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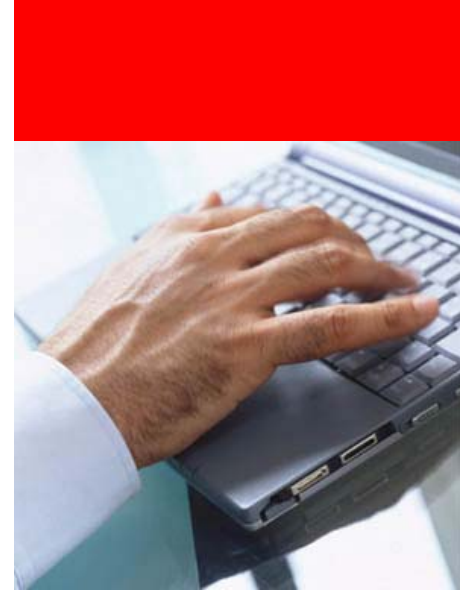


## **Maximum Availability Architecture (MAA) Best Practices for Planned Maintenance: Online Patching and Rolling Upgrades with Oracle Database**

Ray Dutcher, Maximum Availability Architecture, Oracle  
Michael Nowak, Maximum Availability Architecture, Oracle  
Joe Meeks, HA/MAA Product Manager, Oracle

# Program **Agenda**

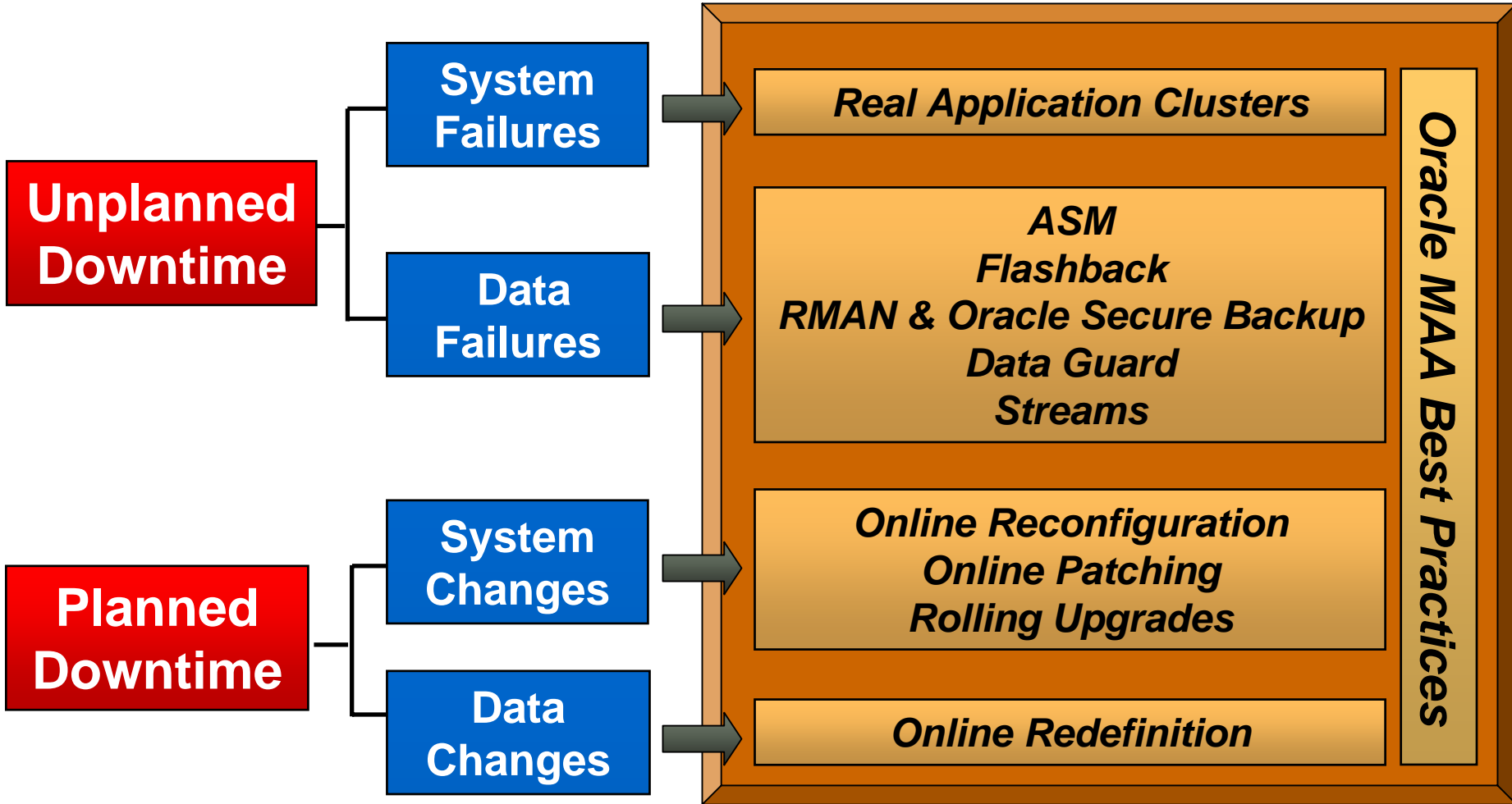
- MAA (in case you haven't heard)
- Good News!
- Online Patching
- Oracle Clusterware and RAC Rolling Upgrade
- Data Guard SQL Apply Rolling Upgrade
- SQL Apply Extended Data Type Support
- Customer Use Cases



