Oracle12c New Features including Release 2 New Features

Dan Hotka
Author/Instructor
Oracle Ace Director 🍀

www.DanHotka.com
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Dan Hotka
Author/Instructor/Oracle Expert
CEO
DHotka@Earthlink.net
515 279 3361
Dan Hotka

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Additional Reading

- **Oracle12c New Features**
  - By Robert Freeman;
  - Available in the book store???
  - www.Amazon.com
Agenda

- Oracle New Features
  - Pluggable Database
  - New Table/Index Partitioning
  - More New Features
    - Full Transportable Export/Import
    - Temporary Undo
    - Multiple Indexes using same columns
    - Transaction Guard
Agenda

- New SQL Syntax
  - New Analytical Functions
  - New SQL Features
  - New Options for Sequences
  - Enhanced Join Syntax
  - Increased column size limits
Agenda

- New PL/SQL Features
  - PL/SQL And SQL
  - Enhanced DBMS_UTILITY
  - New UTL_CALL_STACK
  - Enhanced DBMS_SQL
  - Enhanced Native SQL
Audience Background

A few questions:

– What Oracle Database are you running?
– When do you plan to go to Oracle12?
– Working with Oracle12 Now?
– What is your Oracle background?
  • Newbee 1 – 3 years 4 – 8 years 8+ years?
– What is your main role?
  • Power User  Analyst  Developer  DBA  Management?
#1 Pluggable DB
Pluggable Database

- The ‘c’ in Oracle12
  - Container
    - Plugable databases come into the environment as a database that ‘contains’ other database
  - Consolidate
    - Allows for the sharing of resources, backup/recovery schemes, and ease of management of similar application DBs
  - Cloud
    - This new environment lends itself well for the cloud computing environment
Pluggable Database

How it works:

- **Root**
  - Contains metadata and common users
- **Seed**
  - A template for new PDB’s
- **PDB**
  - The actual application DB...just like a non-CDB.

Illustration from Oracle12.1 Documentation
How it works:

- 1 set of Oracle executables per container
  - Think of the savings in memory/processing power alone!
- Sharing of features:
  - Container setup features shared across all PDB’s automatically
  - Data guard, rac,
  - Resource management (memory, disk, etc)
  - Backup
- Eases management of lots of similar database environments
Pluggable Database

Support

- Supports up to 252 databases per container DB
- Users can share PDB’s
  - Called common users
- Can use SQL*Plus, DBCA, Enterprise Mngr Cloud Control, SQL Developer, or Server Control to manage the CDB and PDB’s.
**Pluggable Database**

**Oracle12 CDB**

- **SID:** Orcl
- **Service Name:** ORCL
- **Container Name:** CDB$ROOT
- **Accounts:**
  - Sys
  - System
  - C## - common users

```
Alter Session Set container = <service name>;
```

**PDB #1**

- **Service Name:** ORCLPDB1
- **Accounts:**
  - DBA User
  - Users/Developers

**PDB #2**

- **Service Name:** ORCLPDB2
- **Accounts:**
  - DBA User
  - Users/Developers

- Application Data TS
- SYSTEM/SYSYSAUX TS
- TEMP TS

- Application Data TS
- SYSTEM/SYSYSAUX TS
- TEMP TS

Upto 250 more PDB’s
Oracle12.1.0.2 New Features

- Can do cross PDB queries
  - Select ename from containers(user0.EMP) where CON_ID in (3,5)
  - This will search these 2 PDB’s for the schema and table
  - Downside…less flexibility if you code this way…
    - Maybe a synonym solution in a future release???
- Standby DB – No Logging clause at the PDB Level
- Can subset PDB’s by tablespace
Pluggable Database

Oracle12.1.0.2 New Features

- Support for new In-Memory solutions
- Support for flashback options
- Maintains state of PDB’s between database restarts
Problems

- Same synonym names pointing to different objects
- Same schema names
- Supports Oracle12 DBs only

Some planning is needed to insure consistency of common names across applications
Partitioning Enhancements
Partitioning Enhancements

- **Moving Partitions online**
  - Can now move partitions and subpartitions online.

