SPC BENCHMARK 1™

FULL DISCLOSURE REPORT

FUJITSU LIMITED
ETERNUS DX8900 S4

SPC-1 V3.8

SUBMISSION IDENTIFIER: A32009

SUBMITTED FOR REVIEW: MARCH 23, 2019
First Edition – March 2019

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 Fujitsu Limited 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. Fujitsu Limited 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 Fujitsu Limited representative for information on products and services available in your area.

© Copyright Fujitsu Limited 2019. 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.

Eternus and the Fujitsu logo are trademarks or registered trademarks of Fujitsu Limited 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.spcresults.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 ................................................................................................. 12  
  Benchmark Configuration and Tested Storage Configuration ............................................. 12  
  Benchmark Configuration Creation Process .................................................................... 14  
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  
  Space Optimization Techniques .................................................................................... 28  
  Data Persistence Test ..................................................................................................... 29  
Appendix A: Supporting Files ............................................................................................. 30  
Appendix B: Third Party Quotation .................................................................................... 31  
Appendix C: Tuning Parameters and Options .................................................................... 32  
Appendix D: Storage Configuration Creation .................................................................... 35  
  Step 1 – Creation of RAID Groups ................................................................................. 35  
  Step 2 – Creation of the Logical Volumes ...................................................................... 35  
  Step 3 – Creation of the Global Hot Spares .................................................................. 35  
  Step 4 – Assignment of LUN Mapping to the Linux Host Systems .............................. 35  
  Step 5 – Creation of the twenty four way striped logical volumes ............................... 35  
  Step 6 – Configuration of FC Switch zoning ................................................................. 48  
  Referenced Scripts ........................................................................................................ 48  
Appendix E: Configuration Inventory ................................................................................ 49  
Appendix F: Workload Generator ....................................................................................... 50  
  Referenced Scripts ........................................................................................................ 50


**AUDIT CERTIFICATION**

Mr. Kun Katsumata  
Fujitsu Limited  
1250 East Arques Ave.  
PO box 3470  
Sunnyvale, CA 94088-3470

March 22, 2019

I verified the SPC Benchmark 1™ (SPC-1™ V3.8) test execution and performance results of the following Tested Storage Product:

**ETERNUS DX8900 S4**

The results were:

<table>
<thead>
<tr>
<th>SPC-1 IOPS™</th>
<th>10,001,522</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPC-1 Price-Performance™</td>
<td>$644.16/SPC-1 KIOPS™</td>
</tr>
<tr>
<td>SPC-1 IOPS™ Response Time</td>
<td>0.418 ms</td>
</tr>
<tr>
<td>SPC-1 Overall Response Time</td>
<td>0.249 ms</td>
</tr>
<tr>
<td>SPC-1 ASU Capacity</td>
<td>90,452 GB</td>
</tr>
<tr>
<td>SPC-1 ASU Price</td>
<td>$71.23/GB</td>
</tr>
<tr>
<td>SPC-1 Total System Price</td>
<td>$8,442,522.88</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 v3.0.2-1-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](http://www.spcresults.org) under the Submission Identifier A32009.
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 each 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 in accordance with the SPC Policies:

The Tested Storage Configuration (TSC) used eight sparsely populated racks to hold the DX8900 S4 components. The Priced Storage Configuration consolidates the DX8900 S4 components into two racks. If the TSC had been configured with just two racks, there would not have been a difference in the reported SPC-1 performance.

Respectfully Yours,

Doug Johnson, Certified SPC Auditor
LETTER OF GOOD FAITH

March 8, 2019
From: Yoshinori Tenero, Fujitsu Limited

To: Doug Johnson, SPC Auditor
Perflabs, Inc. DBA Infisizing
68 Lourdes Drive
Leominster, MA 01453 6709 USA

Contact Information: Kun Katsumata
Fujitsu America, Inc.
1250 East Arques Ave. PO Box 3470
Sunnyvale, CA 94088, U.S.A.

Subject: SPC-1 Letter of Good Faith for the FUJITSU Storage ETERNUS DX8900 S4

Fujitsu Limited 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 V3.8 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:

Yoshinori Tenero  
Vice President, System Development Div.

March 8, 2019
# SPC Benchmark 1™

## Executive Summary

**Fujitsu Limited**

**ETERNUS DX8900 S4**

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPC-1 IOPS™</td>
<td>10,001,522</td>
</tr>
<tr>
<td>SPC-1 Price-Performance™</td>
<td>$644.16/SPC-1 KIOPS™</td>
</tr>
<tr>
<td>SPC-1 IOPS™ Response Time</td>
<td>0.418 ms</td>
</tr>
<tr>
<td>SPC-1 Overall Response Time</td>
<td>0.249 ms</td>
</tr>
<tr>
<td>SPC-1 ASU Capacity</td>
<td>90,452 GB</td>
</tr>
<tr>
<td>SPC-1 Space Effectiveness Ratio</td>
<td>NA</td>
</tr>
<tr>
<td>SPC-1 ASU Price</td>
<td>$71.23/GB</td>
</tr>
<tr>
<td>SPC-1 Total System Price</td>
<td>$6,442,522.88</td>
</tr>
</tbody>
</table>

**Data Protection Level**

- Protected 2 (RAID1)

**Physical Storage Capacity**

- 230,400 GB

**Pricing Currency / Target Country**

- U.S. Dollars / USA

**SPC-1 V3.8**

**Submission Identifier: A32009**

**Submitted For Review: March 23, 2019**
**Tested Storage Product Description**

FUJITSU Storage ETERNUS DX8900 S4 is the perfect platform to consolidate storage in data centers by providing leading performance headroom, business continuity and automated operation capabilities. It facilitates the transition to full flash-configurations and allows the efficient management of flexible data service levels in terms of capacity, speed and costs.

For more details, visit:

