Oracle Active Data Guard Best Practices
Standby For More Than Disaster Recovery

Larry M. Carpenter
Distinguished Product Manager, Oracle USA

Vinay Srihari
Senior Manager, Oracle USA
Active Data Guard Development

Nagesh Konduru
Senior DBA Manager Internet Services, Apple
Agenda

- What is Active Data Guard?
- How do applications use it?
- A Real Life Experience.
- What’s New in 11.2?
What is Data Guard?

- Data availability and data protection for the Oracle Database
- Up to \textit{thirty} standby databases in a single configuration
- Physical standby used for queries, reports, test, or backups
Active Data Guard 11g Release 1
Get more bang for your Buck (or Euro or whatever)!

- Offload read-only queries to an up-to-date physical standby
- Perform fast incremental backups on a physical standby
Active Data Guard 11g Release 2
Get more transparency in your applications!

- Control Application access to up to date information
- Corruptions get automatically repaired!
How much work are we talking here?

- If your application has a read only part
  - No Brainer – Just point it at your Active Data Guard standby!
- If your application has a read only part that may write
  - A little bit more setup but still doable.
- If your application only has one way to connect
  - Then you are going to have to do some work.
- In any event, you need to use services to connect to your databases.
  - It is the best practice anyway.
- And if possible, use session pools
How do applications use Active Data Guard?

- Some Examples
  - Using a Reader Farm for Read Only applications.
    - Really ramping up.
  - Using OBIEE with Active Data Guard
    - Some Configuration required
  - Developing for Active Data Guard with TopLink
    - Getting a handle on your application
  - Using Siebel with Active Data Guard
    - A work in progress!
- So many applications so little time!
Reader farms with Active Data Guard

Scale-out Query Performance to Web-Scale*

Active Data Guard Reader Farm

DR included *
Using OBIEE and Active Data Guard

- Oracle BI EE Server must be configured to route all database modifications to the primary database.
- Configure Oracle BI EE to:
  - Disable Oracle BI EE from creating temporary tables in the database. This prevents Oracle BI EE from issuing DML statements while connecting to the standby database.
  - All scripts that modify database content must specify a primary database connection pool explicitly.
- Running Oracle BI EE with Active Data Guard provides a highly scalable solution for off loading query work from the Production database.
- See “Key Best Practices” at end for link to paper.
TopLink Application Development and Active Data Guard

• New or existing applications built using Oracle TopLink can be configured to use Active Data Guard
  – Increase database capacity and reduce the load on the primary database server
  – Improve performance for all transactions, both read/write and read-only workloads
  – Increase the utilization of existing standby databases

• Uses Read Only Service
• Requires an Additional Connection Pool
• See “Key Best Practices” at end for link to paper
Currently working on making Siebel CRM work transparently with Active Data Guard

Like TopLink applications, the solution uses Services and Connection Pools for Read-Only and Read-Write.

 Writes are always directed to the Primary database.

 Reads are directed to the Active Data Guard standby.

 Uses the new Service Level Agreement for Query Lag to route reads back to the Primary if the standby falls too far behind the Primary.
  
  More on that capability later in the talk.
Siebel CRM sends online queries to ADG standby
Most read-only traffic goes to ADG standby

- Sessions usage statistics are collected in Siebel log
  - Number of Select processed
    - By Read-Only (RO)
    - By Read-Write (RW) sessions
  - Number of Insert/Update/Delete processed by RW session
- Siebel Log file (Object Manager trace) snapshot:

```
DBC_CONN_POOL: ******* Session Usage Summary ******
Number of SELECT statements processed by RO session= 685
Number of SELECT statements processed by RW session= 126
Number of DML statements processed by RW session= 449
```
Introducing Nagesh Konduru
A Real Life Experience!
Oracle 11g
Active Data Guard

High Scalability
High Availability

Real-Time Data Changes
Reader Farm

Apple
Nagesh Konduru
Senior DBA Manager
Internet Services
Our Requirements

- Migrate from Data Guard Logical Standby to Active Data Guard (ADG) Reader Farm
- Easily scale out Reader Farm to handle peak load
- High Availability (zero outage)
- Real-time data changes to Reader Farm
- Offload reporting from online database
- Support all index and data types
- Ease of maintenance
Reader Farm Architecture

