Internet | Red | Large | 16 | 7 |
| | Internet | Red | Small | 32 | 5 |
| | Internet | Green | Large | 64 | 3 |

Row Store – Organized in rows

Data Organized for vertical scanning to reduce read time.

Each column has its own structure

Provides quick access to single column but as calculations involves multiple columns more time is spent in calculation.

Compression



| Amount |
|--------|
| 180 |
| 170 |
| 177 |
| 190 |
| 170 |
| 171 |
| 192 |

MAX = 192

8 bits needed

| Amount(192 MAX) |
|-----------------|
| 12 |
| 22 |
| 15 |
| 2 |
| 22 |
| 21 |
| 0 |

MAX = 21

5 bits needed

Value Encoding

| Color |
|-------|
| Red |
| Red |
| Green |
| Green |
| Red |
| Red |
| Green |

| Color ID |
|----------|
| 0 |
| 0 |
| 1 |
| 1 |
| 0 |
| 0 |
| 1 |

| ID | Color |
|----|-------|
| 0 | Red |
| 1 | Green |

Replaces data type with dictionary & indices.

Number of distinct values (cardinality) plays key role in column size

Dictionary Encoding

Compression



```
select QUARTER, COUNT(1) NoOfRepetition
from DIM_TIME_NEW
where "YEAR" IN (2016, 2017)
group by QUARTER
```

| Results | Messages |
|---------|----------|
|---------|----------|

| QUARTER | NoOfRepetition |
|---------|----------------|
| Q1 | 181 |
| Q2 | 182 |
| Q3 | 184 |
| Q4 | 184 |

| Quarter | Start | Count |
|---------|-------|-------|
| Q1 | 1 | 181 |
| Q2 | 182 | 364 |
| Q3 | 184 | 548 |
| Q4 | 184 | 732 |

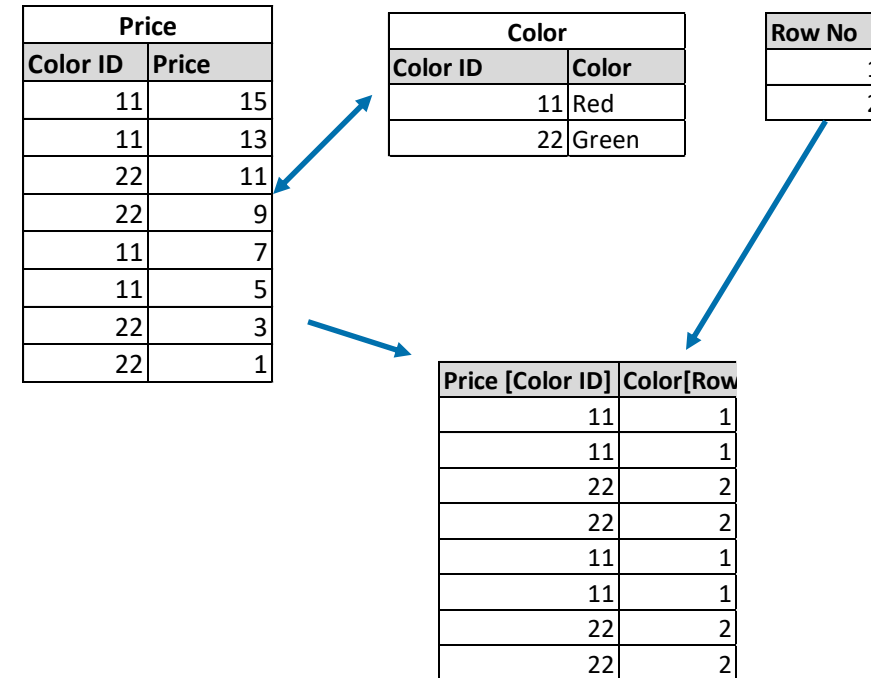
VertiPaq Store

| Q.ID | Quarter |
|------|---------|
| 0 | Q1 |
| 1 | Q2 |
| 2 | Q3 |
| 3 | Q4 |

| Q.ID | Count |
|------|-------|
| 0 | 181 |
| 1 | 182 |
| 2 | 184 |
| 3 | 184 |

Run Length Encoding (RLE)

A relationship is a data structure that maps **IDs in one table to row numbers in another table**



Hierarchy & Relationship



Thank You



People matter, results count.

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