



ORACLE®

SPC BENCHMARK 2™

EXECUTIVE SUMMARY

ORACLE CORPORATION

ORACLE ZFS STORAGE ZS5-2

SPC-2™ V1.6

SUBMITTED FOR REVIEW: MARCH 29, 2017

SUBMISSION IDENTIFIER: B12001

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

Test Sponsor and Contact Information	
Test Sponsor Primary Contact	Oracle – http://www.oracle.com Steven Johnson – steven.a.johnson@oracle.com 500 Eldorado Blvd. Broomfield, CO 80021 Phone: (303) 272-9476
Test Sponsor Alternate Contact	Oracle – http://www.oracle.com Jason Schaffer – jason.schaffer@oracle.com 500 Eldorado Blvd. Broomfield, CO 80021 Phone: (303) 272-4743
Auditor	InfoSizing – http://www.sizing.com/ Doug Johnson – doug@sizing.com 63 Lourdes Drive Leominster, MA 01453 Phone: (978) 343-6562

Revision Information and Key Dates

Revision Information and Key Dates	
SPC-2 Specification revision number	V1.6
SPC-2 Workload Generator revision number	V1.2.0
Date Results were first used publicly	March 29, 2017
Date FDR was submitted to the SPC	March 29, 2017
Date the TSC will be available for shipment to customers	April 5, 2017
Date the TSC completed audit certification	March 27, 2017

Tested Storage Product Description

Oracle ZFS Storage Appliance ZS5-2 is a high-performance, unified NAS/SAN system that provides converged cloud storage enabling on-premises storage to seamlessly access public cloud services and features industry-leading Oracle Database integration, in a cost-effective high-availability configuration. Dynamic caching between DRAM, flash cache, all flash, HDD, and cloud storage allows these systems to deliver extreme performance and superior efficiency for demanding enterprise applications and unpredictable cloud workloads. The ZFS Storage ZS5-2 offers simplified set up and management combined with advanced, intuitive management and fine-grained analytics tools. Through deep co-engineering integration, Oracle Database sends cues to the Oracle ZFS Storage Appliance ZS5-2 system, allowing it to intelligently process database I/O and automatically and dynamically tune itself for optimal performance. The ZFS Storage ZS5-2 can scale to 1.5 TB Memory, 72 CPU cores, and 3 PB capacity, with up to 204 TB of Flash Cache in a high-availability configuration. ZFS Storage Appliances deliver full suite of data services such as file, block and object protocols including connectivity over Ethernet, InfiniBand; data reduction technologies such as compression, deduplication, thin provisioning and advanced security options.

SPC-2 Reported Data

SPC-2 Reported Data consists of three groups of information:

- The following SPC-2 Primary Metrics, which characterize the overall benchmark result:
 - SPC-2 MBPS™
 - SPC-2 Price Performance™
 - Application Storage Unit (ASU) Capacity
- Supplemental data to the SPC-2 Primary Metrics.
 - Total Price
 - Data Protection Level
 - Currency Used
 - Target Country
- Reported Data for each SPC Test: Large File Processing (LFP), Large Database Query (LDQ), and Video on Demand Delivery (VOD) Test.

SPC-2 MBPS™ represents the aggregate data rate, in megabytes per second, of all three SPC-2 workloads: Large File Processing (LFP), Large Database Query (LDQ), and Video on Demand (VOD).

SPC-2 Price-Performance™ is the ratio of **Total Price** to **SPC-2 MBPS™**.

ASU (Application Storage Unit) Capacity represents the total storage capacity available to be read and written in the course of executing the SPC-2 benchmark.

Total Price includes the cost of the Priced Storage Configuration plus three years of hardware maintenance and software support.

Data Protection Level of Protected 2 using **Mirroring**, which configures two or more identical copies of user data.

