Network Storage From A to Z

Data storage solutions for the small- to medium-sized business

iomega

an EMC company

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Network Storage From A to Z

Data storage solutions for the small- to medium-sized business

Not so long ago, there was a clear distinction between the data storage needs of small businesses and those of their larger counterparts. Small businesses depended mostly on storage contained in PCs scattered around the office, with maybe a small Windows PC or server used to share files and print services. Most small businesses lacked an IT staff or anyone with the expertise to dive into any complex technology. If files were unavailable for a few hours or even a day, it was an inconvenience, not a disaster. Mostly large enterprises had complex networking infrastructures, with stringent security and performance requirements.

The line between the storage needs of small and larger businesses has blurred dramatically in the past decade. Today's small organizations find themselves tackling many of the same storage issues as their larger counterparts, including:

How to Meet Exploding Storage Requirements The storage needs of small businesses have mushroomed thanks to the digitization of formerly paper documents; increased use of voice, video, and other rich media; the Internet; and regulations requiring years of data and file retention. Many businesses have seen their storage requirements double and triple annually year after year. They need efficient ways to store and share much larger volumes of data without busting their budget or hiring an IT department.

How to Protect Mission-Critical Data As with their larger counterparts, many small businesses rely on processes that are so PC-, software-, and data-dependent that they can barely function without data access for even a few hours. They need to find workable, low-cost ways to backup and protect access to the information that drives their business.

How to Reduce or Eliminate Downtime Small businesses increasingly partner with larger enterprises in a global environment, or work with customers across time zones. They need simple, low cost, efficient ways to keep their data accessible on a 24 by 7 basis without sacrificing backup and maintenance.

How to Fulfill Stringent Audit and Regulatory Requirements It's not just large businesses that are affected by audits and federal regulations such as HIPAA and the Sarbanes Oxley Act. Scores of smaller businesses need simple, workable strategies for storing and protecting sensitive information with a level of effectiveness and sophistication equivalent to that of their enterprise counterparts.

How to Use Storage Effectively in a Virtual Infrastructure As they take advantage of the Web and server based applications such as email and CRM, many small businesses have jumped on the server virtualization bandwagon to reduce hardware and server management costs. These businesses need to find storage that works easily in a virtualized environment.

While these issues can seem daunting to small organizations with few dollars and resources to spare, the good news is that new and evolving small business storage solutions can meet all of these requirements without overwhelming complexity or the need for IT expertise.

In this eBook you will learn about the efficient, economical ways to address the small business storage issues outlined above without busting the small business budget or hiring an IT department.

Help! My business has exploded, my desktops are out of storage, and information is scattered everywhere!

Like most small businesses, your technology investments started small. You invested in a PC for yourself and a few other staff members. Perhaps you have a graphic artist who uses a Mac, or a stubborn techie who likes Linux. Each user keeps his or her files on his PC; when someone needs a file they grab it with a USB flash drive or via email. Perhaps you've activated Windows sharing on a PC so one or more employees can share their files with the rest of you.

Suddenly your business grew and what happened? Some of your PCs are running out of storage. Files are scattered across PCs so you can't find the one you need. You have different versions of files in different places. Which is the most current, relevant version? In many cases nobody knows.

With any small business there comes a time when a bunch of isolated, unconnected desktop or laptop PCs simply doesn't work any more. That's when it's time to consolidate, centralize, and share file storage across the network.

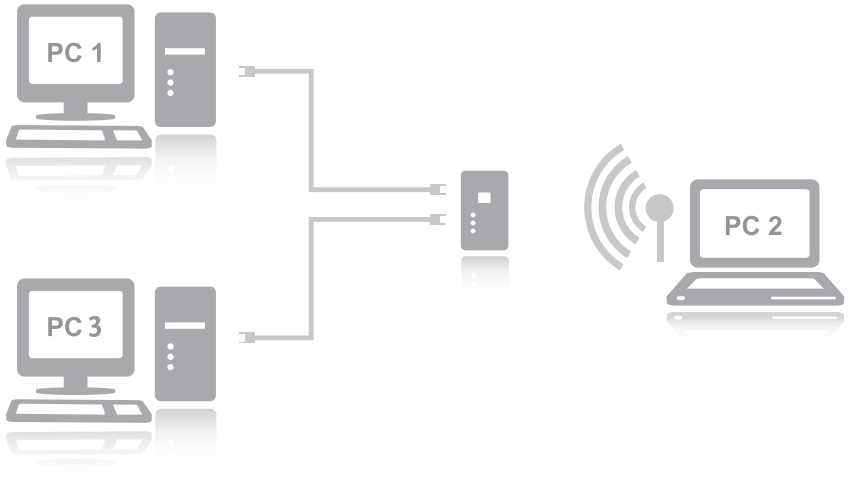
Why consolidate? There are lots of reasons.

It's more efficient PC-based file storage is inherently inflexible and inefficient. Some of your PC's may have huge amounts of storage to spare, but no way share it, while others constantly run out of storage and require repeated internal storage upgrades or the addition of connected external hard drives. When you centralize and share storage, you get a single storage pool that you can slice, dice, and allocate to users and applications efficiently and easily without having to add internal or external hard drives to PCs with limited unused storage. Upgrades are less frequent and the storage you have is used much more efficiently.

It's more organized When all your files are stored in one place, they're easier to find. It's easier to keep track of which file is the most current. And since you don't have to have multiple versions of the same files spread across the office, you save on data storage space.

It's easier to protect You know your employees should be backing up their files but, really, who does? It's just a matter of time before files are lost with no way to get them back. Put all your storage in one place and it's easier to implement a single robust backup strategy that's efficient, effective and easy to enforce.

Ok, so now you know you should consolidate and share storage, but how do you do that?



There are three basic ways:

Direct-Attached Storage (DAS)

Direct attached storage refers to the storage attached directly to a PC or server. You can share files stored on one of your PC's hard disks or buy a server running Windows Server Foundation or Windows Small Business Server and share its internal storage. As discussed earlier, you can also add storage to an internal bay of your server or add external storage via USB or FireWire.

These are viable solutions, but if you haven't yet made the leap to the world of servers, consider your other options carefully. Why?

