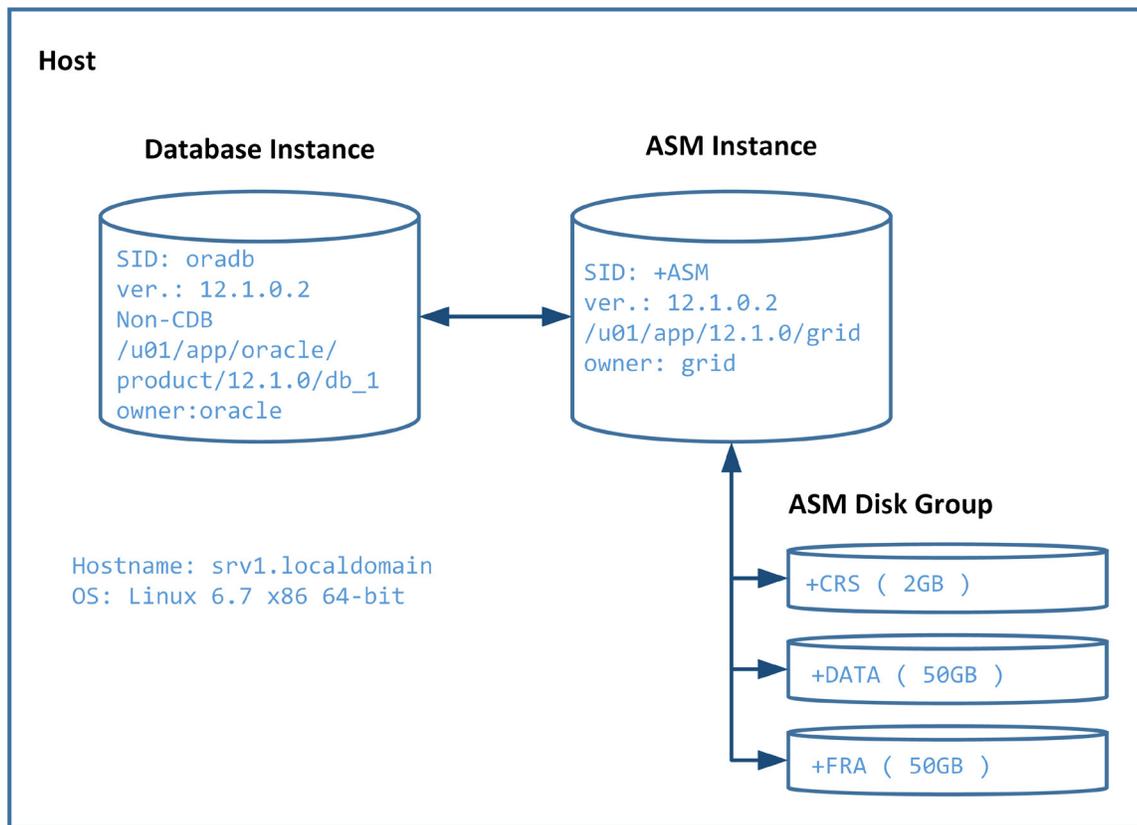


Practice Title	Create an Oracle 12c Physical Standby Database
Purpose	This tutorial describes the procedure to create a Physical Standby database.
Software version	The practice will build an Oracle Physical Standby database version 12.1.0.2 on Oracle Linux 6.7 64-bit.
Document version	1.0, Sep-2016
Required Software / Files	<p>Putty</p> <p>This freeware utility provides a command line prompt to connect to a Linux server from Windows.</p> <p>Oracle VirtualBox</p> <p>Oracle VirtualBox software, version 5. This tutorial was implemented on VirtualBox 5.0.12 for Windows.</p> <p>VirtualBox Appliance</p> <p>The tutorial has been built based on an Oracle virtual machine appliance where an Oracle database version 12.1.0.2 has been installed with ASM in Linux version 6.7.</p> <p>The procedure to create an Oracle database 12c with ASM in a virtual appliance from scratch is described in the practice "Installing Oracle Database 12c R1 on Linux 6 with ASM". It is available in the first section of this course.</p>
Hardware	Free space in your hosting machine is required. We will work on two appliances each make take about 42 GB of disk storage.

