

WHITE PAPER

# Hitachi Unified Compute Platform for Oracle Real Application Clusters Database 12c using Hitachi Virtual Storage Platform G200

Reference Architecture Guide

By Amol Bhoite

August 2017

# Feedback

Hitachi Data Systems welcomes your feedback. Please share your thoughts by sending an email message to [SolutionLab@hds.com](mailto:SolutionLab@hds.com). To assist the routing of this message, use the paper number in the subject and the title of this white paper in the text.

## Revision History

Revision	Changes	Date
AS-612-00	Initial release	August, 2017

# Table of Contents

- Solution Overview ..... 1**
  - Business Benefits ..... 2
  - High Level Infrastructure..... 2
- Key Solution Components ..... 4**
  - Hitachi Virtual Storage Platform Gx00 Models ..... 5
  - QuantaGrid D51B-2U ..... 5
  - Hitachi Dynamic Link Manager Advanced..... 5
  - Brocade Switches..... 6
  - Cisco Switches ..... 6
  - Red Hat Enterprise Linux..... 6
  - Oracle Database With the Real Application Clusters Option ..... 6
  - Hitachi Infrastructure Analytics Advisor..... 7
  - Hitachi Storage Advisor ..... 7
- Solution Design ..... 7**
  - Storage Architecture..... 7
  - Server and Application Architecture ..... 11
  - SAN Architecture ..... 12
  - Network Architecture..... 12
  - Solution Execution..... 14
- Engineering Validation ..... 20**
  - Test Methodology..... 20
  - Test Results ..... 21

# Hitachi Unified Compute Platform for Oracle Real Application Clusters Database 12c using Hitachi Virtual Storage Platform G200

## Reference Architecture Guide

Use this reference architecture guide to see how Hitachi Unified Compute platform for Oracle Real Application Cluster provides a high performance, integrated converged solution for Oracle. The environment uses Hitachi Virtual Storage Platform G200 (VSP G200) and QuantaGrid D51B-2U Servers with Intel Xeon E5-2620 v4 processors. With this, design an Oracle converged infrastructure to meet your requirements and budget.

Hitachi Unified Compute Platform for Oracle Database is engineered, pre-tested, and qualified to provide predictable performance and the highest reliability in demanding, dynamic Oracle environments. This solution is validated to ensure consistent, predictable results.

This proven solution to optimize your Oracle database environment integrates servers, storage systems, and networks. The environment provides reliability, high availability, scalability, and performance while processing small-scale to large-scale on-line transaction processing (OLTP) and online analytical processing (OLAP) workloads. The dedicated servers run Oracle Database 12c R1 with the Oracle Real Application Cluster (RAC) option. The operating system is Red Hat Enterprise Linux 7.3. This reference architecture document is for you if you are in one of the following roles:

- Database administrator
- Storage administrator
- Database performance analyzer
- IT professional with the responsibility of planning and deploying an Oracle Database solution

To use this reference architecture guide, you need familiarity with the following:

- Hitachi Virtual Storage Platform G200
- QuantaGrid D51B-2U servers
- Server Storage area networks
- Oracle RAC Database 12c Release 1
- Oracle Automatic Storage Management (Oracle ASM)
- Red Hat Enterprise Linux
- Hitachi Dynamic Link Manager v8.5 (HDLM)

---

Note — Testing of this configuration was in a lab environment. Many things affect production environments beyond prediction or duplication in a lab environment. Follow the recommended practice of conducting proof-of-concept testing for acceptable results in a non-production, isolated test environment that otherwise matches your production environment before your production implementation of this solution.

---

## Solution Overview

This reference architecture implements Hitachi Unified Compute platform for Oracle Real Application Cluster on two nodes using Hitachi Virtual Storage Platform G200. This environment addresses the high availability, performance, and scalability requirements for OLTP and OLAP workloads. Tailor your implementation of this solution to meet your specific needs.

To keep up with the growth of Oracle databases, companies have rushed to add storage and servers without considering how existing storage resources might be better utilized. This often requires the addition of more administrators and software layers to manage the expansion of resources.

Without a holistic strategy for optimizing the Oracle environment, unsystematic growth and its associated uncontrolled costs can create an increasingly expensive cycle. Through a combination of our solutions and expertise in Oracle environments, Hitachi Data Systems can help companies control capital and operational costs, while increasing performance, data protection, and flexibility. We can help ensure the right information is available in the right place, at the right time – and for the right cost.

## Business Benefits

- Predictable, repeatable, reliable results with pre-validated reference architectures
- Faster speed to deploy and increased ability to meet changing needs, with a single source for components and prescriptive guides
- Extreme reliability of Hitachi Storage
- Non-disruptive, high-speed data replication that enables immediate use of data in decision support, software testing and development, and data protection operations
- Logical snapshot data replication, which allows immediate use without impacting host service or performance levels
- Simplified and centralized storage management with Hitachi Command Suite

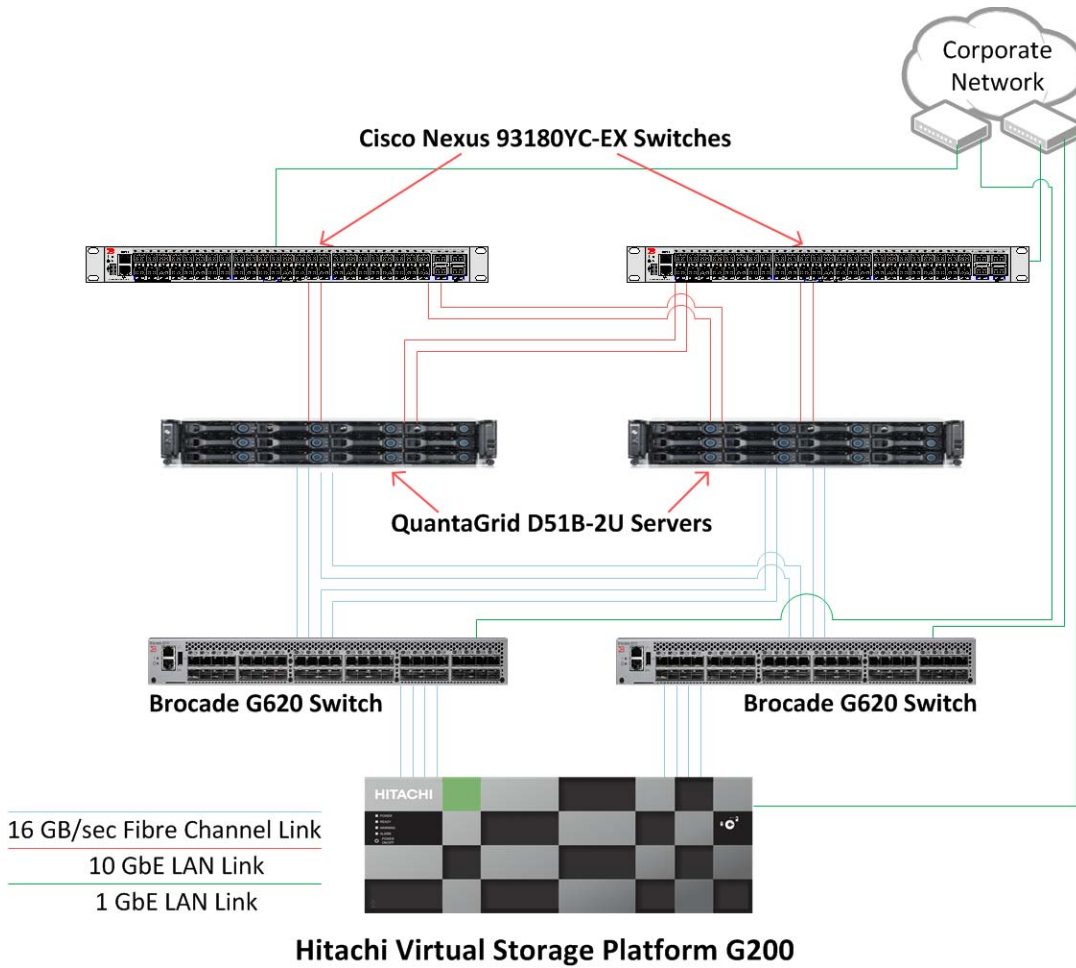
## High Level Infrastructure

Figure 1 shows the high-level infrastructure for this solution.

