What’s New in Oracle Data Pump?

Oracle Database 19c

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What’s New in Data Pump 19c?

- Suppress Encrypted Columns Clause
- Set Max Data Pump Jobs & Parallelism
- Explicitly Enable Authenticated Roles
- Use Any Object Store Credentials
- Wildcards in Object Store Dumpfile Name
- Transportable Tablespaces Test Mode
- Transportable Tablespaces Import Read-Only Tablespaces
- Recap of Release 18c and Release 12.2 Features
Data Pump 19c: Suppress Encrypted Columns Clause

• Migrate to a database having TDE encrypted tablespaces
  – TDE does not support encrypted columns (e.g., Oracle Cloud)

• Example:
  ```
  impdp hr DIRECTORY=dpump_dir1 DUMPFILE=hr.dmp SCHEMAS=hr
  TRANSFORM=OMIT_ENCRYPTION_CLAUSE:Y
  ```

• Details:
  – Default: N - column encryption clauses in `CREATE TABLE` are enabled, Y = suppressed
  – Valid for TABLE object types

Documentation: Utilities Guide > Import CLI > `TRANSFORM`
Data Pump 19c: Set Max Data Pump Jobs & Parallelism

• DBA can more easily govern Oracle Data Pump resource utilization
  
  • **MAX_DATAPUMP_JOBS_PER_PDB** database parameter (Changed)
    – Default: 100, Range: 0 to **250** or Auto - 50% of SESSIONS
    – Must be same for each RAC instance, dynamic, and modifiable per-PDB
  
  • **MAX_DATAPUMP_PARALLEL_PER_JOB** database parameter (New)
    – Default: 50, Range: 1 to **250** or Auto - 25% of SESSIONS
    – Can be different for each RAC instance, dynamic, and modifiable per-PDB

**Documentation**: Database Reference > [Initialization Parameters](#)
Data Pump 19c: Explicitly Enable Authenticated Roles

• Specify whether to use authenticated roles for export and import

• `ENABLE_SECURE_ROLES=YES | NO`
  – available for `expdp` and `impdp` clients, and for the Oracle Data Pump PL/SQL API

• Default: `NO` – does not enable authenticated protected roles

• Beginning with release 19c you must explicitly enable authenticated roles for an export or import job

**Documentation**: Database Readme
• Data Pump 19c: Use Any Object Store Credentials
  • Import from Oracle Cloud, AWS or Azure object store
  • CREDENTIAL Data Pump impdp client CLI parameter
    – No longer constrained to using the ADB default credential
    – Object store credentials added to database DBMS_CLOUD.CREATE_CREDENTIAL()
    – Data Pump validates the credential exists and the user has read access
  • BEGIN
    DBMS_CLOUD.CREATE_CREDENTIAL(
    credential_name => 'MY_CRED_NAME',
    username => 'adwc_user@oracle.com',
    password => 'Auth token'); END; (or password for OCI/C)
  • impdp admin/password@ADWC1_high
    directory=data_pump_dir
    credential=MY_cred_name  ...

Documentation: 19c & 18.3 Utilities Guide > Import CLI > Credential
Data Pump 19c: Wildcards in Dumpfile Name

• Oracle Data Pump allows wildcards for dumpfile in object store

• Dumpfile Specification
  – A wildcard character can be specified in the file-name of a URL-based dump file spec
  – simplifies importing multiple dump files, can’t be used in bucket-name component

• Example:

  impdp admin/password@ATPC1_high
directory=data_pump_dir credential=my_cred_name
dumpfile= https://swiftobjectstorage.us-phoenix-1.oraclecloud.com/v1/atpc/atpc_user/exp%u.dmp...

Documentation: Utilities Guide > Database Readme
Data Pump 19c: Transportable Tablespaces Test Mode

- Test a TTS or Full Transportable `expdp` without setting the source `READ ONLY`.

