Oracle Exadata Tips, Tricks, and Best Practices: Backup and Recovery (S316821)

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Exadata Database Machine
Best Platform To Run The Oracle Database On

- **Ideal Database Platform**
  - Best Machine for Data Warehousing
  - Best Machine for OLTP
  - Best Machine for Database Consolidation

- **Unique** Architecture Makes it
  - Fastest, Lowest Cost
New Exadata X2-8

- Full Rack Database Machine for large deployments
  - Consolidation, or Large OLTP and DW workloads
  - Complements existing X2-2

- 2 8-socket Intel EX servers (Sun Fire X4800)
  - Doubles Database CPU cores to 128
  - Quadruples Database Memory to 2TB
  - Oracle Solaris or Oracle Linux
  - 10GB Ethernet connectivity to Data Center

- Same 14 storage servers and InfiniBand Network
  - New Intel 6-core CPUs in Storage Servers
Backup and Recovery of an Exadata Database Machine

- Exadata provides superior performance for the Oracle Database
- B&R with Recovery Manager and Oracle Secure Backup or a 3rd party B&R tool
- B&R to tape and/or disk
- B&R across Ethernet or InfiniBand
Exadata Backup and Recovery
Key Benefits: Fast and Simple

• Fast Backup, Restore and Recovery Rates for Oracle Database Machine Full Rack
  – 20 TB/Hr full image backups
  – 10-46 TB/Hr effective backup rate for incremental backups
  – 24 TB/Hr restore rates
  – 2.1 TB/Hr recovery rates
  – Above rates pertain to physical files. With compression, effective backup/restore rates will multiply

• Simple Operations
  – Simple RMAN commands to backup, restore or recover the database – same as any other Oracle platform
  – Automatically parallelized across all storage servers
Exadata Backup and Recovery
Key Benefits: Data Aware and Integrated with other Oracle Features

- **Data Aware**
  - Detection of block corruptions
  - Auto repair and manual block repair options

- **Integrated and works transparently**
  - OLTP and Data Warehouse Applications
  - RAC, Data Guard, flashback technologies, ASM, Exadata
  - Oracle native compression capabilities
    - OLTP (typically 3 X compression)
    - Exadata Hybrid Columnar Compression (typically 10-15 X compression)
Agenda

• Best Practices
  – Disk Based Backup & Recovery
    • Using Exadata Storage
    • Using Third Party Storage
  – Tape Based Backup & Recovery
    • Using Oracle Secure Backup
    • Using Third Party Media Management Vendor
  – Backup & Recovery using Data Guard
Best Practices: Disk based B&R
Disk based Backup and Recovery
Exadata Storage Server Grid Disk layout

The faster (outer) 40% of the disk is assigned to the DATA Area
The slower (inner) 60% of the disk is assigned to the RECO Area

• Recommended disk group configuration
• Can be configured automatically during deployment
Disk Based Backup & Recovery
Using Exadata Storage provides the fastest rates

- **Backup (and restore) rates**
  - 20 TB/Hr for Full Rack configurations
  - Effectively 10-46 TB/Hr for incremental backups
- **Restore rates into existing files**
  - 24TB/hr for Full Rack Configuration
- **Typical Redo Apply (recovery) rates**
  - 200MB redo/sec (720GB redo/hour) for OLTP Workloads
  - 600MB redo/sec (2.1TB redo/hour) for Direct Load Workloads
Disk Based Backup & Recovery
Strategy and Advantages

• Use RMAN incrementally updated backups
  – Image Copy stored in the Fast Recovery Area and created once on the initial backup
  – Nightly Incremental Backups created in the Fast Recovery Area
  – Incremental Backups merged into Image Copies on a 24 hour delay basis

• Key advantages over tape only based backups strategies
  – Potential for using backups directly with no restore
  – Reduce backup windows and resources with incremental backups
  – Faster recovery for corruptions and some Tablespace Point In Time Recovery (TSPITR) cases
Disk Based Backup & Recovery
Exadata Best Practices for Backups

• Create a Database Service “backup” that runs on all the instances of the database
  – Use incremental backups and block change tracking
  – Data block inspection is offloaded to Exadata

• For highest throughput allocate 16 RMAN Channels
  – Listener Load Balancing distribute the connections between the two instances
  – Use fewer channels if highest throughput is not needed

• Set init.ora parameter
  _file_size_increase_increment=2143289344

• Minimal CPU Impact Observed
Disk Based Backup & Recovery
Exadata Best Practices for Restores