The configuration of Virtual Storage Platform G200 and QuantaGrid D51B-2U Servers has the following:

- Fully redundant hardware
- Dual Fabric connectivity between hosts and storage

Figure 1



To avoid any performance impact to the production database, Hitachi Data Systems recommends using a configuration with the following:

- A dedicated storage system for the production database
- A dedicated storage system for storing backup data, if needed

## Key Solution Components

The key solution components for this solution are listed in Table 1 and Table 2.

**TABLE 1. HARDWARE COMPONENTS**

Hardware	Detailed Description	Version	Quantity
Hitachi Virtual Storage Platform G200	<ul style="list-style-type: none"> <li>■ Two Controllers</li> <li>■ 8 × 16 Gbps Fibre Channel Ports</li> <li>■ 8 × 12 Gbps Backend SAS Ports</li> <li>■ 64 GB cache memory</li> <li>■ 20 × 1.92 TB SSDs Plus 1 spare</li> </ul>	83-04-23-20/00	1
QuantaGrid D51B-2U Servers	<ul style="list-style-type: none"> <li>■ 2 × Intel Xeon Processor E5-2620 v4 (2.10 GHz, 85W)</li> <li>■ 384 GB (16 GB × 24) DDR4 2133 ECC Registered Memory</li> <li>■ HDD 2 × 1.2 TB 10K 2.5" SAS 12 Gbps</li> <li>■ RAID 10 Controller card</li> </ul>	3.45.00	2
	<ul style="list-style-type: none"> <li>■ Dual Port 10GbE Intel® 82599ES PCI-E x8, Gen3 NIC card</li> </ul>		4
	<ul style="list-style-type: none"> <li>■ Dual Port 10GbE SFP, PCI-e x8, OCP LAN mezzanine NIC card</li> </ul>		2
	<ul style="list-style-type: none"> <li>■ Qlogic QLE2672-SP.P -16 Gb dual port Fibre Channel HBA,</li> <li>■ PCIe x8 Gen3</li> </ul>	3.29	4
Brocade Fibre Channel Switches	<ul style="list-style-type: none"> <li>■ G620</li> <li>■ 16 Gbps Fibre Channel port</li> <li>■ Brocade hot-pluggable SFP+, LC connector</li> </ul>	V8.0.1	2
Cisco Nexus	<ul style="list-style-type: none"> <li>■ 93180YC-EX</li> <li>■ 48 × 10/25G fiber ports</li> <li>■ 6 × 40/100 Gbps Quad SFP (QSFP28) ports</li> </ul>	07.56	2

TABLE 2. SOFTWARE COMPONENTS

Software	Version	Function
Red Hat Enterprise Linux	RHEL 7.3 (Kernel Version - 3.10.0-514.16.1.el7.x86_64)	Operating System
Oracle 12c	12c Release 1(12.1.0.2.0)	Database Software
Oracle Real Application Cluster	12c Release 1(12.1.0.2.0)	Cluster Software
Oracle Automatic Storage Management	12c Release 1(12.1.0.2.0)	Volume Management and File System Software
Hitachi Dynamic Link Manager	8.5.1	Multipath Software
Hitachi Storage Navigator	Microcode dependent	Storage management Software
Hitachi Storage Advisor (HSA)	2.1.0	Storage orchestration software
Hitachi Infrastructure Analytics Advisor (HIAA)	2.1	Analytics Software

## Hitachi Virtual Storage Platform Gx00 Models

[Hitachi Virtual Storage Platform Gx00 models](#) are based on industry-leading enterprise storage technology. With flash-optimized performance, these systems provide advanced capabilities previously available only in high-end storage arrays. With the Virtual Storage Platform Gx00 models, you can build a high performance, software-defined infrastructure to transform data into valuable information.

Hitachi Storage Virtualization Operating System provides storage virtualization, high availability, superior performance, and advanced data protection for all Virtual Storage Platform Gx00 models. This proven, mature software provides common features to consolidate assets, reclaim space, extend life, and reduce migration effort.

This solution uses Virtual Storage Platform G200, which supports [Oracle Real Application Clusters](#).

## QuantaGrid D51B-2U

[QuantaGrid D51B-2U](#) is a general-purpose rackmount server designed for optimal performance and power efficiency. This allows owners to upgrade computing performance without overextending power consumption and offers non-latency support to virtualization environments that require the maximum memory capacity. QuantaGrid D51B-2U provides flexible I/O scalability for today's diverse data center application requirements.

## Hitachi Dynamic Link Manager Advanced

[Hitachi Dynamic Link Manager Advanced](#) combines all the capabilities of Hitachi Dynamic Link Manager and Hitachi Global Link Manager into a comprehensive multipathing solution. It includes capabilities such as the following:

- Path failover and failback
- Automatic load balancing to provide higher data availability and accessibility

This solution uses the **extended round-robin load balancing policy** configuration in Hitachi Dynamic Link Manager Advanced. This policy determines which path to allocate based on whether the data of the I/O to be issued is sequential with the immediately preceding data issued to the I/O.



If the data is sequential with the preceding data, the extended round-robin load balancing policy normally issues the same path for distributing the I/O that was issued to the immediately preceding I/O. However, after issuing a specified number of I/Os to a path, this policy then switches processing to the next path.

If the data is not sequential with the preceding data, the extended round-robin load balancing policy issues a path for distributing the I/O in order from among all the connected paths. Balancing the load across all available paths optimizes IOPS and response time.

## Brocade Switches

Brocade Switches Brocade and Hitachi Data Systems partner to deliver storage networking and data center solutions. These solutions reduce complexity and cost, as well as enable virtualization and cloud computing to increase business agility.

The solution uses the following Brocade products:

- Brocade G620, 48 port Fibre Channel

## Cisco Switches

The Cisco Nexus Switch product line provides a series of solutions that attempt to make it easier to connect and manage disparate data center resources with software-defined networking (SDN). Leveraging the Cisco Unified Fabric, which unifies storage, data and networking (Ethernet/IP) services, the Nexus Switches create an open, programmable network foundation built to support a virtualized data center environment.

The solution uses the following Cisco products:

- Nexus 93180YC-EX, 48 × 10/25 GbE switch

## Red Hat Enterprise Linux

[Red Hat Enterprise Linux](#) delivers military-grade security, 99.999% uptime, support for business-critical workloads, and so much more. Ultimately, the platform helps you reallocate resources from maintaining the status quo to tackling new challenges.

## Oracle Database With the Real Application Clusters Option

[Oracle Database](#) has a multi-tenant architecture so you can consolidate many databases quickly and manage them as a cloud service. Oracle Database also includes in-memory data processing capabilities for analytical performance. Additional database innovations deliver efficiency, performance, security, and availability. Oracle Database comes in two editions: Enterprise Edition and Standard Edition 2.

[Oracle Real Application Clusters](#) (Oracle RAC) is a clustered version of Oracle Database. It is based on a comprehensive high-availability stack that can be used as the foundation of a database cloud system, as well as a shared infrastructure. This ensures high availability, scalability, and agility for any application.

