

21c New Features You Won't Hear About From Oracle



AKA
Do You Want Fries With That?

Introduction

Unsafe Harbor Statement

- This room is an unsafe harbor
- You can rely on the information in this presentation to help you protect your data, your databases, your organization, and your career
- No one from Oracle has previewed this presentation
- No one from Oracle knows what I am going to say
- No one from Oracle has supplied any of my materials

- Warning: Oracle employees cannot criticize Oracle's customers ...
I've never been an Oracle employee ... so ...
I can ... and ... I do ... and ... I will





- Oracle ACE Director Alumnus
- Oracle Educator
 - Adjunct Professor, University of Washington, Oracle Program, 1998-2009
 - Consultant: Harvard University
 - Guest lecturer at universities in Canada, Chile, Costa Rica, New Zealand, Norway, Panama, and the U.S.
 - Conference seminars ... 153 country visits, 43 countries ... since 2008
- IT Professional
 - Member, Oracle Database Security Partner Advisory Council
 - The Morgan behind www.morganslibrary.org
 - The Morgan behind www.dbsecworx.com
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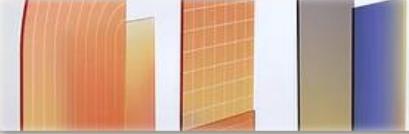
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Migration 

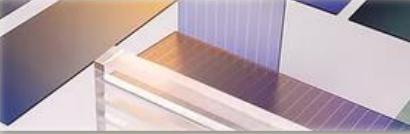
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Defense-in-Depth Requires Protecting Data & Databases

DBSecWorx enhances your security by reducing the exploitable landscape

DBSecWorx News

- The DBSecWorx team has taken on a new project: Building a working demo of Oracle Label Security (OLS). OLS is under-appreciated and under-utilized: Something we need to change if we are going to support our community's efforts to harden databases. To follow our work on the project follow the [OLS Project](#) link.
- Database 21c is available in the OCI Cloud. We are securing it today.

We start with the assumption that every network is vulnerable; that there is always an insider.

Our focus is the Oracle Databases where your secrets are stored.

What makes us different?

Defense in Depth Delivered

SQLcillin GLOGIN



[Oracle Database Exploit Protection](#)

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www.morganslibrary.org

Morgan's Library

Did you miss Oracle 20c? Oracle 21c has been released in the OCI Cloud and the docs are available for download. The Morgan's Library team has both a 20c and a 21c database and we are updating the Library. 21c security monographs will be posted at dbsecworx.com soon.

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Mad Dog Morgan



Morgan @ OpenWorld



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The Daily Rant: Working in 21c Yet? Why Not?

```
[dmorgan@test21 ~]$ sudo su oracle
[oracle@test21 dmorgan]$ cd $ORACLE_HOME
[oracle@test21 dbhome_1]$ sqlplus / as sysdba

SQL*Plus: Release 21.0.0.0.0 - Production on Fri Dec 11 21:12:38 2020
Version 21.1.0.0.0

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Oracle Database 21c Enterprise Edition Release 21.0.0.0.0 - Production
Version 21.1.0.0.0

SQL> ]
```

Business Case

- Some time in the next 3-5 years you will be forced to do one of two things
 - Migrate to an Oracle Container Database
 - Execute a career change
- The organization you current work for will either upgrade to CDBs and PDBs or do business with unsupported applications running on an unsupported database with limited or no access to bug fixes and security patches
- That upgrade to 21c+ will force a legacy architecture to working with mandatory migration from Oracle's a container database
- If you do not know how to create common user, common role, and common profile you are a decade behind where you should be
- And, needless to say it is your responsibility to not only learn how to work with and manage a container database ... it is your responsibility to learn all of the critically important new features in Oracle Database versions 20c through 23c
- Today is an excellent day to start that adventure



New in 20c

20c Legacy Architecture No Longer Supported

- As of Oracle Database 20c the legacy, non container, architecture is
 - Not just deprecated
 - Not just not supported
 - It is no longer available
- If you are waiting for your employer to migrate to a Container Database to learn it ... expect to make some expensive errors at work
- It likely isn't going to turn out well for either of you

- One of the first things I noticed in Oracle 20c was that it is now configurable as a PMEM database

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PMem Is a Revolutionary Memory Technology

PMem provides a unique combination of affordable larger capacity and support for data persistence. With innovative technology offering distinctive operating modes, it adapts to your needs across workloads.

Boost Performance with Data Persistence

PMem gives you access to more data in memory, enabling you to process large amounts of data faster. Unlike DRAM, data remains in PMem, allowing you to retain data even when powered off – helping protect your systems from data loss.

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Optane™ PMem enables you to affordably increase your memory capacity per socket, extract value from larger data sets and increase the utility of each server.