  - `TTS_CLOSURE_CHECK`: ON | OFF | FULL | TEST_MODE
    - Preview an export for time to complete
    - Check for unforeseen closure issues

- Resulting dumpfile cannot be imported
  - If attempted, error will be issued

Documentation: Utilities Guide > Export CLI > TRANSPORTABLE > `TTS_CLOSURE_CHECK`
Data Pump 19c: TTS Import Read-Only Tablespaces

• Allows Read-Only Tablespaces during Transportable Tablespaces import

  TRANSPORTABLE=NEVER | ALWAYS | KEEP_READ_ONLY | NO_BITMAP_REBUILD
  – Restores pre-12.2 ability to have tablespace files mounted on two databases at once

• Example:

  impdp system DIRECTORY=dpump_dir DUMPFILE=dumpfile_name
  TRANSPORT_DATAFILES=datafile_name
  TRANSPORTABLE=KEEP_READ_ONLY

• Prevents fix-up of timezone data and rebuilding of bitmaps

Documentation: Utilities Guide > Import CLI > TRANSPORTABLE
What’s New in Data Pump 18c?

- **Data Pump Import** `DATA_OPTIONS` parameter `CONTINUE_LOAD_ON_FORMAT_ERROR` option
- Data Pump warns on import that encrypted fixed user database link passwords must be reset
- Oracle Data Pump full or partial export and import operations can include a unified audit trail
Data Pump 18c: Continue Load on Format Error

• **CONTINUE_LOAD_ON_FORMAT_ERROR** is an import **DATA_OPTIONS** parameter
  
  — Condition: if a stream format error is encountered while loading table data
  
  — Action: Data Pump import skips forward to the start of next granule

• This parameter enables partial import of a corrupt dump file

**Documentation**: Utilities Guide > Import CLI > [Data_Options](#)
Data Pump 18c: TDE Encrypted Password Warning

• Oracle Data Pump import now (like export) generates an ORA-39395:
  Warning: object <database link name> requires password reset after import

• If fixed-user database passwords are encrypted, database link passwords are not exported - Export stores a known invalid password

• Reset the database link password with the command:
  ALTER DATABASE LINK database_link_name CONNECT TO schema_name IDENTIFIED BY password;

**Documentation:** Advanced Security Guide > [Using Oracle Data Pump With Encrypted Data Dictionary Data](#)
Data Pump 18c: Can Include a Unified Audit Trail

• A unified audit trail can be included for full or partial export and import

• Oracle Data Pump uses unified auditing to monitor and record specific user database actions and centralize all audit records in one place

• How to use a unified audit trail:
  – Create the policy: SQL CREATE AUDIT POLICY (or alter an existing policy)
  – Enable and disable the policy with SQL statements: AUDIT and NOAUDIT

Documentation: Utilities Guide > Overview > Auditing Data Pump Jobs
What’s New in Data Pump 12.2?

• Parallel Export/Import of Metadata
• Substitution Variables & Wildcards
• REMAPDIRECTORY
• Long Identifier support
• TRUSTEXISTING_TABLE_PARTITIONS
• Validation & Verification options
• Other 12.2 Features
Parallel Metadata Export: How It USED TO Work

Pre-12.2

• Start with ESTIMATE phase
  – Gather table data objects
  – Other workers remain idle until data objects are gathered
• Metadata exported serially
• Data exported in parallel
Parallel Metadata Export: How it Works Now

New Feature in 12.2

- Start with Analysis step
  - Metadata objects passed immediately to workers as they are found
  - E.g. Worker 1 finds a set of TABLE definitions, they are handed off to worker 2
- ESTIMATE phase still happens, but metadata no longer held up by estimate
- Notes:
  - Works for dumpfile jobs if source database is 12.2
  - Transportable and Full Transportable jobs are not (yet) parallel for metadata
  - ESTIMATE phase now uses STATISTICS only
  - Restart works as always
Parallel Metadata Export: Logfile

