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Overview of Using Oracle Compression Advisor

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Purpose Statement

This document provides an overview of features and enhancements included in release 23ai. It is intended solely to help you assess the business benefits of upgrading to 23ai and planning for the implementation and upgrade of the product features described.

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Table of contents

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Introduction

Oracle Advanced Compression includes a comprehensive set of compression capabilities to help organizations maximize resource utilization and reduce costs. Advanced Compression allows IT administrators to significantly reduce their overall database storage footprint, and improve query performance, by enabling compression for all types of data, including:

Advanced Row Compression

Enables table data to be compressed during all types of data manipulation operations, including DML INSERT and UPDATE operations. An intelligent algorithm minimizes compression overhead during write operations, thereby making compression viable for both Data Warehouse and OLTP workloads

Advanced LOB Compression

Provides compression for LOB segments managed by Oracle SecureFiles – a high performance and powerful infrastructure for managing unstructured data such as images, documents, videos and more

Advanced Index Compression

Reduces the size of supported unique, and non-unique indexes. Advanced Index Compression provides significant space savings while also improving performance for queries that are executed using indexes

Compression Advisor

An easy way to get started, with Advanced Compression, is by using the free compression advisor.

The “DBMS_COMPRESSION” PL/SQL package (commonly called Compression Advisor) gathers compression-related information within a database environment. This includes estimating the compressibility of both uncompressed partitioned, and non-partitioned tables, and gathering row-level compression information on previously compressed tables/partitions. Compression advisor provides organizations with the storage reduction information needed to make compression-related usage decisions.

The output of running compression advisor is an estimation of the compression ratio, for the specific table, that was the target of compression advisor. The output indicates the “COMPRESSION RATIO” presented as a number such as 2.1. This number indicates that, for this specific table or partition, the estimated compression ratio is 2.1x, which represents about a 50% reduction in the footprint of the table or partition should compression be enabled.

The compression ratio achieved in a given environment depends on the data being compressed, specifically the cardinality of the data. In general, organizations can expect to reduce their storage space consumption by a factor of up to 2x to 4x by using Advanced Row Compression. That is, the amount of space consumed by uncompressed data will be two to four times larger than that of the compressed data.

Compression Advisor is included with Oracle Database Enterprise Edition.

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Using the GET_COMPRESSION_RATIO Procedure

When using the GET_COMPRESSION_RATIO procedure to estimate compression ratios, different constants are specified as parameters, these include:

Constant	Type	Value	Description
COMP_NOCOMPRESS	NUMBER	1	No compression
COMP_ADVANCED	NUMBER	2	Advanced row compression
COMP_QUERY_HIGH	NUMBER	4	High for query warehouse compression (Hybrid Columnar Compression)
COMP_QUERY_LOW	NUMBER	8	Low for query warehouse compression (Hybrid Columnar Compression)
COMP_ARCHIVE_HIGH	NUMBER	16	High archive compression (Hybrid Columnar Compression)
COMP_ARCHIVE_LOW	NUMBER	32	Low archive compression (Hybrid Columnar Compression)
COMP_BLOCK	NUMBER	64	Compressed block
COMP_LOB_HIGH	NUMBER	128	High compression level for LOB operations
COMP_LOB_MEDIUM	NUMBER	256	Medium compression level for LOB operations
COMP_LOB_LOW	NUMBER	512	Low compression level for LOB operations
COMP_INDEX_ADVANCED_HIGH	NUMBER	1024	High compression level for indexes
COMP_INDEX_ADVANCED_LOW	NUMBER	2048	Low compression level for indexes
COMP_RATIO_LOB_MINROWS	NUMBER	1000	Minimum required number of LOBs in the object for which LOB compression ratio is to be estimated
COMP_BASIC	NUMBER	4096	Basic table compression
COMP_RATIO_LOB_MAXROWS	NUMBER	5000	Maximum number of LOBs used to compute the LOB compression ratio
COMP_INMEMORY_NOCOMPRESS	NUMBER	8192	In-Memory with no compression
COMP_INMEMORY_DML	NUMBER	16384	In-Memory compression level for DML
COMP_INMEMORY_QUERY_LOW	NUMBER	32768	In-Memory compression level optimized for query performance
COMP_INMEMORY_QUERY_HIGH	NUMBER	65536	In-Memory compression level optimized on query performance as well as space saving
COMP_INMEMORY_CAPACITY_LOW	NUMBER	131072	In-Memory low compression level optimizing for capacity
COMP_INMEMORY_CAPACITY_HIGH	NUMBER	262144	In-Memory high compression level optimizing for capacity
COMP_RATIO_MINROWS	NUMBER	1000000	Minimum required number of rows in the object for which HCC ratio is to be estimated
COMP_RATIO_ALLROWS	NUMBER	-1	To indicate the use of all the rows in the object to estimate HCC ratio
OBJTYPE_TABLE	PLS_INTEGER	1	Identifies the object whose compression ratio is estimated as of type table
OBJTYPE_INDEX	PLS_INTEGER	2	Identifies the object whose compression ratio is estimated as of type index