Protected 2: *The single point of failure of any component in the configuration will not result in permanent loss of access to or integrity of the SPC-2 Data Repository.*

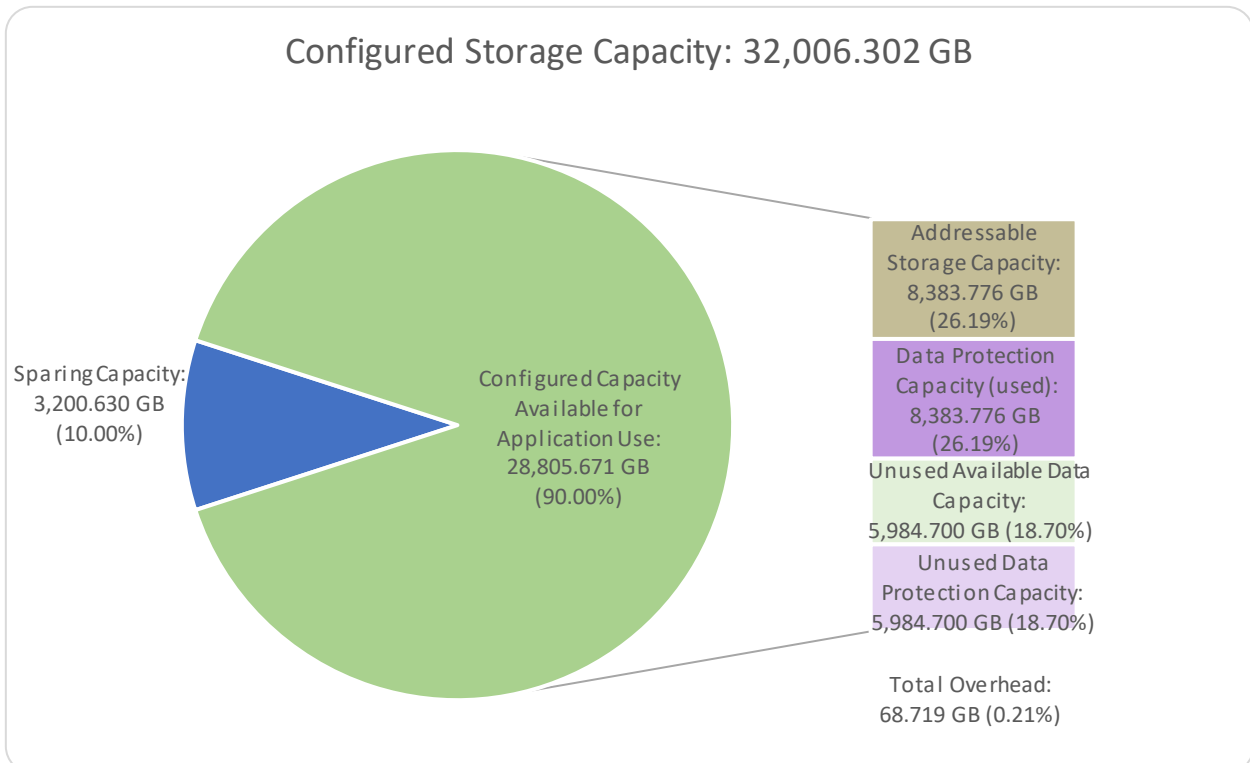
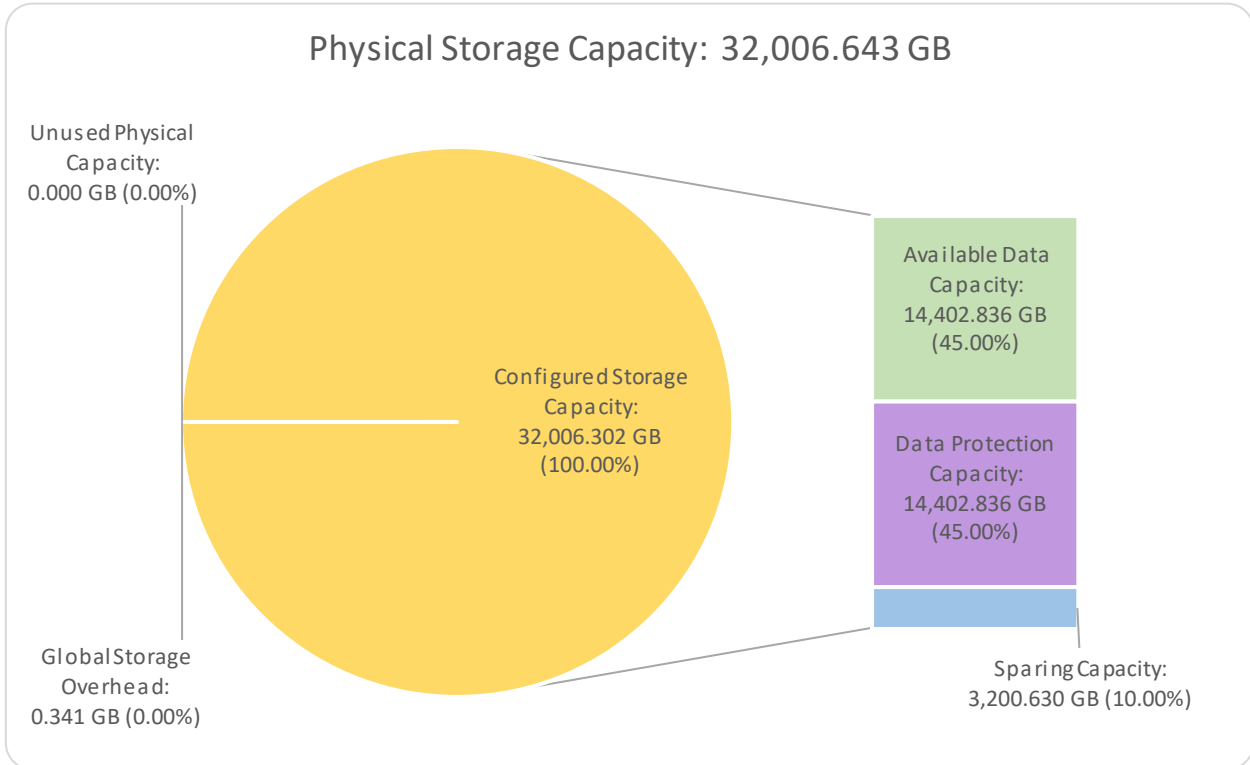
Currency Used is formal name for the currency used in calculating the **Total Price** and **SPC-2 Price-Performance™**. That currency may be the local currency of the **Target Country** or the currency of a difference country (*non-local currency*).

