SPC Benchmark 1™

Full Disclosure Report

Huawei Technologies Co., Ltd
Huawei OceanStor 5300 V5

SPC-1 V3.7

Submission Identifier: A31015

Submitted for Review: August 28, 2018
First Edition – August 2018

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Benchmark Specification and Glossary

The official SPC Benchmark 1™ (SPC-1™) specification is available on the website of the Storage Performance Council (SPC) at www.storageperformance.org.

The SPC-1™ specification contains a glossary of the SPC-1™ terms used in this publication.
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AUDIT CERTIFICATION

Zhong Xu
Huawei Technologies Co., Ltd.
Huawei Industrial Base, Bantian,
Longgang, Shenzhen city,
Guangdong province, China

August 24, 2018

I verified the SPC Benchmark 1™ (SPC-1™ Revision 3.7) test execution and performance results of the following Tested Storage Product:

HUAWEI OCEANSTOR 5300 V5

The results were:

<table>
<thead>
<tr>
<th>Test Description</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPC-1 IOPS™</td>
<td>450,212</td>
</tr>
<tr>
<td>SPC-1 Price-Performance™</td>
<td>$416.27/SPC-1 KIOPS™</td>
</tr>
<tr>
<td>SPC-1 IOPS™ Response Time</td>
<td>0.577 ms</td>
</tr>
<tr>
<td>SPC-1 Overall Response Time</td>
<td>0.409 ms</td>
</tr>
<tr>
<td>SPC-1 ASU Capacity</td>
<td>11,768 GB</td>
</tr>
<tr>
<td>SPC-1 ASU Price</td>
<td>$15.93/GB</td>
</tr>
<tr>
<td>SPC-1 Total System Price</td>
<td>$187,405.32</td>
</tr>
</tbody>
</table>

In my opinion, these performance results were produced in compliance with the SPC requirements for the benchmark.

The testing was executed using the SPC-1 Toolkit Version 3.0.2-1 build g823a. The audit process was conducted in accordance with the SPC Policies and met the requirements for the benchmark.

A Letter of Good Faith was issued by the Test Sponsor, stating the accuracy and completeness of the documentation and testing data provided in support of the audit of this result.

A Full Disclosure Report for this result was prepared by InfoSizing, reviewed and approved by the Test Sponsor, and can be found at www.spcresults.org under the Submission Identifier A31015.
The independent audit process conducted by InfoSizing included the verifications of the following items:

- The physical capacity of the data repository;
- The total capacity of the Application Storage Unit (ASU);
- The accuracy of the Benchmark Configuration diagram;
- The tuning parameters used to configure the Benchmark Configuration;
- The Workload Generator commands used to execute the testing;
- The validity and integrity of the test result files;
- The compliance of the results from each performance test;
- The compliance of the results from the persistence test;
- The compliance of the submitted pricing model; and
- The differences between the tested and the priced configuration, if any.

The Full Disclosure Report for this result was prepared in accordance with the disclosure requirements set forth in the specification for the benchmark.

The following benchmark requirements, if any, were waived according to the SPC Policies:

- None.

Respectfully Yours,

François Raab, Certified SPC Auditor
LETTER OF GOOD FAITH

Date: August 24, 2018

From: Huawei Technologies Co., Ltd.

To: Mr. Francois Raab, Certified SPC Auditor
   InfoSizing
   20 Kreg Lane
   Manitou Springs, CO 80829

Subject: SPC-1 Letter of Good Faith for the Huawei OceanStor 5300 V5

Huawei Technologies Co., Ltd. is the SPC-1 Test Sponsor for the above listed product. To the best of our knowledge and belief, the required SPC-1 benchmark results and materials we have submitted for that product are complete, accurate, and in full compliance with V3.6 of the SPC-1 benchmark specification.

In addition, we have reported any items in the Benchmark Configuration and execution of the benchmark that affected the reported results even if the items are not explicitly required to be disclosed by the SPC-1 benchmark specification.

Signed:                     Date: 08.04.2018

Meng Guangbin
President of Storage Product Line
SPC BENCHMARK 1™

EXECUTIVE SUMMARY

HUAWEI TECHNOLOGIES CO., LTD
HUAWEI OCEANSTOR 5300 V5

<table>
<thead>
<tr>
<th>SPC-1 IOPS™</th>
<th>450,212</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPC-1 Price-Performance™</td>
<td>$416.27/SPC-1 KIOPS™</td>
</tr>
<tr>
<td>SPC-1 IOPS™ Response Time</td>
<td>0.577 ms</td>
</tr>
<tr>
<td>SPC-1 Overall Response Time</td>
<td>0.409 ms</td>
</tr>
<tr>
<td>SPC-1 ASU Capacity</td>
<td>11,768 GB</td>
</tr>
<tr>
<td>SPC-1 ASU Price</td>
<td>$15.93/GB</td>
</tr>
<tr>
<td>SPC-1 Total System Price</td>
<td>$187,405.32</td>
</tr>
<tr>
<td>Data Protection Level</td>
<td>Protected 2 (RAID-10)</td>
</tr>
<tr>
<td>Physical Storage Capacity</td>
<td>28,640 GB</td>
</tr>
<tr>
<td>Pricing Currency / Target Country</td>
<td>U.S. Dollars / USA</td>
</tr>
</tbody>
</table>

SPC-1 V3.7

SUBMISSION IDENTIFIER: A31015
SUBMITTED FOR REVIEW: AUGUST 28, 2018
Benchmark Configuration Diagram

Host Systems

4 x Huawei FusionServer™ RH2288H V3

2 x QLogic dual-ported QLE2562 FC HBA per FusionServer™

16 x FC connections (4 connections per server)

Huawei OceanStor 5300 V5

2 x Engine Enclosures

4 x OceanStor 5300 V5 Active-Active Controllers (2 per Engine)

64 GB cache per controller (256 GB total)

4 x 4-port 8Gbps Smart I/O Modules (1 per Controller)

4 x 4-port 10Gbps Smart I/O Modules (1 per Controller)

4 x 2-port 12Gbps SAS I/O Modules (1 per Controller)

16 x 900 GB SSDs (8 per Enclosure)

2 x 2U Disk Enclosures

16 x 900 GB SSDs (8 per Enclosure)
Tested Storage Product Description

The new generation of mid-range hybrid flash storage, dedicated to providing the reliable and efficient data services for enterprises.

Cloud-ready operating system, flash-enabled performance, and intelligent management software, delivering top-of-the-line functionality, performance, efficiency, reliability, and ease of use.

Satisfies the data storage requirements of large-database OLTP/OLAP, cloud computing, and many other applications, making it a perfect choice for sectors such as government, finance, telecommunications, and manufacturing.