**12.1.0.2**

- 18-SEP-16 10:55:16.733: Starting "SYSTEM"."MD_EXP_16_12201": system/****** parfile=md_exp_16_12201.par
- 18-SEP-16 10:55:17.600: Startup took 2 seconds
- 18-SEP-16 10:55:17.623: Estimate in progress using BLOCKS method...
- 18-SEP-16 10:55:38.588: Estimated 10 TABLE_DATA objects in 0 seconds
- 18-SEP-16 10:55:56.068: Estimated 36026 TABLE_DATA objects in 79 seconds
- 18-SEP-16 10:55:56.388: Startup took 162 seconds
- 18-SEP-16 10:55:56.556: Startup took 162 seconds
- 18-SEP-16 10:55:56.757: Startup took 162 seconds
- 18-SEP-16 10:55:56.926: Startup took 162 seconds
- 18-SEP-16 10:56:56.020: Processing object type DATABASE_EXPORT/PRE_SYSTEM_IMP Cal OUT/MARKER
- 18-SEP-16 10:56:56.022: Completed 1 MARKER objects in 1 seconds
- 18-SEP-16 10:56:56.023: Processing object type DATABASE_EXPORT/PRE INSTANCE IMP Cal OUT/MARKER
- 18-SEP-16 10:56:56.334: Completed 1 MARKER objects in 0 seconds
- 18-SEP-16 10:56:56.539: Processing object type DATABASE.Export/TABLESPACE

**12.2.0.1**

- 18-SEP-16 15:24:32.166: Starting "SYSTEM"."MD_EXP_16_12201": system/****** parfile=md_exp_16_12201.par
- 18-SEP-16 15:24:32.742: W-1 Startup took 2 seconds
- 18-SEP-16 15:24:35.601: W-3 Startup took 3 seconds
- 18-SEP-16 15:24:36.146: W-2 Startup took 3 seconds
- 18-SEP-16 15:24:36.205: W-4 Startup took 4 seconds
- 18-SEP-16 15:24:36.393: W-5 Startup took 4 seconds
- 18-SEP-16 15:24:36.490: W-6 Startup took 4 seconds
- 18-SEP-16 15:24:36.491: W-7 Startup took 4 seconds
- 18-SEP-16 15:24:36.594: W-8 Startup took 4 seconds
- 18-SEP-16 15:24:36.714: W-9 Startup took 4 seconds
- 18-SEP-16 15:24:36.715: W-10 Startup took 4 seconds
- 18-SEP-16 15:24:37.153: W-12 Startup took 4 seconds
- 18-SEP-16 15:24:37.220: W-14 Startup took 4 seconds
- 18-SEP-16 15:24:37.286: W-16 Startup took 4 seconds
- 18-SEP-16 15:24:37.323: W-3 Processing object type DATABASE.Export/PRE_SYSTEM_IMP Cal OUT/MARKER
- 18-SEP-16 15:24:37.324: W-3 Completed 1 MARKER objects in 0 seconds
- 18-SEP-16 15:24:37.359: W-2 Completed 1 MARKER objects in 0 seconds
- 18-SEP-16 15:24:37.588: W-7 Completed 3 PROFILE objects in 1 seconds
- 18-SEP-16 15:24:37.585: W-8 Completed 1 USER objects in 0 seconds
- 18-SEP-16 15:24:37.664: W-4 Completed 64 ROLE objects in 0 seconds
Parallel Metadata Import

• Pre-12.2:
  – One worker per partition/subpartition
  – PQ used if partitions are large enough
  – Package bodies loaded in parallel

• With patch for bug 22273229
  – Indexes built in parallel
  – Constraints created in parallel
  – Available as backport to 12.1.0.2, 11.2.0.4

• Starting with 12.2
  – Added parallel import of most other metadata objects
  – Some exceptions
    • Types (due to inheritance)
    • Schemas
    • Procedural actions
Parallel Metadata Import: Internals

- Metadata is exported in XML documents
  - Each XML document in dumpfile contains $n$ objects of a given type
- XML documents are allocated to workers 1 document at a time
- Example: 161 users to import
  - Users are exported with up to 80 users per XML document
  - What happens with $\text{PARALLEL}=8$?

