interopLab

Interoperability of Bloombase StoreSafe Security Server and Brocade SAN Switch for Transparent Storage Area Network (SAN) Encryption

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Executive Summary

Brocade enterprise grade fiber channel storage area network (SAN) switches 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 Brocade SAN switches with Bloombase StoreSafe Storage Encryption Server on OS running on x86-based appliances. Host systems on Microsoft Windows, Linux, Solaris, IBM AIX, VMware and Citrix XenServer are validated against Bloombase StoreSafe Storage Encryption appliances securing Dell EMC SAN storage sub-system with Brocade SAN switches as storage interconnects.

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Purpose and Scope

This document describes the steps necessary to integrate Brocade SAN switches 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 Security appliance(s) with FC-HBA(s)
- Preparing SAN storage sub-system
- Interoperability testing on host systems including Red Hat Linux, Novell Linux, Microsoft Windows, IBM AIX, Solaris, VMware ESX and Citrix XenServer

Assumptions

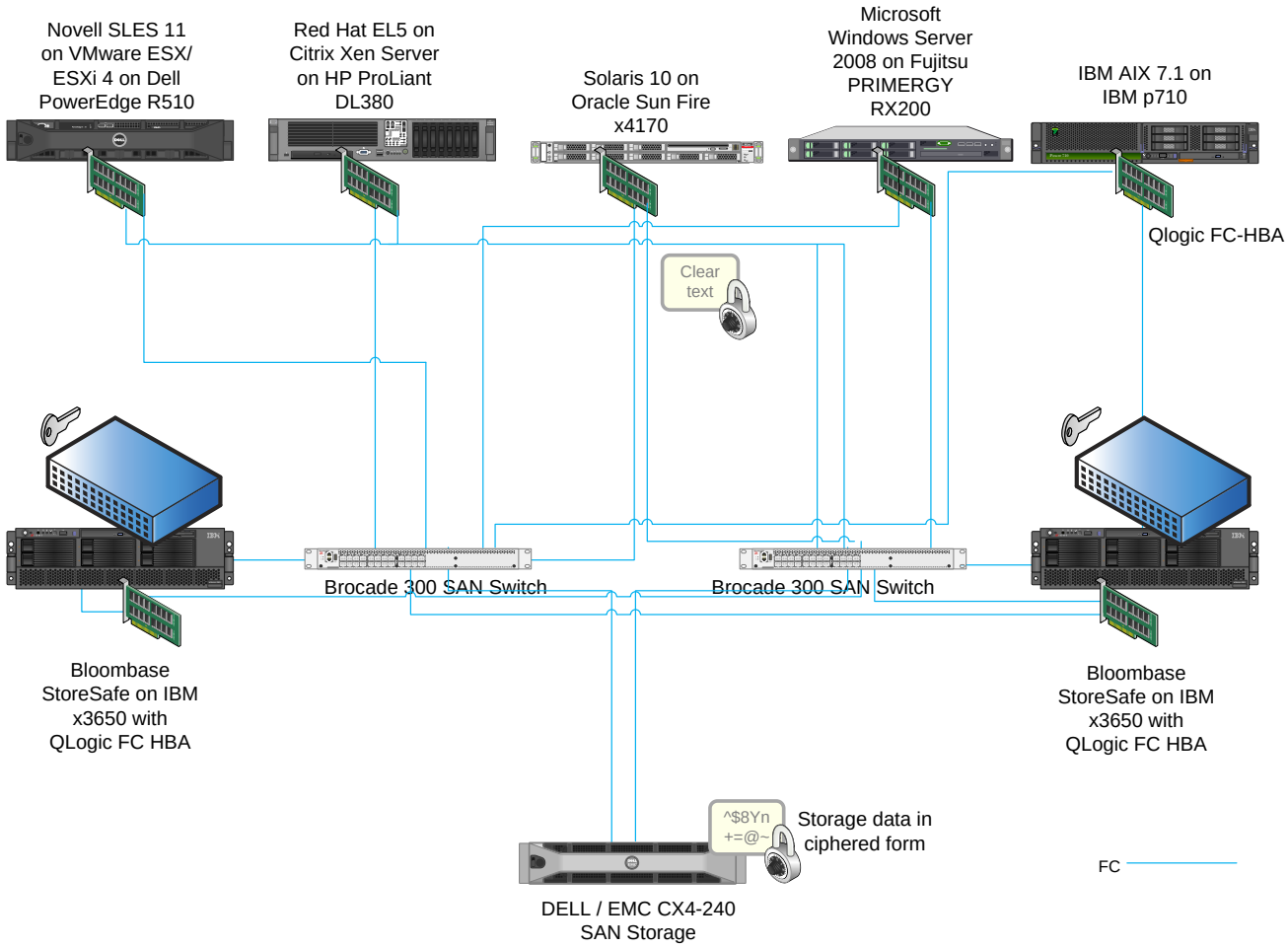
This document describes interoperability testing of Bloombase StoreSafe Security Server appliance on SAN storage sub-system with Brocade SAN switches as interconnects. Therefore, it is assumed that you are familiar with operation of storage systems and major operating systems including Linux, Windows,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