- **Interval-Reference Partitioning**
  - Interval partitioning allows for automatic partitioning of values outside the range of values defined.
  - Reference partitioning has child partitions off the main partition, based on foreign key which becomes the child partition key value.
  - Prior releases could not create an interval partition for the parent table, this restriction has been lifted.
Partitioning Enhancements

- **Cascade Functionality**
  - Can now truncate the reference partitioning
  - A single command now removes all the old/related data
  - Now an all-or-nothing operation

- **Partition maintenance on multiple partitions**
  - Alter partition [add, truncate, drop, split, merge]
Partitioning Enhancements

- **Partial Indexes**
  - Can now have indexes just on some partitions!
    - Oracle11...had to build the index unuseable then rebuild just the ones you wanted...
  - New partition syntax ‘indexing on’ or ‘indexing off’ to define which partitions can/can’t have indexes
Partitioning Enhancements

- Partial Indexes

```sql
CREATE TABLE PRODUCTS (
    MFGID NUMBER,
    PRODUCTID NUMBER,
    RECEIVED_DATE DATE
) INDEXING OFF
PARTITION BY RANGE (RECEIVED_DATE)
(
    PARTITION PART_2011 VALUES LESS THAN
      (TO_DATE('01-JAN-2012', 'DD-MON-YYYY')) INDEXING OFF,
    PARTITION PART_2012 VALUES LESS THAN
      (TO_DATE('01-JAN-2013', 'DD-MON-YYYY')) INDEXING ON,
    PARTITION PART_2013 VALUES LESS THAN
      (TO_DATE('01-JAN-2014', 'DD-MON-YYYY'))
)
ENABLE ROW MOVEMENT;
```
Partitioning Enhancements

- Partial Indexes
  - Useful scripts to see indexing across partitions

```sql
SELECT TABLE_NAME, PARTITION_NAME, INDEXING
FROM USER_TAB_PARTITIONS
WHERE TABLE_NAME = 'PRODUCTS'
ORDER BY PARTITION_POSITION;

<table>
<thead>
<tr>
<th>TABLE_NAME</th>
<th>PARTITION_NAME</th>
<th>INDEXING</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRODUCTS</td>
<td>PART_2011</td>
<td>OFF</td>
</tr>
<tr>
<td>PRODUCTS</td>
<td>PART_2012</td>
<td>ON</td>
</tr>
<tr>
<td>PRODUCTS</td>
<td>PART_2013</td>
<td>OFF</td>
</tr>
</tbody>
</table>
```

```sql
SELECT TABLE_NAME, INDEX_NAME, INDEXING
FROM USER_INDEXES
WHERE TABLE_NAME = 'PRODUCTS'
ORDER BY 2 DESC;

<table>
<thead>
<tr>
<th>TABLE_NAME</th>
<th>INDEX_NAME</th>
<th>INDEXING</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRODUCTS</td>
<td>PRODUCTS_PARTIAL</td>
<td>PARTIAL</td>
</tr>
<tr>
<td>PRODUCTS</td>
<td>PRODUCTS_FULL</td>
<td>FULL</td>
</tr>
</tbody>
</table>
```
Partitioning Enhancements

- **Global Index Maintenance**
  - Drop/truncate/modify partition indexing off ALL make global indexes go ‘stale’
  - Easy to see now with new column ORPHANED_ENTRIES
    - Views: dba/all/user/_INDEXES, _IND_PARTITION
    - Yes…has orphaned entries
    - No…does not have orphaned entries
    - N/A…does not apply…ie: local index or non partitioned table
Partitioning Enhancements

- **Global Index Maintenance**
  - Automatic scheduled job: SYS.PMO_DEFERREDGIDX_MAINT_JOB
    - Runs at 2am daily
  - Alter index rebuild and alter index coalesce partition cleanup also restores these indexes
  - Oracle12 New method
    - Dbms_part.cleanup_didx
      - Uses schema name and table name.
Partitioning Enhancements

- **Automatic Global Stats**
  - Oracle12 gives some control over how partition stats are determined to be stale
  - Tables with incremental set to true...ANY DML makes stats stale
  - Exec DBMS_STATS.set_table_prefs(<schema>, <table>, INCREMENTAL_STALENESS, value)
    - Value = NULL - default behavior
    - USED_LOCKED_STATS - stats never go stale
    - USE_STALE_PERCENT – stats stale after this % of DML
      - And stale_percent can be adjusted using similar syntax
New SQL and PL/SQL Features
New Limits

Increased column size limits

- IF MAX_STRING_SIZE = EXTENDED
  - Varchar2 – new limit 32K
  - NVarchar2 – new limit 32K
  - RAW – new limit 32K