The Primary and Standby Databases Architecture

The architecture of the primary database that will be used to build the standby database is as shown below:



The standby database will have exactly the same design except the hostname and IP address will be different.

Network Configuration

If the IP address assigned to the appliance that you downloaded from my web site does not go compatible with your network, you can either change the settings of your Virtual Network Adapter so that it becomes of the same subnet as of the appliances, or you can change the network settings of the appliance. To change the network settings of your appliance, you need to do the following:

- Use system-config-network utility to change the IP address
- Edit the ip address in /etc/hosts file
- Edit the ip address in the listener.ora files

Data Guard Configuration Specifications

Standby Database Type	Physical Standby
Protection Mode	Maximum Performance
fast-start failover	Disabled
The management interface	SQL*Plus
Standby Database Unique Name	ORADB_S2
Standby Database Hostname	srv2

The Practice Overview

Prepare the Practice Environment

- Clone the Oracle database appliance **twice**: one will be the **primary** and the other will be the **standby**.
- Make some configuration changes on the standby appliance to make it ready for the practice.

Preparing the Primary Database

- Enable archiving mode
- Configure ARCHIVELOG DELETION POLICY in RMAN
- Enable forced logging
- Configure standby redo log files (SRL)
- Set the related primary database initialization parameters
- Enable Flashback Database
- Set CONTROL_FILE_RECORD_KEEP_TIME parameter
- Create a Password File (if it isn't there)
- Configure the tnsnames.ora file

Preparing the Standby System

- Create the required directories
- Create a static listener entry for the standby database
- Create an init<SID>.ora file
- Copy the password file from the primary system
- Configure the tnsnames.ora file

Creating the Physical Standby Database

- Use RMAN to create the physical database online from the primary database
- Set the standby database parameters
- Start the Redo Apply
- Verify the physical standby database is performing properly
- Post creation steps

Practice Procedure

I. Prepare the Practice Environment

1. Make a clone of your Oracle 12c Database appliance. When you clone your appliance, **do not initialize the network card**. This clone will be the primary database.

Give that cloned appliance the name "Primary DB"

2. Make another clone of your Oracle 12c Database appliance. This time **initialize the network card**.

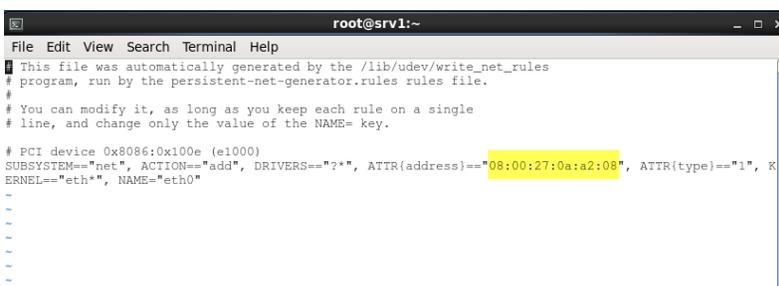
Give that cloned appliance the name "Physical Standby DB"

3. Fix the mac address issue in the "Physical Standby Database".

The issue took place because when you initialize the network card, the VirtualBox will assign it a mac address different from the old one that was recognized by Linux in the appliance. This will make the network card not operational in the appliance.

To fix this issue, perform the following:

- 3.1 Obtain the new MAC address from the **Settings** of the Clone appliance.
- 3.2 Startup the VM appliance and login as root.
- 3.3 Open a terminal window and edit the udev rule for network devices
`/etc/udev/rules.d/70-persistent-net.rules`
- 3.4 Copy the new mac address to the line of your eth0 rule and delete the new rule for eth1.



```
root@srv1:~# cat /etc/udev/rules.d/70-persistent-net.rules
# This file was automatically generated by the /lib/udev/write_net_rules
# program, run by the persistent-net-generator.rules rules file.
#
# You can modify it, as long as you keep each rule on a single
# line, and change only the value of the NAME= key.
#
# PCI device 0x8086:0x100e (e1000)
SUBSYSTEM=="net", ACTION=="add", DRIVERS=="*", ATTR(address)=="08:00:27:0a:a2:08", ATTR(type)=="1", KERNEL=="eth*", NAME="eth0"
```

