



# Oracle Database In-Memory: Enabling Real-time Analytics

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# What is Database In-Memory

# Oracle Database In-Memory Goals

## Real-Time Analytics


Enable Real-Time Business Decisions

## Accelerate Mixed Workload


Run analytics on Operational Systems

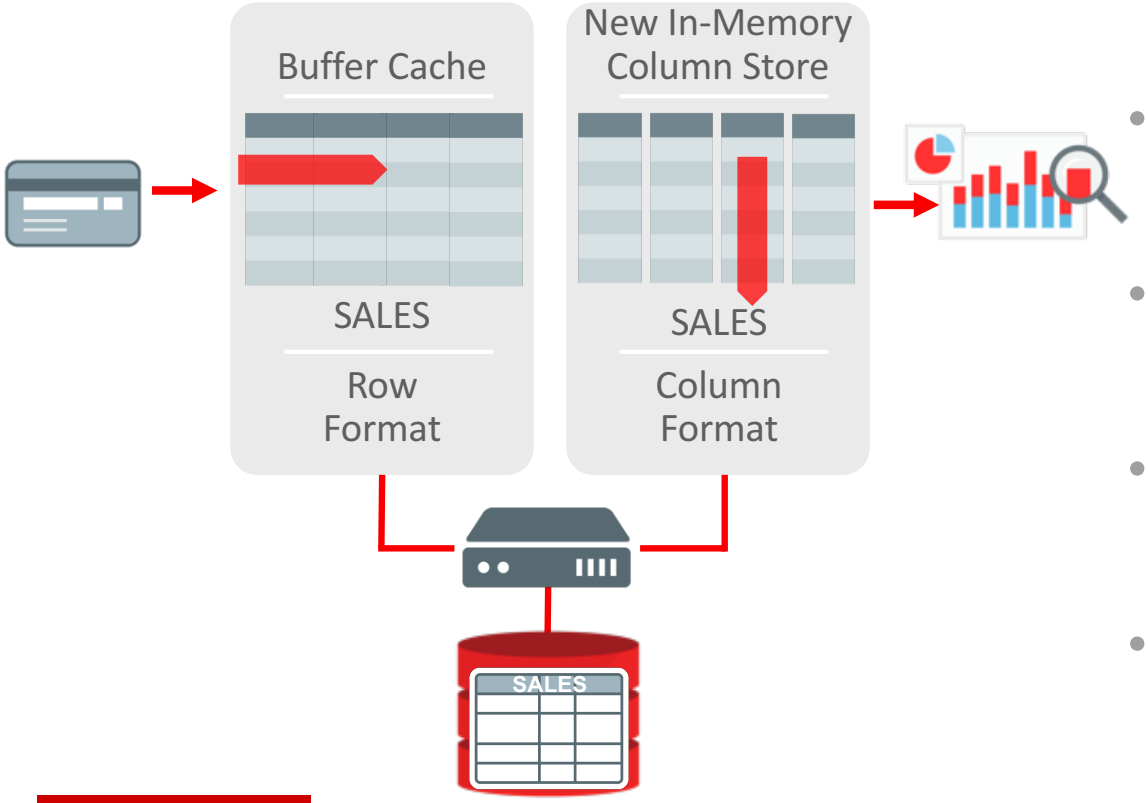
## Risk-Free

Proven Scale-Out, Availability, Security

## Trivial to Implement

No Application Changes
Not Limited by Memory

# Breakthrough: Dual Format Database




- **BOTH** row and column formats for same table
- Simultaneously active and transactionally consistent
- Analytics & reporting use new in-memory Column format
- OLTP uses proven row format

# Oracle Database 12c

- Database In-Memory is an option for Oracle Database 12c Enterprise Edition
- Database In-Memory is included in the first patchset (12.1.0.2) for 12.1
- Available in the Cloud on 12.2
- No additional steps required

