



Last updated: 30-NOV-2011

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Oracle Database 11.2 Upgrade Methods

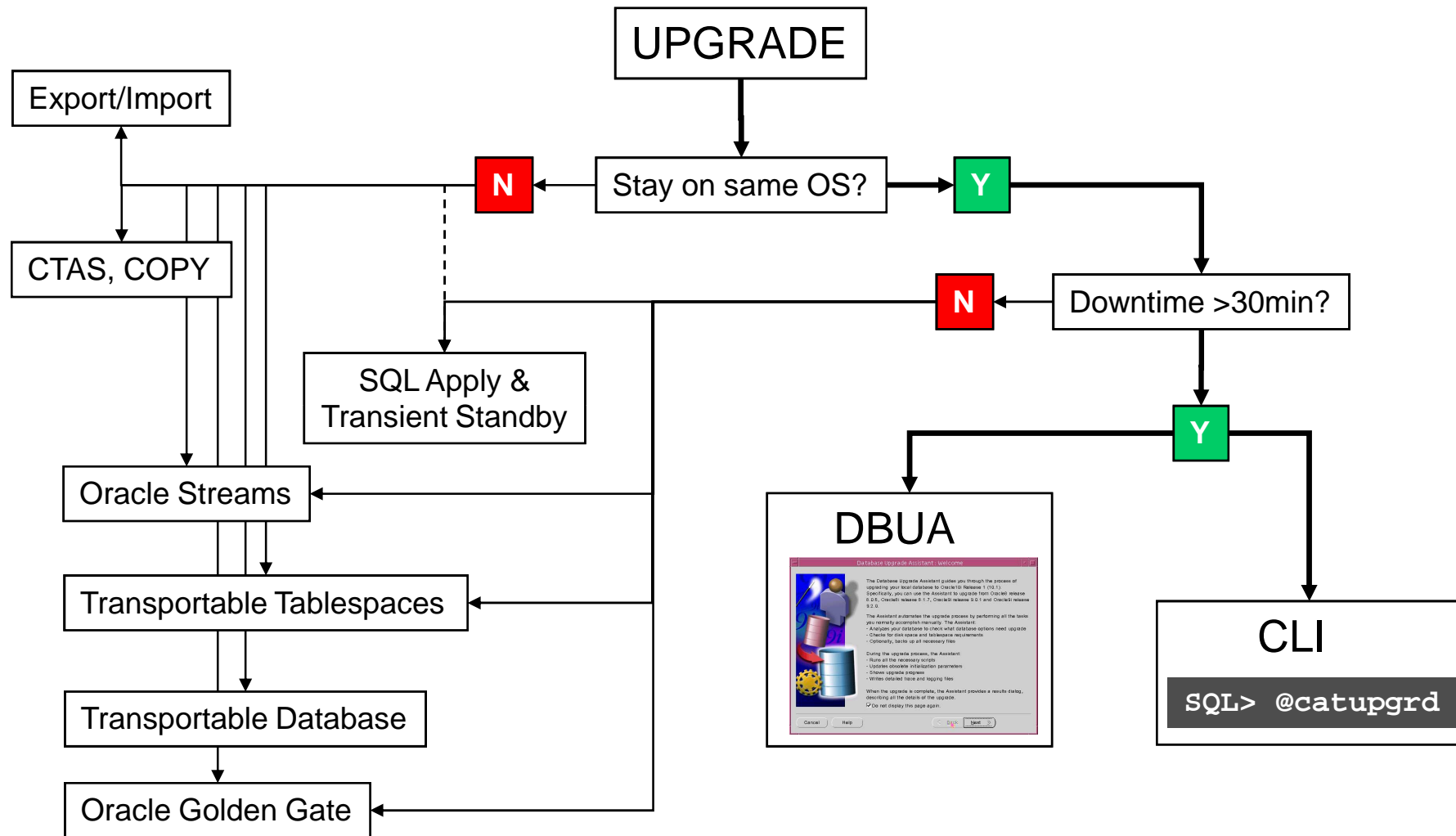
Roy F. Swonger
Senior Director, Database Upgrade & Utilities
ORACLE Corporation

Agenda

- Regular Upgrade Methods
- Post Upgrade Tasks
- Upgrade Alternatives
- Summary



Upgrade Paths



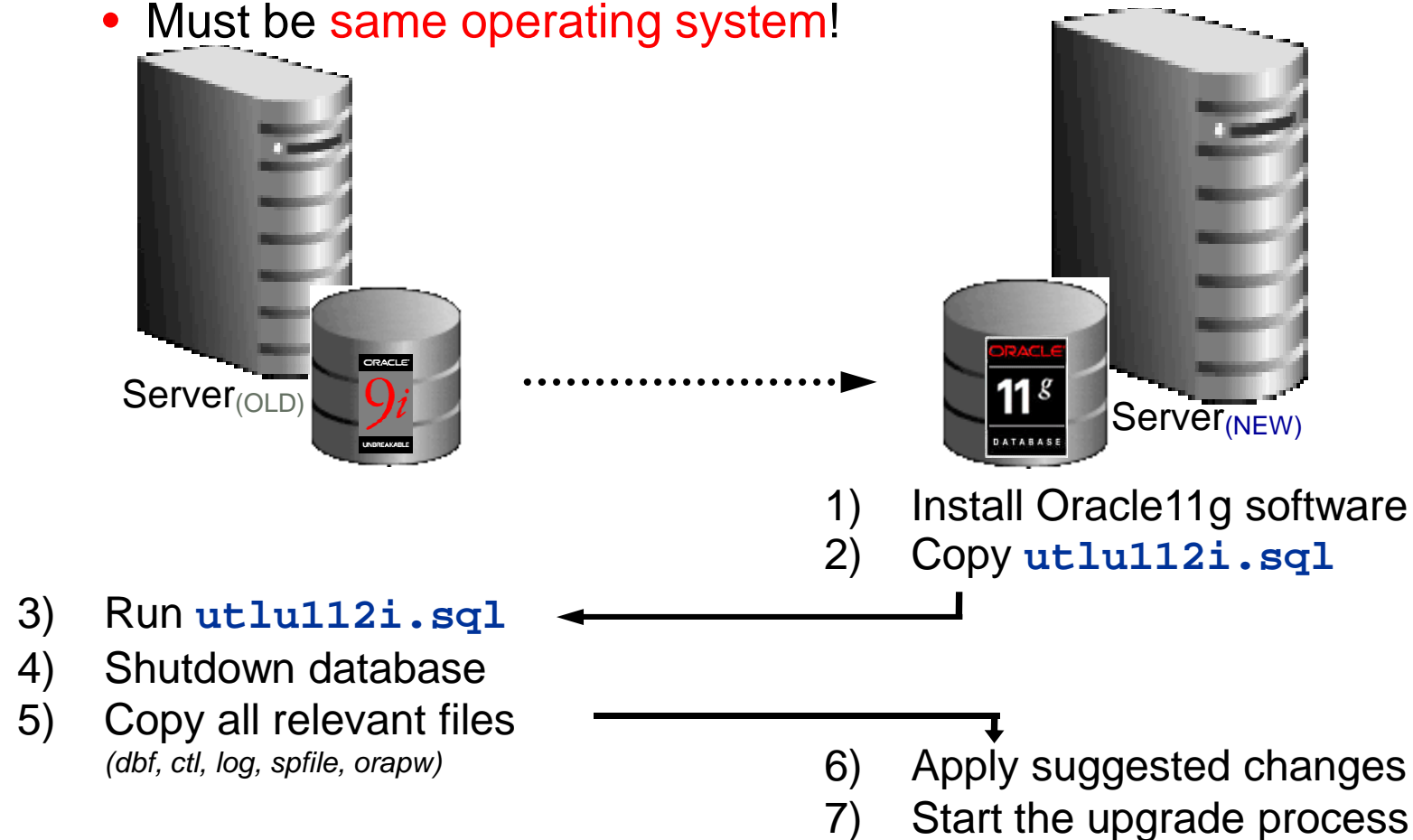
Database Upgrade Assistant (GUI)



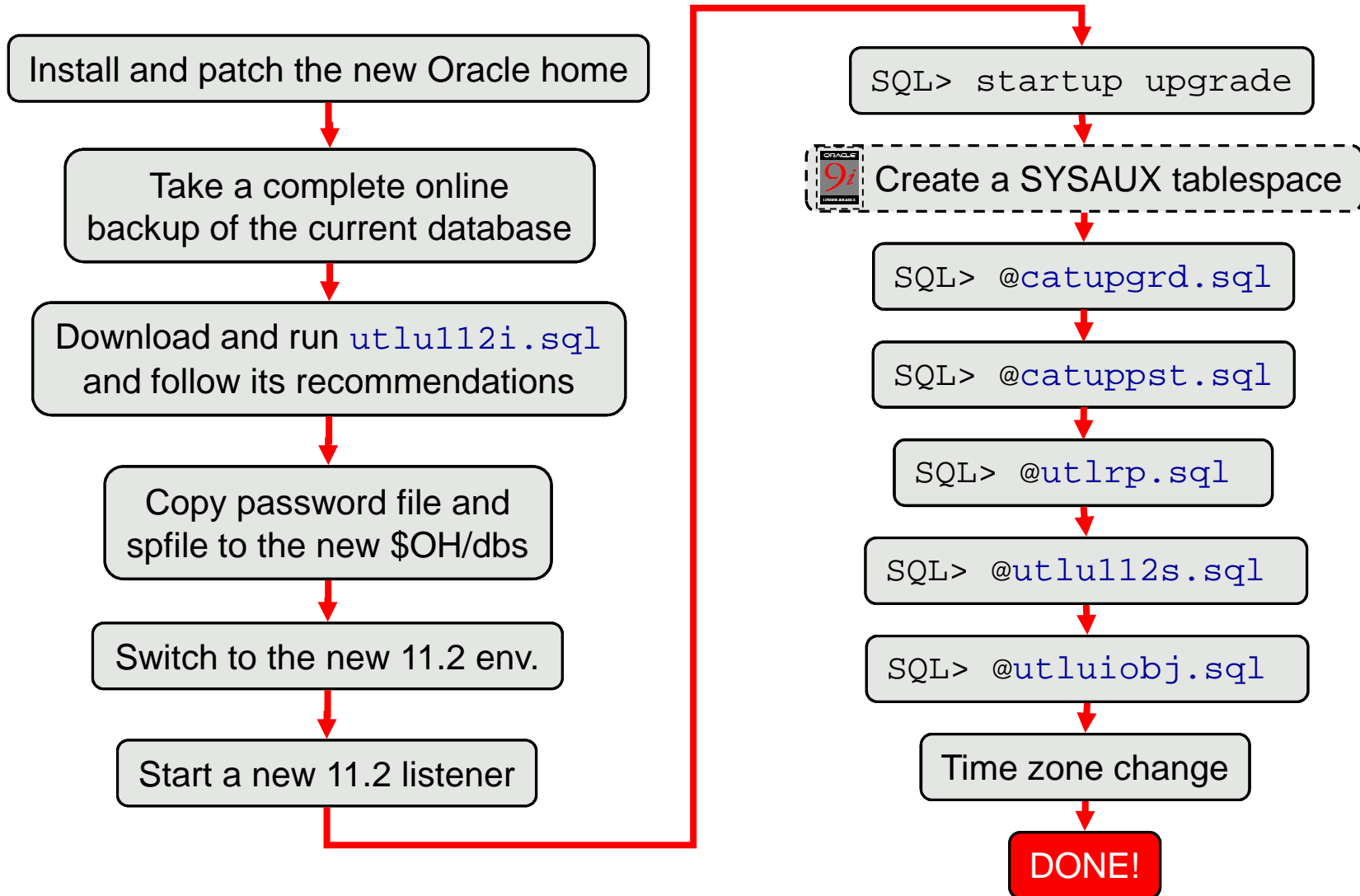
- Features:
 - Graphically led upgrade
 - Lots of important checks
 - RAC *aware* - inclusion of all nodes
 - for RAC (almost) a must !!!
 - Offline Backup and Restore possible
 - ASM upgrade (until 11.1)
 - Oracle XE upgrade
 - Patchset upgrades
 - Logs: `$ORACLE_HOME/cfgtoollogs/dbua`
 - Documentation:
 - Oracle® Database Upgrade Guide
http://download.oracle.com/docs/cd/E11882_01/server.112/e17222/toc.htm
- Limitations:
 - Only usable if upgrading in place, without moving to new system
 - Cannot be restarted if upgrade is interrupted

Command Line Upgrade

- Typical scenario: e.g. changing to a new server
 - Must be **same operating system!**



