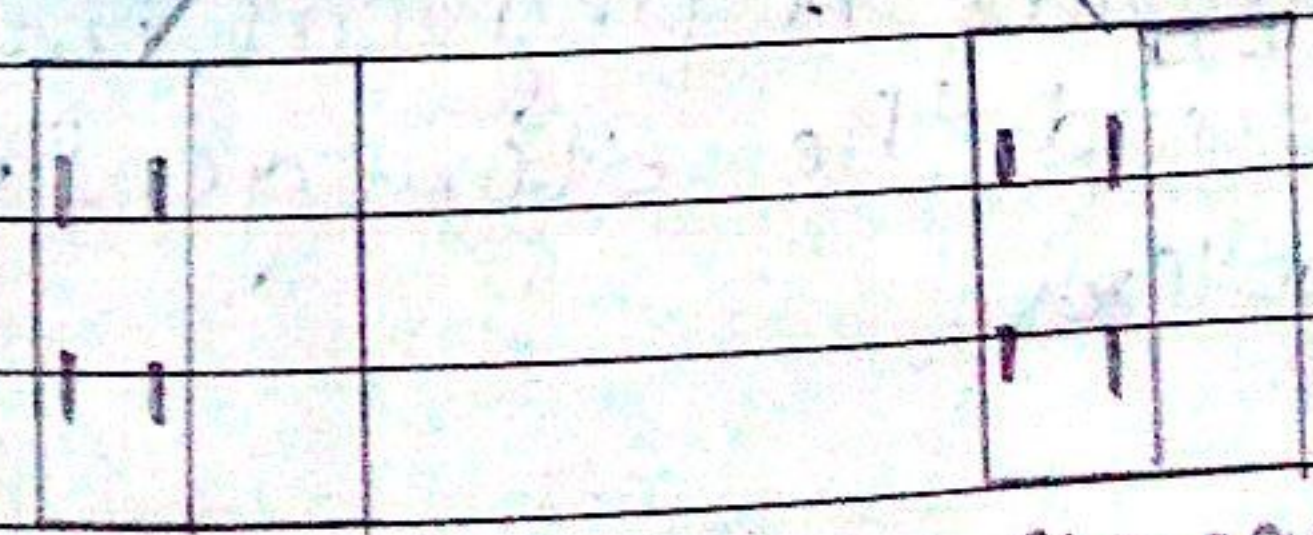
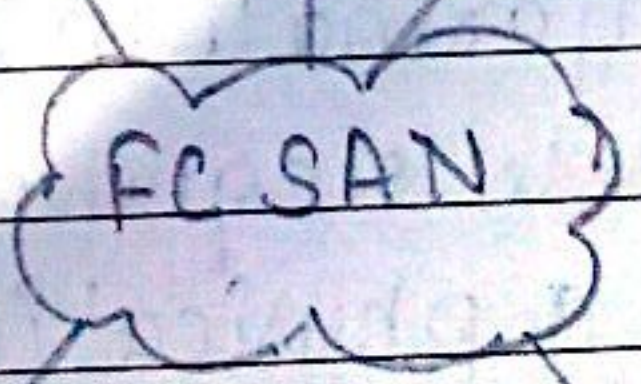
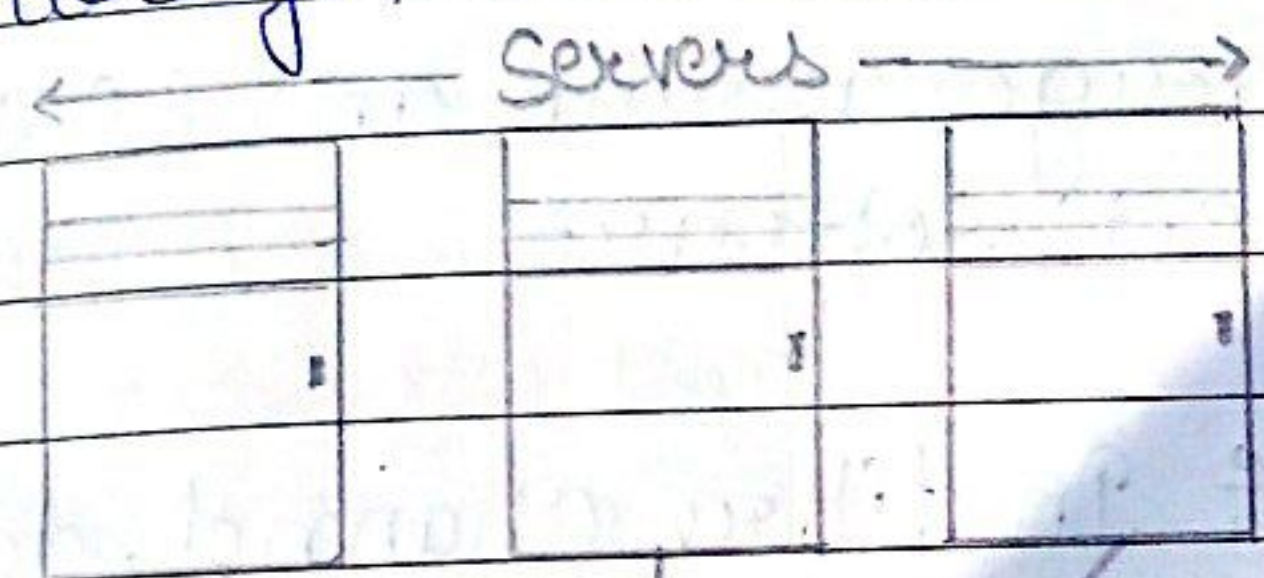


# ASSIGNMENT-2

Ques) Define Storage Area Network?

Ans) A Storage Area Network (SAN) carries data between servers (also known as hosts) and storage devices through fibre channel switches. A SAN enables storage consolidation and allows storage to be shared across multiple servers. It enables organisations to connect geographically dispersed servers and storage.



