



## ISM Unit 2 - This is 2nd unit of ISM handwritten notes

Information Storage And Management (SRM Institute of Science and Technology)

Unit - 2FC [Fiber Channel] :-

Fiber channel architecture forms the fundamental construct of the FC-SAN infrastructure.

Fiber channel is a high speed network technology that runs on the high-speed optical fiber cable and serial copper wire.

It was developed to meet the demand for increased speed of data transfer between the server and mass storage systems. It is introduced by American National Standard Institute (ANSI) in 1988.

High speed data transmission is an important feature of FC network technology. The initial implementation offered a throughput of 200 MB/s and the latest implementation of 16 GFC offers the throughput of 3200 MB/s.

FC architecture is highly scalable and theoretically a single FC network can accommodate approximately 15 million devices.

SAN and its Evolution :-

SAN stands for Storage Area Network

It is a dedicated, specialized and high speed network which provides block level data storage. It delivers the shared tool of storage devices to more than one server.

The main aim of SAN is to transfer the data between the server and storage device. It also allows transferring between the storage systems.

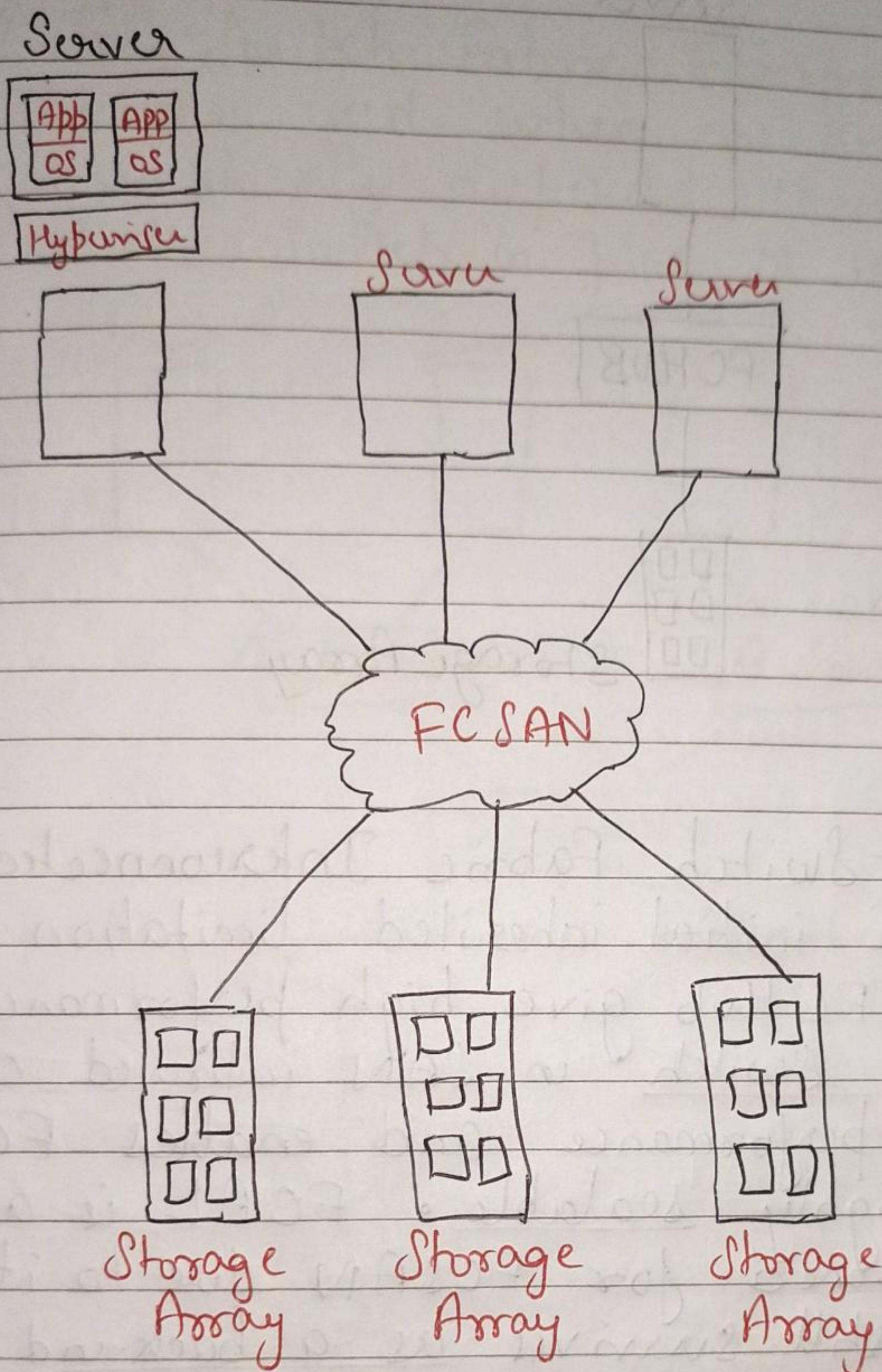
It is used for accessing storage devices such as tape libraries and disk devices from the server.

Common SAN deployments are Fiber Channel SAN (FCSAN) and IPSAN. Fiber channel SAN uses Fiber channel protocol for the transport, commands and info status information. IPSAN uses IP based protocol for communication.

SAN also enables organization to connect geographically dispersed server storage.

