Introduction to Storage Technologies and Terminology

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Agenda

- Introduction
  - Drives Interfaces and Evolution
  - Format Types and Importance
- RAID Technology
  - What is RAID
  - Explanation of RAID levels
- DAS, NAS and SAN
  - Explanation of each technology
  - Where each technology fits – typical applications
- What is Virtualization?

Agenda (cont.)

- What is Unified Storage?
- Microsoft Active Directory
- Snapshot Technology
- Thin Provisioning
- Distributed File System
- Green Technologies
- Conclusion

Introduction

Drives Interfaces and Evolution

Serial ATA (**SATA** or **Serial Advanced Technology Attachment**) is a computer bus interface for connecting host bus adapters to mass storage devices such as hard disk drives and optical drives. Serial ATA was designed to replace the older parallel ATA (PATA) standard (often called by the old name IDE), offering several advantages over the older interface: reduced cable size and cost (7 conductors instead of 40), native hot swapping, faster data transfer through higher signalling rates, and more efficient transfer through an (optional) I/O queuing protocol.

Parallel ATA (se está utilizando la sigla PATA)
ATA-1, la primera versión.
ATA-2, soporta transferencias rápidas en bloque y multiword DMA.
ATA-3, es el ATA-2 revisado y mejorado. Todos los anteriores soportan velocidades de 16 MB/s.
ATA-4, conocido como Ultra-DMA o ATA-33, que soporta transferencias en 33 MB/s.
ATA-5 o Ultra ATA/66, originalmente propuesta por Quantum para transferencias en 66 MB/s.
ATA-6 o Ultra ATA/100, soporte para velocidades de 100 MB/s.
ATA-7 o Ultra ATA/133, soporte para velocidades de 133 MB/s.
ATA-8 o Ultra ATA/166, soporte para velocidades de 166 MB/s.

	SATA I	SATA II	SATA III
Frecuencia	1500 MHz	3000 MHz	6000MHz
Bits/clock	1	1	1
Codificación 8b10b	80%	80%	80%
bits/Byte	8	8	8
Velocidad real	150 MB/s	300 MB/s	600 MB/s

Drive Interfaces and Evolution

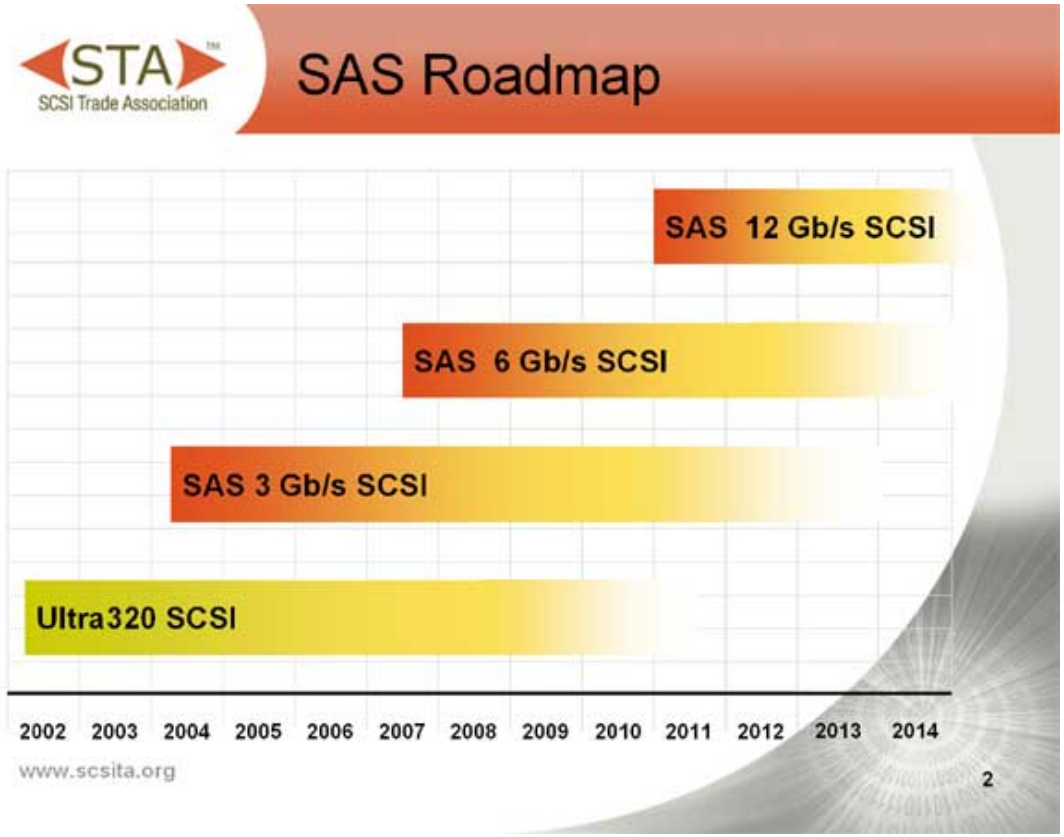
SCSI (Small Computer System Interface) is a set of standards for physically connecting and transferring data between computers and peripheral devices. The SCSI standards define commands, protocols, and electrical and optical interfaces. SCSI is most commonly used for hard disks and tape drives, but it can connect a wide range of other devices, including scanners and CD drives.

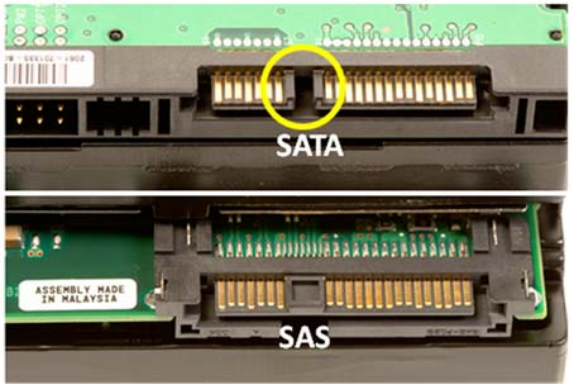
SCSI Chart

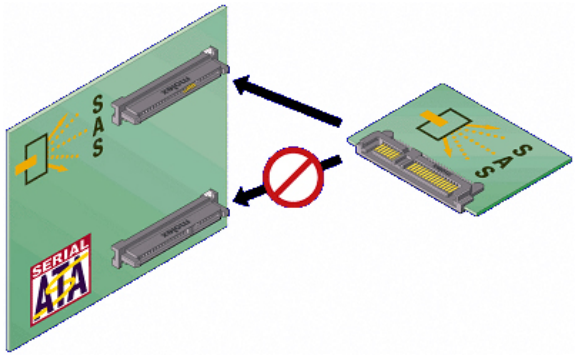
Type	Alternate Name	Bus Width (bits)	Bus Speed (MB's/sec)	Max. Devices	Bus Length (Meters)		
							LVD
SCSI-1					6	25	
Fast SCSI	Narrow Fast SCSI	8	10	8	3	25	
Ultra SCSI	Narrow Ultra SCSI	8	20	8	1.5	25	
Ultra2 SCSI	Narrow Ultra2 SCSI	8	40	8		25	12
Fast Wide SCSI		16	20	16	3	25	
Wide Ultra SCSI		16	40	16	1.5	25	
Wide Ultra2 SCSI		16	80	16		25	12
Ultra3 SCSI	Ultra160 SCSI	16	160	16			12
Ultra320 SCSI		16	320	16			12

Drive Interfaces and Evolution

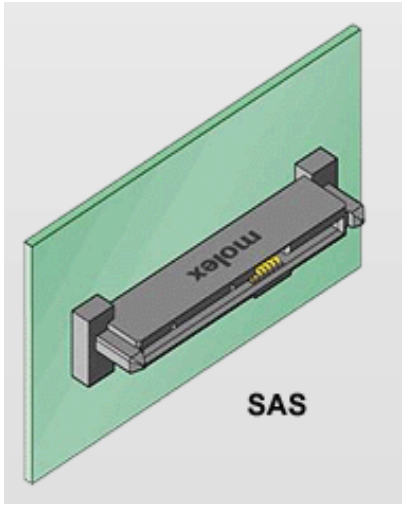
Serial Attached SCSI (**SAS**) is a computer bus used to move data to and from computer storage devices such as hard drives and tape drives. SAS depends on a point-to-point serial protocol that replaces the parallel SCSI bus technology that first appeared in the mid 1980s in data centers and workstations, and it uses the standard SCSI command set. SAS offers backwards-compatibility with second-generation SATA drives. SATA 3 Gbit/s drives may be connected to SAS backplanes, but SAS drives may not be connected to SATA backplanes.

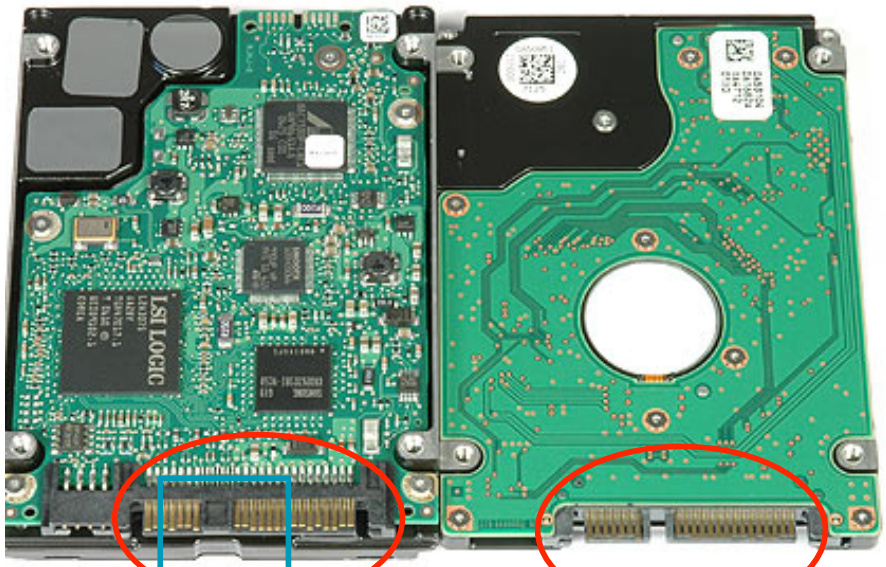


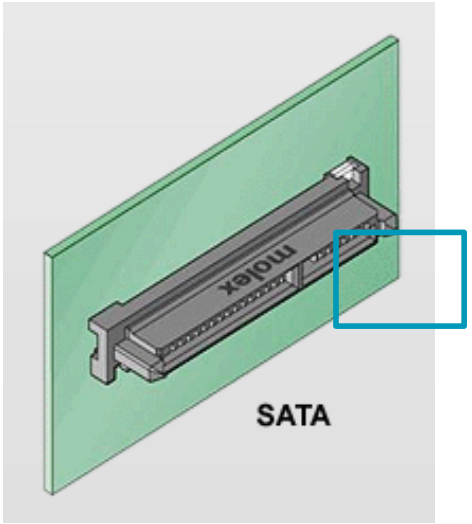


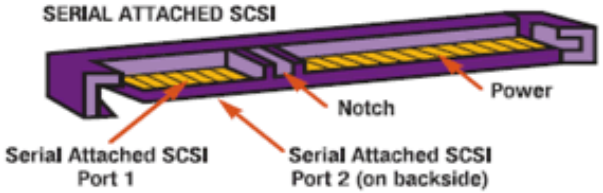


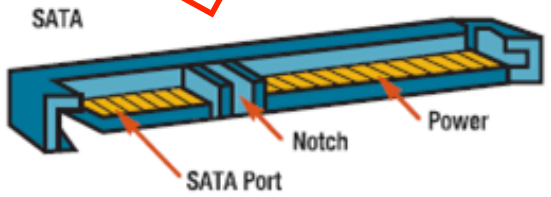
Drive Interfaces and Evolution







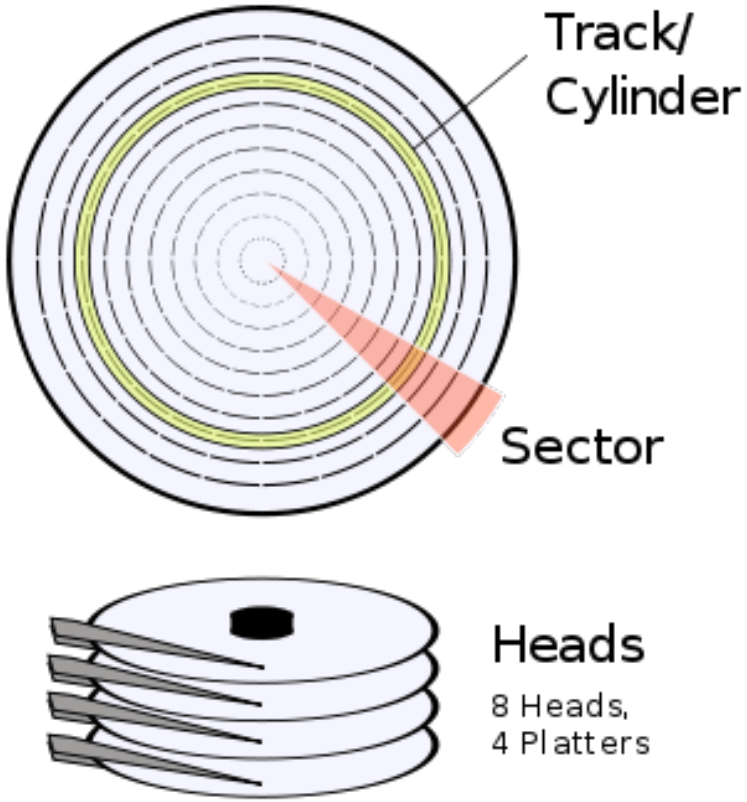




SAS drives have 2 ports ie data can be transferred from 2 sources

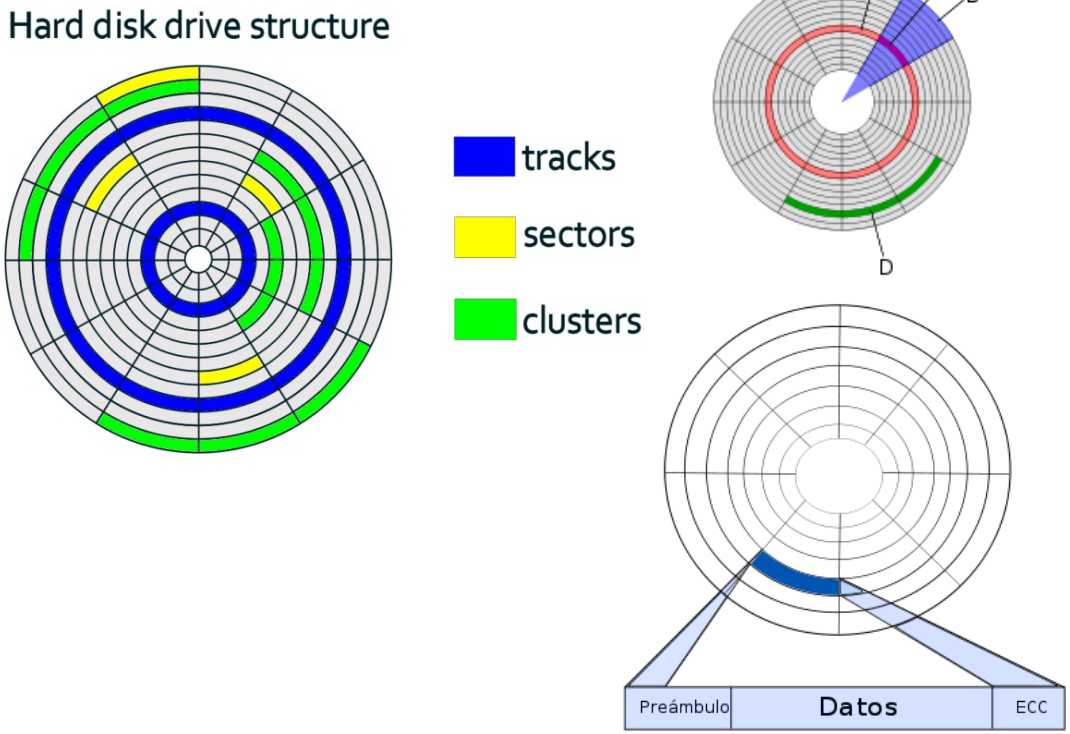
SAS backplane will accept SATA drives But SATA backplane will not accept SAS drives

Format type and Importance



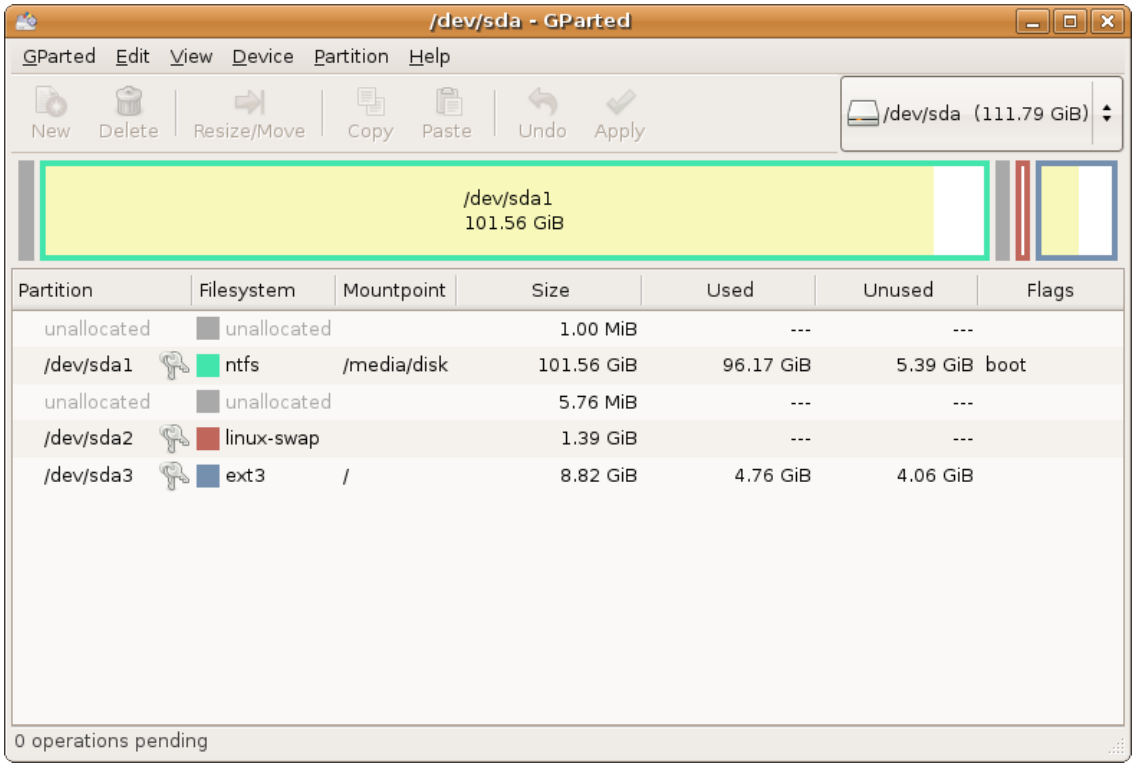
Low Level Format

Disk formatting is the process of preparing a hard disk drive or flexible disk medium for data storage.



