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**Oracle Advanced Compression: Throw Away  
Half of Your Disks and Run Your Database  
Faster**

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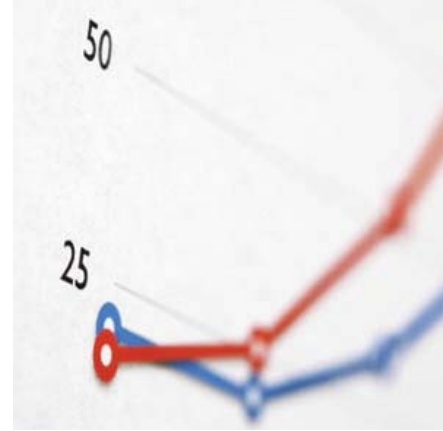
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# Agenda

- Data Growth Challenges
- Advanced Compression Feature Overview
  - Table Compression
  - Unstructured Data Compression
  - Backup Compression
  - Data Guard Network Transport Compression
- Competitive Analysis
- Questions and Answers

# Challenges

- Explosion in Data Volumes
  - Government Regulations (Sarbanes-Oxley, etc)
  - User Generated Content (Web 2.0)
  - Application Consolidation
- IT Managers Must Support Larger Volumes of Data with Limited Technology Budgets
  - Need to optimize storage consumption
  - Also maintain acceptable application performance
- Intelligent and Efficient Compression Technology can Help Address These Challenges



# Introducing Advanced Compression Option

- Oracle Database 11g introduces a comprehensive set of compression capabilities
  - Structured/Relational data compression
  - Unstructured data compression
  - Compression for backup data
  - Network transport compression
- Reduces resource requirements and costs
  - Storage System
  - Network Bandwidth
  - Memory Usage

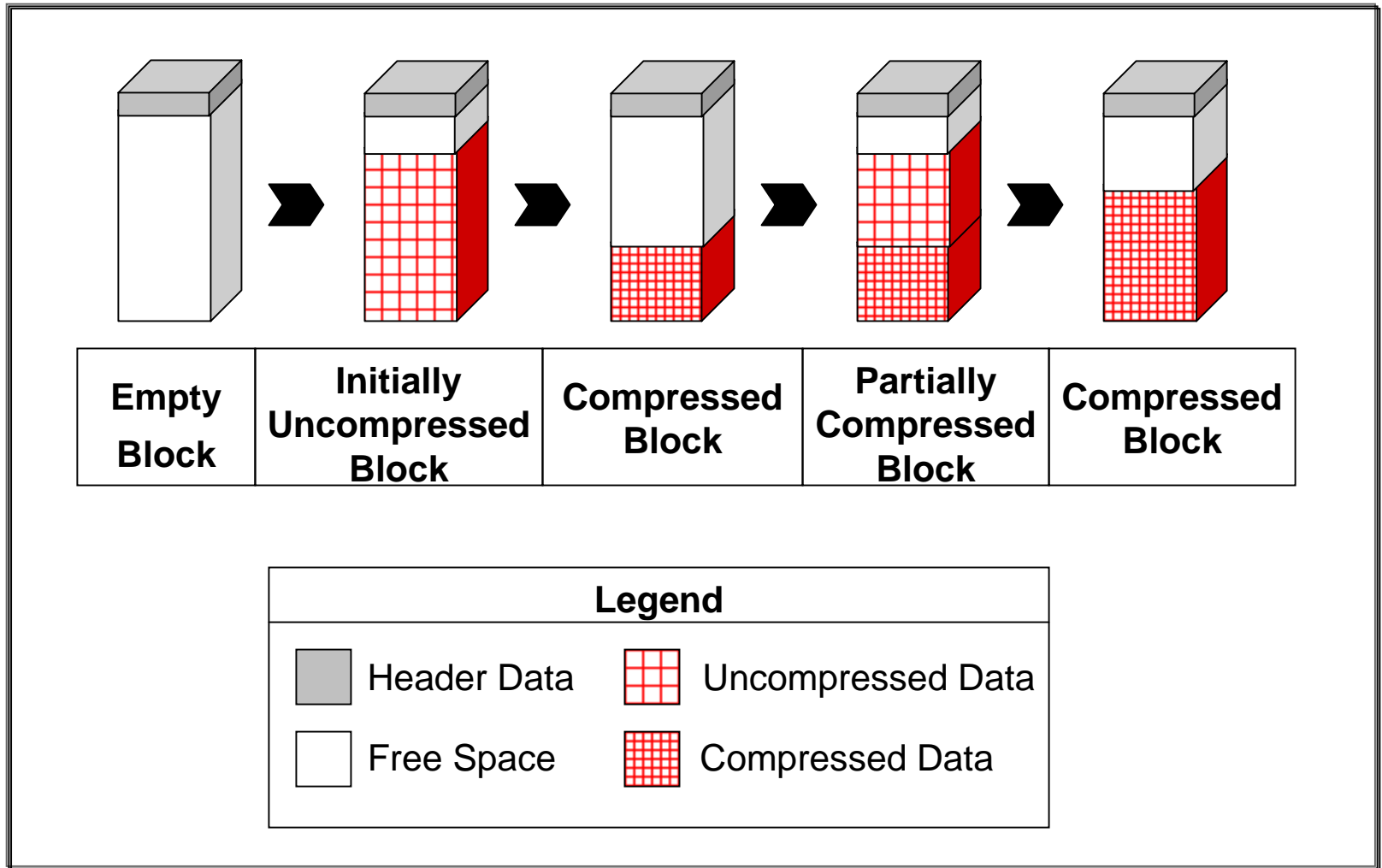
# Table Compression

- Introduced in Oracle Database 9i Release 2
  - Compression during bulk load operations (Direct Load, CTAS)
  - Data modified using conventional DML not compressed
- Optimized compression algorithm for relational data
- Improved performance for queries accessing large amounts of data
  - Fewer IOs
  - Buffer Cache efficiency
- Data is compressed at the database block level
- Compression enabled at either the table or partition level
- Completely transparent to applications

# OLTP Table Compression

- Oracle Database 11g extends table compression for OLTP data
  - Support for conventional DML Operations (INSERT, UPDATE)
- New algorithm significantly reduces write overhead
  - Batched compression ensures no impact for most OLTP transactions
- No impact on reads
  - Reads may actually see improved performance due to fewer IOs and enhanced memory efficiency

# OLTP Table Compression Process



# Block-Level *Batch* Compression



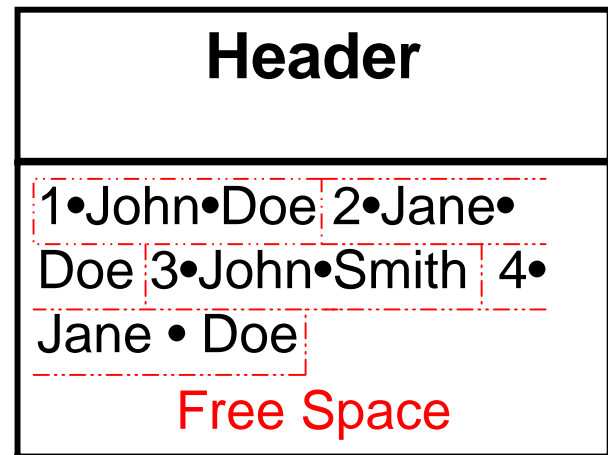
- Patent pending algorithm minimizes performance overhead and maximizes compression
- Individual INSERT and UPDATES do not cause recompression
- Compression cost is amortized over several DML operations
- Block-level (Local) compression keeps up with frequent data changes in OLTP environments
  - Competitors use static, fixed size dictionary table thereby compromising compression benefits
- Extends industry standard compression algorithm to databases
  - Compression utilities such as GZIP and BZ2 use similar adaptive, block level compression

