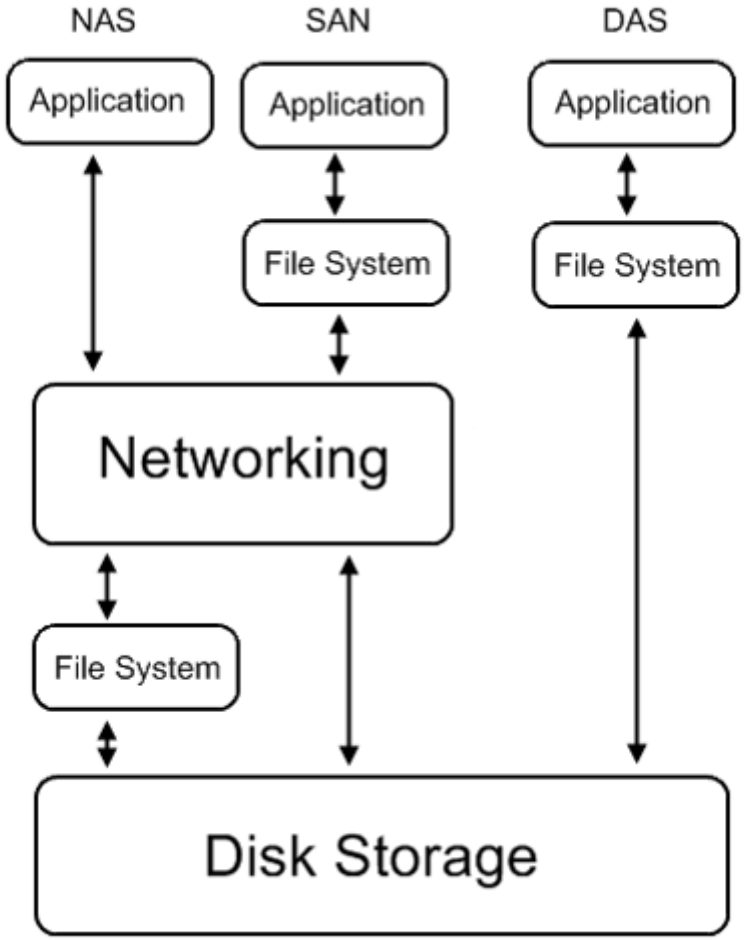
BLOCK DEVICES & FILESYSTEMS

First it is best to define the difference between a block device and filesystem. This is easier grasped if you are familiar with UNIX because it makes an objective distinction between the two things. Still the same applies to Windows.

- A **block device** is a handle to the raw disk.
  - Such as /dev/sda for a disk or /dev/sda1 for a partition on that disk.
- A **filesystem** is layered on top of the block device in order to store data. You can then mount this.
  - Such as mount /dev/sda1 /mnt/somepath.

With those terms in mind it's then easier to see the distinction between the following.

- **DAS** is a block device from a disk which is physically [directly] attached to the host machine.
  - You must place a filesystem upon it before it can be used.
  - Technologies to do this include IDE, SCSI, SATA, etc.
- **SAN** is a block device which is delivered over the network.
  - Like DAS you must still place a filesystem upon it before it can used.
  - Technologies to do this include FibreChannel, iSCSI, FoE, etc.
- **NAS** is a filesystem delivered over the network.
  - It is ready to mount and use.
  - Technologies to do this include NFS, CIFS, AFS, etc.



Most storage devices share the same physical and logical structure, in order to be able to locate the data you want, you need a way to identify where your data resides, so this is the reason of why Hard Disk drives have **sectors** (or simply "**blocks**"), in many cases this reflects the layout of the data written into the physical medium. But accessing your data by addressing the sector number while not very complex, it's an error prone method and you have to keep track yourself of the data you write and the sectors you have written to. So this is where a ***file-system*** comes to the rescue, a simple file-system will help you by addressing the blocks used and providing you a common interface to retrieve your data, the most common paradigm used is the *folder/file* structure (this is why is it called a *file*-system).

So essentially a file-system leaves you with a very simple interface towards your data, and takes care of the housekeeping and remembering in which blocks/sectors it puts your stuff, normally in a file system you will not refer to block numbers to get your data, but to filenames. This explains the difference between a **block** device and a **filesystem**, a filesystem must reside on a block device.

DAS: The simplest storage is a Hard Disk connected to your computer/server. Hard disk drives need to communicate somehow, and they need to use a well defined physical interface and protocol in order for your computer to understand them, the most common interface and protocol employed today for PC is the S-ATA or Serial ATA or Serial Advanced Technology Attachment. So a hard disk which is physically connected trough the same interface to your PC is identified as a **Direct Attached Storage** or **DAS** for short. To make it clear, ANY **block** device which is directly connected to your system makes a DAS, even an USB stick is a DAS (but the interface is USB in this case). And unless you access your disk by block numbers you need a file system on top of it in order to put it at good use.

NAS: But what if you can provide access to your file-system to other computers (for transferring files)? Many protocols have been created over the years to accomplish easy file sharing on a Network with other computers, as an example I will only name the main per Operating System: UNIX and the likes - NFS , DOS/Windows - CIFS/aka.SMB, Apple - AFP. What they do is share files over a network, of course file implies an underlying file-system structure and file-system implies block device, but because it's done over a network it's called as NAS - **Network Attached Storage**. All of this interfaces explicitly prohibit remote lookups of block addresses (for security reasons first) and normally such interfaces are not even implemented. Network file systems can be considered safe enough to be used in a concurrent way, the Protocol implementation will take care of problems due to concurrent access to the same resource (file), normally by locking the file to a single user/requester. While any computer can share files over a network and could be called NAS, normally by NAS you identify only devices which main purpose is to share files over the network. Normally NAS operates on IP/TCP Ethernet networks and most can easily provide access to your data over the Internet.

SAN: et's say that I like to read my data by block numbers, because I've written my own software but I'm in need of many disk drives, more than a single computer can host. The solution would be to share the disks of other computers, but as said before my NAS doesn't provide a way to lookup block numbers remotely. So I will need to use another protocol to share my disk drives, one that doesn't need a file system to operate.

The following interfaces/protocols/networks exists today to share disks over a network:

- ✓ **SCSI** - The father of all ;) While SCSI is a low level protocol is used encapsulated into secondary or transport protocols to send commands to controllers or disks
- ✓ **SAS** - Serial Attacched SCSI This allows to create entire SANs as SAS supports routing and addressing
- ✓ **FC** - Fiber Channel
- ✓ **iSCSI** - Internet SCSI Or simply SCSI over Ethernet (in IP networks)
- ✓ **ATAoE** and similar - ATA over Ethernet

Virtually any low level protocol can be encapsulated into network packets and sent remotely to allow to access the hard disk as it was connected locally. Then you can read your data by block numbers or simply create a file-system on the new block device.