DEFENSE INFORMATION SYSTEMS AGENCY
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IN REPLY REFER TO: Joint Interoperability Test Command (JTE) 24 June 2021

MEMORANDUM FOR DISTRIBUTION

SUBJECT: Joint Interoperability Certification of the Dell EMC PowerMax Array with Management User Interface Software Release 9.1 and Specified Servers

References: (a) Department of Defense Instruction 8100.04, "DoD Unified Capabilities (UC)," 9 December 2010
(b) Office of the Department of Defense Chief Information Officer, "Department of Defense Unified Capabilities Requirements 2013, Change 2," September 2017
(c) through (e), see Enclosure 1

**1. Certification Authority.** Reference establishes the Joint Interoperability Test Command (JITC) as the Joint Interoperability Certification Authority for the Department of Defense Information Network (DoDIN) products, Reference (b).

**2. Conditions of Certification.** The Dell EMC PowerMax Array (models 2000 and 8000) with Management User Interface (UI) Software Release 9.1 and Specified Servers, hereinafter referred to as the System Under Test (SUT), meets the critical requirements of the Unified Capabilities Requirements (UCR), Reference (b), as a Data Storage Controller (DSC) with the conditions listed in Table 1. This certification expires upon changes that affect interoperability, but no later than the expiration date listed in the DoDIN Approved Products List (APL) memorandum.

**Table 1. Conditions**

| Description | | Operational Impact | Remarks |
|---|---|---|---|
| **UCR Waivers** | | | |
| None | | | |
| **TDR#** | **Conditions of Fielding** | | |
| None | | | |
| **TDR#** | **Open Test Discrepancies** | | |
| DMC-0746-014 | DAT-000420: Per the LoC, the SUT relies on the underlying OS of the host server and the site RAE infrastructure to meet the NIS Client directory service requirement. Therefore the SUT does not comply with this requirement. | None UCR Change Requirement | DISA adjudicated this discrepancy as a UCR Change Requirement. |
| DMC-0746-015 | DAT-000430: Per the LoC, the SUT relies on the underlying OS of the host server and the site RAE infrastructure to meet the NIS Netgroups Client directory service requirement. Therefore the SUT does not comply with this requirement. | None UCR Change Requirement | DISA adjudicated this discrepancy as a UCR Change Requirement. |

(Table continues on next page.)

**Table 1. Conditions** (continued)

| Description | | Operational Impact | Remarks |
|---|---|---|---|
| **TDR#** | **Open Test Discrepancies** (continued) | | |
| DMC-0746-017 | DAT-000550: Per Vendor LoC, the site provided Windows Server hosting the Unisphere for PowerMax provides the necessary functionality to address this requirement. However, the Windows Server is not part of the SUT and therefore the SUT does not comply with L3 CoS and QoS requirements. | None<br>UCR Change Requirement | DISA adjudicated this discrepancy as a UCR Change Requirement. |

**LEGEND:**

| | | | |
|---|---|---|---|
| CoS | Class of Service | | |
| DAT | Data Storage Requirement | OS | Operating System |
| DISA | Defense Information Systems Agency | QoS | Quality of Service |
| DMC | Dell EMC | RAE | Required Ancillary Equipment |
| L3 | Layer 3 | SUT | System Under Test |
| LoC | Letter of Compliance | TDR | Test Discrepancy Report |
| NIS | Network Information Service | UCR | Unified Capabilities Requirements |

**3. Interoperability Status.** Table 2 provides the SUT interface interoperability status. Table 3 provides the Capability Requirements and Functional Requirements status and Table 4 provides a DoDIN APL Product Summary, to include subsequent Desktop Review (DTR) updates.

**Table 2. SUT Interface Status**

| Interface | Threshold CR/FR Requirements (See note 1.) | Status | Remarks |
|---|---|---|---|
| **Network Attached Storage (NAS) Interfaces** | | | |
| 1 GbE (Ethernet) (C) | 1 | Not Tested | See note 2. |
| 10 GbE (Ethernet) (C) | 1 | Not Tested | See note 2. |
| **Storage Array Net (SAN) Interfaces** | | | |
| 8 Gbps Fibre Channel (FC) (C) | 1 | Met | See note 3. |
| 16 Gbps FC (C) | 1 | Not Tested | |
| 32 Gbps FC (C) | 1 | Not Tested | |
| **Out-of-Band Management Interfaces** | | | |
| 10 Mbps Ethernet (C) | 1 | Not Tested | See note 2. |
| 100 Mbps Ethernet (C) | 1 | Not Tested | See note 2. |
| 1 GbE (Ethernet) (C) | 1 | Not Tested | See note 2. |
| **Converged Network Adapter (CNA) Interfaces** | | | |
| 10 GbE (Ethernet) (O) | 1 | Not Tested | See note 2. |

**NOTE(S):**
1. The UCR does not identify interface CR/FR applicability. The SUT high-level CR and FR ID numbers depicted in the Threshold CRs/FRs column are cross-referenced with Table 3.2.
2. This SUT interface was not interoperability tested but met this interface requirement based on the Vendor LoC.
3. This interface was validated when the SUT was functionally tested during CS testing.

**LEGEND:**

| | | | |
|---|---|---|---|
| C | Conditional | LoC | Letter of Compliance |
| CNA | Converged Network Adapter | Mbps | Megabits per second |
| CR | Capability Requirement | NAS | Network Attached Storage |
| FC | Fibre channel | O | Optional |
| FR | Functional Requirement | SAN | Storage Array Net |
| GbE | Gigabit Ethernet | SUT | System Under Test |
| Gbps | Gigabit per second | UCR | Unified Capabilities Requirements |
| ID | Identification | | |

## Table 3. SUT Capability Requirements and Functional Requirements Status

| CR/FR ID | UCR Requirement (High-Level) (See note 1.) | UCR 2013 Reference | Status |
|---|---|---|---|
| 1 | Cybersecurity (R) | Section 4 | Met (See note 2.) |
| 2 | Data Storage Controller (DSC) (R) | Section 14 | Partially Met (See note 3.) |
| 3 | IPv6 (R) | Section 5 | Met (See note 3.) |

**NOTE(S):**
1. The annotation of 'required' refers to a high-level requirement category.
2. A USAISEC-TIC-led CS test team conducted CS testing and published the results in a separate report, Reference (d).
3. JITC accepted the Vendor LoC in lieu of IO testing; therefore, the SUT CR/FR status is based on USAISEC-TIC and JITC analysis of the Vendor LoC. See Table 1 for limitations and conditions of the SUT.