[Oracle Automatic Storage Management](#) (Oracle ASM) is a volume manager and a file system for Oracle database files. This supports single-instance Oracle Database and Oracle Real Application Clusters configurations. Oracle ASM is the recommended storage management solution that provides an alternative to conventional volume managers, file systems, and raw devices.

## Hitachi Infrastructure Analytics Advisor

With [Hitachi Infrastructure Analytics Advisor](#), you can define and monitor storage service level objectives (SLOs) for resource performance. You can identify and analyze historical performance trends to optimize storage system performance and plan for capacity growth.

Use Hitachi Infrastructure Analytics Advisor to register resources (storage systems, hosts, servers, and volumes), and set service-level thresholds. You are alerted to threshold violations and possible performance problems (bottlenecks). Using analytics tools, you find which resource has a problem and analyze its cause to help solve the problem. The Infrastructure Analytics Advisor ensures the performance of your storage environment based on real-time SLOs.

## Hitachi Storage Advisor

[Hitachi Storage Advisor](#) is an infrastructure management solution that unifies storage management solutions such as storage provisioning, data protection, and storage management; simplifies the management of large scale data centers by providing smarter software services; and is extensible to provide better programmability and better control.

## Solution Design

This describes the reference architecture environment to implement Hitachi Unified Compute Platform for Oracle with the Real Application Clusters option. The environment uses Hitachi Virtual Storage Platform G200.

The infrastructure configuration includes the following:

- **Oracle RAC Servers** - There are two server nodes configured in an Oracle Real Application Cluster.
- **Storage System** - There are V-VOLs mapped to each port that are presented to the server as LUNs.
- **SAN Connection** - There are SAN connections to connect the Fiber Channel HBA ports to the storage through Brocade G620 switches.

## Storage Architecture

This describes the storage architecture for this solution. It takes into consideration Hitachi Data Systems and Oracle recommended practices for the design and deployment of database storage.

### *Storage Configuration*

This section describes the storage architecture of this reference architecture. It takes into consideration Hitachi Data Systems for Hitachi Virtual Storage Platform and Oracle recommended practices for the design and deployment of database storage.

The high-level storage configuration diagram for this solution is shown in Figure 2.

Figure 2

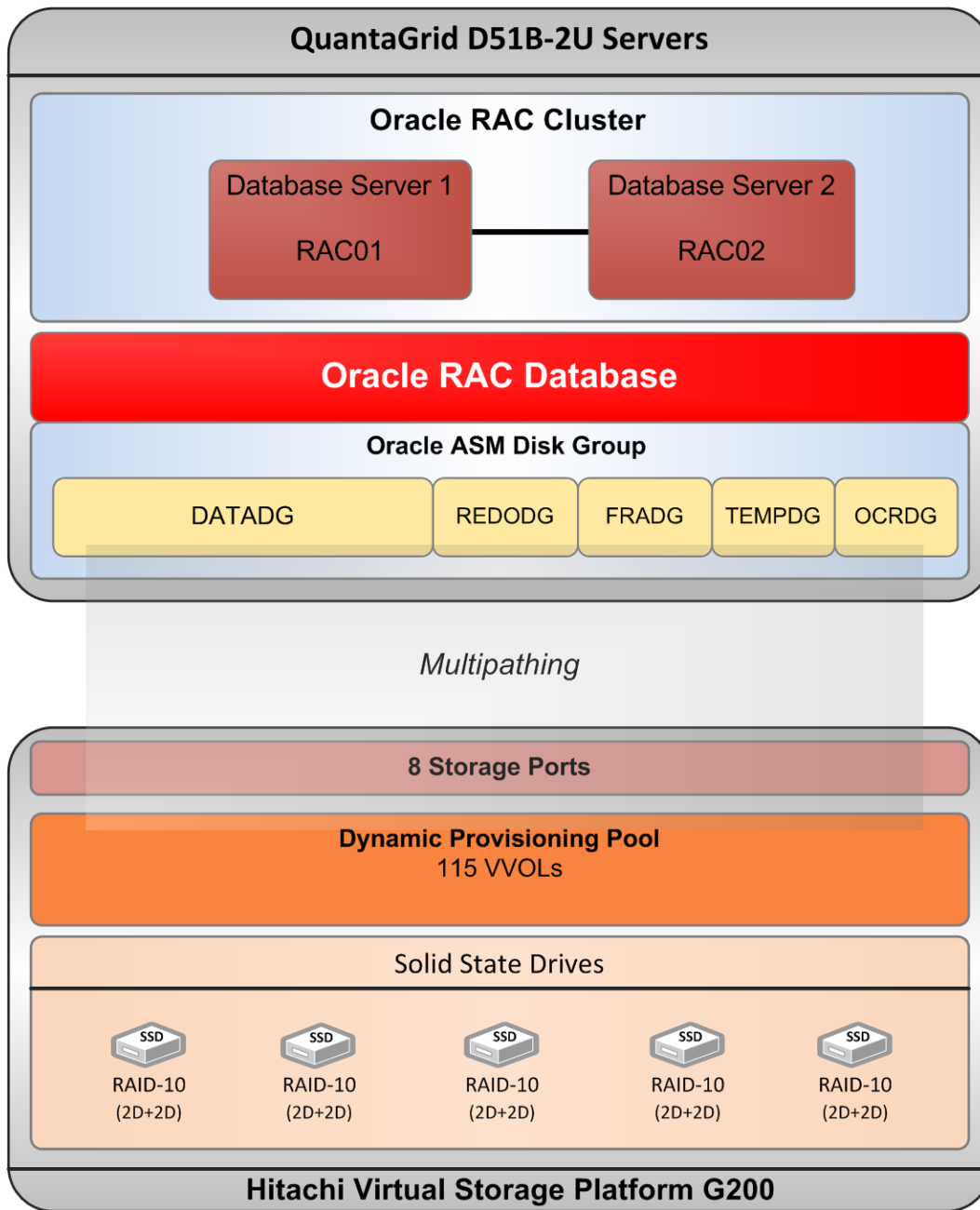


Table 3 shows the storage pool configuration used for this solution.

**TABLE 3. STORAGE POOL CONFIGURATION**

<b>Pool ID</b>	Unified-Compute-Platform-Oracle
<b>Pool Type</b>	Dynamic Provisioning
<b>RAID Group</b>	1-1 – 1-5
<b>RAID Level</b>	RAID-10 (2D+2D)
<b>Drive Type</b>	1.92 TB SSD
<b>Number of Drives</b>	20
<b>Number of Spare Drives</b>	1
<b>Number of LDEVs</b>	20
<b>LDEV size</b>	880 GB
<b>Pool Capacity</b>	17.18 TB

Table 4 shows the logical storage configuration used in this solution.

**TABLE 4. LOGICAL STORAGE CONFIGURATION**

<b>Pool ID</b>	Unified-Compute-Platform-Oracle
<b>Number of VVOLs</b>	115
<b>VVOL Size</b>	64 × 160 GB, 3 × 5 GB, 16 × 40 GB, 16 × 10 GB, 16 × 40 GB
<b>Purpose</b>	<ul style="list-style-type: none"> <li>■ Oracle</li> <li>■ System</li> <li>■ Sysaux</li> <li>■ Undo</li> <li>■ Temp</li> <li>■ Redo Logs</li> <li>■ Parameter and Password file</li> <li>■ Oracle Cluster Registry and Voting Disk</li> </ul>
<b>Storage Port</b>	1A, 2A, 1B, 2B, 3A, 4A, 3B, 4B

## Database Layout

The database layout design uses recommended practices from Hitachi Data Systems for Hitachi Virtual Storage Platform G200 for small random I/O traffic, such as OLTP transactions. The layout also takes into account the Oracle ASM best practices when using Hitachi storage. Base the storage design for database layout needs on the requirements of a specific application implementation. The design can vary greatly from one implementation to another. The components in this solution set have the flexibility for use in various deployment scenarios to provide the right balance between performance and ease of management for a given scenario.

