Performance Innovations with Oracle Database In-Memory

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Safe Harbor Statement

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Competitive Pressures Are Accelerating

It’s a race

- Impatient customer expectations
- Greater need for responsiveness
- Business cycles are accelerating
- Slow and steady doesn’t win anymore
But Unplanned Questions and Events Happen All The Time

It’s dynamic

Unexpected changes occur all the time
Executives need answers anytime
Waiting is not an option
Act now or lose the opportunity
And Stale, Outdated Information Just Doesn’t Cut It

It’s now or never

- No luxury to wait for data refreshes
- Excessive tuning and indexing
- Excessive data loading effort
- Decisions need most current information
53% of executives say too much critical information is delivered too late

Introducing Oracle Database In-Memory

**Powering The Real-Time Enterprise**

100X Acceleration of analytical queries

2X Faster OLTP and Up-to-date analytics

Transparent to existing applications
Oracle Database In-Memory
Transparent Analytics Acceleration

100x Acceleration

Each CPU core scans local in-memory columns at billions of rows/sec scan rate

Data loaded in-memory for active tables or partitions, so works with database of any size

Unique fault-tolerance capability ensures no degradation of performance

Before (no index) 1 minute, 50 seconds
Before (if indexable)
In-Memory (no index)

* Query against 1 Billion Sales records
Scan Billions of Rows per Second per CPU Core

- Each CPU core scans local in-memory columns
- Scans use super fast SIMD vector instructions
- Billions of rows/sec scan rate per CPU core

**Example:** Find all sales in region of CA

>100X Faster
10x Faster Joining and Combining Data

- Converts join processing into fast column scans
- Joins up to 10x faster

Example: Find all sales in outlet stores
Oracle Database In-Memory
Unique Dual-Format Architecture

Up-to-date analytics

Both row and column in-memory formats

Simultaneously active and transactionally consistent ensuring access to freshest data

Eliminates manual tuning and expensive analytic indexes
Optimizing Transaction and Query Performance

Row Format Databases versus Column Format Databases

Row

- Transactions run faster on row format
  - Insert or query a sales order
  - Fast processing few rows, many columns

Column

- Analytics run faster on column format
  - Report on sales totals by state
  - Fast accessing few columns, many rows

Oracle 12c: Stores Data in Both Formats Simultaneously
OLTP is Slowed by Analytic Indexes

- Most OLTP Indexes (e.g. ERP) are only used for analytic queries
- Inserting one row into a table requires updating 10-20 analytic indexes: **Slow**!
- Indexes only speed up anticipated queries & reports
Column Store Replaces Analytic Indexes

- **100x Faster analytics**
  - Works on any columns
  - Better for ad-hoc analytics
  - Less tuning required
- **2x Faster OLTP and Batch**
  - Column store not logged
  - Row Insert cost is lower
Oracle Database In-Memory

Transparent to Applications

100% Compatible

Leverage existing Oracle skillsets and existing Oracle security, availability features

Scales out across multiple servers in a cluster

No need to re-write or re-configure existing applications
In-Memory Speed + Capacity of Low Cost Disk

- Size not limited by memory
- Data transparently moves between tiers
- Each tier has specialized algorithms & compression

<table>
<thead>
<tr>
<th>Speed of DRAM</th>
<th>I/Os of Flash</th>
<th>Capacity of Disk</th>
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- DRAM: Hottest Data
- PCI FLASH: Active Data
- DISK: Cold Data
Scale-Out In-Memory Database to Any Size

• Scale-Out across servers to grow memory and CPUs

• In-Memory queries parallelized across servers to access local column data

• Direct-to-wire InfiniBand protocol speeds messaging
Zero Application Changes

**Full Functionality** - No restrictions on SQL

**Easy to Implement** - No migration of data

**Fully Compatible** - All existing applications run unchanged

**Fully Multitenant Ready** - Oracle Database In-Memory Cloud
Implement in Minutes

1. Configure Memory Capacity
   – inmemory_size = XXX GB

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

3. Drop analytic indexes to speed up OLTP
Ensure Fault Tolerance

- Similar to storage mirroring
- Duplicate in-memory columns on another node
  - Enabled per table/partition
  - Application transparent
- Downtime eliminated by using duplicate after failure
100X Acceleration Dramatically Improves Decisions

• Run 100 queries with the same resources that now can only process 1 query

• Decisions made faster and with higher quality

• **Big Opportunity:** By eliminating indexing overhead, get answers to unplanned questions
The Promise of Real-Time Analytics

The Promise

Don’t analyze “after the fact”
Continuously optimize processes
Respond Instantly to demands

Examples: Dynamic pricing, Smart logistics, Real-Time financial roll-ups
Become a Real-Time Enterprise

Using Oracle Database In-Memory

**Data Driven**
Get immediate answers to any question with real-time analytics

**Agile**
Eliminate latency with analytics directly on OLTP data

**Efficient**
Non-disruptively accelerate all applications

Real-Time Enterprise
Summary: Oracle Database In-Memory

Powering the Real-Time Enterprise

• Extreme Performance: Analytics & OLTP
• Extreme Scale-Out & Scale-Up
• Extreme Availability
• Extreme Simplicity

All In-Memory Benefits With No Application Changes
Powering the
Real-Time Enterprise
Hardware and Software
Engineered to Work Together
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Engineered to Work Together