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Performing Database Recovery

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Objectives

After completing this lesson, you should be able to:

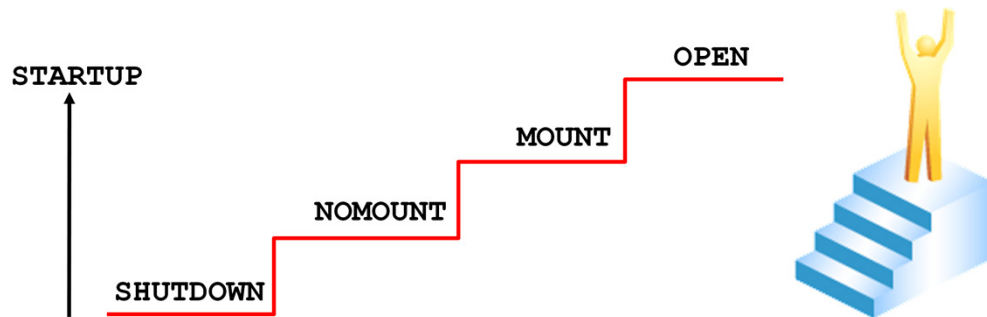
- Determine the need for performing recovery
- Describe and use available options, such as Recovery Manager (RMAN) and the Data Recovery Advisor
- Perform recovery:
 - Control file
 - Redo log file
 - Data file

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Opening a Database

To open a database:

- All control files must be present and synchronized
- All online data files must be present and synchronized
- At least one member of each redo log group must be present



As a database moves from the shutdown stage to being fully open, it performs internal consistency checks with the following stages:

- **NOMOUNT:** For an instance to reach the `NOMOUNT` (also known as `STARTED`) status, the instance must read the initialization parameter file. No database files are checked while the instance enters the `NOMOUNT` state.
- **MOUNT:** As the instance moves to the `MOUNT` status, it checks whether all control files listed in the initialization parameter file are present and synchronized. If even one control file is missing or corrupt, the instance returns an error (noting the missing control file) to the administrator and remains in the `NOMOUNT` state.
- **OPEN:** When the instance moves from the `MOUNT` state to the `OPEN` state, it does the following:
 - Checks whether all redo log groups known to the control file have at least one member present. Any missing members are noted in the alert log.

- Verifies that all data files known to the control file are present unless they have been taken offline. Offline files are not checked until the administrator tries to bring them online. The administrator may take a data file offline and open the instance if the data file does not belong to the `SYSTEM` or `UNDO` tablespaces. If any files are missing, an error noting the first missing file is returned to the administrator and the instance remains in the `MOUNT` state. When the instance finds files that are missing, only the first file causing a problem appears in the error message. To find all files that need recovery, the administrator can check the `v$recover_file` dynamic performance view to get a complete list of the files that need attention:

```
SQL> startup
ORACLE instance started.

Total System Global Area  171966464 bytes
Fixed Size                  775608 bytes
Variable Size              145762888 bytes
Database Buffers           25165824 bytes
Redo Buffers                262144 bytes
Database mounted.
ORA-01157: cannot identify/lock data file 4 - see DBWR trace file
ORA-01110: data file 4: '/oracle/oradata/orcl/users01.dbf'
SQL> SELECT name, error
       2 FROM v$datafile
       3 JOIN v$recover_file
       4 USING (file#);
```

NAME	ERROR
-----	-----
/oracle/oradata/orcl/users01.dbf	FILE NOT FOUND
/oracle/oradata/orcl/example01.dbf	FILE NOT FOUND

- Verifies that all data files that are not offline or read-only are synchronized with the control file. If necessary, instance recovery is automatically performed. However, if a file is out of synchronization to the extent that it cannot be recovered by using the online redo log groups, then the administrator must perform media recovery. If any files require media recovery, an error message noting the first file requiring recovery is returned to the administrator and the instance remains in the `MOUNT` state:

```
ORA-01113: file 4 needs media recovery
ORA-01110: data file 4: '/oracle/oradata/orcl/users01.dbf'
```

Again, `v$recover_file` gives a complete list of files that need attention. Files that are present and require media recovery are listed, but no error message is displayed.

