

An Introduction to iSCSI Storage with Wasabi Storage Builder[®] for IP-SAN

It's no secret that the need for data storage is increasing day by day. It is no longer just large corporations that require a lot of storage; even Small and Medium Businesses (SMBs) are faced with the need to store more data.

There are several factors that are contributing to the need for more storage:

- Data is increasingly being stored digitally. Everything from audio to x-rays, including photos, movies, music, medical images, security video, and nearly all documents, are now stored in a digital format.
- Hard disks, due to their cost and performance benefits, are quickly replacing tape for backing up and archiving data
- Legislation such as the Sarbanes-Oxley requires that certain documents and e-mail be kept for a period of several years.

It's not simply the storage of data that needs to be taken into consideration, that data must also be secure, protected, easy to manage, and accessible over vast distances. Current storage methods have been too expensive, too complex, and fundamentally inadequate for most SMBs. Consequently, their storage choices have been limited.

Storage Pain Points

Until recently, storage options for the SMB have been too expensive, too complex, or too limited. All too often storage products offered features that SMBs didn't need, and certainly didn't want to pay for.

To view in more detail the problems SMBs face with regards to storage, let's look at what their storage options are. Storage today can be broadly categorized as one of two types – Direct Attach Storage (DAS) and Storage Area Networks (SAN).

DAS

As the name implies, this is storage that is directly attached to a server. DAS can be internal – hard drives mounted internally inside the server, usually attached to a RAID controller; or it can be storage that is attached externally to the server, most commonly to a SCSI or Fibre Channel HBA.

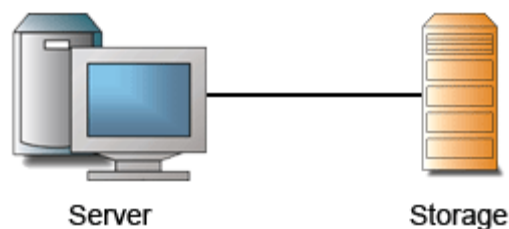


Figure 1: Typical external DAS configuration

Internal DAS has two major drawbacks. The first drawback is lack of scalability. If the server's storage capacity becomes full, additional hard drives must be added to the server. This can present a problem in that there may not be any available space in the server chassis for more hard drives.

Even if there is additional space, this leads us to the second drawback of internal DAS storage. In order to add more hard drives to the server, the server needs to be taken offline and shutdown in order to open up the chassis to install the additional hard drives. If the server is expected to be running 24/7, such as a web server, then the server's data will not be accessible while the system is offline.

External DAS, while more flexible than internal DAS, still has some drawbacks. Cable length is limited so the storage must be located relatively near the server. In addition, the server requires extra hardware, such as a SCSI or Fibre Channel HBA, in order to be able to communicate with the storage, which greatly increases the cost of a server.

SAN

SAN storage allows multiple servers to have access to the same storage resources.

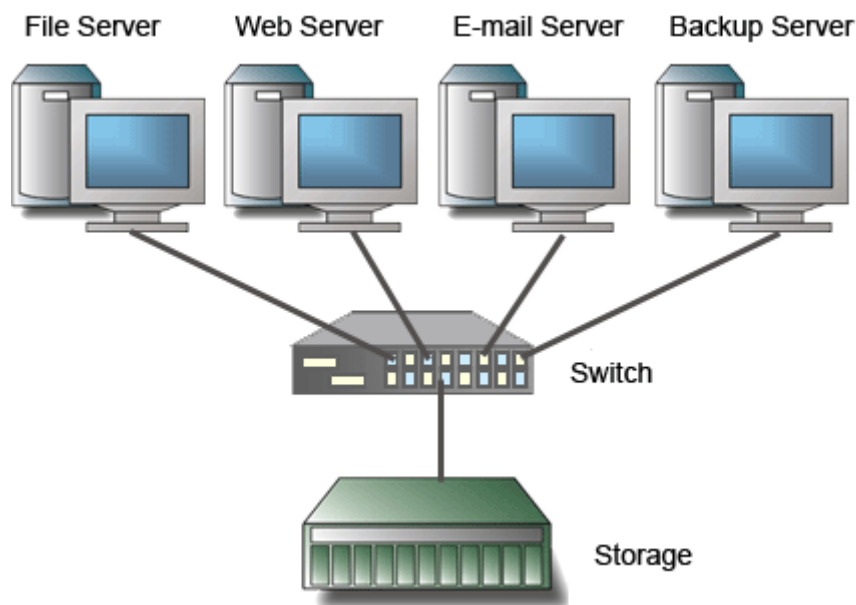


Figure 2: In a SAN, multiple servers can access a shared storage system.