Storage Array

Storage Array

A SAN provides the physical communication infrastructure and enables secure and robust



Communication between host and storage devices

(Que 2) Component of Storage Area Network

Ans 2) ASAN consists of three basic components

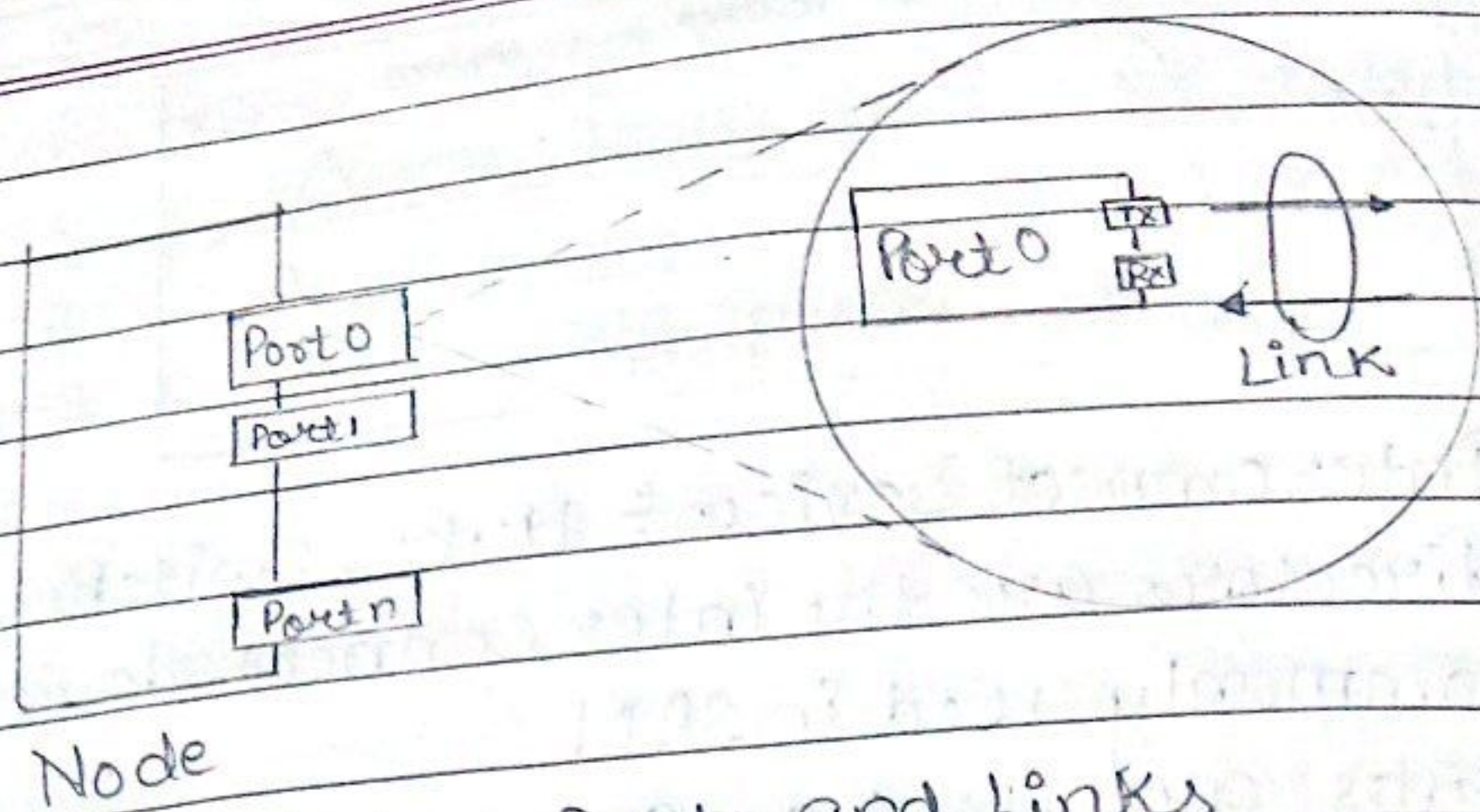
- 1) Servers
- 2) Network infrastructure
- 3) Storage

These components can be further broken down into the following key elements:  
node ports, cabling, interconnecting devices, storage arrays and SAN management software.

1) Node Ports: In fibre channel, devices such as hosts, storage are all referred to as nodes. Each node is a source or destination of information for one or more nodes. Each node requires one or more ports to provide a physical interface for communicating with other nodes. These ports to provide a physical interface are an HBA and the storage front-end adapters.

2)





