

# Upgrade, Migrate & Consolidate to Oracle Database 12c



Mike Dietrich  
Master Product Manager  
Database Upgrade  
Oracle Corporation

Roy Swonger  
Senior Director & Product Manager  
Database Upgrade & Utilities  
Oracle Corporation

# \$> whoami



20 years w/Oracle

Previously with DEC Rdb

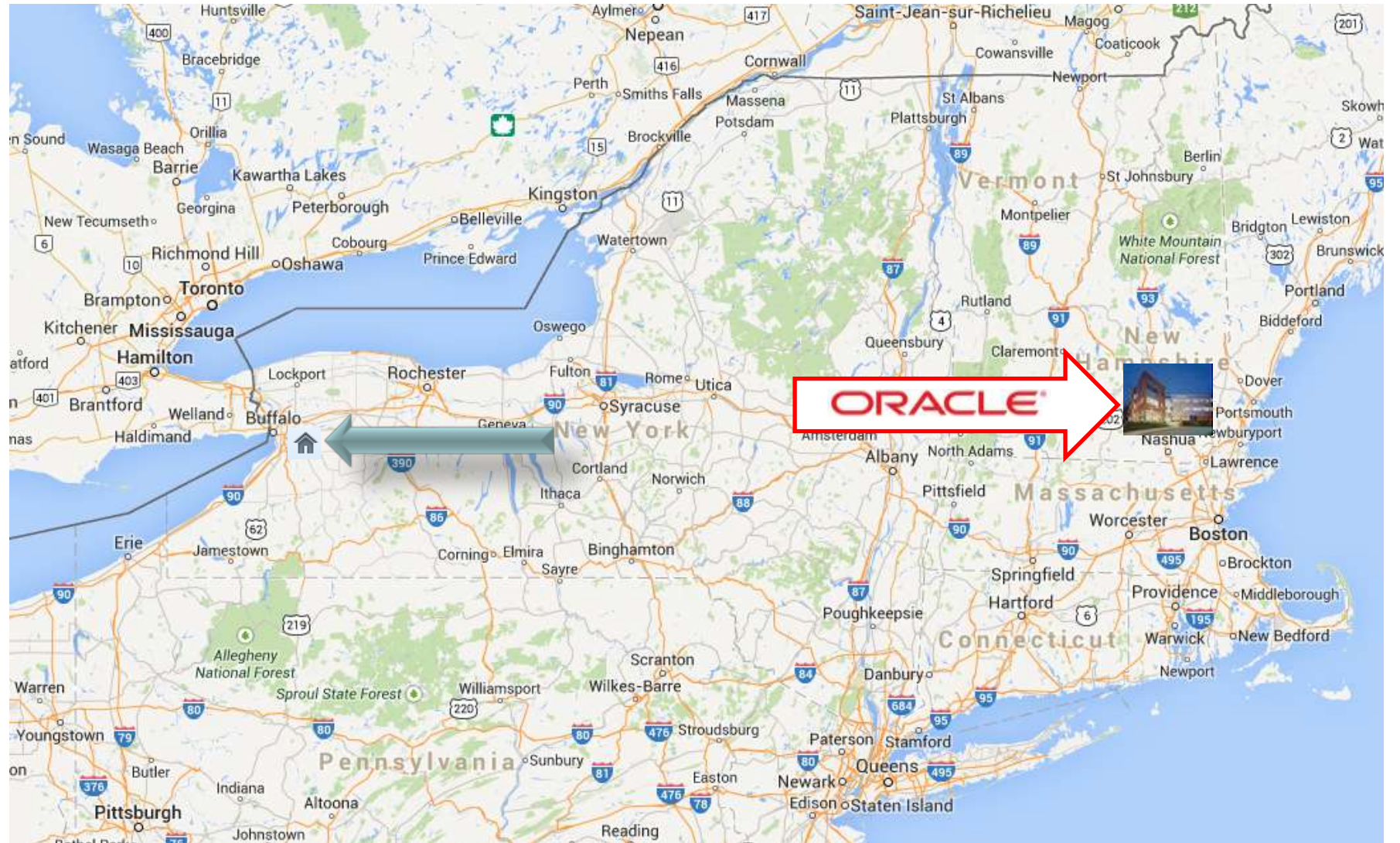
11+ years managing

Data Pump

Database Upgrade

SQL\*Loader

Transportable Tablespaces



# \$> whoami



**Mike Dietrich**

Master Product Manager  
Database Upgrades & Migrations



MikeDietrichDE



<http://blogs.oracle.com/UPGRADE>

6 years

RDBMS Core & Mission Critical Support

5.5 years

Technology Presales for DataGuard, Upgrades

>8 years

ST Upgrade Development Team

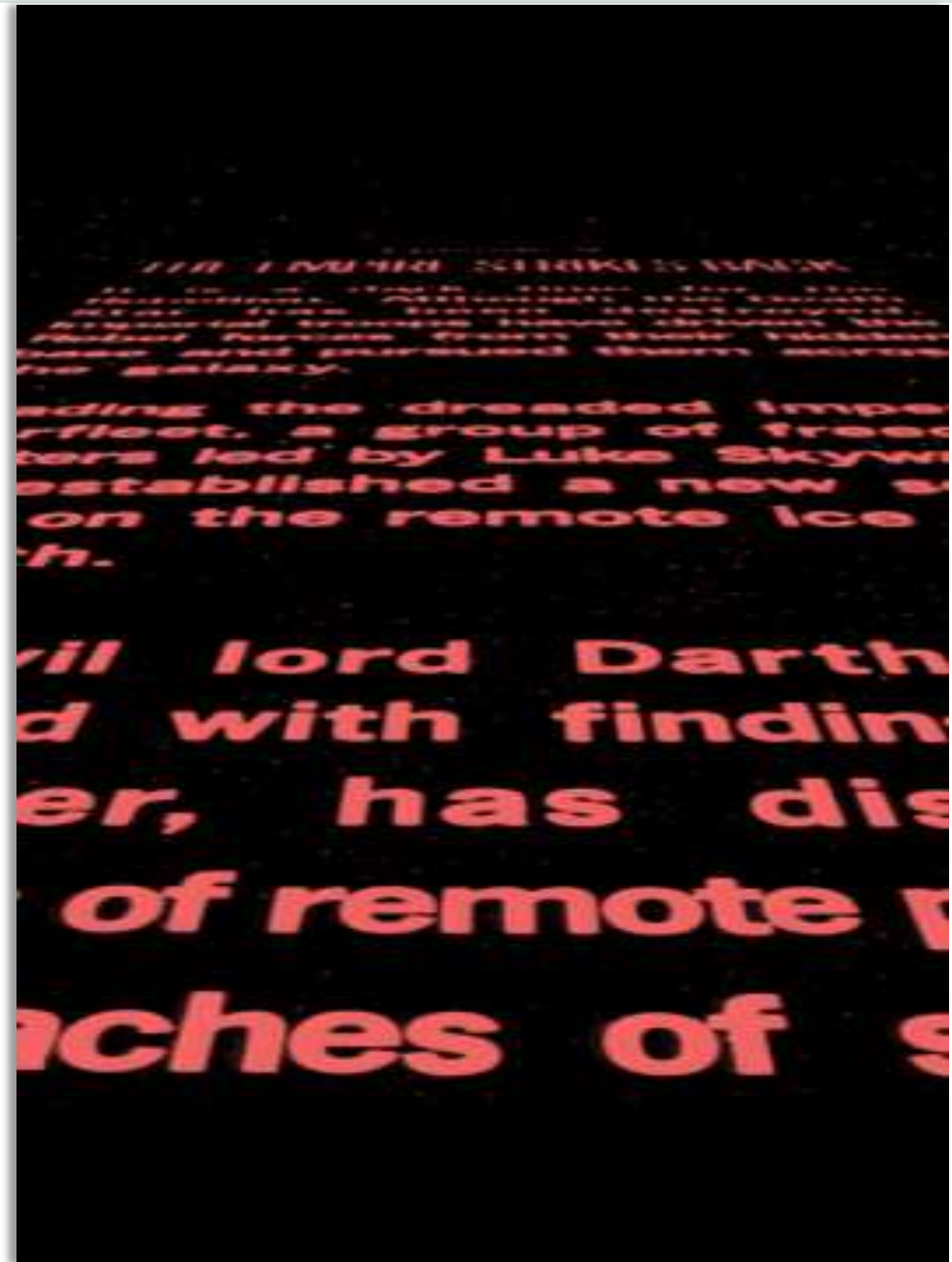
50%  
Reference  
Projects

50%  
Workshops  
Worldwide

+ x%  
Development  
Work

# Upgrade, Migrate & Consolidate

- 1 Introduction
- 2 Preparation Steps
- 3 Upgrade / Migrate / Consolidate
- 4 Fallback Strategies
- 5 New Features
- 6 Performance Management
- 7 Wrap Up



# Reference Involvement

**Customer Success**  
Your success is our aim!



**Non-binding Reference Proposal**  
for

---

**Oracle Database Upgrade Development: Customer Reference Program**



**Company Name and Logo** You agree that your company name (where necessary including your logo) will be called "customer" or "reference customer" for relevant products and projects. Typically we will then use your company name during internal and external presentations or events.

Agree: Yes  No

Comments:

---

**Customer Quote** The quote is a brief statement about how your company has achieved a technological head start or has benefited economically from using Oracle products. Example: "Since we have been using Oracle iProcurement our acquisition costs have fallen by around 20%" – John Doe, CIO, IT Company Inc. With your agreement we will use your quote, for instance, in product brochures.

Agree: Yes  No

Comments:

# Reference Involvement: Results



**Real World Checkpoint**

- Customer:**
  - Payback GmbH
  - Belongs to Loyalty Partner GmbH which belongs to **American Express**
  - HQ in Munich, Germany
  - Develops and operates professional customer loyalty programs based on customized IT solutions
  - Provider for Payback
  - Active in Germany, Poland, India, Italy, Mexico and USA

229

**Real World Checkpoint**

- Project:**
  - Migrate 7TB / 1.5TB from HP-UX to Exadata V1
  - Cross platform, cross Endianness, cross version
  - Oracle 9.3.0.7 on HP-UX to Oracle 11.1.0.7 on OL
  - 4 months planning and migration phase
  - August to November 2009
  - Proposed go-live date: 15-NOV-2009

230

**Real World Checkpoint**

- Customer:**
  - Move everything in **less than 24 hrs**

**“The new parallel upgrade script promises to drastically reduce downtime due to planned maintenance. We saw a 37% improvement over the previous upgrade process in our environment.”**

**Harald Stefan**  
 Leiter Datenbanken  
 Payback GmbH

**Real World Checkpoint**

**Setup:**

Restore Upgrade

232

**Real World Checkpoint**

**Test migrations:**

233

>90000 Downloads since June 2013

**Real World Checkpoint**

- Final test became LIVE migration**

**Real World Checkpoint**

- Live? And alive?**
  - Yes! Go-live in early November 2009
  - Two weeks earlier** than proposed
  - Total upgrade and migration time: **~20 hours**
  - ~2 hours: Restore and recovery
  - ~1 hour: Database upgrade to Oracle 11.1.0.7
  - ~10 hours: Data migration to Exadata V1
  - ~1 hour: Smoke testing and final verification
  - Dramatic performance improvements
  - Job runtimes decreased by 80%

**Real World Checkpoint**

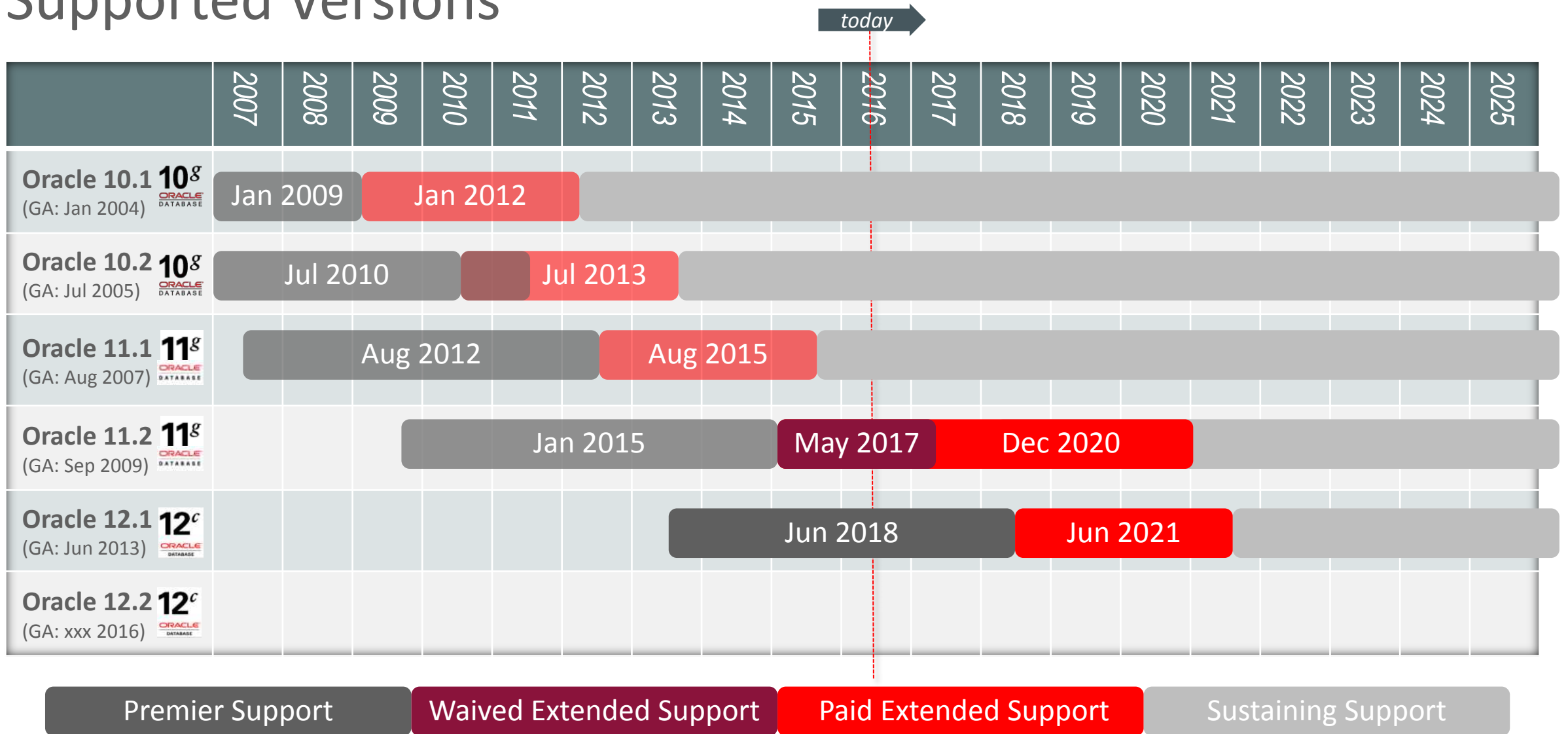
- Most critical job: runtime from 30 hrs to < 2hrs**



When does  
**Oracle Database 11.2**  
run **out** of  
Premier Support?

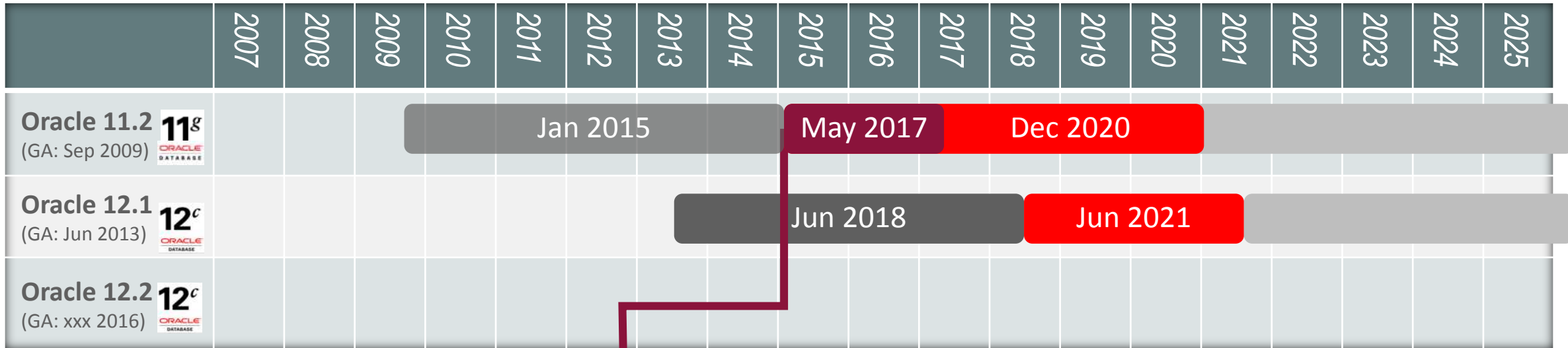
**Already over since 31-Jan-2015**

# Supported Versions





# Patching for Oracle Database 11.2



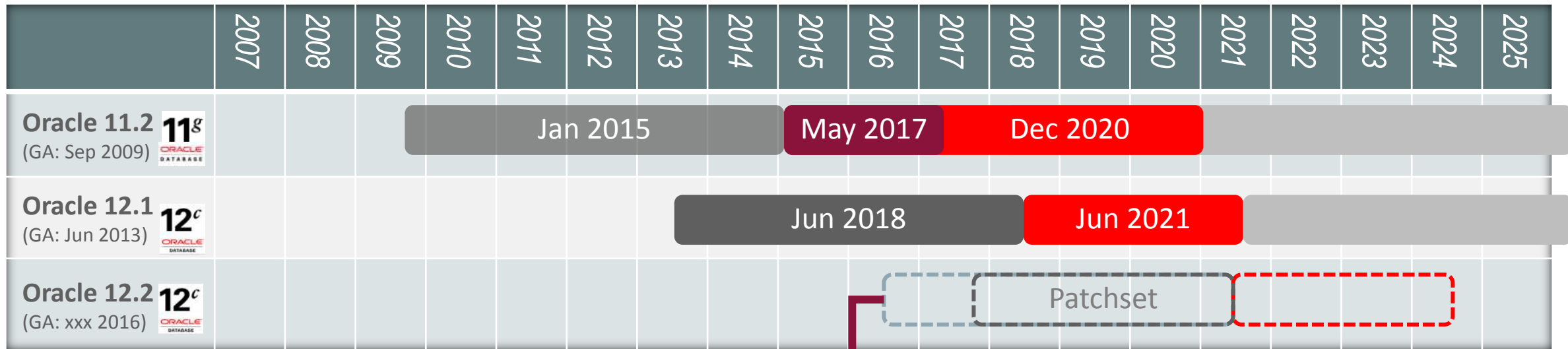
- Release Schedule of Current Database Releases  
[MOS Note.742060.1](https://www.oracle.com/technetwork/middleware/patches/742060-1.html)

Release	Patching Ends	Notes and Exceptions*
11.2.0.3	27-Aug-2015	

# When will **Oracle Database 12.2** be released?

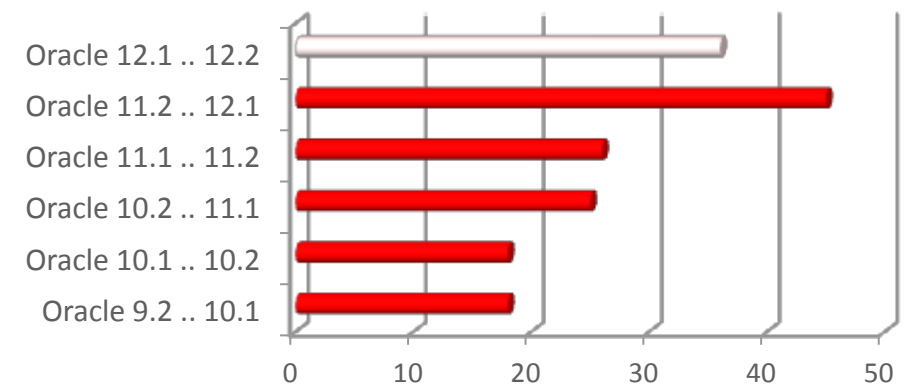
Let's be honest – you will wait usually for the  
**1st patch set** for the **2nd release**

# Why **you can't wait** for the **2nd Release**?



- **Every release is a full release**
- Every release will get a significant number of new features and changes
- **There's no such thing as THE 2<sup>nd</sup> release anymore!**

Span between Releases in Months



# Lifetime Support Policy

- <http://www.oracle.com/us/support/lifetime-support/index.html>
- [MOS Note: 209768.1](#) for Support Policy Explanation and details

## Oracle Lifetime Support Policies

### Expect Lifetime Support

Simple, predictable and flexible, Oracle Lifetime Support helps drive your business success across your entire Oracle technology environment. From database to middleware to applications and hardware, you can now enjoy the benefits of the industry's most comprehensive support coverage.

## Oracle Database Releases

Release	GA Date	Premier Support Ends	Extended Support Ends	Sustaining Support Ends
12.1	Jun 2013	Jul 2018	Jul 2021	Indefinite
11.2	Sep 2009	Jan 2015	Jan 2018	Indefinite
11.1	Aug 2007	Aug 2012	Aug 2015	Indefinite
10.2	Jul 2005	Jul 2010	Jul 2013	Indefinite
10.1	Jan 2004	Jan 2009	Jan 2012	Indefinite
9.2	Jul 2002	Jul 2007	Jul 2010	Indefinite
8.1.7	Sep 2000	Dec 2004	Dec 2006	Indefinite

# Upgrade Companion

- [MOS Note:1462240.1](#) Upgrade Companion 12c

## Oracle Database 12cR1 Upgrade Companion (Version 3.00)

9/17/2013

Welcome to Oracle Database 12cR1 Upgrade Companion. This Upgrade Companion helps you to upgrade from either Oracle9i Release 2 (9.2) or Oracle Database 10g or Oracle Database 11g to Oracle Database 12c Release 1, and includes pre-upgrade, upgrade, and post-upgrade guidance. Oracle continually updates this document as new information becomes available. Check this document prior to performing any upgrade.

**NOTE:** The Oracle Database 12cR1 Upgrade Companion is an instructional document that serves as a companion to the Oracle Database documentation set. This document:

- Does not supply automation tools
- Does not replace [Oracle Database Upgrade Guide](#)
- Describes upgrade requirements for Oracle Databases only. Review your product documentation to plan for upgrade requirements for Oracle applications or other vendor applications running on Oracle Database.

For advice or onsite assistance during a database upgrade, see the ["Accelerate Technology Adoption"](#) web page or the ["Oracle Consulting Upgrade Services"](#) web page. Oracle Advanced Customer Services helps you make better IT decisions by providing you with the option to develop a personalized technology strategy and long-term operational plan for a successful transition to new Oracle capabilities. Oracle Consulting Services is a low-risk, cost-effective choice to complete Oracle upgrades successfully. Oracle Consulting Services can be provided in partnership with your in-house staff, in close coordination with your chosen service provider, or as a remote service.

For application upgrades, see your application documentation and My Oracle Support.

### Modifications

Version 3.00 September 17, 2013

Version 3.00 is a beta release of the Oracle Database 12cR1 Upgrade Companion.

### Modifications

Version 3.10 December 8, 2014

Modified to cover 12.1.0.2 changes.

Version 3.00 January 2013

First release of the Oracle Database 12cR1 Upgrade Companion

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# Database Upgrade: OTN Web Site

- <http://otn.oracle.com/goto/upgrade>



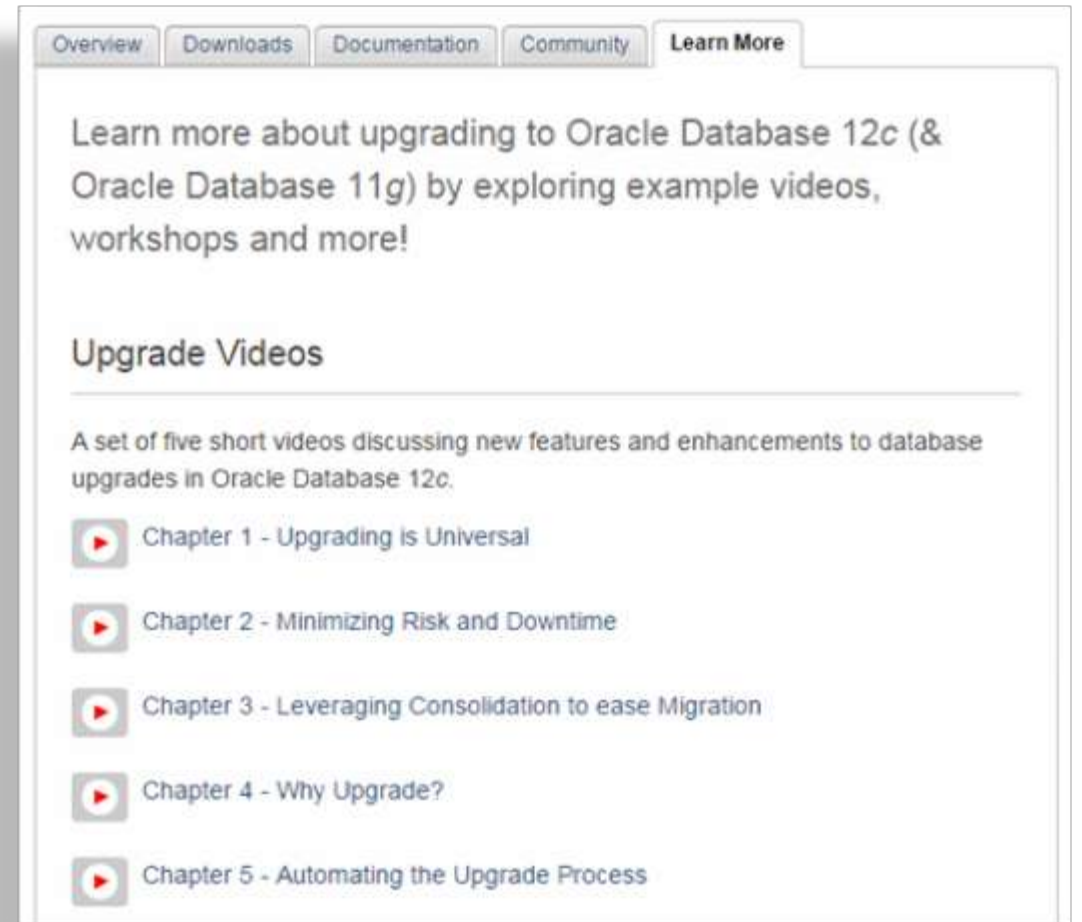
Overview Downloads Documentation Community Learn More

## Oracle Database Upgrades

Upgrading to Oracle Database 12c provides the latest in efficient, reliable, secure data management for mission-critical on-line transaction processing applications, query-intensive data warehouses, and cloud applications. The right planning, preparation, and upgrade steps will make the upgrade process simpler, faster, and more predictable from start to finish.

**White Paper: Upgrading to Oracle Database 12c**

**Video: Upgrading to Oracle Database 12c**



Overview Downloads Documentation Community Learn More

Learn more about upgrading to Oracle Database 12c (& Oracle Database 11g) by exploring example videos, workshops and more!

### Upgrade Videos

A set of five short videos discussing new features and enhancements to database upgrades in Oracle Database 12c.

- ▶ Chapter 1 - Upgrading is Universal
- ▶ Chapter 2 - Minimizing Risk and Downtime
- ▶ Chapter 3 - Leveraging Consolidation to ease Migration
- ▶ Chapter 4 - Why Upgrade?
- ▶ Chapter 5 - Automating the Upgrade Process

# Database Upgrade Blog

- <http://blogs.oracle.com/UPGRADE>

**Upgrade your Database - NOW!**  
Ease your Oracle Database upgrades and migrations - Best Practices, Workshops, Projects - and something about the pleasures of traveling

**Extended Support Fee for Oracle 11.2.0.4 waived until May 31, 2017 - Extended Support until Dec 2020**  
Saturday Oct 17, 2015

**Extended Support Fee for Oracle 11.2.0.4 waived until May 31, 2017 - Extended Support until Dec 2020**  
By Mike Dietrich-Oracle on Oct 17, 2015

Friday, Oct 16, 2015, Oracle announced that the Extended Support for Oracle Database 11.2.0.4 will be waived until May 31, 2017. After this period of Waived Extended Support, Extended Support for Oracle Database 11.2.0.4 will be offered until end of December 2020.

This information can be found here:

- **Oracle Software Technical Support Policies**  
<http://www.oracle.com/us/support/brow/047413.pdf>  
See: Exemptions - For customers with a current support contract meeting:  
Page 6:
- **Oracle Database 11gR2**: The Extended Support fee has been waived for the period of February 2017-May 2017. During this period, you will receive Extended Support during these periods as described in Oracle Technical Support Levels section below.

• **Oracle Lifetime Support Policy**  
<http://www.oracle.com/us/support/brow/047413.pdf>  
Page 6:

**Oracle Database Releases**

Release	GA Date	Former Support Ends	Scheduled Support Ends
6.1.7	Dec 2000	Dec 2004	Dec 2006
9.2	Jul 2002	Jul 2007	Jul 2010
10.1	Jan 2004	Jan 2008	Jan 2012
10.2	Jul 2005	Jul 2010	Jul 2013
11.1	Aug 2007	Aug 2012	Aug 2015
<b>11.2</b>	<b>Sep 2008</b>	<b>Jul 2013</b>	<b>Dec 2020</b>
Enterprise Edition 12.1	Jan 2013	Jul 2018	Jul 2021
Standard Edition (SE) 12.1	Jul 2013	Aug 2018	Not Available
Standard Edition One (SE1) 12.1	Jul 2013	Aug 2018	Not Available
Standard Edition 2 (SE2) 12.1	Sep 2014	Jul 2019	Jul 2021

**Slides Download Center**

**Comprehensive**

- Upgrade, Migrate & Consolidate to Oracle Database 12c**  
Refreshed 23-SEP-2015
- Upgrade Best Practices - 12c**  
(latest update on 8-NOV-2014)
- Upgrade Methods**  
(Refresh: 8-NOV-2014)
- What's New with Upgrades to 12c?**  
Upload: 8-NOV-2014
- Webcast for ISVs Apr-2015: Why Upgrade to Oracle 12c?**  
Upload: 21-APR-2015

**Deep Dive**

- Parallel Multitenant Upgrades**  
c atc ti.pl "Internals"  
Upload: 27-NOV-2014
- Full Transportable Export/Import with RMAN incrementals**  
Upload: 31-JUL-2015
- Single Tenant for DBAs**  
Upload: 30-JUL-2015

**Hands On Lab**

- Hands On Lab**  
**Upgrade, Migrate, Consolidate to 12c**  
Uploaded 9-FEB-2015



# Try the Upgrade: Hands On Lab

- <http://blogs.oracle.com/UPGRADE>

Slides Download Center

**Comprehensive**

**Upgrade, Migrate & Consolidate to Oracle Database 12c**  
Refreshed: 30-NOV-2015

**Why you need to upgrade NOW!**  
Upload: 09-DEC-2015

**Upgrade Best Practices - 12c**  
(latest update on 8-NOV-2014)

**Upgrade Methods**  
(Refresh: 8-NOV-2014)

**What's New with Upgrades to 12c?**  
Upload: 8-NOV-2014

**Webcast for ISVs Apr-2015:  
Why Upgrade to Oracle 12c?**  
Upload: 21-APR-2015

**Deep Dive**

**Parallel Multitenant Upgrades**  
c atc t pl "Internals"  
Refreshed: 09-DEC-2015

**Full Transportable Export/Import with RMAN Incrementals**  
Refreshed: 09-DEC-2015

**Single Tenant for DBAs**  
Refreshed: 09-DEC-2015

**Hands On Lab**

**Hands On Lab**  
Upgrade, Migrate, Consolidate to Oracle Database 12c  
Refreshed: 16-DEC-2015

**Hands-On Lab Instructions**  
Refreshed: 16-DEC-2015

## Oracle Database 12c (12.1.0.2) Upgrade and Migration hands-on Lab

### SYSTEM REQUIREMENTS:

This hands-on lab runs in an Oracle VM VirtualBox environment. In order to run the lab effectively you will need the following:

#### Minimum Hardware:

- Dual-core CPU
- 4 GB RAM
- 40GB free disk space

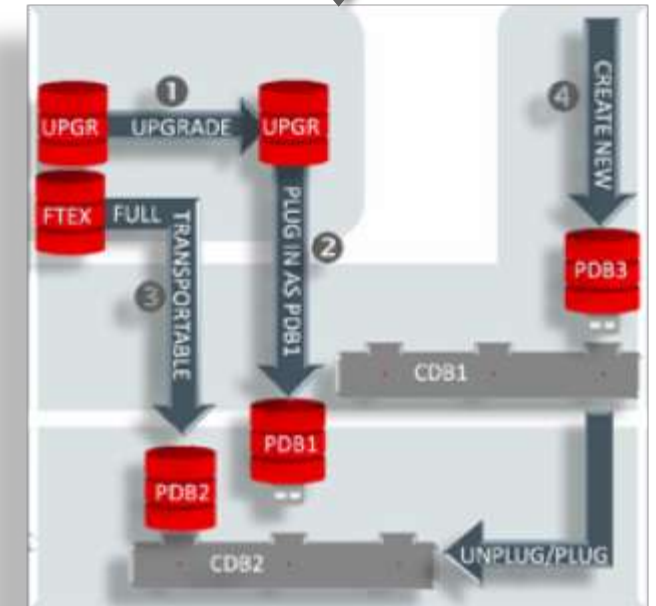
#### Recommended Hardware:

- Quad-core or better CPU
- 8+GB RAM
- 50GB free disk space

#### Required Software:

- Operating system able to address 4+GB RAM. Suggestions include Windows 7, Linux, or Mac OS X
- NOTE: Windows XP cannot address more than 3GB RAM even if you have more than that installed in your system. This makes Windows XP unsuitable for running this hands-on lab
- Oracle VM VirtualBox 4.3.20 . Download the latest version from <http://www.virtualbox.org>
- Also include the VirtualBox Extensions package. This is a separate download from the same location

- Upgrade\_HOL.7z.001 (2,097,152,000 bytes)
- Upgrade\_HOL.7z.002 (2,097,152,000 bytes)
- Upgrade\_HOL.7z.003 (2,097,152,000 bytes)
- Upgrade\_HOL.7z.004 (2,097,152,000 bytes)
- Upgrade\_HOL.7z.005 (2,097,152,000 bytes)
- Upgrade\_HOL.7z.006 (2,097,152,000 bytes)
- Upgrade\_HOL.7z.007 (2,097,152,000 bytes)
- Upgrade\_HOL.7z.008 (815,410,016 bytes)





# Internal Only Download Page

- <http://database.us.oracle.com/pls/htmldb/f?p=301:193:0>

The screenshot displays the Oracle Database Product Management interface. On the left, the 'PM Directory' sidebar lists various categories, with 'Database Upgrade and Utilities' highlighted by a red arrow. The main content area, titled 'Database Product Management', features an 'Upgrades' section with a description of Oracle Database 12c and links to a blog, external site, and internal site. Below this is a 'People' table listing Mike Dietrich and Bob Swincer. An announcement for 'Database 12c Upgrade hands-on lab VM available for download' is also visible. On the right, there are utility widgets for 'Help', 'Category Content Search', and 'Usage Metrics (1 year)' showing 140 views and 9 authenticated visitors.

Name	Email	Specialty
Mike Dietrich	<a href="mailto:mike.dietrich@oracle.com">mike.dietrich@oracle.com</a>	Database Upgrades Technologist
Bob Swincer	<a href="mailto:rob.swincer@oracle.com">rob.swincer@oracle.com</a>	Database Upgrade & UTILITIES

**Announcement** Database 12c Upgrade hands-on lab VM available for download 3 days ago

The hands-on lab for Database Upgrade is now available as a VM Image from [retreiver.us.oracle.com](http://retreiver.us.oracle.com). This lab is suitable both for internal use and for customer workshops. It is essentially the same content used for OOW 2013, Collaborate 13, and OOW Shanghai 2013, but has been updated with the latest versions.

A group of soccer players in white and red jerseys are celebrating with a large golden trophy. They are cheering and raising their arms. The scene is filled with excitement and triumph.

# Who's already live on Oracle Database 12c?

Winners are live on Oracle Database 12c already 😊



Deutsche  
Vermögensberatung  
Vermögensaufbau für jeden!

*“At DVAG we do thorough testing in a 3-step approach for our critical environments. **The decision to upgrade directly to Oracle Database 12c skipping the terminal patch set of the previous database release was taken in order to save us one complete testing cycle, and furthermore the accompanying costs as well”***

**Michael Kuhn, Deutsche Vermögensberatung AG**



*"The migration of all 16 German Electronic Income Tax databases to Oracle Database 12c in less than 10 months went smooth and fine. We are very satisfied with the performance and the robustness of Oracle Database 12c."*

Anja Albrecht, Rechenzentrum der Finanzverwaltung NRW

## FEATURE

### Memorable Performance

By Philip J. Gill

**Swiss insurance leader Die Mobiliar deploys Oracle Database In-Memory to speed business analytics.**

Founded in 1826, Die Mobiliar is the oldest insurance firm in Switzerland. From its headquarters in Berne, the national capital, the company's network of 160 offices and more than 4,000 employees provides home, car, accident, and risk management insurance and other financial services to more than 1.6 million individuals and businesses throughout the Alpine country's 26 cantons. In late 2014, Mobiliar found itself with a database inventory not uncommon to firms with long histories and technology acquired via mergers and acquisitions. The company's database portfolio included IBM DB2 database technology, Microsoft SQL Server, and COBOL applications.

"As you can imagine, it's very difficult to deliver three different types of applications," says Paolo Kreth, team leader for database management. "If you have three different technicians for each, you need different hardware for each."

As Published In



May/June 2015

*Die Mobiliar*  
*Versicherungen & Vorsorge*

Mobiliar was running several instances of Oracle Database 11g, including one that supports its call center's Siebel Customer Relationship Management (Siebel CRM) applications from Oracle, and the company decided its new strategic database platform going forward would be Oracle—specifically, Oracle Database 12c with the Oracle Database In-Memory option.

"We chose Oracle to become our strategic database," says Kreth. "We plan to stop using DB2 over the next 10 years. We need that time frame because all our core applications on the mainframe are written in COBOL."

# Time to Upgrade?

```
[C:\]sqlplus system
```

```
SQL*Plus: Version 3.0.10.1.4 - Production on Tue Oct 01 08:01:23 2013
```

```
Copyright (c) Oracle Corporation 1979, 1993. All rights reserved.
```

```
Enter password:
```

```
Connected to:
```

```
ORACLE RDBMS V6.0.37.6.4, transaction processing option - Production  
PL/SQL V1.0.42.0.0 - Production
```

```
SQL>
```

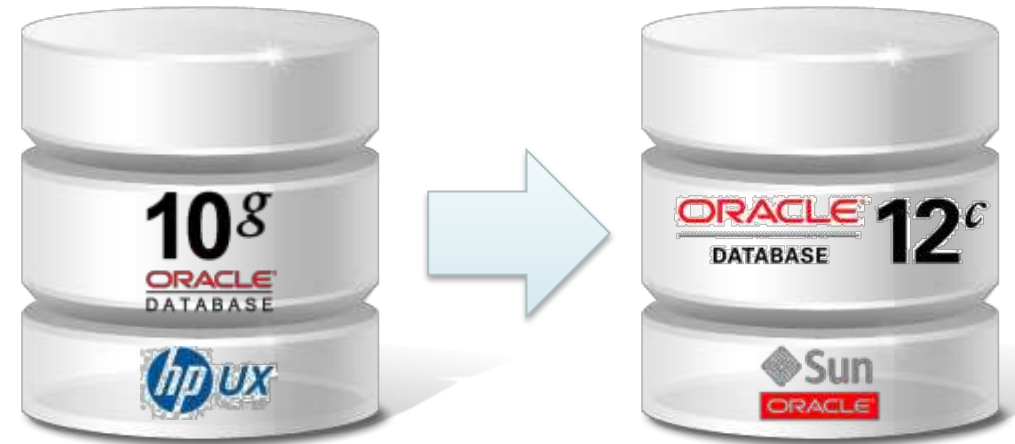
# Terminology: Upgrade vs. Migration



- Upgrade
  - Independent of size



- Migration
  - Usually depending on size



# Why people usually don't upgrade?

*"You need to upgrade now as your release is out of Premier Support already!!!"*

*"Upgrading just costs a lot!"*

*"I don't see any benefits by upgrading to a newer release"*

*"I'm happy with the features of Oracle 8i"*

*"It will just introduce new bugs and issues"*

*"We'll wait for the 2<sup>nd</sup> release only"*

*"Application is not certified"*





# Oracle and SAP – Certified in Oracle Database 12.1.0.2

- **SAP** has already **certified** Oracle 12.1.0.2 as of **March 31, 2015**
- For certified Oracle options see:
  - <http://www.oracle.com/us/solutions/sap/sap-database/index.html>
- **SAP** has already **certified** Oracle 12.1.0.2 with **In-Memory** as of **June 30, 2015**
  - <http://tinyurl.com/CertOracleSAP-InMem>

- <http://tinyurl.com/CertOracleSAP>

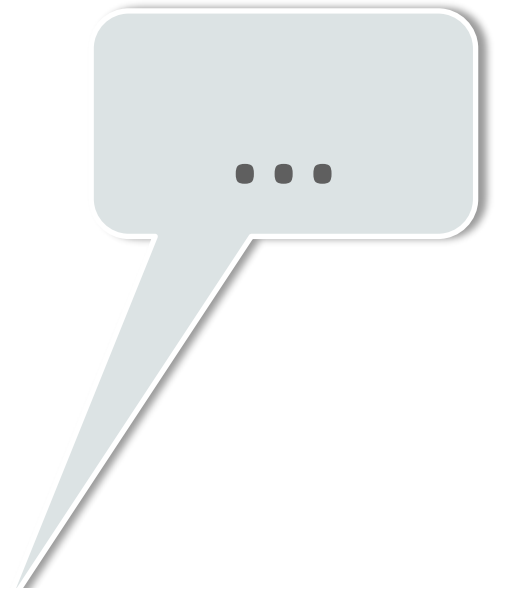
The screenshot shows a blog post on the Oracle website. The header is red with the text 'Upgrade your Database - NOW!' and the Oracle logo. The main content area has a white background with a red title 'SAP on Oracle Database 12c now with Oracle In-Memory' and a byline 'By Mike Dietrich-Oracle on Jul 02, 2015'. The post features the Oracle and SAP logos. The text states: 'On March 31, 2015 SAP has been certified to run on Oracle Database 12.1.0.2: [https://blogs.oracle.com/UPGRADE/entry/sap\\_is\\_now\\_certified\\_on](https://blogs.oracle.com/UPGRADE/entry/sap_is_now_certified_on) As of June 30, 2015, Oracle Database In-Memory is supported and certified for SAP environments for all SAP products based on SAP NetWeaver 7.x, on Unix/Linux, Windows and Oracle Engineered Systems platforms running Oracle Database 12c - in single instance and Oracle Oracle Real Application Clusters deployments. Oracle Database 12c is the database of choice for SAP customers based on In-Memory Technology which is fully supported for SAP BW and SAP OLTP applications. For requirements, restrictions, and implementation details see the documents below.'

- [SAP note 2178980](#)
- Using SAP NetWeaver with Oracle Database In-Memory - an Oracle technical white paper <http://scn.sap.com/docs/DOC-64863>
- Oracle Database 12c In-Memory Option. The Top Tier of a Multi-tiered Database Architecture Oracle/SAP Newsletter article <http://www.oracle.com/us/solutions/sap/123-db12c-imo-en-2209396.pdf>

On the right side, there is a profile for Mike Dietrich, a Senior Product Manager - Database Upgrade & Migration - Oracle Corp. Below the profile is a search bar with the text 'Enter search term:' and a search icon.

# The Magic Questions

- We need to know ...
  - New hardware?
  - Same or different OS? OS version?
  - Character Set change?
  - Single Tenant / Multitenant?
  - Number of databases?
  - Size of databases?
  - Exact database source and target versions?
  - Downtime and fallback requirements?
  - Test environment and tools?



A group of medical professionals, including surgeons and nurses, are gathered around a patient in an operating room. They are all looking intently at the patient, who is lying on a table under a large surgical light. The scene is brightly lit, and the medical staff are wearing scrubs and stethoscopes. The overall atmosphere is one of focused concentration and teamwork.

We fully understand that things often are complicated and business critical

# And things can become **really** complicated ...

----- Original Message -----

**Subject:**RE: Upgrade 8i to 11g

**Date:**Fri, 19 Apr 2013 13:18:56 -0700 (PDT)

**From:** [redacted] <[redacted]@oracle.com>

**To:**Mike Dietrich <mike.dietrich@oracle.com>

Thank you so much for the detailed answer. I have the answers and here they are:

- 1) The customer database is 26 TB (Quite big)
- 2) Customer can afford to have around 5-6 hours of down time.
- 3) The database is ebs Oracle Apps database

Questions I have is for you:

- 1) I was proposing to go to from 8i to 10g and then from there to 11g.
- 2) Any other pro active things to take care before we take the upgrade?
- 3) I see you are an upgrade specialist and want to hear what other thing

- Oracle 8i to 11.2
- 26 TB
- Oracle EBS
- 5-6 hours max downtime

▪ **Good luck!!!**

# Or more work ...

- **Triple** hops

- ↳ Oracle 9.2.0.1

- ↳ Oracle 9.2.0.4

- ↳ Oracle 10.2.0.5

- ↳ Oracle 12.1.0.2

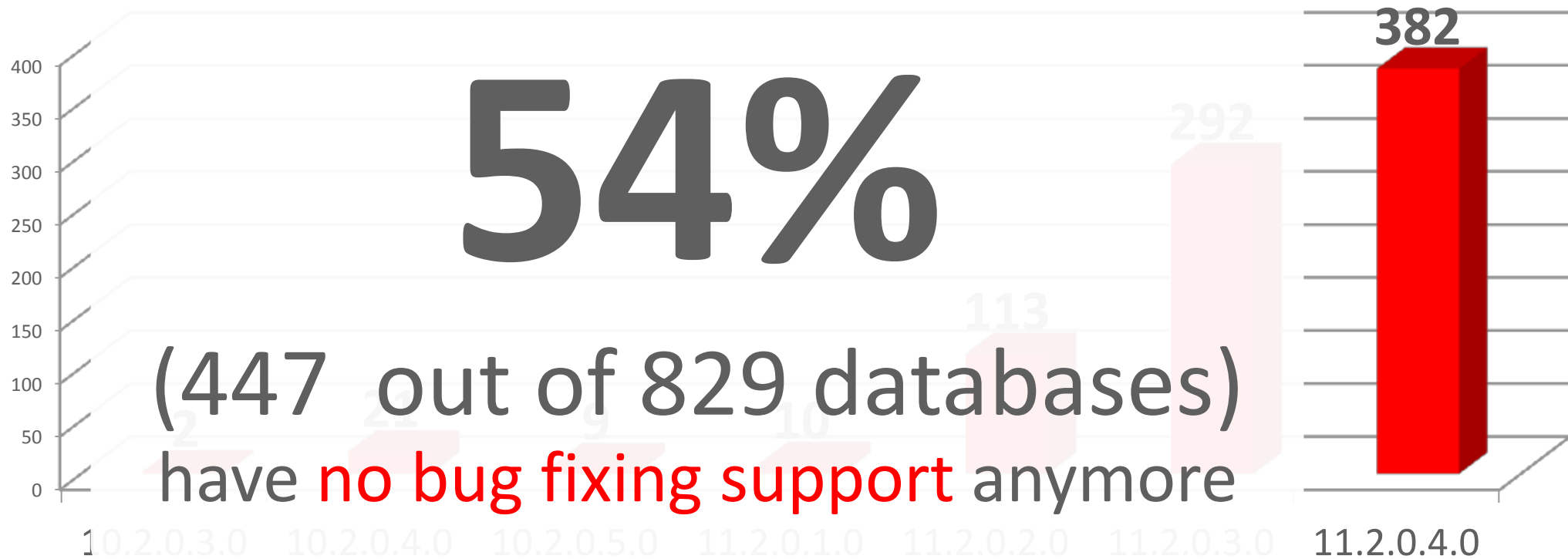
On 6/11/2015 2:55 PM, [REDACTED] wrote:

Hi Larry, i hac that whats to move their 9i DB from a T3 to  
Their are some concerns that GG will work, but there are  
requirements is to upgrade the 9.2.0.1 to 9.2.0.4 then t

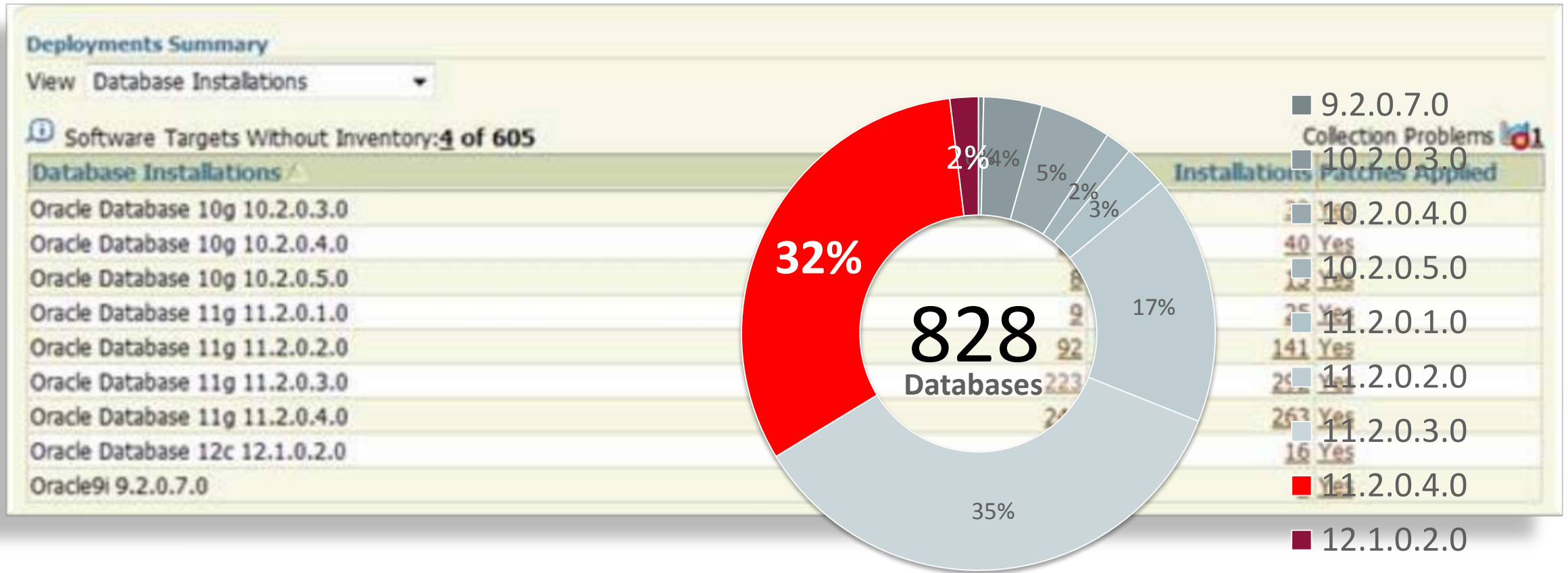
The client wants to get from 9i to 12c in the least steps  
an extra step in the middle. The client has tried export/i

But even if it does not look complicated at first sight ...

## Databases



# Another example ...



# Don't maintain a zoo!

Operating System	Oracle 7	Oracle 8.1	Oracle 9.2	Oracle 10g
AIX 5.3.X			4	
HP-UX 11.0		1		
HP-UX 11.11	1	10	4	
HP-UX 11.2x				
HP-UX 11.31			3	
SOLARIS 8		3		
SOLARIS 9		3	16	
SOLARIS 10				
LINUX REDHAT				
SLES 8.X			5	
SLES 10.X				
WINDOWS 2000				
WINDOWS 2003			2	
WINDOWS 2008				



- 135 Oracle databases
  - 7 different Oracle releases
  - 13 different Oracle patch levels
- 6 different OS vendors
  - 15 different OS versions

■ **2%** of all databases under bug fixing support



# Maintaining a Zoo is **EXPENSIVE**

Operating System	Oracle 7	Oracle 8.1	Oracle 9.2	Oracle 10.1	Oracle 10.2	Oracle 11.1	Oracle 11.2
AIX 5.3.X			4	3			
HP-UX 11.0		1					
HP-UX 11.11	1	10	4				
HP-UX 11.2x				1	5		
HP-UX 11.31			3		18	1	
SOLARIS 8		3					
SOLARIS 9		3	16	2			
SOLARIS 10				1	16	1	1
LINUX REDHAT 5					4		2
SLES 8.X			5				
SLES 10.X					11		
WINDOWS 2000	2						
WINDOWS 2003	1	2	2		8	2	
WINDOWS 2008					1	1	



Maintenance Costs



Upgrade/Migration Costs



# Another example from the Real World

----- Original Message -----

Subject:

Re: & Oracle- Data replication follow up

Date:

Tue, 21 Jan 2014 16:06:30 -0600

From:

To:

CC:

OS change

Application change

Client change

HW change

HI

Thanks for the assistance and connections.

What would be

Downtime Requi

RT0 20 m

RPO as close to zero as possible. CIO did not state specifically zero however.

Size: unk, these are WMS type applications for their inventory, orders, etc,

How Many: Estimated 10-15 instances based on conversation.

10-15 databases

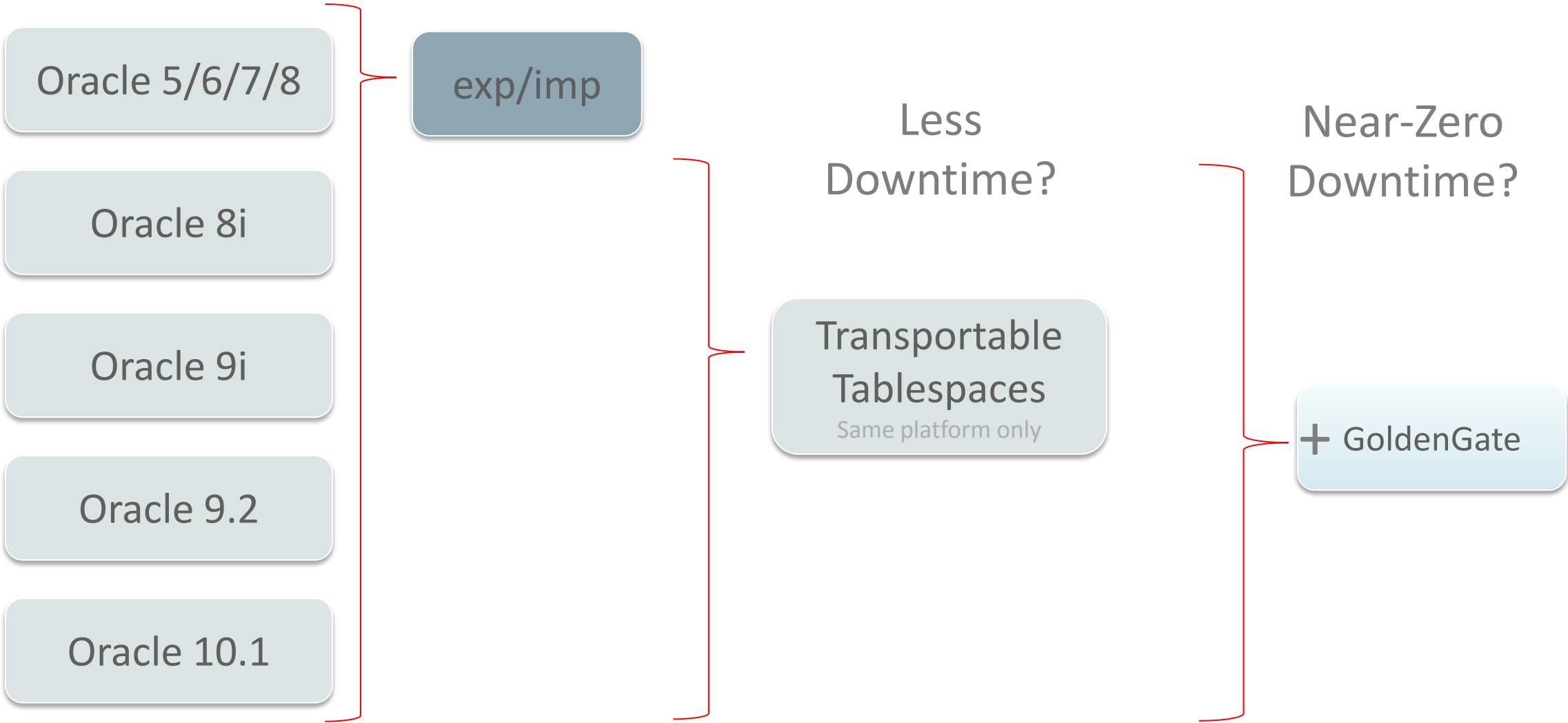
Minimal Downtime between Oracle 7.3 and Oracle 11.2

No upgrade done for ~17 years!!!

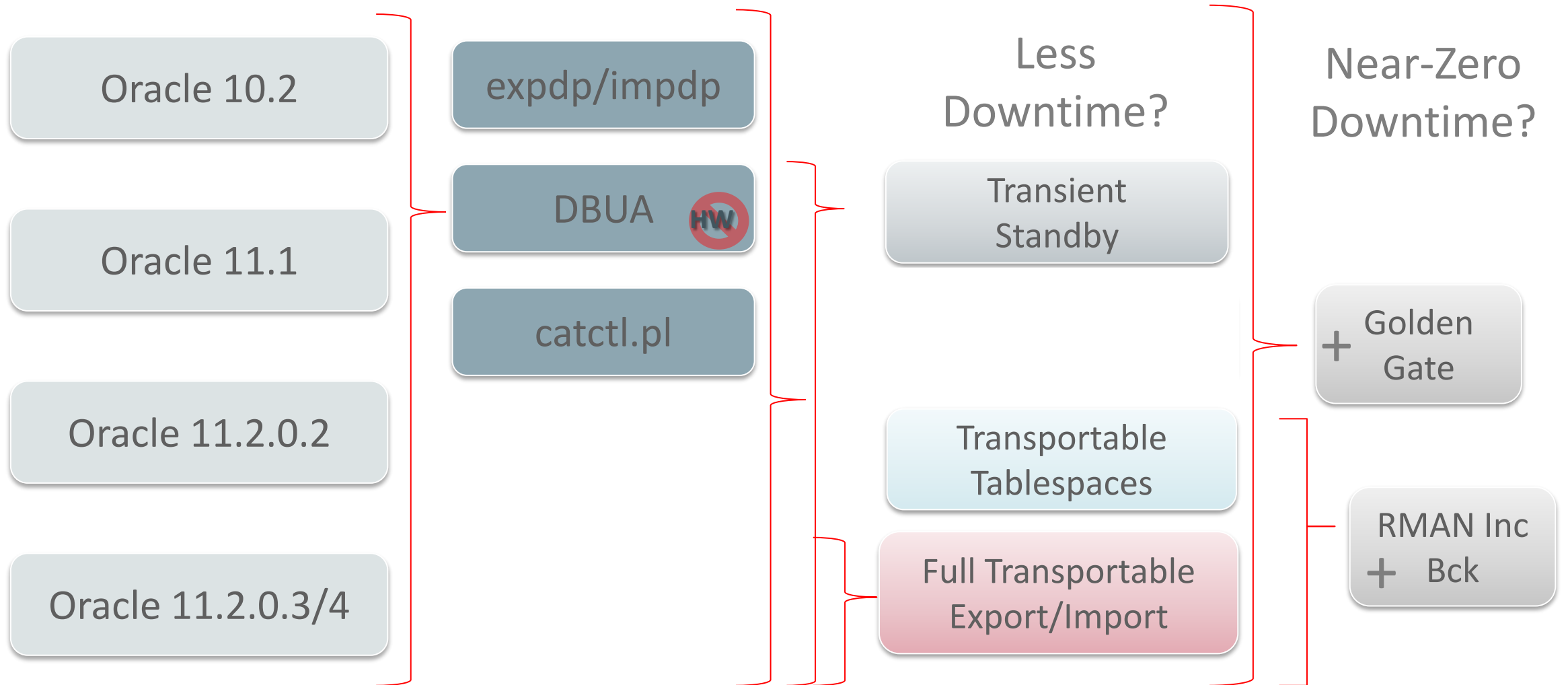
# Recommendation

- Don't sit it out
  - It will just get more complicated and risky
- Beware of application dependencies
- Establish constant database inventory monitoring
- **Move on – upgrade your database(s) NOW!**

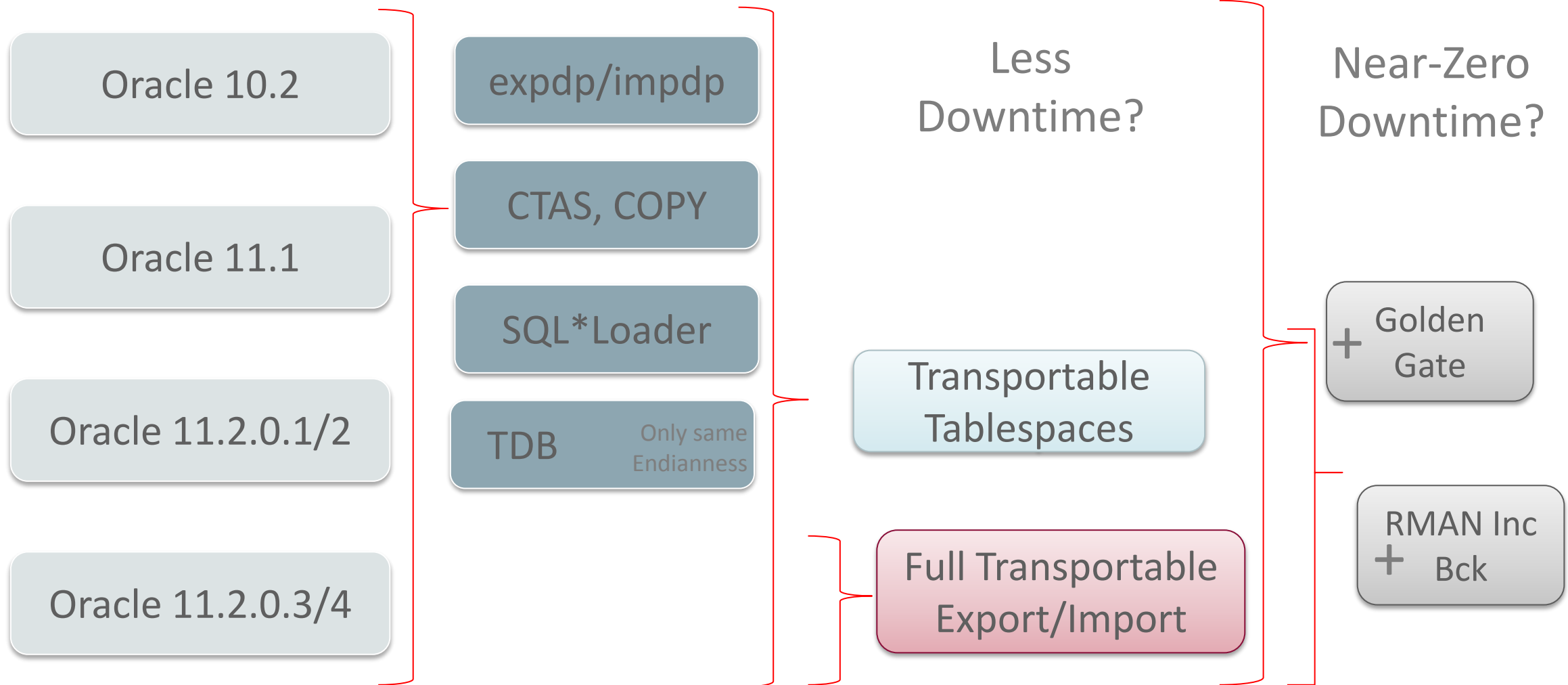
# Upgrade/Migrate **Older** Oracle Releases



# Upgrade Options to Oracle Database 12c



# Migration Options to Oracle Database 12c



# Upgrade/Migration Strategies?

## ▪ Step-by-Step Strategy

- In pieces over time
- Risk mitigating



## ▪ Least Critical First

- Learn more with every step



## ▪ Big-Bang Strategy

- All in one downtime window
- Sometimes necessary due to dependencies

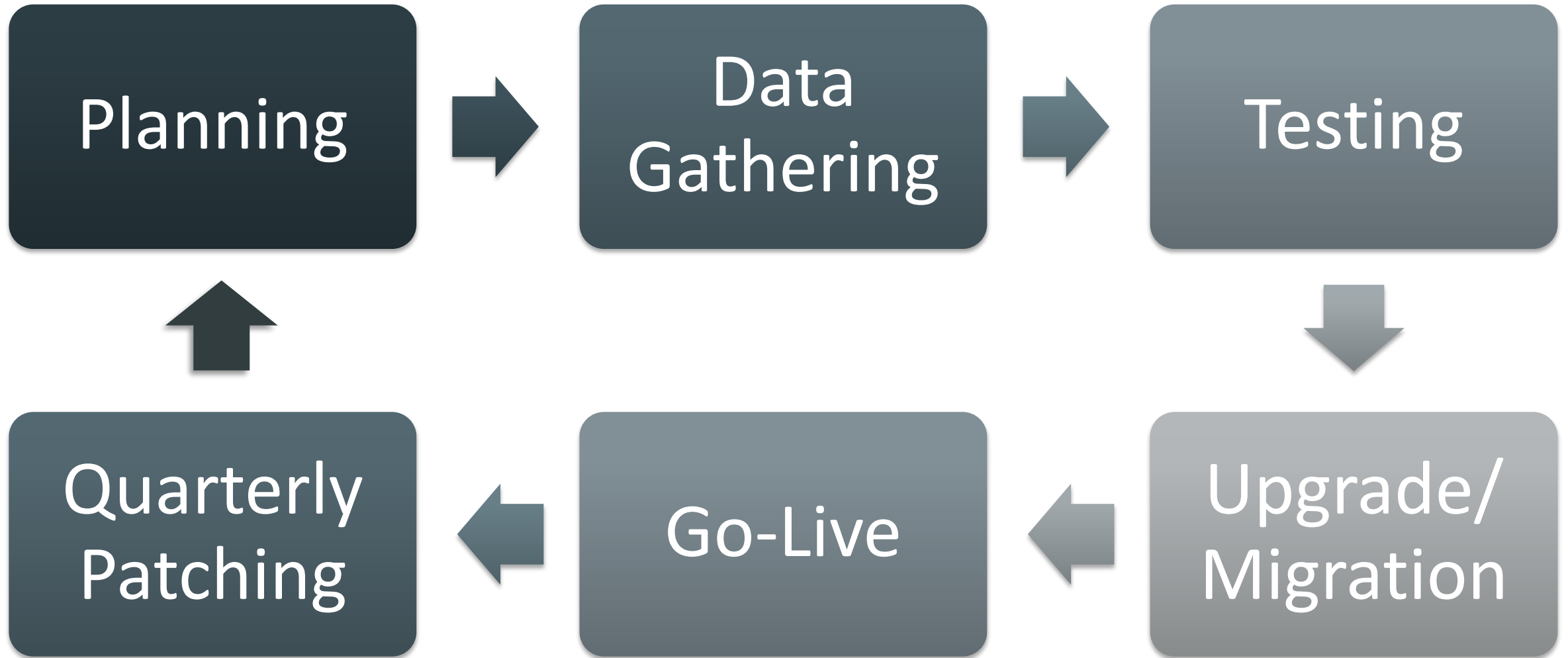


## ▪ Most Critical First

- Learn about almost all from the beginning

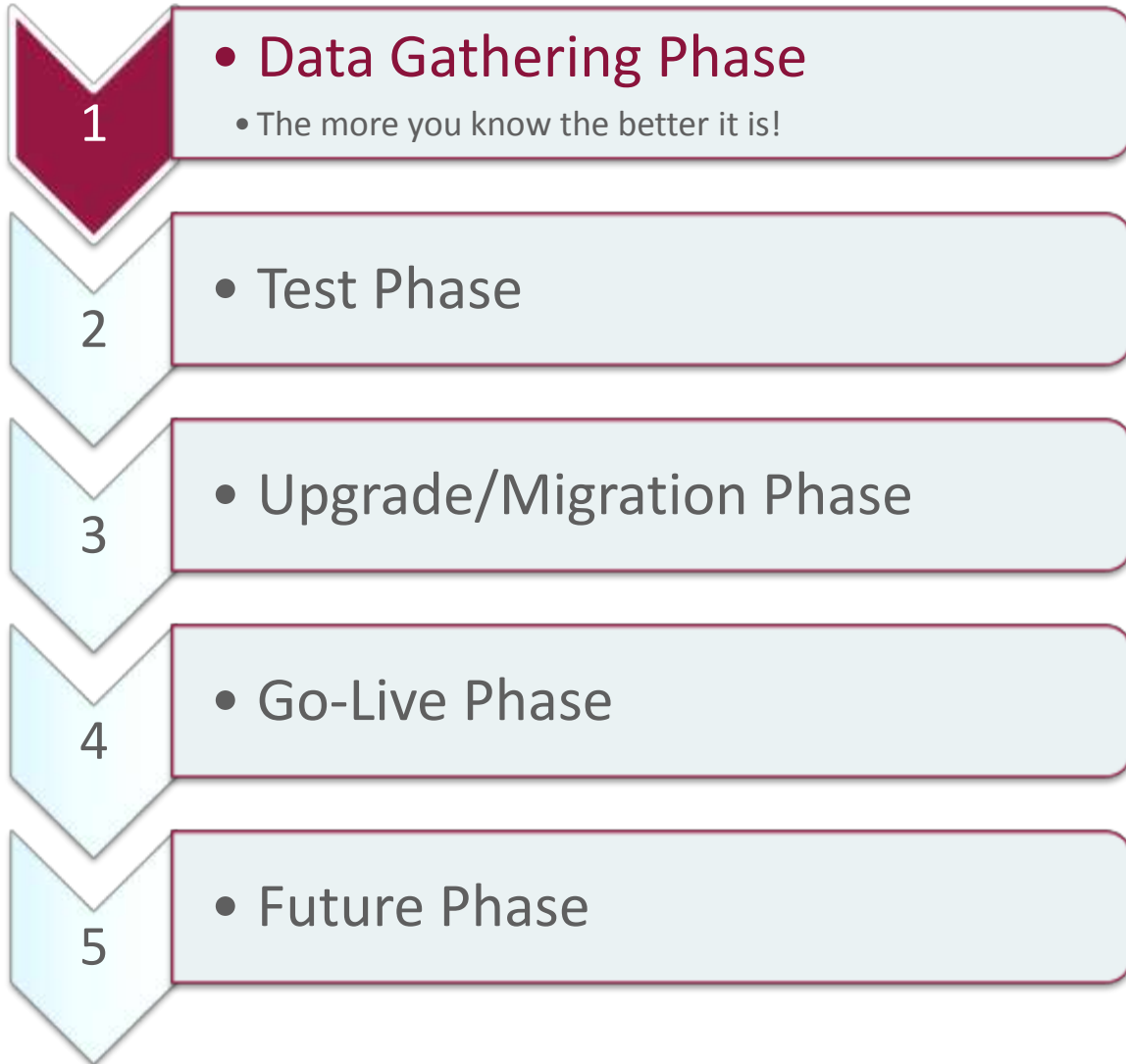


# Project Approach?



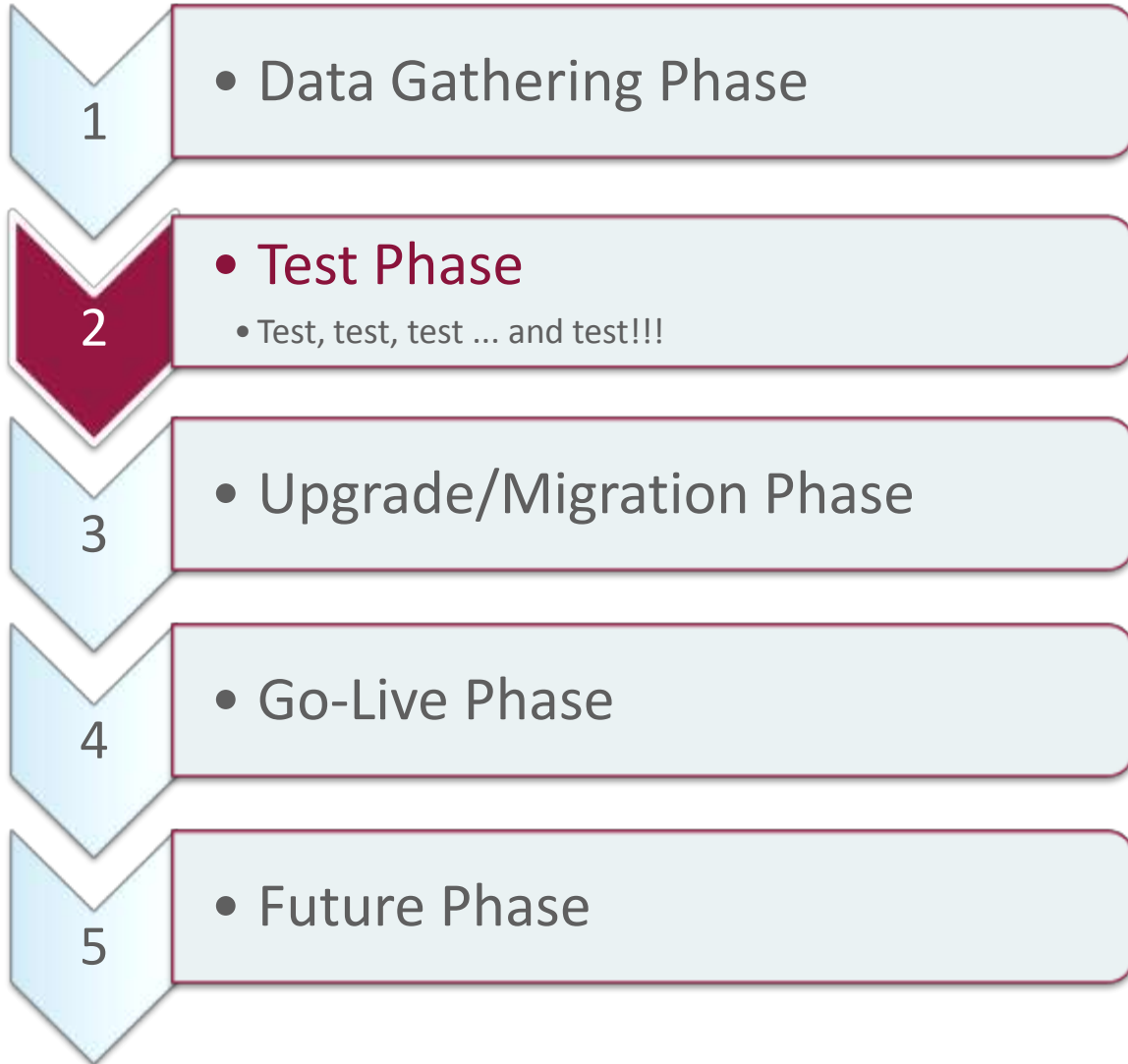


# Project Phases



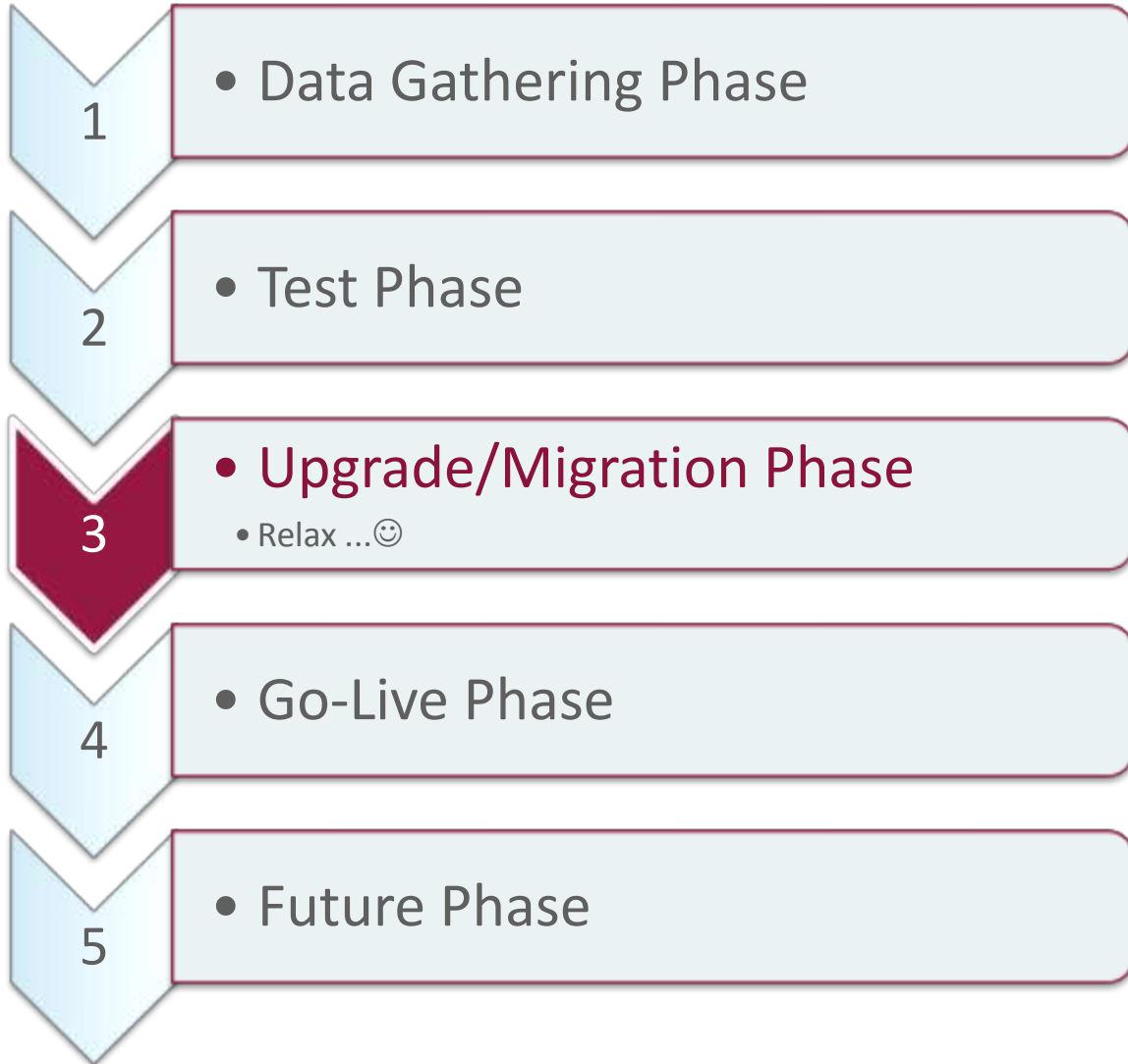
- Application:
  - Owner?
  - Version?
  - Dependencies?
  - Certification?
  - Timeframe?
  - Test budget?
- Database:
  - Owner?
  - Exact version and patches?
  - Size?
  - Downtime?
  - Dependencies?
  - Gateways?
  - Operating system version?

# Project Phases



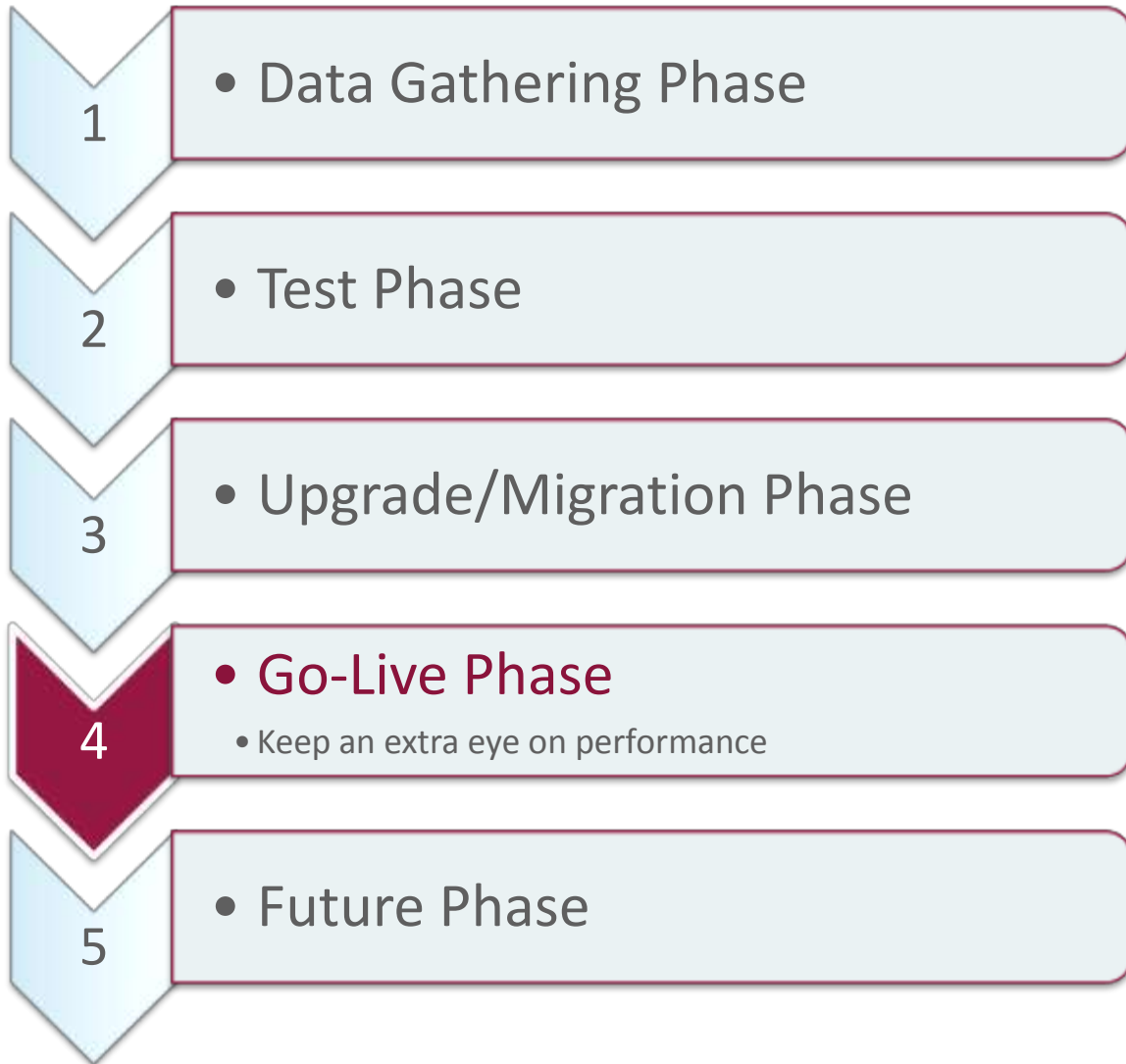
- 1:1 test systems?
- Documentation?
- Network bandwidth?
- Performance data from PROD?
- Testing tools: RAT?
- Batches, long-ops?
- Multiple successful test runs?
- Performance protection?
- Be open to late patches/PSUs!
- Fallback strategy tested?

# Project Phases



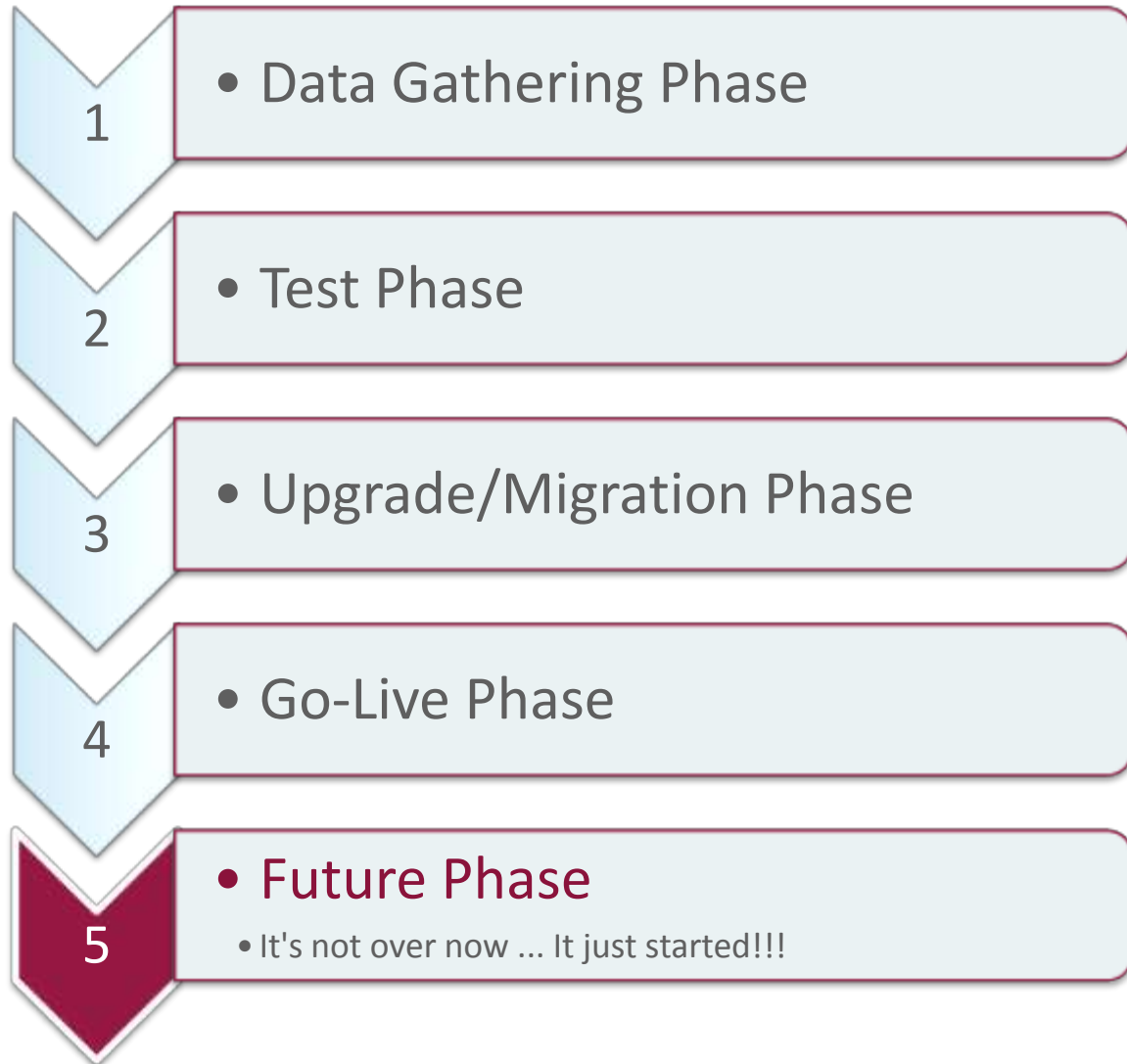
- Is everybody informed?
- Relax and lean back!
- Don't overtestosteronize!!

# Project Phases



- Monitor performance behaviour
- Any issues?
  - Use collected data from pre-upgrade to fix issues
  - Open an SR with Support

# Project Phases



- Don't lean back – it just started!
- Patching strategy?
  - Next available PSU?
  - Next available patch set?
  - When will be the next upgrade?
- Adopt useful new features
  - Many features come for free

# Upgrade, Migrate & Consolidate

- 1 Introduction
- 2 Preparation Steps
- 3 Upgrade / Migrate / Consolidate
- 4 Fallback Strategies
- 5 New Features
- 6 Performance Management
- 7 Wrap Up



Make sure everything is in **good shape ...**

So that you don't go off the rails!



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



```
purge DBA_RECYCLEBIN;
```

# 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
  - Recompile invalid objects **before** upgrade/migration



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



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

# Clean Up: Duplicate Objects

- Always check for **DUPLICATE** objects in SYS & SYSTEM



```
select OBJECT_NAME, OBJECT_TYPE
       from DBA_OBJECTS
       where (OBJECT_NAME,OBJECT_TYPE) in
             (select OBJECT_NAME, OBJECT_TYPE
              from DBA_OBJECTS where OWNER='SYS')
       and OWNER='SYSTEM'
       and OBJECT_NAME not in
       ('AQ$_SCHEDULES_PRIMARY',
        'AQ$_SCHEDULES','DBMS_REPCAT_AUTH');
```

- To clean up use script but **only under Oracle Support's** supervision



```
select 'DROP ' || object_type || ' SYSTEM.' || object_name || ';' from
DBA_OBJECTS
       where (OBJECT_NAME,OBJECT_TYPE) in
             (select OBJECT_NAME, OBJECT_TYPE
              from DBA_OBJECTS where OWNER='SYS')
       and OWNER='SYSTEM'
       and OBJECT_NAME not in
       ('AQ$_SCHEDULES_PRIMARY',
        'AQ$_SCHEDULES','DBMS_REPCAT_AUTH');
```

# 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/utlrbp.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: **Mandatory Components**

- General recommendation:
  - Standardize the set of installed database components throughout your environment
- XDB component is **mandatory** in Oracle Database 12c

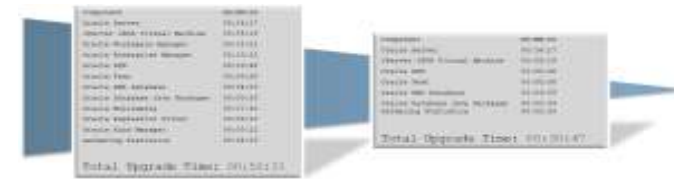
# Components: Removal

- Potential reasons to remove components:

- A component **does not exist anymore** in Oracle Database 12c



- **Speed up** the upgrade process



- A component **is obsolete**



- Further information on our [Blog](#):



<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));
```

    - *Please note: AWR usage requires a Diagnostic Pack license*
    - *Alternative: STATSPACK [MOS Note:466350.1](#) and [MOS Note1931103.1](#)*
  - [MOS Note:1477599.1](#) Best Practices Around Data Collection For Performance Issues




# 25%



of +Terabyte Migrations get delayed or fail because of insufficient network hardware, setup or bandwidth



# Performance: Network Bandwidth

Interface 	Net Data Volume	Theoretical Transfer Throughput	Real World Transfer Throughput
100 Mbit Ethernet	11 MB/sec	40 GB/hour	<30 GB/hour
1 Gbit Ethernet	110 MB/sec	400 GB/hour	<300 GB/hour
10 Gbit Ethernet	1100 MB/sec	4000 GB/hour	<3000 GB/hour
Infiniband IB 4xQDR	4000 MB/sec	14400 GB/hour	<11000 GB/hour

# Performance: Network Strategies

Issue	Solution
Amount of data not transferable?	<ul style="list-style-type: none"><li>▶ Move historical data upfront</li><li>▶ Use Data Guard or Turbo TTS</li></ul>
All transfer types single threaded?	▶ Parallel scp, ftp, NFS ...
Slow hardware?	▶ Parallel network cards, replacements
Different network segments?	▶ Replace old switches/router or check for alternative routes or direct wiring
External networks?	▶ Check upfront bandwidth over distance
Still not enough bandwidth?	▶ Sneakernet:  

# Optional: Integrity Checks

- Health Check (`hcheck.sql`)
  - Download `hcheck.sql` from [MOS Note:136697.1](#)
  - This script will check for known problems in Oracle8i, Oracle9i, Oracle10g and Oracle 11g
  - Requires hOut Helper Package (`hout.sql`) from [MOS Note:101468.1](#)
- RMAN Validation Check
  - `RMAN> backup check logical validate database;`
    - See [MOS Note:836658.1](#) for further details
    - Can be run in multiple parallel channels for faster performance
    - Can be run on selected data files or tablespaces only as well

# Preparation Checklist

- In the **TARGET** environment:

## Checks

- Software Certification Information
- Installation Requirements

## Download

- Software and Patch Sets
- CPUs, PSUs and Bundle Patches
- Single Patches

## Settings

- Parameter Recommendations

# Certification Check

- Verify platform certification in My Oracle Support

**ORACLE** MY ORACLE SUPPORT PowerView is Off

Switch to Cloud Support Roy (Available) (0) Contact Us Help

Knowledge Service Requests Patches & Updates Community **Certifications** Managed Cloud CRM On Demand Systems Collector More...

### Certifications

**Certification Quick Links**

- What's New for Certifications
- Watch a Video Tutorial
- Certification FAQs
- Product Delivery
- Professional Certification Exams
- Lifetime Support

**Getting Started with Certifications**

Search Cloud Save

Product: Oracle Database Release: 12.1.0.1.0 Platform: linux

Check certifications with another product

Tell us how you like the Certify Search! Give Feedback...

Clear Save

**Certification Search**

Search Saved Recent

Compare Releases and Platforms

\* Product: Oracle Database \* Release: 12.1.0.1.0 Platform: linux

Recent (4)

- Linux x86 Red Hat Enterprise Linux 6
- Linux x86-64 Oracle Linux 5
- Linux x86 Oracle Linux 5
- Linux x86-64 Red Hat Enterprise Linux 5

Platform Name (45)

- IBM: Linux on POWER Systems SLES 9
- IBM: Linux on POWER Systems SLES 11
- IBM: Linux on POWER Systems SLES 10

# Software Download

## Base Release (and Oracle 12.1.0.2)

Oracle Software Cloud:  
<http://edelivery.oracle.com/>



Oracle Tech Network:  
<http://otn.oracle.com/indexes/downloads/index.html>



## Patch Sets, PSUs, Patches

My Oracle Support:



# Oracle Database Standard Edition 12.1.0.2 SE2

## Oracle Database 12c - Availability

### (12.1.0.2.0) - Enterprise Edition

Microsoft Windows x64 (64-bit)	File 1, File 2 (2.5 GB)	See All
Linux x86-64	File 1, File 2 (2.5 GB)	See All
Oracle Solaris (SPARC systems, 64-bit)	File 1, File 2 (2.6 GB)	See All
Oracle Solaris (x86 systems, 64-bit)	File 1, File 2 (2.3 GB)	See All
HP-UX Itanium	File 1, File 2 (3.1 GB)	See All
AIX (PPC64)	File 1, File 2 (2.7 GB)	See All
zLinux64	File 1, File 2 (2.3 GB)	See All

### (12.1.0.2.0) - Standard Edition (SE2)

Microsoft Windows x64 (64-bit)	File 1, File 2 (2.6 GB)	
Linux x86-64	File 1, File 2 (2.5 GB)	
Oracle Solaris (SPARC systems, 64-bit)	File 1, File 2 (2.7 GB)	
Oracle Solaris (x86 systems, 64-bit)	File 1, File 2 (2.5 GB)	
HP-UX Itanium	File 1, File 2 (3.3 GB)	
AIX (PPC64)	File 1, File 2 (2.9 GB)	
zLinux64	File 1, File 2 (2.5 GB)	

## <http://tinyurl.com/12102SE2-download>

### Oracle Database 12.1.0.2 Standard Edition (SE2) available for download

By Mike Dietrich-Oracle on Sep 01, 2015

Finally ...

**Oracle Database 12.1.0.2 Standard Edition (SE2) is available for download.**

Some information is already available in the Oracle Database Licensing Information. And you'll find more here: <https://www.oracle.com/database/standard-edition-two/index.html>

Quoting from the pricing document:



<http://www.oracle.com/us/corporate/pricing/databaselicencing-070584.pdf>

"Oracle Database Standard Edition 2 may only be licensed on servers that have a maximum capacity of 2 sockets. When used with Oracle Real Application Clusters, Oracle Database Standard Edition 2 may only be licensed on a maximum of 2 one-socket servers. In addition, notwithstanding any provision in Your Oracle license agreement to the contrary, each Oracle Database Standard Edition 2 database may use a maximum of 16 CPU threads at any time. When used with Oracle Real Application Clusters, each Oracle Database Standard Edition 2 database may use a maximum of 8 CPU threads per instance at any time. The minimums when licensing by Named User Plus (NUP) metric are 10 NUP licenses per server."

# Installation of the new Software

Patch Set /  
Base Release

- Install newest **PATCH SET** or base release  
*(Every patch set is a full release since Oracle Database 11.2)*

PSU / BP

- Apply newest available **Patch Set Update (PSU)** or **Bundled Patch (BP)**

Patches

- Apply **Interim Patches** for known issues

Upgrade

- Now:** Start the database upgrade/migration!!!



# Overview of Database Patch Delivery Methods

- [MOS Note: 1962125.1](#)
  - Including **testing recommendations**



might be visualized like this:

- SPU contains only the CPU program security fixes
- PSU contains the CPU program security fixes and additional high-impact/low-risk critical bug fixes
- BP includes all PSU fixes along with fixes targetted at the specific BP environment

An installation can only use **one** of the SPU, PSU or BP patching methods.

★ Oracle Database - Overview of Database Patch Delivery Methods (Doc ID 1962125.1)

**In this Document**

- [Purpose](#)
- [Scope](#)
- [Details](#)
  - [Post Release Patch Delivery Methods](#)
  - [Types of Proactive Patch \(SPU / PSU / Bundle Patches\)](#)
  - [Version Numbers](#)
  - [Testing Overview](#)
    - [Testing Recommendation by Patch Type](#)
    - [Which Patching Method to Use?](#)
  - [Altering the Patching Method](#)
  - [Patch Conflict Resolution](#)
  - [Frequently Asked Questions \(FAQ\)](#)
  - [Current Database Pro-active Patches](#)
    - [Pro-active Database Patches by Platform / Environment / Version](#)
    - [More Information on Pro-Active Database Patches](#)

# Testing Recommendations by Patch Type

- [MOS Note: 1962125.1](#)

	Interim Patch	PSU, SPU	Bundle Patch	Patch Set Release
Install / Rollback	Yes	Yes	Yes	Yes
Bug Fix Verification	Where possible and relevant			
Admin Activities	Not required	Basic	Basic	Full
Application Function	Not required	Core applications only	Core and non-core applications	Full
Application Performance	Not required	Not required	Not required	Full

# Example: Patch Set 12.1.0.2

- Download patch set 12.1.0.2 from <http://support.oracle.com>

**ORACLE MY ORACLE SUPPORT** PowerView is Off

Switch to Cloud Support Mike (Available) (0) Contact Us Help

Dashboard Knowledge Service Requests **Patches & Updates** Community Certifications Managed Cloud CRM On Demand More...

**Patches and Updates** Give Feedback... Customize Page...

**Patching Quick Links**

What are Recommended Patches?

**Software and Patch Search Sites**

- Oracle Software Delivery Cloud
- Critical Patch Updates and Security Alerts
- Sun Products
- JD Edwards

**Oracle E-Business Suite**

How to Find E-Business Suite & Technology Patches

**Oracle Server and Tools**

Latest Patchsets

All Quick Links open in a new window

**Patch Search**

Search Saved Searches Recent Searches

Number/Name or Bug Number (Simple)

Product is \* Oracle Database - Enterprise

and Release is \* Oracle 12.1.0.2.0

and Platform is

and

Recommended Patch Advisor

JD Edwards Patches Clear Save

Include all products in a family

- Oracle 12.1.0.1.5 for Windows
- Oracle 12.1.0.1.6 for Windows
- Oracle 12.1.0.1.7 for Windows
- Oracle 12.1.0.1.8 for Windows
- Oracle 12.1.0.1.9 for Windows
- Oracle 12.1.0.2.0
- Oracle 7.3.4.0
- Oracle 7.3.4.5
- Oracle 8.0.4.0
- Oracle 8.0.5.2

Search

Patch ID	Description	Release	Updated	Size	Info	Search
<a href="#">21419221</a>	<b>Oracle Database Family: Patchset</b> 12.1.0.2.0 PATCH SET FOR ORACLE DATABASE SERVER	12.1.0.2.0	01-SEP-2015	9.9G	Info	Search
<a href="#">17694377</a>	<b>Oracle Database Family: Patchset</b> 12.1.0.2.0 PATCH SET FOR ORACLE DATABASE SERVER	12.1.0.2.0	01-SEP-2015	7.4G	Info	Search

Total: 2

# Patch Set Installation 11.2.0.4 / 12.1.0.2

- Default: **Out-of-place** patch upgrade!!! It's a full release!!!
  - If you specify an in-place patch upgrade:



# In-place Patch Set Installation 11.2.0.4 / 12.1.0.2

- Only way to do an **in-place** patch set installation

- Example

- Backup your `/dbs` and `/network/admin` files
- `./runInstaller -detachHome ORACLE_HOME=<old-home>`

```
$ ./runInstaller -detachHome ORACLE_HOME=/u01/orahomes/11.2.0
Starting Oracle Universal Installer...

Checking swap space: must be greater than 500 MB.   Actual 10047 MB   Passed
The inventory pointer is located at /etc/oraInst.loc
The inventory is located at /u01/orabase
'DetachHome' was successful.
```

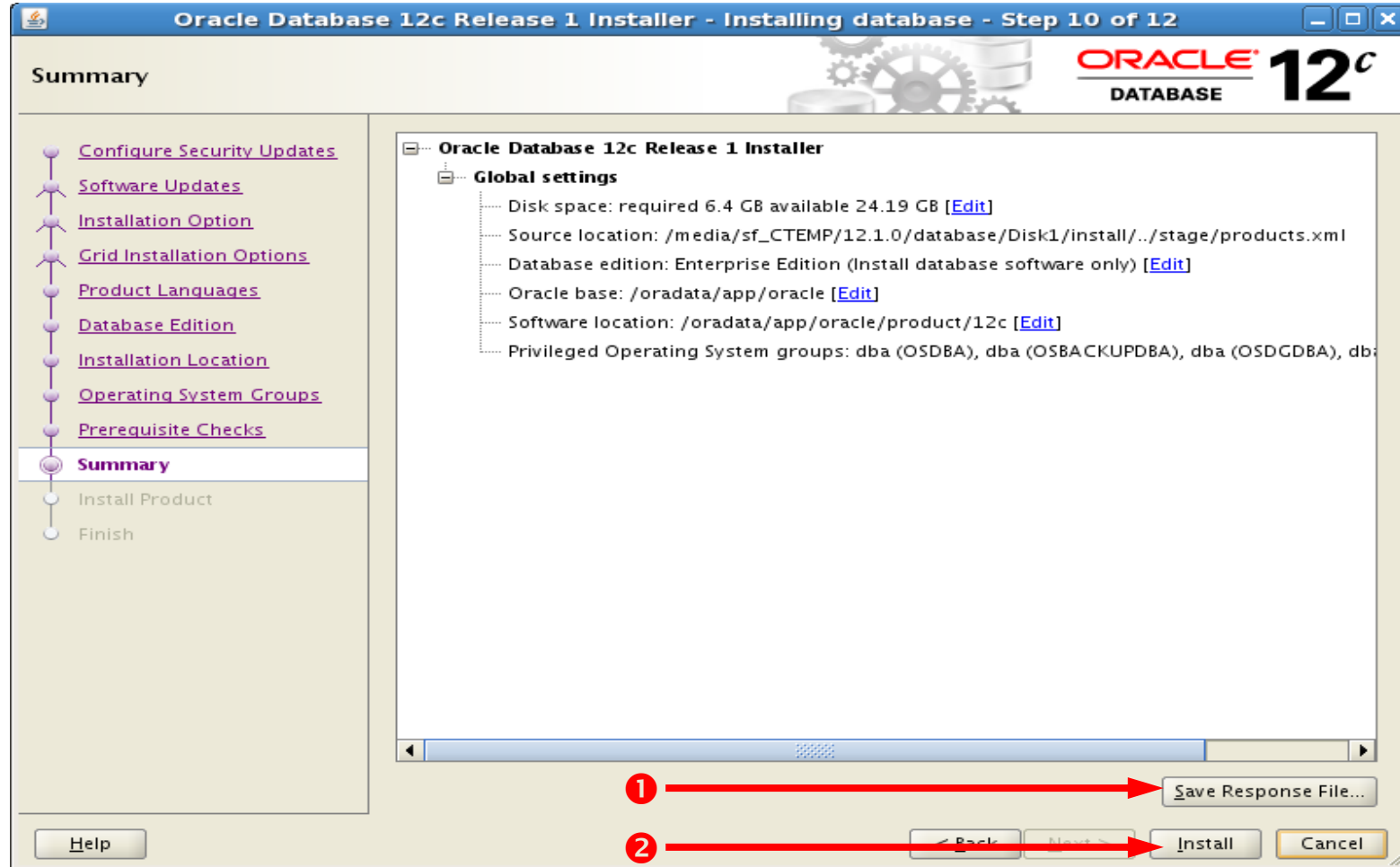
- Remove your previous-home contents
- Install 11.2.0.4/12.1.0.2 into the previous home
- Restore `/dbs` and `/network/admin` files
- Upgrade your database with DBUA or `catupgrd.sql/catctl.pl`

# Unattended Installation/Configuration

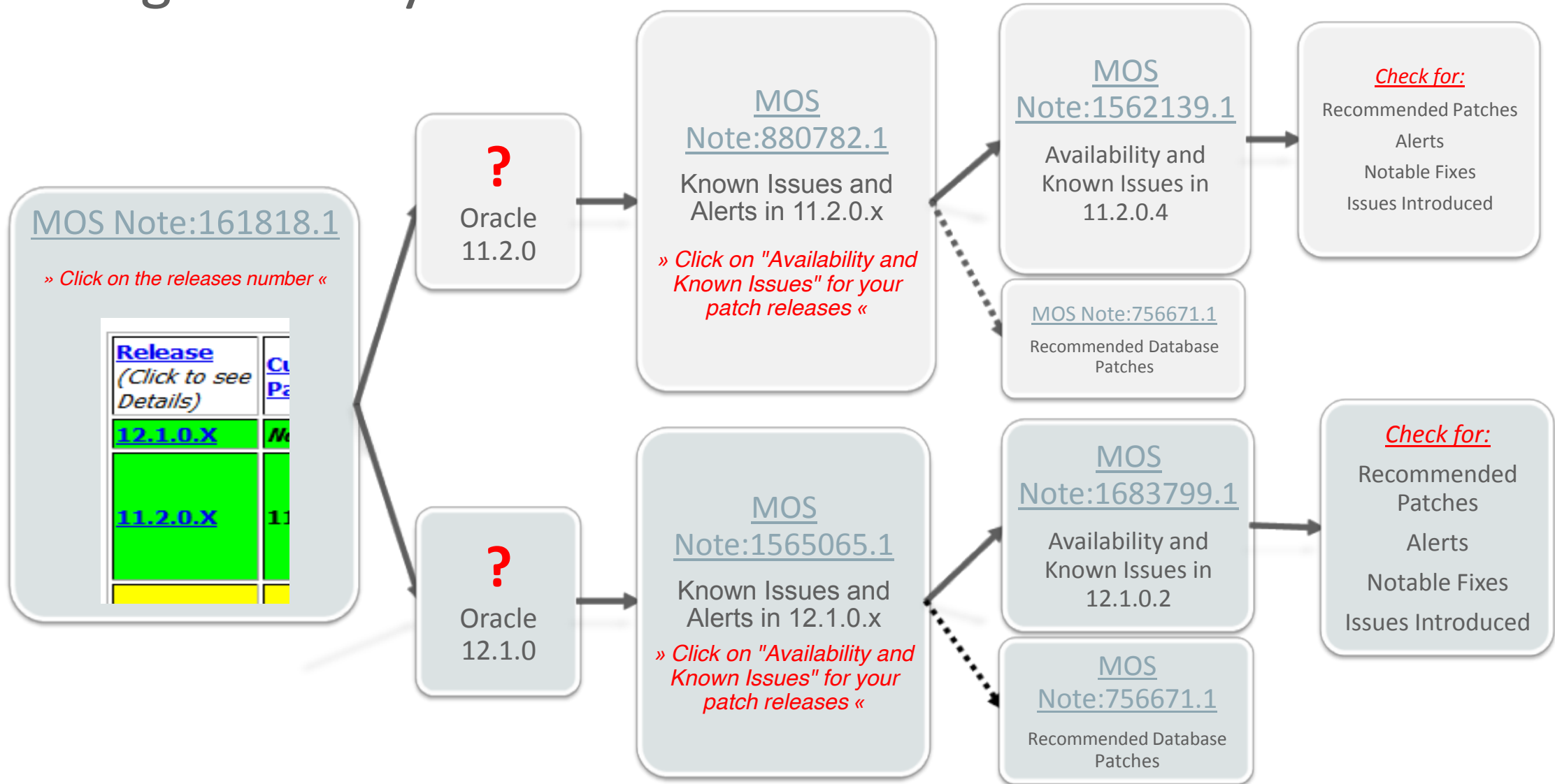
- Oracle 11.2 – see [MOS Note:885643.1](#)
  - SAVE RESPONSEFILE option in OUI available
  - Or: Start OUI “silent” with all required parameters
    - Will work on Windows platform as well
- Home Cloning (script or Lifecycle Management Pack)
  - Prepare a fully patched Oracle Home
  - Create an archive consisting of all files
    - Exclude \*log, \*dbf, tnsnames/listener/sqlnet.ora
  - Unpack archive and then \$ORACLE\_HOME/clone/bin/clone.pl...
    - See your installation guide for more information on cloning an \$OH
- For further information (also OS related) see the Oracle Database Server Installation [Master Note:1156586.1](#)

# Unattended Installation/Configuration

## ■ Oracle Database 12c:



# Patching Notes by Release





# Important Alerts and One-Off-Patches?

- Check for important alerts: [MOS Note:161818.1](#)

## Oracle Database Releases Status Summary

<a href="#">Release</a> <i>(Click for Details)</i>	<a href="#">Current Patch Set</a> <i>(Click for Availability and Known Issues)</i>	<a href="#">Next Patch Set</a>	<a href="#">Premier Support Ends</a>	<a href="#">Extended Support Ends</a>	Notes
<a href="#">12.1.0.X</a>	<a href="#">12.1.0.2</a>	None	-	-	Base release is 12.1.0.1 . 12.1.0.2 is the <a href="#">terminal</a> 12.1 Patch Set and only available for Enterprise Edition and Standard Edition 2 - see <a href="#">Note:2027072.1</a>
<a href="#">11.2.0.X</a>	<a href="#">11.2.0.4</a>	None	Jan-2015	<b>Dec-2020</b> Extended Support fees are waived from Jan-2015 to 31-May-2017 See <a href="#">Note:1067455.1</a>  Patching for 11.2.0.1 ended on 13/Sep/2011 Patching for 11.2.0.2 ended on 31/Oct/2013 Patching for 11.2.0.3 ended on 27/Aug/2015 - See <a href="#">Note:742060.1</a>	Base release is 11.2.0.1. 11.2.0.4 is the <a href="#">terminal</a> 11.2 Patch Set 11.2 Patch Sets are full releases - see <a href="#">Note:1189783.1</a>
<a href="#">11.1.0.X</a>	<a href="#">11.1.0.7</a>	None	Aug-2012	<b>Aug-2015</b> Patching for 11.1.0.7 ended on 31/Aug/2015 for most platforms. <a href="#">Limited Extended Support</a> available for HPUX-Itanium - see <a href="#">Note:1307745.1</a>	Base release is 11.1.0.6 . 11.1.0.7 is the <a href="#">terminal</a> 11.1 Patch Set



# Upgrade Information / Alerts

- Known issues in 12.1.0.x? See [MOS Note:1565065.1](#)

Release	Comments
	Oracle 12c Release 1 (12.1.0.2)
12.1.0.2	Availability and Known issues for 12.1.0.2 <a href="#">Note:1683799.1</a> List of fixes included in 12.1.0.2 <a href="#">Note:1683802.1</a>
	Oracle 12c Release 1 Base Release.
12.1.0.1	Availability and Known issues for 12.1.0.1 <a href="#">Note:1565082.1</a>



# Upgrade Information / Alerts

- **Recommended Database Patches?** See also: [MOS Note:756671.1](#)

## Oracle Engineered Systems

Document	Description	Rolling RAC	Patch Download
<a href="#">Note:888828.1</a>	Recommended Patch Information for Exadata Database Machine and Exadata Storage Server	-	-
<a href="#">Note:22899531.8</a>	12.1.0.2.160419 Bundle Patch for Engineered Systems and DB In-Memory (Apr 2016)	Yes	<a href="#">Patch:22899531</a>
<a href="#">Note:22738657.8</a>	Combo of 12.1.0.2.160419 OJVM PSU and 12.1.0.2.160419 DBBP (Apr 2016)	Part	<a href="#">Patch:22738657</a>

## Database In-Memory (DBIM)

Document	Description	Rolling RAC	Patch Download
<a href="#">Note:22899531.8</a>	12.1.0.2.160419 Bundle Patch for Engineered Systems and DB In-Memory (Apr 2016)	Yes	<a href="#">Patch:22899531</a>
<a href="#">Note:22738657.8</a>	Combo of 12.1.0.2.160419 OJVM PSU and 12.1.0.2.160419 DBBP (Apr 2016)	Part	<a href="#">Patch:22738657</a>

## Patch Set Updates

Document	Description	Rolling RAC	Patch Download
<a href="#">Note:22738582.8</a>	Combo of 12.1.0.2.160419 OJVM PSU and 12.1.0.2.160419 DB PSU (Apr 2016)	Part	<a href="#">Patch:22738582</a>
<a href="#">Note:22674709.8</a>	Oracle JVM Component 12.1.0.2.160419 Database PSU (Apr 2016) (OJVM PSU)	No	<a href="#">Patch:22674709</a>
<a href="#">Note:22291127.8</a>	12.1.0.2.160419 (Apr 2016) Database Patch Set Update (DB PSU)	Yes	<a href="#">Patch:22291127</a>

## Grid Infrastructure

Document	Description	Rolling RAC	Patch Download
<a href="#">Note:22738641.8</a>	Combo of 12.1.0.2.160419 OJVM PSU and 12.1.0.2.160419 GI PSU (Apr 2016)	Part	<a href="#">Patch:22738641</a>
<a href="#">Note:22646084.8</a>	12.1.0.2.160419 (Apr 2016) Grid Infrastructure Patch Set Update (GI PSU)	Yes	<a href="#">Patch:22646084</a>

# Recommended Patches: **PSUs**

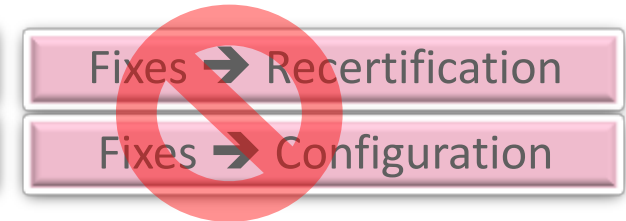
- **Always** install the **latest PSU** as soon as possible

- Most important Notes:



[Note:854428.1](#): Introduction to Database PSU  
[Note:1227443.1](#): PSU Known Issues

- PSU contents:



- PSU characteristics:



- PSU schedule – **4x/year**:



20-OCT-2015 / 19-Jan-2016 / 19-Apr-2016 / 19-Jul-2016

# Recommended Patches: **PSUs**

**NEW**  
MEM

- Check for installed PSUs and patches

- PSU check: `opatch lsinventory -bugs_fixed | grep -i 'DATABASE PSU'`

- Since Oracle Database 12c

- **DBMS\_QOPATCH**



- Find more info:

- <http://tinyurl.com/QOPatch>

## Summary of DBMS\_QOPATCH Subprograms

Table 116-2 DBMS\_QOPATCH Package Subprograms

Subprogram	Description
<a href="#">GET_OPATCH_BUGS Function</a>	Provides a bugs list for a patch in XML format if the patch number is given. If patch is not given then it lists all the bugs installed in all the patches in XML format.
<a href="#">GET_OPATCH_COUNT Function</a>	Provides the total number of installed patches in XML format
<a href="#">GET_OPATCH_DATA Function</a>	Provides top level patch information for the patch (such as Patch ID, patch creation time) in the XML element
<a href="#">GET_OPATCH_FILES Function</a>	Provides the list of files modified in the given patch number in XML format
<a href="#">GET_OPATCH_INSTALL_INFO Function</a>	Returns the XML element containing the ORACLE_HOME details such as patch and inventory location
<a href="#">GET_OPATCH_LIST Function</a>	Provides list of patches installed as an XML element from the XML inventory
<a href="#">GET_OPATCH_LSINVENTORY</a>	Returns whole opatch inventory as XML instance document.
<a href="#">GET_OPATCH_OLAYS Function</a>	Provides overlay patches for a given patch as XML element
<a href="#">GET_OPATCH_PREQS Function</a>	Provides prerequisite patches for a given patch as XML element
<a href="#">GET_OPATCH_XSLT</a>	Returns the style-sheet for the opatch XML inventory presentation
<a href="#">GET_PENDING_ACTIVITY Function</a>	Returns the information related to SQL patches applied on a single instance by querying the binary inventory
<a href="#">GET_SQLPATCH_STATUS Procedure</a>	Displays the SQL patch status by querying from SQL patch registry to produce complete patch level information
<a href="#">IS_PATCH_INSTALLED Function</a>	Provides information (such as patchID, application date, and SQL patch information) on the installed patch as XML node by querying the XML inventory
<a href="#">PATCH_CONFLICT_DETECTION Function</a>	Returns the conflicting patch for a given file, if it conflicts with an existing patch
<a href="#">SET_CURRENT_OPINST Procedure</a>	Sets the node name and instance to get the inventory details specific to it in an Oracle Real Application Clusters (RAC) environment

# Examples using DBMS\_QOPATCH

- Check the inventory:

```
SQL> select xmltransform(DBMS_QOPATCH.GET_OPATCH_LSINVENTORY,  
DBMS_QOPATCH.GET_OPATCH_XSLT) from dual;
```

- Check if a specific patch got installed:

```
SQL> select xmltransform(DBMS_QOPATCH.IS_PATCH_INSTALLED('19303936 '),  
DBMS_QOPATCH.GET_OPATCH_XSLT) from dual;
```

```
Patch Information:  
19303936: applied on 2015-02-20T11:32:11-09:00
```

- Get patch details:

```
SQL> select xmltransform(DBMS_QOPATCH.GET_OPATCH_LIST,  
DBMS_QOPATCH.GET_OPATCH_XSLT) from dual;
```