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GET_COMPRESSION_RATIO Procedure Parameters

Parameter	Description
scratchtbsname	Temporary scratch tablespace that can be used for analysis
ownname / tabowner	Schema of the table to analyze
tabname	Name of the table to analyze
objname	Name of the object
subobjname	Name of the partition or sub-partition of the object
comptype	Compression types for which analysis should be performed When the object is an index, only the following compression types are valid: COMP_INDEX_ADVANCED_HIGH (value 1024) and COMP_INDEX_ADVANCED_LOW (value 2048). **Note:** The following compression types cannot be specified in this parameter for any type of object: COMP_BLOCK (value 64) and COMP_BASIC (value 4096).
blkcnt_cmp	Number of blocks used by compressed sample of the table
blkcnt_uncmp	Number of blocks used by uncompressed sample of the table
row_cmp	Number of rows in a block in compressed sample of the table
row_uncmp	Number of rows in a block in uncompressed sample of the table
cmp_ratio	Compression ratio, blkcnt_uncmp divided by blkcnt_cmp
comptype_str	String describing the compression type
subset_numrows	Number of rows sampled to estimate compression ratio.
objtype	Type of the object, either OBJTYPE_TABLE or OBJTYPE_INDEX
lobname	Name of the LOB column
partname	In case of partitioned tables, the related partition name
lobcnt	Number of lobs actually sampled to estimate compression ratio
index_cr	List of indexes and their estimated compression ratios

Usage Examples

Below are examples, of the GET_COMPRESSION_RATIO procedure, to estimate the compression ratio of a table, index, and LOB.

Syntax for GET_COMPRESSION_RATIO for a table or index.

```
DBMS_COMPRESSION.GET_COMPRESSION_RATIO (
 scratchtbsname          IN      VARCHAR2,
 ownname                 IN      VARCHAR2,
 objname                 IN      VARCHAR2,
 subobjname              IN      VARCHAR2,
 comptype                IN      NUMBER,
 blkcnt_cmp              OUT     PLS_INTEGER,
 blkcnt_uncmp            OUT     PLS_INTEGER,
 row_cmp                 OUT     PLS_INTEGER,
 row_uncmp               OUT     PLS_INTEGER,
 cmp_ratio               OUT     NUMBER,
 comptype_str            OUT     VARCHAR2,
 subset_numrows          IN      NUMBER  DEFAULT COMP_RATIO_MINROWS,
 objtype                 IN      PLS_INTEGER DEFAULT OBJTYPE_TABLE);
```