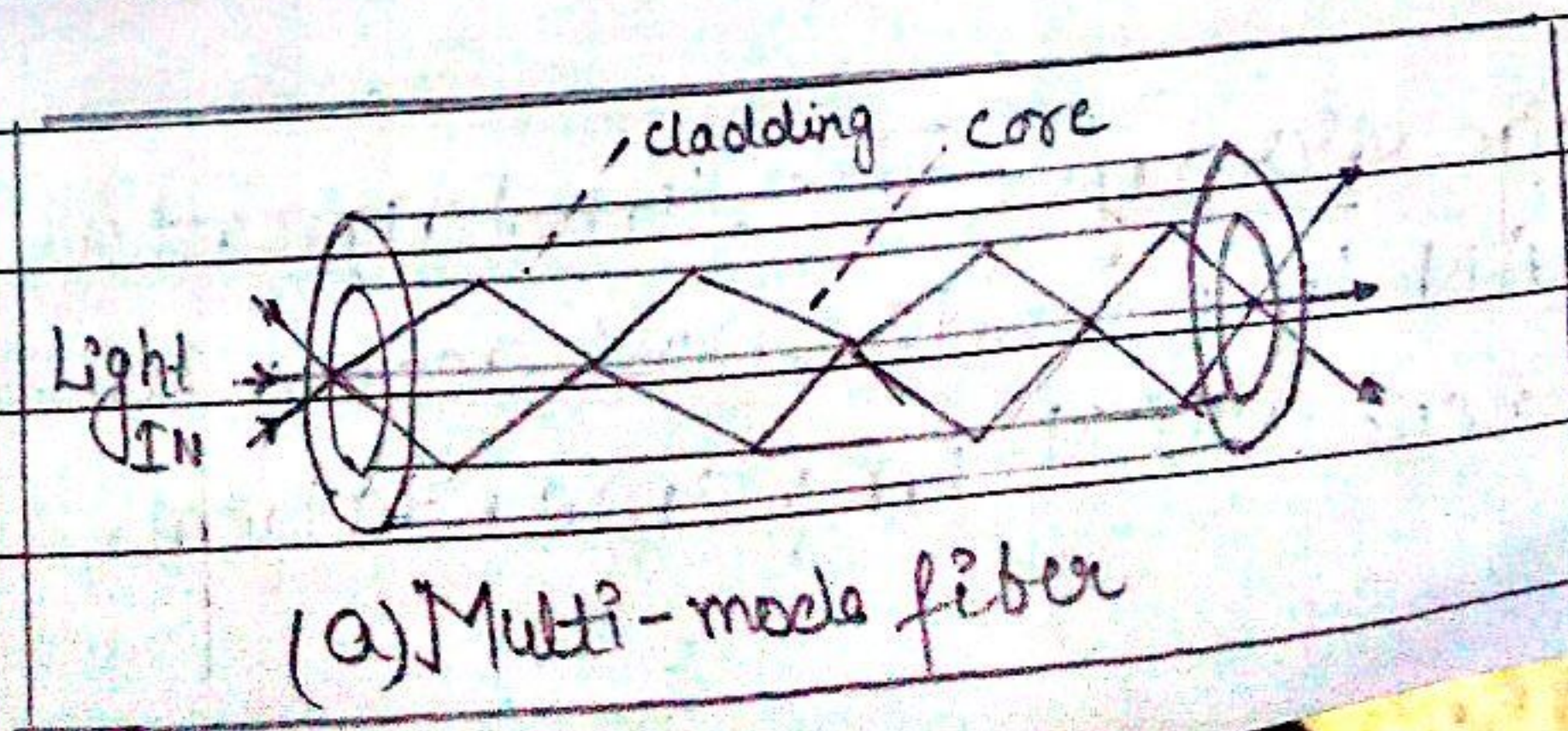
Nodes, Ports and Links

2) Cabling: SAN implementations use optical fiber cabling. Copper can be used for shorter distances for back-end connectivity, as it provides a better signal to noise ratio for distance up to 30 meters. Optical fiber cables carry data in the form of light.

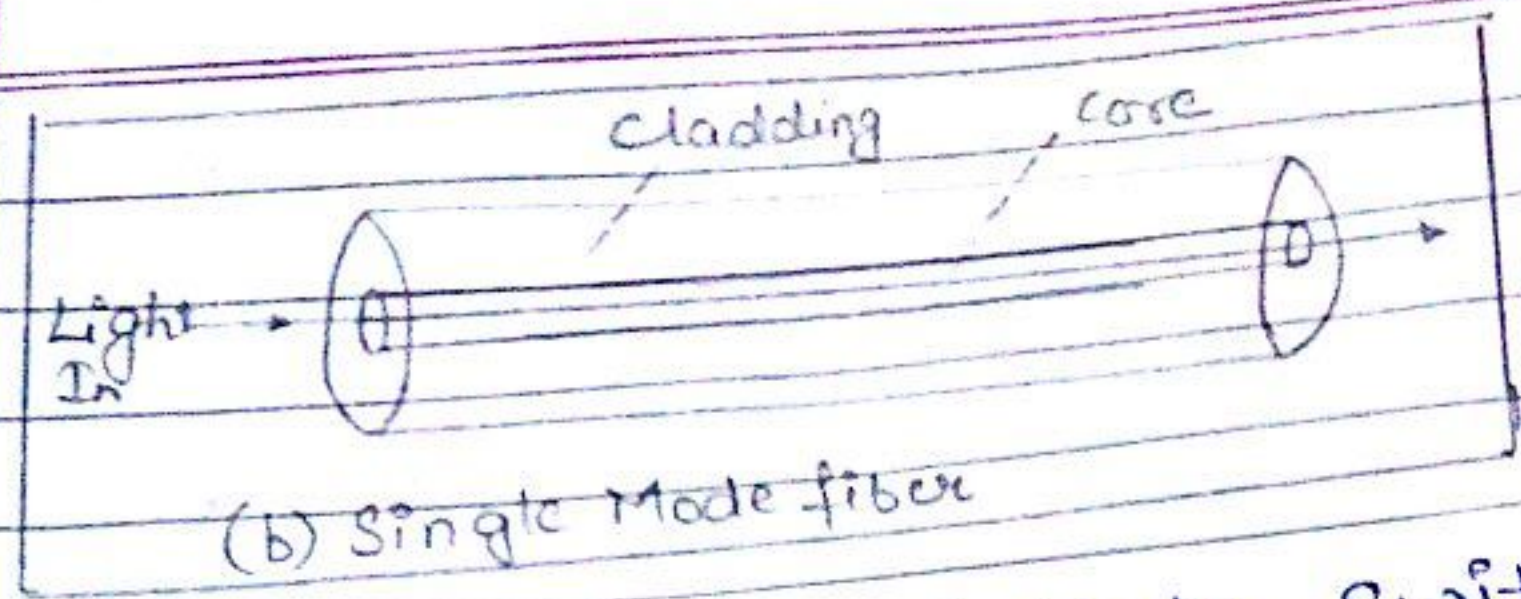
There are two types of optical cables, multi-mode and single-mode.

Multi-mode fiber cable carries multiple beams of light projected at different angles simultaneously onto the core of the cable.

Single-mode fiber cable carries a single ray of light projected at the center of the core.







3) Interconnect Devices: Hubs, switches and directors are the interconnect devices commonly used in SAN. Hubs are used as communication devices in FC-AL implementations. Hubs physically connect nodes in a logical loop or a physical star topology. All the nodes must share the bandwidth because data travels through all the connections points. Switches are more intelligent than hubs and directly route data from one physical port to another. They do not share the bandwidth.

Directors are larger than switches and are deployed for data center implementations. The function of directors is similar to that of FC switches, but directors have higher port count and fault tolerance capabilities.

4) Storage Arrays: The fundamental purpose of a SAN to provide host access to storage resources. SAN implementations

5)

Que  
Ans

1)  
2)  
3)  
4)  
5)  
6)

Qu  
Ans



complement the standard features of storage arrays by providing high availability and redundancy, improved performance and multiple host connectivity.

- 5) SAN management software: SAN management software manages the interface between hosts, interconnect devices and storage arrays. It provides key management functions including mapping of storage devices, switches and servers, monitoring and logical partitioning of SAN called zoning.

Que3) List the various fiber channel ports?

Ans3) The various fiber channel ports are as following:

- 1) N-Port (Node Port)
- 2) NL-Port (Node Loop Port)
- 3) E-Port (Expansion Port)
- 4) F-Port (Fabric Port)
- 5) FL-Port (Fabric Loop Port)
- 6) G-Port (Generic Port)

Que4) Explain fiber channel Architecture?

Ans4) The FC architecture represents true channel with standard interconnecting devices. Connections in a SAN are accomplished using FC transmissions from host to storage.



devices are carried out over Channel Connection such as parallel bus Channel technologies provide high level performance. Fibre Channel Protocol (FCP) is the implementation of serial SCSI-3 over an FC network.

