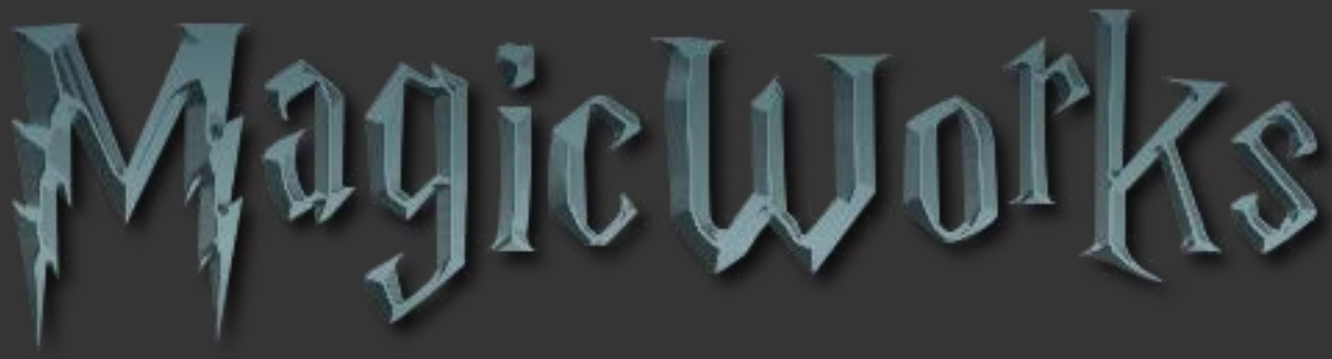
# What's the Problem?




MagicWorks™ are struggling

- Analytics queries too slow
- Data volumes are growing
- Their servers are at capacity
- Queries are already tuned by SQL experts


# Azure SQL Data Warehouse

# Agenda

Service architecture

Elastic performance and scalability

Table storage

Business Continuity

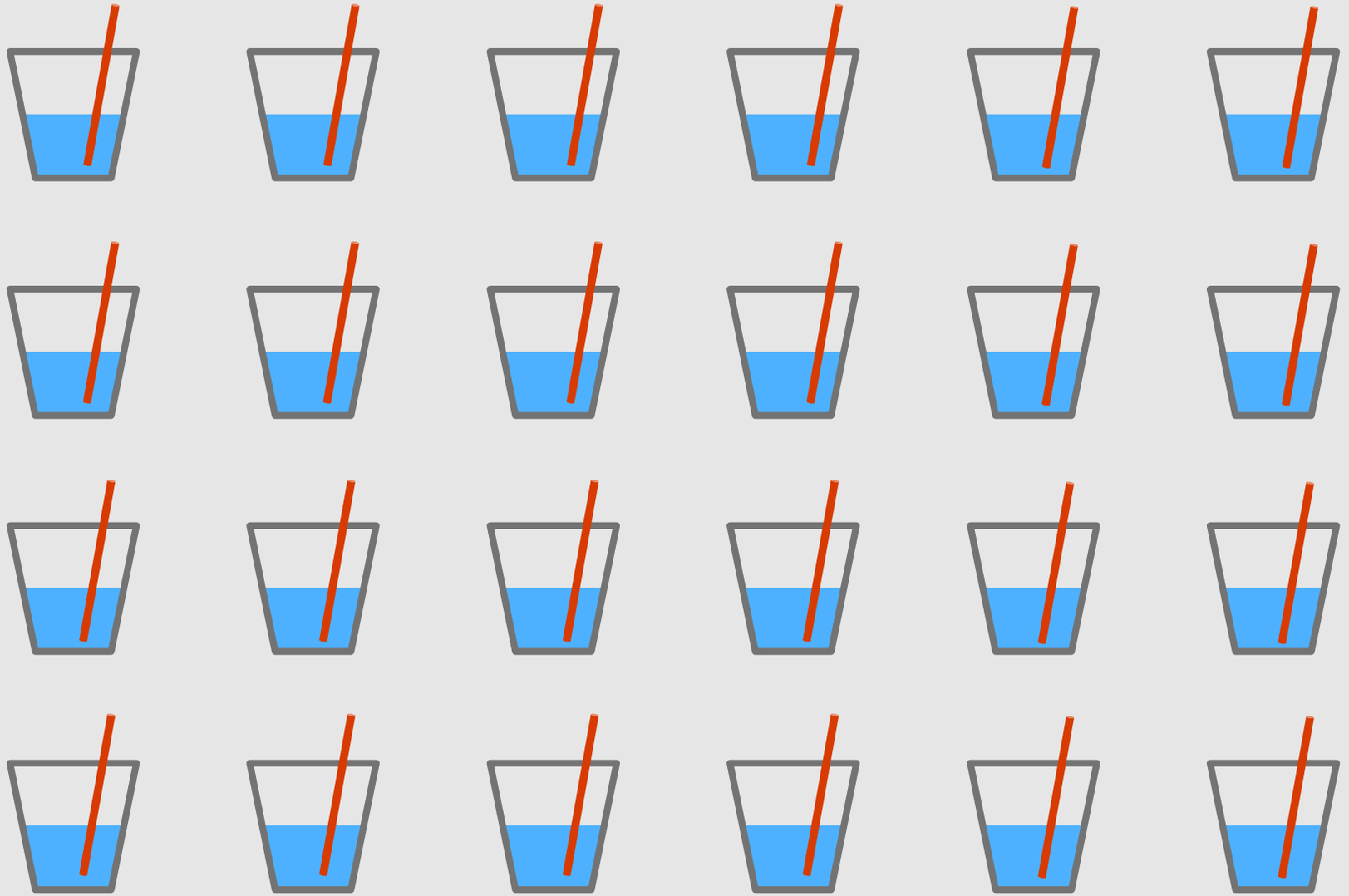
Workload Management

Service Integration

# But first…

Who likes Drinking Games?

# Scaling out: The ultimate team game…



# Target workload: Analytics

Store large volumes of data

Consolidate disparate data into a single location

Shape, model, transform and aggregate data

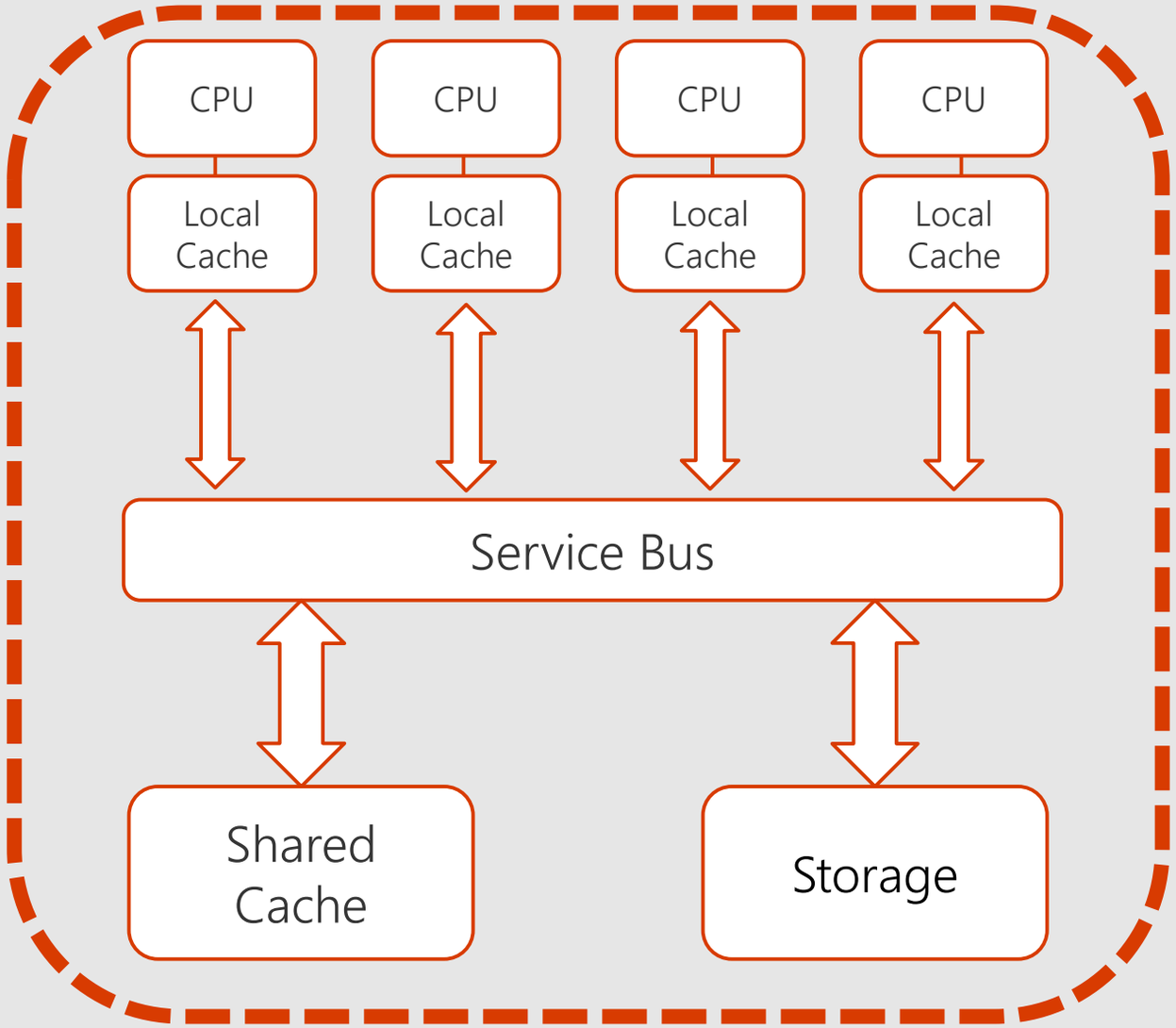
Perform query analysis across large datasets

Ad-hoc reporting across large data volumes

All using simple SQL constructs

"SQL on SQL"

# SQLDW Service Architecture

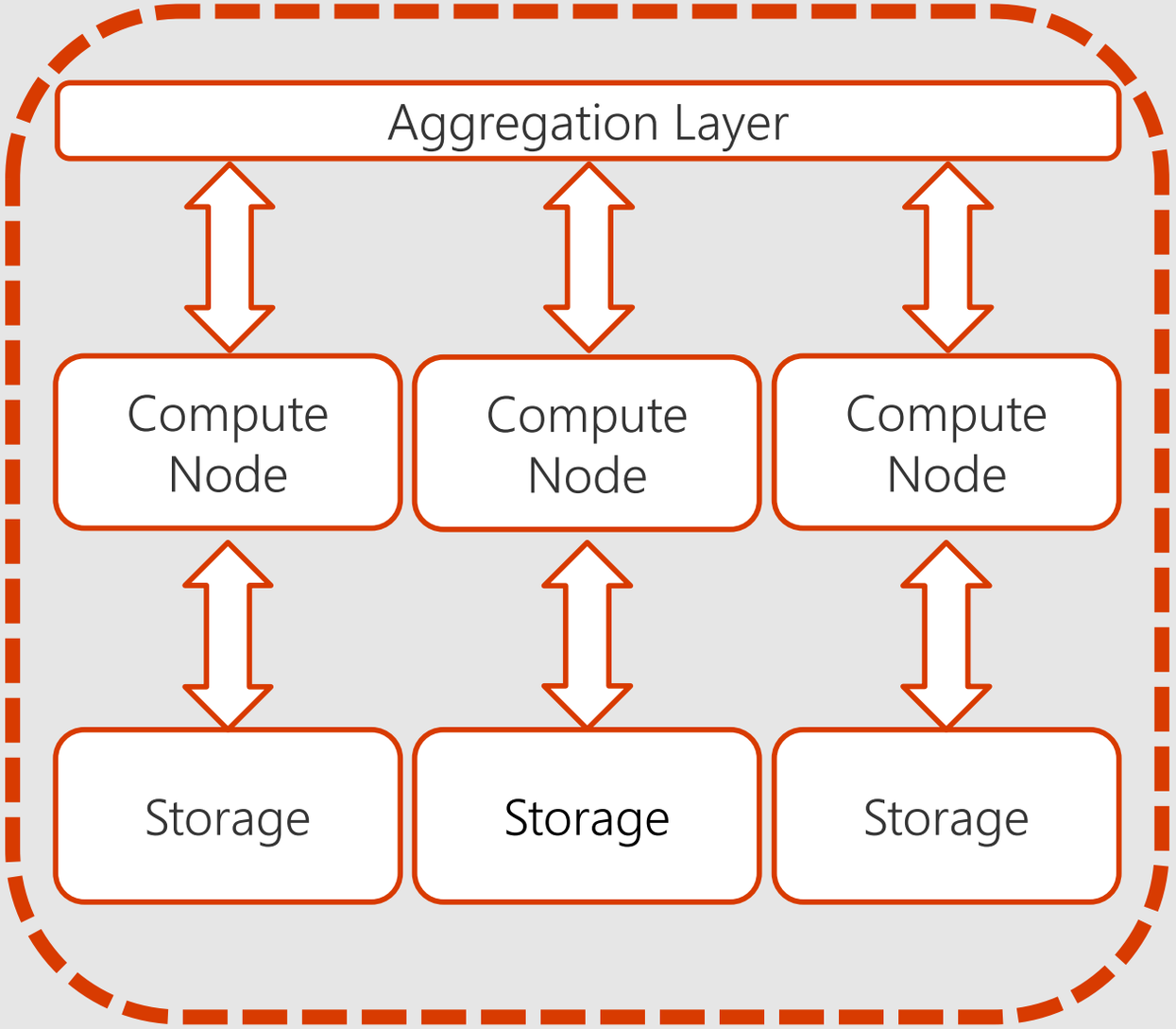


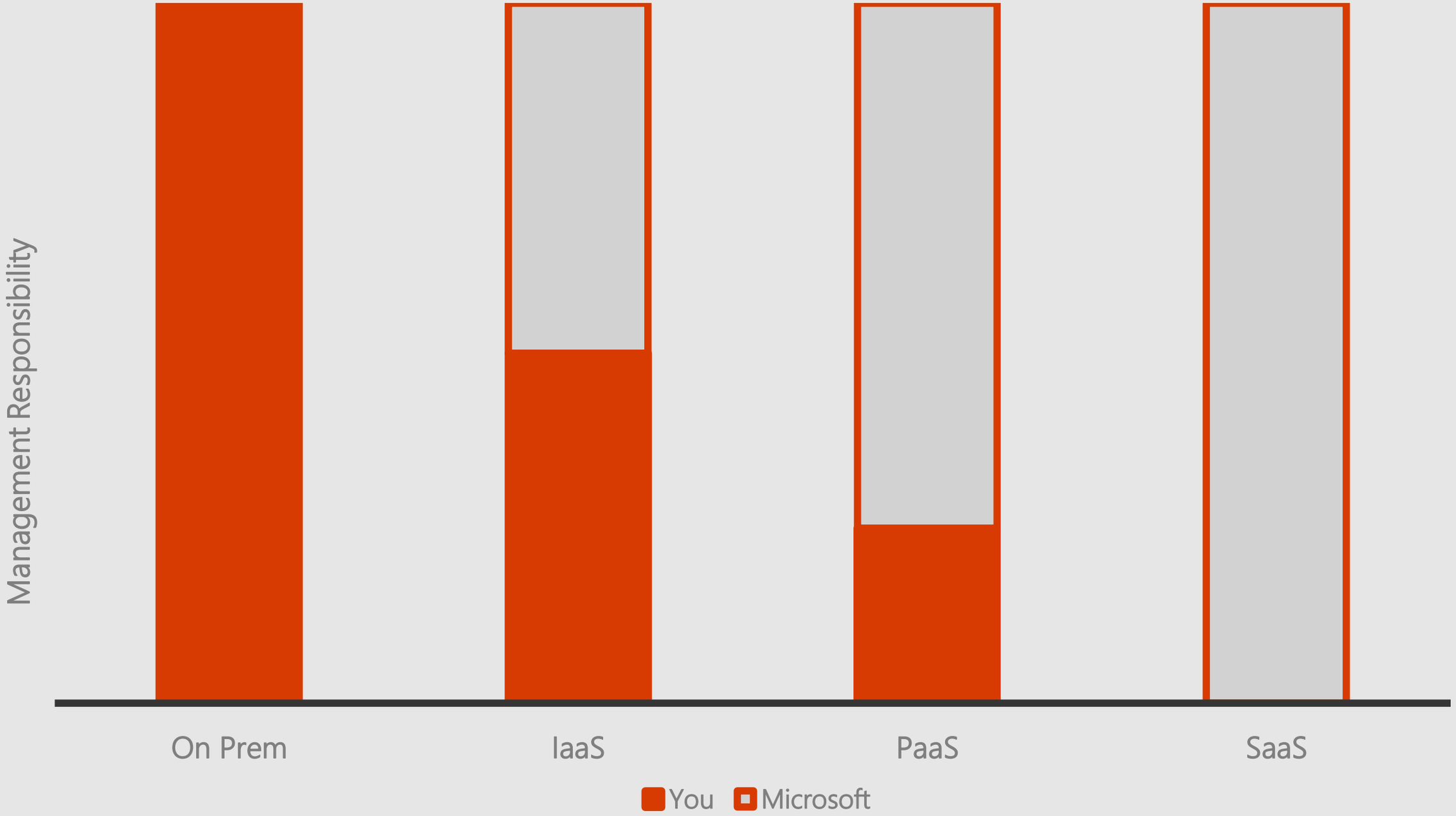

# SMP

Symmetric Multi-Processing
(ie: A Standard SQL Server)

