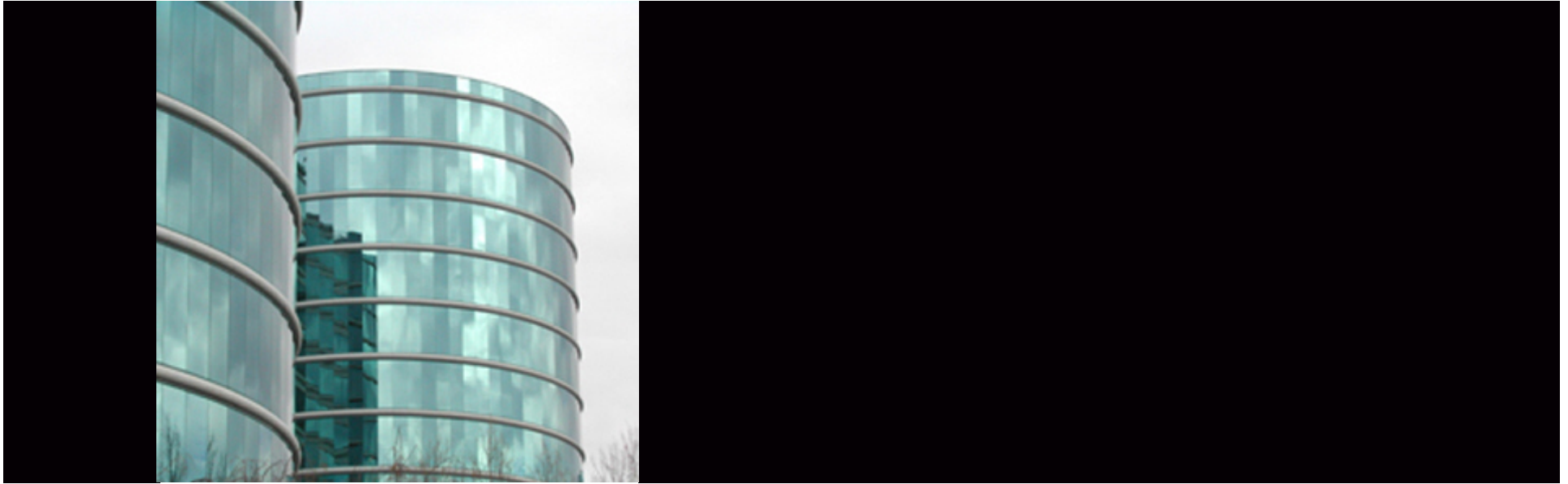


ORACLE®



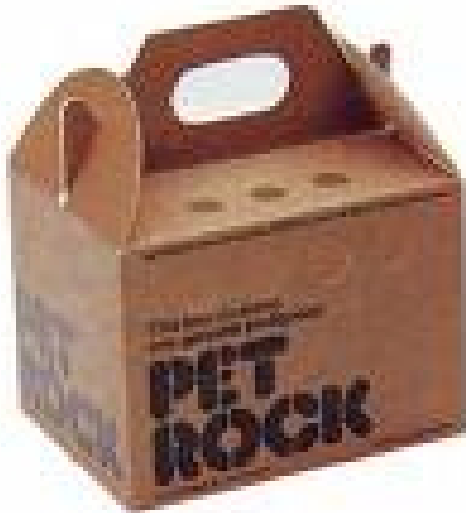
ORACLE[®]



11g New Features of Data Guard

Nick Donatone
Principal Grid Sales Consultant
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Traditional DR – as useful as a . . .



A mirrored copy is not good for. . .

- Up-to-date reporting
- Testing while providing continuous protection
- Fast online backups
- Preventing mirroring of physical corruptions
- Detecting and protecting against lost writes
- WAN deployment for high volume applications
- Fast role transitions
- HA enabled via built-in automatic failover
- Reducing planned downtime using rolling database upgrades
- Peace of mind from continuous knowledge of the database state at your recovery site

Data Guard 11g

Revolutionizing Data Protection and Availability



- Synchronized reporting replica
- Snapshot Standby for testing
- Fast incremental backups on standby
- Oracle validation prior to apply
- Lost-write protection
- High WAN throughput
- Fast failover and switchover
- Enhanced automatic failover
- Transient Logical Standby
- Intelligent, Oracle-aware data protection and availability

Data Guard has evolved to be an integral part of IT operations



Data Guard 11g Enhancements

Improved Data Protection

- Faster redo transport
- Advanced Compression
 - Redo compression for gaps
- Lost-write protection

Higher Availability

- Faster Redo Apply & SQL Apply
- Faster failover & switchover
- Enhanced Fast-Start Failover
- Transient Logical Standby
- New Grid Control HA Console

More Manageability

- SQL Apply – More Automation
- Better RMAN Integration
- Better Security
- Mixed Windows/Linux
- Enhanced Data Guard Broker

Increased ROI

- Snapshot Standby
- Active Data Guard
 - Real-time Query
 - Fast Incremental backup



Redo Transport Enhancements

Improved Data Protection

- New streaming protocol
 - Maximum Performance – ASYNC & ARCH transport
 - Eliminates internal network acks during redo transport
 - You get it by default, nothing to do.
- Result:
 - More efficient network utilization
 - Eliminates impact of network latency on throughput
 - Enhance RPO by getting more data to the standby site – less frequent buffering of workload peaks at primary location
 - Faster gap resolution



