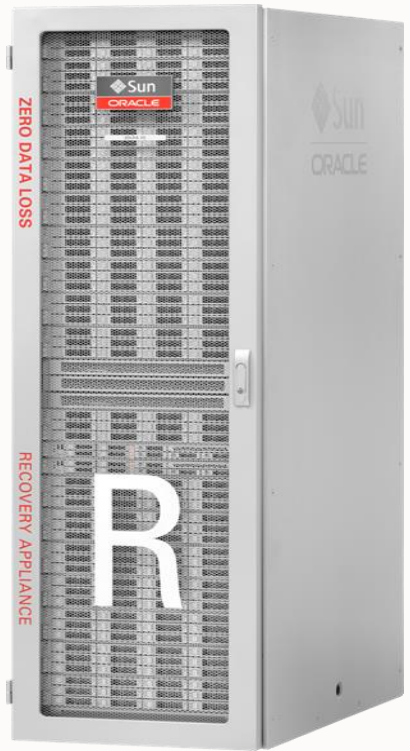
ORACLE

Zero Data Loss Recovery Appliance: Maintenance & Operational Best Practices



MAA Best Practices Team

Server Technologies

April 2021

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Agenda

1. Understand Requirements First
2. RA Deployment Decisions and Key Practices
3. RA Stay Healthy Plan
4. Best Practices Backup and Restore
5. Migration with ZDLRA
6. Oracle Support & Service Request
7. RA Roles and Responsibilities

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MAA Recommendations

- One Recovery Appliance (RA) per data center
- Backup primary and standby databases to their respective local RA
- No RA replication for any database with a remote standby
- Restore operation can use any RA in any location

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Do your business requirements call for multiple Recovery Appliances?

1. Do you need the ability to backup, restore and recover during RA planned maintenance windows (2-6 hours for major upgrades) versus waiting until the planned maintenance completes?

   Yes/No

2. Do you require disaster recovery protection ? (e.g. data center failure, power failure)

   Yes/No

3. Do you require minimal data loss for all protected databases backing up to RA during its planned maintenance windows? (you don't need to restore/recover)

   Yes/No

4. Do you require archive and backups operations to continue during RA planned maintenance windows(2-6 hours) versus waiting until the planned maintenance completes?

   Yes/No

If you answered “Yes” , to any of these questions multiple Recovery Appliances are required.

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Multiple Recover Appliances Required?

- ❑ Did you answer “yes” ?
  - ✓ To ANY of the questions: You will need another Recovery Appliance
  - ✓ Yes to question #1 or #2: Use High Availability for Backup and Recovery
  - ✓ Yes to question #3 or #4 Only: Use Backup Failover to Alternate Appliance Solution

Note: Using Data Guard or GoldenGate?
Backup the production, standby or Golden Gate replica to their respective local RA.

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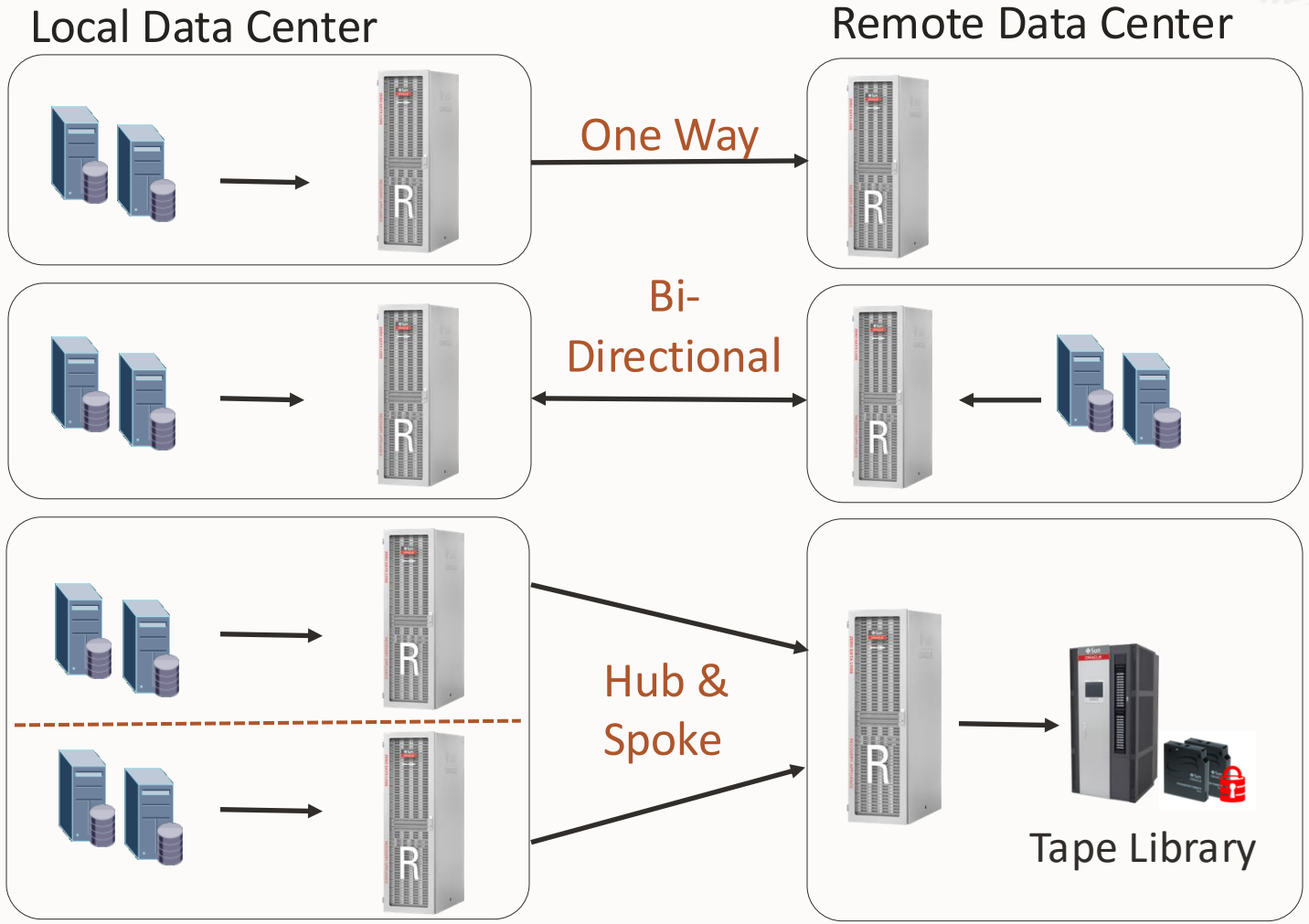
RA Replica: System Outage / Disaster Protection



Recommended for Standalone (Non Data Guard) Databases

REPLICATION BENEFITS

- Protects data from Local or Site-wide failures
- Automated restore from Local Appliance or directly from Remote Appliance

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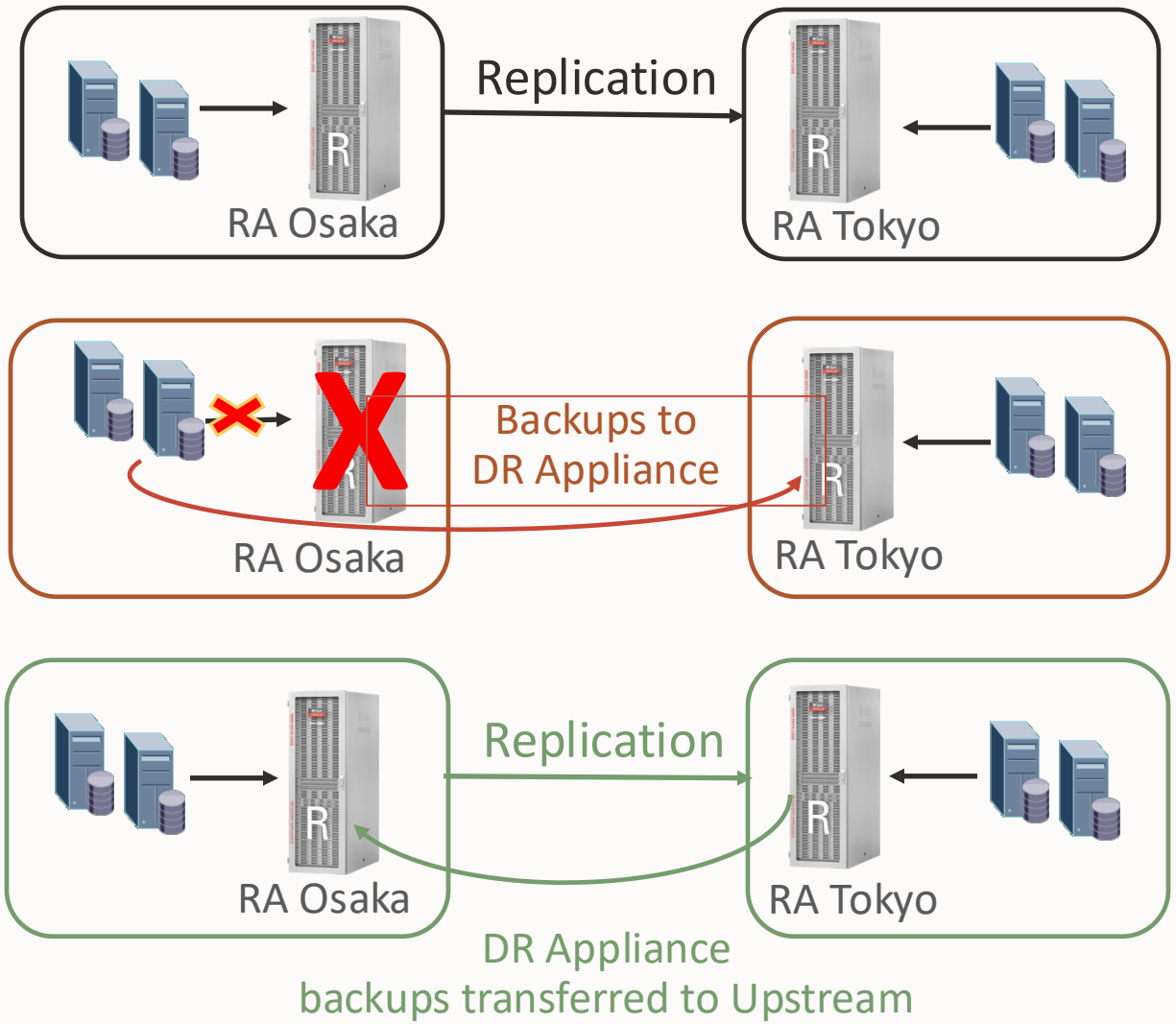
High Availability for Backup & Recovery



RA Osaka normally replicates to RA Tokyo

When upstream appliance (RA Osaka) is not available, backups and redo are redirected to Remote appliance (RA Tokyo)

- Virtual fulls are created as normal
- Sizing DR appliance
  In general, size per Recovery Window Goal(RWG) business requirement:
  1x full backup + N RWG days of incremental and redo/arch log backups
  Bare minimum: 1x full backup + 1 day redo/arch logs backups.

When upstream is back online, DR appliance backups are transferred

- Backups are ingested and processed into virtual fulls
- Normal backups to upstream can be restarted immediately
- Virtual fulls for new backups are created after all transferred backups have completed processing
- Note: Redo Logs sent to the downstream are not automatically copied to the upstream. A restore/recover will pull the logs from the downstream as necessary.

