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**SPC BENCHMARK 1™
EXECUTIVE SUMMARY**

**FUJITSU LIMITED
FUJITSU STORAGE SYSTEMS ETERNUS DX440 S2**

SPC-1 V1.12

Submitted for Review: June 26, 2012

Submission Identifier: A00117

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

| Test Sponsor and Contact Information | |
|---|---|
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Revision Information and Key Dates

| Revision Information and Key Dates | |
|---|---------------------|
| SPC-1 Specification revision number | V1.12 |
| SPC-1 Workload Generator revision number | V2.3.0.0 |
| Date Results were first used publicly | June 26, 2012 |
| Date the FDR was submitted to the SPC | June 26, 2012 |
| Date the Priced Storage Configuration is available for shipment to customers | currently available |
| Date the TSC completed audit certification | June 26, 2012 |

Tested Storage Product (TSP) Description

The Fujitsu ETERNUS DX440 S2 is a flexible, highly reliable storage array, equipped with redundant components to provide uncompromised availability to mid-market requirements. A mixture of 300GB, 450GB, 600GB, and 900GB 10krpm plus 1TB Nearline 2.5" SAS drives are offered. In addition, 300GB, 450GB, and 600GB 15krpm SAS drives, as well as 1TB, 2TB, and 3TB Nearline SAS drives may be used, up to a maximum of 960 drives. SSD drives are available in 100GB, 200GB, and 400GB sizes. The drives may be arranged in a variety of RAID groups, including RAID1, RAID1+0(10), RAID5, RAID6, and RAID5+0(50).

The product is offered with Fibre Channel (*as tested*), iSCSI (*both 1Gbps and 10Gbps*), and FCoE host connections. Up to 8 Channel Adapters (CAs) can be installed, 4 on each the two Control Modules (CMs), with mixed types permitted. Most types have two ports on each CA, however a FC CA is offered with 4 ports. In addition, a number of different snapshot and replication facilities, native disk data encryption, and MAID capabilities are available.

Summary of Results

| SPC-1 Reported Data | |
|---|--------------------------------|
| Tested Storage Product (TSP) Name: Fujitsu Storage Systems ETERNUS DX440 S2 | |
| Metric | Reported Result |
| SPC-1 IOPS™ | 102,989.38 |
| SPC-1 Price-Performance | \$8.62/SPC-1 IOPS™ |
| Total ASU Capacity | 70,224.000 GB |
| Data Protection Level | Protected (<i>Mirroring</i>) |
| Total TSC Price (including three-year maintenance) | \$888,235.30 |

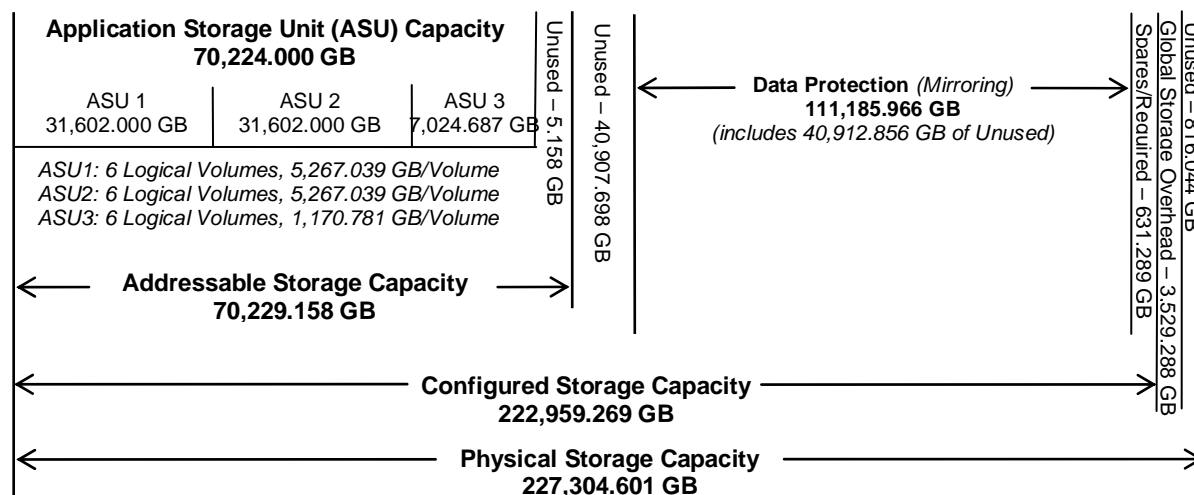
SPC-1 IOPS™ represents the maximum I/O Request Throughput at the 100% load point.

Total ASU (Application Storage Unit) **Capacity** represents the total storage capacity read and written in the course of executing the SPC-1 benchmark.