Network Compression for GAPS

Improved Data Protection

- Data Guard automatically compresses data transmitted to resolve gaps
- Largest benefit in bandwidth constrained environments
 - Reduce transmission time 15-35%, Bandwidth consumption by 35%
 - Faster gap resolution = better data protection
- Requires Oracle Database 11g Advanced Compression
- Enabled with the 'COMPRESSION' attribute

```
log_archive_dest='service=dbname ASYNC  
COMPRESSION=ENABLE...'
```

- Or Edit the Broker property 'RedoCompression'

```
edit database <dbname> set property  
RedoCompression=Enable;
```



Lost Write Detection

Improved Data Protection

- Faulty storage hardware / firmware may lead to lost writes leading to data corruptions
 - Occurs when an I/O subsystem acknowledges the completion of the block write, but the write did not occur in the persistent storage
 - On a subsequent block read, the I/O subsystem returns the stale version of the data block, which might be used to update other blocks of the database
 - Very hard to diagnose such data corruptions when they occur



How to Detect Lost Writes

Improved Data Protection

- Use your Data Guard physical standby!
- Compares versions of blocks
 - Between standby blocks and incoming redo stream
 - Version discrepancy implies lost write on either primary or standby database
- If Primary database corruption is detected, resolve by using the standby to failover and restore data consistency
- Largest increase in protection – lowest (<5%) impact
- Set new Parameter on Primary and Standby to enable

```
alter system set db_lost_write_protect=typical;
```



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Faster Role Transitions

High Availability

- Faster Failover
 - Failover in seconds with Fast-Start Failover
- Faster Redo Apply for physical standby
 - Optimization to enhance parallelism in media recovery
 - OLTP Workload - 95% Improvement (24MB/sec vs 54MB/sec)
 - Batch Workload – 130% Improvement (48MB/sec vs 112MB/sec)
- Faster SQL Apply for logical standby
 - LOB Inserts – 50% improvement
 - OLTP non-partitioned tables – 22% improvement
 - OLTP with partitioned tables – 19% improvement
 - Support for executing DDL in parallel on standby database



Enhanced Fast-Start Failover

High Availability

- Automatic failover for Maximum Performance Mode
 - Data Guard configurations using ASYNC redo transport
 - Maximum allowable data loss is user configurable via Data Guard Broker property:

`FastStartFailoverLagLimit`

- Default setting = 30 seconds, minimum threshold = 10 seconds)
- High Availability for Fast-Start Failover Observer
 - Grid Control will automatically restart the Data Guard Observer on a second host if the primary Observer host fails



Configurable Fast-Start Failover

High Availability

- Immediate automatic failover for user-configurable health conditions

```
ENABLE FAST_START FAILOVER [CONDITION <value>];
```

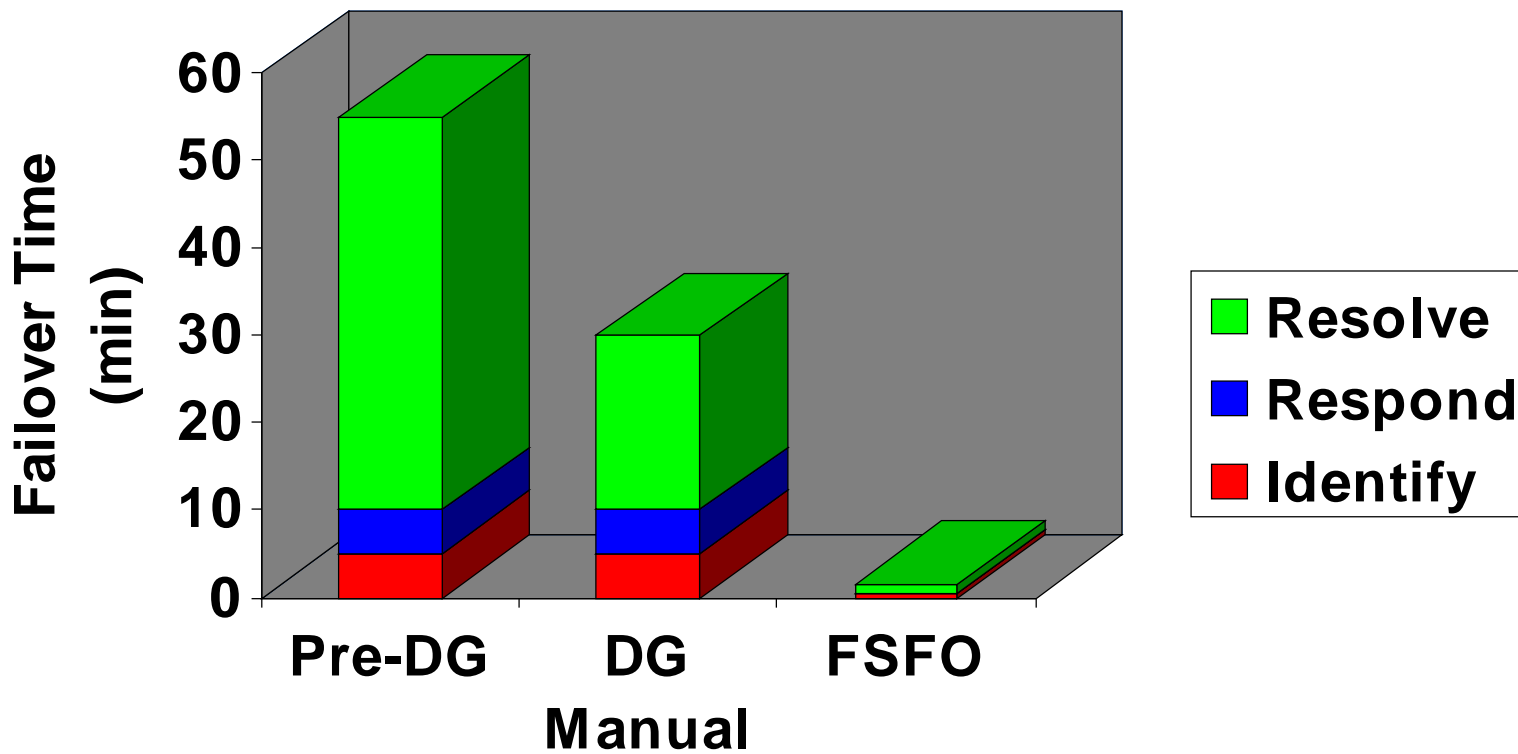
- Condition examples:
 - Datafile Offline
 - Corrupted Controlfile
 - Corrupted Dictionary
 - Inaccessible Logfile
 - Stuck Archiver
 - Any explicit ORA-xyz error
- Apps can request fast-start failover using API

```
DBMS_DG.INITIATE_FS_FAILOVER
```