Keeping a Database Open

After the database is open, it fails in case of the loss of:

- Any control file
- A data file belonging to the system or undo tablespaces
- An entire redo log group (As long as at least one member of the group is available, the instance remains open.)

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After a database is open, instance failure can be caused by media failure: for example, by the loss of a control file, the loss of an entire redo log group, or the loss of a data file belonging to the `SYSTEM` or `UNDO` tablespaces. Even if an inactive redo log group is lost, the database would eventually fail due to log switches.

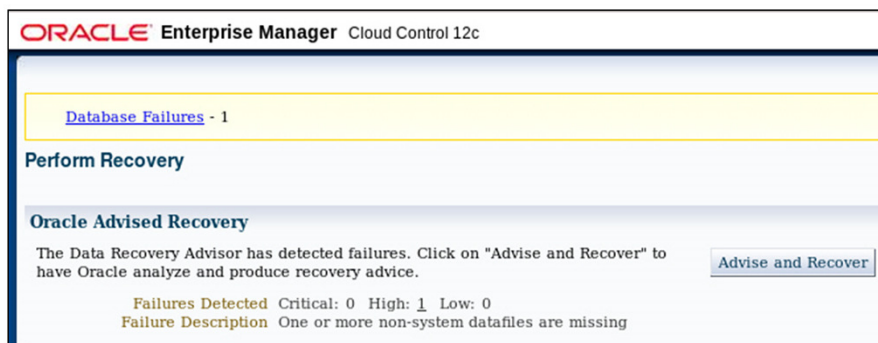
In many cases, the failed instance does not completely shut down but is unable to continue to perform work. Recovering from these types of media failure must be done with the database down. As a result, the administrator must use the `SHUTDOWN ABORT` command before beginning recovery efforts.

The loss of data files belonging to other tablespaces does not cause instance failure, and the database can be recovered while open, with work continuing in other tablespaces.

These errors can be detected by inspecting the alert log file or by using the Data Recovery Advisor.

Data Recovery Advisor

- Fast detection, analysis, and repair of failures
- Handling of down-time and runtime failures
- Minimizing disruptions for users
- User interfaces:
 - Enterprise Manager Cloud Control
 - RMAN command line



The Data Recovery Advisor automatically gathers data failure information when an error is encountered. In addition, it can proactively check for failures. In this mode, it can potentially detect and analyze data failures before a database process discovers the corruption and signals an error. (Note that repairs are always under human control.)

Data failures can be very serious. For example, if your current log files are missing, you cannot open your database. Some data failures (like block corruptions in data files) are not catastrophic because they do not take the database down or prevent you from opening the Oracle database. The Data Recovery Advisor handles both cases: the one when you cannot start up the database (because required database files are missing, inconsistent, or corrupted) and the one when file corruptions are discovered during run time.

The preferred way to address serious data failures is as follows:

1. Fail over to a standby database if you are in a Data Guard configuration. This allows users to come back online as soon as possible.
2. Repair the primary cause of the data failure.

User Interfaces

The Data Recovery Advisor is available in Enterprise Manager Cloud Control. When failures exist, there are several ways to access the Data Recovery Advisor.

You can also use the Data Recovery Advisor by using the RMAN command line:

```
rman target /  
rman> list failure all;
```

Supported Database Configurations

In the current release, the Data Recovery Advisor supports single-instance databases. Oracle Real Application Clusters databases are not supported.

The Data Recovery Advisor cannot use blocks or files transferred from a standby database to repair failures on a primary database. Furthermore, you cannot use the Data Recovery Advisor to diagnose and repair failures on a standby database. However, the Data Recovery Advisor does support failover to a standby database as a repair option (as mentioned previously).

Loss of a Control File

If a control file is lost or corrupted, the instance normally aborts.

- If control files are stored in ASM disk groups, recovery options are as follows:
 - Perform guided recovery using Enterprise Manager.
 - Put database in `NOMOUNT` mode and use an RMAN command to restore control file from existing control file.

```
RMAN> restore controlfile from  
      '+DATA/orcl/controlfile/current.260.695209463';
```

- If control files are stored as regular file system files, then:
 - Shut down the database
 - Copy existing control file to replace lost control file

After control file is successfully restored, open the database.