- **Data and Indexes Tablespace** — Assign an ASM diskgroup for the data and index tablespaces.
- **TEMP Tablespace** — Place TEMP tablespace in this configuration in the Data ASM diskgroup.
- **Undo Tablespace** — Create an UNDO tablespace in this configuration within the Oracle Data ASM diskgroup. Assign one UNDO tablespace for each node in the Oracle RAC environment.
- **Online Redo Logs** — Create ASM diskgroup for Oracle online redo logs.
- **Oracle Cluster Registry and Voting Disk** — Create an ASM diskgroup with normal redundancy to contain the OCR and voting disks and to protect against single disk failure to avoid loss of cluster availability. Place each of these files in this configuration in the OCR ASM diskgroups.
- **Size Settings** — Set the database block size to 8 KB.

Table 5 shows the Oracle RAC Database Settings

TABLE 5. ORACLE RAC DATABASE SETTINGS

Environment	Value
RAC configuration	Yes
ASM	Yes - Oracle RAC Database

Table 6 shows the Oracle Environment Parameters.

TABLE 6. ORACLE ENVIRONMENT PARAMETERS

Setting	Value
SGA_TARGET	128 GB
PGA_AGGREGATE_TARGET	32 GB
DB_CACHE_SIZE	32 GB
DB_KEEP_CACHE_SIZE	16 GB
DB_RECYCLE_CACHE_SIZE	16 GB
LOG_BUFFER	512 MB
USE_LARGE_PAGES	TRUE
FILESYSTEMIO_OPTIONS	SETALL
DISK_ASYNC_IO	TRUE

Table 7 shows the details of the disk mappings from the LUNs to the ASM disk groups for Oracle RAC Database tablespaces.

**TABLE 7. LUNs and Oracle ASM Disk Mappings**

ASM Disk Group	ASM Disk	HDLM LUNs	LUN Details	Purpose
OCRDG	OCRDISK1 - OCRDISK3	/dev/sddlmaa - /dev/sddlmac	3 × 5 GB	Oracle Cluster Registry and Voting Disk
REDODG	REDODISK1 - REDODISK16	/dev/sddlmad - /dev/sddlmap /dev/sddlmba - /dev/sddlmbc	16 × 10 GB	Online REDO log group
FRADG	FRADISK1 - FRADISK16	/dev/sddlmbd - /dev/sddlmbp /dev/sddlmbc - /dev/sddlmmc	16 × 40 GB	Flash Recovery Area
TEMPDG	TEMPDISK1 - TEMPDISK16	/dev/sddlmc - /dev/sddlmdp /dev/sddlmda - /dev/sddlmdc	16 × 40 GB	Temp
DATADG	DATADISK1 - DATADISK64	/dev/sddlmd - /dev/sddlmdp /dev/sddlmeb - /dev/sddlmep /dev/sddlmf - /dev/sddlmfp /dev/sddlmg - /dev/sddlmgp /dev/sddlmha - /dev/sddlmhd	64 × 160 GB	Application Data

## Server and Application Architecture

This reference architecture uses two QuantaGrid D51B-2U servers for a two-node Oracle RAC configuration.

This provides the compute power for the Oracle RAC database to handle complex database queries and a large volume of transaction processing in parallel. Table 8 describes the details of the server configuration for this solution.

**TABLE 8. QUANTAGRID D51B-2U SERVER SPECIFICATIONS**

QuantaGrid Server	Server Name	Role	CPU Core	RAM
Server1	oracle-rac-01	Oracle RAC node 1	16	384 GB (16 GB × 24)
Server2	oracle-rac-02	Oracle RAC node 2	16	384 GB (16 GB × 24)

## SAN Architecture

Map the provisioned LDEVs to multiple ports on Hitachi Virtual Storage Platform G200 (VSP G200). These LDEV port assignments provide multiple paths to the storage system from the host for high availability.

- 8 SAN switch connections are being used for VSP G200 host ports.
- 8 SAN switch connections are being used for server HBA ports.

Table 9 show details of the Fibre Channel switch connect configuration on the Hitachi Virtual Storage Platform G200 ports.

**TABLE 9. SAN HBA CONNECTION CONFIGURATION TO VSP G200**

<i>Server</i>	<i>HBA Ports</i>	<i>Storage Host Group</i>	<i>Switch Zone</i>	<i>Storage System</i>	<i>Storage Port</i>	<i>Brocade G620 Switch</i>
Quanta Server 1	HBA1	QUANTA1_HBA1	QUANTA1_HBA1_ASE42_6_1A	VSP G200	1A	183
	HBA2	QUANTA1_HBA2	QUANTA1_HBA2_ASE42_6_2A		2A	184
	HBA3	QUANTA1_HBA3	QUANTA1_HBA3_ASE42_6_1B		1B	183
	HBA4	QUANTA1_HBA4	QUANTA1_HBA4_ASE42_6_2B		2B	184
Quanta Server 2	HBA1	QUANTA2_HBA1	QUANTA2_HBA1_ASE42_6_3A		3A	183
	HBA2	QUANTA2_HBA2	QUANTA2_HBA2_ASE42_6_4A		4A	184
	HBA3	QUANTA2_HBA3	QUANTA2_HBA3_ASE42_6_3B		3B	183
	HBA4	QUANTA2_HBA4	QUANTA2_HBA4_ASE42_6_4B		4B	184

## Network Architecture

This architecture requires the following separate networks:

- **Private Network (also called cluster interconnect)** — This network must be scalable. In addition, it must meet the low latency needs of the network traffic generated by the cache synchronization of Oracle Real Application Clusters and inter-node communication among the nodes in the cluster.
- **Public Network** — This network provides client connections to the applications and Oracle Real Application Clusters.

Hitachi Data Systems recommends using pairs of 10 Gbps NICs for the cluster interconnect network and public network.

Observe these points when configuring private and public networks in your Oracle Real Application Cluster environment:

- For each server in the clusterware configuration, use at least two identical, high-bandwidth, low-latency NICs for the interconnection.
- Use NIC bonding to provide failover and load balancing of interconnections within a server.
- Set all NICs to full duplex mode.
- Use at least two public NICs for client connections to the application and database.
- Use at least two private NICs for the cluster interconnection.

## Physical Network Configuration

Figure 3 shows the network configuration in this solution.

**Figure 3**

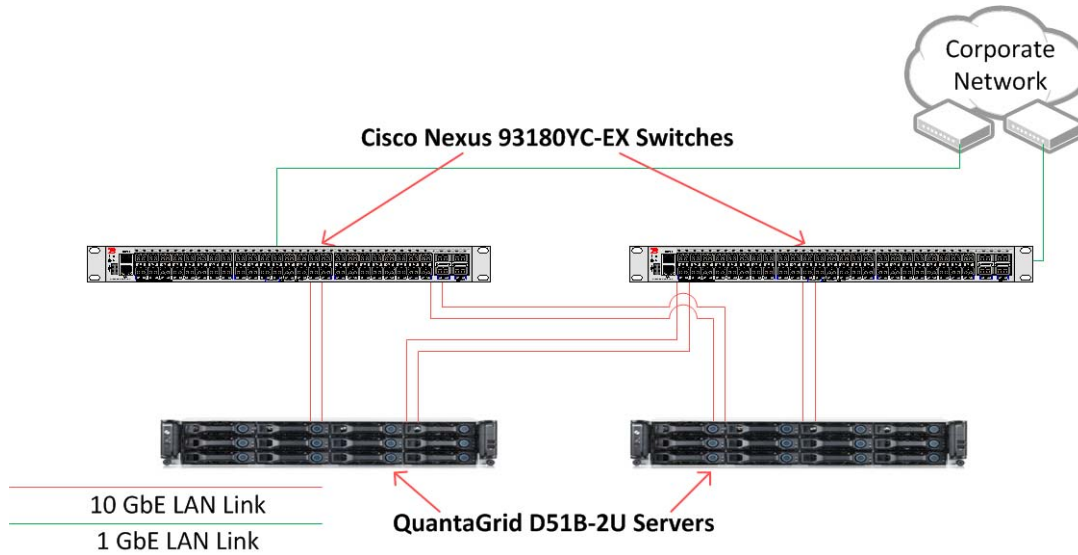


Table 10 shows the network configuration, and Table 11 shows the virtual IP address and SCAN name configuration used when testing the environment. Your values may be different.

