

Storage Technologies

IT403

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Lecture 4



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Common Storage Protocols

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Objectives

Upon completion of this module, you will be able to:

- Describe the definitions of common storage protocols.
- Understand the technical principles of common storage protocols.
- Understand the application scenarios of common storage protocols.

Outlines

- SCSI/iSCSI
- SAS
- FC/FCOE
- PCIe
- IB
- CIFS/NFS
- FTP/HTTP

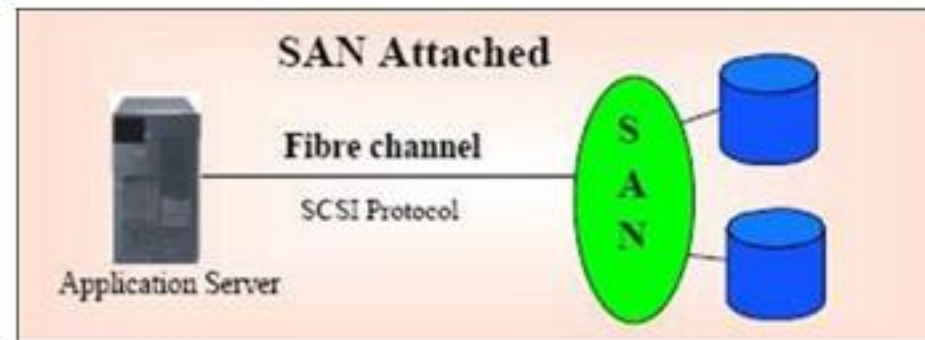


SCSI And iSCSI in Storage

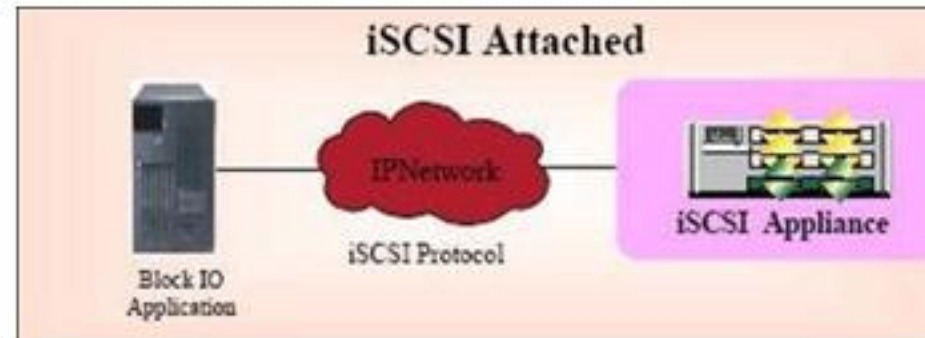


SCSI And iSCSI in Storage

DAS

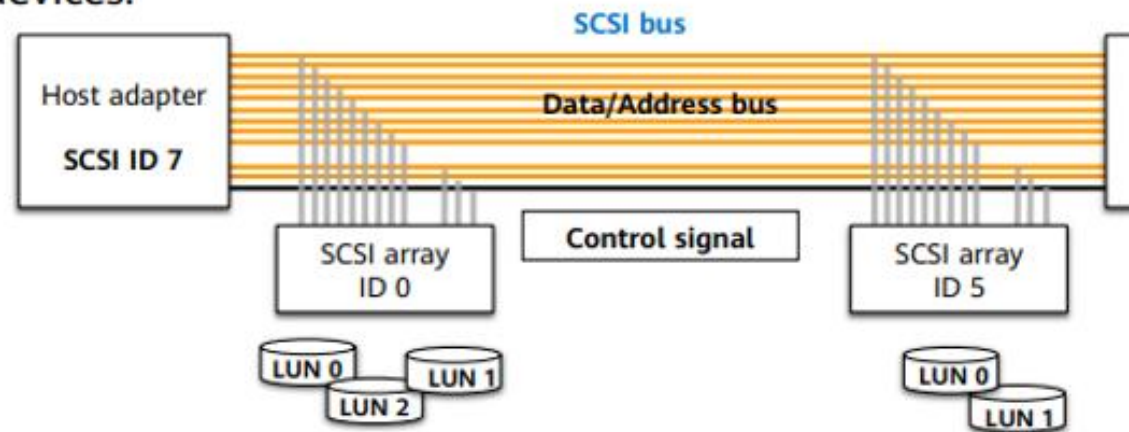


IP-SAN

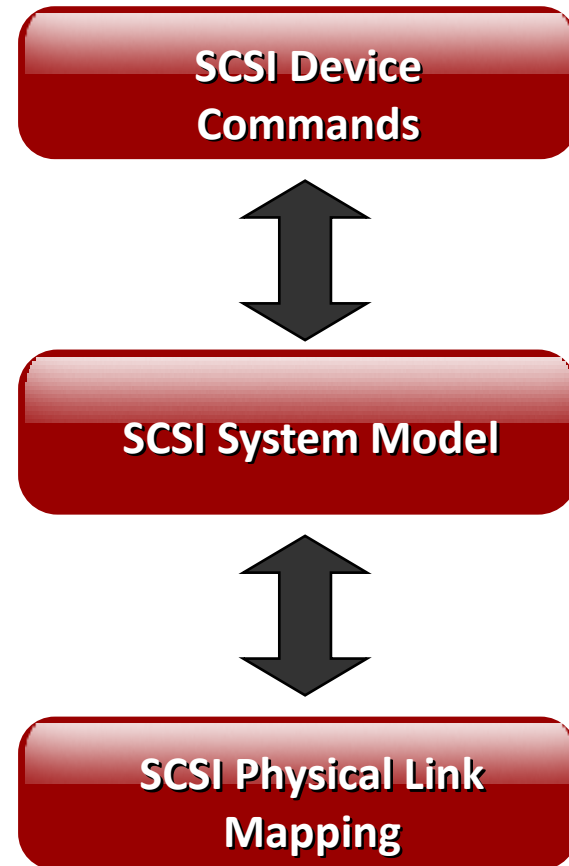


SCSI Protocol and Storage System

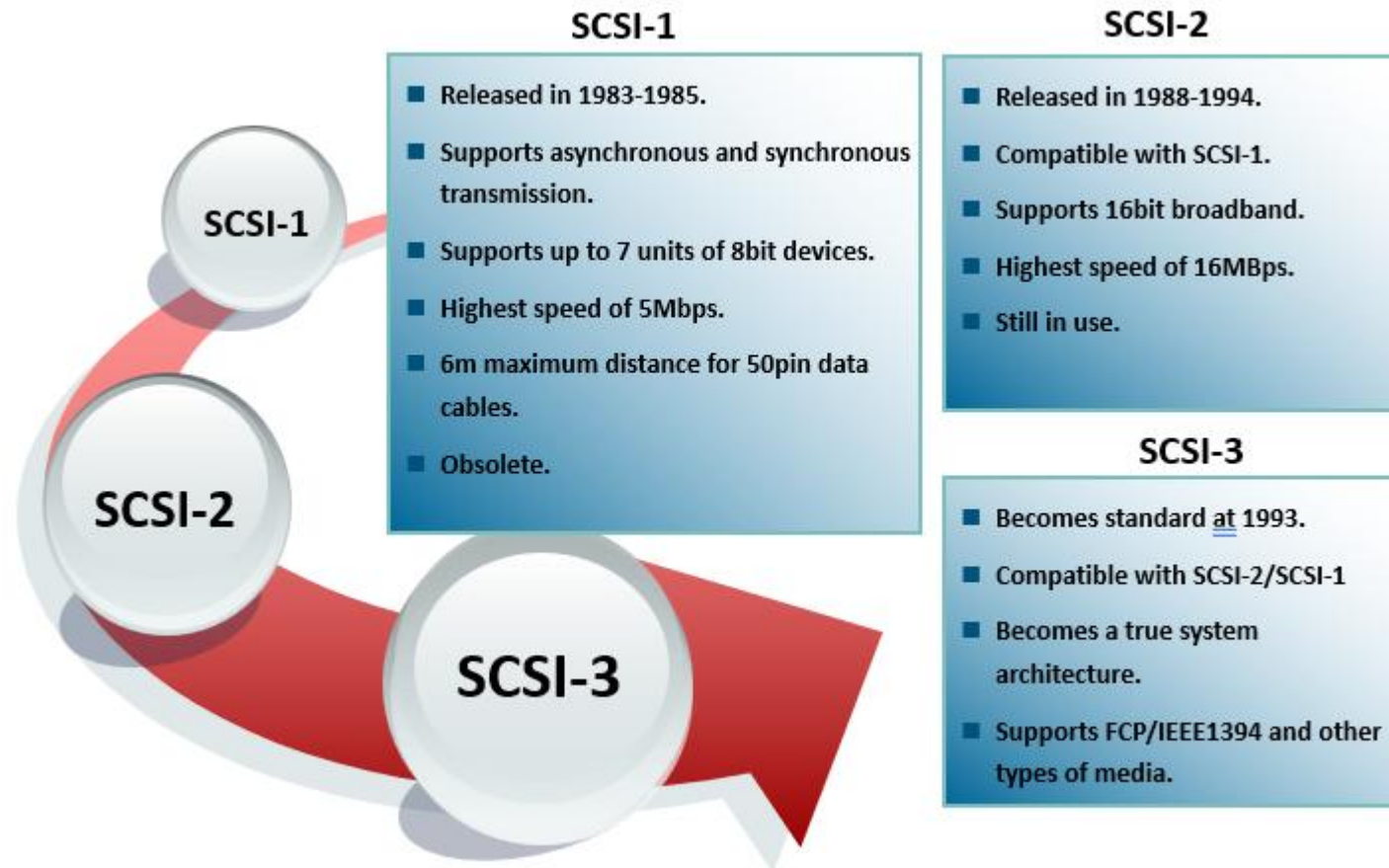
- The SCSI protocol is the basic protocol used for communication between hosts and storage devices.
- DAS uses the SCSI protocol to achieve interconnection between hosts and storage devices.



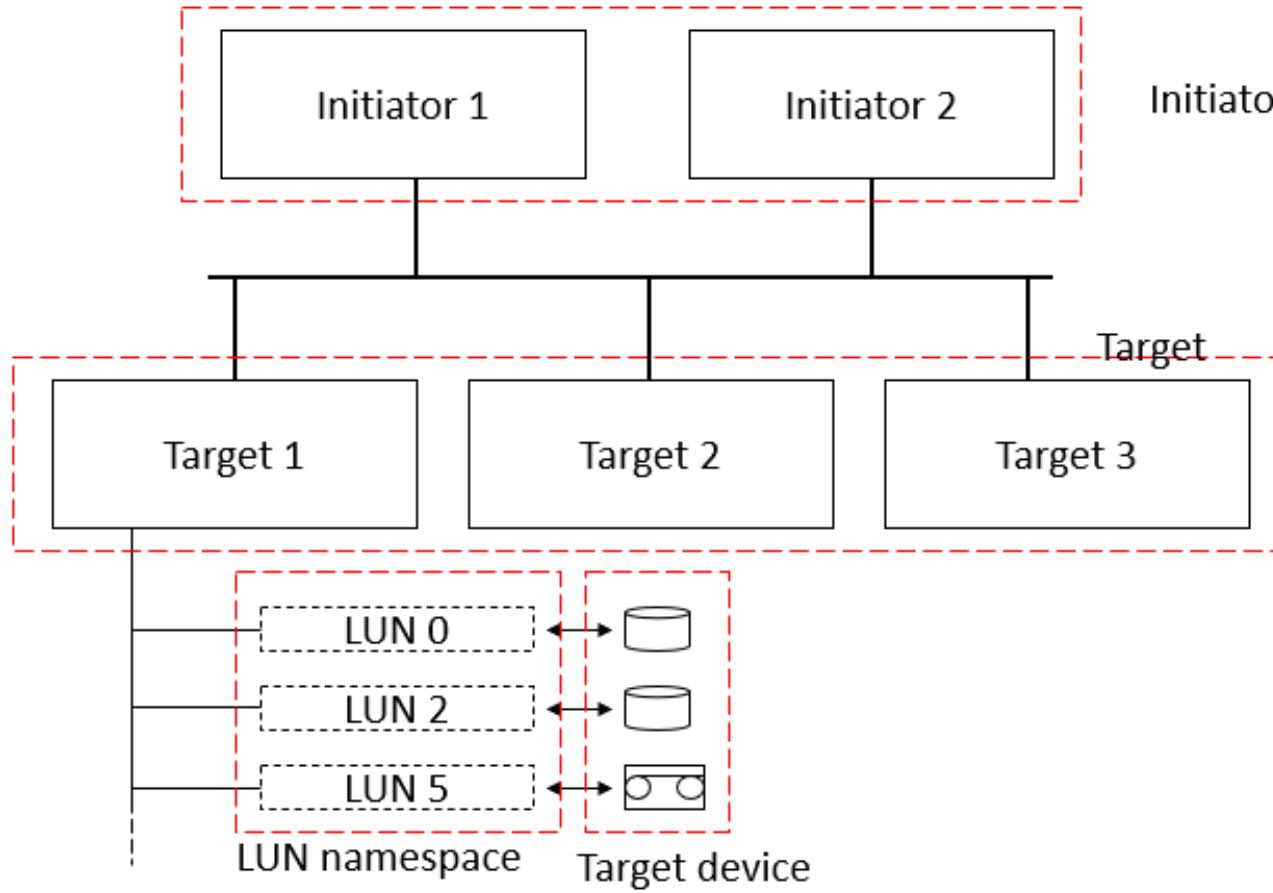
What is SCSI ?



