SPC BENCHMARK 1™
EXECUTIVE SUMMARY

FUJITSU LIMITED
FUJITSU STORAGE SYSTEMS ETERNUS DX440

SPC-1 V1.12

Submitted for Review: March 5, 2010
Submission Identifier: A00089

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

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Test Sponsor Primary Contact	Fujitsu Limited – http://www.fujitsu.com/services/computing/storage/ Fujitsu America Inc. C.A. (Sandy) Wilson Sandy_Wilson@us.fujitsu.com 1250 East Arques Ave P.O. Box 3470 Sunnyvale, CA 94088 3470 Phone: (916) 434-8593
Test Sponsor Alternate Contact	Fujitsu Limited – http://www.fujitsu.com/services/computing/storage/ Fujitsu America Inc. Kun Katsumata Kun_Katsumata@us.fujitsu.com 1250 East Arques Ave P.O. Box 3470 Sunnyvale, CA 94088 3470 Phone: (408) 746-6415 FAX: (408) 746-8016
Test Sponsor Alternate Contact	Fujitsu Limited – http://www.fujitsu.com/services/computing/storage/ Yasuhita Arikawa y.arikawa@jp.fumitsu.com 1-1 Kamikodanaka 4-chrome, Nakahara-ku, Kawasaki-shi, Kanagawa-ken 211-8588, Japan Phone: (044) 754-3632 FAX: (044) 754-3719
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

Revision Information and Key Dates	
SPC-1 Specification revision number	V1.12
SPC-1 Workload Generator revision number	V2.1.0
Date Results were first used publicly	March 5, 2010
Date the FDR was submitted to the SPC	March 5, 2010
Date the priced storage configuration is available for shipment to customers	currently available
Date the TSC completed audit certification	March 4, 2010

Tested Storage Product (TSP) Description

The Fujitsu ETERNUS DX440 is a flexible, highly reliable storage array, equipped with redundant components to provide uncompromised availability for the mid market requirements. A mixture of 300GB, 450GB, and 600GB 15krpm Fibre Channel disk drives, as well as 500GB, 750GB, and 1TB Nearline SATA disk drives may be used, up to a maximum of 420 drives, The drives may be arranged in a variety of RAID groups, including RAID1, RAID1+0(10), RAID5, and RAID6. The product is offered with Fibre Channel (as tested), and iSCSI host connection options. Up to 16 Fibre Channel ports or up to 8 iSCSI ports, or a mixture of port types may be provided. In addition, a number of different snapshot and replication facilities, native disk data encryption, and MAID capabilities are available.

Summary of Results

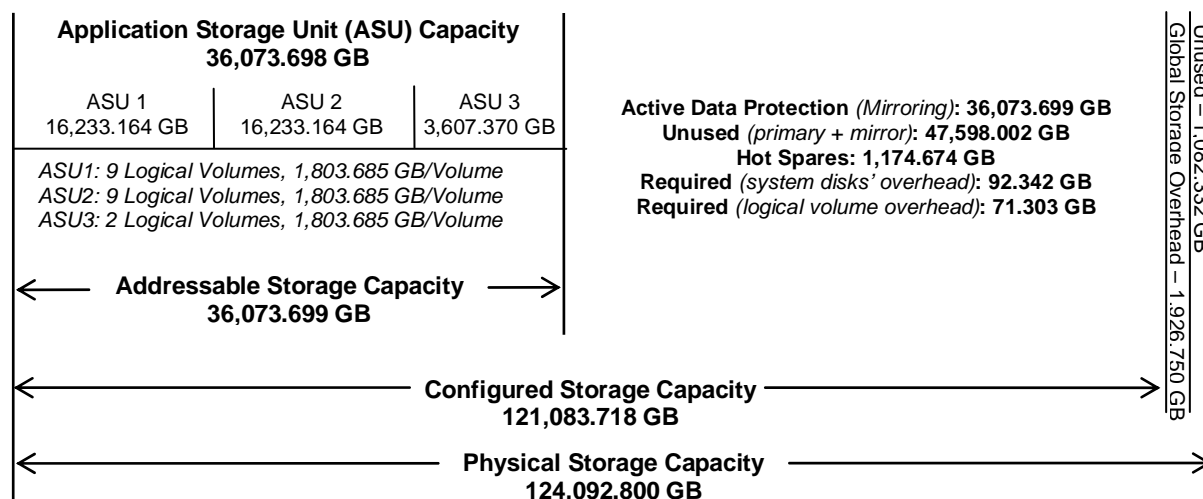| SPC-1 Results	
Tested Storage Configuration (TSC) Name: Fujitsu Storage Systems ETERNUS DX440	
Metric	**Reported Result**
SPC-1 IOPS™	97,498.25
SPC-1 Price-Performance	$5.51/SPC-1 IOPS™
Total ASU Capacity	36,073.698 GB
Data Protection Level	Protected *(Mirroring)*
Total TSC Price (including three-year maintenance)	$537,671