Ports should be used on different cards to avoid single point of failure (SPoF).

**TABLE 10. NETWORK CONFIGURATION**

Server	NIC Ports	Subnet	NIC BOND	IP Address	Network	Cisco Nexus 93180YC-EX Switch	
Quanta Server1	NIC - 0	208	Bond0	192.168.208.15	Private	1	41
	NIC - 1					2	
	NIC - 2	242	Bond1	172.17.242.162	Public Oracle	1	42
	NIC - 3					2	
	NIC - 4	242	-	172.17.242.164	Public Management	1	45
Quanta Server1	NIC - 0	208	Bond0	192.168.208.16	Private	1	43
	NIC - 1					2	
	NIC - 2	242	Bond1	172.17.242.163	Public Oracle	1	44
	NIC - 3					2	
	NIC - 4	242	-	172.17.242.165	Public Management	2	46



TABLE 11. VIRTUAL IP AND SCAN NAME CONFIGURATION

Server	Virtual IP	Scan Name - quanta-cluster-scan
Database Server 1 (Quanta 1)	172.17.242.166	172.17.242.157
Database Server 2 (Quanta 2)	172.17.242.167	172.17.242.158
		172.17.242.159

## Solution Execution

During execution of this solution the following are the Hitachi tools used for data analytics and performance monitoring.

- Hitachi Infrastructure Analytics Advisor (HIAA)
- Hitachi Storage Advisor (HSA)

### *Hitachi Infrastructure Analytics Advisor (HIAA)*

Below are the key features of Hitachi Infrastructure Analytics Advisor.

- Unified infrastructure monitoring dashboard
- Advanced reporting
- Storage I/O controls for SLO management
- System and Resource Events
- Granular Data Collection
- End-to-end monitoring

Please refer to the [Hitachi Infrastructure Analytics Advisor User Guide](#) for more details

Below are screenshots of the Hitachi Infrastructure Analytics Advisor (HIAA) Dashboard tab and Analytics tab for reference.

Figure 4 shows the Hitachi Infrastructure Analytics Advisor Dashboard tab.

Figure 4

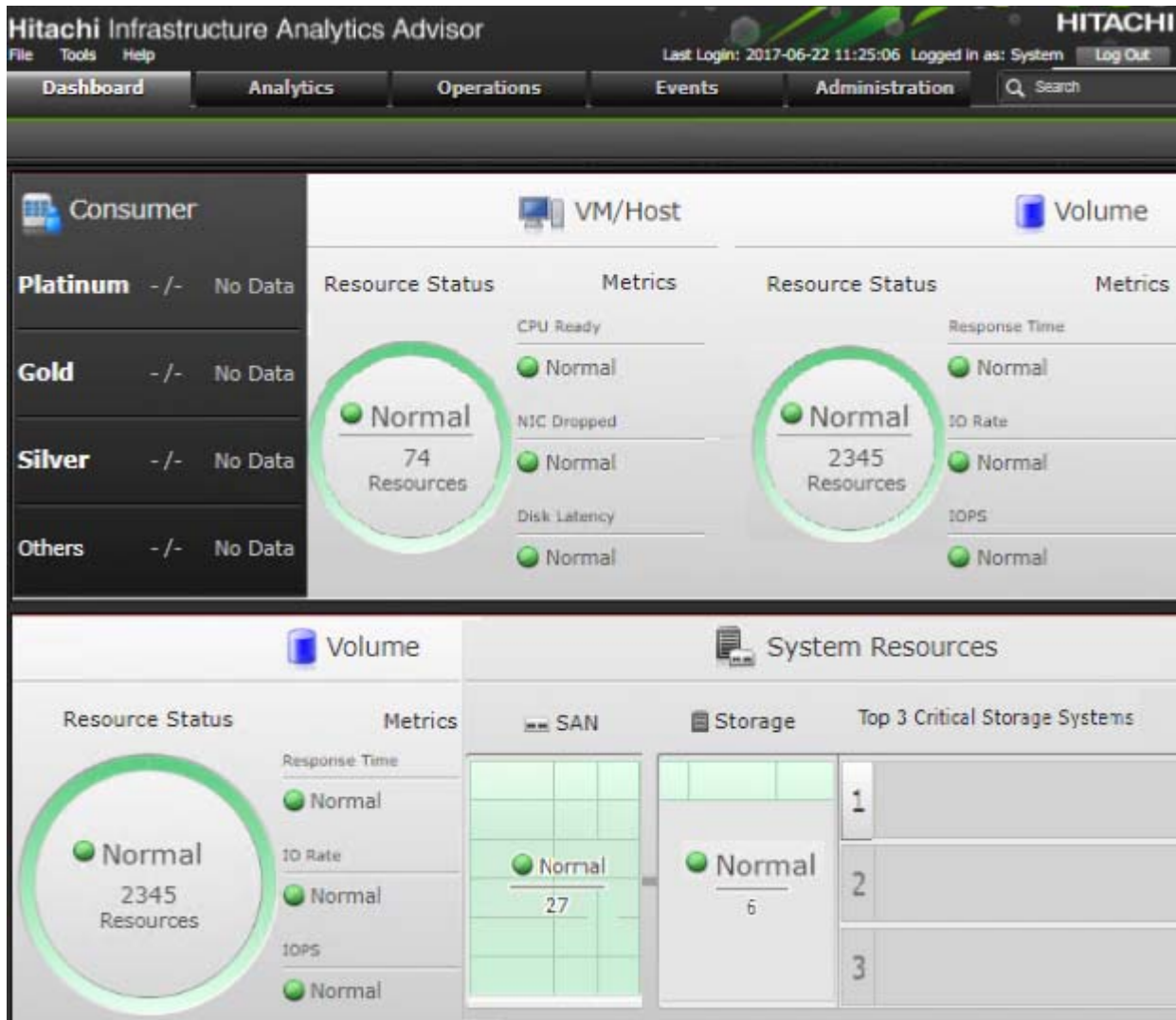
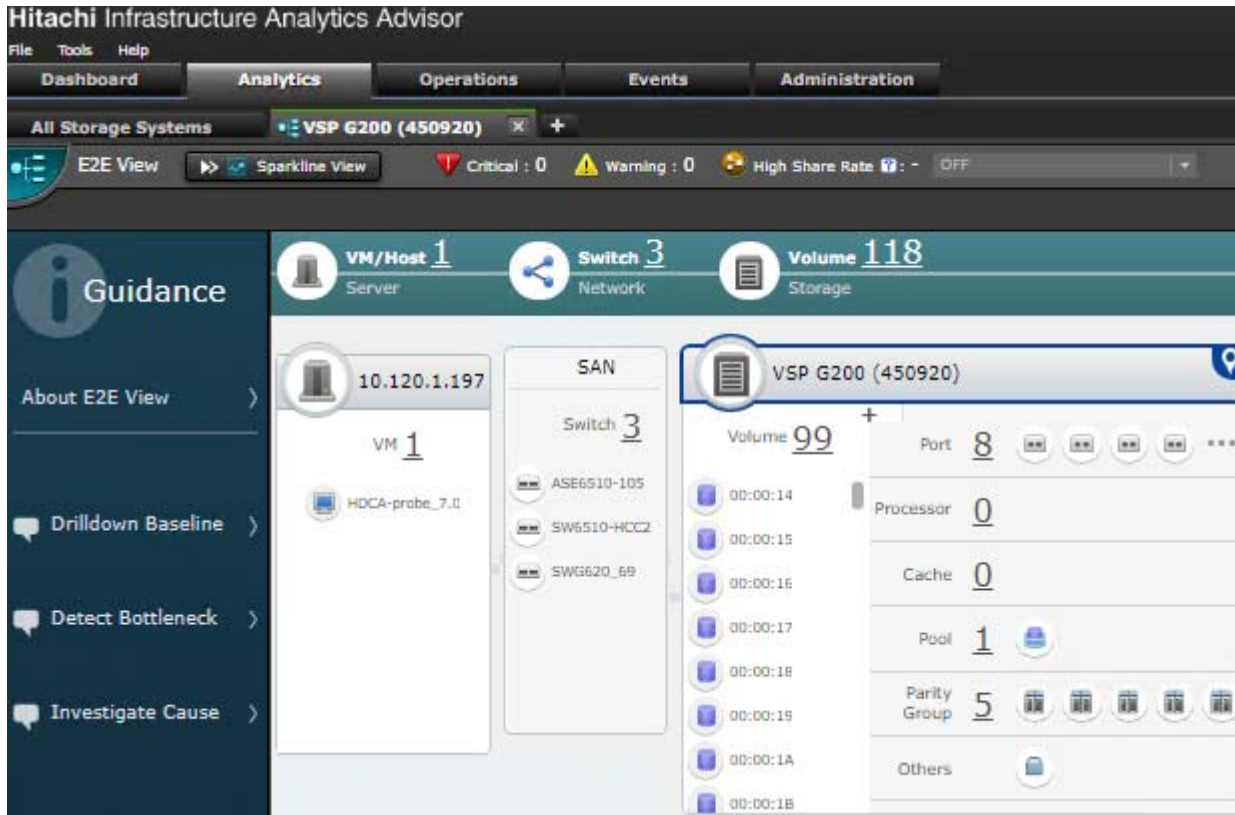