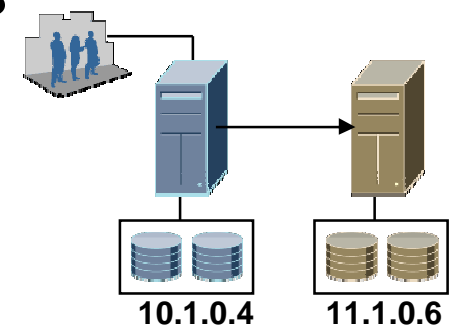
Customer Results

Failover Time

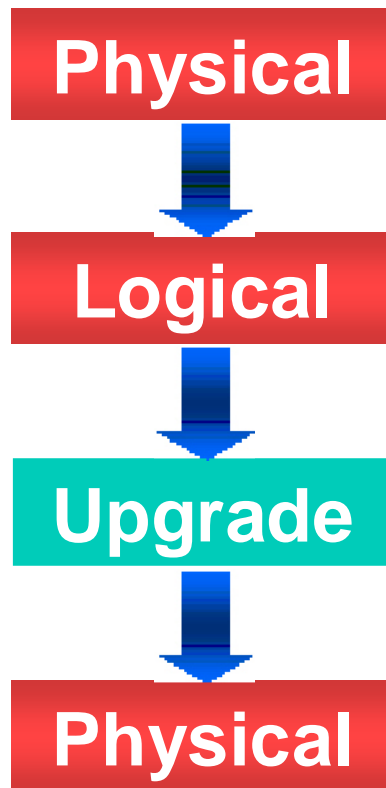


Oracle Rolling Upgrades for Physical People

- Advantages of using SQL Apply rolling upgrade
 - Production database will incur very little downtime.
 - The overall downtime can be as little as the time it takes to perform a switchover.
 - Eliminate application downtime due to PL/SQL recompilation.
 - Validate the upgraded database release without affecting the production database.
- Now, not just for Logical Standby customers



Rolling Upgrades and Physical Standby



- Transient Logical Standby
 - Execute rolling database upgrades using a physical standby database
 - Temporarily convert physical standby to logical to perform the upgrade
 - Potential impact of SQL Apply data type restrictions limited to shorter upgrade window
 - When upgrade is complete – revert to physical standby
- No need for separate logical standby



On Original Primary

- Enable Flashback Database.
 - If not already enabled.
- Create a guaranteed restore point

```
create restore point pre_upgrade guarantee  
flashback database;
```

- Create a physical standby control file:

```
alter database create physical standby  
controlfile as '/tmp/control.phys' reuse;
```

Convert the Original Physical standby database

- Convert it into a logical standby database

```
alter database recover managed standby database cancel;  
alter database recover to logical standby keep identity;  
alter database open;  
execute dbms_logstdby.apply_set('LOG_AUTO_DELETE', 'false');  
alter database start logical standby apply immediate;
```

Upgrade this new logical standby database.

- Catch up with the primary database
- Perform the switchover
 - Move Production to the newly upgraded database.



On the Original Primary

- Flashback to the guaranteed restore point

```
shutdown immediate;
```

```
startup mount
```

```
flashback database to restore point pre_upgrade;
```

- Restore the standby control file from first step

```
shutdown immediate;
```

```
RMAN> startup nomount
```

```
RMAN> restore controlfile from '/tmp/control.phys';
```

```
RMAN> shutdown
```



On the Original Primary Continued

- Upgrade Oracle software
- Switch to upgraded home
- Bring up physical standby

```
startup mount;
```

```
alter database recover managed standby database  
using current logfile disconnect;
```

- Allow new Physical standby database to catch up with new Primary
- If desired, perform a switchover and move Production back to original site.