**MAA**



# Oracle's Integrated HA Solution Set



# Oracle Maximum Availability Architecture

*Integrated suite of best-of-breed HA technologies  
- Scalable, active-active, data centric*

**Best Availability AT  
Lowest Cost**

**Real Application Clusters  
& Clusterware**

Fault Tolerant  
Server Scale-Out

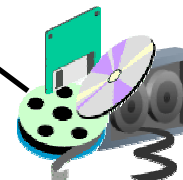
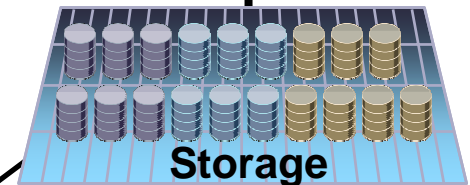
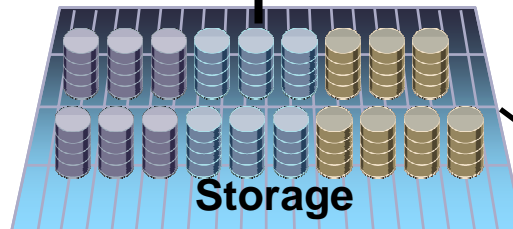
**Online Upgrade**  
Upgrade Hardware  
and Software Online

**Data Guard**  
Fully Active  
Failover Replica  
Rolling Database Upgrades



**Automatic Storage  
Management**

Fault Tolerant  
Storage Scale-Out



**Online Redefinition**  
Redefine Tables Online

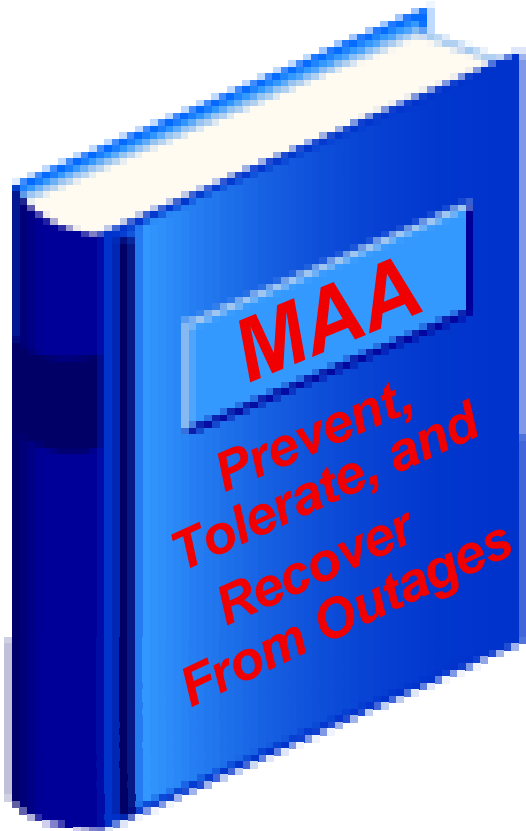
**Flashback**  
Correct Errors by  
Moving Back in Time

**Streams**  
Multi-master Replication  
Hub & Spoke Replication

**Recovery Manager &  
Oracle Secure Backup**  
Data Protection & Archival

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# MAA – Integrated HA Best Practices



- MAA is a blueprint for achieving HA
  - Correlates HA capabilities to customer requirements
  - Operational best practices
  - Prevent, tolerate, and recover
- Tested, validated, and documented
  - Database, Storage, Cluster, Network
  - Oracle Enterprise Manager
  - Oracle Application Server
  - Oracle Applications

[otn.oracle.com/deploy/availability](http://otn.oracle.com/deploy/availability)

## HA Best Practices for Oracle Database

### Oracle Database 11g

- [Oracle Database High Availability Overview 11g Release 1 - Documentation](#)