Complexity You have to do some research and investigation to find the right server for your needs. Then you must purchase, install, and configure the hardware and operating system for your network of PC users. If you're new to server technology this can take a long time with the potential for a high level of frustration. Alternatively you can hire someone to do all this for you—for a fee.

Once your server is installed, its loosely integrated collection of hardware, operating system, and software require ongoing tuning and troubleshooting. The server operating system and software are likely to require frequent patching and updates for continued security and performance.

Availability DAS storage can only be accessed through the server or PC to which it is attached. If that server goes down or is turned off for any reason, the storage will not be available to the network.

Upgrades If you run out of storage you'll probably have to shut down the server to install a new hard disk. This requires downtime and staff resources. Some servers and external storage solutions let you swap hard disks in and out while the server is up and running, but these tend to be at the high end for medium and large business use.

Performance The typical server operating system (OS) is designed to run many different applications, provide many different types of services, and carry out many different tasks simultaneously. A full-fledged OS can have an unnecessary impact on performance if all you really want to do is share files.

Flexibility You can run into similar inefficiencies with server-attached DAS drives just as you did with your PC-attached DAS drives. As your business grows and you add servers to your network, heavily used servers and DAS units will run out of storage frequently, requiring upgrades, while less-used servers will have storage to spare, but none to share with their storage-strapped brethren.

Despite these caveats, DAS can be an inexpensive viable solution for many networks, particularly those that also want to run server applications like email, CRM, and other database solutions.

Storage Area Network (SAN)

An alternative to using DAS is to separate storage from your servers and put it on its own specialized, high performance storage network called a storage area network (SAN). With a SAN, storage is no longer enslaved to a single server but sits independently on the SAN where it can be shared, sliced, diced, and allocated to servers, users and applications from a single pool.

For years, SANs ran on a complex technology called Fibre Channel that was too expensive and complex for all but the most performance-hungry

small businesses. However a fairly new SAN technology called iSCSI offers very good performance, uses the same equipment as your Ethernet network, and is relatively simple to use.

Like DAS, however, SAN storage uses a low-level, block-based storage architecture that requires a server with an operating system to present files to users. Each server needs its own iSCSI host adapter or initiator software to communicate with the SAN. That's why if you're mostly looking to share files and printers, a full-fledged SAN can be overkill. SANs are most appropriate if you need high performance for databases, server based business applications, and email.

Network-Attached Storage (NAS)

Small businesses looking for extra storage to share files and print services should take a close look at network attached storage (NAS). Like a server, a NAS device sits directly on the network And like a server, a NAS device serves files—not bare blocks of storage—to users and applications. However, unlike a server, a NAS device does not require installing, configuring, tuning, and updating a multipurpose operating system. And unlike a SAN, a NAS doesn't need a separate server to serve up its blocks of data as files. Instead, a NAS comes preconfigured with just the parts of an operating system necessary to serve files to users and applications.

Most NAS devices serve files using either the Network File System (NFS), which is an open source file system, or the Common Internet File System (CIFS), which is the system used by Windows to serve files to the user. Many can use both. The growing popularity of Apple desktops and laptops has pushed many network storage devices to also support the Apple File Protocol (AFP).

NAS devices have several advantages:

Independence A NAS can sit anywhere on the network, independent of servers, and serve files to any network connected PC or server. If a server or PC goes down, the NAS is still functional. If power goes down, there's no need for complex reconfiguration. With its simple architecture and setup, a NAS can be up and running again in minutes.

Ease of Use NAS devices typically come as preconfigured, turnkey solutions.. There's no need to install a host adapter or operating system. You simply plug the NAS into the network and, depending on the ease of use of the user interface, you do some very light configuration using a Web browser. There may be a little more configuration to do on PC's and servers accessing the device, but in most cases you're up and running in minutes. Compared to traditional servers, NAS units requires little maintenance, few updates, and little troubleshooting. Whatever administration is necessary can usually be done via a simple Web browser interface.

Easy Upgrades Adding storage to a server usually requires shutting down the server, replacing a drive or adding a new one and then firing up the server again. To get more storage with you simply plug another NAS device into the network and are up and running with additional shared file storage in minutes. Or some NAS devices allow swapping of hard drives or adding internal or external storage while they are in operation (commonly known as "hot swap").

Three Ways to Consolidate

	DAS	SAN	NAS
What is it?	Hard disk storage internal to a server or directly attached via USB, FireWire or eSATA	A specialized network devoted to storage	Hard disk storage with its own network IP address and slimmed down file system.
How is data accessed?	As blocks	As blocks	As files
Pros	Files and data can be shared across LAN. Available in highly reliable configurations such as RAID	Storage independent of servers. Single shared storage pool. Takes backup off the local area network. High performance, especially for database applications.	Can sit anywhere on network. Easy to configure and manage. Easy backup. Requires no traditional server for file serving. Storage still available if file servers down. Easy upgrades. Slimmed down file system for fast performance.
Cons	Storage is enslaved to single server. Storage cannot be shared with other servers. Can be complex to install, configure, and maintain. Can be inefficient. General purpose operating system can slow down file sharing performance.	Can be complex to configure and maintain. Requires traditional servers with SAN controller adapters or software to serve files. Can be expensive.	Not always suitable for high performance database applications.

Flexibility Many NAS devices can share their files easily among Windows, Mac, Unix, and Linux-based PCs. Some are also flexible enough to be used as a NAS, as DAS for a single server, or,as a storage device on a SAN. Many come with capabilities for sharing printers.

Easy Backup NAS devices can be a great storage medium for PC-based backups. Many of these devices come with backup software that is easy to configure and use, both for backing up user PCs to the NAS and backing up the NAS to another storage device, tape, or an external backup service. When all your files are in one place, backup is inherently easier than when they are spread around the office. Some NAS's also come with easy tools for migrating data to the device and replicating data over the network from storage device to storage device.

In summary, depending on the needs of your small business and your technical expertise, you may be best off with DAS, a SAN, or NAS solution. If simple file and print sharing is your goal and your staff has little networking technical expertise, a NAS is often the best solution.

I have a PC, my tech guy has Linux and my graphic artist has a Mac. How can we share files easily?

