Oracle Platinum Partner

Oracle Database 12c Release 2 / 18c
For IT Transformation

Part 1: Oracle 12.2

Part 2: Oracle 18c and 19c

We are giving away books

Please sign up for the raffle!

AZORA

Charles Kim, CEO

Oracle ACE Director

January 2019

Industry Experts

- Viscosity founders hold 25+ years each in the Oracle space
- Authors of 20+ books in the Oracle space
- 4 ACE Directors, only 36 in the United States
  - +1 ACE
- SharePlex Platinum Partner
- Direct connections to Oracle support and Product Managers support
- Expertise in Oracle 11g, 12c, 18c, RAC, ASM, Data Guard, Zero Downtime Upgrades, Performance Tuning, and much more

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We've written 20+ books on Data, Cloud, and Oracle…

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Charles Kim

VISCOSITY NORTH AMERICA

- Oracle ACE Director
- Founder and CEO of Viscosity
- Over 27 years of Oracle Expertise: Mission Critical Databases, RAC, Data Guard, ASM, RMAN, Shareplex/GoldenGate
- Specialize in "**Complex Data Replication** & **Integration**" with **Shareplex** & **GG**
- President - IOUG Cloud Computing SIG
  - Oracle Management Cloud Certified
- Blog Sites: http://DBAExpert.com/blog
- Oracle Exadata Certified Implementation Specialist, (2014, 2016)
- Oracle Certified RAC Expert

vmware vEXPERT

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redhat. CERTIFIED

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ORACLE
ACE Director
My Core Expertise:
Oracle Exadata Implementation Specialist, 2014, 2016
Oracle RAC Certified Expert
Automation – I am an Autonomous DBA ☺
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http://viscosityna.com/resources/dba-resources/twelve-days-12-2/

Welcome to the 12 days of 12c | 12.2 – New Features

For 12 days, Viscosity will release a new article about 12.2 new features, written by our Oracle Ace Directors and Consultants. Be sure to check back every day for the newest article!

On the Twelfth day of 12.2, my DBA gave to me... Pluggable Databases (PDBs)

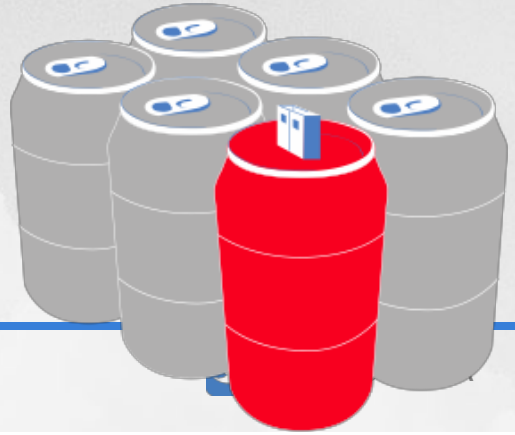
Dec 12, Day 1: RAC and Grid Infrastructure	Dec 13, Day 2: Data Guard	Dec 14, Day 3: Partitioning	Dec 15, Day 4: ASM
Dec 16, Day 5: SQL Performance Tuning	Dec 17, Day 6: ACFS	Dec 18, Day 7: DB Security	Dec 19, Day 8: Index
Dec 20, Day 9: In-Memory	Dec 21, Day 10: RMAN	Dec 22, Day 11: Utilities, PL/SQL, & More	Dec 23, Day 12: Pluggable Databases

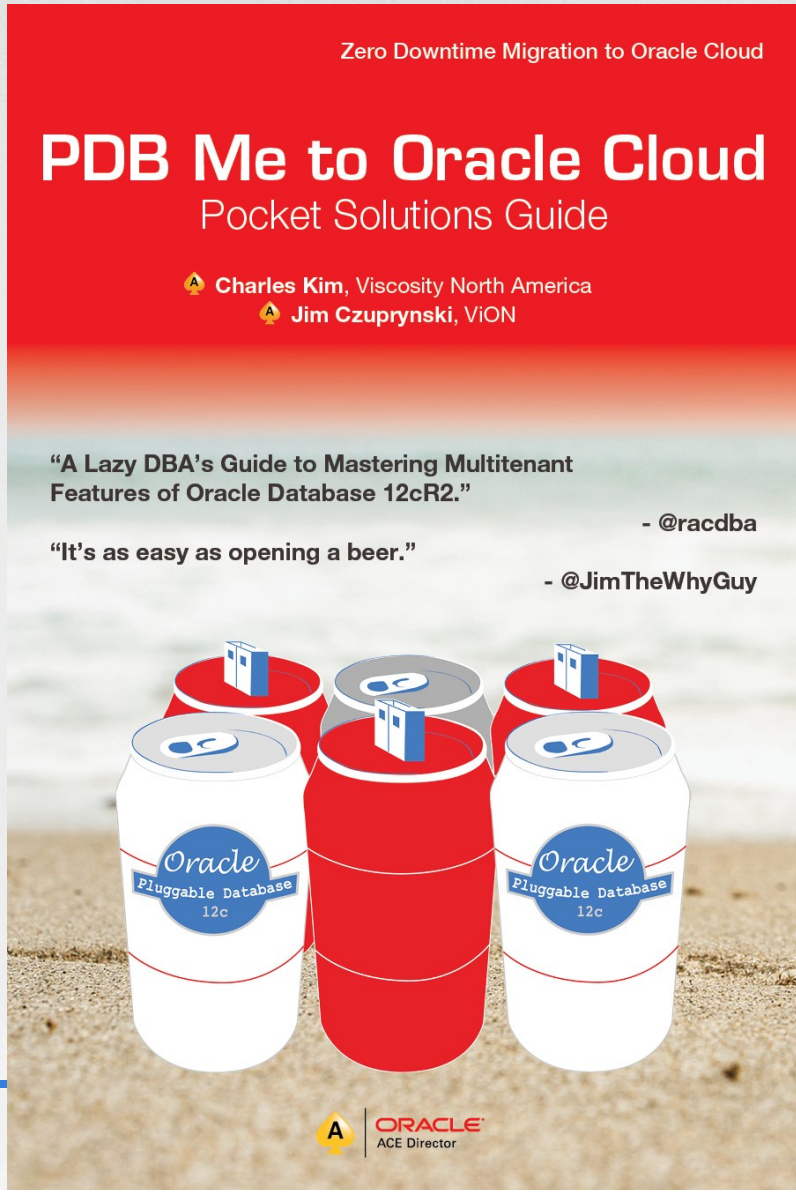
4 Quarters of Tech Deep Dives

Released @OpenWorld 2017

PDB Me ASAP!

A Lazy DBA's Guide to Mastering Multitenant Features of Oracle Database 12cR2





DbA 3.0

Cloud DBA

Now the Autonomous DBA

The Autonomous Database Cloud @OOW 2017

The Changing Role of the DBA: Q&A with Oracle's Penny Avril
http://www.dbta.com/BigDataQuarterly/Articles/The-Changing-Role-of-the-DBA-QandA-with-Oracles-Penny-Avril-120343.aspx

DBA 2.0 Is Dead. Long Live DBA 3.0! By Jim Czuprynski
https://vimeo.com/204365694

Oracle, a **Data** Company ....

@ViscosityNA

Evolution of the DBA

Kind of DBA	Timeline
CLI DBA	Early 90's DBAs
GUI DBA	Late 90's and Dot Com
Google DBA	Dot Com and 2000's
iDBA	Dot Com, IOUG iDBA Master Curriculum
RAC DBAs (MAA DBAs)	2000+ after 9.2 (but major spike with 10.2) **+ Data Guard**
DMA	**2010+ Database Machine Administrator**
vDBA / vRAC DBA	2010+ Evolving role of a DBA in the virtual world
Cloud DBA	2011+ Database Consolidation with Private Database Cloud Oracle Database 12c Launches June 2013
Public Cloud DBA	*2015+ Oracle Public Cloud with Database Cloud Service, Database Backup Cloud Service, Storage Cloud Service, IaaS Cloud Service*
PDBAs	**2017+ Multi-Tenant with Oracle Database 12c Release 2 GA – March 2017**
Oracle 18c	**February 2018 in Oracle Cloud, July 2018 On-Premise**

"It is not the strongest or the most intelligent who will survive but those who can best manage [adapt to] change."

Upgrade Plans

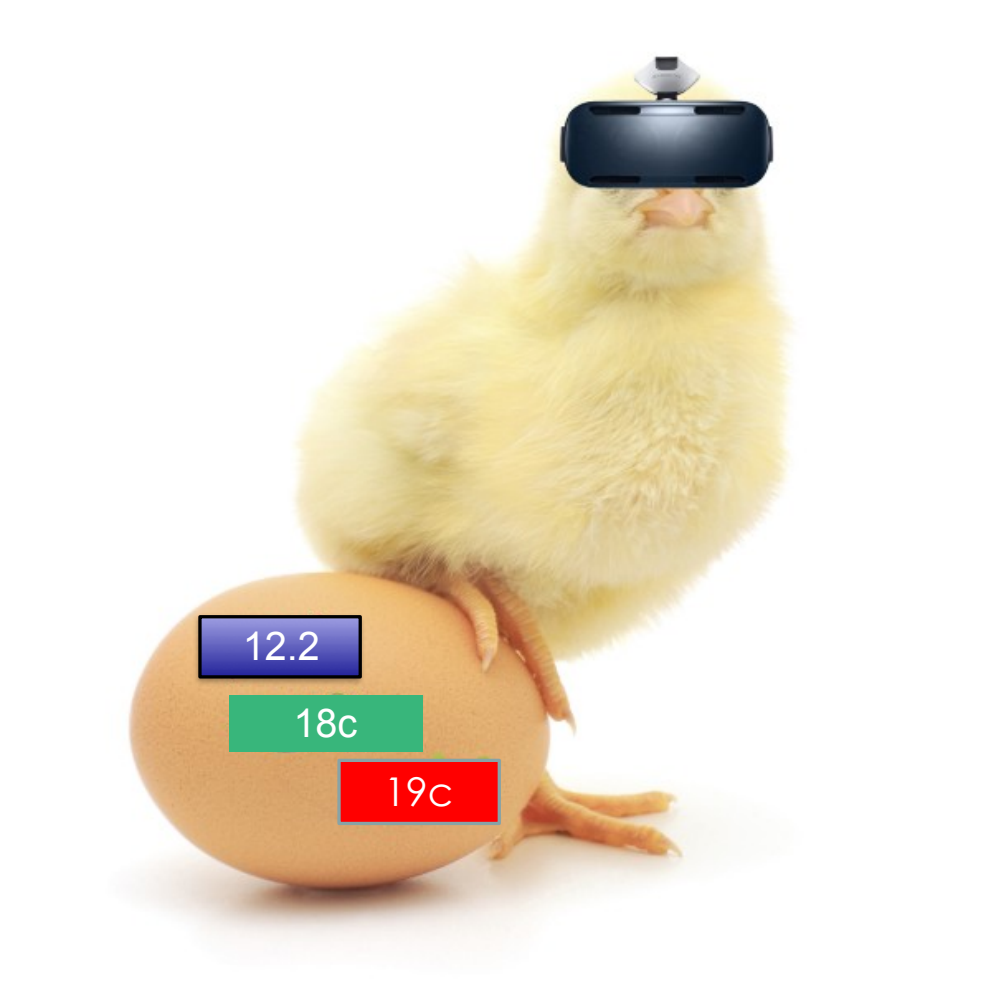
Upgrade On-Premise? Upgrade to the Cloud?

- How many are Terminal Release to Terminal Release customers?
- How many are planning to upgrade in
  - 6 months
  - 12 months
  - 24 months
  - Already There?
- Interesting in doing Zero Downtime and Zero Risk Upgrades?
- Still running legacy versions?

Upgrade Plans

Upgrade to Oracle 19c? Upgrade to 18c?

- Factoids
  - 19c is the Terminal Release of Oracle 12
  - E-Business Suite Customers are told to wait for Oracle 19c
- So When is Oracle 19c coming out?
- So what is the delimma?