- The key advantages of FCP are as follows:
- Sustained transmission bandwidth over long distances
  - Exhibits the characteristics of Channel transport and provides speed up to 85 Gbps.

1) Fibre Channel Protocol Stack: FCP defines the communication protocol in five layers FC-0 through FC-4.

	Application			
FC-4	SCSI	HIPPI	ESCON	ATM IP
FC-2	Framing / Flow Control			
FC-1	Encode / Decode			
FC-0	1 Gbps	2 Gbps	4 Gbps	8 Gbps

### Fibre Channel Protocol Stack

FC-4 Upper Layer Protocol: FC-4 is the upper most layer in the FCP stack. This layer defines the application interfaces and the key upper layer protocols are mapped to the



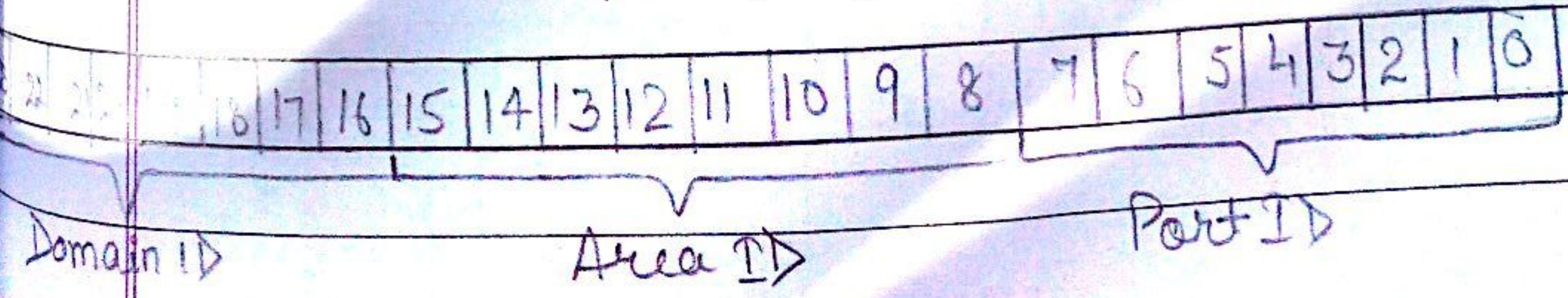
lower FC layers. Some protocols include SCSI, HIPPI, ESCON, ATM and IP

**FC-2 Transport layer:** The FC-2 is the transport layer that contains the payload, address of the source and destination ports and link control information.

**FC-1 Transmission Protocol:** This layer defines the transmission protocol that includes serial encoding and decoding rules, special characters used and error control.

**FC-0 Physical Interface:** FC-0 is the lowest layer in the FC stack. This layer defines the physical interface, media and transmission of raw bits. The FC transmission can use both electrical and optical media.

2) **Fibre Channel Addressing:** The first field of the FC address of an N-port contains the domain ID of the switch. This is an 8 bit field. Out of the possible 256 domain ID's, 239 are available for use, the remaining 17 addresses are reserved for specific services.

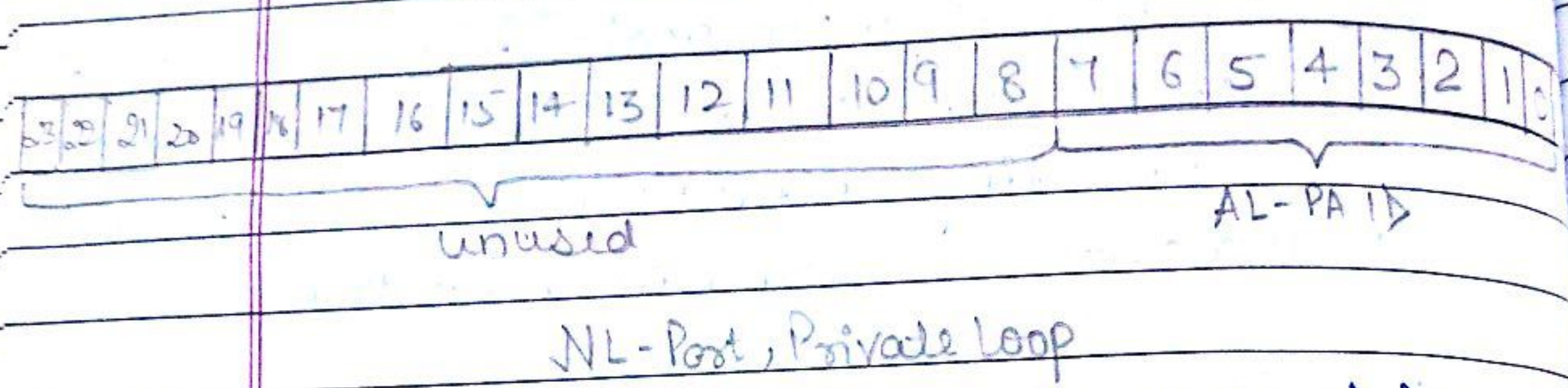
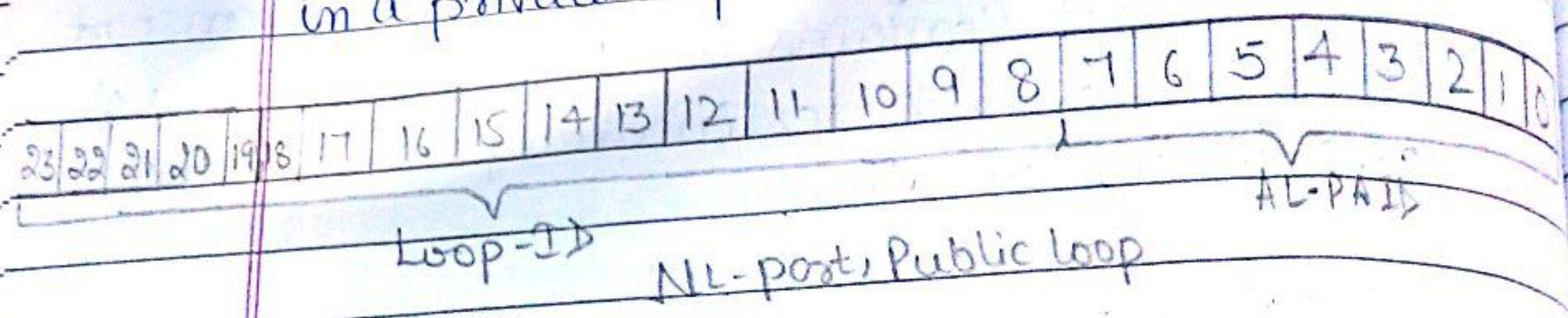


24-bit FC address of N-port





FC Address of an NL-port: The FC addressing scheme for an NL-port differs from other ports. The two upper bytes in FC addresses of NL-port in a private loop are assigned zero value.



