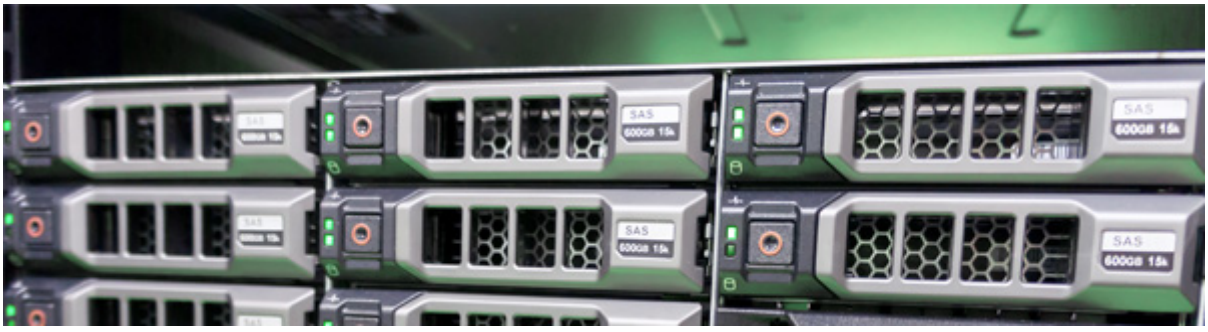

Getting started with storage. Understanding SAN vs NAS vs DAS.

Trying to wrap your head around advanced storage solutions for your home office or business? Not sure where to begin, what the differences are, or even heard of our friends **SAN**, **NAS**, and **DAS**?

I was there many years ago and share your sense of overwhelming anxiety. Storage is a complicated topic. It requires planning. Long term thinking. It's a slow decision, so don't get too eager. Designing a storage solution should not be taken lightly, especially by business users with important data at stake. Bad decisions can not only be costly, but extremely devastating. In fact, many businesses never recover from storage mistakes!

I spent several years as an IT Manager where I had the opportunity of rebuilding the entire back-end server infrastructure. I directly purchased, installed, configured, and personally evaluated a variety of storage devices; ranging from cheap, few hundred dollar solutions, to some very cool and serious hardware, including some enterprise solutions that cost upwards of many several tens-of-thousands of dollars.

Suffice to say, I'm pretty comfortable talking about hard drives, small and mid-sized business storage solutions, advantages and disadvantages of different storage methods, and the optimal use of those methods across a variety of applications, e.g., databases, basic network storage, massive storage capacities.

This post is intended to save you research, money, and provide a big picture view of the storage landscape. This should be considered a surface level starting point for storage options, so you can dig deeper into the topics and applications that apply specifically to your situation. This post is largely meant to help conceptualize the differences between DAS, SAN and NAS — not provide a true technical difference. I'm assuming you are very new to storage solutions! ***Always consult with an expert!***

Your first file server. The Super Desktop.

So you ran out of space on your first file server. You know the one — the expertly crafted Super Desktop design. That's the very elegant design where you shove in as many hard drives as possible, turn it on, hope it works, and pray Western Digital invents a Petabyte hard drive before you ever have to gracefully deal with this storage issue again.

Only problem is, they didn't invent that hard drive. So now you have to figure out how to expand to a higher capacity storage solution without losing all your current data. Which brings us to the first lesson of storage management.

Temporary Extra Storage: Necessary for migrating data

Assuming the tastefully designed Super Desktop has a 6TB RAID 5, we can't simply rip all the old 2TB drives out and replace them with 4TB drives. That would destroy all the data! Unfortunately temporary storage is a requirement when it comes to migrating data, and will have to be kept in mind when designing the next storage solution, and the next solution after that.

A quick note about RAID. Don't take risks with your data!

Remember with RAID 5 you lose a single disk for parity. With RAID 6 you lose two disks for parity. In other words, RAID 5 can sustain one disk loss, whereas RAID 6 can sustain two disk losses (simultaneously). Of course, once your parity is rebuilt (by replacing the failed drive) you can continue operations with the aforementioned disk losses.

As a rule though, you should stop using storage that has sustained disk losses and only use it after it has recovered from rebuilding. It's not always possible in business computing, and there are ways to build redundant storage arrays, but most users reading this post are not going to be running RAID 50, 60 or other more fancy configurations. Just let your RAID rebuild itself before you do anything with it.

