Storages

Basic and Dynamic Disks

- Basic Disks offer compatibility (MS-DOS)
- Dynamic Disks offer more features
- Basic Disk (One disk)
  - Size of volume on disk can be adjusted
  - Boot from basic disk
- Dynamic disk
  - Some configurations support booting
  - Can use multiple disks
- Basic disks can be converted to dynamic

Dynamic Disk Support

- All Server 2000 OS's and above
- Windows 8.1
- Windows 8
- Windows 7 Professional/Enterprise/Ultimate
- Windows Vista Enterprise and Ultimate
- Windows XP Professional

Combining Multiple Disks

- Spanned Volume
  - Combined free space from multiple drives
  - No speed improvements or redundancy
  - Does not support booting
- Mirrored Volume
  - Duplicates data across two disks
  - Data copied to two disks. Supports one disk failure
  - Can be used to boot the operating system

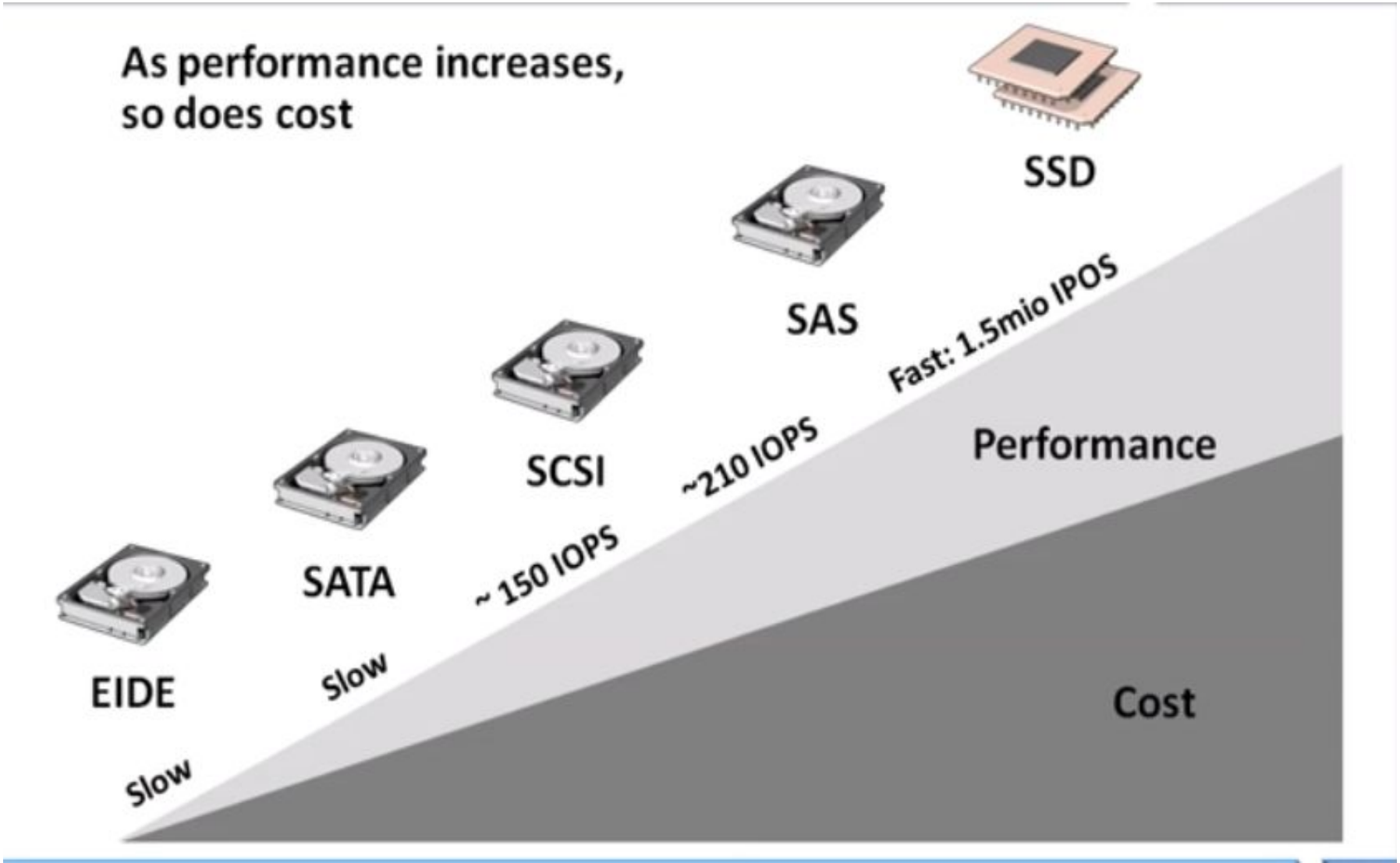
Combining Multiple Disks

- Striped Volume
  - 2 or more disks
  - Data spread evenly across all disks
  - No redundancy
  - Improved read and write performance
  - Does not support booting