While many small businesses operate solely on Windows based PCs or Mac computers, it's not uncommon for a small business to have a combination of two or three of these. Perhaps your business has five to 10 or more Windows based PCs and one or two Macs used by your graphic or media artists. Or perhaps your owner has a Mac at home and wants to use one at work as well. You may even have one techie person in your company who loves Linux or is using a Linux based PC for a particular specialized application.

How can your business share its files with these various users? You have three choices:

- You can configure one or more of these different PCs to share files with the others.
- You can install a Windows or Mac OS/X based server on your network and then configure it to support all three client operating systems or vice versa. In fact, all these operating systems support client PCs running other operating systems. However, configuring them takes a certain amount of technical expertise and troubleshooting time. It's no secret that Windows servers tend to favor Windows clients and Mac servers tend to favor Mac clients.

That's why businesses looking to share files and printing among Macs, Windows, and Linux based PC's often take the third option, which is Network Attached Storage (NAS).

NAS devices are simple way to add storage to your network and share files with many different types of clients. You simply plug a NAS device directly into the network, do some simple Web based configuration, and you are up and running in minutes.

If you're working with mix of client operating systems on the network, you should make sure your NAS comes with built-in support for the following file sharing protocols:

Network File System (NFS), a file sharing protocol commonly familiar to Unix and Linux based PC's.

Common Internet File System (CIFS), also known as Server Message Block, a file sharing protocol commonly used in Windows-based networks.

Bonjour, a protocol used by Mac OS/X computers to discover printers and other computers and their services on the network.

Apple FileProtocol (AFP), a file services protocol used by the Macintosh OS and OS X.

Many NAS products support most or all of these protocols, which makes it very easy to connect all of your Macs, Windows PCs, and Unix/Linux systems to share files and NAS attached printers. Very little configuration is needed. Magically, they all just work.

Everyone tells me we should be backing up our desktops and servers but we can't afford the time or the downtime. What should we do?

You know you should be backing up your desktop computers and laptops, which frequently store the most recent information at your company. Unfortunately, the sad truth is that you and your colleagues probably don't. Why? Backing up a PC is time consuming and not as easy as it should be, so you put it off, and then you put it off again.

If some of your staff actually takes the trouble to back up their PCs, they're probably doing it infrequently, and may in fact be doing it incorrectly. When it comes time to actually recover files and data you may be unpleasantly surprised.

Operating without a backup strategy is risky behavior if your company is highly dependent on applications and information. If your company falls under federal regulations such as HIPAA or the Sarbanes Oxley Act, you may be in the unsavory position of having to swallow a fairly steep fine. You don't have to be a large hospital to fall under HIPAA, you could just be small doctor's office.

That's why just about any business needs to devise a workable strategy for backing up its desktop and laptop PC's and, even more important, for restoring that information when a file is corrupted,or lost or when a power failure or natural disaster takes systems down.

For most small- and medium-sized businesses there are four basic ways to do backup:

- Backup to Tape
- Backup to Disk—DAS
- Backup to Disk—NAS
- Backup to Disk—SAN

Backup to Tape

Tape was the chosen medium for backup for many years, thanks to its low cost and high reliability. Tape also has the advantage of portability, which meant it can be taken off site easily.

Tape is still a viable backup medium today. However, tape has major drawbacks in comparison to today's other backup solutions:

It's slow Compared to disk storage, tape performance is slow. While tape was viable for backing the volumes of business data typical in the past, data storage has grown so enormously and backup windows have shrunk so much in most organizations, that there is often not enough time in the day or night to execute a full tape backup.

It is difficult and time consuming Somebody must be routinely responsible for loading, rotating and changing tapes—typically on a daily or weekly basis— and many small businesses don't have the staff time and expertise to take on that responsibility.

It's not easily accessible Tape is not a random access medium. Restoring data from tape requires considerable staff time to find, load, and access a file from the tape.

It's not always reliable Tape backup devices such as autoloaders and tape libraries have mechanical parts that can fail. If tape backup is not handled the right way, you may never find out about a mechanical failure or user error until you need to restore data from tape.

Despite these drawbacks, tape's low cost and mobility make it a viable, low-cost solution for backup—if you have the time, the will, and the know-how.

Backup to Disk

Hard disk storage used to be expensive and unreliable, but over the years prices have come down and reliability has gone up so much that disk is now a very viable medium for backup.

The advantages of disk-based backup are many:

It's fast There's no comparison between the performance of disk-based backup and restore and tape. What might take hours when you're backing up to tape could take minutes when you're backing up to or restoring data from a hard disk.

In addition to traditional backup there are also other useful disk-based data protection methods. For example, replication copies data from one disk to a second disk at a separate location. For companies that have little or no backup window, there's little alternative to the performance of disk based data protection.

It's easy Once the disk storage is installed, there's no need to load, rotate or change anything for a long time. You can configure an automatic backup strategy and then let it run on its own.

It's easily accessible Hard disks are random access devices, so retrieving a file from a hard disk is almost instantaneous and can usually be done by the user. With a tape you often have to wait several minutes while someone loads the tape and the backup software winds the tape over to the correct spot for retrieving the file.

Disk-based backup can be accomplished using DAS, NAS, or a SAN.

DAS backup can be either PC- or server-based:

PC-based You can attach an external hard drive to each PC and configure PC-based backup software to do regular backups. This can be practical for one or two PC's, but it can quickly become impractical for a rapidly growing small business with lots of PCs. You usually have to depend on the PC users to let backups take place, which is risky, particularly if users are on the road frequently.

Server-based You can install a backup server with its own DAS and backup all your PCs over the LAN. This is a great way to have centralized control over the backup process. However, it does require setting up and maintaining a server and server operating system and software, with all the requisite tuning and updating. Servers can also become a network bottleneck if they're pulling data off of several PCs over the LAN.

Nevertheless, DAS based backup can be a viable solution for many small businesses as a speedier alternative to tape. Some organizations back up PCs to DAS for performance and then back up server-based DAS to tape as a secondary measure for portability, taking the tapes off site for storage where they can be retrieved in the event of a local disaster.

NAS

NAS makes a great backup solution for many small businesses because it's easy to set up and maintain. Like network-based DAS backup it lets you push all your PC backups over the network to a single storage device, but unlike DAS, which has to be attached to a server, NAS can be located anywhere on the LAN.