As Brocade SAN switches are hardware option to Bloombase StoreSafe storage encryption system, you are recommended to refer to installation and configuration guides of specific model of Brocade SAN switch for the deployment 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 Storage Encryption Server Appliance

Server	IBM eServer xSeries x3650 M3
Processors	2 x Intel Xeon 5600-series quad-core 3.6 GHz
Memory	8 GB
Operating System	Bloombase OS 5.5 – Hardened and customized OS based on Linux kernel version 2.6.26 64-bit
Storage Encryption Software	Bloombase StoreSafe Security Server

SAN Switch

Model	2 x Brocade 300 SAN Switch
Link Speed	8/4/2 Gbps auto-sensing

Fiber Channel Host Bus Adapters

Model	QLogic QLE2562	QLogic QLE2462	QLogic QLA2342
Speed	8 Gbps	4 Gbps	2 Gbps
Interface	PCI-E	PCI-E	PCI-X

Storage Area Network (SAN)

SAN Storage	Dell / EMC CX4-240 SAN Storage
Link Speed	8/4/2 Gbps auto-sensing

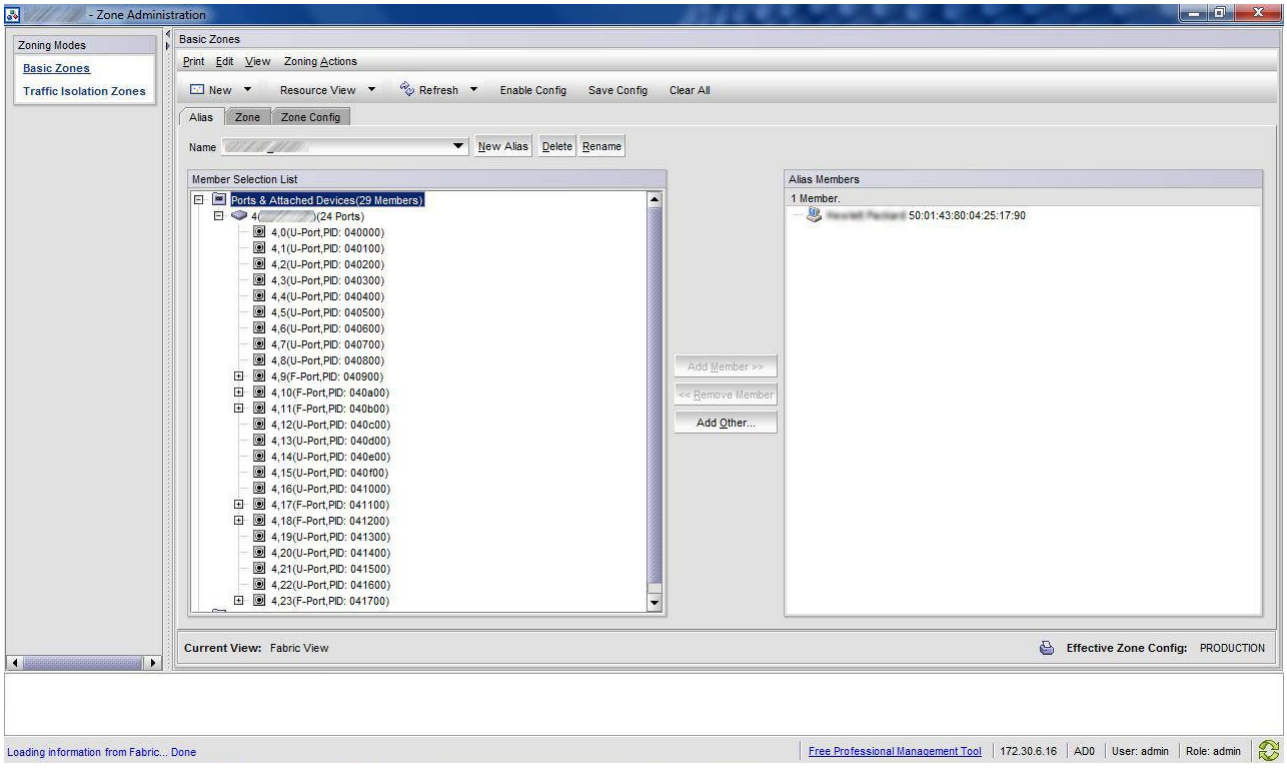
Storage Hosts

Model	Dell PowerEdge R510	HP ProLiant DL380	Oracle Sun Fire x4170	Fujitsu PRIMERGY RX200	IBM p710
Operating System	Novell SLES 11 on VMware ESX/ESXi 4	Red Hat EL5 on Citrix XenServer	Solaris 10	Microsoft Windows Server 2008	IBM AIX 7.1
Host Bus Adapter	QLogic QLE2562	QLogic QLE2562	QLogic QLE2562	QLogic QLE2562	QLogic QLE2562

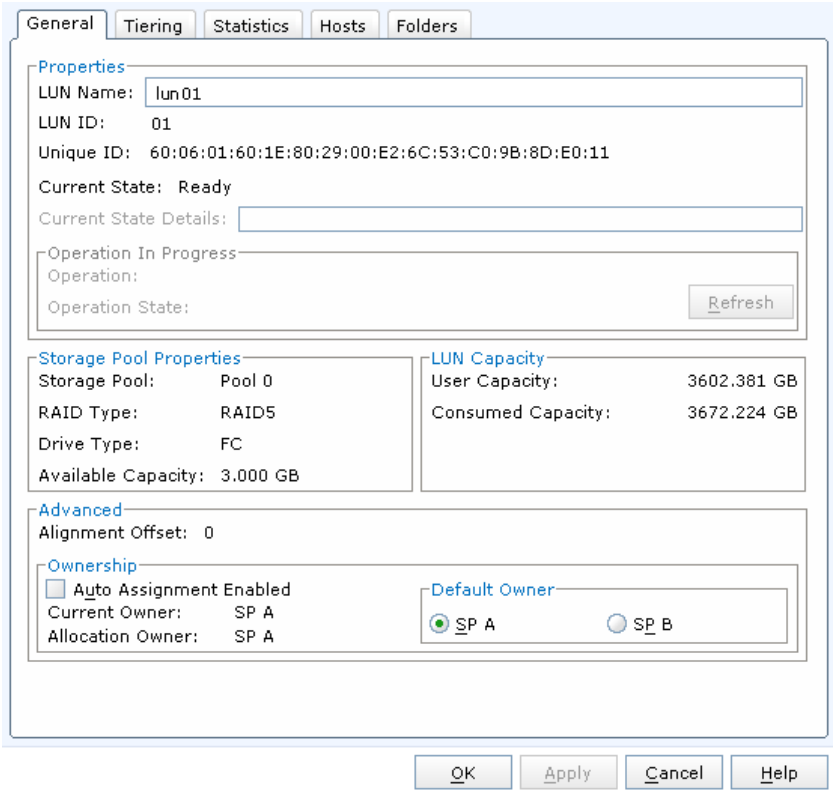
Configuration Overview

SAN Fabric

The virtual disks on Dell / EMC SAN are exposed to Bloombase StoreSafe appliance for access.