```
Patch details: ...
```

# Upgrade Information / Alerts

- Alerts and new issues with 12.1.0.2? [MOS Note:1683799.1](#)

## General Alerts / Issues

Bug/Doc	Fixed in PSU/Bundle	Description	Updated
<a href="#">Note 1608167.1*</a>		ORA-600 [kdsgrp1] ORA-1555 / ORA-600 [ktbdchk1: bad dscn] due to Invalid Commit SCN in INDEX block	17/Apr/2016
<a href="#">20144308+</a>		ORA-27086 or ORA-1182 RMAN May Overwrite a SOURCE Database File during TTS, TSPITR, etc when OMF is used in SOURCE. ORA-1578 ORA-1122 in SOURCE afterwards	02/Nov/2015
<a href="#">20369110</a>		ORA-600[9999] / Cannot enable more than 8 kernel options (such as uniaud , olap, lbac etc..)	14/Jul/2015
<a href="#">20881450+</a>	12.1.0.2.DBBP:160119	Wrong results or Assorted dumps and errors querying HCC tables with OLTP blocks	06/Apr/2016
<a href="#">Note 1944645.1*</a>	12.1.0.2.3	ORA-600 [kdblckcheckerror]..[6266] corruption with self-referenced chained row. ORA-600 [kdsgrp1] / Wrong Results / ORA-8102	01/Mar/2016
<a href="#">Note:1957710.1*P</a>	12.1.0.2.160419	12c Hang: LGWR waiting for 'lgwr any worker group' or ORA-600 [kcrfrgv_nextlwn_scn] ORA-600 [krr_process_read_error_2] on IBM AIX / HPIA	18/Apr/2016

## Upgrade Issues

Bug/Doc	Fixed in PSU/Bundle	Description	Updated
<a href="#">Note:2058461.1*</a>		Corruption during Recovery after upgrading to 12c for Compressed Tables - Superseded	06/Apr/2016
<a href="#">20540751</a>		Auto task SQL tuning advisor enabled but not running after upgrade to 12.1.0.2	17/Apr/2016
<a href="#">19787643P</a>		Windows: SQLLDR.EXE - SQL Loader fails to start - oranfsodm12.dll is missing	17/Dec/2015
<a href="#">19664340+</a>	12.1.0.2.DBBP02	ORA-20000 "unable to gather statistics concurrently" during upgrade to 12.1	14/Jul/2015
<a href="#">19536415</a>	12.1.0.2.3	DB upgrade to 12.1 fails with ORA-600 [kkaegso: PUBLIC]	17/Dec/2015
<a href="#">19291380</a>	12.1.0.2.3	ORA-38802/ORA-38803/ORA-38804 from CREATE EDITION or SET EDITION during upgrade	17/Dec/2015
<a href="#">19141838</a>	12.1.0.2.160119	ORA-600 [qksanGetTextStr:1] from SQL Plan Management after Upgrade to 12.1	18/Jan/2016

# Upgrade Information / Alerts

- Alerts and **new issues** with 12.1.0.2? [MOS Note:1683799.1](#)

## **Notable fixes included in 12.1.0.2**

This section lists fixes / enhancements in 12.1.0.2 which may cause a notable change in behaviour.

<a href="#">Note:1927261.1C</a>	OPPS\$ users identified with a password (OS_AUTHENT_PREFIX) can connect using OS authentication - correctly raise ORA-1017 in 12.1.0.2 onwards
<a href="#">14675058C</a>	A package procedure with zero arguments should not have a row in ALL_ARGUMENTS

## **Issues introduced in 12.1.0.2**

This section lists bugs **introduced** in 12.1.0.2 (if any). Such issues may be either serious or trivial but the aim is to list them all to help customers assess the risk of applying the Patch Set on top of 12.1.0.1

Bug/Doc	Description	Updated
<a href="#">Note:2058461.1*</a>	Corruption during Recovery after upgrading to 12c for Compressed Tables - Superseded	06/Apr/2016
<a href="#">22474054</a>	ORA-600 [504] ... [gcs resource hash] from LMS during remastering crashing the instance	18/Apr/2016
<a href="#">22022760</a>	SMON may exhibit High CPU Utilization in ADG standby instance	15/Mar/2016
<a href="#">21971099</a>	12c wrong cardinality from SQL analytic windows functions	28/Mar/2016
<a href="#">21826068</a>	Wrong Results when _optimizer_aggr_groupby_elim=true	18/Apr/2016
<a href="#">21482099</a>	ORA-7445 [opitca] or ORA-932 errors from aggregate GROUP BY elimination - superseded	28/Feb/2016
<a href="#">21030693</a>	ORA-600 [qerpxMObjVI6] from parallel query on partitioned table	14/Jul/2015
<a href="#">20634449</a>	Wrong results from OUTER JOIN with a bind variable and a GROUP BY clause in 12.1.0.2	18/Jan/2016
<a href="#">20632205</a>	Excessive PGA memory allocation / slow parse for Query REWRITE with an MV	18/Apr/2016
<a href="#">20540751I</a>	Auto task SQL tuning advisor enabled but not running after ungrade to 12.1.0.2	17/Apr/2016



# Upgrade Information / Alerts

- Alerts and **new issues** with 11.2.0.4? [MOS Note:1562139.1](https://mos.cis.oracle.com/1562139.1)

## Issues introduced in 11.2.0.4

This section lists bugs **introduced** in 11.2.0.4 (if any). Such issues may be either serious or trivial but the aim is to list them all to help customers assess the risk of applying the Patch Set on top of 11.2.0.3

Bug/Doc	Fixed in PSU/Bundle	Description	Updated
<a href="#">18973907</a>		Memory corruption / various ORA-600/ORA-7445 using database links between 11.2.0.4/12.1.0.1 and earlier versions	04/Jul/2014
<a href="#">18723434</a>		DBA_TABLESPACE_USAGE_METRICS.tablespace_size can be incorrect for ASM tablespaces after applying 11.2.0.4	23/May/2014
<a href="#">18665660</a>		High child cursor counts due to OPTIMIZER_MISMATCH with Optimizer_features_enable=9.2.0	27/Jun/2014
<a href="#">18644187</a>		Correlated set subquery not unnested with fix for 16765564	02/May/2014
<a href="#">18559920</a>		Wrong results from XMLtype virtual column	17/Jun/2014
<a href="#">18458318</a>		Low quality font image file created using stored Java after upgrade to 11.2.0.4	23/Apr/2014
<a href="#">18456514</a>		ORA-12705 in Logical Standby database after upgrade to 11.2.0.4	28/May/2014
<a href="#">18455956</a>		RMAN "restore primary controlfile" doesn't convert role of controlfile	23/May/2014
<a href="#">18421653</a>		Suboptimal XQuery performance (Unoptimized XML construct detected)	17/Jun/2014
<a href="#">18353141</a>		Wrong result from analytical query with NLS_SORT set	17/Jun/2014
<a href="#">18315328</a>	<a href="#">18418934</a>	11.2.0.4.BP09 ORA-600 [kkqjdpvdpd: no join pred found.] from JPPD with window functions	14/Jul/2014
<a href="#">18166577</a>	<a href="#">18384391</a>	11.2.0.4.BP09 ORA-600 errors possible with fix for bug 16402712 present	14/Jul/2014
<a href="#">18141472</a>	<a href="#">18325460</a>	11.2.0.4.BP09 EXEMPT ACCESS POLICY not working correctly in RAC	15/Jul/2014
<a href="#">18115594</a>	<a href="#">18230522</a>	11.2.0.4.BP09 ORA-7445 [kkpamCheckTransJoin] from full partition-wise join on REFERENCE partitioned object	14/Jul/2014
<a href="#">18045331</a>	<a href="#">17501296</a>	11.2.0.4.BP09 ORA-604 / PLS-306 attempting to delete rows from table with Text index after upgrade to 11.2.0.4	14/Jul/2014
<a href="#">17956707</a>	<a href="#">18160822</a>	11.2.0.4.BP06 ORA-4030 after upgrade to 11.2.0.4 - superseded	14/Apr/2014
<a href="#">17897511</a>	<a href="#">18018515</a>	11.2.0.4.3 High CPU in qctHasFakeBind (can cause 'cursor: pin S wait on X' waits)	15/Jul/2014
	<a href="#">17397545</a>	11.2.0.4.3 ORA-600 [kdtigetrow-2] from MERGE statement with LOG ERRORS INTO	15/Jul/2014
	<a href="#">17614227</a>	11.2.0.4.3 Evadata ASM rebalance takes a long time after flash failure (roll-reboot)	15/Jul/2014

# Important **Optimizer** Issues and Fixes

- Things to consider before upgrade to Oracle Database 12.1.0.2 to **avoid Poor Performance** or **Wrong Results**: [MOS Note:2034610.1](#)

No PSU	PSU 1	2	3	4	5	160119	160419	Bugs Fixed
Patch 19855835 for 12.1.0.2.0							160419	Document 19855835.8 Upgrade slow when reorganizing large stats history tables <b>NB: Only applicable for upgrades from 11.2.0.3 or below. Apply before running the 12.1.0.2 upgrade script. There is no benefit to applying it later on.</b>
Patch 20879889 for 12.1.0.2.0								Included in PSU 160419 and above
Patch 21800251 for 12.1.0.2.0					Included in PSU 5 and above		Patch 20807398 for 12.1.0.2.160419	Document 20476175.8 High VERSION_COUNT (in V\$SQLAREA) for query with OPT_PARAM('_fix_control') hint
					Patch 20807398 for 12.1.0.2.5			Document 20807398.8 ORA-600 [kgl-hash-collision] with fix to bug 20465582 installed
Patch 21091518 for 12.1.0.2.0								
Patch 13542050 for 12.1.0.2.0	Request Patch 13542050 for 12.1.0.2.1	Request Patch 13542050 for 12.1.0.2.2	Patch 13542050 for 12.1.0.2.3	Patch 13542050 for 12.1.0.2.4		Included in PSU 160419 and above		Document 13542050.8 A mutex related hang with holder around 65534 (0xffff)
Patch 18430870 for 12.1.0.2.0								
Patch 18650065 for 12.1.0.2.0							Patch 18650065 for 12.1.0.2.160419	Document 18650065.8 Wrong Results on Query with Subquery Using OR EXISTS or Null Accepting Semijoin
Patch 19174639 for 12.1.0.2.0								
Patch 21171382 for 12.1.0.2.0								
Document 21171382.8 Enh: AUTO_STAT_EXTENSIONS preference on DBMS_STATS								

- Things to consider before upgrade to Oracle Database 11.2.0.4 to **avoid Poor Performance** or **Wrong Results**: [MOS Note:1645862.1](#)



# Important SQL Plan Management Issues and Fixes

- Patches to Consider for 12.1.0.2 to **Avoid Problems** with **SQL Plan Management** (SPM): [MOS Note:2035898.1](#)

No PSU	PSU 1	2	3	4	5	160119	160419	Bugs Fixed
<a href="#">Patch 18747342</a> for 12.1.0.2.0						<a href="#">Patch 18747342</a> for 12.1.0.2.160119		<a href="#">Document 18747342.8</a> Plan reproduction fails for SQL statement with a [NOT] EXISTS select list subquery
<a href="#">Patch 18961555</a> for 12.1.0.2.0								<a href="#">Document 18961555.8</a> Static PL/SQL baseline reproduction broken by fix for bug 18020394
<a href="#">Patch 19141838</a> for 12.1.0.2.0						<i>Included in PSU 160119 and above</i>		<a href="#">Document 19141838.8</a> ORA-600 [qksanGetTextStr:1] from SQL Plan Management after Upgrade to 12.1
<a href="#">Patch 20476175</a> for 12.1.0.2.0						<i>Included in PSU 5 and above</i>		<a href="#">Document 20476175.8</a> High VERSION_COUNT (in V\$SQLAREA) for query with OPT_PARAM('_fix_control') hint
<a href="#">Patch 21075138</a> for 12.1.0.2.0				<a href="#">Patch 21075138</a> for 12.1.0.2.3				<a href="#">Document 21075138.8</a> SPM does not reproduce plan with SORT UNIQUE
<a href="#">Patch 21463894</a> for 12.1.0.2.0								<a href="#">Document 21463894.8</a> Failure to reproduce plan with fix for bug 20978266 (supersedes <a href="#">Document 20978266.8</a> SQL not using plan in plan baselines and plans showing as not reproducible)
<a href="#">Patch 20877664</a> for 12.1.0.2.0						<i>Included in PSU 160119 and above</i>		<a href="#">Document 20877664.8</a> SQL Plan Management Slow with High Shared Pool Allocations

- Patches to Consider for 11.2.0.4 to Avoid Problems with SQL Plan Management (SPM): [MOS Note:2034706.1](#)
- Patches to Consider for 11.2.0.3 to Avoid Problems with SQL Plan Management (SPM): [MOS Note: 1948958.1](#)

# Important **Optimizer** Issues and Fixes – **SPARC SOLARIS**

- Things to Consider to avoid RDBMS Performance problems on **SPARC**
  - For **12.1.0.2**: [MOS Note:1970525.1](#)

Document	Description	Patch Download
<a href="#">Bug:19308965</a>	RAW HAZARDS SEEN WITH RDBMS CODE ON SOLARIS T5	<a href="#">Patch:19308965</a>
<a href="#">Bug 13846337</a>	QESASIMPLEMULTICOLKEYCOMPARE NOT OPTIMIZED FOR SOLARIS SPARC64	<a href="#">Patch:13846337</a>
Bug 20726468 is merge patch for both BUGS 13846337 19308965	MERGE REQUEST ON TOP OF 12.1.0.2.0 FOR BUGS 13846337 19308965	<a href="#">Patch:20726468</a>
<a href="#">Document 18647293.8</a>	DISPATCHER HANG CAUSES DATABASE OUTAGE  Oracle has fixed this problem first in <a href="#">bug 10194190</a> for RAC and ASM and then also for DCD and dispatchers in <a href="#">bug 18647293</a>	<a href="#">Patch:18647293</a>

- For **11.2.0.3 /11.2.0.4**: [MOS Note:1680269.1](#)

Document	Description	Patch Download
<a href="#">Document 1280982.8</a>	PERFORMANCE ISSUES DUE TO BYTE-SWAPPING (Fixed in included in 11.2.0.4)	<a href="#">Patch:1280982</a>
<a href="#">Document 11809222.8</a>	DB STARTUP SLOW ON SPARC SYSTEMS (Fixed in 11.2.0.4 via bug <a href="#">1280982</a> ). This fix includes the fix for bug 8916255 - N%NCPY ALGORITHM NEEDS TO IGNORE THREADS WHEN CALCULATING CPU COUNT	<a href="#">Patch:11809222</a>
<a href="#">Document 1660269.8</a>	IDENTIFY CORRECT EFFECTIVE MULTIPLIER FOR SPARC T5 PROCESSOR (Fixed in 11.2.0.4 and 12.1.0.1)	<a href="#">Patch:1660269</a>
<a href="#">Document 12851600.8</a>	DATABASE TO USE CRITICAL THREADS FEATURE IN SOLARIS (Fixed in 11.2.0.4)	<a href="#">Patch:12851600</a>
<a href="#">Document 16336109.8</a>	Solaris: Poor IO performance on vertica for 11.2 compared to 10.2 (Fixed in 12.1.0.1 (Base Release) and 12.2.0.3 (Server Patch Set))	<a href="#">Patch:16336109</a>
<a href="#">Document 13551400.8</a>	High "log file parallel write" and "log file sync" when vertica ODM is used (The fix for 13551400 is first included in 12.1.0.1 (Base Release), 11.2.0.4 (Server Patch Set), and 11.2.0.3.9 Database Patch Set Update)	<a href="#">Patch:13551400</a>
<a href="#">Bug:19308965</a>	RAW HAZARDS SEEN WITH RDBMS CODE ON SOLARIS T5	<a href="#">Patch:19308965</a>
<a href="#">Bug:13846337</a>	QESASIMPLEMULTICOLKEYCOMPARE NOT OPTIMIZED FOR SOLARIS SPARC64	<a href="#">Patch:13846337</a>
<a href="#">Bug:17381609</a>	EVAL OF LTP% LIKE PREDICATE IS ORDERS OF MAGNITUDE SLOWER THAN ASCII LIKE	<a href="#">Patch:17381609</a>

# Download Patch Sets, PSUs, BPs, CPUs – Quick Reference

- [MOS Note:1454618.1 - Quick Reference to Patch Numbers for Database PSU, SPU\(CPU\), Bundle Patches and Patch Sets](#)

[Base Releases](#)

[Patchsets](#)

[PSU, SPU\(CPU\), Bundle Patches](#)

[12.1.0.2](#)

[12.1.0.1](#)

[11.2.0.4](#)

[11.2.0.3](#)

[11.2.0.2](#)

[11.2.0.1](#)

[11.1.0.7](#)

[11.1.0.6](#)

[10.2.0.5](#)

[10.2.0.4](#)

[10.2.0.3](#)

[10.2.0.2](#)

[10.2.0.1](#)

[10.1.0.5](#)

[10.1.0.4](#)

[10.1.0.3](#)

[10.1.0.2](#)

[9.2.0.8](#)

[9.2.0.7](#)

[9.2.0.6](#)

[9.2.0.5](#)

[9.2.0.4](#)

[8.1.7.4](#)

[QJVM PSU Patches](#)

[12.1.0.2](#)

[12.1.0.1](#)

[11.2.0.4](#)

[11.2.0.3](#)

[11.1.0.7](#)

[Mitigation Patch](#)

## PSU, SPU(CPU), Bundle Patches

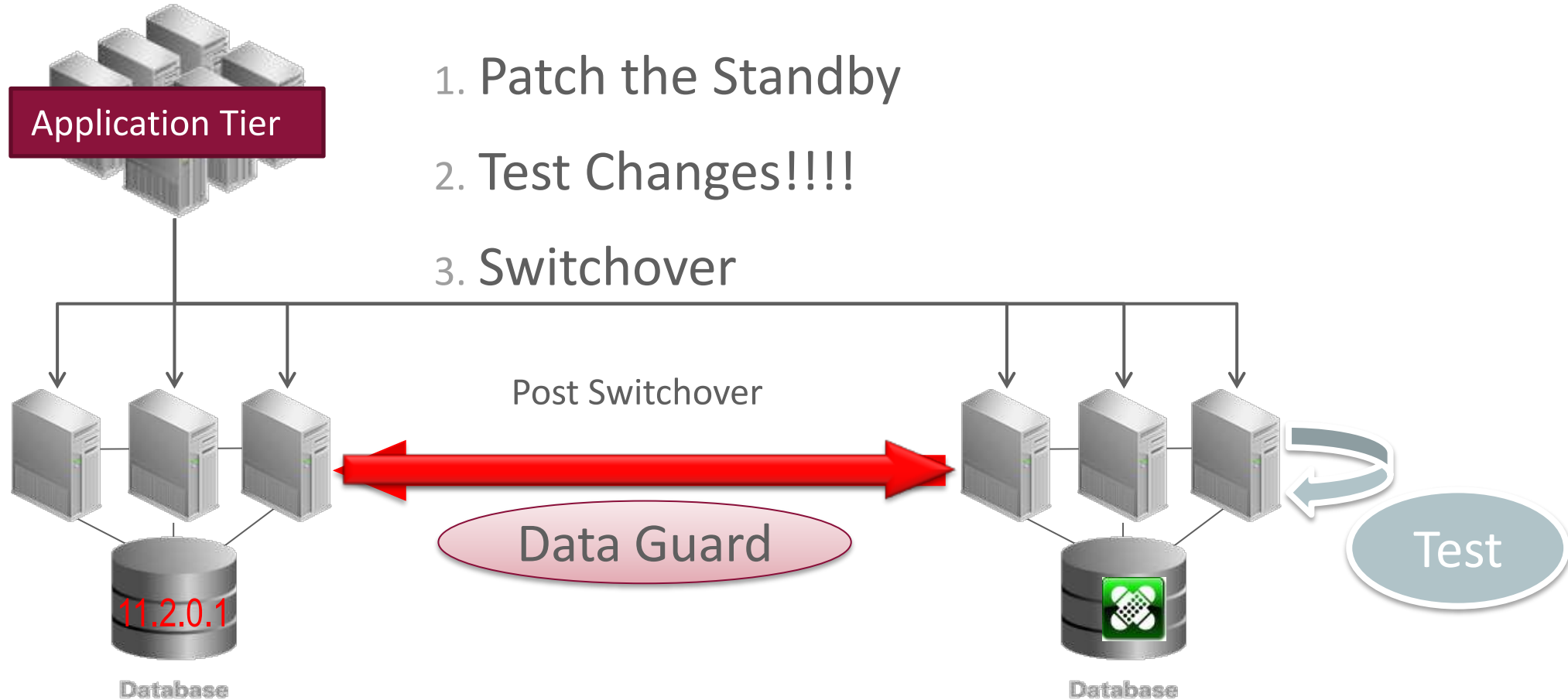
12.1.0.2				
Description	PSU	GI PSU	Proactive Bundle Patch	Bundle Patch (Windows 32bit & 64bit)
APR2016	<a href="#">22291127</a> (12.1.0.2.160419)	<a href="#">22646084</a> (12.1.0.2.160419)	<a href="#">22899531</a>	<a href="#">22809813</a> (12.1.0.2.160419)
JAN2016	<a href="#">21948354</a> (12.1.0.2.160119)	<a href="#">22191349</a> (12.1.0.2.160119)	<a href="#">22243551</a>	<a href="#">22310559</a> (12.1.0.2.160119)
OCT2015	<a href="#">21359755</a> (12.1.0.2.5)	<a href="#">21523234</a> (12.1.0.2.5)	<a href="#">21744410</a> (12.1.0.2.13)	<a href="#">21821214</a> (12.1.0.2.10)
JUL2015	<a href="#">20831110</a> (12.1.0.2.4)	<a href="#">20996835</a> (12.1.0.2.4)	<a href="#">21188742</a> (12.1.0.2.10)	<a href="#">21126814</a> (12.1.0.2.7)
APR2015	<a href="#">20299023</a> (12.1.0.2.3)	<a href="#">20485724</a> (12.1.0.2.3)	<a href="#">20698050</a> (12.1.0.2.7)	<a href="#">20684004</a> (12.1.0.2.4)
JAN2015	<a href="#">19769480</a> (12.1.0.2.2)	<a href="#">19954978</a> (12.1.0.2.2)	<a href="#">20141343</a> (12.1.0.2.4)	<a href="#">19720843</a> (12.1.0.2.1)
OCT2014	<a href="#">19303936</a> (12.1.0.2.1)	<a href="#">19392646</a> (12.1.0.2.1)	<a href="#">19404326</a> (12.1.0.2.1)	N/A



A man in a dark suit is speaking in a server room. The background features server racks with "Sun ORACLE" logos and a vertical "EXALOGIC" sign. The text "Patching for High Availability" is overlaid in white.

# Patching for High Availability

# Patch the Standby First

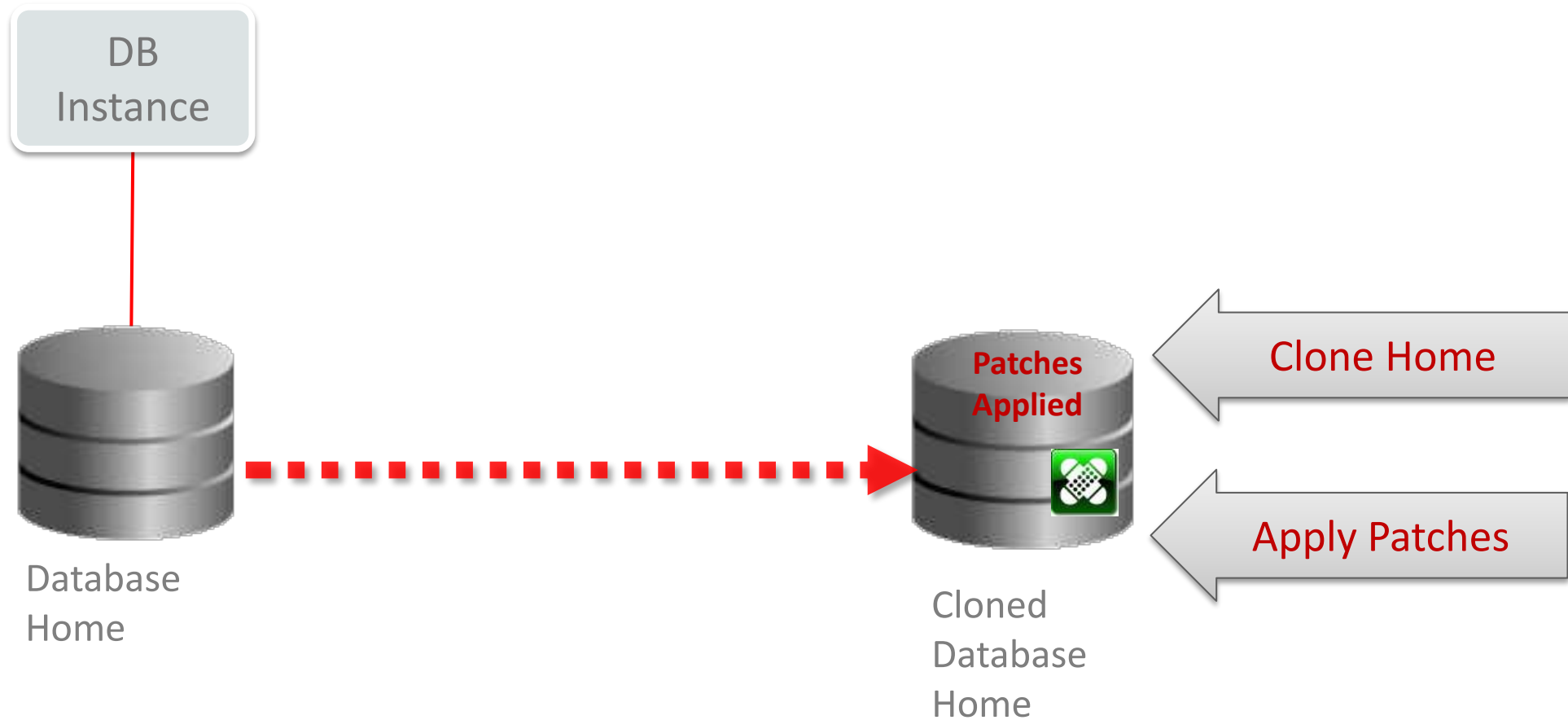


- [MOS Note:1265700.1 - Data Guard Standby-First Patch Apply](#)



# Out-of-Place Patching

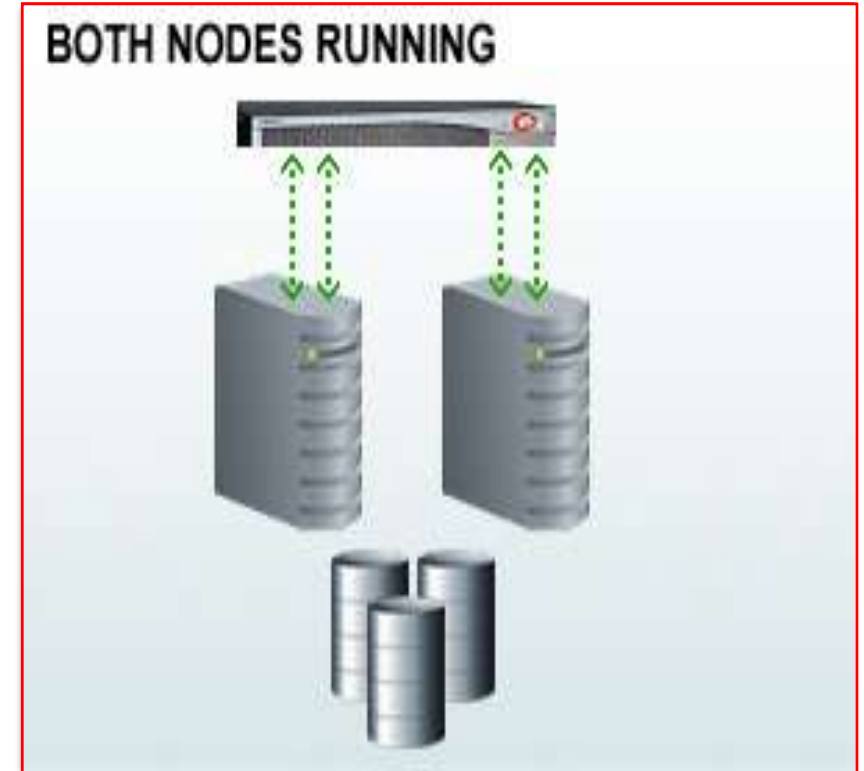
Reduce the Downtime



# Rolling Real Application Cluster Patching

## Zero Application Downtime

- Zero downtime rolling patch upgrade across RACs
- Patch support node-by-node in a rolling fashion



# Online Patching aka **Hot Patching**

- Zero downtime for some patches

[MOS Note:761111.1](#)

[RDBMS Online Patching Aka Hot Patching](#)



1. Apply Shared Library
2. Map into text Area
3. Use new patched functions

*Notes:*

- *Increases memory footprint*
- *Patch offline on next downtime*
- *P1 or diagnostic patches*

# Parameter Recommendations



- General guidelines:

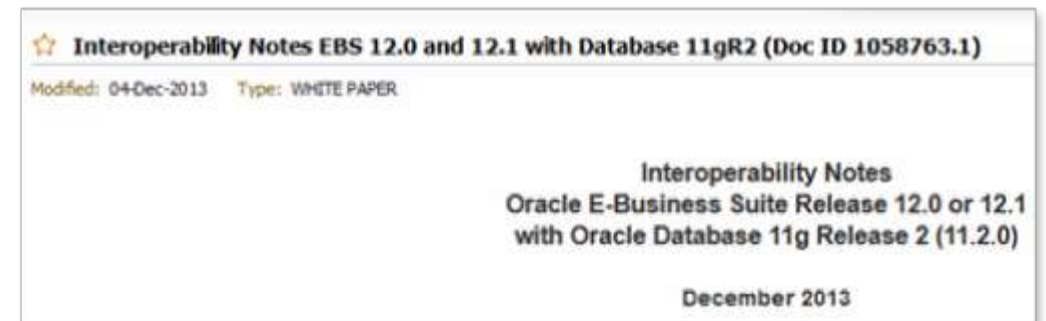
- The fewer parameters you have in your `spfile`, the better

- **Remove outdated parameters, underscores, events ...**

- Unless directed by applications (e.g. E-Business Suite, Siebel, SAP etc.) to set them

- [MOS Note:216205.1](#) *DB Init Parameters for EBS R11i*

- [MOS Note:396009.1](#) *DB Init Parameters for EBS R12*



- Don't use OFE ...

- `alter session set OPTIMIZER_FEATURES_ENABLE='11.2.0.3';`



# Remove Outdated Parameters

- Example: Internal Oracle production database
  - Multimedia (ORDIM) component took very long to upgrade

```
_complex_view_merging = FALSE
_multi_join_key_table_lookup = FALSE
_library_cache_advice = FALSE
_index_join_enabled = FALSE
_push_join_union_view = FALSE
_push_join_predicate = FALSE
_always_semi_join = OFF
_pred_move_around = FALSE
_unnest_subquery = FALSE
_predicate_elimination_enabled = FALSE
_eliminate_common_subexpr = FALSE
_no_or_expansion = FALSE
event = '10195 trace_name context forever'
event = '10778 trace_name context forever'
```

Upgrade time  
for ORDIM:  
**49** minutes

*Remove all  
underscores  
and events*

Upgrade time  
for ORDIM:  
**7** minutes

Factor  
**x7**



# Why do we give parameter recommendations?

- June 6, 2012

[https://www.pcworld.com/article/257045/6\\_5m\\_linkedin\\_passwords\\_posted\\_online\\_after\\_apparent\\_hack.html](https://www.pcworld.com/article/257045/6_5m_linkedin_passwords_posted_online_after_apparent_hack.html)

## Update: LinkedIn Confirms Account Passwords Hacked

UPDATED 2:15 p.m. PT

LinkedIn Wednesday confirmed that at least some passwords compromised in a major security breach correspond to LinkedIn accounts.



Francisco Silva, Director at LinkedIn, confirmed the hack on the company's blog

Wednesday afternoon and outlined steps to take. He wrote that those with compromised passwords should change their password as soon as possible. A password is no longer valid.

Silva added that owners of compromised

### Background

LinkedIn Security professionals suspected that the business-focused social network LinkedIn suffered a major breach of its password database. Recently, a file containing 6.5 million unique hashed passwords appeared in an online forum based in Russia. More than 200,000 of these passwords have reportedly been cracked so far.

The file only contains passwords hashed using the SHA-1 algorithm and does not include user names or any other data, security researchers say. However, the breach is so serious that security professionals advise people to change their LinkedIn passwords immediately.

It's unknown at this point how the file ended up on a public forum or exactly which site the passwords originate from; however, signs indicated this is indeed a breach of LinkedIn.

# Parameter Recommendations

SEC\_CASE\_SENSITIVE\_LOGON

Values: { **TRUE** | FALSE }

Explanation: Enables or disables password case sensitivity

Annotation: Deprecated since Oracle 12c

**NEW**

**Recommendation:** Age out passwords having PASSWORD\_VERSIONS<11G

```
select USERNAME, PASSWORD_VERSIONS from DBA_USERS;
USERNAME      PASSWORD_VERSIONS
-----
APP_USER      10G 11G 12C
BOSS          10G
```

When recreated, passwords will get **salted**

# Parameter Recommendations

**NEW**  
MEMO

SQLNET.ALLOWED\_LOGON\_VERSION\_SERVER

Values: { 8 | 10 | 11 | 12 | 12a }

- 12a for Oracle Database 12c authentication protocols (strongest protection)
- 12 for the critical patch updates CPUOct2012 and later Oracle Database 11g authentication protocols (recommended)
- **11** for Oracle Database 11g authentication protocols (default)
- 10 for Oracle Database 10g authentication protocols
- 8 for Oracle9i authentication protocol

Explanation: Determines min. authentication protocol when connection to a DB

Annotation: ORA-28040 or ORA-3134 when lower client tries to connect

**Recommendation:** Set it to 12 in your `sqlnet.ora` file(s) if you don't connect with <10.2.0.5 clients



# Parameter Recommendations



## AUDIT\_TRAIL

Values: { none | os | db [, extended] | xml [, extended] }

Explanation: Enables or disables database auditing

Annotation:

- AUD\$ will be moved into SYS schema if OLS and/or DBV is installed
  - Run `olspreupgrade.sql` from the 12c home
  - <http://docs.oracle.com/database/121/UPGRD/preup.htm#UPGRD60015>
- Unified Auditing **is enabled by default in MIXED MODE in a new DB**
  - <http://docs.oracle.com/database/121/DBSEG/auditing.htm#DBSEG822>
  - `SQL> select VALUE from V$OPTION where PARAMETER='Unified Auditing';`
  - **To turn off default policies:**
    - `SQL> noaudit policy ORA_SECURECONFIG;`
    - `SQL> noaudit policy ORA_LOGON_FAILURES;`

**Recommendation:** Make sure AUDIT\_TRAIL is set correctly:

- NONE if you don't want to have traditional auditing on
- Any other value depending on your auditing needs
- For further information see: <http://tinyurl.com/UnifiedAuditing>

# Parameter Recommendations

DEFERRED\_SEGMENT\_CREATION

Values: { **TRUE** | FALSE }

Explanation: New tables will not allocate segments until a row is inserted

Annotation: Default is TRUE since Oracle Database 11.2

- Tablespace must be locally managed
- COMPATIBLE ≥ 11.2.0
- Performance penalty when the first row is inserted
- May cause contention issues using many Data Pump workers
- See [MOS Note 1216282.1](#)

**Recommendation:** **Set it to FALSE**  
except for rare cases where an application creates a large number of empty tables with may never get used

# Parameter Recommendations

JOB\_QUEUE\_PROCESSES

Values: { 0 – 1000 }

Explanation: Max number of jobs being able to run concurrently in the database

Annotation: Default is 1000 since Oracle Database 11.1

- If set to 0 no recompilation will happen
- Too high settings can cause issues during **concurrent stats gathering (new in 11.2)**

**Recommendation:** Set it to number of physical/real **CPU cores**  
<http://tinyurl.com/job-queue-processes>



# Parameter Recommendations

`_DATAFILE_WRITE_ERRORS_CRASH_INSTANCE`

Values: { **TRUE** | FALSE }

Explanation: An **I/O write error** to *ANY* data file will crash the instance

Old behaviour (FALSE): Write error will OFFLINE the data file if

- Database is in archivelog mode
- Data file does not belong to the SYSTEM tablespace
  - In that case it would initiate a SHUTDOWN ABORT

Annotation: Default behavior has changed since patch set 11.2.0.2  
Change is documented in [MOS Note: 7691270.8](#)

Recommendation: **Just be aware of this change**

# Parameter Recommendations

**NEW**  
MEM

MAX\_STRING\_SIZE

Values:

{ **STANDARD** | EXTENDED }

- STANDARD
  - Length limits prior to Oracle Database 12c apply
    - VARCHAR2/NVARCHAR2: 4000 bytes and RAW: 2000 bytes
- EXTENDED
  - New 32767 byte limit applies
  - Requires COMPATIBLE ≥ 12.0.0

Explanation:

Controls the maximum size of VARCHAR2, NVARCHAR2, and RAW data types

Annotation:

Change from STANDARD ⇔ EXTENDED is allowed, but no way back  
Database in UPGRADE mode: `@?/rdbms/admin/utl32k.sql`

Recommendation:

**Evaluate carefully as data will be stored in LOBs**

[http://docs.oracle.com/database/121/SQLRF/statements\\_3001.htm#i2181663](http://docs.oracle.com/database/121/SQLRF/statements_3001.htm#i2181663)

# New Parameters in Oracle Database 12c

**NEW**  
MEM

## ▪ Oracle Database 12.1.0.1

- CELL\_OFFLOADGROUP\_NAME
- CONNECTION\_BROKERS
- DB\_BIG\_TABLE\_CACHE\_PERCENT\_TARGET
- DB\_INDEX\_COMPRESSION\_INHERITANCE
- DNFS\_BATCH\_SIZE
- ENABLE\_PLUGGABLE\_DATABASE
- HEAT\_MAP
- MAX\_STRING\_SIZE
- NONCDB\_COMPATIBLE
- OPTIMIZER\_ADAPTIVE\_FEATURES
- OPTIMIZER\_ADAPTIVE\_REPORTING\_ONLY
- PARALLEL\_DEGREE\_LEVEL
- PARALLEL\_FAULT\_TOLERANCE\_ENABLED
- PDB\_FILE\_NAME\_CONVERT
- PGA\_AGGREGATE\_LIMIT
- SPATIAL\_VECTOR\_ACCELERATION
- TEMP\_UNDO\_ENABLED
- THREADED\_EXECUTION
- UNIFIED\_AUDIT\_SGA\_QUEUE\_SIZE
- USE\_DEDICATED\_BROKER

## ▪ Oracle Database 12.1.0.2

- DBFIPS\_140
- COMMON\_USER\_PREFIX
- DB\_PERFORMANCE\_PROFILE
- ENABLE\_GOLDENGATE\_REPLICATION (11.2.0.4 and 12.1.0.2)
- EXCLUDE\_SEED\_CDB\_VIEW
- INMEMORY\_CLAUSE\_DEFAULT
- INMEMORY\_FORCE
- INMEMORY\_MAX\_POPULATE\_SERVERS
- INMEMORY\_QUERY
- INMEMORY\_SIZE
- INMEMORY\_TRICKLE\_REPOPULATE\_SERVERS\_PERCENT
- OPTIMIZER\_INMEMORY\_AWARE
- PDB\_LOCKDOWN
- PDB\_OS\_CREDENTIAL

<http://tinyurl.com/Parameters12c>

# Deprecated and Obsolete Parameters in Oracle Database 12c

## ▪ Oracle Database 12.1.0.1

### – Deprecated:

- `sec_case_sensitive_logon`

### – Obsolete:

- `_app_ctx_vers`
- `_log_io_size`

## ▪ Oracle Database 12.1.0.2

### – Deprecated:

### – Obsolete:

- `parallel_fault_tolerance_enabled`

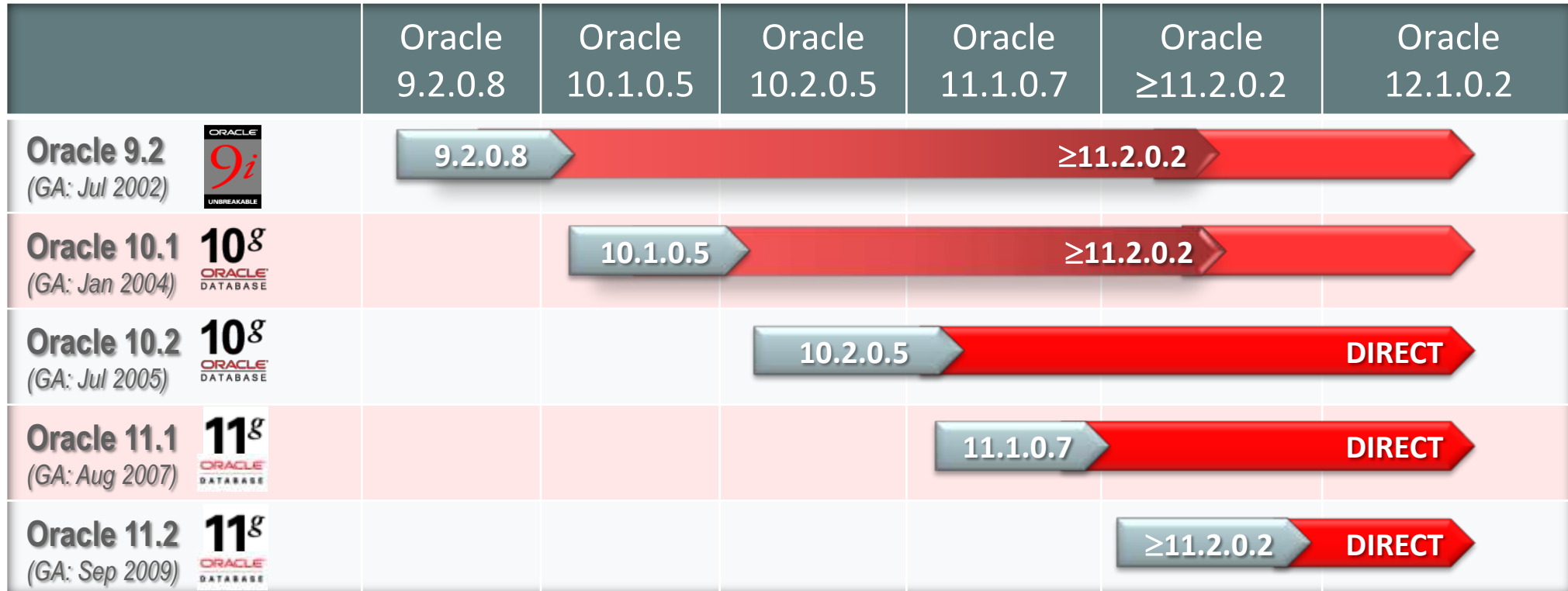
# Upgrade, Migrate & Consolidate

- 1 Introduction
- 2 Preparation Steps
- 3 Upgrade / Migrate / Consolidate**
- 4 Fallback Strategies
- 5 New Features
- 6 Performance Management
- 7 Wrap Up





# Direct Upgrade to Oracle Database 12c



Please note: This graph will apply to database upgrades only!

# 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;
```

# 40%

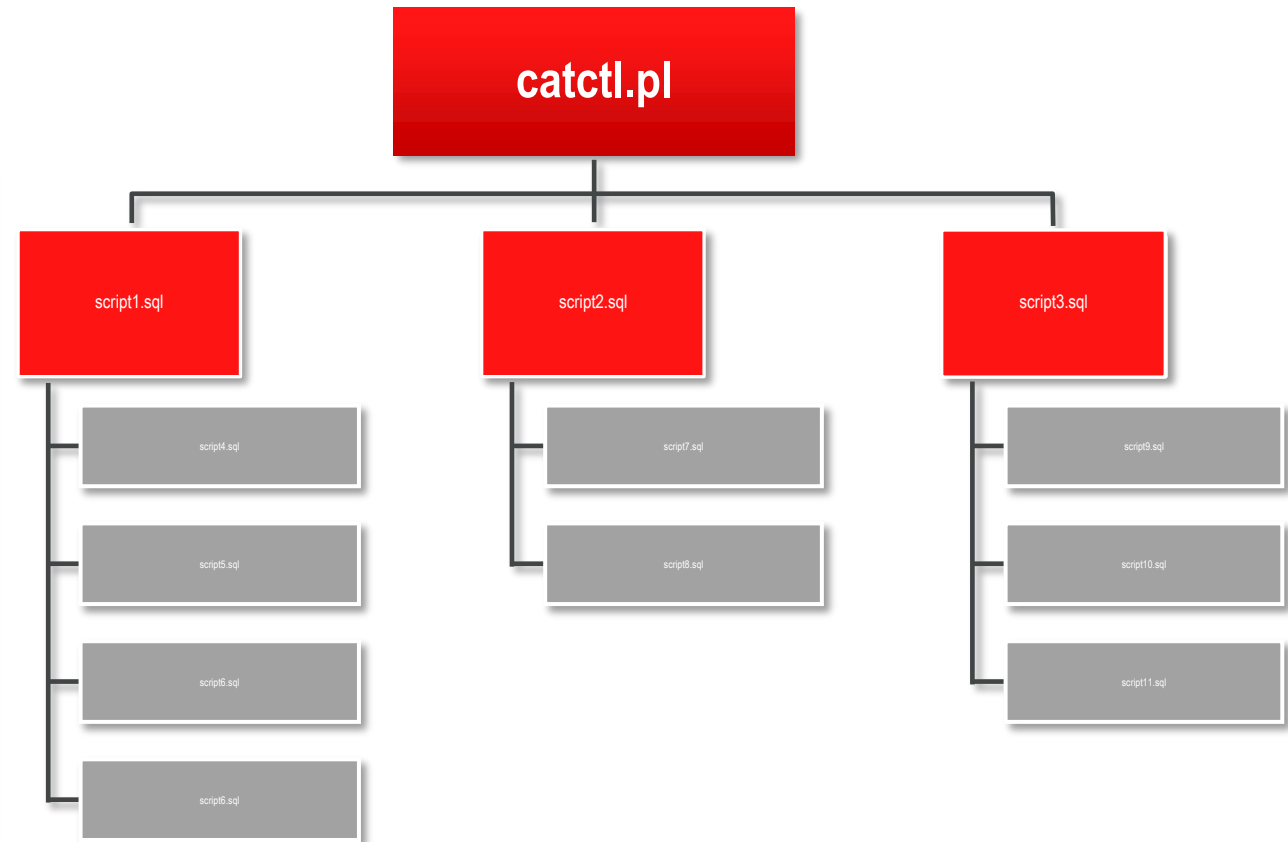
Faster Upgrades in  
Oracle Database 12c



# Faster Upgrade – Less Downtime

## New Parallel Upgrade

- `catctl.pl`
- Runs database upgrade in parallel
- Up to 40% faster upgrade
- Used and proven by **selected Oracle Database 11g** global customers
  - Telco billing
  - >100 SAP systems
  - Large DWH



“The new parallel upgrade script promises to drastically reduce downtime due to planned maintenance. We saw a 37% improvement over the previous upgrade process in our environment.”

## Harald Stefan

Leiter Datenbanken  
Payback GmbH

# Faster Upgrade – Less Downtime

## New Parallel Upgrade

```
$> $ORACLE_HOME/perl/bin/perl catctl.pl -n 8 catupgrd.sql
```



```
Serial Phase #:70 Files: 1 Time: 90s  
Serial Phase #:71 Files: 1 Time: 0s  
Serial Phase #:72 Files: 1 Time: 0s  
Serial Phase #:73 Files: 1 Time: 34s
```

```
Grand Total Time: 1588s
```

```
LOG FILES: (catupgrd*.log)
```

```
Upgrade Summary Report Located in:
```

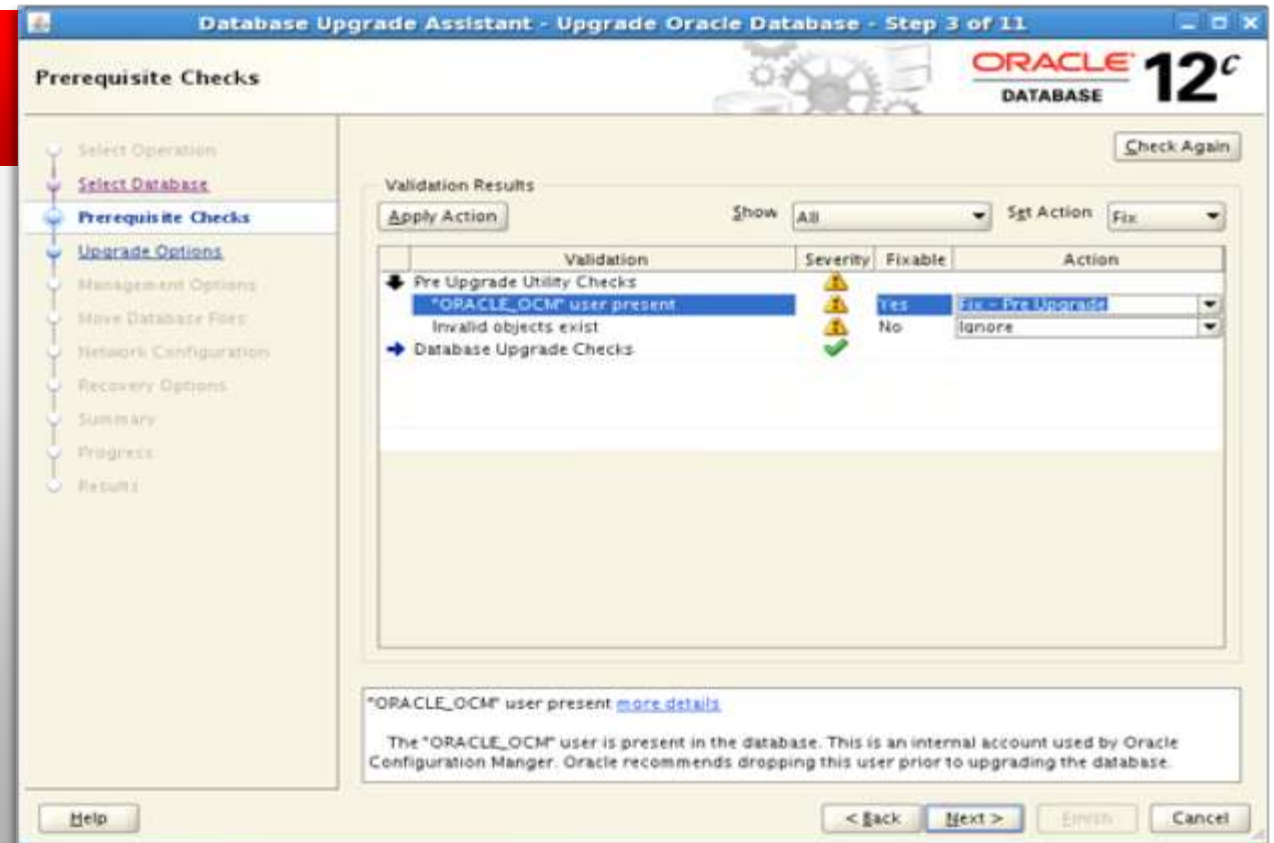
```
/u01/app/oracle/product/12.1.0.2/cfgtoollogs/UPGR/upgrade/upg_summary.log
```

```
Grand Total Upgrade Time: [0d:0h:26m:28s]
```

# Simplified Upgrade

## Database Upgrade Assistant

- Pre-Upgrade Automation
- Parallel Upgrade
- RMAN Integration
- Guaranteed Restore Points
- Activity and Alert Log



“We experienced very few problems and in general the upgrades were very fast.

We were able to upgrade almost all of our 200+ database instances to Database 12c with a downtime of only 30-40 minutes (and that includes some of the pre- and post-tasks).

I have been upgrading Oracle databases since 9i to 10g, and this has been the best release (measured on how easy upgrading is) so far.”

**Daniel Overby Hansen**

Chief Software Developer, Environment Operation  
SimCorp A/S - Denmark



# Enterprise Manager Mass and RAC Upgrades

## EM Cloud Control

- Mass Upgrades
- Grid Infrastructure Upgrades
- RAC Database Upgrades
- Standby Database Upgrades
- Licensed in Lifecycle Management Pack

Select Targets for Upgrade

Search

\* Cluster: slc00-crs8

\* Cluster Database Version: 11.2.0.2.0

Platform: Linux x86-64

Search

Target Name	Target Type	Status	Host Name	Oracle Home	Version
slc00-crs8	Cluster	↑		/u01/app/11.2.0/grid	11.2.0.2.0
db1.us.oracle.com	Cluster Database	↑	slc00exf.us.oracle.com	/u02/app/aime/product/11.2.0/db	11.2.0.2.0
db2.us.oracle.com	Cluster Database	↑	slc00exf.us.oracle.com	/u02/app/aime/product/11.2.0/db	11.2.0.2.0
db3.us.oracle.com	Cluster Database	↑	slc00exf.us.oracle.com	/u02/app/aime/product/11.2.0/db	11.2.0.2.0
+ASM_slc00-crs8	Cluster ASM	↑	slc00exg.us.oracle.com	/u01/app/11.2.0/grid	11.2.0.2.0
has_slc00exg.us.oracle.com	Oracle High Availability Serv	↑	slc00exg.us.oracle.com	/u01/app/11.2.0/grid	11.2.0.2.0
has_slc00exf.us.oracle.com	Oracle High Availability Serv	↑	slc00exf.us.oracle.com	/u01/app/11.2.0/grid	11.2.0.2.0

Columns Hidden: 1

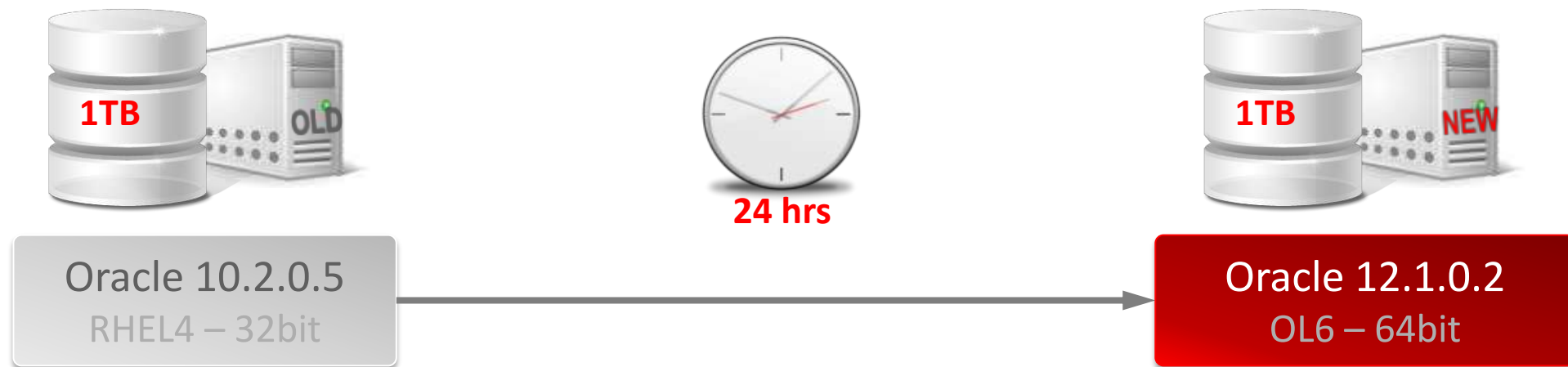
Cancel

# Differences Upgrade to Oracle 11.2 vs Oracle 12c

	Upgrade to Oracle Database 11.2	Upgrade to Oracle Database 12c
<i>Preupgrade check:</i>	<code>utlu112i.sql</code>	<code>preupgrd.sql</code>
<i>Status information:</i>	Limited	Detailed with many recommendations
<i>Fixup scripts:</i>	No	Yes – pre and post upgrade
<i>Upgrade script:</i>	<code>catupgrd.sql</code>	<code>catctl.pl</code>
<i>Parallel:</i>	No	Up to 8 parallel threads – <i>default: 4</i>
<i>Error handling:</i>	No	Any errors in the ORACLE SERVER upgrade will lead to status INVALID

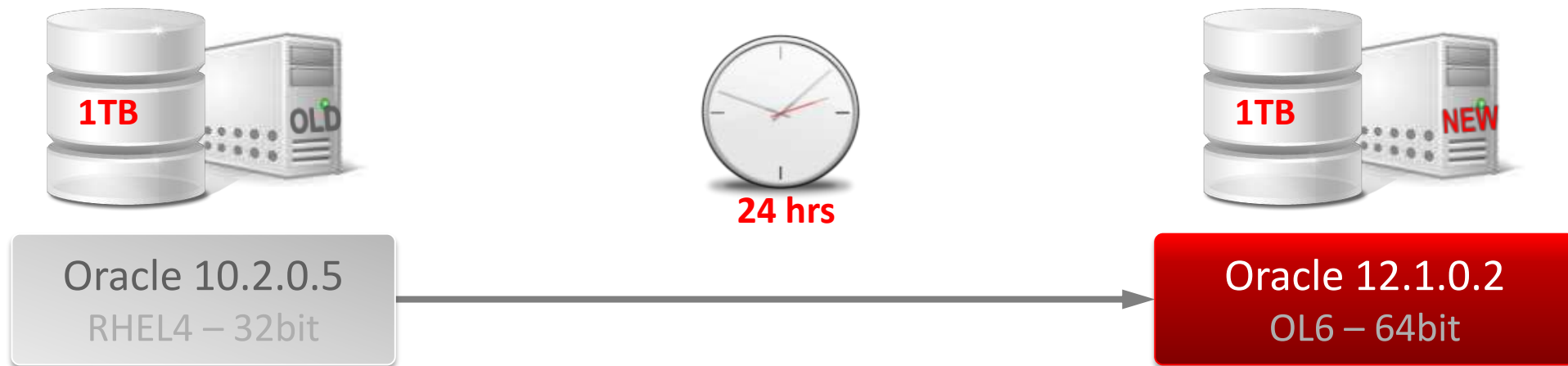
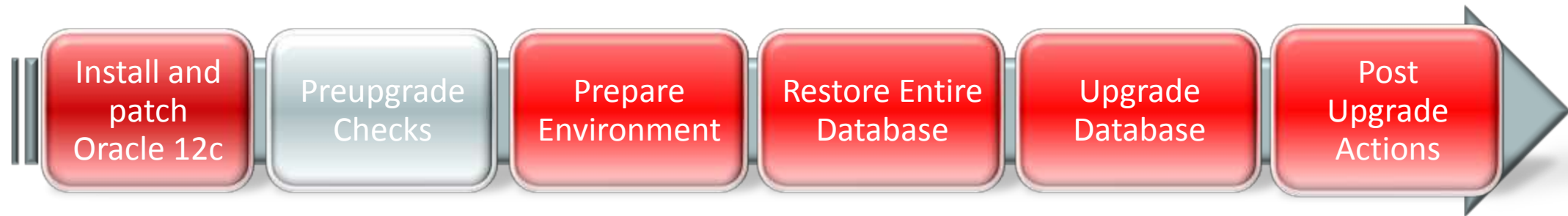
# Case 1: Upgrade to Oracle Database 12c

- Database upgrade including migration to a new server



# Case 1: Upgrade to Oracle Database 12c

- Database upgrade including migration to a new server





## ■ Installation of Oracle Database 12c



**Oracle 12.1.0.2**  
OL6 – 64bit



- PSU ([MOS Note:756671.1](#)) and patches ([MOS Note:1565082.1](#))

### 12.1.0.1 Current Recommended Patches

#### Patch Set Updates

Document	Description	Rolling RAC	Patch Download
<a href="#">Note:17027533.8</a>	12.1.0.1.1 (Oct 2013) Database Patch Set Update (PSU)	Yes	<a href="#">Patch:17027533</a>

#### Issues introduced in 12.1.0.1

This section lists bugs **introduced** in 12.1.0.1 (if any). Such issues may be either serious or trivial but the aim is to list them all to help assess the risk of applying the Patch Set on top of 12.1

Bug/Doc	Description	Updated
<a href="#">17564992</a>	Wrong results with fix for bug 12999577 present	28/Oct/2013
<a href="#">17325413</a>	Drop column with DEFAULT value and NOT NULL definition ends up with dropped column data hitting disk leading to corruption	09/Dec/2013
<a href="#">16825679</a>	Parsing never ends ("spin" in/under kkestGetMCSElInlist)	28/Oct/2013
<a href="#">15984297</a>	ORA-600 [kkqtSetOp.1] during query parse with join elimination and fix for bug 12739252 present	15/Jul/2013
<a href="#">13990707</a>	ORA-600 [kxcbxi] from DML on IOT	22/Oct/2013



Oracle 10.2.0.5  
RHEL4 – 32bit

Oracle 12.1.0.2  
OL6 – 64bit





- Download/execute newest preupgrade scripts: [MOS Note:884522.1](https://www.oracle.com/technetwork/middleware/upgrade/884522-1.html)
  - `preupgrd.sql` and `utluppkg.sql`
  - Files can be found in Oracle 12c's `?/rdbms/admin` as well





- `preupgrd.sql` generates 2 scripts and 1 log for review

```
$ORACLE_BASE/cfgtoollogs/<SID>/preupgrade  
- preupgrade.log  
- preupgrade_fixups.sql  
- postupgrade_fixups.sql
```







▪ Review preupgrade.log

```

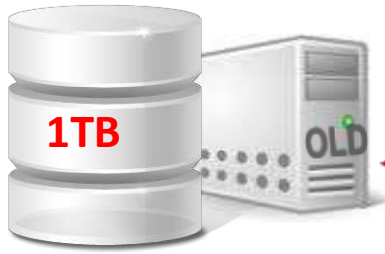
oracle@localhost.localdomain: /u01/app/oracle/cfgtoollogs/V102/preupgrade
File Edit View Terminal Tabs Help
*****
*****
[Pre-Upgrade Checks]
*****
WARNING: --> Process Count may be too low

Database has a maximum process count of 79 which is lower than the
default value of 300 for this release.
You should update your processes value prior to the upgrade
to a value of at least 300.
For example:
  ALTER SYSTEM SET PROCESSES=300 SCOPE=SPFILE
or update your init.ora file.

ERROR: --> Compatible set too low

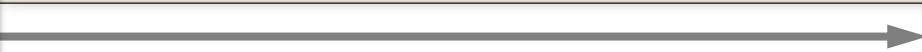
"compatible" currently set at 10.2.0.5.0 and must
be set to at least 11.0.0 prior to upgrading the database.
Do not make this change until you are ready to upgrade
because a downgrade back to 10.2 is not possible once compatible
has been raised.

▪ Update your init.ora or spfile to make this change.
  
```



Oracle 10.2.0.5  
RHEL4 – 32bit

Oracle 12.1.0.2  
OL6 – 64bit



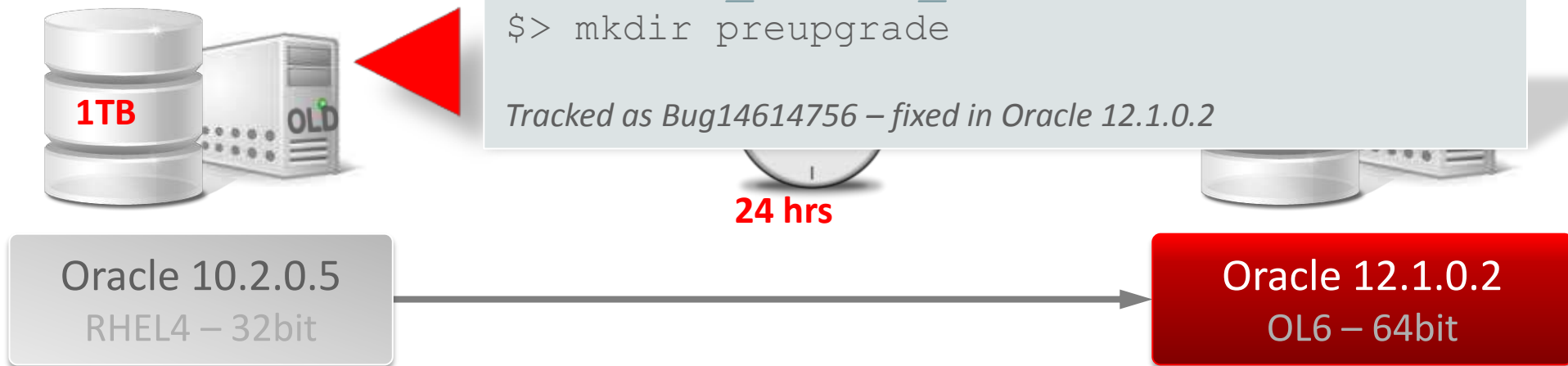


- `preupgrd.sql` won't create output files if `JAVAVM` is:
  - Not present
  - Invalid
  - Option off

- **Workaround:**

```
$> cd $ORACLE_BASE/cfgtoollogs  
$> mkdir <DB_UNIQUE_NAME>  
$> cd <DB_UNIQUE_NAME>  
$> mkdir preupgrade
```

*Tracked as Bug14614756 – fixed in Oracle 12.1.0.2*





▪ Run `preupgrade_fixups.sql`

```

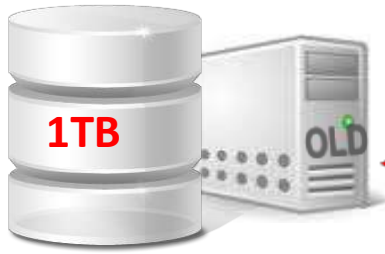
oracle@localhost.localdomain: /u01/app/oracle/cfgtoollogs/V102/preupgrade
SYS:V102> @/u01/app/oracle/cfgtoollogs/V102/preupgrade/preupgrade_fixups.sql
Pre-Upgrade Fixup Script Generated on 2013-02-22 14:44:43  Version: 12.1.0.1  Bui
ld: 006
Beginning Pre-Upgrade Fixups...

PL/SQL procedure successfully completed.

PL/SQL procedure successfully completed.

*****
Check Tag:      DEFAULT_PROCESS_COUNT
Check Summary:  Verify min process count is not too low
Fix Summary:    Review and increase if needed, your PROCESSES value.
*****
Fixup Returned Information:
WARNING:  --> Process Count may be too low

Database has a maximum process count of 79 which is lower than the
default value of 300 for this release.
You should update your processes value prior to the upgrade
to a value of at least 300.
For example:
  
```



Oracle 10.2.0.5  
RHEL4 – 32bit

Oracle 12.1.0.2  
OL6 – 64bit





- Execute suggested actions manually:

```
oracle@localhost.localdomain: /u01/app/oracle/cfgtoollogs/V102/preupgrade
File Edit View Terminal Tabs Help
SYS:V102>
SYS:V102>
SYS:V102> exec dbms_stats.gather_dictionary_stats;
PL/SQL procedure successfully completed.
SYS:V102> ALTER SYSTEM SET PROCESSES=300 SCOPE=SPFILE;
System altered.
SYS:V102> ALTER SYSTEM SET COMPATIBLE='12.1.0' SCOPE=SPFILE;
System altered.
SYS:V102> CREATE PFILE='/u01/app/oracle/product/12.1.0/dbs/initV102.ora'
2 FROM SPFILE;
File created.
SYS:V102> shutdown immediate
Database closed.
Database dismounted.
ORACLE instance shut down.
SYS:V102> █
```



Oracle 10.2.0.5  
RHEL4 – 32bit

Oracle 12.1.0.2  
OL6 – 64bit



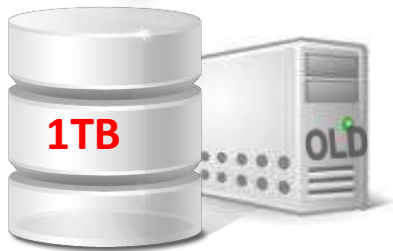
▪ Optional manual actions:

– Remove *Enterprise Manager Database Control Repository*

▪ Otherwise it will be dropped during `catuppst.sql` execution



```
$> emctl stop dbconsole
SQL> @$?/rdbms/admin/emremove.sql
```



Oracle 10.2.0.5  
RHEL4 – 32bit



24 hrs



Oracle 12.1.0.2  
OL6 – 64bit



▪ Optional manual actions:

- **Essential step** if **OLS** (Label Security) and/or **DV** (Database Vault) was already in the database prior to the upgrade

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



- Prepares the move of AUD\$ table from SYSTEM to SYS
- Processes the audit records to minimize downtime
- Moves records to an interim temporary table
- May require DV actions as well (see the documentation)



**24 hrs**



Oracle 10.2.0.5  
RHEL4 – 32bit

Oracle 12.1.0.2  
OL6 – 64bit





## Optional manual actions:

### – Remove **Oracle UltraSearch** before the upgrade

- UltraSearch does not exist in Oracle Database 11.2 and onwards, and it will be uninstalled during the upgrade
- Removing it before the upgrade might save 1-2 minutes upgrade downtime



```
SQL> @?/ultrasearch/admin/wk0deinst.sql SYS password ""
```



Oracle 10.2.0.5  
RHEL4 – 32bit



24 hrs



Oracle 12.1.0.2  
OL6 – 64bit



- Prepare new init.ora:

```
oracle@localhost.localdomain: /u01/app/oracle/product/12.1.0/dbs
File Edit View Terminal Tabs Help
*.compatible='12.1.0'
*.control_files='/oradata/V102/control01.ctl','/oradata/V102/control02.ctl','/oradata/V102/control03.ctl'
*.db_block_size=8192
*.db_domain=''
*.db_name='V102'
*.job_queue_processes=10
*.open_cursors=300
*.pga_aggregate_target=47185920
*.processes=300
*.remote_login_passwordfile='EXCLUSIVE'
*.sessions=92
*.session_cached_cursors=200
*.sga_target=419430400
*.undo_management='AUTO'
*.undo_tablespace='UNDOTBS1'
```



Oracle 10.2.0.5  
RHEL4 – 32bit

Oracle 12.1.0.2  
OL6 – 64bit

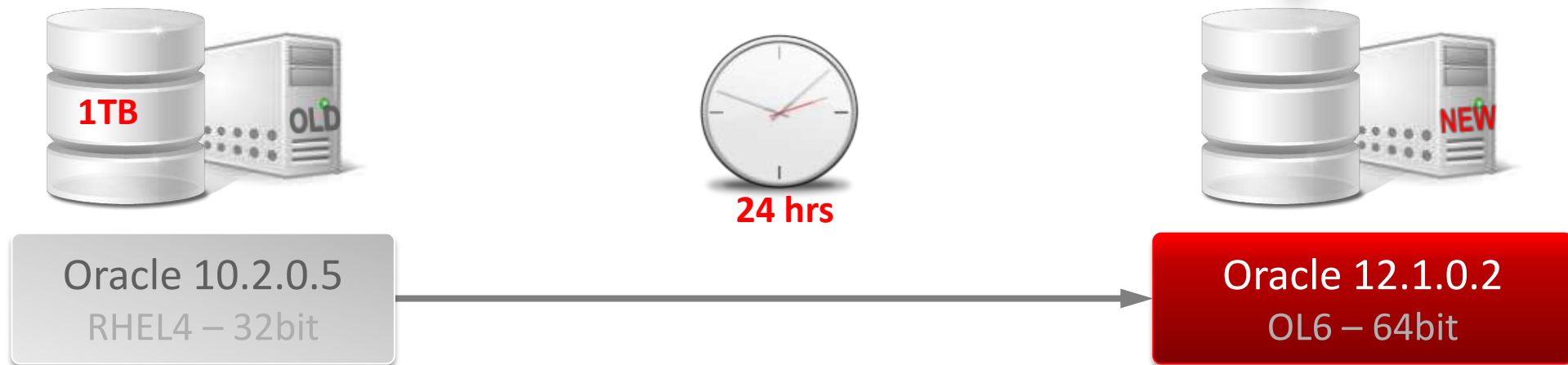






- Create a new password file (*recommended*):

```
$> cd $ORACLE_HOME/dbs  
$> orapwd file=orapwV102  
password=<string> entries=15  
format=12 force=yes
```





▪ **Set the environment:**

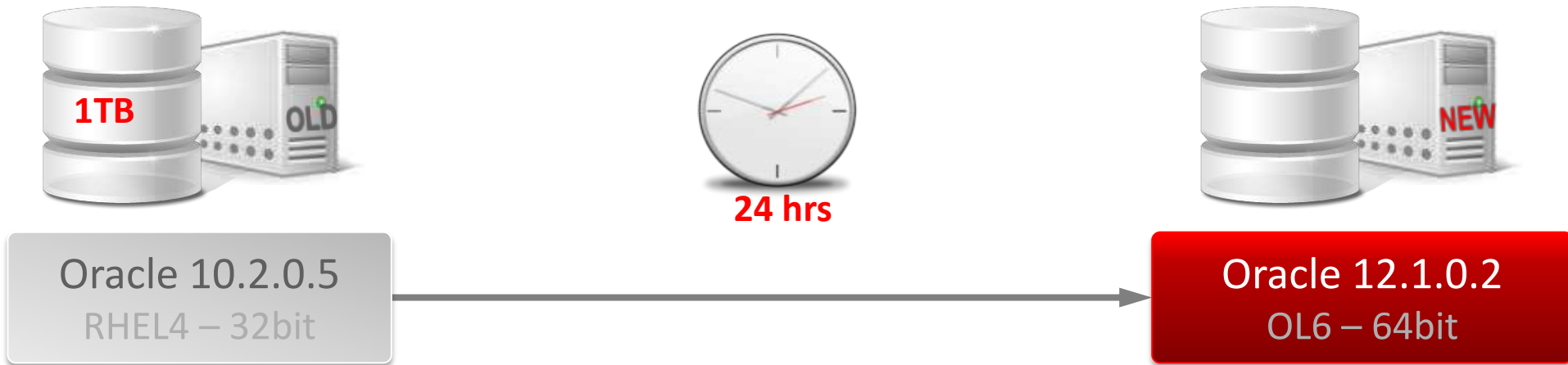
Set ORACLE\_BASE, ORACLE\_HOME, ORACLE\_SID, TNS\_ADMIN, TMP and TMPDIR

Windows only:

Create a new Service:



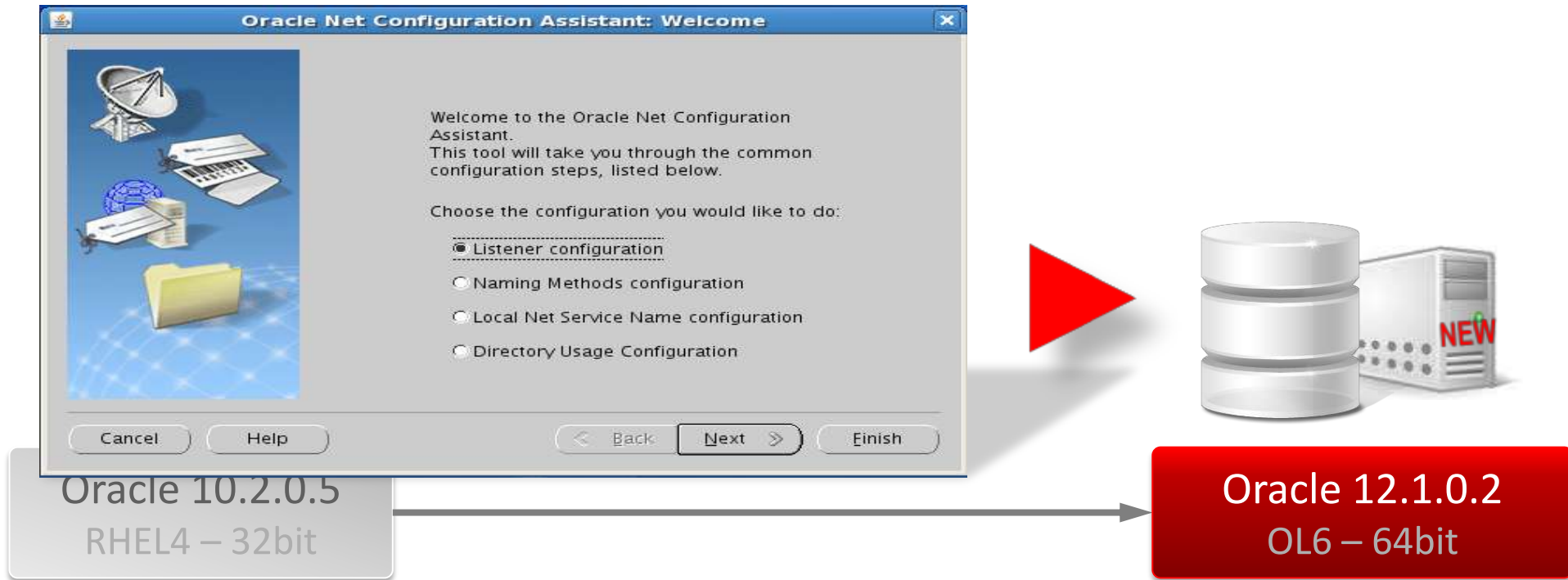
```
oradim -NEW -SID ORASID -SYSPWD passwd -STARTMODE a -PFILE initfile
```





▪ Listener configuration:

- If **clients older than Oracle 11g** connect then you must set:  
`SQLNET.ALLOWED_LOGON_VERSION_SERVER=10`  
in `$ORACLE_HOME/network/admin/sqlnet.ora`





- **Restore & recover** an RMAN Online Backup

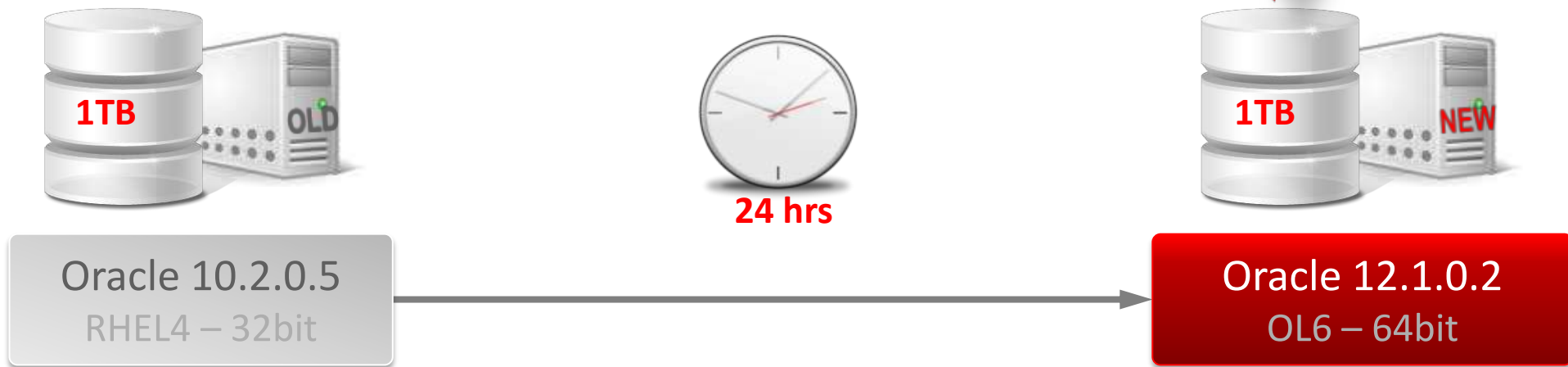
- Recreate TEMP tablespace

- Alternative:

- **Copy** all relevant files to the new server

- Data files, redo logs, control files.

```
RMAN> run {
SET ARCHIVELOG DESTINATION TO
'/fra/tmprest';
RESTORE DATABASE;
RECOVER DATABASE; }
```

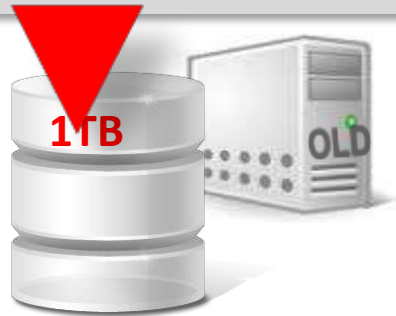




## ▪ Changing OS from 32bit → 64bit

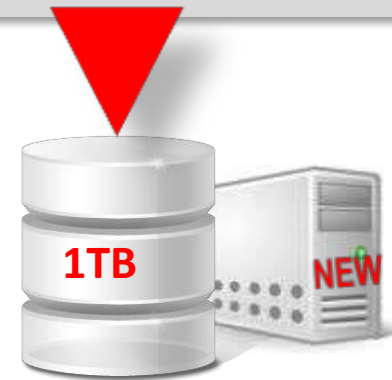
- **No action** required as part of a (patch) **upgrade!!!**
- **Special case:** Keep the database version (not an upgrade!)
  - OLAP must be reloaded with `xumuts.plb` – see [MOS Note:352306.1](#)

```
startup upgrade
@?/rdbms/admin/utlirp.sql
shutdown immediate
```



Oracle 10.2.0.5  
RHEL4 – 32bit

```
startup upgrade
@?/rdbms/admin/utlirp.sql
```



Oracle 10.2.0.5  
OL5.6 – 64bit



■ Start the database in STARTUP UPGRADE mode:

```

oracle@localhost.localdomain: /u01/app/oracle/product/12.1.0/dbs
File Edit View Terminal Tabs Help
[CDB12] oracle@localhost:/u01/app/oracle/product/12.1.0/dbs
$ sqlplus / as sysdba

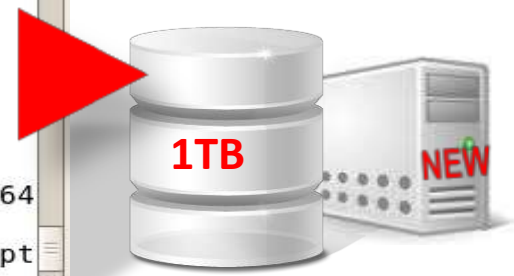
SQL*Plus: Release 12.1.0.1.0 Production on Mon Feb 25 19:57:09 2013

Copyright (c) 1982, 2013, Oracle. All rights reserved.

Connected to an idle instance.

SYS:V102> startup upgrade pfile=initV102.ora
ORACLE instance started.

Total System Global Area  417546240 bytes
Fixed Size                  2288432 bytes
Variable Size              142607568 bytes
Database Buffers           264241152 bytes
Redo Buffers                8409088 bytes
Database mounted.
Database opened.
SYS:V102> exit
Disconnected from Oracle Database 12c Enterprise Edition Release 12.1.0.1.0 - 64
bit Production
With the Partitioning, OLAP, Advanced Analytics and Real Application Testing opt
ions
  
```



Oracle 10.2.0.5  
RHEL4 – 32bit

Oracle 12.1.0.2  
OL6 – 64bit





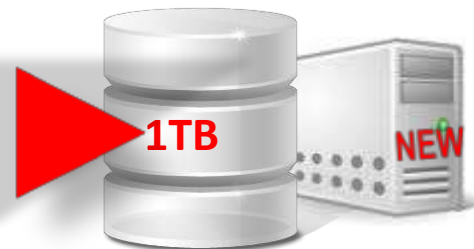
## What happens during STARTUP UPGRADE mode?

### Snippet taken from the **alert.log** during STARTUP UPGRADE:

```
ALTER SYSTEM enable restricted session;
ALTER SYSTEM SET _system_trig_enabled=FALSE SCOPE=MEMORY;
Autotune of undo retention is turned off.
ALTER SYSTEM SET _undo_autotune=FALSE SCOPE=MEMORY;
ALTER SYSTEM SET undo_retention=900 SCOPE=MEMORY;
ALTER SYSTEM SET aq_tm_processes=0 SCOPE=MEMORY;
ALTER SYSTEM SET enable_ddl_logging=FALSE SCOPE=MEMORY;
Resource Manager disabled during database migration: plan '' not set
ALTER SYSTEM SET resource_manager_plan= SCOPE=MEMORY;
ALTER SYSTEM SET recyclebin='OFF' DEFERRED SCOPE=MEMORY;
Resource Manager disabled during database migration
replication_dependency_tracking turned off (no async multimaster ...)
AQ Processes can not start in restrict mode
Completed: ALTER DATABASE OPEN MIGRATE
```



– Suppresses more than 20 expected error messages such as ORA-942



**24 hrs**

Oracle 10.2.0.5  
RHEL4 – 32bit

Oracle 12.1.0.2  
OL6 – 64bit

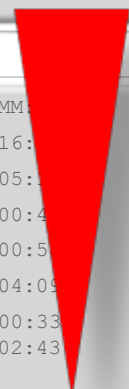


▪ **Upgrade duration** to Oracle Database 12c mainly depends on:

- Number of installed components and database options
- Number of objects in the database due to high amount of new dictionary tables, and restructuring of some base system tables
- To less extent:
  - CPU cores and speed
  - IO throughput

Component	HH:MM:SS
Oracle Server	00:16:17
JServer JAVA Virtual Machine	00:05:19
Oracle Workspace Manager	00:01:01
Oracle Enterprise Manager	00:10:13
Oracle XDK	00:00:48
Oracle Text	00:00:58
Oracle XML Database	00:04:09
Oracle Database Java Packages	00:00:33
Oracle Multimedia	00:07:43
Oracle Expression Filter	00:00:18
Oracle Rule Manager	00:00:12
Gathering Statistics	00:04:53
Total Upgrade Time: 00:52:31	

Component	HH:MM:SS
Oracle Server	00:16:17
JServer JAVA Virtual Machine	00:05:19
Oracle XDK	00:00:48
Oracle Text	00:00:58
Oracle XML Database	00:04:09
Oracle Database Java Packages	00:00:33
Gathering Statistics	00:02:43
Total Upgrade Time: 00:30:47	







## ▪ Speed up the upgrade

– Fresh dictionary stats  
24 hours before upgrade



```
exec  
DBMS_STATS.GATHER_DICTIONARY_STATS;
```

– Stats on XDB objects  
if XDB is in use



```
exec  
DBMS_STATS.GATHER_TABLE_STATS(ownname=>'XDB', tabname=>'XDB$RESOURCE',  
estimate_percent=>NULL);
```

– Process AUD\$ info

- [MOS Note: 1329590.1](#) offers a script to populate missing entries
- If auditing was/is on by accident:



```
truncate table SYS.AUD$ | SYSTEM.AUD$;
```

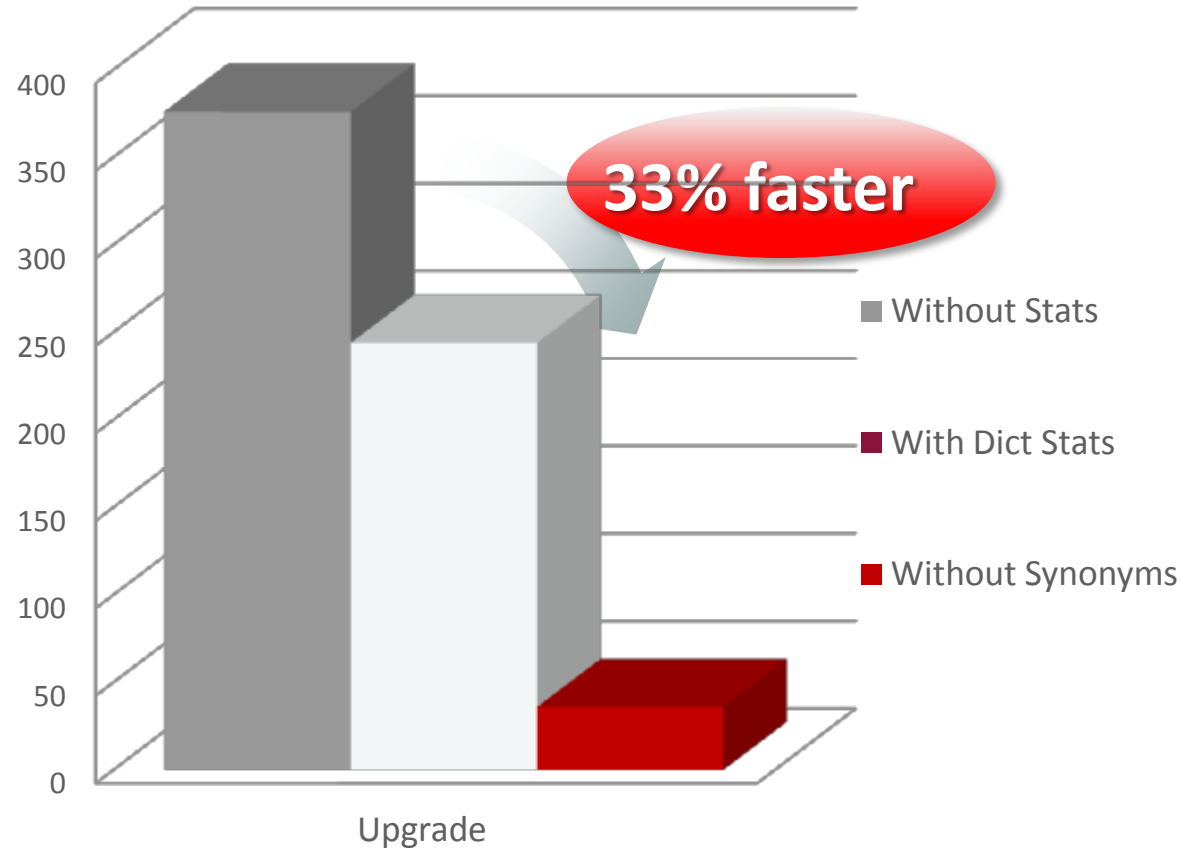


▪ *Real World Case:*

**Create dictionary statistics**

- 4<sup>th</sup> largest retailer worldwide
  - 1.5 million synonyms
  - Oracle 9i → Oracle 11g

Upgrade without/with Dictionary Statistics



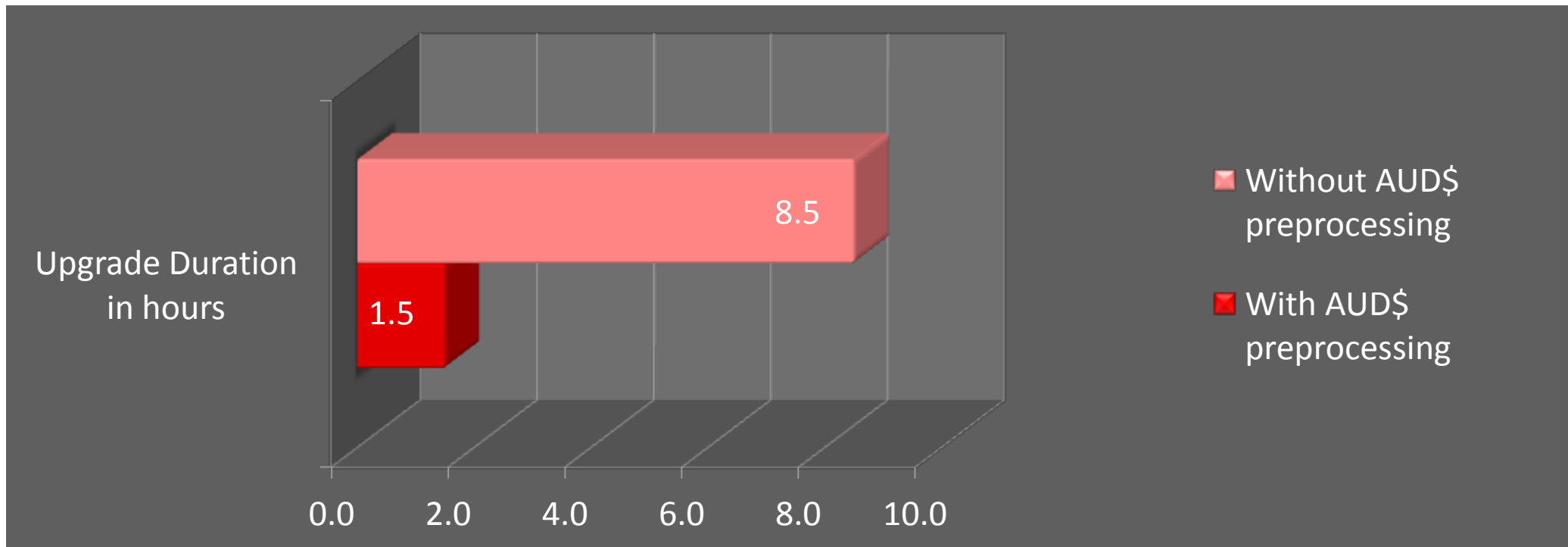


- *Real World Case:*

- Preprocess audit records**

- Saudi Arabian banking customer's core system

- Approximately 75M auditing records in AUD\$ table





- Run the upgrade with `catctl.pl`

```

oracle@localhost.localdomain: /u01/app/oracle/product/12.1.0/rdbms/admin
File Edit View Terminal Tabs Help
$ cd $ORACLE_HOME/rdbms/admin
[CDB12] oracle@localhost: /u01/app/oracle/product/12.1.0/rdbms/admin
[CDB12] oracle@localhost: /u01/app/oracle/product/12.1.0/rdb
$ $ORACLE_HOME/perl/bin/perl catctl.pl -n 3 catupgrd.sql

37 scripts found in file catproc.sql
Next path: catptabs.sql
61 scripts found in file catptabs.sql
Next path: catpdbms.sql
205 scripts found in file catpdbms.sql
Next path: catpdeps.sql
77 scripts found in file catpdeps.sql
Next path: catpprvt.sql
260 scripts found in file catpprvt.sql
Next path: catpexec.sql
26 scripts found in file catpexec.sql
Next path: cmpupgrd.sql
16 scripts found in file cmpupgrd.sql

[Phase 0] type is 1 with 1 Files
  
```

- Default: `n=4`
- Maximum: `n=8`



**Oracle 12.1.0.2**  
OL6 – 64bit

RHEL4 – 32bit

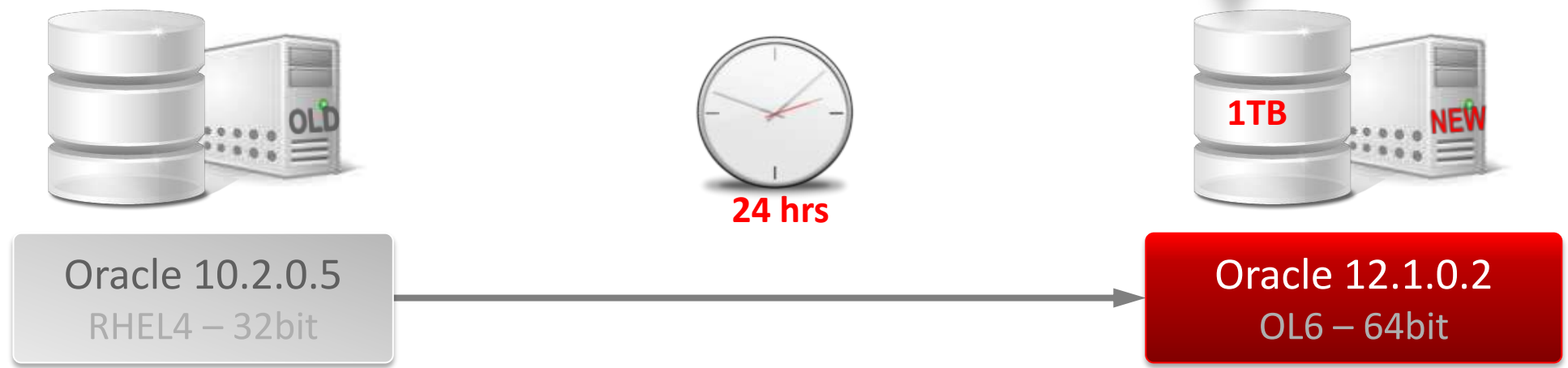




▪ Default location for `catctl.pl` log files

- Current working directory
  - Recommendation: Use `-l parameter` to specify an alternate location
- One log file for each parallel thread

```
6876330 Feb 25 21:04 catupgrd2.log
6626849 Feb 25 21:04 catupgrd1.log
16983150 Feb 25 21:04 catupgrd0.log
```





- Restart the database in normal mode
  - Create an `spfile` from the startup `init.ora` now

```
oracle@localhost.localdomain: /u01/app/oracle/product/12.1.0/dbs
File Edit View Terminal Tabs Help
Copyright (c) 1982, 2013, Oracle. All rights reserved.
Connected to an idle instance.
SYS:V102> startup pfile=initV102.ora
ORACLE instance started.

Total System Global Area 417546240 bytes
Fixed Size 2288432 bytes
Variable Size 142607568 bytes
Database Buffers 264241152 bytes
Redo Buffers 8409088 bytes
Database mounted.
Database opened.
SYS:V102> create spfile from pfile;

File created.
```



Oracle 10.2.0.5  
RHEL4 – 32bit

Oracle 12.1.0.2  
OL6 – 64bit





▪ Recompilation with `utlprp.sql`

– Call `utlprp.sql` directly to customize CPU usage

- Most efficient value for `n` is 2x number of CPU cores

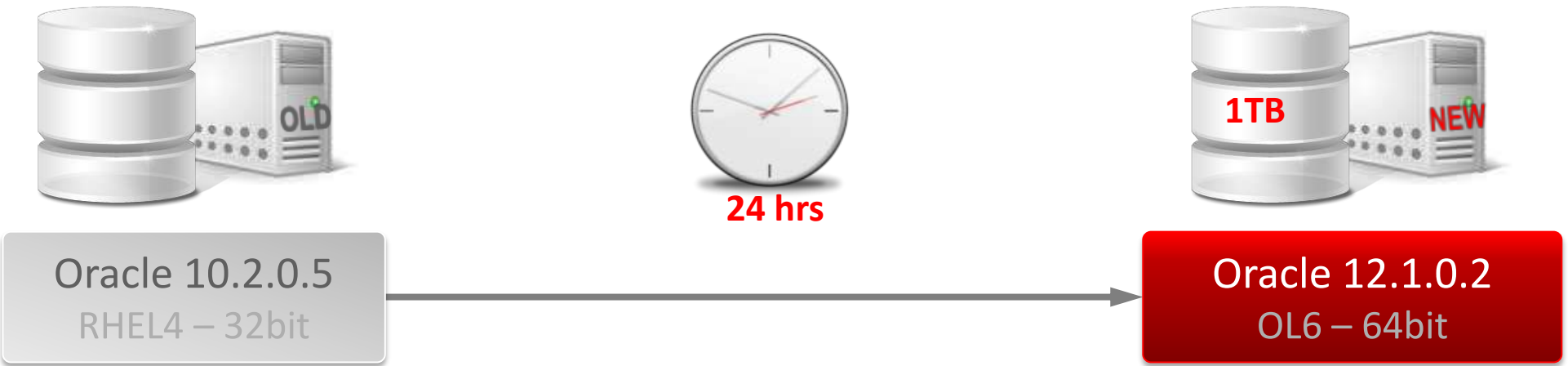
– Gathering fixed objects stats may speed up recompilation



```
SQL> @utlprp n
```



```
exec
DBMS_STATS.GATHER_FIXED_OBJECTS_STATS
;
```





## ■ Monitoring of recompilation

### 1. Objects requiring compilation:

```
SELECT COUNT(*) FROM obj$  
WHERE status IN (4, 5, 6);
```

### 2. Objects compiled already:

```
SELECT COUNT(*) FROM UTL_RECOMP_COMPILED;
```

### 3. Parallel jobs created by UTL\_RECOMP:

```
SELECT job_name FROM dba_scheduler_jobs  
WHERE job_name like 'UTL_RECOMP_SLAVE_%';
```

### 4. Parallel jobs still running:

```
SELECT job_name FROM dba_scheduler_running_jobs  
WHERE job_name like 'UTL_RECOMP_SLAVE_%';
```



Oracle 10.2.0.5  
RHEL4 – 32bit

Oracle 12.1.0.2  
OL6 – 64bit

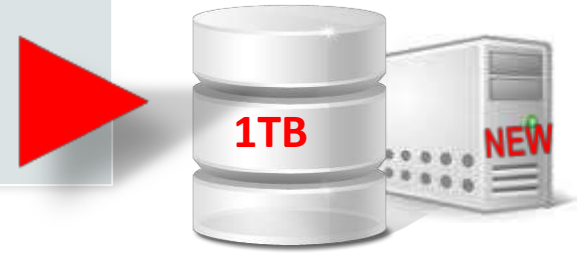




▪ New status in DBA\_REGISTRY for the SERVER component in case of any error **before recompilation**

- Check REGISTRY\$error for error details
- After recompilation the status remains the same compared to previous releases

COMP_ID	COMP_NAME	VERSION	STATUS
<b>CATALOG</b>	Oracle Database Catalo	12.1.0.1.0	<b>INVALID</b>
<b>CATPROC</b>	Oracle Database Packa	12.1.0.1.0	<b>INVALID</b>
JAVAVM	JServer JAVA Virtual M	12.1.0.1.0	VALID
CATJAVA	Oracle Database Java P	12.1.0.1.0	VALID
...			



Oracle 10.2.0.5  
RHEL4 – 32bit

Oracle 12.1.0.2  
OL6 – 64bit



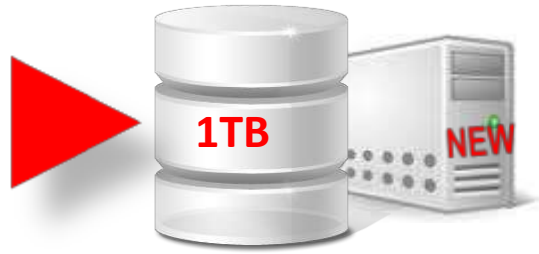
▪ Execute `postupgrade_fixups.sql`

```

oracle@localhost.localdomain: /u01/app/oracle/cfgtoollogs/V102/preupgrade
File Edit View Terminal Tabs Help
SYS:V102> @/u01/app/oracle/cfgtoollogs/V102/preupgrade/postupgrade_fixups.sql
Post Upgrade Fixup Script Generated on 2013-02-22 14:44:43 Version: 12.1.0.1 Bu
ild: 006
Beginning Post-Upgrade Fixups...
PL/SQL procedure successfully completed.

*****
Check Tag:      OLD_TIME_ZONES_EXIST
Check Summary:  Check for use of older timezone data file
Fix Summary:    Update the timezone using the DBMS_DST package after upgrade is c
omplete.
*****
Fixup Returned Information:
INFORMATION: --> Older Timezone in use

Database is using a time zone file older than version 18.
After the upgrade, it is recommended that DBMS_DST package
be used to upgrade the 12.1.0.1.0 database time zone version
to the latest version which comes with the new release.
Please refer to My Oracle Support note number 977512.1 for details.
*****
  
```



Oracle 10.2.0.5  
RHEL4 – 32bit

Oracle 12.1.0.2  
OL6 – 64bit

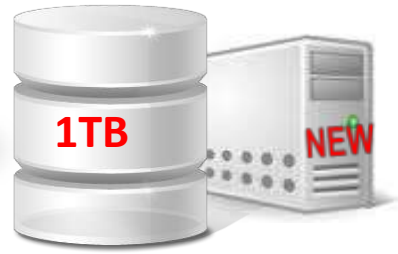




▪ Upgrade status check: `utlu121s.sql`

```

oracle@localhost.localdomain: ~
File Edit View Terminal Tabs Help
SYS:V102> @?/rdbms/admin/utlu121s.sql
.
Oracle Database 12.1 Post-Upgrade Status Tool          02-28-2013 14:38:12
.
Component          Current          Version          Elapsed Time
Name               Status           Number           HH:MM:SS
.
Oracle Server
.                   VALID           12.1.0.1.0      00:23:23
JServer JAVA Virtual Machine
.                   VALID           12.1.0.1.0      00:07:46
Oracle Workspace Manager
.                   VALID           12.1.0.1.0      00:01:32
Oracle XDK
.                   VALID           12.1.0.1.0      00:04:07
Oracle XML Database
.                   VALID           12.1.0.1.0      00:06:50
Oracle Database Java Packages
.                   VALID           12.1.0.1.0      00:00:36
Final Actions
.                   .
Total Upgrade Time: 00:50:44
  
```



Oracle 10.2.0.5  
RHEL4 – 32bit

Oracle 12.1.0.2  
OL6 – 64bit





Invalid objects check

- utluiobj.sql



```

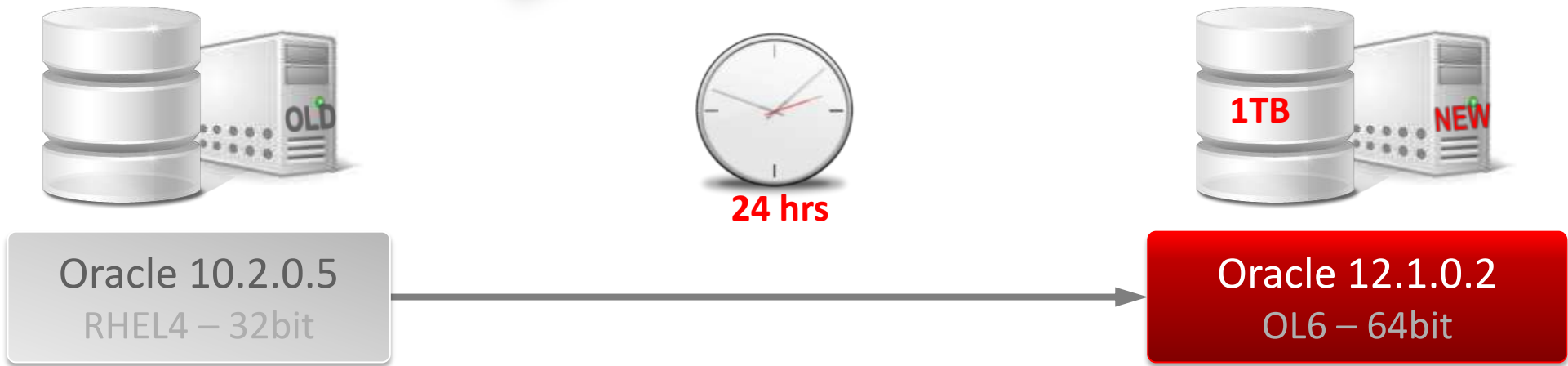
oracle@localhost.localdomain: ~
File Edit View Terminal Tabs Help
SYS:V102>
SYS:V102> @?/rdbms/admin/utluiobj.sql
.
Oracle Database 12.1 Post-Upgrade Invalid Objects Tool 02-28-2013 14:41:12
.
This tool lists post-upgrade invalid objects that were not invalid
prior to upgrade (it ignores pre-existing pre-upgrade invalid objects).
.
Owner                Object Name                Object Type
.
PL/SQL procedure successfully completed.
  
```

- Manual check



```

SQL> select OWNER, OBJECT_NAME, OBJECT_TYPE
from DBA_INVALID_OBJECTS order by 1,2;
  
```





■ Time zone adjustment – important?

8:10 PM - Fri, Mar 09 Boston, MA (BOS)	<b>Different Date</b> 9:55 AM - Sat, Mar 10 Munich, Germany (MUC)	<b>Lufthansa</b> Flight 425 - Airbus A340-600 Class: Business (authorized individuals only)	Non-stop Flight time: 7:45 3845 miles N/A on-time <a href="#">View seats</a>
8:10 PM - Sat, Mar 10 Boston, MA (BOS)	<b>Different Date</b> 9:55 AM - Sun, Mar 11 Munich, Germany (MUC)	<b>Lufthansa</b> Flight 425 - Airbus A340-300 Class: Economy	Non-stop Flight time: 6:45 3845 miles N/A on-time <a href="#">View seats</a>

– Why is the flight 1 hour shorter on Saturday? 😊

Option 1

<b>TURKISH AIRLINES</b> ★★★★ Flight 1878 - Airbus A321 Economy <a href="#">View seats</a> Operated by Turkish Airlines Non-stop, Flight time 2:50, 1691 km Fare rules	Depart MXP 06:45 Fri, 13 May	Arrive IST 10:35 Fri, 13 May
<b>TURKISH AIRLINES</b> ★★★★ Flight 334 - 32B AIRBUS JET Economy <a href="#">View seats</a> <b>Operated by Turkish Airlines</b> Non-stop, Flight time 1:50, 1771 km Fare rules	Depart IST 17:20 Fri, 13 May	Arrive GYD 21:10 Fri, 13 May
<b>TURKISH AIRLINES</b> ★★★★ Flight 333 - 32B AIRBUS JET Economy <a href="#">View seats</a> <b>Operated by Turkish Airlines</b> Non-stop, Flight time 4:15, 1771 km Fare rules	Depart GYD 13:05 Sun, 15 May	Arrive IST 15:20 Sun, 15 May
<b>TURKISH AIRLINES</b> ★★★★ Flight 1635 - Airbus A330 Economy <a href="#">View seats</a> Operated by Turkish Airlines Non-stop, Flight time 2:45, 1563 km Fare rules	Depart IST 17:15 Sun, 15 May	Arrive MUC 19:00 Sun, 15 May

– Same distance but different flight times?



- Time zone adjustment

- Time zone conversion should be done **post upgrade**
  - Required if datatype `TIMESTAMP WITH TIME ZONE` is used
- **Rule:**  $TZ_{Destination} \geq TZ_{Source}$
- Time zone definitions in: `$ORACLE_HOME/oracore/zoneinfo`
- Patch in [MOS Note:412160.1](#)

Oracle Database Release	Default Time Zone Version
10.2.0.3 – 11.1.0.7	DST V4
11.2.0.1	DST V11
11.2.0.2 - <b>11.2.0.4</b>	DST V14
12.1.0.1, <b>12.1.0.2</b>	DST V18
Most recent time zone file:	DST V25



- Time zone adjustment in Oracle 12c – script in: [MOS Note:1585343.1](#)
  - For Oracle 11.2: [MOS Note:977512.1](#)

```

oracle@localhost.localdomain: ~
File Edit View Terminal Tabs Help
SYS:V102> @/home/oracle/DST/DST_adjust.sql
Connected.
Database closed.
Database dismounted.
ORACLE instance shut down.
ORACLE instance started.

Total System Global Area  417546240 bytes
Fixed Size                 2288432 bytes
Variable Size             142607568 bytes
Database Buffers          264241152 bytes
Redo Buffers               8409088 bytes
Database mounted.
Database opened.

PROPERTY_NAME
-----
VALUE
-----
DST_PRIMARY_TT_VERSION
  
```

Database will be restarted!



Oracle 10.2.0.5  
RHEL4 – 32bit

Oracle 12.1.0.2  
OL6 – 64bit





## ▪ RMAN Catalog Upgrade:

- SQL> @\$ORACLE\_HOME/rdbms/admin/**dbmsrmansys.sql**
- \$ rman CATALOG my\_catalog\_owner@catdb  
recovery catalog database Password:  
RMAN> UPGRADE CATALOG;  
RMAN> UPGRADE CATALOG;  
RMAN> EXIT;



▪ See: [https://blogs.oracle.com/UPGRADE/entry/rman catalog upgrade to oracle](https://blogs.oracle.com/UPGRADE/entry/rman_catalog_upgrade_to_oracle)

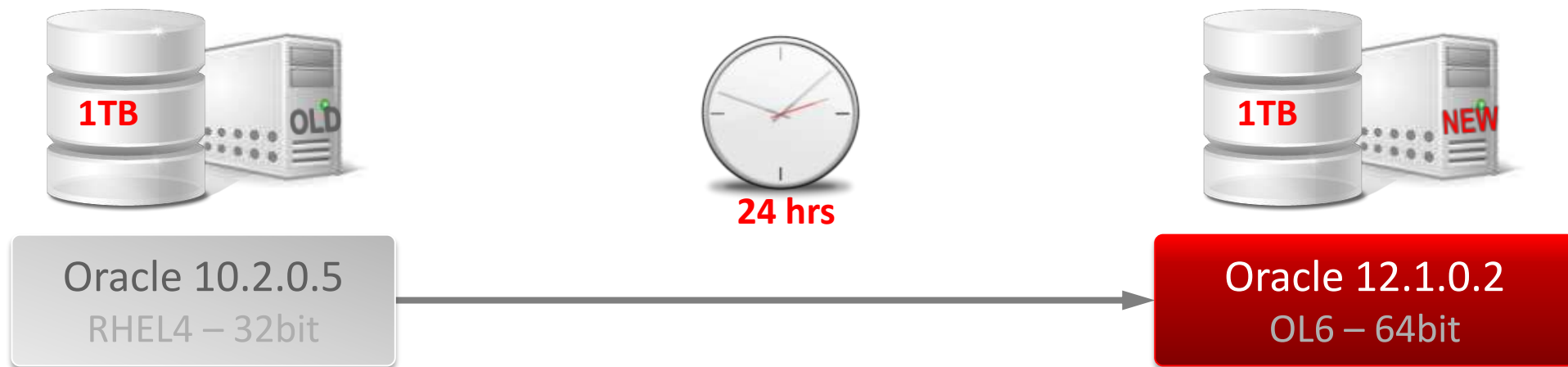
- **RMAN Catalog database needs now to be an EE with Partitioning Option (since 12.1.0.2)** - MOS Note:1927265.1





# Case 1: **Alternative** without HW migration

- If the database would have been upgraded on the existing hardware the Database Upgrade Assistant (DBUA) would have been an alternative



# Case 1: **Alternative** without HW migration

- DBUA:

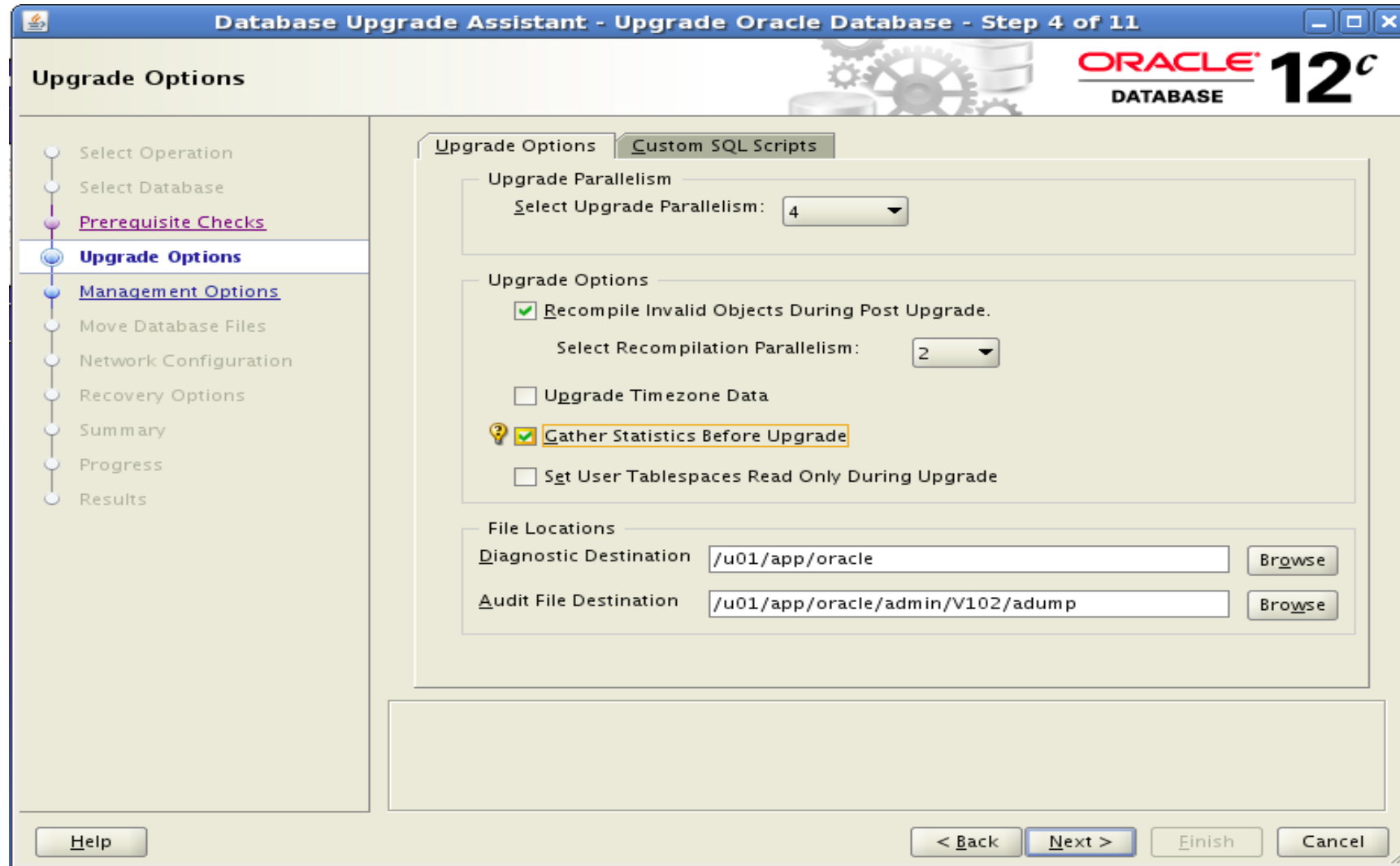
Validation	Severity	Fixable	Action
Pre Upgrade Utility Checks	Warning		
"ORACLE_OCM" user present	Warning	Yes	Fix - Pre Upgrade
Invalid objects exist	Warning	No	Ignore
Database Upgrade Checks	Success		

"ORACLE\_OCM" user present [more details](#)

The "ORACLE\_OCM" user is present in the database. This is an internal account used by Oracle Configuration Manger. Oracle recommends dropping this user prior to upgrading the database.

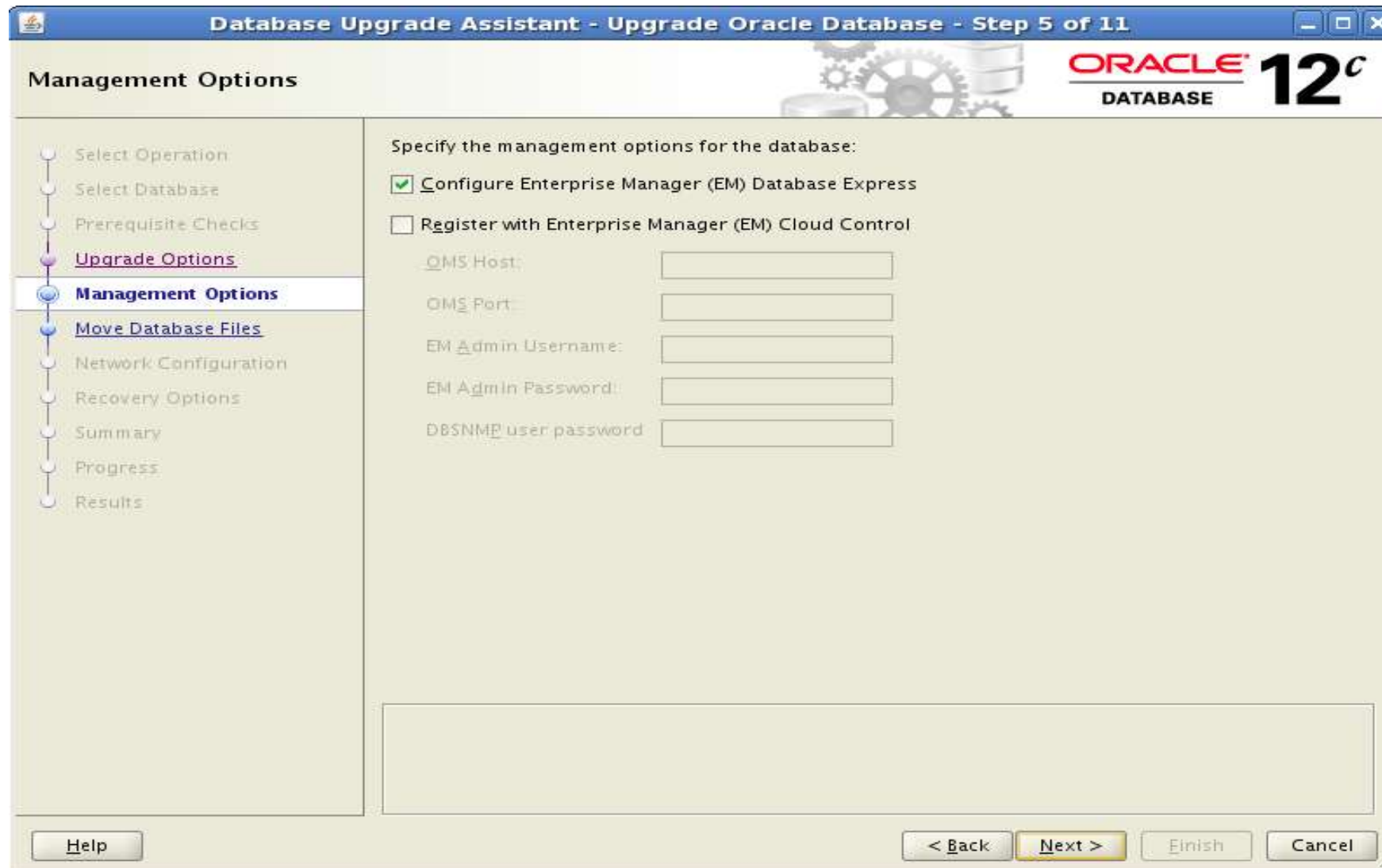
# Case 1: **Alternative** without HW migration

- DBUA:



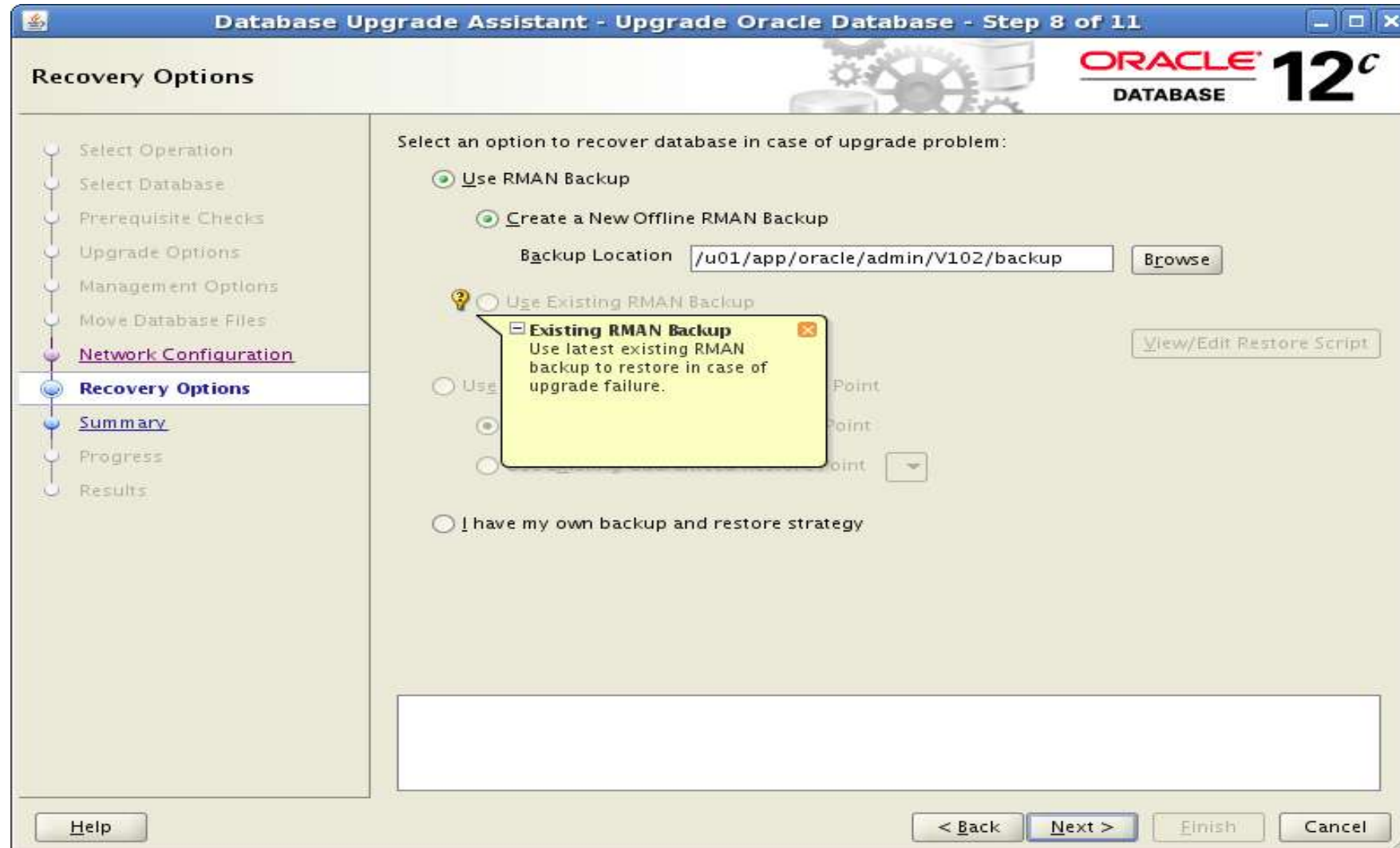
# Case 1: **Alternative** without HW migration

- DBUA:



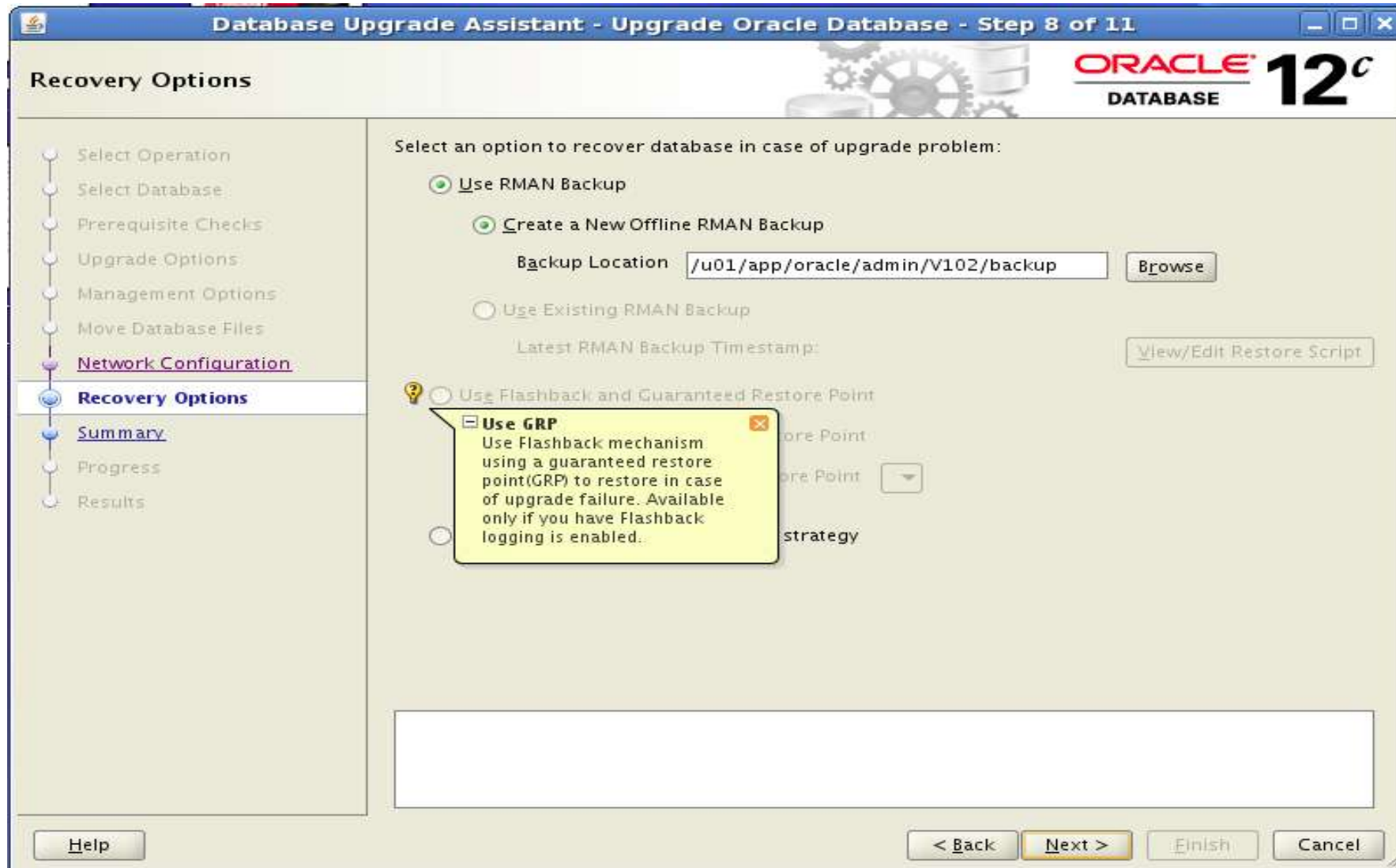
# Case 1: **Alternative** without HW migration

## ■ DBUA:



# Case 1: **Alternative** without HW migration

## ■ DBUA:



# Case 1: **Alternative** without HW migration

- DBUA:

The screenshot shows the Oracle Database Upgrade Assistant (DBUA) interface for upgrading an Oracle Database to version 12c. The main window is titled "Database Upgrade Assistant - Upgrade Oracle Database - Step 10 of 11". The "Progress" section is active, showing a progress bar at 20%. The "Activity Log" window is open, displaying the following log entries:

```
##### Log File:
/u01/app/oracle/cfgtoollogs/dbua/V102/upgrade1/PreUpgrade.log

TRUE
TRUE
      1
Database closed.
Database dismounted.
ORACLE instance shut down.
select count(*) from v$instance
*
ERROR at line 1:
ORA-01034: ORACLE not available
```

The "Activity Log" window also contains a table with the following data:

Time	Status
0:22	Finished
	In Progress

The "Activity Log" window has a "Close" button. The main DBUA window has buttons for "Activity Log", "Alert Log", "Stop", "Help", "< Back", "Next >", "Finish", and "Cancel".

# Case 1: **Alternative** without HW migration

- DBUA:

The screenshot shows the Oracle Database Upgrade Assistant (DBUA) interface during the 'Progress' step of an Oracle Database 12c upgrade. The main window displays a progress bar at 21% and a list of steps on the left. An 'Activity Log' dialog box is open, showing a list of SQL files and their execution status.

**Activity Log**

Time	Status
0:22	Finished
	In Progress

The Activity Log dialog box contains the following text:

```
cmpupord.sql  cmpupmsc.sql  
[Phase 52] type is 1 with 1 Files  
ora_restart.sql  
[Phase 53] type is 1 with 1 Files  
cmpupend.sql  
[Phase 54] type is 1 with 1 Files  
catupend.sql  
[Phase 55] type is 1 with 1 Files  
nothing.sql  
[Phase 56] type is 1 with 1 Files  
nothing.sql  
Using 4 processes.
```



# Case 1: **Alternative** without HW migration

- DBUA:

The screenshot shows the Database Upgrade Assistant (DBUA) interface for upgrading an Oracle Database to version 12c. The main window is titled "Database Upgrade Assistant - Upgrade Oracle Database - Step 10 of 11". The "Progress" section is active, showing a progress bar at 21%. An "Alert Log" window is open, displaying the following log entries:

```
Tue Jul 16 19:31:32 2013  
ALTER SYSTEM SET resource_manager_plan= SCOPE=MEMORY;  
Tue Jul 16 19:31:32 2013  
ALTER SYSTEM SET recyclebin='OFF' DEFERRED SCOPE=MEMORY;  
Resource Manager disabled during database migration  
replication_dependency_tracking turned off (no async multimaster  
replication found)  
AQ Processes can not start in restrict mode  
Starting background process CJQ0  
Tue Jul 16 19:31:32 2013  
CJQ0 started with pid=23, OS id=4667  
Completed: ALTER DATABASE OPEN MIGRATE  
Tue Jul 16 19:31:37 2013  
Thread 1 advanced to log sequence 35 (LGWR switch)  
Current log# 2 seq# 35 mem# 0: /oradata/V102/redo02.log  
Tue Jul 16 19:31:46 2013  
Thread 1 advanced to log sequence 36 (LGWR switch)  
Current log# 3 seq# 36 mem# 0: /oradata/V102/redo03.log
```

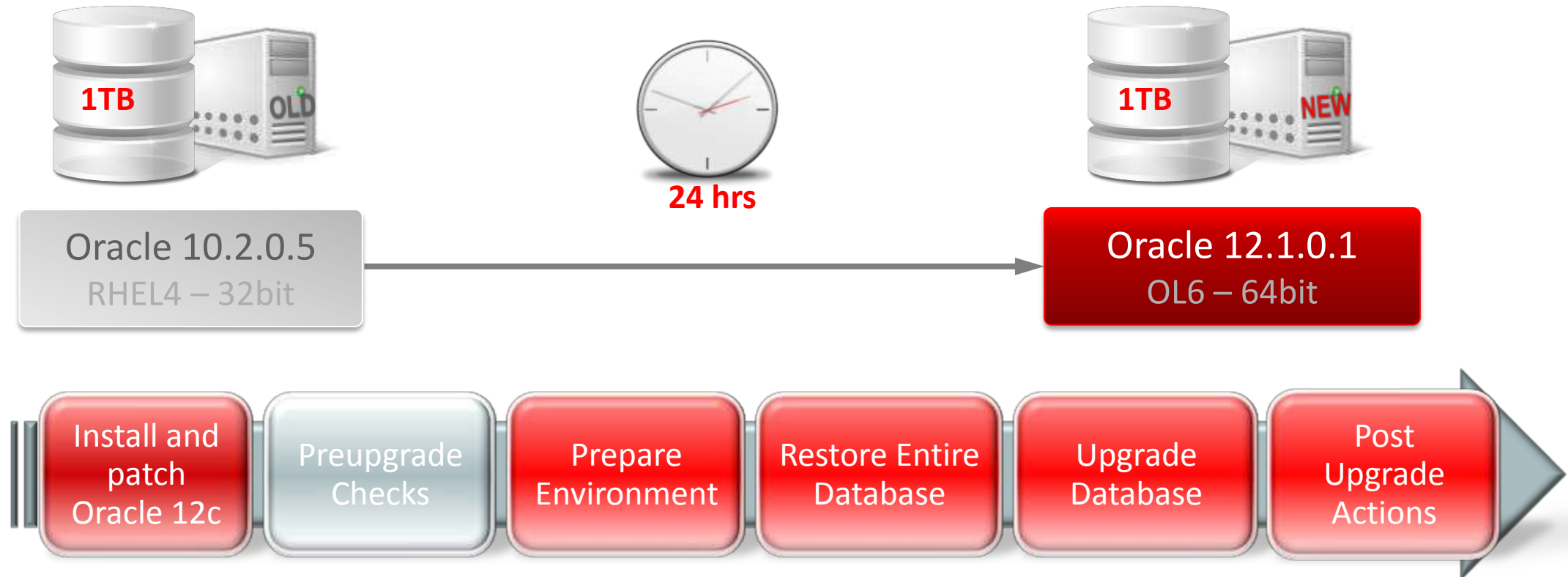
The Alert Log window also includes a table with the following data:

Time	Status
19:22	Finished
	In Progress

The DBUA interface includes a navigation pane on the left with steps: Select Operation, Select Database, Prerequisite Checks, Upgrade Options, Management Options, Move Database Files, Network Configuration, Recovery Options, Summary, Progress (selected), and Results. At the bottom, there are buttons for "Activity Log", "Alert Log", "Stop", "Help", "< Back", "Next >", "Finish", and "Cancel".

# Case 1: Summary

- Database upgrade including migration to a new server





# A small team and an excellent plan

## Upgrade 300 databases at Mobiliar Insurance, Switzerland

# Real World Checkpoint

## Customer

### ▪ Swiss Mobiliar

## Project

## Constraints

## Preparation

## Upgrade

## Success?

## Remarks



- Switzerland's most personal insurer
- Founded 1826 in Bern, oldest Swiss insurance
- Legal form:
  - Cooperative association (mutual company)
- Over 1.7 million persons and firms insured
- Switzerland's no.1 insurer for:
  - Businesses, term life insurances, households
- 80 general agencies at 160 locations
- Over 4,400 employees and 325 trainees
- Awarded Most Trusted Insurance Brand in Switzerland for 13 consecutive years

**Die Mobiliar.** *Die persönlichste Versicherung der Schweiz.*



# Real World Checkpoint

Customer

Project

Constraints

Preparation

Upgrade

Success?

Remarks

- Upgrade 267 databases
  - Oracle Database 11.2.0.3 to Oracle Database 12.1.0.2
  - 80 production databases
- Oracle Cloud Control
- AWR Warehouse (home-made)
- Shell scripts
- Oracle Restart with ASM
- Oracle In Memory
- OID

# Real World Checkpoint

Customer

Project

Constraints

Preparation

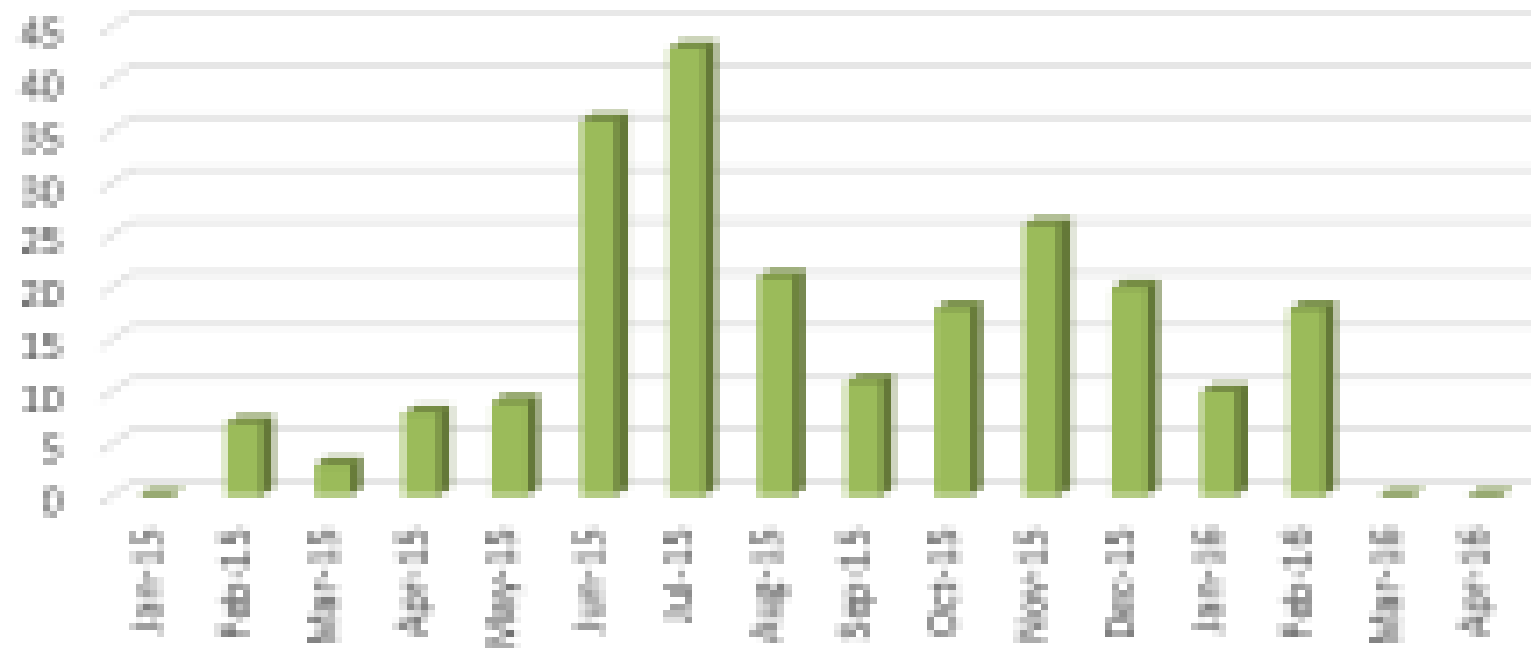
Upgrade

Success?

Remarks

- Project timeline: 24 months
  - **Goal: 18 months**

Migrations per month



# Real World Checkpoint

Customer

Project

Constraints

Preparation

Upgrade

Success?

Remarks

- **Small DBA Team**
  - **Only 3.8 FTE + 1 newbie**
- 2 major software releases of Mobiliar Applications per year resulting in a full month of code freeze
- Bug fixing support for Oracle 11.2.0.3 ended Aug 27, 2015
- Highly complex applications
  - Queries with more than 1000 bind variables and 250 outer joins
- One core team member broke his leg in September 2015 and was absent for almost 2 months



# Real World Checkpoint

Customer

Project

Constraints

Preparation

Upgrade

Success?

Remarks

- All queries, execution time and execution paths are tracked on a self made AWR Performance DWH
- Possibility to compare performance before and after the upgrade on query level
- Performance tests performed by application owner
- Regression tests done during the testing phase of the Mobi Software Release
  - PSU RDBMS 12.1.0.2.4, PSU GRID 12.1.0.2.2
  - Two Oracle Homes on the same server
  - Upgrade with `catctl.pl` embedded into home-built shell script



# Real World Checkpoint

Customer

Project

Constraints

**Preparation**

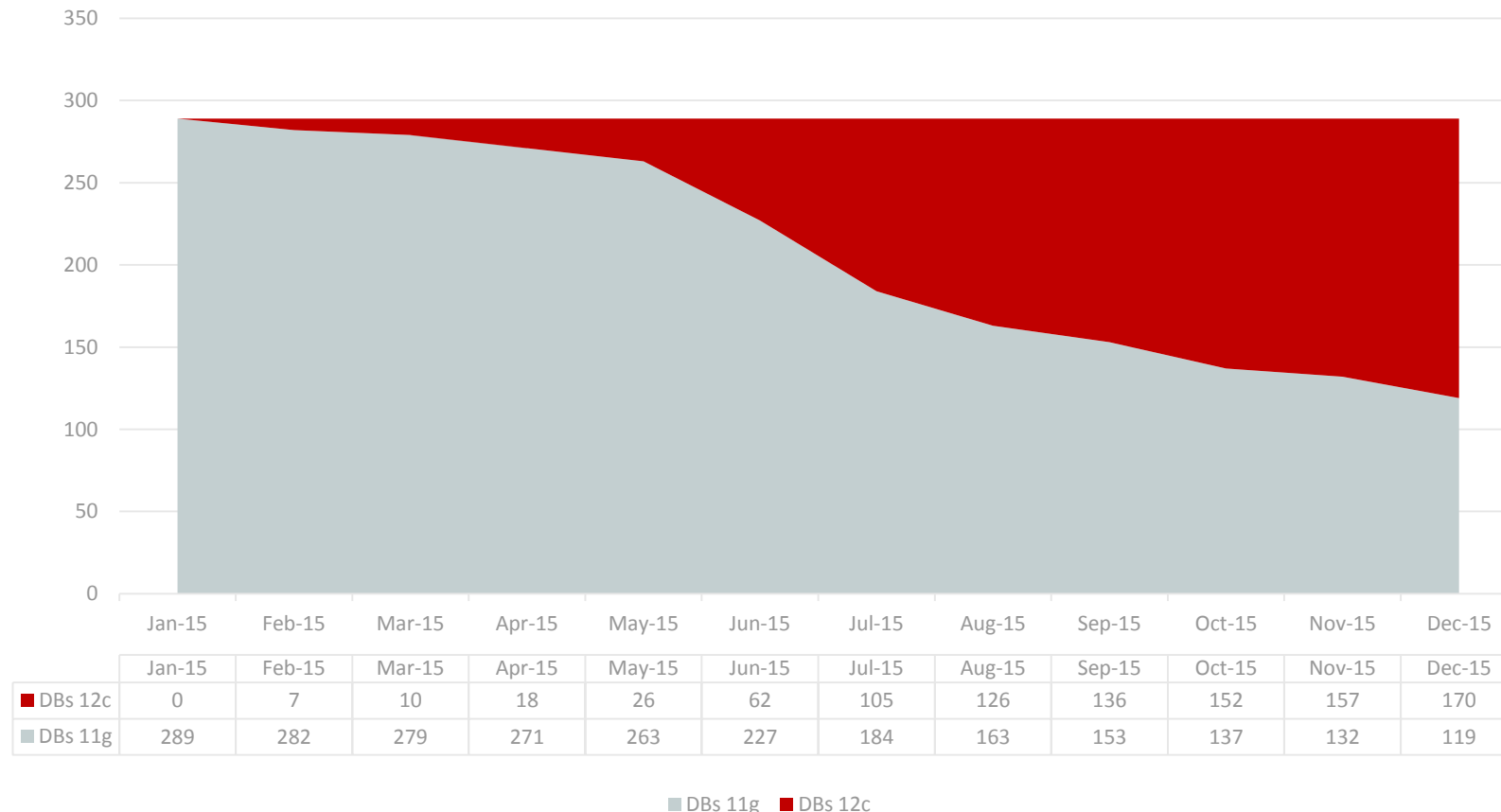
Upgrade

Success?

Remarks

## ■ Project Monitoring with Excel Sheet

Oracle Database Swiss Mobiliar





# Real World Checkpoint

Customer

Project

Constraints

Preparation

Upgrade

Success?

Remarks

- Live? And alive?
  - Yes! First system went live on Feb 4, 2015
  - Current status (Feb 25, 2016):
    - 230 out of 267 databases live on Oracle Database 12.1.0.2
    - 77% upgraded already
    - Project perfectly on schedule



# Real World Checkpoint

Customer

Project

Constraints

Preparation

Upgrade

Success?

Remarks

- No major issues after go live
  - Issues caught during testing, e.g.:
    - Bug 20776435: PARSE OF INMEMORY QUERY IS SPINNING ON CPU
      - Query with 250 Left Joins
      - Workaround:

```
alter session set "_optimizer_inmemory_table_expansion"=false;
```
    - Bug 19677469: NO QUERY REWRITE
      - Workaround:

```
CREATE MATERIALIZED VIEW ... SELECT /*+ MV_MERGE */ ...
```

or:

```
alter system set "_fix_control"='10145667:OFF';
```

# Real World Checkpoint

Customer

Project

Constraints

Preparation

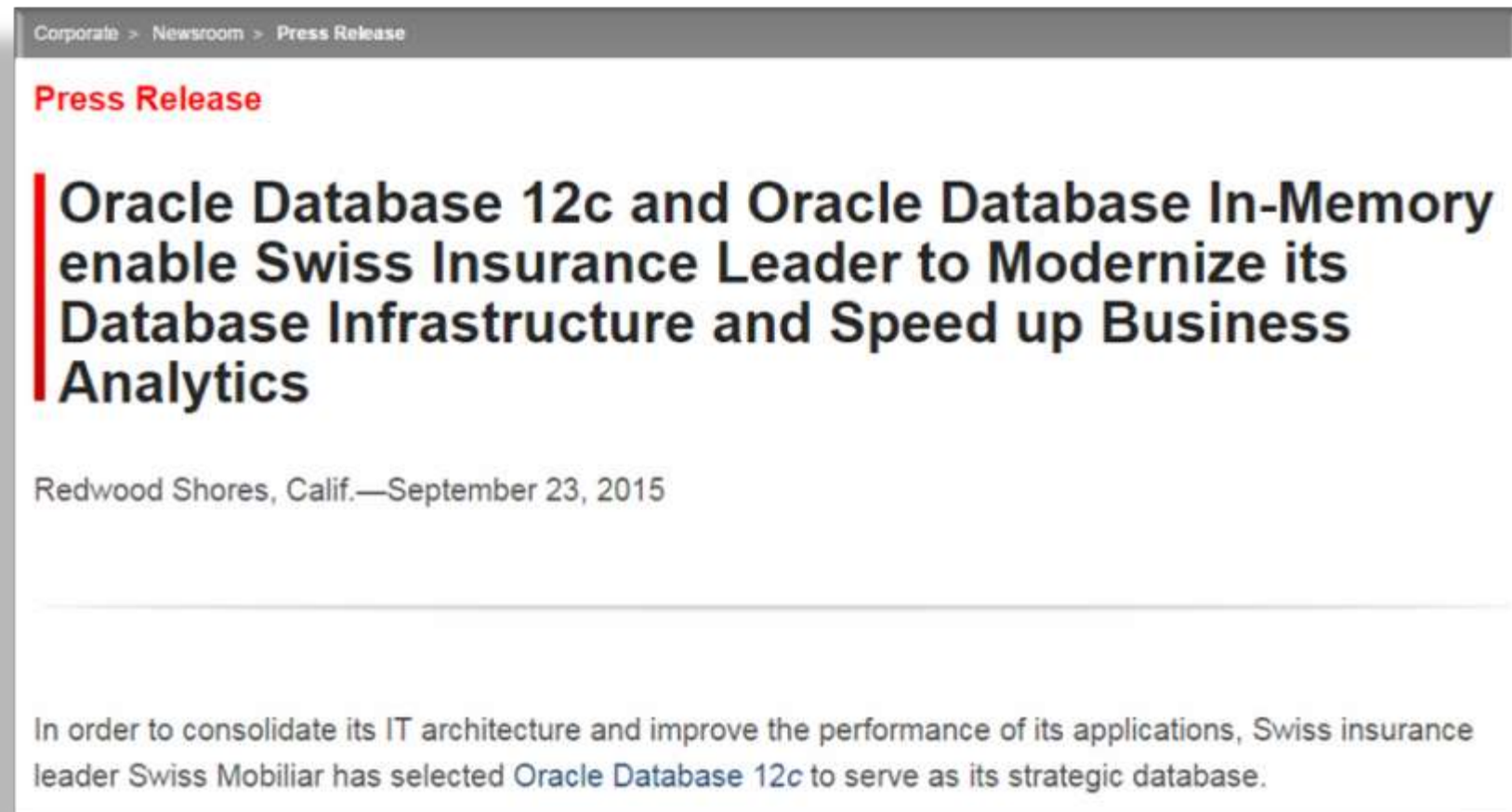
Upgrade

Success?

