



# Interoperability of Spitfire StoreSafe and Emulex FC-HBA for Transparent Storage Area Network (SAN) Encryption

October 9, 2006



## Executive Summary

Emulex LightPulse family of enterprise grade fiber channel host bus adapters (FC-HBA) are validated by Bloomberg's interopLab to run with Spitfire StoreSafe application transparent storage area network (SAN) encryption server. This document describes the steps carried out to test interoperability of Emulex LightPulse HBAs with Spitfire 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 Spitfire StoreSafe appliances with HP StorageWorks SAN storage sub-system and Brocade SAN switches.

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The interoperability tests in this report are carried out at Bloombase interopLab with sponsor from Emulex Corporation.

#### **About Emulex**

Emulex (NYSE:ELX) is a global provider of enterprise-class solutions and technologies that intelligently connect storage, servers and networks, to ensure access to data that's open, secure and adaptable. Emulex is a leader and catalyst for innovation and investment protection with a proven record of success that spans nearly 30 years. The world's leading OEMs rely on Emulex products to build scalable, high-performance storage and server solutions for today's largest, most demanding data centers. At Emulex, we envision a world in which all stored data is networked. Visit us at [www.emulex.com](http://www.emulex.com).

Document No.

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# Purpose and Scope

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

- Preparing Spitfire 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 Sun Solaris

# Assumptions

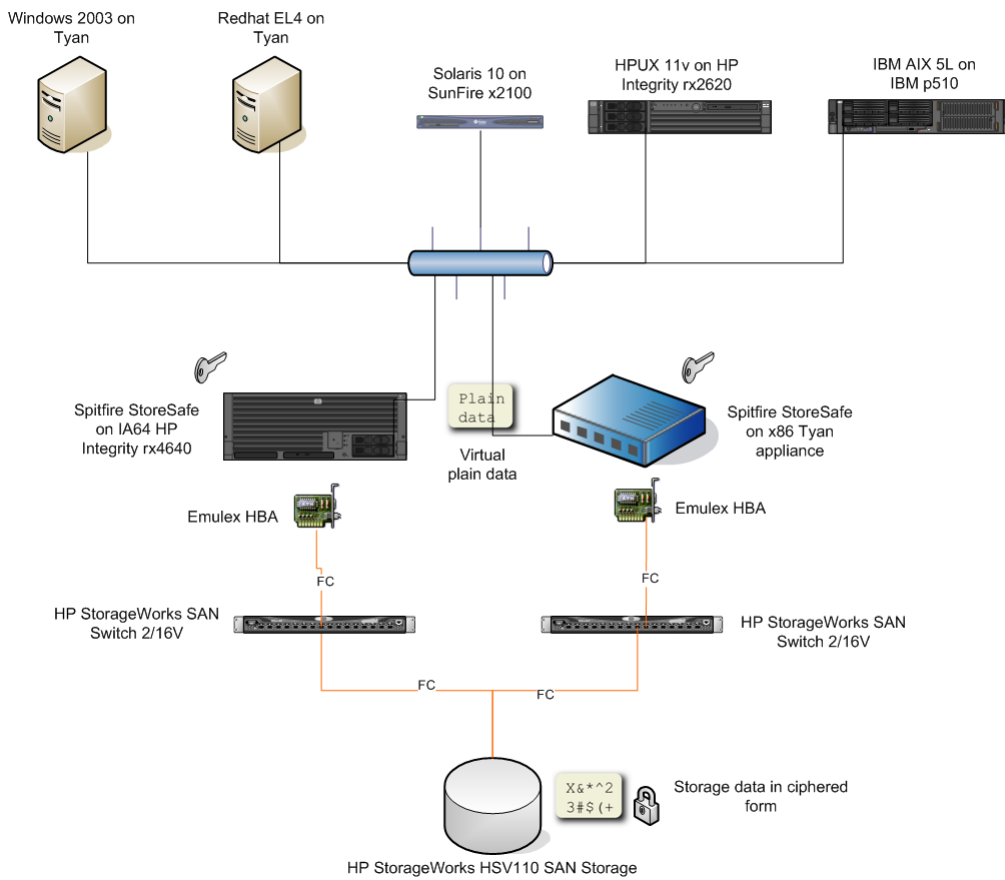
This document describes interoperability testing of Emulex powered Spitfire StoreSafe appliance on a SAN storage sub-system. Therefore, it is assumed that you are familiar with operation of storage systems and major operating systems including Linux, Windows, AIX, HPUX and Solaris. It is also assumed that you possess 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 Spitfire 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 Spitfire 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