### Oracle Database 10g Release 2

- [Oracle Database High Availability Overview 10g Release 2 - Documentation](#)
- [Oracle Database High Availability Best Practices 10g Release 2 - Documentation](#)
- [Roadmap to Maximum Availability Architecture](#)
- [Data Guard Redo Transport & Network Configuration](#)
- [Data Guard Redo Apply & Media Recovery \*Updated!\*](#)
- [Data Guard SQL Apply](#)
- [Rolling Database Upgrades Using Data Guard SQL Apply](#)
- [Optimizing Availability During Planned Maintenance Using Oracle Clusterware and RAC \*New!\*](#)
- [Optimizing Availability During Unplanned Outages Using Oracle Clusterware and RAC \*New!\*](#)
- [Database Upgrade using Transportable Tablespaces](#)
- [Platform Migration using Transportable Tablespaces](#)
- [Platform Migration using Transportable Database](#)
- [Minimal Downtime Migration to ASM \*New!\*](#)
- [Setup Guide: Creating a RAC Logical Standby Database for a RAC Primary Database](#)
- [Data Guard Fast-Start Failover](#)
- [Data Guard Switchover and Failover](#)
- [Client Failover for Highly Available Oracle Databases \*Updated!\*](#)

### Oracle Database 10g Release 1

- [Oracle Database High Availability Architecture and Best Practices 10g Release 1 - Documentation](#)
- [Oracle Database 10g Release 1 Best Practices: Data Guard Redo Apply and Media Recovery](#)
- [Oracle Database 10g Release 1 Best Practices: Data Guard SQL Apply](#)
- [Oracle Database 10g Release 1 Best Practices: Data Guard Role Transitions and Streams](#)

### Oracle Database 10g - General

- [MAA 10g Setup Guide: Creating a RAC Physical Standby Database for a RAC Primary Database](#)
- [MAA 10g Setup Guide: Creating a Single Instance Physical Standby Database for a RAC Primary Database](#)
- [Using Recovery Manager \(RMAN\) with Oracle Data Guard in Oracle Database 10g](#)



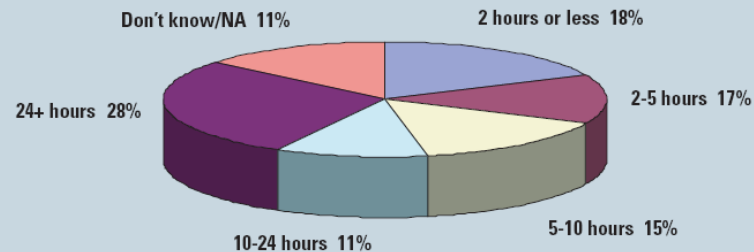
**Good News!**  
**(but you'll have to wait one slide)**



# IOUG 2006 Survey on HA Trends

We understand these problems.....

**FIGURE 5: Total Amount of Planned Downtime Over the Past Year**

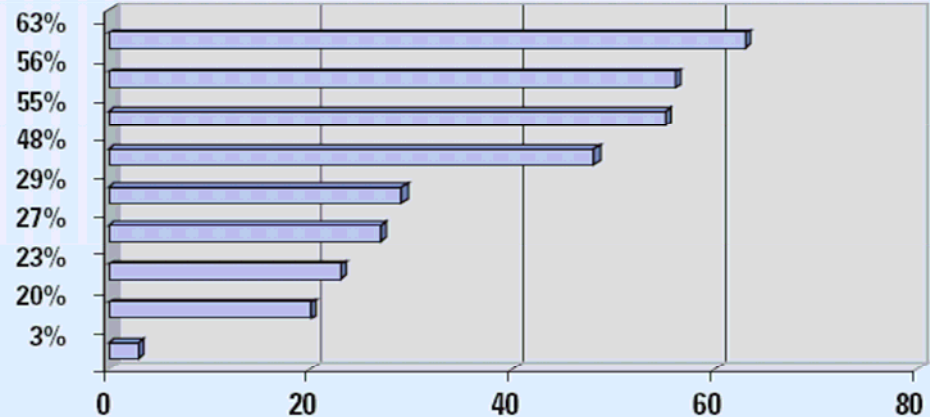


**Source:**

*IOUG Survey on High Availability Trends sponsored by GoldenGate Software, and produced by Unisphere Media, L.L.C.,*

**FIGURE 4: Primary Causes of PLANNED Outages Over the Past Year**

Systems/hardware upgrade  
Routine systems maintenance/testing  
Database upgrade  
Application upgrade  
Systems/hardware migration  
Database migration  
Application migration  
Network upgrade  
Other



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# Good News!

*We have solutions for these problems!*

- Zero downtime
  - Online
    - Online Patches
    - Provisioning with Oracle Clusterware and RAC
    - Storage Maintenance, Storage Migration
    - Schema Structural Changes with Online Redefinition
  - Rolling
    - Oracle Clusterware/RAC upgrades and patches
    - System upgrades and patches with Oracle Clusterware and RAC
    - Software upgrade with ASM
- Minimal Downtime
  - Data Guard
    - Major system or architectural changes not handled by RAC Rolling Upgrade
    - Database upgrades and patchset upgrades
  - Streams
    - Heterogeneous platforms
    - Database and application upgrades when not applicable to Data Guard

