



# Interoperability of Bloombase StoreSafe and Emulex 40Gb Ethernet Network Adapter for Data-at-Rest Encryption

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## Executive Summary

Avago/Broadcom/Emulex carrier grade 40Gb Ethernet adapters / network interface cards (NIC) and fiber-optic transceivers are validated by Bloombase's interopLab to run with Bloombase StoreSafe software appliance to secure NFS Network Attached Storage (NAS) by state-of-the-art encryption. This document describes the steps carried out to test interoperability of Emulex 40G NICs with Bloombase StoreSafe running on x86-based Intel Xeon hardware server with AES-NI cryptographic acceleration. Host system on Red Hat Enterprise Linux (RHEL) / CentOS is validated with Emulex 40G NIC-powered Bloombase StoreSafe securing NFS network shares provisioned at Network Attached Storage (NAS).

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# Purpose and Scope

This document describes the steps necessary to integrate Emulex 40GbE NICs with Bloombase StoreSafe software appliance to secure sensitive corporate business data stored at Network Attached Storage (NAS). Specifically, we cover the following topics:

- Setting up Bloombase StoreSafe software appliance on x86-based server hardware with Emulex 40GbE NIC(s)
- Setting up NAS storage system
- Interoperability testing on host system Red Hat Enterprise Linux (RHEL) / CentOS

# Assumptions

This document describes interoperability testing of Emulex powered Bloombase StoreSafe software appliance on NAS storage system. Therefore, it is assumed that the reader is familiar with operation of storage systems and major operating systems including Linux. It is also assumed that the reader possesses basic UNIX administration skills. The examples provided may require modifications before they are run under specific version(s) of UNIX.

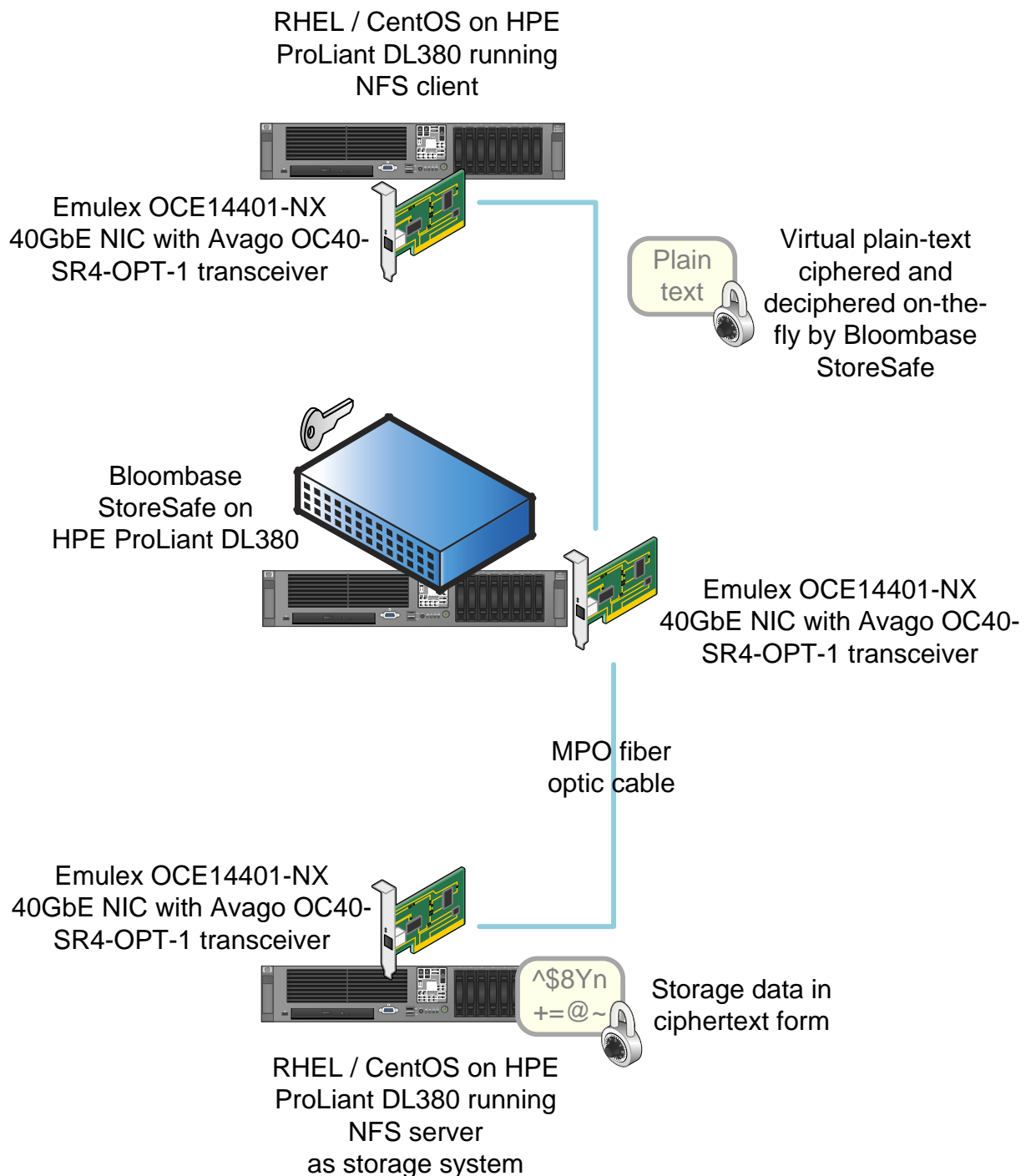
As Emulex 40Gb Ethernet adapters are hardware option to Bloombase StoreSafe, the reader is recommended to refer to installation and configuration guides of specific model of Emulex 40G NIC for the platform to test on. We assume the reader has basic knowledge of storage networking and information cryptography. 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 set up as in below figure:





## Bloombase StoreSafe

<b>Server</b>	HPE ProLiant DL380
<b>Processors</b>	2 x Intel Xeon CPU
<b>Memory</b>	8 GB
<b>Disk Free Space</b>	10 GB
<b>Storage Encryption Software</b>	Bloombase StoreSafe Software Appliance

## 40Gb Ethernet Adapters

<b>Model</b>	Emulex OneConnect OCe14401-NX
<b>Speed</b>	40 Gbps
<b>Interface</b>	PCI-E

## Transceivers

<b>Model</b>	Avago OC40-SR4-OPT-1
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## Network Attached Storage (NAS)

<b>NAS Storage</b>	Red Hat Enterprise Linux (RHEL) / CentOS on HPE ProLiant DL380 running NFS server as storage system
<b>Link Speed</b>	40 Gbps
<b>Ethernet Adapter</b>	Emulex OneConnect OCe14401-NX NIC with Emulex OC40-SR4-OPT-1 transceiver

## Storage Host

<b>Model</b>	HPE ProLiant DL380
<b>Operating System</b>	Red Hat Enterprise Linux (RHEL) / CentOS

**Ethernet Adapter**

Emulex OneConnect OCe14401-NX NIC with Emulex OC40-SR4-OPT-1 transceiver

# Configuration Overview

## Emulex 40Gb Ethernet Adapter

Emulex 40G NICs

- Emulex OCE14401-NX

are installed onto the x86-based Intel Xeon hardware appliance running Bloombase StoreSafe, client host and NAS running Red Hat Enterprise Linux / CentOS.



Avago OC40-SR4-OPT-1 QSFP transceiver modules have been used to pair with the Emulex OCE14401-NX.



MPO multi-mode patch cables were used in this test enabling the Emulex NICs and transceivers to deliver 40Gbps Ethernet network throughput.



Bloombase OS comes with Emulex OneConnect NIC Driver 11.0.232.0 off-the-shelf.

Customers may update the driver binaries optionally by signing on the Bloombase text-based management console and gaining command prompt access by entering the maintenance mode.

Download the latest driver at <http://www.avagotech.com/products/ethernet-connectivity/network-adapters/oce14401-nx#downloads>.

Untar the driver binaries by command:

```
# tar -xvf elx-be2net-dd-rhel7-<version>.tar.gz
```

To update the Emulex OneConnect driver at Bloombase OS, run the following commands:

```
# cd ./elx-rhel7-be2net-dd-<version>
# ./elx_net_install.sh
```

# Bloombase StoreSafe

Bloombase StoreSafe delivers on-the-fly encryption security of file-based, block-based, object-based and sequential storage systems. In this interoperability test, NAS file-based encryption is validated with Emulex 40G NICs.

Home

Main

Logout

Support

About

Help

B

Bloombase StoreSafe Security Server

Greeting

Host Name: storesafe02  
User: admin  
Datetime: 2011-02-18 14:23:55 +0800

Menu Bar

System

Operation

Network Security

High Availability

Administration

Key Management

Spitfire KeyCastle

Hardware Security Module

Find Key Wrapper

Create Key Wrapper

Storage

Language

English

Find Key Wrapper

Name

CA

Subject DN

Serial Number

Effective Date From

Expiry Date From

Active

Issuer DN

Issuer Serial Number

Effective Date To

Expiry Date To

Find

Reset

Add

1-2 of 2

	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

1-2 of 2

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## Encryption Key Configuration

Generate encryption key with name 'key' in bundled Bloombase 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"/> ▼
Revoked	<input type="checkbox"/>
Key Usage	-
Extended Key Usage	-
Owner	admin
Last Update Datetime	-



## Virtual NAS Configuration

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

### Physical Storage Configuration

Red Hat Enterprise Linux (RHEL) / CentOS NFS file share is provisioned via Bloombase StoreSafe web-based management console.