## Spitfire StoreSafe Appliance

<b>Server</b>	HP Integrity rx4640	Tyan 2U server appliance prototype
<b>Processors</b>	2 x Intel Itanium-2 1.6 Ghz	2 x AMD Opteron Dual core
<b>Memory</b>	4 GB	1 GB
<b>Operating System</b>	Spitfire OS for IA64 – Hardened and customized OS based on embedded Linux of kernel version 2.6.11	Spitfire OS for x86 – Hardened and customized OS based on embedded Linux of kernel version 2.6.11
<b>Spitfire StoreSafe</b>	<ul style="list-style-type: none"> <li>Spitfire StoreSafe for SAN – Block based storage encryptor</li> <li>Spitfire StoreSafe for NAS – File based storage encryptor</li> </ul>	<ul style="list-style-type: none"> <li>Spitfire StoreSafe for SAN – Block based storage encryptor</li> <li>Spitfire StoreSafe for NAS – File based storage encryptor</li> </ul>

## Host Bus Adapters

<b>Model</b>	Emulex LP9002L	Emulex LP10000	Emulex LP11000-M4
<b>Speed</b>	2 Gbps	2 Gbps	4 Gbps
<b>Interface</b>	PCI	PCI-X	PCI-E
<b>Driver</b>	8.0.16.27-1	8.0.16.27-1	8.0.16.27-1

## SAN Switch

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

## Storage Area Network (SAN)

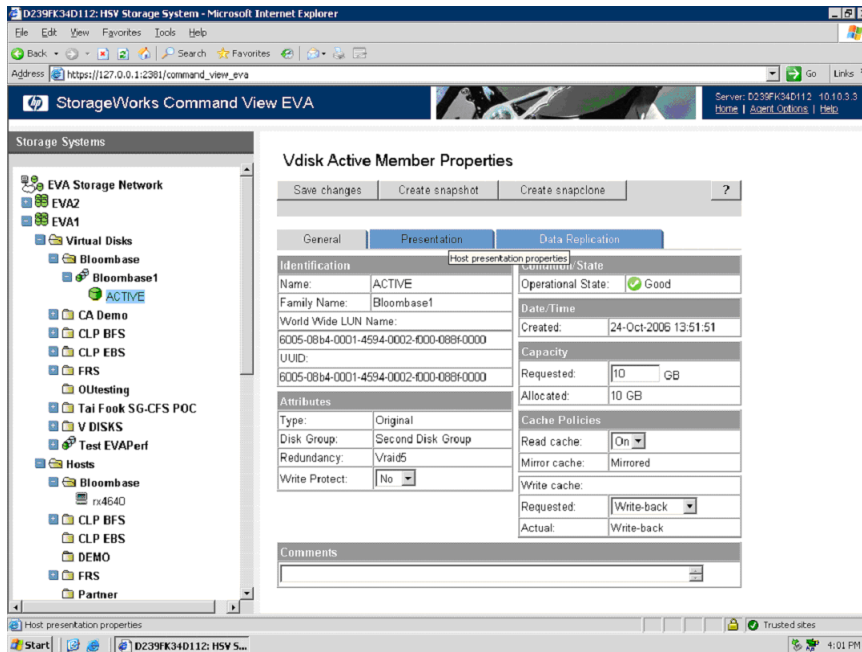
<b>SAN Storage</b>	HP StorageWorks HSV110
<b>Link Speed</b>	2 Gbps
<b>Cache Size</b>	2 GB