Format type and Importance

Partitions & High Level Format



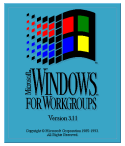
Disk partitioning is the act of dividing a hard disk drive into multiple logical storage units referred to as *partitions*, to treat one physical disk drive as if it were multiple disks.

Format type and Importance

Partitions & High Level Format

EXT, EXT2, EXT3 and EXT4 are format types used in Linux/Unix OS

FAT, FAT16 and FAT32 are format types used in Microsoft OS developed since MS-DOS



NTFS was introduced with Windows NT and actually is the most extended format . Used by OS like Windows 7 and Windows 2008

RAID

What Is RAID?

› RAID is a redundancy architecture for data storage (except RAID 0).

- RAID stands for **R**edundant **A**rray of **I**ndependent **D**isks (formerly Redudant Array of Inexpensive Disks).

› The RAID Level determines how redundancy is achieved and how data is distributed across the disk drives in a disk array.

› The best RAID Level is determined by the type of application(s)

- Different applications require different RAID levels

› RAID provides real-time data protection. (Except RAID 0)

The Driving Factors For RAID

- Reliability greater than single disks
- Performance greater than single disks
- Capacity greater than single disks

RAID Levels

- RAID levels defined
  - RAID 0
  - RAID 1
  - RAID 2 (not used)
  - RAID 3 (not typically used in networks)
  - RAID 4 (not typically used)
  - RAID 5
  - RAID 6

- Hybrid or plus...
  - RAID 0+1 (also known as 0/1, 1/0)
  - RAID 0+5 (also known as 0/5, 5/0, or 50)
  - RAID 0+6 (also known as 0/6, 6/0, or 60)

Definitions

Block Level

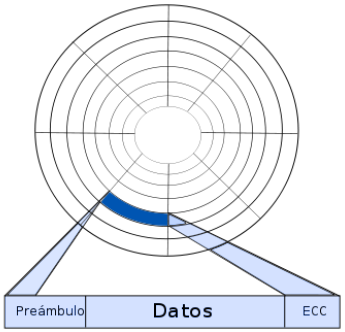
In computing (specifically data transmission and data storage), a **block** is a sequence of bytes or bits, having a nominal length (a *block size*). Data thus structured are said to be *blocked*. The process of putting data into blocks is called *blocking*. Blocking is used to facilitate the handling of the data-stream by the computer program receiving the data.

Data Stripe

In computer data storage, **data striping** is the technique of segmenting logically sequential data, such as a file, in a way that accesses of sequential segments are made to different physical storage devices.

It can also be defined as the amount of data that is accessed on one disk before moving to the next disk in the array.

Remember Format definition?



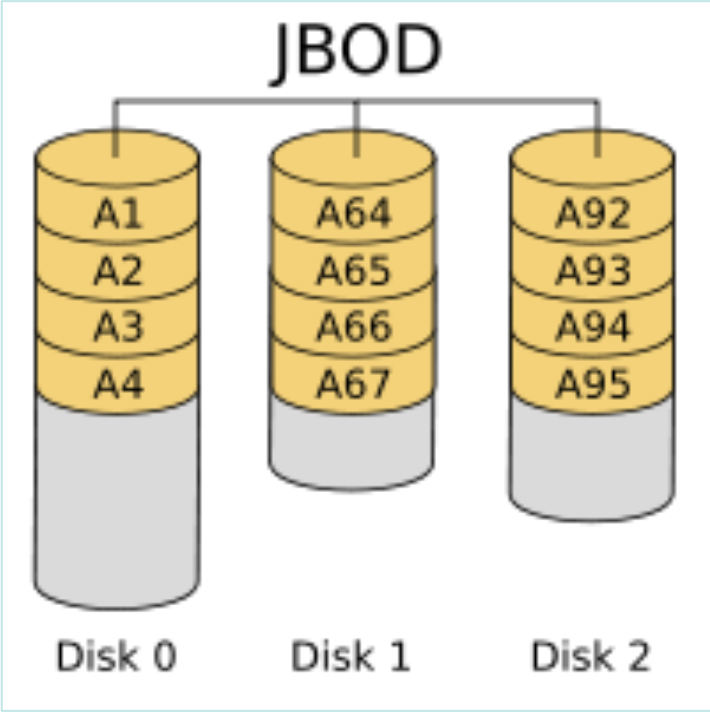
JBOD

› JBOD

Concatenation or **spanning** of disks is not one of the numbered RAID levels, but it is a popular method for combining multiple physical disk drives into one single large virtual disk.

It provides no data redundancy.

Capacity = (HDD * X)



RAID 0

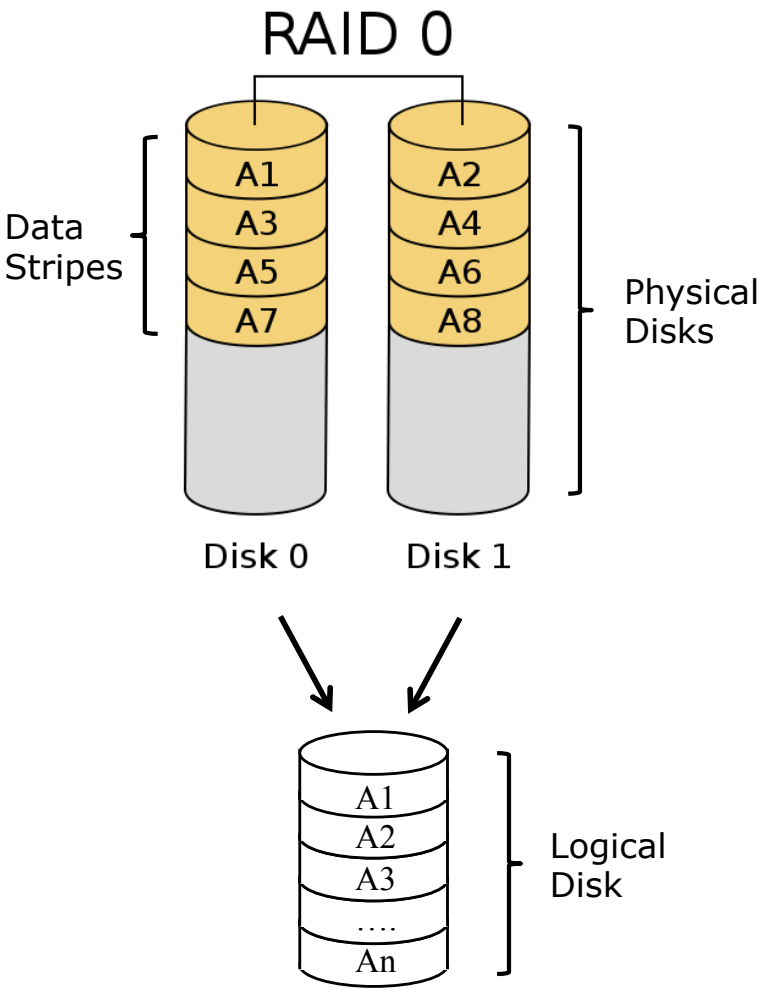
› RAID 0 (Striping with NO Redundancy)

A **RAID 0** (block-level striping) stripes the data between the drives that conforms the array.

Reads and Writes can occur simultaneously on all drives allowing the system to improve the performance by reading/writing more data at same time.

This configuration has no redundancy. In case of failure of any of the array components the whole RAID fails.

Capacity = HDD * X



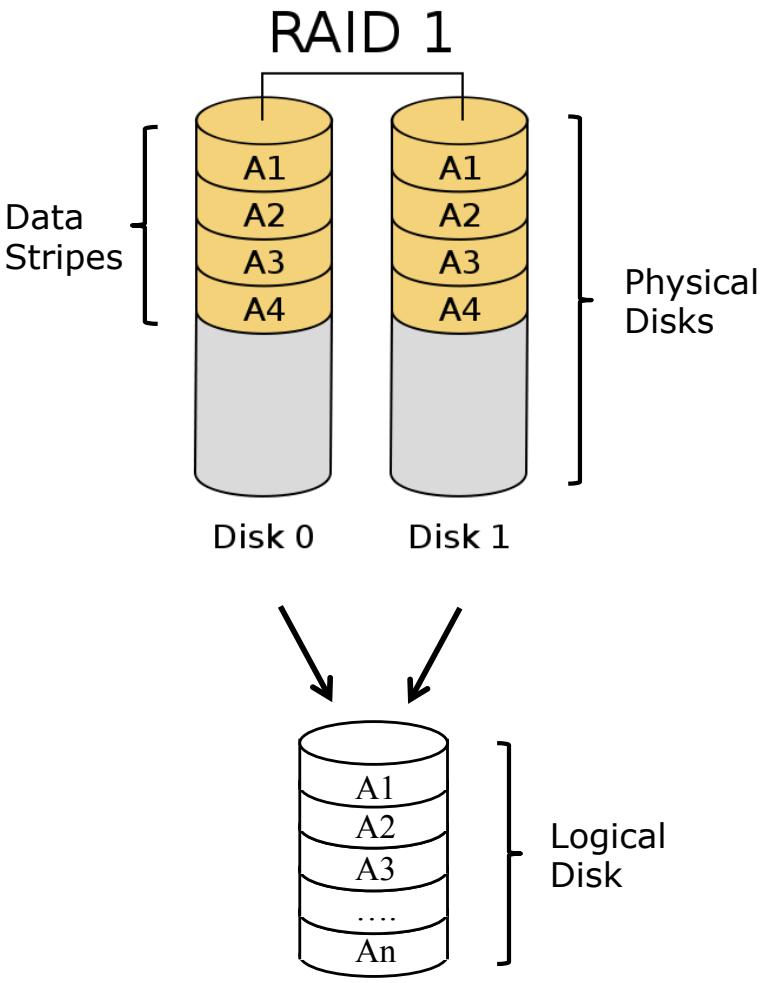
RAID 1

› RAID 1 (Mirroring)

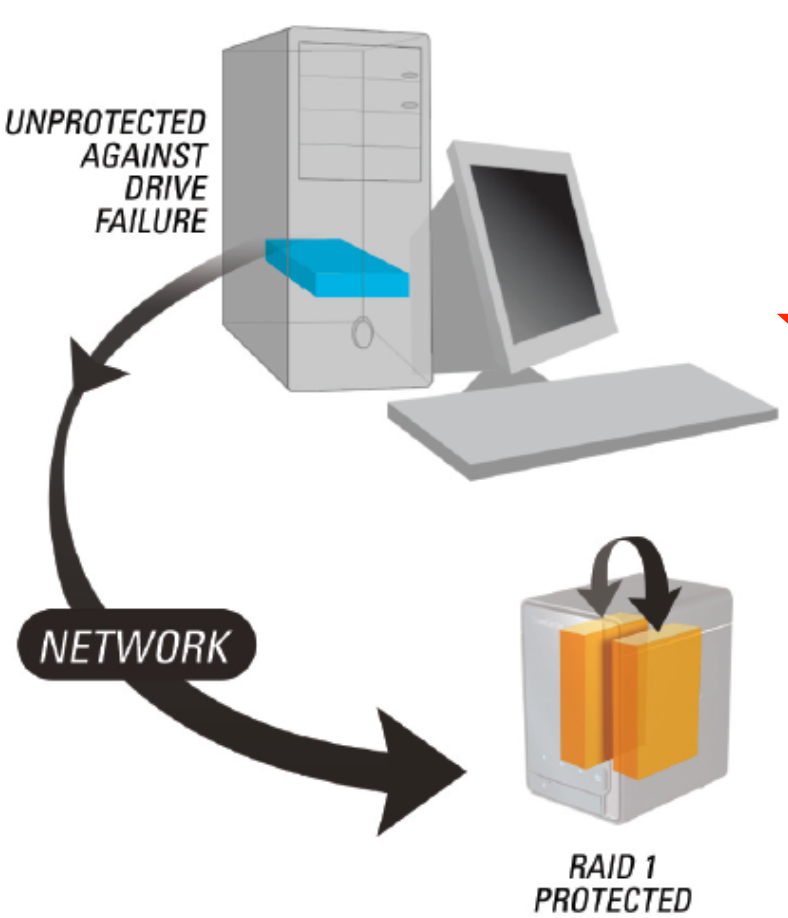
A **RAID 1** (block-level mirroring) striping creates an exact copy (or **mirror**) of a set of data on two or more disks. This is useful when read performance or reliability is more important than data storage capacity.

Data is written to both disk simultaneously. Read requests can be satisfied by data reads from either disk or both disks.

Capacity = (HDD * X) / X



RAID 1 – Practical example



3 copies of the data

RAID 5

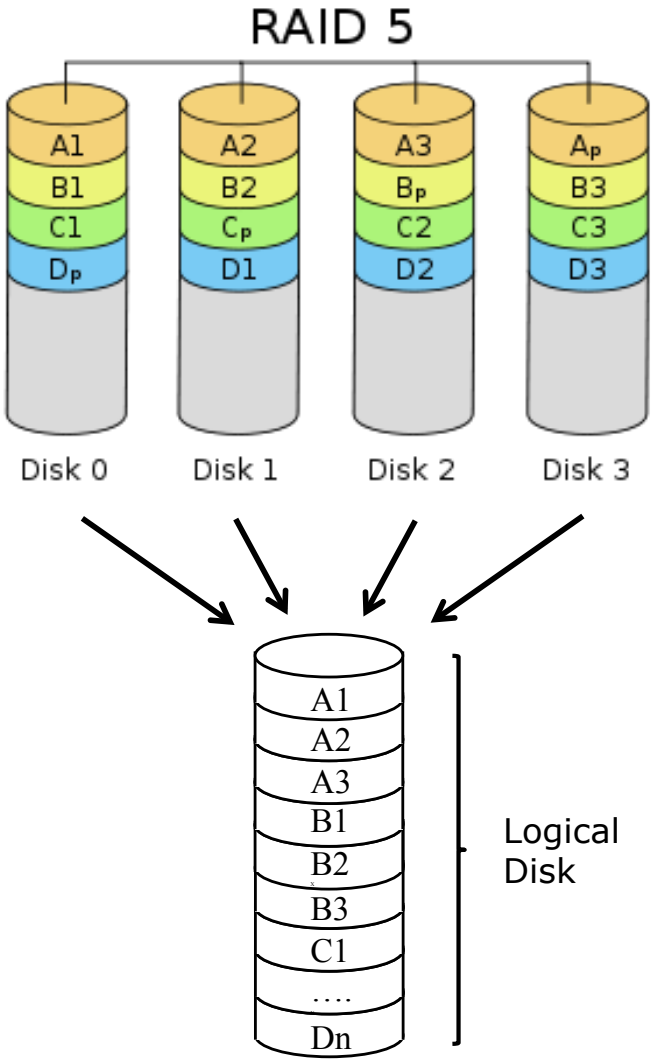
› RAID 5

A **RAID 5** (block-level striping with distributed parity) distributes parity along with the data and requires all drives but one to be present to operate; the array is not destroyed by a single drive failure.

Writes require parity update.

Data can be read from each disk independently.

Capacity = (HDD * X) – (HDD * 1)



RAID 6

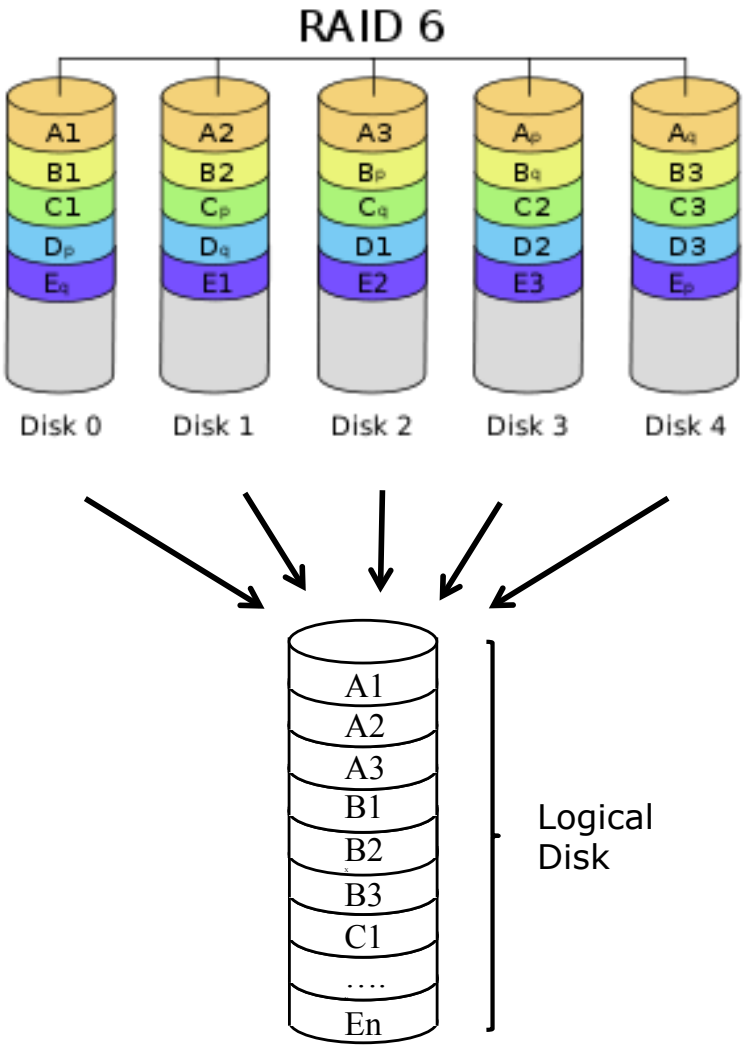
› RAID 6

A **RAID 6** (block-level striping with double distributed parity) provides fault tolerance of two drive failures; the array continues to operate with up to two (2) failed drives. This makes larger RAID groups more practical, especially for high-availability systems.