At this point, you might choose to designate your award-winning 6TB Super Desktop as the temporary storage medium for all your data migration projects in the future. That sounds like a good plan, and it might be, every situation is different. Extra storage never really hurts, although you may need to migrate more than 6TB of data in the future. These sort of issues pop up all the time when dealing with data storage, so you should get used to thinking things through.

Storage: Take your time when designing solutions

Storage requires long-term oriented thinking. You will have to evaluate future needs, repurpose old storage devices towards new goals, and then anticipate how you may want to repurpose the new solutions your implementing after you've outgrown them. I think this is just one of many caveats to keep in mind when it comes to storage. It's a long-term game, so it really is wise to spend some time considering your options.

You may already be thinking of storage solutions that are ideal for future options and easy repurposing; buzzwords we've heard before, SAN (Storage area network) and NAS (Network attached storage). In the future, it's probably still going to be valuable to have extra storage on the network. Even if that old storage solution isn't as fast or as large of a capacity, it will still have a lot of utility as temporary storage!

But actually, there's a third option for our amazing 6TB Super Desktop. Did you notice the keyword in SAN and NAS? Networks! That means multiple computers. Which in turn means SAN and NAS are usually a bit more expensive in total startup costs. Especially considering network wiring and switches which can be laborious to install and configure correctly. Network storage like SAN and NAS also more complex, just because networks can get tricky and require their own planning.

So let's keep it simple for now, avoiding the networked storage (SAN and NAS). Everyone loves saving money, and building poorly thought out solutions teaches valuable lessons. Let's consider the absolute cheapest way to add more storage to our 6TB Super Desktop for as few dollars as possible. Remember, this isn't necessarily the smartest thing to do, but it's entirely possible and can be appropriate under many certain circumstances.

DAS: Directly Attached Storage

I don't want to give you the impression that DAS is the cheap option or even the bad option. It's not. DAS is a versatile option, and it's very cool and useful under specific applications. Directly attached storage can be either extremely cheap or expensive, and it has a lot of advantages. So what exactly is it?

Understanding DAS Analogy: A simple external USB drive.

Conceptually, the most basic form of directly attached storage is an external hard drive connected via a USB cable. That's as simple as it sounds. DAS. A directly attached storage device. However when we talk about storage we tend to mean multiple drives, an array of disks acting together in some way. The DAS concept is the same whether it's one or 24 drives. Similarly, it's the same concept regardless if we use a different cable. Actually, USB is much too slow for large DAS units.

You have probably already seen some external drives that have multiple disks. Western Digital has a Dual-drive external RAID device (http://www.wdc.com/en/products/products.aspx?id=630). Fancy that, it uses Thunderbolt instead of USB, which is a bit (many bits, actually!) faster, allowing it to saturate the read and write capacity of multiple disks! It might not carry the DAS label, but its conceptually the same.

Since DAS isn't an intuitive or marketing friendly acronym, we aren't going to see the term being used in the lower levels of hardware. "Dual-drive" explains the concept much better to consumers, and is more specific in regards to the Western Digital product offering above. When we move into larger arrays of storage, we begin to see the directly attached storage acronym: **DAS**. Again simply meaning, we are directly attaching the storage device to the computer without using a network.

A terrible idea, but super cheap and sometimes effective.

In theory, we could take our 6TB Super Desktop and pile on external drives. We so elegantly stuffed disks in there, I'm sure we could carefully cocoon the computer in external USB storage devices too! Using all those external USB drives would be more of an art project though, clearly not a serious business solution. There are a lot of problems with using USB this way, particularly speed and reliability. But let's move on, pass on the USB cocoon idea, and take a look at more serious DAS hardware to get a sense of what's available. What's a more legitimate DAS option?

A much more serious DAS solution.

Check out the Dell PowerVault MD1220 DAS (http://www.dell.com/us/business/p/powervault-md1220/pd) units. These are pretty awesome and have advanced features not found in external drives. They are clearly more power intensive having to feed up to 24 hard disks, versus one or two disks in an external. You definitely can't power these machines over USB! But with equipment like this you're going to want redundant power supplies anyways. Not to mention that when connecting DAS devices of this caliber, you will need specialized hardware — not simple USB ports!