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

Storage Capacities, Relationships, and Utilization

The following diagram 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-1 Storage Capacity Utilization | |
|------------------------------------|--------|
| Application Utilization | 30.89% |
| Protected Application Utilization | 61.81% |
| Unused Storage Ratio | 36.36% |

Application Utilization: Total ASU Capacity (70,224.000 GB) divided by Physical Storage Capacity (227,304.601 GB)

Protected Application Utilization: Total ASU Capacity (70,224.000 GB) plus total Data Protection Capacity (111,185.966 GB) minus unused Data Protection Capacity (40,912.856 GB) divided by Physical Storage Capacity (227,304.601 GB)

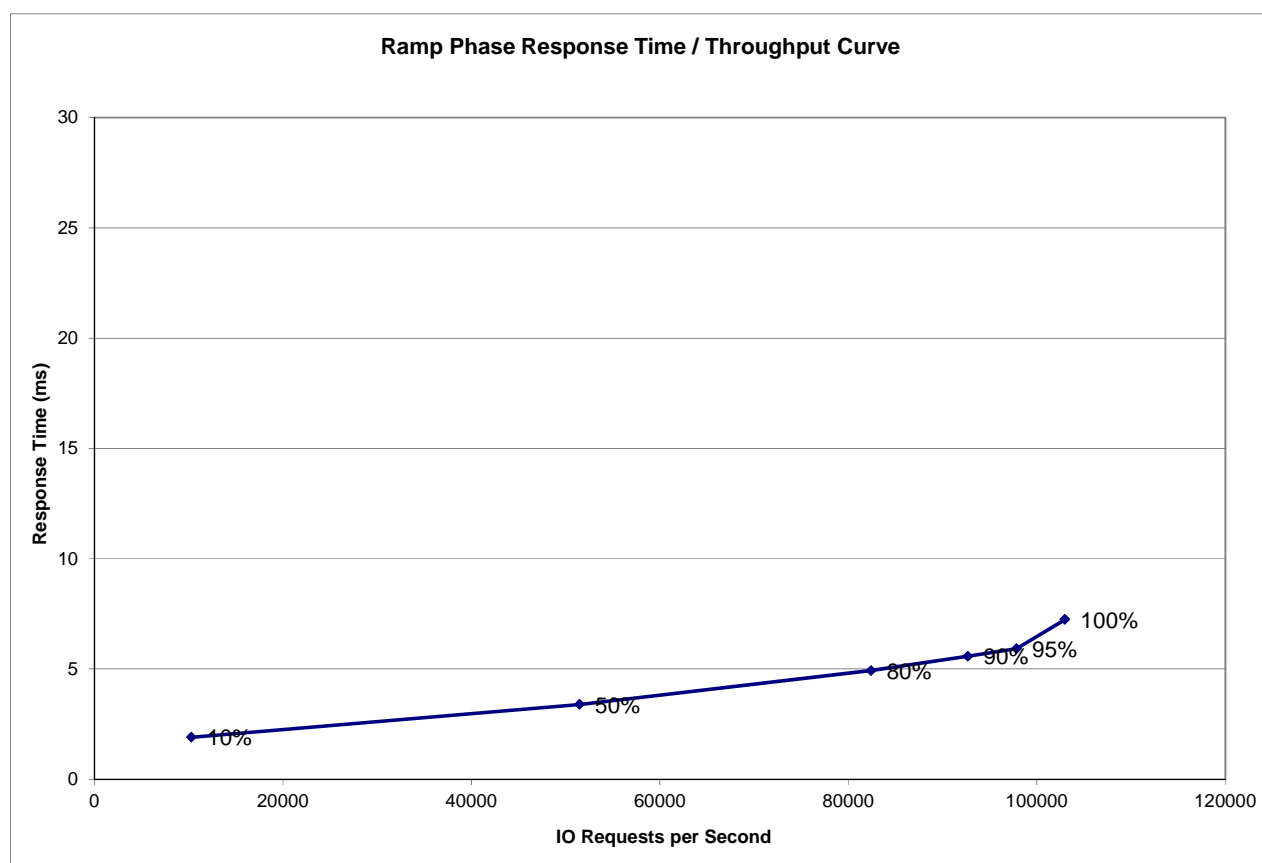
Unused Storage Ratio: Total Unused Capacity (82,646.914 GB) divided by Physical Storage Capacity (227,304.601 GB) and may not exceed 45%.

Detailed information for the various storage capacities and utilizations is available on pages 21-22 in the Full Disclosure Report.

Response Time – Throughput Curve

The Response Time-Throughput Curve illustrates the Average Response Time (milliseconds) and I/O Request Throughput at 100%, 95%, 90%, 80%, 50%, and 10% of the workload level used to generate the SPC-1 IOPS™ metric.

