interopLab

Interoperability of Bloombase StoreSafe Security Server, QLogic FC-HBAs and QLogic SAN Switch for Transparent Storage Area Network (SAN) Encryption

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BLOOMBASE® NET TRACK

Executive Summary

QLogic enterprise grade fiber channel host bus adapters (FC-HBA) and 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 QLogic Fiber Channel HBAs and SAN switches with Bloombase StoreSafe Storage Encryption Server on SpitfireOS running on x86-based appliances. Host systems on Microsoft Windows, Linux, Solaris, IBM AIX, VMware and Citrix XenServer are validated against QLogic-powered Bloombase StoreSafe Storage Encryption appliances with Dell EMC SAN storage sub-system. Host software applications including Oracle Database and Symantec Veritas Storage Foundation for Oracle Real Application Cluster (SFRAC) are also validated.

Document No.

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Purpose and Scope

This document describes the steps necessary to integrate QLogic FC-HBAs and 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 QLogic FC-HBA(s)
- Preparing QLogic Sanbox 5800V Fabric SAN Switch
- 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
- Interoperability testing with Oracle Database and Symantec Storage Foundation for Real Application Cluster (SF-RAC)

Assumptions

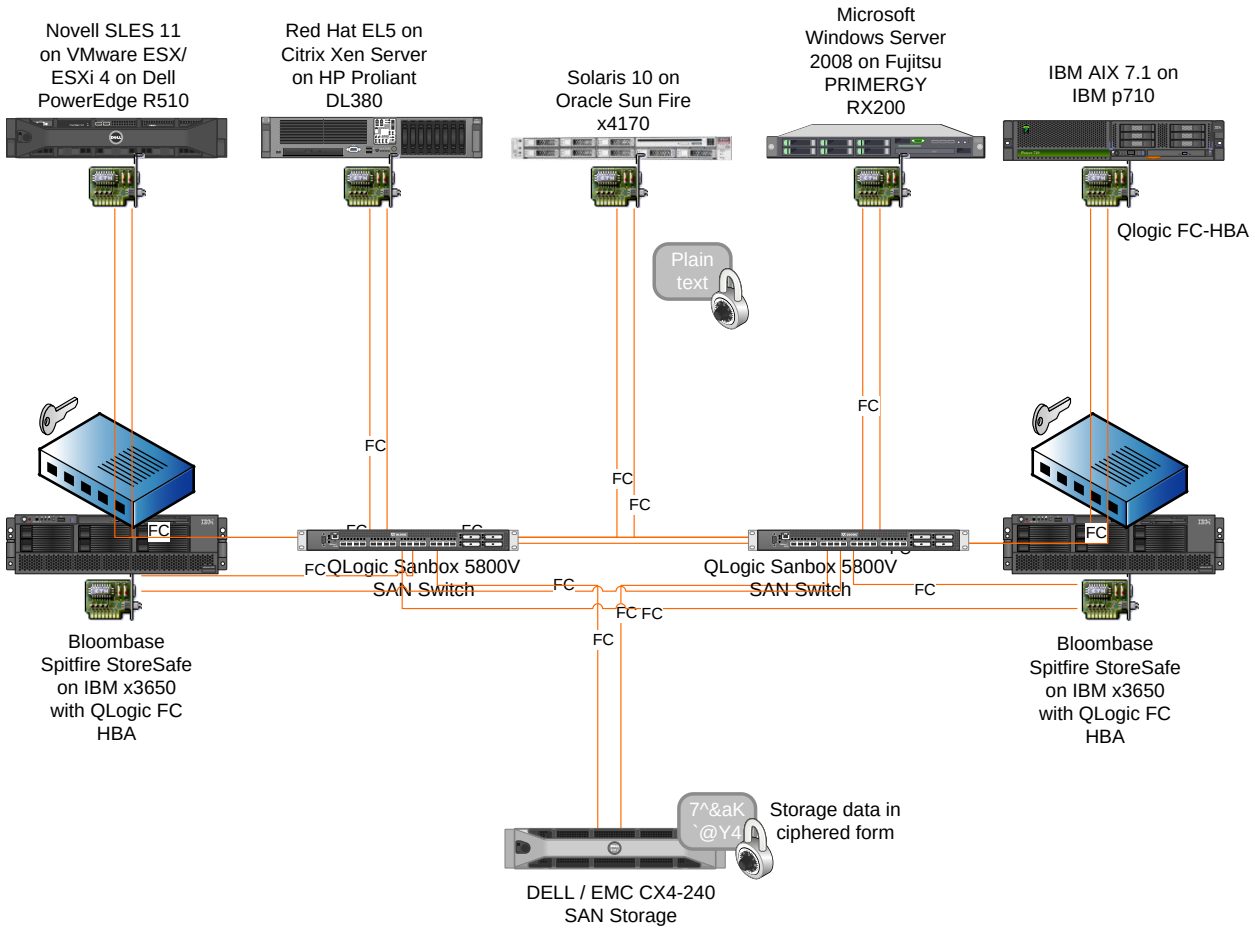
This document describes interoperability testing of QLogic powered Bloombase StoreSafe Security Server appliance on SAN storage sub-system. Therefore, it is assumed that you are familiar with operation of storage systems and major operating systems including Linux, Windows, AIX, HPUX and Solaris. It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