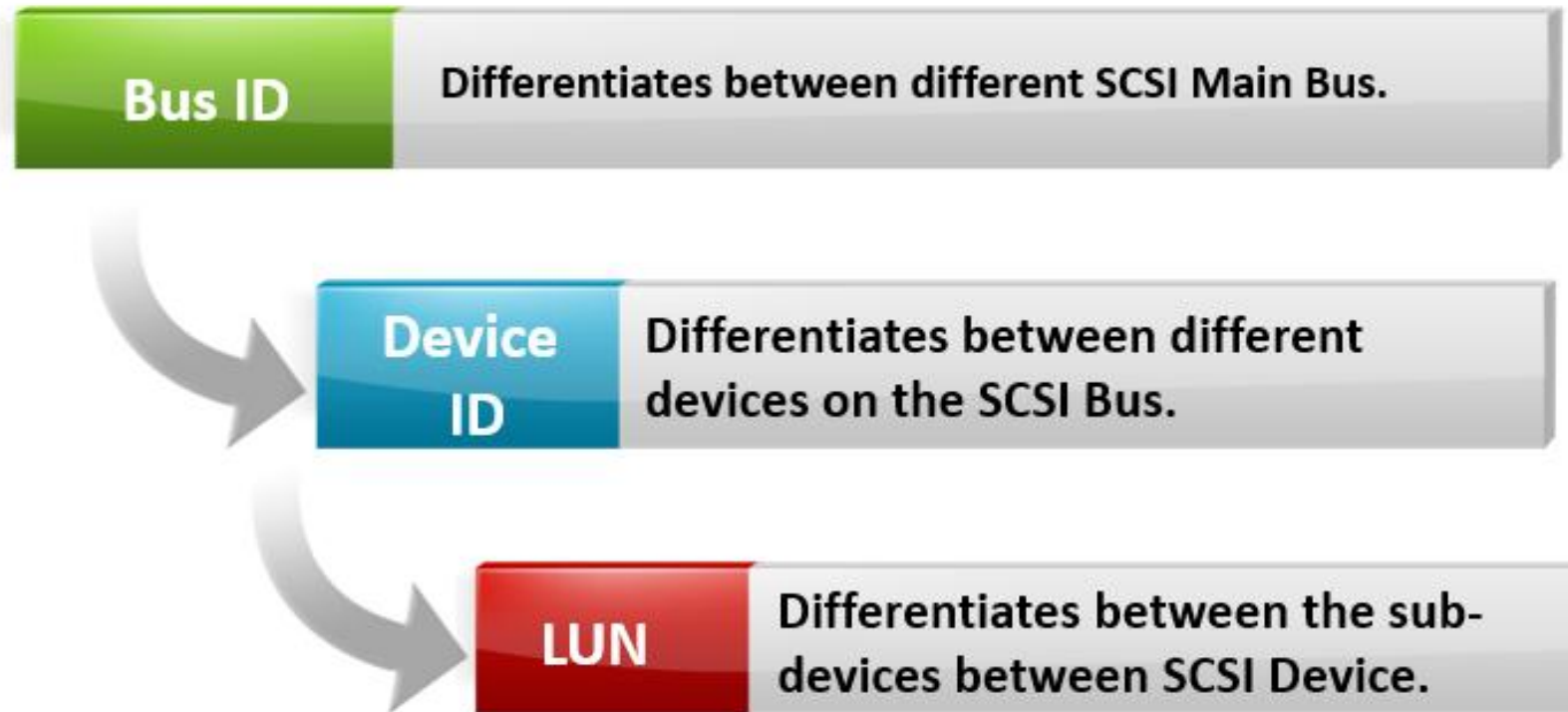
History of SCSI



SCSI Logical Topology



SCSI Protocol Addressing



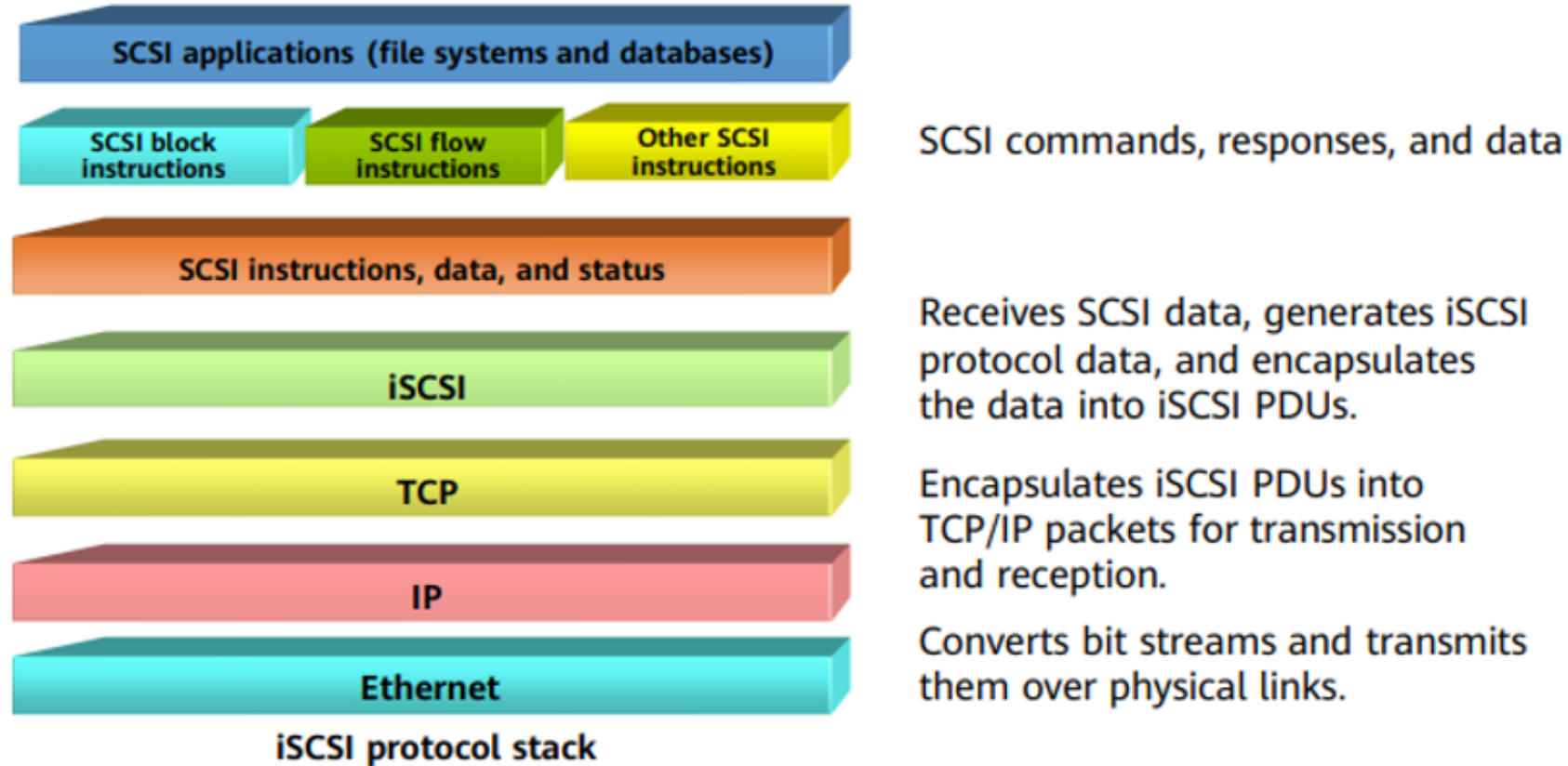
The Birth of iSCSI

- SCSI allows smaller number of connected devices.
- SCSI has very limited device connection distance.



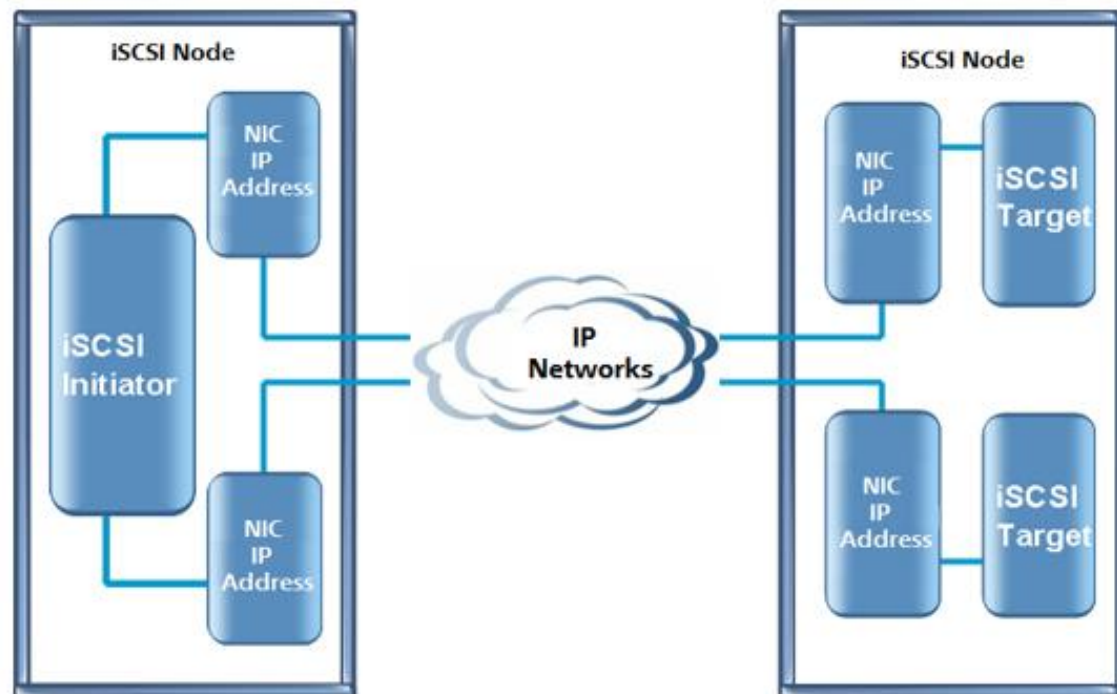
- SCSI Based On IP Network: iSCSI

iSCSI



iSCSI System Architecture

- iSCSI nodes encapsulates the SCSI commands and data blocks into iSCSI PDU, then sends it to the TCP/IP layer where the iSCSI PDU is further encapsulated into IP packets suitable for transmission over IP network.





