



> **BEST PRACTICES
FOR ORACLE HIGH AVAILABILITY
WITH DATA GUARD TECHNOLOGY**
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16. November 2014



Lufthansa Systems

IT that makes your life easier

> Agenda

▶ **ABOUT LUFTHANSA SYSTEMS**

▶ BEFORE YOUR START

▶ IMPLEMENTING PHYSICAL ORACLE DATAGUARD

▶ DATA GUARD BROKER

▶ CLIENT FAILOVER

▶ FAST-START FAILOVER CONFIGURATION(FSFO)

▶ DATA GUARD ADMINISTRATION

▶ DATA GUARD AND VIRTUALISATION



> ABOUT LUFTHANSA SYSTEMS

- ▶ Full Service Provider includes consulting, development and implementation of customized industry solutions and operation of applications in the company's own data centers
- ▶ Leading position in the global aviation industry
- ▶ Leading position in cloud computing
- ▶ About 2.800 employs
- ▶ Offices in Germany and in 16 other countries
- ▶ High-performance data center network with data centers in Kelsterbach near Frankfurt as well as in London, Dallas and Singapore
- ▶ 300 airlines and 150 customers from other Industries
- ▶ About 50 Physical Data Guard Systems



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> BEFORE YOUR START



Customer requesting and technical requirements

Recovery Point Objective (RPO)

- Is data loss acceptable if the primary site fails?
If yes, how much data loss can be tolerated?
- What is the network bandwidth and latency between primary and standby databases?
- How far is your standby database from the primary database?

Recover Time Objective (RTO)

- Preventing user errors that may occur at the primary database from reflecting to the standby database ("Delay")?
- Can Application reconnect automatically after Database Failover ?

Another use of the standby database

- Active Data Guard (up Oracle 11g and upwards)
- Snapshot Database (up Oracle 11g and upwards)
- Rolling Upgrade



> BEFORE YOUR START

Protection Mode

- **MAXIMUM PROTECTION**

More than one standby database requested

- **MAXIMUM AVAILABILITY**

Impact on primary database performance.

Up Oracle 12C Fast Sync (SYNC NOAFFIRM) is possible

- **MAXIMUM PERFORMANCE (DEFAULT)**

LGWR process does not wait for each network I/O to complete before proceeding.

Data loss can occur.



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> IMPLEMENTING PHYSICAL ORACLE DATA GUARD

1. PRIMARY DATABASE PREPARATION

(use the Oracle Standard Documentation or Doc ID 1475344.1 to set all necessary steps)

Some Parameter Setting Recommendation:

- **DB_CREATE_ONLINE_LOG_DEST_1:**
 - Create redologs/standby redologs on the separately filesystem
 - AIX: mount option cio , block size 512 bytes
 - LINUX: mount option dio, block size 1096 bytes
 - OMF Format

- **CONTROL_FILE_RECORDED_KEEP_TIME=30**

- **DISK_ASYNC_IO=TRUE (default)**
when OS can support

- **LOCAL_LISTENER**
when you use none default listener port



> IMPLEMENTING PHYSICAL ORACLE DATA GUARD

Flashback Configuration

- `DB_RECOVERY_FILE_DEST`
- `DB_RECOVERY_FILE_DEST_SIZE`
dependes of the database activities (90% from file system size)
- `DB_FLASHBACK_RETENTION_TARGET=60`

- `LOG_ARCHIVE_DEST_2`
dependes of the protection Mode
 - `Net_timeout = 30 sec (default), not lower`

The Parameters to prevent database corruption

- Oracle Versions \geq 11.2.0.4
`DB_ULTRA_SAFE=DATA_AND_INDEX`
Unless this is a high performance OLTP DB with many SQLs running $<1-2ms$
The use `DB_ULTRA_SAFE=DATA_ONLY`
- Oracle Versions \leq 11.2.0.3
`DB_ULTRA_SAFE = OFF`
`DB_BLOCK_CHECKING = FULL.`
`DB_LOST_WRITE_PROTECT = NONE.`
`DB_BLOCK_CHECKSUM = FULL`



> IMPLEMENTING PHYSICAL ORACLE DATA GUARD

2. CREATING OF PHYSICAL STANDBY DATABASE

- Create all requested missed directories on the standby server
- Create pfile on the primary database and copy it to the standby server
- Change the Init Parameters for Standby Database
- Copy of orapwd from production server to the standby server
- Create spfile from pfile and start standby in “nomount” status
- Create new standby database using RMAN
Oracle 10g – primary database backup is necessary
up Oracle 11g - RMAN duplicate from active database