Primary DB

Active Data Guard
Oracle 11g R1

Standby DB
(Max Availability Mode)

App 1

App 2

App 3

App n

ADG 1

ADG 2

ADG 3

ADG 8

ADG 9

Load Balancer

SYNC

ASYNC
Experience to share

- No impact on Read-only queries on ADGs with simultaneous redo apply, and vice versa

- Real-time Apply now keeps pace with our load

- Guarantee of data consistency between Primary and ADG Standbys

- Large dataset changes on Primary doesn’t impact Real-time data changes to Reader farm

- No restrictions on the types of indexes we can use
Best Practices

- Use Load Balancer between App Layer and Reader Farm
  - Balance out App Connections across multiple ADG Standbys
  - Easy to add / remove Standbys from Load Balancer

- Rigorously test Query performance on ADG reader farm in parallel with massive data changes on Primary Database

- Consistent execution plan of SQLs on Standbys by generating object statistics on Primary Database

- Specify NET_TIMEOUT attribute in LGWR SYNC Redo Transport Mode
Key Learning

- Additional indexes can’t be created on the ADG Standby exclusively for reader farm queries
  - Use Primary Database for all indexes
  - Ensure no negative impact of these indexes to SQLs running on Primary Database

- Apply data guard bundle patch (# 7676737) on 11g R1

- AWR tool is not supported on ADG Standbys
  - Refer to Note 454848.1 for installing and using standby statspack
  - Use statspack report (required patch #8801078)

- For greater than 9 Standby Databases (limit of 10 archive log destinations)
  - Cascading from other Standbys, OR
  - Go for Oracle 11g R2
Thank you Nagesh!

• So, what’s new in 11.2?
  – The 3 R’s – Reading, wRiting and Really having Fun!
    • Ok, the 3rd ‘R’ is really Return On Investment.
  – Reading
    • Enabling Active Data Guard
    • Setting a Service Level Agreement (SLA) for your queries
    • Synchronizing with the Primary database
  – Writing
    • Making DML redirection transparent
  – ROI – or Really having fun!
    • Avoiding media corruption – automatically!
Enabling Active Data Guard Oracle11g Release 1

- SQL*Plus.

```sql
SQL> alter database recover managed standby database cancel;
SQL> alter database open read only;
SQL> alter database recover managed standby database using current logfile disconnect;
```

- And with the Broker

```sql
DGMGRL> edit database ADG set state='apply-off';
SQL> alter database open read only;
DGMGRL> edit database ADG set state='apply-on';
```
So, what’s “New” about that?

• In Oracle Database 11g Release 2
  – If you use the Broker
    
    SQL> alter database open read only;

• That’s it!
  – The Broker will jump in and automatically stop Redo Apply and the restart it after the open has completed.

• And at switchover
  – If Active Data Guard in use at the target standby
    • The original primary will be opened when it becomes a standby after the switchover!

• All the more reason to use the Broker!
Checking the Query Lag

• First release of Active Data Guard
  - QUERY_SCN or V$DATAGUARD_STATS to calculate lag
    
    ```sql
    SQL> SELECT name, value, datum_time, time_computed
           2 FROM V$DATAGUARD_STATS WHERE name like 'apply lag';
    NAME      VALUE        DATUM_TIME           TIME_COMPUTED
    --------- ------------ -------------------- -------------------
    apply lag +00 00:00:00  09/25/2009 13:14:11 09/25/2009 13:14:11
    ```

• New 11.2 V$STANDBY_EVENT_HISTOGRAM view.

    ```sql
    SQL> SELECT * FROM V$STANDBY_EVENT_HISTOGRAM
           WHERE NAME = 'apply lag' AND COUNT > 0;
    NAME         TIME UNIT  COUNT  LAST_TIME_UPDATED
    ------------ ---------- ------ -------------------
    apply lag    0 seconds  48612  09/25/2009 13:20:02
    apply lag    1 seconds    102  09/25/2009 13:15:09
    apply lag    2 seconds     16  09/25/2009 12:20:58
    apply lag    3 seconds     4  09/25/2009 11:15:56
    ```
Defining an SLA for your queries

- Now you can let Active Data Guard check for you!
  - New session setting called STANDBY_MAX_DATA_DELAY
    - **NONE** = queries will be executed regardless of the apply lag on that database. (Default)
    - **Non-zero** = queries will be executed only if the apply lag is less than or equal to STANDBY_MAX_DATA_DELAY.
    - If delay setting exceeded an error is returned
      - ORA-03172: STANDBY_MAX_DATA_DELAY of 2 seconds exceeded
      - Application then decides what to do.
    - **Zero** = queries guaranteed to return the exact same result as if the query were issued on the primary database otherwise the ORA-03172 is returned
      - Requires Maximum Availability and Real-Time Apply
How do you set the SLA?