- 3.5 Enter the new MAC address in the file `/etc/sysconfig/network-scripts/ifcfg-eth0` as well then **reboot** the appliance:



```
[root@srv1 ~]# cat /etc/sysconfig/network-scripts/ifcfg-eth0
DEVICE=eth0
TYPE=Ethernet
UUID=92a5490b-1a26-46ea-8806-2d61037cdb56
ONBOOT=yes
NM_CONTROLLED=yes
BOOTPROTO=dhcp
#HWADDR=08:00:27:A0:83:DF
HWADDR=08:00:27:0A:A2:08
DEFROUTE=yes
PEERDNS=yes
PEERROUTES=yes
IPV4_FAILURE_FATAL=yes
IPV6INIT=no
NAME="System eth0"
```

4. Drop the database from the "Physical Standby Database".
To do it, perform the following:
 - 4.1 Switch to oracle user
 - 4.2 Make sure the database is up and running
 - 4.3 run the dbca
 - 4.4 Delete the ORADB database

5. Change the hostname and IP Address on the "Physical Standby Database".
To do it, perform the following:
 - 5.1 As root and on a terminal command prompt, run system-config-network command.
 - 5.2 Make sure the "Device Configuration" is selected and press ENTER
 - 5.3 Enter the IP address of the machine, DNS and Gateway IP addresses
 - 5.4 Make sure the "DNS Configuration" is selected and press ENTER
 - 5.5 Enter the hostname as srv2
 - 5.6 Confirm the configuration modifications in /etc/sysconfig/network-scripts/ifcfg-eth0
 - 5.7 Accordingly, update /etc/hosts file. Change the hostname to srv2.
 - 5.8 As grid user, fix the hostname in the \$TNS_ADMIN/listener.ora
 - 5.9 Reboot the appliance

6. Start the "Primary DB" appliance and make sure the database is up and running.

7. Make the configurations in Putty for the databases.
 - 7.1 Ping the VM IP address from your host machine to make sure it is seen. It should see it.
 - 7.2 Start Putty and connect to the VM -> IP Address -> Connection -> Keepalive every 5 seconds
 - 7.3 You can control the font in the command prompt Window -> Appearance -> Change button
 - 7.4 Save the configuration for srv1 and srv2.
 - 7.5 Configure /etc/hosts file on both machines so that srv1 and srv2 can see each other.

8. Reconfigure Oracle Restart on the standby database machine. This is necessary, because the hostname in the standby system was changed and therefore the ASM would fail.

8.1 As **root** remove the old Oracle Restart configuration

```
/u01/app/12.1.0/grid/crs/install/roothas.pl -deconfig -force
```

8.2 Add ASM back to Oracle Restart configuration

```
/u01/app/12.1.0/grid/crs/install/roothas.pl
```

8.3 As **grid**: Add ASM back to Oracle Restart configuration

```
su - grid
srvctl add asm
srvctl start asm
```

8.4 As **grid**: recreate ASM server parameter file (SPFILE)

```
# create temporary init+ASM.ora
cd
mkdir tmp
cd tmp

vi init+ASM.ora
asm_diskgroups='CRS','DATA','FRA'
instance_type='asm'
large_pool_size=12M
remote_login_passwordfile='EXCLUSIVE'
ASM_DISKSTRING='/dev/oracleasm/disks/*'
```

8.5 Create the SPFILE and mount the diskgroups

```
sqlplus / as sysasm
alter system set ASM_DISKSTRING='/dev/oracleasm/disks/*';
alter diskgroup CRS mount;
create spfile='+CRS' from pfile='/home/grid/tmp/init+ASM.ora';
shutdown immediate
exit

srvctl start asm
sqlplus / as sysasm
show parameter spfile

srvctl stop asm -f
srvctl start asm

# make sure all the disk groups are mounted
asmcmd
```

```
lsdg  
  
# re-start HAS  
crsctl stop has  
crsctl start has
```

8.6 Add listener back to Oracle Restart configuration

```
srvctl add listener  
srvctl start listener
```

9. Make sure the primary database is registered in the default listener running in the grid home. To do so, login to the primary database machine and perform the following:

```
# in srv1:  
su - oracle  
sqlplus / as sysdba  
show parameter LOCAL_LISTENER  
ALTER SYSTEM SET LOCAL_LISTENER='' scope=both ;  
show parameter SERVICE_NAMES  
alter system REGISTER ;
```

