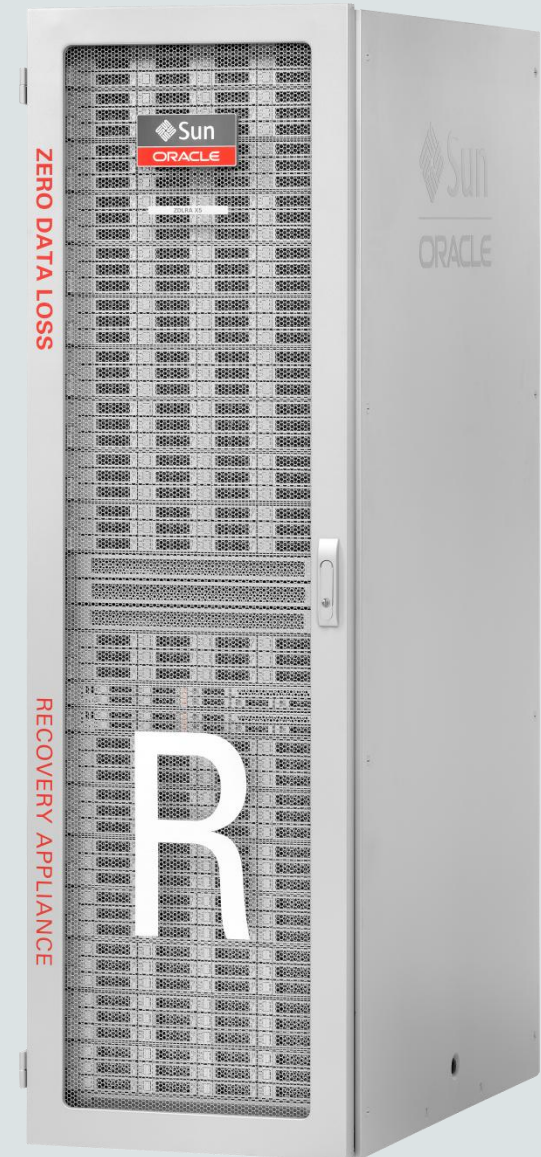# Zero Data Loss Recovery Appliance

Restore Performance Proof of Concept

Oracle Maximum Availability Architecture (MAA)
July 2016

ZERO DATA LOSS

RECOVERY APPLIANCE

R

Database Restore Challenges

- Database restore times are unpredictable and unacceptable when using legacy storage arrays
  - Customers complain about NOT meeting their restore and recovery SLAs
  - Restore times can range from 4 hours to 2+ days for a 30 TB database
  - Restore times can significantly vary when restoring from 1 hour, 1 day, 10 day, or 30 day old backup
  - Restoring a database to an older point in time may require applying various incrementals or a lot of random IOPS if using Copy-on-Write technologies.
- In contrast, Recovery Appliance was built to **scale and perform** for consistent database backup and restore performance

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Example: Recovery Appliance Large Scale Performance POC

Exceeded Customer Expectations for all Test Cases – No Tuning Required

- TEST CASE #1 – Complete Initial Level 0 (Full) Backups of 200 databases within 24 hours
  - Passed: Completed in 6 hours and 17 minutes, 4X faster than required time.

- TEST CASE #2 – Copy Full Backup of 200 databases to tape within 7 days
  - Passed: Backup to tape completed in 2 days and 3 hours, 3X faster than required time.

- TEST CASE #3 – Achieve less than 5 seconds Recovery Point Objective (RPO) on 160 databases via Real-Time Redo
  - Passed: RPO or unprotected data window was consistently < 1 second for all 160x 11.2.0.4 databases.

- TEST CASE #4 – Complete Level 1 (Incremental) Backups of 200 databases within 8 hours
  - Passed: All incremental backups completed and ingested by the Recovery Appliance in 2.5 hours, 3X faster than required time.

- TEST CASE #5 - Restore 2 databases within 8 hours, while Test Cases #3 and 4 are run concurrently
  - Passed: Two databases (11.2.0.4 & 11.1.0.7) were restored in 2 hours, 4X faster than required time.

- RPO was consistently < 1 second for 159x 11.2.0.4 databases via real-time redo transport
  - Ongoing incremental backups completed in 2 hours for 198x databases, 4X faster than required time.