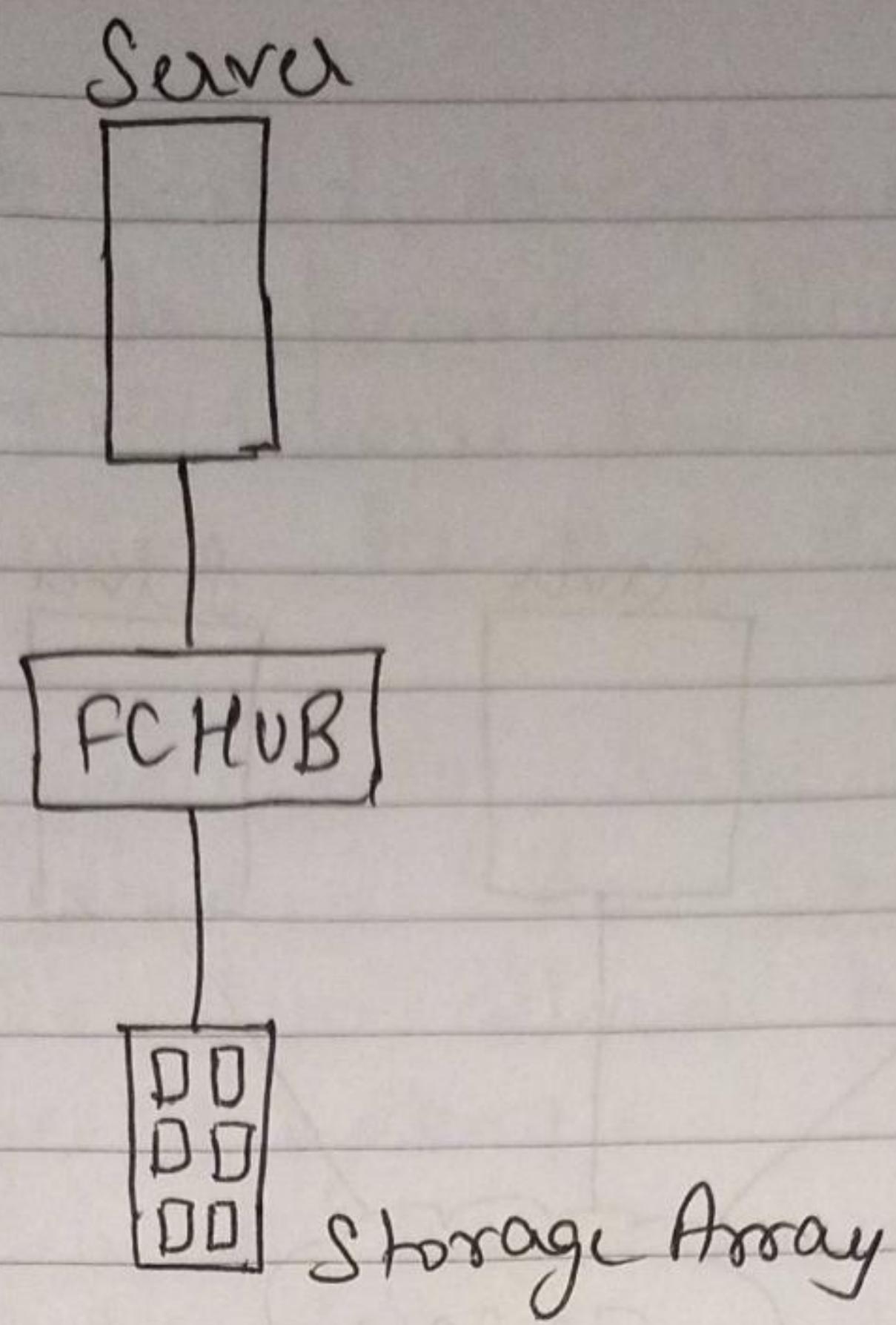
### SAN Implementation :-

Given below is the diagram to demonstrate the implementation of SAN :-

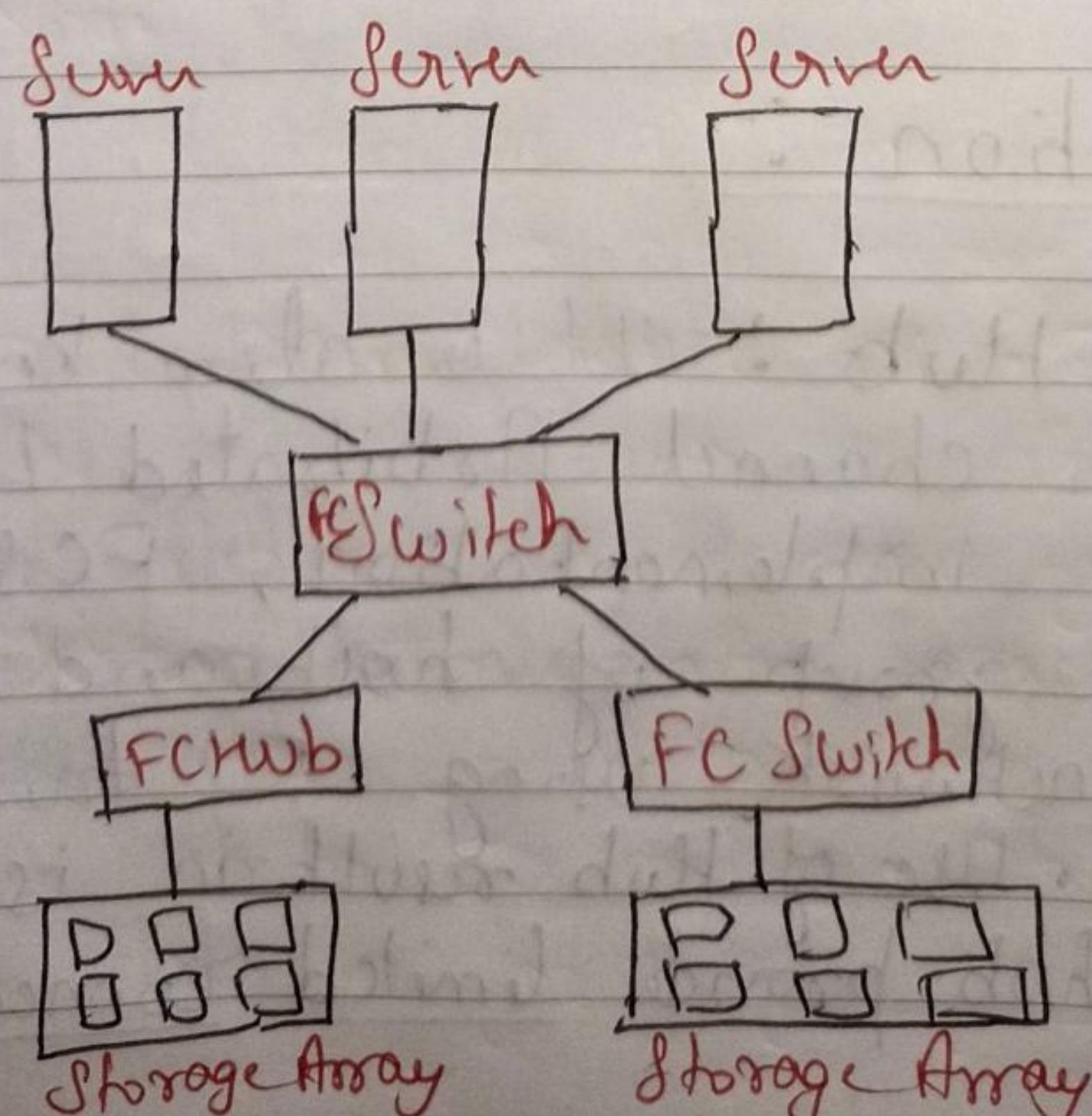


## Evolution :-

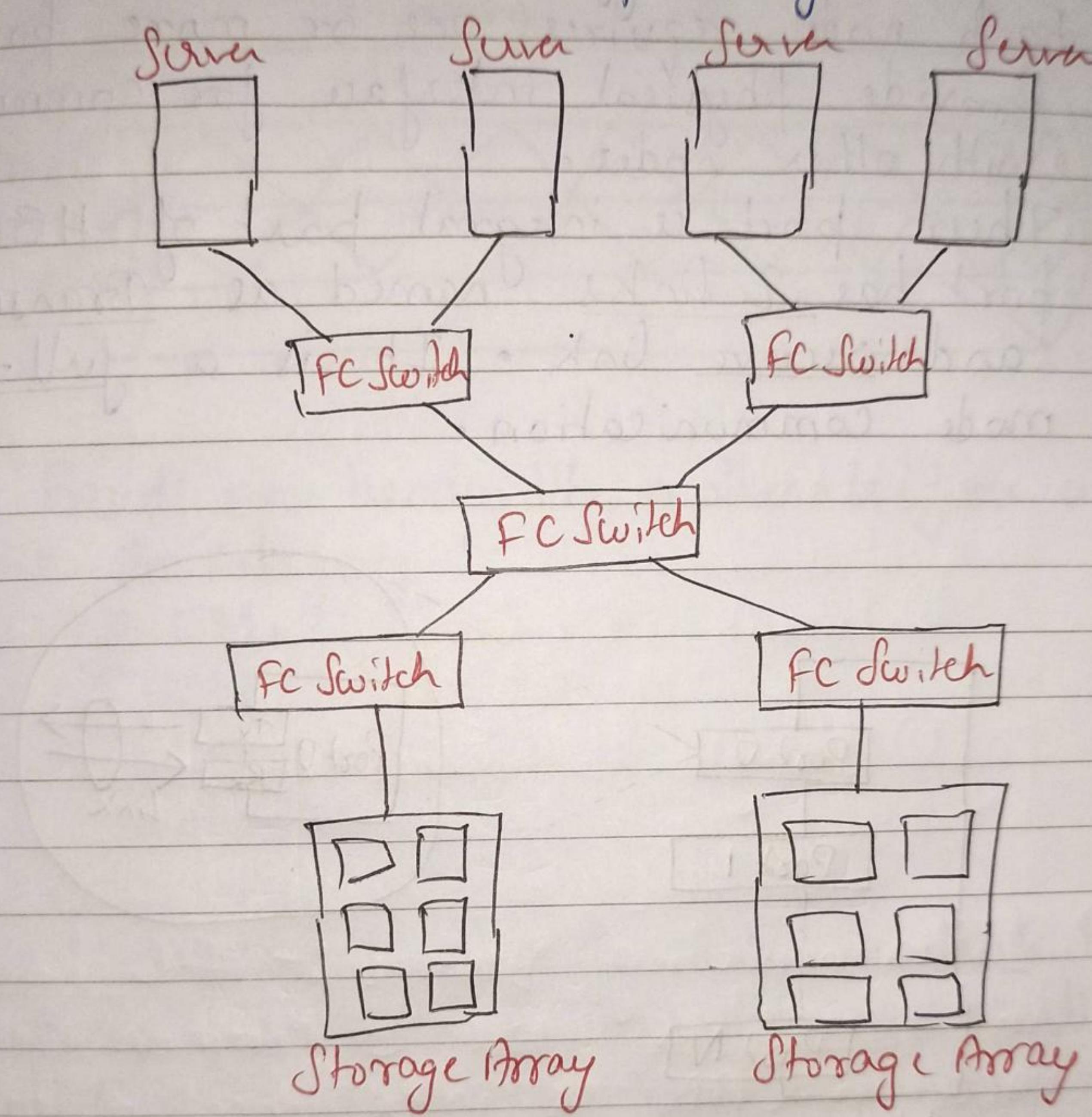
1) FC-Hub :- It is also known as FC-AL (Fiber channel Arbitrated Loop). In the earliest implementation, FCSAN was a simple group of host and storage device to a network using FC hub as a connectivity device. Use of hub result in isolated FC-AL because hub provide limited connectivity & bandwidth.



2) FC-Switch Fabric Interconnected SAN :-  
 The initial inherited limitation associated with FC Hub give high performance FC-Switch. Use of Switch in SAN improved connectivity and performance and enables FCSAN to be highly scalable. FCAL is almost abandoned for FCSAN due to its limitation but still survives as a back-end connectivity option to disk drive.



3) FC-Switch Fabric Enterprise SAN :-  
It is used when we need to connect geographically dispersed storage. In this we use switch in place of HUB.