Each write requires two (2) parity updates (on different drives).

Data can be read from each disk independently.

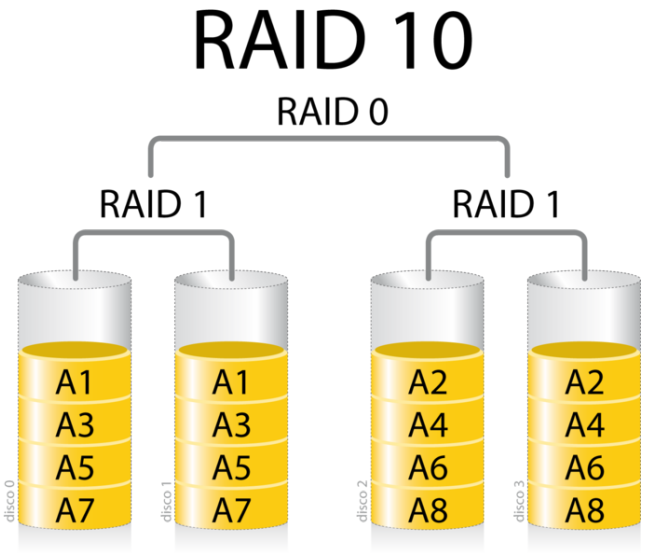
Capacity = (HDD * X) – (HDD * 2)



RAID 10 (1+0)

› RAID 10 (1+0)

A **RAID 10** subsystem that increases safety by writing the same data on two drives (mirroring), while increasing speed by interleaving data across two or more mirrored "virtual" drives (striping). RAID 10 provides the most security and speed but uses more drives than the more common RAID 5 method.



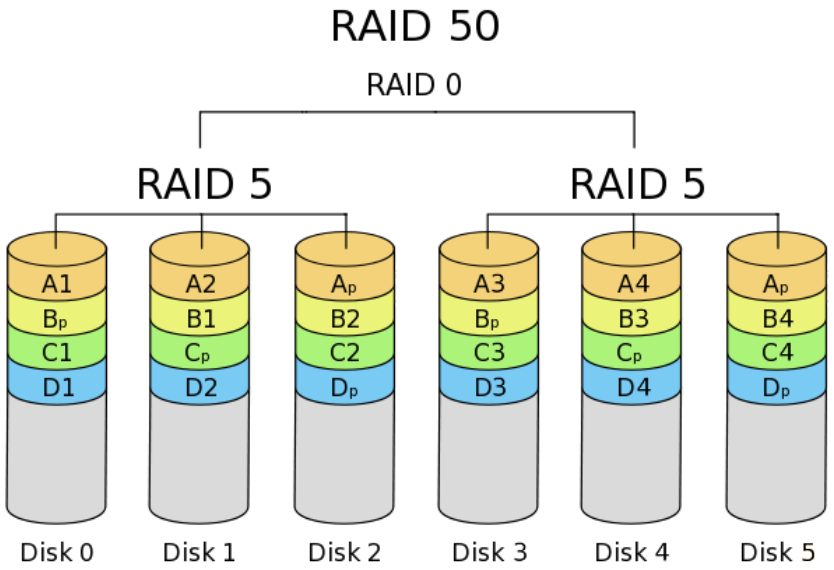
Capacity = (HDD * X) /Y

X=Disk Space
Y= Bottom level division

RAID 50 (5+0)

› RAID 50 (5+0)

A **RAID 50** combines the straight block-level striping of RAID 0 with the distributed parity of RAID 5. This is a RAID 0 array striped across RAID 5 elements. It requires at least 6 drives.



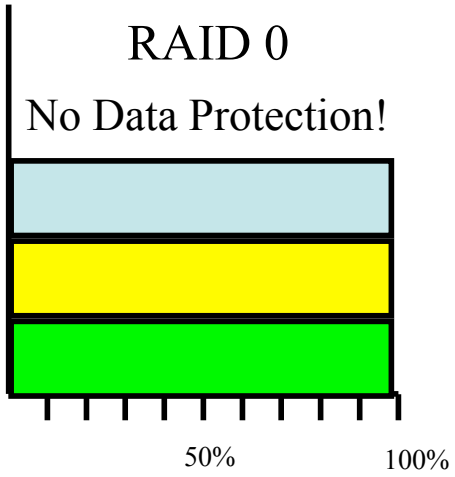
Capacity = (HDD * X) – (Y * 1)

X=Disk Space
Y= Bottom level division

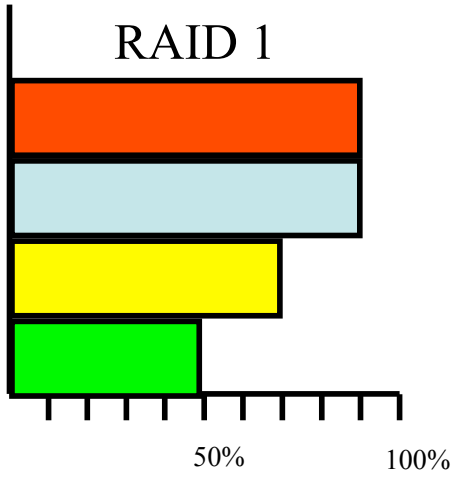
RAID levels compared

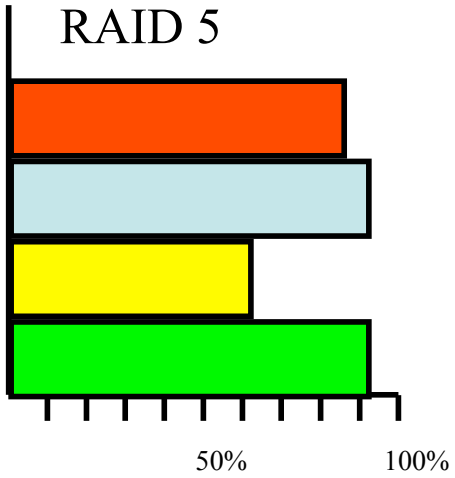
Feature	RAID 0	RAID 1	RAID 5	RAID 6
Minimum No of Drives	2	2	3	4
Data Protection	No Protection	Single Drive Failure	Single Drive Failure	2 drive Failure
Read Performance	High	High	High	High
Write Performance	High	Medium	Low	Low
Capacity Utilisation	100%	50%	67% - 94%	50% to 88%
Typical Applications	High end workstations Video production and editing	Operating system, transaction databases File server, web server	Data warehousing web server, database server, NVR, DVR	Data Archive, back-up to disk, large capacity, high availability solutions,

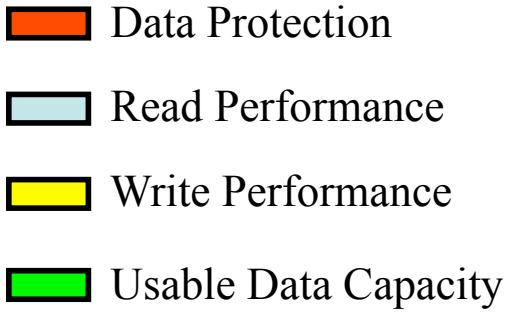
RAID levels compared

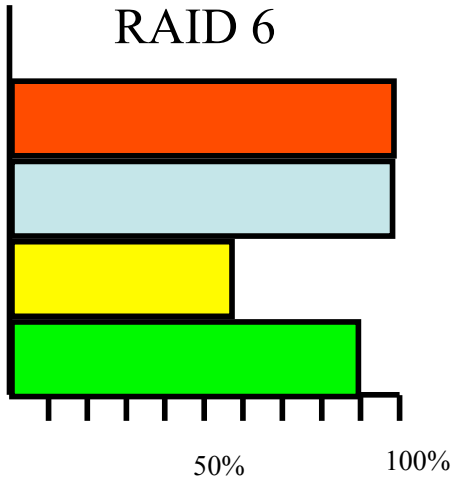


Each RAID level has tradeoffs. Choose the RAID level that best meets your requirements.





