interopLab

Interoperability of Bloombase StoreSafe and ATTO Celerity 16G Fiber-Channel Host Bus Adapter (FC-HBA) for Transparent Data-at-Rest Encryption

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BLOOMBASE® ATTO

Executive Summary

ATTO carrier grade Celerity 16G Fiber Channel Host Bus Adapters (FC-HBA) are validated by Bloombase's interopLab to run with Bloombase StoreSafe to secure Hewlett Packard Enterprise (HPE) MSA P2000 Storage Area Network (SAN) by state-of-the-art encryption. This document describes the steps carried out to test interoperability of ATTO Celerity 16G FC-HBAs with Bloombase StoreSafe Storage Encryption Server running on Intel x86-based commercial-off-the-shelf (COTS) server appliances. Storage client running Red Hat Enterprise Linux (RHEL) 7 on HPE ProLiant DL20 Server with ATTO Celerity 16G FC-HBA is validated with Bloombase StoreSafe Storage Encryption Server securing HPE MSA P2000 FC-SAN.

The interoperability tests in this report are carried out at Bloombase interopLab with sponsor from ATTO Technology, Inc.

About ATTO Technology, Inc.

ATTO Technology, Inc., headquartered in Amherst, New York, is a global leader of storage connectivity and infrastructure solutions for data-intensive computing environments. It is our vision to provide a wide range of end-to-end solutions to help customers better store, manage and deliver their data. We believe that our company's experience in engineering advanced technology into real-world product solutions provides customers a unique competitive advantage. For more information, please refer to https://www.atto.com

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Purpose and Scope

This document describes the steps necessary to integrate ATTO Celerity FC-162E 16G Fiber Channel Host Bus Adapters (FC-HBA) with HPE ProLiant DL20 commercial-off-the-shelf server as storage client and test with Bloombase StoreSafe enterprise storage software appliance to secure sensitive business data managed at Hewlett Packard Enterprise (HPE) MSA P2000 Fiber Channel Storage Area Network (FC-SAN) via Fiber Channel Protocol (FCP). Specifically, we cover the following topics:

- Installing and configuring Bloombase StoreSafe software appliance on HPE ProLiant DL20 server
- Provisioning storage volume at HPE MSA P2000 FC-SAN to be secured by Bloombase StoreSafe
- Interoperability testing on client system with Red Hat Enterprise Linux (RHEL) 7 on HPE ProLiant DL20 server with ATTO Celerity FC-162E 16G FC-HBA

