TECNOLÓGICO DE ESTUDIOS SUPERIORES DE JOCOTITLÁN

Configuring Mirroring in Oracle 19c

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Jocotitlán, Estado de México, 30 de abril de 2025

Oracle 19c Data Guard Mirroring Configuration Guide

1. Basic Architecture

Oracle Data Guard provides a comprehensive disaster recovery solution that maintains one or more synchronized standby databases to protect against data loss and downtime. The basic architecture consists of:

Primary Components:

- **Primary Database**: The production database that serves all user transactions
- **Standby Database(s)**: One or more replicas of the primary database maintained through log shipping and application
- **Redo Transport Services**: Mechanism for transmitting redo data from primary to standby
- **Log Apply Services**: Process that applies received redo data to standby databases
- **Data Guard Broker**: Optional centralized management framework

Architecture Types:

- **Physical Standby**: Block-for-block identical copy, maintained through redo apply
- **Logical Standby**: Maintained through SQL apply, allows limited read-write operations
- **Snapshot Standby**: Temporarily converts physical standby to read-write for testing

Network Configuration:

- Dedicated network links between primary and standby sites
- Oracle Net Services configuration for seamless connectivity
- Multiple network paths for redundancy (recommended)

2. Prerequisites

Hardware Requirements:

- Sufficient storage capacity on standby server (equal or greater than primary)
- Compatible hardware architecture (preferably identical)

- Adequate network bandwidth for redo transmission
- Minimum 1GB RAM per database instance

Software Requirements:

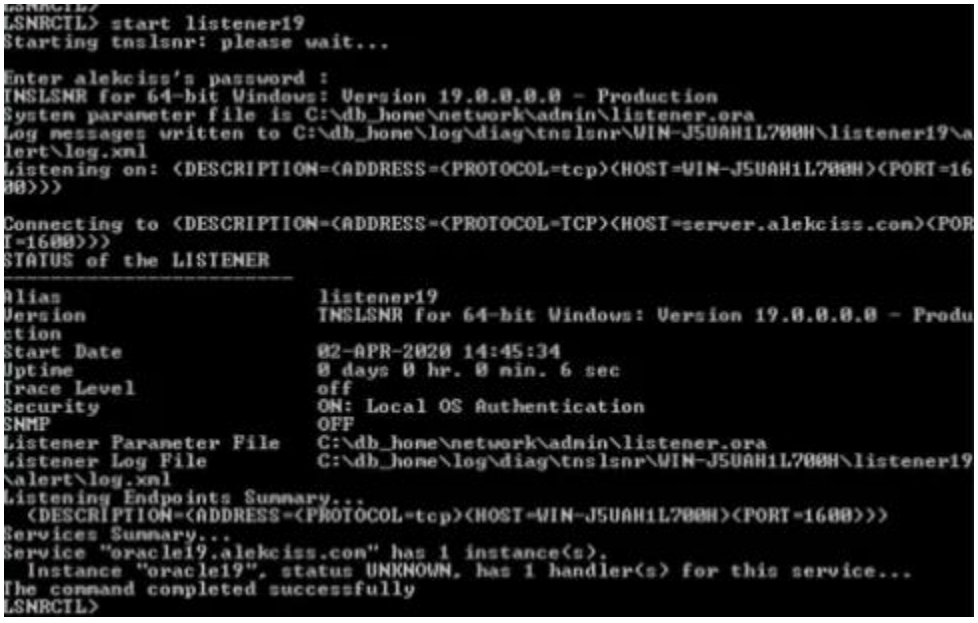
- Oracle Database 19c Enterprise Edition on both primary and standby
- Same Oracle version and patch level on both systems
- Operating system compatibility (preferably identical OS versions)
- Oracle Net Services properly configured

Network Requirements:

- Reliable network connectivity between sites
- Sufficient bandwidth for peak redo generation rates
- Low latency connection (< 100ms recommended for synchronous mode)
- Firewall configuration allowing Oracle traffic (typically port 1521)

Storage Requirements:

