Recovery Manager (RMAN) Configuration and Performance Tuning
Best Practices

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Oracle Products Available Online

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Agenda

- Recovery Manager Overview
- Configuration Best Practices
  - Backup Strategies Comparison
  - Fast Recovery Area (FRA)
- Performance Tuning Methodology
  - Backup Data Flow
  - Tuning Principles
  - Diagnosing Performance Bottlenecks
- Starbucks Case Study
- Summary/Q&A
Oracle Recovery Manager (RMAN)
Oracle-integrated Backup & Recovery Engine

- Intrinsic knowledge of database file formats and recovery procedures
  - Block validation
  - Online block-level recovery
  - Tablespace/data file recovery
  - Online, multi-streamed backup
  - Unused block compression
  - Native encryption

- Integrated disk, tape & cloud backup leveraging the Fast Recovery Area (FRA) and Oracle Secure Backup

*RMAN also supports leading 3rd party media managers*
Most Critical Question To Ask First..

- **What are my recovery requirements?**
  - Assess tolerance for data loss - *Recovery Point Objective (RPO)*
    - How frequently should backups be taken?
    - Is point-in-time recovery required?
  - Assess tolerance for downtime - *Recovery Time Objective (RTO)*
    - Downtime: Problem identification + recovery planning + systems recovery
    - Tiered RTO per level of granularity, e.g. database, tablespace, table, row
  - Determine backup retention policy
    - Onsite, offsite, long-term

- Then.. *how does my RMAN backup strategy fulfill those requirements?*
Option 1: Full & Incremental Tape Backups

- **Well-suited for:**
  - Databases that can tolerate hours/days RTO
  - Environments where disk is premium
  - Low-medium change frequency between backups, e.g. < 20%

- **Backup strategy:**
  - Weekly level 0 and daily ‘differential’ incremental backup sets to tape, with optional backup compression
  - Enable block change tracking - only changed blocks are read and written during incremental backup
  - Archived logs are backed up and retained on-disk, as needed
Script Example

• Configure SBT (i.e. tape) channels:
  – \texttt{CONFIGURE CHANNEL DEVICE TYPE SBT PARMS '<channel parameters>';}

• Weekly full backup:
  – \texttt{BACKUP AS BACKUPSET INCREMENTAL LEVEL 0 DATABASE PLUS ARCHIVELOG;}

• Daily incremental backup:
  – \texttt{BACKUP AS BACKUPSET INCREMENTAL LEVEL 1 DATABASE PLUS ARCHIVELOG;}
Option 2: Incrementally Updated Disk Backups

- **Well-suited for:**
  - Databases that can tolerate no more than a few hours RTO
  - Environments where disk can be allocated for 1X size of database or most critical tablespaces

- **Backup strategy:**
  - Initial image copy to FRA, followed by daily incremental backups
  - Roll forward copy with incremental, to produce new on-disk copy
  - Full backup archived to tape, as needed
  - Archived logs are backed up and retained on-disk, as needed
  - Fast recovery from disk or **SWITCH** to use image copies
Script Example

• Configure SBT channels, if needed:
  – [CONFIGURE CHANNEL DEVICE TYPE SBT PARMS '<channel parameters>'];

• Daily roll forward copy and incremental backup:
  – RECOVER COPY OF DATABASE WITH TAG 'OSS';
  – BACKUP DEVICE TYPE DISK INCREMENTAL LEVEL 1 FOR RECOVER OF COPY WITH TAG 'OSS' DATABASE;
  – [BACKUP DEVICE TYPE SBT ARCHIVELOG ALL;]

• What happens?
  – First run: Image copy
  – Second run: Incremental backup
  – Third run+: Roll forward copy & create new incremental backup

• Backup FRA to tape, if needed:
  – [BACKUP RECOVERY AREA;]
Fast Recovery with RMAN SWITCH Demo
Option 3: Offload Backups to Physical Standby Database in Data Guard Environment

• **Well-suited for:**
  – Databases that require no more than several minutes of recovery time, in event of any failure
  – Environments that can preferably allocate symmetric hardware and storage for physical standby database
  – Environments whose tape infrastructure can be shared between primary and standby database sites