As QLogic FC-HBA(s) and 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 QLogic FC-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 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 SpitfireOS 5.5 – Hardened and customized OS based on Linux kernel version 2.6.26 64-bit
Storage Encryption Software	Bloombase StoreSafe Security Server

Fiber Channel Host Bus Adapters

Model	QLogic QLE2672	QLogic QLE2562	QLogic QLE2462	QLogic QLA2342
Speed	16 Gbps	8 Gbps	4 Gbps	2 Gbps
Interface	PCI-E	PCI-E	PCI-E	PCI-X

SAN Switch

Model	2 x QLogic Sanbox 5800V Fabric SAN Switch
Link Speed	8/4/2 Gbps auto-sensing

Storage Area Network (SAN)

IP 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

Optical Fiber Cables

Model	CommScope Systimax OM3 LC-LC patch cords	Corning OM3 LC-LC patch cords

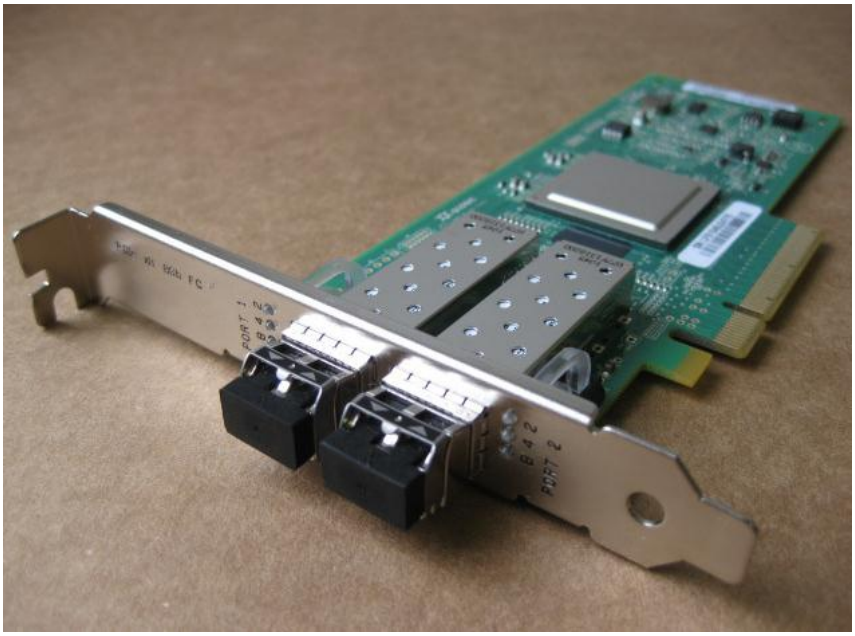
Configuration Overview

QLogic FC-HBA

QLogic FC-HBAs

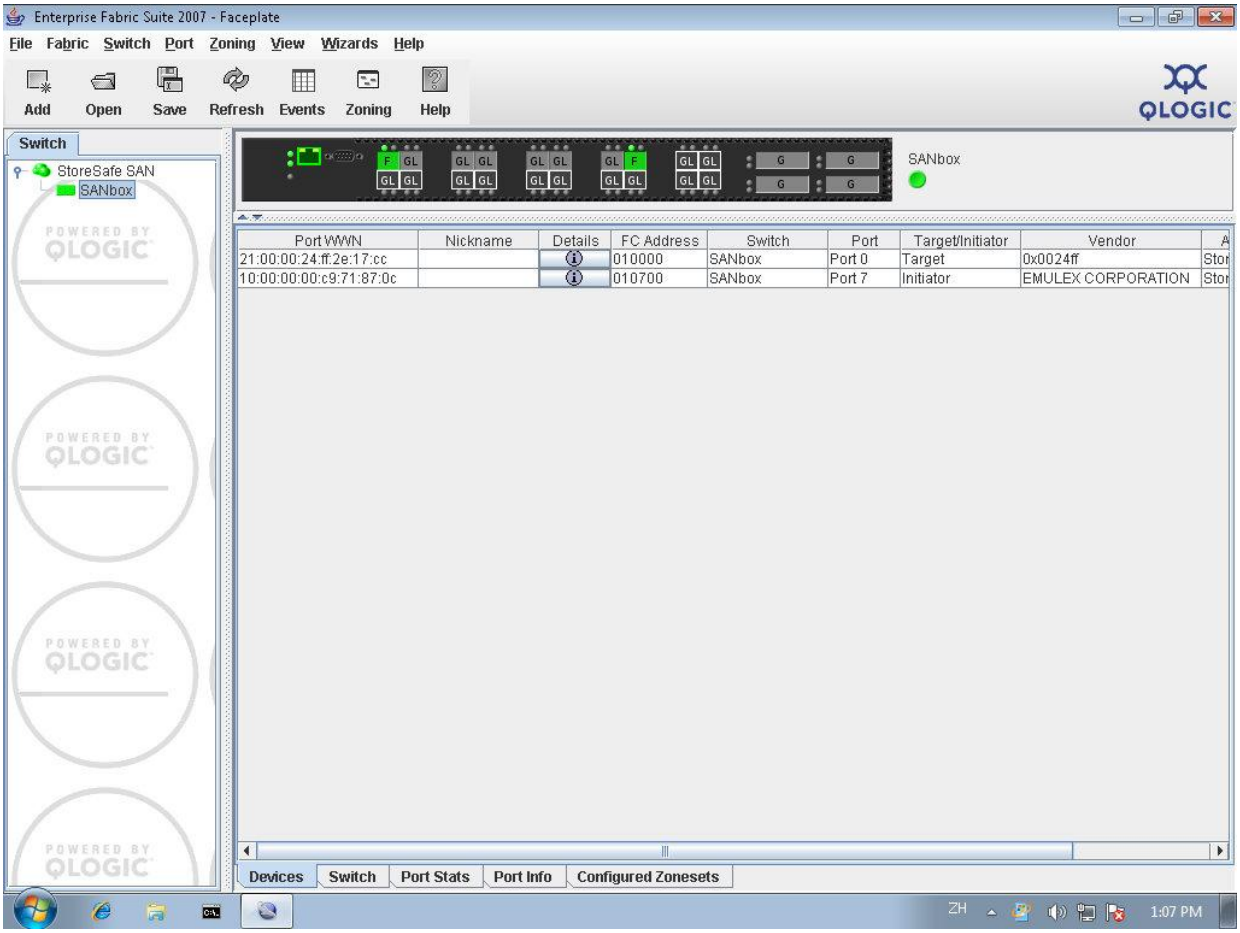
- QLogic QLE2672
- QLogic QLE2562
- QLogic QLE2462
- QLogic QLA2362

