# DirectQuery vs Vertipaq Modes in SSAS Tabular Model

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3 May 2012

# Agenda

- Terminology
- DirectQuery vs In-Memory
- Hybrid Mode

# Abstract

The new and flashy Tabular Model for Analysis Services has been highly pitched with the in-memory (VertiPaq) capability allowing for complex queries to run very fast. This session with some live demo will uncover:

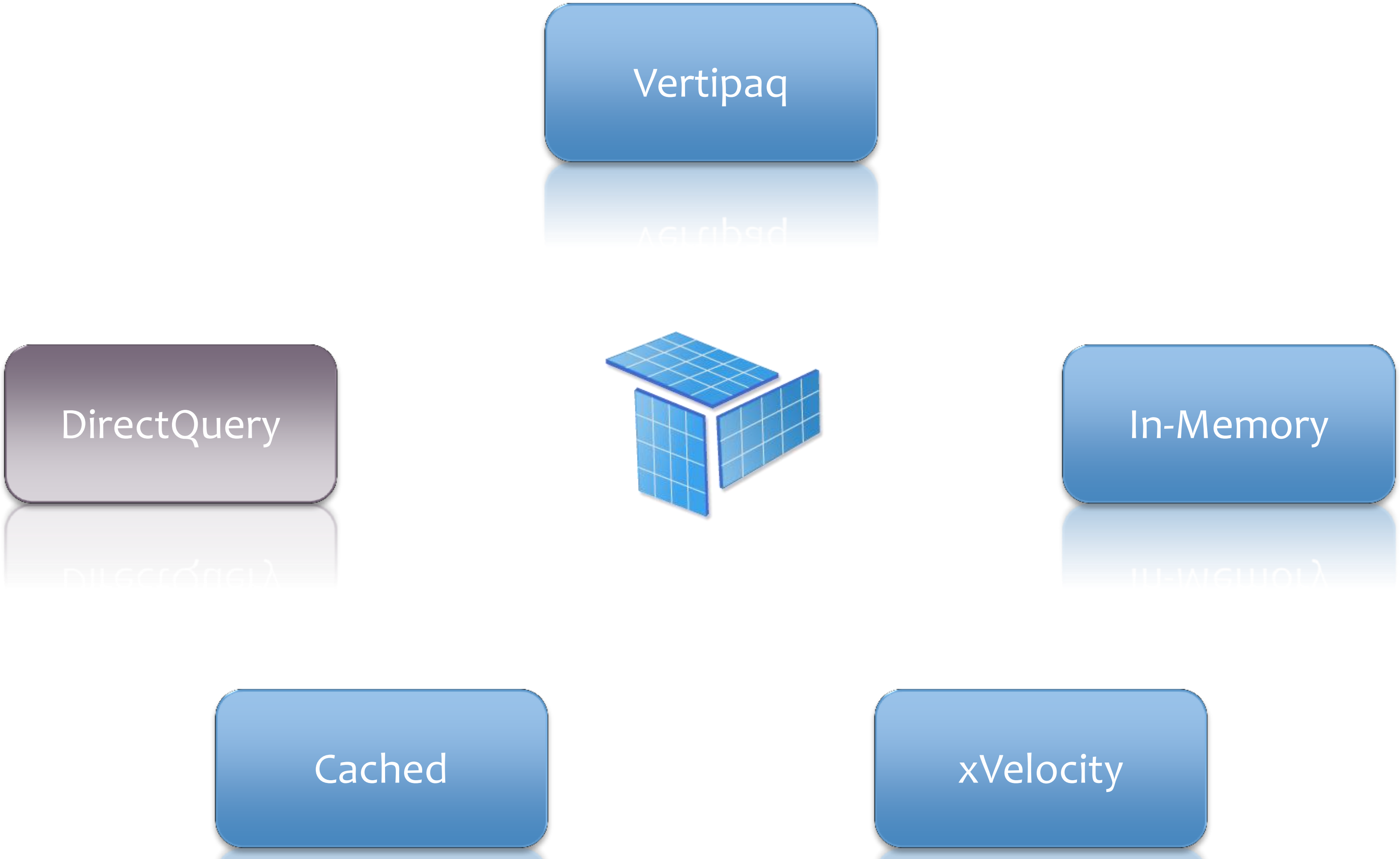
- Advantages and disadvantages of using in-memory cache to store and query data
- Restrictions on DirectQuery tabular model
- Hybrid mode utilization
- Impersonation and Partitioning techniques