• **Backup strategy:**
  – Full and incremental backups offloaded to physical standby database
  – Fast incremental backup on standby with Active Data Guard
  – Backups can be restored to primary or standby database
• Backups can be taken at each database for optimal local protection
## Backup Strategies Comparison

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<tr>
<th>Strategy</th>
<th>Backup Factors</th>
<th>Recovery Factors</th>
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</table>
| **Option 1: Full & Incremental Tape Backups** | • Fast incrementals  
• Save space with backup compression  
• Cost-effective tape storage | • Full backup restored first, then incrementals & archived logs  
• Tape backups read sequentially |
| **Option 2: Incrementally Updated Disk Backups** | • Incremental + roll forward to create up-to-date copy  
• Requires 1X production storage for copy  
• Optional tape storage | • Backups read via random access  
• Restore-free recovery with SWITCH command |
| **Option 3: Offload Backups to Physical Standby Database** | • Above benefits + primary database free to handle more workloads  
• Requires 1X production hardware and storage for standby database | • Fast failover to standby database in event of any failure  
• Backups are last resort, in event of double site failure |
Fast Recovery Area (FRA) Sizing

- If you want to keep:
  - Control file backups and archived logs
    - Estimate total size of all archived logs generated between successive backups on the busiest days x 2 (in case of unexpected redo spikes)
  - Flashback logs
    - Add in \{Redo rate x Flashback retention target time x 2\}
  - Incremental backups
    - Add in their estimated sizes
  - On-disk image copy
    - Add in size of the database minus size of temporary files
  - Further details:
    - [http://download.oracle.com/docs/cd/E11882_01backup.112/e10642/rcmconfb.htm#i1019211](http://download.oracle.com/docs/cd/E11882_01backup.112/e10642/rcmconfb.htm#i1019211)
FRA File Retention and Deletion

When FRA space needs exceed quota, automatic file deletion occurs in the following order:

1. Flashback logs
   - Oldest Flashback time can be affected (with exception of guaranteed restore points)

2. RMAN backup pieces/copies and archived redo logs that are:
   - Not needed to maintain RMAN retention policy, or
   - Have been backed up to tape (via `DEVICE TYPE SBT`) or secondary disk location (via `BACKUP RECOVERY AREA TO DESTINATION ..`)

If archived log deletion policy is configured as:

- **APPLIED ON [ALL] STANDBY**
  - Archived log must have been applied to mandatory or all standby databases
- **SHIPPED TO [ALL] STANDBY**
  - Archived log must have been transferred to mandatory or all standby databases
- **BACKED UP <N> TIMES TO DEVICE TYPE [DISK | SBT]**
  - Archived log must have been backed up at least <N> times

If [APPLIED or SHIPPED] and BACKED UP policies are configured, both conditions must be satisfied for an archived log to be considered for deletion.
Performance Tuning Methodology
Performance Tuning Overview

- RMAN Backup Data Flow
- Performance Tuning Principles
- Diagnosing Performance Bottlenecks
RMAN Backup Data Flow

A. Prepare backup tasks & read blocks into input buffers

B. Validate blocks & copy them to output buffers
   - Compress and/or encrypt data if requested

C. Write output buffers to storage media (DISK or SBT)
   - Media manager handles writing of output buffers to SBT

Restore is inverse of data flow..
Tuning Principles

1. Determine the maximum input disk, output media, and network throughput
   - E.g. Oracle ORION – downloadable from OTN, `dd` command
   - Evaluate network throughput at all touch points, e.g. database server->media management environment->tape system

2. Configure disk subsystem for optimal performance
   - Use ASM
     - Configure external redundancy & leverage hardware RAID
     - If disks will be shared for DATA and FRA disk groups:
       - Provision the outer sectors to DATA for higher performance
       - Provision inner sectors to FRA, which has lower performance, but suitable for sequential write activity (e.g. backups)
     - Otherwise, separate DATA and FRA disks
       - If not using ASM, stripe data files across all disks with 1 MB stripe size.
Tuning Principles