For more details, visit:


Priced Storage Configuration Components

<table>
<thead>
<tr>
<th>8 x QLogic dual-ported QLE2562 FC HBA</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 x OceanStor 5300 V5 Active-Active Controllers (2 per enclosure), each with:</td>
</tr>
<tr>
<td>64 GB cache (256 GB total)</td>
</tr>
<tr>
<td>4 x 4-port 8Gbps Smart I/O Modules</td>
</tr>
<tr>
<td>4 x 4-port 10Gbps Smart I/O Modules</td>
</tr>
<tr>
<td>4 x 2-port 12Gbps SAS I/O Modules</td>
</tr>
<tr>
<td>2 x System enclosures, each with:</td>
</tr>
<tr>
<td>8 x 900 GB SSDs (16 total)</td>
</tr>
<tr>
<td>2 x 2U Disk enclosures, each with:</td>
</tr>
<tr>
<td>8 x 900 GB SSDs (16 total)</td>
</tr>
</tbody>
</table>
## Storage Configuration Pricing

<table>
<thead>
<tr>
<th>Description</th>
<th>Qty</th>
<th>Unit Price</th>
<th>Ext. Price</th>
<th>Disc.</th>
<th>Disc. Price</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hardware &amp; Software</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>53V5-128G-AC2-8FC</td>
<td>2</td>
<td>53,768.00</td>
<td>107,536.00</td>
<td>68%</td>
<td>34,411.52</td>
</tr>
<tr>
<td>SMARTIO10ETH</td>
<td>4</td>
<td>6,288.00</td>
<td>25,152.00</td>
<td>68%</td>
<td>8,048.64</td>
</tr>
<tr>
<td>HSSD-900G2S-A6</td>
<td>32</td>
<td>9,096.00</td>
<td>291,072.00</td>
<td>70%</td>
<td>87,321.60</td>
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<tr>
<td>DAE52525U2-AC-A2</td>
<td>2</td>
<td>10,584.00</td>
<td>21,168.00</td>
<td>68%</td>
<td>6,773.76</td>
</tr>
<tr>
<td>N8GHBA000</td>
<td>8</td>
<td>1,698.00</td>
<td>13,584.00</td>
<td>0%</td>
<td>13,584.00</td>
</tr>
<tr>
<td>SN2F01FCPC</td>
<td>16</td>
<td>14.00</td>
<td>224.00</td>
<td>0%</td>
<td>224.00</td>
</tr>
<tr>
<td>LIC-55V5-BS</td>
<td>1</td>
<td>8,676.00</td>
<td>8,676.00</td>
<td>70%</td>
<td>2,602.80</td>
</tr>
<tr>
<td><strong>Hardware &amp; Software Subtotal</strong></td>
<td></td>
<td></td>
<td>152,966.32</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Support &amp; Maintenance</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>02352FEC-88134ULF-36</td>
<td>2</td>
<td>9,734.00</td>
<td>19,468.00</td>
<td>0%</td>
<td>19,468.00</td>
</tr>
<tr>
<td>88034JVV-88134UHK-36</td>
<td>1</td>
<td>1,926.00</td>
<td>1,926.00</td>
<td>0%</td>
<td>1,926.00</td>
</tr>
<tr>
<td>8812153243</td>
<td>1</td>
<td>13,045.00</td>
<td>13,045.00</td>
<td>0%</td>
<td>13,045.00</td>
</tr>
<tr>
<td><strong>Support &amp; Maintenance Subtotal</strong></td>
<td></td>
<td></td>
<td>34,439.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SPC-1 Total System Price</strong></td>
<td></td>
<td>187,405.32</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SPC-1 IOPS™</strong></td>
<td></td>
<td>450,212</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SPC-1 Price-Performance™ ($/SPC-1 KIOPS™)</strong></td>
<td></td>
<td>416.27</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SPC-1 ASU Capacity (GB)</strong></td>
<td></td>
<td>11,768</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>SPC-1 ASU Price ($/GB)</strong></td>
<td></td>
<td>15.93</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Third-Party Reseller:** Huawei Technologies Co., Ltd. only sells its products to third-party resellers who, in turn, sell those products to U.S. customers. The above reflects the pricing quoted by one of those third-party resellers. See Appendix B of the Full Disclosure Report for a copy of the third-party reseller’s quotation.

**Discount Details:** The discounts shown are based on the storage capacity purchased and are generally available.
**Warranty**: Hi-Care Premier On-Site Service include: 7x24 Technical Assistance Center Access. Access to all new software updates and Online Support. 24x7 with 4-hour On-site Hardware Replacement.

**Availability Date**: Currently available.
Response Time and Throughput Graph

Contact Information

Test Sponsor Primary Contact
Huawei Technologies Co., Ltd – www.huawei.com
Zhong Xu – xuzhong@huawei.com

SPC Auditor
InfoSizing – www.sizing.com
Francois Raab – francois@sizing.com

Revision Information

<table>
<thead>
<tr>
<th>SPC Benchmark 1™ Revision</th>
<th>V3.7.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPC-1 Workload Generator Revision</td>
<td>V3.0.2-1 build g823a</td>
</tr>
<tr>
<td>Publication Revision History</td>
<td>First Edition</td>
</tr>
</tbody>
</table>
CONFIGURATION INFORMATION

Benchmark Configuration and Tested Storage Configuration

The following diagram illustrates the Benchmark Configuration (BC), including the Tested Storage Configuration (TSC) and the Host System(s).

**Storage Network Configuration**

The Tested Storage Configuration (TSC) involved an external storage subsystem made of 4 Huawei OceanStor 5300 V5, driven by 4 host systems (Huawei FusionServer RH2288H V3). The OceanStor controllers were grouped in sets of 2, forming 2 OceanStor Engines. Each FusionServer host system connected one-to-one
to each OceanStor Engine. That connection was established via a port from 1 of the 2 dual-port Fibre Channel HBAs on the FusionServer; and a port from 1 of the 4 4-port Smart I/O Modules on the OceanStor Engine, leaving 12 of these ports inactive in each Engine. These Fibre Channel paths operated at 8Gbps.

**Host System and Tested Storage Configuration Components**

The following table lists the components of the Host System(s) and the Tested Storage Configuration (TSC).

<table>
<thead>
<tr>
<th>Host Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 x Huawei FusionServer™ RH2288H V3</td>
</tr>
<tr>
<td>2 x Intel® Xeon® E5-2667 v4 (3.2 GHz, 8 Cores, 25 MB L3)</td>
</tr>
<tr>
<td>128 GB Main Memory</td>
</tr>
<tr>
<td>Red Hat Enterprise Linux 7.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Priced Storage Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 x QLogic dual-ported QLE2562 FC HBA</td>
</tr>
<tr>
<td>4 x OceanStor 5300 V5 Active-Active Controllers (2 per Engine), each with:</td>
</tr>
<tr>
<td>64 GB cache (256 GB total)</td>
</tr>
<tr>
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</tr>
<tr>
<td>4 x 2-port 12Gbps SAS I/O Modules</td>
</tr>
<tr>
<td>2 x Engine enclosures, each with:</td>
</tr>
<tr>
<td>8 x 900 GB SSDs (16 total)</td>
</tr>
<tr>
<td>2 x 2U Disk enclosures, each with:</td>
</tr>
<tr>
<td>8 x 900 GB SSDs (16 total)</td>
</tr>
</tbody>
</table>

**Differences Between Tested and Priced Storage Configurations**

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

**Component Changes in Revised Full Disclosure Report**

The following table outlines component changes that were made in revisions to this Full Disclosure Report.

<table>
<thead>
<tr>
<th>Original Component</th>
<th>Revised Component</th>
<th>Description of Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>n/a</td>
<td>n/a</td>
<td>Initial submission</td>
</tr>
</tbody>
</table>
Benchmark Configuration Creation Process

Customer Tuning Parameters and Options

All the customer tuning parameters and options that have been altered from their default values for this benchmark are included in Appendix C and in the Supporting Files (see Appendix A).

