

**Deduplication of an Oracle
database using EMC
NetWorker Module for
Oracle 5.0**

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Table of Contents

General Information.....	4
Requirements Product Architecture.....	4
Deduplication Components.....	5
Product Architecture.....	6
Backup Overview.....	6
An example of a manual Oracle RMAN backup script follows on the next page.....	8
Example of a Manual Oracle RMAN Backup.....	9
Restore Overview.....	10
Example of a Restore Oracle RMAN Script.....	10
Illustration Environment.....	12
Installation Overview.....	12
Before You Begin.....	13
Installation of NetWorker Module for Oracle Software on the Oracle Server.....	13
Manual backups.....	18
NetWorker Media Database.....	22
Scheduled Backups.....	26
NetWorker Management Console Reporting.....	28
Cloning and Staging.....	29
Restores.....	30
NMO Deduplication Limitations.....	40
Best Practices Guidelines.....	40
Oracle Data.....	40
RMAN backup levels.....	40
CPU utilization.....	41
RMAN Tuning.....	42
Referenced Documentation.....	44

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General Information

NetWorker® Module for Oracle 5.0 represents the software's first integration with the Avamar deduplication server. This feature empowers users to conduct Oracle deduplication backups and restores via the integrated use of a deduplication storage node (Avamar server). A deduplication backup can be either a manual backup initiated within RMAN or a scheduled backup via the NetWorker Management Console scheduler framework.

There are a number of differences and additional configuration items to consider when deploying NetWorker Module for Oracle 5.0 to perform deduplication backups. This article highlights these considerations and provides guidance for deployment. It is not intended to be a step by step guide, nor does it replace the Installation Guide or Release Notes. This article assumes a level of knowledge using NetWorker, Avamar, Oracle, and NetWorker Module for Oracle.

Note: The following information is not intended to be a substitute for the Release Notes or normal pre-delivery technical planning.

Requirements Product Architecture

The information in this article was written with reference to NetWorker Module for Oracle 5.0 (or later), NetWorker 7.5 (or later), and requires the following specific software versions:

- EMC NetWorker 7.5 or later
- EMC Avamar server 3.7.2-57 or later
- Data Store appliance

The following NetWorker licenses are also required:

- Deduplication option - 1 per Avamar server
- DBO for AFTD device (free of charge for the first 10 TB)
- NetWorker Module for Oracle license

Deduplication Components

The following EMC components must exist in the data zone infrastructure to perform deduplication Oracle backups.

1) Avamar Server –a disk-based backup product built on client server technology. The key feature is deduplicating data from various clients on the De-dupe node such that only a single instance of any unique data is maintained on the Avamar server. The Avamar server is represented in the NetWorker server configuration as a new NetWorker RAP resource called a Deduplication node. The resource is accessible through nsradmin utility and the NetWorker Management Console.

2) NetWorker backup server – provides services to back up and recover data for the NetWorker client computers in a datazone. All NetWorker servers and clients are managed from the NetWorker Console server. The Console server also provides reporting and monitoring capabilities for all NetWorker servers and clients. For the purpose of this article, the NetWorker Console server and NetWorker backup server will be the same host.

3) NetWorker Module for Oracle is an add-on module for NetWorker installed on an Oracle application server. With NetWorker Module for Oracle, you can perform the following tasks:

- Manual Oracle backups (deduplication or non)
- Scheduled Oracle backups (deduplication or non)
- Restores of Oracle backup data (deduplication or non)
- Automated media management

Product Architecture

The key feature offered by an Avamar server is the deduplication of data from various NetWorker deduplication clients such that only a single instance of any unique data chunk is maintained on the Avamar server. The deduplication of data is done on the client host saving network bandwidth by eliminating the transmission of duplicated blocks over the LAN / WAN.

An EMC Avamar server interacts with the NetWorker server and NMO software during deduplication backups and restores. The Avamar server is configured as a NetWorker deduplication node, and deduplicates the data from various clients, including the NMO clients. (The Avamar server must also be available when a deduplication client resource is created).

On the Oracle server, the binary responsible for deduplication is called nsravtar. It is included in the NetWorker client software package commencing in version 7.4.1 and higher. The nsravtar process chunks and hashes the backup data, and compares already known hashes of data chunks local to the server, or known remotely to the Avamar server. To improve backup and restore performance, nsravtar utilizes file cache and hash cache data structures stored in the nsr\dedup\cache directory of the client machine.

Backup Overview

During a deduplication backup, the data is first analyzed and broken into chunks. Hashes are generated for these chunks, and a comparison is made to local cache to determine if this is an already known hash. No further lookups are needed if a similar hash is found locally on the Oracle server. If the local lookup fails to find a similar hash, a query to the Avamar server (defined as a NetWorker Deduplication storage node) is made to determine if this hash is known to the Avamar server in general – perhaps from other clients in the infrastructure that might have generated the same hash id from their backups. If that lookup is successful, the data from the Oracle server is not sent; the hash table locally stored on the Oracle server is updated. If the lookup on the Avamar server did not find the hash id, the data is sent from the Oracle server to the Avamar

server (NetWorker deduplication storage node). The hash id is updated on both the Oracle server and Avamar server, and media tracking information (NetWorker metadata) is sent to the NetWorker backup server. The metadata sent to the backup server is typically very small, usually only a few bytes per file saved. It is generally recommended that you store the metadata on an AFTD to improve performance and access times.

There are some new additional NSR_* variables to facility manual RMAN initiated dedup backups. Set these parameters in the RMAN script through SEND or PARMS options (where SEND is the preferable method), or for automatically configured channels.

NSR_DEDUP_BACKUP is mandatory for manual deduplication backups only. It should not be set for scheduled backups because this information will be sent by savegrp at run time (similar behavior as for NSR_GROUP, NSR_SERVER parameters). FALSE is the default for the Boolean value: TRUE or FALSE. It specifies whether to perform a deduplication backup or not.

NSR_DEDUP_NODE: Mandatory for manual deduplication backups only. It should not be set for scheduled backups because this info will be sent by savegrp at run time. String value: <Avamar server name as set in the NW deduplication node>. Default value: none. It specifies the Avamar server that will store the client's data.

NSR_DEDUP_CACHE_TAG: Mandatory. String value: <nsravtar cache name>. Default: / (forward slash) signifying the root directory. It specifies the name for the cache to be used by nsravtar during the NMO backup. The recommended cache tag name is <ORACLE_SID or net service name>_<channel ID> (ORCL102_t1). This parameter must be set to a different value for each channel because each nsravtar process needs its own set of caches. This parameter should not contain the client's name.

Review the latest release of the NetWorker Module for Oracle Administrators guide for a complete list of the supported NSR* variables that may be defined in the RMAN script.

During the course of an NMO deduplication backup, the Oracle spawned server process will spawn an nsrvtar process for each SBT_TAPE channel allocated in the RMAN script. The nsrvtar process is CPU intensive, no more than 4 channels should be allocated per dedupe RMAN backup as that would greatly slow system performance.

If a single RMAN channel will generate more than one NetWorker save set (backup piece) due to the backup configuration, there will be a separate nsrvtar process created for each save set, but there will be a single nsrvtar process per channel at any given time. For example, assume that there are 19 datafiles in the Oracle database, and a single SBT_TAPE channel is allocated in the RMAN script, with a filesperset value set to 5. The result of this would be 5 datafiles that are bundled together into a backup piece. This Oracle backup piece would be equivalent to a NetWorker save set name. The Oracle spawned a server process would call on nsrvtar to begin the above noted chunk and hash process. Once the backup piece is saved, the nsrvtar process exits and a new one begins for the next Oracle backup piece. This would continue 4 times since $4 * 5$ filesperset would cover the amount of work required to backup the data.

Tracking information is updated in the NetWorker Client File Indexes throughout the backup runtime. The nsrmmd background process on the NetWorker storage node server records tracking information in the NetWorker media database through the nsrmmdbd service. The media database entry contains extended attributes that identify the backup as a deduplication backup. A detailed illustration of the new deduplication attributes is included in later section of this document. The Oracle process sends tracking information to the NetWorker client file index using the nsrindexd service.

An example of a manual Oracle RMAN backup script follows on the next page.

Example of a Manual Oracle RMAN Backup

```
run {
allocate channel t1 type 'SBT_TAPE';
allocate channel t2 type 'SBT_TAPE';

send
'NSR_ENV=(NSR_SERVER=ecc1,NSR_CLIENT=oracle,NSR_DEDUP_BACKUP=TRU
E,NSR_DEDUP_NODE=avamar01-01)';
send channel t1 'NSR_ENV=(NSR_DEDUP_CACHE_TAG=orac_t1)';
send channel t2 'NSR_ENV=(NSR_DEDUP_CACHE_TAG=orac_t2)';
backup full filesperset 4 format '/FULL_%d_%U/' database;
release channel t1;
release channel t2;
}
```

Reviewing the above script we see:

- We are allocating 2 SBT_TAPE channels
- We are passing to both of these channels values in NSR_SERVER – the name of the NetWorker backup server, NSR_CLIENT – the name of the Oracle application host we are conducting the backup from, NSR_DEDUP_BACKUP – Boolean true or false, and NSR_DEDUP_NODE – the NetWorker deduplication storage node.
- Passing a unique CACHE_TAG to each of the 2 channels
- Defining the level of backup, degree of Oracle parallelism, and backup piece name format we wish to have.
- Finally releasing the allocated channels

With this script, we are going to bundle up to 4 datafiles at a time (from the filesperset) on each channel. This means that we should see no more than 2 nsrvtar background processes executing at any given point in time at the OS level .

