



# Supercharge Booting Servers Directly from a Storage Area Network

The benefits of SAN Fibre Channel and FCoE connectivity

## At a Glance

The full line of Emulex FC HBAs and FCoE CNAs provide “Boot from SAN” functionality, offering enhanced server and storage management capabilities as well as reduced total system costs. This paper highlights the manageability benefits, the availability benefits and the major configuration steps for booting from a SAN.

## Products

- Emulex LightPulse® HBAs and blade server connectivity solutions.
- Emulex OneConnect™ FCoE CNAs and blade server connectivity solutions

## Applications

- Storage availability
- Server consolidation
- Server redeployment
- Disaster recovery
- OS image management

## Introduction

Traditional servers today use a variety of data storage solutions, including direct attach (DAS), network attach (NAS) and storage area network (SAN). Historically, these servers were configured to boot their operating system from an internal storage device (typically a parallel SCSI hard disk). As organizations implement large-scale data centers, sometimes with thousands of servers, they have sought methods to increase efficiencies through exclusive use of shared storage even for booting. In addition, with the dramatic increase in the use of rack-mount and blade servers, there is a particularly acute need to convert to diskless servers and rely completely on shared storage devices.

This paper discusses the capability of booting servers directly from OS images located on the SAN through a Fibre Channel host bus adapter (HBA) or a Fibre Channel over Ethernet (FCoE) converged network adapter (CNA). It describes the Emulex “Boot from SAN” implementation, and how it delivers a markedly enhanced level of manageability and availability, even in heterogeneous computing environments with distinct hardware and operating system requirements. Finally, it describes the four major steps involved in properly configuring a server to “Boot from SAN.”

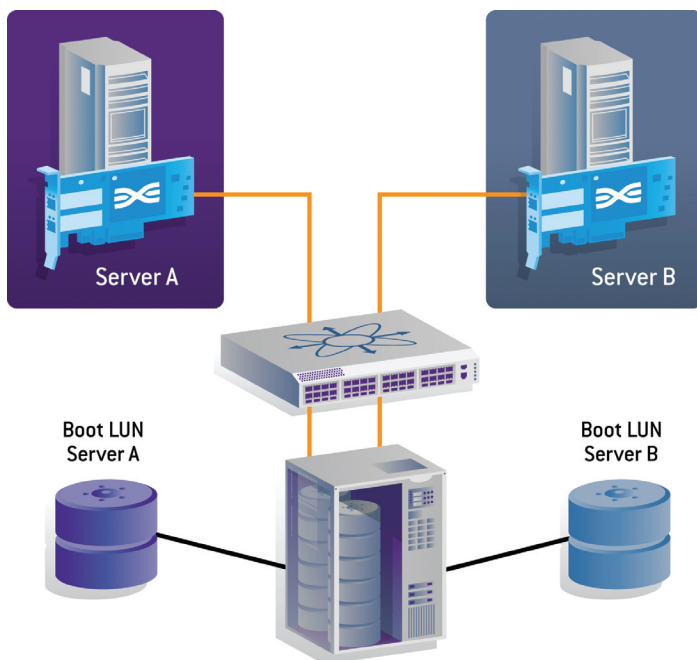
## What is “Boot from SAN”?

“Boot from SAN” has become a de facto description for the capability of servers loading and executing an operating system from a device on the SAN. A SAN provides a common link between multiple servers and storage systems, allowing independent scaling of storage and/or server processing power as requirements demand (see Figure 1).

As with locally attached storage, boot from SAN allows servers to load their operating systems directly from a SAN storage device. For instance in an x86 system, by extending the server system x86 BootBIOS, boot from SAN functionality is provided by the x86 BootBIOS contained on Emulex LightPulse HBAs or OneConnect UCNAs in the server. When properly configured, the HBA or CNA then ‘points’ the server to boot from a LUN on the SAN just like pointing to a partition on a local disk.



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**Figure 1** This “Boot from SAN” diagram shows two servers using Emulex Fibre Channel HBAs (or UCNAs) to access their boot images which are located on an external array.