3. Tune RMAN to fully utilize disk subsystem and tape

   - Use asynchronous I/O
     - For disk backup:
       - If the system does not support native asynchronous I/O, set `DBWR_IO_SLAVES`.
         - Four slave processes allocated per session
     - For tape backup:
       - Set `BACKUP_TAPE_IO_SLAVES`, unless media manager states otherwise.
         - One slave process allocated per channel process
3. Tune RMAN to fully utilize disk subsystem and tape
   – For backups to disk, allocate as many channels as can be handled by the system.
     • For image copies, one channel processes one data file at a time.
     • For backups to tape, allocate one channel per tape drive.
     • “But allocating # of channels greater than # of tape drives increases backup performance..so that’s a good thing, right?”
   – **No..restore time can be degraded due to tape-side multiplexing**
     • If `BACKUP VALIDATE` duration (i.e. read phase) where:
       – Time \{channels = tape drives\} \sim Time \{channels > tape drives\}
         • Bottleneck is most likely in media manager.
         • Discussed later in ‘Diagnosing Performance Bottlenecks’
       – Time \{channels = tape drives\} \gg Time \{channels > tape drives\}
         • Tune read phase (discussed next)
Read Phase - RMAN Multiplexing

- Multiplexing level: maximum number of files read by one channel, at any time, during backup
  - $\text{Min}(\text{MAXOPENFILES}, \text{FILESPERSET})$
  - $\text{MAXOPENFILES}$ default = 8
  - $\text{FILESPERSET}$ default = 64
  - Larger vs smaller backup set trade-offs
    - Restore performance
      - All data files vs. single data file
      - Backup restartability
- $\text{MAXOPENFILES}$ determines number and size of input buffers
  - Number and size of input buffers in $\text{V$BACKUP\_ASYNC\_IO/V$BACKUP\_SYNC\_IO}$
  - All buffers allocated from PGA, unless disk or tape I/O slaves are enabled (SGA by default or $\text{LARGE\_POOL}$, if set)
Read Phase - RMAN Input Buffers

- **MAXOPENFILES ≤ 4**
  - Each buffer = 1MB, total buffer size for channel is up to 16MB
    - **MAXOPENFILES=1** => 16 buffers/file, 1 MB/buffer = 16 MB/file
      - Optimal for ASM or striped system
- **4 < MAXOPENFILES ≤ 8**
  - Each buffer = 512KB, total buffer size for channel is up to 16MB. Number of buffers per file will depend on number of files.
    - **MAXOPENFILES=8** => 4 buffers/file, 512 KB/buffer = 2 MB/file
      - Optimal for non-striped system
      - Reduce the number of input buffers/file to more effectively spread out I/O usage (since each file resides on one disk)
- **MAXOPENFILES > 8**
  - Each buffer = 128KB, 4 buffers per file, so each file will have 512KB buffer
4. If `BACKUP VALIDATE` still does not utilize available disk I/O & there is available CPU and memory:
   - Increase RMAN buffer memory usage
     - With Oracle Database 11g Release 11.1.0.7 or lower versions -
       - Set `_BACKUP_KSFQ_BUFCNT` (default 16) = # of input disks
         - Number of input buffers per file allocated
         - Achieve balance between memory usage and I/O
           - E.g. Setting to 500 for 500 input disks may exceed tolerable memory consumption
       - Set `_BACKUP_KSFQ_BUFSIZE` (default 1048576) = stripe size (in bytes)
     - With Oracle Database 11g Release 2 -
       - Set `_BACKUP_FILE_BUFCNT`, `_BACKUP_FILE_BUFSIZE`
       - Restore performance can increase with setting these parameters, as output buffers used during restore will also increase correspondingly
       - Refer to Support Note 1072545.1 for more details
       - **Note:** With Oracle Database 11g Release 2 & ASM, all buffers are automatically sized for optimal performance
Backup Data Flow

A. Prepare backup tasks & read blocks into input buffers
B. Validate blocks & copy them to output buffers
   - Compress and/or encrypt data if requested
C. Write output buffers to storage media (DISK or SBT)
   - Media manager handles writing of output buffers to SBT
Tuning Principles