**LEGEND:**

| | | | |
|---|---|---|---|
| CR | Capability Requirement | JITC | Joint Interoperability Test Command |
| CS | Cybersecurity | LoC | Letter of Compliance |
| DSC | Data Storage Controller | R | Required |
| FR | Functional Requirement | SUT | System Under Test |
| ID | Identification | TIC | Technology Integration Center |
| IO | Interoperability | UCR | Unified Capabilities Requirements |
| IPv6 | Internet Protocol version 6 | USAISEC | U.S. Army Information Systems Engineering Command |

## Table 4. DoDIN APL Product Summary

| **Product Identification** | | | |
|---|---|---|---|
| Product Name | Dell EMC PowerMax Array with Management UI and Specified Servers | | |
| Software Release | Software Release 9.1 | | |
| UCR Product Type(s) | Data Storage Controller | | |
| Product Description | Dell PowerMax array is an external flash storage array accessible for I/O and management over SAN. | | |
| **Product Components** | **Component Name** (See note.) | **Tested Version** | **Remarks** |
| Dell EMC PowerMAX Array with Management UI and Specified Servers | **PowerMax 2000 Array** PowerMax 8000 Array | NA | |
| | **Unisphere for PowerMax** | 9.1 | |
| | **Solutions Enabler** | 9.1 | |
| | **Windows Server 2016** | Windows Server 2016 | Site provided |
| | FC Supported Server | (See note 2.) | |

**NOTE(S):**
1. Components bolded and underlined were functionally tested by USAISEC-TIC. The other components in the family series were not tested; however, JITC certified the other components for joint use because they utilize the same software and similar hardware as tested and certified components and JITC analysis determined they were functionally identical for interoperability certification purposes or the product was added after the Cybersecurity testing was completed.
2. The FC Supported Server is a Generic Linux or Windows OS Server supporting CIFS, NFS, Load-Balancing, LDAP, GNS, and other required OS functions for Dell PowerMax as a Data Storage Controller.

**LEGEND:**

| | | | |
|---|---|---|---|
| APL | Approved Products List | NFS | Network File System |
| CIFS | Common Internet File System | OS | Operating System |
| DoDIN | Department of Defense Information Network | SAN | Storage Area Network |
| FC | Fibre Channel | SUT | System Under Test |
| GNS | Global Name Service | TIC | Technology Integration Center |
| I/O | Input / Output | UCR | Unified Capabilities Requirements |
| JITC | Joint Interoperability Test Command | UI | User Interface |
| LDAP | Lightweight Directory Access Protocol | USAISEC | U.S. Army Information Systems Engineering Command |
| NA | Not Applicable | | |

**4. Test Details.** This certification is based on review of the Vendor Letter of Compliance (LoC) and DISA Certifying Authority (CA) Recommendation for inclusion on the DoDIN APL. JITC accepted the Vendor LoC in lieu of interoperability testing. USAISEC-TIC completed review of the Vendor's LoC on 30 July 2020. A USAISEC-TIC-led Cybersecurity (CS) test team conducted CS testing and published the results in a separate report, Reference (d).

**5. Additional Information.** JITC distributes interoperability information via the JITC Electronic Report Distribution (ERD) system, which uses Unclassified-but-Sensitive Internet Protocol Data (formerly known as NIPRNet) e-mail. Interoperability status information is available via the JITC System Tracking Program (STP). STP is accessible by .mil/.gov users at https://stp.fhu.disa.mil/. Test reports, lessons learned, and related testing documents and references are on the JITC Joint Industry Toolkit (JIT) at https://jit.fhu.disa.mil/. Due to the sensitivity of the information, the CS Assessment Package (CAP) that contains the approved configuration and deployment guide must be requested directly from the APCO via e-mail: disa.meade.ie.list.approved-products-certification-office@mail.mil. All associated information is available on the DISA APCO website located at https://aplits.disa.mil/.

**6. Point of Contact (POC).** USAISEC-TIC testing POC: Ms. Michelle Lavery; commercial telephone 520-533-3766; DSN 312-821-3766; e-mail address: michelle.w.lavery.civ@mail.mil. JITC certification POC: Ms. Lisa Esquivel; commercial telephone 520-538-5531; email address: lisa.r.esquivel.civ@mail.mil; mailing address: Joint Interoperability Test Command, ATTN: JTE (Ms. Lisa Esquivel), P.O. Box 12798, Fort Huachuca, Arizona 85670-2798. The APCO tracking number for the SUT is 1923901.

FOR THE COMMANDER:

CLARK.BRADLEY.ALAN.1231466564 Digitally signed by CLARK.BRADLEY.ALAN.1231466564 Date: 2021.06.24 15:15:33 -07'00'

3 Enclosures a/s

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HQUSAISEC, AMSEL-IE-IS
APCO

## ADDITIONAL REFERENCES

(c) Joint Interoperability Test Command (JITC), "Department of Data Storage Controller (DSC) Test Procedures Version 1.0 for Unified Capabilities Requirements (UCR) 2013 Change 2," October 2019

(d) U.S. Army Information Systems Engineering Command, Mission Engineering Directorate, Technology Integration Center (USAISEC MED TIC), "Cybersecurity Assessment Report for Dell EMC PowerMAX Array and Management UI Software Release 9.1 (Tracking Number 1923901)," August 2020

(e) Dell EMC, "Letter of Compliance (LoC) for Dell EMC PowerMax Array and Management UI Software Release 9.1 (Tracking Number 1923901)," July 2020

## CERTIFICATION SUMMARY

**1. SYSTEM AND REQUIREMENTS IDENTIFICATION.** The Dell EMC PowerMAX Array (models 2000 and 8000) with Management User Interface Software Release 9.1 and Specified Servers is hereinafter referred to as the System Under Test (SUT). Table 2-1 depicts the SUT identifying information and requirements source.

**Table 2-1. System and Requirements Identification**

| | |
|---|---|
| **System Identification** | |
| Sponsor | United States Army |
| Sponsor Point of Contact | Mr. Jordan Silk, United States Army Information Systems Engineering Command, Mission Engineering Directorate (USAISEC-MED), Building (Bldg) 53302, Fort Huachuca, AZ 85613; E-mail: Jordan.R.Silk.civ@mail.mil |
| Vendor Point of Contact | Dell Technologies, 263 Prospect Hill Road, Waltham, MA 02451, E-mail: dell.apl.certification.team@dell.com |
| System Name | PowerMax Array (models 2000 and 8000) with Management User Interface and Specified Server |
| Increment and/or Version | 9.1 (Management User Interface) |
| Product Category | Data Storage Controller |
| **System Background** | |
| Previous certifications | None |
| **Tracking** | |
| APCO ID | 1923901 |
| JITC STP ID | 8472 |
| **Requirements Source** | |
| Unified Capabilities Requirements | Unified Capabilities Requirements 2013, Change 2, Section 5 (IPv6), Section 14 (Online Storage Controller) |
| Remarks | None |
| **Test Organization(s)** | USAISEC-TIC |

**LEGEND:**

| | | | |
|---|---|---|---|
| APCO | Approved Products Certification Office\ | MED | Mission Engineering Directorate |
| ID | Identification | STP | System Tracking Program |
| IPv6 | Internet Protocol Version 6 | TIC | Technology Integration Center |
| JITC | Joint Interoperability Test Command | USAISEC | U.S. Army Information Systems Engineering Command |

**2. SYSTEM DESCRIPTION.** A Data Storage Controller (DSC) is a specialized multiprotocol computer system with an attached disk array that serves in the role of a disk array controller and end node in Base/Post/Camp/Station (B/P/C/S) networks. The DSC is typically a Military Department (MILDEP) asset connected to the Assured Services Local Area Network (ASLAN); however, the DSC is not considered part of the ASLAN.

