



# iSCSI technologies in HP ProLiant servers with multifunction network adapters

technology brief

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# Abstract

This technology brief explains Internet Small Computer System Interface (iSCSI) technologies implemented in the HP ProLiant server line and clarifies how these technologies provide a simple and cost-effective infrastructure option for data center environments. It also explains accelerated iSCSI technology and how it is implemented in ProLiant servers using either embedded network interface cards (NICs) or optional multifunction NICs or mezzanine cards.

## Introduction

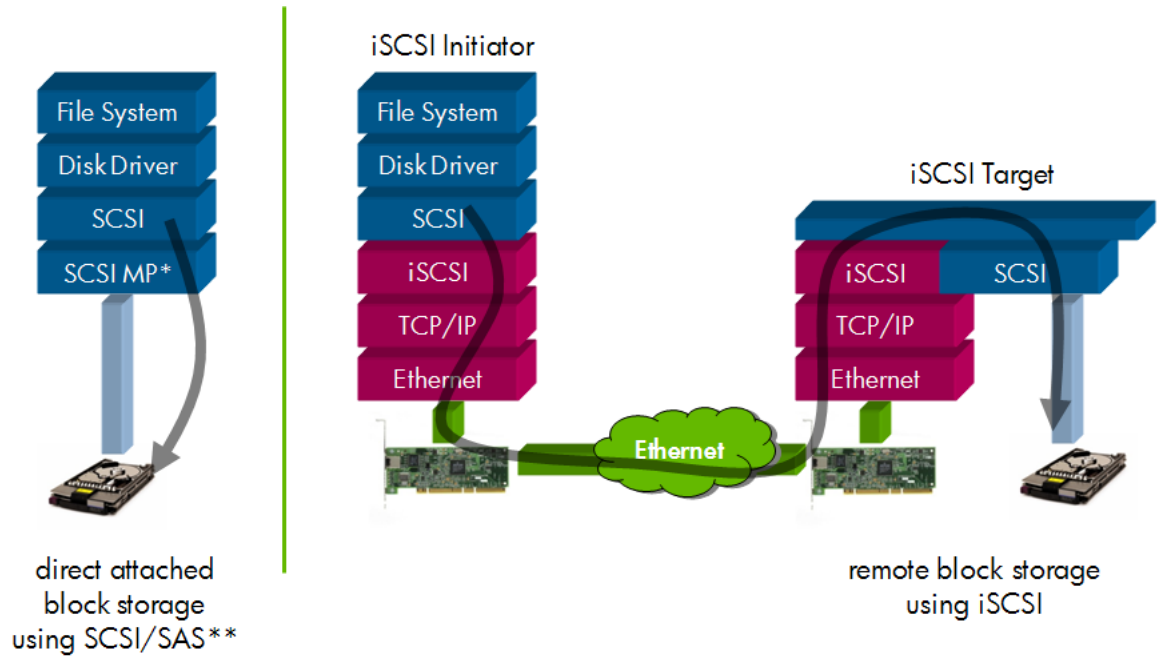
iSCSI is a standard that implements the Small Computer System Interface (SCSI) protocol for interacting with storage devices over a Transmission Control Protocol over Internet Protocol (TCP/IP) network. The most common implementation of iSCSI is over Gigabit Ethernet. iSCSI serves the same purpose as Fibre Channel (FC) in providing access to storage area networks (SANs), but iSCSI reduces much of the cost, complexity, and compatibility issues associated with FC SANs.

As part of the iSCSI working group of the Internet Engineering Task Force (IETF), HP engineers had hands-on involvement in writing the iSCSI specification that is used by all iSCSI providers. HP also developed the first multifunction network adapter that combined Ethernet and iSCSI capabilities in a single network card, including support for TCP/IP offload engine (TOE) and iSCSI acceleration.

## iSCSI message exchange

iSCSI follows the SCSI architectural model, which is based on message exchange between an initiator and a storage resource, or target (Figure 1).

