SPC BENCHMARK 1™

FULL DISCLOSURE REPORT

HUAWEI TECHNOLOGIES CO., LTD
HUAWEI OCEANSTOR™ 18500 V3

SPC-1 V3.2

SUBMISSION IDENTIFIER: A31003

SUBMITTED FOR REVIEW: DECEMBER 27, 2016
Second Edition – February 2018

THE INFORMATION CONTAINED IN THIS DOCUMENT IS DISTRIBUTED ON AN AS IS BASIS WITHOUT ANY WARRANTY EITHER EXPRESS OR IMPLIED. The use of this information or the implementation of any of these techniques is the customer’s responsibility and depends on the customer’s ability to evaluate and integrate them into the customer’s operational environment. While each item has been reviewed by Huawei for accuracy in a specific situation, there is no guarantee that the same or similar results will be obtained elsewhere. Customers attempting to adapt these techniques to their own environment do so at their own risk.

This publication was produced in the United States. Huawei may not offer the products, services, or features discussed in this document in other countries, and the information is subject to change with notice. Consult your local Huawei representative for information on products and services available in your area.

© Copyright Huawei 2016. All rights reserved.

Permission is hereby granted to publicly disclose and reproduce this document, in whole or in part, provided the copyright notice as printed above is set forth in full text on the title page of each item reproduced.

Trademarks

SPC Benchmark 1, SPC-1, SPC-1 IOPS, SPC-1 LRT and SPC-1 Price-Performance are trademarks of the Storage Performance Council.

Huawei, the Huawei logo, FusionServer™ and OceanStor™ are trademarks or registered trademarks of Huawei in the United States and other countries. All other brands, trademarks, and product names are the property of their respective owners.

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.
Table of Contents

Audit Certification ................................................................................................................. 4
Letter Of Good Faith ................................................................................................................ 6
Executive Summary .................................................................................................................. 7
Configuration Information ....................................................................................................... 13
  Benchmark Configuration and Tested Storage Configuration ............................................. 13
  Benchmark Configuration Creation Process ........................................................................ 15
Benchmark Execution Results ............................................................................................... 16
  Benchmark Execution Overview .......................................................................................... 16
  SUSTAIN Test Phase ........................................................................................................... 17
  RAMPD_100 Test Phase ....................................................................................................... 20
  Response Time Ramp Test .................................................................................................... 23
  Repeatability Test ................................................................................................................ 25
  Data Persistence Test .......................................................................................................... 28
Appendix A: Supporting Files ............................................................................................... 29
Appendix B: Third Party Quotation ........................................................................................ 30
Appendix C: Tuning Parameters and Options ......................................................................... 33
Appendix D: Storage Configuration Creation ....................................................................... 35
Appendix E: Configuration Inventory ..................................................................................... 44
Appendix F: Workload Generator .......................................................................................... 45
Audit Certification

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

December 26, 2016

I verified the SPC Benchmark 1™ (SPC-1™ Revision3.2) test execution and performance results of the following Tested Storage Product:

**HUAWEI OCEANSTOR™ 18500 V3**

<table>
<thead>
<tr>
<th>Test Case</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPC-1 IOPS™</td>
<td>2,340,241</td>
</tr>
<tr>
<td>SPC-1 Price-Performance™</td>
<td>$0.55/SPC-1 IOPS™</td>
</tr>
<tr>
<td>SPC-1 IOPS™ Response Time</td>
<td>0.723 ms</td>
</tr>
<tr>
<td>SPC-1 Overall Response Time</td>
<td>0.537 ms</td>
</tr>
<tr>
<td>SPC-1 ASU Capacity</td>
<td>76,408 GB</td>
</tr>
<tr>
<td>SPC-1 ASU Price</td>
<td>$16.84/GB</td>
</tr>
<tr>
<td>SPC-1 Total System Price</td>
<td>$1,286,535.26</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 Build d34fb3c. 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.storageperformance.org](http://www.storageperformance.org) under the Submission Identifier A31003.
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: December 27, 2016

From: Huawei Technologies Co., Ltd.

To: Mr. Francois Ramb, Certified SPC Auditor
InfoSizing, Inc.
20 Kreg Lane
Manlius Springs, CO 80829

Subject: SPC-1 Letter of Good Faith for the Huawei OceanStor 18500 V3

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 V3.2 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: Fan Ruiqi
President of Storage Product Line

Date: 2016.12.27

Huawei Technologies Co., Ltd.
Huawei OceanStor™ 18500 V3
# EXECUTIVE SUMMARY

**SPC Benchmark 1™**

**EXECUTIVE SUMMARY**

**HUAWEI TECHNOLOGIES CO., LTD**

**HUAWEI OCEANSTOR™ 18500 V3**

<table>
<thead>
<tr>
<th>SPC-1 IOPS™</th>
<th>2,340,241</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPC-1 Price-Performance™</td>
<td>$549.75/SPC-1 KIOPS™</td>
</tr>
<tr>
<td>SPC-1 IOPS™ Response Time</td>
<td>0.723 ms</td>
</tr>
<tr>
<td>SPC-1 Overall Response Time</td>
<td>0.537 ms</td>
</tr>
<tr>
<td>SPC-1 ASU Capacity</td>
<td>76,408 GB</td>
</tr>
<tr>
<td>SPC-1 ASU Price</td>
<td>$16.84/GB</td>
</tr>
<tr>
<td>SPC-1 Total System Price</td>
<td>$1,286,535.26</td>
</tr>
</tbody>
</table>

- Data Protection Level: Protected 2 (RAID-10)
- Physical Storage Capacity: 214,800 GB
- Pricing Currency / Target Country: U.S. Dollars / USA

**SPC-1 V3.2**

**SUBMISSION IDENTIFIER: A31003**

**SUBMITTED FOR REVIEW: DECEMBER 27, 2016**
Benchmark Configuration Diagram

**Host Systems**

13 x Huawei FusionServer™ RH5885 V3

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

208 x FC connections
   (16 connections per server)

**Huawei OceanStor™ 18500 V3**

16 x OceanStor™ 18500 V3 Active-Active Controllers

- 256 GB cache per controller (4096 GB total)
- 64 x 4-port 8Gbps Smart I/O Modules
- 8 x 12-port 12Gbps SAS I/O Modules
- 2 x PCIe 16 port switches
- 16 x 2U disk enclosures
- 240 x 900 GB SSDs

**Tested Storage Configuration (TSC)**
Tested Storage Product Description

The OceanStor™ 18000 series storage systems is an optimal choice for mission-critical enterprise applications. The OceanStor™ 18500 and OceanStor™ 18800 have a storage platform designed for next-generation data centers that require virtualization, hybrid cloud, thin IT, and a low carbon footprint.

These enterprise storage solutions are scalable from 2 to 16 controllers and up to 7 PB storage capacity.

This OceanStor™ 18000 series provides critical data storage for finance, government, energy, manufacturing, transport, education, and telecommunication industries.