The SUT is a Data Storage Controller (DSC). The DELL PowerMax Array is an external flash storage array accessible for Input/Output (I/O) and management over Storage Area Network (SAN). It requires a Fiber Channel (FC) switch for both I/O and management and also a 'FC Supported Server' to integrate end users that support Common Internet File System or Network File System protocols. The Management interface consists of a Solution Enabler (a library and Windows services) and Unisphere for PowerMax, a Wildfly-based Java Web application server that exposes a browser-based User Interface (UI). Unisphere is the only access point to the array in this configuration. It leverages the FC connection for the management of the array. Storage

blocks are controlled by the server-based operating system and are accessed by Fibre Channel, Fibre Channel over Ethernet (FCoE), CIFS, or NFS protocols.

**Component 1. Dell EMC PowerMax 2000 Array:** The PowerMax 2000 provides fast end-to-end Non-Volatile Memory express (NVMe) and Storage Class Memory (SCM) performance, and data services. PowerMax bricks can be scaled from the base capacity of 13TB up to 1PBe in 13TB increments.

**Sub-Component 1a. Dell EMC Unisphere for PowerMax:** Unisphere is an HTML5 web-based application which enables configuration and management of the PowerMax Array.

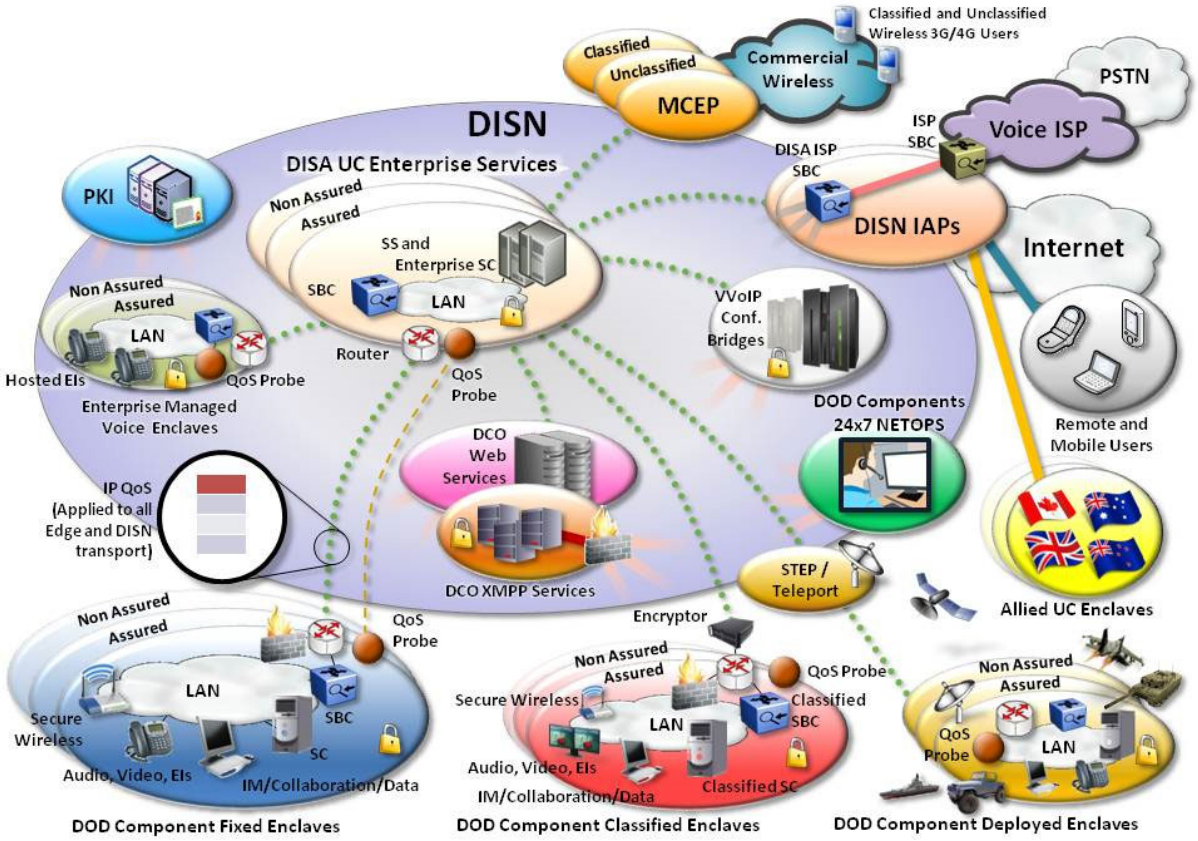
**Sub-Component 1b. Dell EMC Solutions Enabler:** Provides a comprehensive command-line interface (SYMCLI) to manage the storage environment. Solutions Enabler is available as a host-based component, as part of embedded management, or as a virtual application. Solutions Enabler provides two mechanisms to control access to arrays: host-based access and user-based access.

**Sub-Component 1c. Fibre Channel (FC) Supported Server:** Server-based operating system (Linux or Windows) required for the SUT to interface with end users that support Network File System or Common Internet File System Protocol over Internet Protocol.

**3. OPERATIONAL ARCHITECTURE.** The Department of Defense Information Network (DoDIN) architecture is a two- level network hierarchy consisting of Defense Information Systems Network (DISN) backbone switches and Service/Agency installation switches. The Department of Defense (DoD) Chief Information Officer (CIO) and Joint Staff policy and subscriber mission requirements determine which type of switch can be used at a particular location. The DoDIN Capability (DC) architecture, therefore, consists of several categories of switches. Figure 2-1 depicts the notional operational DoDIN architecture in which the SUT may be used and Figure 2-2 the DSC functional model.

**4. TEST CONFIGURATION.** The U.S. Army Information Systems Engineering Command-Technology Integration Center (USAISEC-TIC) did not perform interoperability testing for the SUT. JITC accepted the Vendor's LoC in lieu of testing. USAISEC-TIC completed review of the Vendor's LoC on 30 July 2020. The test team verified the required functions and features of the SUT by reviewing the Vendor's LoC. A USAISEC-TIC-led Cybersecurity (CS) test team conducted CS testing and published the results in a separate report, Reference (d).