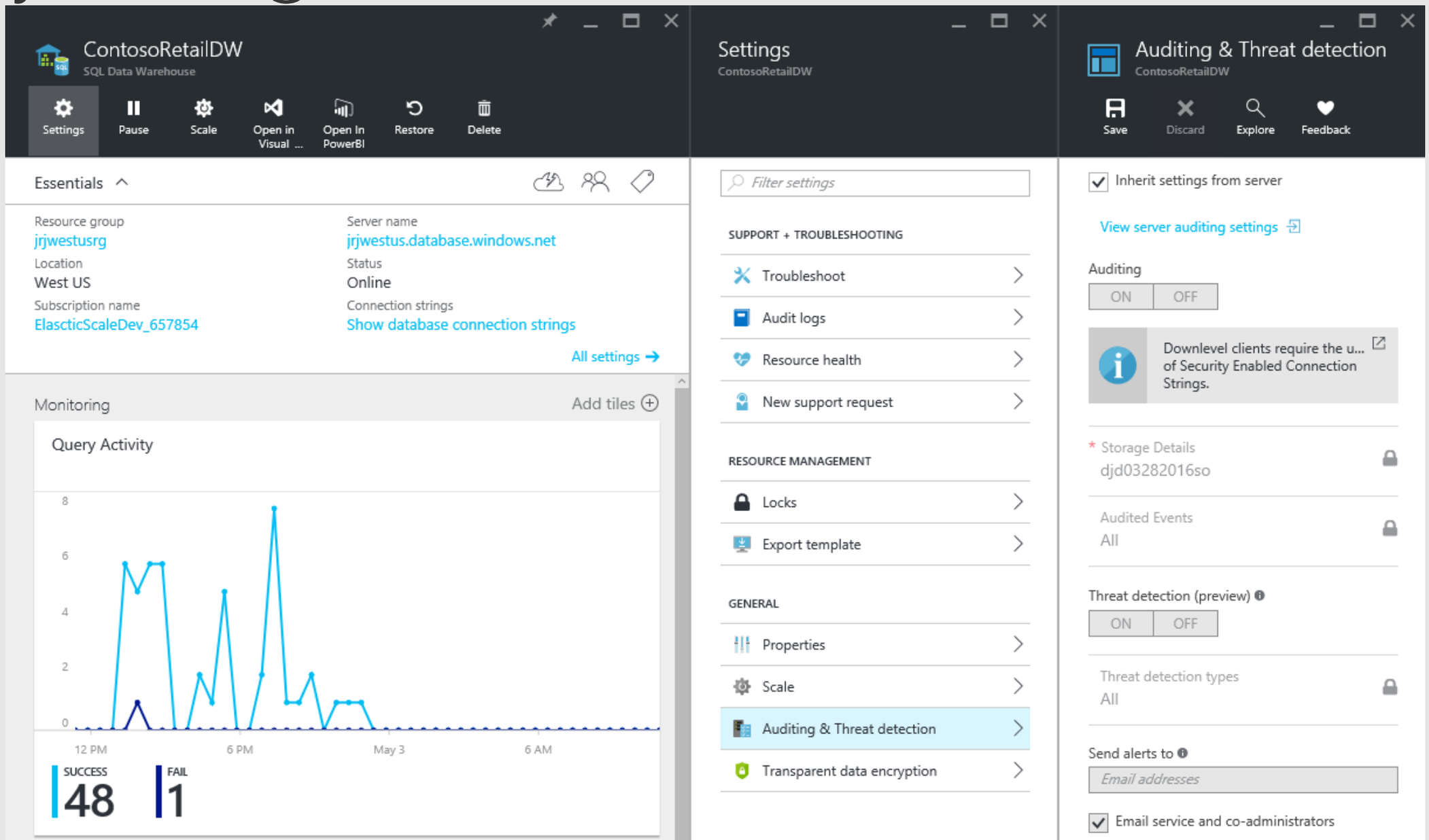
# MPP

Massively Parallel Processing




Management Responsibility
On Prem
IaaS
PaaS
SaaS
You
Microsoft

# Fully managed PaaS



# Connectivity

Windows or Linux

ODBC

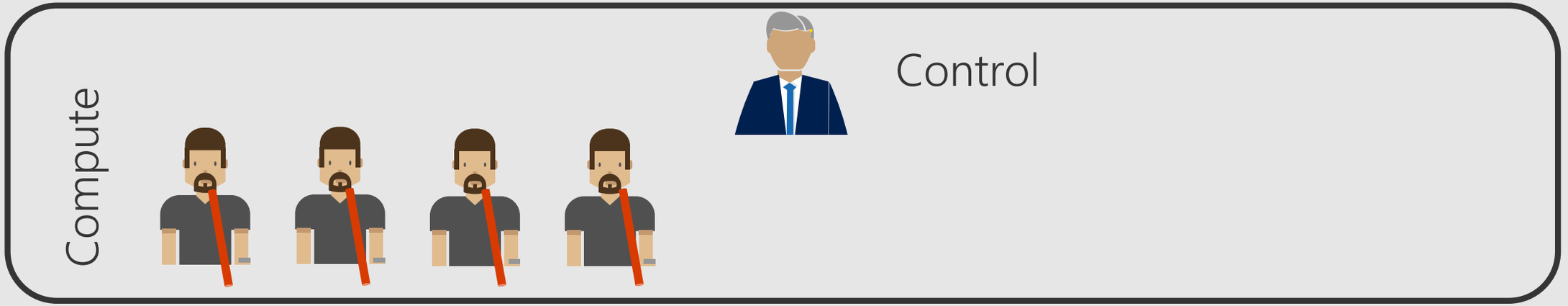
OLEDB

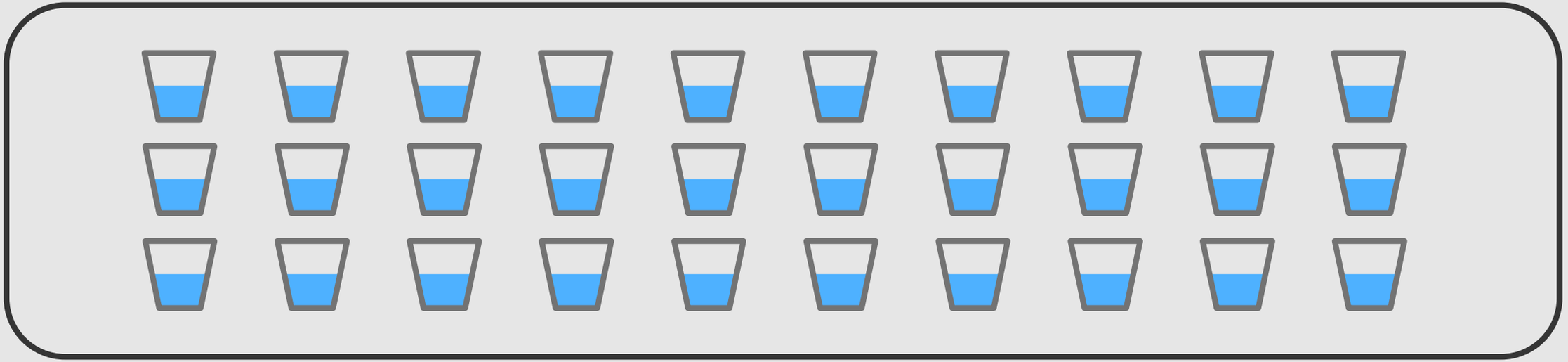
JDBC

ADO.NET

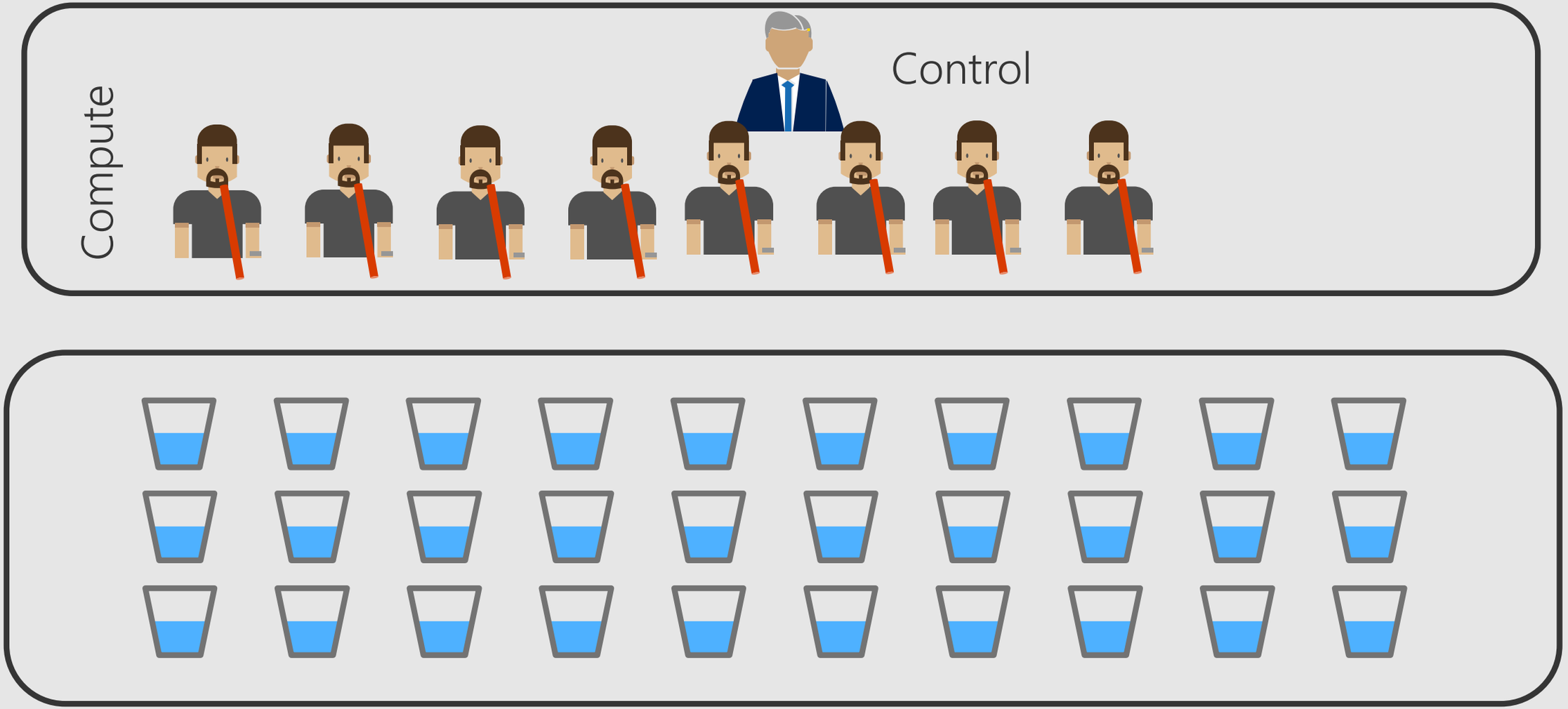
PHP

# Separation of compute from storage

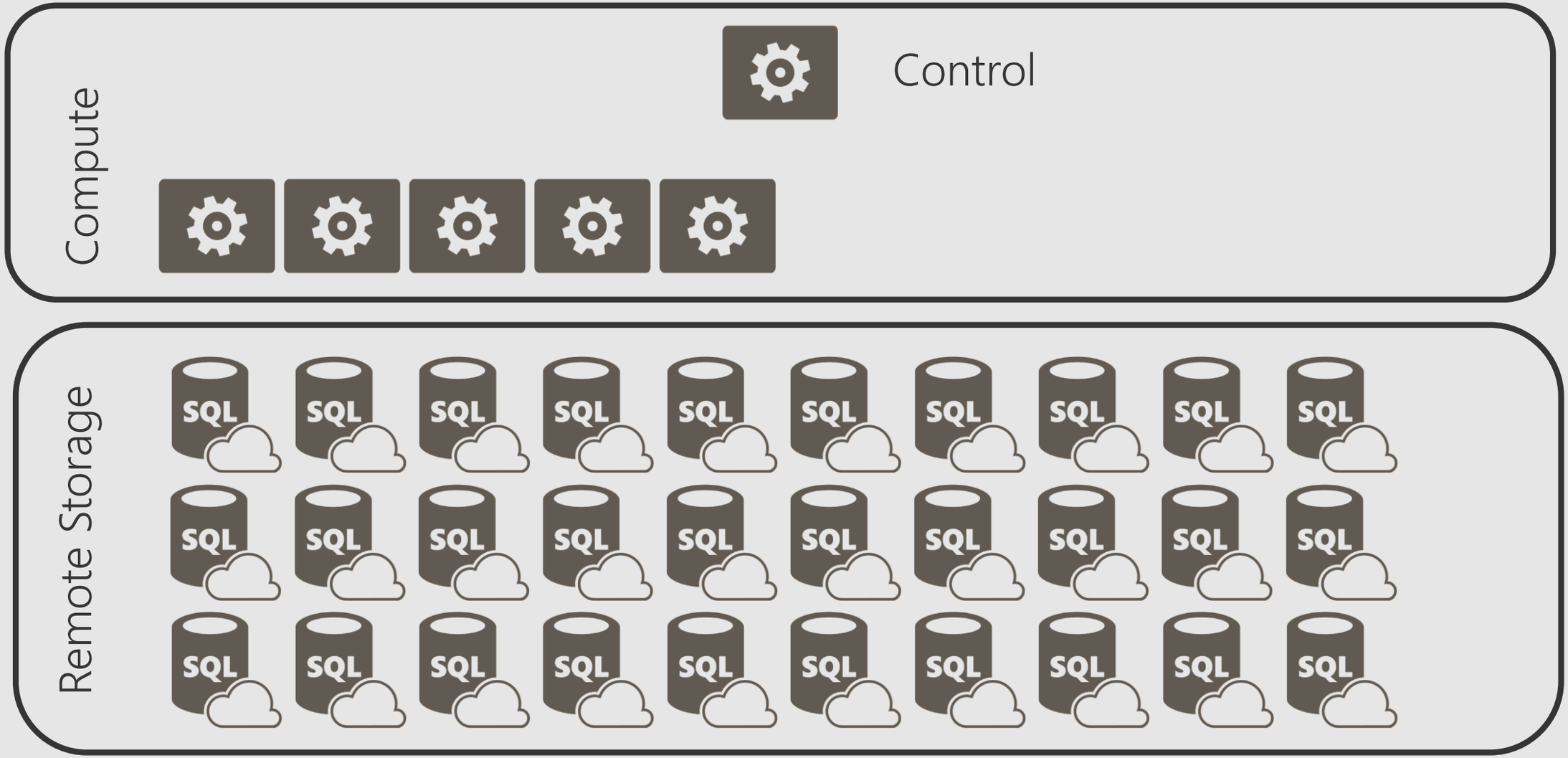



# Separation of compute from storage

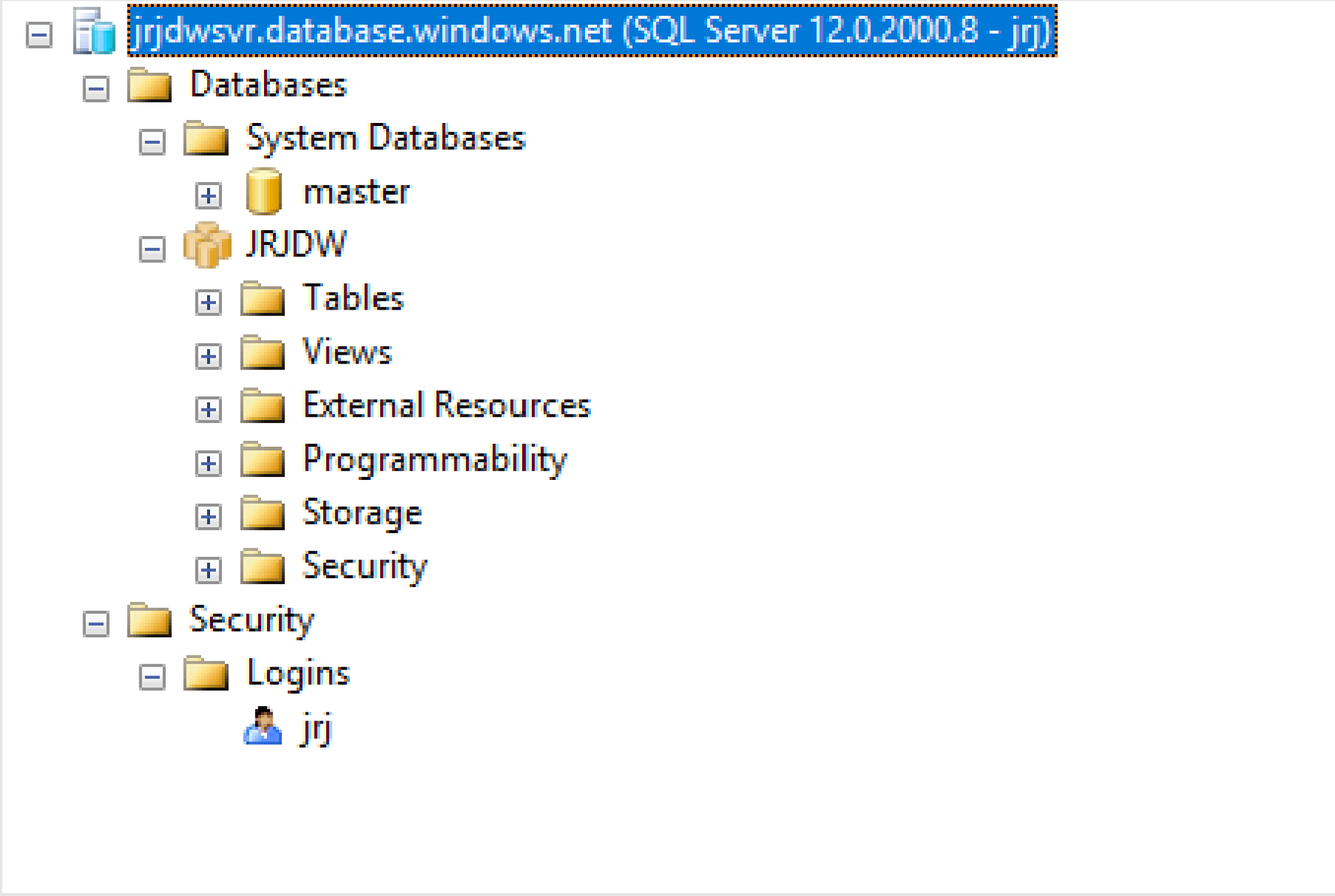



# Separation of compute from storage



# Instance

- Logical server
- Database
  - Schemas
  - Tables
  - Views
  - Stored Procedures
  - UDFs
- Security
  - Logins
  - Users
  - Certificates



# Demo: Creating & Connecting to Azure SQLDW

# Nodes:

```
SELECT   [pdw_node_id]    AS node_id
,        [type]           AS node_type
,        [name]           AS node_name
FROM     sys.[dm_pdw_nodes]
;
```

# Distributions:

```
SELECT   [distribution_id]    AS dist_id
,        [pdw_node_id]        AS node_id
,        [name]               AS dist_name
,        [position]           AS dist_position
FROM     sys.[pdw_distributions]
;
```

# Lab 001 – Connecting to SQLDW
*10 mins*

# Elastic performance & scalability

# Scale up architecture

One bucket (motherboard)

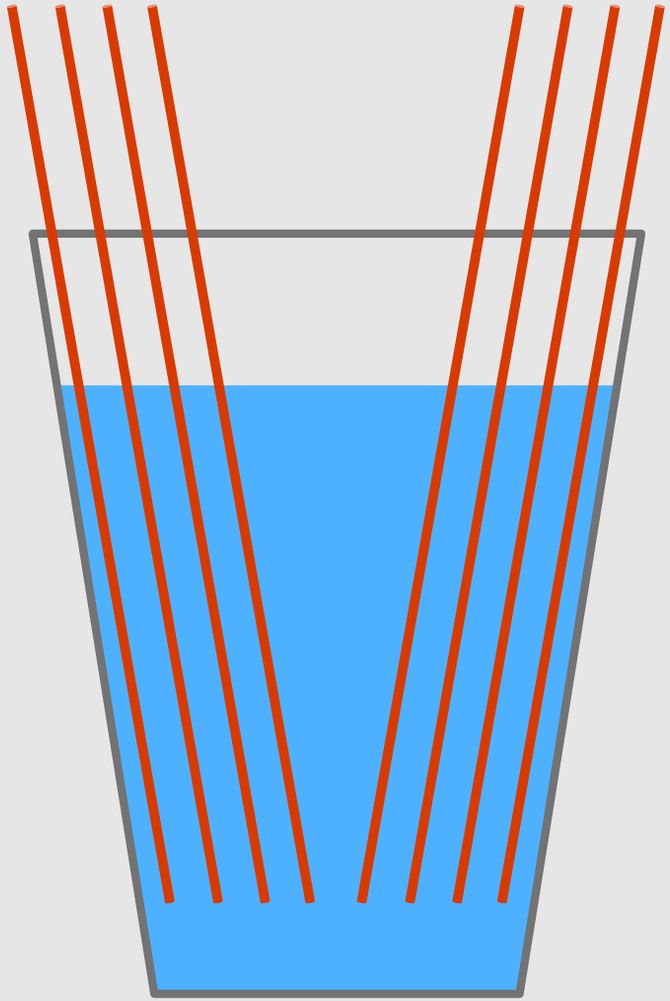
Contains all the water (resources)

Drinking through straws (logical procs)

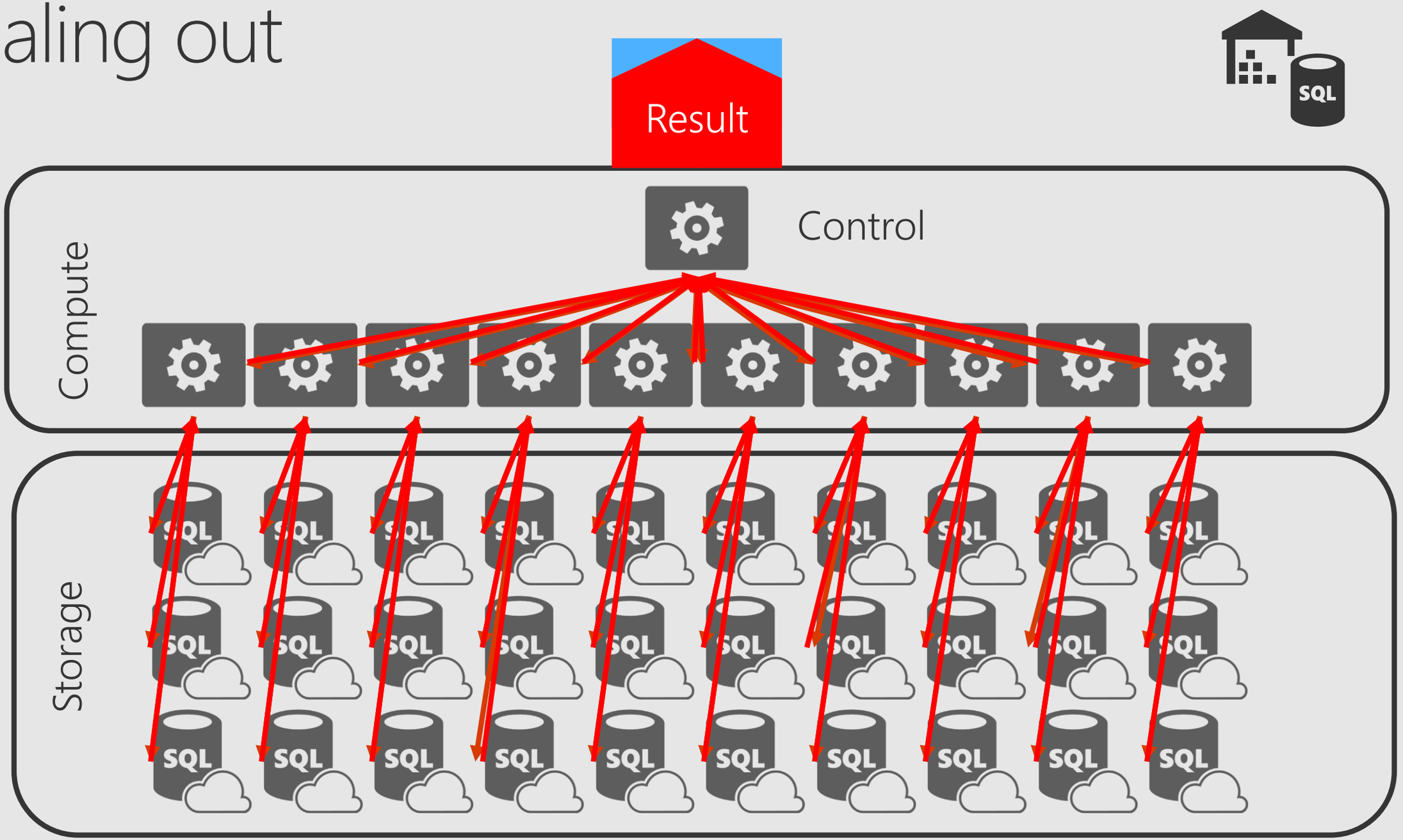
Want more resources?