SAN Storage



A LUN is created at Dell / EMC CX4 SAN with below parameters

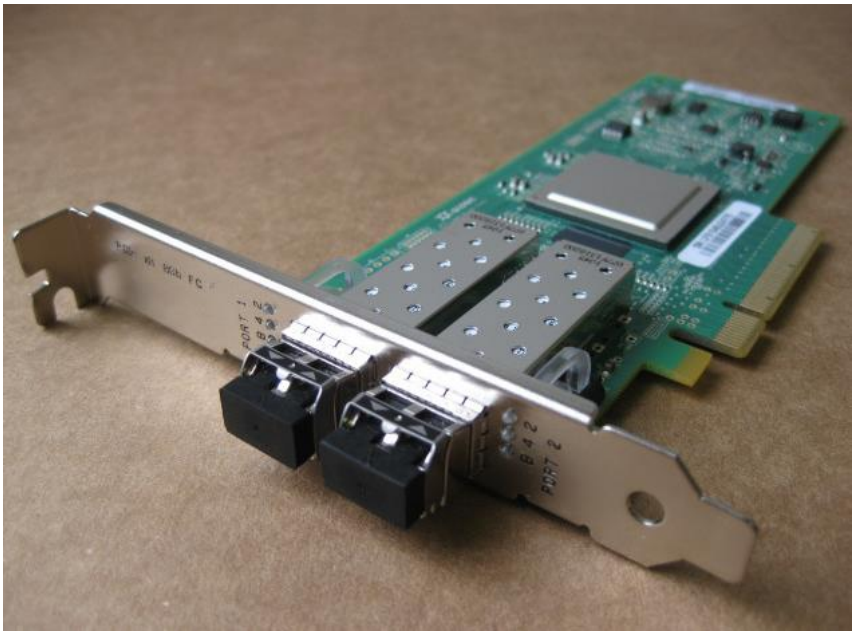
Name	luno1
Capacity	3 TB
Redundancy	RAID5

QLogic FC-HBA

QLogic FC-HBAs

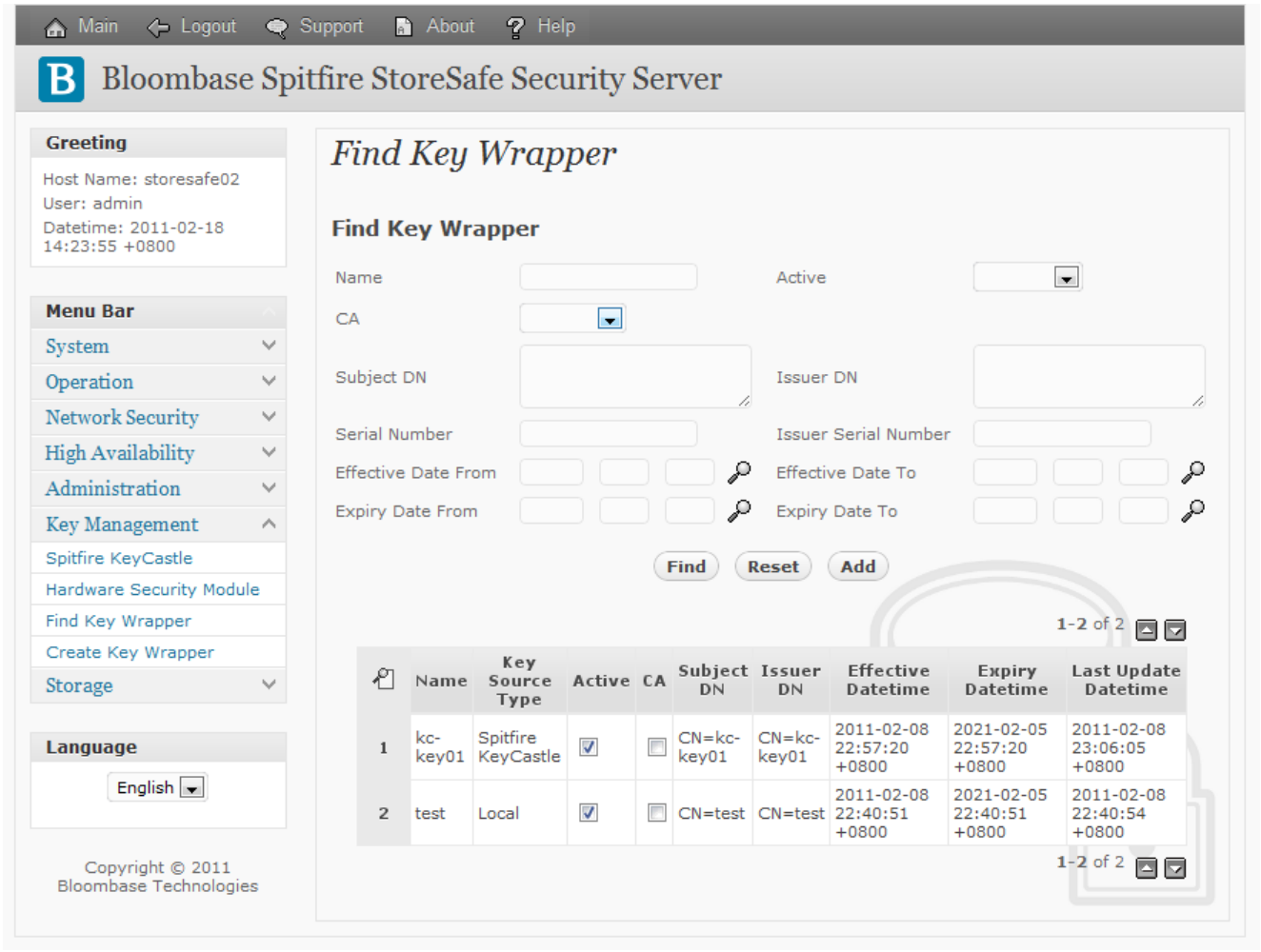
- QLogic QLE2562
- QLogic QLE2462
- QLogic QLA2362