Restore Overview

During a restore operation, the execution workflow is simpler than the one for backup since there is no need to chunk and hash the data. The RMAN script is the main driver of the restore, which would once again define the SBT_TAPE channel allocations, and would use the NSR_SERVER variable to define the NetWorker backup server to utilize for the backup. The NSR_CLIENT variable is also needed to define the NetWorker Client File Index database to use for the look up of the backup pieces that Oracle requires in the restore procedure.

Example of a Restore Oracle RMAN Script

```
run {  
allocate channel t1 type 'SBT_TAPE' parms  
'ENV=(NSR_SERVER=ecc1,NSR_CLIENT=oracle)';  
restore database;  
release channel t1;  
}
```

As you can see, the variables needed during the backup to explicitly define that a deduplication backup is the desired function are not required for a restore operation. i.e. NSR_DEDUP_BACKUP=TRUE,NSR_DEDUP_NODE=avamar01-01 are not needed in the RMAN script.

During execution of the RMAN script, Oracle parses the RMAN script to determine what various Oracle objects are needed. A lookup in the recovery catalog (if one is used) or the target databases control file determines the various backup pieces needed to facilitate the restore.

Once Oracle builds a list of the various backup pieces, it calls on the Media Management Layer (MML) to fetch them. Since NetWorker Module for Oracle was linked with Oracle during the installation, it facilitates the MML duties Oracle calls upon.

NMO translates the object name requested by RMAN into a format that the NetWorker server understands, and forwards the names to the NetWorker server to verify that the backup pieces exist in the NetWorker client file index and media database.

It starts an nsrvtar process when the Oracle Server (which NMO is linked with) process determines, based on information in the NetWorker media database, that the data comes from a deduplication backup.

The NetWorker nsrmmd process reads hash IDs stored on the volume (from the backup), and passes them back to Oracle. Next, the Oracle process passes the hash IDs to the nsrvtar process, which in turn retrieves the corresponding data from the Avamar server (NetWorker deduplication Storage node).

Nsrvtar does not perform the actual write function of the data back on to the disk.

Oracle does this as it is in charge of performing the actual I/O operation from / to disk.

The Avamar server is commonly setup in a replication format, such that all data which exists of Avamar server_A, would be replicated on Avamar server_B. During the data backup, the media database is populated with extended attributes for each backed up NetWorker saveset. During a restore if nsrvtar attempts to contact the Avamar server (NetWorker deduplication storage node), but is not successful (i.e. system is down), nsrvtar will automatically contact the replication member of the original server to retrieve the desired data.

NOTE: The Avamar replication server must be registered with the NetWorker server at the time of the backup or it will not be used for a recovery.

In addition to defining the Avamar server as a NetWorker dedup storage node, there must also be a Deduplication node resource for the replication Avamar server in order for the restore from the alternate location to succeed.

Illustration Environment

This illustration uses the following environment

Oracle Application server

TCP name = oracle

Solaris 8 – 64 bit

Oracle Version 9.2.0.1.0 - 64 bit

NetWorker Module for Oracle 5.0 – 64 bit

NetWorker Client 7.5

NetWorker Backup Server

TCP name = ecc1

Window 2003 – 32 bit x86

NetWorker 7.5 x86 – 32 bit

NetWorker Management Console 3.5

Avamar Server

TCP name = avamar01-01

Linux Enterprise Linux ES release 4 – 64 bit

Avamar server v4.0.3.18

NetWorker Client 7.5 - 64 bit

Installation Overview

This section provides an overview of the installation process for some key components. It is included as an aid and is not intended to be a comprehensive guide. Refer to the appropriate NetWorker Installation Guide, Administration Guide, and NetWorker Module for Oracle Install Guide and Release Notes for the latest procedures. These should be referenced prior to installation and configuration.

Before You Begin

1. Install and configure an Avamar 3.7.2 or later server at your site according to the instructions found in the Avamar System Installation Manual for your platform.
2. Ensure that this server is running Avamar 3.7.2-57 or later server software and ensure that it is fully operational.
3. Install the NetWorker 7.5 client on the Oracle Application host and verify that basic deduplication backup and recover functionality exists.

Installation of NetWorker Module for Oracle Software on the Oracle Server

IMPORTANT: This task requires operating system root privileges on the Avamar server utility node.

1. Open a command shell and log onto the Oracle Application server as the root user.
2. Obtain the NetWorker Module for Oracle 5.0 software and familiarize yourself with the Multiplatform Installation Guide and Release Notes.
3. Verify that a previous version of NetWorker Module for Oracle is not currently installed. If it is, uninstall it first, then install NMO 5.

```
# pkginfo -I LGTOOnmo
```

```
ERROR: information for "LGTOOnmo" was not found
```

```
(This shows that there is no pre-existing version of NMO installed on the system)
```

4. Change to the directory containing the NetWorker software.

5. Unzip and untar the NMO software

```
# ls
```

```
nmo50_solaris_64.tar.gz
```

```
# gunzip *
```

```
# tar -xvf nmo50_solaris_64.tar
```

```
x LGTO_METAFILE_solaris8w_nmo.mf, 970 bytes, 2 tape blocks
```

x LGTONmo, 0 bytes, 0 tape blocks
x LGTONmo/pkgmap, 1886 bytes, 4 tape blocks
x LGTONmo/pkginfo, 588 bytes, 2 tape blocks
x LGTONmo/root, 0 bytes, 0 tape blocks
x LGTONmo/root/etc, 0 bytes, 0 tape blocks
x LGTONmo/root/etc/nsrnmo.sh, 7610 bytes, 15 tape blocks
x LGTONmo/root/usr, 0 bytes, 0 tape blocks
x LGTONmo/root/usr/lib, 0 bytes, 0 tape blocks
x LGTONmo/root/usr/lib/libnwor.so, 31782560 bytes, 62076 tape blocks
x LGTONmo/install, 0 bytes, 0 tape blocks
x LGTONmo/install/checkinstall, 6130 bytes, 12 tape blocks
x LGTONmo/install/copyright, 41 bytes, 1 tape blocks
x LGTONmo/install/postinstall, 30438 bytes, 60 tape blocks
x LGTONmo/install/postremove, 8664 bytes, 17 tape blocks
x LGTONmo/install/preinstall, 1056 bytes, 3 tape blocks
x LGTONmo/install/preremove, 5363 bytes, 11 tape blocks
x LGTONmo/reloc, 0 bytes, 0 tape blocks
x LGTONmo/reloc/lib, 0 bytes, 0 tape blocks
x LGTONmo/reloc/lib/nsr, 0 bytes, 0 tape blocks
x LGTONmo/reloc/lib/nsr/nmo, 0 bytes, 0 tape blocks
x LGTONmo/reloc/lib/nsr/nmo/sparcv9, 0 bytes, 0 tape blocks
x LGTONmo/reloc/lib/nsr/nmo/sparcv9/libcommonssl.7.5.179.so, 9366928 bytes, 18295
tape blocks
x LGTONmo/reloc/sbin, 0 bytes, 0 tape blocks
x LGTONmo/reloc/sbin/fdiff.jar, 46491 bytes, 91 tape blocks
x LGTONmo/reloc/sbin/nsrnmo, 7610 bytes, 15 tape blocks
x LGTONmo/reloc/sbin/nsrnmoadmin, 1813512 bytes, 3543 tape blocks
x LGTONmo/reloc/sbin/nsrnmodrpostcmd, 509 bytes, 1 tape blocks
x LGTONmo/reloc/sbin/nsrnmoinfo, 1637544 bytes, 3199 tape blocks
x LGTONmo/reloc/sbin/nsrnmoprobe, 1960960 bytes, 3830 tape blocks
x LGTONmo/reloc/sbin/nsrnmostart, 1971912 bytes, 3852 tape blocks
x LGTONmo/reloc/sbin/nsroraclecat, 1708808 bytes, 3338 tape blocks
x LGTONmo/reloc/sbin/nsrorara, 1918368 bytes, 3747 tape blocks
x LGTONmo/reloc/sbin/nwor.jar, 273306 bytes, 534 tape blocks

```
x LGTONmo/reloc/sbin/nwora_res.jar, 278800 bytes, 545 tape blocks
x LGTONmo/reloc/share, 0 bytes, 0 tape blocks
x LGTONmo/reloc/share/man, 0 bytes, 0 tape blocks
x LGTONmo/reloc/share/man/man1m, 0 bytes, 0 tape blocks
x LGTONmo/reloc/share/man/man1m/nsrnmo.1m, 3040 bytes, 6 tape blocks
x LGTONmo/reloc/share/man/man1m/nsrnmoadmin.1m, 7232 bytes, 15 tape blocks
x LGTONmo/reloc/share/man/man1m/nsrnmoinfo.1m, 2090 bytes, 5 tape blocks
x LGTONmo/reloc/share/man/man1m/nsrnmostart.1m, 2436 bytes, 5 tape blocks
x LGTONmo/reloc/share/man/man1m/nsroraclecat.1m, 4004 bytes, 8 tape blocks
x LGTONmo/reloc/share/man/man1m/nsrorara.1m, 1798 bytes, 4 tape blocks
x sd_products.res, 46610 bytes, 92 tape blocks
#
```