Notes:
- Works for conventional (dumpfile) jobs
- Not (yet) for transportable jobs or network mode
- Restart works same as always
- Status command will show multiple workers on metadata

(Workers 8-$n$ would be idle)
Parallel Metadata Import: Logfile

• Comparison with PARALLEL=8 for 27586 object grants and METRICS=Y
  — 12.1.0.2

15-SEP-16 13:57:06.374: Completed 27586 OBJECT_GRANT objects in 50 seconds
  — 12.2.0.1

15-SEP-16 11:59:35.190: W-7 Processing object type DATABASE_EXPORT/SCHEMA/SEQUENCE/GRANT/OWNER_GRANT/OBJECT_GRANT
15-SEP-16 11:59:49.304: W-4 Completed 27586 OBJECT_GRANT objects in 10 seconds
15-SEP-16 11:59:49.304: W-4 Completed by worker 1 3426 OBJECT_GRANT objects in 10 seconds
15-SEP-16 11:59:49.304: W-4 Completed by worker 2 3440 OBJECT_GRANT objects in 10 seconds
15-SEP-16 11:59:49.304: W-4 Completed by worker 3 3440 OBJECT_GRANT objects in 10 seconds
15-SEP-16 11:59:49.304: W-4 Completed by worker 4 3440 OBJECT_GRANT objects in 9 seconds
15-SEP-16 11:59:49.304: W-4 Completed by worker 5 3440 OBJECT_GRANT objects in 10 seconds
15-SEP-16 11:59:49.304: W-4 Completed by worker 6 3520 OBJECT_GRANT objects in 10 seconds
15-SEP-16 11:59:49.304: W-4 Completed by worker 7 3440 OBJECT_GRANT objects in 10 seconds
15-SEP-16 11:59:49.304: W-4 Completed by worker 8 3440 OBJECT_GRANT objects in 10 seconds
## Performance: Parallel Metadata Import

- Examples from E-Business Suite test database

<table>
<thead>
<tr>
<th>Object Type</th>
<th>Count</th>
<th>11.2.0.4 PARALLEL=32</th>
<th>12.1.0.2 PARALLEL=8</th>
<th>12.1.0.2 PARALLEL=32 With Patch</th>
<th>12.2.0.1 PARALLEL=8</th>
<th>12.2.0.1 PARALLEL=32</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>OBJECT_GRANT (owner)</td>
<td>27586</td>
<td>49</td>
<td>50</td>
<td>51</td>
<td>10</td>
<td>22</td>
<td>Hard connect for each grant</td>
</tr>
<tr>
<td>SYNONYM</td>
<td>43254</td>
<td>105</td>
<td>109</td>
<td>111</td>
<td>25</td>
<td>44</td>
<td></td>
</tr>
<tr>
<td>TYPE</td>
<td>4364</td>
<td>108</td>
<td>114</td>
<td>119</td>
<td>111</td>
<td>110</td>
<td>Handled by single worker</td>
</tr>
<tr>
<td>PROCACT_SCHEMA</td>
<td>606</td>
<td>198</td>
<td>216</td>
<td>214</td>
<td>152</td>
<td>175</td>
<td>Handled by single worker</td>
</tr>
<tr>
<td>TABLE</td>
<td>33164</td>
<td>923</td>
<td>1160</td>
<td>1298</td>
<td>368</td>
<td>248</td>
<td></td>
</tr>
<tr>
<td>OBJECT_GRANT (table)</td>
<td>358649</td>
<td>541</td>
<td>543</td>
<td>578</td>
<td>142</td>
<td>157</td>
<td>Hard connect for each grant</td>
</tr>
<tr>
<td>INDEX</td>
<td>53190</td>
<td>6721</td>
<td>5770</td>
<td>360</td>
<td>418</td>
<td>272</td>
<td></td>
</tr>
<tr>
<td>PACKAGE</td>
<td>53217</td>
<td>424</td>
<td>476</td>
<td>474</td>
<td>114</td>
<td>54</td>
<td></td>
</tr>
<tr>
<td>VIEW</td>
<td>34690</td>
<td>538</td>
<td>583</td>
<td>593</td>
<td>151</td>
<td>184</td>
<td></td>
</tr>
<tr>
<td>PACKAGE_BODY</td>
<td>52092</td>
<td>1363</td>
<td>1974</td>
<td>1186</td>
<td>1981</td>
<td>959</td>
<td>Always parallel since 11.2</td>
</tr>
</tbody>
</table>

