



RMAN backups in a RAC Environment

Edward Whalen
Performance Tuning
Corporation



Speaker Qualifications

- Edward Whalen, CTO and Founder of Performance Tuning Corporation
- Author for Oracle Press and Microsoft Press
- Teaches classes on Oracle and RAC implementation and performance tuning
- Field consultant working with this technology on a daily basis



Objectives

At the end of this module the student will understand the following tasks and concepts.

- Understand the basic functionality of the Oracle Recovery Manager.
- Understand how to perform basic backup and recovery operations using RMAN.



RAC Review

- Real Application Clusters (RAC)
 - One database
 - Multiple Instances accessing this database
 - All datafiles, controlfiles, redo log files and undo files are shared
 - Clustered Filesystem
 - ASM



ASM Review

- Automatic Storage Management
 - Small Oracle instance
 - Diskgroups made up of multiple disks
 - Managed via SQL*Plus, Grid Control or DB Control
 - Looks like raw devices to the OS



Intro to RMAN

- Oracle Recovery Manager
 - Used to back up Oracle databases
 - Used to back up Archive Log files
 - Used to delete Archive Log files
 - Used to back up Control files
 - Can back up spfiles
 - Necessary for backing up ASM



RMAN Features

- Backup and Restore Client
- Complete or Partial Backups
- Full or Incremental Backups
- Automatically tracks new tablespaces and data files



RMAN Features

- Detects corrupted blocks and reports them
- Does unused block compression
- Employs binary compression for disk backups
- Can test backups without restoring them



RMAN Features

- Can backup to tape (media manager)
- Can backup to disk
 - Can compress backup
 - Two compression types



RMAN Backups sbt vs. disk

- Backup to tape
- Backup to disk



RMAN Backup to Tape

■ Pros

- Backup goes directly from database to media manager
- Uses third party media manager
- Efficient
- Automated

■ Cons

- DBA loses some control
- Backup is not immediately available



RMAN Backup to Disk

■ Pros

- Backup is immediately available
- Restore is fast
- DBA is responsible for backup

■ Cons

- Takes a lot of disk space



Backup Recommendations

- DBA is responsible for doing backups to disk
 - Compressed disk backup
- Sys Administrators take disk backups and back them up to tape on a scheduled basis
- Both are tested on a regular basis



RMAN 11g New Features

- Data Recovery Advisor
- Improved integration with Data Guard
- Improved handling of long-term backups
- Backup failover for archived redo logs in the flash recovery area
- Archived log deletion policy enhancements



RMAN 11g New Features

- Network-enabled database duplication without backups
- Recovery catalog enhancements
- Multisection backups
- Undo optimization
- Improved block media recovery performance
- Improved block corruption detection



RMAN 11g New Features

- Faster backup compression
- Block change tracking support for standby databases
- Improved scripting with RMAN substitution variables
- Integration with VSS-enabled applications
- Lost write detection



RMAN 11g New Features

- Backup of read-only transportable tablespaces
- Backup and recovery enhancements in OEM
- Oracle Flashback Transaction
- Flashback data archive
- Improved media recovery performance for databases on SMP systems



RMAN Metadata

- Stores Backup Metadata
 - Stored scripts
 - Backup settings
 - History
- Metadata can be stored in
 - RMAN Recovery Catalog
 - Control files



RMAN Metadata

- Recovery Catalog
- Control files



The RMAN Recovery Catalog

■ Recovery Catalog

- Can be stored in its own tablespace on a separate server
- Amount of metadata is only limited by disk space
- Your entire enterprise can share the same RMAN recovery catalog



Recovery Catalog Options

- RMAN defaults to the NOCATALOG connect option
 - Uses the target database controlfile for storing recovery metadata
 - Useful for simple backup and recovery options for a single database
- With the CATALOG connect option, a Recovery Catalog may be used
 - A Recover Catalog is a centralized recovery metadata repository
 - Useful for simple to complex backup and recovery options for multiple databases on multiple servers



RMAN Using Controlfiles

- RMAN records will eventually “age out” of the control file and the records will be reused
 - Use the `CONTROLFILE_RECORD_KEEP_TIME` init.ora parameter to control the retention period (default is 7 days)
- Rebuilding the control file will result in RMAN record loss
 - The command “alter database backup controlfile to trace;” does not backup RMAN records
 - Use “alter database backup controlfile to ‘<location>’;” instead to create a binary controlfile copy that maintains RMAN records



Why Use a Recovery Catalog?

