



Interoperability of Bloombase Spitfire StoreSafe Security Server and QLogic 10GbE Ethernet Adapter for Transparent Network Attached Storage (NAS) Encryption

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BLOOMBASE[®]



Executive Summary

QLogic enterprise grade 10GbE ethernet adapters / network interface cards (NIC) are validated by Bloombase's interopLab to run with Bloombase Spitfire StoreSafe Security Server to secure CIFS, Samba and NFS Network Attached Storage (NAS) by state-of-the-art encryption. This document describes the steps carried out to test interoperability of QLogic 10G NICs with Bloombase Spitfire StoreSafe Encryption Server on SpitfireOS running on Intel x86-based server appliances. Host systems on Microsoft Windows and Red Hat Linux are validated with QLogic 10G NIC-powered Bloombase Spitfire StoreSafe Storage Encryption appliances securing NetApp FAS2240 unified storage system.

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

About QLogic

QLogic is a leading supplier of high-performance storage networking solutions, which include controller chips, host adapters and fabric switches that are the backbone of storage networks for most Global 2000 corporations. The company delivers a broad and diverse portfolio of products that includes Fibre Channel HBAs, blade server embedded Fibre Channel switches, Fibre Channel stackable switches, iSCSI HBAs, iSCSI routers and storage services platforms for enabling advanced storage management applications. For more information, refer to <http://www.qlogic.com>

Document No.

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Purpose and Scope

This document describes the steps necessary to integrate QLogic 10GbE NICs with Bloombase Spitfire StoreSafe enterprise storage security server to secure sensitive corporate business data stored at Network Attached Storage (NAS). Specifically, we cover the following topics:

- Preparing Bloombase Spitfire StoreSafe Security appliance(s) with QLogic 10GbE NIC(s)
- Preparing NAS storage system
- Interoperability testing on host systems including Red Hat Linux and Microsoft Windows

Assumptions

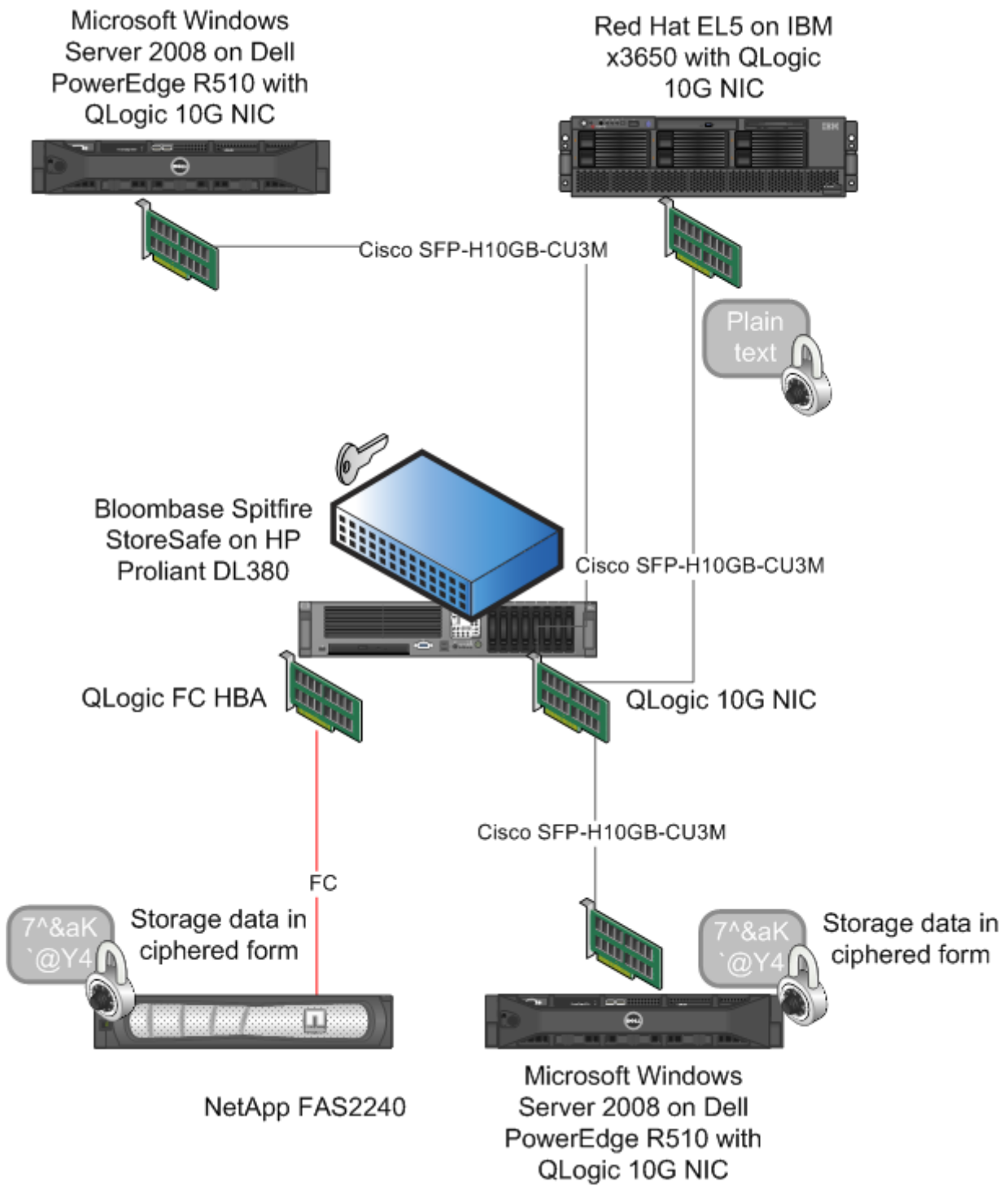
This document describes interoperability testing of QLogic powered Bloombase Spitfire StoreSafe Security Server appliance on NAS storage sub-system. Therefore, it is assumed that you are familiar with operation of storage systems and major operating systems including Linux, and Microsoft Windows. It 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 10GbE ethernet adapters are hardware option to Bloombase Spitfire StoreSafe storage encryption system, you are recommended to refer to installation and configuration guides of specific model of QLogic 10G NIC 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