Backup Media & Methodologies Compared

	TAPE	DAS	SAN	NAS
Pro	Inexpensive media. Very transportable. Can be taken offsite easily.	Fast backup and recovery. Highly reliable configuratons available. Random access. Data protection alternatives such as replication or snapshot possible. Snapshots do not interfere with data access.	Very fast. Backup doesn't interfere with LAN performance.	Easy to set up and maintain. Many NAS devices come with integrated backup solutions. Can be anywhere on LAN. Some NAS devices offer fast, block-based backup like SANs.
Con	Slow backup and recovery. Sequential data access. Requires resources and expertise to load, rotate, change tapes. Mechanical parts not always reliable.	Backups and restores over LAN can hog bandwidth. PC backups may require knowledgeable cooperative employees.	Can be complex and expensive to configure and manage.	May not be as fast as SAN. Backup occurs over LAN

Some NAS products come with their own tightly integrated backup and replication software tuned and preconfigured to work with that device. That can make setting up and implementing your backup strategy quick and easy. And backups to NAS can be automated so there's little need for a staff person who has other things to do to take on the daily task of backup, as is required with tape backup.

If you're looking for extra protection from natural disasters, look for a NAS backup solution that can also replicate over a wide area network to another storage device. You get the offsite advantages of tape without the tape handling issues.

SAN

With their fast, block-based disk architecture, Storage Area Networks are great solutions for high performance backups. By placing storage on a specialized storage network, SANs take the burden of backup off your regular corporate LAN so the performance of other network applications doesn't get bogged down.

You don't have to know Fibre Channel technology to operate a SAN. iSCSI is simple to use, offers very good SAN performance, and runs over typical Ethernet switches.

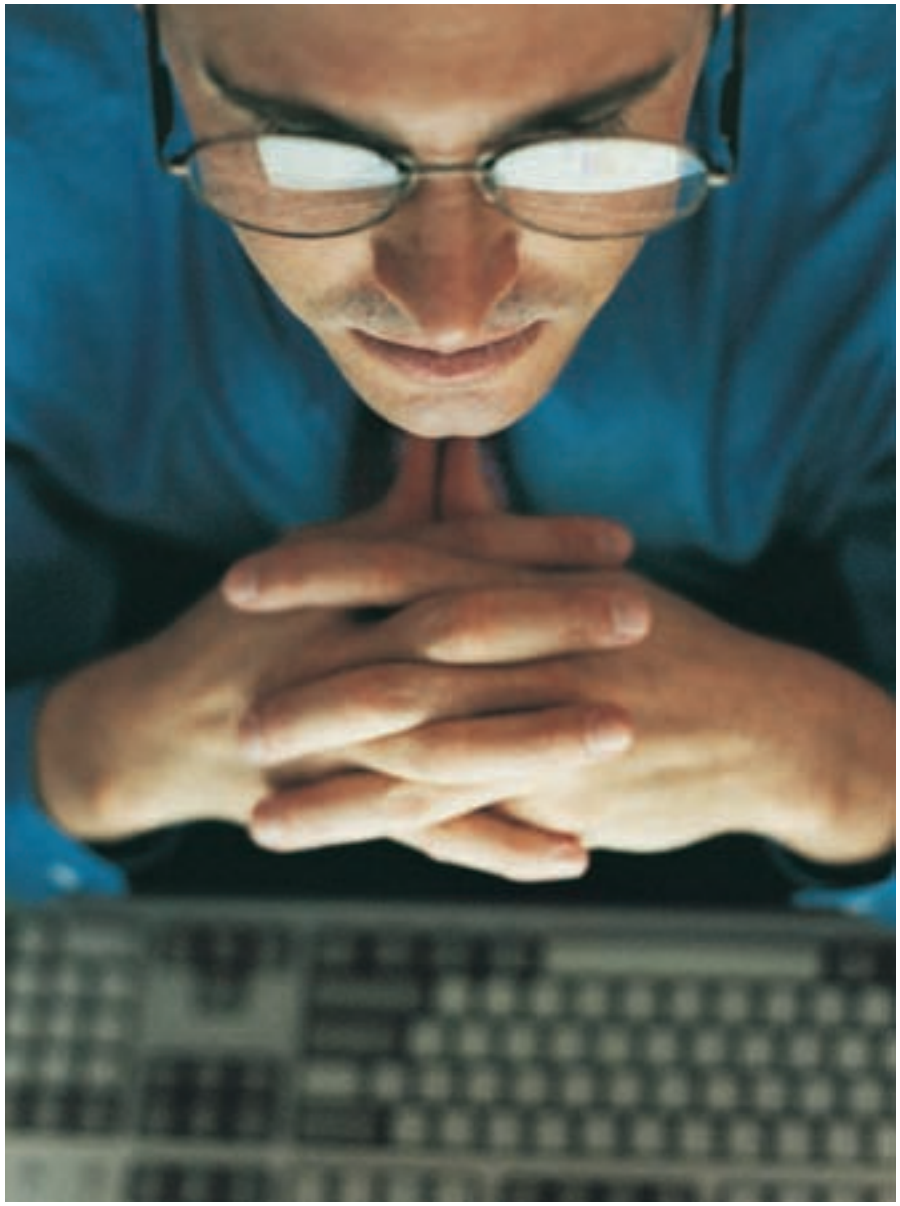
Even simpler, however, is taking advantage of the iSCSI capabilities offered by some of today's NAS products. Many NAS units can partition off some storage as fast block based iSCSI SAN storage. Plug your PC or backup server into the storage with an Ethernet cable, do some simple configuration on the storage device and the host server or PC, and you can run high-speed SAN-style backups on a portion of your NAS, while the rest of the device serves files over the LAN.

Sometimes I delete files accidentally or files get corrupted. How I get them back fast?

One of the great advantages of disk-based backup is that it can be done quickly with little disruption to your businesses applications and operations. One way to protect files is with automated daily backups to DAS or a NAS. Most backup solutions allow you to make occasional full backups to disk and frequent incremental backups—backups of data that has changed since the last full backup—daily or even several times a day.

Thanks to fast disk-based incremental backups, if you accidentally delete a file or if a file, a directory, or an entire system becomes corrupted due to a virus or user or hardware error, you can recover that file or data from prior state quickly and easily so you can get right back to work.