# Oracle Database In-Memory: Simple to Implement

1. Configure Memory Capacity
   - `inmemory_size = XXX GB`

2. Configure tables or partitions to be in memory
   - `alter table | partition … inmemory;`

3. Later drop analytic indexes to speed up OLTP

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# Oracle In-Memory Advisor

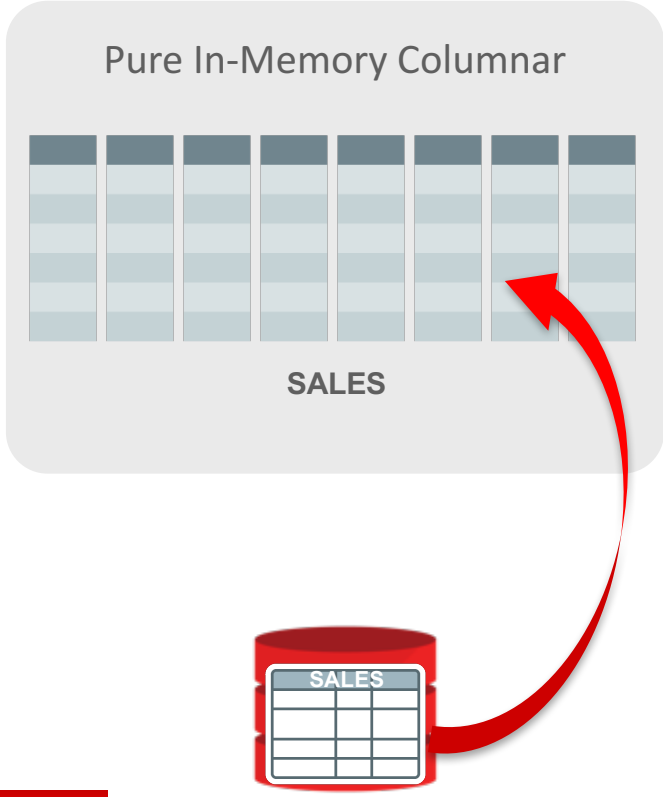
| Object Type | Object | Estimated In-Memory Size | Analytics Processing Seconds | Estimated Reduced Analytics Processing Seconds | Estimated Analytics Processing Performance Improvement Factor | Benefit / Cost Ratio (Improvement Factor / In-Memory Size) |
|---|---|---|---|---|---|---|
| Table | SOE.LOGON | 451.76MB | 2114 | 1,887 | 9.3X | 20.586 |
| Table | SOE.CARD_DETAILS | 607.32MB | 8346 | 7,248 | 7.6X | 12.514 |
| Table | SOE.ADDRESSES | 1.09GB | 5237 | 4,621 | 8.5X | 7.798 |
| Partition | SOE.PRODUCT_MOCKUP.Y2014Q1 | 812.6MB | 2003 | 1,489 | 3.9X | 4.799 |
| Table | SOE.CUSTOMERS | 1.10GB | 108 | 95 | 8.2X | 7.455 |
| Table | SOE.ORDER_ITEMS | 2.19GB | 7128 | 6,393 | 9.7X | 4.429 |
| Table | SOE.ORDERS | 1.34GB | 3512 | 2,917 | 5.9X | 4.403 |
| Table | SOE.PRODUCT_INFORMATION | 1.78MB | 2873 | 2,205 | 4.3X | 2.416 |
| Partition | SOE.PRODUCT_MOCKUP.Y2013Q4 | 1.62GB | 97 | 1,489 | 3.7X | 2.284 |
| Partition | SOE.PRODUCT_MOCKUP.Y2014Q2 | 3.37GB | 642 | 493 | 4.3X | 1.276 |

- New In-Memory Advisor
- Analyzes existing DB workload via AWR & ASH repositories
- Provides list of objects that would benefit most from being populated into IM column store