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 and Relationships

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.

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┌──────────────────────────────────────────────────┐                                                    ┌─┐
│   Application Storage Unit (ASU) Capacity          │                                                    │U│G│U│
│              36,073.698 GB                          │                                                    │n│l│n│
├─────────────┬─────────────┬─────────────┤          │   Active Data Protection (Mirroring): 36,073.699 GB │
│   ASU 1     │   ASU 2     │   ASU 3     │          │   Unused (primary + mirror): 47,598.002 GB          │
│ 16,233.164 GB│ 16,233.164 GB│ 3,607.370 GB│        │          Hot Spares: 1,174.674 GB                   │
├─────────────┴─────────────┴─────────────┤          │   Required (system disks' overhead): 92.342 GB      │
│ ASU1: 9 Logical Volumes, 1,803.685 GB/Volume│      │   Required (logical volume overhead): 71.303 GB     │
│ ASU2: 9 Logical Volumes, 1,803.685 GB/Volume│      │                                                     │
│ ASU3: 2 Logical Volumes, 1,803.685 GB/Volume│      │                                                     │
├──────────────────────────────────────────┤        │                                                     │
│  ←——— Addressable Storage Capacity ———→   │                                                             │
│              36,073.699 GB                 │                                                             │
├──────────────────────────────────────────────────────────────── Configured Storage Capacity ──────────→│
│                                                     121,083.718 GB                                        │
├──────────────────────────────────────────────────────────── Physical Storage Capacity ─────────────────→│