If you're using a NAS solution to store backups, check to see if it comes with—or works easily with—software that offers point-in-time backup and recovery. Then you can rest assured that you'll never really lose a precious file or data that you really need for your business.



Help! My servers are constantly running out of storage!

So let's say you've taken the server plunge. You may be using a server to share files and printers or you may use it to run Microsoft Exchange or a CRM application. Perhaps you have two or three servers running a combination of these functions and each has its own DAS setup.

What is likely to happen over time?

Storage inefficiency You may find that one server, perhaps your email server, is constantly running out of storage space, while another server always seems to have too much storage space to spare, but no way to share it. This is a very inefficient scenario and the biggest reason why DAS solution is ultimately inefficient for growing small businesses.

Management headaches Most DAS solutions have their own proprietary management software and interfaces and are not easy to manage remotely. You may find yourself with multiple different DAS solutions, each with its own management quirks and annoyances.

Consolidate

As with PCs, the answer to server overload is to consolidate your storage, unchain it from the server, and place it on the network where it can be shared among multiple servers and PCs. Why?

It's efficient You get a shared pool of networked storage that you can slice, dice, and allocate to users, applications, and servers at will. No more overloaded servers sitting next to servers with storage to spare.

It's easy to upgrade You no longer have to shut down your server and its applications to upgrade your storage. You can add storage to the network and make it instantly available without affecting your applications.

When it's time to upgrade your servers, it's no longer necessary to throw out the storage with the server or spend the time to migrate data to another server. You simply connect the new server to the network and configure it for access to your network storage.

It's cost effective Storage makes up a significant portion of your server's price and internal space. Separate storage on the network and you can spend fewer dollars on servers or buy more server performance and reliability for your dollar. You can also pack more servers into a smaller space, if that's what you need to do, taking advantage of compact rack mount servers or even blade servers.

You have two choices for network storage: a SAN and a NAS.

SAN

Storage Area Networks (SANs) separate storage from your servers and put it on its own specialized high-performance storage network where it can be pooled and allocated to servers and applications. When a server runs out of storage, you simply allocate more storage from the SAN, rather than taking down the server to add physical storage.

NAS

Nothing beats the simplicity of NAS for fulfilling the needs of a typical small business. A NAS device sits directly on the network and, like a server, serves up files, not storage blocks. There are many advantages to NAS as a small business storage solution.

Independence NAS devices can sit anywhere on the network, completely independent of servers, serving up files to any network connected PC's or servers. If a server or PC goes down, the NAS is still functional. If power goes down, there's no need for complex reconfiguration. With its simplicity, a NAS can be up and running again in minutes.

East of Use NAS devices typically come as preconfigured turnkey solutions. There's no need to install a host adapter or complex server operating system. You simply plug the NAS into the network and do some very light configuration, usually with a Web browser, and your NAS is up and running and accessible to your PCs.

Easy Upgrades T o get more storage with NAS you simply plug in another NAS device and you're up and running with additional file storage in minutes.

Flexibility Today some NAS solutions also come with some built-in iSCSI capability, which can provide fast block-based storage to performance-hungry server applications that need it, while still allowing you to share and print files. In some cases you don't even need a switch or special host adapter. You simply plug your server directly into the iSCSI port on the NAS. So you get the best of both worlds in a single easy-to-use and configure device.

When I wasn't looking, my servers suddenly became mission-critical. How can I protect them without breaking the bank?

If your business is like most, it has become more and more data and technology dependent. Whereas downtime and lost data used to be nuisances, today they can completely stop you from doing business, particularly if many of your business sales and other transactions take place over the Web. Many small businesses today are also subject to industry and/or governmental regulations, requiring them to take effective steps to protect customer information.

Just how do you protect your data storage without breaking the bank? An effective backup strategy, combined with a technology called RAID (Redundant Array of Independent Disks) can keep your data storage up and running and your information protected without breaking the bank. Both can be accomplished using direct server attached storage, but they are far simpler to implement when they come preconfigured on a NAS device.

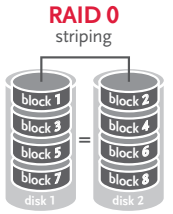
RAID

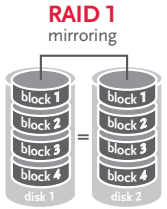
Hard disks are a lot more reliable than they used to be, but they still have mechanical parts that can fail. The best way to protect hard disk data is to store it on multiple disks, a technique called redundancy, and that's exactly what a Redundant Array of Independent Disks (RAID) does.

RAID is simply a collection of two or more hard disks linked together by software or controller firmware that lets a second or third hard disk take over storing information if the first disk fails. When RAID is working properly, ALL your data remains safe and accessible after a hard disk failure.

There are different RAID techniques, also known as RAID levels, used to protect data storage and each technique has a number assigned to it.

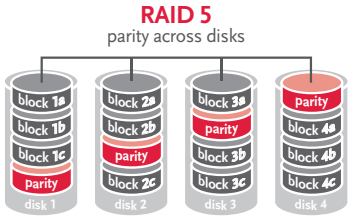
RAID 0 is a simple organization of disks for performance. In RAID 0 parts of the data set are distributed or striped, across multiple disk drives so that they can all work on I/O at the same time for higher performance. RAID 0 has no redundancy for data protection.

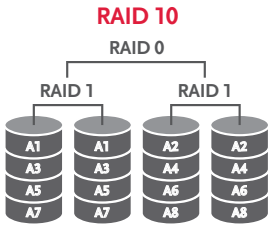




RAID 1, the simplest form of RAID for data protection, simply writes your data to two separate hard disks concurrently, so if one fails, the other still provides access to all your data.

Other popular RAID levels include RAID 5 and 6, which write your data across four or more drives, along with something called parity information that can be used to rebuild your data if one of those drives fails.





RAID 10 is a combination of RAID 1 and RAID 0, writing your data across multiple pairs of drives simultaneously to provide higher performance and data protection.

Why do you need RAID protection if you back up your data religiously? Because restoring systems and data from a previous backup requires significant time and resources, and you will lose any data written to disk since your last backup. It's best to prevent data loss first, so you minimize business disruptions and maximize uptime. Over the past five years, RAID has become a very affordable way to accomplish this.