Assumptions

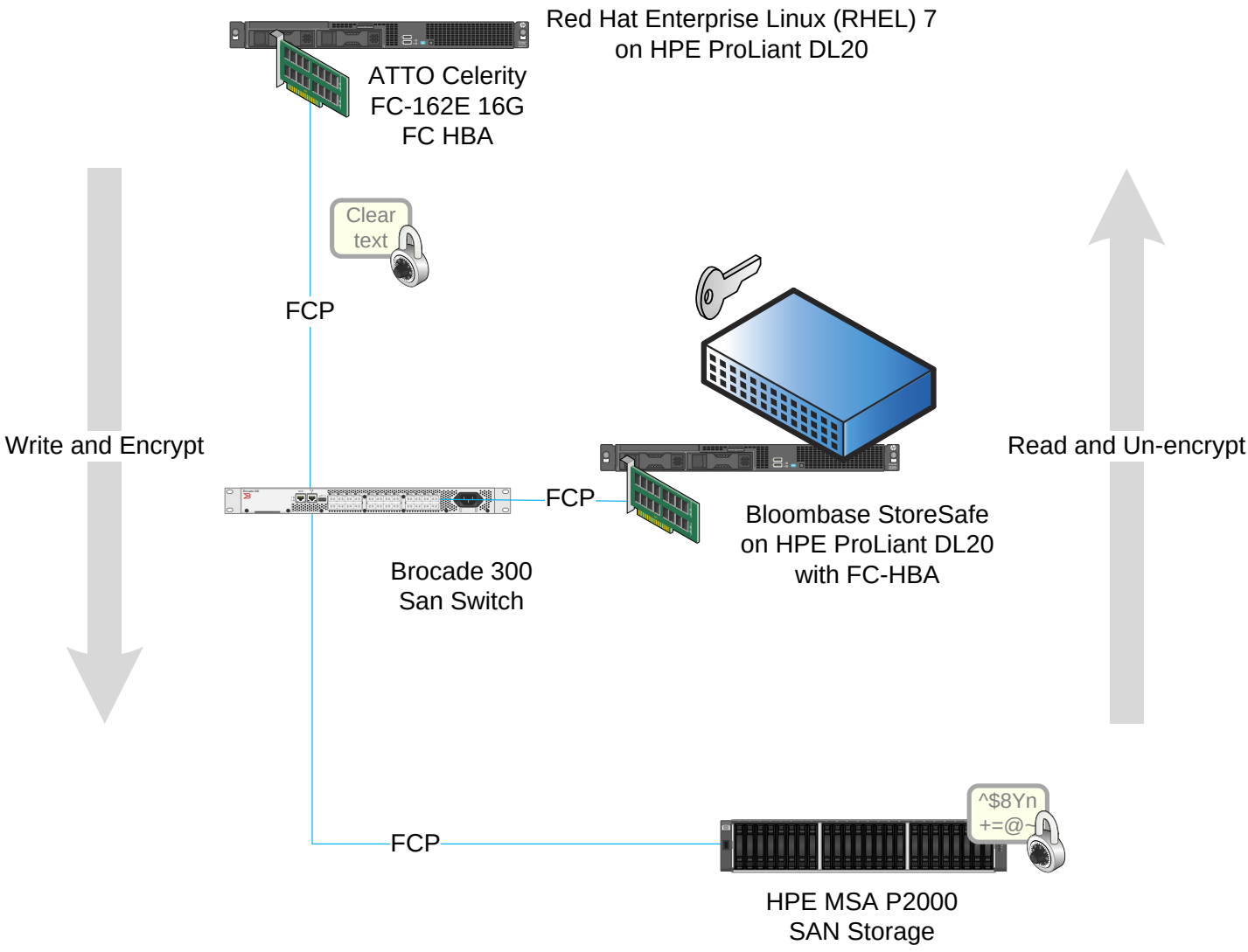
This document describes interoperability testing of ATTO Celerity FC-162E 16G FC-HBA with Bloombase StoreSafe on HPE ProLiant DL20 Server for data-at-rest encryption. It is assumed that you are familiar with operation of storage systems and major operating systems including UNIX and/or Linux. It is also assumed that you possess basic UNIX administration skills. The examples provided may require modifications before they could be run under your version of UNIX.

You are recommended to refer to installation and configuration guides of specific model of ATTO Celerity FC-HBA for the client platform you are going to test on. We assume you have basic knowledge of storage networking and information cryptography. For specific technical product information of Bloombase StoreSafe, please refer to our website at https://www.bloombase.com or Bloombase SupPortal https://supportal.bloombase.com.

Infrastructure

Setup

The validation testing environment is set up as in below figure:



Bloombase StoreSafe Storage Encryption Server

Server	HPE ProLiant DL20 Gen9 Server
Processors	1 x Intel Xeon E3-1240V5 series quad-core 8M cache 3.5 GHz
Memory	8 GB
Storage Encryption Software	Bloombase StoreSafe Software Appliance v3.4

Storage Client

Model	HPE ProLiant DL20 Gen9 Server
Operating System	Red Hat Enterprise Linux (RHEL) 7
Fiber Channel Host Bus Adapter	ATTO Celerity FC-162E 16G FC-HBA

Fiber Channel Storage Area Network (SAN)

