# NEXSAN
## A StorCentric Company

# BEAST and E-Series

# VMware Best Practices Guide

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# Contents

Nexsan
www.nexsan.com

Nexsan High Density Storage
VMware Best Practices Guide

# About this manual

This best practices guide provides high-level information and guidance for setting up Nexsan E-Series and Nexsan BEAST Storage Systems in a VMware environment using vSphere.

**Note** While Nexsan makes every effort to ensure the accuracy of technical documentation, screen images and procedures may change after publication. In case of discrepancy, please check for the latest updates on the E-Series and BEAST Documents and Downloads page. Also, refer to the latest Release Notes.

## Conventions

Here is a list of text conventions used in this document:

| Convention | Description |
|---|---|
| underlined blue | Cross-references, hyperlinks, URLs, and email addresses. |
| **boldface** | Labels on the physical Nexsan Storage System or interactive items in the graphical user interface (GUI). |
| *italics* | System messages and non-interactive items in the GUI. References to software user guides. |
| `monospace` | Command-line interface (CLI) text or text that refers to file or directory names. |
| **`monospace bold`** | Text strings that must be entered by the user in the CLI or in text fields in the GUI. |

## Notes, tips, cautions, and warnings

**Note** Notes contain important information, present alternative procedures, or call attention to certain items.

**Tip** Tips contain handy information for end-users, such as other ways to perform an action.

**CAUTION:** In hardware manuals, cautions alert the user to items or situations which may cause damage to the Nexsan Storage System or result in mild injury to the user, or both. In software manuals, cautions alerts the user to situations which may cause data corruption or data loss.

**WARNING: Warnings alert the user to items or situations which may result in severe injury or death to the user.**

## Contacting Nexsan

For questions about Nexsan products, please visit the Nexsan support Web page, and the E-Series and BEAST Documents and Downloads page. If you are unable to find the answer to your question there, please see our contact information below.

### *Service and support*

Nexsan's Technical Services Group provides worldwide assistance with installation, configuration, software support, warranty, and repair for all Nexsan products. A variety of service and support programs are available to provide you with the level of coverage and availability your operation requires.

**Nexsan Headquarters**

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**European Head Office, UK**

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**Worldwide Web site**

www.nexsan.com

**E-Series and BEAST support:**

https://helper.nexsansupport.com/esr_support

**Contact:**

https://helper.nexsansupport.com/contact

## Related documents

The following Nexsan product manuals contain related information:

- *Nexsan High-Density Storage User Guide*
- *Nexsan High-Density Storage Plugin for VMware vCenter User Guide*
- *Nexsan Snapshots and Replication User Guide*
- *Nexsan Multipathing Best Practices Guide*

# Chapter 1

# Recommendations and requirements

This chapter contains the following sections:

1

## Introducing the Nexsan VMware plugin

The Nexsan High-Density Storage Plugin for VMware vCenter enables monitoring, configuration, provisioning, and maintenance of Nexsan Storage Systems, and integrates Nexsan Storage with VMware vSphere.

The plugin is also intended to enable vCenter administrators to understand relationships between VMware infrastructure – ESXi hosts and clusters, datastores and virtual machines – and Nexsan Storage Systems, Nexsan Volumes, and Storage Pools, particularly where these systems are handled by different teams.

To install and start using the plugin for E-Series and BEAST Storage Systems, go to https://helper.nexsansupport.com/esr_vmware on the Nexsan Support pages, to download the software, installation guide, and user documentation.

## VAAI hardware acceleration

Nexsan E-Series Storage Systems include a built-in VAAI (vStorage APIs for Array Integration) plugin to provide hardware acceleration for VMware ESXi environments. VAAI hardware acceleration functionality enables the VMware ESXi host to offload specific virtual machine and storage management operations to E-Series Storage Systems. With storage hardware assistance, the VMware ESXi host performs these operations faster and consumes less CPU, memory, and storage fabric bandwidth.

