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Recovery Manager (RMAN) Configuration and Performance Tuning Best Practices

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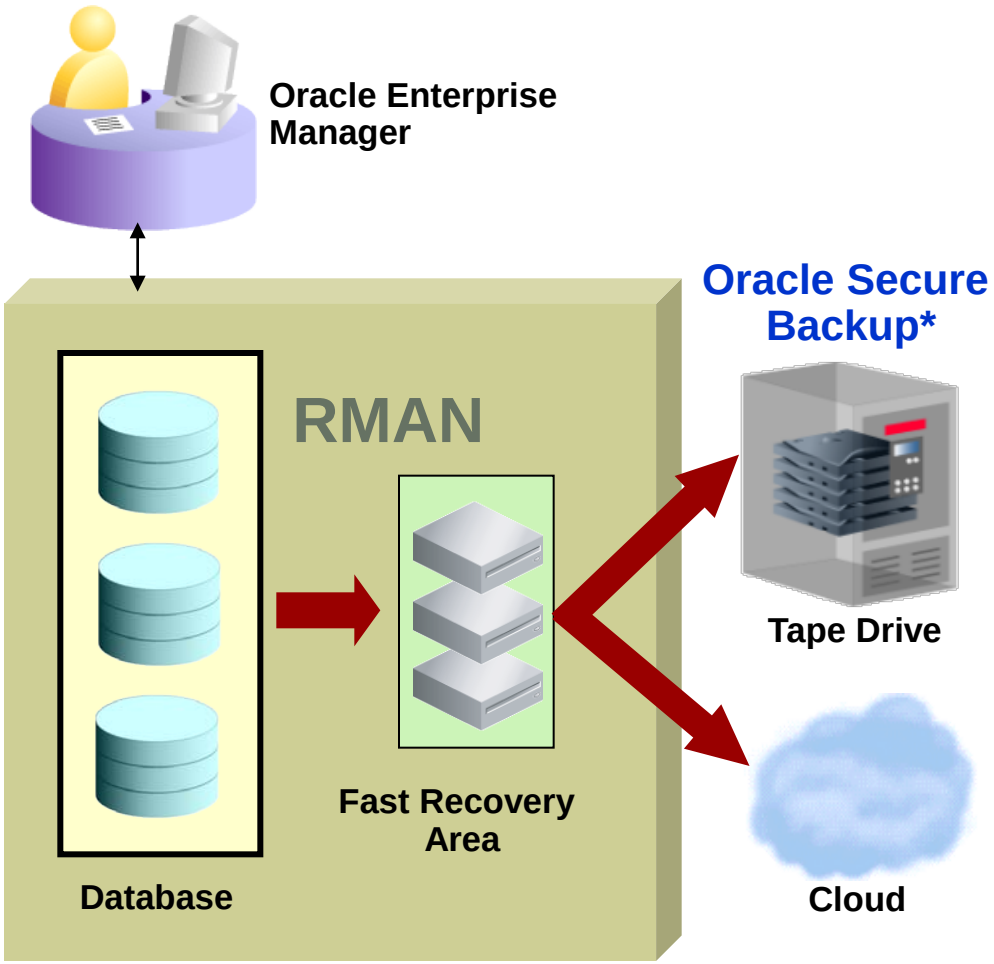
Agenda

- 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

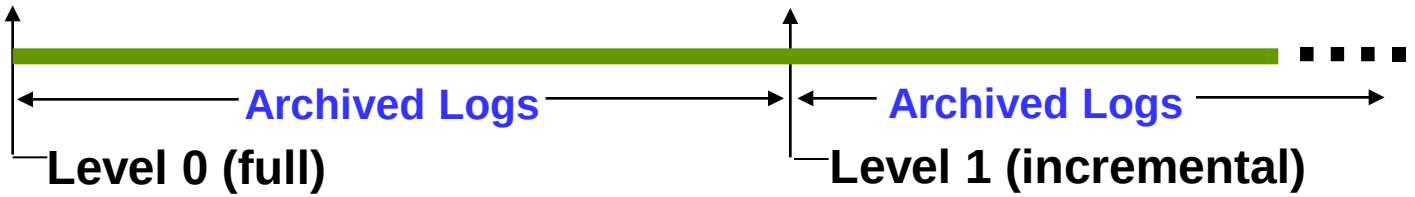
***RMAN also supports leading 3rd party media managers**

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:
  - **`CONFIGURE CHANNEL DEVICE TYPE SBT PARMS '<channel parameters>';`**
- Weekly full backup:
  - **`BACKUP AS BACKUPSET INCREMENTAL LEVEL 0 DATABASE PLUS ARCHIVELOG;`**
- Daily incremental backup:
  - **`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
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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

Strategy	Backup Factors	Recovery Factors
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_01/backup.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