For more details, visit:


Priced Storage Configuration Components

<table>
<thead>
<tr>
<th>Quantity</th>
<th>Item Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>104 x</td>
<td>QLogic dual-ported QLE2562 FC HBA</td>
</tr>
<tr>
<td>16 x</td>
<td>OceanStor™ 18500 V3 Active-Active Controller, each with:</td>
</tr>
<tr>
<td></td>
<td>256 GB cache (4096 GB total)</td>
</tr>
<tr>
<td></td>
<td>4 x 4-port 8Gbps Smart I/O Module</td>
</tr>
<tr>
<td></td>
<td>8 x 12-port 12Gbps SAS I/O Module</td>
</tr>
<tr>
<td></td>
<td>16 x 2U disk enclosure, each with:</td>
</tr>
<tr>
<td></td>
<td>15 x 900 GB SSD (240 total)</td>
</tr>
<tr>
<td></td>
<td>2 x PCIe 16 port switch</td>
</tr>
<tr>
<td></td>
<td>1 x Service Processor</td>
</tr>
<tr>
<td></td>
<td>1 x 8-port KVM</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>85V3-4C1TE-AC</strong> OceanStor 18500 V3 Engine (Four Controller, AC240HV/DC, 1TB Cache, 16'4 port SmartIO I/O module, 2*12 port 12Gb SAS Entire Sharing I/O module, SPE72C0600) ,Enhanced Version</td>
<td>4</td>
<td>291,029.00</td>
<td>1,164,116.00</td>
<td>72%</td>
<td>325,952.48</td>
</tr>
<tr>
<td><strong>LP5POIEV3H</strong> 2 port Pcie I/O module</td>
<td>16</td>
<td>3,245.00</td>
<td>51,920.00</td>
<td>75%</td>
<td>12,980.00</td>
</tr>
<tr>
<td><strong>SSD900-2-H2</strong> 900GB SSD SAS Disk Unit(2.5&quot;)</td>
<td>240</td>
<td>10,621.00</td>
<td>2,549,040.00</td>
<td>75%</td>
<td>637,260.00</td>
</tr>
<tr>
<td><strong>DAE22525U2-H-AC</strong> Disk Enclosure (2U,2.5&quot;,AC240HVDC,DAE22525U2)</td>
<td>16</td>
<td>7,032.00</td>
<td>112,512.00</td>
<td>75%</td>
<td>28,128.00</td>
</tr>
<tr>
<td><strong>RACK-SYS-H-AC</strong> OceanStor 18000 V3 Series System Cabinet</td>
<td>2</td>
<td>23,672.00</td>
<td>47,344.00</td>
<td>75%</td>
<td>11,836.00</td>
</tr>
<tr>
<td><strong>SV4-V3H</strong> Service Processor (1U, AC240HDVC,8GB Cache,Including Windows OS Softw are and Security softw are)</td>
<td>1</td>
<td>15,042.00</td>
<td>15,042.00</td>
<td>75%</td>
<td>3,760.50</td>
</tr>
<tr>
<td><strong>KVM-HIGH-END</strong> KVM,KVM,1U, 17&quot; LED, 8 KVM ports, With Power Cable,1 USB Straight signal cables/With mounting Accessories</td>
<td>1</td>
<td>634.00</td>
<td>634.00</td>
<td>0%</td>
<td>634.00</td>
</tr>
<tr>
<td><strong>SWITCH-V3H</strong> PCIe Switch(AC240HV/DC,2GB Cache,16 Port,SWE1603P05)</td>
<td>2</td>
<td>6,350.00</td>
<td>12,700.00</td>
<td>75%</td>
<td>3,175.00</td>
</tr>
<tr>
<td><strong>OQSFPOM00</strong> Quadwire 40 Gb/s Parallel AOC</td>
<td>32</td>
<td>1,494.00</td>
<td>47,808.00</td>
<td>0%</td>
<td>47,808.00</td>
</tr>
<tr>
<td><strong>PDU20000-V3-H</strong> AC Pow er Distribution Unit</td>
<td>8</td>
<td>127.00</td>
<td>1,016.00</td>
<td>0%</td>
<td>1,016.00</td>
</tr>
<tr>
<td><strong>HS-SAS-1-01</strong> High Speed Cable, External MiniSAS HD Cable,1m, (28AWG<em>4P</em>2B(S), Indoor use</td>
<td>24</td>
<td>55.00</td>
<td>1,320.00</td>
<td>0%</td>
<td>1,320.00</td>
</tr>
<tr>
<td><strong>HS-SAS-3-01</strong> High Speed Cable,Mini SAS HD Cable,3m, (28AWG<em>4P</em>2B(S), Indoor use</td>
<td>24</td>
<td>96.00</td>
<td>2,304.00</td>
<td>0%</td>
<td>2,304.00</td>
</tr>
<tr>
<td><strong>N8GHBA000</strong> QLOGIC QLE2562 HBA Card, Pcie, 8Gbps DualPort FC Multimode LC Optic Interface</td>
<td>104</td>
<td>1,000.00</td>
<td>104,000.00</td>
<td>0%</td>
<td>104,000.00</td>
</tr>
<tr>
<td><strong>VADMSMR02</strong> Software Service, Trend Micro, 05280169,Original Manufacturer Service, 1Year, 7&quot;24 Standard Service, 10 users</td>
<td>2</td>
<td>314.00</td>
<td>628.00</td>
<td>0%</td>
<td>628.00</td>
</tr>
<tr>
<td><strong>SN2F01FPC</strong> Patch Cord,DL/C/PC,DL/C/PC,Mult-mode, 3m, A1a.2.2mm, OM3 bending insensitive</td>
<td>208</td>
<td>11.00</td>
<td>2,288.00</td>
<td>0%</td>
<td>2,288.00</td>
</tr>
<tr>
<td><strong>P-16mm^2-Olivine-LSZH</strong> Power Cable,450V/750V,H07Z-K UL3386, 16mm^2, 107A, LSZH Cable, VDE, UL</td>
<td>10</td>
<td>3.80</td>
<td>38.00</td>
<td>0%</td>
<td>38.00</td>
</tr>
<tr>
<td><strong>C3006BK01</strong> Power Cable,600V/1000V,ZA-RVV,3x6mm^2,Black(3Cores:Brow n,Blue,Yellow/Green),46A,Outdoor Cable,CE (Unit: meter)</td>
<td>80</td>
<td>6.90</td>
<td>552.00</td>
<td>0%</td>
<td>552.00</td>
</tr>
<tr>
<td><strong>85V3-LBASIC-N</strong> Basic Softw are Suite License(OceanStor OS, DeviceManager ,SmartThin, SmartMotion ,SmartQos, Smart Partition, SmartCache, SmartMigration, Smart Erase, Smart Multi- tenant, SystemReporter, Cloud Service)</td>
<td>1</td>
<td>5,631.00</td>
<td>5,631.00</td>
<td>72%</td>
<td>1,576.68</td>
</tr>
<tr>
<td><strong>85V3-LBASIC200</strong> Basic Softw are Suite Capacity License (101-200TB)</td>
<td>200</td>
<td>644.00</td>
<td>128,800.00</td>
<td>72%</td>
<td>36,064.00</td>
</tr>
<tr>
<td><strong>85V3-LULTRAPATH</strong> OceanStor UltraPath Softw are License</td>
<td>1</td>
<td>2,386.00</td>
<td>2,386.00</td>
<td>72%</td>
<td>668.08</td>
</tr>
</tbody>
</table>