- Use a logon trigger to set the maximum delay whenever a user logs into the standby

```sql
SQL> connect sys/oracle@prod as sysdba
Connected.

SQL> CREATE OR REPLACE TRIGGER hr_logon_set_SLA_trigger
2  AFTER LOGON ON hr.schema
3  BEGIN
4    IF (SYS_CONTEXT('USERENV','DATABASE_ROLE')
5      IN ('PHYSICAL STANDBY'))
6    THEN
7      execute immediate 'ALTER SESSION SET STANDBY_MAX_DATA_DELAY=2;'
8    END IF;
9  END;
10 /

Trigger created.
```
To Sync or Not to Sync
That is the question!

• What if you do not want to allow queries to occur until the standby is in sync with the Primary?
  – Another logon trigger with a new command

```sql
SQL> connect sys/oracle@prod as sysdba
Connected.
SQL> CREATE OR REPLACE TRIGGER hr_logon_sync_trigger
    2  AFTER LOGON ON hr.schema
    3  BEGIN
    4    IF (SYS_CONTEXT('USERENV','DATABASE_ROLE')
    5       IN ('PHYSICAL STANDBY'))
    6    THEN
    7        execute immediate 'ALTER SESSION SYNC WITH PRIMARY;'
    8    END IF;
    9    END;
10   /
Trigger created.
```
What does it do?

• Logging into the standby will block
  – Until all redo data has been applied.
  • Redo is that which has already been received by the standby database at the time that the command is issued
  – ORA-03173 error is returned immediately if the redo transport status at the standby database is not SYNCHRONIZED or if Redo Apply is not active.
  – Same two requirements as setting the session parameter STANDBY_MAX_DATA_DELAY to Zero otherwise the error ORA-03173 is returned.
Writing to an Active Data Guard Standby

- DML is allowed as long as it goes somewhere else
  - Over a database link that is created on the Primary
    SQL> create public database link write_ADG connect to HR
    2 identified by oracle using 'prod';
    Database link created.
  - Which arrives via Redo Apply and can be used for DML
    SQL> insert into REGIONS@write_ADG values (99, 'Active Data Guard');
    1 row created.
    SQL> commit;
    Commit complete.

- Synonyms can help but can be a performance impact if you get it wrong
Redirecting Writes Safely

• Schema Redirect is the way to go.
  – May still needs application work but is not prone to errors
  – Functions correctly no matter which database the application connects to for Reads and Writes.

• Uses a new user and synonyms and a database link

```
SQL> connect sys/oracle@prod as sysdba
Connected.
SQL> create user hr_syn identified by oracle account unlock;
User created.
SQL> grant connect, resource, create session, create synonym to hr_syn;
Grant succeeded.
SQL> create public database link hr_prod using 'prod';
Database link created.
```
Configure the ‘Real’ User

• Connect as the real user and assign the new user the required privileges and create the synonyms

  ```sql
  SQL> connect hr/oracle@prod
  Connected.
  SQL> grant all on regions to hr_syn;
  Grant succeeded.
  SQL> create synonym r_regions for hr.regions;
  Synonym created.
  SQL> create synonym w_regions for hr.regions;
  Synonym created.
  ```

• Failing to create the synonyms as the real user will cause problems later if the application connects to the ‘Primary’ database.
  - More on that in a minute
Configure the ‘New’ User

• Now you create the synonyms as the ‘new’ user.

```sql
SQL> connect hr_syn/oracle@prod
Connected.
SQL> create synonym r_regions for hr.regions;
Synonym created.
SQL> create synonym w_regions for hr.regions@hr_prod;
Synonym created.
```

• As the ‘New’ user, reading from R_REGIONS will go local but writing to W_REGIONS will go over the database link back to the Primary database.