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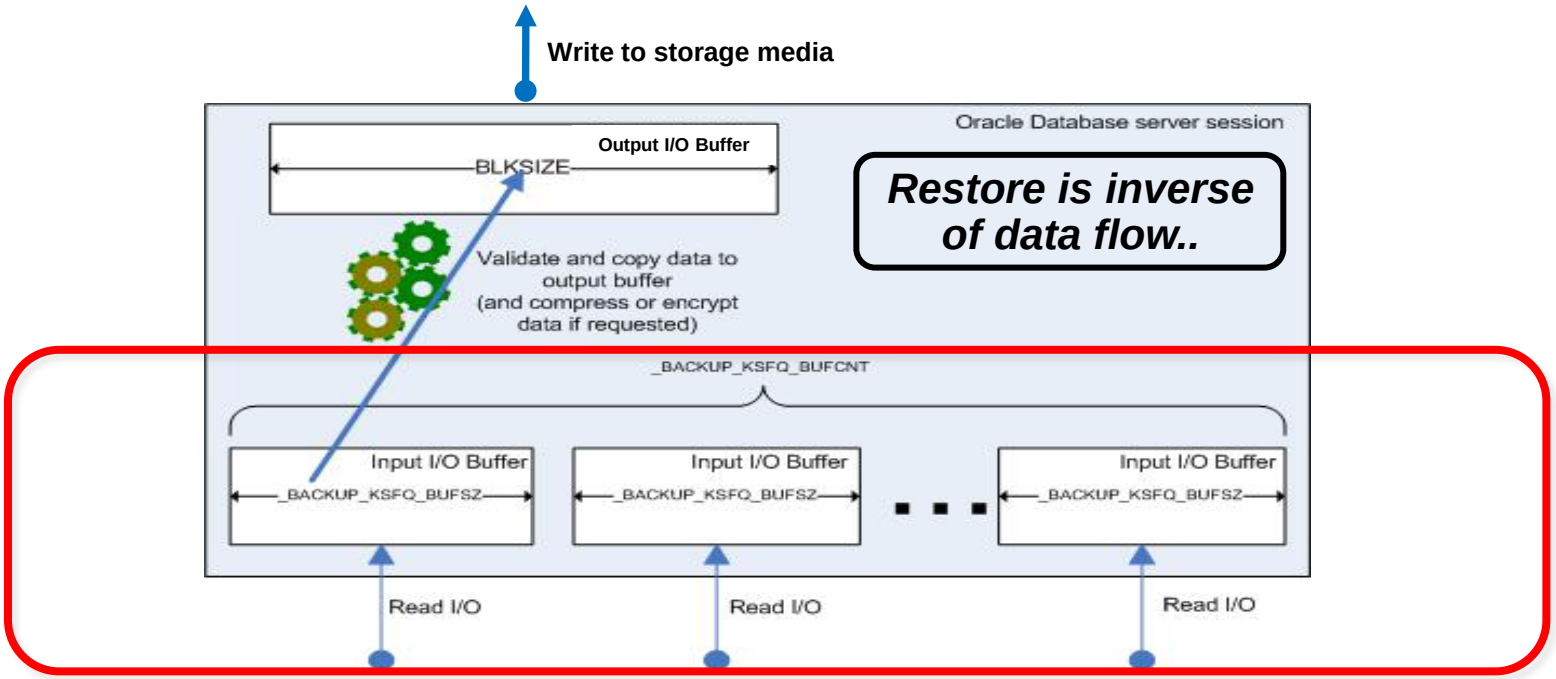
Performance Tuning Overview

- 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**



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

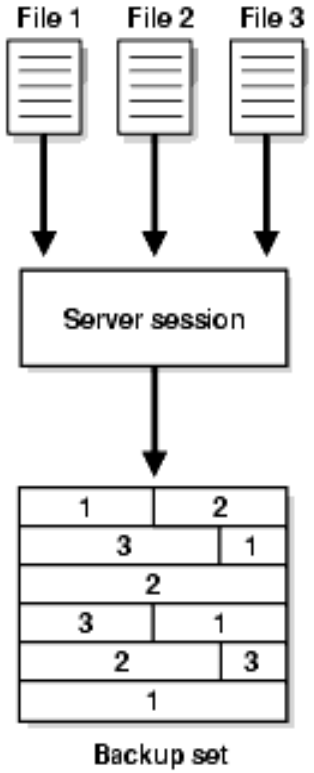
3. Tune RMAN to fully utilize disk subsystem and tape

   - 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

Tuning Principles

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} ~= Time {channels > tape drives}
         - Bottleneck is most likely in media manager.
         - Discussed later in 'Diagnosing Performance Bottlenecks'
       - Time {channels = tape drives} >> 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
  - **`Min(MAXOPENFILES, FILESPERSET)`**
  - **`MAXOPENFILES` default = 8**
  - **`FILESPERSET` default = 64**
    - Larger vs smaller backup set trade-offs
      - Restore performance
        - All data files vs. single data file
      - Backup restartability
- **`MAXOPENFILES`** determines number and size of input buffers
  - Number and size of input buffers in **`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 **`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