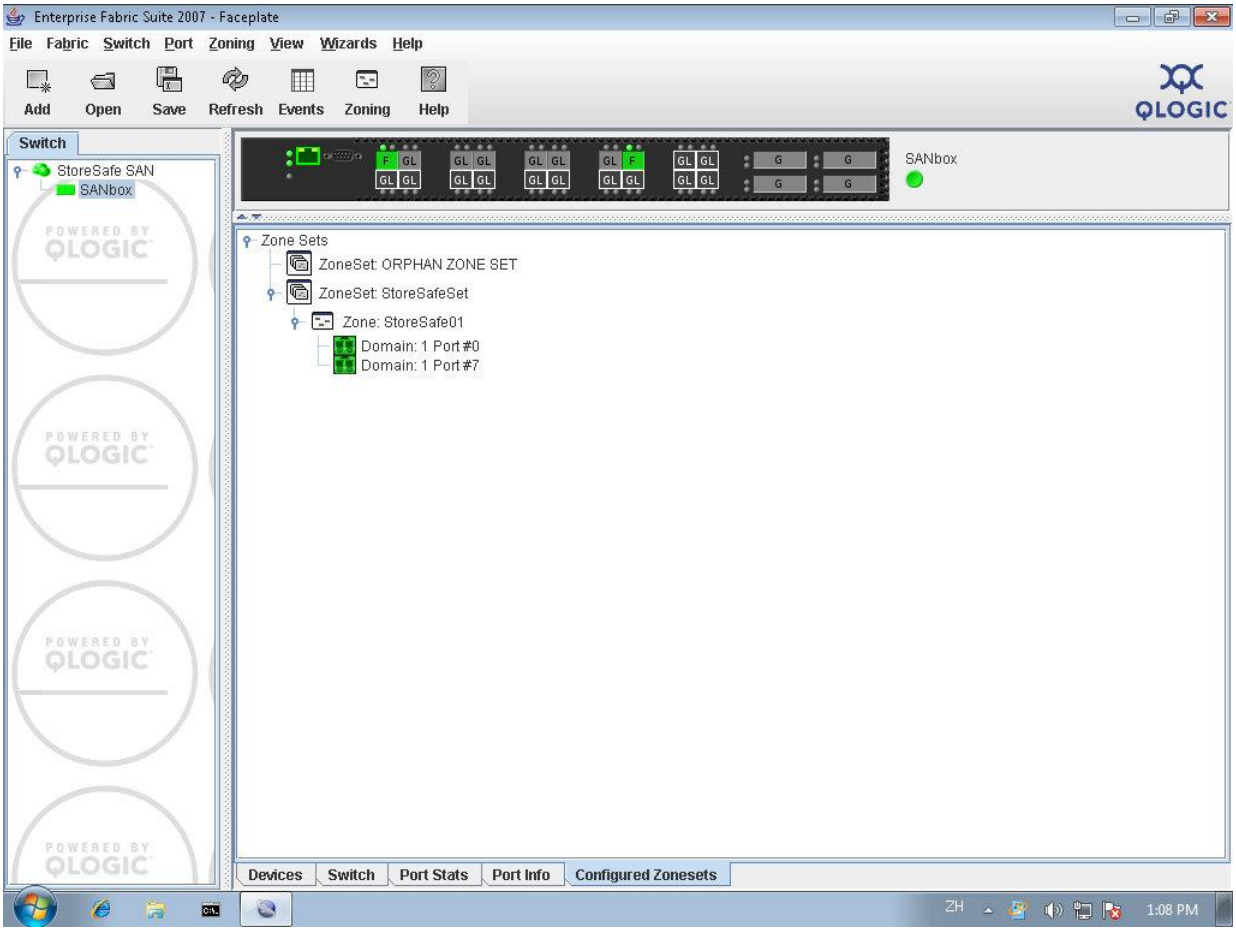
are installed onto the x86-based appliance running Bloombase SpitfireOS 5.5.