Sharing storage offers several benefits including improved scalability, more efficient use of disk space, and easier management and maintenance due to consolidation of storage resources.

Traditionally, SAN storage has used a Fibre Channel (FC) interface. Fibre Channel is a data transmission protocol and includes components such as HBAs, switches, and cables. FC technology has generally been out of reach for SMBs; primarily due to the high cost of implementation, but also because many SMBs do not want to pay for the specialized knowledge required to configure and manage FC networks. Consequently, SMBs have not been able to take advantage of the benefits offered by SAN storage.

As the need increases for SMBs to face the same storage issues as large companies, but without the budgets or knowledge needed to implement FC, a lower-cost solution is required.

iSCSI Eases the Pain

iSCSI stands for Internet Small Computer System Interface. iSCSI works by sending SCSI data packets over Ethernet. An IP SAN is a SAN that uses iSCSI instead of FC for its data transmission. Using standard Ethernet cables, adapters, and switches it is possible to build a low-cost IP SAN. IP SANs enable SMBs to realize the benefits of SAN storage, without the higher costs and added complexity associated with Fibre Channel.

Because iSCSI uses standard Ethernet components, the cost of an IP SAN is much lower than an FC SAN. Due to the economies of scale, Ethernet components are typically 10% – 25% the cost of FC components. Additionally, implementing and configuring an IP SAN is much simpler since most SMBs are already knowledgeable of IP concepts and practices.

iSCSI solutions are an ideal fit for the exploding storage requirements of the SMB market, and open up new opportunities for OEMs, SIs, and VARs who offer storage solutions. The iSCSI market is forecast to be a \$2.8 billion market by 2008, with 60% of that revenue coming from the SMB market.

iSCSI Benefits

iSCSI offers many benefits and is perfectly suited for the SMB market. Benefits include:

Cost-effective

iSCSI uses standard Ethernet components. It does not require expensive, specialized hardware.

Easy-to-use

iSCSI uses Ethernet, which is widely used and understood.

Scalable

iSCSI storage targets can be connected to a standard Ethernet switch. If more storage is needed, it is easy to deploy additional iSCSI targets by plugging a new iSCSI target into the switch.

Flexible

iSCSI storage can be allocated for multiple servers, making more efficient use of disk capacity and making storage management less complex.

Extensible

Using Ethernet and the internet infrastructure. iSCSI storage targets can be located next to a server, in the next room, or across the world.

Secure

iSCSI storage targets have several layers of security to prevent unauthorized access.

iSCSI: How it Works

iSCSI is a protocol for connecting external storage to a server. It takes SCSI data packets and encapsulates them into IP packets, which are then transmitted over Ethernet. iSCSI devices are classified as either an initiator or a target. The initiator is the computer system that will be using the iSCSI storage. For example, the computer system could be a file or e-mail server. The target is the iSCSI storage device. The following figure shows a basic iSCSI configuration, with the initiator being directly attached to the target.

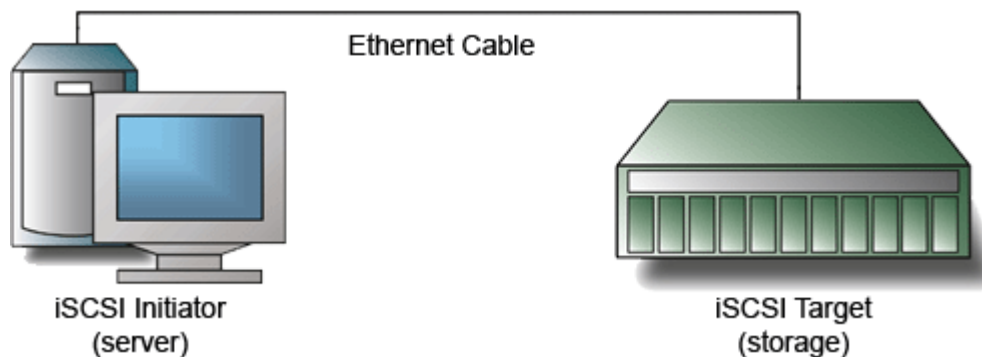


Figure 3: The Ethernet cable is plugged into standard Gigabit Ethernet ports.

iSCSI can also be used as part of an IP SAN, with multiple initiators and multiple iSCSI targets all connected through an Ethernet switch, as shown in the following figure.