# Online Patching

ORACLE<sup>®</sup> 11<sup>g</sup>  
DATABASE

Preferred solution for

- Debug patches
- Qualified interim patches



# Help finish this conversation...

- The following is a discussion between Joan, the applications manager, and Dave, the DBA manager



*Hi Dave. What a nice weekend it was.*

*Dave, did you get that patch from Oracle that we talked about last week?*

*We need to talk about scheduling the downtime for that patch.*

*It sure was. We certainly appreciate the warm weather here in Rochester, New York.*

*Yes, we pulled it down from Metalink on Friday*

*Actually, we don't need to have that conversation.....*



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# Online Patching Ins and Outs

- *How in the world do they do that?*
  - Fixed code is provided via a shared library
  - Processes “jump” to patched code at a safe execution point.
- *That sounds a lot different than traditional patches. What’s up with these differences?*
  - It is a bit different. One key conceptual difference is that online patches are activated at an instance level which is different than traditional patches activated at an \$ORACLE\_HOME level
- *Is this going to affect the way I applying patches?*
  - Not at all. Applying an online patch is done with your old friend OPatch. It is also possible to apply via EM deployment procedures
- *So is this available on all platforms?*
  - For now, we support linux (32 and 64-bit) and Solaris (64-bit)
- *This sounds great. Why isn’t every patch an online patch?*
  - Each patch is assessed individually to determine if it can be applied online. The ultimate goal is to make all patches online patches

# Online Patching Best Practices

- Apply one instance at a time
- When rolling back online patches, ensure all patched instances are included
  - Avoids the dangerous and confusing situation of having different software across instances using the same `$ORACLE_HOME`
- Assess memory impact on a test system before deploying to production
  - Example: `pmap` command
- Never remove `$ORACLE_HOME/hpatch` directory
- MAA Paper: [Optimizing Availability During Planned Maintenance Using Oracle Clusterware and RAC](#)



# *Online Patching Demo*



# Online Patching Demo

- See the MAA Demonstrations web page at:

<http://www.oracle.com/technology/deploy/availability/demonstrations.html>

## High Availability Demonstrations

demo **Oracle Active Data Guard 11g**

This demonstrates the benefits of using a synchronized physical standby database that is open read-only to offload ad-hoc queries and reporting from your production database, thus achieving fast, predictable response times for read-write business transactions. Click on demo link to run the demo in your browser using flash and manually advance through several introductory slides. When the actual demonstration begins it will automatically run through to completion. Click [here](#) for the complete MAA best practices presentation that complements this demonstration and includes the experiences of Amazon.com with Oracle Active Data Guard 11g.

demo **Data Guard Fast-Start Failover - Automatic Database Failover for High Availability in an MAA configuration**

This demonstrates automatic failover between an Oracle RAC primary database and an Oracle RAC standby database in an MAA configuration. Following failover, the original primary is automatically reinstated as a standby database, and automatically resynchronized with the new primary database. Thus high availability and maximum data protection are achieved during a site failure with zero manual intervention required. The demo automatically runs in your browser when you click on the demo link - use the control's at the bottom of the demo screen if you prefer to manually advance the demo. Click [here](#) for the accompanying presentation that includes the production experiences of Amazon.com with Data Guard Fast-Start Failover.

demo **Online Patching with Oracle Database 11g**

This demonstrates a patch being applied online to Oracle Database 11g in order to achieve continuous and uninterrupted database service. The demo automatically runs in your browser when you click on the demo link - use the control's at the bottom of the demo screen if you prefer to manually advance the demo. Click [here](#) for the accompanying presentation of MAA best practices and capabilities included with the Oracle Database to minimize planned downtime during software upgrades.

demo **E-Business Suite Site Failure - Automatic Application and Database Failover**

This demonstrates a completely automated site failover for an MAA configuration of E-Business Suite Release 12 running under load. Data Guard Fast-Start Failover automates database failover. A role change trigger fires at failover time - and executes an