SAN Storage	Hewlett Packard Enterprise (HPE) MSA P2000 SAN

SAN Switch

SAN Switch	Brocade 300 SAN Switch

Configuration Overview

ATTO Celerity Fiber Channel Host Bus Adapter

ATTO FC-HBA

- ATTO Celerity FC-162E 16G FC-HBA

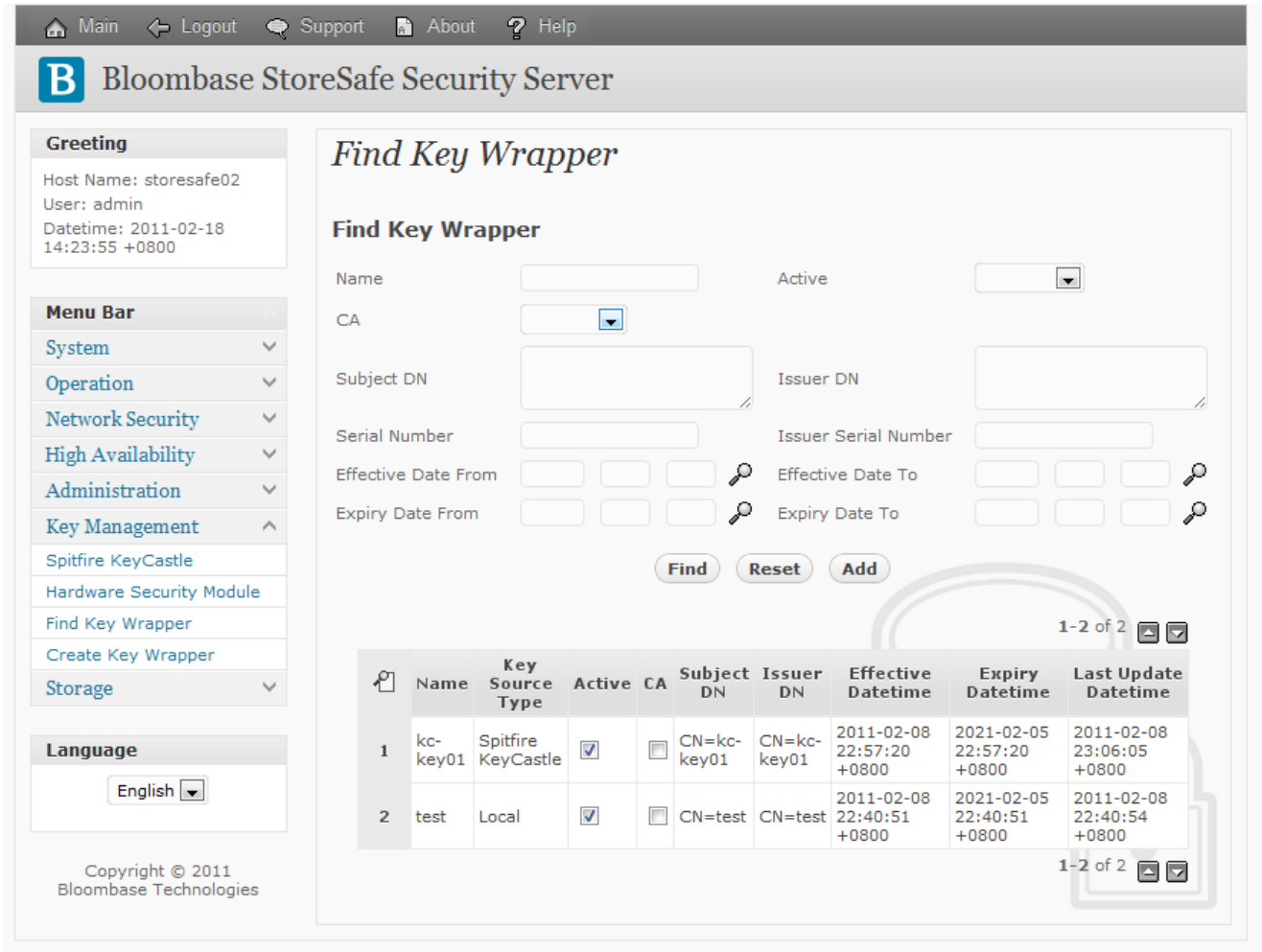
is installed at HPE ProLiant DL20 Server running Red Hat Enterprise Linux (RHEL) 7 as storage client to Bloombase StoreSafe.