## Benefits of Booting from the SAN

Booting from SAN yields numerous benefits to an organization’s computing infrastructure and investment. Key benefits of Boot from SAN include:

**Centralized OS image management**—OS images are stored on the SAN devices, so maintenance and upgrades can be managed from a central point, eliminating ‘touch time’ on each individual server. In addition, diskless blades can use the SAN storage array exclusively.

**Availability**—RAID technology and disk mirroring provide higher system availability transparent to the operating system. RAID5 allows failure of physical disk hardware with no impact on system availability.

**Disaster recovery**—Disk mirroring capabilities provide for constant mirroring of disk images, both locally and to remote sites. In a disaster recovery situation, the server can be quickly redirected to a remote OS boot image with no data loss. In addition, back-up servers can be replaced and targeted to boot from an OS image in the event of server failure or malfunction.

**Server redeployment and failure recovery**—SAN technology provides numerous capabilities for cloning of systems and distribution of operating system environments. This, in combination with boot from SAN, allows servers to be deployed and redeployed for various tasks through OS image management, thereby leveraging the availability of a robust storage infrastructure.

## The Benefits of the Emulex Implementation of Boot from SAN

Emulex adapter boot functionality provides numerous benefits for configuring SAN boot. Depending on the host server, these benefits include:

**Universal Boot**—Emulex HBAs and CNAs are exceptional in that they provide one universal boot code image supporting three system types:

- **x86 BootBIOS**—typically found in x86 and x64 BIOS-based platforms
- **UEFI**—Unified Extensible Firmware Interface is the new standard developed to replace BIOS and EFI (Itanium 64) interface; it has been broadly adopted by all major computer vendors
- **OpenBoot**—F-code boot functionality for Sun® SPARC systems or IBM PowerPC systems running AIX or Linux

These code images reside in the Emulex adapter in flash memory. The system BIOS automatically senses the correct boot protocol to use and transparently executes it.

**Multi-topology support**—All three Fibre Channel topologies are supported by Emulex, including: point-to-point, fabric and public/private arbitrated loops.

**Multi-initiator support**—Emulex allows configuring multiple Emulex adapters in a system. Because of the time required to scan a device, Emulex recommends that no more than eight Emulex adapters be configured for boot.

**Boot fail over/sequential booting**—If the first boot entry in the boot table for an individual HBA or CNA fails due to a disk hardware error, the Emulex adapter will sequentially attempt to boot from the next boot entry. In conjunction with disk mirroring, this provides failover protection by automatically redirecting boot when necessary, without user intervention. In a system with multiple Emulex adapters, the sequence can proceed from one Emulex adapter to the next in similar fashion if the fabric or storage connected to that adapter is not available. Emulex supports up to eight redundant boot paths.

**Boot device selection by WWPN or D\_ID**—Emulex allows Fibre Channel devices to be selected by either their WorldWide Port Name (WWPN) or their Destination ID (DID).

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## The Inner Workings of Boot from SAN

There are several requirements to enable a server to boot from a Fibre Channel or FCoE device on a SAN. Proper configuration of the Emulex adapter's boot parameters is the key to trouble-free booting and OS operation.

As mentioned above, Emulex provides universal boot code within its adapters. Based on the system architecture, the proper protocol is automatically selected at boot time. Emulex was also first to support boot from SAN in UEFI environments, providing system administrators with all the rich features UEFI standard is designed to deliver.

There are four general steps involved in configuring a server to boot from a SAN. Please consult Emulex documentation for information specific to your system configuration and operating systems (see references).

**1 Configuring the HBA and CNA.** As described above, the initial step of configuration is confirming that boot code is loaded and enabled on the HBA or CNA, either the universal image or a particular image of choice. Emulex provides command-line utilities and the OneCommand™ Manager management software for updating boot and firmware flash images, in addition to managing adapter parameters.

Once a boot image is present on the Emulex adapter, additional configuration steps are required to enable boot redirection to the SAN.

**2 Boot disk information.** When the Emulex adapter is configured for booting, it must also be configured to a point boot device on the SAN. Emulex allows the SAN device to be identified by its WWPN, D\_ID or AL\_PA (arbitrated loop physical address). The LUN number on this SAN device must also be identified in the configuration function properly.