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Operational modes in Optane™ Persistent Memory offer different functions giving you flexible configuration; the two modes are Memory Mode and App Direct Mode. Learn more [here](#).

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Intel® Optane™ persistent memory incorporates hardware encryption. With AES 256-bit encryption, it helps protect data at rest from cyberattacks with minimal impact on performance.

[Click for more Optane™ technology options](#)

[Read the Optane™ PMem 200 series product brief](#)

20c Persistent Memory Database (2:2)

- If you can get the servers ... Oracle already has the database that supports it

```
CREATE PMEM FILESTORE <filestore_name>
MOUNTPOINT '<path_and_file_name>'
BACKINGFILE '<path_and_backing_file_name>' [REUSE]
SIZE <integer> <M | G | T>
BLOCK SIZE <2 | 4 | 8 | 16 | 32>K
AUTOEXTEND ON NEXT <integer> <K | M | G | T>
MAXSIZE <integer> <K | M | G | T>;
```

```
CREATE PMEM FILESTORE uw_pmfs
MOUNTPOINT '/u03/oracle/pmemfs/perfile1'
BACKINGFILE '/u04oracle/pmembf/bakfile1'
SIZE 500G
BLOCK SIZE 8K
AUTOEXTEND ON NEXT 25G
MAXSIZE 10T;
```

```
ALTER PMEM FILESTORE uw_pmfs AUTOEXTEND;
ALTER PMEM FILESTORE uw_pmfs DISMOUNT;

ALTER PMEM FILESTORE uw_pmfs MOUNT
MOUNTPOINT '/u03/oracle/pmemfs/perfile2'
BACKINGFILE '/u04oracle/pmembf/bakfile2

ALTER PMEM FILESTORE uw_pmfs RESIZE 20T;

DROP PMEM FILESTORE uw_pmfs INCLUDING CONTENTS FORCE;
```

20c SecureFile Defragmentation

- SecureFile fragmentation negatively impacts
 - LOB sequential read performance
 - Secure file DML performance
 - Free space search efficiency

- 19c

```
-- not supported
ALTER TABLE <table_with_LOB_storage> SHRINK SPACE CASCADE;

-- very expensive
ALTER TABLE <table_with_LOB_storage> MOVE LOB ....;
```

- 21c

```
supported
ALTER TABLE <table_name> MODIFY LOB (lob_column_name) (SHRINK SPACE);

ALTER TABLE <table_name> SHRINK SPACE CASCADE;
```

- Restarts and recovers from failure or interrupted
- Honors LOB Retention
- Supported everywhere including RAC
- New dynamic performance view V\$SECUREFILE_SHRINK



Forces upgraded password files to be case sensitive

- Database clients can be configured to maintain multiple SSL sessions using different certs
- Support for centrally managed wallets
- STIG compliance built in with the Profile, Password Verify Function and Unified Audit Policies are predefined

```
catpf.sql:Rem      catpf.sql - Create Password Verify Function, STIG profile
catpf.sql:Rem      This script also creates the STIG compliant user profile
catpf.sql:Rem          ORA_STIG_PROFILE with CIS for 12c v3.0.0 and
catpf.sql:Rem  Function: "ora12c_stig_verify_function" - provided from 12c onwards for
catpf.sql:Rem          "STIG for Oracle 12c" password complexity check requirement.
catpf.sql:Rem  Defense Database Security Technical Implementation Guide (STIG) v1 r2
catpf.sql:create or replace function ora12c_stig_verify_function
catpf.sql:GRANT EXECUTE ON ora12c_stig_verify_function TO PUBLIC container=current;
catpf.sql:Defining ora_cis_profile and ora_stig_profile
catpf.sql:  -- Security Technical Implementation Guide for 12c[STIG v1R17].
catpf.sql:  execute immediate 'create profile ora_stig_profile limit

c19.sql:  'Audit policy to implement auditing recommendations from STIG v1 (4 Jan 2019)';
c19.sql:  'Audit policy to track all top level actions to help comply with STIG v1 (4
c19.sql:  'Audit policy to track session logon and logoff actions to help comply with STIG v1
          (4 Jan 2019) and CIS v2.0.0 (12-28-2016) It should be enabled only on privileged users;
          Otherwise it could generate large number of audit records for users who frequently connect
          to the system.';
c19.sql:CREATE AUDIT POLICY ORA_STIG_RECOMMENDATIONS
```

20c Security (2:2)

```
c20.sql: execute immediate 'alter profile ora_stig_profile limit
c20.sql:                      password_verify_function ora12c_stig_verify_function';

secconf.sql:  'CREATE AUDIT POLICY ORA_STIG_RECOMMENDATIONS ' ||
secconf.sql:  '''Audit policy to implement auditing recommendations from STIG v1' ||
secconf.sql:  'comply with STIG v1 (4 Jan 2019) and CIS V2.0.0 (12-28-2016)' ||
secconf.sql:'ORA_STIG_RECOMMENDATIONS',
```