For more test details, refer to the paper linked at: oracle.com/goto/maa -> Zero Data Loss Recovery Appliance

Test Environment for Restore Performance Proof of Concept

- Recovery Appliance X5 configured with 2 Compute Servers and 9 Storage Servers running RA 12.1.1.1.7 software release.

- Exadata X3-2 configured with 4 DB Servers and 16 Storage Servers running a mixture of Oracle 11.2.0.4 and 12.1.0.2 databases – total of 35 databases.
  - Databases range in size from ~1TB to 30TB

- Exadata X3-2 system connected to Recovery Appliance X5 system using 10GigE Network configured with link aggregation (802.3ad aka LACP), providing maximum bandwidth of 40 Gbps or ~12 TB/hour.

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Database Restore Command

- Standard RMAN restore and recovery script with Recovery Appliance:

```
$ rman target sys/<password>@<DB> catalog /@<zdlra_credential_alias>

RMAN> run {
        set until time <date>;
        restore database;
        recover database;
        alter database open resetlogs;
      }
```

- For recovering to final transaction test case, "set until SCN" was used instead of "set until time" using final_change# SCN from the Recovery Appliance catalog:

  - `SQL> select final_change# from rc_database where name = <DB_NAME>`

- For the purpose of this testing, RMAN "restore validate" was used to evaluate how quickly Recovery Appliance processes the restore request and sends the complete database backup to the protected database.

- Restore rate is measured by "Size of the Database" divided by "Restore Elapsed Time"

  – Verified with Recovery Appliance's Restore (Transmit) Rate and Protected Database's Network Ingest Rate.

MAA POC: Database Restore Times Consistently < 3 Hours

Series of Point-in-Time Restore Tests Conducted from Recovery Appliance to Exadata

- Recovery Appliance holds 50 days of database backups for a 30 TB database at the start of testing.

Test#	Restore Date	(Point-in-Time)	Restore Elapsed Time (hrs:mins:secs)	~Average Restore Rate (TB/hr)
1	09-Feb-2016	(50 days old)	2:37:30	11.4
2	19-Feb-2016	(40 days old)	2:39:36	11.2
3	29-Feb-2016	(30 days old)	2:43:59	11.0
4	09-Mar-2016	(20 days old)	2:43:44	11.0
5	19-Mar-2016	(10 days old)	2:53:04	10.4
6	29-Mar-2016	(1 day old)	2:53:01	10.4
7	30-Mar-2016	(zero data loss)	2:48:12	10.7

Note: No other backup or restore operations were run during these tests.

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Resource Usage Summary

- The following graphs are representative of any of the test cases but was specifically taken from the zero data loss restore test case:

| 30-Mar-2016 (zero data loss restore)	2:48:12 (duration)	~10.7 TB/hr (average rate)

- Graphs derived from Recovery Appliance Enterprise Manager BI Reports

Results Summary

- Network Utilization from Ingest Traffic during Restore
  - Recovery Appliance Ingest (Receive) Rate is low – only real-time redo ingested during restore.
  - No backup traffic during restore.

**Recovery Appliance Network Utilization (Receive Rate - Gb/s)**
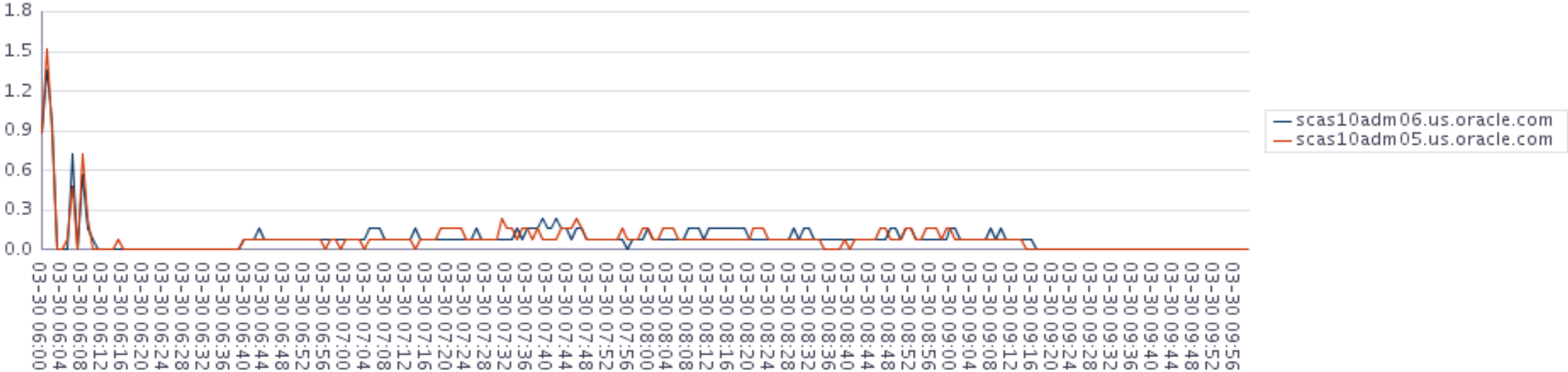
Results Summary (Cont.)