Benefits

- **Best practice to preserve HA during planned or unplanned downtime**
- **Database backup & restore/recoverability available from either upstream and downstream**

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Backup Failover to Alternate RA

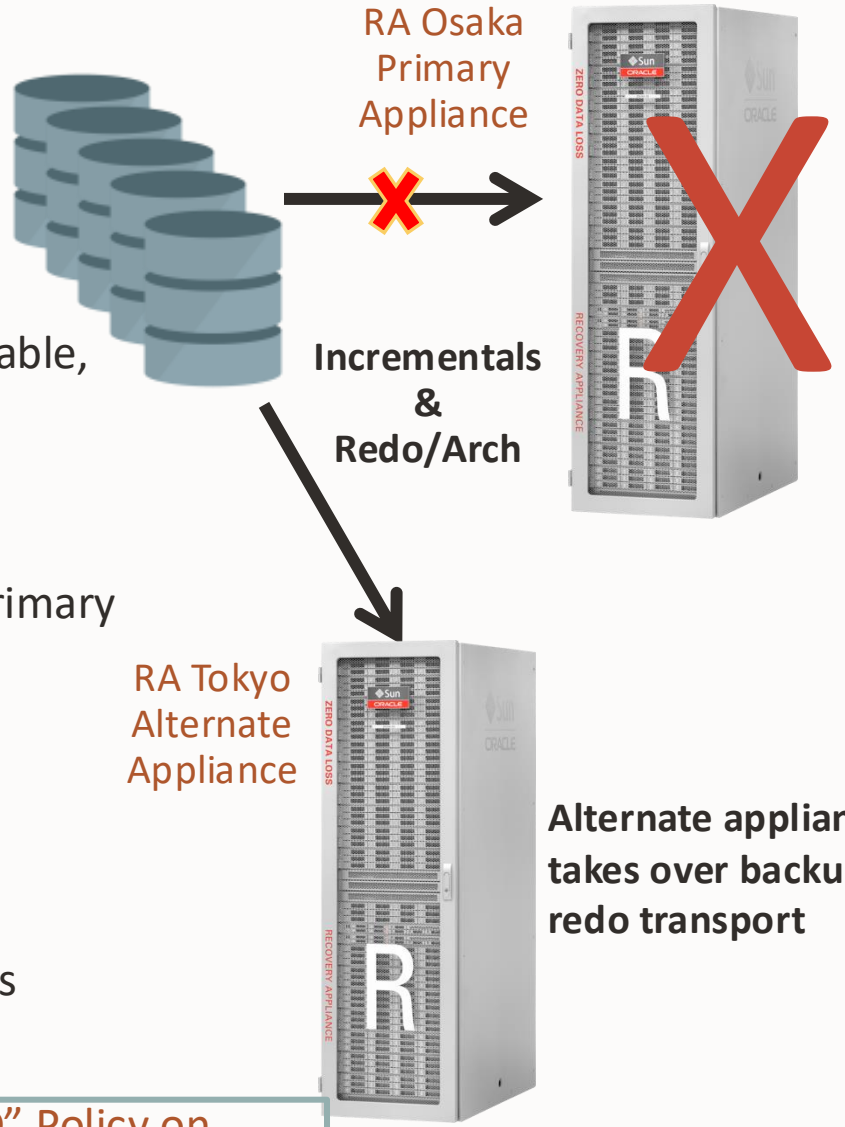
Incrementals and Redo normally sent to Primary RA

Alternate RA serves as backup staging area when primary RA is unavailable, then syncs with primary RA afterwards

- No virtual fulls created on alternate, hence recoverability not supported
- Space sized for ‘n’ incrementals and archived log backups during primary downtime period

Benefits:

- Preserves backup and redo shipment continuity during planned maintenance / upgrades
- Prevents local Fast Recovery Areas from filling up with archived logs
- Block Change Tracking continues



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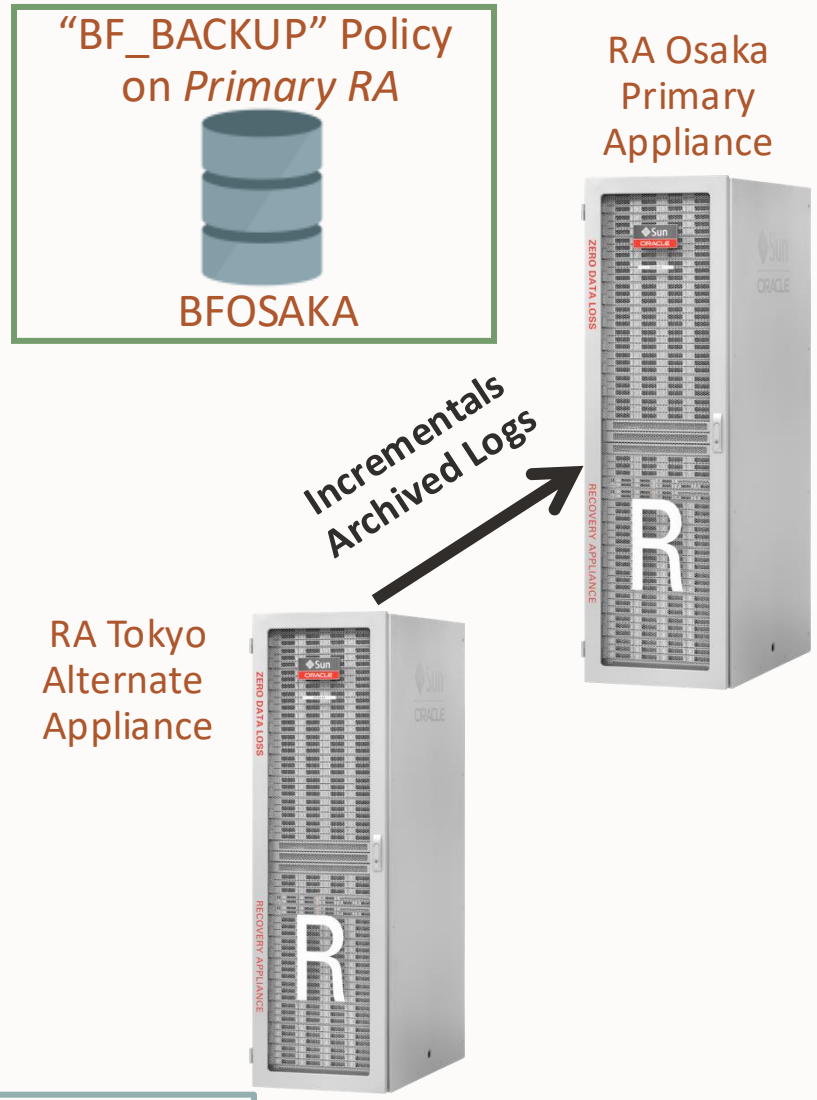
Backup Failover to Alternate RA - Continue

Backup and redo failover destination when primary appliance is unavailable

- Alternate appliance takes over backups and redo transport
- When primary appliance is back online, all interim backups are replicated from alternate and virtual full backups are created on primary
- Once all virtual fulls are completed, backups and redo transport can restart to the primary appliance
- Backup Failover" within the same data center requires both Recovery Appliances to be configured on the same replication subnet.



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Recovery Appliance Solutions Summary

High Availability for Backup and Recovery (Non-Data Guard Databases)

- •Backup and Redo to RA Replica during RA maintenance and unplanned downtime
- Restore from RA Replica
- More capacity required due to RA replication
- See: Configuring High Availability ZDLRA client for backup and restore (Doc ID 2432144.1)

Backup Failover to Alternate Appliance (Standalone/Primary/Standby Databases)

- Backups and Redo to Alternate RA during RA maintenance and unplanned downtime
- Restore from Alternate NOT available
- Less capacity required because RA replication was not setup
- See: Implementing Additional High Availability Strategies in the Zero Data Loss Recovery Appliance Administrator's Guide.

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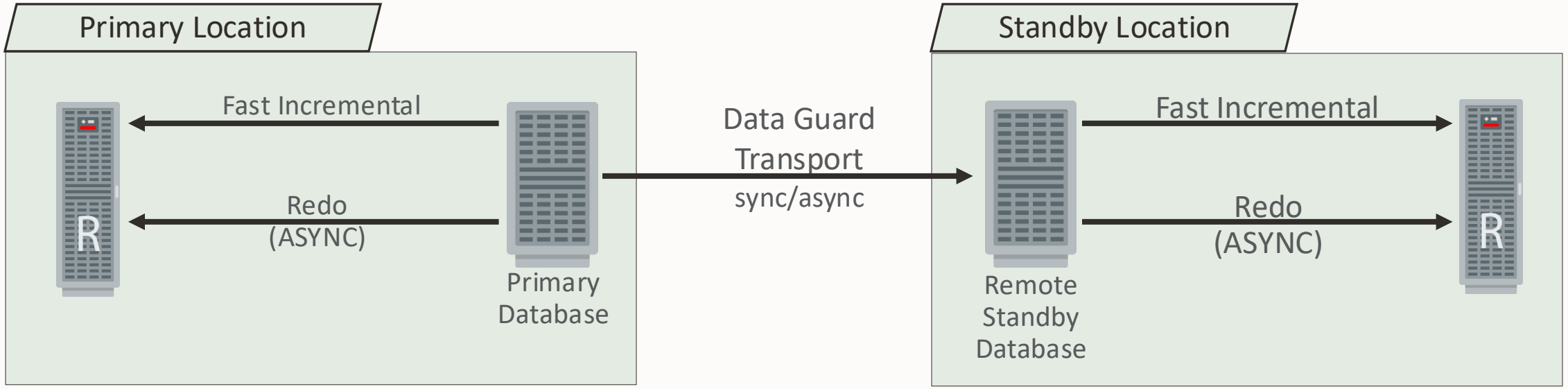
Recovery Appliance & Data Guard



MAA Recommendations:

- One Recovery Appliance (RA) per data center
- Backup primary and standby databases to the local RA
- No RA replication for any databases with a remote standby needed
- Restore operation can use any RA in any location

Active Data Guard License on primary and standby, is NOT required for using Fast Incremental and Real-time Redo exclusively to RA.

See: Licensing Documentation

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Recovery Appliance and Data Guard

Maximum Availability Architecture (MAA) White Paper

Post Data Guard role transition

- No change in backup operations. Continue to backup both the primary and standby databases to the local RA

Deploying the Zero Data Loss Recovery Appliance in a Data Guard Configuration

- Refer to http://www.oracle.com/technetwork/database/availability/recovery-appliance-data-guard-2767512.pdf / Deploying Zero Data Loss Recovery Appliance in a Data Guard Configuration (Updated March 2020)

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Network Configuration Options

ZDLRA Supports 10GigE / 25GigE and InfiniBand

- 10 GigE or 25 GigE is the recommended for protected database to RA connectivity
  - Ethernet based connectivity provides optimal backup and restore rates due to RA's resource management.

  - Note: While IB connectivity is supported, be aware of the following:
    - IB will not realize the full IB network bandwidth due to RA resource management(managed throttling) .
    - IB setup will introduce software update complexity.
    - Owner's Guide, Chapter 9 has details on how to configure Backup Ingest over IB

- Note: Real-Time Redo Transport uses 10 GigE or 25 GigE network ONLY

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Network Configuration Options - continue

VLAN for network isolation

- Backup and restore traffic from different VLANs is not routed.
- Recovery Appliance supports VLAN tagging on the ingest network
  - Protected DB hosts on different and isolated VLANs can be connected directly to the RA
  - Enabling 8021.Q VLAN Tagging in Zero Data Loss Recovery Appliance Over Ingest Networks (Doc ID 2047411.1)

Replication Network: Typically configured via OEDA before RA SW install

- Replication network configuration, post install
  - Post Install - Replication Network Configuration for ZDLRA (Doc ID 2126047.1)
- When Replication network is configured: VLAN tagging is not supported·
- Protected Databases must use the ingest network.

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Recovery Appliance Security

Customers requiring end to end security

Client to Recovery Appliance, or Recovery Appliance to Client

- Upcoming: Security in Flight (TCPS, HTTPS) ➔ Provided upon request
- Adding a protected database Recovery Appliance VPC user credentials to an existing OID wallet (Doc ID 2211759.1)

Security in the Recovery Appliance

- Recovery Appliance administrators responsibilities
  - Create Virtual Private Catalog (VPC) User
  - Assign protected databases to a specific VPC User
  - The protected database administrator can see all databases that share a common VPC user

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Adjusting Default Settings

Do not make any changes to Recovery Appliance

- **IT'S AN APPLIANCE and it's already optimized**
- Restrictions and supported configuration exceptions in MOS note 2172842.1

If required, use MAX_RETENTION_WINDOW to enforce hard limits on data retention for all databases within a protection policy.

- **Use cases where there are stringent compliance / regulatory requirements**
  - **Best practices is to set the value to 5 days or greater (50% above the Recovery Window for large ranges)**
- Backups are forcibly removed after exceeding window
- Recovery Window Goals should be used to manage backup space consumption
- Using an aggressive MAX_RETENTION_WINDOW (one not adhering to best practice) may delay backup processing and indexing due to increased and less efficient PURGE task jobs.

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Use Recommended RA Software

Very Important

- Subscribe to MOS alerts and refer periodically to the following notes:
  - Recovery Appliance Critical Issues MOS note for critical issues alerts (SUBSCRIBE NOW)
  - Recovery Appliance Supported Versions MOS note for latest software update

Use Recommended RA Software to avoid known critical issues

- Number 1 method to avoid problems: Upgrade to recommended software release
- Zero Data Loss Recovery Appliance Supported Versions (Doc ID 1927416.1)
- Zero Data Loss Recovery Appliance Upgrade and Patching (Doc ID 2028931.1)
- Patches are cumulative and include
  - Bug fixes (Avoid a bug before it happens)
  - Enhancements (Modification to RA process flow)

Coordinate with Platinum Patching

- Schedule early & Open Proactive SR

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Don’ts

- Don’t ignore incidents:
  - Resolve and understand
- Don’t neglect the RA
  - Monitor the system
- Don’t Submit multiple request to Delete databases
  - Multiple – concurrent database deletions can have a negative impact on the RA
  - Avoid Delete Database commands as much as possible or limit deletions to 1 or 2 concurrently for large database deletions
  - Start with the smallest and work up, monitor for successful completion.

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Don’ts

- Don’t repeat backup or recovery scripts after a failure
  - First troubleshoot the reason.
  - Typically a client side issue.
  - Rapid and repeated executions of a script may impact the RA.