6. Install the NetWorker Linux client software in the default location:

```
# pkgadd -d .
```

The following packages are available:

```
1 LGTONmo   EMC NetWorker Module for Oracle
            (sparc) 5.0 [LNMs_2008.Build.237]
```

Select package(s) you wish to process (or 'all' to process all packages). (default: all) [?,??,q]: 1

Processing package instance <LGTONmo> from </disk2/nw/nmo/5>

EMC NetWorker Module for Oracle

```
(sparc) 5.0 [LNMs_2008.Build.237]
```

```
Copyright (c) 1990-2009, EMC Corporation
```

```
## Executing checkinstall script.
```

```
Using </usr> as the package base directory.
```

```
## Processing package information.
```

```
## Processing system information.
```

```
8 package pathnames are already properly installed.
```

```
## Verifying disk space requirements.
## Checking for conflicts with packages already installed.
## Checking for setuid/setgid programs.
```

This package contains scripts that will be executed with super-user permission during the installation of this package.

Do you want to continue with the installation of <LGTONmo> [y,n,?] **y**

Installing EMC NetWorker Module for Oracle as <LGTONmo>

```
## Executing preinstall script.
## Installing part 1 of 1.
/etc/nsrnmo.sh
/usr/lib/libnwora.so
/usr/lib/nsr/nmo/sparcv9/libcommonssl.7.5.179.so
/usr/sbin/fdiff.jar
/usr/sbin/nsrnmo
/usr/sbin/nsrnmoadmin
/usr/sbin/nsrnmodrpostcmd
/usr/sbin/nsrnmoinfo
/usr/sbin/nsrnmoprobe
/usr/sbin/nsrnmostart
/usr/sbin/nsroraclecat
/usr/sbin/nsrorara
/usr/sbin/nwora.jar
/usr/sbin/nwora_res.jar
/usr/share/man/man1m/nsrnmo.1m
/usr/share/man/man1m/nsrnmoadmin.1m
/usr/share/man/man1m/nsrnmoinfo.1m
/usr/share/man/man1m/nsrnmostart.1m
/usr/share/man/man1m/nsroraclecat.1m
/usr/share/man/man1m/nsrorara.1m
[ verifying class <none> ]
```

Executing postinstall script.

*** Important Information for Completing your NMO Installation ***

Depending on the Oracle version you are running,
you may have to link the Oracle executable
and/or shutdown and restart Oracle
before you are ready to use NMO.

Please, consult your Installation Guide for complete instructions.

*** Important Information for Configuring NetWorker Module backups ***

You can now start the NMC Backup Configuration wizard to configure the backups.

To start the wizard:

1. In your web browser, go to the URL of the console server
http://nmc_server_name:9000 (the default port is 9000).
2. Log in to the console server.
3. Select the appropriate server name and double-click NetWorker to start the
NetWorker Administration interface.
4. Click the Configuration button, right-click Clients on the left pane, and
select Client Backup Configuration > New, from the right-click menu.

Installation of <LGTONmo> was successful.

The following packages are available:

- 1 LGTONmo EMC NetWorker Module for Oracle
(sparc) 5.0 [LNMs_2008.Build.237]

Select package(s) you wish to process (or 'all' to process
all packages). (default: all) [?,??,q]: **q**

#

8. Log in as the ORACLE_HOME owner:

su - o92 (where for this example o92 is the ORACLE_HOME_owner)

9. Link the NMO library.

IMPORTANT: The file name used in the command varies based on the OS executed on.

```
$ cd $ORACLE_HOME/lib
```

```
$ ln -s /usr/lib/libnwor.so libobk.so
```

10. Validate that libobk.so is now pointing to the NMO 5.0 library.

```
$ /usr/ccs/bin/what $ORACLE_HOME/lib/libobk.so
```

```
/u01_9_2/app/oracle/product/9.2/lib/libobk.so:
```

```
Module Name: EMC NetWorker Module for Oracle
```

```
Module Vers: 5.0
```

```
Product: NetWorker
```

```
Release: LNMs_2008.Build.237
```

```
Build number: 237
```

```
Build date: Thu Feb 12 09:41:23 PST 2009
```

```
Build arch.: solaris8w
```

```
Build info: DBG=0,OPT=-O2 -fno-strict-aliasing
```

```
SunOS 5.8 Generic February 2000
```

```
$
```

Manual backups

Manual backup initiated within RMAN or a scheduled backup via the NetWorker Management Console scheduler framework both result from the execution of an Oracle RMAN backup script.

In a manual backup, the RMAN script must include additional NSR_* variables to denote that a deduplication backup is the desired action. i.e. NSR_DEDUP_BACKUP, NSR_DEDUP_CACHE, NSR_DEDUP_CACHE_TAG:

See an example of this script below. In the example, we are not using an RMAN recovery catalog, therefore the target database control file is used to contain the Oracle metadata that generated from the backup.

```
$ rman nocatalog target sys/sys@orac cmdfile=manual1
```

Recovery Manager: Release 9.2.0.1.0 - 64bit Production

Copyright (c) 1995, 2002, Oracle Corporation. All rights reserved.

connected to target database: ORAC (DBID=854902833)
using target database controlfile instead of recovery catalog

```
RMAN> run {
2> allocate channel t1 type 'SBT_TAPE';
3> allocate channel t2 type 'SBT_TAPE';
4>
5> send
'NSR_ENV=(NSR_SERVER=ecc1,NSR_CLIENT=oracle,NSR_DEDUP_BACKUP=TRUE,NSR_DEDUP_NODE=avamar01-01)';
6>
7> send channel t1 'NSR_ENV=(NSR_DEDUP_CACHE_TAG=orac_t1)';
8>
9> send channel t2 'NSR_ENV=(NSR_DEDUP_CACHE_TAG=orac_t2)';
10>
11> backup full filesperset 4 format '/FULL_%d_%U/' database;
12>
13> release channel t1;
14> release channel t2;
15> }
16>
allocated channel: t1
channel t1: sid=12 devtype=SBT_TAPE
channel t1: NMO v5.0.0.0

allocated channel: t2
channel t2: sid=17 devtype=SBT_TAPE
```

channel t2: NMO v5.0.0.0

sent command to channel: t1

sent command to channel: t2

sent command to channel: t1

sent command to channel: t2

Starting backup at 18-FEB-09

channel t1: starting full datafile backupset

channel t1: specifying datafile(s) in backupset

input datafile fno=00005 name=/u01_9_2/app/oracle/oradata/orac/example01.dbf

input datafile fno=00010 name=/u01_9_2/app/oracle/oradata/orac/xdm01.dbf

input datafile fno=00006 name=/u01_9_2/app/oracle/oradata/orac/indx01.dbf

input datafile fno=00009 name=/u01_9_2/app/oracle/oradata/orac/users01.dbf

channel t1: starting piece 1 at 18-FEB-09

channel t2: starting full datafile backupset

channel t2: specifying datafile(s) in backupset

including current SPFILE in backupset

including current controlfile in backupset

input datafile fno=00001 name=/u01_9_2/app/oracle/oradata/orac/system01.dbf

input datafile fno=00003 name=/u01_9_2/app/oracle/oradata/orac/cwmlite01.dbf

channel t2: starting piece 1 at 18-FEB-09

61819 1234992381 2 0 0 1 22220 0 ca-oracle (pid22220) 37 Saving data to

deduplication node %s 1 12 11 avamar01-01

42923 1234992381 2 0 0 1 22220 0 ca-oracle (pid22220) 2 %s 1 42 93 AVCTL Service

Log: nsravtar version 4.0.3-24 built on Sep 13 2008 11:32:49 running on Solaris

61819 1234992382 2 0 0 1 22221 0 ca-oracle (pid22221) 37 Saving data to

deduplication node %s 1 12 11 avamar01-01

42923 1234992382 2 0 0 1 22221 0 ca-oracle (pid22221) 2 %s 1 42 93 AVCTL Service

Log: nsravtar version 4.0.3-24 built on Sep 13 2008 11:32:49 running on Solaris

61187 1234992382 2 0 0 1 22220 0 ca-oracle (pid22220) 39 De-Dup session

established successfully 0

61187 1234992384 2 0 0 1 22221 0 ca-oracle (pid22221) 39 De-Dup session established successfully 0

56076 1234992446 2 0 0 1 22220 0 ca-oracle (pid22220) 20 AVCTL %s: successful 1 0 6 backup

66754 1234992446 2 0 0 1 22220 0 ca-oracle (pid22220) 35 De-Dupe session closed successfully 0