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The options for recovery from the loss of a control file depend on the storage configuration of the control files and on whether at least one control file remains or have all been lost.

If using ASM storage, and at least one control file copy remains, you can perform guided recovery using Enterprise Manager or perform manual recovery using RMAN as follows:

1. Put the database in `NOMOUNT` mode.
2. Connect to RMAN and issue the `RESTORE CONTROLFILE` command to restore the control file from an existing control file, for example:

```
restore controlfile from  
      '+DATA/orcl/controlfile/current.260.695209463';
```
3. After the control file is successfully restored, open the database.

If your control files are stored as regular file system files and at least one control file copy remains, then, while the database is down, you can just copy one of the remaining control files to the missing file's location. If the media failure is due to the loss of a disk drive or controller, copy one of the remaining control files to some other location and update the instance's parameter file to point to the new location. Alternatively, you can delete the reference to the missing control file from the initialization parameter file. Remember that Oracle recommends having at least two control files at all times.

Note: Recovering from the loss of all control files is covered in the course titled *Oracle Database 12c: Backup and Recovery Workshop*.

Loss of a Redo Log File

If a member of a redo log file group is lost and if the group still has at least one member, note the following results:

- Normal operation of the instance is not affected.
- You receive a message in the alert log notifying you that a member cannot be found.
- You can restore the missing log file by dropping the lost redo log member and adding a new member.
- If the group with the missing log file has been archived, you can clear the log group to re-create the missing file.

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Recovering from the loss of a single redo log group member should not affect the running instance.

To perform this recovery by using SQL commands:

1. Determine whether there is a missing log file by examining the alert log.
2. Restore the missing file by first dropping the lost redo log member:

```
ALTER DATABASE DROP LOGFILE MEMBER '<filename>'
```

Then add a new member to replace the lost redo log member:

```
ALTER DATABASE ADD LOGFILE MEMBER '<filename>'
TO GROUP <integer>
```

Note: If you are using Oracle Managed Files (OMF) for your redo log files and you use the preceding syntax to add a new redo log member to an existing group, that new redo log member file will not be an OMF file. If you want to ensure that the new redo log member is an OMF file, then the easiest recovery option would be to create a new redo log group and then drop the redo log group that had the missing redo log member.

3. If the media failure is due to the loss of a disk drive or controller, rename the missing file.
4. If the group has already been archived, or if you are in `NOARCHIVELOG` mode, you may choose to solve the problem by clearing the log group to re-create the missing file or

files. You can clear the affected group manually with the following command:

```
ALTER DATABASE CLEAR LOGFILE GROUP <integer>;
```

Note: Enterprise Manager does not allow you to clear a log group that has not been archived. Doing so breaks the chain of redo information. If you must clear an unarchived log group, you should *immediately* take a full backup of the whole database. Failure to do so may result in a loss of data if another failure occurs. To clear an unarchived log group, use the following command:

```
ALTER DATABASE CLEAR UNARCHIVED LOGFILE GROUP <integer>
```

Loss of a Data File in NOARCHIVELOG Mode

If the database is in `NOARCHIVELOG` mode and if any data file is lost, perform the following tasks:

1. Shut down the instance if it is not already down.
2. Restore the entire database—including all data and control files—from the backup.
3. Open the database.
4. Have users re-enter all changes that were made since the last backup.



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The loss of *any* data file from a database in `NOARCHIVELOG` mode requires complete restoration of the database, including control files and all data files.

With the database in `NOARCHIVELOG` mode, recovery is possible only up to the time of the last backup. So users must re-enter all changes made since that backup.

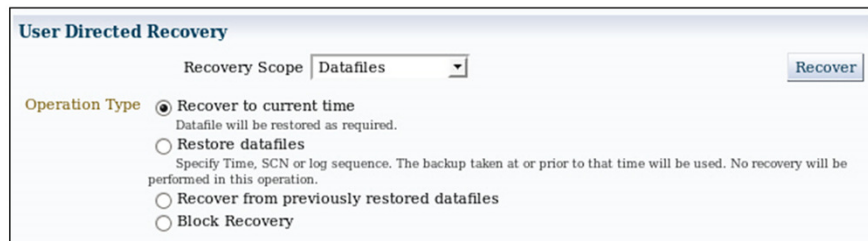
To perform this type of recovery by using Enterprise Manager Cloud Control:

1. Shut down the instance if it is not already down.
2. Select Availability > Backup & Recovery > Perform Recovery.
3. Select Whole Database as the type of recovery.