20c Users & Roles

- New Users
 - DV_OWNER
- New Roles
 - AVTUNE_PKG_ROLE
 - BDSQL_ADMIN
 - BDSQL_USER
 - GSMROOTUSER_ROLE
 - PPLB_ROLE
- Desupported Role
 - CSW_USR_ROLE

20c Data Dictionary Views

- New
 - DBA_OGG_AUTO_CAPTURED_TABLES
 - USER_OGG_AUTO_CAPTURED_TABLES

This should serve as a really strong hint that if you haven't studied Unified Auditing you are running out of time to get your skills current



Desupported

- ALL_DEF_AUDIT_OPTS
- AUDIT_ACTIONS
- DBA_AUDIT_EXISTS
- DBA_AUDIT_OBJECT
- DBA_AUDIT_SESSION
- DBA_AUDIT_STATEMENT
- DBA_AUDIT_TRAIL
- DBA_COMMON_AUDIT_TRAIL
- DBA_FGA_AUDIT_TRAIL
- DBA_OBJ_AUDIT_OPTS
- DBA_PRIV_AUDIT_OPTS
- DBA_STMT_AUDIT_OPTS
- USER_AUDIT_OBJECT
- USER_AUDIT_SESSION
- USER_AUDIT_STATEMENT
- USER_AUDIT_TRAIL
- USER_OBJ_AUDIT_OPTS
- V\$XML_AUDIT_TRAIL

20c Initialization (Startup) Parameters

- New

- DBNEST_ENABLE
- DBNEST_PDB_FS_CONF
- DIAGNOSTICS_CONTROL
- INMEMORY_DEEP_VECTORIZATION
- PMEM_FILESTORE
- TABLESPACE_ENCRYPTION_DEFAULT_ALGORITHM



Desupported

- AUDIT_FILE_DEST
- AUDIT_SYS_OPERATIONS
- AUDIT_SYSLOG_LEVEL
- AUDIT_TRAIL
- IGNORE_CASE
- UNIFIED_AUDIT_SGA_QUEUE_SIZE

Another reminder that you need to get yourself up to speed on Unified Auditing

20c PL/SQL Packages: Desupported

- DBMS_CLR
- ★ DBMS_OBFUSCATION_TOOLKIT
- DBMS_OBFUSCATION_TOOLKIT_FFI
- ORDIMDPCALLOUTS
- ORD_ADMIN

If any of your security is based on DBMS_OBFUSCATION_TOOLKIT ... the clock is ticking

20c PL/SQL Packages: New

- DBFS_OFS_CONVERSION
- DBMS_ADBTASK_ADMIN
- DBMS_AQ_IND_MON
- DBMS_AQ_SUB
- DBMS_AUTO_SQLSET
- **DBMS_AUTO_ZONEMAP**
- DBMS_AUTO_ZONEMAP_INTERNAL
- **DBMS_AVTUNE**
- DBMS_AWRHUB_SERVER
- DBMS_AWRHUB_SOURCE
- DBMS_AWR_ANALYTICS
- ★ **DBMS_BLOCKCHAIN_TABLE**
- DBMS_BLOCKCHAIN_UTL
- **DBMS_CLOUD**
- DBMS_CLOUD_TYPES
- DBMS_DLM
- DBMS_GSM_DDL
- DBMS_GSM_SEC
- DBMS_HCS_LOG
- DBMS_MAX_STRING_SIZE
- DBMS_MDX_UTIL
- ★ **DBMS_MLE**
- **DBMS_OPTIM_BUNDLE**
- DBMS_PQDIAG
- **DBMS_TABLE_DATA**
- DBMS_TSDP_PROTECT_INT
- ★ **DBMS_USER_CERTS**
- LBAC_POLICY_ADMIN_INT
- LTI

21c DBMS_BLOCKCHAIN_TABLE

- Subprograms

 **DELETE_EXPIRED_ROWS**

- **GET_BYTES_FOR_ROW_HASH**
- **GET_BYTES_FOR_ROW_SIGNATURE**
- **GET_SIGNED_BLOCKCHAIN_DIGEST**
- **SIGN_ROW**
- **VERIFY_ROWS**

 **VERIFY_TABLE_BLOCKCHAIN**

- In addition to introducing this supported package DBMS_MLE in 20 the new Object Type MLE Language is in namespaces 1 and 147
- The Multi-Lingual Engine (MLE) package allows users to execute JavaScript code inside the Oracle Database and exchange data seamlessly between PL/SQL and JavaScript
- The JavaScript code can execute PL/SQL and SQL through the use of built-in JavaScript modules