*import time in seconds*
Substitution Variables for Dumpfile Name

• Substitution variables for dumpfile name:
  - Pre-12.2: %U generates a fixed-width 2-digit number
    - e.g. dumpfile=exp%U.dmp
  - New option for 12.2 expdp or impdp:
    - %l or %L: Incrementing number from 01 up to 2,147,483,646
  - New options in 12.2 expdp only:
    - %d or %D: Day of Month in DD format
    - %m or %M: Number of Month in MM format
    - %y or %Y: Year in YYYY format
    - %t or %T: Full date in YYYYMMDD format

$ expdp system/oracle directory=mydir \        
  filesize=50K dumpfile=exp%T_%L.dmp full=y 
...  
...  
. . exported "WMSYS"."WM$METADATA_MAP" 
0 KB  0 rows 
Master table "SYSTEM"."SYS_EXPORT_FULL_01" successfully 
loaded/unloaded 
***************************************************************************** 
Dump file set for SYSTEM.SYS_EXPORT_FULL_01 is: 
/home/oracle/exp20160917_01.dmp 
/home/oracle/exp20160917_02.dmp 
/home/oracle/exp20160917_03.dmp 
...  
...  
/home/oracle/exp20160917_67.dmp 
/home/oracle/exp20160917_68.dmp 
/home/oracle/exp20160917_69.dmp 
/home/oracle/exp20160917_70.dmp 
/home/oracle/exp20160917_71.dmp 
/home/oracle/exp20160917_72.dmp 
Job "SYSTEM"."SYS_EXPORT_FULL_01" successfully 
completed at Sat Sep 17 23:47:31 2016 elapsed 0
00:03:00
Wildcards for TRANSPORT_DATAFILES

• Use a wildcard in 12.2 instead of listing every file

• Pre-12.2:
  TRANSPORT_DATAFILES=users01.dbf
  TRANSPORT_DATAFILES=users02.dbf
...
  TRANSPORT_DATAFILES=data1.dbf
  TRANSPORT_DATAFILES=data2.dbf
...

• New Feature: wildcards
  – * (asterisk) matches multiple characters
  – ? (question mark) matches a single character

  TRANSPORT_DATAFILES=users*.dbf
  TRANSPORT_DATAFILES=data?.dbf
...

```
$ impdp system/oracle@pdb2 network_link=sourcedb \  version=12 full=y transportable=always metrics=y \  exclude=statistics \  directory=mydir \  logfile=pdb2.log \  transport_datafiles='/u02/oradata/CDB2/pdb2/user*.dbf'
```
REMAPDIRECTORY

• Applies to DDL where directory specs are used
  – E.g. CREATE TABLESPACE

• Change directory spec **without** changing filenames

• Useful when moving between OS platforms
  – Example: importing dumpfile created on OpenVMS into database on Linux

REMAPDIRECTORY="'DB1$:[HRDATA.PAYROLL]':'/db1/hrdata/payroll/'"
LONG Identifiers

- **Oracle 12.1.0.2**: 1-30 bytes
  - `CREATE TABLE abcdefghijklmnopqrstuvwxyzabcd;
  - **Oracle 12.2.0.1**: 1-128 bytes
  - If `COMPATIBLE ≥ 12.2.0`
  - `CREATE TABLE abcdefghijklmnopqrstuvwxyz_abcedefghijklmnopqrstuvwxyz_abcedefgh...`
  - Database name: ≤ 8 byte
  - Disk Groups, PDBs, rollback segments and tablespace names ≤ 30 bytes

[https://docs.oracle.com/database/122/SQLRF/Database-Object-Names-and-Qualifiers.htm#SQLRF51129](https://docs.oracle.com/database/122/SQLRF/Database-Object-Names-and-Qualifiers.htm#SQLRF51129)
Long Identifier Support in Data Pump

• Long (128-byte) identifiers are supported in 12.2 by
  – Data Pump expdp/impdp
  – SQL*Loader
  – ORACLE_LOADER access driver
  – ORACLE_DATAPUMP access driver
  – External Tables

• Importing database must support 128-byte identifiers
  – Be careful when exporting with VERSION=12.1 or earlier
TRUST_EXISTING_TABLE_PARTITIONS