are installed onto the x86-based appliance running Bloombase OS 5.5.



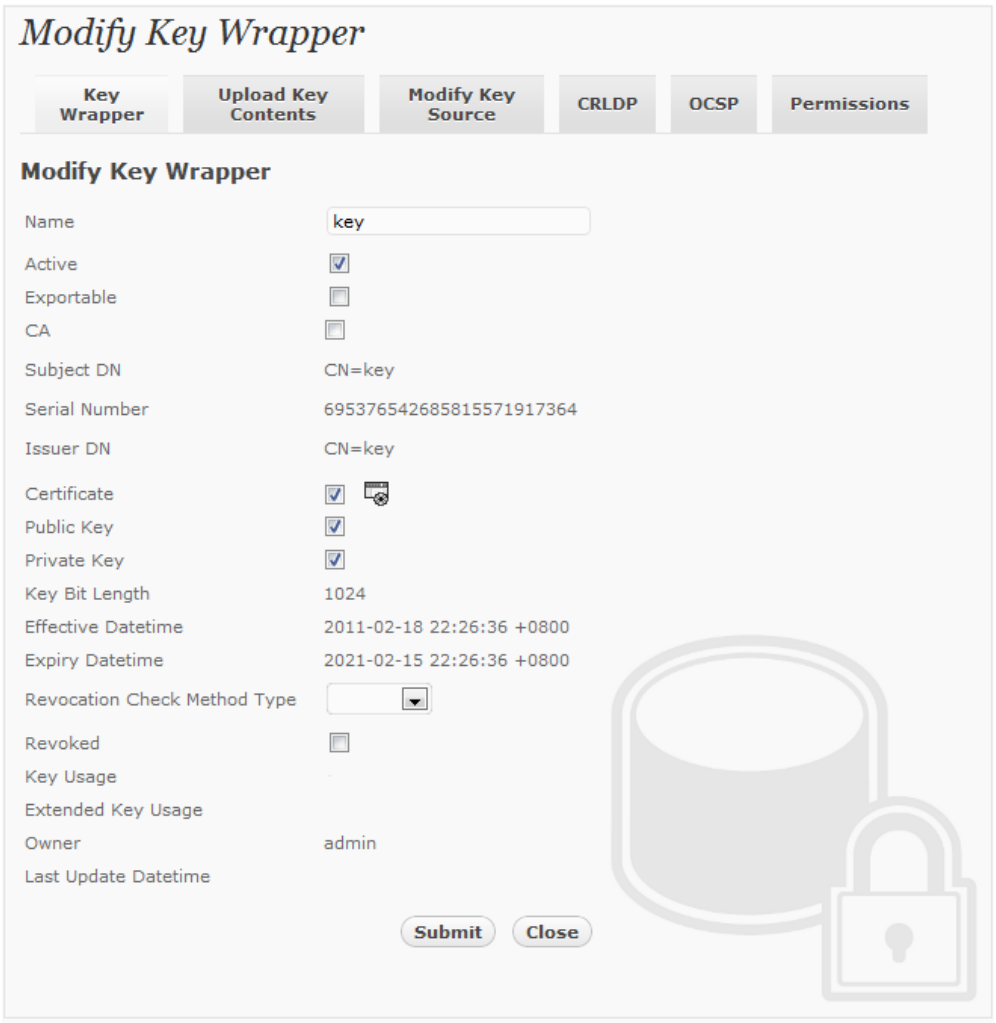
Bloombase StoreSafe Security Server

StoreSafe supports both file-based and block-based on-the-fly storage encryption. In this interoperability test exercise, fiber channel SAN block-based encryption is validated against Brocade SAN switches.