E-Series systems support these VAAI functions:

- **Full Copy**: This feature enables the storage arrays to make full copies of data within the array without the need for the VMware ESXi server to read and write the data. Rather than reading and writing each block of data, the server sends a single SCSI (Extended Copy) command for a set of contiguous blocks to instruct the storage array to copy the blocks from one location to another. The actual work is performed on the storage array. This enhancement saves time when cloning a virtual machine, performing a Storage Motion, or deploying virtual machines from a template.

- **Block Zero**: This feature enables storage arrays to zero out a large number of blocks to speed up virtual machine provisioning. Instead of sending multiple redundant write commands over the network, the server uses the SCSI Write Same command to instruct the storage device to write the same data to a number of blocks. Instead of having the host wait for the operation to complete, the storage array returns to the requesting service as though the process of writing zeros has been completed. This can be especially helpful when thick-provisioning virtual disks.

- **Hardware Assisted Locking**: This feature provides an alternate means of protecting data in VMware virtual machine file systems (VMFS). When a host accesses a common data store, only block-level data is locked during access, leaving the rest of the logical unit accessible by other hosts. This also improves the scalability of large ESXi servers sharing a VMFS data store.

See also Enabling VAAI hardware acceleration on page 20

# Recommended Nexsan storage configurations

To use Nexsan Storage Systems in a VMware environment, make sure to review these requirements and recommendations.

**Note** Nexsan recommends these default configurations because of their versatility. However, you may get better performance using different settings based on your specific environment and I/O characteristics.

### RAID configurations

Depending on your data protection and performance requirements, use RAID 5 or RAID 6, and approximately 10 disks per array.

### Use one LUN per array

Given that the VMware datastore size limit is 64 TB, Nexsan recommends using only one LUN per array, and reducing the number of disks per RAID set if necessary to stay below that limit.

> ⚠ **CAUTION:** Placing multiple LUNs or datastores on the same disks may severely impact performance.

### Load balancing

Distribute arrays evenly between the controllers in dual-controller storage systems.

See also Recommended VMware host and storage configurations below

# Recommended VMware host and storage configurations

Nexsan recommends the following for VMware host and storage infrastructure configurations:

- Use one datastore per LUN, and either use VMware Storage Distributed Resource Scheduler (DRS) or manually distribute VMs across them. Datastores spanning multiple LUNs are supported, but not recommended, as ESXi will not automatically load-balance across them.

- If all concurrently active VMs have similar workloads, distribute them evenly across datastores. If workloads differ, place VMs with similar workloads on the same datastore, and/or place VMs with high random I/O, such as large databases, on a separate datastore.

- Review the planned VMware storage configuration against the VMware configuration maximums here: https://configmax.vmware.com/

- For redundancy, use at least a dual-port HBA in each ESXi host. Also, set up each ESXi host with at least one path to each Nexsan E-Series or BEAST controller. To provide maximum redundancy against controller, switch, SFP, or cable failures, if the system is using Fibre Channel or Ethernet switches, use two switches. Then, connect from both switches to one port on each host and to one port on each controller.

- Limit each ESXi host to eight total paths per LUN. You can use switch zoning, LUN mapping, or access controls on the E-Series or BEAST, as necessary. Higher path counts are supported, but may result in increased failover and discovery times.

- Use VMFS6 on ESXi 6.5 or later (minimum VMFS5).

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# VMware and Nexsan provisioning requirements

VMware ESXi supports two models of storage provisioning: thick provisioning and thin provisioning. Please see "Thin Provisioning and Space Reclamation" on the *VMware Docs* Web pages.

## *Thick provisioning*

With thick provisioning, which follows a traditional storage provisioning model, you allocate a large amount of storage space in advance, in anticipation of future storage needs. However, some or all of the allocated space might remain unused, causing under-utilization of storage capacity.

Thick provisioning IS fully supported on Nexsan E-Series and BEAST storage systems.

## *Thin provisioning*

In contrast with thick provisioning, thin provisioning helps to eliminate storage under-utilization problems by allocating storage space in a flexible, on-demand manner. With ESXi, you can use two models of thin provisioning: array-level thin provisioning (NOT supported on Nexsan E-Series and BEAST storage systems - see below), and virtual disk-level thin provisioning.