3) FC Frame: An FC frame consists of five parts: start of frame (SOF), frame header, data field, cyclic redundancy check (CRC), and end of frame (EOF). The SOF and EOF act as delimiters. The frame header is 24 bytes long and contains addressing information for the frame. The CRC checksum facilitates error detection for the content of the frame.

SOF 4 bytes	Frame Header 24 bytes	Data field 0-2112 bytes	CRC 4 bytes	EOF 4 bytes
----------------	--------------------------	----------------------------	----------------	----------------

R-CTL	Destination ID	
CS-CTL	Source ID	
Type	CTL	
SEQ	DF-CTL	Sequence Count
	OX-ID	Rx-ID
Offset		

FC-FRAME



- 4) Structure and organization of FC Data:
  - 1) Exchange operation: An exchange operation enables two N-ports to identify and manage a set of information units. This unit maps to a sequence. Sequence can be both unidirectional and bidirectional depending upon the type of data sequence exchange between the initiator and the target
  - 2) Sequence: A sequence refers to a contiguous set of frames that are sent from one port to another.
  - 3) Frame: A frame is the fundamental unit of data transfer at Layer 2
- 5) Flow Control: FC technology uses two flow-control mechanisms: buffer-to-buffer credit (BB-credit) and end-to-end credit (EE-credit)
  - BB-Credit: FC uses the BB-credit mechanism for hardware-based flow control. BB-credit controls the maximum number of frames that can be present over the link at any given point in time. The BB-credit mechanism provides frame acknowledgment through the Receiver Ready (R-RDY) primitive
  - EE-Credit: The function to end-to-end credit, known as EE-credit, is similar to that BB-Credit. The EE-credit mechanism affects the flow control flow in class 1 & class 2 traffic only



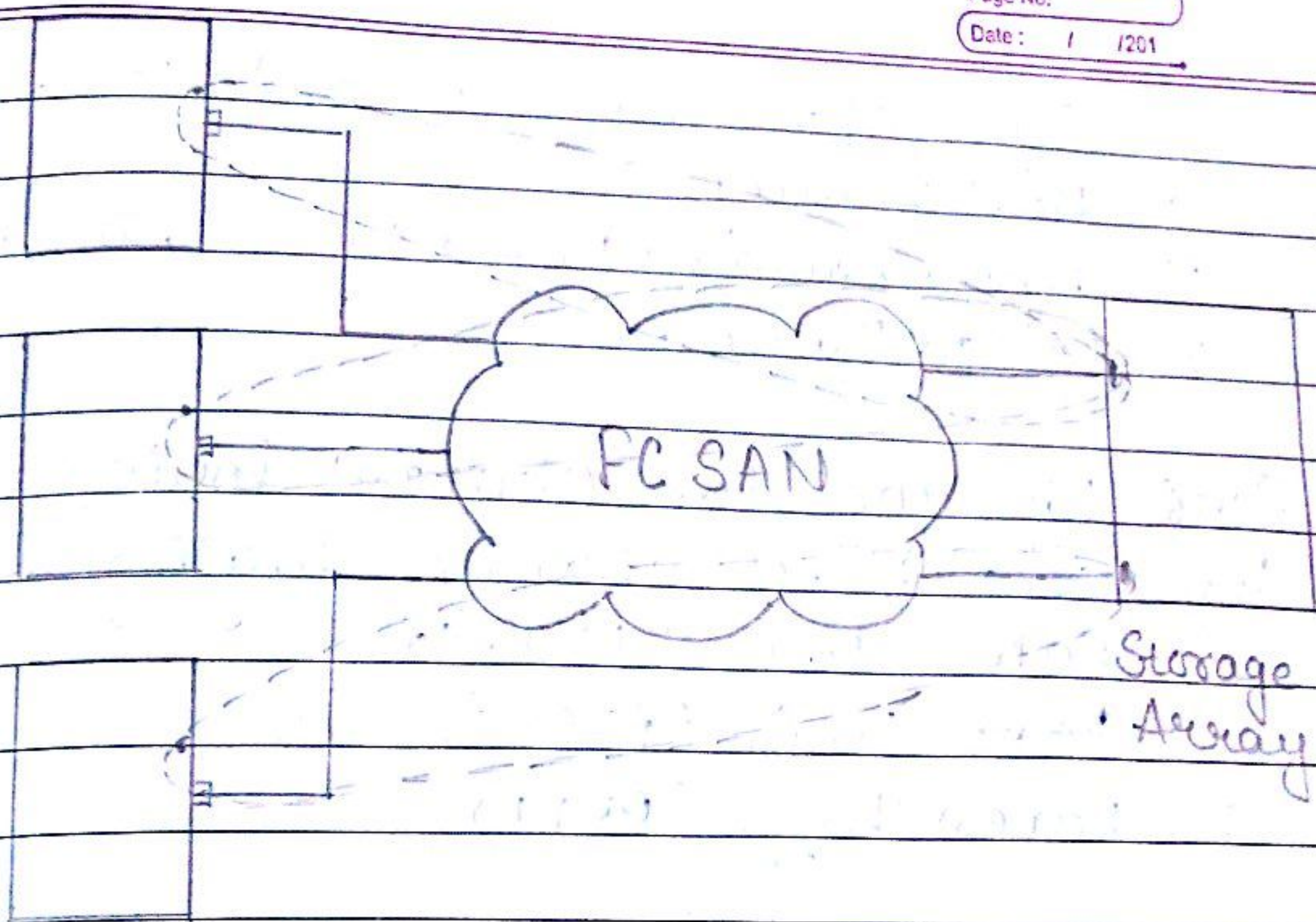
6) Classes of service:

	Class 1	Class 2	Class 3
Communication type	Dedicated Connection	Non-dedicated Connection	Non-dedicated Connection
Flow Control	End-to-End Credit	End-to-End BtoB Credit	BtoB Credit
Frame delivery	In order	Order not guaranteed	Order not guaranteed
Frame acknowledgement	Acknowledged	Acknowledged	Not-Acknowledged
Multiplexing	No	Yes	Yes
Bandwidth utilization	Poor	Moderate	High

Que 5) What is Zoning and what are its different type?