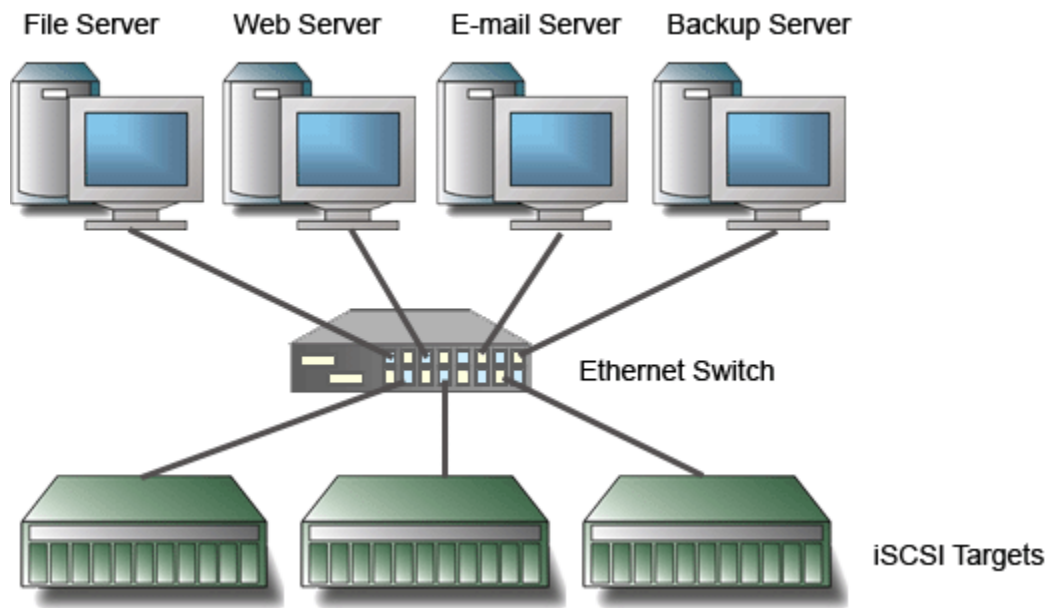


Figure 4: An IP-SAN consisting of multiple servers (initiators) and iSCSI targets.

In this configuration, all of the storage is available to any of the servers. This allows storage to be more efficiently allocated. It also provides better scalability. Should more storage capacity be required, simply attach an additional iSCSI storage target into the switch. There is no need to shutdown any of the servers, and the iSCSI targets will remain online and continue to be accessible.

All that is required for the server to communicate with the iSCSI target is for the server to have an iSCSI initiator installed. An iSCSI initiator is used to establish communication between the server (initiator) and the iSCSI target. While there are iSCSI initiator host bus adaptors available from several hardware vendors, there are software iSCSI initiators that are freely available and typically included with virtually every major operating system, including Windows and Linux. These software iSCSI initiators allow standard Ethernet ports to be used to communicate with an iSCSI target. So, unlike DAS or Fibre Channel storage, which require an HBA or a motherboard with embedded SCSI or FC support (which add to the cost of the server), using a server as an iSCSI initiator does not require the purchase of any specialized hardware.

Once an iSCSI initiator is installed, it is used to login to and establish a connection with the iSCSI target. Once the initiator has logged in, the iSCSI target is a virtual hard disk, and appears to the operating system exactly as a local hard drive. For example, in Windows, you use the standard Disk Administration tool to create partitions and format the iSCSI virtual disk, and it gets assigned a drive letter.