## Storage Hosts

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

# Configuration Overview

## SAN Storage



A virtual disk is created at SAN with below parameters

<b>Name</b>	Bloombase1
<b>Capacity</b>	10 GB

| **Redundancy**

| RAID5

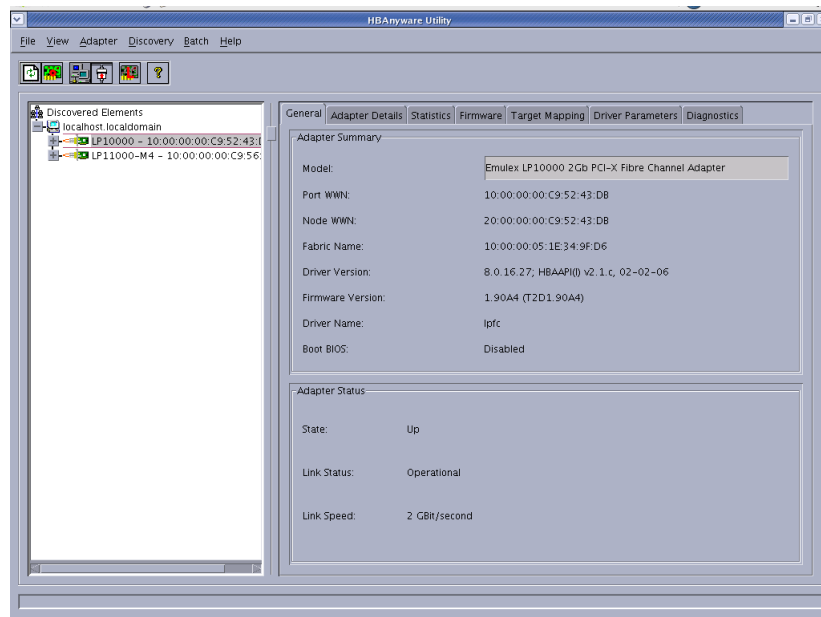
## Emulex HBA

Emulex LightPulse HBAs

- Emulex LP9002L
- Emulex LP10000
- Emulex LP11000-M4

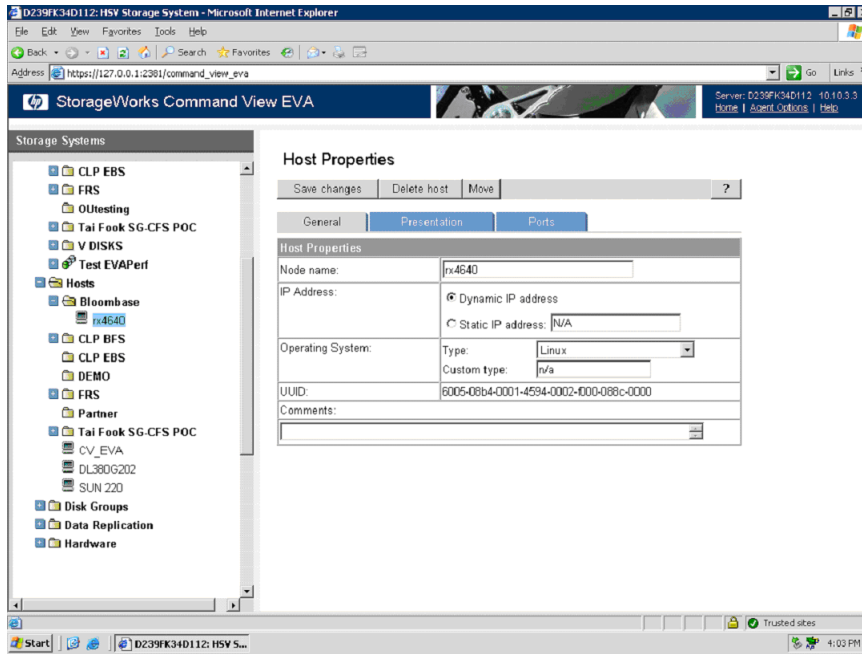
are installed onto both IA64-based and x86-based appliances operating on SpitfireOS.