- Offers a single enterprise-wide repository for maximum flexibility
- Allows the use of stored RMAN scripts
- Allows you to restore a database from a previous incarnation (period before RESETLOGS)
- Easier to handle the loss of a control file
- Allows creation of reports on the target database at previous points in time
- Maintains consistent RMAN channel configuration default values



Accessing RMAN

- Must be invoked by an account with SYSDBA privileges
- Beware!
 - Linux has two RMANs
 - rman (default path) is reverse man
 - \$ORACLE_HOME/bin/rman is the recovery manager



Invoking RMAN

- With a recovery catalog

`$ORACLE_HOME/bin/rman TARGET / CATALOG user/passwd@service`

- Example

`$ORACLE_HOME/bin/rman TARGET / CATALOG sys/ora123@cat`

`$ORACLE_HOME/bin/rman TARGET sys/pwd@rac1 CATALOG
sys/ora123@cat`

- Using the controlfile

`$ORACLE_HOME/bin/rman TARGET SYS/passwd@service`

- Example

`$ORACLE_HOME/bin/rman TARGET SYS/ora123@orcl`



Creating a Recovery Catalog

- Create a Recovery Catalog Tablespace

```
CREATE TABLESPACE "RECOV_CAT"
```

```
LOGGING
```

```
DATAFILE '/opt/oracle/product/10.1.0/oradata/orcl/
```

```
RECOV_CAT.dbf' SIZE 100M
```



Creating a Recovery Catalog

- Create the rman schema

```
CREATE USER rman IDENTIFIED BY cat  
  TEMPORARY TABLESPACE temp DEFAULT  
  TABLESPACE recov_cat QUOTA UNLIMITED ON  
  recov_cat;
```

- Grant RECOVERY_CATALOG to the
 rman schema rman

```
GRANT RECOVERY_CATALOG_OWNER TO rman;
```



Creating a Recovery Catalog

- Connect to Oracle with either SQLPlus or RMAN

```
sqlplus rman/cat@orcl
```

```
$ORACLE_HOME/bin/rman TARGET / CATALOG
```

```
rman/cat@orcl
```

- Run the CREATE CATALOG script to create the recovery catalog
 - RMAN> CREATE CATALOG



Validating the Recovery Catalog

- Connect into the Oracle database as rman and select from user_tables

```
sqlplus rman/cat@orcl
```

```
SELECT table_name from user_tables
```

- Connect into RMAN

```
$ORACLE_HOME/bin/rman TARGET / CATALOG
```

```
rman/cat@orcl
```

- Note “connected to recovery catalog database”



Connecting with RMAN

- Connect into the target database using
SYS
- Connect into the recovery catalog using
rman
- Connect into both the target database and
recovery catalog using both
\$ORACLE_HOME/bin/rman TARGET
sys/ora123@orcl CATALOG rman/cat@orcl



Registering a Target Database in the Recovery Catalog

- Connect into RMAN
- Run register database
- Validate with report schema
- Once registered
 - Configuration settings are associated with this database
 - Scripts are associated with this database



RMAN Information

- The show command displays information about the RMAN configuration
 - show all – displays everything
- The list command displays information about previous backups
 - list backup – displays a list of backups
- The report commands creates RMAN reports on operations



RMAN Configuration

■ Configure Devices

- sbt device is the media manager

- Veritas

- Legato

- Tivoli

- Local disk can be used

■ Configure Channels

- Used to perform the backups



Configuring Devices

- Setup default devices

- Configure media manager

- CONFIGURE DEFAULT DEVICE TYPE TO sbt;