Tuning Principles

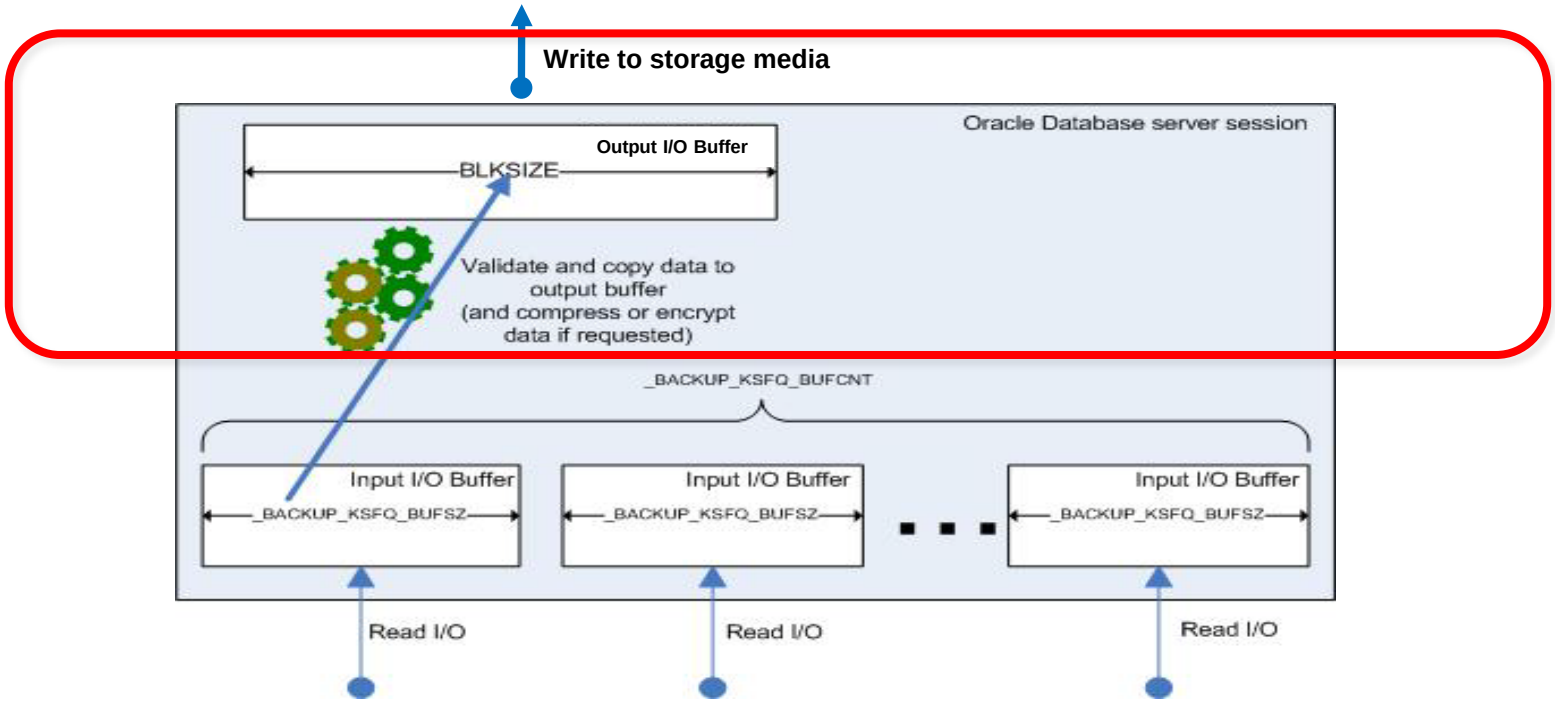
4. If **BACKUP VALIDATE** still does not utilize available disk I/O & there is available CPU and memory:
   - Increase RMAN buffer memory usage
     - With Oracle Database 11*g* Release 11.1.0.7 or lower versions -
       - Set **_BACKUP_KSFQ_BUFCNT** (default 16) = # of input disks
         - Number 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_BUFSZ** (default 1048576) = stripe size (in bytes)
     - With Oracle Database 11*g* Release 2 -
       - Set **_BACKUP_FILE_BUFCNT,_BACKUP_FILE_BUFSZ**
     - 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

Tuning Principles

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 **(LONG_WAITS/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

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Starbucks Enterprise Data Warehouse (EDW) Backup and Recovery Tuning

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September 22, 2010

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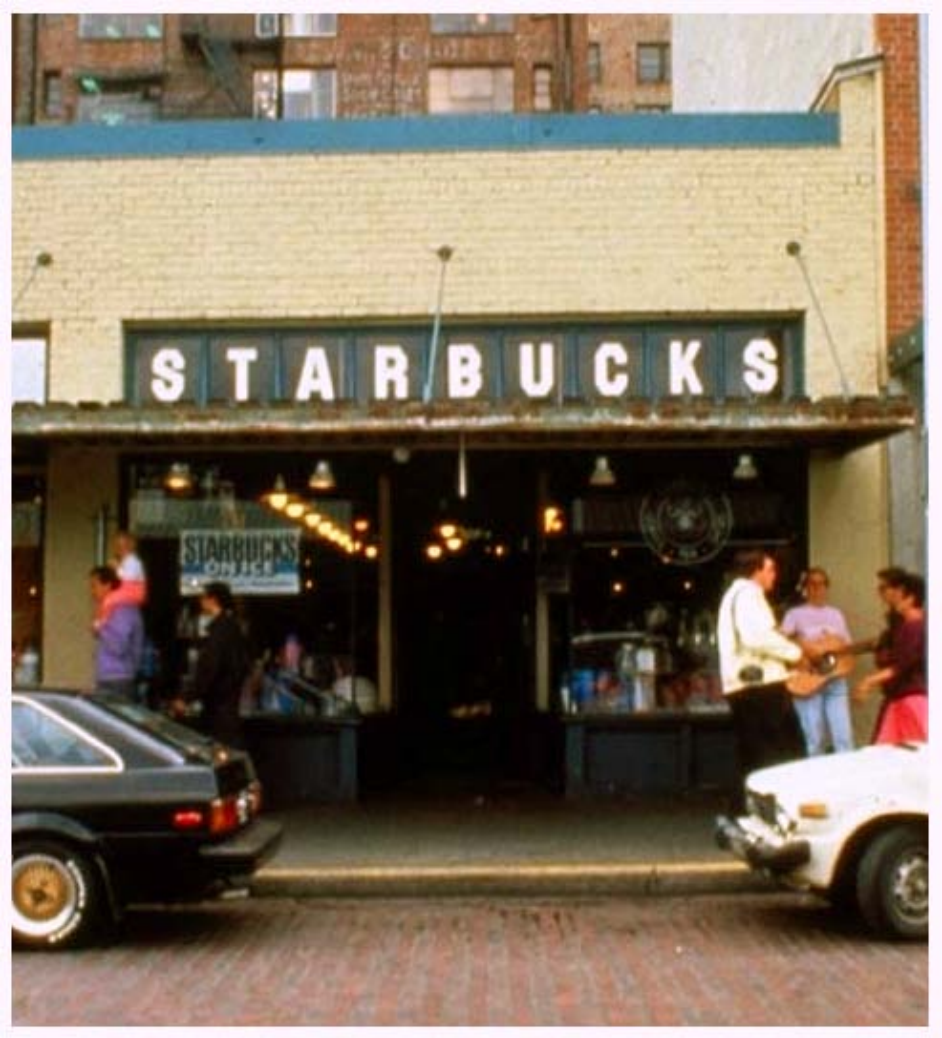
Starbucks Enterprise Data Warehouse (EDW) Backup and Recovery Tuning