60894 1234992448 2 0 0 1 22220 0 ca-oracle (pid22220) 19 %s exited with "%s" 2 20 18 /usr/sbin/nsravtar 0 7 Success

channel t1: finished piece 1 at 18-FEB-09

piece handle=/FULL_ORAC_b6k7md98_1_1/ comment=API Version 2.0,MMS Version 5.0.0.0

channel t1: backup set complete, elapsed time: 00:01:17

channel t1: starting full datafile backupset

channel t1: specifying datafile(s) in backupset

input datafile fno=00002 name=/u01_9_2/app/oracle/oradata/orac/undotbs01.dbf

input datafile fno=00004 name=/u01_9_2/app/oracle/oradata/orac/drsys01.dbf

input datafile fno=00007 name=/u01_9_2/app/oracle/oradata/orac/odm01.dbf

input datafile fno=00008 name=/u01_9_2/app/oracle/oradata/orac/tools01.dbf

channel t1: starting piece 1 at 18-FEB-09

61819 1234992459 2 0 0 1 22220 0 ca-oracle (pid22220) 37 Saving data to deduplication node %s 1 12 11 avamar01-01

42923 1234992459 2 0 0 1 22220 0 ca-oracle (pid22220) 2 %s 1 42 93 AVCTL Service Log: nsravtar version 4.0.3-24 built on Sep 13 2008 11:32:49 running on Solaris

61187 1234992460 2 0 0 1 22220 0 ca-oracle (pid22220) 39 De-Dup session established successfully 0

56076 1234992522 2 0 0 1 22221 0 ca-oracle (pid22221) 20 AVCTL %s: successful 1 0 6 backup

66754 1234992522 2 0 0 1 22221 0 ca-oracle (pid22221) 35 De-Dupe session closed successfully 0

60894 1234992524 2 0 0 1 22221 0 ca-oracle (pid22221) 19 %s exited with "%s" 2 20 18 /usr/sbin/nsravtar 0 7 Success

channel t2: finished piece 1 at 18-FEB-09

piece handle=/FULL_ORAC_b7k7md99_1_1/ comment=API Version 2.0,MMS Version 5.0.0.0

```
channel t2: backup set complete, elapsed time: 00:02:31
56076 1234993088 2 0 0 1 22220 0 ca-oracle (pid22220) 20 AVCTL %s: successful 1 0
6 backup
66754 1234993088 2 0 0 1 22220 0 ca-oracle (pid22220) 35 De-Dupe session closed
successfully 0
60894 1234993090 2 0 0 1 22220 0 ca-oracle (pid22220) 19 %s exited with "%s" 2 20
18 /usr/sbin/nsrvtar 0 7 Success
channel t1: finished piece 1 at 18-FEB-09
piece handle=/FULL_ORAC_b8k7mdb1_1_1/ comment=API Version 2.0,MMS Version
5.0.0.0
channel t1: backup set complete, elapsed time: 00:10:40
Finished backup at 18-FEB-09

released channel: t1

released channel: t2
```

Recovery Manager complete.

```
$
$
```

From the last line we can see that RMAN completed the backup successfully, and that the backup generated 3 backup pieces (piece handle=). These backup piece names are going to be the NetWorker save set name.

NetWorker Media Database

We can review the status and other extended information of the deduplication Oracle backups from the contents in the NetWorker media database. To limit the output of mminfo to only the save sets created using deduplication, one must use the "-q dedupe" option. Users must use -S option to list the extended attributes for the deduplication backups:

D:\Software\nw>mminfo -S -q dedupe

ssid=4103896569 savetime=2/18/2009 4:26:17 PM (1234992377)

oracle:RMAN:/FULL_ORAC_b6k7md98_1_1/

level= sflags=vF size=228 files=1 insert=2/18/2009

create=2/18/2009 complete=2/18/2009 browse=3/18/2009 11:59:59 PM

retent=2/18/2010 11:59:59 PM

clientid=f3392fd1-00000004-499c41ee-499c42fc-00021900-b27e35b9

*Client path: /NetWorker/ecc1/oracle;

*Data set size: 151257088;

*De-Dup session id: 4;

*De-Dup snapup time: 2009-02-18;

*Deduplication: Yes;

*Deduplication host: avamar01-01;

*Domain: /NetWorker/ecc1;

*New data on De-Dup Node: 29695.00;

*New files: 1;

*Size on De-Dup Node: 151257088.00;

Clone #1: cloneid=1234992376 time=2/18/2009 4:26:16 PM retent=2/18/2010

flags=F

frag@ 0 valid=4288430961 file/rec= 0/0 rn=0 last=2/18/2009

Clone #2: cloneid=1234992377 time=2/18/2009 4:26:17 PM retent=2/18/2010

flags=F

frag@ 0 valid= 10240870 file/rec= 0/0 rn=0 last=2/18/2009

ssid=4087119355 savetime=2/18/2009 4:26:18 PM (1234992378)

oracle:RMAN:/FULL_ORAC_b7k7md99_1_1/

level= sflags=vF size=228 files=1 insert=2/18/2009

create=2/18/2009 complete=2/18/2009 browse=3/18/2009 11:59:59 PM

retent=2/18/2010 11:59:59 PM

clientid=f3392fd1-00000004-499c41ee-499c42fc-00021900-b27e35b9

*Client path: /NetWorker/ecc1/oracle;

*Data set size: 351010816;

*De-Dup session id: 5;

*De-Dup snapup time: 2009-02-18;
 *Deduplication: Yes;
 *Deduplication host: avamar01-01;
 *Domain: /NetWorker/ecc1;
 *New data on De-Dup Node: 103424.00;
 *New files: 1;
 *Size on De-Dup Node: 351010816.00;
 Clone #1: cloneid=1234992378 time=2/18/2009 4:26:18 PM retent=2/18/2010
 flags=F
 frag@ 0 valid=4288430961 file/rec= 0/0 rn=0 last=2/18/2009
 Clone #2: cloneid=1234992379 time=2/18/2009 4:26:19 PM retent=2/18/2010
 flags=F
 frag@ 0 valid= 10240870 file/rec= 0/0 rn=0 last=2/18/2009
 ssid=4070342215 savetime=2/18/2009 4:27:34 PM (1234992454)
 oracle:RMAN:/FULL_ORAC_b8k7mdb1_1_1/
 level= sflags=vF **size=228** files=1 insert=2/18/2009
 create=2/18/2009 complete=2/18/2009 browse=3/18/2009 11:59:59 PM
 retent=2/18/2010 11:59:59 PM
 clientid=f3392fd1-00000004-499c41ee-499c42fc-00021900-b27e35b9
 *Client path: /NetWorker/ecc1/oracle;
 *Data set size: 3249799168;
 *De-Dup session id: 6;
 *De-Dup snapup time: 2009-02-18;
 *Deduplication: Yes;
 *Deduplication host: avamar01-01;
 *Domain: /NetWorker/ecc1;
 *New data on De-Dup Node: 1357775.00; *New files: 1;
 *Size on De-Dup Node: 3249799168.00;
 Clone #1: cloneid=1234992454 time=2/18/2009 4:27:34 PM retent=2/18/2010
 flags=F
 frag@ 0 valid=4288430961 file/rec= 0/0 rn=0 last=2/18/2009
 Clone #2: cloneid=1234992455 time=2/18/2009 4:27:35 PM retent=2/18/2010
 flags=F
 frag@ 0 valid= 10240870 file/rec= 0/0 rn=0 last=2/18/2009

Here you will notice some additional spaces to simplify the separation of the 3 Oracle backup pieces saved. Also note that the size (in bold) of each saveset is only a few bytes and not the actual size of the backed up data.

The deduplication extended attributes have the following definitions:

*Client path: provided by nsravtar. The Domain of the backed-up client as registered with the Avamar server.

*Data set size: calculated by NMO. The size, in bytes, of data passed to NMO by Oracle Server process prior to deduplication.

*De-Dedup session id: provided by nsravtar. ID of the Avamar session that created the snap-up. It is used to identify the backup on Avamar server.

*De-Dedup snapup time: provided by nsravtar. Represents the time when this backup was marked as finished on the Avamar server node.

*Deduplication: Set in NW client resource. Indicates the deduplication backup. This field is used during restore to determine whether the deduplication restore workflow should be used.

*Deduplication host: Set in NW client resource. Name or IP address of the primary Avamar host containing the backup.

*Domain: provided by nsravtar. NW server domain under which snap-up would be registered on Avamar server.

*New data on De-Dup Node: provided by nsravtar. Number of bytes of data sent to the Avamar server during this backup. It represents the new unique instances of data not previously stored on the Avamar server.

*New files: calculated by NMO. Number of backup pieces included in the save set. Since each NMO save set contains a single backup piece, this field will always be set to 1.

* Replication host: Set in NW client resource. Name or IP address of the Avamar server to which the primary server is replicated. It may be empty when the Avamar server is not set for replication.

*Size on De-Dup Node: provided by nsravatar. The total size, in bytes of the data, associated with the given snap-up protected by Avamar server. It contains the size of data sent to NMO by Oracle (*Data set size), plus the size of NetWorker metadata.