**Figure 1.** Diagram of block storage using SCSI (left) and iSCSI (right)

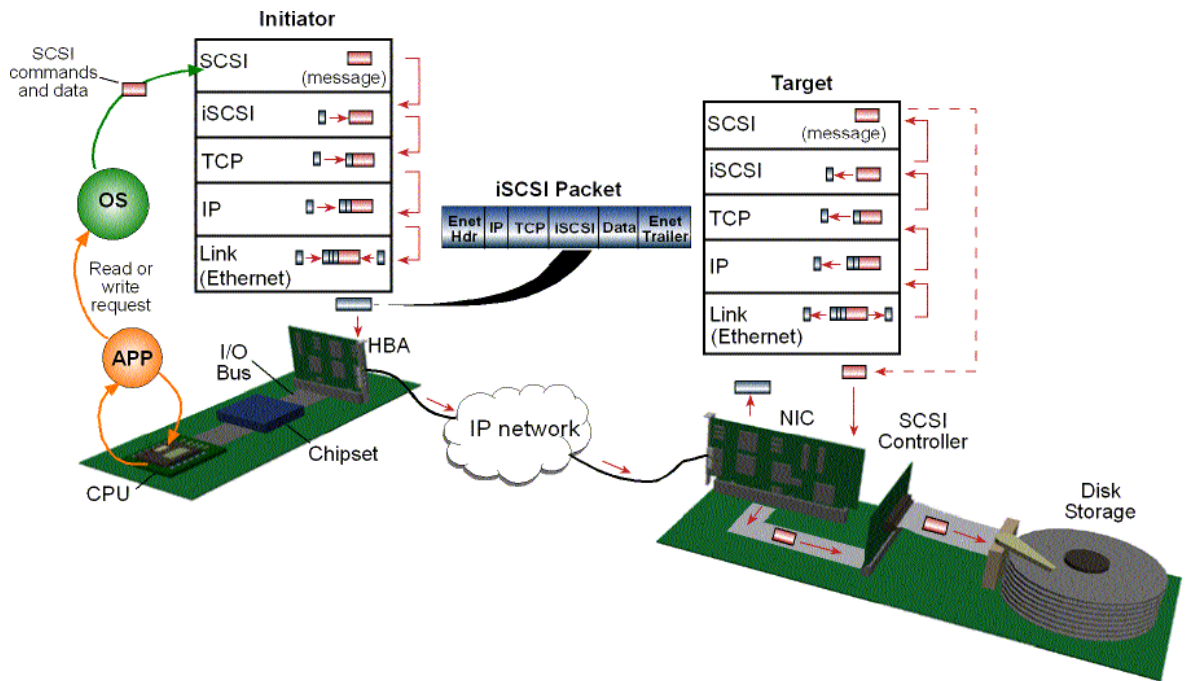


\* Multipathing  
\*\* Serial Attached SCSI

iSCSI initiators access targets using the iSCSI protocol. While the target is usually a hard drive enclosure or another computer, it can also be any other storage device that supports the iSCSI protocol, such as a tape drive. The iSCSI stack at both ends of the path encapsulates SCSI block commands into Ethernet packets for transmission over IP networks.

Figure 2 illustrates a message exchange between an initiator and a target. The process begins when an application sends a request to the operating system (OS) to read or write data. The OS generates the appropriate SCSI commands and data request in the form of a message. Before the message can be sent over an IP network, it is processed through iSCSI to encapsulate the request into the TCP/IP protocol stack (attaching routing, error checking, and control information) for transmission over the network. This can be accomplished using driver-level or OS-level software, or it can be offloaded to the host bus adapter (HBA). The HBA transmits the packets over the IP network. When the packets reach the target device, they go through a reverse process to reassemble the data, which is then moved to the SCSI controller. The SCSI controller fulfills the request by writing data to or reading data from the target device. If it is a read transaction, the target returns data to the initiator using the iSCSI protocol.

**Figure 2.** Message exchange between an initiator and target using the iSCSI protocol mode



Initiators include software initiators and HBAs. Software initiators require CPU resources to manage the protocol stack. A more efficient approach is to offload management of the protocol to an iSCSI HBA, such as the HP NC373i Integrated Multifunction Gigabit server adapter.