Encryption Key Configuration

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

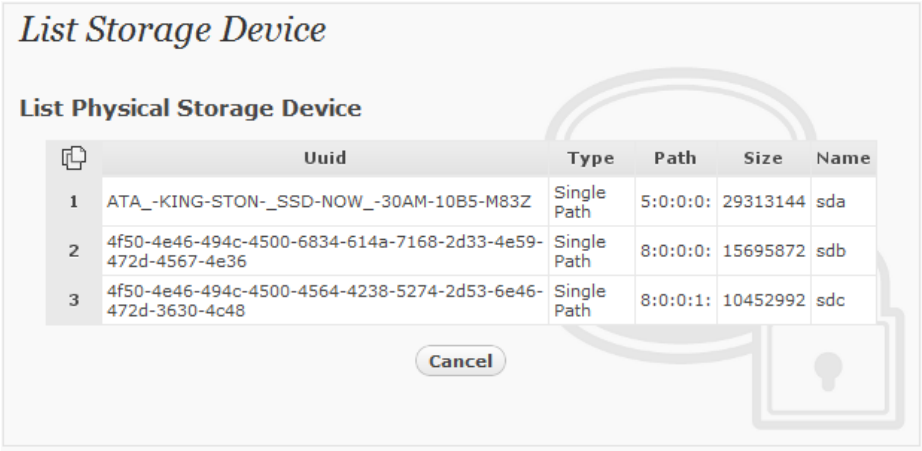


Virtual SAN Configuration

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

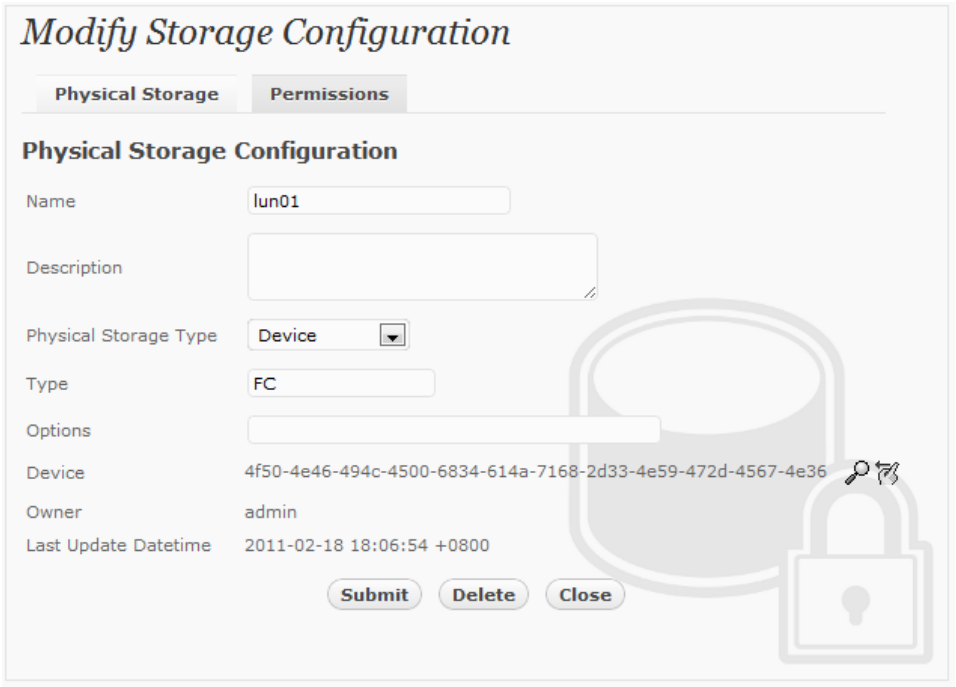
Physical Storage Target Configuration

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



Physical storage namely 'luno1' is configured to map to the storage device to be encrypted by 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.