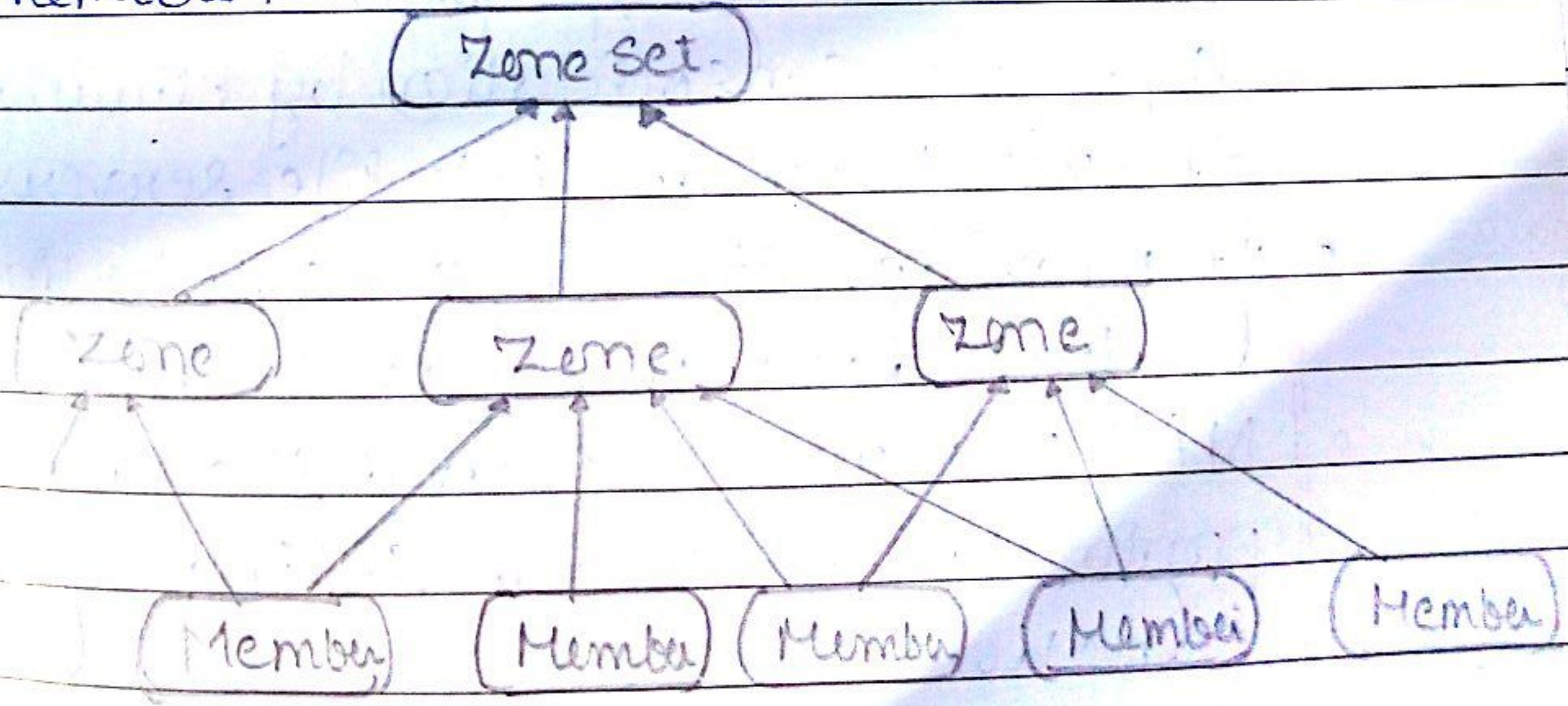
Ans 5) Zoning is an FC Switch function that enables nodes within the fabric to be logically segmented into groups that can communicate with each other. When a device logs onto a fabric, it is registered with name server. When a port logs onto a fabric, it goes through a device discovery process with other devices registered in the name server.





### Zoning

Multiple Zone Set may be defined in a fabric but only one Zone Set can be active a time. A Zone set is set of Zone and Zone is a set of members.



Members, Zones and Zone Sets



- Type of zoning are as following:
- 1) Port zoning
  - 2) WWN zoning (World wide Name)
  - 3) Mixed zoning.

Que 6) List the fibre channel logging types?

- Ans 6) The fibre channel logging types are:
- 1) Fabric login (FLOGI)
  - 2) Port login (PLOGI)
  - 3) Process login (PRLI)

Que 7) Define Network Attached Storage?

Ans 7) Network Attached Storage (NAS) is an IP-based file sharing device attached to a local area network. Network Attached storage provides the advantage of server consolidation by eliminating the need for multiple file servers.

- It provides storage consolidation through file-level data access and sharing.
- NAS uses network and file sharing protocols to perform filing and storage functions.

Que 8) List the benefits of NAS?

Ans 8) The benefits of NAS are as followings:

- 1) Supports Comprehensive access to information



- 2) Improved efficiency
- 3) Improved flexibility
- 4) Centralized storage
- 5) Simplified management
- 6) Scalability
- 7) High availability
- 8) Security

Ques) Explain NAS file Input output?

Ans) NAS uses file-level access for all of its I/O operations. File I/O is a high-level request that specifies the file to be accessed but does not specify its logical block address.

1) File System and Remote File Sharing: A file system is a structured way of storing and organizing data files. Many file systems maintain a file access table to simplify the process of finding and accessing files.