# OLTP Table Compression

## Employee Table

ID	FIRST_NAME	LAST_NAME
1	John	Doe
2	Jane	Doe
3	John	Smith
4	Jane	Doe

## Initially Uncompressed Block



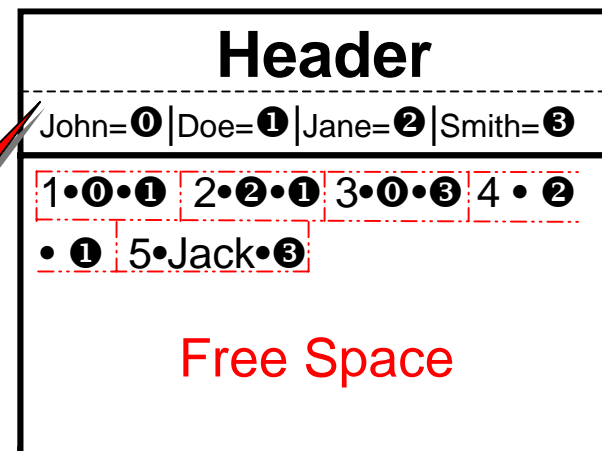
```
INSERT INTO EMPLOYEE
VALUES (5, 'Jack', 'Smith');
COMMIT;
```

# OLTP Table Compression

## Employee Table

ID	FIRST_NAME	LAST_NAME
1	John	Doe
2	Jane	Doe
3	John	Smith
4	Jane	Doe
5	Jack	Smith

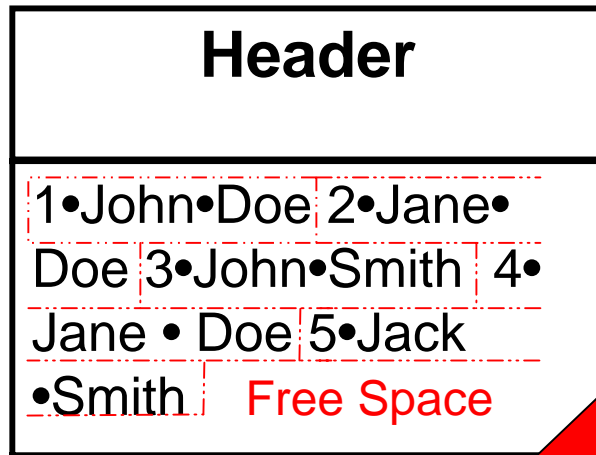
## Compressed Block



Local  
Symbol Table

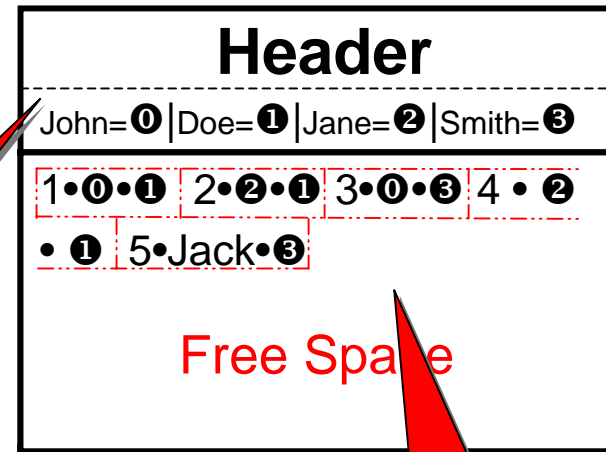
# OLTP Table Compression

## Uncompressed Block



Local  
Symbol Table

## Compressed Block



More Data  
Per Block

# Table Compression Syntax

OLTP Table Compression Syntax:

```
CREATE TABLE emp (  
    emp_id NUMBER  
    , first_name VARCHAR2(128)  
    , last_name VARCHAR2(128)  
    ) COMPRESS FOR ALL OPERATIONS;
```

---

Direct Load Compression Syntax (default):

```
CREATE TABLE emp (  
    emp_id NUMBER  
    , first_name VARCHAR2(128)  
    , last_name VARCHAR2(128)  
    ) COMPRESS [FOR DIRECT_LOAD OPERATIONS];
```

# OLTP Table Compression

## *Best Practices*

- Compress your 10 Largest Tables
  - 80/20 Rule – 20% of your Tables Consume 80% of your Space
- Better Compression with Bigger Block Sizes
  - Higher Probability of Duplicate Values
- B-Tree Index Compression
  - Validate Index and Review INDEX\_STATS
    - INDEX\_STATS.OPT\_CMPR\_COUNT
    - INDEX\_STATS.OPT\_CMPR\_PCTSAVE
- Bitmap Indexes are Highly Compressed
  - Good for low and medium cardinality

# OLTP Table Compression

## *Getting Started with Compression*

- Compression Advisor
  - Shows projected compression ratio for uncompressed tables
  - Reports actual compression ratio for compressed tables



```
oracle@obe11g:~/advisor
File Edit View Terminal Tabs Help
SQL> SET SERVEROUTPUT ON
SQL> EXEC dbms_tabcomp.getratio(tabname=>'SH.HZ_PARAM_TAB_C',sampling_percent=>20)

Sampling table : SH.HZ_PARAM_TAB_C
Sampling percentage : 20%
Compression ratio by block count : 4.23837209302325581395348837209302325581
Compression ratio by row count : 4.24324324324324324324324324324324324

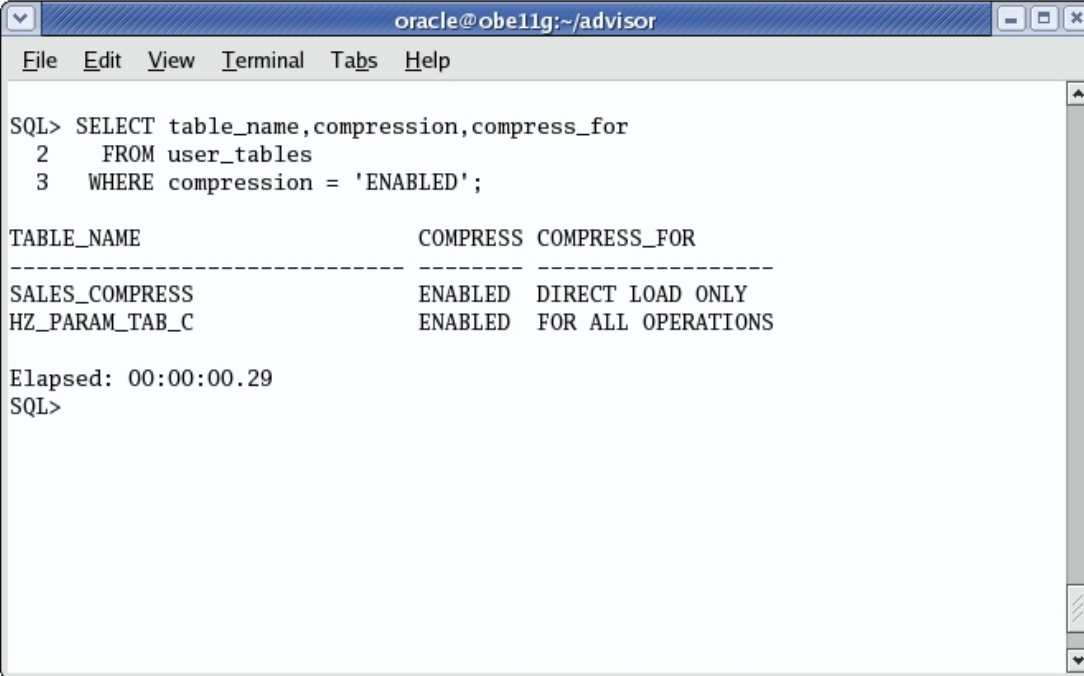
PL/SQL procedure successfully completed.

SQL> SQL> █
```

# OLTP Table Compression

## *Getting Started with Compression*

- Monitoring Compression
  - DBA\_TABLES
    - COMPRESSION (ENABLED/DISABLED)
    - COMPRESS\_FOR (ALL OPERATIONS / DIRECT LOAD OPERATIONS)



```
oracle@obe11g:~/advisor
File Edit View Terminal Tabs Help

SQL> SELECT table_name,compression,compress_for
2 FROM user_tables
3 WHERE compression = 'ENABLED';

TABLE_NAME                COMPRESS COMPRESS_FOR
-----
SALES_COMPRESS            ENABLED  DIRECT LOAD ONLY
HZ_PARAM_TAB_C            ENABLED  FOR ALL OPERATIONS

Elapsed: 00:00:00.29
SQL>
```