- Network Utilization from Restore Traffic
  - Recovery Appliance Restore (Transmit) Rate to database maxed out at 40 Gbps (i.e. 20 Gbps per Recovery Appliance node shown in graph)
  - 40 Gbps is maximum restore bandwidth in Recovery Appliance (4x 10GE ports in LACP mode)

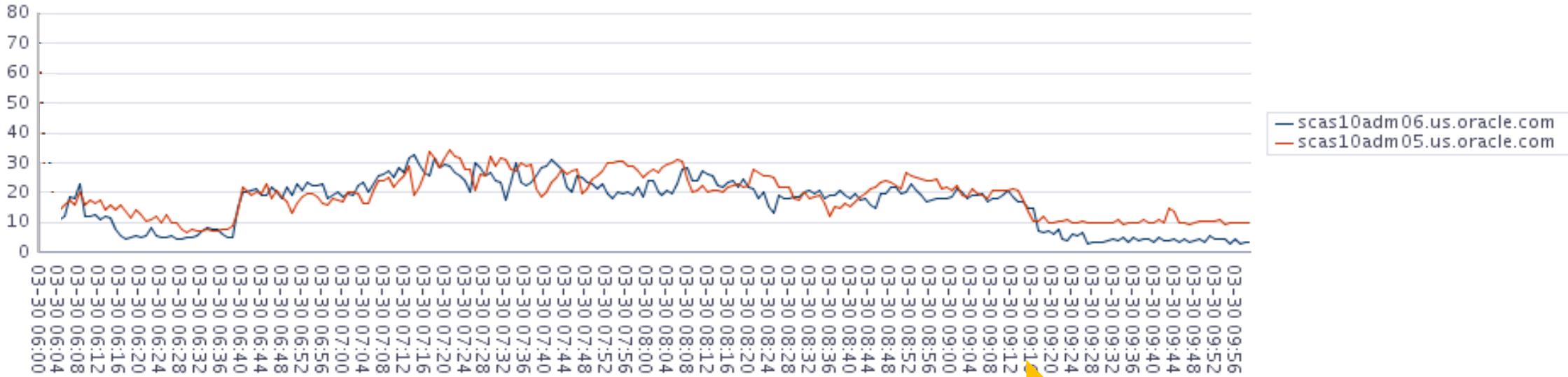**Recovery Appliance Network Utilization (Transmit Rate - Gb/s)**
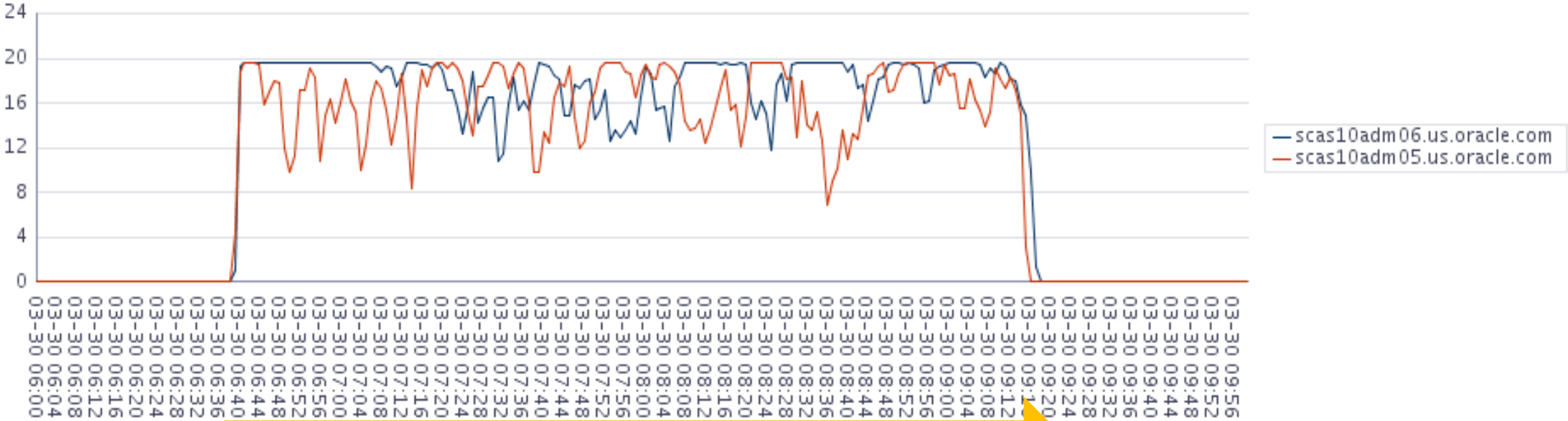
Results Summary (Cont.)