**Priced Storage Configuration Components**

<table>
<thead>
<tr>
<th>Component Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>2x Emulex LPe16002 dual port 16Gb Fiber Channel HBAs per Host System</td>
<td>(used in PRIMERGY RX2540 M1, PRIMERGY RX300 S8)</td>
</tr>
<tr>
<td>2x Emulex LPe32002 dual port 32Gb Fiber Channel HBAs per Host System</td>
<td>(used in 16 of the PRIMERGY RX2540 M4)</td>
</tr>
<tr>
<td>1x Emulex LPe16002 dual port 16Gb Fiber Channel HBA</td>
<td>(used in 1 of the PRIMERGY RX2540 M4)</td>
</tr>
<tr>
<td>1x Emulex LPe32002 dual port 32Gb Fiber Channel HBA</td>
<td></td>
</tr>
<tr>
<td>All LPe16002s and LPe32002s were connected at a link speed of 16Gbps (176 ports total)</td>
<td></td>
</tr>
<tr>
<td>1x DS8900 S4, with:</td>
<td></td>
</tr>
<tr>
<td>12x Controller Module Enclosures – 2.5” – 2RU, each with:</td>
<td></td>
</tr>
<tr>
<td>24x 400GB SSD Storage Devices</td>
<td></td>
</tr>
<tr>
<td>2x Control Modules (CM), each with:</td>
<td></td>
</tr>
<tr>
<td>768 GB cache (1,536 GB total)</td>
<td></td>
</tr>
<tr>
<td>2x Channel Adapters (CA) with 4x 16Gbps or 32Gbps host ports</td>
<td></td>
</tr>
<tr>
<td>Or</td>
<td></td>
</tr>
<tr>
<td>4x Channel Adapters (CA) with 2x 16Gbps or 32Gbps host ports</td>
<td></td>
</tr>
<tr>
<td>All CMs have 8 ports linked at 16 Gbps (192 ports total)</td>
<td></td>
</tr>
<tr>
<td>12x Drive Enclosures, each with:</td>
<td></td>
</tr>
<tr>
<td>24x 400GB SSD Storage Devices</td>
<td></td>
</tr>
<tr>
<td>(576 SSDs total)</td>
<td></td>
</tr>
<tr>
<td>2x Brocade G630 Fiber Channel Switches, each with:</td>
<td></td>
</tr>
<tr>
<td>96 FC ports of which 92 ports are populated with 16Gbps SFP</td>
<td></td>
</tr>
<tr>
<td>2x Brocade 6520 Fiber Channel Switches, each with:</td>
<td></td>
</tr>
<tr>
<td>96 FC ports of which 92 ports are populated with 16Gbps SFP</td>
<td></td>
</tr>
<tr>
<td>(368 16Gbps ports total)</td>
<td></td>
</tr>
</tbody>
</table>
# Storage Configuration Pricing

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>Source</th>
<th>Qty</th>
<th>Unit Price</th>
<th>Ext. Price</th>
<th>Disc.</th>
<th>Disc. Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>ET894SBU</td>
<td>ET DX8900S4 Frontend Encl. T2</td>
<td>1</td>
<td>1</td>
<td>169,850.00</td>
<td>169,850.00</td>
<td>75%</td>
<td>42,462.50</td>
</tr>
<tr>
<td>ETTCAU</td>
<td>ET DX8900S4 Controller Encl. Contr. x2</td>
<td>1</td>
<td>12</td>
<td>196,800.00</td>
<td>2,361,600.00</td>
<td>75%</td>
<td>590,400.00</td>
</tr>
<tr>
<td>ETTEADU</td>
<td>ET DX8900S4 Drive Encl. 2.5 x1</td>
<td>1</td>
<td>12</td>
<td>9,320.00</td>
<td>111,840.00</td>
<td>75%</td>
<td>27,960.00</td>
</tr>
<tr>
<td>ETSKC30U</td>
<td>DX8x00S3S4 Pow Cable IEC60320 C14 2x3m</td>
<td>1</td>
<td>26</td>
<td>300.00</td>
<td>7,800.00</td>
<td>75%</td>
<td>1,950.00</td>
</tr>
<tr>
<td>ETTHFCB</td>
<td>DX8x00S4 Inter Card FC 4Port 16G x1</td>
<td>1</td>
<td>6</td>
<td>10,790.00</td>
<td>64,740.00</td>
<td>75%</td>
<td>16,185.00</td>
</tr>
<tr>
<td>ETTHFDB</td>
<td>DX8x00S4 Inter Card FC 4Port 32G x1</td>
<td>1</td>
<td>30</td>
<td>28,190.00</td>
<td>845,700.00</td>
<td>75%</td>
<td>211,425.00</td>
</tr>
<tr>
<td>ET8900-W004360-AAN</td>
<td>ETERNUS DX8900S4 Warranty Uplift, 36 Months, Enhanced Plus Level, 24x7 4hr Onsite, Prepaid billing</td>
<td>1</td>
<td>1</td>
<td>3,535,477.59</td>
<td>3,535,477.59</td>
<td>70%</td>
<td>1,060,643.28</td>
</tr>
<tr>
<td>G630-SYS-P405S-3</td>
<td>PREMIER 4HR ONSITE SUPPORT, G630 Switch</td>
<td>1</td>
<td>2</td>
<td>25,286.00</td>
<td>50,572.00</td>
<td>0%</td>
<td>50,572.00</td>
</tr>
<tr>
<td>6520-SYS-P405S-3</td>
<td>PREMIER 4HR ONSITE SUPPORT, BR-6520-48-16G, BR-6520-96-16G, BR-6520-48-8G</td>
<td>1</td>
<td>2</td>
<td>16,858.00</td>
<td>33,716.00</td>
<td>0%</td>
<td>33,716.00</td>
</tr>
</tbody>
</table>

**Hardware & Software Subtotal**: 5,297,591.60

**Support & Maintenance Subtotal**: 1,144,931.28

**Total System Price**: 6,442,522.88

---

**Discount Details**: The discounts shown are based on the storage capacity purchased and are generally available. **Warranty**: The 3-year maintenance and support included in the above pricing meets or exceeds a 24x7 coverage with a 4-hour response time. **Availability Date**: Currently available.
Response Time and Throughput Graph

Contact Information

Test Sponsor Primary Contact
Fujitsu Limited – http://www.fujitsu.com/services/computing/storage/
Kun Katsumata – kkatsumata@us.fujitsu.com

SPC Auditor
InfoSizing – www.sizing.com
Doug Johnson – doug@sizing.com

Revision Information

<table>
<thead>
<tr>
<th>Revision Information</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPC Benchmark 1™ Revision</td>
<td>V3.8</td>
</tr>
<tr>
<td>SPC-1 Workload Generator Revision</td>
<td>v3.0.2-1-g823a</td>
</tr>
<tr>
<td>Publication Revision History</td>
<td>Initial Publication</td>
</tr>
</tbody>
</table>
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 Benchmark Configuration utilized 44 PRIMERGY servers as hosts systems to drive the Tested Storage Configuration. Each host system had four 16Gbps Fiber Channel connections; one connection to each of the four Brocade Fiber Channel switches. Each Brocade switch had two 16Gbps connections to each of the 24 Control Modules in the DX8900 S4. Additionally, each Control Module was connected to the other Control Modules via the Frontend enclosure in the DX 8900 S4.