Figure 5 shows the Hitachi Infrastructure Analytics Advisor Analytics tab.

Figure 5



Below are the performance graphs from the Hitachi Infrastructure Analytics Advisor that are captured during Oracle Orion Random Read, Random Write, Sequential Read, and Sequential Write performance tests.

Figure 6 shows a Hitachi Data Center Analytics performance page with Storage IOPS Vs Response Time, a **Random Read** Orion test performance graph.

**Figure 6**

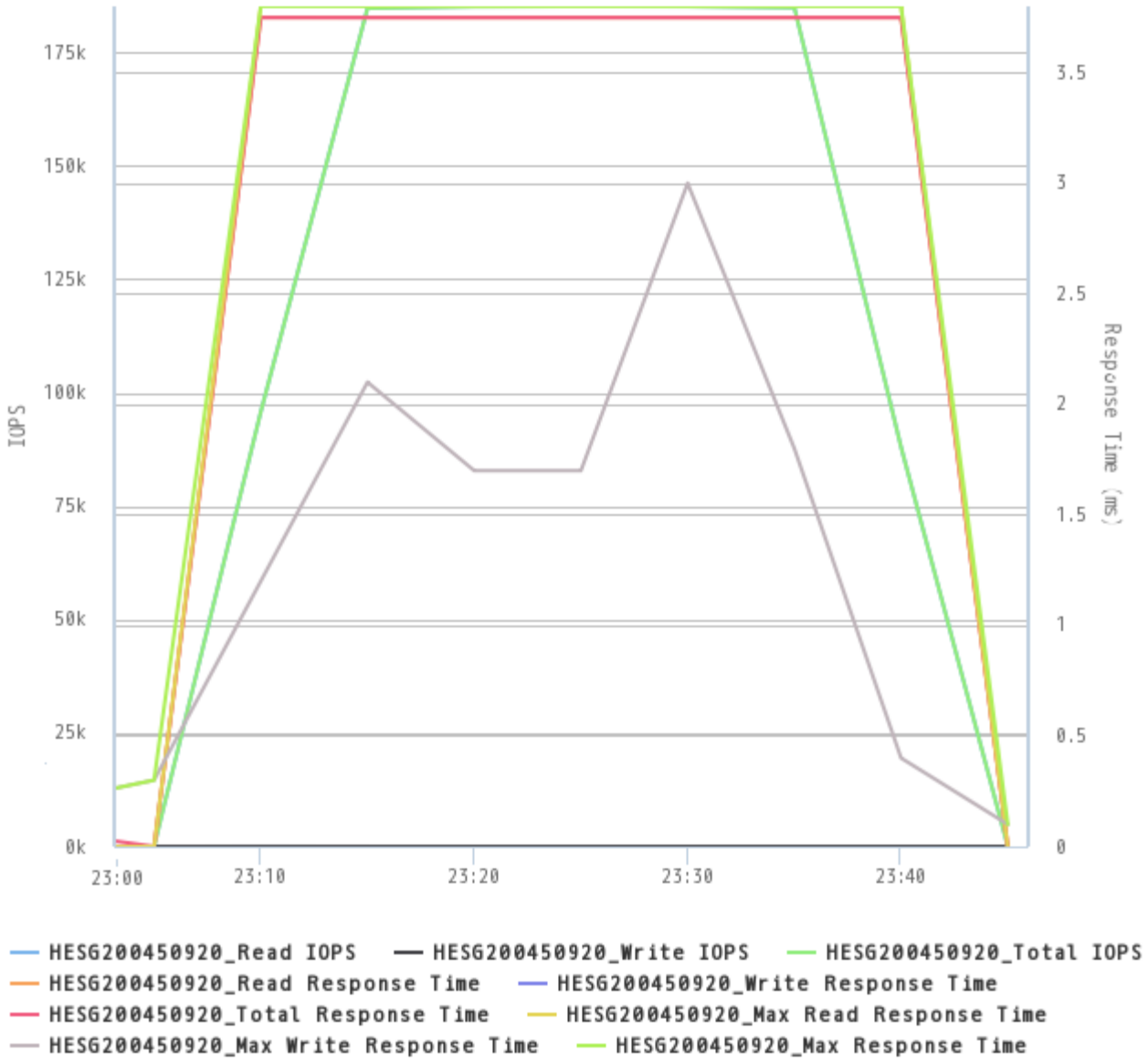


Figure 7 shows Hitachi Data Center Analytics performance page with Storage IOPS Vs Response Time, a **Random Write** Orion test performance graph.