Connecting to DAS devices.

A variety of cables can connect DAS units, including fiber optics, SATA, SAS, etc. Sticking with the Dell MD1220 example above, the computer you're connecting to will need a specialized piece of hardware that provides SAS ports. Dell recommends the PERC H800 (http://www.dell.com/learn/us/en/04/campaigns/dell-raid-controllers) for this DAS unit. Just like Apple's Thunderbolt (and the Western Digital product above), we can daisy-chain the MD1220 DAS units for an even larger array. Now we're talking! We could stack 24 drives in one MD1220 with 24 drives from a second MD1220 and so on! I've done things like this, and let me just say that it's very cool to hear so many disks spin and whir up. Imagine writing your files across dozens of disks and watching all those disk lights blink!

DAS units might be a little fancier than external USB drives, but the external hard drive analogy is a good way to visualize the same concept. Your computer will treat the Dell MD1220 similarly to an internal drive, or an external hard drive that you just plugged in. For clarity, directly attached storage units like the Dell MD1220 will require some configuration and setup. They aren't as plug and play as a thumb drive, but they are pretty easy to manage nonetheless.

Things to remember about DAS.

There are some noteworthy things to mention about DAS and how it differs. Generally, you are not able to dedicate the hard disks to multiple computers. SAN and NAS are specifically designed to be shared resources by multiple computers, whereas DAS is designed to be used by (usually) a single computer. The Dell MD1220 actually allows you to split the 24 drives in half, dedicating 12 disks to one computer and the other 12 disks to second computer (if you wanted to do so).

So why would anyone choose DAS for their storage strategy over SAN and NAS? Simple. When it comes to speed, networks are much slower than directly attached storage. Especially in terms of latency, DAS is several times faster than SAN and NAS. Even entry-level direct attached storage is faster than enterprise-level network storage. You can get great performance out of SAN devices, but it just doesn't compare for certain applications.

The main downside to directly attached storage is that it's a dedicated resource for (usually) a single computer, and it can't be managed over a network. While DAS is cheaper in the strict sense, DAS is not necessarily cheaper in all scenarios. SAN units may be much more expensive, but they gain some economies of scale with many networked computers. It really depends on your situation if you're considering it from a cost-perspective. The upside to DAS is performance.

Advantages of DAS: Direct Attached Storage.

- Simpler to setup and configure over NAS / SAN
- Cheaper than NAS / SAN in terms of raw storage
- Networks not necessary, doesn't use IP addresses
- Faster, more performant and better latency over SAN / NAS
- Easier to deal with overall considering all things

Disadvantages of DAS: Direct Attached Storage

- Dedicated resource to a single computer

- No economies of scale in sharing the storage
- Can't manage DAS via a network
- Requires a special hardware connection

The Super Desktop 2.0

So now that we know a little bit more about DAS, we've gone ahead and added a RAID card to our Super Desktop. We had the option to expand the beautifully designed 6TB Super Desktop with a bunch of external hard drives over USB, but instead we spent a little bit more money on Dell's MD1220.

Unfortunately, for the purpose of this example, we decided to fill the DAS unit with a bunch of 73GB, 15K RPM drives in RAID 5. That added a total usable space of a bout 1.5TB. It wasn't the best decision, because we were actually trying to solve our storage capacity issue. So now we are running a very expensive 7.5TB Super Desktop with a big DAS unit connected. For clarity, we still have our 6TB partition and a 1.5TB partition.

We could have done this cheaper with a simple external hard drive, actually that probably would have given us more usable space. But as we learned, professional DAS devices like the MD1220 have the advantage of speed. In fact, they're really quite good for building servers that require low-latency — that is, DAS solutions like the MD1220 are AMAZING for demanding, hard-hitting, speed-absolutely-required applications. Unless we're considering distributed computing, implementing DAS is going to be your best choice for overpowered super servers and mission critical apps, that simply MUST GO ON. Which brings us to a special point.

Speed vs Storage Capacity are two ends of the storage spectrum

On one side of, we have speed. Increasing speed is usually at the cost of Capacity. Likewise, increase Capacity usually comes at the cost of Speed. We could probably add a third dimension to this for Cost. Because with enough money, you can achieve a satisfying mix of both.