- The JavaScript code itself can execute PL/SQL and SQL through built-in JavaScript modules

```
set serveroutput on;

DECLARE
  ctxh      dbms_mle.context_handle_t;
  source    CLOB;
  greeting  dbms_id;
BEGIN
  ctxh := dbms_mle.create_context();                      -- create MLE execution context
  dbms_mle.export_to_mle(ctxh, 'person', 'World');        -- export value from PL/SQL

  source := q'~
  var bindings = require("mle-js-bindings");
  var person = bindings.importValue("person"); // Imp. value prev. exported with PL/SQL
  var greeting = "Hello, " + person + "!";
  bindings.exportValue("greeting", greeting); // Export value to PL/SQL
  ~';

  dbms_mle.eval(ctxh, 'JAVASCRIPT', source);           -- eval src in execution context
  dbms_mle.import_from_mle(ctxh, 'greeting', greeting); -- Imp. previously exported val
  dbms_output.put_line('Greetings from MLE: ' || greeting);
  dbms_mle.drop_context(ctxh);
END;
/
Greetings from MLE: Hello, World!
```

20c SQL: New



Block Chain Tables
Immutable Tables

- EXCEPT Set Operator
- INTERSECT ALL Set Operator
- MINUS ALL Set Operator

```
SQL> UPDATE ledger0 SET tx_value = 200;
UPDATE ledger0 SET tx_value = 200
*
ERROR at line 1:
ORA-05715: operation not allowed on the blockchain table

SQL> DELETE FROM ledger0;
DELETE FROM ledger0
*
ERROR at line 1:
ORA-05715: operation not allowed on the blockchain table

SQL> TRUNCATE TABLE ledger0;
TRUNCATE TABLE ledger0
*
ERROR at line 1:
ORA-05715: operation not allowed on the blockchain table

SQL> DROP TABLE ledger0;
DROP TABLE ledger0
*
ERROR at line 1:
ORA-05723: drop blockchain or immutable table LEDGER0 not allowed
```

20c SYS_CONTEXT Function: New

- SYS_CONTEXT Process Identifier (PID)
- Returns the process from V\$SESSION for the current session in one step / without a subquery

```
SELECT UNIQUE sid FROM v$mystat;

SID
-----
261

SELECT process FROM v$session WHERE sid=261;

PROCESS
-----
1680:4228

SELECT sys_context('USERENV', 'PID') FROM dual;

SYS_CONTEXT('USERENV', 'PID')
-----
1680:4228
```

20c PL/SQL Pragma and PL/SQL Warnings: New

- Pragma SUPPRESSES_WARNING_6009
- Informational Warning Messages
 - 06027 -- Pragma Inline
 - 06028 -- Pragma Coverage
 - 06029 -- Pragma Suppress Warning
- Severe Warning Messages
 - 05026 -- Identifier should not be specified on the END statement for an unlabeled construct
 - 05027 -- END statement identifier 'string' should match label 'string' at line string, column string
 - 05028 -- END statement identifier 'string' should match the name of TRIGGER 'string'
 - 05029 -- Statement has more than one label specified for it.

20c Feature Usage Report Procedures: New

- DBMS_FEATURE_APPROX_QP -- approximate query processing
- DBMS_FEATURE_IM_BASE_LEVEL -- in-memory level usage

New in 21c

Welcome to 21c: 21.3.0.0

- I am now 258 days into working with Oracle 21c

```
[dmorgan@test21 ~]$ sudo su oracle
[oracle@test21 dmorgan]$ cd $ORACLE_HOME
[oracle@test21 dbhome_1]$ sqlplus / as sysdba

SQL*Plus: Release 21.0.0.0.0 - Production on Fri Dec 11 21:12:38 2020
Version 21.1.0.0.0

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Version 21.1.0.0.0

SQL> 
```

Welcome to 21c

- 8 days into the GA release: 21.3.0.0.0

```
[dmorgan@test21 ~]$ sudo su oracle
[oracle@test21 dmorgan]$ cd $ORACLE_HOME
[oracle@test21 dbhome_1]$ sqlplus / as sysdba

SQL*Plus: Release 21.0.0.0.0 - Production on Thu Aug 26 02:52:47 2021
Version 21.3.0.0.0

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Version 21.3.0.0.0

SQL> ■
```

- There are only 2 versions of the Oracle Database that should be on your radar ... 19.11 and 21.3 ... everything else is a distraction

Welcome to 21c

- Download 21.3 at <https://otn.oracle.com> or <https://edelivery.oracle.com>
- Download the current docs at <https://docs.oracle.com>
- If you thought there was a lot of content in 20c ... you might want to tighten your seat belt



21c Attention Log (1:2)

