



ORACLE®

**SPC BENCHMARK 2™
EXECUTIVE SUMMARY**

**ORACLE CORPORATION
ORACLE ZFS STORAGE
ZS3-4 (2-NODE CLUSTER)**

SPC-2™ V1.5

**Submitted for Review: September 10, 2013
Submission Identifier: B00067**

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

Test Sponsor and Contact Information	
Test Sponsor Primary Contact	Oracle Corporation – 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 Corporation – http://www.oracle.com Jason Schaffer – Jason.Schaffer@oracle.com 500 Eldorado Blvd. Broomfield, CO 80021 Phone: (303) 272-4743 FAX: (303) 272-9704
Auditor	Storage Performance Council – http://www.storageperformance.org Walter E. Baker – AuditService@StoragePerformance.org 643 Bair Island Road, Suite 103 Redwood City, CA 94063 Phone: (650) 556-9384 FAX: (650) 556-9385

Revision Information and Key Dates

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SPC-2 Specification revision number	V1.5
SPC-2 Workload Generator revision number	V1.2
Date Results were first used publicly	September 10, 2013
Date FDR was submitted to the SPC	September 10, 2013
Date the TSC will be available for shipment to customers	November 5, 2013
Date the TSC completed audit certification	September 6, 2013

Tested Storage Product (TSP) Description

Oracle's ZFS Storage ZS3-4 is a high-performance storage system that offers enterprise-class SAN and NAS capabilities with industry-leading Oracle Database integration, in a cost-effective high-availability configuration. The ZFS Storage ZS3-4 offers simplified set up and management combined with industry-leading storage analytics.

The ZFS Storage ZS3-4 can scale to 2 TB Memory, 80 CPU cores, and 3.4 PB capacity, with up to 12.8 TB of Flash Cache in a high-availability configuration.

ZFS Storage Appliances deliver additional economic value with bundled data services such as file- and block-level protocols including connectivity over InfiniBand, Compression, Deduplication, Thin provisioning, DTrace Analytics, Virus Scan, Snapshots, Triple Mirror, Triple Parity RAID, Phone-home, NDMP, Clustering, etc.

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
- 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 as detailed on page on page 17 of the corresponding Full Disclosure Report.

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

***Protected 1:** 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.

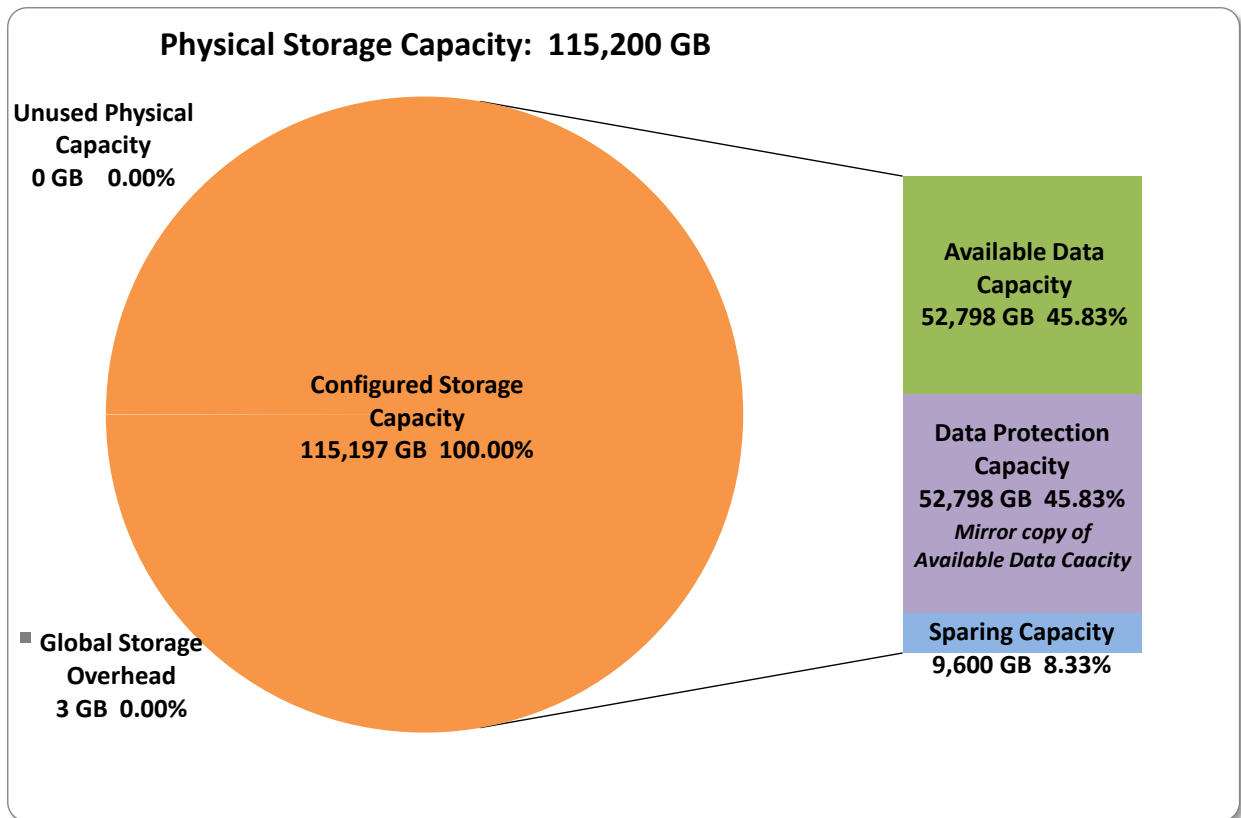
SPC-2 Reported Data (continued)