Volume	Layout	Type	File System	Status	Capacity	Free Space	% Free	Fault Tolerance	Overhead
System (C:)	Partition	Basic	NTFS	Healthy (System)	52.54 GB	10.69 GB	20 %	No	0%
iSCSI-1 (E:)	Partition	Basic	NTFS	Healthy	156.33 GB	156.27 GB	99 %	No	0%
iSCSI-2 (F:)	Partition	Basic	NTFS	Healthy	156.29 GB	156.23 GB	99 %	No	0%

Disk 0 Basic 52.54 GB Online	System (C:) 52.54 GB NTFS Healthy (System)
Disk 1 Basic 156.33 GB Online	iSCSI-1 (E:) 156.33 GB NTFS Healthy
Disk 2 Basic 156.29 GB Online	iSCSI-2 (F:) 156.29 GB NTFS Healthy

Figure 5: Once logged in, the iSCSI targets appear just as if they were local storage.

What You Can Do With iSCSI Storage

One of the benefits of iSCSI is its flexibility. iSCSI storage can be used in many different ways.

Shared Storage for Server Virtualization

Server virtualization is a technology that enables users to run multiple operating systems concurrently on a single physical server. Each of the operating systems is running in its own virtual server, which enables more efficient utilization of hardware resources and provides flexibility and cost-savings. Virtual servers residing on iSCSI storage that is shared by multiple physical servers can be migrated rapidly between the physical servers because only the virtual machine's configuration and state information needs to be migrated. In this regard, iSCSI has a clear advantage over internal DAS storage, which cannot be shared with other physical servers, and external DAS, which may lack the flexibility of iSCSI to accommodate multiple physical servers.

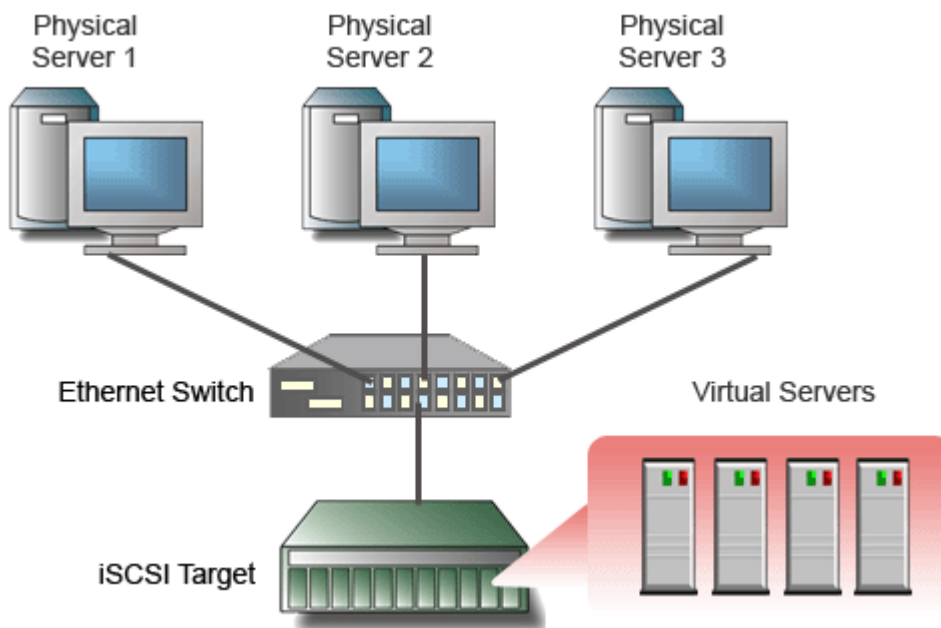


Figure 6: Shared Storage for Server Virtualization

Scalable Storage

Additional storage can easily be added by simply attaching more iSCSI targets to the switch, and the server system doesn't need to be shutdown.