**Figure 7**

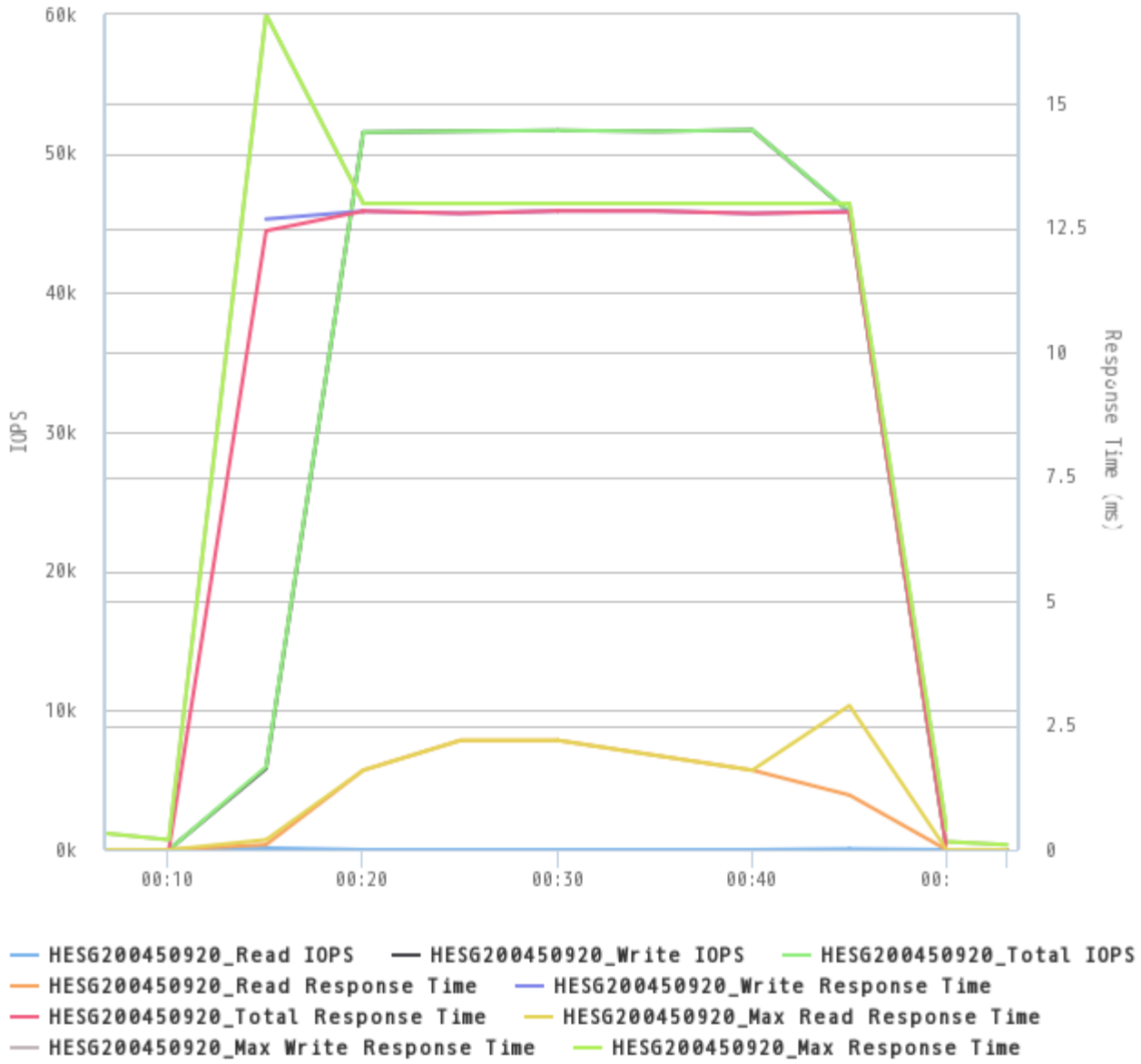


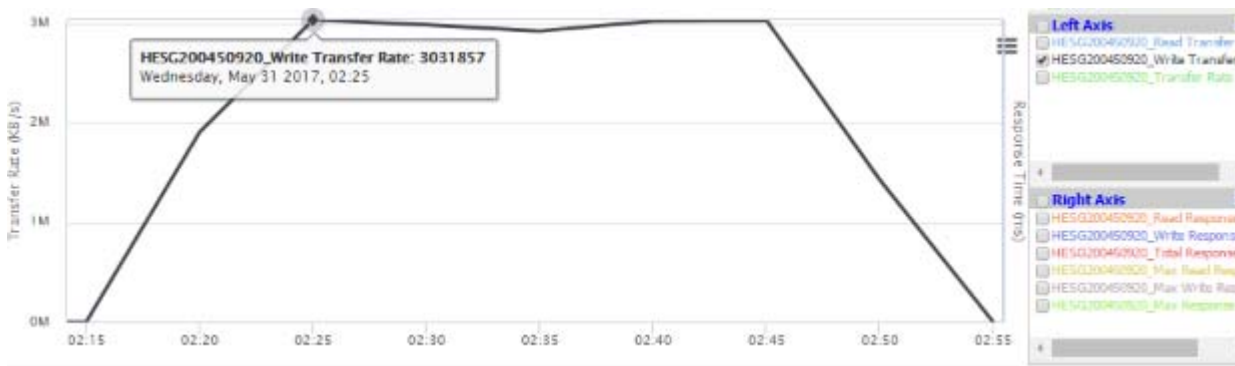
Figure 8 shows Hitachi Data Center Analytics performance page with **Sequential Read** Orion test performance graph.

**Figure 8**



Figure 9 shows Hitachi Data Center Analytics performance page with **Sequential Write** Orion test performance graph.

**Figure 9**



### Hitachi Storage Advisor (HSA)

Hitachi Storage Advisor is a unified software management tool that reduces the complexity of managing storage systems by simplifying the setup, management, and maintenance of storage resources.

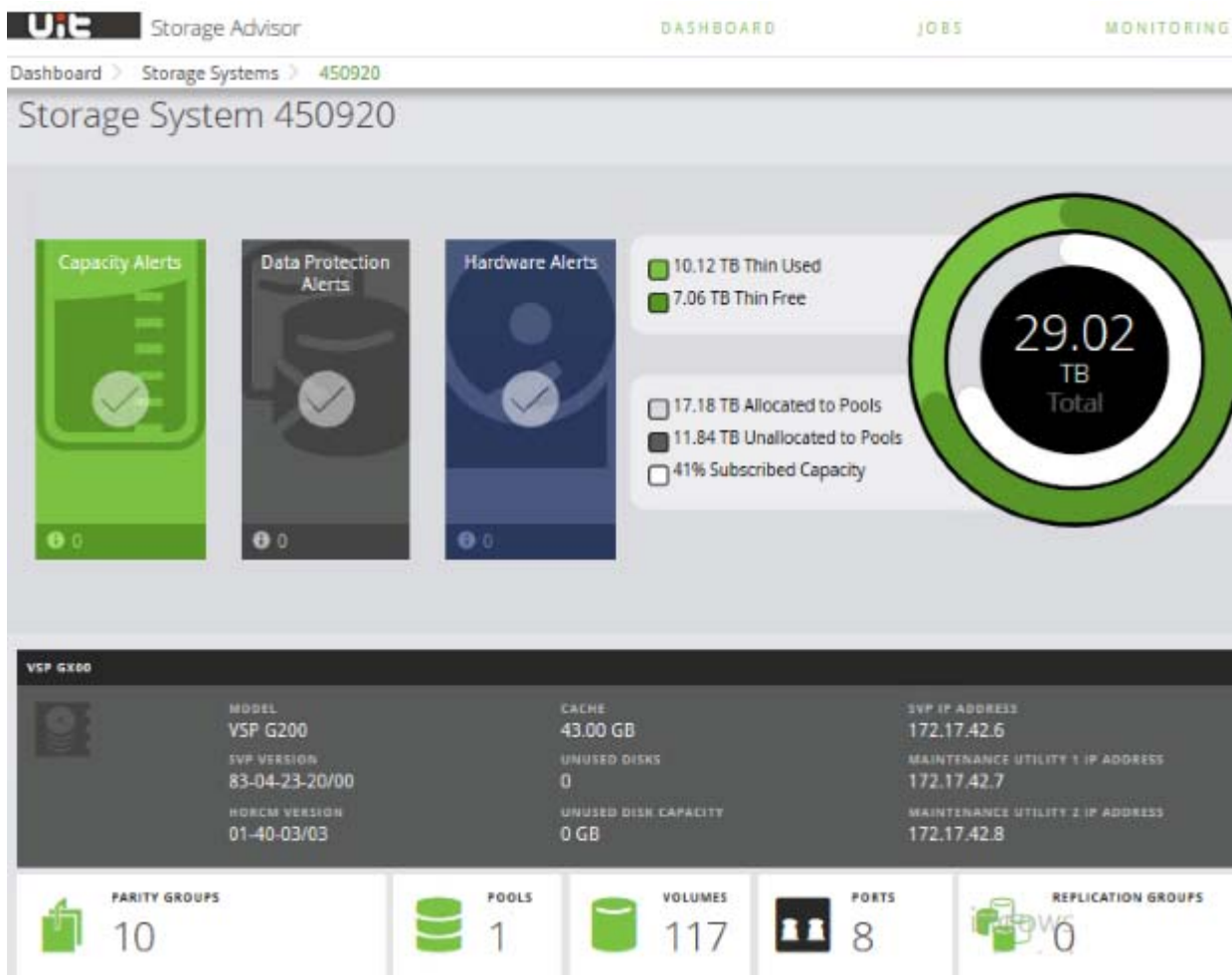
Some of the key Storage Advisor capabilities include:

- Simplified user experience for managing infrastructure resources.
- Recommended system configurations to speed initial storage system setup and accelerate new infrastructure resource deployments.
- Integrated configuration workflows with Hitachi recommended practices to streamline storage provisioning and data protection tasks.
- Common, centralized management for supported storage systems.
- A REST-based API to provide full management programmability and control in addition to unified file-based management support.
- Storage Advisor enables automated SAN zoning during volume attaches and detach. Optional auto-zoning eliminates the need for repetitive zoning tasks to be performed on the switch.

Please refer to the [Hitachi Storage Advisor User Guide](#) for more details.

Figure 10 shows Hitachi Storage Advisor with VSP G200 storage system.

**Figure 10**



## Engineering Validation

This summarizes the key observations from the test results for Hitachi Unified Compute platform for Oracle with Hitachi Virtual Storage Platform G200 and QuantaGrid D51B-2U Servers.

## Test Methodology

The test results are demonstrated using Oracle Orion and Peakmarks tools.

### *Oracle Orion*

Oracle Orion is a tool for predicting the performance of an Oracle database without having to install Oracle or create a database. Unlike other I/O calibration tools, Oracle Orion is expressly designed for simulating Oracle database I/O workloads using the same I/O software stack as Oracle. Orion can also simulate the effect of striping performed by Oracle Automatic Storage Management.

For more information about Orion, see "I/O Configuration and Design" in the [Oracle Database Performance Tuning Guide](#).



The Oracle Orion 12.1.0.2.0 tool is used to validate this solution.

### Peakmarks

[Peakmarks](#) is the leading benchmark software for Oracle platforms for the following:

- Performance verification (quality assurance)
- Evaluation of different infrastructure products, technologies, and solutions (price/performance comparison)
- Performance optimization (improvement in efficiency)

This provides transparency and comparability in price versus performance considerations for Oracle infrastructures

The Peakmarks 9.2 tool is used to validate this solution.

### Database Parameters

Table 12 shows parameter details for an Oracle two-node Real Application Cluster ASM database.

**TABLE 12. ORACLE DATABASE PARAMETERS**

Oracle Database Parameter	Value
compatible	12.1.0.2.0
cluster_database	TRUE
cluster_database_instances	2
Oracle Database size	8 TB
Database Storage Type	ASM
Database fill factor	80%

### Test Results

Table 13 lists the results of **Oracle Orion** test cases used to validate this solution.

**TABLE 13. Oracle Orion Test Results**

Test Case	Test / Workload type	Metric	Value	
1	Storage performance - 100% OLTP Random Read (8k)	Max. IO/s	146,115	185,093
		Avg. RT	0.95 ms	3.6 ms
2	Storage performance - 100% OLTP Random Writes (8k)	Max. IO/s	38,862	49,296
		Avg. RT	1.19 ms	Average of 2 to 13 ms range



**TABLE 13. Oracle Orion Test Results (Continued)**

Test Case	Test / Workload type	Metric	Value
3	Storage performance - 100% OLAP Sequential Reads (1024K)	Max. Throughput	7.6 GB/s
4	Storage performance - 100% OLAP Sequential Writes (1024K)	Max. Throughput	2.95 GB/s

Table 14 lists the results of **Peakmarks** test cases used to validate this solution.

**TABLE 14. Peakmarks Test Results**

Test Case	Test / Workload Type	Metric	Value
1	Storage performance random read (STO-RR)	Max. IO/s	95,878
		Avg. RT	1.1 ms
2	Storage performance random write (STO-RWF)	Max. IO/s	78,973
		Avg. RT	1 ms
3	Storage performance sequential read (STO-SR)	Max. Throughput	6.1 GB/s
4	Storage mixed random read write (STO-MIX 20% update ratio)	Max. IO/s	53,207
		Avg. RT	1.1 ms
5	Database medium OLTP select performance - 25 rows per transaction (DBX-S25)	Throughput in transactions per second	2,492
		Throughput in rows per second	62,305
		Avg. RT for SQL statement	1.5 ms
6	Server performance test - OLTP 25 rows per transaction(SRV-S25)	Throughput in transactions per second	14,423
		Throughput in rows per second	461,524
		Throughput in logical buffer reads per second	12,107,210
		Avg. RT for SQL statement	0.4 ms
7	CPU processor performance test - Arithmetic ADD operation (CP2-SA)	Throughput in operations per second	<b>59,308,673,491</b>

## For More Information

Hitachi Data Systems Global Services offers experienced storage consultants, proven methodologies and a comprehensive services portfolio to assist you in implementing Hitachi products and solutions in your environment. For more information, see the [Services](#) website.

Live and recorded product demonstrations are available for many Hitachi products. To schedule a live demonstration, contact a sales representative. To view a recorded demonstration, see the [Resources](#) website.

Hitachi Data Systems Academy provides best-in-class training on Hitachi products, technology, solutions and certifications. Hitachi Data Systems Academy delivers on-demand web-based training (WBT), classroom-based instructor-led training (ILT) and virtual instructor-led training (vILT) courses. For more information, see the Hitachi Data Systems Services [Training and Certification](#) website.

For more information about Hitachi products and services, contact your sales representative or channel partner or visit the [Hitachi Data Systems](#) website.

Corporate Headquarters  
2845 Lafayette Street  
Santa Clara, CA 95050-2639 USA  
[www.HDS.com](http://www.HDS.com)    [community.HDS.com](http://community.HDS.com)

Regional Contact Information  
**Americas:** +1 866 374 5822 or [info@hds.com](mailto:info@hds.com)  
**Europe, Middle East and Africa:** +44 (0) 1753 618000 or [info.emea@hds.com](mailto:info.emea@hds.com)  
**Asia Pacific:** +852 3189 7900 or [hds.marketing.apac@hds.com](mailto:hds.marketing.apac@hds.com)

HITACHI is a trademark or registered trademark of Hitachi, Ltd., Microsoft, Active Directory, Hyper-V, SharePoint, SQL Server, and Windows Server are trademarks or registered trademarks of Microsoft Corporation. Other notices if required. All other trademarks, service marks and company names are properties of their respective owners.

Notice: This document is for informational purposes only, and does not set forth any warranty, expressed or implied, concerning any equipment or service offered or to be offered by Hitachi Data Systems Corporation.

AS-612-00, August 2017.