Maximize Availability With Oracle Database 12c

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HA?
Oracle Database 12c: Extreme Availability

- Oracle Database 12c introduces significant new (HA) capabilities that
  - Drastically cut down planned and unplanned downtime
  - Eliminate compromises between HA and Performance
  - Tremendously boost operational productivity

- These take Availability to unprecedented new levels
  - Next-generation Maximum Availability Architecture (MAA)
  - Optimized for Oracle
**Maximum Availability Architecture**

**Production Site**
- **RAC**
  - Scalability
  - Server HA
- **Flashback**
  - Human error correction

**Application Continuity**
- Application HA

**Global Data Services**
- Service Failover / Load Balancing

**Active Replica**
- **Active Data Guard**
  - Data Protection, DR
  - Query Offload
- **GoldenGate**
  - Active-active
  - Heterogeneous
- **RMAN, Oracle Secure Backup**
  - Backup to tape / cloud

**Edition-based Redefinition, Online Redefinition, Data Guard, GoldenGate**
- Minimal downtime maintenance, upgrades, migrations
Oracle Database 12c
High Availability Key New Features

- Application Continuity
- Global Data Services
- Data Guard Enhancements
- RMAN Enhancements
- Flex ASM
- Other HA Enhancements
- GoldenGate Update
In-Flight Work: Dealing With Outages

Current Situation

- Database outages can cause in-flight work to be lost, leaving users and applications in-doubt
- Often leads to
  - User pains
  - Duplicate submissions
  - Rebooting mid-tiers
  - Developer pains
Solving Application Development Pains
New in Oracle Database 12c

Transaction Guard
A reliable protocol and API that returns the outcome of the last transaction

Application Continuity
Safely attempts to replay in-flight work following outages and planned operations
Transaction Guard
Preserve and Retrieve COMMIT Outcome

- API that supports known commit outcome for every transaction
- Without Transaction Guard, upon failures – transaction retry can cause logical corruption
- With Transaction Guard, applications can deal gracefully with error situations, vastly improving end-user experience
- Used transparently by Application Continuity
Application Continuity
Masks Unplanned/Planned Outages

- Replays in-flight work on recoverable errors
- Masks many hardware, software, network, storage errors and outages when successful
- Improves end-user experience and productivity without requiring custom app development
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Databases in Replicated Environments

Challenges

- No seamless way to efficiently use all the databases
- No automated load balancing and fault tolerance
Global Data Services
Load Balancing and Service Failover for Replicated Databases

- Extends RAC-style service *failover, load balancing* (within and across data centers), and *management* capabilities to a set of replicated databases
- Takes into account network latency, replication lag, and service placement policies
- Achieve higher availability, improved manageability and maximize performance
Global Data Services

Active Data Guard Example

- Reporting client routed to ‘best’ database
  - Based on location, response time, data, acceptable data lag
  - Reports will automatically run on least loaded server

- Reporting client failover
  - If preferred database not available, will route to another database in same region or a remote database

- Global service migration
  - Automatically migrates services based on failover/switchover - if primary database is down, start Call Center service on the new primary
Global Data Services

GoldenGate Example

- Call Center Client connections and requests transparently routed to the *closest / best* database
  - Runtime load balancing metrics give client real-time information on which database to issue next request
- If a database fails, its global services restarted on another replica

GoldenGate Call Center Service
Global Data Services
Use Case: Active Data Guard without GDS

Critical E-Commerce App accessing
Active Data Guard Standby

Order Capture

Orders Service
Data Guard
Primary

Order History View
History Service
Active Standby

What happens when
Active Standby is down?