- Buy a bigger bucket

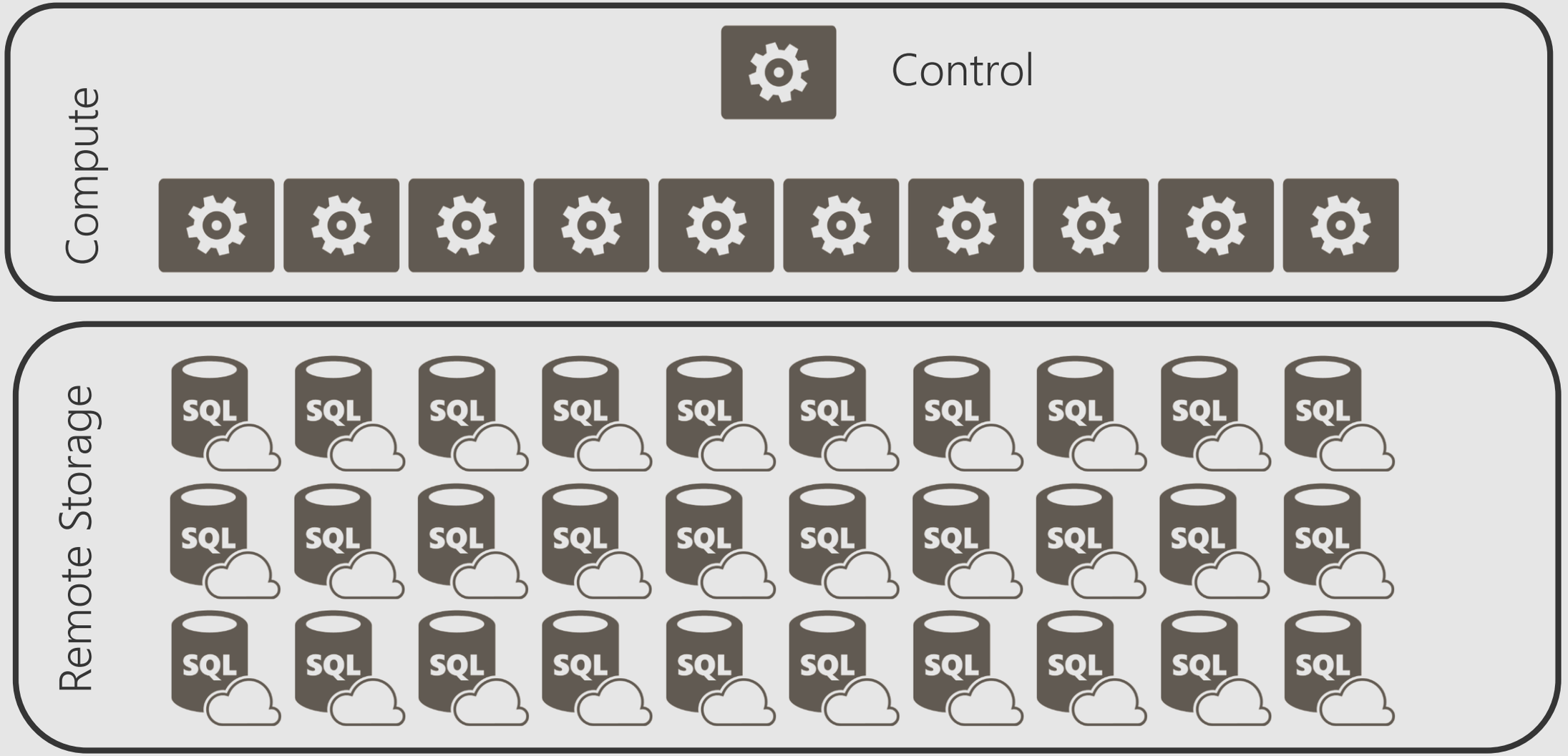
Sometimes you only get one straw…



# Scaling out



# Independently scale compute



# Data Warehouse Units

Normalized amount of compute

Converts to billing units i.e. what you pay


Relates directly to number of compute nodes

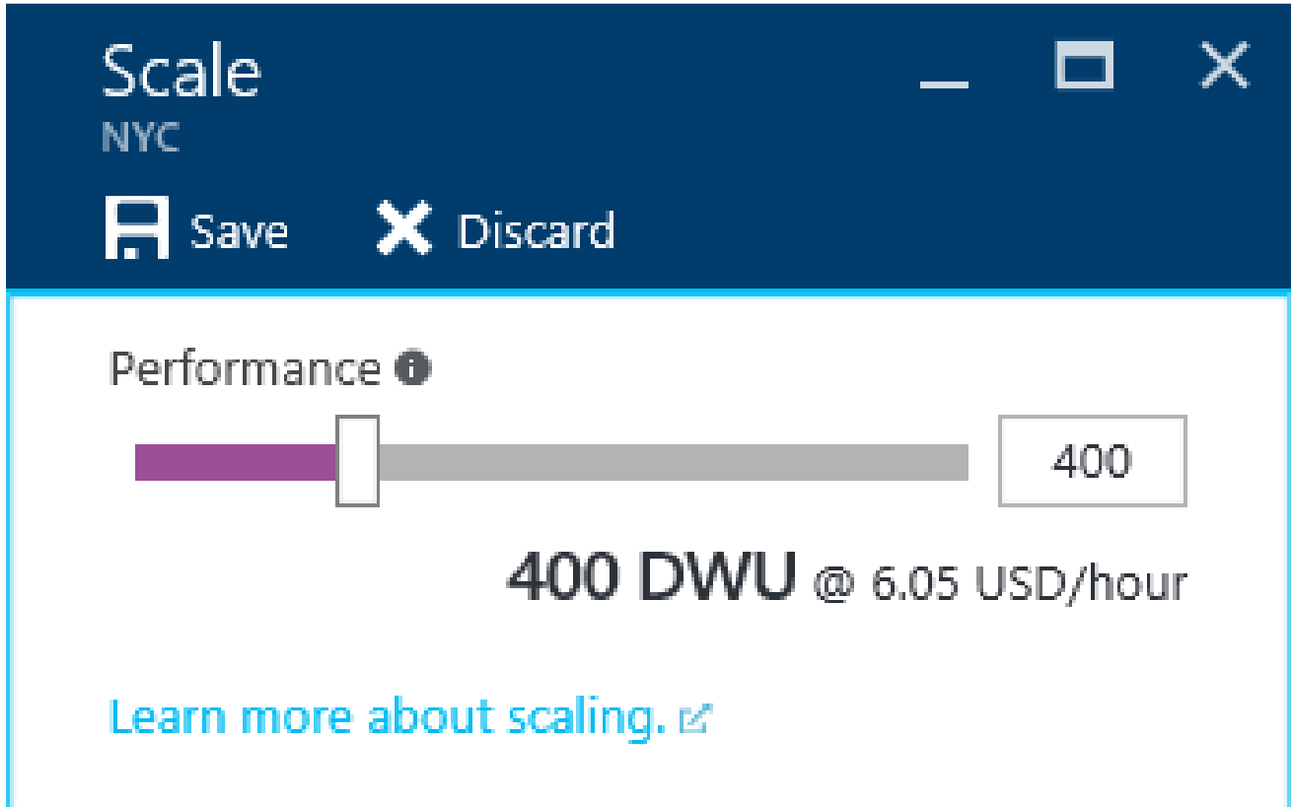
| DWU |
| --- |
| 100 |
| 200 |
| 300 |
| 400 |
| 500 |
| 600 |
| 1000 |
| 1200 |
| 1500 |
| 2000 |
| 3000 |
| 6000 |

# Service objective

```
SELECT   db.[name]                      AS [db_name]
,        ds.[edition]                   AS [db_edition]
,        ds.[service_objective]         AS [db_slo]
FROM     sys.[database_service_objectives]   AS ds
JOIN     sys.[databases]                     AS db
ON       ds.[database_id] = db.[database_id]
WHERE    ds.[edition]     = 'DataWarehouse'
;
```

# Changing Service Level Objectives (SLO)

```
ALTER DATABASE ContosoDW
MODIFY
(service_objective = 'DW1000'
)
;
```



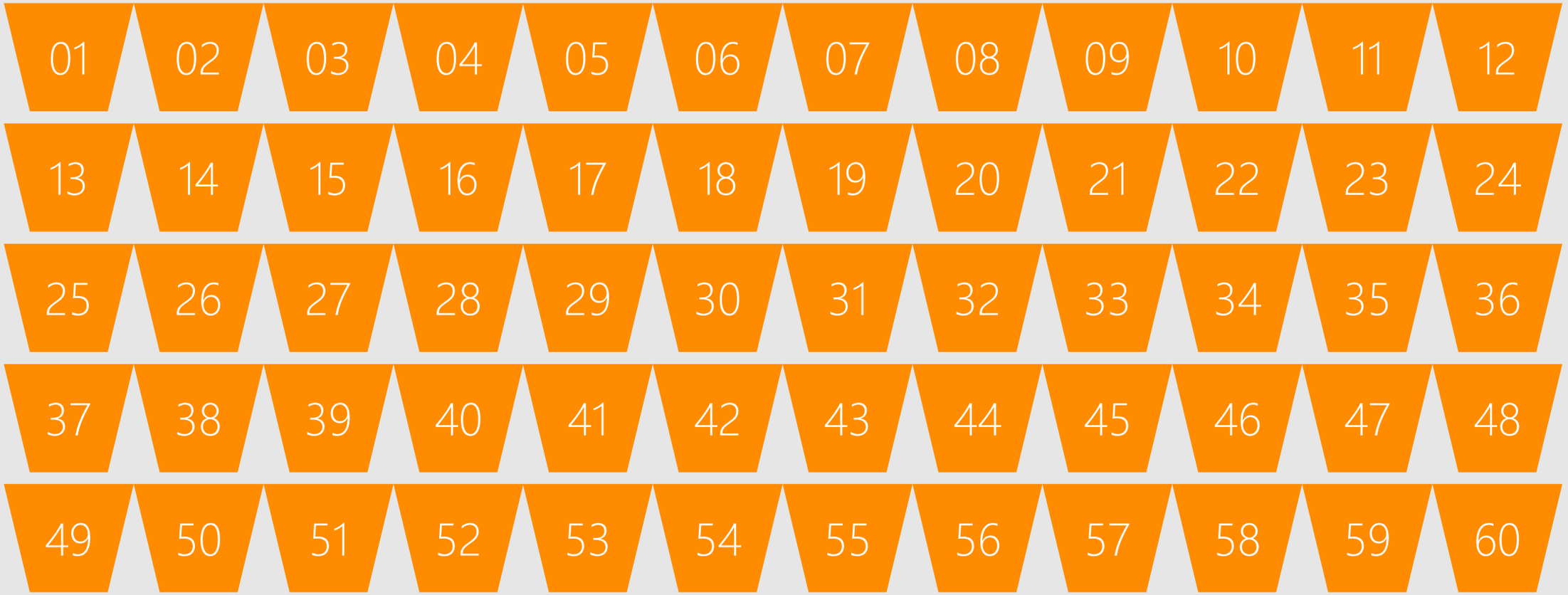
# Changing Service Level Objectives (SLO)

```
Set-AzureRmSqlDatabase
        -DatabaseName “Database"
        -ServerName “Server"
        -RequestedServiceObjectiveName "DW1000"
```