- Don’t make modifications to the RA configuration
  - Zero Data Loss Recovery Appliance - Installing Third-Party Software and Modifying Internal Appliance Software (Doc ID 2014361.1) - (oratab, .zdlra env, databasemachine.xml)

- Don’t take periodic Level 0
  - Virtual Level 0 requires only one level 0 followed by level 1s
  - Note: A level 0 may be requested
    - By Support
    - To preserve recoverability in event of backup corruption detected on the RA

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Don’ts

- Don’t **backup** a Data Guard primary & standby to the same RA
  - See Deploying the Zero Data Loss Recovery Appliance in a Data Guard Configuration
- Don’t **backup** Data Guard primary **and send redo** from standby to the same RA
  - Backups and redo must be sent from the same database to the same RA
- Don’t **register** databases with identical DBIDs to the same RA
  - See Cloning a Protected Database” within the ZDLRA Protected Database Configuration Guide
- Don’t backup to another media
  - Switching to another media can impact past and future backups made to the RA
- Dual backup strategies are complex and should be avoided if possible
  - Dual backup strategies are designed for migration
  - Dual Backup Strategy MOS Notes:
    - Implementing a Dual Backup Strategy with Backups to Disk and Recovery Appliance (Doc ID 2154461.1)
    - Implementing a Dual Backup Strategy with Backups to Tape and Recovery Appliance (Doc ID 2154471.1)

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Dos

- Validate the backup/restore network first:
  - Use Zero Data Loss Recovery Appliance Network Test Throughput script (Doc ID 2022086.1)
    - requires qperf, NOT OS agnostic
  - How to measure network performance from RMAN for ZDLRA or Cloud Backups (Doc ID 2371860.1) – uses RMAN's "NETTEST" option, OS agnostic
- File a NEW SR for any new issue
  - Refer to Service Requests and Escalation Process section
- Set NLS_DATE_FORMAT before calling rman scripts
  - e.g. in Linux: export NLS_DATE_FORMAT="yyyy-mm-dd hh24:mi:ss"

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Dos

- Use Multi Section: set Section Size to 64GB
  - Number of sections per datafile is limited to 256.
  - When a section size of 64GB is used:
    - Large datafiles > 16TB will automatically see > 64GB section size as determined by RMAN
      - if (sizeof(datafile) > 16TB) , section size = sizeof(datafile) / 256
    - Small datafiles < 64GB will not have sections
  - A 64GB section size: allows for efficient processing in ZDLRA's flash cache
    - Forces filesperset to 1

- Use the latest libra (The RMAN client sbt library that supports ZDLRA)
  - Download the latest sbt library (libra module) (Doc ID 2219812.1)
  - For RAC: Distribute to ALL nodes in the cluster
  - Do NOT update the libra.so on the ZDLRA, unless directed by support.

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Monitoring RA's Health

Monitor the Appliance on a daily basis

- EM Unified Management Dashboard
  - Review twice daily
- System Activity Script **(Doc ID 2275176.1)**
  - Run daily and monitor trends
- EM notifications
  - Review and act on notifications
- Run exachk Monthly and review findings
  - How To update exachk outside ZDLRA Install, Patching and Upgrade **(Doc ID 2399688.1)**
  - Use diff to compare month to month
  - Run pre and post patching
- Review Capacity Planning Report Monthly or Bi-Monthly

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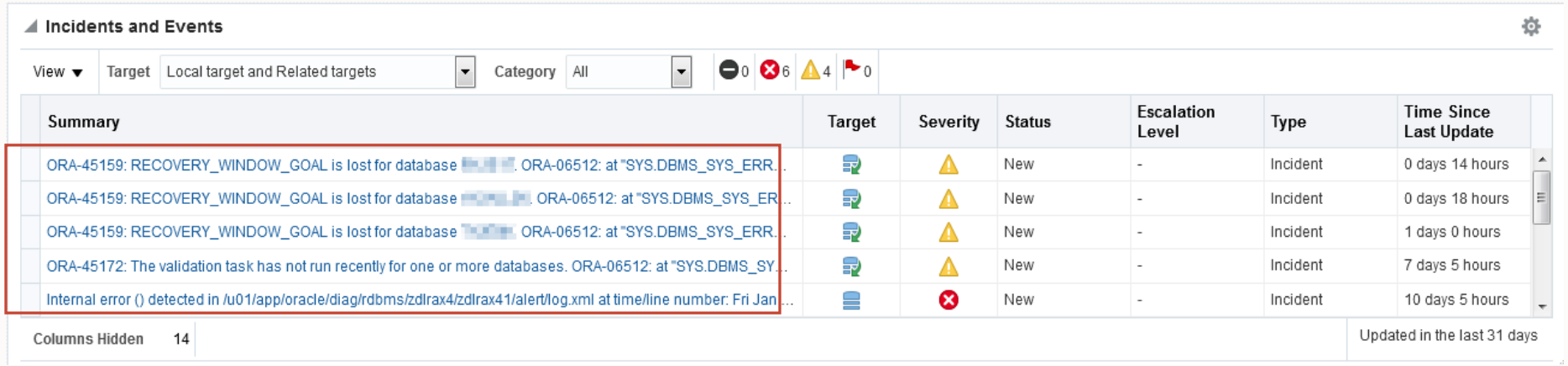
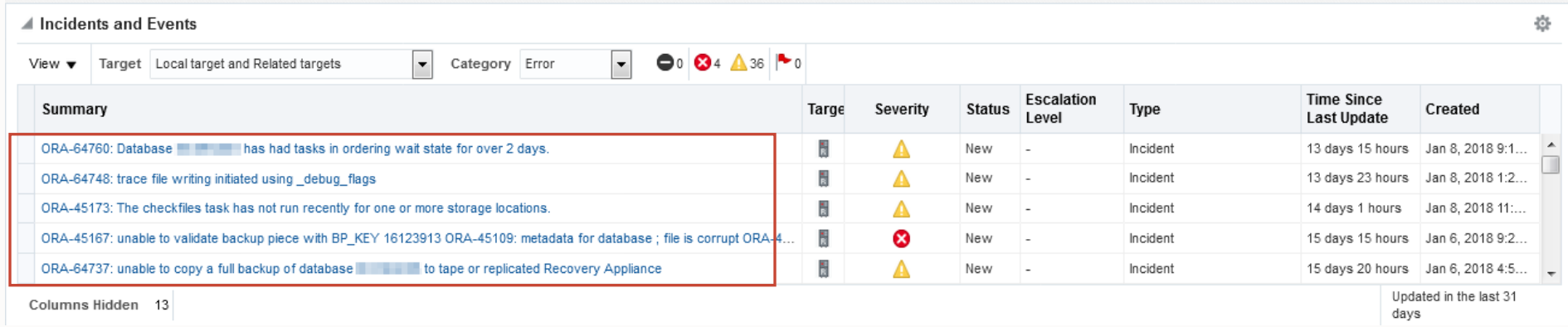
Is the ZDLRA Healthy? Oracle Enterprise Manager





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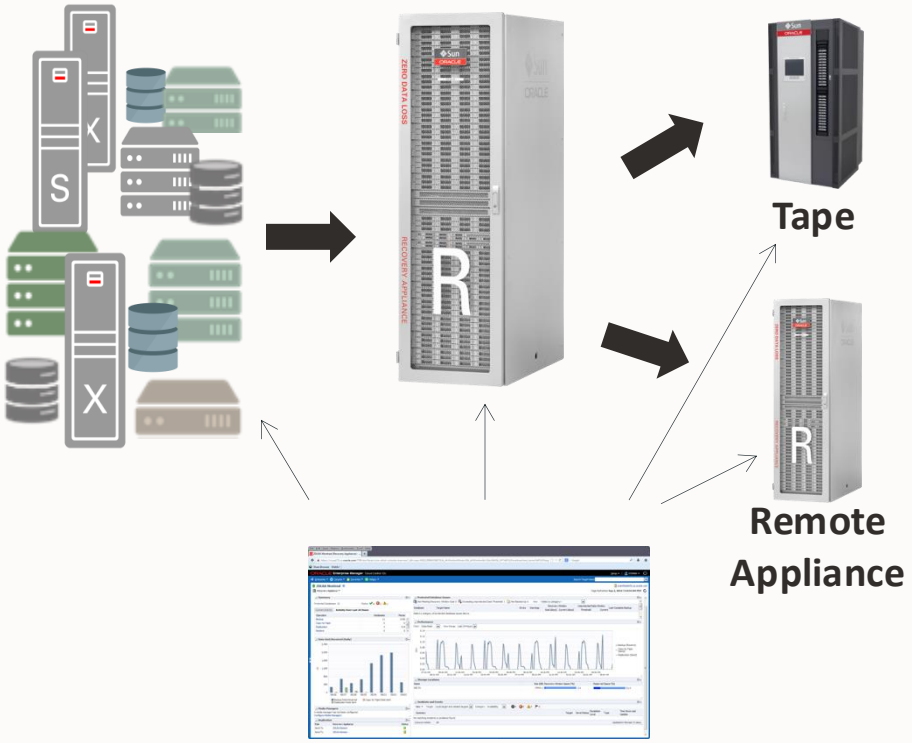
Unified End-to-End Control



Recovery Appliance Admin centrally monitors and manages all database protection activity across all tiers

Database Admin monitors the protection status of their database from disk, to tape, to replica

- Offloaded replicas and tape backups appear in Recovery Catalog

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Best Practice – Unified Management Dashboard

1) Summary

Shows the number of protected databases, and summarizes their health status, current activity, and activity within the last 24 hours. For more information, click the links in the Operation column: Backup, Copy-to-Tape, Replication, and Restore.

2) Protected Database Issues

Highlights issues relating to backup and recovery status for protected databases. The View menu filters the data on key categories.

3) Data Sent/Received (Daily)

Displays daily throughput over the past week.

4) Performance

Charts performance statistics for Data Rate and Queued Data. The statistics are filterable by day, week, or month.

5) Media Managers

Displays the configured media manager for copy-to-tape operations.

6) Storage Locations

Summarizes total available space and usage by indicating how much has been consumed to meet the disk recovery window goal for all databases, and what percentage of total space is reserved space for databases backing up to the specified storage location.

7) Replication

Lists the downstream Recovery Appliances to which this Recovery Appliance is replicating, and also the upstream Recovery Appliances from which this Recovery Appliance is receiving

8) Incidents and Events

Summarizes all warnings or alerts that have been generated by Cloud Control monitoring of all targets associated with the Recovery Appliance. From this section, drill down for further detail on the issues.

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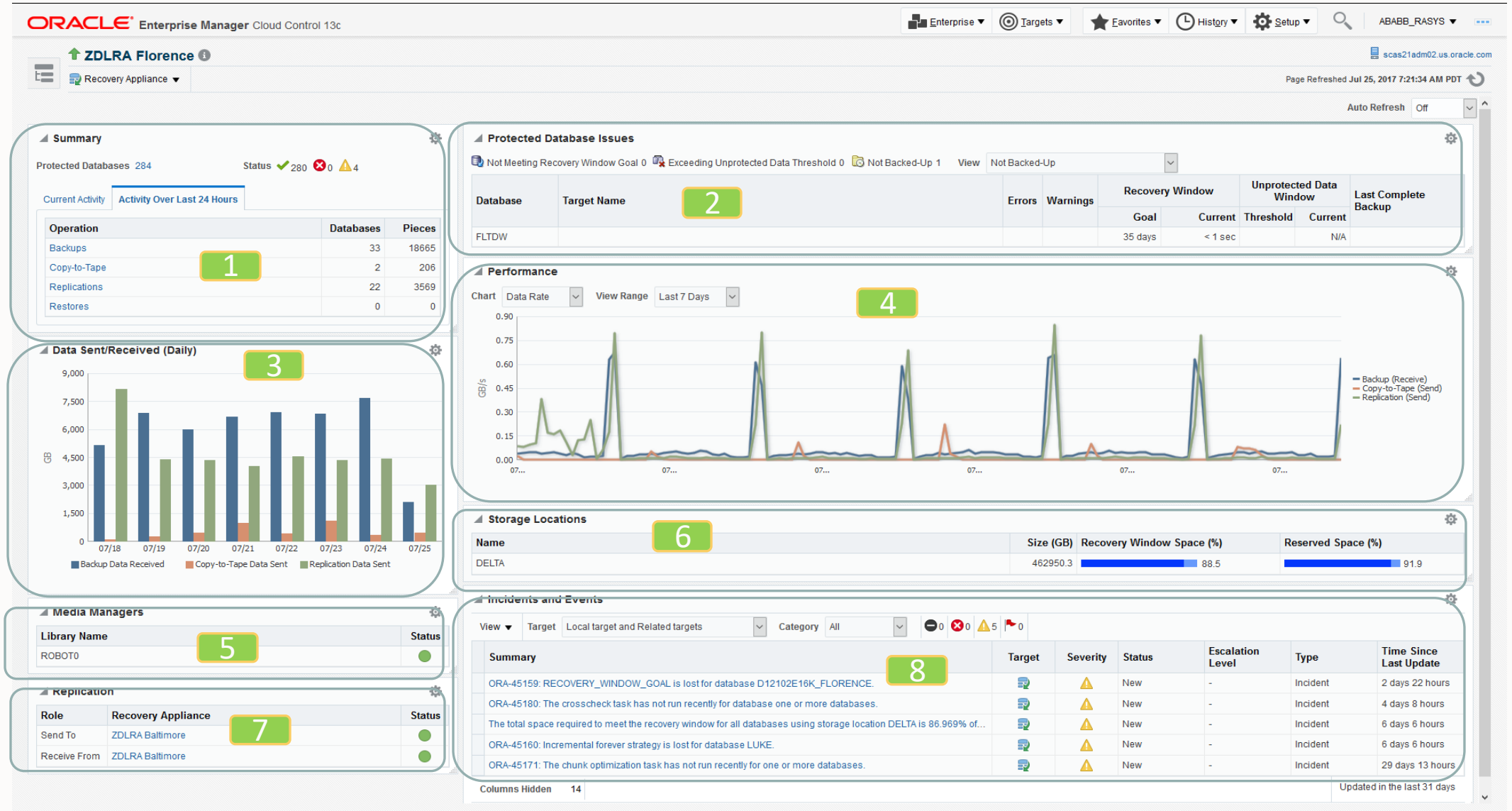
Best Practices – Unified Management Dashboard - Continue