• Pre-12.2
  – Importing into existing table was done serially
  – Data Pump couldn’t be sure that partitioning in DB matched partitioning in dumpfile

• New 12.2 Parameter:
  DATA_OPTIONS=TRUST_EXISTING_TABLE_PARTITIONS
  – Big performance boost
  – If partitions don’t match...error:

ORA-31693: Table data object "SH"."SALES_BIG_PT":"SALES_2000" failed to load/unload and is being skipped due to error:
ORA-29913: error in executing ODCIEXTTABLEFETCH callout
ORA-14401: inserted partition key is outside specified partition
Data Validation & Verification
Extra Validation for Things That Should Never Happen

• \texttt{DATA\_OPTIONS=VALIDATE\_TABLE\_DATA}
  – Import only
  – Validates date and number formats of table data
  – Default is no validation

• \texttt{DATA\_OPTIONS=VERIFY\_STREAM\_FORMAT}
  – Export only
  – Default is no verification

ORA-02374: conversion error loading table "DPV"."TEST18"
ORA-12899: value too large for column C1 (actual: 500, maximum: 498)
ORA-02372: data for row: C8 : '

ORA-31694: master table "SCOTT"."SYS_EXPORT_TABLE_01" failed to load/unload
ORA-02354: error in exporting/importing data
ORA-26009: stream verification error: [1], [0], [0], [0]
Other 12.2 Features (1)

• Use direct path load in network mode!
  – *Specify* `ACCESS_METHOD=DIRECT_PATH with NETWORK_LINK=<dblink>`
  – Allows network import of LONG and LONG RAW

• Data Pump available in Instant Client
  – *Tools* package for Instant Client
  – Includes SQL*Loader, expdp, impdp, exp, imp

• Views that describe available transforms
  – `DBMS_METADATA_TRANSFORMS`
  – `DBMS_METADATA_TRANSFORM_PARAMS`
  – `DBMS_METADATA_PARSE_ITEMS`
SQL*Plus History

- SQL> SET HISTORY ON
- SQL> SET HISTORY 1000
- Example:
  - SQL> hist
    - Lists all commands from the history
  - SQL> hist 7 run
    - Will run the 7th command from the list

Syntax

```
HISTORY
```

Enables users to run, edit, or delete previously used SQL*Plus, SQL, or PL/SQL commands from the history list in the current session. You can enable or disable the HISTORY command in the current SQL*Plus session by using the SET HISTORY command.

The HISTORY command enables you to:

- List all entries in the command history list.
- Run an entry in the command history list.
- Edit an entry in the command history list.
- Delete an entry from the command history list.
- Clear all entries in the command history list.

https://docs.oracle.com/database/122/SQPUG/HISTORY.htm#SQPUG-GUID-CCF9B047-3122-4644-BA06-5FA4B5812E9F

What's New in Oracle Data Pump?
Other 12.2 Features (2)

• New interactive commands
  – `TRACE` parameter can be set for a running job
    • No need to stop/restart job for tracing to take effect
  – `STOP_WORKER` command
    • Kill an individual worker you believe to be hung or stuck
  – Both will be documented in MOS notes

• Enhanced log files
  – When `METRICS=Y`
    • Show worker ID for each item processed
    • Show access method for each table
  – Include contents of parfile in logfile

```sql
18-SEP-16 15:24:30.950: ;;;
18-SEP-16 15:24:30.951: ;;  Parfile values:
18-SEP-16 15:24:30.953: ;;  parfile: job_name=md_exp_16_12201
18-SEP-16 15:24:30.955: ;;  parfile: reuse_dumpfiles=Y
18-SEP-16 15:24:30.957: ;;  parfile: logtime=all
18-SEP-16 15:24:30.958: ;;  parfile: metrics=Y
18-SEP-16 15:24:30.960: ;;  parfile: parallel=16
18-SEP-16 15:24:30.962: ;;  parfile: full=Y
18-SEP-16 15:24:30.963: ;;  parfile: logfile=md_exp_16_12201.log
18-SEP-16 15:24:30.966: ;;  parfile: directory=EBSIMP
18-SEP-16 15:24:30.968: ;;;
```

What’s New in Oracle Data Pump?
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