Command Line Upgrade – Step-by-Step



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- Summary

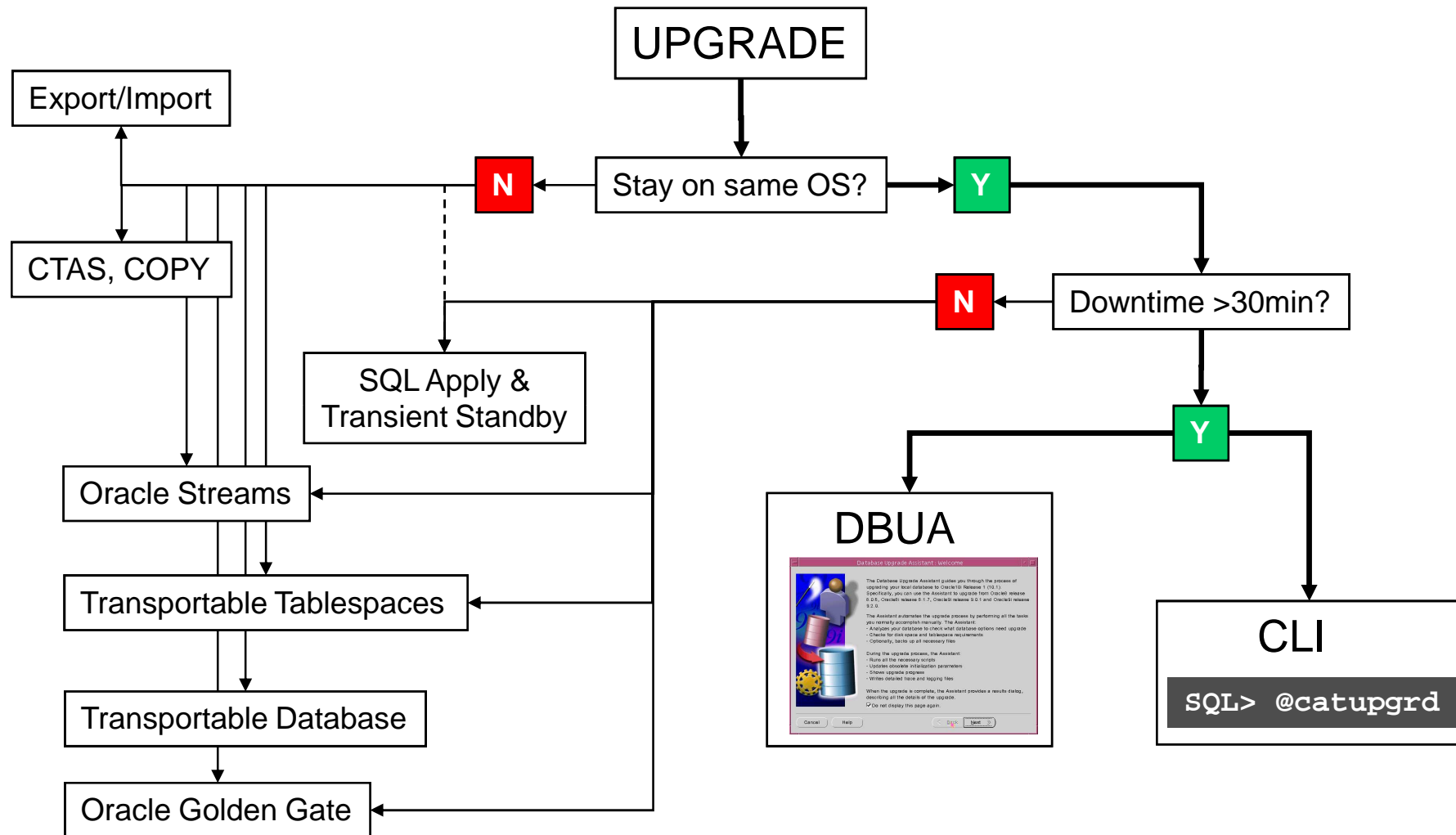




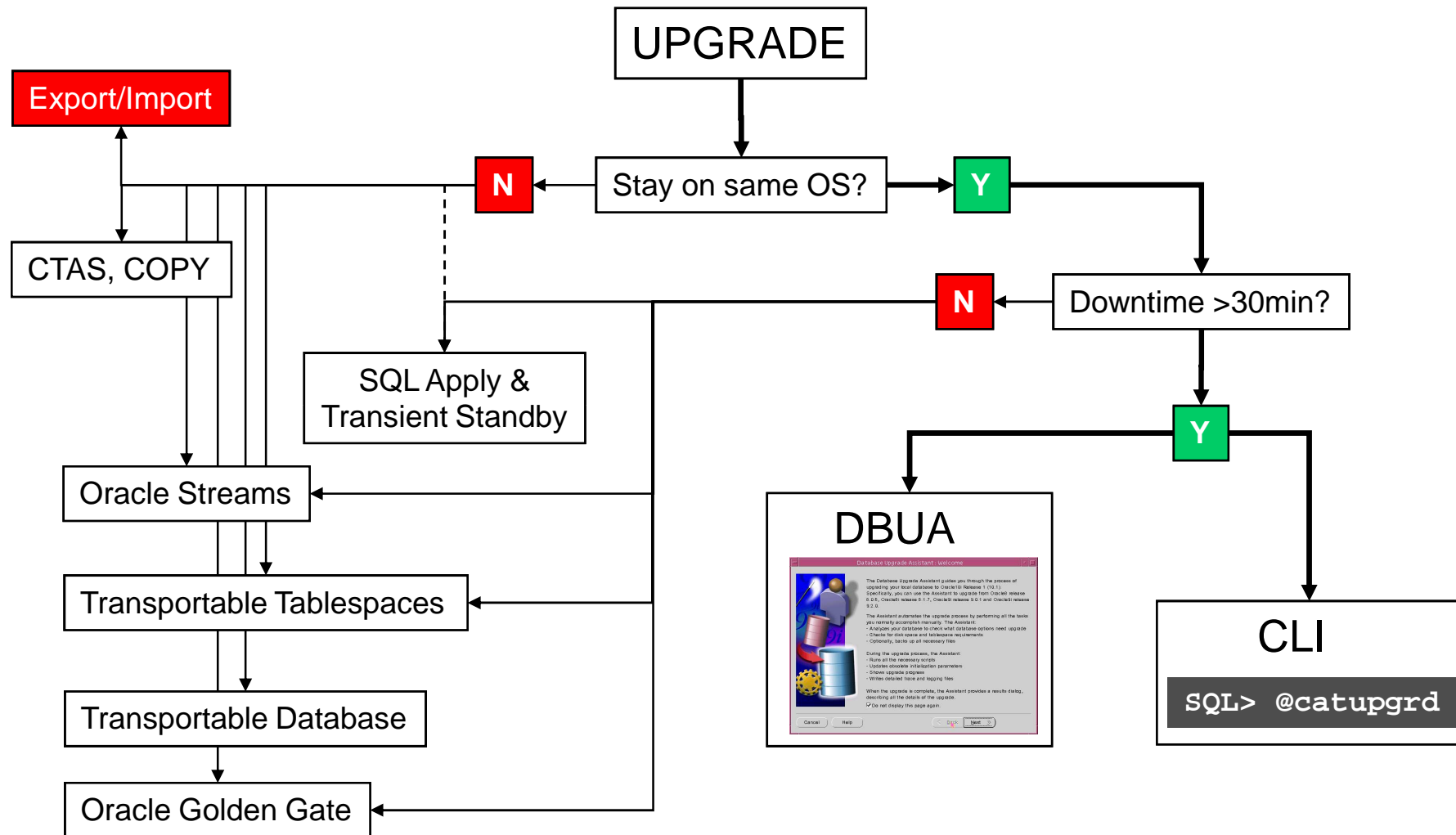
Upgrade Alternatives

- Migration methods
 - Cross-platform
 - Cross-endian
- Minimal downtime methods
 - What does "minimal downtime" really mean?
 - 12 hours?
 - 60 minutes?
 - 5 minutes?
 - Less?
 - No downtime at all?

Upgrade Paths

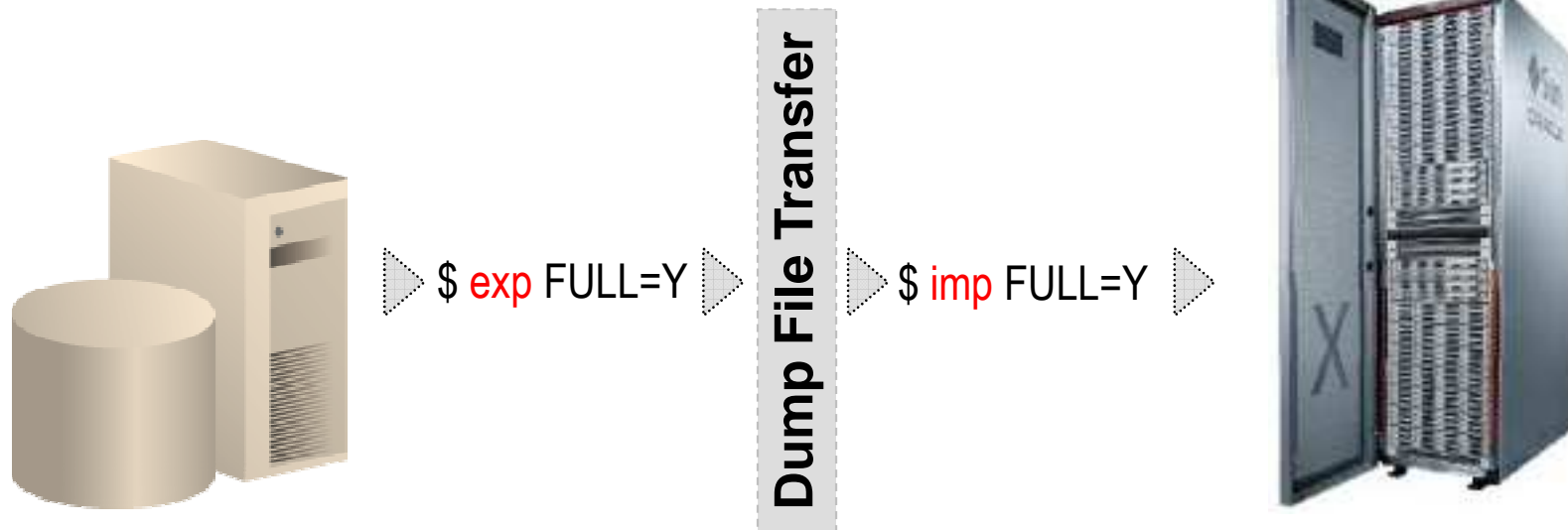


Upgrade Paths



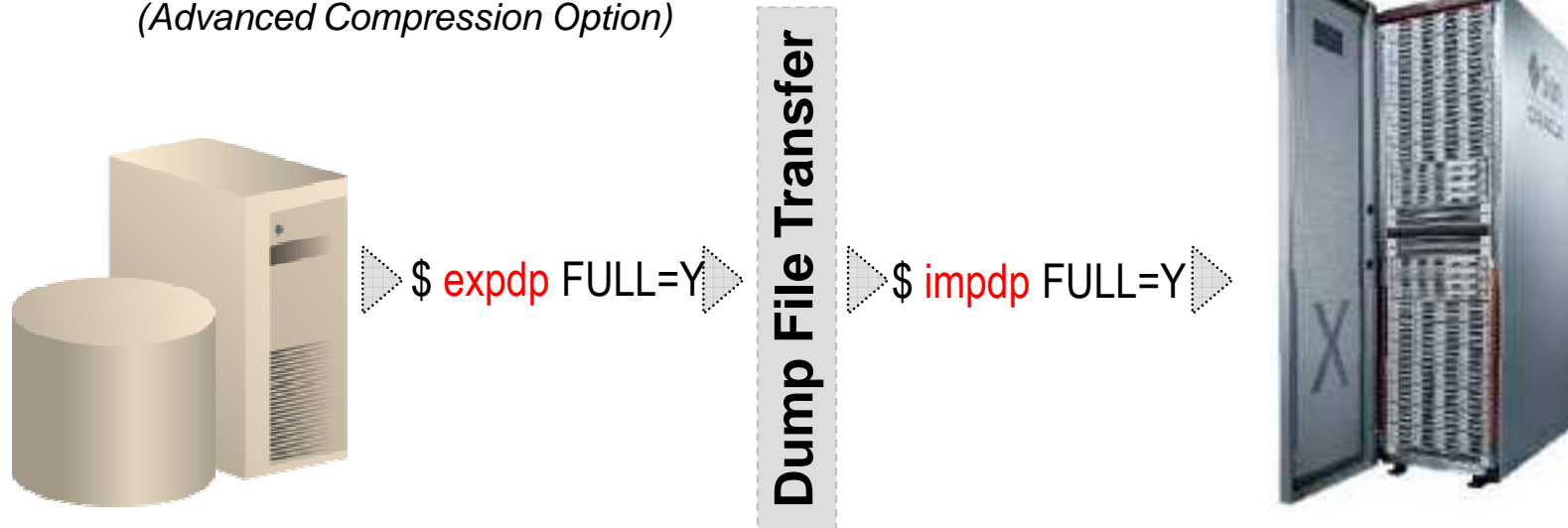
Export/Import: Original exp/imp

- Import of all versions \geq Oracle V5 possible
- "exp" is *not supported* in 11g anymore
 - But the utility is still there and can be used
 - "imp" is still supported for importing older dumpfiles
- Not really fast but well known and reliable
 - Relation between amount of data and runtime



Export/Import: Data Pump expdp/impdp

- The “new” faster export-import, available starting with 10.1
 - As of 10.2, handles everything except for XMLSCHEMA types
 - As of 11.1, handles all data types
- Powerful concept:
 - PARALLEL export and import of data (single-threaded for metadata)
 - EXCLUDE & INCLUDE (For examples see [Note:341733.1](#))
 - COMPRESS=ALL starting in 11.1
(Advanced Compression Option)