**Hardware & Software Subtotal:** $1,221,988.74
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

<table>
<thead>
<tr>
<th>Test Sponsor Primary Contact</th>
<th>Huawei Technologies Co., Ltd. – <a href="http://www.huawei.com">www.huawei.com</a></th>
<th>Zhong Xu – <a href="mailto:xuzhong@huawei.com">xuzhong@huawei.com</a></th>
</tr>
</thead>
<tbody>
<tr>
<td>SPC Auditor</td>
<td>InfoSizing – <a href="http://www.sizing.com">www.sizing.com</a></td>
<td>Francois Raab – <a href="mailto:francois@sizing.com">francois@sizing.com</a></td>
</tr>
</tbody>
</table>

Revision Information

<table>
<thead>
<tr>
<th>SPC Benchmark 1™ Revision</th>
<th>V3.2.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPC-1 Workload Generator Revision</td>
<td>V3.0 build d34fb3c</td>
</tr>
</tbody>
</table>

Publication Revision History
- First Edition: December 27, 2016
- Second Edition: February 15, 2018
- Updated SPC-1 Price-Performance™ metric based on SPC-1 v3.6.0 definition.
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 16 Huawei OceanStor 18500, driven by 13 host systems (Huawei FusionServer RH5885 V3). Each FusionServer connected one-to-one to each OceanStor. That connection was established via a port from one of the eight dual-port Fibre Channel HBAs on the FusionServer; and a port from one of the four 4-port Smart I/O Modules on the OceanStor, leaving 3 of these ports inactive. 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>13 x Huawei FusionServer™ RH5885 V3</td>
</tr>
<tr>
<td>4 x Intel Xeon E7-4820 V2 (2.0 GHz 8 Core 16 MB L3)</td>
</tr>
<tr>
<td>256 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>104 x QLogic dual-ported QLE2562 FC HBA</td>
</tr>
<tr>
<td>16 x OceanStor™ 18500 V3 Active-Active Controller, each with:</td>
</tr>
<tr>
<td>256 GB cache (4096 GB total)</td>
</tr>
<tr>
<td>4 x 4-port 8Gbps Smart I/O Module</td>
</tr>
<tr>
<td>8 x 12-port 12Gbps SAS I/O Module</td>
</tr>
<tr>
<td>16 x 2U disk enclosure, each with:</td>
</tr>
<tr>
<td>15 x 900 GB SSD (240 total)</td>
</tr>
<tr>
<td>2 x PCIe 16 port switch</td>
</tr>
<tr>
<td>1 x Service Processor</td>
</tr>
<tr>
<td>1 x 8-port KVM</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>LV per ASU</th>
<th>LV Capacity</th>
<th>Used per LV</th>
<th>Total per ASU</th>
<th>% ASU Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASU-1</td>
<td>18</td>
<td>1,910.2</td>
<td>1,910.2</td>
<td>34,383.4</td>
</tr>
<tr>
<td>ASU-2</td>
<td>18</td>
<td>1,910.2</td>
<td>1,910.2</td>
<td>34,383.4</td>
</tr>
<tr>
<td>ASU-3</td>
<td>2</td>
<td>3,820.4</td>
<td>3,820.4</td>
<td>7,640.7</td>
</tr>
<tr>
<td><strong>SPC-1 ASU Capacity</strong></td>
<td><strong>76,407.5</strong></td>
<td></td>
<td></td>
<td></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>240</td>
<td>895.0</td>
<td>214,800.0</td>
</tr>
<tr>
<td><strong>Total Physical Capacity</strong></td>
<td></td>
<td><strong>214,800.0</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Physical Capacity Utilization</strong></td>
<td></td>
<td></td>
<td><strong>35.57%</strong></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 15 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.

**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 Date</th>
<th>Start Time</th>
<th>End Time</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transition Period</td>
<td>21-Dec-16</td>
<td>18:37:18.246</td>
<td>22:37:18.246</td>
<td>4:00:00.000</td>
</tr>
<tr>
<td>Measurement Interval</td>
<td>21-Dec-16</td>
<td>22:37:18.246</td>
<td>6:37:19.246</td>
<td>8:00:01.000</td>
</tr>
</tbody>
</table>

SUSTAIN – Throughput Graph

![Throughput Graph (SUSTAIN @ 2,340,000 IOPS)](image)
SUSTAIN – Response Time Graph

![Response Time Graph (SUSTAIN @ 2,340,000 IOPS)](image)

SUSTAIN – Data Rate Graph

![Data Rate Graph (SUSTAIN @ 2,340,000 IOPS)](image)
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>0.0004</td>
<td>0.0001</td>
<td>0.0003</td>
<td>0.0002</td>
<td>0.0006</td>
<td>0.0003</td>
<td>0.0005</td>
<td>0.0001</td>
</tr>
<tr>
<td>Difference</td>
<td>0.004%</td>
<td>0.002%</td>
<td>0.006%</td>
<td>0.000%</td>
<td>0.000%</td>
<td>0.005%</td>
<td>0.005%</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 Date</th>
<th>Start Time</th>
<th>End Time</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transition Period</td>
<td>22-Dec-16</td>
<td>6:38:18.346</td>
<td>6:41:18.346</td>
<td>0:03:00.000</td>
</tr>
<tr>
<td>Measurement Interval</td>
<td>22-Dec-16</td>
<td>6:41:18.346</td>
<td>6:51:19.346</td>
<td>0:10:01.000</td>
</tr>
</tbody>
</table>

RAMPD_100 – Throughput Graph
RAMPD_100 – Response Time Graph

![Response Time Graph (RAMPD_100 @ 2,340,000 IOPS)](image)

RAMPD_100 – Data Rate Graph

![Data Rate Graph (RAMPD_100 @ 2,340,000 IOPS)](image)
**RAMPD_100 – Response Time Frequency Graph**

![Response Time Frequency Graph](image)

**RAMPD_100 – 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>ASU</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>0.0002</td>
<td>0.0002</td>
<td>0.0002</td>
<td>0.0002</td>
<td>0.0007</td>
<td>0.0002</td>
<td>0.0004</td>
<td>0.0001</td>
</tr>
<tr>
<td>Difference</td>
<td>0.007%</td>
<td>0.008%</td>
<td>0.015%</td>
<td>0.000%</td>
<td>0.033%</td>
<td>0.012%</td>
<td>0.004%</td>
<td>0.009%</td>
</tr>
</tbody>
</table>

**RAMPD_100 – I/O Request Summary**

<table>
<thead>
<tr>
<th>Category</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>I/O Requests Completed in the Measurement Interval</td>
<td>1,404,139,377</td>
</tr>
<tr>
<td>I/O Requests Completed with Response Time &lt;= 30 ms</td>
<td>1,404,048,667</td>
</tr>
<tr>
<td>I/O Requests Completed with Response Time &gt; 30 ms</td>
<td>90,710</td>
</tr>
</tbody>
</table>
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