Order Capture

Orders Service
Data Guard
Primary

Order History View
History Service
Active Standby

Orders Service
Data Guard
Primary

Order History View
 trì
Active Standby

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Global Data Services

Use Case: Active Data Guard with GDS: All HA

When Active Standby is down …
- GDS fails over History Service to primary, redirects connection through FAN/FCF
Global Data Services

- Load-balancing of application workloads across regions, enabling optimal resource utilization
- Extends RAC-like connect time & run time load balancing globally
- Elastically add/remove databases from the GDS infrastructure
- Supports seamless service failover
- Easier management for globally distributed multi-database configurations
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Zero Data Loss Challenge

Synchronous Communication Leads To Performance Trade-Offs

The longer the distance, the larger the performance impact
Data Guard Async – Today

Some Data Loss Exposure Upon Disaster
Active Data Guard Far Sync – New in 12.1

Zero Data Loss For Async Deployments

- Far Sync: light-weight Oracle instance: standby control file, standby redo logs, archived redo logs, no data files
- Receives redo synchronously from primary, forwards redo asynchronously in real-time to standby
- Upon Failover: Async standby transparently obtains last committed redo from Far Sync and applies: zero data loss failover
- Second Far Sync Instance can be pre-configured to transmit in reverse direction after failover/switchover
- Terminal standbys required to be Active Data Guard Standbys
Active Data Guard Far Sync

Operational Flow

Primary -> SYNC -> Far Sync Instance -> ASYNC -> Standby
Active Data Guard Far Sync
Operational Flow (contd.)

No Compromise Between Availability and Performance!

Zero Data Loss
Active Data Guard Far Sync

Benefits

- Best data protection, least performance impact
- Low cost and complexity
- Best way to implement a near DR + Far DR model
- Relevant to existing Data Guard ASYNC configurations
- Data Guard Failover? No Problem! Just do it – No Data Loss!
Active Data Guard Real-Time Cascading
Eliminates Propagation Delay

- In 11.2, Standby 1 waits till log switch before forwarding redo from archived logs to Standby 2

- In 12.1, Standby 1 forwards redo to Standby 2 in real-time, as it is received: no propagation delay for a log switch

- Standby 2 (Active Data Guard Standby) is up-to-date for offloading read-only queries and reports
Data Guard Fast Sync
Reduced Primary Database Impact for Maximum Availability

- For SYNC transport: remote site acknowledges received redo before writing it to standby redo logs
- Reduces latency of commit on primary
- Better DR – increased SYNC distance
- If network round-trip latency less than time for local online redo log write, synchronous transport will not impact primary database performance
Data Guard
Other New Features in Oracle Database 12c

1. Rolling Upgrade With Active Data Guard
   - Automate complexity through simple PL/SQL Package: `DBMS_ROLLING` (12.1.0.1 onwards), with simple Init, Build, Start, Switchover, Finish procedures
   - Additional Data Type Support: XML OR, Binary XML, Spatial, Image, Oracle Text, DICOM, ADTs (simple types, varrays), …

2. DML on Global Temporary Tables
   - Temporary undo is not logged in redo logs
   - Enables DML on global temporary tables on Active Data Guard: more reporting support
   - Set by default on Active Data Guard standby

3. Validate Role Change Readiness
   - Ensure Data Guard configuration ready for switchover with automated health checks – verify no log gaps, perform log switch, detects any inconsistencies, ensures online log files cleared on standby, …

4. Unique Sequences
   - Primary allocates a unique range of sequence numbers to each Standby
   - Enables more flexible reporting choices for Active Data Guard
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High Availability Key New Features

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- **RMAN Enhancements**
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Fine-grained Table Recovery From Backup

- Simple `RECOVER TABLE` command to recover one or more tables (most recent or older version) from an RMAN backup
- Eliminates time and complexity associated with manual restore, recover & export
  - Enables fine-grained point-in-time recovery of individual tables instead of the contents of the entire tablespace
12c RMAN Recover Table Example

RMAN> recover table mv_maint.inventory
until scn 1777348
auxiliary destination '/u01/uax'
datapump destination '/u01/recover';

1. Creates an auxiliary instance
2. Performs PIT restore and recovery of the auxiliary database
   SYSTEM, SYSAUX, UNDO and tablespace containing table
3. Data Pump export of table
4. Data Pump import into original database
5. Drops auxiliary instance and auxiliary data files
Multiple tables, preserves PK/FK relationships