- The new attention log is a structured, externally modifiable file that contains information about critical and highly visible database events
- The log contains a pre-determined, translatable series of messages, with one message for each event
- Use the log to quickly access information about critical events that require action ... this is Oracle's answer to the Alert Log hardly anyone reads until there is an outage
- Each instance, in a RAC environment has its own attention log
- Messages Types: Error, Warning, Notification, or Additional information
- Urgency Values: Immediate, Soon, Deferrable, or Information
- Scope Values: Session, Process, PDB Instance, CDB Instance, CDB Cluster, PDB (for issues in persistent storage that a database restart will not fix), or CDB (for issues in persistent storage that a database restart will not fix)
- Target User Values: The user who must act on the message (Clusterware Admin, CDB admin, or PDB admin)

21c Attention Log (2:2)

```
[oracle@test21 log]$ pwd
/u01/app/oracle/diag/rdbms/test21db_iad25g/test21db/log
[oracle@test21 log]$ ls -l
total 56
drwxr-x--- 2 oracle asmadmin 4096 Dec 11 2020 attention
-rw-r----- 1 oracle asmadmin 19353 Aug 19 16:07 attention.log
drwxr-x--- 2 oracle asmadmin 4096 Dec 11 2020 ddl
drwxr-x--- 2 oracle asmadmin 4096 Dec 19 2020 debug
-rw-r----- 1 oracle asmadmin 3108 May 3 01:09 debug.log
drwxr-x--- 2 oracle asmadmin 4096 Dec 17 2020 hcs
-rw-r----- 1 oracle asmadmin 1410 Aug 24 14:24 hcs_test21db.log
drwxr-x--- 2 oracle asmadmin 4096 Dec 11 2020 imdb
drwxr-x--- 2 oracle asmadmin 4096 Dec 11 2020 test
[oracle@test21 log]$
```

```
{
  "ERROR"      : "GEN0 (ospid: 24229): terminating the instance due to ORA error 495",
  "URGENCY"    : "IMMEDIATE",
  "INFO"       : "Additional Information Not Available",
  "CAUSE"      : "The instance termination routine was called",
  "ACTION"     : "Check alert log for more information relating to instance termination rectify the error and
restart the instance",
  "CLASS"      : "CDB Instance / CDB ADMINISTRATOR / AL-1003",
  "TIME"       : "2021-01-17T02:19:27.281+00:00"
}
```



- Oracle Wallet Manager
- SHA-1 for DBMS_CRYPTO
- SHA-1 for SQL*Net
- MD4
- MD5
- Oracle has changed the AUTHID of a lot of their built-in packages from DEFINER to CURRENT_USER ... this has the potential to break things so substantial testing must be built into upgrade planning

Just like the wake-up call earlier about Unified Auditing

You should be making a note right now to check use of each of these ... you have only a year or two to replace them

21c Users, Roles and Profiles

- New Users
 - DGPDB_INT
- New Roles
 - MAINTPLAN_APP
- Desupported Role
 - DV_PUBLIC
 - DV_REALM_OWNER
 - DV_REALM_SOURCE
- New Profile Resource
 - ★ **PASSWORD_ROLLOVER_TIME**
 - After a password change: The number of days during which both passwords are simultaneously valid

```
ALTER PROFILE default LIMIT password_rollover_time 2;
```

- Though you really should NEVER assign anyone to the default profile unless you want to be the next T-Mobile

 21c System Privileges: New

- Create Logical Partition Tracking
- Drop Logical Partition Tracking
- Execute Dynamic MLE
- Enable Diagnostics

21c Dynamic Performance Views: New

- GV\$ACTIVITY_MVIEW
- GV\$ACTIVITY_TABLE
- GV\$ALL_ACTIVE_SESSION_HISTORY
- GV\$ALL_SQL_MONITOR
- GV\$ALL_SQL_PLAN
- GV\$ALL_SQL_PLAN_MONITOR
- GV\$AQ_DEQUEUE_SESSIONS
- GV\$AQ_PARTITION_STATS
- GV\$ASM_ACFSAUTORESIZE
- GV\$AV_BTT_CACHE
- GV\$BCAPPLY_STATS
- GV\$BUILD_INFO
- GV\$COMPATIBILITY_REQUIREMENT
- GV\$CONNECTION_BROKER
- GV\$CONSENSUS_CLIENTS
- GV\$CONSENSUS_LOGS
- GV\$CONSENSUS_STATS
- GV\$CONTAINER_TOPOLOGY
- GV\$CON_WAITCLASSMETRIC
- GV\$CON_WAITCLASSMETRIC_HISTORY
- GV\$DG_BROKER_PROPERTY
- GV\$DG_BROKER_PROPERTY_INT
- GV\$DIAG_USER_TRACE_RECORDS
- GV\$EQ_CACHED_PARTITIONS
- GV\$EQ_CROSS_INSTANCE_JOB
- GV\$EQ_DEQUEUE_SESSIONS
- GV\$EQ_INACTIVE_PARTITIONS
- GV\$LCR_CACHE
- GV\$LISTENER_HEALTH
- GV\$EQ_MESSAGE_CACHE
- GV\$EQ_MESSAGE_CACHE_ADVICE
- GV\$EQ_MESSAGE_CACHE_STAT
- GV\$EQ_NONDUR_SUBSCRIBER
- GV\$EQ_NONDUR_SUBSCRIBER_LWM
- GV\$EQ_PARTITION_STATS
- GV\$EQ_REMOVE_DEQUEUE_AFFINITY
- GV\$EQ_SUBSCRIBER_LOAD
- GV\$EQ_SUBSCRIBER_STAT
- GV\$EQ_SUBSCR_REGISTRATION_STATS
- GV\$EQ_UNCACHED_PARTITIONS
- GV\$FOREIGN_DATAFILE_COPY
- GV\$GCS_LOCK_STATE_RESOLUTION_HISTORY
- GV\$LISTENER_HEALTH
- GV\$MDX_CURSOR
- GV\$MDX_CURSOR_DEPENDENCY
- GV\$PKCS11_PATH
- GV\$PQ_SLAVEINFO
- GV\$QUERY_BLOCK_ORIGIN
- GV\$RESULT_SUBCACHE_STATISTICS
- GV\$SECUREFILE_SHRINK

