interopLab

Interoperability of Bloombase StoreSafe Security Server and Emulex FC-HBAs for Transparent Storage Area Network (SAN) At-Rest Data Encryption

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BLOOMBASE®

Executive Summary

Emulex LightPulse family of enterprise grade fiber channel host bus adapters (FC-HBA) are validated by Bloombase's interopLab to run with Bloombase StoreSafe application transparent storage area network (SAN) encryption server. This document describes the steps carried out to test interoperability of Emulex LightPulse HBAs with Bloombase StoreSafe on SpitfireOS running on x86 and IA64 based appliances. Host systems on Microsoft Windows, Linux, Sun Solaris, IBM AIX and HP-UX are validated against Emulex powered Bloombase StoreSafe appliances with HP StorageWorks SAN storage sub-system and Brocade SAN switches.

Document No.

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Purpose and Scope

This document describes the steps necessary to integrate Emulex LightPulse HBAs with Bloombase StoreSafe enterprise storage security server to secure sensitive corporate business data in a storage area network (SAN). Specifically, we cover the following topics:

- Preparing Bloombase StoreSafe appliance(s) with Emulex LightPulse HBA(s)
- Preparing SAN storage sub-system
- Interoperability testing on host systems including Linux, Windows, IBM AIX, HP-UX and Oracle Sun Solaris

Assumptions

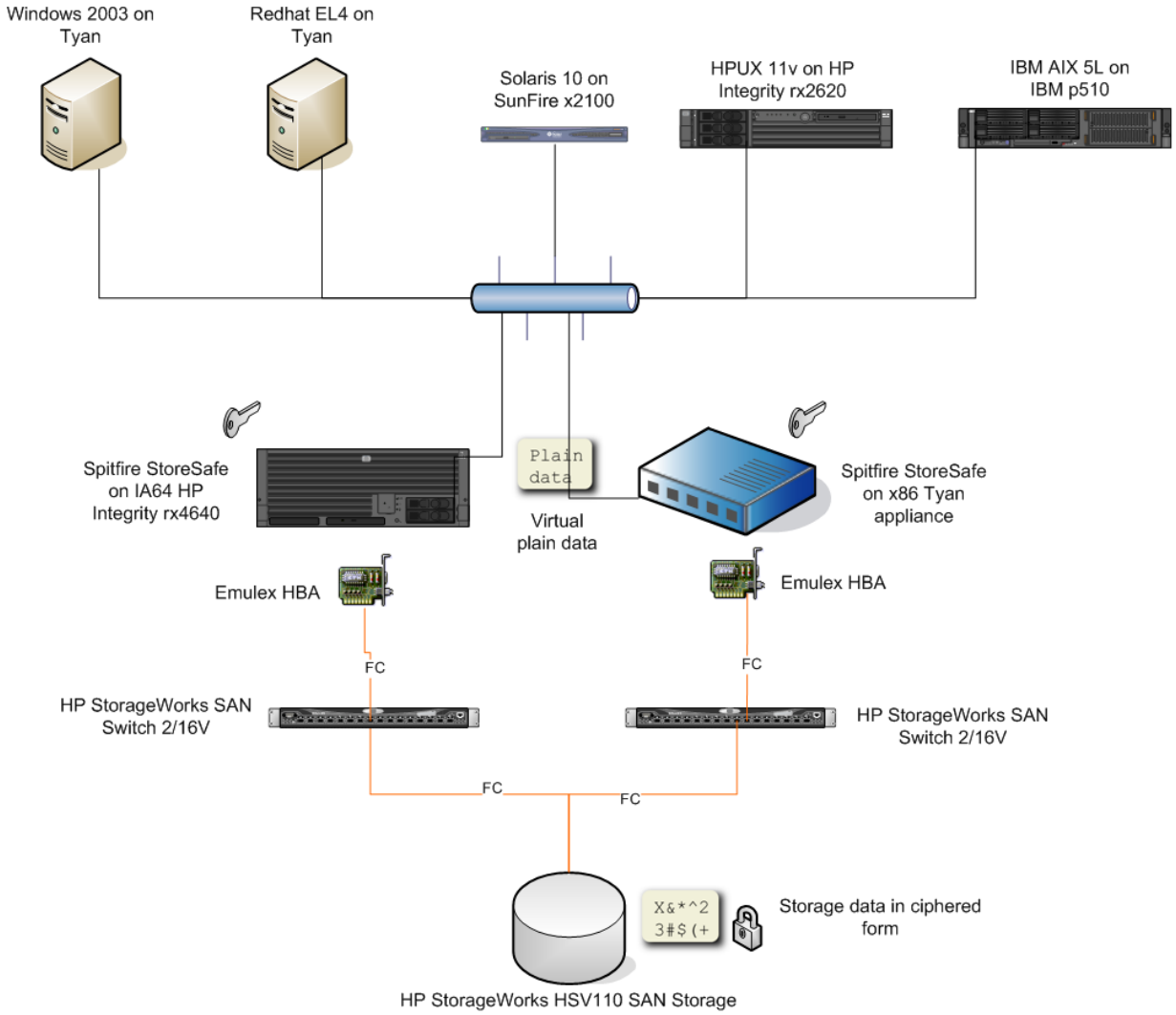
This document describes interoperability testing of Emulex powered Bloombase StoreSafe appliance on a SAN storage sub-system. Therefore, it is assumed that you are familiar with operation of storage systems and major operating systems including Linux, Windows, AIX, HPUX and Solaris. It is also assumed that you posssess basic UNIX administration skills. The examples provided may require modifications before they are run under your version of UNIX.