5. RMAN backup compression & encryption guidelines
   - Both operations depend heavily on CPU resources
   - Increase CPU resources or use LOW/MEDIUM setting
   - Verify that uncompressed backup performance scales properly, as channels are added
   - Note - if data is encrypted with:
     • TDE column encryption
       – For encrypted backup, data is double encrypted (i.e. encrypted columns treated as if they were not encrypted)
     • TDE tablespace encryption
       – For compressed & encrypted backup, encrypted tablespaces are decrypted, compressed, then re-encrypted
       – If only encrypted backup, encrypted blocks pass through backup unchanged
6. Tune RMAN output buffer size
   - Output buffers => blocks written to **DISK** as copies or backup pieces
     or to **SBT** as backup pieces
   - Four buffers allocated per channel
   - Default buffer sizes
     - **DISK**: 1 MB
     - **SBT**: 256 KB
       - Adjust with **BLKSIZE** channel parameter
       - Set **BLKSIZE** >= media management client buffer size
       - No changes needed for Oracle Secure Backup
     - Output buffer count & size for disk backup can be manually adjusted
       - Details in **Support Note 1072545.1**
       - **Note:** With Oracle Database 11g Release 2 & ASM, all buffers are automatically sized for optimal performance
Performance Tuning Overview

• RMAN Backup Data Flow
• Performance Tuning Principles
• Diagnosing Performance Bottlenecks
Diagnosing Performance Bottlenecks – Pt. 1

• Query `EFFECTIVE_BYTES_PER_SECOND` column (EBPS) for ‘AGGREGATE’ row in `V$BACKUP_ASYNC_IO` or `V$BACKUP_SYNC_IO`
  – If EBPS < storage media throughput, run `BACKUP VALIDATE`
• Case 1: `BACKUP VALIDATE` time ~= actual backup time, then read phase is the likely bottleneck.
  – Refer to RMAN multiplexing and buffer usage guidelines
  – Investigate ‘slow’ performing files
• Find data file with highest `(LONGWAITS/IO_COUNT)` ratio
  • If ASM, add disk spindles and/or re-balance disks
  • Move file to new disk or multiplex with another ‘slow’ file
Diagnosing Performance Bottlenecks – Pt. 2

• Case 2: **BACKUP VALIDATE** time << actual backup time, then buffer copy or write to storage media phase is the likely bottleneck.
  – Refer to backup compression and encryption guidelines
  – If tape backup, check media management (MML) settings:
    • TCP/IP buffer size
    • Media management client/server buffer size
    • Client/socket timeout
    • Media server hardware, connectivity to tape
    • Enable tape compression (but not RMAN compression)
Restore & Recovery Performance Best Practices

- Minimize archive log application by using incremental backups
- Use block media recovery for isolated block corruptions
- Keep adequate number of archived logs on disk
- Increase RMAN buffer memory usage
- Tune database for I/O, DBWR performance, CPU utilization
- Refer to MAA Media Recovery Best Practices paper
  - [Active Data Guard 11g Best Practices](#) (includes best practices for Redo Apply)
Starbucks Case Study
Starbucks Enterprise Data Warehouse (EDW) Backup and Recovery Tuning

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September 22, 2010
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Starbucks Enterprise Data Warehouse (EDW) Backup and Recovery Tuning

• Starbucks Background and EDW Architecture

• EDW Backup and Recovery Strategy
  • Issues/Challenges with Tape Backups

• Course of Action to Resolve Tape Backup Performance Issue
Global Brand Grows from a Single Store
The Starbucks of Today

**Licensed Stores:**
- Grocery stores
- Borders Book stores
- Airports, convention centers

**Company-operated stores in the U.S. and International**

**Foodservice:**
- "We Proudly Brew," serving coffee through hotels, colleges, hospitals, airlines
EDW - Who it Supports

• Production EDW supports Starbucks internal business users
  • 10 TB VLDB warehouse, growing 1-2 TB per year
  • Provides reports to the store level – sales, staffing, etc.
• Thousands of stores directly access the EDW
  • Web-based dashboard reports via company intranet
  • Monday Morning Mayhem
• Front-end reporting with Microstrategy
• Leveraging Ascential DataStage ETL Tool
  • Toad, SQL Developer, and other ad-hoc tools used by developers and QA
• And Much, Much, More…..
Production Hardware

- Servers –
  4 CPU HP ia64
  1.5 GHz CPU
  16 GB RAM
- Network –
  Infiniband Private Interconnect
- Public Network –
  Gigabit Ethernet
- Storage –
  SAN, ASM
- 12 TB RAID 1+0 (DATA DG), 146 GB Drives
- 14 TB RAID 5 (FRA DG), 300 GB Drives
- Oracle Database
  11.1.0.7 EE
- Media Manager –
  NetBackup 6.5.5
- RMAN Backup & Recovery