Common RAID Levels Compared

	RAID 1	RAID 3	RAID 5	RAID 6
How it works	Data written concurrently to two separate disks	Stripes (distributes) data across multiple disks. Parity information stored on separate hard disk	Stripes data across multiple disks. Parity information distributed across disks	Stripes data across multiple disks. Distributes parity but uses second parity element in case first fails
Pro	Mirrored drive immediately available if primary disk fails	Requires storage only 1.25 times the size of data stored (in 5-disk configuration). High performance	Distributed parity means faster parity writes. Requires storage only 1.25 times size of data stored. Higher performance than RAID 1	More fault tolerant than RAID 5. Better performance than RAID 1
Con	Requires two complete copies of data. Inefficient. High cost. Not as high performance as other RAID levels	Dedicated parity disk can be single point of failure and bottleneck for parity writes. Data must be rebuilt in case of failure	Not as high performing for streaming media as RAID 3. Data must be rebuilt in case of failure	Less efficient use of storage than RAID 5 or RAID 3
Good for	Any application where high performance not requirement	High performance streaming applications	Database applications requiring performance and reliability	Same as RAID 5 but requiring extra protection

There are three principal ways to take advantage of RAID:

DAS RAID You can purchase a traditional server containing direct attached storage with RAID protection built in or you can attach an external RAID box to your server. Both will give you excellent data protection. The drawbacks:

- You'll need the expertise and time to purchase, configure, and manage a traditional server, operating system, and RAID storage.
- If your server fails, you'll lose access to your data.
- If you have lots of servers, you'll find yourself running out of storage on some, while others have storage to spare but no way to share it.
- If you have multiple RAID solutions with multiple management interfaces, you'll need the time and expertise on staff to learn and use them.

SAN RAID If you already have a storage area network, you can install RAID storage on the SAN. You'll get great performance, but you'll also need the staff resources and expertise to manage a SAN, which can be complex. That's why if you don't need performance for a database or similar application, a small business is probably better off not taking on a full fledged SAN.

NAS RAID NAS-based RAID is a great solution for businesses that don't need the performance of a SAN but want to take advantage of networked storage. Why?

- NAS is easy to install and maintain. You just plug it into the network anywhere, do some simple configuration with a Web browser, and you're up and running.
- NAS lets you share networked storage across all your network attached PC's and servers. If you need more storage you can simply install another NAS.

If you intend to store mission critical data on your NAS, make sure the NAS comes with built-in RAID capabilities. Many do. Which RAID level you use will depend on your budget and the level of performance and protection you require. RAID 10 provides maximum protection, followed by RAID 6 and RAID 1 but your actual usable storage will be less than what you would get with a typical RAID 5 configuration.

If you need the performance of SAN-based storage for a particular application, such as email or a database, look into a NAS that has iSCSI capability and can partition some storage for fast block based performance. Purchase one of these NAS/SAN devices and you can have the best of both worlds—the simplicity of NAS with the performance of a SAN.

Backup

RAID will keep your data storage running and accessible in the even of disk failure, but it won't protect you from a massive failure due to a natural disaster, data corruption, or a virus attack. That's why you also need to back up your data as a second level of protection, and preferably store some backups off site.

The issues with server backup are similar to those of PC backup, which is covered in depth in chapter 4.

Tape has a lot of advantages for backing up server data, including low cost and high portability. However, tape is too slow for many of today's storage heavy, globally connected businesses that simply don't have sufficient downtime for their backup window. It requires staff time to properly manage, and requires a server with network backup software in order to implement and manage your backups over the network.

That's why many organizations have opted for disk-based server backup. Disk is a fast and relatively low-cost medium for backup that can help you reduce or even eliminate your backup window.

Disks also enable other technologies that can add an extra layer of protection:

Snapshot creates an instant image of our file system and data on disk storage without interfering with live applications.

Replication creates and maintains replicas of your hard disk data storage at a remote site. Replicas can be created and updated over the wide area network asynchronously, meaning occasionally—such as a few times a day—or they can be updated synchronously, so that every time data is written to one site, it's written to another. Synchronous replication is also called mirroring. Replication can be expensive and difficult to manage, but it's a powerful data protection solution for a company with very high level data protection needs.

The beauty of disk-based data protection is that it can be automated so that it occurs without any need to change or rotate tapes.

Disk-based backup can be done via DAS, NAS, or over a SAN.

DAS backup If you have small number of servers, using direct attached storage as a backup medium is a viable solution. However it can become unwieldy as the number of servers multiples and backup creates a bottleneck on your LAN.

SAN backup SAN based backup is a great solution because it takes backup off your data network, where it can create a bandwidth bottleneck. If you already have a SAN installed or you need the extra performance a SAN provides for robust database and messaging applications, backing up to SAN based storage makes sense. However, SANs require a significant amount of management time and expertise, so it usually doesn't make sense as a small business backup solution alone.

NAS backup Backing up to NAS is a great solution for small businesses because NAS devices are easy to install and maintain. Many NAS devices come with their own integrated backup software that can be used to backup your network servers to the NAS device. Many also include built in NAS-to-NAS or NAS to external storage file copying capabilities for an additional level of backup. And some also let you backup data from the NAS to an online backup service so your mission critical data can be stored offsite where it can be recovered in the event of a natural disaster. The advantage: you get offsite backup without the hassle of tape handling.

If you go the NAS route, look for a product that includes these features and lets you automate scheduled full and incremental data backups. Incremental backups simply back up the data that has changed or been created since the previous backup.

If you feel you absolutely need SAN-based backup for data from one or two applications such as a database or email, look for a NAS device that allows you to partition part of it off as block based SAN storage. You then get the best of both worlds: the simplicity of a NAS with fast, SAN based backup.

At my business, email is the most popular application. What is the best storage solution for Microsoft Exchange?

If your business is like most it probably runs to a great degree on email. In fact, most businesses today are more dependent on email for communications than the telephone. Email often serves as a record of communications and transactions that may have to be retained for a long time for business, legal, or regulatory purposes. Eventually you'll find yourself running out of storage.

Direct Attached Storage (DAS) is an obvious solution for storing Exchange data. However, as your Exchange systems and data grow you may find yourself running out of DAS storage.