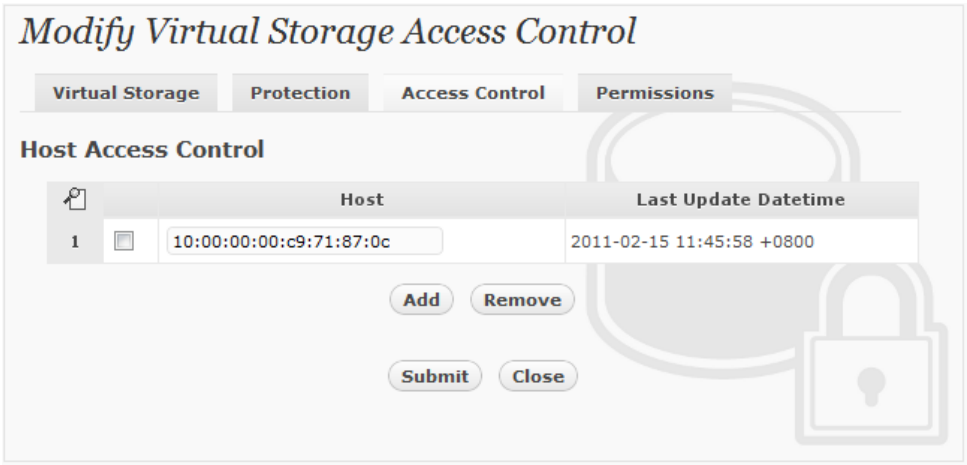


Encrypted Virtual Storage Provisioning

Virtual storage namely ‘sano1’ of type ‘FC’ is created to virtualize physical storage ‘luno1’ 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 '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 Brocade SAN switches, FC-HBAs, Bloombase StoreSafe Security Server, appliance hardware platform, and host platform.

Test Condition	Candidate
SAN Switch	• Brocade 300 SAN Switch
Storage System	• Dell / EMC CX4-240 SAN storage
HBA	• QLogic QLE2562 • QLogic QLE2462 • QLogic QLA2362

Storage Encryption Appliance	• Bloombase StoreSafe Security Server on x86-based IBM x3650
Host Server Hardware	• Dell PowerEdge R510
	• HP ProLiant DL-380
	• Oracle Sun Fire x4170
	• Fujitsu PRIMERGY RX200
	• IBM p710
Host Operating Systems	• Microsoft Windows Server 2008
	• Red Hat EL 5
	• Novel SELS
	• Solaris 10
	• IBM AIX
	• VMware ESX/ESXi (hypervisor)
	• Citrix XenServer (hypervisor)

Raw Storage Device Tests

The following tests are carried out at storage host operating systems to access encrypted SAN storage by Bloombase StoreSafe appliances via Brocade SAN switches

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 hosts to access encrypted SAN storage by Bloombase StoreSafe appliances via operating system file-systems with Brocade SAN switches as interconnects

- ext3 for Linux
- NTFS for Microsoft Windows
- JFS for IBM AIX
- UFS for Solaris

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

Softlink/Symbolic link move	• Valid for UNIX-based storage host systems only (Linux, AIX, HPUX, Solaris) • Platform equivalence of UNIX's mv • Valid for UNIX-based storage host systems only (Linux, AIX, HPUX, Solaris)

Application Tests – Oracle Database Server

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

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	✓	

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

Brocade SAN switches

- Brocade 300 SAN switch

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

Bloombase Product	Operating System	Brocade SAN Switches
Bloombase StoreSafe Security Server	Microsoft Windows Server 2008	Brocade 300 SAN switch
	Red Hat Enterprise Linux 5	Brocade 300 SAN switch
	Novel SELS 11	Brocade 300 SAN switch
	Solaris 10	Brocade 300 SAN switch
	IBM AIX 7	Brocade 300 SAN switch
	VMware ESX/ESXi 4 (hypervisor)	Brocade 300 SAN switch
	Citrix Xen Server (hypervisor)	Brocade 300 SAN switch

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 Microsoft Windows, http://software.intel.com/en-us/articles/dd-for-windows/
4. Oracle database server, https://www.oracle.com/database
5. Transaction Processing Performance Council, http://www.tpc.org/tpcc/
6. Brocade 300 SAN Switch, http://www.brocade.com/products/all/switches/product-details/300-switch/index.page