5 Node RAC Database

- Public GigE Network
- Infiniband Private Interconnect
- Dedicated GigE Backup Network
- 4 x 2G FC Connections
- 2 x MDS 9509 San Switches
- 16 x 2G FC connections
- Storage Area Network
- 2 x 2G FC connections
- NetBackup Media Server
  NBU 6.5.5
- Sun T2000
- Tape Library
  Quantum Scalar I2K
  2 x LTO2 tape drives per FC port
  2 x FC ports
  Total of 4 x LTO2 tape drives
Starbucks Enterprise Data Warehouse (EDW) Backup and Recovery Tuning

- Starbucks Background and EDW Architecture

- EDW Backup and Recovery Strategy
  - Issues/Challenges with Tape Backups

- Course of Action to Resolve Tape Backup Performance Issue
Backup Strategy

• RPO – Anytime within the last 24 hours, Backup window of 24 hours
• RMAN Incrementally Updated Backup Strategy
  • Disk - Flash Recovery Area (FRA)
    • Daily Incremental update of image copy with ‘SYSDATE – 1’
    • Daily Level 1 Differential Incremental Backups
      • Daily Script:
        { RECOVER COPY OF DATABASE WITH TAG 'WEEKLY_FULL_BKUP'
          UNTIL TIME 'SYSDATE - 1';
          BACKUP INCREMENTAL LEVEL 1 FOR RECOVER OF COPY WITH TAG WEEKLY_FULL_BKUP DATABASE;
          BACKUP AS BACKUPSET ARCHIVELOG ALL NOT BACKED UP DELETE ALL INPUT;
          DELETE NOPROMPT OBSOLETE RECOVERY WINDOW OF 1 DAYS DEVICE TYPE DISK; }
  • Tape
    • Weekly: BACKUP RECOVERY AREA
    • Each day, for rest of the week: BACKUP BACKUPSET ALL
Backup Performance to FRA

- Daily Incremental Update + Incremental Backup
  - 1 hr 45 minutes -> 2 hrs 30 minutes depending upon workload
  - 60-75 minutes for `RECOVER COPY OF DATABASE`..
  - 30-45 minutes for incremental backup set creation + time to purge old backup pieces

- The backup set is typically 250-350 GB but can vary depending on the workload

- 4 RMAN channels to disk running on single RAC node
Backup Performance to Tape

• Daily Backup of Backup Sets to Tape
  • Using 2 channels on 1 node takes 60-90 minutes (some concern here with speed)

• Weekly Backup of Recovery Area to Tape
  • With 4 channels (2 channels per node) backing up 10.5 TB in FRA, backup duration can be highly variable.
  • Backup will sometimes run in 15-16 hours and other times 30+ hours!
  • Why the wide variance?
  • But first, what is expected backup rate?
What is Expected Backup Rate?

- LTO-2 tape drive can backup at roughly 70 MB/sec compressed (or better)
  - 4 drives x 70 MB = 280 MB/sec (1 TB/hr)
- Is the tape rate supported by FRA disk?
  - RMAN – BACKUP VALIDATE DATAFILECOPY ALL
  - Observed rate (read phase) > 1 TB/hr
- What is the effect of GigE connection to media server?
  - Maximum theoretical speed is 128 MB/sec
  - With overhead, ~115 MB/sec per node
  - Maximum rate from 2 nodes is 230 MB/sec (828 GB/hr)
  - Observed rate is more like 180 MB/sec (650 GB/hr)
- Conclusion: GigE throttles overall backup rate
  - FRA backup time = 10.5 TB / 650 GB/hr = ~16 hrs
  - Something else going on with backup time variance..
Why So Much Variance in FRA Backup Time?

