



**SPC BENCHMARK 1™  
EXECUTIVE SUMMARY**

**IBM CORPORATION  
IBM POWER 780 SERVER (*WITH SSDs*)**

**SPC-1 V1.13**

**Submitted for Review: April 11, 2013  
Submission Identifier: A00130**

## EXECUTIVE SUMMARY

### Test Sponsor and Contact Information

Test Sponsor and Contact Information	
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### Revision Information and Key Dates

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<b>SPC-1 Specification revision number</b>	V1.13
<b>SPC-1 Workload Generator revision number</b>	V2.3.0
<b>Date Results were first used publicly</b>	April 11, 2013
<b>Date the FDR was submitted to the SPC</b>	April 11, 2013
<b>Date the Priced Storage Configuration is available for shipment to customers</b>	May 2, 2012
<b>Date the TSC completed audit certification</b>	April 10, 2013

### Tested Storage Product (TSP) Description

Designed for virtualized consolidation of business critical workloads, the IBM® Power® 780 Server (Model 9179-MHD) is a symmetric multiprocessing, rack-mounted server. This modular system uses one to four enclosures that are four EIA units tall and housed in a 19-inch rack. Each enclosure contains four powerful POWER7+ processor modules, high density memory DIMMs using 4 Gb technology, and a high-performance PCIe Gen2 I/O backplane.

The EXP30 Ultra SSD I/O Drawer (#EDR1) enables the attachment of up to 30 solid state drives (SSDs) in just 1U of rack space without using PCIe slots. This ultra-dense SSD option is attached using a new GX++ 2-port, PCIe2 x8 Adapter (#1914), which provides a pair of PCIe2 connections from the EXP30 drawer directly into a high bandwidth server bus (GX++). A Power 780 server can support the attachment of up to 8 EXP30 drawers.

## Summary of Results

SPC-1 Reported Data	
Tested Storage Product (TSP) Name: IBM Power 780 server (with SSDs)	
Metric	Reported Result
SPC-1 IOPS™	780,081.02
SPC-1 Price-Performance™	\$4.56/SPC-1 IOPS™
Total ASU Capacity	28,400.000 GB
Data Protection Level	Protected 1 (Mirroring)
Total Price	\$3,557,709.00
Currency Used	U.S. Dollars
Target Country for availability, sales and support	USA

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

SPC-1 Price-Performance™ is the ratio of **Total Price** to SPC-1 IOPS™.

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

A **Data Protection Level** of **Protected 1** using **Mirroring** configures two or more identical copies of user data.

***Protected 2:** The single point of failure of any **storage device** in the configuration will not result in permanent loss of access to or integrity of the SPC-1 Data Repository.*

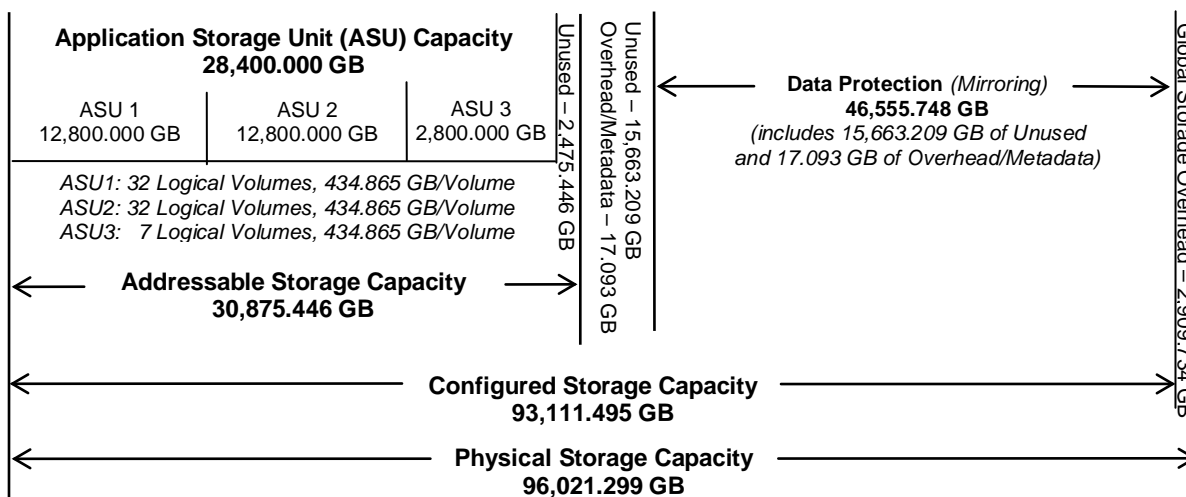
**Total Price** includes the cost of the Priced Storage Configuration plus three years of hardware maintenance and software support as detailed on page 6.