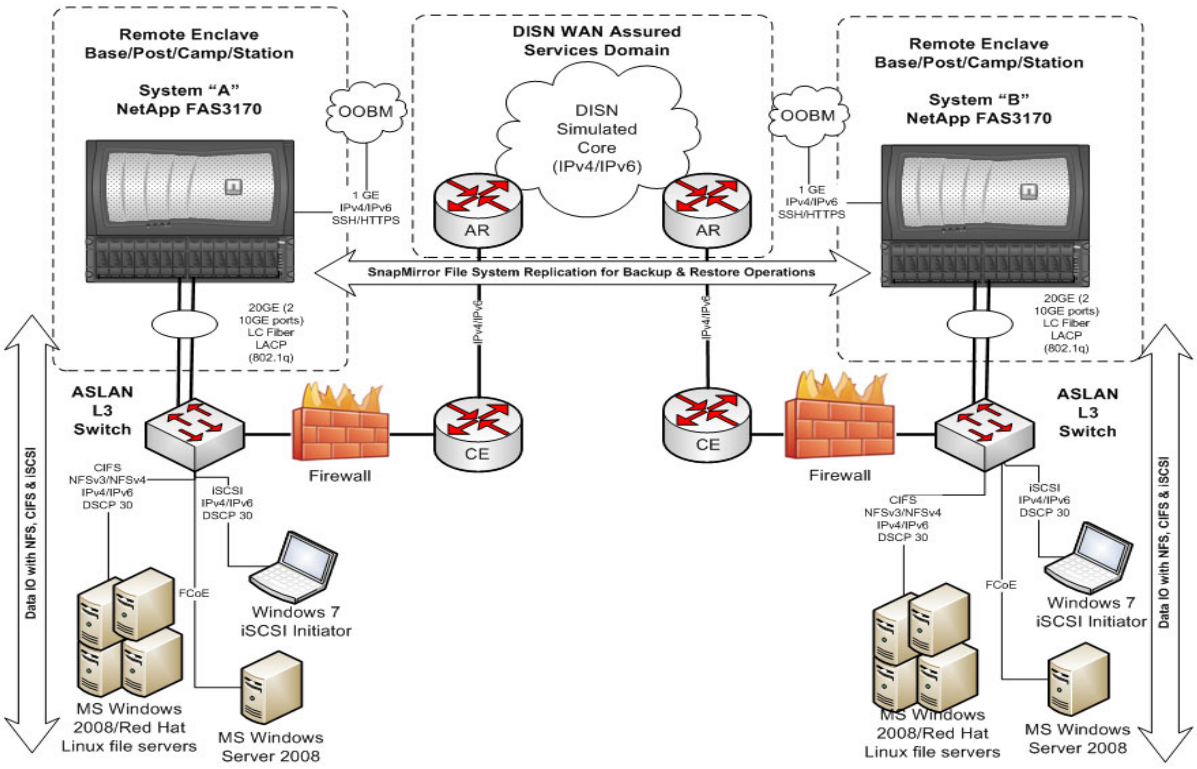
**5. METHODOLOGY.** The USAISEC-TIC reviewed the Vendor's LoC using DSC requirements derived from the Unified Capabilities Requirements (UCR) 2013, Change 2, reference (b), and DSC test procedures derived from reference (c). Any discrepancy noted in the operational environment will be evaluated for impact on the existing certification. These discrepancies will be adjudicated to the satisfaction of DISA via a vendor Plan of Action and Milestones (POA&M), which will address all new critical Test Discrepancy Reports (TDRs) within 120 days of identification.




**LEGEND:**

| | | | |
|---|---|---|---|
| ASLAN | Assured Services Local Area Network | MFSS | Multifunction Softswitch |
| AS-SIP | Assured Services Session Initiation Protocol | NETOPS | Network Operations |
| DCO | Defense Connection Online | PKI | Public Key Infrastructure |
| DISA | Defense Information Systems Agency | QoS | Quality of Service |
| DISN | Defense Information Systems Network | SBC | Session Border Controller |
| DISR | Department of Defense Information Technology Standards Registry | SRTP | Secure Real-Time Transport Protocol |
| | | SS | Softswitch |
| EBC | Edge Boundary Controller | SSL | Secure Socket Layer |
| EI | End Instrument | TLS | Transport Layer Security |
| IP | Internet Protocol | UC | Unified Capabilities |
| IPSec | Internet Protocol Security | VLAN | Virtual Local Area Network |
| ISP | Internet Service Provider | VVoIP | Voice and Video over IP |
| LSC | Local Session Controller | XMPP | Extensible Messaging and Presence Protocol |

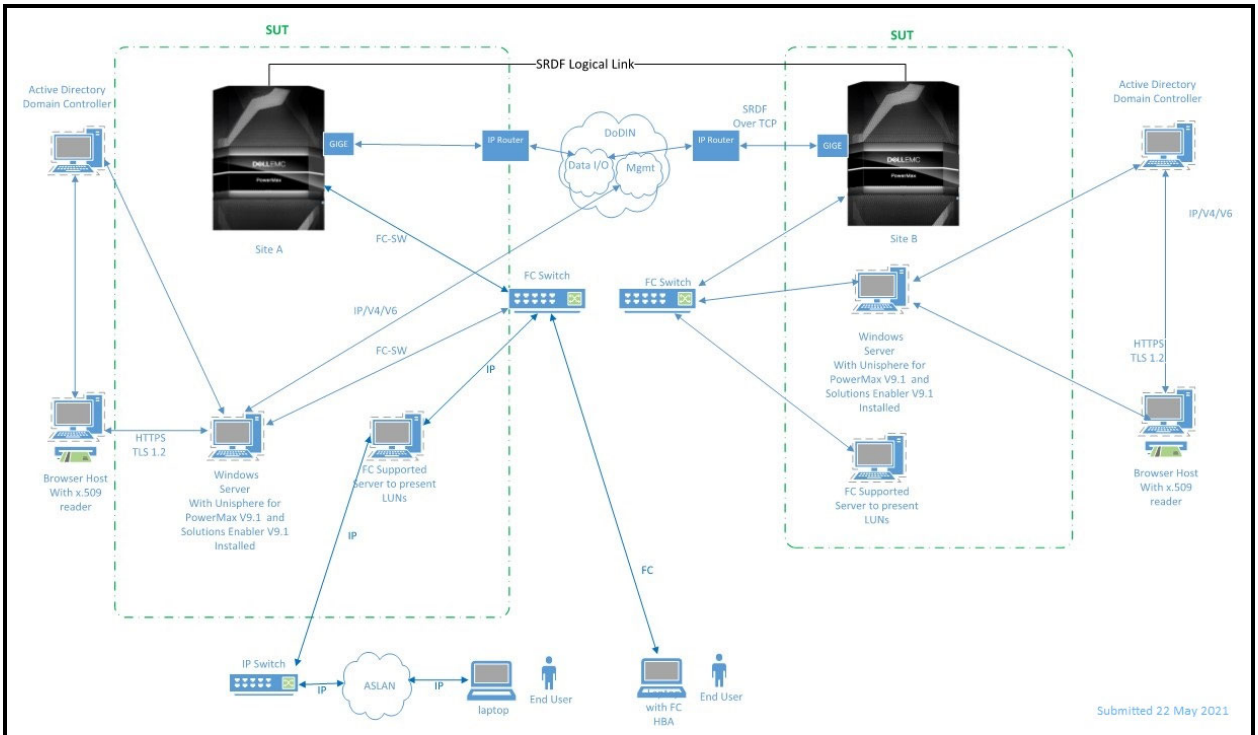
**Figure 2-1. Notional DoDIN Network Architecture**




**LEGEND:**

| | | | |
|---|---|---|---|
| AR | Aggregation Router | IPv4 | Internet Protocol version 4 |
| ASLAN | Assured Services Local Area Network | IPv6 | Internet Protocol version 6 |
| CE | Customer Edge | iSCSI | Internet Small Computer Systems Interface |
| CIFS | Common Internet File System | LACP | Link Aggregation Control Protocol |
| DISN | Defense Information Systems Network | MS | Microsoft |
| DSCP | Differentiated Services Code Point | NFSv3 | Network File System version 3 |
| FCoE | Fibre Channel Over Ethernet | NFSv4 | Network File System version 4 |
| GE | Gig Ethernet | OOBM | Out of Band Management |
| HTTPS | Hypertext Transfer Protocol | SSH | Secure Shell |