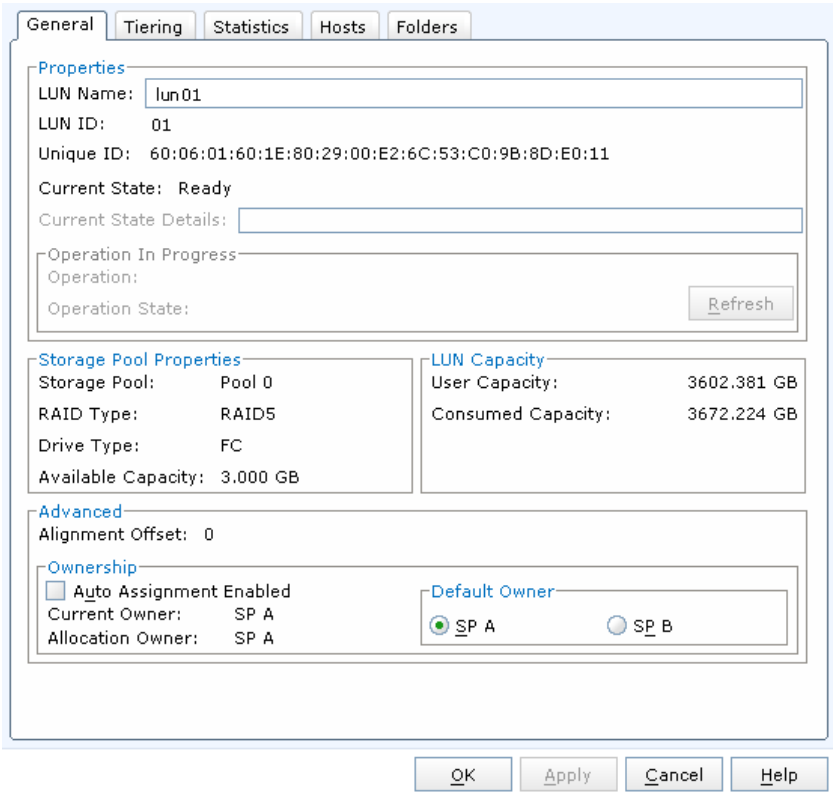
SAN Fabric

The virtual disks on Dell / EMC SAN are exposed to Bloombase StoreSafe appliance for access via QLogic Sanbox 5800V Fabric SAN Switch.





SAN Storage



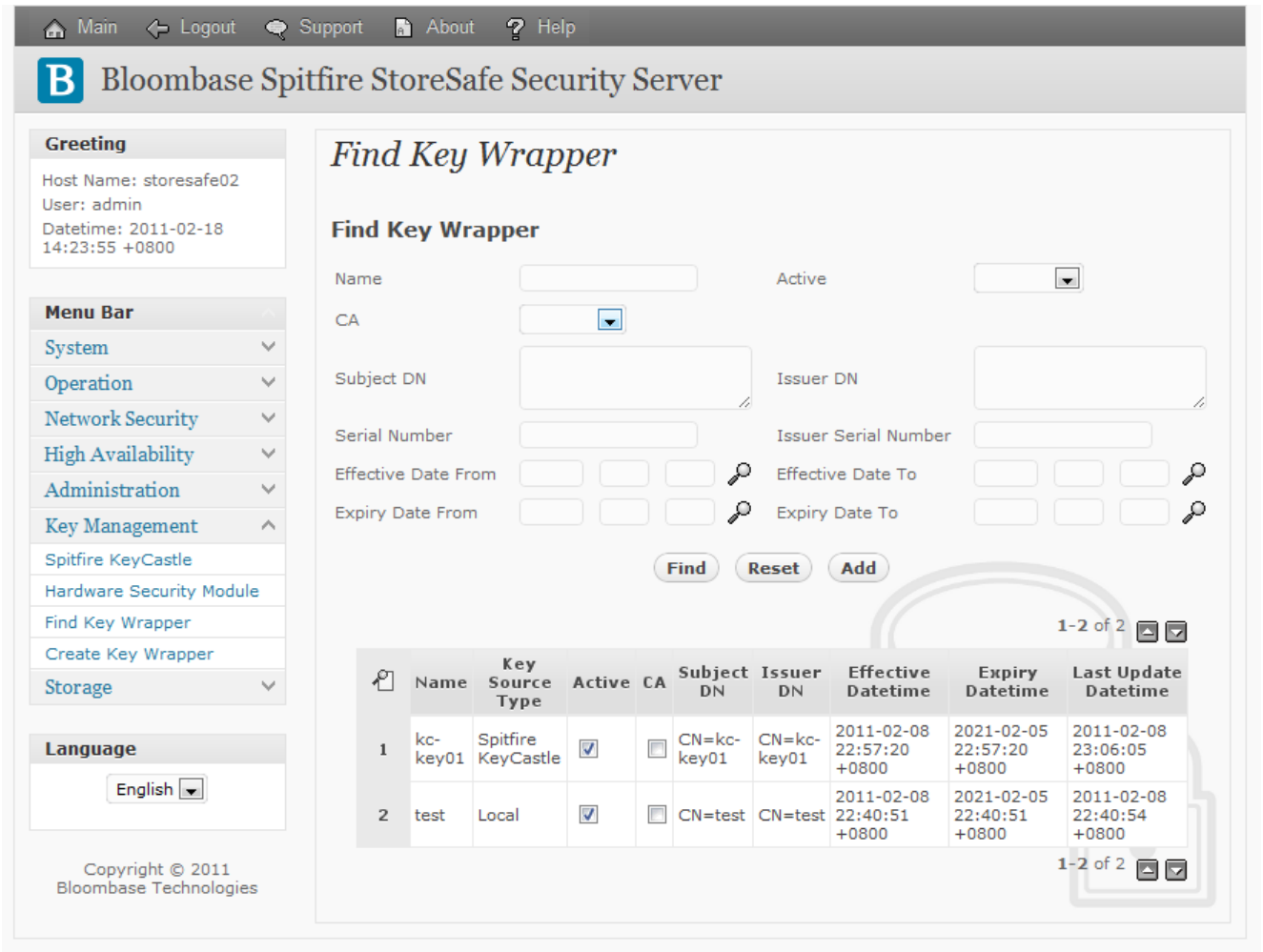
A LUN is created at Dell / EMC CX4 SAN with below parameters

