



**SPC BENCHMARK 1™
EXECUTIVE SUMMARY**

**IBM CORPORATION
IBM SYSTEM STORAGE DS8870**

SPC-1 V1.12

Submitted for Review: October 3, 2012

Submission Identifier: A00120

Revised: October 15, 2012

EXECUTIVE SUMMARY

Test Sponsor and Contact Information

| Test Sponsor and Contact Information | |
|---|--|
| Test Sponsor Primary Contact | IBM Corporation – http://www.ibm.com Bruce McNutt – bmcnutt@us.ibm.com IBM ARC 650 Harry Road San Jose, CA 95120 Phone: (408) 927-2717 FAX: (408) 927-2050 |
| Test Sponsor Alternate Contact | IBM Corporation – http://www.ibm.com David Whitworth – davidw@us.ibm.com 11501 Burnet Rd. Austin, TX 78758 Phone: (512) 286-9218 |
| 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 | V2.2.0 |
| Date Results were first used publicly | October 3, 2012 |
| Date the FDR was submitted to the SPC | October 3, 2012 |
| Date the revised FDR was submitted to the SPC Revised chart scaling on pages 30, 35, 48 and 52 of the Full Disclosure Report to provide a more clear illustration of various response time values. | October 15, 2012 |
| Date the Priced Storage Configuration is available for shipment to customers | October 19, 2012 |
| Date the TSC completed audit certification | September 28, 2012 |

Tested Storage Product (TSP) Description

The DS8870 represents the latest in this series of enterprise disk storage systems designed for high-performance, high-capacity and resiliency. New with the 8870 are a major upgrade of the processing complex and system bandwidth.

Summary of Results

| SPC-1 Reported Data | |
|--|--------------------------------|
| Tested Storage Product (TSP) Name: IBM System Storage DS8870 | |
| Metric | Reported Result |
| SPC-1 IOPS™ | 451,082.27 |
| SPC-1 Price-Performance | \$10.81/SPC-1 IOPS™ |
| Total ASU Capacity | 56,232.000GB |
| Data Protection Level | Protected (<i>Mirroring</i>) |
| Total TSC Price (including three-year maintenance) | \$4,875,005.70 |

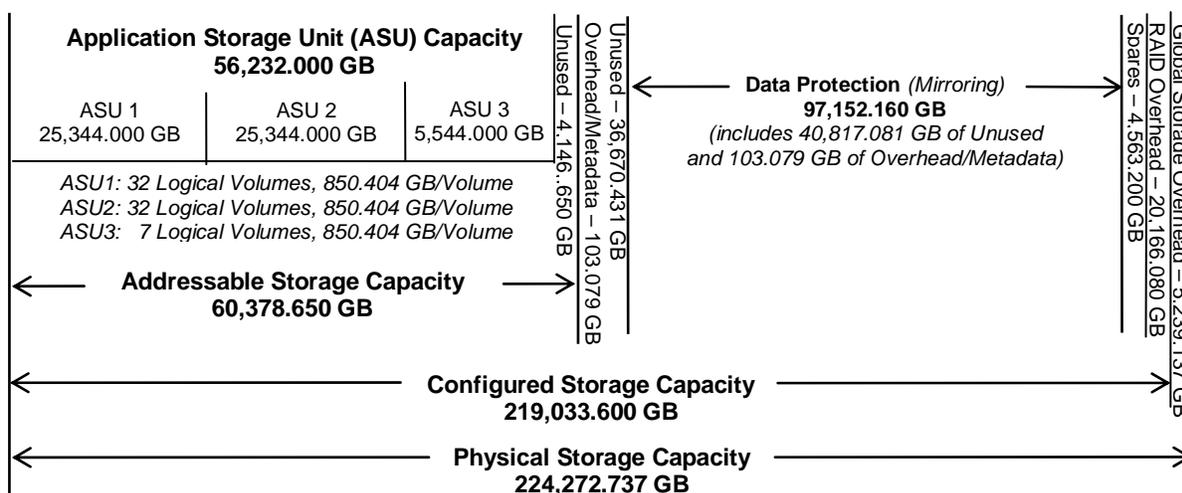
SPC-1 IOPS™ represents the maximum I/O Request Throughput at the 100% load point.