Remarks

- Oracle In-Memory boosts performance

– Read on: <http://tinyurl.com/Mobi12c>



Corporate > Newsroom > Press Release

**Press Release**

**Oracle Database 12c and Oracle Database In-Memory enable Swiss Insurance Leader to Modernize its Database Infrastructure and Speed up Business Analytics**

Redwood Shores, Calif.—September 23, 2015

---

In order to consolidate its IT architecture and improve the performance of its applications, Swiss insurance leader Swiss Mobiliar has selected Oracle Database 12c to serve as its strategic database.

# Real World Checkpoint

## Customer

*"The entire upgrade project of our 300 Oracle databases at Die Mobiliar is running very well.*

## Project

## Constraints

*When we catch issues, we fix them before going live.*

## Preparation

*And features such as Oracle In-Memory add a lot of performance boost to some of our applications.*

## Upgrade

## Success?

*Especially the Oracle Upgrade Reference Program was a great help and added a lot of value to our project's progress.*

## Remarks

*We are very happy and satisfied with the upgrade process and the reliability and performance of Oracle Database 12c".*

Paolo Kreth, Group Manager Databases, Die Mobiliar

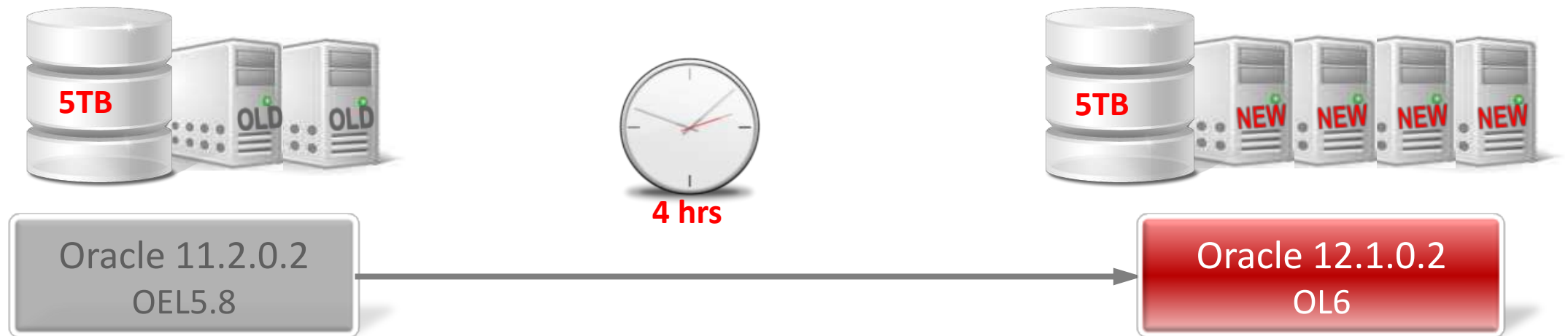
# Upgrade, Migrate & Consolidate

- 1 Introduction
- 2 Preparation Steps
- 3 Upgrade / Migrate / Consolidate**
- 4 Fallback Strategies
- 5 New Features
- 6 Performance Management
- 7 Wrap Up



# Case 2: Upgrade RAC and move to ASM

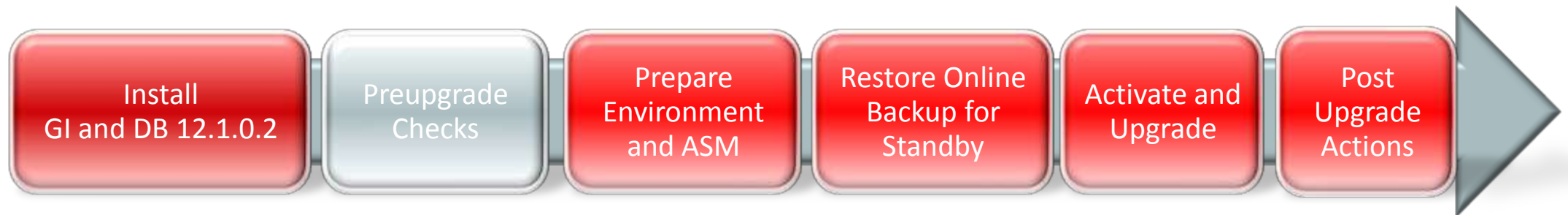
- RAC Database migration to a new cluster including upgrade





# Case 2: Upgrade RAC and move to ASM

- RAC Database migration to a new cluster including upgrade



4 hrs



Oracle 11.2.0.2  
OEL5.8

Oracle 11.2.0.2  
PHYSICAL STANDBY

# Use a Physical Standby for Hardware Migration

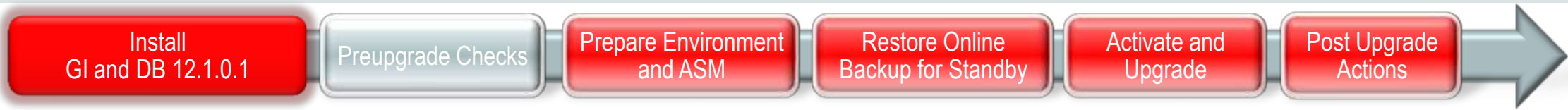
- Fast and simple: Test it several times!
- Does not require **source release** software **on target hardware**
  - *Mixed Oracle Version support with Data Guard Redo Transport Services* ([Doc ID 785347.1](#))
- Could include migration to RAC and/or ASM
  - *Migrating to RAC using Data Guard* ([Doc ID 273015.1](#))
- Works cross platform (same Endianness) in **some** cases
  - *Data Guard Support for Heterogeneous Primary and Physical Standbys...* ([Doc ID 413484.1](#))



# Case 2: Upgrade RAC and move to ASM

- RMAN mixed platform support
  - Duplicate, restore and recovery
    - [MOS Note:1079563.1](#) → Only supported for:
      - DUPLICATE FROM ACTIVE DATABASE
      - Backup-based DUPLICATE using image copies or backup sets
      - RESTORE and RECOVER using image copies or backup sets
        - Bit change requires utlirp.sql to invalidate PL/SQL and code





## ▪ Grid Infrastructure installation

- Always install/upgrade **Oracle Clusterware first!**
  - Install it into a **new Grid Infrastructure home**
  - GI version  $\geq$  resources (ASM, RDBMS ...)
    - Rule is valid until 4<sup>th</sup> digit – PSUs can differ and can be higher in e.g. DB Home



# Grid Infrastructure Installation

- Oracle Home/Base
  - Grid Infrastructure should be in a different location than the database's `ORACLE_BASE`
  - Part of the GI home is owned by `root` once `root.sh/rootupgrade.sh` has been run



```
oracle@rac2:~$ pwd
/u01/app/12.1.0/grid_1
```



```
oracle@rac2:/u01/app/oracle$ pwd
/u01/app/oracle/product/11.2.0/dbhome_1
```

```
oracle@rac2:/u01/app/12.1.0$ pwd
/u01/app/12.1.0
oracle@rac2:/u01/app/12.1.0$ ls -lrt
total 4
drwxr-xr-x 70 root oinstall 4096 Jan 15 01:23 grid_1
```

Upgrade, Migrate & Consolidate to Oracle Database 12c

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Windows: Remote Registry Service must be enabled – see: <https://technet.microsoft.com/en-us/library/cc754820.aspx>

# Grid Upgrade Planning, Prep and Prereqs

- RAC Best Practice / Starter Kit

Start here:

- Generic: [MOS Note: 810394.1](#)

Then study the one for your platform(s):

- Linux: [MOS Note: 811306.1](#)
- Windows: [MOS Note: 811271.1](#)
- AIX: [MOS Note: 811293.1](#)
- HP-UX: [MOS Note: 811303.1](#)
- SPARC Solaris: [MOS Note: 811280.1](#)

- ORAchk (formerly RACchk)

- [MOS Note:1268927.1](#)

- Cluvfy

- [MOS Note:316817.1](#)

- EXAchk

- [MOS Note:1070954.1](#)

- Very useful notes:

- [MOS Note: 1096952.1](#) - Master Note for RAC, Clusterware and Grid Infrastructure
- [MOS Note: 1053147.1](#) - 11.2 Clusterware and Grid Home – What you need to know!

- Just in case: [MOS Note: 759868.1](#)- How to Convert RAC ASM/DB instances to non-RAC ASM/DB instances

# RAC Upgrade ORAchk Upgrade Readiness Assessment

- **Upgrade Readiness Assessment** with ORAchk: [MOS Note:1457357.1](#)
- **Download** the newest version of ORAchk: [MOS Note:1268927.1](#)



[Download ORAchk 12.1.0.2.5](#)

[Download ORAchk For Oracle IAM 12.1.0.2.5](#)

If you want to run ORAchk against Oracle Identity and Access Manager suite then choose ORAchk for Oracle IAM, if not not choose ORAchk.

ORAchk for Oracle IAM contains the normal ORAchk plus extension modules for Oracle Identity and Access Management suite.

## ORAchk Health Checks For The Oracle Stack

ORAchk replaces the popular RACcheck tool, extending the coverage based on prioritization of top issues reported by users, to proactively scan for known problems within the area of:

- + Oracle Database
- + Enterprise Manager Cloud Control (12c only)
- + E-Business Suite
- + Oracle Hardware Systems
- + Oracle Identity and Access Management
- + Oracle Siebel
- + Oracle PeopleSoft

### ORAchk features:

- Proactively scans for the most impactful problems across the various layers of your stack
- Simplifies and streamlines how to investigate and analyze which known issues present a risk to you
- Lightweight tool that runs within your environment without requiring config data to be sent to Oracle
- High level reports show your system health risks with the ability to drill down into specific problems and understand their resolutions
- Can be configured to send email notifications when it detects problems
- Collection Manager, a companion Application Express web app, provides a single dashboard view of collections across your entire enterprise

ORAchk will expand in the future with more high impact checks in existing and additional product areas. If you have particular checks or product areas you would like to see covered, please post suggestions in the ORAchk subspace in My Oracle Support Community.

# RAC Upgrade ORAchk Upgrade Readiness Assessment

- Upgrade Readiness feature of ORAchk
  - Pre Upgrade
    - `$> orachk -u -o pre`
  - Post Upgrade
    - `$> orachk -u -o post`



# GI Home: Planning, Prep and Prereqs

- 11.2/12.1 GI Home **cannot reside on a shared cluster file system** (e.g. ocfs2, Veritas CFS)
  - NFS based shared storage is supported
  - Installer will allow move from 10.2 on CFS to 11.2 on non-CFS
- All cluster nodes must be up and running
  - Remove any down nodes, or start them if possible
- Unset environment variables `ORACLE_HOME`, `ORACLE_BASE` and `ORA_CRS_HOME` for the installing user - the install scripts handle these
- Avoid OUI `AttachHome` issues
  - Set the following parameter in the SSH daemon configuration file `/etc/ssh/sshd_config` on all cluster nodes before running OUI
    - `LoginGraceTime 0`
  - Restart `sshd`
- Provision network resources for **Single Client Access Name (SCAN)**

# SCAN: Planning, Prep and Prereqs

- Since Oracle Database 11.2 clients connect to the database using SCAN VIPs
- The SCAN is associated with the entire cluster rather than an individual node
- Resolves to up to 3 IP Addresses in DNS or GNS
  - IP addresses returned in a round-robin manner
- SCAN listeners run under the Grid Infrastructure Home
- Provides load balancing and failover for client connections
- Check this white paper for more details:
  - [Oracle Real Application Clusters 11g Release 2 Overview of SCAN \(PDF\)](http://www.oracle.com/technetwork/database/clustering/overview/scan-129069.pdf)  
<http://www.oracle.com/technetwork/database/clustering/overview/scan-129069.pdf>

# SCAN: Planning, Prep and Prereqs

- SCAN VIPs - Network Requirement
  - A single client access name (SCAN) configured in DNS

```
[root@cluster1 oracle]# nslookup  
  
mycluster-scan1  
Server:          120.20.190.70  
Address:         120.20.190.70#53  
Name: mycluster -scan1.mydomain.com  
Address: 10.148.46. 79  
Name: mycluster -scan1.mydomain.com  
Address: 10.148.46. 77  
Name: mycluster -scan1.mydomain.com  
Address: 10.148.46. 78
```

# Completing the Upgrade

- **Top Level Flow:**
  - Verify the hardware/software environment
  - Install the software
  - Configure the software
  - Finalize the upgrade

# Completing the Upgrade

- Top Level Flow:
  - **Verify the hardware/software environment**
  - Secure Shell
    - We recommend using OUI to set up `ssh`
      - Old `ssh` setup not always considered valid by 11.2/12.1 OUI, due to tighter restrictions, but OUI will correct it
    - OUI will validate `ssh` before allowing you to continue
      - Watch out for `stty` commands or profile messages that may cause the automatic setup of `ssh` to fail
  - Cluster Verification Utility
    - Integrated into OUI but recommended to run before an install/upgrade
    - Has “fixup scripts” to correct certain failures (e.g. kernel parameters)
    - The most recent version is available from OTN
      - <http://www.oracle.com/technetwork/products/clustering/overview/index.html>

# Completing the Upgrade

- Top Level Flow:

- ☑ Verify the hardware/software environment

- **Install the software**

- Oracle Universal Installer – `./runInstaller`

- Should find existing Oracle Clusterware and suggest upgrade to Grid Infrastructure

- **Must run installer as the previous version's software owner**

- If you need to collect debug tracing (request from support)

- `./runInstaller -debug`

- Output is written to `stdout` by default

- Use `script` command to capture the output

# Completing the Upgrade

- Additional information: Pinning nodes [from documentation]

In order to change the node pin behavior the appropriate command is the `/crsctl pin/unpin css/` command, to pin or unpin any specific node. Pinning a node means that the association of a node name with a node number is fixed. If a node is not pinned, its node number may change if the lease expires while it is down. The lease of a pinned node never expires. Deleting a node with the `/crsctl delete node/` command implicitly unpins the node.

During upgrade of Oracle Clusterware, all servers are pinned, whereas after a fresh installation of Oracle Clusterware 11/g /release 2 (11.2), all servers you add to the cluster are unpinned.

You cannot unpin a server that has an instance of Oracle RAC that is older than Oracle Clusterware 11/g/ release 2 (11.2) if you installed Oracle Clusterware 11/g/ release 2 (11.2) on that server.

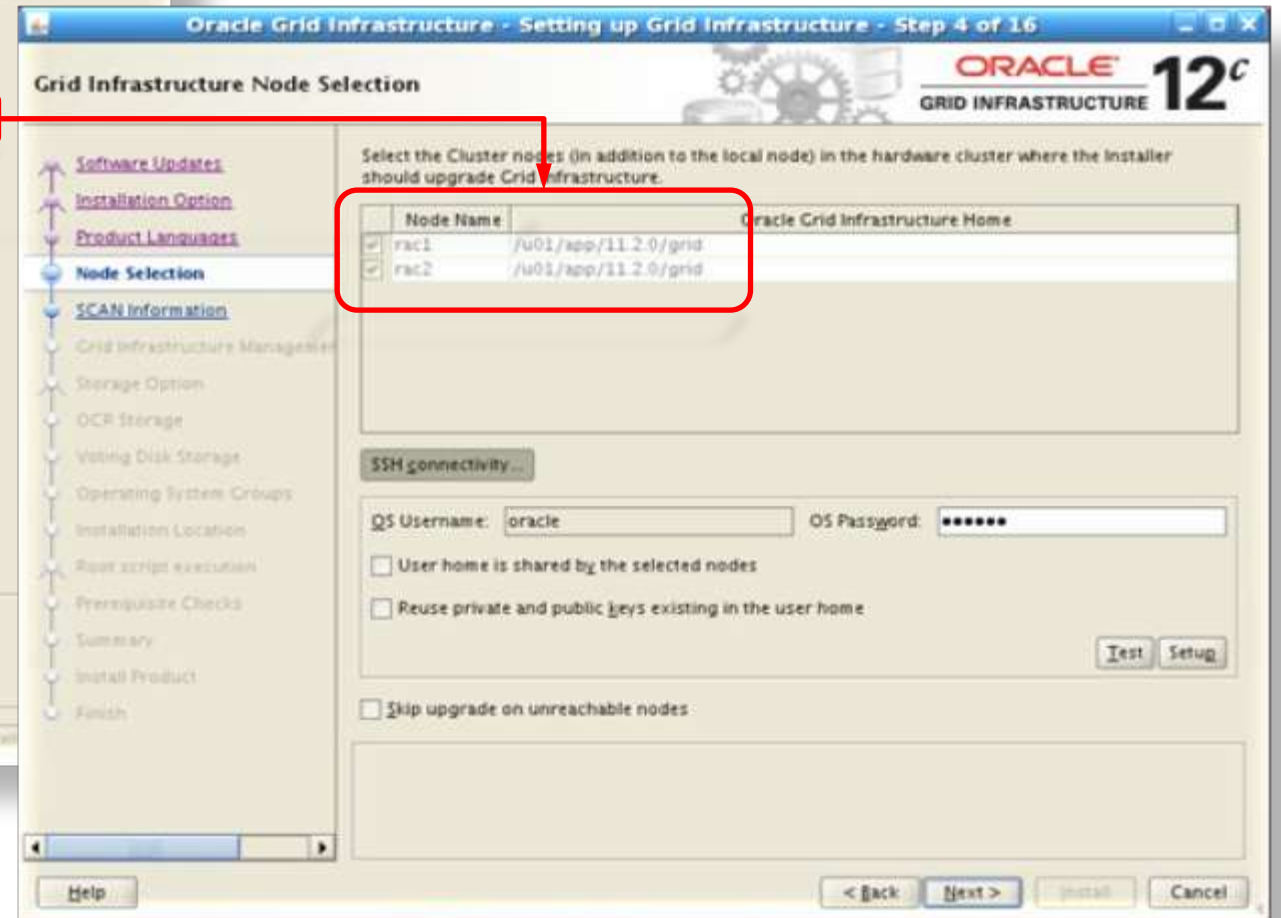
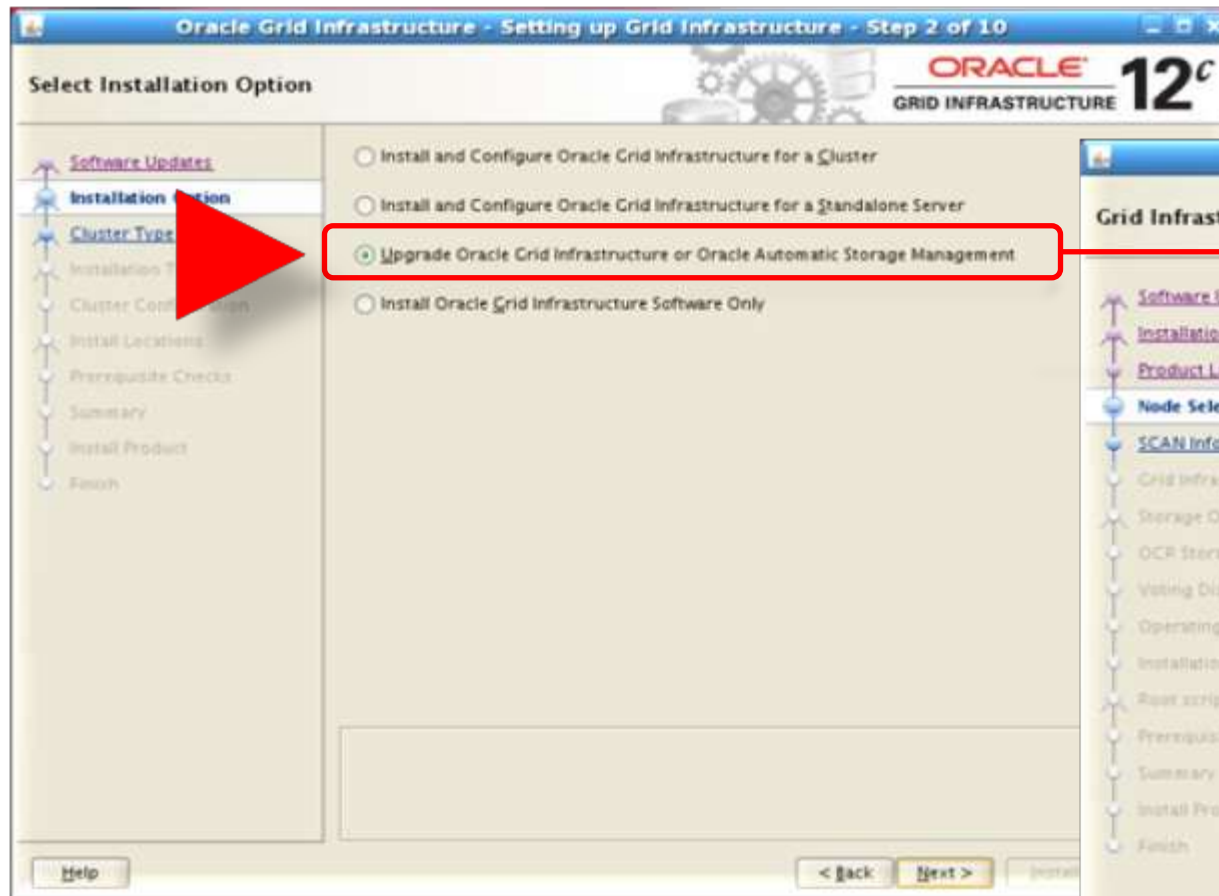
Pinning a node is required for rolling upgrade to Oracle Clusterware 11.2 and will be done automatically. We have seen cases where customer perform a manual upgrade and this would fail due to unpinned nodes.

# Oracle **Grid Infrastructure** 12.1.0.1 Upgrade

- How to Upgrade to Oracle Grid Infrastructure 12c Release 1
  - [Oracle Grid Infrastructure Installation Guide](#)
- 12c Grid Infrastructure Quick Reference:
  - [MOS Note:1517182.1](#)
- Pre 12.1 Database Issues in 12c Grid Infrastructure Environment
  - [MOS Note: 1568834.1](#)
- How to Upgrade to 12c Grid Infrastructure if OCR or Voting File is on Raw/Block Device
  - [MOS Note:1572925.1](#)

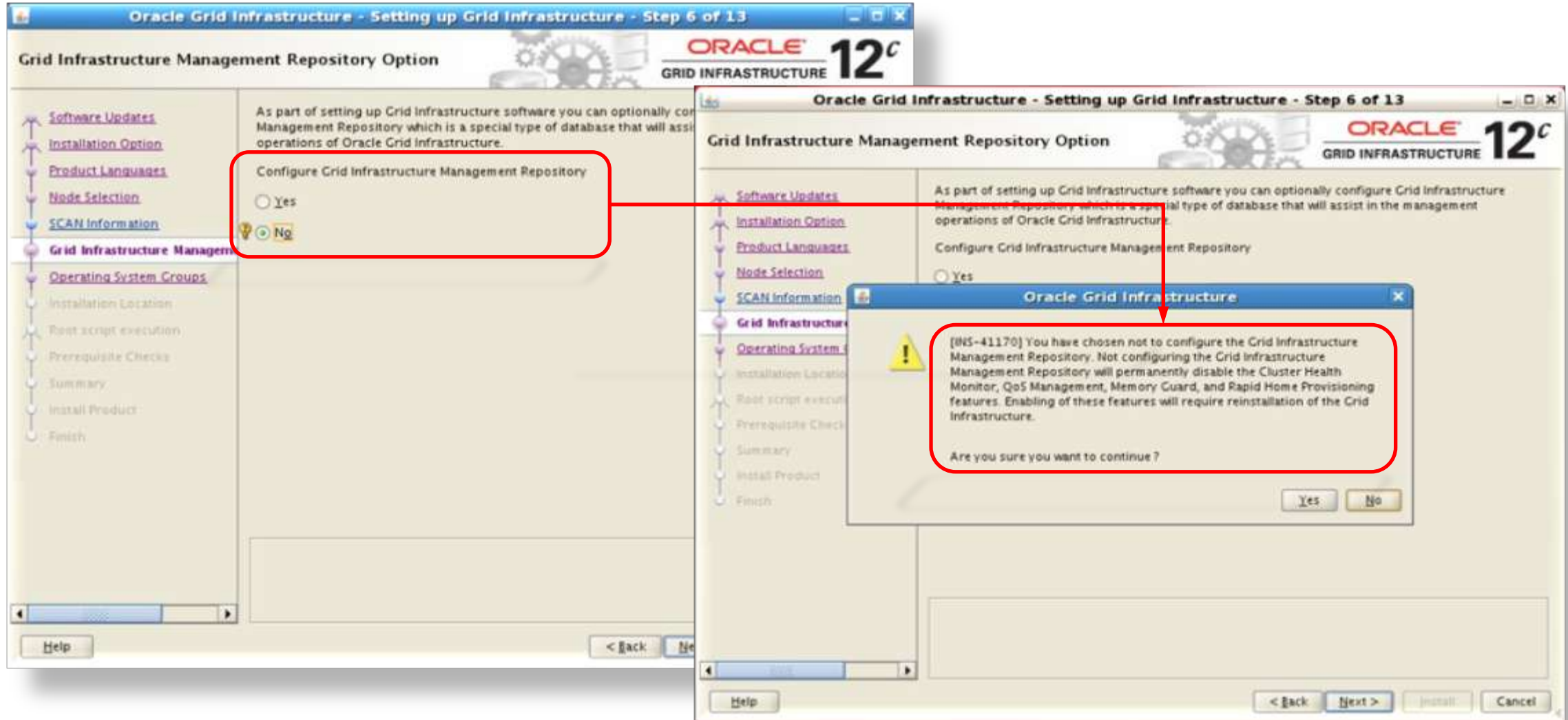


# Grid Infrastructure Installation/Upgrade



# Grid Infrastructure Installation/Upgrade

This choice has been made obsolete in Oracle 12.1.0.2 as GIMR is mandatory



# GIMR? MGMTDB?

- **Grid Infrastructure Management Repository**

- What is stored inside?

- <http://docs.oracle.com/database/121/CWADD/troubleshoot.htm#CWADD92242>

- SID? –MGMTDB      DBNAME? \_MGMTDB

- It is a **single-tenant** database (CDB with one PDB) since Oracle 12.1.0.2

- Previous installations of the GIMR will be deleted

- The information can be preserved if necessary

- OUI will choose automatically the first OCR disk group

- GIMR will take roughly 750MB per day per node - default retention is 3 days

- **More details:**

- [How to Handle the Oracle GIMR](#)

- [https://blogs.oracle.com/UPGRADE/entry/grid\\_infrastructure\\_management\\_repository\\_gimr](https://blogs.oracle.com/UPGRADE/entry/grid_infrastructure_management_repository_gimr)

- [MOS Note: 1568402.1 - FAQ: 12c Grid Infrastructure Management Repository \(GIMR\)](#)

# Grid Infrastructure Installation/Upgrade

**Oracle Grid Infrastructure - Setting up Grid Infrastructure - Step 8 of 13**

**Specify Installation Location**

Specify the Oracle Grid Infrastructure for a Cluster Oracle base is installed in a path indicating the Oracle Grid Infrastructure owner.

Oracle base:

Specify a location for storing Oracle software files separate directory. This software directory is the Oracle Grid Infrastructure.

Software location:

**Oracle Grid Infrastructure - Setting up Grid Infrastructure - Step 11 of 14**

**Perform Prerequisite Checks**

Verification Result

Some of the minimum requirements for installation are not completed. Review and fix the issues listed in the following table, and recheck the system.

Ignore All

Checks	Status	Fixable
Physical Memory	Warning	No
Oracle patch:12539000	Failed	No

**Details:**

Oracle patch:12539000 - This test checks that the Oracle patch "12539000" has been applied in home "/u01/app/11.2.0/grid".

Check Failed on Nodes: [\[rac2, rac1\]](#)

Verification result of failed node: rac2

Details:

- PRVG-1253 : Required Oracle patch is not found on node "rac2" in home "/u01/app/11.2.0/grid".
- Cause: Required Oracle patch is not applied.
- Action: Apply the required Oracle patch.

[Back to Top](#)

Verification result of failed node: rac1

Details:

- PRVG-1253 : Required Oracle patch is not found on node "rac1" in home "/u01/app/11.2.0/grid".

# Grid Infrastructure Installation/Upgrade

The image shows the Oracle Grid Infrastructure installation wizard at Step 12 of 13, titled "Execute Configuration scripts". The progress bar indicates 79% completion. The status list shows that "Execute Root Scripts" is the current step. A table lists the scripts to be executed:

Number	Script Location	Nodes
1	/u01/app/12.1.0/grid_1/rootupgrade.sh	rac2,rac1

Below the table, instructions are provided for executing the scripts. A terminal window on the right shows the execution of the script, with the following output:

```
CRS-4133: Oracle High Availability Services has been stopped.
CRS-4123: Oracle High Availability Services has been started.
2014/01/15 01:51:09 CLSRSC-343: Successfully started Oracle clusterware stack

clscfg: EXISTING configuration version 5 detected.
clscfg: version 5 is 12c Release 1.
Successfully accumulated necessary OCR keys.
Creating OCR keys for user 'root', privgrp 'root'..
Operation successful.
Start upgrade invoked..
Started to upgrade the Oracle Clusterware. This operation may take a few minutes
.
Started to upgrade the OCR.
Started to upgrade the CSS.
The CSS was successfully upgraded.
Started to upgrade Oracle ASM.
Started to upgrade the CRS.
The CRS was successfully upgraded.
Oracle Clusterware operating version was successfully set to 12.1.0.1.0
2014/01/15 01:54:25 CLSRSC-325: Configure Oracle Grid Infrastructure for a Cluster ... succeeded
```

# Clusterware - ASM - DB Compatibility

- See [MOS Note:337737.1](#)

Clusterware	ASM	DB	Certified
12.1	12.1	12.1	Y
12.1	12.1	11.2 <sup>(a)</sup>	Y
12.1	12.1	11.1 <sup>(a)</sup>	Y
12.1	12.1	10.2 <sup>(a)</sup>	Y
11.2	11.2 <sup>(b)</sup>	11.2	Y
11.2	11.2 <sup>(b)</sup>	11.1	Y
11.2	11.2 <sup>(b)</sup>	10.2	Y

(a) Pre-12.1 database instances require an ASM instance resident on the same node as the database instance. Pre-12.1 database instances cannot leverage the implicit HA of Flex ASM.

(b) The Matrix is valid after the (rolling) upgrade has been completed. During the upgrade you may use an older ASM version.

(c) Linux specific: see [Note 781628.1](#)

(d) The ASM version needs to be at least 10.1.0.3

Clusterware	ASM	DB	Certified
11.1	11.1	11.1 <sup>(c)</sup>	Y
11.1	11.1	10.2	Y
11.1	11.1	10.1	Y
11.1	10.2	11.1	Y
11.1	10.2	10.2	Y
11.1	10.2	10.1	Y
11.1	10.1 <sup>(d)</sup>	11.1	Y
11.1	10.1 <sup>(d)</sup>	10.2	Y
11.1	10.1	10.1	Y
10.2	10.2	10.2	Y
10.2	10.2	10.1	Y
10.2	10.1 <sup>(d)</sup>	10.2	Y
10.2	10.1	10.1	Y
10.1	10.1	10.1	Y

# Oracle Clusterware & ASM Upgrade

- Documentation:
  - Oracle Clusterware Administration and Deployment Guide 12c  
[http://docs.oracle.com/cd/E16655\\_01/rac.121/e17886/toc.htm](http://docs.oracle.com/cd/E16655_01/rac.121/e17886/toc.htm)
- Grid Infrastructure Upgrade Known Issues:
  - [Note: 948456.1](#): Pre 11.2 Database Issues in 11gR2 Grid Infrastructure
- Oracle Clusterware rolling upgrade:
  - [Note: 338706.1](#): Oracle Clusterware Rolling Upgrades
- RAC Best Practices Starter Kit:
  - [Note:810394.1](#): RAC Assurance Support Team: RAC and Oracle Clusterware Starter Kit and Best Practices
- Rolling ASM Upgrades:
  - [http://docs.oracle.com/cd/E16655\\_01/install.121/e17888/procstop.htm#CWLIN524](http://docs.oracle.com/cd/E16655_01/install.121/e17888/procstop.htm#CWLIN524)

# Oracle Grid Infrastructure Patch Sets – 11g only!!!

- Oracle Grid Infrastructure Patch Set 11.2.0.3:
  - Patch set is a bit misleading: it's a full release!
  - Installation is out-of-place only into a separate home
  - To upgrade from GI 11.2.0.1 to GI 11.2.0.2 or later:
    - Apply PSU 11.2.0.1.2 (or newer) in-place
      - Rolling upgrade ASM issue for 11.2.0.1=>11.2.0.2 (bug 9329767)
      - Rolling upgrade ASM issue for 11.2.0.2=>11.2.0.3 (bug12539000)
  - RAC/Grid Infrastructure Upgrade Note:
    - [Note:810394.1](#): RAC Assurance Support Team: RAC and Oracle Clusterware Starter Kit and Best Practices (Generic)
    - Also see platform-specific notes linked from the generic starter kit
  - **VERY IMPORTANT:**
    - Follow [all instructions](#) in [Note:1212703.1](#)
      - Make sure MULTICAST is setup correctly [Note:1054902.1](#) – section D
      - Make sure to check [Oracle Database Readme 11g Release 2 Section 1.37](#) - "Open Bugs"
    - Then upgrade GI within OUI



# Oracle **EXADATA** 11.2.0.3/4 Patching – **plus 10.2.0.x**

- For certification, recommendations, issues, current patches etc. see
  - [MOS Note:888828.1](#)  
Database Machine and Exadata Storage Server 11.2 Supported Versions
  - [MOS Note 1306814.1](#): Oracle Software Patching with **OPLAN**
- Patch Upgrade from 11.2.0.1/11.2.0.2 **to 11.2.0.3**:
  - [MOS Note:1373255.1](#)  
Database Upgrade on Exadata Database Machine to 11.2.0.3
    - *MULTICAST is already setup correctly on a Database Machine V2*
- Patch Upgrade **to 11.2.0.4**:
  - [MOS Note:1565291.1](#):  
11.2.0.4 Grid Infrastructure and Database Upgrade for 11.2.0.2 BP12 **and later**
  - [MOS Note:1555036.1](#):  
11.2.0.4 Grid Infrastructure and Database Upgrade for 11.2.0.2 BP11 **and earlier**
- **Exadata and Oracle 10.2**:
  - [MOS Note:1965897.1](#) - Oracle Database 10g Release 2 Support on Exadata

# Oracle **EXADATA** 12.1.0.2 Upgrade

- [MOS Note:1306791.2](#)  
Information Center: Oracle Exadata Database Machine
- [MOS Note:1364356.2](#)  
Information Center: Upgrading Oracle Exadata Database Machine
- [MOS Note:1681467.1](#)   
**GI and Database Upgrade** from 11.2.0.2-4, 12.1.0.1 to 12.1.0.2 on Exadata
- [MOS Note:888828.1](#)  
Exadata Supported Versions
- [MOS Note:1537407.1](#)  
Requirements and restrictions when using Oracle 12c on Exadata
- [MOS Note:1571789.1](#): Exadata Storage Software 12.1
  - Smart Scan support on Exadata with Oracle Database 12c
  - IO Resource Manager works with 12c – also with Multitenant
  - Cell-to-cell data transfer for faster ASM resync, resilver, rebalance

Install  
GI and DB 12.1.0.2

Preupgrade Checks

Prepare Environment  
and ASM

Restore Online  
Backup for Standby

Activate and  
Upgrade

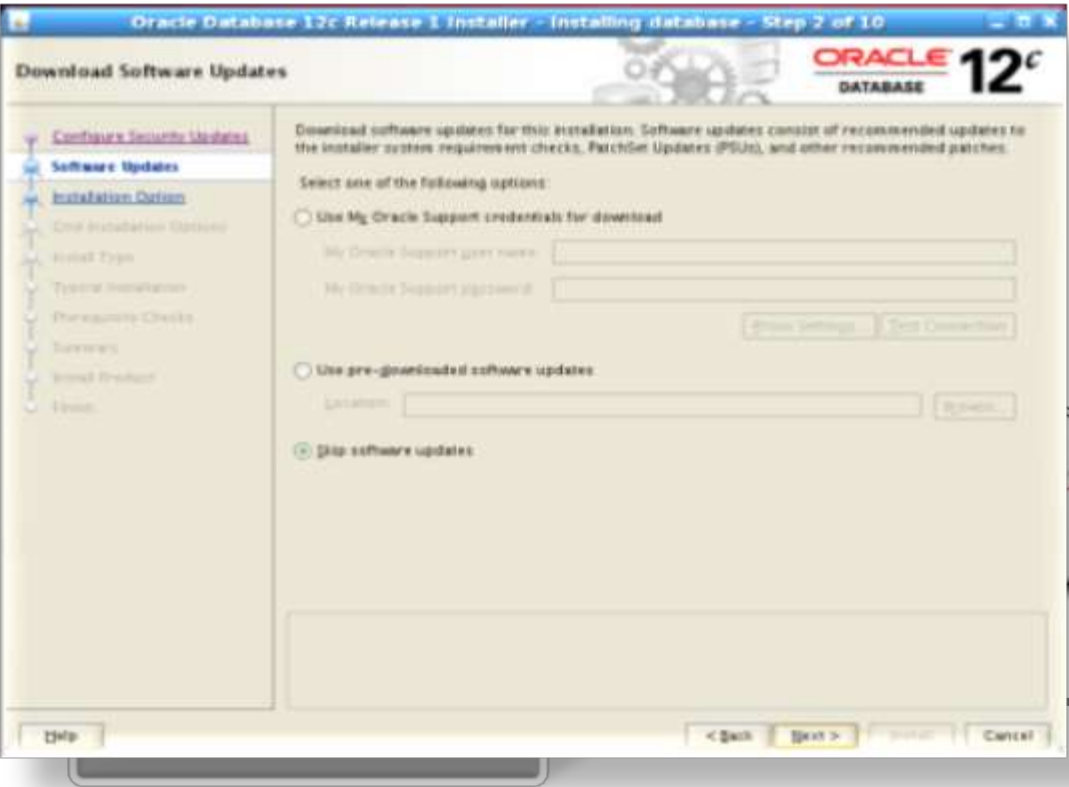
Post Upgrade  
Actions



Database software installation:

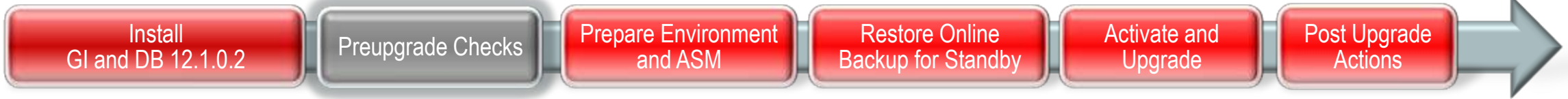
– Oracle Database 12.1.0.2

▪ For recovery only there's no need to install Oracle Database 11.2.0.2

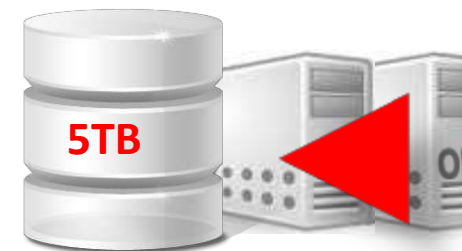


Oracle 12.1.0.2  
OL6





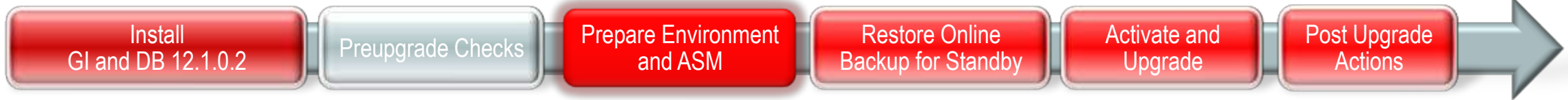
- Download/execute newest preupgrade scripts: [MOS Note:884522.1](#)
  - `preupgrd.sql` and `utluppkg.sql`
  - Files can be found in Oracle 12c's `?/rdbms/admin` as well



Oracle 11.2.0.2  
OEL5.8

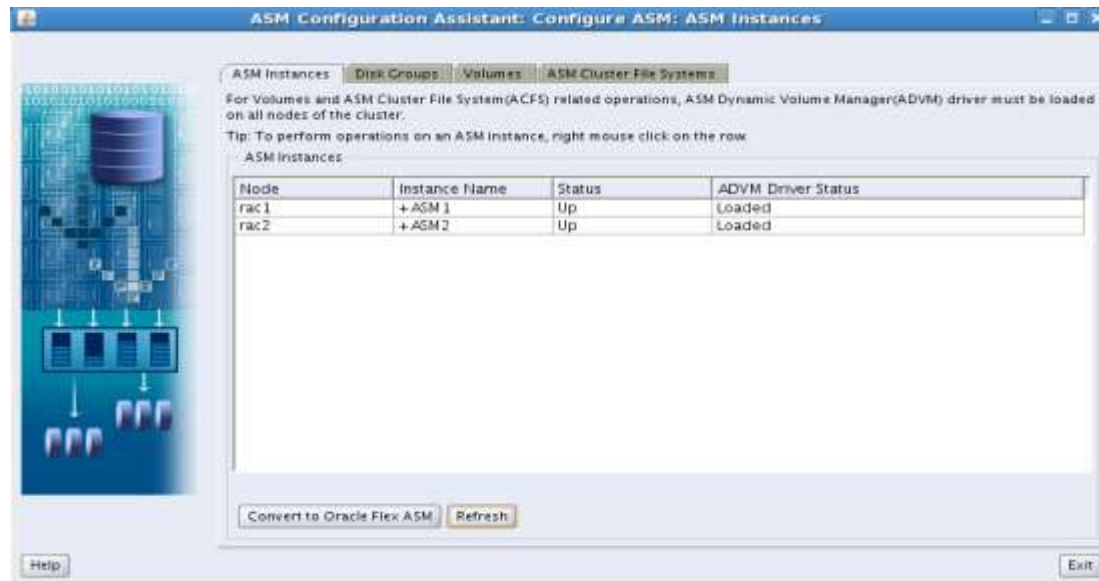
Upgrading From Version	Script Build/Date	Upgrade To Target Version
10.2.0.5, 11.1.0.7, 11.2.0.1, 11.2.0.2, 11.2.0.3	Copy of initial 12.1.0.1 files May 2013	<p>12cR1 (12.1.0.1) for Windows - <a href="#">preupgrade_12.1.0.1.0_0_crlf.zip</a>            12cR1 (12.1.0.1) for all other platforms - <a href="#">preupgrade_12.1.0.1.0_0_lf.zip</a></p> <p>The preupgrade tool has changed in version 12.1. Unzip one of the above zip files that is appropriate for your platform. The zip file contains <code>preupgrd.sql</code> and <code>utluppkg.sql</code> which together make up the preupgrade tool. Copy them and run <code>preupgrd.sql</code> according to the directions given in the Oracle Database Upgrade Guide.</p>

Oracle 12.1.0.2  
OL6



▪ Prepare Storage for ASM: [MOS Note 452924.1](#)

- Raw disk
- Logical unit numbers (LUNs)
- Raw logical volumes (LVM) – not recommended
- NFS and dNFS Volumes are supported - see and [MOS: 1570073.1](#) and documentation: [https://docs.oracle.com/cd/E11882\\_01/install.112/e47689/app\\_nas.htm#LADBI1372](https://docs.oracle.com/cd/E11882_01/install.112/e47689/app_nas.htm#LADBI1372)



Oracle 12.1.0.2  
OL6



# Configuring ASM with ASMCA

**Create Disk Group**

Disk Group Name:

Redundancy  
 Redundancy is achieved by storing multiple copies of the data on different failure groups. Normal redundancy needs disks from at least two different failure groups, and high redundancy from at least three different failure groups.

High  Normal  External (None)

Select Member Disks  
 Show Eligible  Show All

Quorum failure groups are used to store voting files in extended clusters and do not contain any user data. They require ASM compatibility of 11.2 or higher.

<input type="checkbox"/>	Disk Path	Header Status	Disk Name	Size (MB)	Failure Group	Force	Quorum
<input checked="" type="checkbox"/>	/dev/sdb1	MEMBER	DATA_0000	1023	DATA_0000	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	/dev/sdc1	MEMBER	DATA_0001	1023	DATA_0001	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	/dev/sdd1	MEMBER	DATA_0002	1023	DATA_0002	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	/dev/sde1	MEMBER	DATA_0003	1023	DATA_0003	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	/dev/sdf1	MEMBER	DATA_0004	1023	DATA_0004	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	/dev/sdg1	MEMBER	DATA_0005	1023	DATA_0005	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	/dev/sdh1	MEMBER	DATA_0006	1023	DATA_0006	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	/dev/sdi1	MEMBER	DATA_0007	1023	DATA_0007	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	/dev/sdj1	MEMBER	DATA_0008	1023	DATA_0008	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	/dev/sdk1	MEMBER	DATA_0009	1023	DATA_0009	<input type="checkbox"/>	<input type="checkbox"/>

Note: If you do not see the disks which you believe are available, check the Disk Discovery Path limits set of disks considered for discovery.

Disk Discovery Path: /dev/sd[b-k]1

Disk Group Attributes  
 An allocation unit (AU) is the fundamental unit in which contiguous data is stored. The AU size cannot be modified later.

Allocation Unit Size (MB):

Specify minimum software versions for ASM, Database and ASM volume

ASM Compatibility: 12.1.0.0.0

Database Compatibility:

ADVM Compatibility:

Refer Oracle Automatic Storage Management Administrator's Guide for more information.

ASM Instances | **Disk Groups** | Volumes | ASM Cluster File Systems

You can choose to create a new disk group or add disks to an existing disk group. To create dynamic volumes, you need disk groups with 11.2 ASM compatibility.

Tip: To perform operations on a disk group, right mouse click on the row.

Disk Groups

Disk Group Name	Size (GB)	Free (GB)	Usable (GB)	Redundancy	State
DATA	9.99	1.89	1.89	EXTERN	MOUNTED(2 of 2)

ASM Instances | **Disk Groups** | Volumes | **ASM Cluster File Systems**

ASM Cluster File System (ACFS) can be used to store files such as Executables, Oracle Diagnostic files, Application configuration files, etc. To use ACFS, you need to create an ASM Volume first.

Tip: The table shows both mounted and dismounted file systems. For dismounted file systems, the last known mount point is shown. To perform operations on an ASM Cluster File System, right mouse click on the row.

ASM Cluster File Systems

Mount Point	State	Volume Device	Size (GB)	Volume	Disk Group	Used %
/mnt/jan	MOUNTED(2 of 2)	/dev/asm/vol1-449	1.00	VOL1	DATA	13.28

ASM Instances | **Disk Groups** | **Volumes** | ASM Cluster File Systems

ASM volumes are typically formatted with ASM Cluster File System (ACFS). ACFS can be used to store files such as Executables, Oracle Diagnostic files, Application configuration files, etc. To create an ASM Cluster File System, you need to create an ASM Volume first.

Tip: To perform operations on a volume, right mouse click on the row.

Volumes

Volume	Volume Device	Disk Group	State	Usage	Mount Point	Size (GB)
VOL2	/dev/asm/vol2-449	DATA	UNKNOWN	Unknown		2.50
RVOL2	/dev/asm/rvol2-449	DATA	UNKNOWN	Unknown		2.50
VOL1	/dev/asm/vol1-449	DATA	ENABLED(2 of 2)	ACFS	/mnt/jan	1.00



▪ Restore backup into ASM – see [MOS Note:1617946.1](#)

Source → 11.2.0.2	Destination → 12.1.0.2 (ASM)
Make sure archive logging is on	
Switch on Force Logging	Create identical trace file structure
	Create a password file with identical PW
Adjust init.ora	Adjust init.ora
Adjust tnsnames.ora	Adjust listener.ora and tnsnames.ora
	<b>DUPLICATE FOR STANDBY FROM ACTIVE DATABASE</b>
	Adjust controlfile names
Switch on log transport	Switch on managed recovery mode



4 hrs

Oracle 11.2.0.2  
OEL5.8

Oracle 11.2.0.2  
PHYSICAL STANDBY



# Restore Backup into ASM – Before Oracle 11g

- Make sure the backup is available on DESTINATION

- `rman target /`  
connected to target database (not started)
- `RMAN> startup nomount`
- `RMAN> restore spfile to pfile '$ORACLE_HOME/dbs/initSTY.ora' from '$ORACLE_BKD/my.spfile';`

- Modify init.ora:

- `*.db_create_file_dest='+DG1'`
- `*.db_recovery_file_dest='+FRA1'`

- Connect again with RMAN to restore the backup into ASM

- `rman target sys/password@source auxiliary /`
- `RMAN> startup auxiliary nomount;`
- `RMAN> duplicate target database for standby dorecover;`

- Rename controlfiles and switch on log transport and recovery





- Stop on production
- Final synchronization
- Activate standby, and Upgrade it!

```
$ $ORACLE_HOME/perl/bin/perl catctl.pl \  
-n 8 catupgrd.sql  
SQL> @?/rdbms/admin/utlsp.sql
```

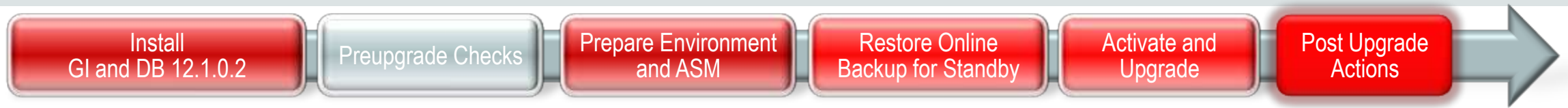
Oracle 11.2.0.2  
OEL5.8



Oracle 11.2.0.2  
PHYSICAL STANDBY

# Synch and Activate Standby

- Stop the application on SOURCE
- Get the last changes written into logfiles on all nodes
  - `SQL> alter system archive log current;`
- Stop the production database on SOURCE
  - `$> srvctl stop database -d PROD`
- Check if logfile got shipped and applied
- Stop managed recovery for the standby on DESTINATION
  - `SQL> alter database recover managed standby database cancel;`  
`SQL> shutdown immediate`
- Bring the standby back in mount and initiate the activation:
  - `SQL> alter database recover managed standby database finish skip standby logfile;`  
`SQL> alter database commit to switchover to primary;`
- Create temporary tablespaces



- Register resources to Clusterware
- Advance ASM compatibility
- Set `CLUSTER_DATABASE` to TRUE
- Start the instances on all nodes





## ▪ Register the database and its instances to Clusterware

- `$> srvctl add database -d PROD -o /oracle/base/product/11.2.0/dbhome -p '+DG1/prodspfile.ora'`
- `$> srvctl add instance -d PROD -i PROD1 -n mynode1`
- If you upgrade without moving to new hardware you'll execute:
  - `$> srvctl upgrade database -d <SID> -o <new$OH>`

## ▪ Advance ASM diskgroup compatibility

- `ASMCA> alter diskgroup data set attribute 'compatible.asm'='11.2';`
- `ASMCA> alter diskgroup data set attribute 'compatible.rdbms'='11.2';`

## ▪ Move OCR and Voting into ASM (just if source was below 11g)

- `$> ocrconfig -add +data`
- `$> ocrconfig -delete /dev/raw/raw1`
- `$> crsctl replace votedisk +VOTING`

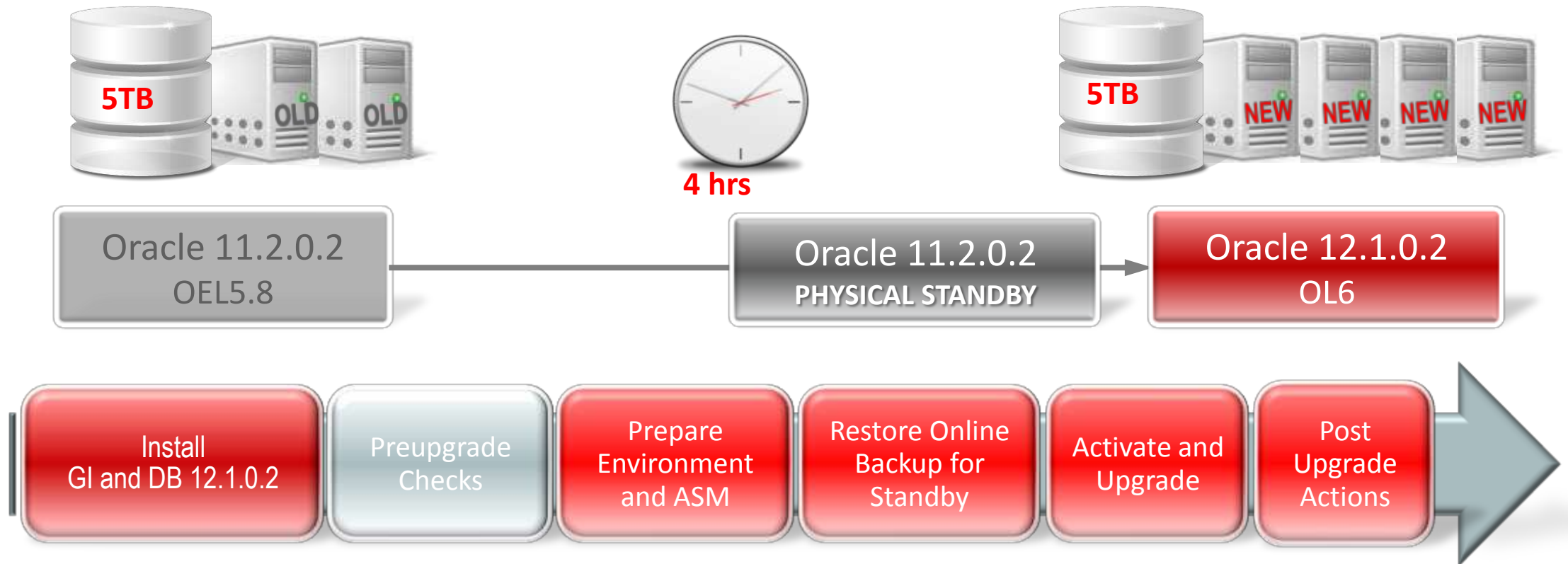
## ▪ Set `CLUSTER_DATABASE` to `TRUE` and start the instances on all nodes

# Important Notes and White Papers

- TWP: Migration to Oracle ASM  
<http://www.oracle.com/technetwork/database/features/availability/maa-wp-10gr2-asmmigrationwithdg-133513.pdf>
- [Note 452924.1](#) - How to Prepare Storage for ASM
- Note 265633.1 - ASM Technical Best Practices
- Note 249992.1 - New Feature on ASM (Automatic Storage Manager)
- Note 345180.1 - How to duplicate a controlfile when ASM is involved
- [Note 252219.1](#) - Steps To Migrate/Move a Database From Non-ASM to ASM And Vice-Versa
- [Note: 787793.1](#) - Creating a physical standby from ASM primary
- [Note:1079563.1](#) - RMAN duplicate support for mixed platform
- Note: 430278.1 - Can you restore RMAN backups taken on 32-bit Oracle with 64-bit Oracle?

# Case 2: Summary

- RAC Database migration to a new cluster including upgrade



# Real World Checkpoint



## Customer

### ▪ Interhyp AG

## Project

– Financial institution

## Constraints

– HQ in Munich/Germany

## Preparation

– Bank for residential and development financing

## Upgrade

– Banking service provider to other German key banks

## Success?

– 100% subsidiary of Dutch ING Bank

## Remarks

# Real World Checkpoint



Customer

Project

Constraints

Preparation

Upgrade

Success?

Remarks

- Scope:
  - Upgrade **6x** 2-node-RAC systems
  - Oracle 10.1.0.5 ⇒ Oracle 11.2.0.2 with ASM
    - RH Linux 32bit ⇒ RH Linux 64bit
    - Hardware exchange for key systems:  
2-node cluster ⇒ 4-node cluster



# Real World Checkpoint



Customer

Project

Constraints

Preparation

Upgrade

Success?

Remarks

- Constraints:
  - Downtime window: **4 hrs** per database
    - Upgrade/migrations one after another
  - Network bandwidth not sufficient for Data Pump
  - LOBs in the source database

# Real World Checkpoint

Customer

Project

Constraints

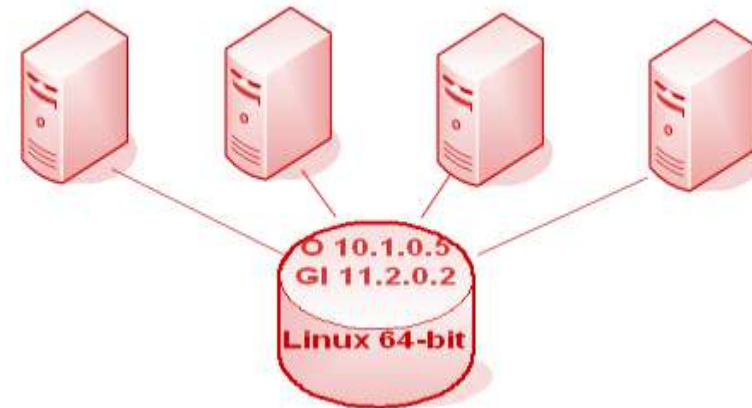
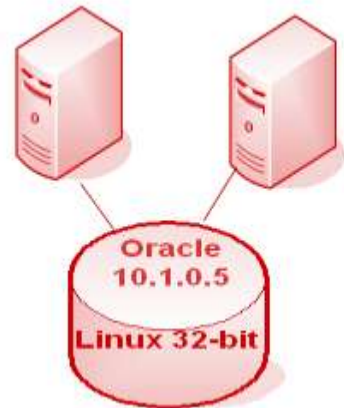
Preparation

Upgrade

Success?

Remarks

- Prepare new cluster
  - Install Oracle Grid Infrastructure 11.2 and patch it
- Decrease upgrade duration to ~30 minutes
  - Remove unused components from production db



# Real World Checkpoint

Customer

Project

Constraints

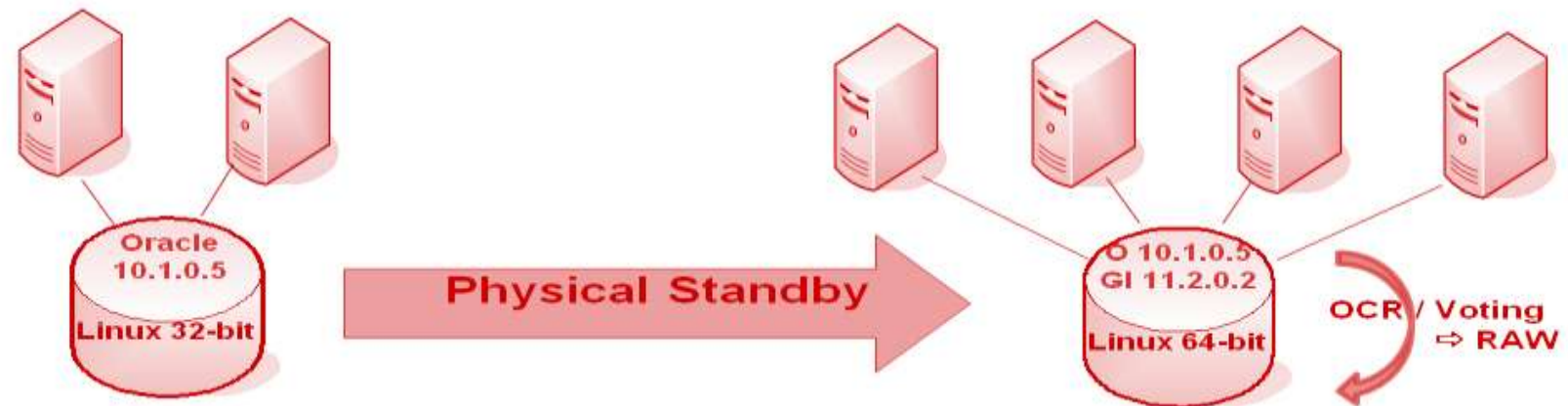
Preparation

Upgrade

Success?

Remarks

- Physical standby as **migration vehicle**
  - Avoid copy downtime
    - Oracle 10.1.0.5 ⇒ Oracle 10.1.0.5 within 11.2 ASM  
*Note: This wasn't officially certified, but will work in this case*
  - Activate standby and upgrade it
    - **Can be tested many times!!**



# Real World Checkpoint

Customer

Project

Constraints

Preparation

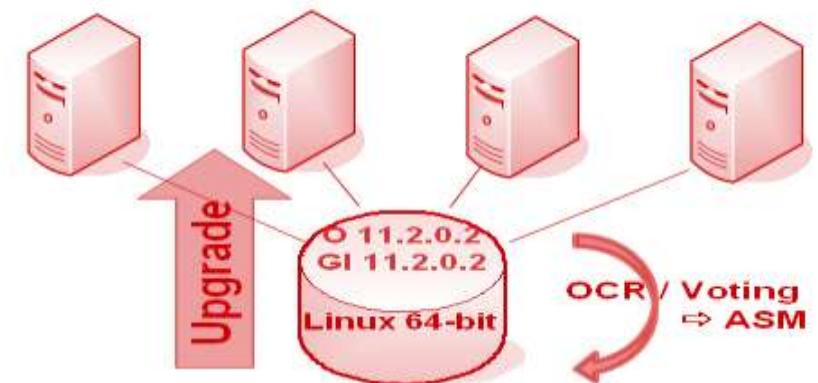
**Upgrade**

Success?

Remarks

## ▪ Upgrade

- Activate standby and put into `STARTUP UPGRADE`
  - Invalidate and compile all packages/code (32bit  $\Rightarrow$  64bit!)
- Post upgrade:
  - Register database to Clusterware
  - Move OCR/Voting into ASM



# Real World Checkpoint



Customer

- Live? And alive?

Project

- Yes!!! Go Live: 27-NOV-2010

Constraints

- Total downtime: **~2 hours**

Preparation

- Database upgrade time:

Upgrade

- 24 minutes + 5 minutes recompilation

Success?

- Very robust using the entire Oracle software stack

Remarks

# Real World Checkpoint



Customer

Project

Constraints

Preparation

Upgrade

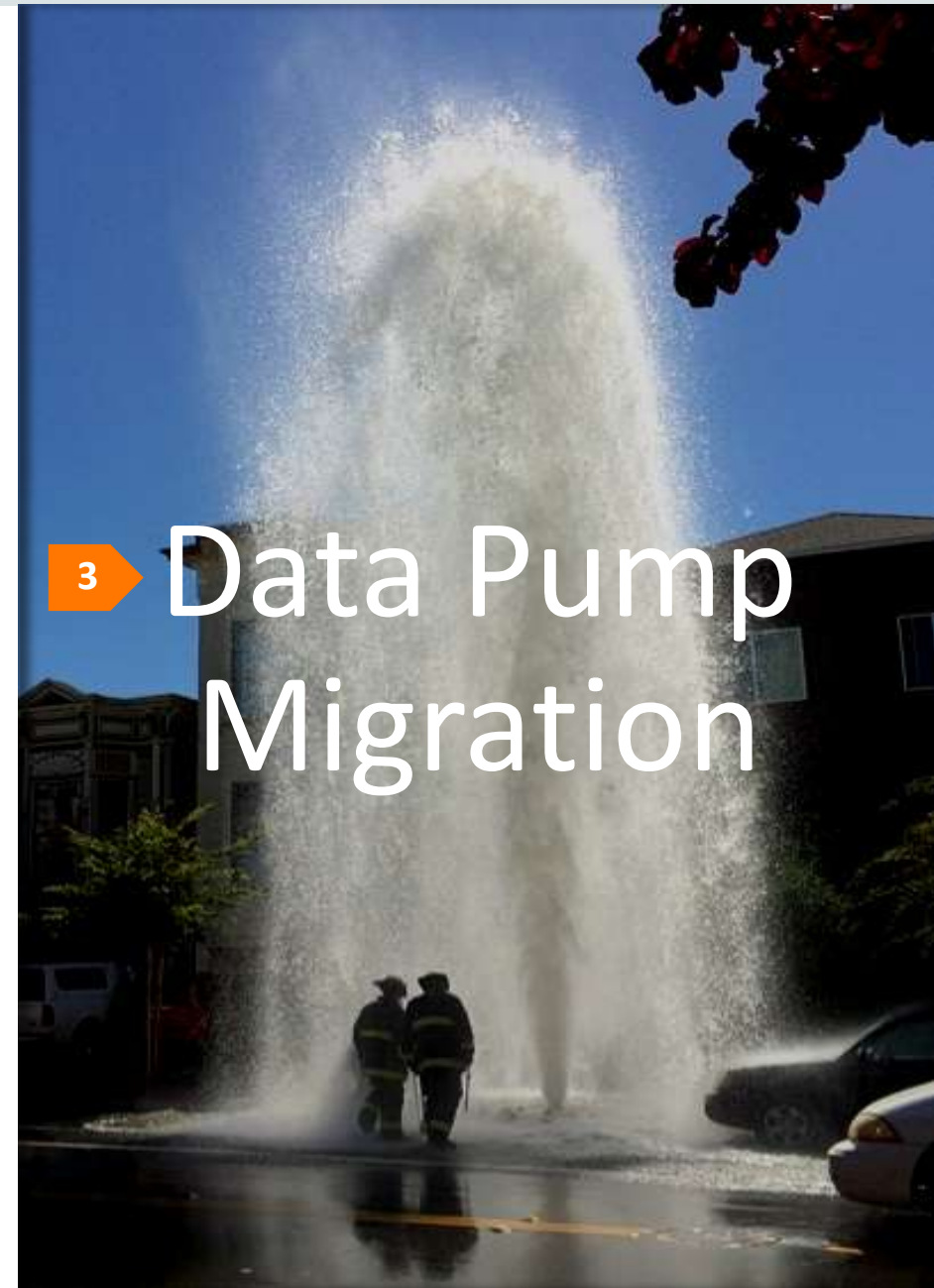
Success?

Remarks

- Well ... the optimizer ...
  - We found some optimizer issues
    - Reports were affected
    - Remedy: Hints, rewrite and patches and SQL Profiles
- Don't argue with Support when you have Exadata BP on a regular Linux RAC
  - MOS Note:1459365.1:  
Exadata Bundle Patches and Non-Exadata Systems

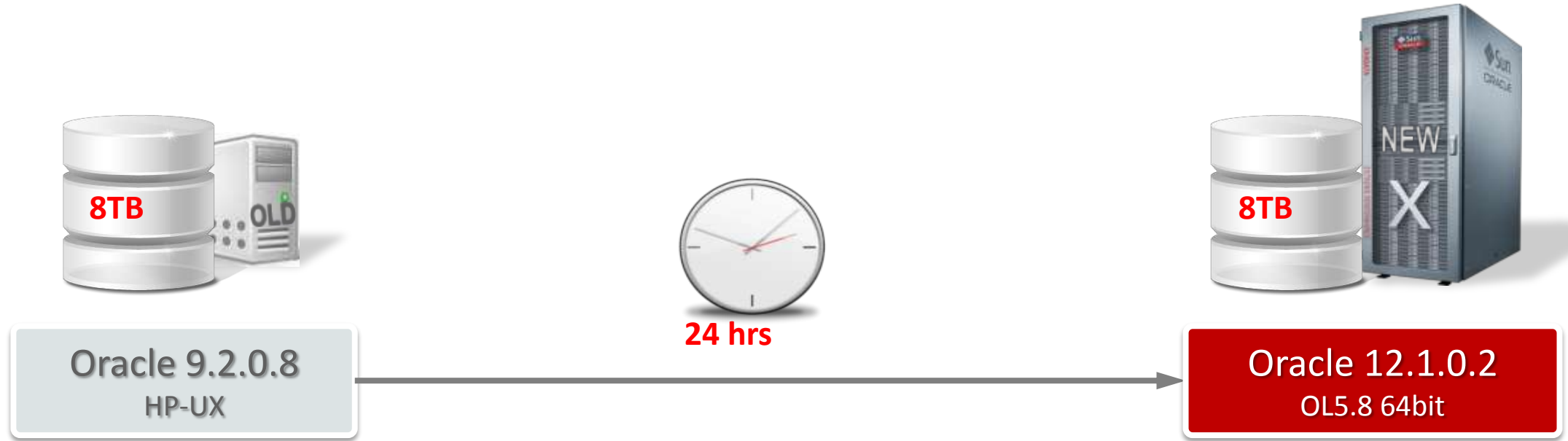
# Upgrade, Migrate & Consolidate

- 1 Introduction
- 2 Preparation Steps
- 3 Upgrade / Migrate / Consolidate**
- 4 Fallback Strategies
- 5 New Features
- 6 Performance Management
- 7 Wrap Up



# Case 3: Cross Endianness Migration with Data Pump


- Migration of a single instance database to Exadata





# Case 3: Cross Endianness Migration

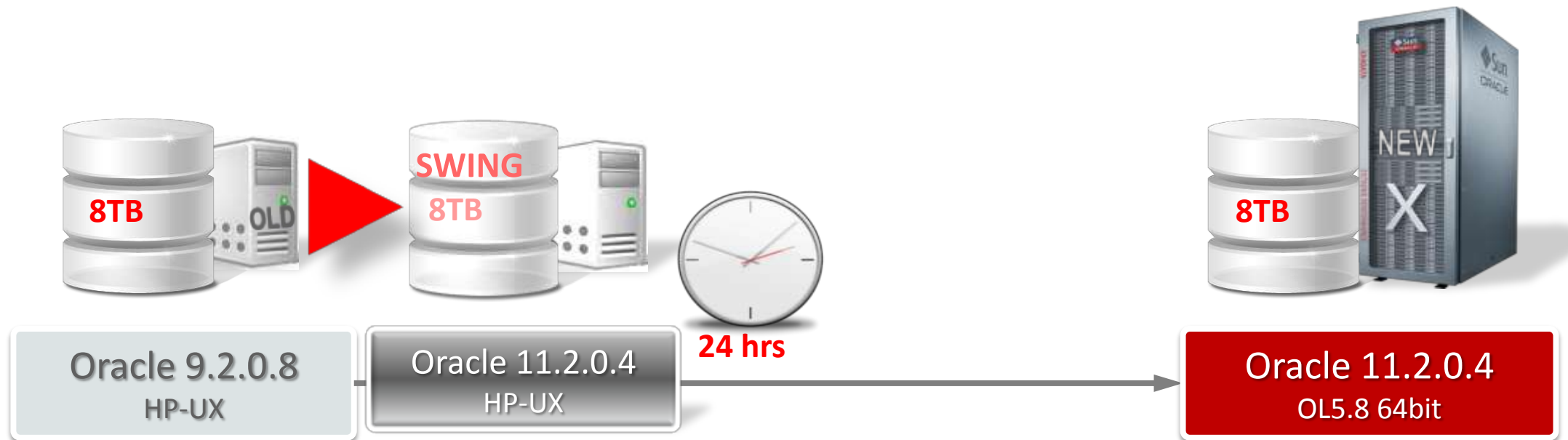
- **Basic options** with Oracle 9i:

- `exp` and `imp` 
- Import of all versions  $\geq$  Oracle V5 possible
  - `exp` is *not supported* for general use since Oracle 11g
    - But the utility is still there and can be used
  - `imp` is still supported



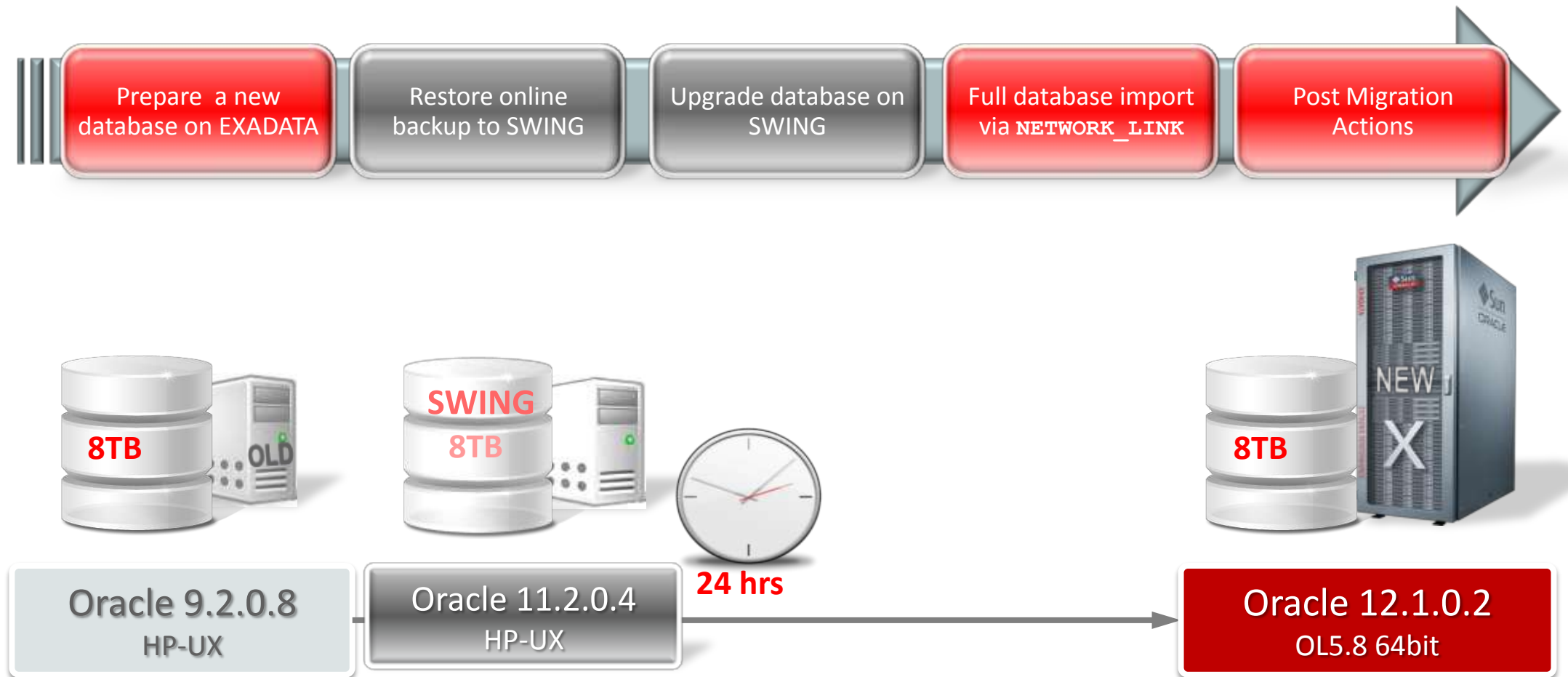
# Case 3: Cross Endianness Migration

- **Better options** since Oracle 10g:
  - Data Pump `expdp` and `impdp`
    - Usually the first option to try
  - Cross platform Transportable Tablespaces (xTTS)
    - More complicated, more manual steps than pure Data Pump



# Case 3: Cross Endianness Migration

- Migration of a single instance database to Exadata



# Data Pump Overview

- The “new” faster export-import
  - Available starting with Oracle 10.1
  - Powerful concept:
    - Restartable via job interface
    - Command line and API (DBMS\_DATAPUMP)
    - PARALLEL export and import of data (single-threaded for metadata)
    - EXCLUDE & INCLUDE (For examples see [MOS Note:341733.1](#))
    - COMPRESS=ALL starting in Oracle 11.1  
(requires Advanced Compression Option)
    - NETWORK\_LINK for direct import via a database link
    - Master Note for Data Pump: [MOS Note:1264715.1](#)
    - For Compatibility and version changes: [MOS Note:553337.1](#)

# Data Pump Overview

## ▪ Limitations

- Not compatible with "old" exp/imp
  - Since Oracle 11.2: "Old" par files can be used *legacy* interface
    - Will not take advantage of new features such as parallelism
  - "Old" exp dump files cannot be imported by Data Pump
- Restrictions:
  - For Oracle 10.2, handles everything *except* for XMLSCHEMA types
  - As of Oracle 11.1, handles all data types
  - Known Issues: Master Note for Data Pump: [MOS Note:1264715.1](#)
- LONG and LOB data
  - Generally slow because of the data type implementation
  - **STRONG RECOMMENDATION to migrate to SecureFiles**
    - Data Pump can work in parallel on SecureFiles type

**NEW** New in Oracle 12c: TRANSFORM=**LOB\_STORAGE**:SECUREFILE

# Data Pump **Best Practices**

- For *full exports*:
  - Role `EXP_FULL_DATABASE` is required
- For **export consistency** use:
  - `FLASHBACK_SCN=<scn>`
  - `FLASHBACK_TIME=SYSTIMESTAMP`  
alternative:
    - `CONSISTENT=Y` [since Oracle 11.2 – Legacy Interface]
      - This will increase UNDO requirements for the duration of the export
- Always set parameters:
  - `EXCLUDE=STATISTICS`
  - `METRICS=YES`

# Data Pump Best Practices

## Performance Tips

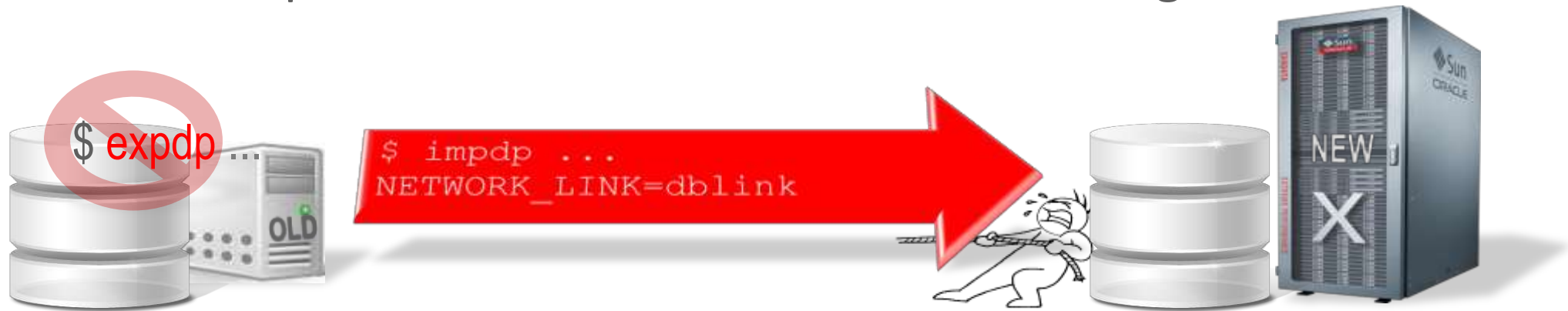
- Use `PARALLEL=n`
  - Typically  $n = 2x$  <number of CPU cores>
- `EXCLUDE=STATISTICS` on export
- Enable parallel import of indexes: apply patch for bug [21539301](#)
  - Available for 11.2.0.4 and 12.1.0.2
- New feature in 12c: `TRANSFORM=DISABLE_ARCHIVE_LOGGING:Y`
  - Apply patch for bug [20778442](#)



# Data Pump Best Practices

## Network Mode

- Direct import via database link
  - Parameter: NETWORK\_LINK
    - Run only `impdp` on the target system - **no expdp** necessary
    - No dump file written, no disk I/O, no file transfer needed
- Restrictions of database links apply:
  - Does not work with LONG/LONG RAW and certain object types
- Performance: Depends on network bandwidth and target's CPUs

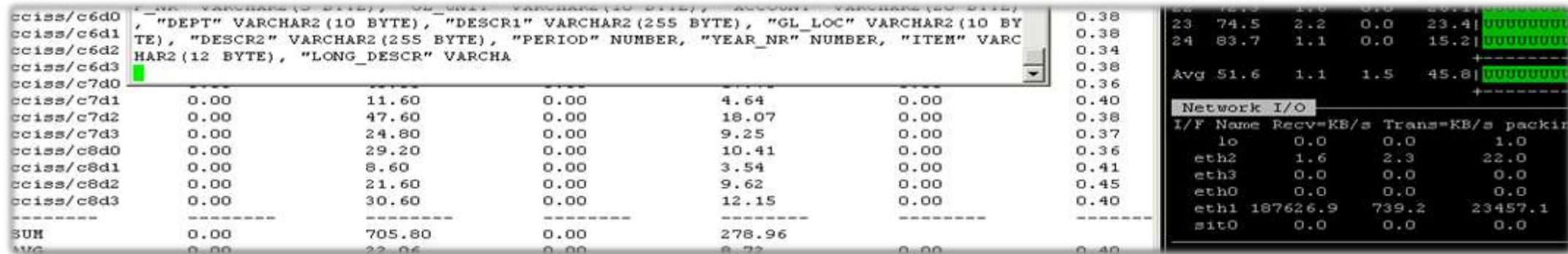
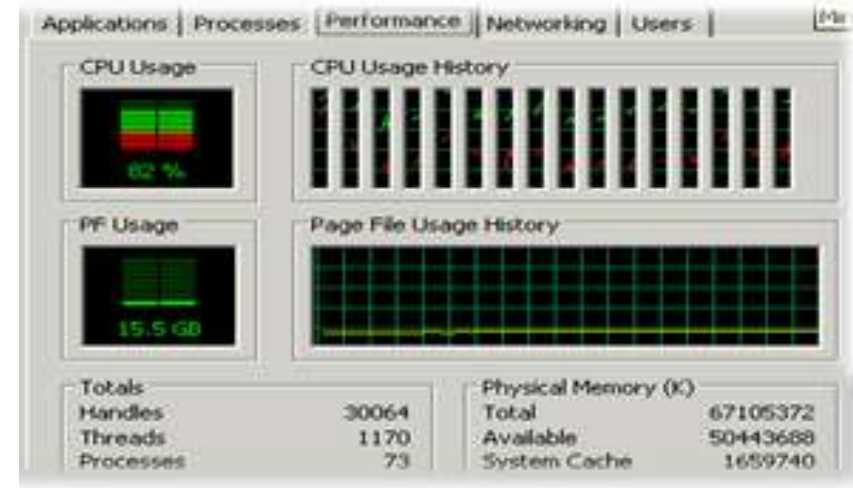




# Data Pump Best Practices

## Network Mode

- *Real World Case:*  
**Kaiser Permanente, Medicare (USA)**
  - impdp on NETWORK\_LINK with 8 vs 16 CPU cores
    - 10Gbit connection leveraged up to 8 Gbit
    - 1 TB table copied in ~15 min ⇒ **4 TB/hour**
  - Network bandwidth and CPU bound



# Data Pump Filtering

- Filtering is very powerful
  - If using `EXCLUDE` parameter, everything else is included
  - If using `INCLUDE` parameter, everything else is excluded
  - **Can't use `EXCLUDE` and `INCLUDE` in the same Data Pump job**
  - Specify complete path or partial path
    - Objects matching the specified path will be excluded/included
    - Query to find exclude/include object types:
      - ```
select unique seq_num, full_path
from sys.datapump_paths
where het_type = 'DATABASE_EXPORT'
order by seq_num;
```
      - | <b>job_type:</b> | <b>het_type:</b>     |
|------------------|----------------------|
| FULL             | DATABASE_EXPORT      |
| SCHEMA           | SCHEMA_EXPORT        |
| TABLE            | TABLE_EXPORT         |
| TRANSPORTABLE    | TRANSPORTABLE_EXPORT |

# Data Pump Filtering

- **EXCLUDE** example

```
expdp system/manager schema=hr exclude=statistics ...
```

VS

```
expdp system/manager schema=hr  
exclude=SCHEMA_EXPORT/TABLE/STATISTICS
```

```
select unique SEQ_NUM, FULL_PATH  
from SYS.DATAPUMP_PATHS  
where HET_TYPE = 'SCHEMA_EXPORT' AND  
FULL_PATH like '%STATISTICS%' order by SEQ_NUM;
```

```
77 SCHEMA_EXPORT/TABLE/INDEX/STATISTICS  
78 SCHEMA_EXPORT/TABLE/INDEX/STATISTICS/INDEX_STATISTICS  
221 SCHEMA_EXPORT/TABLE/INDEX/STATISTICS  
222 SCHEMA_EXPORT/TABLE/INDEX/STATISTICS/FUNCTIONAL_AND_BITMAP  
223 SCHEMA_EXPORT/TABLE/INDEX/STATISTICS/FUNCTIONAL_AND_BITMAP/INDEX_STATISTICS  
225 SCHEMA_EXPORT/TABLE/STATISTICS  
226 SCHEMA_EXPORT/TABLE/STATISTICS/TABLE_STATISTICS  
227 SCHEMA_EXPORT/TABLE/STATISTICS/USER_PREF_STATISTICS
```

# Data Pump Filtering

- **INCLUDE** example:

```
impdp system/manager tables=hr.employees
```

- Same results but includes everything with "table" in the path:

```
impdp system/manager schemas=hr  
      include=table:\ "= \'EMPLOYEES\' \"
```

- Includes the **table definition** only:

```
impdp system/manager schemas=hr  
      include=table/table:\ "= \'EMPLOYEES\' \"
```

- Some of the TABLE object paths

```
SCHEMA_EXPORT/TABLE/TABLE  
SCHEMA_EXPORT/TABLE/TABLE_DATA  
SCHEMA_EXPORT/TABLE/GRANT
```

## Data Pump **News** in Oracle 12c

- Full transportable export/import for an entire database
- Support for multitenant container databases and pluggable databases
- **New ...**
  - VIEWS\_AS\_TABLES parameter
    - Lets you export the contents of a view as a table
  - TRANSFORM parameter options
    - TRANSFORM=DISABLE\_ARCHIVE\_LOGGING:Y
      - Will disable archive logging during import for tables and/or indexes
    - TRANSFORM=LOB\_STORAGE:SECUREFILE
    - TRANSFORM=STORAGE:N
    - TRANSFORM=TABLE\_COMPRESSION:<compression\_clause>
  - LOGTIME=[ NONE | STATUS | LOGFILE | ALL ] parameter
    - Will write timestamps on status and/or logfile messages

# Data Pump News in Oracle 12c

**NEW**  
MEMO

- TRANSFORM option to enable Advanced/HCC Compression

- Example:

- TRANSFORM=TABLE\_COMPRESSION:"compress for query high"

- **But:** Granularity only on the entire import

- Workarounds:

- **Precreate objects**

- Downside: Will slow down import!!!

*or:*

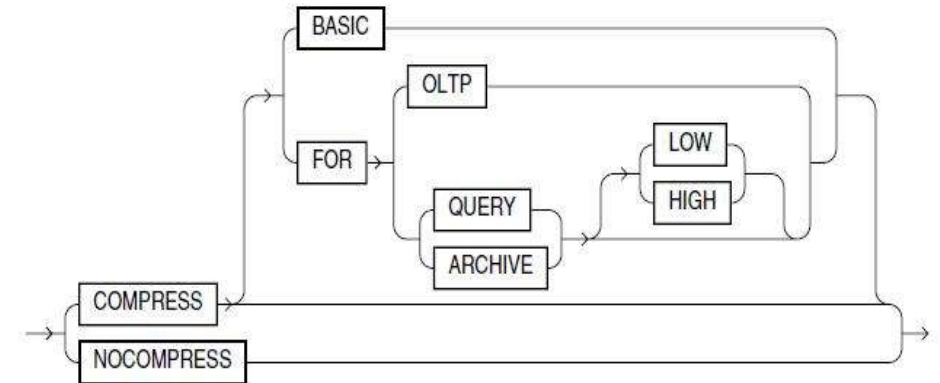
- **Precreate the tablespace with COMPRESS option**

- create tablespace ARCHHIGH datafile 'archhigh.ora' size 100G default compress for archive high;

- Then run Data Pump with TRANSFORM=TABLE\_COMPRESSION:N

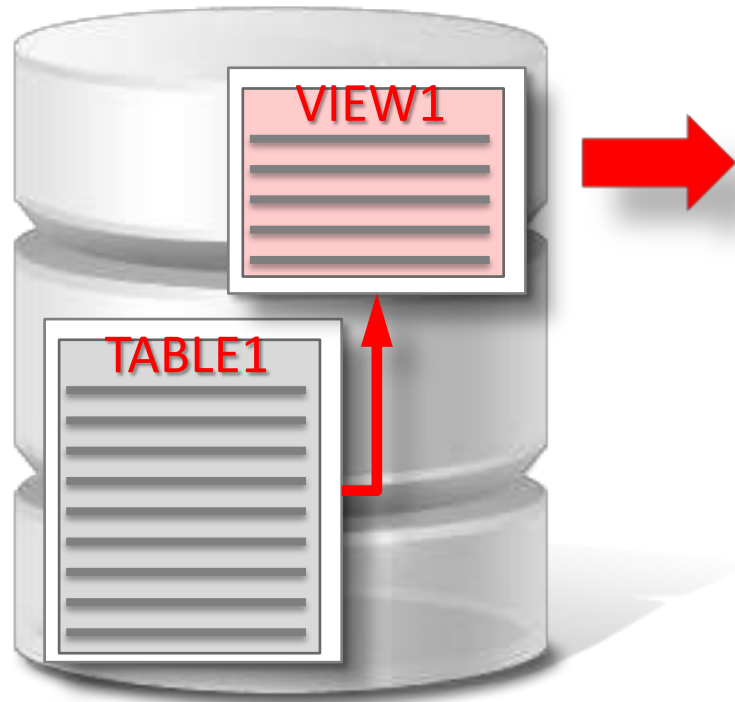
- This will drop all embedded compression attributes associated with the tables

- Now tablespace compression option will be used for all newly created tables



# Exporting Views as Tables

**NEW**  
MEM



```
expdp system/mgr  
views_as_tables=scott.view1 ...
```



```
impdp system/mgr  
remap_table=view1:scott.table1 ...
```



# LOGTIME Parameter

**NEW**  
MEM

- Without vs With LOGTIME=ALL

```
oracle@localhost.localdomain: /tmp
File Edit View Terminal Tabs Help
Starting "HUGO"."SYS_EXPORT_SCHEMA_01": hugo/*
-dp.log dumpfile=dp.dmp schemas=hugo logtime=no
Estimate in progress using BLOCKS method...
Processing object type SCHEMA_EXPORT/TABLE/TABLE_DATA
Total estimation using BLOCKS method: 108.0 MB
Processing object type SCHEMA_EXPORT/USER
Processing object type SCHEMA_EXPORT/SYSTEM_GRANT
Processing object type SCHEMA_EXPORT/ROLE_GRANT
Processing object type SCHEMA_EXPORT/DEFAULT_ROLE
Processing object type SCHEMA_EXPORT/PRE_SCHEMA/PROCACT_SCHEMA
Processing object type SCHEMA_EXPORT/TABLE/TABLE
Processing object type SCHEMA_EXPORT/TABLE/COMMENT
Processing object type SCHEMA_EXPORT/TABLE/INDEX/INDEX
Processing object type SCHEMA_EXPORT/TABLE/CONSTRAINT/CONSTRAINT
Processing object type SCHEMA_EXPORT/TABLE/INDEX/STATISTICS/INDEX_STATISTICS
Processing object type SCHEMA_EXPORT/VIEW/VIEW
Processing object type SCHEMA_EXPORT/TABLE/STATISTICS/TABLE_STATISTICS
Processing object type SCHEMA_EXPORT/STATISTICS/MARKER
. . exported "HUGO"."TEST3"
. . exported "HUGO"."TEST1"
. . exported "HUGO"."TEST2"
Master table "HUGO"."SYS_EXPORT_SCHEMA_01" successfully loaded/unloaded
*****
Dump file set for HUGO.SYS_EXPORT_SCHEMA_01 is:
/tmp/dp_all.dmp

oracle@localhost.localdomain: /tmp
File Edit View Terminal Tabs Help
03-APR-14 17:57:54.735: Estimate in progress using BLOCKS method...
03-APR-14 17:57:55.886: Processing object type SCHEMA_EXPORT/TABLE/TABLE_DATA
03-APR-14 17:57:55.924: Total estimation using BLOCKS method: 108.0 MB
03-APR-14 17:57:56.226: Processing object type SCHEMA_EXPORT/USER
03-APR-14 17:57:56.265: Processing object type SCHEMA_EXPORT/SYSTEM_GRANT
03-APR-14 17:57:56.280: Processing object type SCHEMA_EXPORT/ROLE_GRANT
03-APR-14 17:57:56.306: Processing object type SCHEMA_EXPORT/DEFAULT_ROLE
03-APR-14 17:57:56.684: Processing object type SCHEMA_EXPORT/PRE_SCHEMA/PROCACT_SCHEMA
03-APR-14 17:58:00.465: Processing object type SCHEMA_EXPORT/TABLE/TABLE
03-APR-14 17:58:11.215: Processing object type SCHEMA_EXPORT/TABLE/COMMENT
03-APR-14 17:58:12.107: Processing object type SCHEMA_EXPORT/TABLE/INDEX/INDEX
03-APR-14 17:58:13.356: Processing object type SCHEMA_EXPORT/TABLE/CONSTRAINT/CONSTRAINT
03-APR-14 17:58:13.402: Processing object type SCHEMA_EXPORT/TABLE/INDEX/STATISTICS/INDEX_STATISTICS
03-APR-14 17:58:14.782: Processing object type SCHEMA_EXPORT/VIEW/VIEW
03-APR-14 17:58:15.747: Processing object type SCHEMA_EXPORT/TABLE/STATISTICS/TABLE_STATISTICS
03-APR-14 17:58:15.766: Processing object type SCHEMA_EXPORT/STATISTICS/MARKER
03-APR-14 17:58:27.576: . . exported "HUGO"."TEST3" 82.76 MB 726184 rows
03-APR-14 17:58:27.654: . . exported "HUGO"."TEST1" 10.35 MB 90773 rows
03-APR-14 17:58:27.693: . . exported "HUGO"."TEST2" 17.47 KB 37 rows
03-APR-14 17:58:28.312: Master table "HUGO"."SYS_EXPORT_SCHEMA_01" successfully loaded/unloaded
03-APR-14 17:58:28.319: *****
03-APR-14 17:58:28.321: Dump file set for HUGO.SYS_EXPORT_SCHEMA_01 is:
03-APR-14 17:58:28.328: /tmp/dp_all.dmp
```





# Enhanced Compression Algorithm



## ■ COMPRESSION\_ALGORITHM

### – Defines the compression algorithm when compressing dump files

- BASIC            The same algorithm used in previous versions. Good compression, without severely impacting on performance
- LOW :            For use when reduced CPU utilization is a priority over compression ratio
- MEDIUM:       Recommended option. Similar characteristics to BASIC, but uses a different algorithm
- HIGH:            Maximum available compression, but more CPU intensive

### – Performance:

- Compression ratio
- CPU usage

```
$ expdp scott/tiger tables=emp directory=mydir  
dumpfile=emp.dmp logfile=expdp_emp.log  
compression=all compression_algorithm=medium
```

### – Requires Advanced Compression Option license

# Enhanced Compression Algorithm

**NEW**  
MEM

- Customer evaluation

- BASIC  
at 3.5 TB/hour

| Disk-Group-I/O   |       |         |                 |           |         |             |  |
|------------------|-------|---------|-----------------|-----------|---------|-------------|--|
| Name             | Disks | AvgBusy | Read Write-KB/s | TotalMB/s | xfers/s | BlockSizeKB |  |
| slot02           | 6     | 9.3%    | 123120.4 0.0    | 120.2     | 241.1   | 510.7       |  |
| slot03           | 6     | 6.7%    | 103354.8 0.0    | 100.9     | 202.2   | 511.1       |  |
| slot05           | 6     | 9.0%    | 130420.9 7.0    | 127.4     | 262.0   | 497.8       |  |
| slot06           | 6     | 10.5%   | 158841.9 175.3  | 155.3     | 329.3   | 511.1       |  |
| slot08           | 6     | 8.4%    | 130835.3 0.0    | 127.8     | 256.0   | 511.0       |  |
| slot09           | 6     | 10.1%   | 136525.9 0.0    | 133.3     | 267.0   | 511.3       |  |
| slot10           | 6     | 6.6%    | 140383.4 0.0    | 137.1     | 275.0   | 510.6       |  |
| slot11           | 6     | 6.8%    | 112600.0 2.0    | 110.0     | 220.7   | 510.3       |  |
| Groups= 8 TOTALS | 48    | 1.4%    | 1036082.5 184.3 | 1012.0    | 2053.3  |             |  |

- MEDIUM  
at 7.0 TB/hour

| Disk-Group-I/O   |       |         |                 |           |          |             |  |
|------------------|-------|---------|-----------------|-----------|----------|-------------|--|
| Name             | Disks | AvgBusy | Read Write-KB/s | TotalMB/s | xfers/s  | BlockSizeKB |  |
| slot02           | 6     | 14.5%   | 255770.4 0.0    | 249.8     | 500.9    | 510.7       |  |
| slot03           | 6     | 16.0%   | 273037.4 11.5   | 266.6     | 535.1    | 510.3       |  |
| slot05           | 6     | 15.4%   | 264851.1 17.5   | 258.7     | 519.0    | 510.3       |  |
| slot06           | 6     | 13.2%   | 222160.7 425.5  | 217.4     | 502.4    | 413.1       |  |
| slot08           | 6     | 15.0%   | 267156.6 1.5    | 260.9     | 523.3    | 510.5       |  |
| slot09           | 6     | 14.8%   | 263140.4 6.5    | 257.0     | 515.3    | 510.6       |  |
| slot10           | 6     | 14.6%   | 259603.7 2.5    | 253.5     | 508.5    | 510.5       |  |
| slot11           | 6     | 14.9%   | 258113.0 5.4    | 252.1     | 505.8    | 510.4       |  |
| Groups= 8 TOTALS | 48    | 2.5%    | 2063833.5 470.4 | 2015.9    | 4110.285 |             |  |

**2x**

# Real World Checkpoint



## Customer

### ▪ Payback GmbH

## Project

– Belongs to Loyalty Partner GmbH which belongs to **American Express**

## Constraints

– HQ in Munich, Germany

## Preparation

– Develops and operates professional customer loyalty programs based on customized IT solutions

## Migration

▪ Provider for Payback

## Success?

▪ Active in Germany, Poland, India, Italy, Mexico and USA

## Remarks



# Real World Checkpoint



- Customer
- Project**
- Constraints
- Preparation
- Migration
- Success?
- Remarks

- Migrate **7TB / 1.5TB** from HP-UX to **Exadata V1**
  - Cross platform, cross Endianness, cross version
    - Oracle 9.2.0.7 on HP-UX ⇒ Oracle 11.1.0.7 on OL
  - 4 months planning and migration phase
    - August to November 2009
  - Proposed go-live date
    - 15-NOV-2009



# Real World Checkpoint



Customer

Project

Constraints

Preparation

Migration

Success?

Remarks

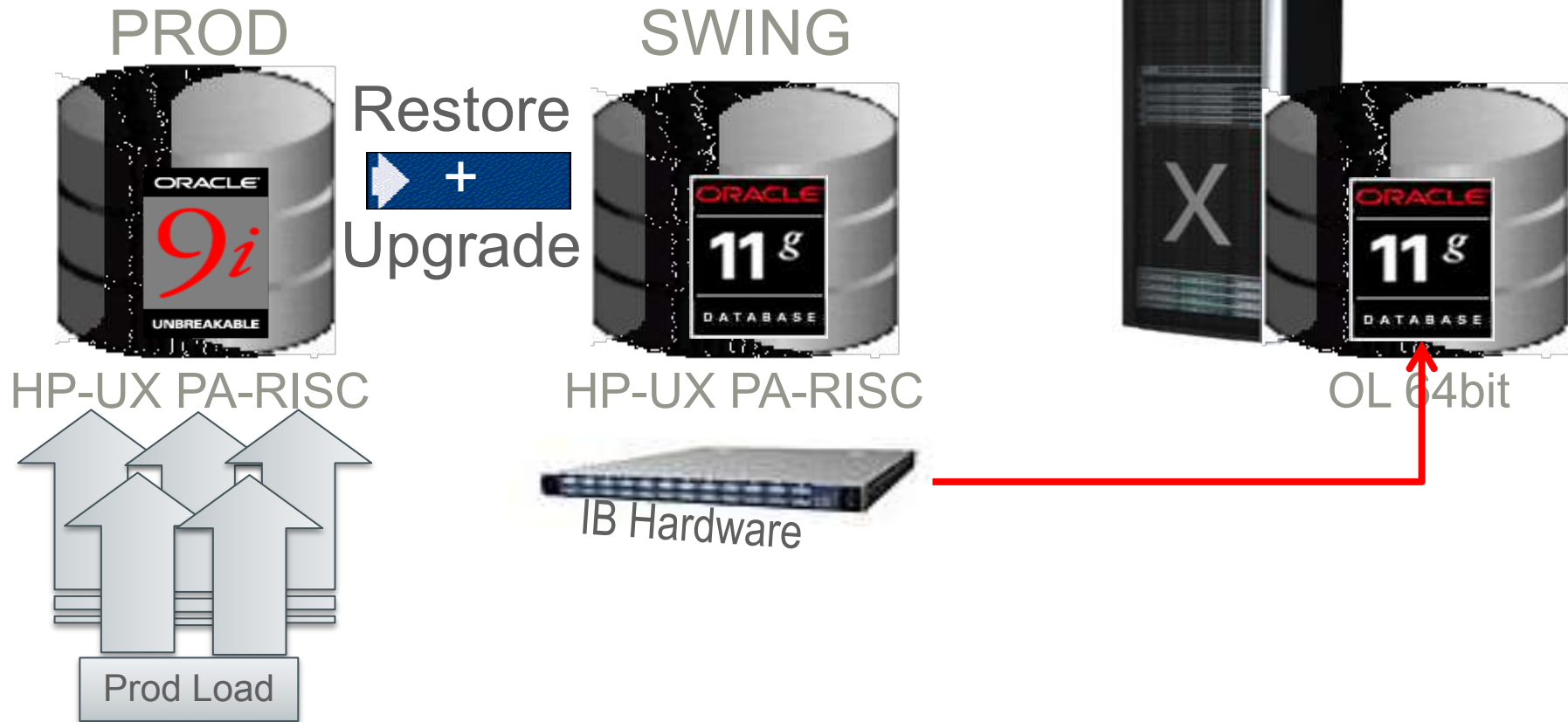
- Move everything in **less than 24 hrs**
- Network bottleneck
  - Remedy:  
Install extra InfiniBand hardware into HP box  
⇒ ~ 3GB/sec throughput!

# Real World Checkpoint



- Customer
- Project
- Constraints
- Preparation**
- Migration
- Success?
- Remarks

Setup:

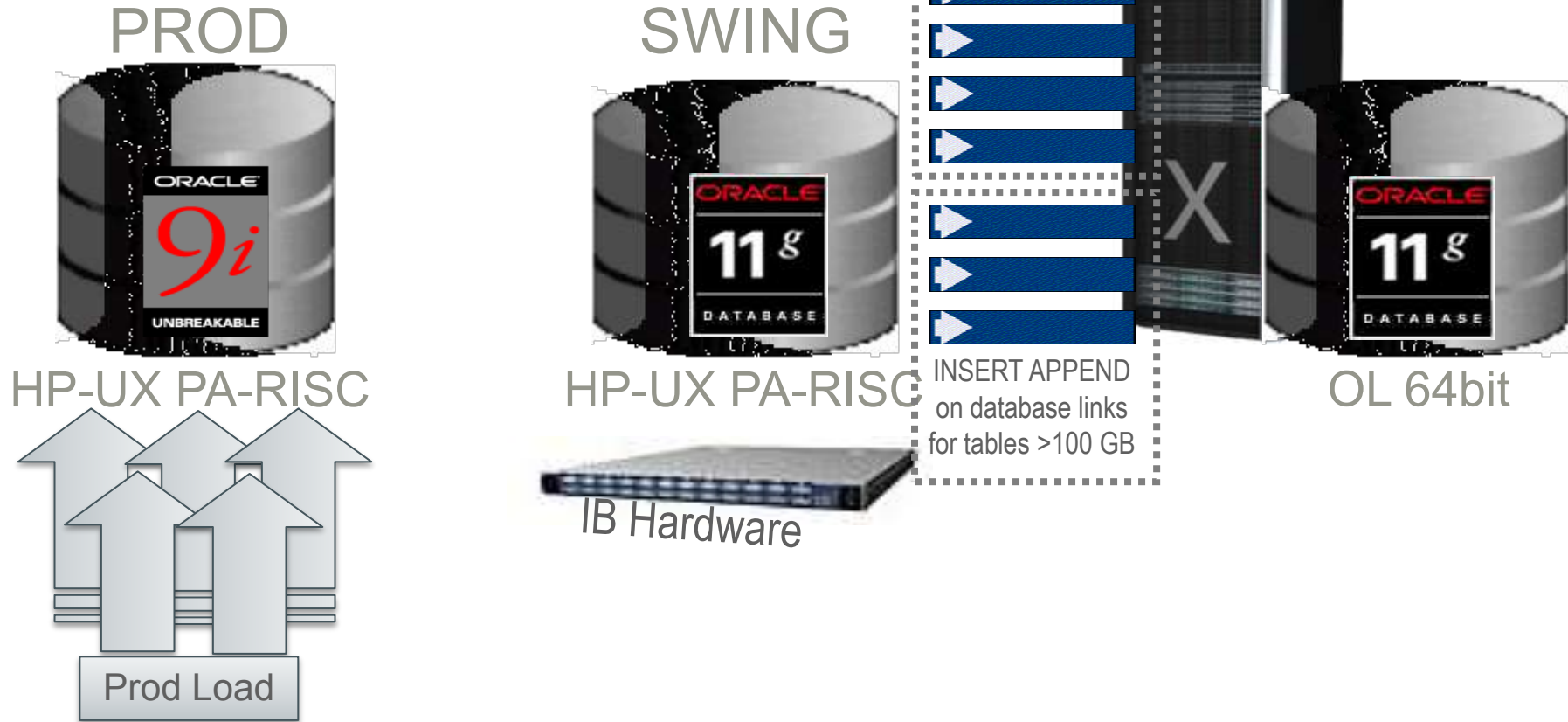


# Real World Checkpoint



- Customer
- Project
- Constraints
- Preparation**
- Migration
- Success?
- Remarks

▪ Test migrations:

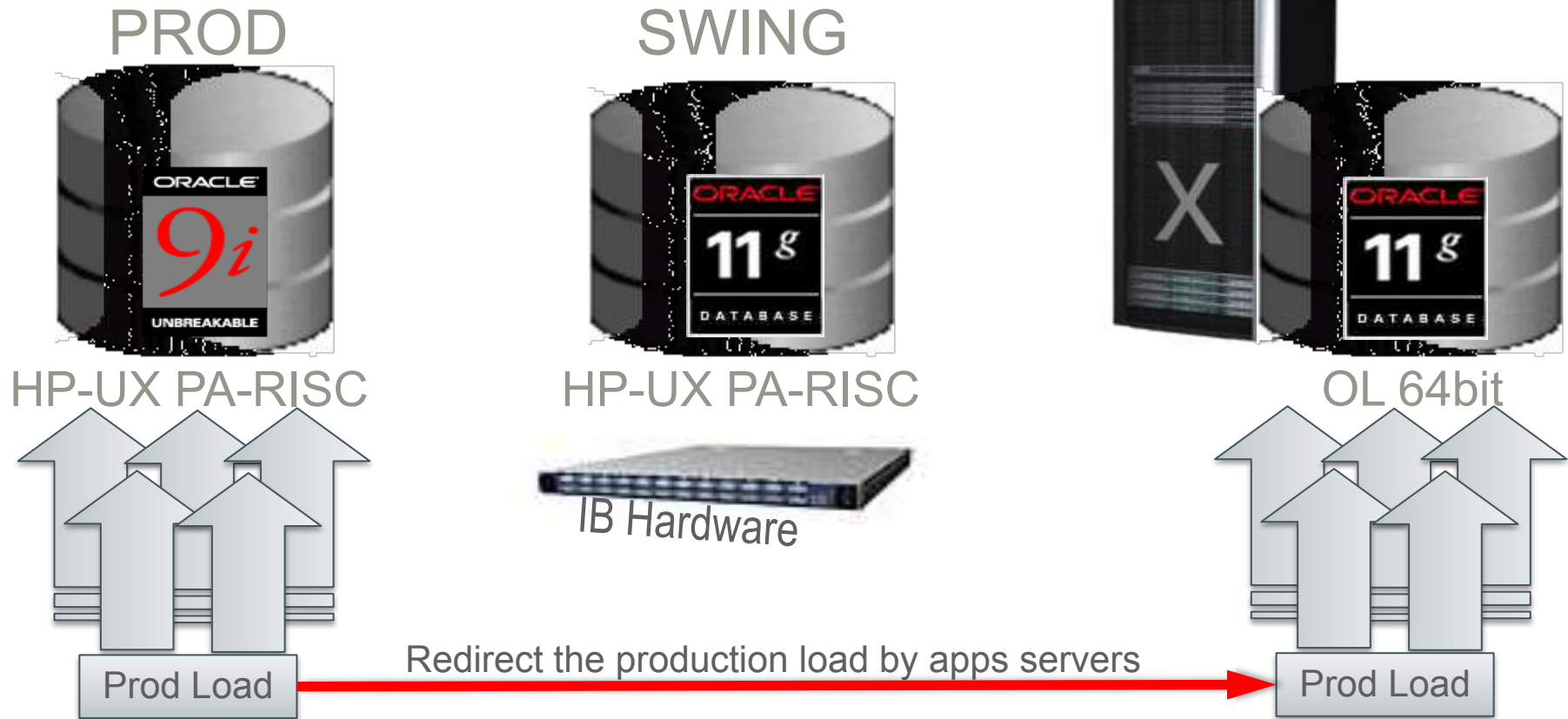


# Real World Checkpoint



- Customer
- Project
- Constraints
- Preparation**
- Migration
- Success?
- Remarks

Parallel **live** loads: **Performance tests**





# Real World Checkpoint



Customer

- **Final test** became **LIVE** migration

Project

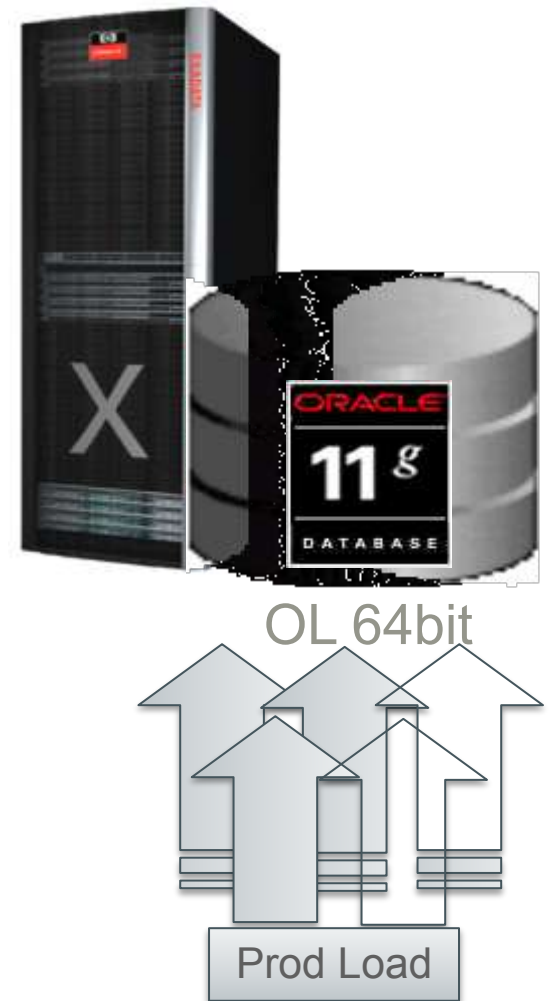
Constraints

Preparation

**Migration**

Success?

Remarks



# Real World Checkpoint



Customer

Project

Constraints

Preparation

Migration

Success?

Remarks

- Live? And alive?
  - Yes! Go-live in early November 2009
    - **Two weeks earlier** than proposed
  - Total upgrade and migration time: **~20 hours**
    - ~ 8 hours: Restore and recovery
    - ~ 1 hour: Database upgrade to Oracle 11.1.0.7
    - ~10 hours: Data migration to Exadata V1
    - ~ 1 hour: Smoke testing and final verification
  - Dramatic performance improvements
    - Job runtimes decreased by 80%
    - **User complaints** about too fast performance ... really!!

# Real World Checkpoint



- Customer
- Project
- Constraints
- Preparation
- Migration
- Success?
- Remarks

- Not a single piece of SQL got changed!!!
  - Most critical job**: runtime from 30 hrs to < 2hrs

| Operation           | Name     | Estimated Rows | Cost  | Time (s) | Exec. Count | Actual Rows | Temp. C  |
|---------------------|----------|----------------|-------|----------|-------------|-------------|----------|
| SELECT STATEMENT    |          | 6571K          |       |          | 31          | 491         |          |
| PX COORDINATOR      |          |                |       |          | 31          | 491         |          |
| PX SEND QC (RANDOM) | TQ10004  | 1639M          | 6571K |          | 19          | 19K         |          |
| SORT GROUP BY       |          | 1639M          | 6571K |          | 19          | 19K         | 736M 170 |
| PX RECEIVE          |          | 1639M          | 6571K |          | 15          | 211M        |          |
| PX SEND HASH        | TQ10002  | 1639M          | 6571K |          | 15          | 211M        |          |
| SORT GROUP BY       |          | 1639M          | 6571K |          | 15          | 211M        |          |
| PX RECEIVE          |          | 1639M          | 6571K |          | 19          | 247M        |          |
| PX SEND HASH        | TQ10002  | 1639M          | 6571K |          | 15          | 247M        |          |
| SORT GROUP BY       |          | 1639M          | 6571K |          | 15          | 247M        |          |
| HASH JOIN           |          | 7416M          | 1247K |          | 15          | 7267M       |          |
| JOIN FILTER CREATE  | #P0000   | 42M            | 47K   |          | 15          | 42M         |          |
| PX RECEIVE          |          | 42M            | 47K   |          | 15          | 42M         |          |
| PX SEND HASH        | TQ10000  | 42M            | 47K   |          | 15          | 42M         |          |
| PX BLOCK ITERATOR   |          | 42M            | 47K   |          | 15          | 42M         |          |
| TABLE ACCESS        | DIM_CARD | 42M            | 47K   |          | 215         | 42M         |          |
| PX RECEIVE          |          | 7414M          | 1197K |          | 15          | 7413M       |          |
| PX SEND HASH        | TQ10001  | 7414M          | 1197K |          | 15          | 7413M       |          |
| JOIN FILTER USE     | #P0000   | 7414M          | 1197K |          | 15          | 7413M       |          |
| PX BLOCK ITERATOR   |          | 7414M          | 1197K |          | 15          | 7413M       |          |
| TABLE ACCESS        | FACT_TRK | 7414M          | 1197K |          | 9190        | 7413M       |          |



# Real World Checkpoint



Customer

- Same customer again ... Payback GmbH

Project

Constraints

Preparation

Upgrade

Success?

Remarks



# Real World Checkpoint



Customer

Project

Constraints

Preparation

Upgrade

Success?

Remarks

- Migrate **14TB** from **Exadata V1** to **Exadata X2-2**
  - 2 months planning and migration phase
    - June to July 2012
  - Proposed go-live date
    - 22-JUL-2012
  - [MOS Note: 1055938.1](#)  
**Migrating** from HP Oracle Database Machine to Sun Oracle Database Machine 11.2 **using Data Guard**

# Real World Checkpoint



Customer

- Database has grown from 7TB to **14TB**

Project

- Downtime: **less than 8 hrs**

Constraints

- Network "bottleneck"

Preparation

- Remedy: Extra IB cabled connection from V1 to X2-2

Upgrade

Success?

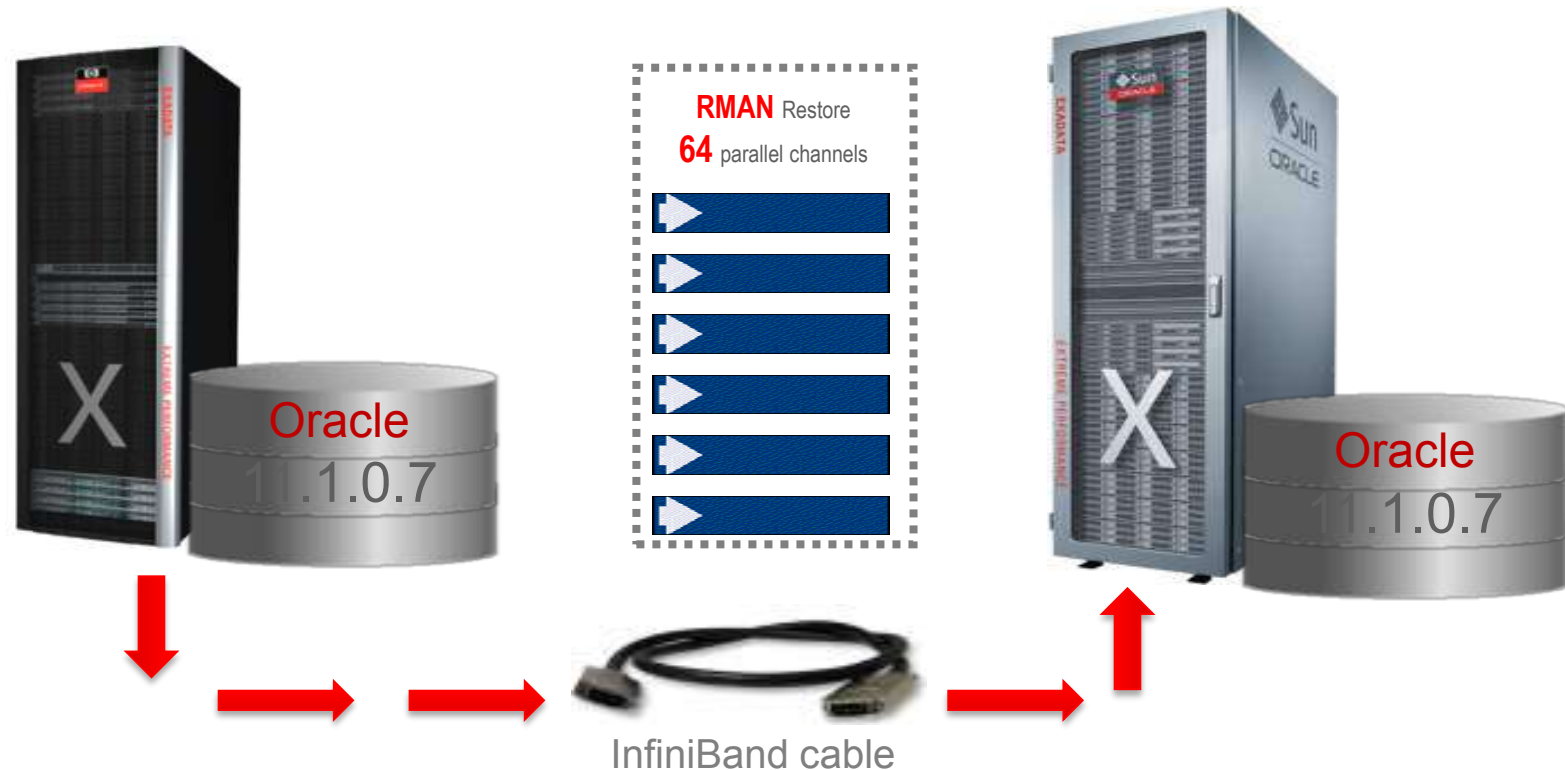
Remarks

# Real World Checkpoint



- Customer
- Project
- Constraints
- Preparation**
- Upgrade
- Success?
- Remarks

- Restoring **14TB** with RMAN
  - DUPLICATE FOR STANDBY FROM ACTIVE DATABASE
- Removed unused components from the source database

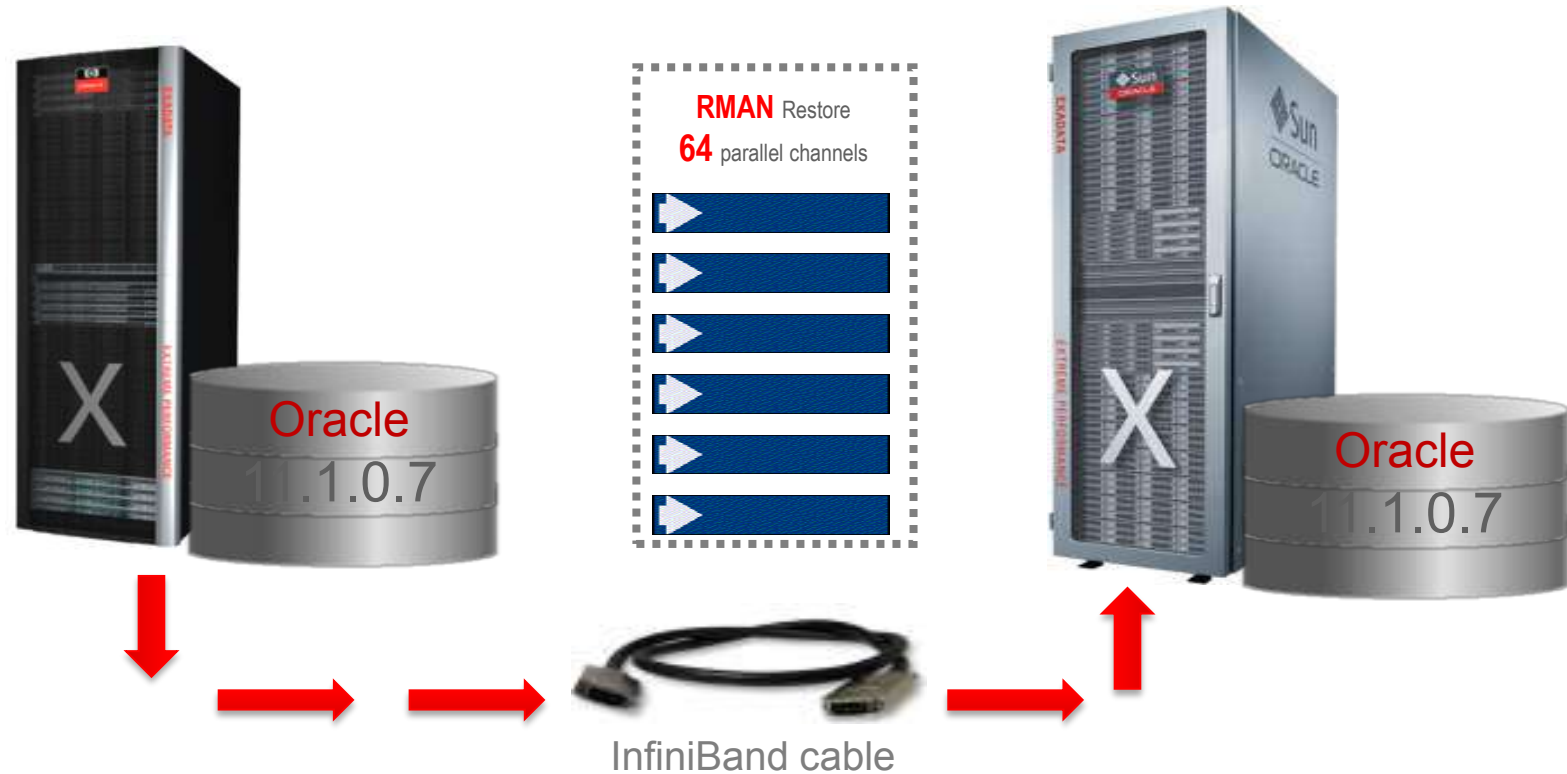


# Real World Checkpoint



- Customer
- Project
- Constraints
- Preparation
- Upgrade**
- Success?
- Remarks

- Live upgrade/migration
  - RMAN Restore and Recovery: **<3 hours**
  - 64 parallel RMAN channels allocated: >4TB/hour





# Real World Checkpoint



Customer

Project

Constraints

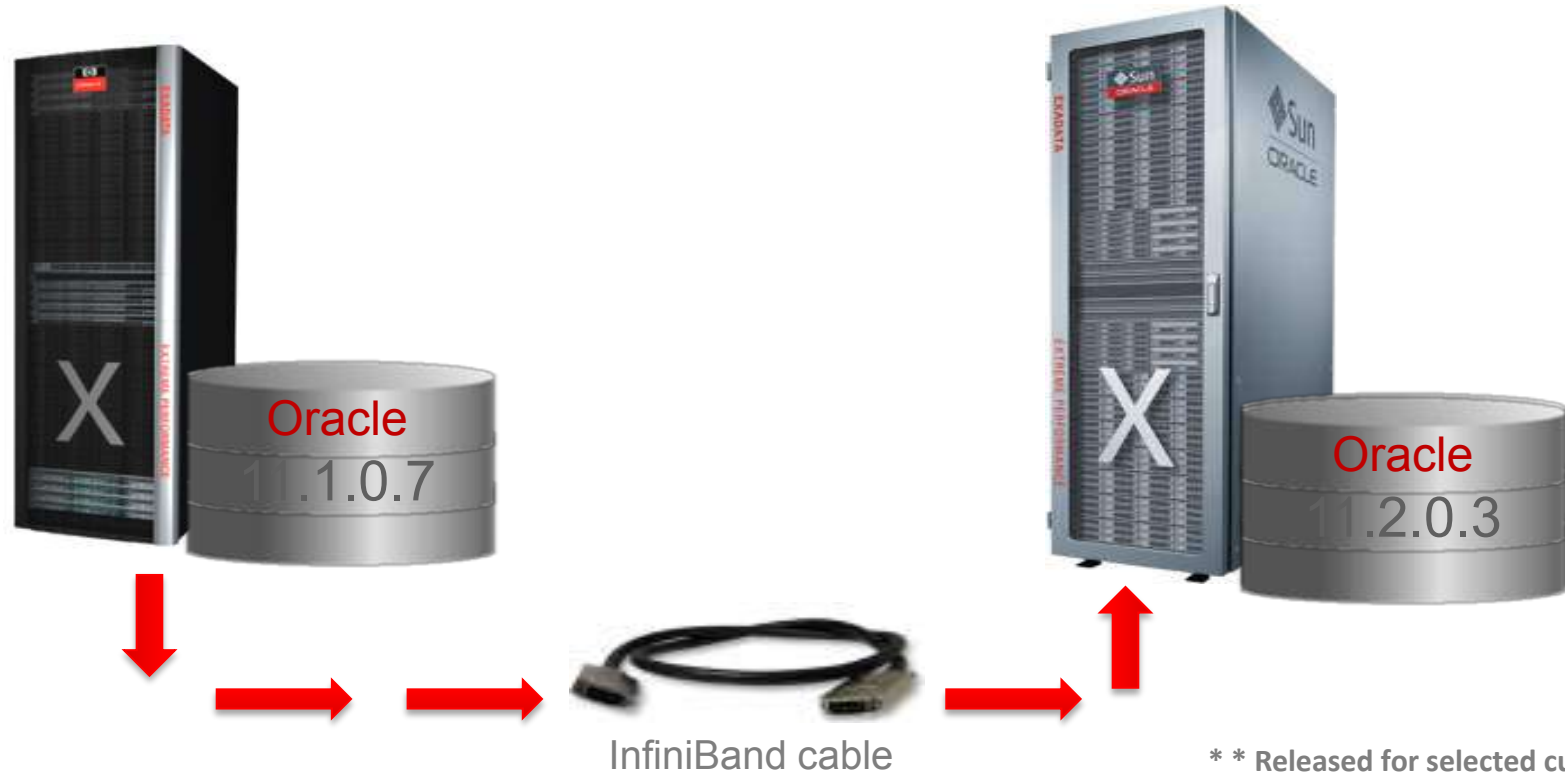
Preparation

Upgrade

Success?

Remarks

- Database upgrade 11.1.0.7 ⇒ 11.2.0.3
  - Using the **new PARALLEL UPGRADE\*** scripts
    - Total database upgrade time** including recompilation and time zone change: **20 mins**



\*\* Released for selected customers only



# Real World Checkpoint



Customer

Project

Constraints

Preparation

Upgrade

Success?

Remarks

- Live? And alive?
  - Yes! Go-live on 3-JUL-2012
    - **Almost three weeks earlier** than proposed
  - Total migration and upgrade time: **~4 hours**
    - < 3 hours: Restore for Standby and recovery
    - < 20 mins: Database upgrade to Oracle 11.2.0.3
    - ~ 40 mins: Extra tasks (crsctl etc.)
  - Significant performance improvements
    - Job runtimes decreased again by 30-60%

# Real World Checkpoint



Customer

Project

Constraints

Preparation

Upgrade

Success?

Remarks

- A few plans did change – but we were prepared 😊
  - Had captured all plans from AWR into an SQL Tuning Set
  - Remedied failing plans with SQL Plan Management

# Upgrade, Migrate & Consolidate

- 1 Introduction
- 2 Preparation Steps
- 3 Upgrade / Migrate / Consolidate**
- 4 Fallback Strategies
- 5 New Features
- 6 Performance Management
- 7 Wrap Up



# Concept Transportable Tablespaces