Combining Multiple Disks

- RAID-5
  - Fault tolerant. (Supports one drive failure)
  - Requires 3 disks or more
    - One drive lost to parity
  - Fast read but slow write performance
  - Available on server OS's only
  - Does not support booting

Disk Types & Performance



DAS

DAS disks are physically attached to the server

Advantages:

- Easy to configure
- Inexpensive solution

Disadvantages:

- Isolated because it attaches only to a single server
- Slower

Server with attached disks

NAS

NAS is storage that is attached to a dedicated storage device and accessed through network shares

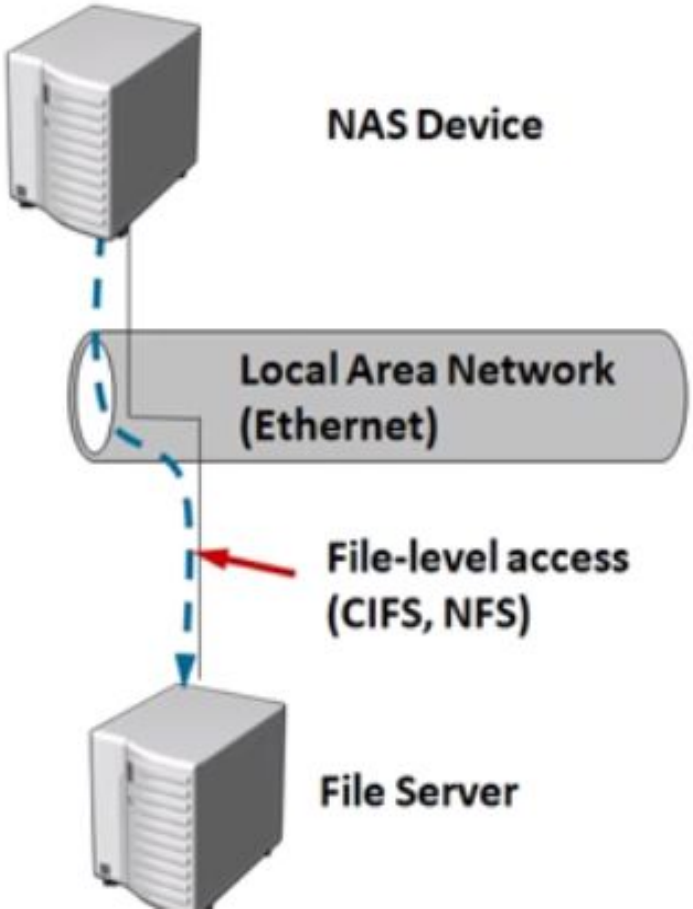
Advantages:

- Relatively inexpensive
- Easy to configure

Disadvantages:

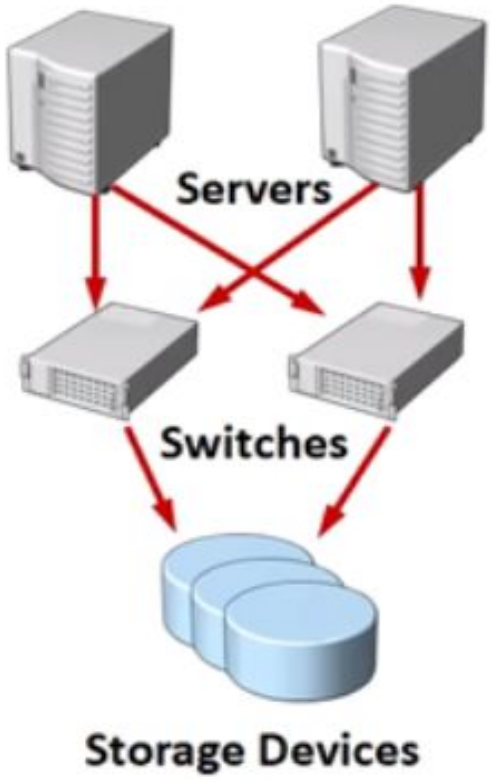
- Slower access times
- Not an enterprise solution

NAS offers centralized storage at an affordable price



SAN

SANs offers higher availability with the most flexibility



Advantages:

- Fastest access times
- Easily expandable
- Centralized storage
- High level of redundancy

Disadvantages:

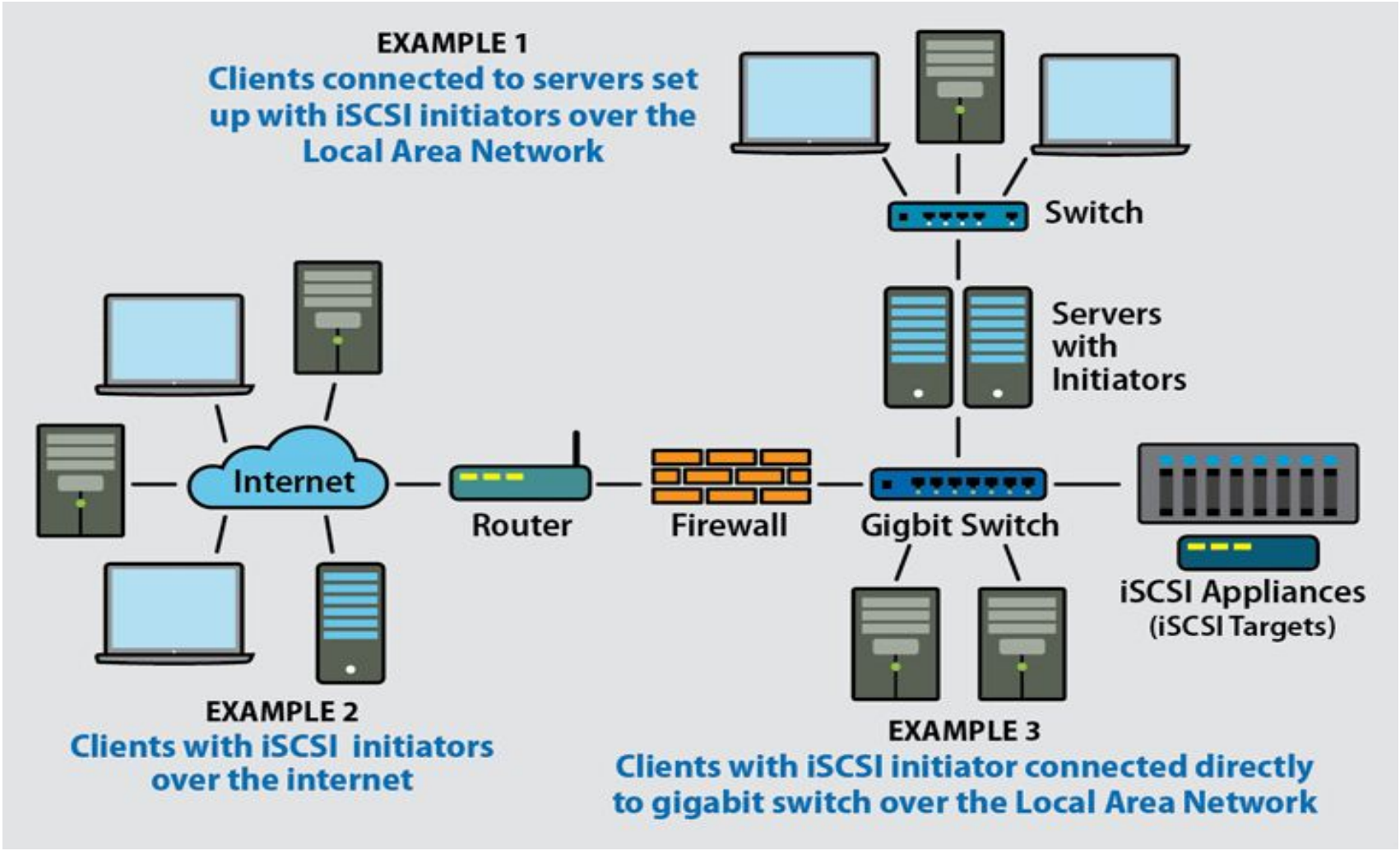
- More expensive
- Requires specialized skills

SANs can be implemented using Fibre Channel or iSCSI

iSCSI

- Inexpensive and simple way to configure connections to remote disk.
- A transport layer protocol that works on top of the TCP.
- It enables block-level SCSI data transport between the iSCSI initiator and the storage target over TCP/IP networks.
- Redundant.
- Fault Tolerant.
- Highly Available.

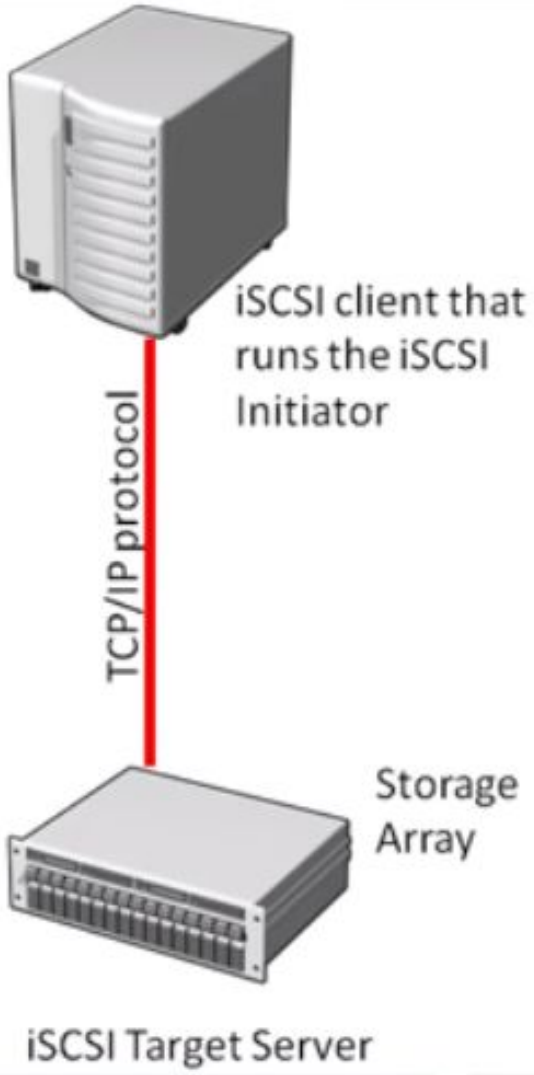
iSCSI


EXAMPLE 1
Clients connected to servers set up with iSCSI initiators over the Local Area Network
Switch
Servers with Initiators
Internet
Router
Firewall
Gigbit Switch
iSCSI Appliances
(iSCSI Targets)
EXAMPLE 2
Clients with iSCSI initiators over the internet
EXAMPLE 3
Clients with iSCSI initiator connected directly to gigabit switch over the Local Area Network