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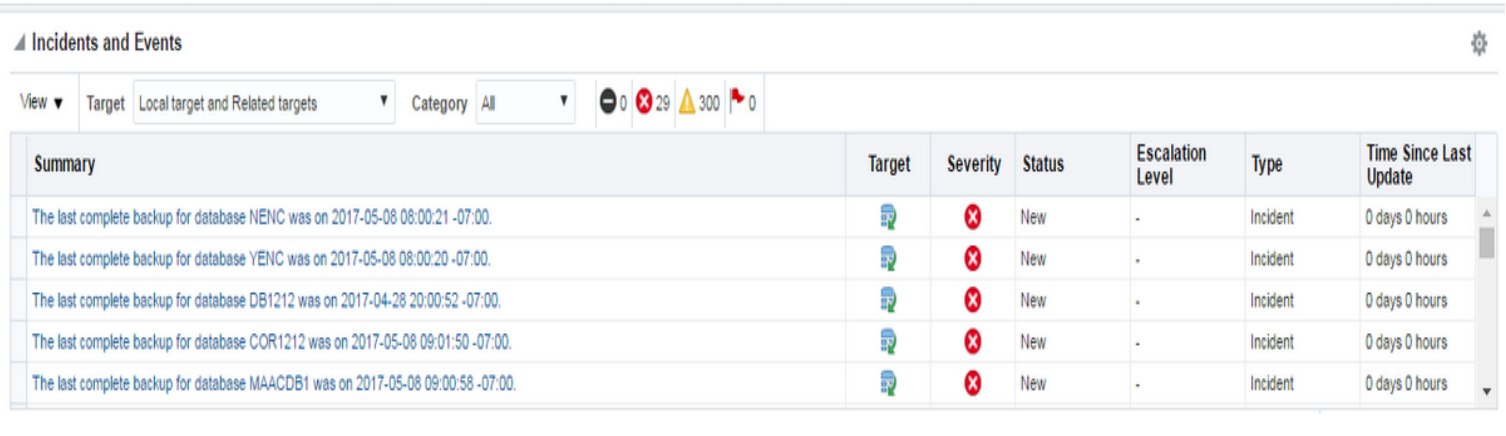
Best Practices – Leverage OEM notifications

Recovery Appliance alert notification setup using Oracle Enterprise Manager (Doc ID 2262003.1)

Example of alerts and notification for old backups:



Host=[redacted]
Target type=**Recovery Appliance**
Target name=**ZDLRA Montreal**
Categories=**Availability**
Message=**The last complete backup for database [redacted] 2995 minutes old.**
Severity=**Critical**
Event reported time=**May 8, 2017 1:35:56 PM PDT**
Operating System=**Linux**
Platform=**x86_64**
Associated Incident Id=**27852**
Associated Incident Status=**New**
Associated Incident Owner=
Associated Incident Acknowledged By Owner=**No**
Associated Incident Priority=**None**
Associated Incident Escalation Level=**0**
Event Type=**Metric Alert**
Event name=**dblra_protected_database:last_backup_age**
Metric Group=**dblra_protected_database**
Metric=**last_backup_age**
Metric value=**2995**
Key Value=[redacted]
Key Column 1=**db_unique_name**
Key Column 1 Value=**MAACDB1**
Key Column 2=**policy_name**
Key Column 2 Value=**CDB_PROT**
Key Column 3 Value=
Key Column 4 Value=
Key Column 5 Value=
Key Column 6 Value=
Key Column 7 Value=
Rule Name=**RULE_LAST_BACKUP_AGE,rule 190**
Rule Owner=**SYSMAN**
Update Details:
The last complete backup for database MAACDB1 is 2995 minutes old.

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Zero Data Loss Recovery Appliance System Activity Script

Zero Data Loss Recovery Appliance System Activity Script (Doc ID 2275176.1)

Contains multiple queries, providing:

- Catalog version
- General state of the system
- Examination of running tasks on the system
- Task history for the last day
- Space usage
- Locking information
- Check status of replication server if it exists
- Incidents for the last five days
- Display each database's current progress processing their datafiles
- API commands over the last 2 weeks
- Notable config changes

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Is the ZDLRA Healthy? System Activity Report

Items to watch for: Bad report

VERSION		NAME	CURRENT_TIME
27-11-2017 15:21:40	ZDLRA_12.1.1.1.8.201711_LINUX.X64_RELEASE	GLPZDLRA	09-DEC-2017 19:41:04

TASK_TYPE	STATE	CURRENT_COUNT	LAST_EXECUTE_TIME	WORK_TYPE	MIN_CREATION
CROSSCHECK_DB	EXECUTABLE	1		Maintenance	08-DEC-2017
PLAN_DF	EXECUTABLE	498,959		Maintenance	22-NOV-2017
VALIDATE	EXECUTABLE	228		Maintenance	02-SEP-2017
REBUILD_INDEX	EXECUTABLE	805		Maintenance	21-OCT-2017
OPTIMIZE	EXECUTABLE	224		Maintenance	28-NOV-2017
OPT_DF	EXECUTABLE	98		Maintenance	22-NOV-2017
RESTORE_RANGE_REFRESH	EXECUTABLE	203		Maintenance	08-DEC-2017
DB_STATS_REFRESH	EXECUTABLE	1		Maintenance	08-DEC-2017
RM_INC_FILES	EXECUTABLE	1		Work	28-NOV-2017
OBSOLETE_SBT	EXECUTABLE	1		SBT	28-NOV-2017
PURGE_DUP	EXECUTABLE	213		Work	13-NOV-2017
INDEX_BACKUP	EXECUTABLE	179,451		Work	01-DEC-2017
CROSSCHECK_DB	EXECUTABLE	10		Work	29-NOV-2017
BACKUP_ARCH	EXECUTABLE	1,072		Work	09-DEC-2017
PURGE_DF	EXECUTABLE	298,722		Work	09-DEC-2017
INDEX_BACKUP	ORDERING_WAIT	112		Work	13-NOV-2017
PURGE_DUP	RUNNING	1	09-DEC-2017 18:47:01	Work	13-NOV-2017
BACKUP_ARCH	RUNNING	2	09-DEC-2017 19:38:15	Work	09-DEC-2017
PURGE	RUNNING	1	09-DEC-2017 06:36:12	Work	08-DEC-2017
PURGE_DF	RUNNING	94	09-DEC-2017 19:38:11	Work	09-DEC-2017
DEFERRED_DEL	RUNNING	4	09-DEC-2017 19:40:04	Work	09-DEC-2017
PURGE_DUP	STALL_WHEN_WAIT	172,675		Work	31-OCT-2017
CHECK_FILES	TASK_WAIT	1		Maintenance	19-NOV-2017
VALIDATE	TASK_WAIT	1		Maintenance	12-JUN-2017
OPT_DF	TASK_WAIT	293		Maintenance	09-OCT-2017
CROSSCHECK_DB	TASK_WAIT	218		Work	21-NOV-2017
PURGE_DF	TASK_WAIT	3		Work	09-DEC-2017

Watch for :

If there are tasks of WORK TYPE in RUNNING state and created a day earlier then investigate.

If there are tasks of MAINTENANCE or SBT TYPE present and their creation time is older than one week then it should be investigated.

A large number of task in executable state for the same task_type.

The same task type is increasing in the number of jobs (current_count) over time.

A system with ordering waits that are older than 1 day.

A system with tasks in stall_when_wait.
This should only be seen if Oracle Support is troubleshooting the RA.

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Is the ZDLRA Healthy? System Activity Report

```
VERSION                                                                  NAME      CURRENT_TIME
------------------------------------------------------------------------ --------- --------------------
27-11-2017 15:21:40  ZDLRA_12.1.1.1.8.201711_LINUX.X64_RELEASE           GLPZDLRA  11-JAN-2018 19:58:14


--## General state of the system
--##
--## When a ZDLRA is healthy the system should look like:
TASK_TYPE            STATE           CURRENT_COUNT LAST_EXECUTE_TIME    WORK_TYPE   MIN_CREATION
-------------------- --------------- ------------- -------------------- ----------- ------------
INDEX_BACKUP         EXECUTABLE                  1                      Work        11-JAN-2018
INDEX_BACKUP         RUNNING                    93 11-JAN-2018 19:34:36 Work        11-JAN-2018
BACKUP_ARCH          RUNNING                     4 11-JAN-2018 19:55:58 Work        11-JAN-2018
PURGE_DUP            RUNNING                     5 11-JAN-2018 19:56:21 Work        11-JAN-2018


--## Task history for the last day:
--## Seeing what work has completed recently can be informative.
--## It is a basic indication of what has happened.

TASK_TYPE            STATE               CNT MIN_COMPLETION_TIME         MAX_COMPLETION_TIME
-------------------- --------------- ---------- ----------------------------- -----------------------------
BACKUP_ARCH          COMPLETED           11,046 10-JAN-2018 19:58:16          11-JAN-2018 19:57:40
DB_STATS_REFRESH     COMPLETED              131 10-JAN-2018 20:06:01          11-JAN-2018 19:55:40
DEFERRED_DEL         COMPLETED           24,602 10-JAN-2018 19:58:14          11-JAN-2018 19:58:09
HISTOGRAM            COMPLETED                8 10-JAN-2018 20:11:02          11-JAN-2018 17:12:22
INDEX_BACKUP         COMPLETED           24,599 10-JAN-2018 19:58:14          11-JAN-2018 19:58:06
OBSOLETE_SBT         COMPLETED                1 11-JAN-2018 05:10:31          11-JAN-2018 05:10:31
PURGE_DUP            COMPLETED              266 11-JAN-2018 00:29:46          11-JAN-2018 19:58:11
RESTORE_RANGE_REFRESH COMPLETED          29,737 10-JAN-2018 20:06:02          11-JAN-2018 19:55:52
RM_INC_FILES         COMPLETED              131 10-JAN-2018 20:06:00          11-JAN-2018 19:55:37
```

The Good:

Minimum creation time for active tasks is within the last 24 hours for work tasks .

Task history state should indicate work is being completed.

Review other sections

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Is the ZDLRA Healthy? exachk

Database Server

Status	Type	Message	Status On	Details
FAIL	OS Check	System is exposed to ZDLRA Critical Issue RA12	All Database Servers	View
FAIL	OS Check	System is exposed to ZDLRA Critical Issue RA10	All Database Servers	View

Update exachk for RA:

- How to update exachk outside ZDLRA Install, Patching and Upgrade **(Doc ID 2399688.1)**

Database Server

Status	Type	Message	Status On	Details
FAIL	OS Check	System is exposed to ZDLRA Critical Issue RA12	All Database Servers	Hide

ZDLRA Critical Issue RA12

Recommendation	Benefit / Impact: This critical issue delivers 5 new fixes, including a rare race condition that can result in a corrupted backup within RA when a hang occurs in the servlet session. The patch will prevent any further corruption due to this bug but a new backup will have to be sent. Restore or subsequent validation of the corrupted datafile will detect the corruption. This patch supersedes critical issue (RA10). Other bugs fixed by the patch are A reporting issue with regards to the Recovery Window for a given database that has multiple incarnations and dropped files reporting no data - Bug 22187259 A scheduling issue where the backup of archive logs received via Real Time Redo shipping will interrupt background tasks performed by the appliance - Bug 22213097 The inclusion of patch 22304421 for systems running 12.1.0.2.BP13 Grid Infrastructure - Bug 23010146 The RA-Automation RPM can be created with 0 bytes leading to a failure during the installation of the Recovery Appliance - Bug 23024869 Action / Repair: See below document 2124925.1 for additional details
Links	1. Note: 2124925.1 - (RA12) Backup sent to ZDLRA can become corrupted when there are hangs in servlet sessions (Doc ID 2124925.1)
Needs attention on	[redacted]
Passed on	-

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exachk & RA Information Center

Oracle Recovery Appliance Assessment Report

System Health Score is 97 out of 100 (detail)

Cluster Summary

Cluster Name	zdlra01
OS/Kernel Version	LINUX X86-64 OELRHEL 6 2.6.39-400.286.3.el6uek.x86_64
CRS Home - Version	/u01/app/12.1.0.2/grid - 12.1.0.2.160419
DB Home - Version - Names	/u01/app/oracle/product/12.1.0.2/dbhome_1 - 12.1.0.2.160419 - zdlra01
EM Agent Home	/u01/app/emagent/agent_13.2.0.0.0
Exadata Version	12.1.2.3.3
Number of nodes	16
Database Servers	2
Storage Servers	11
IB Switches	3
exachk Version	12.2.0.1.3_20170719
Collection	exachk_ra01dbadm01_zdlra01_083017_101537.zip
Duration	7 mins, 53 seconds
Executed by	root
Collection Date	30-Aug-2017 10:16:18

