SPC Benchmark 1™
Executive Summary

IBM Corporation
IBM XIV Storage System Gen3 (Version 11.3)

SPC-1 V1.14

Submitted for Review: June 10, 2013
Submission Identifier: A00135
EXECUTIVE SUMMARY

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Revision Information and Key Dates

<table>
<thead>
<tr>
<th>Revision Information and Key Dates</th>
<th>V1.14</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPC-1 Specification revision number</td>
<td>V1.14</td>
</tr>
<tr>
<td>SPC-1 Workload Generator revision number</td>
<td>V2.3.0</td>
</tr>
<tr>
<td>Date Results were first used publicly</td>
<td>June 10, 2013</td>
</tr>
<tr>
<td>Date the FDR was submitted to the SPC</td>
<td>June 10, 2013</td>
</tr>
<tr>
<td>Date the Priced Storage Configuration is available for shipment to customers</td>
<td>June 25, 2013</td>
</tr>
<tr>
<td>Date the TSC completed audit certification</td>
<td>April 24, 2013</td>
</tr>
</tbody>
</table>

Tested Storage Product (TSP) Description

XIV is a versatile, high-end disk storage solution with an innovative grid architecture that can provide clients excellent performance and scalability while significantly reducing costs and complexity. XIV includes automated data placement that needs no tuning as application workloads change. Version 11.3 offers flash memory as cache storage (included in this submission). Version 11.3 also includes capacity on demand (selection of capacity and price points implemented by software).
Summary of Results

<table>
<thead>
<tr>
<th>SPC-1 Reported Data</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Tested Storage Product (TSP) Name: IBM XIV Storage System Gen3 (Version 11.3)</td>
<td></td>
</tr>
<tr>
<td>Metric</td>
<td>Reported Result</td>
</tr>
<tr>
<td>SPC-1 IOPS™</td>
<td>180,020.29</td>
</tr>
<tr>
<td>SPC-1 Price-Performance™</td>
<td>$5.42/SPC-1 IOPS™</td>
</tr>
<tr>
<td>Total ASU Capacity</td>
<td>44,358.865 GB</td>
</tr>
<tr>
<td>Data Protection Level</td>
<td>Protected 1 (Mirroring)</td>
</tr>
<tr>
<td>Total Price</td>
<td>$976,071.30</td>
</tr>
<tr>
<td>Currency Used</td>
<td>U.S. Dollars</td>
</tr>
<tr>
<td>Target Country for availability, sales and support</td>
<td>USA</td>
</tr>
</tbody>
</table>

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 1: 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 8.

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 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 may be listed as an integer value, for readability.
EXECUTIVE SUMMARY

SPC BENCHMARK 1™ V1.14 EXECUTIVE SUMMARY Submission Identifier: A00135
IBM Corporation Submitted for Review: JUNE 10, 2013
IBM XIV Storage System Gen3 (Version 11.3)

Configured Storage Capacity: 111,020 GB

- Sparing Capacity: 15,000 GB 13.51%
- Available Data Capacity: 96,020 GB 86.49%

Addressable Storage Capacity: 46,042 GB 41.47%

- Metadata: 69 GB 0.06%
- Unused Data Capacity: 1,899 GB 1.71%

Data Protection Capacity: 48,010 GB 43.24%

includes copies of above Metadata and Unused Data Capacity

Available Data Capacity: 96,020 GB 86.49%

Addressable Storage Capacity: 46,042 GB

- 20 Logical Volumes, 1,031 GB per Volume (ASU-1)
- 20 Logical Volumes, 1,031 GB per Volume (ASU-2)
- 5 Logical Volumes, 962 GB per Volume (ASU-3)

Total ASU Capacity: 44,359 GB 96.34%

ASU-1 Capacity: 19,961 GB 45.00%
- 20 Logical Volumes 998 GB/Volume

ASU-2 Capacity: 19,961 GB 45.00%
- 20 Logical Volumes 998 GB/Volume

ASU-3 Capacity: 4,436 GB 10.00%
- 5 Logical Volumes 887 GB/Volume

Unused Addressable Capacity: 1,683 GB 3.66%
**Application Utilization:**

**Application Utilization:** Total ASU Capacity \((44,358.865 \text{ GB})\) divided by Physical Storage Capacity \((180,000.000 \text{ GB})\)

**Protected Application Utilization:** Total ASU Capacity \((44,358.865 \text{ GB})\) plus total Data Protection Capacity \((48,010.000 \text{ GB})\) minus unused Data Protection Capacity \((3,582.416 \text{ GB})\) divided by Physical Storage Capacity \((180,000.000 \text{ GB})\)