Thin provisioning enables you to report more virtual storage space than actual physical capacity. This discrepancy can lead to storage over-subscription, also called over-provisioning. When you use thin provisioning, you must monitor actual storage usage to avoid exceeding physical storage space.

### *Virtual disk thin provisioning*

When you create a virtual machine, a certain amount of storage space on a datastore is provisioned to virtual disk files. For more information, see "Virtual Disk Thin Provisioning" on the *VMware Docs* Web pages.

Virtual disk thin provisioning IS fully supported on Nexsan E-Series and BEAST storage systems.

### *Array thin provisioning*

You can use thin-provisioned storage arrays with ESXi, but it is NOT supported in Nexsan E-Series and BEAST. For more information, see "ESXi and Array Thin Provisioning" on the *VMware Docs* Web pages.

1

# Chapter 2

# Setting up VMware

This chapter contains the following sections:

2

## Configuring the vSphere environment

Perform the following steps to configure the vSphere environment for use with Nexsan Storage.

▶ **To prepare vSphere for hosting Nexsan Storage Systems:**

1. Install the Nexsan RAID Storage Plugin for VMware vCenter. Go to
   https://helper.nexsansupport.com/esr_vmware on the Nexsan Support pages, to register and to
   download the software, and installation and user guides.

2. Configure multipathing on all ESXi hosts using the Nexsan scripts, available from
   https://helper.nexsansupport.com/esr_downloads on the Nexsan Support pages. To set up
   multipathing, see Configuring multipathing for VMware below.

3. Use vCenter Update Manager to update all ESXi hosts to the most recent version and patch level.

   **Note** You can also manually update the servers by downloading the patches from my.vmware.com.

4. Make sure that all of your host bus adapters (HBAs) are updated to the latest firmware version and
   patch level.

5. For HBAs and their drivers, ensure that all storage HBAs and driver versions are approved for VMware.
   See Changing queue depth for HBAs on page 14.

## Configuring multipathing for VMware

Use this procedure to configure multipathing for VMware using the Nexsan configuration scripts posted on
the Nexsan E-Series/BEAST VMware support pages. Please see https://helper.nexsansupport.com/esr_
downloads

You can set up multipathing using scripts for either

- PowerCLI, for Windows users, or
- ESXi shell, logging in via SSH.

Both scripts support options to configure the multipathing behavior for currently connected LUNs and new
LUNs, and default to our latest recommendations for our products in general use cases: round-robin across
optimized paths, and switching paths for each I/O.

For environments with specific requirements, this can be changed using the options below.

**Note** If you prefer to configure multipathing manually rather than using the Nexsan scripts, use the settings
`VMW_PSP_RR` and `IOs=1`. For details, see "Managing Path Policies" in the VMware vSphere 6.5
Documentation Center.

▶ **To configure multipathing using PowerCLI:**

1. Install PowerCLI for VMware. In Windows PowerShell, enter:

   ```
   Install-Module VMware.PowerCLI

   Set-PowerCLIConfiguration -InvalidCertificateAction Prompt
   ```

2. Connect either to vCenter or an ESXi Server:

   ```
   Connect-VIServer <IP address>
   ```

3. Specify the host:

| Host type | Command |
|---|---|
| One ESXi (single host) | `$hosts = Get-VMHost` |
| All hosts in all data centers | `$hosts = Get-VMHost` |
| One specific host | `$hosts = Get-VMHost <host name>` |
| All hosts in a specific data center | `$hosts = Get-Datacenter <data center> \| Get-VMHost` |

4. Display the current multipathing policy for current LUNs, and the default policy for new LUNs:

   `.\nexsan-vmw-multipath.ps1 $hosts`

5. Set the multipathing policy:

| Policy | Command |
|---|---|
| Nexsan-recommended default (round-robin, change path every I/O) | `.\nexsan-vmw-multipath.ps1 $hosts -Enable` |
| Explicitly to MRU | `.\nexsan-vmw-multipath.ps1 $hosts -Enable -MRU` |
| Round-robin, changing path every <n> I/Os | `.\nexsan-vmw-multipath.ps1 $hosts -Enable -IOPs <n>` |
| Round-robin, changing path every <n> bytes | `.\nexsan-vmw-multipath.ps1 $hosts -Enable -Bytes <n>` |
| ESXi default | `.\nexsan-vmw-multipath.ps1 $hosts -Disable` |