SAS (Serial Attached SCSI)



SAS in Storage System

Background of SAS

- The parallel bus has been developed to the peak and the bandwidth limit is reached.
- Serial buses such as FC, IB, and the Ethernet have the following disadvantages for storage applications:
 - FC: It is expensive, and applicable to complex networking and long-distance scenarios.
 - IB: It is expensive, and the networking is complex.
 - iSCSI: The latency is high, and the transmission rate is low.



SCSI in serial mode: SAS

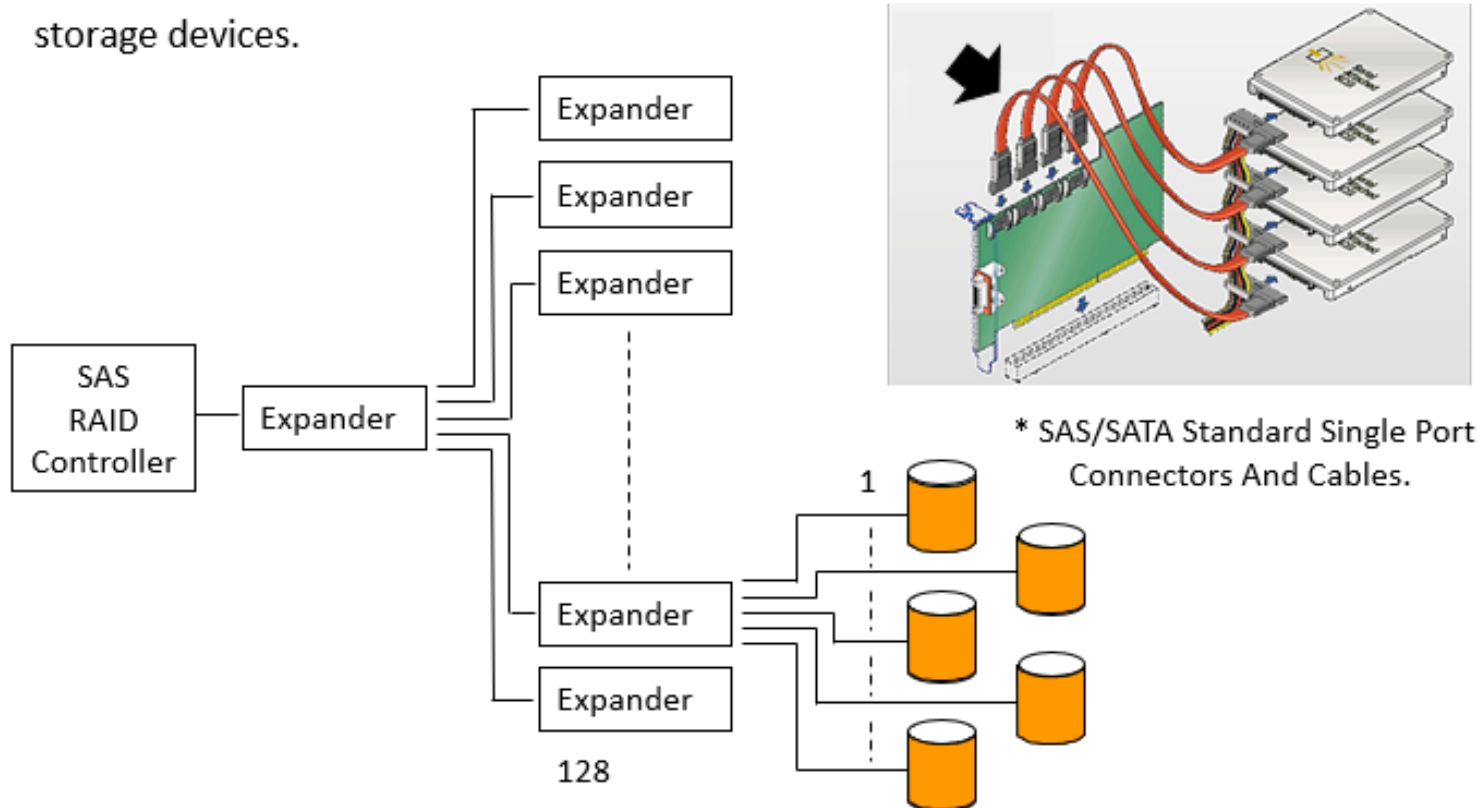
What is SAS

- SAS is the serial standard of the SCSI bus protocol.
- SAS uses the serial technology to achieve higher transmission rate and better scalability, and is compatible with SATA disks.
- SAS adopts the point-to-point architecture to achieve a transmission rate of up to 3 Gbit/s, 6 Gbit/s, 12 Gbit/s, or higher. The full-duplex mode is supported.



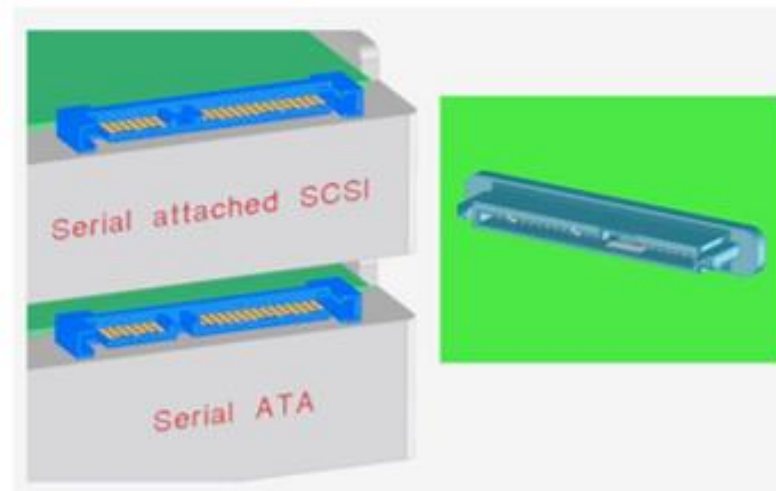
SAS Expansion Capabilities

- SAS architecture uses expander to perform interface expansion and has very good expansion capabilities. SAS domain can connect up to the maximum of 16384 units of storage devices.



SAS Features

- SAS: Serial Attached SCSI, is the serial standard for SCSI bus protocol.
- SAS uses serial technology to obtain higher transmission rate and better expansion capability, and it is compatible with SATA hard disks.
- SAS current transmission rates are up to 3Gbps, 6Gbps, 12Gbps or higher, and supports full-duplex mode connection.