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 (*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 | 25.07% |
| Protected Application Utilization | 50.19% |
| Unused Storage Ratio | 36.40% |

Application Utilization: Total ASU Capacity (*56,232.000 GB*) divided by Physical Storage Capacity (*224,272.737 GB*)

Protected Application Utilization: Total ASU Capacity (*56,232.000 GB*) plus total Data Protection Capacity (*97.152.160 GB*) minus unused Data Protection Capacity (*40,817.081 GB*) divided by Physical Storage Capacity (*224,272.737 GB*)

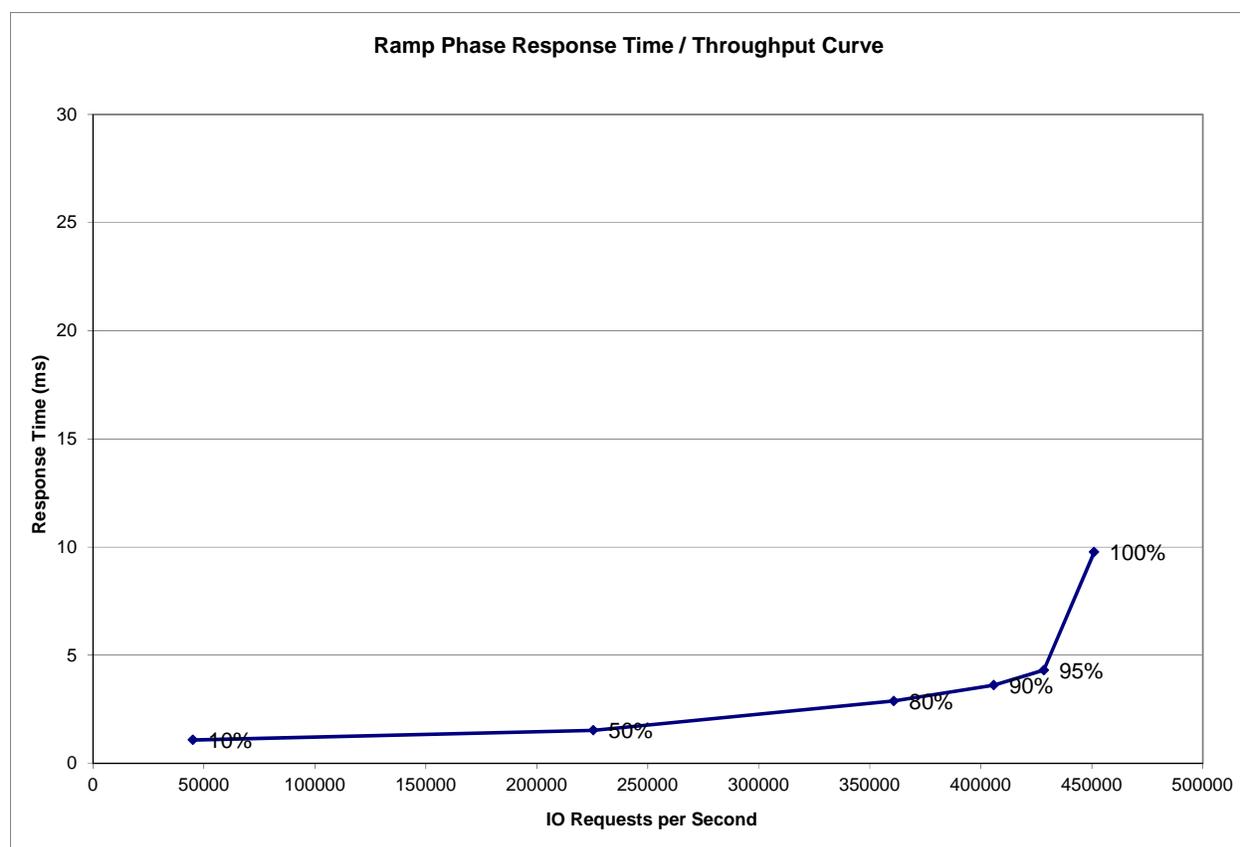
Unused Storage Ratio: Total Unused Capacity (*81,634.162 GB*) divided by Physical Storage Capacity (*224,272.737 GB*) and may not exceed 45%.

