Columnstore in SQL Server 2016

Niko Neugebauer

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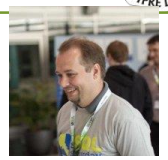

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- They spend their **FREE** time to give you this event.
- Because they are crazy. ☺
- Because they want **YOU**
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3 Sponsor Sessions at **15:25**

- Don’t miss them, they might be getting distributing some **awesome prizes**!

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Next Events:

Porto.Data

- 29 October UPTEC 19:00

1. Analytics (what's that)

is the process of discovery and communication of the meaningfull patterns in Data

1. Analytics

What is it all about:

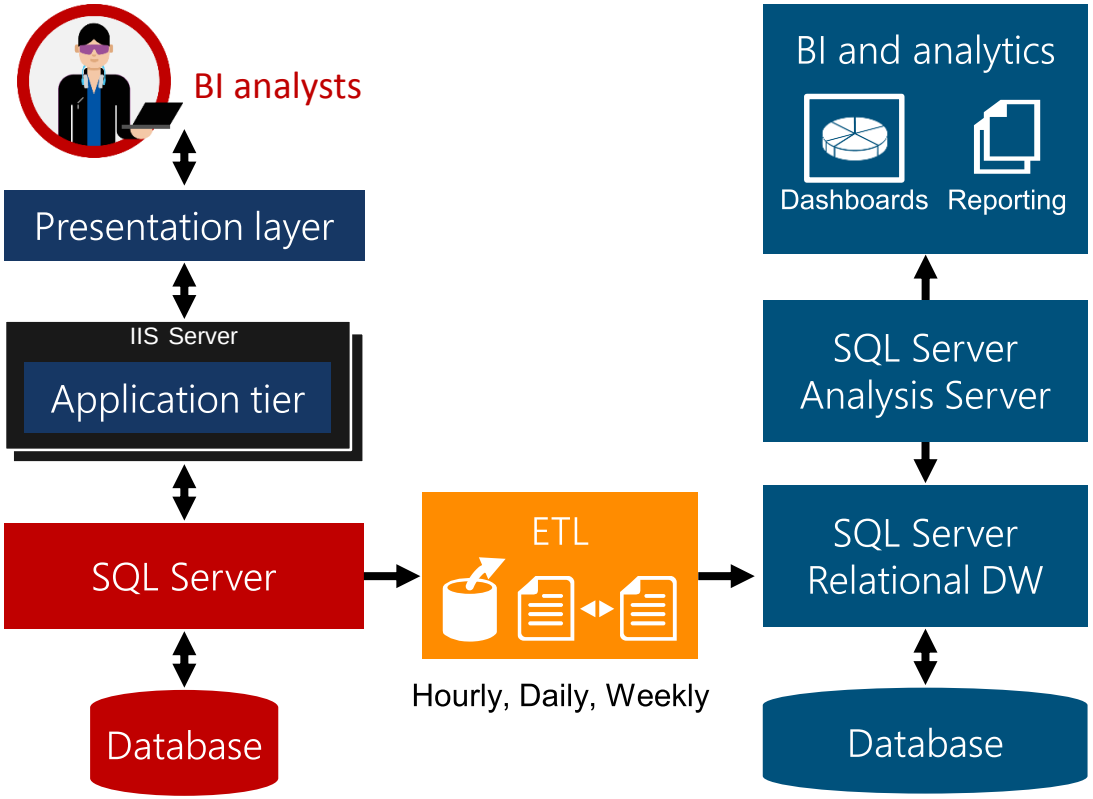
- Predictive Analytics, Prescriptive Analytics, Business Analytics, Machine Learning, Data Mining
- OLAP - Online Analytical Processing
- Big Data

- But technically it all goes down to the one thing we treasure the most: the DATA

1. Analytics Faces

- **Analytics** – is the process of discovery and communication of meaningful patterns in data.
- **Reporting** - extraction of the aggregated information for further analysis.
- **Querying** - data extraction process