## Components of FC-SAN :-

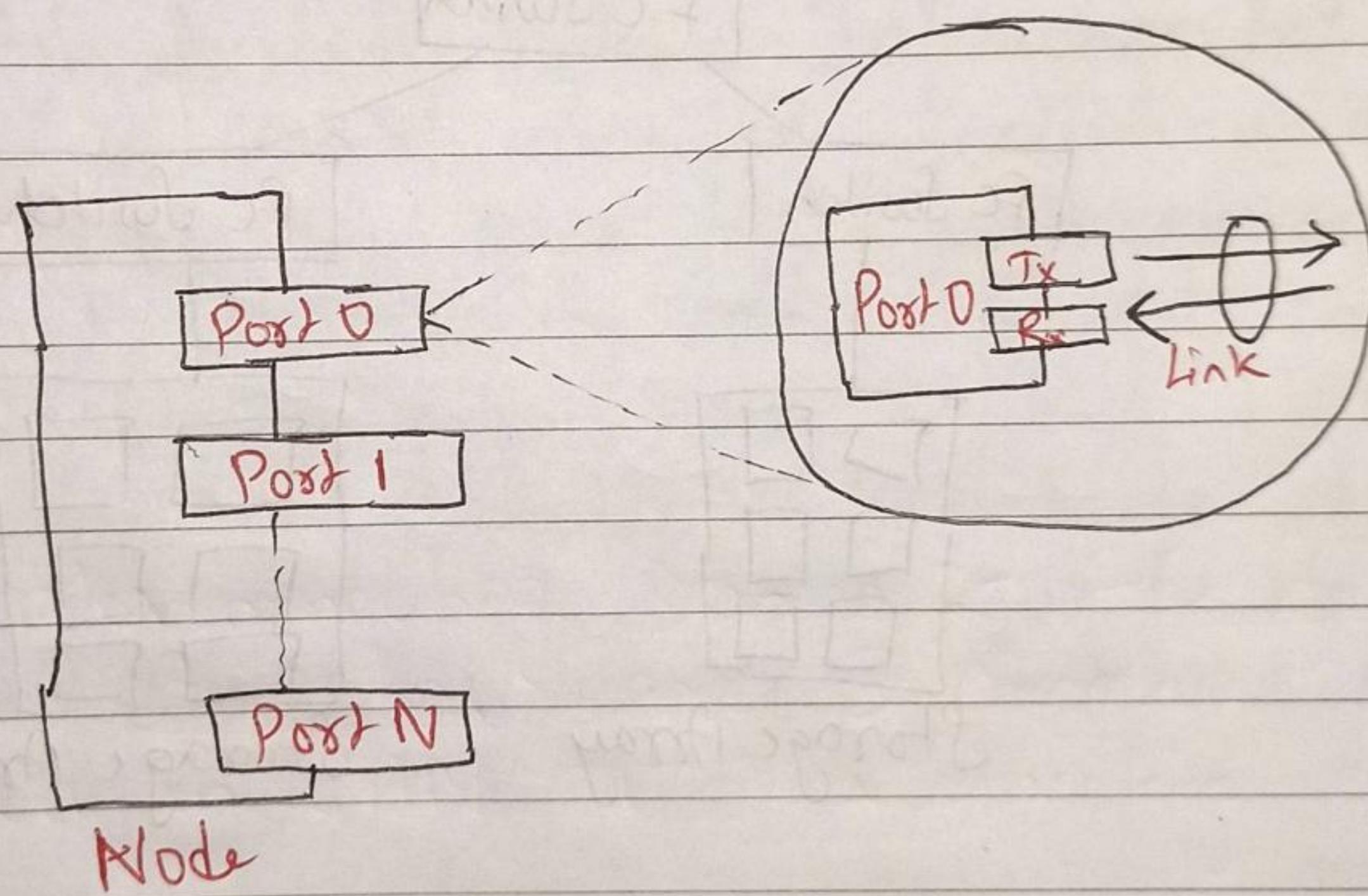
- 1) Node port
- 2) Cables and Connectors
- 3) Interconnecting & devices
- 4) SAN management & Software

## > Node Ports :-

In Fibre channel network, the end device such as host, storage array and tape libraries are referred to as node.

Each node requires one or more port to provide physical interface for communicating with other nodes.

These port is integral part of HBA. Each port has 2 links named as Transmit link and receive link. It is a full-duplex mode communication.

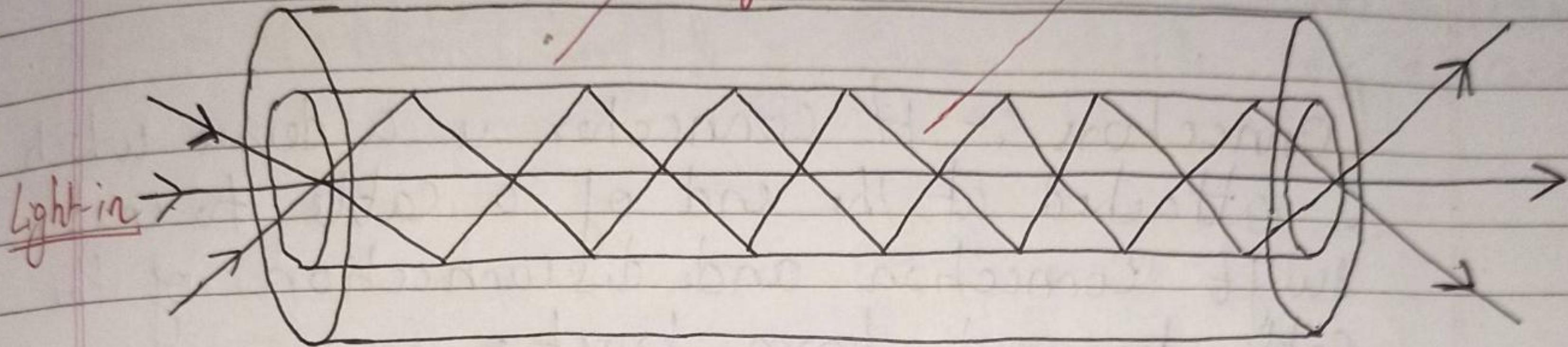


## 2) Cables and Connectors :-

SAN implementation use optical fiber cabling. Copper can be used for shorter distance for back-end connectivity because it provides an acceptable signal-to-noise ratio for distance up to 30 meters. Optical cable carry data in form of light.

## Types of Cables :-

i) Multimode Fiber :- It carries multiple beam of light projected at different angle simultaneously.



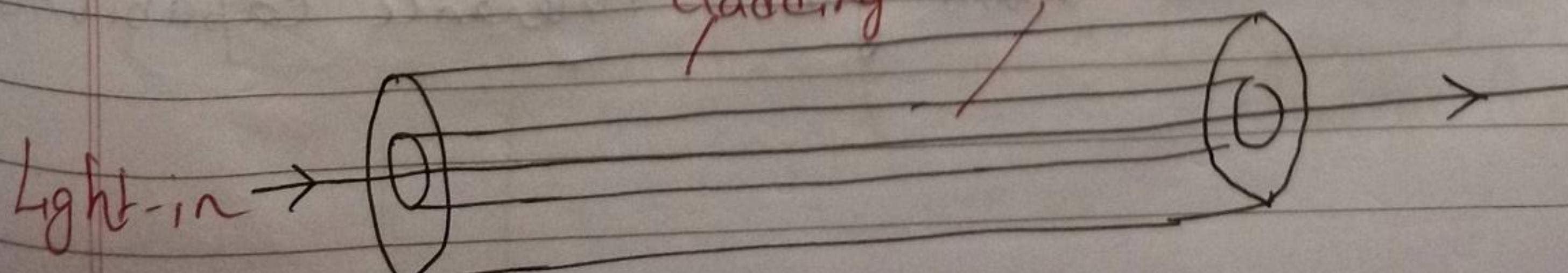
Based on bandwidth, multimode fiber is classified into 3 categories :-

- a) OM<sub>1</sub> (62.5 μm)
- b) OM<sub>2</sub> (50 μm)
- c) OM<sub>3</sub> (50 μm)  
Laser optimized

Disadvantages :- In MMF, multiple beam traveling inside a cable tend to disperse and collide. This collision weaken the strength of the light after certain distance which is known as modal dispersion.

It is typically used for short distance.

ii) Single-mode Fiber (SMF) :- It carry a single ray of light projected at the center of the core.



SMF is used for long distance cable runs. It provide minimum attenuation over maximum distance (10 km). Diameter range of core = 7 - 11 microns (common 9 microns).

Connectors :- A connector is a device which is attached at the end of a cable to enable swift connection and disconnection of the cable to and from port.

Types :-

- a) Standard Connector
- b) Lucent Connector
- c) Straight tip Connector

3) Interconnecting Devices :- FC hubs, switch and directors are 3 common devices used in SAN as interconnecting devices.

HUB are used as a communication devices in FCAL. Switch are more intelligent than Hubs and directly route data from one physical port to another. Directors are high-end switches with high port count and better fault tolerance capabilities.

4) SAN Management Software :- It manages the interconnecting devices. It can manage all the resource from central location.

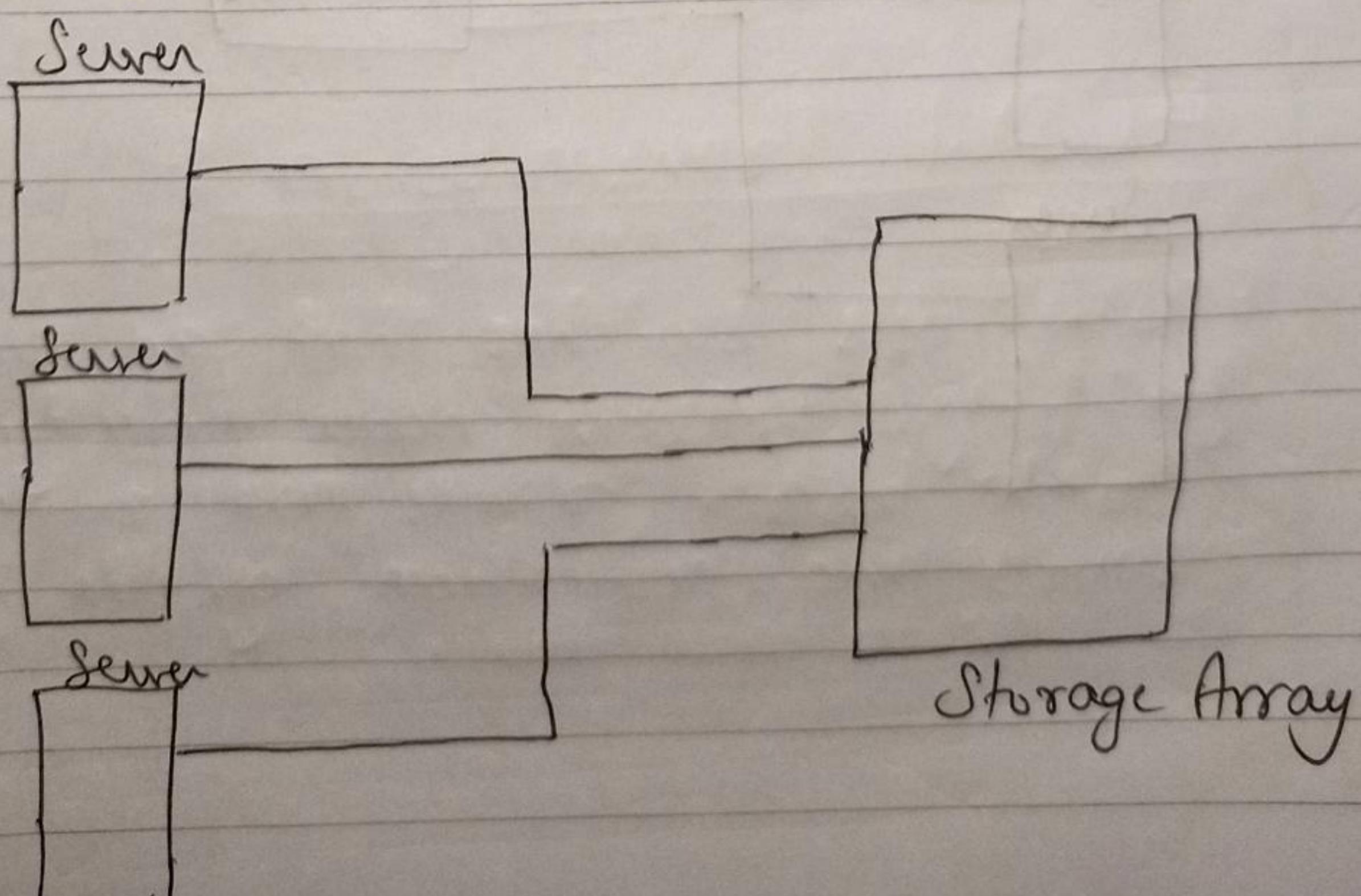
function :-

- i) Mapping of storage device, switches & servers.
- ii) Monitoring & generating alerts for discovered devices.