- Three Problem Areas Identified
  - Link Aggregation on the Media Server
    - Spent a lot of time making sure this was working
  - Network Load Balancing from Network Switch
    - On occasion, 3 out of 4 RMAN channels jumped on one port of Network Interface Card (NIC)
  - Processor Architecture on Media Server
    - T2000 Chip – 1 chip x 4 cores x 4 threads
    - Requires setting interrupts to load balance across the 4 cores
    - One core completely pegged during tests
Starbucks Enterprise Data Warehouse (EDW) Backup and Recovery Tuning

• Starbucks Background and EDW Architecture

• EDW Backup and Recovery Strategy
  • Issues/Challenges with Tape Backups

• Course of Action to Resolve Tape Backup Performance Issue
Tuning Objective

• Decrease Variance in Backup Time

• Increase Backup Throughput for Future Growth
  • EDW capacity increasing from 12->17 TB over next month
  • Backup window still 24 hours
  • Current 720 MB/s throughput will overrun window at 17 TB
  • Desired throughput is ~ 1 TB/hr to accommodate growth & meet backup window

• Simplify Backup Hardware Architecture
Proposed Solution 1 - Eliminate Separate Media Server & Install Media Server on 2 RAC Nodes

- Benefits
  - Reduces Backup Complexity
  - Eliminates 1 GigE Network Bottleneck
  - Eliminates Network Load Balancing Issues
  - Easier to Monitor

[Diagram showing network components and connections, including media servers, storage area network, and backup network.]
Proposed Solution 2 – Use NetBackup SAN Clients

- Benefits
  - Eliminates 1 GigE Network Bottleneck
  - Eliminates Network Load Balancing Issues

Diagram showing network connections and components including HP rx4640, San Clients, Storage Area Network, and NetBackup Media Server.
What is New Theoretical Bottleneck?

- LTO-3 tape drive backs up at ~140 MB/s compressed (or better)
  - 2 drives (1 drive / node) x 140 MB/sec = 280 MB/s (1 TB/hr)
- Is tape speed supported by FRA disk?
  - RMAN - `BACKUP VALIDATE DATAFILECOPY ALL`
- Observed rate > 1 TB/hr (with 4 RMAN channels)
- Is tape speed limited by connection over fiber?
  - Each Node has 4 x 2 Gb Fiber Connections with EMC PowerPath Multipathing software
  - Storage Engineer – “1.37 GB/Sec max rate for cluster.”
  - Two tape drives - 280 MB/s out of 1.37 GB/s
    - 20% of available I/O capacity utilization
  - FRA backup time: 10.5 TB / 1 TB/hr = 10.5 hrs
    - 35% performance improvement vs. today (16 hrs)
Finally – Some Real RMAN Tuning

• Tests were conducted with running a `BACKUP VALIDATE DATAFILECOPY ALL` command with 2 channels
  • Test 1 – 2 channels on 1 node
  • Test 2 - 2 channels on 2 nodes (1 channel/node)

• FRA disk group is comprised of 72 – 193 GB LUNs
  • `_BACKUP_KSFQ_BUFCNT` = 16 (default) => 200 MB/s (720 GB/hr)
    = 32  => 250 MB/s (900 GB/hr)
    = 64  => 300 MB/s (1 TB/hr)

• **50% read rate improvement** when correctly tuned
• **Yes,** I can fully drive 2 LTO-3s with 2 channels, based on `BACKUP VALIDATE` testing
Test 1 – 1 Node with 2 Channels

- Test _BACKUP_KSFQ_BUFCNT = 16, 32, 64
Test 2 – 2 Channels with 1 Channel per Node

Node 1 - \(_{\text{BACKUP\_KSFO\_BUFCNT}} = 16, 32, 64\)

Node 2 - \(_{\text{BACKUP\_KSFO\_BUFCNT}} = 16, 32, 64\)
Initial Results of Tape Backup Testing
Media Server Installed on RAC Nodes
• 1 channel per node (2 channels total) + 2 LTO-3 Drives
  • Observed backup rate of 200 MB/s (720 GB/hr) vs. theoretical 280 MB/s (1 TB/hr with 2 x 140 MB/s for LTO-3)
  • Recall: RMAN VALIDATE (read rate) > 1 TB/hr, so RMAN not bottleneck
• Other possible factors:
  • Database compression – Yes, but can’t account for all of the lower backup rates
  • Tuning – Additional performance might be gained by tuning media server parameters
  • Hardware Setup – HBA ports configuration or how tapes are zoned to the servers
After Rezoning Tape Drives to HBAs
2 Channels with 1 Channel per Node

- Node 1 ~ 145 MB/s
- Node 2 ~ 120 MB/s
  - 33% improvement after rezoning

Node 1 Backup Throughput:
Four Channels with 2 Channels per Node
Achieved Backup Rate ~ 1.6 TB/Hour