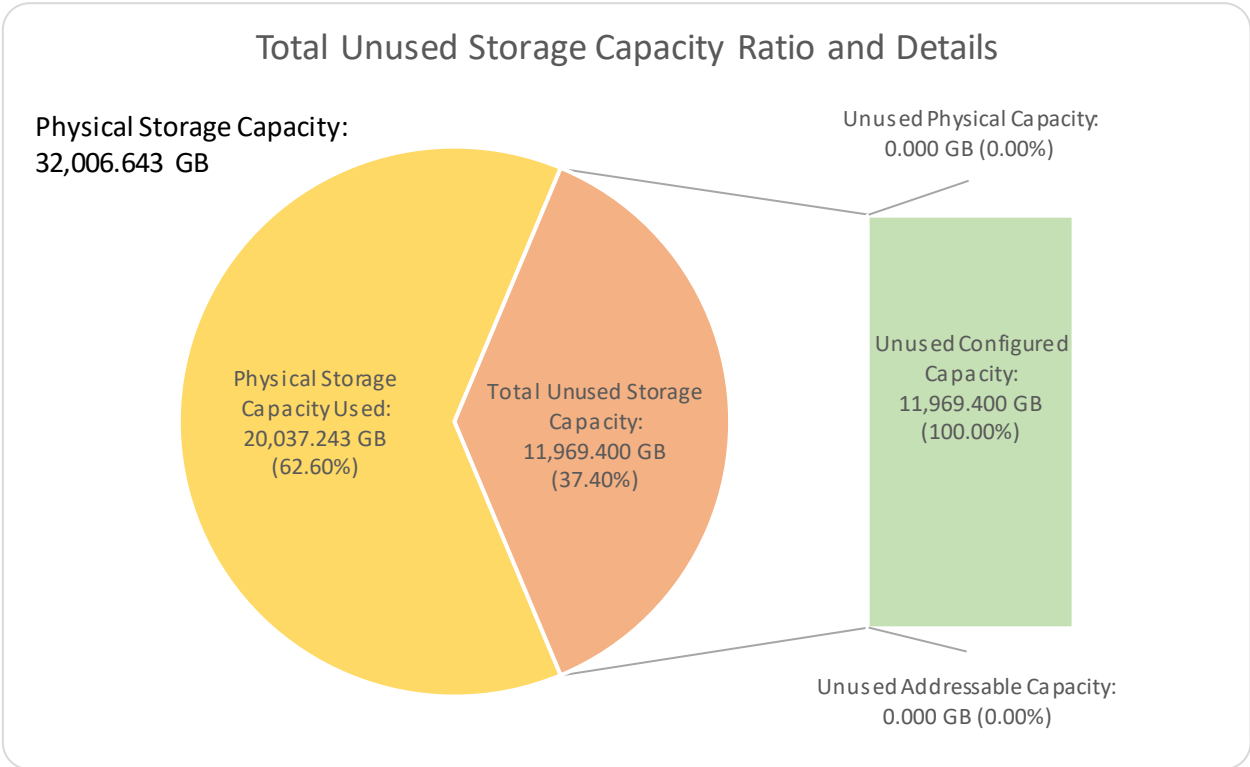
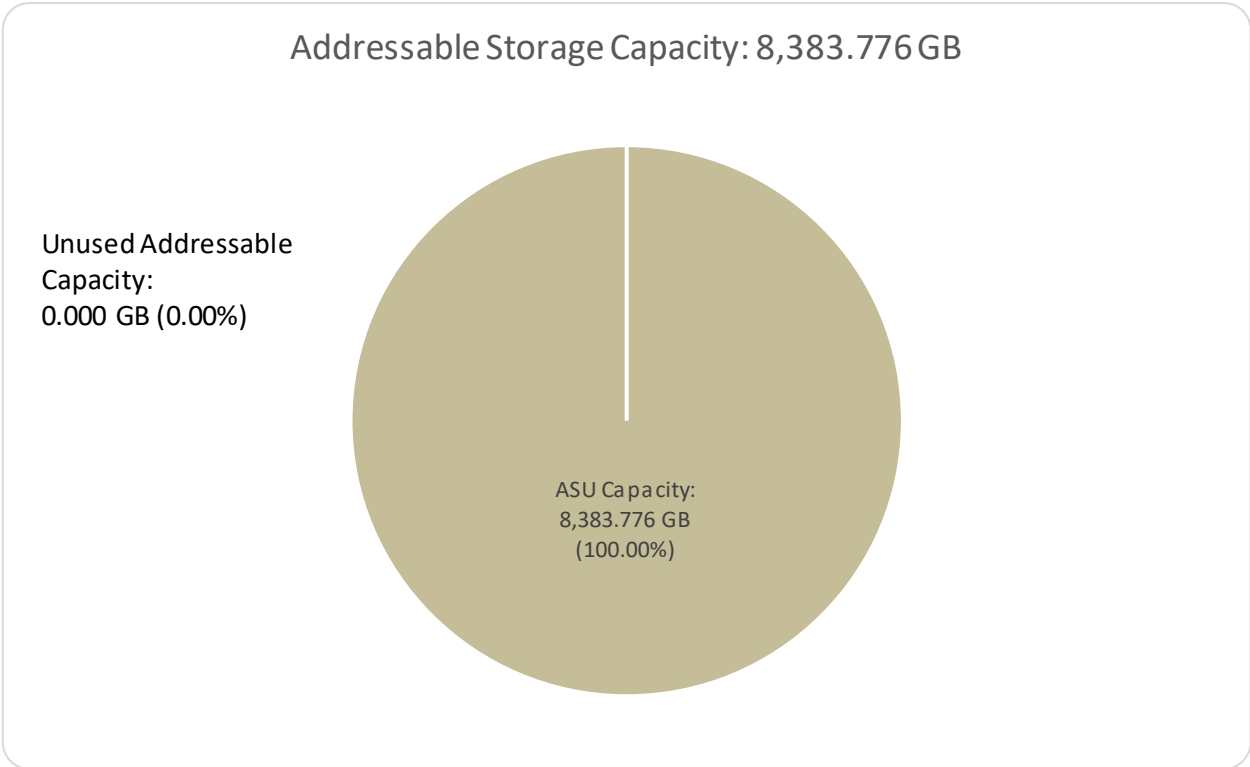
The **Target Country** is the country in which the Priced Storage Configuration is available for sale and in which the required hardware maintenance and software support is provided either directly from the Test Sponsor or indirectly via a third-party supplier.