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



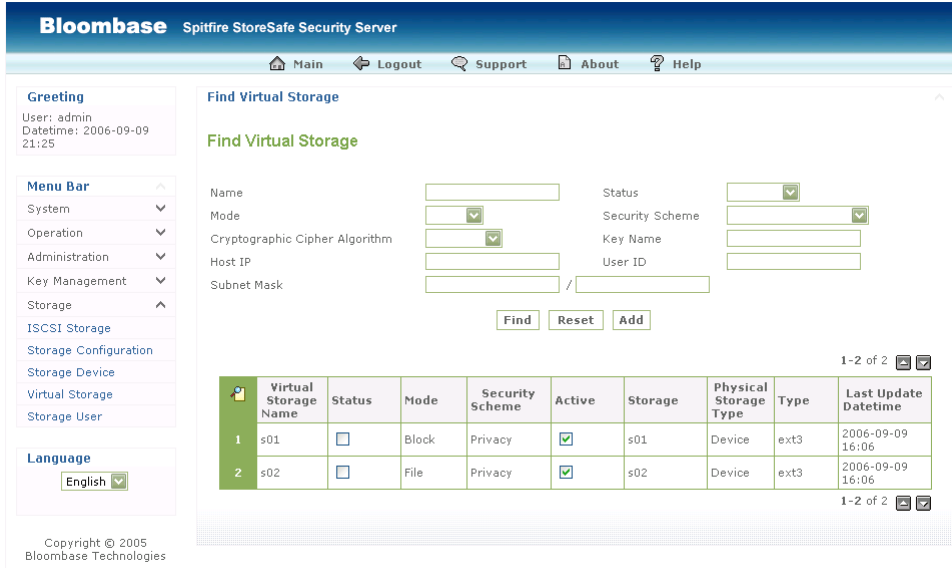
## SAN Fabric

The virtual disks on SAN are exposed to Spitfire StoreSafe appliance, namely rx4640, for access.



# Spitfire StoreSafe

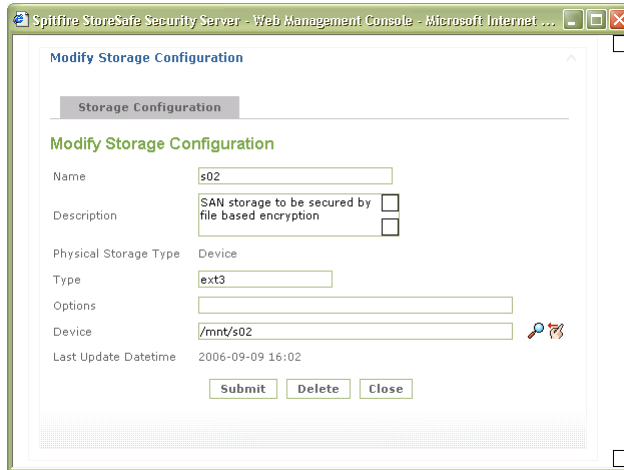
Spitfire StoreSafe supports both file-based and block-based on-the-fly storage encryption. In this interoperability test exercise, both file-based and blocked-based encryption modes are validated against Emulex LightPulse HBAs. Spitfire StoreSafe file and block-based virtual storage and physical storage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