> IMPLEMENTING PHYSICAL ORACLE DATA GUARD

RMAN: DUPLICATE FROM ACTIVE DATABASE

Oracle 11.2:

- DUPLICATE FROM ACTIVE DATABASE uses datafiles image copies which does not support section size, compression
- No string for the target connection
- Only "push" technique (DUPLICATE FROM ACTIVE DATABASE only from primary)

Oracle 12.1:

- DUPLICATE FROM ACTIVE DATABASE USING COMPRESSED BACKUPSET
- "Pull" technique (DUPLICATE FROM ACTIVE DATABASE from standby) with backup sets
- A net string for the target connect



> IMPLEMENTING PHYSICAL ORACLE DATAGUARD

RMAN: TESTING RMAN DUPLICATE for Oracle 12C

- Connection from Primary
- Connection from the Standby (script started on Standby)
- Connection from Primary using COMPRESSED backup sets
- Connection from Primary using backup sets and 4 parallel streams
- Connection from primary without backup sets

RESULT:

- By default, backup sets will be used if channels are not specified
- Backups with backup sets are quicker than without
- Compressed backups take much more CPU and were much slower
- Parallel backups are quicker (if the network has sufficient throughput)



> IMPLEMENTING PHYSICAL ORACLE DATA GUARD

3. ACTIVATE STANDBY DATABASE

- Check flashback setting on the standby database
- Standby Redologs
 - Standby redologs should be created on primary and standby databases.
 - Group number of standby redologs: group number of redologs + 1.
 - Size of standby redologs should be equal to the size of redologs
- Set on Recovery
 - Oracle 10g/11G
 - ALTER DATABASE RECOVER MANAGED STANDBY DATABASE DISCONNECT FROM SESSION USING CURRENT LOGFILE;
 - For Oracle 12C
 - Real-Time Apply is default.
 - ALTER DATABASE RECOVER MANAGED STANDBY DATABASE DISCONNECT;
- Set on Log shipping on the primary database



Run Switchover using SQL*Plus before you start to configure Data Guard Broker



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> DATA GUARD BROKER

- It is a centralized management tool that can be used to manage the entire configuration using a GUI (Enterprise Manager) or CLI (DGMGRL) interface.
- It provides an extensive health check mechanism for the primary database, standby databases and supporting services in the configuration.
- It reduces the complexity of role management services. Switchover and Failover operations can be performed from a centralized console.



> DATA GUARD BROKER

1. CONFIGURE SPECIFIC STATIC LISTENER ENTRY (DB_UNIQUE_NAME_DGMGRL) IN THE LISTENER OF EACH INSTANCE.

A static entry is needed for the Broker to be able to connect remotely to a database that has been shut down by the Broker during certain operations.

They are required for the Broker to complete the following operations:

- Switchover from the Primary database to a Physical Standby database
- Reinstatement of failed Primary database after a manual or automatic failover has occurred.
- Conversion of a Snapshot Standby database back to a Physical Standby database.



ORA-12514 will occur during switchover in the case of the wrong listener configuration



> DATA GUARD BROKER

2. START DATA BROKER

- Set the broker configuration files on the primary and standby databases on 2 different locations

example

```
DG_BROKER_CONFIG_FILE1 = '$ORACLE_BASE/ADMIN/<SID>/DGBROKER/DR1<DB_UNIQUE_NAME>.DAT';  
DG_BROKER_CONFIG_FILE2 = '/ORADATA/<SID>/DGBROKER/DR2<DB_UNIQUE_NAME>.DAT';
```

- Start dataguard broker process (dmon) on the primary and standby databases

```
ALTER SYSTEM SET DG_BROKER_START=TRUE;
```

The broker log file is created in the same directory as the alert log and is named drc<\$ORACLE_SID>.log.