Grid Control High Availability Console

High Availability - Mozilla Firefox

ORACLE Enterprise Manager 11g Grid Control

Setup Help Log Out

Grid Target Performance **High Availability** Server Schema Data Movement Software and Support

Search All

dglnx2.us.oracle.com (Host)

Page Refreshed Nov 7, 2007 6:51:47 AM GMT-08:00

Availability Summary

Available Since **Nov 6, 2007 4:02:36 PM GMT-08:00**

Overall Availability **99.25%**

Primary Database **london.us.oracle.com**

Day	Start	End	Availability
Nov 6, 2007	9:51:47 AM	Nov 7, 2007 9:51:47 AM	99.20%
Week	Oct 31, 2007 9:51:47 AM	Nov 7, 2007 9:51:47 AM	99.25%
Month	Oct 8, 2007 9:51:47 AM	Nov 7, 2007 9:51:47 AM	99.25%

Availability Events

Show: All Open Events

Severity	Message	Target	Time
Info	Switchover to london.us.oracle.com completed	london.us.ora	2007-11-06 21:07:2
Info	Switchover to london.us.oracle.com started	london.us.ora	2007-11-06 21:05:0
Info	Startup completed	london.us.ora	2007-11-06 13:14:2
Info	Shutdown completed	london.us.ora	2007-11-06 13:14:1

Backup/Recovery

Show: london.us.oracle.com - Primary

Last Backup: N/A

Next Scheduled Backup: N/A

Instance Recovery Time: 13 sec

Oldest Flashback Database Time: N/A

Flash Recovery Area /private2/oracle/flash_recovery_area (80.0 GB)

Usable Flash Recovery Area **99.76%**

Data Guard

Data Guard Status: **Normal**

Protection Mode: **Maximum Performance**

Fast-Start Failover: **Disabled**

Database	Host	Role	Data Guard Status	Transport Lag	Apply Lag
london.us.o	dglnx2.us.o	Primary	Normal	N/A	N/A
newyork.us	dglnx3.us.o	Logical Standby	Normal	3.0 sec	0.0 sec
zurich.us.or	dglnx1.us.o	Physical Standby	Normal	3.0 sec	0.0 sec

Primary Redo Generation Rate

Current Redo Generation Rate **0.21 KB/sec**



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- Transient Logical Standby
- New Grid Control HA Console

More Manageability

- SQL Apply – More Automation
- Better RMAN Integration
- Better Security
- Mixed Windows/Linux
- Enhanced Data Guard Broker

Increased ROI

- Snapshot Standby
- Active Data Guard
 - Real-time Query
 - Fast Incremental backup



SQL Apply – Logical Standby

Manageability

- Data Type
 - XMLType data type (CLOB)
- Support for Cross-Functional Oracle features
 - Flash Recovery Area for all archive logs
 - Transparent Data Encryption (TDE)
 - Encrypted Tablespaces
 - DBMS_FGA (Fine Grained Auditing)
 - DBMS_RLS (Virtual Private Database)
- Role-specific DBMS_SCHEDULER jobs
 - (PRIMARY, LOGICAL STANDBY, BOTH)
- SQL Apply engine
 - Dynamic SQL Apply parameter changes
 - No shutdown of RAC instances at switchover or failover



Enhanced RMAN Integration

Manageability

- Direct remote instantiation of remote standby database
 - RMAN duplicate for standby - no intermediate storage
- Block-change tracking on physical standby databases
 - Enables fast incremental backup on standby
 - Part of the Active Data Guard option



Standby Creation 11g

- New “FROM ACTIVE DATABASE” clause
 - Performs the backup, transport to the standby site and restore over the network using parallel channels.
 - No interim storage needed for a copy of the backup file.
- Simple steps performed on the Standby server
 1. Do a software-only install on the standby database system.
 2. Setup OracleNet.
 - Create a static listener entry for the standby, start the listener.
 - Create Oracle Net connect descriptors for the Standby at the Primary site and for the Primary at the Standby site.
 3. Create an init.ora file with only the DBNAME in it.
 4. Create a password file with the same SYS password.
 5. Create any necessary directories.
 6. Startup nomount the standby instance.
 7. Execute the command on the next slide.



Standby Creation 11g

Across the network!

```
rman
connect target sys/oracle@chicago;
connect auxiliary sys/oracle;

run {
  allocate channel prmy1 type disk;
  allocate channel prmy2 type disk;
  allocate channel prmy3 type disk;
  allocate channel prmy4 type disk;
  allocate auxiliary channel stby type disk;
  duplicate target database for standby from active database
  spfile
    parameter_value_convert 'Chicago','Boston'
    set db_unique_name='Boston'
    set db_file_name_convert='/Chicago/', '/Boston/'
    set log_file_name_convert='/Chicago/', '/Boston/'
    set control_files='/Oracle/oradata/Boston/control.ctl'
}
```



Enhanced RMAN Integration Manageability

- More RMAN Integration with Data Guard
 - One RMAN session connected to the catalog can manage the RMAN configuration of multiple Data Guard configurations
 - Archived logs deletion policies enhanced
 - Delete logs when shipped only or shipped & applied
 - Definable for Mandatory or Optional standby databases
 - Backups taken on any combination of primary or physical standbys
 - Backup control file can be restored directly for any primary or standby database
 - No need to take separate controlfile backups on each database anymore, just on one database.
 - Primary or Standby



Enhanced Data Guard Security

Manageability

- SYS user and password files no longer required for redo transmission authentication
 - Authentication possible using SSL - requires ASO, OID
 - Uses PKI Certificates
 - Requires all Data Guard databases to be in the same enterprise domain
- Authentication still possible using a password file (default)
 - Can also specify a user other than SYS for redo transport authentication

`redo_transport_user`

- This user must have the SYSOPER privileges
- Requires password for this user to be the same at primary and all standbys