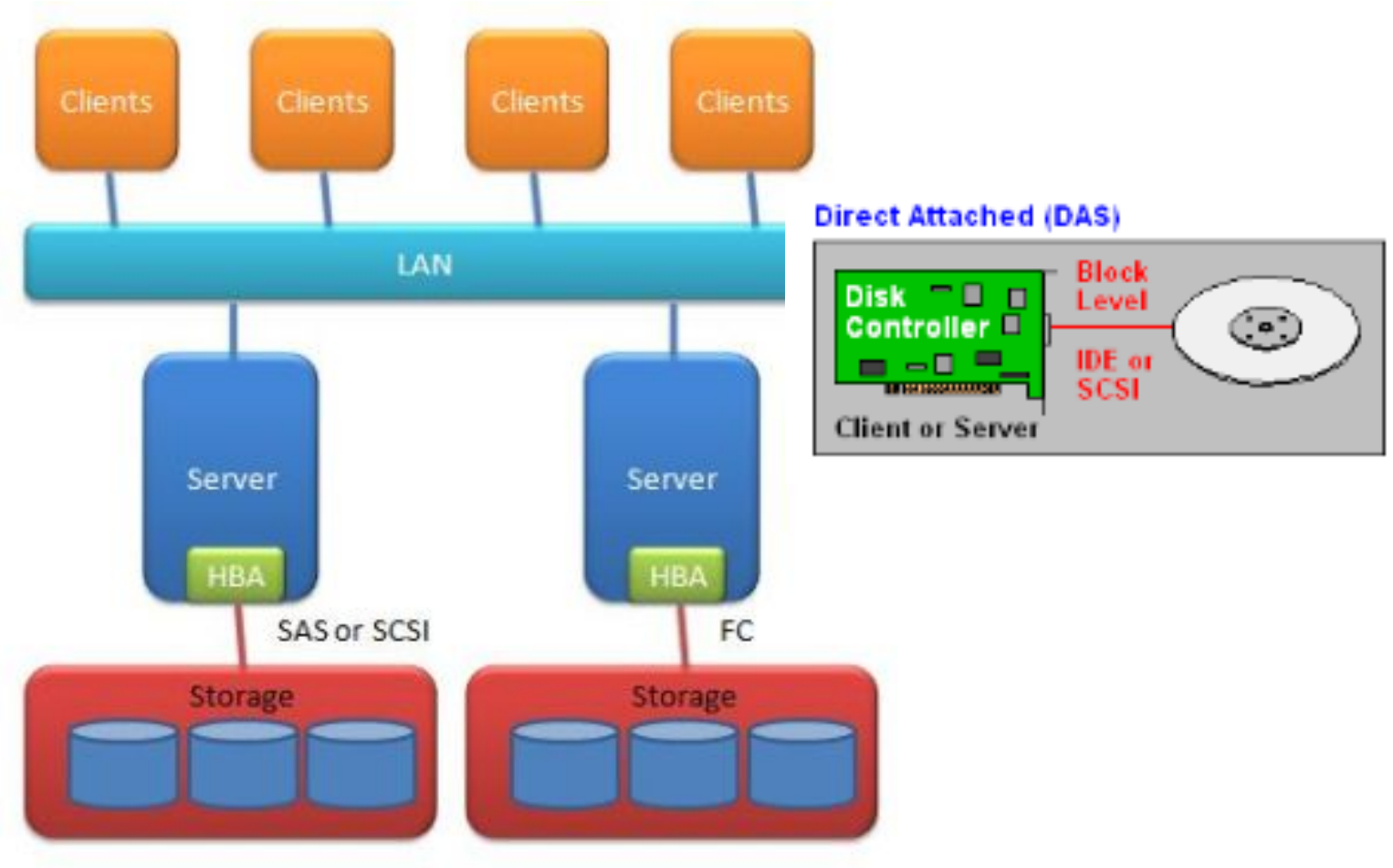




DAS, NAS and SAN

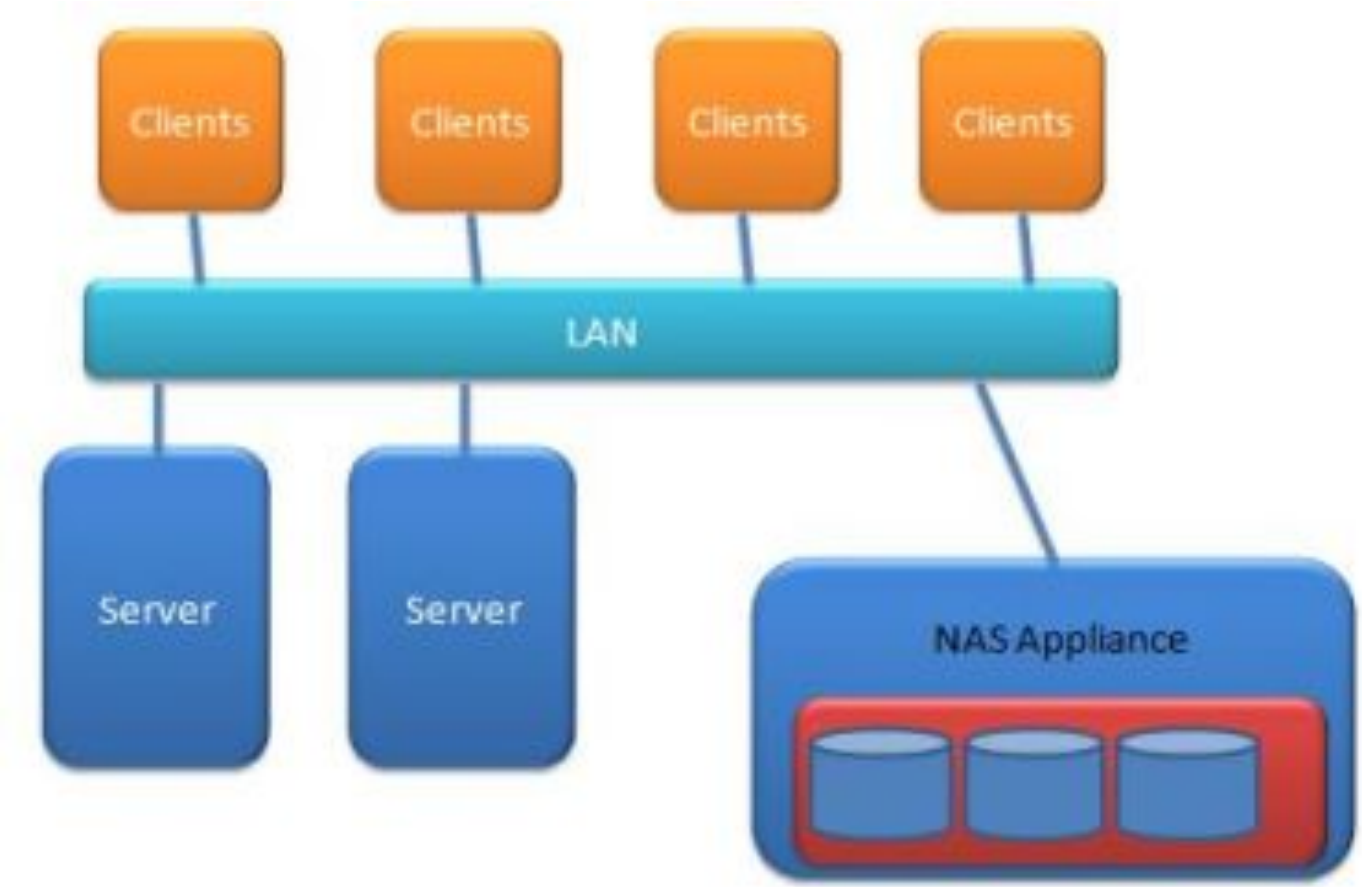
DAS

› Direct Attached Storage



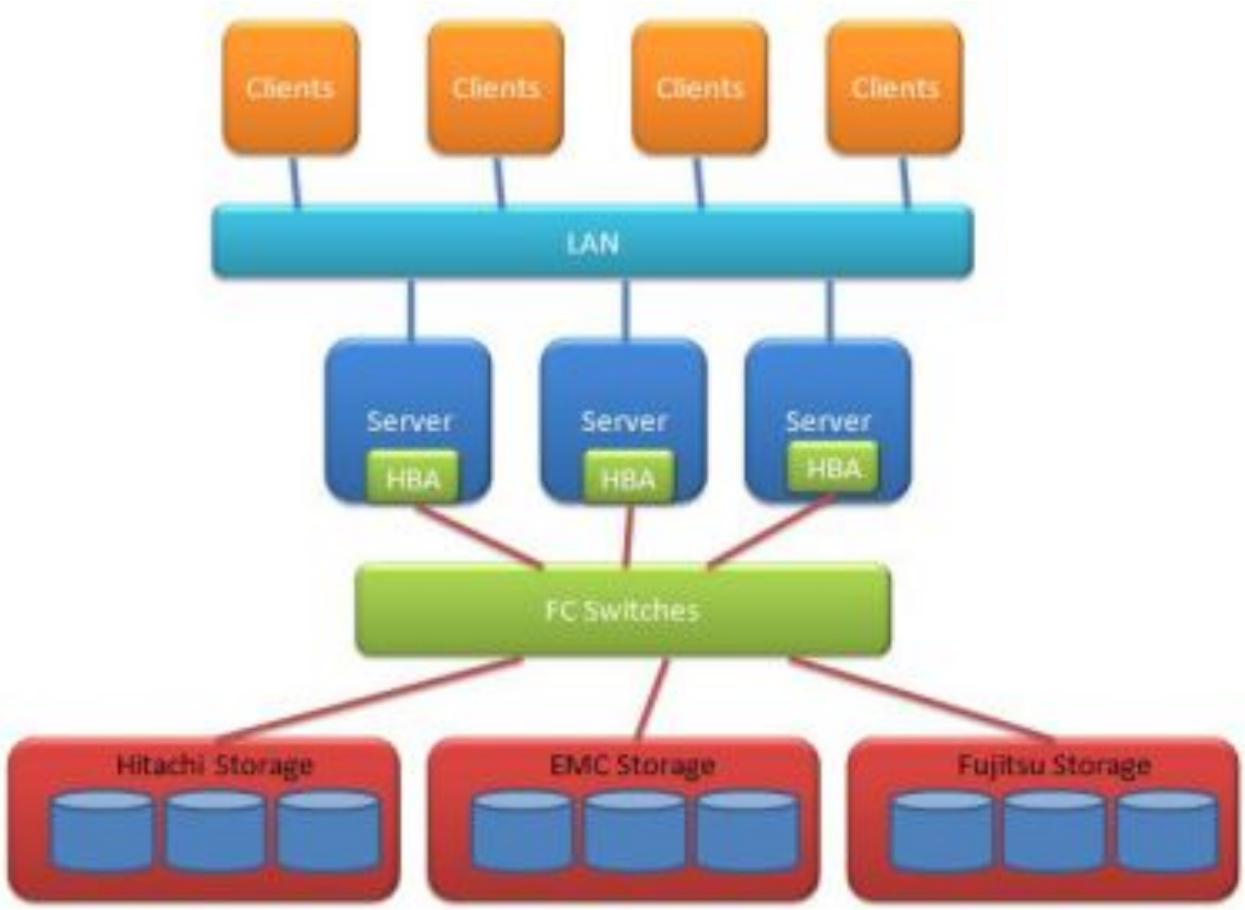
NAS

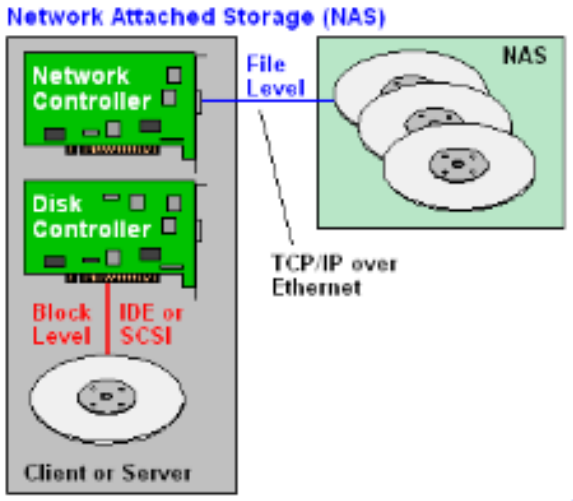
- Network Attached Storage



SAN

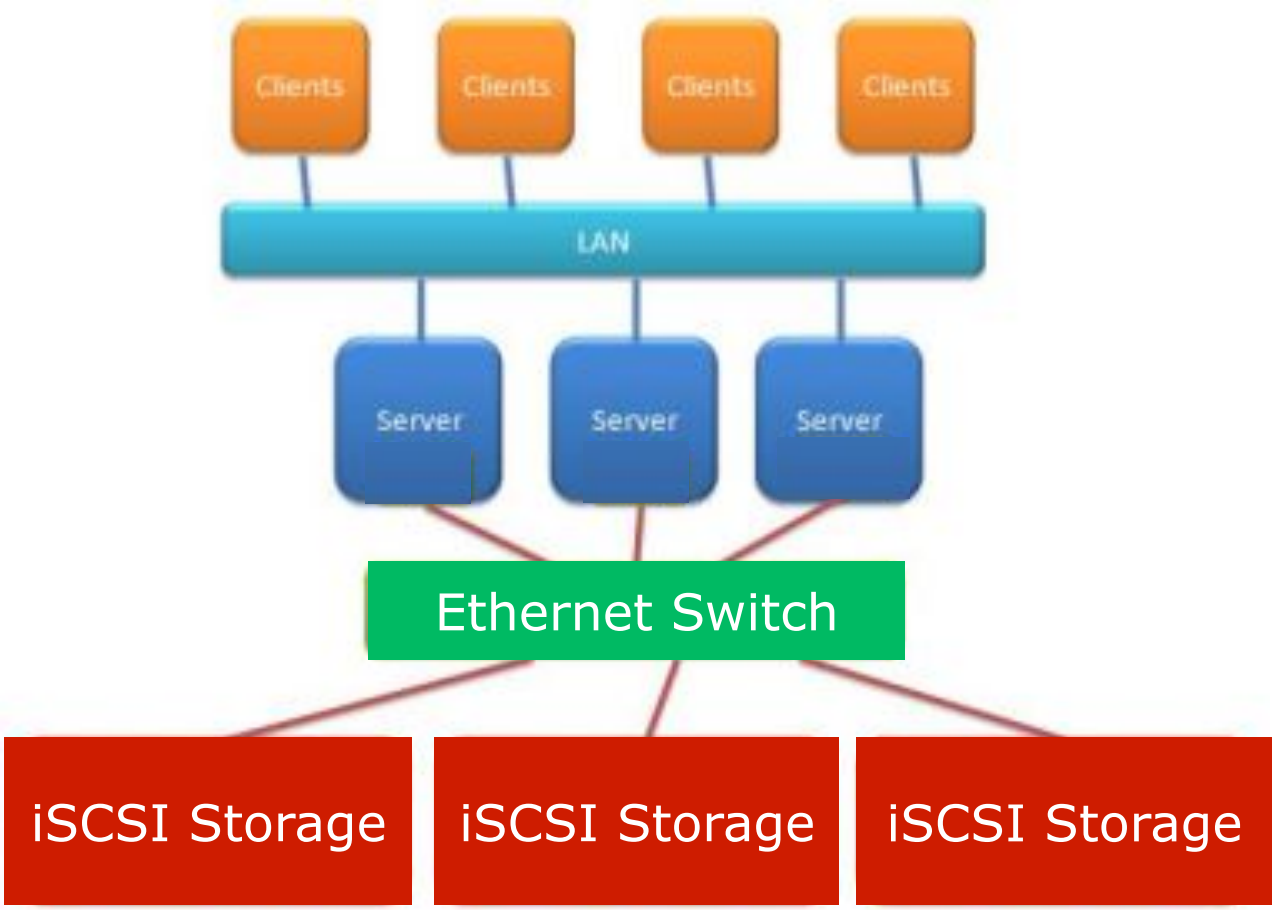
› Storage Area Network

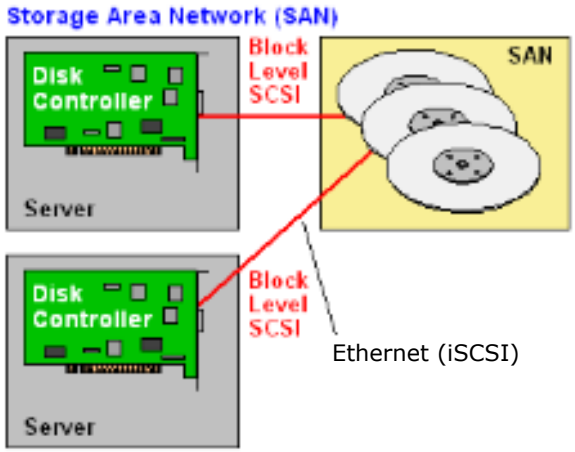




IP SAN

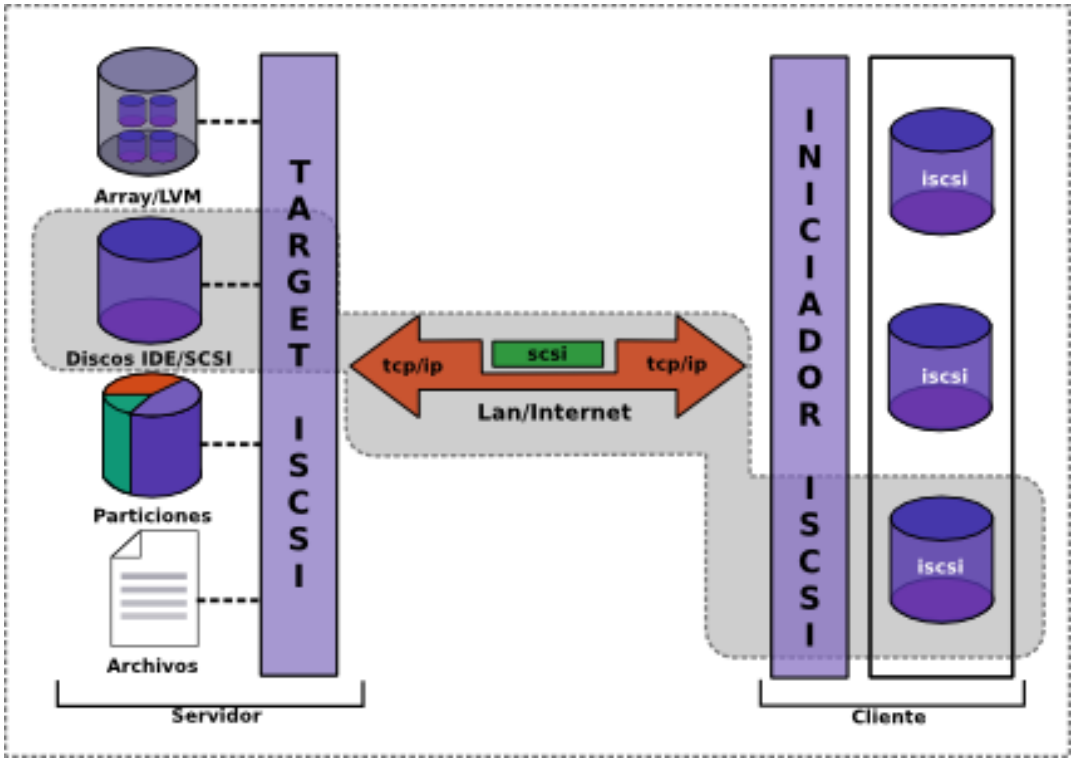
› Internet Protocol Storage Area Network



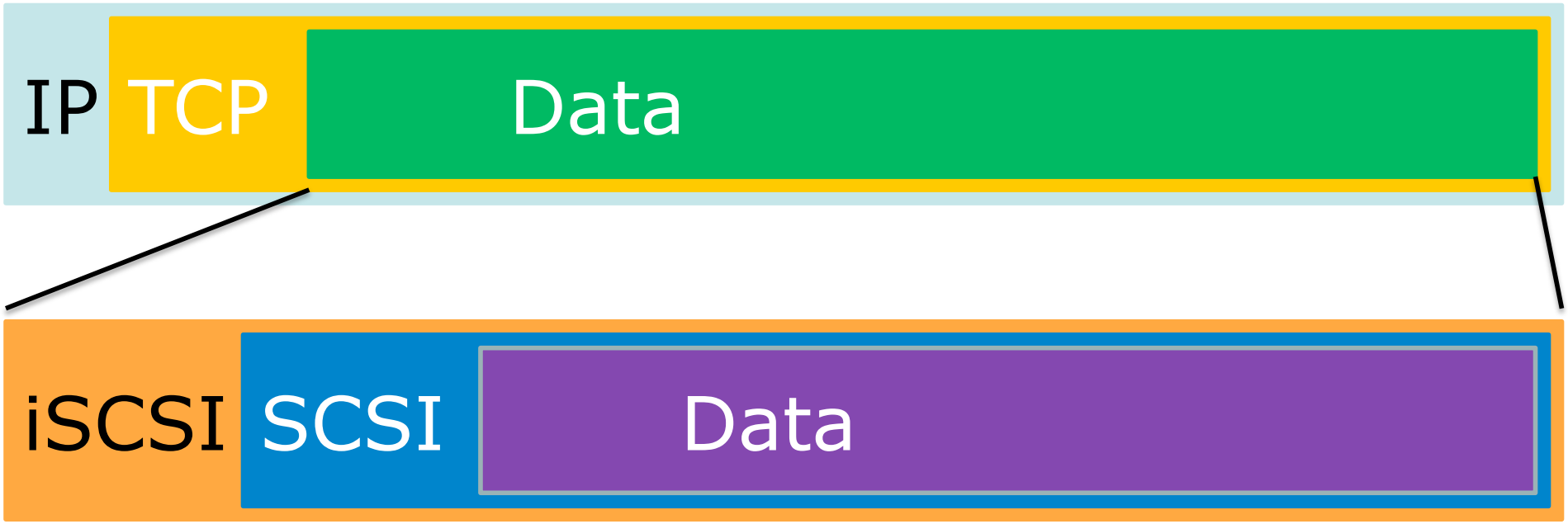


iSCSI (Internet Small Computer System Interface)

In computing, **iSCSI,** is an abbreviation of **Internet Small Computer System Interface**, an Internet Protocol (IP)-based storage networking standard for linking data storage facilities. By carrying SCSI commands over IP networks, iSCSI is used to facilitate data transfers over intranets and to manage storage over long distances. iSCSI can be used to transmit data over local area networks (LANs), wide area networks (WANs), or the Internet and can enable location-independent data storage and retrieval. The protocol allows clients (called *initiators*) to send SCSI commands (*CDBs*) to SCSI storage devices (*targets*) on remote servers. It is a Storage Area Network (SAN) protocol, allowing organizations to consolidate storage into data center storage arrays while providing hosts (such as database and web servers) with the illusion of locally-attached disks. Unlike traditional Fibre Channel, which requires special-purpose cabling, iSCSI can be run over long distances using existing network infrastructure.

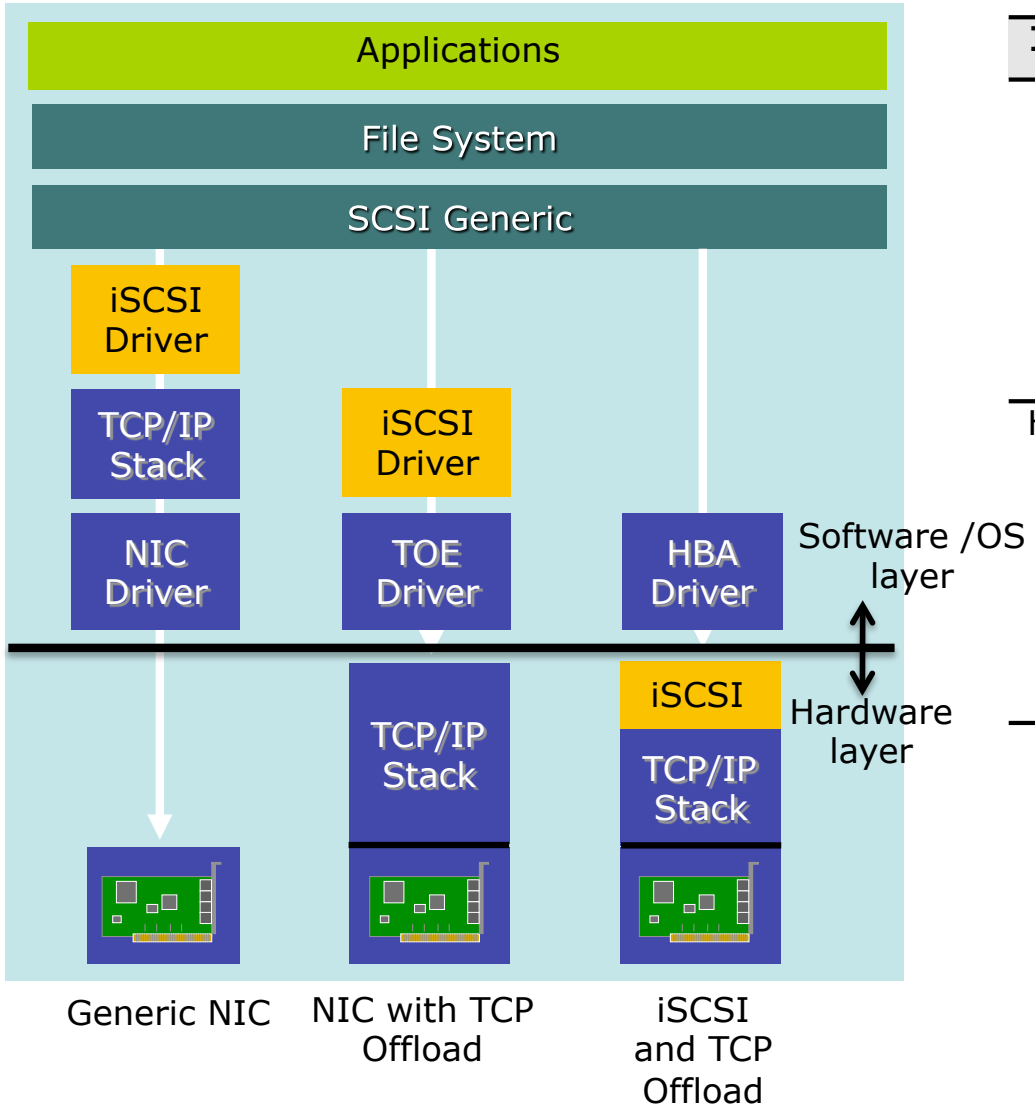


iSCSI Network Packet



- Uses the IP network to carry iSCSI storage traffic.
- TCP: Provides reliable transport over Ethernet.
- Applicable to LAN or WAN.

Software Initiator vs. Hardware Initiator



Initiator	Pros	Cons
Software Initiator	1. Cheap solution. 2. Many OSs support. 3. NIC is std. device on hosts.	The iSCSI offload costs the CPU resources.
Hardware Initiator	1. Provides TCP and iSCSI Offload, reducing the CPU Overhead. 2. Includes extra ROM to allow booting from iSCSI storage.	The iSCSI HBA is more expensive than NIC.