Why You Should Consider Upgrading to Oracle 12.2 or 18c

11.2 Premier Support Ended - ULA?
12.1.0.2 Premier Support End
Even Oracle 19c ?

State of Oracle Cloud

Oracle Classic

FY16

State of Oracle Cloud

Oracle Added Some Spice

FY16

FY17

State of Oracle Cloud

Oracle is on the attack

FY16

FY17

FY18

State of Oracle Cloud

Oracle is on the attack

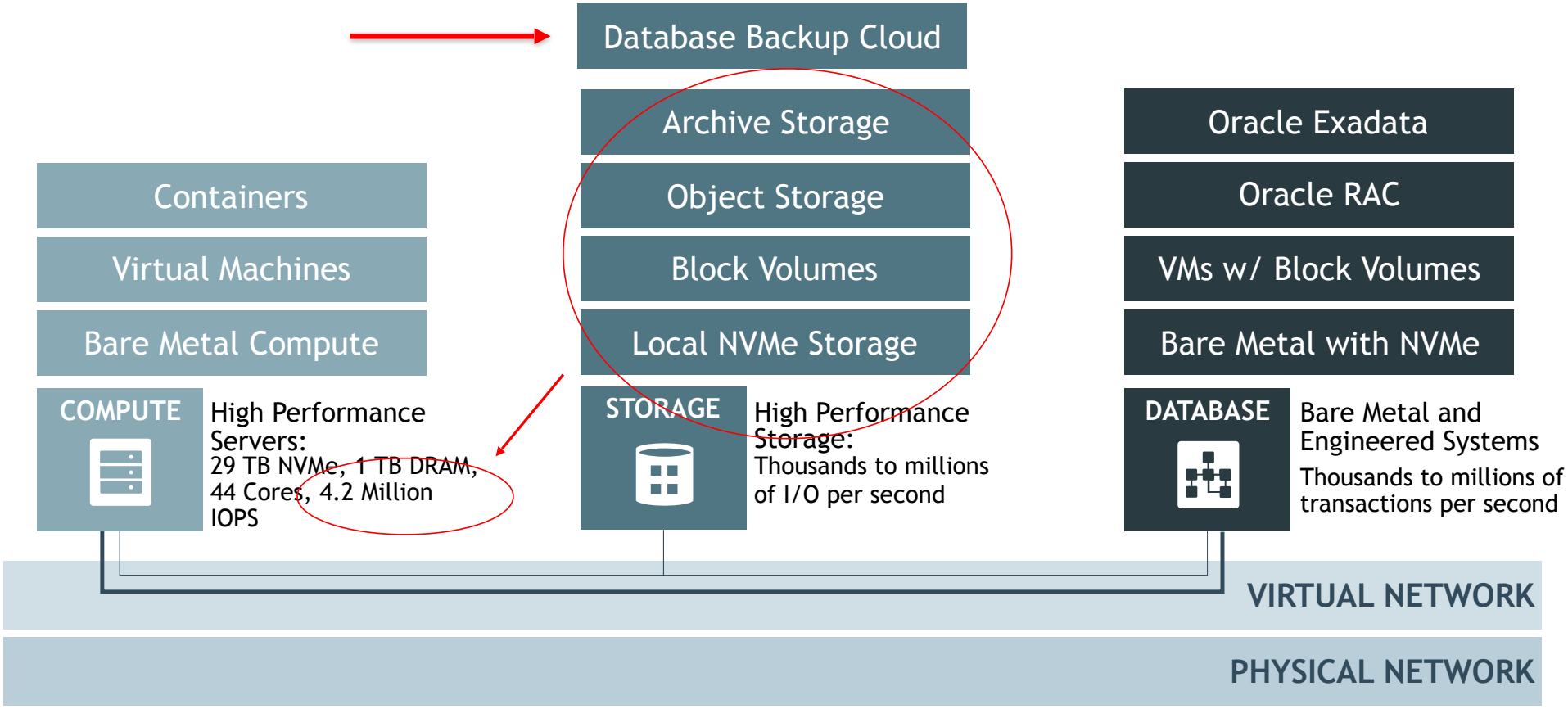
FY16

FY17

FY18

FY19
On Fire

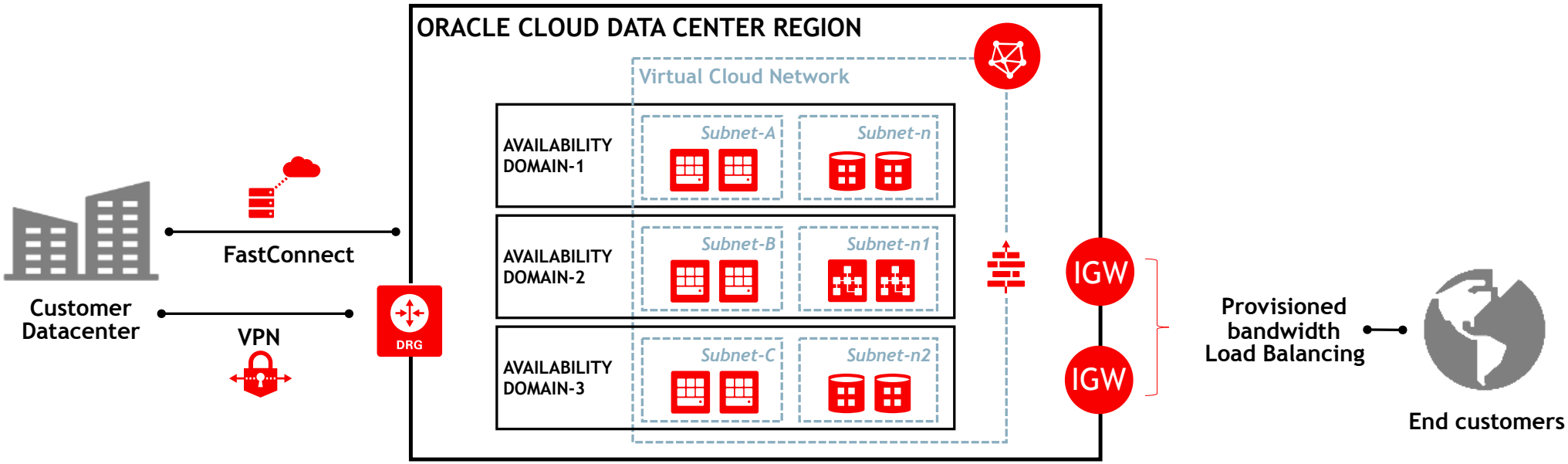
High Performance Cloud Services: Compute, Storage, Database



Virtual Network: High-Fidelity Private Networks and Access

Secure, reliable connectivity: IPSec VPN, FastConnect

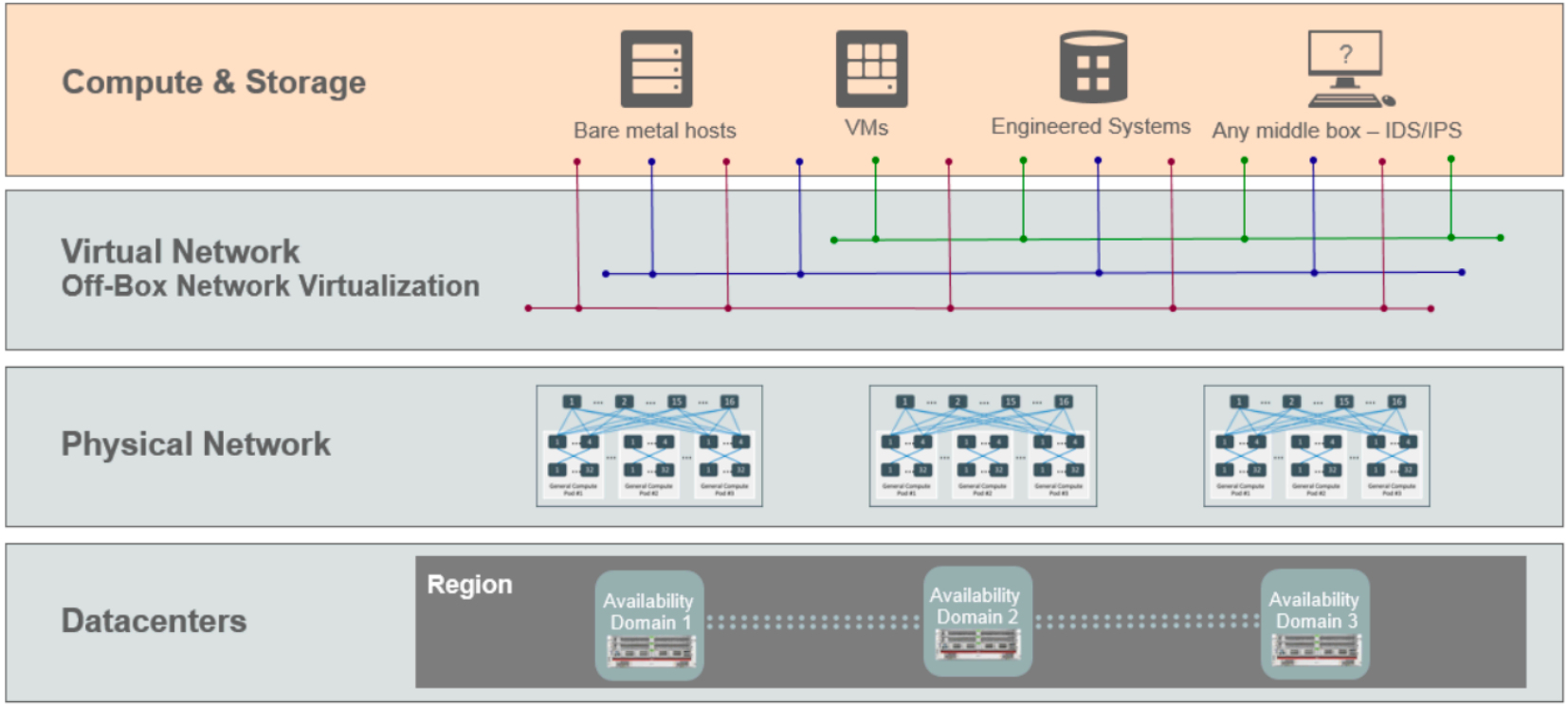
Deep VCN control: Subnets, routing rules, IP address space, firewall rules



Console or API-driven; same fabric for all core services; all traffic encrypted and isolated

Off-box Network Virtualization

Highly-configurable private overlay networks, move management and IO out of the hypervisor, and enable lower overhead and bare metal instances

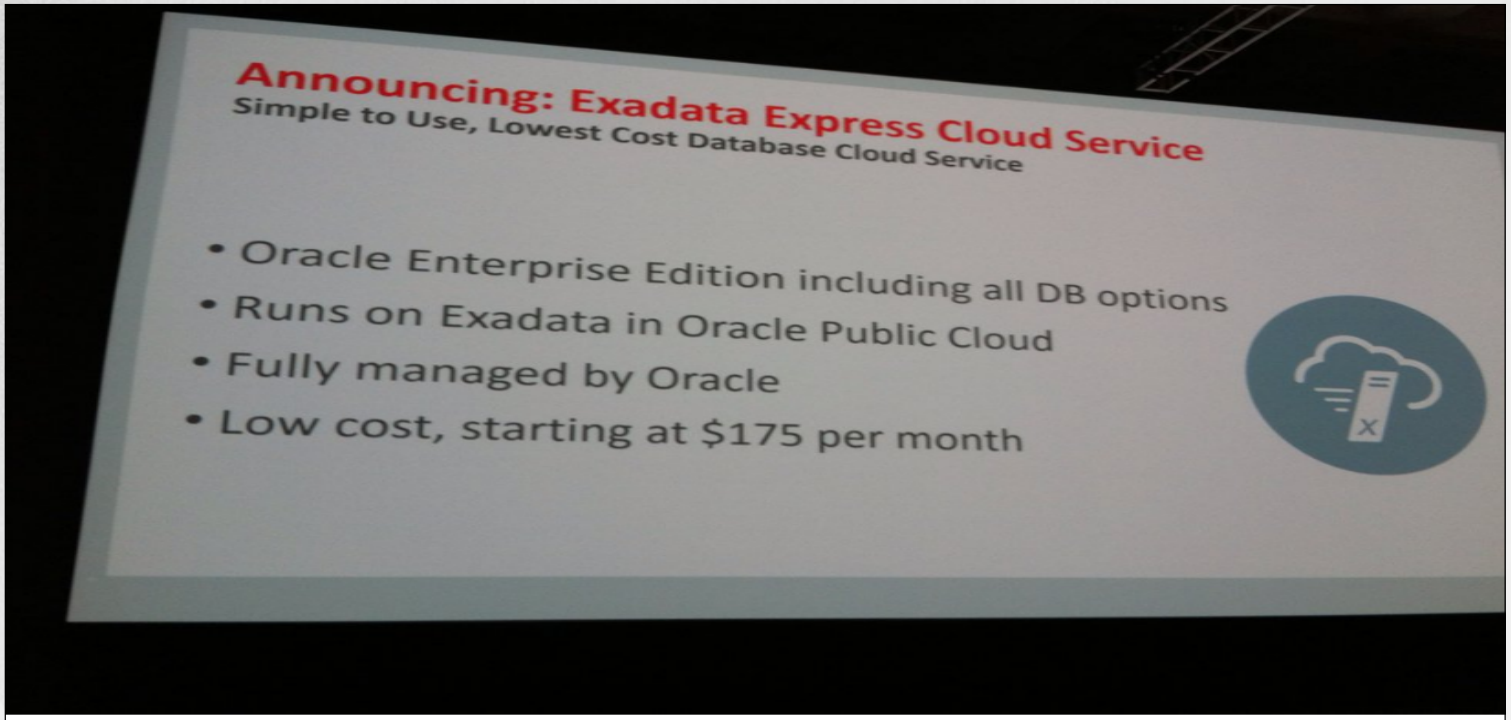


Hybrid Cloud

Journey For The Next 5-7 Years

- Last year at OOW, Hurd said that the Hybrid Cloud will exist for the next 5-7 years
  - Invest in a high throughput from On-Premise to Cloud
  - Consider moving data center to the same region and proximity as the cloud vendor
- Move Disaster Recovery site to the cloud
  - Ask us about our Edge Cloud (Cloud Adjacency)

Oracle Database 12cR2 introduced on the Cloud 9/18/2016



Rich Niemiec @RichNiemiec · 18 Sep 2016
Larry announces Exadata Express Cloud Service running 12cR2 for $175/month with all features. Available now! pic.twitter.com/3tqJdDuzJe

2 21 23

On-Premise Oracle Database 12cR2 released just under 6 months later on 3/1/17

Oracle Release Dates

Oracle Database 11g Release 1	Aug 2007
Oracle Database 11g Release 2	Sept 2009
Oracle Database 12c Release 1	June 2013
Oracle Database 12c Release 1 (Patchset) - 12.1.0.2	June 2014
Oracle Database 12c Release 2	March 2017
Oracle Database 12c Release 2 First Bundled Patch	May 2017
Oracle Database 12c Release 2 RU (July 18)	July 2017
Oracle 18c - "Cloud First"	February 2018
Oracle 18c – Available on Exadata	February 2018
Oracle 18c – Available on ODA	March 2018
Oracle 18c – On-Premise	July 2018

New Oracle Database Release and Upgrade Model
Starting in Oracle 12.2

Summary

- Annual feature release of Oracle Database software
  - Improve quality by reducing the number of software changes released at one time
  - Customers will continue to get bug fixes for terminal releases for up to eight years

- **Quarterly Release Updates (RUs)** and **Release Update Revisions (RURs)**
  - RUs are proactive, highly tested bundles of critical fixes which enable customers to avoid known issues
    - **Replace BPs**
  - RURs contain security and regression fixes to an RU
    - Allow customers to install RUs after they are field-proven, while staying current on security
  - Rus and RURs provide the stability benefits of PSUs with the proactive maintenance benefits of BPs
  - Rus and RURs ship on same January, April, July, October proactive patch schedule as today with RU for 12.2.0.1 in July

RU and RUR for 12.2

- In July 2017 Oracle will release
- a Database RU (= Proactive Bundle Patches (BPs)),
- a Grid Infrastructure RU,
- and an OJVM RU.