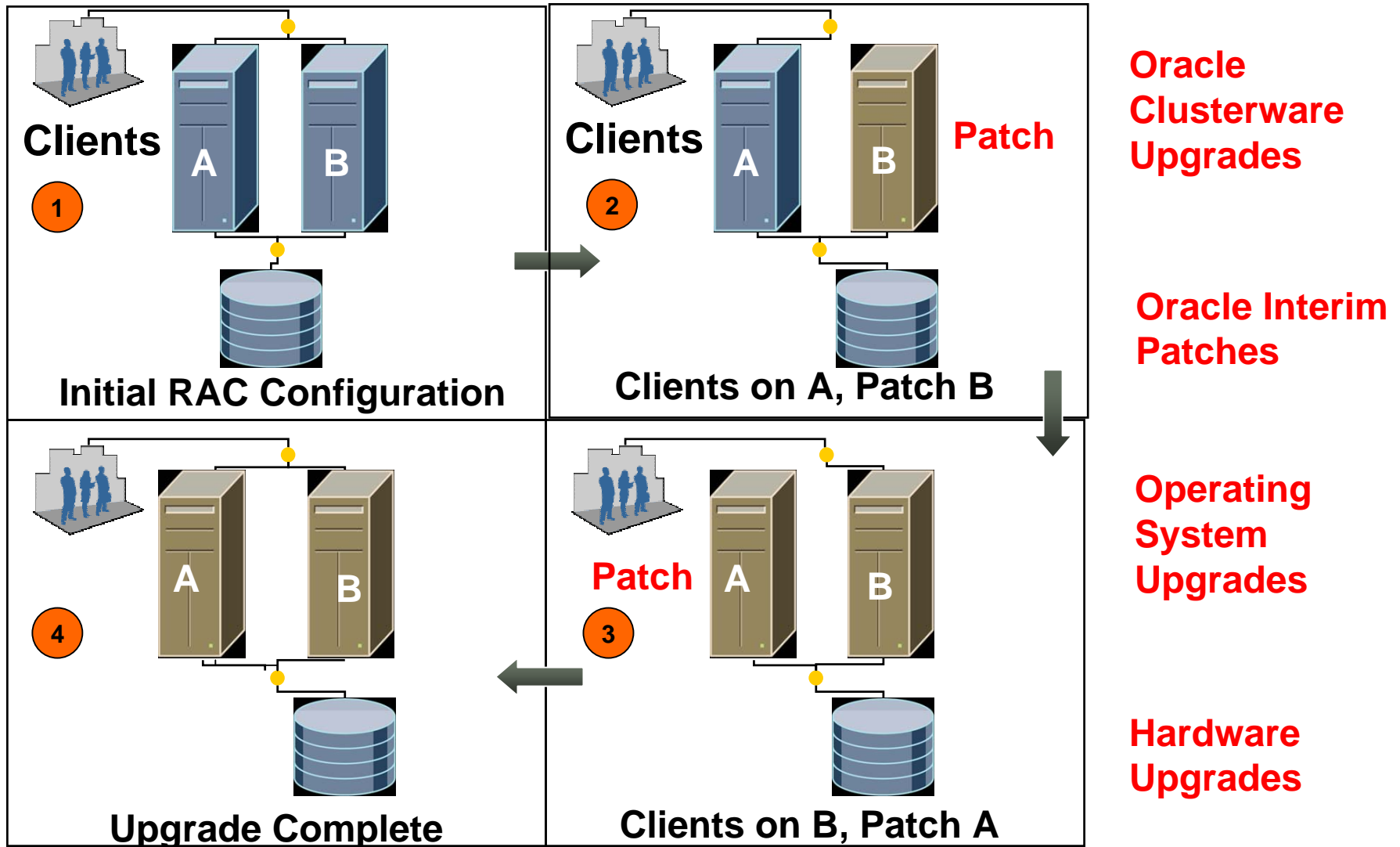
# Rolling Upgrades using Oracle Clusterware / RAC

Preferred solution for

- System and hardware upgrades
- Operating system upgrades
- Oracle Clusterware upgrades
- Qualified interim patches



# Rolling Upgrades using Oracle Clusterware and RAC



# Oracle Clusterware and RAC Planned Maintenance Best Practices

- MAA Paper: [Optimizing Availability During Planned Maintenance Using Oracle Clusterware and RAC](#)
- Perform proper Capacity Planning
- Test and validate patch installation and fallback in test environment
  - Use Guaranteed Restore Points for fallback
- Migrate work off node/instance being patched
  - Follow MAA client best practices
  - Ensure no long running transactions on affected instance
- Shutdown immediate for rolling patches
  - If shutdown abort is needed, tune for efficient instance recovery
- Disable/Enable Oracle Clusterware resources being worked on
- Separate \$ORACLE\_HOME for RDBMS and ASM
- Always relink Oracle when patching the OS in a rolling manner
- Use minimize\_downtime option of Opatch for non rolling patches
- Grid Provisioning best practices in MAA white paper

# Downtime is our enemy

Planned Maintenance Category	Benefit
Grid provisioning	<b>Zero database downtime</b>
Hardware, BIOS, firmware, OS upgrade and patches	<b>Zero database downtime</b>
Oracle Clusterware upgrades and patches	<b>Zero database downtime</b>
Online and Rolling RDBMS/ASM(10g) patches	<b>Zero database downtime</b>
Non-rolling RDBMS/ASM patches	<b>40-60% reduction in database downtime</b>