Export/Import: **exp/imp** Hints

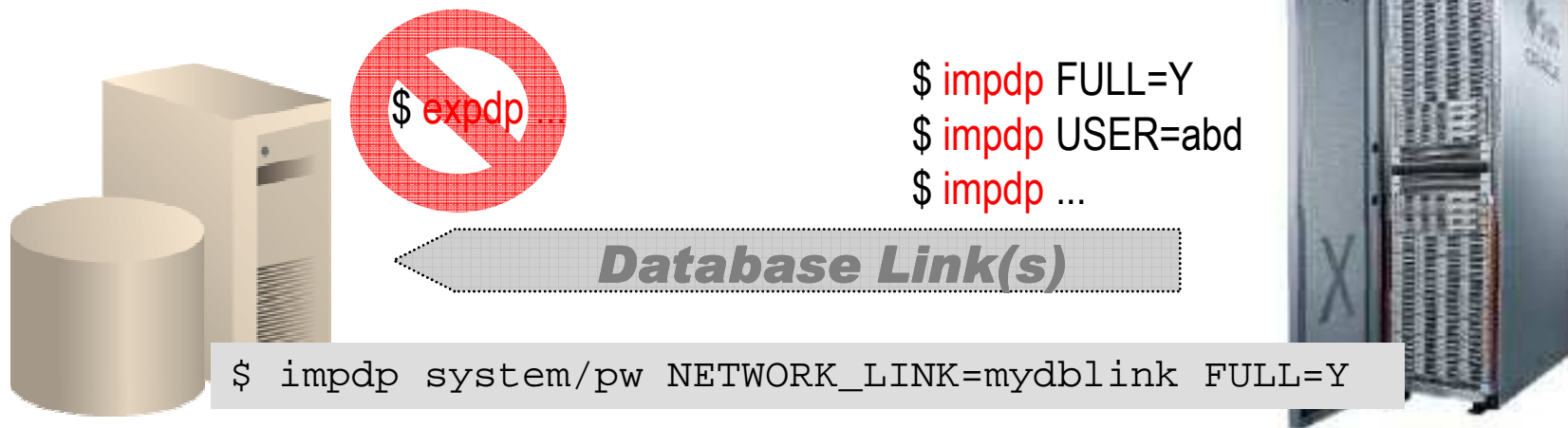
- Transfer dump files always in **BINARY** mode
- Always perform full database export as user **SYSTEM**
 - Ensures a consistent export
 - GRANTs on SYS's objects have to be exported separately
- Original exp/imp:
 - Import takes approximately 3x times as long as Export
 - Export always with the lowest involved database version
 - Import always with **imp** of target database (see also: [Note:286775.1](#))
 - Export performance
 - **DIRECT=Y** ... bypasses SQL-Layer, but no conversions!
 - Parallelize export by dividing into logical independent chunks of data
 - Import performance
 - Increase **BUFFER**
 - **INDEXES=N** ... build indexes later in parallel ... **INDEXFILE=...**
 - Parameter **COMMIT_WRITE=NOWAIT** (10g) or **COMMIT_WAIT=NOWAIT** (11g) during import

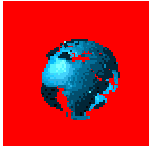
Export/Import: **expdp/impdp** Hints

- Transfer dump files always in **BINARY** mode
- Always perform full database export as user **SYSTEM**
 - Ensures a consistent export
 - Allows for parallel DML
 - GRANTs on SYS's objects have to be exported separately
- For Compatibility and version changes: [Note:553337.1](#)
- Performance:
 - Data Pump will take advantage of all the resources it is given
 - Specify PARALLEL up to 2x number of CPUs
 - Automatically chooses the fastest method possible: Direct Path, External Tables, or Conventional Path)
 - Import performance
 - EXCLUDE=STATISTICS on export or import
 - EXCLUDE=INDEXES on import. Use SQLFILE parameter to get index definitions, build in parallel after the data import

Export/Import: Data Pump Network Mode

- Direct import from source to target over a database link
 - Parameter: NETWORK_LINK
 - Run only `impdp` on the target system - **no expdp necessary**
 - No dumpfile needed: no disk I/O, no file transfer needed
- Restriction of DB Links
 - Does not work with LONG/LONG RAW and object types with nested tables





Real World Checkpoint



Customer

Project

Constraints

Preparation

Upgrade

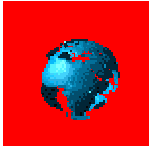
Remarks

Success?

- The Customer:
Loyalty Partner Solutions
 - HQ in Munich, Germany
 - Develops and operates professional customer loyalty programs based on customized IT solutions
 - Provider for Payback, Europe's largest bonus program



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Real World Checkpoint



Customer

Project

Constraints

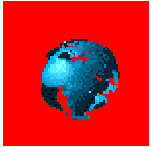
Preparation

Upgrade

Remarks

Success?

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



Real World Checkpoint



Customer

Project

Constraints

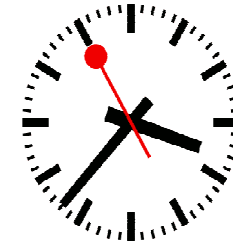
Preparation

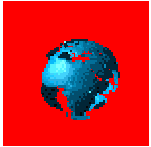
Upgrade

Remarks

Success?

- Constraints:
 - Move everything in less than 24 hrs
 - Network bottleneck
 - Customer installed InfiniBand hardware into source system
 - ⇒ ~ 3GB/sec throughput!

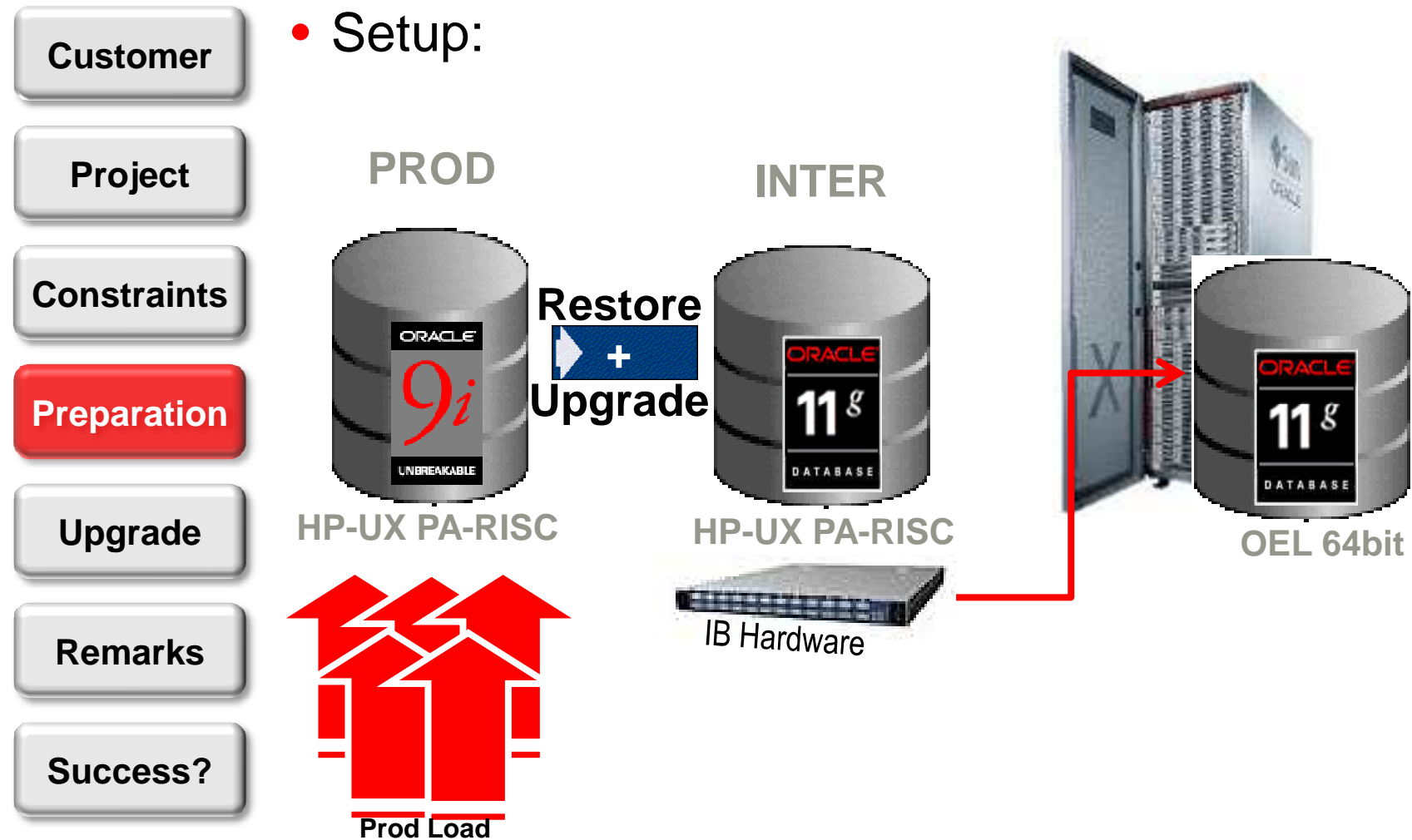




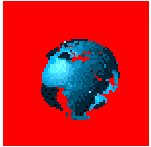
Real World Checkpoint



LOYALTY PARTNER SOLUTIONS



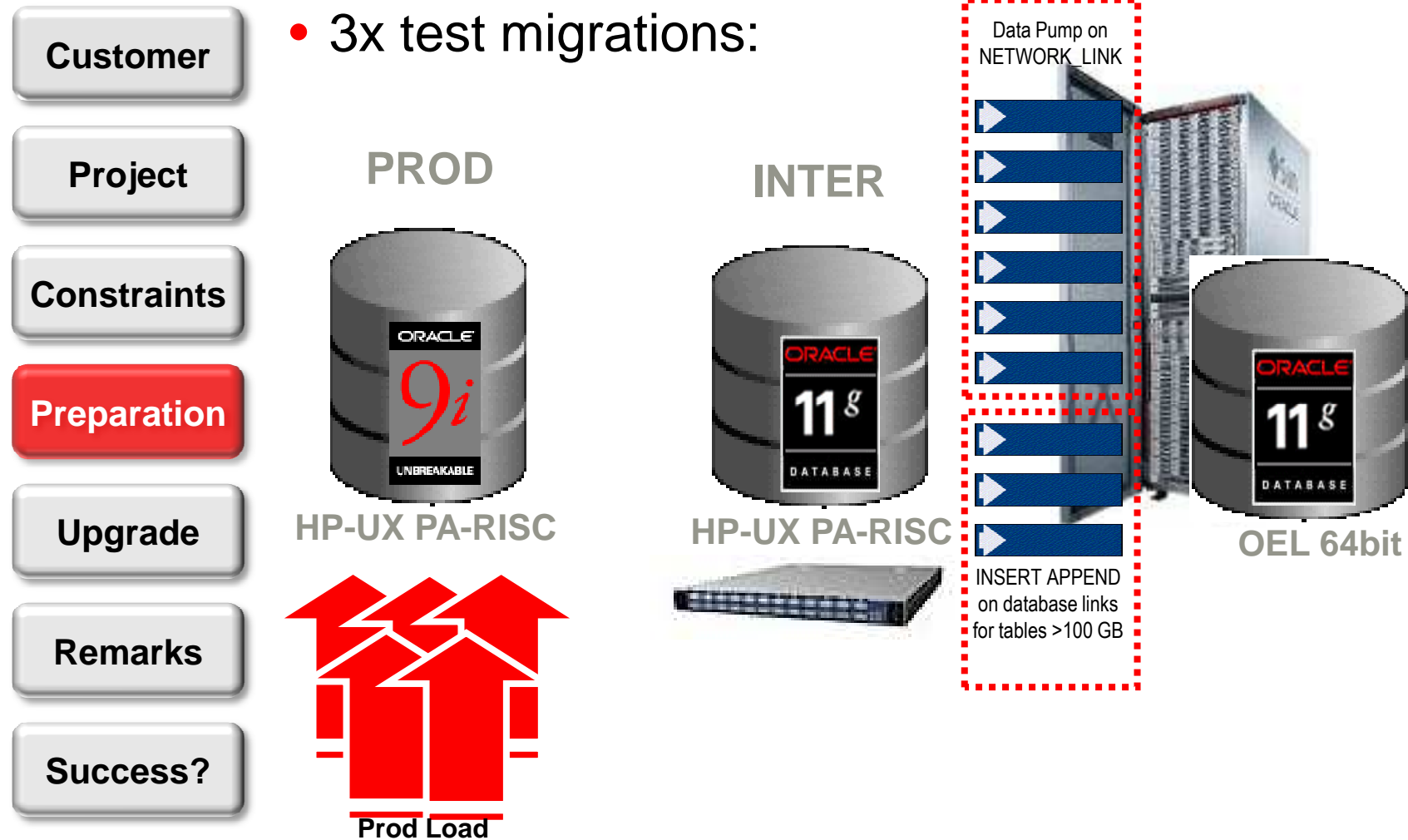
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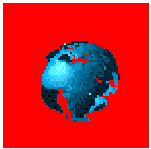
Real World Checkpoint