More Flexible Configurations

Manageability

- Increased flexibility in Data Guard configurations
 - Data Guard 10g supports mixed word-sizes (32-bit and 64-bit) in the same configuration
- Data Guard 11g supports mixed Windows/Linux in the same Data Guard configuration
 - Physical standby only
 - Same endianness required on all platforms
- See [MetaLink Note 413484.1 Data Guard Support for Heterogeneous Primary and Standby Systems](#)



Data Guard Broker

Manageability

- All the Fast-Start Failover enhancements
- No bounce required to change protection modes from Maximum Performance to Maximum Availability
 - Also available in 10.2.0.3
- Support for single instance databases configured for HA using Oracle Clusterware (cold failover cluster)
 - Also available in 10.2.0.4
- New Property `DGConnectIdentifier` simplifies database connection definitions
 - Previously known as the `InitialConnectIdentifier` property.
 - Was only used for initial configuration creation
 - Now is retained as the connection string
 - Relates to the 'SERVICE' attribute of `log_archive_dest_n`
 - Enables use of all OracleNet capabilities



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- Faster failover & switchover
- Enhanced Fast-Start Failover
- Transient Logical Standby
- New Grid Control HA Console

More Manageability

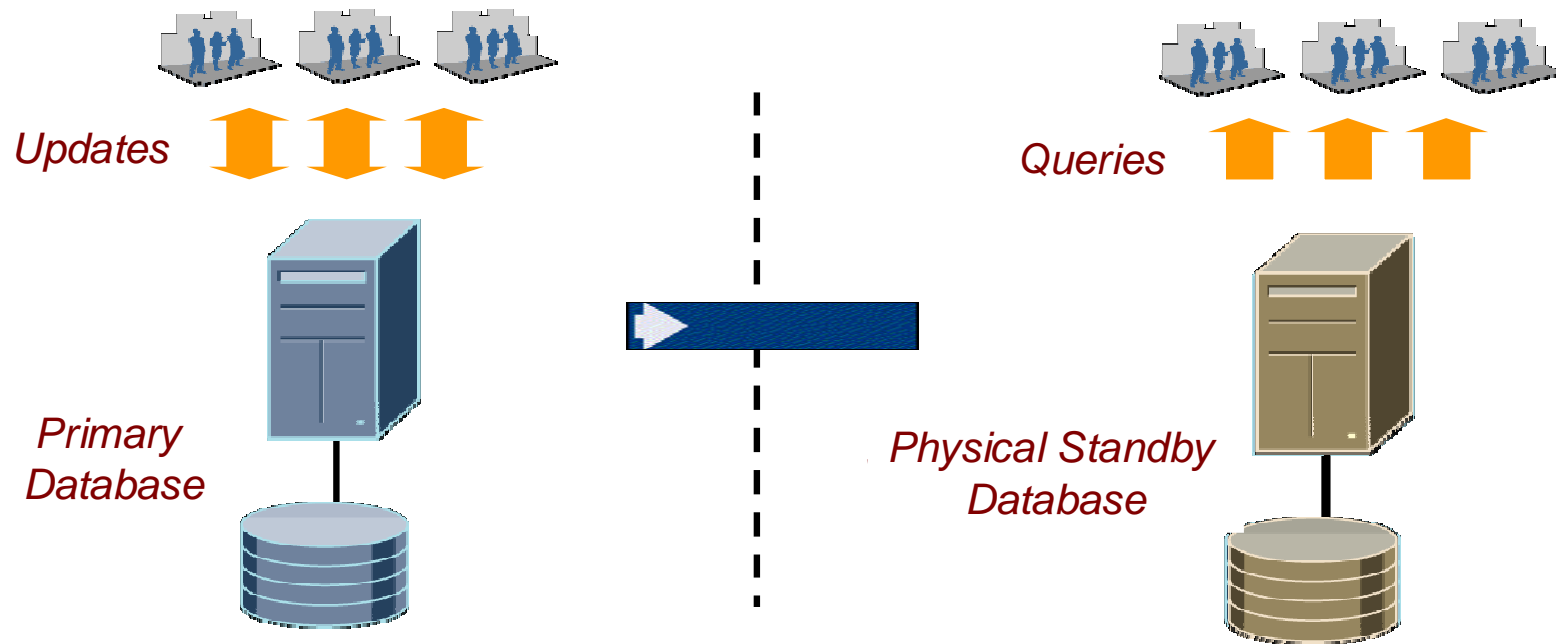
- SQL Apply – More Automation
- Better RMAN Integration
- Better Security
- Mixed Windows/Linux
- Enhanced Data Guard Broker

Increased ROI

- Snapshot Standby
- Active Data Guard
 - Real-time Query
 - Fast Incremental backup