```
expdp 'sys/sys@sys sys dba' ... "..."
TRANSPORTABLE tablespaces=TS1, TS2 ...
```

- TTS feature available since Oracle 8i
- Cross platform support since Oracle 10g



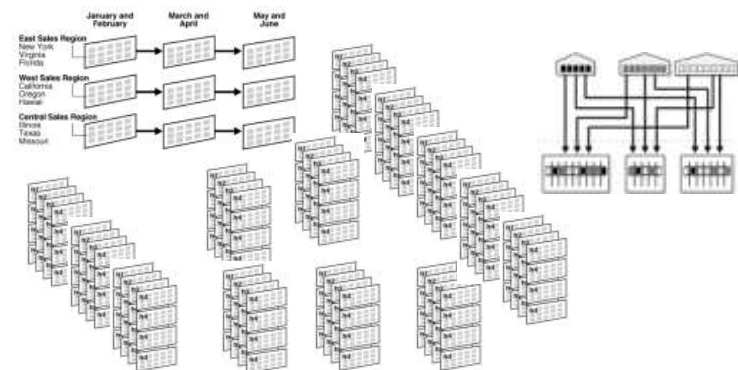
# Transportable Tablespaces Pros and Cons

## ■ Pro

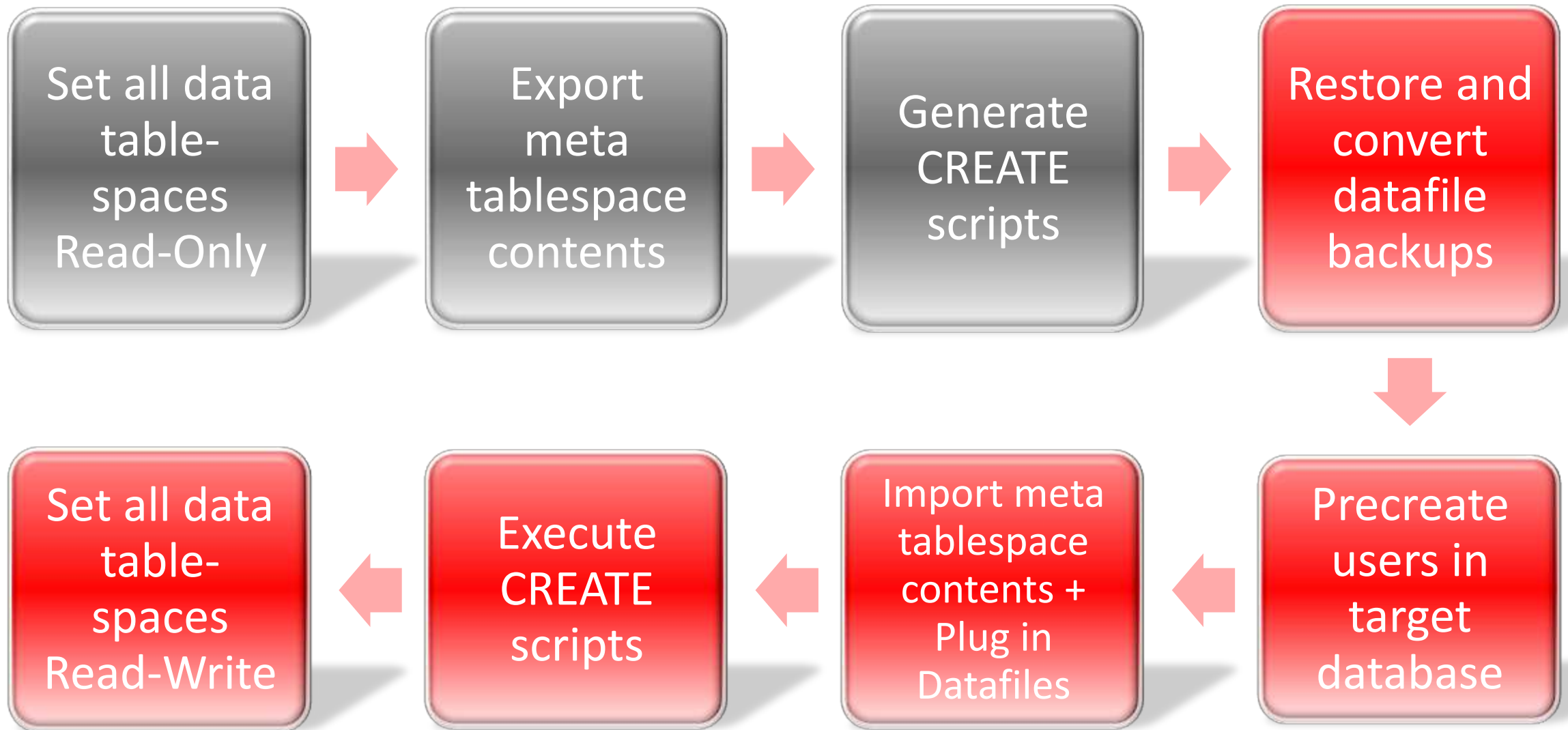
- Potentially very fast
  - Copying large files can be faster than exporting & importing everything
  - No need to rebuild indexes
- Cross platform since Oracle 10g
- Decrease copy/convert time by using RMAN Incremental Backups
- Proven solutions for EBS and other apps available

## ■ Con

- SYSTEM/SYSAUX can't be transported
- Complexity is your enemy
  - Too many objects to rebuild
    - Views, synonyms, sequences ...
    - **Simple is better for fast TTS!!!**
  - Too many objects in tablespaces slow down meta expdp/impdp
    - **(Sub)partitions**, partitioned indexes ...



# Workflow



# Concept Transportable Tablespaces xTTS

- Cross platform support

- `V$TRANSPORTABLE_PLATFORM`


**LITTLE ENDIAN PLATFORMS**

HP IA Open VMS  
HP Open VMS  
HP Tru64 UNIX

Linux IA (32-bit)  
Linux IA (64-bit)  
Linux x86 64-bit

Microsoft Windows IA (64-bit)  
Microsoft Windows x86 64-bit  
Microsoft Windows IA (32-bit)

Solaris Operating System (x86)  
Solaris Operating System (x86-64)

FILE  
  
COPY




**BIG ENDIAN PLATFORMS**

HP-UX (64-bit)  
HP-UX IA (64-bit)

AIX-Based Systems (64-bit)  
IBM zSeries Based Linux  
IBM Power Based Linux

Solaris[tm] OE (32-bit)  
Solaris[tm] OE (64-bit)

FILE  
  
COPY



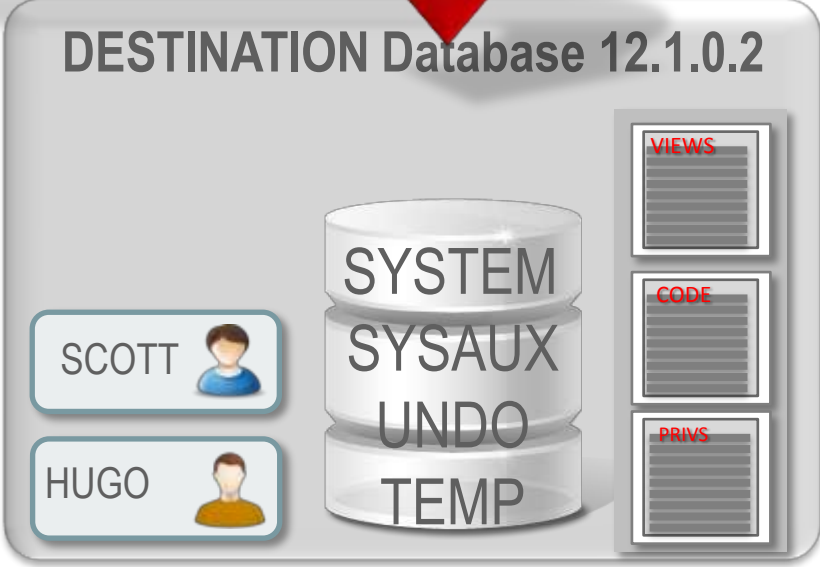
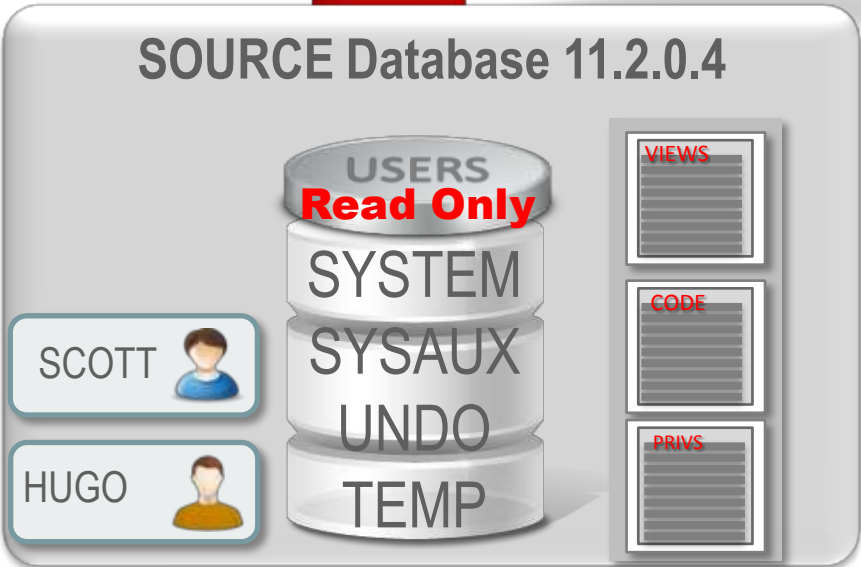
# Concept Transportable Tablespaces xTTS

- TTS cross platform
  - RMAN creates a file copy
  - Can be done on source or target system
    - Use the faster storage
  - Takes approximately the same amount of time as a backup and requires staging space
  - Multiple channels can be used
  - Example:

```
RMAN> CONVERT TABLESPACE users,example
      TO PLATFORM 'Linux IA (32-bit)'
      FORMAT='/stage/transport_linux/%U';
```
  - DBMS\_FILE\_TRANSFER converts implicitly and does not require staging but is generally slower

# Upgrade/Migration: Transportable Tablespaces

Rebuild meta information  
(views, synonyms, trigger, roles etc)



# Possible options

- Moving meta information

- The “**brute force**” approach

- Data Pump



```
expdp/impdp CONTENT=METADATA_ONLY
```

- The “**smart**” approach

- DBMS\_METADATA



```
SELECT DBMS_METADATA.GET_DDL('SYNONYM', SYNONYM_NAME,  
OWNER) FROM all_synonyms where owner='PUBLIC' and  
table_owner not in ('SYS');
```

# Transportable Tablespaces

- Avoid physical file copies when possible

- Use a physical standby as your transporter



- Mount from two sides

- Tablespaces can be mounted from two databases at the same time as long as the files are set read-only on OS level



- Take special care on:

- Time zone versions must be equal prior to transport
  - Otherwise Data Pump will block the meta import
- Be careful with starting values for sequences

# Real World Checkpoint



## Customer

### ▪ Fuji Xerox Singapore

## Project

## Constraints

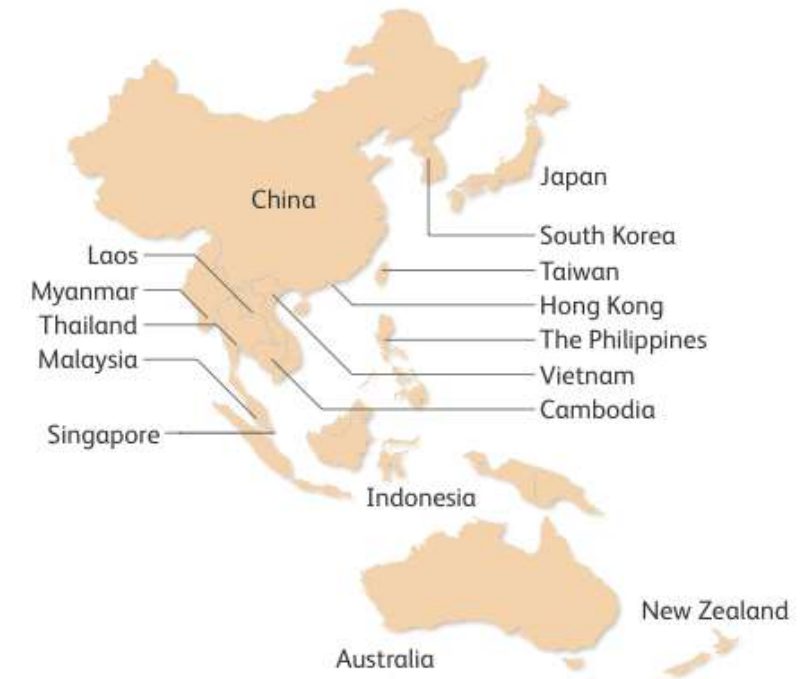
## Preparation

## Migration

## Success?

## Remarks

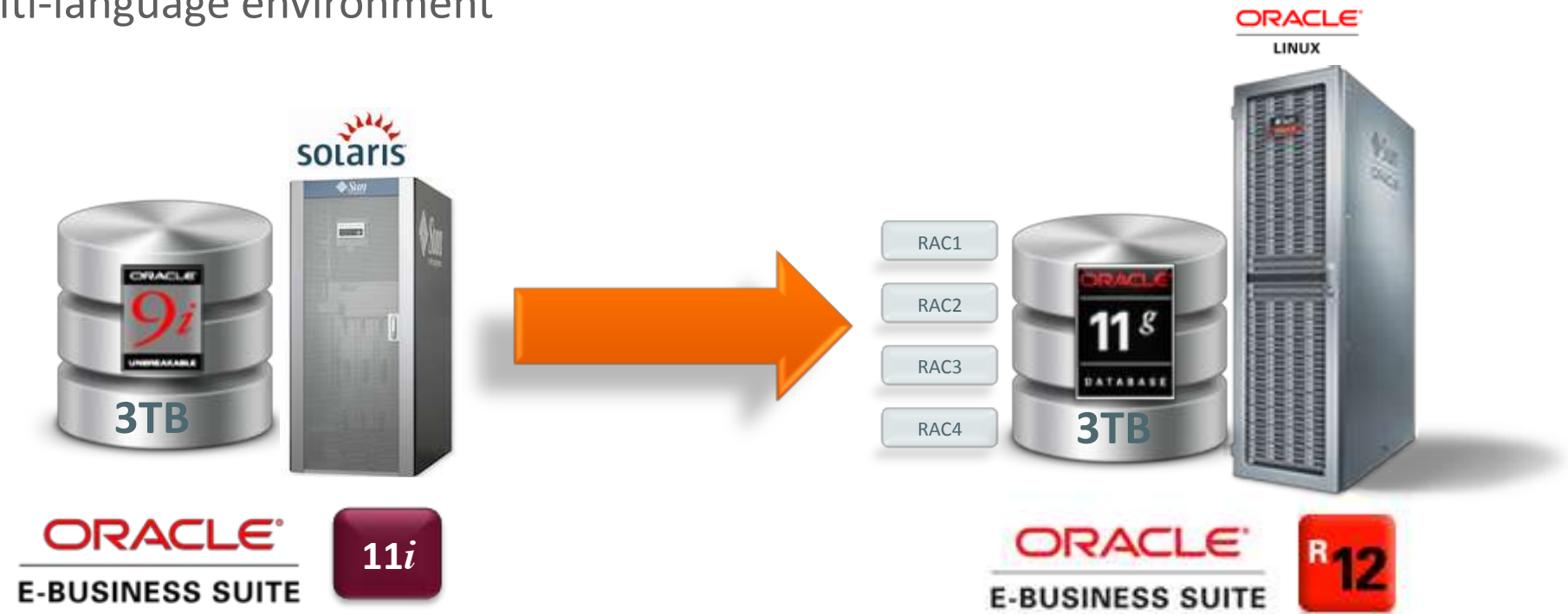
- Headquartered in Tokyo, locations throughout the Asia-Pacific region
- Global leader in document services and communications
- Over ¥1 trillion annual revenue
- 45,000+ employees



# Real World Checkpoint

- Customer
- Project**
- Constraints
- Preparation
- Migration
- Success?
- Remarks

- Upgrade and migrate Oracle E-Business Suite database and applications
  - Multi-language environment



# Real World Checkpoint



Customer

Project

Constraints

Preparation

Migration

Success?

Remarks

- Database hosts information from multiple countries in a single EBS instance
  - Includes nine different alphabets
- OS and Endian Conversion
- Coordination of EBS and DB upgrades and patching
- Single 1Gbit network card on source system
- No testing impact on PROD allowed
- Initial migration testing showed **7+ days** of downtime

# Real World Checkpoint



Customer

Project

Constraints

Preparation

Migration

Success?

Remarks

- Database Migration Options
  - ☒ exp/imp: too slow
  - ☒ Data Pump, xTTS: requires 10g or newer
  - ☑ **Decision: upgrade DB, then use xTTS**
- Test plan
  - Multiple test runs to understand and tune the process
  - Copy of production environment to avoid any impact on business operations during testing
- Worked with third-party SI, Oracle ACS and Oracle Development early in the process



# Real World Checkpoint

Customer

Project

Constraints

**Preparation**

Migration

Success?

Remarks

- Detailed migration planning



A screenshot of a migration planning table. The table has multiple columns and rows. A red rectangular box highlights a specific row in the middle of the table. The text in the table is mostly illegible due to blurring.



A screenshot of a migration planning table, similar to the one on the left. A red bracket highlights a section of the table, spanning several rows. The text in the table is mostly illegible due to blurring.

# Real World Checkpoint



Customer

Project

Constraints

Preparation

Migration

Success?

Remarks

- Addressed network speed issues
  - Reduced file copy time from **9 hours to 4 hours**
    - Added network cards to source system (total 4 x 1Gbit)
    - Parallel scripts to copy data files from source to target
- Identified and applied helpful patches on source and target systems
- Tuned parameters and parallelism for EBS upgrade
- Analyzed and tuned post-upgrade performance on target system

# Real World Checkpoint

Customer

Project

Constraints

Preparation

**Migration**

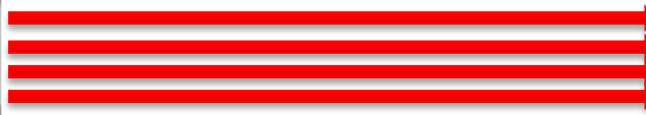
Success?

Remarks

1. Install target environment
2. Upgrade source DB to 11g on Solaris
3. Migrate across platform using xTTS
4. Upgrade EBS to R12 on Exadata



Cross-platform Transportable  
Tablespaces



# Real World Checkpoint



Customer

- **YES:** went live in Spring 2013

Project

- Some EBS actions required or desirable prior to the DB upgrade

Constraints

Preparation

- E.g. Patch to improve performance on the `DR$PENDING` table

Migration

- Just a few post-upgrade DB tuning steps needed

Success?

- Re-registered services to fix load imbalance in RAC
- Found and fixed a few recommended parameter settings that had been missed

Remarks

- And some EBS tuning as well
  - Increased number of JVM to accommodate more users
  - Modified Forms OC4J Container values to improve navigation

# Real World Checkpoint



Customer

Project

Constraints

Preparation

Migration

Success?

Remarks

- Database upgrade is often only part of the project



- The more current your source version, the less work is involved in an upgrade or migration
- Tune your application, not just your database!

# Real World Checkpoint

## Customer

## Project

## Constraints

## Preparation

## Migration

## Success?

## Remarks

- One of the top 5 banks in the world
  - Based in North America
  - Businesses include consumer banking, credit cards, asset management, business finance, investment banking...
  - Over \$2 trillion in assets, more than \$100 Billion in annual revenue
  - 240,000 employees in 60 countries



# Real World Checkpoint

Customer

Project

Constraints

Preparation

Migration

Success?

Remarks

- 70+ TB to migrate and upgrade

|                            | Current Configuration  | New Configuration      |
|----------------------------|------------------------|------------------------|
| CPUs                       | 16 single-core         | 4 x 8-core             |
| Operating System<br>Endian | Big                    | Little                 |
| File System                | Veritas CFS, SFRAC 4.1 | Veritas CFS, SFRAC 5.1 |
| Disk Group                 | 1 per DB               | 3-4 per DB             |
| Database size              | 70+ TB                 | <b>70+TB</b>           |
| Database Version           | Oracle 10.2.0.4        | Oracle 11.2.0.2        |

# Real World Checkpoint

Customer

Project

Constraints

Preparation

Migration

Success?

Remarks

- Endian conversion
  - Both OS- and database-level endian conversions needed
- Data synchronization
  - Up to the minute before conversion
- Conversion Window
  - Migration *and basic testing*: **48 hours**
- Size & Scale of data
  - 70+ TB, **millions of sub-partitions**, extremely active OLTP system



# Real World Checkpoint

Customer

Project

Constraints

Preparation

Migration

Success?

Remarks

- **Explore Data Movement Options**
  - Copying 70TB over the 10Gb network = **~20 hours**
  - And it doesn't include DB cross-endian conversion!
- Customer decision:
  - Use already licensed *Veritas Portable Data Containers*
  - Turbo TTS was not available yet
    - *No need to license 3<sup>rd</sup> party software anymore!*
- **Explore Database Conversion Options**
  - Many options evaluated
  - Customer decision:
    - Cross-Platform Transportable Tablespaces

# Real World Checkpoint

Customer

Project

Constraints

Preparation

**Migration**

Success?

Remarks

- Migration Weekend: Met plan almost exactly!

| Duration | Action                                                  |
|----------|---------------------------------------------------------|
| 3 hours  | Graceful application shutdown, backup                   |
| 6 hours  | Instantiate and validate DB on swing server             |
| 6 hours  | Data Pump metadata export                               |
| 1 hours  | OS-level endian conversion                              |
| 20 hours | RMAN CONVERT processing                                 |
| 8 hours  | Data Pump metadata import                               |
| 5 hours  | Post-migration tasks (TNSNAMES, re-create dblink, etc.) |
| 2 hours  | Post-migration validation & smoke testing               |
| 35 hours | Migrate 70+ TB cross-endian!!!                          |
| 51 hours | Total time                                              |

# Real World Checkpoint

Customer

Project

Constraints

Preparation

Migration

Success?

Remarks

- **YES** ...just a couple of post-upgrade tweaks:
  - Wrong `job_queue_processes` setting blocked parallel recompilation
    - **Remedy**: Set it to a value greater than 0 starting in 11.2
  - High MUTEX contention after upgrade
    - **Remedy**: Apply newest **PSU** – it had all the fixes!!!

# Real World Checkpoint

Customer

Project

Constraints

Preparation

Migration

Success?

Remarks

- **Expect the unexpected** -- especially things you don't control! In this case...
  - Windows security group decided to roll out new security profiles on migration weekend
  - Upgrade weekend delayed by US debt ceiling negotiations
  - ...what will happen during **your** big migration?
- Does it really need to be said? **Test!!!**

# Speed Up Transportable Tablespaces

- Usually the biggest **pain points** with TTS
  - **Downtime** due to:
    - Duration to copy very large amounts of data
    - Duration to convert many tablespaces cross Endianness
- New technique: **Avoid the copy & convert phase**
  - RMAN can convert **incremental backups** cross platform
    - Available since Oracle 11.2.0.3 for Exadata only
    - Available for Linux x86-64 with Oracle 11.2.0.4
    - Available on all platforms starting with Oracle 12c
    - See [MOS Note:1389592.1](#) for description and Linux PERL scripts



# The biggest pain points of TTS?

- Copy and convert a large database
- Rebuild all the meta information

# TTS Pain Points

- **Size**

- Solution:

- **RMAN Incremental Backups**

- PERL scripts in [MOS Note:1389592.1](#) and in [MOS Note: 2005729.1](#)
- Source: 10.2.0.3 or newer
- Target: 11.2.0.4 or newer

- **Complexity**

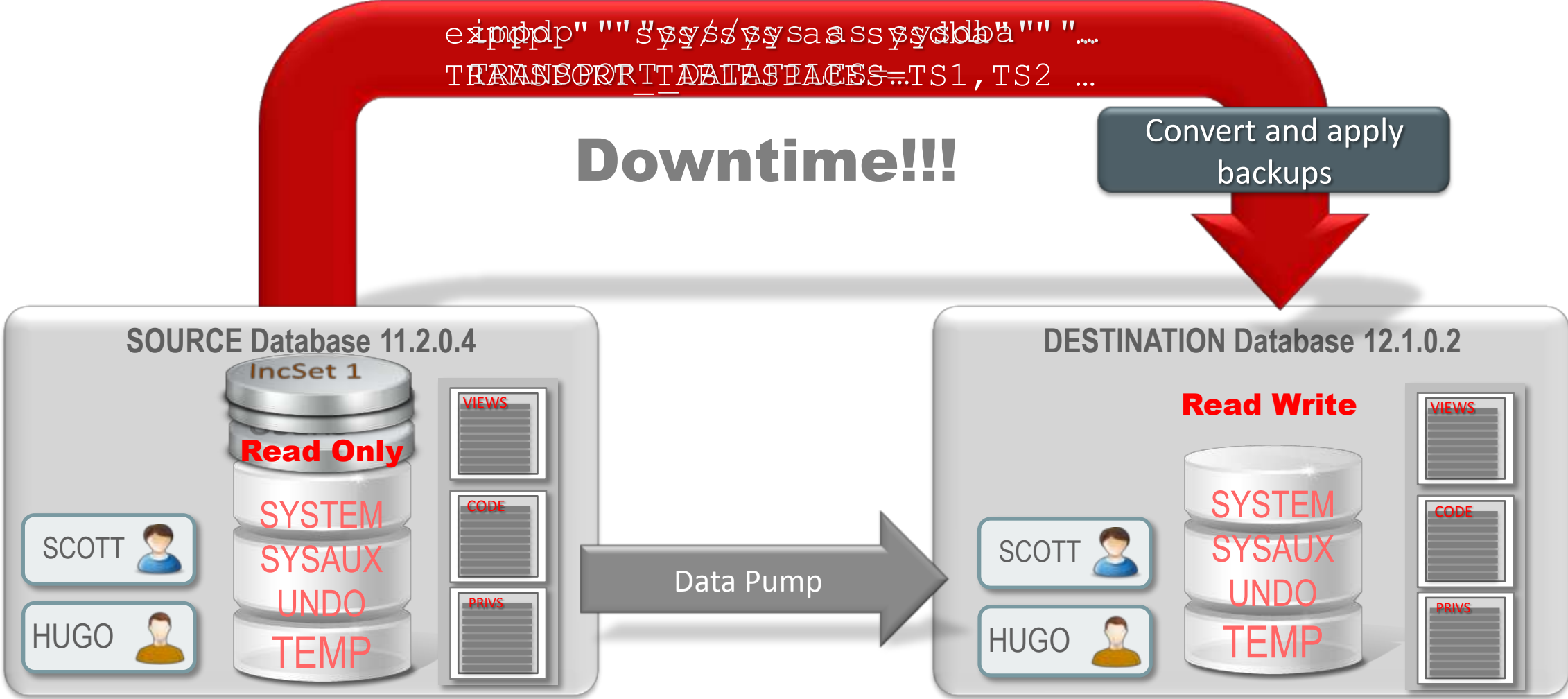
- Solution:

- **Full Transportable Export/Import**

- Data Pump feature allows One Command Migration
- Source: 11.2.0.3 or newer
- Target: 12.1.0.1 or newer

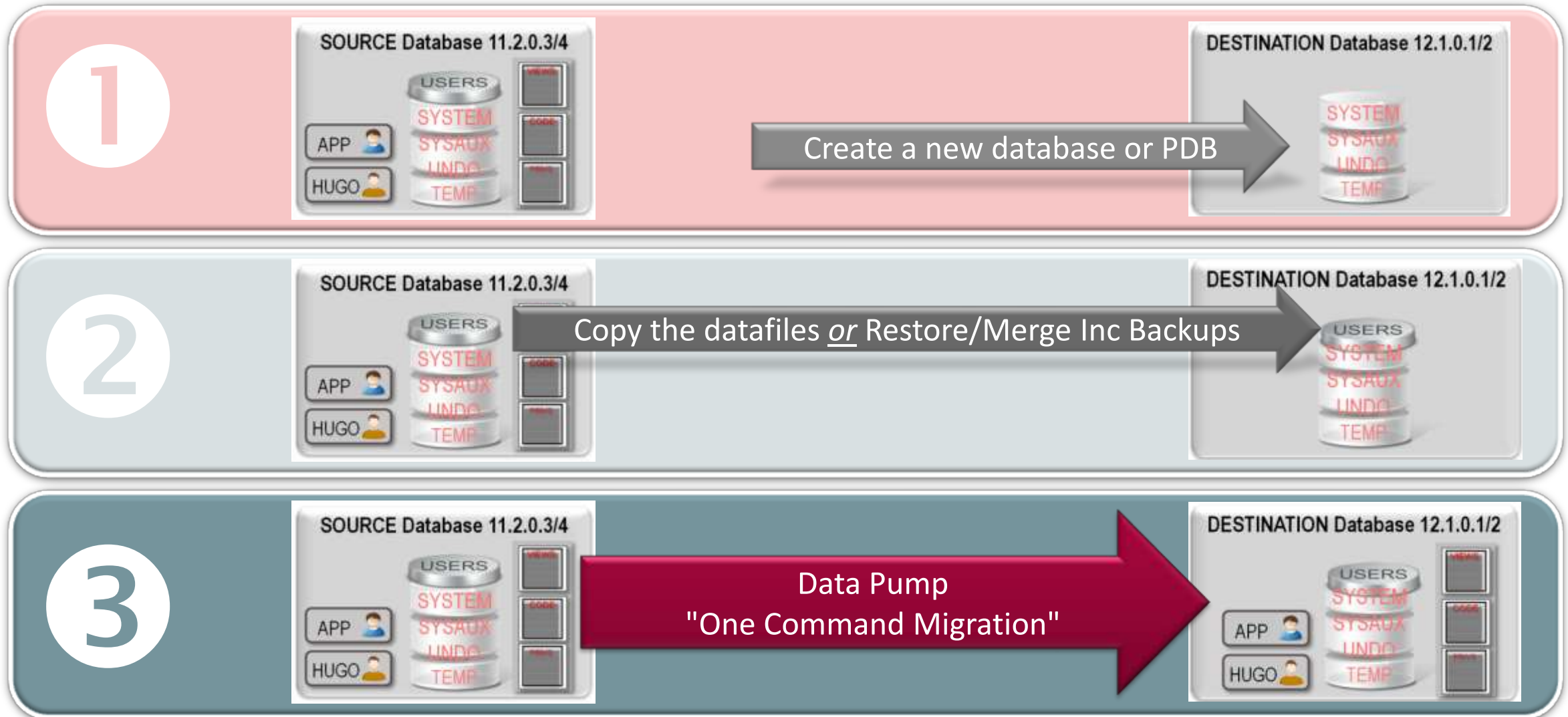


# Pure Transportable Tablespace with Incremental Backups

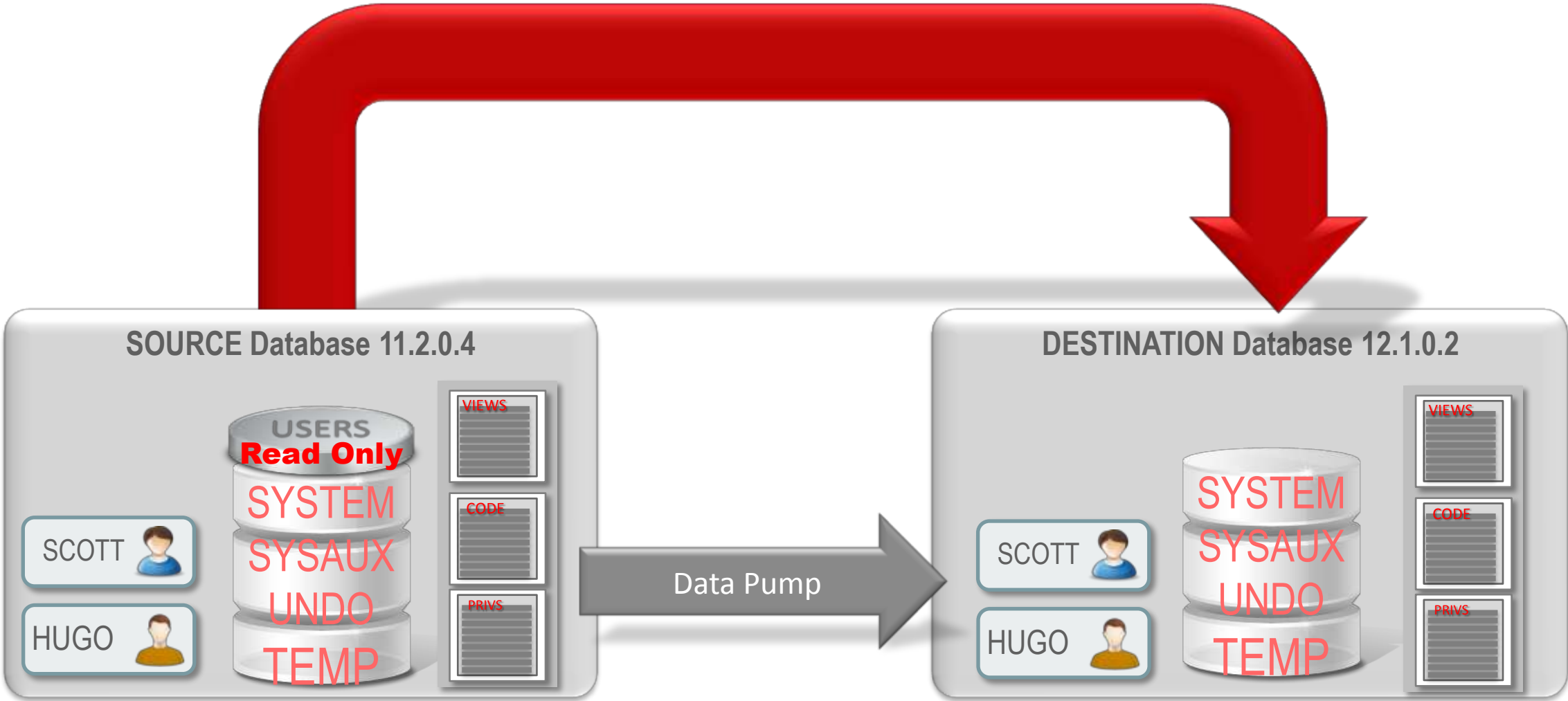




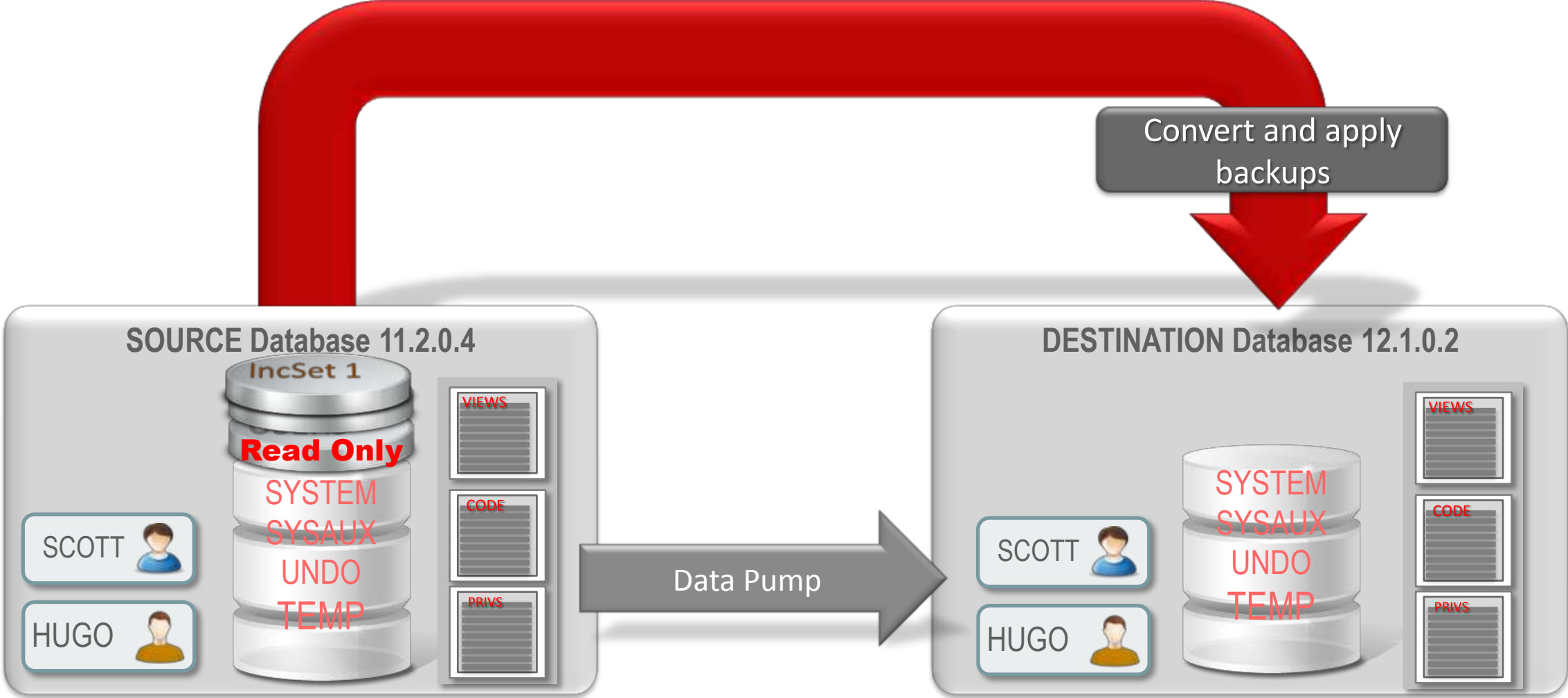
# Full Transportable Export/Import in 3 Steps



# Full Transportable Export/Import with Copies



# Full Transportable Export/Import with Backups





# Let's do it

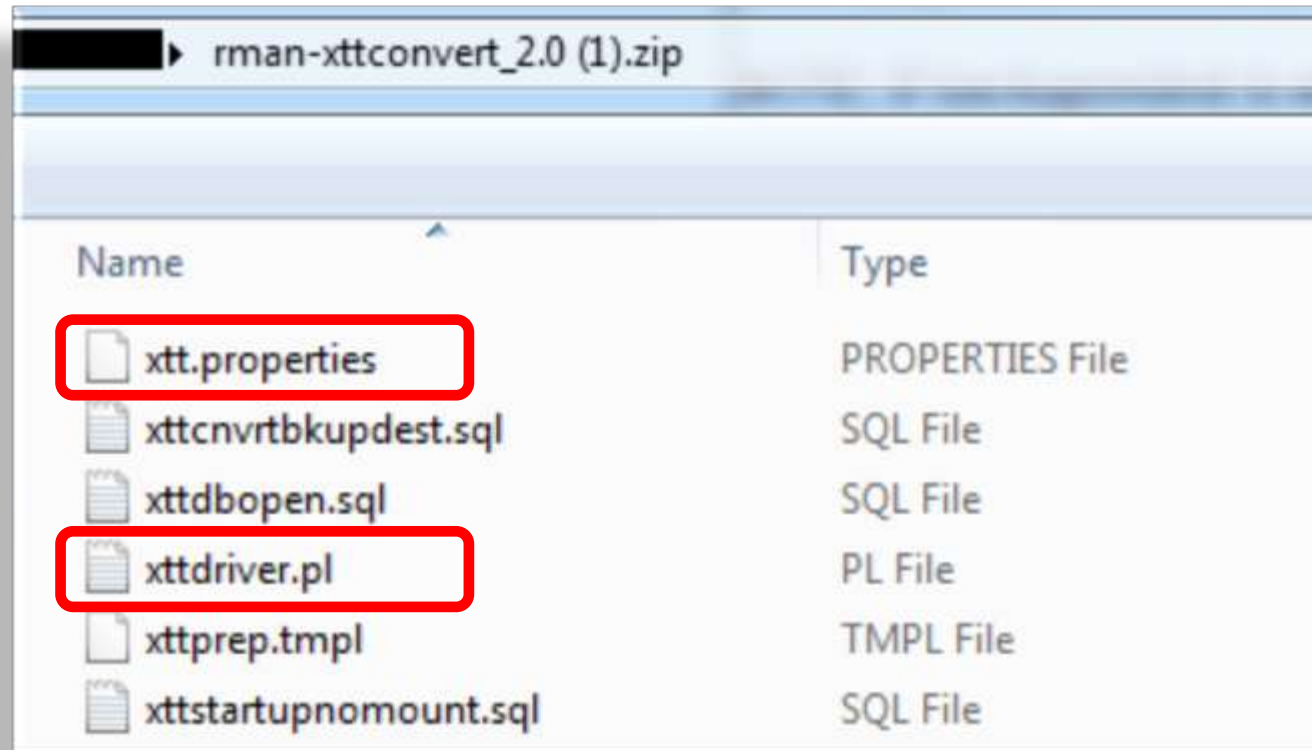
**Full Transportable Export/Import  
using RMAN Incremental Rolled Forward Backups**

# Overview - Phases

- Phase 1 - Initial Setup phase
- Phase 2 - Prepare phase
- Phase 3 - Roll Forward phase
- Phase 4 - Final Incremental Backup
- Phase 5 - Transport Phase: Import all Metadata
- Phase 6 - Validate the Transported Tablespaces
- Phase 7 - Cleanup

# Phase 1 - Initial Setup phase

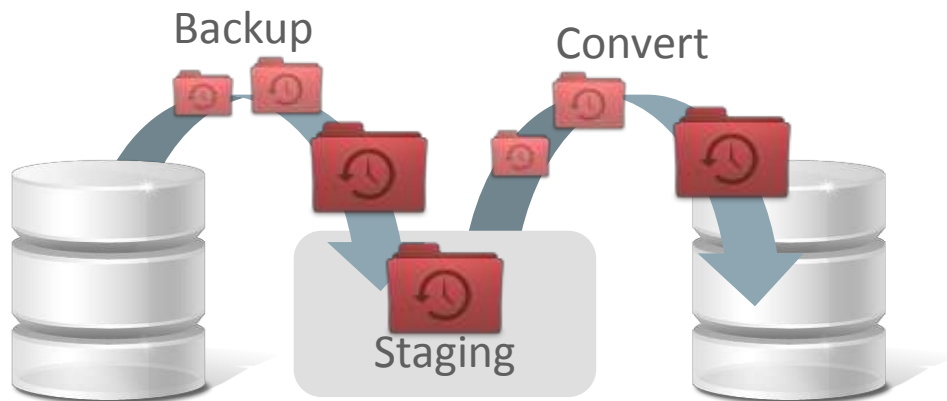
- Download the PERL scripts from [MOS Note:1389592.1](#)
  - Key scripts:



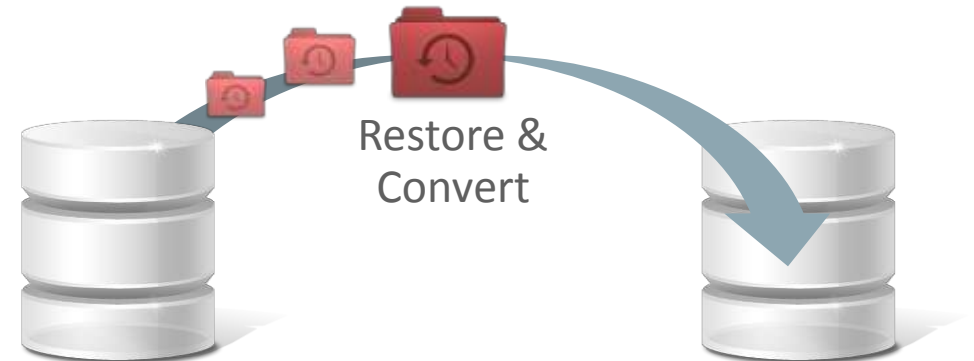
- Extract them to: `/home/oracle/xtt`

# Phase 1 - Initial Setup phase

- Choose the best method
  - **RMAN backup / convert**
    - Faster
    - Requires staging space for CONVERT
    - `xttdriver.pl -p` and `-c`



- **DBMS\_FILE\_TRANSFER**
  - Slower
  - Does not require staging space
  - CONVERT happens implicitly
  - `xttdriver.pl -S` and `-G`



# Phase 1 - Initial Setup phase

- Create a destination database
  - For **Full Transportable Export/Import**:
    - SourceDB must be 11.2.0.3 or higher
    - DestDB must be 12.1.
  - COMPATIBLE equal or higher
  - Identical database character sets
  - Identical national character sets
  - Identical time zone versions

| Oracle Database Release                                             | Default Time Zone Version |
|---------------------------------------------------------------------|---------------------------|
| 10.2.0.3, 10.2.0.4, 10.2.0.5                                        | DST V4                    |
| 11.1.0.6 , 11.1.0.7                                                 | DST V4                    |
| 11.2.0.1                                                            | DST V11                   |
| 11.2.0.2 , 11.2.0.3, <b>11.2.0.4</b>                                | DST V14                   |
| 12.1.0.1, <b>12.1.0.2</b>                                           | DST V18                   |
| Most recent interim patch:<br>See <a href="#">MOS Note:412160.1</a> | DST V24                   |



# Phase 1 - Initial Setup phase

- Identify tablespaces to be transported
- Configure:

## xtt.properties

```
## Tablespaces to transport
## =====
tablespaces=TS1,TS2

## Source database platform ID
## =====
platformid=13

## Source system file locations
## =====
## Location where datafile copies are created
## during the "-p prepare" step.
dfcopydir=/oracle/DQ1/rman_stage

## backupformat
## -----
## Location where incremental backups are created.
backupformat=/oracle/DQ1/rman_stage
```

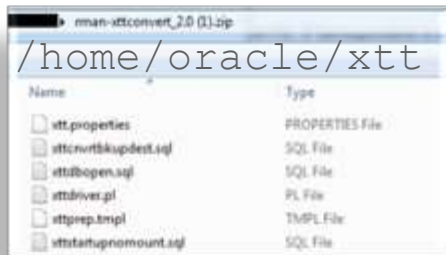
```
## Destination system file locations
## =====
## Location where datafile copies are placed by the user
## when they are transferred manually from source system.
stageondest=/oracle/DQ1/rman_stage

## storageondest
## -----
## Location where the converted datafile copies will be
## written during the "-c conversion of datafiles" step.
## This is the final location of the datafiles
## where they will be used by the destination database.
storageondest=/oracle/DQ1/sapdata50

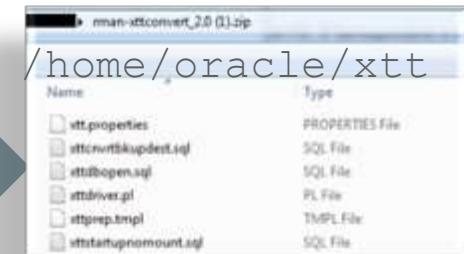
## backupondest
## -----
## Location where converted incremental backups
## on the destination system will be written during
## the "-r roll forward datafiles" step.
backupondest=/oracle/DQ1/rman_stage_incr
```

# Phase 1 - Initial Setup phase

- Enable block change tracking in source database  
`ALTER DATABASE ENABLE BLOCK CHANGE TRACKING USING FILE '<name>' REUSE;`
- Copy all xtt-scripts to the destination host
- Set `TMPDIR=/home/oracle/xtt` on both hosts



Copy xtt scripts including modified xtt.properties



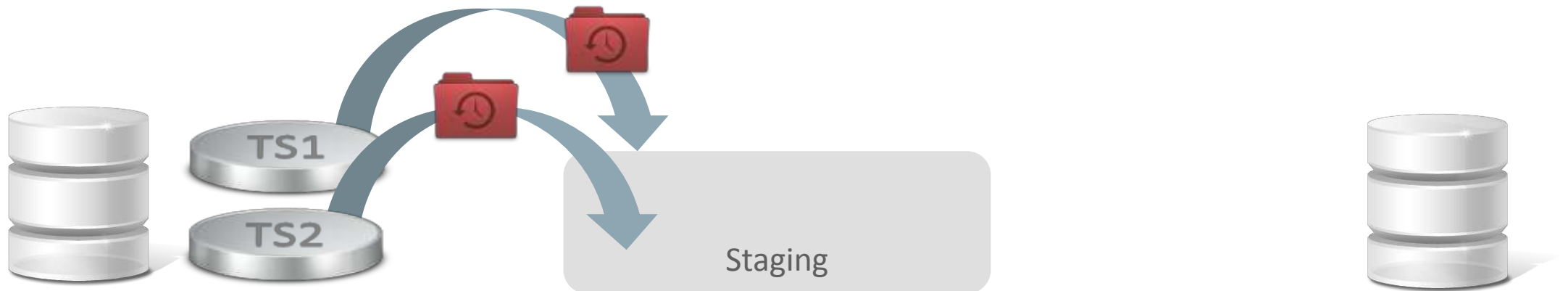
# Phase 2 - Prepare phase

- Create data file copies on **source**

```
[oracle@source]$ $ORACLE_HOME/perl/bin/perl xttdriver.pl -p
```

– Creates the following files used later:

- xttplan.txt
- rmanconvert.cmd

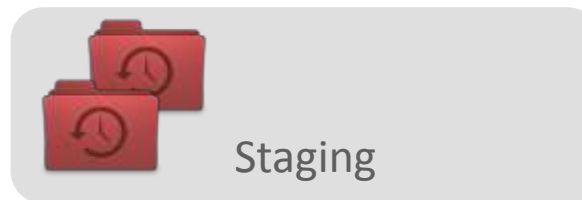


# Phase 2 - Prepare phase

- Transfer files to **destination** host
  - Not necessary if your staging location is available to the destination host (NFS etc)
  - `xtt.properties: dfcopydir = stageondest`

```
## Source system file locations
## =====
## Location where datafile copies are created
## during the "-p prepare" step.
dfcopydir=/oracle/DQ1/rman_stage
```

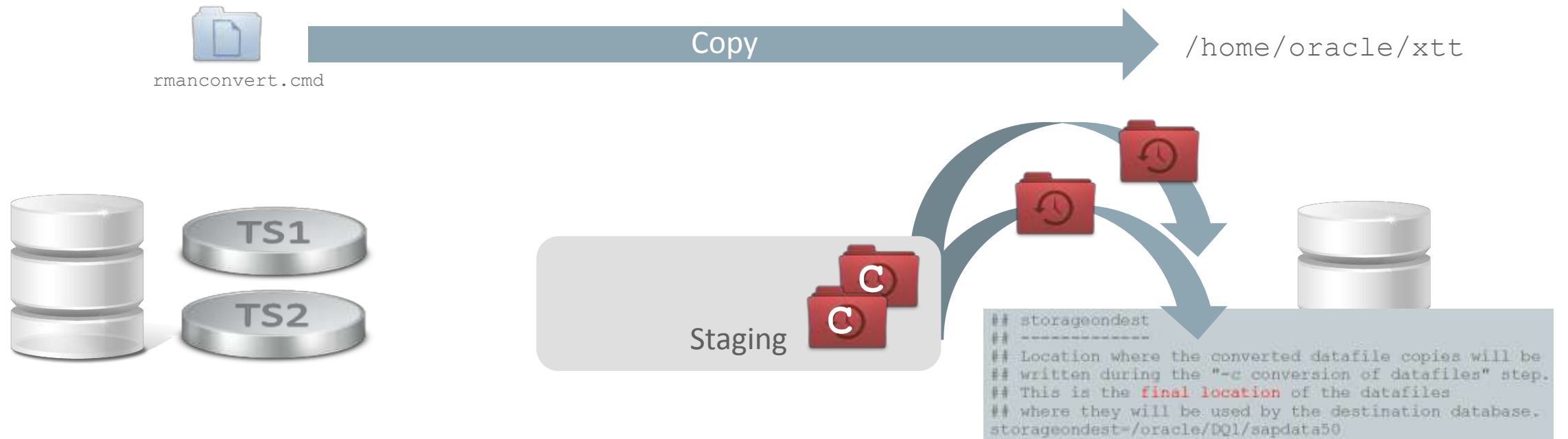
```
## Destination system file locations
## =====
## Location where datafile copies are placed by the user
## when they are transferred manually from source system.
stageondest=/oracle/DQ1/rman_stage
```



# Phase 2 - Prepare phase

- Copy `rmanconvert.cmd` to destination
- Convert the data file copies and write them to `storageondest`

```
- [oracle@dest]$ $ORACLE_HOME/perl/bin/perl xttdriver.pl -c
```



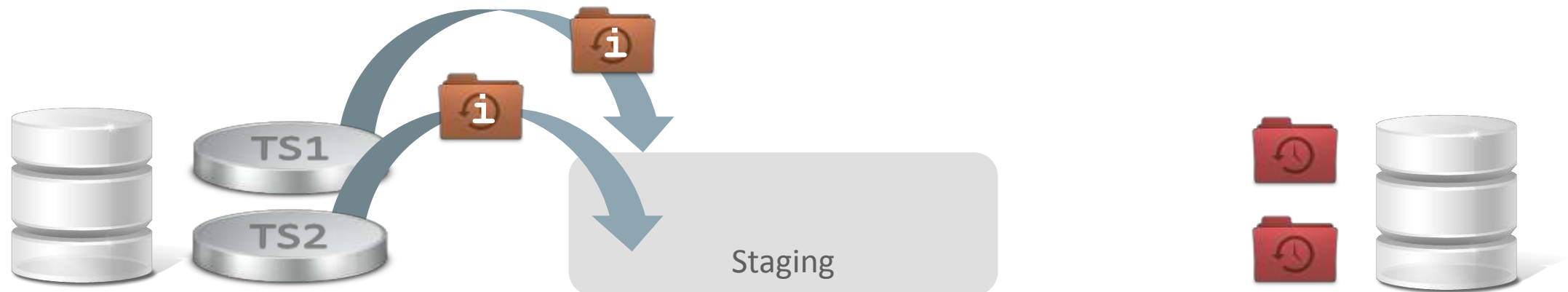
# Phase 3 - Roll Forward phase

- Create incremental backups on **source**

```
[oracle@source]$ $ORACLE_HOME/perl/bin/perl xttdriver.pl -i
```

– Creates the following files used later:

- tsbkupmap.txt
- incrbackups.txt [not necessary here due to NFS mount]

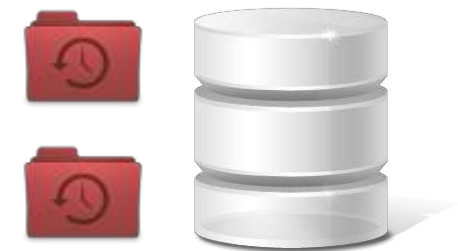
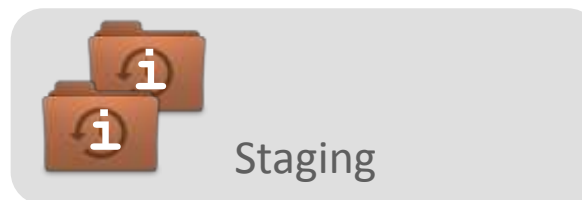


# Phase 3 - Roll Forward phase

- Transfer incremental backups to **destination** host
  - Not necessary if your staging location is available to the destination host (NFS etc)
  - `xct.properties: backupformat= stageondest`

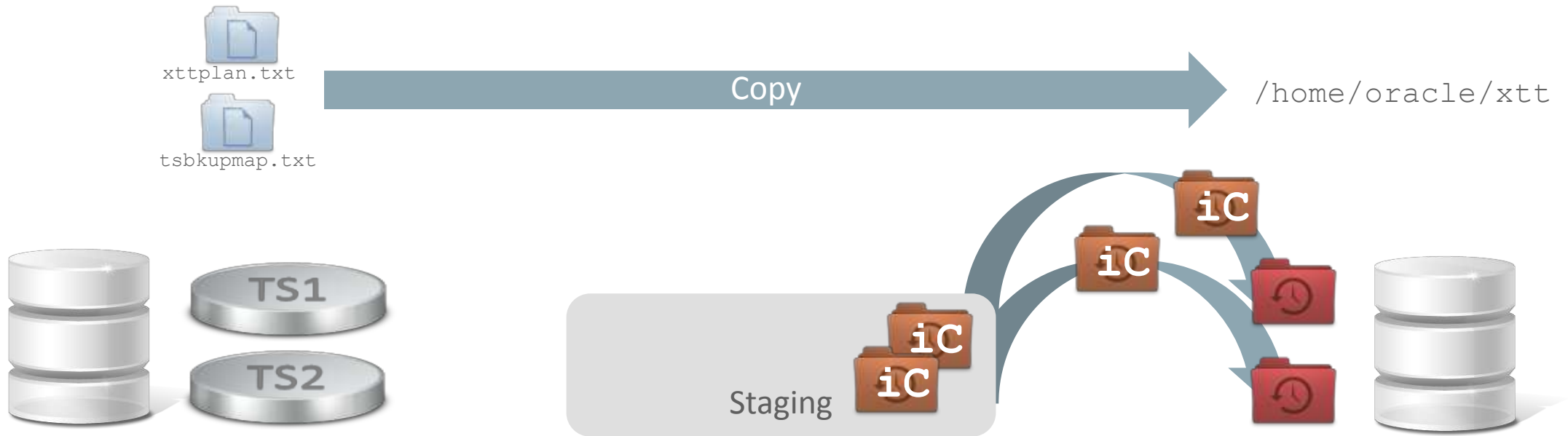
```
## backupformat
## -----
## Location where incremental backups are created
backupformat=/oracle/DQ1/rman_stage
```

```
## Destination system file locations
## =====
## Location where datafile copies are placed by the user
## when they are transferred manually from source system.
stageondest=/oracle/DQ1/rman_stage
```



# Phase 3 - Roll Forward phase

- Copy `xttpplan.txt` and `tsbkupmap.txt` to destination
- Convert the inc backups and merge them into tablespace files on `storageondest`  
– `[oracle@dest]$ $ORACLE_HOME/perl/bin/perl xttdriver.pl -r`



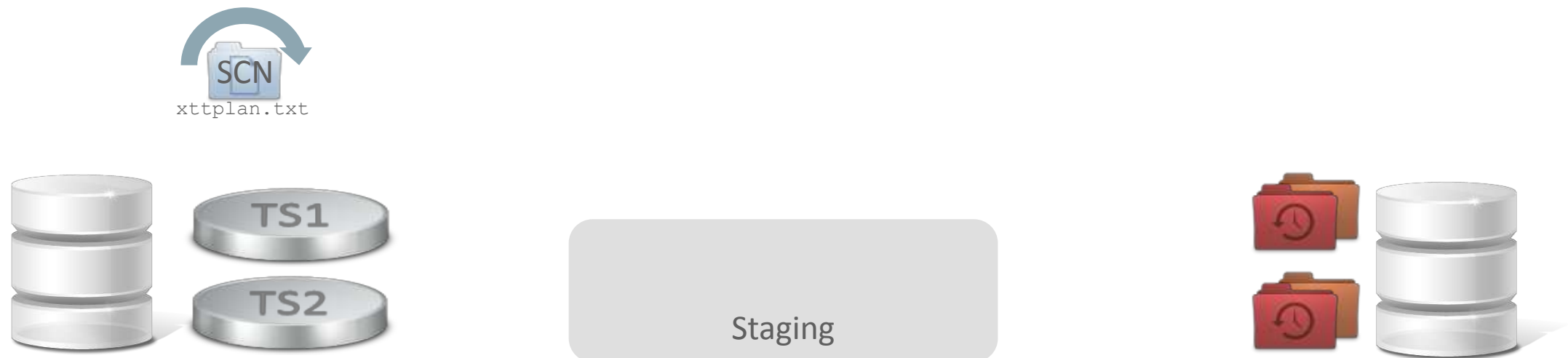


# Phase 3 - Roll Forward phase

- Record FROM\_SCN on **source** for next incremental backup

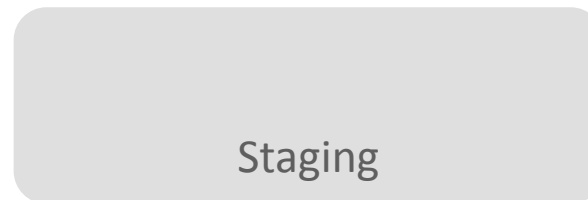
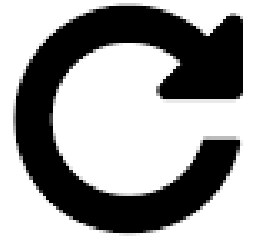
```
[oracle@source]$ $ORACLE_HOME/perl/bin/perl xttdriver.pl -s
```

– Writes it into xttplan.txt



# Phase 3 - Roll Forward phase

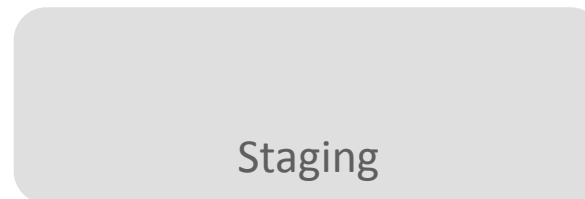
- Repeat entire Phase 3 as often as necessary
  - Increase of frequency will decrease file sizes



# Phase 4 - Final Incremental Backup

- Set tablespaces read/only – **Downtime!**

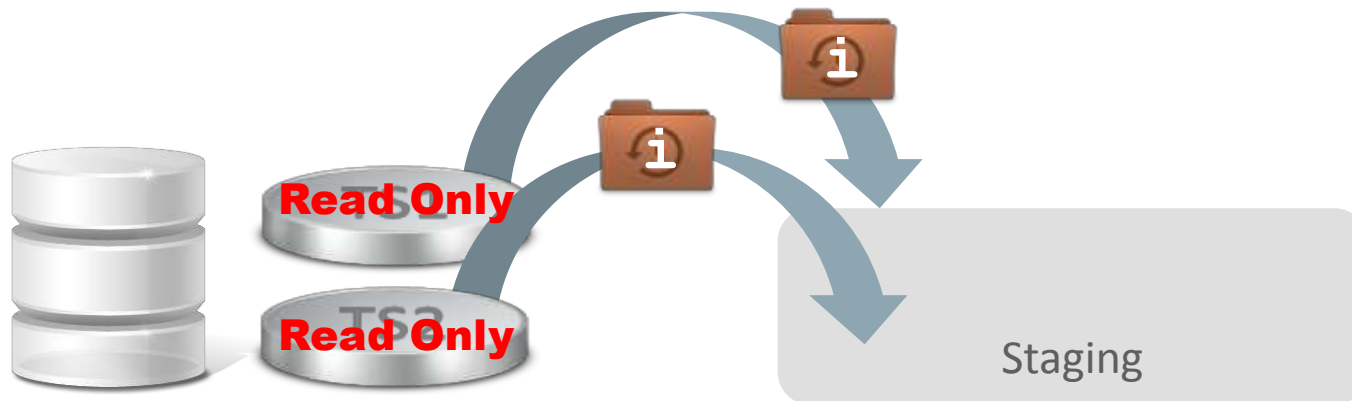
```
SQL:SOURCEDB> alter tablespace TS1 read only;  
SQL:SOURCEDB> alter tablespace TS2 read only;
```



# Phase 4 - Final Incremental Backup

- Create **final** incremental backup on **source**

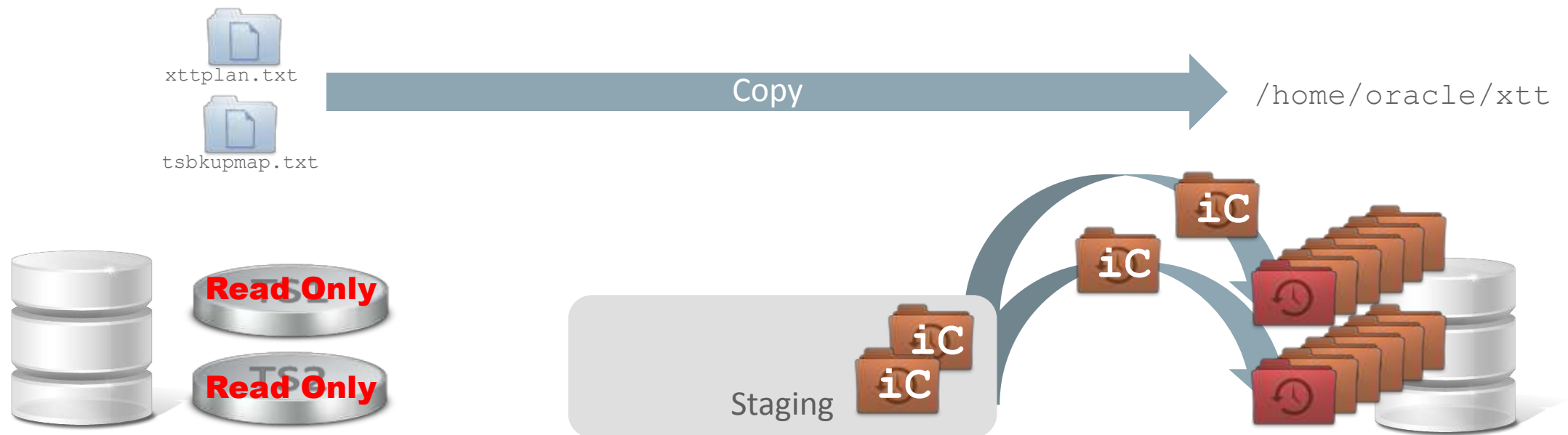
```
[oracle@source]$ $ORACLE_HOME/perl/bin/perl xttdriver.pl -i
```



# Phase 4 - Final Incremental Backup

- Copy `xttpplan.txt` and `tsbkupmap.txt` to **destination**
- Convert **final** inc backups and merge them into tablespace files

```
[oracle@dest]$ $ORACLE_HOME/perl/bin/perl xttdriver.pl -r
```



# Phase 5 - Transport Phase: Import all Metadata

- Prepare destination database for **Full Transportable Export/Import**

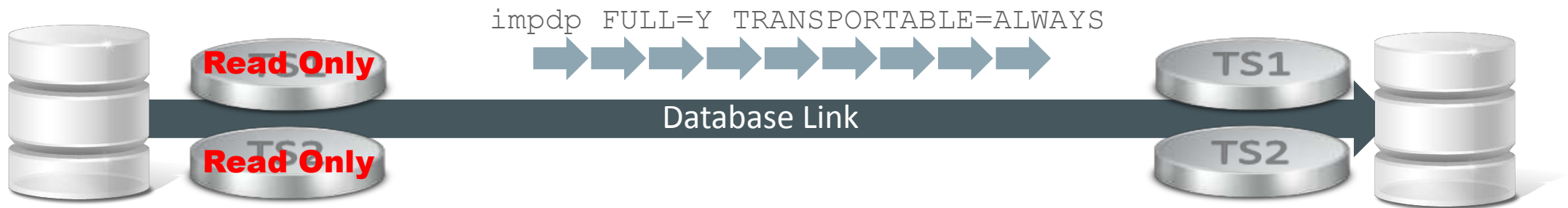
- SQL:DESTDB> CREATE DIRECTORY ftex\_dir AS '/home/oracle/dp';
- SQL:DESTDB> GRANT READ, WRITE ON DIRECTORY ftex\_dir TO mike;
- SQL:DESTDB> CREATE PUBLIC DATABASE LINK v112 USING 'v112';



# Phase 5 - Transport Phase: Import all Metadata

- Start **Full Transportable Export/Import**

```
[oracle@dest]$ impdp mike/passwd@v121 NETWORK_LINK=v121  
FULL=Y TRANSPORTABLE=ALWAYS [VERSION=12]  
METRICS=Y EXCLUDE=STATISTICS  
LOGTIME=ALL LOGFILE=ftex_dir:v112fullimp.log  
TRANSPORT_DATAFILES='/oracle/DQ1/sapdata50/ts1.dbf'  
TRANSPORT_DATAFILES='/oracle/DQ1/sapdata50/ts2.dbf'
```



# Phase 6 - Validate the Transported Tablespaces

- Validate transported tablespaces

- RMAN> validate tablespace TS1, TS2 check logical;





# Phase 7 - Cleanup

- Set tablespaces on **source** read/write
- Cleanup all files created for this process
- Cleanup staging area if not done already



A photograph of three FC Barcelona players celebrating a goal on a football pitch. They are wearing their dark blue and maroon kits with 'QATAR AIRWAYS' on the front. The player in the center has his mouth wide open in a shout, and the other two have their arms around his shoulders. The background shows a stadium with spectators and a goal net.

Yes, we made it 😊

It looks a bit complicated at first sight but once you tried it, it may be the game changer

# Documentation and Information

## ■ Transportable Tablespaces – Information

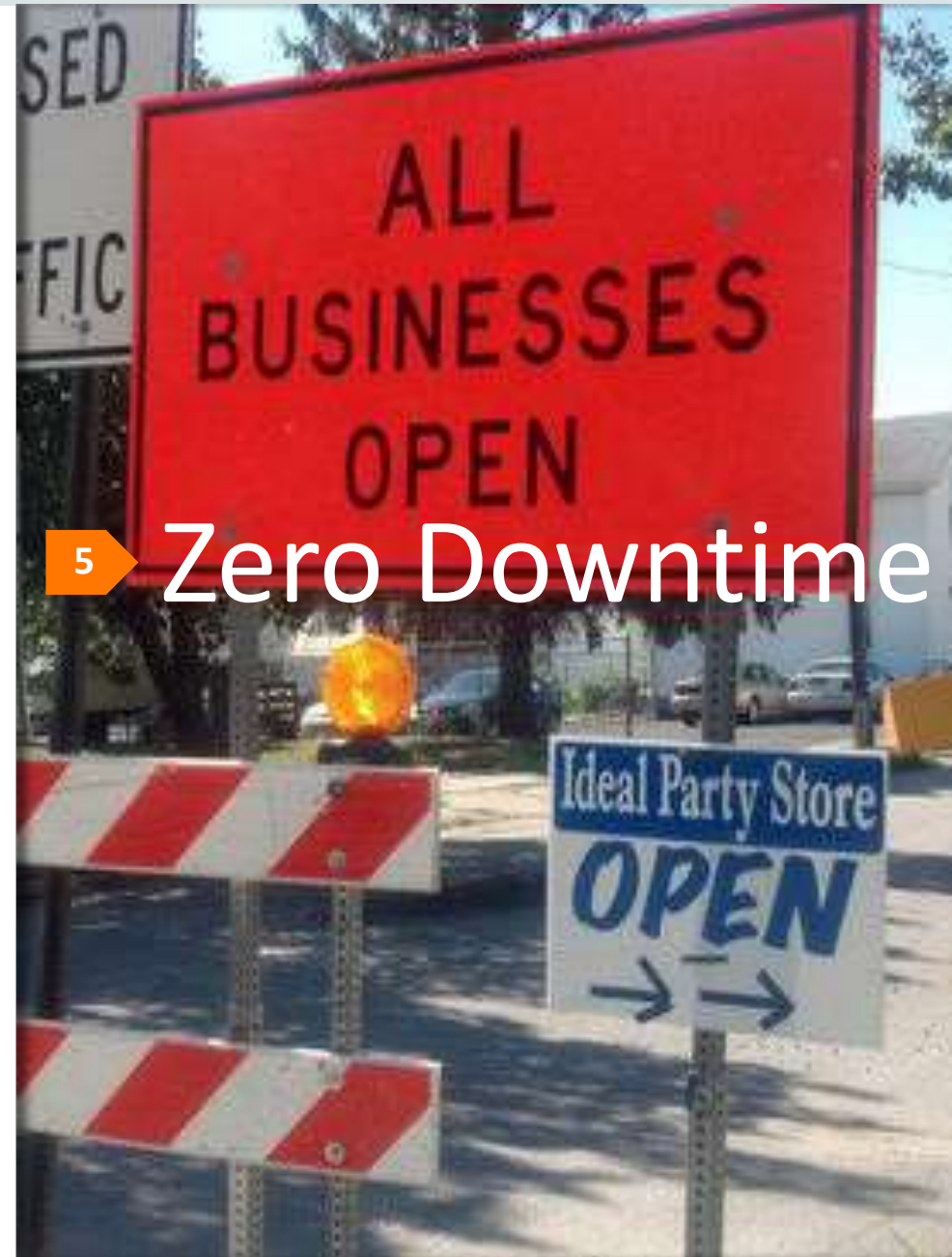
- [MOS Note:1166564.1](#) Master Note for Transportable Tablespaces Common Questions and Issues
- [MOS Note:1454872.1](#) Transportable Tablespace Restrictions and Limitations: Details, Reference, and Version Where Applicable
- For TTS White Papers see the MAA webpage:  
<http://www.oracle.com/technetwork/database/features/availability/oracle-database-maa-best-practices-155386.html>
- Database Upgrades using TTS:  
<http://www.oracle.com/technetwork/database/features/availability/maa-wp-11g-upgradetts-132620.pdf>
- Platform Migration using Transportable Database (RMAN):  
<http://www.oracle.com/technetwork/database/features/availability/maa-wp-10gr2-platformmigrationtdb-131164.pdf>
- Customer example: Amadeus Customer Case  
<http://www.oracle.com/technetwork/database/features/availability/s281209-amadeus-130978.pdf>

# EBS Upgrades

- Resources for EBS
  - [MOS Note:1581549.1](#)  
Best Practices for Minimizing Oracle E-Business Suite Release 12 Upgrade Downtime
- Oracle recommends that you upgrade to the latest Database version certified for your EBS release
  - MOS ⇒ Certifications ⇒ E-Business Suite ⇒ <version> ⇒ <platform>
    - Then select the latest certified database release

# Upgrade, Migrate & Consolidate

- 1 Introduction
- 2 Preparation Steps
- 3 Upgrade / Migrate / Consolidate**
- 4 Fallback Strategies
- 5 New Features
- 6 Performance Management
- 7 Wrap Up




# Case 5: Near-Zero Downtime

- Platform migration with near-zero downtime



# Introduction

- True ZERO Downtime is about more than the database
  - Oracle TimesTen In-Memory Database can do that 
  - Oracle GoldenGate can deliver zero operational downtime depending on the application
- Replication technologies are easier to handle and setup
  - A limited downtime will occur to switch clients/application
    - *Active/active scenarios are possible depending on the application and usage scenario*

## ▪ Concept:



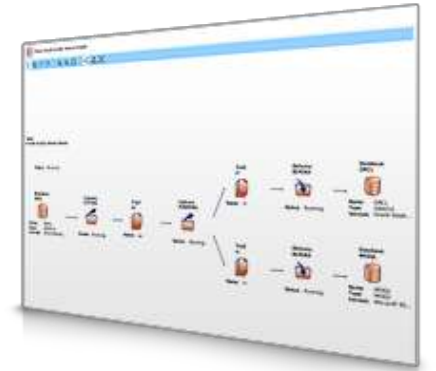
## ▪ Technologies:

- **Oracle GoldenGate**
  - NOTE: Oracle Streams is deprecated as of Oracle Database 12c

# Oracle GoldenGate

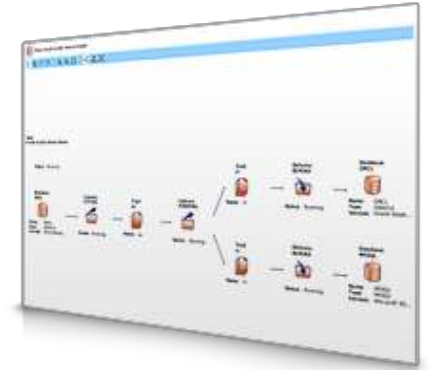
- Paid option of the database
  - Migratable license for 1 year which includes Active Data Guard
- Works with many Oracle database versions
  - GoldenGate 12.1 supports Oracle  $\geq$  11.1.0.6
    - GoldenGate 11.2 supports Oracle  $\geq$  10.2.0.4
      - *For earlier database versions (8i (DML only), 9i-11.1) use GoldenGate 10.4*
- Oracle GoldenGate Installation and Setup Guide
- Also works with non-Oracle databases (DB2, Teradata ...)
- GoldenGate White Paper: **Zero Downtime Upgrade with OGG**

<http://www.oracle.com/technetwork/middleware/goldengate/overview/ggzerodowntimedatabaseupgrades-174928.pdf>





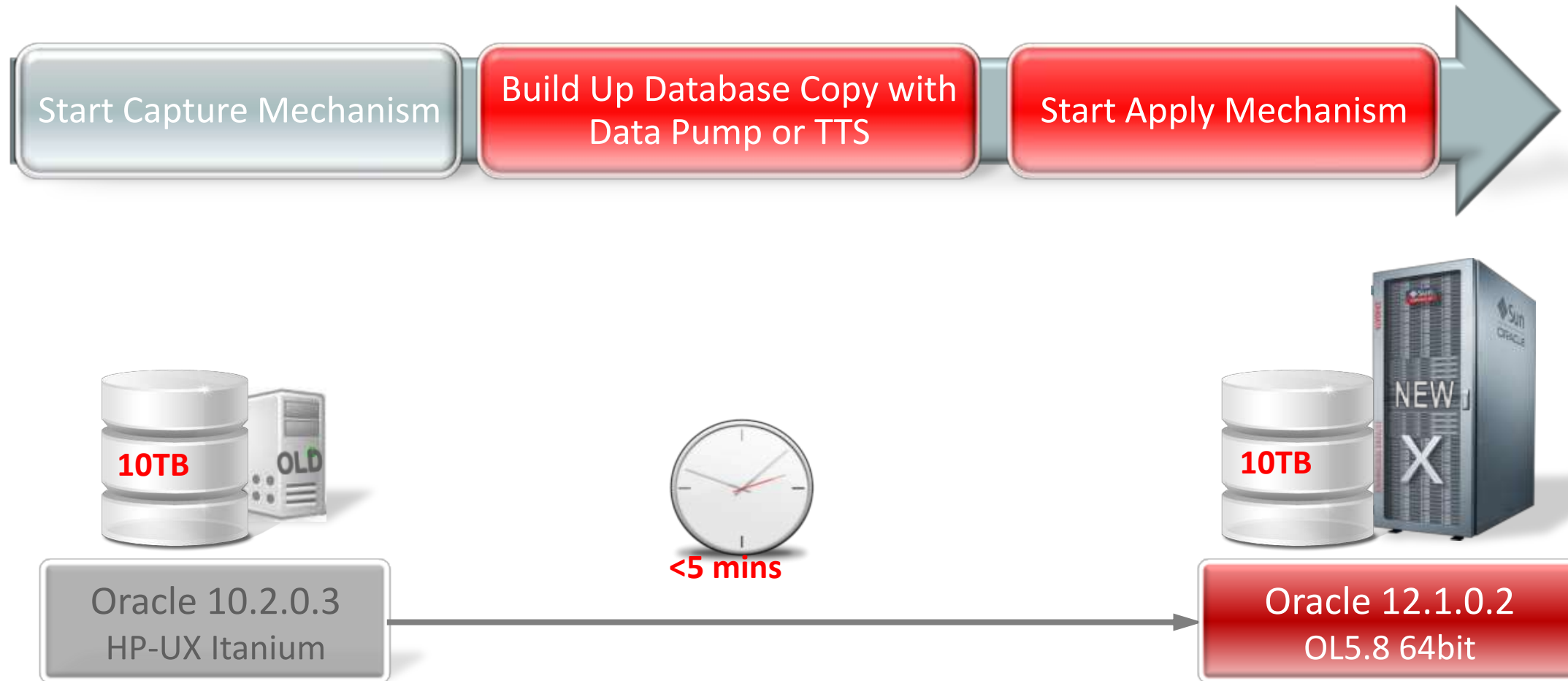
# Is your database ready for Oracle GoldenGate?



- Complete Database Profile OGG readiness check
  - [MOS Note:1298562.1:](#)  
[Oracle GoldenGate database Complete Database Profile check script for Oracle DB \(All Schemas\) Classic Extract](#)
- Check OGG readiness for Schema Only
  - [MOS Note: 1296168.1](#)  
[Oracle GoldenGate database Schema Profile check script for Oracle DB](#)
-

# Case 5: Near-Zero Downtime

- Platform migration with near-zero downtime

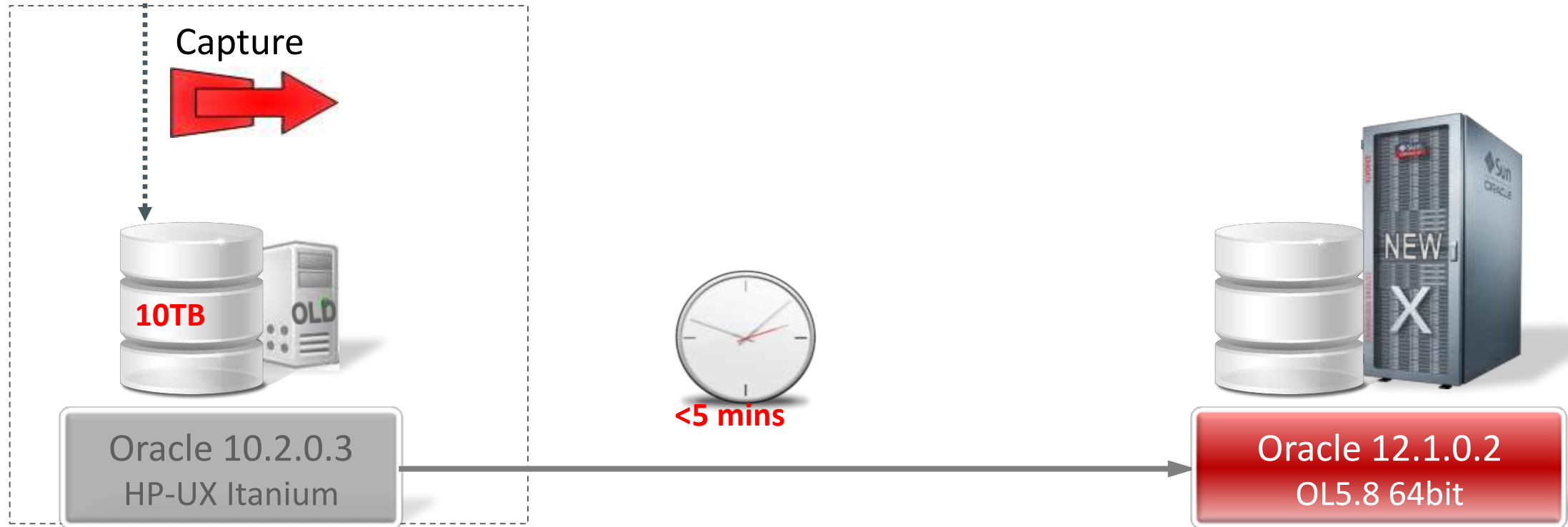


Start Capture Mechanism

Build Up Database Copy  
with Data Pump or TTS

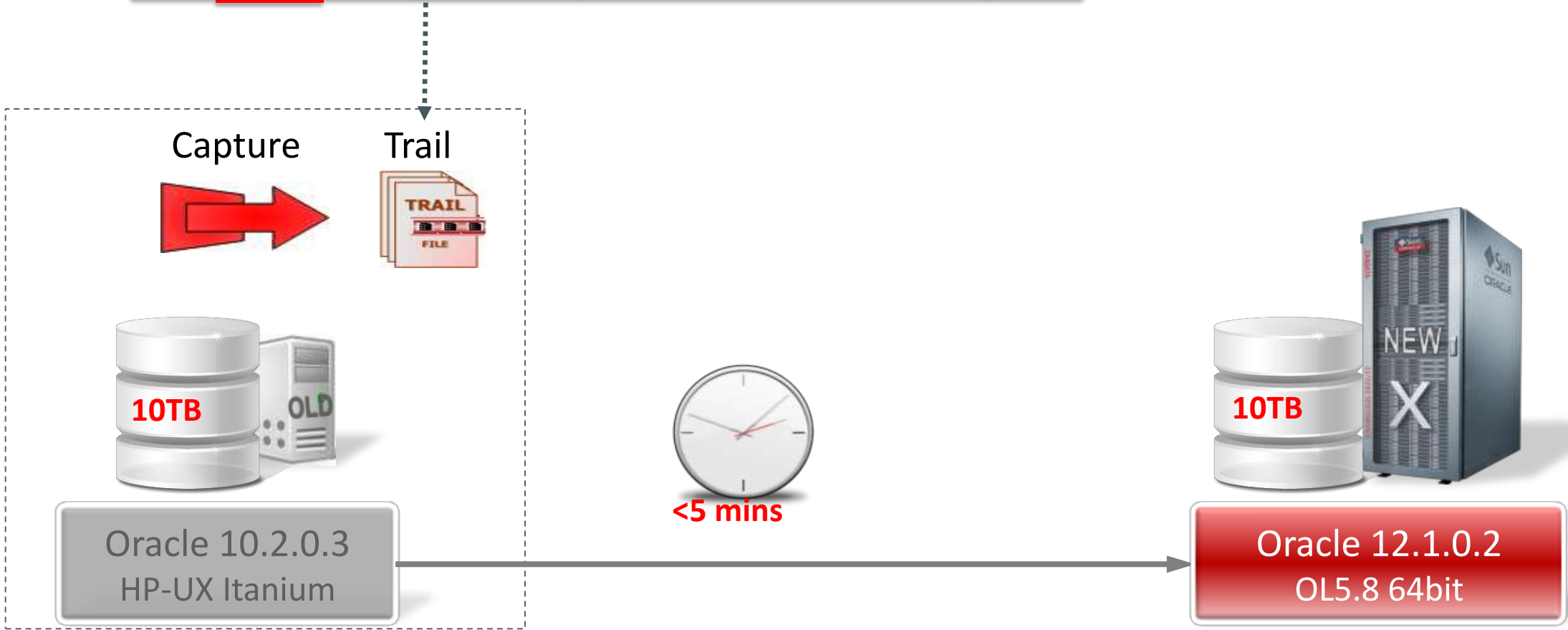
Start Apply Mechanism

**Capture**: committed transactions are captured (and can be filtered) as they occur by reading the transaction logs



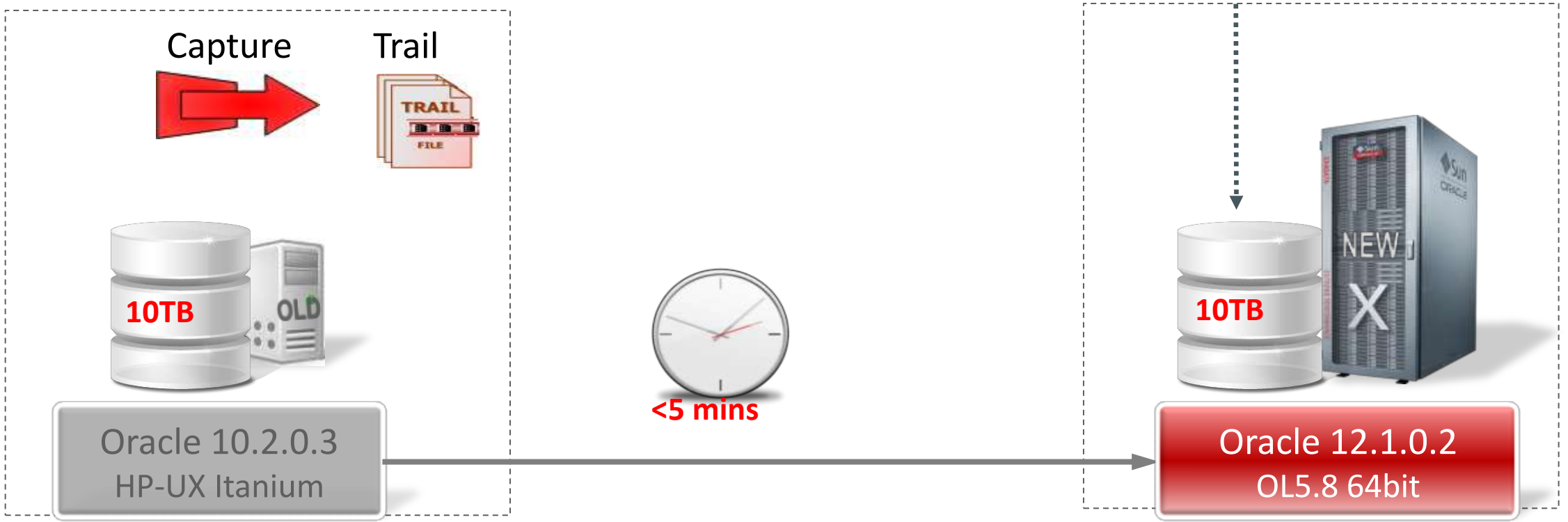


**Trail:** stages and queues data for routing



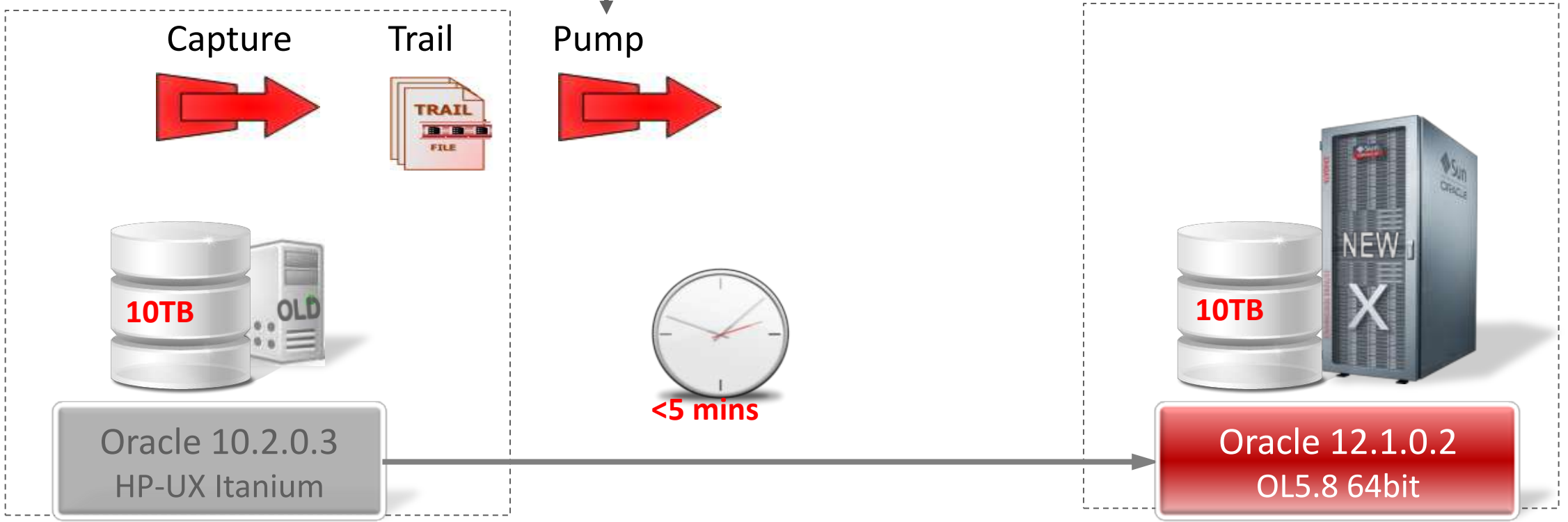


Build up the target database using:  
- Transportable Tablespaces x-Platform  
- Export/Import with Data Pump





**Pump:** distributes data for routing to target(s)

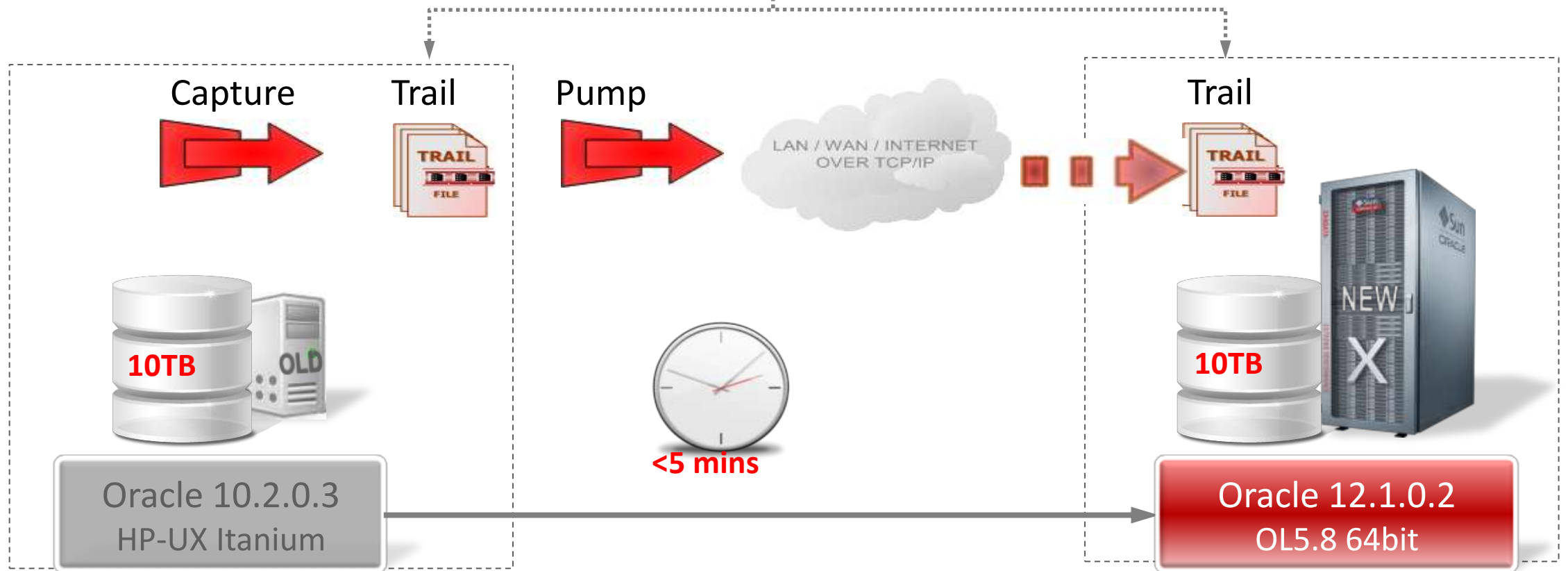


Start Capture Mechanism

Build Up Database Copy  
with Data Pump or TTS

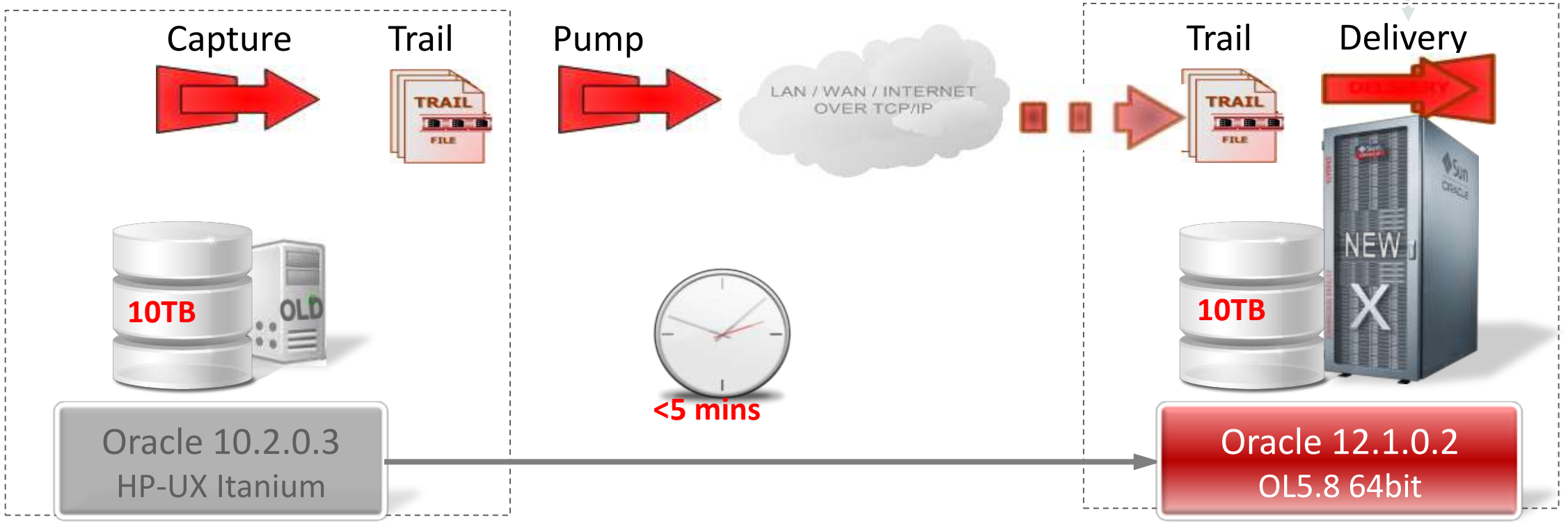
Start Apply Mechanism

**Route:** data is compressed, encrypted for routing to target(s)





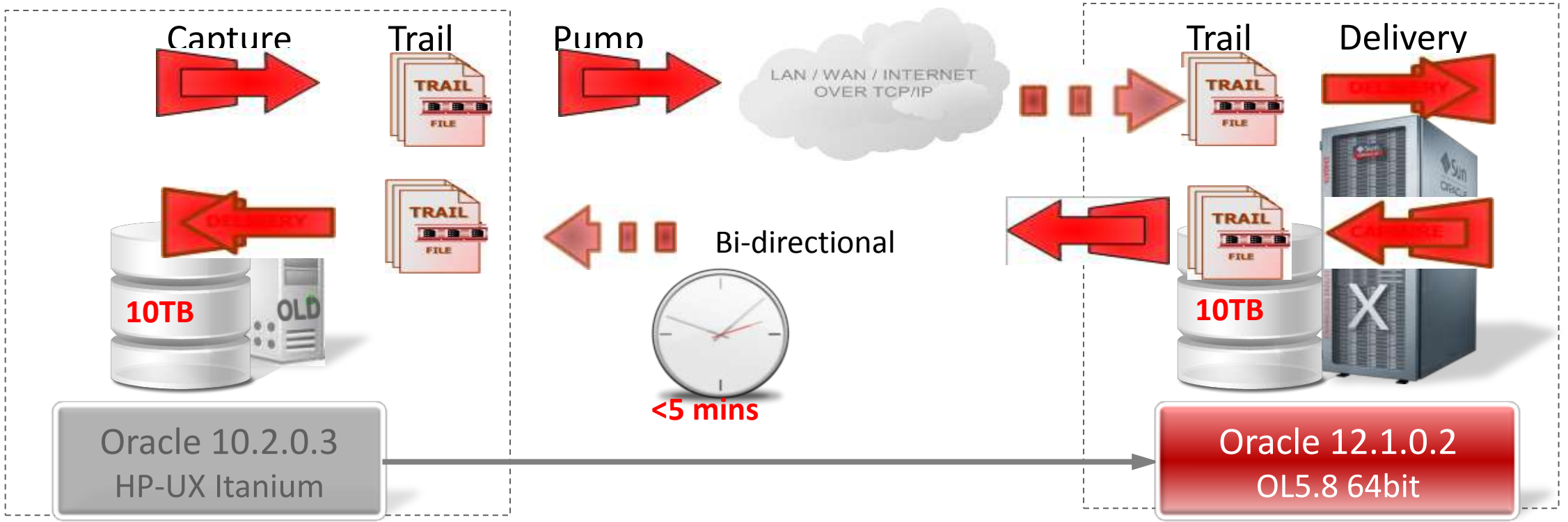
**Delivery:** applies data with transaction integrity, transforming the data as required







GoldenGate works bidirectionally - from higher to lower release as well!



# Migration with GoldenGate

**aMADEUS**

Your technology partner



# Real World Checkpoint

Customer

Project

Constraints

Preparation

Migration

Success?

Remarks

- Amadeus is a leading transaction processor for the global travel and tourism industry

**DISTRIBUTION  
BUSINESS**

711 airlines  
110,000+ hotel properties  
30 car rental companies  
50+ cruise and ferry lines  
207 tour operators  
24 insurance companies  
95 railways

**IT SOLUTIONS**

Inventory  
Departure Control  
e-Commerce

Airlines  
Airports  
Hotels  
Rail






20,000+ tx/sec (peak)  
< 0.3 sec response time  
10 Petabytes of storage  
3+ million net bookings/day  
> 1 billion tx/day

# Real World Checkpoint

- Customer
- Project**
- Constraints
- Preparation
- Migration
- Success?
- Remarks

- Migrate Oracle 10g production databases to Oracle 11g on new HW and/or OS platform

| Source                                        |                                                                                       | Target                                    |
|-----------------------------------------------|---------------------------------------------------------------------------------------|-------------------------------------------|
| Oracle 10.2.0.3<br>RAC<br>HPUX v2             |    | Oracle 11.2.0.2/3<br>RAC<br>HPUX v3       |
|                                               |    | Oracle 11.2.0.2/3<br>RAC<br>RHE Linux     |
| Oracle 10.2.0.3<br>Single Instance<br>HPUX v2 |  | Oracle 11.2.0.2/3<br>RAC One<br>RHE Linux |

# Real World Checkpoint

Customer

Project

Constraints

Preparation

Migration

Success?

Remarks

- **Fixed quarterly outage windows**
- Maximum of **5 minutes database downtime**
- No service impact outside the outage window
- Endian change: HP-UX ⇔ to Linux (big ⇔ little endian)
- Possibility of **fallback** during and after the outage
- High volume of DB changes (redo of up to 20MB/sec)
- Large database sizes (up to 14TB)
- Possibility for physical re-organization
  - Fresh data dictionary
  - Tablespace and partitioning redesign

# Real World Checkpoint

Customer

Project

Constraints

**Preparation**

Migration

Success?

Remarks

- In-depth proof of concept (supported by Oracle)
  - Focusing on functional aspects
  - Focusing on data volume
- Standardized migration process model with timeline
- Home-made scripts and procedures to support setup, monitoring, tuning and switch over
- Training of in-house specialist supporting the DBAs

# Real World Checkpoint

Customer

Project

Constraints

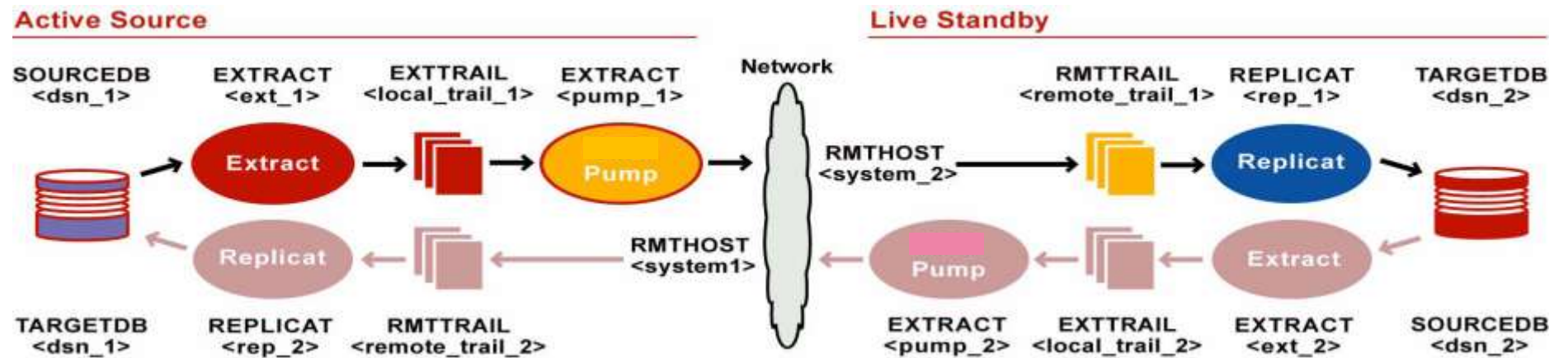
Preparation

**Migration**

Success?

Remarks

- Instantiation of new 11g database: expdp from Physical Standby
- Installation, configuration, tuning of GG replication



- Comparison of source/target DB content (**Veridata**)
- Rehearsals of switch over and fallback
- Switch over: Stop replication / Start reverse-replication

# Real World Checkpoint

- Customer
- Project
- Constraints
- Preparation
- Migration
- Success?**
- Remarks

- 15 databases successfully migrated, so far (*Oct 2012*)

| Source                                        | Target                                    | Migrated |
|-----------------------------------------------|-------------------------------------------|----------|
| Oracle 10.2.0.3<br>RAC<br>HPUX v2             | Oracle 11.2.0.2/3<br>RAC<br>HPUX v3       | 6        |
|                                               | Oracle 11.2.0.2/3<br>RAC<br>RHE Linux     | 3        |
| Oracle 10.2.0.3<br>Single Instance<br>HPUX v2 | Oracle 11.2.0.2/3<br>RAC One<br>RHE Linux | 6        |

- Switchover duration: 2-6 minutes
- No fallback performed



# Real World Checkpoint

Customer

Project

Constraints

Preparation

Migration

Success?

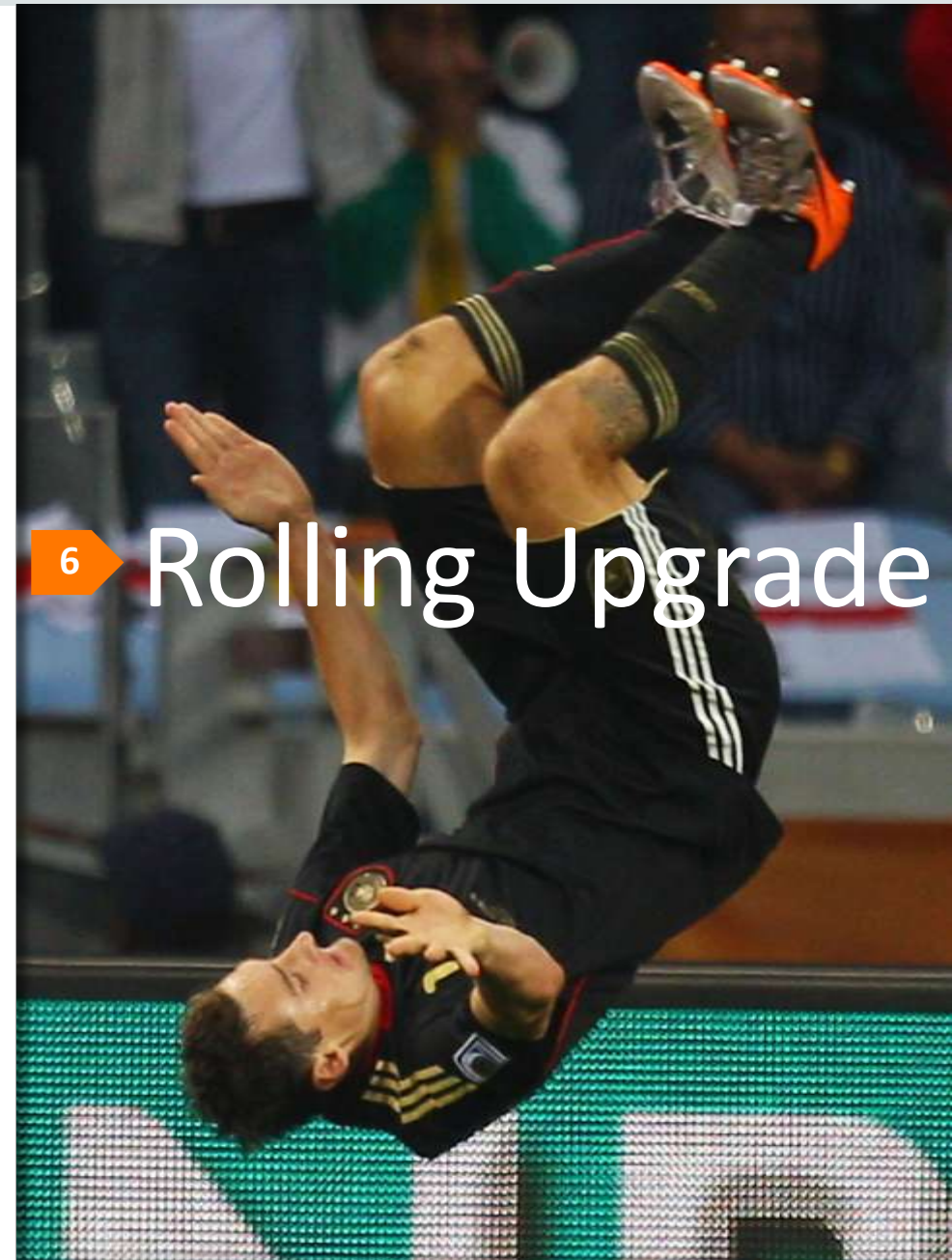
Remarks

- The concept proved to handle a smooth and secure migration across different DB versions and HW/OS platforms
- To be considered ...
  - Instantiation of target database (incl. Plan Stability)
  - Customized GG setup per database
  - Handling of unsupported data types (e.g. ANYDATA)
  - Impact of supplemental logging on source DB
  - Effort of tuning GG for DBs with high DML rate (e.g. parallel replicate processes)



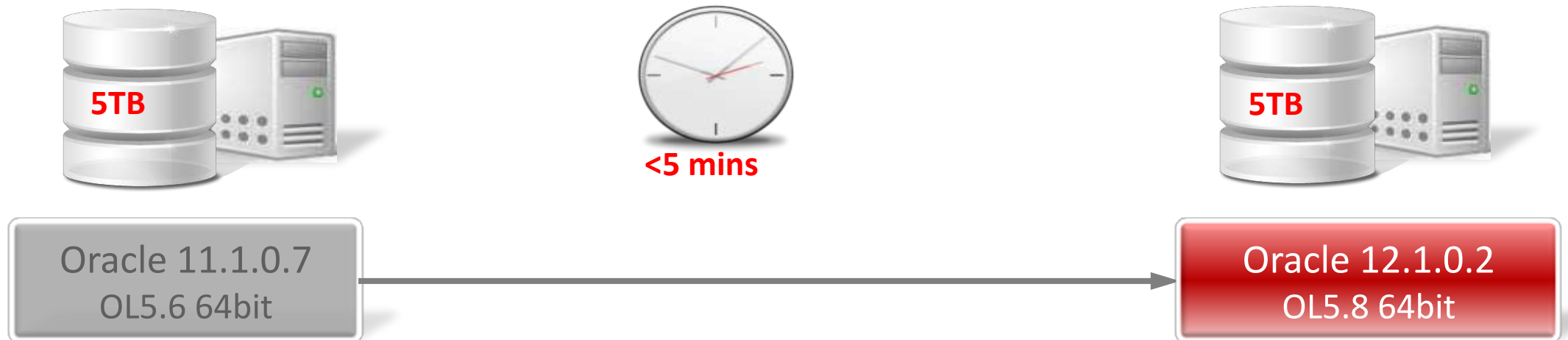
# Upgrade, Migrate & Consolidate

- 1 Introduction
- 2 Preparation Steps
- 3 Upgrade / Migrate / Consolidate**
- 4 Fallback Strategies
- 5 New Features
- 6 Performance Management
- 7 Wrap Up



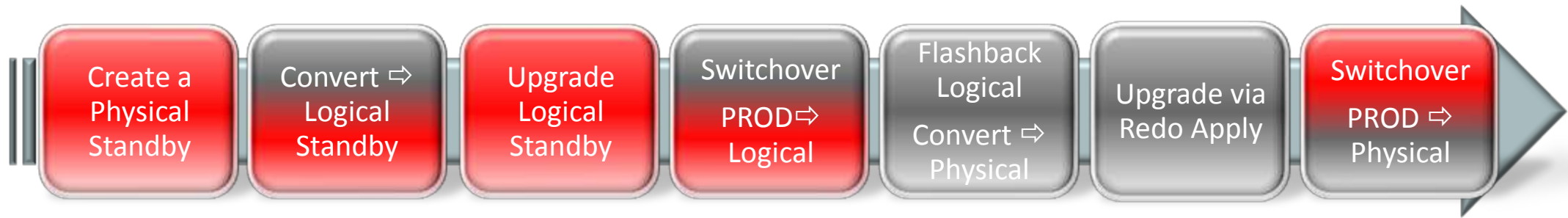
# Case 6: Real Rolling Upgrade

- Rolling database upgrade with less than 5 min downtime



# Case 6: Real Rolling Upgrade

- Rolling database upgrade with less than 5 min downtime



Oracle 11.1.0.7  
OL5.6 64bit

Oracle 12.1.0.2  
OL6 64bit

# Basic Facts and Information

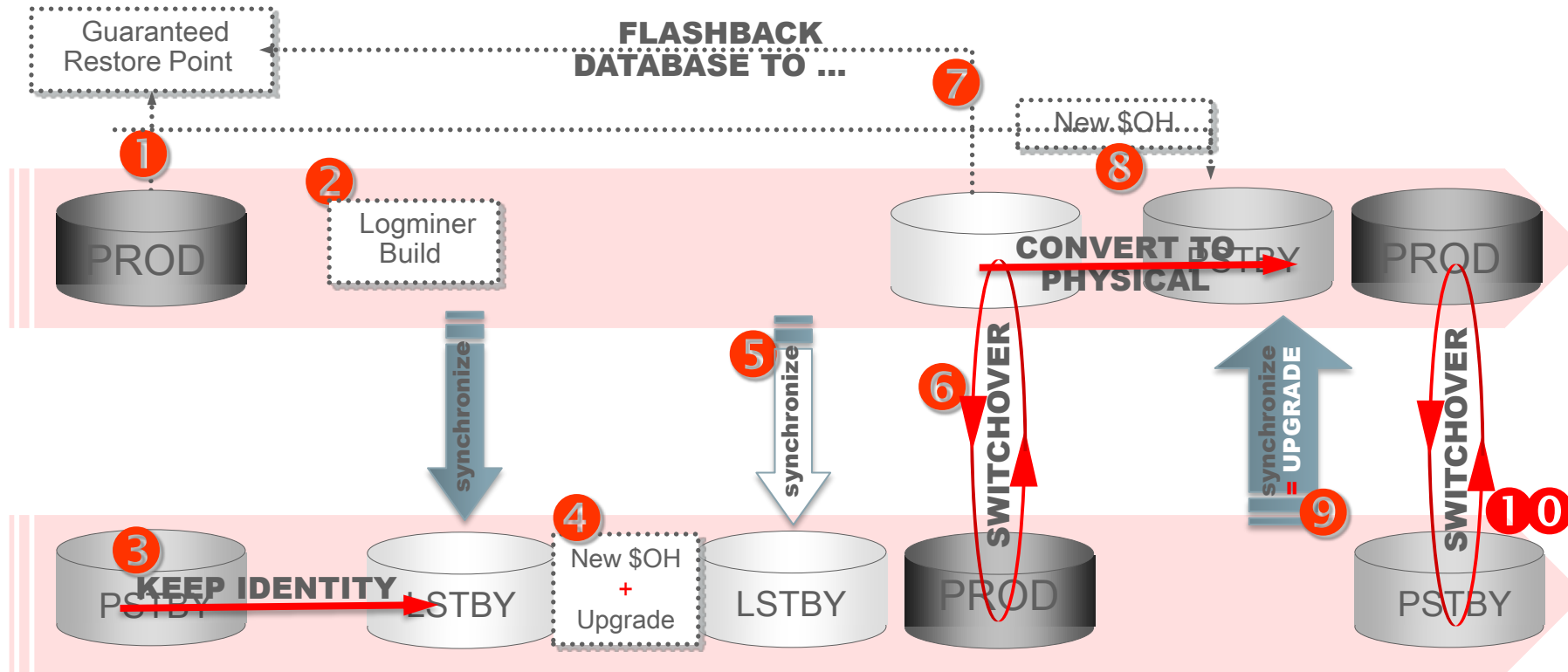
- Different types of standby databases

|                 | <b>Physical Standby</b>      | <b>Logical Standby</b> | <b>Transient Standby</b>                                  |
|-----------------|------------------------------|------------------------|-----------------------------------------------------------|
| Standby Type    | Block identical copy of PROD | Logical copy of PROD   | Physical, converted temporarily into Logical – and return |
| Apply Technique | Redo Apply                   | SQL Apply              | Redo and SQL Apply                                        |
| Build Up        | RMAN DUPLICATE               | Convert from Physical  | RMAN Duplicate, then Convert                              |
| Switchover      | < 1 min                      | Seconds                | Seconds + < 1 min                                         |

# Transient Logical Standby

- Concept:
  - Build up a Physical Standby database
  - Convert the Physical Standby into a Logical Standby
  - Upgrade the Logical Standby database
  - Switchover – Standby will be production system now
  - **Then: Flashback the former production database**
  - **Convert it into a Physical Standby**
  - **Upgrade just by log apply**
  - Eventually: Switchover to the original setup
    - Works pretty straight forward with Oracle Database 11g
      - Will work with Oracle Database 10g as well but requires more steps

# Transient Logical Standby - Workflow



# Transient Logical Standby – White Paper

- Transient Upgrade Concept:

<http://www.oracle.com/technetwork/database/features/availability/maa-wp-11g-transientlogicalrollingu-1-131927.pdf>

Database Rolling Upgrade Using  
Transient Logical Standby:

Oracle Data Guard 11g

*Oracle Maximum Availability Architecture White Paper  
September 2008*

- Shell scripts in [Note:949322.1](#) for automation:

<http://www.oracle.com/technetwork/database/features/availability/maa-wp-11g-upgrades-made-easy-131972.pdf>

Database Rolling Upgrades Made

Easy by Using a Data Guard

Physical Standby Database

*Oracle Maximum Availability Architecture White Paper  
October 2011*



# DBMS\_ROLLING

- Data Guard **Simple** Rolling Upgrade
  - Semi-automation of Transient Logical Standby Rolling Upgrade
  - Works with Data Guard Broker
  - Procedure DBMS\_ROLLING
    - INIT\_PLAN
    - DESTROY\_PLAN
    - BUILD\_PLAN
    - SET\_PARAMETER
    - START\_PLAN
    - SWITCHOVER
    - FINISH\_PLAN
    - ROLLBACK\_PLAN
  - Usable for maintenance tasks beginning with Oracle 12.1.0.1
  - Usable for upgrades beginning with the first patch set of Oracle 12c
    - *DBMS\_ROLLING usage will require a license for Active Data Guard*

# DBMS\_ROLLING - Planning & Setup Phase



- Generate an *upgrade plan*
  - Call `DBMS_ROLLING.INIT_PLAN`
    - Generates an upgrade plan with a configuration specific set of instructions to guide the administrator through the upgrade process
  - Call `DBMS_ROLLING.SET_PARAMETER`
    - Modify parameters of the rolling upgrade
- Prepare your changes to the database

# DBMS\_ROLLING – Execution Phase

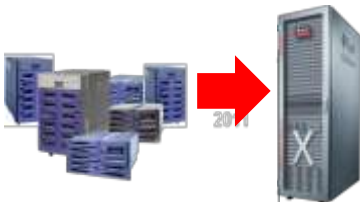


- Start the Execution Phase
  - Call `DBMS_ROLLING.START_PLAN`
    - Configures primary and standby databases participating in the upgrade
- Make changes to the standby database
  - *Upgrade time*
- Role exchange
  - Call `DBMS_ROLLING.SWITCHOVER`
    - Swaps roles between current primary and new primary with the changes, switchover is only downtime required

# DBMS\_ROLLING – End Phase

- Finish the Rolling Upgrade
  - Call `DBMS_ROLLING.FINISH_PLAN`
    - Completes upgrade of the old primary and bystanders and resynchronizes with the new primary

# Nippon Steel & Sumitomo Metal - Factory System



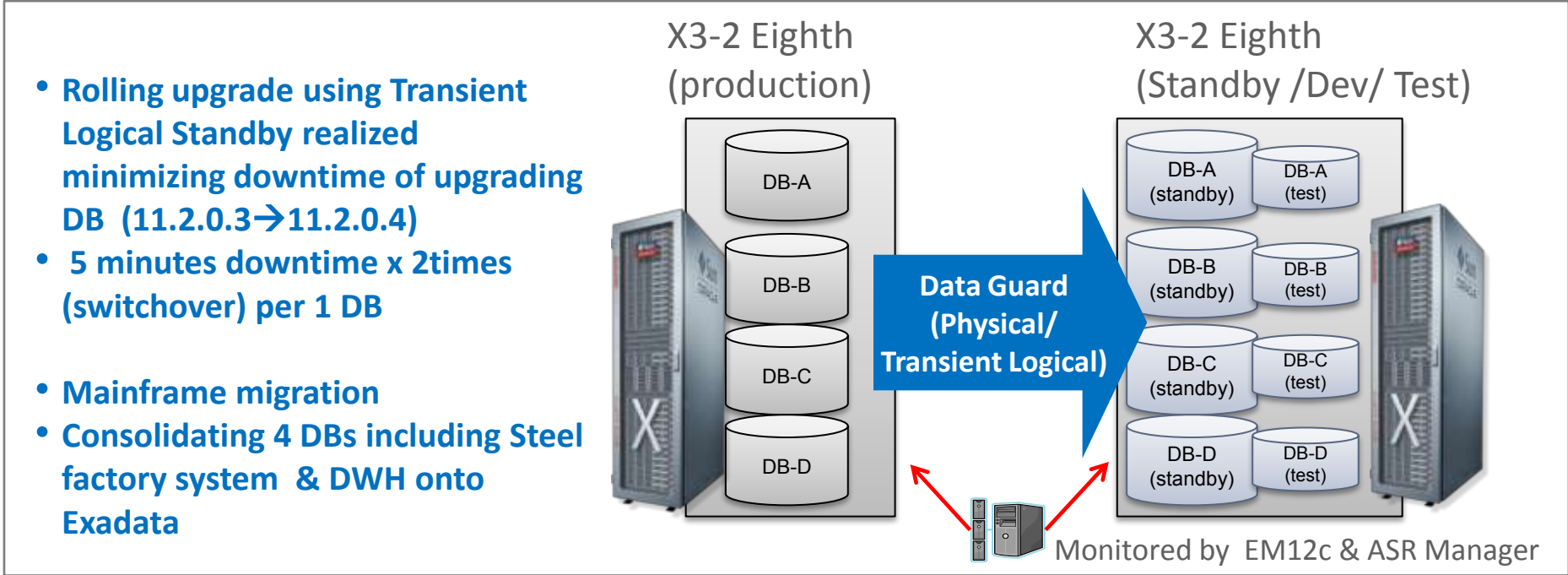
| Benefits                                                                                                                                                                                  | Consolidation of database                                                           | Minimize planned Downtime                                                                            | High performance                                                                    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| <p><i>“Consolidating 4 Databases including Steel factory systems onto Exadata providing High performance and reliability, Enabling making use of High Quality of infrastructure.”</i></p> |  | <p>5 minutes</p>  |  |

## Business Objectives

- High availability
- DB Infra consolidation

## Solution

- Adopting Exadata providing high performance and high availability
- Rolling upgrade using Data Guard minimizes planned downtime



# Speed up the upgrade with Transient Standby

Universität Bielefeld



# Real World Checkpoint

## Customer

- Bielefeld University, Germany
  - Mid size university in Germany
  - 18,000 students and 1,600 employees
  - IT lead for 33 German universities

## Project

## Constraints

## Preparation

## Migration

## Success?

## Remarks



# Real World Checkpoint

Customer

Project

Constraints

Preparation

Migration

Success?

Remarks

- Goal:
  - Decrease **patching downtime** to **less than 5 minutes**
- Stage 1:
  - Upgrade/migrate 10 key DBs from Oracle 9.2 to Oracle 11g
    - Single Instance ⇒ RAC, ASM, Data Guard
- **Stage 2:**
  - **Rolling upgrade from Oracle 11.1.0.6 to 11.1.0.7**



# Real World Checkpoint

Customer

Project

Constraints

Preparation

Migration

Success?

Remarks

- **Less than 5 minutes downtime**
  - Database patch set and release upgrade
- **No downtime**
  - Clusterware and ASM upgrades and PSUs

# Real World Checkpoint

Customer

Project

Constraints

**Preparation**

Migration

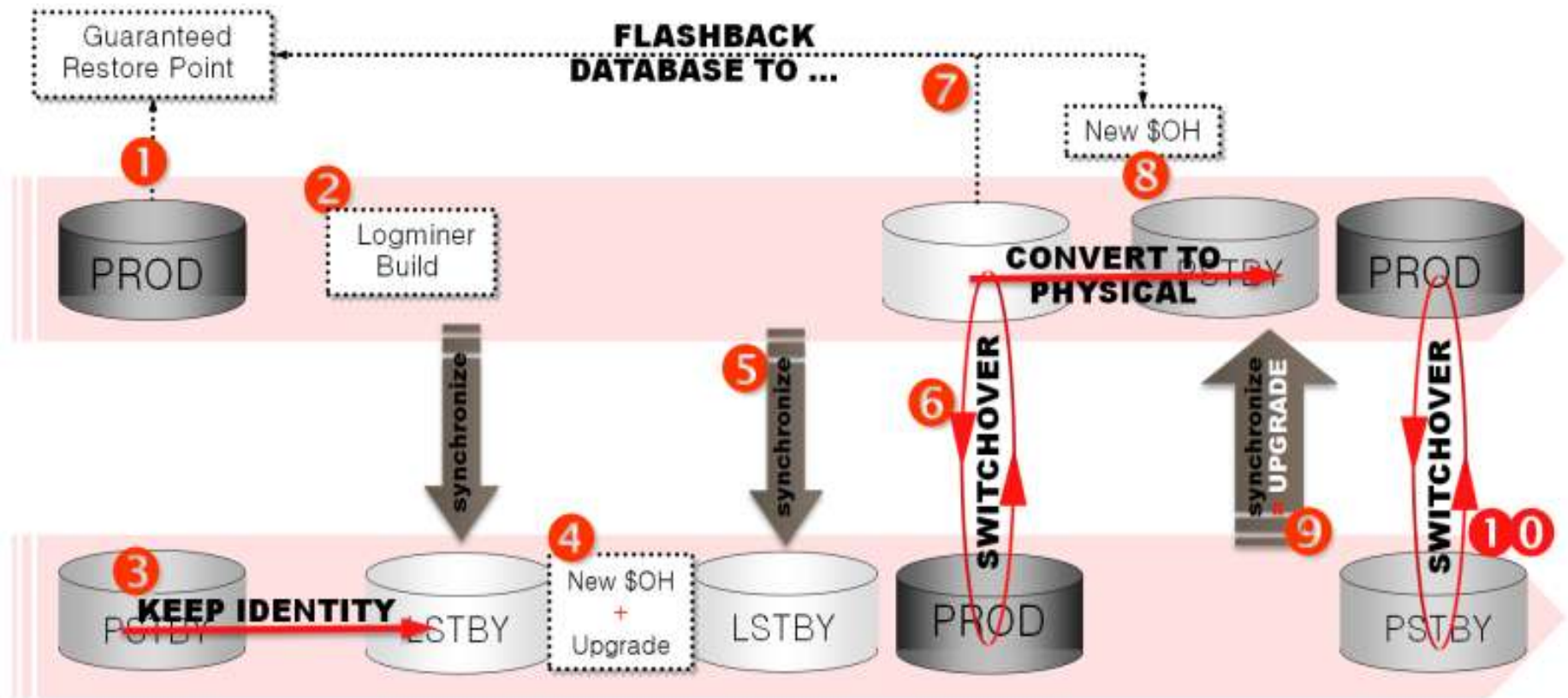
Success?

Remarks

- Stage 1:
  - Several test migrations and upgrades
  - Similar test system to the production Oracle/SUN Solaris cluster, including test standby system
  - Setup Oracle Grid Control
  - Performance monitoring with SPA
  - Tuning with SQL Tuning/Access Advisor
- Stage 2:
  - Test the rolling upgrade with Transient Standby

# Real World Checkpoint

- Customer
- Project
- Constraints
- Preparation
- Migration**
- Success?
- Remarks



# Real World Checkpoint

Customer

▪ Yes 😊

Project

– **Friday, February 13/14, 2009:**

Constraints

▪ Transient Standby for the database upgrade from Oracle Database 11.1.0.6 to 11.1.0.7

Preparation

▪ 2 minutes overall downtime

Migration

▪ [OOW 2009 presentation](#)

Success?

– July 30, 2012:

Remarks

▪ Rolling upgrade from Oracle Clusterware/ASM 11.1.0.7 to **Oracle Grid Infrastructure 11.2.0.3** with ASM **without any downtime**

▪ Rolling upgrade with `OPatch apply -minimize_downtime` for **July 2012 PSU** with **no downtime**

# Real World Checkpoint

Customer

Project

Constraints

Preparation

Migration

Success?

Remarks

- The XDB component was `INVALID` before the upgrade
  - Logminer was not willing to extract logs
  - **Lesson learned:**  
Make sure all components in `DBA_REGISTRY` are `VALID`
- Further information:
  - Database Rolling Upgrade Using Transient Logical Standby  
<http://www.oracle.com/technetwork/database/features/availability/maa-wp-11g-transientlogicalrollingu-1-131927.pdf>
  - Database Rolling Upgrades Made Easy by Using a Data Guard Physical Standby Database  
<http://www.oracle.com/technetwork/database/features/availability/maa-wp-11g-upgrades-made-easy-131972.pdf>

# Upgrade, Migrate & Consolidate

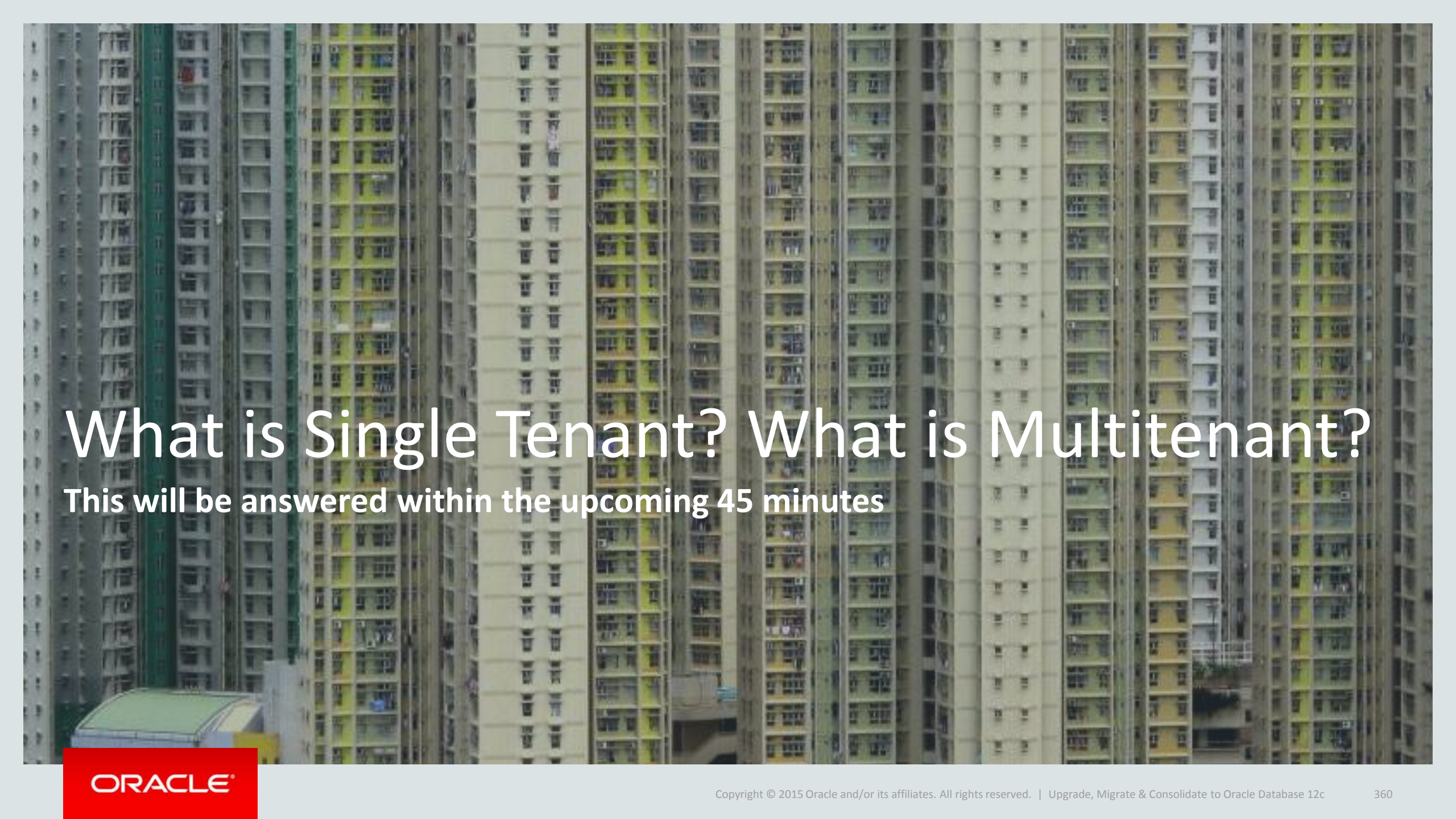
- 1 Introduction
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# Plug into Oracle Multitenant

- 1 Overview
- 2 Plug in
- 3 Upgrade
- 4 Working
- 5 Reality





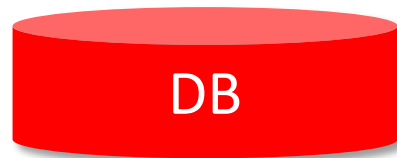
# What is Single Tenant? What is Multitenant?

This will be answered within the upcoming 45 minutes



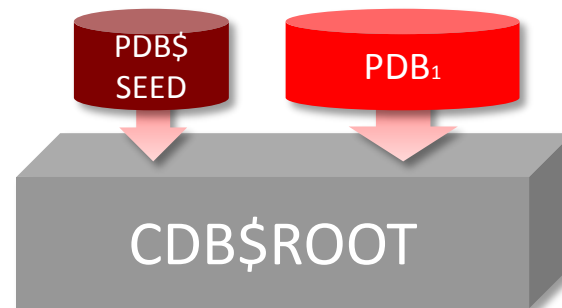
# Three possible database deployments in Oracle 12c

- Stand Alone



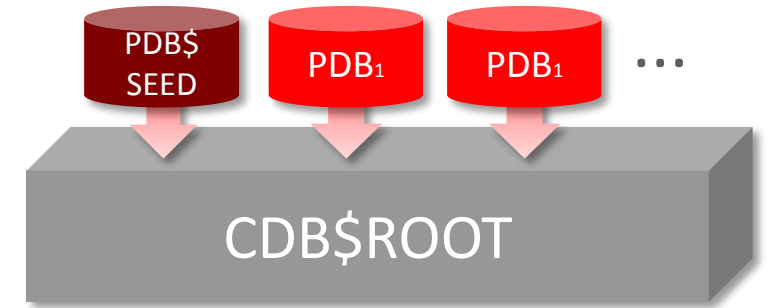
- Single Tenant

- One active PDB



- Multitenant

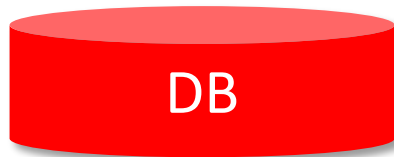
- Up to 252 active PDBs



# Three possible database deployments in Oracle 12c

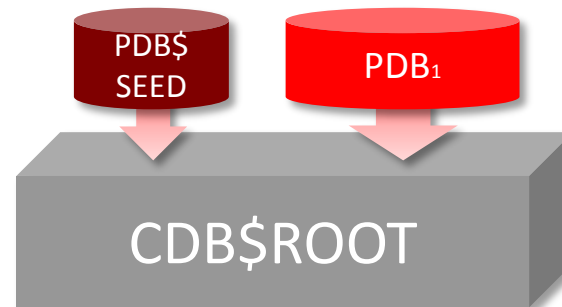
## ■ Stand Alone

- Same as in previous releases



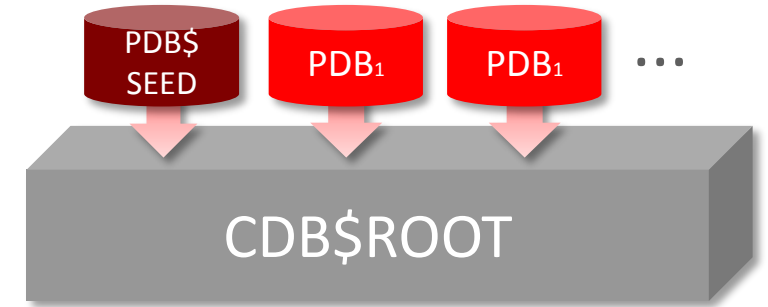
## ■ Single Tenant

- No extra license required
- Possible with SE and EE



## ■ Multitenant

- Requires Multitenant license
- Requires Enterprise Edition



# Some well-known **concepts** will **change**

- >200 pages **new documentation** in the Administrator's Guide

- [https://docs.oracle.com/database/121/ADMIN/part\\_cdb.htm#BGBIDDFD](https://docs.oracle.com/database/121/ADMIN/part_cdb.htm#BGBIDDFD)

## Part VI

### Managing a Multitenant Environment

Part VI discusses the Oracle Multitenant option and managing a multitenant environment. It contains the following chapters.

- Chapter 36, "Overview of Managing a Multitenant Environment"
- Chapter 37, "Creating and Configuring a CDB"
- Chapter 38, "Creating and Removing PDBs with SQL\*Plus"
- Chapter 39, "Creating and Removing PDBs with Cloud Control"
- Chapter 40, "Administering a CDB with SQL\*Plus"
- Chapter 41, "Administering CDBs and PDBs with Cloud Control"
- Chapter 42, "Administering PDBs with SQL\*Plus"
- Chapter 43, "Viewing Information About CDBs and PDBs with SQL\*Plus"
- Chapter 44, "Using Oracle Resource Manager for PDBs with SQL\*Plus"
- Chapter 45, "Using Oracle Resource Manager for PDBs with Cloud Control"
- Chapter 46, "Using Oracle Scheduler with a CDB"

- Oracle Multitenant Overview WP

- <http://www.oracle.com/technetwork/database/multitenant-wp-12c-1949736.pdf>



# Why you must play with Oracle Single/Multitenant

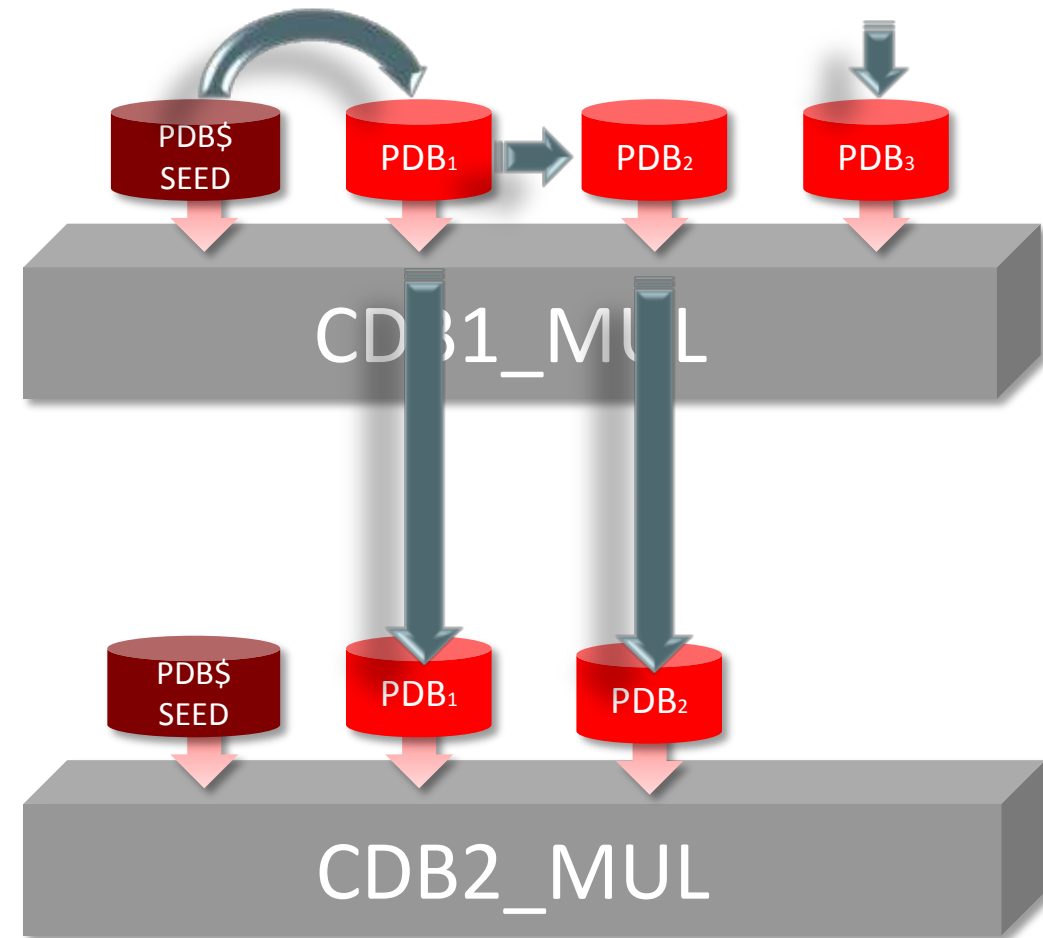
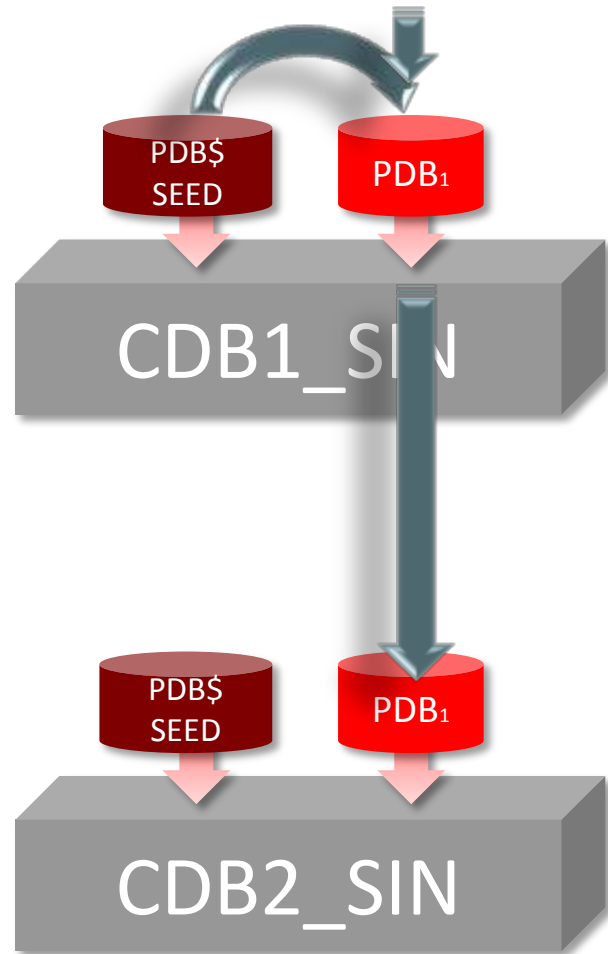
- Oracle Database 12c non-CDB works as expected
- You don't have to use Oracle Multitenant
  - *But ...*

## 8.1.1 Deprecation of Non-CDB Architecture

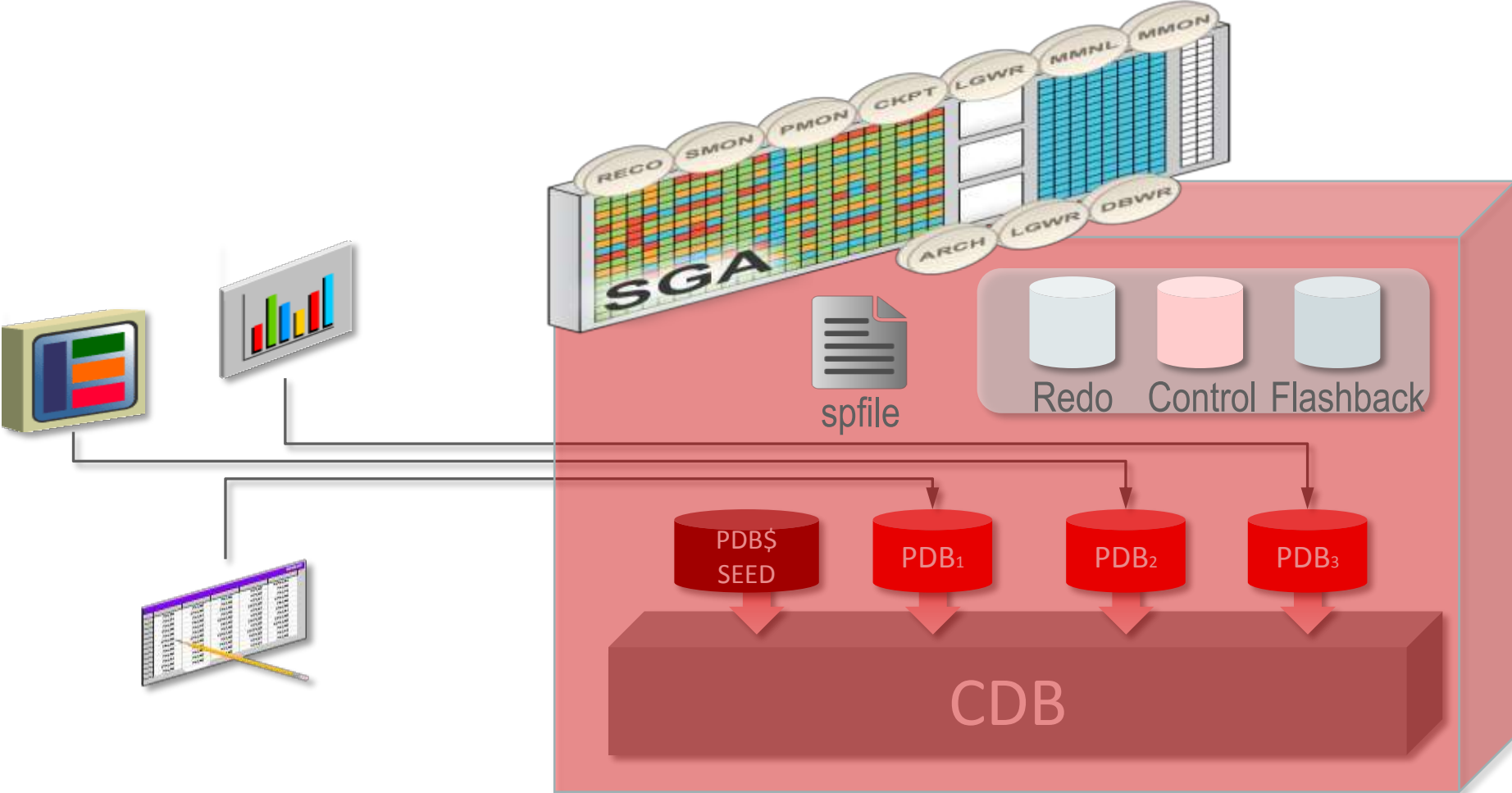
The non-CDB architecture is deprecated in Oracle Database 12c, and may be desupported and unavailable in a release after Oracle Database 12c Release 2. Oracle recommends use of the CDB architecture.

<https://docs.oracle.com/database/121/UPGRD/deprecated.htm#BABDBCJI>

# Oracle Single/Multitenant – Concepts



# Oracle Single/Multitenant – Sharing Resources



# New Container Database – DBCA vs. Scripts

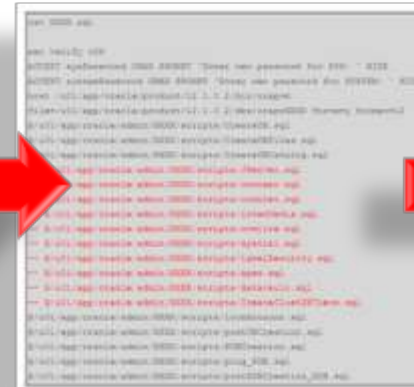
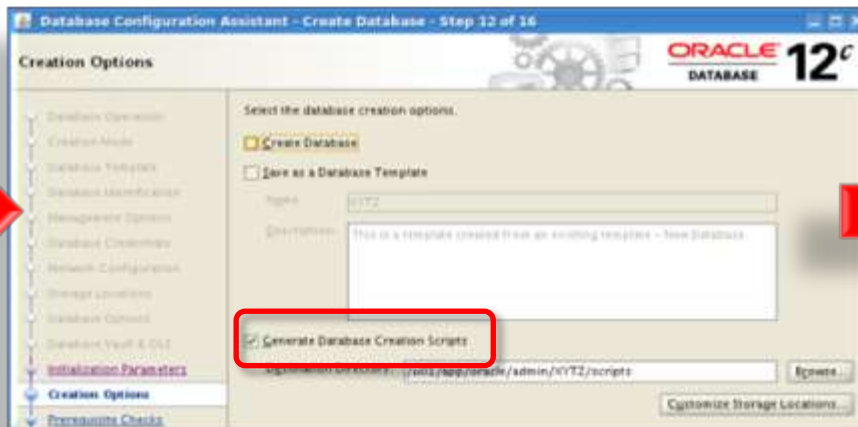
Create a new Container Database



Create a new Pluggable Database

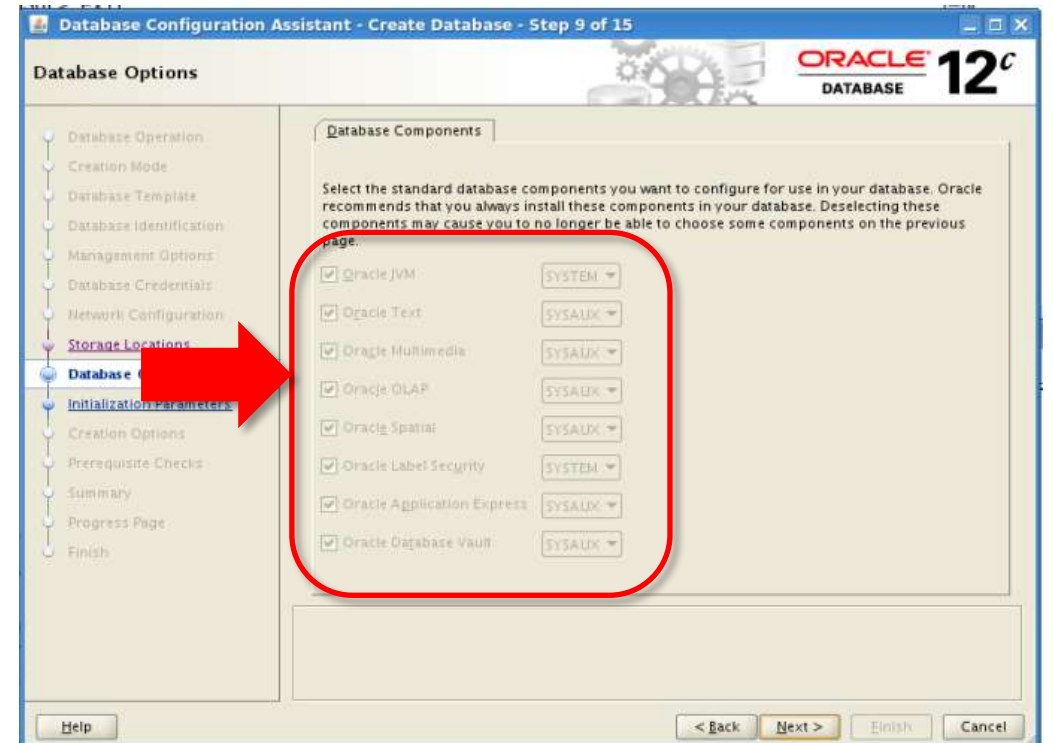
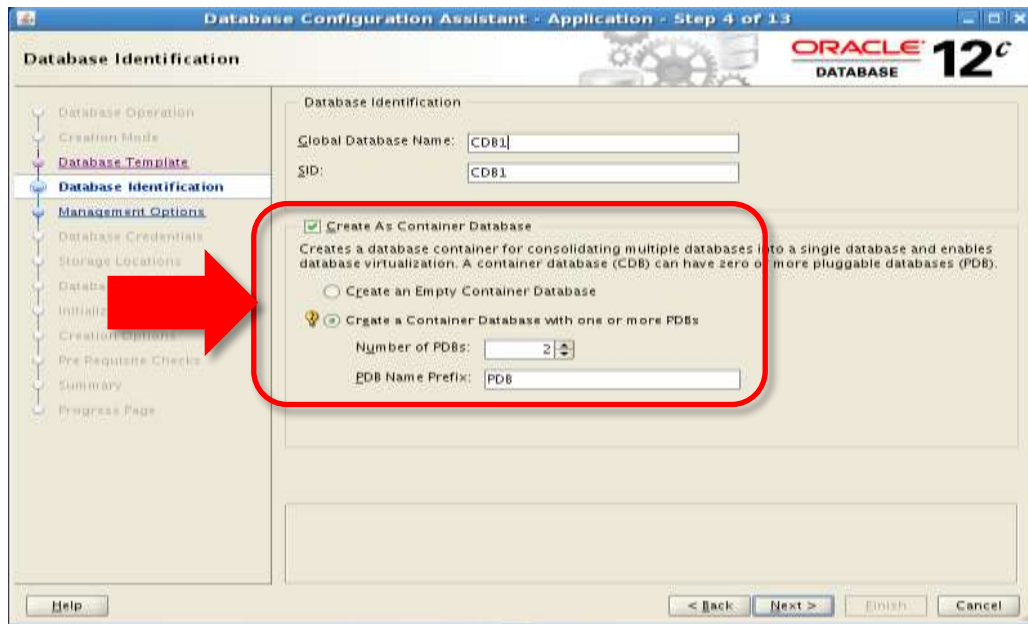
or

Plugin an Oracle 12c Database



# DBCA: Create a container database

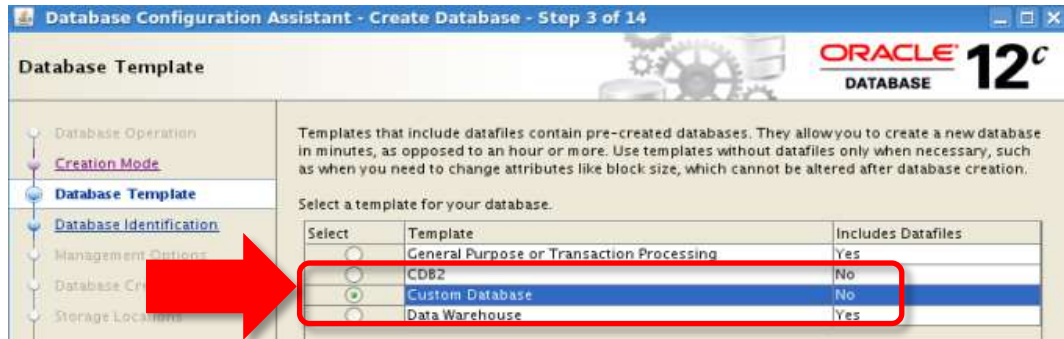
- All options will be created



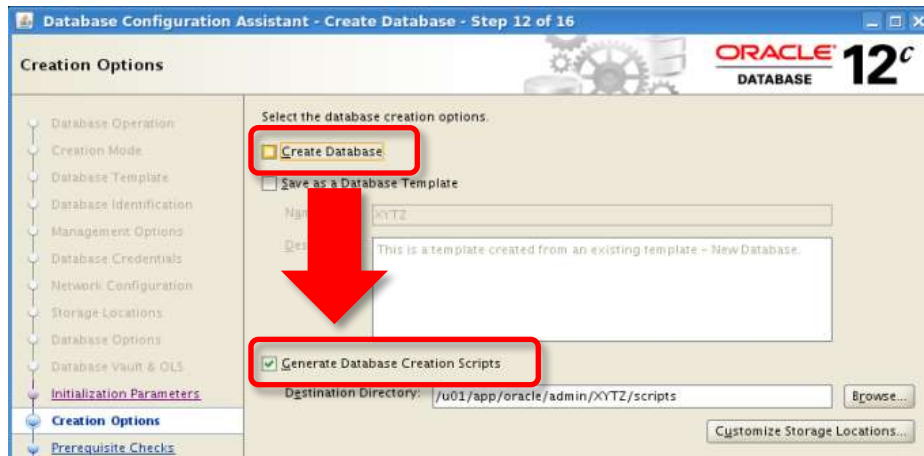


# Scripts: Create a container database

- Create a Custom Database in DBCA



- Scripts Only



- Command Line

– Subset of options possible

- [MOS Note: 2001512.1](#)  
[Creating a CDB with a Subset of Options](#)