The Average Response Time measured at the any of the above load points cannot exceed 30 milliseconds or the benchmark measurement is invalid.



Response Time – Throughput Data

| | 10% Load | 50% Load | 80% Load | 90% Load | 95% Load | 100% Load |
|------------------------------------|-----------|-----------|-----------|-----------|-----------|------------|
| I/O Request Throughput | 10,307.53 | 51,487.03 | 82,413.86 | 92,697.84 | 97,855.65 | 102,989.38 |
| Average Response Time (ms): | | | | | | |
| All ASUs | 1.90 | 3.39 | 4.93 | 5.58 | 5.92 | 7.25 |
| ASU-1 | 2.66 | 4.33 | 6.10 | 6.84 | 7.25 | 7.87 |
| ASU-2 | 1.55 | 2.72 | 4.03 | 4.61 | 4.91 | 5.39 |
| ASU-3 | 0.45 | 1.71 | 2.84 | 3.32 | 3.56 | 6.73 |
| Reads | 4.15 | 6.01 | 8.17 | 9.09 | 9.60 | 10.27 |
| Writes | 0.44 | 1.69 | 2.82 | 3.30 | 3.53 | 5.28 |

Priced Storage Configuration Pricing

| Product ID | Product Name | Qty | Unit List Price | Extended LP | Discount % | Discounted Price |
|----------------|--|-----|-----------------|---------------|------------|---------------------|
| ET442SAU | DX440 S2 Base System Rackmount (AC200V, 3RU) | 1 | \$39,515.00 | \$39,515.00 | 30% | \$27,660.50 |
| ETNHF24 | FC Host Interface, pair - 8 ports (2/4/8 Gbps, Host/Remote Connect) | 2 | \$10,300.00 | \$20,600.00 | 30% | \$14,420.00 |
| ETNM86 | 48GB Cache Memory for DX440 S2 (8GB two sets of 3) | 2 | \$36,000.00 | \$72,000.00 | 30% | \$50,400.00 |
| ETNAD2CU | Drive Enclosure (2.5" HDD) Rackmount (AC200V, 2RU) | 32 | \$6,000.00 | \$192,000.00 | 30% | \$134,400.00 |
| ETND3HC | 300GB/10krpm 2.5" Disk Drives | 762 | \$865.00 | \$659,130.00 | 30% | \$461,391.00 |
| ETNRKC2U | Base Rack - Standard (42RU) with Front & Rear doors, side panels without Earthquake stabilizer | 1 | \$3,150.00 | \$3,150.00 | 30% | \$2,205.00 |
| ETNRKD2U | Expansion Rack - Standard (42RU) with Front & Rear doors, no side panels without Earthquake stabilizer | 1 | \$3,150.00 | \$3,150.00 | 30% | \$2,205.00 |
| ETNC2Q6-L | Rack-to-rack Extension Cables (6 meters) | 2 | \$715.00 | \$1,430.00 | 30% | \$1,001.00 |
| ETNP16U-L | Power Distribution Unit for DX (AC240V, 30A - 8 enclosures, 2RU) | 5 | \$1,520.00 | \$7,600.00 | 30% | \$5,320.00 |
| S6361-F3631-L2 | QLogic 8Gbps Dual Port Fibre Channel Host Bus Adapter | 8 | \$1,920.00 | \$15,360.00 | 10% | \$13,824.00 |
| 61-343827-003 | Fibre Channel Cable LC-LC 3 m | 16 | \$132.00 | \$2,112.00 | 30% | \$1,478.40 |
| | (Provide 24 hour per day / 7days per week 4 hour response maintenance for 36 months) | | | | | |
| | 36 months, Enhanced Plus | 1 | \$248,472.00 | \$248,472.00 | 30% | \$173,930.40 |
| | SFPs are included. | | | | | |
| | | | | Total: | | \$888,235.30 |