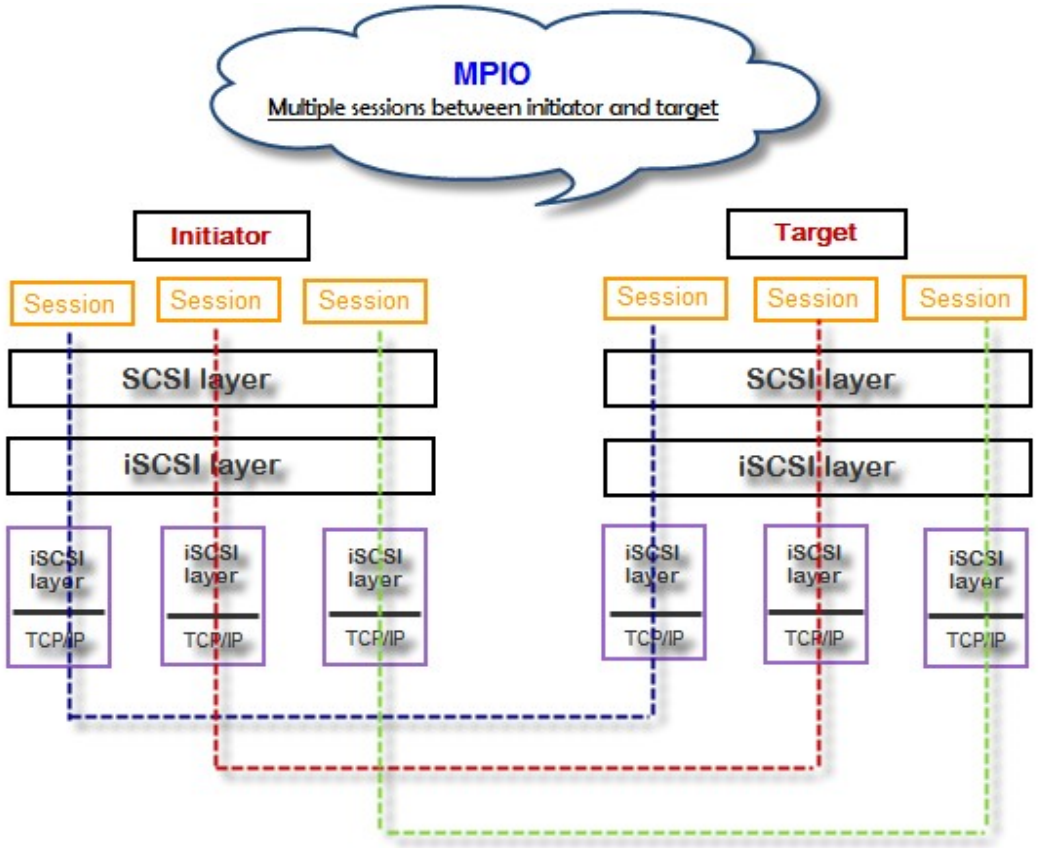
MPIO Multipath I/O

Multipath I/O – fault-tolerance and performance enhancement.

It is a drive in the OS.

Many OSs support it natively, such as MPIO on WS2008, dm-multipath on Linux, MPxIO on Solaris.

The MPIO policy can be modified per LUN setting.



MC/S Multiple Connections per Session

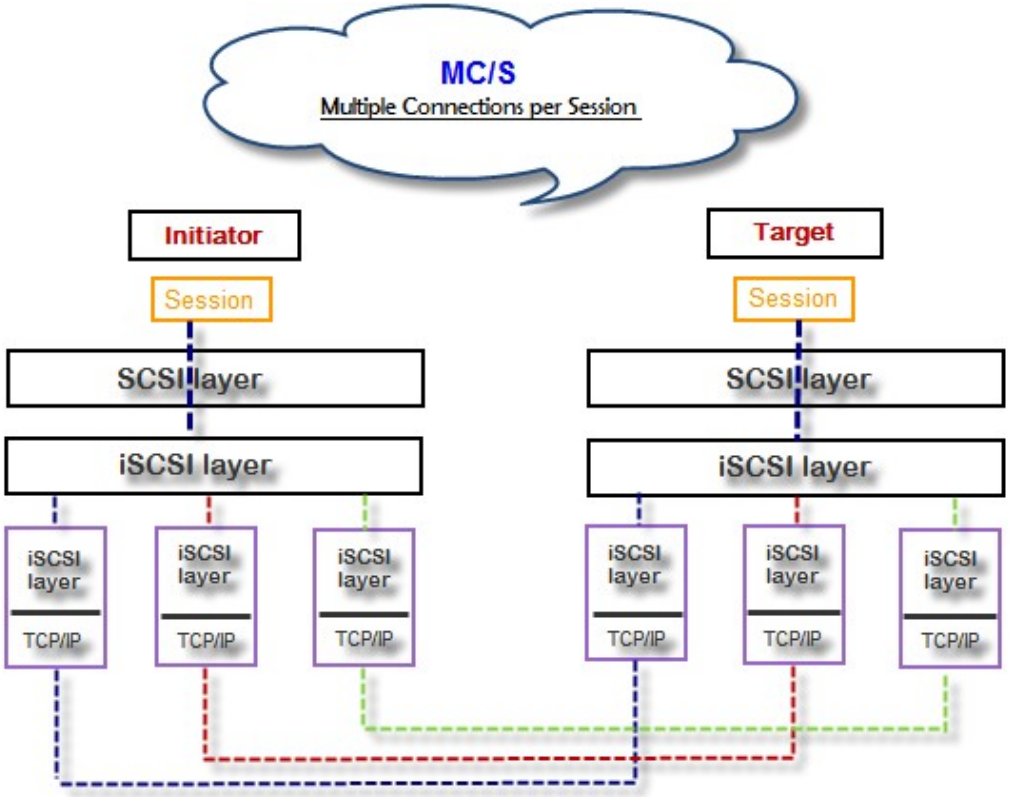
Multiple Connections per Session – a feature of iSCSI protocol.

Also has advantages of fault-tolerance and performance enhancement.

Part of the iSCSI protocol.

The MC/S policy applies to all LUN on the same target.

Good solution for client OS, such as Win7.



Typical Applications

Direct Attached Storage

- Primary storage for small businesses
- Departmental applications
- Project applications – Further education
- Local Back-up
- Archive

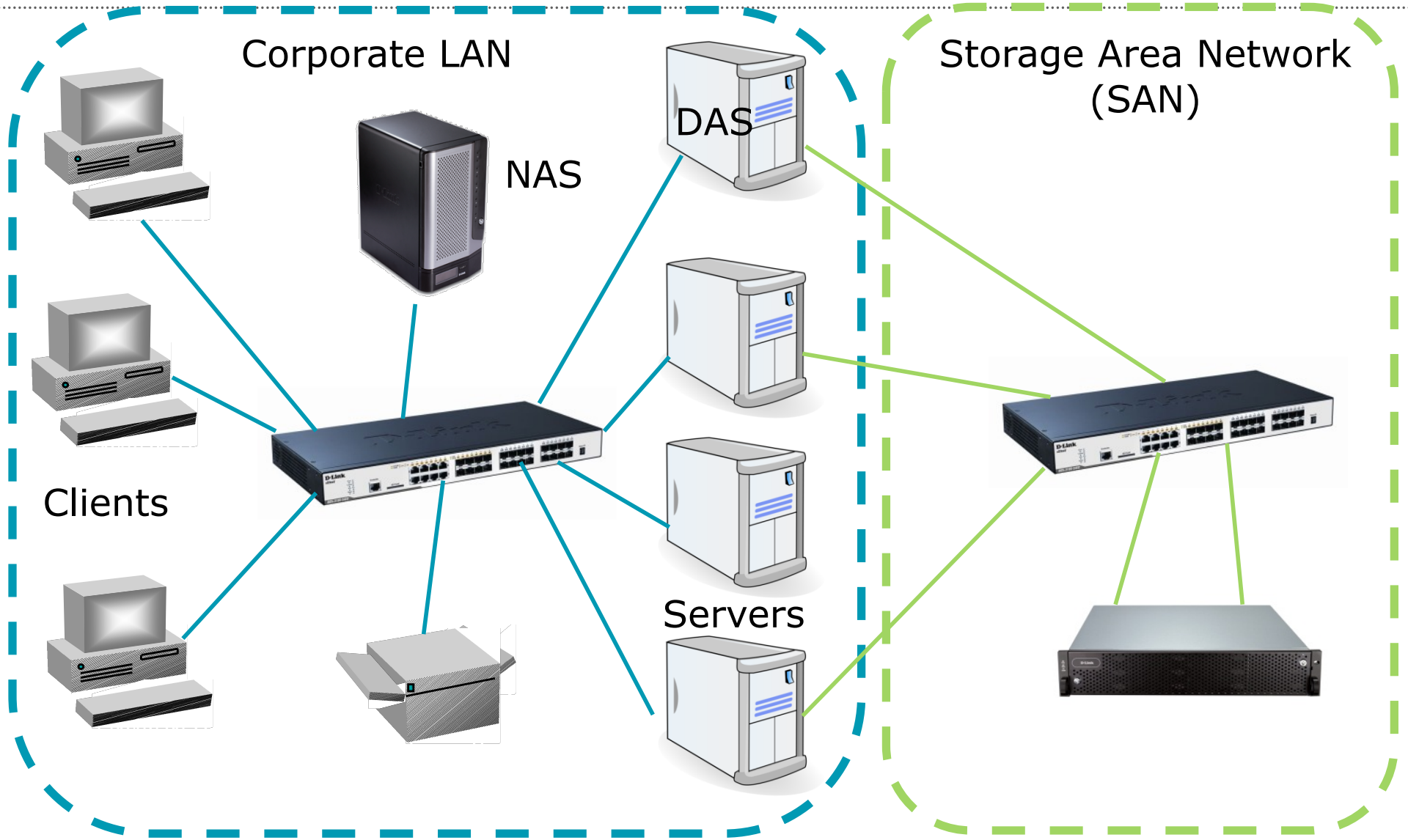
Storage Area Network

- Storage consolidation
- Disaster recovery
- Remote mirroring
- Server-less & LAN free backup
- Midrange / Departmental Applications
  - CRM
  - High performance workstation storage
- Branch or Small Office / Work Group Storage

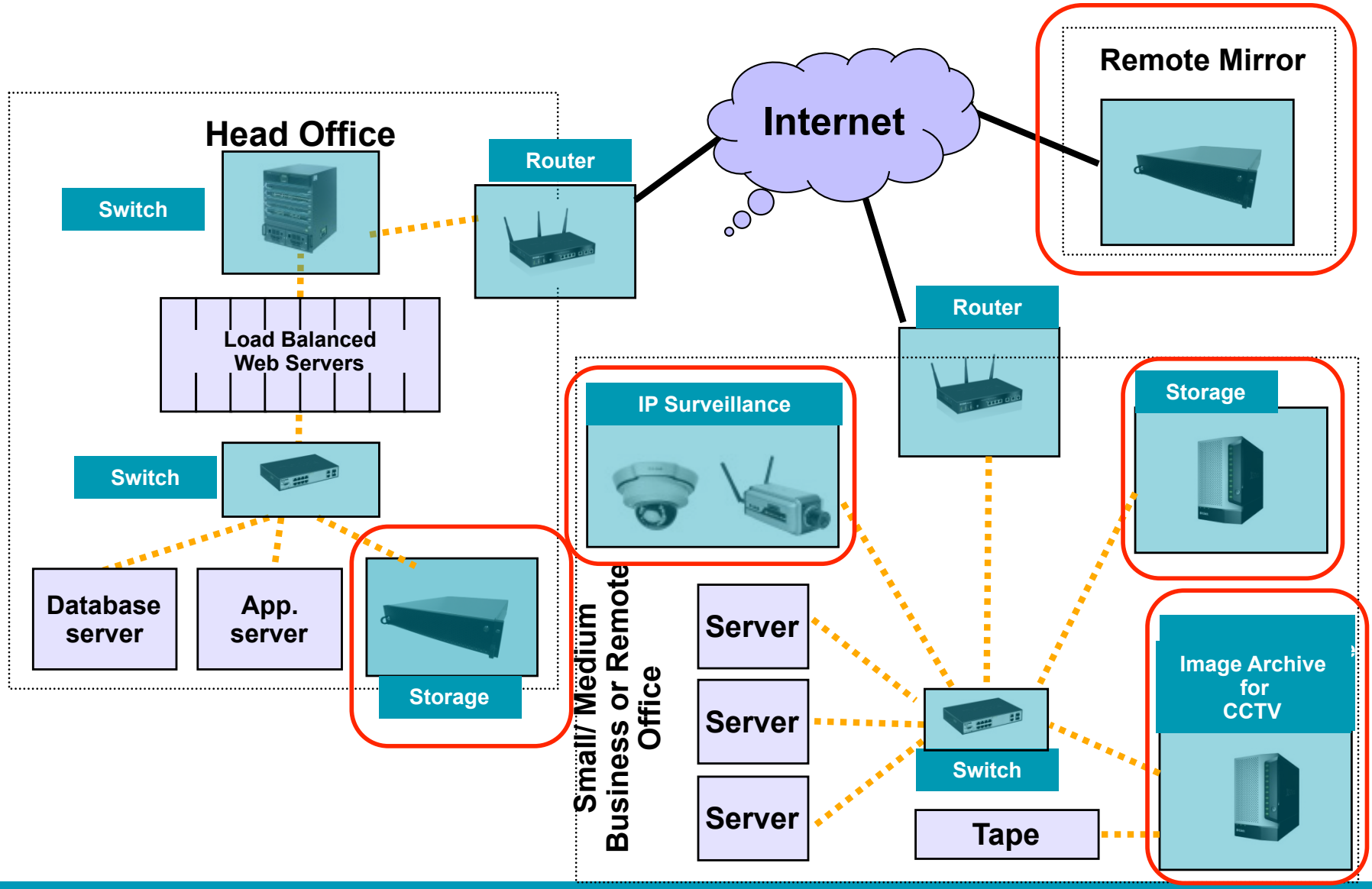
Network Attached Storage

- Shared Storage
  - For SME's or for departments in large organizations
- Primary storage for SME's
- File/Print server
- Video Imaging
- Graphical Image store
- Replacing traditional back-up methods
- Onsite repository for back-up data

DAS, NAS and SAN Applications



Typical Storage Applications



Hosted Cloud Service

SAN
DSN-6000

D-Link's iSCSI SAN arrays provide managed service providers with a cost-effective, high performance, scalable storage platform for cloud storage and backup services.

Benefits:

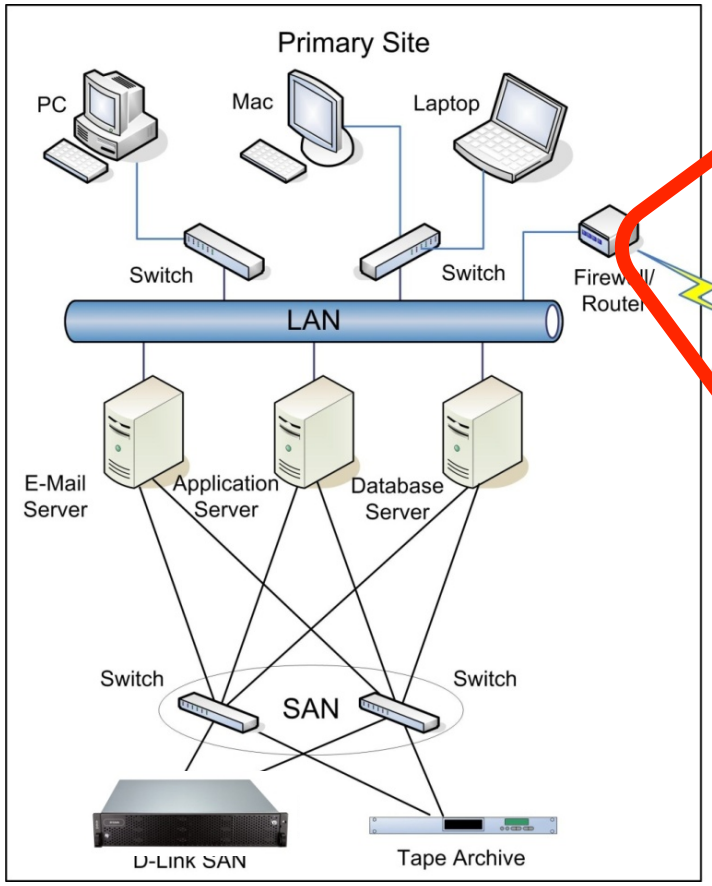
- Web-based management from anywhere
- Data accessibility from anywhere
- Quicker data restore

Desktop Online Backup (Disk-to-Cloud)	Appliance Online Backup (Disk-to-Disk-to-Cloud)
WAN Speed User Experience Requires PC to be online	**LAN Speed User Experience** Continues backup at off-hours
High-Maintenance OS compatibility and application conflict issues	**Low-Maintenance** No desktop software
Backup Only	**Backup & File Sharing**

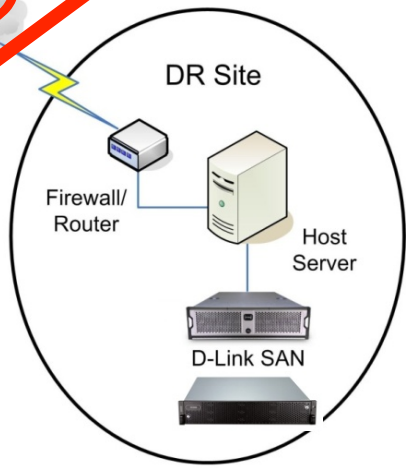
Disaster Recovery

Storage virtualization can simplify disaster recovery strategies. Instead of paying for a remote, one-to-one data center, for example, application environments can be recreated on fewer off-site servers.