Unfortunately, unlike with file and print sharing, NAS doesn't make a particularly good, high-performance repository for Microsoft Exchange data. In fact Microsoft Exchange doesn't support storage on a NAS. Why? Microsoft Exchange is a database storage environment that performs much better with block-based storage than the file-based storage architecture of a NAS.

However, today there are NAS devices that come with support for iSCSI in addition to their typical NAS protocols. Shared storage on an iSCSI device looks to a host server as one of its internal drives and lets the host read and write data to the storage in blocks rather than files. Many NAS devices can be used both for file serving and as an iSCSI storage device.

When you use one of these NAS devices you get the best of both worlds: fast, block based storage for your Microsoft Exchange server and an easy to use network storage solution for sharing files and printing on your network.

Make sure any iSCSI enabled NAS you purchase has been validated and certified by Microsoft, which means it has been tested to Microsoft standards and has the technical features and requirements for working successfully with Microsoft Exchange.

What do I do if there's a storage support problem when I'm not in the office?

It's the weekend or the evening and someone on your staff can't get to their files. Do you or another staff member have to drop everything and run into the office to troubleshoot your storage infrastructure? Do you have to tell the employee that he or she will simply have to wait until the next day or after the weekend?

Actually if your storage is NAS based, it may offer a Web-based management interface that lets you access the NAS storage remotely in a secure manner. With Web browser access you can even monitor and troubleshoot storage with your iPhone while you are walking down the street. Depending on your NAS device, you may be able to change your NAS settings, create and assign storage folders, schedule backups, and even receive system generated alerts before your users discover the problem.

If you are looking for a small business storage solution that you can manage easily, a NAS device with Web-based remote management makes a great choice.

I'm on the road and I need a file. What do I do?

How many times have you been at an important business meeting only to realize you don't have an important presentation file or spreadsheet? Fortunately there's an easy solution that can prevent a lot of embarrassment and lost time.

Many NAS devices come with remote access that lets you connect and use your NAS storage from the road with a simple Web browser. You simply type in your preconfigured NAS URL, log in with your user name and password, and you have access to your files and folders. You can read and download files from your NAS or upload updated documents, photos and videos, from your laptop to the NAS storage device anytime, anywhere.

Make sure the NAS device offers secure, encrypted access, which is usually done via SSL. Make sure it also offers the ability to set up secure guest access accounts so you can give trusted employees, partners, or contractors access to specific files they need without providing access to other files you don't want them to see.

Help! I have too many servers! What's this I hear about server virtualization and what does it mean for my data storage?

Servers sometimes have a habit of multiplying like rabbits, particularly if your business depends to a large extent on the Web and Web-based applications. Before long you can end up with a mountain of physical server hardware that is expensive, power hungry, and difficult to manage. You may also find that some of your most important older mission critical applications are running on older, underpowered servers, while your newer, less important applications are running on the latest hardware, with plenty of CPU power to spare.

This situation is widely known as ***server sprawl***, and, as with DAS, it's inefficient and expensive. However there's a cure for sever sprawl called ***server virtualization***.

Server virtualization encapsulates an entire server, including the operating system and software, and abstracts it from the server hardware. With server virtualization you can pack several of these encapsulated virtual servers, each with its own operating systems and software, onto a single physical server without worrying about one virtual server interfering with any of the others. You can even have one virtual server running Windows and another running Linux (or any other operating system) sitting peacefully on the same physical server. All of these encapsulated servers run on top of a virtualization hypervisor, which isolates and manages the interactions between the virtual machines and the underlying physical server hardware. Server virtualization hypervisor solutions are available from many different vendors, most notably VMware, which pioneered the technology on X86 servers, Microsoft, and Citrix.

The benefits are of virtualization are many.

No more server sprawl With server virtualization you can pack multiple virtual servers on a single physical server and reduce your server hardware by half or more. You save on hardware, power, and cooling costs as well as the management burden involved in maintaining large numbers of physical servers.

Enhanced business agility Unlike physical servers, which must be purchased, shipped, and configured, virtual machines can be created on an existing physical server in minutes and moved from physical server to physical server quickly and easily. With server virtualization companies can gear up new initiatives in hours or days instead of weeks or months.

Affordable disaster recovery Sophisticated business continuity scenarios such as site-to-site replication once required identical server hardware at each site, with those at the secondary site essentially doing nothing until they were needed during a disaster. Virtualization allows physical or virtual servers to be replicated to virtual servers running on any usable

server hardware. The secondary site servers can even be running live applications at the same time as they are holding virtual replicas, reducing the cost of business continuity dramatically.

Network storage is the most viable solution for server virtualization, particularly if you intend to use tools such as VMware's VMotion to move server virtualization instances from physical server to physical server.

Virtualization solutions generally work with both NAS and SAN devices.

NAS makes a great moderately-priced network storage solution that is easy to configure and use for a server virtualization implementation. Make sure your NAS has been tested and certified for your server virtualization solution, whether it is from VMware, Microsoft, Citrix, or another vendor. For virtual-machine-based applications that require the block based performance of a SAN, look for a NAS that lets you partition some storage off as block based SAN storage.

Any kind of network storage must have a very high level or reliability if it is going to be shared among multiple applications and users. If you're going to combine server virtualization with a NAS, make sure the device offers fault tolerant features such as RAID and support for Uninterruptible Power Supplies, which provide temporary power to the devices during a power interruption. Some NAS devices also come with user-replaceable disk drives so you can get them up and running again quickly in the event of hard disk failure.

What other useful small business applications can I take advantage of with my NAS devices?

The beauty of NAS devices, aside from affordability and ease of use, is that they often come with features that make some essential small business functions easy to implement.

Media server Some NAS devices come with built in media servers, allowing you to stream videos and other content to PC's and other devices across a network or the Internet.

Photo Uploading Some NAS devices come with simple tools for uploading photos automatically to network storage using a USB port or wireless Bluetooth. These features can be especially useful in businesses such as real estate or insurance agencies that frequently shoot pictures on the road. With remote access you can upload these photos from a remote location very soon after they're taken.