2) Accessing a File System: A file system must be mounted before it can be used. The operating system mounts a local file system during the boot process. The mount process creates a link between the file system and operating system. When mounting a file system, the operating system organizes



Page No. \_\_\_\_\_  
Date: / / 201

files and directories in a tree like structure

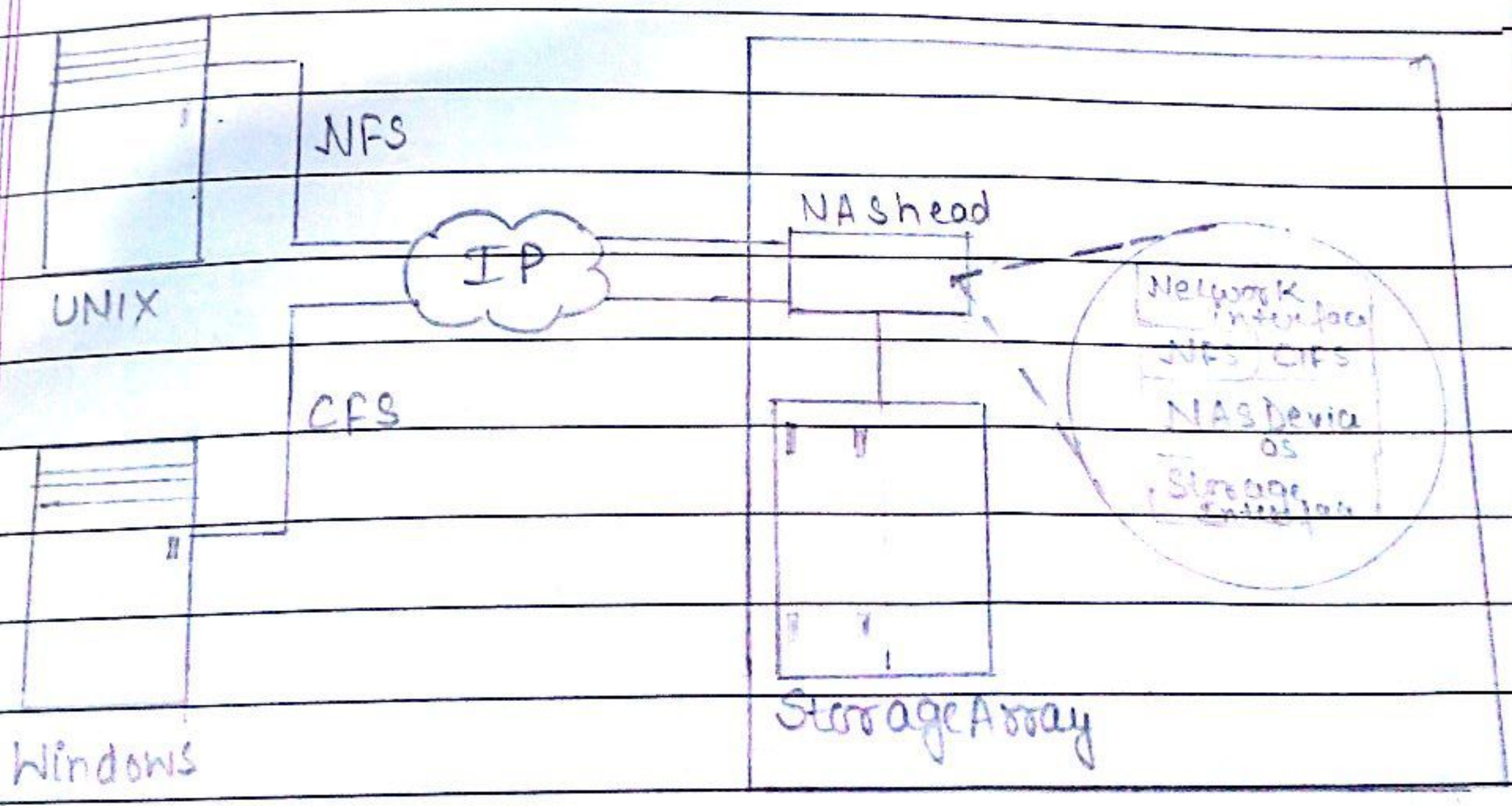
5) File Sharing: File sharing refers to storing and accessing data over a network. In file sharing environment, a user who creates the file determines the type of access to be given to other users and controls changes to the file. When multiple users try to access a shared file at the same time, a protection scheme is required to maintain data integrity and at the same time, make this sharing possible. FTP is a client/server protocol that enable data transfer over a network. An FTP server and an FTP client communicate with each other using TCP as the transport protocol. A distributed file system (DFS) is a file system that is distributed across several hosts. A DFS can provide hosts with direct access to the entire file system, while ensuring efficient management and data security.

Ques) List the Component of NAS?

Ans) A NAS devices has the following components



- 1) NAS head (CPU and Memory)
- 2) One or more network interface (NICs) cards which provide connectivity to the network
- 3) An optimized operating system for managing NAS functionality
- 4) NFS and CIFS protocol for file sharing
- 5) Industry-Standard Storage protocols to connect and manage physical disk resources, such as ATA, SCSI or FC