# Table Compression Results

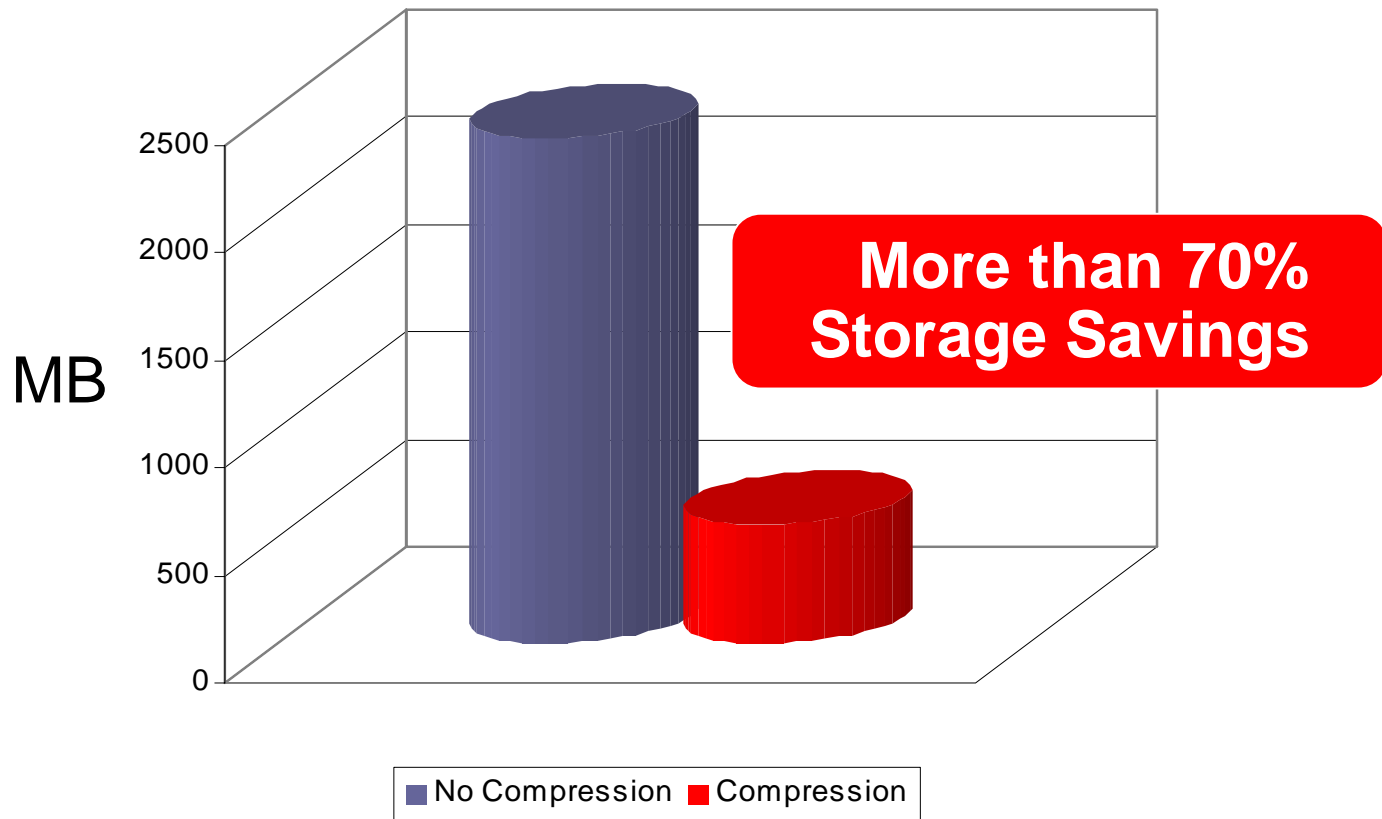


# Real World Compression Overview

- Data from Oracle's implementation of Oracle Applications
  - Compressed the 10 Largest Tables
    - Two copies of each table: Compressed and Uncompressed
  - Oracle Enterprise Linux
  - Oracle Database 11g Release 1
- Test Queries
  - Full Table Scan
  - Index Range Scan
  - DML Operations (Insert, Update, Delete)