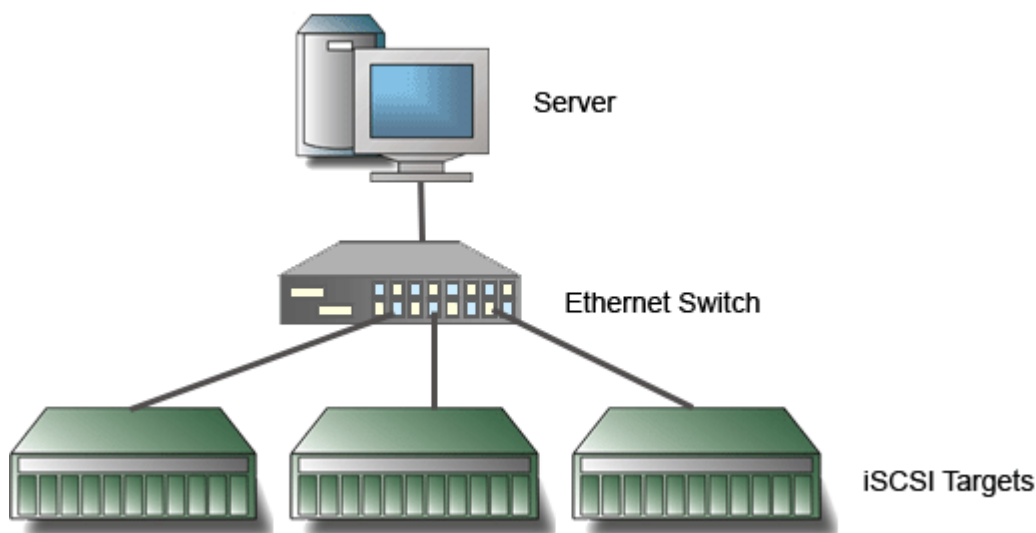


Figure 7: Scalable Storage

Consolidated Storage

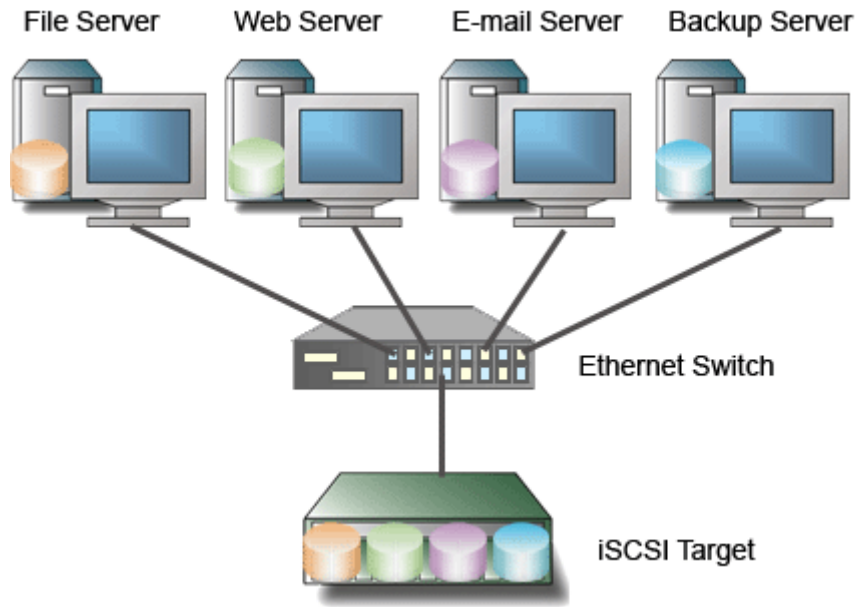


Figure 8: Consolidated Storage

Each server is allocated its own dedicated storage. Consolidated storage is more efficient, secure, and easier to manage.

Direct-Attach Storage (IP-DAS)

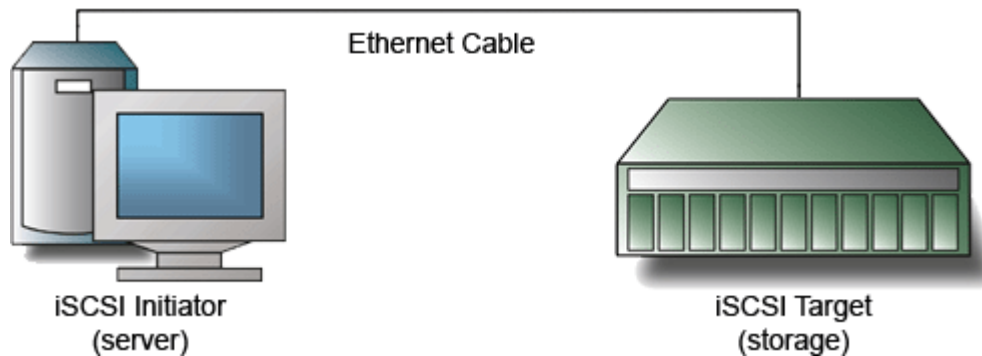


Figure 9: IP-DAS

iSCSI is used instead of SCSI or Fibre Channel DAS. Using the motherboard's Ethernet port and free iSCSI initiator software eliminates the need to buy an expensive SCSI or Fibre Channel HBA or motherboard.