*PowerShell*

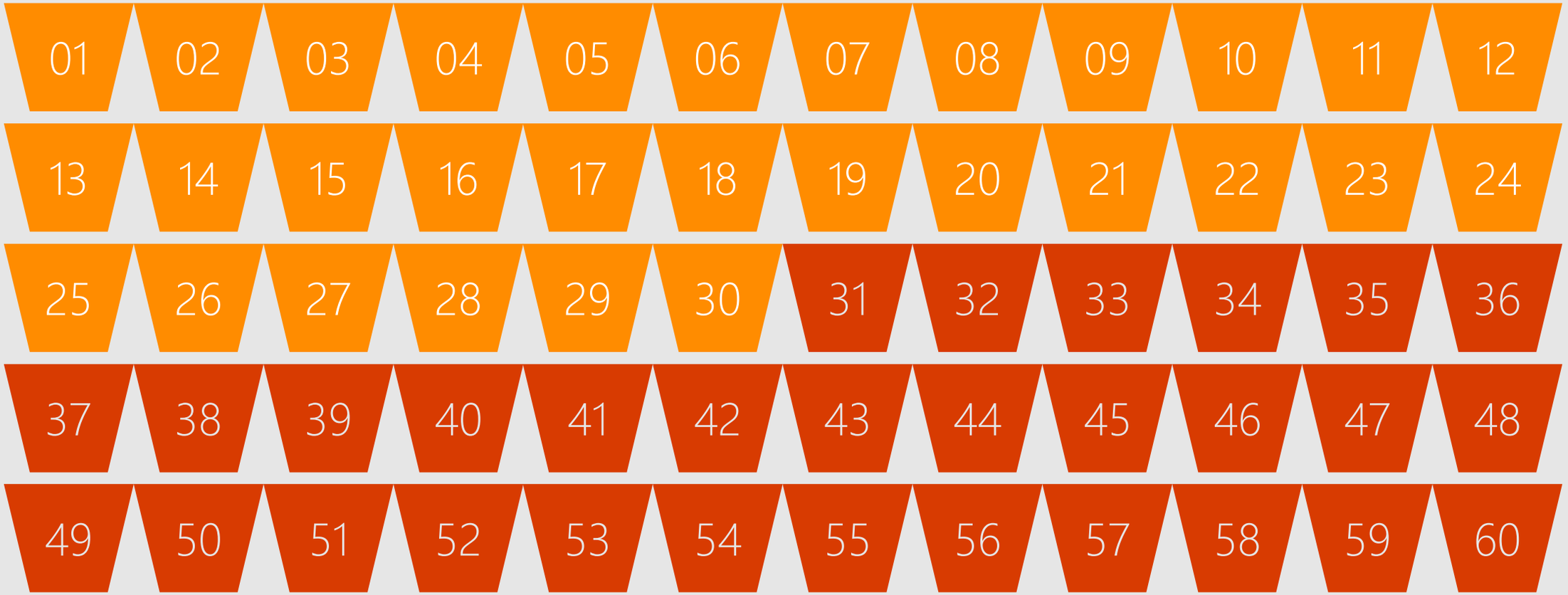
# Mapping Compute in SQLDW

DW100



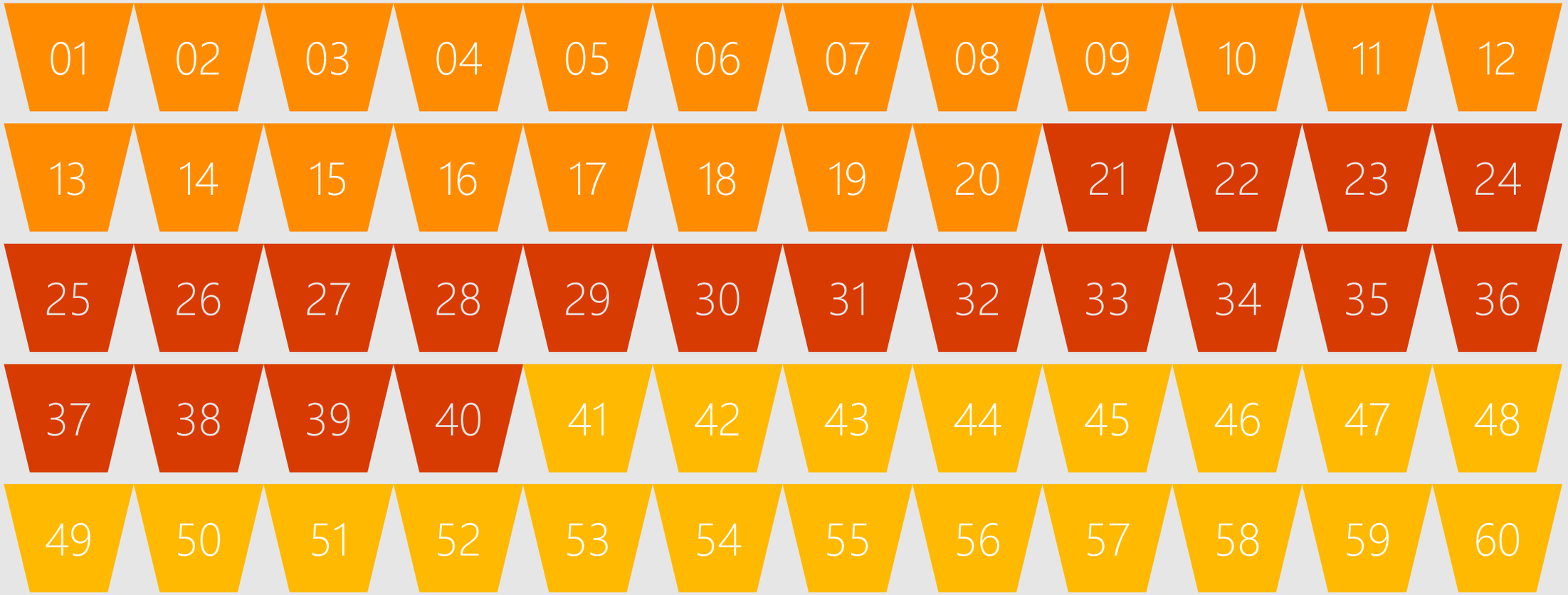
# Mapping Compute in SQLDW

DW200



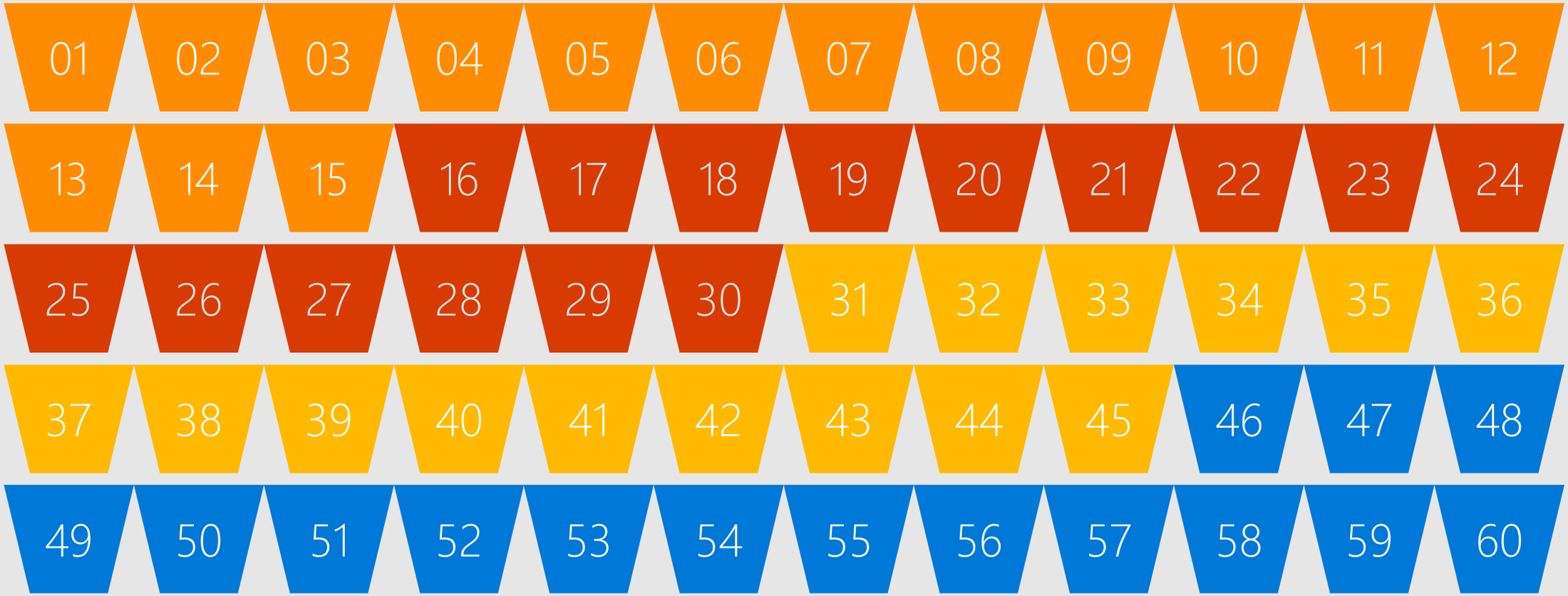
# Mapping Compute in SQLDW

DW300



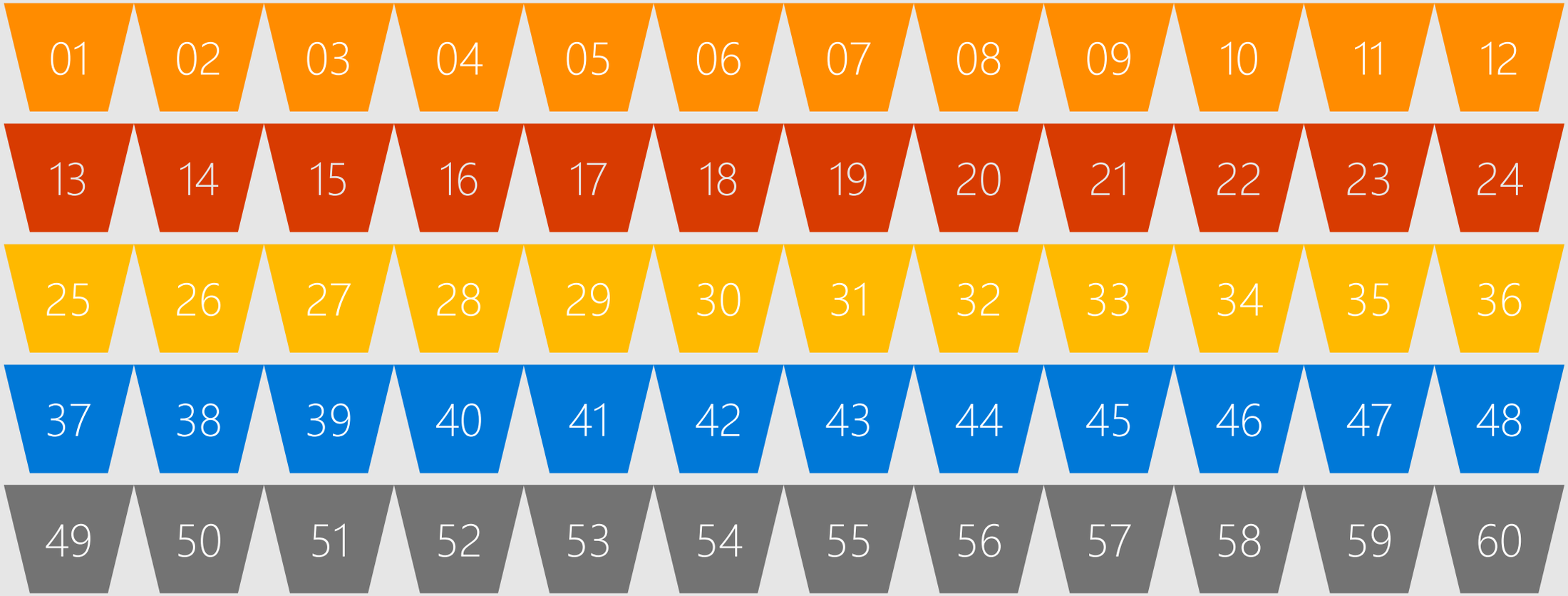
# Mapping Compute in SQLDW

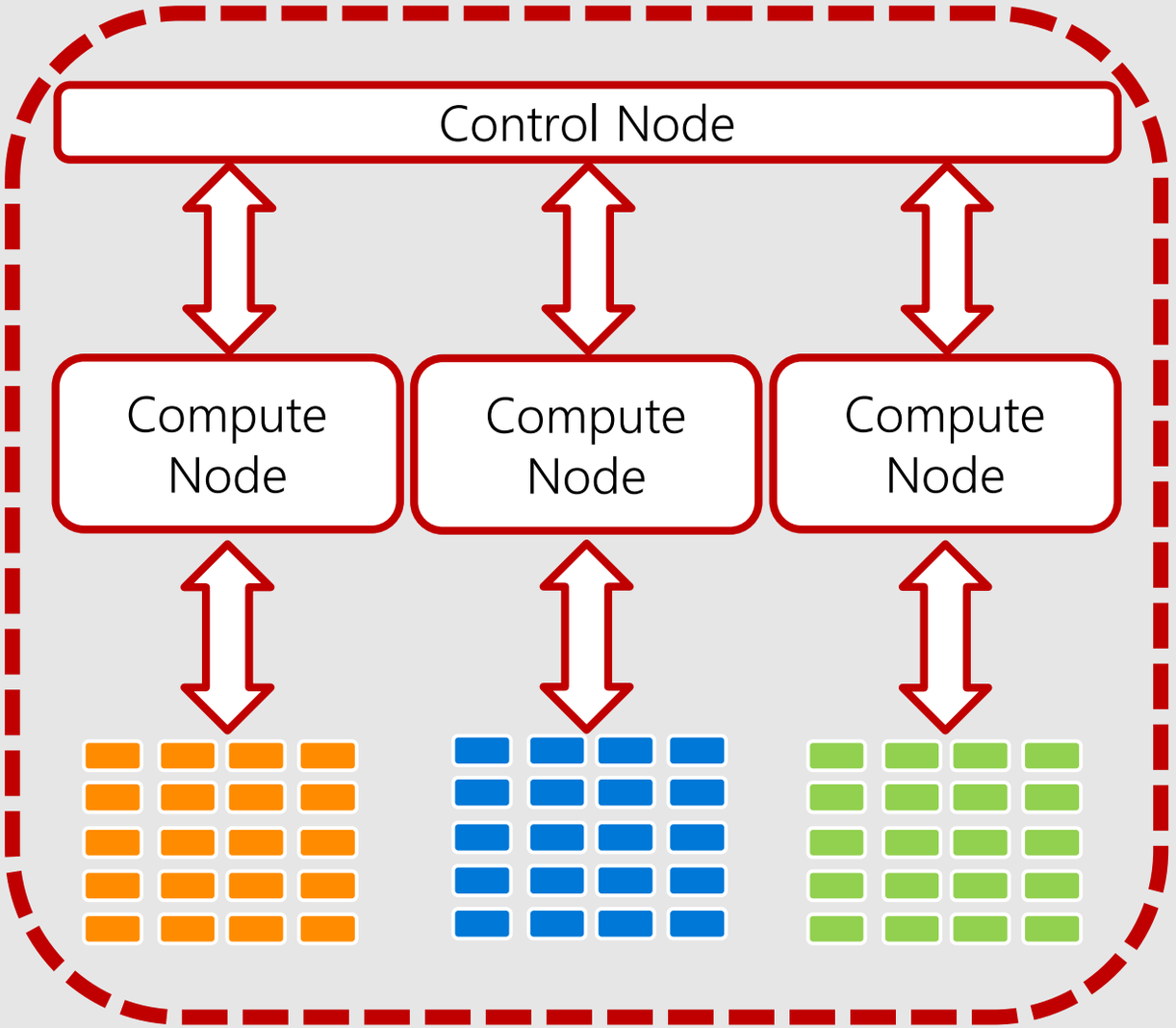
DW400



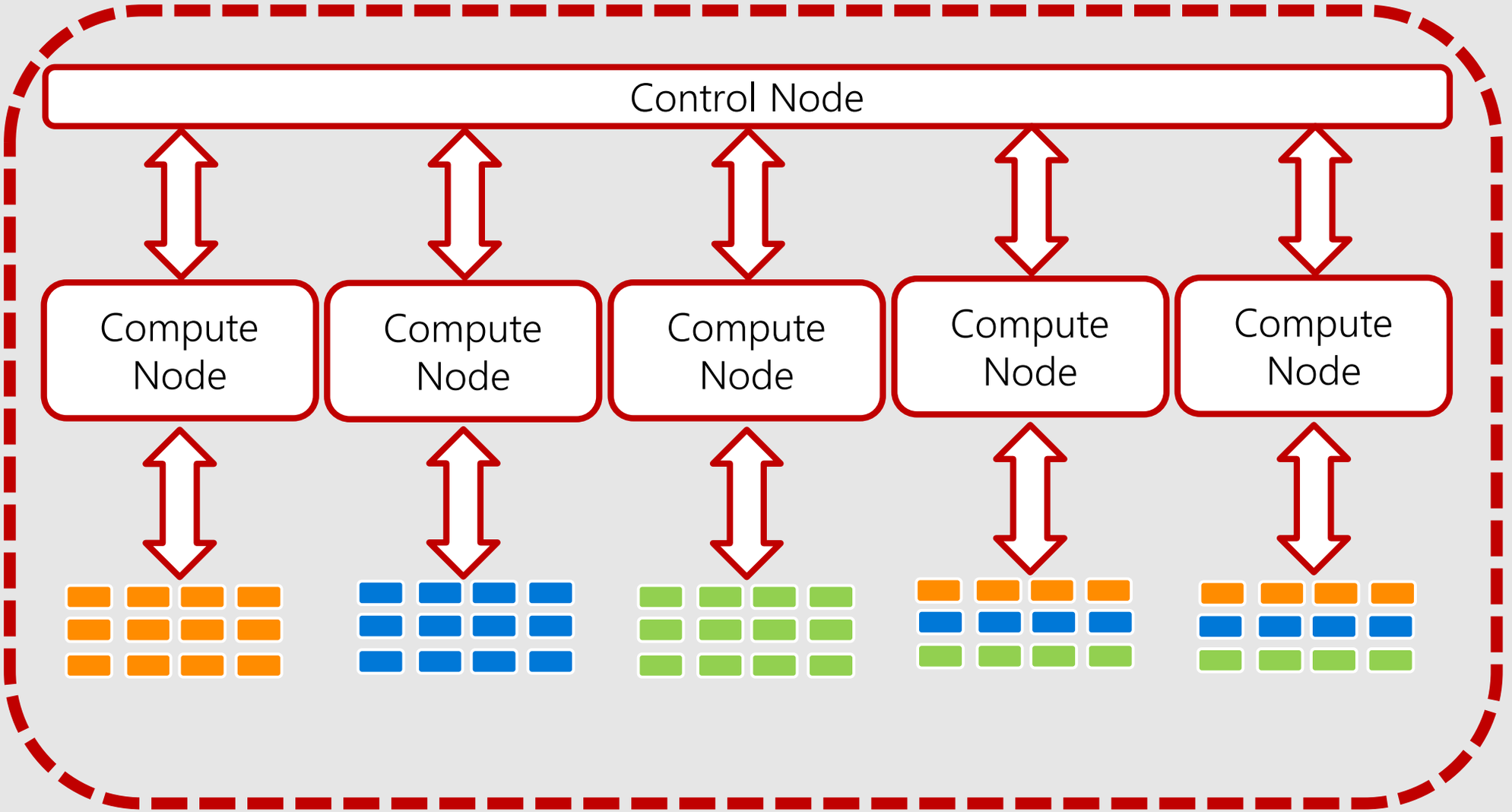
# Mapping Compute in SQLDW

DW500



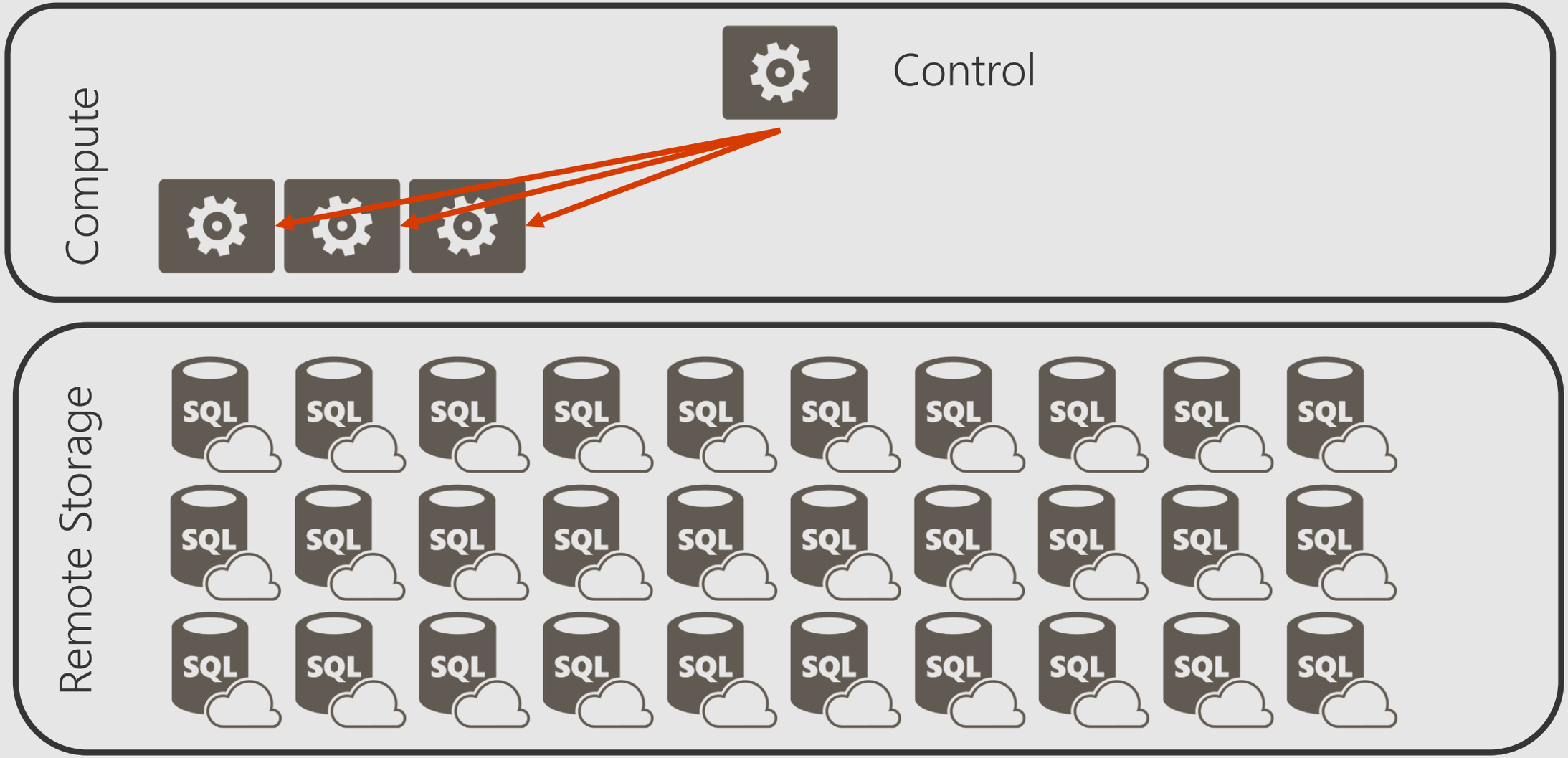



300 DWUs As An MPP diagram



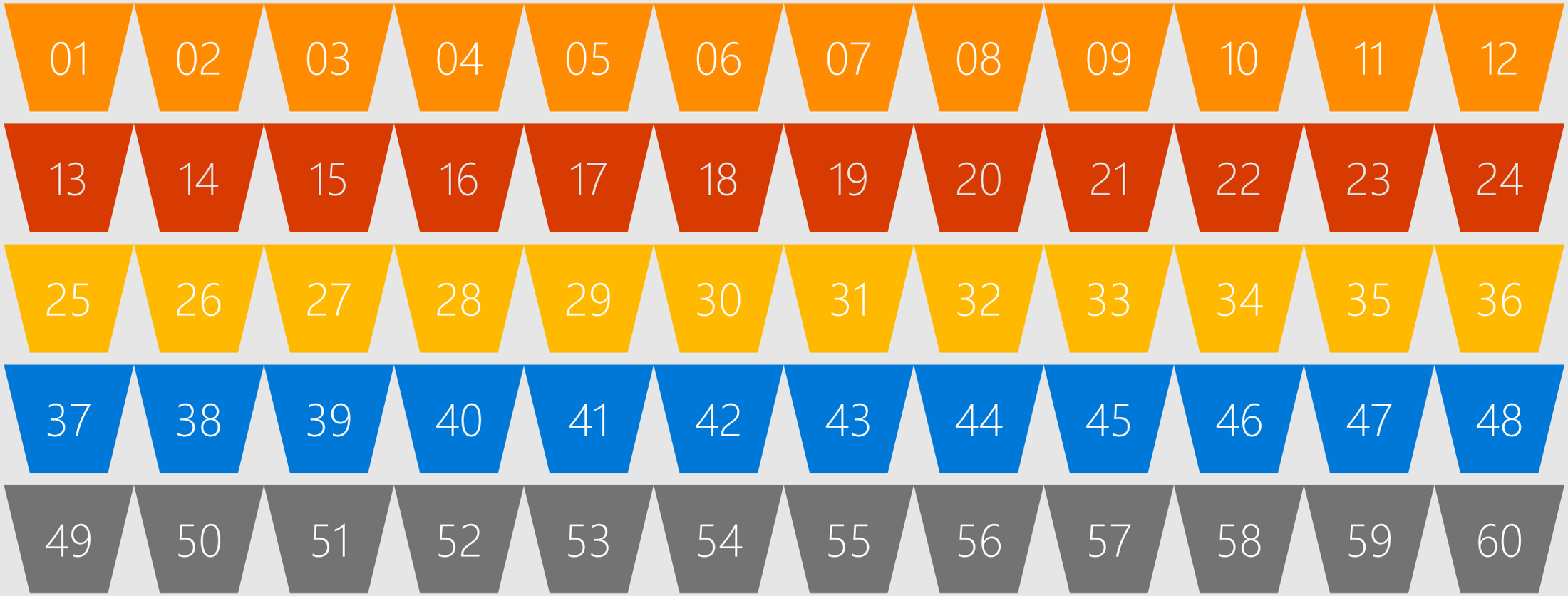

500 DWUs As An MPP diagram

# Pause and resume workload



# Pausing compute in SQLDW

DW500



# Pausing compute in SQLDW

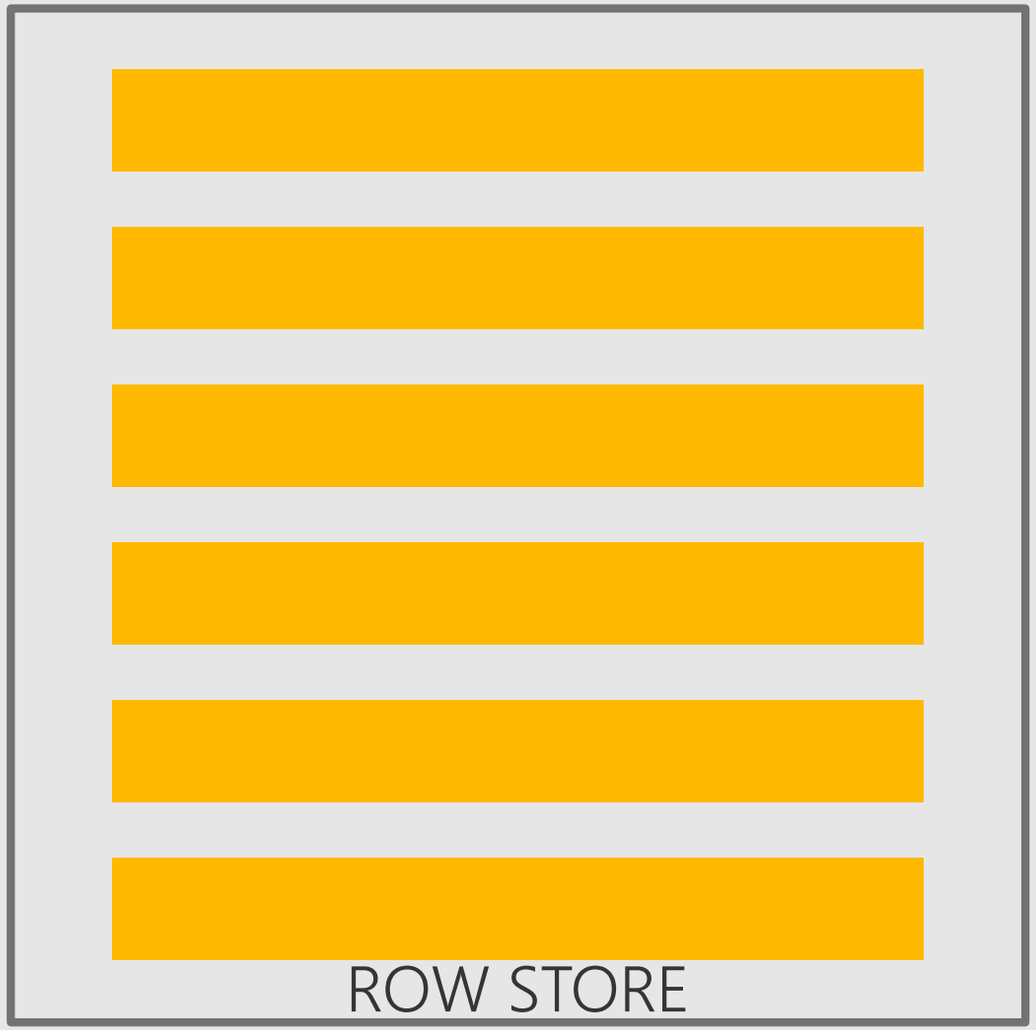
```
Suspend-AzureRmSqlDatabase
    –ResourceGroupName "ResourceGroup"
    –ServerName "Server"
    –DatabaseName "Database"
```

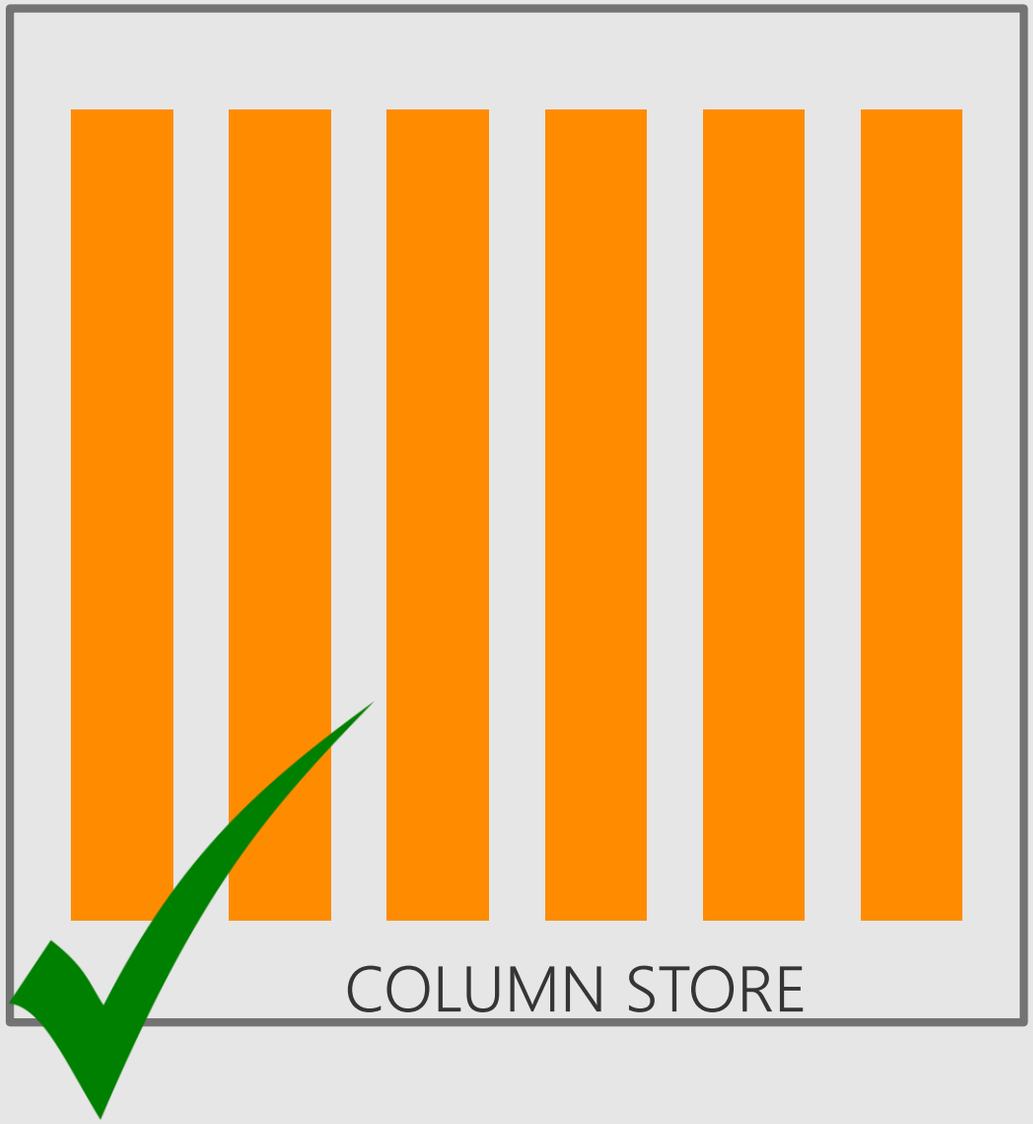
```
Resume-AzureRmSqlDatabase
    –ResourceGroupName "ResourceGroup"
    –ServerName "Server"
    –DatabaseName "Database"
```

*PowerShell*

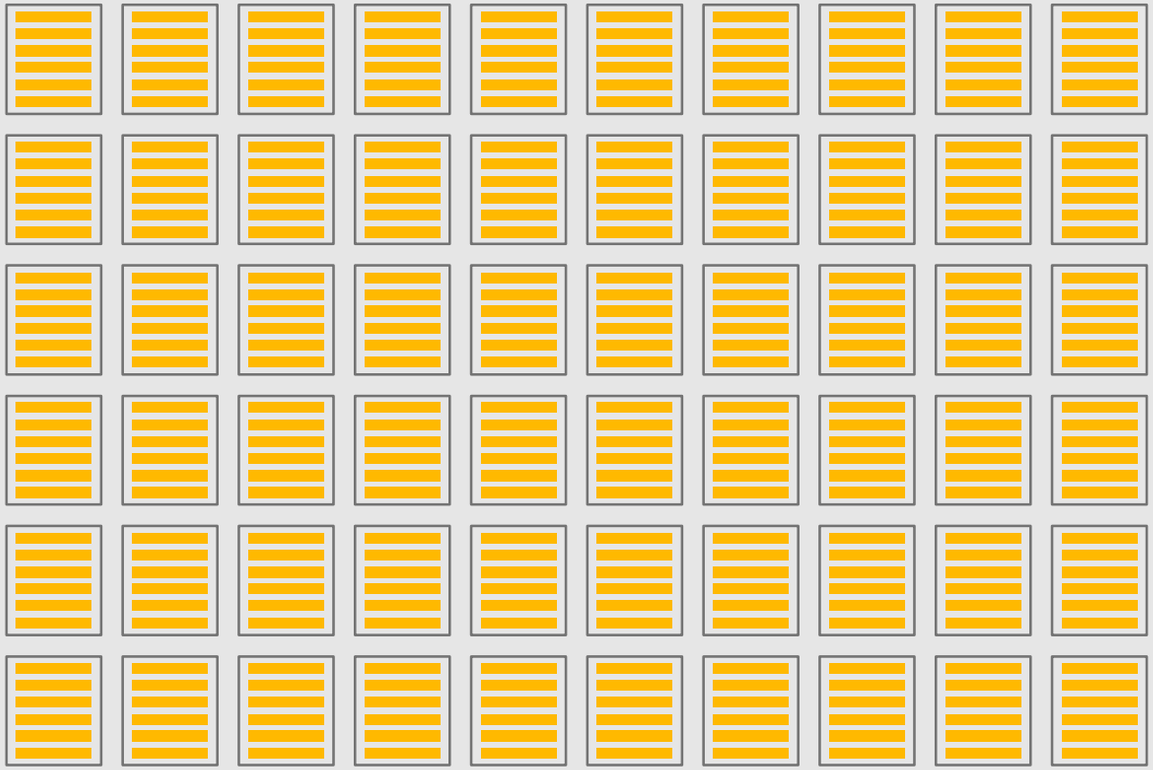
# Table Storage

# Table Storage: Row store & Column store



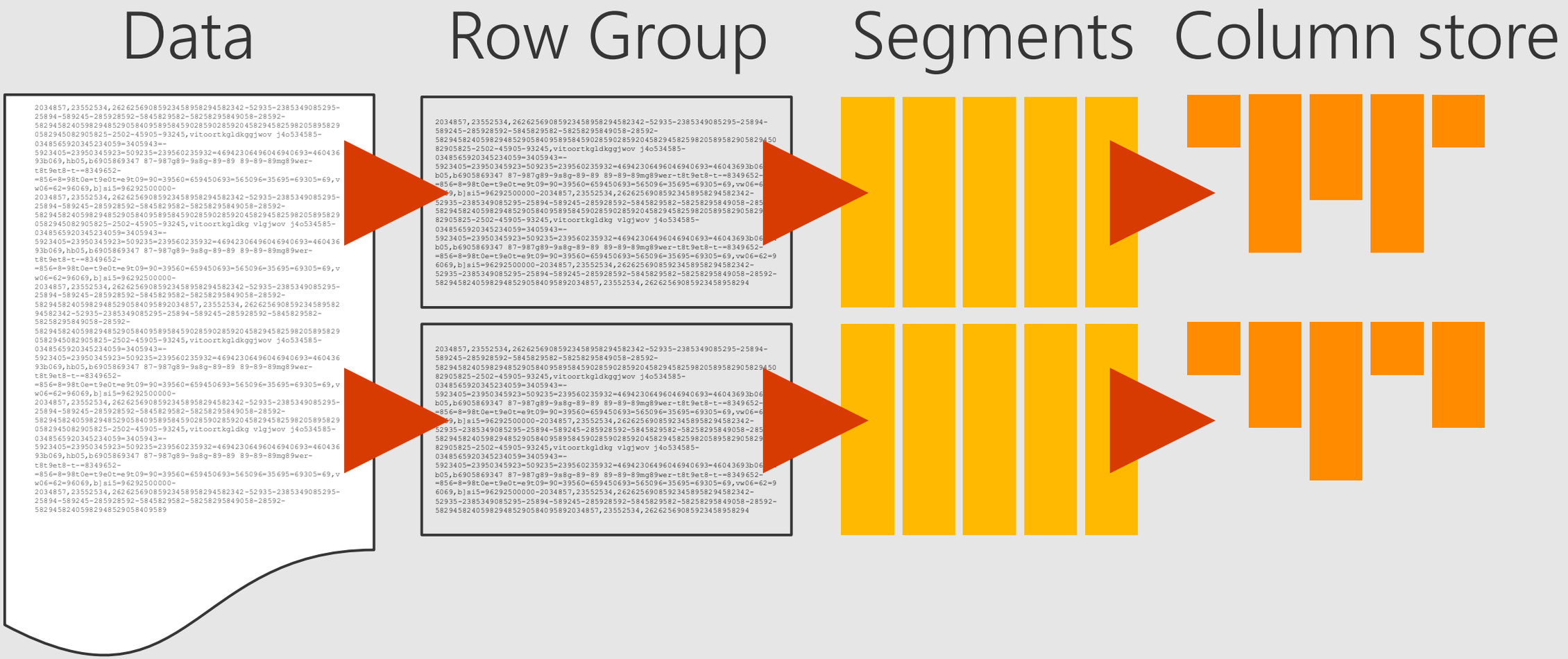
# Scaling out: Impact of distributions on tables



ROW STORE

COLUMN STORE