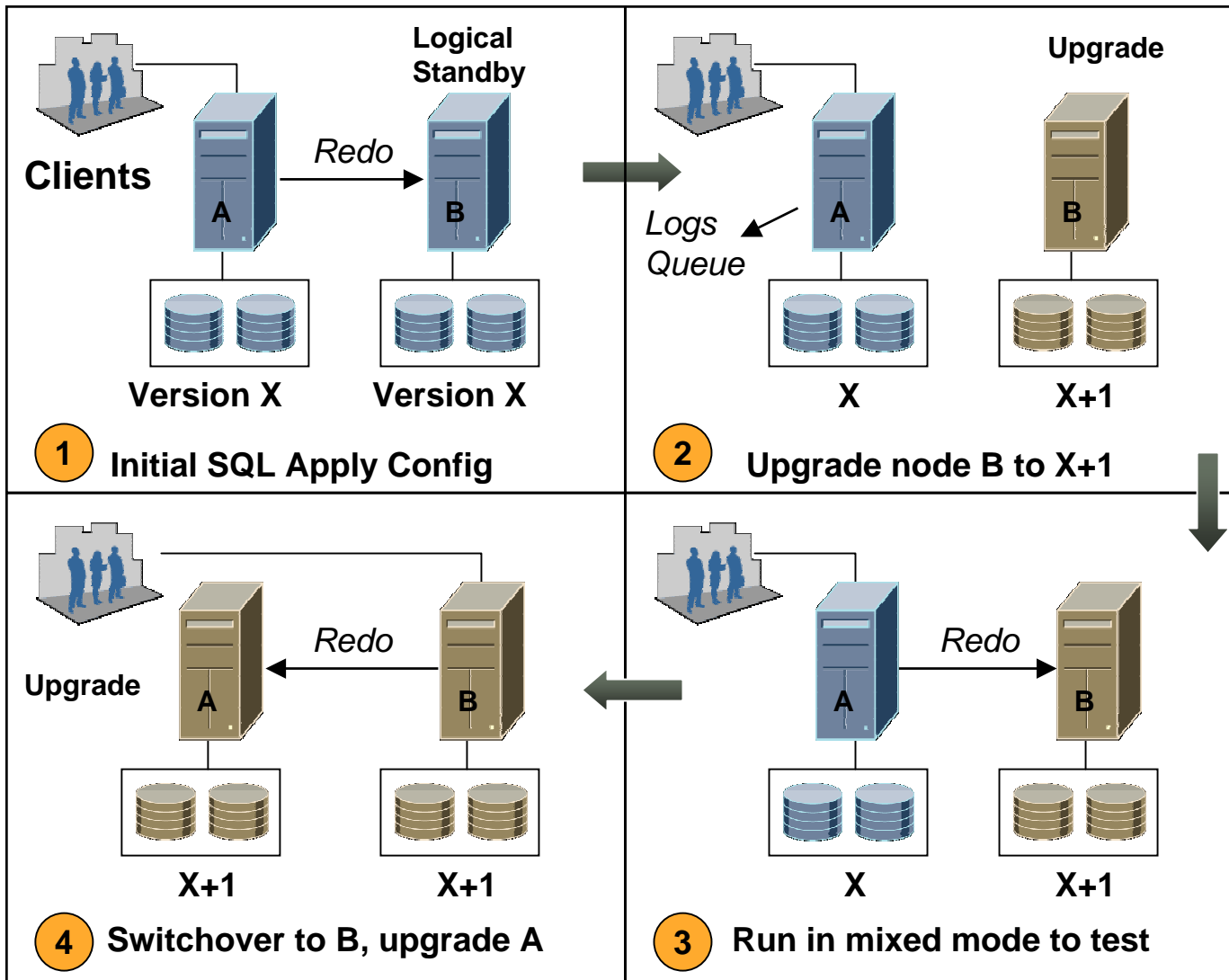
# Planned Maintenance with Data Guard



## Preferred Solution for

- Database patchset and major release upgrades
- Cluster-wide System or HW maintenance that cannot leverage RAC
- ASM upgrades (for 10g only)
- “Selected” platform migrations, a couple examples:
  - 32-bit to 64-bit, same OS family
  - HP-UX PA-RISC and HP-UX Itanium
- Fast migration to RAC, new storage (ex: ASM), or a new Data Center

# SQL Apply – Rolling Database Upgrades



**Patch Set Upgrades**

**Major Release Upgrades**

# Patchset Apply Downtime Comparison

<u>SQL Apply Rolling Upgrade</u>	<u>Conventional Upgrade</u>
<b>Seconds to 2 minutes</b>	<b>~ 1 hour</b>
Data Guard Switchover time • catupgrd and utlrp are still run but do not impact availability	<b>Catupgrd.sql</b> <ul style="list-style-type: none"><li>• 13-56 minutes</li><li>• Depends on CPU, I/O, DB objects</li></ul> <b>utlrp.sql</b> <ul style="list-style-type: none"><li>• Average: 3-6 minutes</li><li>• Compiles invalid objects</li><li>• Timings depend on # of invalid objects</li></ul>
+ any application restart requirements	+ any application restart requirements

- You eliminate application downtime for catupgrd.sql
- You eliminate application downtime due to PL/SQL recompilation.
- You can validate the upgraded database release without affecting the primary database.