There are three methods for configuring the boot disk information within the HBA or CNA:

**Configuration with a GUI or CLI utility**—Manual configuration is provided by one of the three boot images (x86 BootBIOS, OpenBoot and EFIBoot). Depending on the underlying system, Emulex provides a GUI or command-line utility to define the boot disk configuration.

The GUI-based boot BIOS utility provides IT administrators with the flexibility to configure adapters prior to initiation of the operating system, helping to significantly reduce server deployment time. With the Emulex boot BIOS utility, IT administrators can manually add new devices, change adapter boot order and deploy multi-boot configurations. Commonly used commands can be easily accessed helping to streamline navigation while the ability to verify adapter connectivity prior to OS initiation helps to improve management efficiency.

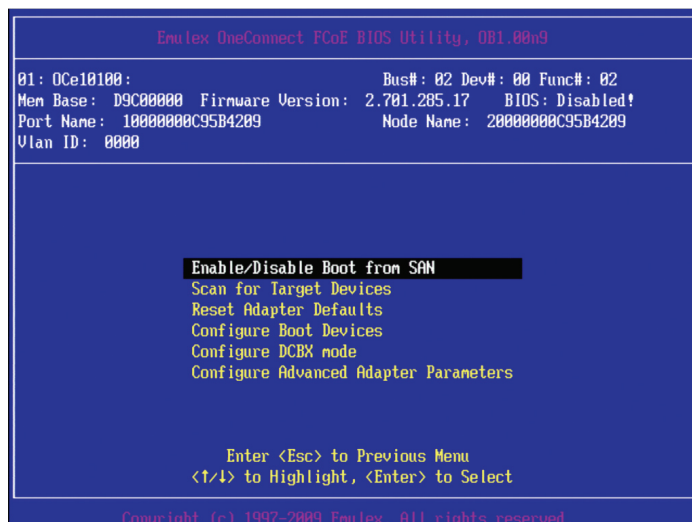


Figure 2 Emulex boot BIOS utility.

The following are the primary capabilities of Emulex Boot BIOS utility (See Figure 2):

- Enable/Disable Boot from SAN
- Scanning for target devices
- Resetting adapter defaults
- Configuring boot devices
- Configuring advanced adapter parameters

Emulex's boot BIOS configuration utility helps IT administrators improve management and efficiency within data center environments.

**Integrated with blade server provisioning software**—Emulex provides pre-boot, scriptable utilities as a programmatic way to integrate with blade server provisioning solutions in order to deliver seamless, automated boot from SAN setup. This applies, for example, to HP's Rapid Deployment Pack (RDP) in BladeSystem environments. Though automated, this also requires knowledge of the SAN and LUN configuration.

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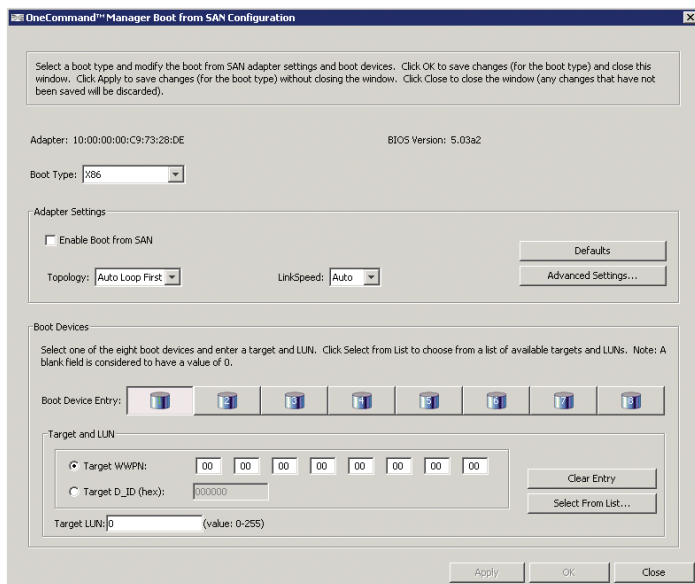


Figure 3 OneCommand Manager's online "Boot from SAN" configuration.