- Configure disk backup

- CONFIGURE DEFAULT DEVICE TYPE TO DISK;

- It can also be setup to use compressed savesets

- CONFIGURE DEVICE TYPE DISK BACKUP TYPE TO COMPRESSED BACKUPSET;



Configuring Backup Compression

- Turn on Compression
 - CONFIGURE DEVICE TYPE disk BACKUP TYPE to COMPRESSED BACKUPSET;
- Choose Compression Algorithm
 - CONFIGURE COMPRESSION ALGORITHM TO '*alg_name*';
 - BZIP2 (default)
 - ZLIB



Configuring Backup Compression

- BZIP2 (default)

- We've experienced a 100GB database backup in 15GB of space
- Excellent Compression
- High CPU

- ZLIB (new in Oracle 11g)

- Less compression
- Less CPU used



Configuring Channels

- Channel is the device path to the backup media
- With a disk device, this is the path
CONFIGURE CHANNEL DEVICE TYPE DISK
FORMAT '/u03/oracle/backup/ora_df%U';
 - Many options available



Configuring Parallel Backup

- Backup using a compressed disk backup with parallelism 2

```
CONFIGURE DEFAULT DEVICE TYPE TO disk;  
CONFIGURE DEVICE TYPE disk PARALLELISM 2;  
CONFIGURE DEVICE TYPE disk BACKUP TYPE TO COMPRESSED  
  BACKUPSET;  
CONFIGURE CHANNEL DEVICE TYPE DISK MAXPIECESIZE 2G;  
CONFIGURE CHANNEL DEVICE TYPE DISK FORMAT = /tmp/%U;  
BACKUP DATABASE;
```



Configuring Parallel Backup to Separate Disk Drives

- Backup using a compressed disk backup with parallelism 2 to two different disks

```
CONFIGURE DEFAULT DEVICE TYPE TO disk;  
CONFIGURE DEVICE TYPE disk PARALLELISM 2;  
CONFIGURE DEVICE TYPE disk BACKUP TYPE TO COMPRESSED  
  BACKUPSET;  
CONFIGURE CHANNEL DEVICE TYPE DISK MAXPIECESIZE 2G;  
CONFIGURE CHANNEL 1 DEVICE TYPE DISK FORMAT = '/u01/%U';  
CONFIGURE CHANNEL 2 DEVICE TYPE DISK FORMAT = '/u02/%U';  
BACKUP DATABASE;
```



Configuring Channels on Multiple Nodes

- Backup using a compressed disk backup with parallelism 2 to two different disks

```
CONFIGURE DEFAULT DEVICE TYPE TO disk;
```

```
CONFIGURE DEVICE TYPE disk PARALLELISM 2;
```

```
CONFIGURE DEVICE TYPE disk BACKUP TYPE TO COMPRESSED  
BACKUPSET;
```

```
CONFIGURE CHANNEL DEVICE TYPE DISK MAXPIECESIZE 2G;
```

```
CONFIGURE CHANNEL 1 DEVICE TYPE DISK connect  
'sys/pwd@node1' FORMAT = '/u01/%U';
```

```
CONFIGURE CHANNEL 2 DEVICE TYPE DISK connect  
'sys/pwd@node2' FORMAT = '/u01/%U';
```

```
BACKUP DATABASE;
```



Configuring Controlfile Backups

- Controlfiles can be set to auto backup whenever a backup occurs by setting autobackup on.

```
CONFIGURE CONTROLFILE AUTOBACKUP on;
```



Performing Backups

- There are a number of different ways to do backups

BACKUP DATABASE

BACKUP TABLESPACE 'USERS';

BACKUP INCREMENTAL LEVEL 0 DATABASE;

BACKUP CURRENT CONTROLFILE;