## FC Connectivity :-

- 1) Point - to - Point
- 2) Fiber channel Arbitrated Loop
- 3) Fiber channel Switched Fabric

1) Point - to - Point :- It is the simplest FC configuration in which two devices are directly connected to each other.



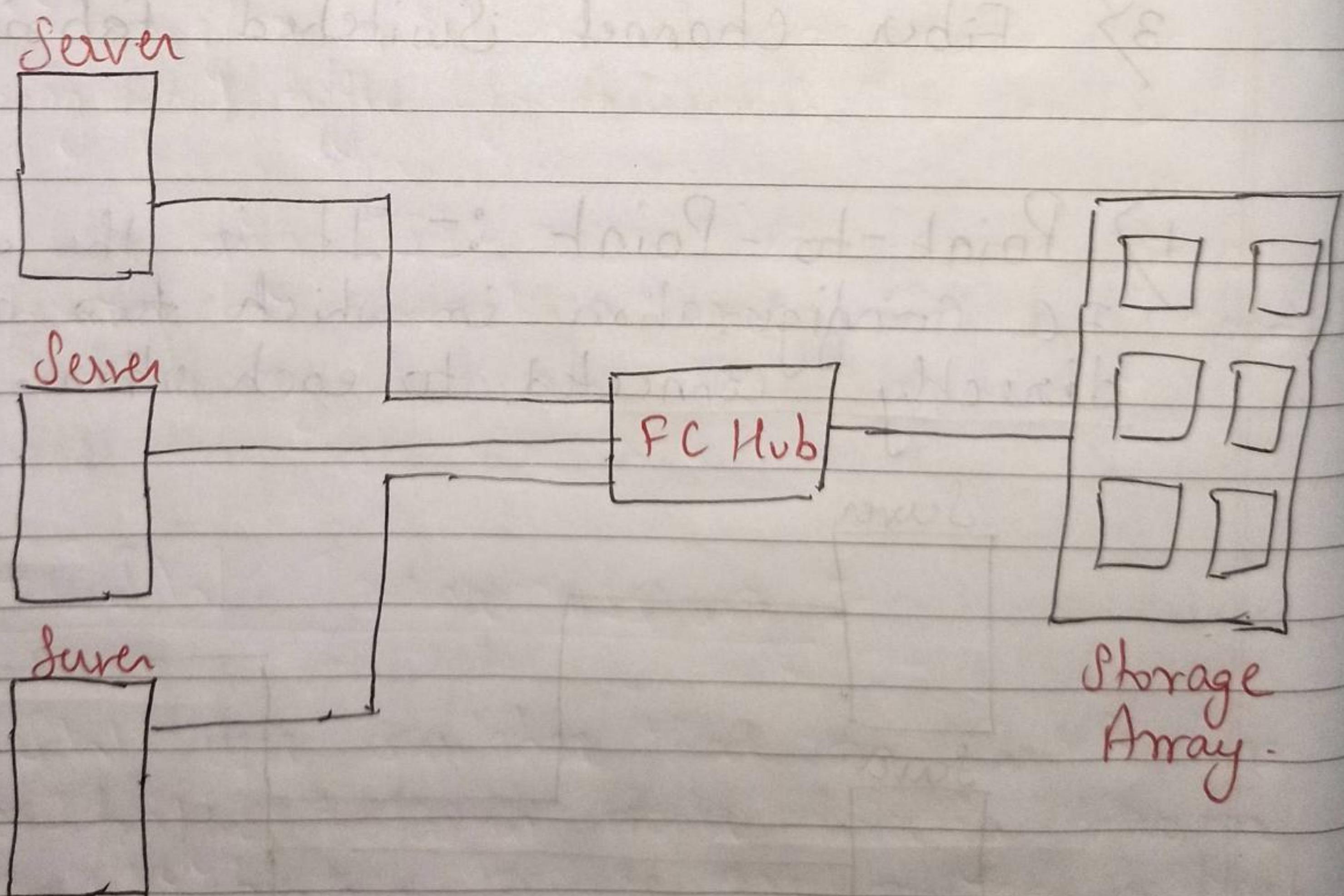
This connection provides dedicated connection for data transmission between nodes.

Limitations :-

- (i) Difficult to Scale
- (ii) Limited Connectivity.

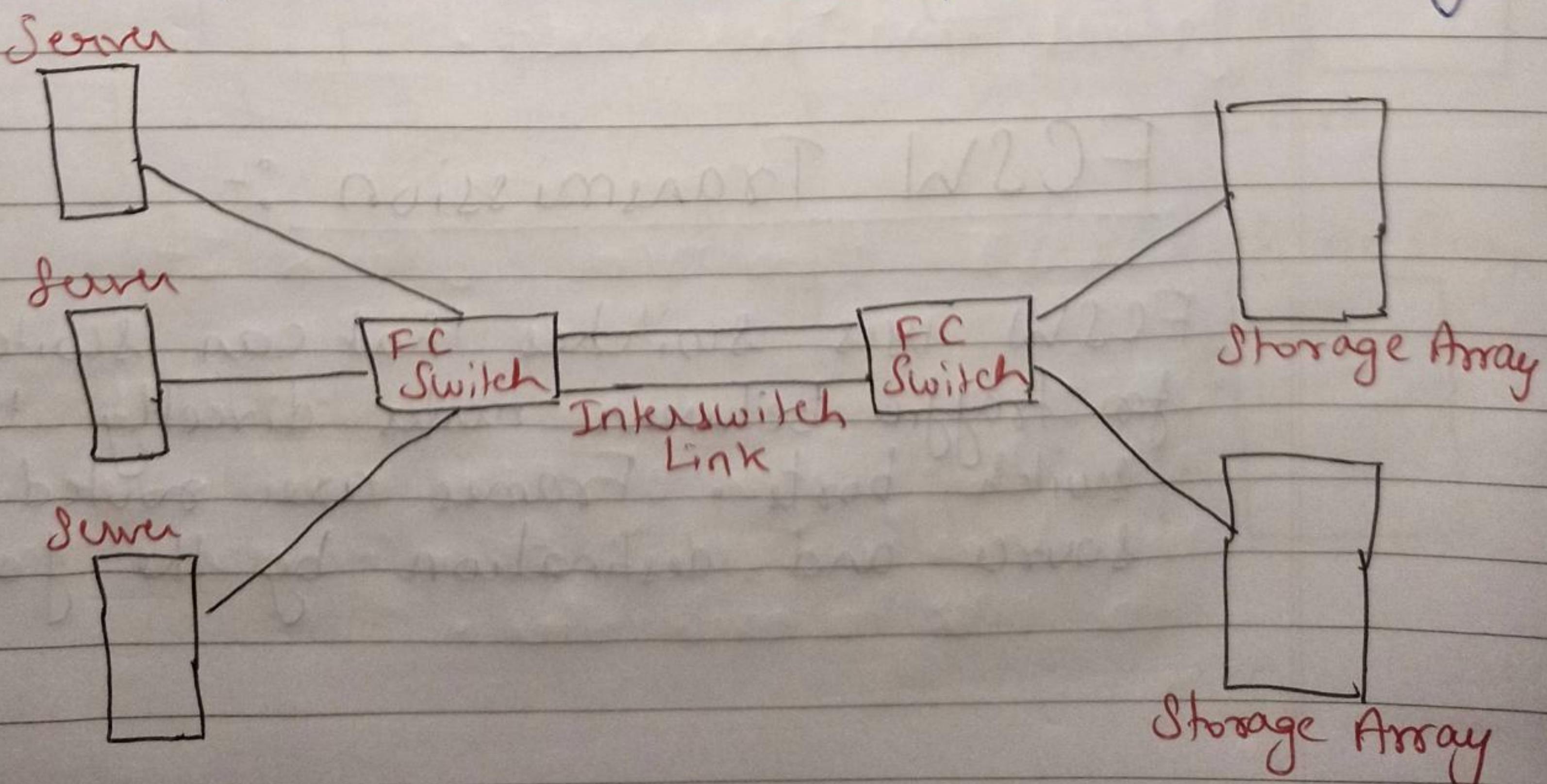
2) Fiber Channel Arbitrated Loop :-

In FC-AL configuration, devices are attached to a shared loop. It has the characteristics of a token ring topology and a physical star topology.



Drawback :-

- 1) It shares the loop and only one device can perform I/O operation at a time. Because each device in a loop must wait for its turn to process an I/O request, the overall performance in FC-AL environment is low.
- 2) FCAL uses only 8 bits of 24 bit Fiber channel addressing and enables 127 devices and since one address is reserved so 126 nodes can be connected to loop.
- 3) Adding and removing a device result in loop re-initialization, which can cause a momentary pause in loop traffic.
- 3) Fiber channel Switched Fabric :- Unlike loop configuration, Fiber channel switched Fabric (FCSW) network provides dedicated data path and scalability.