**Unused Storage Ratio:** Total Unused Capacity \((76,144.832 \text{ GB})\) divided by Physical Storage Capacity \((180,000.000 \text{ GB})\) 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 IOPSTM 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 Curve Diagram](image)

Response Time – Throughput Data

<table>
<thead>
<tr>
<th>I/O Request Throughput</th>
<th>10% Load</th>
<th>50% Load</th>
<th>80% Load</th>
<th>90% Load</th>
<th>95% Load</th>
<th>100% Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>All ASUs</td>
<td>0.41</td>
<td>0.74</td>
<td>1.89</td>
<td>3.32</td>
<td>3.21</td>
<td>4.60</td>
</tr>
<tr>
<td>ASU-1</td>
<td>0.41</td>
<td>0.78</td>
<td>1.81</td>
<td>3.51</td>
<td>3.25</td>
<td>5.05</td>
</tr>
<tr>
<td>ASU-2</td>
<td>0.51</td>
<td>1.26</td>
<td>5.46</td>
<td>8.74</td>
<td>9.12</td>
<td>11.65</td>
</tr>
<tr>
<td>ASU-3</td>
<td>0.37</td>
<td>0.42</td>
<td>0.49</td>
<td>0.53</td>
<td>0.52</td>
<td>0.56</td>
</tr>
<tr>
<td>Reads</td>
<td>0.51</td>
<td>1.27</td>
<td>4.08</td>
<td>7.17</td>
<td>7.38</td>
<td>10.85</td>
</tr>
<tr>
<td>Writes</td>
<td>0.34</td>
<td>0.39</td>
<td>0.45</td>
<td>0.81</td>
<td>0.49</td>
<td>0.52</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
<th>Unit Price</th>
<th>Discount</th>
<th>Extended price with Discount</th>
</tr>
</thead>
<tbody>
<tr>
<td>2812-214 IBM XIV Storage System Model 214, all HW includes 3 year warranty.</td>
<td>1</td>
<td>$187,195.00</td>
<td>70%</td>
<td>$56,158.50</td>
</tr>
<tr>
<td>Interface/Data modules, w/ 12 x 1 TB disk option.</td>
<td>15</td>
<td>$101,250.00</td>
<td>70%</td>
<td>$455,625.00</td>
</tr>
<tr>
<td>SSD cache (6TB)</td>
<td>1</td>
<td>$405,000.00</td>
<td>70%</td>
<td>$121,500.00</td>
</tr>
<tr>
<td>5639-YYB XIV Software</td>
<td>1</td>
<td>$516,750.00</td>
<td>60%</td>
<td>$206,700.00</td>
</tr>
<tr>
<td>5639-XX3 XIV Software Support (3 years)</td>
<td>1</td>
<td>$206,700.00</td>
<td>60%</td>
<td>$82,680.00</td>
</tr>
<tr>
<td>IBM SAN24B-5 8Gb FC Switch</td>
<td>1</td>
<td>$33,503.00</td>
<td>20%</td>
<td>$26,802.40</td>
</tr>
<tr>
<td>Warranty extension for switch (add 2x1 year)</td>
<td>2</td>
<td>$2,330.00</td>
<td>20%</td>
<td>$3,728.00</td>
</tr>
<tr>
<td>Short wave 25m Fibre Channel cable</td>
<td>24</td>
<td>$189.00</td>
<td>20%</td>
<td>$3,628.80</td>
</tr>
<tr>
<td>8Gbps Dual Port FC adapter (HBA)</td>
<td>6</td>
<td>$4,583.00</td>
<td>30%</td>
<td>$19,248.60</td>
</tr>
<tr>
<td><strong>Total Price</strong></td>
<td></td>
<td><strong>$976,071.30</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

**IBM XIV® System Storage Gen3**  
*Version 11.3*

- 6 – 2TB Interface Modules  
- 9 – 2TB Data Modules  
- 180 – 2 TB 7200 RPM SAS disk drives  
  (12 – disk drives per module)

**IBM XIV® System Storage Gen3 (Version 11.3)**

- 360 GiB RAM memory/cache  
- 6,000 GB Flash cache (15 – 400 GB Flash modules)  
- 6 – 2 TB Interface Modules  
- 9 – 2 TB Data Modules  
- 24 – 8 Gbps FC front-end connections (12 used)  
- 30 – 4x6 Gbps SAS backend connections (30 used)  
- 180 – 2 TB 7200 RPM SAS disk drive  
  (12 per interface and data module)  
- 1 – IBM SAN48B-5 16Gbps FC switch  
- 24 – Short Wave 25m fibre channel cables