Interconnect

COMMSCOPE SYSTIMAX OM3 3-meter 50/150 micron multi-mode fiber-optic cables with LC-LC terminations are used in this interoperability testing.

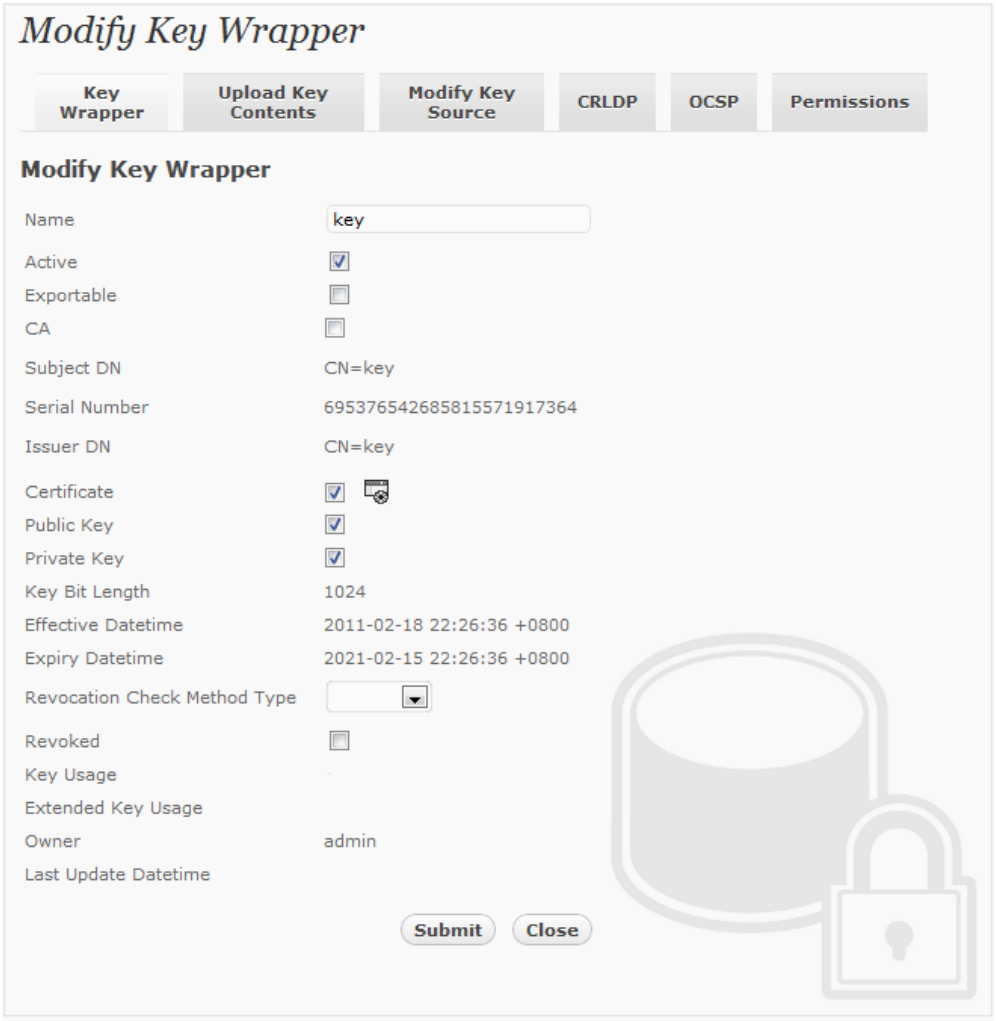
Bloombase StoreSafe Software Appliance

Bloombase StoreSafe supports file-based, share-based, block-based and object-based on-the-fly storage encryption. In this interoperability testing effort, SAN block-based encryption is provisioned to the client system with ATTO Celerity 16G FC-HBA installed.