As Emulex LightPulse HBA(s) are hardware option to Bloombase StoreSafe storage encryption system, you are recommended to refer to installation and configuration guides of specific model of Emulex LightPulse HBA for the 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 http://www.bloombase.com or Bloombase SupPortal http://supportal.bloombase.com

Infrastructure

Setup

The validation testing environment is setup as in below figure



Bloombase StoreSafe Security Server Appliance

Server	HP Integrity rx4640	Tyan 2U server appliance prototype
Processors	2 x Intel Itanium-2 1.6 GHz	2 x AMD Opteron Dual core
Memory	4 GB	1 GB
Operating System	SpitfireOS for IA64 – Hardened and customized OS based on embeded Linux of kernel version 2.6.11	SpitfireOS for x86 – Hardened and customized OS based on embeded Linux of kernel version 2.6.11
Bloombase StoreSafe	• Bloombase StoreSafe for SAN – Block based storage encryptor • Bloombase StoreSafe for NAS – File based storage encryptor	• Bloombase StoreSafe for SAN – Block based storage encryptor • Bloombase StoreSafe for NAS – File based storage encryptor

Host Bus Adapters

Model	Emulex LP9002L	Emulex LP10000	Emulex LP11000	Emulex LPe12000	Emulex LPe16000
Speed	2 Gbps	2 Gbps	4 Gbps	8 Gbps	16 Gbps
Interface	PCI	PCI-X	PCI-X	PCIe	PCIe
Driver	8.0.16.27-1	8.0.16.27-1	8.0.16.27-1	8.0.16.27-1	8.0.16.27-1

SAN Switch

Model	2 x HP StorageWorks SAN Switch 2/16V
Link Speed	2 Gbps

Storage Area Network (SAN)