# Column store



# Why does ColumnStore help?

| Name | Species |
|---|---|
| Hedwig | Owl |
| Mrs. Norris | Cat |
| Crookshanks | Cat |
| Pigwidgeon | Owl |
| Nagini | Snake |
| Errol | Owl |
| Scabbers | Rat |
| Fawkes | Phoenix |
| Hermes | Owl |
| Fluffy | Dog |

| Name | Species |
|---|---|
| Mrs. Norris | Cat |
| Crookshanks | Cat |
| Fluffy | Dog |
| Hedwig | Owl |
| Pigwidgeon | Owl |
| Errol | Owl |
| Hermes | Owl |
| Fawkes | Phoenix |
| Scabbers | Rat |
| Nagini | Snake |

| Name | Species |
|---|---|
| Mrs. Norris: 1 | Cat: 2 |
| Crookshanks: 1 | Dog: 1 |
| Fluffy: 1 | Owl: 4 |
| Hedwig: 1 | Phoenix: 1 |
| Pigwidgeon: 1 | Rat: 1 |
| Errol: 1 | Snake: 1 |
| Hermes: 1 | |
| Fawkes: 1 | |
| Scabbers: 1 | |
| Nagini: 1 | |

Run Length Encoding

# Indexes

## Primary Indexing

Heap = Base Row Store

Clustered Index (CI) = Base Row Store maintained as a B-Tree

Clustered Columnstore Index (CCI) = Base Column Store

## Secondary Indexing

Non Clustered Index (NCI) = Secondary B-Tree Index

NCI can be on Heap

NCI can be on Clustered Columnstore Index (NCI on CCI)

# Business Continuity and Disaster Recovery

# Storage Snapshots

## System RPO

8 hours

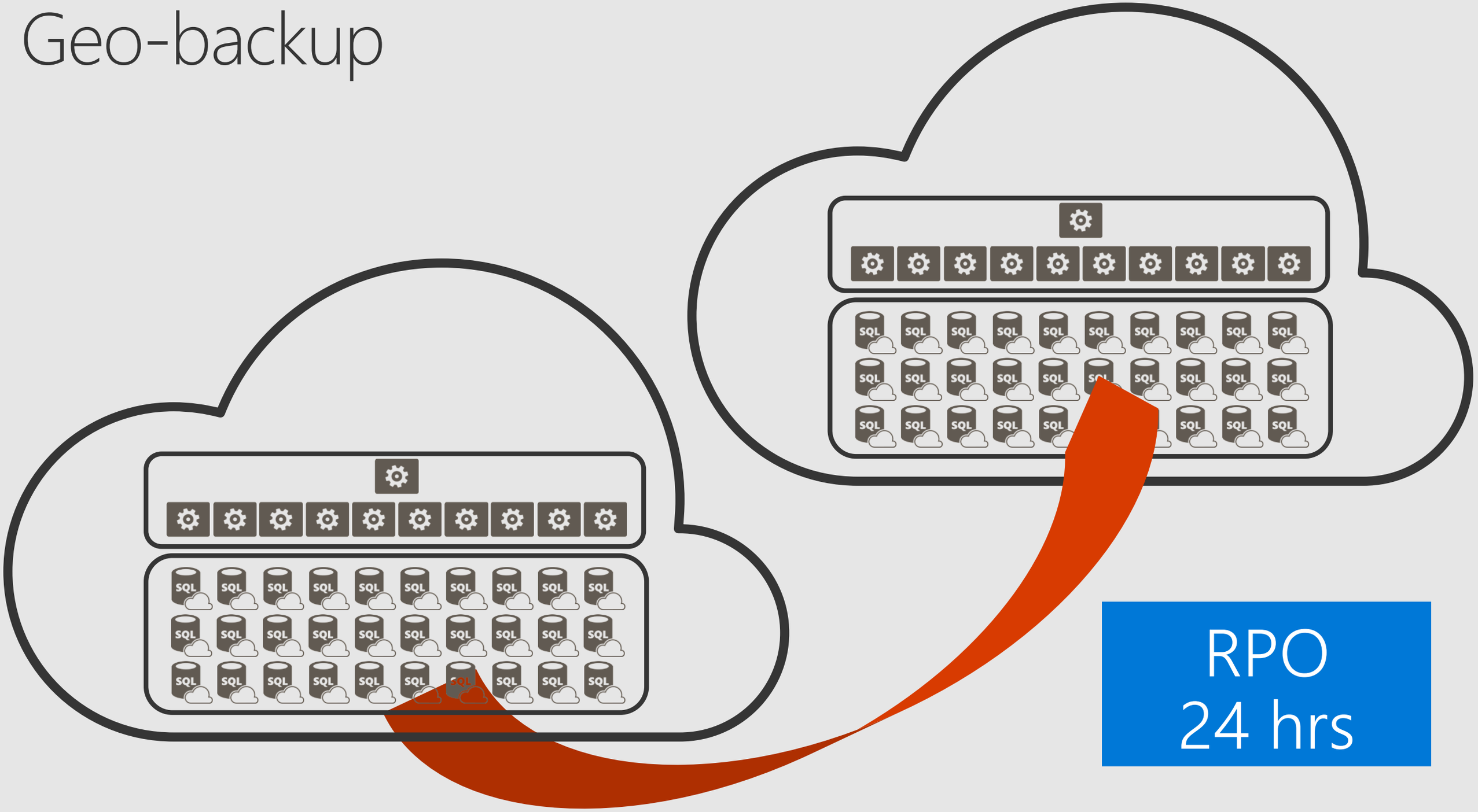
## Snapshot frequency

Every few hours (generally 4)