**Note:** Database Tuning Pack license required

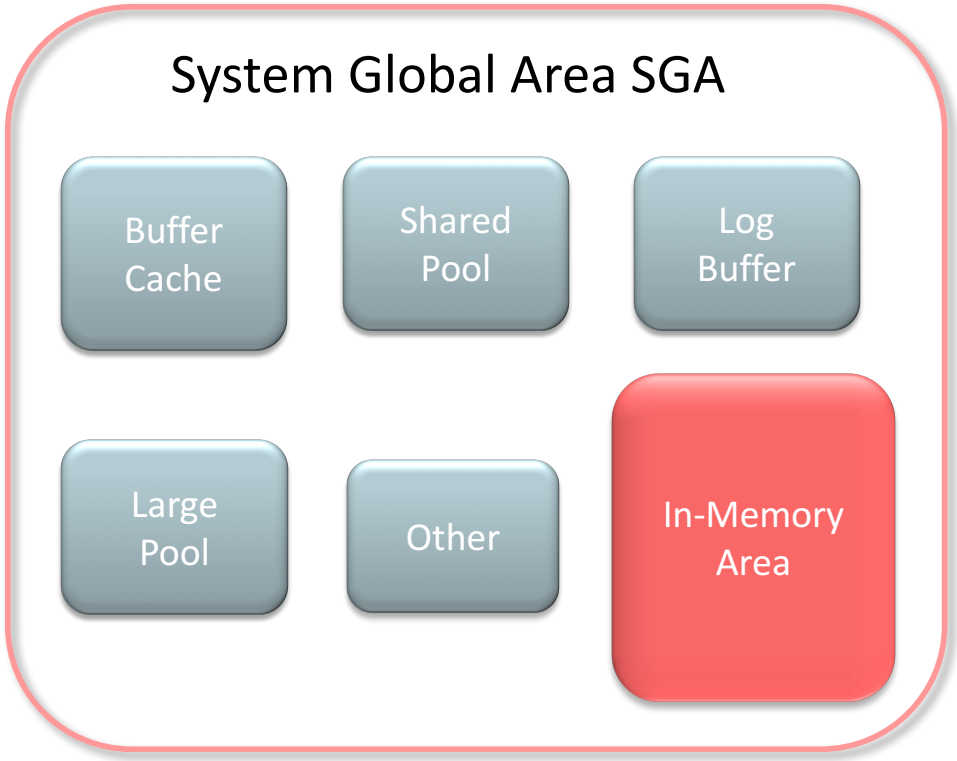
# How does it work

# Oracle In-Memory Columnar Technology




- Pure in-memory column format
  - Enable for subset of database
  - Cheap to maintain – no logging or IO
  - Allows efficient OLTP
  - No change to disk format
- Built **seamlessly** into Oracle Database
  - Appears as a new storage type
  - **Transparent** to Applications
  - All Enterprise Features work ..
    - Availability – RAC, Flashback, DataGuard, etc.
    - Security – Encryption, Auditing, etc.

# In-Memory Area: New Static Area within SGA




- Contains data in the new In-Memory Column Format
- Controlled by INMEMORY_SIZE parameter
  - Minimum size of 100MB
- SGA_TARGET must be large enough to accommodate this area

# Real-Time Analytics

## Scanning and filtering data more efficiently

### Columnar Format

Access only the columns you need

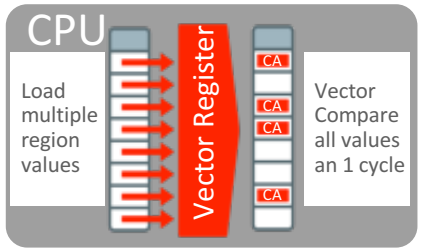
### Compression

Scan & filter data in compressed format

### Storage Indexes


Prune out any unnecessary data from the column

### SIMD Vector Processing




Process multiple column values in a single CPU instruction

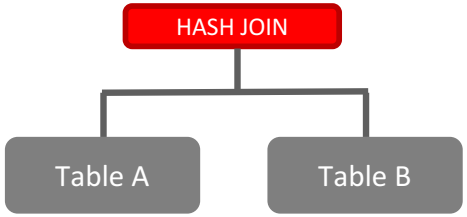
# Real-time Analytics

## Improves all aspects of analytic queries

### Data Scans


- Speed of memory
- Scan and Filter only the needed Columns
- Vector Instructions