Detailed information for the various storage capacities and utilizations is available on pages 23-24 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 | 45,089.86 | 225,493.94 | 360,839.78 | 405,899.16 | 428,462.79 | 451,082.27 |
| Average Response Time (ms): | | | | | | |
| All ASUs | 1.08 | 1.53 | 2.88 | 3.61 | 4.31 | 9.77 |
| ASU-1 | 1.43 | 1.95 | 2.85 | 3.49 | 4.12 | 5.18 |
| ASU-2 | 1.17 | 1.62 | 2.51 | 3.14 | 3.79 | 4.86 |
| ASU-3 | 0.31 | 0.60 | 3.11 | 4.09 | 4.95 | 21.65 |
| Reads | 2.31 | 3.04 | 4.27 | 5.05 | 5.74 | 6.89 |
| Writes | 0.29 | 0.54 | 1.98 | 2.68 | 3.38 | 11.64 |

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

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

Priced Storage Configuration Pricing

| Product | Description | Qty | Unit Price | List Price | % disc't | Ext'd Price |
|----------|--|-----|---------------|---------------|----------|---------------|
| 2423-961 | IBM System Storage DS8870 | 1 | \$ 72,419.00 | \$ 72,419.00 | 50% | \$ 36,209.50 |
| 1 | 9xE factory merge | 3 | \$ - | \$ - | 50% | \$ - |
| 100 | Eligible for EU Shipment | 1 | \$ - | \$ - | 50% | \$ - |
| 201 | Storage Enclosure Infrastructure | 1 | \$ - | \$ - | 50% | \$ - |
| 351 | 961 - 96E Position 1 | 1 | \$ - | \$ - | 50% | \$ - |
| 352 | 961 - 96E Position 2 | 1 | \$ - | \$ - | 50% | \$ - |
| 353 | 961 - 96E Position 3 | 1 | \$ - | \$ - | 50% | \$ - |
| 700 | OEL Indicator | 1 | \$ - | \$ - | 50% | \$ - |
| 713 | IBM System Storage Easy Tier Indicator | 1 | \$ - | \$ - | 50% | \$ - |
| 840 | 200.1 to 250.0 TB capacity | 1 | \$ - | \$ - | 50% | \$ - |
| 900 | Non-Standby CoD | 1 | \$ - | \$ - | 50% | \$ - |
| 1051 | Battery Assembly | 2 | \$ 16,200.00 | \$ 32,400.00 | 50% | \$ 16,200.00 |
| 1082 | Line Cord (US/LA/AP/Canada) | 1 | \$ 7,000.00 | \$ 7,000.00 | 50% | \$ 3,500.00 |
| 1120 | Management Console - English Laptop Internal | 1 | \$ 9,160.00 | \$ 9,160.00 | 50% | \$ 4,580.00 |
| 1241 | Disk Enclosure Pair | 5 | \$ 20,000.00 | \$ 100,000.00 | 50% | \$ 50,000.00 |
| 1242 | HD STD Enclosure Indicator | 5 | \$ - | \$ - | 50% | \$ - |
| 1246 | HD Disk Drive Cable Group 1 | 1 | \$ 7,000.00 | \$ 7,000.00 | 50% | \$ 3,500.00 |
| 1301 | I/O Enclosure Pair PCIE | 2 | \$ 11,780.00 | \$ 23,560.00 | 50% | \$ 11,780.00 |
| 1321 | PCI-E Cable Group 2 | 1 | \$ 4,100.00 | \$ 4,100.00 | 50% | \$ 2,050.00 |
| 1731 | DS8000 LMC R7.0 | 1 | \$ 40,000.00 | \$ 40,000.00 | 50% | \$ 20,000.00 |
| 5108 | 146 GB 15K Drive Set FDE | 15 | \$ 53,909.00 | \$ 808,635.00 | 50% | \$ 404,317.50 |
| 3053 | Device Adapter Pair I | 4 | \$ 15,000.00 | \$ 60,000.00 | 50% | \$ 30,000.00 |
| 3153 | 8 Gb 4 port SW FCP/FICON Adapter PCIE | 8 | \$ 37,312.00 | \$ 298,496.00 | 50% | \$ 149,248.00 |
| 4317 | 1TB Processor Memory (16-core) | 1 | \$ 926,280.00 | \$ 926,280.00 | 50% | \$ 463,140.00 |
| 4404 | 16-core Processor Card | 1 | \$ 333,820.00 | \$ 333,820.00 | 50% | \$ 166,910.00 |
| 7034 | OEL - 25 TB | 1 | \$ - | \$ - | 50% | \$ - |
| 7045 | OEL - 200 TB | 1 | \$ - | \$ - | 50% | \$ - |
| 7051 | OEL - 1 Value Unit | 1 | \$ - | \$ - | 50% | \$ - |
| 7053 | OEL - 10 Value Unit | 1 | \$ - | \$ - | 50% | \$ - |
| 7055 | OEL - 50 Value Unit | 1 | \$ - | \$ - | 50% | \$ - |
| 7065 | OEL - 200 Value Unit | 2 | \$ - | \$ - | 50% | \$ - |
| 7083 | IBM System Storage Easy Tier indicator | 1 | \$ - | \$ - | 50% | \$ - |
| 2398-LFA | DS8000 Function Authorization | 1 | \$ - | \$ - | 40% | \$ - |
| 7034 | OEL - 25 TB | 1 | \$ - | \$ - | 40% | \$ - |
| 7045 | OEL - 200 TB | 1 | \$ - | \$ - | 40% | \$ - |
| 7051 | OEL - 1 Value Unit | 1 | \$ 6,666.00 | \$ 6,666.00 | 40% | \$ 3,999.60 |
| 7053 | OEL - 10 Value Unit | 1 | \$ 53,659.00 | \$ 53,659.00 | 40% | \$ 32,195.40 |
| 7055 | OEL - 50 Value Unit | 1 | \$ 140,794.00 | \$ 140,794.00 | 40% | \$ 84,476.40 |
| 7065 | OEL - 200 Value Unit | 2 | \$ 429,677.00 | \$ 859,354.00 | 40% | \$ 515,612.40 |
| 7083 | IBM System Storage Easy Tier | 1 | \$ - | \$ - | 40% | \$ - |

