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National Business Center at the Department of the Interior: RMAN Improves Backup and Recovery Efficiency in a Multi-platform, Multi-application Environment

"RMAN online backups increased the speed of our backups by 30% and reduced application downtime by 85%, versus third party tools."

- Rama Balaji, Oracle Certified Professional
Senior Oracle DBA, Infoteknow International, Inc.

OVERVIEW

The National Business Center (NBC) provides business services to government agencies in the areas of Financial Management, Human Resources Management, Training, Acquisitions, Information Technology Hosting, Aviation Services, Appraisal Services, and other administrative areas. One of the top priority areas in the Information Technology Hosting unit at NBC is data protection and fast data retrieval in case of disk failure or disaster recovery.

The NBC's data center runs its Oracle databases on multiple platforms (z/OS, Sun Solaris, Linux) and utilizes various applications including SAP, Oracle Federal Financials, and other third party applications. Before the introduction of Oracle Recovery Manager (RMAN) in 2001, all the OLTP databases and data mart databases (total of ~3TB) on the mainframe and other platforms were being backed up using third party tools at the OS level. This case study describes how NBC implemented RMAN on all platforms, from UNIX/Linux to the mainframe, resulting in faster backups and reduced application downtime.

RMAN USAGE FOR SAP DATABASES (UNIX)

The Financial and Business Management System (FBMS) is the Department of the Interior's single, integrated finance and administrative system used by all Bureaus. FBMS is implemented using SAP and ancillary third party applications, running on Oracle. The non-SAP Oracle databases are backed up directly using RMAN scripts, while SAP's BRBackup tool is used for the SAP databases (which calls RMAN via wrapper scripts). Both RMAN and BRBackup backup to tape are performed via specialized Tivoli Data Protection agents.

Using RMAN, NBC backs up 350 GB of data from Oracle databases daily. At this time, NBC supplements this strategy by performing weekly offline OS backups of their databases to tape using Tivoli Storage Manager (TSM). All backups are scheduled by BMC's Control-M product. Though restores from the offline OS backups have failed from time to time, RMAN has always successfully restored full database backups. In addition, point-in-time recovery from RMAN online backups has been an advantage to NBC, which offline OS backups can't provide. RMAN has proven to be very reliable, fast, and easy to implement. OS backup methods

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**Corporate profile:
National Business Center**

o   **Located within the Department of Interior, the National Business Center (NBC), for over 30 years, has supported the offices and bureaus within the department, as well as federal agencies outside the department, as a Shared Service Center, providing world class business management systems and services.**

o   **NBC offers a diverse, yet integrated set of administrative solutions, and is currently the only federal agency designated by both OMB and OPM as a Center of Excellence in the financial management and human resources lines of business.**

Oracle Database Backup and Recovery Solution:

o   **RMAN backup and recovery tool along with Tivoli Data Protection for Oracle.**

o   **200+ Oracle databases across various platforms, including z/OS (Mainframe), UNIX, and Linux totaling 3 TB of data.**

require that each block (empty or used) be read and written, whereas RMAN only needs to read and write blocks that are in use or have ever been used, saving considerable tape usage and backup time. Because of RMAN's reliability and benefits, NBC is seriously considering discontinuing the use of offline OS backups, and exclusively run RMAN backups.

In addition, the ability to perform online backups is crucial to meeting the growing demand of NBC's servers across various platforms. To speed up the backups further, NBC is planning to implement Tivoli LAN-free backups. Tivoli LAN-free speeds up the backup process by allowing the client system to write data directly to SAN attached storage devices (fibre channel LTO2 tape drives) instead of passing the data through the Tivoli server via the ethernet network. Not only does it speed up the backups, it frees up bandwidth on the LAN for other uses.