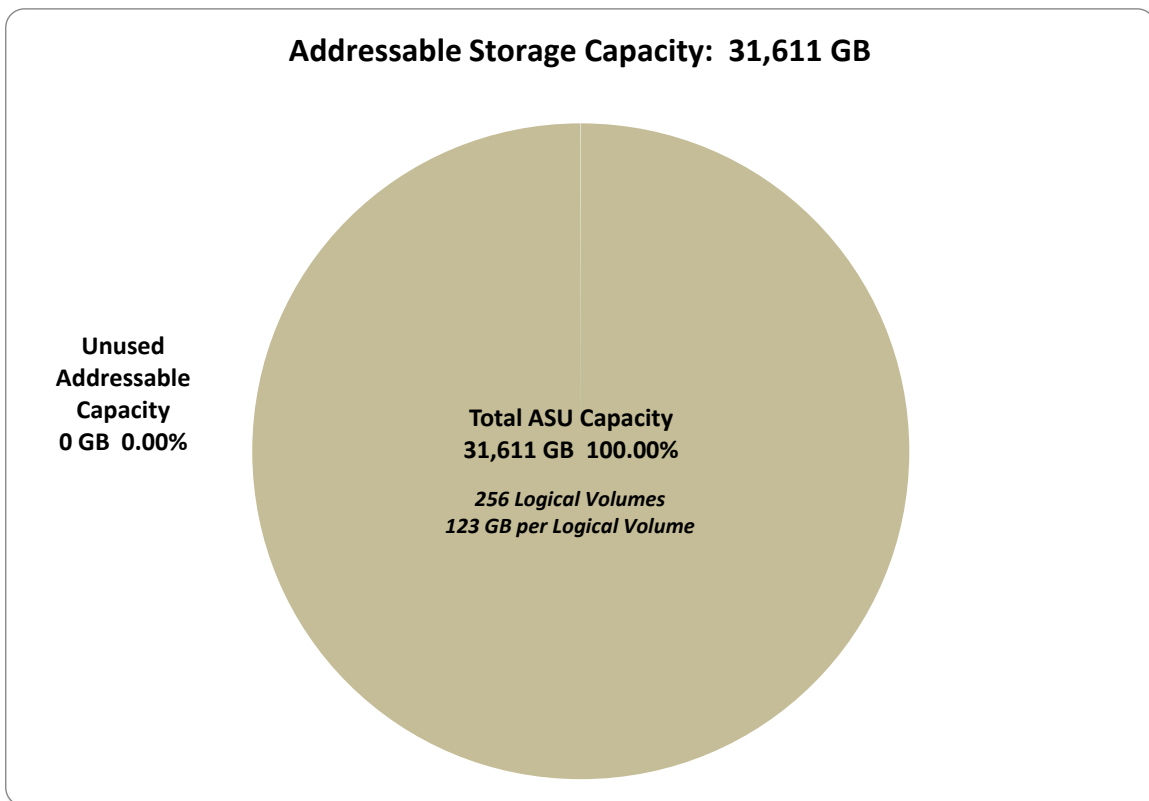
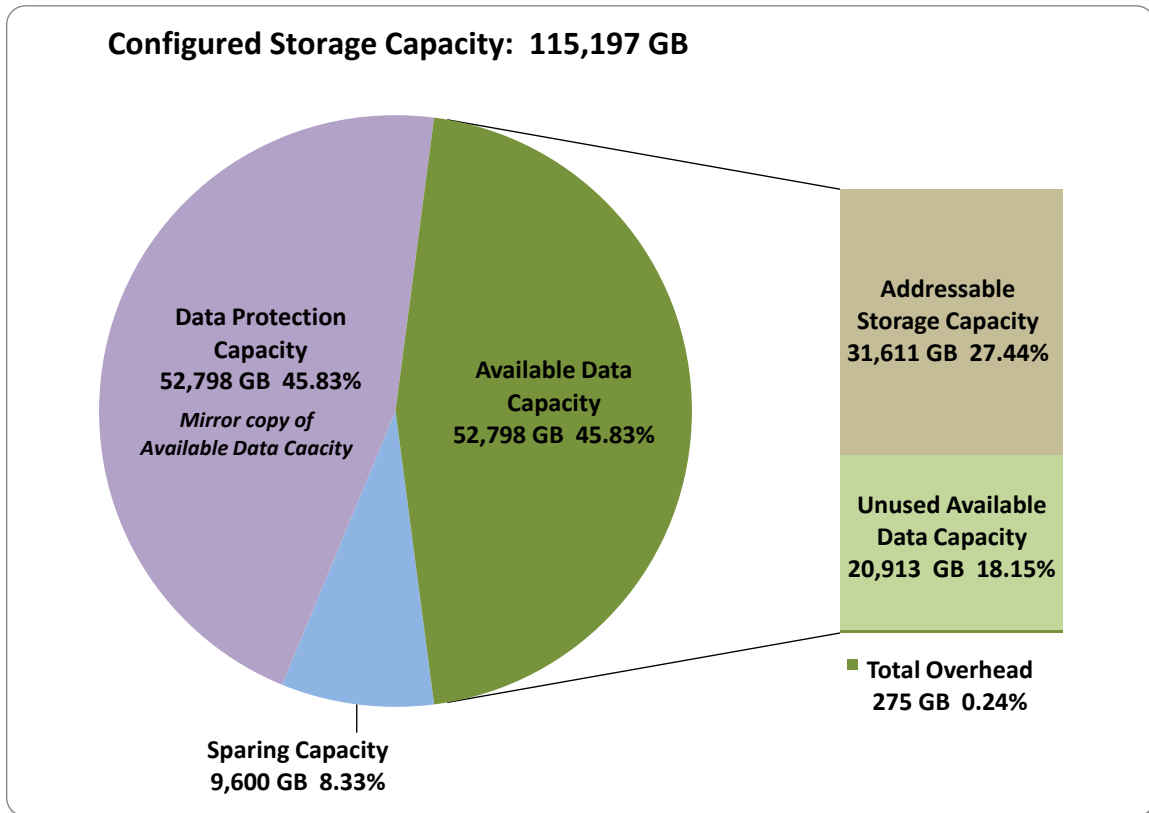
SPC-2 Reported Data				
Oracle ZFS Storage ZS3-4 (2-node cluster)				
SPC-2 MBPS™	SPC-2 Price-Performance	ASU Capacity (GB)	Total Price	Data Protection Level
17,244.22	\$22.53	31,610.959	\$388,472.03	Protected 2 (Mirroring)
<i>The above SPC-2 MBPS™ value represents the aggregate data rate of all three SPC-2 workloads: Large File Processing (LFP), Large Database Query (LDQ), and Video On Demand (VOD)</i>				
SPC-2 Large File Processing (LFP) Reported Data				
	Data Rate (MB/second)	Number of Streams	Data Rate per Stream	Price-Performance
LFP Composite	12,755.37			\$30.46
Write Only:				
1024 KiB Transfer	10,562.74	1,024	10.32	
256 KiB Transfer	3,313.15	1,024	3.24	
Read-Write:				
1024 KiB Transfer	17,030.42	2,048	8.32	
256 KiB Transfer	5,705.64	512	11.14	
Read Only:				
1024 KiB Transfer	20,157.03	128	157.48	
256 KiB Transfer	19,763.24	1,024	19.30	
<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	19,709.74			\$19.71
1024 KiB Transfer Size				
4 I/Os Outstanding	20,222.59	128	157.99	
1 I/O Outstanding	20,359.76	256	79.53	
64 KiB Transfer Size				
4 I/Os Outstanding	19,355.37	256	75.61	
1 I/O Outstanding	18,901.23	1,024	18.46	
<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
	19,267.55	24,500	0.79	\$20.16