SAN Storage	HP StorageWorks EVA5000 / HSV110
Link Speed	2 Gbps
Cache Size	2 GB

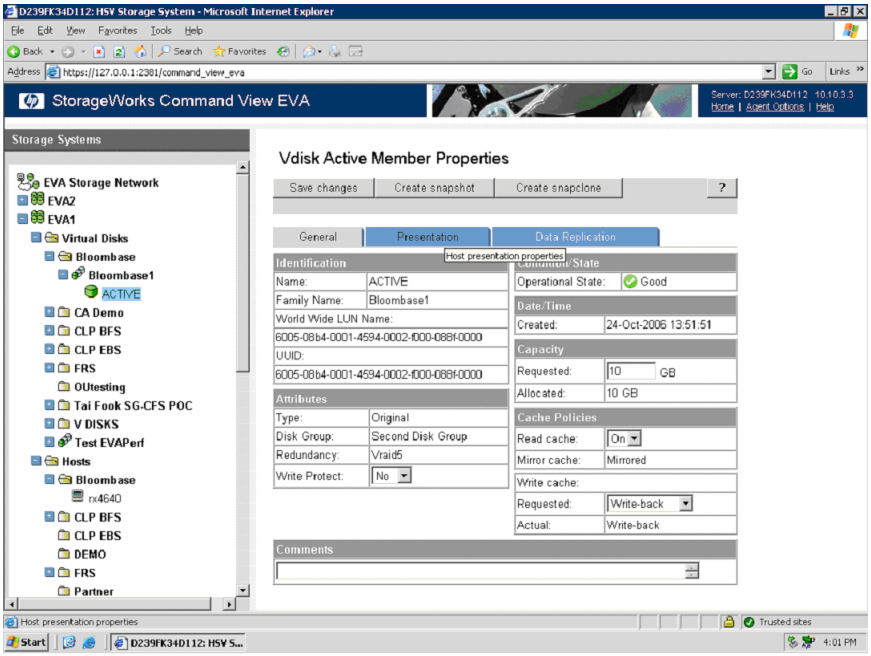
Storage Hosts

Model	Tyan 1U server appliance prototype	Tyan 1U server appliance prototype	HP Integrity rx2620	IBM System p5 510	Sun Microsystems x2100
Operating System	Windows 2003 Server	Redhat EL4	HPUX 11i v2	AIX 5L	Solaris 10
Network File Client	Built-in Windows Network Share	Built-in NFS client	Built-in NFS client	Built-in NFS client	Built-in NFS client
ISCSI Initiator	Microsoft iSCSI initiator version 2.02	Built-in iSCSI initiator	Built-in iSCSI initiator	Built-in iSCSI initiator	Built-in iSCSI initiator

Configuration Overview

Configuration Overview

SAN Storage



A virtual disk is created at SAN with below parameters

Name	Bloombase1

Capacity	10 GB
Redundancy	RAID5

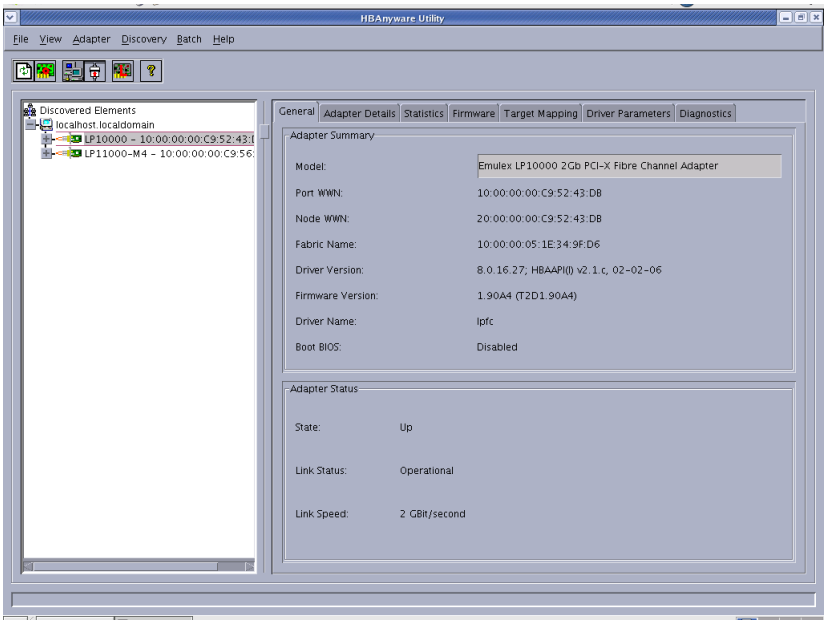
Emulex HBA

Emulex LightPulse HBAs

- Emulex LP9002L
- Emulex LP10000
- Emulex LP11000-M4
- Emulex LPe12000
- Emulex LPe16000

