

DB2® 10.5

with BLU Acceleration



<Speaker Name Here>

<Speaker Title Here>

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DB2® 10.5

with BLU Acceleration

**Multi-workload database
software for the era of Big Data**

BLU Acceleration – *Extreme performance and storage savings, leveraging dynamic “in-memory” and columnar technologies, for analytic processing*

DB2 pure Scale – *High availability, extreme scalability, and application transparency for OLTP workloads*

Mobile - *Rich capabilities to support mobile devices*

NoSQL – *Continue to support the next generation of applications*

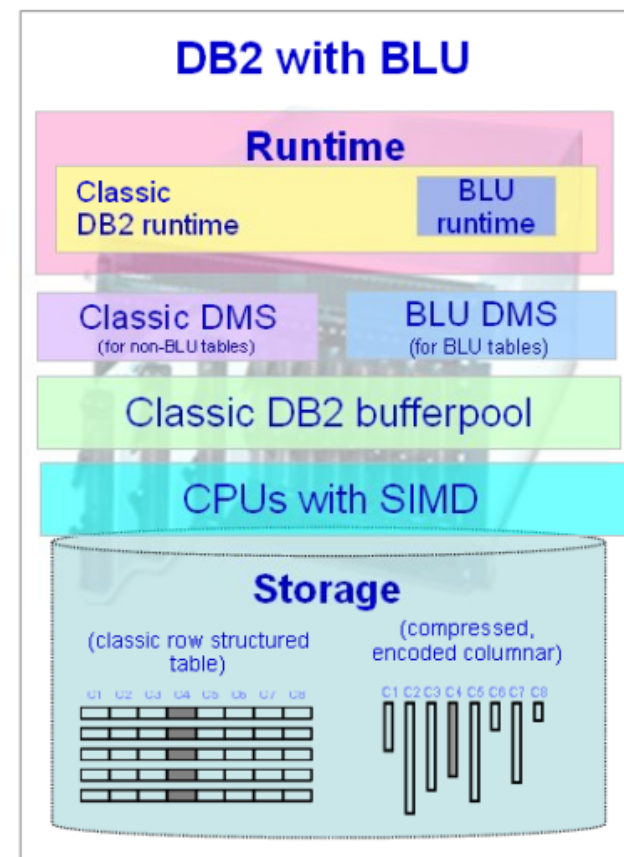
Oracle Application Compatibility – *Continue to reduce the cost and risk associated with migrating Oracle applications to DB2*

Enhanced Tooling - *Reducing the total cost of ownership with DB2 and making the adoption, management, monitoring, and maintenance very simple*

What is DB2 with BLU Acceleration?

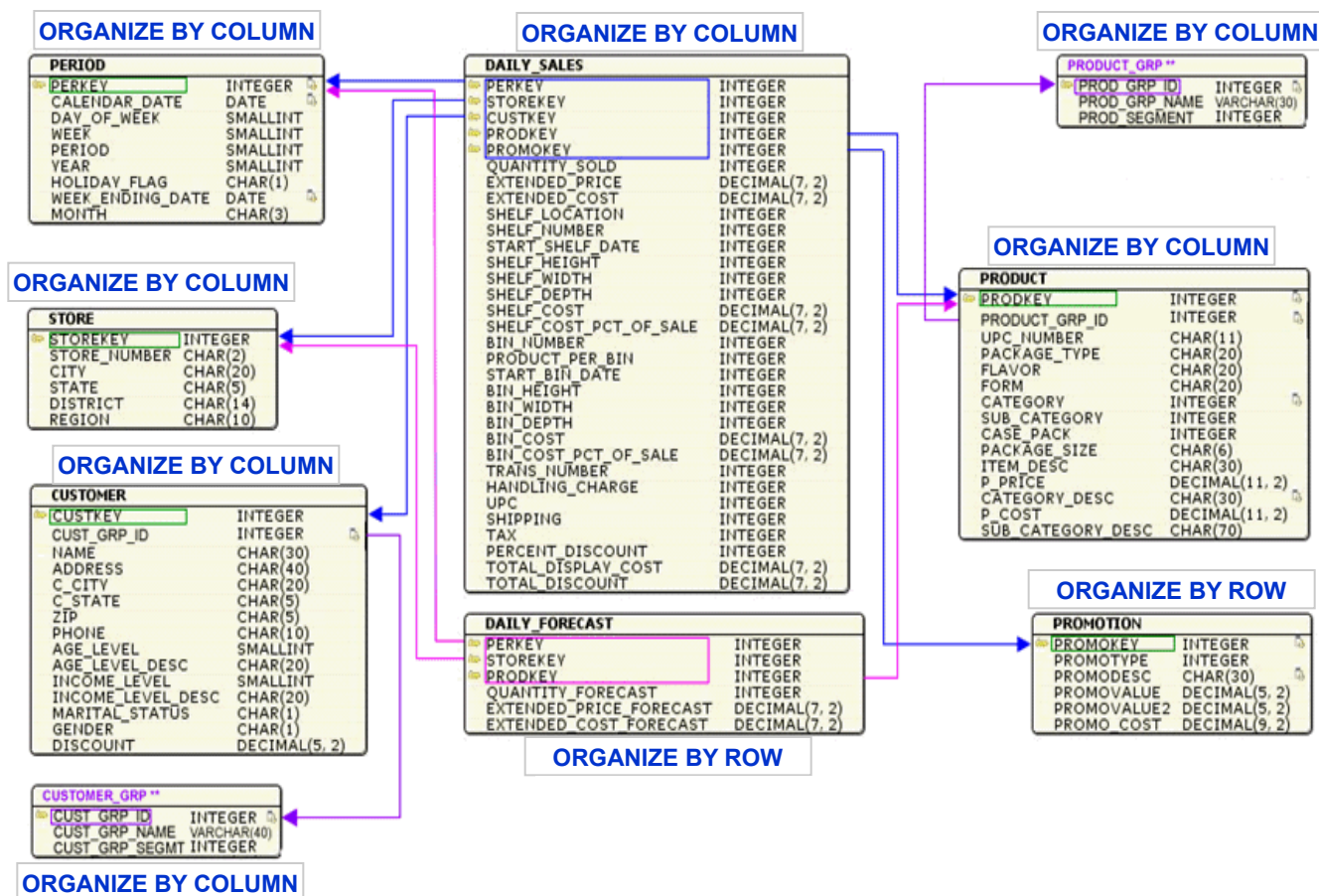
■ New technology for analytic queries in DB2 LUW