LOYALTY PARTNER SOLUTIONS



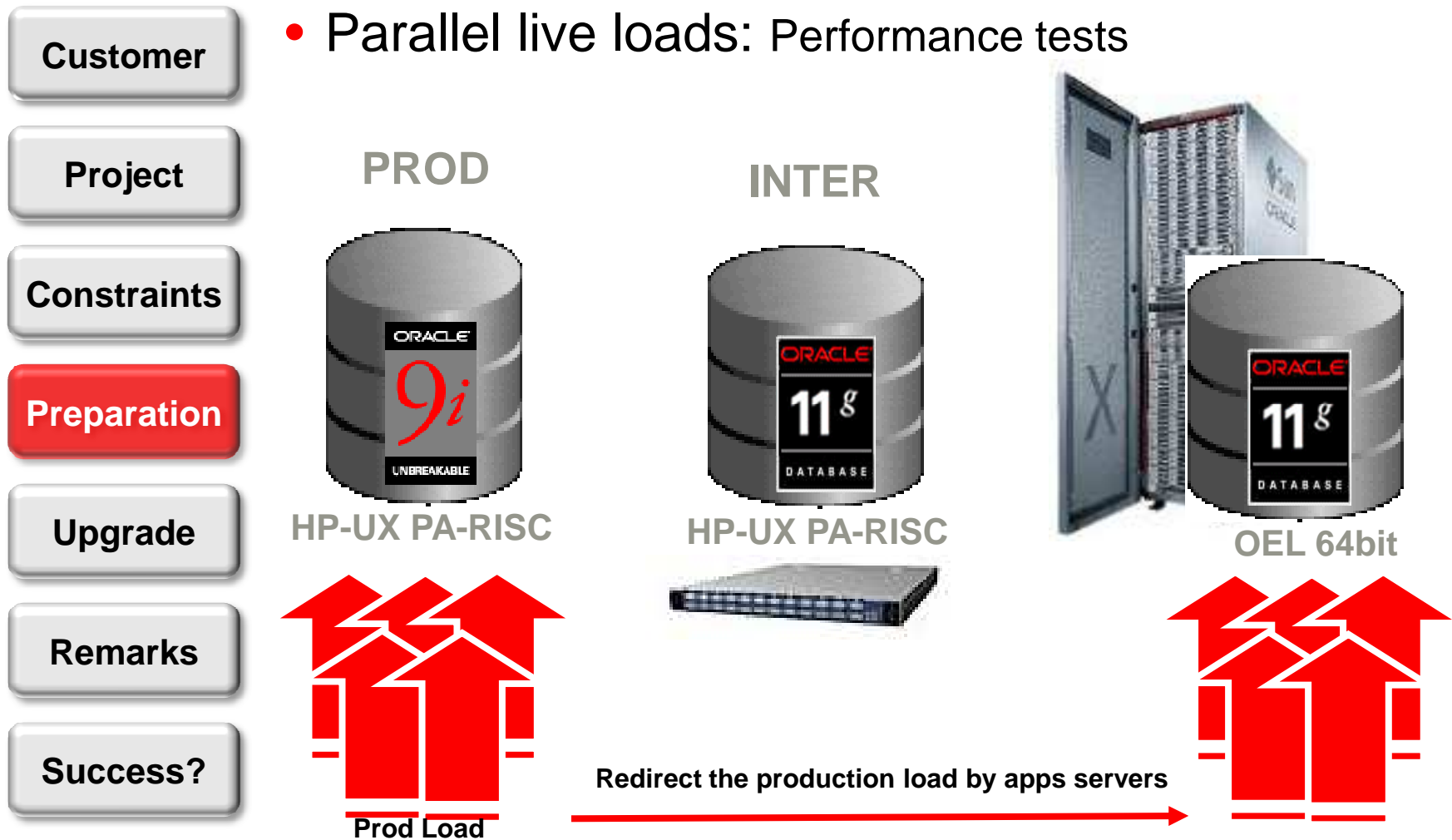
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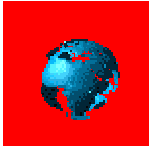
Real World Checkpoint



LOYALTY PARTNER SOLUTIONS



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Real World Checkpoint



LOYALTY PARTNER SOLUTIONS

Customer

- Live upgrade/migration

Project

Constraints

Preparation

Upgrade

Remarks

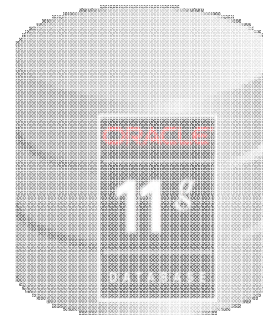
Success?

PROD

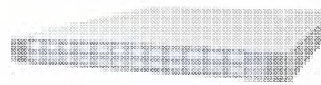


HP-UX PA-RISC

INTER



HP-UX PA-RISC

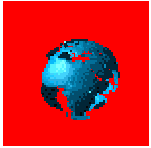


OEL 64bit



Prod Load

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Real World Checkpoint



Customer

Project

Constraints

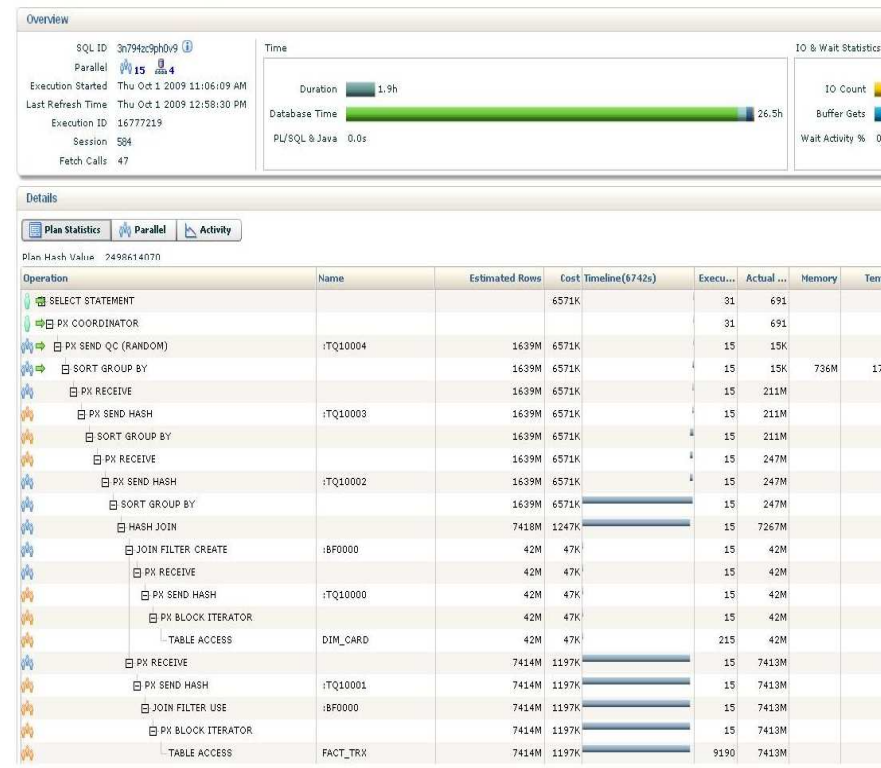
Preparation

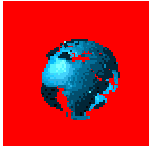
Upgrade

Remarks

Success?

- Example: Job runtime from 30 hrs to < 2hrs
 - And not a single piece of SQL changed





Real World Checkpoint



Customer

Project

Constraints

Preparation

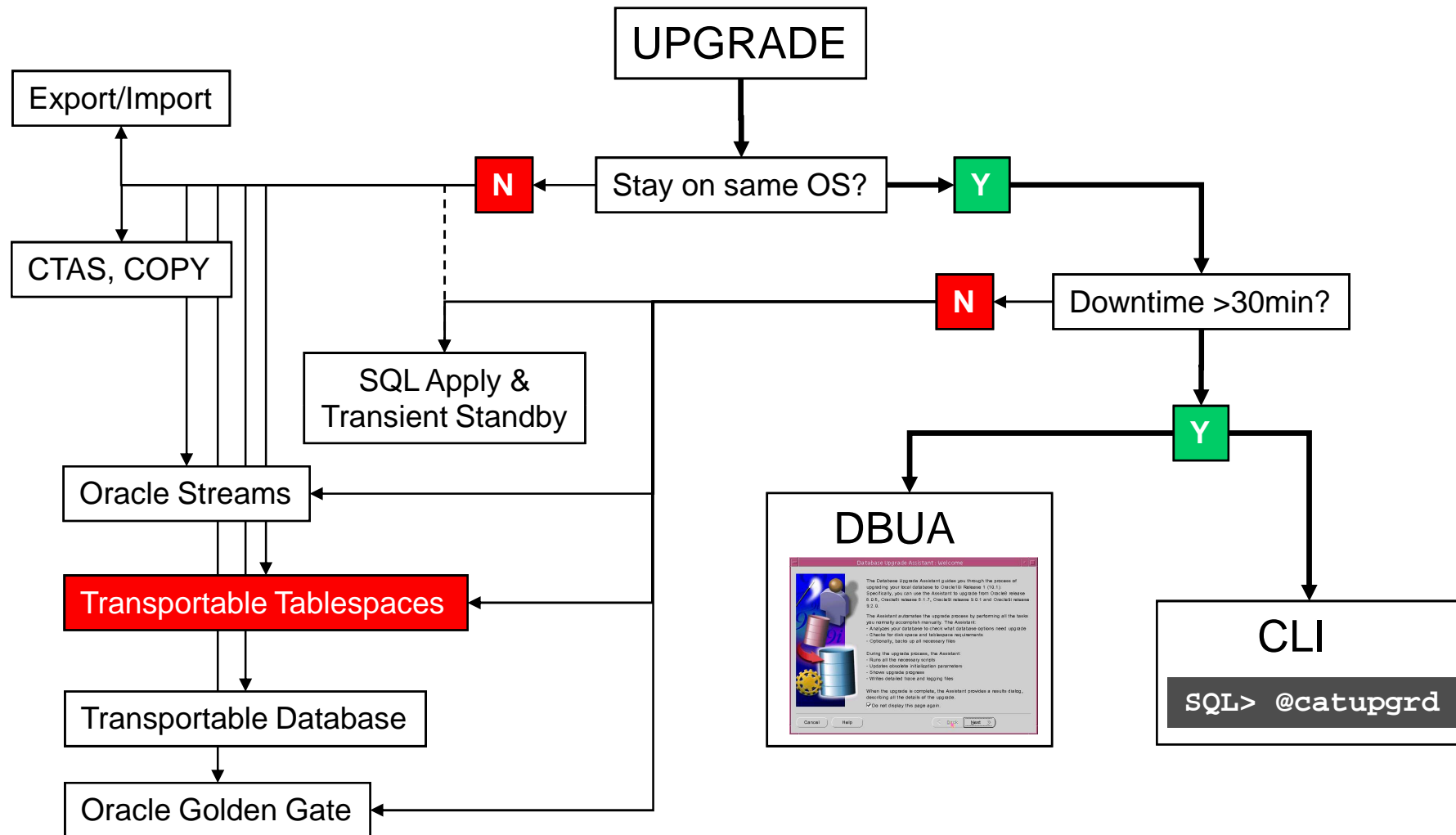
Upgrade

Remarks

Success?

- Live? And alive?
 - Yes! Go-live in early November 2009
 - Two weeks earlier than proposed
 - Restore, recovery, upgrade and final migration done in ~20 hrs
 - Dramatic performance improvements
 - Job runtimes decreased by 80%
 - **User complaints** about too fast performance ... really!!

Upgrade Paths



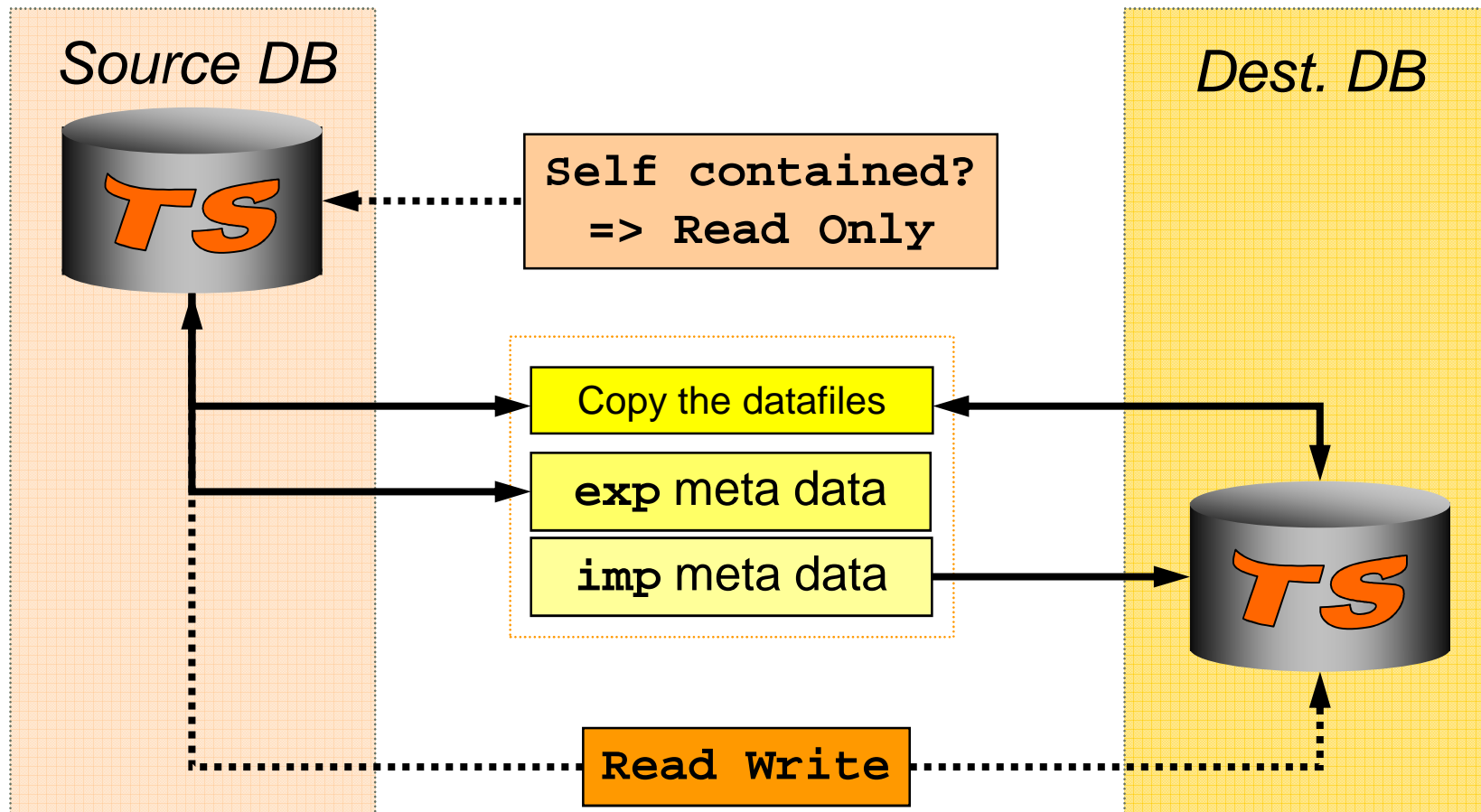


Transportable Tablespaces

- Simple Concept:
 - Create an "empty" database in the new environment
 - Plug in all data tablespaces from source to target database
 - Works cross-platform and cross-Endianness since Oracle Database 10g
- Performance Potential
 - "Possibly" very fast upgrade
 - Physical file copy can be much faster than exporting/importing data
- Complexity could be constraining
 - SYSTEM+SYSAUX tablespaces can't be transported
 - Additional steps necessary to move views, synonyms etc.