**2**

► **To configure multipathing using ESXi shell:**

1. Enable SSH on the ESXi server and log in as root.

2. Copy the `nexsan-vmw-multipath.sh` script to the ESXi server. See the VMware Knowledge Base article "Using SCP to copy files to or from an ESX host (1918)", at https://kb.vmware.com/s/article/1918

3. Display the multipathing policy for existing LUNs, and the default policy for new LUNs:
   `sh ./nexsan-vmw-multipath.sh`

4. Set the multipathing policy:

| Policy | Command |
|---|---|
| Nexsan-recommended default (round-robin, change path every I/O) | `sh ./nexsan-vmw-multipath.sh -enable` |
| Explicitly to MRU | `sh ./nexsan-vmw-multipath.sh -enable -mru` |
| Round-robin, changing path every <*n*> I/Os | `sh ./nexsan-vmw-multipath.sh -enable -iops <n>` |
| Round-robin, changing path every <*n*> bytes | `sh ./nexsan-vmw-multipath.sh -enable -bytes <n>` |
| ESXi default | `sh ./nexsan-vmw-multipath.sh -disable` |

## Optimizing multipathing

Use this procedure to optimize pathing for both iSCSI and Fibre Channel connections.

Nexsan Storage Systems support all modes of VMware multipathing.

► **To optimize load balancing:**

1. Run the system at full production level for several days to generate performance logs.

2. Use the VMware Performance pages or the Nexsan vCenter Plugin to analyze the host port and disk usage.

3. Adjust array load by moving VMs to less-used datastores.

4. Adjust port load in ESXi Path management.

## Changing queue depth for HBAs

If you notice unsatisfactory performance of your HBAs, you can use this procedure to change their maximum queue depths. The maximum value refers to the queue depths reported for various paths to the LUN.

When multiple virtual machines are active on a LUN, the value of *Disk.SchedNumReqOutstanding* is also relevant. In this case, the queue depth value is equal to whichever value is the lower of the two settings: adapter queue depth or *Disk.SchedNumReqOutstanding*. In that case, set both adapter queue depth and *Disk.SchedNumReqOutstanding* to the same lower setting value.

In general, the following formula applies to each path between the host machine and the array:

[Total number of LUNs] * QDepth < [Array queue depth]

**Notes:**

- As queue depth increases, so often do IOPS and latency. You should select a QDepth that meets the IOPS and latency requirements of your installation.

- The default queue depth value of 32 is usually satisfactory for Emulex HBA cards.

- For Fibre Channel HBAs under vSphere 6.5, set the QDepth to its maximum setting.

- You only need to set the maximum queue depth when more than one virtual machine is active on a LUN.

► **To change the queue depth for an HBA:**

1. Determine which HBA module is loaded by running the applicable command in the service console.

    If you are using QLogic, run:

    - `vmkload_mod -l | grep qla`

    OR

    If you are using Emulex, run:

    - `vmkload_mod -l | grep lpfc`

2. Run the applicable queue depth command.

    If you are using QLogic, run:

    - `esxcfg-module -s ql2xmaxqdepth=16 <HBA module>`
      (where `<HBA module>` is the result of the previous step)

    OR

    If you are using Emulex, run:

    - `esxcfg-module -s lpfc0_lun_queue_depth=16 <HBA module>`
      (where `<HBA module>` is the result of the previous step)

    **Note** These example commands set HBA LUN queue depths to 16.

3. Reboot the ESXi host.

2

2

# Chapter 3

## Setting up Nexsan Storage

This chapter contains the following sections:

3

## Preparing the system

Nexsan recommends the following preparatory checks prior to configuring Nexsan Systems for use with vSphere:

- Wherever possible, update your Nexsan Storage System to the latest available firmware. See Service and support on page vi.

- For dual-controller systems, do the following:

    - Distribute arrays evenly between the controllers.

    - Make sure **System Mode** is set to **All Ports All LUNs (APAL)**.

        **Notes:**

        Dual-controller E-Series P Storage Systems always operate in APAL mode.