Tested Storage Configuration Creation

A detailed description of how the logical representation of the TSC was created is included in Appendix D and in the Supporting Files (see Appendix A).

Tested Storage Configuration Inventory

An inventory of the components in the TSC, as seen by the Benchmark Configuration, is included in Appendix E and in the Supporting Files (see Appendix A).

Workload Generator Storage Configuration

The SPC-1 Workload Generator storage configuration commands and parameters used to invoke the execution of the tests are included in Appendix F and in the Supporting Files (see Appendix A).

Logical Volume Capacity and ASU Mapping

The following table details the capacity of each ASU and how they are mapped to logical volumes (LV).

<table>
<thead>
<tr>
<th>ASU</th>
<th>LV Capacity</th>
<th>Used per LV</th>
<th>Total per ASU</th>
<th>% ASU Capacity</th>
<th>SPC-1 ASU Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASU-1</td>
<td>294.3</td>
<td>294.2</td>
<td>5,295.7</td>
<td>45.00%</td>
<td>294.3</td>
</tr>
<tr>
<td>ASU-2</td>
<td>294.3</td>
<td>294.2</td>
<td>5,295.7</td>
<td>45.00%</td>
<td>294.3</td>
</tr>
<tr>
<td>ASU-3</td>
<td>588.5</td>
<td>588.4</td>
<td>1,176.8</td>
<td>10.00%</td>
<td>588.5</td>
</tr>
</tbody>
</table>

Physical Storage Capacity and Utilization

The following table details the Physical Capacity of the storage devices and the Physical Capacity Utilization (percentage of Total Physical Capacity used) in support of hosting the ASUs.

<table>
<thead>
<tr>
<th>Devices</th>
<th>Count</th>
<th>Physical Capacity</th>
<th>Total Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>900GB SSD</td>
<td>32</td>
<td>895.0</td>
<td>28,640.0</td>
</tr>
<tr>
<td>Total Physical Capacity</td>
<td></td>
<td>28,640.0</td>
<td></td>
</tr>
<tr>
<td>Physical Capacity Utilization</td>
<td></td>
<td>41.09%</td>
<td></td>
</tr>
</tbody>
</table>

Data Protection

The data protection level used for all logical volumes was Protected 2, which was accomplished by configuring 16 pools of 18 drives into 16 RAID-10 arrays.
**BENCHMARK EXECUTION RESULTS**

This portion of the Full Disclosure Report documents the results of the various SPC-1 Tests, Test Phases, and Test Runs.

**Benchmark Execution Overview**

**Workload Generator Input Parameters**

The SPC-1 Workload Generator commands and input parameters for the Test Phases are presented in the Supporting Files (see Appendix A).

**Primary Metrics Test Phases**

The benchmark execution consists of the Primary Metrics Test Phases, including the Test Phases SUSTAIN, RAMPD_100 to RAMPD_10, RAMPU_50 to RAMPU_100, RAMP_0, REPEAT_1 and REPEAT_2.

Each Test Phase starts with a transition period followed by a Measurement Interval.

**Measurement Intervals by Test Phase Graph**

The following graph presents the average IOPS and the average Response Times measured over the Measurement Interval (MI) of each Test Phase.

![Measurement Intervals by Test Phase Graph](image)

**Exception and Waiver**

None.
SUSTAIN Test Phase

SUSTAIN – Results File

The results file generated during the execution of the SUSTAIN Test Phase is included in the Supporting Files (see Appendix A) as follows:

- SPC1_METRICS_0_Raw_Results.xlsx

SUSTAIN – Execution Times

<table>
<thead>
<tr>
<th>Interval</th>
<th>Start Time</th>
<th>End Time</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transition Period</td>
<td>16-Aug-18  16:45:27</td>
<td>17-Aug-18  02:45:27</td>
<td>10:00:00</td>
</tr>
<tr>
<td>Measurement Interval</td>
<td>17-Aug-18  02:45:27</td>
<td>17-Aug-18  10:45:28</td>
<td>8:00:01</td>
</tr>
</tbody>
</table>

SUSTAIN – Throughput Graph

[Throughput Graph Image]
SUSTAIN – Response Time Graph

![Response Time Graph](image_url)

SUSTAIN – Data Rate Graph

![Data Rate Graph](image_url)
SUSTAIN – Response Time Frequency Graph

![Response Time Frequency Graph](image)

SUSTAIN – Intensity Multiplier

The following table lists the targeted intensity multiplier (Defined), the measured intensity multiplier (Measured) for each I/O STREAM, its coefficient of variation (Variation) and the percentage of difference (Difference) between Target and Measured.

<table>
<thead>
<tr>
<th></th>
<th>ASU1-1</th>
<th>ASU1-2</th>
<th>ASU1-3</th>
<th>ASU1-4</th>
<th>ASU2-1</th>
<th>ASU2-2</th>
<th>ASU2-3</th>
<th>ASU3-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defined</td>
<td>0.0350</td>
<td>0.2810</td>
<td>0.0700</td>
<td>0.2100</td>
<td>0.0180</td>
<td>0.0700</td>
<td>0.0350</td>
<td>0.2810</td>
</tr>
<tr>
<td>Measured</td>
<td>0.0350</td>
<td>0.2810</td>
<td>0.0700</td>
<td>0.2100</td>
<td>0.0180</td>
<td>0.0700</td>
<td>0.0350</td>
<td>0.2810</td>
</tr>
<tr>
<td>Variation</td>
<td>0.0010</td>
<td>0.0003</td>
<td>0.0007</td>
<td>0.0004</td>
<td>0.0014</td>
<td>0.0007</td>
<td>0.0010</td>
<td>0.0003</td>
</tr>
<tr>
<td>Difference</td>
<td>0.008%</td>
<td>0.001%</td>
<td>0.009%</td>
<td>0.001%</td>
<td>0.001%</td>
<td>0.001%</td>
<td>0.006%</td>
<td>0.002%</td>
</tr>
</tbody>
</table>
RAMPD_100 Test Phase

RAMPD_100 – Results File

The results file generated during the execution of the RAMPD_100 Test Phase is included in the Supporting Files (see Appendix A) as follows:

- SPC1_METRICS_0_Raw_Results.xlsx

RAMPD_100 – Execution Times

<table>
<thead>
<tr>
<th>Interval</th>
<th>Start Time</th>
<th>End Time</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transition Period</td>
<td>17-Aug-18 10:46:27</td>
<td>17-Aug-18 10:49:27</td>
<td>0:03:00</td>
</tr>
</tbody>
</table>

RAMPD_100 – Throughput Graph
RAMPD_100 – Response Time Graph

RAMPD_100 – Data Rate Graph
RAMPD_100 – Response Time Frequency Graph

The following table lists the targeted intensity multiplier (Defined), the measured intensity multiplier (Measured) for each I/O STREAM, its coefficient of variation (Variation) and the percentage of difference (Difference) between Target and Measured.