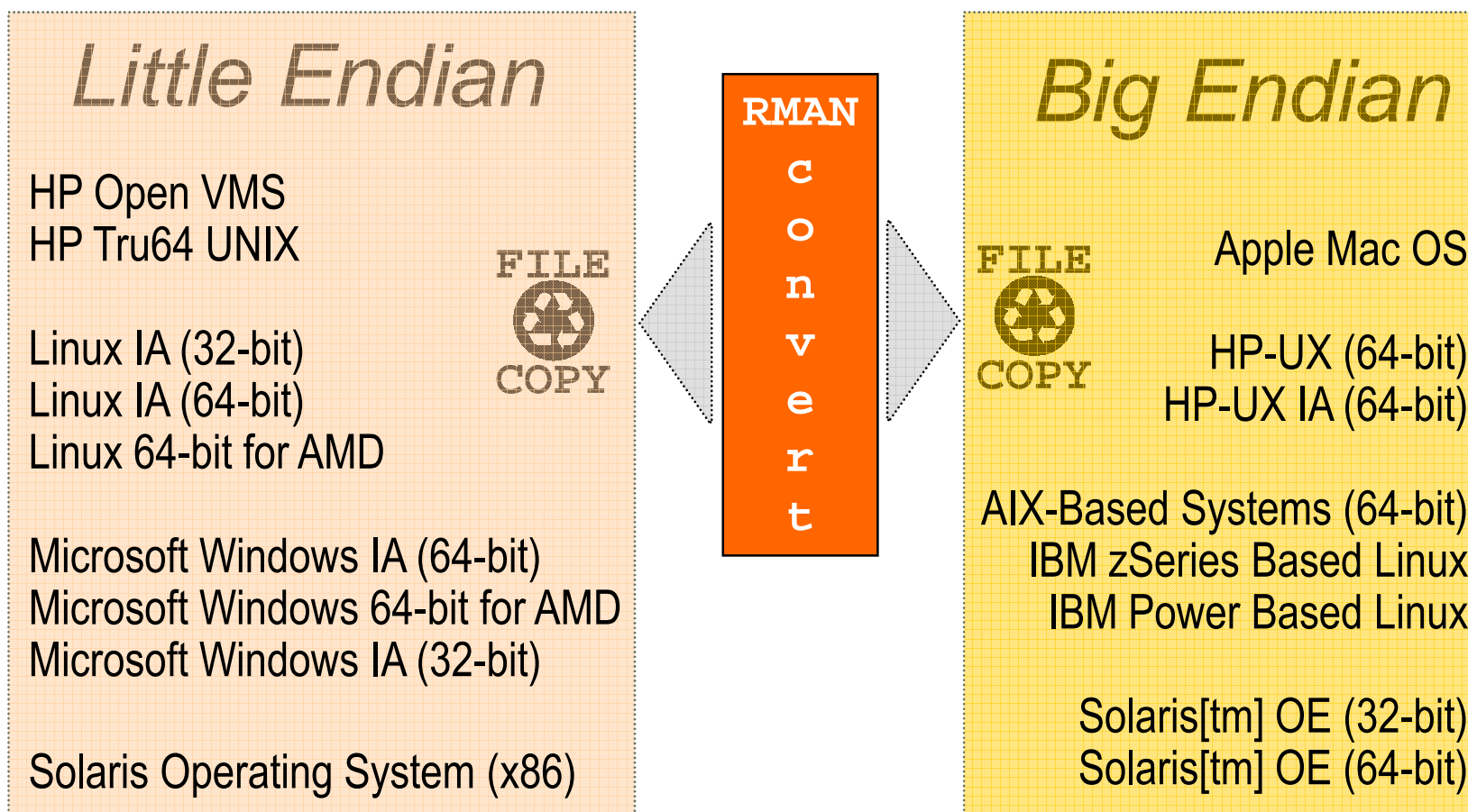
Transportable Tablespaces

- General TTS concept
 - Feature available since Oracle 8i



Portable Tablespaces

- TTS x-platform (v\$transportable_platform):



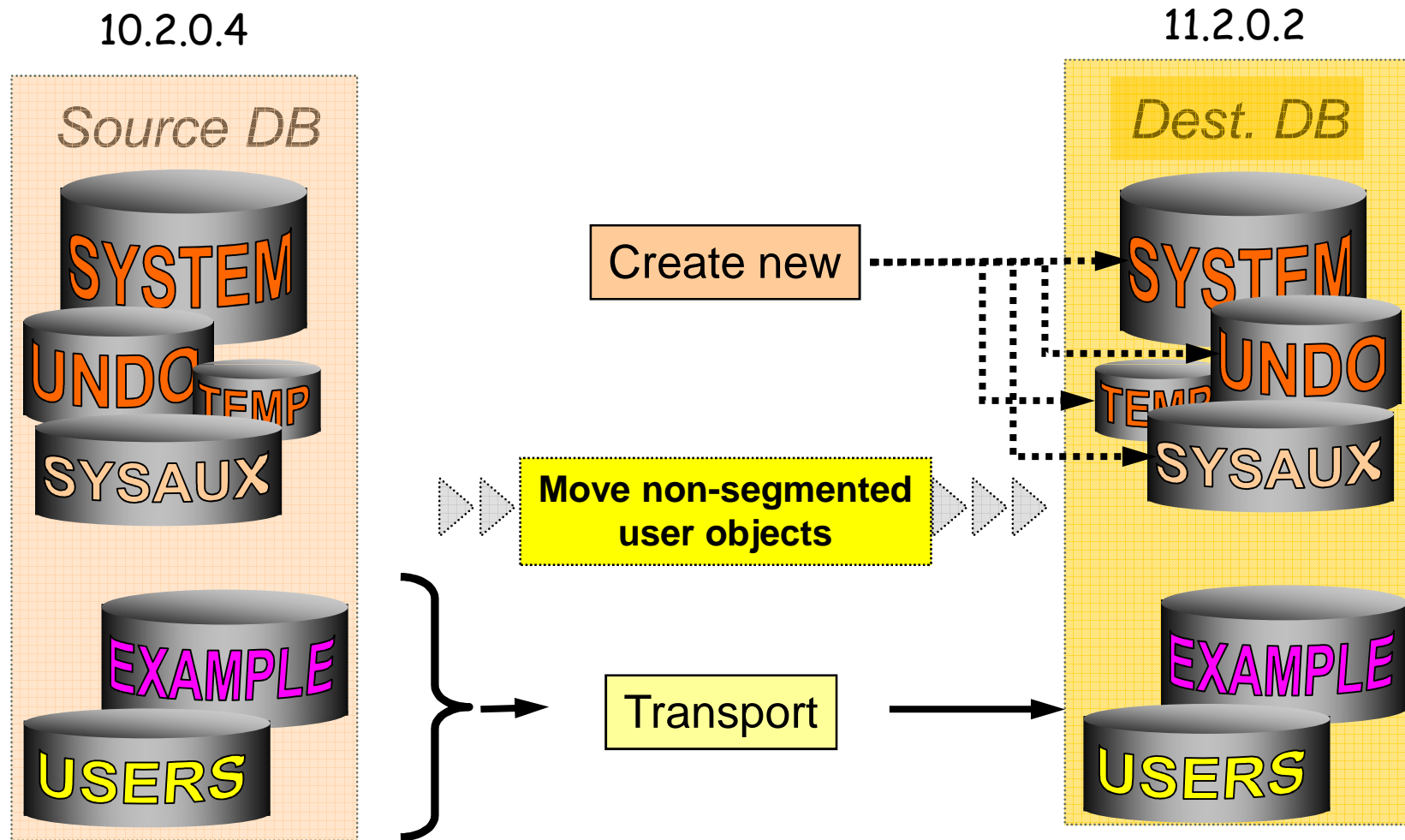
Transportable Tablespaces



- TTS cross endian
 - 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
 - Example:

```
RMAN> CONVERT TABLESPACE users,example  
TO PLATFORM 'Linux IA (32-bit)'  
FORMAT=' /tmp/transport_linux/%U';
```

Transportable Tablespaces





Possible options

- Non-segmented objects - 3 possible ways
 - The "brutal" way
 - 8i/9i: exp/imp with ROWS=N
 - 10g/11g: expdp/impdp CONTENT=METADATA_ONLY
 - The "smart" way
 - Generate scripts
 - String concatenation with || ...
 - DBMS_METADATA
 - The "very smart" way
 - RMAN clone (DUPLICATE) with SKIP TABLESPACES option
- In any case: Take extra care on sequence's start values!!



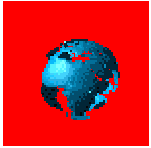
Transportable Tablespaces

- Tips & Tricks
 - Talk as early as possible to the application development if TTS will be your upgrade strategy
 - Simple is Better for fast TTS!!!
 - Use a Physical Standby as transport system
 - Fallback possibility to the old system
 - Eliminate time needed to transfer files
 - If you don't move datafiles:
 - Tablespaces can be mounted from both databases simultaneously as long as they are READ ONLY
 - As soon as a tablespace is set READ WRITE on the target database it will be "lost" to the source
 - Make sure source and target database have **EQUAL TIME ZONE definitions**
 - If TZsource=V11 then patch TZtarget to V11 first



Documentation and Information

- Transportable Tablespaces - Information
 - 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 examples:
 - Amadeus Customer Case
<http://www.oracle.com/technetwork/database/features/availability/s281209-amadeus-130978.pdf>
 - The Hartford Case
<http://www.oracle.com/technetwork/database/features/availability/thehartfordprofile-xtts-133180.pdf>



Real World Checkpoint

Customer

Project

Constraints

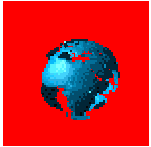
Preparation

Upgrade

Remarks

Success?

- The Customer:
 - One of the largest financial institutions 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

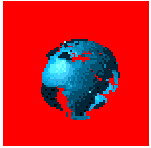
Upgrade

Remarks

Success?

- Project scope: 70+ TB to migrate and upgrade

	Current Configuration	New Configuration
CPUs	16 single-core	4 x 8-core
Operating System 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	70+TB
Database Version	Oracle 10.2.0.4	Oracle 11.2.0.2



Real World Checkpoint

Customer

Project

Constraints

Preparation

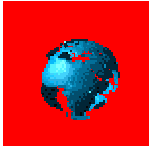
Upgrade

Remarks

Success?

- Constraints:

- Endian conversion
 - Both OS- and Database-level endian conversions needed
- Data synchronization
 - Up to the minute before conversion
- Conversion Window
 - Migration *and smoke testing* must be completed within **48 hours**
- Size & Scale of data
 - 70+ TB, **millions of sub-partitions**, extremely active system



Real World Checkpoint

Customer

Project

Constraints

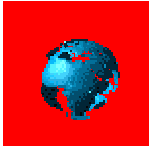
Preparation

Upgrade

Remarks

Success?

- **Explore Data Movement Options**
- FTP or NFS file copy to new system
 - 10Gb Ethernet backbone
 - Copying 70TB over the network = **~20 hours**
 - And it doesn't include DB cross-endian conversion!
- Veritas Portable Data Containers
 - Platform-independent virtual volumes for export
 - Can then be imported and mounted with same or different endian
 - Time needed is proportional to number, not size, of data files (generally just a few seconds)



Real World Checkpoint

Customer

Project

Constraints

Preparation

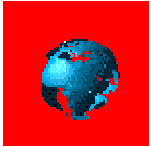
Upgrade

Remarks

Success?

- Migration Weekend

Duration	Action
3 hours	Graceful application shutdown, backup
6 hours	Instantiate and validate DB on swing server
6 hours	Data Pump metadata export
1 hour	OS-level endian conversion
20 hours	RMAN CONVERT processing
8 hours	Data Pump metadata import
5 hours	Post-migration tasks (TNSNAMES, re-create dblinks, 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

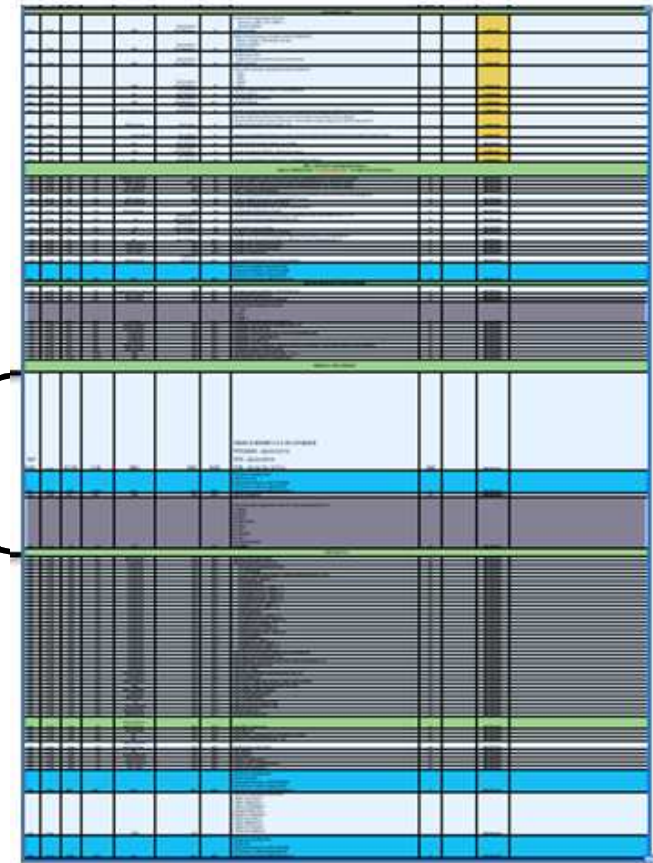
Upgrade

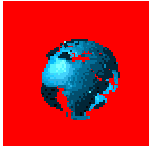
Remarks

Success?

