



# Interoperability of Bloomberg StoreSafe and ATTO FastFrame 10GbE Ethernet Adapter for Transparent Data-at-Rest Encryption

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**BLOOMBASE**<sup>®</sup>



## Executive Summary

ATTO carrier grade FastFrame 10GbE Ethernet adapters / network interface cards (NIC) are validated by Bloomberg's interopLab to run with Bloomberg StoreSafe to secure Hitachi Data Systems (HDS) HNAS Network Attached Storage (NAS) by state-of-the-art encryption. This document describes the steps carried out to test interoperability of ATTO FastFrame 10GbE NICs with Bloomberg StoreSafe Storage Encryption Server on BloombergOS running on Intel x86-based commercial-off-the-shelf server appliances. Storage client running Red Hat Enterprise Linux (RHEL) 7 on HPE ProLiant DL20 Server with ATTO FastFrame 10GbE NICs is validated with ATTO FastFrame 10GbE powered Bloomberg StoreSafe Storage Encryption appliance securing Hitachi Data Systems (HDS) HNAS storage system.

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The interoperability tests in this report are carried out at Bloombase interopLab with sponsor from ATTO Technology, Inc.

About ATTO Technology, Inc.

ATTO Technology, Inc., headquartered in Amherst, New York, is a global leader of storage connectivity and infrastructure solutions for data-intensive computing environments. It is our vision to provide a wide range of end-to-end solutions to help customers better store, manage and deliver their data. We believe that our company's experience in engineering advanced technology into real-world product solutions provides customers a unique competitive advantage. For more information, please refer to <https://www.atto.com>

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# Purpose and Scope

This document describes the steps necessary to integrate ATTO FastFrame NS12 10GbE network interface cards (NIC) with Bloomberg StoreSafe enterprise storage software appliance to secure sensitive corporate business data managed at Hitachi Data Systems (HDS) HNAS Network Attached Storage (NAS) via iSCSI, NFS, and CIFS protocols. Specifically, we cover the following topics:

- Installing Bloomberg StoreSafe software appliance with ATTO FastFrame NS12 10GbE NIC on HPE ProLiant DL20 server
- Interoperability testing on client system with Red Hat Enterprise Linux (RHEL) 7 on HPE ProLiant DL20 server with ATTO FastFrame NS12 10GbE NIC

# Assumptions

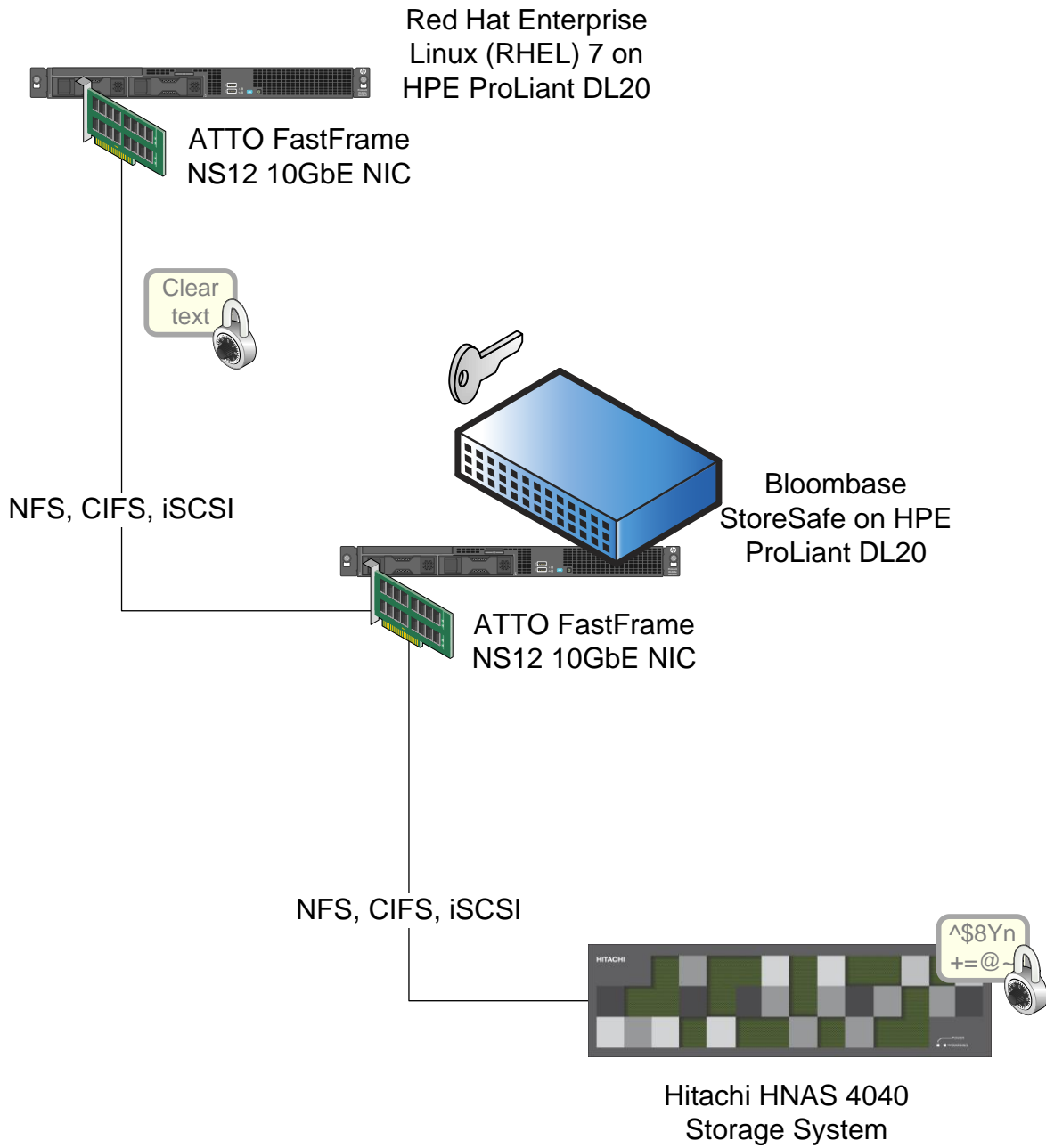
This document describes interoperability testing of ATTO FastFrame NS12 10GbE NIC with Bloomberg StoreSafe on HPE ProLiant DL20 Server for data-at-rest encryption. It is assumed that you are familiar with operation of storage systems and major operating systems including UNIX and/or Linux. It is also assumed that you possess basic UNIX administration skills. The examples provided may require modifications before they could be run under your version of UNIX.