<table>
<thead>
<tr>
<th>ASU1-1</th>
<th>ASU1-2</th>
<th>ASU1-3</th>
<th>ASU1-4</th>
<th>ASU2-1</th>
<th>ASU2-2</th>
<th>ASU2-3</th>
<th>ASU3-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defined</td>
<td>0.0350</td>
<td>0.2810</td>
<td>0.0700</td>
<td>0.2100</td>
<td>0.0180</td>
<td>0.0700</td>
<td>0.0350</td>
</tr>
<tr>
<td>Measured</td>
<td>0.0350</td>
<td>0.2810</td>
<td>0.0700</td>
<td>0.2100</td>
<td>0.0180</td>
<td>0.0700</td>
<td>0.0350</td>
</tr>
<tr>
<td>Variation</td>
<td>0.0007</td>
<td>0.0004</td>
<td>0.0008</td>
<td>0.0003</td>
<td>0.0011</td>
<td>0.0007</td>
<td>0.0009</td>
</tr>
<tr>
<td>Difference</td>
<td>0.013%</td>
<td>0.014%</td>
<td>0.061%</td>
<td>0.011%</td>
<td>0.027%</td>
<td>0.014%</td>
<td>0.020%</td>
</tr>
</tbody>
</table>

RAMPD_100 – I/O Request Summary

| I/O Requests Completed in the Measurement Interval | 270,121,521 |
| I/O Requests Completed with Response Time <= 30 ms | 270,121,521 |
| I/O Requests Completed with Response Time > 30 ms | 0 |
Response Time Ramp Test

Response Time Ramp Test – Results File

The results file generated during the execution of the Response Time Ramp Test is included in the Supporting Files (see Appendix A) as follows:

- SPC1_METRICS_0_Raw_Results.xlsx

Response Time Ramp Test – Phases

The Response Time Ramp Test is comprised of 11 Test Phases, including six Ramp-Down Phases (executed at 100%, 95%, 90%, 80%, 50%, and 10% of the Business Scaling Unit) and five Ramp-Up Phases (executed at 50%, 80%, 90%, 95%, and 100% of the Business Scaling Unit).

Response Time Ramp Test – Average Throughput Graph
Response Time Ramp Test – Average Response Time Graph

![Average Response Time Graph (Response Time Ramp Test)](image)

Response Time Ramp Test – RAMPD_10 Response Time Graph

![Response Time Graph (RAMPD_10 @ 45,020 IOPS)](image)
Repeatability Test

Repeatability Test Results File

The results file generated during the execution of the Repeatability Test is included in the Supporting Files (see Appendix A) as follows:

- SPC1_METRICS_0_Raw_Results.xlsx

Repeatability Test Results

The throughput measurements for the Response Time Ramp Test (RAMPD) and the Repeatability Test Phases (REPEAT_1 and REPEAT_2) are listed in the tables below.

<table>
<thead>
<tr>
<th>Test Phase</th>
<th>100% IOPS</th>
<th>10% IOPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAMPD</td>
<td>450,212.9</td>
<td>45,033.3</td>
</tr>
<tr>
<td>REPEAT_1</td>
<td>450,214.7</td>
<td>45,013.4</td>
</tr>
<tr>
<td>REPEAT_2</td>
<td>450,242.6</td>
<td>45,027.1</td>
</tr>
</tbody>
</table>

REPEAT_1_100 – Throughput Graph

![Throughput Graph Image]
REPEAT_1_100 – Response Time Graph

![Response Time Graph](image1)

REPEAT_2_100 – Throughput Graph

![Throughput Graph](image2)
Repeatability Test – Intensity Multiplier

The following tables lists the targeted intensity multiplier (Defined), the measured intensity multiplier (Measured) for each I/O STREAM, its coefficient of variation (Variation) and the percent of difference (Difference) between Target and Measured.

**REPEAT_1_100 Test Phase**

<table>
<thead>
<tr>
<th></th>
<th>ASU1-1</th>
<th>ASU1-2</th>
<th>ASU1-3</th>
<th>ASU1-4</th>
<th>ASU2-1</th>
<th>ASU2-2</th>
<th>ASU2-3</th>
<th>ASU3-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defined</td>
<td>0.0350</td>
<td>0.2810</td>
<td>0.0700</td>
<td>0.2100</td>
<td>0.0180</td>
<td>0.0700</td>
<td>0.0350</td>
<td>0.2810</td>
</tr>
<tr>
<td>Measured</td>
<td>0.0350</td>
<td>0.2810</td>
<td>0.0700</td>
<td>0.2100</td>
<td>0.0180</td>
<td>0.0700</td>
<td>0.0350</td>
<td>0.2810</td>
</tr>
<tr>
<td>Variation</td>
<td>0.0013</td>
<td>0.0004</td>
<td>0.0009</td>
<td>0.0003</td>
<td>0.0018</td>
<td>0.0007</td>
<td>0.0009</td>
<td>0.0004</td>
</tr>
<tr>
<td>Difference</td>
<td>0.052%</td>
<td>0.004%</td>
<td>0.013%</td>
<td>0.006%</td>
<td>0.008%</td>
<td>0.045%</td>
<td>0.056%</td>
<td>0.005%</td>
</tr>
</tbody>
</table>

**REPEAT_2_100 Test Phase**

<table>
<thead>
<tr>
<th></th>
<th>ASU1-1</th>
<th>ASU1-2</th>
<th>ASU1-3</th>
<th>ASU1-4</th>
<th>ASU2-1</th>
<th>ASU2-2</th>
<th>ASU2-3</th>
<th>ASU3-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defined</td>
<td>0.0350</td>
<td>0.2810</td>
<td>0.0700</td>
<td>0.2100</td>
<td>0.0180</td>
<td>0.0700</td>
<td>0.0350</td>
<td>0.2810</td>
</tr>
<tr>
<td>Measured</td>
<td>0.0350</td>
<td>0.2810</td>
<td>0.0700</td>
<td>0.2100</td>
<td>0.0180</td>
<td>0.0700</td>
<td>0.0350</td>
<td>0.2811</td>
</tr>
<tr>
<td>Variation</td>
<td>0.0011</td>
<td>0.0003</td>
<td>0.0008</td>
<td>0.0004</td>
<td>0.0013</td>
<td>0.0006</td>
<td>0.0008</td>
<td>0.0002</td>
</tr>
<tr>
<td>Difference</td>
<td>0.031%</td>
<td>0.010%</td>
<td>0.003%</td>
<td>0.001%</td>
<td>0.063%</td>
<td>0.003%</td>
<td>0.018%</td>
<td>0.022%</td>
</tr>
</tbody>
</table>
Data Persistence Test

Data Persistence Test Results file

The results files generated during the execution of the Data Persistence Test is included in the Supporting Files (see Appendix A) as follows:

- SPC1_PERSIST_1_0_Raw_Results.xlsx
- SPC1_PERSIST_2_0_Raw_Results.xlsx

Data Persistence Test Execution

The Data Persistence Test was executed using the following sequence of steps:

- The PERSIST_1_0 Test Phase was executed to completion.
- The Benchmark Configuration was taken through an orderly shutdown process and powered off.
- The Benchmark Configuration was powered on and taken through an orderly startup process.
- The PERSIST_2_0 Test Phase was executed to completion.