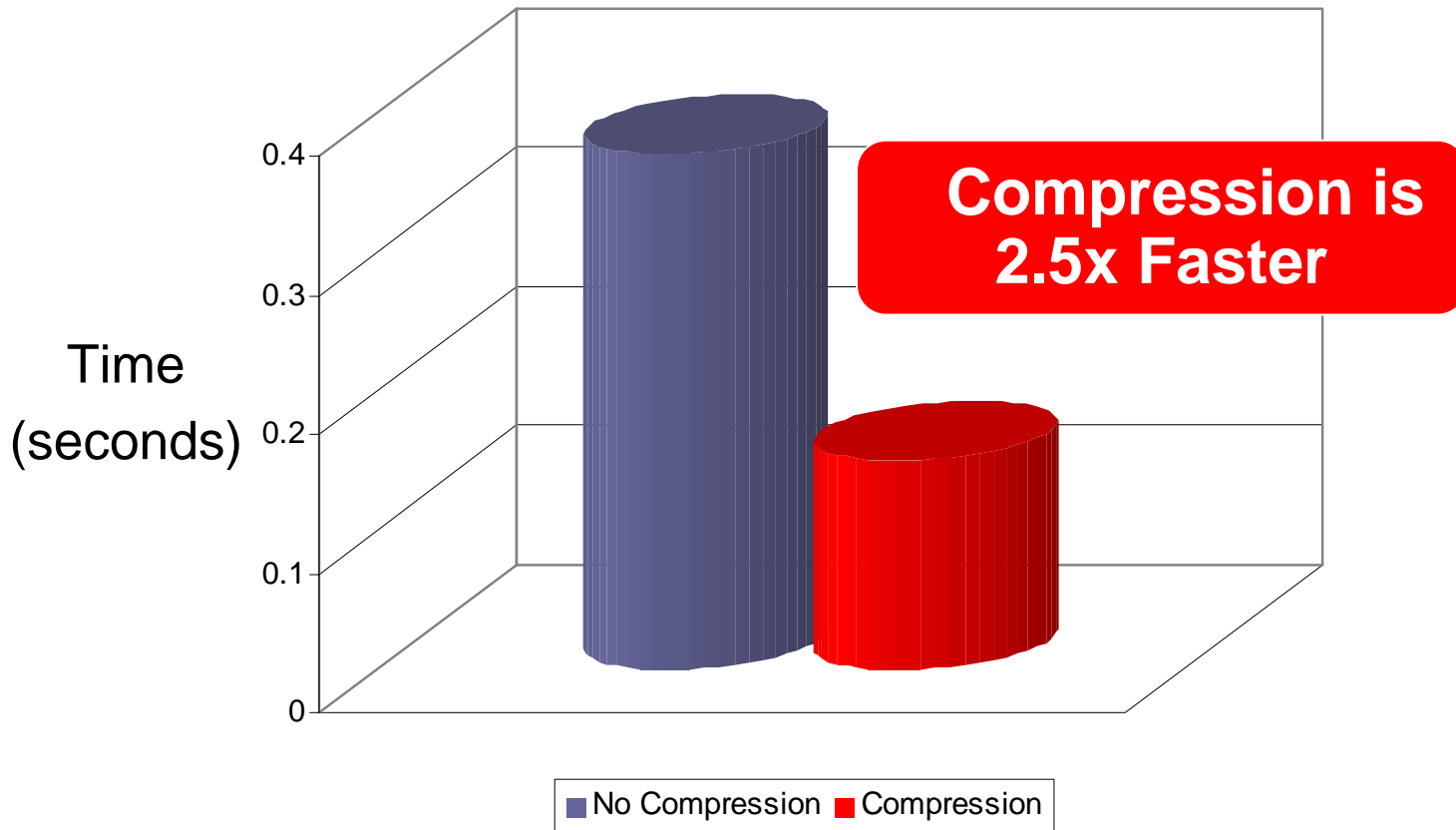
# Real World Compression Results

## Storage Utilization



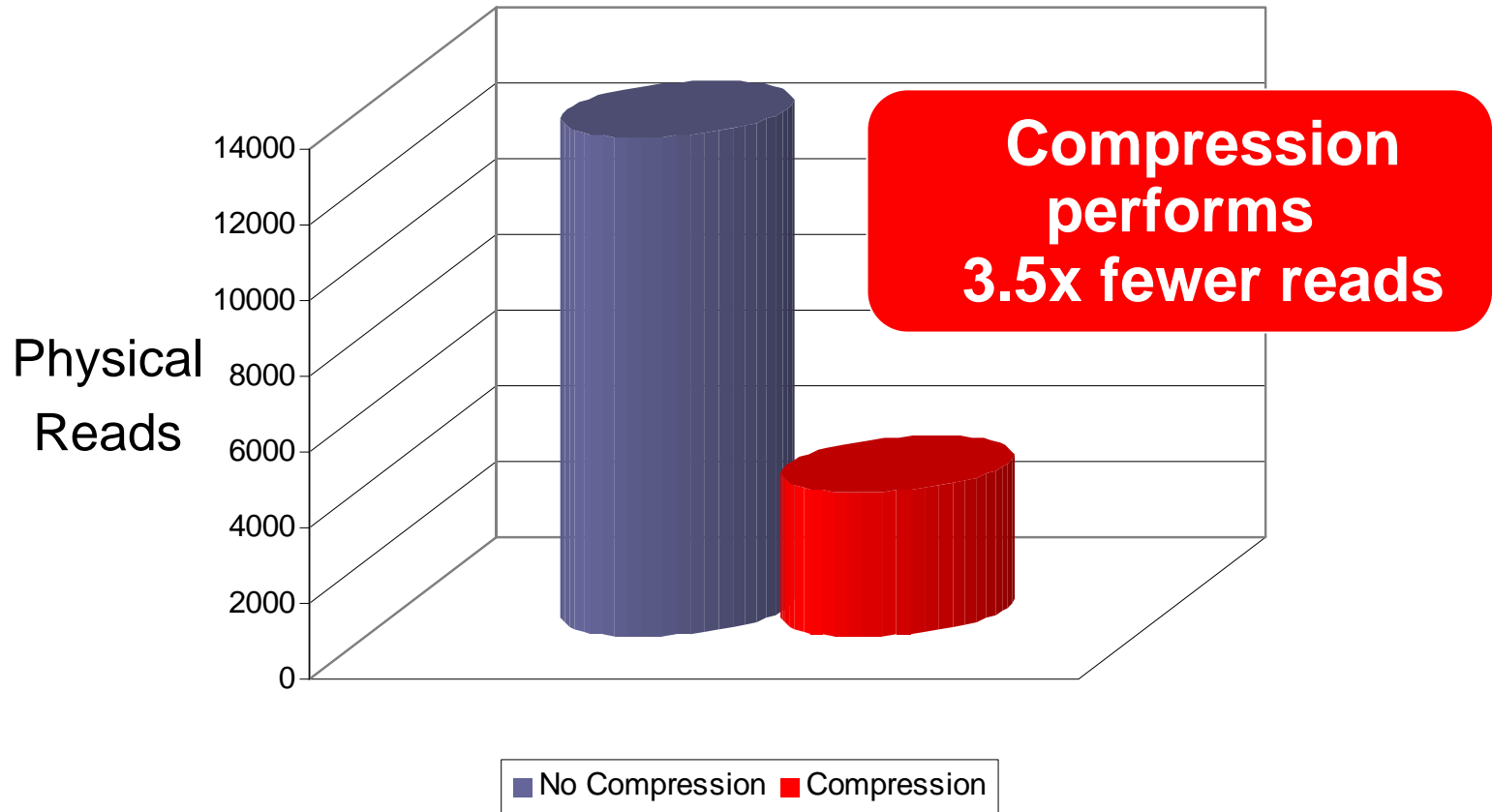
# Real World Compression Results

## Table Scan Performance



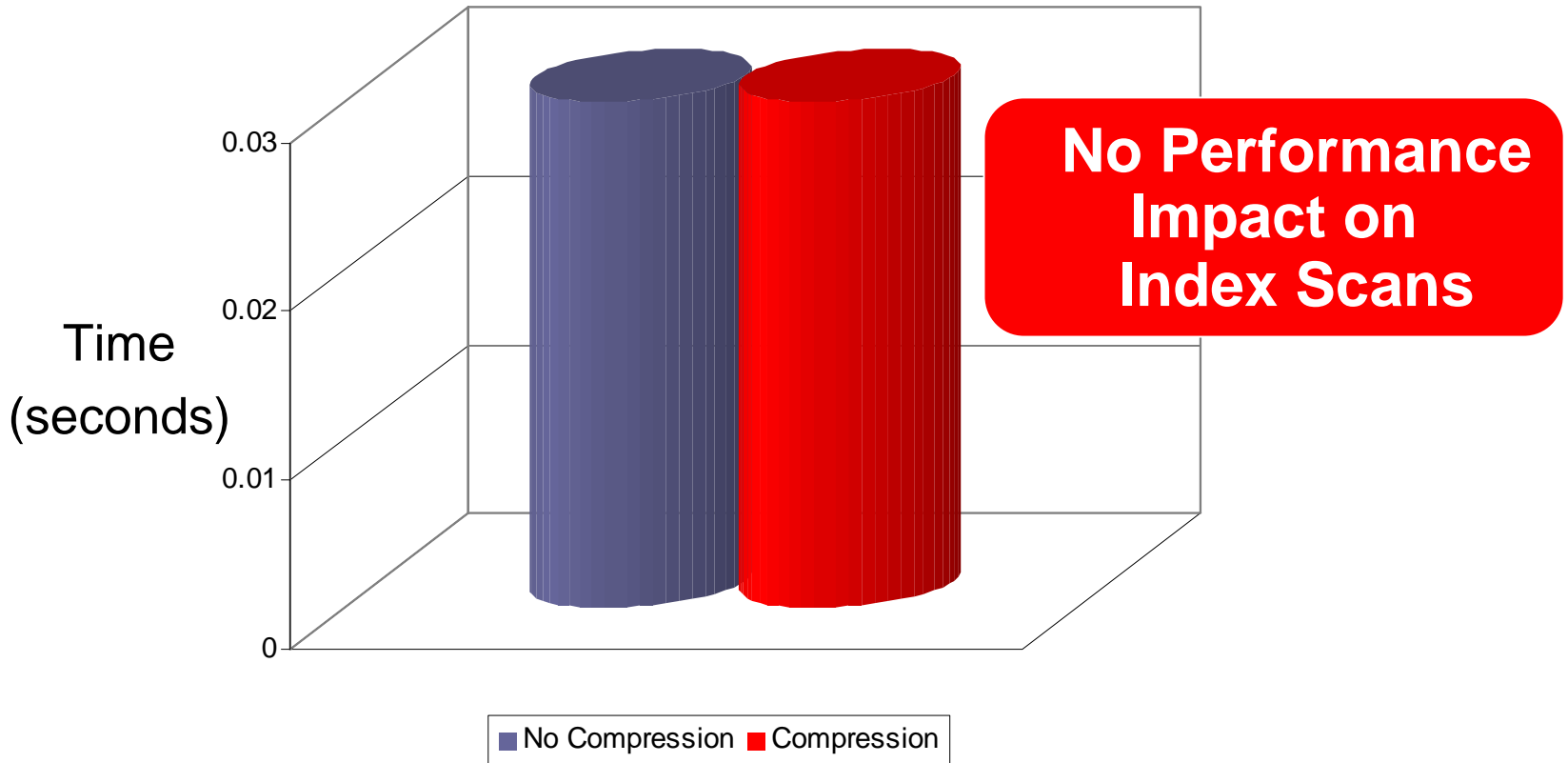
# Real World Compression Results

## Table Scan Reads



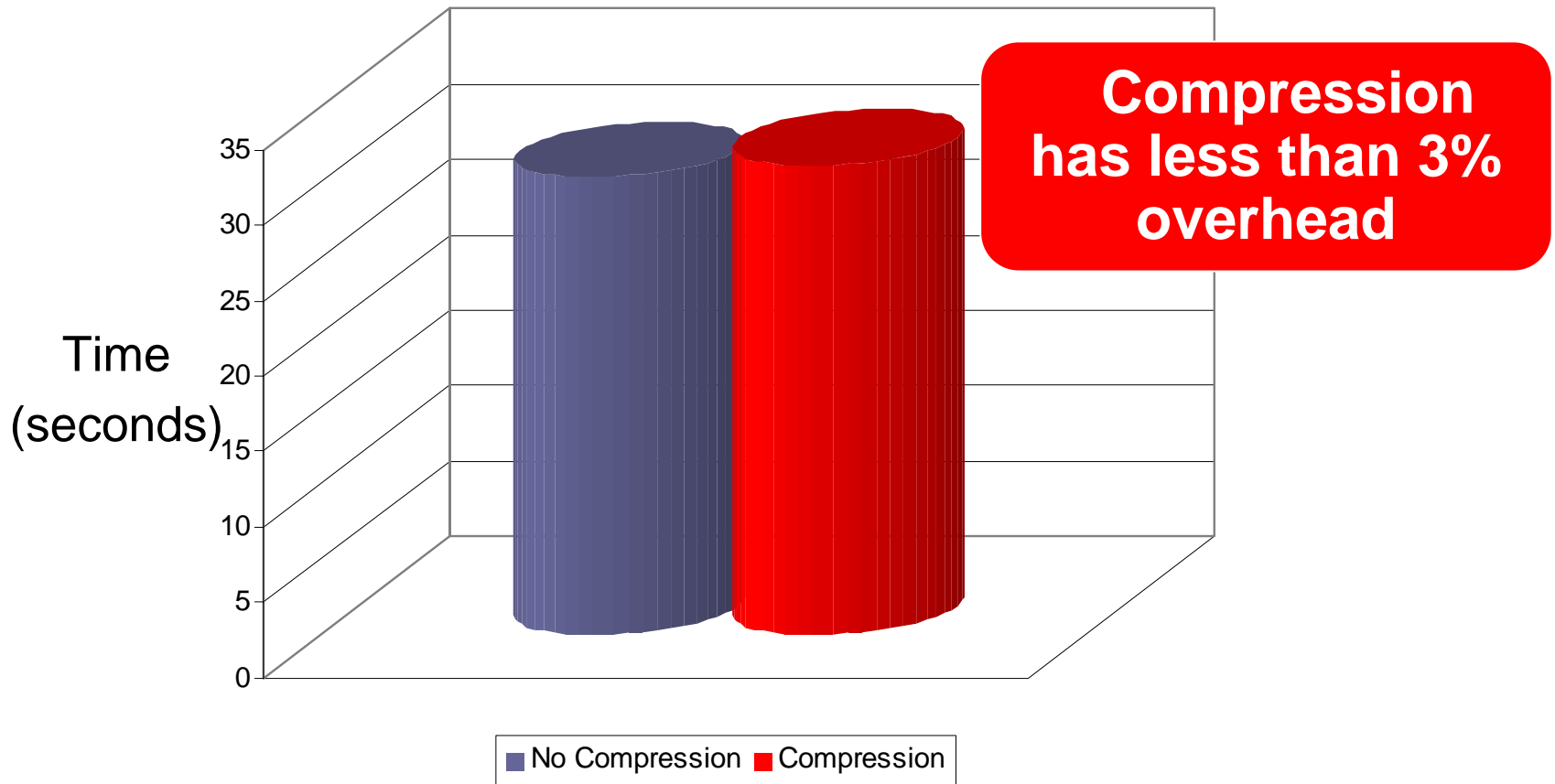
# Real World Compression Results

## Index Range Scan Performance



# Real World Compression Results

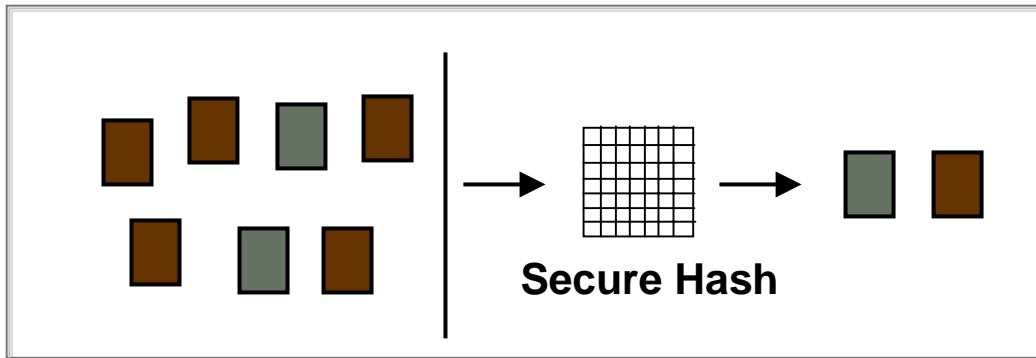
## DML Performance



# Introduction to SecureFiles

- SecureFiles is a new 11g feature designed to break the performance barrier keeping file data out of databases
- Next-generation LOB
  - Superset of LOB interfaces allows easy migration from LOBs
  - Transparent deduplication, compression, and encryption
  - Leverage the security, reliability, and scalability of database
- Enables consolidation of file data with associated relational data
  - Single security model
  - Single view of data
  - Single management of data
  - Scalable to any level using SMP scale-up or grid scale-out

# SecureFiles Deduplication



- Enables storage of a single physical image for duplicate data
- Significantly reduces space consumption
- Dramatically improves writes and copy operations
- No adverse impact on read operations
  - May actually improve read performance for cache data
- Duplicate detection happens within a table, partition or sub-partition
- Specially useful for content management, email applications and data archival applications

# SecureFiles Compression

- Huge storage savings
  - Industry standard compression algorithms
  - 2-3x compression for typical files (combination of doc, pdf, xml)
- Allows for random reads and writes to Compressed SecureFile data
- Can be specified at a partition level
- Automatically detects if SecureFile data is compressible
  - Skips compression for already compressed data
  - Auto-turn off compression when space savings are minimal or zero