Name	luno1
Capacity	3 TB
Redundancy	RAID5

Optical Fiber Cables

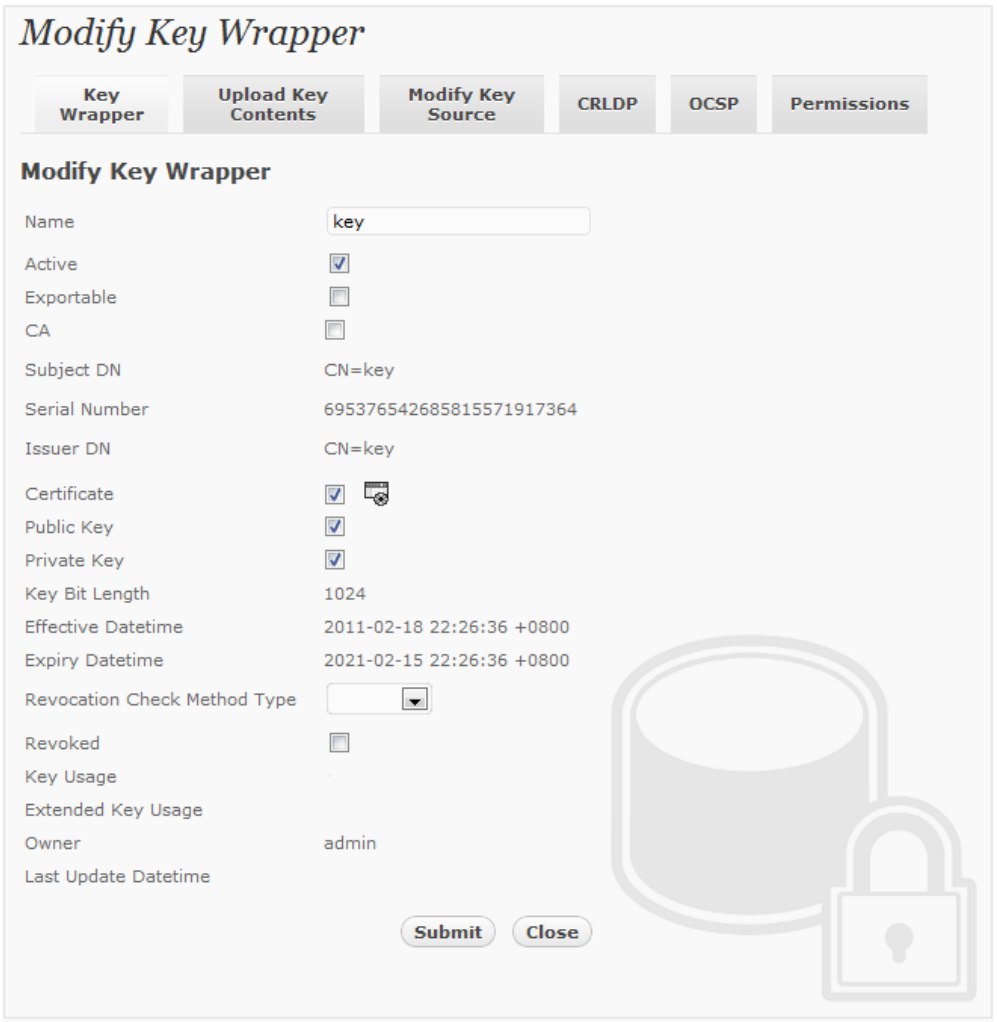
Bloombase StoreSafe Security Server

Bloombase 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 QLogic FC-HBAs.