Bloombase Spitfire StoreSafe Storage Encryption Server Appliance

Server	HP Proliant DL380
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 Spitfire StoreSafe Security Server

10GbE Ethernet Adapters

Model	QLogic QLE3242
Speed	10 Gbps
Interface	PCI-E

Interconnects

Model	Cisco SFP-H10GB-CU3M (37-0961-03) 10GBASE-CU SFP+ 3m Twinax Cable
Link Speed	10 Gbps

Network Attached Storage (NAS)

NAS Storage	Microsoft Windows Server 2008 on Dell PowerEdge R510 with QLogic 10G NIC
Link Speed	10 Gbps

Storage Area Network (SAN)

SAN Storage	NetApp FAS2240
Link Speed	8 Gbps

Storage Hosts

Model	Dell PowerEdge R510	IBM x3650
Operating System	Microsoft Windows Server 2008	Red Hat EL5
Ethernet Adapter	QLogic QLE3242	QLogic QLE3242

Configuration Overview

QLogic 10GbE Ethernet Adapter

QLogic 10G NICs

- QLogic QLE3242

are installed onto the Intel x86-based appliance running Bloombase SpitfireOS 5.5 and other storage hosts running Windows Server 2008 and Red Hat Enterprise Linux 5



```
QLogic 1/10 GbE Converged/Intelligent Ethernet Driver v5.0.24
qlcnic 0000:01:00.0: 2MB memory map
qlcnic 0000:01:00.0: phy port: 0 switch_mode: 0,
    max_tx_q: 1 max_rx_q: 8 min_tx_bw: 0x0,
    max_tx_bw: 0x64 max_mtu:0x2580, capabilities: 0xeea0fae
qlcnic 0000:01:00.0: Supports FW dump capability
qlcnic 0000:01:00.0: firmware v4.9.34
qlcnic: 00:0e:1e:06:eb:f0 3200 Series Dual Port 10Gb Intelligent Ethernet Adapter Board Chip rev
0x58
qlcnic 0000:01:00.0: using msi-x interrupts
qlcnic 0000:01:00.0: eth2: XGbE port initialized
qlcnic 0000:01:00.1: 2MB memory map
qlcnic 0000:01:00.1: phy port: 1 switch_mode: 0,
    max_tx_q: 1 max_rx_q: 8 min_tx_bw: 0x0,
    max_tx_bw: 0x64 max_mtu:0x2580, capabilities: 0xeea0fae
qlcnic 0000:01:00.1: Supports FW dump capability
qlcnic 0000:01:00.1: firmware v4.9.34
qlcnic 0000:01:00.1: using msi-x interrupts
qlcnic 0000:01:00.1: eth3: XGbE port initialized

lspci :

01:00.0 Ethernet controller: QLogic Corp. Unknown device 8020 (rev 58)
01:00.1 Ethernet controller: QLogic Corp. Unknown device 8020 (rev 58)

01:00.0 0200: 1077:8020 (rev 58)
01:00.1 0200: 1077:8020 (rev 58)

lsmod:
qlcnic                152592  0

Server 1:
# ethtool eth3
Settings for eth3:
    Supported ports: [ TP FIBRE ]
    Supported link modes:
    Supports auto-negotiation: No
    Advertised link modes: 10000baseT/Full
    Advertised auto-negotiation: No
    Speed: 10000Mb/s
    Duplex: Full
    Port: Twisted Pair
    PHYAD: 1
    Transceiver: external
    Auto-negotiation: off
    Supports Wake-on: d
    Wake-on: d
    Current message level: 0x00000000 (0)
    Link detected: yes

Server 2:
# ethtool eth5
Settings for eth5:
    Supported ports: [ TP FIBRE ]
    Supported link modes:
    Supports auto-negotiation: No
    Advertised link modes: 10000baseT/Full
    Advertised auto-negotiation: No
    Speed: 10000Mb/s
```

```
Duplex: Full
Port: Twisted Pair
PHYAD: 1
Transceiver: external
Auto-negotiation: off
Supports Wake-on: d
Wake-on: d
Current message level: 0x00000000 (0)
Link detected: yes
```