- Two levels of compression provide different compression ratios
- SecureFiles Compression is independent of table or index compression

# SecureFiles Compression Syntax

## Compression Syntax

```
CREATE TABLE docs (  
  doc_id NUMBER,  
  doc BLOB)  
  LOB(image) STORE AS SECUREFILE  
  (TABLESPACE lob_tbs COMPRESS);
```

---

## Deduplication Syntax

```
CREATE TABLE images (  
  image_id NUMBER,  
  image BLOB)  
  LOB(image) STORE AS SECUREFILE  
  (TABLESPACE lob_tbs DEDUPLICATE);
```

# Data Pump Compression

- Metadata compression available since Oracle Database 10g
- Oracle Database 11g extends compression to table data during exports
  - No need to decompress before import
- Single step compression of both data and metadata
  - Compressed data directly hits disk resulting in reduced disk space requirements
  - Internal tests reduced dump file size up to 75%
- Compression factor comparable to GNU gzip utility
- Application transparent
  - Complete Data Pump functionality available on compressed files

# Data Pump Compression

- Performance cost: ~10% overhead
- Compression Ratio: comparable to gzip

Compression Method	OE/SH Schemas	Spatial Table	Spatial Schema
<code>expdp compression=none</code>	6.0 MB	26.6 MB	443 MB
<code>expdp compression=all</code>	1.5 MB (74.7%)	9.9 MB (62.7%)	140 MB (68.4%)
<code>gzip -cv1</code>	1.1 MB (82.7%)	11.4 MB (57.1%)	162 MB (63.4%)
<code>gzip -cv6</code>	835 KB (86.2%)	10.2 MB (61.7%)	142 MB (68.0%)
<code>gzip -cv9</code>	818 KB (86.5%)	10.1 MB (62.0%)	141 MB (68.2%)
<code>compress</code>	1.6 MB (74.2%)	13.8 MB (48.1%)	198 MB (55.3%)

# Backup Compression

- Fast RMAN Compression
  - Compresses the backup set contents before writing them to disk or tape
  - No extra decompression steps are required during recovery when you use RMAN compression
  - High performance, industry standard compression algorithm
    - 40% faster backup compression versus Oracle Database 10g
  - Suitable for fast, incremental daily backups
  - Reduces network usage

