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Automatic Data Optimization with Oracle Database 12*c*

Gregg Christman
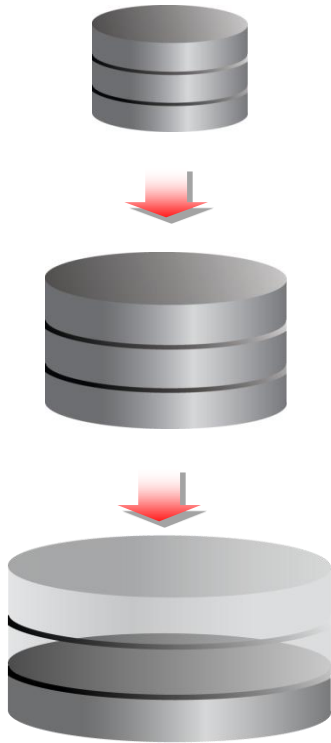Senior Product Manager, ACO/HCC

Oracle Database 12*c*
Automatic Data Optimization

- Data Growth Trends

- Oracle Compression

- Heat Map

- Automatic Data Optimization

- Summary

Data Growth Challenges

- **IT must support exponentially growing amounts of data**
  - Explosion in online access and content
  - Government data retention regulations
- **Performance often declines as data balloons**
- **IT budgets are flat or decreasing**
- **Need to grow data**
  - Without hurting performance
  - Without growing storage/administrative cost
  - Storage tiering and compression tiering are key

Growth in Data Diversity and Usage
1,800 Exabytes of Data in 2011, 20x Growth by 2020

Today's Drivers

Enterprise
45% per year growth
in database data

Cloud
80% of new
applications
and their data

Regulation
300 exabytes in
archives by 2015

Emerging Growth Factors

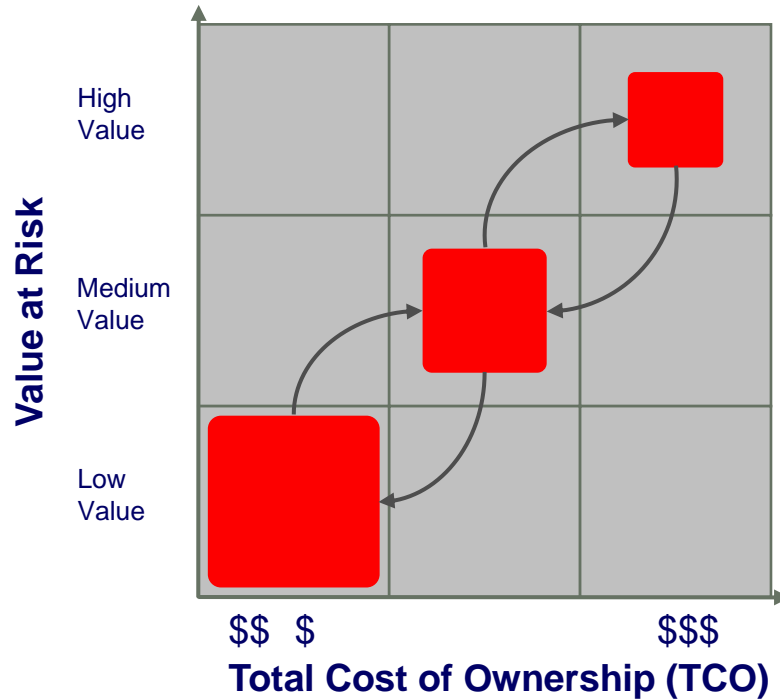**Mobile**
#1 Internet access device in 2013

Big Data
Large customers top 50PB

Social Business
$30B/year in commerce by 2015

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Information Lifecycle Management
Managing Data Over its Lifetime

Value at Risk

High Value

Medium Value

Low Value

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Total Cost of Ownership (TCO)

"The policies, processes, practices, and tools used to align the business value of information with the most appropriate and cost effective IT infrastructure from the time information is conceived through its final disposition."

Storage Networking Industry Association (SNIA) Data Management Forum

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Compression Techniques

COMPRESSION TYPE:	SUITABLE FOR:
Basic Compression	Read only tables and partitions in Data Warehouse environments or "inactive" data partitions in OLTP environments
Advanced Row Compression	Active tables and partitions in OLTP and Data Warehouse environments
Advanced LOB Compression and Deduplication	Non-relational data in OLTP and Data Warehouse environments
Advanced Network Compression and Data Guard Redo Transport Compression	All environments
RMAN/Data Pump Backup Compression	All environments
Index Key Compression	Indexes on tables for OLTP and Data Warehouse
Hybrid Columnar Compression – Warehouse Level	Read only tables and partitions in Data Warehouse environments
Hybrid Columnar Compression – Archive Level	"Inactive" data partitions in OLTP and Data Warehousing environments