Our 1.5TB partition on the Super Desktop 2.0 would be particularly great at running a decent sized database. Easily able to handle thousands of queries per second, no problem. Optimizing specific configurations towards a particular purpose is beyond the scope of this post, but let me mention that RAID 5 might not be your best choice for a heavily used database. Anyways, let's keep moving.

You decided to download Wikipedia and consumed the remaining terabytes of space pretty quickly. The Super Desktop 2.0 is starting to become a real pain in the neck. You could keep expanding with DAS devices, but you really need something more robust, and particularly you want something accessible by all your networked computers. What we need is some sort of network attached storage: **NAS**!

In theory, you could be using our Super Desktop as a NAS device. It's entirely possible to setup a computer like our Super desktop with a DAS (directly attached storage) array and then share that partition over the network. In fact, that's all a NAS device really is!

NAS: Network Attached Storage

Little did you know the Super Desktop was already a fancy Network Attached Storage device. A network storage device is conceptually simple. Any computer, regardless of number of disks and the size of storage space available, can be considered a NAS if it acts as a file server on the network. Said another way, a network attached storage (NAS) device is just a computer that shares files over the network. That's it!

I think where people become confused about network attached storage devices is when they use a special interface or operating system other than Windows. Or when that NAS has a fancy array of hard drives, perhaps even a DAS-like array built-in similar to the MD1220.

Let's go back to the beginning. Remember that NAS devices are a computer with any amount of disks or storage space available. Western Digital has a starter NAS device (http://www.wdc.com/en/products/products.aspx?id=1140). Even though this only has a single hard drive, it's connected to the network, and is therefore a NAS. Conceptually this is almost identical to the external USB hard drive, except instead of a USB cable connection, a NAS will (usually) be using an Ethernet connection — or at least some networking cable.

Connected a NAS to the Network means it has an IP Address.

Computer networking goes beyond this post, but a NAS is essentially assigned an IP address and is then available via that IP over the network. It's worth pointing out that since both SAN and NAS are network storage mediums, they both have some sort of network interface and IP addresses.

You might be wondering to yourself: is this little Western Digital network hard drive really a computer? The answer is yes! It actually has its own processor, RAM, and all that! It's a true computer that probably runs some variant of Linux. You could, in theory, install software on it just like a regular computer, although it might not have the hardware inputs you require (like a mouse, keyboard, and graphics connection for your monitor). But trust me, it's a computer all the same!

Which brings up another important difference. Directly attached storage devices are generally not considered computers. They are more akin to a peripheral like your mouse or keyboard. In other words, DAS devices are simply connected to the computer. Not a computer themselves.

This is in contrast to SAN and NAS devices, which generally can be considered computers. They require a processor, operating system, RAM, and at least one network card. SAN and NAS devices are simply specialized computers that allow OTHER computers to access their storage over the network. There may be technical nuances here, regarding this and the previous statement about DAS devices not being computers, but I'm trying to illustrate overall concepts and not the exact technicalities. Nowadays, just about everything (even SIM cards (http://en.wikipedia.org/wiki/Subscriber_identity_module)) have some sort of microprocessor or ALU and could therefore be considered "a computer".

Why does this matter? Who cares if DAS, NAS, or SAN is a computer?

Your computer cares! It treats each differently. Your processor (and potentially RAID card) are going to be responsible for managing the directly attached storage unit. From the perspective of the computer, the DAS is physically a part of the same computer. In the Super Desktop example we've been using, the Desktop thinks the

big MD1220 box off to the side is physically apart of the same computer — even though it doesn't physically appear to be enclosed as "one computer".

The above is in contrast with a network attached storage device. Your computer doesn't believe a NAS is physically part of the "same computer". The computer sees a NAS as storage provided by some other computer, accessible over the network. This is a big distinction!

How a DAS appear to computers:

Pretend we are now using a Macbook. If we connect an External USB drive (DAS analogy) to the notebook, we are going to see an additional drive become available. Mac is smart enough to categorize this as a "device" in the Finder sidebar. Your computer doesn't ***actually*** believe a USB device is physically a part of the same computer, but again the USB analogy is only meant to help conceptualize true DAS enclosures.