Here is an example of an RMAN online backup script, followed by a report and deletion of obsolete backups:

```
run {
    allocate channel t1 type 'sbt_tape' parms

     'ENV=(tdpo_optfile=/opt/tivoli/tsm/client/
     oracle/bin64/tdpo.opt)';
    backup
     tag fullbkup
      format 'df_%t_%s_%p'
       (database);
    sql 'alter system archive log current';
     backup archivelog all delete input;
    release channel t1;
    resync catalog;
}
run {
    crosscheck backupset;
    report obsolete;
    delete obsolete;
}
```

With one command, the default settings can be changed for all RMAN sessions. For example, the retention policy, by default, is set to keep only one backup at any time. By issuing the following command from RMAN prompt, the retention policy is changed from redundancy of one backup to 35 backups.

```
RMAN> CONFIGURE RETENTION POLICY TO REDUNDANCY 35;

old RMAN configuration parameters:
CONFIGURE RETENTION POLICY TO REDUNDANCY 1;
new RMAN configuration parameters:
CONFIGURE RETENTION POLICY TO REDUNDANCY 35;
new RMAN configuration parameters are successfully
stored
starting full resync of recovery catalog
full resync complete
```

All backups older than the most recent 35 backups are automatically marked as obsolete. An obsolete backup report is generated every day, before they are deleted.

Oracle Environment:
o   **Oracle 8.1.7.4, 9.2.0.7, 10.1.0.5, and 10.2.0.2**

Application Environment:
o   **SAP (R/3 4.70, BW v3.5, XI v3.0, Solutions Manager v3.2, Portal v6.0)**
o   **Oracle Federal Financial Applications 11.5.10.1**
o   **Other third party application tools.**

SAP databases backup strategy:
o   Daily RMAN online backup **to tape via Tivoli Data Protection (TDP) .**
o   **Archivelog files are backed up and deleted during the middle of the day.**
o   **Weekly Tivoli cold backup (including non-Oracle files)**
o   **Obsolete backups are reported and deleted every day.**
o   **Controlfile autobackup is enabled.**

RMAN catalog database backup strategy:
o   **Daily operating system cold backup is taken on the RMAN catalog databases during the day and a copy is sent offsite.**

Similarly, default DEVICE TYPE and environment variables such as TDPO_OPTFILE are set automatically using CONFIGURE command. The CONFIGURE command helps standardize RMAN settings across all databases:

```
RMAN>show all;
RMAN configuration parameters are:
CONFIGURE RETENTION POLICY TO REDUNDANCY 35;
CONFIGURE DEFAULT DEVICE TYPE TO 'SBT_TAPE';
CONFIGURE CHANNEL DEVICE TYPE 'SBT_TAPE' PARMS
'ENV=(TDPO_OPTFILE=/opt/tivoli/tsm/client/oracle/bin64/t
dpo. opt)';
```

For restore of the database, a simple restore script suffices:

```
create script rest1 {
allocate channel t1 type 'sbt_tape' parms

'ENV=(tdpo_optfile=/opt/tivoli/tsm/client/oracle/
bin/tdpo.opt)';
restore controlfile;
restore database;
alter database mount;
recover database;
alter database open resetlogs;
release channel t1;
}
run {
  execute script rest1;
}
```

RMAN USAGE FOR ORACLE FINANCIALS DATABASES (LINUX)

While NBC uses SAP for its large clients, NBC's small clients' accounting operations and IT services are implemented using Oracle Federal Financials 11i (OFF). NBC uses RMAN to backup these databases running on Linux servers. Oracle Federal Financial databases are backed up using daily RMAN online backups via Tivoli Data Protection agents, which are installed on each server. While the backup/restore implementation for OFF is similar to FBMS, RMAN is also used to clone the OFF production databases. Using RMAN for this purpose has been a major time and labor saver versus manual cloning methods. Cloning is used to refresh test and QA servers from production for the purpose of testing patches, especially security-related patches.

The following advantages were realized using RMAN to clone databases versus manual methods:

- o RMAN restore is faster than using Tivoli tape restore operation at the OS level as RMAN only restores the blocks that have ever been used.

- o The clone database DBID is automatically changed at the end of the cloning operation.