The addition or removal of a device in a switched fabric is minimally disruptive, it does not affect the ongoing traffic between other devices.

FCSW is also referred to as fabric connect. A fabric is a logical space in which all nodes communicate with one another in a network.

Each node in fabric has a unique 24 bit fabric address for communication.

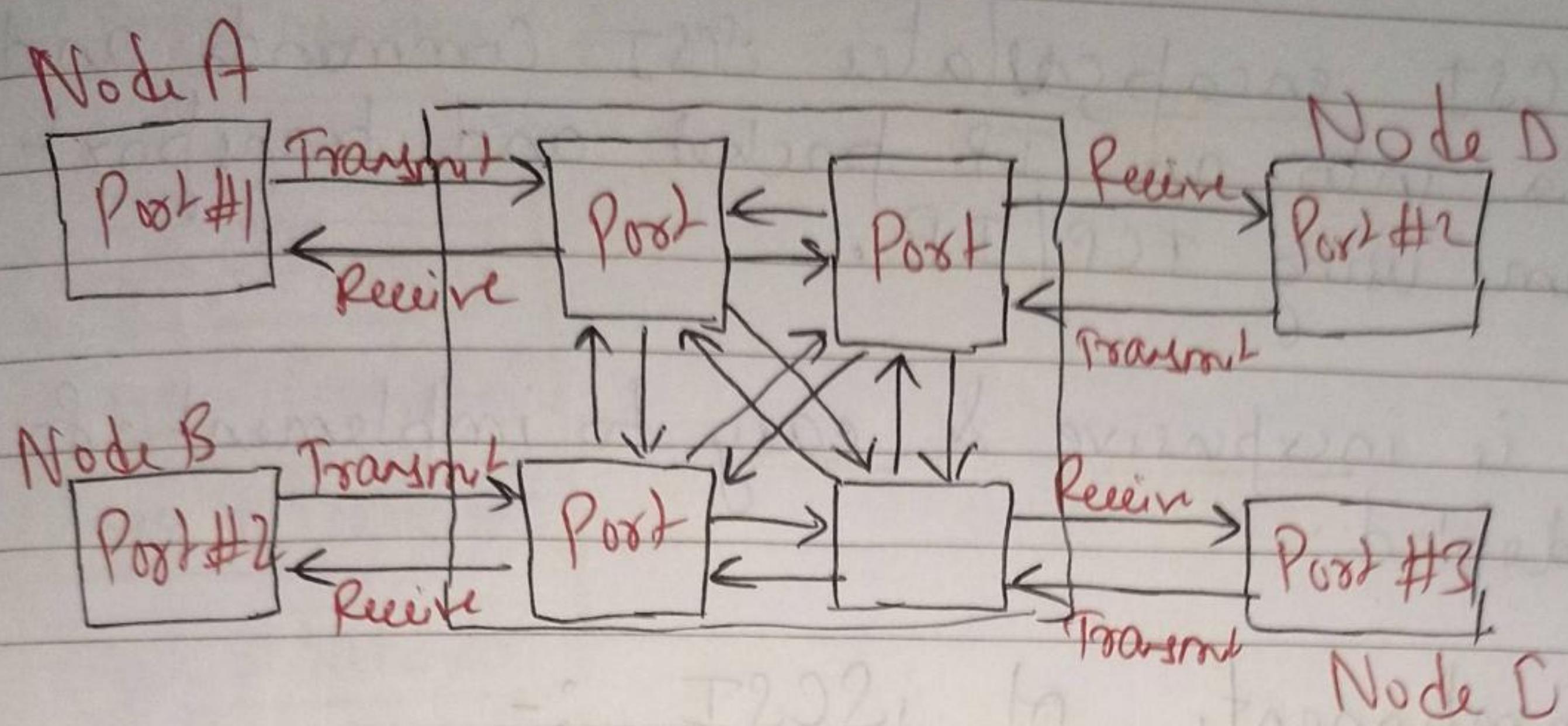
The link between two switches is known as Interswitch Link (ISL).

ISL enables switches to be connected together to form a single larger fabric. ISL is used to transfer host-to-storage data and fabric management traffic from one switch to another.

By using ISL, a switched fabric can be expanded to connect a large number of nodes.

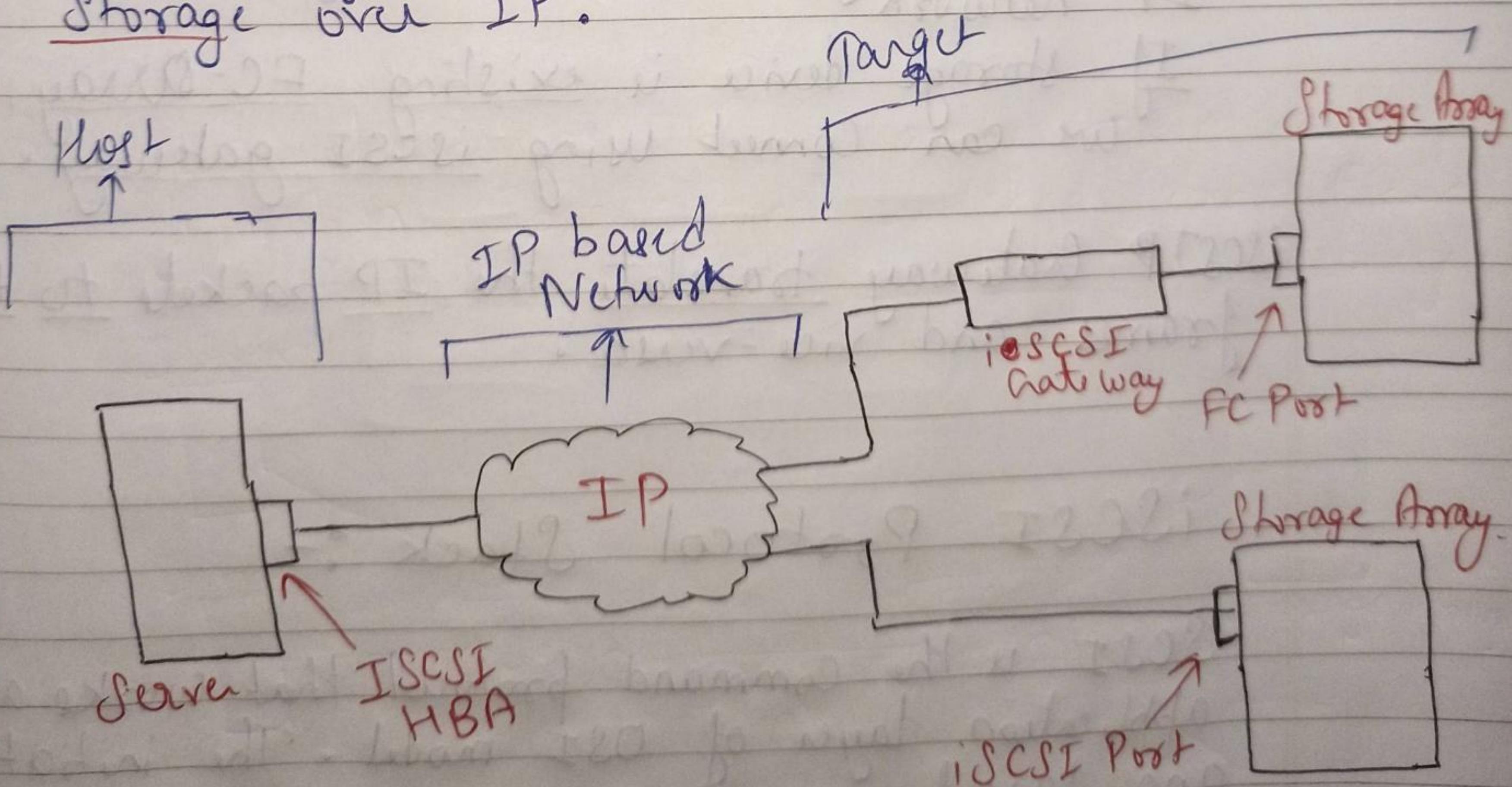
## FCSW Transmission :-

FCSW uses switches that can switch data for traffic between nodes directly through switch ports. Frames are routed between source and destination by the fabric.



## iSCSI (Internet SCSI) :-

iSCSI is an IP based protocol that establishes and manages the connection between host and storage over IP.



\* iSCSI encapsulates SCSI Commands and data into an IP packet and transport them using TCP/IP.

\* It is inexpensive & easy to implement - So widely adopted.