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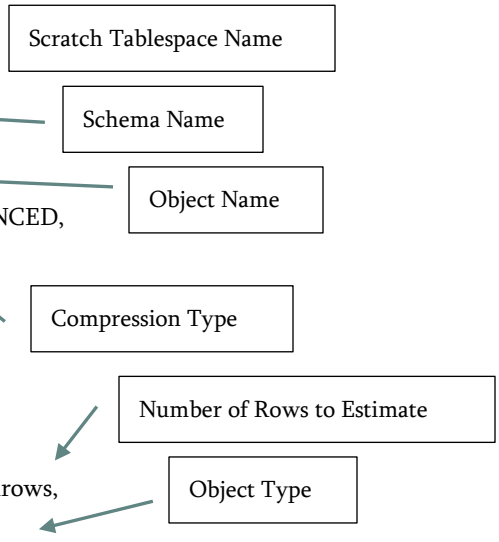
Estimating compression ratio for a table using Advanced Row Compression

```
SET SERVEROUTPUT ON
DECLARE
 blkcnt_cmp          PLS_INTEGER;
 blkcnt_uncmp        PLS_INTEGER;
 row_cmp             PLS_INTEGER;
 row_uncmp           PLS_INTEGER;
 cmp_ratio           NUMBER;
 comptype_str        VARCHAR2(32767);
BEGIN
  DBMS_COMPRESSION.GET_COMPRESSION_RATIO (
        scratchtbsname  => 'USERS' ,
        ownname         => 'TEST' ,
        objname         => 'SALES' ,
        subobjname      =>  NULL ,
        comptype        =>  DBMS_COMPRESSION.COMP_ADVANCED,
        blkcnt_cmp      =>  blkcnt_cmp,
        blkcnt_uncmp    =>  blkcnt_uncmp,
        row_cmp         =>  row_cmp,
        row_uncmp       =>  row_uncmp,
        cmp_ratio       =>  cmp_ratio,
        comptype_str    =>  comptype_str,
        subset_numrows  => DBMS_COMPRESSION.comp_ratio_minrows,
        objtype         => DBMS_COMPRESSION.objtype_table
);
DBMS_OUTPUT.put_line( 'Number of blocks used by the compressed sample of the object :  ' || blkcnt_cmp);
DBMS_OUTPUT.put_line( 'Number of blocks used by the uncompressed sample of the object :  ' || blkcnt_uncmp);
DBMS_OUTPUT.put_line( 'Number of rows in a block in compressed sample of the object :  ' || row_cmp);
DBMS_OUTPUT.put_line( 'Number of rows in a block in uncompressed sample of the object :  ' || row_uncmp);
DBMS_OUTPUT.put_line ('Estimated Compression Ratio of Sample :  ' || cmp_ratio);
DBMS_OUTPUT.put_line( 'Compression Type :  ' || comptype_str);
END;
/
```



Output of Compression Advisor Estimate for Advanced Row Compression (Table)

Number of blocks used by the compressed sample of the object	: 165
Number of blocks used by the uncompressed sample of the object	: 629
Number of rows in a block in compressed sample of the object	: 599
Number of rows in a block in uncompressed sample of the object	: 157
Estimated Compression Ratio of Sample	**: 3.8**
Compression Type	: “Compress Advanced”