Traditional operational/analytics architecture



Key issues

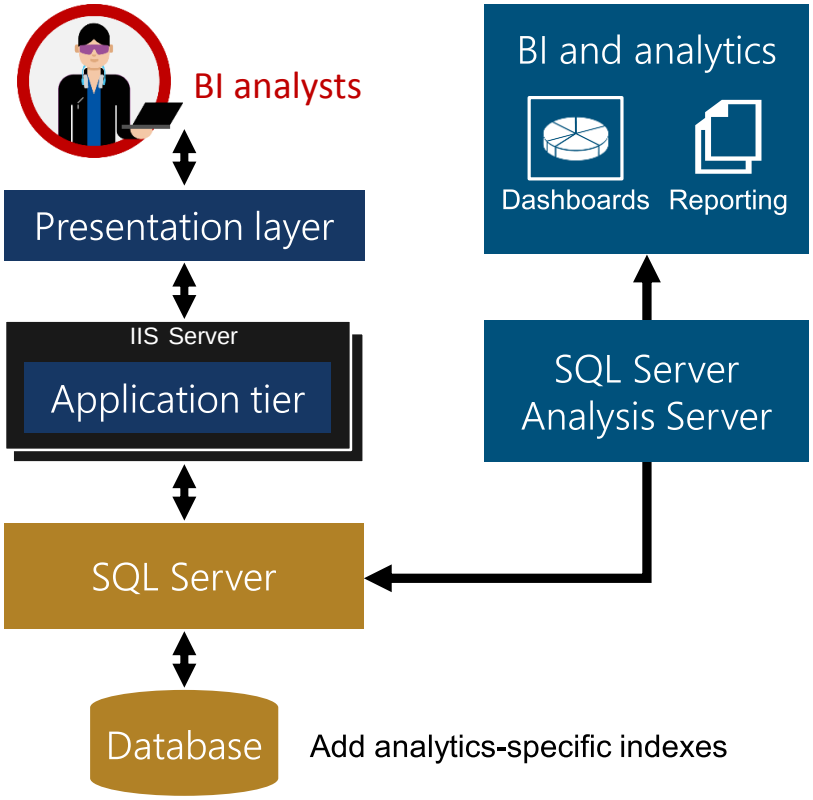
Complex implementation

Requires two servers (capital expenditures and operational expenditures)

Data latency in analytics

More businesses demand; requires real-time analytics

Minimizing data latency for analytics



Benefits

No data latency

No ETL

No separate data warehouse

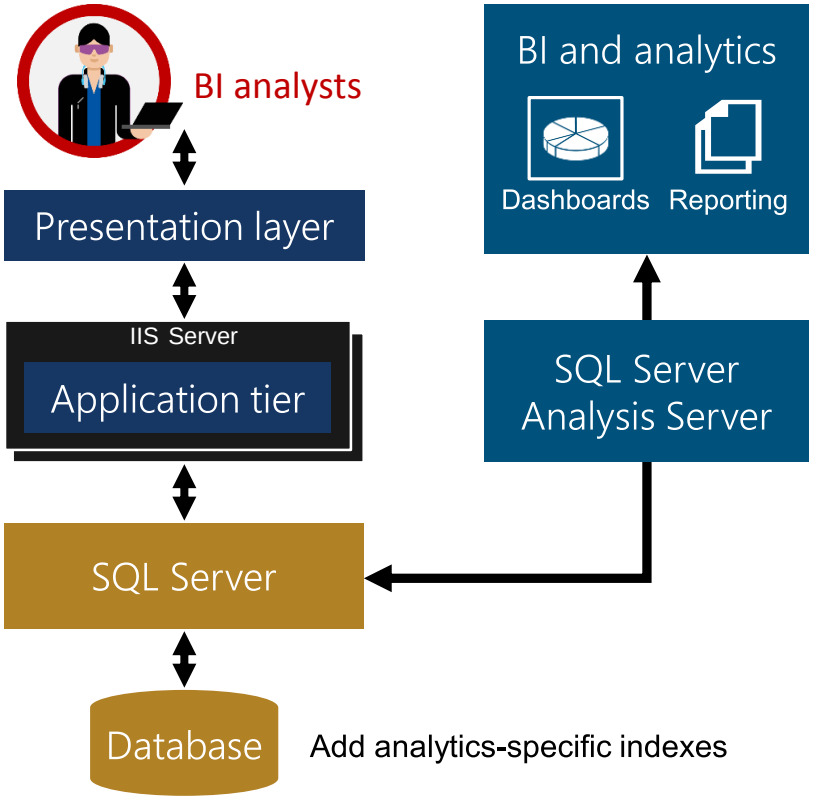
Challenges

Analytics queries are resource intensive and can cause blocking

Minimizing impact on operational workloads

Sub-optimal execution of analytics on relational schema

Operational Analytics



What is operational analytics and what does it mean to you?

Operational analytics with disk-based tables

Operational analytics with In-Memory OLTP

2. Traditional Operational Analytics Problems:

- Costs
- Integration Problems (data types, constraints, network problems, etc)
- Delay for getting the actual data

2. Modern Operational Analytics notes:

- Nothing substitutes analytics
  queries performance possible
  using schemas customized (Star/Snowflake)
  and/or
  pre-aggregated cubes

3. Database Trends

Right now, 5 types of Major Investments:

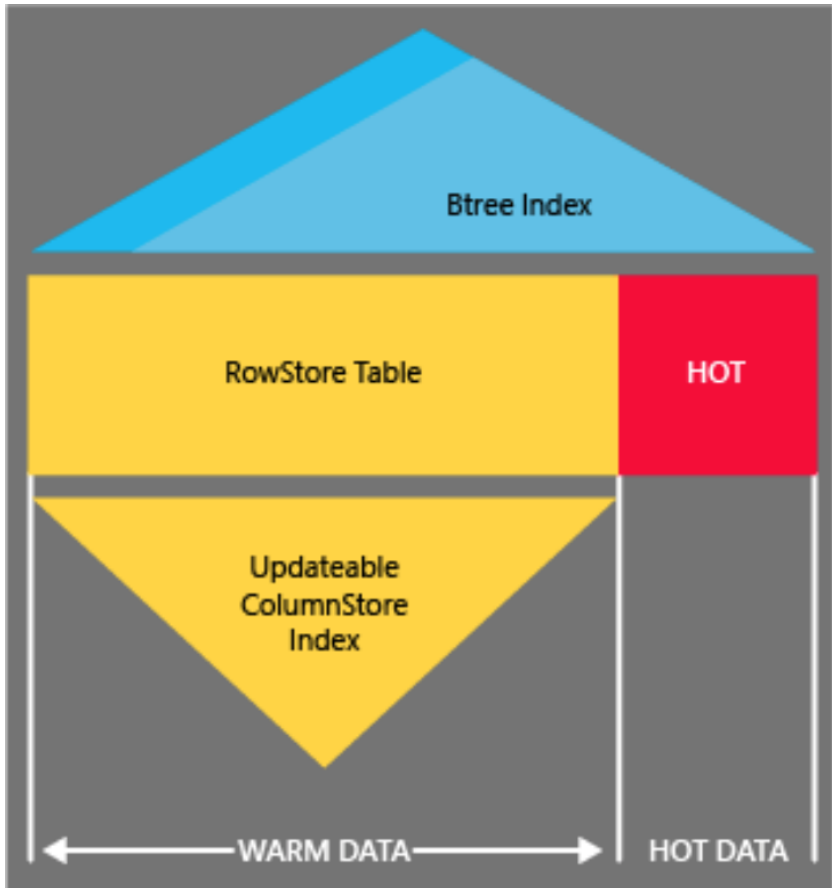
- Analytics
- Big Data
- High Availability
- In-Memory
- Columnstore

4. Operational Analytics in SQL Server 2016

There are now 2 types of Operational Analytics:

- Operational Analytics for RowStore
- Operational Analytics for InMemory

Operational Analytics Structure

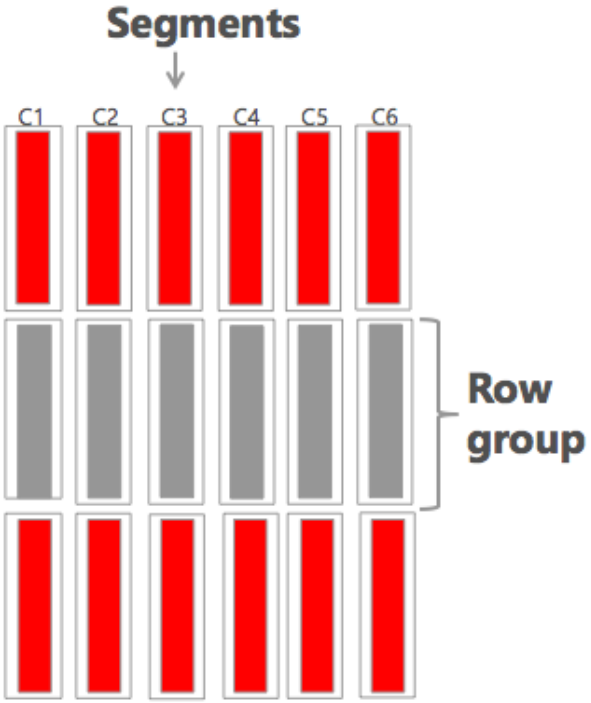


COLUMNAR STORAGE

Columnstore Indexes are:

- Verytically separated
- Grouped into Segments
- Extremely compressed
- Tuned for processing

large volumes of data



Row Store vs Column Store

ID	First Name	Last Name	Salary
1	Jody	Philipps	43.03
2	Mark	Johnson	37.08
3	Matt	Markensen	16.81
4	Gail	Lindberg	24.90

Row Store Index:

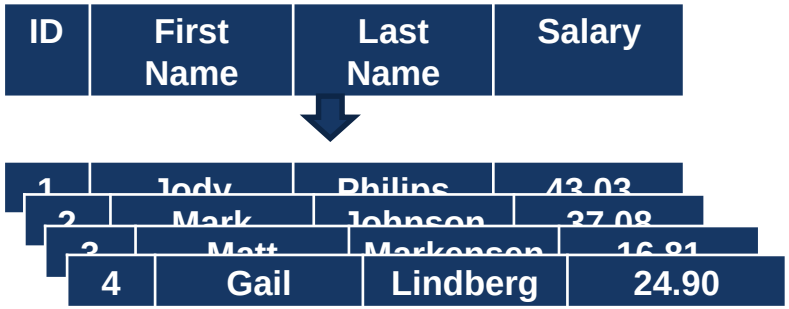
1, Jody, Philips, 43.04;
2, Mark, Johnson, 37.08;
...

Column Store Index:

1, 2, 3, 4;
Jody, Mark, Matt, Gail;
...