Snapshot Standby

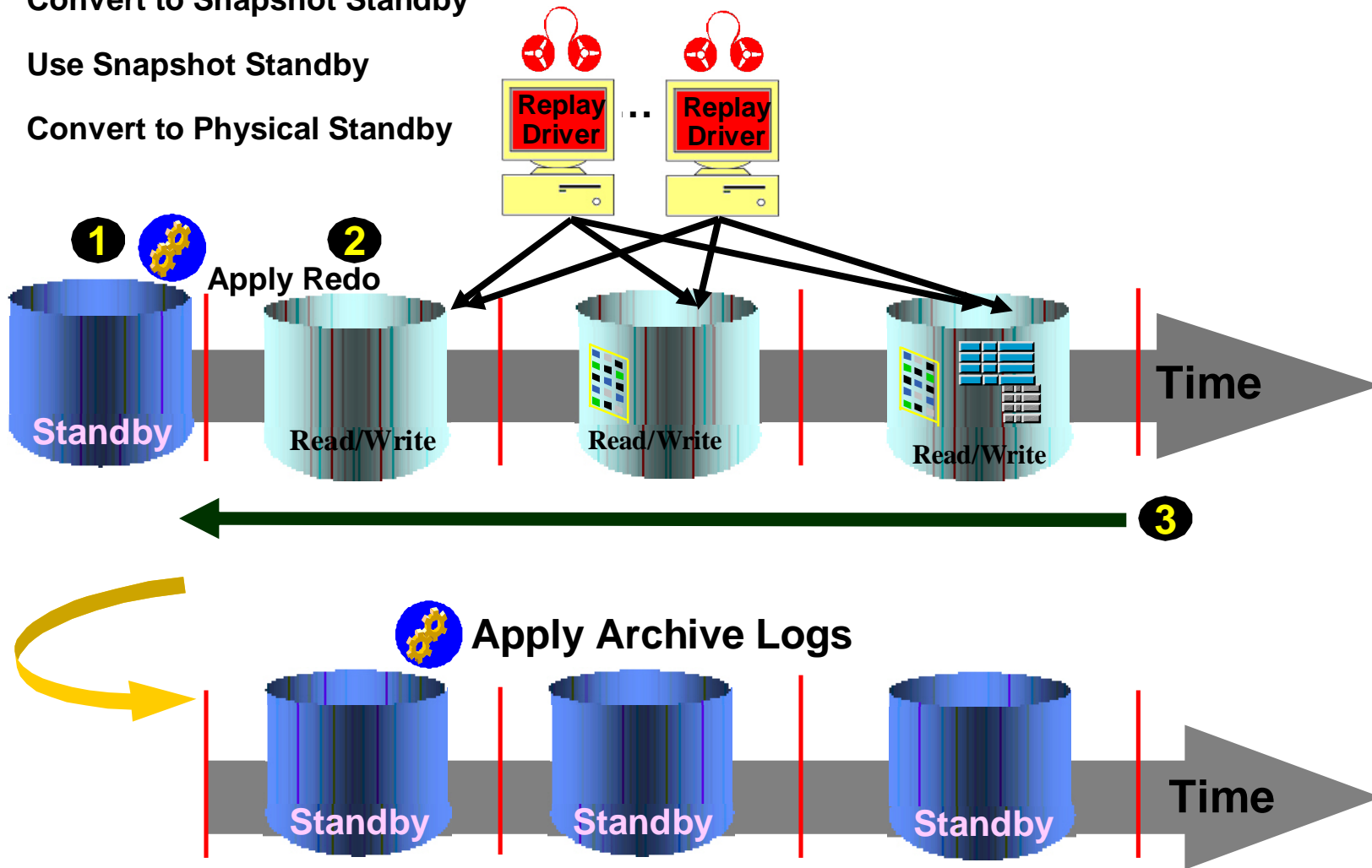
Increase ROI



- Preserves zero data loss – continuous redo transport while open read-write
- Truly leverages standby database and DR hardware for multiple purposes
- Similar to storage snapshots, but provides DR at the same time and uses single copy of storage

Use With Real Application Testing

1. Convert to Snapshot Standby
2. Use Snapshot Standby
3. Convert to Physical Standby



Using 11g Grid Control

The screenshot displays the Oracle Enterprise Manager 11g Grid Control interface. The top navigation bar includes menus for File, Edit, View, History, Bookmarks, Tools, and Help. The main content area is titled "Data Guard" and shows the page was refreshed on November 7, 2007, at 6:49:35 AM GMT-08:00. The interface is logged in as SYS.

Data Guard Overview:

- Data Guard Status: ✓ Normal
- Protection Mode: Maximum Performance
- Fast-Start Failover: Disabled

Primary Database:

- Name: london.us.oracle.com
- Host: dglxn2
- Data Guard Status: ✓ Normal
- Current Log: 119
- Properties: Edit

Standby Progress Summary:

The transport lag is the time difference between the primary last update and the standby last received redo. The apply lag is the time difference between the primary last update and the standby last applied redo.

Database	Transport Lag (seconds)	Apply Lag (seconds)
newyork.us.oracle.com	0	3

Standby Databases:

Buttons: Edit, Remove, Switchover, Failover, **Convert**, Add Standby Database

Select	Name	Host	Data Guard Status	Role	Last Received Log	Last Applied Log	Estimated Failover Time
<input checked="" type="radio"/>	zurich.us.oracle.com	dglxn1	✓ Normal	Snapshot Standby	118	117	Not available
<input type="radio"/>	newyork.us.oracle.com	dglxn3	✓ Normal	Logical Standby	118	118	0 seconds

Performance:

- Data Guard Performance
- Log File Details

Additional Administration:

- Verify Configuration
- Remove Data Guard Configuration

Oracle Database 10g vs 11g

10.2 – Steps Required

Standby

```
> alter database recover managed standby database
cancel;
> create restore point before_lt guarantee flashback
database;
```

Primary

```
> alter system archive log current;
> alter system set log_archive_dest_state_2=defer;
```

Standby

```
> alter database activate standby database;
> startup mount force;
> alter database set standby database to maximize
performance;
> alter system set log_archive_dest_state_2=defer;
> alter database open;
```

PERFORM TESTING, ARCHIVE LOGS NOT SHIPPED

```
> startup mount force;
> flashback database to restore point before_lt;
> alter database convert to physical standby;
> startup mount force;
> alter database recover managed standby database
disconnect from session;
```

Primary

```
> Alter system set log_archive_dest_state_2=enable
```

11.1 – Steps Required

Standby

```
> alter database convert to snapshot standby;
PERFORM TESTING, ARCHIVE LOGS CONTINUE TO BE
SHIPPED
> alter database convert to physical standby;
```

Can you work around this?