**Host System and Tested Storage Configuration Components**

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

| Host Systems | 16x Fujitsu PRIMERGY RX2540 M4, each with:
| | 2x Intel® Xeon® Platinum 8168 CPU (2.7GHz, 24 Cores, 33MB Cache) |
| | 384GB Main Memory |
| | Red Hat Enterprise Linux Server 6.9 |
| | 2x PFC EP LPe32002 2x 32Gb Broadcom |
| | 1x Fujitsu PRIMERGY RX2540 M4, with:
| | 2x Intel® Xeon® Platinum 8168 CPU (2.7GHz, 24 Cores, 33MB Cache) |
| | 384GB Main Memory |
| | Red Hat Enterprise Linux Server 6.9 |
| | 1x PFC EP LPe32002 2x 32Gb Broadcom |
| | 1x PFC EP LPe16002 |
| | 11x Fujitsu PRIMERGY RX2540 M1, each with:
| | 2x Intel® Xeon® E5-2699 v3 CPU (2.3GHz, 18 Cores, 45MB Cache) |
| | 384GB Main Memory |
| | Red Hat Enterprise Linux Server 6.9 |
| | 2x PFC EP LPe16002 |
| | 16x Fujitsu PRIMERGY RX300 S8, each with:
| | 2x Intel® Xeon® E5-2697 v2 CPU (2.7GHz, 12 Cores, 30MB Cache) |
| | 128GB Main Memory |
| | Red Hat Enterprise Linux Server 6.9 |
| | 2x PFC EP LPe16002 |

| Tested Storage Configuration | 2x Emulex LPe16002 dual port 16Gb Fiber Channel HBAs per Host System (used in PRIMERGY RX2540 M1, PRIMERGY RX300 S8) |
| | 2x Emulex LPe32002 dual port 32Gb Fiber Channel HBAs per Host System (used in 16 of the PRIMERGY RX2540 M4) |
| | 1x Emulex LPe16002 dual port 16Gb Fiber Channel HBA |
| | 1x Emulex LPe32002 dual port 32Gb Fiber Channel HBA (used in 1 of the PRIMERGY RX2540 M4) |

All LPe16002s and LPe32002s were connected at a link speed of 16Gbps (176 ports total)
**Differences Between Tested and Priced Storage Configurations**

The TSC used eight sparsely populated racks to hold the DX8900 S4 components. The PSC consolidates the DX8900 S4 components into two racks. If the TSC had been configured with just two racks, there would not have been a difference in the reported SPC-1 performance.

**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 Application Storage Unit Mapping**

The following table details the capacity of the Application Storage Units (ASUs) and how they are mapped to logical volumes (LVs). All capacities are reported in GB.

<table>
<thead>
<tr>
<th>LV per ASU</th>
<th>Used per LV</th>
<th>Total per ASU</th>
<th>% ASU Capacity</th>
<th>Optimized*</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASU-1</td>
<td>1,130.6</td>
<td>40,703.4</td>
<td>45.0%</td>
<td>No</td>
</tr>
<tr>
<td>ASU-2</td>
<td>1,130.6</td>
<td>40,703.4</td>
<td>45.0%</td>
<td>No</td>
</tr>
<tr>
<td>ASU-3</td>
<td>1,130.6</td>
<td>9,045.2</td>
<td>10.0%</td>
<td>No</td>
</tr>
</tbody>
</table>

*See Space Optimization Techniques

**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. All capacities are reported in GB.

<table>
<thead>
<tr>
<th>Devices</th>
<th>Count</th>
<th>Physical Capacity</th>
<th>Total Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>400 GB SSD</td>
<td>576</td>
<td>400.0</td>
<td>230,400</td>
</tr>
</tbody>
</table>

**Data Protection**

The data protection level used for all LVs was **Protected 2 (RAID1)**, which was accomplished by configuring multiple FC paths, dual controllers, dual power, dual fans, and RAID1 device protection.
**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 (MI).

**Measurement Intervals by Test Phase Graph**

The following graph presents the average IOPS and the average Response Times measured over the 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 &amp; Time</th>
<th>End Date &amp; Time</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transition Period</td>
<td>05-Mar-19 14:50:49</td>
<td>05-Mar-19 16:50:49</td>
<td>2:00:00</td>
</tr>
<tr>
<td>Measurement Interval</td>
<td>05-Mar-19 16:50:49</td>
<td>06-Mar-19 00:50:50</td>
<td>8:00:01</td>
</tr>
</tbody>
</table>

SUSTAIN – Throughput Graph

![Throughput Graph (SUSTAIN @ 10,001,000 IOPS)](image)
SUSTAIN – Response Time Graph

![Response Time Graph](image)

SUSTAIN – Data Rate Graph

![Data Rate Graph](image)
SUSTAIN – 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 Defined 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>0.0002</td>
<td>0.0001</td>
<td>0.0002</td>
<td>0.0001</td>
<td>0.0001</td>
<td>0.0001</td>
<td>0.0001</td>
<td>0.0001</td>
</tr>
<tr>
<td>Difference</td>
<td>0.005%</td>
<td>0.002%</td>
<td>0.004%</td>
<td>0.000%</td>
<td>0.008%</td>
<td>0.004%</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 &amp; Time</th>
<th>End Date &amp; Time</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transition Period</td>
<td>06-Mar-19 00:51:49</td>
<td>06-Mar-19 00:54:49</td>
<td>0:03:00</td>
</tr>
<tr>
<td>Measurement Interval</td>
<td>06-Mar-19 00:54:49</td>
<td>06-Mar-19 01:04:50</td>
<td>0:10:01</td>
</tr>
</tbody>
</table>

RAMPD_100 – Throughput Graph

![Throughput Graph](image)
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 Defined 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>0.0002</td>
<td>0.0001</td>
<td>0.0001</td>
<td>0.0001</td>
<td>0.0003</td>
<td>0.0002</td>
<td>0.0002</td>
<td>0.0001</td>
</tr>
<tr>
<td>Difference</td>
<td>0.012%</td>
<td>0.000%</td>
<td>0.002%</td>
<td>0.001%</td>
<td>0.006%</td>
<td>0.004%</td>
<td>0.005%</td>
<td>0.003%</td>
</tr>
</tbody>
</table>

RAMPD_100 – I/O Request Summary

| I/O Requests Completed in the Measurement Interval | 6,000,925,272 |
| I/O Requests Completed with Response Time <= 30 ms | 6,000,669,251 |
| I/O Requests Completed with Response Time > 30 ms | 256,021 |
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-url)
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 @ 1,000,100 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 table below.