- Identical directory structure recommended
- Sufficient disk space for database files, logs, and backups
- High-performance storage for optimal redo apply rates



3. Key Configuration in Oracle 19c

a. Essential Parameters in Primary (init.ora/spfile):

-- Database Identification

DB_NAME = 'PRODDB'

DB_UNIQUE_NAME = 'PRODDB_PRIMARY'

DB_DOMAIN = 'company.com'

-- Archive Log Configuration

LOG_ARCHIVE_DEST_1 = 'LOCATION=/u01/app/oracle/archivelog
VALID_FOR=(ALL_LOGFILES,ALL_ROLES)
DB_UNIQUE_NAME=PRODDB_PRIMARY'

LOG_ARCHIVE_DEST_2 = 'SERVICE=STANDBY_TNSNAME LGWR SYNC
VALID_FOR=(ONLINE_LOGFILES,PRIMARY_ROLE)
DB_UNIQUE_NAME=PRODDB_STANDBY'

LOG_ARCHIVE_DEST_STATE_1 = 'ENABLE'

LOG_ARCHIVE_DEST_STATE_2 = 'ENABLE'

-- Data Guard Specific Parameters

LOG_ARCHIVE_CONFIG =
'DG_CONFIG=(PRODDB_PRIMARY,PRODDB_STANDBY)'

LOG_ARCHIVE_FORMAT = '%t_%s_%r.arc'

LOG_ARCHIVE_MAX_PROCESSES = 4

ARCHIVE_LAG_TARGET = 0

-- Remote File Management

DB_FILE_NAME_CONVERT =
'/u01/app/oracle/oradata/PRODDB/','/u01/app/oracle/oradata/STANDBY/'

LOG_FILE_NAME_CONVERT =
'/u01/app/oracle/oradata/PRODDB/','/u01/app/oracle/oradata/STANDBY/'

-- Standby File Management

STANDBY_FILE_MANAGEMENT = 'AUTO'

FAL_SERVER = 'STANDBY_TNSNAME'

FAL_CLIENT = 'PRIMARY_TNSNAME'

-- Performance and Protection

LOG_BUFFER = 16777216

FILESYSTEMIO_OPTIONS = 'SETALL'

b. Network Configuration

Primary Site tnsnames.ora:

```
PRODDB_PRIMARY =
  (DESCRIPTION =
    (ADDRESS = (PROTOCOL = TCP)(HOST = primary-server)(PORT = 1521))
    (CONNECT_DATA =
      (SERVER = DEDICATED)
      (SERVICE_NAME = PRODDB)
    )
  )
STANDBY_TNSNAME =
  (DESCRIPTION =
    (ADDRESS = (PROTOCOL = TCP)(HOST = standby-server)(PORT = 1521))
    (CONNECT_DATA =
      (SERVER = DEDICATED)
      (SERVICE_NAME = STANDBY
```

Standby Site tnsnames.ora:

```
PRODDB_STANDBY =
  (DESCRIPTION =
    (ADDRESS = (PROTOCOL = TCP)(HOST = standby-server)(PORT = 1521))
    (CONNECT_DATA =
      (SERVER = DEDICATED)
      (SERVICE_NAME = STANDBY)
    )
  )

PRIMARY_TNSNAME =
  (DESCRIPTION =
    (ADDRESS = (PROTOCOL = TCP)(HOST = primary-server)(PORT = 1521))
    (CONNECT_DATA =
      (SERVER = DEDICATED)
      (SERVICE_NAME = PRODDB)
    )
```

4. Implementation Process

a. Enable Force Logging:

-- On Primary Database

ALTER DATABASE FORCE LOGGING;

ALTER SYSTEM SWITCH LOGFILE;

-- Verify force logging status

SELECT FORCE_LOGGING FROM V$DATABASE;

b. Create Control Files for Standby:

-- Generate control file creation script

ALTER DATABASE CREATE STANDBY CONTROLFILE AS '/tmp/standby_control.ctl';

-- Alternative: Create backup-based standby

RMAN TARGET /

BACKUP DATABASE PLUS ARCHIVELOG;