- MAX_STRING_SIZE = STANDARD (default behavior)
  - Varchar2 – limit 4K
  - NVarchar2 – limit 4K
  - RAW – limit 2K
<table>
<thead>
<tr>
<th>Database Type</th>
<th>Current Table Limit</th>
<th>Current PL/SQL Limit</th>
<th>Oracle12c New Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Varchar2</td>
<td>2K</td>
<td>4K</td>
<td>32K</td>
</tr>
<tr>
<td>Nvarchar2</td>
<td>2K</td>
<td>4K</td>
<td>32K</td>
</tr>
<tr>
<td>Raw</td>
<td>2K</td>
<td>4K</td>
<td>32K</td>
</tr>
</tbody>
</table>
New init.ora setting: Max_String_Size

- Set to EXTENDED
  - Allows new limits
- Set to STANDARD
  - Old limits used
- NO Going Back!!!!
- Indexed column max size 6400 Bytes
  - Make sure no indexes are using long varchar columns
- Read my blog on this topic
New SQL Syntax

- JSON Support (Release 12.1.0.2)
- New Analytic SQL Features
- New SQL Features
- New Functions
- New Options for Sequences
- Enhanced Join Syntax
- Increased column size limits
New SQL Syntax

- JSON Database support
  - Oracle12.1.0.2 now supports JSON stored in the database
  - Can use SQL to access via JSON documents
New SQL Syntax

JSON doc stored in Customers.Document column

Accessed via SQL!

```sql
select
c.document.firstName,
c.document.lastName,
c.document.address.city,
c.document.phoneNumbers
from customers c;
```
New SQL Syntax

- New Analytical SQL Features
  - Clustering works with groupings of survey data in BI
  - Cluster_Details New Function
    - Returns xml string cluster details for each row selected
  - Cluster_Id Function Enhanced
    - Can use either a pre-defined clustering model or perform dynamic clustering
  - Cluster_Distance New Function
    - Predicts cluster membership.
New SQL Syntax

- Table Syntax (create or alter)
  - Period_Definition – temporary validity (start and end date) for which each row in the table is valid
  - Visible/Invisible
  - Truncate now has a cascade feature
- Partitioning
  - A plethora of changes – Attend the seminar or class…
New SQL Syntax

Index Syntax

- Drop index online
- Can set UNUSED online now
- Drop a constraint online as well
- Partitioning options with indexes covered with the Table partitioning new features
- Indexes can be on the same set of columns IF:
  - The indexes are of different types/partitioning/uniqueness
  - ONLY one of the indexes is VISABLE at any given time
New SQL Syntax

Oracle 12.1.0.2 New Syntax

- Approx Count
  - Perfect when ‘close enough’ is good enough
  - Much faster than count
  - Smaller footprint
  - [See Dan Hotka Blog on this topic](http://www.DanHotka.com)
  - Oracle claims 97% accurate
  - Ignores nulls
  - Cannot use on blobs/clobs/external objects/etc
New SQL Syntax

```
Connected to:
Oracle Database 12c Enterprise Edition Release 12.1.0.2.0 - 64bit Production
With the Partitioning, OLAP, Advanced Analytics and Real Application Testing options

SQL> set autotrace on explain
SQL> set timing on
SQL> select COUNT(DISTINCT(lahmanid)) from master;

COUNT(DISTINCT(LAHMANID))
-------------------------
15350

Elapsed: 00:00:00.28

Execution Plan

Plan hash value: 3951756302

<table>
<thead>
<tr>
<th>Id</th>
<th>Operation</th>
<th>Name</th>
<th>Rows</th>
<th>Bytes</th>
<th>Cost (%CPU)</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>SELECT STATEMENT</td>
<td></td>
<td>1</td>
<td>8</td>
<td>138 (2)</td>
<td>00:00:01</td>
</tr>
<tr>
<td>1</td>
<td>SORT AGGREGATE</td>
<td></td>
<td>1</td>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>VIEW</td>
<td>UV_DAG_0</td>
<td>15350</td>
<td>119K</td>
<td>138 (2)</td>
<td>00:00:01</td>
</tr>
<tr>
<td>3</td>
<td>HASH GROUP BY</td>
<td></td>
<td>15350</td>
<td>149K</td>
<td>138 (2)</td>
<td>00:00:01</td>
</tr>
<tr>
<td>4</td>
<td>TABLE ACCESS FULL</td>
<td>MASTER</td>
<td>61400</td>
<td>599K</td>
<td>136 (0)</td>
<td>00:00:01</td>
</tr>
</tbody>
</table>
```
Connected to:
Oracle Database 12c Enterprise Edition Release 12.1.0.2.0 - 64bit Production
With the Partitioning, OLAP, Advanced Analytics and Real Application Testing options