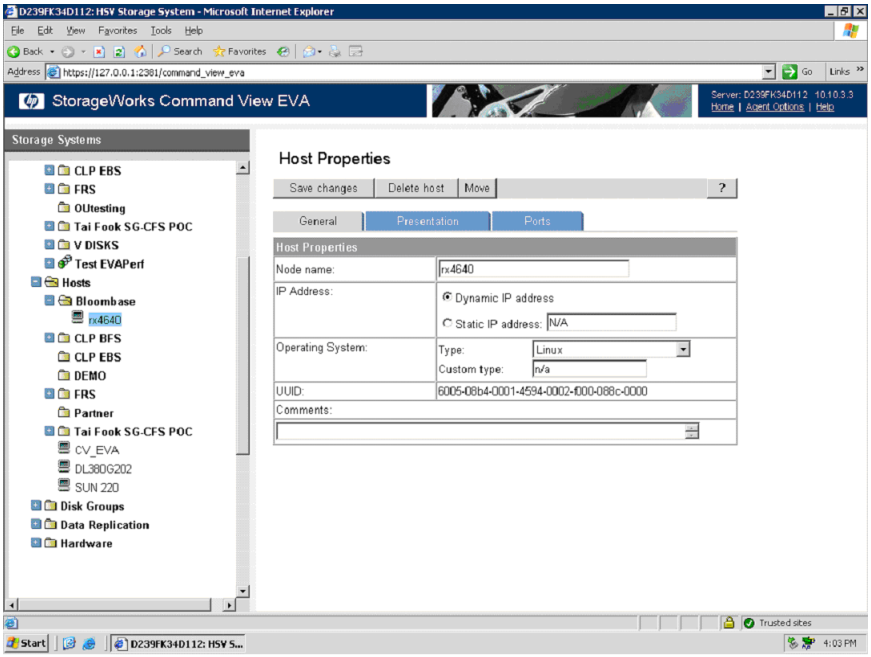
are installed onto both IA64-based and x86-based appliances operating on SpitfireOS.

Below shows how the HBAs are installed and configured via Emulex HBAnyware Utility.