# Backup Compression Syntax

## FAST RMAN Compression Configuration

```
RMAN> CONFIGURE COMPRESSION ALGORITHM 'zlib';
```

## RMAN Compression Syntax

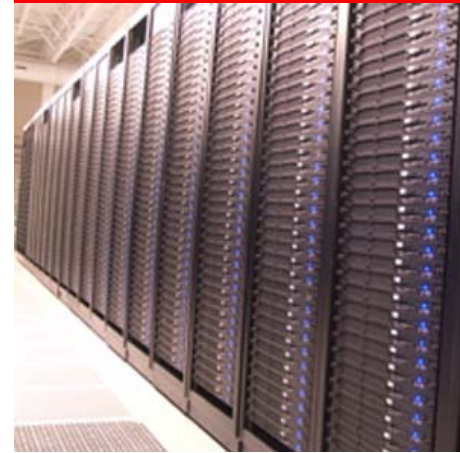
```
RMAN> backup as COMPRESSED BACKUPSET database  
archive log all
```

---

## DataPump Syntax

```
PROMPT> expdp hr FULL=y  
DUMPFILE=dpump_dir:full.dmp COMPRESS
```

# **RMAN Compression Results**

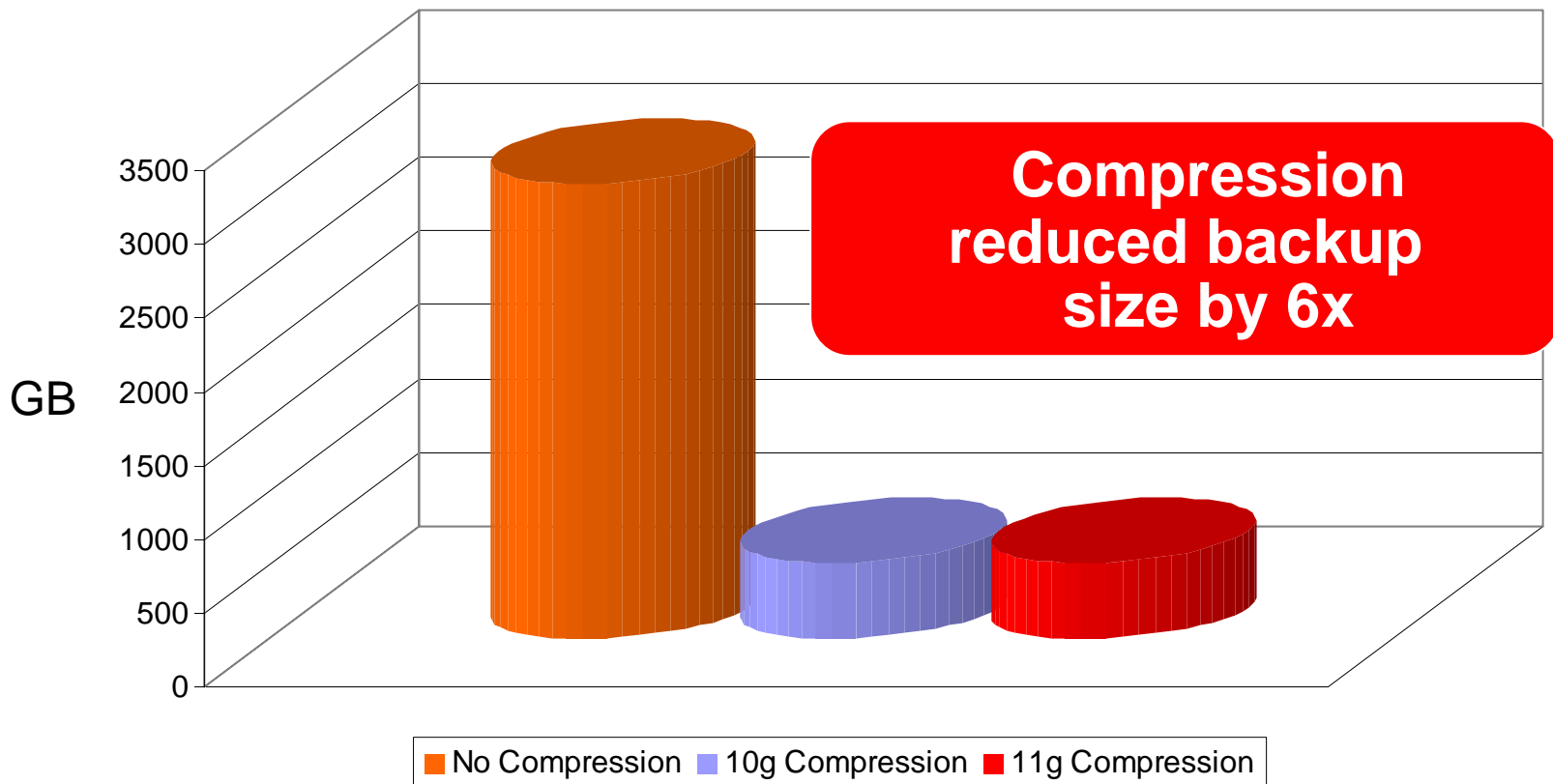


# RMAN Compression Overview

- Data from Oracle's implementation of Oracle Applications
  - 3.5 GB Database
  - Oracle Enterprise Linux
  - Oracle Database 11g Release 1
- Test 1: Slow I/O (16 MB/s)
  - 11g RMAN without Compression
  - 10g RMAN with Compression
  - 11g RMAN with FAST Compression
- Test 2: Fast I/O (200 MB/s)
  - 11g RMAN without Compression
  - 10g RMAN with Compression
  - 11g RMAN with FAST Compression