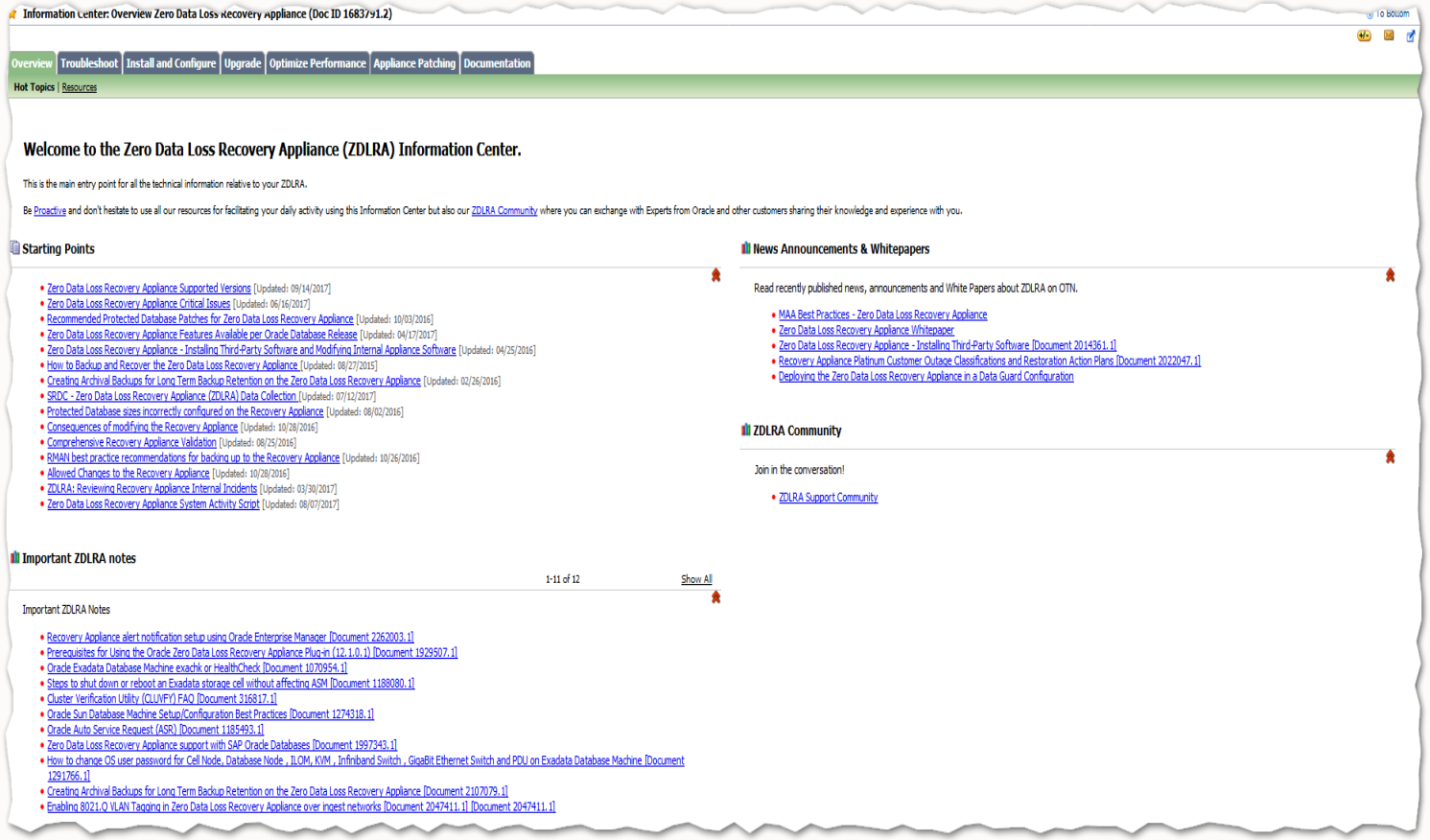
Note! This version of exachk is considered valid for 78 days from today or until a new version is available

Table of Contents

Report Feature

- Show Failed checks only
- Show checks with the following status:
  Fail Warning Info Pass
- Show details of the following regions:
  - Infrastructure Software and Configuration Summary
  - Findings needing further review
  - Systemwide Automatic Service Request (ASR) healthcheck
  - Component Elapsed Times
  - Top 10 Time Consuming Checks

Information Center: Overview Zero Data Loss Recovery Appliance (Doc ID 1683791.2)



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How to Determine If ZDLRA Is Keeping up With Load

Determining whether unprocessed task list is growing (over 7 day period):

```
SELECT count(*)
  FROM ra_task
 WHERE archived='N';
```

Problem: task queue growing over time
Action: review system activity report/EM open SR

Determine whether incidents are active for delays in performing busywork:

```
SELECT error_text
  FROM ra_incident_log
 WHERE status='ACTIVE'
   AND error_text like '%has not run%';
```

Problem: Active incidents log indicates busywork not running
Action: Review system activity report/EM open SR

Tasks with highest numbers *(RA_TASK.PRIORITY)* are busywork tasks

- DB_STATS_REFRESH, RESTORE_RANGE_REFRESH, OPT_DF, OPTIMIZE, REBUILD_INDEX, VALIDATE, CHECK_FILES, CROSSCHECK_DB

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ORDERING_WAIT tasks

- Occurs when a backup piece won't tile with existing Delta Pools
- Causes:
  - Unprocessed incrementals from polling directory
  - Missing incremental level 1 backup
  - Incremental level 1 backup taken against a level 0 backup that is not in Delta Pool (may be on local storage in Protected DB or replica or on tape
  - Missing datafile incarnation information : open resetlogs
  - Unsupported features used in backup piece:

    maxpiecesize, rman encryption, datafile copy

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ORDERING_WAIT tasks -- investigating

Current script for investigating ORDERING_WAIT issues is available from support in a MOS note:

- **Diagnostic SQL script for tasks in ORDERING_WAIT status on Recovery Appliance (Doc ID 2095949.1)**

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Lost RESTORE_RANGE

Uses of restore ranges:

- RECOVERY RANGE output from EM
- RA_<disk|sbt>_RESTORE_RANGE views
- UNPROTECTED_WINDOW information and alerts

For a restore range to be valid we need:

- Archivelogs to cover the range
- ZDLRA Disk file backups for all datafiles that were taken during the range
- Backup of controlfile

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Diagnosing RESTORE RANGE problems

Compare restore range of ZDLRA storage against all storage

```
select * from ra_disk_restore_range
where db_key = <db_key> order by low_time;
----------------------------
select * from rc_restore_range
where db_key = <db_key> order by low_time;
```

- Make sure that the restore range has been recomputed

```
select  count(*), max(completion_time) from ra_task
where task_type = 'RESTORE_RANGE_REFRESH' and archived = 'Y' and db_key=<db_key>;
```

- See what RMAN thinks about recovery of database

```
RMAN> restore preview database;
```

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Diagnosing RESTORE RANGE problems (cont.)

Get list of logs to make sure that they tile

```
select thread#, first_change#, first_time, next_change#, next_time
from rc_backup_redolog  join rc_backup_piece using (bs_key, db_key)
where db_key = <db_key> and ba_access='Local' and first_time > sysdate - <RWG>
order by thread#, first_change#;
```

Get list of datafiles to make sure that they overlap with archivelogs

```
select file#, checkpoint_change#, checkpoint_time, absolute_fuzzy_change#
from rc_backup_datafile join rc_backup_piece using (bs_key, db_key)
where db_key = <db_key> and ba_access='Local' order by file#, checkpoint_change#;
```

Get list of control files to make sure that one is usable

```
select c.completion_time
from rc_backup_controlfile c join rc_backup_piece using (bs_key, db_key)
where db_key = <db_key> and ba_access='Local' order by c.completion_time;
```

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Recovery Appliance BI Reports

Reports are available to help the Recovery Appliance administrator understand resource utilization, alerts, and historical operations

Reports examples include:

- Active Incidents
- API History
- Capacity Planning
- Recovery Window Summary
- Top 10 Databases by Data Transfer
- Protected Databases Details
- Chargeback Reports

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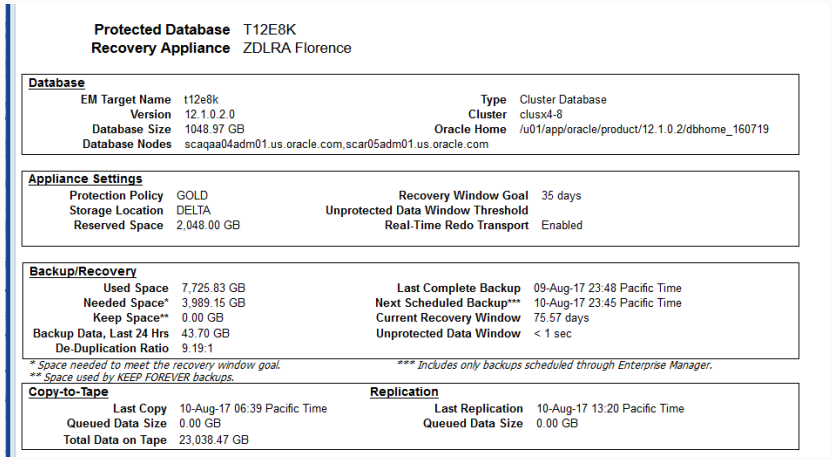
Protected Database Report

Recoverability information per database!

Top section contains the following information:

- Protected Database
- Space Used
- RPO / Recovery Window
- Unprotected Window
- Last Backup time
- Last Tape Copy
- Last Replication



Protected Database T12E8K
Recovery Appliance ZDLRA Florence

Database

EM Target Name	t12e8k	**Type**	Cluster Database
Version	12.1.0.2.0	**Cluster**	clusx4-8
Database Size	1048.97 GB	**Oracle Home**	/u01/app/oracle/product/12.1.0.2/dbhome_160719
Database Nodes	scaqaa04adm01.us.oracle.com,scar05adm01.us.oracle.com		

Appliance Settings

Protection Policy	GOLD	**Recovery Window Goal**	35 days
Storage Location	DELTA	**Unprotected Data Window Threshold**	
Reserved Space	2,048.00 GB	**Real-Time Redo Transport**	Enabled

Backup/Recovery

Used Space	7,725.83 GB	**Last Complete Backup**	09-Aug-17 23:48 Pacific Time
Needed Space*	3,989.15 GB	**Next Scheduled Backup*****	10-Aug-17 23:45 Pacific Time
Keep Space**	0.00 GB	**Current Recovery Window**	75.57 days
Backup Data, Last 24 Hrs	43.70 GB	**Unprotected Data Window**	< 1 sec
De-Duplication Ratio	9.19:1		

** Space needed to meet the recovery window goal.*
*** Space used by KEEP FOREVER backups.*
**** Includes only backups scheduled through Enterprise Manager.*

Copy-to-Tape

Last Copy	10-Aug-17 06:39 Pacific Time
Queued Data Size	0.00 GB
Total Data on Tape	23,038.47 GB

Replication

Last Replication	10-Aug-17 13:20 Pacific Time
Queued Data Size	0.00 GB

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Chargeback Report – Pay as RA Storage is Utilized (Least)

Charge for space as it is used on the Recovery Appliance

Recovery Appliance - Protected Database Chargeback Report

Chargeback - Space Breakdown
Current Space: The amount of disk space on the Recovery Appliance currently used by this protected database during the time period indicated.
Reserved Space: The minimum amount of disk space on the Recovery Appliance reserved for use by this protected database to meet its recovery window goal.
Recovery Window Space: The estimated space (in GB) that is needed to meet the recovery window goal for this protected database.

The Current Space, Recovery Window Space and Copy to Tape values in the charts and tables are cumulative.

*Note: The protected database chargeback is based on the copy to tape space, plus either the current space or the recovery window space, whichever is **lower**.*

Chargeback - Budgetary Breakdown
Chargeback Amount: The fixed amount charged for the database for a given time period.
Chargeback Amount Delta: This difference in chargeback between the current and previous reported value.

The yearly report is the sum of the monthly chargeback values for each year.

Note: Below each chart is a table with the same data which you can filter and sort by column, if needed.

Protected Database Details

Protected Database	**T12E8K**
Recovery Appliance	**ZDLRA Florence**
Protection Policy	**GOLD**
Chargeback - Recovery Appliance	**0.05**
Chargeback - Copy to Tape	**0.01**

T12E8K — **Recovery Appliance - Monthly Chargeback (Last 12 Months)**

T12E8K — **Recovery Appliance Chargeback - Space Breakdown**

Scenario: Think of this as similar to an metered model where the customer only pays for utilization. The database being protected is charged only for the space utilized.

Example: A 6 month retention would ramp up in cost since utilization on month 1 is lower than month 6.