Encryption Key Configuration

Generate encryption key with name `key01` in bundled Bloombase KeyCastle key life-cycle management tool

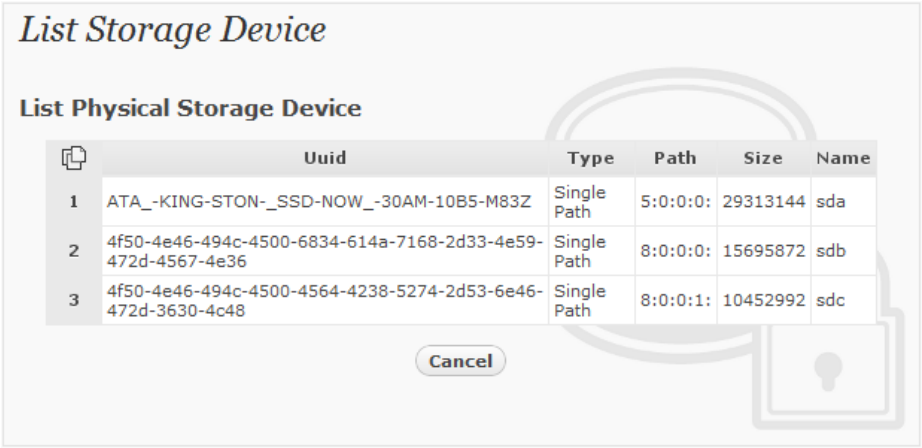


Virtual Storage Configuration

Bloombase StoreSafe block-based virtual storage and physical storage settings are configured as follows.

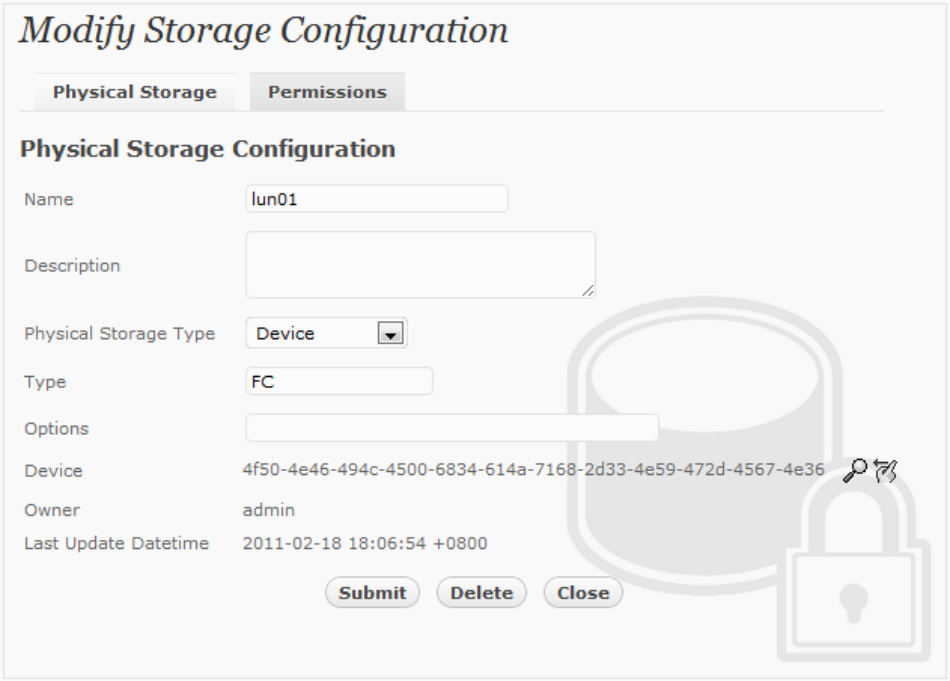
Physical Storage Target Configuration

Bloombase StoreSafe should be able to mount to LUNs of SAN storages and shows on 'List Storage Device' tool



Physical storage namely `lun01` is configured to map to the storage device to be encrypted by Bloombase StoreSafe

Bloombase StoreSafe secures SAN contents block by block. Volumes can be secured one by one by specific cryptographic cipher, bit length, encryption key, etc.