# SQL Apply Rolling Upgrade Requirements

- Check for logical standby unsupported data types
  - Temporarily suspend changes to unsupported objects
  - Consider Data Pump in conjunction with `DBA_LOGSTDBY_EVENTS`
  - Consider SQL Apply rolling upgrade with extended data type support
- Retain DB parameter `COMPATIBLE` at current version
- Set the logical standby database destination `LOG_ARCHIVE_DEST_n` parameter to `OPTIONAL`
- Disable Data Guard Broker configuration
- Create a database link on each database to the other database
- Perform switchover in the Rolling Upgrade process without using the `PREPARE` operation

# SQL Apply Rolling Upgrade Best Practices

- MAA Paper: Rolling Database Upgrades Using Data Guard SQL Apply
- Clone the ORACLE\_HOME for patchsets
- Test and validate patch(es)
- Create a guaranteed restore point before patchset apply
- Use an Archived Redo Log Repository during Logical Standby upgrade phases
- Use and Test fallback procedures
  - Software backup/restore testing and validation
  - Downgrade with flashback in less than 2 minutes
- Use MAA best practices
  - Switchover
  - SQL Apply
  - Client

# Performing a Rolling Upgrade With an Existing Physical Standby Database

- Same benefits as SQL Apply Rolling Upgrade
- You start and end with a Physical Standby
- Temporary conversion to a Logical Standby
- 10g paper, see MetaLink note [300479.1](http://www.oracle.com/technology/deploy/availability/htdocs/maa.htm#Database)

<http://www.oracle.com/technology/deploy/availability/htdocs/maa.htm#Database>

- 11g New Feature (paper in CY 2008)

```
ALTER DATABASE RECOVER TO LOGICAL STANDBY KEEP IDENTITY;
```



# Planned Maintenance Using a Standby

# Planned Maintenance Using a Standby

Expected Downtime < 1 minute

- Phase 1: Follow evaluation process of the upgrade companion (metalink note [Note 466181.1](#) ) which includes rigorous testing and planning
- Phase 2: Confirm Oracle Software and Hardware Compatibility (see Note.413484.1)
- Phase 3: Perform planned maintenance on the standby environment
- Phase 4: Evaluate behavior of the standby environment
- Phase 5: Data Guard switchover with automatic client failover
- Fallback: Data Guard switchover to previous configuration