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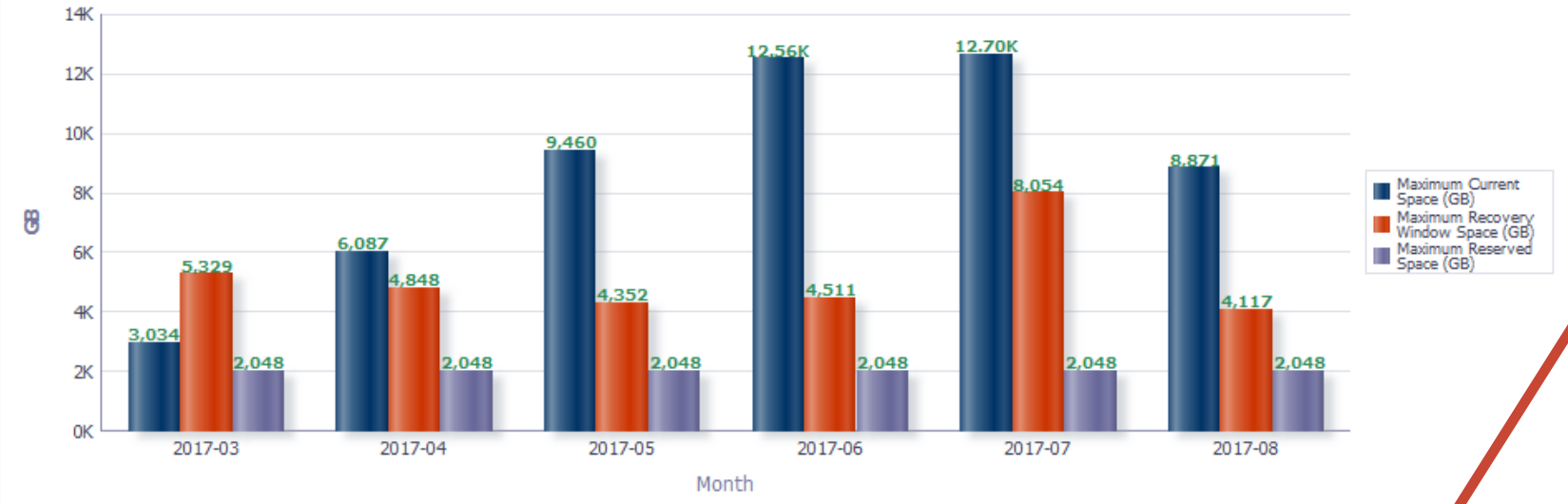
Chargeback Report- Pay as RA Storage is Utilized-cont'd

Monthly RA Storage space consumption for this database.

Display of RA space used to calculate the chargeback.

T12E8K — **Recovery Appliance - Monthly Chargeback (Last 12 Months)**

T12E8K — **Recovery Appliance Chargeback - Space Breakdown**



Year	Month	Database	Maximum Current Space (GB)	Maximum Recovery Window Space (GB)	Maximum Reserved Space (GB)	Space Used for ChargeBack (GB)
2017	03	T12E8K	3034.14	5328.82	2048	3034.14
2017	04	T12E8K	6087.21	4847.5	2048	4847.5
2017	05	T12E8K	9459.77	4352.21	2048	4352.21
2017	06	T12E8K	12558.35	4511.3	2048	4511.3
2017	07	T12E8K	12698.74	8053.57	2048	8053.57
2017	08	T12E8K	8871.02	4116.51	2048	4116.51

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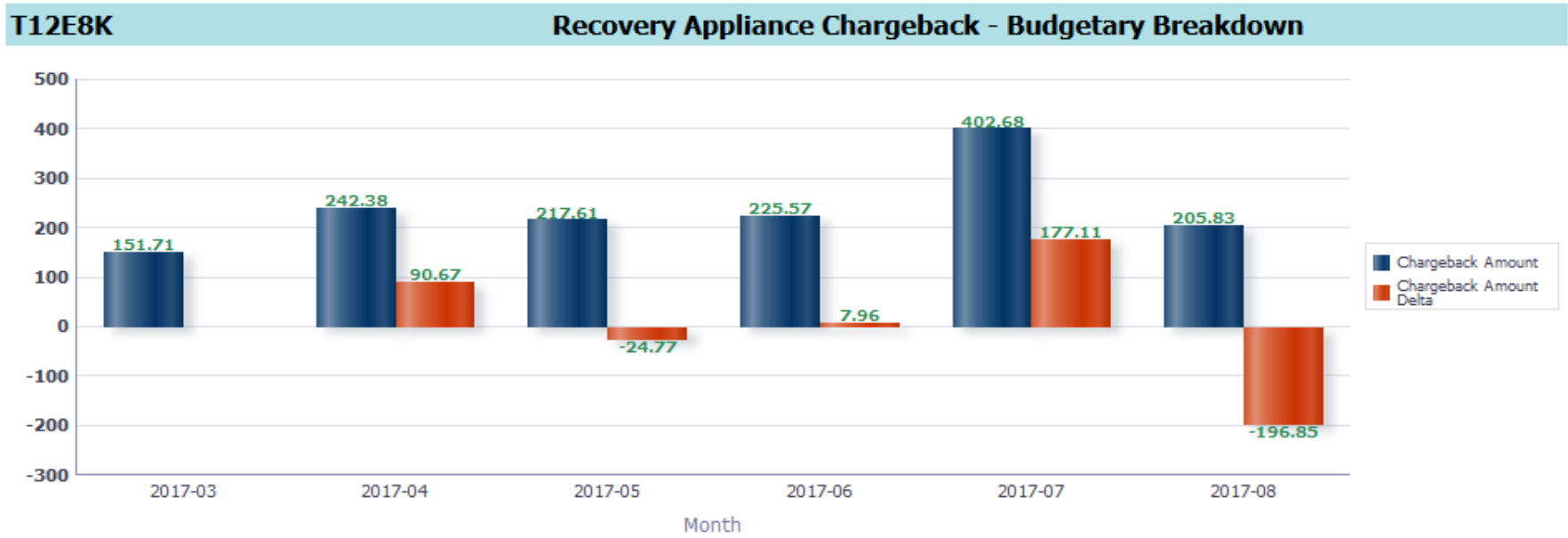
Chargeback Report- Pay as RA Storage is Utilized-cont'd

Monthly cost for this database on RA Storage.



Year	Month	Database	Chargeback Amount	Chargeback Amount Delta
2017	03	T12E8K	$151.71	$0.00
2017	04	T12E8K	$242.38	$90.67
2017	05	T12E8K	$217.61	($24.77)
2017	06	T12E8K	$225.57	$7.96
2017	07	T12E8K	$402.68	$177.11
2017	08	T12E8K	$205.83	($196.85)

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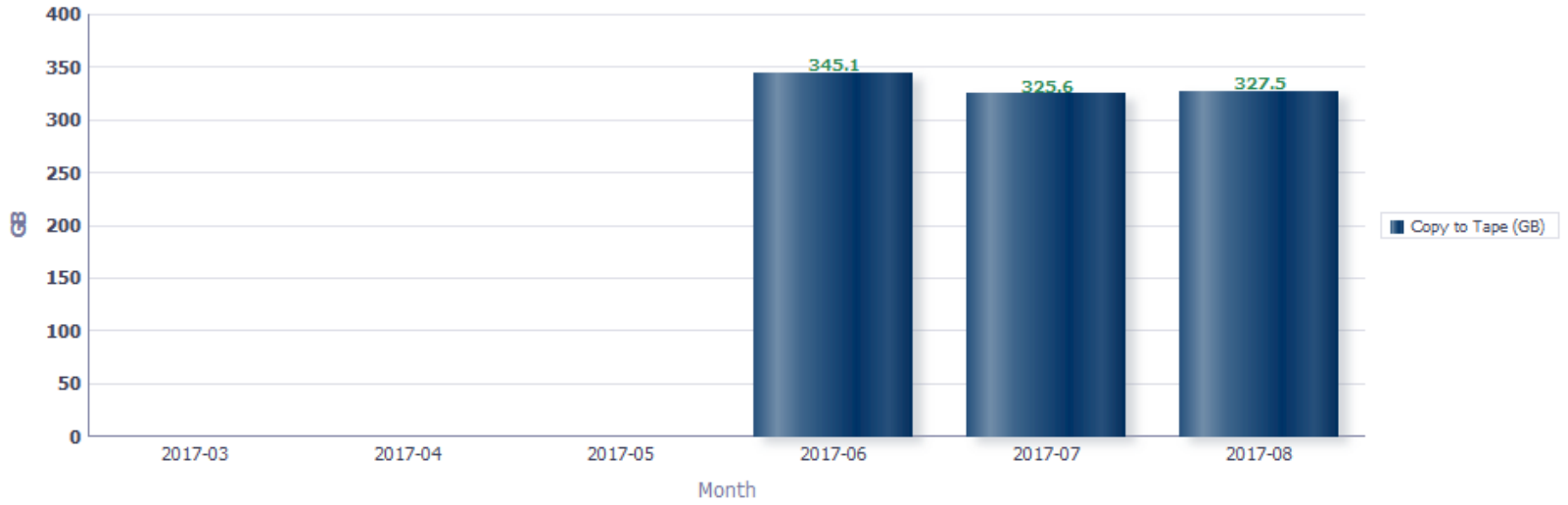
Chargeback Report- Pay as RA Storage is Utilized-cont'd

Monthly tape storage space consumption for this database.

T12E8K **Copy to Tape - Monthly Chargeback (Last 12 Months)**

T12E8K **Copy to Tape Chargeback - Space Breakdown**



Year	Month	Database	Copy to Tape (GB)
2017	03	T12E8K	0
2017	04	T12E8K	0
2017	05	T12E8K	0
2017	06	T12E8K	345.06
2017	07	T12E8K	325.61
2017	08	T12E8K	327.53

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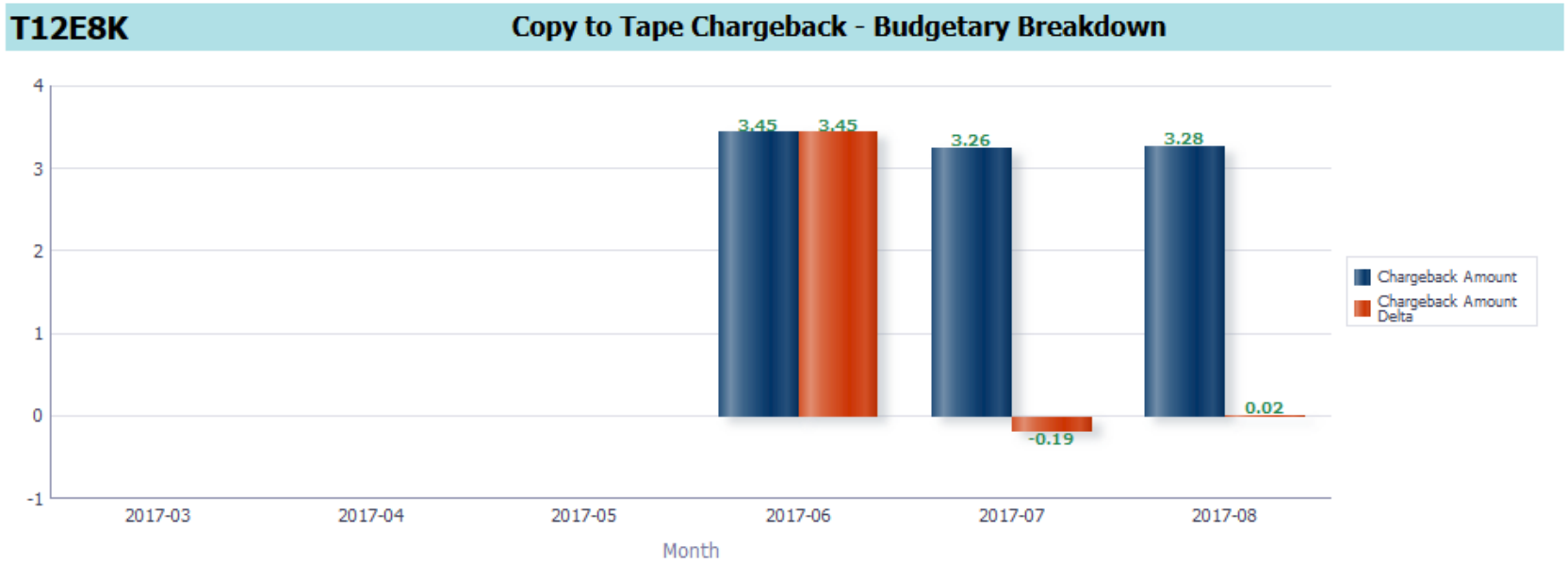
Chargeback Report- Pay as RA Storage is Utilized-cont'd

Monthly cost for this database on tape.



Year	Month	Database	Chargeback Amount	Chargeback Amount Delta
2017	03	T12E8K	$0.00	
2017	04	T12E8K	$0.00	$0.00
2017	05	T12E8K	$0.00	$0.00
2017	06	T12E8K	$3.45	$3.45
2017	07	T12E8K	$3.26	($0.19)
2017	08	T12E8K	$3.28	$0.02

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1. Understand Requirements First
2. RA Deployment Decisions and Key Practices
3. RA Stay Healthy Plan
4. Best Practices Backup and Restore
5. Migration with ZDLRA
6. Oracle Support & Service Request
7. RA Roles and Responsibilities

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Backup & Configuration Overview

Steps to Backup & Configure a Database using Enterprise Manager Cloud Control

- Create Protection Policy on Recovery Appliance (RA)
- Add Protected Database to RA
- Configure Backup Settings for Protected Database
- Schedule ONE-TIME Level 0 (Full) Backup with “Custom Backup”, then Level 1s with “Oracle-Suggested Recovery Appliance Backup”

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What To Do With Existing Backups?