BACKUP SPFILE



SPFILE Backups

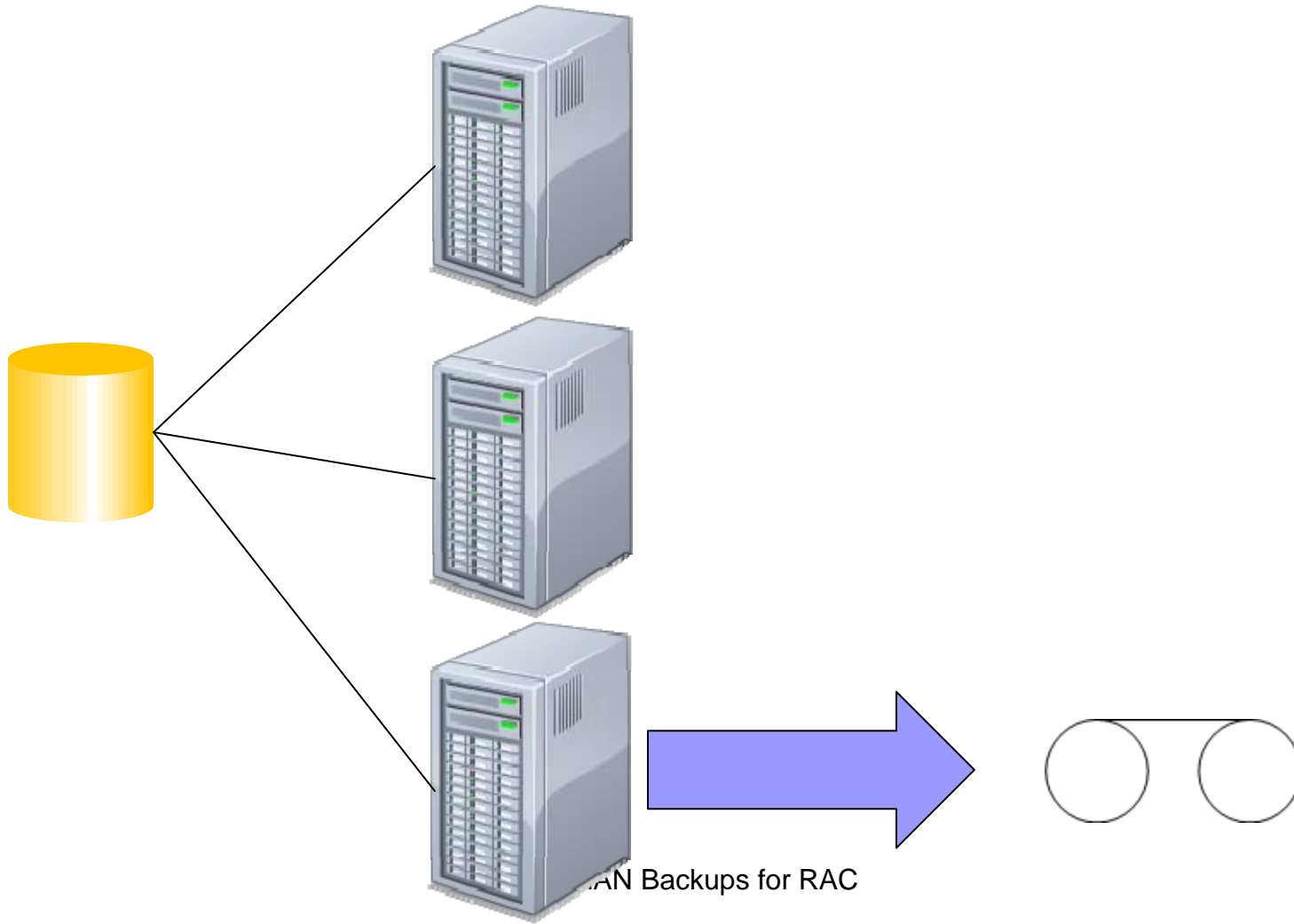
- RMAN backups are great
- Create pfiles as a backup for the spfile
 - `CREATE PFILE='/u01/initRAC.ora'`
`FROM`
`SPFILE='+DATADG/';`
 - Useful for resetting parameters
 - The ASM instance must be up