• Yes, this is where you need to change your application to use the new synonym names.
  – I said it required some work.
But how does it work?

- Applications still log in as the ‘Real’ user no matter what database they attach to.
- Applications always use the synonym names.
- A trigger determines what ‘user’ they will be using.

```sql
SQL> CREATE OR REPLACE TRIGGER hr_logon_switch_schema_trigger
2  AFTER LOGON ON hr.schema
3  BEGIN
4  IF (SYS_CONTEXT('USERENV','DATABASE_ROLE')
5      IN ('PHYSICAL STANDBY'))
6  THEN
7     execute immediate
8     'alter session set current_schema = hr_syn';
9  END IF;
10 END;
11 /
```

Trigger created.
After that it is child’s play

```sql
SQL> select * from r_regions where region_name='OpenWorld';

REGION_ID  REGION_NAME
----------  -------------------------
    10  OpenWorld

SQL> update w_regions set region_id=88 where region_name='OpenWorld';
1 row updated.

SQL> commit;
Commit complete.

SQL> select * from r_regions where region_name='OpenWorld';

REGION_ID  REGION_NAME
----------  -------------------------
    88  OpenWorld
```
No matter where the application connects

- Application connects to the Active Data Guard Standby
  - Reads from R_REGIONS are local to the standby
  - Writes to W_REGIONS go to the primary

- Application connects to the Primary (No context switch)
  - Reads from R_REGIONS are local to the primary
  - Writes to W_REGIONS are also local to the primary

- Remember, the role of a database can change.
  - Depending on how you configure your services the ‘reader’ may not always connect to the standby so you want it to work correctly no matter where you are.
  - That is why you needed to create the synonyms for the ‘real’ user as well as for the ‘new’ user.
What about Write only tables?

• If the tables the application needs to write are ‘write-only’ like an auditing or report table.
  – You might be able to get away without any application changes to make it work.
  – Also works if there are just a ‘few’ reads

• Just need a synonym for those tables in the new user.

```
SQL> connect hr_syn/oracle@prod
Connected.
SQL> create synonym regions for hr.regions@hr_prod;
Synonym created.
```

• Now writes to REGIONS always go to the Primary.
  – Yes, REGIONS is a silly example but it was easier to type!
Avoiding Media Corruptions

• Finally! The “Really Having Fun”!
  – Ok, more ROI. Spoil Sports!
• Nothing is more annoying or frightening to DBA’s than when an application gets this error:
  – ORA-01578: ORACLE data block corrupted (file # 5, block # 140)
• Bells ring, people shout, users get upset, DBA’s take aspirin and try to fix the problem.
• No one really knows how long it will take to fix.
• Be nice if these kinds of errors fixed themselves.
• Wouldn’t it be even nicer if the error was never seen?
Life isn’t perfect
But it’s getting better!

• ‘Stuff’ happens to disks.
• If you have Active Data Guard, the app that would have gotten that error would never even see the error.
• What do you have to do to make this work?
  – Absolutely N O T H I N G ! It’s automatic.
• Consider - We’re using Active Data Guard
• We corrupted a data block (#140) in the REGIONS table in the Examples data file (#5)
  – I am not going to show you how, sorry.
• The application tries to read the REGIONS table.
• What do you think happens?
Absolutely NOTHIN G!

- No ORA-01578!

```
SQL> select * from regions;

REGION_ID  REGION_NAME
----------  -------------------------
   1    Europe
   2  Americas
   3     Asia
   4 Middle East and Africa
   88 OpenWorld
   99 Active Data Guard
```

- I told you it was automatic.
Behind the Scenes

• This is what really happened.

Sat Sep 26 12:57:03 2009
Requesting Auto BMR for (file# 5, block# 140)
Waiting Auto BMR response for (file# 5, block# 140)
Auto BMR successful

• Pretty cool huh?
• The same thing will happen if the block was corrupted on the Active Data Guard standby.
  – The corrupted block will be repaired from the Primary
• There is a limit to how many times we will do this.
  – We don’t want to mask the fact that your disks are suffering a really serious breakdown!
Active Data Guard

- High Availability
- Disaster Recovery
- Data Protection
- High Performance
- No Restrictions
- Return On Investment
- No Holds Barred!