- DB2 column-organized tables add columnar capabilities to DB2 databases
 - Table data is stored column organized rather than row organized
 - Using a vector processing engine
 - Using this table format with star schema data marts provides **significant improvements to storage, query performance, ease of use, and time-to-value**
- New unique runtime technology which leverages the CPU architecture and is **built directly into the DB2 kernel**
- New unique encoding for **speed and compression**
 - This new capability is both main-memory optimized, CPU optimized, and I/O optimized



Mixing Row and Columnar Tables

- DB2 10.5 supports mixing row and columnar tables seamlessly
 - In the same tablespace and bufferpools
 - In the same query
- Best query performance for analytic queries usually occurs with all tables columnar
- Mixing row and columnar can be necessary
 - Point queries (highly selective access) favor row-organized tables with index access
 - Small, frequent, write operations favor row-organized tables



How Fast Is It?

Results from the DB2 10.5 Beta

| Customer | Speedup over DB2 10.1 |
|----------------------------------|-----------------------|
| Large Financial Services Company | 46.8x |
| Global ISV Mart Workload | 37.4x |
| Analytics Reporting Vendor | 13.0x |
| Global Retailer | 6.1x |
| Large European Bank | 5.6x |

10x-25x
Improvement
is common

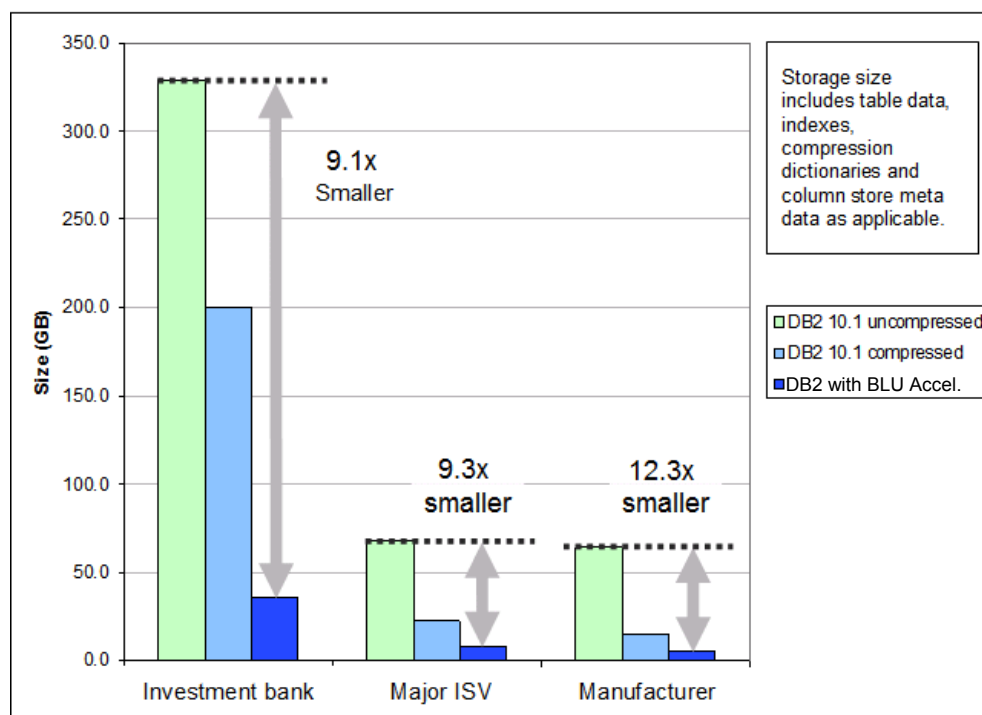


*"It was amazing to see the faster query times compared to the performance results with our row-organized tables. **The performance of four of our queries improved by over 100-fold! The best outcome was a query that finished 137x faster by using BLU Acceleration.**"*