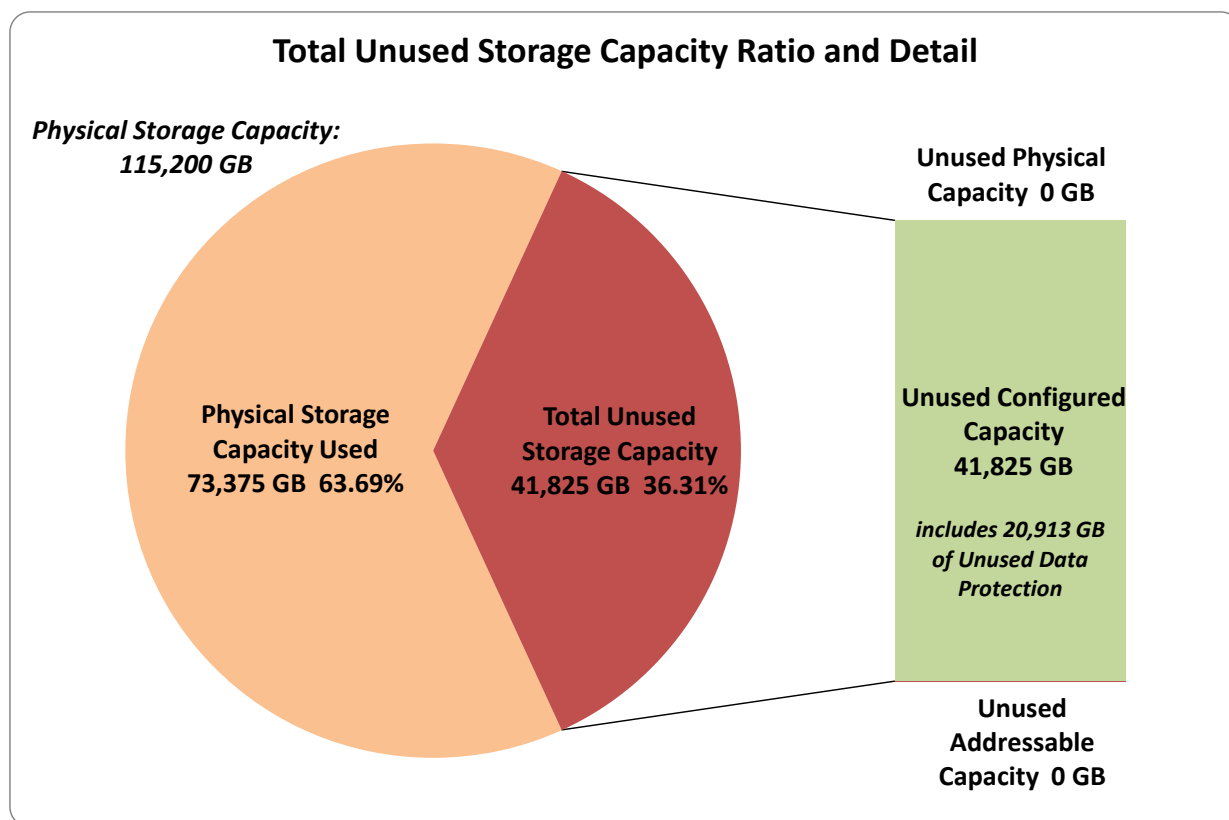
Storage Capacities and Relationships

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.

The capacity values in each of the following four charts are listed as integer values, for readability, rather than the decimal values listed elsewhere in this document.







SPC-2 Storage Capacity Utilization	
Application Utilization	27.44%
Protected Application Utilization	56.12%
Unused Storage Ratio	36.31%

Application Utilization: Total ASU Capacity (31,610.959 GB) divided by Physical Storage Capacity (115,200.000 GB).

Protected Application Utilization: Total ASU Capacity (31,610.959 GB) plus total Data Protection Capacity (52,798.498 GB) minus unused Data Protection Capacity (20,912.660 GB) divided by Physical Storage Capacity (115,200.000 GB).

Unused Storage Ratio: Total Unused Capacity (41,825.321 GB) divided by Physical Storage Capacity (115,200.000 GB) and may not exceed 45%.