RMAN> recover table mv_maint.emp, mv_maint.dept until scn 1777348 auxiliary destination '/u01/aux' datapump destination '/u01/recover';
12c Recover Table Example

Rename a table:

```
RMAN> recover table mv_maint.inventory
until scn 1777348
auxiliary destination '/u01/aux'
datapump destination '/u01/recover'
remap table mv_maint.inventory:inventory_new;
```
Other RMAN Restore Table 12c Options

- Place table in a different tablespace
  remap tablespace
- Just create the Data Pump dump file
  notableimport
- Restore a just a table partition
  recover table mv_maint.inventory:P1
Cross-Platform Backup & Restore
Simplified Platform Migration

- Simplifies procedure for platform migration
- Minimize read-only impact with multiple incremental backups
RMAN Cross-Platform Backup example

- Startup source database read only
- BACKUP command must contain either the FOR TRANSPORT or TO PLATFORM clause:
- Copy backup set to destination server
- Issue RESTORE command
RMAN Transporting Example

RMAN> BACKUP TO PLATFORM='Linux x86 64-bit'
FORMAT '/tmp/xplat_backups/db_trans_%U.bck'
DATABASE;

- Copy backup set to destination platform and restore:

RMAN> RESTORE FOREIGN DATABASE TO NEW
FROM BACKUPSET '/tmp/xplat_restores/db_trans_%U.bck';
Multitenant Environment (Container/Pluggable)
Oracle Multitenant Backup & Restore
Fine-Grained Backup & Recovery to Support Consolidation

- While connected to root, `BACKUP DATABASE` command backs up CDB, including all PDBs
- While connected to root, `RESTORE DATABASE` and `RECOVER DATABASE` command restores and recovers CDB, including all PDBs

- Can backup any pluggable database while connected as SYS to root container
- Backup and recover specific pluggable databases with new `PLUGGABLE DATABASE` keywords:
  - `RMAN> BACKUP PLUGGABLE DATABASE <PDB1>, <PDB2>;`
  - `RMAN> BACKUP tablespace SALES<PDB>:SALES;`

- PDB Complete Recovery
  - `RMAN> RESTORE PLUGGABLE DATABASE <PDB> ;`
  - `RMAN> RECOVER PLUGGABLE DATABASE <PDB> ;`
RMAN Connection as SYS to Pluggable

Scope limited to pluggable database

- While connected to a pluggable database as SYS, can only operate on currently connected to pluggable database files:

```
$ rman target sys/foo@salespdb

RMAN> backup database;
RMAN> restore database;
RMAN> recover database;
```
RMAN B&R in Multitenant
Pluggable Database PIT Recovery

```
$ rman target /
RMAN> alter pluggable database salespdb close;
RMAN> RUN {
SET UNTIL SCN 1998737;
RESTORE PLUGGABLE DATABASE salespdb;
RECOVER PLUGGABLE DATABASE salespdb;
ALTER PLUGGABLE DATABASE salespdb OPEN RESETLOGS; }
```

- SQL> select pdb_incarnation# from v$pdb_incarnation;


Pluggable Database PIT Recovery

Internals

- RMAN restores PDB data files
- Requires root container’s UNDO tablespace to perform pluggable database PIT recovery
- RMAN creates an auxiliary database containing root’s SYSTEM, SYSAUX, and UNDO tablespace
- If using a FRA, auxiliary database datafiles are temporarily stored in FRA
- If not using a FRA, specify the auxiliary database destination via AUXILIARY DESTINATION clause
RMAN Duplicate to Create Pluggable

- RMAN DUPLICATE leverages restore process (from backup or source DB) to create new clone or standby database
- Clone the entire CDB or ROOT + selected PDBs