Principles of SAS Cable

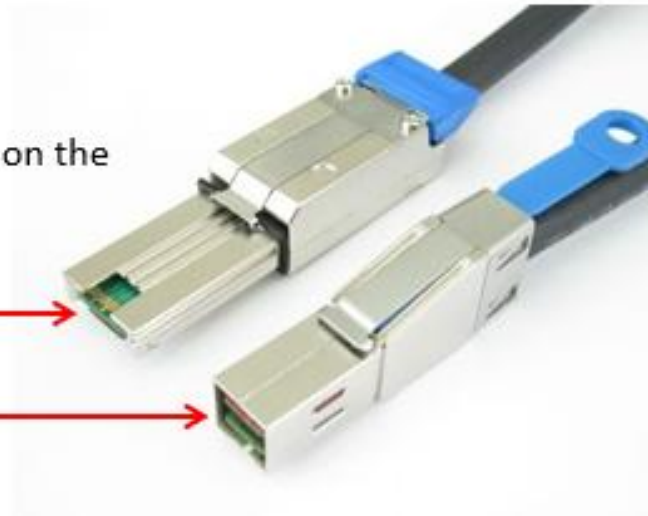
- SAS cables commonly has 4 paths, and the speed of each path commonly used is 12GB/s.
- SAS devices are connected in the form of loops (also known as chains).

SAS Cable Connector is shown on the picture on the right.

Mini SAS



High Density Mini SAS



Comparison Between SAS And Other Transmission Technologies

Types of Technology	Main Advantages	Main Disadvantages	Fields Of Application
ATA	Low Cost	Low Performance	PC
SCSI	Medium Performance	Drawbacks of Parallel Technologies	Enterprise Grade Storages
FC	High Performance, High Reliability	High Cost	High End Storages
SATA	Low Cost, High Capacity	Low Performance and Low Reliability	Mid and Low End Storages
SAS	High Performance, High Reliability	Medium Cost	Mid and Low End Storages

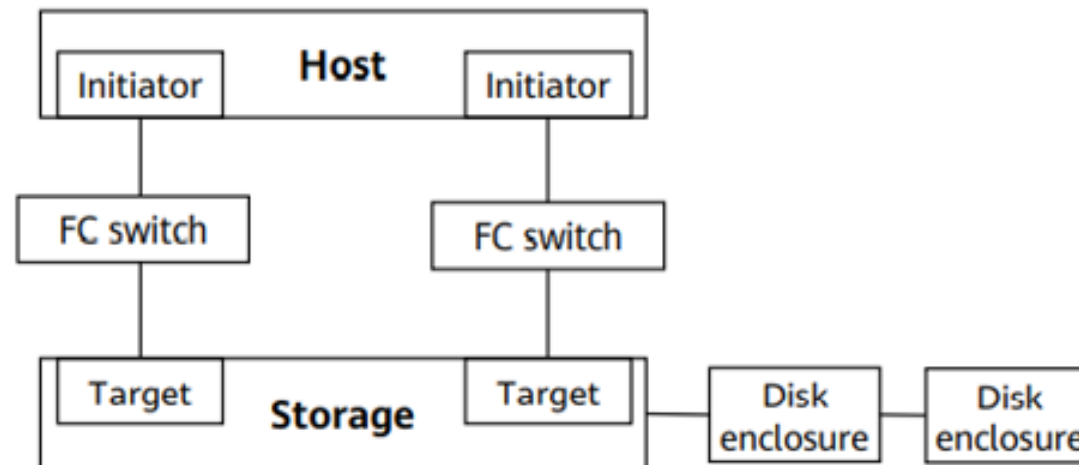


Fibre Channel (FC) /FCOE

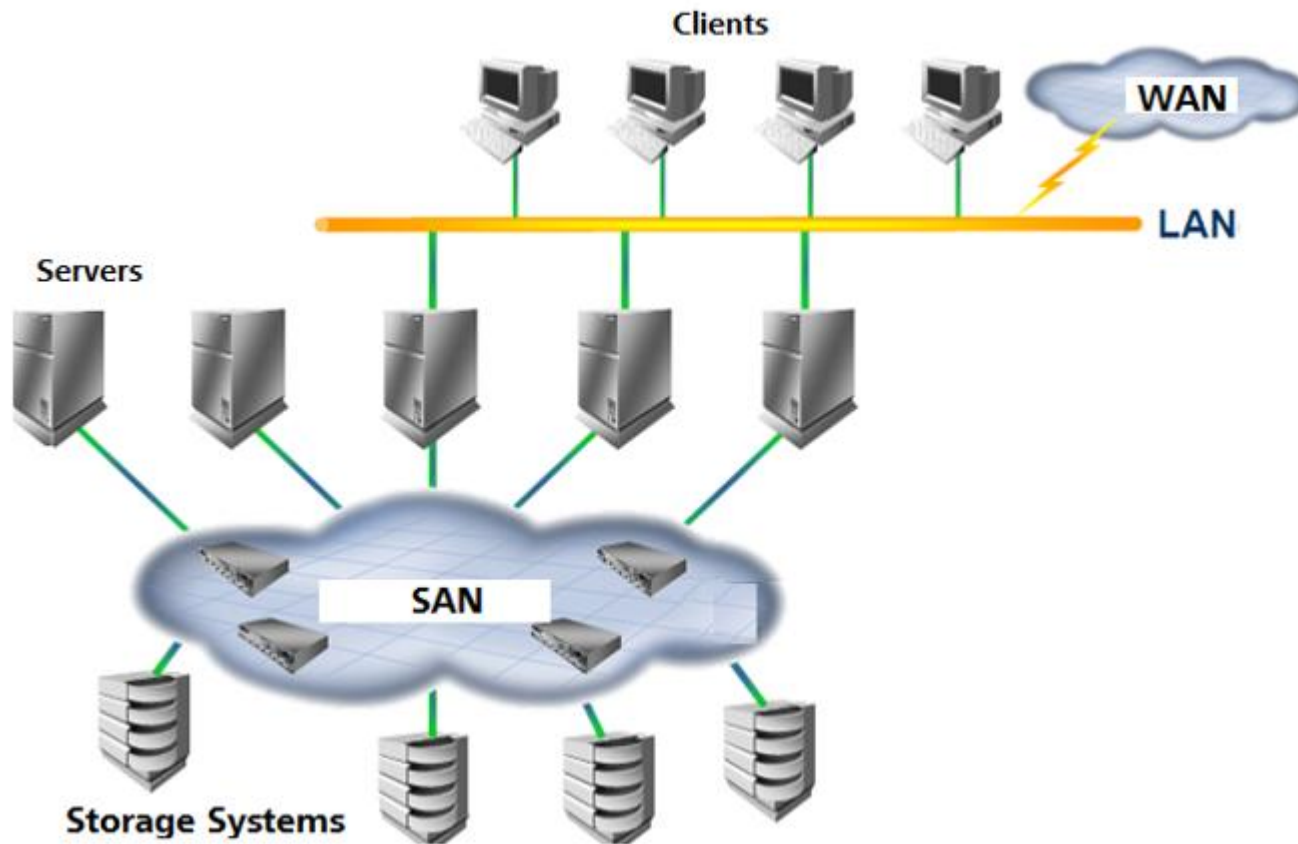


FC in Storage

- FC can be referred to as the FC protocol, FC network, or FC interconnection. As FC delivers high performance, it is gradually used for front-end host access on point-to-point and switch-based networks.
- FC brings the following advantages to the storage network:
 - The scalability is improved.
 - The transmission distance is increased.
 - Security problems are solved.



Fibre Channel (FC) In Storages



FC Adapter

- The FC host bus adapter (HBA) supports FC network applications and provides high-bandwidth and high-performance storage network solutions.