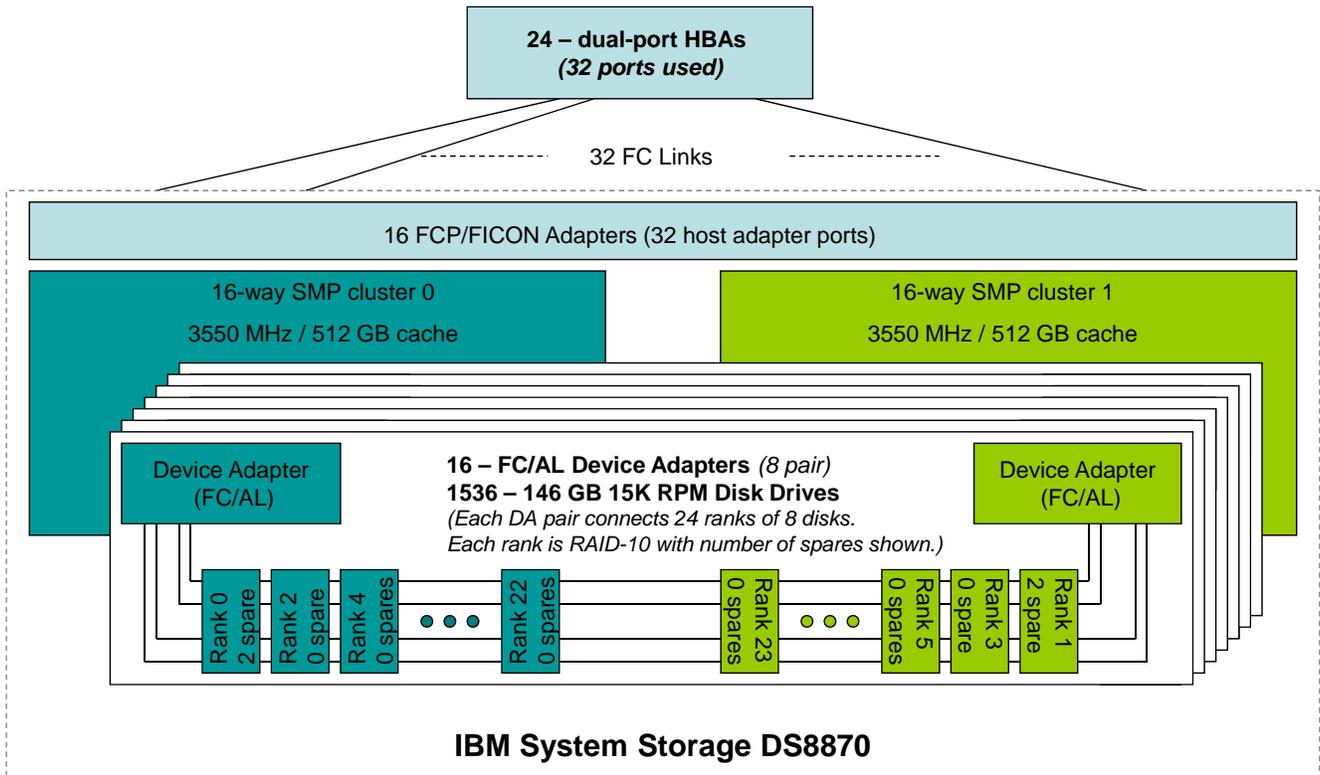
Priced Storage Configuration Pricing (continued)