SQL> set autotrace on explain
SQL> set timing on
SQL> select APPROX_COUNT_DISTINCT(lahmanid) from master;

APPROX_COUNT_DISTINCT(LAHMANID)
--------------------------------
   15247

Elapsed: 00:00:00.25
Execution Plan

Plan hash value: 123011908

<table>
<thead>
<tr>
<th>Id</th>
<th>Operation</th>
<th>Name</th>
<th>Rows</th>
<th>Bytes</th>
<th>Cost (%CPU)</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>SELECT STATEMENT</td>
<td></td>
<td>1</td>
<td>10</td>
<td>136</td>
<td>00:00:01</td>
</tr>
<tr>
<td>1</td>
<td>SORT AGGREGATE APPROX</td>
<td></td>
<td>1</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>TABLE ACCESS FULL</td>
<td>MASTER</td>
<td>61400</td>
<td>599K</td>
<td>136</td>
<td>00:00:01</td>
</tr>
</tbody>
</table>

SQL> _
New SQL Syntax

- **New Options for Sequences**
  - KEEP and NOKEEP feature added
    - Works with database Replay
    - Controls if NEXTVAL retains its original value (keep feature) or not (nokeep feature)
  - Can be used as Table column default values!
Oracle12.1.0.2 New Features

- New READ privilege
  - Better than SELECT privilege as SELECT can lock for update
- True Read-only privilege
New SQL Syntax

- VIEW Enhancements
  - Columns can be made visible and invisible as well
  - BEQUEATH option to override default Invokers rights
Functions in WITH Clause

– Now can have a PL/SQL function as part of a WITH clause

WITH
FUNCTION get_domain(url VARCHAR2) RETURN VARCHAR2 IS
    pos BINARY_INTEGER;
    len BINARY_INTEGER;
BEGIN
    pos := INSTR(url, 'www.');
    len := INSTR(SUBSTR(url, pos + 4), '.') - 1;
    RETURN SUBSTR(url, pos + 4, len);
END;
SELECT DISTINCT get_domain(catalog_url)
    FROM product_information;
New SQL Syntax

- Pattern Matching enables patterns to be found across multiple rows

```sql
SELECT *
FROM Ticker MATCH_RECOGNIZE (  
    PARTITION BY symbol  
    ORDER BY tstamp  
    MEASURES STRT.tstamp AS start_tstamp,  
        LAST(DOWN.tstamp) AS bottom_tstamp,  
        LAST(UP.tstamp) AS end_tstamp  
    ONE ROW PER MATCH  
    AFTER MATCH SKIP TO LAST UP  
    PATTERN (STRT DOWN+ UP+)  
    DEFINE  
        DOWN AS DOWN.price < PREV(DOWN.price),  
        UP AS UP.price > PREV(UP.price)  
    ) MR  
ORDER BY MR.symbol, MR.start_tstamp;
```
New SELECT Syntax

- Row Limiting clause works with Top-N to specify the number or percentage of rows to return
- Does not work with For Update
- Offset is 0 if not defined
  - 0 if negative number
  - Fractions truncated
- WITH TIES works with the order by clause
  - To return the % of rows including matching values of the last item

Source: Oracle Documentation
New SQL Syntax

- New Join Syntax
  - Cross_Outer_Apply_Clause
    - Allows a variation of the ANSI CROSS JOIN or ANSI LEFT OUTERJOIN with left correlation support.
    - Specify CROSS APPLY to perform a variation of the ANSI Cross Join
    - Specify OUTER APPLY to perform a variation of the ANSI Left Outer Join

Source: Oracle Documentation
New SQL Syntax

SELECT d.department_name, v.employee_id, v.last_name
FROM departments d CROSS APPLY (SELECT * FROM employees e
    WHERE e.department_id = d.department_id) v
WHERE d.department_name IN ('Marketing', 'Operations', 'Public Relations')
ORDER BY d.department_name, v.employee_id;

SELECT d.department_name, v.employee_id, v.last_name
FROM departments d OUTER APPLY (SELECT * FROM employees e
    WHERE e.department_id = d.department_id) v
WHERE d.department_name IN ('Marketing', 'Operations', 'Public Relations')
ORDER by d.department_name, v.employee_id;
New SQL Syntax