## File Based Protection

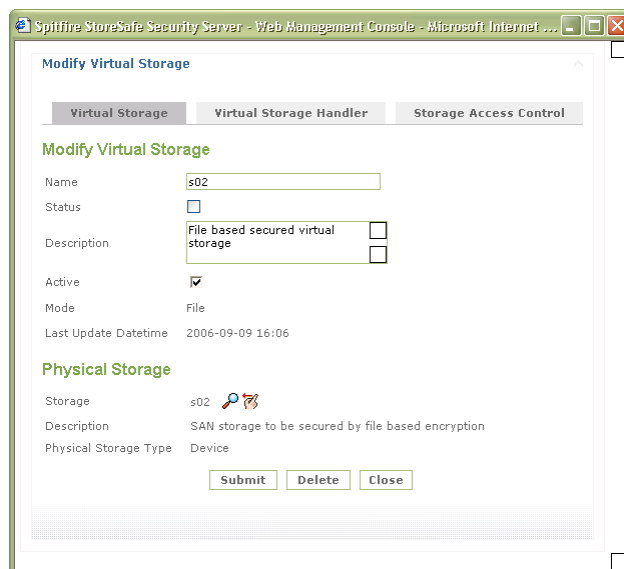
Physical storage s02 is configured in Spitfire StoreSafe for NAS server with storage physically located in SAN storage accessible at path /mnt/s02 via Emulex LightPulse HBAs.

S02 physical volume is configured to run on ext3 filesystem as shown in below screen capture of Spitfire StoreSafe web-based management console.



Virtual storage namely s02 is created on Spitfire StoreSafe for NAS storage encryption server to virtualize physical SAN storage s02 as a network share. S02 virtual storage is secured using AES 256-bit cryptographic cipher and is configured to be accessible by authorized hosts only using storage networking protocols including NFS and CIFS.

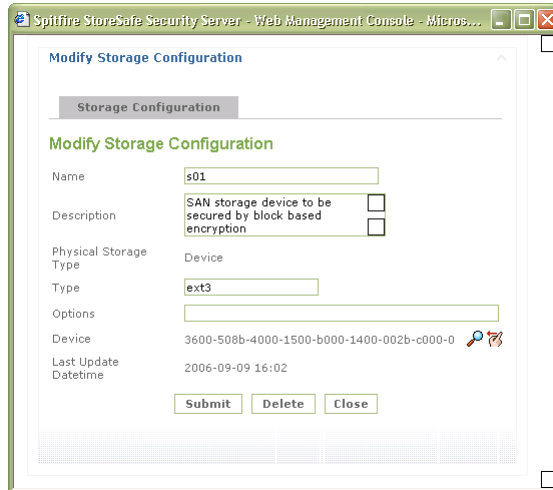
Plain persistent data are sent from storage host to Spitfire StoreSafe for NAS via NFS and/or CIFS. When Spitfire StoreSafe for NAS intercepts the plain sensitive contents, they are encrypted on-the-fly and committed to SAN storage via Emulex LightPulse HBAs.