**Currency Used** is formal name for the currency used in calculating the **Total Price** and **SPC-1 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.

## 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	29.58%
Protected Application Utilization	61.75%
Unused Storage Ratio	37.78%

**Application Utilization:** Total ASU Capacity (28,400.000 GB) divided by Physical Storage Capacity (96,021.299 GB).

**Protected Application Utilization:** Total ASU Capacity (28,400.000 GB) plus total Data Protection Capacity (46,555.748 GB) minus unused Data Protection Capacity (15,663.209 GB) divided by Physical Storage Capacity (96,021.299 GB).

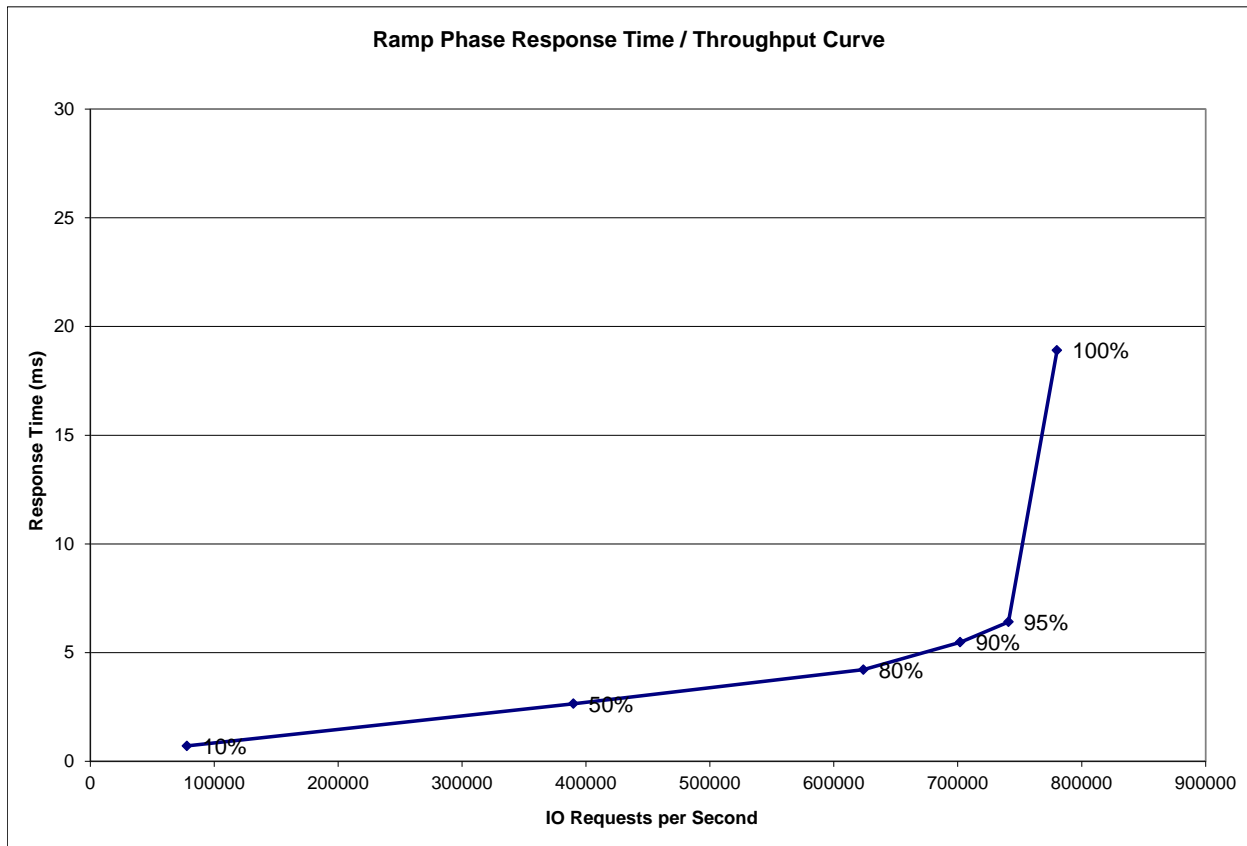
**Unused Storage Ratio:** Total Unused Capacity (36,277.310 GB) divided by Physical Storage Capacity (96,021.299 GB) and may not exceed 45%.