Encryption Key Configuration

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

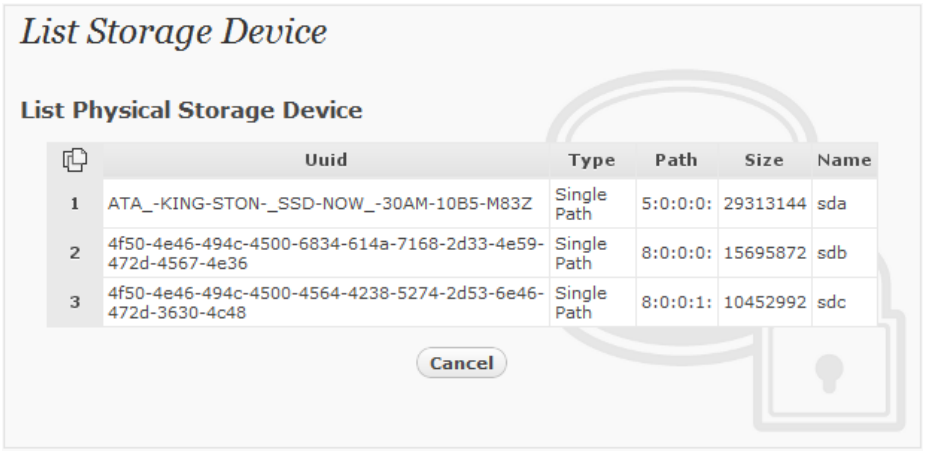


Virtual SAN Configuration

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

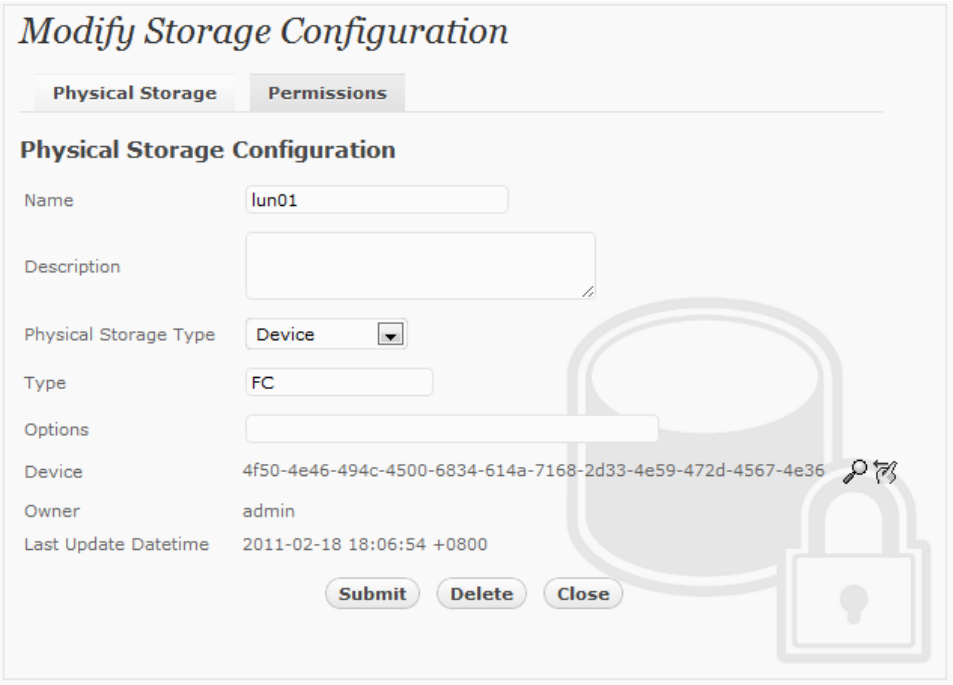
Physical Storage Target Configuration

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 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.