A true DAS enclosure like the Dell MD1220 would appear to be "within" the same computer. It would function as an "internal" drive (depending on how it is partitioned), even though it is clearly not internal in the literal, physical sense. The DAS analogy I provided breaks down partially because USB devices are designed to be Hot Swappable whereas DAS enclosures are not. On Windows the external USB analogy works much better.

On Windows, the USB drive appears and is made available as an unique partition. The USB drive is assigned its own unique letter, behaving much like an internal hard drive would on Windows — appearing as (C:\), (D:\), (E:\), etc. While Windows does also recognizes it is actually an external USB device, the lettered partitions make the DAS concept a easier to grasp. Connecting a Dell MD1220 would simply provide additional drive letters (depending on how you configured and partitioned it) similar to the external USB.

How NAS appears to computers:

Pretend again that we are on our Macbook. If we connected to the 6TB partition on the Super Desktop, it would appear distinctly different than an external USB drive. Remember that a DAS functions as if it were "within" the computer it is connected to. A NAS remains and functions as a separate computer that you will have to connect to with credentials (user and password).

Once connected to a NAS, you will see folders, or more aptly named "Shares". Shares are just special folders that are accessible over the network. NAS solutions are built around the concept of providing users access to "Shares". This is an area beyond the scope of this post, but to offer an example, we could say "My Share" on "Super Desktop" is now shared over the network.

We could even create multiple user logins and provide different levels of access here. You can probably start to piece together why NAS devices are useful. Network attached storage devices are particularly good are sharing information and allowing for collaboration. Many businesses get a central file server (NAS) setup fairly quickly, so they can collaborate on files more easily across multiple computers. This might be changing a bit with Cloud Storage solutions, but I digress.

On Windows, you can find Shares provided by NAS devices under the “Network” icon. On Mac, you will see a “Shared” listing on the sidebar of Finder which is automatically populated. If the topic of file servers interests you, go ahead and research SMB (http://en.wikipedia.org/wiki/Server_Message_Block) and Samba.

Since we already mentioned the Dell MD1220 above, we can look at its equivalent NAS form factor. Remember, the major difference between a NAS and DAS is that one is a computer (NAS) and one needs to connect to a computer (DAS). Check out the Dell PowerVault NX3200 NAS (http://www.dell.com/us/business/p/powervault-nx/pd). If you click on the specifications, they will actually list the processors within. Aha! Proof it is a computer!

Continuing with the Super Desktop, it would probably be wise to move Wikipedia off our low-capacity, high-speed MD1220 DAS unit, and over onto a new NX3200 NAS. We can repurpose that MD1220 for something more appropriate (like a really demanding application!) Woo!

Things to remember about NAS.

A network attached storage device is a computer that provides Shares to other computers and users over a network. A computer can be considered a NAS device regardless of number of disks and disk size, so long as it shares storage over a network. Usually though, when referring to NAS devices, it’s commonly understood to mean a specialized computer with multiple disk array(s).

A NAS device is a shareable resource. Multiple users and computers can benefit. This contrasts in comparison to a DAS (directly attached storage) device which is dedicated to the computer it directly connects to. The disk arrays in both NAS and DAS are similar in function and operation, meaning you can create similar RAIDS and partition styles on both.

While network attached storage is economical and ideal for collaboration and sharing, it really isn’t the best choice for performance critical applications. The downside to network attached storage is complexity (introduced by relying on a network) and latency speed. You generally would not want to operate a heavily-used database from a NAS.

Advantages of NAS: Network Attached Storage.

- Economical way to provide large storage to many persons or computers
- Several times easier to setup and configure versus SAN
- Easy way to provide RAID redundancy to mass amount of users
- Allows users permissions, folder privileges, restricted access to documents, etc
- Higher utilization of storage resources

Disadvantages of NAS: Network Attached Storage

- Requires IP Address(es) and takes up network space
- Slower latency and potentially maximum data-transfer issues
- Performance can be affected by network status

Recall our triumph of human engineering from earlier, the Super Desktop 2.0! We have a MD1220 (**DAS**) connected to it. We are sharing our 6TB over the network (**NAS**). Now it's time to push our art project into the enterprise realm and start dealing with storage area networks, or **SAN**!