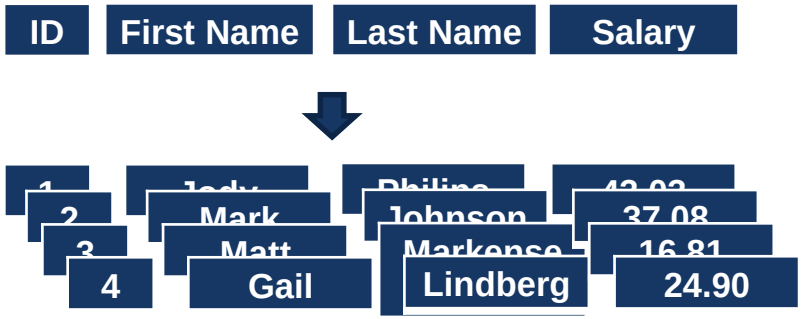
Row Store vs Column Store

Row Store



Data is stored on the disk tuple by tuple

Column Store



Data is stored on the disk column by column

Row Store vs Column Store

Row Store

- ★ Easy to add & modify tuples
- ▬ Might read unnecessary data

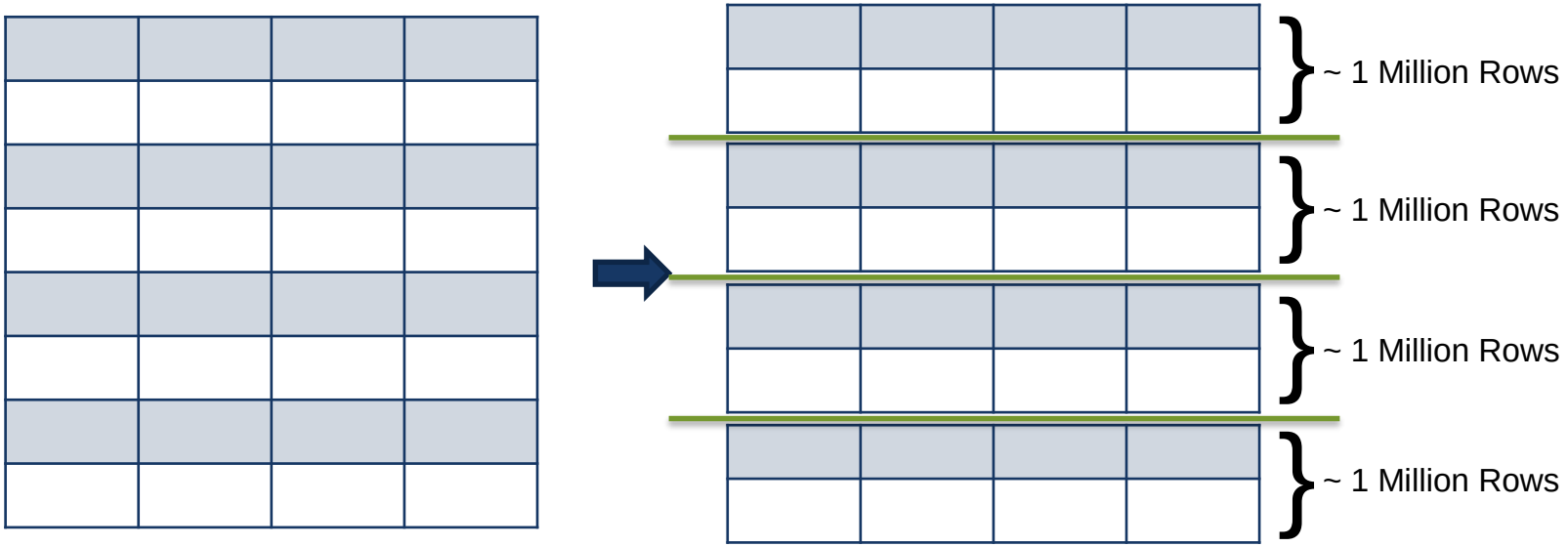
Column Store

- ★ Reading only relevant data
- ▬ Tuple writes require multiple accesses

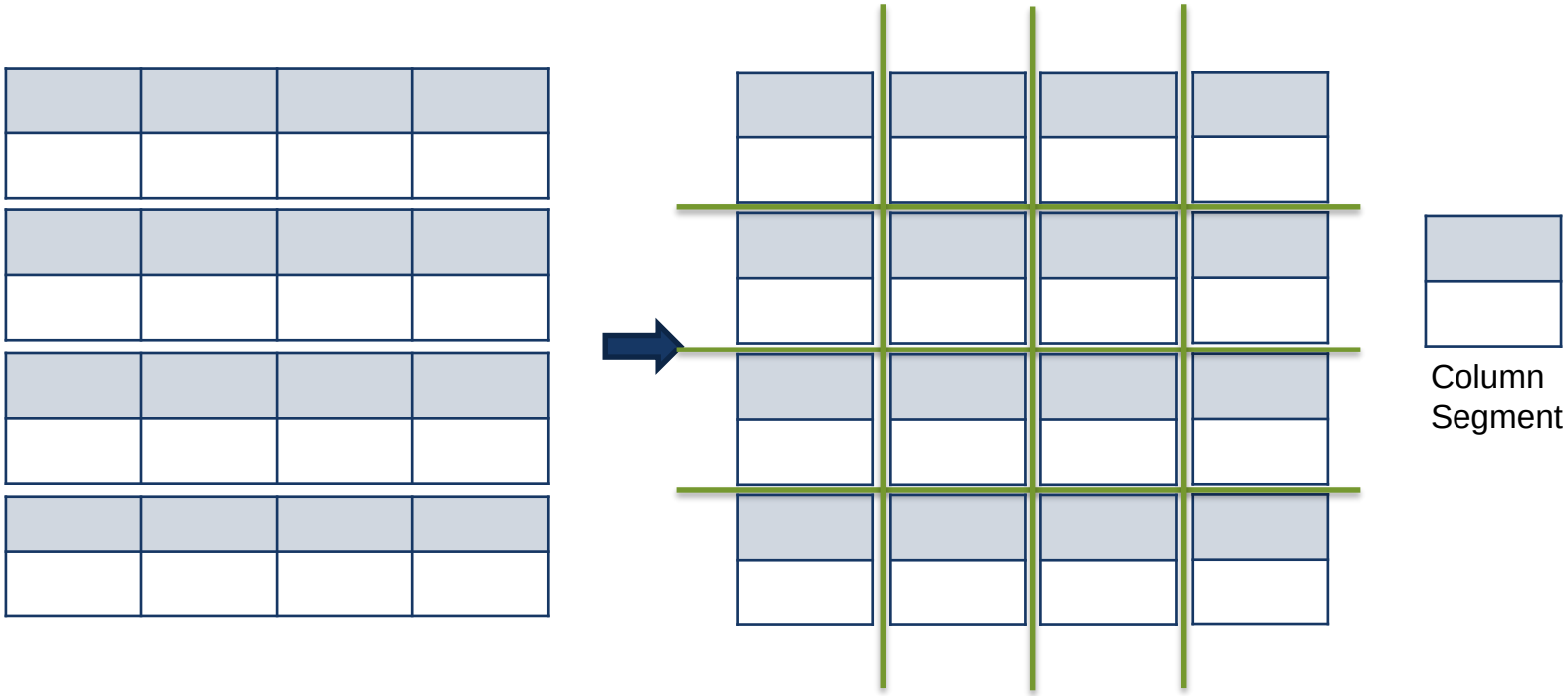
Phases of Columnstore Index creation:

1. Row Groups separation
2. Segment creation
3. Compression

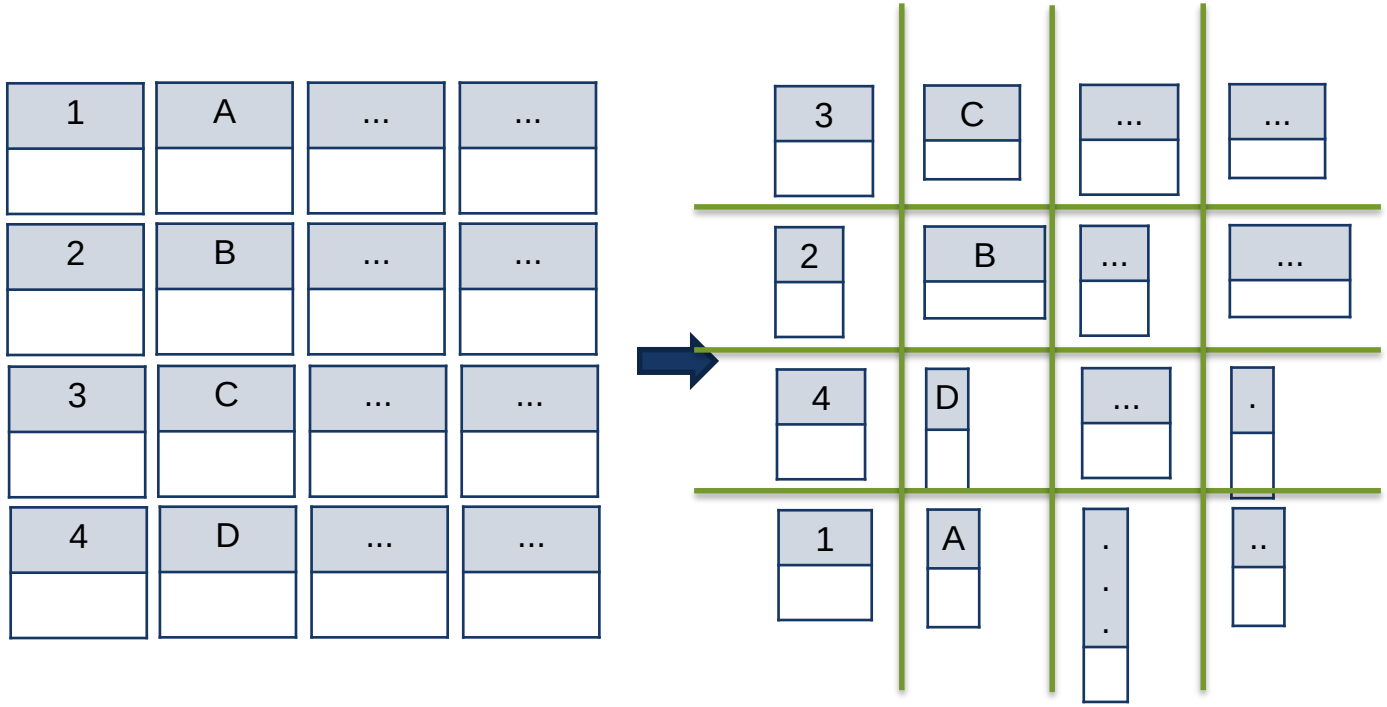
1. Row Groups creation



2. Segments separation



3. Compression (involves reordering, compression)



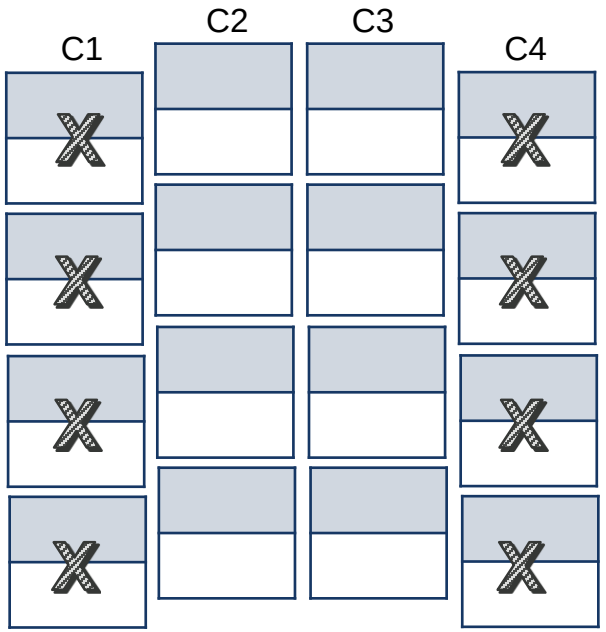
SEGMENTS

A Segment ...

- Contains around 1 Million Rows of **unordered data**
- Logical unit of data operations (no matter how many 8K Pages or Extents are involved) (8 MB ~= 1000 Pages ~= 130 Extents)
- Agressive “Read-Ahead”
- Large Object Cache (New since SQL Server 2012)
- New Memory Broker separates between Row Store & Column Store

Segment column selection

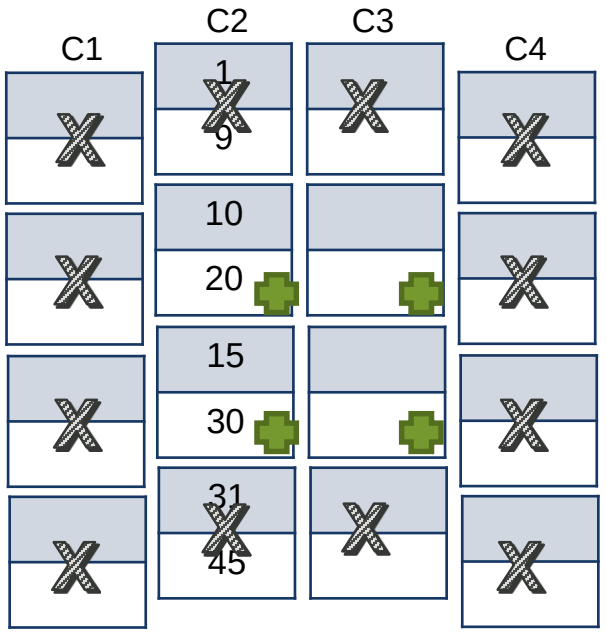
```
SELECT sum(C2), sum(C3)
        FROM dbo.FactOnlineSales
        WHERE C2 > 10 and C2 <=20;
```