> DATA GUARD BROKER

3. BROKER CONFIGURATION WITH DGMGRL

- Create a broker configuration

```
DGMGRL> CONNECT /
```

```
CREATE CONFIGURATION <configuration name> AS  
PRIMARY DATABASE IS <database name>  
CONNECT IDENTIFIER IS <connect identifier>;
```

```
ADD DATABASE <database name> AS  
CONNECT IDENTIFIER IS <connect identifier>  
MAINTAINED AS {PHYSICAL|LOGICAL}
```

- Enable a broker configuration

```
DGMGRL> ENABLE CONFIGURATION;
```

- Check the broker logfile



> DATA GUARD BROKER

- Check Configuration

```
DGMGRL> show configuration verbose;
```

Example

```
DGMGRL> SHOW CONFIGURATION VERBOSE;  
CONFIGURATION - T1201T  
PROTECTION MODE: MAXAVAILABILITY
```

```
DATABASES:  
T1201T_4 - PRIMARY DATABASE  
T1201T_3 - PHYSICAL STANDBY DATABASE  
FAST-START FAILOVER: DISABLED
```

**CONFIGURATION STATUS:
SUCCESS**

In the case of ERROR and WARNING check drc<\${ORACLE_SID}>.log and alert<\${ORACLE_SID}>.log to get more information.



> DATA GUARD BROKER

- The change of the properties



Most changes (check Oracle Documentation to get complete list) need to be made using `dgmgrl`, otherwise the Broker is not aware of the new values and you'll end up having to drop and recreate the Broker configuration.

Example

```
DGMGRL> edit database 'LORA112' set property 'ArchiveLagTarget'=1200;  
Property "ArchiveLagTarget" updated
```

```
DGMGRL> edit database 'LORA112_2' set property 'ArchiveLagTarget'=1200;  
Property "ArchiveLagTarget" updated
```



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> CLIENT FAILOVER

- OCI Automatic client failover in a Data Guard configuration includes relocating Database Services to new the primary database. Make sure, that service_name used to connect the database is not included in the service_names parameter neither in primary nor in standby database.

1. Create and start new Service on the primary database

```
EXEC DBMS_SERVICE.CREATE_SERVICE('SERVICE_NAME','SERVICE_NAME');
```

```
EXEC DBMS_SERVICE.START_SERVICE('SERVICE_NAME');
```

2. Configure client TNSNAMES.ORA entry to connect to the database using SERVICE_NAME

```
<SERVICE_NAME>.WORLD =  
(DESCRIPTION =  
  (CONNECT_TIMEOUT=5)(TRANSPORT_CONNECT_TIMEOUT=3)(RETRY_COUNT=3) (only for Oracle Client up 11Gr2)  
  (ADDRESS_LIST=  
    (ADDRESS = (PROTOCOL = TCP)(Host = <Horstname1>)(Port = <Listener_Port>))  
    (ADDRESS = (PROTOCOL = TCP)(Host = <Horstname2>)(Port = <Listener_Port>))  
  )  
  (CONNECT_DATA =  
    (SERVER = DEDICATED)  
    (SERVICE_NAME = <Service_NAME>)  
  )  
)
```



> CLIENT FAILOVER

3. Create trigger to start service on on the primary database during startup

```
CREATE OR REPLACE PACKAGE body manage_dgswitch_pkg AS
  PROCEDURE manage_dgservice as
    role varchar(30);
    ora_err varchar(100);
    active_service number;
  BEGIN
    select database_role into role from v$database;
    if role='PRIMARY' then
      select count(*) into active_service
      from sys.v_$active_services where name = '&SERVICE_NAME';
      if (active_service<1) then
        dbms_service.start_service('&SERVICE_NAME');
      end if;
    end if;
  EXCEPTION
    when others then
      ora_err := substr(sqlerrm,1,100);
      execute immediate 'ALTER SESSION SET events "20099 incident(MANAGE_DGSWITCH_PKG)";
      raise_application_error(-20099,ora_err);
  END manage_dgservice;
END manage_dgswitch_pkg;

CREATE OR REPLACE TRIGGER manage_dgservice after startup on database
BEGIN
  manage_dgswitch_pkg.manage_dgservice;
END;
/
```



> CLIENT FAILOVER

- **Configure OCI Client Failover, when Application can use only ONE IP address**

Configure add IP address (VIP) and VIP Listener, that switched to another server during switchover and failover, if the database starts as primary database.