iSCSI

- **iSCSI transmits SCSI commands over IP networks**

Component	Description
IP network	Provides high performance and redundancy
iSCSI targets	Run on the storage device and enable access to the disks
iSCSI initiators	A software component or host adapter on the server that provides access to iSCSI targets
IQN	A globally unique identifier used to address initiators and targets on an iSCSI network



iSCSI Components

iSCSI Initiator:

These technologies package SCSI commands into network packets and direct them to the storage target. The software-based iSCSI initiator is the least expensive of the options, and is often included in the operating system (OS).

HBA: Host-based adapters (HBA) is a hardware device. HBAs are more expensive than software, but higher performance with more functionality.

iSCSI Components

iSCSI target:

iSCSI transports packets across TCP/IP networks. The iSCSI target is the remote storage, which appears to the host system as a local drive. The iSCSI protocol links the hosts and storage over IP networks: LAN, WAN, and Internet.

When the packets arrive at the iSCSI target, the protocol disassembles the packets to present SCSI commands to the operating system. If iSCSI has encrypted the network packet, it decrypts the packet at this stage.

RAID

RAID or Disk Array: The hard disk drives are grouped together using hardware or software and is treated as a single data storage unit.

- The data is recorded across multiple hard disk drives in parallel, increasing the access time significantly.

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- The data is recorded across multiple hard disk drives in parallel, increasing the access time significantly.
- The array of multiple hard disk drives which forms the RAID can also be partitioned and assigned with a file system.

RAID Functions

- **Striping** is the process in which consecutive logical bytes of data is stored per blocks in the consecutive physical disks which forms the array.

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RAID Functions

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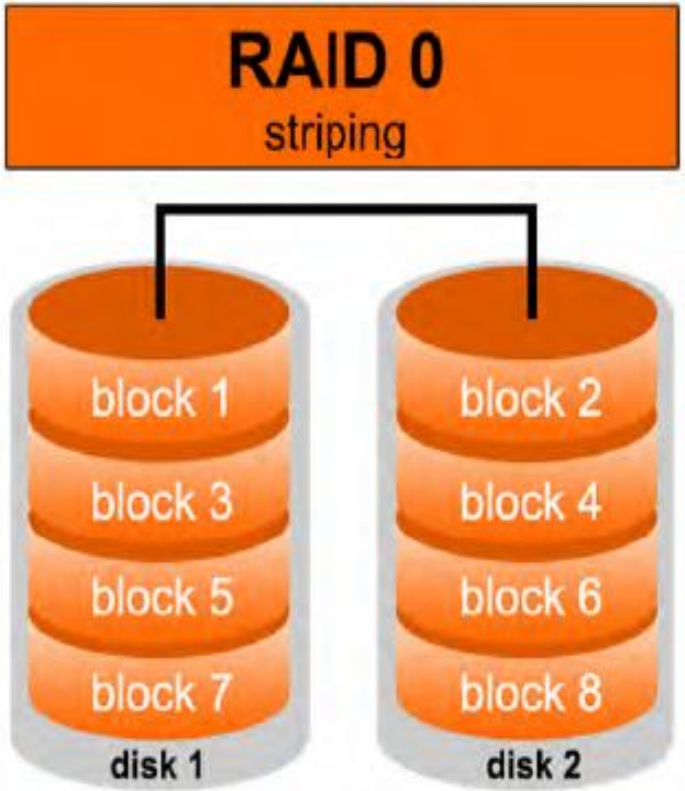
- **Mirroring** is the process in which the data is written to the same block on two or more physical disks in the array.
- **Parity Calculation** - If there are N number of disks in the RAID array, N-1 consecutive blocks are used for storing data blocks and the Nth block is used for storing the parity.