│                                                     124,092.800 GB                                        │
```

Unused – 1,082.332 GB
Global Storage Overhead – 1,926.750 GB

SPC-1 Storage Capacity Utilization	
Application Utilization	29.07%
Protected Application Utilization	58.17%
Unused Storage Ratio	39.23%

Application Utilization: Total ASU Capacity *(36,073.698 GB)* divided by Physical Storage Capacity *(124,092.800 GB)*.

Protected Application Utilization: Total ASU Capacity *(36,073.698 GB)* plus total Data Protection Capacity *(59,908.351 GB)* minus unused Data Protection Capacity *(23,799.001 GB)* divided by Physical Storage Capacity *(124,092.800 GB)*.

Unused Storage Ratio: Total ASU Capacity *(36,073.698 GB)* plus total Data Protection Capacity *(59,908.351 GB)* minus unused Data Protection Capacity *(23,799.001 GB)* divided by Physical Storage Capacity *(124,092.800 GB)*.

Detailed information for the various storage capacities and utilizations is available on pages 19-20 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.
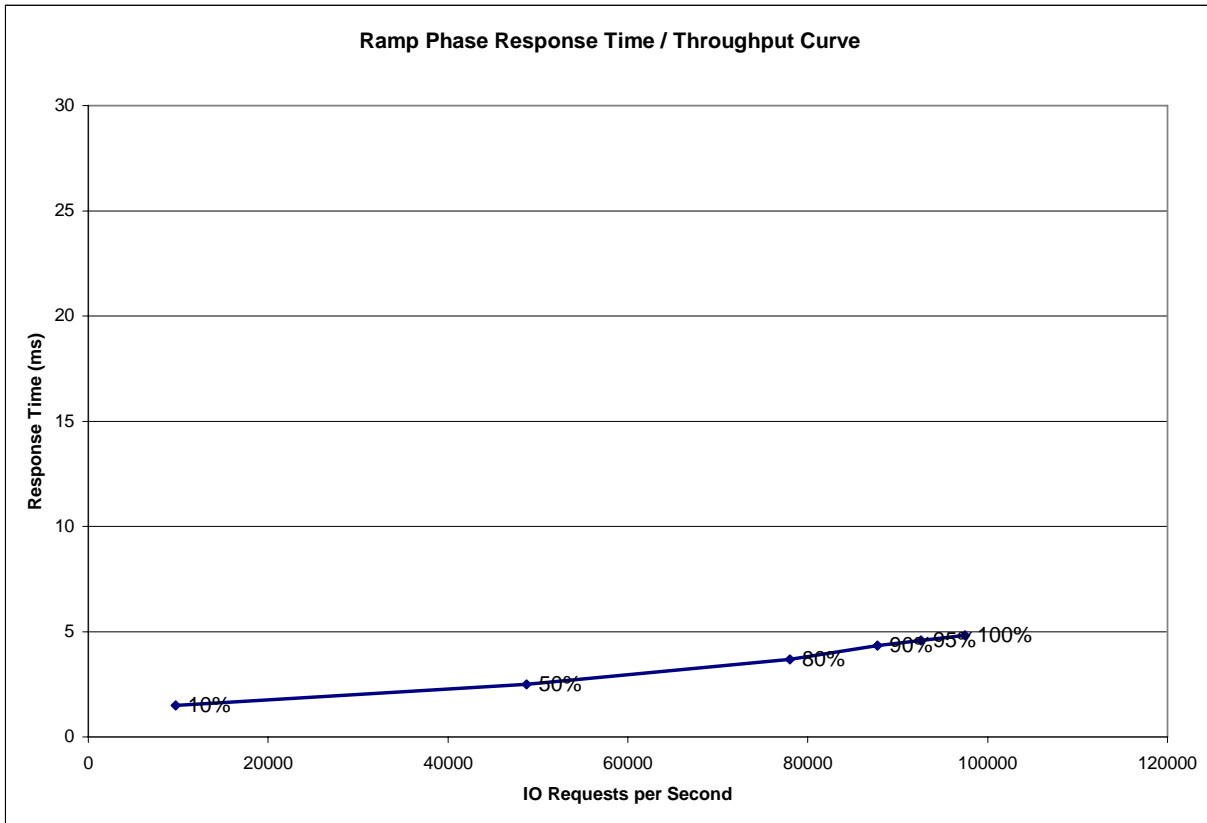
Response Time – Throughput Data

	10% Load	50% Load	80% Load	90% Load	95% Load	100% Load
I/O Request Throughput	9,749.74	48,742.72	78,009.39	87,736.79	92,578.86	97,498.25
Average Response Time (ms):						
All ASUs	1.50	2.50	3.69	4.33	4.59	4.83
ASU-1	2.05	3.22	4.55	5.24	5.54	5.81
ASU-2	1.34	2.56	3.98	4.75	5.11	5.47
ASU-3	0.40	0.93	1.75	2.20	2.35	2.47
Reads	3.22	4.93	6.74	7.70	8.16	8.62
Writes	0.38	0.92	1.70	2.13	2.26	2.36

Priced Storage Configuration Pricing

Item	Product Id	Description	Qty	Unit $	Extd $
	Fujitsu ETERNUS DX440				
1	ET44S20AU	ETERNUS DX440 FLOOR STAND MODEL	1		
2	ETMDE2BU	ADDITIONAL DRIVE ENCLOSURES FOR DX440	9		
3	ETMDE3BU	ADDITIONAL DRIVE ENCLOSURES FOR DX440 (Extension Cable Type)	4		
3	ETMER4U	EXPANSION RACK FOR DX440	2		
4	ETMM44U	16GB CACHE MEMORY FOR DX440	2		