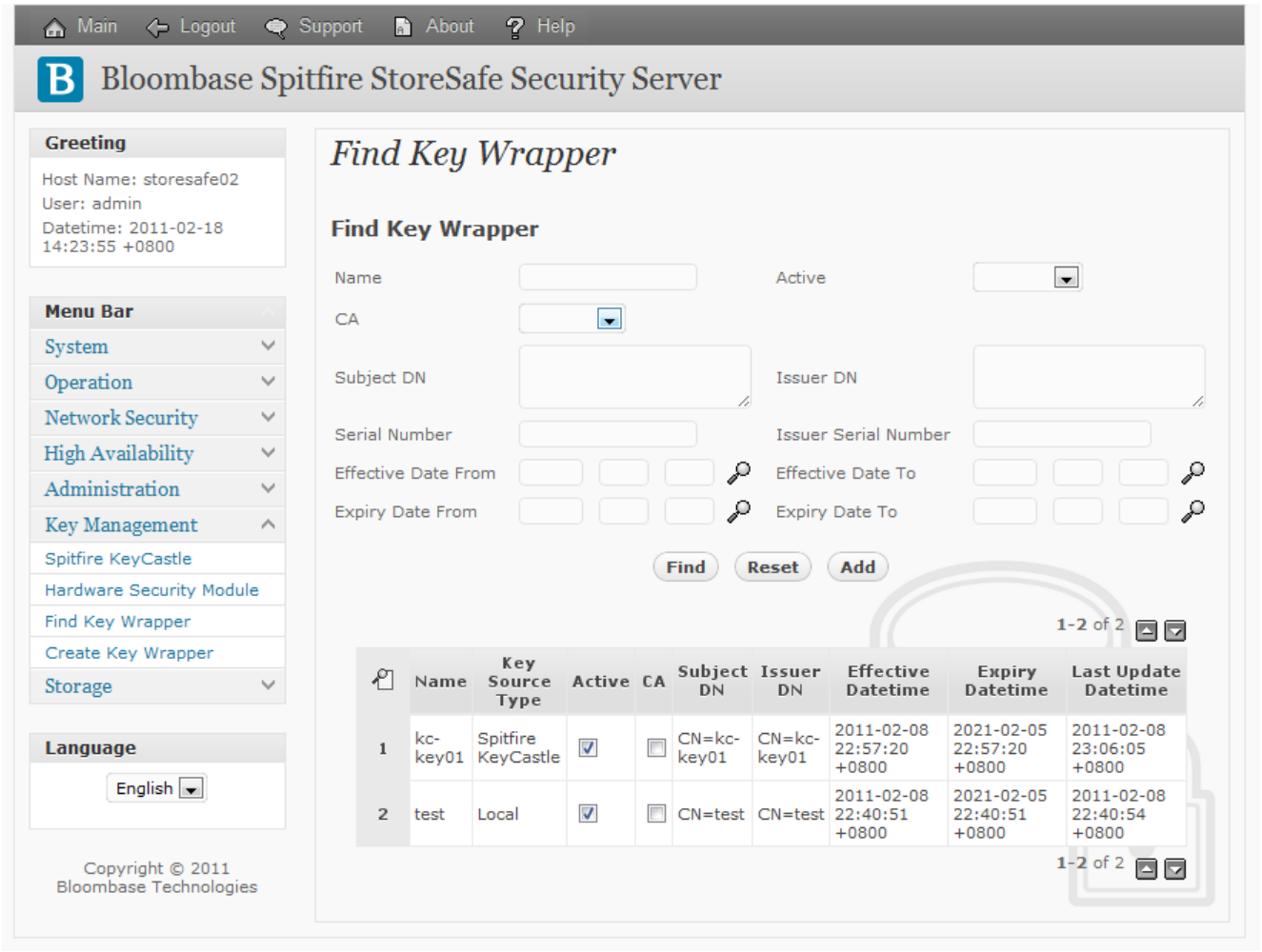
SAN Fabric

The virtual disks on SAN are presented to Bloombase StoreSafe appliance, namely rx4640, for access.