**Figure 2-2. Data Storage Controller Functional Reference Model**




**LEGEND**:

| | | | |
|---|---|---|---|
| ASLAN | Assured Services Local Area Network | IP | Internet Protocol |
| DoDIN | Department of Defense Information Network | LOC | Letter of Compliance |
| FC | Fibre Channel | LUNs | Logical Unit Numbers |
| FC-SW | Fibre Channel Switch | SRDF | Symmetrix Remote Data Facility |
| GIGE | Gigabit Ethernet | SUT | System Under Test |
| HBA | Host Bus Adapter | TCP | Transmission Control Protocol |
| HTTPS | HyperText Transfer Protocol Secure | TLS | Transport Layer Security |
| I/O | Input/Output | V | Version |

**Figure 2-3. SUT Test Configuration**

**6. INTEROPERABILITY REQUIREMENTS, RESULTS, AND ANALYSIS.** The interface, Capability Requirements (CR) and Functional Requirements (FR), and other requirements for DSCs are established by UCR 2013, Change 2, Section 14.2.

**a. Interface Status.** The USAISEC-TIC testing interface status of the SUT is provided in Table 3-1. The DSC may conditionally provide physical interfaces for, at a minimum, 1 Gigabit Ethernet (GbE) and 10 GbE in conformance with Institute of Electrical and Electronics Engineers (IEEE) 802.3 for Ethernet Local Area Network (LAN) interfaces. The SUT is a block level storage array that natively supports Fibre Channel (FC) and requires the FC Supported Server for Network Attached Storage interfaces. The system may conditionally provide physical interfaces for out-of-band management (OOBM) access and services with 10/100 Megabit per second (Mbps) Ethernet interfaces as a minimum. Services shall include remote access with at least one of the following protocols: Secure Shell version 2 (SSHv2), Transport Layer Security (TLS), Hyper Text Transfer Protocol Secure (HTTPS), and Simple Network Management Protocol (SNMP) version 3; and the protocols shall be secured in accordance with Section 4, Information Assurance. Per the Vendor LoC, the SUT does not meet this conditional requirement and therefore it not included in this certification. The system may conditionally provide FC physical interfaces and FC Protocol interfaces and services as per American National Standards Institute (ANSI) X3.230, X3.297, and X3.303. The SUT met this conditional requirement with the Vendor LoC. The system may optionally provide physical interfaces for FC over Ethernet (FCoE) services over a 10GbE physical interface in conformance with the ANSI T11 FC-BB-5 standard for FCoE with a Converged Network Adapter (CNA). The SUT met this optional requirement with the Vendor LoC.

**b. Capability and Functional Requirements and Status.**

1) The UCR 2013, section 14.2 includes the Storage System requirements in the subparagraphs below.

a) The system shall provide a Redundant Array of Independent Disks (RAID) for multiple disk drives. The system shall provide a configuration option to select the specific RAID level to be provisioned in the disk array. The RAID levels available for use shall be subject to the specific vendor implementation. At a minimum, the RAID level shall be dual parity RAID-6 for Serial Advanced Technology Attachment (SATA) drives and RAID-5 for Serial Attached Small Computer Systems Interface (SCSI) and FC drives, although stronger RAID levels are acceptable. The SUT met this requirement with the Vendor LoC.

b) The system shall be capable of 99.9 percent availability. The SUT met this requirement with the Vendor LoC.

c) The system shall provide a management control function for low-level system monitoring and control functions, interface functions, and remote management. The management control function shall provide an Ethernet physical interface(s) for connection to the owner's (i.e., MILDEP) management network/LAN and also provide status. The monitoring shall include an initial system check, system cooling fans, temperatures, power supplies, voltages, and system power state tracking and logging. The SUT met this requirement with the Vendor LoC.

d) The system shall provide data storage replication (e.g., mirroring) services [Internet protocol (IP) version 4 (IPv4) and version 6 (IPv6)] between systems that are configured as source and destination replication pairs. The replication operations shall provide capabilities for data backup replication, system replication and migration, and system disaster recovery (DR) services in support of continuity of operations (COOP) planning. The SUT met this requirement with the Vendor LoC.

e) When the system interfaces to an Integrated Data Protection (IDP) service and the IDP makes copies of data storage information on to another DSC for periodic data storage backup, DR/COOP, migration, and data archiving operation, the system replication service shall complete the replication regardless of the host connection protocols used between the application servers and the DSC. The SUT met this requirement with the Vendor LoC.

f) The system replication and migration services shall provide capabilities to replicate data storage and configuration information onto another standby DSC system for migrating data storage information. The SUT met this requirement with the Vendor LoC.

g) The system DR services shall provide capabilities to replicate data storage and configuration information onto another standby DSC system for DR/COOP. The SUT met this requirement with the Vendor LoC.

h) The system shall provide configurable modes for replication (mirroring) operations between the source DSC and the destination DSC. During replication, both the source and the destination must be in a known good state. The configurable modes shall be Asynchronous or Synchronous and are depicted in UCR 2013, Change 1, Table 14.2-1, Replication Operation Modes. The SUT met this optional requirement with the Vendor LoC.

2) The UCR 2013, section 14.3 includes the Storage Protocol requirements in the subparagraphs below.

a) The system shall provide a Network File System version 3 (NFSv3) server for file systems data input/output (I/O). The SUT met this requirement with the Vendor LoC.

b) The system shall provide a NFS version 4 (NFSv4) server for file systems data I/O. The SUT met this optional requirement with the Vendor LoC.

c) The system shall provide a NFS version 4.1 (NFSv4.1) server, including support for parallel NFS for file systems data I/O. The SUT met this operational requirement with the Vendor LoC.

d) The system shall provide a CIFS version 1.0 (CIFSv1.0) server for file systems data I/O. The SUT met this requirement with the Vendor LoC.

e) The system shall provide a CIFS version 2.0 (CIFSv2.0) server for file systems data I/O. The SUT met this optional requirement with the Vendor LoC.

f) The system shall provide Internet Small Computer Systems Interface (iSCSI) server (target) operations for data I/O of Logical Units (LUNs) to clients (initiators). The SUT met this optional requirement with the Vendor LoC.

g) The system shall provide FCP server (target) operations for data I/O of FCP LUNs to clients (initiators). The SUT met this optional requirement with the Vendor LoC.

h) The system shall provide FCoE server (target) operations for data I/O of FCP LUNs to clients (initiators). The SUT met this optional requirement with the Vendor LoC.

i) The system shall provide a HTTPS server for file system data I/O and management access to the storage controller operating system. The session shall be secured with SSL or Transport Layer Security (TLS), per Internet Engineering Task Force (IETF) Request for Comment (RFC) 5246, and shall comply with Section 4, Information Assurance, for that protocol. Per the Vendor's LoC, the SUT does not meet this optional requirement and therefore it is not included in this certification.

j) The system shall provide SSHv2 or TLS for management access to the storage controller operating system. The SSHv2 or TLS implementation shall comply with Section 4, Information Assurance, for that protocol. The SUT met this requirement with the Vendor LoC.