<table>
<thead>
<tr>
<th>Test Phase</th>
<th>100% IOPS</th>
<th>10% IOPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAMPD</td>
<td>10,001,522.1</td>
<td>1,000,086.6</td>
</tr>
<tr>
<td>REPEAT_1</td>
<td>10,001,587.2</td>
<td>1,000,202.0</td>
</tr>
<tr>
<td>REPEAT_2</td>
<td>10,001,716.1</td>
<td>1,000,116.5</td>
</tr>
</tbody>
</table>

REPEAT_1_100 – Throughput Graph

![Throughput Graph (Repeat_1_100 @ 10,001,000 IOPS)](image-url)
**REPEAT 1_100 – Response Time Graph**

Response Time Graph (Repeat 1_100 @ 10,001,000 IOPS)

- ASU1
- ASU2
- ASU3
- All ASUs

**REPEAT 2_100 – Throughput Graph**

Throughput Graph (Repeat 2_100 @ 10,001,000 IOPS)

- ASU1
- ASU2
- ASU3
- All ASUs
**REPEAT_2_100 – Response Time Graph**

![Response Time Graph](image)

**Repeatability Test – Intensity Multiplier**

The following tables list 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 Defined 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>0.0002</td>
<td>0.0001</td>
<td>0.0001</td>
<td>0.0000</td>
<td>0.0002</td>
<td>0.0002</td>
<td>0.0001</td>
<td>0.0001</td>
</tr>
<tr>
<td>Difference</td>
<td>0.013%</td>
<td>0.004%</td>
<td>0.006%</td>
<td>0.002%</td>
<td>0.009%</td>
<td>0.004%</td>
<td>0.003%</td>
<td>0.000%</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>0.0002</td>
<td>0.0001</td>
<td>0.0001</td>
<td>0.0001</td>
<td>0.0002</td>
<td>0.0001</td>
<td>0.0002</td>
<td>0.0001</td>
</tr>
<tr>
<td>Difference</td>
<td>0.010%</td>
<td>0.002%</td>
<td>0.000%</td>
<td>0.000%</td>
<td>0.020%</td>
<td>0.002%</td>
<td>0.004%</td>
<td>0.002%</td>
</tr>
</tbody>
</table>
Space Optimization Techniques

**Description of Utilized Techniques**

The TSC did not use any space optimization techniques.

**Physical Free Space Metrics**

The following table lists the Physical Free Space as measured at each of the required points during test execution. If space optimization techniques were not used, “NA” is reported.

<table>
<thead>
<tr>
<th>Physical Free Space Measurement</th>
<th>Free Space (GB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>After Logical Volume Creation</td>
<td>NA</td>
</tr>
<tr>
<td>After ASU Pre-Fill</td>
<td>NA</td>
</tr>
<tr>
<td>After Repeatability Test Phase</td>
<td>NA</td>
</tr>
</tbody>
</table>

**Space Optimization Metrics**

The following table lists the required space optimization metrics. If space optimization techniques were not used, “NA” is reported.

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPC-1 Space Optimization Ratio</td>
<td>NA</td>
</tr>
<tr>
<td>SPC-1 Space Effectiveness Ratio</td>
<td>NA</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>1,236,219,154</td>
</tr>
<tr>
<td>Total Number of Logical Blocks Verified</td>
<td>587,348,595</td>
</tr>
<tr>
<td>Total Number of Logical Blocks Overwritten</td>
<td>648,870,559</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>

Committed Data Persistence Implementation
Redundantly configured batteries inside the ETERNUS DX8900S4 storage system allow data in cache memory to be moved to non-volatile memory or to physical disk drives in the event of a power outage. This secured data can then be maintained in that state indefinitely until the power is restored.
**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>/D_Creation</td>
<td>Storage configuration creation</td>
<td>root</td>
</tr>
<tr>
<td>definitions.exp</td>
<td>Procedure definitions</td>
<td>/D_Creation</td>
</tr>
<tr>
<td>doFDRcfg.sh</td>
<td>Shell script to configure the array</td>
<td>/D_Creation</td>
</tr>
<tr>
<td>DX8900S4_20190208.exp</td>
<td>Configure CLI expect script</td>
<td>/D_Creation</td>
</tr>
<tr>
<td>DX8900S4_20190208makeLV.sh</td>
<td>Linux LVM configuration script</td>
<td>/D_Creation</td>
</tr>
<tr>
<td>DX8900S4_20190208switch.exp</td>
<td>Configure switches expect script</td>
<td>/D_Creation</td>
</tr>
<tr>
<td>showFormatStatus.exp</td>
<td>Check for physical format progress</td>
<td>/D_Creation</td>
</tr>
<tr>
<td>/E_Inventory</td>
<td>Configuration inventory</td>
<td>root</td>
</tr>
<tr>
<td>log_BeforeF_JX190305084945.zlg_001.txt</td>
<td>Configuration details before the run</td>
<td>/E_Inventory</td>
</tr>
<tr>
<td>log_AfterJ_JX190305084945.zlg2_001.txt</td>
<td>Configuration details after the run</td>
<td>/E_Inventory</td>
</tr>
<tr>
<td>/F_Generator</td>
<td>Workload generator</td>
<td>root</td>
</tr>
<tr>
<td>doFDRall_01.sh</td>
<td>Master run file 1</td>
<td>/F_generator</td>
</tr>
<tr>
<td>doFDRall_02.sh</td>
<td>Master run file 2</td>
<td>/F_generator</td>
</tr>
<tr>
<td>exportLog.exp</td>
<td>Storage array log export</td>
<td>/F_generator</td>
</tr>
<tr>
<td>exportSupportSave.exp</td>
<td>Switch configuration export</td>
<td>/F_generator</td>
</tr>
<tr>
<td>SPC1_DX8900S4_20190208.asu</td>
<td>ASU configuration file</td>
<td>/F_generator</td>
</tr>
<tr>
<td>SPC1_DX8900S4_20190208.hst</td>
<td>Host configuration file</td>
<td>/F_generator</td>
</tr>
</tbody>
</table>

All tuning done via GUI (see Appendix C)
APPENDIX B: THIRD PARTY QUOTATION
All components are available directly through the Test Sponsor (Fujitsu Limited).
APPENDIX C: TUNING PARAMETERS AND OPTIONS

The standard Fujitsu GUI was used to apply the Tuning options for this test.

1. In order to execute some of the commands listed below it is necessary to create an user account with maintainer role. Please create such user account and login with the new account.

2. Change DCMF (Disk Command Multiplication Factor) value from the default (1) to (10) for all RAID Groups.

   The following GUI screen (RAID Group -> Tuning -> Modify RAID Group Parameter) is used for each RAID Group and the DCMF parameter is changed to 10 as highlighted in red frame below:

3. Disable Debug Trace

   The following GUI setting was applied.

   System-> System Settings -> Setup Debug Mode: The Master Trace Level was set to Off (Default: Standard)
4. Disable Read Sequential/Write Sequential
   The following GUI setting was applied.
   System-> System Settings -> Setup Subsystem Parameters:
   Flexible Write Through was set to Disable (Default: Enable)
Read Sequential/Write Sequential was set to Disable (Default: Enable)
APPENDIX D: STORAGE CONFIGURATION CREATION

The standard Fujitsu Command Line tool (CLI) was used to create the ETERNUS DX8900 S4 SPC-1 configuration.

The ‘master’ script, doFDRcfg.sh, was executed, which in turn, invoked the script, DX8900S4_20190208.exp. The ‘master’ script included shell commands to monitor the progress as the physical formatting proceeded, which used the expect script showFormatStatus.exp to pick up the status information from the array.

The DX8900S4_20190208.exp script completed steps 1-4, described below for the 176 host port configuration.