RMAN backups to disk or NFS share (including Data Domain share)

- Can be imported into the Recovery Appliance via “polling”
- Become part of the Incremental Forever strategy on the RA

Backups taken using 3rd party backup software

- Leave the agent in place on the protected DB hosts until retention expires
- Leverage dual backup (disk & tape) strategy if needed in interim
- Removing agents saves system resources

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Backup Best Practices

Use Transparent Data Encryption (TDE) instead of RMAN encryption

- RMAN encryption will prevent ZDLRA from creating Virtual Full Backups (VB$).

Use native database compression instead of RMAN compression

- RMAN compression will result in additional CPU utilization on the Protected Database client
- RMAN compressed backups require decompression and recompression on the ZDLRA

Use block change tracking for all protected databases

```
rman target <target string> catalog <catalog string>
  backup  device type sbt
  cumulative incremental level 1
  filesperset 1  section size 64g  database
  plus archivelog  not backed up  filesperset 32;
```

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Impact of TDE Encryption

Advanced Security Option requires a Level 0 when:

- first key (encrypt) a tablespace
- rekey a tablespace
- masterkey rotation

- If RA upgraded to **19.2.1.1.2-RELEASE or later** (RA takes a level 0 as needed)

  When you first key (encrypt), rekey a tablespace or master key rotation

  - The next L1 backup will automatically create the level 0 of datafiles required as necessary via Smart Incremental feature.

- If RA version is **12.2.1.1.2-201810-RELEASE** (INTERIM 1) OCT 2018 PSU but less than **19.2.1.1.2-RELEASE**

  When you first key (encrypt) or rekey a tablespace or master key rotation

  - The NEXT backup for that tablespace MUST be a level 0

Avoid RMAN compression against a TDE tablespace as RMAN encryption will be automatically enabled, preventing the RA from creating Virtual Backups.

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Backup Best Practices – Cont.

Incremental level 0 (full) as first backup

Subsequent **cumulative incremental level 1** backups “Incremental Forever”

Use **section size** of 64GB

Use **filesperset** 1 for one datafile per backupset

Limit channel allocation to 4 per node

Virtual Full Backup Creation Monitoring

- After a L1 incremental backup: RA indexes it and builds the corresponding Virtual Full. Check EM or SAR for error messages like *“ORA-64760: Database XYZ has had tasks in ordering wait state for over X days.”*
  - Refer to MOS note: **Diagnostic SQL script for tasks in ORDERING_WAIT status on Recovery Appliance (Doc ID 2095949.1)**

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Restore & Recovery Best Practices

Use RMAN Restore Database / Recover Database as you would today

- No new RMAN commands to learn. Intelligent built-in recovery catalog in RA
- RMAN is aware of the validated backups on disk, tape or replica. Restore is transparent and simple
- Restore directly from tape or RA Replica without staging on local RA if local disk backups are not present

Performance considerations

- Maximize # of RMAN channels for Restore: Consider other active databases on a target.
- Restore operations are always auto prioritized within RA without preventing other backup operations
- BCT: Works against the most recent VL Full. With cumulative, BCT will stop if VLF 7 days out.

Bigfile Tablespace Practices and Considerations (recall backup best practice using SECTION SIZE)

- Oracle 11g databases can restore initial L0 with SECTION SIZE to parallelize sections across channels
  - Restoring virtual fulls (created from L1s) **does** parallelize sections **(As of RA Software 12.1.1.1.8.201710)**
- Oracle 12c databases can restore L0 and virtual fulls with SECTION SIZE parallelism across channels

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Database Migration Process using ZDLRA

Cross Endian - Big Endian ⇔ Little Endian

Uses Virtual Level 0 backup of source database and Restore/Recover on destination

Refer to MOS Note: Cross Platform Database Migration using ZDLRA (Doc ID 2460552.1)

Same Endian - Leverage Data Guard

Data Guard Support for Heterogeneous Primary and Physical Standby in Same Data Guard Configuration (Doc ID 413484.1)

Creating a Physical Standby Database in an 11.2, 12.1, 12.2 or later environment (Doc ID 2275154.1)[1]

Source database backups available on the ZDLRA, instantiate new database on the destination platform using RMAN DUPLICATE FOR STANDBY

[1]When using RMAN to DUPLICATE a database, connect to the ZDLRA as CATALOG and configure the RMAN AUXILIARY SBT channels for the ZDLRA.

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Cross Platform DB Migration using ZDLRA - Benefits

Primary benefits:

- Significant reduction in downtime (Potentially less than 2 hours of service downtime)
- Application service is **Read Only** during most of the *service downtime*
- New ZDLRA tool (dbmigusera.pl) simplifies cross platform migration by automating steps, especially useful for large databases
- Migration time is not impacted by the size of the database
- Supports migration to the same or higher DB version

Read Only downtime based on

- Final incremental backup & recovery step Incremental size < 5% of the database
- Final tablespace metadata export/import duration (only necessary for cross platform)
- Number of target tablespaces – import is done serially
- Application service switchover from source to destination database

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Leverage Data Guard and ZDLRA - Benefits

Primary benefits:

- Near-Zero to Zero downtime during switchover to destination database
- Increased availability during the migration process vs transportable tablespace approach
- With Active Data Guard, standby database can be used to offload read-only activities from primary (e.g. reporting), until switchover is performed

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Opening a Service Request

Proactively update the SR with as MUCH details as you can

*** critical time-sensitive information might be lost! ***

1. Problem statement with Use Case, Timeline (before problem, any changes, when problem occurs)
2. Impact Analysis
3. Refer to MOS notes:
   - **SRDC - Zero Data Loss Recovery Appliance (ZDLRA) Data Collection (Doc ID 2154189.1)**
   - **Zero Data Loss Recovery Appliance System Activity Script (Doc ID 2275176.1)**
   - **ZDLRA Detailed Troubleshooting Methodology (Doc ID 2408256.1)**
   - **How to create a Technical Service Request (SR) in My Oracle Support (Doc ID 1321379.1)**
   - **How to Create Service Requests for Software Issues Using a Hardware Support Identifier (Doc ID 1439980.1**)
   - **Who to contact to discuss details, corrections or changes to a Support Contract (Doc ID 1250376.1)**
4. Remember to escalate an SR which is not progressing to your satisfaction. Escalation brings management attention to the issue. You can escalate an SR of any severity

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Escalations : *Bringing Management Attention to your Service Request*

Asking to increase the severity of your service request is **NOT** an escalation, even though customers follow the same process

An escalation is bringing Oracle Support Management's attention to your service request

- Proactive reasons to escalate an issue:
  - Communicate business issues to managers within Oracle Support

- Reactive reasons to escalate an issue
  - Encountering critical roadblocks
  - Dissatisfied with resolution or response

Describe Impact of Problem: Project deadlines?, Lost Revenue?, Government reporting? Increase in Recoverability and Data Loss Potential

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How to Escalate or Change Severity

1. Call the 24x7 Support Hotline
   Toll Free: 0800.891.5899
   http://www.oracle.com/support/contact.html
2. Choose option #1 for an existing service request
3. Enter all digits of the SR number followed by #
4. Choose the option to **ESCALATE** the SR
   Do **NOT** choose the option to speak to the owning engineer, **you want to speak to an Escalation Manager** (formerly called Duty Manager) in order to escalate or change the severity of the SR. Always request a call back from the Escalation Manager when escalating an SR!

Engineered Systems Hardware Replacements:

Choose the option for Field Delivery Dispatch to schedule, change or check the status of a Field Engineer visit for hardware replacement

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When Calling for Engineered Sys. Support…

The following options will direct your call to the relevant team:

Press "1" for Existing Service Requests

- Enter Service Request#. If lookup is successful:
  - Press “1” to speak to the engineer working your service request
    - If Engineer is available, call will connect
    - If engineer is not available
      - Press “1” to leave VM or,
      - Press “2“ to speak to the next available EEST engineer
  - If there is no FS Task, press “2” to Escalate the Service Request
  - If there is a FS task,
    - Press “2” for Field Delivery Dispatch
    - Press “3” for Escalation Request

Press “2” for New Service Requests

- Press “1” Engineered Systems
  - For Technical Product Issues Press “1”
  - For Non-Technical Issues such as My Oracle Support or Support Identifier Issues Press “2”

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Service Request Severity Levels

Partnership

Severity Level	Business & Technical Impact	1st Response	Update Frequency	Resolution Time
1	Mission Critical Business Impact	< 1 Hour (telephone preferred)	Continual Updates 24x7	Co-Owned
2	Serious Business Impact	Communication Preference	Multiple Updates 24-48 hours	Co-Owned
3	Minor Business Impact	Communication Preference	Updates 2-3 Business Days	Co-Owned
4	No Business Impact	Communication Preference	Updates 3-5 Business Days	Co-Owned

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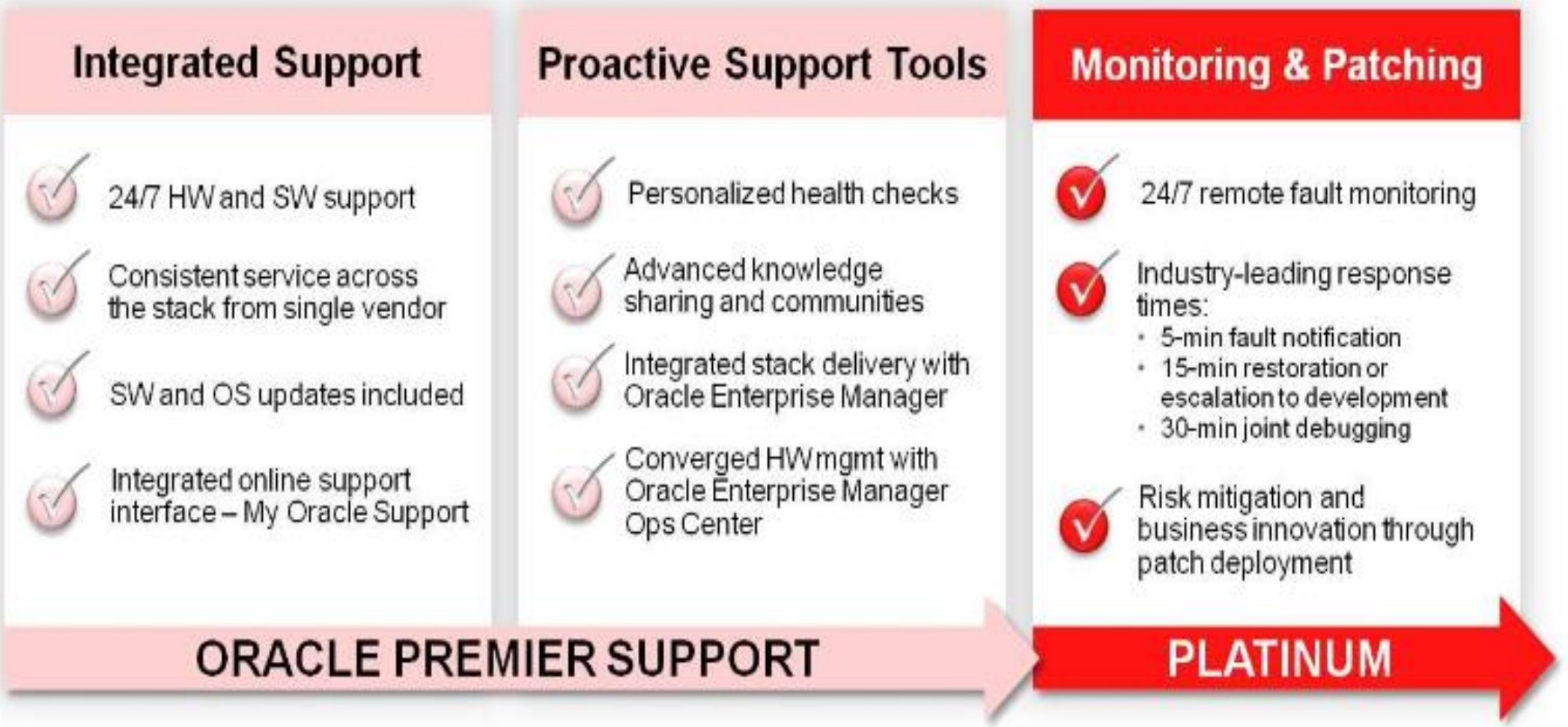
Platinum Support for Recovery Appliance



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Typical questions from new ZDLRA customers

New ZDLRA Customer

1. Who will manage this?
2. How will my team support it?

This section provides information to help you answer these questions.