Maintaining Protection (RPO) in 10.2 while in Snapshot mode

- Create an Archive Log Repository (ALR)
 - Note [434164.1](#) Data Guard Redo Log Repository Example
- This will ensure that the redo is being shipped and stored at the standby site while the standby is open read write and not able to receive the redo.
- Put the Archive Log Repository in place before you begin the Snapshot process.
- When the Physical standby has been returned
 - Use these logs to catch it up with the Primary
 - Or use an incremental backup of the Primary
- **This is not required in Oracle Database 11g**



Basic Steps for an ALR

1. Create a standby controlfile
2. Create a pfile from the primary
3. Copy the standby controlfile and pfile to the ALR site
4. Make any changes to the ALR pfile
5. Create the Flash Recovery Area and Dump directories
6. Copy the password file from the Primary database to the ALR
7. Setup the Oracle Network connection descriptors
8. Restore the standby controlfile to the ALR
9. Add standby redo logs to the ALR
10. Setup Primary to Transmit to the ALR
11. Verify the ALR is receiving logs



Snapshot Standby

Increase ROI

- In Summary
 - Simpler to implement
 - Much better RTO/RPO
 - Oracle Database 11g – only 2 Steps Required
 - On the Physical Standby Database
 - alter database convert to snapshot standby;
 - PERFORM TESTING
 - ARCHIVE LOGS CONTINUE TO BE SHIPPED
 - alter database convert to physical standby;

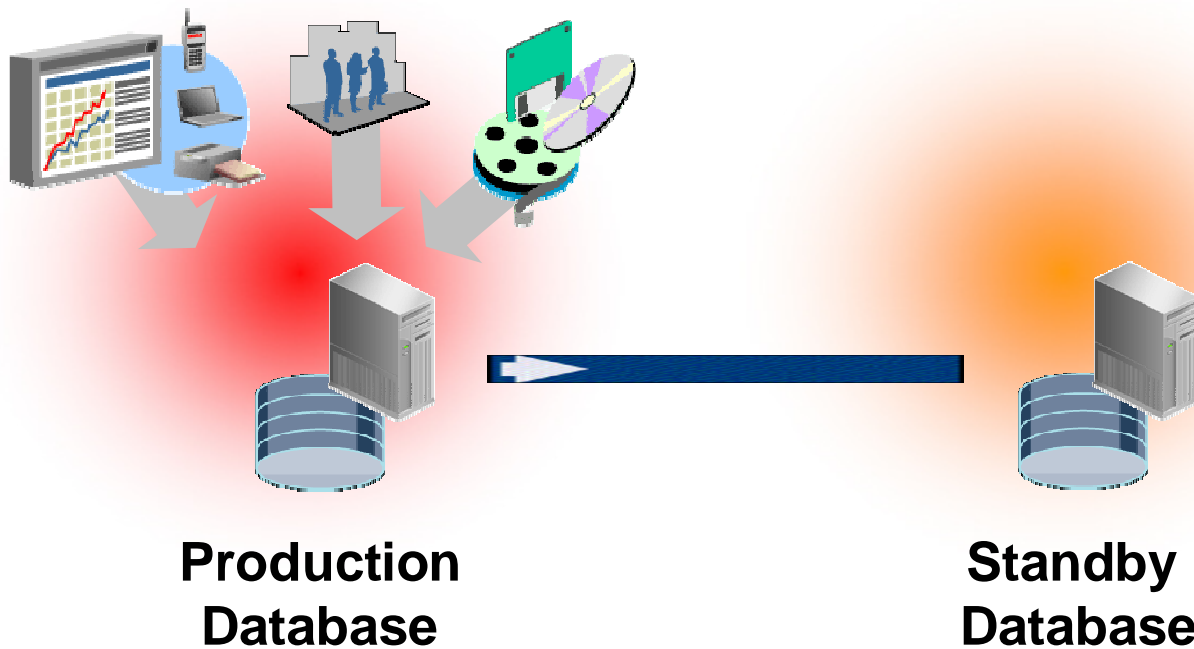


Get the most boost from your Standby

- A final look at
 - ‘Investing in Traditional Disaster Recovery’
- And a look forward to
 - ‘Investing in Improved Quality of Service’
- Data Guard has always provided a certain level of service from the standby databases.
- With Oracle Database 11g we’ve blown the lid off of that one!