RAID- 0

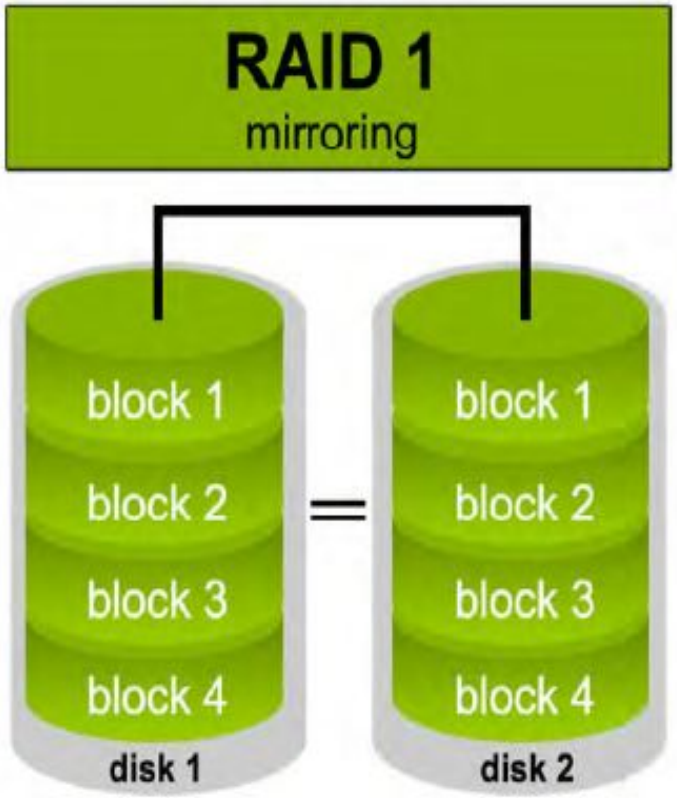
- RAID 0 is also called as Data Striping with o Parity information. RAID 0 requires a minimum of 2 Hard Disk drives.
- The advantages of RAID 0 is the increase in performance due to the parallelism in the read and write process.



RAID- 1

RAID 1

- RAID 1 is called as Data Mirroring. RAID 1 requires a minimum of two or more Hard Disk drives.
- The advantages of RAID 1 are good Performance in the read operation as the data is read simultaneously from several disks.



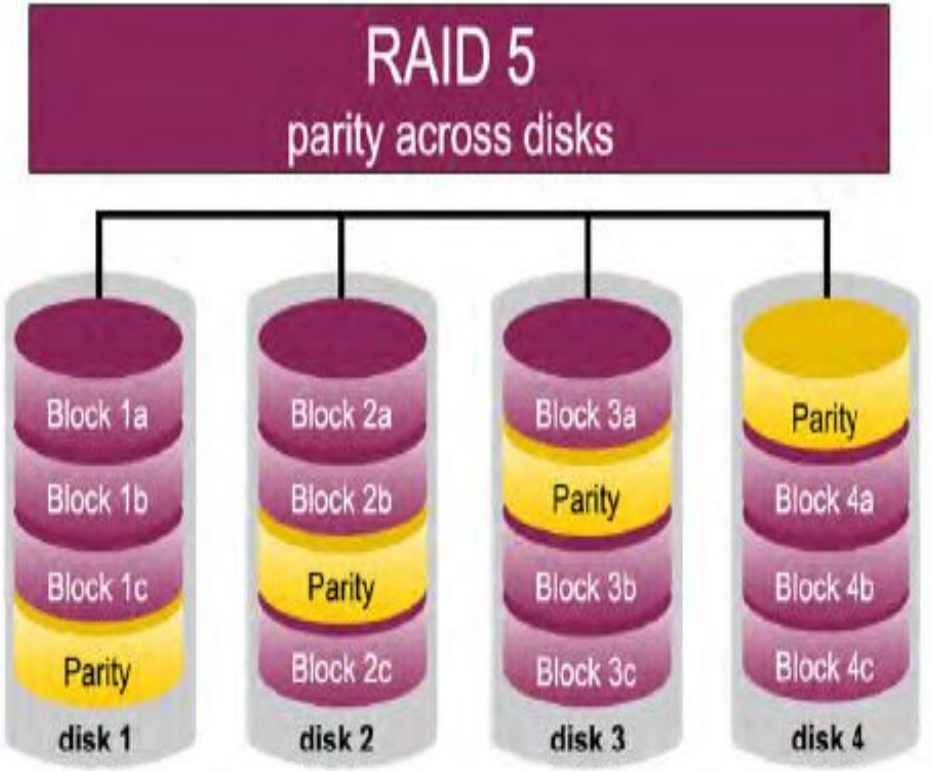
RAID- 4

- RAID 4 is a process of independent, whole Block Access in which the data is stored across the number of disks (N-1) and the other disk acts as a dedicated Parity Drive which stores the parity information.