Each expect script included the docli procedure, which was used to issue the CLI commands to the array. That procedure used ssh for communication with the array. A second procedure in the script, doexit, was used to conclude the execution sequence at the end of the script.

Step 1 – Creation of RAID Groups
A total of 288 RAID Groups were created, according to the configuration plan, ConfigurationDesign_DX8900S4_20190208.xlsx, which is typically prepared in concert with a Fujitsu SE. Each RAID Group was made up of 2 disk drives in a RAID1(1+1) configuration and assigned to a specific CM for operational control. The RAID Groups were named RG#00-00 through RG#b1-11.

Step 2 – Creation of the Logical Volumes
Wide striped logical volumes were created across 12 sets of RAID Groups (each with 12 RAID Groups). Eight volumes were created on each of the RAID Groups, one for each of the eight Fiber Channel ports of each controller, for a total of 192 logical volumes.

Step 3 – Creation of the Global Hot Spares
No drives were designated as the Global Hot Spare.

Step 4 – Assignment of LUN Mapping to the Linux Host Systems
The DX8900S4_20190208.exp script provided mapping to 176 host ports.

The port LUN mapping was assigned for each of the Logical Volumes using 8 ports on Channel Adapters (CA) in each of the 24 Controller Modules (CM). Each of the volumes, which were defined on RAID Groups owned by a CM, were assigned LUN numbers on the active ports on the CAs installed on the same CM.

Step 5 – Creation of the twenty four way striped logical volumes.
Built in logical volume manager in Linux is used to stripe each pair of LUNs presented by ETERNUS DX8900 S4 array.

This is done in 3 steps included in the DX8900S4_20190208makeLV.sh script.
1. Create Physical Volumes (PV) for each LUN presented from DX8900 S4.

```
pvcreate /dev/disk/by-id/scsi-36000000e00d31000003101300000000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000003101300001000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000003101300002000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000003101300003000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000003101300004000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000003101300005000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000003101300006000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000003101300007000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000003101300008000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000003101300009000
pvcreate /dev/disk/by-id/scsi-36000000e00d3100000310130000a000
pvcreate /dev/disk/by-id/scsi-36000000e00d3100000310130000b000
pvcreate /dev/disk/by-id/scsi-36000000e00d3100000310130000c000
pvcreate /dev/disk/by-id/scsi-36000000e00d3100000310130000d000
pvcreate /dev/disk/by-id/scsi-36000000e00d3100000310130000e000
pvcreate /dev/disk/by-id/scsi-36000000e00d3100000310130000f000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000003101300010000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000003101300011000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000003101300012000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000003101300013000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000003101300014000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000003101300015000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000003101300016000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000003101300017000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000003101300018000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000003101300019000
pvcreate /dev/disk/by-id/scsi-36000000e00d3100000310130001a000
pvcreate /dev/disk/by-id/scsi-36000000e00d3100000310130001b000
pvcreate /dev/disk/by-id/scsi-36000000e00d3100000310130001c000
pvcreate /dev/disk/by-id/scsi-36000000e00d3100000310130001d000
pvcreate /dev/disk/by-id/scsi-36000000e00d3100000310130001e000
pvcreate /dev/disk/by-id/scsi-36000000e00d3100000310130001f000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000003101300020000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000003101300021000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000003101300022000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000003101300023000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000003101300024000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000003101300025000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000003101300026000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000003101300027000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000003101300028000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000003101300029000
pvcreate /dev/disk/by-id/scsi-36000000e00d3100000310130002a000
pvcreate /dev/disk/by-id/scsi-36000000e00d3100000310130002b000
pvcreate /dev/disk/by-id/scsi-36000000e00d3100000310130002c000
pvcreate /dev/disk/by-id/scsi-36000000e00d3100000310130002d000
```
pvcreate /dev/disk/by-id/scsi-36000000e00d3100000031013002e0000
pvcreate /dev/disk/by-id/scsi-36000000e00d3100000031013002f0000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000000310130030000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000000310130031000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000000310130032000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000000310130033000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000000310130034000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000000310130035000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000000310130036000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000000310130037000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000000310130038000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000000310130039000
pvcreate /dev/disk/by-id/scsi-36000000e00d3100000031013003a0000
pvcreate /dev/disk/by-id/scsi-36000000e00d3100000031013003b0000
pvcreate /dev/disk/by-id/scsi-36000000e00d3100000031013003c0000
pvcreate /dev/disk/by-id/scsi-36000000e00d3100000031013003d0000
pvcreate /dev/disk/by-id/scsi-36000000e00d3100000031013003e0000
pvcreate /dev/disk/by-id/scsi-36000000e00d3100000031013003f0000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000000310130040000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000000310130041000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000000310130042000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000000310130043000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000000310130044000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000000310130045000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000000310130046000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000000310130047000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000000310130048000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000000310130049000
pvcreate /dev/disk/by-id/scsi-36000000e00d3100000031013005000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000000310130051000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000000310130052000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000000310130053000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000000310130054000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000000310130055000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000000310130056000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000000310130057000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000000310130058000
pvcreate /dev/disk/by-id/scsi-36000000e00d31000000310130059000
pvcreate /dev/disk/by-id/scsi-36000000e00d3100000031013005a000
pvcreate /dev/disk/by-id/scsi-36000000e00d3100000031013005b000
pvcreate /dev/disk/by-id/scsi-36000000e00d3100000031013005c000
pvcreate /dev/disk/by-id/scsi-36000000e00d3100000031013005d000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013005e0000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013005f0000
pvcreate /dev/disk/by-id/scsi-3600000e00d3100000310130060000
pvcreate /dev/disk/by-id/scsi-3600000e00d31000003101300610000
pvcreate /dev/disk/by-id/scsi-3600000e00d31000003101300620000
pvcreate /dev/disk/by-id/scsi-3600000e00d31000003101300630000
pvcreate /dev/disk/by-id/scsi-3600000e00d31000003101300640000
pvcreate /dev/disk/by-id/scsi-3600000e00d31000003101300650000
pvcreate /dev/disk/by-id/scsi-3600000e00d31000003101300660000
pvcreate /dev/disk/by-id/scsi-3600000e00d31000003101300670000
pvcreate /dev/disk/by-id/scsi-3600000e00d31000003101300680000
pvcreate /dev/disk/by-id/scsi-3600000e00d31000003101300690000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013006a0000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013006b0000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013006c0000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013006d0000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013006e0000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013006f0000
pvcreate /dev/disk/by-id/scsi-3600000e00d31000003101300700000
pvcreate /dev/disk/by-id/scsi-3600000e00d31000003101300710000
pvcreate /dev/disk/by-id/scsi-3600000e00d31000003101300720000
pvcreate /dev/disk/by-id/scsi-3600000e00d31000003101300730000
pvcreate /dev/disk/by-id/scsi-3600000e00d31000003101300740000
pvcreate /dev/disk/by-id/scsi-3600000e00d31000003101300750000
pvcreate /dev/disk/by-id/scsi-3600000e00d31000003101300760000
pvcreate /dev/disk/by-id/scsi-3600000e00d31000003101300770000
pvcreate /dev/disk/by-id/scsi-3600000e00d31000003101300780000
pvcreate /dev/disk/by-id/scsi-3600000e00d31000003101300790000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013007a0000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013007b0000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013007c0000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013007d0000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013007e0000
pvcreate /dev/disk/by-id/scsi-3600000e00d31000003101300800000
pvcreate /dev/disk/by-id/scsi-3600000e00d31000003101300810000
pvcreate /dev/disk/by-id/scsi-3600000e00d31000003101300820000
pvcreate /dev/disk/by-id/scsi-3600000e00d31000003101300830000
pvcreate /dev/disk/by-id/scsi-3600000e00d31000003101300840000
pvcreate /dev/disk/by-id/scsi-3600000e00d31000003101300850000
pvcreate /dev/disk/by-id/scsi-3600000e00d31000003101300860000
pvcreate /dev/disk/by-id/scsi-3600000e00d31000003101300870000
pvcreate /dev/disk/by-id/scsi-3600000e00d31000003101300880000
pvcreate /dev/disk/by-id/scsi-3600000e00d31000003101300890000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013008a0000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013008b0000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013008c0000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013008d0000
pvcreate /dev/disk/by-id/scsi-3600000e00d3100000310130008e0000
pvcreate /dev/disk/by-id/scsi-3600000e00d3100000310130008f0000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000900000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000910000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000920000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000930000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000940000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000950000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000960000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000970000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000980000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000990000
pvcreate /dev/disk/by-id/scsi-3600000e00d3100000310130009a0000
pvcreate /dev/disk/by-id/scsi-3600000e00d3100000310130009b0000
pvcreate /dev/disk/by-id/scsi-3600000e00d3100000310130009c0000
pvcreate /dev/disk/by-id/scsi-3600000e00d3100000310130009d0000
pvcreate /dev/disk/by-id/scsi-3600000e00d3100000310130009e0000
pvcreate /dev/disk/by-id/scsi-3600000e00d3100000310130009f0000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000a00000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000a10000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000a20000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000a30000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000a40000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000a50000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000a60000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000a70000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000a80000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000a90000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000aa0000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000ab0000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000ac0000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000ad0000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000ae0000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000af0000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000b00000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000b10000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000b20000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000b30000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000b40000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000b50000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000b60000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000b70000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000b80000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000b90000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000ba0000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000bb0000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000bc0000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000bd0000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000be0000
pvcreate /dev/disk/by-id/scsi-3600000e00d310000031013000bf0000