If you have a database in `NOARCHIVELOG` mode that has an incremental backup strategy, RMAN first restores the most recent level 0 and then RMAN recovery applies the incremental backups.

Loss of a Noncritical Data File in ARCHIVELOG Mode

If a data file is lost or corrupted, and if that file does not belong to the `SYSTEM` or `UNDO` tablespace, you restore and recover the missing data file.



The screenshot shows the 'User Directed Recovery' dialog box. At the top, the title is 'User Directed Recovery'. Below the title, there is a 'Recovery Scope' dropdown menu set to 'Datafiles' and a 'Recover' button. Under the 'Operation Type' section, there are four radio button options: 'Recover to current time' (which is selected), 'Restore datafiles', 'Recover from previously restored datafiles', and 'Block Recovery'. A small text note under 'Recover to current time' states: 'Datafile will be restored as required.' Another note under 'Restore datafiles' states: 'Specify Time, SCN or log sequence. The backup taken at or prior to that time will be used. No recovery will be performed in this operation.'

With the database in `ARCHIVELOG` mode, the loss of any data file not belonging to the `SYSTEM` or `UNDO` tablespaces affects only the objects that are in the missing file. The rest of the database remains available for users to continue work.

To restore and recover the missing data file by using Enterprise Manager Cloud Control, use the Data Recovery Advisor or perform the following steps:

1. Select Availability > Backup & Recovery > Perform Recovery.
2. In the User Directed Recovery section, select Datafiles in the Recovery Scope menu and then select "Recover to current time."
3. Click Recover to begin the guided restore and recovery process.
4. Click Add to select the data files to restore and recover.
5. Specify whether you want to restore the files to the default location or (if a disk or controller is missing) to a new location.
6. Submit the RMAN job to restore and recover the missing files.

Because the database is in `ARCHIVELOG` mode, recovery is possible up to the time of the last commit and users are not required to re-enter any data.

Loss of a System-Critical Data File in ARCHIVELOG Mode

If a data file is lost or corrupted, and if that file belongs to the `SYSTEM` or `UNDO` tablespace, perform the following tasks:

1. The instance may or may not shut down automatically. If it does not, use `SHUTDOWN ABORT` to bring the instance down.
2. Mount the database.
3. Restore and recover the missing data file.
4. Open the database.

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Data files belonging to the `SYSTEM` tablespace or containing `UNDO` data are considered system critical. A loss of one of these files requires the database to be restored from the `MOUNT` state (unlike other data files that may be restored with the database open).

To perform this recovery by using Enterprise Manager Cloud Control:

1. If the instance is not already shut down, shut it down.
2. Mount the database.
3. Select Availability > Backup & Recovery > Perform Recovery.
4. In the User Directed Recovery Section, select Datafiles in the Recovery Scope menu and then select "Recover to current time."
5. Click Add to select all data files that need recovery.
6. Specify whether you want to restore the files to the default location or (if a disk or controller is missing) to a new location.
7. Submit the RMAN job to restore and recover the missing files.
8. Open the database. Users are not required to re-enter data because the recovery is up to the time of the last commit.

Quiz

An Oracle Database instance will not fail if the following event occurs:

- a. Loss of a control file if there is a remaining multiplexed control file
- b. Loss of the `SYSTEM` tablespace
- c. Loss of one redo log member if there is a remaining multiplexed redo log member from the same group of the lost member
- d. Loss of the active undo tablespace

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Answer: c

Summary

In this lesson, you should have learned how to:

- Determine the need for performing recovery
- Describe and use available options, such as Recovery Manager (RMAN) and the Data Recovery Advisor
- Perform recovery:
 - Control file
 - Redo log file
 - Data file

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Practice: Overview

This practice covers recovering from the loss of a:

- Control file
- Noncritical data file
- System-critical data file

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