• For restore into existing files
  – Create a Database Service “restore” that runs on all the instances of the database.
  – Use 2 RMAN channels per instance
Disk Based Backup & Recovery
Script Examples on Exadata

- RMAN configuration
  configure default device type to disk;
  configure device type disk parallelism 16;

- RMAN script for nightly incremental level 1 backup
  run {
    recover
    copy of database
    with tag full_backup;
    backup
    incremental level 1
    for recover of copy
    with tag full_database
    database;
  }
Disk Based Backup & Recovery
Alternative Fast Recovery Area on Exadata

Sun Oracle Database Machine

Oracle Exadata Storage Servers

InfiniBand Network
Disk Based Backup & Recovery
Alternative Fast Recovery Area on Exadata

- Allocate additional (SATA) Exadata Storage Servers for a dedicated Fast Recovery Area

- Additional Exadata Storage Servers must be installed in another rack

- Key Benefits
  - Better failure isolation when using separate backup hardware
  - Allows use of lower cost space for backup
Disk Based Backup & Recovery
Using non-Exadata storage

- Performance and complexity will vary
- No MAA best practices

• Observations
  - Utilize IP based protocols like iSCSI or NFS
  - SAN HBA and network rates may limit the backup rate
  - Must use an intermediate server that acts as an iSCSI or NFS server if SAN Based storage
    • Similar to the way the Media Server bridges between the Exadata DB Machine and the tape library
Best Practices: Tape based B&R
MAA Validated Architecture

Sun Oracle Database Machine

Sun Fire X4170
Oracle Secure Backup Admin Servers

InfiniBand Network

2 Sun Fire X4275
Oracle Secure Backup Media Servers

Fiber Channel SAN

Sun StorageTek SL500
Tape based Backup and Recovery
Exadata Storage Server Grid Disk layout

The faster (outer) 80% of the disk is assigned to the DATA Area
The slower (inner) 20% of the disk is assigned to the RECO Area

- Recommended disk group configuration
- Can be configured automatically during deployment
Tape Based Backup & Recovery
Using Exadata Storage and Oracle Secure Backup provide the fastest rates

- **Backup rates**
  - Limited by number of tape drives
  - 179MB/sec per LTO4 tape drive
  - 8.6TB/Hr for 14 tape drives
  - 29TB/Hr with Exadata Database Machine Full Rack Configuration and 64 LTO4 tape drives.

- **Restore rates**
  - Limited by number of tape drives
  - 162MB/sec per tape drive
  - 7.8TB/hr for Full Rack Configuration
Tape Based Backup & Recovery
Strategy and Implementation

• **Oracle Database tape backup strategy:**
  − Weekly RMAN level 0 (full) backup
  − Daily RMAN cumulative incremental level 1 backup

• **To scale and maintain availability:**
  − For HA start with at least two media servers with a dual ported Host Channel Adapter (HCA) per media server, bonded for HA
  − Add tape drives until all the media server’s HBA or HCA bandwidth is consumed
  − Add media servers and associated tape drives when the Media Servers HCA bandwidth is consumed
  − Tape based backups scale linearly by adding Media Servers and Tape Drives
Tape Based Backup & Recovery
Benefits and Trade-Offs of Tape only solution

• Benefits
  – Fault Isolation from Exadata Storage
  – Maximizes Exadata Database Machine capacity and bandwidth
  – Move backup off-site easily
  – Keep multiple copies of backups in a cost effective manner

• Trade-Offs
  – Disk-based solutions have better recovery times for data and logical corruptions and certain tablespace point in time recovery scenarios
  – No differential incremental backups are available
Tape Based Backup & Recovery
Configuration Best Practices for Tape

• Must use an Ethernet or InfiniBand based configuration
  – Hardware changes to Database Machine are not supported

• Smaller databases can use Gigabit Ethernet
  – Use a dedicated interface for the transport to eliminate impact to client access network
  – Typically a dedicated backup network is in place
  – Maximum throughput with the GigE network is 120 MB/sec X Number of Database Servers
  – For a full Database Machine, 960 MB/sec possible

• Use InfiniBand for best performance
  – Bigger database needing faster backup rates
  – Lower CPU overhead
Tape Based Backup & Recovery
InfiniBand Configuration Best Practices for Tape

• Database nodes and Media Server configuration
  – Use Oracle Enterprise Linux on the Media Server
  – Use same kernel and OFED packages as used on Exadata Database Machine
  – Enable IPoIB connected mode and MTU changes on the media server
  – No changes on database nodes needed