II. Preparing the Primary Database

1. Enable the archiving mode in the primary database (srv1):

```
su - oracle
sqlplus / as sysdba
SELECT LOG_MODE FROM V$DATABASE ;

ALTER SYSTEM SET LOG_ARCHIVE_DEST_1 = 'LOCATION=USE_DB_RECOVERY_FILE_DEST' scope=BOTH;
SHUTDOWN IMMEDIATE
STARTUP MOUNT
ALTER DATABASE ARCHIVELOG;
ALTER DATABASE OPEN;
ALTER SYSTEM SWITCH LOGFILE;
SELECT NAME FROM V$ARCHIVED_LOG;
```

2. Enable forced logging option in the database:

```
SELECT FORCE_LOGGING FROM V$DATABASE;
ALTER DATABASE FORCE LOGGING;
SELECT FORCE_LOGGING FROM V$DATABASE;
```

3. Configure Standby Redo Log files. Those files will be used after switchover or failover.

Determine the appropriate number of standby redo log file groups:

```
SELECT GROUP#, BYTES/1024/1024 MB FROM V$LOG;
SELECT THREAD#, INSTANCE FROM V$THREAD ;
```

Thus, number of standby redo log required is: $(3+1)*1=4$

```
ALTER DATABASE ADD STANDBY LOGFILE THREAD 1 '+FRA' SIZE 50M ;
ALTER DATABASE ADD STANDBY LOGFILE THREAD 1 '+FRA' SIZE 50M ;
ALTER DATABASE ADD STANDBY LOGFILE THREAD 1 '+FRA' SIZE 50M ;
ALTER DATABASE ADD STANDBY LOGFILE THREAD 1 '+FRA' SIZE 50M ;
SELECT GROUP#,THREAD#,SEQUENCE#,ARCHIVED,STATUS FROM V$STANDBY_LOG;
```

4. Set Primary Database Initialization Parameters

```
show parameter DB_UNIQUE_NAME

ALTER SYSTEM SET LOG_ARCHIVE_CONFIG='DG_CONFIG=(ORADB,ORADB_S2)' scope=BOTH;

ALTER SYSTEM SET LOG_ARCHIVE_DEST_2= 'SERVICE=ORADB_S2 ASYNC
VALID_FOR=(ONLINE_LOGFILES,PRIMARY_ROLE) DB_UNIQUE_NAME=ORADB_S2' scope=BOTH;
```

```
# (optional) to force the primary db to switch logfile after specific time of inactivity
ALTER SYSTEM SET ARCHIVE_LAG_TARGET=1800 scope=BOTH;

# should be EXCLUSIVE
show parameter REMOTE_LOGIN_PASSWORDFILE
# FAL = fetch archive log
show parameter FAL_SERVER ;
alter system set FAL_SERVER = 'ORADB_S2' scope=BOTH;

# No need to set DB_FILE_NAME_CONVERT, as the standby system has the same directory structure
SQL> SHOW PARAMETER DB_FILE_NAME_CONVERT

show parameter STANDBY_FILE_MANAGEMENT
ALTER SYSTEM SET STANDBY_FILE_MANAGEMENT='AUTO' scope=BOTH;

# Get list of directory-dependent parameters and create the directories in the standby server:
SELECT NAME, VALUE FROM V$PARAMETER WHERE upper(VALUE) LIKE upper('%/oradb/%');
```

5. Enable Flashback Database (optional but recommended and we should do it for our practice)

```
ALTER SYSTEM SET DB_FLASHBACK_RETENTION_TARGET =2880 SCOPE=BOTH;
ALTER DATABASE FLASHBACK ON;
```

6. Set CONTROL_FILE_RECORD_KEEP_TIME parameter

```
show parameter CONTROL_FILE_RECORD_KEEP_TIME
ALTER SYSTEM SET CONTROL_FILE_RECORD_KEEP_TIME=30 SCOPE=BOTH;
```