SPC-2 Reported Data				
Oracle ZFS Storage ZS5-2				
SPC-2 MBPS™	SPC-2 Price-Performance	ASU Capacity (GB)	Total Price	Data Protection Level
24,397.12	\$8.89	8,383.776	\$217,011.94	Protected 2 (Mirroring)
<i>The above SPC-2 MBPS™ value represents the aggregate data rate of all three SPC-2 workloads: Large File Processing (LFP), Large Database Query (LDQ), and Video On Demand (VOD).</i>				
Currency Used:		"Target Country":		
U.S. Dollars		USA		
SPC-2 Large File Processing (LFP) Reported Data				
	Data Rate (MB/second)	Number of Streams	Data Rate per Stream	Price-Performance
LFP Composite	19,997.48			\$10.85
Write Only:				
1024 KiB Transfer	11,961.22	512	23.36	
256 KiB Transfer	11,883.74	512	23.21	
Read-Write:				
1024 KiB Transfer	18,782.75	512	36.69	
256 KiB Transfer	18,986.04	512	37.08	
Read Only:				
1024 KiB Transfer	29,064.06	512	56.77	
256 KiB Transfer	29,307.04	512	57.24	
<i>The above SPC-2 Data Rate value for LFP Composite represents the aggregate performance of all three LFP Test Phases: (Write Only, Read-Write, and Read Only).</i>				
SPC-2 Large Database Query (LDQ) Reported Data				
	Data Rate (MB/second)	Number of Streams	Data Rate per Stream	Price-Performance
LDQ Composite	28,814.51			\$7.53
1024 KiB Transfer Size				
4 I/Os Outstanding	29,395.56	512	57.41	
1 I/O Outstanding	29,267.33	512	57.16	
64 KiB Transfer Size				
4 I/Os Outstanding	28,238.18	512	55.15	
1 I/O Outstanding	28,356.95	512	55.38	
<i>The above SPC-2 Data Rate value for LDQ Composite represents the aggregate performance of the two LDQ Test Phases: (1024 KiB and 64 KiB Transfer Sizes).</i>				
SPC-2 Video On Demand (VOD) Reported Data				
	Data Rate (MB/second)	Number of Streams	Data Rate per Stream	Price-Performance
	24,379.39	31,000	0.79	\$8.90