- No More PSUs or Bundle Patches for the 12.2.0.1 release

- The first RUR (= Patch Set Updates (PSUs)) for 12.2.0.1 is planned for October 2017
- October 2017, the 2nd RU for Oracle Database 12.2.0.1 is expected
- January 2018, the 3rd RU is expected and the 2nd RUR is expected
  - Speculations: Are to release only 2 RURs per RU

Database 12.2.0.1 Proactive Patch Information (Doc ID 2285557.1)

Database 12.2.0.1 Proactive Patch Information (Doc ID 2285557.1)

Introduction

This My Oracle Support document lists all the Release Update and Release Update Revision patches released for Database 12.2.0.1.0. Oracle recommends that the latest Update/Revision is deployed to all Database systems.

This document will be updated every time a new Update/Revision patch is released, which is generally once a quarter.

12.2.0.1 Database Release Update (Update)

Each bundle patch includes the Database component fixes packaged as a singleton patch.

The same Database Update patch is included in Grid Infrastructure Release Update patches as the Database Component patch.

Please carefully review the README file supplied with the patch.

The table below shows the Database Release Update patches available for 12.2.0.1.

The Database fixes included in the various Updates are listed in Note 2245178.1, 12.2.0.1 Database Release Update - List of Fixes in each Update/Revision

Release Date	Version	Download Link	Included in Windows Bundle
15-Jan-2019	12.2.0.1.190115 (Jan 2019) Database Release Update	Patch 28822515	12.2.0.1.190115 WIN DB BP Patch 28810696
16-Oct-2018	12.2.0.1.181016 (Oct 2018) Database Release Update	Patch 28662603	12.2.0.1.181016 WIN DB BP Patch 28574555
17-Jul-2018	12.2.0.1.180717 (Jul 2018) Database Release Update	Patch 28163133	12.2.0.1.180717 WIN DB BP Patch 27937914
17-Apr-2018	12.2.0.1.180417 (Apr 2018) Database Release Update	Patch 27674384	12.2.0.1.180417 WIN DB BP Patch 27426753
16-Jan-2018	12.2.0.1.180116 (Jan 2018) Database Release Update	Patch 27105253	12.2.0.1.180116 WIN DB BP Patch 27162931
17-Oct-2017	12.2.0.1.171017 (Oct 2017) Database Release Update	Patch 26710464	12.2.0.1.171017 WIN DB BP Patch 26758841
14-Aug-2017	12.2.0.1.170814 (Jul 2017) Database Release Update	Patch 26609817	12.2.0.1.170814 WIN DB BP Patch 26204214
18-Jul-2017	12.2.0.1.170718 (Jul 2017) Database Release Update	Patch 26123830	12.2.0.1.170718 WIN DB BP Patch 26204212

12.2.0.1 Grid Infrastructure Release Update (Update)

Each GI Release Update (Update) patch includes the Database and Clusterware component patches.

Please carefully review the README file supplied with the patch.

The table below shows the Grid Infrastructure Update patches available for 12.2.0.1.

The Database fixes included in the various GI Updates are listed in Note 2245185.1, "12.2.0.1 Grid Infrastructure Release Update - List of Fixes in each Update/Revision"

The Grid Infrastructure fixes (Clusterware and ACFS) included in the various GI Updates are listed in Note 2245185.1, "12.2.0.1 Grid Infrastructure Release Update - List of Fixes in each Update/Revision"

Release Date	Version	Download Link
15-Jan-2019	12.2.0.1.190115 (Jan 2019) GI Release Update	Patch 28828733
16-Oct-2018	12.2.0.1.181016 (Oct 2018) GI Release Update	Patch 28714316
17-Jul-2018	12.2.0.1.180717 (Jul 2018) GI Release Update	Patch 28183653
17-Apr-2018	12.2.0.1.180417 (Apr 2018) GI Release Update	Patch 27468969
16-Jan-2018	12.2.0.1.180116 (Jan 2018) GI Release Update	Patch 27100009
17-Oct-2017	12.2.0.1.171017 (Oct 2017) GI Release Update	Patch 26737266
14-Aug-2017	12.2.0.1.170814 (Jul 2017) GI Release Update	Patch 26550256
18-Jul-2017	12.2.0.1.170718 (Jul 2017) GI Release Update	Patch 26133434

PSUs are Very Important - (N-1)

MOS 756671.1 - Oracle Recommended Patches - Oracle Database
http://www.dbaexpert.com/blog/master-reference-for-psus/

Non Exadata Real Application Clusters (RAC) 12.1.0.2

Document	Description	Rolling RAC	Patch Download
Note:25437795.8	Combo of 12.1.0.2.170418 OJVM PSU and 12.1.0.2.170418 DBBP (Apr 2017)	Part	<<Patch:25437795>>
Note:25437695.8	Oracle JavaVM Component 12.1.0.2.170418 Database PSU (Apr 2017) (OJVM PSU)	No	<<Patch:25437695>>
Note:25434018.8	Combo of 12.1.0.2.170418 OJVM PSU and 12.1.0.2.170418 GI PSU (Apr 2017)	Part	<<Patch:25434018>>
Note:25434003.8	12.1.0.2.170418 (Apr 2017) Grid Infrastructure Patch Set Update (GI PSU)	Yes	<<Patch:25434003>>
Note:25433352.8	12.1.0.2.170418 Database Proactive Bundle Patch (Apr 2017)	Yes	<<Patch:25433352>>

Non Exadata Non RAC

Document	Description	Rolling RAC	Patch Download
Note:25437795.8	Combo of 12.1.0.2.170418 OJVM PSU and 12.1.0.2.170418 DBBP (Apr 2017)	Part	<<Patch:25437795>>
Note:25437695.8	Oracle JavaVM Component 12.1.0.2.170418 Database PSU (Apr 2017) (OJVM PSU)	No	<<Patch:25437695>>
Note:25433980.8	Combo of 12.1.0.2.170418 OJVM PSU and 12.1.0.2.170418 DB PSU (Apr 2017)	Part	<<Patch:25433980>>
Note:25433352.8	12.1.0.2.170418 Database Proactive Bundle Patch (Apr 2017)	Yes	<<Patch:25433352>>
Note:25171037.8	12.1.0.2.170418 (Apr 2017) Database Patch Set Update (DB PSU)	Yes	<<Patch:25171037>>

Non Exadata Real Application Clusters (RAC) 11.2.0.4

Document	Description
Note:25476126.8	11.2.0.4.170418 (Apr 2017) Grid Infrastructure Patch Set Update (GI PS
Note:25440422.8	Combo of 11.2.0.4.170418 OJVM PSU and 11.2.0.4.170418 GI PSU (Ap
Note:25434033.8	Oracle JavaVM Component 11.2.0.4.170418 Database PSU (Apr 2017)

Non Exadata Non RAC

Document	Description
Note:25440428.8	Combo of 11.2.0.4.170418 OJVM PSU and 11.2.0.4.170418 DB PSU (A
Note:25434033.8	Oracle JavaVM Component 11.2.0.4.170418 Database PSU (Apr 2017)

NEW IN 12.2

12.2 Release Date - Release Schedule of Current Database Releases (Doc ID 742060.1)

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Planning For Upgrading to 12.2 or 18c

Helpful MOS Notes:

Oracle 18c - Complete checklist for Manual Upgrade for Multitenant Architecture Oracle Databases from 12.1.x.x to 18.x.x.x (Doc ID 2422161.1)
Oracle DB 18c - Complete Checklist for Manual Upgrades to Non-CDB Oracle Database 18c (Doc ID 2418045.1)
Oracle 18c - Complete Checklist for Upgrading to Oracle Database 18c (18.x) using DBUA (Doc ID 2418576.1)

To Bottom

- Complete Checklist for Manual Upgrades to non-CDB Oracle Database 12.2
  - MOS 2173141.1
- Complete Checklist for Manual Upgrade for Multitenant Architecture Oracle Databases from 12.1. to 12.2
  - MOS 2173144.1
- Complete Checklist for Upgrading to Oracle Database 12.2 using DBUA
  - MOS 2189854.1
- Check for known Issues and alerts on a regular basis: 12.2.0.1 Base Release – Availability and Known Issues
  - MOS 2239820.1

- ORAchk - Health Checks for the Oracle Stack
  - MOS 1268927.2

Oracle Database 12c Release 2

Upgrade Paths

Minimum Effort Upgrades to Oracle 12c Release 2 (12.2)	
Source Database	Target Database
11.2.0.3 / 11.2.0.4	12.2.x
12.1.0.1 / 12.1.0.2	12.2.x

Intermediate upgrade paths				
Source Database		Intermediate upgrade path		Target database
11.2.0.1 / 11.2.0.2	→	11.2.0.4	→	12.2.x
11.1.0.6 / 11.1.0.7	→	11.2.0.4	→	12.2.x
10.2.0.2/10.2.0.3/10.2.0.4/10.2.0.5	→	11.2.0.4 / 12.1.0.2	→	12.2.x
10.1.0.5	→	11.2.0.4 / 12.1.0.2	→	12.2.x
9.2.0.8	→	11.2.0.3 / 11.2.0.4	→	12.2.x

Oracle Database 12c Release 2

For Super Old Versions

Intermediate upgrade paths				
Source Database		**Intermediate upgrade path**		**Target database**
7.3.3 (lower)	→	7.3.4 --> 9.2.0.8 --> 11.2.0.3 or higher	→	12.2.x
8.0.5 (or lower)	→	8.0.6 --> 9.2.0.8 --> 11.2.0.3 or higher	→	12.2.x
8.1.7 (or lower)	→	8.1.7 --> 9.2.0.8 --> 11.2.0.3 or higher	→	12.2.x
9.0.1.3 (or lower)	→	9.0.1.3 --> 9.2.0.8 --> 11.2.0.3 or higher	→	12.2.x
9.2.0.7 (or lower)	→	9.2.0.7 --> 11.2.0.3 or higher	→	12.2.x
9.2.0.8	→	11.2.0.3 / 11.2.0.4	→	12.2.x

Data Guard Standby - First Patch Apply (11.2)

Doc ID 1265700.1 - Data Guard Standby-First Patch Apply

Starting in Oracle Database 11.2.0.1 and later

- Apply candidate patch(see below) first on the standby database (Binary Only)
- Evaluate candidate patch
- Switchover
- Apply patch(es) on old primary database including DataPatch
- Switchover (Switch Back)

Candidates Patches:

- Database home interim patches
- Exadata bundle patches (e.g. Monthly and quarterly database patches for Exadata)
- Database patch set updates (PSUs)

- What is allowed:
- 11.2.0.4 JulPSU to 11.2.0.4 OctPSU
- 12.1.0.2 JulPSU to 12.1.02 OctPSU

- What is NOT allowed:
- 11.2.0.3 JulPSU to 11.2.0.4
- 11.2.0.4 JulPSU to 12.1.0.2

Read the README.html file

Database Upgrade Assistant (DBUA)

Complete Checklist for Upgrading to Oracle Database 12.2 using DBUA:

MOS 2189854.1

- DBUA checks before the upgrade:
  - Invalid user accounts or roles
  - Invalid data types or invalid objects
  - De-supported character sets
  - **Adequate resources** (rollback segments, tablespaces, and free disk space)
  - Missing SQL scripts needed for the upgrade
  - Listener running (if Oracle Enterprise Manager Database Control upgrade or configuration is requested)
  - Oracle Database software linked with Database Vault option. If Database Vault is enabled, Disable Database Vault before upgrade (Vault installed by default on).
- Deinstallation Tool integrated with Installation Media

Upgrade SQL Automation

New Pre-Upgrade Script

- preupgrd.sql
- Executes pre-upgrade checks
- Runs in source environment
- Generates fixup scripts
  - preupgrade_fixups.sql
  - postupgrade_fixups.sql
- MOS Note:884522.1

```
**************************************************************************
Fixup:       PURGE_RECYCLEBIN
Description: Check that recycle bin is empty
**************************************************************************
Fixup Succeeded
**************************************************************************


**************************************************************************
                      [Pre-Upgrade Recommendations]
**************************************************************************

                        ****************************************
                        ********* Dictionary Statistics *********
                        ****************************************

Please gather dictionary statistics 24 hours prior to
upgrading the database.
To gather dictionary statistics execute the following command
while connected as SYSDBA:
    EXECUTE dbms_stats.gather_dictionary_stats;
```

Preparation Checklist

- In the **SOURCE** environment:

Clean Up	❑ Empty the recycle bin ❑ Check for INVALID objects in SYS & SYSTEM ❑ Check for duplicate objects in SYS & SYSTEM
Components	❑ Check for INVALID components ❑ Check for mandatory components ❑ Remove obsolete components
Performance	❑ Preserve performance statistics ❑ Check network performance
Optional	❑ Perform Integrity checks

Clean Up: Recycle Bin

- Especially before patch set or release upgrade purge the recycle bin:
  - Since Oracle 12c this will be done by the preupgrade_fixups.sql

```
purge DBA_RECYCLEBIN;
```

- General recommendation:
  - Empty the recycle bin at least once per week with an automatic job during off-peak times

Clean Up: Invalid Objects

- Check for INVALID objects
  - There should be no invalid objects in Oracle supplied user schemas – especially none owned by SYS or SYSTEM

```
select unique OBJECT_NAME,
OBJECT_TYPE, OWNER from
DBA_OBJECTS where
STATUS='INVALID' order by
OWNER;
```

  - Recompile invalid objects before upgrade/migration

```
@?/rdbms/admin/utlrp.sql
```

Components: Validation Check

- Make sure all components are VALID before upgrade

```
Select COMP_ID, COMP_NAME,
STATUS, VERSION from
DBA_REGISTRY where
STATUS<>'VALID';
```

  - Components are INVALID?

```
@?/rdbms/admin/utlrp.sql
```

  - If that does not correct component status, further diagnosis might be required

MOS Note:472937.1:
Information On Installed Database Components
MOS Note:753041.1:
How to diagnose Components with NON VALID status

Components: Removal

- Potential reasons to remove components:
  - A component does not exist anymore in Oracle Database 12c
  - Speed up the upgrade process
  - A component is obsolete

http://tinyurl.com/ComponentCleanup

Performance: Preserve Statistics

Gather accurate performance statistics from production

Accurate means: Starting at least 1 month before the upgrade

Use Automatic Workload Repository (AWR) Snapshots interval 30-60 minutes and retention ~40 days

Extract AWR:

SQL> @?/rdbms/admin/awrextr.sql

Performance snapshot comparison using AWR DIFF reports:

```
SQL>select * from table(
DBMS_WORKLOAD_REPOSITORY.AWR_DIFF_REPORT_HTML(<DBID>, 1, 101, 121, <DBID>, 1, 201, 221));
```

MOS Note:1477599.1 Best Practices Around Data Collection For Performance Issues

Pre-Upgrade/Migrate Considerations
Always Consider Minimal or Zero Downtime Approach

- Set Guaranteed Restore Points accordingly
- Ensure AWR retention is long enough to capture historical data for comparison
- Backup your database statistics, in case an older SQL plan needs restoring
- Definitely consider RAT for real workload testing, instead of synthetic workloads tests
- If upgrading older version of RAC to new version in place, special consideration need to be understood
  - 9i RAC to 12c RAC
  - Upgrade to 12c GI stack first, Flex ASM or not
  - Legacy clients may not support new Net connections

Upgrade to 12.2 from 11.2.0.4

- For Oracle Database 11.2.0.4 – the Terminal (final) Patch Set for Oracle Database 11.2 – **Oracle will waive** (*no extra cost, no action required*) **Extended Support** to **every customer with a valid support contract until ~~May 31, 2017~~** until Dec 31, 2018
  (see the updated information here:
  https://mikedietrichde.com/2017/01/27/release-dates-oracle-database-12-2-0-1-on-prem-extended-support-waiving-for-oracle-11-2-0-4-12-1-0-2/

- You can extend the **Extended Support for Oracle Database 11.2.0.4 until 31-DEC-2020** – but then at the usual extra cost.
  This information can be found in MOS Note:742060.1.

Oracle Database Extended Support Fees Waived

Database 12.1 Extended Support Fee Waived through July 2019

By: Steven Chan | Senior Director

Oracle's Lifetime Support policy has three phases: Premier Support, Extended Support, and Sustaining Support. For details about coverage during each phase, see:

- Oracle Lifetime Support Policies

You can purchase a support plan for your licensed products to obtain Premier Support. There is an additional fee for Extended Support.

Premier Support for Database 12.1 runs to July 31, 2018. Extended Support for Database 12.1 runs to July 31, 2021. The Extended Support fee for Oracle Database 12c 12.1 has been waived to July 31, 2019. See:

- Release Schedule of Current Database Releases (Doc ID 742060.1)

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- Oracle Lifetime Support Policies

You can purchase a support plan for your licensed products to obtain Premier Support. There is an additional fee for Extended Support.

Extended Support for Database 11.2 runs to December 31, 2020. The Extended Support fee for Oracle Database 11gR2 11.2 has been waived to December 31, 2018. See:

- Release Schedule of Current Database Releases (Doc ID 742060.1)

End of Patching

Release	Patching Ends	Notes and Exceptions*
12.2.0.1	TBD	Patching for 12.2.0.1 will end two years after Release 18 is available for on-prem platforms (non-Engineered Systems).
12.1.0.2	**31-Jul-2021**	Extended Support fees waived through July 31, 2019. Beginning Aug 1, 2019 an ES service contract is required.
12.1.0.1	**31-Aug-2016**	Patching has ended for this release.
11.2.0.4	**31-Dec-2020**	Extended Support fees waived until Dec 31, 2018. An ES service contract is required starting 1-Jan-2019.

http://www.oracle.com/us/support/library/oracle-lifetime-support-policy-faq-069234.pdf

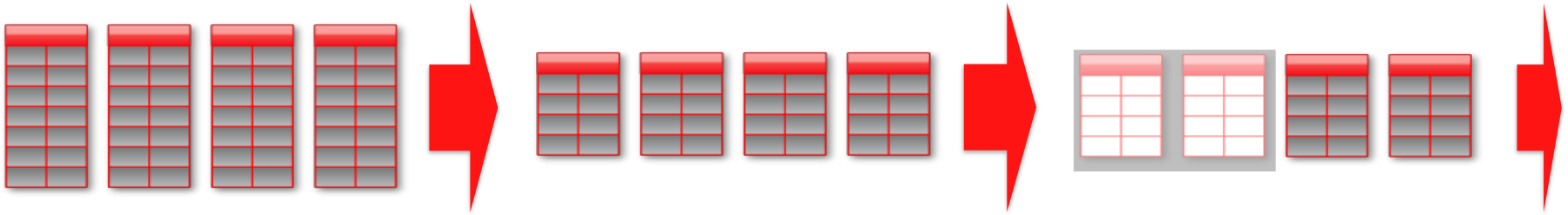
Q: What is the pricing for the Extended Support option?

A: We've announced a simple and predictable support policy, and our Extended Support pricing will follow that principle. Extended Support will be offered on specific defined releases for a period of 3 years following the end of the Premier Support period, so, years 6 – 8 in the life of the product.

For the first year of the Extended Support period, year 6 in the life of the product, the additional fee will be calculated as 10% of the your current annual support fee. For example, if your annual support fee is $100, the fee for Extended Support would be $10 and your total fee for support would be $110 ($100 + $10).

For years two and three, years 7 and 8 in the life of the product, the additional fee will be calculated as 20% of the your current annual support fee. For example, if your annual support fee is $100, the fee for Extended Support would be $20 and your total fee for support would be $120 ($100 + $20). When you move into the Sustaining Support period, your annual support fee would continue to be the base fee of $100.

Query 10TB of data in milliseconds!!! How?



10 TB of user data
Requires 10 TB of IO

1 TB
with compression

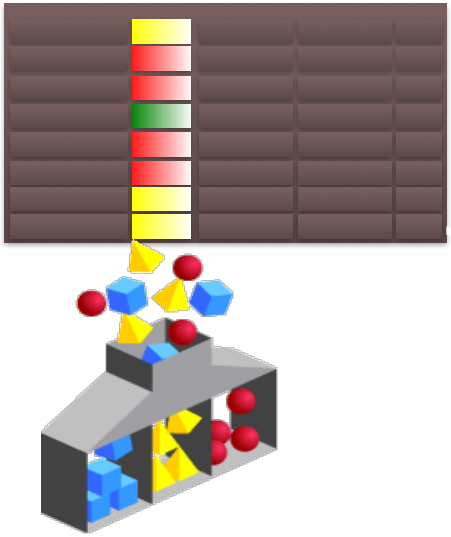
100 GB
with partition pruning

X7-2 HA ODA
With 2 Trays of SSD

Seconds
On ODA

Data is 10x Smaller, Backups are 10x Smaller

HCC - Hybrid Columnar Compression
Highest Capacity, Lowest Cost



Faster and Simpler
Backup, DR, Caching, Reorg, Clone

- Data is organized and compressed by column
  - Dramatically better compression
- Speed Optimized **Query Mode** for Data Warehousing
  - **10X compression typical**
  - **Runs faster because of Exadata offload!**
- Space Optimized **Archival Mode** for infrequently accessed data
  - **15X to over 50X compression typical**

Benefits Multiply

Mission Critical

Zero Downtime Upgrades and Migrations

Zero Risk With Reverse Replication

Silent Installation of RAC / ASM / DB - Oracle Database 12.2

Different Way of Installing / Configuring Oracle

- Create 2-4 Node RAC environments easily with automation
- Create ASM instances in silent mode (for non-RAC)
- Create ASM Disk Groups with automation
- Perform Silent Installations of Oracle DB Software
- Create Databases with dbca in silent mode

Automate Oracle 12.2 RAC Installation

Unzip Oracle Grid Infrastructure 12.2 binaries to the target GI Home only on 1 Node

↓

Download and extract the latest OPatch

↓

Apply one-offs (because there is a bug with running root.sh - causes failure on the first node)

→

```
/u01/app/12.2.0.1/grid/gridSetup.sh -silent -applyOneOffs /u01/app/stage/GI/OPatch/28183653/28163133
/u01/app/12.2.0.1/grid/gridSetup.sh -silent -applyOneOffs /u01/app/stage/GI/OPatch/28183653/28163190
/u01/app/12.2.0.1/grid/gridSetup.sh -silent -applyOneOffs /u01/app/stage/GI/OPatch/28183653/28163235
/u01/app/12.2.0.1/grid/gridSetup.sh -silent -applyOneOffs /u01/app/stage/GI/OPatch/28183653/26839277
/u01/app/12.2.0.1/grid/gridSetup.sh -silent -applyOneOffs /u01/app/stage/GI/OPatch/28183653/27144050
```

run gridSetup.sh - ./gridSetup.sh -silent -skipPrereqs -responseFile /u01/app/12.2.0.1/grid/grid.rsp

run orainstRoot.sh - /u01/app/oraInventory/orainstRoot.sh
run root.sh - /u01/app/12.2.0.1/grid/root.sh
On EACH NODE

As install user, execute the following command to complete the configuration:
/u01/app/12.2.0.1/grid/gridSetup.sh -executeConfigTools -responseFile /u01/app/12.2.0.1/grid/grid.rsp [-silent]

General Database Administration

12cR2 Initialization Parameters

- Oracle 12c Release 2 now has **4649 initialization parameters**
- Oracle 12c Release 2 now has **412 documented** and **4237 hidden.**

- Oracle 12c R2 has **746 V$ views and 1,312 X$ tables**

- There is also an **additional column on many V$ views** for Container ID (**CON_ID**) with PDBs (Pluggable Databases) and CDBs (Container Database).
- Make sure that you adjust any scripts that you have to accommodate this new column.

Oracle Database Security

Built over MANY years...

Fully Encrypted Database

Tablespace Encryption (TDE)

Encryption in the Silicon (M7)

Oracle Multi-Tenant Security (PDBs)

Oracle Audit Vault

Oracle Database Vault

DB Security Evaluation #19

Transparent Data Encryption

EM Configuration Scanning

Fine Grained Auditing (9i)

Secure application roles

Client Identifier / Identity propagation

Oracle Label Security (2000)

Proxy authentication

Enterprise User Security

Global roles

Virtual Private Database (8i)

Database Encryption API

Strong authentication (PKI, Kerberos, RADIUS)

Native Network Encryption (Oracle7)

Database Auditing

Government customer

Full Database Encryption

TDE Tablespace Offline Conversion

- No storage overhead

Requires downtime

Role-Based

Conditional Auditing

Auto Lockout of Inactive Accounts

CREATE PROFILE time_limit LIMIT INACTIVE_ACCOUNT_TIME 30;

1977

@ViscosityNA

Security

- **Encryption**
  - In 12.2, encryption of a tablespace can be deployed with zero downtime.
  - You can encrypt, decrypt, and rekey a tablespace using Transparent Data Encryption (TDE) in live conversion.
  - You cannot encrypt, decrypt or rekey a temporary tablespace online.
- **Future Tablespaces to be Encrypted**
  - For Oracle Cloud
  - ALTER SYSTEM SET ENCRYPT_NEW_TABLESPACES = CLOUD_ONLY;
  - AES128

- **Separation of Duty for Administering RAC Clusters**
  - The intent of SYSRAC, is to provide only the minimal set of privileges for the RAC admin to perform daily tasks.
  - The SYSRAC privilege is for RAC, whereas the SYSDG privilege is for Data Guard.
  - The SYSRAC privilege reduces the reliance on SYSDBA on production RAC systems.
  - SYSRAC privilege is the default mode for connecting to the database by clusterware agent; e.g, when executing RAC utilities such as SRVCTL.