• Minimal CPU impact
  – Observed less than 1 CPU Core used per instance
Tape Based Backup & Recovery
Configuration Best Practices for Tape Backup

• For tape based backup create a Database Service “backup” that runs on all the instances of the database.
  – Use incremental backups and block change tracking
    • Data block inspection is automatically offloaded to Exadata
  – Use tape hardware compression in addition to Oracle DBMS OLTP and EHCC compression

• Allocate 1 RMAN channel per tape drive for the backup
  – Let Listener Load Balancing distribute the connections between all the instances
    • Spreads the backup I/O’s evenly over all database nodes
Tape Based Backup & Recovery
Configuration Best Practices for Tape Restore

- For tape based backup create a Database Service "restore" that runs on all the instances of the database.
  - Allocate 1 RMAN Channel per tape drive
RMAN configuration
   configure default device type to sbt;
   configure device type sbt parallelism 14;

RMAN script for weekly backup
   run {
      backup incremental level 0 database tag 'weekly_level0';
      backup archivelog all not backed up;
   }

RMAN script for daily backup
   run {
      backup cumulative incremental level 1 database tag 'daily_level1'
      backup archivelog all not backed up tag 'archivelogs';
   }
Tape Based Backup & Recovery
Oracle Secure Backup Advantages

• Oracle Secure Backup (OSB) tape-based backup advantages
  – Fastest database backup to tape via tight integration with RMAN
    • Unused block compression
    • Inactive Undo blocks not backed up
  – Very low cost
  – MAA Validated
Tape Based Backup & Recovery
Oracle Secure Backup Configuration Best Practices

- Configure the Preferred Network Interface (PNI) to direct the OSB traffic over the InfiniBand network interface

```
ob> lspni (List Preferred Network Interface)
mediaserver1:
  PNI 1:
    interface: mediaserver1-ib
    clients:  dbnode1, dbnode2, dbnode3, dbnode4, dbnode5, dbnode6, dbnode7, dbnode8
  PNI 2:
    interface: mediaserver1
    clients:  adminserver
```
Exadata Database Machine
Oracle Secure Backup & Recovery Best Practices

• Backup and Recovery Performance and Best Practices for Sun Oracle Database Machine and Exadata

Third Party Media Management Vendor (MMV)
No additional complexity

- Third party MMV B&R works the same as it does on non-Exadata platforms
  - Third party vendors test and validate their own products
  - Contact the MMV for configuration best practices
  - No additional certification specific to Exadata required

- Tune the network communication within the MMV to exploit the full potential of the InfiniBand or GigE networks

- Production customers are using third party tape backup products to backup Exadata systems today
Backup & Recovery using Data Guard
Offload backups to Standby

- Both disk and tape based backups can be performed from the Physical Standby Data Guard environment
  - Offloads the backup to the standby environment
  - Reduce backup times with fast incremental backups
  - Eliminate impact to the primary environment

- Additional Data Guard benefits
  - Auto block repair with zero impact on application
  - Offload reads and reporting, backups, and testing
  - Used for planned maintenance and rolling database upgrade
  - Used for disaster recovery or high availability with Data Guard Fast-Start Failover
Exadata Database Machine
Data Guard Best Practices

- Oracle Data Guard: Disaster Recovery for Sun Oracle Database Machine and Exadata
Conclusion

- Works for any database of any size

- Fastest Backup, Restore and Recovery on Exadata
  - Multi Terabyte/Hour backup, restore and recovery

- Simple RMAN Commands

- Data aware and integrated with Oracle features

- MAA validated
Upcoming Exadata Sessions
Wednesday, September 22

• 1:00 pm – 2:00 pm
  – Oracle Exadata Tips, Tricks, and Best Practices: Backup and Recovery (S316821)
  – Moscone South, Room 307

• 4:45 pm – 5:45 pm
  – Oracle Exadata Tips, Tricks, and Best Practices: Migrating to the Oracle Exadata (S316822)
  – Moscone South, Room 307
Upcoming Exadata Sessions
Thursday, September 23

• 12:00 pm – 1:00 pm
  – Oracle Exadata Technical Deep Dive: Architecture and Internals (S316820)
  – Moscone South, Room 103

• 3:00 pm – 4:00 pm
  – The X-Files: Managing the Oracle Exadata and Highly Available Oracle Databases (S316974)
  – Moscone South, Room 102
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