2. Create two Volume Groups with physical extent size of 512KiB
   vgcreate asu_vg1 /dev/sda
   vgextend asu_vg1 /dev/sddx
   vgextend asu_vg1 /dev/sdr
   vgextend asu_vg1 /dev/sdev
   vgextend asu_vg1 /dev/sdi
   vgextend asu_vg1 /dev/sddr
   vgextend asu_vg1 /dev/sdq
   vgextend asu_vg1 /dev/sdex
   vgextend asu_vg1 /dev/sdm
   vgextend asu_vg1 /dev/sdej
   vgextend asu_vg1 /dev/sds
   vgextend asu_vg1 /dev/sdfb
   vgextend asu_vg1 /dev/sdae
   vgextend asu_vg1 /dev/sdft
   vgextend asu_vg1 /dev/sdt
   vgextend asu_vg1 /dev/sdfd
   vgextend asu_vg1 /dev/sdai
   vgextend asu_vg1 /dev/sdfw
   vgextend asu_vg1 /dev/sdu
   vgextend asu_vg1 /dev/sdff
   vgextend asu_vg1 /dev/sdar
   vgextend asu_vg1 /dev/sdgf
   vgextend asu_vg1 /dev/sdw
   vgextend asu_vg1 /dev/sdf1
   vgextend asu_vg1 /dev/sdas
   vgextend asu_vg1 /dev/sdgg
   vgextend asu_vg1 /dev/sdz
vgextend asu_vg1 /dev/sdfp
vgextend asu_vg1 /dev/sdat
vgextend asu_vg1 /dev/sdgh
vgextend asu_vg1 /dev/sdy
vgextend asu_vg1 /dev/sdfh
vgextend asu_vg1 /dev/sdau
vgextend asu_vg1 /dev/sdgi
vgextend asu_vg1 /dev/sdx
vgextend asu_vg1 /dev/sdfj
vgextend asu_vg1 /dev/sdav
vgextend asu_vg1 /dev/sdgj
vgextend asu_vg1 /dev/sdac
vgextend asu_vg1 /dev/sdfm
vgextend asu_vg1 /dev/sdb
vgextend asu_vg1 /dev/sdtt
vgextend asu_vg1 /dev/sdaa
vgextend asu_vg1 /dev/sdfr
vgextend asu_vg1 /dev/sdk
vgextend asu_vg1 /dev/sdqv
vgextend asu_vg1 /dev/sdav
vgextend asu_vg1 /dev/sdtt
vgextend asu_vg1 /dev/sdaa
vgextend asu_vg1 /dev/sdfr
vgextend asu_vg1 /dev/sdk
vgextend asu_vg1 /dev/sdv
vgextend asu_vg1 /dev/sdec
vgextend asu_vg1 /dev/sdaf
vgextend asu_vg1 /dev/sdfq
vgextend asu_vg1 /dev/sdf
vgextend asu_vg1 /dev/sdep
vgextend asu_vg1 /dev/sdab
vgextend asu_vg1 /dev/sdfs
vgextend asu_vg1 /dev/sdd
vgextend asu_vg1 /dev/sdel
vgextend asu_vg1 /dev/sdag
vgextend asu_vg1 /dev/sdfu
vgextend asu_vg1 /dev/sde
vgextend asu_vg1 /dev/sddz
vgextend asu_vg1 /dev/sdah
vgextend asu_vg1 /dev/sdfv
vgextend asu_vg1 /dev/sdh
vgextend asu_vg1 /dev/sdne
vgextend asu_vg1 /dev/sdaj
vgextend asu_vg1 /dev/sdfx
vgextend asu_vg1 /dev/sdg
vgextend asu_vg1 /dev/sdak
vgextend asu_vg1 /dev/sdfe
vgextend asu_vg1 /dev/sdfy
vgextend asu_vg1 /dev/sdp
vgextend asu_vg1 /dev/sded
vgextend asu_vg1 /dev/sdal
vgextend asu_vg1 /dev/sdfz
vgextend asu_vg1 /dev/sdj
vgextend asu_vg1 /dev/sder
vgextend asu_vg1 /dev/sdan
vgextend asu_vg1 /dev/sdga
vgextend asu_vg1 /dev/sdl
vgextend asu_vg1 /dev/sdef
vgextend asu_vg1 /dev/sdam
vgextend asu_vg1 /dev/sdgc
vgextend asu_vg1 /dev/sdn
vgextend asu_vg1 /dev/sdeh
vgextend asu_vg1 /dev/sdao
vgextend asu_vg1 /dev/sdgb
vgextend asu_vg1 /dev/sdo
vgextend asu_vg1 /dev/sdfo
vgextend asu_vg1 /dev/sdap
vgextend asu_vg1 /dev/sdgd
vgextend asu_vg1 /dev/sdv
vgextend asu_vg1 /dev/sdet
vgextend asu_vg1 /dev/sdaq
vgextend asu_vg1 /dev/sdge