Another mminfo query without the -S flag yields the following less detailed report.

```
D:\Software\nw>mminfo -av -q dedupe
```

volume	client	date	time	size	ssid	fl	lvl	name
ecc1.001	oracle	2/18/2009	4:26:17 PM	228	B			4103896569 cb RMAN:/FULL_ORAC_b6k7md98_1_1/
ecc1.001	oracle	2/18/2009	4:26:18 PM	228	B			4087119355 cb RMAN:/FULL_ORAC_b7k7md99_1_1/
ecc1.001	oracle	2/18/2009	4:27:34 PM	228	B			4070342215 cb RMAN:/FULL_ORAC_b8k7mdb1_1_1/

You can also gather information about the saved data from the NetWorker Client File Index:.

```
D:\Software\nw>nsrinfo -n oracle -N /FULL_ORAC_b7k7md99_1_1/ oracle  
scanning client `oracle' for all savetimes from the oracle namespace  
/FULL_ORAC_b7k7md99_1_1/, date=1234992378 2/18/2009 4:26:18 PM  
1 object found
```

Scheduled Backups

During a manual backup, users explicitly define deduplication variables to denote a de-dupe backup. In a scheduled backup, the savegrp process on the NetWorker backup server will pass additional parameters to the Oracle application server to indicate that a deduplication backup should occur. These parameters are passed if the NetWorker client resource has the “Deduplication backup” box checked in the client resource “Apps & Modules” tab selected.

The savegrp process passes the deduplication specific parameters to the NMO process nsrnmstart on the Oracle application server. It processes these options and converts them into NMO-specific parameters which are then passed to Oracle as part of the SEND command specified during RMAN invocation.

In addition to passing the deduplication specific parameters, other parameters are passed, such as NSR_SERVER, NSR_GROUP, and NSR_CLIENT

The following corresponding NMO parameters will be passed automatically in a typical scheduled deduplication backup:

NSR_DEDUP_BACKUP = TRUE

NSR_DEDUP_NODE = <Avamar server name as set in the NW Deduplication node>

NSR_CLIENT = <NW client name as registered with Avamar server>

Note: At the end of a scheduled backup, NMO runs backups up the nsr/res/nwora.res file. Since this file are very small it is not backed up using the deduplication workflow.

Note: Be sure to set the NSR_DEDUP_CACHE_TAG parameter to a different value for each channel. See the above example in the Manual Backups

The following output shows the additional Deduplication arguments passed during an NMO deduplication scheduled backup:

```
D:\Software\nw>savegrp -vvv test
```

```
32451:savegrp: oracle:/scripts/oracle/92/sched/sched1 level=incr
```

```
7236:savegrp: Group will not limit job parallelism
```

```
32493:savegrp: oracle:probe started
```

```
savefs -s ecc1 -c oracle -g test -p -l full -R -v -F /scripts/oracle/92/sched/sched1
```

```
oracle:/scripts/oracle/92/sched/sched1 level=full, dn=0, mx=1, vers=pools, p=12
```

```
64690:savegrp: savegrp:test * oracle:Probe See the file C:\Program
```

```
Files\Legato\nsr\tmp\sg\test\ss0.000002 for output of save command.
```

```
7340:savegrp: oracle:probe succeeded.
```

```
32494:savegrp: oracle:/scripts/oracle/92/sched/sched1 started
```

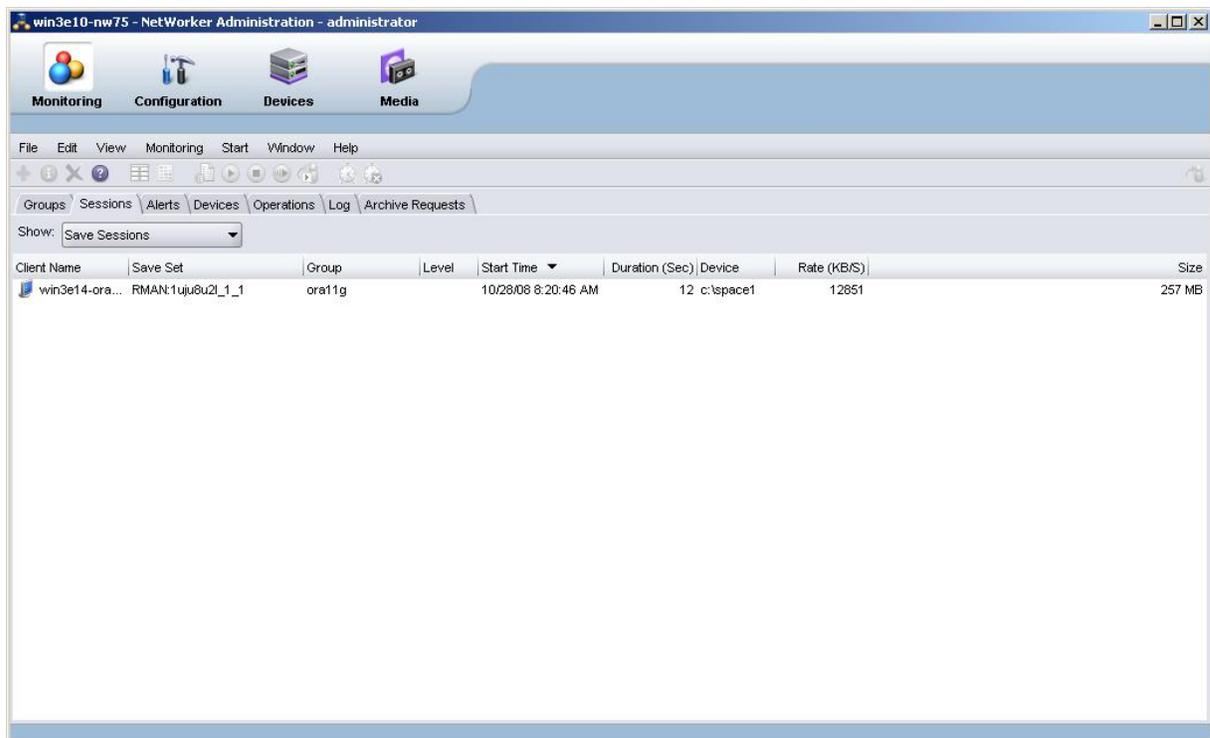
```

nsrnm0 -s ecc1 -g test -LL -m oracle -a "Deduplication backup=yes" -a "Deduplication
node=avamar01-01" -a "Deduplication client name=oracle" -l ful
l -W 78 -N /scripts/oracle/92/sched/sched1 /scripts/oracle/92/sched/sched1
64690:savegrp: savegrp:test * oracle:/scripts/oracle/92/sched/sched1 See the file
C:\Program Files\Legato\nsr\tmp\sg\test\ss0.000003 for output of sa
ve command.
7341:savegrp: oracle:/scripts/oracle/92/sched/sched1 succeeded.
32494:savegrp: oracle:index started

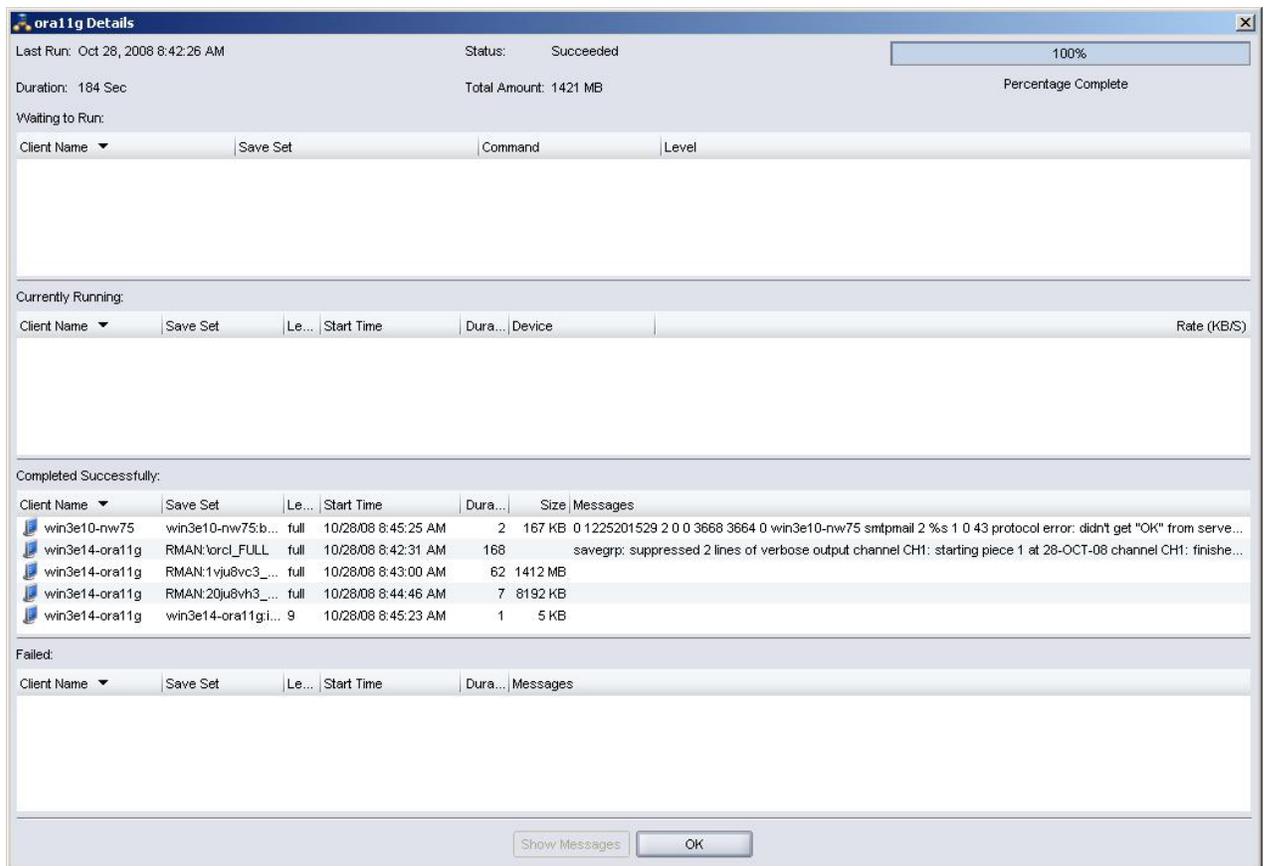
```