## Snapshot retention

7 days

# Geo-backup



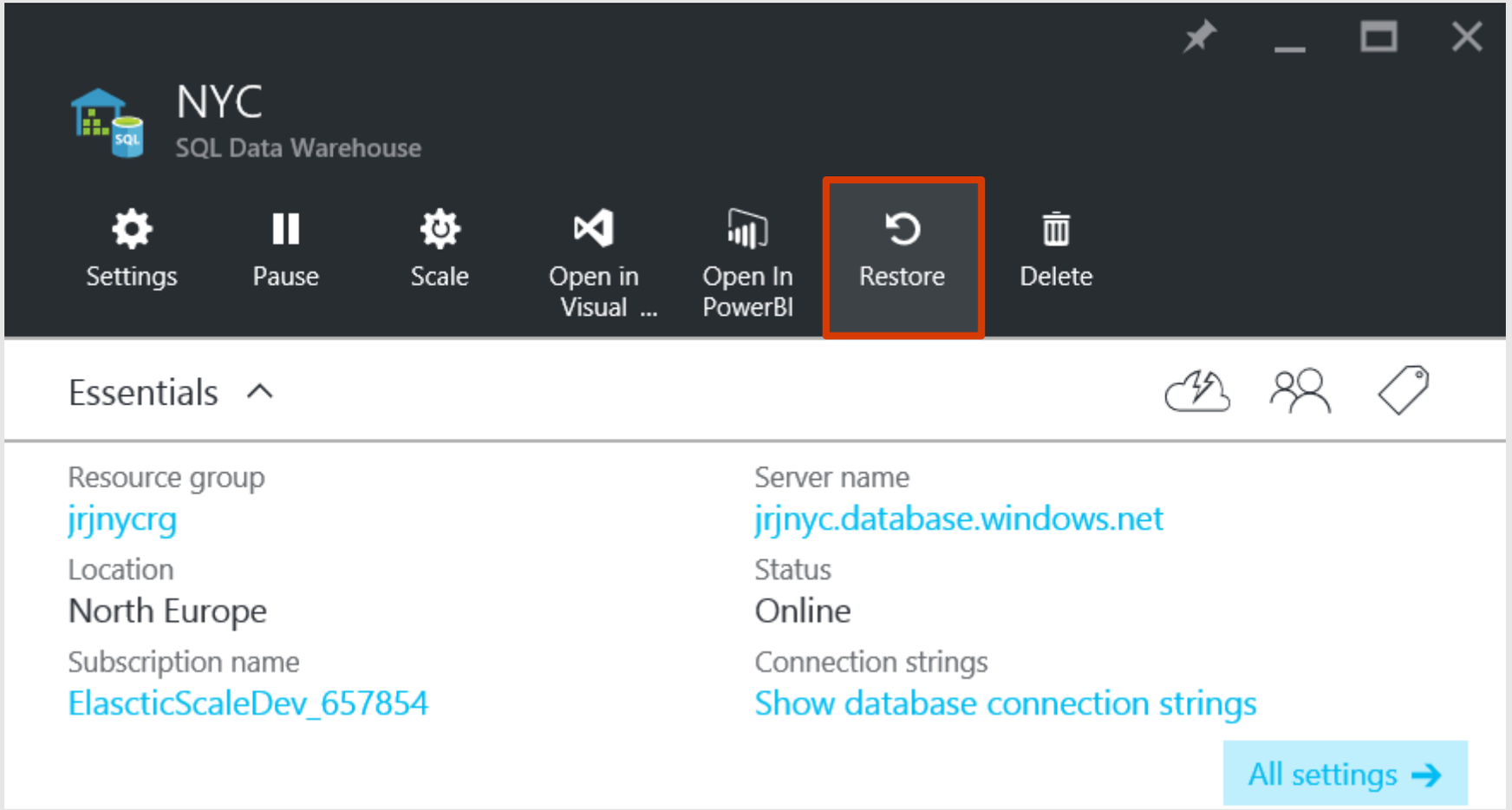
# Restore

Same server overwrite (fastest)

In-region

Geo restore

# Restoring in the Portal



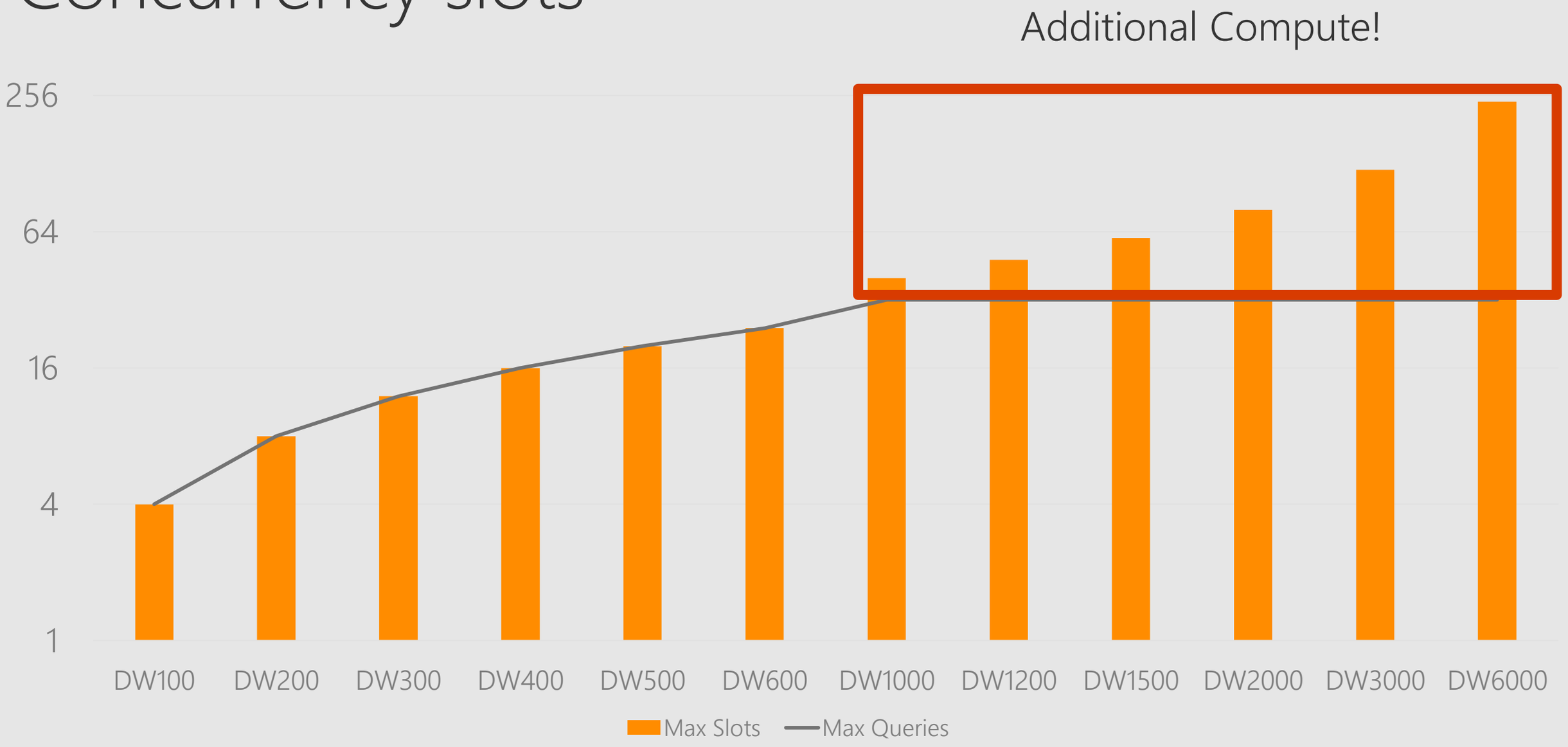
# Snapshots

```
SELECT  [run_id]                    AS bkup_run_id
,       [session_id]                AS session_id
,       [request_id]                AS request_id
,       [name]                      AS bkup_name
,       [submit_time]               AS bkup_submit_time
,       [start_time]                AS bkup_start_time
,       [end_time]                  AS bkup_end_time
,       [total_elapsed_time]        AS bkup_duration_ms
,       [total_elapsed_time]/1000.0 AS bkup_duration_sec
FROM    sys.pdw_loader_backup_runs
;
```

# Workload Management

# Concurrent queries

# Concurrency slots



# Resource classes

## Dynamic

- Increases resource consumption as you scale
- No increase in concurrency as you scale

## Static

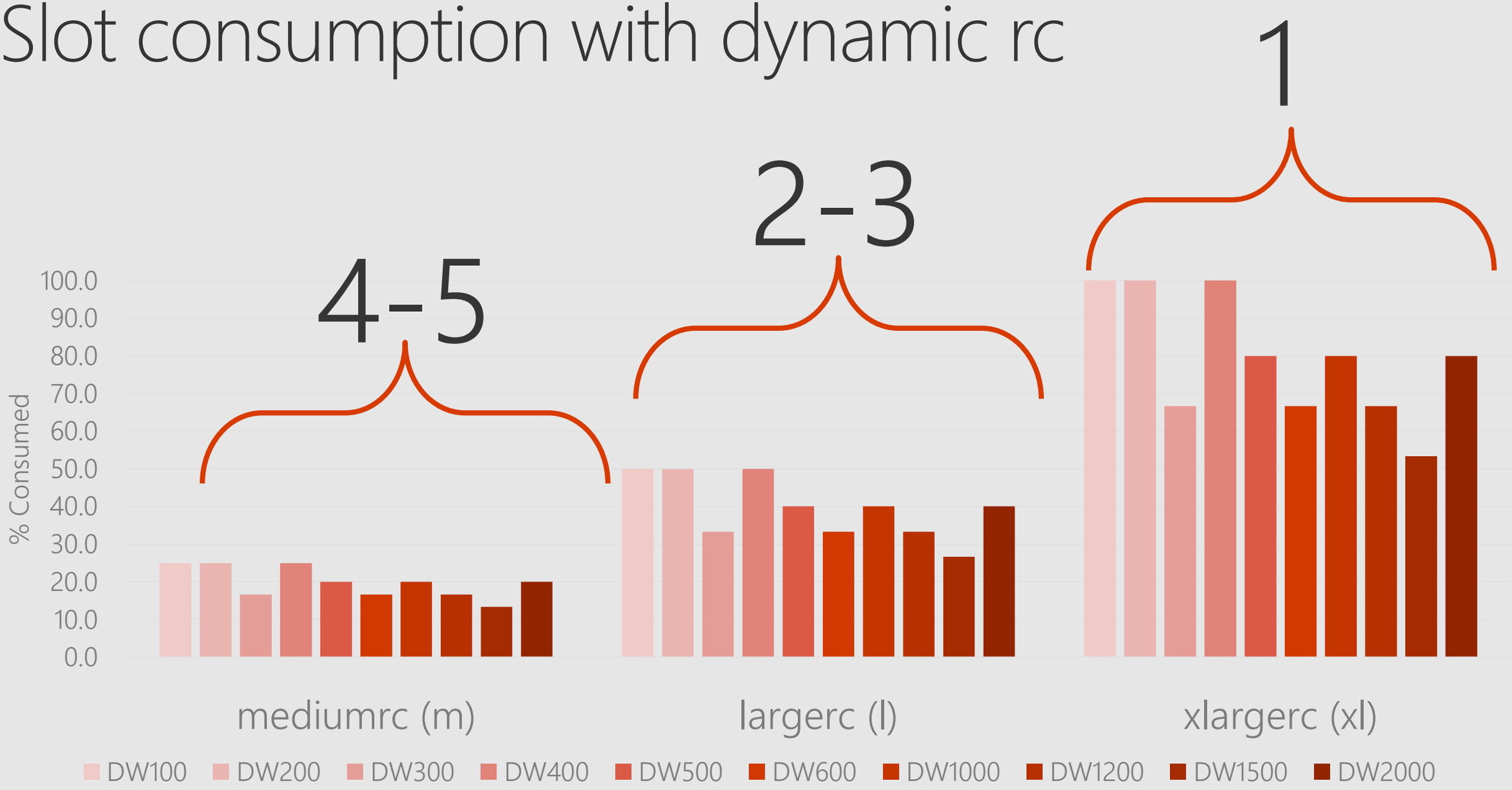
- Maintain resource consumption as you scale
- Increase concurrent queries as you scale

| Consume Slots | Increase memory<br>Isolate resources |
| --- | --- |

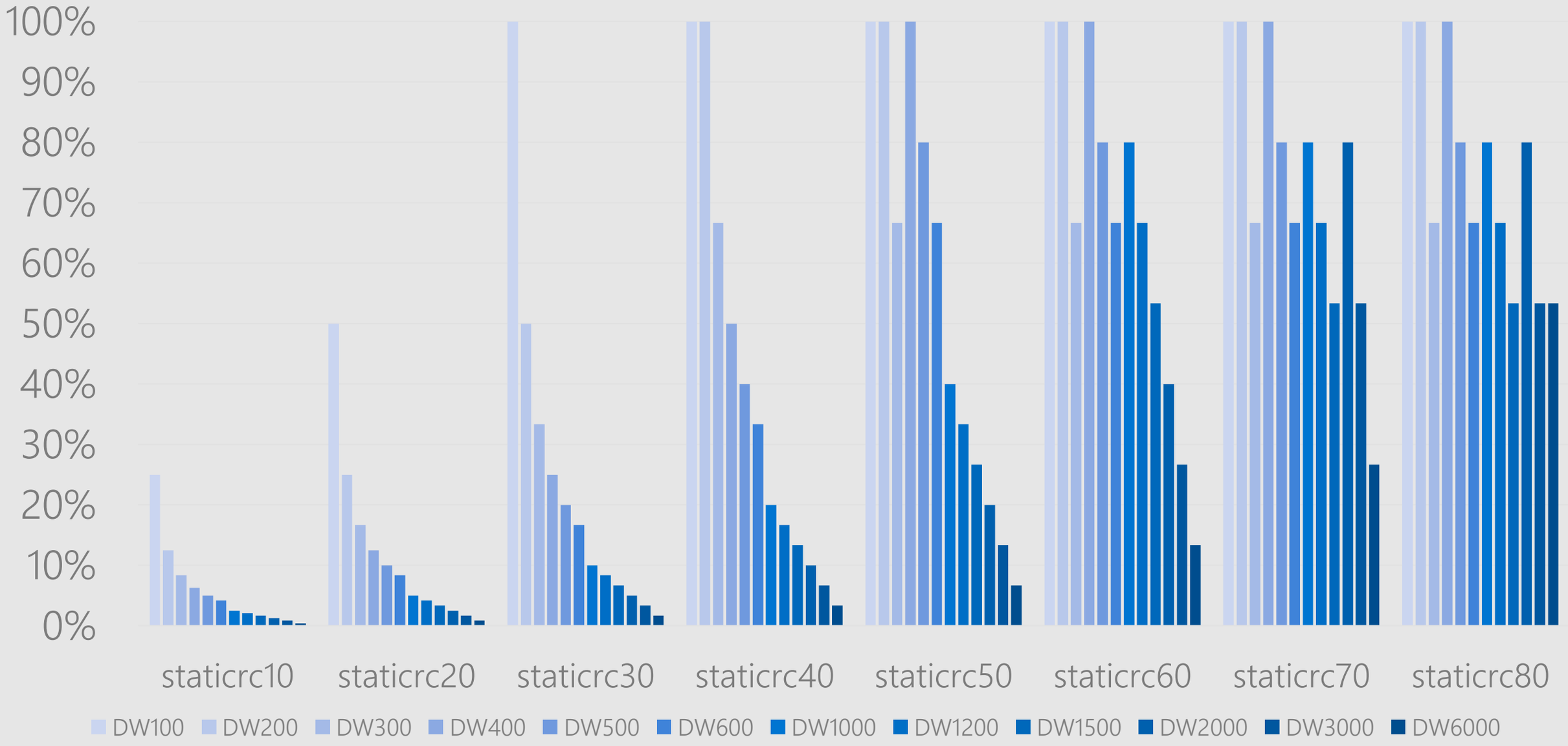
# Resource classes

```
-- Pre-req
CREATE USER data_loader FOR LOGIN data_loader
;
-- Add user to static rc
EXEC sp_addrolemember 'staticrc40','data_loader'
;
-- Remove user from static rc
EXEC sp_droprolemember 'staticrc40','data_loader'
;
```