Prerequisite:

- Familiarity with basic Tabular Model project creation will be useful, but not mandatory

Tabular Model Architecture and Solution

# Terminology



Vertipaq

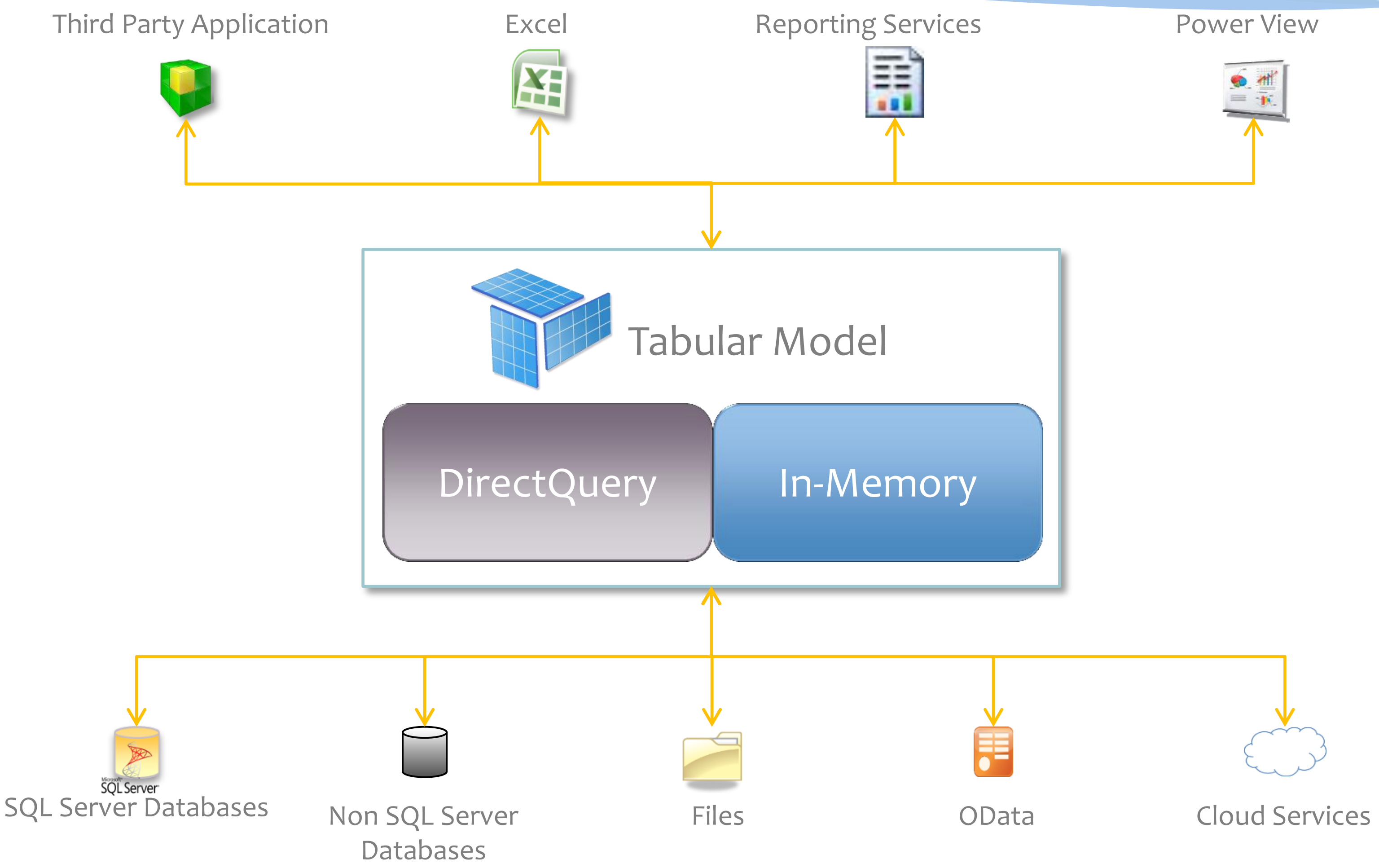
DirectQuery

In-Memory

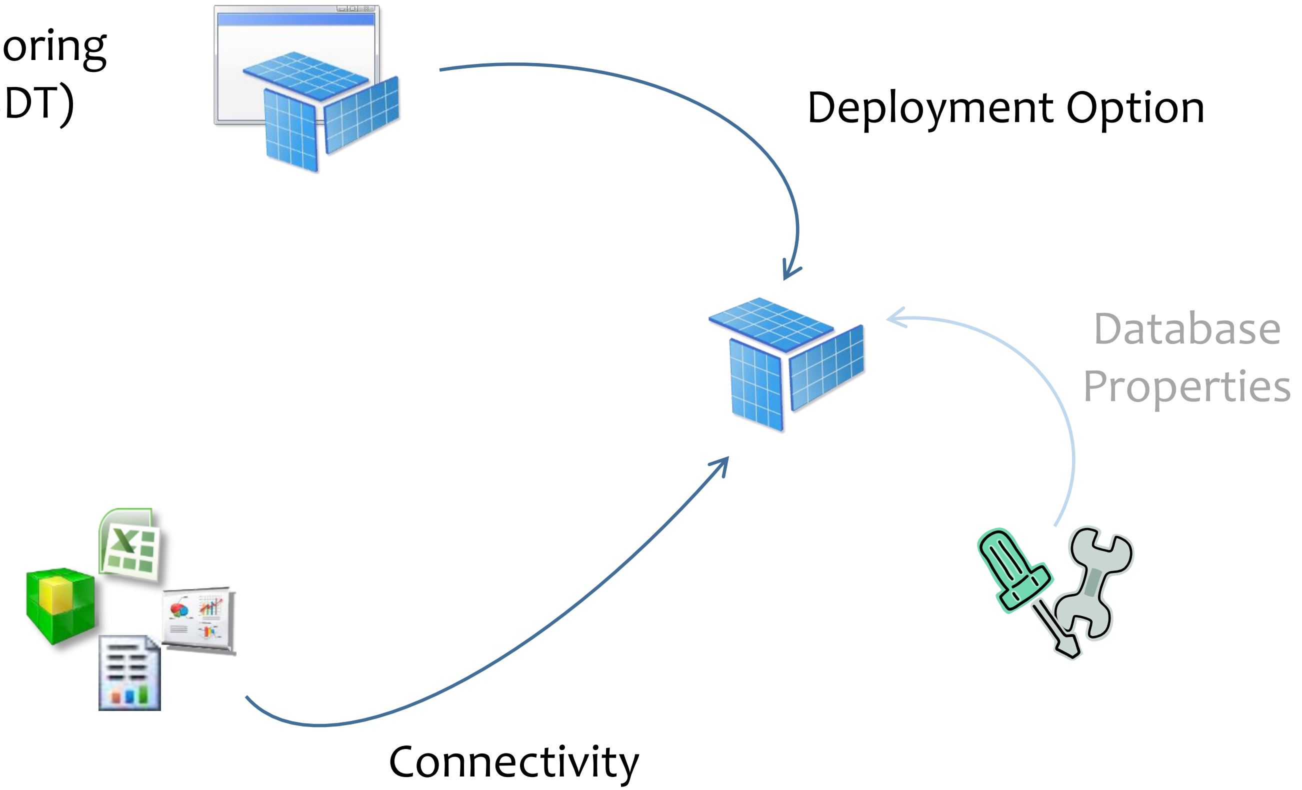
Cached

xVelocity

# Tabular Model Architecture



# Tabular Model Solutions



Authoring
(SSDT)