NetWorker Management Console Reporting

The NMC GUI displays information about running backups and restores in the Monitoring -> Sessions tab. This information contains the rate of data being backed up or restored, and the total size of protected data. The NMC GUI also displays the size of each save set in the Group Details Window.



For deduplication backups, you are able to view the total size of protected data in the backup in the Group details window. The value shown is prior to the benefits of deduplicating the data. Hence, you would usually find substantially less data has been sent to the Avamar server (NetWorker Deduplication Storage node). You can view this amount by selecting Monitoring -> Groups -> Double click the deduplication group -> Total Amount



The NMC GUI doesn't contain any indication that the information is for deduplication backups and that the data is stored on the Avamar server and not the NetWorker storage device.

Cloning and Staging

When a user performs cloning or staging of the NetWorker save sets, only the metadata (hash IDs) stored on the NetWorker volumes get cloned or staged. Data stored on the Avamar server is not affected by these operations.

Restores

Here is a typical example in which the Oracle database needs to be restored from backup media to the most current point in time. Please reference the Oracle Backup and Recovery administrators' manual for all the possible restore operations that may be conducted within RMAN.

In this example we first define the ORACLE instance we are going to be performing the restore on, bring the database to mount mode, rename some files to simulate database failure, and then execute our restore script.

```
$ export ORACLE_SID=orac
```

```
$ sqlplus
```

```
SQL*Plus: Release 9.2.0.1.0 - Production on Thu Feb 19 12:02:19 2009
```

```
Copyright (c) 1982, 2002, Oracle Corporation. All rights reserved.
```

```
Enter user-name: sys as sysdba
```

```
Enter password:
```

```
Connected to:
```

```
Oracle9i Enterprise Edition Release 9.2.0.1.0 - 64bit Production
```

```
With the Partitioning, OLAP and Oracle Data Mining options
```

```
JServer Release 9.2.0.1.0 - Production
```

```
SQL> shutdown immediate;
```

```
Database closed.
```

```
Database dismounted.
```

```
ORACLE instance shut down.
```

```
SQL> host
```

```
$
```

```
$cd /u01_9_2/app/oracle/oradata/orac
```

Here we can see all the files that make up the database orac. We are going to rename a couple of them so the database fails to start.

\$ ls -las

total 8584634

```
  2 drwxr-xr-x  3 o92   oinstall   512 Jan 21 19:07 .
  2 drwxr-xr-x  3 o92   oinstall   512 Mar 13 2006 ..
 22 drwxr-xr-x  2 o92   oinstall 10752 Feb 19 02:13 archive
4448 -rw-r-----  1 o92   oinstall 2269184 Feb 19 12:02 control01.ctl
4448 -rw-r-----  1 o92   oinstall 2269184 Feb 19 12:02 control02.ctl
4448 -rw-r-----  1 o92   oinstall 2269184 Feb 19 12:02 control03.ctl
41024 -rw-r--r--  1 o92   oinstall 20979712 Feb 19 12:02 cwmlite01.dbf
41024 -rw-r-----  1 o92   oinstall 20979712 Feb 19 12:02 drsys01.dbf
304832 -rw-r--r--  1 o92   oinstall 155983872 Feb 19 12:02 example01.dbf
51264 -rw-r--r--  1 o92   oinstall 26222592 Feb 19 12:02 indx01.dbf
41024 -rw-r--r--  1 o92   oinstall 20979712 Feb 19 12:02 odm01.dbf
204944 -rw-r-----  1 o92   oinstall 104858112 Feb 19 02:13 redo01.log
204944 -rw-r-----  1 o92   oinstall 104858112 Feb 19 12:02 redo02.log
204944 -rw-r-----  1 o92   oinstall 104858112 Feb 17 20:53 redo03.log
819632 -rw-r-----  1 o92   oinstall 419438592 Feb 19 12:02 system01.dbf
84048 -rw-r--r--  1 o92   oinstall 42999808 Apr 10 2006 temp01.dbf
20512 -rw-r--r--  1 o92   oinstall 10493952 Feb 19 12:02 tools01.dbf
6423648 -rw-r-----  1 o92   oinstall 3287293952 Feb 19 12:02 undotbs01.dbf
51264 -rw-r-----  1 o92   oinstall 26222592 Feb 19 12:02 users01.dbf
78160 -rw-r--r--  1 o92   oinstall 39985152 Feb 19 12:02 xdb01.dbf
```

\$ mv system01.dbf system01.org

\$ mv indx01.dbf indx01.org

\$ exit

SQL> startup mount;

ORACLE instance started.

Total System Global Area 123176264 bytes

Fixed Size 730440 bytes

Variable Size 88080384 bytes

Database Buffers 33554432 bytes

Redo Buffers 811008 bytes

Database mounted.

SQL> **quit**

Disconnected from Oracle9i Enterprise Edition Release 9.2.0.1.0 - 64bit Production

With the Partitioning, OLAP and Oracle Data Mining options

JServer Release 9.2.0.1.0 – Production

With the database in mount state (not open), we are ready to perform our restore. As noted previously, there is no need to specify the NSR_DEDUP_BACKUP, or NSR_DEDUP_NODE variables in the RMAN script as needed for manual NMO deduplication backups. During the restore, the backup pieces required for the restore will be requested by Oracle. NMO will provide the data regardless of whether the backup was a deduplication or not for each backup piece requested.

In this example we are connecting to the target database “orac” and are using the target databases control file rather than a RMAN recovery catalog.

\$ rman nocatalog target sys/sys cmdfile=/scripts/oracle/92/restoredb

Recovery Manager: Release 9.2.0.1.0 - 64bit Production

Copyright (c) 1995, 2002, Oracle Corporation. All rights reserved.

connected to target database: ORAC (DBID=854902833)

using target database controlfile instead of recovery catalog

RMAN> run {

```
2> allocate channel t1 type 'SBT_TAPE' parms
'ENV=(NSR_SERVER=ecc1,NSR_CLIENT=oracle)';
3>
```

```
4> restore database;
```

```
5> release channel t1;
```

```
6> }
```

```
7>
```

```
allocated channel: t1
```

```
channel t1: sid=13 devtype=SBT_TAPE
```

```
channel t1: NMO v5.0.0.0
```

```
Starting restore at 19-FEB-09
```

```
channel t1: starting datafile backupset restore
```

```
channel t1: specifying datafile(s) to restore from backup set
```

```
restoring datafile 00010 to /u01_9_2/app/oracle/oradata/orac/xd01.dbf
```

```
61820 1235063549 2 0 0 1 26333 0 ca-oracle (pid26333) 43 Recovering data from
deduplication node %s 1 12 11 avamar01-01
```

```
42923 1235063549 2 0 0 1 26333 0 ca-oracle (pid26333) 2 %s 1 42 93 AVCTL Service
```

```
Log: nsravtar version 4.0.3-24 built on Sep 13 2008 11:32:49 running on Solaris
```

```
61187 1235063550 2 0 0 1 26333 0 ca-oracle (pid26333) 39 De-Dup session
```

```
established successfully 0
```

```
56076 1235063554 2 0 0 1 26333 0 ca-oracle (pid26333) 20 AVCTL %s: successful 1 0
```

```
7 restore
```

```
66754 1235063554 2 0 0 1 26333 0 ca-oracle (pid26333) 35 De-Dupe session closed
```

```
successfully 0
```

```
60894 1235063556 2 0 0 1 26333 0 ca-oracle (pid26333) 19 %s exited with "%s" 2 20
```

```
18 /usr/sbin/nsravtar 0 7 Success
```

```
channel t1: restored backup piece 1
```

```
piece handle=/FULL_ORAC_c0k7mkha_1_1/ tag=TAG20090218T183002
```

```
params=NULL
```

```
channel t1: restore complete
```

```
channel t1: starting datafile backupset restore
```

```
channel t1: specifying datafile(s) to restore from backup set
```