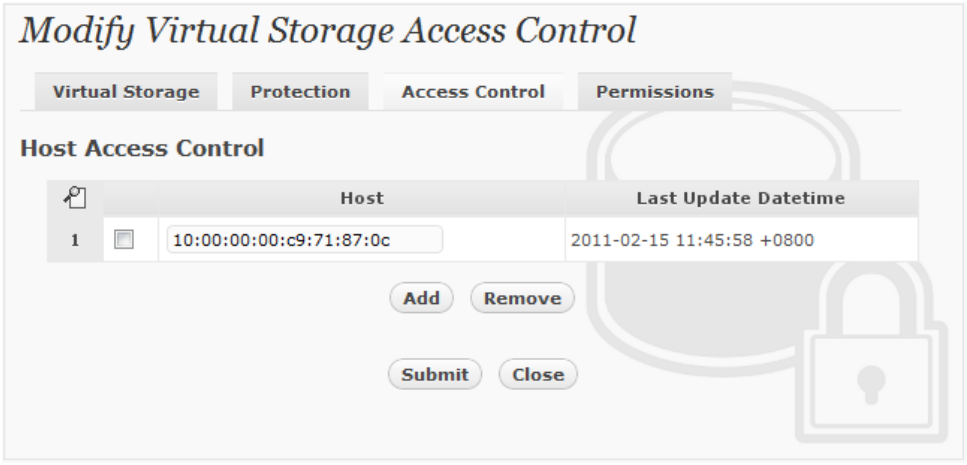


Encrypted Virtual Storage Provisioning

Virtual storage namely `lun01` of type `FC` is created to virtualize physical storage `lun01` for transparent encryption protection over FCP

Protection type is specified as `Privacy` and secure the FC SAN LUN using `AES-XTS 256`-bit encryption with encryption key `key01`.

Fiber channel protocol access control relies mainly on LUN masking for host based access control, the WWN of host HBA on 'Host' of 'Host Access Control' section is configured as follows:



Validation Tests

Test Scenarios

Validation Matrix

Validation tests span across models of ATTO Celerity 16G FC-HBAs, Bloombase StoreSafe, server hardware platform, and client host platform.

Test Condition	Candidate
Fiber Channel Host Bus Adapter	ATTO Celerity FC-162 FC-HBA
Storage System	Hewlett Packard Enterprise (HPE) MSA P2000 SAN
SAN Switch	Brocade 300 SAN Switch
Storage Encryption	Bloombase StoreSafe on x86-based HPE ProLiant DL20 Gen9 server
Client System	Red Hat Enterprise Linux (RHEL) 7 with ATTO Celerity FC-162 FC-HBA

Raw Storage Device Tests

The following tests are carried out at storage host operating system with ATTO Celerity FC-162-FC-HBAs to access encrypted Hewlett Packard Enterprise (HPE) MSA P2000 FC-SAN storage through Bloombase StoreSafe as a storage proxy.

Test	Description
Write disk with zeros	Write zeros into encrypted storage target via Bloombase StoreSafe, platform equivalence of UNIX's dd if=/dev/zero of=/dev/sda
Read disk to null device	Read from encrypted storage target via Bloombase StoreSafe, platform equivalence of UNIX's dd if=/dev/sda of=/dev/null
Wipe disk with random data	Write random zeros and ones into encrypted storage target, platform equivalence of UNIX's dd if=/dev/urandom of=/dev/sda

File System Tests

The following tests are carried out at storage host installed with ATTO Celerity FC-162 16G FC-HBA to access encrypted Hewlett Packard Enterprise (HPE) MSA P2000 FC-SAN storage via Bloombase StoreSafe as a bump-in-the-wire configuration delivering application-transparent encryption security.