Storage Capacities, Relationships and Utilization

The following four charts and table document the various storage capacities, used in this benchmark, and their relationships, as well as the storage utilization values required to be reported.





SPC-2 Storage Capacity Utilization	
Application Utilization	26.19%
Protected Application Utilization	52.50%
Unused Storage Ratio	37.40%

Application Utilization: Total ASU Capacity (8,383.776 GB) divided by Physical Storage Capacity (32,006.643 GB).

Protected Application Utilization: Total ASU Capacity (8,383.776 GB) plus total Data Protection Capacity (14,402.836 GB) minus unused Data Protection Capacity (5,984.700 GB) divided by Physical Storage Capacity (32,006.643 GB).

Unused Storage Ratio: Total Unused Capacity (11,969.400 GB) divided by Physical Storage Capacity (32,006.643 GB) and may not exceed 45%.

Priced Storage Configuration Pricing

Part Number	Description	Quantity	US List	Total List	Discount	Net Price
7112310	Oracle ZFS Storage ZS5-2: controller	2	\$22,878	\$45,756	40.00%	\$27,454
7111036	One 16 GB DDR4-2133 DIMM (for factory installation)	48	\$394	\$18,912	20.00%	\$15,130
7110371	Oracle Storage 12 Gb SAS-3 HBA PCIe, low profile: 16 Port (for factory installation)	2	\$1,183	\$2,366	40.00%	\$1,420
7113645	Cable: 3 meters, mini SAS HD to mini SAS HD (for factory installation)	8	\$110	\$880	40.00%	\$528
7104073	Oracle Dual Port QDR InfiniBand Adapter M3 (for factory installation)	6	\$2,740	\$16,440	40.00%	\$9,864
7105174	QSFP to QSFP passive copper cable: 3 meter (for factory installation)	12	\$180	\$2,160	40.00%	\$1,296
333A-25-15-NEMA	Power cord: North America and Asia, 2.5 meters, 5-15P plug, C13 connector, 15 A (for factory installation)	4	\$13	\$52	40.00%	\$31
7113126	Oracle Storage Drive Enclosure DE3-24P: base chassis (for factory installation)	2	\$3,706	\$7,412	40.00%	\$4,447
7115078	One 800 GB 2.5-inch SAS SSD with marlin bracket (for factory installation)	40	\$2,770	\$110,800	40.00%	\$66,480
6331A-N	2.5-inch HDD filler panel (for factory installation)	8	\$0	\$0	20.00%	\$0
333A-25-15-NEMA	Power cord: North America and Asia, 2.5 meters, 5-15P plug, C13 connector, 15 A (for factory installation)	4	\$13	\$52	40.00%	\$31
X2821A-Z-N	Sun Datacenter Switch IB-36 is a 1RU 36 port managed QDR InfiniBand Switch. The switch utilizes standard QSFP connectors. Comes with redundant power supplies.	2	\$14,980	\$29,960	40.00%	\$17,976
X2121A-3M-N	QSFP to QSFP passive copper cable:	16	\$180	\$2,880	40.00%	\$1,728
X311L-N	Pwrcord,N.A./Asia,2.5m, 5-15P,15A,C13	4	\$13	\$52	40.00%	\$31
7104074	Oracle Dual Port QDR InfiniBand Adapter M3	8	\$2,740	\$21,920	40.00%	\$13,152.00
	Oracle Premium Support for Systems: 1-Year 7/24, 2 hour response time.	3	\$0	\$93,471	0.00%	\$57,444
	TOTALS			\$353,113		\$217,011.94