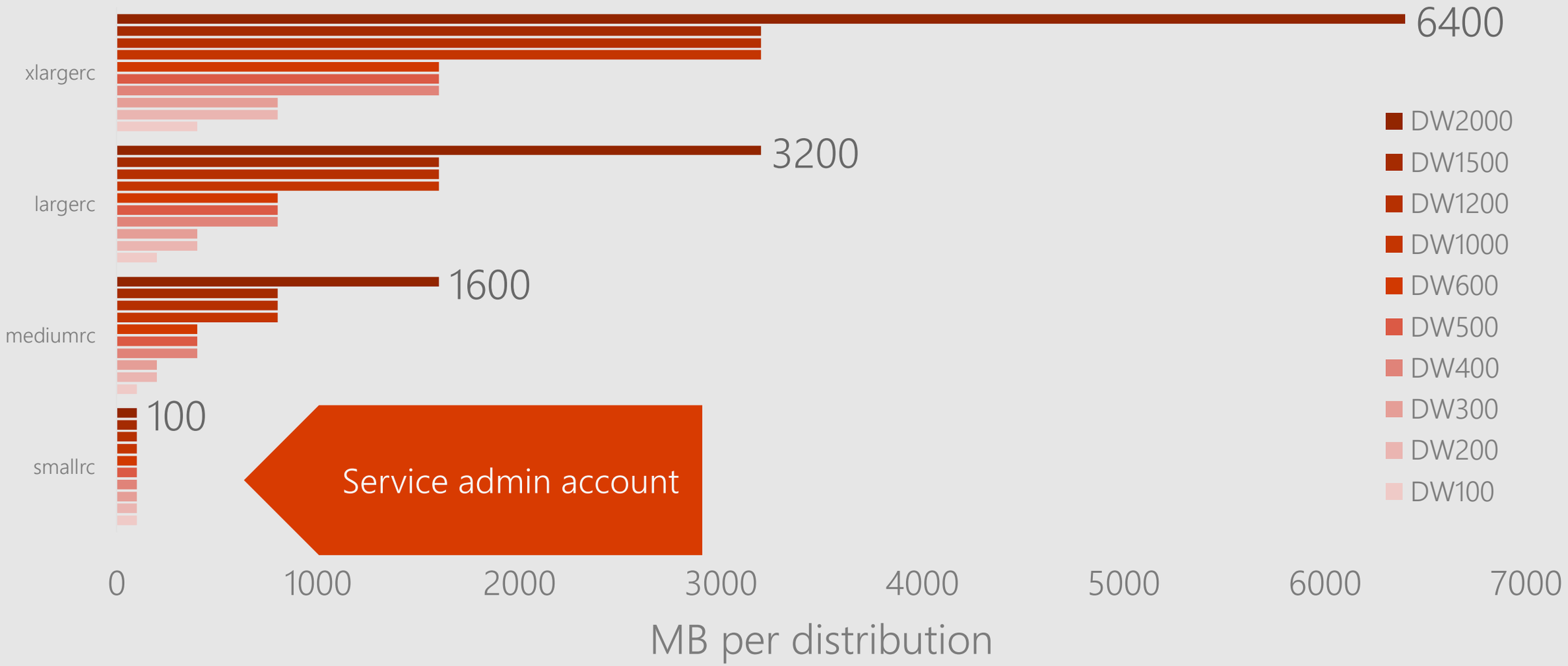
# Slot consumption with dynamic rc



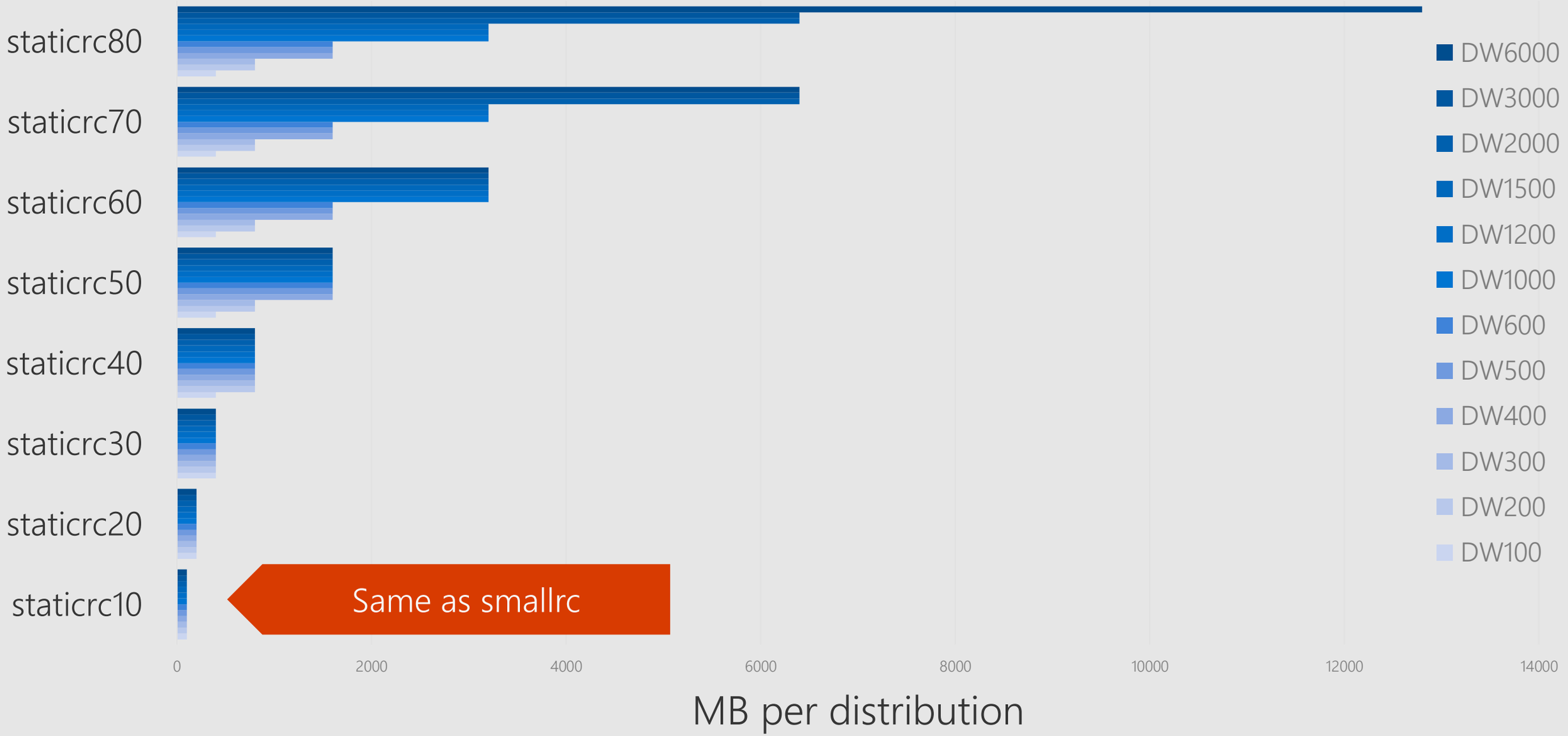
# Slot consumption with static rc



# Memory Allocation for dynamic rc



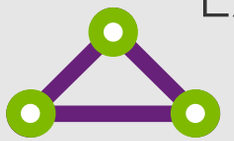
# Memory allocation for staticrc



# Integration with other services

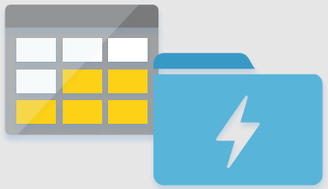
# Common Integration points

Data Factory



ExpressRoute

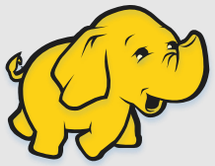
Azure Active Directory



Blob / ADLS

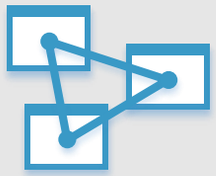


SQLDB



HDInsight

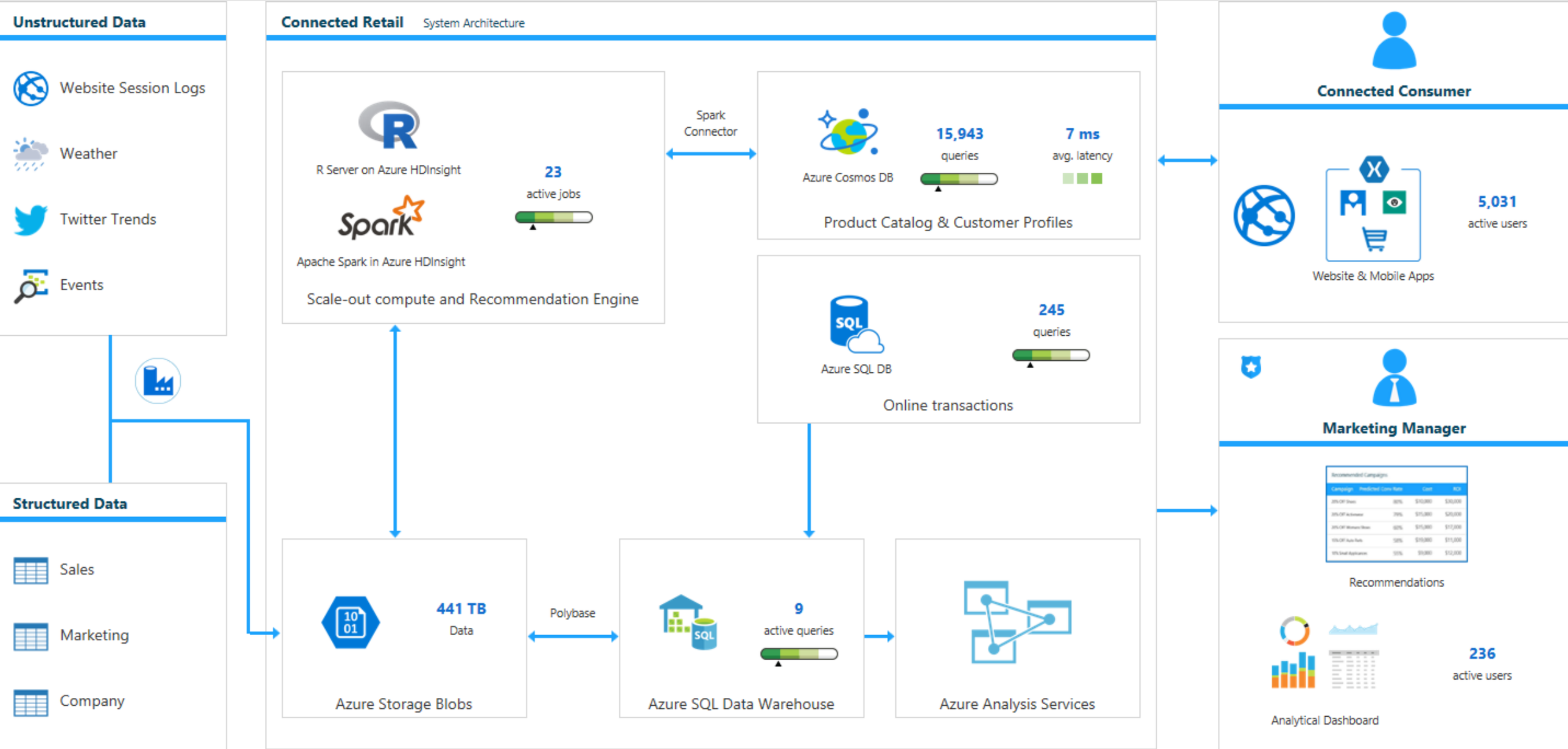
ADLA



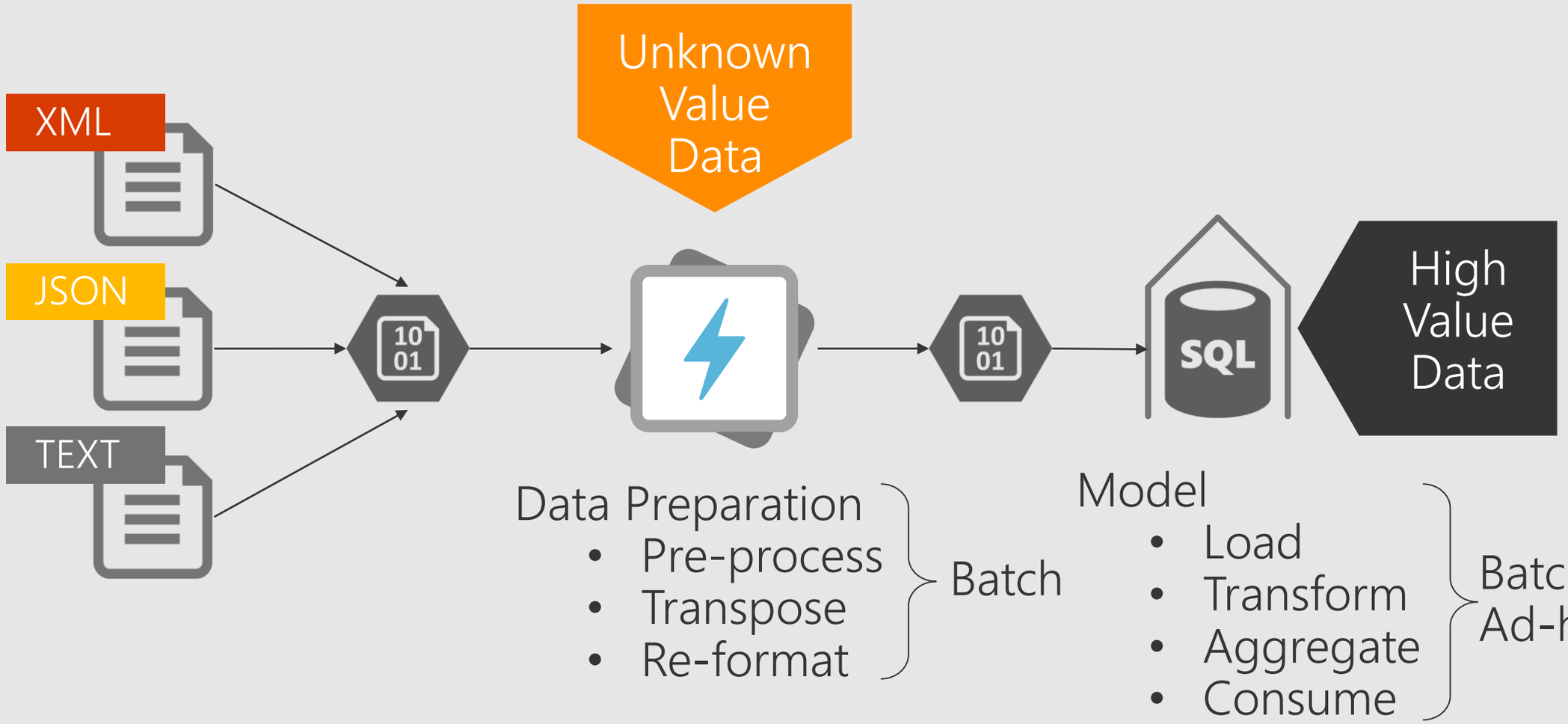
Analysis Services

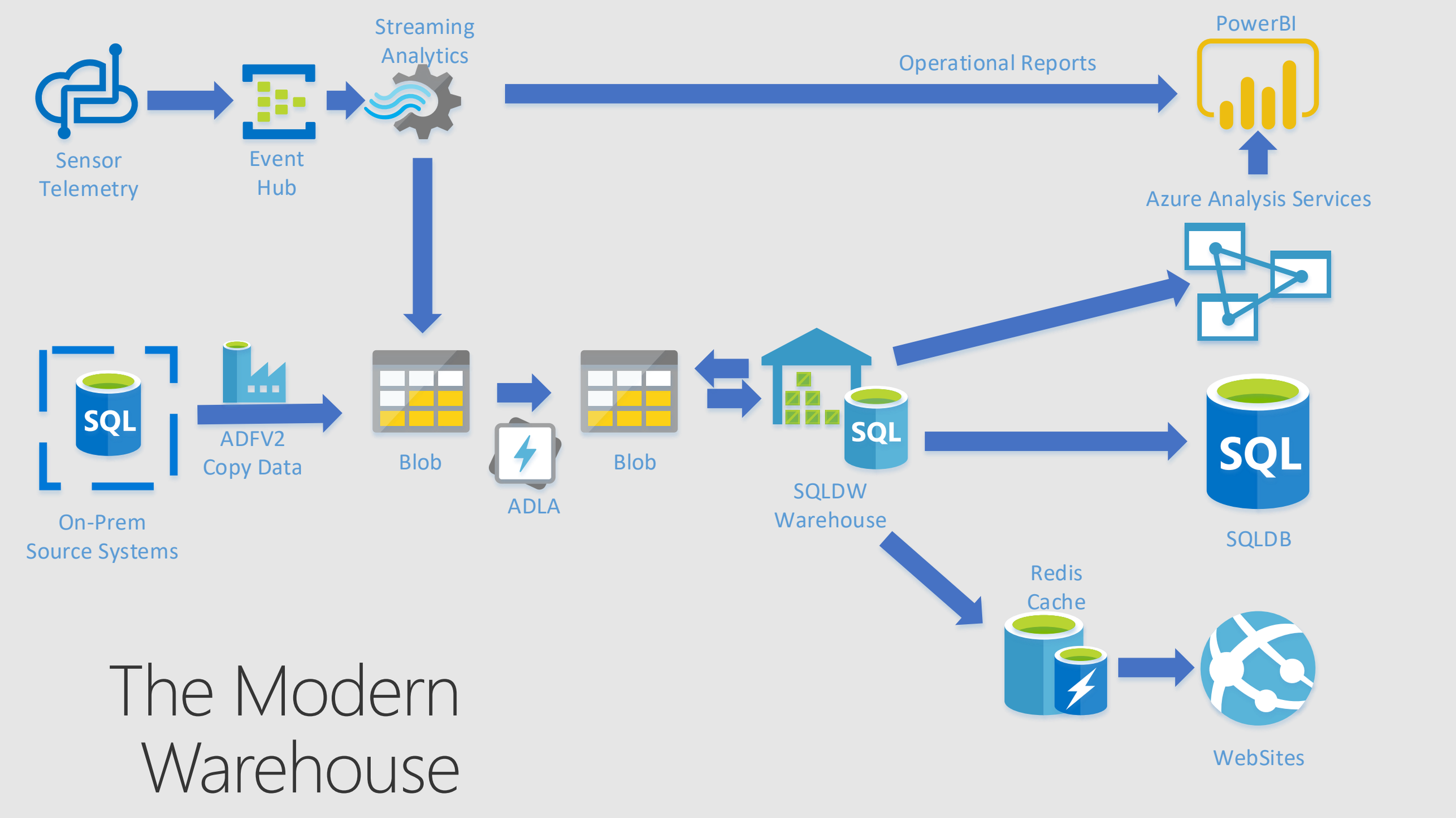
PowerBI

# Cloud Data Warehouse



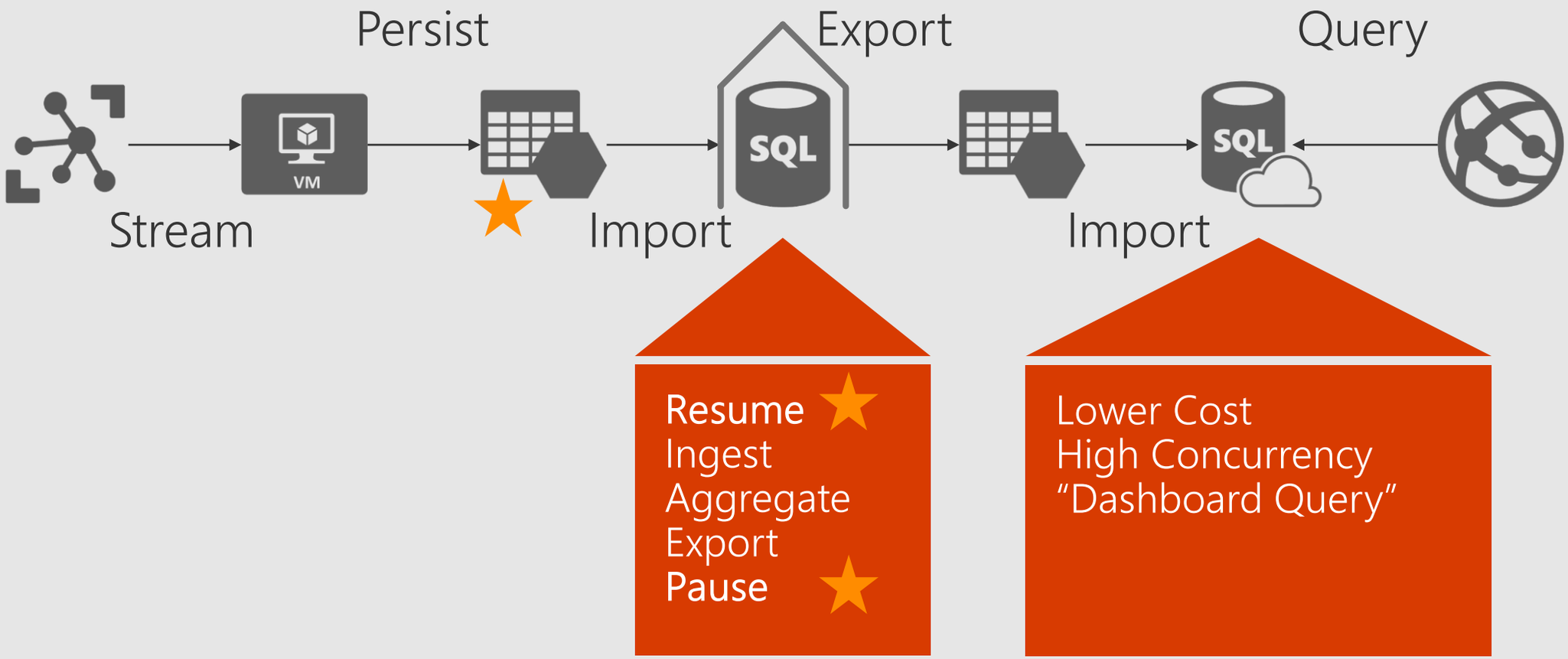
# ADL & SQLDW


Unknown
Value
Data
XML
JSON
TEXT
10
01
10
01
SQL
High
Value
Data
Data Preparation
• Pre-process
• Transpose
• Re-format
Batch
Model
• Load
• Transform
• Aggregate
• Consume
Batch
Ad-hoc