### Modify Storage Configuration

**Physical Storage****Permissions**

#### Physical Storage Configuration

Name	centos-nfs
Description	
Physical Storage Type	Remote
Type	Network File System (NFS)
Host	192.168.10.191
Share Name	/share
Read Size	8192
Write Size	8192
Synchronous	<input type="checkbox"/>
Mount Hard	<input type="checkbox"/>
Options	
Virtual Storage	
Owner	admin
Last Update Datetime	2016-02-01 14:30:08 +0800

**Submit****Delete****Close**



## Encrypted Virtual Storage Provisioning

Virtual storage namely 'remote01' of type 'File' is created to virtualize physical storage 'centos-nfs' for application transparent bump-in-the-wire encryption protection over NFS protocol on Emulex 40GbE NICs.

### Modify Virtual Storage

Virtual Storage

Protection

Access Control

Permissions

#### Modify Virtual Storage

Name

remote01

x

Status

☒

Description

^

v

Active

☒

Mode

File

Owner

admin

Last Update Datetime

2016-02-01 14:32:18 +0800

#### Settings

Offline Setting



Disabled

v

#### Physical Storage

Storage

centos-nfs



Description

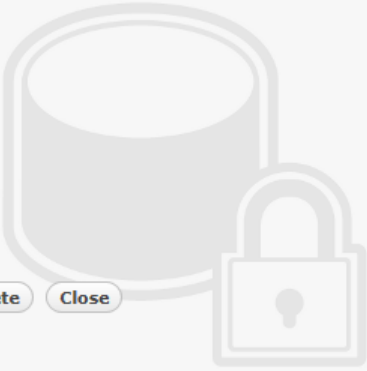
Physical Storage Type

Remote

Submit

Delete

Close



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

### Modify Virtual Storage Handler

**Virtual Storage** Protection Access Control Permissions

#### Virtual Storage Protection

Protection Type

#### Encryption Keys

		Key Name	Last Update Datetime
1		key	

#### Cryptographic Cipher

Cipher Algorithm

Bit Length



Provision authorized subnet 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
<div>Add Remove</div>			

^ Less Options

### NFS File System Object Attributes

Native File Permission ☐

Root Squash ☐


Weak Cache Consistency ☐

Default User Identifier


Default Group Identifier

Default Mode

### Host Access Control

	Host	Access Control List	Last Update Datetime
<div>Add Remove</div>			

### Subnet Access Control

		Subnet	Access Control List	Last Update Datetime
1	<input type="checkbox"/>	<input type="text" value="192.168.56.0"/> / <input type="text" value="255.255.255.0"/>	<input checked="" type="checkbox"/> Read <input checked="" type="checkbox"/> Write	2016-02-05 08:43:24 +0800
<div>Add Remove</div>				


### Negative Access Control

Deny Directory ☐ Read ☐ Write ☐ Create ☐ Delete ☐ Move

Deny File ☐ Read ☐ Write ☐ Create ☐ Delete ☐ Move

Submit

Close



# Validation Tests

## Test Scenarios

### Validation Matrix

Validation tests span across models of Emulex 40G NICs, Bloombase StoreSafe, appliance hardware platform, and client host platform.

Test Condition	Component
Ethernet Adapter	Emulex OCE14401-NX with Avago OC40-SR4-OPT-1
Storage System	Red Hat Enterprise Linux (RHEL) / CentOS on x86-based HPE ProLiant DL380 running NFS server as storage system
Storage Encryption Appliance	Bloombase StoreSafe on x86-based Intel Xeon HPE ProLiant DL380

Client Host Hardware	HPE ProLiant DL380
Client Host Operating System	Red Hat Enterprise Linux (RHEL) / CentOS running NFS client

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## File System Tests

The following tests are carried out at storage host to access encrypted NAS storage via Emulex powered Bloombase StoreSafe via NFS protocol:

- ext3 for Linux

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
Softlink/Symbolic link removal	Platform equivalence of UNIX's rm
Softlink/Symbolic link move	Platform equivalence of UNIX's mv

---

# 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	✓	

# Conclusion

Emulex 40G NICs

- Emulex OCE14401-NX

pass all Bloombase interopLab's interoperability tests with Bloombase StoreSafe

Bloombase Product	Client Operating System	Network Interface Card
Bloombase StoreSafe	Red Hat Enterprise Linux / CentOS	Emulex OCE14401-NX with Avago OC40-SR4-OPT-1 transceivers



# Acknowledgement

We would like to thank Avago Technologies / Broadcom Limited/ Emulex Corporation for sponsoring and supporting the 40G NICs and transceivers used in the 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 Technical Specifications, <http://www.bloombase.com/content/8936QA88>
2. Bloombase StoreSafe Compatibility Matrix, <http://www.bloombase.com/content/8396639C>
3. Avago / Emulex 40G NICs, <http://www.avagotech.com/products/ethernet-connectivity/network-adapters/oce14401-nx>