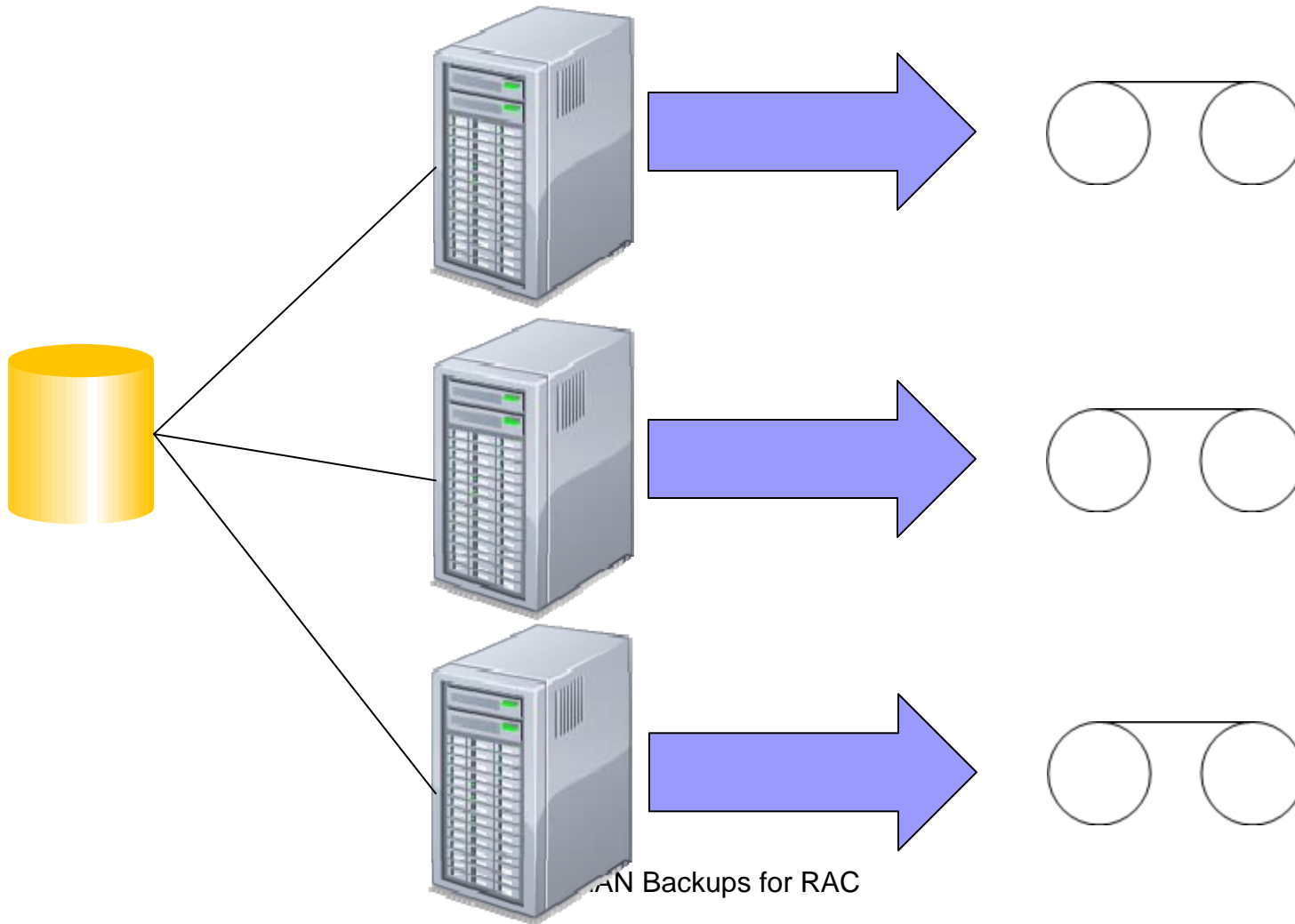
RAC Database Backups

- RAC backups from one node
- RAC backups from multiple nodes

RAC Backups From One Node



RAC Backups From Multiple Nodes





RAC Backups from one Node

- RAC database backups are essentially the same as single instance backups, if you setup all database files on shared disk
- Backup from one node
 - Exception: you must back up all threads of archive log files (all nodes)
- Should backup Cluster files at the same time