21c Dynamic Performance Views: Desupported

- V\$CELL_DB_HISTORY
- V\$OBJECT_USAGE
- V\$XML_AUDIT_TRAIL

21c Native JSON Data Type: New

- JSON data type defined as BLOB_BASE

```
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Version 21.3.0.0.0
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Version 21.3.0.0.0

SQL> create table json_test (testcol JSON);

Table created.

SQL> desc json_test
 Name      Null?    Type
-----  -----
 TESTCOL          JSON

SQL> SELECT object_name, object_type FROM dba_objects WHERE created > sysdate-1/24;

OBJECT_NAME          OBJECT_TYPE
-----  -----
SYS_IL0000175194C00001$$      INDEX
JSON_TEST              TABLE
SYS_LOB0000175194C00001$$      LOB
```

21c PL/SQL Packages: Desupported

- DBMS_CRYPTO_TOOLKIT
- DBMS_CRYPTO_TOOLKIT_FFI
- DBMS_CRYPTO_TOOLKIT_TYPES
- DBMS_HETEROGENEOUS_SNAPSHOT
- DBMS_HS_PARALLEL
- DBMS_HS_PARALLEL_METADATA
- DBMS_HS_PASSTHROUGH
- DBMS_IAS_CONFIGURE
- DBMS_IAS_QUERY
- DBMS_IAS_SESSION
- DBMS_IAS_TEMPLATE
- DBMS_LIBCACHE
- DBMS_LIBCACHE\$DEF
- DBMS_MGWMDG
- DBMS_SERVER_TRACE
- DBMS_WRR_STATE
 - present in 21.1 but dropped in 21.3
- DBMS_WRR_STATE_BASE
 - present in 21.1 but dropped in 21.3
- ORDIMGSIG_PKG
- ORDIMGSI_PKG
- ORD_DICOM_ADMIN_PRV
- ORD_DICOM_CT
- ORD_DICOM_PKG
- UTL_ORAMTS
- UTL_SPADV

Are any applications at your organization dependent on IAS?
Internet Application Server

21c PL/SQL Packages: New

- DBMS_ACTIVITY
- DBMS_APP_CONT_REPORT
- DBMS_AUDIT_MGMT_SUPPORT
- DBMS_AUTO_MV
- DBMS_CLOUD_ADMIN_INTERNAL
- DBMS_CLOUD_CAPABILITY
- DBMS_CLOUD_CORE
- DBMS_CLOUD_INTERNAL
- DBMS_CLOUD_MACADM
- DBMS_CLOUD_REQUEST
- DBMS_CLOUD_TASK
- DBMS_CUBE_PRVTEXP
- DBMS_EDITIONS_UTILITIES2
- DBMS_FLASHBACK_ARCHIVE_MIGRATE
- **DBMS_IMMUTABLE_TABLE**
- DBMS_MAINTPLAN
- DBMS_REPLAYHUB
- DBMS_SWAT
- DBMS_SWAT_ARM_INTERNAL
- DBMS_SWAT_INTERNAL
- DBMS_SWAT_MM_INTERNAL
- DBMS_SWAT_MM_UTILS
- DBMS_SWAT_VER_INTERNAL
- DBMS_SYS_MLE
- DBMS_TEQK
- TKHCS_LOG_PKG
- UTL_RECOMP2