Security

Zero Downtime Encryption and Decryption

- TDE encryption now available for all tablespaces; including SYSTEM, SYSAUX, and UNDO
- Extend encryption and hashing algorithms to include ARIA, GOST, and SEED Encryption Algorithms for International Standards.
- Perform offline conversion of a tablespace, without additional storage overhead.
- To encrypt an existing tablespace online, you must login to the database with the SYSKM role. To encrypt the SYSTEM or SYSAUX tablespace, you must login with the SYSDBA role.
  - `SQL> ALTER TABLESPACE sysaux ENCRYPTION ONLINE USING 'AES256' ENCRYPT;`
- Decrypt a tablespace online without any downtime
  - `SQL> ALTER TABLESPACE sysaux ENCRYPTION ONLINE DECRYPT;`

Starting in 18c: You can encrypt sensitive credential data stored in data dictionary - SYS.LINK$ & SYS.SCHEDULER$_CREDENTIAL system tables; Previously obfuscated.

SQL*Plus

History

login.sql behavioral changes
DOC ID: 2241021.1

spool JSON + CSV
`set markup csv on`

- set hist on

- SQL> set hist 1000
- SQL> show hist
  history is ON and set to "1000"

- set feedback only

Return # of rows only without displaying output of the query

SQL> help hist
HIST[ORY] [N {RUN | EDIT | DEL[ETE]}] | [CLEAR]

SQL> show hist

SQL> hist 2 run
SQL> hist 3 del

SQL> hist clear

```
SQL> hist
  1  select name from v$database;
  2  select instance_name, host_name from v$instance;
  3  help hist

SQL> hist 3 del
SQL> hist 1 run

NAME
---------
MERIT

SQL> hist 1 edit
```

```
SQL> select name from v$database;

NAME
---------
MERIT

SQL> select instance_name, host_name from v$instance;

INSTANCE_NAME
----------------
HOST_NAME
----------------------------------------------------------------
merit
ika82


SQL> hist
  1  select name from v$database;
  2  select instance_name, host_name from v$instance;
```

DBMS_TNS

- Perform a TNSPING from the Database
  - Resolves a TNS name and return the corresponding Oracle connection string
  - Works for TNS Alias and EZ*Connect

```
SQL> select dbms_tns.resolve_tnsname('&TNS_ALIAS') from dual;
```

HUGE Improvements – 12cR2

- In 12c, **object names for users, roles, tables, columns, indexes, constraints, etc. have been increased from 30 bytes to 128 bytes** with a few limitations.
- The limit for **tablespace names and pluggable databases is still 30 bytes**, but others all increase to 128 bytes.
- You will **notice this change in the dictionary views** where the **VARCHAR2 columns will shows as 128 bytes** instead of 30 bytes.
- It also **helps in migrations** from non-Oracle systems where the name is longer than 30 characters.
- The best enhancement in **12c R2** is **32K VARCHAR is default**. This allows the extending of the VARCHAR data types without having to enable the extended mode specifically (early 12c). The size limit for both **VARCHAR2 and NVARCHAR2 is 32K**.

Long Name Identifiers

- Table Name to 128 bytes
- Column Name to 128 bytes

Long Table Name

SQL> create table ECOUG_oracle_users_are_super_cool_in_RALEIGH_NC_in_2018_tab
(oracle_database_12c_release_2_is_available_for_general_availability_column_1 integer);

Table created.

Long Column Name

Partitioning

Partitioning Overview

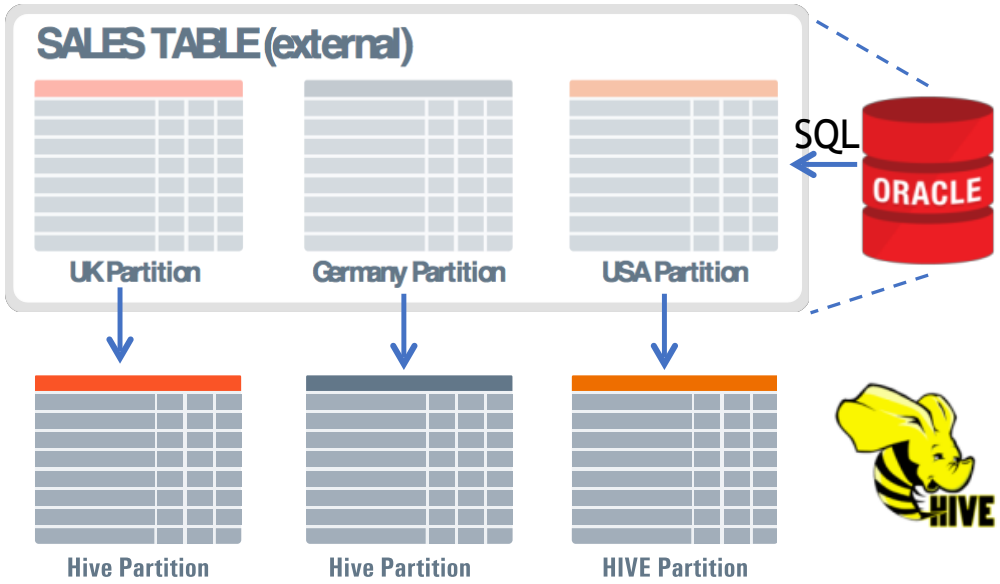
Additional Features

- Convert Non-Partitioned Table to a Partitioned Table
- Read-Only Partitions
- Multi-Column List Partition
- Split Partition with Online Maintenance
- Create a Partitioned External Table
  - Support to map partitioned Hive tables into the Oracle Database ecosystem as well as providing declarative partitioning on top of any Hadoop Distributed File System (HDFS) based data store.
  - External Tables Can Access Data Stored in Hadoop Data Sources Including HDFS and Hive

Big Data Innovations

Partitioned External Tables

- External tables can be partitioned
  - using any partitioning technique
- Partition pruning
  - For faster query performance
- Basic partition maintenance
  - Add, drop, exchange



18c Oracle Database

In 18c: Inline and In-Memory External Tables

Thanks Oracle: Graphics

Partitioning

Convert Non-Partitioned Table To A Partitioned Table Example

- ALTER TABLE mytable MODIFY
  PARTITION BY RANGE (tab_id) INTERVAL (25)
  (PARTITION p1 VALUES LESS THAN (100),
  PARTITION p2 VALUES LESS THAN (1000))
  ONLINE
  UPDATE INDEXES
  (IDX1_tab_id LOCAL (PARTITION ip1 VALUES LESS THAN (MAXVALUE)));

- With **ONLINE** option, zero downtime conversion to Partitioning Strategy

Partitioning

Read-Only Partitions Example

- CREATE TABLE mytable (
  tab_id NUMBER(10) NOT NULL,
  tab_desc VARCHAR2(20))
  READ WRITE PARTITION BY RANGE (tab_id)
  (PARTITION mytable_p1 VALUES LESS THAN (100),
  PARTITION mytable_p2 VALUES LESS THAN (1000) READ ONLY)
  );

- Old Method: Make tablespace read-only

- Implications: Simplified Backups, Tiering of Data

Partitioning

Multi-Column List Partitions Example

- CREATE TABLE mytable (
  tab_id NUMBER(10) NOT NULL,
  tab_desc VARCHAR2(20),
  tab_code VARCHAR2(2),
  tab_channel NUMBER(2))
  PARTITION BY LIST (tab_code, tab_channel)
  (PARTITION mytable_p1 VALUES (('AB',10), ('AC',20)),
  PARTITION mytable_p2 VALUES (DEFAULT));

Partitioning
Split Partitions in 12.2


```
ALTER TABLE mytable
SPLIT PARTITION p1 at (100)
INTO (PARTITION p1_1, PARTITION p1_2) ONLINE;
```

(Can Split Sub-Partitions too – both in 12cR2)

18c Oracle Database

In 18c: Alter Table **Merge Partition Online** &
Alter Table **Merge Subpartition Online**

Partitioning
Merge Partitions Example in 18c

- With UPDATE INDEXES clause, the indexes remain usable during the move operation

Merge Range Partitions:

```
ALTER TABLE four_seasons
MERGE PARTITIONS quarter_one, quarter_two
INTO PARTITION quarter_two UPDATE INDEXES ONLINE;
```

Merge List Partitions:

```
ALTER TABLE q1_sales_by_region
MERGE PARTITIONS q1_northcentral, q1_southcentral
INTO PARTITION q1_central STORAGE(MAXEXTENTS 20) ONLINE;
```

Partitioning

Misc New Features

- **Automatic List Partitioning**
  - The automatic list partitioning method enables list partition creation on demand.
- **Deferred Segment Creation for Automatic List Partitions and Interval Subpartitions**
  - Saving disk space when partition and subpartition creation is in the presence of data.
- **Creating a Table for Exchange with a Partitioned Table**
  - Tables can be created with FOR EXCHANGE WITH clause, to exactly match the definition of the partitioned table for partition exchange command.

Online Table Move

Zero DownTime

- ALTER TABLE ... MOVE ... ONLINE
- ALTER TABLE ... MOVE PARTITION ... ONLINE
- ALTER TABLE ... MOVE SUBPARTITION ... ONLINE
- ALTER TABLE consultant_details
  MOVE
  ONLINE
  COMPRESS
  TABLESPACE data_ts1
  UPDATE INDEXES (idx1 TABLESPACE index_ts1,
  idx2 TABLESPACE index_ts2);

- Table move operation now also supports automatic index maintenance as part of the move.
- With UPDATE INDEXES clause, the indexes remain usable during the move operation

Data Guard

Maximum Availability Architcture

“Disaster strikes without warning.
> Data loss strikes without warning.”

Evolution of Data Guard

Oracle Version	Big Feature Added
Oracle 7.3	Hot Standby
Oracle 8i	Read-Only Physical Standby Managed Recovery
Oracle 9i	Logical Standby, Switchover/Failover Automatic Gap Resolution Cascaded Redo
Oracle 10g	Real-time apply Standby Redo Logs FSFO Flashback Database on DG
Oracle 11g	Active Data Guard Redo Compression Snapshot Standby Rolling Transient Upgrades RMAN Duplicate from Active Database
Oracle 12.1.0.1	Far Sync Fast Sync (LOG_ARCHIVE_DEST_n attributes SYNC and NOAFFIRM) Data Guard Broker Switchover Enhancements SYSDG Role Online Standby Database File Rename Significantly Improved Rolling Upgrades (DBMS_ROLLING)

More DG 12.1 New Features Overview

- Resumeable Switchover
- Can do DML operations on Temporary tables on ADG instances
- Can use sequences on ADG
  - Cache
  - NoOrder
- Can do Incremental Updates over TNS from the standby database

- Do not need using current logfile for real-time apply
  - `DEFAULT: alter database recover managed standby database using current logfile disconnect;`
- Can move location of an online data file … moves on the primary database do not affect the standby

Data Guard

dbca

- Create standby databases with DBCA
  - Must use command line dbca interface
  - Can only create from Non Multi-tenant primary database
  - Cannot do RAC
  - `dbca -createDuplicateDB`
    `-gdbName global_database_name`
    `-primaryDBConnectionString easy_connect_string_to_primary`
    `-sid database_system_identifier`
    `[-createAsStandby`
    `[-dbUniqueName db_unique_name_for_standby]]`
    `[-customScripts scripts_list]`

- -createAsStandby followed by dbUniqueName For Standby
- `[-customScripts scripts_list]`
  - List of scripts to be executed
  - Oracle will execute the scripts in the order they are listed
- No Need for TNSNAMES.ORA entry
- Can use easy connect string
- `"host[:port][/service_name][:server][/instance_name]"`

Data Guard

dbca

```
$ dbca -silent -createDuplicateDB \
-gdbName viscorcl \
-primaryDBConnectionString rac01:1521/viscorcl \
-sid viscorcl -createAsStandby \
-dbUniqueName sviscorc
Enter SYS user password:
Listener config step
33% complete
Auxiliary instance creation 66% complete
RMAN duplicate 100% complete
Look at the log file "/u01/app/oracle/cfgtoollogs/dbca/sviscorc/viscorc.log" for further details.
```

Data Guard

NoLogging & MIRA

NoLogging on Primary

- Nologging blocks are recorded in the control file on the physical standby database
- On the Standby
  `RMAN RECOVER DATABASE NONLOGGED BLOCK`
- After switchover, the old primary database must be in a mounted state

Multiple Instance Redo Apply (MIRA)

- Can run Redo Apply in some or all of the standby instances
- Redo Apply scales as wide as standby RAC configuration
- ALTER DATABASE RECOVER MANAGED STANDBY DATABASE command now accepts a new INSTANCES [ALL | integer] clause
- All the instances must be in the same mounted or open mode
- cannot specify which RAC instance(s) will perform the redo apply

Data Guard

In-Memory with Active Data Guard

ORACLE 12c
DATABASE
IN-MEMORY

In-Memory with Active Data Guard

- IM option can be configured on the primary database, on an ADG standby database, or on both the primary and the ADG standby databases
- The INMEMORY_ADG_ENABLED parameter needs to be enabled
  - By default, the INMEMORY_ADG_ENABLED parameter is set to true.
- For RAC configuration, this parameter must be set to the same value across all the RAC instances

Data Guard

Broker Support for Redo Transport of Different Endianness to ZDLRA

ZDLRA

- Can manage a remote redo destination that has a different endianess than the primary database
- Consider cross platform migrations with the ZDLRA and the ability to synchronize databases of heterogeneous configurations with different endianness
- Significantly improve the flexibility of migrating databases from one platform to another with the ZDLRA.