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Estimating Compression Ratio for Advanced Index Compression (LOW level)

```
SET SERVEROUTPUT ON
DECLARE
  blkcnt_cmp          PLS_INTEGER;
  blkcnt_uncmp        PLS_INTEGER;
  row_cmp             PLS_INTEGER;
  row_uncmp           PLS_INTEGER;
  cmp_ratio           NUMBER;
  comptype_str        VARCHAR2(32767);
BEGIN
   DBMS_COMPRESSION.GET_COMPRESSION_RATIO (
          scratchtbsname  => 'USERS' ,
          ownname         => 'TEST' ,
          objname         => 'SALES_IDX' ,
          subobjname      =>  NULL ,
          comptype        =>  DBMS_COMPRESSION.COMP_INDEX_ADVANCED_LOW,
          blkcnt_cmp      =>  blkcnt_cmp,
          blkcnt_uncmp    =>  blkcnt_uncmp,
          row_cmp         =>  row_cmp,
          row_uncmp       =>  row_uncmp,
          cmp_ratio       =>  cmp_ratio,
          comptype_str    =>  comptype_str,
          subset_numrows  => DBMS_COMPRESSION.comp_ratio_minrows,
          objtype         => DBMS_COMPRESSION.objtype_index
);
DBMS_OUTPUT.put_line( 'Number of blocks used by the compressed sample of the object :  ' || blkcnt_cmp);
DBMS_OUTPUT.put_line( 'Number of blocks used by the uncompressed sample of the object :  ' || blkcnt_uncmp);
DBMS_OUTPUT.put_line( 'Number of rows in a block in compressed sample of the object :  ' || row_cmp);
DBMS_OUTPUT.put_line( 'Number of rows in a block in uncompressed sample of the object :  ' || row_uncmp);
DBMS_OUTPUT.put_line ('Estimated Compression Ratio of Sample:  ' || cmp_ratio);
DBMS_OUTPUT.put_line( 'Compression Type :  ' || comptype_str);
END;
/
```

Output of Compression Advisor Estimate for Advanced Index Compression (LOW)

```
Number of blocks used by the compressed sample of the object        : 243
Number of blocks used by the uncompressed sample of the object      : 539
Number of rows in a block in compressed sample of the object        : 499
Number of rows in a block in uncompressed sample of the object      : 145
Estimated Compression Ratio of Sample                               : 2.2
Compression Type                                                    : “Compress Advanced Low”
```


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Syntax for GET_COMPRESSION_RATIO for SecureFiles LOBs:

```
DBMS_COMPRESSION.GET_COMPRESSION_RATIO (
 scratchtbsname         IN     VARCHAR2,
 tabowner               IN     VARCHAR2,
 tabname                IN     VARCHAR2,
 lobname                IN     VARCHAR2,
 partname               IN     VARCHAR2,
 comptype               IN     NUMBER,
 blkcnt_cmp             OUT    PLS_INTEGER,
 blkcnt_uncmp           OUT    PLS_INTEGER,
 lobcnt                 OUT    PLS_INTEGER,
 cmp_ratio              OUT    NUMBER,
 comptype_str           OUT    VARCHAR2,
 subset_numrows         IN     number DEFAULT COMP_RATIO_LOB_MAXROWS);
```

Estimating Compression Ratio for Advanced LOB Compression (MEDIUM level)

```
SET SERVEROUTPUT ON
DECLARE
 blkcnt_cmp              PLS_INTEGER;
 blkcnt_uncmp            PLS_INTEGER;
 row_cmp                 PLS_INTEGER;
 lobcnt                  PLS_INTEGER;
 cmp_ratio               NUMBER;
 comptype_str            VARCHAR2(32767);
BEGIN
  DBMS_COMPRESSION.GET_COMPRESSION_RATIO (
        scratchtbsname   => 'USERS' ,
        tabowner         => 'TEST' ,
        tabname          => 'PARTS' ,
        lobname          =>  'PART_DESCRIPTION' ,
        partname         =>  NULL ,
        comptype         =>  DBMS_COMPRESSION.COMP_LOB_MEDIUM,
        blkcnt_cmp       =>  blkcnt_cmp,
        blkcnt_uncmp     =>  blkcnt_uncmp,
        row_cmp          =>  row_cmp,
        lobcnt           =>  lobcnt,
        cmp_ratio        =>  cmp_ratio,
        comptype_str     =>  comptype_str,
        subset_numrows   => DBMS_COMPRESSION.comp_ratio_lob_maxrows
);
DBMS_OUTPUT.put_line( 'Number of blocks used by the compressed sample of the object :  ' || blkcnt_cmp);
DBMS_OUTPUT.put_line( 'Number of blocks used by the uncompressed sample of the object :  ' || blkcnt_uncmp);
DBMS_OUTPUT.put_line( 'Number of rows in a block in compressed sample of the object :  ' || row_cmp);
DBMS_OUTPUT.put_line( 'Number of LOBS actually sampled :  ' || lobcnt);
DBMS_OUTPUT.put_line ('Estimated Compression Ratio of Sample :  ' || cmp_ratio);
DBMS_OUTPUT.put_line( 'Compression Type :  ' || comptype_str);
END;
/
```