### Joins




- Convert Star Joins into 10X Faster Column Scans
- Search large table for values that match small table

### In-Memory Aggregation

- Create In-Memory Report Outline that is Populated during Fast Scan
- Runs Reports Instantly

# What’s New

# Database In-Memory Available **NOW** in the Cloud

## Exadata Express

- In-Memory available in Database X50IM
  - 50GB of storage / 10GB SGA
- Limited to 5G for the In-Memory Area
- Intended for developers and small departmental users

## Database As a Service

- In-Memory available in **Extreme Performance** service
  - Not available in SE, Enterprise, or High Performance Editions
  - Up to 240GB RAM per node
- Easy way to have customers try DBIM

## Exadata Cloud Service

- In-Memory always available
- 248GB of RAM per node
- Easy way to have customers try DBIM
- Note: Memory to be upgraded to 768GB of RAM per node with X6 based servers

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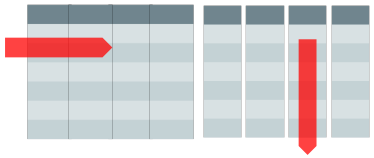
# What’s new in 12.2 for Database In-Memory

## Real-Time Analytics

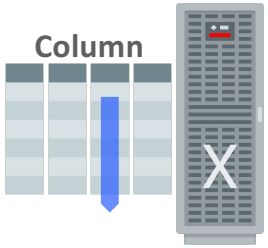
**2X** Faster Joins
**5X** Faster Expressions

## Mixed Workload



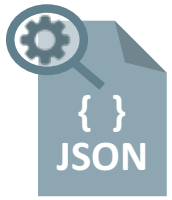
Active Data Guard Support

## Massive Capacity




In-Memory on Exadata Flash

## Multi-model




Native support for JSON Data type

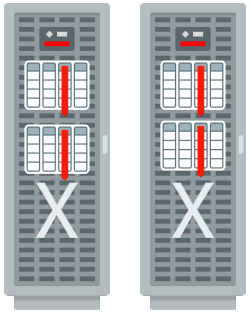
## Automation

Dynamic Data Movement Between Storage & Memory

# Database In-Memory and other Oracle Database features

# Database In-Memory: Scales to Any Size

## Scale-Out

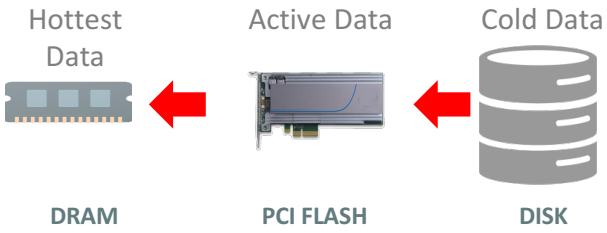


- Scale-Out Across Servers to Grow Memory and CPUs
- In-Memory Queries Parallelized Across Servers