Applications

iSCSI and IP-SAN's are ideally suited for applications where reliability, flexibility, and scalability are required, but cost is a factor.

Small Office / Satellite Office Server

iSCSI storage is the perfect storage solution for small office servers. Whether it's a general purpose file server, or an application-specific server such as an Exchange server, iSCSI provides an economical and scalable solution. Using iSCSI storage targets in a satellite office enables a backup server in the central office to log into the satellite office's iSCSI target and backup its data, providing an additional layer of security as well as protection in case of a disaster at the satellite office.

Disk-based backup

Backing up to disk is more reliable than tape and costs less. With iSCSI storage, you can have large amounts of storage capacity which allows you to perform data backups, and keep those backups online. This way, restoring files from disk is faster and easier than having to dig through old tapes and hoping that the tape media is still good.

Near-line Storage

Near-line storage is for data that may not be needed on a daily basis, but will need to be accessed periodically. In this manner, iSCSI may co-exist in a large enterprise with Fibre Channel storage, where Fibre Channel may be deployed for heavily used transactional databases, and iSCSI is used for data where Fibre Channel performance is not needed.

Clustering for Server Failover

Used in conjunction with a cluster-capable operating system, such as Microsoft® Windows Server 2003, iSCSI enables the creation a low-cost cluster which provides for server failover through the use of shared storage.

Video Surveillance

Data rate and retention time requirements for video surveillance data are increasing, with the results being an explosive increase in the amount of data capacity needed, and an increased strain on IT budgets. In addition to lowering the acquisition cost of storage, iSCSI also provides an easy-to-manage solution that is flexible and scalable, making it the perfect storage solution for video surveillance systems.

Wasabi Storage Builder® for IP-SAN

Wasabi Storage Builder® for IP-SAN software enables OEMs and systems integrators to transform off-the-shelf computer hardware into a cost-effective IP-SAN (iSCSI) storage system. It's a complete turnkey software solution pre-installed on a bootable Compact Flash disk.

Storage Builder for IP-SAN runs on standard hardware components such as Intel and AMD CPUs; Intel, Supermicro, Tyan, and ASUS motherboards; and 3ware, LSI Logic, and Intel RAID controllers and lets SIs and OEMs take advantage of the performance improvements and cost reductions offered by using commodity hardware components.

For even more flexibility and economy, Storage Builder for IP-SAN offers WasabiRAID, a powerful RAID engine that leverages the speed of modern processors to deliver maximum performance while protecting critical data. WasabiRAID supports RAID Levels 0, 1, 10, 5, 50, and spanning. Nested RAID levels can be created by incorporating logical disks created with a RAID HBA; for example, mirror two RAID controllers for fault tolerance at the controller level.

Storage Builder opens up new windows to the high-growth SMB market with iSCSI storage solutions that provide the security, scalability, and flexibility advantages of IP-SAN at lower cost. Using Wasabi Storage Builder for IP-SAN and economical, commodity hardware, OEMs and system integrators can rapidly create powerful iSCSI storage systems with the security, scalability, and flexibility that SMBs require, and at a price that they can afford.

Storage Builder for IP-SAN contains all of the software needed to build an iSCSI target in a reliable Compact Flash Disk-On-Module (DOM). No other software needs to be purchased or installed. This significantly speeds up the installation and assembly process.

All of the software components, including the operating system, iSCSI software, and management utility, are pre-installed on a bootable Compact Flash Disk-On-Module (DOM). You just plug the DOM into the IDE port on the motherboard, and it's ready to go.