BACKUP CURRENT CONTROLFILE FOR STANDBY;

c. Configure Data Guard Broker (Recommended):

-- Enable Data Guard Broker on Primary

ALTER SYSTEM SET DG_BROKER_START=TRUE;

-- Configure broker using DGMGRL

DGMGRL /

CREATE CONFIGURATION 'DR_CONFIG' AS PRIMARY DATABASE IS 'PRODDB_PRIMARY' CONNECT IDENTIFIER IS 'PRODDB_PRIMARY';

ADD DATABASE 'PRODDB_STANDBY' AS CONNECT IDENTIFIER IS 'STANDBY_TNSNAME' MAINTAINED AS PHYSICAL;

ENABLE CONFIGURATION;

5. Types of Protection

Maximum Protection:

- Zero data loss guarantee
- Synchronous redo transmission
- Primary shuts down if standby becomes unavailable

```
ALTER DATABASE SET STANDBY DATABASE TO MAXIMIZE PROTECTION;
```

Maximum Availability:

- Zero data loss under normal conditions
- Automatically degrades to asynchronous if standby unavailable
- Preferred for most production environments

```
ALTER DATABASE SET STANDBY DATABASE TO MAXIMIZE AVAILABILITY;
```

Maximum Performance:

- Asynchronous redo transmission
- Minimal impact on primary performance
- Potential for minimal data loss during disasters

```
ALTER DATABASE SET STANDBY DATABASE TO MAXIMIZE PERFORMANCE;
```

6. Monitoring and Maintenance

a. Useful Commands:

Check Data Guard Status:

-- Primary database status

```
SELECT DATABASE_ROLE, PROTECTION_MODE, PROTECTION_LEVEL
FROM V$DATABASE;
```

-- Archive log shipping status

```
SELECT DEST_ID, STATUS, ERROR FROM V$ARCHIVE_DEST_STATUS;
```

-- Standby database lag

```
SELECT APPLIED_SCN, TO_CHAR(APPLIED_TIME,'DD-MON-YY HH24:MI:SS')
APPLIED_TIME

FROM V$RECOVERY_PROGRESS WHERE ITEM = 'Last Applied Redo';
```

-- Primary database status

```
SELECT DATABASE_ROLE, PROTECTION_MODE, PROTECTION_LEVEL
FROM V$DATABASE;
```

-- Archive log shipping status

```
SELECT DEST_ID, STATUS, ERROR FROM V$ARCHIVE_DEST_STATUS;
```

-- Standby database lag

```
SELECT APPLIED_SCN, TO_CHAR(APPLIED_TIME,'DD-MON-YY HH24:MI:SS')
APPLIED_TIME

FROM V$RECOVERY_PROGRESS WHERE ITEM = 'Last Applied Redo';
```

Monitor Archive Gap:

```
-- On Primary

SELECT MAX(SEQUENCE#) FROM V$ARCHIVED_LOG WHERE ARCHIVED =
'YES';

-- On Standby

SELECT MAX(SEQUENCE#) FROM V$ARCHIVED_LOG WHERE APPLIED =
'YES';
```

Data Guard Broker Commands:

```
DGMGRL> SHOW CONFIGURATION;

DGMGRL> SHOW DATABASE 'PRODDB_PRIMARY';

DGMGRL> SHOW DATABASE 'PRODDB_STANDBY';

DGMGRL> VALIDATE DATABASE 'PRODDB_STANDBY';
```

7. Performance Considerations

Network Optimization:

- Use dedicated high-bandwidth links for redo transport
- Configure multiple LOG_ARCHIVE_DEST parameters for load balancing
- Implement network compression for WAN environments

```
ALTER SYSTEM SET LOG_ARCHIVE_DEST_2 =
'SERVICE=STANDBY_TNSNAME COMPRESSION=ENABLED';
```

Storage Optimization:

- Use high-performance storage for standby database
- Separate redo logs and datafiles on different disk groups
- Configure appropriate LGWR and ARCH process counts

```
ALTER SYSTEM SET LOG_ARCHIVE_MAX_PROCESSES = 8;
```