vgcreate asu_vg2 /dev/sdaw
vgextend asu_vg2 /dev/sdcs
vgextend asu_vg2 /dev/sdbn
vgextend asu_vg2 /dev/sddi
vgextend asu_vg2 /dev/sdbc
vgextend asu_vg2 /dev/sdct
vgextend asu_vg2 /dev/sdbo
vgextend asu_vg2 /dev/sdfe
vgextend asu_vg2 /dev/sdbg
vgextend asu_vg2 /dev/sddf
vgextend asu_vg2 /dev/sdbp
vgextend asu_vg2 /dev/sddj
vgextend asu_vg2 /dev/sdbt
vgextend asu_vg2 /dev/sddp
vgextend asu_vg2 /dev/sdbq
vgextend asu_vg2 /dev/sddk
vgextend asu_vg2 /dev/sdce
vgextend asu_vg2 /dev/sdek
vgextend asu_vg2 /dev/sdbr
vgextend asu_vg2 /dev/sddo
vgextend asu_vg2 /dev/sdcm
vgextend asu_vg2 /dev/sdfa
vgextend asu_vg2 /dev/sdbs
vgextend asu_vg2 /dev/sddm
vgextend asu_vg2 /dev/sdco
vgextend asu_vg2 /dev/sdfc
vgextend asu_vg2 /dev/sdbu
vgextend asu_vg2 /dev/sddn
vgextend asu_vg2 /dev/sdcp
vgextend asu_vg2 /dev/sdfg
vgextend asu_vg2 /dev/sdbv
vgextend asu_vg2 /dev/sddq
vgextend asu_vg2 /dev/sdcq
vgextend asu_vg2 /dev/sdfi
vgextend asu_vg2 /dev/sdbw
vgextend asu_vg2 /dev/sdds
vgextend asu_vg2 /dev/sdcr
vgextend asu_vg2 /dev/sdfk
vgextend asu_vg2 /dev/sdbx
vgextend asu_vg2 /dev/sddy
vgextend asu_vg2 /dev/sdax
vgextend asu_vg2 /dev/sdcu
vgextend asu_vg2 /dev/sdby
vgextend asu_vg2 /dev/sddu
vgextend asu_vg2 /dev/sdba
vgextend asu_vg2 /dev/sdcv
vgextend asu_vg2 /dev/sdbz
vgextend asu_vg2 /dev/sddw
vgextend asu_vg2 /dev/sday
vgextend asu_vg2 /dev/sdcw
vgextend asu_vg2 /dev/sdca
vgextend asu_vg2 /dev/sdea
vgextend asu_vg2 /dev/sdbb
vgextend asu_vg2 /dev/sddb
vgextend asu_vg2 /dev/sdcb
vgextend asu_vg2 /dev/sdec
vgextend asu_vg2 /dev/sdaz
vgextend asu_vg2 /dev/sdcx
vgextend asu_vg2 /dev/sdcc
vgextend asu_vg2 /dev/sdee
vgextend asu_vg2 /dev/sdbd
vgextend asu_vg2 /dev/sdcz
vgextend asu_vg2 /dev/sdcd
vgextend asu_vg2 /dev/sdeg
vgextend asu_vg2 /dev/sdbe
vgextend asu_vg2 /dev/sddd
vgextend asu_vg2 /dev/sdcf
vgextend asu_vg2 /dev/sdei
vgextend asu_vg2 /dev/sdbj
vgextend asu_vg2 /dev/sdcy
vgextend asu_vg2 /dev/sdcg
vgextend asu_vg2 /dev/sdem
vgextend asu_vg2 /dev/sdbf
vgextend asu_vg2 /dev/sdda
vgextend asu_vg2 /dev/sdch
vgextend asu_vg2 /dev/sdeo
vgextend asu_vg2 /dev/sdbh
vgextend asu_vg2 /dev/sddc
vgextend asu_vg2 /dev/sdci
vgextend asu_vg2 /dev/sdeq
3. Create 80 Logical Volumes for each ASU with 512KiB Stripe size

```bash
vgextend asu_vg2 /dev/sdbi
vgextend asu_vg2 /dev/sdde
vgextend asu_vg2 /dev/sdcj
vgextend asu_vg2 /dev/sdes
vgextend asu_vg2 /dev/sdbl
vgextend asu_vg2 /dev/sddl
vgextend asu_vg2 /dev/sdck
vgextend asu_vg2 /dev/sdeu
vgextend asu_vg2 /dev/sdbm
vgextend asu_vg2 /dev/sddg
vgextend asu_vg2 /dev/sdcl
vgextend asu_vg2 /dev/sdew
vgextend asu_vg2 /dev/sdbk
vgextend asu_vg2 /dev/sddh
vgextend asu_vg2 /dev/sdcn
vgextend asu_vg2 /dev/sdey

lvcreate -n asu101 -i 96 -I 512 -C y -L 1078272MiB asu_vg1
lvcreate -n asu102 -i 96 -I 512 -C y -L 1078272MiB asu_vg1
lvcreate -n asu103 -i 96 -I 512 -C y -L 1078272MiB asu_vg1
lvcreate -n asu104 -i 96 -I 512 -C y -L 1078272MiB asu_vg1
lvcreate -n asu105 -i 96 -I 512 -C y -L 1078272MiB asu_vg1
lvcreate -n asu106 -i 96 -I 512 -C y -L 1078272MiB asu_vg1
lvcreate -n asu107 -i 96 -I 512 -C y -L 1078272MiB asu_vg1
lvcreate -n asu108 -i 96 -I 512 -C y -L 1078272MiB asu_vg1
lvcreate -n asu109 -i 96 -I 512 -C y -L 1078272MiB asu_vg1
lvcreate -n asu110 -i 96 -I 512 -C y -L 1078272MiB asu_vg1
lvcreate -n asu111 -i 96 -I 512 -C y -L 1078272MiB asu_vg1
lvcreate -n asu112 -i 96 -I 512 -C y -L 1078272MiB asu_vg1
lvcreate -n asu113 -i 96 -I 512 -C y -L 1078272MiB asu_vg1
lvcreate -n asu114 -i 96 -I 512 -C y -L 1078272MiB asu_vg1
lvcreate -n asu115 -i 96 -I 512 -C y -L 1078272MiB asu_vg1
lvcreate -n asu116 -i 96 -I 512 -C y -L 1078272MiB asu_vg1
lvcreate -n asu117 -i 96 -I 512 -C y -L 1078272MiB asu_vg1
lvcreate -n asu118 -i 96 -I 512 -C y -L 1078272MiB asu_vg1
```
lvcreate -n asu119 -i 96 -I 512 -C y -L 1078272MiB asu vg2
lvcreate -n asu120 -i 96 -I 512 -C y -L 1078272MiB asu vg2
lvcreate -n asu121 -i 96 -I 512 -C y -L 1078272MiB asu vg2
lvcreate -n asu122 -i 96 -I 512 -C y -L 1078272MiB asu vg2
lvcreate -n asu123 -i 96 -I 512 -C y -L 1078272MiB asu vg2
lvcreate -n asu124 -i 96 -I 512 -C y -L 1078272MiB asu vg2
lvcreate -n asu125 -i 96 -I 512 -C y -L 1078272MiB asu vg2
lvcreate -n asu126 -i 96 -I 512 -C y -L 1078272MiB asu vg2
lvcreate -n asu127 -i 96 -I 512 -C y -L 1078272MiB asu vg2
lvcreate -n asu128 -i 96 -I 512 -C y -L 1078272MiB asu vg2
lvcreate -n asu129 -i 96 -I 512 -C y -L 1078272MiB asu vg2
lvcreate -n asu130 -i 96 -I 512 -C y -L 1078272MiB asu vg2
lvcreate -n asu131 -i 96 -I 512 -C y -L 1078272MiB asu vg2
lvcreate -n asu132 -i 96 -I 512 -C y -L 1078272MiB asu vg2
lvcreate -n asu133 -i 96 -I 512 -C y -L 1078272MiB asu vg2
lvcreate -n asu134 -i 96 -I 512 -C y -L 1078272MiB asu vg2
lvcreate -n asu135 -i 96 -I 512 -C y -L 1078272MiB asu vg2
lvcreate -n asu136 -i 96 -I 512 -C y -L 1078272MiB asu vg2