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

Response Time Ramp Test – RAMPD_10 Response Time Graph
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>2,340,241.7</td>
<td>234,011.0</td>
</tr>
<tr>
<td>REPEAT_1</td>
<td>2,340,214.4</td>
<td>233,990.5</td>
</tr>
<tr>
<td>REPEAT_2</td>
<td>2,340,110.1</td>
<td>234,007.5</td>
</tr>
</tbody>
</table>

REPEAT_1_100 – Throughput Graph
Repeatability Tests

REPEAT_1_100 – Response Time Graph

![Response Time Graph](image)

REPEAT_2_100 – Throughput Graph

![Throughput Graph](image)
REPEAT_2_100 – Response Time Graph

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>0.0004</td>
<td>0.0001</td>
<td>0.0003</td>
<td>0.0001</td>
<td>0.0007</td>
<td>0.0003</td>
<td>0.0004</td>
<td>0.0001</td>
</tr>
<tr>
<td>Difference</td>
<td>0.026%</td>
<td>0.004%</td>
<td>0.004%</td>
<td>0.007%</td>
<td>0.021%</td>
<td>0.001%</td>
<td>0.030%</td>
<td>0.004%</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>0.2810</td>
</tr>
<tr>
<td>Variation</td>
<td>0.0004</td>
<td>0.0002</td>
<td>0.0005</td>
<td>0.0001</td>
<td>0.0005</td>
<td>0.0003</td>
<td>0.0005</td>
<td>0.0001</td>
</tr>
<tr>
<td>Difference</td>
<td>0.028%</td>
<td>0.005%</td>
<td>0.006%</td>
<td>0.005%</td>
<td>0.000%</td>
<td>0.017%</td>
<td>0.013%</td>
<td>0.002%</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>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Number of Logical Blocks Written</td>
<td>289,423,687</td>
</tr>
<tr>
<td>Total Number of Logical Blocks Verified</td>
<td>144,452,449</td>
</tr>
<tr>
<td>Total Number of Logical Blocks that Failed Verification</td>
<td>0</td>
</tr>
<tr>
<td>Time Duration for Writing Test Logical Blocks (sec.)</td>
<td>301</td>
</tr>
<tr>
<td>Size in bytes of each Logical Block</td>
<td>8,192</td>
</tr>
<tr>
<td>Number of Failed I/O Requests in the process of the Test</td>
<td>0</td>
</tr>
</tbody>
</table>
## 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>mklun.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>13host.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

<table>
<thead>
<tr>
<th>No.</th>
<th>Model</th>
<th>Description</th>
<th>Qty</th>
<th>Unit Price (USD)</th>
<th>Ext. Price (USD)</th>
<th>Disc. (%)</th>
<th>Disc. Price (USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Location</td>
<td>OceanStor 18500 V3 Storage System</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.1.1</td>
<td></td>
<td>OceanStor 18500 V3 Engine/Four controller-AC-240RAID-1TB Cache 1/4 port SHARED 1/12 1/24 port SHARE 1/24R 1/12 SAS Entry Sharing 3/0, version SPEC/02000, SmartVOL Version</td>
<td>4</td>
<td>241,020.00</td>
<td>1,164,080.00</td>
<td>72%</td>
<td>326,042.89</td>
</tr>
<tr>
<td>1.1.2</td>
<td></td>
<td>EXPAND Interface Module</td>
<td>10</td>
<td>3,240.00</td>
<td>61,920.00</td>
<td>75%</td>
<td>15,295.00</td>
</tr>
<tr>
<td>1.1.3</td>
<td></td>
<td>RANK500-24G</td>
<td>242</td>
<td>4,621.00</td>
<td>2,946,940.00</td>
<td>75%</td>
<td>1,890,000.00</td>
</tr>
<tr>
<td>1.1.4</td>
<td></td>
<td>CABINET</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5</td>
<td></td>
<td>EX500-C5-H-AC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5.1</td>
<td></td>
<td>OceanStor 18500 V3 Series System</td>
<td>2</td>
<td>23,677.00</td>
<td>47,354.00</td>
<td></td>
<td>119,300.00</td>
</tr>
<tr>
<td>1.5.2</td>
<td></td>
<td>Option Class Item</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5.3</td>
<td></td>
<td>609P-2V3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5.4</td>
<td></td>
<td>610P-2V3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5.5</td>
<td></td>
<td>620P-2V3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5.6</td>
<td></td>
<td>630P-2V3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.5.7</td>
<td></td>
<td>640P-2V3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.6</td>
<td></td>
<td>QAG-2000-24G</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.7</td>
<td></td>
<td>QAG-2000-24G</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Tuning Parameters and Options

### SPC Benchmark 1™ V3.2

**Huawei Technologies Co., Ltd**  
Huawei OceanStor™ 18500 V3

### FULL DISCLOSURE REPORT

Submission Identifier: A31003  
Submitted for Review: December 27, 2016

---

### Hardware Configuration

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1.8</td>
<td><strong>Accessories</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>VADVEM0102</td>
<td>Software Service: Trend Micro (2 Year Standard Service 13 Users)</td>
<td>2</td>
<td>314.30</td>
<td>628.60</td>
<td>60%</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>SM2F16DPC</td>
<td>Patch Cord DCD/DCD-16 DDC/16DPC, Multimode SMF, 2.00GHz GDM Bending Inspection</td>
<td>200</td>
<td>11.60</td>
<td>2218.00</td>
<td>0%</td>
<td>2218.00</td>
</tr>
<tr>
<td></td>
<td>P-16mm-G-G-Comp-LSZH</td>
<td>Power Cable: 600V/750V, H15E6, UL1569, 16mm2, Yellow/Green, 750V, LSZH, Cable VDE UL (Black/Red)</td>
<td>12</td>
<td>5.00</td>
<td>62.90</td>
<td>0%</td>
<td>62.90</td>
</tr>
<tr>
<td></td>
<td>C30088M01</td>
<td>Power Cable: 600V/750V, 2.5mm2, Yellow/Blue, 4.0mm2, Yellow/Green, 5mm2, Outdoor Cable 0E (500V, 500°C)</td>
<td>99</td>
<td>5.00</td>
<td>500.00</td>
<td>0%</td>
<td>500.00</td>
</tr>
</tbody>
</table>

### Software Configuration

| 1.1.9 | **Storage Software**   |                                                                              |     |                  |                  |        |                   |
|       | 8NV-LG5A01             | Basic Software Suite: Controller OS, Colos Manager, SmartThin, SmartRatio, SmartData, SmartFlash, Block Migration, SmartErase, SmartMonitor, System Monitor, Cloud Service | 1   | 5,541.20         | 5,541.20         | 72%    | 1,270.08          |
|       | 8NV-LG5A200            | Basic Software Suite: Capacity License (50-200TB)                           | 220 | 644.00           | 142,120.00       | 72%    | 31,994.00         |
|       | 86V1-4U-RA-PATH        | OceanStor UltraPath Software License                                        | 1   | 2,356.00         | 2,356.00         | 72%    | 968.08            |