7. Create a password file, if there is not one.

```
ls /u01/app/oracle/product/12.1.0/db_1/dbs/orapwORADB
```

8. Configure the tnsnames.ora file.

Note: In this step, I do not recommend copy the code below from PDF file. Either copy/paste from the putty window itself or enter the settings manually.

```
vi /u01/app/oracle/product/12.1.0/db_1/network/admin/tnsnames.ora
```

```
ORADB=
(DESCRIPTION=
  (ADDRESS=(PROTOCOL=tcp)(HOST=SRV1)(PORT=1521))
  (CONNECT_DATA=
    (SERVICE_NAME=ORADB.localdomain))
)

ORADB_S2=
(DESCRIPTION=
  (ADDRESS=(PROTOCOL=tcp)(HOST=SRV1)(PORT=1521))
  (CONNECT_DATA=
    (SERVICE_NAME=ORADB_S2.localdomain)) (UR=A)
)
```

If sqlnet.ora file is not configured, create it (optional):

```
vi /u01/app/oracle/product/12.1.0/db_1/network/admin/sqlnet.ora
NAMES.DIRECTORY_PATH= (TNSNAMES, EZCONNECT)
```

Test the configuration:

```
tnsping oradb
tnsping oradb_s2
```

9. Fix the root cause of ORA-15173 that is returned by the DUPLICATE command.

It has been observed that when I use the DUPLICATE TARGET DATABASE FOR STANDBY FROM ACTIVE DATABASE command later in the standby system, it will return the following error:

```
RMAN-03009: failure of backup command on prmy2 channel at 03/04/2016 06:46:08
ORA-19505: failed to identify file "+DATA/oradb/spfileoradb.ora"
ORA-15173: entry 'spfileoradb.ora' does not exist in directory 'oradb'
```

For some reason, the RMAN thinks the SPFILE used by the primary database is located in "+DATA/oradb/spfileoradb.ora".

When I log on to the primary database, I observe it is actually located somewhere else:

```
SQL> show parameter spfile
NAME                                TYPE        VALUE
-----
spfile                              string      +DATA/ORADB/PARAMETERFILE/spfi
                                         1e.266.902657117
```

The only workaround that I figured out to fix this issue was to make a copy of the spfile:

```
su - grid
```

```
asmcmd  
cd data  
cd oradb  
cd parameterfile  
cp spfile.266.902657117 +DATA/oradb/spfileORADB.ora
```

III. Prepare the Standby System

1. On the standby server, as oracle create the directories pointed by the parameters.

We are using ASM, so the directories under ASM diskgroups should also be created:

```
su - grid
asmcmd
cd DATA
mkdir ORADB_S2
mkdir ORADB
ls

su - oracle
mkdir /u01/app/oracle/admin/ORADB_S2
mkdir /u01/app/oracle/admin/ORADB_S2/adump
mkdir /u01/app/oracle/admin/ORADB_S2/cdump
```

2. As oracle , create an init<SID>.ora file for the standby database. Just put only DB_NAME in it. RMAN will create the full spfile.

```
su - oracle
echo 'DB_NAME=ORADB' > $ORACLE_HOME/dbs/initORADB_S2.ora
```

3. Copy the password file from the primary database system. Notice the file name is case sensitive.

```
scp root@srv1:/u01/app/oracle/product/12.1.0/db_1/dbs/orapwORADB
/u01/app/oracle/product/12.1.0/db_1/dbs/orapwORADB_S2
ls -al /u01/app/oracle/product/12.1.0/db_1/dbs/orapwORADB_S2
```

4. Similar to what you have done in srv1, configure the tnsnames.ora file:

```
mv /u01/app/oracle/product/12.1.0/db_1/network/admin/tnsnames.ora
/u01/app/oracle/product/12.1.0/db_1/network/admin/tnsnames.ora.bak

# I will take a copy from the primary database system:
scp root@srv1:/u01/app/oracle/product/12.1.0/db_1/network/admin/tnsnames.ora
/u01/app/oracle/product/12.1.0/db_1/network/admin/tnsnames.ora
```

If sqlnet.ora file is not configured, create it (optional):

```
vi /u01/app/oracle/product/12.1.0/db_1/network/admin/sqlnet.ora
NAMES.DIRECTORY_PATH= (TNSNAMES, EZCONNECT)
```

5. Create a static database registry in the listener (as grid).

Note: Although the documentation claims the automatic registration should work fine, I have faced many issues with that. From experience, it is safer to register the database manually in the listener. For example, the DUPLICATE command that we are going to use later to build up the standby database will fail, if you use dynamic registration in your configuration.