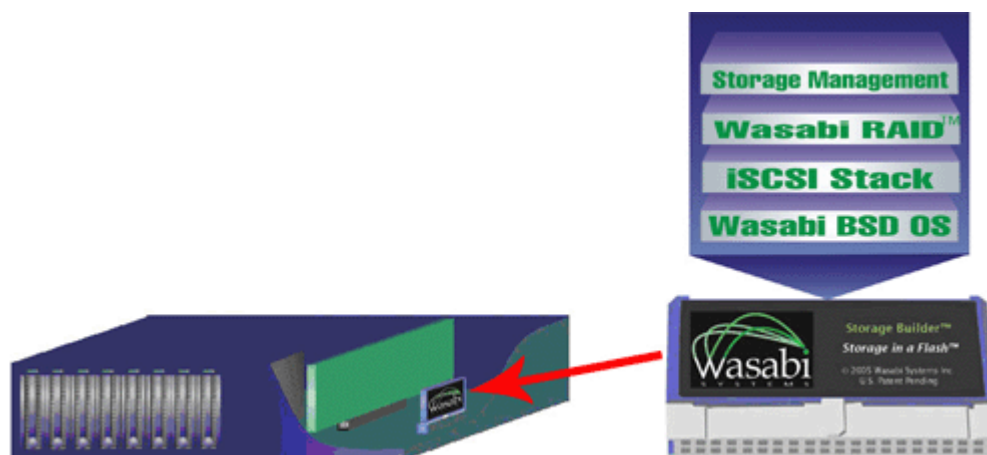


Figure 10: All the software is pre-installed on a bootable Compact Flash Disk-On-Module

Storage Builder Benefits

Building iSCSI targets offers several benefits for system integrators and OEMs, as well as for the end user.

For the VAR/SI/OEM:

- Enables you to provide a high-performance storage solution for your customers that is secure, scalable, and robust.
- Lowers BOM cost by using standard, off the shelf hardware components.
- Wasabi Storage Builder for IP-SAN minimizes assembly time. All required storage software is pre-installed on the DOM and no additional OS or other software is needed on the storage device.
- Provides the flexibility to hit different capacity and price points.
- Branding option allows you to differentiate as well as further promote your brand

For the End User:

- Storage that is specifically targeted to solve their storage needs at a price that is within their budgets
- Storage that is robust and secure
- Storage that is simple to use
- The ability to easily add more storage as needed

The Wasabi Systems Advantage

As important as the product itself is, the company behind the product is equally important. Wasabi Storage Builder leverages the company's legacy of network operating system leadership. The Wasabi Certified® BSD OS is the same network operating system found in devices such as switches and routers that power the world's networking backbone.

Wasabi Storage Builder products leverage years of code development and time-tested network support to deliver a high-performance, fully-optimized, networked storage solution.

Wasabi Systems is not just a product vendor; we are your partner. We'll be with you every step of the way to ensure maximum success of your Storage Builder-based IP-SAN storage program. We offer personalized, high-level support, a comprehensive knowledge-base, application notes for using Storage Builder for IP-SAN targets with popular applications, and much more. A training and certification program ensures you'll be able to deliver the highest level of support to your customers.

We know you have many options from when it comes to selecting a product. We believe that when it comes to selecting the company behind the product there is only one choice – Wasabi Systems.

FAQ

- **Customers are not asking for iSCSI. How can I sell it?**

It may be true as iSCSI is still relatively new in the mind of the end user. Customers may not be asking specifically for iSCSI, but they more than likely have storage problems that could be solved by iSCSI.

- If they are outgrowing their current storage capacity – iSCSI can solve this problem.
- If they do not have an infinite storage budget – iSCSI can solve this problem.
- If they do not perform adequate backups of their critical data because tape is too expensive and difficult to manage – iSCSI can solve this problem.
- If they want storage that is flexible, scalable, secure, and fits within their budget – iSCSI can solve this problem.

Rather than promote iSCSI as a technology, promote a storage solution based on iSCSI, and when customers see how simple and economical a solution based on iSCSI is, it will make closing the sale much easier.