| Product | Description | Qty | Unit Price | List Price | % disc't | Ext'd Price |
|--------------|--|-----|--------------|-----------------|----------|------------------------|
| 2423-96E | IBM System Storage DS8870 Expansion Unit | 1 | \$ 73,500.00 | \$ 73,500.00 | 50% | \$ 36,750.00 |
| 1 | 9xE factory merge | 1 | \$ - | \$ - | 50% | \$ - |
| 100 | Eligible for EU Shipment | 1 | \$ - | \$ - | 50% | \$ - |
| 201 | Storage Enclosure Infrastructure | 1 | \$ - | \$ - | 50% | \$ - |
| 353 | 961 - 96E Position 3 | 1 | \$ - | \$ - | 50% | \$ - |
| 840 | 200.1 to 250.0 TB capacity | 1 | \$ - | \$ - | 50% | \$ - |
| 1082 | Line Cord (US/LA/AP/Canada) | 1 | \$ 7,000.00 | \$ 7,000.00 | 50% | \$ 3,500.00 |
| 1241 | Disk Enclosure Pair | 10 | \$ 20,000.00 | \$ 200,000.00 | 50% | \$ 100,000.00 |
| 1242 | HD STD Enclosure Indicator | 10 | \$ - | \$ - | 50% | \$ - |
| 1249 | HD Disk Drive Cable Group 5 | 1 | \$ 12,000.00 | \$ 12,000.00 | 50% | \$ 6,000.00 |
| 1831 | DS8000 LMC R7.0 indicator | 1 | \$ - | \$ - | 50% | \$ - |
| 5108 | 146 GB 15K Drive Set FDE | 30 | \$ 53,909.00 | \$ 1,617,270.00 | 50% | \$ 808,635.00 |
| 2423-96E | IBM System Storage DS8870 Expansion Unit | 1 | \$ 73,500.00 | \$ 73,500.00 | 50% | \$ 36,750.00 |
| 1 | 9xE factory merge | 1 | \$ - | \$ - | 50% | \$ - |
| 100 | Eligible for EU Shipment | 1 | \$ - | \$ - | 50% | \$ - |
| 201 | Storage Enclosure Infrastructure | 1 | \$ - | \$ - | 50% | \$ - |
| 352 | 961 - 96E Position 2 | 1 | \$ - | \$ - | 50% | \$ - |
| 840 | 200.1 to 250.0 TB capacity | 1 | \$ - | \$ - | 50% | \$ - |
| 1082 | Line Cord (US/LA/AP/Canada) | 1 | \$ 7,000.00 | \$ 7,000.00 | 50% | \$ 3,500.00 |
| 1241 | Disk Enclosure Pair | 10 | \$ 20,000.00 | \$ 200,000.00 | 50% | \$ 100,000.00 |
| 1242 | HD STD Enclosure Indicator | 10 | \$ - | \$ - | 50% | \$ - |
| 1248 | HD Disk Drive Cable Group 4 | 1 | \$ 12,000.00 | \$ 12,000.00 | 50% | \$ 6,000.00 |
| 1831 | DS8000 LMC R7.0 indicator | 1 | \$ - | \$ - | 50% | \$ - |
| 5108 | 146 GB 15K Drive Set FDE | 30 | \$ 53,909.00 | \$ 1,617,270.00 | 50% | \$ 808,635.00 |
| 2423-96E | IBM System Storage DS8870 Expansion Unit | 1 | \$ 73,500.00 | \$ 73,500.00 | 50% | \$ 36,750.00 |