Deployment Option

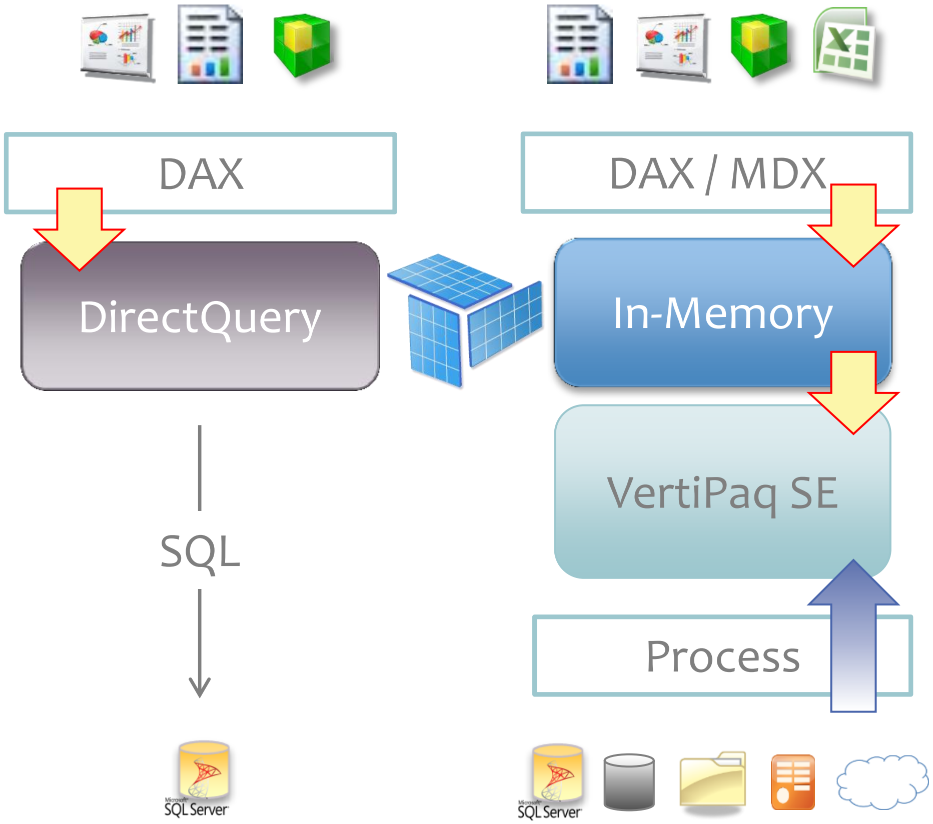
Database
Properties

Connectivity

DirectQuery vs In-Memory

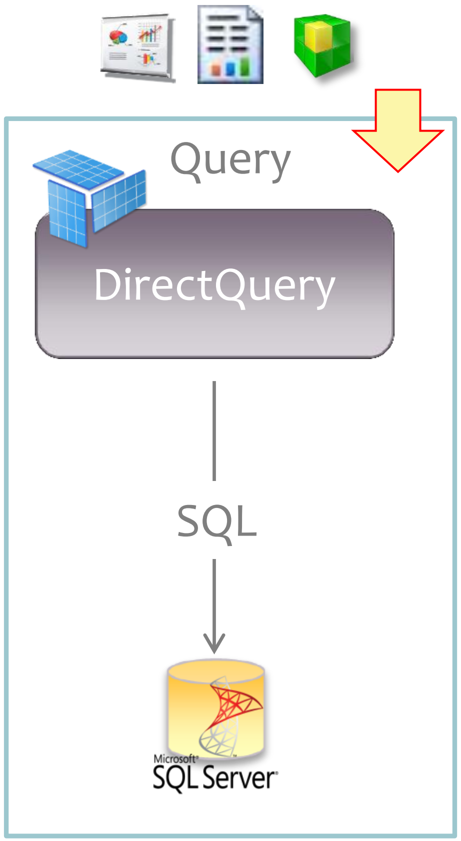
# Execution

# Querying



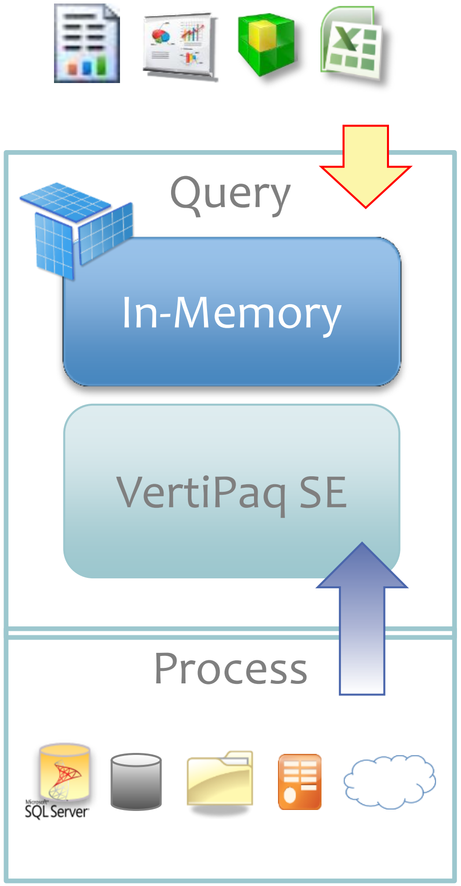
- Data Access
- Query
- Data Sources

# DirectQuery Security



- Role
- DirectQuery Impersonation
  - Impersonate Current User
  - Default (Data Source login)
- Data Source Impersonation
  - Windows User
  - Service Account

# In-Memory Security



- Role
- Row Level Security
- Data Source Impersonation

DirectQuery vs In-Memory

# Design

# Formula Compatibility

- Semantic differences
  - xVelocity in-memory analytics engine (VertiPaq)
  - SQL Server
- No Calculated Column in DirectQuery

# DAX Functions

- Some DAX Functions are not supported in DirectQuery:
  - No equivalent calculations in relational engine
  - No equivalent SQL expressions
  - Performance of converted expressions
  - E.g. `TOTALYTD, SAMEPERIODLASTYEAR`
- More information on BOL:

  http://msdn.microsoft.com/en-us/library/hh213006.aspx

DirectQuery vs In-Memory

# Administration

# Processing Options (In-Memory)

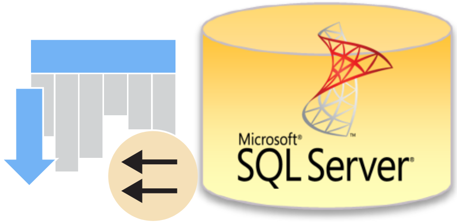
| Mode | Database | Table | Partition |
|---|---|---|---|
| Process Default | × | × | × |
| Process Full | × | × | × |
| Process Data | | × | × |
| Process Clear | × | × | × |
| Process Defrag | | × | |
| Process Add | | | × |
| Process Recalc | × | | |

Further reading:

http://msdn.microsoft.com/en-us/library/hh758414.aspx

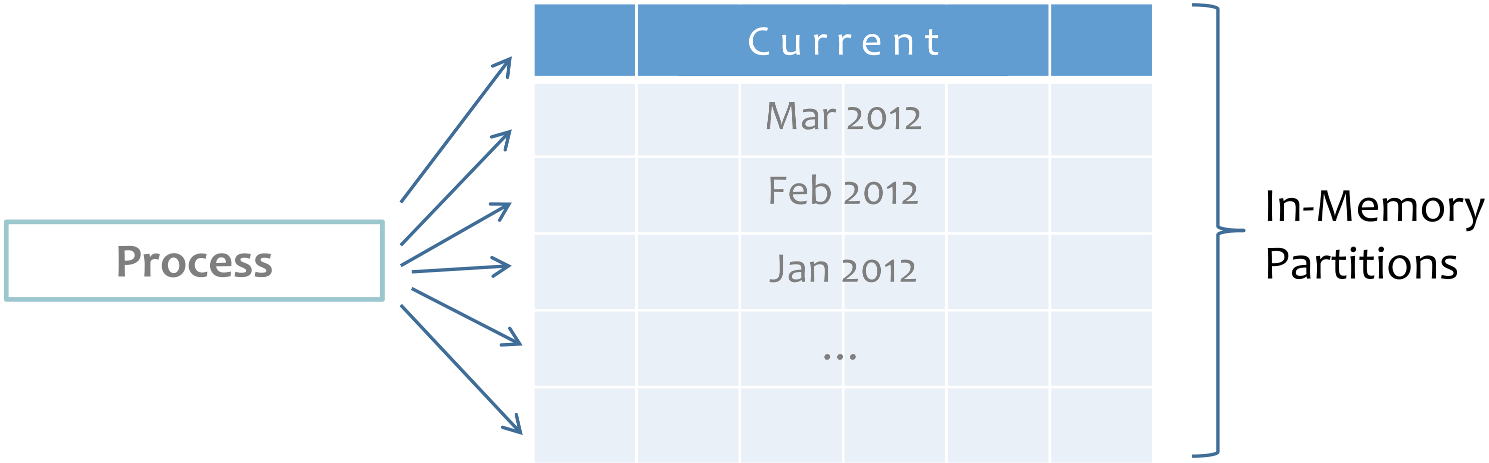
# Partitioning in DirectQuery

- One partition in Tabular Model
  - Can take advantage of Partitioning and ColumnStore Index technology on SQL Server 2012
  - Partitioning / ColumnStore management done at the source database level



# Partitioning in In-Memory

- In-Memory can have multiple mutually exclusive partitions
- To eliminate unnecessary processing and processor load on the AS servers



DirectQuery vs In-Memory

# Pros and Cons

# In-Memory - Pros

- ALL functionality of Tabular Model
  - Calculated Columns, ALL DAX functions
  - Row Level security
  - xVelocity in-memory analytics engine
- Many choices of client tool
  - **Excel**, Power View, SSRS, MDX client*
- Many supported data sources

# In-Memory - Cons

- AS requires Memory & CPU resources
  - Caching
  - Processing
  - Querying
- Diligent Partitioning and Processing
- Out of date data

# DirectQuery - Pros

- **Real time access**
- Scalable
- SQL Server permission
- SQL Server optimisation
- Consistency
- One Partition to manage
- No processing required

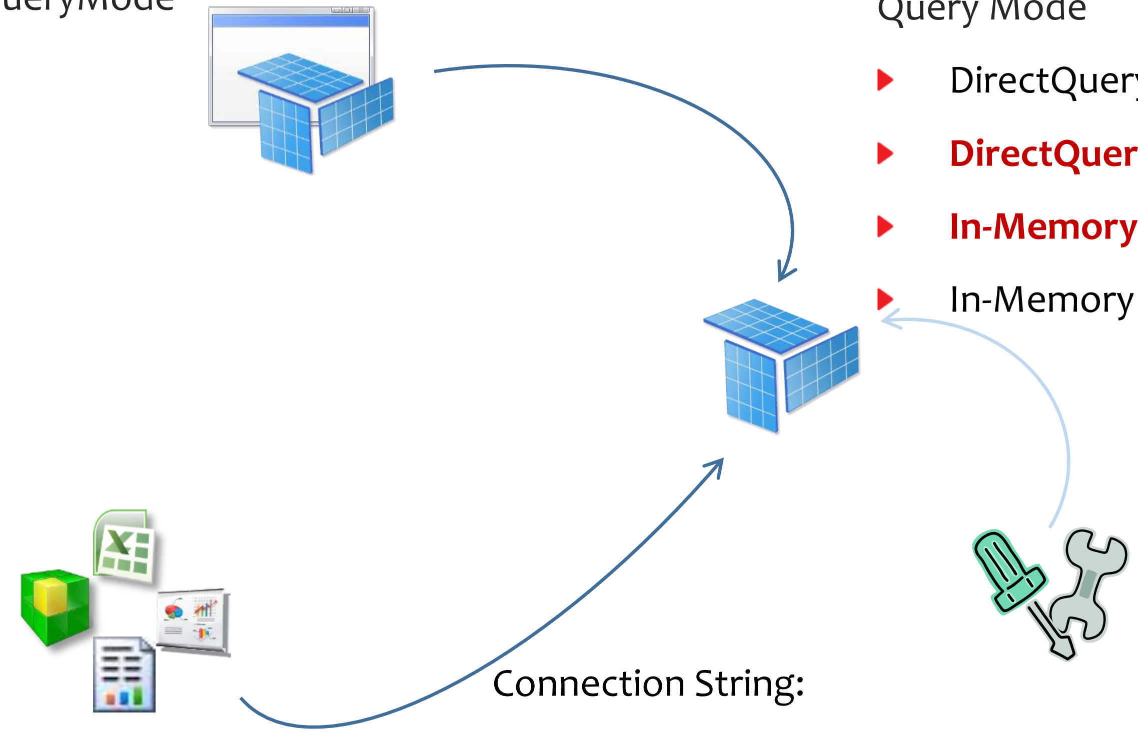
# DirectQuery - Cons

- Restricted DAX functions
- Restricted client tools: PowerView, SSRS
- No Row Level Security
  - Unless defined at the source Database
- No Calculated Columns