- **Isn't Fibre Channel better than iSCSI?**

When it comes to comparing iSCSI with Fibre Channel, it is not necessarily an either/or situation. Fibre Channel will still have its place in higher end enterprise-level environments. For most SMBs, FC SANs are not even considered due to their cost and complexity, so iSCSI allows them to take advantage of the benefits of a SAN at a price they can afford. Even in enterprise environments, iSCSI will be used for secondary applications such as near-line storage and disk-based backup.

- **Is iSCSI better than NAS?**

Networked Attached Storage (NAS) and Storage Area Networks (SAN) are used to provide storage in a networked environment. Beyond that, SAN and NAS are used for different purposes. NAS storage is file-based and SAN storage provides direct access to data blocks. File-based storage can translate files into different file systems and is used primarily when there are clients with different operating systems (e.g., Windows and Linux) that need access to the same files.

Because of the overhead of performing the file translation, NAS performance is slower than iSCSI. Therefore, iSCSI is used where higher performance is needed. Because iSCSI is block-based, meaning that it only “sees” 1’s and 0’s, it does not have the file translation overhead that NAS does. Furthermore, some applications, such as certain database applications, require storage to be block-based and therefore NAS is not a viable option. Since iSCSI storage is generally managed by a server, there is also more control over the storage since it is better integrated with the server’s operating system.

- **Are IP-SANs secure?**

Wasabi Storage Builder for IP-SAN features several mechanisms to ensure that data is secure and protected:

- RAID (Redundant Array of Inexpensive Disks) offers data protection in case of a hard drive failure.
- LUN masking allows system administrators to assign specific iSCSI targets to iSCSI initiators, and to ensure that an iSCSI initiator cannot see targets to which it is not allowed access.
- The Challenge Handshake Authentication Protocol (CHAP) is a user name/password mechanism whereby the iSCSI initiator must supply a valid user name and password in order to login to and establish communication with the iSCSI target. If either the user name or password is incorrect, then access to the iSCSI target is denied.

- **Isn't Fibre Channel performance faster?**

Fibre Channel bandwidth is higher than iSCSI. Fibre Channel bandwidth is 4 Gigabits per second (Gb/s), or about 400 Megabytes per second (MB/s) as compared to 1 Gb/s, or 100 MB/s for iSCSI. However, Storage Builder for IP-SAN supports Multiple Connections per Session (MC/s), which allows multiple Ethernet ports to be used together to provide higher bandwidth. It also provides failover should one of the data paths fail. Furthermore, 10Gb Ethernet, which delivers 1000 MB/s bandwidth, is coming on the scene.

However, theoretical bandwidth is only one factor to consider when talking about performance. Using garden hoses as an analogy, suppose a half inch diameter hose typically can handle 9 Gallons Per Minute (GPM) of water. In this case, the GPM can also be looked at as the bandwidth of the hose. Now suppose that a three quarter inch diameter hose can handle 17 GPM. The three quarter inch diameter hose seems as if it would be better because it has a higher GPM rating than the half inch diameter hose. However, if the water main were only able to supply water at 8 GPM, the higher GPM rating of the three quarter inch diameter hose has no benefit – the end result will still be that water is moving through either hose at 8 GPM.

Similarly, the available bandwidth of an interface does not necessarily mean that performance will be higher through that interface. For example, database applications perform largely random data operations. Random data transfers are limited by the performance of the hard disks, which are the slowest link in the data transfer chain because of the hard disk mechanism. Random data transfers from hard disks will not come close to reaching the maximum bandwidth of iSCSI, much less Fibre Channel. Therefore, it is best to determine the data transfer rate needs of the specific application(s) and use that as a factor in choosing the proper storage platform.

- **Isn't iSCSI too immature to be deployed?**

- iSCSI has been in development for many years and combines two very mature technologies – Ethernet and SCSI.
- iSCSI has the backing of every key industry player.
- IP-SANs are deployed and being used now. In a recent InfoStor survey¹, 17% of respondents indicated that they had already implemented IP-SAN storage, and 20% indicated that they planned to implement IP-SAN storage in the next 12 to 24 months.
- In the same survey users reported that by deploying iSCSI they realized a reduction in capital expenditures and an increased rate of server connectivity.
- With security features such as CHAP and LUN masking, iSCSI is secure and robust.

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¹ Source: ESG iSCSI Study: Mid-Project Findings © 2006 Enterprise Strategy Group, Inc.