- **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



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Foodservice:
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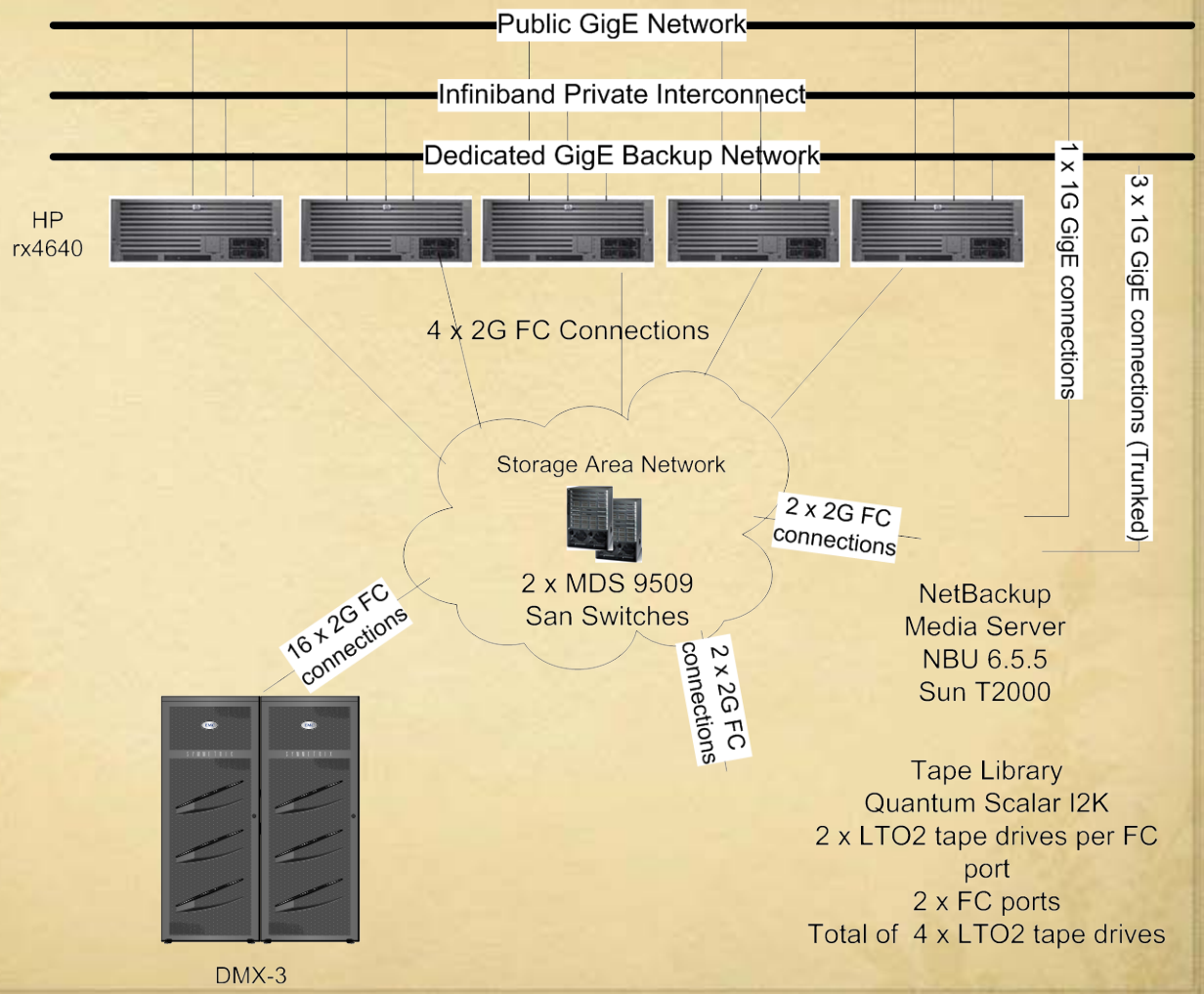
EDW - Who it Supports