Note: For some reason, copy/paste from PDF file into listener.ora file sometimes causes issues with the listener. The same code will work fine, if you copy/paste from a text file. For this reason, I do not recommend copying the code of the listener.ora file from the PDF file. Instead, either you obtain the listener.ora file attached to the lecture, or you enter the code manually into your file.

```
su - grid
vi /u01/app/12.1.0/grid/network/admin/listener.ora

LISTENER =
  (DESCRIPTION_LIST =
    (DESCRIPTION =
      (ADDRESS = (PROTOCOL = TCP)(HOST = srv2.localdomain)(PORT = 1521))
      (ADDRESS = (PROTOCOL = IPC)(KEY = EXTPROC1521))
    )
  )

SID_LIST_LISTENER=
  (SID_LIST=
    (SID_DESC=
      (GLOBAL_DBNAME=ORADB_S2.localdomain)
      (SID_NAME=ORADB_S2)
      (ORACLE_HOME=/u01/app/oracle/product/12.1.0/db_1)
    )
  )

# restart the listener:
srvctl stop listener
srvctl start listener
lsnrctl services
```

Creating the Standby Database

1. Start up the standby instance

```
# in srv2:
su - oracle
export ORACLE_SID=ORADB_S2

# now start up the instance
sqlplus '/ as sysdba'
STARTUP NOMOUNT
exit
```

2. Create the standby database online from the primary database

It can be run from the standby database, i.e. the data will be pulled from the primary, or it can be run from the primary, where the data will be pushed to the standby.

In this example, we run the command on the standby:

```
su - oracle
export ORACLE_SID=ORADB_S2

rman

CONNECT TARGET sys/oracle@ORADB;
CONNECT AUXILIARY sys/oracle@ORADB_S2;
run {
  allocate channel prmy1 type disk;
  allocate channel prmy2 type disk;
  allocate auxiliary channel stby1 type disk;
  DUPLICATE TARGET DATABASE FOR STANDBY FROM ACTIVE DATABASE
  SPFILE
  set 'db_unique_name'='ORADB_S2'
  set control_files='+DATA/ORADB_S2/control1.ctl'
  set db_create_file_dest='+DATA'
  set db_create_online_log_dest_1='+FRA'
  set db_create_online_log_dest_2='+DATA'
  set db_recovery_file_dest='+FRA'
  set DB_RECOVERY_FILE_DEST_SIZE='10G'
  set audit_file_dest='/u01/app/oracle/admin/ORADB_S2/adump'
  set core_dump_dest='/u01/app/oracle/admin/ORADB_S2/cdump'
  nofilenamecheck;
}
```

3. Verify the instance is running fine:

```
sqlplus / as sysdba
SELECT NAME FROM V$DATAFILE;
SELECT GROUP#,THREAD#,SEQUENCE#,ARCHIVED,STATUS FROM V$STANDBY_LOG;
# you will notice the SRL members got multiplexed:
SELECT TYPE, count(*) FROM V$LOGFILE GROUP BY TYPE;
```

4. Remove the multiplexed copy of each SRL group on the standby

```
COLUMN MEMBER FORMAT A50
SELECT GROUP#, MEMBER FROM V$LOGFILE WHERE TYPE='STANDBY' ORDER BY 1,2;

# drop all the members in DATA diskgroup:
ALTER DATABASE DROP STANDBY LOGFILE MEMBER '+DATA/ORADB_S2/ONLINELOG/group_5.2xxx;
```

Note: One of them may return ORA-00261 because it is being used by the transport service. To drop it, on the **primary** database, switch the logfile:

```
alter system switch logfile;
```

The current standby redo log file will be archived and then the multiplexed member can be dropped:

```
ALTER DATABASE DROP STANDBY LOGFILE MEMBER '+DATA/ORADB_S2/ONLINELOG/group_4.276.905630767';
```