        For single-controller systems, only one RAID Controller is active, and failure of this controller makes all arrays and volumes inaccessible. This is the only possible setting on single-controller units.

Figure 3-1: System Mode page



- Check the VAAI third party copy setting and adjust as required. See VAAI hardware acceleration on page 8.

- For ease of management, assign consistent names to arrays, volumes, and VMware datastore. These names display in vCenter and the Nexsan RAID storage plugin.

- If more than one ESXi host will be accessing the same datastore, AutoMAID should be disabled for the array containing that datastore. ESXi continuously reads and writes heartbeats to on-disk areas to arbitrate access between multiple hosts, and AutoMAID may cause these requests to exceed the VMware-defined timeouts. See the VMware Knowledge Base article "VMFS Heartbeat and usage of ATS (52879)" https://kb.vmware.com/s/article/52879 for more information.

# Configuring Nexsan Systems for use with vSphere

Use this procedure for help with setting up Nexsan Systems for use with vSphere.

▶   **To configure Nexsan Storage Systems for use with vSphere:**

1.  When setting up RAID arrays and volumes, follow the recommendations for the storage system you are configuring. See Recommended Nexsan storage configurations on page 9.

2.  Do either of the following:

    **Use the Nexsan RAID plugin for vCenter:**

    a.  Create a VMware storage pool (an array), and then create a Nexsan volume and VMware datastore. See the *Nexsan High-Density Storage Plugin for VMware vCenter User Guide*.

    b.  If necessary, use the wizard in the Nexsan vCenter Plugin to assign hosts to volumes. See "Assigning a host to a Nexsan Volume" in the *Nexsan High-Density Storage Plugin for VMware vCenterUser Guide.*

    OR

    **Use the E-Series Web interface:**

    a.  Create the arrays and volumes.

    b.  Label each volume with a descriptive name.

    c.  Map all volumes, starting with **LUN 0**. Make sure that the **Use same LUN for all ports of the same type** check box is checked.

Figure 3-2: LUN mapping



3.  Give read/write access to all initiators on ESXi hosts that require access to the datastore.

4.  To use the Nexsan RAID plugin for vCenter to configure access, open a volume, and then under **Assigned Hosts**, click **Details** > **Assign Hosts**. Then you can select an initiator and click **Assign**.

    If you change HBAs or add new ESXi hosts, repeat this step or complete the task using the Nexsan vCenter Plugin.

Figure 3-3: Host port access



5.  For iSCSI connections, use Jumbo Frames wherever possible. See "Configure 10Ge iSCSI" and "Configure 1Ge iSCSI" in Chapter 3 of the *Nexsan Nexsan High-Density Storage User Guide*.

## Enabling VAAI hardware acceleration

► **To enable VAAI hardware acceleration:**

**Note** VAAI hardware acceleration is enabled by default. Use this procedure only as needed. A reboot is required to complete this procedure, so advance preparation may be required.

1. Select **System Admin > Cache**.

2. Enable **SCSI third-party copy extensions**.

3. Reboot the Nexsan Storage System.

3

# Glossary

## 1

### 10Gb Ethernet
A 10 gigabit per second (Gb/s) Ethernet connection using either fibre-optic cables or twisted-pair copper wires.

### 10Gb iSCSI
An iSCSI connection that runs on a 10Gb Ethernet network.

### 10GbE
See "10Gb Ethernet" and "10Gb iSCSI".

## A

### Active Directory
Microsoft's directory service, used by all supported Windows operating systems. Abbreviated "AD".

### All Ports All LUNs (APAL) mode
A system mode for Nexsan Storage Systems. In this mode, the entire system operates as a single node. The volumes can be mapped to any or all ports on both RAID controllers. When a controller fails, the ports on that controller become inaccessible. However, if the volumes are mapped to ports on the other controller as well (which requires the host to be configured for multipathing), they remain accessible to the host, which sees the storage become active through its second path.

### array
In Nexsan storage terms, an array is a linked group of one or more physical, independent hard disk drives. In VMware, a storage pool is equivalent to an array. See also "RAID".