**Total of Product:** 1,731,062.76

| 1.1.10 | **Maintenance Support Service** |                                                                              |     |                  |                  |        |                   |
|        | 00126G01               | OceanStor 18500 V3 In-Store Service Engineering                              | 1   | 76,800.81        | 76,800.81        | 20%    | 15,360.16         |
|        | 86V1-4X35-8R1131UH40   | Basic Software Suite: Capacity License (100-200TB)                          | 200 | 182.00           | 36,400.00        | 72%    | 26,124.00         |
|        | 86V1-4U-UD-20034UHP5   | OceanStor UltraPath Software License: H-Care Application Software Upgrade Support Service 36Month | 1   | 715.64           | 715.64           | 72%    | 263.20            |
|        | 86V1-4X35-8R1131UH40   | Basic Software Suite: License (OceanStor OS, Colos Manager, SmartThin, SmartRatio, SmartData, Block Migration, SmartErase, SmartMonitor, System Monitor, Cloud Service) | 1   | 8,899.16         | 8,899.16         | 72%    | 2,147.86          |

**Total of Service (3 years):** 64,568.52

**Total Price:** 1,286,535.26

Notes: H-Care Premier On-Site Service includes: 7/24 Technical Assistance Center Access. Access to all new software updates and Online Support, 24/7/4 hours Onsite Hardware Replacement.
APPENDIX C
Tuing Parameters and Options

---

<table>
<thead>
<tr>
<th>No</th>
<th>Model</th>
<th>Description</th>
<th>Qty.</th>
<th>List Price (USD)</th>
<th>Unit Price (USD)</th>
<th>Disc. Off.</th>
<th>Disc. Price (USD)</th>
</tr>
</thead>
</table>

Payment Terms:

Comments:

Noviant is an Authorized Huawei Value Added Reseller (VAR) of networking and IT products. Products sold by Noviant are factory new unless otherwise specified. All new products sold by Noviant carry their own Original Equipment Manufacturer’s (OEM) Limited Warranty and software licenses. This Quote is valid for 90 days. Prices and availability are 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 canceled 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 these terms and conditions.

Authorized Acceptance: ___________________________  Print Name: ___________________________  Date: ______/____/____

Noviant ___________________________ Print Name: ___________________________ Date: ______/____/____

---

FULL DISCLOSURE REPORT
Submission Identifier: A31003
Submitted for Review: December 27, 2016

SPC Benchmark 1™ V3.2
Huawei Technologies Co., Ltd
Huawei OceanStor™ 18500 V3
APPENDIX C: TUNING PARAMETERS AND OPTIONS

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

- **aio-max-nr.sh** to set the maximum asynchronous I/O
- **nr_requests.sh** to change the I/O scheduler
- **scheduler.sh** to increase the disk queue depth

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 1024 > /sys/block/sdb/queue/nr_requests
```
```
echo 1024 > /sys/block/sdc/queue/nr_requests
```
```
echo 1024 > /sys/block/sdd/queue/nr_requests
```
```
echo 1024 > /sys/block/sde/queue/nr_requests
```
```
echo 1024 > /sys/block/sdf/queue/nr_requests
```
```
echo 1024 > /sys/block/sdg/queue/nr_requests
```
```
echo 1024 > /sys/block/sdh/queue/nr_requests
```
```
echo 1024 > /sys/block/sdi/queue/nr_requests
```
```
echo 1024 > /sys/block/sdj/queue/nr_requests
```
```
echo 1024 > /sys/block/sdk/queue/nr_requests
```
```
echo 1024 > /sys/block/sdl/queue/nr_requests
```
```
echo 1024 > /sys/block/sdm/queue/nr_requests
```
```
echo 1024 > /sys/block/sdn/queue/nr_requests
```
```
echo 1024 > /sys/block/sdo/queue/nr_requests
```
```
echo 1024 > /sys/block/sdp/queue/nr_requests
```
```
echo 1024 > /sys/block/sdq/queue/nr_requests
```
```
echo 1024 > /sys/block/sdr/queue/nr_requests
```
```
echo 1024 > /sys/block/sdt/queue/nr_requests
```
```
echo 1024 > /sys/block/sdu/queue/nr_requests
```
```
echo 1024 > /sys/block/sdv/queue/nr_requests
```
```
echo 1024 > /sys/block/sdw/queue/nr_requests
```
```
echo 1024 > /sys/block/sdx/queue/nr_requests
```
```
echo 1024 > /sys/block/sdy/queue/nr_requests
```
```
echo 1024 > /sys/block/sdz/queue/nr_requests
```
```
echo 1024 > /sys/block/sdaa/queue/nr_requests
```
```
echo 1024 > /sys/block/sdab/queue/nr_requests
```
```
echo 1024 > /sys/block/sdac/queue/nr_requests
```
```
echo 1024 > /sys/block/sdad/queue/nr_requests
```
```
echo 1024 > /sys/block/sdae/queue/nr_requests
```
```
echo 1024 > /sys/block/sdaf/queue/nr_requests
```
```
echo 1024 > /sys/block/sdag/queue/nr_requests
```
```
**scheduler.sh**

```bash
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/sdj/queue/scheduler
echo noop > /sys/block/sdk/queue/scheduler
echo noop > /sys/block/sdl/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/sdz/queue/scheduler
echo noop > /sys/block/sdaa/queue/scheduler
echo noop > /sys/block/sdab/queue/scheduler
echo noop > /sys/block/sdac/queue/scheduler
echo noop > /sys/block/sdad/queue/scheduler
echo noop > /sys/block/sdae/queue/scheduler
echo noop > /sys/block/sdaf/queue/scheduler
echo noop > /sys/block/sdag/queue/scheduler
```
APPENDIX D: STORAGE CONFIGURATION CREATION

Environment
First, the CLI commands from the following command file are copied from the file and pasted into the OceanStor 18500 V3 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 16 disk domains
- Create 16 storage pools
- Create 32 LUNs
- Create one LUN group
- Add the 32 LUNs to the LUN group

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

**mklun.txt**

create disk_domain name=1 disk_list=DAE000.0-14 disk_domain_id=1
create disk_domain name=2 disk_list=DAE010.0-14 disk_domain_id=2
create disk_domain name=3 disk_list=DAE020.0-14 disk_domain_id=3
create disk_domain name=4 disk_list=DAE030.0-14 disk_domain_id=4
create disk_domain name=5 disk_list=DAE100.0-14 disk_domain_id=5
create disk_domain name=6 disk_list=DAE110.0-14 disk_domain_id=6
create disk_domain name=7 disk_list=DAE120.0-14 disk_domain_id=7
create disk_domain name=8 disk_list=DAE130.0-14 disk_domain_id=8
create disk_domain name=9 disk_list=DAE200.0-14 disk_domain_id=9
create disk_domain name=10 disk_list=DAE210.0-14 disk_domain_id=10
create disk_domain name=11 disk_list=DAE220.0-14 disk_domain_id=11
create disk_domain name=12 disk_list=DAE230.0-14 disk_domain_id=12
create disk_domain name=13 disk_list=DAE300.0-14 disk_domain_id=13
create disk_domain name=14 disk_list=DAE310.0-14 disk_domain_id=14
create disk_domain name=15 disk_list=DAE320.0-14 disk_domain_id=15
create disk_domain name=16 disk_list=DAE330.0-14 disk_domain_id=16