RAC Backups from Multiple Nodes

■ Pros

- More CPU available for compression
- More parallelism

■ Cons

- I/Os are all going to the same storage
- More load on the system(s)



Restore Backup

- Restore to one node
 - Apply archive logs from all nodes as requested



Crosscheck Backup

- Crosscheck synchronizes backup pieces on disk with information in the RMAN metadata
- It is a good idea to crosscheck backups and copies before deleting them
CROSSCHECK BACKUP;
CROSSCHECK COPY;



Managing Archive Logs with RMAN

- Archive logs stored within ASM can be difficult to manage
- The recommended option for backing up and removing archivelog files is via RMAN
 - BACKUP ARCHIVELOG;
 - DELETE ARCHIVELOG;



Advanced Archivelog Management

- Backup

```
BACKUP ARCHIVELOG ALL NOT BACKED  
UP SINCE TIME='SYSDATE-1' FORMAT  
'/u01/backup/arch/arch_%U' ;
```

- Backups up archivelogs that have not been backed up in the last day.



Advanced Archivelog Management

- Delete Archivelogs

- DELETE ARCHIVELOG UNTIL TIME 'SYSDATE-1'
BACKED UP 2 TIMES TO DISK;

- Deletes archivelogs over 1 day old that have been backed up at least once.

- Note: In Oracle 11g an archive log needed for Data Guard will not be deleted.



Example RMAN Online Backup Script

- Here is an example for a disk-based online backup:

```
run {
allocate channel c1 device type disk connect 'sys/passwd@node1' format
'/u04/mydb/backup/mydb_%d_%U';
allocate channel c2 device type disk connect 'sys/passwd@node2' format
'/u05/mydb/backup/mydb_%d_%U';
configure controlfile autobackup on;
backup database plus archivelog;
release channel c1;
release channel c2;
}
```



Performing Restores

- First preview the restore

 - RESTORE DATABASE PREVIEW;

 - RESTORE TABLESPACE users PREVIEW;

 - RESTORE DATAFILE 3 PREVIEW;

- Preview allows you to see a report before the restore takes place



Performing Restores

- Performing the Restore

```
RESTORE DATABASE;
```

```
RESTORE TABLESPACE users;
```

```
RESTORE DATAFILE 3;
```



Validating Backups

- Backups can be validated with restore validate

RESTORE DATABASE VALIDATE;

RESTORE CONTROLFILE VALIDATE;

RESTORE TABLESPACE users VALIDATE;

RESTORE ARCHIVELOG ALL VALIDATE;

Example of Complete Recovery Using an RMAN Online Backup

- Here is an example recovery from an online backup (followed by an immediate backup):

```
ORACLE_SID=mydb
export ORACLE_SID
$ORACLE_HOME/bin/rman target mydb/password
Rman> startup nomount;
Rman> set DBID = <enter your DBID>;
Rman> restore spfile from autobackup;
Rman> restore controlfile from autobackup;
Rman> alter database mount;
Rman> restore database;
Rman> recover database;
Rman> alter database open resetlogs;
Rman> shutdown immediate;
Rman> startup mount;
Rman> backup database;
Rman> quit
```

Using OEM to Perform RMAN Backup and Recovery

- The Job Scheduler in OEM can also be used to backup and recover Oracle using RMAN
- In the Backup/Recovery section of the Maintenance page, click **Schedule Backup**.
- There are many options for full and incremental backups

The screenshot displays the Oracle Enterprise Manager 10g Database Control interface. At the top, the title bar reads "ORACLE Enterprise Manager 10g Database Control" with navigation links for "Setup", "Preferences", "Help", and "Logout". Below the title bar, the breadcrumb "Database Instance: database > Schedule Backup" is visible. The main heading is "Schedule Backup".