Data Guard

Subset Standbys

- In 12.1, ENABLED_PDBS_ON_STANDBY initialization parameter only supported two values: all PDBs or none
- The ENABLED_PDBS_ON_STANDBY parameter is only applicable on the physical standby database
  - can accept a list of PDB names or a glob pattern such as "VNAPDB?" or "VNAPDB*a", "VNAPDB2"
  - Glob pattern rules are similar to regular expression rules in common UNIX shells
  - asterisk (*) and question mark (?) wildcard characters are supported.
    - The question mark (?) represents a single unknown character;
      - the asterisk (*) represents matches to any number of unknown characters.
      - This parameter also accepts a minus sign (-) which can be used as the first character in a PDB name to designate that the PDB should be excluded on the standby database

Scheduler

Anti-Affinity Rules
- Specify that a scheduled job cannot run at the same time with another scheduled job
- Leveraging the dbms_scheduler.create_incompatibility procedure
- Add a job or program to an existing compatibility definition with dbms_scheduler.add_to_incompatibility proc
- Remove a job or program from an existing incompatibility definition with the dbms_scheduler.remove_from_incompatibility

Resource Queues
- Define a set of resources for a scheduled job
- A resource, can be anything that is defined with two attributes: name and count with the DBMS_SCHEDULER.CREATE_RESOURCE procedure
- Ensure that the scheduled job will not exceed the resources specified for the job definition.

In-Memory Job
- Create two types of in-memory jobs: repeating (in-memory runtime jobs) and one-time jobs (in-memory full jobs) in-memory jobs
- With repeating in-memory jobs, only the job metadata is written to disk

Data Pump

Parallel Export and Import of Metadata
Functionality has been extended to include metadata for export and import operations

Rename Data Files During TTS Import
* Symbol matches multiple characters and question mark (?) matches a single character

- In Oracle 12.2, use wildcards to simplify our TTS process and lower our management overhead.
- TRANSPORT_DATAFILES=vna_data*.dbf
- TRANSPORT_DATAFILES=vna_index?.dbf

Additional Wildcard Substitution Variables

- New options in 12.2 expdp for date and time are:
  - %d or %D to specify Day of Month in DD format
  - %m or %M to specify number of month in MM format
  - %y or %Y to specify year in YYYY format
  - %t or %T to specify full date in YYYYMMDD format

Data Pump #2

Additional DATA_OPTIONS Parameters

- DATA_OPTIONS=VALIDATE_TABLE_DATA for import - validates date & number formats of table data
  - Default behavior for Data Pump is to perform no validation
  - Want to use this option when the originator of the data is not from a trusted source.

Direct Load in Network Mode

- Data pump now leverages OCIDirPathUnload to unload and load data from the source database for Long and Long Raw data types
- Specify ACCESS_METHOD=DIRECT_PATH parameter with the NETWORK_LINK parameter

Instant Client

- Data pump is now available in the Instance Client.
- Also added SQL*Loader, expdp, impdp, exp, and imp to the tools for instant client

Interactive Commands

- Enable tracing for a running job; do not need to stop/restart the job for the tracing to take effect
- Can kill individual works that we believe to be hung or stuck, with the STOP_WORKER option

Materialized View

Historical Statistics

- DBA_MVREF_STATS –

Stores basic statistics for a materialized view refresh such as the refresh ID and **basic timing statistics** for the refresh operation.

- DBA_MVREF_RUN_STATS –

Stores **detailed** information about each materialized view refresh operation including the following

  - parameters specified when running the refresh operation such as list of materialized views, refresh method, purge option, and so on.
  - number of materialized views refreshed in the refresh operation.
  - detailed **timing statistics** for the refresh operation including **start time, end time, and elapsed time.**

DBA_MVREF_CHANGE_STATS –

Contains **change data load information** for the base tables associated with a materialized view refresh operation.

The details include base table names, materialized view names, number of rows inserted, number of rows updated, number of rows deleted, number of direct-load inserts, PMOPs details, and number of rows at the beginning of the refresh operation.

DBA_MVREF_STMT_STATS –

Contains information related to **each refresh statement** that is part of a single materialized view refresh operation.

This includes information such as materialized view name, refresh ID, the refresh statement, SQLID of the refresh statement, and execution plan of the statement.

Performance

Approximate Query: 100x+ Faster
(Depending on the Query)

Oracle Database 12c
Release 2 Performance
Tuning Tips and Techniques

Instead of (100% accurate – 12.1.0.2):
select count(distinct(empno)) from emp;

Use this for speed (97% accurate – 12.1.0.2):
select **approx_count_distinct**(empno) from emp;

- Oracle: Approximate amount within 97% or so from the actual.
- Explain Plan: with change from SORT GROUP BY to **SORT AGGREGATE APPROX**

In 12c R2, additional approximate percentile functions & capability to reuse approximate aggregations for multiple queries (via materialized views and query rewrite). Toggle to this mode:

alter session set approx_for_count_distinct = TRUE; (12.2 only – distinct counts: ***all*** approximate)

Approximate Query – 12cR2 Only

Other initialization parameters:

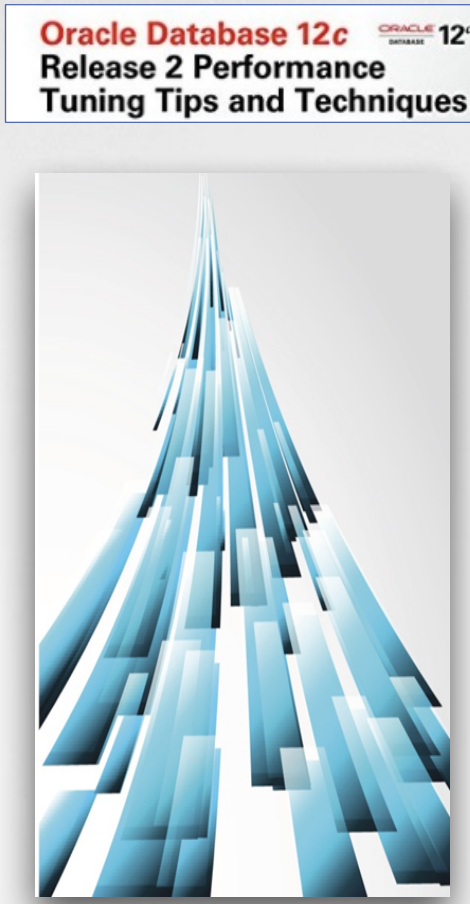
approx_for_aggregation=TRUE

approx_for_percentile=TRUE

Other Approximate Functions:

- APPROX_COUNT_DISTINCT_DETAIL
- APPROX_COUNT_DISTINCT_AGG
- TO_APPROX_COUNT_DISTINCT
- APPROX_MEDIAN
- APPROX_PERCENTILE
- APPROX_PERCENTILE_DETAIL
- APPROX_PERCENTILE_AGG
- TO_APPROX_PERCENTILE

Also in 12cR2 is support for Materialized Views and Query Rewrite



SQL Performance Tuning

- **AWR at PDB Level**
  - Earlier AWR reports could be created only at CDB level. 12.2 reports can now be generated at PDB level
  - Snapshot interval & retention can be controlled at PDB level
  - To check AWR information, at ROOT & PDB level there are two new views
    - AWR_ROOT%
    - AWR_PDB%
- **AWR for Active Data Guard**
  - Primary database or any other remote database can host snapshot repository
  - AWR tables on catalog database gather information on the snapshot of ADG database using database links

- **AWR for Active Data Guard Cont.**
  - Snapshots can be taken manually or automated
- **Optimizer Statistics Advisor**
  - New Optimizer Statistics Advisor, AUTO_STATS_ADVISOR_TASK, aids in diagnosing problems with existing stats gathering practices
  - Like other advisors, it runs in the same maintenance window & recommend changes.
  - Reports are in a user-friendly format, similar to ADDM reports

SQL Performance Tuning #2

- **Per-Process PGA Limits**
  - Ability to restrict the PGA usage at session level, in a particular consumer group
    - SESSION_PGA_LIMIT and DBMS_RESOURCE-MANAGER.CREATE_PLAN_DIRECTIVE
- **Index Monitoring**
  - Turned on by default
  - Tracks usage at execution level rather than parse level
  - V$INDEX_USAGE_INFO keeps track of index usage since last flush
  - DBA_INDEX_USAGE historically tracks and stores when the index was last used, total number of times index was accessed, and much more.

- **Adaptive Plans**
  - The latest update has made Optimizer_Adaptive_Features parameter obsolete
  - Plan adaptive features are controlled by two new parameters:
    - Optimizer_Adaptive_Plans : controls whether the optimizer creates adaptive plans and defaults to TRUE.
    - Optimizer_Adaptive_Statistics : controls whether the optimizer uses adaptive statistics and defaults to FALSE. It includes generations of SQL plan directives, dynamic sampling, automatic re-optimization, and much more.

In-Memory (IM) Virtual Columns – 12cR2

The following initialization parameter must be set (can set when DB running):

INMEMORY_VIRTUAL_COLUMNS=ENABLE (set to DISABLE to turn it off)

To put the table INMEMORY (in the main IM area IMCU):

alter table scott.emp_rich INMEMORY; (**virtual column IM if above parameter set**)

To specifically put virtual column INMEMORY (a **separate area of IM** – IMEU):

alter table scott.emp_rich INMEMORY(yearly_sal);

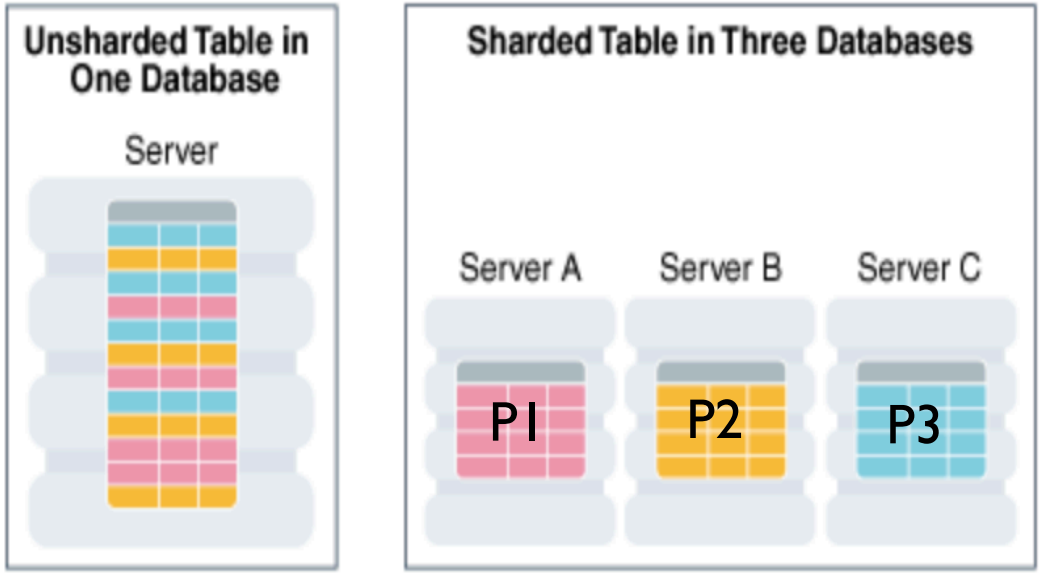
IMCU=*In-Memory Compression Unit;* IMEU=*In-Memory Expression Unit*

Sharding

Sharding

Introductory Primer

- Sharding is a data tier architecture in which data is horizontally partitioned across independent databases.
- Horizontal partitioning involves splitting a database table across shards so that each shard contains the table with the same columns but a different subset of rows. A table split up in this manner is also known as a sharded table.
- Oracle 12.2 supports up to 1000 Shards



Sharding

Introductory Primer

- Shards (Sharded Table): Table that is partitioned into smaller and more manageable pieces among multiple databases
- Sharded Table Family: A sharded table family is a set of tables that are sharded in the same way.
  - The recommended way to create a sharded table family is to specify parent-child relationships between tables using reference partitioning.
- Duplicated Tables: In addition to sharded tables, an SDB can contain tables that are duplicated on all shards.