FC Topologies

Point to Point



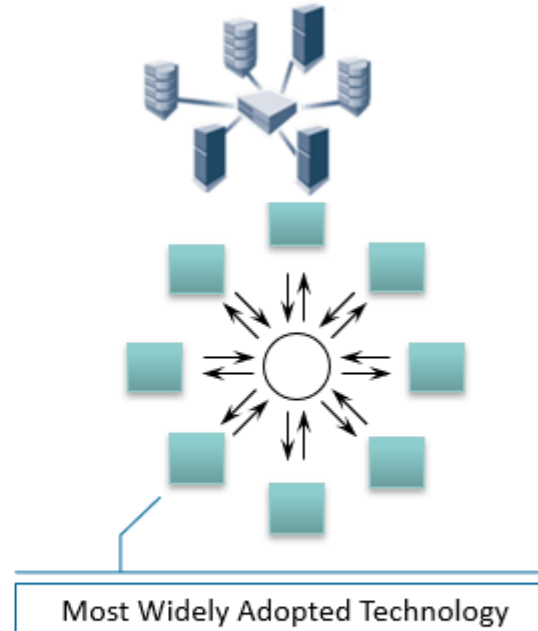
**Only connects 2 devices
(Direct Connection)**

Arbitration Loop



**Supports maximum of
127 devices (Fiber
Hub)**

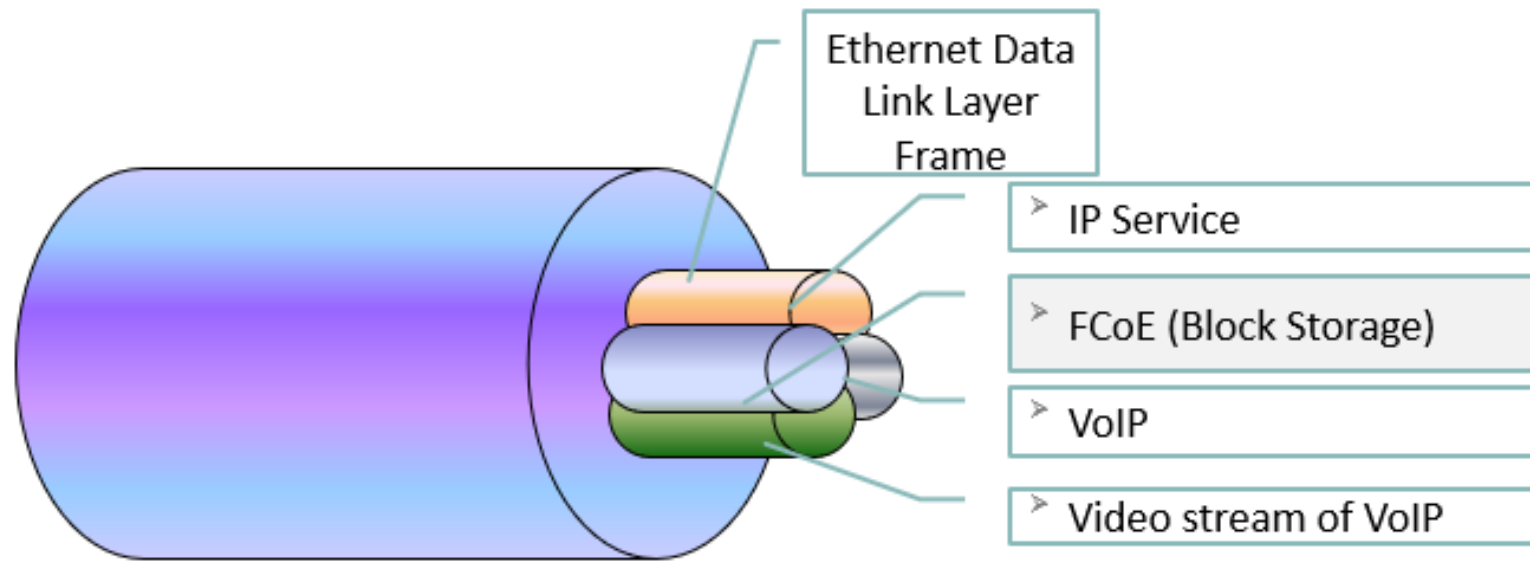
FC Switched Network



**Supports maximum of 16
million devices
(FC Switches)**

FCoE Protocol

- It is a protocol that directly transmits FC signals over the enhanced lossless Ethernet network.
- FCoE encapsulates the FC frame within an Ethernet Frame, allowing LAN and SAN service traffic to be transmitted through the same Ethernet network



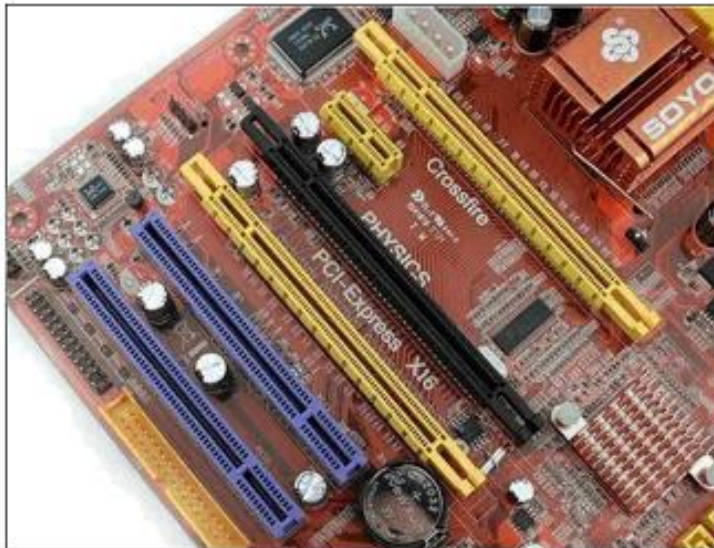


Peripheral Component Interconnect express (PCIe)



What Is PCIe ?

- PCI Express (also known as PCIe) is a high-performance, high-bandwidth serial communications interconnection standard first introduced by Intel



**High-Performance, High-Bandwidth Serial
Communication Interconnection Standard:
PCI Express (PCIe)**

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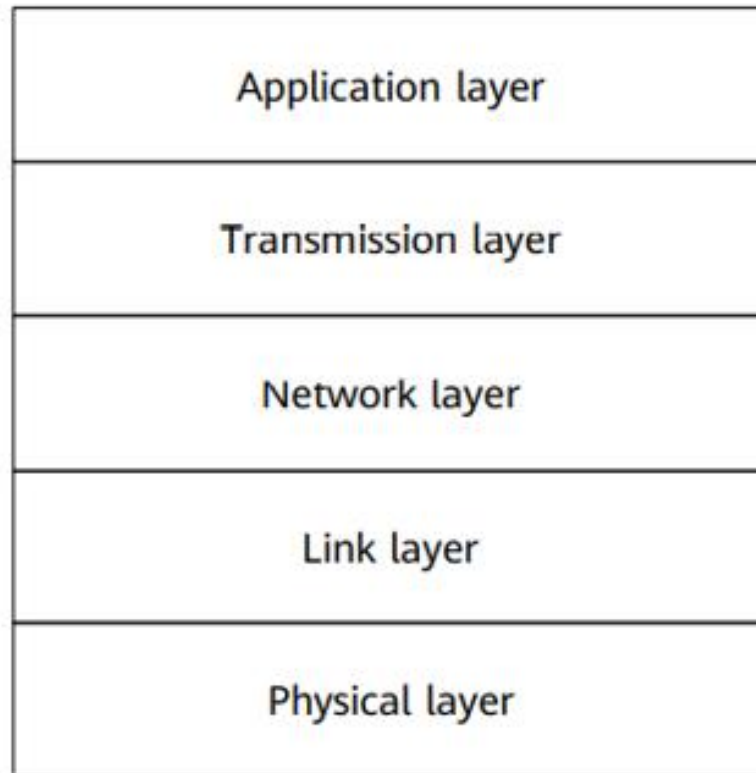
InfiniBand (IB)



What Is IB ?