- 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



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

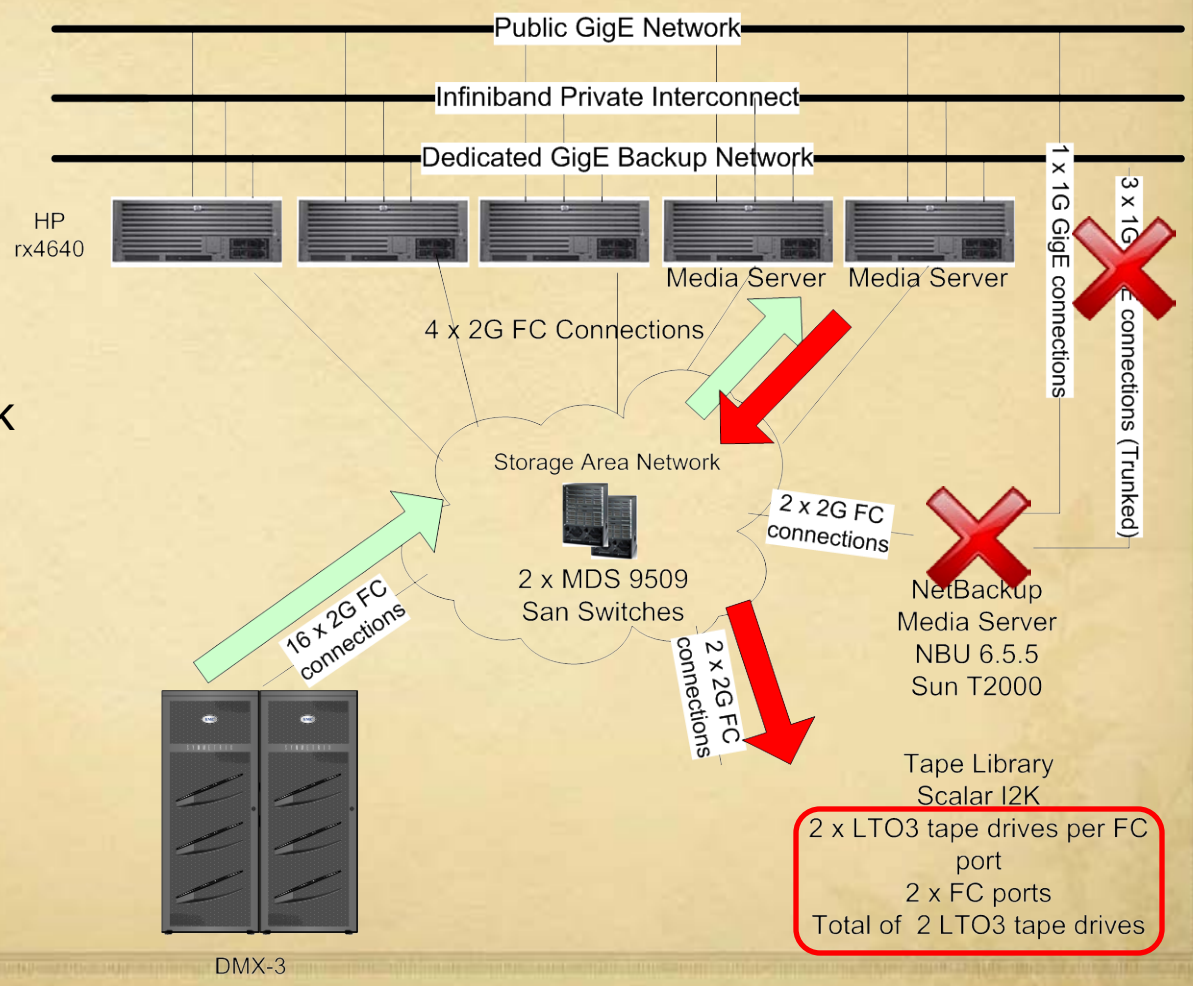
- Starbucks Background and EDW Architecture
- EDW Backup and Recovery Strategy
  - Issues/Challenges with Tape Backups
- **Course of Action to Resolve Tape Backup Performance Issue**

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

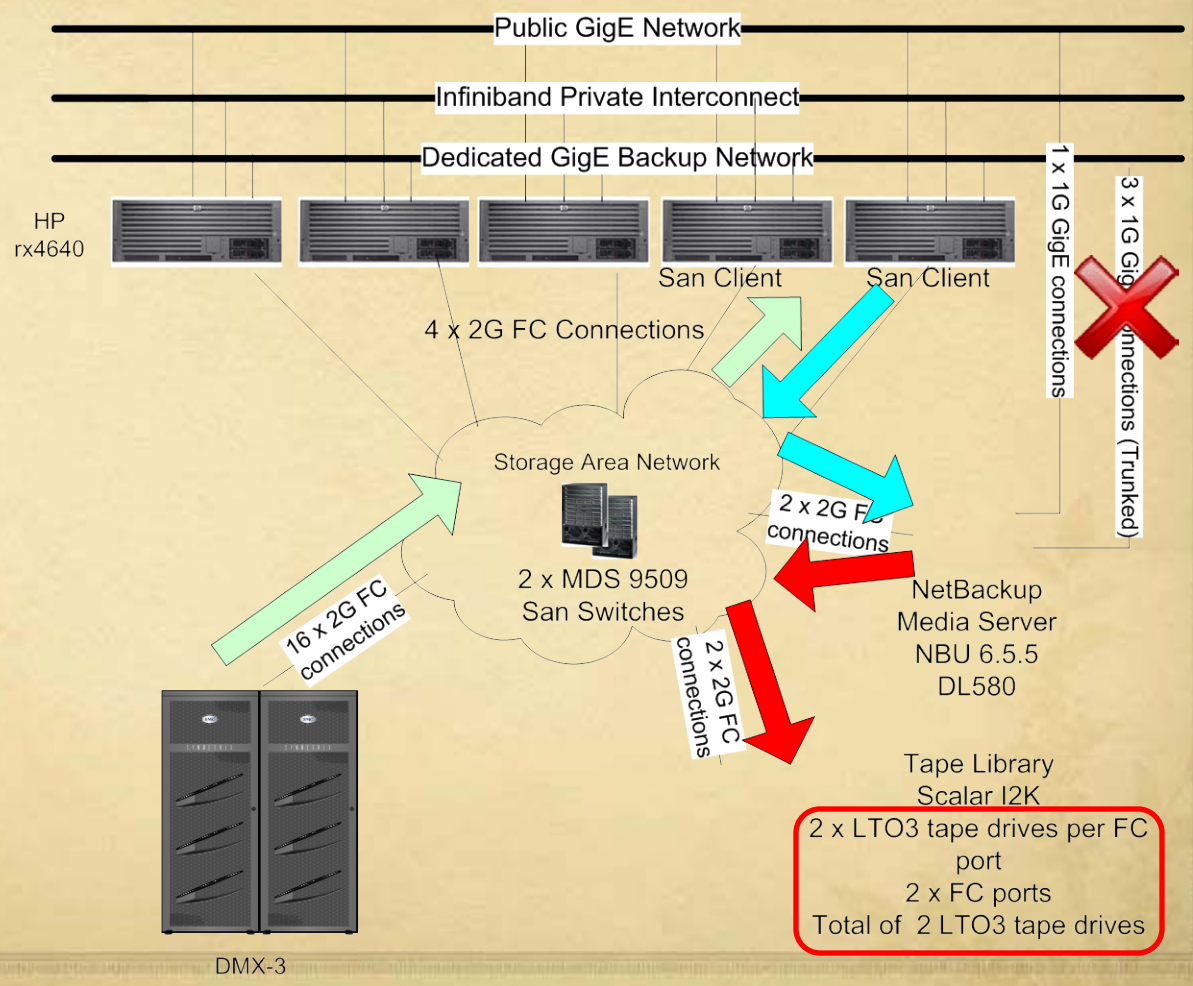
Proposed Solution 1 - Eliminate Separate Media Server & Install Media Server on 2 RAC Nodes