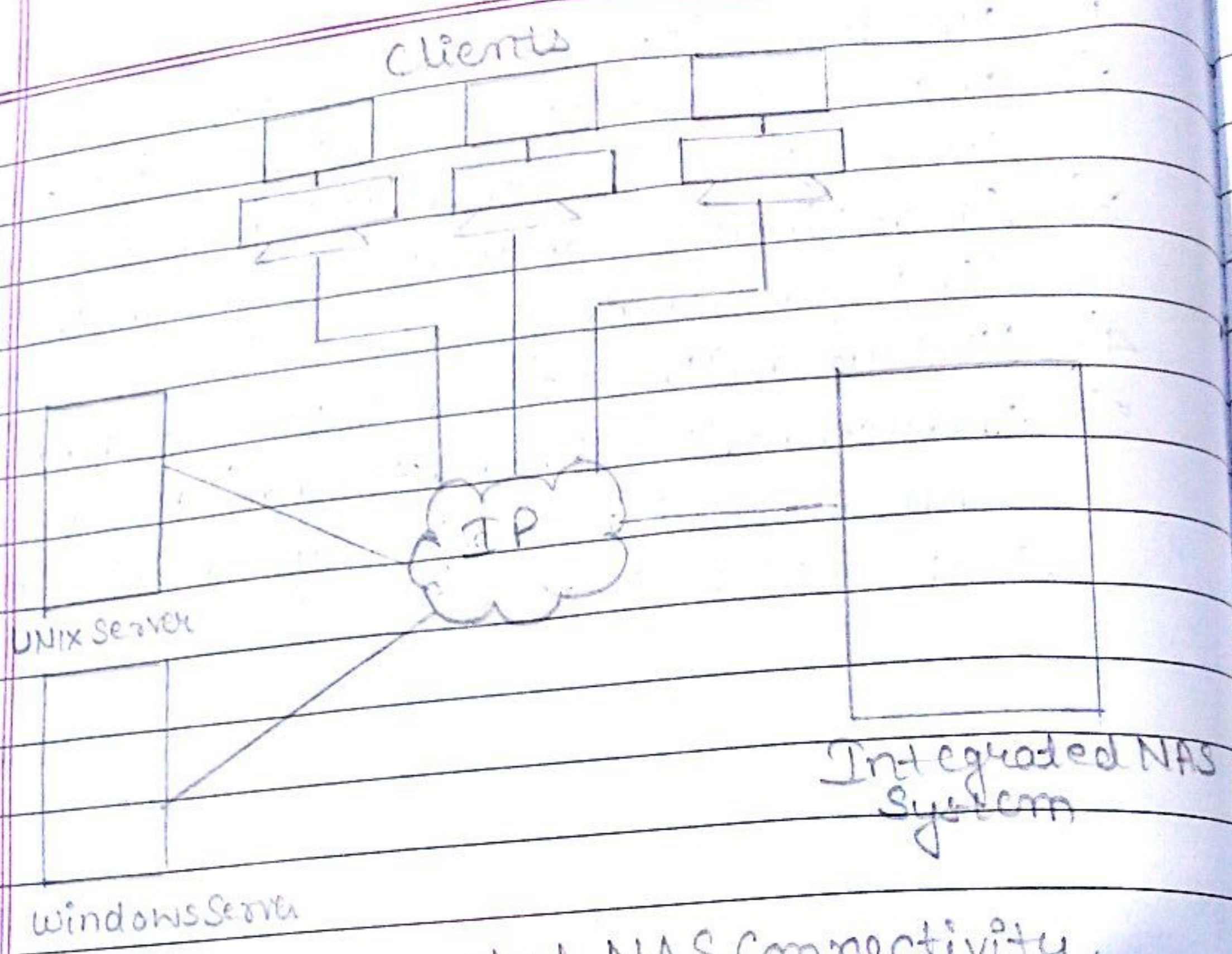
## Components of NAS

Ques) List the various NAS implementation?

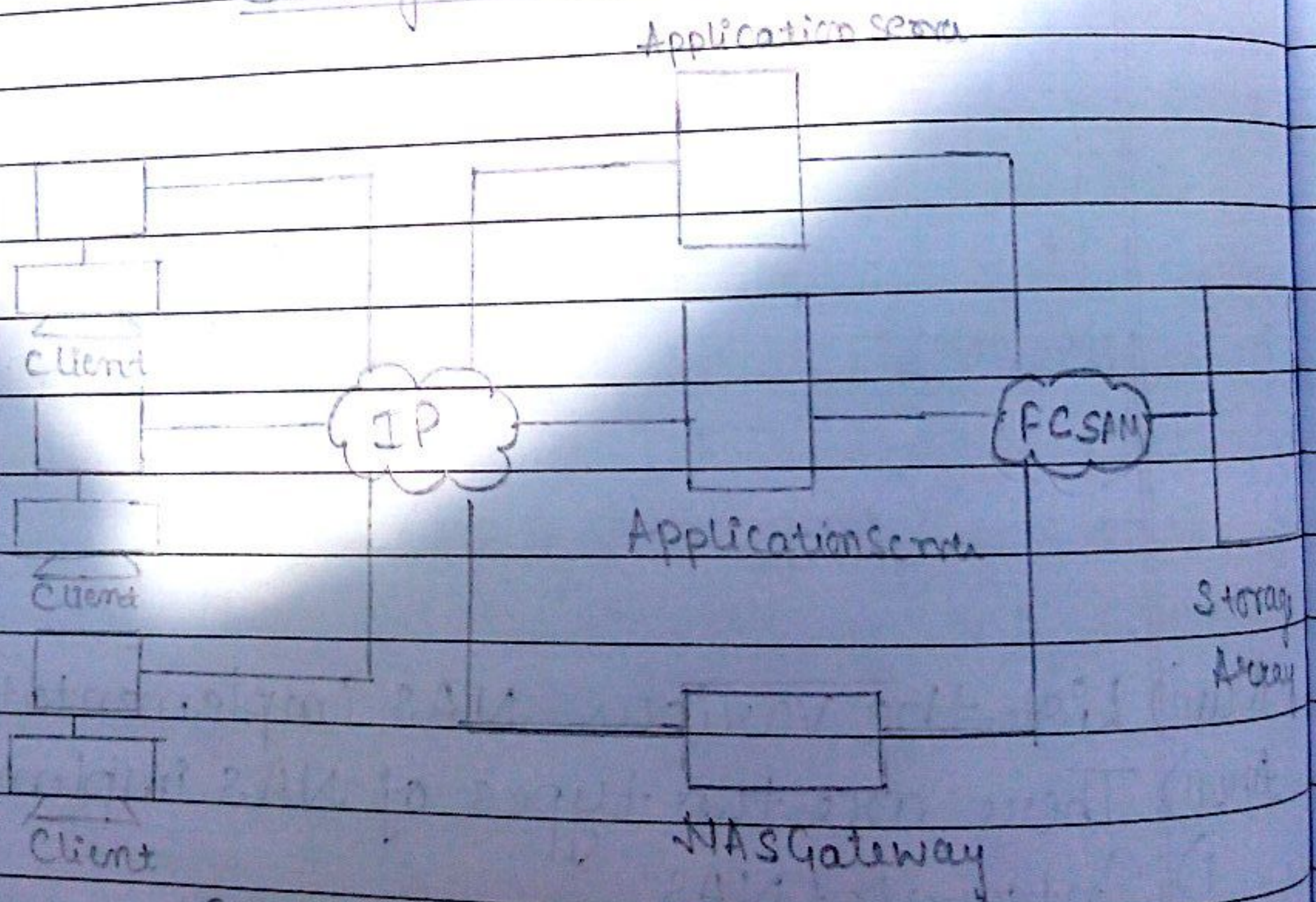
Ans) There are two types of NAS implementations:

- 1) Integrated NAS
- 2) Gateway NAS





Integrated NAS Connectivity



Gateway NAS connectivity



Ques 12) List the various file sharing protocols?

Ans 12) The file sharing protocols are as follows:

- 1) NFS
- 2) CIFS

Ques 13) List the factors affecting NAS performance and availability?

Ans 13) The factors affecting NAS performance and availability are:

- 1) Number of hops
- 2) Authentication with directory service such as LDAP, Active Directory or NIS
- 3) Retransmission
- 4) Overutilized routers and switches
- 5) File/directory lookup and metadata requests
- 6) Overutilized NAS devices
- 7) Overutilized clients