## Online configuration with OneCommand Manager—

OneCommand Manager allows IT administrators to fully configure "Boot from SAN" settings while the server is in online. This capability gives IT administrators the ability to pre-stage "Boot from SAN" settings while the server is operating in a production environment. Thereby, helping them expedite server provisioning by delaying reboot until the next maintenance cycle and eliminating the need to take a server off-line. Emulex's On-line Boot-from-SAN capability introduces greater speed and flexibility in server deployments which helps to reduce costs and optimize SAN availability. (Refer to Figure 3 for a screenshot of this capability.)

**3 Installing the operating system.** Once the HBA or CNA is configured to manage the server boot process, the targeted OS can be installed to the identified LUN on the SAN. The specific methodology for this installation is system architecture-dependent, and described in detail in Emulex documentation (see references).

Note that Emulex has extensive support for today's most popular operating systems including:

- Windows<sup>1</sup>
  - Windows Server 2008 R2 (x64 and Itanium)
  - Windows Server 2008 (x86, x64 and Itanium)
  - Windows Server 2003 (x86, x64 and Itanium)
- Linux
  - Red Hat Enterprise Linux RHEL 4, RHEL 5
  - Novell SLES 9, SLES 10, SLES 11
  - Kernel v2.4 and v2.6
  - Oracle Enterprise Linux 4 and 5
- Solaris
  - Solaris 8, 9 and 10 (SPARC)<sup>2</sup>
  - Solaris 10 (x86 and x64)
- NetWare<sup>3</sup>
  - Version 6.5
- HP-UX
  - HP-UX 11, 11i, 11iv2 (PA-RISC)<sup>4</sup>
  - HP-UX 11iv2 and HP-UX 11iv3 (IA 64)<sup>5</sup>
- VMware
  - ESX Server 3.5, 4.0

<sup>1</sup> Emulex OneConnect CNAs are currently not supported on Windows Itanium platforms.

<sup>2</sup> Emulex OneConnect currently does not support SPARC boot.

<sup>3</sup> Emulex OneConnect is not supported with NetWare.

<sup>4</sup> Older Emulex distributed HP-UX drivers do not feature boot from SAN.

<sup>5</sup> HP-UX Drivers for Emulex HBAS and CNAs are distributed by HP.

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**4 Post-OS install considerations.** Implementing boot from SAN on a server is a relatively straightforward process for seamless operation of boot from SAN. However, there are some dependencies on the operating system, drivers and storage configuration that need to be generally understood in order for this process to go smoothly. Certain items should be considered, depending on the operating system being used:

- **Ensure proper identification of LUNs**—For proper operation through server, SAN reset and re-connection, measures should be taken to make sure LUNs on the SAN retain their numbering after boot from SAN is implemented.
- **Restricted rights to boot disk**—Certain operating systems require exclusive access to a boot LUN, and cannot share or allow access from any other host.
- **Upgrading OS images stored on the SAN**—Certain operating systems require special techniques when upgrading, modifying or patching the base operating system.
- **Replacing Emulex adapters or servers**—Appropriate care should be taken when replacing HBAs or CNAs in a server, or reusing HBAs or CNAs in new servers. Boot code, SAN device and LUN settings from existing boot from SAN configurations should be recorded and replicated in any new hardware configurations.

## Conclusions

The dramatic increase in the complexity and reliability requirements of the business computing environment over the last several years has driven the industry to develop many technologies and methods to simplify support of large networks of hardware and software. Boot from SAN provides a more manageable server boot methodology and increases resource sharing and availability, reducing effort in manpower as well as hardware acquisition and maintenance. Emulex provides enhanced boot from SAN functionality for major platform architectures and operating systems with extensive features and capabilities, increasing overall availability. As the industry moves forward to denser computing, streamlining and eliminating local disk requirements through the use of boot from SAN provides numerous benefits to the organization.

Additional information about Emulex HBAs and CNAs that provide boot from SAN capabilities can be found at [www.emulex.com](http://www.emulex.com).

## References

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