restoring datafile 00006 to /u01_9_2/app/oracle/oradata/orac/indx01.dbf
61820 1235063561 2 0 0 1 26333 0 ca-oracle (pid26333) 43 Recovering data from
deduplication node %s 1 12 11 avamar01-01
42923 1235063561 2 0 0 1 26333 0 ca-oracle (pid26333) 2 %s 1 42 93 AVCTL Service
Log: nsrvtar version 4.0.3-24 built on Sep 13 2008 11:32:49 running on Solaris
61187 1235063561 2 0 0 1 26333 0 ca-oracle (pid26333) 39 De-Dup session
established successfully 0
56076 1235063563 2 0 0 1 26333 0 ca-oracle (pid26333) 20 AVCTL %s: successful 1 0
7 restore
66754 1235063563 2 0 0 1 26333 0 ca-oracle (pid26333) 35 De-Dupe session closed
successfully 0
60894 1235063565 2 0 0 1 26333 0 ca-oracle (pid26333) 19 %s exited with "%s" 2 20
18 /usr/sbin/nsrvtar 0 7 Success
channel t1: restored backup piece 1
piece handle=/FULL_ORAC_c1k7mki3_1_1/ tag=TAG20090218T183002 params=NULL
channel t1: restore complete
channel t1: starting datafile backupset restore
channel t1: specifying datafile(s) to restore from backup set
restoring datafile 00005 to /u01_9_2/app/oracle/oradata/orac/example01.dbf
61820 1235063576 2 0 0 1 26333 0 ca-oracle (pid26333) 43 Recovering data from
deduplication node %s 1 12 11 avamar01-01
42923 1235063576 2 0 0 1 26333 0 ca-oracle (pid26333) 2 %s 1 42 93 AVCTL Service
Log: nsrvtar version 4.0.3-24 built on Sep 13 2008 11:32:49 running on Solaris
61187 1235063577 2 0 0 1 26333 0 ca-oracle (pid26333) 39 De-Dup session
established successfully 0
56076 1235063604 2 0 0 1 26333 0 ca-oracle (pid26333) 20 AVCTL %s: successful 1 0
7 restore
66754 1235063604 2 0 0 1 26333 0 ca-oracle (pid26333) 35 De-Dupe session closed
successfully 0
60894 1235063606 2 0 0 1 26333 0 ca-oracle (pid26333) 19 %s exited with "%s" 2 20
18 /usr/sbin/nsrvtar 0 7 Success
channel t1: restored backup piece 1
piece handle=/FULL_ORAC_bvk7mkha_1_1/ tag=TAG20090218T183002
params=NULL

channel t1: restore complete

channel t1: starting datafile backupset restore

channel t1: specifying datafile(s) to restore from backup set

restoring datafile 00009 to /u01_9_2/app/oracle/oradata/orac/users01.dbf

61820 1235063611 2 0 0 1 26333 0 ca-oracle (pid26333) 43 Recovering data from deduplication node %s 1 12 11 avamar01-01

42923 1235063611 2 0 0 1 26333 0 ca-oracle (pid26333) 2 %s 1 42 93 AVCTL Service Log: nsravtar version 4.0.3-24 built on Sep 13 2008 11:32:49 running on Solaris

61187 1235063611 2 0 0 1 26333 0 ca-oracle (pid26333) 39 De-Dup session established successfully 0

56076 1235063613 2 0 0 1 26333 0 ca-oracle (pid26333) 20 AVCTL %s: successful 1 0 7 restore

66754 1235063613 2 0 0 1 26333 0 ca-oracle (pid26333) 35 De-Dupe session closed successfully 0

60894 1235063615 2 0 0 1 26333 0 ca-oracle (pid26333) 19 %s exited with "%s" 2 20 18 /usr/sbin/nsravtar 0 7 Success

channel t1: restored backup piece 1

piece handle=/FULL_ORAC_c2k7mkii_1_1/ tag=TAG20090218T183002 params=NULL

channel t1: restore complete

channel t1: starting datafile backupset restore

channel t1: specifying datafile(s) to restore from backup set

restoring datafile 00003 to /u01_9_2/app/oracle/oradata/orac/cwmlite01.dbf

61820 1235063626 2 0 0 1 26333 0 ca-oracle (pid26333) 43 Recovering data from deduplication node %s 1 12 11 avamar01-01

42923 1235063626 2 0 0 1 26333 0 ca-oracle (pid26333) 2 %s 1 42 93 AVCTL Service Log: nsravtar version 4.0.3-24 built on Sep 13 2008 11:32:49 running on Solaris

61187 1235063626 2 0 0 1 26333 0 ca-oracle (pid26333) 39 De-Dup session established successfully 0

56076 1235063628 2 0 0 1 26333 0 ca-oracle (pid26333) 20 AVCTL %s: successful 1 0 7 restore

66754 1235063628 2 0 0 1 26333 0 ca-oracle (pid26333) 35 De-Dupe session closed successfully 0

60894 1235063630 2 0 0 1 26333 0 ca-oracle (pid26333) 19 %s exited with "%s" 2 20 18 /usr/sbin/nsravtar 0 7 Success

```

channel t1: restored backup piece 1
piece handle=/FULL_ORAC_c3k7mkiq_1_1/ tag=TAG20090218T183002 params=NULL
channel t1: restore complete
channel t1: starting datafile backupset restore
channel t1: specifying datafile(s) to restore from backup set
restoring datafile 00004 to /u01_9_2/app/oracle/oradata/orac/drsys01.dbf
61820 1235063641 2 0 0 1 26333 0 ca-oracle (pid26333) 43 Recovering data from
deduplication node %s 1 12 11 avamar01-01
42923 1235063641 2 0 0 1 26333 0 ca-oracle (pid26333) 2 %s 1 42 93 AVCTL Service
Log: nsrvtar version 4.0.3-24 built on Sep 13 2008 11:32:49 running on Solaris
61187 1235063641 2 0 0 1 26333 0 ca-oracle (pid26333) 39 De-Dup session
established successfully 0
56076 1235063643 2 0 0 1 26333 0 ca-oracle (pid26333) 20 AVCTL %s: successful 1 0
7 restore
66754 1235063643 2 0 0 1 26333 0 ca-oracle (pid26333) 35 De-Dupe session closed
successfully 0
60894 1235063645 2 0 0 1 26333 0 ca-oracle (pid26333) 19 %s exited with "%s" 2 20
18 /usr/sbin/nsrvtar 0 7 Success
channel t1: restored backup piece 1
piece handle=/FULL_ORAC_c4k7mkit_1_1/ tag=TAG20090218T183002 params=NULL
channel t1: restore complete
channel t1: starting datafile backupset restore
channel t1: specifying datafile(s) to restore from backup set
restoring datafile 00007 to /u01_9_2/app/oracle/oradata/orac/odm01.dbf
61820 1235063656 2 0 0 1 26333 0 ca-oracle (pid26333) 43 Recovering data from
deduplication node %s 1 12 11 avamar01-01
42923 1235063656 2 0 0 1 26333 0 ca-oracle (pid26333) 2 %s 1 42 93 AVCTL Service
Log: nsrvtar version 4.0.3-24 built on Sep 13 2008 11:32:49 running on Solaris
61187 1235063656 2 0 0 1 26333 0 ca-oracle (pid26333) 39 De-Dup session
established successfully 0
56076 1235063658 2 0 0 1 26333 0 ca-oracle (pid26333) 20 AVCTL %s: successful 1 0
7 restore
66754 1235063658 2 0 0 1 26333 0 ca-oracle (pid26333) 35 De-Dupe session closed
successfully 0