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



Proposed Solution 2 – Use NetBackup SAN Clients

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



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

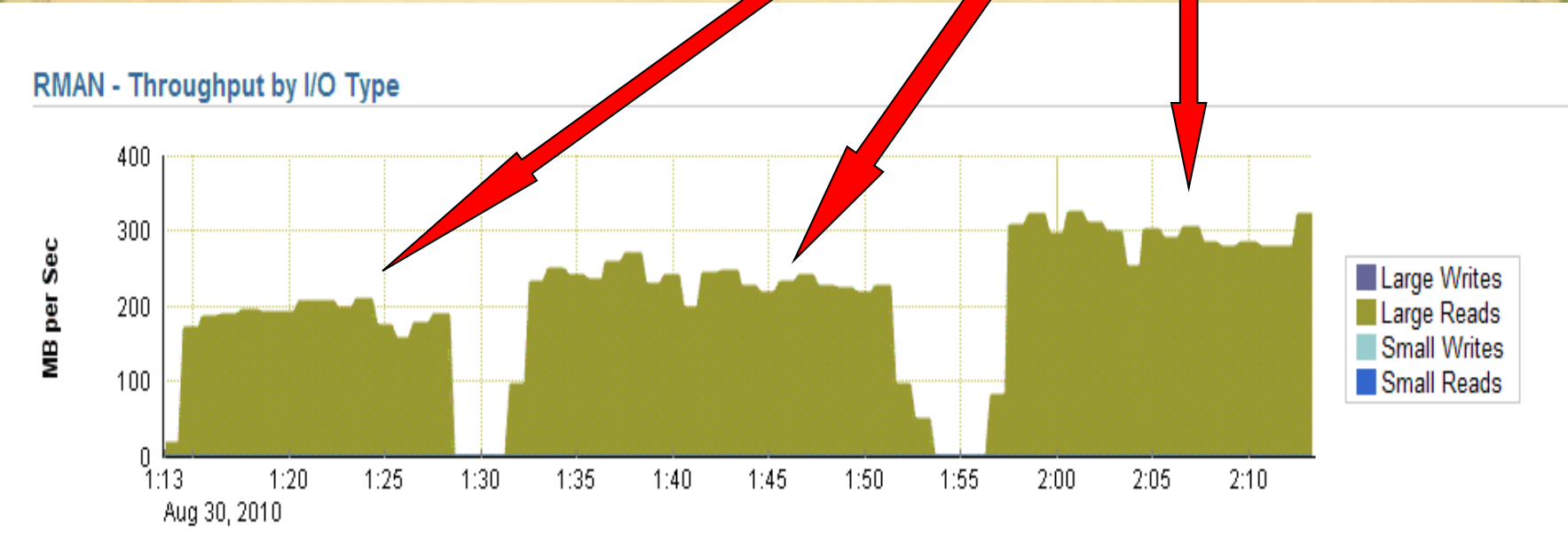
- Tests were conducted with running a **`BACKUP VALIDATE DATAFILECOPY ALL`** command with 2 channels
  - Test 1 – 2 channels on 1 node
  - Test 2 - 2 channels on 2 nodes (1 channel/node)