- Upgrade weekend:
 - Database Upgrade is just part of the job
 - Much work in validating pre- and post-upgrade conditions
 - Coordination with other affected groups is vital!
- Met planned schedule almost exactly!

DB Upgrade section of the project





Real World Checkpoint

Customer

Project

Constraints

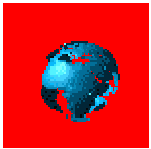
Preparation

Upgrade

Remarks

Success?

- 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?
- Isolating change reduces risk
 - Migrate first, to ensure good behavior on the new OS platform
 - Upgrade in a second downtime
- Does it really need to be said? **Test!!!**
 - Dev testing & Acceptance testing caught issues that were fixed before they could hurt production



Real World Checkpoint

Customer

Project

Constraints

Preparation

Upgrade

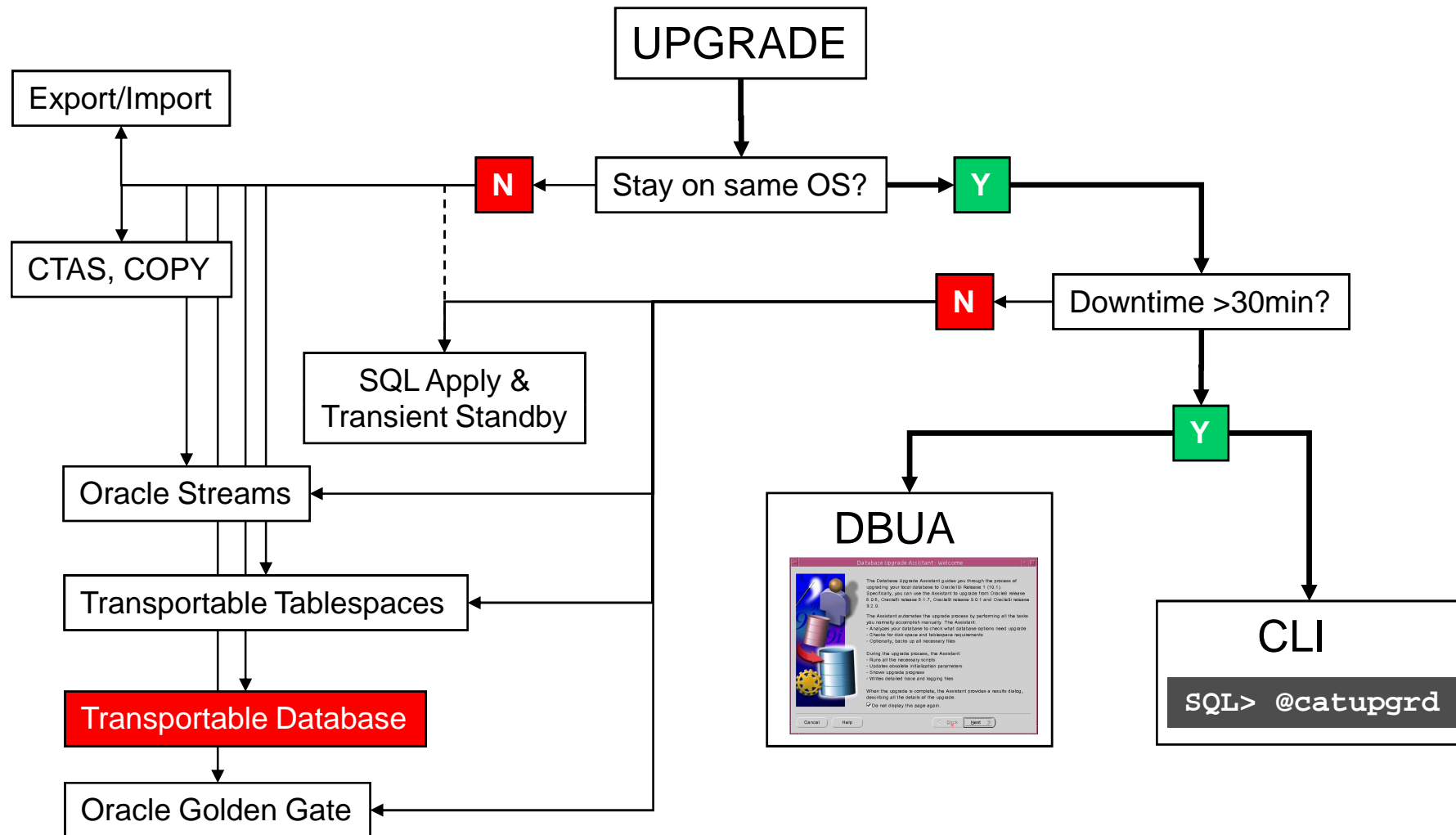
Remarks

Success?

- YES ...just a couple of post-upgrade tweaks:
- `utlrp.sql` jobs were created, but didn't run
 - Expected change in behavior of the `job_queue_processes` parameter starting in Oracle Database 11g Release 2
 - Fixed by setting parameter to non-zero value on node running `utlrp`
- High MUTEX contention after upgrade
 - Bug 10187168 was already fixed in 11.2.0.2.2 PSU
 - However, the fix had to be enabled:

```
_cursor_features_enabled=1026  
event="106001 trace name context forever, level 1024"
```

Upgrade Paths





RMAN Transportable Database

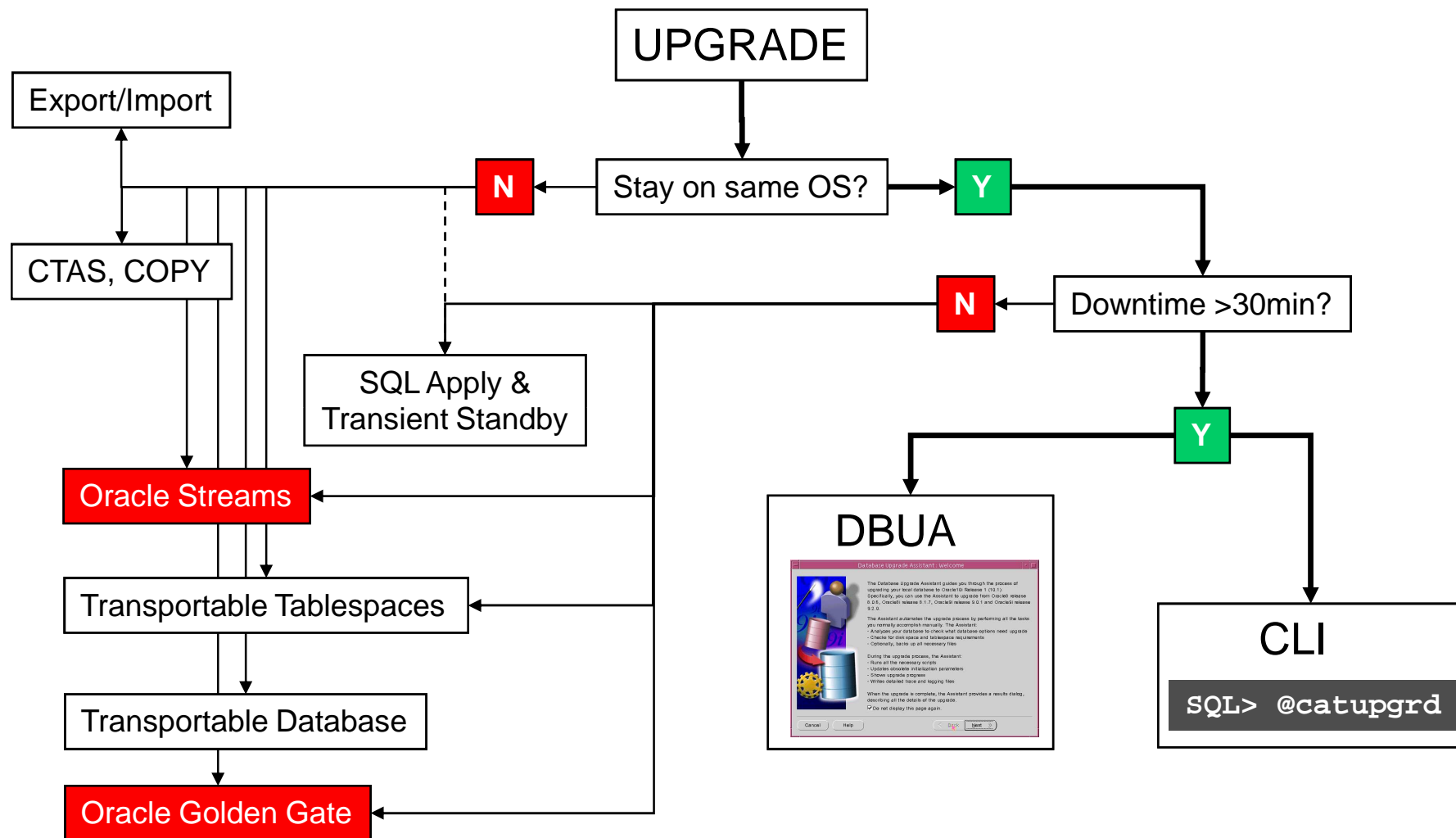
- Feature since Oracle Database 10g Release 2
 - Migration tool, but not **does not perform an upgrade**
 - Automates RMAN steps for system/platform migration
 - Database must be switched to READ ONLY mode
 - Cross-platform, but unfortunately **not** cross-Endian!!!
 - Datafiles must be converted with RMAN into target format
 - RMAN CONVERT DATABASE command
 - Either on the source or the target system – in most cases completes faster on the target system
 - Not a real minimal downtime concept
 - But very comfortable for migrations within one Endianness group



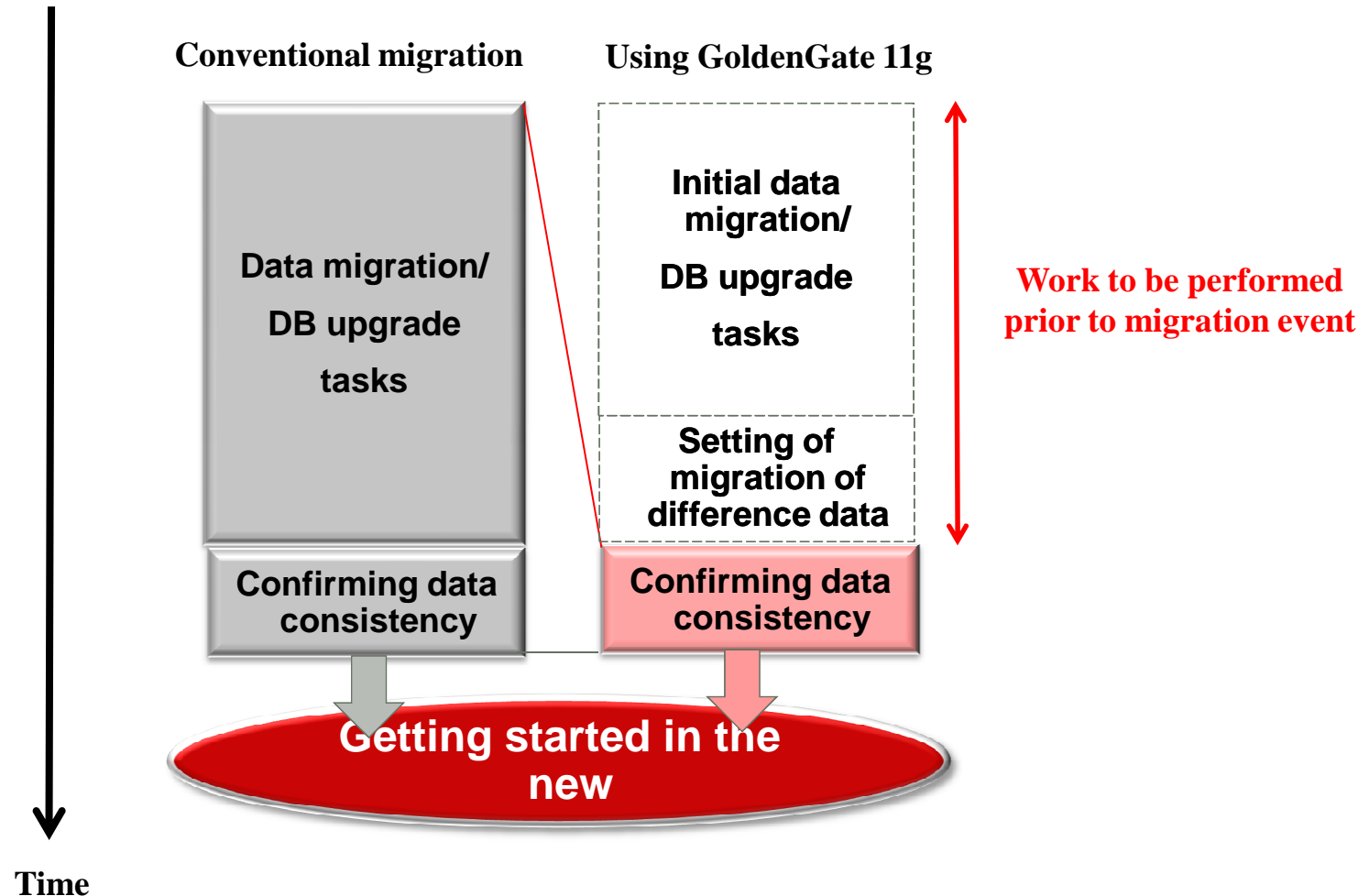
RMAN Transportable Database

- Transportable Database - Information
 - Platform Migration using Transportable Database (RMAN):
<http://www.oracle.com/technetwork/database/features/availability/maa-wp-10gr2-platfrommigrationtdb-131164.pdf>
 - [Note: 413586.1](#)
How To Use RMAN CONVERT DATABASE for Cross Platform Migration