## B

### bit
The smallest unit of digital data, representing a 0 or a 1. Abbreviated "b".

### boot drive
The device from which a computer's operating system is loaded. Typically, an internal hard disk drive (or one of several partitions on such a drive) is used for this purpose, but any attached storage device–such as an optical disc drive, a USB flash drive, or other attached storage–can be used.

### byte
A unit of data that is 8 bits long. Often used for alphanumeric characters. Abbreviated "B".

## C

### Controller
See RAID Controller

# D

**Datastore**

In VMware, datastores are virtual containers for files. Datastores contain structures used to store virtual machine files and hide the details about each storage device. Datastores can also store VM templates, ISO images, and floppy images. See https://pubs.vmware.com

**DNS**

See "Domain Name System".

**Domain Name System**

A program or computer server that implements a name-service protocol. It maps a human-recognizable identifier to a system-internal, often numeric, identification or addressing component (usually an IP address).

# E

**E-Series**

The series of Nexsan units that includes the Nexsan E18, E48, and E60 storage units (and their V and VT variants), the Nexsan E32V, the Nexsan E18X, E48X, and E60X expansion units (and their XV variants), and the Nexsan E32XV. Nexsan E-Series units feature Active Drawer Technology, Anti-Vibration Design, and CoolDrive Technology.

**Ethernet**

A system for connecting a number of computer systems to form a local area network (LAN), with protocols to control the passing of information and to avoid simultaneous transmission by two or more systems. Supports data transfer rates of 10, 100, 1,000, and 10,000 megabits per second (Mb/s). 10, 100, and 1,000Mb/s networks are often referred to as 10BASE-T, 100BASE-T, and 1000BASE-T, respectively. 10,000Mb/s networks are usually referred to as 10Gb Ethernet or 10GbE.

# F

**failover**

The capability of a system to switch over automatically to a redundant or standby system upon the failure or abnormal termination of the previously active system. In Nexsan Storage Systems, failover describes one RAID controller taking over the host connections and RAID set control of the other RAID Controller when that controller fails.

**Fibre Channel**

A gigabit (Gb) speed network technology primarily used for storage networking and the current standard connection type for storage area networks (SANs). Despite its name, Fibre Channel signaling can run on both twisted-pair copper wire and fibre-optic cables.

**Fibre Channel port**

Any entity that actively communicates over a Fibre Channel network. Usually implemented in a device such as disk storage or a Fibre Channel switch. Depending on the system, the Fibre Channel ports on Nexsan Storage Expansions can support 2Gb/s, 4Gb/s, or 8Gb/s connections.

**Fibre Channel switch**

A network switch compatible with the Fibre Channel protocol. Allows the creation of a Fibre Channel network, which is currently the core component of most storage area networks (SANs).

**firmware**

Small, fixed software applications, stored in read-only memory (ROM) or programmable read-only memory (PROM), that internally control various electronic devices. In Nexsan E-Series, and SATABeast/SASBeast storage systems, each RAID controller is loaded with firmware to control its functionality. Occasionally, this firmware must be updated using the Update Firmware page in the graphical user interface.

**frame**

A data packet on an Ethernet or Fibre Channel link. Each frame encapsulates a piece of data with sender and destination information, along with a data integrity check routine. Normal frames can contain data up to 1,500 bytes in length. Jumbo frames can contain larger data payloads (9,000 bytes on Nexsan Storage Systems) and are supported on 1Gb/s and 10Gb/s Ethernet (10GbE) networks. Jumbo frames are typically used to boost performance of iSCSI traffic.

# G

**GB**

Gigabyte. Approximately one billion (1,000,000,000) bytes. Used to describe the storage capacity of hard disk drives. A gigabyte is usually computed as 10^9 (1,000,000,000) bytes, but can also be computed as 2^30 (1,073,741,824) bytes (often called a "binary gigabyte" and abbreviated GiB).

**GB/s**

Gigabytes (GB) per second. Used to describe the speed of network data transmission. 1 GB/s is eight times faster than 1Gb/s.

**GiB**

Gibibyte. A binary gigabyte, computed as 2^30 (1,073,741,824) bytes. See "GB".