- 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

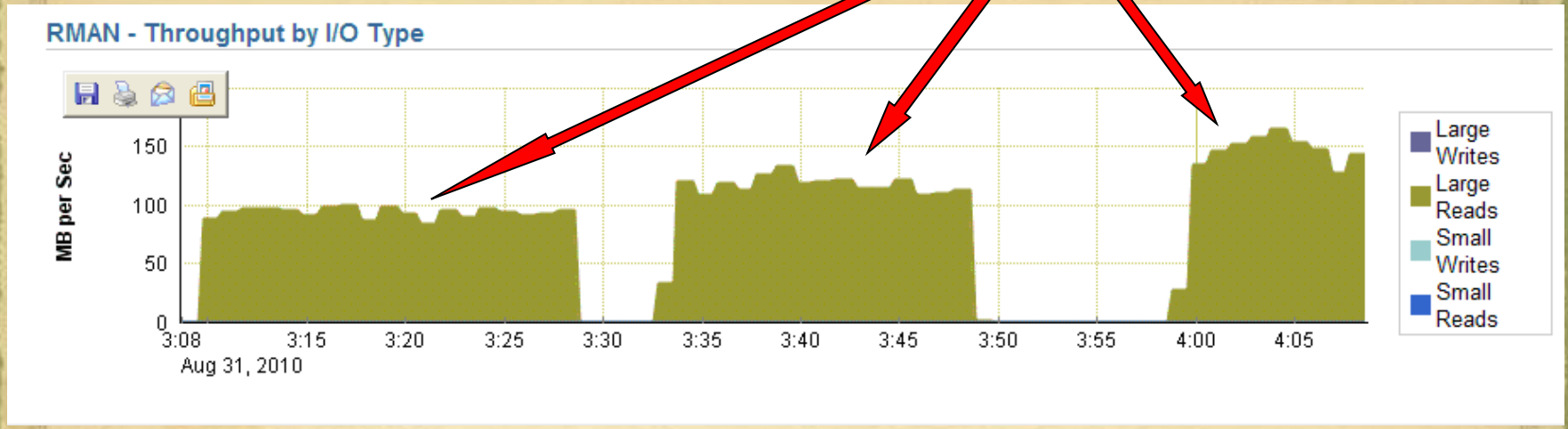
Test 1 – 1 Node with 2 Channels

- Test **_BACKUP_KSFQ_BUFCNT** = 16, 32, 64

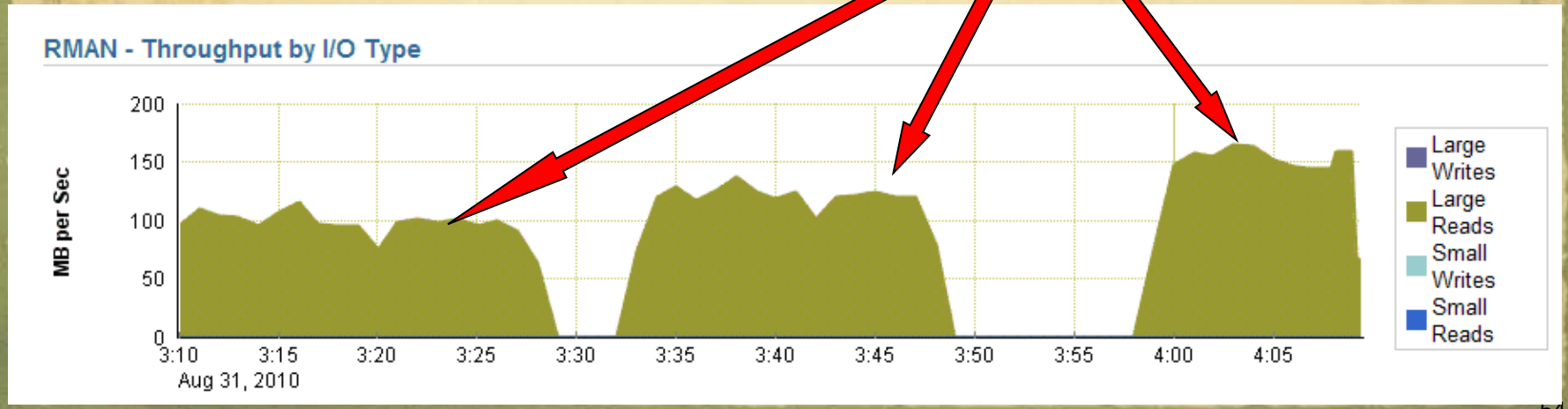


Test 2 – 2 Channels with 1 Channel per Node

Node 1 - **_BACKUP_KSFQ_BUFCNT** = 16, 32, 64



Node 2 - **_BACKUP_KSFQ_BUFCNT** = 16, 32, 64



Initial Results of Tape Backup Testing

Media Server Installed on RAC Nodes

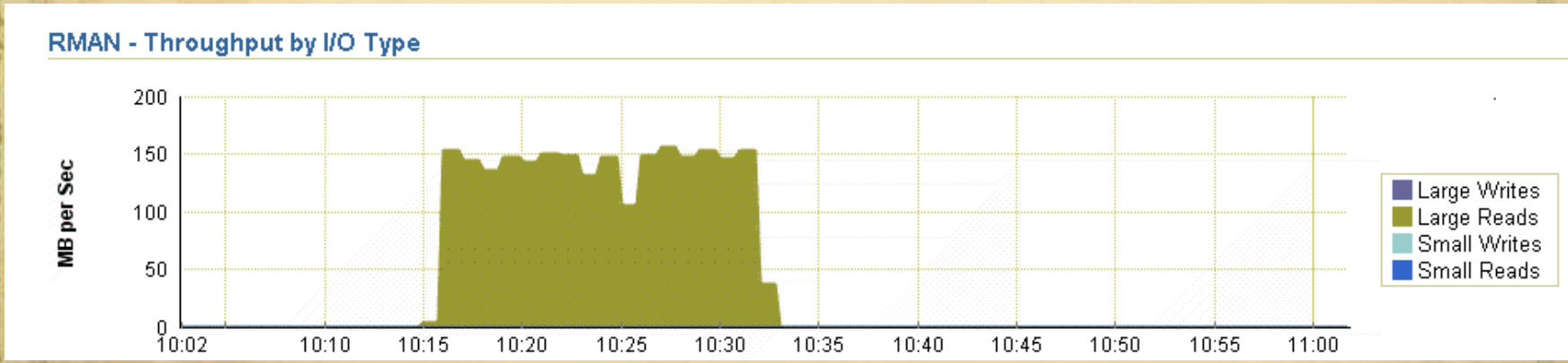
- **1 channel per node (2 channels total) + 2 LTO-3 Drives**
  - **Observed backup rate of 200 MB/s (720 GB/hr) vs. theoretical 280 MB/s (1 TB/hr with 2 x 140 MB/s for LTO-3)**