Upgrade Paths

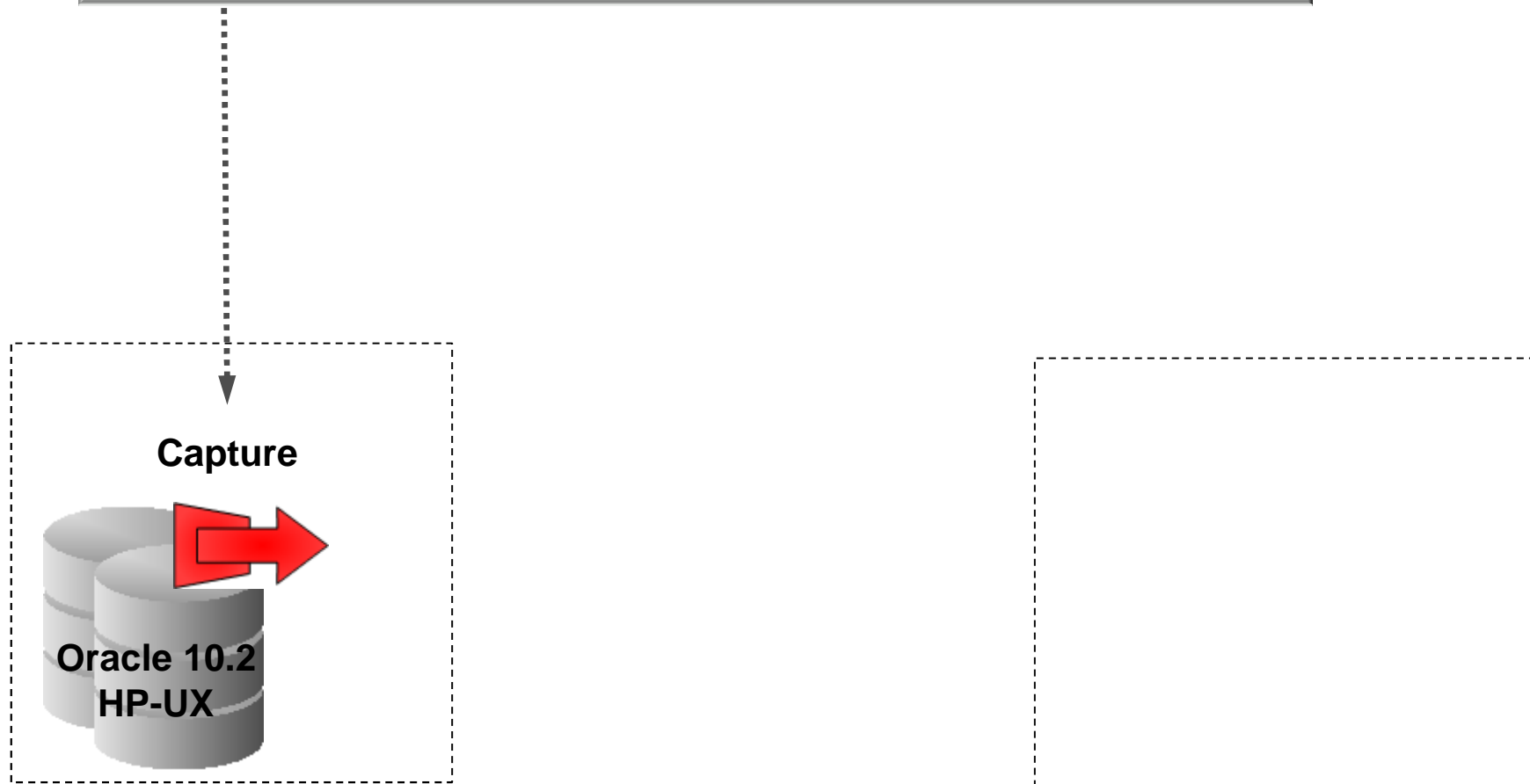


Difference Conventional Migration vs. Oracle GoldenGate



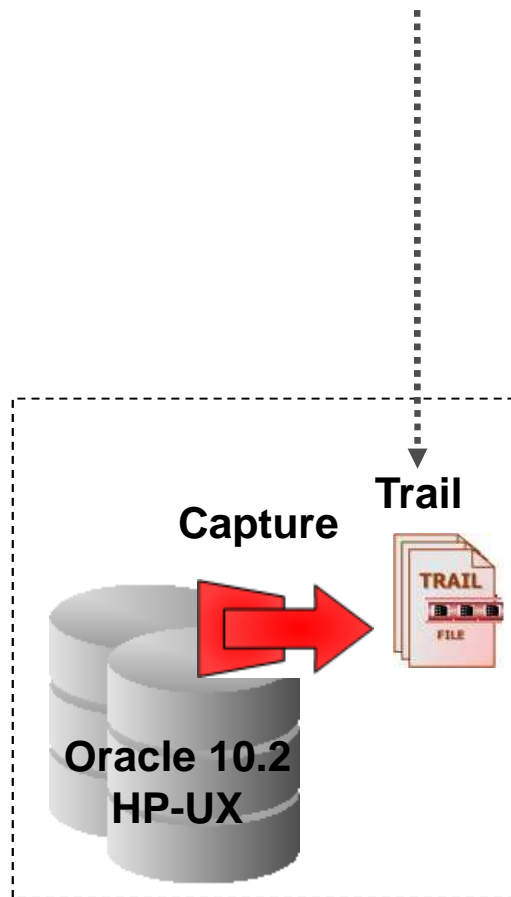
How Oracle GoldenGate Works

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



How Oracle GoldenGate Works

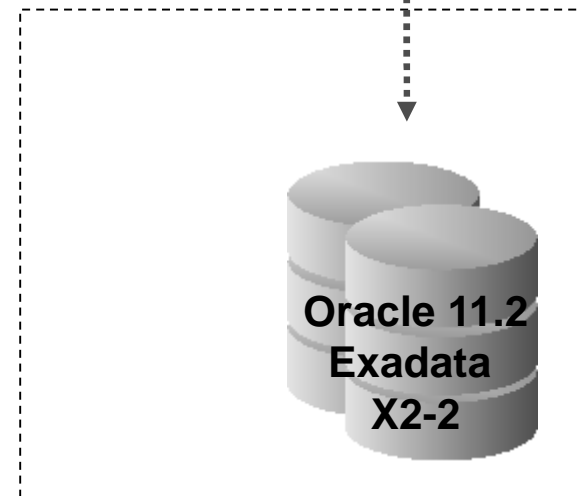
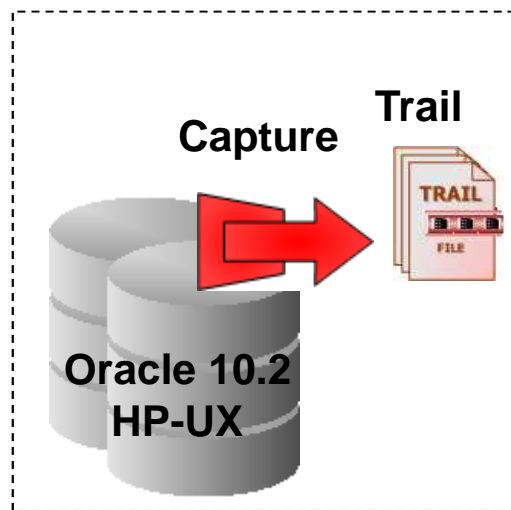
Trail: stages and queues data for routing.



How Oracle GoldenGate Works

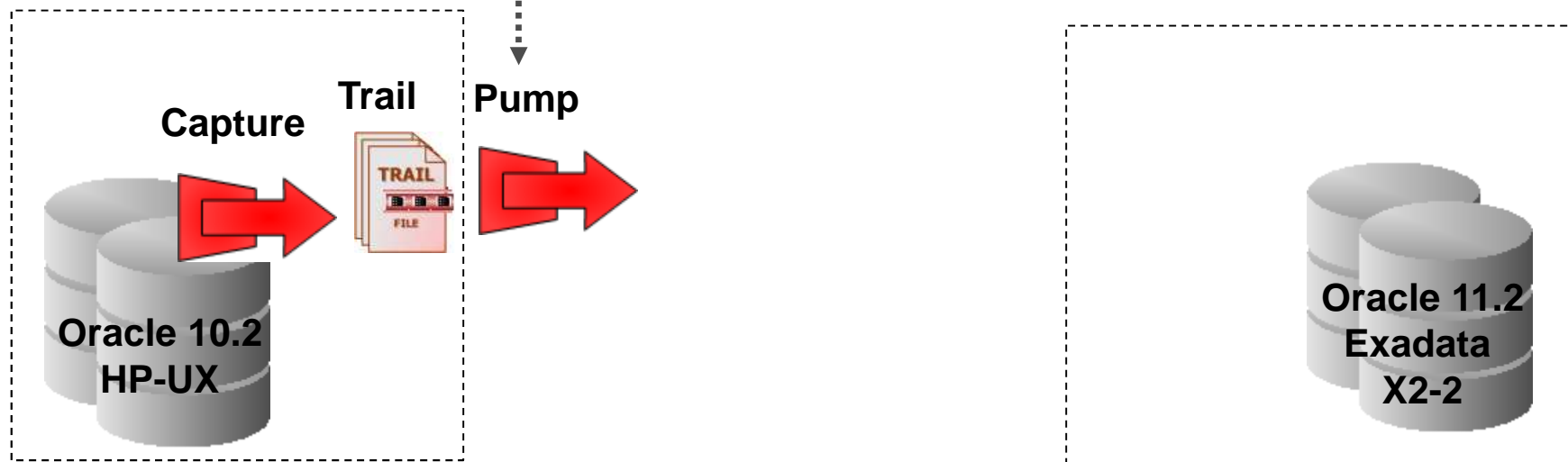
Build up the target database with:

- Transportable Tablespaces x-Platform
- Export/Import with Data Pump



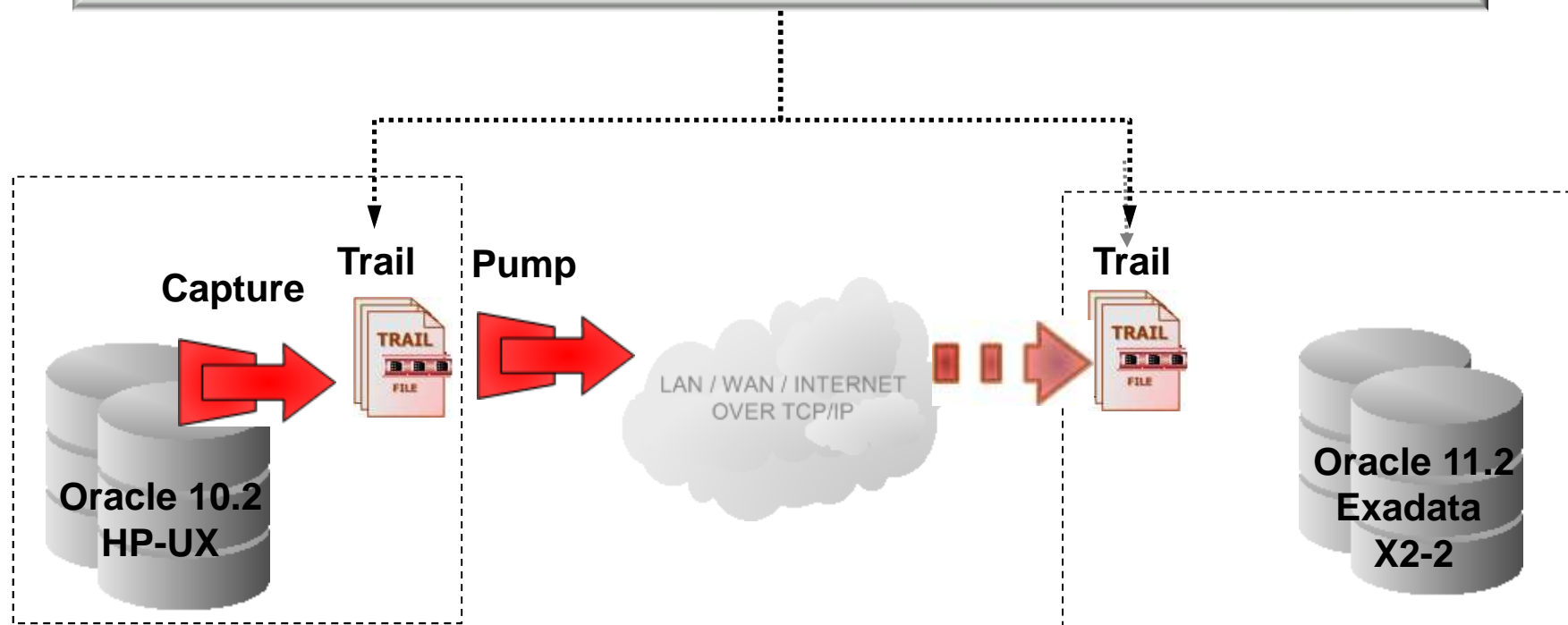
How Oracle GoldenGate Works

Pump: distributes data for routing to target(s)