Detailed information for the various storage capacities and utilizations is available on pages 22-23 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
<b>I/O Request Throughput</b>	77,992.95	389,956.78	623,942.41	702,036.09	740,956.08	780,081.02
<b>Average Response Time (ms):</b>						
<b>All ASUs</b>	0.71	2.65	4.22	5.48	6.41	18.90
<b>ASU-1</b>	0.66	2.59	4.14	5.38	6.31	18.77
<b>ASU-2</b>	0.70	2.64	4.22	5.47	6.42	18.90
<b>ASU-3</b>	0.83	2.79	4.40	5.68	6.63	19.16
<b>Reads</b>	0.52	2.41	3.90	5.12	6.03	18.43
<b>Writes</b>	0.84	2.81	4.43	5.71	6.66	19.20

## Priced Storage Configuration Pricing

Product	Description	Qty	Unit Price	Extended Price
9179-MHD	Server 1:9179 Model MHD	1	\$10,195.00	\$10,195.00
1769	Integrated Multifunction card with SR Optical	4	\$3,358.00	\$13,432.00
1886	146GB 15K RPM SFF SAS Disk Drive (AIX/Linux)	1	\$652.00	\$652.00
1914	GX++ 2-port PCIe2 x8 Adapter	8	\$3,300.00	\$26,400.00
3671	Serv Interface Cable- 2, 3, and 4 Enclosure	1	\$2,000.00	\$2,000.00
3672	Serv Interface Cable- 3 and 4 Enclosure	1	\$3,000.00	\$3,000.00
3673	Serv Interface Cable- 4 Enclosure	1	\$4,000.00	\$4,000.00
3716	Processor Cable, 2--4-Drawer System, 4 socket	1	\$5,000.00	\$5,000.00
3717	Processor Cable, 3--4-Drawer System, 4 socket	1	\$10,000.00	\$10,000.00
3718	Processor Cable, 4-Drawer System, 4 socket	1	\$12,000.00	\$12,000.00
5287	PCIe2 2-port 10GbE SR Adapter	4	\$3,930.00	\$15,720.00
5532	System AC Power Supply, 1925 W	8	\$1,502.00	\$12,016.00
5652	Disk/Media Backplane	4	\$4,000.00	\$16,000.00
5665	FSP/Clock Pass Through Card	2	\$900.00	\$1,800.00
5771	SATA Slimline DVD-RAM Drive	1	\$392.00	\$392.00
5899	PCIe2 4-port 1GbE Adapter	4	\$394.00	\$1,576.00
6006	Power Control Cable (SPCN) - 3 meter	1	\$52.00	\$52.00
6577	Power Cable - Drawer to IBM PDU, 200-240V/10A	24	\$19.00	\$456.00