## Scale-Up

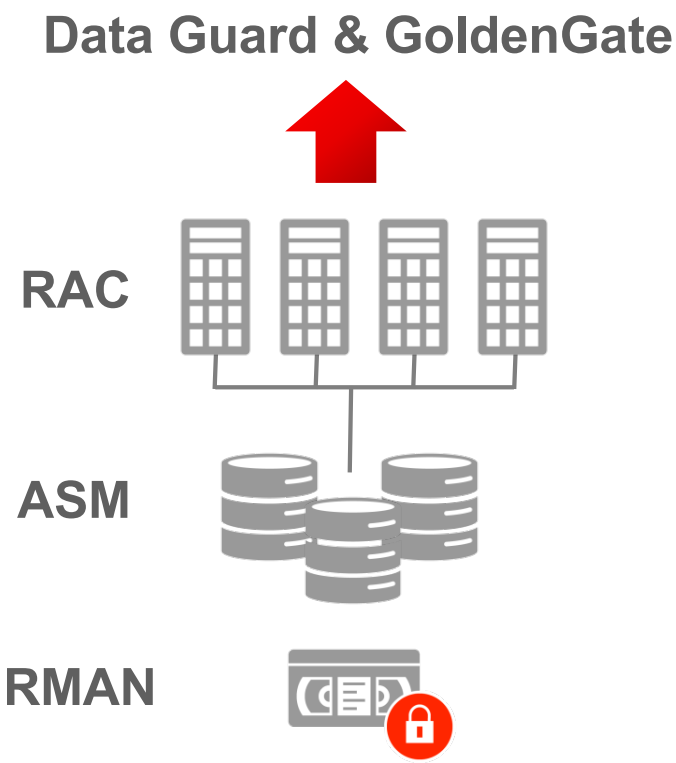
- Scale-Up on large SMPs
  - NUMA Optimized

## Combine with Flash and Disk




- Easily place data on most cost effective tier
- Simultaneously Achieve:
  - Speed of DRAM
  - I/Os of Flash
  - Cost of Disk

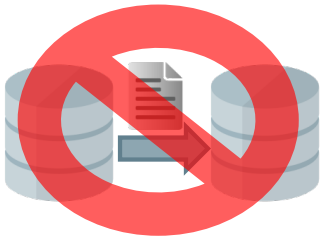
# Database In-Memory: Industrial Strength Availability




- Pure In-Memory format does not change Oracle's storage format, logging, backup, recovery, etc.
- All Oracle's proven availability technologies work transparently
- Protection from all failures
  - Node, site, corruption, human error, etc.

# Database In-Memory: Trivial to Implement

## Easy to Deploy



No data migration

## 100% Compatible

ORACLE E-BUSINESS SUITE

ORACLE FUSION APPLICATIONS

ORACLE PEOPLESOFT

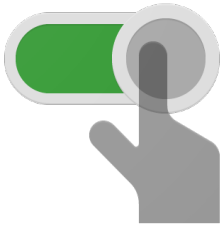
ORACLE JD EDWARDS

No application changes

## Full Functionality


No SQL restrictions

## Simple to Configure



No complex setup
Set column store size
Declare In-Memory tables

# How are customers using Oracle Database In-Memory

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# Database In-Memory References

**AT&T WiFi** – Data Warehouse

- Business Objects reports 100X faster
- ETL processes improved by 50% faster
- No changes to SAP Business Objects reports

**Villeroy & Boch** – SAP BW

- SAP BW COPA queries 30 – 33X faster
- SAP Transaction list queries 4 – 4,800X faster
- Avoided expensive & risky upgrade to S4/Hana

**BOSCH** – SAP CRM

- Dropped all custom indexes
- Analytic queries 2-20X faster, DML 2-3X faster
- No changes to application required

**Die Mobiliar** – Mixed Workload

- Analytic queries 50-200X faster
- Database size reduced considerably
- Phase out of Netezza and mainframe systems

# Where can I get more information

# Additional Resources

**Join the Conversation**

- https://twitter.com/TheInMemoryGuy
- https://blogs.oracle.com/in-memory/
- https://www.facebook.com/OracleDatabase
- http://www.oracle.com/goto/dbim.html

**White Papers (otn.com)**

- Oracle Database In-Memory White Paper
- Oracle Database In-Memory Aggregation Paper
- When to use Oracle Database In-Memory
- Oracle Database In-Memory Advisor

**Videos**

- Oracle Database In-Memory YouTube Channel
- oracle.com
  - Powering the Real-Time Enterprise
  - Industry Experts Share Perspectives

  oracle.com/us/corporate/events/dbim/index.html
- YouTube - Juan Loaiza: Software in Silicon

**Additional Questions**

- In-Memory blog: blogs.oracle.com/In-Memory
- My email: andy.rivenes@oracle.com

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