- o The new clone database can be immediately registered in the catalog and backed up using RMAN.

The following steps are used to clone OFF databases:

- TDPO.OPT file is changed to point to the source node in Tivoli.

- Set DB_FILE_NAME_CONVERT, LOG_FILE_NAME_CONVERT parameters in the target database initialization file.

- Connect to the RMAN catalog.

- Connect to the target database.

- Connect to the auxiliary instance in the no mount mode.

- Run the following RMAN script:

```
run {
      allocate auxiliary channel aux1 type
'sbt_tape' parms
'ENV=(DSMI_ORC_CONFIG=/opt/tivoli/tsm/client/oracl
e/ testdb/dsm.opt,
DSMI_DIR=/opt/tivoli/tsm/client/oracle/testdb,
TDPO_OPTFILE=/opt/tivoli/tsm/client/oracle/testdb/
tdpo.opt)';
   duplicate target database to TEST
PFILE=/ora002/oracle/shrdev04db/9.2.0/dbs/
initTEST.ora;
}
```

- Open and register the database in RMAN.

- Create necessary tempfiles after this restore.

- Register the database in Tivoli with the new node.

- Change TDPO.OPT file with the new node.

- Run a backup of the new database.

RMAN USAGE FOR DATA WAREHOUSE & OLTP DATABASES (Z/OS, MAINFRAME)

The majority of NBC's databases still reside on the mainframe systems, and most of the data mart applications use RMAN to backup their Oracle8i through 10g databases. Large batch jobs load data into these databases, on a daily basis. To minimize system impact during developers' access during the day and eliminate potentially large space usage by archived logs, these databases are run in NOARCHIVELOG mode. Offline backups are made every evening, and allow recovery to a previous day's batch job, which is important to the developers. These databases, with a total of 500GB of data, are backed up using an incremental backup strategy. A level 0 backup (i.e. full backup) runs on Sunday during the maintenance window followed by Level 2 on Monday night, Level 1 on Tuesday, Level 2 on Wednesday, Level 1 again on Thursday, etc. Before RMAN was implemented in 2001, all these databases were backed up offline nightly using Disk Management Systems (DMS). DMS backups typically took 3 to 4 hours for each database, versus RMAN incremental backups, which completed in 20 minutes, allowing the next day's batch jobs to start sooner. Because of RMAN's fast, easy,

and reliable backup and recovery methods, NBC has decided not to renew its DMS licenses.

The following RMAN Job Control Language (JCL) script creates an incremental level 0 backup each Sunday:

```
//OFPDBR10 JOB (XXXXXXXXX),'ORACLE RMAN',CLASS=8,
//          MSGCLASS=X,MSGLEVEL=(1,1),NOTIFY=XXXXXXX
/*JOBPARM S=%%\M\SYSID3
//*
//RMAN EXEC ORARMN92,REGION=0M,SYSOUT=DUMMY
//*
//STEPLIB  DD DISP=SHR,DSN=ORACLE.V9R2M0.V9204.CMDLOAD
//ORA$LIB  DD DISP=SHR,DSN=ORACLE.V9R2M0.V9204.MESG
//BSQ      DD DISP=SHR,DSN=ORACLE.V9R2M0.V9204.SQL
//SYSERR   DD SYSOUT=*
//SYSOUT   DD SYSOUT=*
//ORA@ORMN DD DUMMY
//TNSNAMES DD *
FPBR=(DESCRIPTION=(ADDRESS=(PROTOCOL=XM)(SID=FPDB)))
//*
//SYSIN    DD *
CONNECT CATALOG RMAN/PASSWD
CONNECT TARGET SYSTEM/PASSWD@FPDB
REPLACE SCRIPT ALLOC_0_FPDB_CART {
ALLOCATE CHANNEL DEV1 TYPE "EDM0" PARMS 'OROEDM3P.FPDB';
BACKUP INCREMENTAL LEVEL 0
TAG 'WEEK FPDB BAK LEV0'
FORMAT '/DSN/ORACLE.RMAN.BKUP.FPDB.*%u' POOL 2
(DATABASE);
RELEASE CHANNEL DEV1;
RESYNC CATALOG;
}

RUN {
    EXECUTE SCRIPT ALLOC_0_FPDB_CART;
}
```