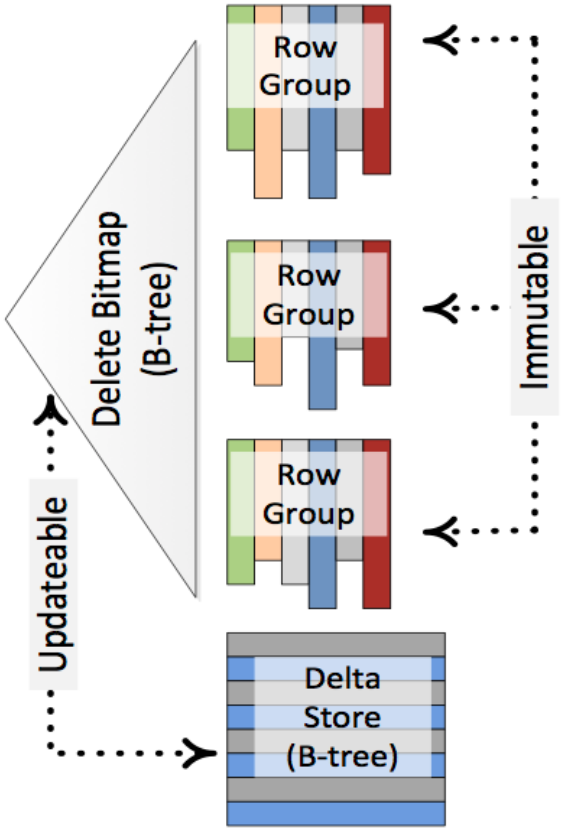
Segment elimination

```
SELECT sum(C2), sum(C3)
        FROM dbo.FactOnlineSales
        WHERE C2 > 10 and C2 <=20;
```