- Thank You!
### HA Sessions, Labs, & Demos by Oracle Development

<table>
<thead>
<tr>
<th>Date</th>
<th>Location</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sunday, 11 October</strong></td>
<td>Hilton Hotel Imperial Ballroom B</td>
<td>3:45p Online Application Upgrade</td>
</tr>
<tr>
<td><strong>Monday, 12 October</strong></td>
<td>Marriott Hotel Golden Gate B1</td>
<td>11:30a Introducing Oracle GoldenGate Products</td>
</tr>
<tr>
<td><strong>Monday, 12 October</strong></td>
<td>Moscone South</td>
<td>1:00p Oracle’s HA Vision: What’s New in 11.2, Room 103</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4:00p Database 11g: Performance Innovations, Room 103</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2:30p Oracle Streams: What's New in 11.2, Room 301</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5:30p Comparing Data Protection Solutions, Room 102</td>
</tr>
<tr>
<td><strong>Tuesday, 13 October</strong></td>
<td>Moscone South</td>
<td>1:00a Oracle Streams: Replication Made Easy, Room 308</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11:30a Backup &amp; Recovery on the Database Machine, Room 307</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11:30a Next-Generation Database Grid Overview, Room 103</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1:00p Oracle Data Guard: What’s New in 11.2, Room 104</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2:30p GoldenGate and Streams - The Future, Room 270</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2:30p Backup &amp; Recovery Best Practices, Room 104</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2:30p Single-Instance RAC, Room 300</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4:00p Enterprise Manager HA Best Practices, Room 303</td>
</tr>
<tr>
<td><strong>Tuesday, 13 October</strong></td>
<td>Marriott Hotel Golden Gate B1</td>
<td>11:30a GoldenGate Zero-Downtime Application Upgrades</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1:00p GoldenGate Deep Dive: Architecture for Real-Time</td>
</tr>
<tr>
<td><strong>Wednesday, 14 October</strong></td>
<td>Moscone South</td>
<td>10:15a Announcing OSB 10.3, Room 300</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11:45a Active Data Guard, Room 103</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5:00p Exadata Storage &amp; Database Machine, Room 104</td>
</tr>
<tr>
<td><strong>Thursday, 15 October</strong></td>
<td>Moscone South</td>
<td>9:00a Empowering Availability for Apps, Room 300</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12:00p Exadata Technical Deep Dive, Room 307</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1:30p Zero-Downtime DB Maintenance, Room 103</td>
</tr>
</tbody>
</table>

### Hands-on Labs Marriott Hotel Golden Gate B2

<table>
<thead>
<tr>
<th>Date</th>
<th>Session</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Monday</strong></td>
<td>11:30a-2:00p Oracle Active Data Guard, Parts I &amp; II</td>
</tr>
<tr>
<td><strong>Thursday</strong></td>
<td>9:00a-11:30a Oracle Active Data Guard, Parts I &amp; II</td>
</tr>
</tbody>
</table>

### Demos Moscone West DEMOGrounds

**Mon & Tue 10:30a - 6:30p; Wed 9:15a - 5:15p**

- Maximum Availability Architecture (MAA), W-045
- Oracle Streams: Replication & Advanced Queuing, W-043
- Oracle Active Data Guard, W-048
- Oracle Secure Backup, W-044
- Oracle Recovery Manager & Flashback, W-046
- Oracle GoldenGate, 3709
Key Best Practices Documentation

- MAA Best Practices
  http://www.oracle.com/technology/deploy/availability/htdocs/maa.htm#Database

- Active Data Guard and Redo Apply

- Configuring Oracle TopLink Applications with Oracle Active Data Guard

- Configuring Oracle Business Intelligence Enterprise Edition Server with Oracle Active Data Guard
For More Information

search.oracle.com

Active Data Guard

or

oracle.com
The preceding is intended to outline our general product direction. It is intended for information purposes only, and may not be incorporated into any contract. It is not a commitment to deliver any material, code, or functionality, and should not be relied upon in making purchasing decisions. The development, release, and timing of any features or functionality described for Oracle’s products remains at the sole discretion of Oracle.