k) The system shall provide Web-based Distributed Authoring and Versioning (WebDAV), per IETF RFC 4918, in support of Cloud-based virtualized storage infrastructures. Per the Vendor's LoC, the SUT does not meet this optional requirement and therefore it is not included in this certification.

l) The system shall implement the Representational State Transfer (REST) software architecture for distributed hypermedia systems and Cloud-based virtualized storage infrastructures. Per the Vendor LoC, the SUT does not meet this optional requirement and therefore it is not included in this certification.

m) The system shall implement the Storage Networking Industry Association (SNIA) Cloud Data Management Interface (CDMI) standard. Per the Vendor's LoC, the SUT does not meet this optional requirement and therefore it is not included in this certification.

n) The system shall provide Global Name Space (GNS) or single name space functionality. The GNS functionality shall provide the capability to aggregate disparate and remote network-based file systems to provide a consolidated view to reduce complexities of localized file management and administration. The GNS functionality shall provide large (i.e., 14 Petabyte [PB] or greater) working pools of disks, transparent data migration, and it shall serve to reduce the number of storage mount points and shares. Each system shall have a dedicated and unique GNS. The SUT met this requirement with the Vendor LoC.

3) The UCR 2013, section 14.4 includes the Network Attached Storage Interface requirements in the subparagraphs below.

a) If the SUT supports NAS, the system shall provide physical interfaces for Gigabit Ethernet (GbE) and 10 Gigabit Ethernet (10 GbE) services in conformance with Institute of Electrical and Electronics Engineers (IEEE) 802.3 for Ethernet LAN interfaces. Per the Vendor LoC, the SUT is a block storage device only and does not meet this conditional requirement.

b) If the SUT supports NAS, the system shall be able to provision, monitor, and detect faults, and to restore Ethernet services in an automated fashion. Per the Vendor LoC, the SUT is a block storage device only and does not meet this conditional requirement.

c) If the SUT supports NAS, the system shall provide physical interfaces for OOBM access and services with 10/100 Mbps Ethernet interfaces as a minimum. Services shall include remote access with at least one of the following protocols: SSHv2, SSL, HTTPS, and SNMPv3; and the protocols shall be secured in accordance with Section 4, Cybersecurity. Per the Vendor LoC, the SUT is a block storage device only and does not meet this conditional requirement. Additionally, CS testing was accomplished by a USAISEC-TIC-led Cybersecurity test team and the results published in a separate report, Reference (e).

d) If the SUT supports NAS, when the system uses Ethernet, Fast Ethernet, GbE, and 10GbE interfaces, the interfaces shall be autosensing, auto-detecting, and auto-configuring with incoming and corresponding Ethernet link negotiation signals. Autosensing, auto-detecting, and auto-configuring only applies to interfaces below 10GbE interfaces. Per the Vendor LoC, the SUT is a block storage device only and does not meet this conditional requirement.

e) If the SUT supports NAS, Ethernet services of the system and the Logical Link Interworking Function (IWF) of the system shall terminate the Media Access Control (MAC) layer of Ethernet as described in Ethernet Standard IEEE 802.3. Per the Vendor LoC, the SUT is a block storage device only and does not meet this conditional requirement.

f) If the SUT supports NAS, Ethernet services of the system shall support jumbo frames with a configurable Maximum Transmission Unit (MTU) of 9000 bytes or greater, excluding Ethernet encapsulation. When Ethernet encapsulation is included in the frame size calculation, an additional 22 bytes must be included for the MAC header (14 bytes), the Virtual LAN (VLAN) tag (4 bytes), and the Cyclical Redundancy Check (CRC) Checksum (4 bytes) fields in the Ethernet frame, resulting in a maximum of 9022 bytes or greater. The system shall also support a configurable MTU between 1280 bytes and 1540 bytes to ensure packets can transit type 1 encryptors. The system default MTU shall be 1540 bytes. Per the Vendor LoC, the SUT is a block storage device only and does not meet this conditional requirement.

g) If the SUT supports NAS, Ethernet services of the system shall allocate a unique Ethernet MAC address to each Ethernet interface associated with a VLAN, as per IEEE 802.1Q. Per the Vendor LoC, the SUT is a block storage device only and does not meet this conditional requirement.

h) If the SUT supports NAS, Ethernet services of the system shall support "Link Aggregation," as per IEEE 802.3ad or IEEE 802.1AX-2008, and use with the Link Aggregation

Control Protocol. Per the Vendor LoC, the SUT is a block storage device only and does not meet this conditional requirement.

i) Ethernet services of the system shall provide Link Layer Discovery Protocol (LLDP), as per IEEE 802.1AB. Per the Vendor LoC, the SUT does not meet this optional requirement.

4) The UCR 2013, section 14.5, states the system shall provide Fibre Channel (FC) physical interfaces and FCP interfaces and services as per American National Standards Institute (ANSI) X3.230, X3.297, and X3.303. The SUT met this optional requirement with the Vendor LoC.

5) The UCR 2013, section 14.6 includes the Converged Network Adapter Interface requirements in the subparagraphs below.

a) The system shall provide physical interfaces for FCoE services over a 10GbE physical interface in conformance with the ANSI T11 FC-BB-5 standard for FCoE with a Converged Network Adapter (CNA). The SUT met this optional requirement with the Vendor LoC.

b) The system shall provide physical interfaces for Data Center Bridging [DCB, also known as Converged Enhanced Ethernet (CEE)] features, and functionality, per the standards depicted in Table 14.6-1, Physical Interfaces for Data Center Bridging. The SUT met this optional requirement with the Vendor LoC.

6) The UCR 2013, section 14.7 includes the IP Networking requirements in the subparagraphs below.

a) The system shall meet the IPv6 requirements defined in Section 5.2.2, Mapping of RFCs to UC Profile Categories, for a simple server/network appliance. The SUT met this requirement with the Vendor LoC.

b) The system shall provide statically provisioned or dynamically adjusted large IP packet receive buffers for replication (mirroring) session traffic received on the Ethernet physical interfaces. The receive buffers may be statically provisioned or the operating system of the system may dynamically self-adjust the packet receive buffer size based on measurements of the E2E path bandwidth, Maximum Segment Size (MSS), Round Trip Time (RTT), and the percentage of packet loss. The system shall provide a default and minimum IP packet receive buffer size of 2048 KB per replication (mirroring) session. The system shall provide a statically provisioned or dynamically adjusting maximum IP packet receive buffer size of up to 8192 KB per replication (mirroring) session. The SUT met this requirement with the Vendor LoC.

c) The system shall provide an optimized congestion control (congestion avoidance) algorithm in Transmission Control Protocol (TCP) for avoidance of traffic loss on communications paths in high-speed networks with high latency or large bandwidth-delay products. The SUT met this requirement with the Vendor LoC.