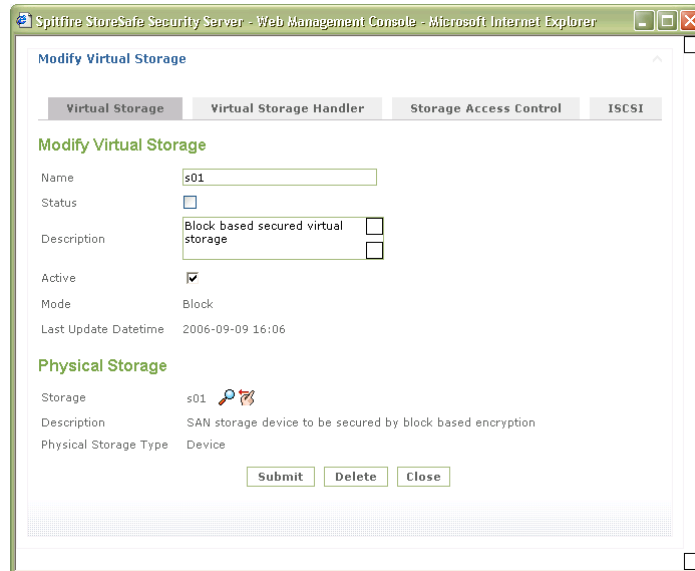
## Block Based Protection

Spitfire StoreSafe for NAS secures SAN contents file by file. Files can be secured one by one by specific cryptographic cipher, bit length, encryption key, etc. For applications where storage contents are persisted on raw/uncooked volumes or data protection unit does not require to be down to file level, one may choose to encrypt per entire partition/volume/device.

Spitfire StoreSafe for SAN encrypts SAN storage device using block based storage encryption. S01 physical storage is configured in Spitfire StoreSafe web-based management console to access disk with UUID 3600-508b-4000-1500-b000-1400-002a-6000-0 as a raw storage device.



s01 physical SAN device accessed using Emulex LightPulse HBAs has to be configured to be virtualized by s01 virtual storage where transparent on-the-fly block-based storage encryption can be triggered automatically by iSCSI requests from hosts. S01 virtual storage is secured by AES 256-bit cryptographic cipher.



# Validation Tests

## Test Scenarios

### Validation Matrix

Validation tests span across models of Emulex LightPulse HBAs, Spitfire StoreSafe model, appliance hardware platform, and host platform.

Test Condition	Candidate
HBA	<ul style="list-style-type: none"><li>• Emulex LP9002L</li><li>• Emulex LP10000</li><li>• Emulex LP11000-M4</li></ul>
Spitfire StoreSafe	<ul style="list-style-type: none"><li>• Spitfire StoreSafe for SAN</li><li>• Spitfire StoreSafe for NAS</li></ul>
Appliance	<ul style="list-style-type: none"><li>• IA64</li><li>• x86</li></ul>
Host	<ul style="list-style-type: none"><li>• Microsoft Windows Server 2003</li><li>• Redhat EL 4</li></ul>

- IBM AIX 5L
- HPUX 11iv2
- Solaris 10

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## Filesystem Tests

The following tests are carried out at storage hosts to access encrypted SAN storage via Emulex powered Spitfire 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	<ul style="list-style-type: none"> <li>● Platform equivalence of UNIX's chmod</li> <li>● Valid for UNIX-based storage host systems only (Linux, AIX, HPUX, Solaris)</li> </ul>
Softlink/Symbolic link removal	<ul style="list-style-type: none"> <li>● Platform equivalence of UNIX's rm</li> <li>● Valid for UNIX-based storage host systems only (Linux, AIX, HPUX, Solaris)</li> </ul>
Softlink/Symbolic link move	<ul style="list-style-type: none"> <li>● Platform equivalence of UNIX's mv</li> <li>● Valid for UNIX-based storage host systems only (Linux, AIX, HPUX, Solaris)</li> </ul>

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## 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	✓

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# Conclusion

Emulex LightPulse HBAs

- Emulex LP9002L
- Emulex LP10000
- Emulex LP11000-M4

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

Bloombase Product	Operating System	Emulex HBAs
Spitfire StoreSafe for NAS	Windows Server 2003	LP9002L, LP10000, LP11000-M4
	Linux	LP9002L, LP10000, LP11000-M4
	Solaris	LP9002L, LP10000, LP11000-M4
	AIX	LP9002L, LP10000, LP11000-M4
	HPUX	LP9002L, LP10000, LP11000-M4
Spitfire StoreSafe for SAN	Windows Server 2003	LP9002L, LP10000, LP11000-M4
	Linux	LP9002L, LP10000, LP11000-M4
	Solaris	LP9002L, LP10000, LP11000-M4
	AIX	LP9002L, LP10000, LP11000-M4

HPUX

LP9002L, LP10000, LP11000-M4

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