Traditional Physical Standby Databases

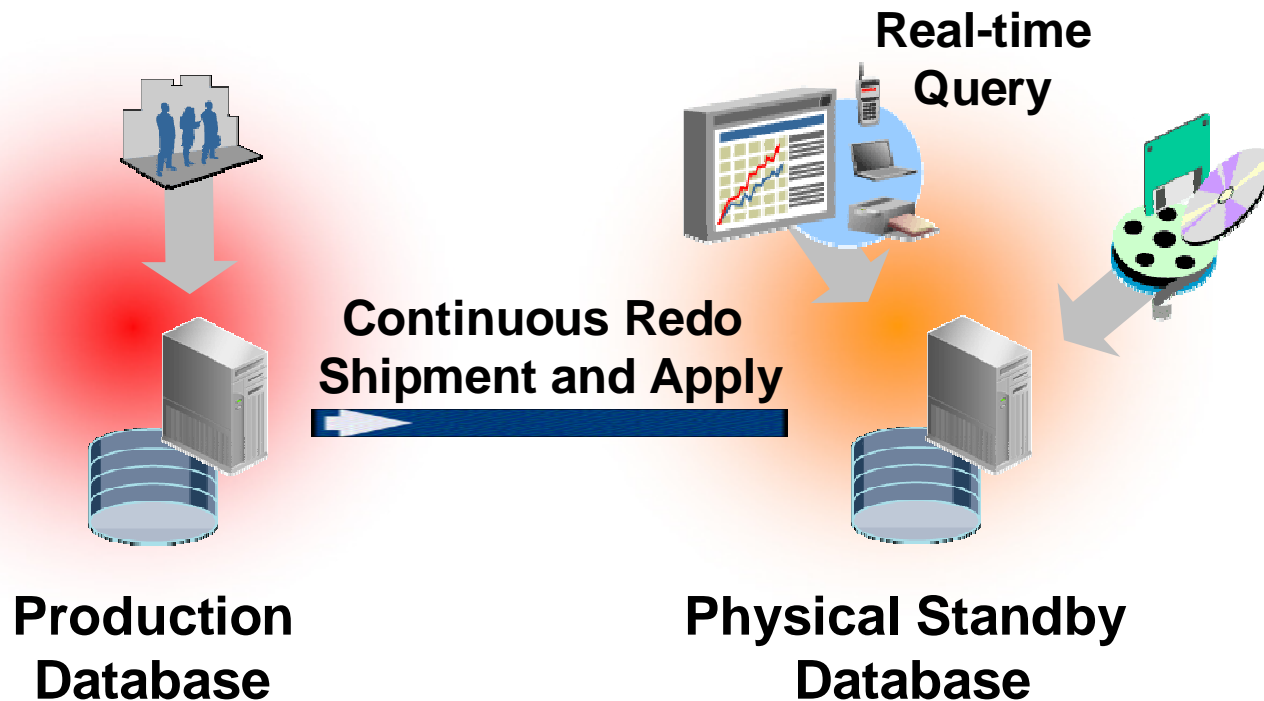
Investment in Disaster Recovery only



- Applications, backups, reports run on production only

Active Data Guard 11g

Increase ROI - Real-time Query



- Offload read-only queries to physical standby
- Offload fast incremental backups to physical standby



What's New

Data Guard 11g

- Recovery (redo apply) must be stopped to open a standby read-only
 - Same functionality as previous Data Guard releases
- Redo Apply has exclusive access to data files – reads not allowed
- Not possible to guarantee read consistency while redo apply is active

Data Guard 11g with the Active Data Guard Option

- Physical Standby is open read-only while redo apply is active
- Read consistency is guaranteed
- Redo apply is not adversely affected by read-only workload



Active Data Guard Benefits

Increase ROI - Invest in Improving Quality of Service

Physical standby in recovery  Simultaneous read & recovery

All read activity on production  Shift read-only workload to standby

Disaster protection only  Performance protection

Standby systems rarely used  Regularly used for production

Complex replication used to create reporting replica  Simple replication with very high performance and no restrictions



Conclusion

Data Guard 11g Delivers

- *Maximum return on investment* - All standby databases can be utilized for productive purposes while in standby role. Idle resources are eliminated WITHOUT increasing complexity
- *Optimum data protection and availability* - You always know the state of your standby database and it can very quickly (in seconds), assume the primary role
- *Lower cost and complexity* - rich management interface, mature capabilities, integrated with the Oracle Database



Resources

- **This presentation was originally given at UKOUG “What’s New With Oracle Data Guard? Revolutionizing Data Protection and Availability” by Larry Carpenter & Tim Chien**
- **Oracle Data Guard 11g - technical white paper**
http://www.oracle.com/technology/deploy/availability/pdf/twp_dataguard_11gr1.pdf
- **Oracle Active Data Guard 11g - data sheet**
<http://www.oracle.com/technology/products/database/oracle11g/pdf/active-data-guard-11g-datasheet.pdf>
- **Oracle HA Portal on OTN:**
<http://www.oracle.com/technology/deploy/availability/>
- **Maximum Availability Architecture white papers:**
<http://www.oracle.com/technology/deploy/availability/htdocs/maa.htm>
- **Oracle HA Customer Success Stories on OTN:**
http://www.oracle.com/technology/deploy/availability/htdocs/HA_CaseStudies.html
 - **How Dell I.T. Implements Snapshot Standby Functionality Using Oracle Data Guard 10g Release 2**
http://www.oracle.com/technology/deploy/availability/htdocs/Dell_CaseStudy.html
- **Taneja Group - New Approaches to Data Protection and DR**
<http://www.oracle.com/technology/deploy/availability/htdocs/analysts/tanejagroupdatabasestorage.pdf>
- **Enterprise Strategy Group – Data Protection and Disaster Recovery**
<http://www.oracle.com/technology/deploy/availability/htdocs/analysts/enterprisestrategygroupdataguard.pdf>



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