First, let's remember that NAS and DAS devices appear differently when they are connected to a computer. Understanding how a Shared Folder (from a NAS device) and an external USB device (DAS) differ in appearance is going to help conceptualize our final storage friend. Storage area networks (SAN) have some relationship to "how" these storages appear to computers.

SAN: Storage area networks

The essential difference between SAN and NAS is a clarification in how the network storage is being accessed. Well, actually that's not true. SAN and NAS are both accessed over a network by TCP / IP protocols. What I mean to say, is that other computers access SAN and NAS devices differently. Wait, I just said that? See, it is easy to confuse SAN and NAS. Let's start over.

- Remember what **DAS** is good at? **Speed. Speed. SPEED.**
- Remember what **NAS** is good at? **Sharing. High Utilization. Flexibility.**

Combining the best of DAS and NAS.

What if we wanted the performance of DAS with the benefits of NAS? We would find ourselves envisioning some sort of **directly attached network storage** (kinda) or **SAN**! And when it comes to enterprise-level, datacenter-level, or virtual computing environments, storage area networks are really the thing to do. The attempt to solve unify the best of both worlds.

> *I should mention that if you don't have a virtual environment or serious computing needs, a SAN isn't a realistic option, especially if you have a smaller budget. Even if a SAN is within your budget, they really are designed for higher-end computing, virtual computing, complex configurations, and serious economies of scale. This post is intended to help newcomers grasp the concepts of different storage solutions. If you found this post helpful, you will likely need to research networking and many other topics before considering a SAN.*

We do have a NAS out on the network, which is really great for storing Wikipedia, but not so great for… say, running an Operating System from. While it's entirely possible to Map a network Drive on Windows (http://windows.microsoft.com/en-us/windows/create-shortcut-map-network-drive#1TC=windows-7) and make a NAS Shared folder appear to as a local lettered drive, it's just not the same thing. Although, mapping a network drive is conceptually similar to the function that SANs provide.

I alluded to this earlier, but a **SAN is a more sophisticated NAS device that allows others computers to treat its partitions like a DAS**. Wow! In other words, a SAN is a network attached storage device, that other computer connect to over a network, and can treat as an "internal" or "directly attached" or "dedicated" hard drive. That does sound intriguing, don't you agree?

How does SAN magic work, you wonder? Didn't I say NAS was slow? (Yes.) How are we going to "directly attach" a network device? And what makes SAN more complex than NAS devices? These are good questions. Let me start by saying that SAN solutions vary quite a bit from implementation to implementation, require (at least some) network planning, and usually require some additional software to deal with. Storage area networks are not for faint of heart.

Firstly, SANs are complex because computer networks are (usually) complex. This is especially true in environments where SANs are commonly needed. While a NAS can be auto-assigned an IP address, SANS will definitely need dedicated IP addresses. Multiple addresses, probably going to different switches and fun stuff like that. This isn't a big deal, but SAN implementations sometimes involve virtual networks, switching rules, and planning for the physical wiring. That stuff is difficult to roll into an already very long post. So for the rest of this post I'll instead be focusing on more surface layer material.

Explaining the storage area network

To help explain the magical SAN, let's revisit our modern marvel, our trusty Super Desktop! If you remember, we have that low-capacity, but super fast 1.5TB partition provided by the MD1220 DAS unit (we put twenty-four 73GB, 15K RPM drives in it.) This DAS deserves some praise, and is quite awesome — you'll see why!

> *This MD1220 is fast. Really fast actually. It's difficult to imagine an array of 24 disks working together NOT being fast. Especially when we're talking about several thousand dollars worth of computing equipment. You may not know though, there will definitely be diminishing returns for each drive you add to a RAID. After 6 or so disks in RAID 5, the speed doesn't improve much and might get worse at SOME point. If we needed even higher performance, we would probably opt for RAID 10, solid state disks, or maybe a combination of both. Don't shy away from optimizing the application either!*
>
> *I mentioned this briefly before, but we didn't choose the optimal configuration in our Super Desktop example, but I'm trying to illustrate the point that you should REALLY plan ahead and think designs through! Storage is a long-term decision, it's complicated, nuanced, and mildly annoying. But it is certainly worthy of your undivided attention.*

Our Super Desktop wasn't designed to be a SAN, but it wasn't really designed to be a NAS either and we accomplished that. So let's keep going, and do **A LOT of pretending** along the way! We are going to take our MD1220 and repurpose it for our SAN. But instead of creating Shares (folders) on the network, we are going to be creat-

ing and sharing logical partitions. In other words, our fancy SAN provides entire virtual drives over the network — which is a big contrast with a NAS that simply provides virtual folders over the network.