**gigabit interface converter**

A standard for transceivers, commonly used with Gigabit (Gb) Ethernet and Fibre Channel, with a hot-swappable electrical interface. Gigabit interface converter ports can support a wide range of physical media, from copper to optical fibre, at lengths of up to hundreds of kilometers.

**graphical user interface**

A type of user interface that allows users to interact with electronic devices using images rather than text commands. Nexsan Storage Systems use a graphical user interface for system configuration.

**GUI**

See "graphical user interface".

# H

**host**

A physical computer, server, or other device which accesses the volumes in a Nexsan Storage System. The host can be connected to the Nexsan Storage System with a Fibre Channel connection, an iSCSI connection, or a SAS connection. A VMware host computer runs virtual machines.

**hot spare**

A spare disk in a RAID array designated as "hot standby", available to replace a failed disk without requiring a system shutdown.

**HTTPS**

(HTTP Secure) Communications protocol for secure communication over a computer network, with especially wide deployment on the Internet. Technically, it is not a protocol in itself; rather, it is the result of simply layering the Hypertext Transfer Protocol (HTTP) on top of the SSL/TLS protocol, thus adding the security capabilities of SSL/TLS to standard HTTP communications.

# I

**I/O**

Input/Output. The communication between an information processing system (such as a computer or a Nexsan Storage System's RAID controller), and the outside world (either an operator or another information processing system). Inputs are the signals or data received by the system, and outputs are the signals or data sent from it.

**IP address**

Internet Protocol address. A numerical label assigned to each device (such as a computer, printer, or Nexsan Storage System) on a computer network that uses TCP/IP for communication.

**IP Configuration Tool**

One of six Nexsan Storage Tools. Allows users to configure the IP address of a Nexsan Storage System on the local subnet.

**iSCSI**

Internet Small Computer System Interface. A transport protocol that provides for the SCSI protocol to be carried over a TCP/IP network.

**iSCSI initiator**

In storage networks, initiators are typically software or hardware Fibre Channel, iSCSI, or SAS adapters accessing information on disk storage systems, the targets.

# J

**jumbo frame**

See "frame".

# K

**KB**

Kilobyte. Approximately one thousand (1,000) bytes. Used to describe the storage capacity of hard disk drives and the stripe size in RAIDs. A kilobyte is usually computed as 10^3 (1,000) bytes, but can also be computed as 2^10 (1,024) bytes (often called a "binary kilobyte" and abbreviated KiB).

**Kbit**

Kilobit. Approximately one thousand (1,000) bits.

**KiB**

Kibibyte. A binary kilobyte. Computer as 2^10 (1,024) bytes. See "KB".

# L

**load balance policy**

In multipathing, a set of instructions for the multipathing software to follow in order to ensure that I/O transfers through host paths are optimally routed and that no one path gets overloaded with data.

**logical unit**

See "volume".

**LUN**

Logical Unit Number. An identification scheme for storage disks that supports a small number of logical units. On Nexsan Storage Systems, LUNs are assigned to volumes and are addressed as LUN 0 through 254.

# M

**MB**

Megabyte. Approximately one million (1,000,000) bytes. Used to describe the storage capacity of hard disk drives. A megabyte is usually computed as 10^6 (1,000,000) bytes, but can also be computed as 2^20 (1,048,576) bytes (often called a "binary megabyte" and abbreviated MiB).

**MB/s**

Megabytes (MByte) per second. Used to describe the speed of network data transmission. 1 MB/s is eight times faster than 1Mb/s.

**Mbit**

Megabit. Approximately one million (1,000,000) bits.

**Mbit/s**

Megabits (Mb) per second. Used to describe the speed of network data transmission.

**MiB**

Mibibyte. A binary megabyte. Computed as 2^20 (1,048,576) bytes. See MByte.

multipathing

A means of presenting volumes to a particular host or hosts via redundant data paths. The intent is to maintain I/O in the event of a path failure. Multipathing may also be used to increase performance. If not configured properly, multipathing may lead to data corruption, as an operating system may not inherently realize that the redundant paths are of the same volume and thus could treat them as different volumes.