SAN
DSN-6000



NAS
DNS-1200



IP Surveillance

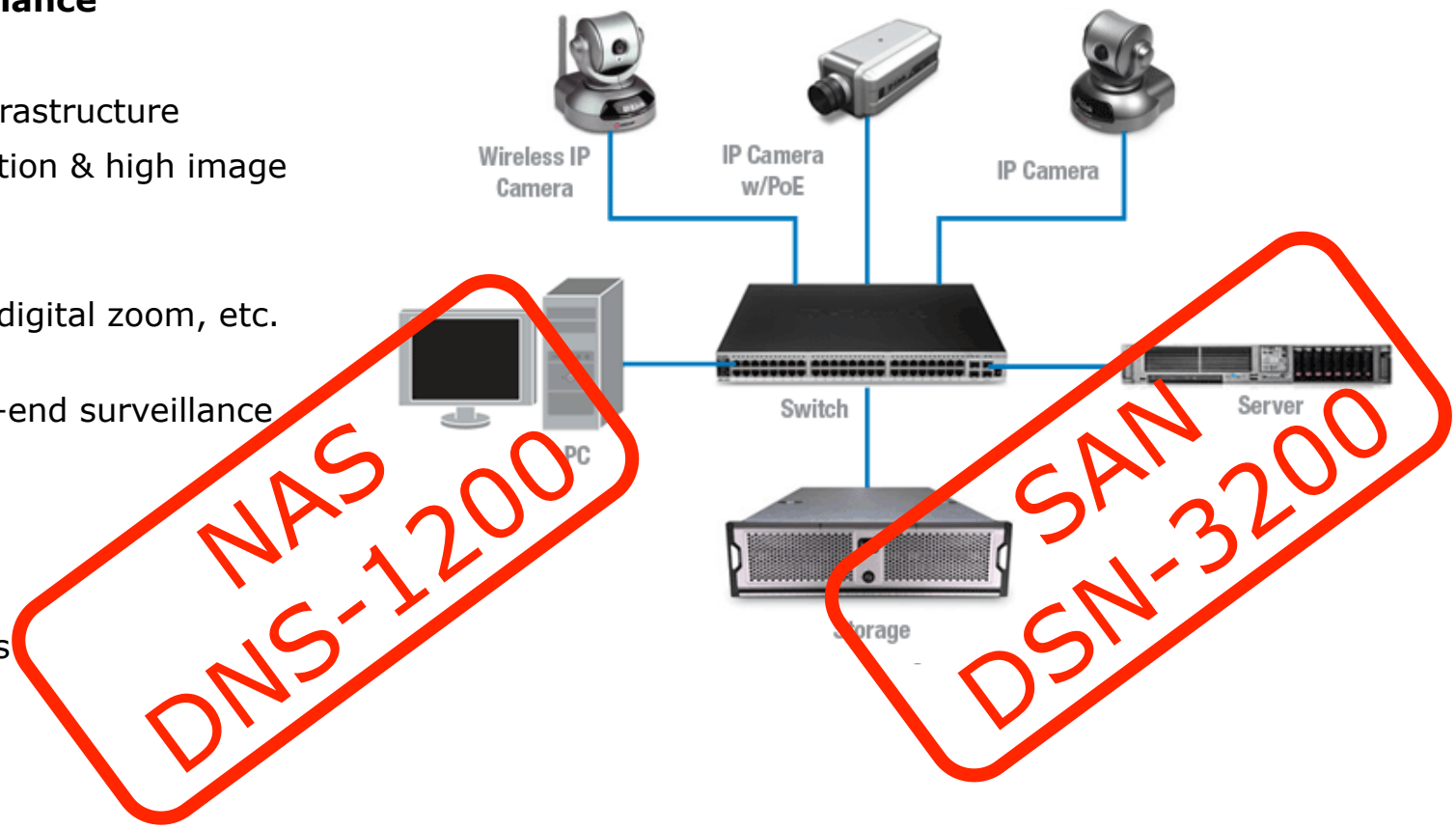
D-Link IP video surveillance solutions allow clients to monitor, store and archive video, audio, and associated application data over the Internet or private intranets.

Benefits of IP Surveillance

- High scalability
- Use of existing IP infrastructure
- High security encryption & high image quality
- Remote accessibility
- Advanced features—digital zoom, etc.

D-Link offers an end-to-end surveillance solution, including

- IP cameras
- Network switches
- iSCSI SAN arrays
- Professional services



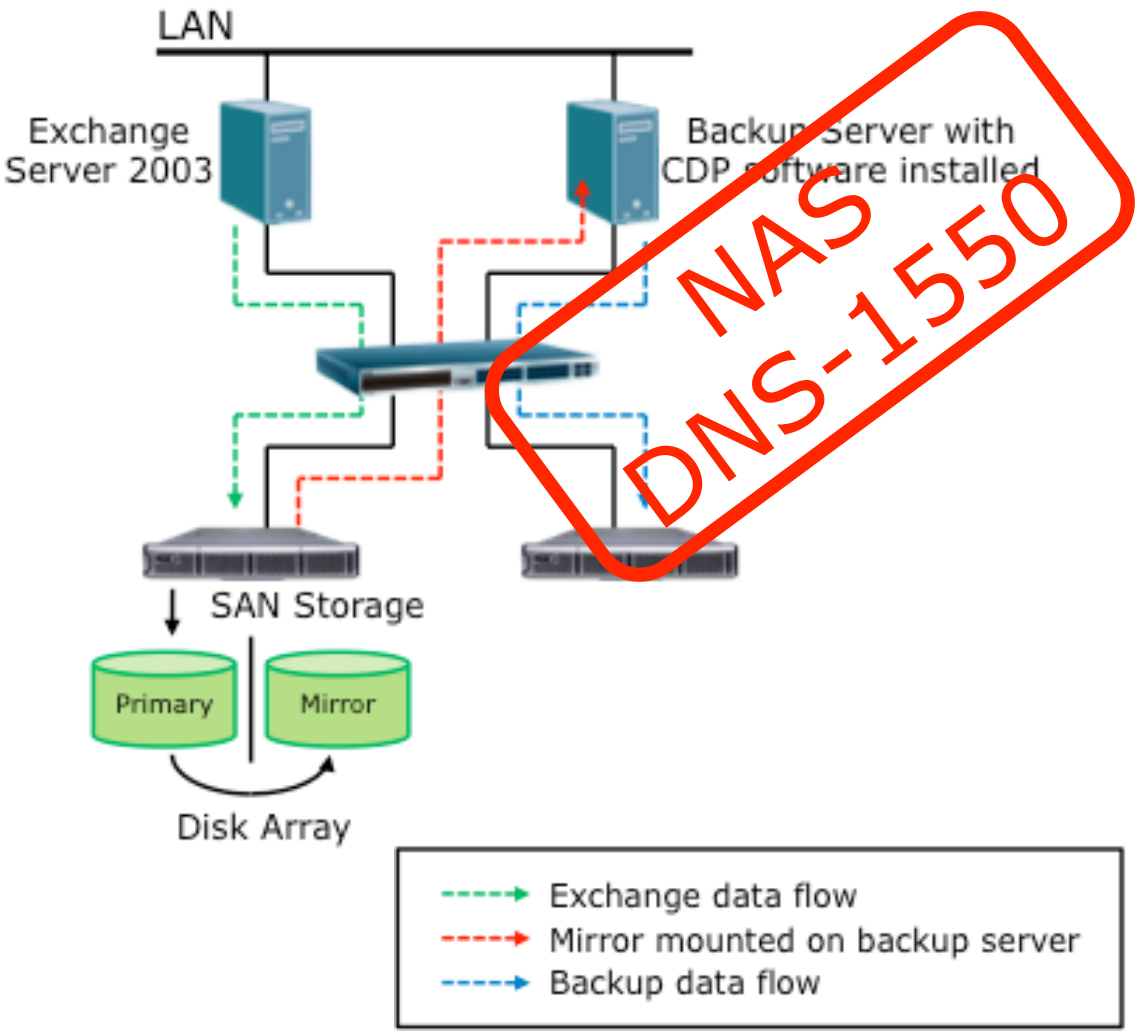
Audio & Video Post Production

- D-Link iSCSI SAN arrays offer customers centralized, high-speed, redundant storage platforms that these applications require
- Multiple workstations can collaborate with no frame drops and minimal latency
- Optimized to work with Pro Tools software

Disk to Disk (D2D) Backup

Benefits:

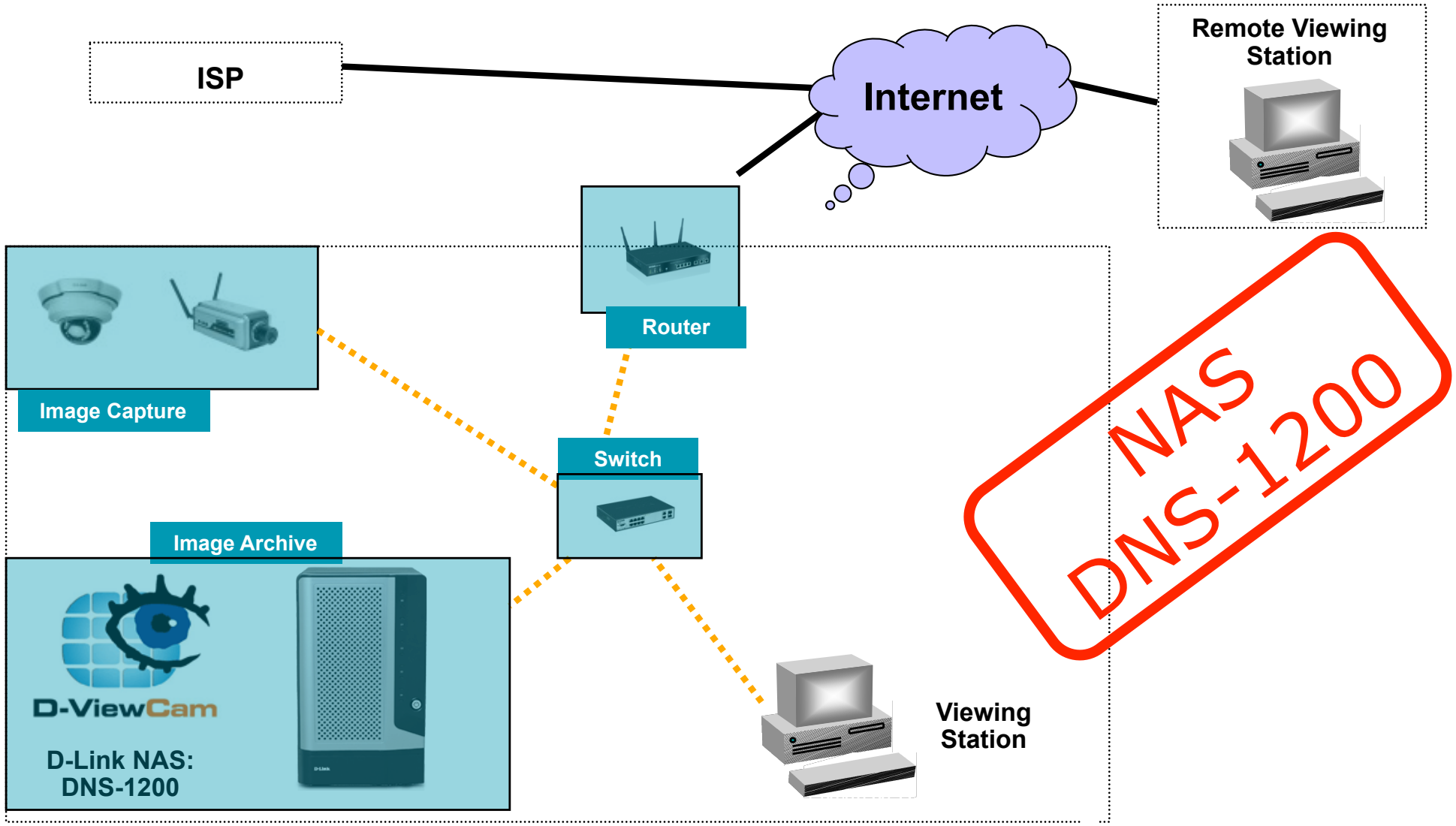
- Higher speeds → faster backups and recovery
- Better reliability → better content integrity
- Random access ability → faster data recovery → shorter downtimes
- Better scalability → less IT administration time and cost
- Easier management → less IT administration time



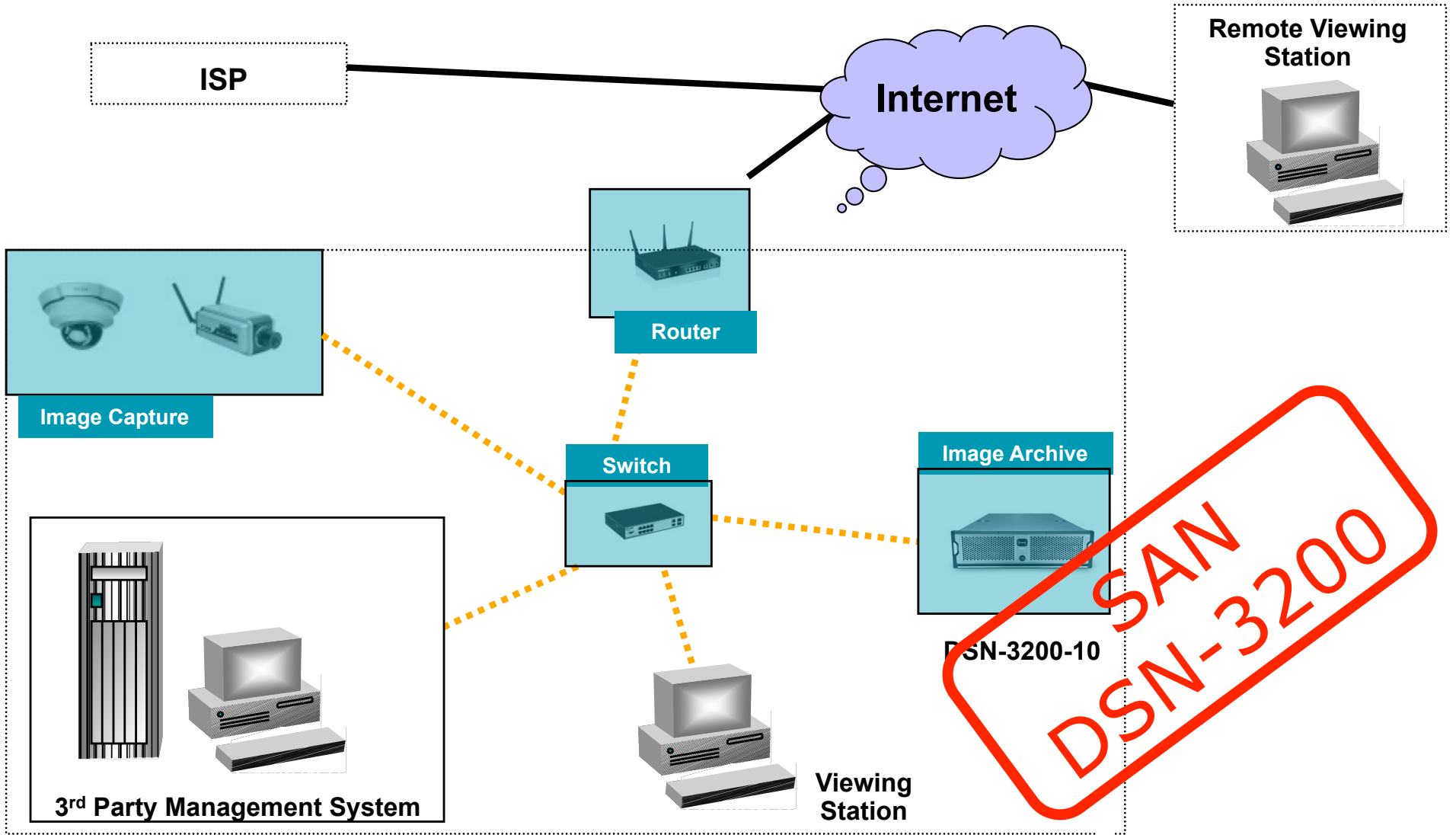
SAN DSN-3200

NAS DNS-1550

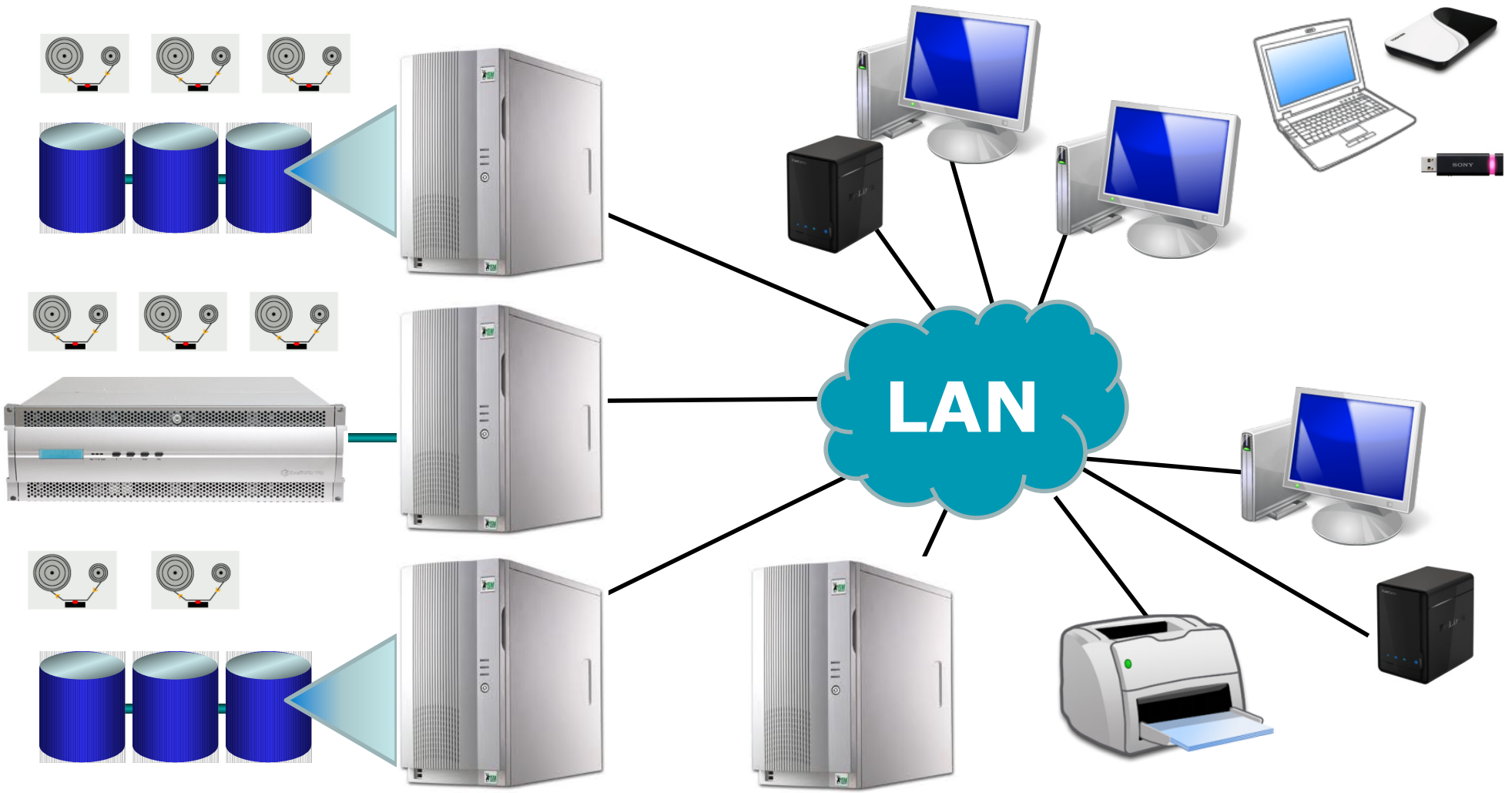
CCTV Application: D-Link NAS



CCTV Application: IP-SAN



Typical Storage Environment



Storage Consolidation

Benefits:

Simplified storage architecture

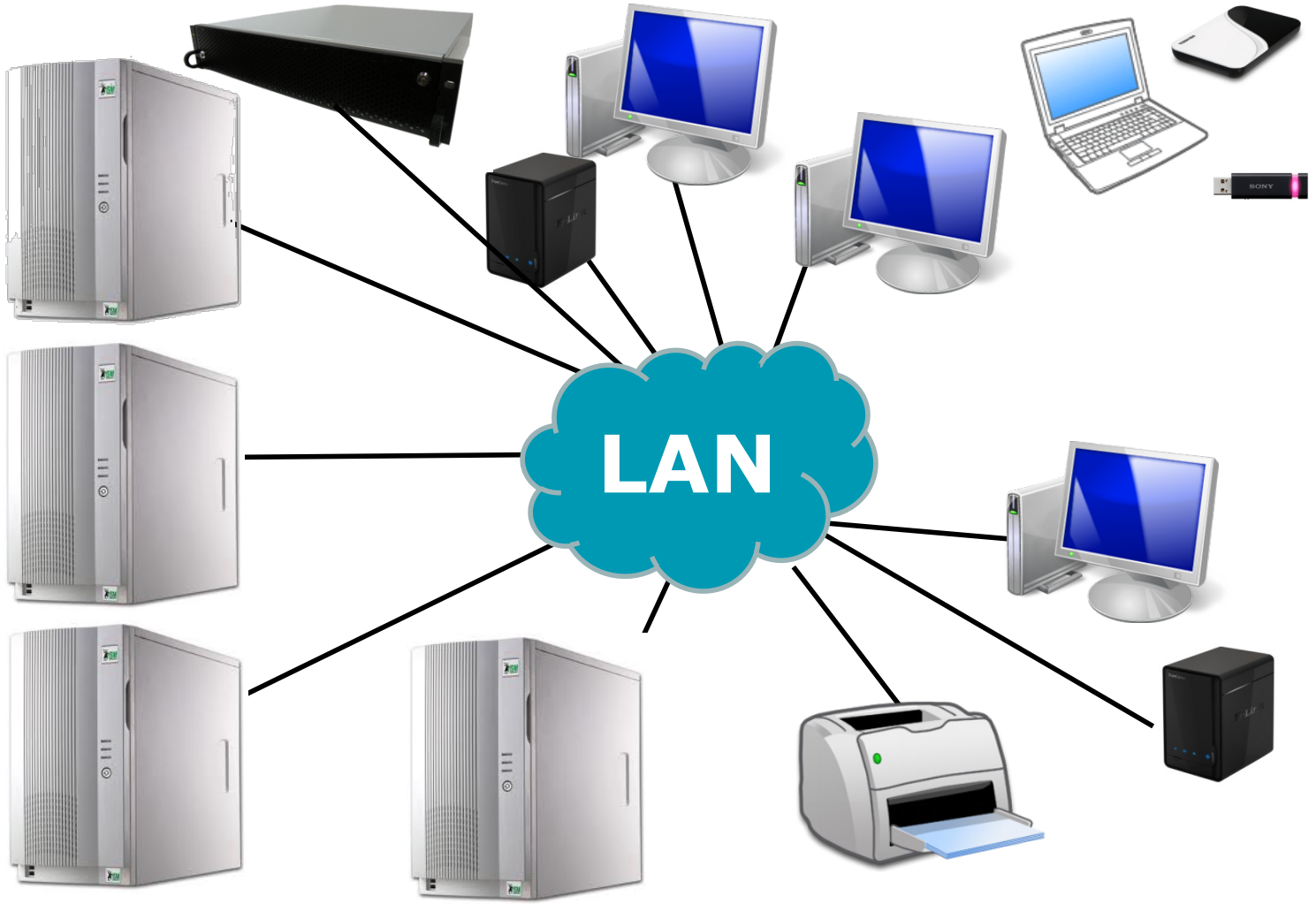
Easier to manage

Storage investment spread across multiple servers

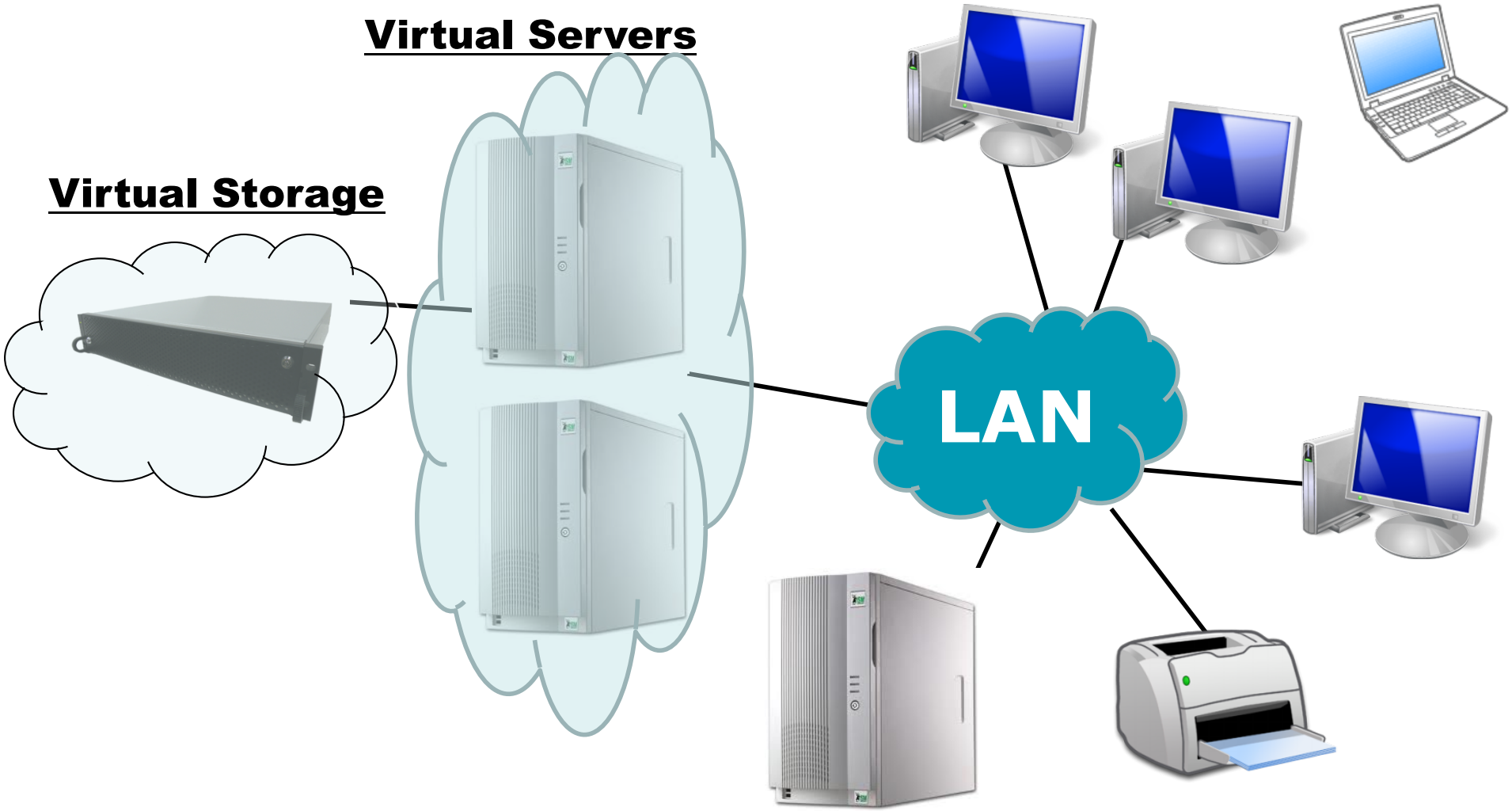
High capacity Utilisation

Reduced administration costs

Simplified back-up



IT Managers ideal Environment



¿What is Virtualization?

Virtualization

In computing, is the creation of a virtual (rather than actual) version of something, such as a hardware platform, operating system, a storage device or network resources.

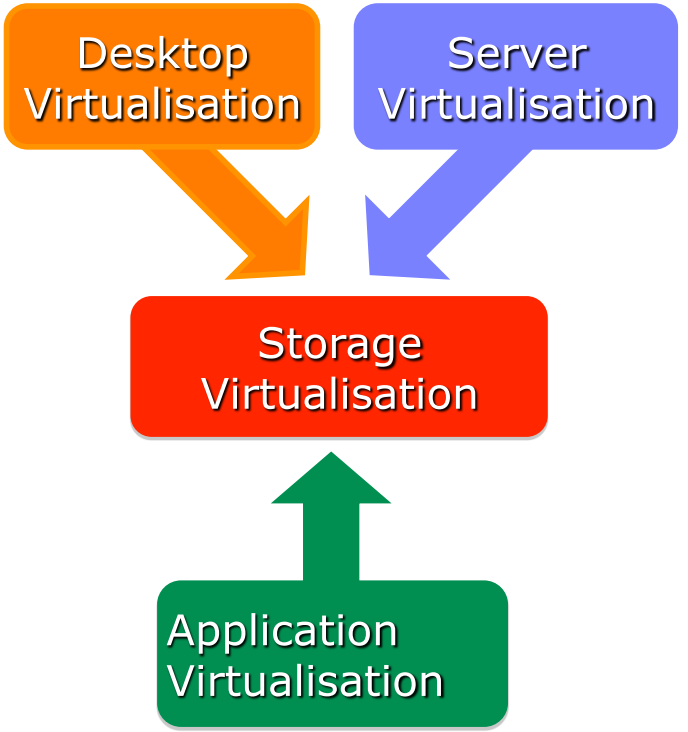
Virtualisation

- Desktop & Server Virtualisation are the driving forces for storage virtualisation

- Virtualisation is strategic

- Implementing Virtualisation
  - Phase 1: Consolidation
  - Phase 2: Business Continuity
    Disaster Recovery

- Virtualisation in 2011/2012
  - Microsoft Hyper-V will open new markets

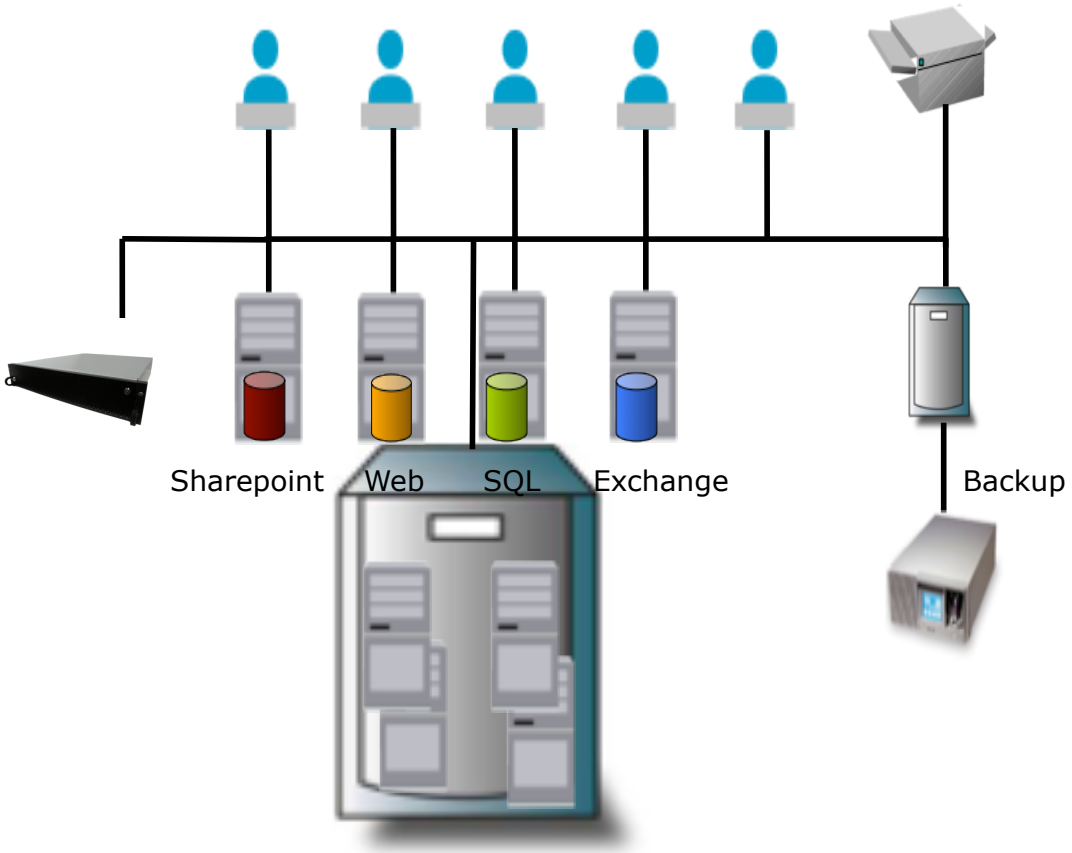


What is Server Virtualisation ?

vmware

Windows Server 2008 Hyper-V

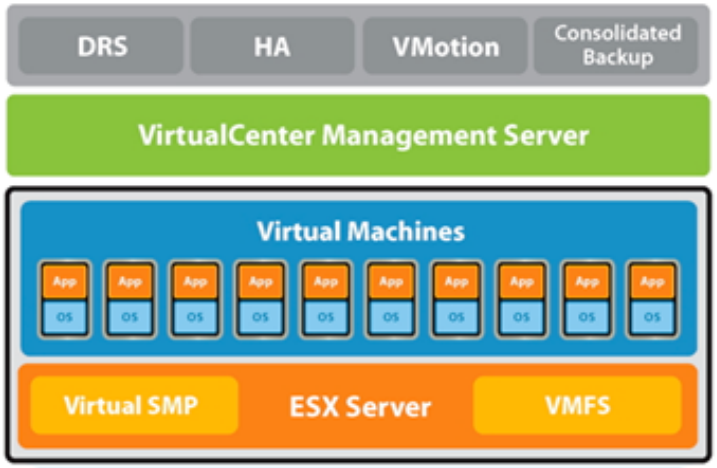
Xen Server™



Benefits:

- **Reduced Energy costs**
- **Simplified Management**
- **Reduced Management costs**
- **Simplified Management**
- **Improved Flexibility**
- **Improved responsiveness**

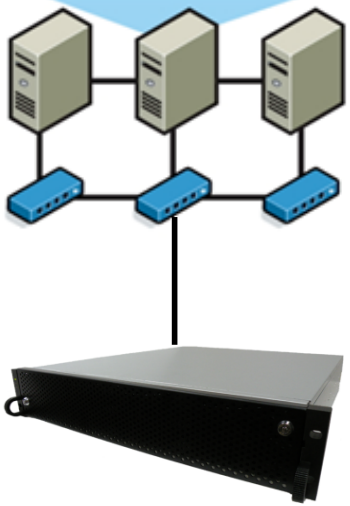
Virtualisation: Where does D-Link fit ?