Detailed information for the various storage capacities and utilizations is available on pages 25-26 in the Full Disclosure Report.

Differences between the Tested Storage Configuration (TSC) and Priced Storage Configuration

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

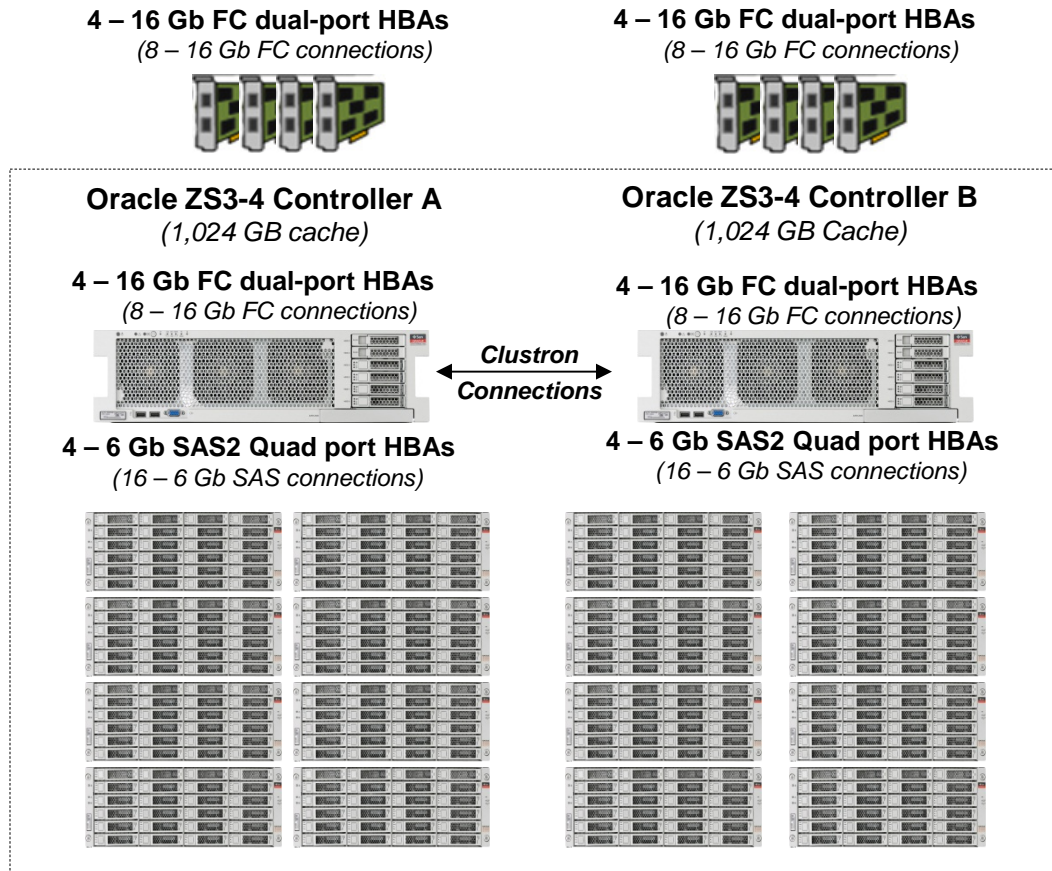
Priced Storage Configuration Pricing

Part Number	Description	Quantity	US List	Total List	Discount	Net Price
7105725	Oracle ZFS Storage ZS3-4 appliance (for factory installation) Note: Each controller includes 2 SAS PCIe 6Gb 16 port adapters and 8 mini SAS to mini SAS HD cables.	2	54,681.00	109,362.00	40.00%	65,617.20
7105053	Two 16 GB DDR3-1066 DIMMs (for factory installation).	64	444.00	28,416.00	20.00%	22,732.80
7103790	SAS PCIE 6Gbs 16 port (for factory installation)	4	1,167.00	4,668.00	40.00%	2,800.80
7106737	Cable: 3 meters, mini SAS to mini SAS HD	16	250.00	4,000.00	40.00%	2,400.00
SR-JUMP-1MC13	Power cord: Sun Rack 2 jumper, 1 meter, C14RA plug, C13 connector, 13 A (for factory installation)	4	29.00	116.00	40.00%	69.60
DS2-0BASE	Sun disk shelf: base chassis with 2 SAS-2 I/O modules, 2 AC PSUs and 2 cooling fans (for factory installation)	16	4,905.00	78,480.00	40.00%	47,088.00
DS2-4URK-19U	Sun disk shelf: universal rail kit for 19-inch depth racks (for factory installation)	16	230.00	3,680.00	40.00%	2,208.00
7101274	300GB 15K RPM disk	384	411.00	157,824.00	40.00%	94,694.40
SR-JUMP-1MC13	Power cord: Sun Rack 2 jumper, 1 meter, C14RA plug, C13 connector, 13 A (for factory installation)	32	29.00	928.00	40.00%	556.80
SR-1242-N	Sun Rack II, 42U, 1200mm depth, 600mm width, empty shipping only (do not install product inside the rack while it is on this pallet)	2	2,149.00	4,298.00	20.00%	3,438.40
SR-10K-L630-N	Sun Rack II 10kVA PDU, Single Phase, 48 Supplied Amps Max, NEMA L6-30P on 4m captive cords, Data Center Two 30A NEMA L6-30R (30A breakers), 42 C13 and 6 C19 Outlets in 6 Groups, Current Metering.	2	900.00	1,800.00	20.00%	1,440.00
SR-JUMPKIT-N	Jumper Cable Start Up Kit: qty 10 of 1 meter C13 plugs + qty 10 of 2 meter C13 plugs + qty 2 1 meter C19 plugs + Qty 2 2meter C19 plugs	2	198.00	396.00	20.00%	316.80
7101674	Sun Storage 16Gbs FC PCIe HBA, dual port, Qlogic	16	2,035.00	32,560.00	40.00%	19,536.00