EB95	System CEC Enclosure	4	\$12,000.00	\$48,000.00
EC53	Operator Panel	1	\$1,000.00	\$1,000.00
EDR1	EXP30 Ultra SSD I/O Drawer	8	\$32,092.00	\$256,736.00
EM42	0/128GB CoD DDR3 Memory (4X32GB) DIMMS	16	\$2,200.00	\$35,200.00
EMA3	Activation of 100 GB DDR3 POWER7+ Memory	10	\$18,500.00	\$185,000.00
EN07	PCIe x8 Cable 3m	16	\$445.00	\$7,120.00
EPH2	0/32 Core POWER7+, 16 DDR3 Memory Slots	4	\$77,877.00	\$311,508.00
EPHC	1-Core Activation for Processor Feature EPH2	64	\$5,678.00	\$363,392.00
ES02	387GB 1.8in SAS SSD for AIX/Linux with eMLC	240	\$7,990.00	\$1,917,600.00
EU09	Service Processor-3	2	\$4,000.00	\$8,000.00
7014-T42	Rack 1:Rack Model T42	1	\$3,970.00	\$3,970.00
6069	Front door (Black) for High Perforation (2m racks)	1	\$550.00	\$550.00
6098	Side Panel (Black)	2	\$150.00	\$300.00
6492	PDU to Wall Powercord 14'	4	\$400.00	\$1,600.00
7188	Power Dist Unit-Side Mount	3	\$1,000.00	\$3,000.00
ESC1	Rack Shipping and Handling - A	1	\$400.00	\$400.00
7316-TF3	Rack-Mounted Flat Panel Console Kit	1	\$3,459.00	\$3,459.00
7042-CR7	HMC Rack-mounted Hardw.Mgmt.Console	1	\$8,735.00	\$8,735.00
5692-A6P	System Software / DVD Process Charge	2	\$118.00	\$236.00
5765-G99	IBM AIX Enterprise Edition Version 7.1 per processor	64	\$4,225.00	\$270,400.00
5765-PVE	PowerVM Enterprise Edition per processor	64	\$2,800.00	\$179,200.00
5771-AEZ	AIX SW Maintenance, 1 Year per processor	192	\$1,326.00	\$254,592.00
5771-PVE	PowerVM Enterprise Edition SW Maintenance: 1 Yr	192	\$884.00	\$169,728.00
5771-RS1	HMC SW Maintenance, 1 year	3	\$337.00	\$1,011.00
	Monthly HW Maintenance	24	\$24,091.00	\$578,184.00
	<b>Total Extended Price</b>			<b>\$4,743,612.00</b>
	Field Delegation Discount			25.00%
	<b>Discounted Price</b>			<b>\$3,557,709.00</b>