This solution is implemented using „After startup“ trigger



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> FAST-START FAILOVER CONFIGURATION

- Health Condition (default)
- Datafile Offline
- Corrupted Dictionary
- Corrupted Controlfile



> FAST-START FAILOVER CONFIGURATION

1. Determine the protection mode

Protection Mode Prerequisites

Oracle 10g: Maximum Availability

Up Oracle 11g: Maximum Availability, Maximum Performance

2. Specify the target standby database with the FastStartFailoverTarget configuration property

Example

```
DGMGRL> edit database 'T1201_2' set property  
> FastStartFailoverTarget='T1201_3';
```

```
DGMGRL> edit database 'T1201_3' set property  
> FastStartFailoverTarget='T1201_2';
```

3. Set The FastStartFailoverLagLimit (only for Maximum Performance Protection Mode)

4. Set FastStartFailoverthreshold metric (default 30 sec)

Do not set **FastStartFailoverthreshold** to low (<30 sec) value



> FAST-START FAILOVER CONFIGURATION

5. Observer Configuration

■ Observer Tasks

- Monitors the availability of the primary database and initial FSFO
- Reinstates new standby database after FSFO

■ Conditions for FSFO Failover

- By default the observer will initiate failover to the target standby if **ALL** of the following are true:
 - observer is running
 - observer and the standby both lose contact with the primary
 - observer is still in contact with the standby
 - FastStartFailoverthreshold timeout has elapsed



> FAST-START FAILOVER CONFIGURATION

- **How Observer Monitoring really works?**

In below example **FastStartFailoverthreshold** =30 sec

The observer will be pinging SQL Net ping using every few seconds.

If a ping takes more than $30/2$ seconds then the ping is canceled, the connection is dropped and a new connection made and a new ping sent. So if the primary freezes up for anything more than 15 seconds and then takes more than 15 seconds to open a new connector and answer the 2nd ping, the Observer will see it as dead, even though no errors have been reported. So it then signals the target standby to perform failover. The standby checks how long since it heard from the primary and sure enough it says its more than 30 seconds, though there is no direct evidence for this, just the acknowledgment that it accepted the failover so it must have been more than 30 seconds.



> FAST-START FAILOVER CONFIGURATION

▪ **Location**



The best location, when the observer is located separate from the production and standby data centers and connects to the production and standby database via the same network used by the client application.

- We install observer on the application server (if it is possible) in the different Environment
- **The Steps to configure Observer on the application server in the different Environment**
 - Install the complete Oracle Client Administrator
Observer must match the database version Compatibility Matrix (Doc ID 1625597.1)
 - Configure the *tnsnames.ora* file on the observer system so that the observer is able to connect to the primary database and the pre-selected target standby database.
 - Configure External Password Store (Note: 340559.1)
no license for the Advanced Security Option required



> FAST-START FAILOVER CONFIGURATION

■ **Observer stop/start**

- Observer should be started as background process.

If you start observer manual using dgmgrl command line and you leave the session, the connection to the database will be lost.

From 11.2 onwards, one can use the following command to start observer:

```
dgmgrl -logfile /tmp/observer.log sys/passwd@connect_string "start observer" &
```

- After observer start the new process (dgmgrl) will be start

■ **Observer start script (here example for Oracle 12C)**

```
export ORACLE_BASE=/ora_u01/app/oraagt
export TNS_ADMIN=/ora_u01/app/oraagt/admin/network
export ORACLE_HOME=/ora_u01/app/oraagt/product/12.1.0.1/client64
```

```
# Set up search paths
```

```
export PATH=$PATH:/bin:/usr/bin:/usr/sbin:/usr/local/bin:/usr/openwin/bin:/usr/ccs/bin/./
export BASE_PATH=$PATH
export PATH=$ORACLE_HOME/bin:$BASE_PATH
```

```
dgmgrl -logfile $ORACLE_BASE/Observer/log/ob<DB_NAME>.log /@<db_connect_string> "start observer
file='/ora_u01/app/oraagt/product/12.1.0.1/client64/<DB_NAME>.dat" &
```



> FAST-START FAILOVER CONFIGURATION

- **Observer stop script (here example for Oracle 12C)**

```
export ORACLE_BASE=/ora_u01/app/oraagt
export TNS_ADMIN=/ora_u01/app/oraagt/admin/network
export ORACLE_HOME=/ora_u01/app/oraagt/product/12.1.0.1/client64
```

```
# Set up search paths
```

```
export PATH=$PATH:/bin:/usr/bin:/usr/sbin:/usr/local/bin:/usr/openwin/bin:/usr/ccs/bin/./
export BASE_PATH=$PATH
export PATH=$ORACLE_HOME/bin:$BASE_PATH
```

```
dgmgrl -logfile $ORACLE_BASE/Observer/log/ob<DB_NAME>.log << eof
connect /@<db_connect_string_primary>
stop observer;
```

- **Integrate this script into server runlevel to provide automatic stop/start during server reboot**