7) The UCR 2013, section 14.8 includes the Name Services requirements in the subparagraphs below.

a) The system shall provide Lightweight Directory Access Protocol (LDAP) directory services per IETF RFC 4510. The SUT met this requirement with the Vendor LoC.

b) The system shall provide Kerberos authentication service per IETF RFC 4120. The SUT met this requirement with the Vendor LoC.

c) The system shall provide Domain Name System (DNS) client functionality. The SUT met this requirement with the Vendor LoC.

d) The system shall provide Network Information Service (NIS) client directory service functionality. The SUT does not comply with this requirement because the SUT relies on the site host server and Required Ancillary Equipment, which are not part of the SUT, to meet this NIS requirement. DISA adjudicated this discrepancy as a Change Requirement, as described in Table 1.

e) The system shall provide NIS Netgroups client directory service functionality. The SUT does not comply with this requirement because the SUT relies on the site host server and Required Ancillary Equipment, which are not part of the SUT, to meet this NIS requirement. DISA adjudicated this discrepancy as a Change Requirement, as described in Table 1.

f) The system shall provide Network Basic Input/Output System (NETBIOS) over TCP/IP (NBT) Name Resolution and Windows Internet Name Service (WINS). The SUT met this optional requirement with the Vendor LoC.

g) The system shall provide Internet Storage Name Service (iSNS) client functionality per IETF RFC 4171. The SUT met this requirement with the Vendor LoC.

h) If the system has a FC interface then the system shall provide FC Name and Zone Service. The SUT is a client to name services. The SUT met this conditional requirement with the Vendor LoC.

8) The UCR 2013, section 14.9 includes the Security Services requirements in the subparagraphs below.

a) The system shall provide IPSec per RFC 4301. The SUT met this optional requirement with the Vendor LoC.

b) The system shall provide Encapsulating Security Payload (ESP) per RFC 4303. The SUT met this optional requirement with the Vendor LoC.

c) The system shall provide Internet Key Exchange version 2 (IKEv2) per RFC 4306. The SUT met this optional requirement with the Vendor LoC.

d) The system shall provide a configurable Packet Filter (Firewall) service to block unauthorized access (for intrusion prevention) while permitting authorized communications. The Packet Filter service shall use a "stateless" design that does not degrade performance and shall filter all packets received based on interface, source IP address, protocol, port, Type of Service (TOS), or Time To Live (TTL). The Packet Filter service shall provide a configuration policy for defining combinations of multiple packet match rules and processing actions. The SUT met this optional requirement with the Vendor LoC.

e) The system shall provide encryption of data at rest at a minimum of AES-256 in accordance with Federal Information Processing Standard (FIPS) 140-2 level 1 or higher to provide the following capabilities:

1. Rapid crypto-shredding (destruction) of data, in accordance with National Institute of Standards and Technology 800-88, for tactical systems that operate in harm's way and may fall into enemy hands. The SUT met this requirement with the Vendor LoC.

2. Rapid recovery from sensitive data spills, where the wrong data is accidentally written to the wrong place. The SUT met this requirement with the Vendor LoC.

f) The system shall comply with all appropriate STIGs to include the Database Security Technical Implementation Guide. Security testing is accomplished by a USAISEC-TIC-led Cybersecurity test team and the results published in a separate report, Reference (c).

9) The UCR 2013, section 14.10, states the system shall provide an Application Programming Interface (API) to enable interaction with other software and systems. The interactions shall include routines, data structures, object classes, and protocols used to communicate between the consumer and implementer of the API. The API protocol and message format (e.g., Extensible Markup Language [XML]) shall be subject to the specific vendor system operating system implementation. The SUT met this requirement with the Vendor LoC.

10) The UCR 2013, section 14.11 includes the Class of Service and Quality of Service requirements in the subparagraphs below.

a) The system shall provide Class of Service (CoS) and Quality of Service (QoS) marking on egress traffic at layer 2 per IEEE 802.1p and, Section 7.2.1.3, Class of Service Markings, and Section 7.2.1.4, Virtual LAN Capabilities. Traffic classification and marking must occur before the egress transmission of the Ethernet frame with a rule or policy engine that matches on various storage and management protocol types as offered by the system. The SUT does not comply with this optional requirement because the SUT relies on the site host server and Required Ancillary Equipment, which are not part of the SUT, to meet this Layer 2 requirement.

b) The system shall provide CoS and QoS marking on egress traffic at layer 3 per Section 6, Network Infrastructure End-to-End Performance. Traffic classification and marking must occur before the egress transmission of the IP packet with a rule or policy engine that

matches on various storage and management protocols that occur within the system, such as those listed in Table 14.11-1. The IP packets are marked in the TOS field of the IPv6 packet header with Differentiated Services Code Point (DSCP) values from 0 and 63, inclusive. These are to be used in the ASLAN, non-ASLAN, and extended networks for per-hop CoS and QoS traffic conditioning by the network elements. The SUT does not comply with this requirement because the SUT relies on the site host server and Required Ancillary Equipment, which are not part of the SUT, to meet this Layer 3 requirement. DISA adjudicated this discrepancy as a Change Requirement, as described in Table 1.

11) The UCR 2013, section 14.12 includes the Virtualization requirements in the subparagraphs below.

a) The system shall provide virtualized Data Storage Controller (vDSC) functionality and individual protocol server processes. The vDSC shall meet all the requirements of a DSC with minor exceptions that are related to design and technical limitations associated with the complete virtualization of an operating system, which include internal counters for attributes of the physical system, QoS traffic processing, and per vDSC Mobile IP correspondent node binding cache limitations. Per the Vendor LoC, the SUT does not meet this optional requirement and therefore it is not included in this certification.

b) The vDSC capability within the system shall provide secure, Private Networking Domains (PNDs) for Ethernet, VLANs, and IP that isolate the network domains of system units. The PND shall support the use of duplicate IP addresses and IP subnet address ranges among those of any other configured vDSC in the system. The PND shall provide a dedicated IP Forwarding Information Base (FIB) per vDSC. Per the Vendor LoC, the SUT does not meet this optional requirement and therefore it is not included in this certification.

c) The vDSC shall provide an individual Command Line Interface (CLI) context with the full command set of the system, with the scope of the commands limited to the individual vDSC CLI context. Per the Vendor LoC, the SUT does not meet this optional requirement and therefore it is not included in this certification.

d) The vDSC shall provide a programmatic API with the full command set of the system with the scope of the API commands limited to the individual vDSC context. Per the Vendor LoC, the SUT does not meet this optional requirement and therefore it is not included in this certification.

e) The vDSC capability within the system shall provide an individual GNS unique from the system or shall provide a single name space that provides the capability to aggregate disparate hardware and storage architectures into a single file system. The GNS shall provide the capability to aggregate disparate and remote network-based file systems, providing a consolidated view to reduce complexities of localized file management and administration. The GNS shall provide large working pools of disks and transparent data migration, and shall serve to reduce the number of storage mount points and shares. The single name space shall be spread across multiple physical network access server heads all representing the same file system without replication. The single name space shall include the ability to tier data automatically

within the same file system. Per the Vendor LoC, the SUT does not meet this optional requirement and therefore it is not included in this certification.

**7. HARDWARE/SOFTWARE/FIRMWARE VERSION IDENTIFICATION.** Table 3-3 provides the SUT components' hardware, software, and firmware tested. The JITC accepted the vendor's LoC in lieu of interoperability testing.

**8. TESTING LIMITATIONS.** None

**9. CONCLUSION(S).** The SUT meets the critical interoperability requirements for a Data Storage Controller in accordance with the UCR and is certified for joint use with other DoDIN Products listed on the Approved Products List (APL). The SUT meets the interoperability requirements for the interfaces listed in Table 3-1.