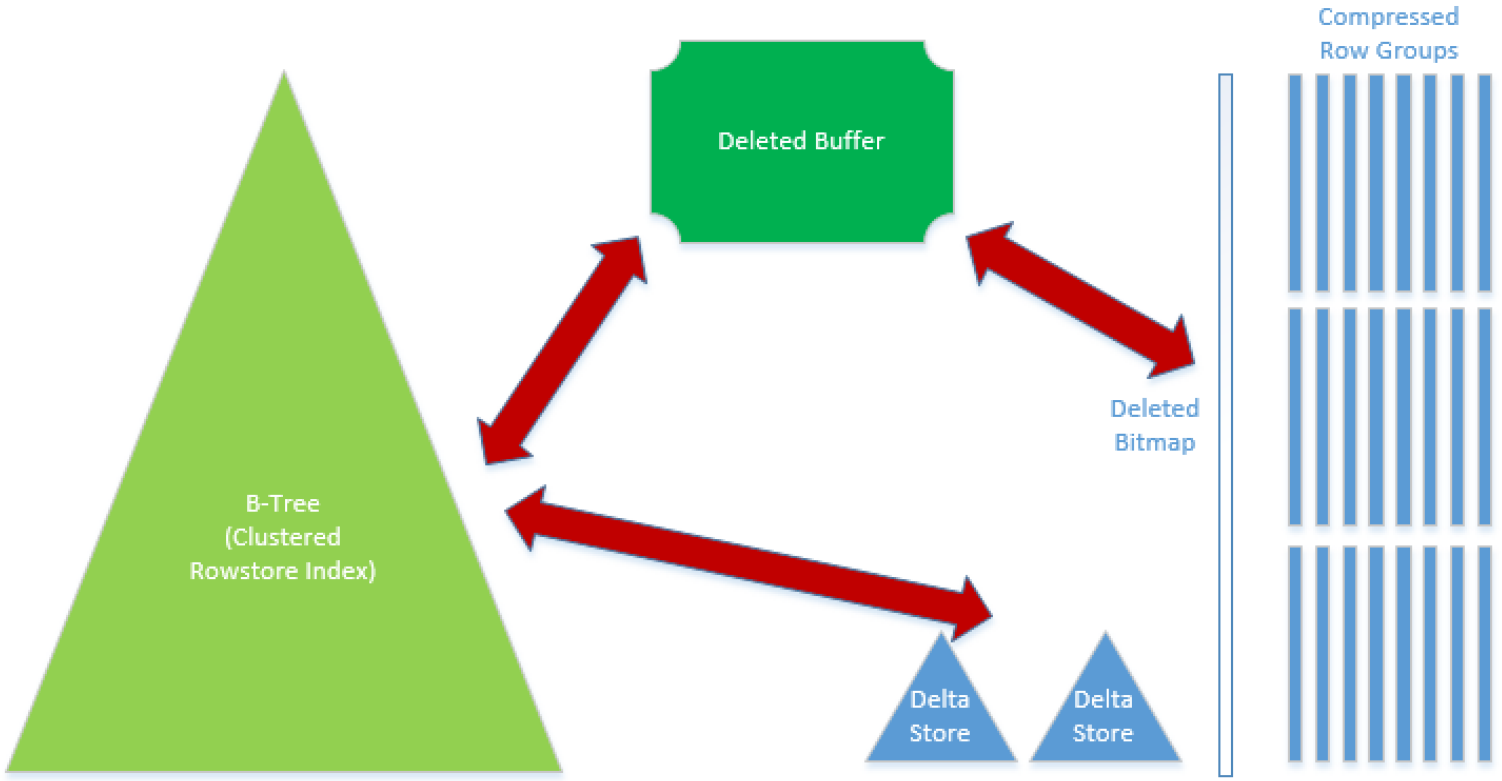
Min Value	1
Max Value	9



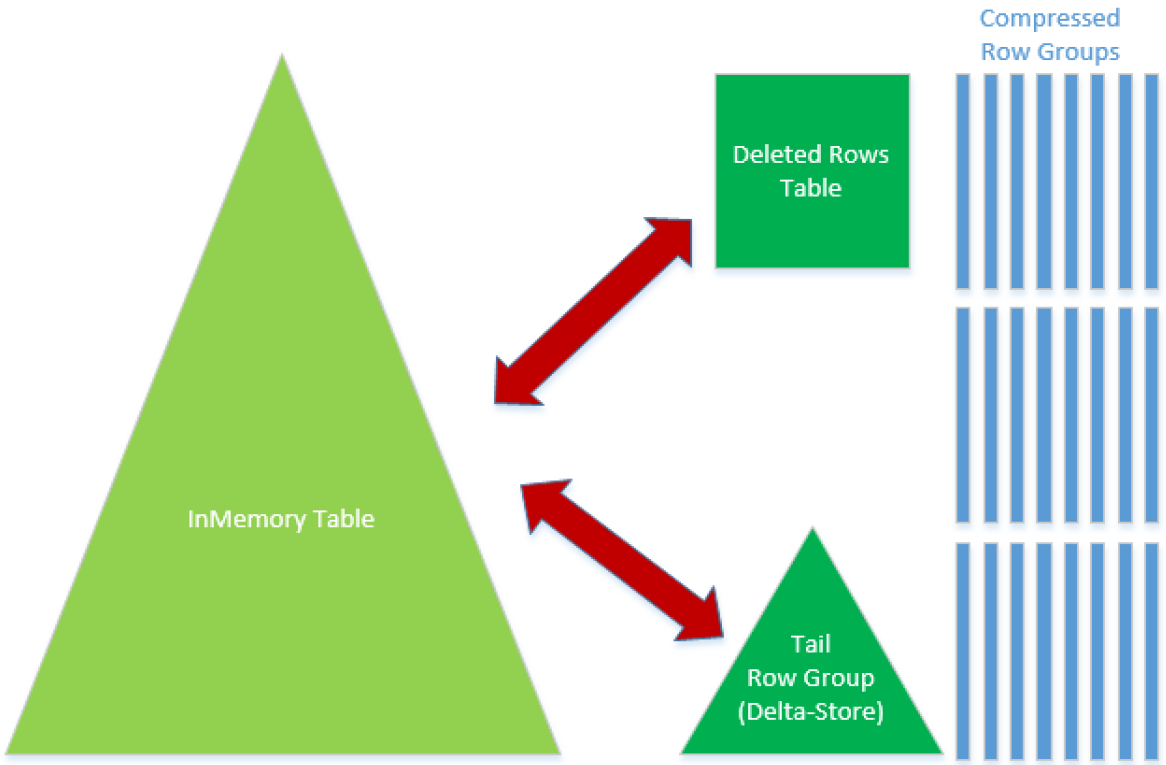
Columnstore in SQL Server 2014



Operational Analytics



5. In-Memory Operational Analytics



5. In-Memory Operational Analytics

sys.sp_memory_optimized_cs_migration – compresses data from InMemory OLTP Table into In-Memory Columnstore

Runs in interop mode only so far (it is changing with every release)

Single core execution only (so far), but hey, it's a Batch Mode! ☺

Demo

Clustered Columnstore

- Primary & Foreign Keys
- Nonclustered Indexes
- NCI Locking

Other Improvements

- High Availability
- Batch Mode
- Performance Improvements
- Data Loading Improvements
- Maintenance Improvements
- Monitorting Improvements (DMV, Extended Events, Perf

High Availability

- Readable Secondaries for Availability Groups – through Snapshot & Read Committed Snapshot Isolation Levels support

Batch Mode Improvements

- Batch Mode support for 1 core execution plan operators
- Batch Mode support for the Sort operator
- Batch Mode support for the Multiple Distinct Count operations
- Batch Mode support for the Left Anti-Semi Join operators
- Batch Mode support for the Windowing functions

Performance Improvements

- String Predicate Pushdown for the Clustered Columnstore Index Scan operator in Batch Mode
- Simple Aggregate Predicate Pushdown
- Significantly improved performance for the Data Loading for Columnstore Indexes

Data Loading Improvements

- SIMD support
- Delta-Stores are not Page-Compressed!!!

Maintenance Improvements:

- Better Index Reorganize (removes deleted rows, less memory pressure)

New DMVs:

- sys.dm_column_store_object_pool
- sys.dm_db_column_store_row_group_physical_stats
- sys.dm_db_column_store_row_group_operational_stats
- sys.dm_db_index_operational_stats
- sys.dm_db_index_physical_stats
- sys.internal_partitions

Obrigado!

Resources:

My Columnstore Blogpost Series (70+):

http://www.nikoport.com/columnstore

CISL – Open Source Columnstore Library:

https://github.com/NikoNeugebauer/CISL