- New Join Syntax
  - Lateral clause for Inline Views
    - Allows for columns in the inline view to be accessed!

```
SELECT * FROM employees e, (SELECT * FROM departments d
WHERE e.department_id = d.department_id);
ORA-00904: "E"."DEPARTMENT_ID": invalid identifier

SELECT * FROM employees e, LATERAL(SELECT * FROM departments d
WHERE e.department_id = d.department_id);
```

Source: Oracle Documentation
New SQL Syntax

- **New Join Syntax**
  - Partial Join Evaluation
  - Goal is to avoid generating duplicate rows
  - Replaces DISTINCT operation
  - Used with aggregate functions off of UNION clauses
    - S = Semi Join which stops with the first hit
    - NA = null-aware

Source: OOW Optimizer Booth 2012
New SQL Syntax

SELECT COUNT (*)
FROM   CUSTOMERS C,
WHERE  C.CUST_CREDIT_LIMIT > ALL
       (SELECT T.UNIT_COST
        FROM   SALES S, COSTS T
        WHERE  T.PROD_ID = S.PROD_ID);

Oracle11 – runs for minutes

Oracle12 with Null-Aware Join runs in 7 seconds

SELECT COUNT (*)
FROM   CUSTOMERS C,
       (SELECT T.UNIT_COST
        FROM   SALES S, COSTS T
        WHERE  T.PROD_ID S= S.PROD_ID) V
WHERE  C.CUST_CREDIT_LIMIT NA <= V.UNIT_COST;

Source: OOW Optimizer Booth 2012
New SQL Syntax

Another Example:

Oracle11 syntax vs Oracle12 syntax
New SQL Syntax

- **Increased column size limits**
  - IF `MAX_STRING_SIZE = EXTENDED`
    - Varchar2 – new limit 32K
    - NVarchar2 – new limit 32K
    - RAW – new limit 32K
  - `MAX_STRING_SIZE = STANDARD` (default behavior)
    - Varchar2 – limit 4K
    - NVarchar2 – limit 4K
    - RAW – limit 2K
New PL/SQL Features

- PL/SQL And SQL
- Enhanced DBMS_UTILITY
- New UTL_CALL_STACK
- Enhanced DBMS_SQL
- Enhanced Native SQL
New PL/SQL Features

- **PL/SQL and SQL**
  - Same new size limits on Varchar2, Nvarchar2, and Raw
    - Same options to turn it on...
  - Bulk Collect supports the Fetch First SQL Features
  - PL/SQL Functions that Run Faster in SQL
    - Support for the previously discussed WITH SQL syntax
  - Invisible Columns
    - CAN be directly referenced via PL/SQL
      - NOT using ‘*’ syntax...
    - Can make columns visible/invisible too
Granting Roles to PL/SQL Programs

- A major problem in the past is a called program accesses a table...the connected user needed permissions to both the program and the underlying table
- Oracle12 allows for permissions to be granted to just the package/procedure/function so the users cannot directly access the underlying tables!
New PL/SQL Features

- Easily another 25 or so packages
  - Not time to cover all here
  - Coverage for PDB's, etc

- DBMS_Utility
  - Expand_SQL_Text
    - Easily exposes the SQL contained in a view

- UTL_Call_Stack
  - Provides info on currently executing sub programs
    - Info includes name, owner, and line numbers
  - Enhanced Native SQL
New PL/SQL Features

- **UTL_Call_Stack**
  - Provides info on currently executing sub programs
    - Info includes name, owner, and line numbers
  - Programs include:
    - Backtrace_Depth_Line_Unit
    - Error_Depth_Msg_Number
    - Unit_Line
    - Subprogram
New PL/SQL Features

- **DBMS_SQL.Parse**
  - Now has a schema input parameter

- **Enhanced Native SQL**
  - Also now supports the Fetch First SQL feature
Additional Oracle12c New Features

- Oracle12c New Features
  - Index compression – 1x to 3x greater
    - See Dan Hotka blog on this topic
Additional 12.1.0.2 New Features

- APEX Listener added to release
- Restful access/services now available for mobile apps
  - Can tie directly to JSON documents
  - Works well with JavaScript
  - Oracle NoSQL
  - APEX (came from APEX!)
Additional 12.1.0.2 New Features

- HADOOP Support
  - SQL via External Tables
  - New HIVE data storage types
- New init.ora for Temporary Tables
  - TEMP_UNDO_ENABLE
    - Stores redo info in temp tablespace reducing redo TS activity
    - Can be altered at the session level
What have we learned?

- New Database Features
- New SQL Syntax
- New PL/SQL Features
- Keep in touch
  - Dan@DanHotka.com