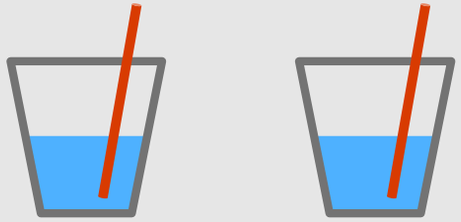



# The Modern Warehouse

# The On-Demand Processor



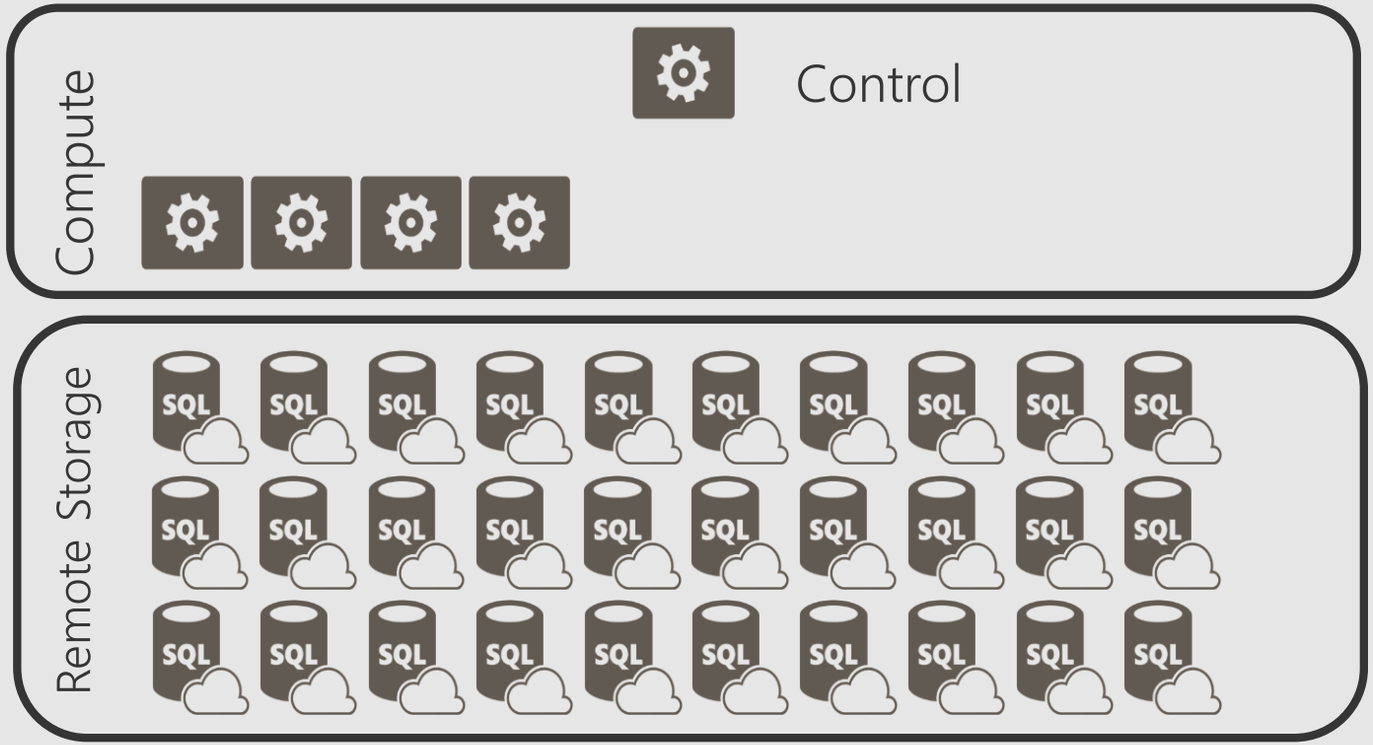
# Summary



# What did we learn?

Scale-out distributed query engine


Fully managed
Completely elastic
Platform as a Service (PaaS)




De-coupled storage from compute

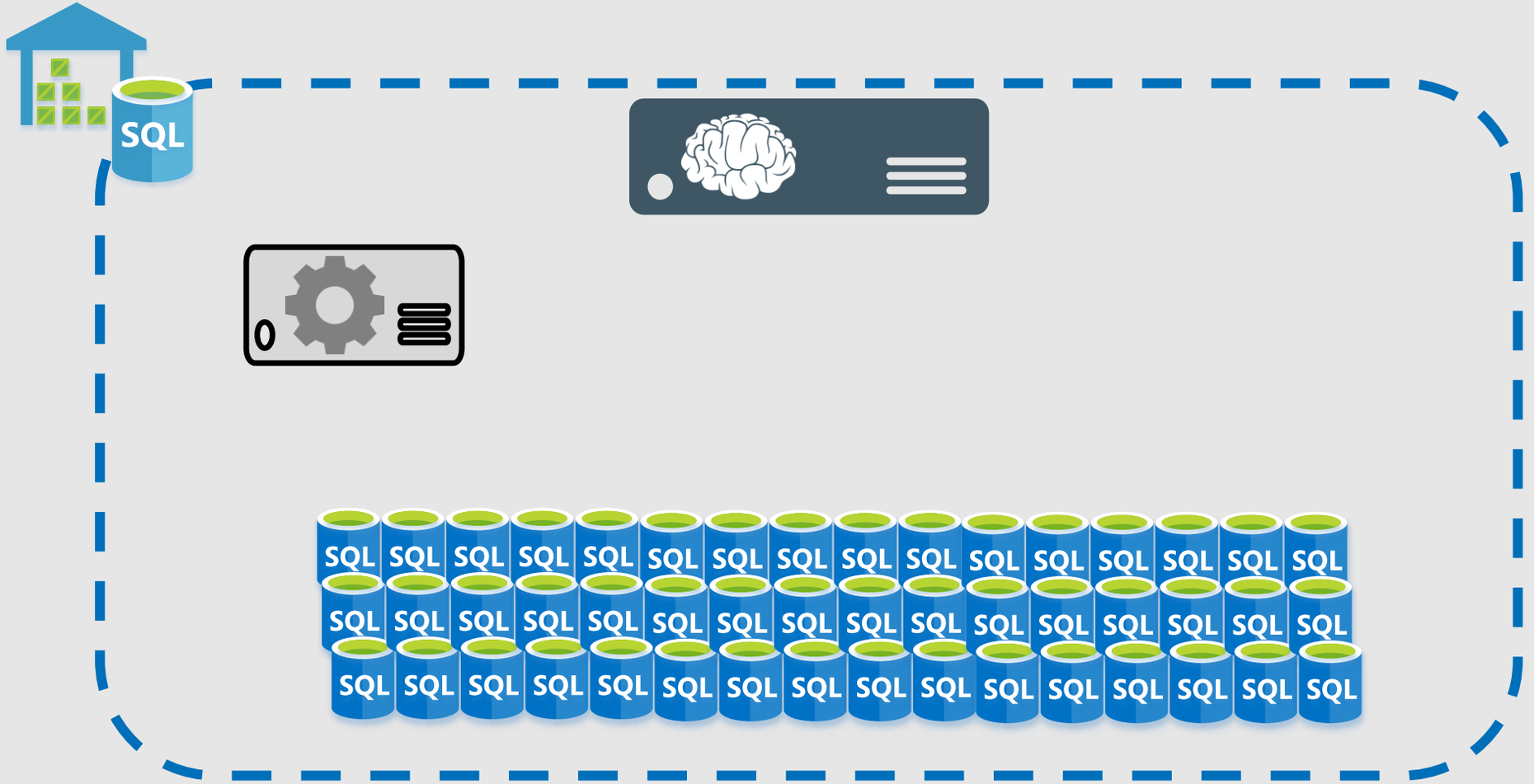
MagicWorks

# Will SQLDW Help?


- Distributed Scale-Out queries will speed up their analytics
- PetaByte scale storage can handle their growth
- Can elastically scale to handle unforeseen circumstances

# Azure SQLDW Gen 1

# 100 DWUs


SQL
0
SQL SQL SQL SQL SQL SQL SQL SQL SQL SQL SQL SQL SQL SQL SQL SQL
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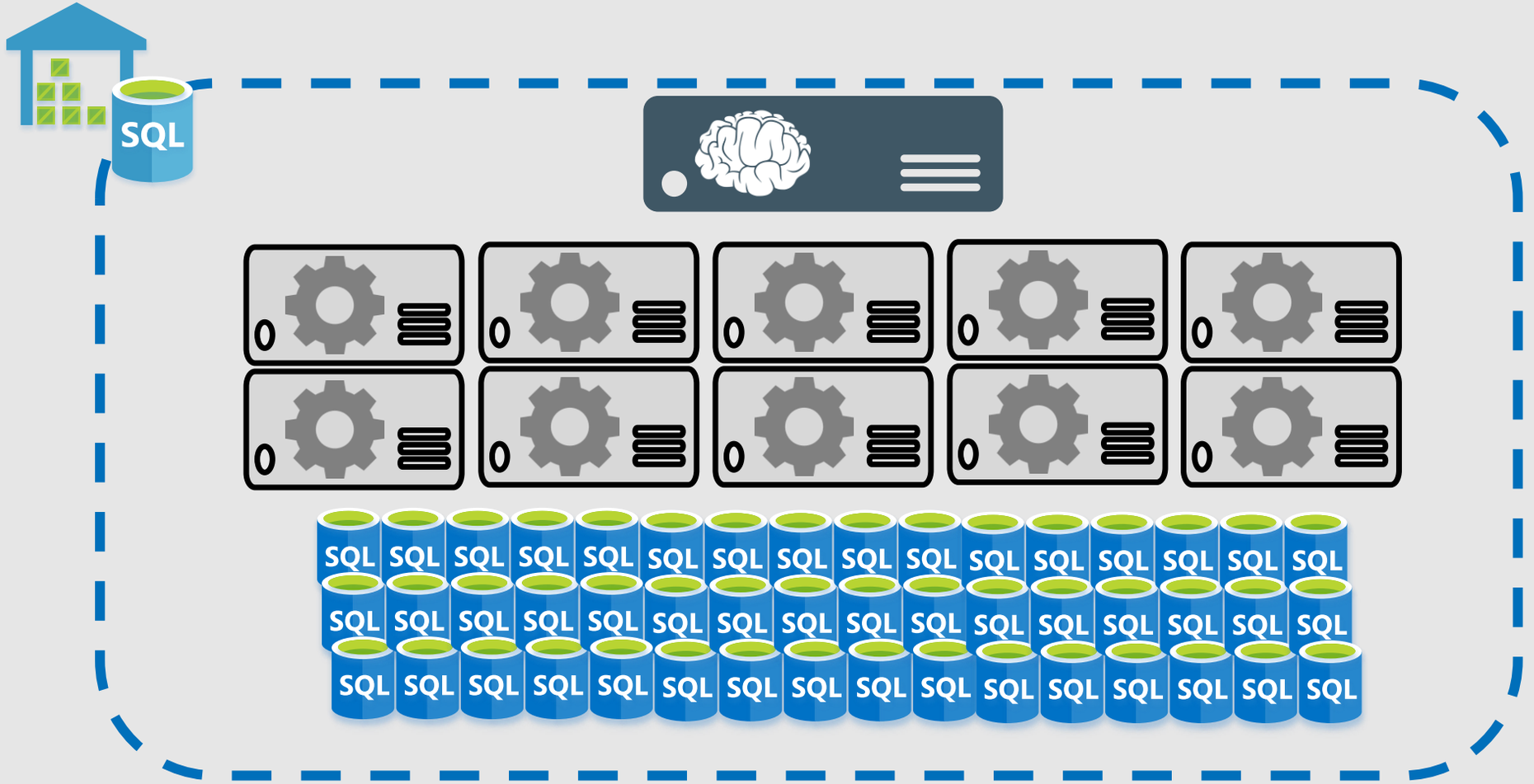
SQL SQL SQL SQL SQL SQL SQL SQL SQL SQL SQL SQL SQL SQL SQL SQL

# 100 DWUs = 1 Compute Node

# 1000 DWUs


SQL
SQL SQL SQL SQL SQL SQL SQL SQL SQL SQL SQL SQL SQL SQL SQL SQL
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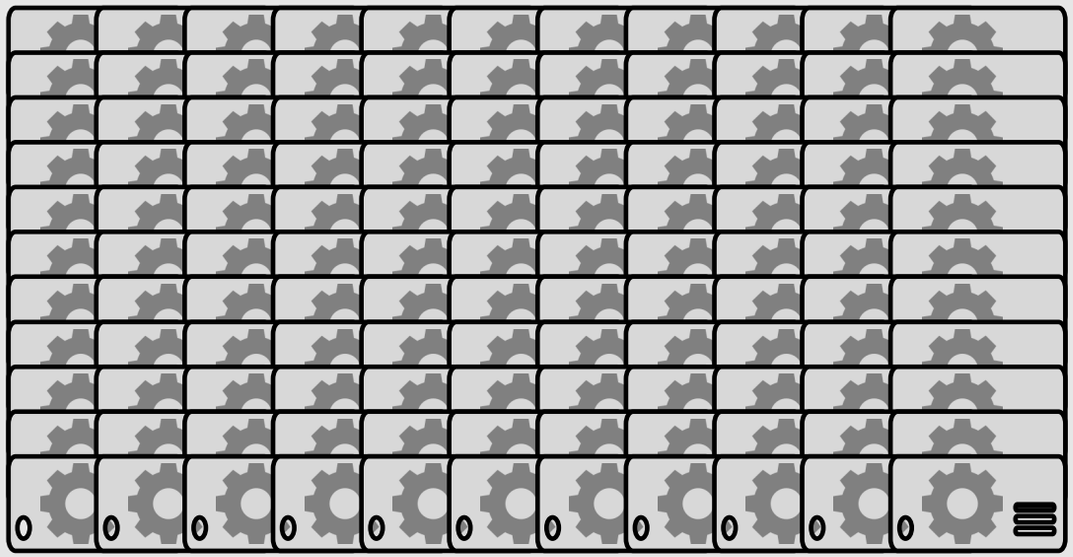
# 6000 DWUs is a 1-to-1 mapping of compute to distributions

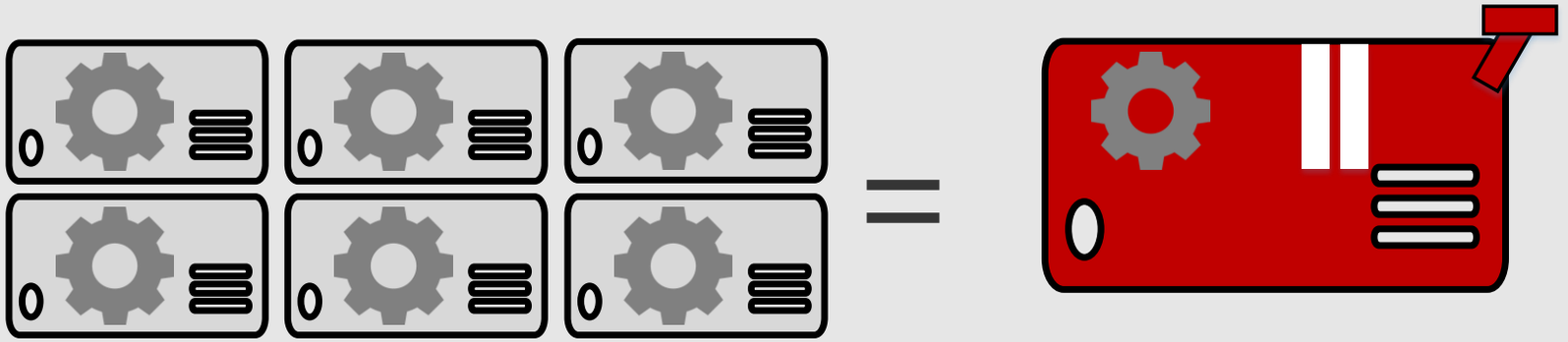


60x


60x

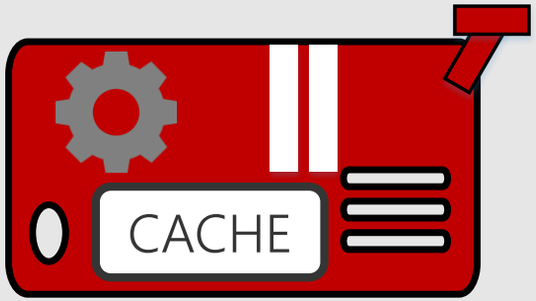
# Azure SQLDW Gen 2

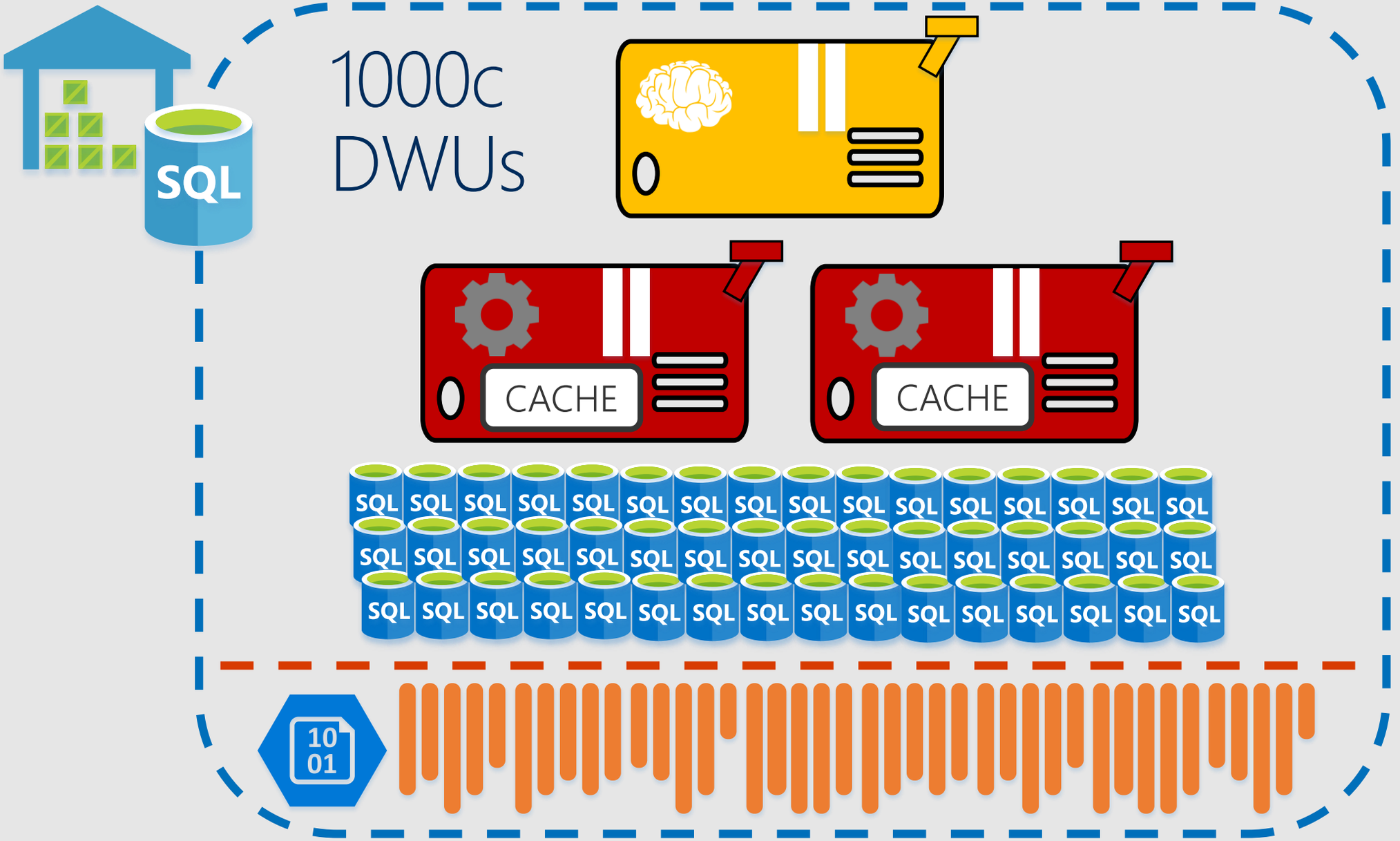
# Node Sizing



# Separate Column Store

# Caching




1000c
DWUs
SQL
CACHE
CACHE
SQL
10
01

| Gen 1 DWU | G1 Nodes | G1 Concurrency | Gen 2 DWU | G2 Nodes | G2 Concurrency |
|---|---|---|---|---|---|
| 100 | 1 | 4 | | | |
| 200 | 2 | 8 | | | |
| 300 | 3 | 12 | | | |
| 400 | 4 | 16 | | | |
| 500 | 5 | 20 | | | |
| 600 | 6 | 24 | | | |
| 1000 | 10 | 32 | 1000c | 2 | 32 |
| 1200 | 12 | 32 | | | |
| 1500 | 15 | 32 | 1500c | 3 | 32 |
| 2000 | 20 | 48 | 2000c | 4 | 48 |
| | | | 2500c | 5 | 48 |
| 3000 | 30 | 64 | 3000c | 6 | 64 |
| | | | 5000c | 10 | 64 |
| 6000 | 60 | 128 | 6000c | 12 | 128 |
| | | | 7500c | 15 | 128 |
| | | | 10000c | 20 | 128 |
| | | | 15000c | 30 | 128 |
| | | | 30000c | 60 | 128 |