lvcreate -n asu201 -i 96 -I 512 -C y -L 1078272MiB asu vg1
lvcreate -n asu202 -i 96 -I 512 -C y -L 1078272MiB asu vg1
lvcreate -n asu203 -i 96 -I 512 -C y -L 1078272MiB asu vg1
lvcreate -n asu204 -i 96 -I 512 -C y -L 1078272MiB asu vg1
lvcreate -n asu205 -i 96 -I 512 -C y -L 1078272MiB asu vg1
lvcreate -n asu206 -i 96 -I 512 -C y -L 1078272MiB asu vg1
lvcreate -n asu207 -i 96 -I 512 -C y -L 1078272MiB asu vg1
lvcreate -n asu208 -i 96 -I 512 -C y -L 1078272MiB asu vg1
lvcreate -n asu209 -i 96 -I 512 -C y -L 1078272MiB asu vg1
lvcreate -n asu210 -i 96 -I 512 -C y -L 1078272MiB asu vg1
lvcreate -n asu211 -i 96 -I 512 -C y -L 1078272MiB asu vg1
lvcreate -n asu212 -i 96 -I 512 -C y -L 1078272MiB asu vg1
lvcreate -n asu213 -i 96 -I 512 -C y -L 1078272MiB asu vg1
lvcreate -n asu214 -i 96 -I 512 -C y -L 1078272MiB asu vg1
lvcreate -n asu215 -i 96 -I 512 -C y -L 1078272MiB asu vg1
lvcreate -n asu216 -i 96 -I 512 -C y -L 1078272MiB asu vg1
lvcreate -n asu217 -i 96 -I 512 -C y -L 1078272MiB asu vg1
lvcreate -n asu218 -i 96 -I 512 -C y -L 1078272MiB asu vg1

lvcreate -n asu219 -i 96 -I 512 -C y -L 1078272MiB asu vg2
lvcreate -n asu220 -i 96 -I 512 -C y -L 1078272MiB asu vg2
lvcreate -n asu221 -i 96 -I 512 -C y -L 1078272MiB asu vg2
lvcreate -n asu222 -i 96 -I 512 -C y -L 1078272MiB asu vg2
lvcreate -n asu223 -i 96 -I 512 -C y -L 1078272MiB asu vg2
lvcreate -n asu224 -i 96 -I 512 -C y -L 1078272MiB asu vg2
lvcreate -n asu225 -i 96 -I 512 -C y -L 1078272MiB asu vg2
lvcreate -n asu226 -i 96 -I 512 -C y -L 1078272MiB asu vg2
lvcreate -n asu227 -i 96 -I 512 -C y -L 1078272MiB asu vg2
lvcreate -n asu228 -i 96 -I 512 -C y -L 1078272MiB asu vg2
Step 6 – Configuration of FC Switch zoning.

Four FC switches were used in the configuration: sb10,sb20 (Brocade G630),sb30,sb40 (Brocade 6520). Each switch belong to it’s own fabric and the following script is used to setup zones so that each HBA port belongs to 48 1-1 zones representing the CA ports. 

DX8900S4_20190208switch.exp script is executed against each switch to configure the zones.

Referenced Scripts

- doFDRcfg.sh
- definitions.exp
- DX8900S4_20190208.exp
- showFormatStatus.exp
- DX8900S4_20190208makeLV.sh
- DX8900S4_20190208switch.exp
APPENDIX E: CONFIGURATION INVENTORY

The following files (included in the Supporting Files) capture the configuration before and after the test run:

- `log_BeforeF_JX190305084945.zlg_001.txt`
- `log_AfterJ_JX190305084945.zlg2_001.txt`
APPENDIX F: WORKLOAD GENERATOR

The ASU configuration file can be found in the Supporting Files.

- SPC1_DX8900S4_20190208.asu

The Host configuration file can be found in the Supporting Files.

- SPC1_DX8900S4_20190208.hst

The following ‘master’ script was used to execute the required ASU pre-fill, Primary Metrics Test (Sustainability Test Phase, IOPS Test Phase, and Response Time Ramp Test Phase), Repeatability Test (Repeatability Test Phase 1 and Repeatability Test Phase 2), the SPC-1 Persistence Test Run 1 and the SPC-2 Persistence Test in an uninterrupted sequence with doFDRall_1XV.sh and doFDRall_2H.sh.

The ‘master’ script invokes various other scripts which appear below in the Referenced Scripts section with a brief description of each referenced script.

- doFDRall_01.sh
- doFDRall_02.sh

Referenced Scripts

The ‘master’ script invokes the following script in order to export the log file from the storage array.

- exportLog.exp

The following script is executed in order to export the Switch configuration from the FC switches.

- exportSupporSave.exp