Following the level 0 backup, a level 2 backup is taken on Monday followed by Level 1 backup on Tuesday, and these incremental backups are alternated for the rest of the weekdays. An example of a level 2 backup on Monday follows:

```
CONNECT CATALOG RMAN/PASSWD
CONNECT TARGET SYSTEM/PASSWD@FPDB
REPLACE SCRIPT ALLOC_2_FPDB_CART {
ALLOCATE CHANNEL DEV1 TYPE "EDM0" PARMS 'OROEDM3P.FPDB';
BACKUP INCREMENTAL LEVEL 2
TAG 'MON_FPDB_BAK_LEV2'
FORMAT '/DSN/ORACLE.RMAN.BKUP.FPDB.*%u' POOL 2
(DATABASE);
RELEASE CHANNEL DEV1;
RESYNC CATALOG;
}
RUN {
    EXECUTE SCRIPT ALLOC_2_FPDB_CART;
    }
```

The below is an example of an online backup using Oracle Database 10g, where you have RMAN catalog database and target databases spread across different Logical Partitions (LPARS). This required TNS entries defined in JCL, which runs the RMAN backup script. Notice the difference in the FORMAT option of the

BACKUP command, compared to the previous Oracle9i JCL scripts. This JCL also backs up archivelog files and cleans them up.

```
//OQTTXRBK JOB (XXXXXXXXX),
//               'RMAN BACKUP',
//
MSGCLASS=X,CLASS=S,NOTIFY=XXXXXXX,REGION=0M
//*
//RMAN EXEC ORARMN10,REGION=0M,SYSOUT=DUMMY
//*
//STEPLIB  DD DISP=SHR,DSN=ORACLE.V1R1M1.CMDLOAD
//         DD DISP=SHR,DSN=ORACLE.V1R1M0.CMDLOAD
//ORA$LIB  DD DISP=SHR,DSN=ORACLE.V1R1M0.MESG
//SQL      DD DISP=SHR,DSN=ORACLE.V1R1M1.SQL
//         DD DISP=SHR,DSN=ORACLE.V1R1M0.SQL
//SYSERR   DD SYSOUT=*
//SYSOUT   DD SYSOUT=*
//TNSNAMES DD *
QTTX  =
   (DESCRIPTION =
     (ADDRESS LIST =
     (ADDRESS = (COMMUNITY = tcp )(PROTOCOL = TCP)
               (HOST=hostname)(Port = XXXX))
     )
     (CONNECT_DATA = (SID = QTTX))
   )
QRMN  =
   (DESCRIPTION =
     (ADDRESS_LIST =
     (ADDRESS = (COMMUNITY = tcp )(PROTOCOL = TCP)
               (HOST=hostname)(Port = XXXX))
     )
     (CONNECT_DATA = (SID = QRMN))
   )
//*
//SYSIN    DD *
CONNECT CATALOG RMAN/PASSWD@QRMN
CONNECT TARGET RMAN/PASSWD@QTTX
REPLACE SCRIPT FULL_BKUP_QTTX {
ALLOCATE CHANNEL PRD1 TYPE "EDM0" PARMS 'OREDM10P.QTTX';
BACKUP TAG FULLBKUP
FORMAT '/DSN/ORACLE.RMAN.BKUP.QTTX.%u.P%p.C%c'
(DATABASE);
SQL 'ALTER SYSTEM ARCHIVE LOG CURRENT';
BACKUP ARCHIVELOG ALL
    FORMAT '/DSN/ORACLE.RMAN.BKUP.QTTX.ARCH.%u.P%p.C%c'
    DELETE INPUT;
RELEASE CHANNEL PRD1;
RESYNC CATALOG;
}
RUN {
   EXECUTE SCRIPT FULL_BKUP_QTTX;
   }
```