## Embedded and optional multifunction network adapters with accelerated iSCSI

Until recently, the typical server environment required separate connectivity products for networking, storage, interconnects, and infrastructure management. Because HP multifunction network adapters function as both iSCSI HBAs and Ethernet NICs, they support multiple functions through a single connection.

iSCSI allows Ethernet server adapters to function both as network adapters and as storage HBAs, providing access to storage boxes and servers over a single connection and simplifying network infrastructure. HP multifunction adapters support hardware-assisted, or accelerated iSCSI operation—that is, offloading the iSCSI software to the server adapter for improved system performance.

The HP ProLiant Essentials Accelerated iSCSI Pack is required to enable accelerated iSCSI on HP servers with embedded Multifunction Gigabit Ethernet server adapters. It is not required for the multifunction mezzanine cards and multifunction Gigabit Ethernet server adapters because accelerated iSCSI is included on these optional cards. For more information on the Accelerated iSCSI Pack, please go to [www.hp.com/go/iscsi](http://www.hp.com/go/iscsi).

A complete list of multifunction network adapters, mezzanine cards, and ProLiant servers and server blades that support multifunction networking is available at <http://h18004.www1.hp.com/products/servers/proliant-advantage/networking.html>.

## iSCSI boot

Within a Red Hat, SUSE Linux®, Microsoft® Windows® Server 2003, or Microsoft Windows Server 2003 for 64-bit Extended Systems computing environment, iSCSI boot allows the host server to boot from a remote OS image located on a SAN. An iSCSI firmware image (iSCSI boot option ROM) on the host server makes the remote disk drive appear as a local, bootable C: drive. The server is configured to connect to and boot from the iSCSI target disk on the network and to download the OS image from the iSCSI target disk. The HP iSCSI boot solution also includes scripts to significantly simplify the installation process. HP supplies the iSCSI boot option ROM at no cost to users. Adding an iSCSI HBA card is not required. The HP NC-Series iSCSI Boot Package for Windows is available at this URL:

[http://h20000.www2.hp.com/bizsupport/TechSupport/SoftwareDescription.jsp?lang=en&cc=us&wItem=MTX-028ce39726d74abfbb046f153f&jumpid=reg\\_R1002\\_USEN](http://h20000.www2.hp.com/bizsupport/TechSupport/SoftwareDescription.jsp?lang=en&cc=us&wItem=MTX-028ce39726d74abfbb046f153f&jumpid=reg_R1002_USEN).

The HP NC-Series iSCSI Boot Direct Install Package for Linux is available at this URL:

<http://h20000.www2.hp.com/bizsupport/TechSupport/SoftwareDescription.jsp?lang=en&cc=US&wItem=MTX-212a7a437b374218b9fe4e8db0>.

Table 1 lists HP multifunction network adapters with iSCSI boot capability.

**Table 1.** iSCSI boot capability on HP multifunction network adapters

Multifunction network adapter	iSCSI Boot for Linux	iSCSI Boot for Windows
HP NC370x Gigabit server adapter (all models)	Yes	Yes
HP NC371x Gigabit server adapter (all models)	Yes	Yes
HP NC373x Gigabit server adapter (all models)	Yes	Yes
HP NC374x Gigabit server adapter (all models)	Yes	Yes
HP NC380x Gigabit server adapter (all models)	Yes	Yes
HP NC382x Gigabit server adapter (all models)	Yes	Yes

# iSCSI functionality

iSCSI provides ProLiant servers ready access to storage resources over the same cable used for networking. It is an alternative solution to more expensive FC because it uses existing network infrastructure to connect SAN storage to ProLiant servers that do not have FC connectivity. Upgrading from direct attached storage (DAS) to an iSCSI-connected SAN array allows greater flexibility and asset utilization. Using common infrastructure reduces complexity and cost. Consolidating storage in a centralized pool through a SAN leads to greater efficiency because servers can have shared access to storage. Therefore, that data storage can be managed, increased, and protected from a single control point.

iSCSI can also provide access to FC storage from application servers. This lowers the cost-per-port to access an existing FC storage array.

## Operating distance

It is possible for an iSCSI-based network to economically span great distances using commonly available wide area networks (WANs). Longer operating distances will allow users to mirror and archive data at remote sites for disaster protection.

## Manageability

Using bridging products, iSCSI allows users to create SAN capacity over an IP network. iSCSI can use some existing IP-based network management software such as HP SmartStart and HP Systems Insight Manager (SIM).