Interconnects

Cisco SFP-H10GB-CU3M 10GBASE-CU SFP+ 3m Twinax Cables are used to establish 10Gbps interconnects between host, Spitfire StoreSafe Security Server and NAS.



Bloombase Spitfire StoreSafe Security Server

Spitfire StoreSafe supports both file-based and block-based on-the-fly storage encryption. In this interoperability test exercise, NAS file-based encryption is validated with QLogic 10G NICs.

Find Key Wrapper

Name: Active:

CA:

Subject DN: Issuer DN:

Serial Number: Issuer Serial Number:

Effective Date From: Effective Date To:

Expiry Date From: Expiry Date To:

	Name	Key Source Type	Active	CA	Subject DN	Issuer DN	Effective Datetime	Expiry Datetime	Last Update Datetime
1	kc-key01	Spitfire KeyCastle	<input checked="" type="checkbox"/>	<input type="checkbox"/>	CN=kc-key01	CN=kc-key01	2011-02-08 22:57:20 +0800	2021-02-05 22:57:20 +0800	2011-02-08 23:06:05 +0800
2	test	Local	<input checked="" type="checkbox"/>	<input type="checkbox"/>	CN=test	CN=test	2011-02-08 22:40:51 +0800	2021-02-05 22:40:51 +0800	2011-02-08 22:40:54 +0800


Encryption Key Configuration


Generate encryption key with name 'key' in bundled Spitfire KeyCastle key life-cycle management tool

Modify Key Wrapper

Key Wrapper | Upload Key Contents | **Modify Key Source** | CRLDP | OCSP | Permissions

Modify Key Wrapper

Name	<input type="text" value="key"/>
Active	<input checked="" type="checkbox"/>
Exportable	<input type="checkbox"/>
CA	<input type="checkbox"/>
Subject DN	CN=key
Serial Number	695376542685815571917364
Issuer DN	CN=key
Certificate	<input checked="" type="checkbox"/> 
Public Key	<input checked="" type="checkbox"/>
Private Key	<input checked="" type="checkbox"/>
Key Bit Length	1024
Effective Datetime	2011-02-18 22:26:36 +0800
Expiry Datetime	2021-02-15 22:26:36 +0800
Revocation Check Method Type	<input type="text" value=""/> ▾
Revoked	<input type="checkbox"/>
Key Usage	-
Extended Key Usage	-
Owner	admin
Last Update Datetime	-



Virtual NAS Configuration

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

Modify Virtual Storage

Virtual Storage | Protection | Access Control | Permissions

Modify Virtual Storage

Name: remote01

Status:

Description:

Active:

Mode: File

Owner: admin

Last Update Datetime: 2011-02-18 13:15:13 +0800

Physical Storage

Storage: remote-emc01  

Description:

Physical Storage Type: Remote



Physical Storage Configuration

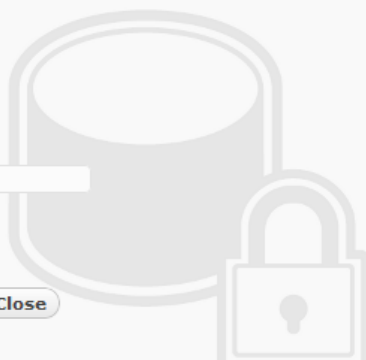
Windows Server 2008 CIFS/Samba file share is provisioned at Bloombase Spitfire StoreSafe Security Server management console.

Modify Storage Configuration

Physical Storage **Permissions**

Physical Storage Configuration

Name	remote-emc01
Description	
Physical Storage Type	Remote
Type	Common Internet File System (CIFS)
Host	192.168.10.191
Share Name	cifs02
Read Size	
Write Size	
Synchronous	<input type="checkbox"/>
Mount Hard	<input type="checkbox"/>
User	user
Password	•••••
Options	
Owner	admin
Last Update Datetime	2011-02-18 13:14:58 +0800



Encrypted Virtual Storage Provisioning

Virtual storage namely 'remote01' of type 'File' is created to virtualize physical storage 'remote-emc01' for application transparent bump-in-the-wire encryption protection over CIFS.