As ATTO FastFrame NS12 10GbE NIC is hardware option to Bloomberg StoreSafe, you are recommended to refer to installation and configuration guides of specific model of ATTO FastFrame 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 Bloomberg StoreSafe, please refer to our website at <https://www.bloomberg.com> or Bloomberg SupPortal <https://supportal.bloomberg.com>.

# Infrastructure

## Setup

The validation testing environment is set up as in below figure:





## Bloomberg StoreSafe Storage Encryption Server

<b>Server</b>	HPE ProLiant DL20 Gen9 Server
<b>Processors</b>	1 x Intel Xeon E3-1240V5 series quad-core 8M cache 3.5 GHz
<b>Memory</b>	8 GB
<b>Storage Encryption Software</b>	Bloomberg StoreSafe Software Appliance v3.4
<b>Network Interface Card</b>	ATTO FastFrame NS12 10GbE Ethernet adapter

## Storage Client

<b>Model</b>	HPE ProLiant DL20 Gen9 Server
<b>Operating System</b>	Red Hat Enterprise Linux (RHEL) 7
<b>Network Interface Card</b>	ATTO FastFrame NS12 10GbE Ethernet adapter

## Network Attached Storage (NAS)

<b>NAS Storage</b>	Hitachi Data Systems (HDS) HNAS 4040 Storage System
<b>Network Connection Speed</b>	10Gbps

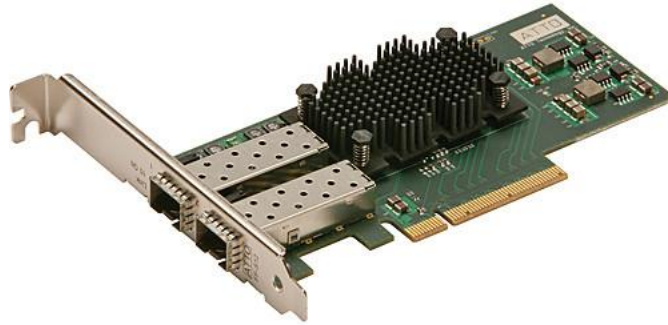
# Configuration Overview

## ATTO FastFrame Ethernet Adapter

ATTO NIC

- ATTO FastFrame NS12 10GbE NIC

is installed at HPE ProLiant DL20 Server running Bloombase StoreSafe.



## Interconnect

COMMSCOPE SYSTIMAX OM3 3-meter 50/150 micron multi-mode fiber-optic cables with LC-LC terminations are used in this interoperability testing.



## Bloombase StoreSafe Software Appliance

Bloombase StoreSafe supports file-based, share-based, block-based and object-based on-the-fly storage encryption. In this interoperability testing effort, NAS file-based encryption is validated with ATTO FastFrame NS12 NICs.