```
cat XXXX.sql

set verify off

ACCEPT sysPassword CHAR PROMPT 'Enter new password for SYS: ' HIDE
ACCEPT systemPassword CHAR PROMPT 'Enter new password for SYSTEM: ' HIDE

host /u01/app/oracle/product/12.1.0.2/bin/orapwd
file=/u01/app/oracle/product/12.1.0.2/dbs/orapwXXXX force=y format=12
@/u01/app/oracle/admin/XXXX/scripts/CreateDB.sql
@/u01/app/oracle/admin/XXXX/scripts/CreateDBFiles.sql
@/u01/app/oracle/admin/XXXX/scripts/CreateDBCatalog.sql
-- @/u01/app/oracle/admin/XXXX/scripts/JServer.sql
-- @/u01/app/oracle/admin/XXXX/scripts/context.sql
-- @/u01/app/oracle/admin/XXXX/scripts/ordinst.sql
-- @/u01/app/oracle/admin/XXXX/scripts/interMedia.sql
-- @/u01/app/oracle/admin/XXXX/scripts/cwmlite.sql
-- @/u01/app/oracle/admin/XXXX/scripts/spatial.sql
-- @/u01/app/oracle/admin/XXXX/scripts/labelSecurity.sql
-- @/u01/app/oracle/admin/XXXX/scripts/apex.sql
-- @/u01/app/oracle/admin/XXXX/scripts/datavault.sql
-- @/u01/app/oracle/admin/XXXX/scripts/CreateClustDBViews.sql
@/u01/app/oracle/admin/XXXX/scripts/lockAccount.sql
@/u01/app/oracle/admin/XXXX/scripts/postDBCcreation.sql
@/u01/app/oracle/admin/XXXX/scripts/PDBCcreation.sql
@/u01/app/oracle/admin/XXXX/scripts/plug_PDB.sql
@/u01/app/oracle/admin/XXXX/scripts/postPDBCcreation_PDB.sql
```

# Scripts: Create a container database

- Subset of Database Options?
- See:
  - [MOS Note: 2001512.1](#)  
[Creating a CDB with a subset of options](#)
  - [MOS Note: 1616554.1](#)  
[Customization of Database Options in a Multitenant Setup](#)
- Scripts to edit:
  - CreateDBCatalog.sql
    - Remove Workspace Manager (owminst.plb)
  - <SID>.sql
    - Remove all unwanted components
    - Be aware of dependencies

```
cat XXXX.sql

set verify off
ACCEPT sysPassword CHAR PROMPT 'Enter new password for SYS: ' HIDE
ACCEPT systemPassword CHAR PROMPT 'Enter new password for SYSTEM: ' HIDE
host /u01/app/oracle/product/12.1.0.2/bin/orapwd
file=/u01/app/oracle/product/12.1.0.2/dbs/orapwXXXX force=y format=12
@/u01/app/oracle/admin/XXXX/scripts/CreateDB.sql
@/u01/app/oracle/admin/XXXX/scripts/CreateDBFiles.sql
@/u01/app/oracle/admin/XXXX/scripts/CreateDBCatalog.sql
-- @/u01/app/oracle/admin/XXXX/scripts/JServer.sql
-- @/u01/app/oracle/admin/XXXX/scripts/context.sql
-- @/u01/app/oracle/admin/XXXX/scripts/ordinst.sql
-- @/u01/app/oracle/admin/XXXX/scripts/interMedia.sql
-- @/u01/app/oracle/admin/XXXX/scripts/cwmlite.sql
-- @/u01/app/oracle/admin/XXXX/scripts/spatial.sql
-- @/u01/app/oracle/admin/XXXX/scripts/labelSecurity.sql
-- @/u01/app/oracle/admin/XXXX/scripts/apex.sql
-- @/u01/app/oracle/admin/XXXX/scripts/datavault.sql
-- @/u01/app/oracle/admin/XXXX/scripts/CreateClustDBViews.sql
@/u01/app/oracle/admin/XXXX/scripts/lockAccount.sql
@/u01/app/oracle/admin/XXXX/scripts/postDBCcreation.sql
@/u01/app/oracle/admin/XXXX/scripts/PDBCcreation.sql
@/u01/app/oracle/admin/XXXX/scripts/plug_PDB.sql
@/u01/app/oracle/admin/XXXX/scripts/postPDBCcreation_PDB.sql
```

# Run SQL scripts with `catcon.pl`

- **Administrative scripts** have to be started via `catcon.pl`:

```
$> $ORACLE_HOME/perl/bin/perl catcon.pl -u SYS -d  
$ORACLE_HOME/rdbms/admin -e -s -b create_dictionary catcdb.sql
```

## – Most useful `catcon.pl` options:

- `-u` Username and optionally password
- `-d` Directory containing the script to execute (default: current directory)
- `-e` Echo on
- `-s` Spools the output of every script
- `-l` Directory to write logfiles into (default: current directory)
- `-b` Base name for logfiles (mandatory option)
- `-c` Containers in which to run sql scripts
- `-f` Ignore PDBs which are closed

```
Usage: catcon [-u username[/password]] [-U username[/password]]  
[-d directory] [-l directory]  
[{-c|-C} container] [-p degree-of-parallelism]  
[-z EZConnect strings]  
[-e] [-s]  
[-E { ON | errorlogging-table-other-than-SPERRORLOG } ]  
[-I]  
[-g]  
[-f]  
[-r]  
-b log-file-name-base  
--  
{ sqlplus-script [arguments] | --x<SQL-statement> } ...
```

- See [MOS Note: 1932340.1 - How to execute sql scripts in Multitenant environment \(catcon.pl\)](#)

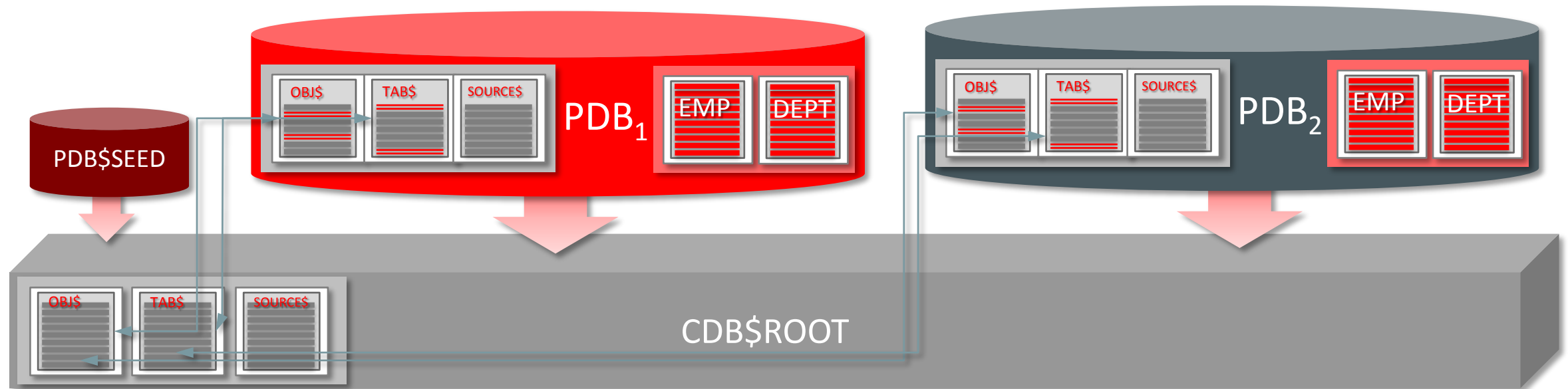
# Example `catcon.pl`

- Run the `preupgrd.sql` in all containers

```
$> $ORACLE_HOME/perl/bin/perl  
    $ORACLE_HOME/rdbms/admin/catcon.pl  
    -n 1  
    -d $ORACLE_HOME/rdbms/admin  
    -l /home/oracle/upgrade  
    -b preupgrd  
    preupgrd.sql
```

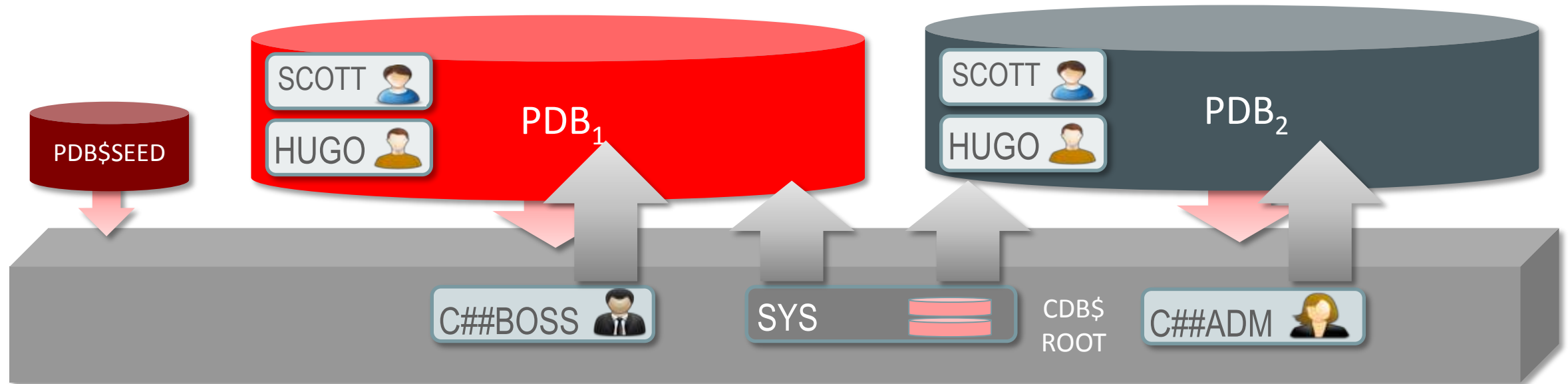
# CDB-PDB: Who's who?

- Data dictionary and objects



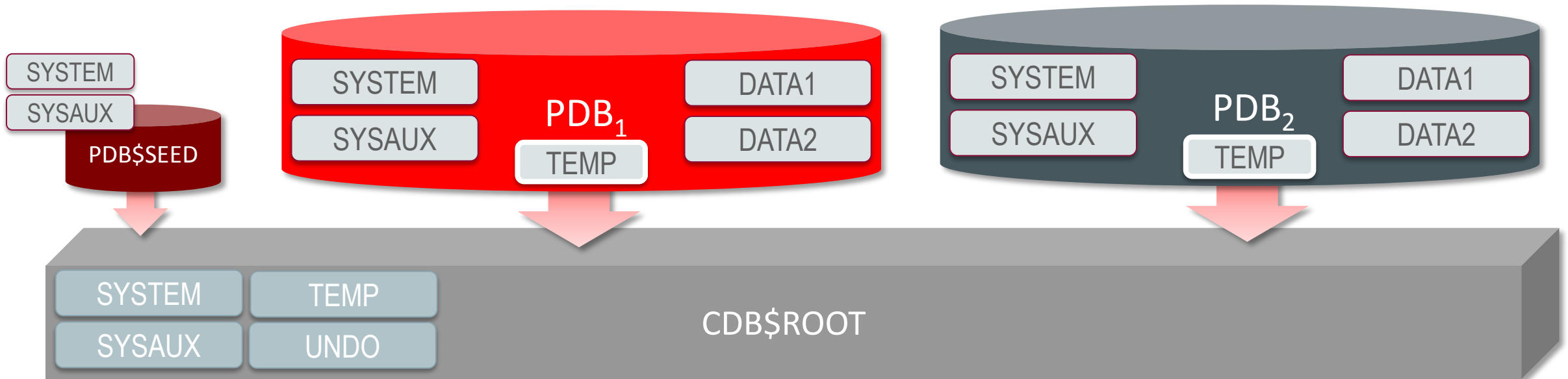
# CDB-PDB: Who's who?

- Common user (`common_user_prefix`)
- Local user



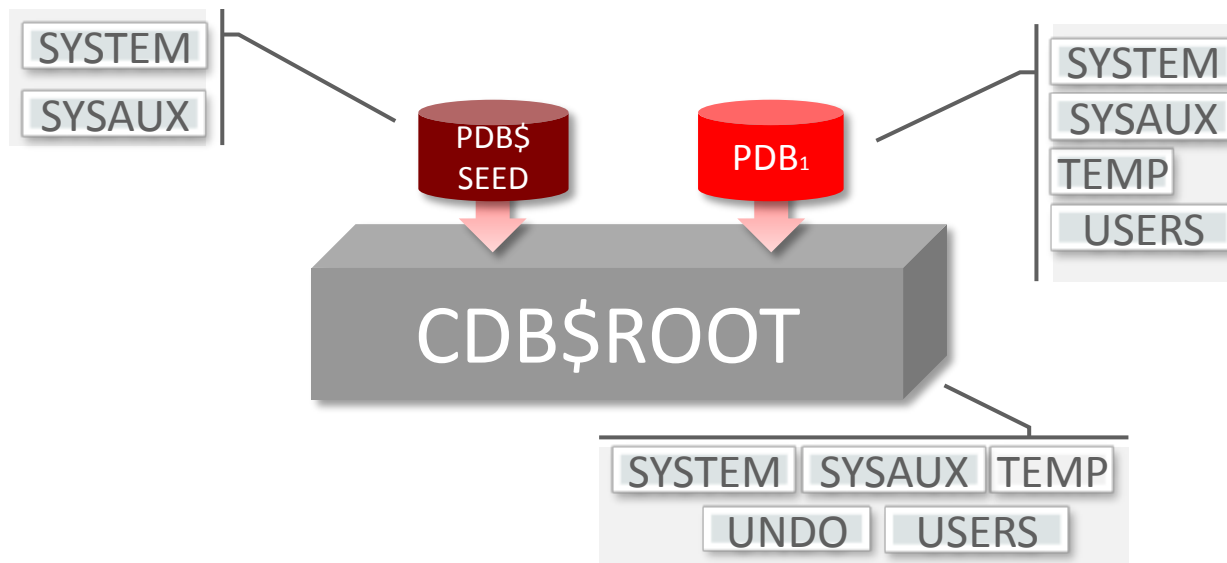
# CDB-PDB: Who's who?

- Tablespaces



# Footprint on Disk – Single Tenant

- Each container has its own SYSTEM tablespace
- Each container has its own SYSAUX tablespace
- CDB\$ROOT and PDB have their own TEMP tablespaces





# Plug into Oracle Multitenant

- 1 Overview
- 2 Plug in**
- 3 Upgrade
- 4 Working
- 5 Reality



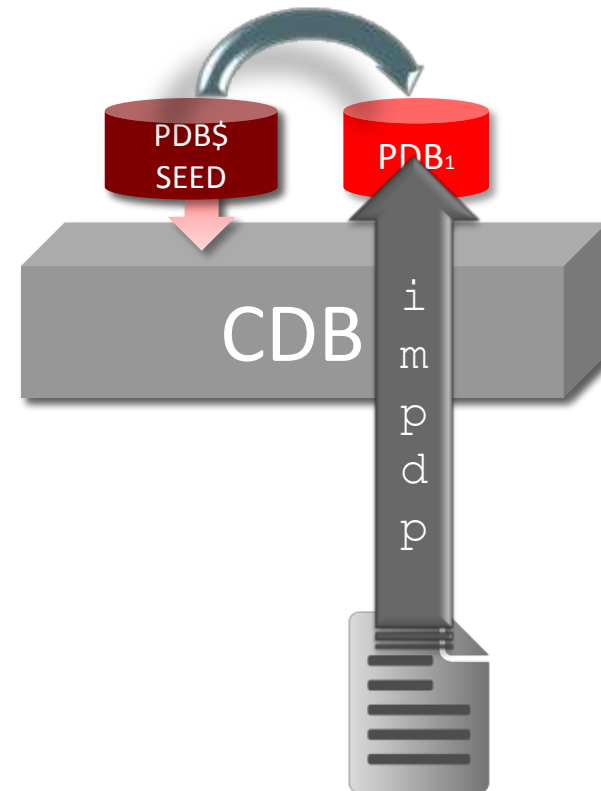
# Creation of a New Pluggable Database

- Fast provisioning from PDB\$SEED

```
create pluggable database PDB1
admin user adm1 identified by pwd
file_name_convert=(
'/oradata/CDB2/pdbseed',
'/oradata/CDB2/pdb1')
```

- PDB\_FILE\_NAME\_CONVERT

- Transport with TTS or FTEX
- Import data with `impdp`
  - Dump file or `NETWORK_LINK`
  - `imp` for  $\leq$  Oracle 9i



# Cloning of a Pluggable Database

- Fast cloning of a PDB

- Local\*:

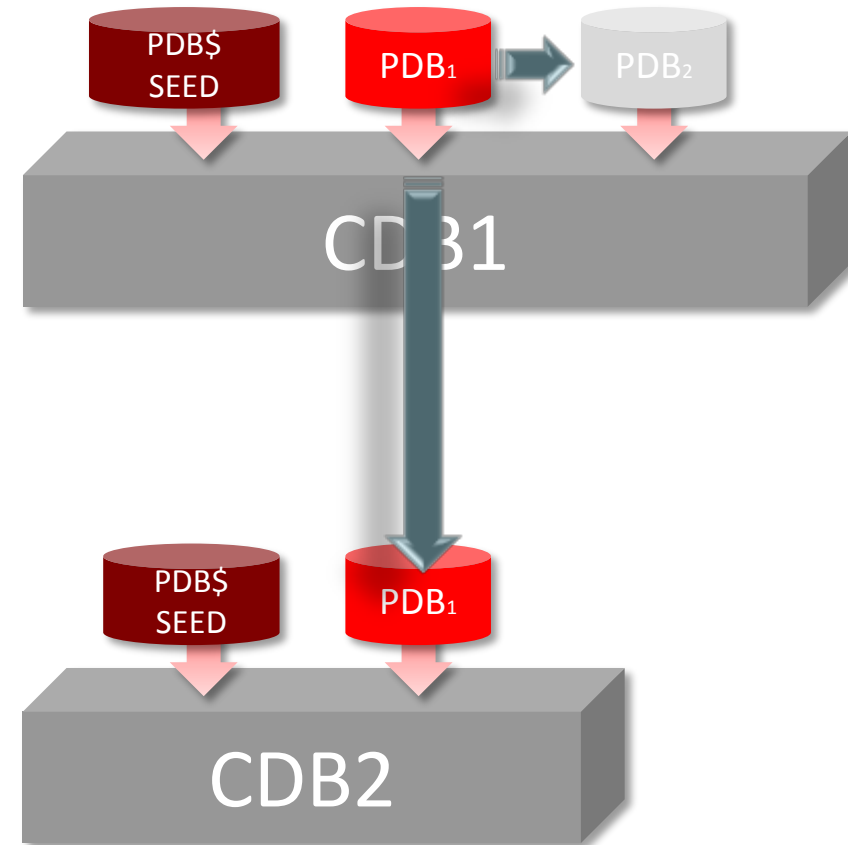
```
create pluggable database  
PDB2 from PDB1;
```

*\* not available with Single Tenant*

- Remote:

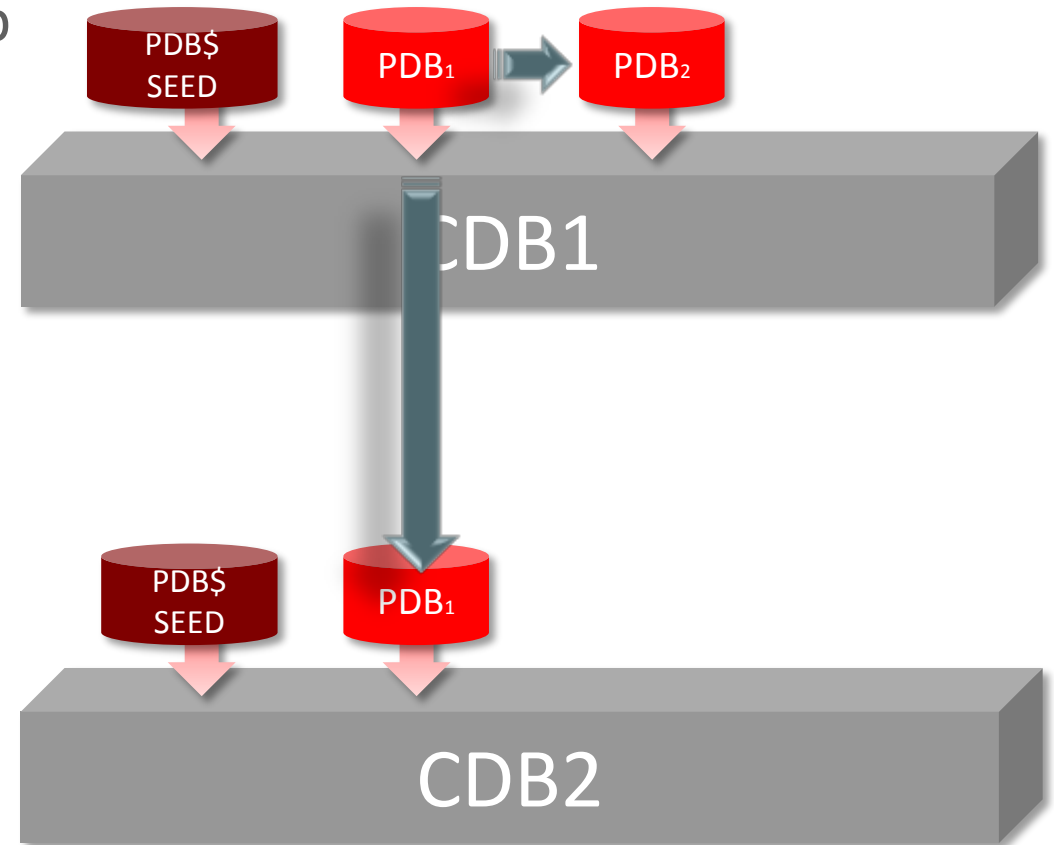
```
create pluggable database  
PDB1 from PDB1@CDB1;
```

- *@CDB1 specifies a database link!!!*
- *In Oracle 12.1 the source PDB must be quiesced*



# Cloning of a Pluggable Database

- Also supported:
  - Snapshot cloning with ACFS, ZFS and NetApp
    - `CREATE PLUGGABLE DATABASE pdb2 FROM pdb1 SNAPSHOT COPY;`
- Since Oracle Database 12.1.0.2
  - Subset Cloning
    - `CREATE PLUGGABLE DATABASE pdb2 FROM pdb1 FILE_NAME_CONVERT=('.','/..') USER_TABLESPACES=('data1', 'data2');`
  - Metadata Cloning
    - `CREATE PLUGGABLE DATABASE pdb2 FROM pdb1 FILE_NAME_CONVERT=('.','/..') NO DATA;`



# Upgrade and Plugin as PDB

- Database upgrade
- Start database read-only
- Create XML description file

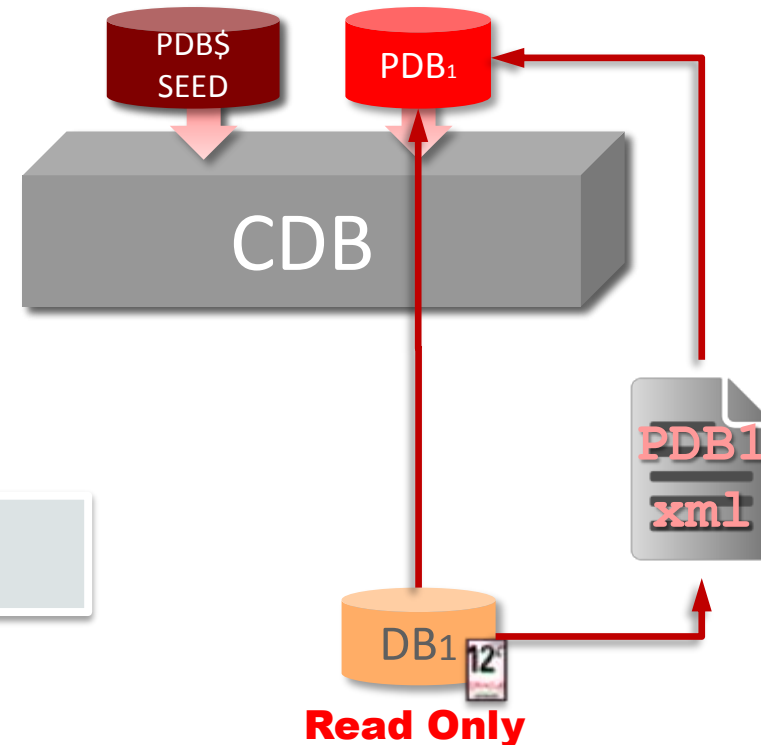
```
exec DBMS_PDB.DESCRIBE ('PDB1.xml');
```

- Shutdown database
- Plugin database

```
create pluggable database PDB1  
using ('PDB1.xml') nocopy tempfile reuse;
```

- Sanity operations

```
start ?/rdbms/admin/noncdb_to_pdb.sql
```

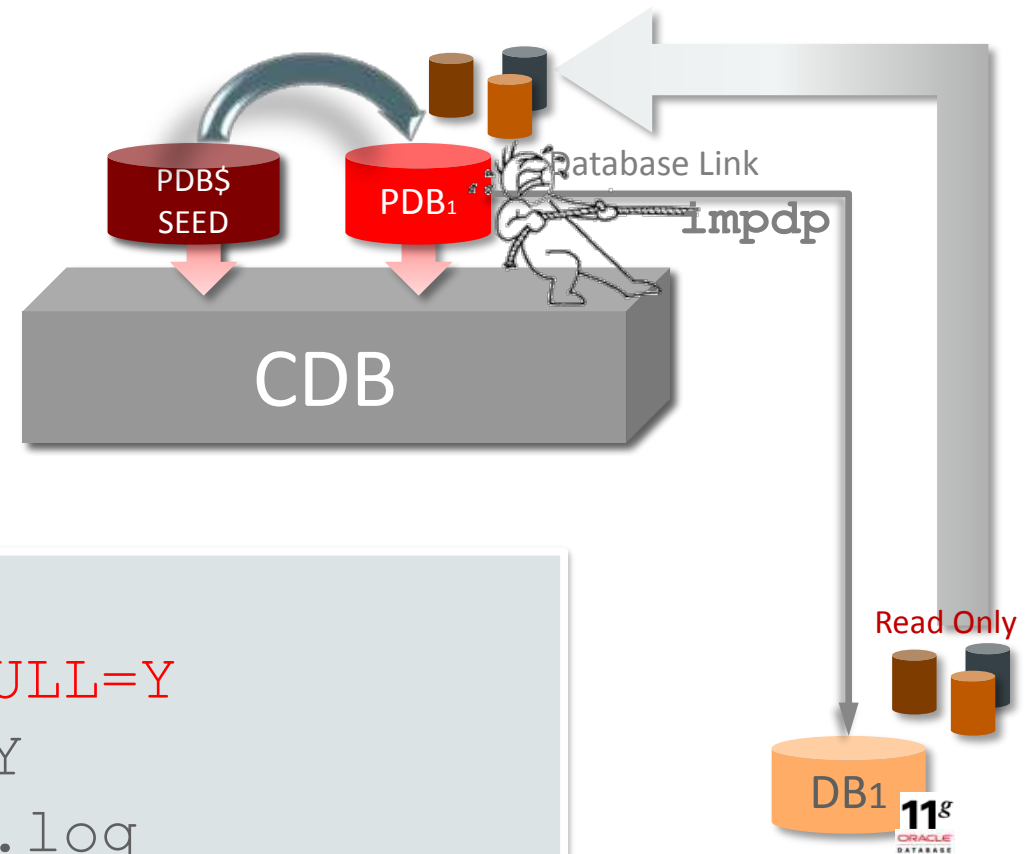


`noncdb_to_pdb.sql`

- Sanity script when plugging in a stand-alone database
- Irreversible
- Runs only once in the life of a database
- Runtime depends ...

# Full Transportable Export/Import

- Create a fresh database/PDB
- Create database link to source
- Tablespaces read-only – *downtime!*
- Copy datafiles to destination
- Run impdp on NETWORK\_LINK



```
impdp oow/passwd@PDB1
NETWORK_LINK=DB1 VERSION=12 FULL=Y
TRANSPORTABLE=ALWAYS METRICS=Y
LOGFILE=oow_dir:src112fullimp.log
TRANSPORT_DATAFILES='/oradata/ts1.dbf' ...
```

# Plug into Oracle Single-/Multitenant

- 1 Overview
- 2 Plug in
- 3 Upgrade**
- 4 Working
- 5 Reality





# Why does a PDB require an upgrade?

- Each PDB has its own Data Dictionary
  - The [documentation](#) states:

## Ease of database upgrade

If the definition of a data dictionary table existed in every PDB, and if the definition were to change in a new release, then each PDB would need to be upgraded separately to capture the change. Storing the table definition only once in the root eliminates this problem.

## Metadata links

Oracle Database stores metadata about dictionary objects only in the root. For example, the column definitions for the `OBJ$` dictionary table, which underlies the `DBA_OBJECTS` data dictionary view, exist only in the root. As depicted in [Figure 18-1](#), the `OBJ$` table in each PDB uses an internal mechanism called a [metadata link](#) to point to the definition of `OBJ$` stored in the root.

- Comparing `OBJ$` in `CDB$ROOT` 

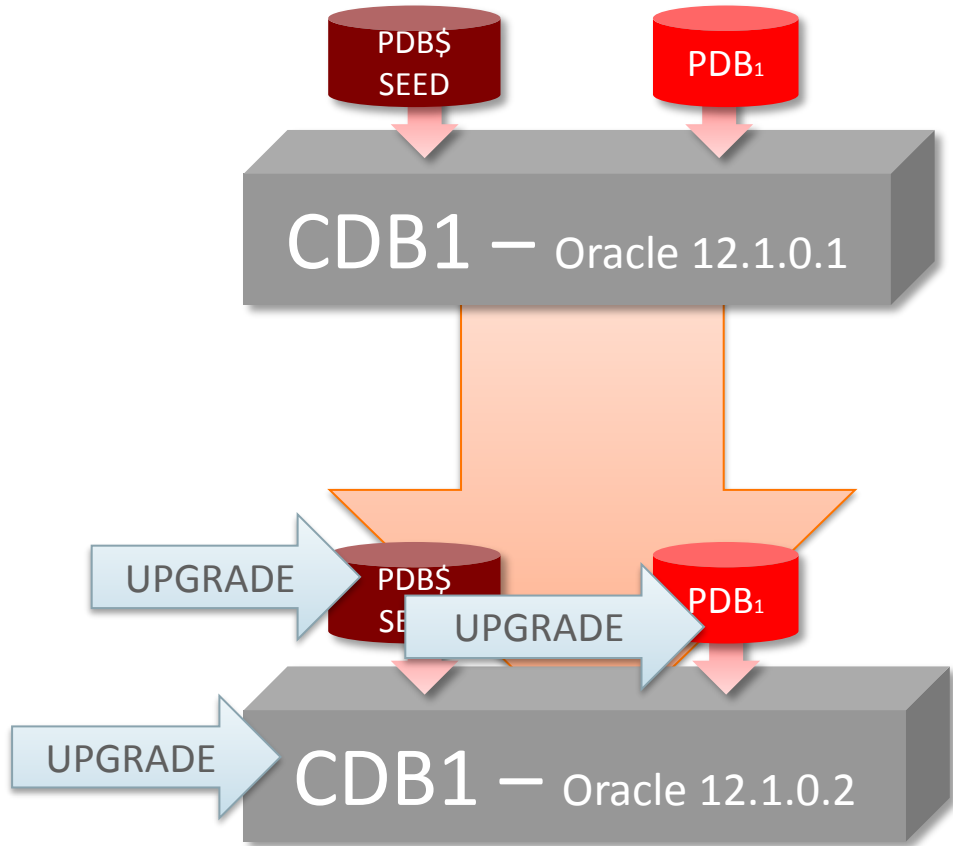
| TYPE  | NAME  | FILE_ID | BYTES    | BLOCKS |
|-------|-------|---------|----------|--------|
| TABLE | OBJ\$ | 1       | 11534336 | 1408   |

versus PDB 

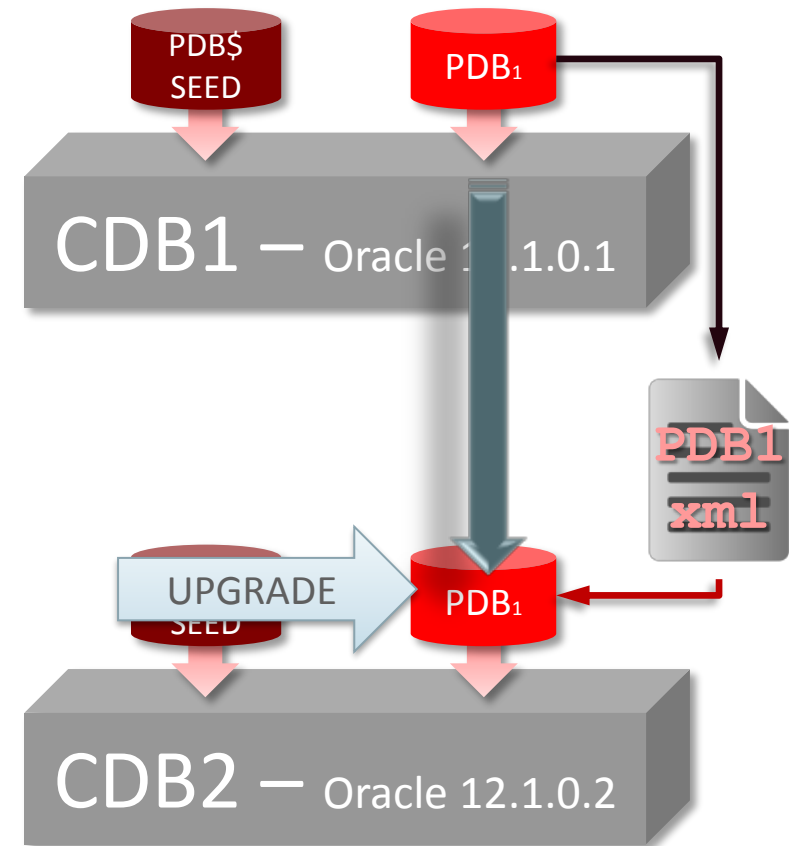
| TYPE  | NAME  | FILE_ID | BYTES    | BLOCKS |
|-------|-------|---------|----------|--------|
| TABLE | OBJ\$ | 9       | 10485760 | 1280   |

# Upgrade: Two Strategies

- Everything at once

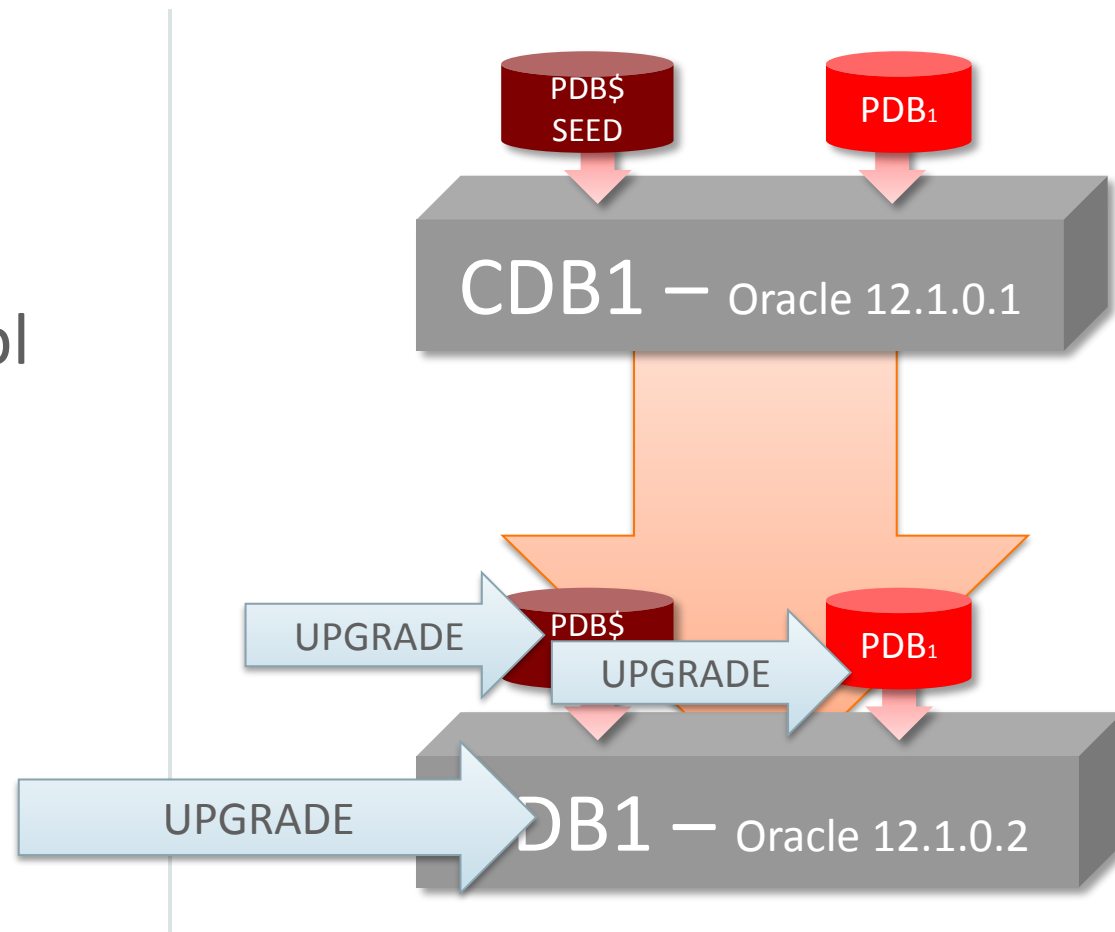


- Unplug/plugin/upgrade

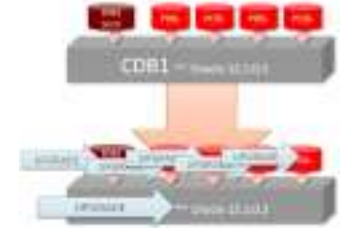


# Upgrade: **Everything at once**

- 2 upgrade cycles
  - Cycle 1: CDB\$ROOT
  - Cycle 2: PDB\$SEED and PDB
- Execute all scripts with catcon.pl



# Upgrade: Everything at once



- Overview description - detailed steps can be found at:

[https://blogs.oracle.com/UPGRADE/entry/upgrade\\_pdb1\\_everything\\_at\\_once1](https://blogs.oracle.com/UPGRADE/entry/upgrade_pdb1_everything_at_once1)

- **Source:**

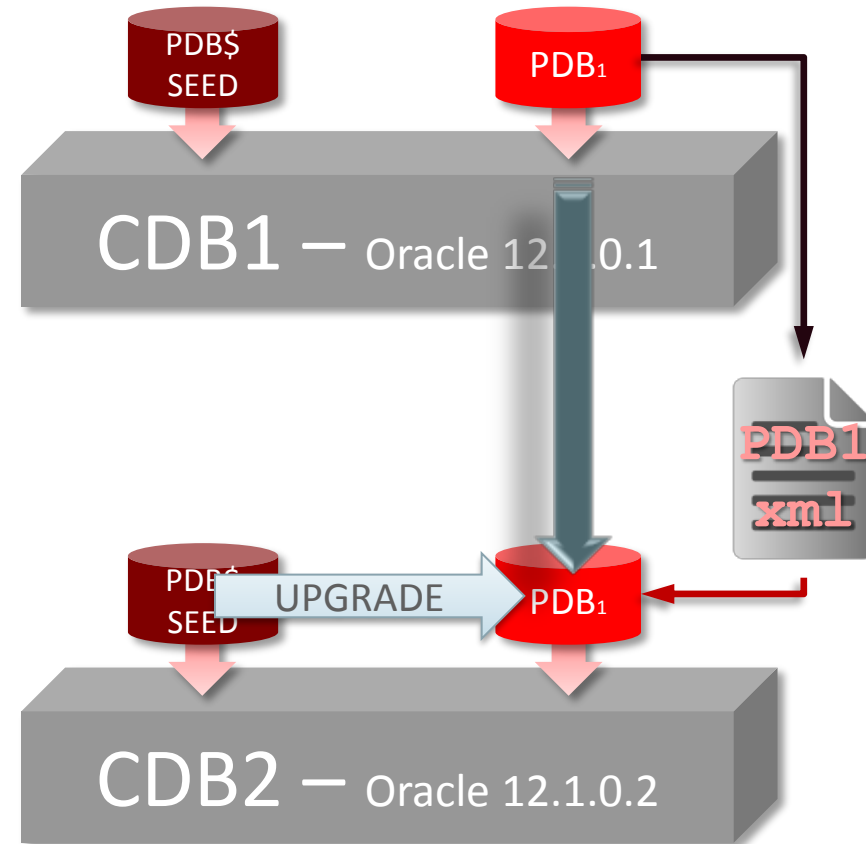
- Copy new preupgrd.sql and utluppkg.sql into source' \$OH/rdbms/admin
- \$ORACLE\_HOME/perl/bin/perl \$ORACLE\_HOME/rdbms/admin/catcon.pl -n 1 -d \$ORACLE\_HOME/rdbms/admin -l /home/oracle/mike -b preupgrd preupgrd.sql
- ALTER PLUGGABLE DATABASE ALL OPEN;
- \$ORACLE\_HOME/perl/bin/perl \$ORACLE\_HOME/rdbms/admin/catcon.pl -n 1 -d \$ORACLE\_HOME/cfgtoollogs/cdbupgr/preupgrade -l /home/oracle/mike -b preupgrade\_fixups preupgrade\_fixups.sql

- **Destination:**

- STARTUP UPGRADE
- ALTER PLUGGABLE DATABASE ALL OPEN UPGRADE;
- cd \$ORACLE\_HOME/rdbms/admin
- \$ORACLE\_HOME/perl/bin/perl catctl.pl -d \$ORACLE\_HOME/rdbms/admin -n 16 -M -l /home/oracle/mike catupgrd.sql
  - The important file with timings per PDB for a quick check is called upg\_summary.log and can be found in:  
\$ORACLE\_HOME/cfgtoollogs/<SID>/upgrade/upg\_summary.log
- STARTUP
- ALTER PLUGGABLE DATABASE ALL OPEN;
- \$ORACLE\_HOME/perl/bin/perl \$ORACLE\_HOME/rdbms/admin/catcon.pl -n 1 -d \$ORACLE\_HOME/cfgtoollogs/cdbupgr/preupgrade -l /home/oracle/mike -b postupgrade\_fixups postupgrade\_fixups.sql
- \$ORACLE\_HOME/perl/bin/perl catcon.pl -n 1 -e -b utlup -d ''.''' utlup.

# Upgrade: Unplug/plug/upgrade

- 1 upgrade cycle
  - PDB only
- With or without catcon.pl
- You must take a backup immediately after upgrade!!!



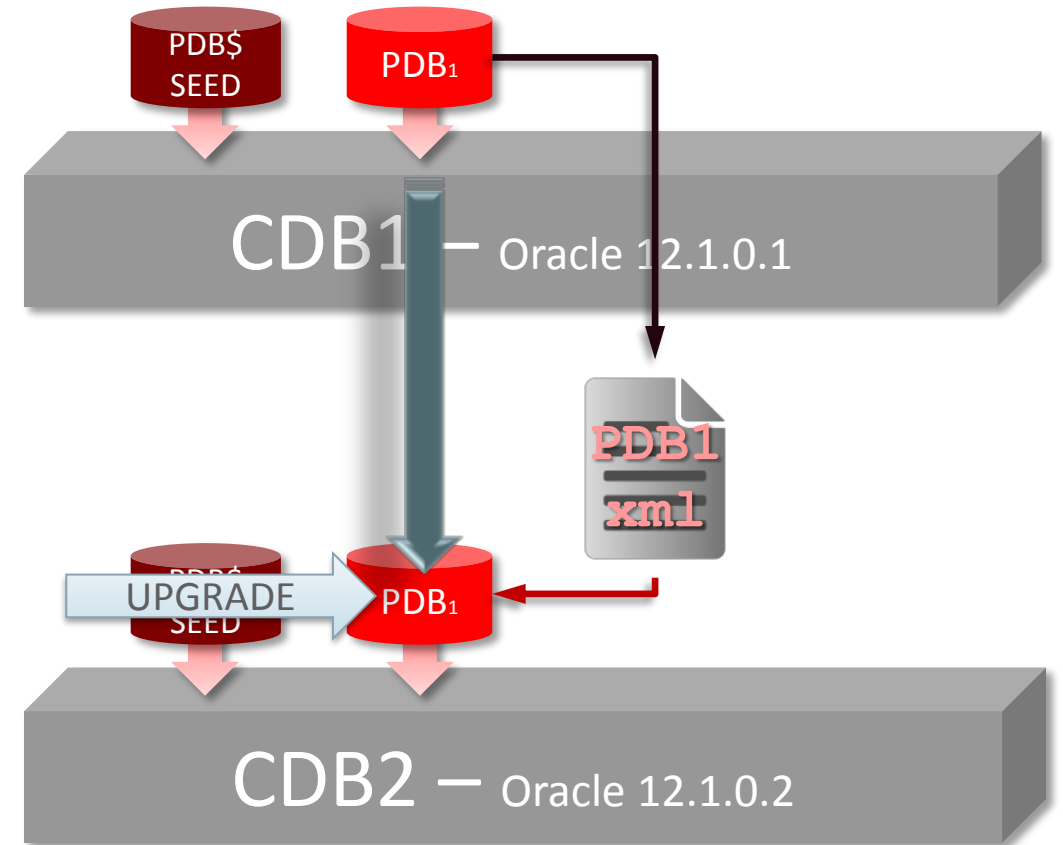
# Upgrade: **One/many at a time** – Step by Step – 1/2

## ▪ In CDB1:

- `alter session set container=PDB1;`
- `@?/rdbms/admin/preupgrd.sql`
- `@/u01/app/oracle/cfgtoollogs/CDB1/preupgrade/preupgrade_fixups.sql`
- `exec dbms_stats.gather_dictionary_stats;`
- `alter session set container=CDB$ROOT;`
- `alter pluggable database PDB1 close;`
- `alter pluggable database PDB1 unplug into '/stage/pdb1.xml';`
- `drop pluggable database PDB1 keep datafiles;`
- `exit`

## ➤ Detailed steps:

[https://blogs.oracle.com/UPGRADE/entry/upgrade\\_pdbs\\_one\\_at\\_a](https://blogs.oracle.com/UPGRADE/entry/upgrade_pdbs_one_at_a)



# Upgrade: **One/many at a time** – Step by Step – 2/2

## ■ In CDB2:

In SQL\*Plus:

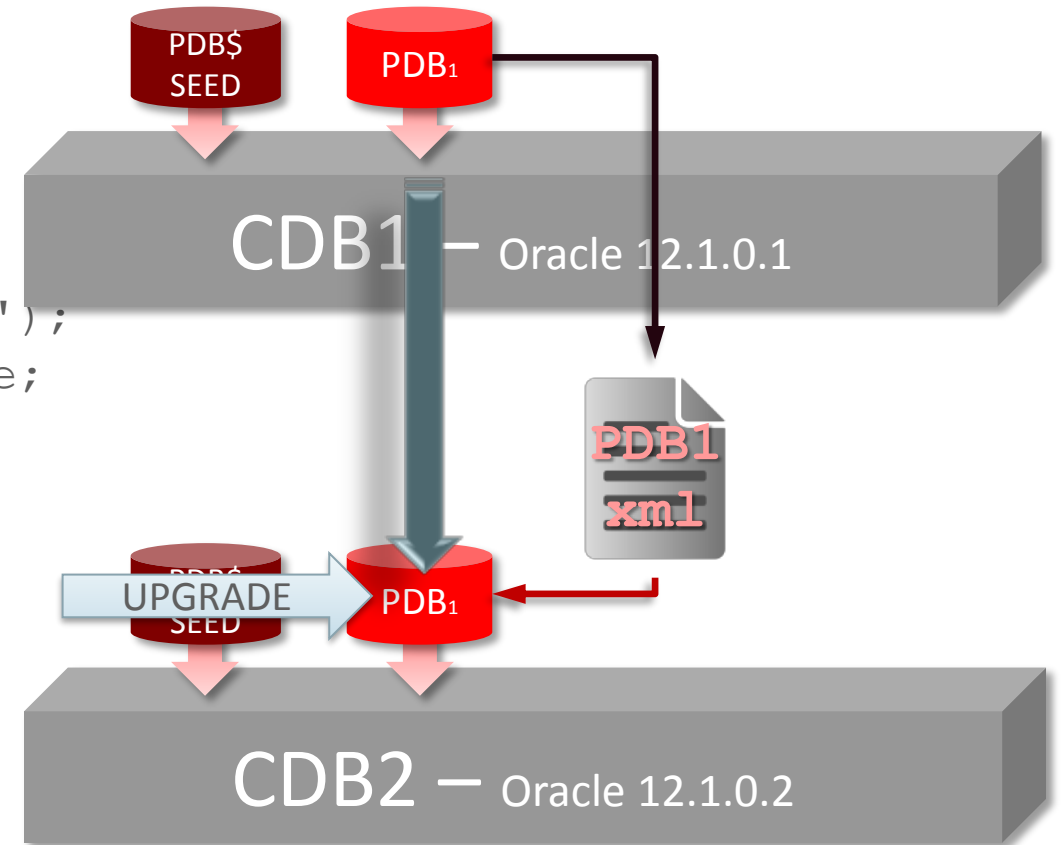
- alter session set container=CDB\$ROOT;
- \* create pluggable database pdb1 using '/stage/pdb1.xml' file\_name\_convert=('/oradata/CDB1/pdb1', '/oradata/CDB2/pdb1');
- alter pluggable database PDB1 open upgrade;
- #exit

## On the command prompt:

- \$> cd \$ORACLE\_HOME/rdbms/admin
- \$> \$ORACLE\_HOME/perl/bin/perl catctl.pl -c "PDB1" catupgrd.sql

## Back in SQL\*Plus:

- alter session set container=pdb1;
- startup
- @?/rdbms/admin/utlpr.sql

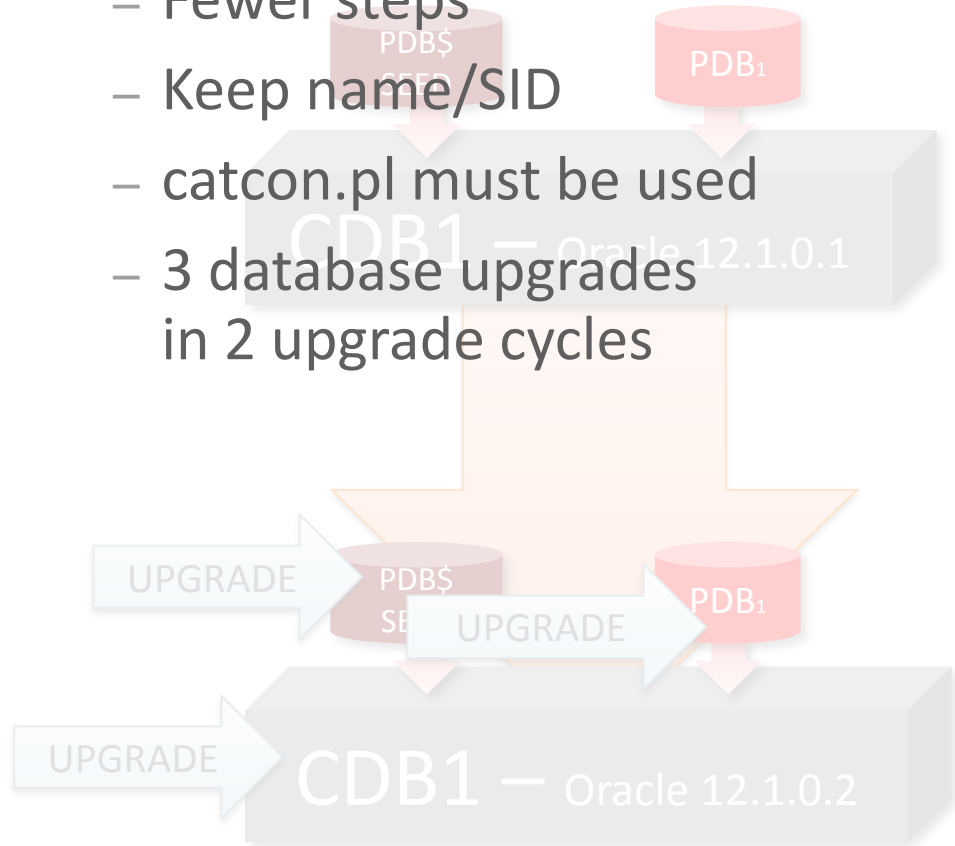


**\* A Plug-In-Check can be done before this step – but it will always result in "NO" as COMPATIBLE=12.1.0.2 per default in every Oracle 12.1.0.2 database when created with the DBCA**

# Two Strategies – Pros and Cons?

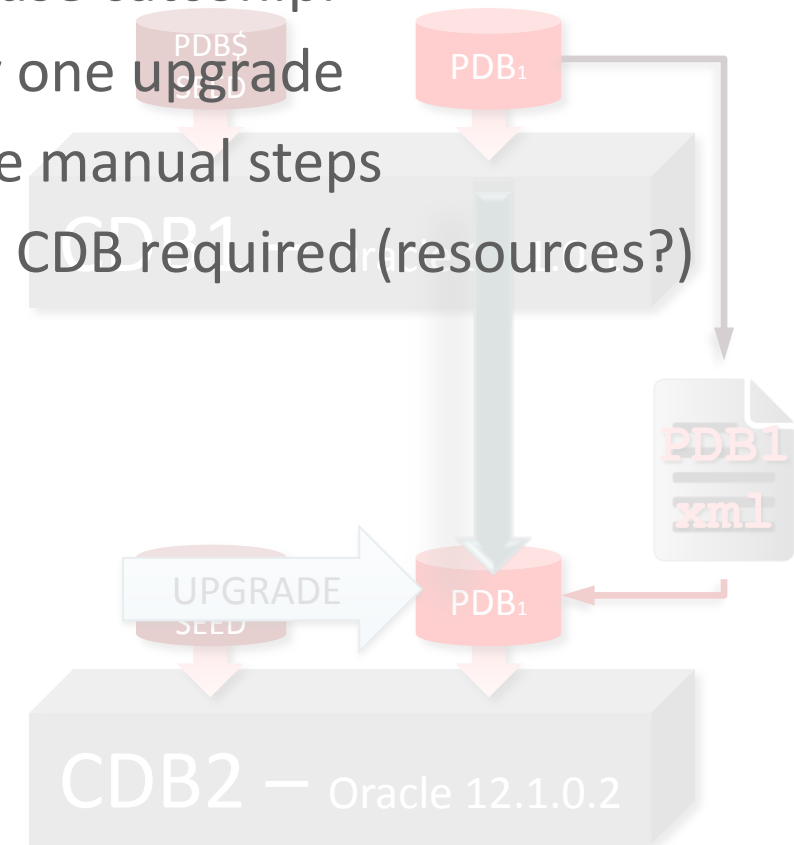
- **Everything at once**

- Fewer steps
- Keep name/SID
- catcon.pl must be used
- 3 database upgrades in 2 upgrade cycles



- **Unplug/plugin/upgrade**

- Can use catcon.pl
- Only one upgrade
- More manual steps
- New CDB required (resources?)





# Downgrade – Simplified Description

- Works for CDB/PDB entirely as well as for single/multiple PDBs
- Manual tasks
  - catdwgrd.sql in current environment
  - catrelod.sql in previous environment
  - Don't change COMPATIBLE
- Datapatch must roll back SPU/PSUs/BPs manually

# Plug into Oracle Single-/Multitenant

- 1 Overview
- 2 Plug in
- 3 Upgrade
- 4 Working**
- 5 Reality



# Startup – SAVE the STATE

- You need to startup a PDB
  - ALTER PLUGGABLE DATABASE pdb1 OPEN;
- By default PDBs need to be started manually
  - ALTER PLUGGABLE DATABASE pdb1 SAVE STATE;
    - This preserves the last state of a PDB
  - ALTER PLUGGABLE DATABASE pdb1 DISCARD STATE;
    - This removes any state preservation

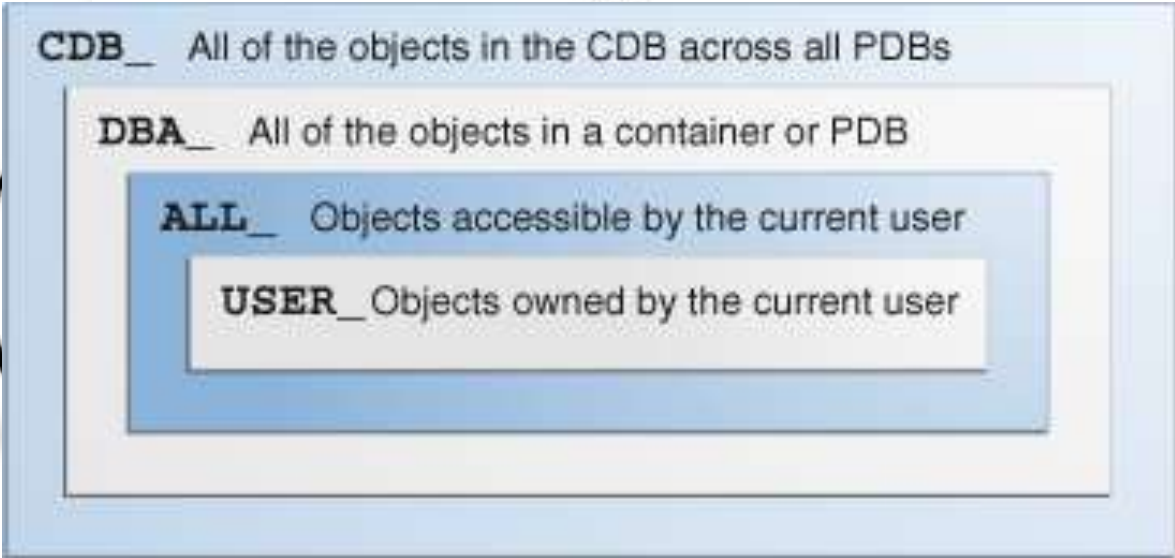


# CON\_ID - The Important Differentiator

| CDB_USERS                |  |
|--------------------------|--|
| USERNAME                 |  |
| USER_ID                  |  |
| PASSWORD                 |  |
| ACCOUNT_STATUS           |  |
| LOCK_DATE                |  |
| EXPIRY_DATE              |  |
| DEFAULT_TABLESPACE       |  |
| TEMPORARY_TABLESPACE     |  |
| CREATED                  |  |
| PROFILE                  |  |
| INITIAL_RSRC_CONSUMER_GI |  |
| EXTERNAL_NAME            |  |
| PASSWORD_VERSIONS        |  |
| EDITIONS_ENABLED         |  |
| AUTHENTICATION_TYPE      |  |
| PROXY_ONLY_CONNECT       |  |
| COMMON                   |  |
| LAST_LOGIN               |  |
| ORACLE_MAINTAINED        |  |
| <b>CON_ID</b>            |  |

| Value in CON_ID Column | Description |
|------------------------|-------------|
|------------------------|-------------|

|   |                                 |
|---|---------------------------------|
| 0 | The data pertains to the entire |
|---|---------------------------------|



| CDB_TEMP_FILES  |  |
|-----------------|--|
| FILE_NAME       |  |
| FILE_ID         |  |
| TABLESPACE_NAME |  |
| BYTES           |  |
| BLOCKS          |  |
| STATUS          |  |
| RELATIVE_FNO    |  |
| AUTOEXTENSIBLE  |  |
| MAXBYTES        |  |
| MAXBLOCKS       |  |
| INCREMENT_BY    |  |
| USER_BYTES      |  |
| USER_BLOCKS     |  |
| <b>CON_ID</b>   |  |

| CDB_ROLE_PRIVS  |  |
|-----------------|--|
| GRANTEE         |  |
| GRANTED_ROLE    |  |
| ADMIN_OPTION    |  |
| DELEGATE_OPTION |  |
| DEFAULT_ROLE    |  |
| COMMON          |  |
| <b>CON_ID</b>   |  |

| CDB_WORKLOAD_REPLAY_SCHEDULES |  |
|-------------------------------|--|
| SCHEDULE_NAME                 |  |
| DIRECTORY                     |  |
| STATUS                        |  |
| <b>CON_ID</b>                 |  |

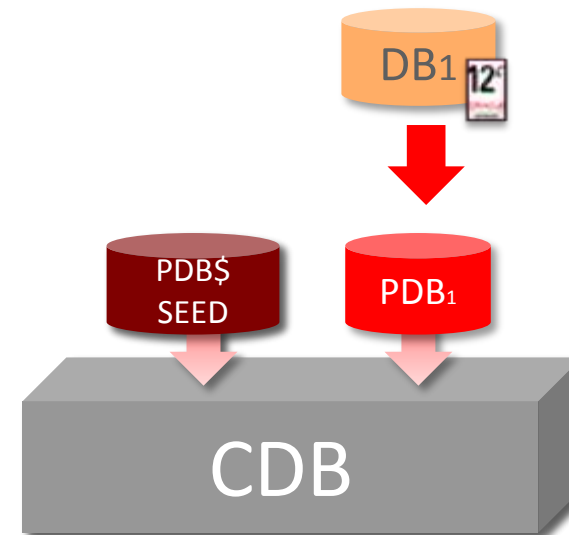
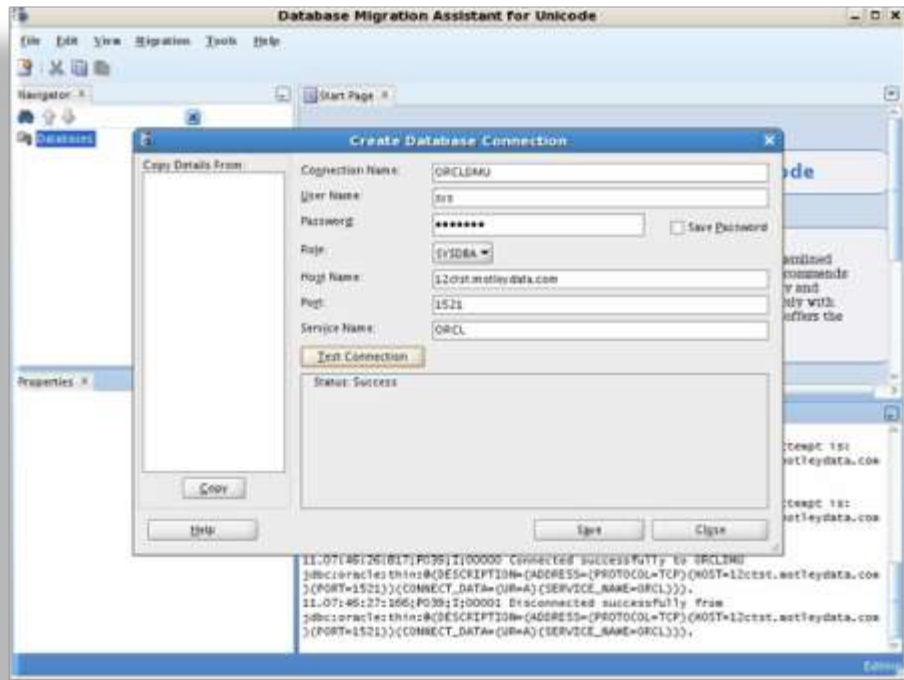
| CDB_SQLSET      |  |
|-----------------|--|
| ID              |  |
| CON_DBID        |  |
| NAME            |  |
| OWNER           |  |
| DESCRIPTION     |  |
| CREATED         |  |
| LAST_MODIFIED   |  |
| STATEMENT_COUNT |  |
| <b>CON_ID</b>   |  |

| CDB_VIEWS        |  |
|------------------|--|
| OWNER            |  |
| VIEW_NAME        |  |
| TEXT_LENGTH      |  |
| TEXT_VC          |  |
| TYPE_TEXT_LENGTH |  |
| TYPE_TEXT        |  |
| OID_TEXT_LENGTH  |  |
| OID_TEXT         |  |
| VIEW_TYPE_OWNER  |  |
| VIEW_TYPE        |  |
| SUPERVIEW_NAME   |  |
| EDITIONING_VIEW  |  |
| READ_ONLY        |  |
| CONTAINER_DATA   |  |
| BEQUEATH         |  |
| ORIGIN_CON_ID    |  |
| <b>CON_ID</b>    |  |



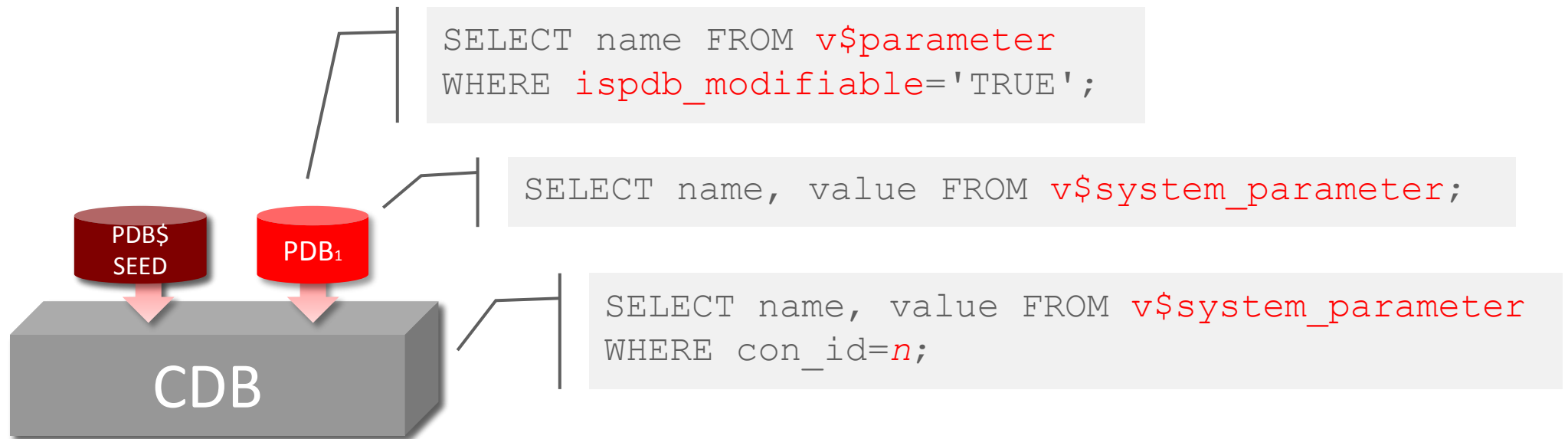
# Database Character Sets in Oracle Multitenant

- Only 1 common character set
- Conversion required?
  - [DMU 2.0](#) (and higher) can convert character sets before or after plug-in



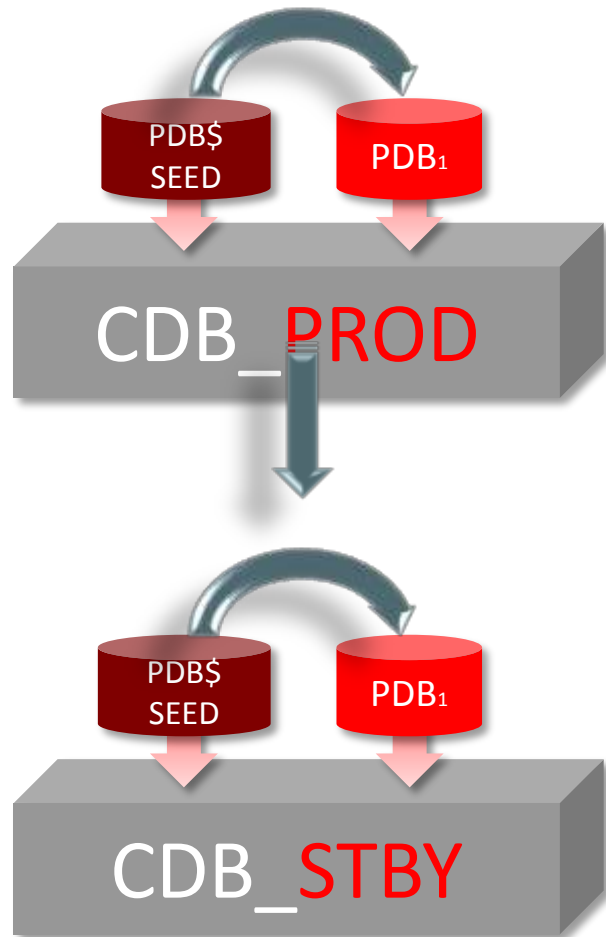
# Parameters in a PDB

- Over 180 parameters can be adjusted per single PDB
  - SPFILE: Parameters valid for all containers
  - V\$SYSTEM\_PARAMETER: Parameters valid within a PDB



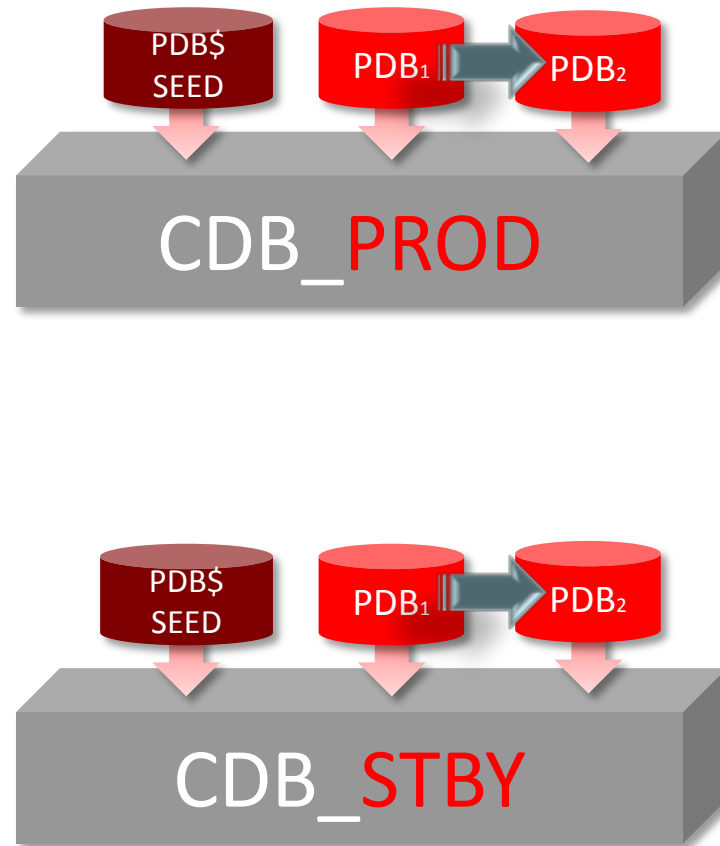
# Standby Databases

- Provision a new PDB

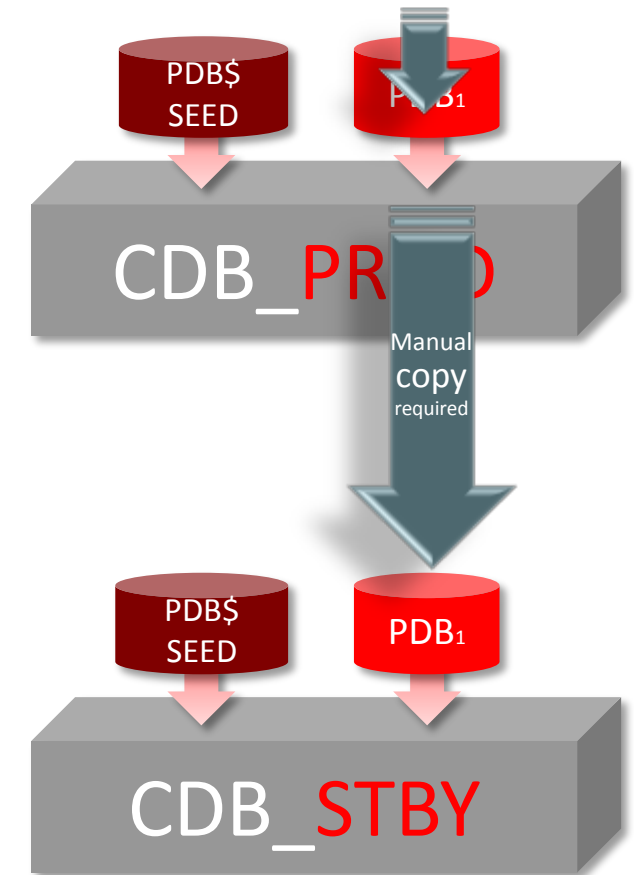


- Cloning of a PDB – ADG!!

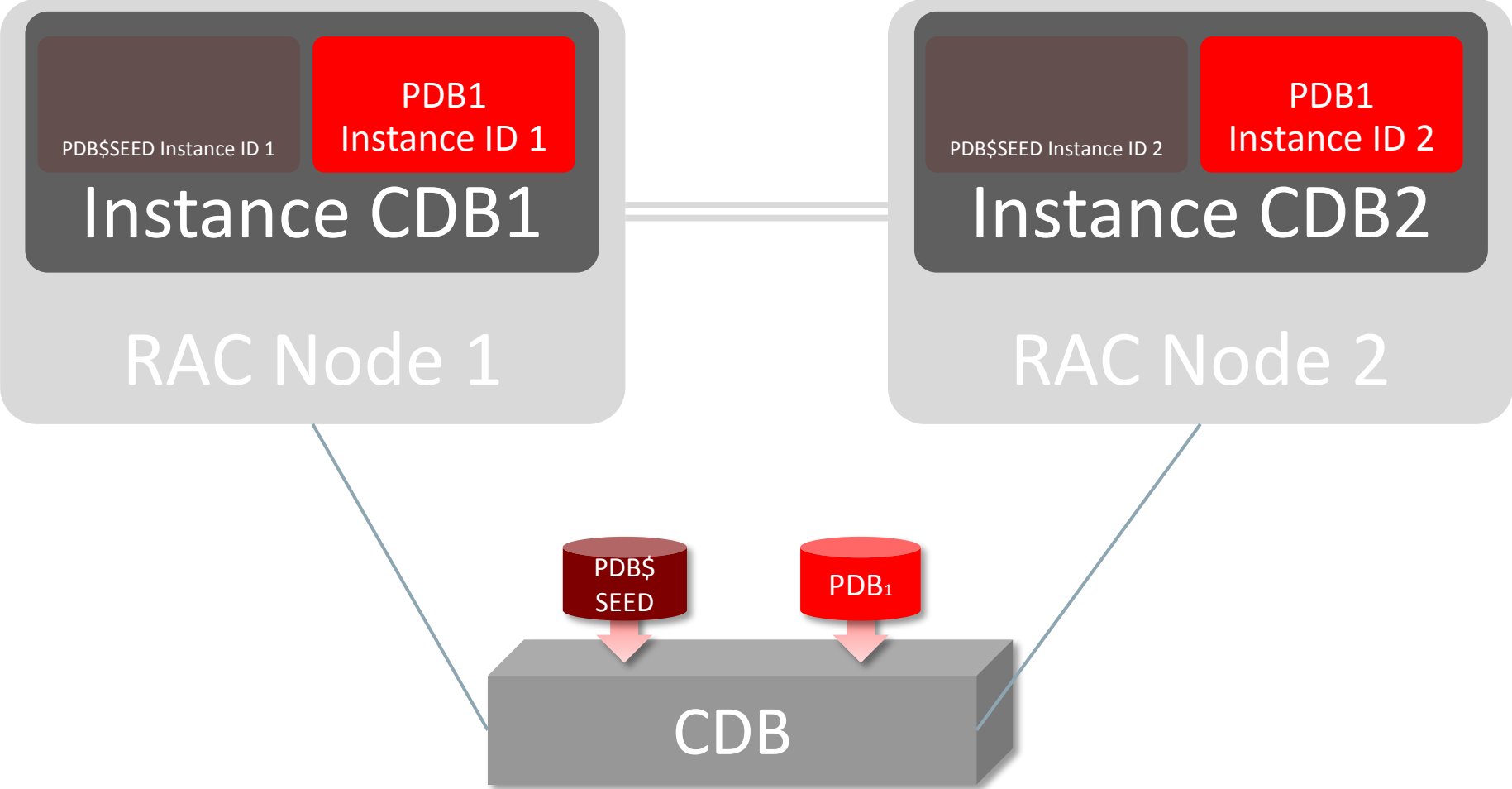
– Not for Single Tenant or SE2



- Plugin an existing PDB



# RAC and PDBs





# RAC and PDBs

```
oraaha@rwsbf07:~$ crsctl status res
Name          Target State      server
-----
Local Resources
ora.ASMNET1LSNR_ASM.lsnr
  ONLINE ONLINE   rwsbf07
  ONLINE ONLINE   rwsbf08
ora.DG1_RWSBF07_08.dg
  ONLINE ONLINE   rwsbf07
  ONLINE ONLINE   rwsbf08
ora.LISTENER.lsnr
  ONLINE ONLINE   rwsbf07
  ONLINE ONLINE   rwsbf08
ora.OCRVD_RWSBF07_08.dg
  ONLINE ONLINE   rwsbf07
  ONLINE ONLINE   rwsbf08
ora.net1.network
  ONLINE ONLINE   rwsbf07
  ONLINE ONLINE   rwsbf08
ora.ons
  ONLINE ONLINE   rwsbf07
  ONLINE ONLINE   rwsbf08
Cluster Resources
ora.LISTENER_SCAN1.lsnr
  1 ONLINE ONLINE   rwsbf08 STABLE
ora.LISTENER_SCAN2.lsnr
  1 ONLINE ONLINE   rwsbf07 STABLE
ora.LISTENER_SCAN3.lsnr
  1 ONLINE ONLINE   rwsbf07 STABLE
ora.MGMTLSNR
  1 ONLINE ONLINE   rwsbf08 169.254.77.64 10.196
  .108.53 10.196.212.4
  8, STABLE
ora.asm
  1 ONLINE ONLINE   rwsbf07 Started, STABLE
  2 ONLINE ONLINE   rwsbf08 Started, STABLE
  3 OFFLINE OFFLINE STABLE
ora.cdb.db
  1 ONLINE ONLINE   rwsbf07 Open, STABLE
  2 ONLINE ONLINE   rwsbf08 Open, STABLE
ora.cdb.pdb1_1_single.svc
  2 OFFLINE OFFLINE STABLE
ora.cdb.pdb1_1_uniform.svc
  1 ONLINE ONLINE   rwsbf07 STABLE
  2 ONLINE ONLINE   rwsbf08 STABLE
ora.cdb.pdb1_2_single.svc
  2 OFFLINE OFFLINE STABLE
ora.cdb.pdb1_2_uniform.svc
  1 ONLINE ONLINE   rwsbf07 STABLE
  2 ONLINE ONLINE   rwsbf08 STABLE
ora.cdb.pdb1_3_uniform.svc
  1 ONLINE ONLINE   rwsbf07 STABLE
  2 ONLINE ONLINE   rwsbf08 STABLE
ora.cdb.pdb1_4_uniform.svc
  1 ONLINE ONLINE   rwsbf08 STABLE
  2 ONLINE ONLINE   rwsbf07 STABLE
```



# Backup & Recovery

- Backup and recovery with RMAN

- Entire CDB with all PDBs



```
BACKUP DATABASE PLUS ARCHIVELOG;  
RESTORE DATABASE;  
RECOVER DATABASE;
```

- Just the CDB\$ROOT only



```
BACKUP DATABASE ROOT;  
RESTORE DATABASE ROOT;  
RECOVER DATABASE ROOT;
```

- PDBs:



```
BACKUP PLUGGABLE DATABASE sales, hr;  
RESTORE PLUGGABLE DATABASE 'pdb$seed', sales, hr;  
RECOVER PLUGGABLE DATABASE 'pdb$seed', sales, hr;
```

# Diagnosing Issues

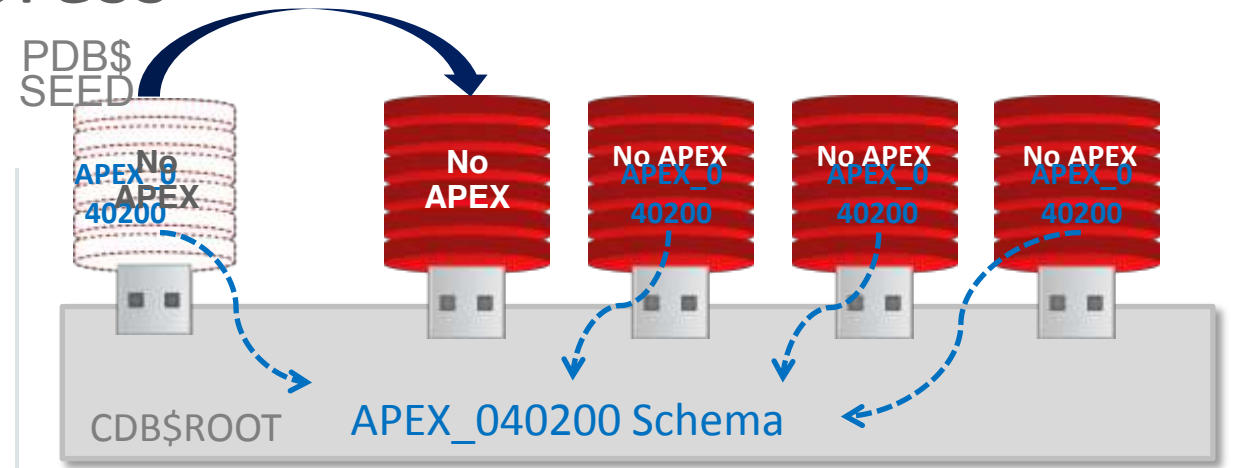
- The alert.log isn't always a great help

```
oracle@localhost.localdomain: /u01/app/oracle/diag/rdbms/cdb12/CDB12/tra
File Edit View Terminal Tabs Help
ORA-06512: at "APEX_040200.WWV_FLOW_MAIL", line 987
ORA-06512: at "APEX_040200.WWV_FLOW_WORKSHEET_API", line 5012
Mon Nov 18 14:42:18 2013
Errors in file /u01/app/oracle/diag/rdbms/cdb12/CDB12/trace/CDB12_j033_14758.trc
:
ORA-12012: error on auto execute of job "APEX_040200"."ORACLE_APEX_WS_NOTIFICATIONS"
ORA-27452: "ORACLE_APEX_MAIL_QUEUE" is an invalid name for a database object.
ORA-06512: at "APEX_040200.WWV_FLOW_MAIL", line 998
ORA-06512: at "APEX_040200.WWV_FLOW_MAIL", line 987
ORA-06512: at "APEX_040200.WWV_FLOW_WORKSHEET_API", line 5012
Mon Nov 18 14:42:22 2013
Errors in file /u01/app/oracle/diag/rdbms/cdb12/CDB12/trace/CDB12_j031_14750.trc
:
ORA-12012: error on auto execute of job "APEX_040200"."ORACLE_APEX_WS_NOTIFICATIONS"
ORA-27452: "ORACLE_APEX_MAIL_QUEUE" is an invalid name for a database object.
ORA-06512: at "APEX_040200.WWV_FLOW_MAIL", line 998
ORA-06512: at "APEX_040200.WWV_FLOW_MAIL", line 987
ORA-06512: at "APEX_040200.WWV_FLOW_WORKSHEET_API", line 5012
Mon Nov 18 14:43:20 2013
XDB installed.
```

  
*Happened in which PDB(s)?*

# APEX – Oracle Application Express

- Remove "common" APEX from the CDB\$ROOT container
  - `apxremov_con.sql`
- Install APEX locally in PDBs only - will ease your life a lot
  - `apexins.sql` or `apxrtins.sql`
  - Save upgrade downtime
  - Unplug/plug without APEX version conflicts
  - More flexibility
    - Different APEX versions
    - No "common" APEX upgrade necessary

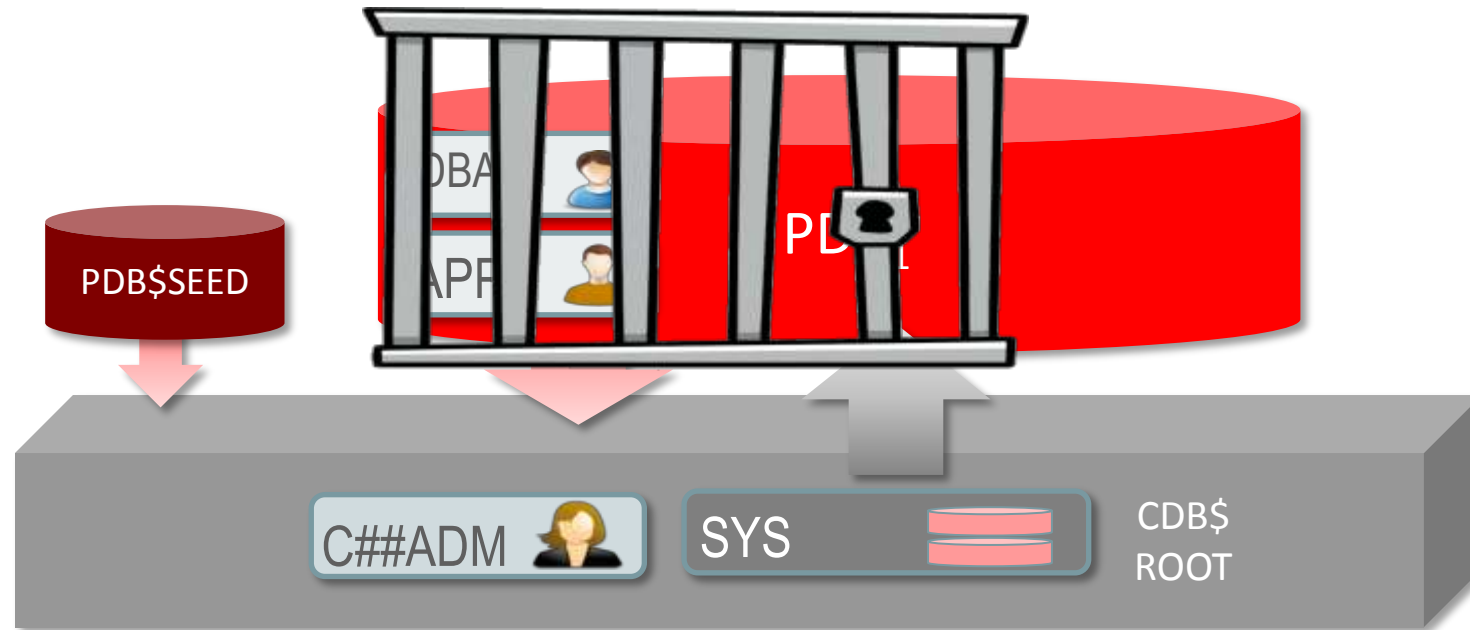


# Oracle Database Vault

- Database Vault **must be enabled in CDB root**
- Database Vault **can be enabled/disabled separately in PDBs**
  - `DBMS_MACADM.ENABLE_DV`
  - `DBMS_MACADM.DISABLE_DV`
  - <http://docs.oracle.com/database/121/DVADM/dvdisabl.htm#DVADM71063>
- Each PDB can have its own local DV owner and DV account manager
- Security policies are enforced locally in each PDB
- Documentation:
  - <http://docs.oracle.com/database/121/DVADM/dvintro.htm#DVADM71131>

# Separation

- Security concept delivers isolation by default



# AWR – Where are the AWR tables?



Level  
1

08.05.2015 14:46

## AWR Tables in a Multitenant DB

Diese Frage wurde **beantwortet**

Experts,

I have a couple of scripts which I run against WRH\$ tables in order to obtain "custom" AWR reports.

I used them multiple times in previous database versions, but when I tried to run them in a 12c multitenant environment all I got were empty reports.

I have only one PDB created in the CDB, when I connected to it, I found that the WRH\$ tables are not being populated (wrh\$\_sqlstat for example)

I've been searching for information about this behaviour in the community and MOS but couldn't find anything about it.

DB Version: 12.1.0.2

OS Version: RHEL 6

Thanks in advance

# AWR – Automatic Workload Repository

- AWR data is stored in CDB\$ROOT only
  - But is visible from within each PDB
  - `awrrpt.sql` works on CDB and PDB level
  - Unplug/plug of a PDB does not carry AWR data

```
SYS:CDB2> select con_id,max(snap_id)
 2          from dba_hist_sqlstat
 3          group by con_id order by 1;
```

| CON_ID | MAX(SNAP_ID) |
|--------|--------------|
| 1      | 57           |
| 3      | 57           |
| 4      | 57           |

- Find a full list of all management features (ASH, ADDM, Stats etc) in PDB/CDB here:  
[https://docs.oracle.com/database/121/ADMIN/cdb\\_admin.htm#BAJCBDJA](https://docs.oracle.com/database/121/ADMIN/cdb_admin.htm#BAJCBDJA)



# AWR Lite Snapshots

- [MOS Note:1993045.1](#)

## Reducing AWR resource consumption using LITE mode snapshots

- **Automatic** snapshots

- `_AWR_SNAPSHOT_LEVEL = BASIC | LITE | TYPICAL | ALL | BESTFIT`

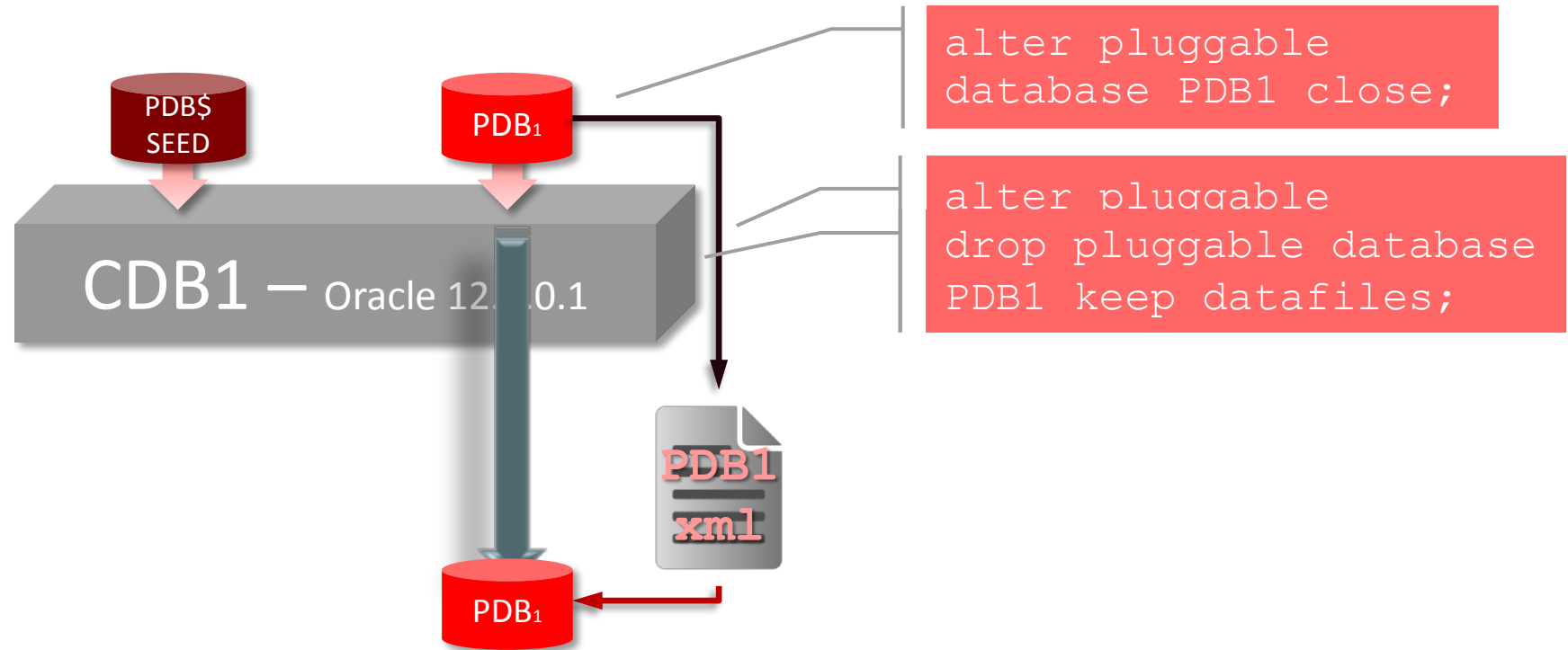
- **On-demand** snapshots

- `SQL> exec dbms_workload_repository.create_snapshot('LITE');`

- Introduced with Oracle Database 12.1.0.2

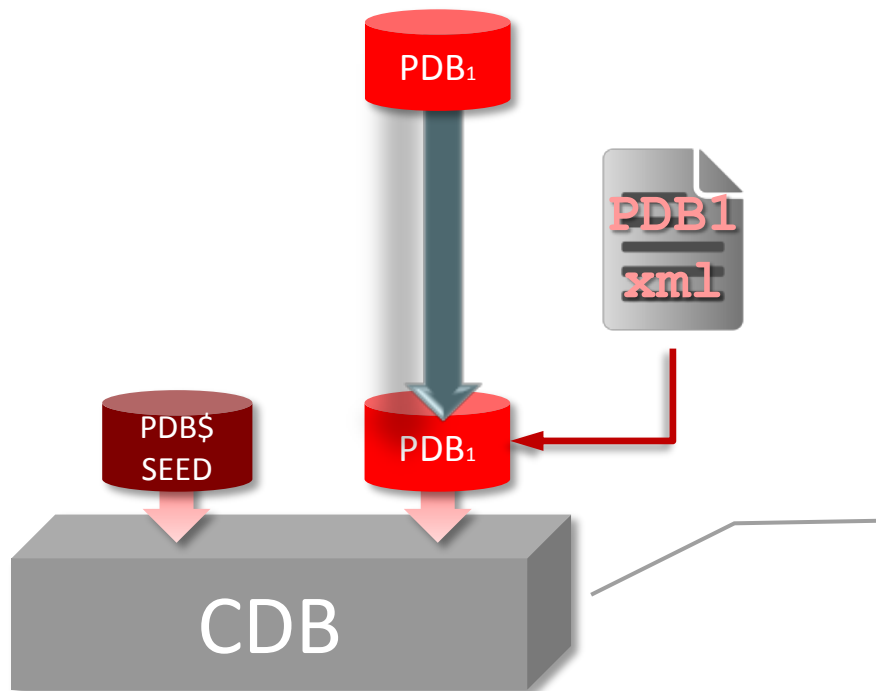
# Drop your PDB upon unplug

- If you miss this step:
  - Information will be kept in the CDB\$ROOT's dictionary
  - Issues when you create/plugin another PDB with the same name



# Plugin Compatibility Check

- Not always as helpful as intended
  - COMPATIBLE → NO ???