\* Components of iSCSI :-

(a) Initiator (host)

(b) Target

(c) IP based Network

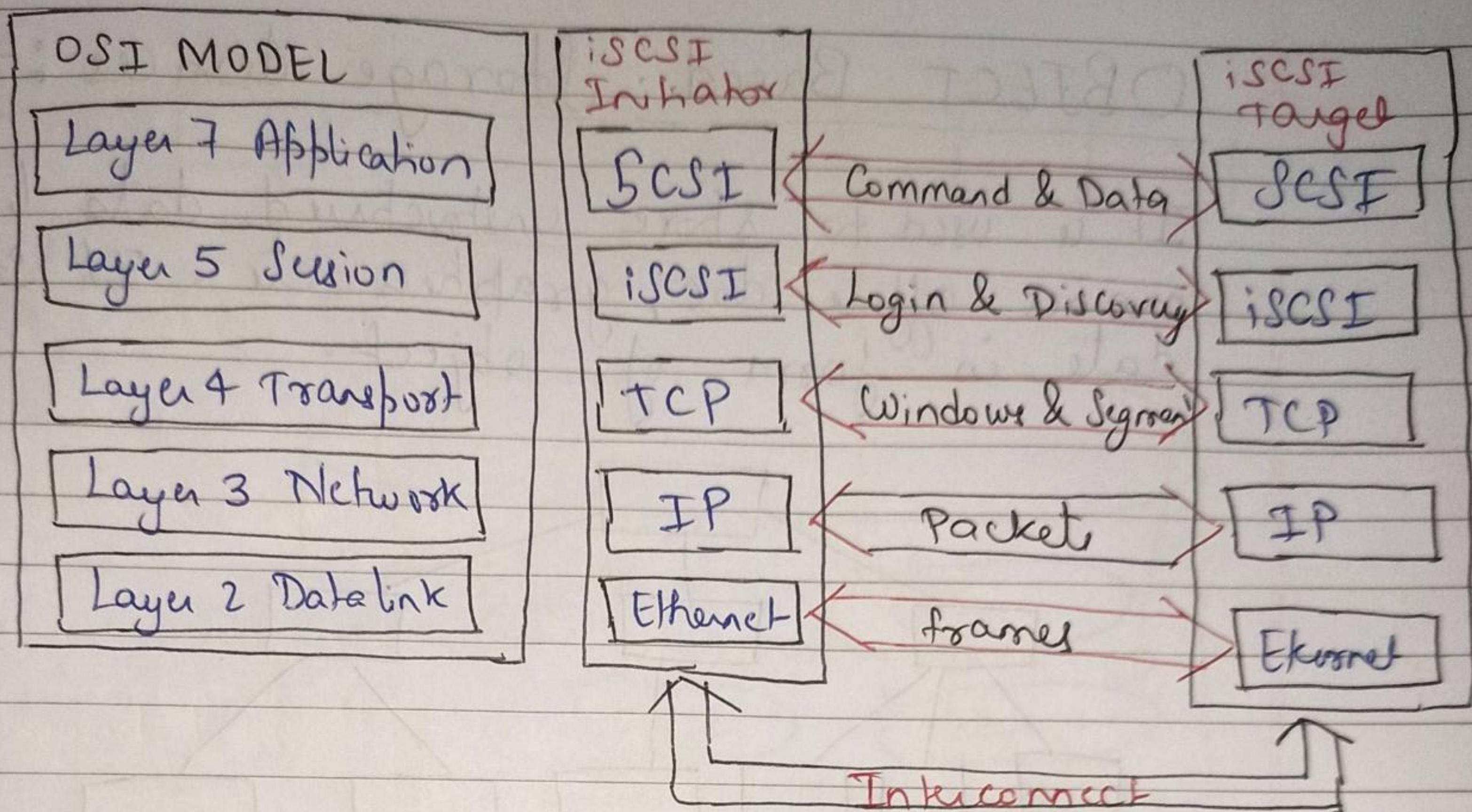
If storage device is iSCSI Capable then we can directly connect storage device to IP network.

If storage device is existing FC-Array, then we can connect using iSCSI gateway.

iSCSI Gateway translate the IP packets to FC frames and vice-versa.

iSCSI Protocol Stack :-

SCSI is the command protocol that works at application layer of OSI model. The initiator and target use SCSI commands and responses to talk to each other.



iSCSI is Session Layer protocol that initiates a reliable session between devices that recognise SCSI command & TCP/IP.

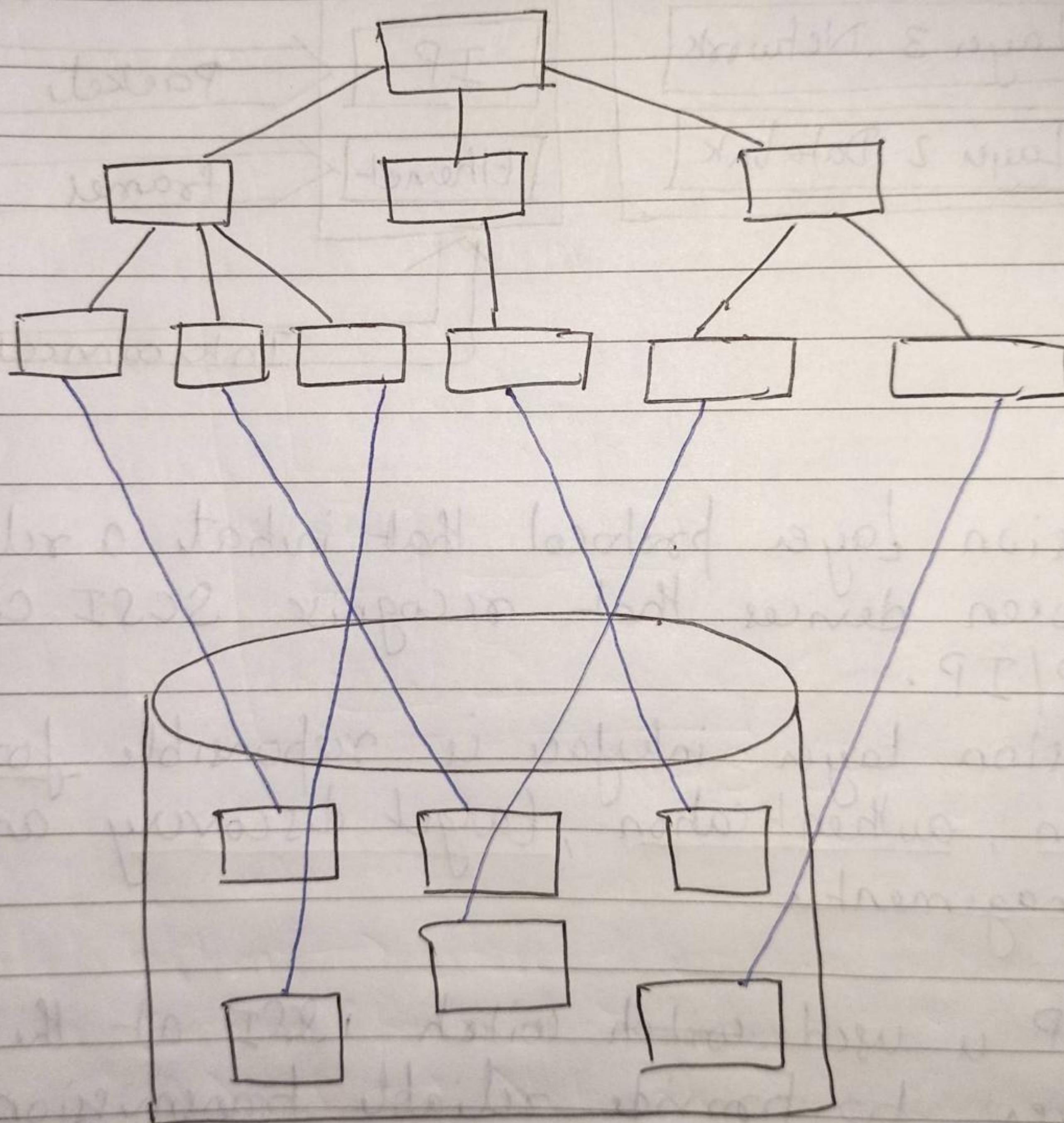
Session layer interface is responsible for handling login, authentication, target discovery and session management.

TCP is used switch with iSCSI at the transport layer to provide reliable transmission. TCP Control message flow, windows & retransmission. TCP relies on the network layer to provide the global addressing and connectivity.

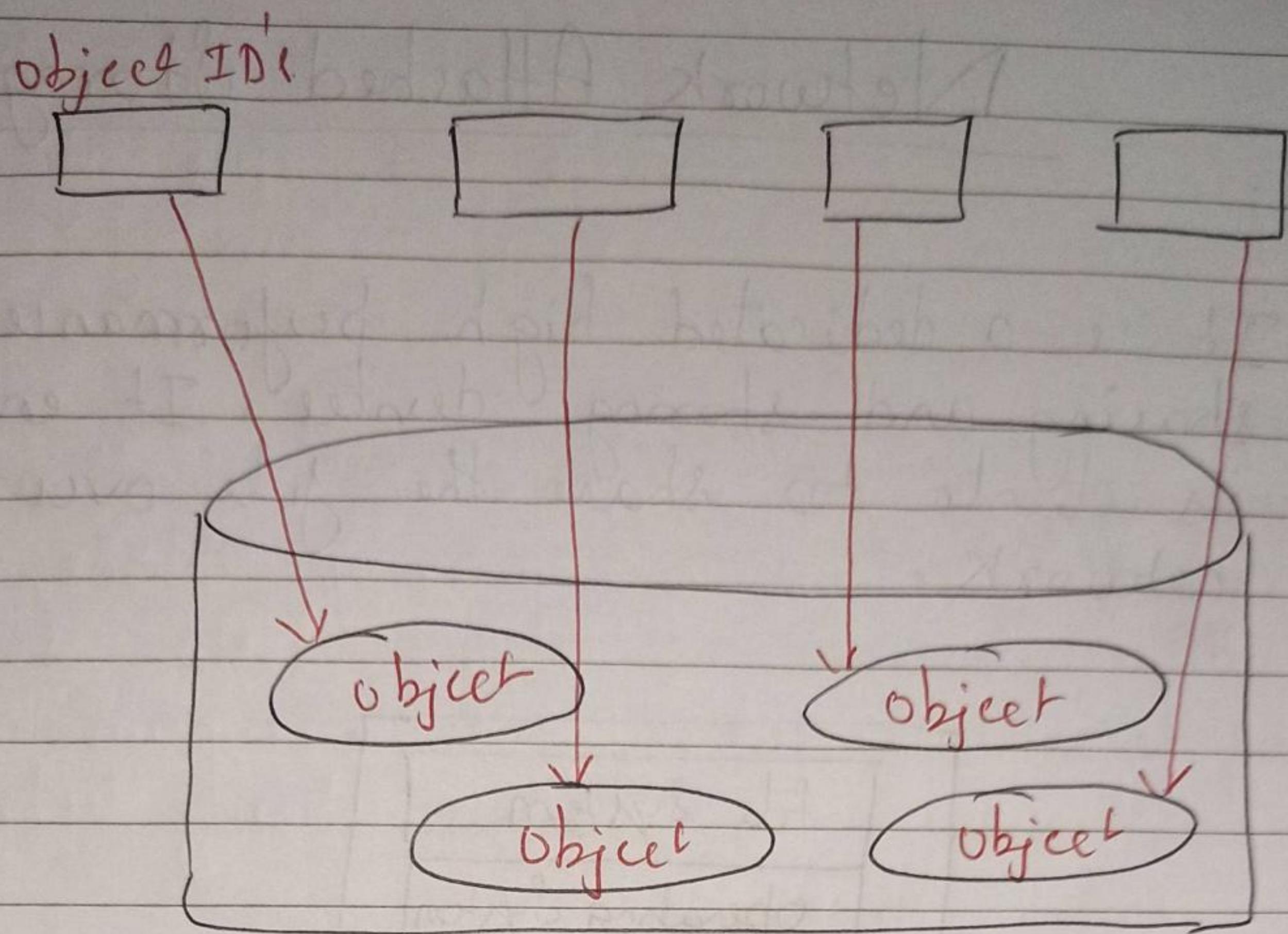
The layer 2 protocol at the data link layer of this model enable node-to-node communication through a physical network.