RAID- 5

RAID 5

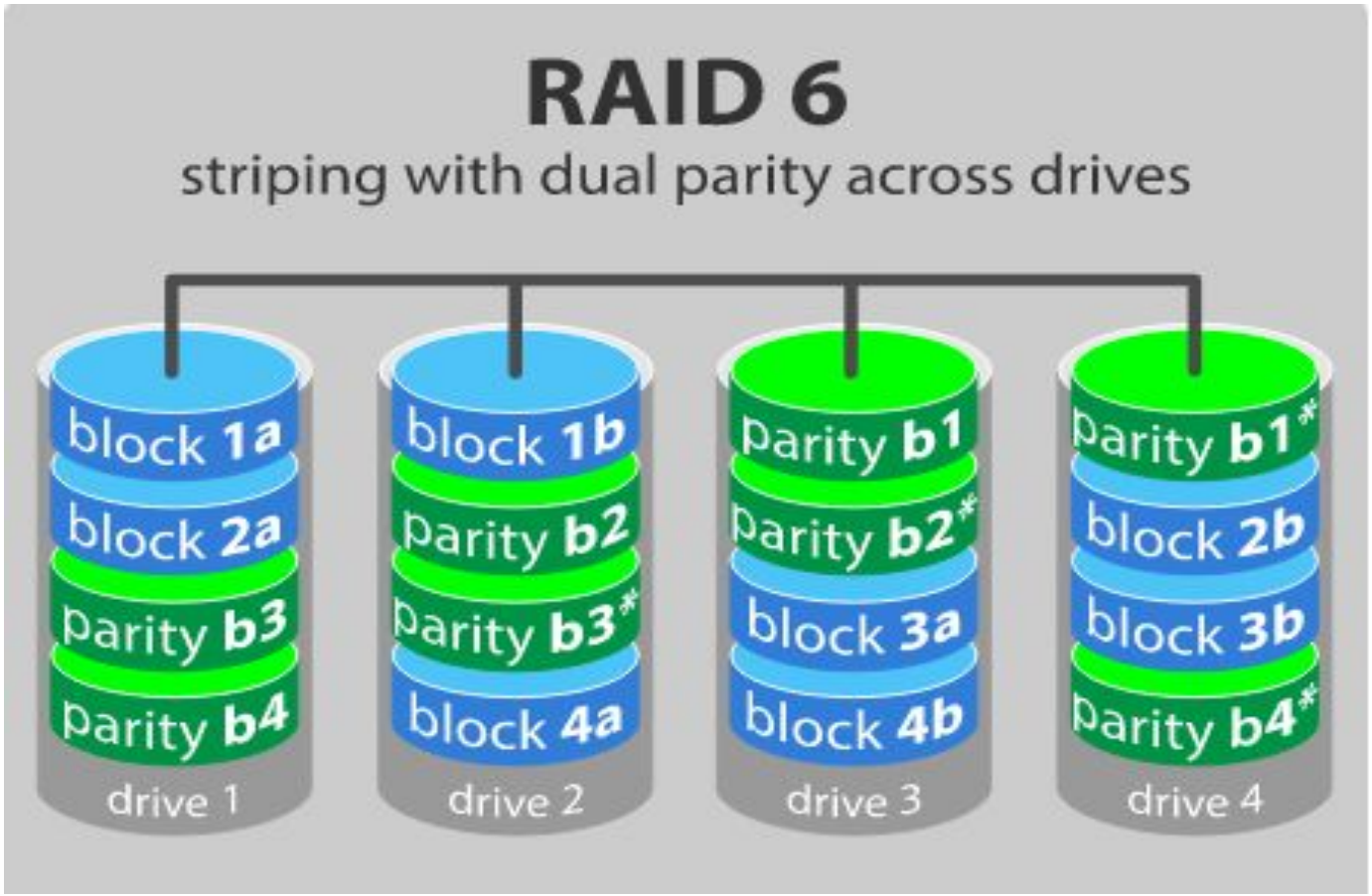
- RAID 5 is the process identical to the RAID 4, but the parity is striped across multiple drives in the array.
- RAID 5 requires a minimum of 3 hard disk drives for its configuration.
- The advantage of RAID 5 is the Good read performance due to the parallelism like RAID 0.



RAID- 6

- Like with RAID 5, read data transactions are very fast.
- If two drives fail, you still have access to all data, even while the failed drives are being replaced. So RAID 6 is more secure than RAID 5.