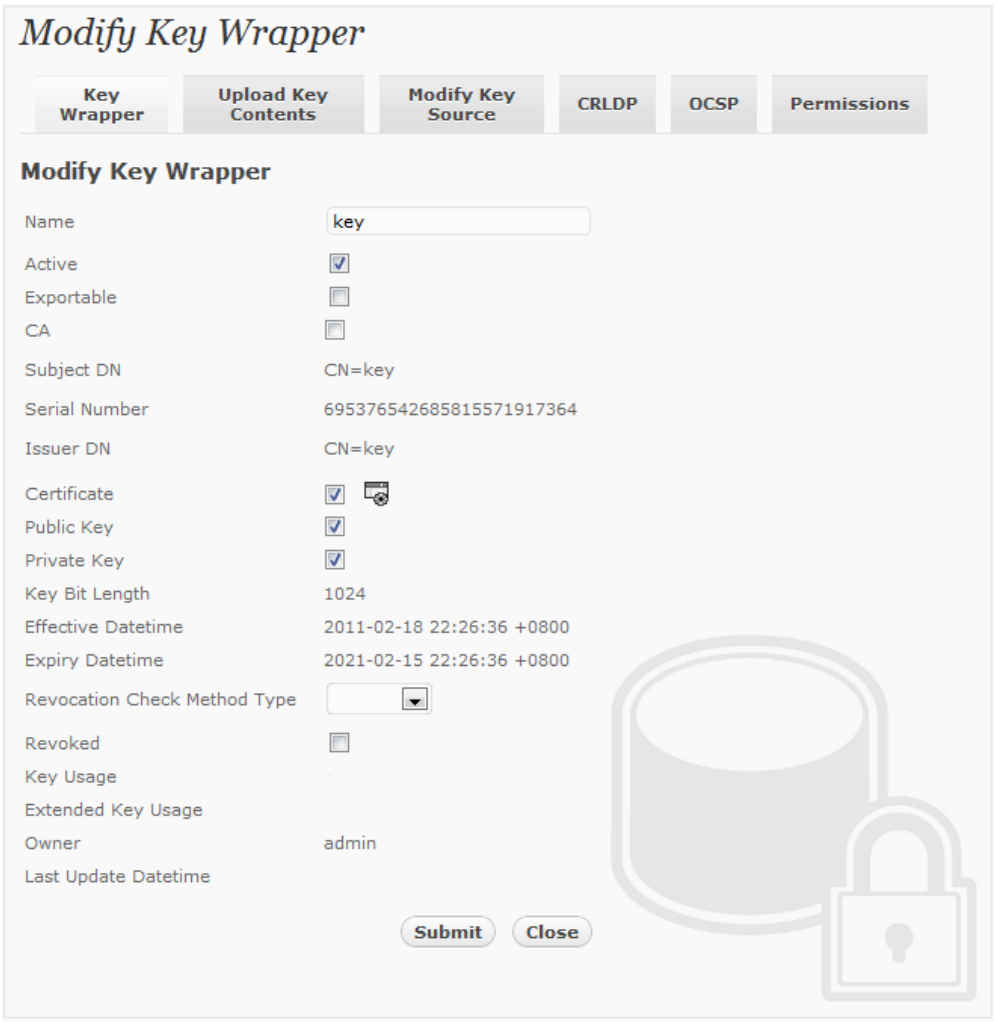
Bloombase StoreSafe Security Server

Bloombase StoreSafe supports both file-based and block-based on-the-fly storage encryption. In this interoperability test exercise, both file-based and blocked-based encryption modes are validated against Emulex LightPulse HBAs. Bloombase StoreSafe file and block-based virtual storage and physical storage settings are configured as followings.



Encryption Key Configuration

Generate encryption key with name ‘key’ in bundled Bloombase KeyCastle key life-cycle management tool