Pluggable Databases

PDB Consolidation Efficiency

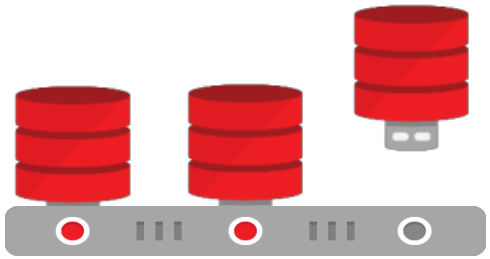
Deployment	Aggregate Throughput	Average Response Time	CPU Utilization	Memory Footprint per DB	Storage IOPS
252 non-CDBs	72,600 tps	6.7 ms	68%	1702 MB	271,400
252 PDBs	130,300 tps	9.9 ms	68%	208 MB	131,200
PDBs vs. non-CDBs	+80%	+3 ms	Identical	-8x	-2x

Multitenant

18c Oracle Database

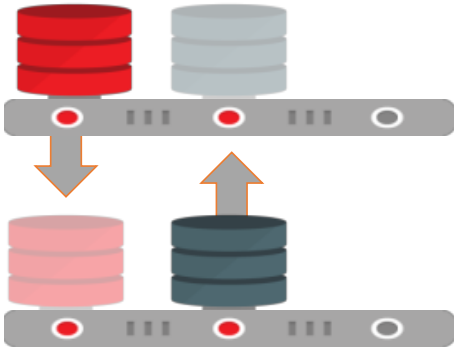
VISCOSITY NORTH AMERICA

Oracle 12c



- Container managed database virtualization
- Manage Many as one (Great!)
  - Patching, Backup, Security, Online Cloning, Online Relocation

Oracle Database 18c



- Per-PDB Switchover
- Transportable Backups
- Snapshot Carousel
- Faster Upgrades

Advantage: Increased Agility

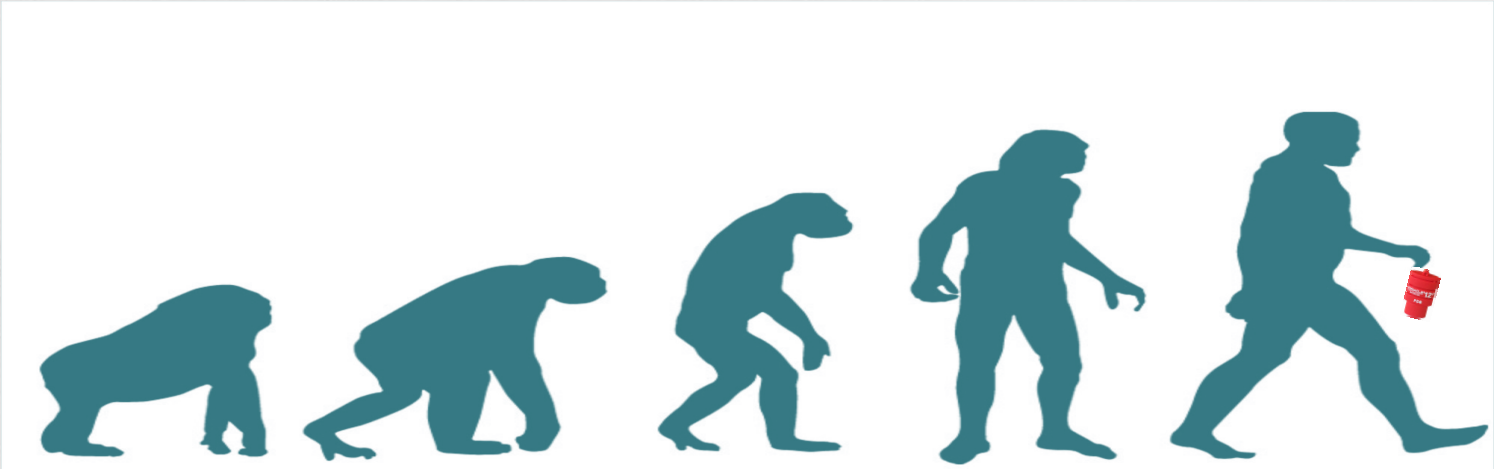
NEW IN 12.2

Manage many as one *but retain granular control when appropriate*

Requirement	Schema Consolidation	Multitenant
Patching and upgrades	• All or nothing • Need to negotiate maintenance window for all tenants	• Perform centrally where applicable • Patch/upgrade individual tenant PDBs via unplug/plug
Tenant Mobility • Load balancing • To / from cloud	Cumbersome, time-consuming, with outage • RMAN restore • Data Pump Export/Import	Fast and simple • Unplug/Plug (12.1) • *PDB Relocate (12.2) – online!*
Point-in-time recovery	• RMAN or DataPump	• PDB Flashback
Provisioning new tenants	• Create schema, run install script • RMAN restore or DataPump Import	• PDB Cloning (local, remote)
Creating clones	• Full data set and full physical copies only • No subsetting • No thin provisioning • RMAN or Data Pump	• Fast, simple PDB cloning • *Hot clones, refreshable clones (12.2)* • Data sets: Full, partial or metadata only • Physical: Full copy or snapshot clone

Evolution of Multitenant Cloning

NEW IN 12.2



Read Only Source – **Cold/ Remote Clone**

Read Write Source – **Hot/ Refresh Clone**

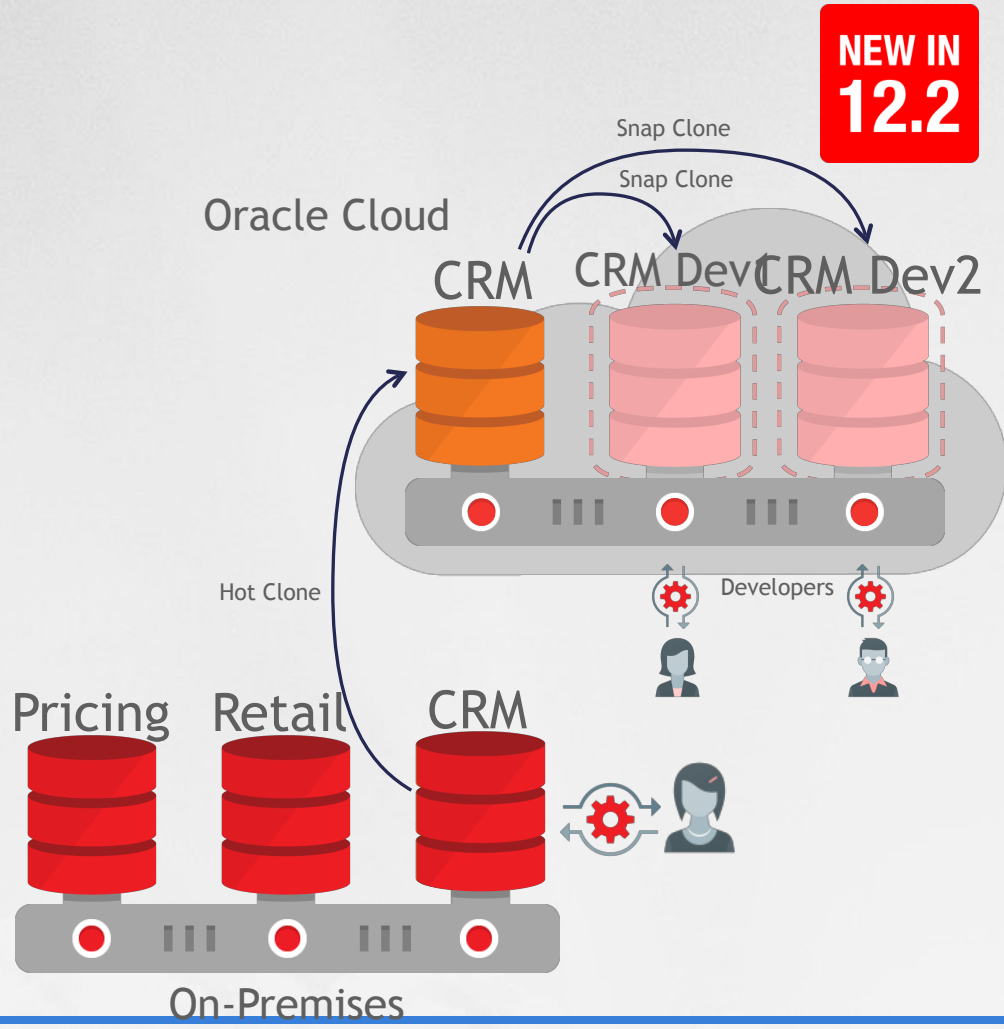
Online **Relocate**

PDB

- **Hot Clones**
  - Oracle 12.2 Multitenant option, fully integrates the concept of "hot clones" with the ability to perform on-line cloning of PDBs.
    - With hot clones, the source database is still open for read-write mode.
    - All PDB clones in Oracle 12.2 are hot clones and will be referred to as clones.
- **Read-Only Refreshable PDBs** ——— Poor Man's ADG?
  - On Oracle 12.2, PDBs can be cloned while the source PDB is online.
  - With Refreshable PDBs, we can have the PDB refresh data from the source PDB with delta changes, since the last refresh automatically (define in nnn Minutes) or on demand.

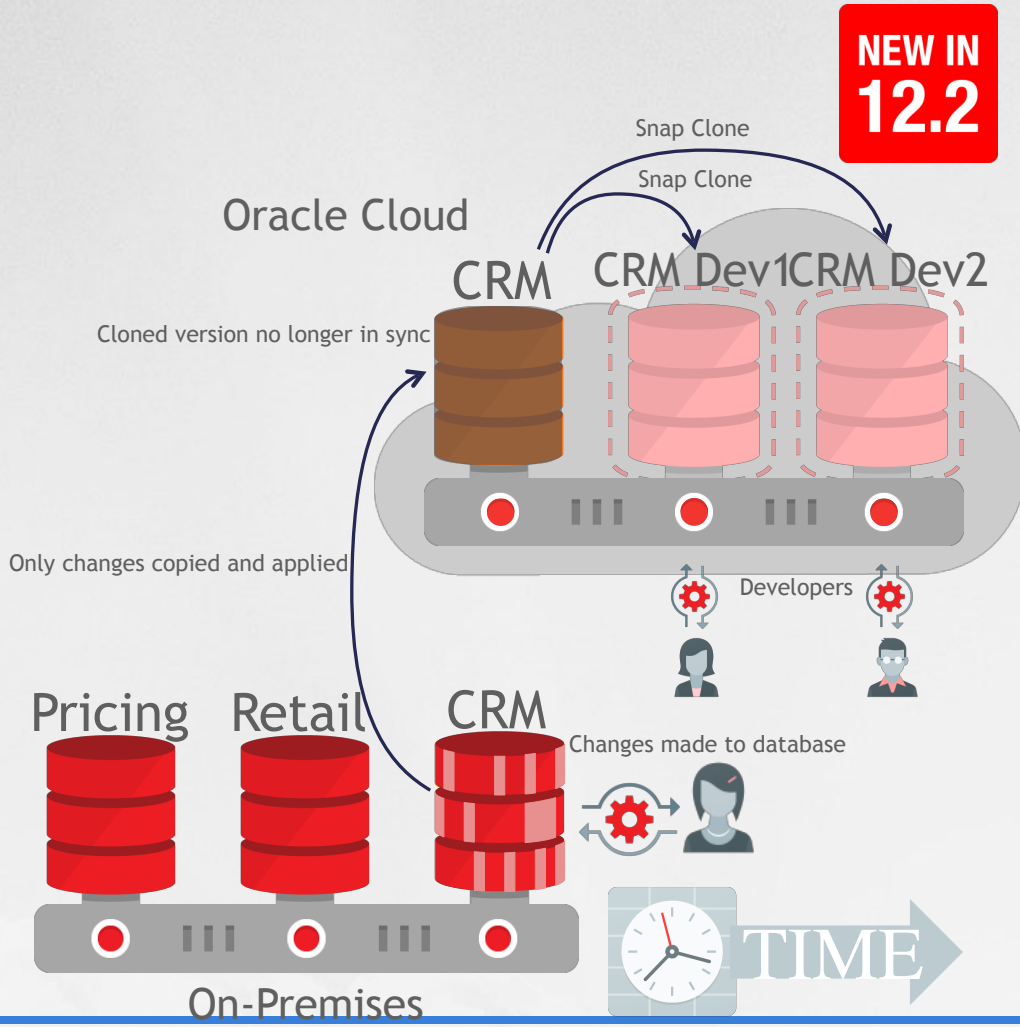
PDB Hot Clone

- PDB Hot Clone
  - Online test master instantiation



PDB Refresh

- PDB Hot Clone
  - Online test master instantiation
- PDB Refresh
  - Incremental refresh of clone with latest data



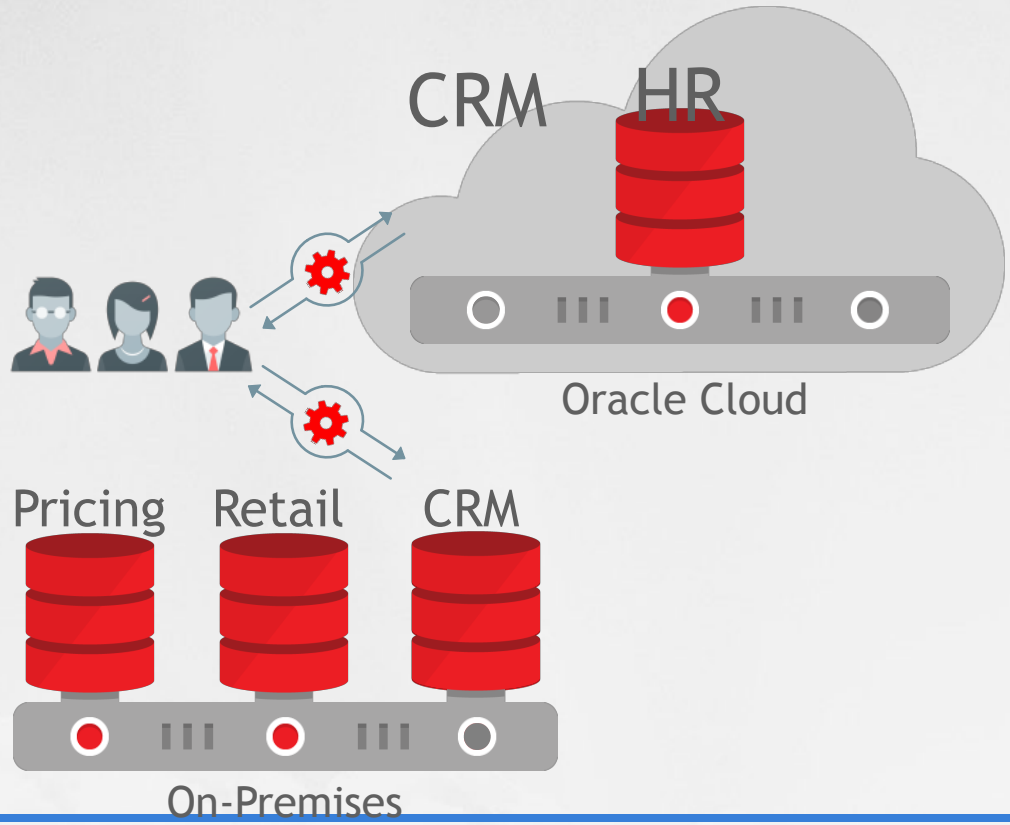
PDB Relocate

- **PDB Relocate**
  - Oracle offers a new RELOCATE clause to the CREATE PLUGGABLE DATABASE, to "relocate" a PDB from one container database (CDB) to another container database.
  - The PDB can be relocated to another CDB on the same server, within the same data center or across data centers.
  - While the relocation process is occurring, database connections still persist on the original PDB. When the statement completes, there will be two transactionally consistent PDBs running.
    - When the PDB is ready, the relocated PDB will be brought online on the new target CDB.