# DATA TABLES

## Table 3-1. SUT Interface Status

| Interface | Threshold CR/FR Requirements (See note 1.) | Status | Remarks |
|---|---|---|---|
| **Network Attached Storage (NAS) Interfaces** | | | |
| 1 GbE (Ethernet) (C) | 1 | Not Tested | See note 2. |
| 10 GbE (Ethernet) (C) | 1 | Not Tested | See note 2. |
| **Storage Array Net (SAN) Interfaces** | | | |
| 8 Gbps Fibre Channel (FC) (C) | 1 | Met | See note 3. |
| 16 Gbps FC (C) | 1 | Not Tested | |
| 32 Gbps FC (C) | 1 | Not Tested | |
| **Out-of-Band Management Interfaces** | | | |
| 10 Mbps Ethernet (C) | 1 | Not Tested | See note 2. |
| 100 Mbps Ethernet (C) | 1 | Not Tested | See note 2. |
| 1 GbE (Ethernet) (C) | 1 | Not Tested | See note 2. |
| **Converged Network Adapter (CNA) Interfaces** | | | |
| 10 GbE (Ethernet) (O) | 1 | Not Tested | See note 2. |

**NOTE(S):**
1. The UCR does not identify interface CR/FR applicability. The SUT high-level CR and FR ID numbers depicted in the Threshold CRs/FRs column are cross-referenced with Table 3.2.
2. This SUT interface was not interoperability tested but met this interface requirement based on the vendor LoC and the system description diagram provided by the vendor.
3. This interface was validated when the SUT was functionally tested during CS testing.

**LEGEND:**

| | | | |
|---|---|---|---|
| C | Conditional | LoC | Letter of Compliance |
| CNA | Converged Network Adapter | Mbps | Megabits per second |
| CR | Capability Requirement | NAS | Network Attached Storage |
| FC | Fibre channel | O | Optional |
| FR | Functional Requirement | SAN | Storage Array Net |
| GbE | Gigabit Ethernet | SUT | System Under Test |
| Gbps | Gigabits per second | UCR | Unified Capabilities Requirements |
| ID | Identification | | |

## Table 3-2. Capability and Functional Requirements and Status

| CR/FR ID | UCR Requirement (High-Level) (See note 1.) | UCR 2013 Reference | Status |
|---|---|---|---|
| 1 | **Cybersecurity** (R) | Section 4 | See note 2. |
| 2 | **Data Storage Controller (DSC)** (R) | | |
| | Storage System (R) | 14.2 | Met |
| | Storage Protocol (R) | 14.3 | Met |
| | Network Attached Storage Interface (R) | 14.4 | Met |
| | Storage Array Network Interface (O) | 14.5 | Met |
| | Converged Network Adapter Interface (O) | 14.6 | Met |
| | IP Networking (R) | 14.7 | Met |
| | Name Services (R) | 14.8 | Partially Met (See note 3.) |
| | Security Services (R) | 14.9 | Met (See note 2.) |
| | Interoperability (R) | 14.10 | Met |
| | Class of Service and Quality of Service (R) | 14.11 | Not Met (See note 3.) |
| | Virtualization (O) | 14.12 | Not Met (See note 4.) |
| 3 | **IPv6 (R)** | Section 5 | Met (See note 5.) |

**NOTE(S):**
1. The annotation of 'required' refers to a high-level requirement category.
2. A USAISEC-TIC-led CS test team conducted CS testing and published the results in a separate report, Reference (d).
3. See Table 1 for the limitations and conditions of the SUT.
4. The SUT does not support this optional requirement.
5. JITC accepted the Vendor LoC in lieu of IO testing; therefore, the SUT CR/FR status is based on USAISEC-TIC and JITC analysis of the Vendor LoC. See Table 1 for limitations and conditions of the SUT.

**LEGEND:**

| | | | |
|---|---|---|---|
| CIFS | Common Internet File System | LoC | Letter of Compliance |
| CR | Capability Requirement | NFS | Network File System |
| CS | Cybersecurity | O | Optional |
| DSC | Data Storage Controller | R | Required |
| FR | Functional Requirement | SUT | System Under Test |
| GNS | Global Name Space | TIC | Technology Integration Center |
| ID | Identification | UCR | Unified Capabilities Requirements |
| IO | Interoperability | USAISEC | U.S. Army Information Systems Engineering Command |
| IP | Internet Protocol | v | Version |
| JITC | Joint Interoperability Test Command | | |

## Table 3-3. SUT Hardware/Software/Firmware Version Identification

| Components (See note 1.) | Release | Sub-component | Function |
|---|---|---|---|
| **PowerMax 2000 Array** | 9.1 | N/A | Storage Array |
| PowerMax 8000 Array | 9.1 | N/A | Storage Array |
| **Unisphere for PowerMax** | 9.1 | N/A | Web-based application which enables configuration and management of the PowerMax Array |
| **Solutions Enabler** | 9.1 | N/A | Command-line interface to manage the storage environment |
| **Windows Server 2016** (Site-Provided.) | MS Server 2016 | N/A | Host for management apps (Unisphere for PowerMax and Solutions Enabler) and accessibility to the storage array. |
| FC Supported Server | Windows or Linux Server (See note 2.) | N/A | Server that enables the SUT to translate NFS and CIFS IP packets to Fibre Channel for storage in the Powermax Array |

**NOTE(S):**
1. Components bolded and underlined were tested by USAISEC-TIC. The other components in the family series were not tested; however, JITC certified the other components for joint use because they utilize the same software and similar hardware as tested and certified components and JITC analysis determined they were functionally identical for interoperability certification purposes or the product was added after the Cybersecurity testing was completed.
2. Generic Linux or Windows OS Server supporting CIFS, NFS, Load-Balancing, LDAP, GNS, and other required Operating System functions for Dell PowerMax as a Data Storage Controller.

**LEGEND:**

| | | | |
|---|---|---|---|
| CIFS | Common Internet File System | NFS | Network File System |
| FC | Fibre Channel | OS | Operating System |
| GNS | Global Name Service | SUT | System Under Test |
| JITC | Joint Interoperability Test Command | TIC | Technology Integration Center |
| LDAP | Lightweight Directory Access Protocol | USAISEC | U.S. Army Information Systems Engineering Command |
| MS | Microsoft | | |
| N/A | Not Applicable | | |

## Table 3-4. Test Infrastructure Hardware/Software/Firmware Version Identification

| System Name | Software Release | Function |
|---|---|---|
| **Required Ancillary Equipment** | | |
| Active Directory | | |
| Public Key Infrastructure | | |
| Online Certificate Status Protocol | | |
| Remote Authentication Dial-In User Service | | |
| Network Time Protocol | | |
| Simple Network Management Protocol | | |
| **Test Network Components** | | |
| Fiber Channel Switch | Brocade 6510 | Transcodes FC to IP and IP to FC |
| Host Server | Windows Server 2016 | OS |
| Client Workstation | 4.12.0.134 | Axway Desktop Validator |
| | 7.0.2.448 | ActivClient |

**LEGEND:**

| | | | |
|---|---|---|---|
| FC | Fibre Channel | OS | Operating System |
| IP | Internet Protocol | | |