If you understand the difference between a folder and an entire hard drive, you can start to see why storage area networks are pretty powerful tools. You can't install an Operating System on a NAS — that doesn't even make sense! But you can install Windows, OS X, or Linux on a SAN partition. With SANs, you can actually let other computers boot from the network partitions. Again, we're really just treating a NAS as a directly attached, "internal" drive.

Our Super Desktop design may be the pinnacle of human achievement, but we're actually going to need to get a true SAN device in place for the remainder of this. I mean, there's only so much you can do with Windows Home Premium (haha, this example is amazing.) So let's get serious and put this art project behind us. Say hello to the Dell PowerVault MD3 SAN (http://www.dell.com/us/business/p/powervault-md32x0i-series/pdhttp://www.dell.com/us/business/p/powervault-md32x0i-series/pd).

At first glance, the DAS, NAS, and SAN devices all look similar. It should not come as a surprise that many people get them confused, their physical appearance is dominated by a large array of disks.

Addressing confusion about DAS, NAS and SAN.

Actually, when I was first learning about business-class storage, I got hung up in the abstraction details. So let me address some minor points here. The array of disks in each of the DAS, NAS, and SAN function the same on ALL of the enclosures. However, the way in which these enclosures are connected, and put to action, is what separates them into their respective categories.

For clarity, we are able to create RAID 0, 1, 5, 10, 50, 60 logical disks on ALL of these enclosures types (DAS, NAS and SAN). Remember, **physical** disks are abstracted into **logical** RAID disks that are created by these enclosures and subsequently "seen" by the computer!

Individual, physical disks make up logical RAID disks. Logical disks are then made available to the computer (DAS: directly attached) or shared over the network (SAN). The operating system is installed on the logical disk, and doesn't care much whether it is provided via DAS or SAN. Once you have an OS running, you can create Share folders on the network (NAS).

- *A SAN could therefore have several DAS enclosures connected to it. The SAN+DAS enclosures store the virtual (or logical) disks for the operating system. This computer could in turn go on to be configured into a network file server (providing NAS services).*

- *Similarly, a NAS could have several DAS enclosures connected to it. The NAS+DAS enclosures could provide massive amounts of storage to users and computers on the network, but the NAS+DAS solution could not provide "logical disks" to those computers. Special software is generally required to create a SAN.*

- A DAS needs to be directly connected to a computer, as the name implies!

Moving onwards with SAN from the Super Desktop

We have finally retired our brilliant Super Desktop design. We have moved onto a more legitimate network of devices; the MD3 SAN, the NX3200 NAS, and the MD1220 DAS. But wait!

What will we attach our MD1220 DAS to? Remember that a DAS is akin to a peripheral (like a mouse and keyboard) and is not a computer itself like a NAS or SAN. Was our DAS investment useless!? Au contraire, dear reader! I'm so glad we're talking about this! Because what makes these MD1220 DAS enclosures so very cool, is that we can directly attach them to our NX3200 NAS or our MD3 SAN! Wow!

> *Dell gets my **HIGH FIVE** for designing awesome enclosures.*

There are hundreds of different form factors and DAS solutions that work similar and can help mitigate the risk of poor planning. Synology (http://www.synology.com/en-us/) provides a few NAS+DAS hybrids that are pretty cool if you want to see other examples of the above. But let's move onto wrapping this post up. We're going to attach our MD1220 DAS to our MD3 and talk about SAN magic.

SAN Magic!

Without getting too advanced, the magic of SAN is combining the benefits of network attached storage and treating it as directly attached storage. Your typical SAN will not only have an array of disks, but an array of ethernet or network ports to offload data. Multiple network ports is an effort to give SANs a serious speed boost. While SANs may or may not ever perform as well as DAS enclosures, it is possible to get pretty good results.