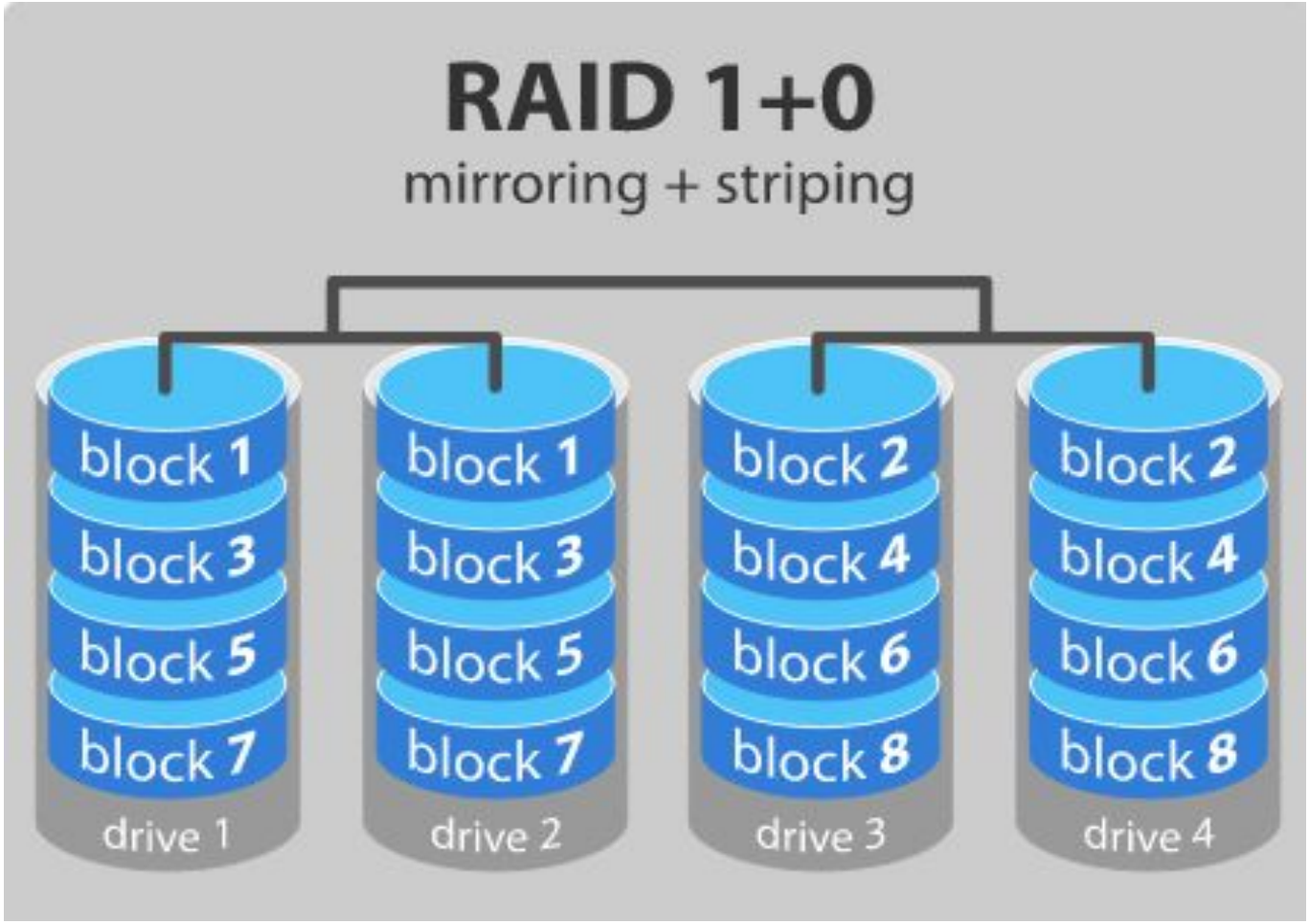
RAID- 6



RAID- 10

- If something goes wrong with one of the disks in a RAID 10 configuration, the rebuild time is very fast since all that is needed is copying all the data from the surviving mirror to a new drive.

RAID- 10



Storage Virtualization

- Uses virtualization concepts which enables better functionality and advanced features within and across storage systems.
- Hides the complexity of the SAN by pooling together multiple storage devices to appear as a single storage device.

Types of Storage Virtualization

Host based:

- Provided by a server.
- Presents a single drive for the applications.
- Depends on the software at the server often at the OS level.

Types of Storage Virtualization

Appliance Based:

- A hardware appliance is used which sits on the storage network.

Network Based:

- Similar to the appliance based except that it works at the switching level.

Advantages of Storage Virtualization

- Improvised storage management in an IT environment.

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- Improvised storage management in an IT environment.
- Better storage utilization.
- Less energy usage.
- Increase in loading and backup speed.
- Cost effective, no need to purchase additional software and hardware.

Disadvantages of Storage Virtualization

- More complicated network topology.
- SPOF.
- The entire network is compromised if any server is infected or breached.

Types of Virtualization

- **Block Virtualization:** The abstraction (separation) of logical storage (partition) from the physical storage so that the partition can be accessed without regard to the physical storage.

Types of Virtualization

- **File Virtualization:** File virtualization eliminates the dependencies between the data accessed at the file level and the physical location where the files are stored.

iSCSI

SCSI :

- Family of Interfaces for requesting services from I/O devices
- Logical unit- Individual I/O devices
- Uses Logical Addressing of data blocks
- Two Types : Parallel SCSI, Serial SCSI.

iSCSI

- IP based standard for linking data storage devices over a network.
- Supports Gigabit Ethernet Interface
- Enables location independent data storage and retrieval
- Uses existing building blocks (SCSI, TCP)
- Point to point direct connections
- Transfer SCSI packets

iSCSI

- Two types of Devices:
  - iSCSI Initiator
  - iSCSI Target
- iSCSI Initiator:
  - Request Commands to execute
  - Also called as Client
  - Starts the Communication

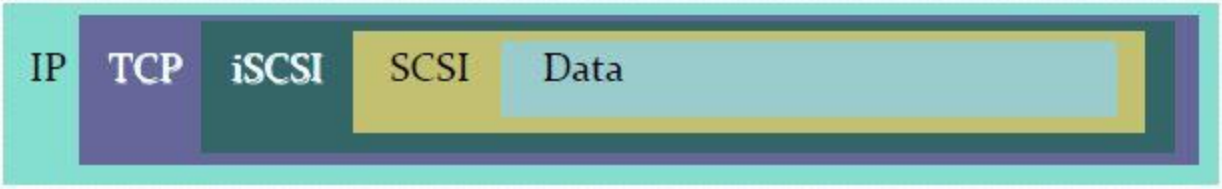
Cont...