Data Persistence Test Results

<table>
<thead>
<tr>
<th>Data Persistence Test Phase: Persist1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Number of Logical Blocks Written</td>
</tr>
<tr>
<td>Total Number of Logical Blocks Verified</td>
</tr>
<tr>
<td>Total Number of Logical Blocks Overwritten</td>
</tr>
<tr>
<td>Total Number of Logical Blocks that Failed Verification</td>
</tr>
<tr>
<td>Time Duration for Writing Test Logical Blocks (sec.)</td>
</tr>
<tr>
<td>Size in bytes of each Logical Block</td>
</tr>
<tr>
<td>Number of Failed I/O Requests in the process of the Test</td>
</tr>
</tbody>
</table>

Committed Data Persistence Implementation

The persistency of committed data is implemented at two levels. At the disk level, data loss is prevented through the use of RAID 10 arrays. At the controller level, all caches are mirrored across controllers, where write requests are only completed once the local cache has been successfully mirrored in another controller’s cache. In addition, cache content is protected from a loss of power by flushing the cache content to permanent flash memory, as soon as a power loss is detected. The flushing action is powered by a battery backup located in each controller.
APPENDIX A: SUPPORTING FILES

The following table details the content of the Supporting Files provided as part of this Full Disclosure Report.

<table>
<thead>
<tr>
<th>File Name</th>
<th>Description</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>/SPC1_RESULTS</td>
<td>Data reduction worksheets</td>
<td>root</td>
</tr>
<tr>
<td>SPC1_INIT_0_Raw_Results.xlsx</td>
<td>Raw results for INIT Test Phase</td>
<td>/SPC1_RESULTS</td>
</tr>
<tr>
<td>SPC1_METRICS_0_Quick_Look.xlsx</td>
<td>Quick Look Test Run Overview</td>
<td>/SPC1_RESULTS</td>
</tr>
<tr>
<td>SPC1_METRICS_0_Raw_Results.xlsx</td>
<td>Raw results for Primary Metrics Test</td>
<td>/SPC1_RESULTS</td>
</tr>
<tr>
<td>SPC1_METRICS_0_Summary_Results.xlsx</td>
<td>Primary Metrics Summary</td>
<td>/SPC1_RESULTS</td>
</tr>
<tr>
<td>SPC1_PERSIST_1_0_Raw_Results.xlsx</td>
<td>Raw results for PERSIST1 Test Phase</td>
<td>/SPC1_RESULTS</td>
</tr>
<tr>
<td>SPC1_PERSIST_2_0_Raw_Results.xlsx</td>
<td>Raw results for PERSIST2 Test Phase</td>
<td>/SPC1_RESULTS</td>
</tr>
<tr>
<td>SPC1_Run_Set_Overview.xlsx</td>
<td>Run Set Overview Worksheet</td>
<td>/SPC1_RESULTS</td>
</tr>
<tr>
<td>SPC1_VERIFY_0_Raw_Results.xlsx</td>
<td>Raw results for first VERIFY Test Phase</td>
<td>/SPC1_RESULTS</td>
</tr>
<tr>
<td>SPC1_VERIFY_1_Raw_Results.xlsx</td>
<td>Raw results for second VERIFY Test Phase</td>
<td>/SPC1_RESULTS</td>
</tr>
<tr>
<td>/C_Tuning</td>
<td>Tuning parameters and options</td>
<td>root</td>
</tr>
<tr>
<td>aio-max-nr.sh</td>
<td>Set maximum asynchronous I/O</td>
<td>/C_Tuning</td>
</tr>
<tr>
<td>nr_requests.sh</td>
<td>Increase disk queue depth</td>
<td>/C_Tuning</td>
</tr>
<tr>
<td>scheduler.sh</td>
<td>Change the I/O scheduler</td>
<td>/C_Tuning</td>
</tr>
<tr>
<td>/D_Creation</td>
<td>Storage configuration creation</td>
<td>root</td>
</tr>
<tr>
<td>mkln.txt</td>
<td>Create the storage environment</td>
<td>/D_Creation</td>
</tr>
<tr>
<td>mkvolume.sh</td>
<td>Create the Logical Volumes</td>
<td>/D_Creation</td>
</tr>
<tr>
<td>/E_Inventory</td>
<td>Configuration inventory</td>
<td>root</td>
</tr>
<tr>
<td>shstorage.tcl</td>
<td>Captures profile of storage environment</td>
<td>/E_Inventory</td>
</tr>
<tr>
<td>profile1_volume.log</td>
<td>List of logical volumes before INIT</td>
<td>/E_Inventory</td>
</tr>
<tr>
<td>profile1_storage.log</td>
<td>List of storage devices before INIT</td>
<td>/E_Inventory</td>
</tr>
<tr>
<td>profile2_volume.log</td>
<td>List of logical volumes after restart</td>
<td>/E_Inventory</td>
</tr>
<tr>
<td>profile2_storage.log</td>
<td>List of storage devices after restart</td>
<td>/E_Inventory</td>
</tr>
<tr>
<td>/F_Generator</td>
<td>Workload generator</td>
<td>root</td>
</tr>
<tr>
<td>slave_asu.asu</td>
<td>Defining LUNs hosting the ASUs</td>
<td>/F_generator</td>
</tr>
<tr>
<td>4host.HST</td>
<td>Host configuration file</td>
<td>/F_generator</td>
</tr>
<tr>
<td>full_run.sh</td>
<td>Executing all test phases</td>
<td>/F_generator</td>
</tr>
</tbody>
</table>
## Appendix B: Third Party Quotation

![Noviant报价单](image)

<table>
<thead>
<tr>
<th>No.</th>
<th>Model</th>
<th>Description</th>
<th>Qty.</th>
<th>Unit Price (USD)</th>
<th>Disc. (off)</th>
<th>Total Disc. Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Phase</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Location</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1.1</td>
<td>OceanStor 5500 V5 Main Equipment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1.1.1</td>
<td>Controller Enclosure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5300 V5(2U, Dual Ctrl, AC240V, HV/DC, 128GB, SmartIO, 88GB FC, 4 Port, 4120bps SAS, 2525, SPE34C0225)</td>
<td>2</td>
<td>53768</td>
<td>68%</td>
<td>34,411.52</td>
<td></td>
</tr>
<tr>
<td>1.1.2</td>
<td>Expanding Interface Module</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SMARTIO10 ETH, 4 port SmartRO I/O module(SFP+, 10Gb Eth/PoE/En(V325F)/Scale-out)</td>
<td>4</td>
<td>6288</td>
<td>68%</td>
<td>38,048.64</td>
<td></td>
</tr>
<tr>
<td>1.1.3</td>
<td>Disk Components</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>HSSD-900G2S-A6, 900GB SSD SAS Disk Unit(2.5”)</td>
<td>32</td>
<td>9096</td>
<td>70%</td>
<td>87,321.60</td>
<td></td>
</tr>
<tr>
<td>1.1.4</td>
<td>Disk Enclosure</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>DAE5252SU-2-AC-A2, Disk Enclosure(2U, AC240V/DC, 2.5”, Expanding Module, 25 Disk Slots, without Disk Unit: DAE5252SU-2)</td>
<td>2</td>
<td>10584</td>
<td>70%</td>
<td>6,773.76</td>
<td></td>
</tr>
<tr>
<td>1.1.5</td>
<td>HBA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NSGHBA000, QLOGIC QLE2562 HBA Card, PCIe, 8Gbps DualPort, Fiber Channel Multimode LC Optic Interface, English Manual, No Drive CD</td>
<td>8</td>
<td>1698</td>
<td>0%</td>
<td>13,584.00</td>
<td></td>
</tr>
<tr>
<td>1.1.6</td>
<td>Accessory</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SN2F01FCPEC, Patch Cord, DLC/PC, DLC/PC, Multimode, 3m, 1A, 2.2mm, 42mm DLC/OM3, bending insensitive</td>
<td>16</td>
<td>14</td>
<td>0%</td>
<td>224.00</td>
<td></td>
</tr>
<tr>
<td>1.1.7</td>
<td>Storage Software</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LIC-53V5-BS, Basic Software License(including DeviceManager, SmartThin, SmartMulti-tenant, SmartMigration, SmartErasure, SmartMotion, SystemReporter, eService, SmartQuota, NFS, CIFS, NDMP, UltraPath)</td>
<td>1</td>
<td>6676</td>
<td>70%</td>
<td>2,602.00</td>
<td></td>
</tr>
</tbody>
</table>