A section titled "Current Database Information" contains a sub-section "Backup Jobs" with the text: "You have one or more backup jobs that are currently running or scheduled for this target." Below this, a paragraph states: "Based on your disk and/or tape configuration, Oracle provides an automated backup strategy, or you can develop your own backup strategy with customized options."

The "Oracle-Suggested Backup" section includes a description: "Schedule a backup using Oracle's automated backup strategy." and a button "Schedule Oracle-Suggested Backup". A note below explains: "This option will back up the entire database. The database will be backed up on daily and weekly intervals."

The "Customized Backup" section prompts the user to "Select the object(s) you want to back up." with a button "Schedule Customized Backup". Radio button options include: "Whole Database" (selected), "Tablespaces", "Datafiles", "Archivelogs", and "All Recovery Files on Disk". A note specifies: "These files include all archivelogs and disk backups that are not already backed up to tape."

The "Backup Strategies" section is divided into "Oracle-suggested:" and "Customized:". The "Oracle-suggested:" list includes: "Provides an out-of-the-box backup strategy based on the backup destination. Options may vary based on the database version.", "Sets up recovery window for backup management", "Automates backup management", and "Schedules recurring backups". The "Customized:" list includes: "Specify the objects to be backed up", "Choose a disk or tape backup destination", "Override the default backup settings", and "Schedule the backup".

The "Host Credentials" section instructs: "To perform a backup, supply operating system login credentials to access the target database." It features input fields for "Username" (containing "aaromero") and "Password" (masked with asterisks), and a checkbox for "Save as Preferred Credential".

At the bottom, there are navigation links "Database | Setup | Preferences | Help | Logout" and a copyright notice: "Copyright © 1996, 2005, Oracle. All rights reserved. About Oracle Enterprise Manager 10g Database Control".



Duplicating or Cloning Databases

- Data Guard
 - Use Duplicate Database for Standby
 - Creates database with same DBID
- Duplicate Database
 - Creates a database with a New DBID
- Duplicate does not reset the catalog!



Duplicate Database (10g)

1. Backup Primary
2. Connect to Primary and Auxiliary (standby)
3. Duplicate Database for Standby



Duplicate Database (10g)

- Connect to the TARGET (primary)
- Connect to the CATALOG
- `$ORACLE_HOME/bin/rman TARGET sys/pwd@prim CATALOG rman/cat@orcl`
- `RMAN> BACKUP DATABASE PLUS ARCHIVELOG;`



Duplicate Database (10g)

- Connect to the TARGET (primary)
- Connect to the AUXILIARY (standby)
- Connect to the CATALOG
\$ORACLE_HOME/bin/rman TARGET sys/pwd@prim
AUXILIARY sys/pwd@stdby CATALOG rman/cat@orcl
- Duplicate the database
RMAN> DUPLICATE DATABASE FOR STANDBY;



Duplicate Database (11g)

1. Connect to Primary and Auxiliary (standby)
2. Duplicate Database for Standby



Duplicate Database (11g)

- Connect to the TARGET (primary)
- Connect to the AUXILIARY (standby)
- Connect to the CATALOG
\$ORACLE_HOME/bin/rman TARGET sys/pwd@prim
AUXILIARY sys/pwd@stdby CATALOG rman/cat@orcl
- Duplicate the database
RMAN> DUPLICATE DATABASE FOR STANDBY
FROM ACTIVE DATABASE;



Best Practices and Tips

- Use ASM
- If feasible use smallfile tablespaces
- Use backup paralellism
- Backup to disk, then to tape



Summary

- RMAN Concepts
- RMAN Functionality
- 10g New Features



Questions?

- Address questions here
- Email ewhalen@perftuning.com
- Web: www.perftuning.com