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Oracle Advanced Compression
Transparent, Smaller, *Faster*

- 100% Application Transparent
- End-to-end Cost/Performance Benefits across CPU, DRAM, Flash, Disk & Network
- Runs Faster: OLTP Apps (Transactional & Analytics) & DW
- Reduces Database Footprint
  - CapEx & OpEx savings
  - Increases Cloud ROI through Database Footprint reduction in DRAM Memory

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Managing Storage Challenges

Manage more data without incurring additional cost

Compress data, without impacting performance

Tier and compress data based on usage

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Oracle Advanced Compression
New Features, New Feature Names

Oracle Database 11g	Oracle Database 12c
OLTP Compression	Advanced Row Compression
Secure Files Compression	Advanced LOB Compression
Secure Files De-duplication	Advanced LOB Deduplication
Hybrid Columnar Compression	Hybrid Columnar Compression
NEW	Heat Map (Object and Row Level)
NEW	Automatic Data Optimization
NEW	Temporal Optimization

Oracle Advanced Compression

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Understanding Data Usage Patterns

Database 'heat map'

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Understanding Data Usage Patterns

Database 'heat map'

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12c Heat Map – Visualize Data Usage

Insight identifies opportunities & drives automation

Table Level Heat Map
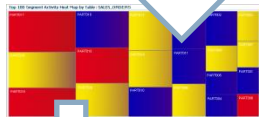
Partition Level Heat Map

Row Level Heat Map

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Heat Map
Enterprise Manager

Heat Map
What it tracks

HOT

Active

Actively updated

Frequent Access

Infrequently updated, Frequently Queried

Occasional Access

Infrequent access for query and updates

Dormant

Long term analytics & compliance

COLD

- **"Heat Map" tracking**
  - Database level Heat Map shows which tables and partitions are being used
  - Block level Heat Map shows last modification at the block level

- **Comprehensive**
  - Segment level shows both reads and writes
  - Distinguishes index lookups from full scans
  - Automatically excludes stats gathering, DDLs or table redefinitions

- **High Performance**
  - Object level at no cost
  - Block level < 5% cost

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Automatic Data Optimization

Usage based data compression

01110101010010
10000100010101

Hot Data	Warm Data	Archive Data
1010101011101010011010 1	10101010111010100110101110000101 00	101010101110101001101011100001010001011 011
110000101000101101110 10	0101101110101010010100100100001 000	101010010010010000100010101011011001011
1010010100100100001 0001	1010101101001011010011100001010 010	010011100001010010010000100100000100010 10
01010110100101101001 110	0101000010010000100010101011010 010	101010101110101001101011100001010001011 011
0001010010010100001 0010	1000010100100101001010110111000 010	101010101110101001101011100001011101011 001
0001000101010111001 1010	1110010100100101001010110111011 010	
1010010100100100001 0001		

3X
Advanced Row Compression

10X
Columnar Query Compression

15X
Columnar Archive Compression

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Automatic Data Optimization
Policy-based management

- **Declarative Policy Specification: Condition ➔ Action**

  - alter table sales ilm add **row store compress advanced row after 3 days of no modification**;

  - Conditions are time period after creation, access, modification of data, or **customized**

  - Actions can be Compression Tiering or Tablespace Tiering

- **Policies are inherited from the tablespace or table**

  - New tables inherit from tablespace; can also be applied to existing tables

  - New partitions (including interval partitions) inherit from table

Simple Declarative SQL extension
Automatic Data Optimization

ALTER TABLE sales ILM add

Active	▪ Advanced Row Compressed (2-4x) ▪ Affects ONLY Candidate Rows ▪ Cached in DRAM & FLASH	compress for advanced row **after 2 days of no update**
Frequent Access	▪ HCC Query Compressed (10x) ▪ High Performance Storage	compress for query low **after 1 week of no update**
Occasional Access	▪ HCC Query Compressed (10x) ▪ Low Cost Storage	tier to SATA Tablespace
Dormant	▪ HCC Archive Compressed (15-50X) ▪ Archival Storage	compress for archive high **after 6 months no access**

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Up to 15x Smaller Footprint & Faster Queries
Automatic Data Optimization for OLTP

- Hybrid Columnar Compression now complements Advanced Row Compression

- Best Practice:
  - Step 1: **Use Advanced Row Compression for entire DB** and then
  - Step 2: **ADO automatically converts into HCC Query compressed** once the updates cool down, and is used mainly for reporting

    => Query speed of columnar & 10x smaller footprint
  - Step 3: **ADO automatically converts into HCC Archive compressed** once data cools down further and is no longer frequently queried

    => 15-50x smaller footprint

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Optimizes Data Based on Heat Map

Automatic Data Optimization for DW

- Data generally comes in via Bulk Loading
- Workload dominated by queries, even during loading