# SQL Apply Extended Data Type Support

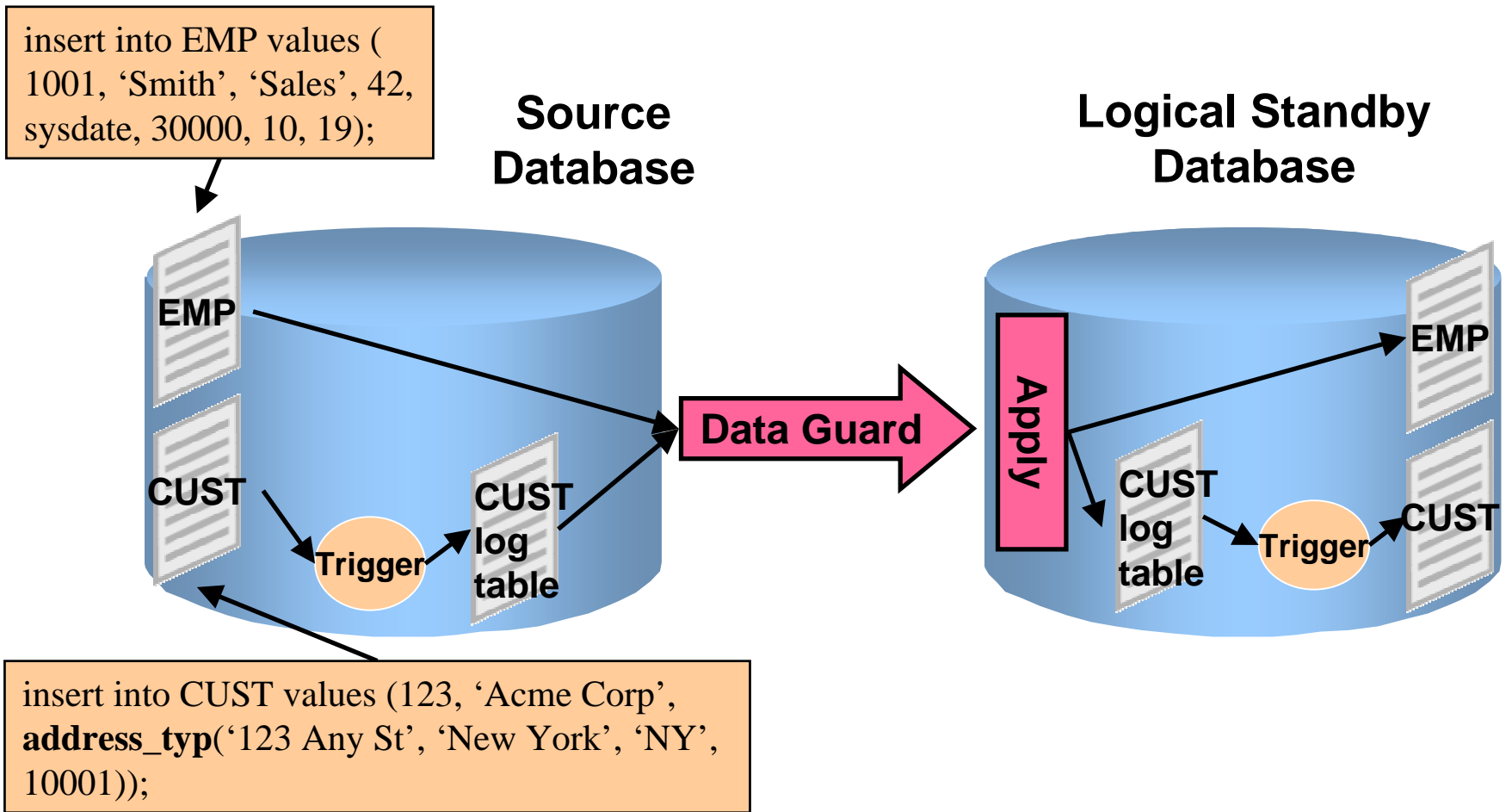
# SQL Apply

## Extended Data Type Support

- Leverage standby-side triggers to keep tables in sync that contain unsupported data types
  - Targeting future 11g release with backport to 10g (10.2.x)
- For tables with unsupported data type(s)
  - Utilize table triggers and log tables that contain only supported types
- For tables with only supported data types
  - Normal SQL Apply replication
- Initial extended data types supported (planned)
  - Object columns with simple or nested objects
  - Varrays
  - Partial Spatial types (SDO\_GEOMETRY)
- Additional types that may be supportable in future releases
  - E.g. XML, object tables

# SQL Apply

## Extended Data Type Support





# *Summary*

# Summary

*If you want to...*

*You should use...*

Apply a debug patch or an online-qualified interim patch	Online Patching
Upgrade Oracle Clusterware or install a rolling-qualified interim patch	RAC Rolling Upgrade
Perform cluster-wide system maintenance that cannot leverage RAC Rolling Upgrade	Data Guard Switchover
Upgrade to a new patchset or major version	SQL Apply Rolling Upgrade
Upgrade to a new patchset or major version with qualified extended data type support	SQL Apply Extended Data Type Support

# Look what customers are doing...



- Nokia Siemens Networks
  - The TSP7000 telecommunication platform offers a reliable, standards-based solution for meeting the high security and availability requirements of modern telecommunications applications.
    - Central services of the TSP7000 are data storage, the provision of support for network technologies, and the integration of network management systems.
  - Oracle Clusterware/RAC rolling upgrades and patches are integrated with the TSP7000 software update mechanism thereby ***eliminating downtime and service interruption***

# Look what customers are doing...


- Allstate Insurance Company



- Use of the following *to maximize availability*
  - RAC Rolling Upgrade
  - SQL Apply Rolling Upgrade
  - Data Guard switchover
- Openworld 2007 Session S291923
  - *“Implementing Oracle Maximum Availability Architecture at Allstate Insurance, Using Oracle 10g RAC, ASM, Oracle Data Guard, Flashback Database, RMAN and Oracle Grid Control”*
  - **Greatly reduces down time for mission critical applications** compared to previous architecture
  - *“Let RTO/RPO drive your HA needs”*

# For More Information

<http://search.oracle.com>

or

<http://www.oracle.com/technology/deploy/availability/htdocs/maa.htm>

# References

- Oracle Documentation


- [Database Upgrade Guide \(10.2\)](#) (Part Number B14238-01)
- [Data Guard Concepts and Administration](#)
- Oracle Clusterware and Oracle Real Application Clusters Installation and Configuration Guide for <your platform>

- MAA home page on OTN

- <http://www.oracle.com/technology/deploy/availability/htdocs/maa.htm>
- [Oracle Database High Availability Overview 10g Release 2 - Documentation](#)
- [Oracle Database High Availability Best Practices 10g Release 2 - Documentation](#)

- Detailed Best Practice Papers for the subjects covered in this presentation are/will be published on the MAA page on OTN (first URL above)

- [Oracle Database 10g Release 2 Best Practices: Rolling Database Upgrades Using Data Guard SQL Apply](#)
- [Transitioning E-Business Suite to the Maximum Availability Architecture with Minimal Downtime: E-Business Suite 11i.10.2 and Database 10gR2](#)
- [Oracle Database 10g Release 2 Best Practices: Client Failover for Highly Available Oracle Databases](#)
- [Data Guard Switchover and Failover](#)
- [Optimizing Availability During Planned Maintenance Using Oracle Clusterware and RAC](#)



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