### Total of Product

| Total of Product | 152,966.32 |

### Appendix B: Third Party Quotation

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APPENDIX C

Tuning Parameters and Options

---

FULL DISCLOSURE REPORT

Submission Identifier: A31015

Submitted for Review: August 28, 2018

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SPC Benchmark 1™ V3.7

Huawei Technologies Co., Ltd

Huawei OceanStor 5300 V5
<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
<th>Price (in USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Huawei OceanStor 5300 V5 Installation Service - Engineering</td>
<td>1</td>
<td>13,045.00</td>
</tr>
<tr>
<td>Basic Software License (Including DeviceManager, SmartThin, SmartMultitenant, SmartMigration, SmartErase, SmartMotion, SystemReporter, eService, SmartQuota, NFS, CIFS, NDMP, UltraPath) - Hi-Care Application Software Upgrade Support Service - 36 Month(s)</td>
<td>1</td>
<td>1,920.00</td>
</tr>
<tr>
<td>Huawei Technologies Co., Ltd Submitted for Review: August 28, 2018</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Huawei OceanStor 5300 V5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total of Service (3 years)</td>
<td></td>
<td>34,439.00</td>
</tr>
<tr>
<td>Total Price</td>
<td></td>
<td>187,405.32</td>
</tr>
</tbody>
</table>

Notes: Hi-Care Premier On-Site Service include: 7*24 Technical Assistance Center Access. Access to all new software updates and Online Support. 24*7*4 Hours Onsite Hardware Replacement.

Payment Terms:

Comments:

Noviant is an Authorized Value Added reseller (VAR) of networking products. Products sold by NF are factory new unless otherwise specified. All new products sold by NF carry its own Original Equipment Manufacturer's (OEM) Limited Warranty and software licenses. This Quote is valid for 90 days. Prices and availability is subject to change without notice. Installation and configuration costs are not included in the quoted pricing unless specified. A 20% Restocking Fee applies to all cancelled orders and/or returned products. Special Orders are non-returnable. Buyer is responsible for payment of all applicable taxes and freight charges. Issuance of customer PO against this Quote constitutes acceptance of Noviant Sales Terms conditions.

I agree to the these terms and conditions.

Authorized Acceptance: ___________ Print Name: ___________ Date: ___________

Noviant: ___________ Print Name: ___________ Date: ___________
APPENDIX C: TUNING PARAMETERS AND OPTIONS

The following scripts, listed below, were used to set tuning parameters and options:

- `aio-max-nr.sh` to change the maximum number of AIO operations to 1048576
- `nr_requests.sh` to change `nr_requests` from 128 to 2048 on each Host System for each device
- `scheduler.sh` to change the I/O scheduler from `cfq` to `noop` on each Host System, which will result in all incoming I/O requests inserted into a simple, unordered FIFO queue

The scripts described above are included in the Supporting Files (see Appendix A) and listed below.

```
aio-max-nr.sh
  echo 1048576 > /proc/sys/fs/aio-max-nr

nr_requests.sh
  echo 2048 >/sys/block/sdb/queue.nr_requests
  echo 2048 >/sys/block/sdc/queue.nr_requests
  echo 2048 >/sys/block/sdd/queue.nr_requests
  echo 2048 >/sys/block/sde/queue.nr_requests
  echo 2048 >/sys/block/sdf/queue.nr_requests
  echo 2048 >/sys/block/sdg/queue.nr_requests
  echo 2048 >/sys/block/sdh/queue.nr_requests
  echo 2048 >/sys/block/sdi/queue.nr_requests
  echo 2048 >/sys/block/sdj/queue.nr_requests
  echo 2048 >/sys/block/sdk/queue.nr_requests
  echo 2048 >/sys/block/sdl/queue.nr_requests
  echo 2048 >/sys/block/sdm/queue.nr_requests
  echo 2048 >/sys/block/sdn/queue.nr_requests
  echo 2048 >/sys/block/sdo/queue.nr_requests
  echo 2048 >/sys/block/sdp/queue.nr_requests
  echo 2048 >/sys/block/sdq/queue.nr_requests
  echo 2048 >/sys/block/sdr/queue.nr_requests
  echo 2048 >/sys/block/sds/queue.nr_requests
  echo 2048 >/sys/block/sdt/queue.nr_requests
  echo 2048 >/sys/block/sdu/queue.nr_requests
  echo 2048 >/sys/block/sdv/queue.nr_requests
  echo 2048 >/sys/block/sdw/queue.nr_requests
  echo 2048 >/sys/block/sdx/queue.nr_requests
  echo 2048 >/sys/block/sdy/queue.nr_requests

• scheduler.sh
  echo noop >/sys/block/sdb/queue/scheduler
  echo noop >/sys/block/sdc/queue/scheduler
  echo noop >/sys/block/sdd/queue/scheduler
  echo noop >/sys/block/sde/queue/scheduler
  echo noop >/sys/block/sdf/queue/scheduler
  echo noop >/sys/block/sdg/queue/scheduler
```
```
echo noop >/sys/block/sdh/queue/scheduler
echo noop >/sys/block/sdi/queue/scheduler
echo noop >/sys/block/sdj/queue/scheduler
echo noop >/sys/block/sdk/queue/scheduler
echo noop >/sys/block/sdi/queue/scheduler
echo noop >/sys/block/sdm/queue/scheduler
echo noop >/sys/block/sdn/queue/scheduler
echo noop >/sys/block/sdo/queue/scheduler
echo noop >/sys/block/sdp/queue/scheduler
echo noop >/sys/block/sdq/queue/scheduler
echo noop >/sys/block/sdr/queue/scheduler
echo noop >/sys/block/sds/queue/scheduler
echo noop >/sys/block/sdt/queue/scheduler
echo noop >/sys/block/sdu/queue/scheduler
echo noop >/sys/block/sdv/queue/scheduler
echo noop >/sys/block/sdw/queue/scheduler
echo noop >/sys/block/sdx/queue/scheduler
echo noop >/sys/block/sdy/queue/scheduler
```
**APPENDIX D: STORAGE CONFIGURATION CREATION**

**Environment**

First, the CLI commands from the following command file are copied and pasted into the OceanStor 5300 V5 CLI window. These commands are executed on one of the Host Systems.

- *mklun.txt*

Next, the following shell script is executed on one of the Host Systems.