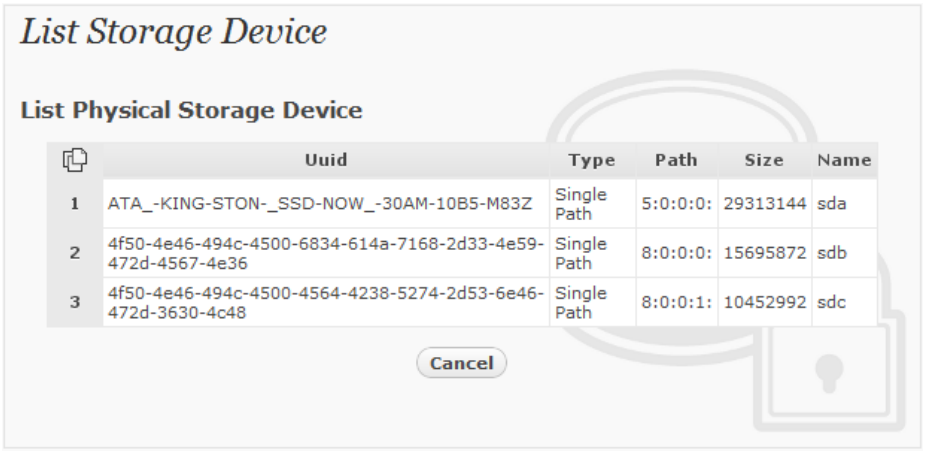


Virtual SAN Configuration

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

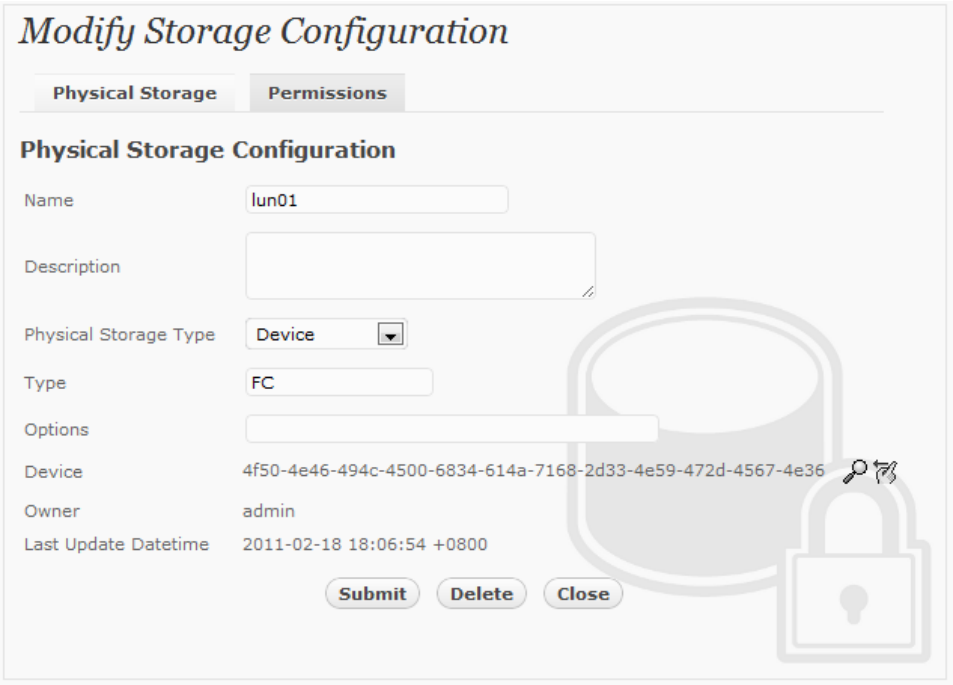
Physical Storage Target Configuration

After zoning and LUN mask are properly configured at SAN switches, Bloombase StoreSafe should be able to mount to LUNs of HP SAN storage and shows on 'List Storage Device' tool



Physical storage namely 'luno1' 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 specifying cryptographic cipher, bit length, encryption key, etc.

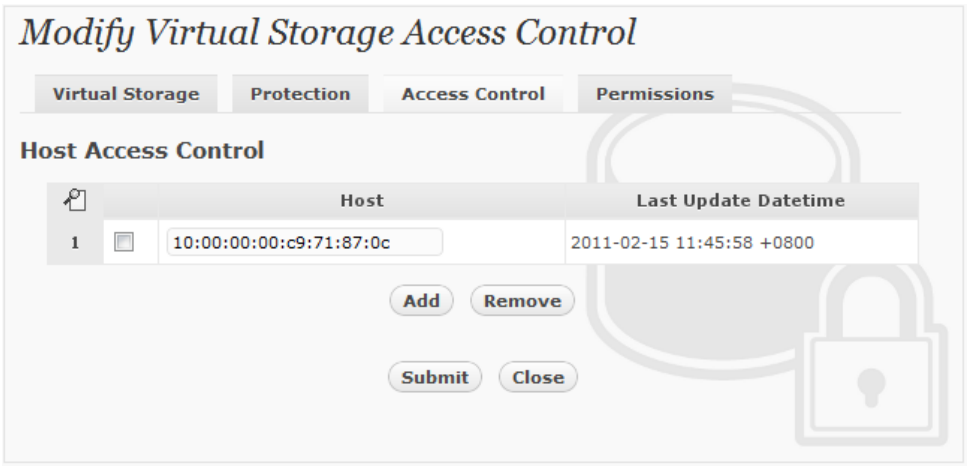


Encrypted Virtual Storage Provisioning

Virtual storage namely 'san01' 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 HP FC SAN LUN using AES-XTS 256-bit encryption with encryption key 'key'

Fiber channel protocol access control relies mainly on LUN mask 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 Emulex LightPulse HBAs, Bloombase StoreSafe model, appliance hardware platform, and host platform.