- Kent Collins, Database Solutions Architect, BNSF Railway

Storage Savings

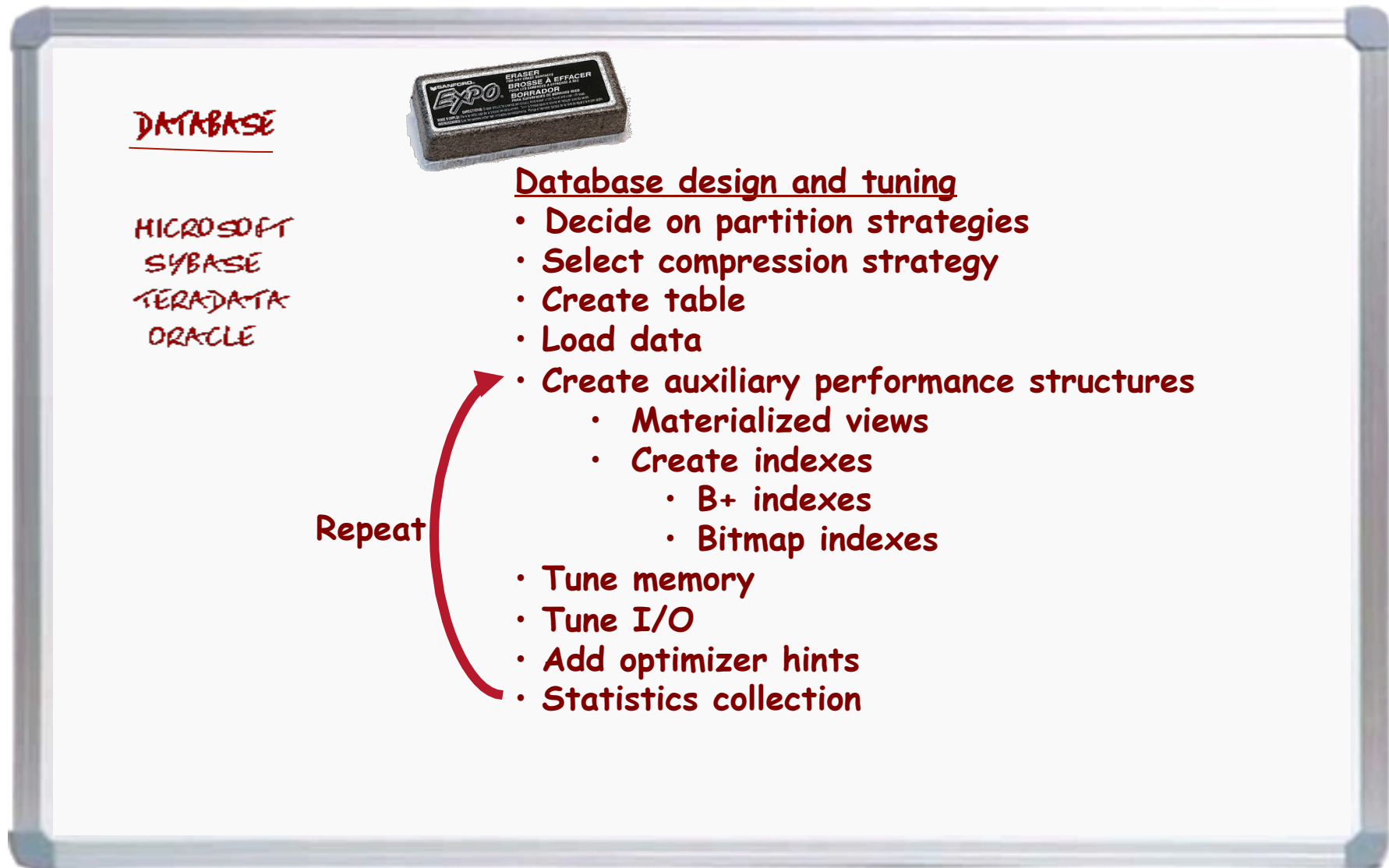
- **Multiple examples of data requiring substantially less storage**
 - 5% of the uncompressed size
 - Fewer objects required
- **Multiple compression techniques**
 - Combined to create a near optimal compression strategy
- **Compression algorithm adapts to the data**