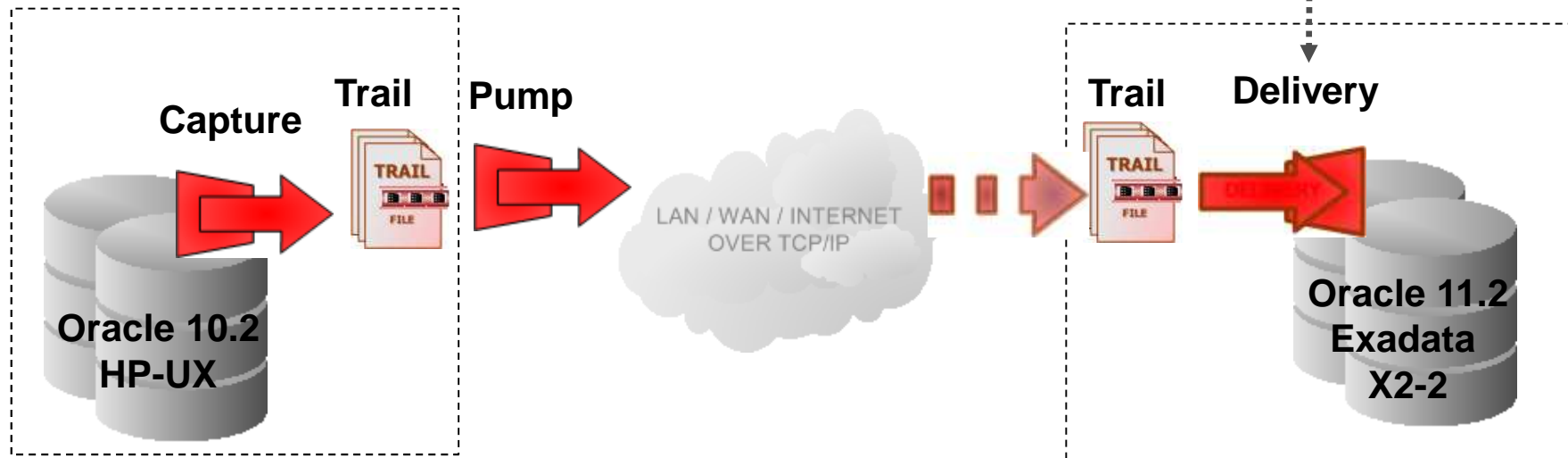
How Oracle GoldenGate Works

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



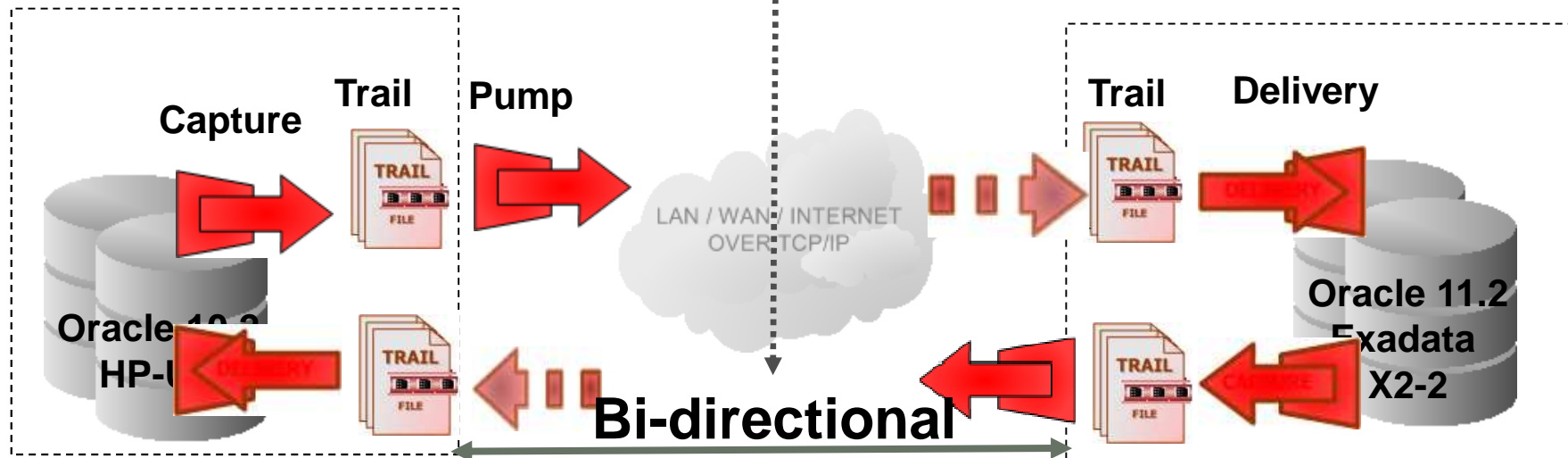
How Oracle GoldenGate Works

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



How Oracle GoldenGate Works

Golden Gate works **bidirectional** -
from higher to lower release as well!





Oracle Streams

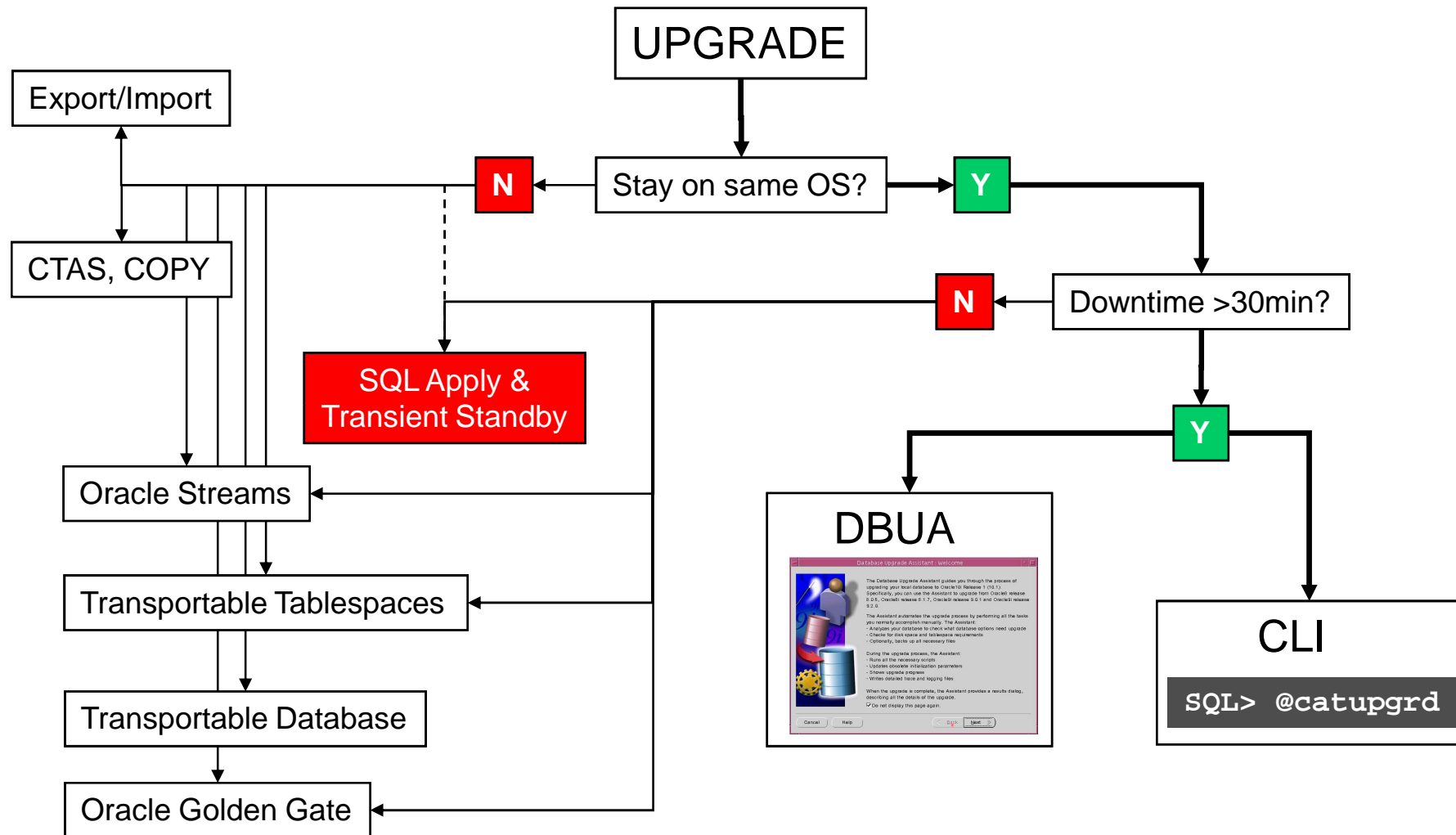
- Free feature of the database
- Works with versions starting with Oracle 9iR2
- Some effort necessary to set it up
- Logminer infrastructure
- Data type restrictions (LONG, objects, others)
 - [Oracle Streams Concepts and Administration, Chapter 4](#)
- Performance limitations
- How to:
 - Oracle® Streams Concepts and Administration: Appendix D/E
http://download.oracle.com/docs/cd/E11882_01/server.112/e17069/ap_strmnt.htm#CIHJBIAA
 - Oracle Streams Replication Best Practices
http://download.oracle.com/docs/cd/E14072_01/server.112/e10705/ptrep_best.htm



Oracle GoldenGate

- Paid option of the database
 - Migratable license for 1 year which includes Active Data Guard
- Works with Oracle database versions
 - GoldenGate 10.4: 8i (DML Only), 9i, 10.1, 10.2, 11.1
 - GoldenGate 11g: 9.2.0.7, 10.1+, 10.2.0.4+, 11.1+, 11.2+
- Generally faster, easier to setup and use than Streams
 - Applies to fallback as well
- Fewer data type restrictions than Streams
- [Oracle GoldenGate Installation and Setup Guide](#)
- Also works with non-Oracle databases
- GoldenGate OTN page:
<http://www.oracle.com/technetwork/middleware/goldengate/overview/index.html>
<http://www.oracle.com/technetwork/middleware/data-integration/goldengate1111-cert-matrix-349179.xls>

Upgrade Paths



Logical Standby with Oracle Data Guard

- 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: Upgrade of the former production database
 - Eventually: Switchover to the original roles
 - Downtime less 2 minutes
 - BUT:
 - Usually no OS change possible
 - Exceptions: see [MOS Note: 1085687.1](#)
 - Logminer has known restrictions
 - Data type support
 - Performance



Agenda

- Regular Upgrade Methods
- Post Upgrade Tasks
- Upgrade Alternatives
- Summary





Upgrade Summary

- Choosing an upgrade method depends on:
 - Database environment
 - Amount of downtime that is acceptable
 - DBA's knowledge and tolerance for complexity
- If possible, using the DBUA is the recommended method for simplicity and ease-of-use
- Always create an online backup with RMAN
- Please remember:
Upgrade has never been easier - but you still have to test!!!
- 11g R2 is a stable database release so go for it!



Full-day Database Upgrade Workshops in Australia & New Zealand!

- Currently planned for
 - 13-MAR-2012: Perth
 - 15-MAR-2012: Brisbane
 - 16-MAR-2012: Melbourne
 - 19-MAR-2012: Wellington
 - 21-MAR-2012: Sydney
- More details to come...

Oracle Database 11g Upgrade Seminar

Are you considering upgrading or migrating your database to Oracle 11g?

Are you unsure of what's involved and the latest best practices for upgrading Oracle databases?

Join us in this rare opportunity to hear directly from Oracle's Upgrade Development Team. The seminar will focus on the latest best practices, tips and tricks, and common pitfalls to make your step to Oracle Database 11g Release 2 a successful one. Oracle's Upgrade Development team will provide everything you need to know about upgrading to Oracle Database 11g including:

The seminar will provide an overview on:

- How to move to Oracle Database 11.2 including
 - Database Upgrade
 - Characterset Migration
 - Minimal Downtime Migration
 - OS Platform Exchange
 - Exadata Migration
- All the required preparatory steps
- Mitigating risk with
 - SQL Plan management
 - Real Application Testing
- Performance enablement
- Successful customer cases

Get the slides: blogs.oracle.com/UPGRADE

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Friday Nov 18, 2011

11.2.0.3 Pre-Upgrade Script Now Available!
By roy.swonger on Nov 18, 2011

It took a little while because of upgrades to My Oracle Support, but the pre-upgrade script for Oracle Database 11.2.0.3 is now available for download. If you want the latest pre-upgrade script for any supported version of the database, simply go to [MOS Note 884522.1](#) and download the script that corresponds to your destination release. This is a lot easier than downloading the entire kit in order to obtain the script!

Category: Best Practice Tags: none
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Thursday Nov 17, 2011

DOAG Conference 2011: Seven Flavors of Database Upgrades
By Mike Dietrich on Nov 17, 2011


Thanks to everybody who did attend at my [DOAG Conference](#) session in Nürnberg this year "**Seven Flavor of Database Upgrades**" (or in German: "*7 Wege zum Datenbank-Upgrade - Geschichten, die das Leben schrieb*"). And thanks for your patience staying with me in overtime as well 😊

In case you'd like to download the slides I've presented at the session please [download them via this link](#) or from the download section to your right.


Category: Workshop Tags: conference doag german group oracle slides user
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Friday Nov 11, 2011

Upgrade & Migration Workshop in Singapore
By Mike Dietrich on Nov 11, 2011



About



Mike Dietrich
Consulting Member of Technical Staff - Database Upgrade Development Group - Oracle Corporation

Based near Munich in Germany and [spending plenty of time in airplanes](#) to run either upgrade workshops or work onsite with reference customers. Acting as interlink between customers and the Upgrade Development.

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