- Commands:
  RMAN> DUPLICATE TARGET DATABASE TO <CDB1>;
  RMAN> DUPLICATE TARGET DATABASE TO <CDB1> PLUGGABLE DATABASE <PDB1>, <PDB2>;
Better Performance
Other New Features in Oracle Database 12c

- Enhanced Multi-section Backup capability: now supports image copies and incremental backups
- Enhanced Active Duplicate
  - Cloning workload moved to destination server via auxiliary channels, relieving resource bottlenecks on source
  - Cloning can now use RMAN compression and multi-section capability to further increase performance
Run SQL Commands Directly from RMAN Command Line

- **Old:**
  - RMAN> sql ‘alter system switch logfile’;

- **New in 12c:**
  - RMAN> alter system switch logfile;
  - RMAN> select name from v$datafile;
Run SQL Directly from RMAN Prompt

Reduces complexity

Old:

sql "alter database datafile "/u01/dbfile/o12c/users01.dbf" offline";
set newname for datafile '/u01/dbfile/o12c/users01.dbf'
to '/u02/dbfile/o12c/users01.dbf';

New in 12c:

alter database datafile '/u01/dbfile/o12c/users01.dbf' offline;
set newname for datafile '/u01/dbfile/o12c/users01.dbf'
to '/u02/dbfile/o12c/users01.dbf';
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Automatic Storage Management (ASM) Overview

Current State

RAC Cluster

One to One Mapping of ASM Instances to Servers

Shared Disk Groups

Wide File Striping

ASM Cluster Pool of Storage

Disk Group A

Disk Group B

ASM Disk

Database Instance

Node 1

Node 2

Node 3

Node 4

Node 5

ASM Instance

DB_A

DB_B

DB_B

DB_B

DB_C
Flex ASM: Eliminate 1:1 Server Mapping

New: ASM Storage Consolidation in Oracle Database 12c

Databases share ASM instances

Shared Disk Groups

Wide File Striping
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Other HA Enhancements

1. **Online Datafile Move**
   - Relocate a datafile while users are actively accessing data: `ALTER DATABASE MOVE DATAFILE ...`
   - Maintains data availability during storage migration

2. **Online Redefinition Enhancements**
   - Improved `sync_interim_table` performance
   - Ability to redefine table with VPD policies
   - Improved resilience of `finish_redef_table`
   - Better handling of multi-partition redefinition

3. **Separation of Duties**
   - `SYSGD / SYSBACKUP`: Data Guard & RMAN specific administrative privileges
   - No access to user data: enforce security standards throughout the enterprise

4. **Additional Online Operations**
   - Drop index online / Alter index unusable online / Alter index visible / invisible online
   - Drop constraint online / Set unused column online
   - Online move partition: `ALTER TABLE ... MOVE PARTITION ... ONLINE`
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Oracle GoldenGate 12c*
Low-Impact, Real-Time Data Integration & Transactional Replication

*: GoldenGate 12c for Oracle Database 12c will be available in FY14
GoldenGate Zero Downtime Migration/Upgrade

Seamless Migration and Upgrades to Oracle Database 12c*

- Consolidate/migrate/maintain systems without downtime
- Minimize risk with failback option
- Validate data before switchover
- Use Active-Active replication for phased user migration

*GoldenGate 12c for Oracle Database 12c will be available in FY14
Oracle GoldenGate for Active-Active Databases

Increase ROI on Existing Servers & Synchronize Data

- Utilize secondary systems for transactions
- Enable continuous availability during unplanned & planned outages
- Synchronize data across global data centers
- Use intelligent conflict detection & resolution

*: GoldenGate 12c for Oracle Database 12c will be available in FY14
Oracle Database 12c

Extreme Availability: Summary

- Oracle Database 12c offers a tremendously sophisticated set of high availability (HA) capabilities

- These capabilities
  - Further reduce downtime
  - Significantly improve productivity
  - Eliminate traditional compromises

- OTN HA Portal: http://www.oracle.com/goto/availability

- Maximum Availability Architecture: http://www.oracle.com/goto/maa
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