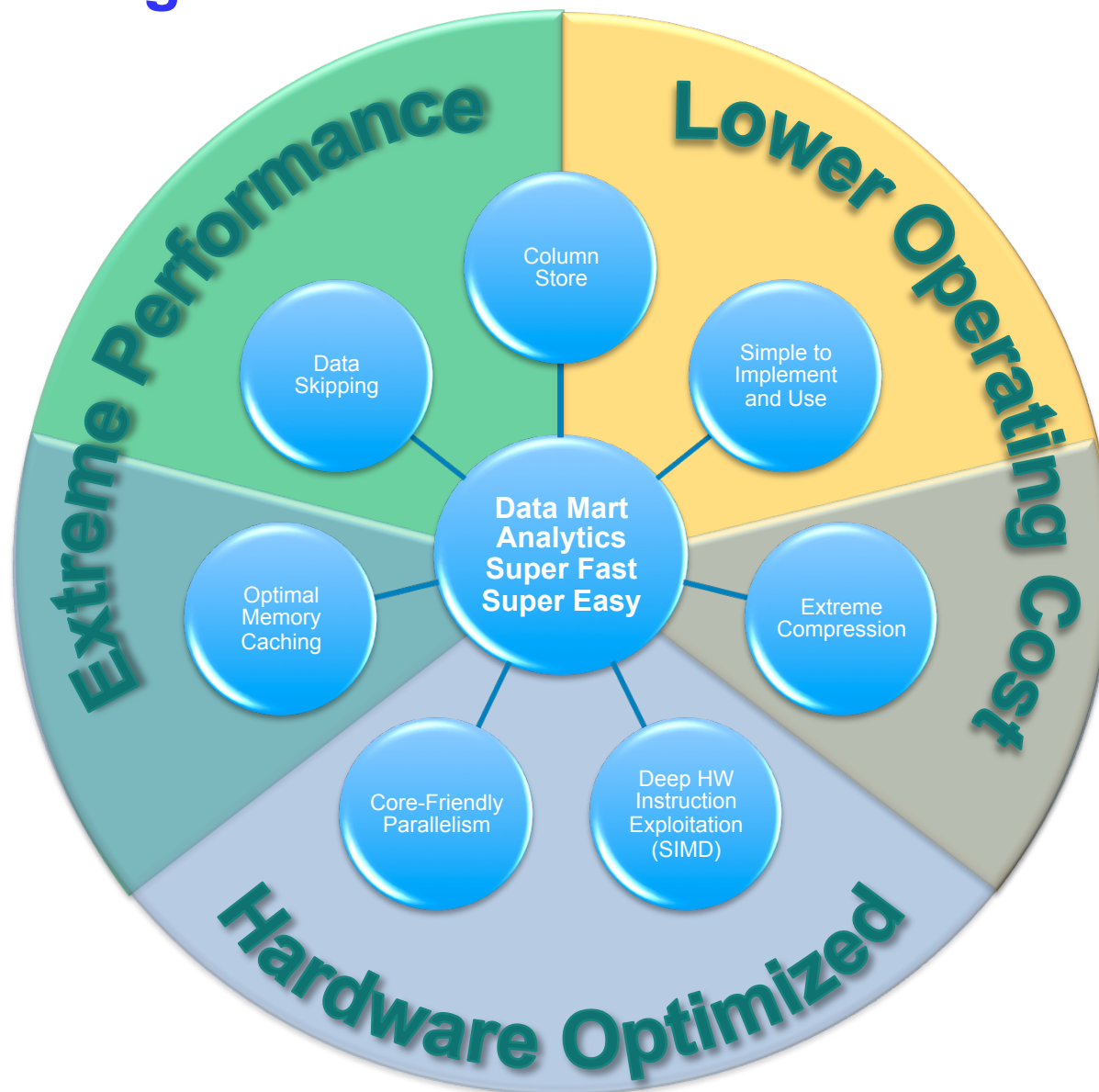
Seamless Integration into DB2

- **Built seamlessly into DB2 – Integration and coexistence**
 - Column-organized tables can coexist with existing, traditional, tables
 - Same schema, same storage, same memory
 - Integrated tooling support
 - Optim Query Workload Tuner (OQWT) recommends BLU Acceleration deployments
- **Same SQL, language interfaces, administration**
 - Column-organized tables or combinations of column-organized and row-organized tables can be accessed within the same SQL statement
- **Dramatic simplification – Just “Load and Go”**
 - Faster deployment
 - Fewer database objects required to achieve same outcome
 - Requires less ongoing management due to it's optimized query processing and fewer database objects required
 - Simple migration
 - Conversion from traditional row table to BLU Acceleration is easy
 - DB2 Workload Manager (WLM) identifies workloads to tune
 - Optim Query Workload Tuner recommends BLU Acceleration table transformations
 - Users only notice speed up; DBA's only notice less work!
 - Management of single server solutions less expensive than clustered solutions

Analytic Database Management Complexity



The Seven Big Ideas of DB2 with BLU Acceleration



7 Big Ideas: ① Simple to Implement and Use

- **LOAD and then... run queries**
 - No indexes
 - No REORG (it's automated)
 - No RUNSTATS (it's automated)
 - No MDC
 - No MQTs or Materialized Views
 - No partitioning
 - No statistical views
 - No optimizer hints
- **It is just DB2!**
 - Same SQL, language interfaces, administration
 - Reuse DB2 process model, storage, utilities











7 Big Ideas: ① Simple to Implement and Use

- **One setting optimized the system for BLU Acceleration**
 - Set `DB2_WORKLOAD=ANALYTICS`
 - Informs DB2 that the database will be used for analytic workloads
- **Automatically configures DB2 for optimal analytics performance**
 - Makes column-organized tables the default table type
 - Enables automatic workload management
 - Enables automatic space reclaim
 - Page and extent size configured for analytics
 - Memory for caching, sorting and hashing, utilities are automatically initialized based on the server size and available RAM
- **Simple Table Creation**
 - If `DB2_WORKLOAD=ANALYTICS`, tables will be created column organized automatically
 - For mixed table types can define tables as `ORGANIZE BY COLUMN` or `ROW`
 - Compression is always on – no options
- **Easily convert tables from row-organized to column-organized**
 - `db2convert` utility