5	ETMHF88U	HOST INTERFACE (8GBPS, FC, 8-PORT)	2		
6	ETMFC3MU	300GB/15KRPM DISK DRIVE X2 (RAID1) (includes qty 416 disk drives)	208		
7	Item #1 through #6 total	ETERNUS DX440 Storage Array System	1	$712,194	$712,194
8	61-343827-015	LC/LC Fibre Channel Cable, 15 M. (Multimode - 50/125um, Riser Rated)	8	$181	$1,448
9	QLE2562-2	Qlogic 8Gbps HBA	4	$2,533	$10,132
10	ETDX44-W059360-AAI	ETDX 440 Warranty, 36 Months, Basic Level, Mon-Fri, 12x5 Phone Support 8AM-8PM Local Time, 9x5 Onsite and Parts 8AM-5PM Local	1	$0	
11	ETDX44-U004361-AAI	ETDX 440 Warranty Uplift, 36 Months Enhanced Plus Level, 24x7x365 Phone Onsite and Parts (Sev1 Resp. Time - 4 Hours),	1	$132,588	$132,588
12	ETDX44-N067005-AAI	ETDX 440 Installation during normal business hours Eternus Installation, One Time billing	1	$1,575	$1,575
13	FTSPS-ET-QSDX440	Professional Services-ETERNUSDX Model 440 Quickstart	1	$11,275	$11,275
		Total Fujitsu Product List Price			$712,194
		Product Discount		40%	
		Net Product Price			$427,316
		Total Non Fujitsu Product List Price			$11,580
		Product Discount		40%	
		Net Non Fujitsu Product Price			$6,948
		Total Service List Price			$145,438
		Service Discount		29%	
		Net Service Price			$103,407
		Total Sell Price, including 3 years Service			**$537,671**

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

Due to the availability of equipment within the test lab, the expansion cabinets used for the benchmark, containing the expansion drive enclosures had the drive enclosures mounted differently than they are for the DX440. Physically they are the same drive enclosures, but in these two expansion cabinets, they were mounted with the long dimension in the vertical, while in the normal mounting for the DX440, the long dimension is horizontal. The electrical / optical fibre channel connections were the same as in the standard mounting for the DX440. There is no affect on performance of the orientation of the drive enclosures within the expansion cabinets. The four drive enclosures in the base cabinet were mounted in the standard horizontal structure for the DX440.