7101676	Sun Storage 16Gbs FC optics, SR, Qlogic	32	1,152.00	36,864.00	40.00%	22,118.40
X9732A-Z-N	2M LC to LC FC Optical Cable RoHS-6 compliant	16	65.00	1,040.00	40.00%	624.00
	Oracle Premium Support for Systems: 1-Year 7/24, 2 hour response time.	3		167,195.52		102,830.83
TOTALS				631,627.52		388,472.03

The following 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.

Priced Storage Configuration Diagram



Oracle ZFS Storage ZS3-4 (2-node cluster)

- 2 – Oracle ZFS ZS3-4 controllers** (cluster configuration)
(1,024 GB cache per controller, 2,048 GB total)
- 8 – 16 Gb FC dual-port HBAs** (4 HBAs per controller)
(8 – 16 Gb FC connections per controller, 16 total, 16 used)
- 8 – 6 Gb SAS2 quad-port HBAs** (4 HBAs per controller)
(16 – 6 Gb SAS2 connections per controller, 32 total, 32 used)
- 16 – Sun disk shelf base** (2 SAS I/O modules per base)
- 384 – 300 GB 15K RPM SAS Disk Drives**
- 2 – Sun Rack II 42U**
- 2 – Sun Rack II 10kVA PDU**

Priced Storage Configuration Components

Priced Storage Configuration Components:
8 – Sun Storage 16 Gbps FC PCIe dual-port HBAs with 16 – Sun Storage 16 Gbps FC optics
Oracle ZFS Storage ZS3-4 (2-node cluster) 2 – Oracle ZFS ZS3-4 controllers (<i>cluster configuration</i>) 1024 GB cache/memory per controller (<i>2048 GB total</i>) 8 – Sun Storage 16 Gbps FC PCIe dual-port HBAs with 16 – Sun Storage 16 Gbps FC optics (<i>4 FC HBAs and 8 FC optics per controller</i>) 8 – 16 Gb FC front-end connections per controller (<i>16 – 16 Gb FC front-end connections total, 16 used</i>) 4 – SAS PCIe 6 Gb adapters (<i>2 adapters included with each controller</i>) 4 physical SAS connections per adapter 4 logical SAS connections per physical connection 16 logical SAS connections per adapter 8 physical SAS connections per controller (<i>16 total, 16 used</i>)
4 – SAS PCIe 6 Gb adapters (<i>2 additional adapters per controller</i>) 4 physical SAS connections per adapter 4 logical SAS connections per physical connection 16 logical SAS connections per adapter 8 physical SAS connections per controller (<i>16 total connections, 16 connections used</i>)
16 – Sun disk shelf base each with 2 SAS I/O modules, 2 AC PSUs and 2 cooling fans
384 – 300 GB 15K RPM disk drives
2 – Sun Rack II, 42U
2 – Sun Rack II 10kVA PDU, single phase, 48 supported amps max