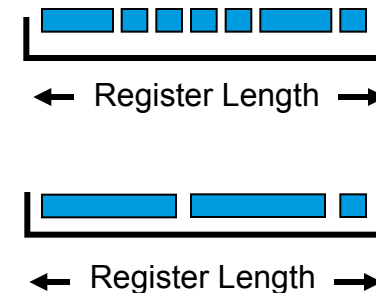
7 Big Ideas: 2 Compute Friendly Encoding and Compression

- **Massive compression with approximate Huffman encoding**
 - More frequent the value, the fewer bits it takes
- **Register-friendly encoding dramatically improves efficiency**
 - Encoded values packed into bits matching the register width of the CPU
 - Fewer I/Os, better memory utilization, fewer CPU cycles to process

LAST_NAME Encoding

| | |
|----------|---|
| Johnson |  |
| Smith |  |
| Smith |  |
| Smith |  |
| Smith |  |
| Johnson |  |
| Smith |  |
| Gilligan |  |
| Sampson |  |
| Smith |  |

Packed into register length













7 Big Ideas: 2 Data Remains Compressed During Evaluation

- **Encoded values do not need to be decompressed during evaluation**
 - Predicates and joins work directly on encoded values

```
SELECT COUNT(*) FROM T1 WHERE LAST_NAME = 'SMITH'
```

LAST_NAME **Encoding**

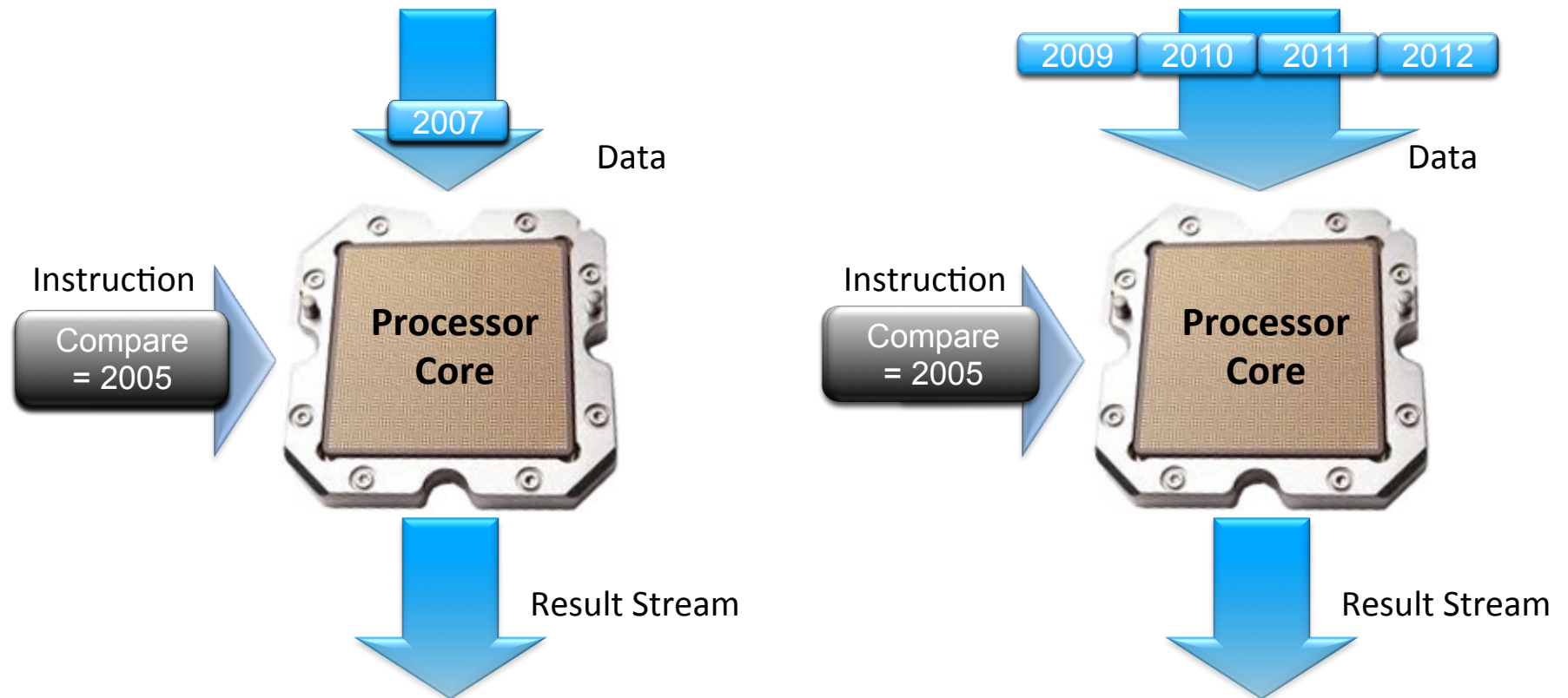
| | |
|----------|---|
| Johnson |  |
| Smith |  |
| Smith |  |
| Smith |  |
| Smith |  |
| Johnson |  |
| Smith |  |
| Gilligan |  |
| Sampson |  |
| Smith |  |