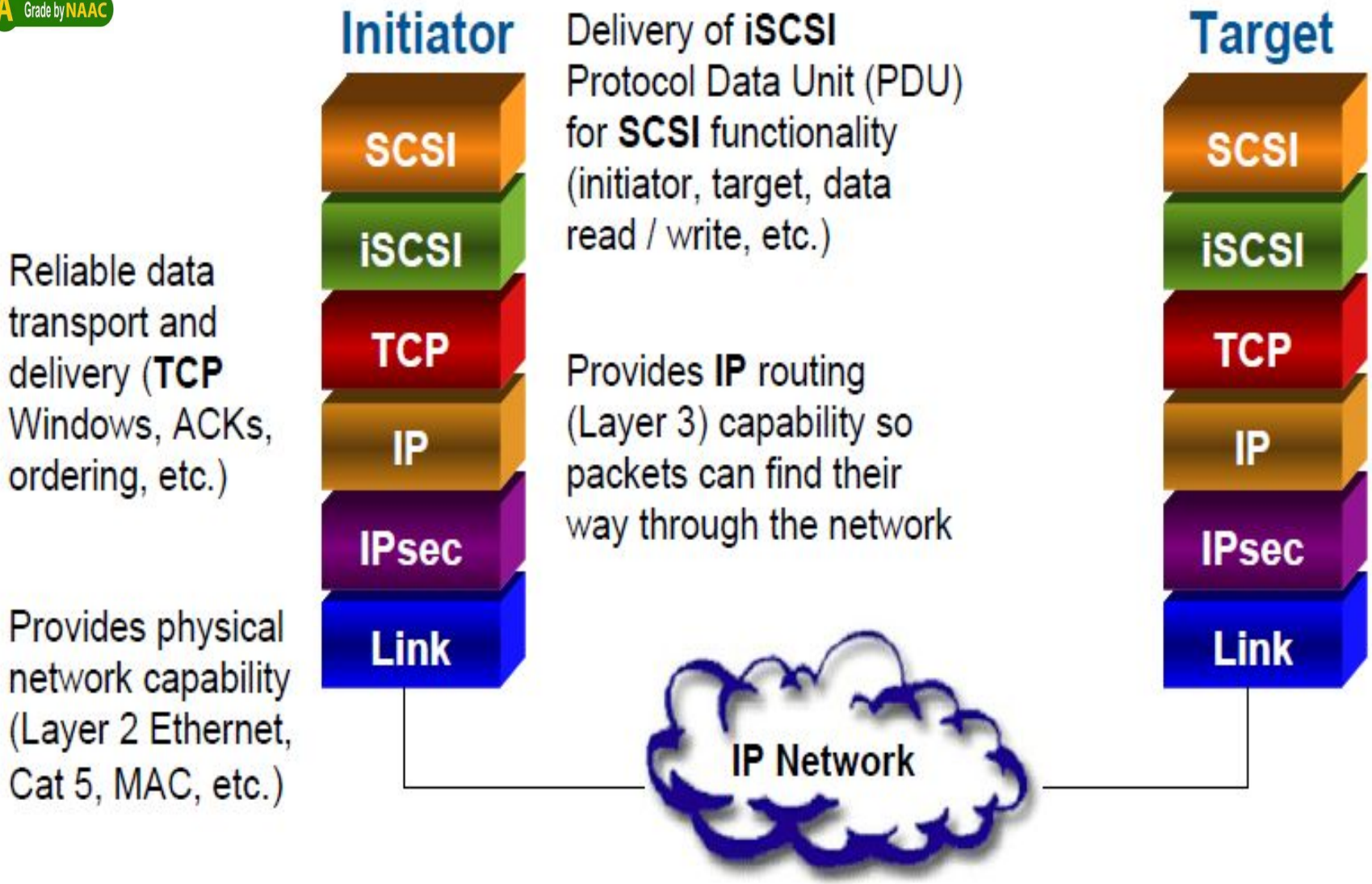
iSCSI Target:

- Responds to the request
- Also Called as Server
- It is device that carry out commands
- Endpoint within target executes command called as Logical Unit.
- CDB (Command Descriptor Block)
- Task – command or linked set of command

iSCSI Protocol

- Based on SCSI
- Enables block storage application over TCP/IP networks
- It is bi-directional
- Monitors and validates I/O operation
- IP Packet





FCIP

- Fibre Channel over IP (FCIP) transparently connects FC SAN islands over IP networks.
- Encapsulates and tunnels FC frames through an IP network.
- Uses TCP for flow control and error handling.
- Data encryption and data security measures used in FCIP environments, including IP Security (IPsec) and Internet Key Encryption (IKE).

FCoE

- FCoE is FC frames **encapsulated in Layer 2 Ethernet frames designed** to utilize a Lossless Ethernet environment

– Large maximum size of FC requires Ethernet Jumbo Frames

– No TCP, so Lossless environment required

– No IP routing