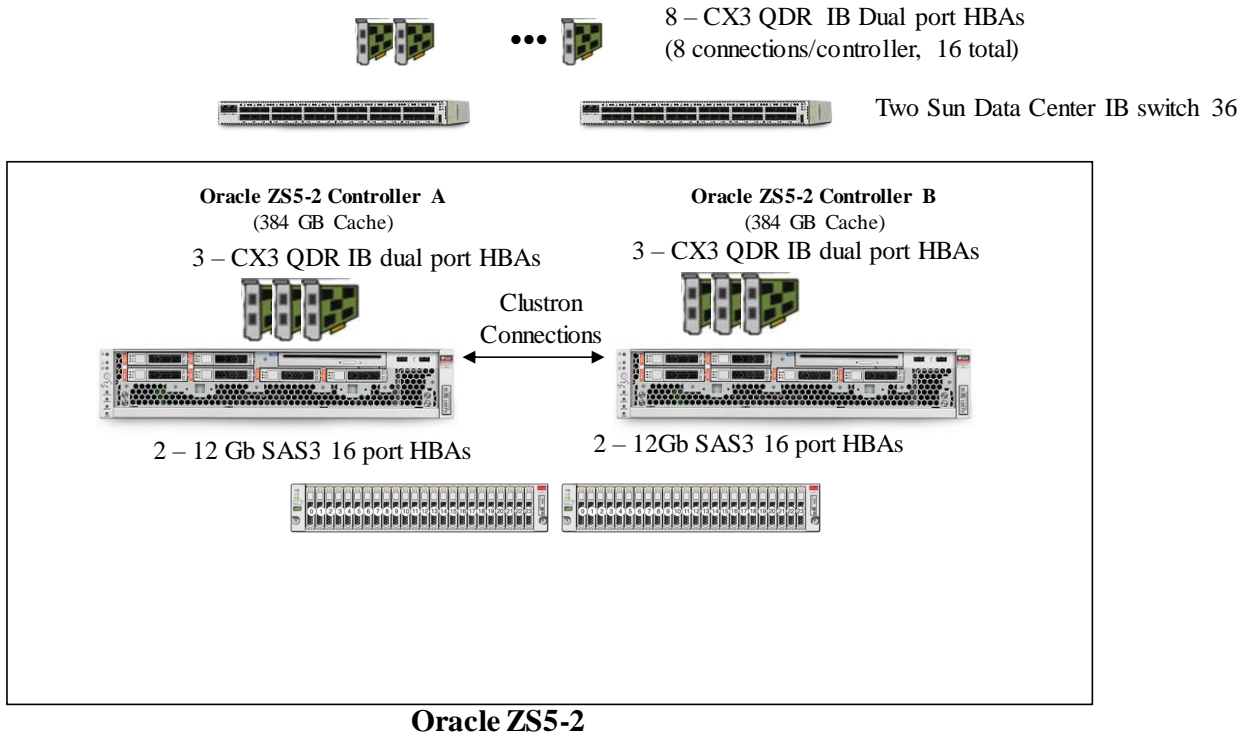
The above pricing includes the following:

- Acknowledgement of new and existing hardware and/or software problems within four hours.
- Onsite presence of a qualified maintenance engineer or provision of a customer replaceable part within four hours of the above acknowledgement for any hardware failure that results in an inoperative Priced Storage Configuration component.

Differences between Tested Storage Configuration and Priced Storage Configuration

There were no differences between the TSC and Priced Storage Configuration.

Priced Storage Configuration Diagram



- 40 – 800 GB SSD SAS3 Disk Drives
- 2 – Oracle ZFS ZS5-2 controllers (Cluster configuration) 384 GB cache per controller
- 6 – QDR IB dual-port HBAs (3 HBAs per controller) 6 – QDR connections per controller, 12 total, 12 used
- 4 – 12 Gb SAS3 16-port HBAs(2 HBAs per controller)(8 –12 Gb SAS3 connections per controller, 16 total, 8 used)
- 2 –Oracle Storage Drive Enclosure DE3-24P
- 40 – 800 GB SSD SAS3 Disk Drives

Priced Storage Configuration Components

Priced Storage Configuration
8 – Oracle Dual Port QDR IB Adapter M3 CX-3 (2 per host)
2 – Sun Datacenter Switch IB-36 QDR
Oracle ZFS Storage ZS5-2 2 – Oracle ZFS ZS5-2 controllers (cluster configuration) 384 GiB cache/memory per controller (768 GiB total)
6 – Oracle Dual Port QDR IB Adapter M3 CX-3 (3 per controller) providing: 6 – QDR InfiniBand front-end connections per controller <i>(12 – QDR InfiniBand front-end connections total, 12 used)</i>
4 – Oracle Storage 12 Gb SAS-3 16-port adapters (2 per controller) providing: <i>(2 adapters per controller)</i> <i>(1 adapter per controller included with base unit)</i> 4 physical SAS ports per adapter 4 logical SAS connections per physical port 16 logical SAS connections per adapter 8 physical SAS ports per controller 32 logical SAS connections per controller <i>(64 logical connections total, 32 used)</i>
2 – Oracle Storage Drive Enclosures DE3-24P
40 – 800 GB SSD SAS3 disk drives <i>(20 disk drives per enclosure)</i>