- **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

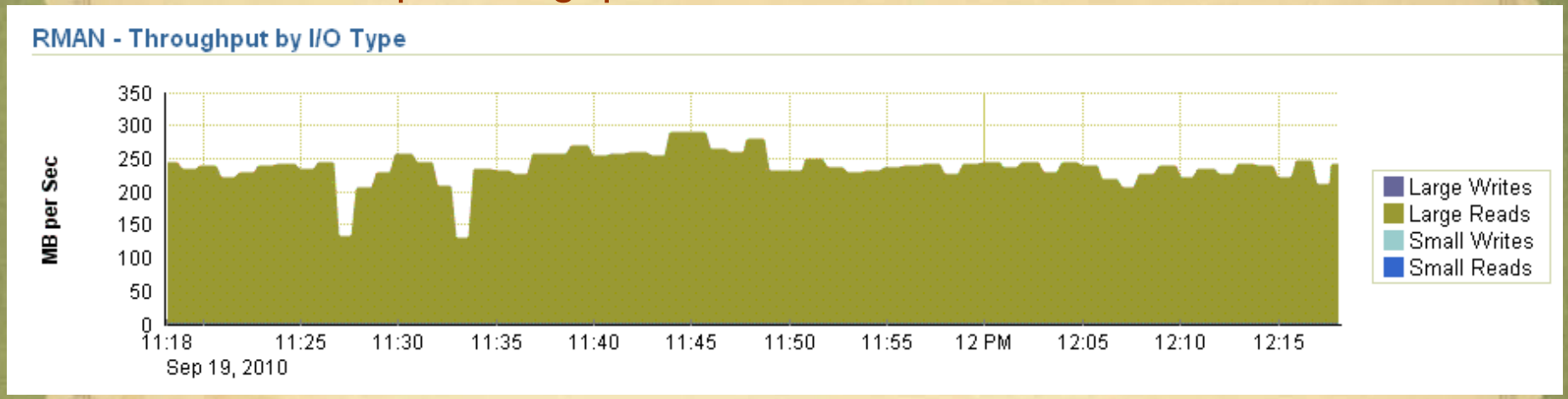
- Node 1 ~ 145 MB/s
- Node 2 ~ 120 MB/s
  - **33% improvement after rezoning**

Node 1 Backup Throughput:

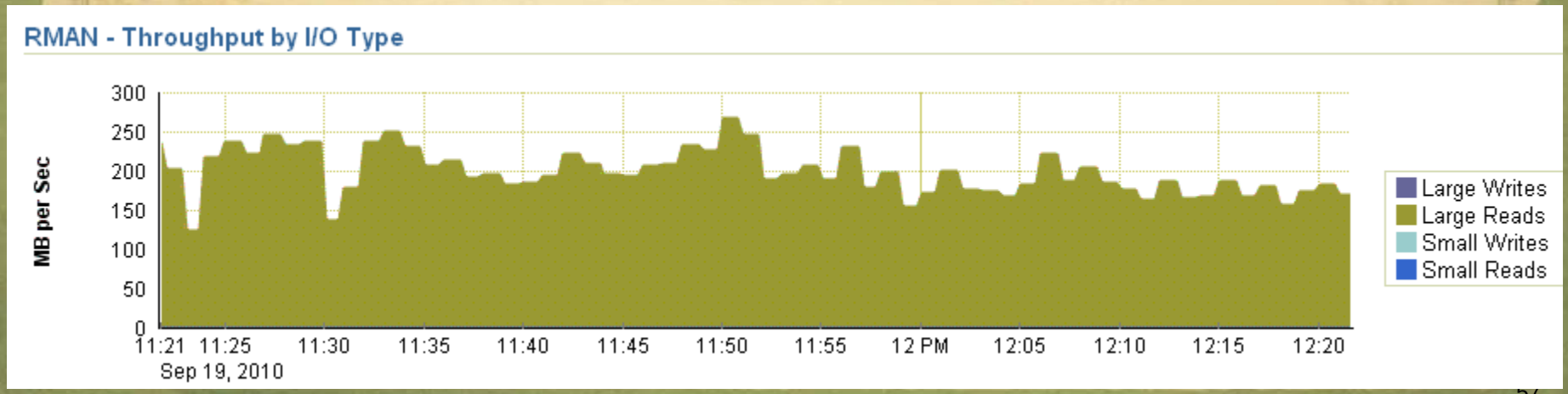


Four Channels with 2 Channels per Node
Achieved Backup Rate ~ 1.6 TB/Hour

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

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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 11*g* Release 2 RMAN with ASM behave differently in memory buffer allocation versus older releases?

Key HA Sessions, Labs, & Demos by Oracle Development

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

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

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

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

Demos Moscone West DEMOGrounds

Mon & Tue 9:45a - 5:30p; Wed 9:00a - 4:00p

Maximum Availability Architecture (MAA)
Oracle Active Data Guard
Oracle Secure Backup
Oracle Recovery Manager & Flashback
Oracle GoldenGate
Oracle Real Application Clusters
Oracle Automatic Storage Management

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*

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