- Overview:
 - The IB technology is specifically designed for server connections, and is widely used for communication between servers (for example, replication and distributed working), between a server and a storage device (for example, SAN and DAS), and between a server and a network (for example, LAN, WAN, and the Internet).
- Highlights:
 - Standard-protocol-based
 - High bandwidth and low latency
 - RDMA
 - Transmission uninstallation

IB Layers



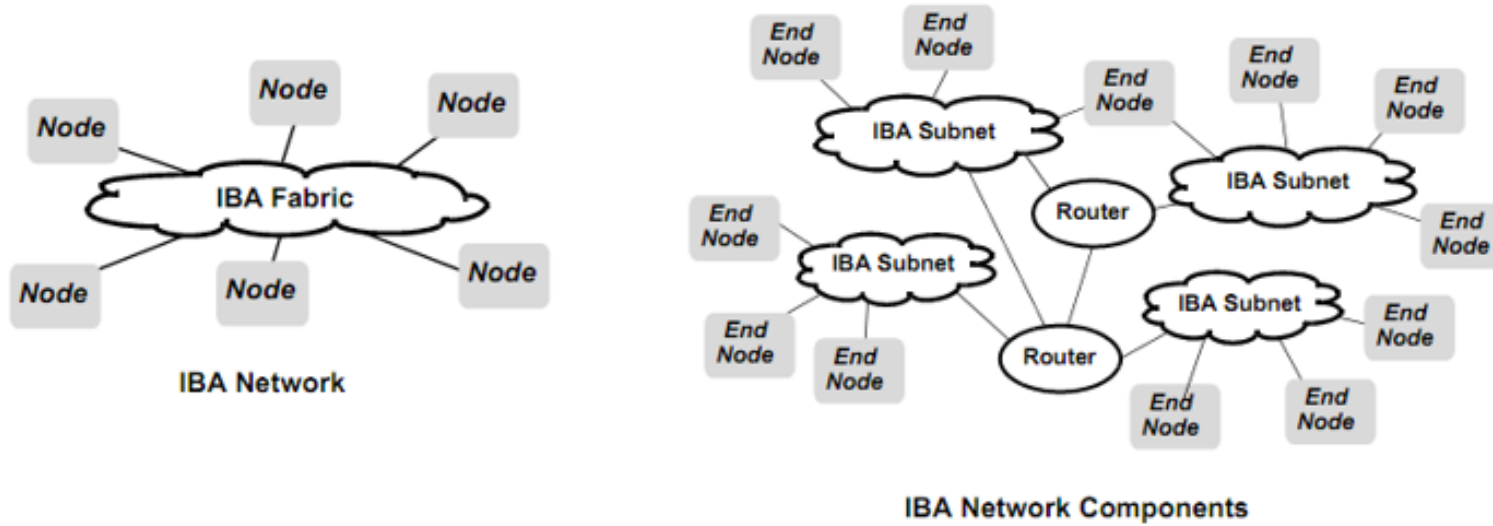
Sends, receives, and reassembles data packet segments.

Provides addressing and routing.

Provides data packet design and point-to-point connection for local subsystems.

Determines the connection rate.

IB Architecture (IBA)



- Components of InfiniBand Architecture (IBA):
- Node: Host Channel Adapter (HCA), Host Target Adapter (HTA).
- Network: Switch, Routers.
- Physical: Links (Fiber or Cables), Repeaters.

IB Interface

- **Channel Adapter (CA)** is divided into 2 different types as below:
 - **Host Channel Adapter (HCA):** It is used at the hosts side such as Mellanox HCA products.
 - **Target Channel Adapter (TCA):** It is used mainly on the IB switches side or serve as the interface on the storage systems.

IB Switches:



IB Connectors:



Host Channel Adapter (HCA):



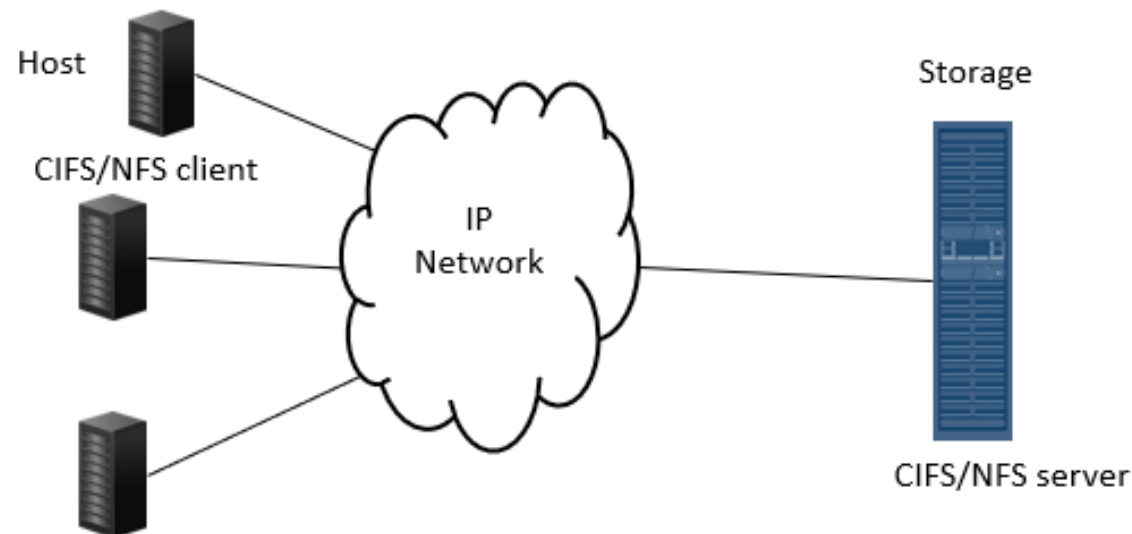
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CIFS (Common Internet File System)/ NFS (Network File System)



CIFS/NFS In Storage Systems

- The two most common network sharing protocols for NAS are: CIFS and NFS.
 - **CIFS (Common Internet File System):** CIFS refers to the collective name of SMB (Server Message Block). Network file sharing between Windows hosts is achieved by using Microsoft's own CIFS service.
 - **NFS (Network File System)** is a network file system that uses NFS extensively for cloud computing and databases. UNIX-like operating systems such as Linux/UNIX/AIX/HP-UX/Mac OS X uses NFS to provide network file system storage services.



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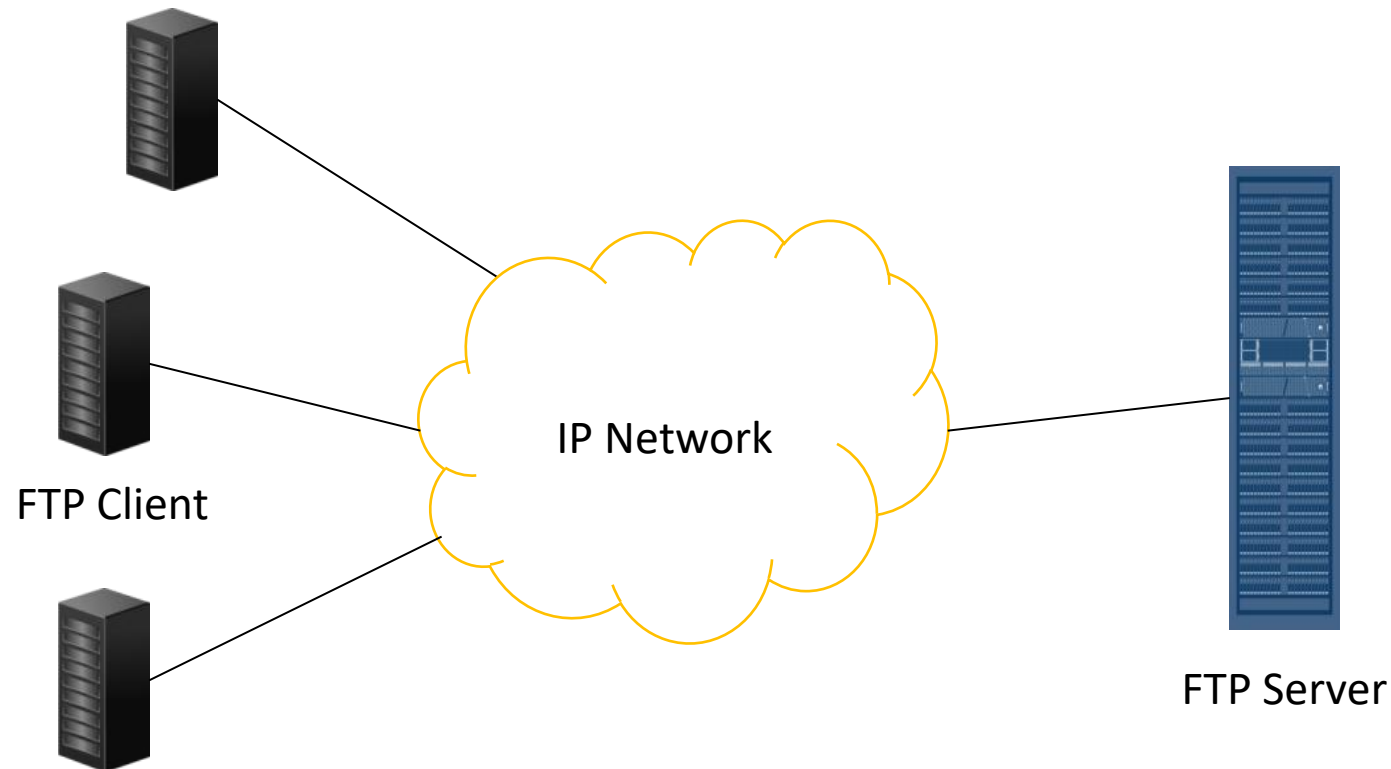
File Transfer Protocol (**FTP**)/ Hypertext transfer protocol (**HTTP**)