```
SET SERVEROUTPUT ON
DECLARE
    compatible CONSTANT VARCHAR2(3) :=
        CASE DBMS_PDB.CHECK_PLUG_COMPATIBILITY(
            pdb_descr_file => '/data/pdb1.xml',
            pdb_name => PDB1)
        WHEN TRUE THEN 'YES' ELSE 'NO'
END;

BEGIN
    DBMS_OUTPUT.PUT_LINE(compatible);
END;
/
```

# PDB\_PLUG\_IN\_VIOLATIONS

- Issues before or after plugin
  - PDB\_PLUG\_IN\_VIOLATIONS doesn't get purged
  - Some *useless* entries

```
SQL> select name,cause,type,message,status from PDB_PLUG_IN_VIOLATIONS where name='TESTRAC';
```

| NAME    | CAUSE          | TYPE    | MESSAGE                                                                                     | STATUS  |
|---------|----------------|---------|---------------------------------------------------------------------------------------------|---------|
| TESTRAC | OPTION         | WARNING | Database option DV mismatch: PDB installed version NULL. CDB installed version 12.1.0.1.0.  | PENDING |
| TESTRAC | OPTION         | WARNING | Database option OLS mismatch: PDB installed version NULL. CDB installed version 12.1.0.1.0. | PENDING |
| TESTRAC | Non-CDB to PDB | WARNING | PDB plugged in is a non-CDB, requires noncdb_to_pdb.sql be run.                             | PENDING |

# PDB\$SEED's objects/files **excluded** by default

- `exclude_seed_cdb_view=TRUE`

```
CON_ID FILE_NAME
-----
1 /oradata/CDB2/system01.dbf
1 /oradata/CDB2/sysaux01.dbf
1 /oradata/CDB2/undotbs01.dbf
1 /oradata/CDB2/users01.dbf
3 /oradata/CDB2/pdb2/sysaux01.dbf
3 /oradata/CDB2/pdb2/system01.dbf
4 /oradata/CDB2/pdb3/system01.dbf
4 /oradata/CDB2/pdb3/user01.dbf
4 /oradata/CDB2/pdb3/sysaux01.dbf

9 rows selected.
```

- No worries – RMAN does it correct!

- `exclude_seed_cdb_view=FALSE`

```
CON_ID FILE_NAME
-----
1 /oradata/CDB2/system01.dbf
1 /oradata/CDB2/sysaux01.dbf
1 /oradata/CDB2/undotbs01.dbf
1 /oradata/CDB2/users01.dbf
2 /oradata/CDB2/pdbseed/sysaux01.dbf
2 /oradata/CDB2/pdbseed/system01.dbf
3 /oradata/CDB2/pdb2/sysaux01.dbf
3 /oradata/CDB2/pdb2/system01.dbf
4 /oradata/CDB2/pdb3/sysaux01.dbf
4 /oradata/CDB2/pdb3/user01.dbf
4 /oradata/CDB2/pdb3/system01.dbf

11 rows selected.
```

# Not supported yet with Oracle Multitenant

- **Flashback Pluggable Database**
    - Flashback Database works but will flashback CDB\$ROOT including all PDBs
  - **Oracle Streams**
  - **Heat Map**
  - **Automatic Data Optimization**
  - **BEQ connection to a PDB**
  - **DBVERIFY**
  - **Data Recovery Advisor (DRA)**
- Database Change Notification
  - Continuous Query Notification (CQN)
  - Client Side Cache
  - Flashback Transaction Backout

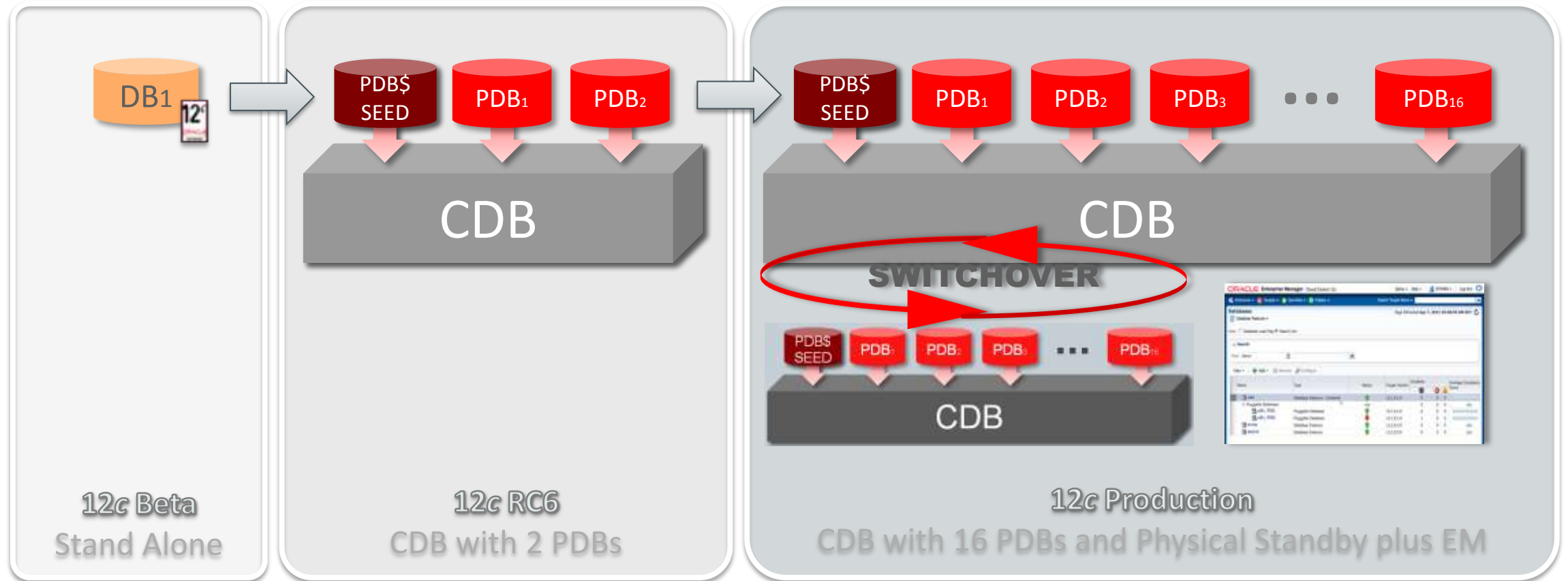
# Plug into Oracle Multitenant

- 1 Overview
- 2 Plug in
- 3 Upgrade
- 4 Working
- 5 Reality**



# Real World Customer Experience

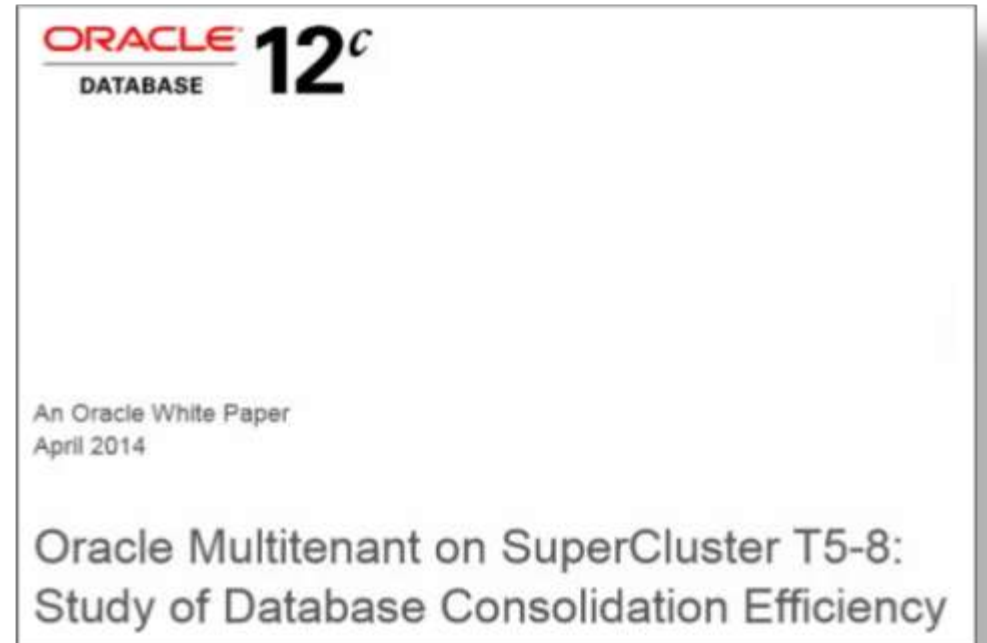
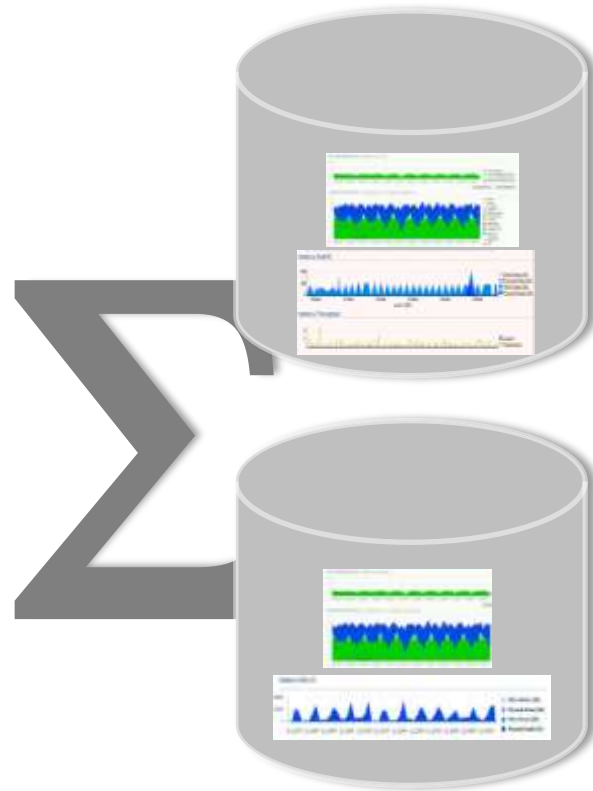
- @Oracle – Production Environment





# Real World Customer Experience

- Consolidation planning factors
  - IO
  - CPU
  - Memory usage
  - Redo rate



<http://www.oracle.com/technetwork/database/multitenant/learn-more/oraclemultitenantt5-8-final-2185108.pdf>

# Real World Customer Experience

"A bit more work regarding monitoring but **a lot of improvements**"

"If we talk about whether a DBA's life is much easier I think its a **mixed bag**"

"If seen as 15 different databases I don't think I would have configured them on this cluster. But as deployment of **15 PDBs within one container it has been made possible**"

"It is very stable"

"Issues may get to you now at once"

"I am definitely **impressed with the quality and stability side**"



# Upgrade, Migrate & Consolidate

- 1 Introduction
- 2 Preparation Steps
- 3 Upgrade / Migrate / Consolidate**
- 4 Fallback Strategies
- 5 New Features
- 6 Performance Management
- 7 Wrap Up

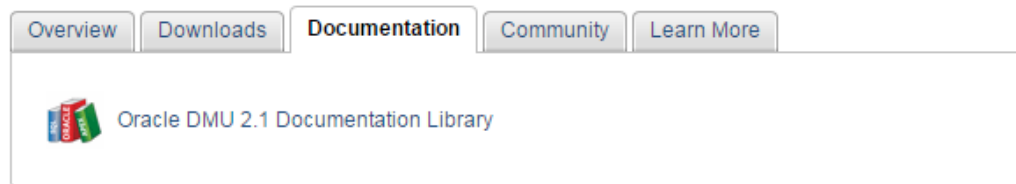


## 8 Character Set Conversion

# Character Set Conversion



- **DMU** – Data Migration Assistant for Unicode
  - Installed in every \$ORACLE\_HOME since Oracle 11.2.0.4
  - Supports migrations in place to AL32UTF8 and UTF8 character sets only
  - <http://www.oracle.com/technetwork/database/database-technologies/globalization/dmu/overview/index.html>
  - [MOS Note:2018250.1 - Tips For and Known Issues With The DMU 2.1](#)
  - Documentation:



## Oracle Database Migration Assistant for Unicode Documentation Release 2.1

### Overview

#### Welcome

The Database Migration Assistant for Unicode helps you to migrate database character sets to Unicode. Oracle recommends migrating database character sets to Unicode for maximum compatibility and extensibility. As part of the migration process, the Database Migration Assistant for Unicode enables you to avoid possible problems, such as data loss or data truncation. In addition, the Database Migration Assistant for Unicode can be used to verify the data quality of an existing Unicode database.

#### Documentation

|                                                                        |                                     |
|------------------------------------------------------------------------|-------------------------------------|
| <a href="#">Database Migration Assistant for Unicode Release Notes</a> | <a href="#">i</a> <a href="#">↓</a> |
| <a href="#">Database Migration Assistant for Unicode Guide</a>         | <a href="#">i</a> <a href="#">↓</a> |

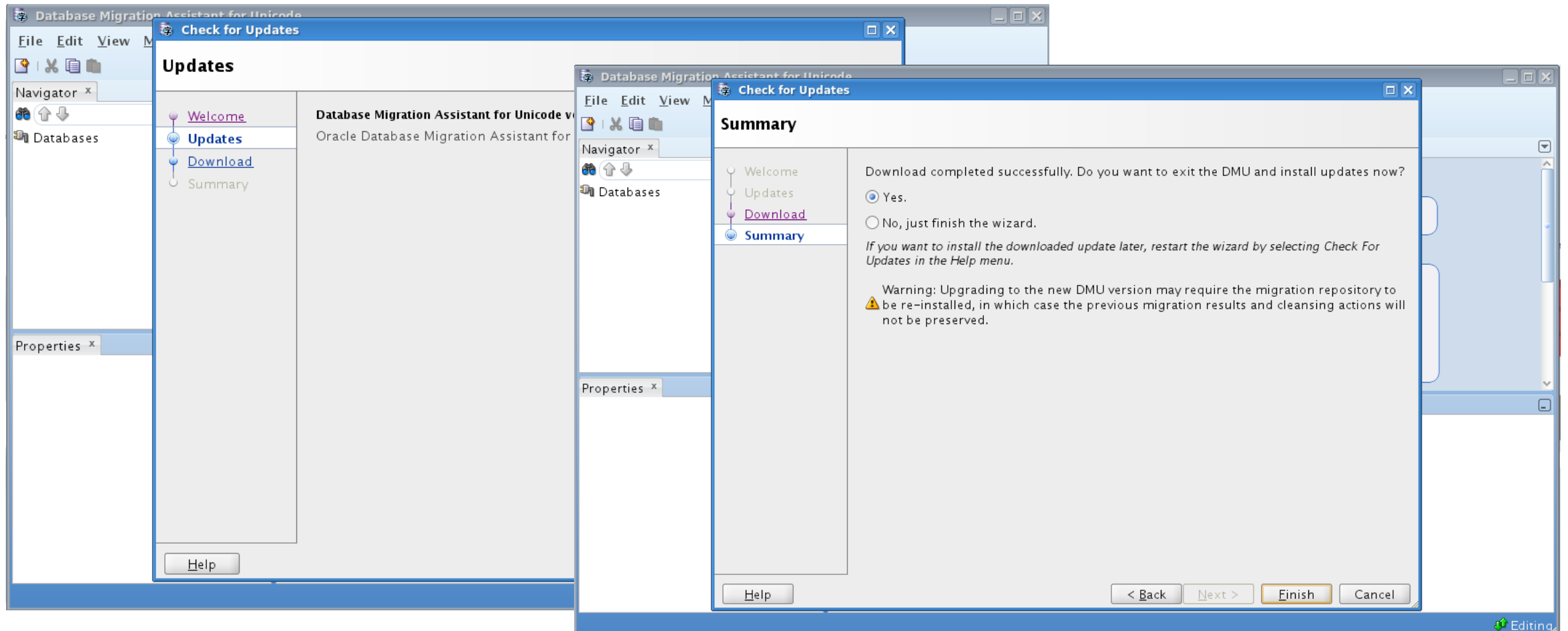
# Character Set Conversion - DMU

- Before you start: `$ chmod +x dmsh`

```
$ cd $ORACLE_HOME/dmu
[UPGR] oracle@localhost:/u01/app/oracle/product/12.1.0.2/dmu
$ ls -lrt
total 132
-rw-r--r-- 1 oracle oinstall      53 Jul 19 2012 dmsh
-rw-r--r-- 1 oracle oinstall 18432 Dec 23 2012 dmw64.exe
-rw-r--r-- 1 oracle oinstall 32768 Dec 23 2012 dmw32.exe
-rw-r--r-- 1 oracle oinstall 18432 Dec 23 2012 dm64.exe
-rw-r--r-- 1 oracle oinstall 32768 Dec 23 2012 dm32.exe
drwxr-xr-x 3 oracle oinstall  4096 Jul 21 2014 sleepycat
drwxr-xr-x 7 oracle oinstall  4096 Jul 21 2014 ide
drwxr-xr-x 9 oracle oinstall  4096 Jul 21 2014 dm
drwxr-xr-x 2 oracle oinstall  4096 Jul 21 2014 timingframework
drwxr-xr-x 8 oracle oinstall  4096 Jul 21 2014 modules
drwxr-xr-x 2 oracle oinstall  4096 Jul 21 2014 jlib
```

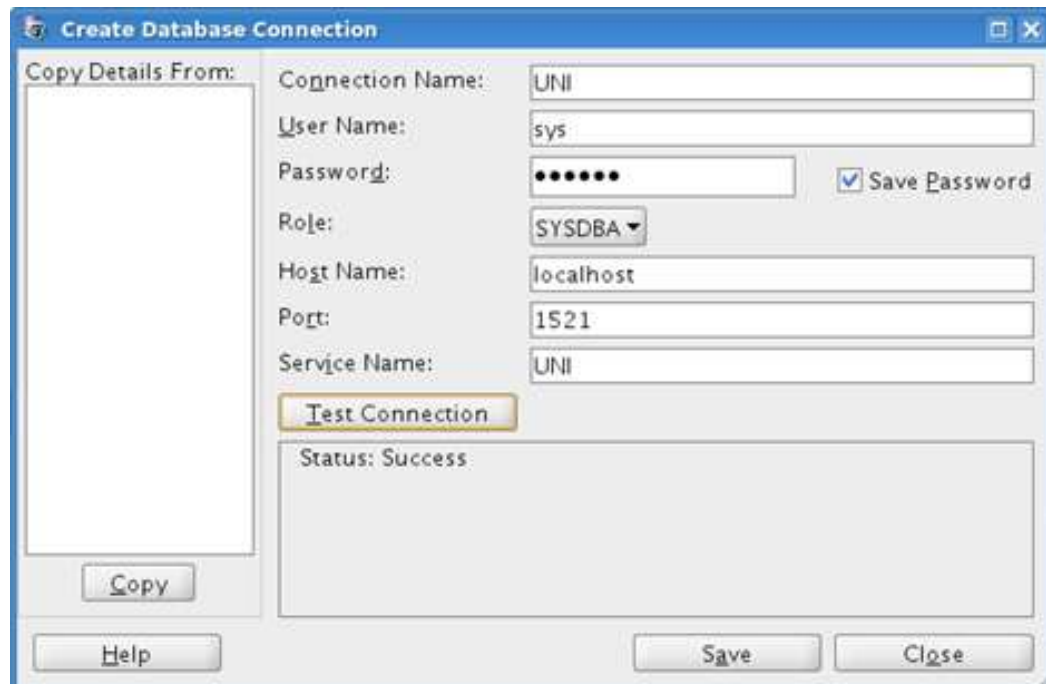
# Character Set Conversion - DMU

- Check for a newer version of DMU:

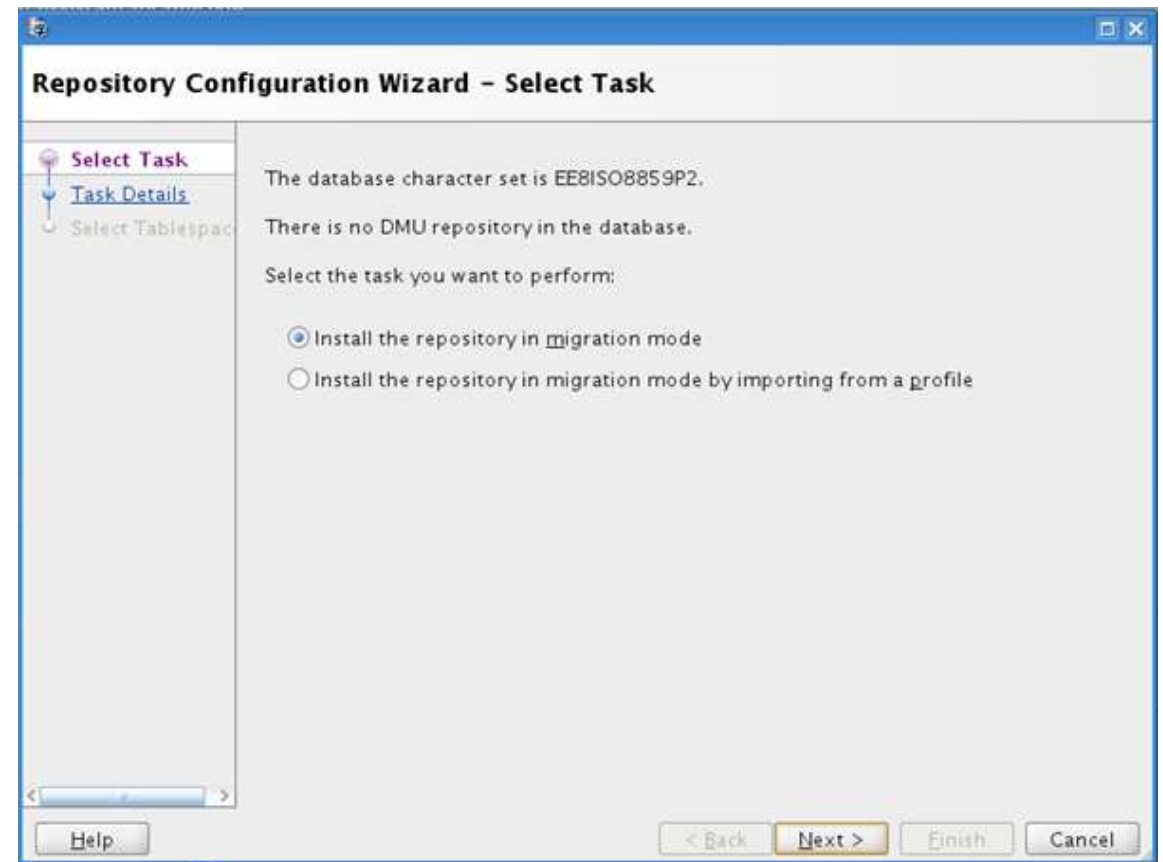


# Character Set Conversion - DMU

- Define connections:

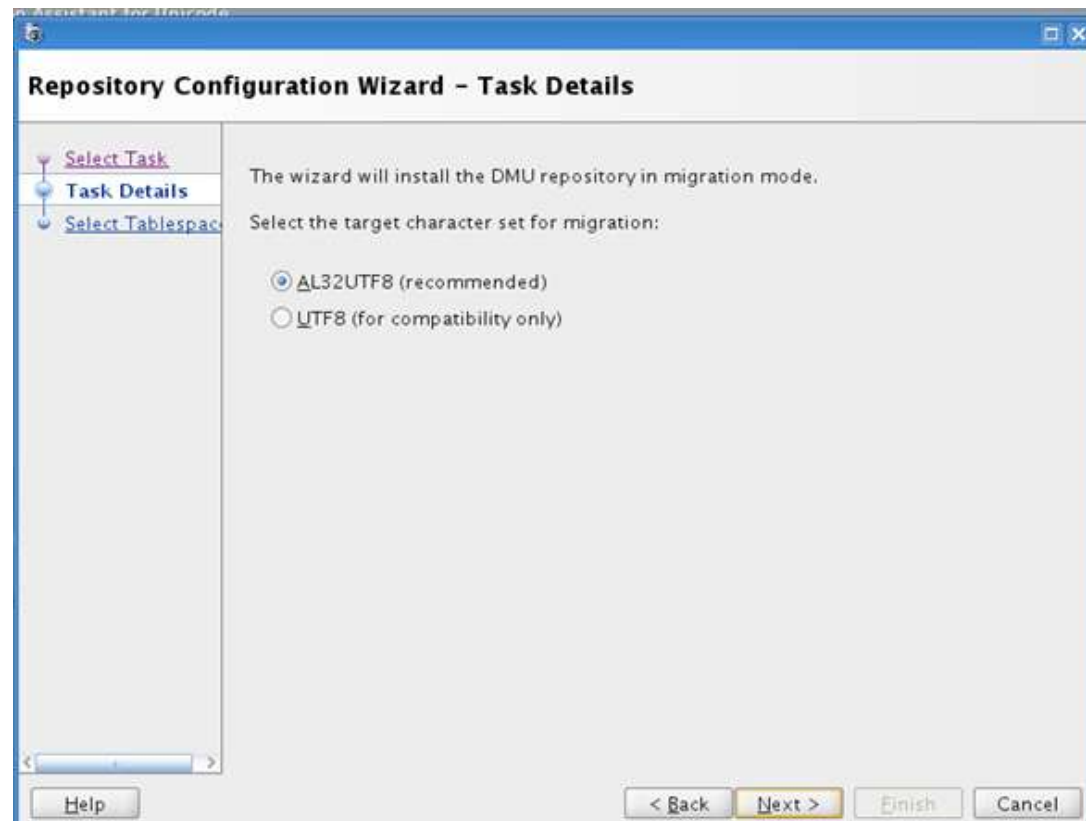


- Repository Configuration Wizard:

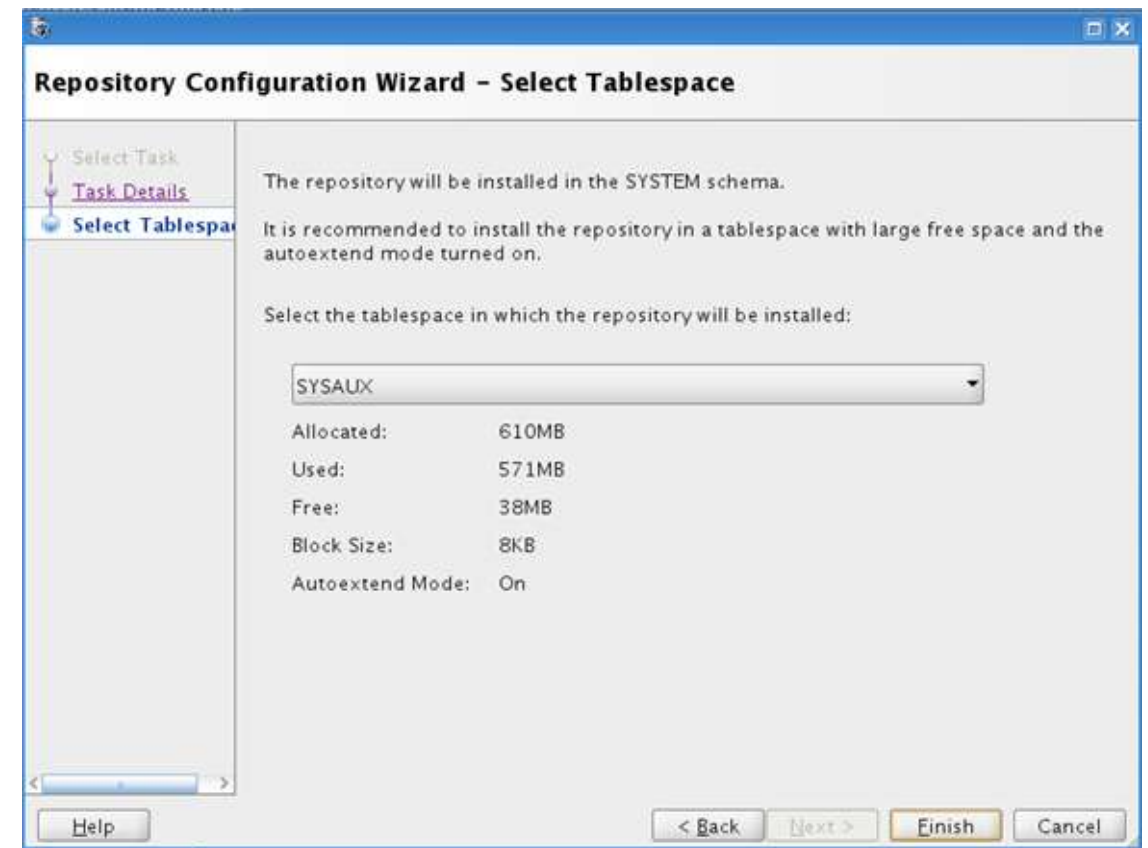


# Character Set Conversion - DMU

- Choose target character set:



- Choose repository tablespace:





# Character Set Conversion - DMU

The screenshot shows the Database Migration Assistant for Unicode interface. The main window displays the migration status for a database named 'UNI'. The interface is divided into three main sections, each representing a step in the migration process:

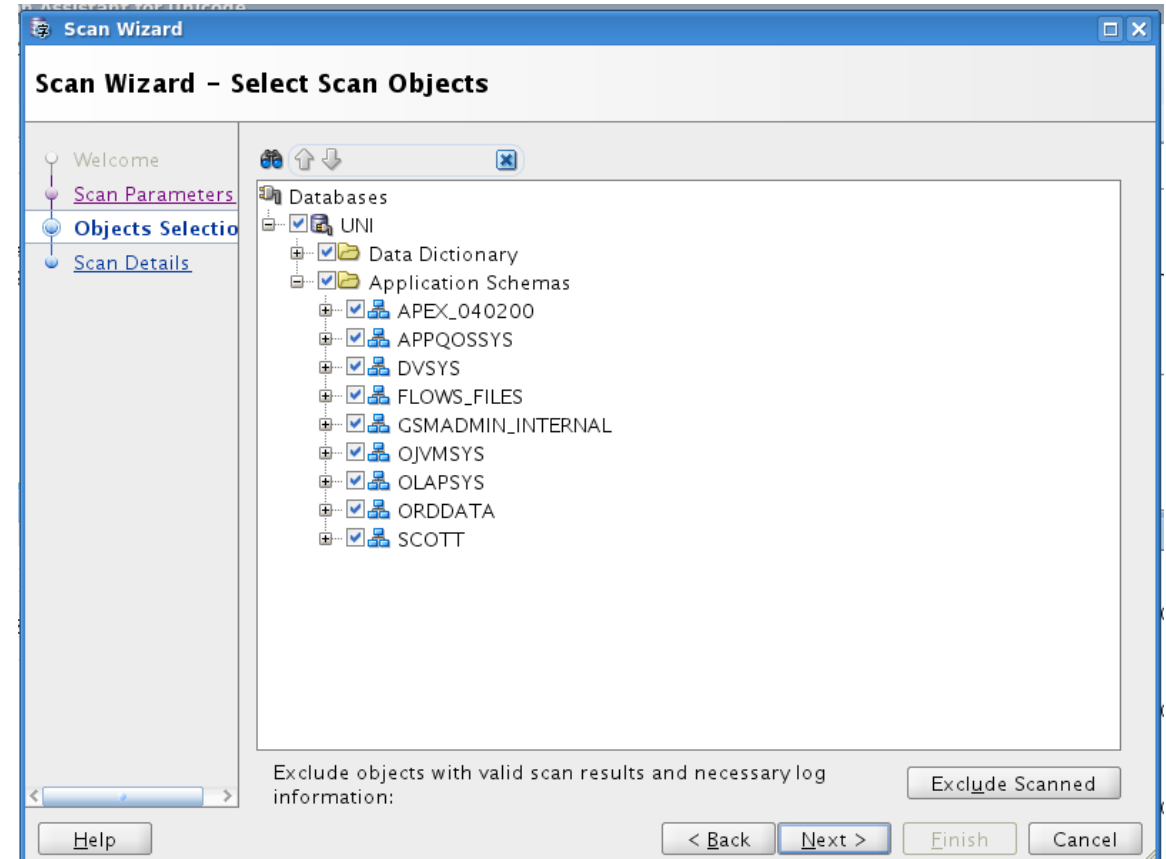
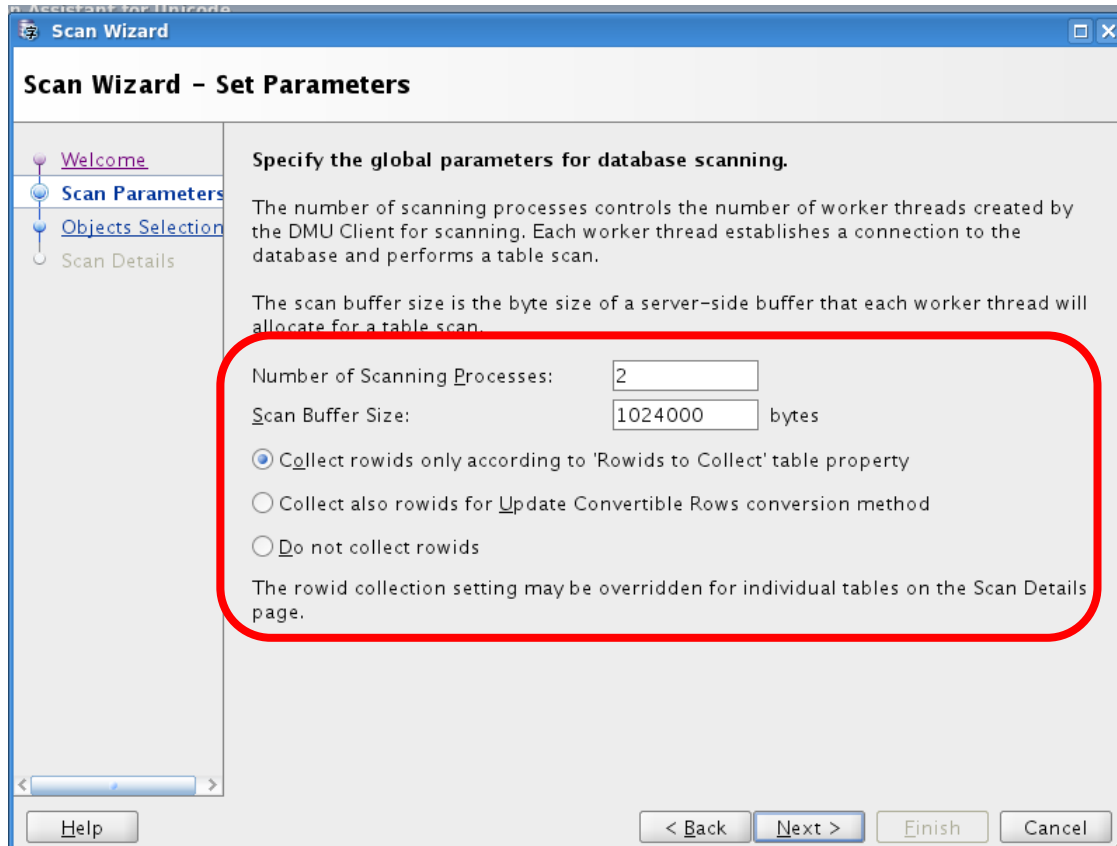
- Step 1: Install the DMU Repository**
  - Before the database can be migrated, the DMU repository must be installed in the SYSTEM schema. [More...](#)
  - Status:** The DMU repository has been installed.
  - Next Action:** Proceed with scanning the database for migration issues.
- Step 2: Scan the Database**
  - The database must be scanned to test all its character data for conversion issues. [More...](#)
  - Status:** The database has not been scanned yet.
  - Next Action:** [Scan all character data in the database to check for conversion issues.](#)
- Step 3: Resolve Migration Issues**
  - Issues discovered by scanning the database need to be resolved before the database can be successfully converted. [More...](#)
  - Status:**  Unresolved convertibility issues found.
  - Turning off the FORCE LOGGING mode of the database and/or tablespaces may improve conversion performance, though at the expense of the ability to perform media recovery. [More...](#)
  - Some character columns have not been scanned. Scan those columns before attempting conversion. [More...](#)
  - Next Action:**

The 'Properties' pane on the left shows the following details for the 'UNI' database:

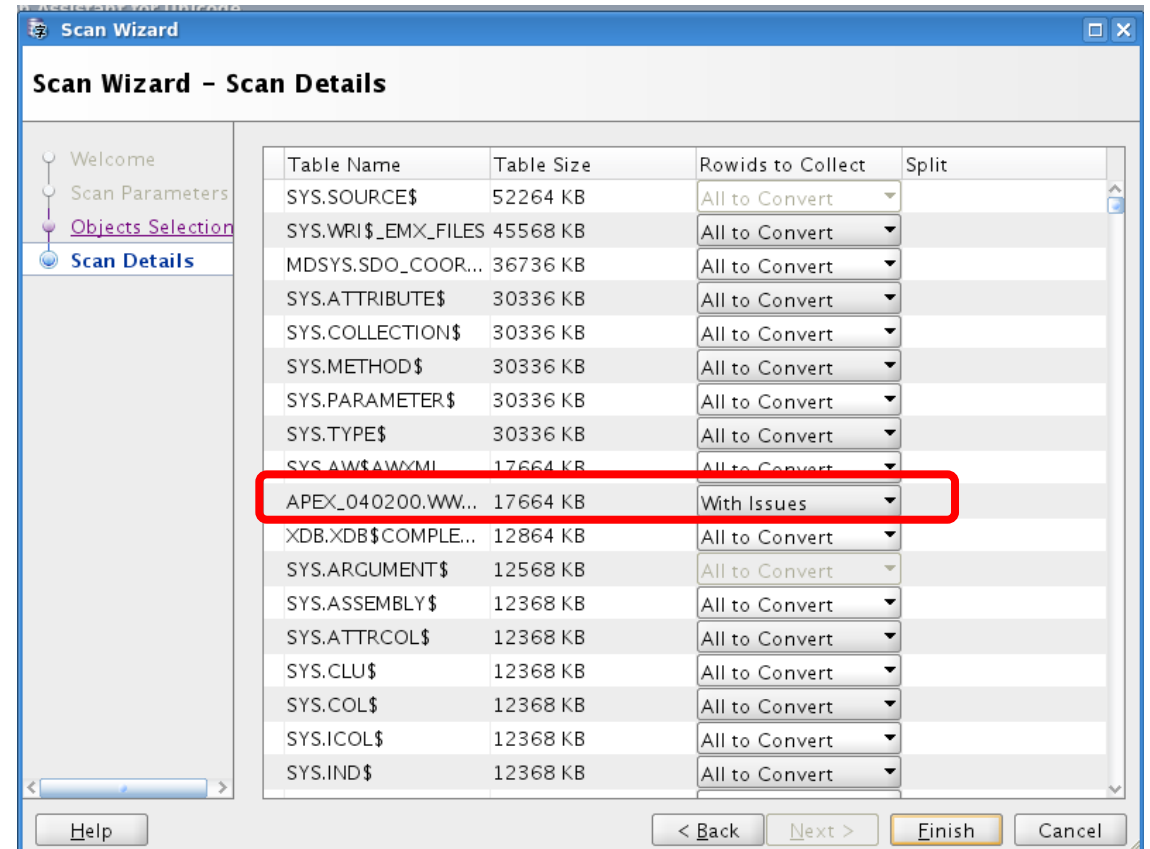
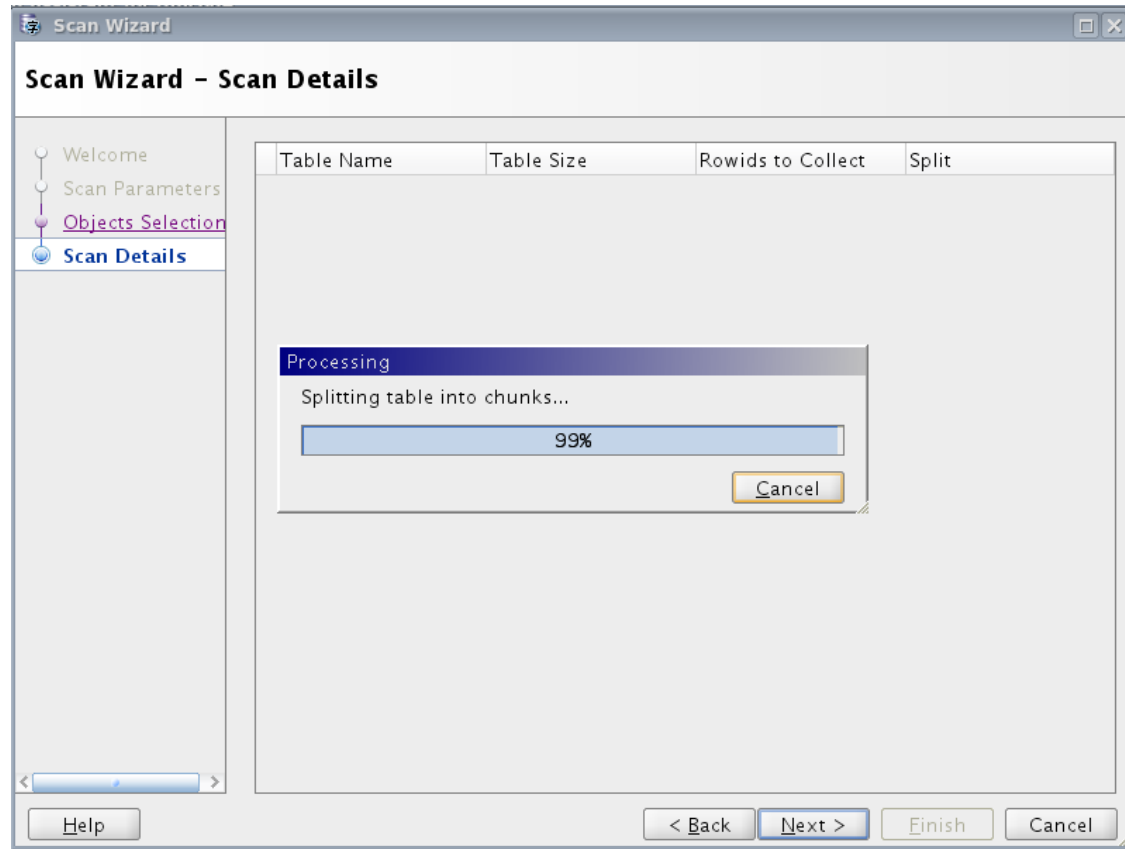
|              |           |
|--------------|-----------|
| Host Name    | localhost |
| Port         | 1521      |
| User Name    | sys       |
| User Role    | SYSDBA    |
| Service Name | UNI       |

A red arrow points from the 'Properties' pane to the 'Step 2: Scan the Database' section. A red box highlights the 'Step 1' section.

# Character Set Conversion - DMU



# Character Set Conversion - DMU



# Character Set Conversion - DMU

| Name                       | S... | Size | Min ROW... | Max RO... | T... | Start Time | End Time   | Progress |
|----------------------------|------|------|------------|-----------|------|------------|------------|----------|
| ✓ SYS.METASTYLESHEET       |      | 6 MB | --         | --        | 1    | 2015-09... | 2015-09... | 78%      |
| ✓ APEX_040200.WWW_FLOW_STE |      | 6 MB | --         | --        | 2    | 2015-09... | 2015-09... | 100%     |
| ✓ APEX_040200.WWW_FLOW_PLU |      | 4 MB | --         | --        | 1    | 2015-09... | 2015-09... | 100%     |
| ⊗ APEX_040200.WWW_FLOW_REO |      | 4 MB | --         | --        | 1    | 2015-09... |            | 0%       |
| ✓ SYS.JAVASNM\$            |      | 3 MB | --         | --        | 2    | 2015-09... | 2015-09... | 100%     |
| ✓ SYS.AW\$AWCREATE         |      | 3 MB | --         | --        | 2    | 2015-09... | 2015-09... | 100%     |
| ✓ SYS.AW\$EXPRESS          |      | 3 MB | --         | --        | 2    | 2015-09... | 2015-09... | 100%     |

**Scan Database**

The full database scan is complete, elapsed time: 00:00:46.399. Please see the scan report for details.

OK

# Character Set Conversion - DMU

Start Page x | UNI x | **Migration Status** x | Scan Progress x

### Step 2: Scan the Database

The database must be scanned to test all its character data for conversion issues. [More...](#)

✓ **Status:** The entire database has been scanned.

**Next Action:** Proceed with resolving migration issues.

---

### Step 3: Resolve Migration Issues

Issues discovered by scanning the database need to be resolved before the database can be successfully converted. [More...](#)

✓ **Status:**  There are no unresolved convertibility issues.

- Convertible data found in External Table. [More...](#)
- The current setting rules out CTAS conversion method for tables with Row Movement disabled. [More...](#)
- Turning off the FORCE LOGGING mode of the database and/or tablespaces may improve conversion performance, though at the expense of the ability to perform media recovery. [More...](#)

**Next Action:** View the warnings concerning database objects and proceed with the database conversion.

---

### Step 4: Convert the Database

In this step, the database is physically converted to Unicode. [More...](#)

**Status:** Not Started.

**Next Action:**

# Character Set Conversion - DMU

The screenshot displays the Oracle Enterprise Manager interface for character set conversion. The main window shows the 'Scan Parameters' section with the following values:

- Number of Scanning Processes: 2
- Scan Buffer Size: 1024000 Bytes
- Scan Status: Scanned
- Tables to Convert: 49
- Rows to Convert: 33790

The 'Scan Results' section shows a table with two tabs: 'Current Data' and 'Including Effects of Scheduled Cleansing'. The 'Including Effects of Scheduled Cleansing' tab is active, showing the following data:

|          | Need No Co... | Need Conve... | Exceed Col... | Exceed Dat... | Invalid Bina... | Total        |
|----------|---------------|---------------|---------------|---------------|-----------------|--------------|
| VARCHAR2 | 13214852 c... | 0 cells       | 0 cells       | 0 cells       | 0 cells         | 13214852 ... |
| VARRAY   | 40244 cells   | 0 cells       | 0 cells       | 0 cells       | 0 cells         | 40244 cells  |
| CLOB     | 109688 cells  | 40468 cells   | 0 cells       | 0 cells       | 0 cells         | 150156 cells |
| CHAR     | 2497 cells    | 0 cells       | 0 cells       | 0 cells       | 0 cells         | 2497 cells   |
| LONG     | 278194 cells  | 0 cells       | 0 cells       | 0 cells       | 0 cells         | 278194 cells |
| ANYDATA  | 27 cells      | 0 cells       | 0 cells       | 0 cells       | 0 cells         | 27 cells     |
| Total    | 13645502 c... | 40468 cells   | 0 cells       | 0 cells       | 0 cells         | 13685970 ... |
| Total %  | 99.704%       | 0.296%        | 0.000%        | 0.000%        | 0.000%          | 100%         |

An inset window shows the 'Readiness' tab with the following information:

- Data Readiness for Conversion: Ready for conversion
- Warning: The database contains convertible data in External Table.

An 'Apply' button is visible at the bottom right of the main window.

# Character Set Conversion - DMU

The screenshot displays the Oracle Database Migration Assistant for Unicode (DMU) interface. The 'Migration' menu is open, showing options such as 'Migration Status Panel', 'Configure DMU Repository...', 'Refresh DMU Repository...', 'Scan Database...', 'Database Scan Report...', 'Problem Data Report...', 'Bulk Cleansing...', 'Convert Database...', 'Export Migration Profile...', and 'Generate GoldenGate Parameters...'. A red arrow points to the 'Convert Database...' option. The 'Migration Status' panel is visible, showing the status of the database conversion process. The 'Status' section indicates that there are no unresolved convertibility issues, with a 'Retest' button. The 'Next Action' is to view warnings and proceed with conversion. The 'Step 4: Convert the Database' section is highlighted with a red box, indicating the current step in the process. The 'Status' for this step is 'Not Started', and the 'Next Action' is to proceed with the conversion.

**Migration**

- Migration Status Panel
- Configure DMU Repository...
- Refresh DMU Repository...
- Scan Database...
- Database Scan Report...
- Problem Data Report...
- Bulk Cleansing...
- Convert Database...
- Export Migration Profile...
- Generate GoldenGate Parameters...

**Migration Status**

Database

The entire database has been scanned. [More...](#)

The entire database has been scanned.

Proceed with resolving migration issues.

**Migration Issues**

scanning the database need to be resolved before the database can be successfully

**Status:**  There are no unresolved convertibility issues. [Retest](#)

- Convertible data found in External Table. [More...](#)
- The current setting rules out CTAS conversion method for tables with Row Movement disabled. [More...](#)
- Turning off the FORCE LOGGING mode of the database and/or tablespaces may improve conversion performance, though at the expense of the ability to perform media recovery. [More...](#)

**Next Action:** View the warnings concerning database objects and proceed with the database conversion.

**Step 4: Convert the Database**

In this step, the database is physically converted to Unicode. [More...](#)

**Status:** Not Started.

**Next Action:**

# Character Set Conversion - DMU

Start Page x UNI x Migration Status x **Conversion Details** x Scan Progress x

**Conversion Steps:**

Execute Pre-Conversion Tasks [Edit Database Conversion Parameters](#)

**Step Details:**

Description:

SQL

```
SQL
ALTER SYSTEM ENABLE RESTRICTED SESSION
ALTER SYSTEM SET JOB_QUEUE_PROCESSES = 0 SCOPE=MEMORY
ALTER SYSTEM SET AQ_TM_PROCESSES = 0 SCOPE=MEMORY
ALTER TRIGGER "SYS"."AW_TRUNC_TRG" DISABLE
ALTER TRIGGER "SYS"."AW_REN_TRG" DISABLE
ALTER TRIGGER "SYS"."AW_DROP_TRG" DISABLE
ALTER TRIGGER "SYS"."XDB_PL_TRIG" DISABLE
ALTER TRIGGER "SYS"."OJDS$ROLE_TRIGGER$" DISABLE
ALTER TRIGGER "GSMADMIN_INTERNAL"."GSMLOGOFF" DISABLE
ALTER TRIGGER "MDSYS"."SDO_NETWORK_DROP_USER" DISABLE
ALTER TRIGGER "MDSYS"."SDO_NETWORK_DROP_USER" DISABLE
```

Convert

**Ready for Conversion**

? The database is ready for AL32UTF8 conversion. You may monitor the overall progress of Unicode conversion in the Conversion Progress dialog box and the detailed progress by selecting each conversion step. Please make sure you have taken a full backup of the database before you start the conversion.

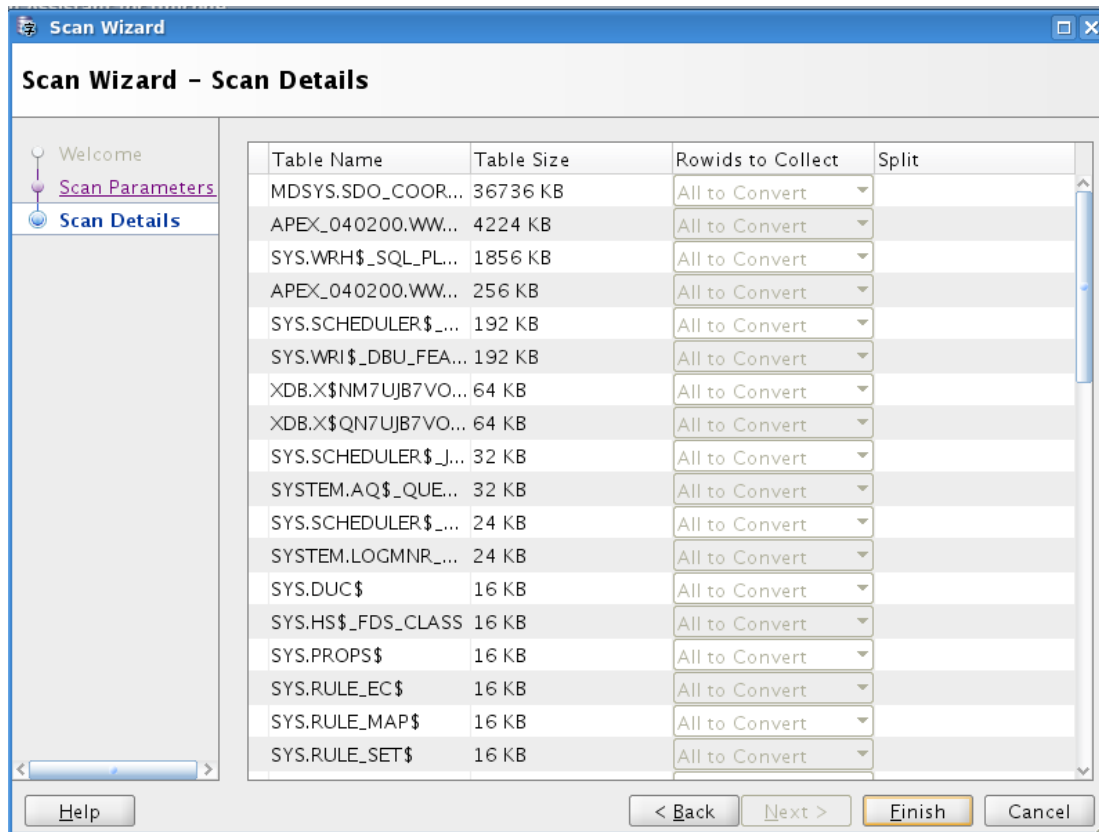
To start converting database, press "Yes".

Yes No

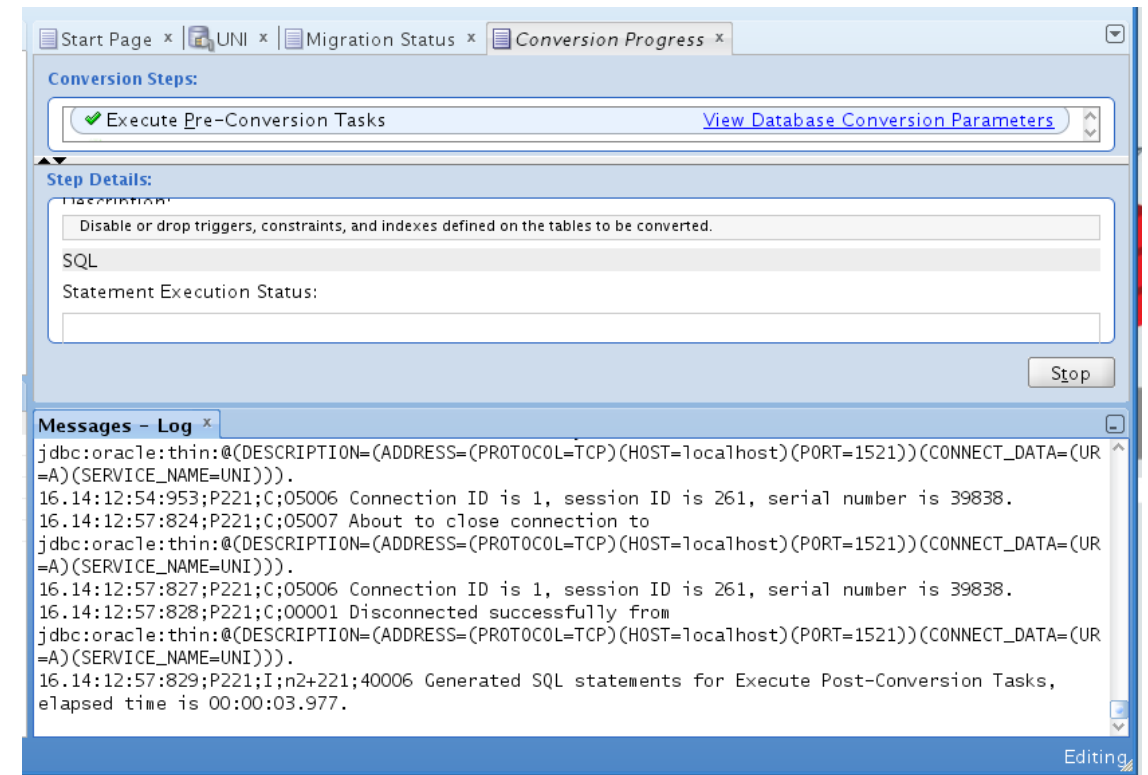


# Character Set Conversion - DMU

- Scan Wizard will be called again:

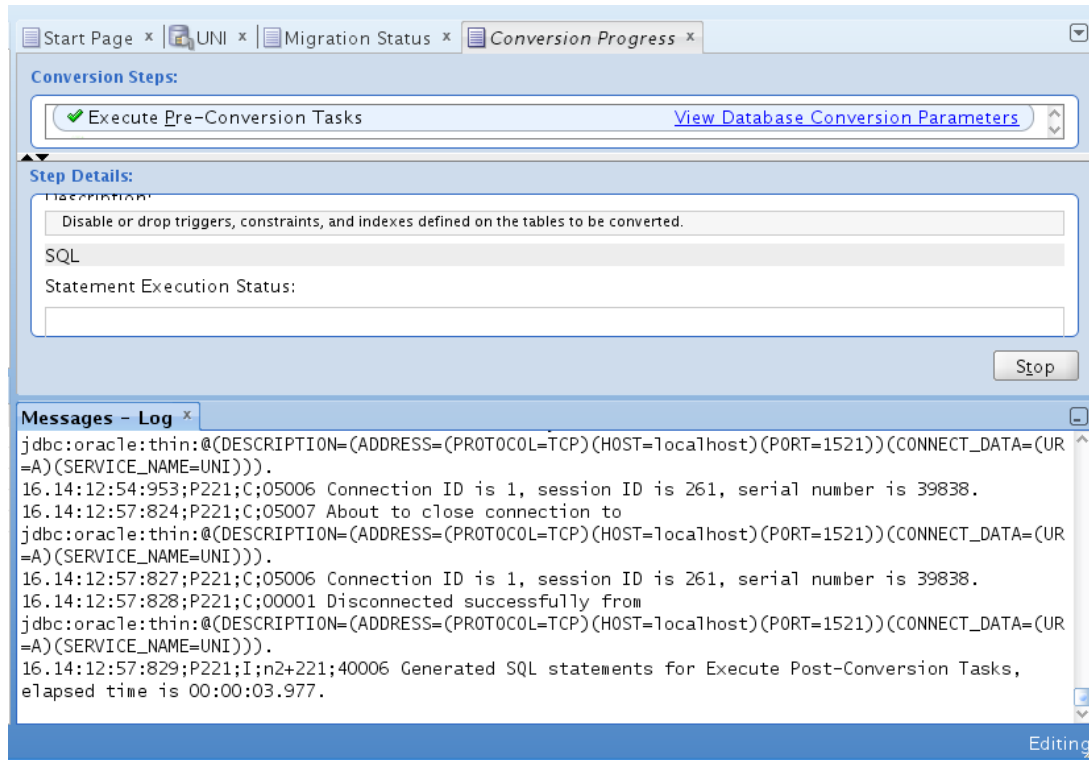


- Execute pre-conversion tasks:



# Character Set Conversion - DMU

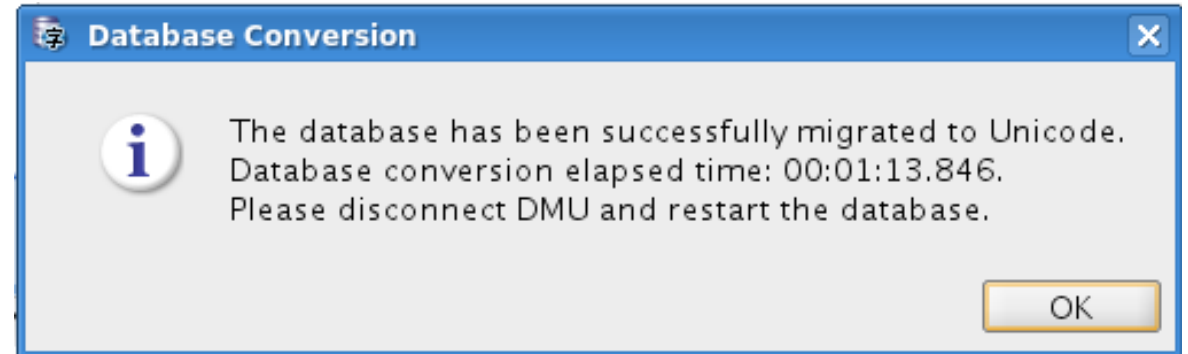
- SQL generation:



The screenshot shows the Oracle Database Migration Utility (DMU) interface. The 'Conversion Steps' section is active, showing 'Execute Pre-Conversion Tasks' with a green checkmark. Below this, the 'Step Details' section is visible, containing a description: 'Disable or drop triggers, constraints, and indexes defined on the tables to be converted.' The 'SQL' section is empty, and the 'Statement Execution Status' section is also empty. A 'Stop' button is located at the bottom right of the 'Step Details' section. The 'Messages - Log' section at the bottom shows the following log entries:

```
jdbc:oracle:thin:@(DESCRIPTION=(ADDRESS=(PROTOCOL=TCP)(HOST=localhost)(PORT=1521))(CONNECT_DATA=(UR=A)(SERVICE_NAME=UNI))).
16.14:12:54:953;P221;C;05006 Connection ID is 1, session ID is 261, serial number is 39838.
16.14:12:57:824;P221;C;05007 About to close connection to
jdbc:oracle:thin:@(DESCRIPTION=(ADDRESS=(PROTOCOL=TCP)(HOST=localhost)(PORT=1521))(CONNECT_DATA=(UR=A)(SERVICE_NAME=UNI))).
16.14:12:57:827;P221;C;05006 Connection ID is 1, session ID is 261, serial number is 39838.
16.14:12:57:828;P221;C;00001 Disconnected successfully from
jdbc:oracle:thin:@(DESCRIPTION=(ADDRESS=(PROTOCOL=TCP)(HOST=localhost)(PORT=1521))(CONNECT_DATA=(UR=A)(SERVICE_NAME=UNI))).
16.14:12:57:829;P221;I;n2+221;40006 Generated SQL statements for Execute Post-Conversion Tasks,
elapsed time is 00:00:03.977.
```

- Done!



The screenshot shows a 'Database Conversion' dialog box with a blue title bar. It contains an information icon (i) and the following text: 'The database has been successfully migrated to Unicode. Database conversion elapsed time: 00:01:13.846. Please disconnect DMU and restart the database.' An 'OK' button is located at the bottom right of the dialog box.

# Upgrade, Migrate & Consolidate

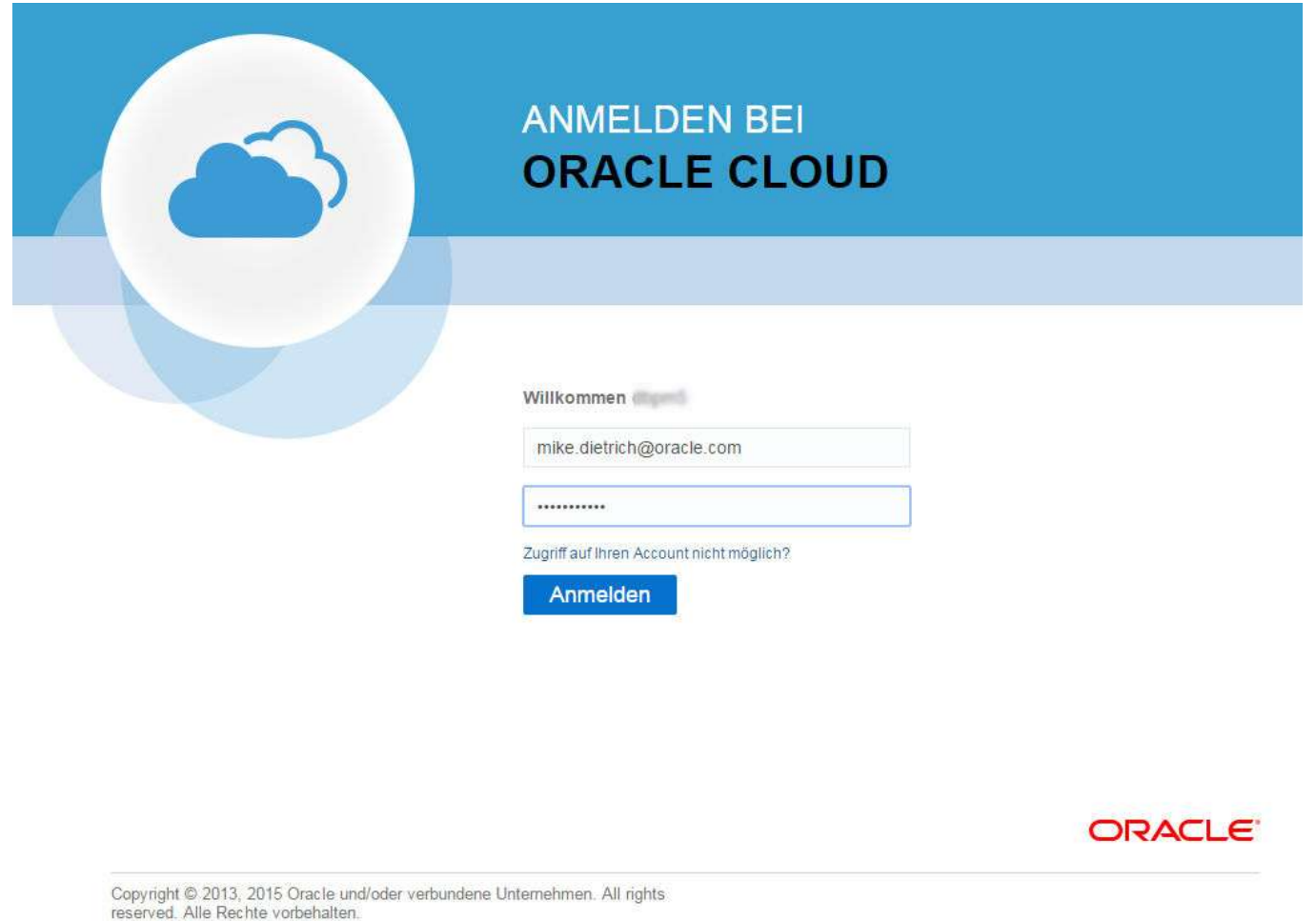
- 1 Introduction
- 2 Preparation Steps
- 3 Upgrade / Migrate / Consolidate**
- 4 Fallback Strategies
- 5 New Features
- 6 Performance Management
- 7 Wrap Up



**9** Into the Cloud

# Requirements

- Oracle Cloud (DBaaS) Account
- Local database (on premise)



ANMELDEN BEI  
**ORACLE CLOUD**

Willkommen @oracle

mike.dietrich@oracle.com

.....

Zugriff auf Ihren Account nicht möglich?

**Anmelden**

**ORACLE**

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# Database Environment in the DBaaS Cloud

- Choose your service:



## Oracle Database Cloud Service

Subscription: Trial (Expires: 1-Nov-2015 8:34 AM CET)  
Data Center: US Commercial 2  
Identity Domain: *idam5*  
Cloud Services Account: *idam5*  
Category: Oracle Database Public Cloud Services

[Open Service Console](#) ★ 📊 ☰

### Servicelevel

#### Oracle Database Cloud Service

Oracle-Datenbanksoftware vorab auf einer Oracle Cloud Virtual Machine installiert.  
Datenbankinstanzen werden für Sie mit den von diesem Assistenten bereitgestellten Konfigurationsoptionen erstellt.  
Zusätzliches Cloud-Tooling ist zu Backup-, Recovery- und Patching-Zwecken verfügbar.

#### Oracle Database Cloud Service - Virtual Image

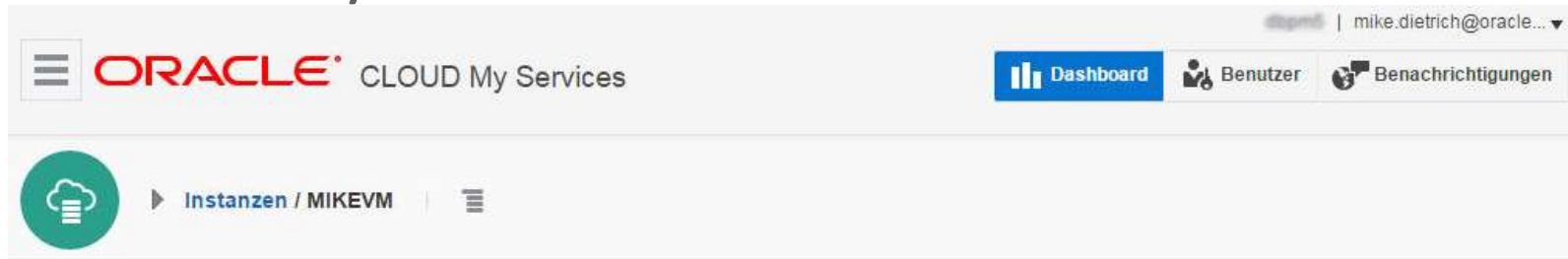
Oracle-Datenbanksoftware vorab auf einer Oracle Cloud Virtual Machine installiert.  
Datenbankinstanzen werden manuell von Ihnen oder mit DBCA erstellt.  
Es ist kein zusätzliches Cloud-Tooling verfügbar.

PDB →

VM only – plus tarball →

# Database Environment in the DBaaS Cloud

- Connect to your database



**Überblick**

1 Knoten

**Administration**

Patch-Informationen anzeigen

Ab 17.09.2015 14:57 Uhr UTC ↻

| Knoten | OCPUs | Speicher | Speicherung |
|--------|-------|----------|-------------|
| 1      | 2     | 15 GB    | 83 GB       |

## Knoten

**MIKEVM**

Öffentliche IP: [redacted]

SQL \*Net-Port: 1521  
SID: MIKE  
Container Name: MIKE  
PDB-Name: MIKEPDB1

## Activity

## Weitere Informationen

Edition: Enterprise Edition - Extreme Performance  
Servicelevel: Oracle Database Cloud Service

```
SQL*Plus: Release 12.1.0.2.0 Production on Thu Sep 17 15:01:48 2015
Copyright (c) 1982, 2014, Oracle. All rights reserved.

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

SQL> show pdbs

CON_ID CON_NAME                                OPEN MODE  RESTRICTED
-----
2 PDB$SEED                                    READ ONLY  NO
3 MIKEPDB1                                    READ WRITE NO
```



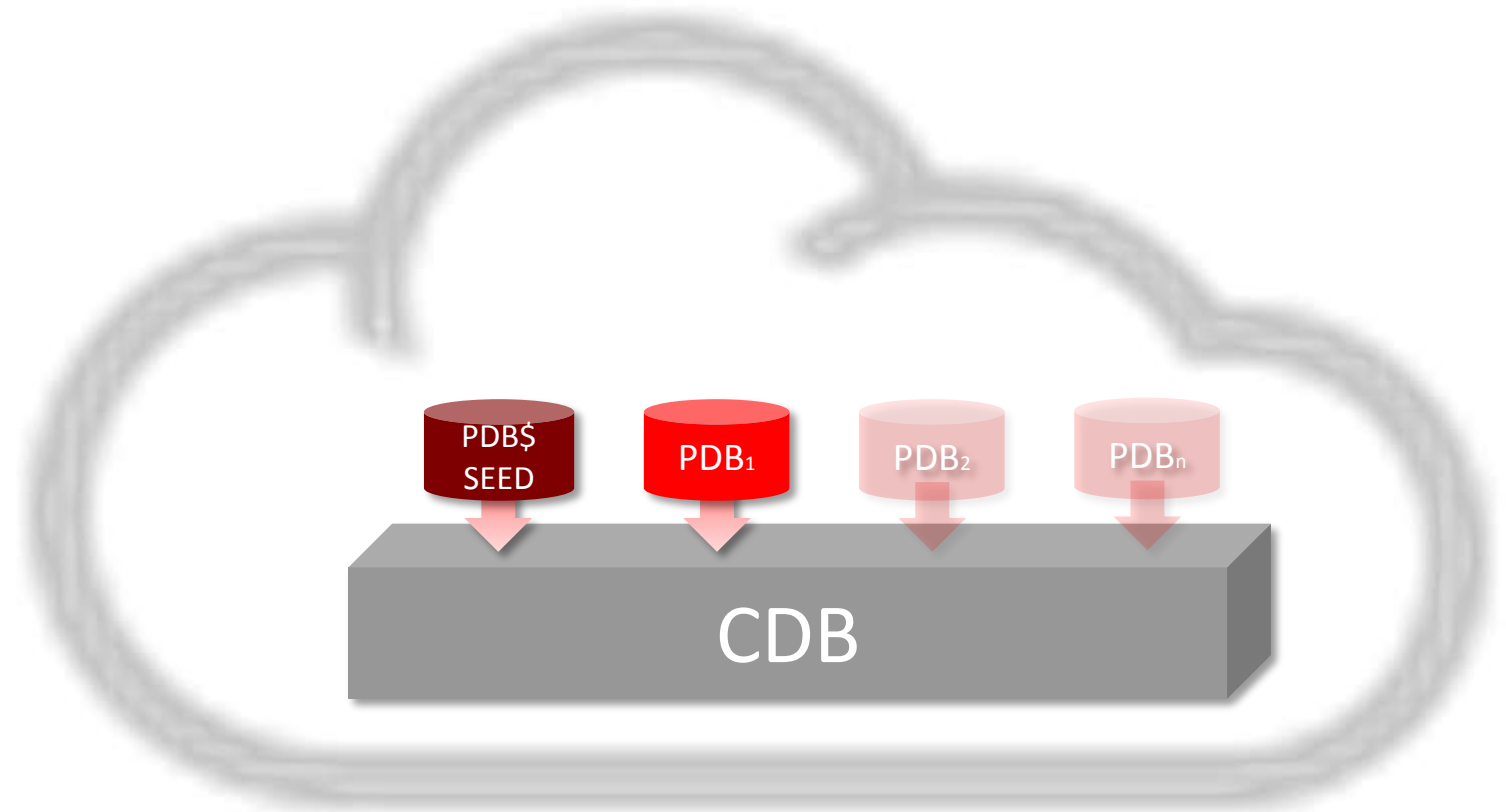


# Migration Options

## Into the Oracle Cloud

# Migration to the Oracle Database Cloud Service

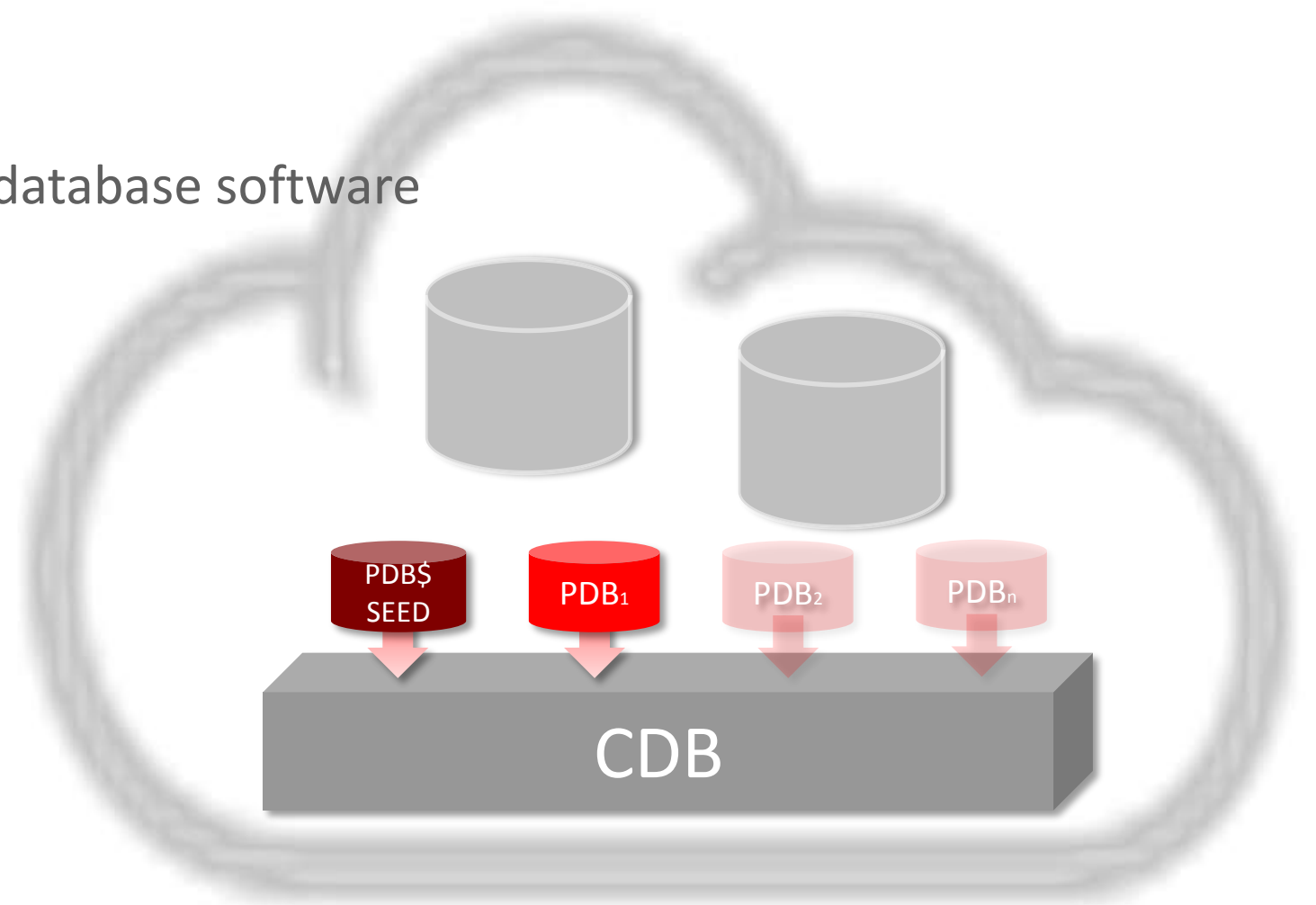
- You'll get:
  - 1 container database
  - 1 pluggable database
- You'll have to do:
  - Just start ...





# Migration to the Oracle Database Cloud Service – VM Image

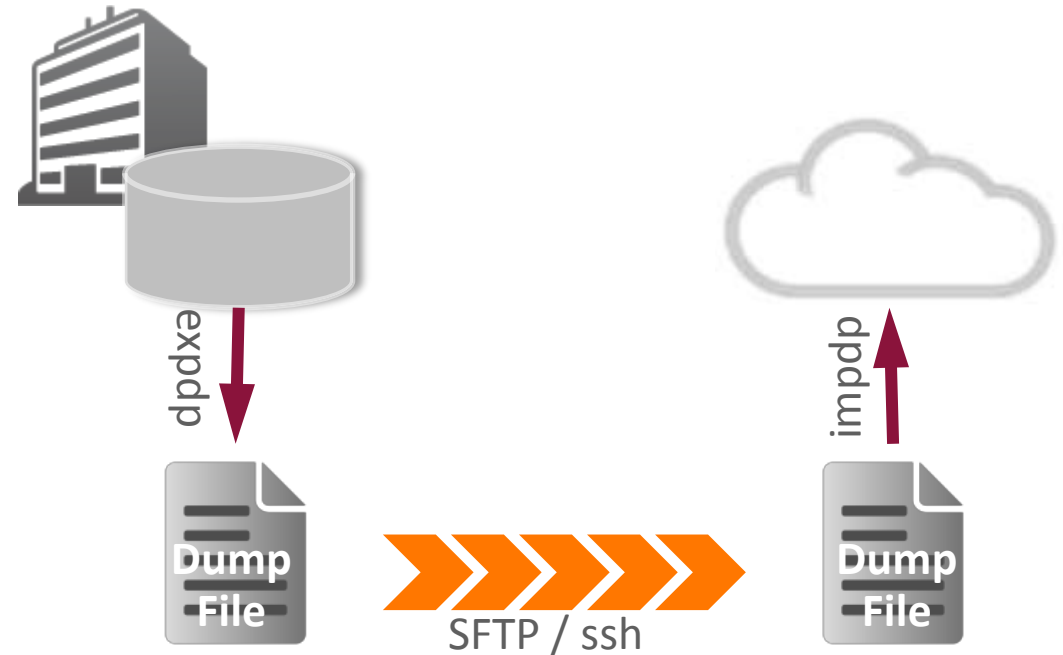
- You'll get:
  - A virtual machine
  - A tar ball containing the Oracle database software
- You'll have to:
  - Unpack the tar ball
  - Install Oracle Database 12.1.0.2
  - Patch Oracle Database 12.1.0.2
  - Create your database(s)



# Data Pump – Conventional Export/Import

- **expdp**
- Transfer dump file into the cloud
- **impdp**
- NETWORK\_LINK an option
  - Tunnel sqlnet over ssh
- Works:
  - Cross versions
  - Cross OS platforms
  - Cross character sets

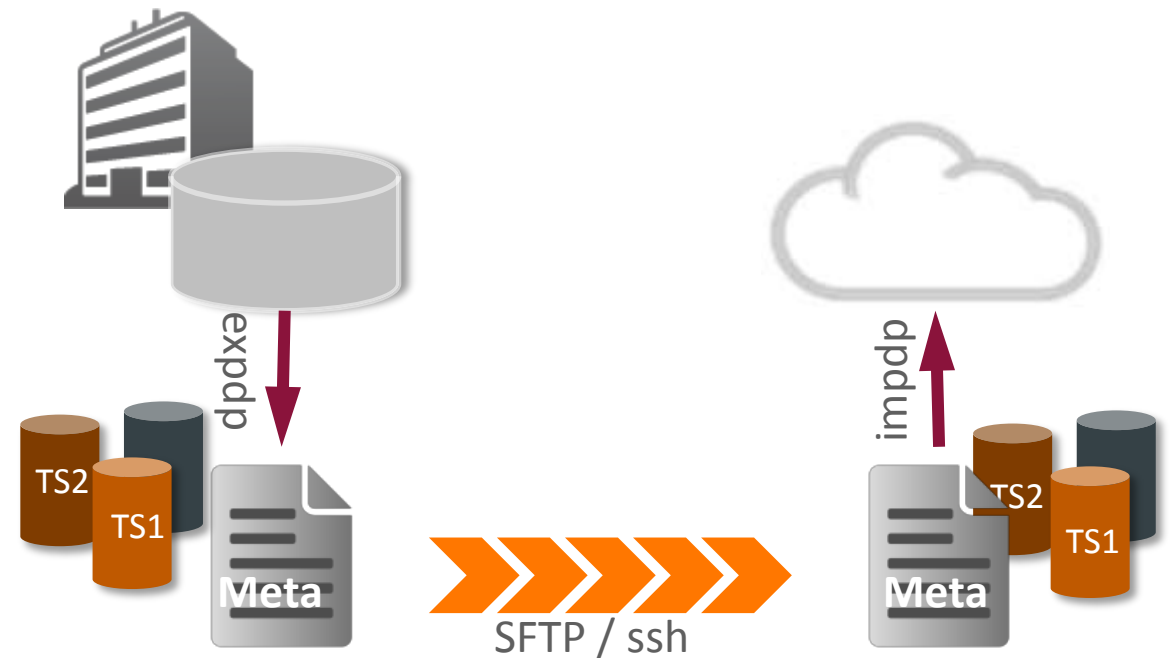
## Migration



# Transportable Tablespaces

- **expdp meta information**
- Transfer into the cloud:
  - Tablespace files
  - Meta dump files
- **impdp meta information**
- Works:
  - Cross versions
  - Cross OS platforms (convert!)
- Potential character set migration required upfront

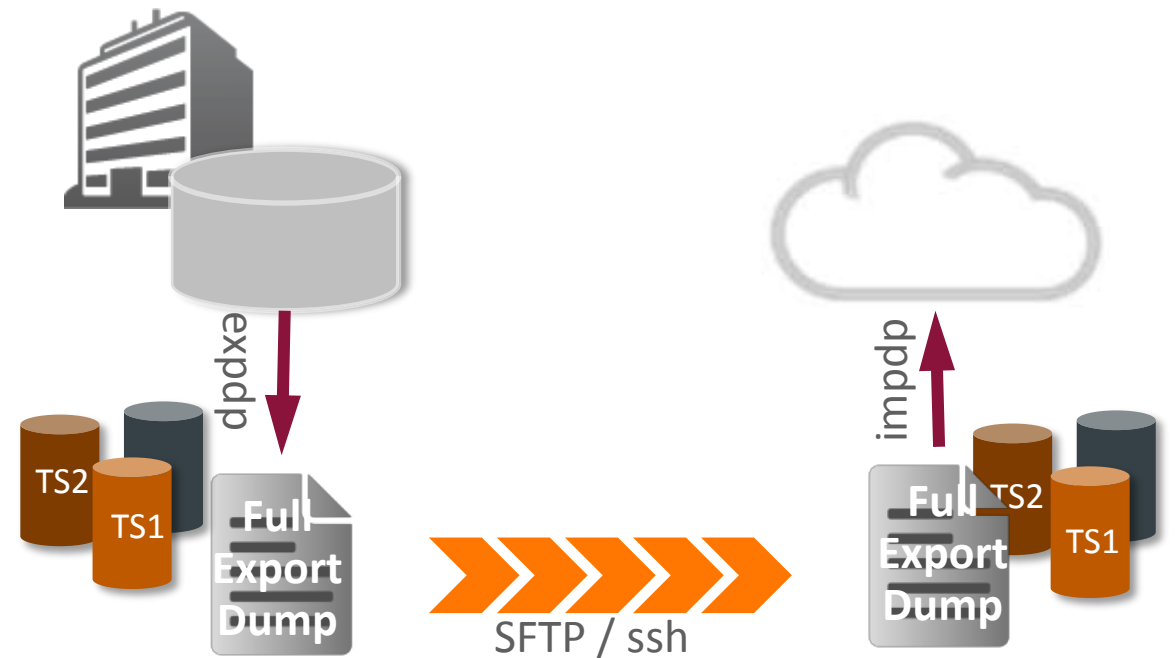
## Migration



# Full Transportable Export/Import

- **expdp meta information**
- Transfer into the cloud:
  - Tablespace files
  - Dump file
    - NETWORK\_LINK an option
- **impdp one-command migration**
- Works:
  - Cross versions with  $\geq 11.2.0.3$
  - Cross OS platforms (convert!)
- Character set must match

## Migration

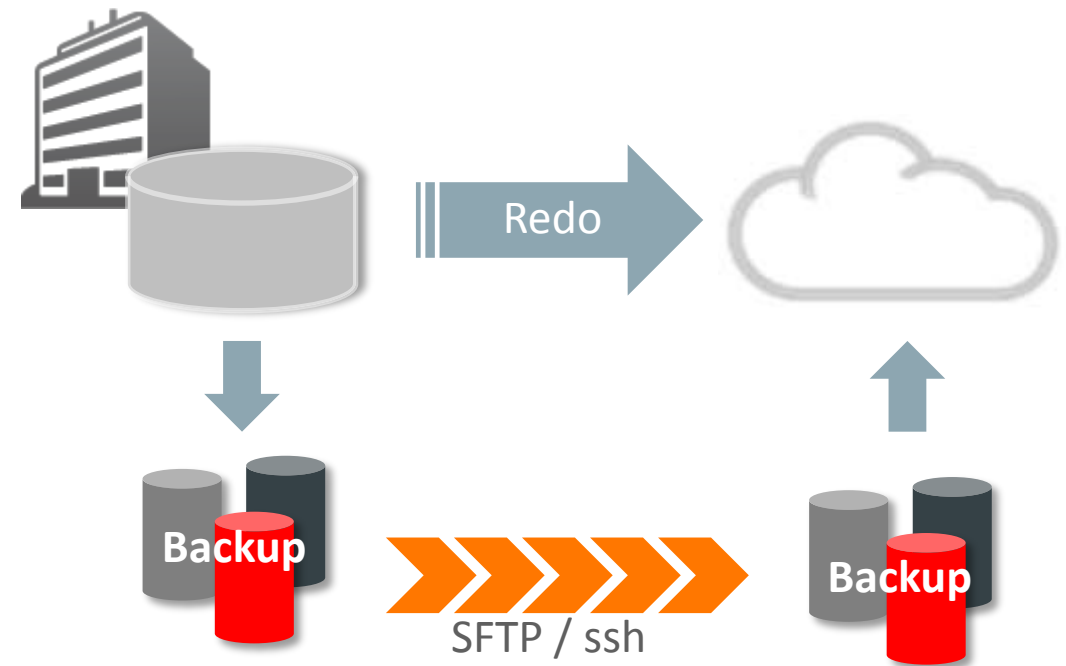


# Data Guard as Transport Vehicle

- Transfer into the cloud:
  - RMAN backup
    - DUPLICATE FOR STANDBY FROM ACTIVE DATABASE is an option
- Works:
  - Little Endian OS platforms
  - Same version
  - Stand-alone/stand-alone or PDB/PDB
- DR to cloud using (Active) Data Guard



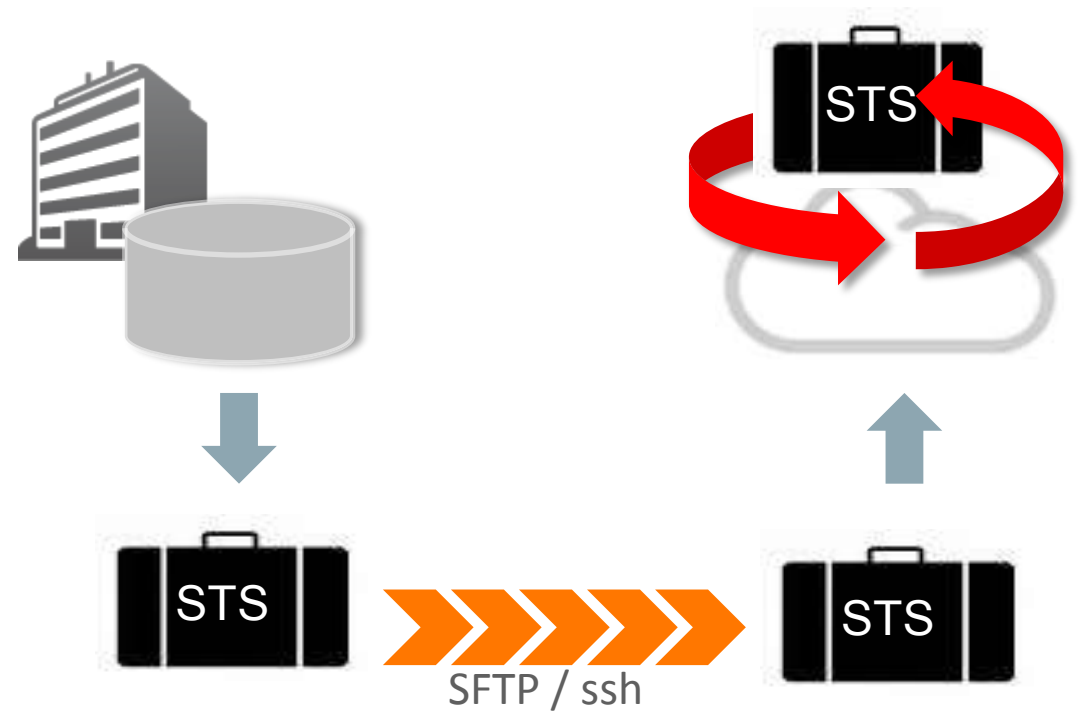
## Migration



# Save Testing Costs

- SQL Performance Analyzer
  - No license required

- Approach:



# Journey to the Cloud

- <http://blogs.oracle.com/UPGRADE>

## Upgrade your Database - NOW!

Ease your Oracle Database upgrades and migrations - Best Practices, Workshops, Projects - and something about the pleasures of traveling

ORACLE

» [SuSE SLES 12 certif...](#) | [Main](#) | [New PREUPGRD.SQL is...](#) »

### Recent Posts

- Differences between Automatic Statistics Gathering job and GATHER\_SCHEMA\_STATS
- Collaborate16 - See you soon!!!
- What happened to the blog post about "12c parameters"?
- Upgrade Workshop on March 2, 2016 in Switzerland
- DBUA and Read-Only Tablespaces - Things to Know
- How to find out if a PSU has been applied? DBMS\_QOPATCH
- New PREUPGRD.SQL is available for Upgrades to 12c
- TDE is wonderful - Journey to the Cloud V
- SuSE SLES 12 certified with Oracle Database 12.1.0.2
- Oracle January 2016 CPU PSU BP available now - BE AWARE OF CHANGES IN PATCH NUMBERING

### TDE is wonderful - Journey to the Cloud V

By Mike Dietrich-Oracle on Jan 28, 2016

#### What happened so far on my Journey to the Cloud?

- [Part I - Push a Button \(Dec 3, 2015\)](#)
- [Part II - Switch On/Off and Remove \(Dec 4, 2015\)](#)
- [Part III - Patch, patch, patch \(Dec 22, 2015\)](#)
- [Part IV - Clean Up APEX \(Jan 19, 2016\)](#)
- You are here ==> [Part V - TDE is wonderful \(Jan 28, 2016\)](#)

**Today's journey:**  
**Learn about TDE (Transparent Data Encryption) and other secrets**


What I really really love about my job: Every day I learn something new.

But sometimes learning can be frustrating at the beginning. And so it was for Roy and myself in the past days when we explored the use of TDE (Transparent Data Encryption) in our DBaaS Cloud environments. But many thanks to Brian Spendolini for his continuous 24x7 support 😊

Never heard of **Transparent Data Encryption** before? Then [please read on here](#). It's usually part of ASO (Advanced Security Option) but it is included in the cloud offering.

But first of all before taking care on TDE and PDBs I tried to deploy a new DBaaS VM ...

### About



**Mike Dietrich**  
Master Product Manager - Database Upgrade & Migrations - Oracle

Based in Germany. Interlink between customers/partners and the Upgrade Development. Running workshops

# Managing Mixed Environments

- Enterprise Manager Hybrid Cloud Control

The screenshot displays the Oracle Enterprise Manager Cloud Control 12c interface. At the top, the title bar reads "ORACLE Enterprise Manager Cloud Control 12c". Below this is a navigation bar with "Enterprise", "Targets", "Favorites", and "History" menus. The main content area shows a host configuration page for "host.example.com". A red rectangular box highlights the "Oracle Cloud" link in the top right corner of the host configuration area. Below the host name, there are "Agent" settings and a "Summary" section with "General" and "Monitoring" tabs. The "General" tab shows "Status Up", "Availability (%) 100.00", and "Host emhybridjava-wls-1.compute-". The "Monitoring" tab is active, showing "Monitored Targets" with "Showing: All (3) Broken (0) Not Uploading (0)". Action buttons for "View", "Configure", "Remove", and "Detach" are visible at the bottom of the monitoring section.

– [https://docs.oracle.com/cd/E24628\\_01/doc.121/e24473/hybrid-cloud.htm#EMADM15141](https://docs.oracle.com/cd/E24628_01/doc.121/e24473/hybrid-cloud.htm#EMADM15141)



# Upgrade, Migrate & Consolidate

- 1 Introduction
- 2 Preparation Steps
- 3 Upgrade / Migrate / Consolidate
- 4 Fallback Strategies**
- 5 New Features
- 6 Performance Management
- 7 Wrap Up

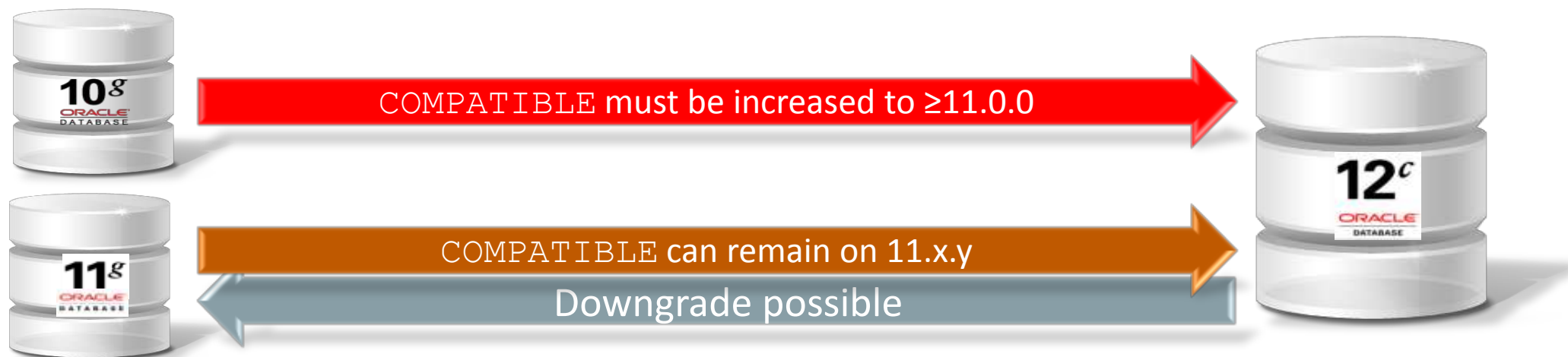


# Fallback Strategy – Strategy

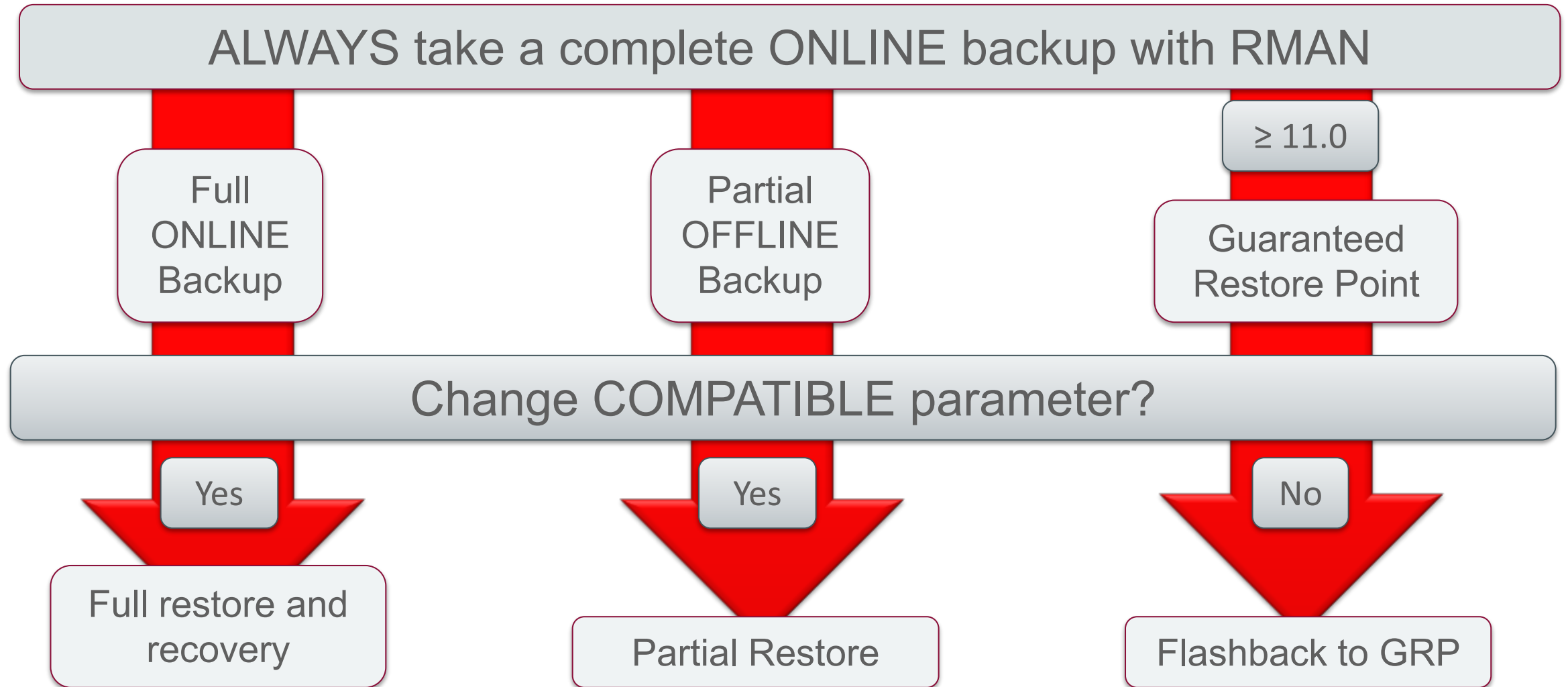
- **Never** start an upgrade or migration **without evaluating and testing** your options *for going back* ...
- Complete RMAN Online Backup is always a must
- Clarify:
  - Fallback requirements in minutes/hours/days
  - How to deal with issues happening **during** the upgrade
  - How to deal with issues hours/days **after** the upgrade
  - Will you get additional downtime to change COMPATIBLE?

# Parameter COMPATIBLE

- Minimum COMPATIBLE in Oracle Database 12c: 11.0.0
  - 11.0.0 and 11.1.0 are equivalent
  - Recommendation:
    - Change it 7-10 days after upgrade – but restart required
  - SQL> `alter system set compatible='12.1.0' scope=spfile;`
  - COMPATIBLE can't be turned back



# Fallback Strategy - Issues **during** upgrade



# Fallback: Online Backup

- Restore a backup
  - Complete online backup (RMAN)
  - Please verify:
    - Where is your backup located? Tapes, HD, off site...
    - Does the restore work?
    - How long will the restore take?
    - How long will the recovery take?
  - Recommendation:
    - Have a valid online backup in any case – **and test it!!!**



# Fallback: Offline Backup

- Restore a **partial** offline backup
  - Put all **data tablespaces** in read-only mode
    - That's downtime!
  - Shutdown the database IMMEDIATE
  - Copy SYSTEM, UNDO, TOOLS, SYSAUX, XDB, DRSYS and ODM data files plus control files and redo logs
  - In case of failure:
    - Shutdown and copy all partial backup files back
    - Startup in the old environment and recreate TEMP
  - Advantages:
    - Fast and simple, even COMPATIBLE can be changed



# Fallback: Restore Point

- Flashback to a guaranteed restore point
  - `COMPATIBLE` cannot be changed



| Pre Upgrade Environment                                            | Post Upgrade Environment                                                                                  |
|--------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| <pre>CREATE RESTORE POINT grpt GUARANTEE FLASHBACK DATABASE;</pre> |                                                                                                           |
|                                                                    |                                                                                                           |
|                                                                    | <pre>SHUTDOWN IMMEDIATE STARTUP MOUNT; FLASHBACK DATABASE TO RESTORE POINT grpt; SHUTDOWN IMMEDIATE</pre> |
| <pre>STARTUP MOUNT;</pre>                                          |                                                                                                           |
| <pre>ALTER DATABASE OPEN RESETLOGS;</pre>                          |                                                                                                           |
| <pre>DROP RESTORE POINT grpt;</pre>                                |                                                                                                           |

# Fallback Strategy – Issues **after** upgrade

AGAIN take a complete ONLINE backup with RMAN after the upgrade

≥ 11.1

Change COMPATIBLE parameter?

Yes

Data Pump  
Re-Import

Yes

Oracle  
GoldenGate

No

Downgrade



# Fallback: Data Pump

- Downgrade with `expdp/impdp` to 10.x

- [MOS Note:553337.1](#)

- Prepare an empty database for the import “just in case”

- Then:

- Run `expdp` from the 12.1 database home with the `VERSION` parameter equal to the target database `COMPATIBLE` setting

- Import using `impdp` from the target database home

- `NETWORK_LINK` can be used for downgrades as well

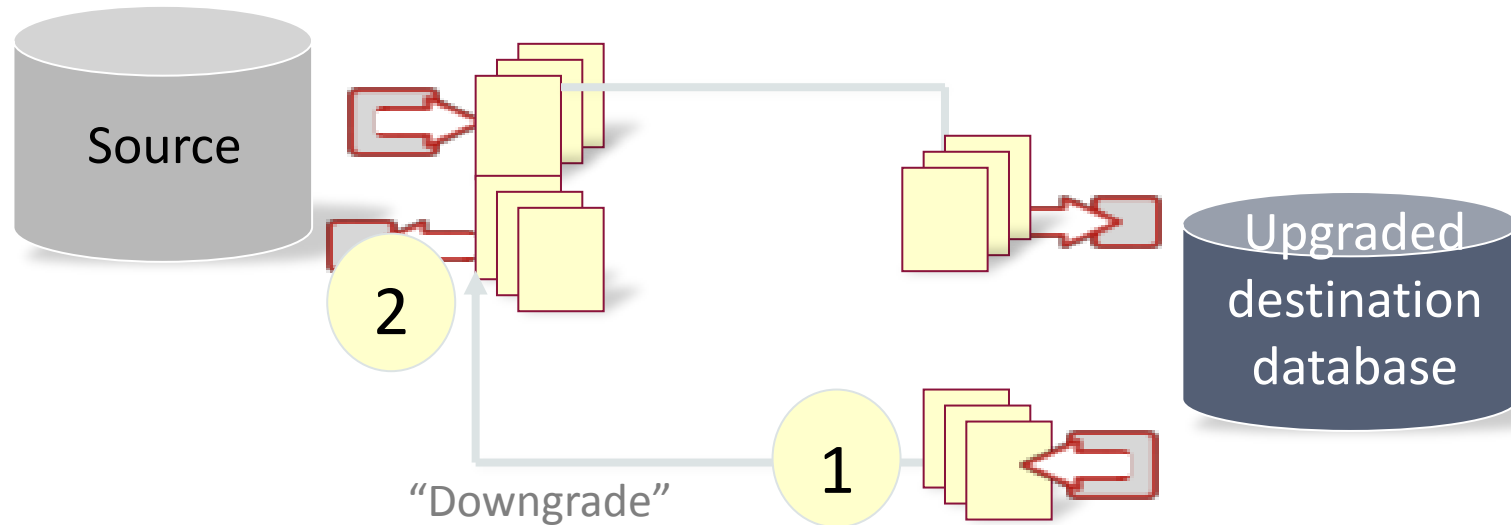


| Export From  | Import To    | Export Version to Use                                        | Import Version to Use         |
|--------------|--------------|--------------------------------------------------------------|-------------------------------|
| Release 11.2 | Release 11.1 | Data Pump Export Release 11.2 with <code>VERSION=11.1</code> | Data Pump Import Release 11.1 |
| Release 11.1 | Release 10.2 | Data Pump Export Release 11.1 with <code>VERSION=10.2</code> | Data Pump Import Release 10.2 |
| Release 10.2 | Release 10.1 | Data Pump Export Release 10.2 with <code>VERSION=10.1</code> | Data Pump Import Release 10.1 |



# Fallback: GoldenGate

- Downgrade with Oracle GoldenGate
  - Version/platform independent



# Fallback: Downgrade

- Downgrade with `catdwgrd.sql`

- Upgrade Guide – Downgrading a database to an earlier release:

- <https://docs.oracle.com/database/121/UPGRD/downgrade.htm#UPGRD007>

- [MOS Note:1516622.1](#):

- *How to Downgrade Oracle Database 12c Release 1 (12.1) to Previous Versions*

- *Special actions required for DV, OLS and other things – please see the note and the documentation*

- Downgrade possible to:

- Oracle 11.1.0.7

- Oracle 11.2.0.x

- Do not change COMPATIBLE



# Fallback: Downgrade

- Basic steps to downgrade with `catdwgrd.sql`

- In Oracle Database 12c environment:

```
SQL> SPOOL /tmp/downgrade.log
SQL> STARTUP DOWNGRADE
SQL> @catdwgrd.sql
SQL> SHUTDOWN IMMEDIATE
SQL> SPOOL OFF
```

- In Oracle Database 11g environment:

```
SQL> STARTUP UPGRADE
SQL> SPOOL /tmp/reload.log
SQL> @catrelod.sql
SQL> SPOOL OFF
```



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# Oracle Database 12c **New Features Guide**

- [http://docs.oracle.com/cd/E16655\\_01/server.121/e17906/toc.htm](http://docs.oracle.com/cd/E16655_01/server.121/e17906/toc.htm)

## **1 Oracle Database 12c Release 1 (12.1) New Features**

---

This chapter contains descriptions of all of the features that are new to Oracle Database 12c Release 1 (12.1). This chapter contains the following sections:

- 
- [Application Development](#)
  - [Business Intelligence and Data Warehousing](#)
  - [Compression and Archiving](#)
  - [Database Overall](#)
  - [High Availability](#)
  - [Manageability](#)
  - [Performance](#)
  - [Oracle RAC and Grid Infrastructure](#)
  - [Security](#)
  - [Spatial and Graph](#)
  - [Unstructured Data](#)
  - [Upgrades](#)
  - [Windows](#)

# Oracle Database 12c Interactive Quick Reference

- [http://www.oracle.com/webfolder/technetwork/tutorials/obe/db/12c/r1/poster/OUTPUT\\_poster/poster.html#](http://www.oracle.com/webfolder/technetwork/tutorials/obe/db/12c/r1/poster/OUTPUT_poster/poster.html#)

Oracle Database 12c: INTERACTIVE QUICK REFERENCE

Oracle Database 12c is designed specifically for 21st century database infrastructure requirements.

Combining the ability to simplify via consolidation and deliver the agility of a service-oriented perform via in-database virtualization, Oracle Database 12c delivers efficiency while improving user service levels.

The quick reference tool includes:

- Key OBA and dynamic performance views
- Entity-relationship diagrams (ERDs) illustrating the referential connections between views
- Architecture diagrams with hotspots that allow you to drill down into more details
- Categorized list of background processes, with additional information about each

Plug into the Cloud.

Oracle Database 12c: INTERACTIVE QUICK REFERENCE

Home DBA Views Performance Views Architecture Views Database Architecture Multitenant Architecture Background Processes

Search:

Select a category

- Recoverable Operations
- Registry
- Replication
- Resource Manager
- Scheduler and Jobs
- SecureFile LOBs
- Security
- Spatial
- Storage
- Streams
- Tables and Columns
- Transparent Session Migration
- Unified Auditing
- Workload Intelligence

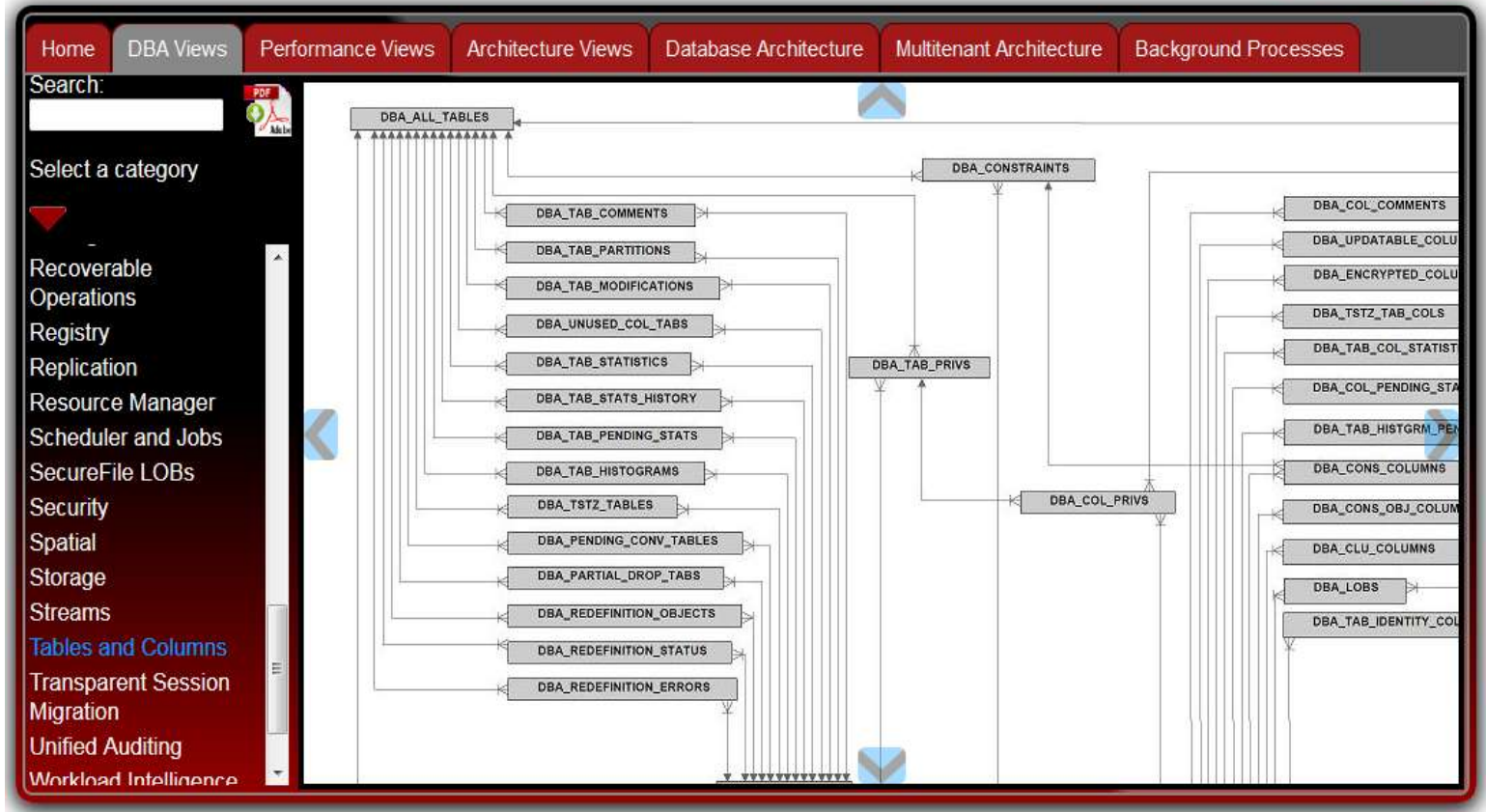
Advisors

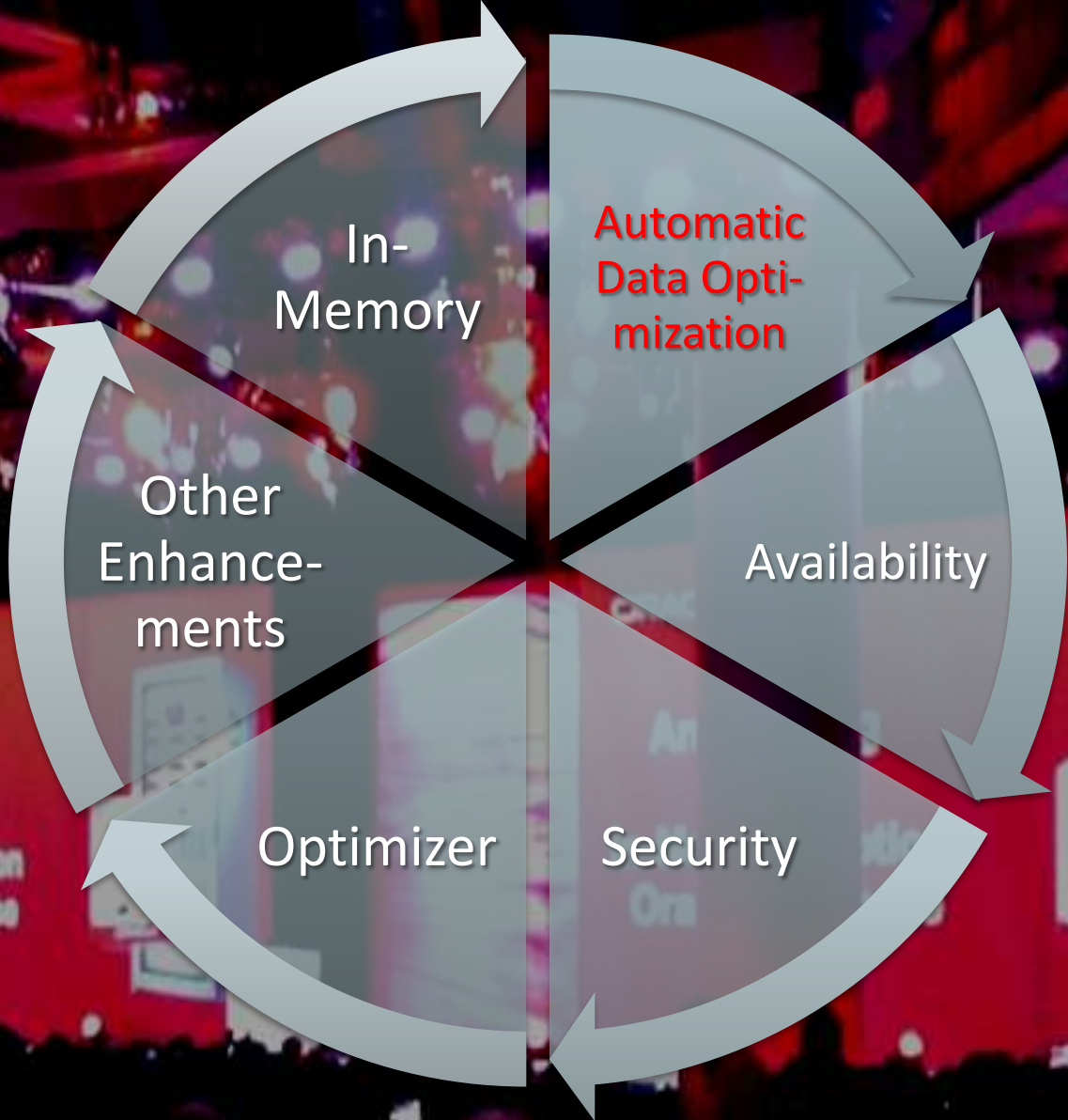
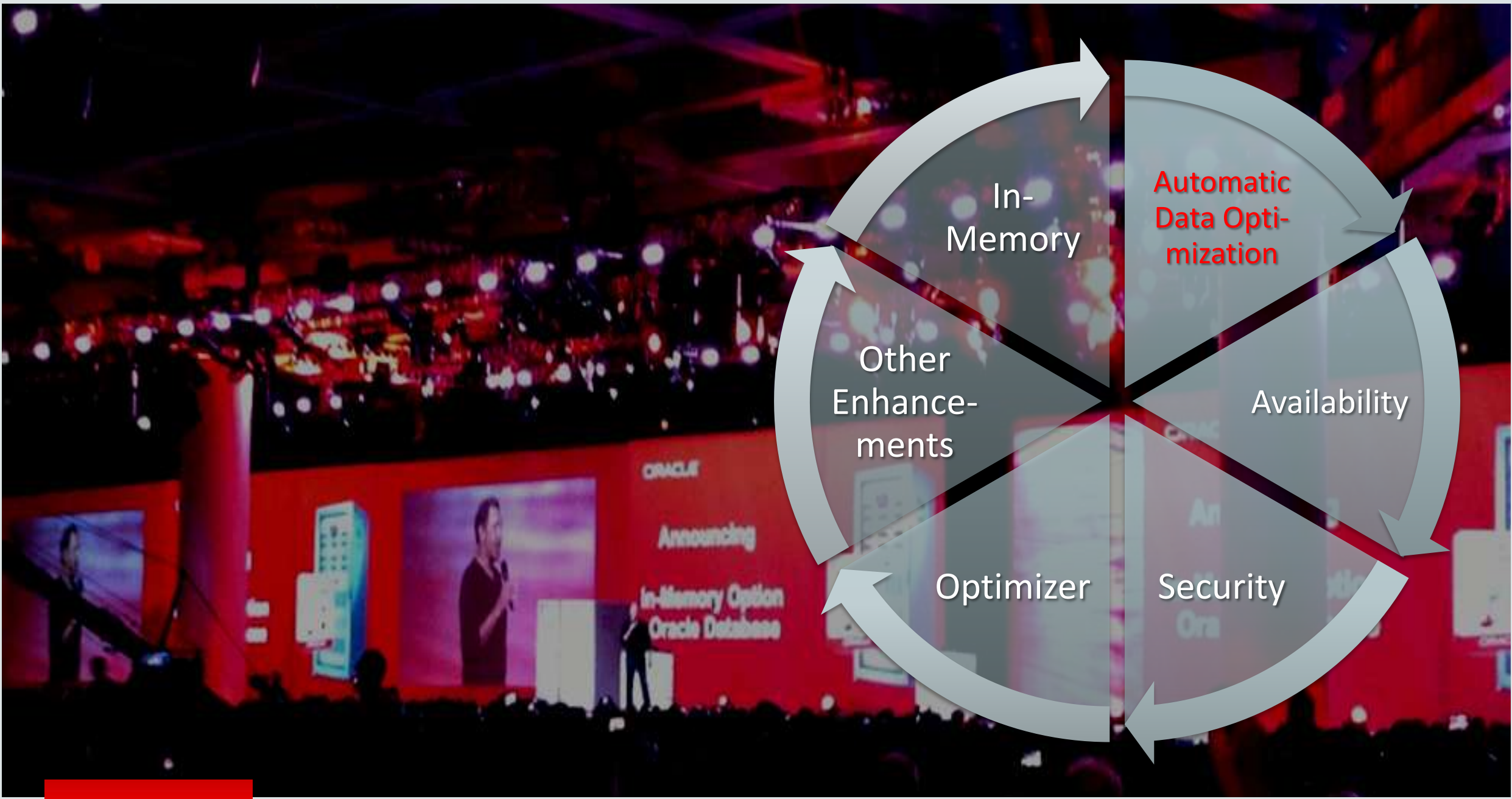
| Views               | Name                | NUM | Type         |
|---------------------|---------------------|-----|--------------|
| V\$ADVISOR_PROGRESS | V\$ADVISOR_PROGRESS |     | NUMBER       |
| V\$DB_CACHE_ADVICE  | V\$DB_CACHE_ADVICE  |     | VARCHAR2(30) |
| V\$JAVA_POOL_ADVICE | V\$JAVA_POOL_ADVICE |     | NUMBER       |

Performance Views

## Oracle Database 12c: INTERACTIVE QUICK REFERENCE

ORACLE®

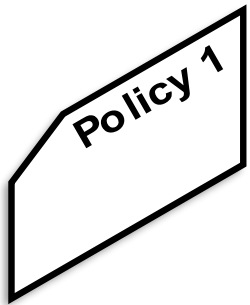






# Automatic Data Optimization

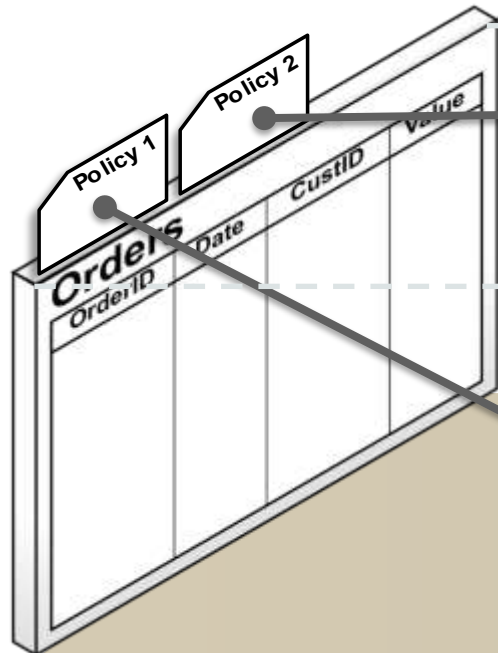
## Simplifying the life cycle of data



- An in-memory heat map tracks block and segment access
  - Data is periodically written to disk
  - Information is accessible by views or stored procedures
- Users can attach policies to tables to compress or tier data based on access to data
  - Tables or Partitions can be moved between compression levels whilst data is still being accessed
- New feature of the **Advanced Compression Option**

# Automatic Data Optimization

Add compression and tiering policies to tables



Compress Partitions with Hybrid columnar compression if they haven't been modified in 180 days

Compress Partitions with row compression if they haven't been modified in 30 days

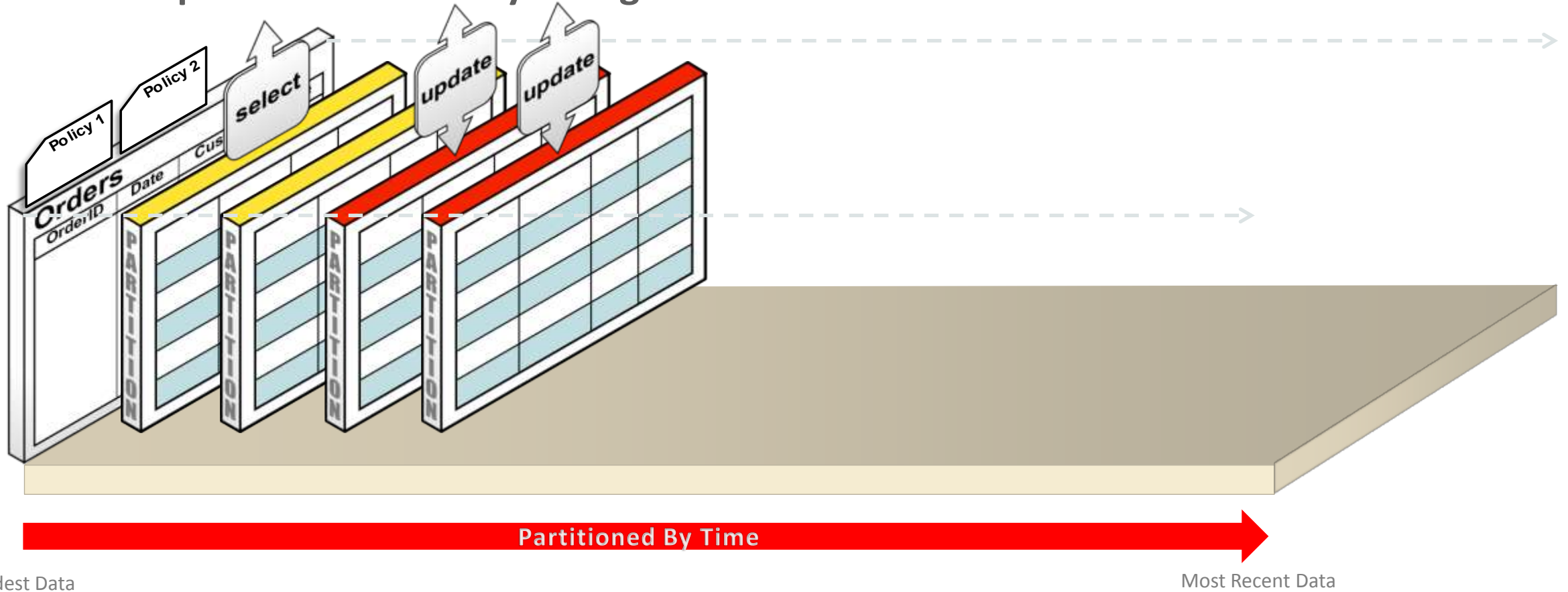
Oldest Data

Most Recent Data



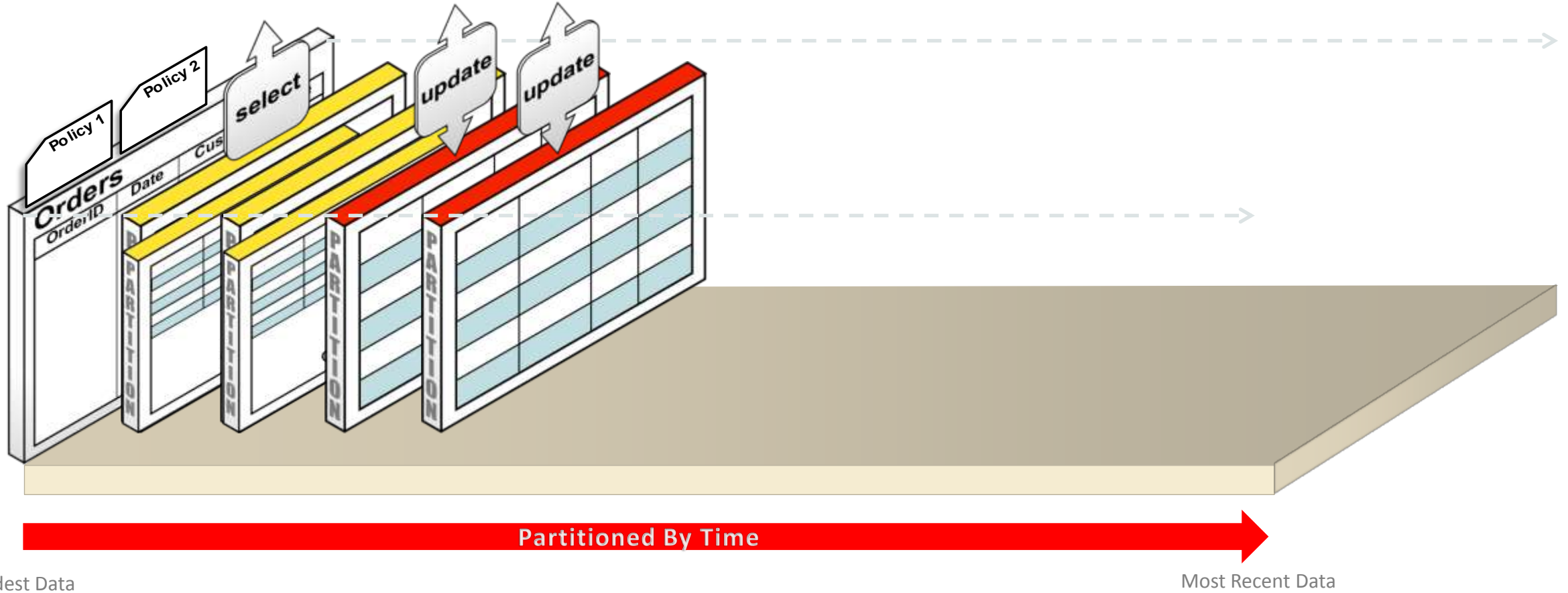
# Automatic Data Optimization

A heat map tracks the activity of segments and blocks



# Automatic Data Optimization

Policies are automatically applied to tables

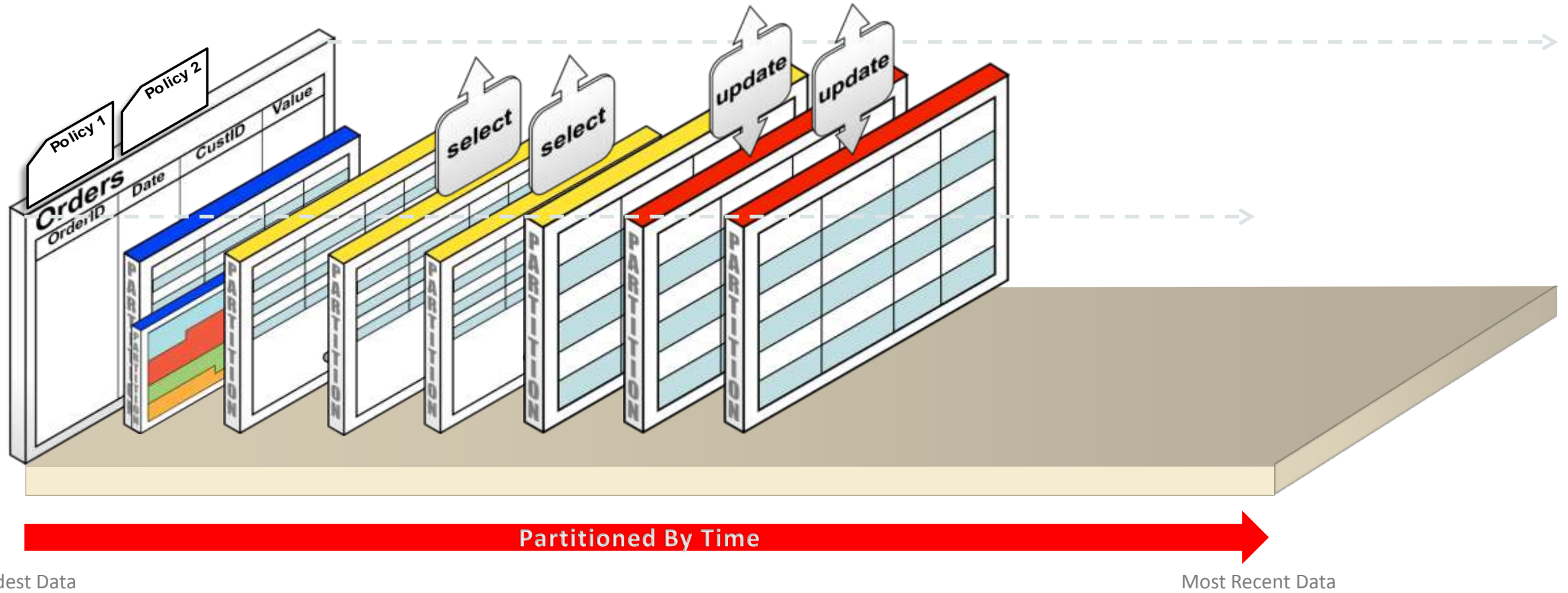


Oldest Data

Most Recent Data

# Automatic Data Optimization

Policies are automatically applied to tables

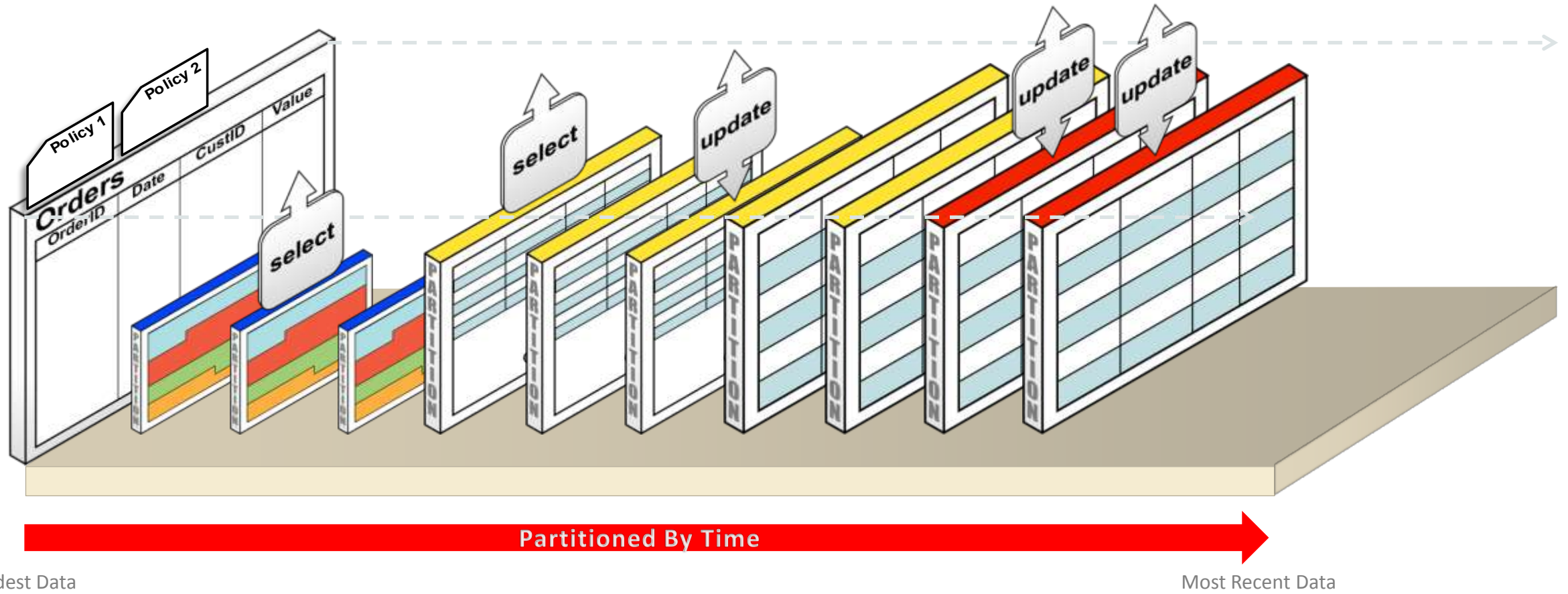


Oldest Data

Most Recent Data

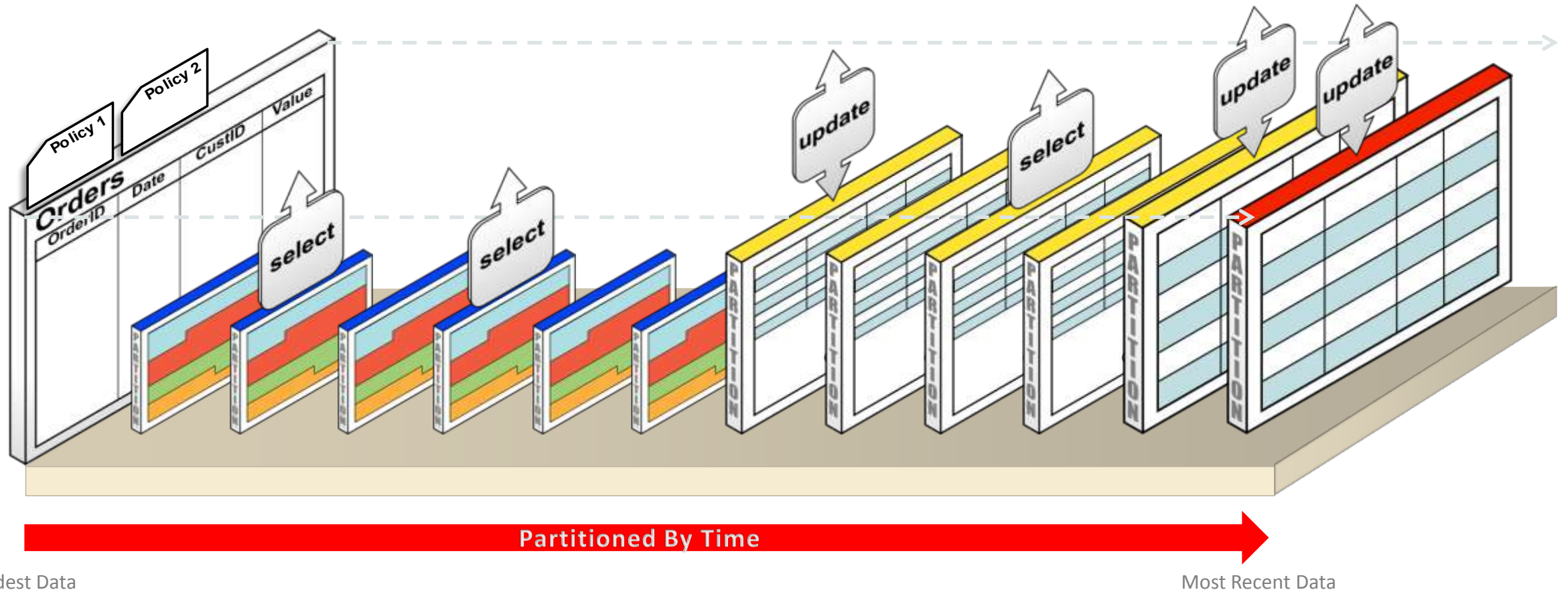
# Automatic Data Optimization

Policies are automatically applied to tables



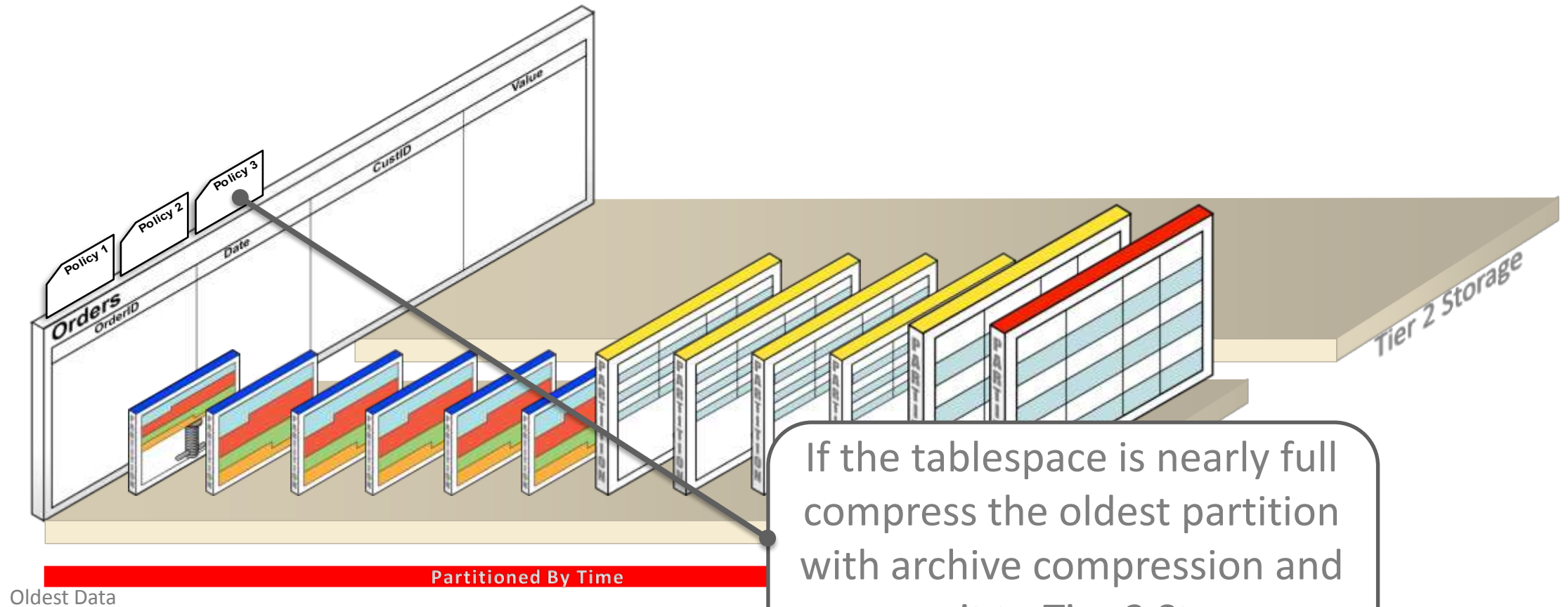
# Automatic Data Optimization

Reduce storage footprint, read compressed data faster

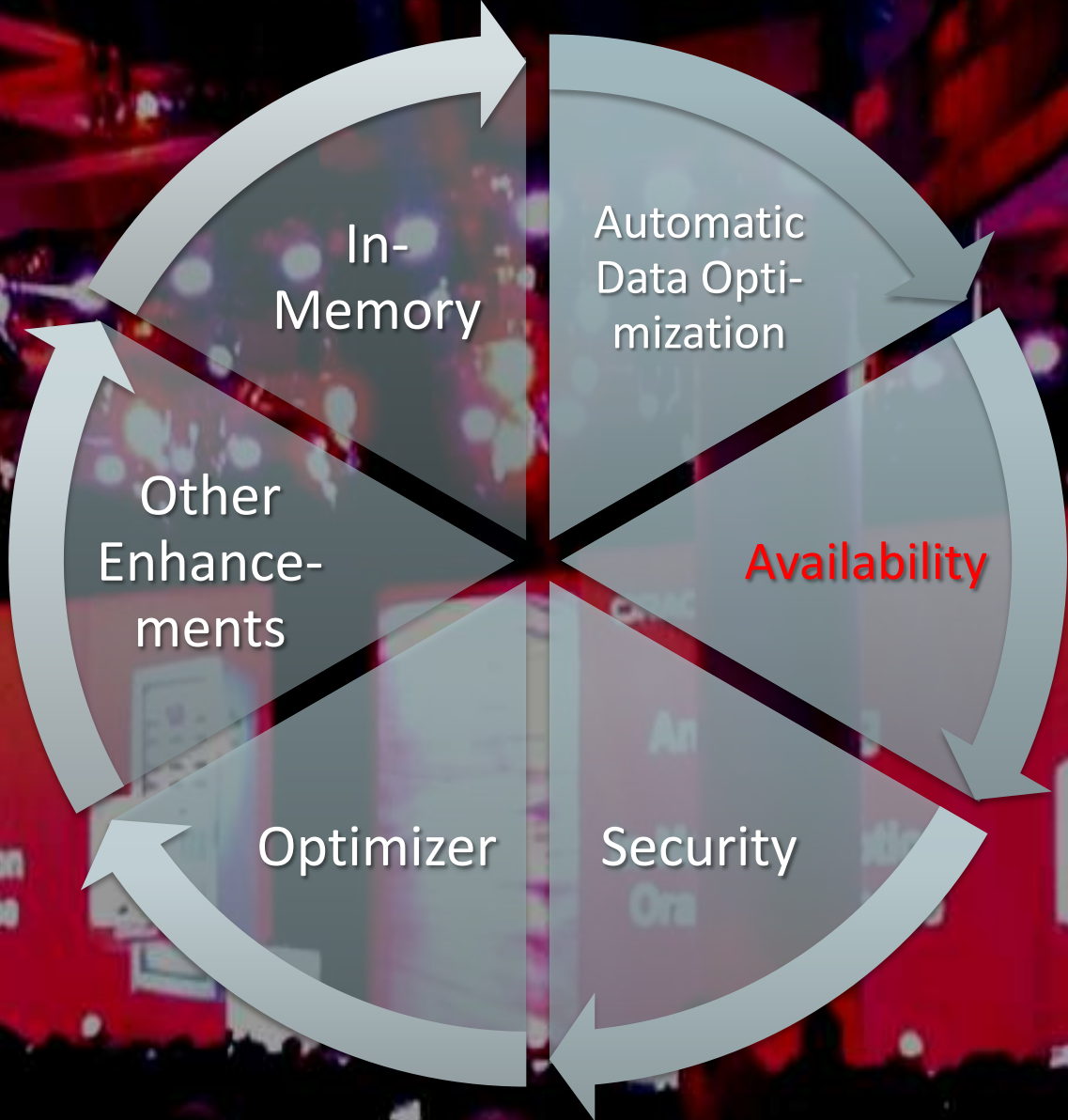
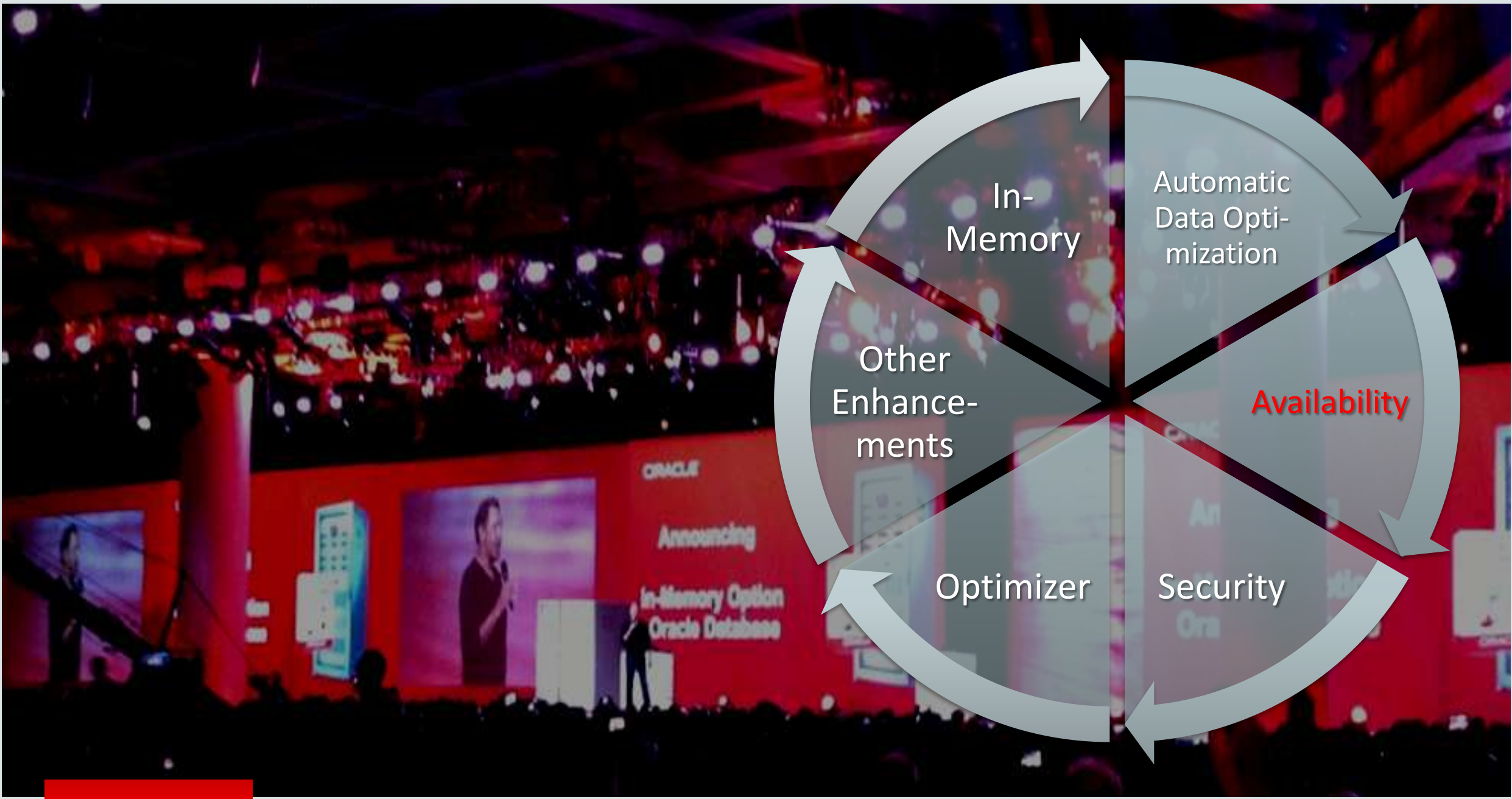


# Automatic Data Optimization

Automatically tier data to lower cost storage

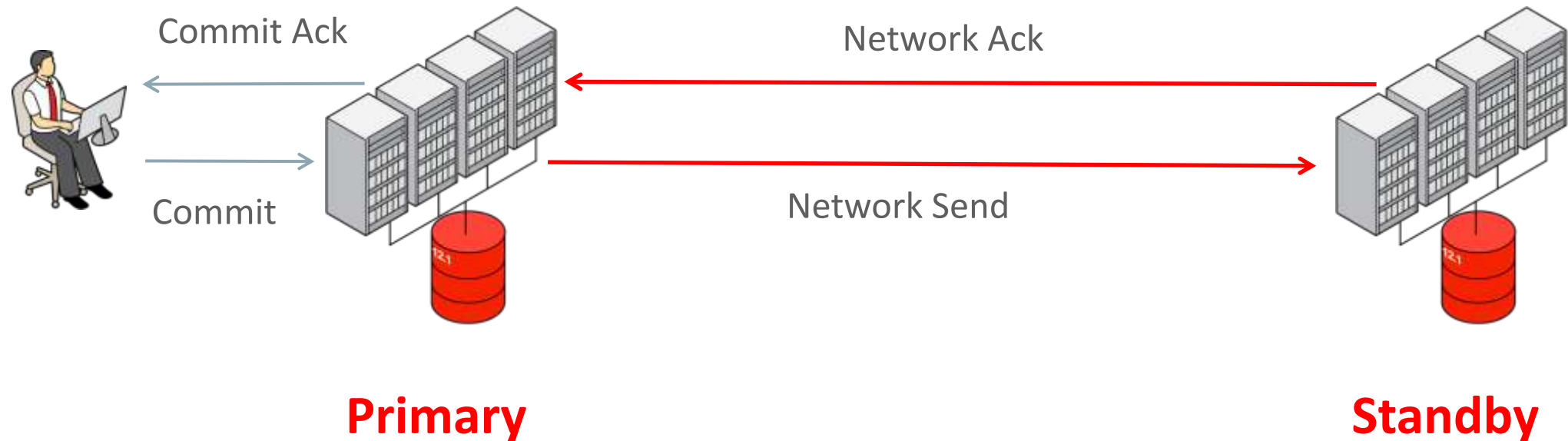






# Zero Data Loss Challenge

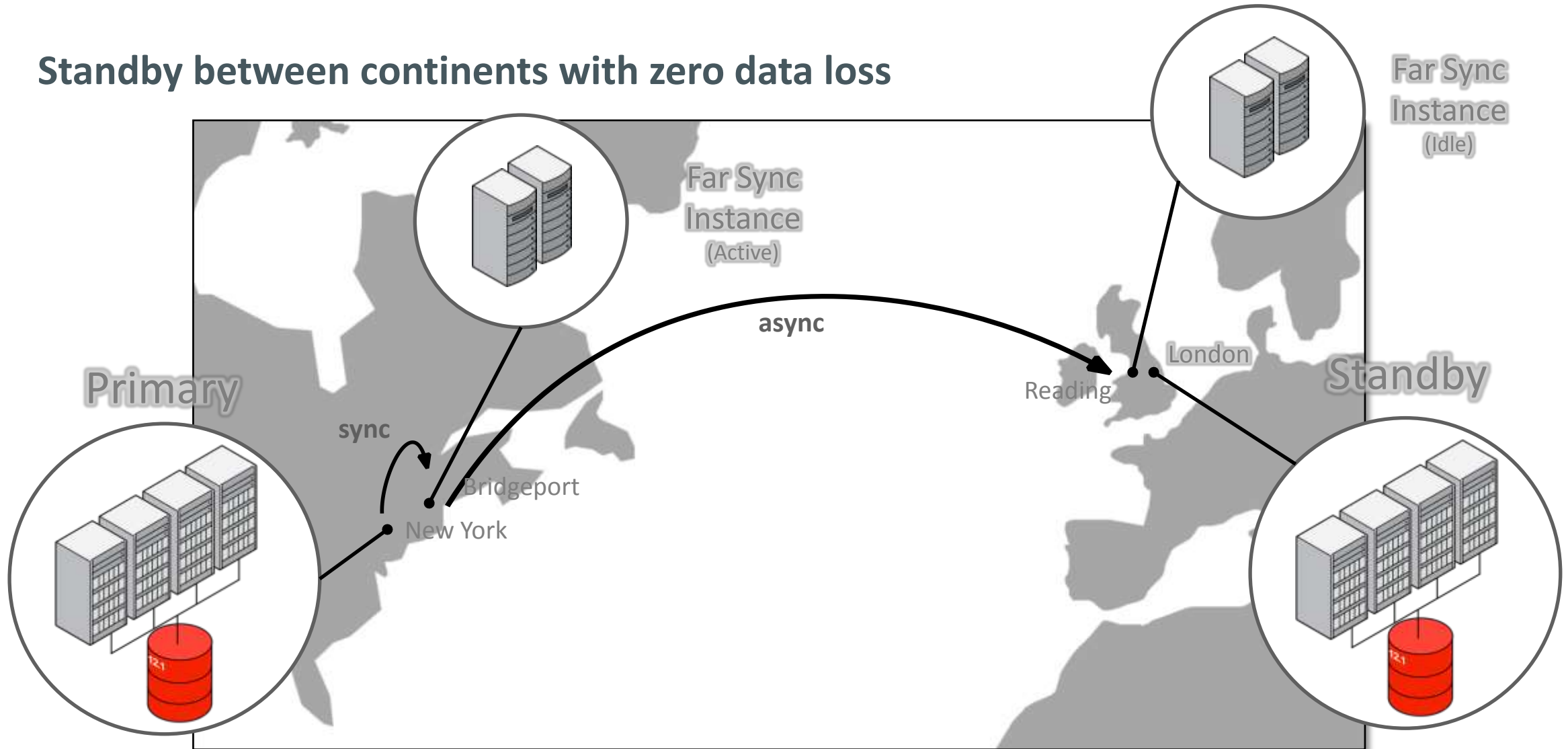
## Trade-off between Zero Data Loss and Performance



The longer the distance, the larger the performance impact

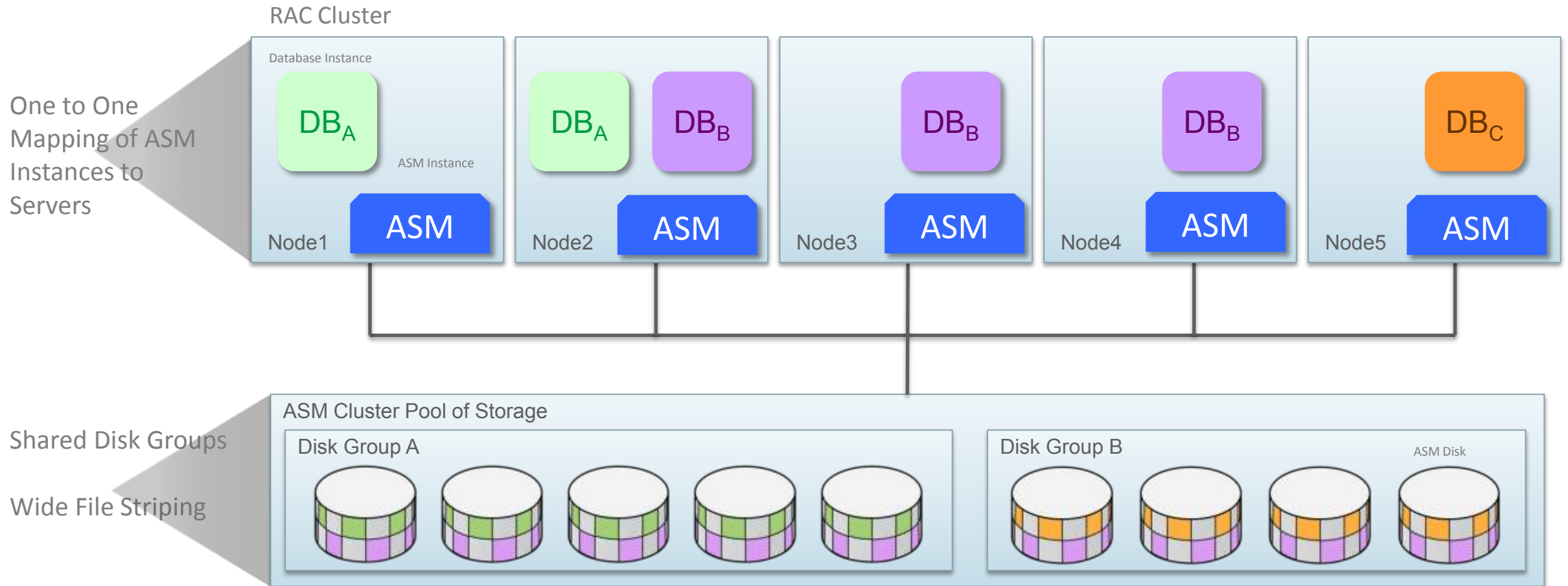
# Active Data Guard Far Sync

Standby between continents with zero data loss



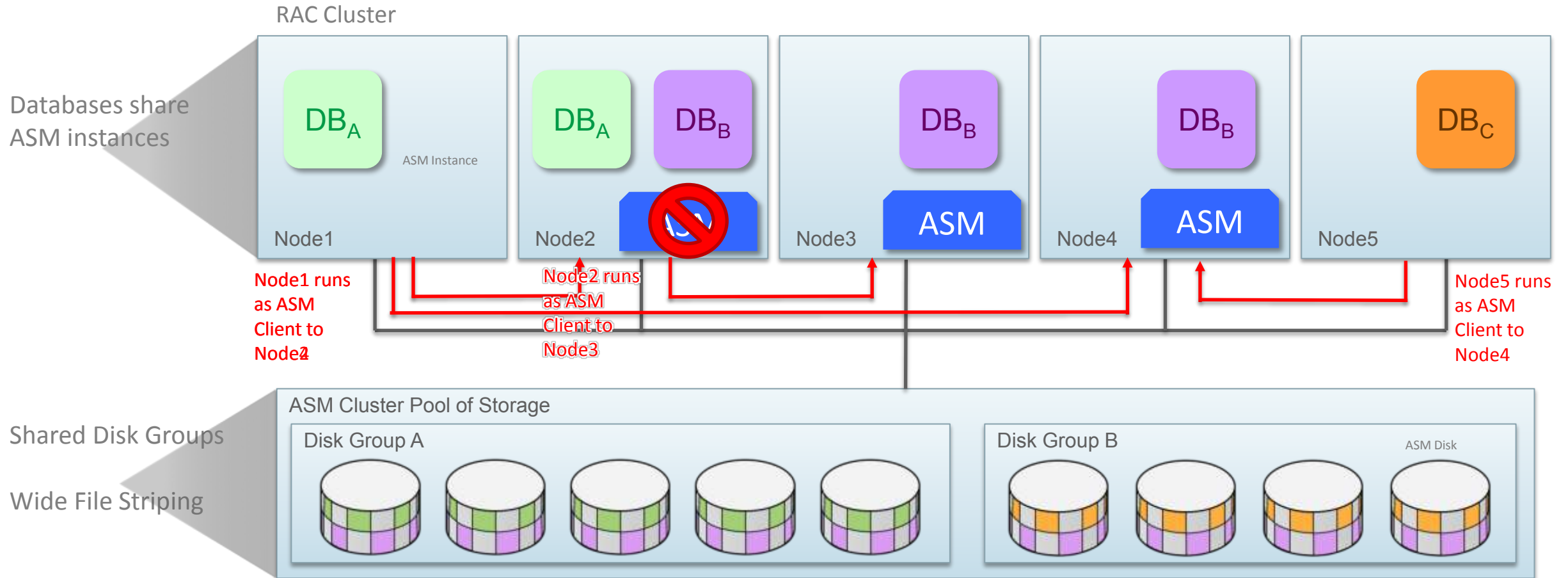
# Oracle ASM 12c – Overview

- Oracle ASM 12c Standard Deployment

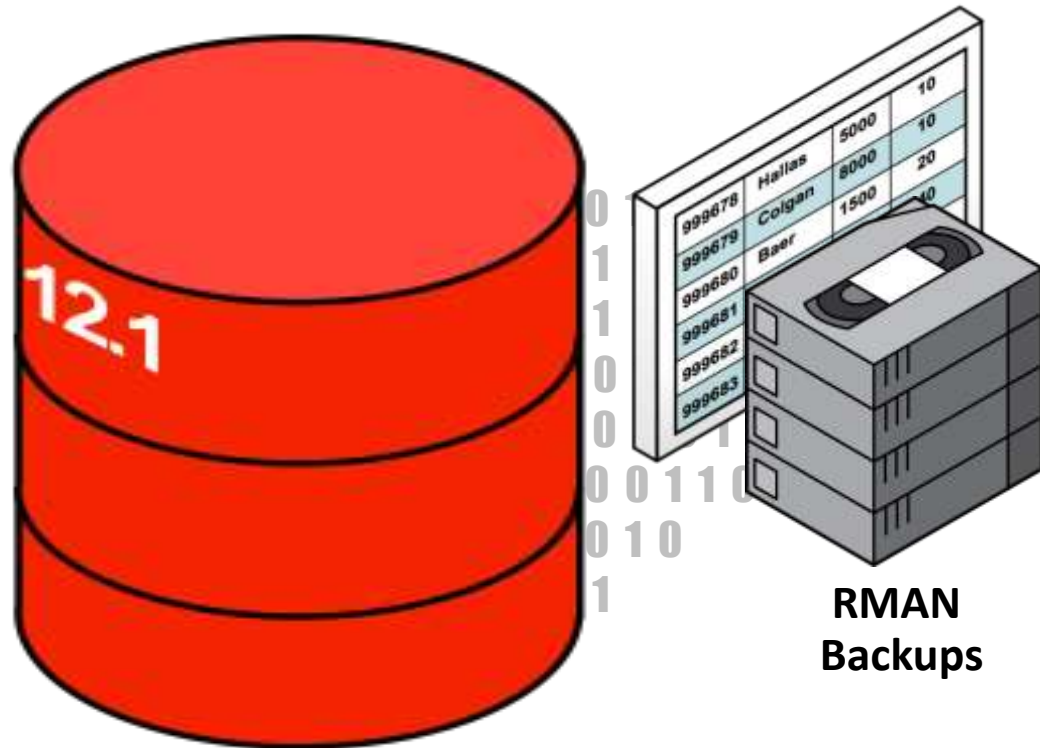


# Introducing Oracle Flex ASM

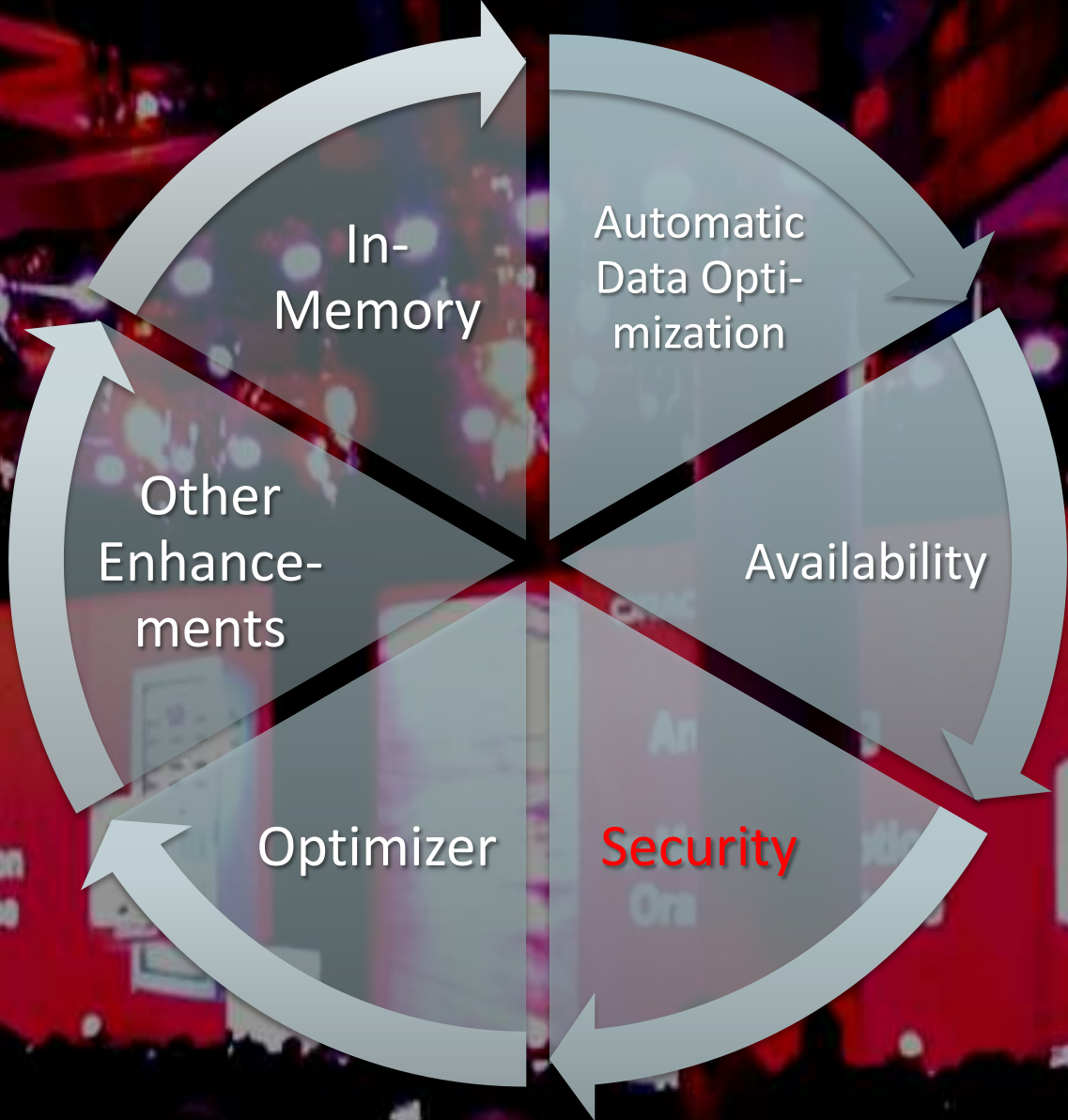
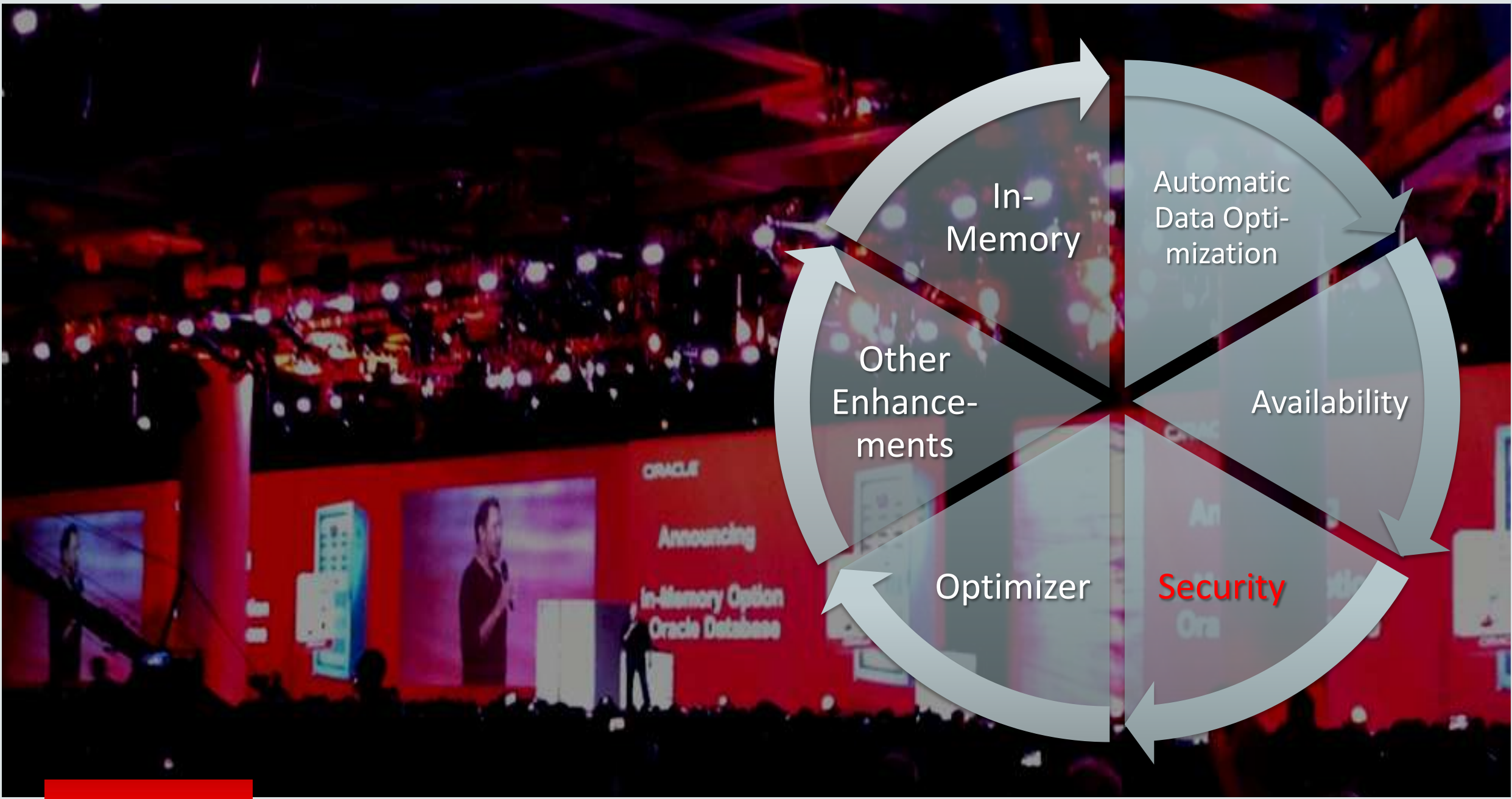
- Removal of One to One Mapping and HA



# Fine-grained Table Recovery From Backup

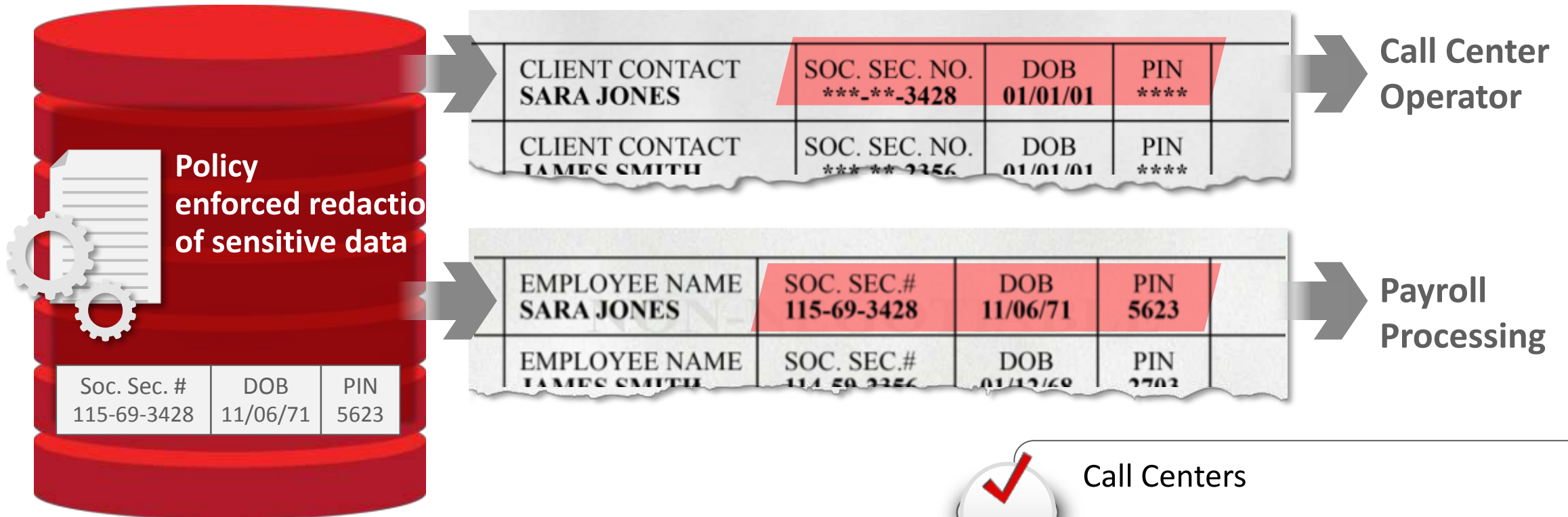


- Simple **RECOVER TABLE** command to recover one or more tables (most recent or older version) from an RMAN backup
- Eliminates time and complexity associated with manual restore, recover & export



# Redacting Sensitive Data

## Mask Application Data Dynamically



- ✓ Call Centers
- Decision Support Systems
- Systems with PII, PHI, PCI data

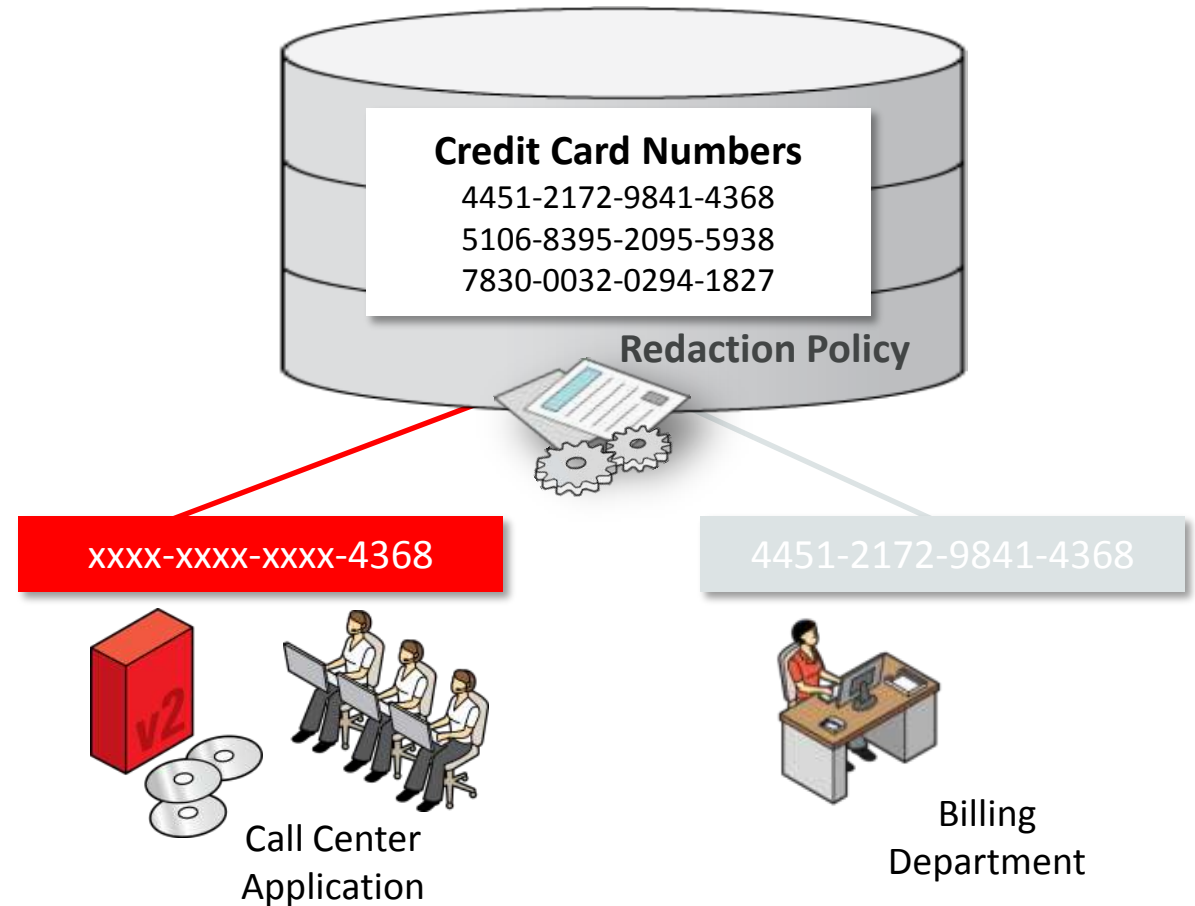


# Redaction of Sensitive Data Displayed

## Preventive Control for Oracle Database 12c

### Oracle Advanced Security

- Real-time sensitive data redaction based on database session context
- Library of redaction policies and point-and-click policy definition
- Consistent enforcement, policies applied to data
- Transparent
- Backported to Oracle 11.2.0.4

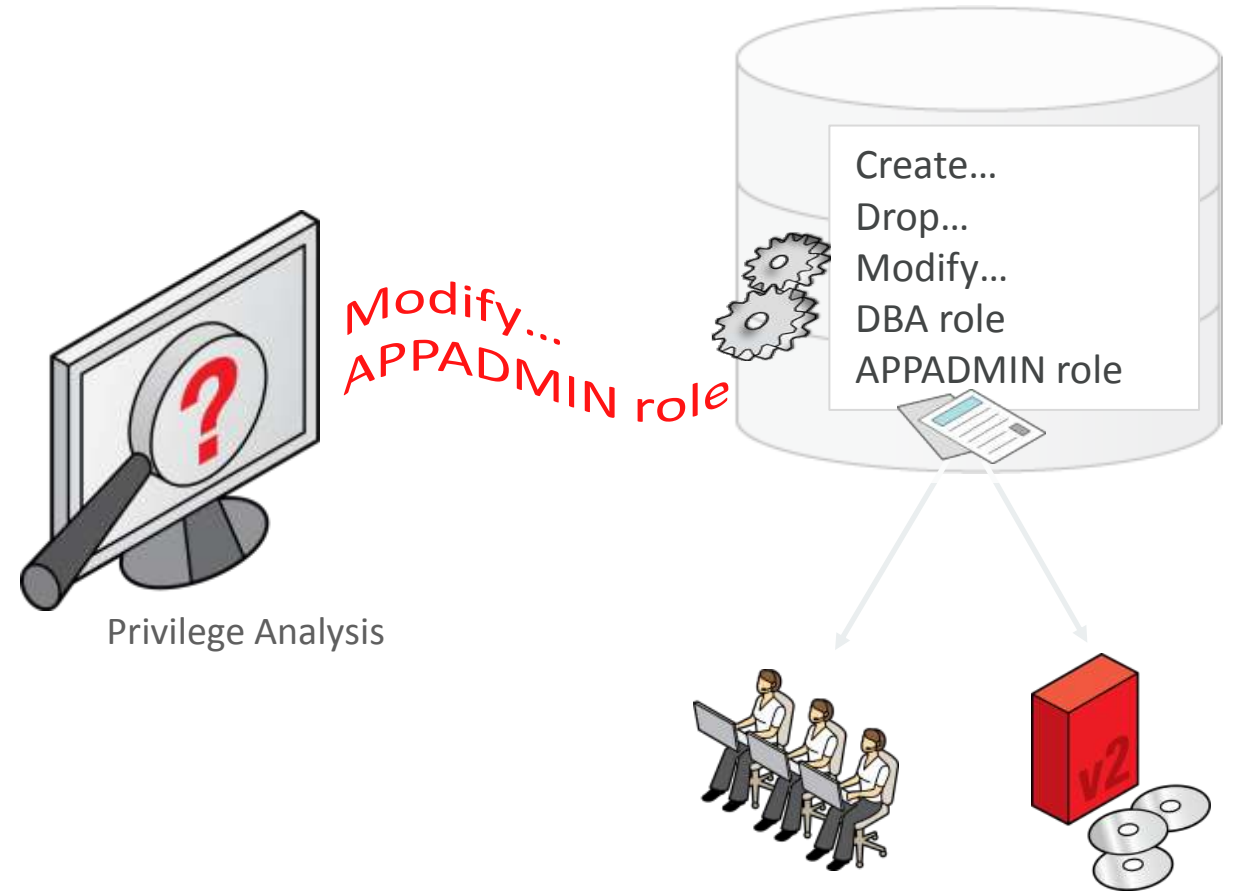


# Discover Use of Privileges and Roles

## Administrative Control for Oracle Database 12c

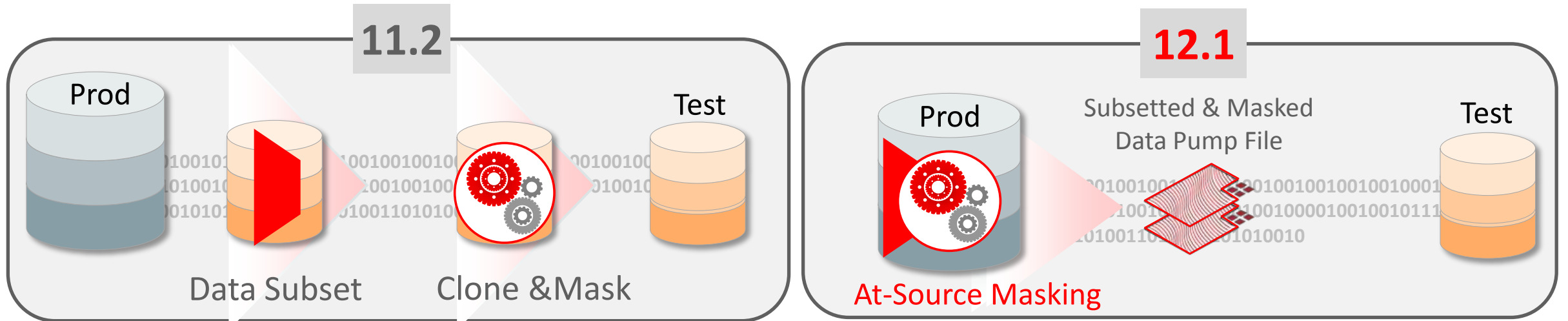
### Oracle Database 12c EE

- Turn on **privilege capture mode**
  - DBMS PRIVILEGE CAPTURE
- Report on actual privileges and roles used in the database
- Helps revoke unnecessary privileges
- Enforce least privilege and reduce risks
  - Part of **Oracle Database Vault** license



# Data Masking

## Securely Provisioning Test Systems

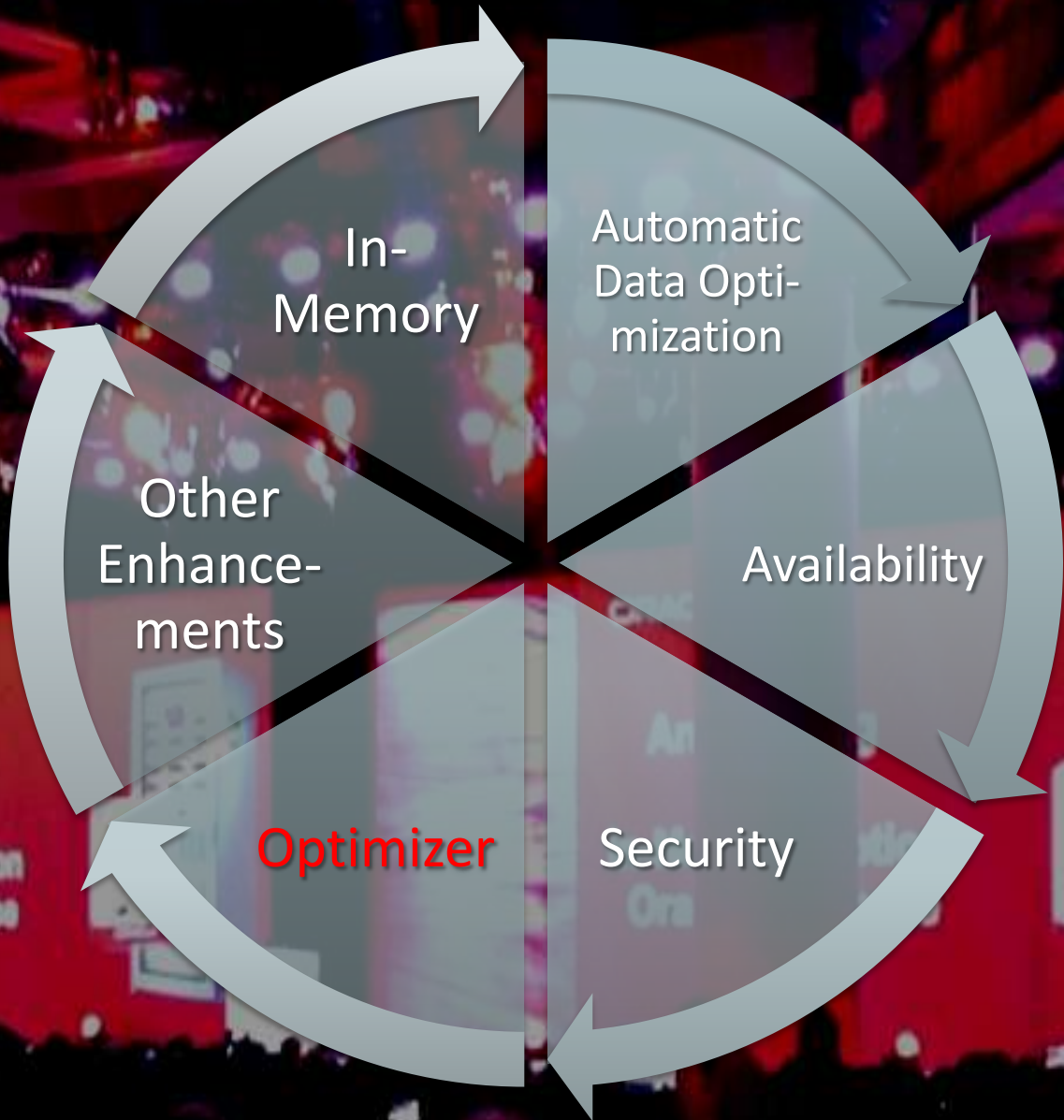
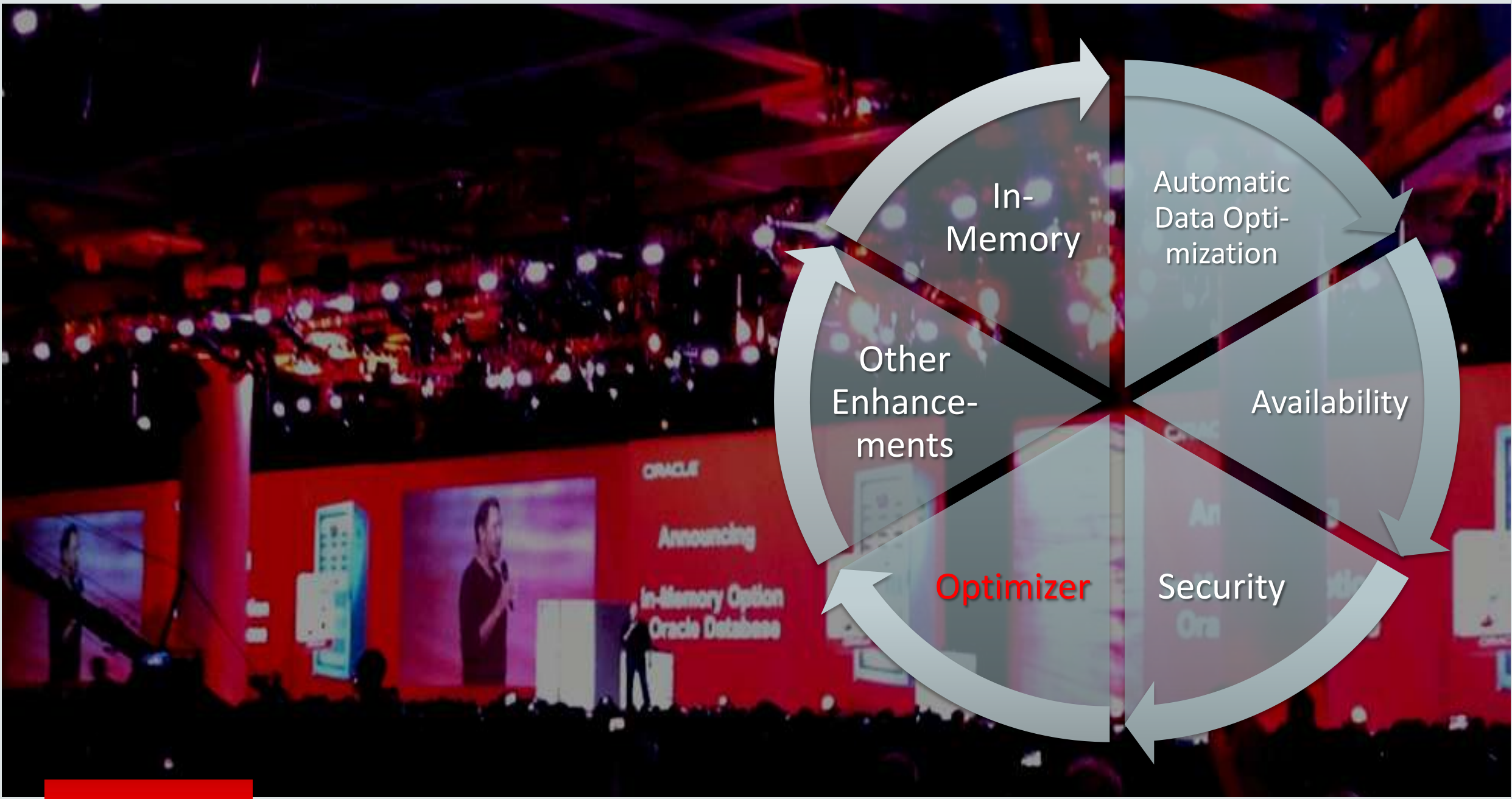


- Production data subsetted first
- Sensitive data masked separately

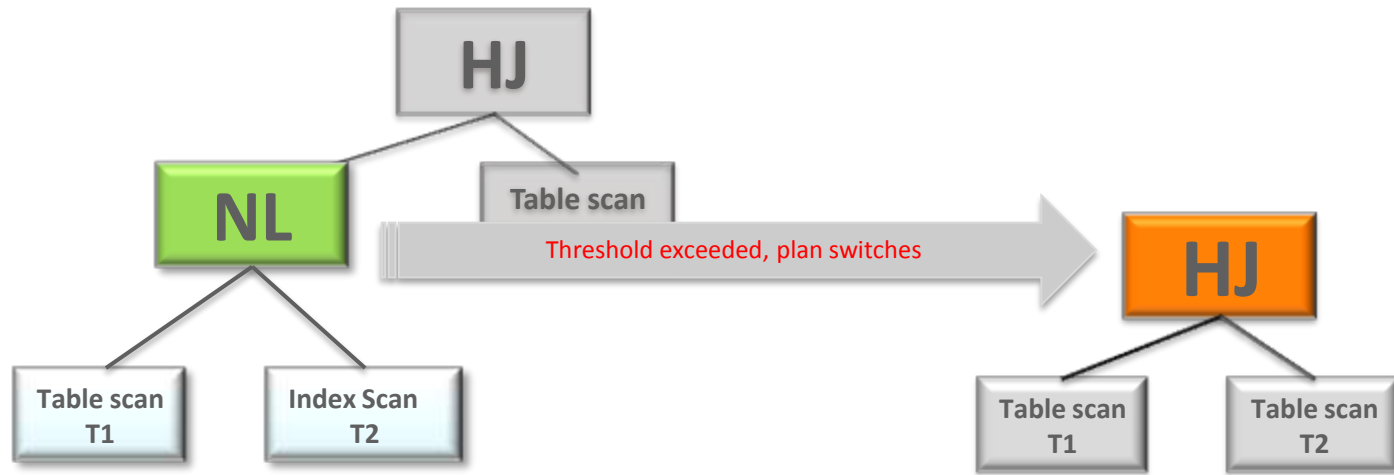
- Mask At-Source
- Minimize sensitive data exposure

# No longer part of ASO anymore!

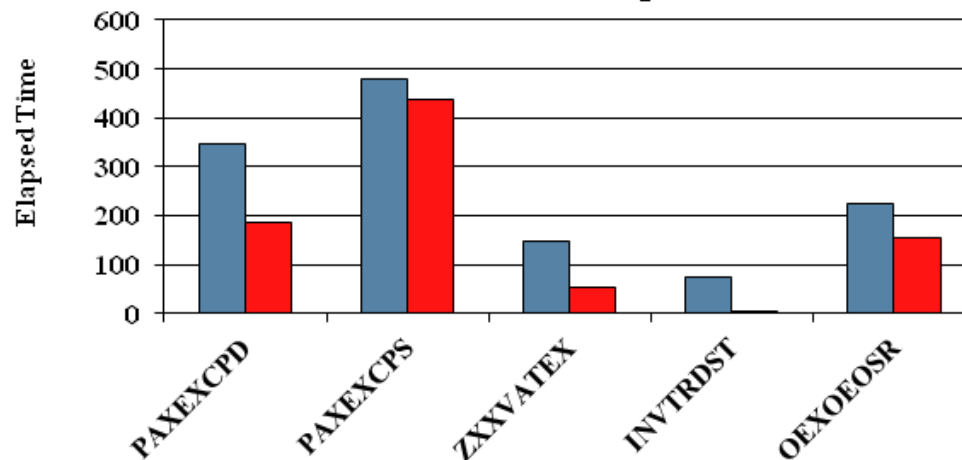
- Network encryption
  - Native and SLS/TLS
- Strong authentication services
  - Kerberos, PKI and RADIUS
- Available in all licensed editions of all supported releases



# Adaptive Execution Plans



Oracle E-Business Suite Reports



- Plan decision deferred until runtime
- Final decision is based on statistics collected during execution
- If statistics prove to be out of range, sub-plans can be swapped
- Bad effects of skew eliminated
- `_optimizer_adaptive_plans`

# Statistic Enhancements with Oracle Database 12c

- New types of histograms
  - Top Frequency and Hybrid
- Online statistics gathering
  - Statistics gathered as part of CTAS or IAS commands
- Session level statistics for GTTs
  - Private statistics for GTT on per session basis - GLOBAL\_TEMP\_TABLE\_STATS is SESSION per default
- Enhanced incremental statistics
- Automatic detection of column groups
- Statistic gathering reporting

# Simplified Analysis of Big Data

## Pattern Matching

Ascending Order

| TID  | NAME | PRICE  | TIME     |
|------|------|--------|----------|
| 3415 | ORCL | 33.21  | 10:11:50 |
| 2341 | ORCL | 33.11  | 10:11:57 |
| 3401 | IBM  | 197.54 | 10:11:59 |
| 2202 | AAPL | 409.27 | 10:12:00 |
| 7838 | AAPL | 33.10  | 10:12:01 |
| 7309 | ORCL | 33.11  | 10:12:02 |
| 7499 | ORCL | 33.12  | 10:12:03 |
| 7521 | ORCL | 33.11  | 10:12:04 |
| 7566 | IBM  | 196.59 | 10:12:05 |
| 7654 | IBM  | 196.54 | 10:12:06 |
| 7698 | IBM  | 196.22 | 10:12:07 |
| 7782 | APPL | 409.53 | 10:12:08 |
| 7783 | APPL | 409.56 | 10:12:09 |
| 2229 | APPL | 410.11 | 10:12:10 |
| 2221 | APPL | 410.56 | 10:12:11 |
| 7552 | APPL | 409.66 | 10:12:12 |
| 2335 | APPL | 33.45  | 10:12:13 |
| 1252 | ORCL | 33.67  | 10:12:14 |
| 2278 | ORCL | 33.67  | 10:12:15 |
| 2278 | ORCL | 24.96  | 10:12:16 |
| 2231 | HPQ  | 183.22 | 10:12:17 |
| 6777 | IBM  | 25.35  | 10:12:18 |
| 1969 | HPQ  | 412.45 | 10:12:19 |
| 2251 | APPL | 33.67  | 10:12:19 |
| 9997 | ORCL | 33.78  | 10:12:20 |
| 2346 | ORCL | 33.78  | 10:12:20 |

```
Select * from
Ticker MATCH_RECOGNIZE (
...
PATTERN(X+ Y+ W+ Z+)
...
DEFINE X AS (price < PREV(price)),
       Y AS (price > PREV(price)),
       W AS (price < PREV(price)),
       Z AS (price > PREV(price))
...
)
```



- Scalable discovery of business event sequences
  - Clickstream logs: sessionization, search behaviour
  - Financial transactions: fraud detection, double bottom (“W”) stock analysis
  - Telco: dropped calls
  - Medical sensors: automated medical observations and detections



# Pattern Matching

## Finding Double Bottom (W)

```
    }
    next = lineNext.getQuantity();
}

if (q.isEmpty() || eq(q, prev)) {
    state = "F";
    return state;
}

return state;
}

private boolean eq(String a, String b) {
    if (a.isEmpty() || b.isEmpty()) {
        return false;
    }
    return a.equals(b);
}

private boolean gt(String a, String b) {
    if (a.isEmpty() || b.isEmpty()) {
        return false;
    }
    return Double.parseDouble(a) > Double.parseDouble(b);
}

private boolean lt(String a, String b) {
    if (a.isEmpty() || b.isEmpty()) {
        return false;
    }
    return Double.parseDouble(a) < Double.parseDouble(b);
}

public String getState() {
    return this.state;
}
}
BadFactorv badFactorv = BadFactorv.getInstance();
```

```
SELECT first_x, last_z
FROM ticker MATCH_RECOGNIZE (
    PARTITION BY name ORDER BY time
    MEASURES FIRST(x.time) AS first_x,
             LAST(z.time) AS last_z
    ONE ROW PER MATCH
    PATTERN (X+ Y+ W+ Z+)
    DEFINE X AS (price < PREV(price)),
           Y AS (price > PREV(price)),
           W AS (price < PREV(price)),
           Z AS (price > PREV(price) AND
                z.time - FIRST(x.time) <= 7 ))
```

250+ Lines of Java and PIG

12 Lines of SQL

20x less code, 5x faster

# Optimizer with Oracle Database 12c

- What to expect from the Optimizer in Oracle Database 12c

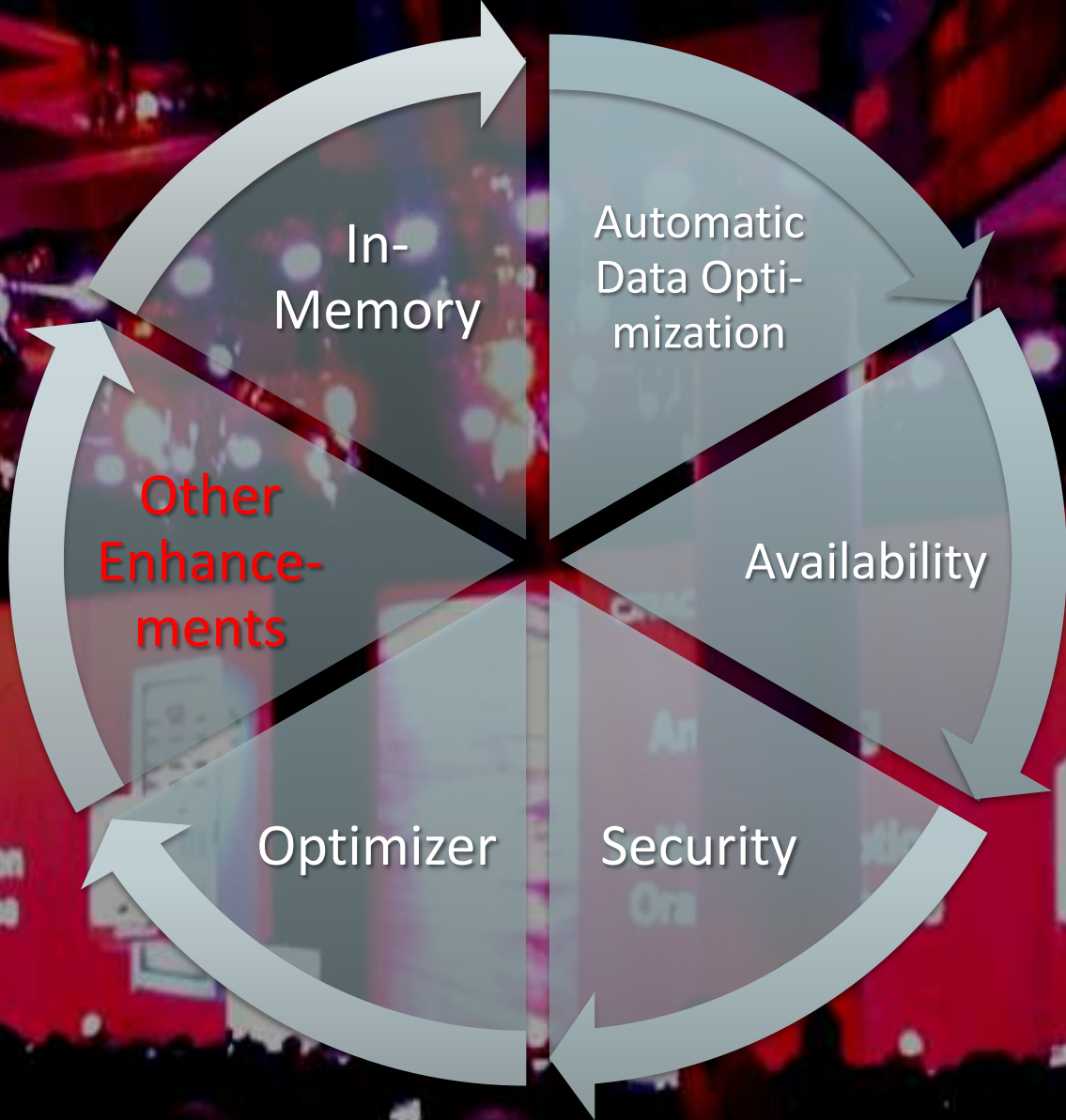
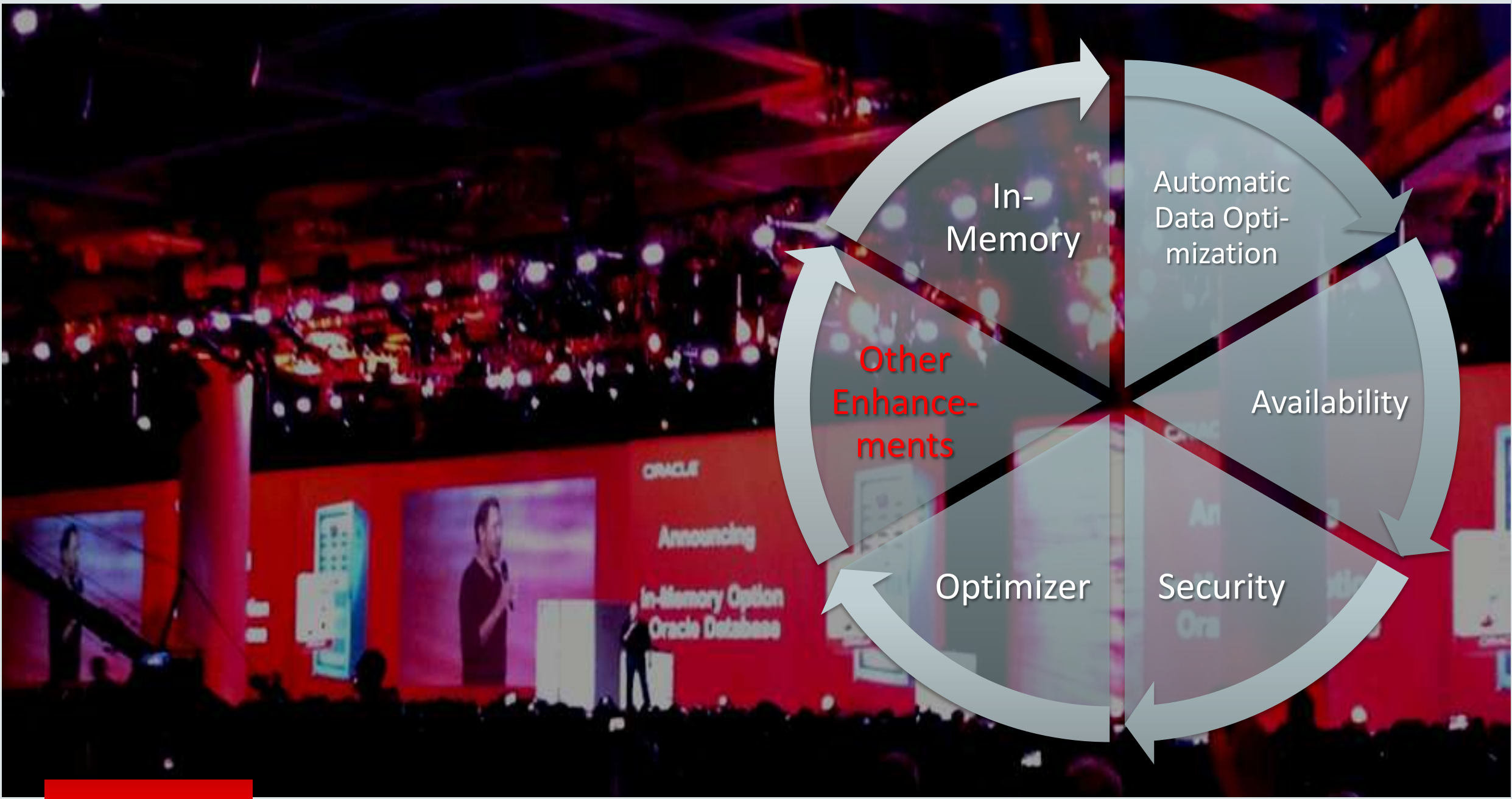
- <http://www.oracle.com/technetwork/database/bi-datawarehousing/twp-optimizer-with-oracledb-12c-1963236.pdf>

Oracle White Paper  
June 2013

Optimizer  
with Oracle Database 12c

# Various 12c optimizer parameters

- Please test carefully:
  - `optimizer_dynamic_sampling`
- Please disable:
  - `_optimizer_adaptive_plans=FALSE`
  - `_optimizer_aggr_groupby_elim=FALSE`
  - `_optimizer_unnest_scalar_sq=FALSE`
  - `_rowsets_enabled=FALSE`
  - `_optimizer_reduce_groupby_key=FALSE`
  - `_kks_obsolete_dump_threshold=0` or `8`



# Online Move of Datafiles

- Rename or relocate datafiles online [EE Feature]
  - Move from one type of storage to another, or into ASM
  - Examples:

- Rename:

```
ALTER DATABASE MOVE DATAFILE '/data/user1.dbf' TO  
'/data/user001.dbf';
```

- Relocate:

```
ALTER DATABASE MOVE DATAFILE '/data/user1.dbf' TO  
'/test/user1.dbf';
```

- Copy:

```
ALTER DATABASE MOVE DATAFILE '/data/user1.dbf' TO  
'/test/user1.dbf' KEEP;
```

# IDENTITY

- Example:

Create a table where the id column is always populated by Oracle

```
CREATE TABLE t1
(id NUMBER GENERATED AS IDENTITY,
 first_name varchar2(30));
INSERT INTO t1(first_name) values ('Hugo');
```

| <i>ID</i> | <i>FIRST_NAME</i> |
|-----------|-------------------|
| 1         | Hugo              |

Create a table where the id column is populated by Oracle when not provided

```
CREATE TABLE t2
(id NUMBER GENERATED BY DEFAULT AS IDENTITY
 (START WITH 100 INCREMENT BY 10),
 first_name varchar2(30));
```

# Row Limit

- Example:

Select only the first 5 rows

```
SELECT employee_id, last_name
FROM employees
ORDER BY employee_id
FETCH FIRST 5 ROWS ONLY;
```

Select the first 5% of rows and those whose salary “ties” with the lowest of the 5%

```
SELECT employee_id, last_name, salary
FROM employees
ORDER BY salary
FETCH FIRST 5 PERCENT ROWS WITH TIES;
```

# 32K VARCHAR2 / NVARCHAR2

- **Example:**

Enable 32k support in the Oracle Database 12c

```
ALTER SYSTEM set MAX_STRING_SIZE=EXTENDED scope=SPFILE;
```

```
SHUTDOWN IMMEDIATE  
STARTUP UPGRADE  
@?/rdbms/admin/utl32k.sql
```

Create table with 32k varchar2

```
CREATE TABLE Applicants  
(id NUMBER GENERATED AS IDENTITY,  
first_name varchar2(30),  
last_name varchar2(30),  
application date,  
CV varchar2(32767)  
);
```



# Enterprise Manager Express

ORACLE Enterprise Manager Database Express 12c

SDB2 (12.1.0.0.2) Configuration Storage Security Performance

Help SYSTEM Log Out

Database Home Page Refreshed 5:54:47 PM GMT-0700 Auto Refresh 1 Minute

**Status**

Up Time: 2 days, 7 hours, 4 minutes, 18 seconds  
 Type: Single Instance (sdb2)  
 Version: 12.1.0.0.2 Enterprise Edition  
 Database Name: SDB2  
 Platform Name: Linux x86 64-bit  
 Host Name: slc02kor  
 Oracle Home: /ade/b/4123031419/oracle  
 Instance Name: sdb2  
 Thread: 1  
 Archiver: Stopped

**Performance**

Activity Class: Services

Legend: CPU Cores (red), Wait (orange), User I/O (blue), CPU (green)

**Incidents - Last 24 Hours**

| Ins... | Time         | Inci... | Pro... | Error       |
|--------|--------------|---------|--------|-------------|
| 1      | Fri Jun 8... | 2713    | 1      | exceptio... |

**Resources**

**Host CPU**

**Active Sessions**

**Memory**

**Data Storage**

**Running Jobs**

| Ins... | Owner | Name | Ela... | Started |
|--------|-------|------|--------|---------|
|        |       |      |        |         |
|        |       |      |        |         |
|        |       |      |        |         |
|        |       |      |        |         |
|        |       |      |        |         |

**SQL Monitor - Last Hour (20 max)**

| Status | Duration | ID            | Sessi... | Parallel | Database Time | SQL Text   |
|--------|----------|---------------|----------|----------|---------------|------------|
|        | 29.0m    | 3j3t587bt0vqw | 34       |          | 3.4m          | declare    |
|        | 12.0s    | 6kd5jj7kr8swv | 34       |          | 3.3s          | SELECT ... |
|        | 12.0s    | 6kd5jj7kr8swv | 34       |          | 3.0s          | SELECT ... |
|        | 12.0s    | 6kd5jj7kr8swv | 34       |          | 3.3s          | SELECT ... |
|        | 12.0s    | 6kd5jj7kr8swv | 34       |          | 3.4s          | SELECT ... |
|        | 12.0s    | 6kd5jj7kr8swv | 34       |          | 3.1s          | SELECT ... |



# Enterprise Manager Express

- Manual configuration of the HTTP port for EM Express
  - In init.ora/spfile (default setting):
    - `dispatchers=(PROTOCOL=TCP) (SERVICE=sample XDB)`
  - Check on which port EM Express is configured:
    - `SQL> select DBMS_XDB_CONFIG.getHTTPport() from dual;`
      - `SQL> select DBMS_XDB_CONFIG.getHTTPSport() from dual;`
  - Set a new port:
    - `SQL> exec DBMS_XDB_CONFIG.setHTTPport(5500);`
      - `SQL> exec DBMS_XDB_CONFIG.setHTTPSport(8080);`
  - Now access the EM Express homepage in the browser:
    - `http://database-hostname:port/em`
      - <http://localhost:5500/em>
  - The configuration will have to be done for the CDB and every single PDB on different ports

# Enterprise Manager Cloud Control 12c

- Discovered Oracle Database 12c targets:

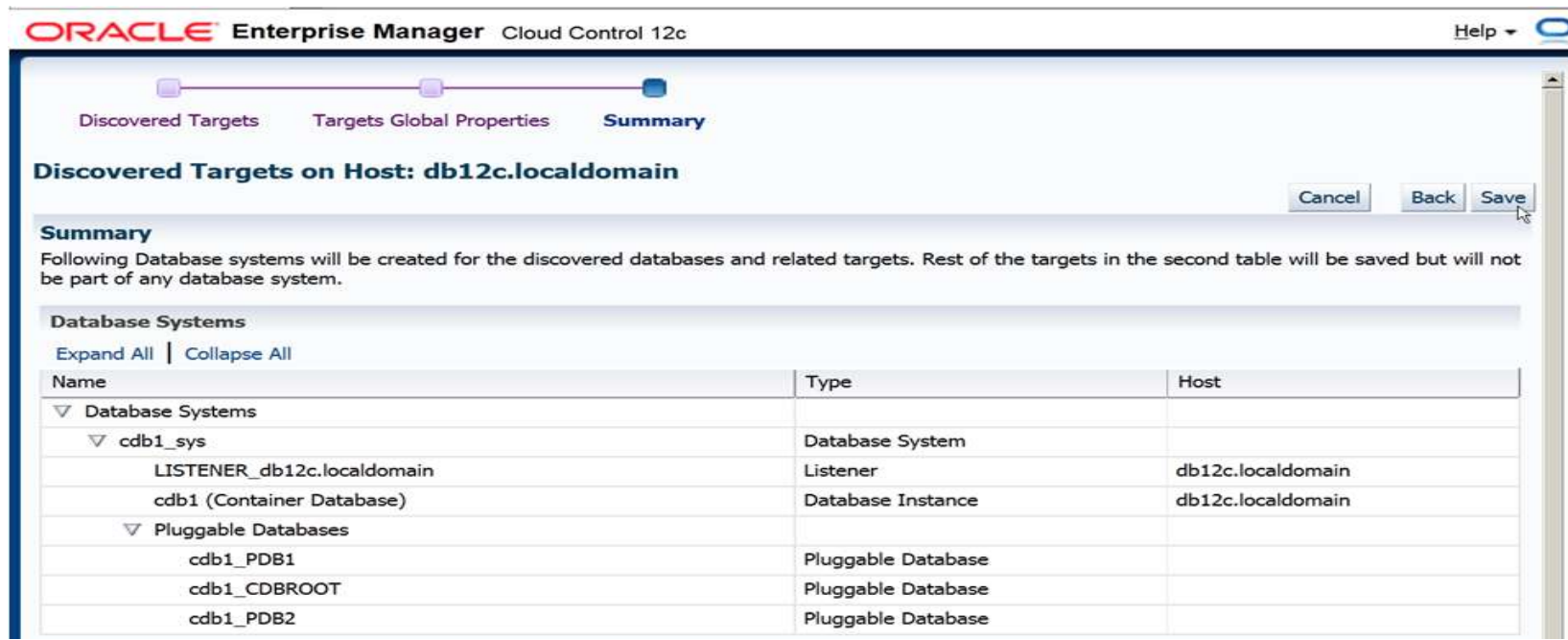
The screenshot shows the Oracle Enterprise Manager Cloud Control 12c interface. The top navigation bar includes 'ORACLE Enterprise Manager Cloud Control 12c', user 'SYSMAN', and 'Log Out'. The main content area is titled 'Databases' and shows a search list of database targets. The table below displays the discovered targets:

| Name                  | Type                          | Status | Target Version | Incidents |   |   | Average Compliance Score |
|-----------------------|-------------------------------|--------|----------------|-----------|---|---|--------------------------|
|                       |                               |        |                |           |   |   |                          |
| ▼ cdb1                | Database Instance : Container |        | 12.1.0.1.0     | 0         | 0 | 0 |                          |
| ▼ Pluggable Databases |                               | n/a    |                | 0         | 0 | 0 | n/a                      |
| cdb1_PDB1             | Pluggable Database            |        | 12.1.0.1.0     | 0         | 0 | 0 |                          |
| cdb1_PDB2             | Pluggable Database            |        | 12.1.0.1.0     | 1         | 0 | 0 |                          |
| emrep                 | Database Instance             |        | 11.2.0.3.0     | 0         | 0 | 0 | n/a                      |
| saiproduct            | Database Instance             |        | 11.2.0.3.0     | 0         | 0 | 0 | n/a                      |



# Enterprise Manager Cloud Control 12c

- Plug-in "*Enterprise Manager For Oracle Database (DB) 12.1.0.4*" already released via EM Self-Update
  - Supports Oracle Database 12.1.0.2
  - Discovers CDBs and PDBs



The screenshot displays the Oracle Enterprise Manager Cloud Control 12c interface. The top navigation bar includes the Oracle logo, "Enterprise Manager Cloud Control 12c", and a "Help" dropdown menu. Below the navigation bar, there are three tabs: "Discovered Targets", "Targets Global Properties", and "Summary", with "Summary" being the active tab. The main content area is titled "Discovered Targets on Host: db12c.localdomain" and includes "Cancel", "Back", and "Save" buttons. A "Summary" section provides a brief overview: "Following Database systems will be created for the discovered databases and related targets. Rest of the targets in the second table will be saved but will not be part of any database system." Below this, a "Database Systems" section contains "Expand All" and "Collapse All" links. A table lists the discovered database systems and pluggable databases.

| Name                       | Type               | Host              |
|----------------------------|--------------------|-------------------|
| Database Systems           |                    |                   |
| cdb1_sys                   | Database System    |                   |
| LISTENER_db12c.localdomain | Listener           | db12c.localdomain |
| cdb1 (Container Database)  | Database Instance  | db12c.localdomain |
| Pluggable Databases        |                    |                   |
| cdb1_PDB1                  | Pluggable Database |                   |
| cdb1_CDBROOT               | Pluggable Database |                   |
| cdb1_PDB2                  | Pluggable Database |                   |

# Customer Reference

## Neustar company profile



- **Neustar** is the first real-time provider of cloud-based information services and data analytics, enabling marketing and IT security professionals to promote and protect their businesses. With a commitment to privacy and neutrality, Neustar operates complex data registries and uses its expertise to deliver actionable, data-driven insights that help clients make high-value business decisions in real time, one customer interaction at a time.
- *Webcast about achieving ~300x performance gains with Oracle Spatial in Oracle Database 12c is available [here](#).*
- *More information is available at [www.neustar.biz](http://www.neustar.biz). Connect with Neustar on [Facebook](#), [Twitter](#), and [LinkedIn](#).*

# ElementOne on 12c

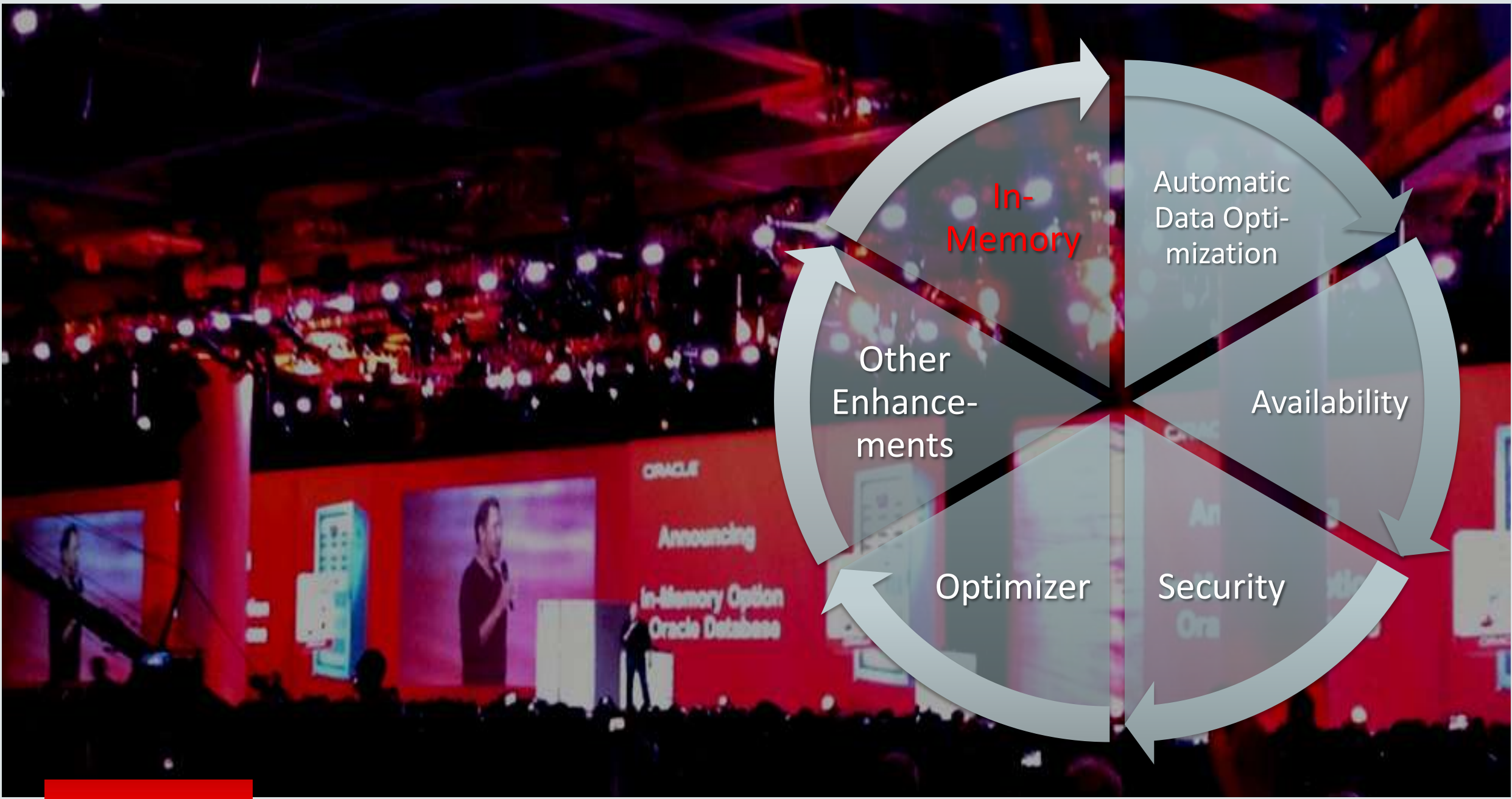
## Miscellaneous Features

- Reduction in redo/undo generation using global temporary tables resulting in **1.7x** performance boost
- **2x** performance gains with inline PL/SQL functions
- Up to **10x** faster processing time with constructing large CLOBs / BLOBs
- Faster response times with cross session result set cache

"Our experience with upgrade has been very positive, upgrading to 12c, and we have been very impressed with the robustness of 12c."

**Nick Salem**

Distinguished Engineer  
Neustar, Inc.



In-Memory

Automatic Data Optimization

Availability

Other Enhancements

Optimizer

Security



# Optimizing Transaction and Query Performance

## Row Format Databases versus Column Format Databases

Row



- Transactions run faster on row format
  - Insert or query a sales order
  - Fast processing few rows, many columns

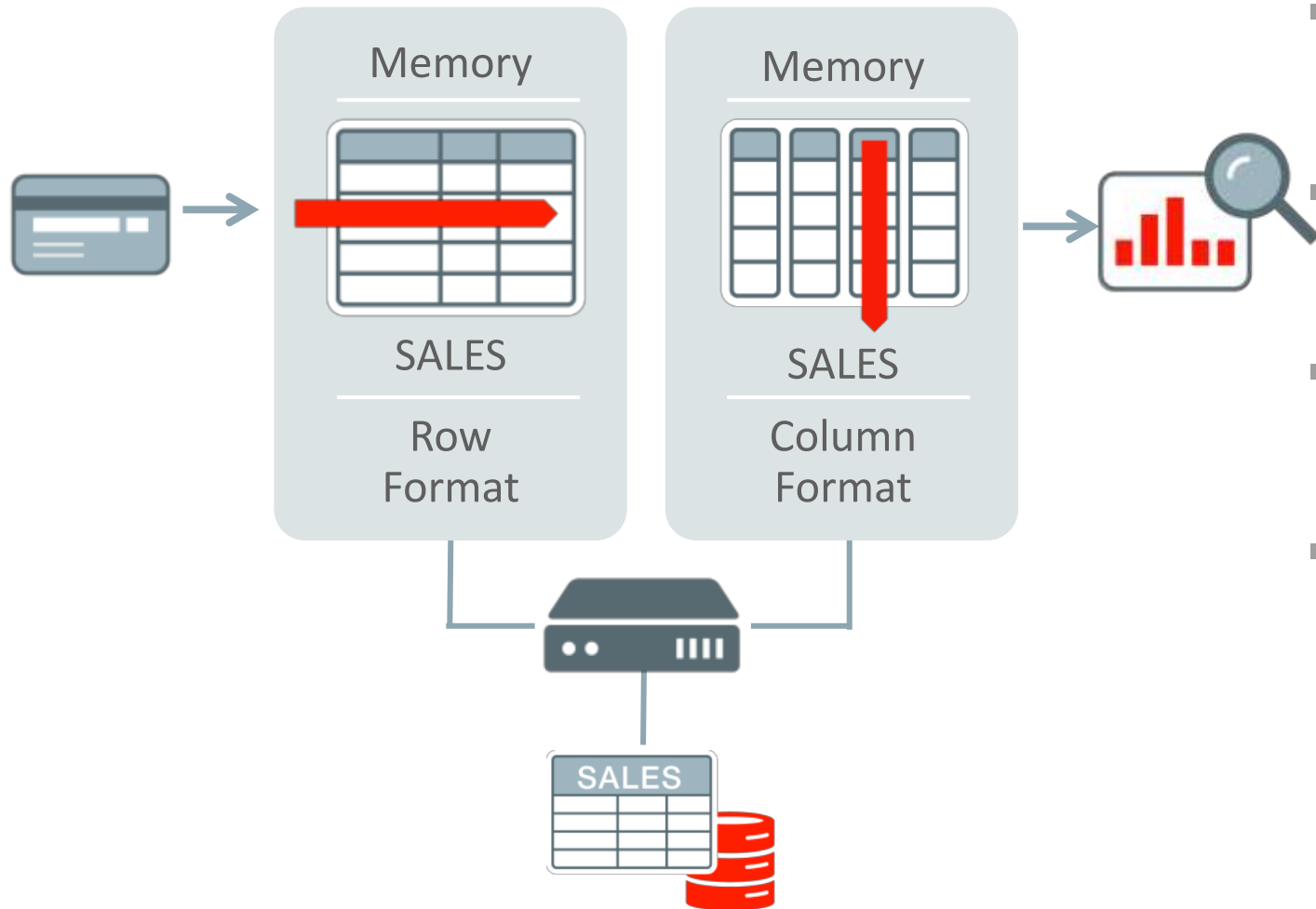
Column



- Analytics run faster on column format
  - Example : Report on sales totals by region
  - Fast accessing few columns, many rows

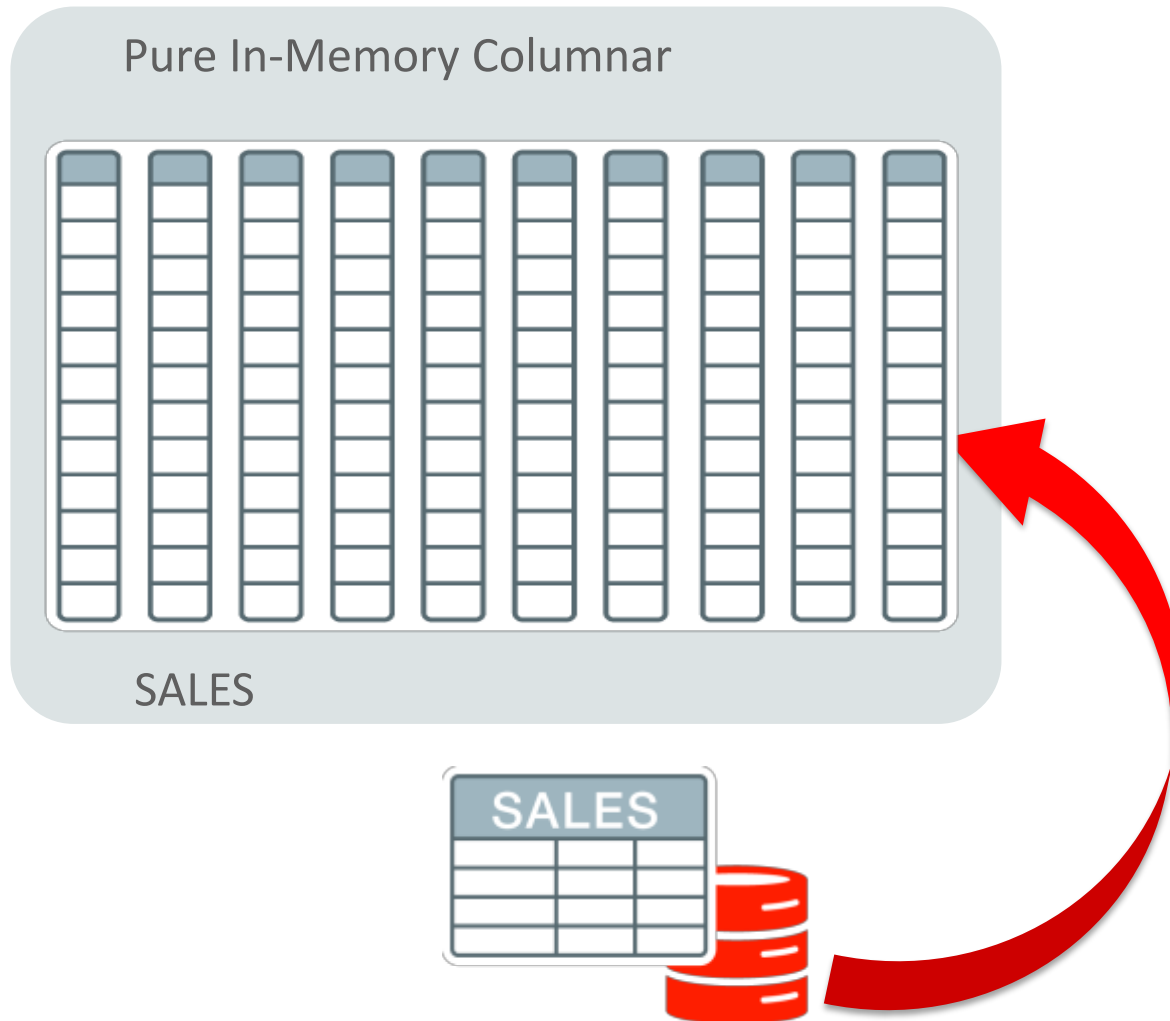
Until Now Must Choose One Format and Suffer Tradeoffs

# Dual Format In-Memory Database



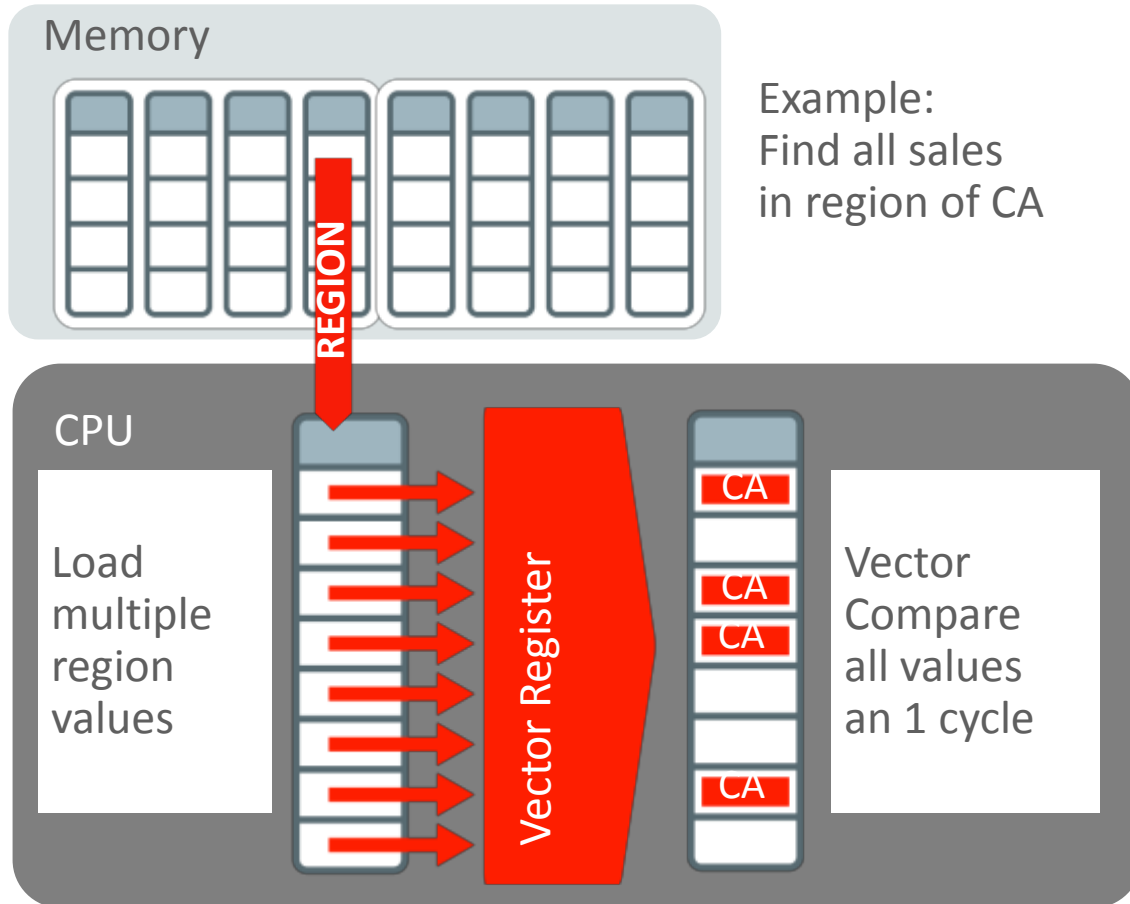
- **BOTH** row and column in-memory formats for same table
- Simultaneously active and transactionally consistent
- Analytics & reporting use new in-memory Column format
- OLTP uses proven row format

# Oracle In-Memory Columnar Technology



- Pure in-memory column format
  - Not persistent, and no logging
  - Quick to change data: fast OLTP
- 2x to 20x compression
- Enabled at table/partition level
- Available on all hardware platforms

# Orders of Magnitude Faster Analytic Data Scans

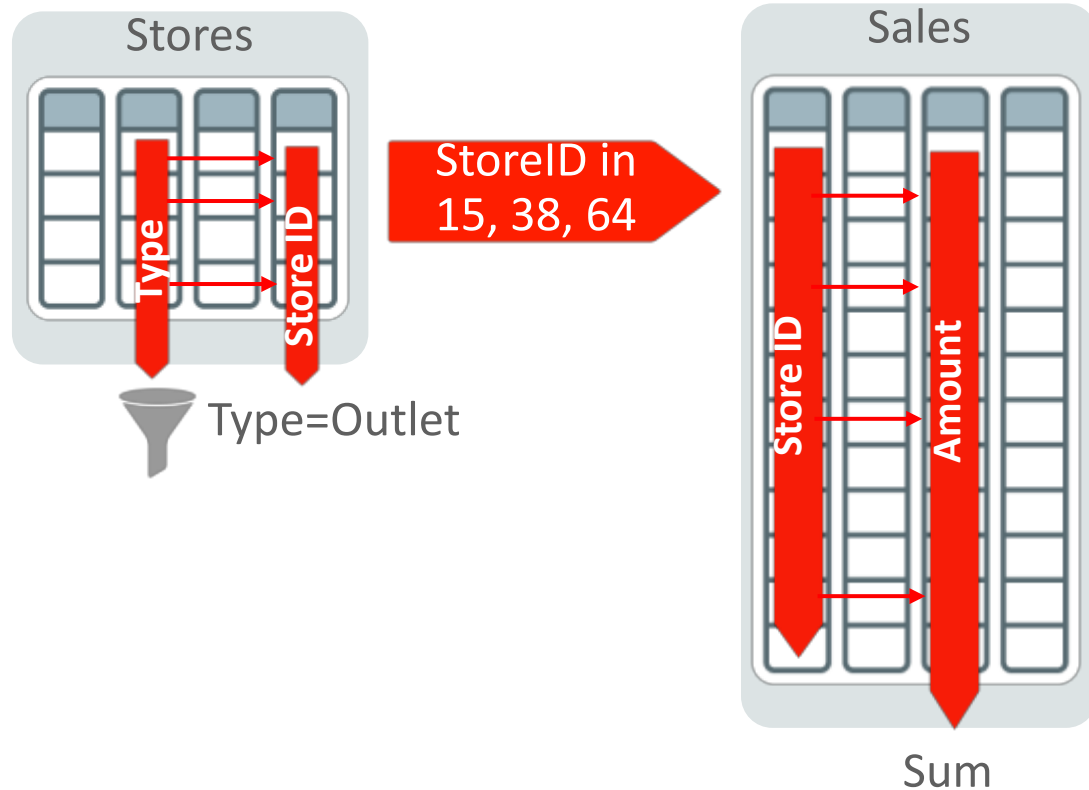


> 100x Faster

- Each CPU core scans local in-memory columns
- Scans use super fast SIMD vector instructions
- Originally designed for graphics & science
- **Billions of rows/sec** scan rate per CPU core
- Row format is millions/sec

# Joining and Combining Data Also Dramatically Faster

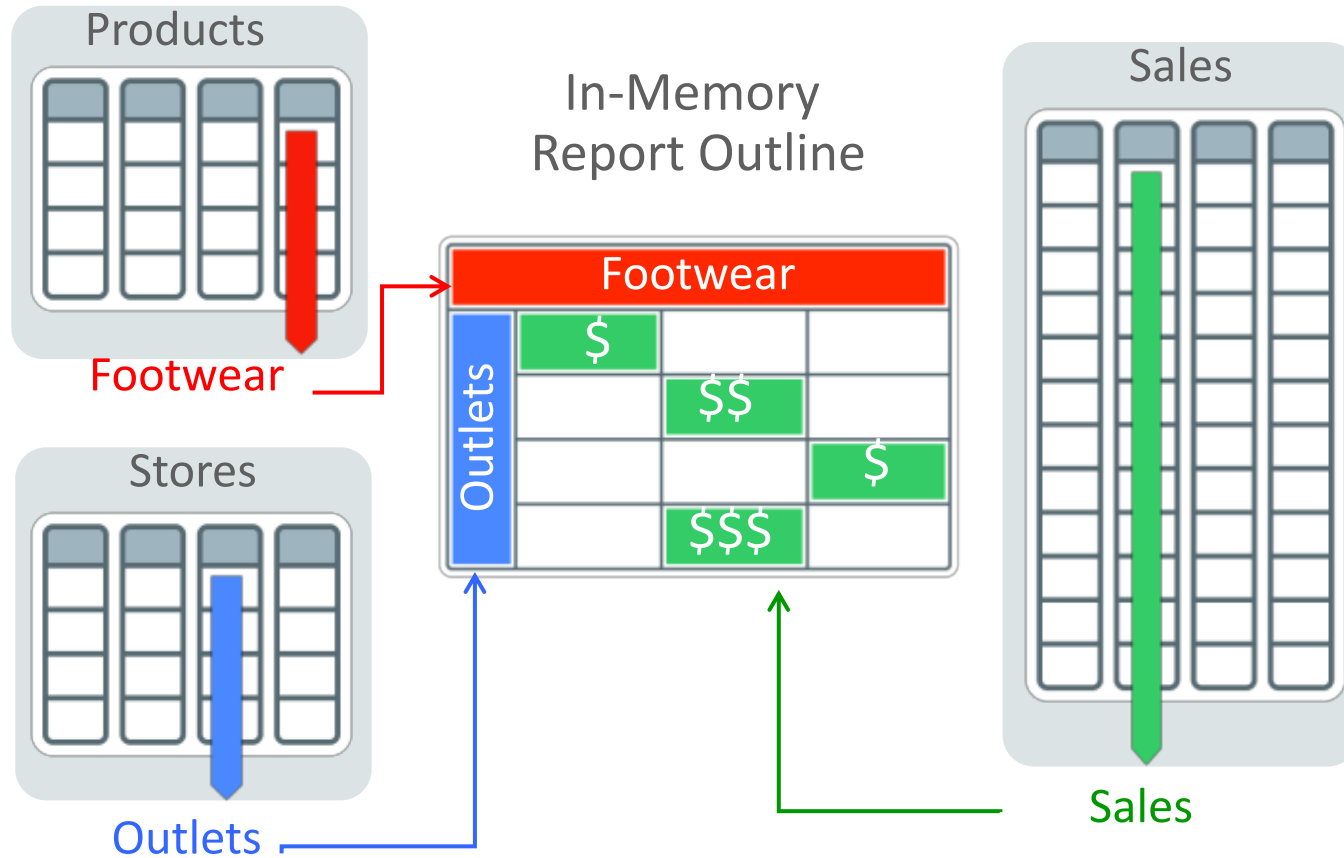
**Example:** Find total sales in outlet stores



- Converts joins of data in multiple tables into fast column scans
- Joins tables **10x** faster

# Generates Reports Instantly

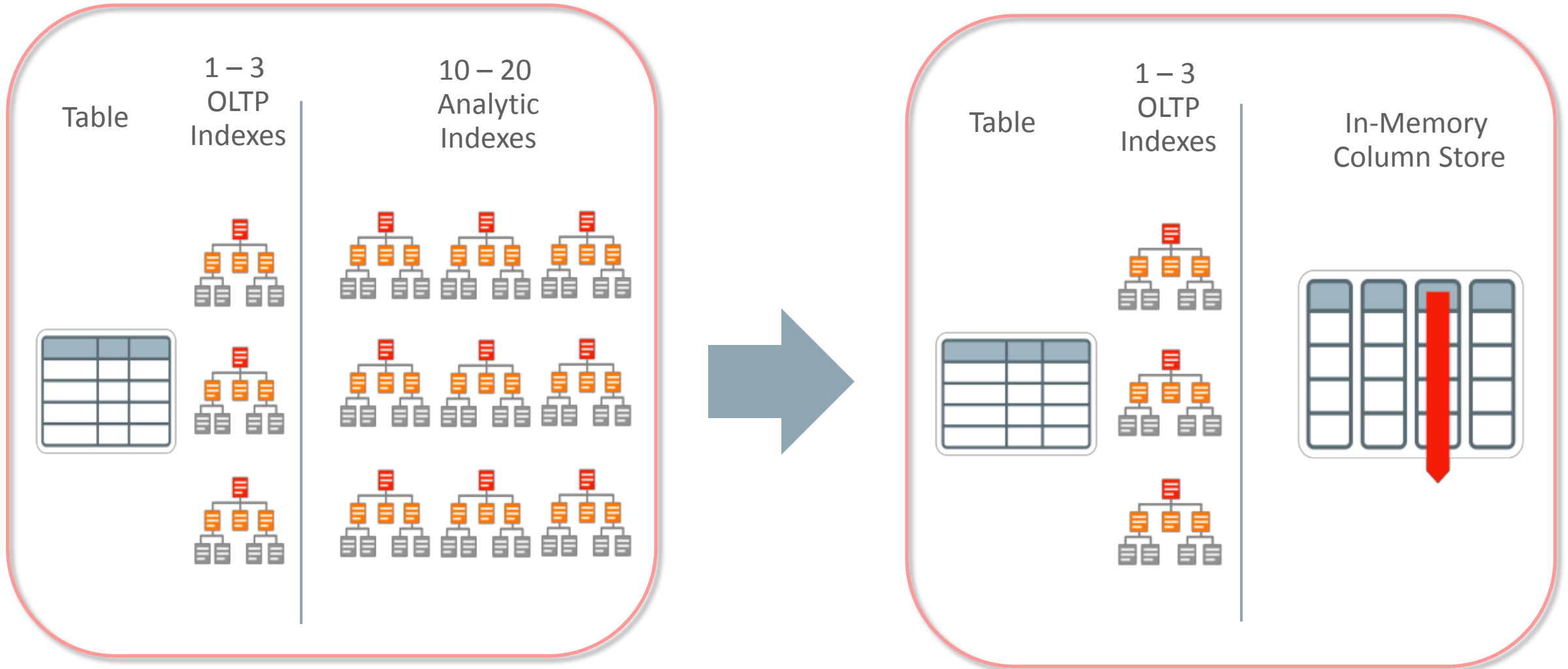
**Example:** Report sales of footwear in outlet stores



- Dynamically creates in-memory report outline
- Then report outline filled-in during fast fact scan
- Reports run much faster without predefined cubes

# Complex OLTP is Slowed by Analytic Indexes

## Column Store Replaces Analytic Indexes



# Oracle In-Memory: Simple to Implement

1. Configure Memory Capacity

```
inmemory_size = XXX GB
```

2. Configure tables or partitions to be in memory

```
alter table | partition ... inmemory;
```

3. Hide - and later - drop analytic indexes to speed up OLTP



# Oracle In-Memory: Simple to Implement

- INMEMORY\_CLAUSE\_DEFAULT
- INMEMORY\_FORCE
- INMEMORY\_MAX\_POPULATE\_SERVERS
- INMEMORY\_QUERY
- INMEMORY\_SIZE
- INMEMORY\_TRICKLE\_REPOPULATE\_SERVERS\_PERCENT
- OPTIMIZER\_INMEMORY\_AWARE

- Documentation:

<http://docs.oracle.com/database/121/ADMIN/memory.htm#ADMIN14257>

- White Paper:

<http://www.oracle.com/technetwork/database/in-memory/overview/twp-oracle-database-in-memory-2245633.html>

# Oracle In-Memory Requires Zero Application Changes

**Full Functionality**

- No restrictions on SQL

**Fully Multitenant**

- No migration of data

**Fully Compatible**

- All existing applications run unchanged

**ORACLE®**  
E-BUSINESS SUITE


**ORACLE®**  
FUSION APPLICATIONS

**ORACLE®**  
JD EDWARDS

**ORACLE®**  
PEOPLESOFT

**ORACLE®**  
SIEBEL

**Uniquely Achieves All In-Memory Benefits With No Application Changes**

The background of the slide features several black silhouettes of business professionals in suits, some holding red folders, standing in a modern office environment with a grid of circular lights on the wall.

“In terms of how easy the in-memory option was to use, it was actually almost boring. It just worked - just turn it on, select the tables, nothing else to do.”

**Mark Rittman**

Chief Technical Officer  
Rittman Mead

**rittmanmead**

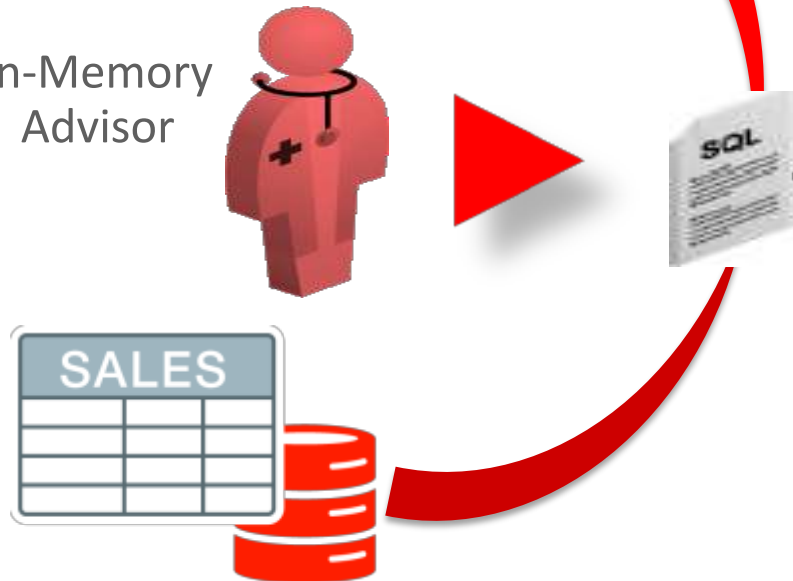


DELIVERED INTELLIGENCE

# Which tables/partitions? Oracle In-Memory Advisor

In-Memory Columnar Store

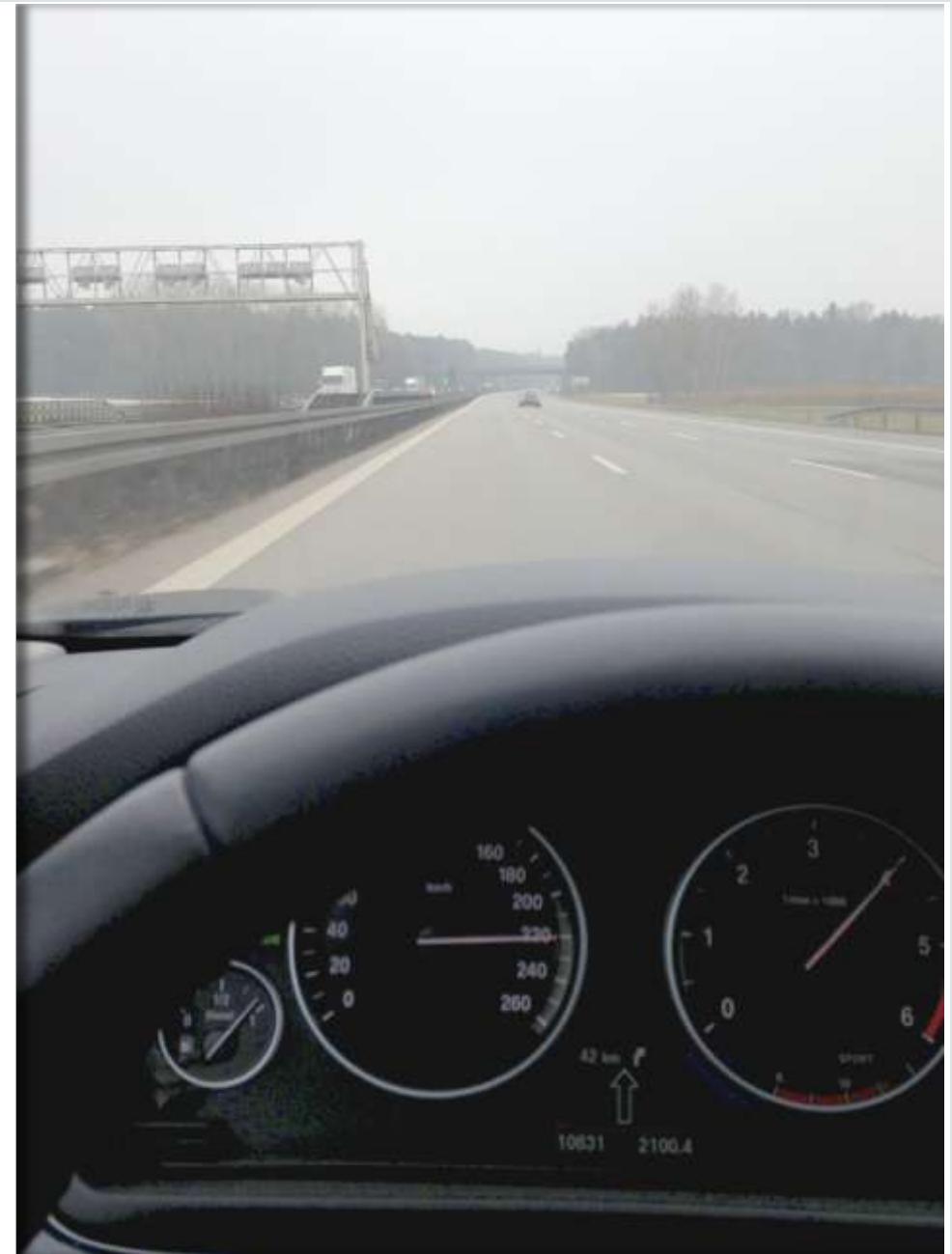
In-Memory  
Advisor



- Download the Advisor from [MOS Note: 1965343.1](https://mos.csd.oraclecorp.com/mos/notes/1965343.1)
- Install it in any 11.2.0.3 or newer database
- Will create SQL scripts to read tables/partitions into In-Mem
- Part of the Oracle **Tuning Pack** license
- Further Information on OTN: <http://www.oracle.com/technetwork/database/manageability/inmemory-advisor-2412222.html>

# Upgrade, Migrate & Consolidate

- 1 Introduction
- 2 Preparation Steps
- 3 Upgrade / Migrate / Consolidate
- 4 Fallback Strategies
- 5 New Features
- 6 Performance Management
- 7 Wrap Up



# Performance Checklist

## Prepare

- Adjust maintenance windows
- Configure statistics retention
- Configure incremental statistics
- Adjust memory and optimizer parameters
- Configure AWR, ASH and ADDM

## Stability

- Preserve and transport execution plans

## Test

- General test guidelines
- Real Application Testing

## Optimize

- System Statistics
- Automatic Tuning Advisor

## Features

- Enable Performance Features

# Things to do right after upgrade

- Adjust **default maintenance windows**

- Check:



```
SQL> select CLIENT_NAME, STATUS from DBA_AUTOTASK_CLIENT;
```

- Default:

- Week**day** windows: 10pm to 2am (4 hours)
    - Week**end** windows: 6am to 2am (20 hours)


- Resource Manager is active

Maintenance Window Group Assignment



| Window           | Optimizer Statistics Gathering      |                          | Segment Advisor                     |                          | Automatic SQL Tuning                |                          |
|------------------|-------------------------------------|--------------------------|-------------------------------------|--------------------------|-------------------------------------|--------------------------|
|                  | Select All                          | Select None              | Select All                          | Select None              | Select All                          | Select None              |
| WEDNESDAY_WINDOW | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| THURSDAY_WINDOW  | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| FRIDAY_WINDOW    | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| SATURDAY_WINDOW  | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| SUNDAY_WINDOW    | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| MONDAY_WINDOW    | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |
| TUESDAY_WINDOW   | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input checked="" type="checkbox"/> | <input type="checkbox"/> |

- Adjust windows



```
SQL> exec DBMS_SCHEDULER.SET_ATTRIBUTE(  
    'MONDAY_WINDOW', 'REPEAT_INTERVAL',  
    'freq=daily;byday=MON;byhour=05;byminute=0;  
    bysecond=0');  
SQL> exec DBMS_SCHEDULER.SET_ATTRIBUTE(  
    'MONDAY_WINDOW', 'DURATION', numtodsinterval(2, 'hour'));
```

# Things to do right after upgrade

## ▪ Configure **statistics history retention period**

- Check space usage:



```
SQL> select SPACE_USAGE_KBYTES/1024  
MB from V$SYSAUX_OCCUPANTS where  
OCCUPANT_NAME='SM/OPTSTAT';
```

- Check retention:

- Default: 31 days



```
SQL> select  
DBMS_STATS.GET_STATS_HISTORY_RETENTION from DUAL;
```

- Adjust setting

- Example: 10 days



```
SQL> exec  
DBMS_STATS.ALTER_STATS_HISTORY_RETENTION(10);
```



# Things to do right after upgrade

- Configure **incremental statistics collection**

- Set for selected partitioned tables only:



```
SQL> exec  
DBMS_STATS.SET_TABLE_PREFS ('SH', 'SALES '  
, 'INCREMENTAL', 'TRUE');
```

- Global setting:

- **Not recommended**



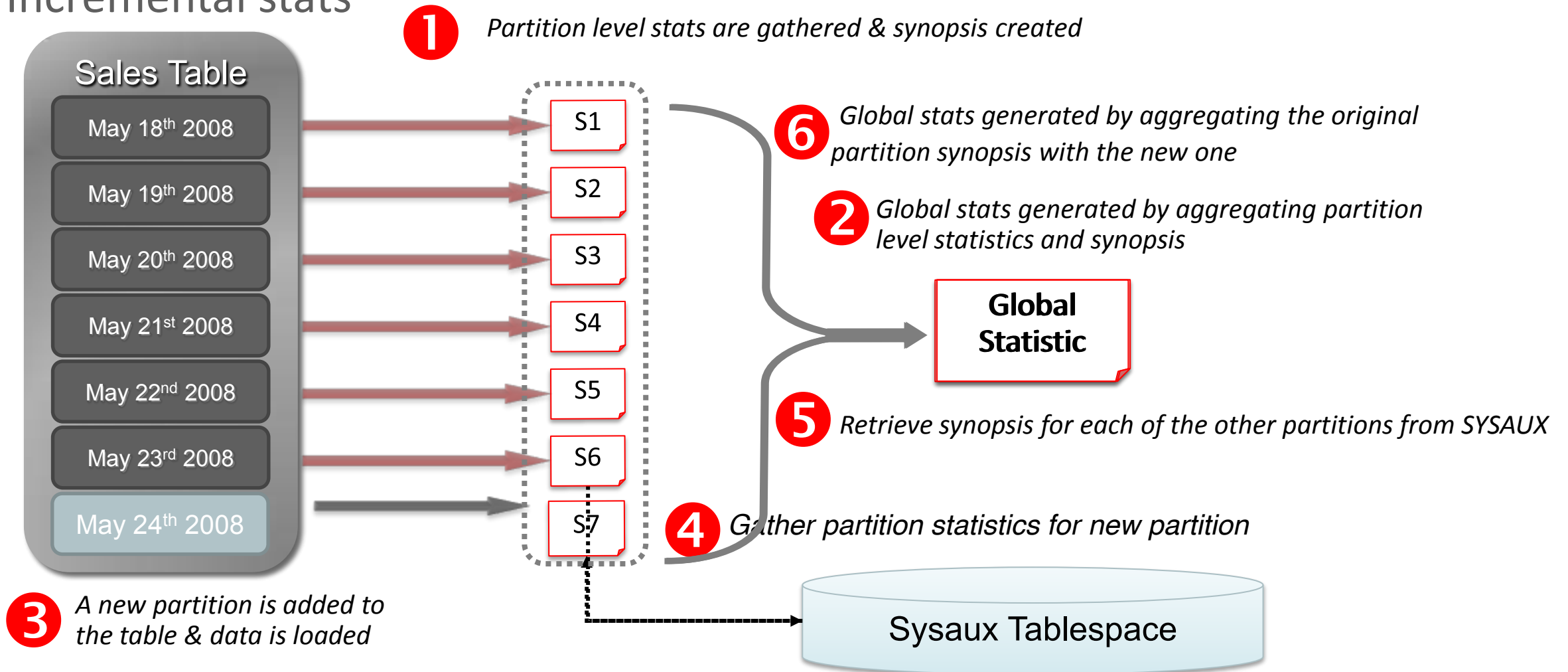
```
SQL> exec  
DBMS_STATS.SET_GLOBAL_PREFS ('INCREMENTAL', 'TRUE');
```

- Result:

- Faster statistics collection for partitioned tables
- Statistics will be generated for touched partitions only
  - Stats for that table must be gathered with GRANULARITY parameter set to AUTO
  - ESTIMATE\_PERCENT must be set to AUTO\_SAMPLE\_SIZE

# Things to do right after upgrade

## Incremental stats



# Things to do right after upgrade

**NEW**  
MEM

- **New in Oracle Database 12c**

- Incremental stats work with partition exchange

- Define that "changed" partitions won't be eligible for new stats generation **until ...**:



```
SQL> exec  
      DBMS_STATS.SET_DATABASE_PREFS ('INCREMENTAL_STALENESS', 'USE_STALE_PERCENT');
```

- ... this stale percentage is reached:



```
SQL> exec DBMS_STATS.SET_DATABASE_PREFS ('STALE_PERCENT', '12');
```

- Default would be 10% - **but only when enabled**

# Things to do right after upgrade

- [MOS Note:2107602.1 - Things to Consider When Using Incremental Statistics](#)

For 12c

| Document                            | Description                                                                          | Patch Download                 |
|-------------------------------------|--------------------------------------------------------------------------------------|--------------------------------|
| <a href="#">Document 19790972.8</a> | DBMS_STATS CAUSING LIBRARY CACHE LOCKS WITH SUBPARTITION TABLE                       | <a href="#">Patch:19790972</a> |
| <a href="#">Document 16851194.8</a> | Growth of SYSAUX tablespace with incremental statistics without growth in table data | <a href="#">Patch:16851194</a> |
| <a href="#">Document 19450139.8</a> | Slow gather table stats with incremental stats enabled                               | <a href="#">Patch:19450139</a> |
| <a href="#">Bug 21258096</a>        | UNNECESSARY INCREMENTAL PARTITION GATHERS/HISTOGRAM REGATHERS                        | <a href="#">Patch 21258096</a> |
| <a href="#">Bug 21498770</a>        | AUTOMATIC INCREMENTAL STATISTICS JOB TAKING MORE TIME ON 12.1.0.2                    | <a href="#">Patch 21498770</a> |

# Things to do right after upgrade

**NEW**  
MEM

## ■ DBMS\_STATS.REPORT\_STATS\_OPERATIONS



```
variable mystatrep2 clob;  
set long 1000000  
begin  
:mystatrep2 := DBMS_STATS.REPORT_STATS_OPERATIONS (since=>SYSTIMESTAMP-  
1,until=>SYSTIMESTAMP, detail_level=>'TYPICAL',format=>'HTML');  
end;  
/  
spool /tmp/stats.html  
print mystatrep2  
spool off
```

| Operation Id | Operation          | Target                  | Start Time                                      | End Time                                        | Status    | Total Tasks | Successful Tasks | Failed Tasks |
|--------------|--------------------|-------------------------|-------------------------------------------------|-------------------------------------------------|-----------|-------------|------------------|--------------|
| 533          | gather_table_stats | SYS.UTL_RECOMP_SORTED   | 14-NOV-14<br>03.17.47.343268<br>AM +00:00< /td> | 14-NOV-14<br>03.17.47.385371<br>AM +00:00       | COMPLETED | 1           | 1                | 0            |
| 532          | gather_table_stats | SYS.UTL_RECOMP_COMPILED | 14-NOV-14<br>03.17.47.236383<br>AM +00:00       | 14-NOV-14<br>03.17.47.280170<br>AM +00:00       | COMPLETED | 1           | 1                | 0            |
| 531          | gather_table_stats | SYS.UTL_RECOMP_SORTED   | 14-NOV-14<br>03.17.47.01867<br>2 AM +00:00      | 14-NOV-14<br>03.17.47.066938<br>AM +00:00       | COMPLETED | 1           | 1                | 0            |
| 530          | gather_table_stats | SYS.UTL_RECOMP_COMPILED | 14-NOV-14<br>03.17.46.608364<br>AM +00:00       | 14-NOV-14<br>03.17.46.972567<br>AM +00:00< /td> | COMPLETED | 1           | 1                | 0            |
| 513          | gather_table_stats | SYS.UTL_RECOMP_SORTED   | 14-NOV-14<br>03.17.42.838234<br>AM +00:00       | 14-NOV-14<br>03.17.42.869526<br>AM +00:00       | COMPLETED | 1           | 1                | 0            |
| 512          | gather_table_stats | SYS.UTL_RECOMP_COMPILED | 14-NOV-14<br>03.17.42.762746<br>AM +00:00       | 14-NOV-14<br>03.17.42.79721<br>4 AM +00:00      | COMPLETED | 1           | 1                | 0            |
| 511          | gather_table_stats | SYS.UTL_RECOMP_SORTED   | 14-NOV-14<br>03.17.42.55448<br>AM +00:00        | 14-NOV-14<br>03.17.42.59494<br>AM +00:00        | COMPLETED | 1           | 1                | 0            |

# Things to do right after upgrade

**NEW**  
MEM

## ▪ DBMS\_STATS.REPORT\_GATHER\_SCHEMA\_STATS



```
SET LINES 300 PAGES 0
SET LONG 1000000
COLUMN REPORT FORMAT A200
VARIABLE my_report CLOB;
BEGIN
    :my_report := DBMS_STATS.REPORT_GATHER_SCHEMA_STATS (ownname => 'OE',
detail_level => 'TYPICAL', format => 'HTML');
END;
/
spool /tmp/stats.html
print mystatrep2
spool off
```

| Operation Id      | Operation                            | Target                              | Start Time                          | End Time                            | Status    | Total Tasks | Successful Tasks | Failed Tasks | Active Tasks |
|-------------------|--------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|-----------|-------------|------------------|--------------|--------------|
| 844               | gather_schema_stats (reporting mode) | OE                                  | 04-JAN-13 07:53:22.139066 AM -08:00 | 04-JAN-13 07:53:32.193332 AM -08:00 | COMPLETED | 37          | 37               | 0            | 0            |
| TASKS             |                                      |                                     |                                     |                                     |           |             |                  |              |              |
| Target            | Type                                 | Start Time                          | End Time                            | Status                              |           |             |                  |              |              |
| OE.CATEGORIES_TAB | TABLE                                | 04-JAN-13 07:53:28.494543 AM -08:00 | 04-JAN-13 07:53:31.676793 AM -08:00 | COMPLETED                           |           |             |                  |              |              |
| OE.SYS_C005568    | INDEX                                | 04-JAN-13 07:53:31.567054 AM -08:00 | 04-JAN-13 07:53:31.648979 AM -08:00 | COMPLETED                           |           |             |                  |              |              |
| OE.SYS_C005569    | INDEX                                | 04-JAN-13 07:53:31.664588 AM -08:00 | 04-JAN-13 07:53:31.666127 AM -08:00 | COMPLETED                           |           |             |                  |              |              |
| OE.SYS_C005570    | INDEX                                | 04-JAN-13 07:53:31.668909 AM -08:00 | 04-JAN-13 07:53:31.669885 AM -08:00 | COMPLETED                           |           |             |                  |              |              |
| OE.SYS_C005571    | INDEX                                | 04-JAN-13 07:53:31.673296 AM -08:00 | 04-JAN-13 07:53:31.674499 AM -08:00 | COMPLETED                           |           |             |                  |              |              |

# Things to do right after upgrade

- Configure **Automatic Shared Memory Management**

- SGA\_TARGET

- Set minimum values:



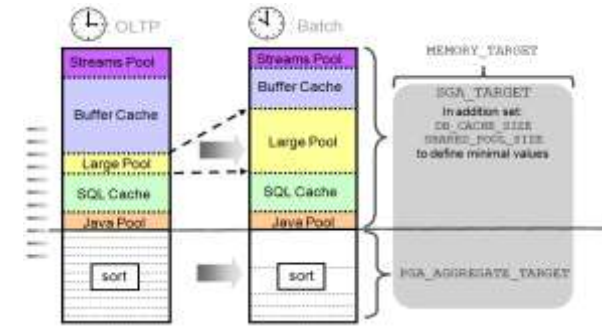
```
DB_CACHE_SIZE  
SHARED_POOL_SIZE
```

- If SGA resize by MMAN happens too frequently:

```
"_MEMORY_BROKER_STAT_INTERVAL"=900  
Default is 30 (seconds)
```

- MEMORY\_TARGET

- Set only for ASM and for databases with constant load



# Things to do right after upgrade

- Configure **Automatic Shared Memory Management**

- PGA\_AGGREGATE\_TARGET

- Check:

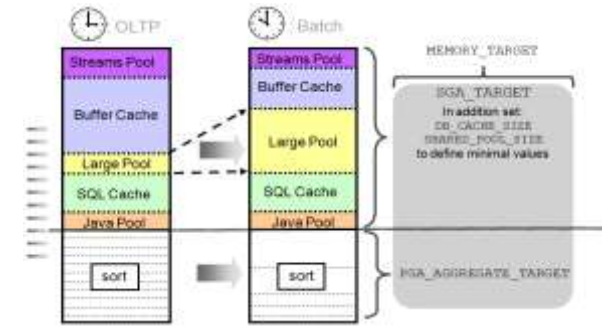


```
SQL> SELECT FROM V$PGASTAT;
```

- Guidelines:



```
OLTP: SGA=80% - PGA=20% of available memory  
DSS: SGA=30% - PGA=70% of available memory
```



**NEW**

PGA\_AGGREGATE\_LIMIT

- Values: *integer* [ K | M | G ]
- Default: >2GB and 200% of PGA\_AGGREGATE\_TARGET and 3MB x PROCESSES – it will not exceed 120% of physical memory – SGA size
- Setting it to 0 will mean "no limit"



# Parameter Information Oracle 11.2/12c

`_RUN_EVERYTHING_FAST=TRUE`

Values: { TRUE | MAYBE | IM\_IN\_A\_BAD\_MOOD | DON'T\_CARE }

Explanation: Oracle runs always fast, doesn't it?

Recommendation: Tune your application, not only your database

Don't try this at home. This picture has been taken on a closed circuit by an experienced German driver driving a decent German car 😊



# Parameter Recommendations Oracle 12.1.0.2

**NEW**  
MEMO

`_OPTIMIZER_AGGR_GROUPBY_ELIM`

Values: { **TRUE** | FALSE }

Explanation: Optimizer can eliminate some GROUP BY operations if possible

Example:

```
SQL> explain plan for
 2 select /*+ opt_param('_optimizer_aggr_groupby_elim',
'false')*/
 3   dummy, sum(cnt)
 4     from (select dummy,
 5             count(*) cnt
 6             from dualcopy
 7             group by dummy)
 8   group by dummy
 9 ;
Explained
```

| Id | Operation         | Name     |
|----|-------------------|----------|
| 0  | SELECT STATEMENT  |          |
| 1  | HASH GROUP BY     |          |
| 2  | VIEW              |          |
| 3  | HASH GROUP BY     |          |
| 4  | TABLE ACCESS FULL | DUALCOPY |

```
SQL> explain plan for
 2 select /*+
opt_param('_optimizer_aggr_groupby_elim', 'true')*/
 3   dummy, sum(cnt)
 4     from (select dummy,
 5             count(*) cnt
 6             from dualcopy
 7             group by dummy)
 8   group by dummy
 9 ;
Explained
```

| Id | Operation         | Name     |
|----|-------------------|----------|
| 0  | SELECT STATEMENT  |          |
| 1  | HASH GROUP BY     |          |
| 2  | TABLE ACCESS FULL | DUALCOPY |

**Recommendation:** **FALSE – or patch!** Wrong Results with GROUP BY Clause in Nested Query ([Doc ID 21826068.8](#))

# Parameter Recommendations

`_OPTIMIZER_COST_BASED_TRANSFORMATION`

Values: { ON | OFF }

Explanation: See [MOS Note: 1082127.1](#) for more details on CBQT

Annotation: Default is ON since Oracle Database 10.2  
CBQT can add a high overhead at parse time but can yield considerable benefits by way of a better plan for the statement

Recommendation: **Set it to OFF until 11.2.0.3**  
due to limited gain and some open issues. See [MOS Note: 567354.1](#)

#### Known Bugs

You can restrict the list below to issues likely to affect one of the following versions by clicking the relevant button:

The list below is restricted to show only bugs believed to affect version 11.2.0.3.  
Other bugs may affect this version but have not been confirmed as being relevant yet.

There are 7 bugs listed.

| NB | Bug      | Fixed                                  | Description                                                                      |
|----|----------|----------------------------------------|----------------------------------------------------------------------------------|
|    | 14602250 | 12.1.0.0                               | ORA-600 [12327] with correlated aggregation                                      |
|    | 14593548 | 12.1.0.0                               | ORA-600 [qctcte1] from a query                                                   |
|    | 12537316 | 12.1.0.0                               | ORA-600 / ORA-7445 for SQL with merged subquery                                  |
|    | 14561651 | 11.2.0.2.BP19, 11.2.0.3.BP13, 11.2.0.4 | Wrong result for query with NULL augmented lateral OUTER join                    |
|    | 11728984 | 12.1.0.0                               | ORA-600 [qctcte1] on query with select list subquery and GROUP BY                |
|    | 10013899 | 11.2.0.4, 12.1.0.0                     | Allow CBQT for some DML / DDL                                                    |
|    | 9765175  | 12.1.0.0                               | ORA-932 from query with CASE expression containing a subquery in the THEN clause |

# Parameter Recommendations Oracle 12.1.0.2

**NEW**  
IEM

INMEMORY\_FORCE

Values: { DEFAULT | OFF }

Explanation: In-Memory Optimization

**Recommendation:** OFF – Unless you have an Oracle In-Memory license

# Parameter Recommendations

SESSION\_CACHED\_CURSORS

Default:

50

Explanation:

Specifies the number of session cursors to cache.  
More information in [MOS Note: 30804.1](#)

Annotation:

Cursor caching mechanism was changed in Oracle 10.2.0.4

**Recommendation:**

**Set it to 200** and adjust the value later.

Use [MOS SCRIPT: 208857.1](#) to adjust parameters  
SESSION\_CACHED\_CURSORS and OPEN\_CURSORS usage based.  
Too high values may lead to fragmentation in shared pool

# Parameter Information Oracle 11.2/12c

`_MEMORY_IMM_MODE_WITHOUT_AUTOSGA`

Values: { **TRUE** | FALSE }

Explanation: Switching this parameter to FALSE will prevent the SGA from doing resize operations even though neither SGA\_TARGET nor MEMORY\_TARGET are set.

Annotation: A generic enhancement in 11.2.0.1 was made to allow IMMEDIATE mode requests even when SGA\_TARGET (or MEMORY\_TARGET) is not set. This enhancement has been introduced to prevent ORA-4031 errors due to shared pool pressure

Recommendation: **Just be aware of this change**

To turn feature off:

```
alter system set "_memory_imm_mode_without_autosga"=FALSE;
```

Further information: [MOS Note:1269139.1](#)

# Parameter Information Oracle 11.2/12c

## OPTIMIZER\_MODE

Values: { ALL ROWS | FIRST\_ROWS |  
FIRST\_ROWS\_[1|10|100|1000] }

Explanation: Establishes the default behavior for choosing an optimization approach for the instance

Annotation: Obsolete settings (will be ignored):  
optimizer\_mode=choose  
optimizer\_mode=rule  
Only the /\*+RULE \*/ hint will still work

Recommendation:

---

# Parameter Information Oracle 11.2.0.4/12c

OPTIMIZER\_DYNAMIC\_SAMPLING

Values: { 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 }

Explanation: If statistics are not available it controls whether dynamic stats will be gathered, and the sample size

Annotation:

- 0: Off
- 2: Check  $\leq 64$  blocks - generate stats during parse
- **11: NEW SETTING**
  - Use **dynamic statistics automatically** when the Optimizer deems it
  - Verifies cardinality and implements a time limit for the estimate
  - Results **persist** as *Shareable Statistics*
  - *Different behavior between 11.2.0.4 and 12.1.0.x*

Recommendation: See [Oracle Database SQL Tuning Guide](#) for details



# Parameter Information Oracle 11.2/12c

## OPTIMIZER\_DYNAMIC\_SAMPLING

| Level | When the Optimizer Uses Dynamic Statistics                                                                                                                                                                                                                                                                                                                                                                   | Sample Size (Blocks)     |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|
| 0     | Do not use dynamic statistics                                                                                                                                                                                                                                                                                                                                                                                | n/a                      |
| 1     | Use dynamic statistics for all tables that do not have statistics, but only if the following criteria are met: <ul style="list-style-type: none"><li>There is at least 1 nonpartitioned table in the query that does not have statistics.</li><li>This table has no indexes.</li><li>This table has more blocks than the number of blocks that would be used for dynamic statistics of this table.</li></ul> | 32                       |
| 2     | Use dynamic statistics if at least one table in the statement has no statistics. This is the default setting.                                                                                                                                                                                                                                                                                                | 64                       |
| 3     | Use dynamic statistics if any of the following conditions is true: <ul style="list-style-type: none"><li>The statement meets level 2 criteria.</li><li>The statement has one or more expressions used in the WHERE clause predicates, for example, WHERE SUBSTR(CUSTLASTNAME, 1, 3).</li></ul>                                                                                                               | 64                       |
| 4     | Use dynamic statistics if any of the following conditions is true: <ul style="list-style-type: none"><li>The statement meets level 3 criteria.</li><li>The statement uses complex predicates (an OR or AND operator between multiple predicates on the same table).</li></ul>                                                                                                                                | 64                       |
| 5     | Use dynamic statistics if the statement meets level 4 criteria.                                                                                                                                                                                                                                                                                                                                              | 128                      |
| 6     | Use dynamic statistics if the statement meets level 4 criteria.                                                                                                                                                                                                                                                                                                                                              | 256                      |
| 7     | Use dynamic statistics if the statement meets level 4 criteria.                                                                                                                                                                                                                                                                                                                                              | 512                      |
| 8     | Use dynamic statistics if the statement meets level 4 criteria.                                                                                                                                                                                                                                                                                                                                              | 1024                     |
| 9     | Use dynamic statistics if the statement meets level 4 criteria.                                                                                                                                                                                                                                                                                                                                              | 4086                     |
| 10    | Use dynamic statistics for all statements.                                                                                                                                                                                                                                                                                                                                                                   | All blocks               |
| 11    | Use dynamic statistics automatically when the optimizer deems it necessary. The resulting statistics are persistent in the statistics repository, making them available to other queries.                                                                                                                                                                                                                    | Automatically determined |

Page 248 – SQL Tuning Guide – Oracle Database 12c

# Parameter Information Oracle 11.2/12c

## OPTIMIZER\_USE\_PENDING\_STATISTICS

Values: { FALSE | TRUE }

Explanation: **Mitigate the risk of newly created object statistics**  
Object statistics persist through an upgrade

Recommendation:

- ▼ Switch on Pending Statistics:  
SQL> exec DBMS\_STATS.SET\_GLOBAL\_PREFS('PENDING','TRUE');
- ▼ Gather new Oracle 12c statistics as "pending":  
SQL> DBMS\_STATS.GATHER\_SCHEMA\_STATS('SH');
- ▼ Verify critical statements using pending 12c statistics:  
SQL> alter session set optimizer\_use\_pending\_statistics=TRUE;
- ▼ Once everything is good publish them:  
SQL> exec DBMS\_STATS.PUBLISH\_PENDING\_STATS();

# Parameter Information Oracle 11.2/12c

STATISTICS\_LEVEL

Values: { TYPICAL | ALL | BASIC }

Explanation: Specifies the level of collection for database and operating system statistics. The Oracle Database collects these statistics for a variety of purposes, including making self-management decisions

Annotation: TYPICAL enables:

- Automatic SGA Tuning (SGA\_TARGET)
- Automatic Statistics Collection
- Active Session History (ASH)
- DML Monitoring

Recommendation: **Don't set it or set it explicitly to TYPICAL**

# Parameter Information Oracle 11.2/12c

CONTROL\_MANAGEMENT\_PACK\_ACCESS

Values: { DIAGNOSTIC+TUNING | DIAGNOSTIC | NONE }

Explanation: Specifies which of the Server Manageability Packs should be active

Annotation:

- Default Enterprise Edition: DIAGNOSTIC+TUNING
- Default Standard Edition: NONE

Recommendation: **Adjust it according to your license set**

STATSPACK can still be used but has very limited functionality

- STATSPACK Guide : [MOS Note:394937.1](#)
- Turn of AWR/ASH in case you'll use STATSPACK

# Things to do right after upgrade

- Configure **Automatic Workload Repository (AWR)**

- Data gathered by MMON and stored in SYSAUX

- Check settings:



```
SQL> select * from DBA_HIST_WR_CONTROL;
```

- Change settings:

- Example:

- Retention: 40 days (57600 min)
- Interval: 30 minutes



```
SQL> exec  
DBMS_WORKLOAD_REPOSITORY.MODIFY_  
SNAPSHOT_SETTINGS (57600, 30)
```

- Important scripts in ?/rdbms/admin:

```
Size and trend:      awrinfo.sql  
AWR report SI:      awrrpt.sql  
AWR report RAC:     awrrpti.sql  
AWR report SQLID:  awrsqrpt.sql
```