## OBJECT Based Storage devices :-

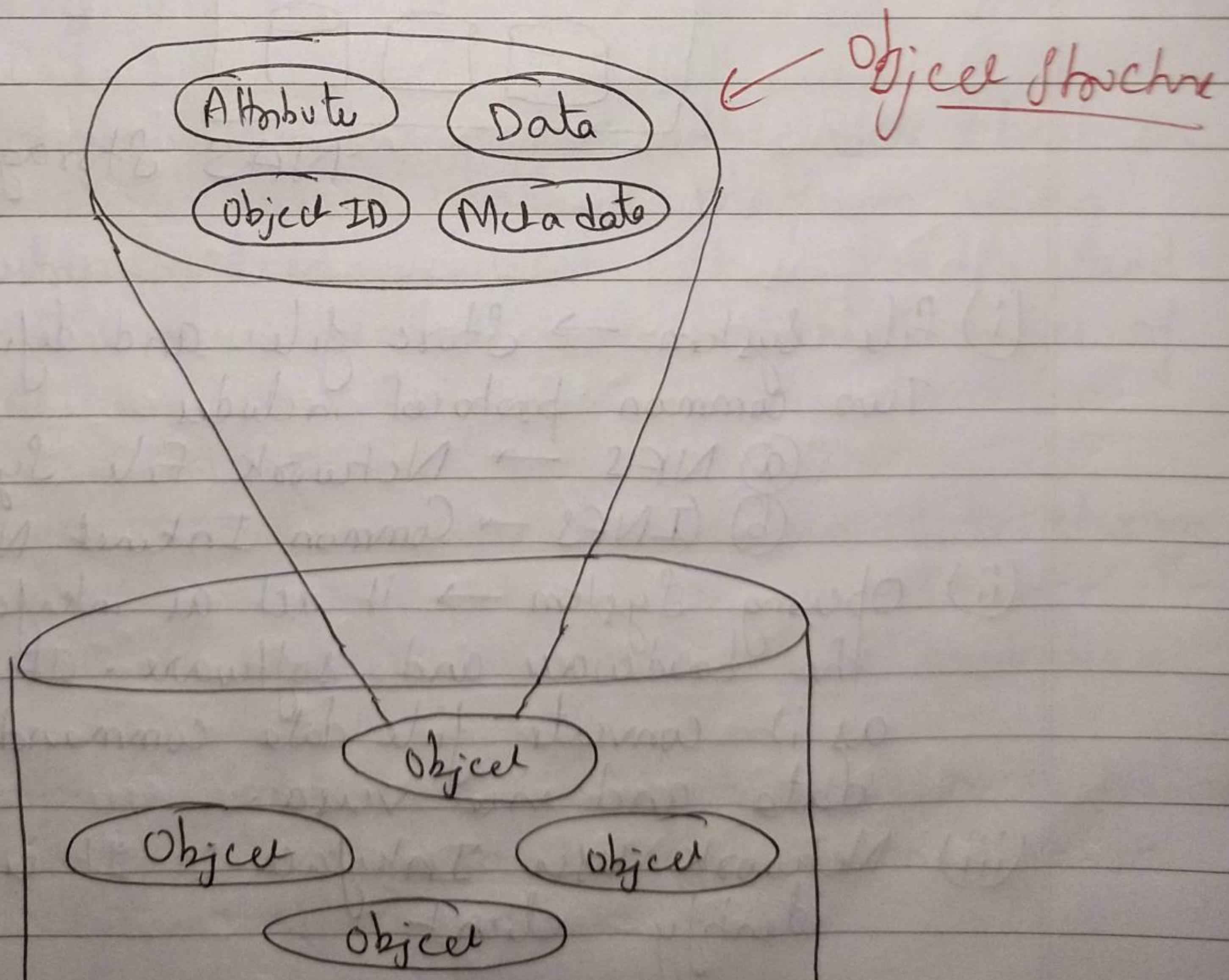
It is used to store unstructured data like movies & office doc, graphics etc. It stores data in form of object.



Hierarchical file system.



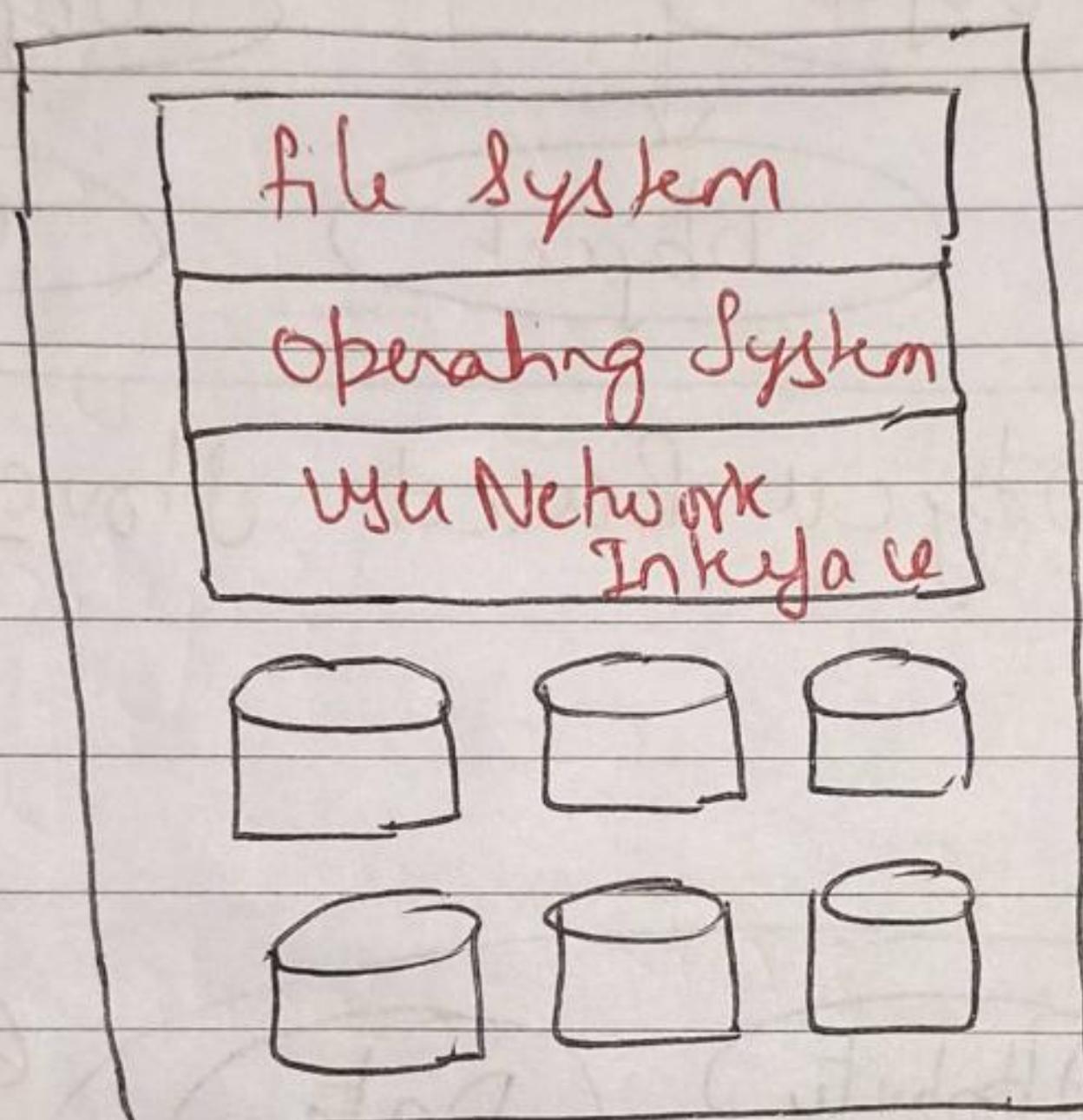
Object Based Storage



Object based storage

# Network Attached Storage (NAS):

It is a dedicated high performance file sharing and storing device. It enables its clients to share the file over an IP network.



NAS Storage device.