PDB Relocate

NEW IN 12.2

- PDB Hot Clone
  - Online test master instantiation
- PDB Refresh
  - Incremental refresh of clone with latest data
- PDB Relocate
  - Relocate with no downtime



Proxy PDB

CREATE PLUGGABLE DATABASE proxy_pdb1 AS PROXY FROM other_pdb_from_another_cdb@proxy_link;

ALTER PLUGGABLE DATABASE proxy_pdb1 OPEN;

Notes:

- Essentially an EMPTY PDB with SYSTEM, SYSAUX, TEMP and UNDO tablespaces copied to the local instance
- Need to consider network performance considerations
- DB link is used for the initial creation of the proxy PDB
- Has full DDL support (unlike DB Links)
- All DML and DDL occur on the remote DB
  - ALTER DATABASE and ALTER PLUGGABLE DATABASE commands refer to the proxy DB only and not the referenced PDB
- CONTAINERS clause executes on the remote DB

PDB Use Cases

- Proxy
  - Move Databases from on-premise to the Cloud and missed a batch job
    - Security company asked us to keep SharePlex/ GG on the source database just in case they missed something for end of the month and end of the quarter
  - Monitor Production Databases from a single database environment
    - Leverage Containers in clause to monitor all databases with a single SQL statement

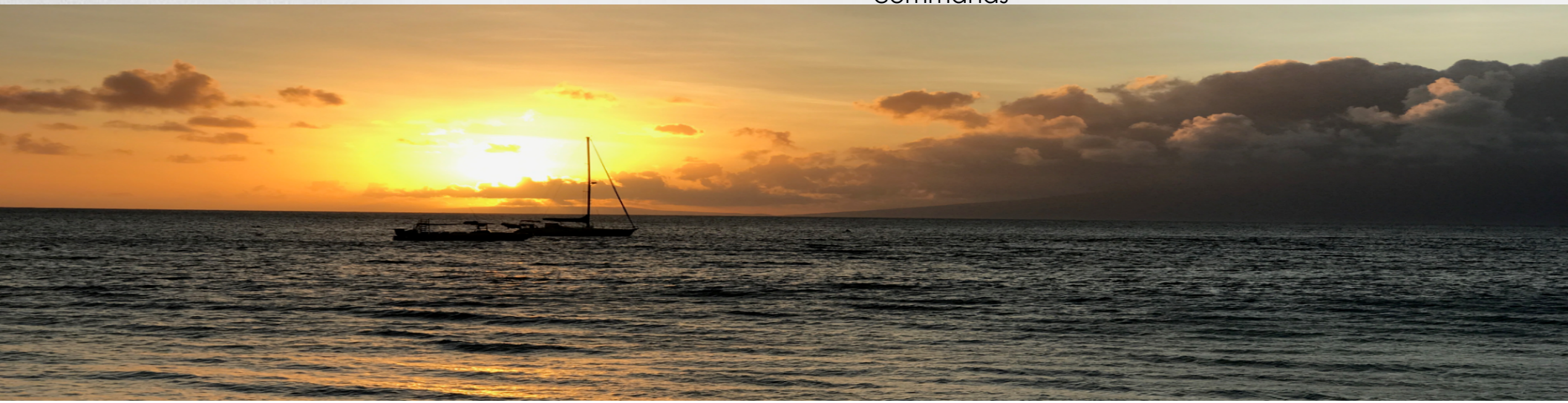
Refresh-able PDB

READ-ONLY PDB

- Does not replace Active Data Guard but it can be a poor man's solution
  - Can tolerate 15-30 minute delay in data

Never Refresh DEV Again

- Golden image production is refreshed on set interval
  - Snapshot / clone from the refreshed PDB
  - Provision full size copy of PDB from refreshed PDB
  - Create multiple environments with just few commands



PDB Restore Points

- What is a PDB Restore Point
  - A user-defined name associated with an SCN corresponding to the time the restore point was created unique to the PDB
- Normal Restore Point
  - A label for an SCN or point in time
  - Stored in the control file
  - Ages out
- Guaranteed Restore Point
  - A restore point for which the database is guaranteed to retain the flashback logs for a flashback operation.
  - Stored in the controlfile
  - Must be explicitly dropped
- Clean Restore Point
  - A PDB restore point that is created when the PDB is closed and when there are no outstanding transactions for that PDB
  - Only applies to CDBs that use shared undo

NEW IN 12.2

RMAN

Perform Flashback on a PDB to PIT

- Perform a flashback database operation to rewind an individual PDB to a previous point in time
- In 12.2 users can execute a database flashback on a CDB across PDB, PITR or PDB flashback operations.
- The PDB on which a Flashback Database operation is being performed must be closed
  - SQL> CREATE RESTORE POINT vnapdb_grp_before_changes GUARENTEE FLASHBACK DATABASE;

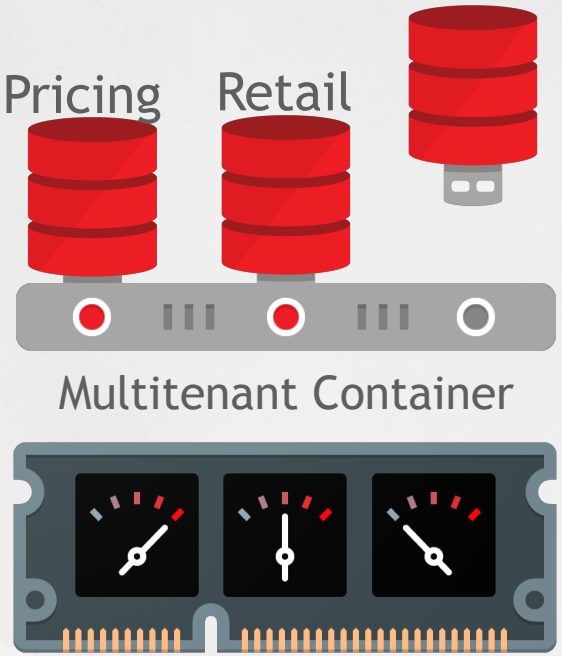
Flashback a PDB

- RMAN> SHUTDOWN IMMEDIATE;
- RMAN> STARTUP MOUNT;
- RMAN> FLASHBACK PLUGGABLE DATABASE vnapdb TO RESTORE POINT vnapdb_grp_before_changes AUXILIARY DESTINATION '/temp/aux_dest';
- RMAN> ALTER PLUGGABLE DATABASE vnapdb OPEN RESETLOGS;

Isolation with Economies of Scale

NEW IN 12.2

- Flashback PDB
- Per-PDB character set
- 4k PDBs per CDB
  (4,096 - increased from 252)
- AWR data at PDB level
- Memory & I/O resource prioritization in addition to CPU
- Configurable isolation via Lockdown Profiles
- PDB-level failover capability with Data Guard Broker



PDB

CPU Count, Max PDBs, Localized AWR, PDBAs & Character Set

- **PDB CPU Count**
  - With Oracle 12.2, we can set the CPU_COUNT initialization parameters at the PDB level.
  - In Oracle 12.1, CPU limits were imposed on the PDB as part of the CDB Resource Plan definition.
- **4096 PDBs per CDB**
  - When PDBs were first introduced in Oracle 12.1, the number of PDBs per CDB was 252
  - Now it has increased 4,096.
- **Localized AWR**
  - Having the AWR at the PDB level, allows for a granular level of tuning and diagnostics.
- **PDBAs**
  - Oracle now introduces the concept of the Pluggable DBAs (PDBAs), so that each PDB can be potentially maintained by a PDB Administrator.
- **PDBS with Different Character Sets**
  - In Oracle 12.2, CDBs can have PDBs with different character sets, as long as the root container's character set is the superset of all of the PDB character sets.

PDB

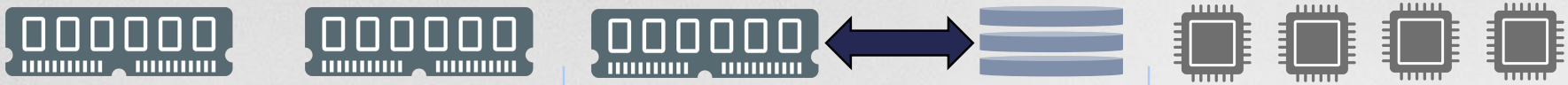
Mutiple Time Zone Support

- **Heat Map**
  - PDBs are able to benefit from Oracle's Automatic Data Optimization capabilities, because Oracle PDBs now have full Heat Map support.

- **Support for PDBs with Different Time Zone File Versions and Database Time Zones**
  - Now, PDBs in a CDB can be in different time zone file versions and database time zones.

Resource Manager Enhancements with Multiten

NEW IN 12.2



Memory Management

- Much requested capability
  - Not possible in 12.1
  - However, consolidation very successful without this capability!
- Memory RM parameters now at PDB level
- New parameter SGA_Min_Size
  - Partition memory per PDB
  - Use for low density consolidation of platinum / core applications
  - Avoid in other use cases

I/O on Commodity Storage

- 2 new per PDB parameters
  - MAX_IOPS & MAX_MBPS
  - Can be dynamically altered
- Rate limits for PDBs on non-Exadata storage
  - Error if set for CDB$Root
  - Error if set on Exadata system
- IORM only possible with Exadata storage in 12.1
  - Still more flexible on Exadata!
    - Automatic throttling based on shares
    - DBA doesn't need to know IOPS and MBPS of storage & workloads

CPU Count per PDB

- Limits CPU consumed by each PDB
  - In 12.1 this is expressed in percentage terms in CDB resource plan
- In 12.2 we have CPU Count as per-PDB parameter
  - No need to re-compute percentage when migrating PDB between boxes of different configurations
  - Percentage still supported for compatibility
  - Lower setting wins

PDB I/O Rate Limits

NEW IN 12.2

Feature

- 2 new PDB parameters
  - MAX_IOPS: maximum I/O requests per second
  - MAX_MBPS: maximum MegaBytes per second of I/O
  - Parameters can be dynamically altered
- Parameters can only be set at the PDB level on non-Exadata systems
  - Setting at the root level results in an error
  - Setting on Exadata results in an error

Dealing with Shared Access

NEW IN 12.2

PDB LOCKDOWN PROFILES

PDB OS CREDENTIAL

PATH PREFIX & CREATE_FILE_DEST

Lockdown Profiles: Apply Limits to Privileges

PDB_LOCKDOWN initialization parameter to enable the a PDB lockdown profile

NEW IN 12.2

- Lockdown profiles are complementary to grants
- Grants alone are "all or nothing"
- Lockdown profiles add granular control of the capabilities enabled by the grant

```
grant alter system
to pdb_user;
```

```
alter lockdown
profile p1 disable
statement=
('ALTER SYSTEM')
clause=('SET')
option= ALL EXCEPT
('plsql_code_type'
,'plsql_debug'
,'plsql_warnings');
```

- Scope of 'alter system'
  - ~~cursor_sharing~~
  - ~~ddl_lock_timeout~~
  - ~~optimizer_mode~~
  - ~~parallel_degree_limit~~
  - plsql_code_type
  - plsql_debug
  - plsql_warnings
  - ~~resource_manager_plan~~
  - ~~skip_unused_indexes~~
  - …

More Lockdown Examples

- Limit Init.ORA Parameters
- Set any Min/Max values on Init Parameter

- ALTER LOCKDOWN PROFILE Lock_init_PROFILE DISABLE STATEMENT = ('ALTER SYSTEM') CLAUSE = ('SET') OPTION = ('CPU_COUNT') MINVALUE = '4' MAXVALUE = '16';
- Others to consider:
  - PARALLEL_MAX_SERVERS
  - PGA_AGGREGATE_TARGET

- Forces Common to Login to the root CDB and change to PDB. Does not allow direct PDB connection

- ALTER LOCKDOWN PROFILE Lock_common_PROFILE DISABLE FEATURE = ('COMMON_USER_CONNECT');

- Disable anything to do with the Partitioning and/or DB Queueing Option

- ALTER LOCKDOWN PROFILE Lock_queue_PROFILE DISABLE OPTION = ('DATABASE QUEUING');

- ALTER LOCKDOWN PROFILE Lock_part_PROFILE DISABLE OPTION = ('PARTITIONING');

Lock out OS Access and Network Access

Set as Default PDB Lockdown

- Run this on the Root CDB and disable all Network and OS Access
- Override at PDB level (if needed)

- ALTER LOCKDOWN PROFILE Lock_Default_profile DISABLE FEATURE = ('NETWORK_ACCESS', 'OS_ACCESS');

- Lockdown Internet

- ALTER LOCKDOWN PROFILE Lock_Internet_profile DISABLE FEATURE = ('UTL_HTTP', 'UTL_SMTP');

- Disable Alter Database and Alter Pluggable Database

- ALTER LOCKDOWN PROFILE Lock_Alter_profile DISABLE STATEMENT = ('ALTER DATABASE', 'ALTER PLUGGABLE DATABASE');

- ALTER LOCKDOWN PROFILE Lock_System_profile DISABLE STATEMENT = ('ALTER SYSTEM') CLAUSE = ('SET') OPTION= ('NLS_DATE_FORMAT');

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