Encode

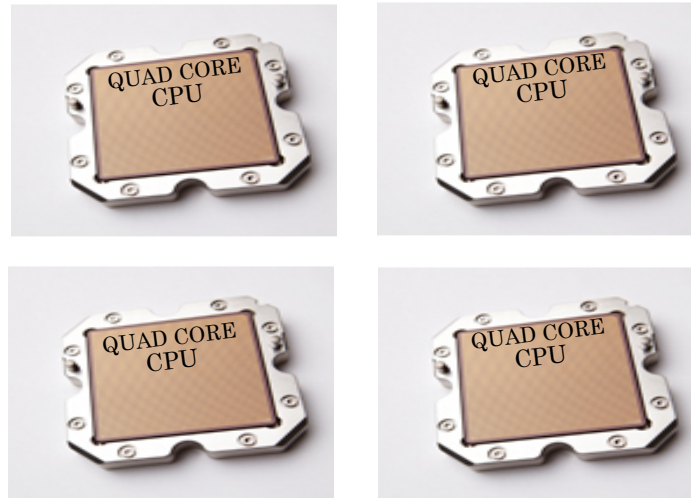
7 Big Ideas: ③ Multiply the Power of the CPU

- Performance increase with Single Instruction Multiple Data (SIMD)
- Using hardware instructions, DB2 with BLU Acceleration can apply a single instruction to many data elements simultaneously
 - Predicate evaluation, joins, grouping, arithmetic



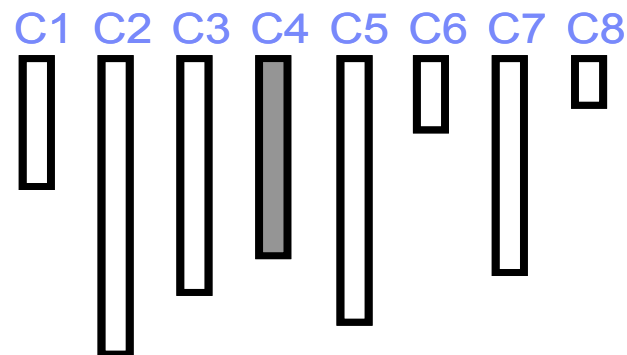
7 Big Ideas: 4 Core-Friendly Parallelism

- **Careful attention to physical attributes of the server**
 - Queries on BLU Acceleration tables automatically parallelized
- **Maximizes CPU cache, cacheline efficiency**



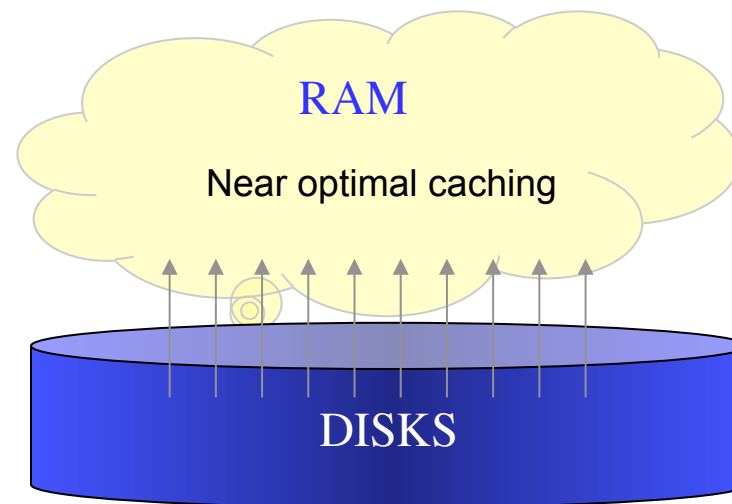
7 Big Ideas: 5 Column Store

- **Minimal I/O**
 - Only perform I/O on the columns and values that match query
 - As queries progresses through a pipeline the working set of pages is reduced
- **Work performed directly on columns**
 - Predicates, joins, scans, etc. all work on individual columns
 - Rows are not materialized until absolutely necessary to build result set
- **Improved memory density**
 - Columnar data kept compressed in memory
- **Extreme compression**
 - Packing more data values into very small amount of memory or disk
- **Cache efficiency**
 - Data packed into cache friendly structures



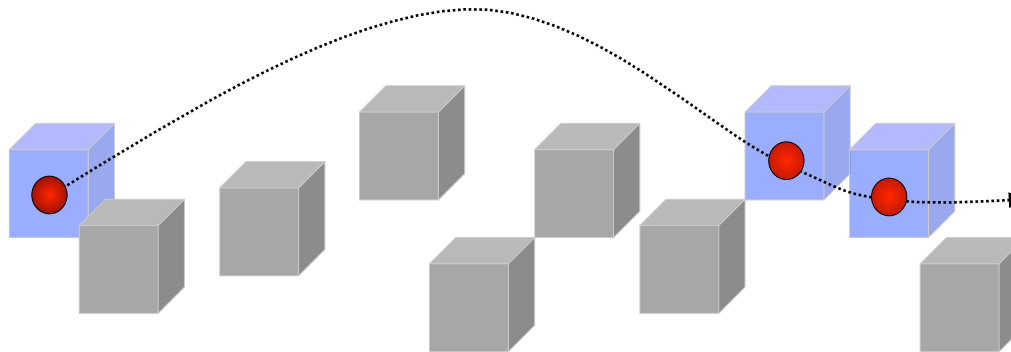
7 Big Ideas: ⑥ Scan-Friendly Memory Caching