Memory Configuration:

- Adequate SGA sizing on standby for efficient apply
- Configure appropriate LOG_BUFFER size
- Use FILESYSTEMIO_OPTIONS for improved I/O performance

8. Switchover/Failover

a. Switchover Example:

Planned Switchover Process:

```
-- Step 1: Verify no lag on standby

SELECT APPLIED_SCN FROM V$RECOVERY_PROGRESS WHERE ITEM =
'Last Applied Redo';


-- Step 2: Prepare primary for switchover

ALTER DATABASE COMMIT TO SWITCHOVER TO STANDBY WITH SESSION
SHUTDOWN;


-- Step 3: Switch standby to primary role
```

```
ALTER DATABASE COMMIT TO SWITCHOVER TO PRIMARY WITH SESSION SHUTDOWN;


-- Step 4: Start both databases
STARTUP;
ALTER DATABASE OPEN;
```

Using Data Guard Broker:

```
DGMGRL> SWITCHOVER TO 'PRODDB_STANDBY';
```

Failover Process (Emergency):

```
-- On Standby (becoming new primary)
ALTER DATABASE RECOVER MANAGED STANDBY DATABASE FINISH;
ALTER DATABASE COMMIT TO SWITCHOVER TO PRIMARY WITH SESSION SHUTDOWN;
STARTUP;
ALTER DATABASE OPEN;
```

9. Post-Configuration Validation

Connectivity Testing:

```
-- Test TNS connectivity from both sites
TNSPING PRIMARY_TNSNAME
TNSPING STANDBY_TNSNAME
```

Log Shipping Verification:

-- Generate activity on primary

```
ALTER SYSTEM SWITCH LOGFILE;
```

-- Check archive destination status

```
SELECT DEST_ID, STATUS, ERROR FROM V$ARCHIVE_DEST_STATUS
WHERE DEST_ID = 2;
```

-- Verify logs received on standby

```
SELECT SEQUENCE#, FIRST_TIME, NEXT_TIME FROM V$ARCHIVED_LOG
ORDER BY SEQUENCE# DESC;
```

Data Synchronization Test:

-- Create test table on primary

```
CREATE TABLE DG_TEST (ID NUMBER, TEST_DATA VARCHAR2(100));

INSERT INTO DG_TEST VALUES (1, 'Data Guard Test - ' || SYSDATE);

COMMIT;
```

-- Force log switch and verify on standby

```
ALTER SYSTEM SWITCH LOGFILE;
```

-- Check data on standby (after log apply)

```
SELECT * FROM DG_TEST;
```

Performance Validation:

-- Monitor apply rates

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

-- Check for any apply errors

```
SELECT MESSAGE FROM V$DATAGUARD_STATUS WHERE SEVERITY IN
('Error','Fatal');
```

Final Health Check:

```
-- Comprehensive status check
SELECT
    d.DATABASE_ROLE,
    d.PROTECTION_MODE,
    d.PROTECTION_LEVEL,
    d.SWITCHOVER_STATUS
FROM V$DATABASE d;


-- Archive destination summary
SELECT
    DEST_ID,
    DESTINATION,
    STATUS,
    ERROR
FROM V$ARCHIVE_DEST_STATUS
WHERE STATUS != 'INACTIVE';
```

References

[1] Oracle Corporation, "Oracle Data Guard Concepts and Administration, 19c," Oracle Database Documentation, Oracle Corporation, Redwood City, CA, USA, 2019. [Online]. Available: https://docs.oracle.com/en/database/oracle/oracle-database/19/sbydb/

[2] Oracle Corporation, "Oracle Database Administrator's Guide, 19c," Oracle Database Documentation, Oracle Corporation, Redwood City, CA, USA, 2019. [Online]. Available: https://docs.oracle.com/en/database/oracle/oracle-database/19/admin/

[3] Oracle Corporation, "Oracle Data Guard Broker," Oracle Database Documentation, Oracle Corporation, Redwood City, CA, USA, 2019. [Online]. Available: https://docs.oracle.com/en/database/oracle/oracle-database/19/dgbkr/