--------------------------------------

create storage_pool name=pool1 disk_type=SSD capacity=4500GB disk_domain_id=1
    stripe_depth=32KB raid_level=RAID10 pool_id=1
create storage_pool name=pool2 disk_type=SSD capacity=4500GB disk_domain_id=2
    stripe_depth=32KB raid_level=RAID10 pool_id=2
create storage_pool name=pool3 disk_type=SSD capacity=4500GB disk_domain_id=3
    stripe_depth=32KB raid_level=RAID10 pool_id=3
create storage_pool name=pool4 disk_type=SSD capacity=4500GB disk_domain_id=4 stripe_depth=32KB raid_level=RAID10 pool_id=4
create storage_pool name=pool5 disk_type=SSD capacity=4500GB disk_domain_id=5 stripe_depth=32KB raid_level=RAID10 pool_id=5
create storage_pool name=pool6 disk_type=SSD capacity=4500GB disk_domain_id=6 stripe_depth=32KB raid_level=RAID10 pool_id=6
create storage_pool name=pool7 disk_type=SSD capacity=4500GB disk_domain_id=7 stripe_depth=32KB raid_level=RAID10 pool_id=7
create storage_pool name=pool8 disk_type=SSD capacity=4500GB disk_domain_id=8 stripe_depth=32KB raid_level=RAID10 pool_id=8
create storage_pool name=pool9 disk_type=SSD capacity=4500GB disk_domain_id=9 stripe_depth=32KB raid_level=RAID10 pool_id=9
create storage_pool name=pool10 disk_type=SSD capacity=4500GB disk_domain_id=10 stripe_depth=32KB raid_level=RAID10 pool_id=10
create storage_pool name=pool11 disk_type=SSD capacity=4500GB disk_domain_id=11 stripe_depth=32KB raid_level=RAID10 pool_id=11
create storage_pool name=pool12 disk_type=SSD capacity=4500GB disk_domain_id=12 stripe_depth=32KB raid_level=RAID10 pool_id=12
create storage_pool name=pool13 disk_type=SSD capacity=4500GB disk_domain_id=13 stripe_depth=32KB raid_level=RAID10 pool_id=13
create storage_pool name=pool14 disk_type=SSD capacity=4500GB disk_domain_id=14 stripe_depth=32KB raid_level=RAID10 pool_id=14
create storage_pool name=pool15 disk_type=SSD capacity=4500GB disk_domain_id=15 stripe_depth=32KB raid_level=RAID10 pool_id=15
create storage_pool name=pool16 disk_type=SSD capacity=4500GB disk_domain_id=16 stripe_depth=32KB raid_level=RAID10 pool_id=16

create lun name=lun1 pool_id=1 capacity=2248GB owner_controller=0A lun_id=1
create lun name=lun2 pool_id=1 capacity=2248GB owner_controller=0B lun_id=2
create lun name=lun3 pool_id=2 capacity=2248GB owner_controller=0C lun_id=3
create lun name=lun4 pool_id=2 capacity=2248GB owner_controller=0D lun_id=4
create lun name=lun5 pool_id=3 capacity=2248GB owner_controller=0C lun_id=5
create lun name=lun6 pool_id=3 capacity=2248GB owner_controller=0D lun_id=6
create lun name=lun7 pool_id=4 capacity=2248GB owner_controller=1A lun_id=7
create lun name=lun8 pool_id=4 capacity=2248GB owner_controller=0B lun_id=8
create lun name=lun9 pool_id=5 capacity=2248GB owner_controller=1A lun_id=9
create lun name=lun10 pool_id=5 capacity=2248GB owner_controller=1B lun_id=10
create lun name=lun11 pool_id=6 capacity=2248GB owner_controller=1C lun_id=11
create lun name=lun12 pool_id=6 capacity=2248GB owner_controller=1D lun_id=12
create lun name=lun13 pool_id=7 capacity=2248GB owner_controller=1C lun_id=13
create lun name=lun14 pool_id=7 capacity=2248GB owner_controller=1D lun_id=14
create lun name=lun15 pool_id=8 capacity=2248GB owner_controller=1A lun_id=15
create lun name=lun16 pool_id=8 capacity=2248GB owner_controller=1B lun_id=16
create lun name=lun17 pool_id=9 capacity=2248GB owner_controller=2A lun_id=17
create lun name=lun18 pool_id=9 capacity=2248GB owner_controller=2B lun_id=18
create lun name=lun19 pool_id=10 capacity=2248GB owner_controller=2C lun_id=19
create lun name=lun20 pool_id=10 capacity=2248GB owner_controller=2D lun_id=20
create lun name=lun21 pool_id=11 capacity=2248GB owner_controller=2C lun_id=21
create lun name=lun22 pool_id=11 capacity=2248GB owner_controller=2D lun_id=22
create lun name=lun23 pool_id=12 capacity=2248GB owner_controller=2A lun_id=23
create lun name=lun24 pool_id=12 capacity=2248GB owner_controller=2B lun_id=24
create lun name=lun25 pool_id=13 capacity=2248GB owner_controller=3A lun_id=25
create lun name=lun26 pool_id=13 capacity=2248GB owner_controller=3B lun_id=26
create lun name=lun27 pool_id=14 capacity=2248GB owner_controller=3C lun_id=27
create lun name=lun28 pool_id=14 capacity=2248GB owner_controller=3D lun_id=28
create lun name=lun29 pool_id=15 capacity=2248GB owner_controller=3C lun_id=29
create lun name=lun30 pool_id=15 capacity=2248GB owner_controller=3D lun_id=30
create lun name=lun31 pool_id=16 capacity=2248GB owner_controller=3A lun_id=31
create lun name=lun32 pool_id=16 capacity=2248GB owner_controller=3B lun_id=32

create lun_group name/lg lun_group_id=1

add lun_group lun lun_group_id=1 lun_id_list=1-4,9-12,17-20,25-28
add lun_group lun lun_group_id=1 lun_id_list=5-8,13-16,21-24,29-32

Step 2 - Create Mapping View, Host Group and Host

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

- Create a mapping view
- Create a host group
- Create 13 hosts
- Add the 13 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 13 hosts