Video Surveillance Many retail environments and other small businesses can benefit from an affordable, easy-to-use video surveillance solution. IP network cameras are a perfect solution for video surveillance. Some NAS devices come with tools that discover those cameras automatically and provide an easy interface for setting up your surveillance system. You can then watch live video from any networked PC using a Web browser or even from an iPhone if your NAS offers Web based remote access. You can also schedule automatic video recording for the hours that you need it. Make sure your NAS device offers this capability and compatibility with your chosen IP cameras.

Digital Signage Digital signage is popping up in more and more retail and sales environments, alerting customers to special sales or other items. According to an Arbitron study, 75 percent of surveyed consumers find digital signage helpful and 29 percent have made an unplanned purchase after seeing a product featured on an in-store display.

Digital signage can be expensive, but some NAS devices come with built-in media servers that can stream video to digital picture frames. Add a compatible digital picture frame to the LAN anywhere in the store and you can stream your chosen content to it, whether it be digital photos, audio, or video.

The possibilities are endless, depending on your small business needs and you get robust, affordable, easy to use storage as well for your business files.

Keep Things Simple

With all the demands, rules, and regulations involved in small business storage, keeping your business running with the storage and data protection it requires can sometimes feel overwhelming. That's why it's important to keep things as simple as you can. If your needs can be met with a NAS instead of a full fledged server, go for the NAS. If you feel as if you need SAN performance for certain applications or data protection, see if you can fulfill those needs with a NAS that offers some SAN storage.

If you live in an active hurricane, flood, or earthquake zone and you need to keep a copy of your data off-site for business continuity, try working with a service instead of taking on the responsibility and hassle of setting up your own offsite backup and storage. Keep it simple and you can spend your valuable time and resources on your business, rather than dealing with technology headaches and complexities.

Iomega®: A Market Leader in Affordable, Easy-to-use, Dependable Network Storage Solutions

Iomega is a recognized world leader in innovative small business storage solutions, with more than 410 million storage device sales since 1980. As a wholly-owned subsidiary of EMC® Corporation, the world's leading developer and provider of information infrastructure technology and solutions, Iomega specializes in fast, robust, reliable small business storage solutions that are also affordable and easy to use. Iomega's product portfolio includes the industry-leading StorCenter™ family of network storage solutions in desktop and rackmount configurations that offer fast, reliable network attached storage in capacities from 1TB all the way up to 24TB.

EMC LifeLine™, the management software that powers all Iomega StorCenter NAS devices, delivers robust functionality that stores, shares, manages and protects data.

Drawing on EMC's expertise as the world's leading provider of information management solutions, LifeLine offers enterprise-class data protection, file management and media serving capabilities right out of the box.

LifeLine is purpose-built for small business and distributed environments— where multiple computers or other digital devices are present on a network, where multiple users share files, where robust protection for those files is required, or simply where increased storage capacity is desired.

LifeLine offers built-in data protection capabilities including RAID (redundant array of independent disk) and the popular and award-winning EMC Retrospect® Express backup software, which protects more than 10 million PCs worldwide.

Thanks to LifeLine, StorCenter NAS devices are "always-on" for instant retrieval of any file from any networked device at any time from any place—even remote locations. The software supports specialized features for business users, such as a print server, email fault notification, and support for Microsoft Active Directory. It also supports media streaming for digital signage or consumer use with iTunes® or media players like games consoles

Together with LifeLine, all StorCenter products offer:

Easy setup Four mouse clicks and you can be up and running, serving files to your PCs over the network in minutes.

Support for Windows, Macintosh, and Linux PC's All your employees can store and access files on Iomega NAS easily, regardless of the operating system running on their PC's.

VMware Certification All Iomega NAS's have been tested and validated as viable storage solutions for VMware-based server virtualization installations. Some have also been validated for Citrix XenServer

Robust, easy-to-use data protection Data protection features include RAID; UPS support; EMC Retrospect Express backup software; and NAS-to-NAS replication. Iomega NAS users also have the option of Mozy online backup services for an easy offsite backup solution.

Built-in media server for sharing and accessing videos, music, and photos from any network connected PC or other compatible device. Tools are also included for easy set up of digital signage and video surveillance solutions.

Web-based remote access that lets users at home or on the road access and upload files using a Web browser.

iSCSI block access for high-performance database application storage and backup. All Iomega NAS's can be partitioned easily for both file- and block based storage on the same device.

Iomega StorCenter Network Storage Solutions

Iomega StorCenter ix2-200 offers capacities of 1TB, 2TB, and 4TB in a desktop form factor with printer sharing and optional RAID 1 data protection.

Iomega StorCenter ix-4-200d offers capacities of 2TB, 4TB, and 8TB with RAID 5 and 10 data protection, print sharing, user replaceable hard drives, a USB port for external hard drives, dual gigabit Ethernet connections, Active Directory support, email and SNMP monitoring, and VMware and XenServer virtualization certification.

Iomega StorCenter Pro ix-4-200r offers capacities of 2TB and 4TB in a rackmount form factor with RAID 5 and RAID 10 data protection, hot-swappable hard drives, a USB port for externally attached hard drives, built-in printer sharing, email and SNMP monitoring, and Windows Active Directory support.

Iomega StorCenter ix12-300r offers capacities from 4TB all the way up to 24TB in a rack mount configuration, plus four gigabit Ethernet connections with link aggregation for maximum performance; RAID 0, 1, 5, 6, and 10; hot swappable hard drives, VMware and Citrix XenServer virtualization certification, Active Directory support; and email and SNMP monitoring,

Iomega's network storage solutions are perfect for the growing small- to medium-sized business that wants maximum ease of use and data protection in an affordable, all-in-one solution.

About Iomega

Iomega Corporation, a wholly owned subsidiary of EMC Corporation, is a worldwide leader in innovative storage and network security solutions for small businesses, home offices, consumers and others. The Company has sold more than 410 million digital storage drives and disks since its inception in 1980. Today, Iomega's product portfolio includes one of the industry's broadest selection of direct-attached external hard drives; industry leading network attached storage products for the home and small business; and the ScreenPlay™ family of multimedia drives that makes it easy to move video, pictures and other digital files from the computer room to the livingroom. To learn about all of Iomega's digital storage products and managed services solutions, please go to the Web at www.iomega.com.

www.iomega.com/NAS