- **New algorithms cache in RAM effectively**
- **High percent of interesting data fits in memory**
 - We leave the interesting data in memory with the new algorithms
- **Data can be larger than RAM**
 - No need to ensure all data fits in memory
 - Optimization for in memory and I/O efficiency



7 Big Ideas: 7 Data Skipping

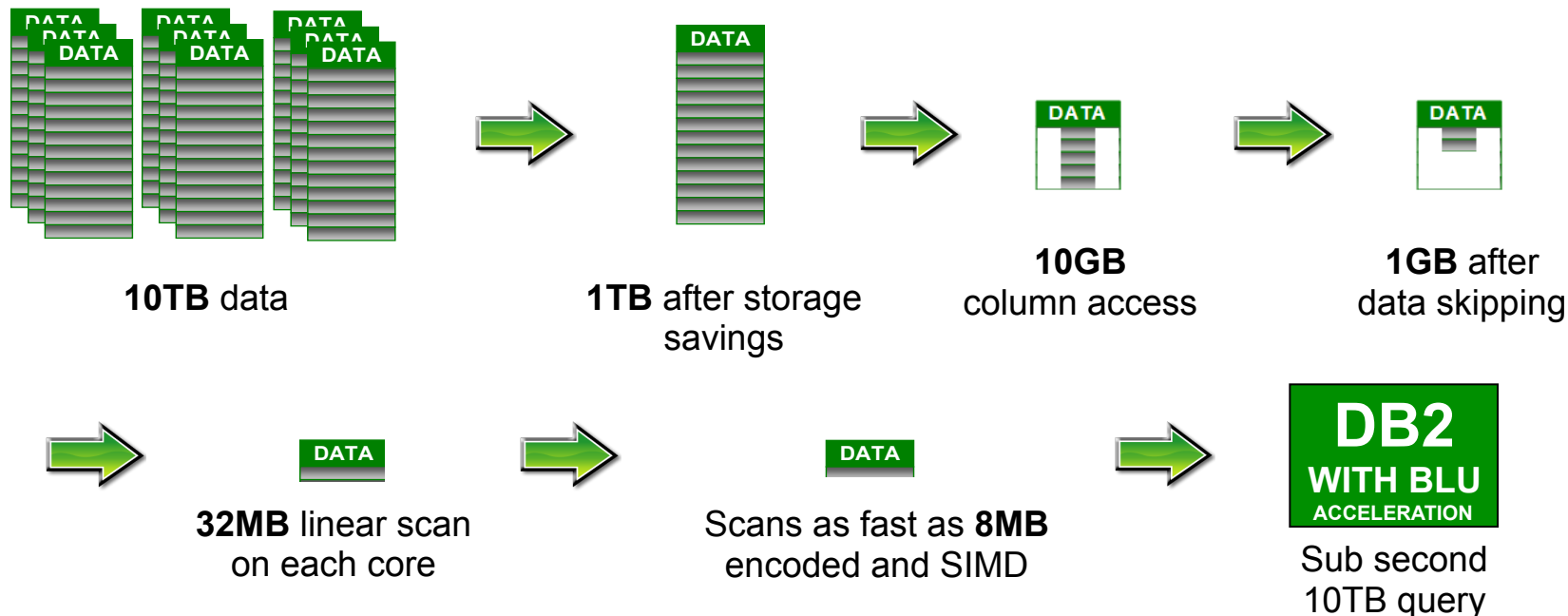
- Automatic detection of large sections of data that do not qualify for a query and can be ignored
- Order of magnitude **savings in all of I/O, RAM, and CPU**
- **No DBA action to define or use – truly invisible**
 - Persistent storage of min. and max. values for sections of data values



7 Big Ideas: How DB2 with BLU Acceleration Helps

~Sub second 10TB query – An Optimistic Illustration

- The system – 32 cores, 10TB table with 100 columns, 10 years of data
- The query: `SELECT COUNT(*) from MYTABLE where YEAR = '2010'`
- The optimistic result: sub second 10TB query! Each CPU core examines the equivalent of just 8MB of data

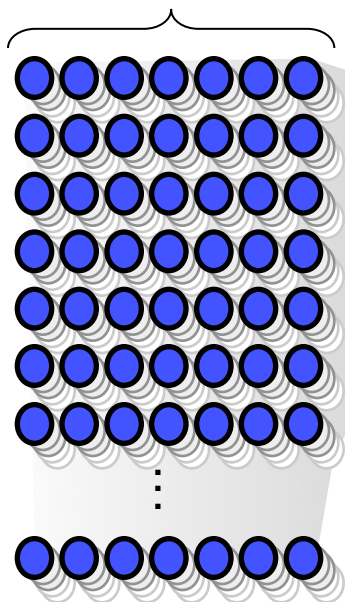


Unlimited Concurrency with “Automatic WLM”