- Ext3 for Linux

Test	Description
Directory creation	Platform equivalence of UNIX's mkdir
Directory rename	Platform equivalence of UNIX's mv
Directory removal	Platform equivalence of UNIX's rm
Directory move	Platform equivalence of UNIX's mv
File creation	Platform equivalence of UNIX's echo XXX ›
File rename	Platform equivalence of UNIX's mv
File removal	Platform equivalence of UNIX's rm
File move	Platform equivalence of UNIX's mv

File append – by character	Platform equivalence of UNIX's echo XXX ››
File append – by block	Platform equivalence of UNIX's echo XXX ››
File parameters inquiry	Platform equivalence of UNIX's ls *X
File permission configurations	• Platform equivalence of UNIX's chmod • Valid for UNIX-based storage host systems only (Linux, AIX, HPUX, Solaris)
Softlink/Symbolic link removal	• Platform equivalence of UNIX's rm • Valid for UNIX-based storage host systems only (Linux, AIX, HPUX, Solaris)
Softlink/Symbolic link move	• Platform equivalence of UNIX's mv • Valid for UNIX-based storage host systems only (Linux, AIX, HPUX, Solaris)

Result

Raw Storage Device Tests

Test	Validation Pass	Remarks
Write disk with zeros	✓	
Read disk to null device	✓	
Wipe disk with random data	✓	

File System Tests

Test	Validation Pass	Remarks
Directory creation	✓	
Directory rename	✓	
Directory removal	✓	
Directory move	✓	

File creation	✓
File rename	✓
File removal	✓
File move	✓
File append – by character	✓
File append – by block	✓
File parameters inquiry	✓
File permission configurations	✓
Softlink/Symbolic link removal	✓
Softlink/Symbolic link move	✓

Conclusion

ATTO Celerity 16G FC-HBAs

- ATTO Celerity FC-162 16G FC-HBAs

pass all Bloombase interopLab's interoperability tests with Bloombase StoreSafe storage encryption server

Bloombase Product	Storage System	SAN Switch	Fiber Channel Host Bus Adapter
Bloombase StoreSafe Software Appliance	Hewlett Packard Enterprise (HPE) MSA P2000 FC-SAN	Brocade 300 SAN Switch	ATTO Celerity FC-162 16G FC-HBA

Acknowledgement

We would like to thank ATTO Technology, Inc. for sponsoring and supporting the 16G FC-HBAs used in the tests of this technical report.

Disclaimer

The tests described in this paper were conducted in the Bloombase InteropLab. Bloombase has not tested this configuration with all the combinations of hardware and software options available. There may be significant differences in your configuration that will change the procedures necessary to accomplish the objectives outlined in this paper. If you find that any of these procedures do not work in your environment, please contact us immediately.

Technical Reference

1. Bloombase StoreSafe Technical Specifications, http://www.bloombase.com/content/8936QA88
2. Bloombase StoreSafe Compatibility Matrix, http://www.bloombase.com/content/e8Gzz281
3. dd for Unix, https://en.wikipedia.org/wiki/Dd_(Unix)
4. Oracle database server, https://www.oracle.com/database/index.html
5. Transaction Processing Performance Council, http://www.tpc.org/tpcc/
6. ATTO Celerity FC-162 16G FC-HBA, https://www.atto.com/products/fc-adapters/fibre-channel-hba/16gb/CTFC-162E-000
7. Hewlett Packard Enterprise (HPE) MSA P2000 FC-SAN, https://www.hpe.com/h20195/V2/Getdocument.aspx?docname=c04168365
8. Brocade 300 SAN Switch, http://www.brocade.com/en/products-services/storage-networking/fibre-channel/300-switch.html