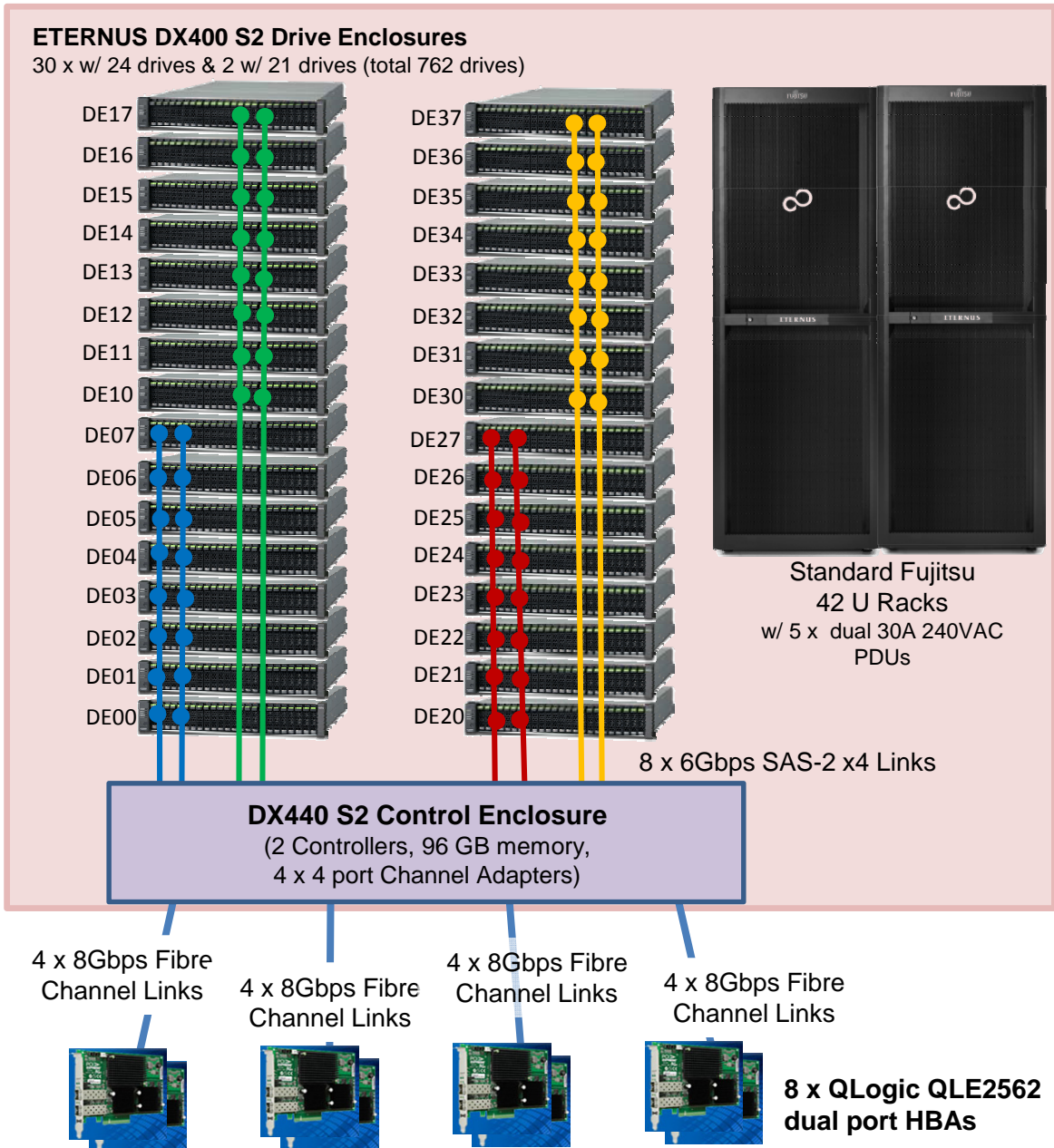
The above pricing includes hardware maintenance and software support for three years, 7 days per week, 24 hours per day. The hardware maintenance and software support provides the following:

- Acknowledgement of new and existing problems with four (4) hours.
- Onsite presence of a qualified maintenance engineer or provision of a customer replaceable part within four (4) hours of the above acknowledgement for any hardware failure that results in an inoperative Priced Storage Configuration that can be remedied by the repair or replacement of a Priced Storage Configuration component.

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 Diagram



Priced Storage Configuration Components

| Priced Storage Configuration |
|--|
| 8 – QLogic QLE2562 dual port FC HBAs (<i>8 Gbps</i>) |
| Fujitsu Storage Systems ETERNUS DX440 S2 2 – Controller Modules, each with: 48 GB cache (<i>96 GB total</i>) Flash Memory power fail protection 2 – Channel Adapter modules, each with 4 –8 Gbps Fibre Channel ports (<i>front-end Host connections, 8 total and 8 used</i>) (<i>16 connections available and 16 used with both controllers</i>) 4 – SAS Expander Drive interfaces, QSFP SAS-2 (<i>backend connections to first drive enclosure</i>) (<i>8 backend connections total, 8 used</i>) |
| 32 –ETERNUS DX400 S2 Drive Enclosures, each with 2 – I/O Modules, each with SAS Expander Drive interface, QSFP SAS-2 (<i>2 total, 2 used</i>) |
| 762 – 300 GB 10K RPM 2.5" SAS Disk Drives: <i>24 disk drives in each of 30 ETERNUS DX400 S2 Drive Enclosures</i> <i>21 disk drives in each of 2 ETERNUS DX80 S2 Drive Enclosures</i> |
| 2 – standard Fujitsu 42U racks with a total of 5 dual 30A 240VAC PDUs |