Benchmark Configuration (BC)/Tested Storage Configuration (TSC)/ Priced Storage Configuration Diagram
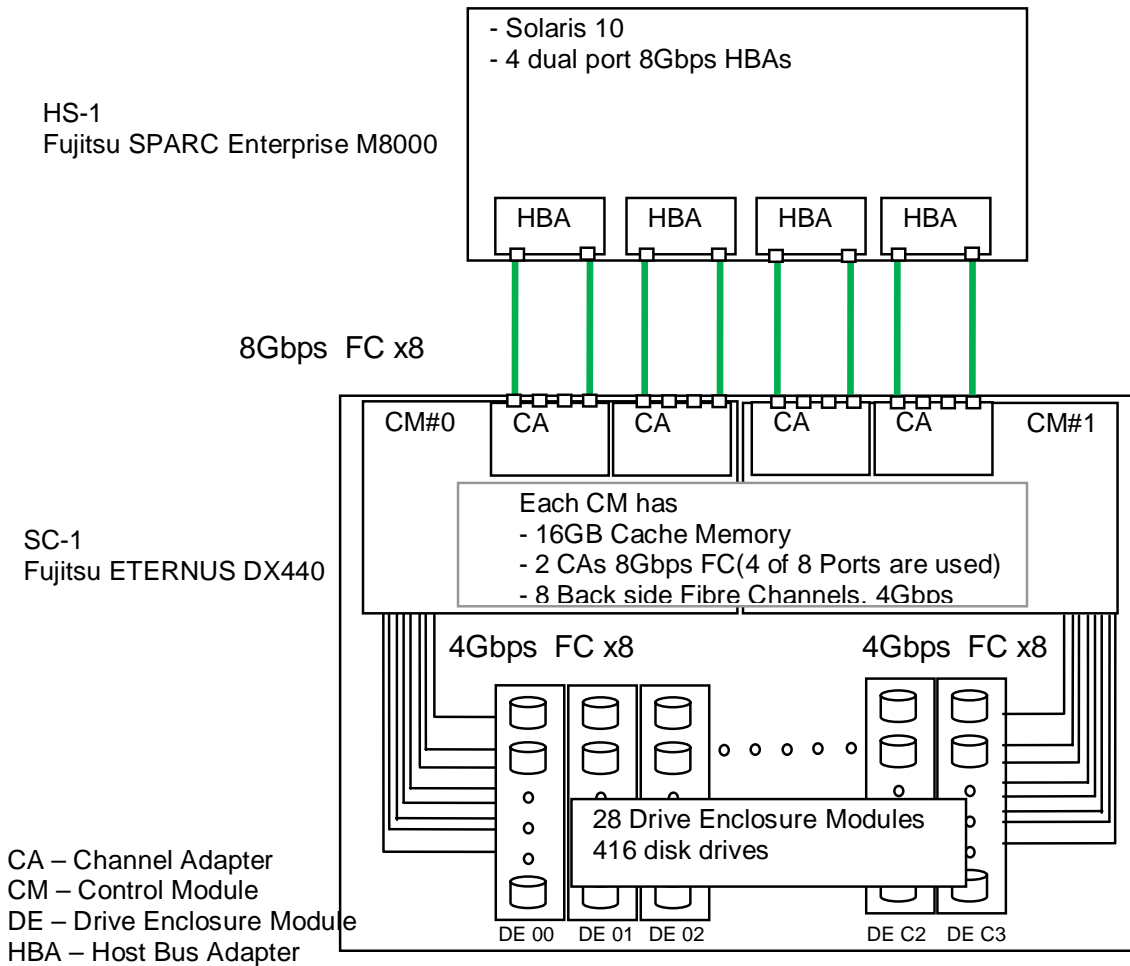
HS-1
Fujitsu SPARC Enterprise M8000

- Solaris 10
- 4 dual port 8Gbps HBAs

HBA   HBA   HBA   HBA

8Gbps FC x8

CM#0   CA   CA   CA   CA   CM#1

Each CM has
- 16GB Cache Memory
- 2 CAs 8Gbps FC(4 of 8 Ports are used)
- 8 Back side Fibre Channels, 4Gbps

SC-1
Fujitsu ETERNUS DX440

4Gbps FC x8   4Gbps FC x8

28 Drive Enclosure Modules
416 disk drives

CA – Channel Adapter
CM – Control Module
DE – Drive Enclosure Module
HBA – Host Bus Adapter

DE 00   DE 01   DE 02   DE C2   DE C3

Benchmark Configuration (BC)/Tested Storage Configuration (TSC)/ Priced Storage Configuration Components

Host System:	Tested Storage Configuration (TSC) / Priced Storage Configuration:

HS-1: Fujitsu SPARC Enterprise M8000
 	
16 – 2.4 GHz SPARC64 VI chips each with:
    128 KB L1 instruction cache,
    128 KB L1 data cache, 6 MB L2 cache
	4 –Qlogic QLE2562-2 dual-port 8 Gbps HBAs

512 GB main memory	**SC-1: Fujitsu Storage Systems
	        ETERNUS DX440**
	
	2 – Controller Modules, each with:
	
	    16 GB cache *(32 GB total)*
	
	    2 – Channel Adapter modules *(4 total)*,
	        each Channel Adapter with
	        4 – Fibre Channel ports
	            (16 ports total, 8 ports used)
	
	    8 – Fibre Channel Expander Drive Interfaces
	        (16 total)

Solaris 10	
Solaris Volume Manager	
PCIe	
WG	8 – Front side Fibre Channels (8 Gbps) 16 – Back side Fibre Channels (4 Gbps)

	28 – Drive Enclosure Modules, each with dual
	    switched FC-AL interfaces, 15 hot swap drive
	    slots

	416 – 300 GB 15K RPM disk drives
	    *(408 in 68 RAID Groups, 4 reserved for
	    system use, and 4 Hot Spares)*