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Output of Compression Advisor Estimate for Advanced LOB Compression (MEDIUM level)

Number of blocks used by the compressed sample of the object	: 199
Number of blocks used by the uncompressed sample of the object	: 389
Number of rows in a block in compressed sample of the object	: 293
Number of LOBS actually sampled	: 55
Estimated Compression Ratio of Sample	**: 1.9**
Compression Type	: "Compress Medium"

Understanding Compression Advisor Results

The example advisor output below, the result of running the advisor code above for Advanced Row Compression (Compress Advanced), shows the type of output that is possible with compression advisor.

Number of blocks used by the compressed sample of the object	: 165
Number of blocks used by the uncompressed sample of the object	: 629
Number of rows in a block in compressed sample of the object	: 599
Number of rows in a block in uncompressed sample of the object	: 157
Estimated Compression Ratio of Sample	**: 3.8**
Compression Type	: "Compress Advanced"

In this example, the "Estimated Compression Ratio of Sample" for Advanced Row Compression (Compress Advanced) determined by compression advisor, is 3.8x.This represents an approximate space reduction of up to 74% the table when compressed with Advanced Row Compression.

The Estimated Compression Ratio is shown in **RED** to help identify the output field. The actual output would not appear this way.

Compression advisor typically provides accurate estimates, of the actual compression results obtained after implementing compression.

In general, typical compression ratios for tables, indexes and LOBS includes:

- OLTP Table Compression and Advanced Row Compression users can typically expect compression ratios in the range of up to 2x to 4x
- Hybrid Columnar Compression users can typically expect compression ratios in the range of up to 6x to 15x
- Advanced Index Compression users can typically expect compression ratios in the range of up to 2x to 5x
- Advanced LOB Compression users can typically expect compression ratios in the range of up to 2x to 3x

Note: The compression ratio achieved, in a given environment, depends on the nature of the data being compressed.

It is important to note that compression advisor builds two temporary tables (for comparison purposes) as part of the estimation process for Advanced Row Compression (Hybrid Columnar Compression uses four tables). The temporary tables are created using the prefix 'cmp3$' and/or 'cmp4$' and are dropped by the compression

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advisor when no longer required. Although these temporary tables are removed after compression advisor completes, you will need available free space for compression advisor to build the temporary tables.

SecureFiles LOB Compression Advisor Enhancements

A new parameter, byte_comp_ratio, was added in this release and provides the ratio of bytes of uncompressed data to the bytes of compressed data for LOBs.

In Oracle Database 23ai, the compression advisor for LOBs procedure has also been enhanced to estimate the compression ratio faster for both inline and out-of-line LOBs, while using less space. Now you can also estimate the compression ratio for BasicFiles LOBs. This helps you decide whether you want to compress your BasicFiles LOBs before migrating BasicFiles LOBs to SecureFiles LOBs.

You can also estimate the compression ratio at the LOB byte level, and the time taken, in hours to compress the LOB data in the table.

For example:

Consider that you have inserted 1000 LOBs, of 3K each, in separate tables where one table stored the LOBs inline, and the other table stored the LOBs out-of-line (overriding the default).

