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Fannie Mae: Breaking the 1 TB/Hour Backup Barrier

FannieMae

"RMAN allows us to easily manage backup and recovery for all Oracle databases. In particular, time is of the essence when performing recovery, and RMAN significantly reduces the skill and effort required by our DBAs. In addition, since RMAN comes with the Oracle database, it relieves us from having to certify yet another third party tool."

-- Prasad Badiganti
Senior DBA
Fannie Mae

Corporate Profile: Fannie Mae

- Nation's largest source of financing for home mortgages.
- Helped over 60 Million Home Owners
- $5.9 trillion in housing finance
- http://www.fanniemae.com/

Oracle Database Backup and Recovery Solution

- Oracle Database 9.2.0.4
- Oracle Recovery Manager (RMAN)
- 300 Databases encompass 15-20 TB of data
- Efficient utilization of resources to accommodate the backup windows.

OVERVIEW

Oracle databases underpin Fannie Mae's OLTP and OLAP/BI applications, including PeopleSoft, Siebel, MicroStrategy, Brio, BusinessObjects and other in-house developed business applications, supporting all core data warehousing functions. Fannie Mae relies on RMAN across 300 databases, encompassing 15-20 TB, for reliable backup to and recovery from tape storage.

INTRODUCTION

Fannie Mae, a Fortune 50 company and one of the largest financial services corporations in the world, provides financial products and services that make it possible for low-, moderate-, and middle-income families to achieve homeownership. Since 1968, Fannie Mae has provided more than 60 million homeowners with more than $5.9 trillion in housing finance. Fannie Mae is the country's second largest corporation, in terms of assets, and the nation's largest provider of mortgage funds.

RECOVERY STRATEGY

To accommodate their growing data sizes (e.g. 6 TB database growing to projected 12+ TB in the next two years), and at the same time, shrink backup windows to alleviate system performance issues experienced by their business applications end users, Fannie Mae performed a major backup and recovery tuning exercise with the goal to achieve an average 1 TB/hr throughput on backup. RMAN enables Fannie Mae to simplify backup operations and intelligently recover their Oracle databases.

What follows is an account of the steps performed and lessons learned from the exercise.

TUNING STRATEGY

Fannie Mae divided their environment into the following subsystems, each of which was analyzed to support a throughput of 1 TB/hr:

OS Performance

Fannie Mae generated a list of all data files from the output of the backup, and executed a UNIX dd to read from all the files and write to /dev/null. With 8 HBAs connected to the disk SAN, all files could be read at a maximum rate of 700 MB/sec.

RMAN Performance

RMAN BACKUP VALIDATE command was used to determine optimal RMAN read throughput during backup, along with adjustment of FILESPERSET and MAXOPENFILES configuration parameters, the first specifying maximum number of files to be grouped into one backup set, and the second, the maximum number of files opened for reading by a single channel at any time. By changing these parameters, overall throughput improves with parallel reading of files by each channel; however, in the event that a backup is interrupted, a greater number of files must be re-read to complete the backup set upon restarting the backup. Considering this trade-off, Fannie Mae set FILESPERSET and MAXOPENFILES to 9, and found a satisfactory RMAN read throughput of 400 MB/sec.

Tape Drive Performance

Fannie Mae determined optimal tape drive read performance to be 65-70 MB/sec per 9940B tape drive. Two tape drives per HBA saturated at 90 MBPS. Thus, each tape drive on the HBA was estimated to read at 45 MB/sec.

Four HBAs were then configured for the tape SAN to realize ~360 MB/sec total throughput. However, the best performance came in at 270 MB/sec. They ascertained that the shortfall was due to the 4 domain configuration for the GS 320 server, which load balanced read/write processing across domains, resulting in lower overall throughput. To eliminate this load balancing effect, 4 additional HBAs were added to the tape SAN. This resulted in a throughput of 300 MB/sec, which could meet the overall target of 1 TB/hr backup. Fannie Mae also improved performance by enabling tape compression.

With the changes to RMAN and tape configurations, Fannie Mae dramatically reduced their backup windows, from an estimated 36+ hours to an average of 6.5 hours, for a 6 TB database.

System Configuration: Before Tuning

Compaq GS 320 running Tru64 5.1B

- **16 GB RAM**
- **16 CPUs**

Oracle9i Database Release 9.2.0.4

- **2.2 TB**
- **350 datafiles**

8 Host Bus Adapters (HBAs) connected to disk Storage Area Network (SAN)

StorageTek 9940 B tape drives

- **4 HBAs connected to tape SAN**
- **3 tape drives per HBA**

RMAN Settings

- **FILESPERSET=1**
- **30 channels with MAXOPENFILES=16**

Veritas NetBackup 4.5 Settings

- **Tape drive multiplexing set to 5**
- **Tape drive compression not enabled**

Changes in System Configuration: After Tuning

Storage Tek 9940 B tape drives

- **8 HBAS connected to tape SAN**
- **2 tape drives per HBA**
- **Maximum of 8 tape drives available at any time**
- **Tape drive compression enabled**
- **Tape drive multiplexing disabled**

RMAN Settings

- **FILESPERSET=9**
- **8 channels (one for each available tape drive), with MAXOPENFILES=9**

CONCLUSION

After achieving the 1 TB/hr target, Fannie Mae is now applying the same tuning methodology to large Oracle databases running on other platforms and storage media, including Sun servers and EMC disk arrays, and realizing significant backup performance gains. Their application end users now see increased system availability and performance due to shorter backup windows. Fannie Mae's experience outlines the steps to effective, systematic tuning, beginning with isolating each component in your backup environment, determining maximum throughput for each, and finally, implementing the necessary changes to take advantage of RMAN parallelism and multiplexing.

For More Information

- Oracle9i Recovery Manager User's Guide
- Tuning Oracle Recovery Manager
- **RMAN Performance Testing at Sun Customer Performance Center: 1 TB/hr Backup & Restore**
- **HP & RMAN Performance Benchmarking: 3 TB/hr Backup, 1 TB/hr Restore**

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