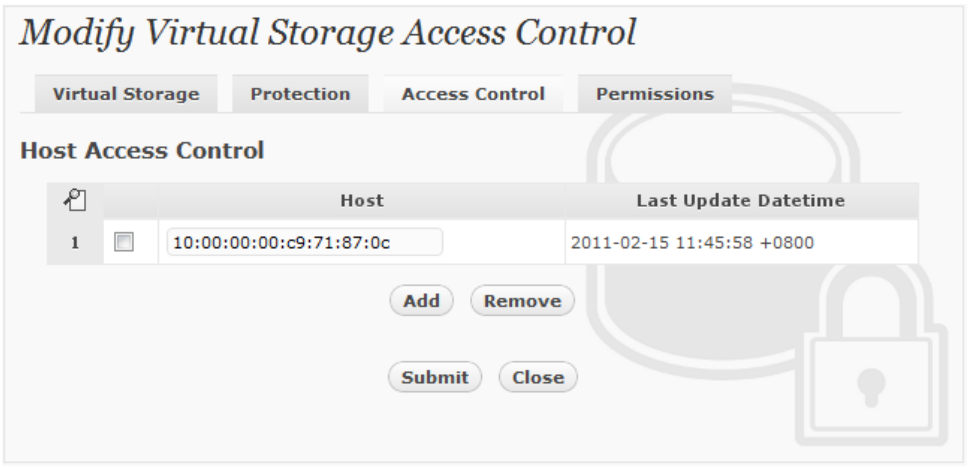


Encrypted Virtual Storage Provisioning

Virtual storage namely '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 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 QLogic FC-HBAs and SAN switches, Bloombase StoreSafe Security Server, appliance hardware platform, and host platform.

Test Condition	Candidate
HBA	• QLogic QLE2672 • QLogic QLE2562 • QLogic QLE2462 • QLogic QLA2362
SAN Switch	• QLogic Sanbox 5800V Fabric SAN Switch
Storage System	• Dell / EMC CX4-240 SAN storage
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)
Application Software	• Oracle Database 11g • Symantec Veritas Storage Foundation for Oracle RAC (SFRAC) 5.1

Raw Storage Device Tests

The following tests are carried out at storage host operating systems to access encrypted SAN storage via QLogic powered Bloombase StoreSafe appliances directly

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 via QLogic powered Bloombase StoreSafe appliances via operating system file-systems

- ext3 and Symantec Storage Foundation for Linux
- NTFS for Microsoft Windows
- JFS and Symantec Storage Foundation for IBM AIX
- UFS and Symantec Storage Foundation 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 • 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 Server on Symantec Veritas Storage Foundation for Oracle RAC

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 Server on Symantec Veritas Storage Foundation for Oracle RAC

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

QLogic FC-HBAs

- QLogic QLE2672
- QLogic QLE2562
- QLogic QLE2460
- QLogic QLA2362

and QLogic SAN switches

- QLogic Sanbox 5800V Fabric SAN switch

pass all Bloombase interopLab's interoperability tests with Bloombase StoreSafe enterprise storage encryption server on file system access, Oracle Database applications and Symantec Storage Foundation for Oracle RAC (SFRAC).

Bloombase Product	Operating System	QLogic FC-HBAs	QLogic SAN Switches
Bloombase StoreSafe Security Server	Microsoft Windows Server 2008	QLE2672, QLE2562, QLE2460, QLE2362	QLogic Sanbox 5800V SAN Switch
	Red Hat Enterprise Linux 5	QLE2672, QLE2562,	QLogic Sanbox 5800V SAN

	QLE2460, QLE2362	Switch
Novel SELS 11	QLE2672, QLE2562, QLE2460, QLE2362	QLogic Sanbox 5800V SAN Switch
Solaris 10	QLE2672, QLE2562, QLE2460, QLE2362	QLogic Sanbox 5800V SAN Switch
IBM AIX 7	QLE2672, QLE2562, QLE2460, QLE2362	QLogic Sanbox 5800V SAN Switch
VMware ESX/ESXi 4 (hypervisor)	QLE2672, QLE2562, QLE2460, QLE2362	QLogic Sanbox 5800V SAN Switch
Citrix Xen Server (hypervisor)	QLE2672, QLE2562, QLE2460, QLE2362	QLogic Sanbox 5800V SAN Switch

Acknowledgement

We would like to thank QLogic Corporation for sponsoring and supporting the FC-HBAs and SAN switches used in 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 Security Server Technical Specifications, http://www.bloombase.com/content/8936QA88
2. Bloombase StoreSafe Security Server 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, www.oracle.com/us/products/database
5. Transaction Processing Performance Council, http://www.tpc.org/tpcc/
6. QLogic FC-HBAs, http://www.qlogic.com/Products/adapters/Pages/FibreChannelAdapters.aspx
7. QLogic Fiber Channel switches, http://www.qlogic.com/Products/Switches/Pages/FibreChannelSwitches.aspx
8. Symantec Veritas Storage Foundation for Oracle RAC, http://www.symantec.com/storage-foundation-for-oracle-rac