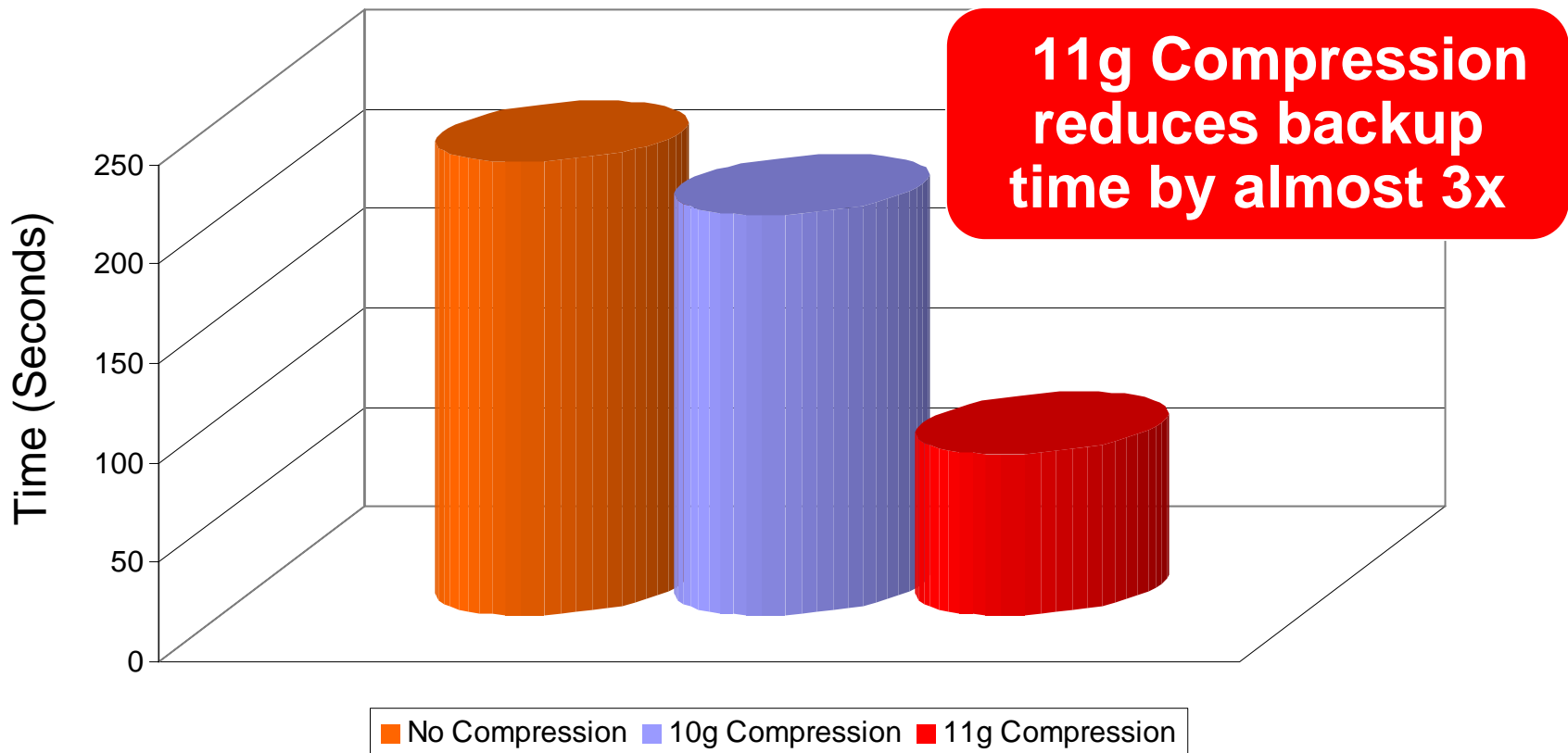
# Backup Compression Results

## Backup Size Comparison



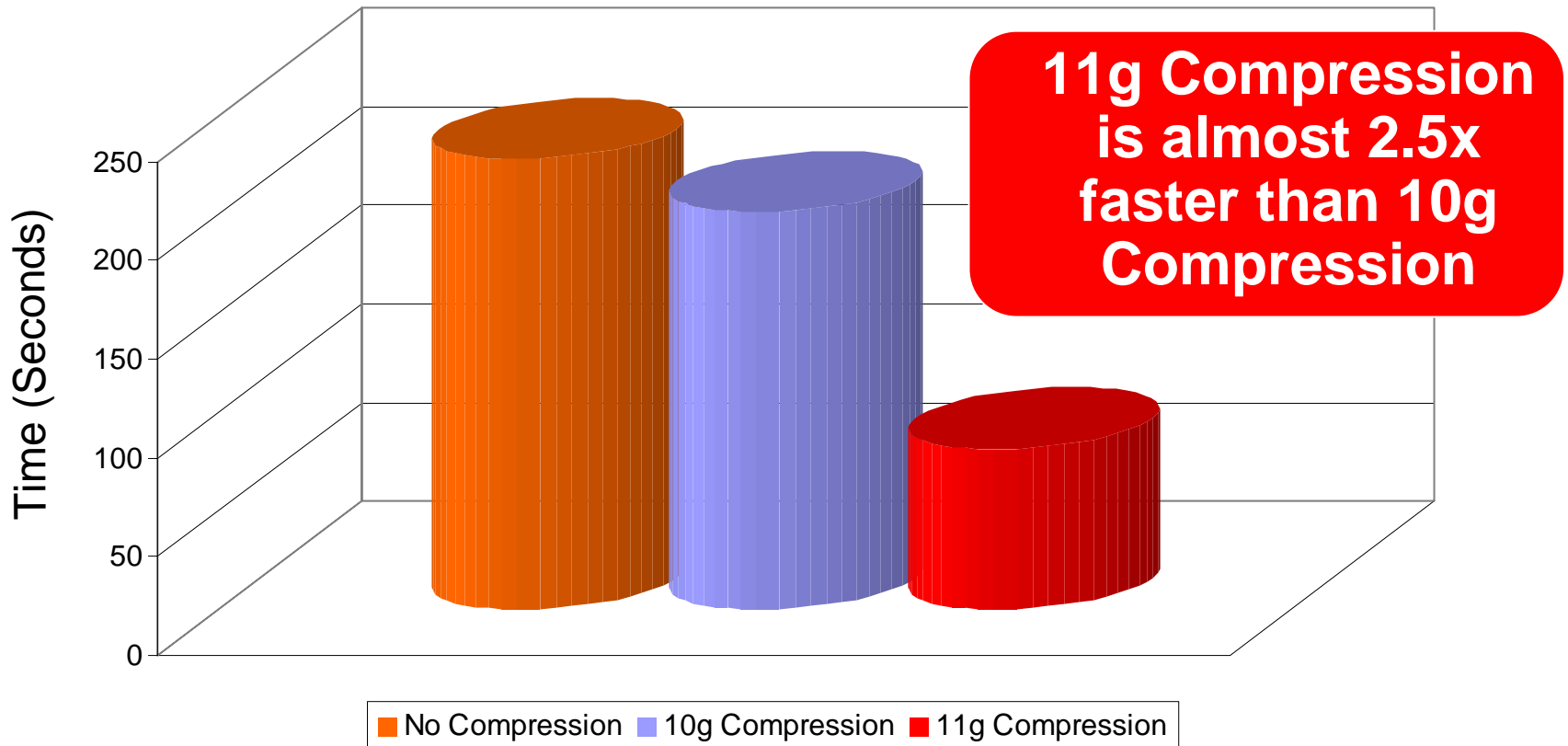
# Backup Compression

## Backup **Speed** Comparison Slow I/O (Tape)



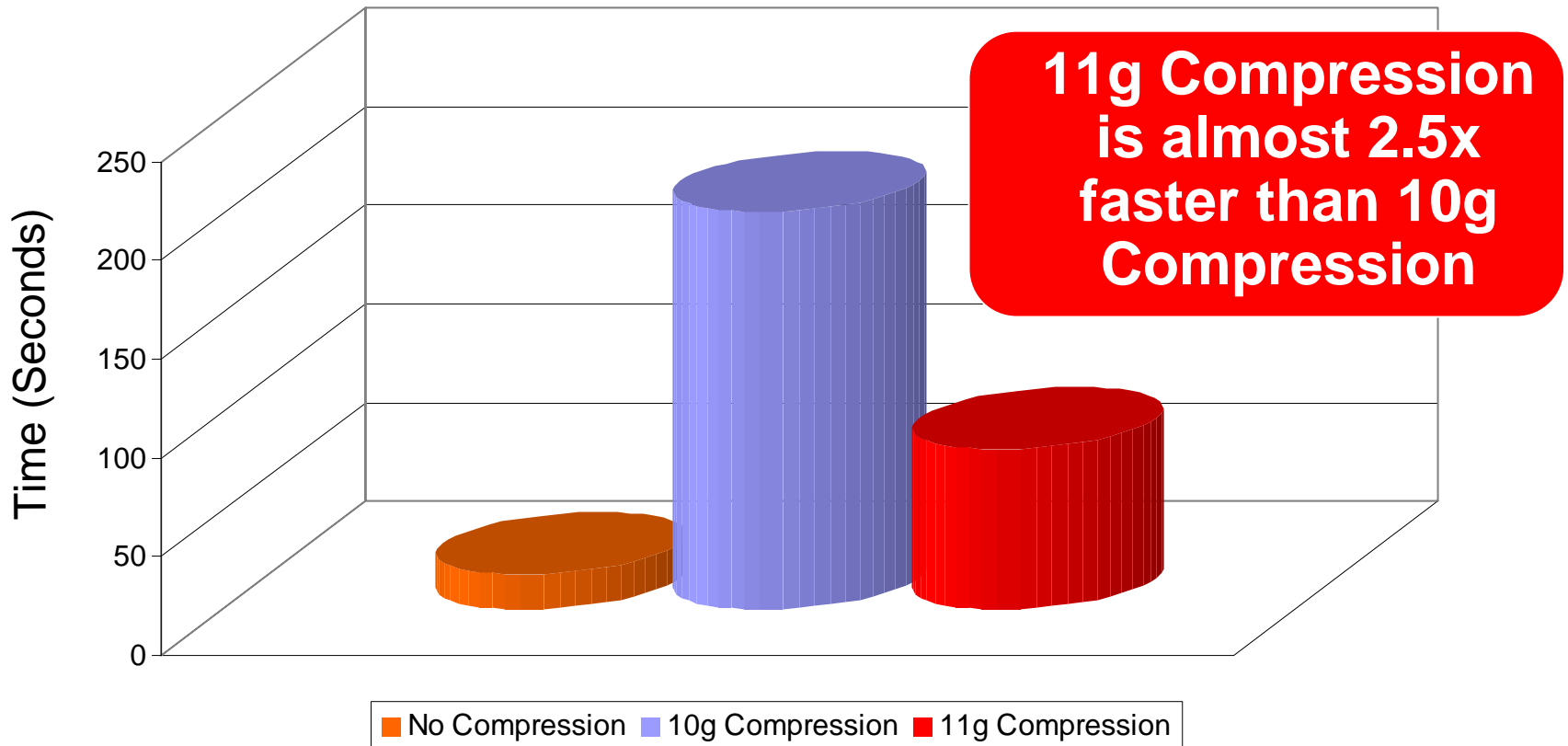
# Backup Compression

## Backup **Speed** Comparison Slow I/O (Tape)



# Backup Compression

## Backup **Speed** Comparison Fast I/O (Disk)



# Oracle Data Guard



- Redo Shipping
  - Send redo data over network from primary to standby
  - Size of redo data typically small (transactional) and not network-bound
- Gap Resolution
  - After network outage – resynchronize standby
  - Size of redo data much larger

# Network Compression

## *Oracle Data Guard Redo Transport Services*

- Fast re-sync of standby database after network outages
- Lower bandwidth networks (<100Mbps)
  - 15-35% less time required to transmit 1 GB of data
  - Bandwidth consumption reduced up to 35%
- High bandwidth networks (>100 Mbps)
  - Compression will not reduce transmission time
  - But will reduce bandwidth consumption up to 35%

# Competitive Analysis



# Competitive Analysis – DB2

<b>Oracle</b>	<b>IBM DB2</b>
Block level compression	Table/partition level compression dictionary
<ul style="list-style-type: none"><li>- Adaptive / dynamic compression</li><li>- Unlimited compression values</li></ul>	<ul style="list-style-type: none"><li>- New data may not be compressed / offline rebuild symbol table</li><li>- Max 4K values per table</li></ul>
Zero decompression overhead	Some decompression overhead
<ul style="list-style-type: none"><li>- Minimal compression overhead</li><li>- Batched compression</li></ul>	<ul style="list-style-type: none"><li>- More compression overhead</li><li>- Transactional compression</li></ul>
Index compression	None
Unstructured data compression and de-duplication (SecureFiles)	None

# Competitive Analysis – DB2

- Even without compression, Oracle needs less disk space than DB2:
  - Oracle uses variable length representation for numbers – DB2 uses fixed length