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

mklun.txt

create mapping_view name=mv mapping_view_id=1

create host_group name=hg host_group_id=1

create host name=h1 operating_system=Linux host_id=1
create host name=h2 operating_system=Linux host_id=2
create host name=h3 operating_system=Linux host_id=3
create host name=h4 operating_system=Linux host_id=4
create host name=h5 operating_system=Linux host_id=5
create host name=h6 operating_system=Linux host_id=6
create host name=h7 operating_system=Linux host_id=7
create host name=h8 operating_system=Linux host_id=8
create host name=h9 operating_system=Linux host_id=9
create host name=h10 operating_system=Linux host_id=10
create host name=h11 operating_system=Linux host_id=11
create host name=h12 operating_system=Linux host_id=12
create host name=h13 operating_system=Linux host_id=13

add host_group host host_group_id=1 host_id_list=1,2,3,4,5,6,7,8,9,10,11,12,13
add mapping_view host_group mapping_view_id=1 host_group_id=1
add mapping_view lun_group mapping_view_id=1 lun_group_id=1

add host initiator host_id=1 initiator_type=FC wwn=21000024ff5332ab
add host initiator host_id=1 initiator_type=FC wwn=21000024ff5470a4
add host initiator host_id=1 initiator_type=FC wwn=21000024ff5470a5
add host initiator host_id=1 initiator_type=FC wwn=21000024ff3c5c28
add host initiator host_id=1 initiator_type=FC wwn=21000024ff3c5c29
add host initiator host_id=1 initiator_type=FC wwn=21000024ff543b14
add host initiator host_id=1 initiator_type=FC wwn=21000024ff543b15
add host initiator host_id=1 initiator_type=FC wwn=21000024ff4380b6
add host initiator host_id=1 initiator_type=FC wwn=21000024ff4380b7
add host initiator host_id=1 initiator_type=FC wwn=21000024ff2f9192
add host initiator host_id=1 initiator_type=FC wwn=21000024ff2f93a9c
add host initiator host_id=1 initiator_type=FC wwn=21000024ff2f93a9d
add host initiator host_id=1 initiator_type=FC wwn=21000024ff2f93a9e
add host initiator host_id=2 initiator_type=FC wwn=21000024ff4b826a
add host initiator host_id=2 initiator_type=FC wwn=21000024ff4b826b
add host initiator host_id=2 initiator_type=FC wwn=21000024ff536ac2
add host initiator host_id=2 initiator_type=FC wwn=21000024ff536ac3
add host initiator host_id=2 initiator_type=FC wwn=21000024ff536ac4
add host initiator host_id=2 initiator_type=FC wwn=21000024ff536ac5
add host initiator host_id=2 initiator_type=FC wwn=21000024ff536ac6
add host initiator host_id=2 initiator_type=FC wwn=21000024ff536ac7
add host initiator host_id=3 initiator_type=FC wwn=21000024ff53337c
add host initiator host_id=3 initiator_type=FC wwn=21000024ff53337d
add host initiator host_id=3 initiator_type=FC wwn=21000024ff53337e
add host initiator host_id=3 initiator_type=FC wwn=21000024ff53337f
add host initiator host_id=3 initiator_type=FC wwn=21000024ff53338a
add host initiator host_id=3 initiator_type=FC wwn=21000024ff53338b
add host initiator host_id=3 initiator_type=FC wwn=21000024ff53338c
add host initiator host_id=3 initiator_type=FC wwn=21000024ff53338d
add host initiator host_id=3 initiator_type=FC wwn=21000024ff53338e
add host initiator host_id=3 initiator_type=FC wwn=21000024ff53338f
add host initiator host_id=4 initiator_type=FC wwn=21000024ff5332e4
add host initiator host_id=4 initiator_type=FC wwn=21000024ff5332e5
add host initiator host_id=4 initiator_type=FC wwn=21000024ff5332e6
add host initiator host_id=4 initiator_type=FC wwn=21000024ff5332e7
add host initiator host_id=4 initiator_type=FC wwn=21000024ff5332e8
add host initiator host_id=4 initiator_type=FC wwn=21000024ff5332e9
add host initiator host_id=4 initiator_type=FC wwn=21000024ff5332ea
add host initiator host_id=4 initiator_type=FC wwn=21000024ff5332eb
add host initiator host_id=4 initiator_type=FC wwn=21000024ff5332ec
add host initiator host_id=4 initiator_type=FC wwn=21000024ff5332ed
add host initiator host_id=4 initiator_type=FC wwn=21000024ff5332ee
add host initiator host_id=4 initiator_type=FC wwn=21000024ff5332ef
add host initiator host_id=4 initiator_type=FC wwn=21000024ff5332b5
add host initiator host_id=4 initiator_type=FC wwn=21000024ff5f8c1e
add host initiator host_id=4 initiator_type=FC wwn=21000024ff5f8c1f
add host initiator host_id=4 initiator_type=FC wwn=21000024ff4bc459
add host initiator host_id=4 initiator_type=FC wwn=21000024ff8e8d8d
add host initiator host_id=4 initiator_type=FC wwn=21000024ff5f8ca6
add host initiator host_id=4 initiator_type=FC wwn=21000024ff5f8ca7
add host initiator host_id=4 initiator_type=FC wwn=21000024ff5332d2
add host initiator host_id=4 initiator_type=FC wwn=21000024ff8e8bca
add host initiator host_id=4 initiator_type=FC wwn=21000024ff8e8bcb
add host initiator host_id=5 initiator_type=FC wwn=21000024ff4bc458
add host initiator host_id=5 initiator_type=FC wwn=21000024ff36e715
add host initiator host_id=5 initiator_type=FC wwn=21000024ff5333cd
add host initiator host_id=5 initiator_type=FC wwn=21000024ff5333cc
add host initiator host_id=5 initiator_type=FC wwn=21000024ff5333bc
add host initiator host_id=5 initiator_type=FC wwn=21000024ff5333ac
add host initiator host_id=5 initiator_type=FC wwn=21000024ff5333ab
add host initiator host_id=5 initiator_type=FC wwn=21000024ff5333aa
add host initiator host_id=6 initiator_type=FC wwn=21000024ff5333a9
add host initiator host_id=6 initiator_type=FC wwn=21000024ff5333a8
add host initiator host_id=6 initiator_type=FC wwn=21000024ff5333a7
add host initiator host_id=6 initiator_type=FC wwn=21000024ff5333a6
add host initiator host_id=6 initiator_type=FC wwn=21000024ff5333a5
add host initiator host_id=6 initiator_type=FC wwn=21000024ff5333a4
add host initiator host_id=6 initiator_type=FC wwn=21000024ff5333a3
add host initiator host_id=6 initiator_type=FC wwn=21000024ff5333a2
add host initiator host_id=6 initiator_type=FC wwn=21000024ff5333a1
add host initiator host_id=6 initiator_type=FC wwn=21000024ff5333a0
add host initiator host_id=7 initiator_type=FC wwn=21000024ff5333a9
add host initiator host_id=7 initiator_type=FC wwn=21000024ff5333a8
add host initiator host_id=7 initiator_type=FC wwn=21000024ff5333a7
add host initiator host_id=7 initiator_type=FC wwn=21000024ff5333a6
add host initiator host_id=7 initiator_type=FC wwn=21000024ff5333a5
add host initiator host_id=7 initiator_type=FC wwn=21000024ff5333a4
add host initiator host_id=7 initiator_type=FC wwn=21000024ff5333a3
add host initiator host_id=7 initiator_type=FC wwn=21000024ff5333a2
add host initiator host_id=7 initiator_type=FC wwn=21000024ff5333a1
add host initiator host_id=7 initiator_type=FC wwn=21000024ff5333a0
add host initiator host_id=7 initiator_type=FC wwn=2010000e1e3045cc
add host initiator host_id=7 initiator_type=FC wwn=2001000e1e3045cd
add host initiator host_id=7 initiator_type=FC wwn=2100000e1e1a9e30
add host initiator host_id=7 initiator_type=FC wwn=2100000e1e1a9e31