Servers

Network

Storage



D-Link

D-Link

Xen Server™

vmware READY CERTIFIED

Windows Server 2008 Hyper-V™

vmware Ready

Search Results: Your search for "Storage/SAN" returned **10 results**. Display: 10

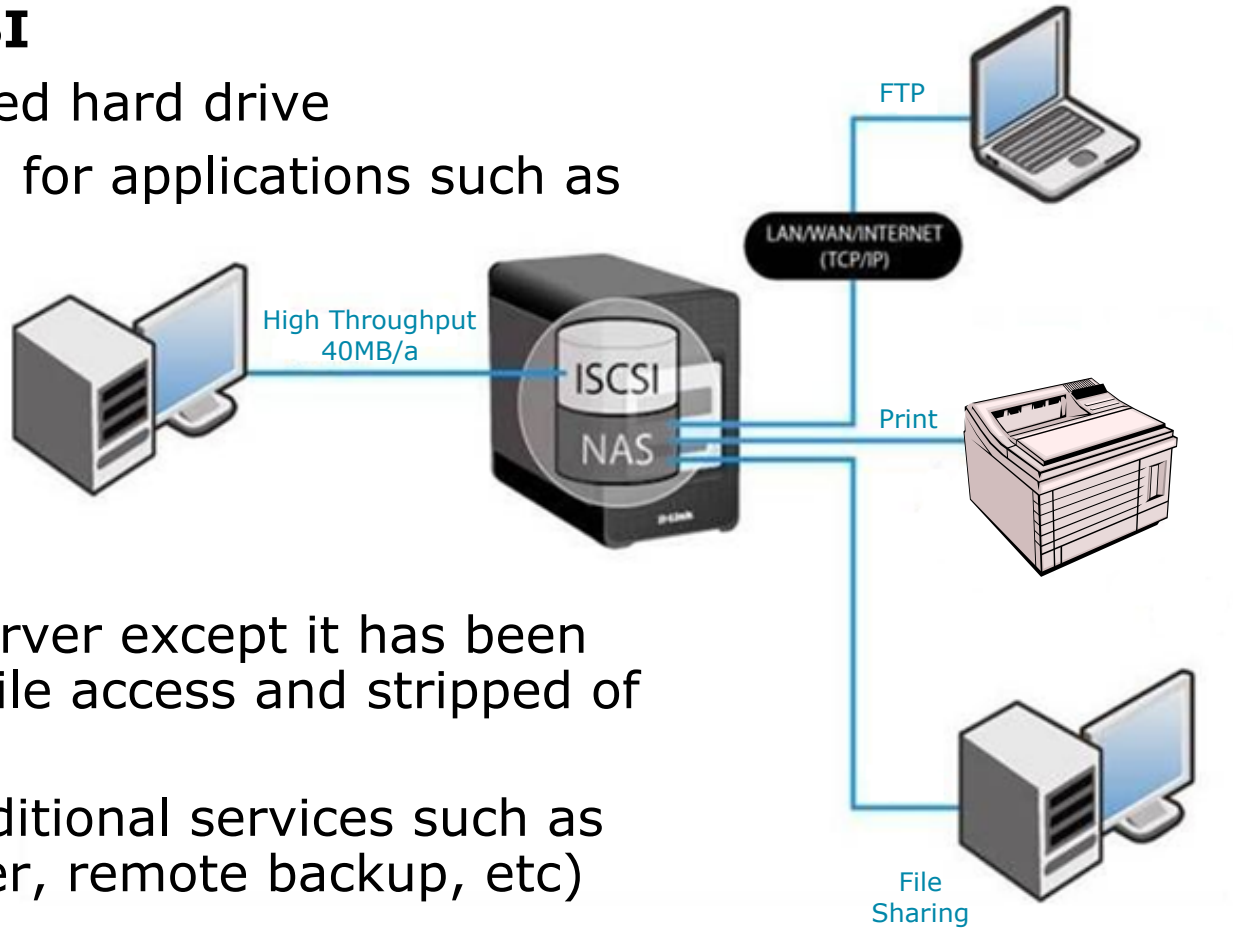
Partner Name	Model	Array Type	Supported Releases
D-Link Systems, Inc.	DSN-1100-10	iSCSI	**ESX** 4.1 U1, 4.1, 4.0 U3, 4.0 U2, 4.0 U1, 4.0, 3.5 U5, 3.5 U4, 3.5 U3, 3.5 U2, 3.5 U1, 3.5
D-Link Systems, Inc.	DSN-2100-10	iSCSI	**ESX** 4.1 U1, 4.1, 4.0 U3, 4.0 U2, 4.0 U1, 4.0, 3.5 U5, 3.5 U4, 3.5 U3, 3.5 U2, 3.5 U1, 3.5
D-Link Systems, Inc.	DSN-3200-10	iSCSI	**ESX** 4.1 U1, 4.1, 4.0 U3, 4.0 U2, 4.0 U1, 4.0
D-Link Systems, Inc.	DSN-3200-10	iSCSI	**ESX** 3.0.3 U1, 3.0.3, 3.0.2 U1, 3.0.2, 3.0.1
D-Link Systems, Inc.	DSN-3400-10	iSCSI	**ESX** 4.1 U1, 4.1, 4.0 U3, 4.0 U2, 4.0 U1, 4.0, 3.5 U5, 3.5 U4, 3.5 U3, 3.5 U2, 3.5 U1, 3.5
D-Link Systems, Inc.	DSN-5110-10	iSCSI	**ESX** 4.1 U1, 4.1, 4.0 U3, 4.0 U2, 4.0 U1, 4.0
D-Link Systems, Inc.	DSN-5210-10	iSCSI	**ESX** 4.1 U1, 4.1, 4.0 U3, 4.0 U2, 4.0 U1, 4.0, 3.5 U5, 3.5 U4, 3.5 U3, 3.5 U2, 3.5 U1, 3.5, 3.0.3 U1, 3.0.3, 3.0.2 U1, 3.0.2, 3.0.1
D-Link Systems, Inc.	DSN-5410-10	iSCSI	**ESX** 4.1 U1, 4.1, 4.0 U3, 4.0 U2, 4.0 U1, 4.0
D-Link Systems, Inc.	DSN-6120	iSCSI	**ESX** 4.1 U1, 4.1, 4.0 U3, 4.0 U2, 4.0 U1
D-Link Systems, Inc.	DSN-6420	iSCSI	**ESX** 4.1 U1, 4.1, 4.0 U3, 4.0 U2, 4.0 U1

What is Unified Storage?

Unified Storage: Concurrent iSCSI and NAS

Characteristics of iSCSI

- Acts as a locally attached hard drive
- Block-level access ideal for applications such as email and databases



Characteristics of NAS

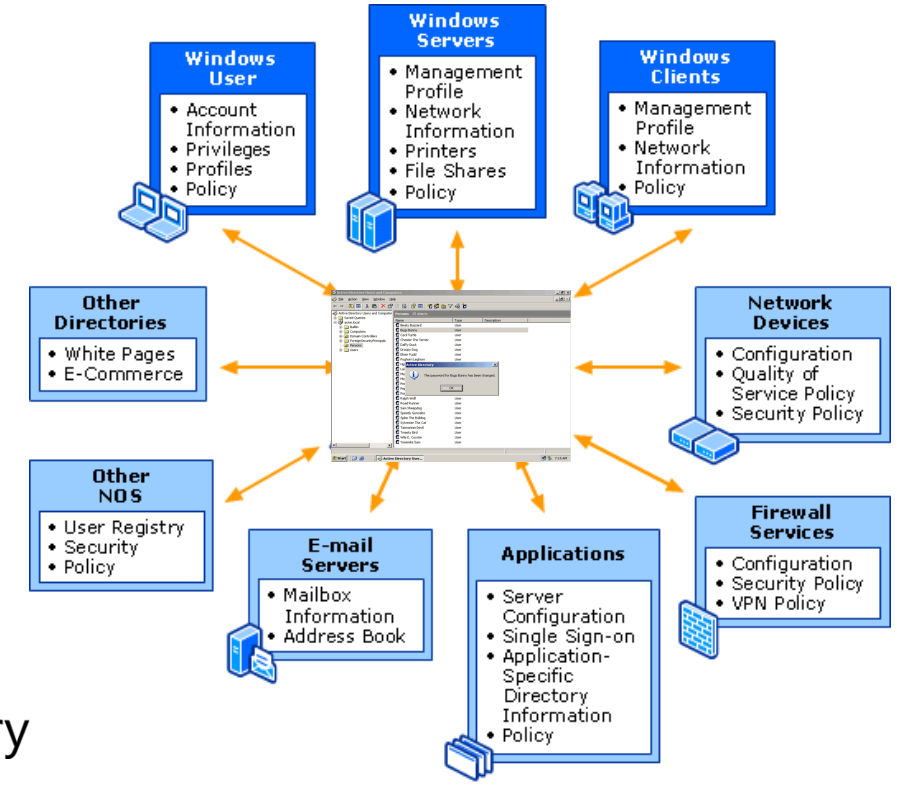
- Like a traditional file server except it has been optimized for efficient file access and stripped of auxiliary utilities.
- D-Link incorporates additional services such as FTP Server , Print server, remote backup, etc)

Microsoft Active Directory Support

Active Directory Service (ADS)

Microsoft Active Directory is a database service that allows for a single point of administration for all shared resources on a network, including

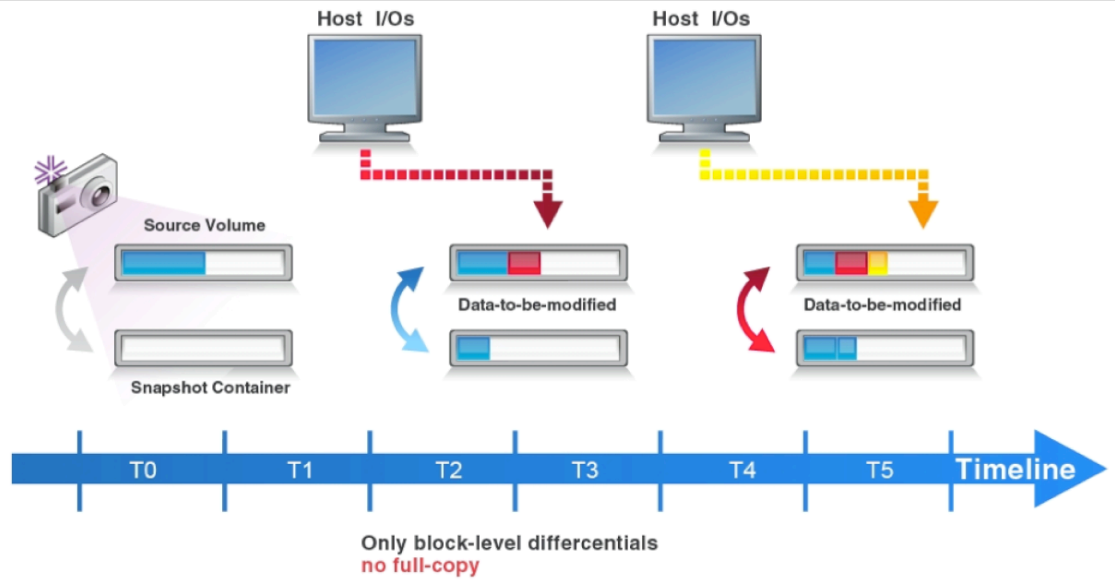
- Files
- Peripheral devices
- Databases
- Web sites
- Users, and services.



Windows Server® Active Directory

Snapshot Technology

Volume Snapshot is the capability to record multiple points in time for the data, so that should an emergency occur, the data can be rolled back to the earlier state without having to restore from backups.

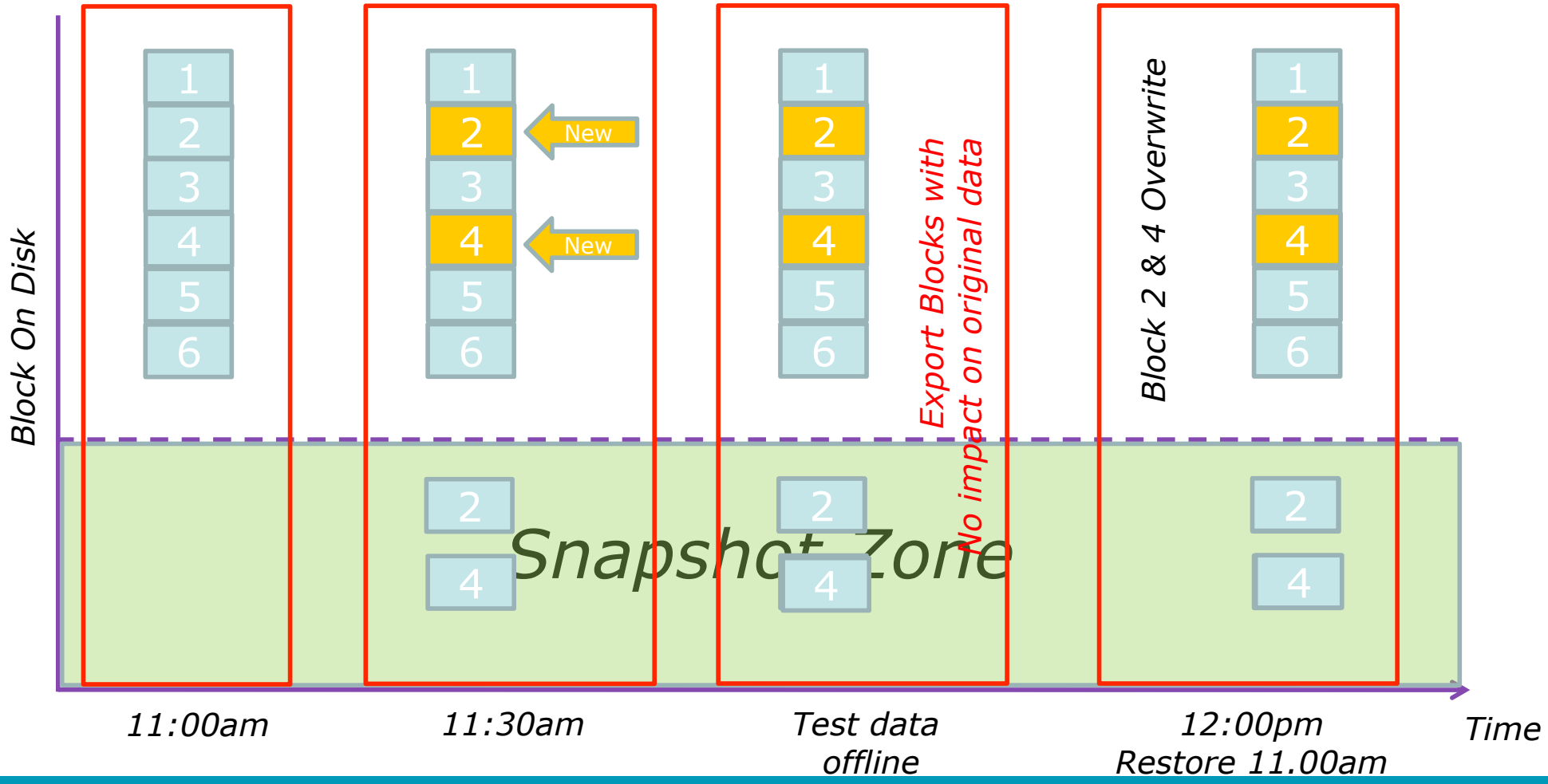


› Benefits:

1. Snapshots shorten the time of data backup
2. Snapshots allow users to instantly restore the data to a designated time
3. Snapshots provide easy backup management

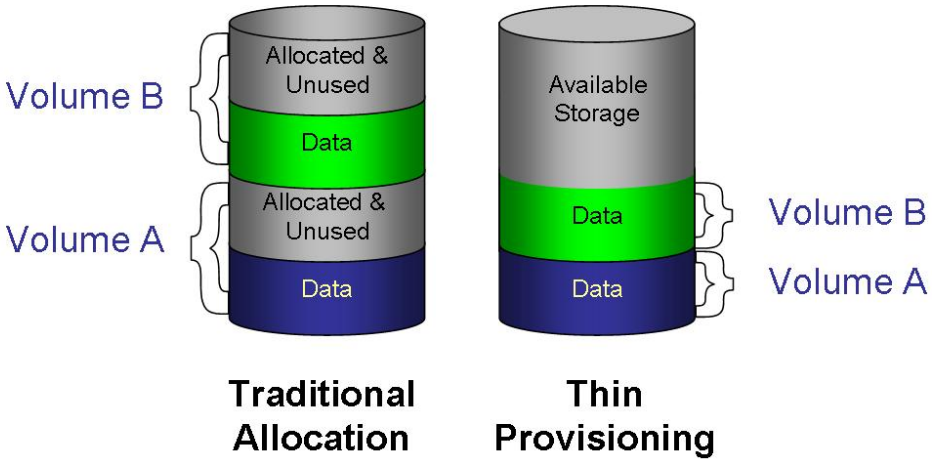
Snapshot Technology

› COW (Copy-On-Write) Snapshot Technology



Thin Provisioning

- Thin Provisioning is a method of optimising the utilisation of available storage
- Thin provisioning allows disk capacity to be allocated to servers on a "just enough" and "just in time" basis.
- Organisations or departments can now be charged for actual capacity usage, reducing operating costs and improving resource management.

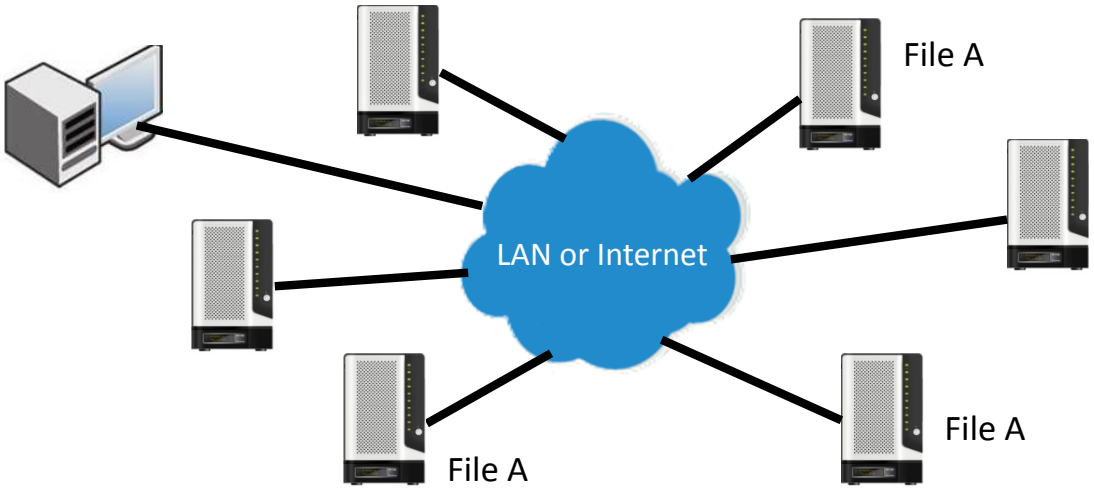


- Benefits
  1. Lower initial purchase cost
  2. Upgrade capacity in line with actual business usage
  3. Enhanced storage capacity utilization
  4. Reduce operation cost

Distributed File System

Distributed File System (DFS)

- **Distributed File System** is a set of client and server services that allow an organization to organize many distributed SMB file shares into a distributed file system.
- DFS provides location transparency and redundancy to improve data availability in the face of failure or heavy load by allowing shares in multiple different locations to be logically grouped under one folder, or DFS root.
- **Benefits:** While many client PCs may have the same file, when using DFS, the files appears grouped under one folder. This is for ease of file discovery and for redundancy.



Green Technologies

Green Technologies

- Hard Drive Hibernation : Hard Drive Hibernation reduces the power consumption and noise, and also extends the life of the hard drives.

- Low Power Consumption : Storage devices are powered by low power consumption CPUs and therefore consumes low power when operation.

- Smart Fan Design : Smart fan design will automatically adjust the fan speed based on temperature measured to efficiently dissipate the heat and conserve the power.

- Green Ethernet : The Green Ethernet feature allows the devices to optimized power usage based on dynamic detection of cable .

- Schedule Power On/Off : The schedule power on/off feature offers the option to flexible operates the device per users' desire.

Conclusions

- There are many applications that need storage, and new applications are appearing every day.
  - We never delete anything. Email is a perfect example
- NAS is perfect for data sharing – if multiple people/sites need to access the same data.
- SAN is better for companies that are upgrading from DAS as they access the data in the same way (SAN storage has the same "look and feel" as DAS).
- There is no clear line that defines NAS and IP-SAN applications:
  - SMB's will use NAS for storage consolidation, others will use IP-SAN
  - Some companies will use a NAS device for disaster recovery applications, others will use a SAN device
- In case you have doubts just select a system that support both.

Si está interesado en almacenamiento de datos le recomendamos visitar:

www.almacenamientodlink.es

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Building Networks for People

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