- *mkvolume.sh*

**Step 1 - Create Disk Domains, Storage Pools, LUNs**

The *mklun.txt* command file, listed below, includes all the CLI commands to perform the following actions:

- Create 4 disk domains
- Create 4 storage pools
- Create 16 LUNs
- Create one LUN group
- Add the 16 LUNs to the LUN group

The command file described above is included in the Supporting Files (see Appendix A) and listed below.

```plaintext
mklun.txt

create disk_domain name=dd00 disk_list=CTE0.0-7 tier0_hotspare_strategy=low
   disk_domain_id=0
create disk_domain name=dd01 disk_list=DAE010.0-7 tier0_hotspare_strategy=low
   disk_domain_id=1
create disk_domain name=dd02 disk_list=CTE1.0-7 tier0_hotspare_strategy=low
   disk_domain_id=2
create disk_domain name=dd03 disk_list=DAE110.0-7 tier0_hotspare_strategy=low
   disk_domain_id=3

create storage_pool name=sp00 disk_type=SSD capacity=2747GB raid_level=RAID10
   pool_id=0 disk_domain_id=0
create storage_pool name=sp01 disk_type=SSD capacity=2747GB raid_level=RAID10
   pool_id=1 disk_domain_id=1
create storage_pool name=sp02 disk_type=SSD capacity=2747GB raid_level=RAID10
   pool_id=2 disk_domain_id=2
create storage_pool name=sp03 disk_type=SSD capacity=2747GB raid_level=RAID10
   pool_id=3 disk_domain_id=3

create lun name=lun_sp00 lun_id_list=0-3 pool_id=0 capacity=686GB
create lun name=lun_sp01 lun_id_list=4-7 pool_id=1 capacity=686GB
create lun name=lun_sp02 lun_id_list=8-11 pool_id=2 capacity=686GB
create lun name=lun_sp03 lun_id_list=12-15 pool_id=3 capacity=686GB

create host name=host0 operating_system=Linux host_id=0
create host name=host1 operating_system=Linux host_id=1
create host name=host2 operating_system=Linux host_id=2
```
create host name=host3 operating_system=linux host_id=3
create lun_group name=lg0 lun_group_id=0
add lun_group lun lun_group_id=0 lun_id_list=0-15

Step 2 - Create Mapping View, Host Group and Host

The **mklun.txt** command file, listed below, includes all the CLI commands to perform the following actions:

- Create 4 hosts
- Create a host group
- Create a mapping view
- Add the 4 hosts to the host group
- Add the host group and the LUN group to the mapping view
- Add the FC port’s WWN to the 4 hosts

The command file described above is included in the Supporting Files (see Appendix A) and listed below.

```
create mapping_view name=mv1 mapping_view_id=1 lun_group_id=0 host_group_id=0
create host_group name=hg0 host_group_id=0 host_id_list=0-3
add host initiator host_id=0 initiator_type=FC wwn=21000024ff7fb903
add host initiator host_id=0 initiator_type=FC wwn=21000024ff7fb716
add host initiator host_id=0 initiator_type=FC wwn=21000024ff7fb717
add host initiator host_id=0 initiator_type=FC wwn=21000024ff7fb902
add host initiator host_id=1 initiator_type=FC wwn=21000024ff17e0bb
add host initiator host_id=1 initiator_type=FC wwn=2100000e1e1c2600
add host initiator host_id=1 initiator_type=FC wwn=210000ae1e1c2601
add host initiator host_id=1 initiator_type=FC wwn=21000024ff17e0a
add host initiator host_id=2 initiator_type=FC wwn=21000024ff17f7d5
add host initiator host_id=2 initiator_type=FC wwn=21000024ff17d7f38
add host initiator host_id=2 initiator_type=FC wwn=21000024ff17d7f39
add host initiator host_id=2 initiator_type=FC wwn=21000024ff17f7df4
add host initiator host_id=3 initiator_type=FC wwn=21000024ff7f431a
add host initiator host_id=3 initiator_type=FC wwn=21000024ff7f431b
add host initiator host_id=3 initiator_type=FC wwn=21000024ff7f78fe
add host initiator host_id=3 initiator_type=FC wwn=21000024ff7f78ff
```

Step 3 - Create Volumes on the Master Host Systems

The **mkvolume.sh** shell script, listed below, is invoked on the master Host Systems to perform the following actions:

- Create 24 physical volumes
- Create a volume group for the 64 physical volumes
- Create 18 Logical Volumes for ASU-1
- Create 18 Logical Volumes for ASU-2
• Create 2 Logical Volumes for ASU-3

The shell script described above is included in the Supporting Files (see Appendix A) and listed below.

```
# mkvolume.sh

pvcreate /dev/sdb
pvcreate /dev/sdc
pvcreate /dev/sdd
pvcreate /dev/sde
pvcreate /dev/sdf
pvcreate /dev/sgd
pvcreate /dev/sdh
pvcreate /dev/sdi
pvcreate /dev/sdj
pvcreate /dev/sdk
pvcreate /dev/sdl
pvcreate /dev/sdm
pvcreate /dev/sdn
pvcreate /dev/sdo
pvcreate /dev/sdp
pvcreate /dev/sdq

vgcreate vg1 /dev/sdb /dev/sdc /dev/sdd /dev/sde /dev/sdf /dev/sgd /dev/sdh
   /dev/sdi /dev/sdj /dev/sdk /dev/sdl /dev/sdm /dev/sdn /dev/sdo /dev/sdp
   /dev/sdq
lvcreate -n asu121 -i 16 -I 512 -C y -L 274g vg1
lvcreate -n asu122 -i 16 -I 512 -C y -L 274g vg1
lvcreate -n asu123 -i 16 -I 512 -C y -L 274g vg1
lvcreate -n asu124 -i 16 -I 512 -C y -L 274g vg1
lvcreate -n asu125 -i 16 -I 512 -C y -L 274g vg1
lvcreate -n asu126 -i 16 -I 512 -C y -L 274g vg1
lvcreate -n asu127 -i 16 -I 512 -C y -L 274g vg1
lvcreate -n asu128 -i 16 -I 512 -C y -L 274g vg1
lvcreate -n asu129 -i 16 -I 512 -C y -L 274g vg1
lvcreate -n asu130 -i 16 -I 512 -C y -L 274g vg1
lvcreate -n asu131 -i 16 -I 512 -C y -L 274g vg1
lvcreate -n asu132 -i 16 -I 512 -C y -L 274g vg1
lvcreate -n asu133 -i 16 -I 512 -C y -L 274g vg1
lvcreate -n asu134 -i 16 -I 512 -C y -L 274g vg1
lvcreate -n asu135 -i 16 -I 512 -C y -L 274g vg1
lvcreate -n asu136 -i 16 -I 512 -C y -L 274g vg1
lvcreate -n asu137 -i 16 -I 512 -C y -L 274g vg1
lvcreate -n asu138 -i 16 -I 512 -C y -L 274g vg1
lvcreate -n asu139 -i 16 -I 512 -C y -L 274g vg1
lvcreate -n asu140 -i 16 -I 512 -C y -L 274g vg1
lvcreate -n asu141 -i 16 -I 512 -C y -L 274g vg1
lvcreate -n asu142 -i 16 -I 512 -C y -L 274g vg1
lvcreate -n asu143 -i 16 -I 512 -C y -L 274g vg1
lvcreate -n asu144 -i 16 -I 512 -C y -L 274g vg1
lvcreate -n asu145 -i 16 -I 512 -C y -L 274g vg1
lvcreate -n asu146 -i 16 -I 512 -C y -L 274g vg1
lvcreate -n asu147 -i 16 -I 512 -C y -L 274g vg1
lvcreate -n asu148 -i 16 -I 512 -C y -L 274g vg1
```

lvcreate -n asu217 -i 16 -I 512 -C y -L 274g vg1
lvcreate -n asu218 -i 16 -I 512 -C y -L 274g vg1
lvcreate -n asu301 -i 16 -I 512 -C y -L 548g vg1
lvcreate -n asu302 -i 16 -I 512 -C y -L 548g vg1
APPENDIX E: CONFIGURATION INVENTORY

An inventory of the Tested Storage Configuration was collected during the execution the script `full_run.sh`. It generated the following log file:

- `profile1_volume.log`  List of configured volumes before the INIT Phase.
- `profile1_storage.log`  List of configured storage before the INIT Phase.
- `Profile2_volume.log`   List of configured volumes after TSC restart.
- `Profile2_storage.log`  List of configured storage after TSC restart.