add host initiator host_id=8 initiator_type=FC wwn=21000024ff535125
add host initiator host_id=8 initiator_type=FC wwn=21000024ff4958c4
add host initiator host_id=8 initiator_type=FC wwn=21000024ff545060
add host initiator host_id=8 initiator_type=FC wwn=21000024ff4b91a8
add host initiator host_id=8 initiator_type=FC wwn=21000024ff4b91a9
add host initiator host_id=8 initiator_type=FC wwn=21000024ff4b900c
add host initiator host_id=8 initiator_type=FC wwn=21000024ff4b900d
add host initiator host_id=8 initiator_type=FC wwn=21000024ff543a5e
add host initiator host_id=8 initiator_type=FC wwn=21000024ff53be6
add host initiator host_id=8 initiator_type=FC wwn=21000024ff543a5f
add host initiator host_id=8 initiator_type=FC wwn=21000024ff2c94ec
add host initiator host_id=8 initiator_type=FC wwn=21000024ff2c94ed
add host initiator host_id=8 initiator_type=FC wwn=21000024ff543be7
add host initiator host_id=8 initiator_type=FC wwn=21000024ff535124

add host initiator host_id=9 initiator_type=FC wwn=21000024ff3faaff
add host initiator host_id=9 initiator_type=FC wwn=21000024ff4a108a
add host initiator host_id=9 initiator_type=FC wwn=21000024ff4a108b
add host initiator host_id=9 initiator_type=FC wwn=21000024ff4b81a0
add host initiator host_id=9 initiator_type=FC wwn=21000024ff4b81a1
add host initiator host_id=9 initiator_type=FC wwn=21000024ff75e889
add host initiator host_id=9 initiator_type=FC wwn=21000024ff53330c
add host initiator host_id=9 initiator_type=FC wwn=21000024ff53330d
add host initiator host_id=9 initiator_type=FC wwn=21000024ff2b0f4e
add host initiator host_id=9 initiator_type=FC wwn=21000024ff5338b4
add host initiator host_id=9 initiator_type=FC wwn=21000024ff540bba
add host initiator host_id=9 initiator_type=FC wwn=21000024ff540bbb
add host initiator host_id=9 initiator_type=FC wwn=21000024ff5338b5
add host initiator host_id=9 initiator_type=FC wwn=21000024ff3faaf

add host initiator host_id=10 initiator_type=FC wwn=21000024ff3c02dd
add host initiator host_id=10 initiator_type=FC wwn=21000024ff371ece
add host initiator host_id=10 initiator_type=FC wwn=21000024ff371eed
add host initiator host_id=10 initiator_type=FC wwn=21000024ff371eda
add host initiator host_id=10 initiator_type=FC wwn=21000024ff75eda2
add host initiator host_id=10 initiator_type=FC wwn=21000024ff75eda3
add host initiator host_id=10 initiator_type=FC wwn=21000024ff5439e4
add host initiator host_id=10 initiator_type=FC wwn=21000024ff5439e5
add host initiator host_id=10 initiator_type=FC wwn=21000024ff55bf518
add host initiator host_id=10 initiator_type=FC wwn=21000024ff55bf519
add host initiator host_id=10 initiator_type=FC wwn=21000024ff55bf51a
add host initiator host_id=10 initiator_type=FC wwn=21000024ff4bf4bfc
add host initiator host_id=10 initiator_type=FC wwn=21000024ff4bf4bfc5
add host initiator host_id=10 initiator_type=FC wwn=21000024ff455ed2
add host initiator host_id=10 initiator_type=FC wwn=21000024ff455ed3
add host initiator host_id=10 initiator_type=FC wwn=21000024ff3c02dc

add host initiator host_id=11 initiator_type=FC wwn=21000024ff533331
add host initiator host_id=11 initiator_type=FC wwn=21000024ff49ae54
add host initiator host_id=11 initiator_type=FC wwn=21000024ff49ae55
add host initiator host_id=11 initiator_type=FC wwn=21000024ff533338
add host initiator host_id=11 initiator_type=FC wwn=21000024ff533339
add host initiator host_id=11 initiator_type=FC wwn=21000024ff4bc1f0
Step 3 - Create Volumes on the Host Systems

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

- Create 32 physical volumes
- Create a volume group for the 32 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/sdg
pvcreate /dev/sdh
pvcreate /dev/sdi
pvcreate /dev/sdj
pvcreate /dev/sdk
pvcreate /dev/sdk
pvcreate /dev/sdl
pvcreate /dev/sdo
pvcreate /dev/sdr
pvcreate /dev/sds
pvcreate /dev/sdt
pvcreate /dev/sdu
pvcreate /dev/sdv
pvcreate /dev/sdx
pvcreate /dev/sdy
pvcreate /dev/sdz
pvcreate /dev/sdaa
pvcreate /dev/sdab
pvcreate /dev/sdac
pvcreate /dev/sdad
pvcreate /dev/sdae
pvcreate /dev/sdaf
pvcreate /dev/sdag


lvcreate -n asu101 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu102 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu103 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu104 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu105 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu106 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu107 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu108 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu109 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu110 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu111 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu112 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu113 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu114 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu115 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu116 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu117 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu118 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu201 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu202 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu203 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu204 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu205 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu206 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu207 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu208 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu209 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu210 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu211 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu212 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu213 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu214 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu215 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu216 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu217 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu218 -i 32 -I 512 -C y -L 1779g vg1
lvcreate -n asu301 -i 32 -I 512 -C y -L 3558g vg1
lvcreate -n asu302 -i 32 -I 512 -C y -L 3558g 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
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

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

spc1 -run SPC1_INIT -iops 45000 -storage slave_asu.asu -output
      ~/newtool/spc1_INIT_45k_iops -master 13host.HST
spc1 -run SPC1_VERIFY -iops 100 -storage slave_asu.asu -output
      ~/newtool/spc1_VERIFY1_100_iops
spc1 -run SPC1_METRICS -iops 2340000 -storage slave_asu.asu -output
      ~/newtool/spc1_METRICS_2340k_iops -master 13host.HST
spc1 -run SPC1_VERIFY -iops 100 -storage slave_asu.asu -output
      ~/newtool/spc1_VERIFY2_100_iops
spc1 -run SPC1_PERSIST_1 -iops 585000 -storage slave_asu.asu -output
      ~/newtool/spc1_PERSIST_585k_iops -master 13host.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

spc1 -run SPC1_PERSIST_2 -iops 585000 -storage slave_asu.asu -output
      ~/newtool/spc1_PERSIST_585k_iops -master 13host.HST