Modify Virtual Storage

Virtual Storage | Protection | Access Control | Permissions

Modify Virtual Storage

Name: remote01

Status:

Description:

Active:

Mode: File

Owner: admin

Last Update Datetime: 2011-02-18 13:15:13 +0800

Physical Storage

Storage: remote-emc01

Description:

Physical Storage Type: Remote



Protection type is specified as 'Privacy' and secure the CIFS share using AES-XTS 256-bit encryption with encryption key 'key'

Modify Virtual Storage Handler

Virtual Storage | Protection | Access Control | Permissions

Virtual Storage Protection

Protection Type: Privacy

Encryption Keys

	Key Name	Last Update Datetime
1	key	

Cryptographic Cipher

Cipher Algorithm: AES

Bit Length: 256



Provision authorized storage user to access virtual storage and assign to access control list

Modify Virtual Storage Access Control

Virtual Storage Protection **Access Control** Permissions

User Access Control

Default Read Write

User Repository

	User	Access Control List	Last Update Datetime
1	<input type="checkbox"/> user	<input checked="" type="checkbox"/> Read <input checked="" type="checkbox"/> Write	2011-02-16 14:23:33 +0800

File System Object Attributes

Default User Identifier

Default Group Identifier

Default Mode

Host Access Control

	Host	Access Control List	Last Update Datetime
--	------	---------------------	----------------------

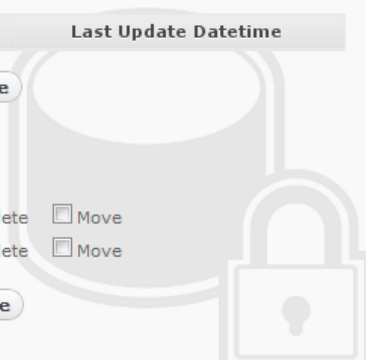
Subnet Access Control

	Subnet	Access Control List	Last Update Datetime
--	--------	---------------------	----------------------

Negative Access Control

Deny Directory Read Write Create Delete Move

Deny File Read Write Create Delete Move



Validation Tests

Test Scenarios

Validation Matrix

Validation tests span across models of QLogic 10G NICs, Bloombase Spitfire StoreSafe Security Server, appliance hardware platform, and host platform.

Test Condition	Candidate
HBA	<ul style="list-style-type: none">QLogic QLE3242
Interconnects	<ul style="list-style-type: none">Cisco SFP-H10GB-CU3M 10GBASE-CU SFP+ 3m Twinax Cable
Storage System	<ul style="list-style-type: none">NetApp FAS2240Microsoft Windows Server 2008
Storage Encryption Appliance	<ul style="list-style-type: none">Bloombase Spitfire StoreSafe Security Server on x86-based HP Proliant DL380
Host Server Hardware	<ul style="list-style-type: none">Dell PowerEdge R510

- IBM x3650
- Host Operating Systems
- Microsoft Windows Server 2008
 - Red Hat EL 5
-

File System Tests

The following tests are carried out at storage hosts to access encrypted NAS storage via QLogic powered Bloombase Spitfire StoreSafe appliances via CIFS and/or NFS

- 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	<ul style="list-style-type: none"> • Platform equivalence of UNIX's chmod • Valid for UNIX-based storage host systems only (Linux, AIX, HPUX,

	Solaris)
Softlink/Symbolic link removal	<ul style="list-style-type: none"> Platform equivalence of UNIX's rm Valid for UNIX-based storage host systems only (Linux, AIX, HPUX, Solaris)
Softlink/Symbolic link move	<ul style="list-style-type: none"> 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

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

QLogic 10G NICs

- QLogic QLE3242

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

Bloombase Product	Operating System	QLogic 10G NIC
Bloombase Spitfire StoreSafe Security Server	Microsoft Windows Server 2008	QLE3242
	Red Hat Enterprise Linux 5	QLE3242

Acknowledgement

We would like to thank QLogic Corporation for sponsoring and supporting the 10G NICs 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 Spitfire StoreSafe Security Server Technical Specifications, <http://www.bloombase.com/content/8936QA88Dh3lD3kYMKxe1VGb8UG490oeNL8Dj>
2. Bloombase Spitfire StoreSafe Security Server Compatibility Matrix, <http://www.bloombase.com/content/8396639C9Q8dkeo46yZ3i7Yvfa6iaCNvwpZ81x>
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 10G NICs, <http://www.qlogic.com/Products/adapters/Pages/IntelligentEthernetAdapters.aspx>