- (i) File System → Store file and defines protocol  
Two common protocol includes
  - (a) NFS → Network file System.
  - (b) CIFS → Common Internet Network file System
- (ii) Operating System → it act as interface between the hardware and software. It is specialized as it converts file data command to block data and vice versa.
- (iii) Network Wu Interface :- It is used to identify client

# Benefits of NAS :-

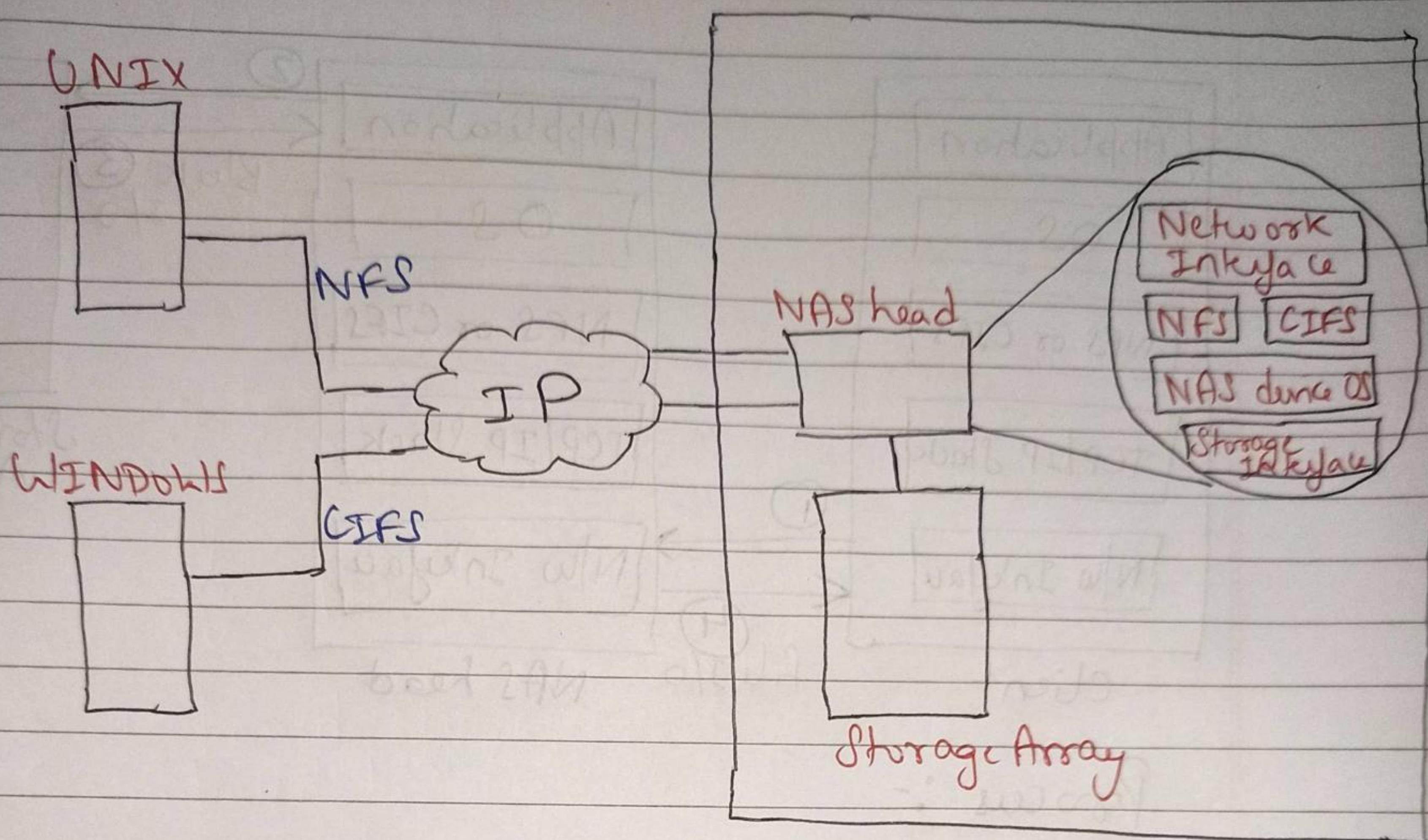
- 1) Comprehensive access to Information :-  
Enables efficient file sharing and support one-to-many and many-to-one configuration. The many-to-one enables NAS device to serve many clients simultaneously. The one-to-many enables one client to connect with many NAS devices.
- 2) Improved efficiency :- NAS delivers better performance compared to a general purpose file system because it uses an OS specified for file sharing.
- 3) Improved Flexibility :- Compatible with clients on both Linux and Windows platform using industry standard protocol. It is flexible and can serve requests from different types of clients.
- 4) Centralized Storage :- Centralized data storage to minimize data duplication on client workstation and ensure greater data protection.
- 5) Simplified Management :- It provides a centralized console that makes it possible to manage file system efficiently.

- 6) Scalability :- Scales well with different utilization profiles and types of business application because of high performance and low latency design
- 7) High availability :- Offers efficient replication and recovery options, enabling high data availability. NAS uses redundant components that provide maximum connectivity options. It supports clustering technology for failover.
- 8) Security :- Ensures security, authentication and file locking
- 9) Low Costing :- NAS is commonly available and has inexpensive Ethernet component.
- 10) Ease of deployment :- Configuration at client is minimal, because the client has required NAS connection & software built-in.

## Components of NAS :-

A NAS device has two key components :-

- (a) NAS head
- (b) Storage

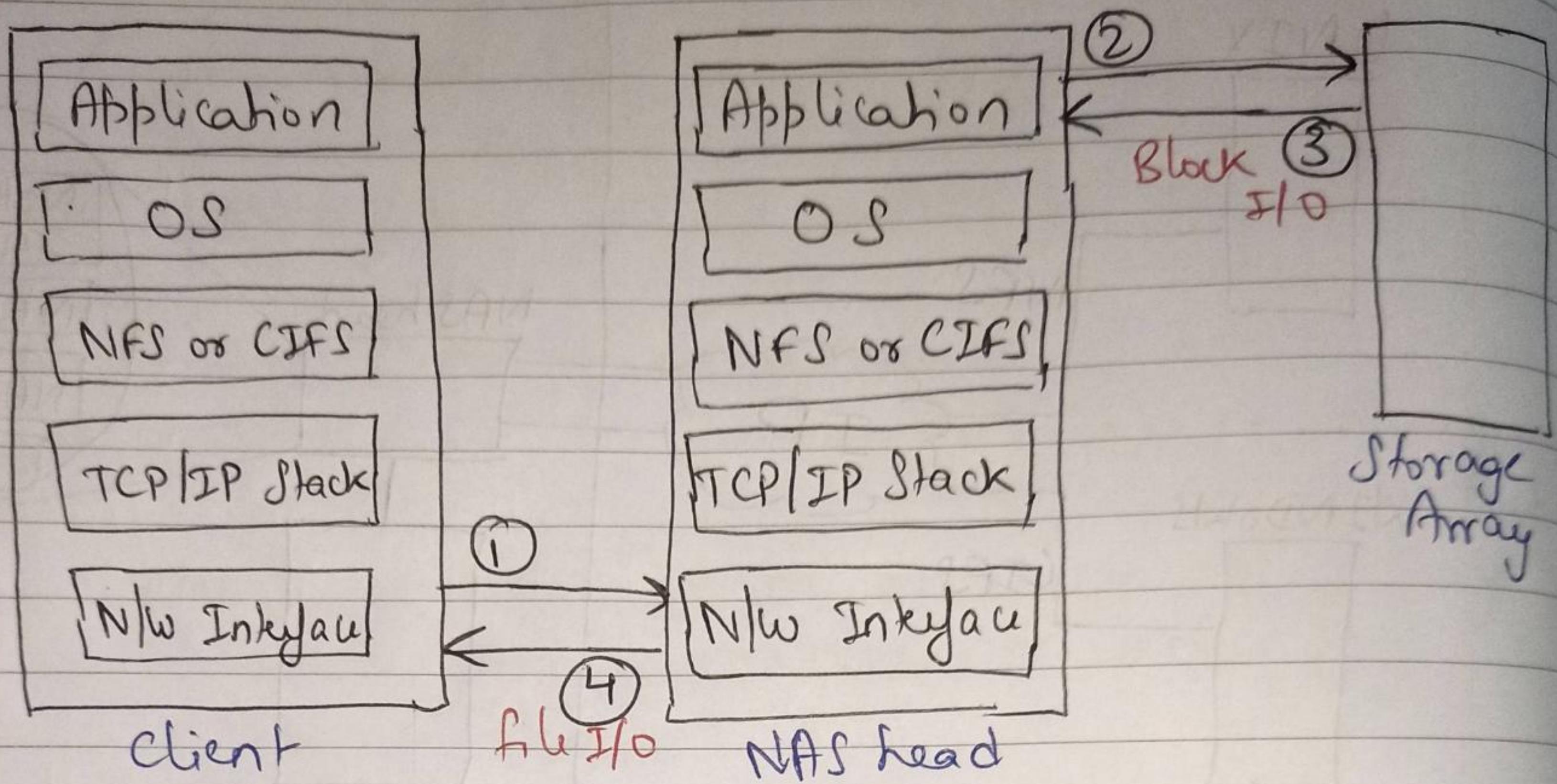


NAS head :- NAS head includes following :-

- \* CPU and memory
- \* Network Interface which provide Connectivity to Client Network and also identify client
- \* NFS, CIFS are protocol for file sharing
- \* NAS dene OS is used to convert file-level request to block-level request and vice-versa.
- \* Storage Interface to connect and manage physical disk resource.

## NAS Input / Output Operation :-

NAS provide file level data access to its client. File I/O is a high-level request that specifies the file to be accessed.



### Process :-

- 1) Client packages an I/O request and forward it to network stack through TCP/IP. The NAS device receives the request from the network.
- 2) The NAS device converts the I/O request into appropriate storage request i.e. block level I/O then performs operation on physical storage.
- 3) When NAS receives data from storage it processes repackaging the data into appropriate file share protocol response.
- 4) NAS device packages this response into TCP/IP and forward it to Client through Network.