Here is an example of RMAN restore script under Oracle9i:

```
//ADPXXXX  JOB (XXXXXXXX),'ORACLE RMAN',CLASS=S,
//             MSGCLASS=X,MSGLEVEL=(1,1),NOTIFY=XXXXXX
//*
//RMAN EXEC ORARMN92,REGION=0M,SYSOUT=DUMMY
//*
//STEPLIB  DD DISP=SHR,DSN=ORACLE.V9R2M0.CMDLOAD
//ORA$LIB  DD DISP=SHR,DSN=ORACLE.V9R2M0.MESG
//BSQ      DD DISP=SHR,DSN=ORACLE.V9R2M0.SQL
//SYSERR   DD SYSOUT=*
```

"By eliminating never used blocks during backup, RMAN significantly reduced the size of our backups. Not only has this improved the speed of our backups, but it has freed up valuable resources such as disk space, tape cartridges, and tape drives."

Justin T. Miller, Senior UNIX System Administrator, National Business Center

```
//SYSOUT   DD SYSOUT=*
//ORA@ORMN DD DUMMY
//TNSNAMES DD *
FTDB=(DESCRIPTION=(ADDRESS=(PROTOCOL=XM)(SID=FTDB)))
//*
//SYSIN    DD *
CONNECT CATALOG RMAN/PASSWD
CONNECT TARGET /@FTDB
REPLACE SCRIPT REST_2_CART {
ALLOCATE CHANNEL DEV1 TYPE "EDM0" PARMS 'OROEDM3P.FTDB';
RESTORE CONTROLFILE;
RESTORE DATABASE;
ALTER DATABASE MOUNT;
RECOVER DATABASE;
ALTER DATABASE OPEN RESETLOGS;
RELEASE CHANNEL DEV1;
}
RUN {
    EXECUTE SCRIPT REST_2_CART;
}
```

Some OLTP databases will also be converted to use RMAN because of its ability to perform online backups. Because of this conversion, application processes do not need to be brought down during the evening and brought back up in the morning. System availability is key to important applications such as Time and Attendance reporting, which cannot be down for the start of the new business day.

DISASTER RECOVERY AND DATA GUARD

NBC also has been using RMAN for creating standby databases managed by Data Guard in Oracle Database 10g. Data Guard is crucial to ensuring availability of the data, in the event of an outage or disaster, by managing the process of failing over to a standby database. Once an RMAN online backup runs on the primary database, the backup is then used to create the standby database using the following commands:

```
RMAN> connect target rman/passwd@PRIM_DB
RMAN> connect auxiliary sys/passwd@STAND_DB
RMAN>
run
{
 allocate auxiliary channel dup1 type 'sbt_tape' parms

'ENV=(tdpo_optfile=/opt/tivoli/tsm/client/oracle/bin64/
tdpo.opt)';
 duplicate target database for standby dorecover;
}
```
Then, connect to standby, catalog and backup the standby database in RMAN.

CONCLUSION

NBC has used RMAN backup and recovery successfully across various operating systems since 2001. RMAN provides the following benefits:

- o Application downtime is minimized since RMAN backups can be performed online.

- o Backup windows are shorter by using incremental backups.

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RMAN Benefits:

RMAN Benefits:
- o   **One standard backup method across all operating systems, servicing multiple applications.**
- o   **Centralized repository of backup and restore information.**
- o   **Common backup and recovery commands.**
- o   **Minimized backup window.**
- o   **Maximized application and database uptime.**
- o   **Reduced tape usage.**

For More Information:
- o   RMAN on OTN

o   Backup management complexity is greatly reduced, as identical RMAN commands can be run across different operating systems.

o   Time and labor spent on cloning databases is reduced, as manual steps are eliminated.

o   Backup integrity is guaranteed, as RMAN validates all blocks for physical corruption.

o   Easier restore and recovery of databases, as well as creation of standby databases versus manual methods.

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December 2006
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