```

60894 1235063660 2 0 0 1 26333 0 ca-oracle (pid26333) 19 %s exited with "%s" 2 20
18 /usr/sbin/nsrvtar 0 7 Success
channel t1: restored backup piece 1
piece handle=/FULL_ORAC_c5k7mkjc_1_1/ tag=TAG20090218T183002 params=NULL
channel t1: restore complete
channel t1: starting datafile backupset restore
channel t1: specifying datafile(s) to restore from backup set
restoring datafile 00008 to /u01_9_2/app/oracle/oradata/orac/tools01.dbf
61820 1235063671 2 0 0 1 26333 0 ca-oracle (pid26333) 43 Recovering data from
deduplication node %s 1 12 11 avamar01-01
42923 1235063671 2 0 0 1 26333 0 ca-oracle (pid26333) 2 %s 1 42 93 AVCTL Service
Log: nsrvtar version 4.0.3-24 built on Sep 13 2008 11:32:49 running on Solaris
61187 1235063671 2 0 0 1 26333 0 ca-oracle (pid26333) 39 De-Dup session
established successfully 0
56076 1235063672 2 0 0 1 26333 0 ca-oracle (pid26333) 20 AVCTL %s: successful 1 0
7 restore
66754 1235063672 2 0 0 1 26333 0 ca-oracle (pid26333) 35 De-Dupe session closed
successfully 0
60894 1235063674 2 0 0 1 26333 0 ca-oracle (pid26333) 19 %s exited with "%s" 2 20
18 /usr/sbin/nsrvtar 0 7 Success
channel t1: restored backup piece 1
piece handle=/FULL_ORAC_c6k7mkjc_1_1/ tag=TAG20090218T183002 params=NULL
channel t1: restore complete
channel t1: starting datafile backupset restore
channel t1: specifying datafile(s) to restore from backup set
restoring datafile 00001 to /u01_9_2/app/oracle/oradata/orac/system01.dbf
61820 1235063686 2 0 0 1 26333 0 ca-oracle (pid26333) 43 Recovering data from
deduplication node %s 1 12 11 avamar01-01
42923 1235063686 2 0 0 1 26333 0 ca-oracle (pid26333) 2 %s 1 42 93 AVCTL Service
Log: nsrvtar version 4.0.3-24 built on Sep 13 2008 11:32:49 running on Solaris
61187 1235063687 2 0 0 1 26333 0 ca-oracle (pid26333) 39 De-Dup session
established successfully 0
56076 1235063757 2 0 0 1 26333 0 ca-oracle (pid26333) 20 AVCTL %s: successful 1 0
7 restore

```
66754 1235063757 2 0 0 1 26333 0 ca-oracle (pid26333) 35 De-Dupe session closed
successfully 0
60894 1235063759 2 0 0 1 26333 0 ca-oracle (pid26333) 19 %s exited with "%s" 2 20
18 /usr/sbin/nsrvtar 0 7 Success
channel t1: restored backup piece 1
piece handle=/FULL_ORAC_c8k7mkjs_1_1/ tag=TAG20090218T183002 params=NULL
channel t1: restore complete
channel t1: starting datafile backupset restore
channel t1: specifying datafile(s) to restore from backup set
restoring datafile 00002 to /u01_9_2/app/oracle/oradata/orac/undotbs01.dbf
61820 1235063771 2 0 0 1 26333 0 ca-oracle (pid26333) 43 Recovering data from
deduplication node %s 1 12 11 avamar01-01
42923 1235063771 2 0 0 1 26333 0 ca-oracle (pid26333) 2 %s 1 42 93 AVCTL Service
Log: nsrvtar version 4.0.3-24 built on Sep 13 2008 11:32:49 running on Solaris
61187 1235063772 2 0 0 1 26333 0 ca-oracle (pid26333) 39 De-Dup session
established successfully 0
56076 1235064384 2 0 0 1 26333 0 ca-oracle (pid26333) 20 AVCTL %s: successful 1 0
7 restore
66754 1235064384 2 0 0 1 26333 0 ca-oracle (pid26333) 35 De-Dupe session closed
successfully 0
60894 1235064386 2 0 0 1 26333 0 ca-oracle (pid26333) 19 %s exited with "%s" 2 20
18 /usr/sbin/nsrvtar 0 7 Success
channel t1: restored backup piece 1
piece handle=/FULL_ORAC_c7k7mkjs_1_1/ tag=TAG20090218T183002 params=NULL
channel t1: restore complete
Finished restore at 19-FEB-09

released channel: t1

Recovery Manager complete.
$
```

With all the Oracle datafiles restored, we now need to perform media recovery on the restored datafiles, and finally bring the database in “open” mode.

\$ sqlplus

SQL*Plus: Release 9.2.0.1.0 - Production on Thu Feb 19 12:40:28 2009

Copyright (c) 1982, 2002, Oracle Corporation. All rights reserved.

Enter user-name: **sys as sysdba**

Enter password:

Connected to:

Oracle9i Enterprise Edition Release 9.2.0.1.0 - 64bit Production

With the Partitioning, OLAP and Oracle Data Mining options

JServer Release 9.2.0.1.0 - Production

SQL> alter database open;

alter database open

*

ERROR at line 1:

ORA-01113: file 1 needs media recovery

ORA-01110: data file 1: '/u01_9_2/app/oracle/oradata/orac/system01.dbf'

SQL> recover database;

Media recovery complete.

SQL> alter database open;

Database altered.

SQL>

NMO Deduplication Limitations

The existing deduplication backup framework does not support the NetWorker data ASMs (NetWorker directives) used by NMO to provide encryption, compression and checksum support. This means that NMO deduplication operations will ignore the setting for NSR_CHECKSUM, NSR_COMPRESSION and NSR_AES_ENCRYPTION when passing the data to the nsrvtar process.

Best Practices Guidelines

This section contains recommendations on when to use NMO deduplication, and some configuration tips to improve the performance of deduplication backups. The benefits of deduplication backups are greatly dependent on the user's environment in which the solution is being deployed

Oracle Data

The “type” of Oracle data in the database is also relevant to the performance of the deduplication solution in addition to the infrastructure. Online Transactional data where there is a high rate of change and uniqueness would typically not complete a backup as quickly as data of a Data Warehouse environment, where the data has a low rate of change and remains more static. This is due to the caching mechanism during the hashing of the data chunks for the backup process. As more data changes, and more unique data is inserted in the database, the commonality factor (unique data chunks not previously known to the Avamar server) for the new data will be low. This would incur the expense of determining if the local cache, or the remote Avamar server already has a copy of such hash ID.

RMAN backup levels

Oracle sends only the data blocks that have been changed since the last backup during an incremental backup. This would typically result in data with a low commonality factor in regards to the NetWorker De-duplication node, thus leading to a low rate of deduplication, and would incur the CPU overhead of going through the hashing process. Therefore, the overhead of de-duplicating data on top of the overhead of Oracle

incremental backups (Oracle spends some time to determine which blocks have changed) will result in reduced performance with insignificant benefits to the amount of stored data. For these reasons full RMAN backups are preferred over incremental ones.

General configuration tips.

- Do not include deduplication clients in the same group as non-deduplication clients.
- Once a deduplication node for a given client has been selected for an initial full backup, continue to use the same deduplication node for the client's backups to take advantage of the data already stored on the server.
- Deduplication backups must be scheduled to avoid the Avamar server read-only periods. Avamar servers spend a percentage of their time running in maintenance mode and may not be available for backups or have limited bandwidth. If NMO deduplication backups run during this period, they may hang until Avamar server resources become available. This limitation needs to be documented in NMO user docs (please follow the NetWorker Admin Guide).

CPU utilization

Backup performance of the first full deduplication backup will be slower than the corresponding traditional full backup of the same data set because of larger CPU utilization. Most of the performance degradation will be attributed to the nsravtar process that consumes maximum amounts of CPU.

Subsequent full backups of the same data benefit from a populated cache file (from the previous full backup), and should be faster than traditional backups. The nsravtar process responsible for chunking and hashing still consumes high CPU cycles, but for a shorter duration.

Below is an example of the nsravtar process as captured from a prstat output.

```
PID USERNAME  SIZE  RSS STATE  PRI NICE   TIME CPU PROCESS/NLWP
22265 o92      52M  30M run   31  0  0:01.03 79% nsravtar/13
```

During the run of the NMO backup using 2 channels, 2 nsravatr processes execute concurrently and share the maximum available CPU on the Oracle application server. Once the work completes for one of the nsravatar processes, it exits and only one nsravatar process remains. This single process would now consume the maximum amount of available CPU. It is common to see CPU 100% utilized during de-duplication of backup on the Oracle server.

RMAN Tuning

To improve deduplication backup performance, a user should ensure that the same cache is used to back up the same data every time. Ensure that the SR_DEDUP_CACHE_ENABLED parameter is set in the RMAN script. Furthermore, RMAN allows associating backup of specific tablespaces with a specific channel to ensure that Oracle does not distribute the data to a different channel when the database structure or size changes. You can take advantage of the same NSR_DEDUP_CACHE_TAG for that channel used during the backup by tuning the RMAN script to specifically load tablespaces under the same channel.

For example, see the example below on how to associate tablespaces with a channel:

```
run {  
  
  allocate channel t1 type 'SBT_TAPE';  
  
  allocate channel t2 type 'SBT_TAPE';  
  
  
  send  
  'NSR_ENV=(NSR_DEDUP_CACHE_ENABLED=TRUE,NSR_SERVER=ecc1,  
  NSR_CLIENT=oracle,NSR_DEDUP_BACKUP=TRUE,NSR_DEDUP_NODE=  
  avamar01-01)';  
  
  
  send channel t1  
  'NSR_ENV=(NSR_DEDUP_CACHE_TAG=orac_t1,NSR_DEDUP_CACHE_E  
  NABLED=TRUE)';
```

```
send channel t2
'NSR_ENV=(NSR_DEDUP_CACHE_TAG=orac_t2,NSR_DEDUP_CACHE_E
NABLED=TRUE)';

backup full filesper 4 format '/FULL_%d_%U'

tablespace CWMLITE, DRSYS, EXAMPLE, INDX, ODM, SYSTEM channel t1
tablespace TOOLS, UNDOTBS1, USERS, XDB channel t2;

release channel t1;
release channel t2;
}
```

Grouping tablespaces that contain similar data in the same channel tag would further improve backup performance.

Referenced Documentation

Oracle® Database Administrator's Guide 11g Release 1 (11.1)

Oracle® Database Backup and Recovery Advanced User's Guide 11g Release 1 (11.1)

EMC® NetWorker® Release 7.4.x NetWorker De-Dupe Node Design and Implementation

EMC® NetWorker® Release 7.5 Administrators Guide

EMC® NetWorker Module for Oracle 5.0 Administrators Guide