Verify the SRL group multiplexed members were removed:

```
SELECT GROUP#, MEMBER FROM V$LOGFILE WHERE TYPE='STANDBY' ORDER BY 1,2;
```

5. Set the necessary Data Guard related initialization parameters for the standby database:

```
ALTER SYSTEM SET FAL_SERVER=ORADB;
ALTER SYSTEM SET FAL_CLIENT=ORADB_S2;
ALTER SYSTEM SET LOG_ARCHIVE_CONFIG='DG_CONFIG=(ORADB,ORADB_S2)';
ALTER SYSTEM SET STANDBY_FILE_MANAGEMENT=AUTO;
ALTER SYSTEM SET LOG_ARCHIVE_DEST_2='SERVICE=ORADB ASYNC DB_UNIQUE_NAME=ORADB
VALID_FOR=(ONLINE_LOGFILE,PRIMARY_ROLE)' scope=both;
```

6. Start the Apply process in the Standby database:

```
ALTER DATABASE RECOVER MANAGED STANDBY DATABASE DISCONNECT;
```

7. Verify Data Guard configuration:

On the standby:

```
SELECT SEQUENCE#, APPLIED, FIRST_TIME, NEXT_TIME,
       replace( NAME ,'+FLASH/ORADB_S2/archivelog/','') FILENAME
FROM V$ARCHIVED_LOG ORDER BY SEQUENCE#;
```

On the primary:

```
ALTER SYSTEM SWITCH LOGFILE;
```

On the standby:

```
SELECT SEQUENCE#, APPLIED, FIRST_TIME, NEXT_TIME,  
       replace( NAME ,'+FLASH/ORADB_S2/archivelog/','') FILENAME  
FROM V$ARCHIVED_LOG ORDER BY SEQUENCE#;
```

Query the physical standby database to monitor Redo Apply and Redo Transport services activity at the standby site:

```
SELECT PROCESS, STATUS, THREAD#, SEQUENCE#, BLOCK#, BLOCKS FROM V$MANAGED_STANDBY;
```

8. Post Creation Steps:

8.1 Configure ARCHIVELOG DELETION POLICY in RMAN in both systems

```
rman target /  
CONFIGURE ARCHIVELOG DELETION POLICY TO APPLIED ON ALL STANDBY;
```

8.2 In the standby system, set ORACLE_SID variable in the oracle os profile:

```
vi ~/.bash_profile  
ORACLE_SID=ORADB_S2; export ORACLE_SID
```

8.3 On the standby database, enable the Flashback Database:

```
sqlplus sys/oracle@oradb_s2 as sysdba  
SELECT LOG_MODE,FLASHBACK_ON FROM V$DATABASE;  
ALTER SYSTEM SET DB_FLASHBACK_RETENTION_TARGET =2880;  
ALTER DATABASE RECOVER MANAGED STANDBY DATABASE CANCEL;  
ALTER DATABASE FLASHBACK ON;
```

8.4 Register the standby database in the Oracle Restart:

```
sqlplus / as sysdba  
shutdown immediate  
exit  
  
srvctl add database -db ORADB_S2 -instance ORADB_S2 -oraclehome  
/u01/app/oracle/product/12.1.0/db_1 -startoption MOUNT -stopoption IMMEDIATE -policy AUTOMATIC -  
role physical_standby -spfile /u01/app/oracle/product/12.1.0/db_1/dbs/spfileORADB_S2.ora  
srvctl start database -d ORADB_S2  
srvctl status database -d ORADB_S2
```

Notes

Standby Database Status

Notice that the standby database is running in MOUNT status. Therefore, no normal user can connect to it. This is the default initial behavior of a freshly created standby database. However, it can be opened to the normal users for read-only operations.

Shutting Down the Databases

1. Stop the standby database:

```
# on srv2
srvctl stop database -d oradb_s2
```

2. Stop the primary database.
3. Shutdown the appliances.

Note: Every time you start this created standby database (in MOUNT mode), you should issue the command to star the apply process (MRP):

```
ALTER DATABASE RECOVER MANAGED STANDBY DATABASE DISCONNECT;
```

Download Copy of the Appliances

If you want a copy of the appliances built up in this tutorial, please drop me a line. I will make them available for you on a public ftp server. To contact me, please visit www.ahmedbaraka.com