  - DB2 has more overhead for VARCHAR data
- SAP BW data needs 30-50% less disk space if stored in Oracle

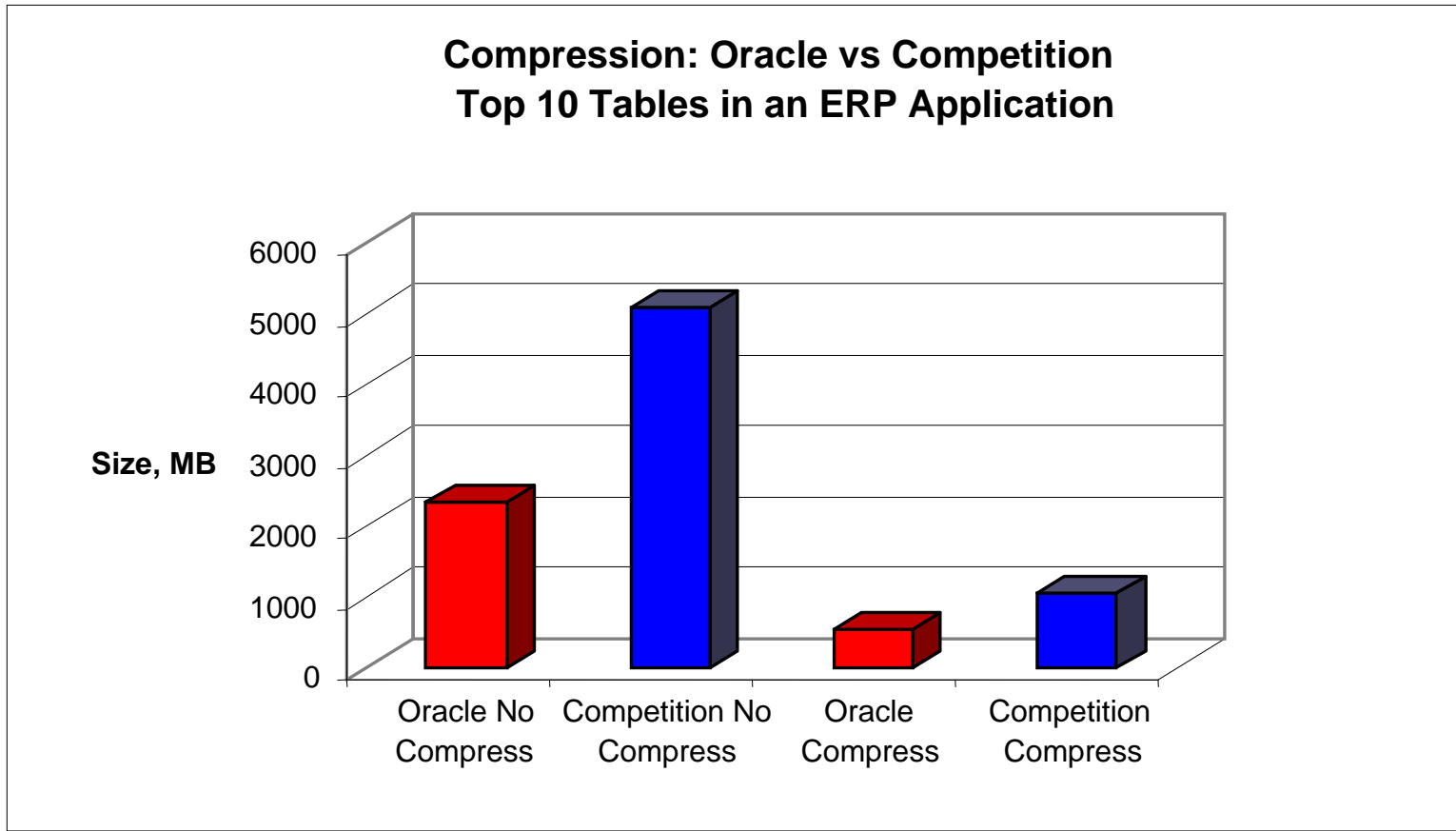
# Competitive Analysis – Teradata

<b>Oracle</b>	<b>Teradata</b>
Block level compression	Field level compression
<ul style="list-style-type: none"><li>- Dynamic compression values</li><li>- Unlimited values</li></ul>	<ul style="list-style-type: none"><li>- Admin must define compression values</li><li>- Max 255 compression values</li></ul>
All data types supported	Limited data type support
<ul style="list-style-type: none"><li>- Minimal compression overhead</li><li>- Batched compression</li></ul>	<ul style="list-style-type: none"><li>- More compression overhead</li><li>- Transactional compression</li></ul>
Backup compression	None
Unstructured data compression and de-duplication (SecureFiles)	None

# Competitive Analysis – Hardware Based Compression

<b>Oracle</b>	<b>Hardware Compression</b>
Database specific compression algorithm	Generic compression algorithm - deficient for databases
Fine grained compression – compress at tablespace, table or partition level	No fine grained compression - compress at file level
Improved read performance in several cases – no decompression overhead	Poor read performance – significant decompression overhead
Improved memory efficiency - data stays compressed in memory	No memory benefits - data needs to be decompressed
Batched algorithm for minimal compression overhead	Data updates are very expensive
Benefits automatically cascade to all environments	Benefits limited to specific hardware environment

# Competitive Analysis



# Summary

- Advanced Compression Option contains comprehensive data compression capabilities for all types of data
  - Structured, Unstructured, Backup, Network Transport
- Reduces storage consumption by 2 to 4 times
- Improves read performance
- Enhances memory, buffer cache utilization
- Complete application transparency
- Benefits diverse application workloads

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