By default, if the LOB is less than 4K, then data is stored in the table segment (inline), otherwise, it is stored in a separate LOB segment (out-of-line). Using Compression Advisor, we will estimate the storage savings for both tables, the results of running compression advisor are as follows:

Sample output of compression ratio for table with inline LOBs:

Estimated block compression ratio:	1
Estimated byte compression ratio:	57.6
Space used (in bytes):	0
Space used (in blocks):	0

Sample output of compression ratio for table with out-of-line LOBs:

Estimated block compression ratio:	1
Estimated byte compression ratio:	56.1
Space used (in bytes):	8MB
Space used (in blocks):	1000

In this example, even though the estimated byte and block compression ratios are almost the same for inline and out-of-line LOBs, the space that is used is different.

In the case of the inline table, LOB segment is not used so the space used is 0. In both cases, the data is approximately 3KB, which is small. Therefore, the data before and after compression uses the same number of blocks (that is 1 block), so the block compression ratio is 1. However, the byte level compression ratio byte_comp_ratio, which compares the actual number of bytes used by the LOBs before and after compression, is 57.6 or 56.1.

Disclaimer: The compression ratio is an approximate value, which is calculated based on the sampled rows in the LOB column. The actual space that you save, when you enable compression for the complete table, may be different.

Estimating LOB Deduplication

Advanced LOB Deduplication enables Oracle Database to automatically detect duplicate LOB data, within a LOB column or partition, and conserve space by storing only one copy of the data. Note that Advanced LOB Deduplication is a feature of Advanced Compression.

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You can estimate the space, that you can save, before enabling Advanced LOB Deduplication. This allows you to make an informed decision whether or not to enable LOB deduplication as well as decide whether you want to deduplicate the resultant SecureFiles LOB, before migrating BasicFiles LOBs to SecureFiles LOBs.

The GET_LOB_DEDUPLICATION_RATIO function estimates the storage space that you can save by enabling the deduplication feature, for existing SecureFiles LOBs and returns the deduplication ratio.

Syntax

```
DBMS_LOB.GET_LOB_DEDUPLICATION_RATIO (
  tablespacename    IN     VARCHAR2,
  tabowner          IN     VARCHAR2,
  loccolumnname     IN     VARCHAR2,
  partname          IN     VARCHAR2,
  dedup_ratio       IN     NUMBER,
  subset_numrows    IN     NUMBER DEFAULT
DEDUP_RATIO_LOB_MAXROWS
);
```

The deduplication ratio (dedup_ratio) is estimated for the number of rows in the LOB column that you specify , the syntax above uses DEDUP_RATIO_LOB_MAXROWS to specify all rows be included in the estimate.

The LOB storage savings depends upon the deduplication ratio achieved. For example, say that the deduplication advisor estimated a deduplication ratio of up to 2.33x, this means that generally, the amount of space consumed by the LOBs, without deduplication, will be up to 2.33 times larger.

Note: The maximum number of LOBs that this function can process is 100000 or 1% of the total number of rows in the table, whichever is lesser.

Disclaimer: The deduplication ratio is an approximate value, which is calculated based on the sampled rows in the LOB column. The actual space that you save, when you enable deduplication for the complete table, may be different.

Compression Advisor Best Practices

- If you get this type of message when estimating Hybrid Columnar Compression:

  ORA-12801: error signaled in parallel query server P002
  ORA-64307: Exadata Hybrid Columnar Compression is not
  supported for tablespaces on this storage type
  Solution: Disable parallel processing for the session (set
  parallel_max_servers=0)

- Compression adviser has the restriction that the scratch tablespace cannot be uniform
- In earlier releases, Oracle did require 1M rows in a table for estimating HCC compression ratios with compression advisor – this restriction was removed in Oracle Database release 12.1.0.2 and above
- Outside compression advisor, there are no restrictions with Hybrid Columnar Compression in regard to the minimal amount of data needed (in tables/partitions) with HCC

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More Information

- See the Oracle *PL/SQL Packages and Types Reference* documentation for more information, and usage examples, about the DBMS_SECUREFILES.GET_LOB_DEDUPLICATION_RATIO function and Compression Advisor (DBMS_COMPRESSION)

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