- CPU Utilization during Restore
  - CPU Utilization increased from 10% to 30% with plenty of head room for concurrent RMAN backup requests.
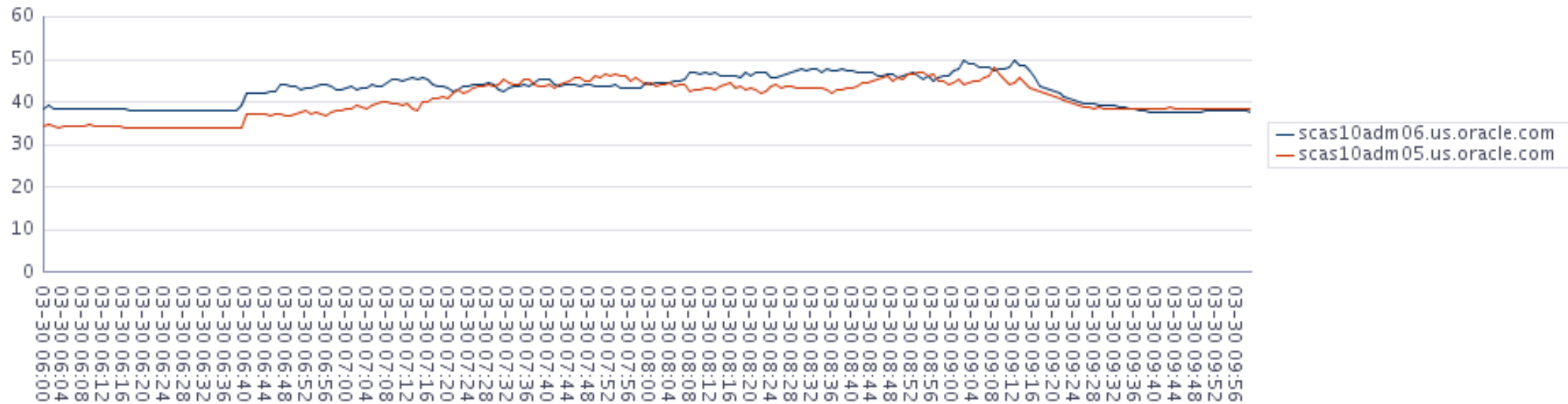 - Restore operations are implicitly given higher priority.

Recovery Appliance CPU Utilization (%)

Restore Interval

Results Summary (Cont.)

- Memory Utilization during Restore
  - Insignificant increase in Memory utilization during restore

Recovery Appliance Memory Utilization (%)

Restore Interval

Overall Proof of Concept Summary

- Recovery Appliance provided consistent restore performance for 30 TB DB across a series of point-in-time test cases. No tuning required.

- Transmit (restore) network rate maximized available network, with all restores completing in less than 3 hours with ~11-12 TB/hr sustained rate.

- Recovery Appliance CPU and memory utilization were not significantly affected during restore operations.

- For information on Recovery Appliance MAA studies, visit: oracle.com/goto/maa -> Zero Data Loss Recovery Appliance

- For general information on Recovery Appliance, visit: oracle.com/recoveryappliance

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