**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:  Active:

CA:

Subject DN:  Issuer DN:

Serial Number:  Issuer Serial Number:

Effective Date From:  Effective Date To:

Expiry Date From:  Expiry Date To:

ID	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 `key01` 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" value=""/>
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

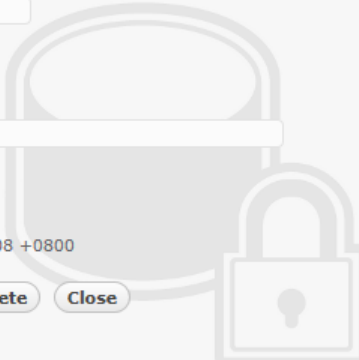
CIFS, NFS and iSCSI storage resources managed by Hitachi HNAS are configured at Bloombase StoreSafe Security Server management console.

### 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



## Encrypted Virtual Storage Provisioning

Virtual storage namely `share01` of type `File` is created to virtualize physical storage `share01` for application transparent bump-in-the-wire encryption protection over NFS and CIFS.

Virtual storage `lun01` of type `Block` is created to virtualize iSCSI physical storage `lun01` for application transparent bump-in-the-wire encryption protection over iSCSI.

### Modify Virtual Storage

**Virtual Storage** | Protection | Access Control | Permissions

#### Modify Virtual Storage

Name: remote01

Status:

Description:

Active:

Mode: File

Owner: admin

Last Update Datetime: 2016-02-01 14:32:18 +0800

#### Settings

Offline Setting: Disabled

#### Physical Storage

Storage: centos-nfs

Description:

Physical Storage Type: Remote

Protection type is specified as `Privacy` and the CIFS, NFS and iSCSI StoreSafe security storage resources are secured using AES 256-bit cipher algorithm and encryption key `key01`.

### 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 Local

	User	Access Control List	Last Update Datetime
---	------	---------------------	----------------------

^ 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
---	------	---------------------	----------------------

### Subnet Access Control

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

### 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 ATTO FastFrame 10GbE NICs, Bloomberg StoreSafe, server hardware platform, and host platform.

Test Condition	Candidate
Network Adapter	ATTO FastFrame NS12 10GbE NIC
Storage System	Hitachi Data Systems (HDS) HNAS 4040
Storage Encryption	Bloomberg StoreSafe on x86-based HPE ProLiant DL20 Gen9 server with ATTO FastFrame NS12 10GbE NIC
Client System	Red Hat Enterprise Linux (RHEL) 7 with ATTO FastFrame NS12 10GbE NIC

## Raw Storage Device Tests

The following tests are carried out at storage host operating systems to access encrypted iSCSI storage via ATTO FastFrame NS12-powered Bloomberg StoreSafe

Test	Description
Write disk with zeros	Write zeros into encrypted storage target via Bloomberg StoreSafe, platform equivalence of UNIX's <code>dd if=/dev/zero of=/dev/sda</code>
Read disk to null device	Read from encrypted storage target via Bloomberg StoreSafe, platform equivalence of UNIX's <code>dd if=/dev/sda of=/dev/null</code>
Wipe disk with random data	Write random zeros and ones into encrypted storage target, platform equivalence of UNIX's <code>dd if=/dev/urandom of=/dev/sda</code>

## File System Tests

The following tests are carried out at storage host with ATTO FastFrame NS12 10GbE NIC to access encrypted Hitachi HNAS storage via Bloomberg StoreSafe with ATTO FastFrame NS12 10GbE NIC

- Ext3 for Linux

Test	Description
Directory creation	Platform equivalence of UNIX's <code>mkdir</code>
Directory rename	Platform equivalence of UNIX's <code>mv</code>
Directory removal	Platform equivalence of UNIX's <code>rm</code>
Directory move	Platform equivalence of UNIX's <code>mv</code>
File creation	Platform equivalence of UNIX's <code>echo XXX &gt;</code>
File rename	Platform equivalence of UNIX's <code>mv</code>
File removal	Platform equivalence of UNIX's <code>rm</code>
File move	Platform equivalence of UNIX's <code>mv</code>

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>

## 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	✓

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# Conclusion

ATTO FastFrame 10GbE NICs

- ATTO FastFrame NS12 10GbE NICs

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

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<b>Bloombase Product</b>	<b>Storage System</b>	<b>Network Adapter</b>
Bloombase StoreSafe Software Appliance	Hitachi Data Systems (HDS) HNAS 4040	ATTO FastFrame NS12 10GbE NIC

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# Acknowledgement

We would like to thank ATTO Technology, Inc. for sponsoring and supporting the 10GbE NICs 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/e8Gzz281>
3. dd for Unix, [https://en.wikipedia.org/wiki/Dd\\_\(Unix\)](https://en.wikipedia.org/wiki/Dd_(Unix))
4. Oracle database server, <https://www.oracle.com/database/index.html>
5. Transaction Processing Performance Council, <http://www.tpc.org/tpcc/>
6. ATTO FastFrame NS12 10GbE NIC, <https://www.atto.com/products/ethernet-adapters/10gbe-and-10gbase-t-nics/10gbe/FFRM-NS12-000>
7. Hitachi HNAS, <https://www.hds.com/en-us/products-solutions/storage/network-attached-storage-platform.html>