```
AWR diff report:    awrgrrpt.sql  
AWR extract:        awrextr.sql  
AWR load:           awrload.sql
```

# Configure AWR, ASH & ADDM

## ▪ Active Session History (ASH)

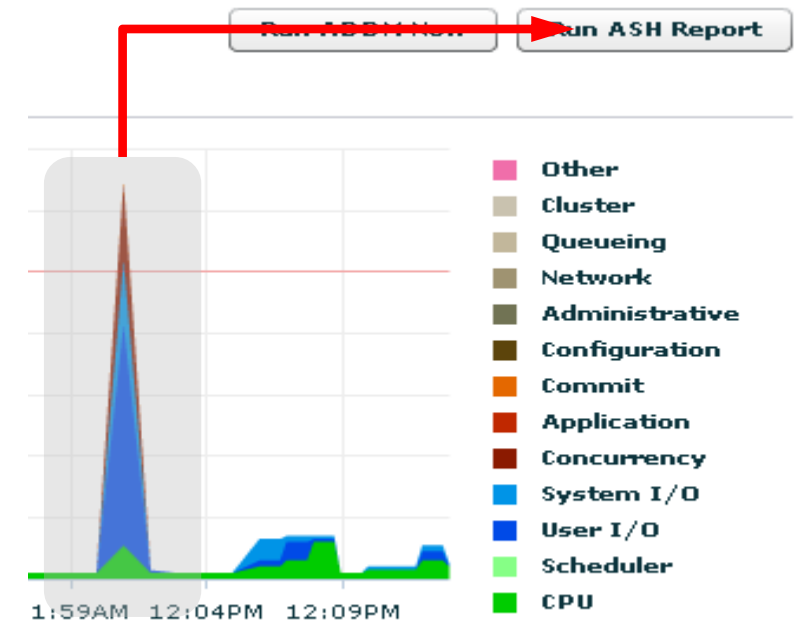
- Data gathered by MMNL
- View: `V$ACTIVE_SESSION_HISTORY`
- Space and time usage:
  - Fixed size, circular buffer:  
2MB x #CPUs (max. 5% SGA or <30MB)
  - Designed to hold ~1 hour of statistics, may flush or fill sooner
  - Further info: [Note:243132.1](#)

## – Important scripts in `?/rdbms/admin`:

|                               |                          |
|-------------------------------|--------------------------|
| ASH report (single instance): | <code>ashrpt.sql</code>  |
| AWR extract (RAC):            | <code>ashrpti.sql</code> |

- Needs to be increased for **Oracle Multitenant**

`__ASH_SIZE`



## ASH Report

Top Activity

- Top Events
- Load Profile
- Top SQL
- Top PL/SQL
- Top Java
- Top Sessions
- Top Objects/Files/Latches
- Activity Over Time

# Configure AWR, ASH & ADDM

**NEW**  
MEM

## ▪ Real-Time ADDM

- Data gathered by MMON
  - Every 3 sec without lock/latch
  - Triggers real-time ADDM analysis
    - Conditions:
- MMON slave process creates report and stores it in AWR
  - DBA\_HIST\_REPORTS



| Issue                 | Condition                                                                                  |
|-----------------------|--------------------------------------------------------------------------------------------|
| High load             | Average active sessions are greater than 3 times the number of CPU cores                   |
| I/O bound             | I/O impact on active sessions based on single block read performance                       |
| CPU bound             | Active sessions are greater than 10% of total load and CPU utilization is greater than 50% |
| Over-allocated memory | Memory allocations are over 95% of physical memory                                         |
| Interconnect bound    | Based on single block interconnect transfer time                                           |
| Session limit         | Session limit is close to 100%                                                             |
| Process limit         | Process limit is close to 100%                                                             |
| Hung session          | Hung sessions are greater than 10% of total sessions                                       |
| Deadlock detected     | Any deadlock is detected                                                                   |

# Performance Checklist

## Prepare

- Adjust maintenance windows
- Configure statistics retention
- Configure incremental statistics
- Adjust memory and optimizer parameters
- Configure AWR, ASH and ADDM

## Stability

- Preserve and transport execution plans

## Test

- General test guidelines
- Real Application Testing

## Optimize

- System Statistics
- Automatic Tuning Advisor

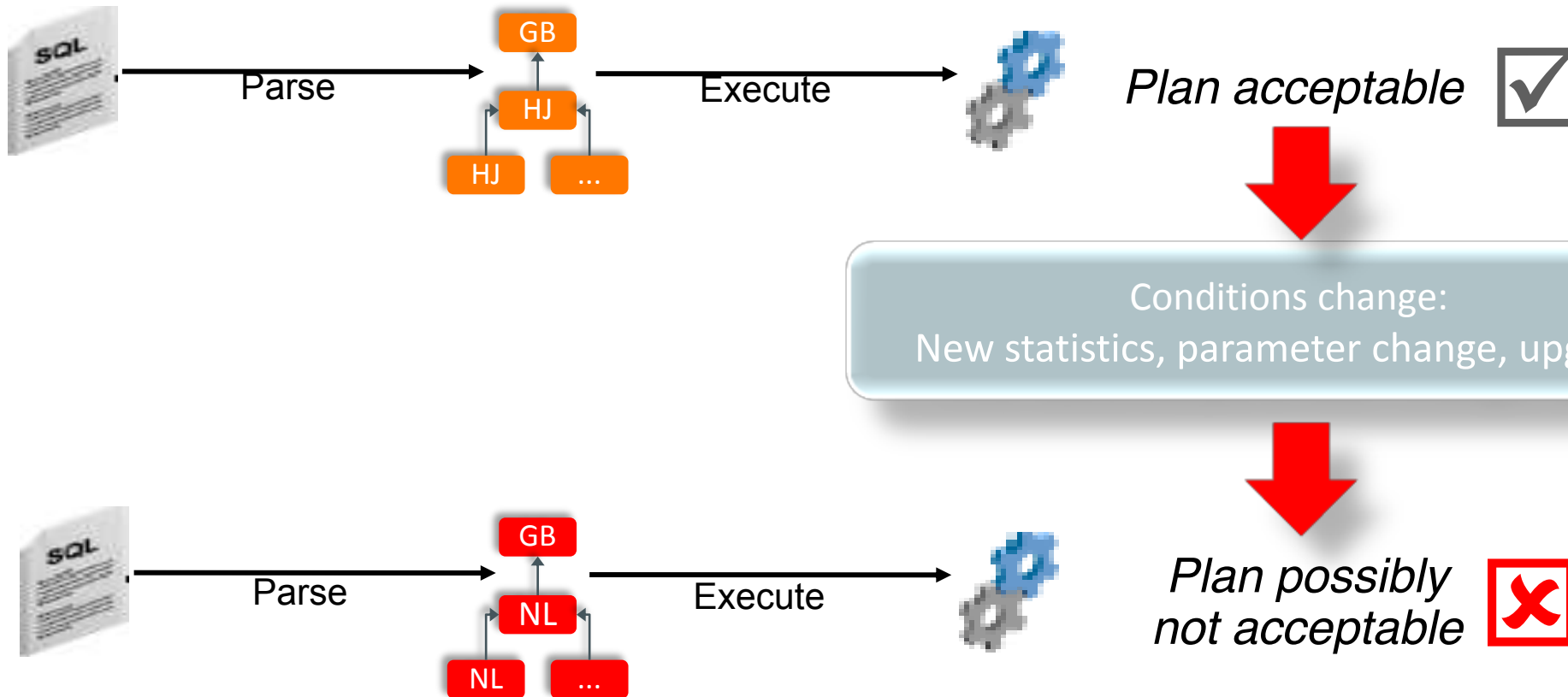
## Features

- Enable Performance Features



# Typical situation **after a change**

- Challenging to "freeze" execution plans



# Strategies to enforce Plan Stability

- Rule Based Optimizer?



Desupported - [MOS Note:189702.1](#)



- Stored Outlines?



Deprecated - [Documentation](#)

- Rewrite plans, tweak parameters, hints ...?



*You have too much spare time?*



## SQL Plan Management

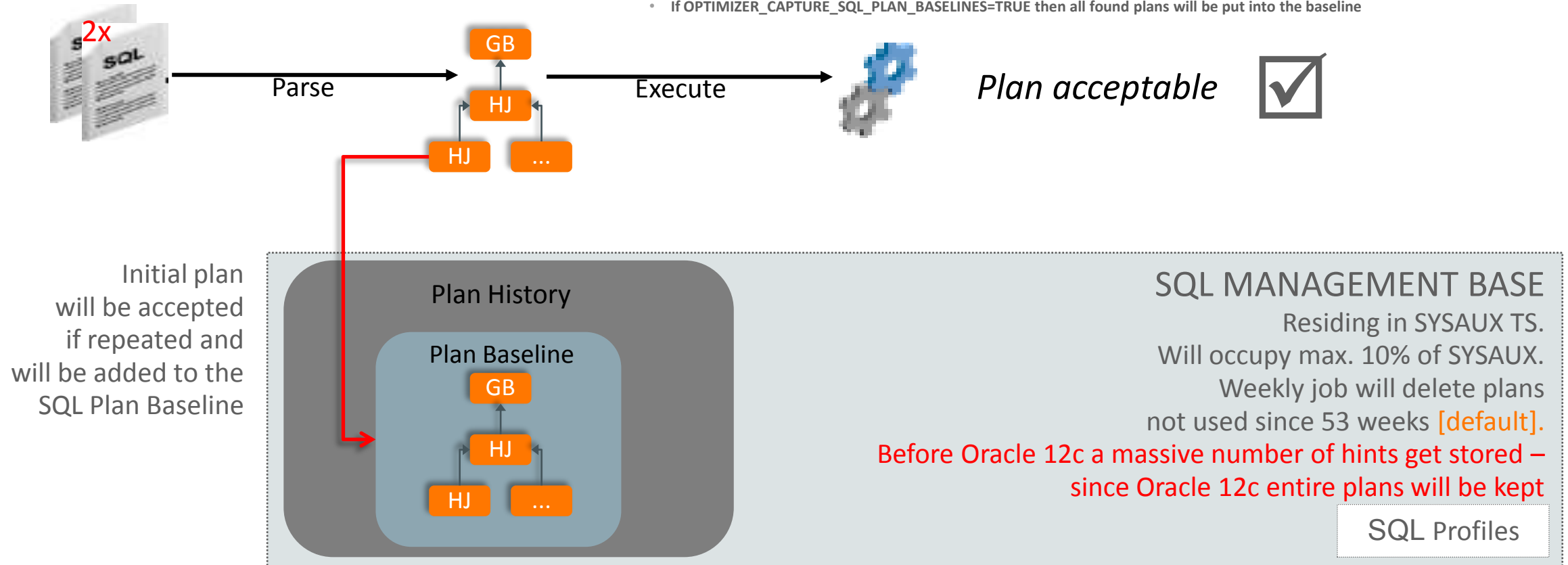
EE Feature - Package: DBMS\_SPM

# SQL Plan Management - Mechanism

## Phase 1 – Baseline Capture

– Set `OPTIMIZER_CAPTURE_SQL_PLAN_BASELINES=TRUE`

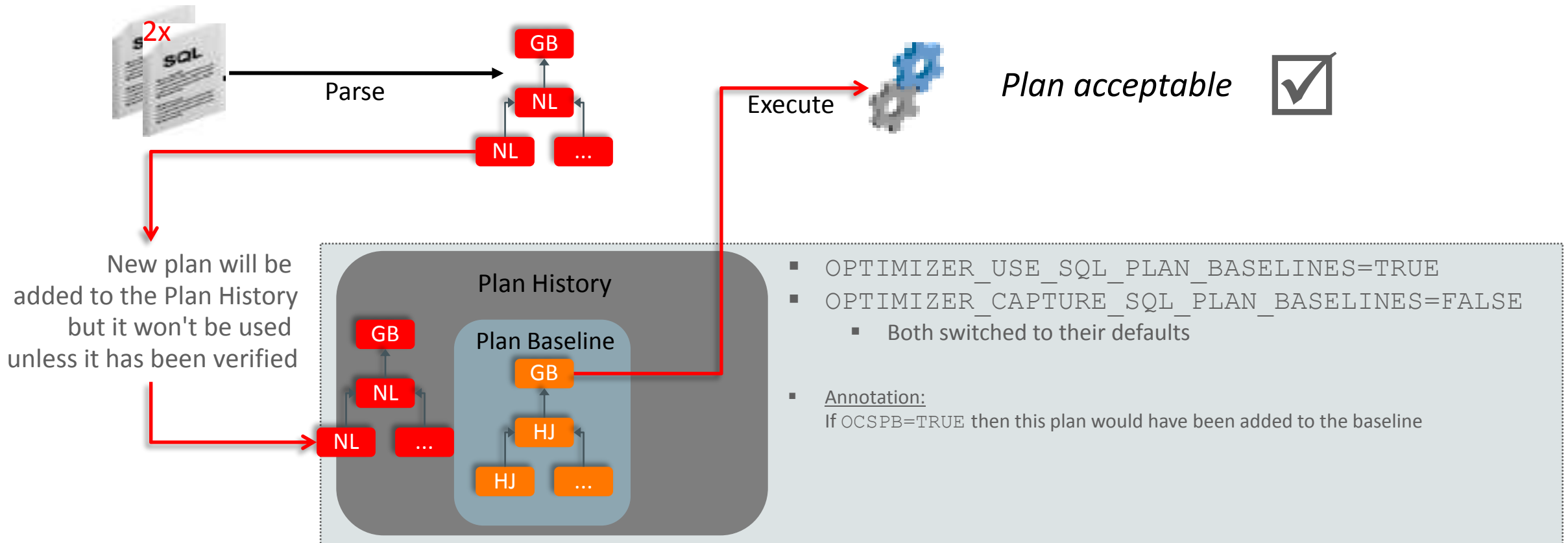
• If `OPTIMIZER_CAPTURE_SQL_PLAN_BASELINES=TRUE` then all found plans will be put into the baseline



# SQL Plan Management - Mechanism

## Phase 2 - Selection

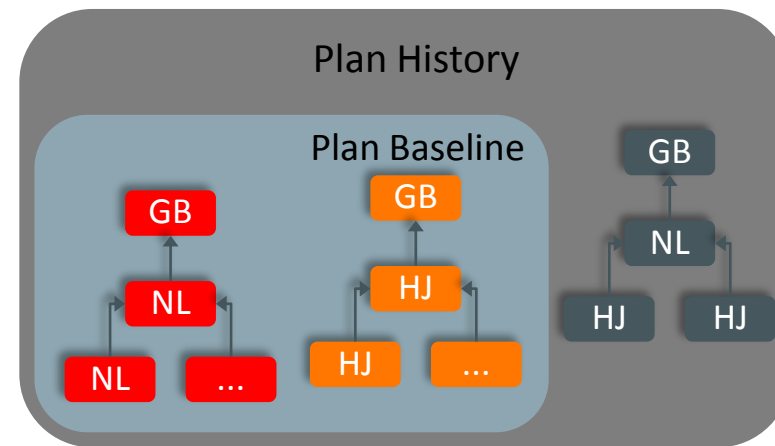
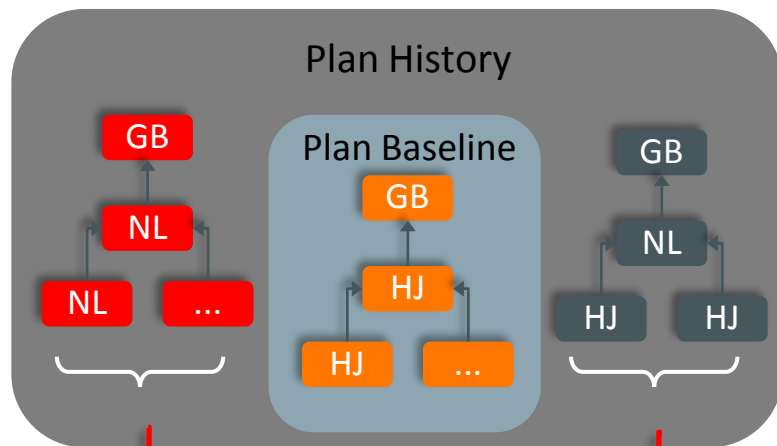
– Same statement parsed again but a different plan will be created



# SQL Plan Management - Mechanism

## Phase 3 - Evolution

– Since Oracle 12.1.0.2:



New `SYS_AUTO_SPM_EVOLVE_TASK` job as part of the *Automatic SQL Tuning Task*

Report: `DBMS_SPM.REPORT_AUTO_EVOLVE_TASK`  
Manual: `DBMS_SPM.CREATE_EVOLVE_TASK`



Optimizer

# SQL Plan Management

## ▪ Configure **SQL Plan Management (SPM)**

– Check settings:



```
SQL> select PARAMETER_NAME, PARAMETER_VALUE  
from DBA_SQL_MANAGEMENT_CONFIG;
```

– Change retention:

▪ Default: 53 weeks



```
SQL> exec  
DBMS_SPM.CONFIGURE ('plan_retention_weeks', 5);
```

– Change space consumption:

▪ Default: 10% of SYSAUX

▪ Plans will be stored in a LOB

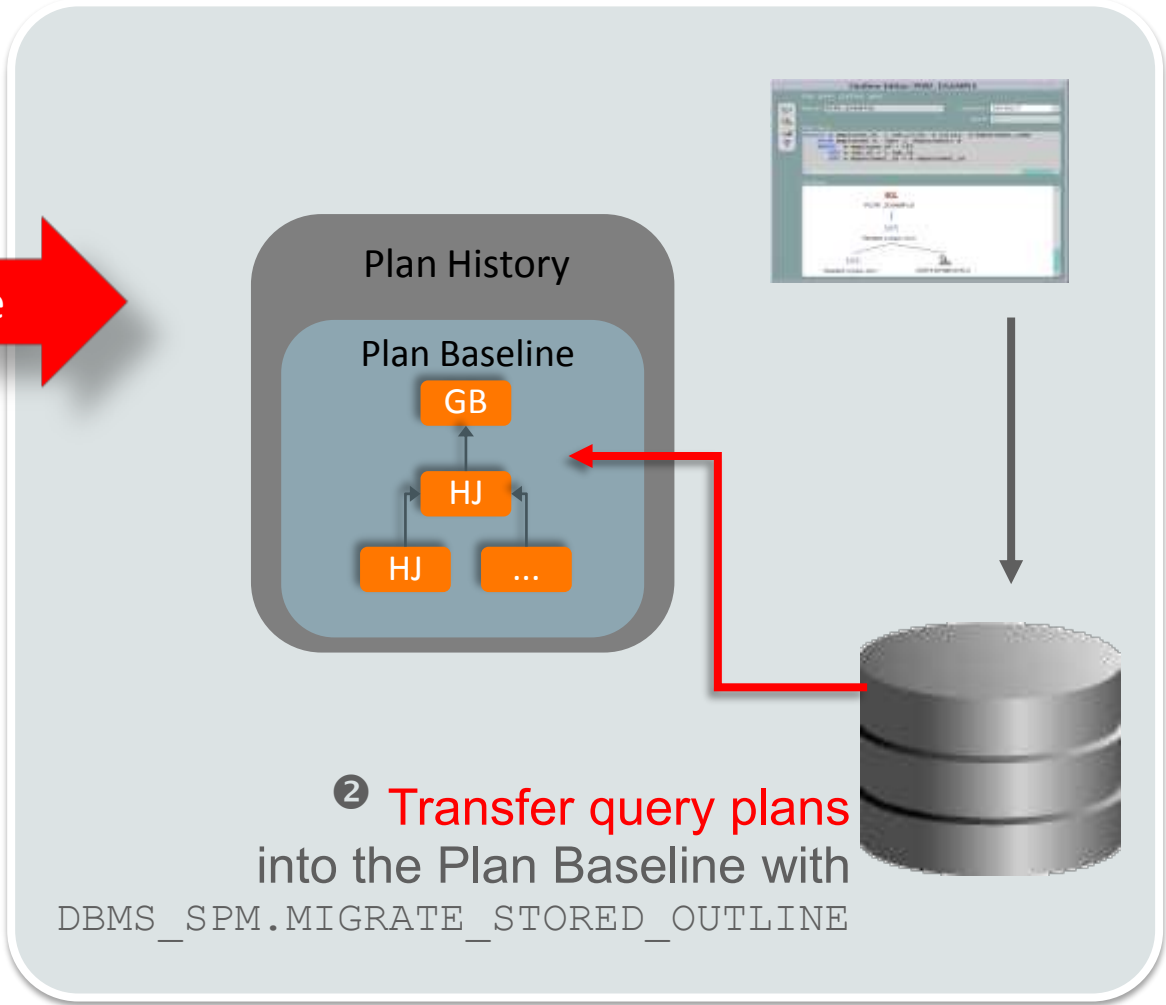
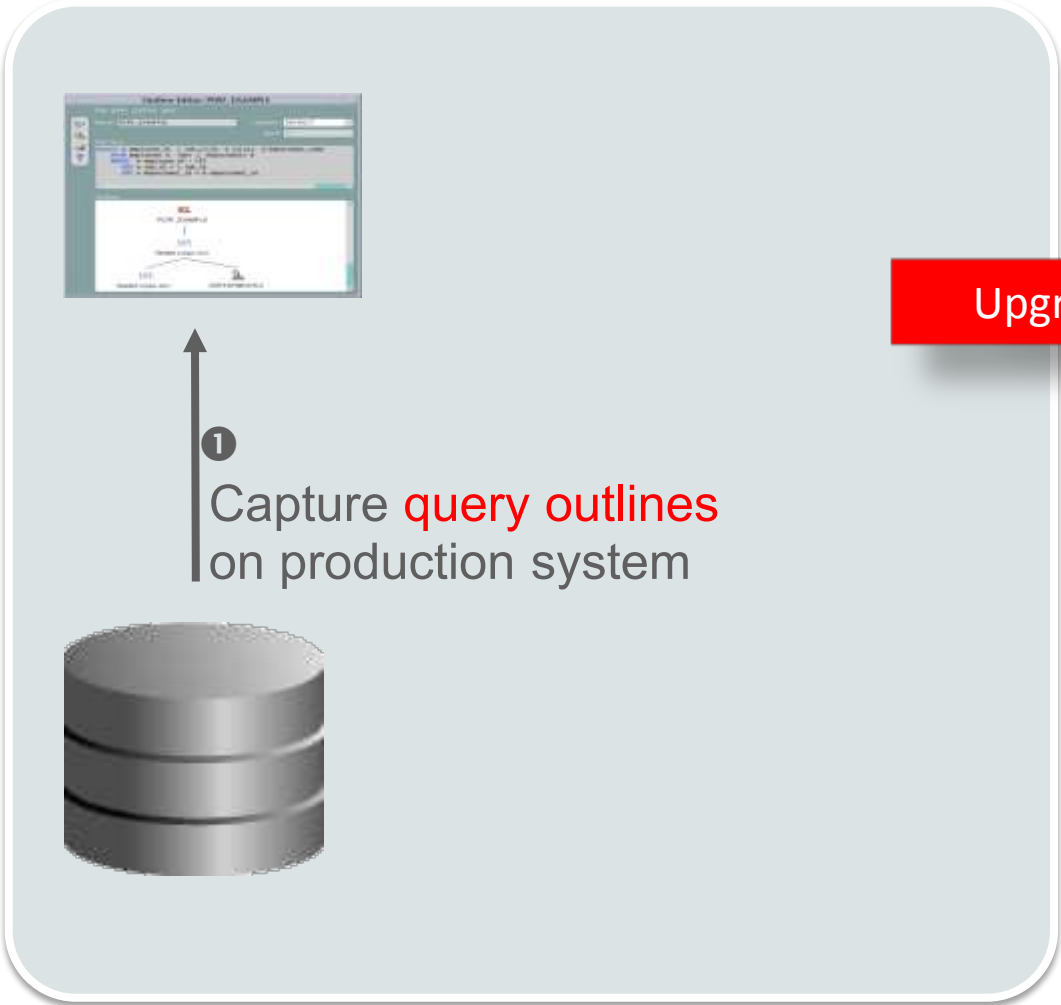


```
SQL> exec  
DBMS_SPM.CONFIGURE ('space_budget_percent', 5);
```

– Sources to load plans from:



# SPM – Plan Stability using **Stored Outlines**



# SPM – Plan Stability using **Stored Outlines**

- Upgrade scenario

- In Oracle 9i/10g:

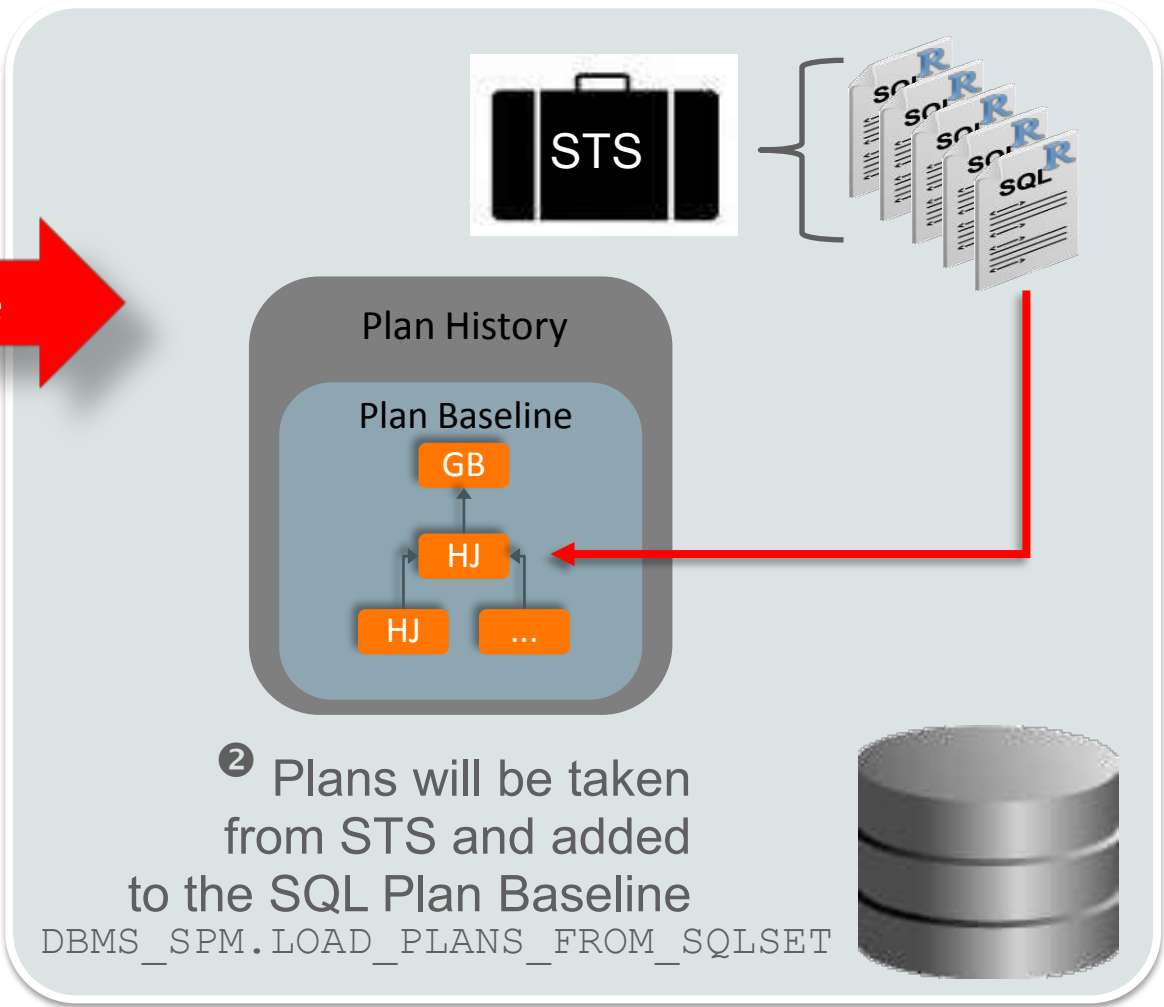
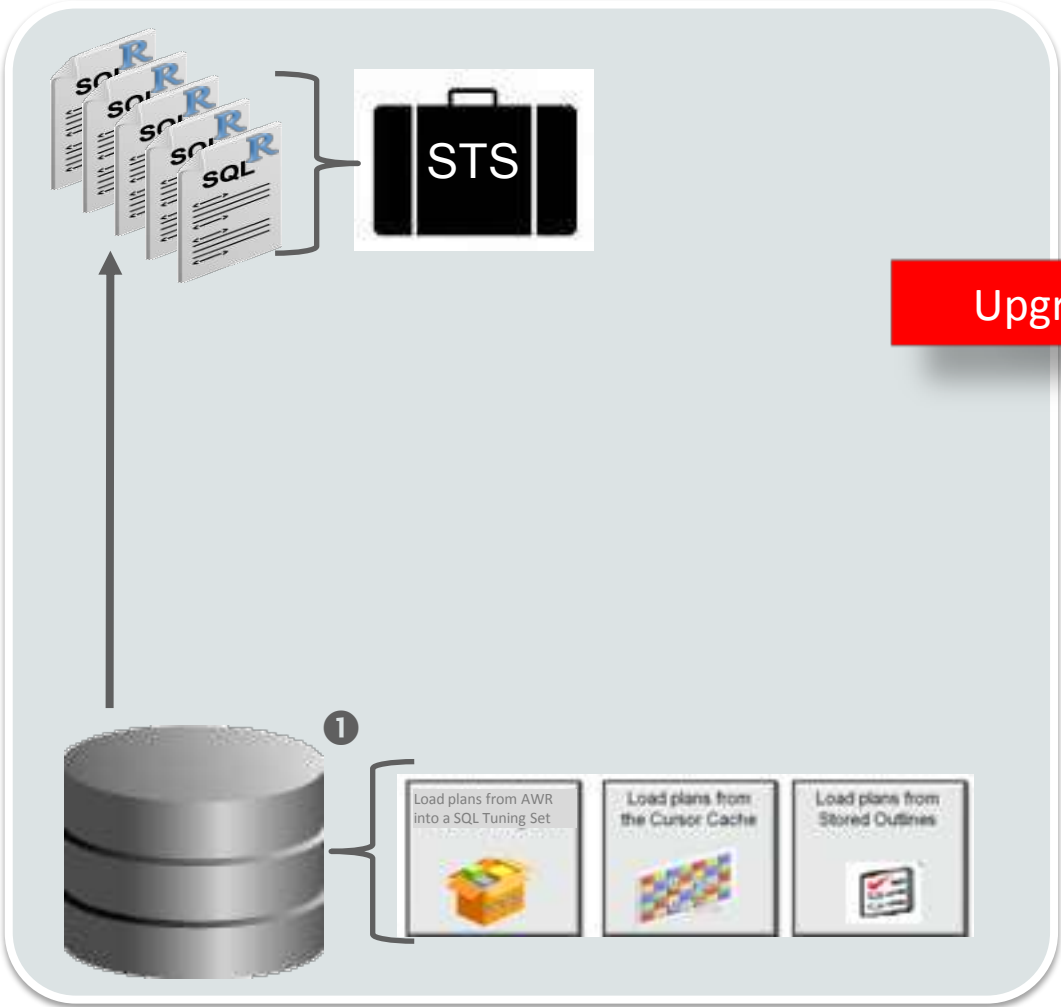
- GRANT CREATE ANY OUTLINE TO APPUSER;
    - ALTER SYSTEM set CREATE\_STORED\_OUTLINES=MYPLANS;
    - Now run the statements you'd like to capture
    - ALTER SYSTEM SET CREATE\_STORED\_OUTLINES=false;
    - Check the category (should be MYPLANS):  
SELECT name, sql\_text, category FROM user\_outlines;

- Upgrade to Oracle 12c

- variable repo clob;
    - exec :repo:=**DBMS\_SPM.MIGRATE\_STORED\_OUTLINE** (  
attribute\_name=>'CATEGORY', attribute\_value=>'MYPLANS');



# SPM – Plan Stability using Plan Capture



# SPM – Plan Stability using Plan Capture

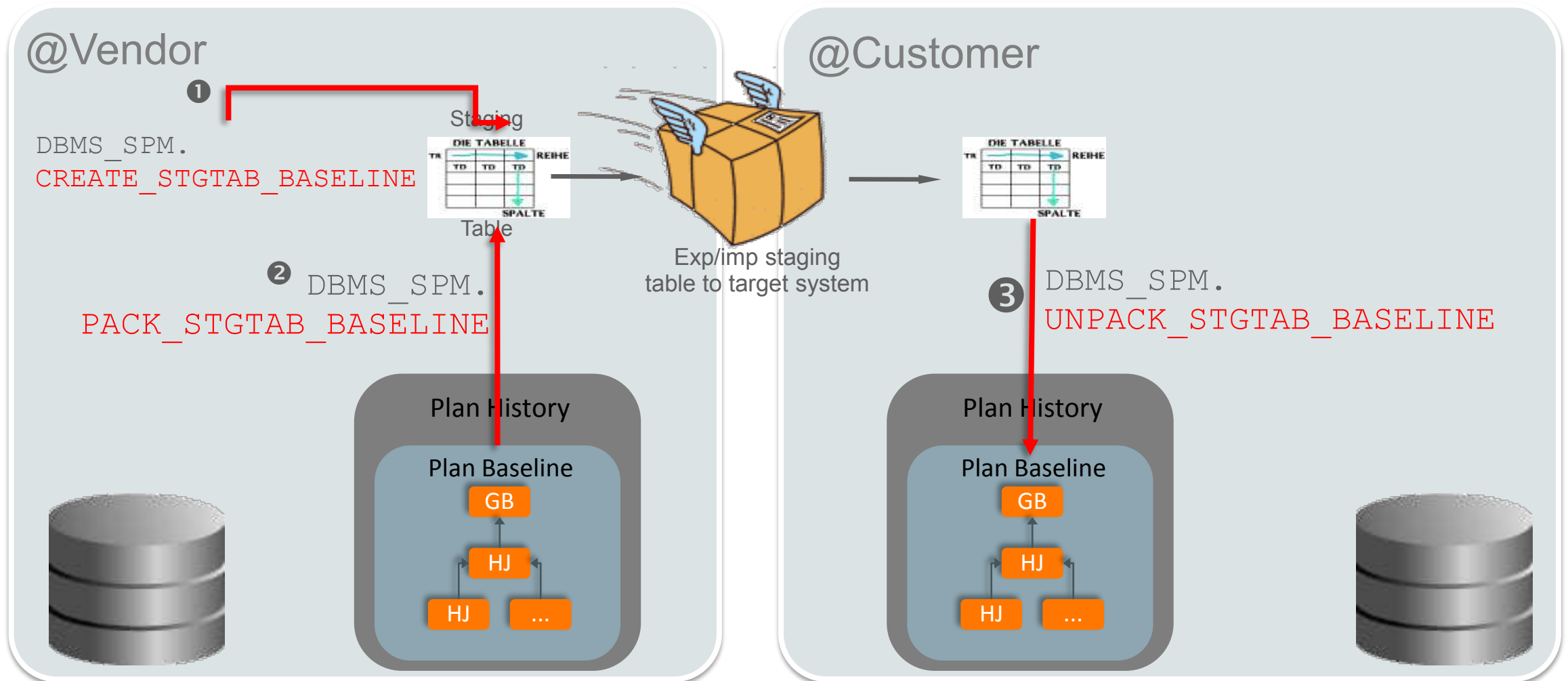
- Upgrade scenario example: Capturing from Cursor Cache

```
– BEGIN
  SYS.DBMS_SQLTUNE.CREATE_SQLSET (
    sqlset_name=>'SPM_STS',description=>'10.2 plans');
END;
/

DECLARE
  stscur dbms_sqltune.sqlset_cursor;
BEGIN
  OPEN stscur FOR
  SELECT VALUE(P) FROM TABLE(dbms_sqltune.select_cursor_cache(
    'parsing_schema_name<>' 'SYS' ',null,null,null,null,1,null,'ALL')) P;
  -->> Populate the SQL Tuning Set
  dbms_sqltune.load_sqlset(sqlset_name=>'SPM_STS',populate_cursor=>stscur);
END;
/

SQL> variable cnt number
SQL> exec :cnt := DBMS_SPM.LOAD_PLANS_FROM_SQLSET(sqlset_name=>'SPM_STS');
```

# SPM – Plan Transport



# SPM – Plan Transport

- Transporting SPM baselines between test and production databases
  - @Test System:
    - Create a staging table using `DBMS_SPM.CREATE_STGTAB_BASELINE`
    - Pack the required baselines into the staging table using `DBMS_SPM.PACK_STGTAB_BASELINE`
    - Export the staging table into a dump file using Data Pump Export and transport it to the destination system
  - @Production System:
    - Import the dump file into the destination database
    - Unpack the SQL Plan Baselines from the staging table into the SQL Management Base of the target system
      - `DBMS_SPM.UNPACK_STGTAB_BASELINE`

# SQL Plan Management

- White Paper:

- <http://www.oracle.com/technetwork/database/bi-datawarehousing/twp-sql-plan-mgmt-12c-1963237.pdf>



- MOS Notes:

- [MOS Note:456518.1](#) SQL Plan Management – Example
- [MOS Note:789888.1](#) How to load plans from AWR into SPM
- [MOS Note:801033.1](#) How to move 10.2 plans into 11g SPM

# Performance Checklist

## Prepare

- Adjust maintenance windows
- Configure statistics retention
- Configure incremental statistics
- Adjust memory and optimizer parameters
- Configure AWR, ASH and ADDM

## Stability

- Preserve and transport execution plans

## Test

- General test guidelines
- Real Application Testing

## Optimize

- System Statistics
- Automatic Tuning Advisor

## Features

- Enable Performance Features

# General Test Guidelines



Upgrade/Migration Process

Post-Upgrade Functionality

Post-Upgrade Performance

Prod Load



# Testing Effort

- Relation between test completeness and costs





# Real Application Testing

- Record a workload and replay it
- Find plan regressions prior to a change
- Multitenant: [MOS Note:1937920.1 – Setup/Run Replay in Multitenant](#)

## Real Application Testing

⇒ Available since Oracle Database 11.1.0.6

⇒ Available also with patch sets Oracle Database 10.2.0.4/5

### Database Replay

DBMS\_WORKLOAD\_CAPTURE

DBMS\_WORKLOAD\_REPLAY

Capture ≥ 9.2.0.8

Replay ≥ 11.1.0.7



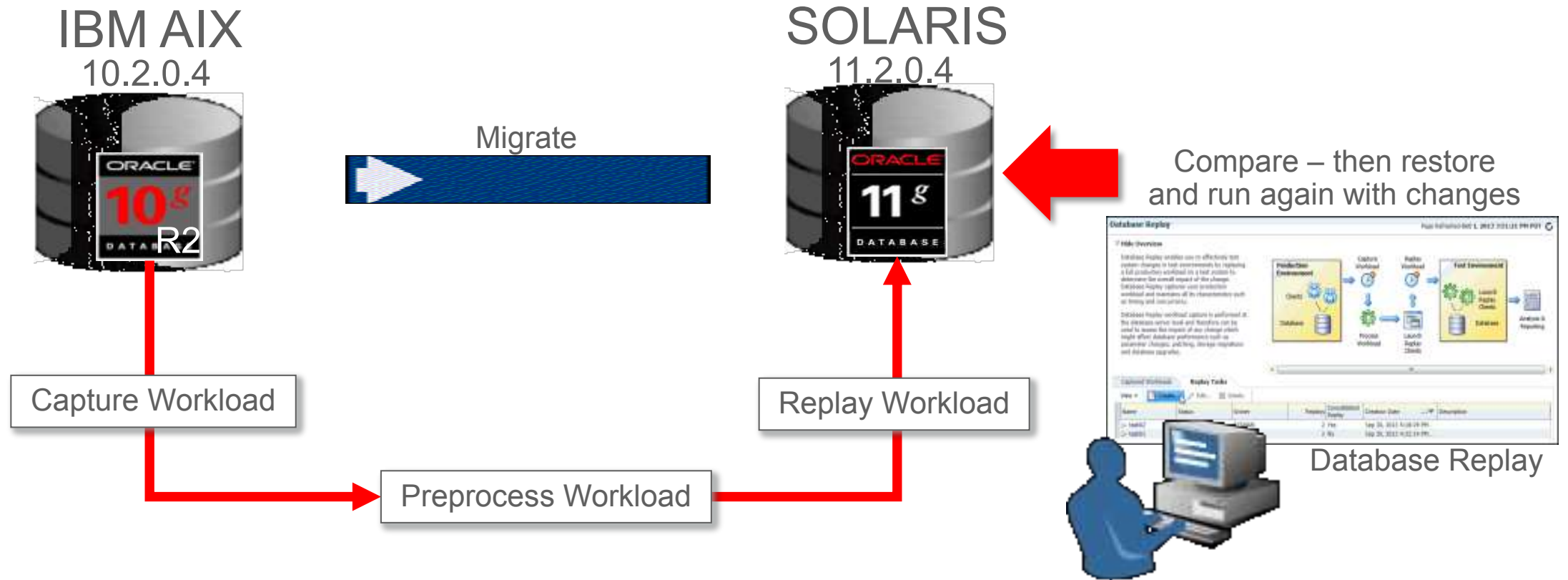
### SQL Performance Analyzer (SPA)

DBMS\_SPA

Gathering ≥ 9i

Evaluation ≥ 10.2.0.4

# Database Replay



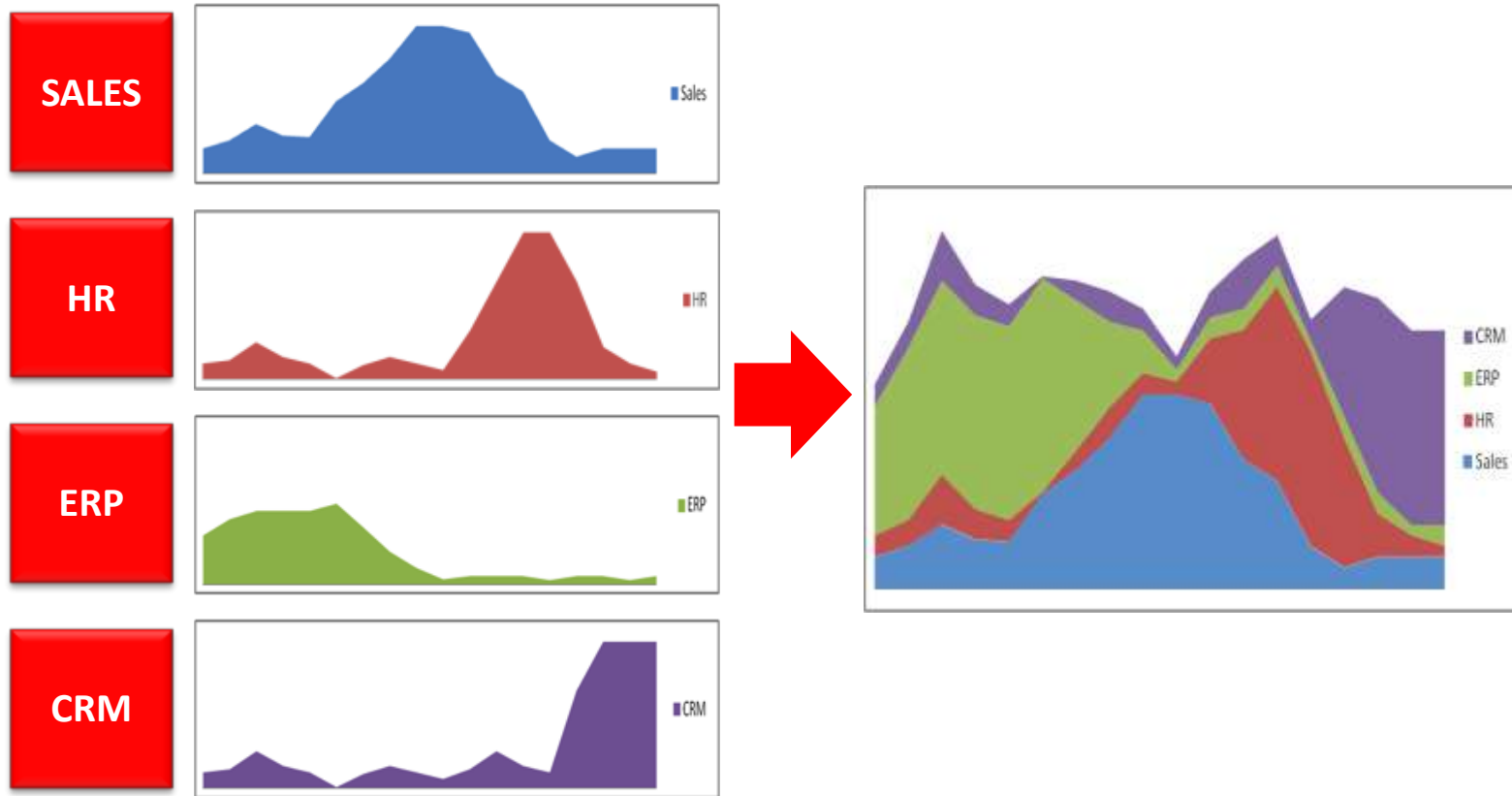
# Database Replay: Analysis & Reporting



- **Error Divergence:** For each call error divergence is reported
  - New: Error encountered during replay not seen during capture
  - Not Found: Error encountered during capture not seen during replay
  - Mutated: Different error produced in replay than during capture
- **Data Divergence**
  - *Replay:* Number of rows returned by each call are compared and divergences reported
  - *User:* Application level validation scripts
- **Performance Reporting**
  - Capture and Replay Report: Provides high-level performance information
  - ADDM Report: Provides in-depth performance analysis
  - AWR, ASH Report: Facilitates comparative or skew analysis

# Consolidated Database Replays

## Validating consolidation strategies



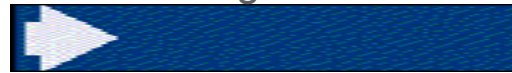
- Allows workload captured on different databases to be consolidated for replay
- Works for manually consolidated databases or Pluggable Databases

# SQL Performance Analyzer

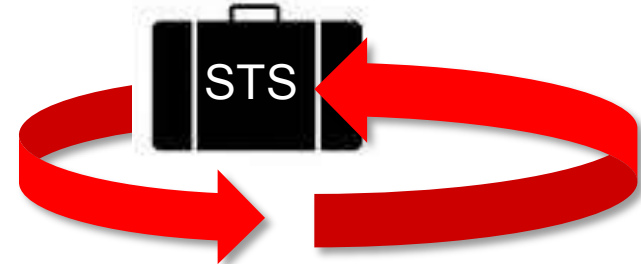
IBM AIX  
10.2.0.4



Migrate



SOLARIS  
12.1.0.2

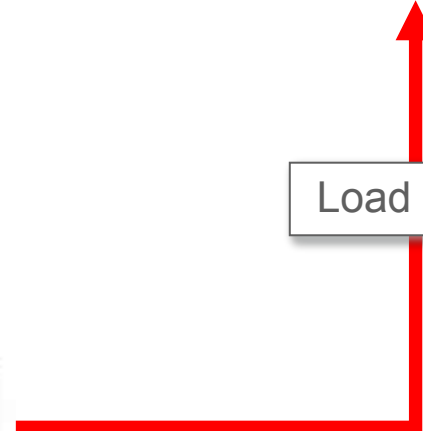


Evaluate, compare and tune –  
over and over again!

Capture SQLs  
into a STS



Load STS



SQL Performance Analyzer



# Resulting Reports

- Example: Report showing regressed statements and plans

## Projected Workload Change Impact:

Overall Impact : 0%  
 Improvement Impact : 0%  
 Regression Impact : 0%

## SQL Statement Count

| SQL Category | SQL Count | Plan Change Count |
|--------------|-----------|-------------------|
| Overall      | 3552      | 1593              |
| Improved     | 658       | 410               |
| Regressed    | 99        | 45                |
| Unchanged    | 1754      | 1129              |
| with Errors  |           |                   |

## SQL Statement

| object_id | sql_text      | Plan Change |
|-----------|---------------|-------------|
| 7277      | a304c09gqxxf3 | 000%        |
| 8144      | f26           | 550%        |

## Execution Plan Before Change:

Plan Hash Value : Unknown

| Id | Operation                   | Name            |
|----|-----------------------------|-----------------|
| 0  | SELECT STATEMENT            |                 |
| 1  | COUNT STOPKEY               |                 |
| 2  | VIEW                        |                 |
| 3  | SORT ORDER BY STOPKEY       |                 |
| 4  | NESTED LOOPS                |                 |
| 5  | TABLE ACCESS BY INDEX ROWID | BUCHUNGEN       |
| 6  | INDEX RANGE SCAN            | I_EID_BUCHUNGEN |
| 7  | TABLE ACCESS BY INDEX ROWID | PERSON          |
| 8  | INDEX UNIQUE SCAN           | SYS_C0010236    |

## Execution Plan After Change:

Plan Id : 27959

Plan Hash Value : 4020578872

| Id  | Operation                   | Name            |
|-----|-----------------------------|-----------------|
| 0   | SELECT STATEMENT            |                 |
| * 1 | COUNT STOPKEY               |                 |
| 2   | VIEW                        |                 |
| * 3 | SORT ORDER BY STOPKEY       |                 |
| 4   | NESTED LOOPS                |                 |
| 5   | NESTED LOOPS                |                 |
| * 6 | TABLE ACCESS BY INDEX ROWID | BUCHUNGEN       |
| * 7 | INDEX RANGE SCAN            | I_EID_BUCHUNGEN |
| * 8 | INDEX UNIQUE SCAN           | SYS_C0012673    |
| * 9 | TABLE ACCESS BY INDEX ROWID | PERSON          |

## SQL Details:

Object ID : 7277  
 Schema Name : UHRZS006  
 SQL ID : a304c09gqxxf3  
 Execution Frequency : 1  
 SQL Text : select a,b,c from ( select ware a,kommentar b, p.nachname c from  
 and eid = 349905 and kommentar like 'show\_user%' and b.ware =  
 60

## Execution Statistics:

| Stat Name    | Impact on Workload | Value Before | Value After | Impact on SQL | % Workload Before | % Workload After |
|--------------|--------------------|--------------|-------------|---------------|-------------------|------------------|
| elapsed_time | -1,61%             | ,022         | 1,206       | -5381,82%     | ,03%              | 4,08%            |
| parse_time   |                    |              | ,001        |               |                   | ,02%             |
| cpu_time     | -,4%               | ,02          | ,22         | -1000%        | ,04%              | 1,3%             |
| buffer_gets  | -,01%              | 1721         | 1802        | -4,71%        | ,2%               | ,28%             |
| cost         |                    |              | 7           |               |                   | 0%               |
| reads        | -20,66%            | 0            | 2215        | -221500%      | 0%                | 7,09%            |
| writes       | 0%                 | 0            | 0           | 0%            | 0%                | 0%               |
| rows         |                    | 36           | 33          |               |                   |                  |

# Hundreds of Databases Using Real Application Testing



*How tomorrow moves*



# Real World Checkpoint



Customer

- CSX

Project

- One of the nation's leading transportation suppliers

Constraints

- Encompasses 21,000 miles of tracks in 23 states, from Florida to Ontario

Preparation

- HQ in Jacksonville, Florida

Upgrade

Success?

Remarks





# Real World Checkpoint



Customer

Project

Constraints

Preparation

Upgrade

Success?

Remarks

- Upgrade and migration of **304 databases** to 11.2.0.2 over a 24 month period (2011-2012)
  - 1/3 production, 2/3 test and development systems
  - Source versions: Oracle 10.2.0.4 and a few Oracle 8i/9i
  - Single Instance on IBM AIX ⇒ **RAC on Linux**
- Plan to use Real Application Testing
  - Guarantee quality and mitigate the risk of upgrading
- Define standards
  - Install 11.2.0.2 and patches and apply latest PSU

# Real World Checkpoint



Customer

- Limited downtime on some business critical systems

Project

- Testing cycles vary from 1-6 months depending on complexity and criticality

Constraints

- Tight on available testing resources

Preparation

Upgrade

- Time

Success?

- People

Remarks

- Systems

- New to Real Application Testing

# Real World Checkpoint



Customer

Project

Constraints

Preparation

Upgrade

Success?

Remarks

- **Close alliance** with Oracle's **Upgrade Development** Group and Oracle's **RAT Pack**
  - CSX agreed to become an official **Oracle Database 11.2 Reference Customer**
    - Monthly status meetings
    - Onsite training
    - Live upgrade and RAT demo
      - **Cloning databases methods** for use with RAT

# Real World Checkpoint



Customer

Project

Constraints

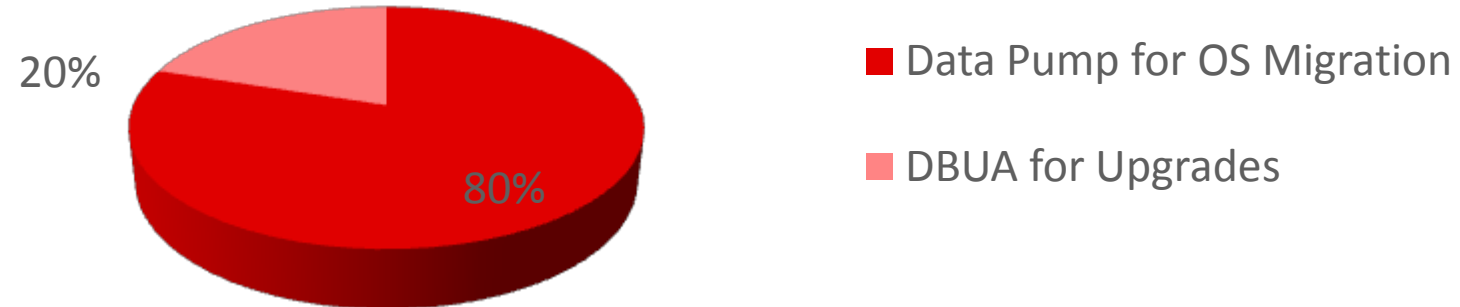
Preparation

**Upgrade**

Success?

Remarks

- Upgrade and migration methods used:



- Policy:
  - Install Oracle SW with latest patches and PSU
  - Combine HW refresh and OS upgrades
- Internal application to track owner, status, success

# Real World Checkpoint



Customer

- Yes –project took 2 years

Project

- **88% of all databases upgraded within 18 months**

Constraints

- Some systems took longer due to business and/or resource constraints

Preparation

Upgrade

- Performance comparison mechanisms are very helpful

Success?

- **Regressions found and fixed before upgrade**

Remarks

- RAT helped a lot to predict workload performance and ensure careful testing

# Real World Checkpoint

Customer

Project

Constraints

Preparation

Upgrade

Success?

Remarks

- “The Real Application Testing tool provided a comprehensive and flexible solution for assessing the impact of the Oracle 11g database upgrade into CSX systems. At CSX we were able to capture real production workloads, replay it in the 11g environment, identify poor performing queries and, fine tune these queries in a test environment before the production implementation.”

*Maritza Gonzalez, Technical Director  
CSX Corporation*

# Real World Checkpoint



Customer

Project

Constraints

Preparation

Upgrade

Success?

Remarks

## More Information?

[https://blogs.oracle.com/UPGRADE/entry/csx\\_corporation\\_upgrades\\_databases\\_2x](https://blogs.oracle.com/UPGRADE/entry/csx_corporation_upgrades_databases_2x)

The screenshot shows a blog post from Oracle's UPGRADE blog. The main title is "CSX Corporation Upgrades Databases 2x Faster With Oracle Real Application Testing" by Mike Dietrich, dated Feb 27, 2014. The article discusses how CSX, a major US railway company, successfully upgraded and migrated its database landscape to Oracle Database 11.2 using Oracle Real Application Testing (RAT). It highlights that the upgrade was completed over a longer period and with significantly reduced testing effort. A quote from Maritza Gonzalez, Technical Director at CSX, is mentioned at the bottom of the article. The screenshot also includes a sidebar with navigation links like "LOCATION UPGRADE", "New Sites + Workshop Recap", and "Upgrade Workshops - Locations". A "Sides Download Center" is visible on the right, offering resources for Oracle Database 12c and DOAG 2013.



**Mike Dietrich**  
Senior Principal Technologist -  
Database Upgrade Development Group  
- Oracle Corporation

Based near Munich/Germany and spending plenty of time in airplanes to run either upgrade workshops or workshops with reference customers. Acting as interlink between customers and the Upgrade Development.

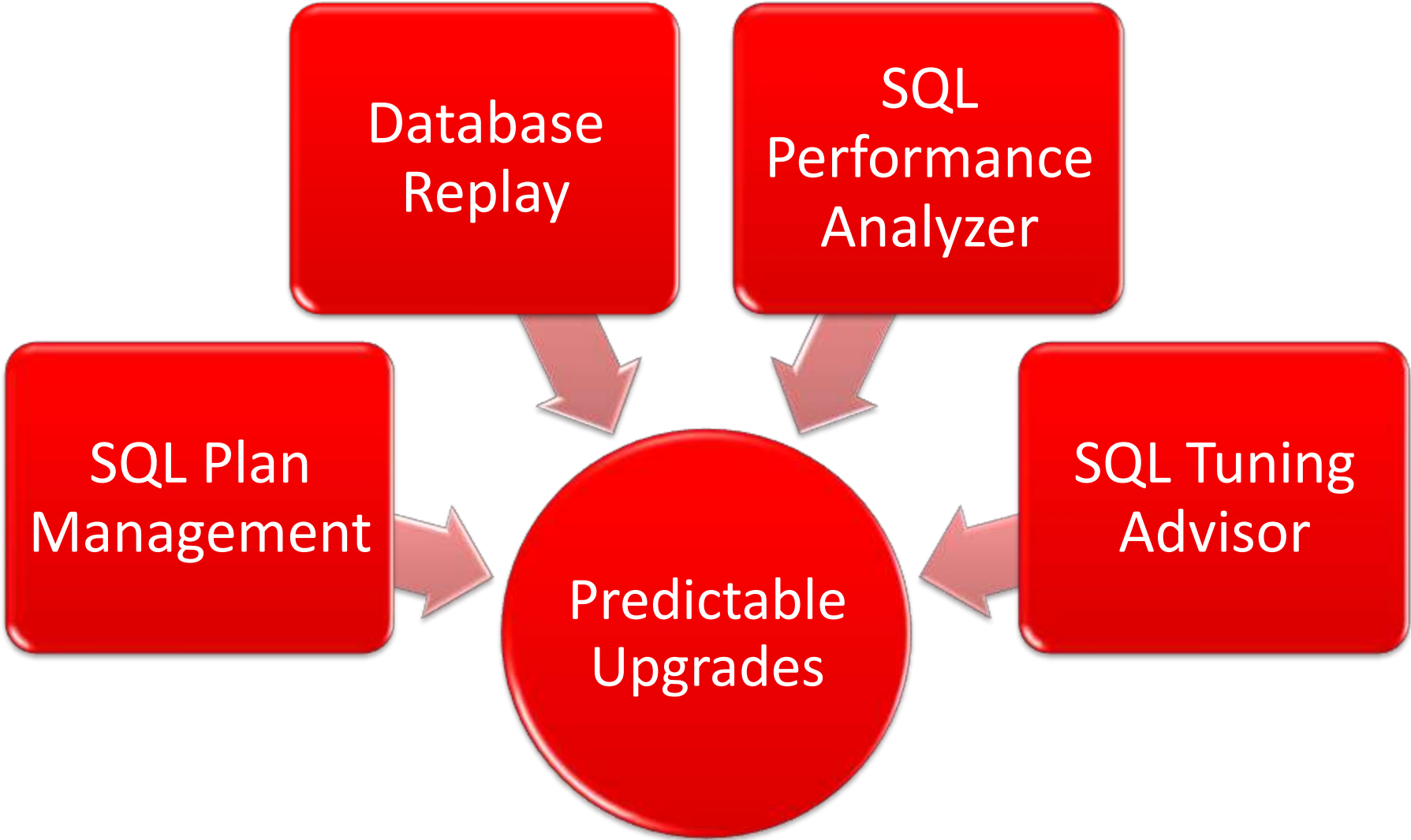
Contact me either via [XING](#) or [LinkedIn](#)

### Sides Download Center

**Upgrade, Migrate & Consolidate to Oracle Database 12c**  
Refreshed 9-MAY-2014

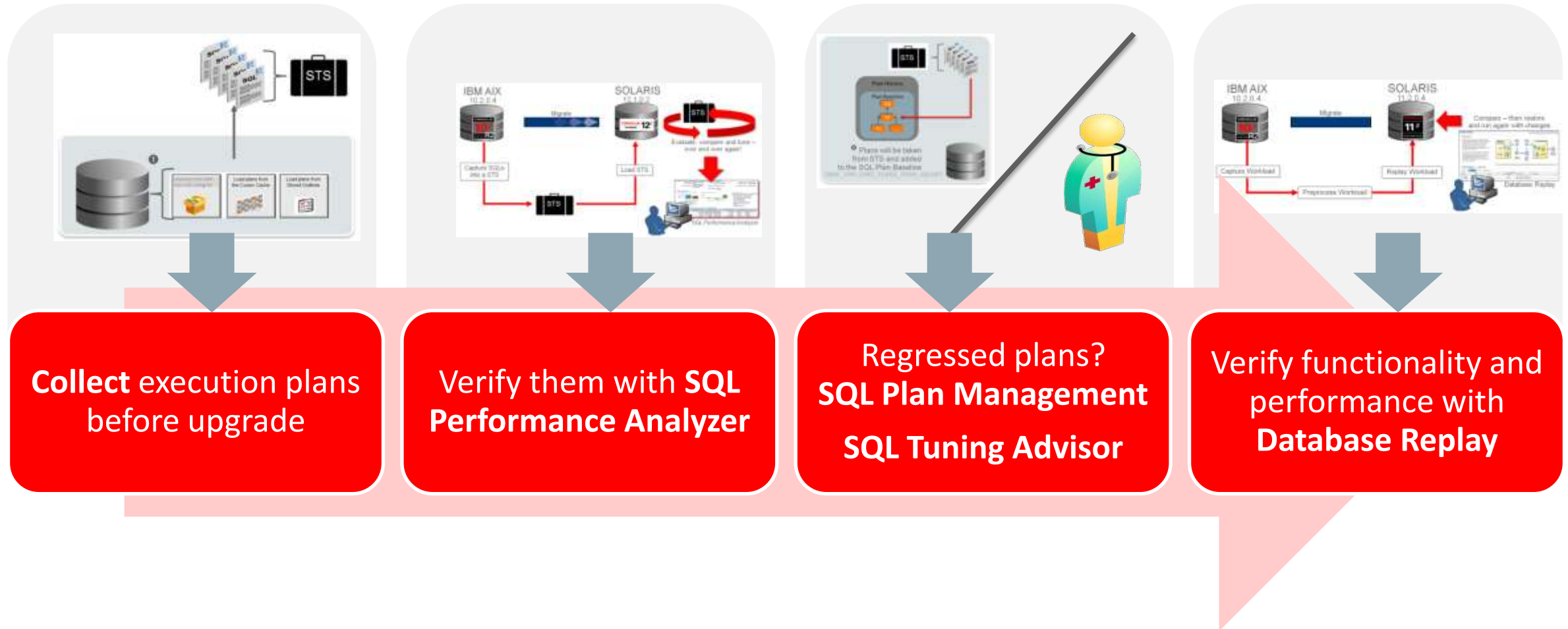
**Multitenant in the Real World**  
DOAG 2013  
Uploaded 20-NOV-2013

# Use the Right Testing Tools





# Testing Tools – Hand-in-Hand



# Performance Checklist

## Prepare

- Adjust maintenance windows
- Configure statistics retention
- Configure incremental statistics
- Adjust memory and optimizer parameters
- Configure AWR, ASH and ADDM

## Stability

- Preserve and transport execution plans

## Test

- General test guidelines
- Real Application Testing

## Optimize

- System Statistics
- Automatic Tuning Advisor

## Features

- Enable Performance Features

# Gather Workload Statistics

Best Practice

- Gather **system statistics** during a regular workload period:

```
SQL> exec
DBMS_STATS.GATHER_SYSTEM_STATS('start');
<< Run it for several hours on a workload – does not generate overhead!!! >>
SQL> exec DBMS_STATS.GATHER_SYSTEM_STATS('stop');
```

- Revert to the defaults:

```
SQL> exec
DBMS_STATS.DELETE_SYSTEM_STATS;
```

```
SQL> select pname NAME, pval1 VALUE, pval2
INFO from AUX_STATS$;
```

| NAME       | VALUE     | INFO             |
|------------|-----------|------------------|
| -----      | -----     | -----            |
| STATUS     |           | COMPLETED        |
| DSTART     |           | 04-03-2011 12:30 |
| DSTOP      |           | 05-03-2011 12:30 |
| FLAGS      | 1         |                  |
| CPUSPEEDNW | 2498,65   |                  |
| IOSEEKTIM  | 11,405    |                  |
| IOTFRSPEED | 25595,605 |                  |
| ...        |           |                  |

# Gather Workload Statistics

INFO

## ▪ Calibrate I/O (Orion): Example

```
SET SERVEROUTPUT ON
DECLARE lat INTEGER;
        iops INTEGER;
        mbps INTEGER;
BEGIN
    DBMS_RESOURCE_MANAGER.CALIBRATE_IO (28, 10, iops, mbps, lat);
    DBMS_OUTPUT.PUT_LINE ('max_iops = ' || iops);
    DBMS_OUTPUT.PUT_LINE ('latency = ' || lat);
    DBMS_OUTPUT.PUT_LINE ('max_mbps = ' || mbps);
end;
/
```

– This is a requirement for AUTODOP (automatic degree of parallelism in 11.2.0.2) – in addition PARALLEL\_DEGREE\_POLICY must be set to AUTO

## ▪ Exadata:

```
SQL> exec DBMS_STATS.GATHER_SYSTEM_STATS ('EXADATA');
```

# Workload Stats: Further Information

INFO

- See the Oracle 11.2 Performance Tuning Guide for all stats:

- [http://download.oracle.com/docs/cd/E11882\\_01/server.112/e16638/stats.htm#PFGRF94743](http://download.oracle.com/docs/cd/E11882_01/server.112/e16638/stats.htm#PFGRF94743)

- See also:

- [13.4.1.2 Multiblock Read Count](#)

If you gather workload statistics, then the `mbrc` value gathered as part of the workload statistics is used to estimate the cost of a full table scan. However, during the gathering process of workload statistics, Oracle Database may not gather the `mbrc` and `mreadtim` values if no table scans are performed during serial workloads, as is often the case with OLTP systems. However, full table scans occur frequently on DSS systems but may run parallel and bypass the buffer cache. In such cases, Oracle Database still gathers the `sreadtim` value because the database performs index lookup using the buffer cache.

- If Oracle Database cannot gather or validate gathered `mbrc` or `mreadtim` values, but has gathered `sreadtim` and `cpuspeed` values, then the database uses only the `sreadtim` and `cpuspeed` values for costing. In this case, the optimizer uses the value of the initialization parameter `DB_FILE_MULTIBLOCK_READ_COUNT` to cost a full table scan. However, if `DB_FILE_MULTIBLOCK_READ_COUNT` is not set or is set to 0 (zero), then the optimizer uses a value of 8 for costing.

# Gather Workload Statistics

Oracle Database 10g/11g only

Best Practice

- Gather **fixed objects statistics** during regular workload 1 week after upgrade:



```
SQL> exec DBMS_STATS.GATHER_FIXED_OBJECTS_STATS;
```

- Will gather stats on X\$ structures
- Redo it 4x per year with a job
  - Findings:
    - MMON may cause too much CPU load if fixed objects stats haven't been generated
    - Internal recursive queries perform better
- **Not necessary anymore in Oracle Database 12c as it is included in the Auto Stats Gathering Job**

# Parameter Information

- `_OPTIMIZER_IGNORE_HINTS`
  - Values: `TRUE` | `FALSE`
  - **SQL hints** that worked in one release may not work in another
  - Test all SQL statements with hints on the new release using the parameter
    - Chances are high that SQL statements will perform better without any hints

# Parameter Information

- OPTIMIZER\_USE\_INVISIBLE\_INDEXES

- Values: TRUE | FALSE

- Background:

With modern IO systems full table scans might be more efficient than index lookups – but dropping and recreating an index is expensive. By making an index invisible to the optimizer the effect on query performance can be detected before it affects production users. This is extremely beneficial in an **Exadata environment**.

- Example:

```
ALTER INDEX idx_ename ON emp(ename) INVISIBLE;  
  
ALTER SESSION SET  
OPTIMIZER_USE_INVISIBLE_INDEXES=TRUE;
```



# Parameter Information

- CELL\_OFFLOAD\_PLAN\_DISPLAY
  - Values: TRUE | FALSE
  - Background:  
Will display you potential savings with a **cell storage**
  - STORAGE indicates which parts of the query could be offloaded to the storage cells using smart scan
  - Example:

```
-----  
| Id | Operation                               | Name |  
-----  
0	SELECT STATEMENT	
*1	HASH JOIN	
*2	HASH JOIN	
*3	TABLE ACCESS STORAGE FULL	SALES
*4	TABLE ACCESS STORAGE FULL	SALES
*5	TABLE ACCESS STORAGE FULL	SALES
-----
```

# SQL Real-Time Monitoring

- **Only source of truth** to monitor the real execution plan
  - Part of Tuning Pack license
  - [MOS Note:1229904.1](#): Real-Time SQL Monitoring in 11g
  - `DBMS_SQLTUNE.REPORT_SQL_MONITOR()` allows to display monitoring information
  - `SET AUTOTRACE TRACE` does not show the "real" plan in some cases
  - Target:
    - Parallel queries, parallel DML or parallel DDL
    - Execution that exceeds 5 sec of CPU or I/O time
  - Global SQL level statistics are collected: `V$SQL_MONITOR`
  - Plan level statistics are collected (#rows, memory, temp space, start/end date): `V$SQL_PLAN_MONITOR`
  - Statistics are updated quasi real-time while the query executes
  - Statistics for completed executions are retained for at least 5 minutes
  - Feature switched on by default

# Manual vs Automatic SQL Tuning

## Manual SQL Tuning

- Complex
- Time consuming
- Never-ending task

## Advisors

Since 10g - improved in 11g

### SQL Tuning Advisor

- Can operate on a single SQL
- Optimizer in Comprehensive Mode
- Potential recommendations:
  - SQL Profiles
  - Indexes

### SQL Access Advisor

- Requires a workload (+50 sql)
- Potential recommendations:
  - Indexes
  - Materialized Views
  - Indexes on MVs
  - Partitioning Advisor

## Automatic SQL Tuning

Since 11g

|                                                |                                                               |
|------------------------------------------------|---------------------------------------------------------------|
| Maximum Time Spent Per SQL During Tuning (sec) | <input type="text"/>                                          |
| Automatic Implementation of SQL Profiles       | <input type="radio"/> Yes <input checked="" type="radio"/> No |
| Maximum SQL Profiles Implemented Per Execution | <input type="text"/>                                          |
| Maximum SQL Profiles Implemented (Overall)     | <input type="text"/>                                          |

# SQL Tuning Advisor

- Can be used in EM or on CLI (via `DBMS_SQLTUNE`)
  - Part of Tuning Pack since Oracle 10g
  - SQL Profiles contain information that lead to improved execution plans without changing the application code
    - Use different optimizer settings
    - Correct wrong/missing statistics and wrong estimates
    - SQL Profiles don't change the original SQL statement
    - SQL Profiles are persistent
    - SQL Profiles can be transported within SQL Tuning Sets (STS)
      - See [Note:751068.1](#) for an example
    - SQL Profiles can be tested and verified without any risk

# SQL Tuning

- Example: Results of SQL Tuning Advisor → SQL Profile

## Recommendations for SQL ID:40yqk9cdfgxgk

Return

Only one recommendation should be implemented.

### SQL Text

```
select /*+ use_nl(c) ordered */ count(*) from sh.sales s, sh.customers c where c.cust_id=s.cust_id and cust_first_name='Dina'
```

### Select Recommendation

Original Explain Plan (Annotated)

Implement

| Select                           | Type        | Findings                                                                              | Recommendations                                                                                                                                                        | Rationale                                                                                                                                                                                                                                                                                                                                                                    | Benefit (%) | New Explain Plan | Compare Explain Plans |
|----------------------------------|-------------|---------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|------------------|-----------------------|
| <input checked="" type="radio"/> | SQL Profile | A potentially better execution plan was found for this statement.                     | Consider accepting the recommended SQL profile.                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                              | 99.77       |                  |                       |
| <input type="radio"/>            | Index       | The execution plan of this statement can be improved by creating one or more indices. | Consider running the Access Advisor to improve the physical schema design or creating the recommended index.<br>SH.CUSTOMERS("CUST_FIRST_NAME")<br>SH.SALES("CUST_ID") | Creating the recommended indices significantly improves the execution plan of this statement. However, it might be preferable to run "Access Advisor" using a representative SQL workload as opposed to a single statement. This will allow to get comprehensive index recommendations which takes into account index maintenance overhead and additional space consumption. | 69.68       |                  |                       |

# SQL Tuning

- Example: Compare original to new explain plan

## Compare Explain Plans

### 1 Original Explain Plan (Annotated)

Indicates an adjustment from the original plan by the SQL Tuning Advisor  
Plan Hash Value **308913612**

[Expand All](#) | [Collapse All](#)

| Operation                   | Line ID | Object            | Object Type    | Order | Rows | Bytes     | Cost    | Time   | CPU Cost      | I/O Cost |
|-----------------------------|---------|-------------------|----------------|-------|------|-----------|---------|--------|---------------|----------|
| SELECT STATEMENT            | 0       |                   |                |       | 9    | 0.017     | 919,732 | 11,037 | 8,498,774,016 | 919,271  |
| SORT AGGREGATE              | 1       |                   |                |       | 8    | 0.017     |         |        |               |          |
| NESTED LOOPS                | 2       |                   |                |       | 7    |           |         |        |               |          |
| NESTED LOOPS                | 3       |                   |                |       | 5    | 16.552    | 919,732 | 11,037 | 8,498,774,016 | 919,271  |
| PARTITION RANGE ALL         | 4       |                   |                |       | 3    | 4,486.538 | 428.6   |        | 7,341,376     | 428      |
| BITMAP CONVERSION TO ROWIDS | 5       |                   |                |       | 2    | 4,486.538 | 428.6   |        | 7,341,376     | 428      |
| BITMAP INDEX FAST FULL SCAN | 6       | SH.SALES_CUST_BIX | INDEX (BITMAP) |       | 1    |           |         |        |               |          |
| INDEX UNIQUE SCAN           | 7       | SH.CUSTOMERS_PK   | INDEX (UNIQUE) |       | 4    |           | 0.1     |        | 1,900         | 0        |
| TABLE ACCESS BY INDEX ROWID | 8       | SH.CUSTOMERS      | TABLE          |       | 6    | 0.012     | 1.1     |        | 9,241         | 1        |

### 2 New Explain Plan With SQL Profile

Plan Hash Value **1818178872**

[Expand All](#) | [Collapse All](#)

| Operation                   | Line ID | Object            | Object Type    | Order | Rows | Bytes     | Cost | Time | CPU Cost    | I/O Cost |
|-----------------------------|---------|-------------------|----------------|-------|------|-----------|------|------|-------------|----------|
| SELECT STATEMENT            | 0       |                   |                |       | 7    | 0.017     | 839  | 11   | 131,239,648 | 832      |
| SORT AGGREGATE              | 1       |                   |                |       | 6    | 0.017     |      |      |             |          |
| HASH JOIN                   | 2       |                   |                |       | 5    | 16.552    | 839  | 11   | 131,239,648 | 832      |
| TABLE ACCESS FULL           | 3       | SH.CUSTOMERS      | TABLE          |       | 1    | 1.371     | 405  | 5    | 22,792,460  | 404      |
| PARTITION RANGE ALL         | 4       |                   |                |       | 4    | 4,486.538 | 428  | 6    | 7,341,376   | 428      |
| BITMAP CONVERSION TO ROWIDS | 5       |                   |                |       | 3    | 4,486.538 | 428  | 6    | 7,341,376   | 428      |
| BITMAP INDEX FAST FULL SCAN | 6       | SH.SALES_CUST_BIX | INDEX (BITMAP) |       | 2    |           |      |      |             |          |

# SQL Tuning Task Command Line Example

```
exec DBMS_SQLTUNE.DROP_TUNING_TASK('my_tuning_task');

DECLARE
  my_task_name VARCHAR2(30);
  my_sqltext CLOB;
BEGIN
  my_sqltext := q'!<your SQL - concatenate lines with ||>!';
  my_task_name := DBMS_SQLTUNE.CREATE_TUNING_TASK(sql_text => my_sqltext,
    user_name => XY, scope => 'COMPREHENSIVE', time_limit => 60,
    task_name => 'my_tuning_task', description => 'test');

END;
/

exec DBMS_SQLTUNE.EXECUTE_TUNING_TASK( task_name => 'my_tuning_task' );

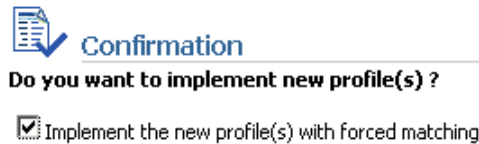
SELECT sofar, totalwork FROM V$ADVISOR_PROGRESS WHERE task_id =
  (SELECT task_id FROM USER_ADVISOR_TASKS WHERE task_name='my_tuning_task');

SET LONG 100000
SET LONGCHUNKSIZE 100000
SET LINESIZE 10000
SET PAGESIZE 10000
SELECT DBMS_SQLTUNE.REPORT_TUNING_TASK( 'my_tuning_task' ) FROM DUAL;
```

# SQL Profile containing literals - not binds

- SQL Profiles can handle statements containing literals (instead of binds) as well:

- Since 11.1.0.6 possible in EM:
- In 10.2 only possible on command line:



```
exec
:p_name:=dbms_sqltune.accept_sql_profile
(task_name=>'XT',name=>'XT_PROFILE', FORCE_MATCH=>TRUE);
```

```
SQL> select name, status, force_matching, sql_text rom dba_sql_profiles;
```

| NAME    | STATUS  | FOR | SQL_TEXT                                                                                                                                   |
|---------|---------|-----|--------------------------------------------------------------------------------------------------------------------------------------------|
| MY_PROF | ENABLED | YES | select /*+ use_nl(c) ordered */ count(*)<br>from sh.sales s, sh.customers c<br>where c.cust_id = s.cust_id<br>and CUST_FIRST_NAME = 'Mike' |



# SQL Profile - evaluation

- SQL Profiles should be evaluated before making them available to every user:

```
exec
:p_name:=dbms_sqltune.accept_sql_profile
task_name=>'XT',name=>'XT_PROFILE',
category=>'TEST_ENV', FORCE_MATCH=>TRUE)
```

- Now evaluate the statement's profile in a limited user context

```
alter session set SQLTUNE_CATEGORY='TEST_ENV';
```

- If verification went fine, make it accessible to everybody

```
exec
dbms_sqltune.alter_sql_profile
(name=>'XT_PROFILE',
attribute_name=>'CATEGORY',value=>'DEFAULT')
```

# SQL Tuning Automation in 11g

- Configure Automatic SQL Tuning

ORACLE Enterprise Manager 11g  
Database Control

Database Instance: ORCL > Automated Maintenance Task

## Automatic SQL Tuning Settings

### Subprogram

[EXECUTE\\_AUTO\\_TUNING\\_TASK Function & Procedure](#)

[REPORT\\_AUTO\\_TUNING\\_TASK Function](#)

[SET\\_AUTO\\_TUNING\\_TASK\\_PARAMETER Procedures](#)

### Description

Executes the Automatic SQL Tuning task immediately (SYS only)

Displays a text report of the automatic tuning task's history

Changes a task parameter value for the daily automatic runs

Show SQL Revert Apply

Maximum Time Spent Per SQL During Tuning (sec) 1200

Automatic Implementation of SQL Profiles  Yes  No

Maximum SQL Profiles Implemented Per Execution 20

Maximum SQL Profiles Implemented (Overall) 10000

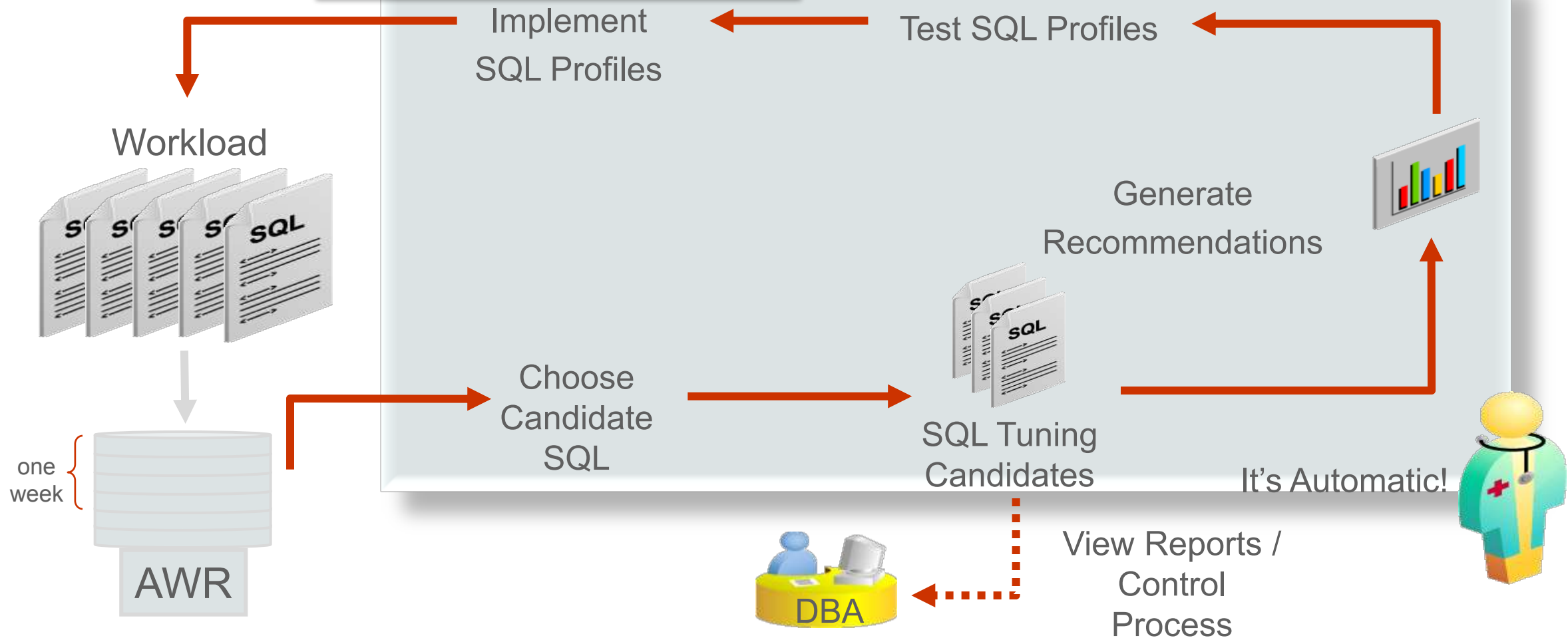
 TIP You need to login as SYS to make the change.

Show SQL Revert Apply

- Package: DBMS\_AUTO\_SQLTUNE

# SQL Tuning Automation since Oracle Database 11g

|                                                |                                                               |
|------------------------------------------------|---------------------------------------------------------------|
| Maximum Time Spent Per SQL During Tuning (sec) | 1200                                                          |
| Automatic Implementation of SQL Profiles       | <input checked="" type="radio"/> Yes <input type="radio"/> No |
| Maximum SQL Profiles Implemented Per Execution | 20                                                            |
| Maximum SQL Profiles Implemented (Overall)     | 10000                                                         |



# Real World Checkpoint



Deutsche Messe  
Hannover · Germany

## Customer

- Deutsche Messe AG
  - HQ in Hannover, Germany
  - Largest trade fair worldwide
  - Key trade fairs:
    - CeBIT
    - Hannover Messe
  - ~1,000,000 m<sup>2</sup> exhibition space

## Project

## Constraints

## Preparation

## Migration

## Success?

## Remarks



# Real World Checkpoint

Customer

Project

Constraints

Preparation

Migration

Success?

Remarks

- Upgrade of a 3-node Oracle 10.2.0.3 RAC Cluster to Oracle 11.1.0.7
  - Move from raw devices to ASM
  - Use Snapshot Standby instead of RMAN to refresh development databases
  - **Tune third-party application with Automatic SQL Tuning**
  - Sun Solaris 10
- Initially 2 databases to upgrade (each ~350GB):
  - CeBIT system
  - Online ordering web application

# Real World Checkpoint

Customer

- Keep the old hardware

Project

- The "worst" application ever ...

Constraints

Preparation

Migration

Success?

Remarks

# Real World Checkpoint

Customer

Project

Constraints

Preparation

Migration

Success?

Remarks

- Performance:
  - AWR snapshots
  - Automatic SQL Tuning showed excellent results
  - Real Application Testing (Database Replay) done during high-load phase during CeBIT 2009

# Real World Checkpoint

Customer

Project

Constraints

Preparation

Migration

Success?

Remarks

## ▪ Upgrade

- Data Pump used for upgrade, consolidation and reorganization
- Everything went well ... until ...
  - Right at the end of `impdp` run the cluster node went down and was restarted
  - Reason: EM Agent was going amok and requested all available RAM and swap until Clusterware cleaned up the situation by a restart
    - **Remedy: Upgrade the agents to the version matching your Grid Control !!!**



# Real World Checkpoint

Customer

Project

Constraints

Preparation

Migration

Success?

Remarks

- Live? And alive?
  - Yes! Go-live in September and October 2009
    - But highest load to be expected in March 2010 (CeBIT!!)
  - Overall downtime: 4 hrs
  - Application is faster than ever
  - Customer kept 3 year old hardware
  - All SAP systems recently upgraded to 11.2.0.3
- More information: OOW 2010 presentation and Success Story
  - [http://apex.oracle.com/pls/apex/f?p=202202:2:::::P2\\_SUCHWORT:messe](http://apex.oracle.com/pls/apex/f?p=202202:2:::::P2_SUCHWORT:messe)
  - <http://www.oracle.com/us/corporate/customers/deutsche-messe-1-db-snapshot-367194.pdf>

# Real World Checkpoint

Customer

- "Heal" a terrible application

Project

Constraints

Preparation

Migration

Success?

Remarks

## Original Explain Plan (Annotated)

⦿ Indicates an adjustment from the original plan by the SQL Tuning Advisor  
Plan Hash Value 2912659397

Expand All | Collapse All

| Operation                   | Line ID | Object                   | Object Type    | Order | Rows | Bytes | Cost      | Time   | CPU Cost       | I/O Cost  |
|-----------------------------|---------|--------------------------|----------------|-------|------|-------|-----------|--------|----------------|-----------|
| SELECT STATEMENT            | 0       |                          |                | 5     |      | 0.077 | 1,073,542 | 12,883 | 10,571,555,840 | 1,072,686 |
| COUNT STOPKEY               | 1       |                          |                | 4     |      |       |           |        |                |           |
| VIEW                        | 2       |                          |                | 3     |      | 0.077 | 1,073,542 | 12,883 | 10,571,555,840 | 1,072,686 |
| TABLE ACCESS BY INDEX ROWID | 3       | XPOBS_dmag_xpobs_changes | TABLE          | 2     |      | 0.030 | 1,073,542 | 12,883 | 10,571,555,840 | 1,072,686 |
| INDEX FULL SCAN             | 4       | XPOBS_C_45CA075D_PK      | INDEX (UNIQUE) | 1     |      |       | 9,750     | 117    | 950,185,280    | 9,673     |

## New Explain Plan With SQL Profile

Plan Hash Value 3211123922

Expand All | Collapse All

| Operation                   | Line ID | Object                   | Object Type | Order | Rows | Bytes | Cost | Time | CPU Cost   | I/O Cost |
|-----------------------------|---------|--------------------------|-------------|-------|------|-------|------|------|------------|----------|
| SELECT STATEMENT            | 0       |                          |             | 6     |      | 0.077 | 5    | 1    | 12,376,813 | 4        |
| COUNT STOPKEY               | 1       |                          |             | 5     |      |       |      |      |            |          |
| VIEW                        | 2       |                          |             | 4     |      | 0.077 | 5    | 1    | 12,376,813 | 4        |
| SORT ORDER BY STOPKEY       | 3       |                          |             | 3     |      | 0.030 | 5    | 1    | 12,376,813 | 4        |
| TABLE ACCESS BY INDEX ROWID | 4       | XPOBS_dmag_xpobs_changes | TABLE       | 2     |      | 0.030 | 4    | 1    | 29,706     | 4        |
| INDEX RANGE SCAN            | 5       | XPOBS_IDX\$\$CHANGES01   | INDEX       | 1     |      |       | 3    | 1    | 21,764     | 3        |

Improvement factor:  
~250,000x !!!

# Performance Checklist

## Prepare

- Adjust maintenance windows
- Configure statistics retention
- Configure incremental statistics
- Adjust memory and optimizer parameters
- Configure AWR, ASH and ADDM

## Stability

- Preserve and transport execution plans

## Test

- General test guidelines
- Real Application Testing

## Optimize

- System Statistics
- Automatic Tuning Advisor

## Features

- Enable Performance Features

## AUTODOP – Automatic Degree of Parallelism

- AUTODOP was introduced in Oracle 11.2.0.2
  - Oracle 12c does not require I/O calibration anymore
    - Default value of 200MB/sec IO rate will be used instead
      - I/O calibration (Orion):



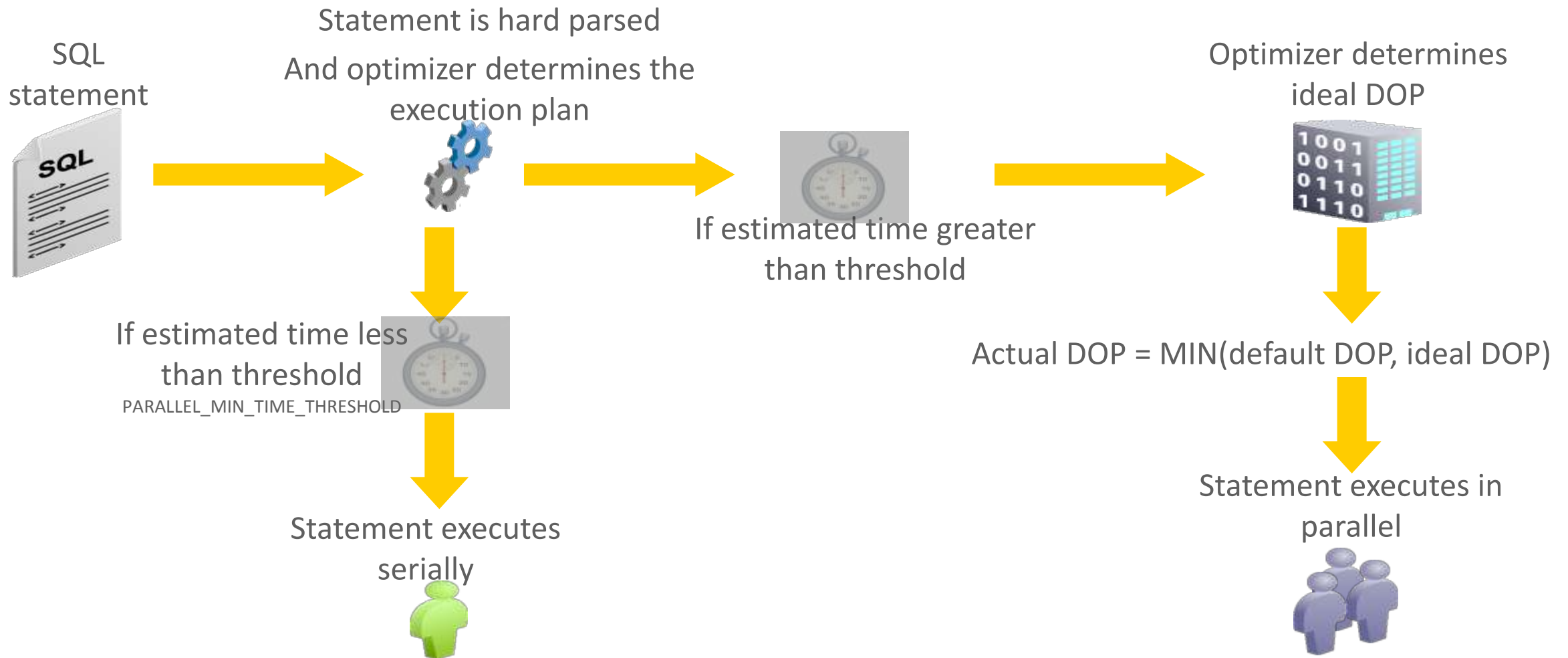
```
SET SERVEROUTPUT ON
DECLARE lat INTEGER;
        iops INTEGER;
        mbps INTEGER;
BEGIN
    DBMS_RESOURCE_MANAGER.CALIBRATE_IO (84, 10, iops, mbps, lat);
    DBMS_OUTPUT.PUT_LINE ('max_iops = ' || iops);
    DBMS_OUTPUT.PUT_LINE ('latency = ' || lat);
    DBMS_OUTPUT.PUT_LINE ('max_mbps = ' || mbps);
end;
/
SELECT * FROM DBA_RSRC_IO_CALIBRATE;
```

- Since Oracle 12c: IO and CPU taken into consideration
  - 11g: Only IO was used
- Enabled by setting init parameter:

```
SQL> ALTER SESSION SET PARALLEL_DEGREE_POLICY=AUTO;
```

# Automated Degree of Parallelism

## How it works



# Adaptive Cursor Sharing

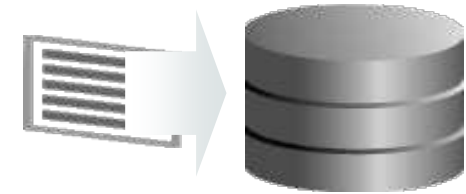
- Adaptive cursor sharing introduced in 11g
- Common problem:
  - When bind variables are used, the initial plan can be suboptimal due to the fact that
    - Future values used in future executions share the initial plan
    - The first set of binds used may not be representative of the majority of executions
  - For explanation and examples see [Note:740052.1](#) and [Note:836256.1](#)
- This feature **monitors the execution statistics** for candidate queries and makes it possible for the same query to **generate and use different execution plans for different set of binds values**
- Parameter: `_optimizer_adaptive_cursor_sharing=FALSE|TRUE`

# PL/SQL Native Compilation

- Since Oracle 11g it's easier, cheaper, faster
  - No directory object needed: compiled library resides in database
  - **No external compiler required – no extra license costs!**
  - Can speed up PL/SQL performance (results may vary)
  - Just two PL/SQL native compilation parameters to set:
    - `PLSQL_CODE_TYPE=NATIVE`
    - `PLSQL_OPTIMIZE_LEVEL=3`
  - Then recompile the schemas:
    - `SQL> exec DBMS_UTILITY.COMPILE_SCHEMA ('<username>');`

# SecureFiles

- SecureFiles = new LOB storage technology
  - Better performance
  - Additional features: deduplication, encryption
- Examples:



```
CREATE TABLE t1 (a CLOB) LOB(a) STORE AS SECUREFILE;  
CREATE TABLE t2 (a CLOB) LOB(a) STORE AS SECUREFILE (DEDUPLICATE);  
CREATE TABLE t3 (a CLOB ENCRYPT USING 'AES128') LOB(a) STORE AS  
SECUREFILE (CACHE);
```

- Tablespace must be ASSM managed
- Initialization parameter:

```
DB_SECUREFILE = [NEVER | PERMITTED | NEW  
PREFERRED | ALWAYS | IGNORE]
```

- `CREATE TABLE t1 (a CLOB);` -- this will be a Securefile!!!



# LONG/LOB ⇒ SecureFile Conversion

- LONG and BasicFiles LOB data types are still supported
  - But they have many limitations (size, performance, operations)
- SecureFiles are fully transparent to applications!
  - Data type still a LOB --- No functional differences --- API access via PL/SQL (DBMS\_LOB), JDBC, .NET, PHP
- 2 conversion options:

LONG  
LONG RAW

CLOB  
BLOB

## DBMS\_REDEFINITION

- [MOS Note:728758.1](#) How to online convert from BasicFiles to SecureFiles
- [http://docs.oracle.com/cd/E11882\\_01/appdev.112/e18294/adlob\\_smart.htm#ADLOB45231](http://docs.oracle.com/cd/E11882_01/appdev.112/e18294/adlob_smart.htm#ADLOB45231)
- Data always online - can be done in parallel

Data Pump Import (12c) using:

```
TRANSFORM=LOB_STORAGE:SECUREFILE
```

```
TRANSFORM=DISABLE_ARCHIVE_LOGGING:Y
```

SecureFile LOB

White Paper: <http://www.oracle.com/technetwork/database/securefilemigrationpaper-130440.pdf>

# Compression

Oracle 8i:  
Index Compression

```
CREATE INDEX emp_idxcomp ... ON  
emp(job,ename) COMPRESS 1;
```

Oracle 9i:  
Table Compression for DWH

```
CREATE TABLE comp_basic...  
COMPRESS [BASIC]
```

Oracle 11g:  
Advanced Compression

```
CREATE TABLE comp_oltp...  
COMPRESS FOR OLTP
```

Oracle 11g:  
Hybrid Columnar Compression

```
CREATE TABLE comp_hccq...  
COMPRESS FOR QUERY LOW|HIGH;
```

```
CREATE TABLE comp_hccq...  
COMPRESS FOR ARCHIVE LOW|HIGH;
```

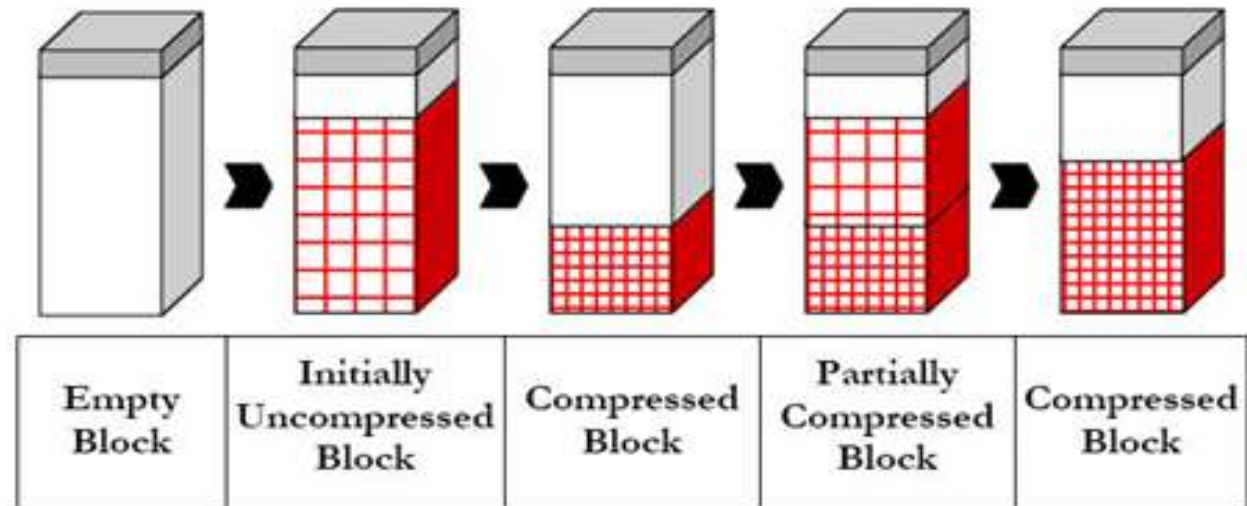
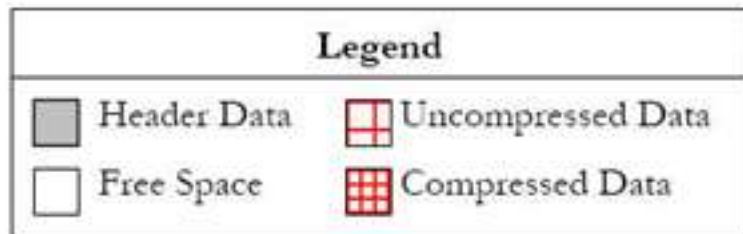
# Compression Overview

- [http://docs.oracle.com/cd/E11882\\_01/server.112/e25494/tables.htm#ADMIN13059](http://docs.oracle.com/cd/E11882_01/server.112/e25494/tables.htm#ADMIN13059)

| <b>Table Compression Method</b>                     | <b>CREATE/ALTER TABLE Syntax</b> | <b>Direct-Path INSERT</b>                       | <b>Notes</b>                                                                                                                                                                                                         |
|-----------------------------------------------------|----------------------------------|-------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Basic compression                                   | COMPRESS [BASIC]                 | Rows are compressed with basic compression.     | COMPRESS and COMPRESS BASIC are equivalent. Rows inserted without using direct-path insert and updated rows are uncompressed.                                                                                        |
| OLTP compression                                    | COMPRESS FOR OLTP                | Rows are compressed with OLTP compression.      | Rows inserted without using direct-path insert and updated rows are compressed using OLTP compression.                                                                                                               |
| Warehouse compression (Hybrid Columnar Compression) | COMPRESS FOR QUERY [LOW HIGH]    | Rows are compressed with warehouse compression. | This compression method can result in high CPU overhead. Updated rows and rows inserted without using direct-path insert are stored in row format instead of column format, and thus have a lower compression level. |
| Archive compression (Hybrid Columnar Compression)   | COMPRESS FOR ARCHIVE [LOW HIGH]  | Rows are compressed with archive compression.   | This compression method can result in high CPU overhead. Updated rows and rows inserted without using direct-path insert are stored in row format instead of column format, and thus have a lower compression level. |

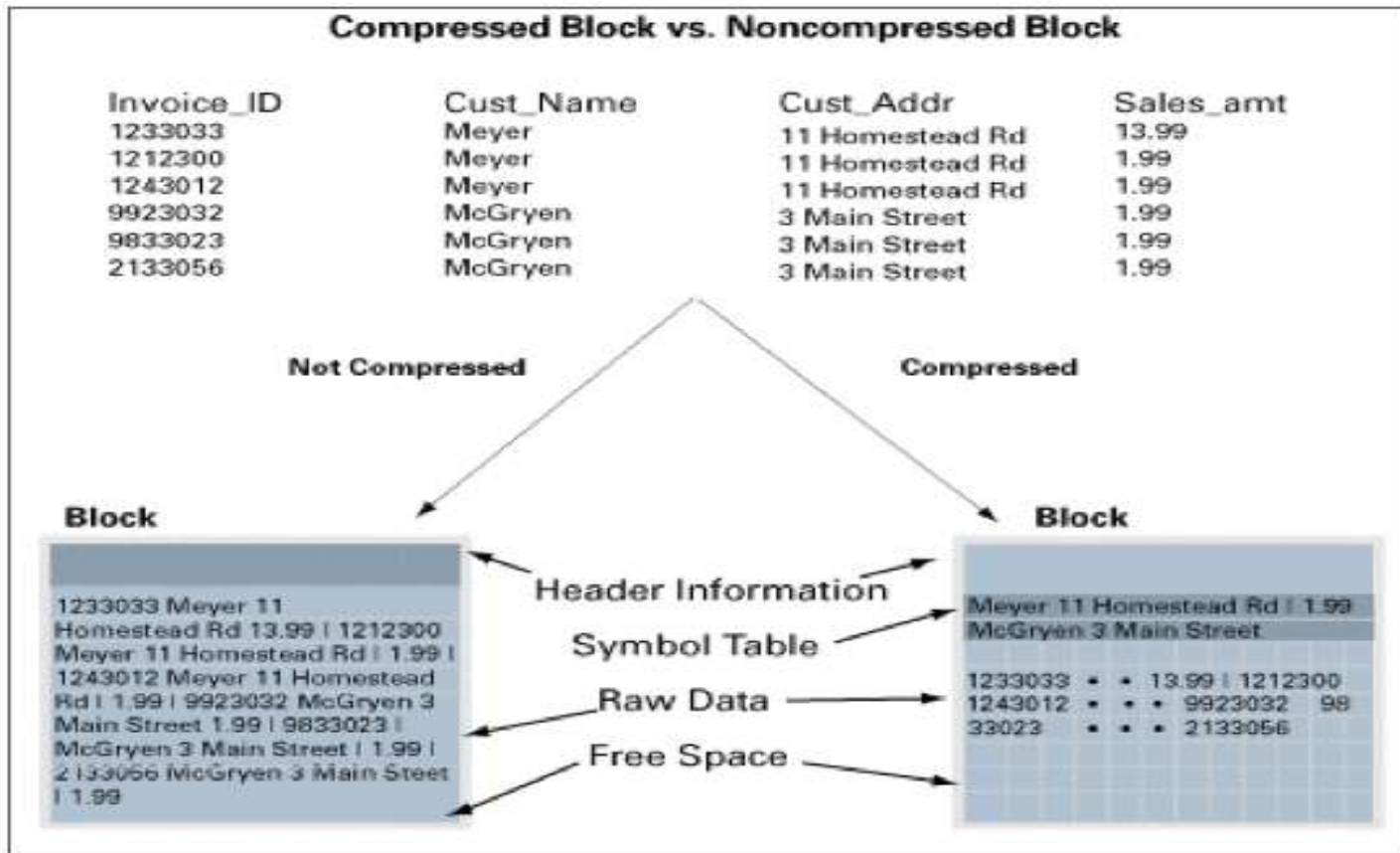
# Advanced Compression

- Advanced Compression since Oracle 11g works for:
  - All types of data
  - Backup → New RMAN compression algorithm
  - Data Pump exports
  - Data Guard gap resolution and LGWR ASYNC transport
- Reduces resource requirements and costs!!!
  - Storage & Performance



# Advanced (OLTP) Compression

- <http://www.oracle.com/technetwork/database/focus-areas/storage/advanced-compression-whitepaper-130502.pdf>



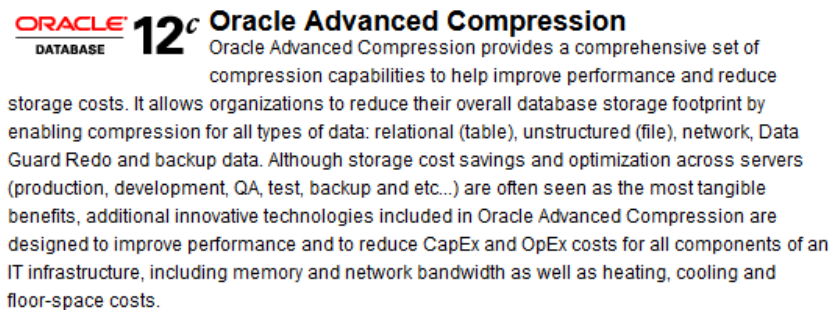
# Advanced Compression

- Compression Advisor

- DBMS\_COMPRESSION since Oracle 11.2

- Download for earlier releases:

<http://www.oracle.com/technetwork/database/options/compression/index.html>

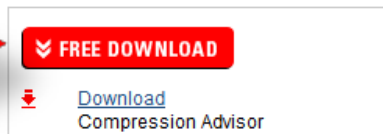


**ORACLE** **12c** Oracle Advanced Compression  
DATABASE

Oracle Advanced Compression provides a comprehensive set of compression capabilities to help improve performance and reduce storage costs. It allows organizations to reduce their overall database storage footprint by enabling compression for all types of data: relational (table), unstructured (file), network, Data Guard Redo and backup data. Although storage cost savings and optimization across servers (production, development, QA, test, backup and etc...) are often seen as the most tangible benefits, additional innovative technologies included in Oracle Advanced Compression are designed to improve performance and to reduce CapEx and OpEx costs for all components of an IT infrastructure, including memory and network bandwidth as well as heating, cooling and floor-space costs.



```
exec DBMS_COMPRESSION.  
GET_COMPRESSION_RATIO (<parameters here>)
```



**FREE DOWNLOAD**

[Download](#)  
Compression Advisor

- Migration in Oracle Database 12c:

- Data Pump import `TRANSFORM=TABLE_COMPRESSION_CLAUSE:<clause>`

# Hybrid Columnar Compression (HCC)

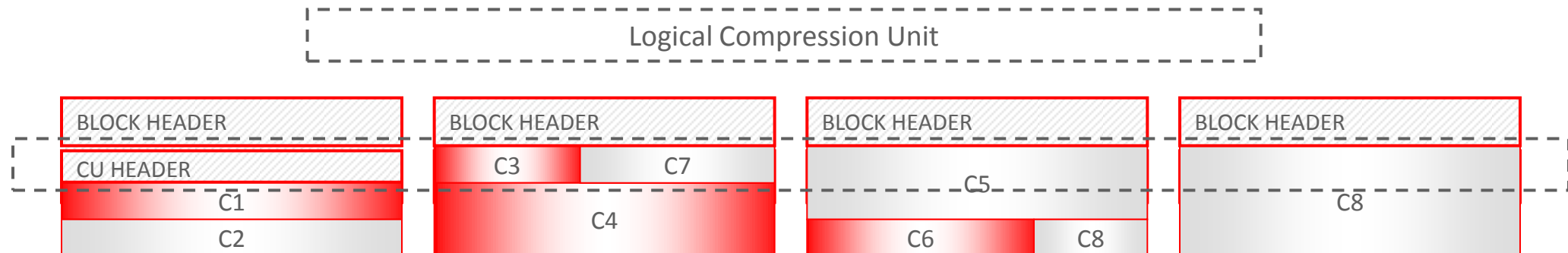
- Available only on Exadata, ZFS and Pillar Axiom 600 Storage
  - WP: <http://www.oracle.com/technetwork/middleware/bi-foundation/ehcc-twp-131254.pdf>
  - No extra license required
  - For historical data getting VERY LITTLE changes
  - Compression ratio is very high
- How it works:
  - Tables are organized into Compression Units (CUs)
    - CUs are larger than database blocks
  - Within Compression Units, data is **organized by column instead of by row**
    - Column organization brings similar values close together, enhancing compression



# Hybrid Columnar Compression (HCC)

- Compression Units

- Logical structure spanning multiple database blocks
- Data organized by column during data load
- Each column is compressed separately
- All column data for a set of rows stored in compression unit





# Upgrade, Migrate & Consolidate

- 1 Introduction
- 2 Preparation Steps
- 3 Upgrade / Migrate / Consolidate
- 4 Fallback Strategies
- 5 New Features
- 6 Performance Management
- 7 Wrap Up



# Advanced Customer Support - Lifecycle Support

Fast, Safe, Efficient; Delivered via Gateway or Onsite



## Consolidation Planning Service



- Identifies optimal scenario and lowers risk
- Analysis of key parameters and components
- Comprehensive consolidation plan
- Detailed projections and recommendations

## Migration Service



- Fast and safe database migration, optimization
- Planning, validation, upgrade, migration
- Migration of huge, complex databases (also SAP environments) in a single weekend
- Compression of up to 70% for better performance

## Load Testing & Analysis Service



- Evaluates impact of planned technology change
- Proactive risk identification
- Comprehensive testing solution
- SQL and Oracle database workload analysis

## Performance Tuning & Benchmark Service



- Maintains optimal performance over time
- Quarterly assessments and monitoring of KPIs
- Best practice recommendations
- Database tuning

# Advanced Customer Support - Lifecycle Support



## ▪ Features

- Database migration, tuning, improvements
  - Compression, reorganization, implementation of further optimizations
- Delivered via secure gateway or onsite

## ▪ Benefits

- Fast, efficient, safe change
- Optimized database
- Better performance
- Risk prevention

## ▪ Long-Term Experience

- More than 2,000 migrations in 12 years



### Centrica, UK

Migration of 4 large databases in SAP environment with minimal downtime



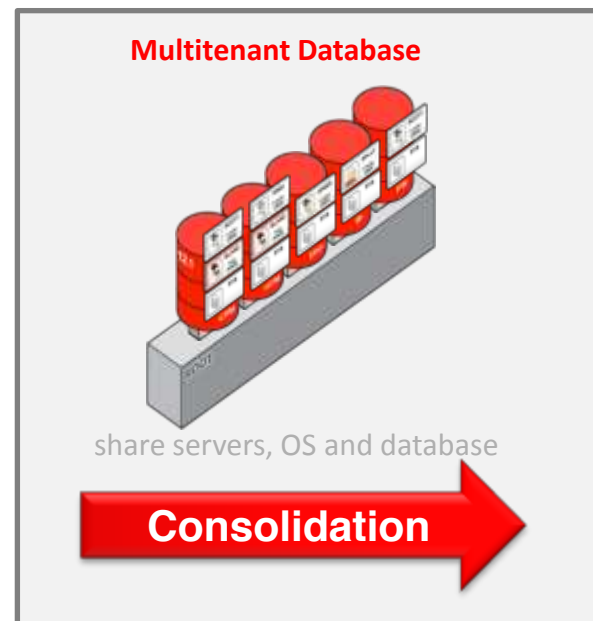
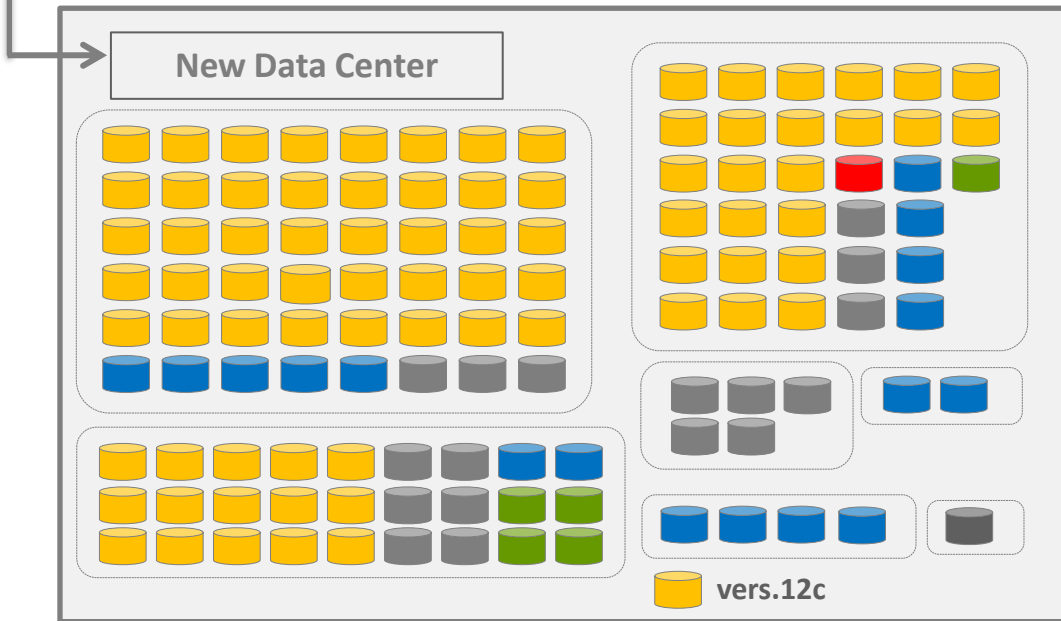
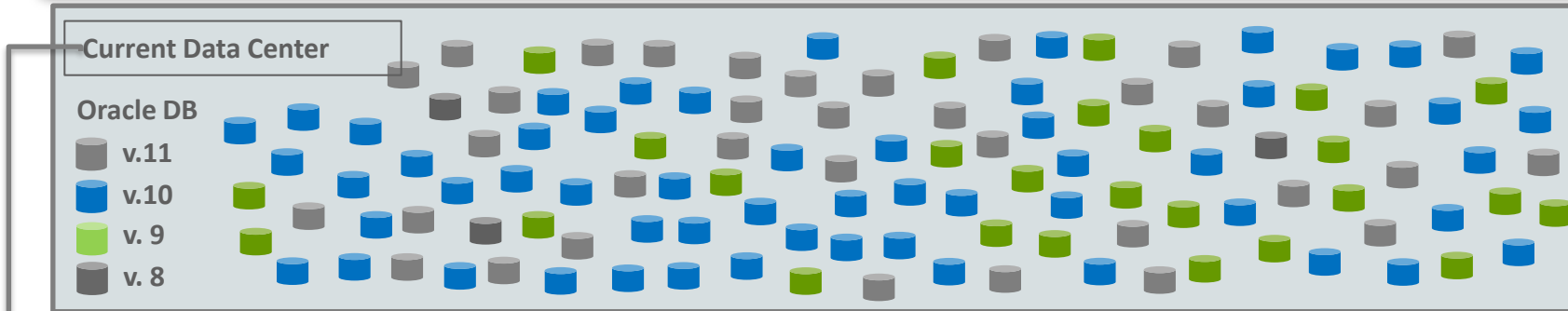
### Endesa, Spain

Datacenter transformation, migration, preproduction testing, implementation

Learn more [here](#)

# Upgrade, Migrate & Consolidate on DB12c

IT landscape for Oracle / Non-Oracle Database and Operating System is very common



**Oracle Consulting Migration Factory:**

over 25% reduction in database upgrade & migration cost and duration (- 40% in Factory effort)

DB Migration Factory delivers breakthroughs in **standardization and automation** – like an assembly line

**Benefit of DB12c and Multitenant Architecture**

- Higher DB performance and System reliability
- DB-OS-HW layers fully integrated, TCO reduction and ROI in shorter time
- More functionality already available as default setup (i.e.Security)
- Less DB Administration (manage many as one), DBAs can move to the next level



# EMEA OC and MF

## Key Contacts

### Emea Migration Factory CoreTeam



Ruud Riemslag



Jo Pugh



Mahesh Rao



Luigi Villa

### MF Offshore Database Solution Components Owners:

**Bala** (Balasubramanian Meyyappan): Oracle DB, GoldenGate, DB Testing

**Shailendra** (Shailendra Surywanshi): Non-Oracle to Oracle DB

**Girish** (Girish Narasanna): DB migration Estimation

**Srini** (Srinivas Thella): DB Application Readiness Assessment

| Cluster             | Database Local Consulting Contact                  |
|---------------------|----------------------------------------------------|
| <b>EMEA overall</b> | Ruud Riemslag / Luigi Villa / Mahesh Rao / Jo Pugh |
| <b>Nordics</b>      | Simon Mørup-Petersen                               |
| <b>Benelux</b>      | Ton van Kooten                                     |
| <b>DE/CH</b>        | Lajos Hodi                                         |
| <b>France</b>       | Claudine Millet                                    |
| <b>Italy</b>        | David Cavanna                                      |
| <b>Iberia</b>       | Anna Moreu                                         |
| <b>UK, Ireland</b>  | Andy Higgins                                       |
| <b>Ecemea-</b>      | Marcel Straka                                      |
| <b>Israel</b>       | Eran Singer                                        |
| <b>Central</b>      | Michael Hoffman                                    |
| <b>GR+NA</b>        | Alkis Nikolaidis / Sherif Mourad                   |
| <b>EG+AO</b>        | Sherif Mourad                                      |
| <b>MEO</b>          | Anil Almeida                                       |
| <b>Saudi</b>        | Ahmad Al-Amer                                      |
| <b>Turkey</b>       | Fatih Kilic                                        |
| <b>South Africa</b> | Janak (Bob) Desai                                  |

# Oracle Database 12c Training

Next Steps: Develop your skills with available training offerings



## Key Oracle Database 12c Courses

### Oracle Database 12c Curriculum

- Oracle Database 12c: New Features for Administrators
- Oracle Database 12c: Administration Workshop
- Oracle Database 12c: Install and Upgrade Workshop
- Oracle Database 12c: Managing Multitenant Architecture
- Oracle Database 12c: High Availability New Features
- Oracle Database 12c: Global Data Services
- Oracle Database 12c: Data Guard Administration – Coming Soon!
- Oracle Database 12c: Performance Management and Tuning – Coming Soon!
- Oracle Database 12c: Clusterware Administration – Coming Soon!
- Oracle Database 12c: ASM Administration – Coming Soon!
- Oracle Database 12c: RAC Administration – Coming Soon!

For more information on training and certification offerings available, please go to:  
<http://education.oracle.com/database12c>

# Resources

- Download slides from:
  - <http://blogs.oracle.com/UPGRADE>



The screenshot shows a blog post from Oracle. At the top, there is a red header with the text "- NOW!" and the Oracle logo. Below the header, the text "ces, Workshops, Projects ..." is visible. The main content area has a navigation link "Main | Next page »". The post is dated "Aug 29, 2013" and titled "Focus on Database Upgrade at OpenWorld 2013". The author is "ew Mendelsohn, Oracle". The post text discusses the Oracle OpenWorld event in September and mentions a "Focus on Database Upgrade" document. A red "ORACLE OPEN WORLD" logo is on the right. Below the text are two tables of sessions. The first table is for "GENERAL SESSIONS" on August 23, 2013, listing a session for Oracle Database 12c. The second table is for "REFERENCE SESSIONS" on August 23, 2013, listing sessions for consolidating databases and various upgrade/migrate/consolidate topics. A large red arrow points from the bottom right of the session tables towards the "Slides Download Center" sidebar. The sidebar includes an "About" section with a photo of Mike Dietrich, a "You'd like to contact me" section, and a "Slides Download Center" section with links to "Upgrade, Migrate & Consolidate to Oracle Database 12c" and "Upgrade & Migrate to Oracle Database 12c".

| Session Title                                                             | Time                | Location               | Code    |
|---------------------------------------------------------------------------|---------------------|------------------------|---------|
| General Session: Oracle Database 12c—<br>Prepared for Clouds and Big Data | 10:45 AM - 11:45 AM | Moscone North - Hall D | GEN8229 |

| Session Title                                                            | Time               | Location            | Code    |
|--------------------------------------------------------------------------|--------------------|---------------------|---------|
| Consolidating Databases with Oracle Database 12c                         | 12:15 PM - 1:15 PM | Moscone South - 102 | CON8707 |
| Different Ways to Upgrade, Migrate, Consolidate with Oracle Database 12c | 3:15 PM - 4:15 PM  | Moscone South - 102 | CON8176 |

# Issues to be aware of

- DBUA Upgrade moving files
  - BUG 18312660 - 12C DBUA OVERWRITES DATAFILES WHEN "MOVE DATABASES FILES AS PART OF UPGRADE"
- Transportable Tablespaces Migration
  - BUG 16396856 - HANG - SINGLE USER OPERATION
    - Note: 1560225.1  
Transportable Tablespace (TTS) Using Impdp Seems to Hang at TRANSPORTABLE\_EXPORT/PLUGTS\_BLK Phase
- Exadata 12.1.0.2
  - Bug# 18925767 - INSTANCES WON'T START IN CLUSTER W/NODES USING EXAFUSION AND NON-EXAFUSION IPC
    - Workaround: alter system set "\_exafusion\_enabled" = false scope = spfile;
- XML Upgrade Issue:
  - Bug 18482096 - [ORA-01917: USER OR ROLE 'ANONYMOUS' DOES NOT EXIST FROM 11202 TO 12102



# Change Log 1 – Feb 4, 2014 – Nov 19, 2014

- 4-Feb-2014
  - Added slide 231 [hidden] for EBS specific resources
  - Added QR codes for the blog
  - Added OU slides at the end plus generated QR code
- 12-Feb-2014
  - Changed the Bielefeld University Transient Rolling Upgrade case to clarify the Transient Component
- 19-Feb-2014
  - Added to slide 166: [MOS Note:1617946.1](#) (Standby Duplication from Active Database)
  - Added slide 328 with PDB\_PLUG\_IN\_VIOLATIONS
  - Added hidden slide 320 – CDB/PDB character sets
  - Added slide 326 – Backup/Recovery
  - Slide 322: Changed the Resource Manager example
- 5-MAR-2014
  - Added hidden slide 198: Data Pump COMPRESSION\_ALGORITHM with example BASIC vs MEDIUM
- 8-APR-2014
  - Added several Notes to slide 161 (Exadata 12c)
- 16-APR-2014
  - Slide 61: Update to 11.2.0.4 for NOTE Poor Performance ( Wrong Query Result Bugs)
  - Slide 315: Changed order of upgrade (SEED now together with PDBs) in accordance with the spec
  - Slide 33: Changed query to detect DUP objects to a more efficient version – credits to Tom Kyte!
- 22-MAY-2014
  - Added WHOAMI slide for Ro, moved Mike's WHOAMI to front
  - Slide 9: Moved current time arrow forward a bit (deleted "Time to upgrade?" slide with cell phones)
  - Slide 52: Updated screenshot (deleted "Establish a Maintenance Strategy" slide)
  - Slide 61, 63, 66, 67: Updated screenshots
  - Slide 115, 190-193, 278: Changed OL6 to OL 5.8 to match certifications available for older releases
  - Slide 151: Slide wording change for Orachk/RACchk
  - Slide 231: Some wording changes such as "brutal" -> "brute force" and "The smart approach" -> "A same-OS approach"
  - Slides 260-267, 277-279: changed "5 min" to "<5 min"
  - Slide 281: Added animation step to have entire diagram reappear at the end
  - Slide 282: Added emphasis around "Made Easy"
  - Slide 327: Updated slide with DMU 2.0 information
  - Slide 337: Updated font to be more visible for 12c beta, RC6, etc.
  - Slide 338, 339, 345, 349: Slide wording updates
  - Slide 375: Hidden by default
  - Slide 401: Fixed typo "Partitoned" -> "Partitioned"
  - Slide 407: added link to SQL Tuning Guide
  - Slide 432: Changed DBMS\_SPM to DBMS\_SPA
- 3-JUN-2014
  - Slide 488 added: Credits
  - Slide 485 added: Issues (collector slide for known issues to be aware of)
  - Slide 424/421: changed sources for plans / removed transport option, changed STS to "AWR into STS"
- 7-JUL-2014
  - Slide 442: Manual Fixed Objects Stats Gathering is not necessary in Oracle 12c anymore as it is included in the Auto Stats Gathering job
  - Slide 238: Added EBS Cert information
  - Slide 309: Added information about remote cloning in PSU3 for 12.1.0.1
- 2-Sep-2014
  - Slide 81: Updated Unified Auditing information
- 10-Sep-2014
  - Slide 137: NEW – RMAN catalog upgrade 12.1.0.2
  - Slides 435-437, 438, 441, 443 (SPM) – redesigned and updated for 12.1.0.2
  - Slide 13: New about Oracle 12.2
- 12-Oct-2014
  - Exchanged several slides with slides from our OOW 2014 talk
  - Slide 60ff: updated flow with 12.1.0.2 information
  - Slide 169: GIMR information for 12.1.0.2 added
- 28-OCT-2014
  - Slide 75 (hidden): Solaris performance regressions
  - Slide 93 (hidden): `_optimizer_aggr_groupby_elim`
  - Slide 45: (now hidden) MOS Note for cleanup does not exist anymore – offered a script to cleanup
  - Slide 45: Query connection . Left parenthesis was missing
  - Slide 92: Added link to the doc explaining INLINE LOB usage and row chaining pitfall with Extended Varchar
- 13-NOV-2014
  - Slide 89: NEW – `job_queue_processes`
  - Slide 100 – NEW – graph slide
  - Slide 103: Changed Screenshot to fit for Oracle 12.1.0.2
  - Slide 182: ASM on NFS → [https://docs.oracle.com/cd/E11882\\_01/install.112/e47689/app\\_nas.htm#LADBI1372](https://docs.oracle.com/cd/E11882_01/install.112/e47689/app_nas.htm#LADBI1372) --- and MOS 1570073.1
  - Slide 335: Added FORCE LOGGING clause to the PDB Standby Slide – does not work right now due to bug:18902135
  - Slide 353: Added Oracle Fail Safe and Flashback Pluggable Database
  - Slide 396: NEW – Statistic Enhancements in Oracle 12c
  - Slide 428: Added ESTIMATE PERCENTAGE
  - Slide 425 NEW: graph slide
  - Slide 430 NEW: In 12c Inc Stats have a way smaller footprint on disk in WRH\$ tables + Inc Stats work with Partitioned Exchange + Stale percentage
  - Slide 431: NEW DBMS\_STATS.REPORT ...
  - Slide 432: NEW DBMS\_STATS.Report
  - Slide 435: NEW `_run_everything_fast=true`
  - Slide 447: Added the information that before 12c only hints got stored but since 12c entire plans will be kept
- 19-NOV-2014
  - Slide 277: Exchanged OGG Link on OTN with Zero Downtime OGG White Paper Link

# Change Log 2 – Dec 9, 2014 – May 27, 2015

- 9-Dec-2014
  - Slide 95: New parameter added to switch InMem completely off
  - Slide 395: Free (not in ASO anymore) Security Features in 12c
  - Slide 86: SQLNET.ALLOWED\_LOGON\_VERSION\_SERVER → changed to 10.2.0.5 and the error number
  - Slide 202: Interhyp Exadata Case: Added MOS Note that Exa BPs are supported in non Exa envs
  - Slide 322-324: Changed designed, added c##-overwrite parameter from 12.1.0.2
  - Slide 65: corrected 12.1.0.1 note number → Now 12.1.0.2
  - Slide 67ff: updated screenshots
  - Slide 441: optimizer\_dynamic\_sampling – added info that it has value 11 option since Oracle 11.2.0.4 – but with less functionality than in 12c
  - Slide 162 – added note 759868.1 (How to step down from RAC to non-RAC) just in case ...
- 21-JAN-2015
  - Slide 5: Removed
  - Slide 505: AutoDOP: Changed to accommodate 12c behavior – credits to Yasin Baskan
  - Slide 316: Added deprecation of non-CDB architecture
  - Slide 353: Added more deprecated features for Multitenant
- 6-Feb-2015
  - Slide 356: Added Flashback Transaction Backout to the list of unsupported CDB features
  - Slide 326: Added new White Paper about Security Concepts in Oracle Multitenant  
<http://www.oracle.com/technetwork/database/multitenant/learn-more/multitenant-security-concepts-12c-2402462.pdf>
  - Slide 162: Reversed order and added Windows Remote Registry info at the bottom with link to Ms Technet
  - Slide 182 (hidden): Added 10.2. Support Note on Exadata - [1965897.1](#) - Oracle Database 10g Release 2 Support on Exadata
  - Slide 183: (hidden) Added [MOS Note:1681467.1](#) GI and Database Upgrade from 11.2.0.2-4, 12.1.0.1 to 12.1.0.2 on Exadata and [MOS Note:1364356.2](#) Info Center Upgrade
  - Slide 59 – Newly added with MOS Note <https://support.oracle.com/epmos/faces/DocumentDisplay?id=1962125.1> Patching Delivery Methods
  - Slide 7/8 – adjusted content to reflect End of Premier Support
- 7-Feb-2015
  - Slide 94: Fixed Doc ID of the support note for the related bug
  - Slide 106: Added reference to Lifecycle Management Pack
  - Slide 279: Softened the wording about zero-downtime upgrades so note that GoldenGate can do this depending on the application and app server configuration
  - Slide 334: changed wording to say that deinstalling options from a PDB is “not supported” instead of often not working
  - Slide 343: Added PDB2 and PDB3, fade them during unplug of PDB1
  - Slide 378: Added note that ADO is part of ACO
  - Slide 388: Changed title to indicate that Far Sync is part of Active Data Guard
  - Slide 431: Added the word “history” so that people don’t get confused between this stats retention and performance statistics retention in AWR
  - Slide master: updated Copyright date to 2015
- 10-FEB-2015
  - Slides 60, 69, 70 (PSU Schedule), 75 (Wrong Results) – all updated/refreshed with current screen shots
  - Slide 76 moved to 60 (still hidden) and updated with screenshot from Note:1962125.1
  - Slide 328 – Brackett was missing in the code example
  - Slide 399 – added “\_optimizer\_apaptive\_plans”
  - Slide 351 – Extended Slide Notes section with more explanation and the underscore to turn multiple lgwr-slaces off
- 26-FEB-2015
  - Slide 14: Added
  - Slide 20: Removed (Link to MAA)
  - Slide 467: added Note Nr for Multitenant Replay <https://support.oracle.com/epmos/faces/DocumentDisplay?id=1937920.1>
  - Slide 246/247 – Added dbms\_file\_transfer
  - Slide 164/165: ORAchK Slides updated – now 2 slides
  - Slide 36: Fixed type
- 22-MAR-2015
  - Slide 4: Added (temporary, just for fun)
  - Slide 68: Updated screenshot so that the note about 12.1.0.2 being EE-only is there
  - Slide 160: Added reference for using standby with different versions, reformatted bullet points to include note titles
- 20-APR-2015
  - Slide 373: Downgrade – removed outdated 11.1.0.7 [MOS Note:443890.1](#) and 11.2.0.x [MOS Note:883335.1](#) – added correct 12c note plus additional information
  - Slide 331 – Added Snapthot Clone syntax
  - Slide 514: Added White Paper Link: <http://www.oracle.com/technetwork/database/securefilesmigrationpaper-130440.pdf>
  - Slide 15/16: Updated Screenshots
  - Slide 376 – Updated Screen Shot
  - Slide 332: corrected typo: TRANSPORT\_DATAFILE\$
- 7-MAY-2015
  - Slides 12 – New slide: 11.2.0.4 vs 12.1.0-2
  - Slide 21 – New Slide: Winners use 12c, as Teaser Slide
  - Slide 25: Added “We’ll wait for the 2<sup>nd</sup> release”
  - Slide 26: New slide: SAP certification
  - Slide 48/49 – consolidated into 1 slide and moved to SLIDE 85
  - Slide 59 – New slide: Where is SE 12.1.0.2
  - Slide 323 – New slide: Possible deployments of Oracle 12c (Stand alone, single tenant, multitenant)
  - Slide 338 – Changed to reflect note about creating a CDB with fewer options
  - Slide 355 – New hidden slide: AWR Lite Snapshots
  - Slide 362 – New slide: Changes for DBAs – to be continued
  - Slide 410 – New slide: Optimizer parameters
  - Slides 490/491 – New slides: The right testing tools
- 13-MAY-2015
  - Slide 214 – Added FLASHBACK\_SCN
  - Slide 215 – Added subtitle, updated with the new way of performing parallel index build, replaced the COMMIT\_WAIT recommendation with transform parameter
  - Slide 216 – Added subtitle, changed line spacing to accommodate
  - Slide 217 – Added subtitle
- 27-May-2015
  - Slide 329 – Changed “PDBs can have their own TEMP” into “PDBs must have” – (Doc ID 2004595.1)

# Change Log 3 – Jun 18, 2015 - ...

- 18-JUN-2015
  - Slide 217: Heading typo corrected "Practices" to "Practices"
  - Slide 164 – DB Home can have higher PSU than GI Home – this is supported
  - Slide 167 – new screenshot for ORAchk 12.1.0.4
  - Slide 534/535: Added for O2O Support by Oracle ACS (even though the slide does not mention O2O)
- 20-JUL-2015
  - Slide 23 – **NEW** – Reference Quote RZF NRW
  - Slide 24 – **NEW** – Reference Article Mobiliar Insurance
  - Slide 28 – Added SAP In Memory information and screenshot
  - Slide 79 – Updated Screenshot "Avoid Poor Performance"
  - Slide 80 – Added 12c Note for SPARC platform
  - Slide 94 – added "physical/real" to the recommendation for CPU cores – added a reference to ASkTom
  - Slide 364: added "BEQ"
  - Slide 324: Updated Screenshot now saying "after 12.2"
  - Slide 92 – Added "in a new DB" for "Unified is enabled by default"
- 1-Sep-2015
  - Slide 19 – Added: Hands on lab
  - Slide 21 – deleted: Data Pump OTN
  - Slide 61 – SE2 updated
  - Slide 65 – Download 12.1.0.2 from MOS refreshed with new patch id
  - Slide 71-73, 76-77, 79: updated screenshots
  - Slide 247/286: Deleted
- 15-Sep-2015
  - Slide 80 – **NEW** – Patches for SPM
  - Slide 282 – **NEW** – OGG Readiness Scripts
  - Stopped noting down changes as I changed too many things ... sorry!

# Credits go to ...

- Tom Kyte
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- Alessandro Suardi, Luca Caimi (Oracle Italia)
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- All the other people from Oracle giving feedbacks and contributing their slides, especially in the New Features section

# Things to include in a future version

- SRDC : Data Collection For Database Upgrade Slow Or Hung Issues (Doc ID 1918865.1)
- SRDC : INVALID objects Before or After Upgrade (Doc ID 1918862.1)
- SRDC - Data Collection for Upgrade issues (Doc ID 1672387.1)
- SRDC - Data Collection for Downgrade Issues (Doc ID 1672880.1)
- New command syntax: `SELECT ename from container(scott.emp) WHERE IN CON_ID;`
- [MOS Note: 1932762.1](#)  
Complete checklist for manual upgrade from 12.1.0.1 to 12.1.0.N (Full CDB Upgrade)
- [MOS Note: 1933391.1](#)  
Complete checklist for 12c R1 PDB upgrade (Upgrading single/multiple PDB)
- [MOS Note: 1932340.1](#)  
How to execute sql scripts in Multitenant environment (catcon.pl)
- [MOS Note: 1933011.1](#)  
Complete Checklist for DBUA Upgrade from 12.1.0.1 to 12.1.0.N
- <https://mosemp.us.oracle.com/epmos/faces/DocContentDisplay?id=1958998.1>
- [MOS Note: 1576755.1 Step by Step Examples of Migrating non-CDBs and PDBs Using ASM for File Storage](#)

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