Node 1 Backup Throughput ~ 240 MB/s:

Node 2 Backup Throughput ~ 200 MB/s (due to other high query activity)
Summary

• Starbucks Background and EDW Architecture

• EDW Backup and Recovery Strategy
  • Issues/Challenges with Tape Backups
    • Identify the bottlenecks in your system and know your theoretical backup speed

• Course of Action to Resolve Tape Backup Performance Issue
  • Re-architect if bottleneck is hardware related
  • Tune RMAN parameters to get the most out of your backup hardware
    • 50% increase in RMAN read performance was achieved by tuning **BACKUP_KSFQ_BUFCNT**
    • RMAN should never be the bottleneck
  • Keep tuning as new bottlenecks are discovered..
Summary/Q&A
Summary

- Recovery & business requirements drive the design of backup / data protection strategy
  - Disk and/or tape, offload to Data Guard?
- RMAN performance tuning is all about answering the question:
  - What is my bottleneck? (then removing it)
- Determine maximum throughput/ceiling of each backup phase
  - Read blocks into input buffers (memory, disk I/O)
  - Copy to output buffers (CPU, esp. compression and/or encryption)
  - Write to storage media (memory, disk/tape I/O, media management/HW configuration)
- Get knowledgeable with media management and tape configuration
  - A smarter DBA = smarter case to make with the SA!
RMAN Trivia Time..

1. In which Oracle release did RMAN first appear?
2. In which Oracle release did the multi-section backup feature first appear?
3. What is the negative effect of RMAN + tape-side multiplexing?
4. Which view reports throughput and memory buffer usage during backup?
5. How does Oracle Database 11g Release 2 RMAN with ASM behave differently in memory buffer allocation versus older releases?
# Key HA Sessions, Labs, & Demos by Oracle Development

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<th>Time</th>
<th>Session</th>
<th>Location</th>
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| **Monday, 20 Sep – Moscone South * ** | 3:30p Extreme Consolidation with RAC One Node, Rm 308  
4:00p Edition-Based Redefinition, Hotel Nikko, Monterey I / II  
5:00p Five Key HA Innovations, Rm 103  
5:00p GoldenGate Strategy & Roadmap, Moscone West, Rm 3020 | **Moscone South**        |
| **Tuesday, 21 Sep – Moscone South * ** | 11:00a App Failover with Data Guard, Rm 300  
12:30p Oracle Data Centers & Oracle Secure Backup, Rm 300  
2:00p ASM Cluster File System, Rm 308  
2:00p Exadata: OLTP, Warehousing, Consolidation, Rm 103  
3:30p Deep Dive into OLTP Table Compression, Rm 104  
3:30p MAA for E-Business Suite R12.1, Moscone West, Rm 2020  
5:00p Instant DR by Deploying on Amazon Cloud, Rm 300 | **Moscone South**        |
| **Wednesday, 22 Sep – Moscone South * ** | 11:30a RMAN Best Practices, Rm 103  
11:30a Database & Exadata Smart Flash Cache, Rm 307  
11:30a Configure Oracle Grid Infrastructure, Rm 308  
1:00p Top HA Best Practices, Rm 103  
1:00p Exadata Backup/Recovery Best Practices, Rm 307  
4:45p GoldenGate Architecture, Hotel Nikko, Peninsula | **Moscone South**        |
| **Thursday, 23 Sep – Moscone South * ** | 10:30a Active Data Guard Under the Hood, Rm 103  
1:30p Minimal Downtime Upgrades, Rm 306  
3:00p DR for Database Machine, Rm 103 | **Moscone South**        |

**Demos Moscone West DEMOGrounds**

**Monday, Sep 20, 12:30 pm - 1:30 pm**
Oracle Active Data Guard

**Tuesday, Sep 21, 5:00 pm - 6:00 pm**
Oracle Active Data Guard

**Hands-on Labs Marriott Marquis, Salon 10 / 11**

**Monday, Sep 20, 12:30 pm - 1:30 pm**
Oracle Active Data Guard

**Tuesday, Sep 21, 5:00 pm - 6:00 pm**
Oracle Active Data Guard

*All session rooms are at Moscone South unless otherwise noted*

*After Oracle OpenWorld, visit [http://www.oracle.com/goto/availability](http://www.oracle.com/goto/availability)*
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