The above log files are included in the Supporting Files (see Appendix A).
APPENDIX F: WORKLOAD GENERATOR

The ASUs accessed by the SPC-1 workload generator, are defined using the script `slave_asu.asu`.

The phases of the benchmark are executed using the script `full_run.sh`. The script pauses at the end of the PERSIST_1 test phase. Once the TSC has been restarted, the PERSIST_2 test phase is executed by pressing ENTER from the console where the script has been invoked.

The above scripts are included in the Supporting Files (see Appendix A) and listed below.

```bash
slave_asu.asu

ASU=1
OFFSET=0
SIZE=0
DEVICE=/dev/vg1/asu101
DEVICE=/dev/vg1/asu102
DEVICE=/dev/vg1/asu103
DEVICE=/dev/vg1/asu104
DEVICE=/dev/vg1/asu105
DEVICE=/dev/vg1/asu106
DEVICE=/dev/vg1/asu107
DEVICE=/dev/vg1/asu108
DEVICE=/dev/vg1/asu109
DEVICE=/dev/vg1/asu110
DEVICE=/dev/vg1/asu111
DEVICE=/dev/vg1/asu112
DEVICE=/dev/vg1/asu113
DEVICE=/dev/vg1/asu114
DEVICE=/dev/vg1/asu115
DEVICE=/dev/vg1/asu116
DEVICE=/dev/vg1/asu117
DEVICE=/dev/vg1/asu118

--
ASU=2
OFFSET=0
SIZE=0
DEVICE=/dev/vg1/asu201
DEVICE=/dev/vg1/asu202
DEVICE=/dev/vg1/asu203
DEVICE=/dev/vg1/asu204
DEVICE=/dev/vg1/asu205
DEVICE=/dev/vg1/asu206
DEVICE=/dev/vg1/asu207
DEVICE=/dev/vg1/asu208
DEVICE=/dev/vg1/asu209
DEVICE=/dev/vg1/asu210
DEVICE=/dev/vg1/asu211
DEVICE=/dev/vg1/asu212
DEVICE=/dev/vg1/asu213
DEVICE=/dev/vg1/asu214
DEVICE=/dev/vg1/asu215
DEVICE=/dev/vg1/asu216
```

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APPENDIX F: WORKLOAD GENERATOR

The ASUs accessed by the SPC-1 workload generator, are defined using the script `slave_asu.asu`.

The phases of the benchmark are executed using the script `full_run.sh`. The script pauses at the end of the PERSIST_1 test phase. Once the TSC has been restarted, the PERSIST_2 test phase is executed by pressing ENTER from the console where the script has been invoked.

The above scripts are included in the Supporting Files (see Appendix A) and listed below.

```bash
slave_asu.asu

ASU=1
OFFSET=0
SIZE=0
DEVICE=/dev/vg1/asu101
DEVICE=/dev/vg1/asu102
DEVICE=/dev/vg1/asu103
DEVICE=/dev/vg1/asu104
DEVICE=/dev/vg1/asu105
DEVICE=/dev/vg1/asu106
DEVICE=/dev/vg1/asu107
DEVICE=/dev/vg1/asu108
DEVICE=/dev/vg1/asu109
DEVICE=/dev/vg1/asu110
DEVICE=/dev/vg1/asu111
DEVICE=/dev/vg1/asu112
DEVICE=/dev/vg1/asu113
DEVICE=/dev/vg1/asu114
DEVICE=/dev/vg1/asu115
DEVICE=/dev/vg1/asu116
DEVICE=/dev/vg1/asu117
DEVICE=/dev/vg1/asu118

--
ASU=2
OFFSET=0
SIZE=0
DEVICE=/dev/vg1/asu201
DEVICE=/dev/vg1/asu202
DEVICE=/dev/vg1/asu203
DEVICE=/dev/vg1/asu204
DEVICE=/dev/vg1/asu205
DEVICE=/dev/vg1/asu206
DEVICE=/dev/vg1/asu207
DEVICE=/dev/vg1/asu208
DEVICE=/dev/vg1/asu209
DEVICE=/dev/vg1/asu210
DEVICE=/dev/vg1/asu211
DEVICE=/dev/vg1/asu212
DEVICE=/dev/vg1/asu213
DEVICE=/dev/vg1/asu214
DEVICE=/dev/vg1/asu215
DEVICE=/dev/vg1/asu216
```
 DEVICE=/dev/vg1/asu217
 DEVICE=/dev/vg1/asu218

 ASU=3
 OFFSET=0
 SIZE=0
 DEVICE=/dev/vg1/asu301
 DEVICE=/dev/vg1/asu302

**full_run.sh**

```bash
#!/bin/sh
expect shstorage.tcl > profile1_storage.log
date > profile1_volume.log
lvdisplay >> profile1_volume.log
date >> profile1_volume.log

/root/SPCv302_2017504/spc1 -run SPC1_INIT -iops 6000 -storage slave_asu.asu -output ./newtool/spc1_INIT_6k_iops -master 4host.HST
/root/SPCv302_2017504/spc1 -run SPC1_VERIFY -iops 1000 -storage slave_asu.asu -output ./newtool/spc1_VERIFY1_1000_iops -master 4host.HST
/root/SPCv302_2017504/spc1 -run SPC1_METRICS -iops 450200 -storage slave_asu.asu -output ./newtool/spc1_METRICS_450k_iops -master 4host.HST
/root/SPCv302_2017504/spc1 -run SPC1_VERIFY -iops 1000 -storage slave_asu.asu -output ./newtool/spc1_VERIFY2_1000_iops -master 4host.HST
/root/SPCv302_2017504/spc1 -run SPC1_PERSIST_1 -iops 150000 -storage slave_asu.asu -output ./newtool/spc1_PERSIST_150k_iops -master 4host.HST
echo "Power cycle TSC, then Enter to continue"
read

expect shstorage.tcl > profile2_storage.log
date > profile2_volume.log
lvdisplay >> profile2_volume.log
date >> profile2_volume.log

/root/SPCv302_2017504/spc1 -run SPC1_PERSIST_2 -iops 150000 -storage slave_asu.asu -output ./newtool/spc1_PERSIST_150k_iops -master 4host.HST
```

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**APPENDIX F**

**Workload Generator**

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**SPC Benchmark 1™ V3.7**

**Huawei Technologies Co., Ltd**

**Huawei OceanStor 5300 V5**

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**FULL DISCLOSURE REPORT**

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