| 1 | 9xE factory merge | 1 | \$ - | \$ - | 50% | \$ - |
| 100 | Eligible for EU Shipment | 1 | \$ - | \$ - | 50% | \$ - |
| 201 | Storage Enclosure Infrastructure | 1 | \$ - | \$ - | 50% | \$ - |
| 351 | 961 - 96E Position 1 | 1 | \$ - | \$ - | 50% | \$ - |
| 840 | 200.1 to 250.0 TB capacity | 1 | \$ - | \$ - | 50% | \$ - |
| 1051 | Battery Assembly | 2 | \$ 16,200.00 | \$ 32,400.00 | 50% | \$ 16,200.00 |
| 1082 | Line Cord (US/LA/AP/Canada) | 1 | \$ 7,000.00 | \$ 7,000.00 | 50% | \$ 3,500.00 |
| 1241 | Disk Enclosure Pair | 7 | \$ 20,000.00 | \$ 140,000.00 | 50% | \$ 70,000.00 |
| 1242 | HD STD Enclosure Indicator | 7 | \$ - | \$ - | 50% | \$ - |
| 1247 | HD Disk Drive Cable Group 2 | 1 | \$ 9,000.00 | \$ 9,000.00 | 50% | \$ 4,500.00 |
| 1301 | I/O Enclosure Pair PCIE | 2 | \$ 11,780.00 | \$ 23,560.00 | 50% | \$ 11,780.00 |
| 1322 | PCIE Cable Group 3 | 1 | \$ 5,000.00 | \$ 5,000.00 | 50% | \$ 2,500.00 |
| 1831 | DS8000 LMC R7.0 indicator | 1 | \$ - | \$ - | 50% | \$ - |
| 5108 | 146 GB 15K Drive Set FDE | 21 | \$ 53,909.00 | \$ 1,132,089.00 | 50% | \$ 566,044.50 |
| 3053 | Device Adapter Pair I | 4 | \$ 15,000.00 | \$ 60,000.00 | 50% | \$ 30,000.00 |
| 3153 | 8 Gb 4 port SW FCP/FICON Adapter PCIE | 8 | \$ 37,312.00 | \$ 298,496.00 | 50% | \$ 149,248.00 |
| 9117-5735 | 8 Gbps dual port FC adapter | 24 | \$ 4,583.00 | \$ 109,992.00 | 30% | \$ 76,994.40 |
| TOTAL | | | | | | \$ 4,875,005.70 |

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.

Priced Storage Configuration Diagram



Priced Storage Configuration Components

| |
|---|
| Priced Storage Configuration: |
| 24 – 8 Gbps dual port FC HBAs |
| IBM System Storage DS8870 |
| 2 –SMP processing clusters |
| Each cluster contains: |
| 16 – processor cores |
| 512 GB – processor memory (1024 GB total) |
| 16 – 8 Gb, 4 port SW FCP/FICON adapter pairs <i>(128 host port front-end connections, 32 used)</i> |
| 8 – 8 Gb, 4 port FC-AL device adapter pairs <i>(4 adapter pair/cluster)</i> <i>(64 backend connections, 64 used)</i> |
| 1 – Management Console <i>(internal laptop)</i> |
| 3 – DS8870 Expansion Units |
| 32 – Disk Enclosure pairs <i>(48 disk drives per enclosure pair)</i> |
| 1,536 – 146 GB, 15K RPM, 2.5" disk drives |