> FAST-START FAILOVER CONFIGURATION

6. ENABLE FAST_START_FAILOVER using DGMGRL

```
DGMGRL> connect /
Connected as SYSDBG.
DGMGRL> enable fast_start failover;
DGMGRL> show configuration verbose;
Configuration
      Name:          T120
      Enabled:       YES
      Protection Mode:  MaxAvailability
      Fast-Start Failover: ENABLED
      Databases:
      T120_2 - Primary database
      T120_3 - Physical standby database

Fast-Start Failover
      Threshold:      40 seconds
      Observer:      oragct2
      Shutdown Primary:  TRUE
      Current status for "T120":
      SUCCESS
```



Run Switchover and Failover Tests with the application using DGMGRL

Not use the manual Switchover using SQL*Plus, otherwise the Broker is not aware of the new values and you'll end up having to drop and recreate the Broker configuration.



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> DATA GUARD ADMINISTRATION

The Steps after Failover

- Startup mount of the new standby database using `dgmgrl`
Observer will reinstate the standby database
- Check Redo/Apply -Transport
- Check Cloud-Control Information (if you use it)
(The bugs: 18881552, 17034352)
- Check, if flashback set to ON on standby databases
- Check, if the protection mode is correct
- Check DataGuard Configuration using `dgmgrl`
- **Remove all old archivelogs and flashback logs on standby and primary database**



> DATA GUARD ADMINISTRATION

Lufthansa Systems RMAN backup concept

- Configure and activate backup on the primary and secondary sites. If the database_role='PRIMARY' the backup will be continued, in another case the script will be finished with "exit 0"
- There is only one RMAN CATALOG in which the primary database is registered. on the primary side.
- It is to recommend having a separately backup for the Disaster Recovery Database with separately RMAN CATALOG in the same location. Due to the fact, that standby database cannot be registered in the RMAN CATALOG, register the primary database in the new RMAN CATALOG.
This new RMAN CATALOG can be used for backup on the standby database.

- For the case, that backup is taken from the PRIMARY database, set the following configuration :

For the standby database:

- Oracle 10g:

```
RMAN> CONNECT TARGET
```

```
RMAN> CONFIGURE ARCHIVELOG DELETION POLICY TO APPLIED ON STANDBY;
```

- Oracle up 11g

```
RMAN> CONNECT TARGET
```

```
RMAN> CONFIGURE ARCHIVELOG DELETION POLICY TO APPLIED ON ALL STANDBY;
```

For the primary database

```
RMAN> CONFIGURE ARCHIVELOG DELETION POLICY TO NONE;
```



> DATA GUARD ADMINISTRATION

■ Parameter changes

Some parameters (e.g ALTER SYSTEM and ALTER DATABASE SET) will be **NOT PROPAGATED** to the standby database.

■ Online data move (Up Oracle 12C)

after datafile move on the primary database the file will be **NOT MOVED** to new location on the standby database.

The steps to do on the standby database:

- cancel media recovery:
alter database recover managed standby database cancel;
- move datafile ' alter database move datafile '<source location>' to '<taget location>';
- activate media recovery:
alter database recover managed standby database disconnect from session;



Configure the job to check the parameter/config differences on the primary and standby databases.



> DATA GUARD ADMINISTRATION

Active DataGuard (Up Oracle 11g)

- Create add service and use "after startup" trigger to handle this service.
- Set Active DataGuard

```
ALTER DATABASE OPEN;
```

```
ALTER DATABASE RECOVER MANAGED STANDBY DATABASE DISCONNECT FROM SESSION USING CURRENT LOGFILE;
```



> DATA GUARD ADMINISTRATION

Data Guard Standby-First Patch Apply (up Oracle Database 11.2.0.1)

- The following types of patches are candidates to be Data Guard Standby-First certified:
 - Database home interim patches
 - Exadata bundle patches (e.g. Monthly and quarterly database patches for Exadata)
 - Database patch set updates



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> DATA GUARD AND VIRTUALISATION



The primary and standby server should run on different physical servers.

- **LINUX VMWARE :**
 - “Affinity Rules” configuration
- **IBM POWER VM:**
 - Create the job to check, if the primary and standby LPAs have different "Hardware system identifier"

- Our Tests (For Oracle 10g/11g/12c)
 - Live Partition Mobility / vMotion with Workload
 - Live Partition Mobility / vMotion with Redo log shipment Workload
 - Live Partition Mobility / vMotion during Fast-Start Failover

- **RESULT:**
 - No Virtualization specific problems have been detected



> THANK YOU FOR YOUR ATTENTION . ANY QUESTIONS?



16. November 2014



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