Test Condition	Candidate
HBA	• Emulex LP9002L • Emulex LP10000 • Emulex LP11000-M4 • Emulex LPe12000 • Emulex LPe16000
Bloombase StoreSafe	• Bloombase StoreSafe for SAN • Bloombase StoreSafe for NAS
Appliance	• IA64

Host	• x86 • Microsoft Windows Server 2003 • Redhat EL 4 • IBM AIX 5L • HPUX 11iv2 • Solaris 10

Filesystem Tests

The following tests are carried out at storage hosts to access encrypted SAN storage via Emulex powered Bloombase StoreSafe appliances

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)

Application Tests – Oracle Database

Test	Remarks
Database creation	Version equivalence of CREATE DATABASE
Schema creation	Version equivalence of CREATE TABLE
Database record insert	Version equivalence of INSERT INTO
Database record query	Version equivalence of SELECT * FROM
Database record update	Version equivalence of UPDATE
Database record delete	Version equivalence of DELETE FROM
Index creation	Version equivalence of CREATE INDEX
Tablespace alteration	Version equivalence of ALTER TABLESPACE
Redo log creation	Automated by Oracle data server, verify by examining Oracle system log
Redo log rotation	Automated by Oracle data server, verify by examining Oracle system log
Archive log creation	Automated by Oracle data server, verify by examining Oracle system log

Result

Filesystem 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	✓	Valid for UNIX-based storage host systems only (Linux, AIX, HPUX, Solaris)
Softlink/Symbolic link removal	✓	Valid for UNIX-based storage host systems only (Linux, AIX, HPUX, Solaris)
Softlink/Symbolic link move	✓	Valid for UNIX-based storage host systems only (Linux, AIX, HPUX, Solaris)

Application Tests – Oracle Database

Test	Validation Pass	Remarks
Database creation	✓	
Schema creation	✓	
Database record insert	✓	
Database record query	✓	
Database record update	✓	
Database record delete	✓	
Index creation	✓	
Tablespace alteration	✓	
Redo log creation	✓	
Redo log rotation	✓	
Archive log creation	✓	

Conclusion

Emulex LightPulse HBAs

- Emulex LP9002L
- Emulex LP10000
- Emulex LP11000-M4
- Emulex LPe12000
- Emulex LPe16000

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

Bloombase Product	Operating System	Emulex HBAs
Bloombase StoreSafe for NAS	Windows Server	LP9002L, LP10000, LP11000-M4, LPe12000, LPe16000
	Linux	LP9002L, LP10000, LP11000-M4, LPe12000, LPe16000
	Solaris	LP9002L, LP10000, LP11000-M4, LPe12000, LPe16000
	AIX	LP9002L, LP10000, LP11000-M4, LPe12000, LPe16000
	HPUX	LP9002L, LP10000, LP11000-M4, LPe12000, LPe16000

Bloombase StoreSafe for SAN	Windows Server	LP9002L, LP10000, LP11000-M4, LPe12000, LPe16000
	Linux	LP9002L, LP10000, LP11000-M4, LPe12000, LPe16000
	Solaris	LP9002L, LP10000, LP11000-M4, LPe12000, LPe16000
	AIX	LP9002L, LP10000, LP11000-M4, LPe12000, LPe16000
	HPUX	LP9002L, LP10000, LP11000-M4, LPe12000, LPe16000

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.

Acknowledgement

Bloombase interopLab would like to thank Emulex for sponsoring the HBAs used in this interoperability testing.

Technical Reference

1. Bloombase StoreSafe Security Server Technical Specifications, http://www.bloombase.com/content/8936QA88
2. Bloombase StoreSafe Security Server Compatibility Matrix, http://www.bloombase.com/content/e8Gzz281
3. Emulex FC HBAs, http://www.emulex.com/products/fibre-channel-hbas.html
4. Emulex 10G CNAs, http://www.emulex.com/products/10gbe-fcoe-cnas.html