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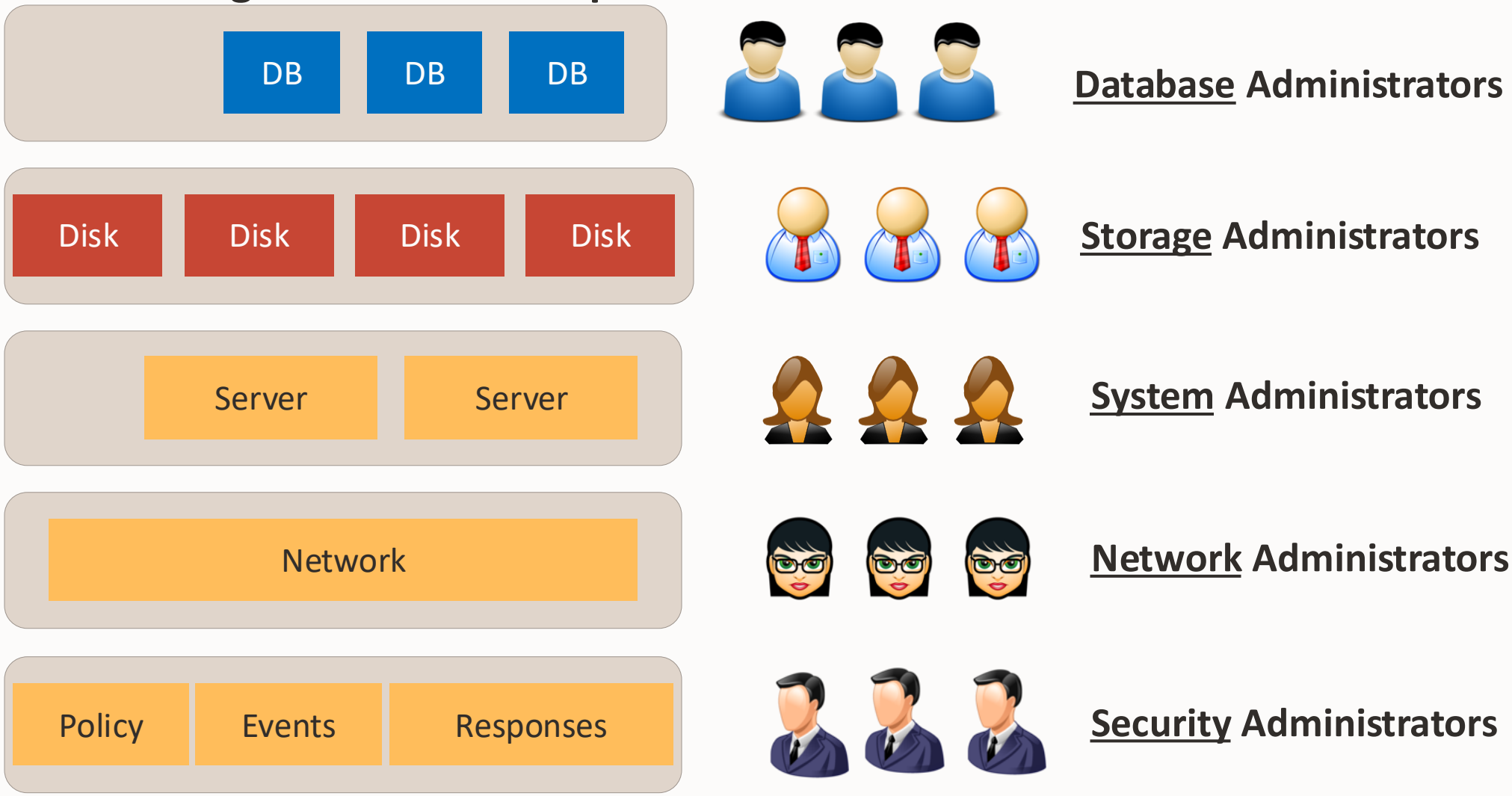
The Starting Point: A Set of Specialist Teams



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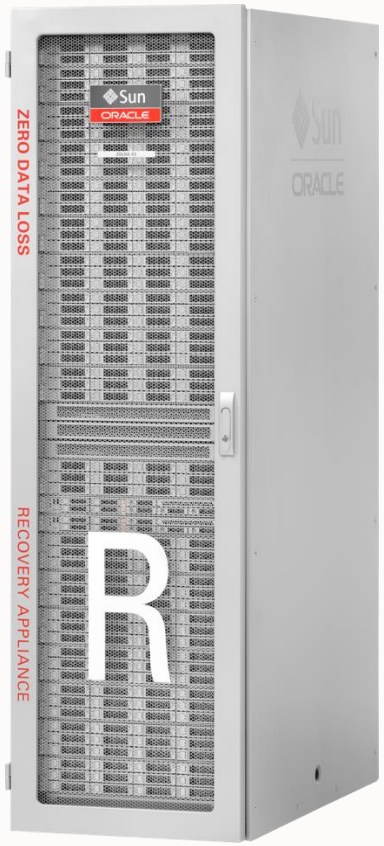
Option 1: Multiple Specialist Teams (status quo[1])



Database Administrators
Storage Administrators

System Administrators

Network Administrators

Security Administrators

[1]- *Each team is assigned a specific ZDLRA set of responsibilities.*

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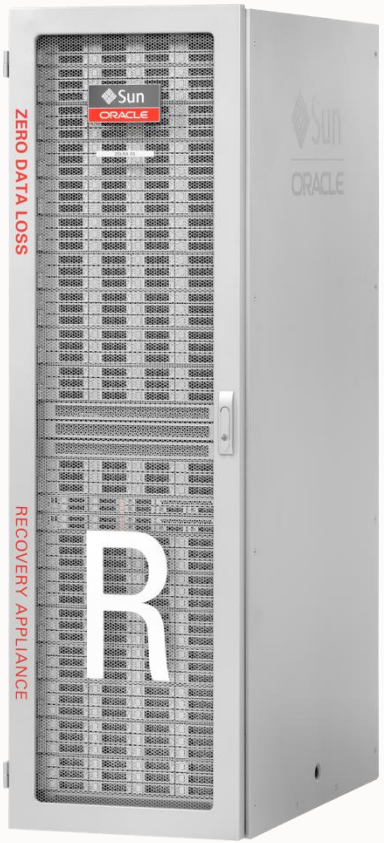
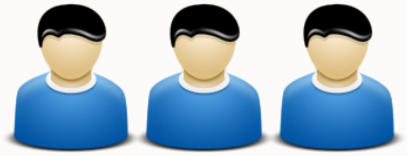
Option 2: Extended RA Team





Database Administrators
Storage Administrators
Primary stakeholders [1]

[1]-*Perfrom main ZDLRA monitoring & administration activities.*

System Administrators

Network Administrators

Security Administrators
Secondary stakeholders [2]

[2]-*Perfrom additional tasks required by the main stakeholders.*

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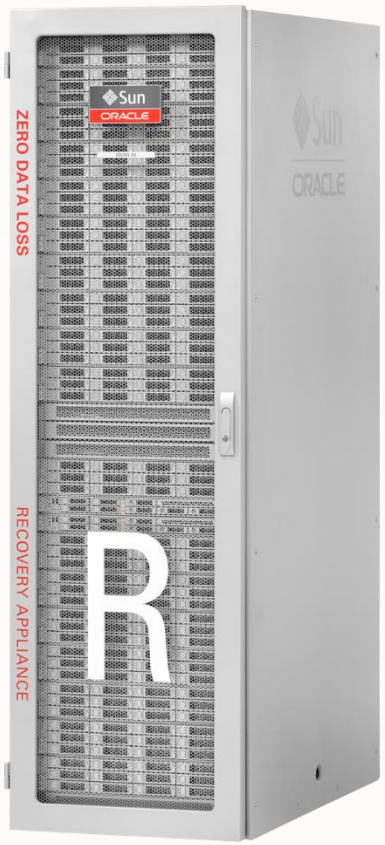
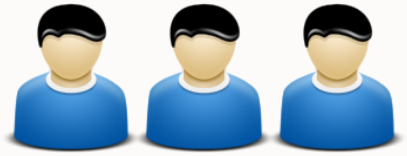
Option 3: RA Machine Administrator





Database Administrators
Storage Administrators
Centralized stakeholders [1]

[1]-Responsible for all ZDLRA activities including monitoring, administration and maintenance.

System Administrators

Network Administrators

Security Administrators

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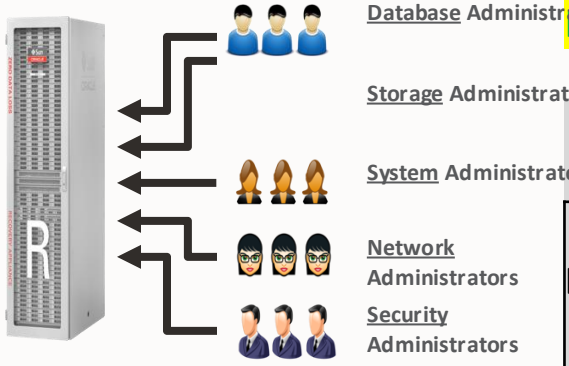
Operational Model 1: Multiple Specialist Teams



RASCI Model - Multiple Specialist Teams

Task	DBA	OS SYSADMIN	NETWORK	STORAGE	CIO	SECURITY
Day-to-day Operation	R	R	R		A	C
Testing	R	R	R		A	C/I
Monitoring	R	R	R		A	C/I
Configuration Management	R	R	R		A	C/I
Patching						
Storage Cells	R				A	C/I
InfiniBand	C		R		A	C/I
Cisco Public Network	C		R		A	C/I
Db Compute Nodes OS	C	R			A	C/I
Database	R				A	C/I
Backing Up RA	R				A	C/I
Upgrading SW		R	R		A	C/I
Replacing HW		R	R		A	C/I
Metering and Charging						

RACI Legend:

- **R** = Responsible
- **A** = Accountable
- **S** = Supportive
- **C** = Consulted
- **I** = Informed

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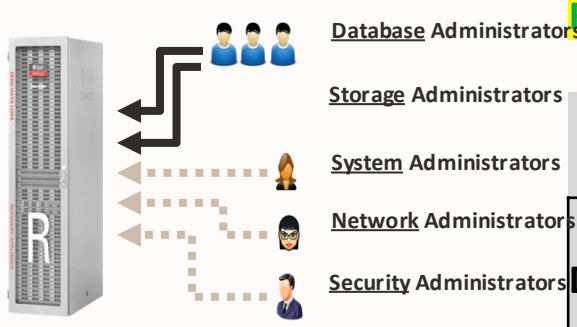
Operational Model 2: Extended RA Team (ERMA)



RASCI Model – Extended RA Team

Task	DBA	OS SYSADMIN	NETWORK	STORAGE	CIO	SECURITY
Day-to-day Operation	R	S	S		A	C
Testing	R	S	S		A	C/I
Monitoring	R				A	C/I
Configuration Management	R				A	C/I
Patching						
Storage Cells	R				A	C/I
InfiniBand	R		S		A	C/I
Cisco Public Network	R		S		A	C/I
Db Compute Nodes OS	R	S			A	C/I
Database	R				A	C/I
Backing Up RA	R				A	C/I
Upgrading SW	R	S	S		A	C/I
Replacing HW	R	S	S		A	C/I
Metering and Charging						

RACI Legend:

- **R** = Responsible
- **A** = Accountable
- **S** = Supportive
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- **I** = Informed

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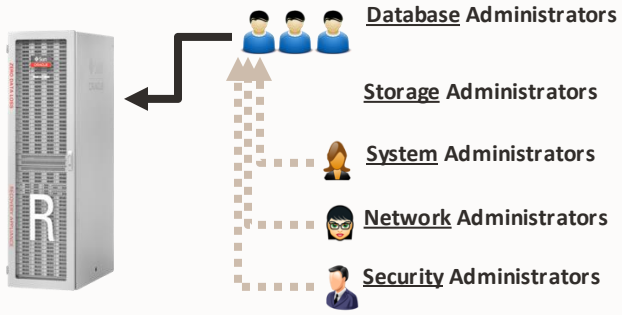
Operational Model 3: RA Machine Administrator (RAMA)



RASCI Model - RA MACHINE ADMINISTRATOR

Task	DBA	OS SYSADMIN	NETWORK	STORAGE	CIO	SECURITY
Day-to-day Operation	R				A	C
Testing	R				A	C/I
Monitoring	R				A	C/I
Configuration Management	R		C		A	C/I
Patching						
Storage Cells	R				A	C/I
InfiniBand	R		C/I		A	C/I
Cisco Public Network	R		C/I		A	C/I
Db Compute Nodes OS	R				A	C/I
Database	R				A	C/I
Backing Up RA	R				A	C/I
Upgrading SW	R				A	C/I
Replacing HW	R				A	C/I
Metering and Charging						

RACI Legend:

- **R** = Responsible
- **A** = Accountable
- **S** = Supportive
- **C** = Consulted
- **I** = Informed

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Summary of Staffing Models

All three models will work.

You decide what is best in your organization.

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OpenWorld Presentations & Resources for Recovery Appliance

OOW 2019:

- Zero Data Loss Recovery Appliance: Expanding Integration with Oracle Cloud
- Zero Data Loss Recovery Appliance: Latest Practices from Oracle Development

OOW 2018:

- Zero Data Loss Recovery Appliance: Leveraging Integration with Oracle Cloud
- Zero Data Loss Recovery Appliance: Insider's Guide to Architecture and Best Practices
- Oracle Recovery Manager: Latest Generation Features for On-Premises and the Cloud

ZDLRA MAA Best Practices:

- https://tinyurl.com/zdlramaa

ZDLRA Documentation:

- https://docs.oracle.com/en/engineered-systems/zero-data-loss-recovery-appliance

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