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### Note

iSCSI devices require storage management tools such as Microsoft iSCSI Software Target. More information is available at this URL: [http://h18006.www1.hp.com/products/storageworks/ms\\_iscsi/index.html](http://h18006.www1.hp.com/products/storageworks/ms_iscsi/index.html)

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## Security

IP networks have a well-defined security infrastructure (encryption and authentication) that makes iSCSI viable for remote back up and disaster recovery applications. FC networks, on the other hand, are primarily protected with physical security.

### Encryption

An iSCSI transfer can optionally encrypt each packet, ensuring security until the packet is decrypted by the receiver. A set of protocols developed by the IETF called Internet Protocol Security (IPSEC) describes two encryption modes: transport and tunnel. Transport mode encrypts only the data portion (payload) of each packet and leaves the header untouched. Tunnel mode, on the other hand, encrypts both the header and the payload for increased security.

### Authentication

iSCSI has provisions to mutually authenticate servers with storage (the process of servers and storage devices proving their identities to each other). iSCSI uses the Challenge Handshake Authentication Protocol with Diffie-Hellman key protocol (DH CHAP). IPSEC can provide further protection with per-packet authentication.

## iSCSI performance

Performance has historically been a major challenge concerning iSCSI technology. Hardware-based iSCSI initiators have accelerated the connection between host servers and storage to significantly increase performance. In April 2008, HP commissioned the Tolly Group to evaluate the performance of multifunction server adapters in ProLiant servers featuring hardware-accelerated iSCSI. The HP end-to-end iSCSI solutions, equipped with NC373T and NC373i Multifunction Gigabit Ethernet adapters, demonstrated up to ten percent improvement in throughput. These hardware-based adapters also significantly reduced CPU utilization compared to software-based iSCSI using the same server hardware. The full report can be downloaded from this website:

<http://www.tolly.com/DocDetail.aspx?DocNumber=208305>.

## Conclusion

iSCSI technologies implemented in ProLiant servers and HP multifunction network adapters provide a less expensive and simpler infrastructure option for data center environments. iSCSI enables improvements in the economics, operating distance, and manageability of storage networks. Using iSCSI instead of FC can potentially result in a lower total cost of ownership (TCO) for businesses. Although the initial cost of iSCSI adapters may be comparable to that of FC HBAs, eventual industry-wide acceptance and volume production are expected to reduce the price for iSCSI adapters. Moreover, depending on application demands, Ethernet SANs can use existing network infrastructures.

## For more information

For additional information, refer to the resources listed below.

Resource description	Web address
HP Multifunction Networking Products	<a href="http://h18004.www1.hp.com/products/servers/proliant-advantage/networking.html">http://h18004.www1.hp.com/products/servers/proliant-advantage/networking.html</a>
HP ProLiant networking Ethernet network adapters	<a href="http://h18004.www1.hp.com/products/servers/networking/index-nic.html">http://h18004.www1.hp.com/products/servers/networking/index-nic.html</a>
HP ProLiant iSCSI Boot for Linux User Guide	<a href="http://h20000.www2.hp.com/bc/docs/support/SupportManual/c00782461/c00782461.pdf">http://h20000.www2.hp.com/bc/docs/support/SupportManual/c00782461/c00782461.pdf</a>
HP ProLiant Accelerated iSCSI for Windows User Guide	<a href="http://bizsupport.austin.hp.com/bc/docs/support/SupportManual/c00577553/c00577553.pdf">http://bizsupport.austin.hp.com/bc/docs/support/SupportManual/c00577553/c00577553.pdf</a>
Tolly Group's test summary of HP Accelerated iSCSI solution	<a href="http://www.tolly.com/TS/2008/HewlettPackard/iSCSISolutions/Tolly208305HPiSCSI.pdf">http://www.tolly.com/TS/2008/HewlettPackard/iSCSISolutions/Tolly208305HPiSCSI.pdf</a>
Configuring iSCSI in a VMware ESX Server 3 Environment	<a href="http://www.vmware.com/pdf/vi3_iscsi_cfg.pdf">http://www.vmware.com/pdf/vi3_iscsi_cfg.pdf</a>

## Call to action

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