Step 1: **Bulk Load directly into HCC Query Compressed**

- 10x smaller footprint, Query speed of Columnar

Step 2: **ADO automatically converts to HCC Archive Compressed and moves to Lower Cost Storage** once its queried infrequently

- Data remains online, with 15-50x smaller footprint, & lower storage cost

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Fast, Flexible Loads & Queries on Columnar

Automatic Data Optimization – Mixed Use

- Fastest Load with uncompressed & Fastest Queries with columnar
  - Mixed workloads often use Java app or 3rd party tools to insert and update data that does not use Bulk Loads, so cannot use Columnar

- Step 1: **Load into uncompressed**, conventional inserts & updates
  - Fast loading, & flexibility of using a regular OLTP app for loading

- Step 2: **ADO moves to Row Compressed or Columnar Compressed or Low Cost Storage** once updates cool down
  - Faster Queries, 3-10x smaller footprint
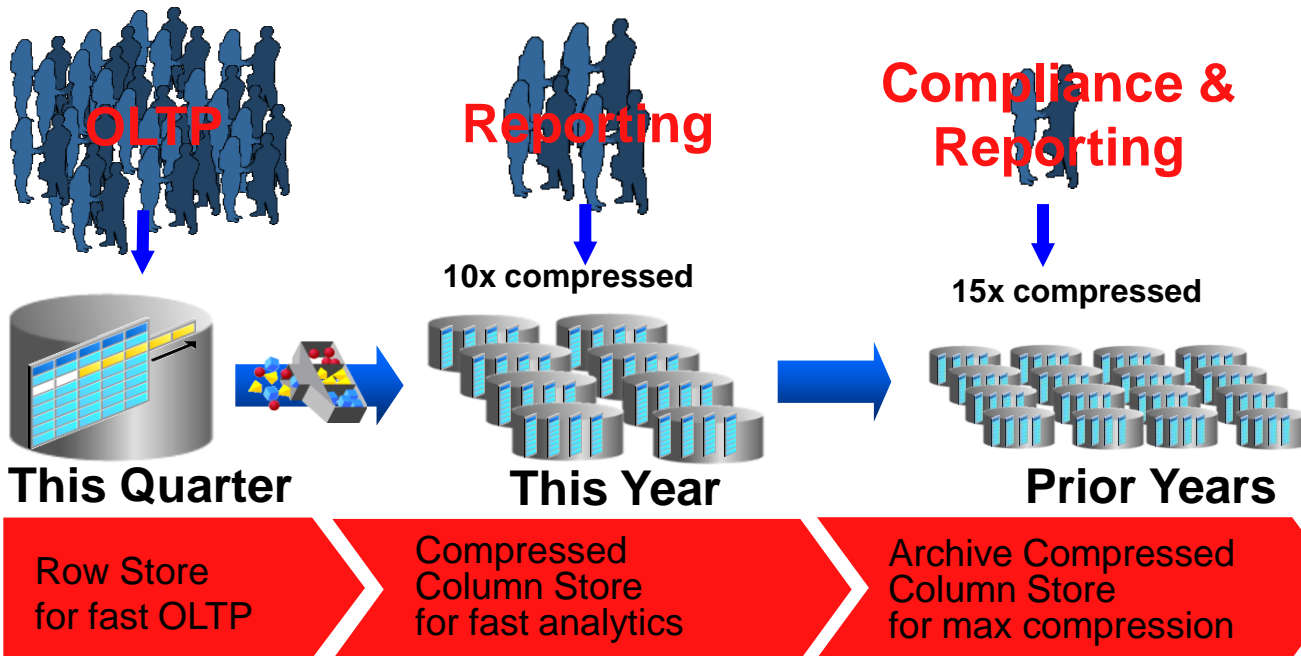
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Scheduled Policy Execution

Automatic Data Optimization

- **Immediate and background policy execution**

  - Policies are executed in maintenance windows

  - Can be manually executed as needed

- **Policies can be extended to incorporate Business Rules**

  - Users can add custom conditions to control placement

    (e.g. 3 months after the ship date of an order)

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Automatic Data Optimization

As data cools, online conversion to columnar compression is automatic

OLTP

Reporting

Compliance & Reporting

10x compressed

15x compressed

This Quarter

This Year

Prior Years

Row Store
for fast OLTP

Compressed
Column Store
for fast analytics

Archive Compressed
Column Store
for max compression

As data ages:

– Activity declines

– Volume grows

– Older data primarily
for reporting

alter table … **add policy**

… **compress for query after 3 months of no modification**

… **compress for archive after 1 year** …

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Summary
Heat Map & Automatic Data Optimization

- **Heat Map**
  - Automatically tracks access
  - Database-aware: maintenance jobs, backups, etc don't affect Heat Map
- **Automatic Data Optimization**
  - Declarative easy-to-use syntax to define data compression & movement policies
  - Extensible with business-specific logic

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