What is FTP ?

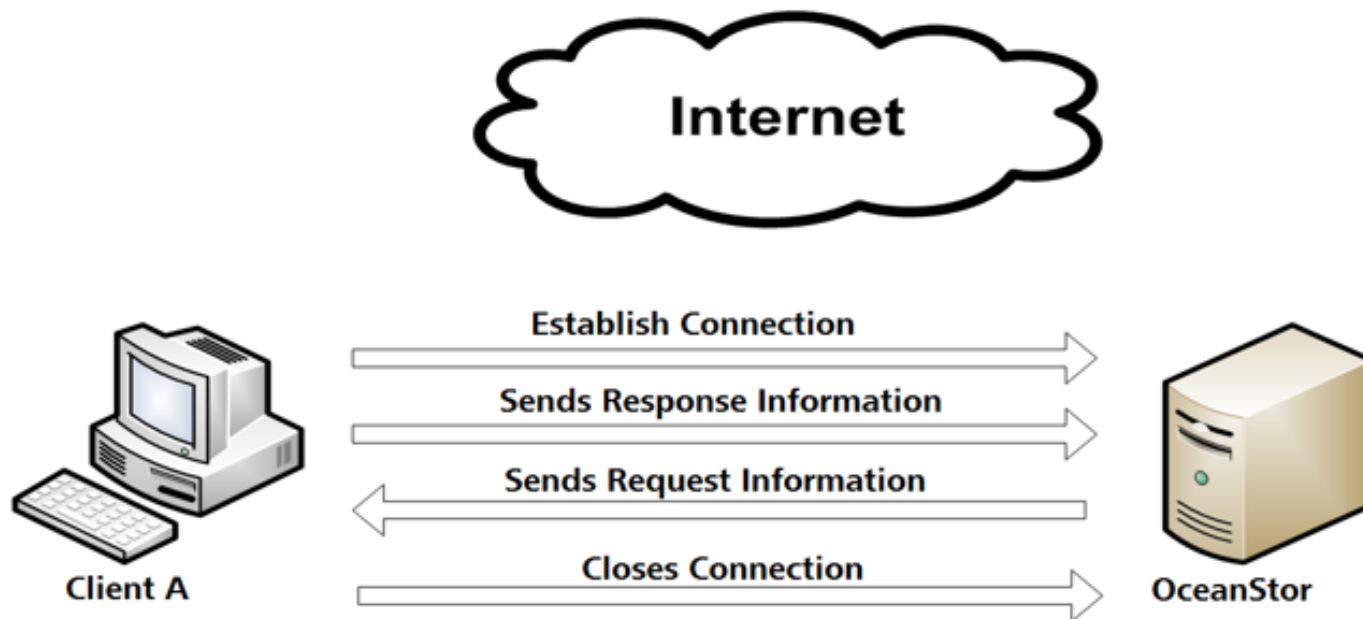
- FTP (File Transfer Protocol) is used to transfer files between a remote server and a local host. It is a common protocol for transferring files on an IP network.
- The FTP protocol is an application layer protocol in the TCP/IP protocol suite. It is used to transfer files between a remote server and a local client and uses TCP ports 20 and 21 for transmission. Port 20 is used to transmit data, and port 21 is used to transmit control messages.

FTP Typical Application Scenario - File Uploads and Downloads

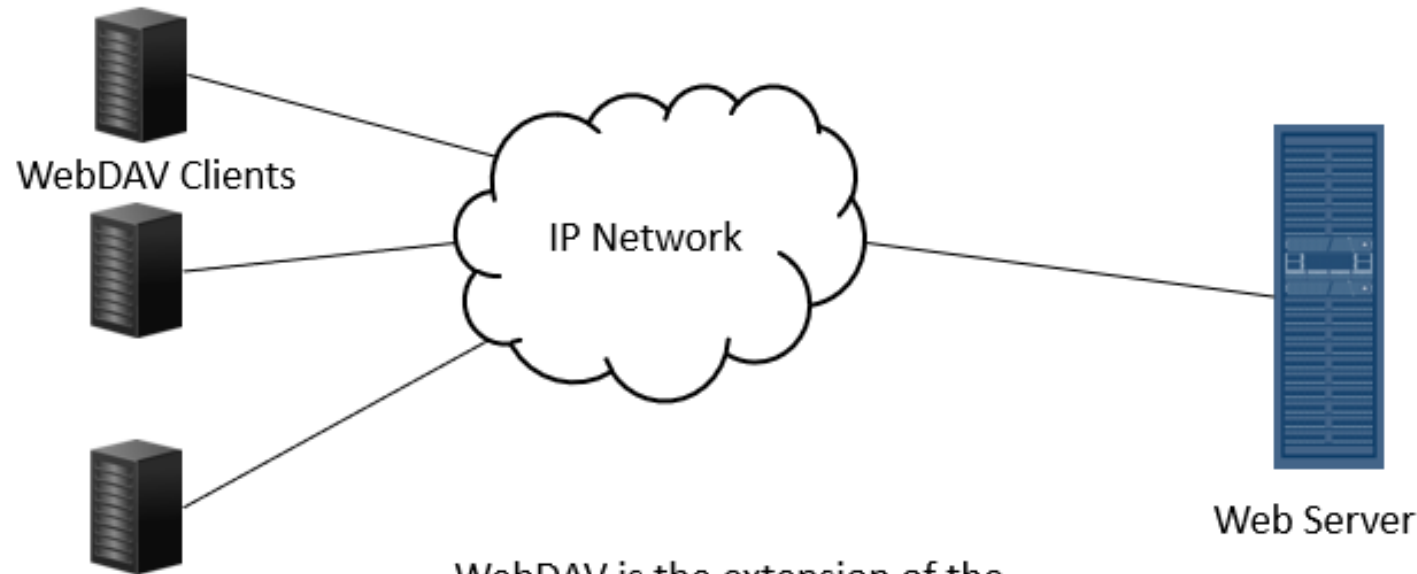


What is HTTP ?

- Hypertext transfer protocol (HTTP) is a data transfer protocol that specifies the rules for the communication between the browser and the web server, and transmission of web document via the Internet.



HTTP Typical Application Scenario - Web Access



WebDAV is the extension of the HTTP 1.0 protocol which allows multiple users to edit and manage files collaboratively.



Thank You