# P

PSC

Platform Services Controller (PSC) "is a component of the VMware Cloud Infrastructure Suite. PSC deals with identity management for administrators and applications that interact with the vSphere platform." See http://docs.vmware.com

# R

RAID

Redundant Array of Independent Disks. A system using multiple hard drives organized into a single logical unit for the sharing or replication of data in order to increase data integrity, fault-tolerance, and throughput. Also referred to as a RAID set. RAIDs are organized into RAID levels, which describe their architecture and configuration.

RAID 5

RAID 5 provides redundancy by writing data and parity information across three or more drives, thereby increasing performance. You need at least three disk drives for a RAID 5 implementation. RAID 5 can withstand a single disk failure without losing data or access to data. It is ideally suited for transaction processing, database applications, file and print servers.

RAID 6

RAID 6 is similar to RAID 5, but with better fault tolerance. RAID 6 stripes blocks of data and parity across an array of drives like RAID 5, except that it calculates two sets of parity information for each parcel of data. This significantly improves fault tolerance: RAID 6 can withstand the failure of any two drives in the array without losing data or access to data. You need at least four disk drives for a RAID 6 implementation. RAID 6 is ideally suited for the same applications as RAID 5, but in situations where additional fault tolerance is required. We recommend adding Nexsan FASTier cache devices to a RAID 6 implementation to improve write performance.

RAID Controller

A hardware device, software program, or combination of the two which manages the physical disk drives in a RAID and presents them as a single logical unit to attached devices. The RAID Controllers in Nexsan Storage Systems are hardware modules. Nexsan RAID Controllers also provide connections for system administration and configuration.

RDM

RDM is "a mapping file in a separate VMFS volume that acts as a proxy for a raw physical storage device. The RDM allows a virtual machine to directly access and use the storage device. The RDM contains metadata for managing and redirecting disk access to the physical device." See About Raw DEvice Mapping, in http://docs.vmware.com

reboot

To restart a computer or computerized electronic device. See also system reboot.

# S

SAS

Serial Attached SCSI. A serial version of the SCSI interface. A point-to-point architecture

that uses a disk controller with four or more channels that operate simultaneously. Each full-duplex channel, known as a SAS port, transfers data at 1.5Gb/s, 3Gb/s, or 6Gb/s in each direction. SAS also supports Serial ATA (SATA) drives, which can be mixed with SAS drives in a variety of configurations.

SATA

Serial Advanced Technology Attachment. A connection standard for fixed and removable hard disk drives.

SCSI

Small Computer System Interface. A collection of standards and proposed standards for input/output (I/O) communication, primarily intended for connecting storage subsystems or devices to hosts.

Storage Pool
See "Array"

# T

TB

Terabyte. Approximately one trillion (1,000,000,000,000) bytes. Used to describe the storage capacity of hard disk drives. A terabyte is usually computed as 10^12 (1,000,000,000,000) bytes, but can also be computed as 2^40 (1,099,511,627,776) bytes (often called a "binary terabyte" and abbreviated TiB).

TiB

Tibibyte. A binary terabyte. Computed as 2^40 (1,099,511,627,776) bytes. See TB.

# V

VAAI

vStorage APIs for Array Integration is a plugin that provides hardware acceleration in VMware ESX and ESXi environments.

vCSA

The vCenter Server Appliance is a pre-configured Linux virtual machine, which is optimized for running VMware vCenter Server® and the associated services on Linux. See http://docs.vmware.com

VMFS

Virtual machine file system, a clustered file system used by VMware vSphere to store virtual machine disk images and snapshots.

volume

An area of usable storage that is addressed as a single unit as if it were a separate, physical disk drive. Volumes can exist on a single disk drive or on a RAID that spans multiple disk drives.

# W

WWN

A World Wide Name (WWN) "or World Wide Identifier (WWID) is a unique identifier used in storage technologies including Fibre Channel, Advanced Technology Attachment (ATA) or Serial Attached SCSI (SAS)." See http://www.wikipedia.org

# NEXSAN

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This product is protected by one or more of the following patents, and other pending patent applications worldwide: United States patents US8,191,841, US8,120,922; United Kingdom patents GB2466535B, GB2467622B, GB2467404B, GB2296798B, GB2297636B

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