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**

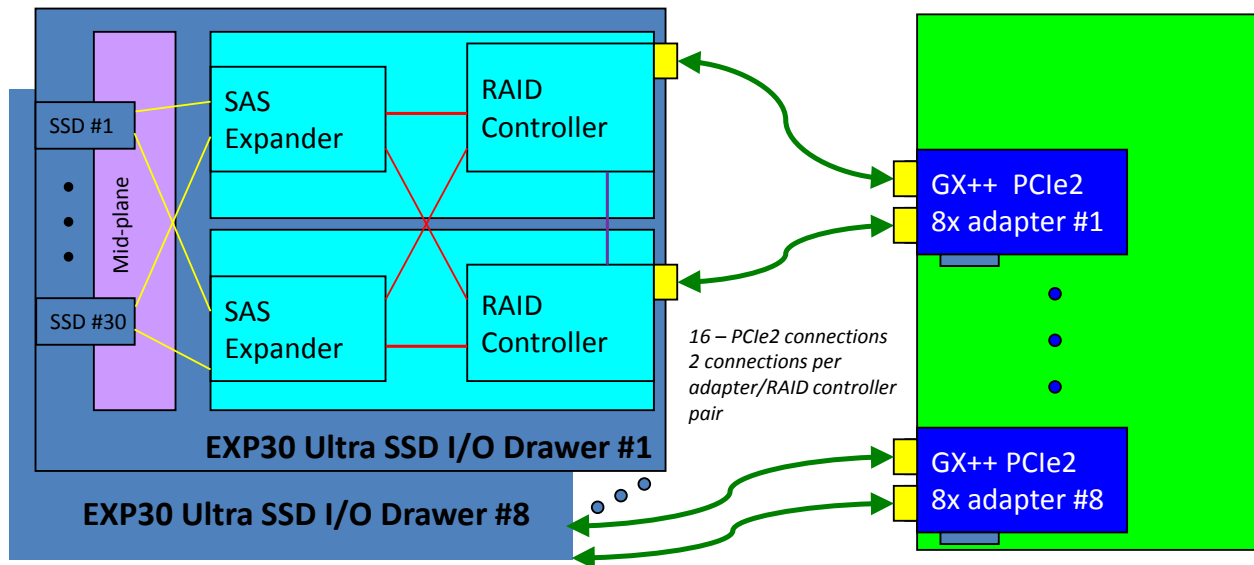
There were no differences between the TSC and Priced Storage Configuration.

**Priced Storage Configuration Diagram**

**IBM Power 780 server**

- AIX 7.1 with service pack TL1/SP7**
- 4 – System Enclosures**
- 16 – Power 7+ processor modules**
  - 4 – 3.724 GHz processor cores/module**  
(64 processors total)
  - 256 KB L2 cache per core
  - 10 MB L3 cache per core
- 1,000 GiB main memory activated**
- 8 – GX++ 2-port PCIe2 8x adapters**
- 2 – Service Processors**
- 8 – EXP30 Ultra SSD I/O Drawers, each with:**
  - 2 – RAID controllers each with:
    - 3.1 GB write cache
    - 1 – PCIe2 port
    - 2 – 4 x 6Gbps SAS PHYs
  - 2 – SAS expanders each with
    - 2 – 4 x 6Gbps SAS PHYs
    - 30 – 1 x 6Gbps SAS PHYs
- 240 – 387 GB, 1.8”, SAS SSDs**  
(30 SSDs per EXP30)
- 1 – Hardware Management Console**
- 1 – Rack with 3 side mounted PDUs**
  - 1 front door, 2 side panels, 1 console kit

- 1x6 Gbps SAS
- 3x6 Gbps SAS
- 4x6 Gbps SAS





## Priced Storage Configuration Components

<b>Priced Storage Configuration:</b>
4 – System Enclosures
<b>IBM Power 780 server</b> with AIX 7.1 with service pack TL1/SP7 16 – Power 7+ processor modules 4 – 3.724 GHz processor cores per module <i>(64 processors total)</i> 256 KB L2 cache per core 10 MB L3 cache per core 2,048 GiB main memory <i>(1,000 GiB activated)</i> 8 – GX++ 2-port PCIe2 adapters 4 – Disk/Media Backplanes 2 – Service Processors 8 – System AC Power Supplies, 1925W
<b>8 – EXP30 Ultra SSD I/O Drawers</b> , each with 2 – RAID controllers, each with 3.1 GB write cache 1 – PCIe2 port 2 – 4 x 6Gbps SAS PHYs 2 – SAS expanders, each with 2 – 4 x 6Gbps SAS PHYs <i>(to RAID controller)</i> 30 – 1 x 6Gbps SAS PHYs <i>(to SSDs)</i>
240 – 387 GB, 1.8", SAS SSDs <i>(30 SSDs per EXP30)</i>
1 – Hardware Management Console
1 – Rack with 3 side mounted PDUs 1 front door, 2 side panels, 1 console kit