Consider that a 1Gbps network port will push about 125MB / second of data. Even with 8 x 1Gbps ports, we can only reach 1GB / second. That's probably enough to saturate 8 disks in RAID 10, but the MD1220 has a full array 24 disks! With three RAID 10's (8 physical disk each) we would likely run into some performance issues if we had, say… 3 different servers connected to our SAN, each with very intensive applications running. For reasons like this, DAS can be a smart option.

Although, some SANs do provide multiple 10Gbps network ports. But we can go back and forth between different configurations. The MD3 San actually supports multiple MD1220's daisy chained together. So it's a bit of a nuance (important to keep in mind), that your available network bandwidth and your disk read and write speeds should be comparable and sufficient for one another.

A lot of things can affect SAN performance though. With SANs, every connected computer's disk activity is can (and probably will) affect other computers. This performance hit is exacerbated in virtual environment where logical RAID disks are further divvied up into smaller logical disks. SANs and virtual computing is a sort of double-edge sword in that way — not having to worry about the underlying physical hardware, but not truly guaranteed physical resources. (Some will shoot back that virtual environments do, in fact, guarantee resources… But I'm not interested in discussing the specifics within this post.)

At the very least, SAN performance requires a bit more work to "guarantee" that it is performing well. It's easy to mess up SANs, if the network connections aren't correct, virtual environments aren't correct, if the apps on those virtual computers aren't correct... A lot of variable and plenty of "uncertainty" there. Or, plenty of room for errors. Again, this is another reason why DAS remains an option (we stated earlier we wouldn't bring crazy distributed computing setups into this.). DAS is a great option for databases, file intensive operations, or other disk intensive ops. And it's just a heck of a lot easier to deal with than SAN.

Advantages of SAN: Storage Area Network

- Economies of scale similar to that of of NAS
- Higher hardware utilization, similar to that of NAS
- Speed similar or comparable to DAS
- Allows virtual environments, cloud computing, etc.

Disadvantages of SAN: Storage Area Network

- Performance affected by other SAN users
- Performance limited by network if configured incorrectly
- Better performance will still be found using DAS hardware
- Requires multiple static IP Addresses
- Generally consumes more IP addresses than NAS devices
- Complex networking planning is necessary
- May want to implement virtual networks / different subnets
- Physical network wiring may affect performance
- Physical network wiring should be thoroughly planned
- Generally more expensive than NAS or DAS

Well I do very much hope you have enjoyed this seriously long post. Again, my goal here was not to delve into the deep technicalities, but offer a surface layer knowledge base for readers. It often helps to walk through scenarios of when to use each enclosure type, and I hope I touched on enough of that here in my examples. Although this post is already very long, I do feel I could have been a bit more comprehensive and left a lot of details out. This is a big topic!

In any case, if you have any questions feel free to comment below or Tweet me!

This entry was posted in Learning (https://vanillavideo.com/blog/category/learning) on January 23, 2014 [https://vanillavideo.com/blog/2014/started-storage-understanding-san-nas-das] by Corey Olson (https://vanillavideo.com/blog/author/corey-olson).

Videography

Order Videography (/order/)

Vanilla Clips (/features/clips/)

Specifications (/features/specifications/)

Video Montages (/products/montage/)

Locations

Corporate Headquarters
1621 W. Carroll Ave.
Chicago, IL 60612

Post Production Suites
10s020 Lakewood Dr.
Willowbrook, IL 60527

Engineering Suites
7311 Seminole Ct.
Darien, IL 60561

Customer Resources

Getting Started (/resources/getting-started/)

Videography Pricing (/resources/prices/)

Common Questions (/resources/faqs/)

Testimonials & Reviews (/resources/testimonials/)

Consultations (/resources/consultations/)

Video Production Services

Wedding Videography (/weddings/)

Business & Corporate (/corporate/)

Sports Videography (/sports/)

Music Video Production (/music/)

Custom Video Project (/custom/)

Contact Us

(866) 948-4336 (/contact/)

Email Us (/contact/)

Facebook (https://www.facebook.com/vanillavideo)

Twitter (https://twitter.com/VanillaVideo)

(844) 948-4336 (/contact/)

US — Chicago, Illinois

Terms of Use (/terms/website/) Privacy Policy (/terms/privacy/) Site Map (/sitemap/)