21c DBMS_IMMUTABLE_TABLE

- So far not part of the official online documentation
- The packages contain utilities that manage automatically created, self-tuning, materialized views

```
dbms_immutable_table.delete_expired_rows(
    schema_name           IN  VARCHAR2,
    table_name            IN  VARCHAR2,
    before_timestamp      IN  TIMESTAMP WITH TIME ZONE DEFAULT NULL,
    number_of_rows_deleted OUT NUMBER)
```

```
DECLARE
  delRows INTEGER;
BEGIN
  dbms_immutable_table.delete_expired_rows('C##UWCLASS', 'AUDIT_LOG', SYSDATE-90, delRows);
  dbms_output.put_line(TO_CHAR(delRows));
END;
/
```

21c DBMS_SWAT

- So far not part of the official online documentation
- The packages contain utilities that manage automatically created, self-tuning, materialized views

21c PL/SQL Packages Changes (1:4)

- CTX_ENTITY has 1 new object
- DBMS_APP_CONT_ADMIN has 5 new objects
- DBMS_AQ has new SEEK procedure
- DBMS_AQADM has 6 new objects
- DBMS_ASH has new FETCH_OBJ_NAME and FETCH_SQLTEXT objects and FETCH_OBJ_NAME_AWR and 3 other objects removed
- DBMS_ASSERT has new SIMPLE_SQL_NAME_LIST function
- DBMS_AUDIT_MGMT_LSBY has 10 new objects
- DBMS_AUTOTASK_PRVT has new REQUEST_GRACE_PERIOD function
- DBMS_AUTO_INDEX has new DROP_AUTO_INDEXES procedure
- DBMS_AUTO_INDEX_INTERNAL has 4 new objects
- DBMS_AW dropped 3 ..._ACCESS_TRACKING objects
- DBMS_AW_INTERNAL has 4 new objects
- DBMS_BACKUP_RESTORE has 5 new objects
- DBMS_BLOCKCHAIN_TABLE has 4 new objects
- DBMS_BLOCKCHAIN_UTL has new IS_COPIER object
- DBMS_CLOUD has 11 new objects
- DBMS_CRYPTO has new PKDECRYPT, PKENCRYPT, SIGN and VERIFY objects
- DBMS_CRYPTO_FFI has new PKDECRYPT, PKENCRYPT, SIGN and VERIFY objects
- DBMS_CUBE has new IMPORT_XML_BLOB procedure
- DBMS_CUBE_LOG has new TABLE_DROP and TABLE_TRUNCATE procedures
- DBMS_DBFS_CONTENT has 5 new objects
- DBMS_DBFS_HS dropped UNLOCKPATH procedure
- DBMS_DBFS_SFS has 25 new objects
- DBMS_DBFS_SFS_ADMIN has new NEWIDAUX object

21c PL/SQL Packages Changes (2:4)

- DBMS_DRS has 37 new objects
- DBMS_EDITIONS_UTILITIES has new ACTUALIZE_ALL procedure
- DBMS_FUSE has new FS_MKSOC function with 3 overloads
- DBMS_GSM_FIX has 12 new objects
- DBMS_GSM_FIXED has 4 new objects
- DBMS_GSM_POOLADMIN has 11 new objects
- DBMS_GSM.Utility has 8 new objects
- DBMS_GSM_SEC has new PUTCATUSER procedure
- DBMS_HADOOP_INTERNAL has new EVAL_PART_KEY_OPERATOR procedure and has dropped 3 objects
- DBMS_HIERARCHY has 3 new objects
- DBMS_INDEX_UTL has new GET_REORG_INDEX_ACTION procedure
- DBMS_INTERNAL_ROLLING has new IS_PLSQL_PRAGMA procedure
- DBMS_IR has new UPDATEFEASABILITYANDIMPACT procedure
- DBMS_ISCHED has new CREATE_CLOUD_CREDENTIAL and RESOLVE3_NAME and dropped DEFINE_CHAIN_RULE and DEFINE_CHAIN_STEP
- DBMS_I_INDEX_UTL has new I_ANALYZE_INDEX and I_COMPUTE_ACTION objects
- DBMS_JSON has new BLOB_TO_JSON, GATHER_STATS, and GET_VIEW_SQL objects
- DBMS_JSON0 has new CHECKPK and GETMAXVCSIZE objects
- DBMS_JSON_INT has new BLOB2JSON procedure
- DBMS_LOGMNR.INIT_REPLCATION_METADATA dropped
- DBMS_LOB LOADFROMFILE and LOB new buffering support
- DBMS_METADATA_UTIL has new IS_SHARD_TBL_IN_SHARD_CATALOG function
- DBMS_ODCI has UPGRADE_SECOBJ procedure removed
- DBMS_PARALLEL_EXECUTE_INTERNAL has 4 new objects
- DBMS_PLSQL_CODE_COVERAGE has new GET_BLOCK_MAP function

21c PL/SQL Packages Changes (3:4)