- DB2 10.5 has built-in and automated query resource consumption control
- Every additional query that runs naturally consumes more memory, locks, CPU, and memory bandwidth. In other database products more queries means more contention
- DB2 10.5 automatically allows a high level of concurrent queries to be submitted, but limits the number that consume resources at any point in time
- Enabled automatically when `DB2_WORKLOAD=ANALYTICS`

Applications and Users

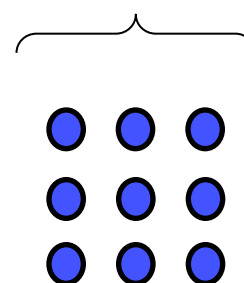
Up to tens of thousands of SQL queries at once



SQL Queries

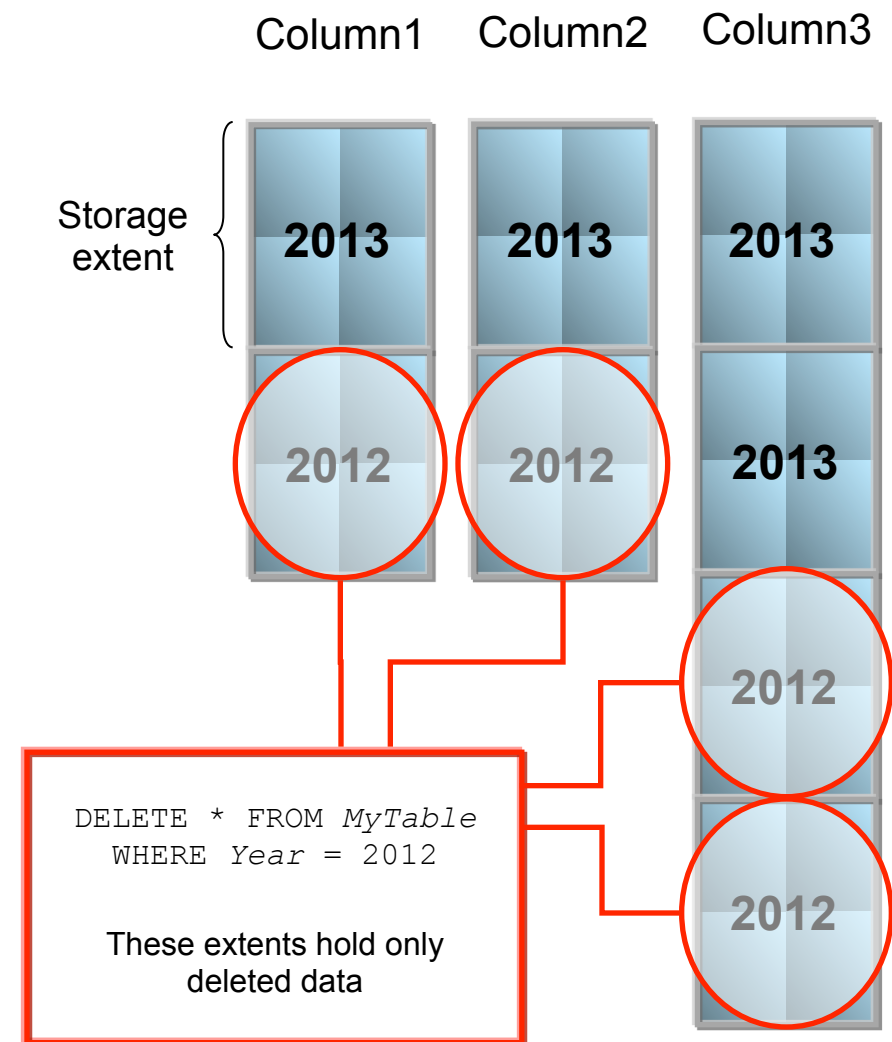
DB2 DBMS kernel

Moderate number of queries consume resources



Automatic Space Reclaim

- **Automatic space reclamation**
 - Frees extents with no active values
 - The storage can be subsequently reused by any table in the table space
- **No need for costly DBA space management and REORG utility**
- **Enabled out-of-the box for column-organized tables when DB2_WORKLOAD=ANALYTICS**
- **Space is freed online while work continues**
- **Regular space management can result in increased performance of RUNSTATS and some queries**



DB2 with BLU Acceleration Early Customer Quotes



“Using DB2 10.5 with BLU Acceleration, our storage consumption went down by about 10x compared to our storage requirements for uncompressed tables and indexes. In fact, I was surprised to find a 3x increase in storage savings compared to the great compression that we already observed with Adaptive Compression on the DB2 10.5 server.”

- Kent Collins, Database Solutions Architect, BNSF Railway



“One of the things I really like about BLU Acceleration is that it enables me to put column-organized tables beside row-organized tables in the same database. In our mixed environment, we realized an amazing 10-25x reduction in the storage requirements for the database when taking into account the compression ratios, along with all the things I no longer need to worry about: indexes, aggregates, and so on.”

-Andrew Juarez, Lead SAP Basis and DBA