The best of both worlds

# Hybrid Mode

# Tabular Model Solutions



DirectQueryMode

- **On**
- Off

Query Mode

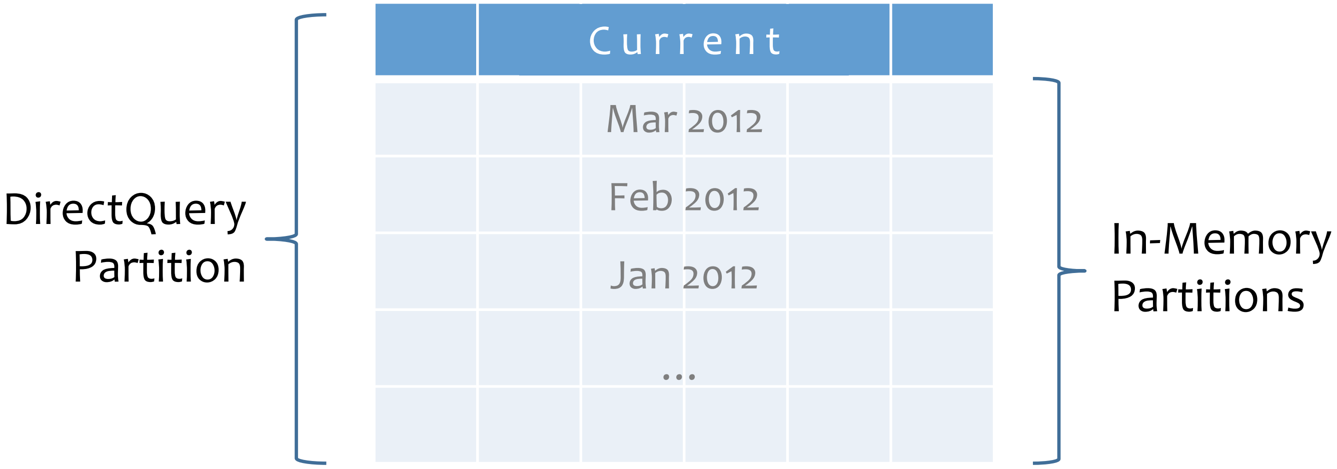
- DirectQuery
- **DirectQuery with In-Memory**
- **In-Memory with DirectQuery**
- In-Memory

Connection String:

- **DirectQueryMode=DirectQuery**
- **DirectQueryMode=In-Memory**

# Partitioning for Hybrid Mode

- One Partition for DirectQuery
  - Processing Option: Never process this partition
- Multiple Partitions for In-Memory (No Overlap)



Current

Mar 2012

Feb 2012

Jan 2012

…

DirectQuery Partition

In-Memory Partitions

# Implications

- Inconsistency
  - Data – stale data in Cache
  - Calculations – semantic differences xVelocity vs SQL
  - Security
- DirectQuery Design
- Flexibility at run time / client tools
  - In-Memory (Excel) or DirectQuery (Real time)

# Wrap Up

# Tabular Model Modes

- In-Memory Mode (default)
- DirectQuery Mode
  - DirectQuery only
  - DirectQuery with In-Memory
  - In-Memory with DirectQuery

# Do I DirectQuery?

- SQL Server database is optimised
  - Columnstore Index
  - Partitioning
  - Contains required most business rules
- High Volume
- Can import non-SQL data into one SQL Server database which will be the source

# Further Reading

- Cathy Dumas' blog

http://cathydumas.com/

http://blogs.msdn.com/b/cathyk/archive/2011/09/06/directquery-101.aspx

- SQLBI – (Marco Russo & Alberto Ferrari)

http://www.sqlbi.com/

- DAX resources (with links to Tabular Model)

http://social.technet.microsoft.com/wiki/contents/articles/1088.dax-resource-center.aspx

# Q & A

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# Thank you!