- DBMS_PLUGTS has new KCP_SETPIRENA procedure
- DBMS_PREUP dropped 20 objects from 19c and added 14 new objects
- DBMS_RCVCAT has 26 new objects, drops ITRANSLATEDPDBID, KTRANSLATEPDBNAME
- DBMS_RCVMAN has 13 new objects
- DBMS_RCVVPC has 8 new objects
- DBMS_REDEFINITION_INTERNAL has 9 new objects
- DBMS_REGISTRY dropped 2 objects
- DBMS_REGISTRY_SYS has 2 new objects
- DBMS_RESULT_CACHE has 7 new objects
- DBMS_SMB_INTERNAL has new INIT_SMB_PARAMETER procedure
- DBMS_SODA has 12 new objects
- DBMS_SODA_ADMIN has 11 new objects
- DBMS_SODA_DML has 3 new objects
- DBMS_SPM_INTERNAL has 6 new objects and dropped LOAD_AUTO_EVOLVE_TASK_CONFIG
- DBMS_SQADM_SYSCALLS has 2 new objects
- DBMS_SQLCONTROL_INTERNAL renamed by prefix dropping all four previously existing objects and added new GET_OBJECT_NAME procedure
- DBMS_SQLPATCH has new VERIFY_QUERYABLE_INVENTORY function
- DBMS_SQLQ_INTERNAL procedures renamed to drop I_ prefix and 4 objects dropped
- DBMS_SQLQ_INTERNAL.CREATE_QUARANTINE_BY_TEXT renamed to _BY_SQLTEXT
- DBMS_SQLTCB_INTERNAL has new FIXQ object
- DBMS_SQLTUNE has1 has 1 new object
- DBMS_SQLTUNE_UTIL0 has 1 new object
- DBMS_SQLTUNE_UTIL1 has 3 new objects
- DBMS_SQLTUNE_UTIL2 has 5 new objects

21c PL/SQL Packages Changes (4:4)

- DBMS_STATS_INTERNAL has 35 new objects
- DBMS_SWRF_INTERNAL has 3 new objects
- DBMS_WORKLOAD_CAPTURE dropped GET_STATE function
- DBMS_WORKLOAD_CAPTURE_I dropped GET_STATE and USER_CALLS_GRAPH
- DBMS_WORKLOAD_REPLAY dropped GET_STATE adds new CONFIGURE
- DBMS_WORKLOAD_REPLAY_I dropped GET_STATE adds new CONFIGURE
- DBMS_WORKLOAD_REPOSITORY has new AWR_EXP procedure
- DBMS_WRR_INTERNAL dropped the EXPORT_REP_EXT_TBL procedure
- DBMS_WRR_PROTECTED has new GET_DBREPLAY_PATCH_INFO function
- DBMS_XPLAN has new COMPARE_CURSOR and COMPARE_EXPLAIN objects
- DBMS_XSTREAM_GG_ADM has new PURGE_TXN_CDR_INFO object
- DBMS_XSTREAM_GG_INTERNAL has new PURGE_TXN_CDR_INFO_INTERNAL object
- DBMS_XS_SIDP has new DODHEXCHANGE2 and DODHEXCHANGE3 procedures
- EXCHANGE has new DO_DDL_JOB procedure
- KBRSI_ICD has 4 objects removed and 19 new objects added
- KUPP\$PROC has 4 new objects
- PRVTEMX_DBHOME has new REPORT_ASH_XML function
- PRVTEMX_PERF has new ACTION_CANCEL_SQL_XML function
- PRVT_AWR_VIEWER has 9 new objects
- PRVT_DBMS_INMEMORY_ADMIN has SPACE_USAGE2 and TRACE removed
- PRVT_DIMENSION_SYS_UTIL dropped the SET_DEBUG procedure
- PRVT_EMX has new OMX_LOCALES function
- XS_ACL has new GRANT_PRIVILEGE and REVOKE_PRIVILEGE procedures

Wrap Up

Business Case

- Some time in the next 3-5 years you will be forced to do one of two things
 - Migrate to an Oracle Container Database
 - Execute a career change
- The organization you current work for will either upgrade to CDBs and PDBs or do business with unsupported applications running on an unsupported database with limited or no access to bug fixes and security patches
- That upgrade to 21c+ will force a legacy architecture to working with mandatory migration from Oracle's a container database
- If you do not know how to create common user, common role, and common profile you are a decade behind where you should be
- And, needless to say it is your responsibility to not only learn how to work with and manage a container database ... it is your responsibility to learn all of the critically important new features in Oracle Database versions 12c through 21c so that you are prepared for 23c
- I hope today you started down the road of a synapse stimulating adventure



Thank you

- For inviting me here today
- To the volunteers that make this user group function
- Please contact them and volunteer a few hours of your time to help them continue to provide programs such as the one you are enjoying today