4.1 Types of Intelligent Storage Systems

Intelligent storage systems generally fall into one of the following two categories:

- High-end storage systems
- Midrange storage systems
  - high-end storage systems have been implemented with *active- active configuration*,
  - midrange storage systems have been implemented with *active-passive configuration*.

4.1.1 High-End Storage Systems

- High-end storage systems, referred to as *active-active arrays*, are generally aimed at large enterprise applications.
- These systems are designed with a large number of controllers and cache memory.
- An active-active array implies that the host can perform I/Os to its LUNs through any of the available controllers (see Figure 4-10).

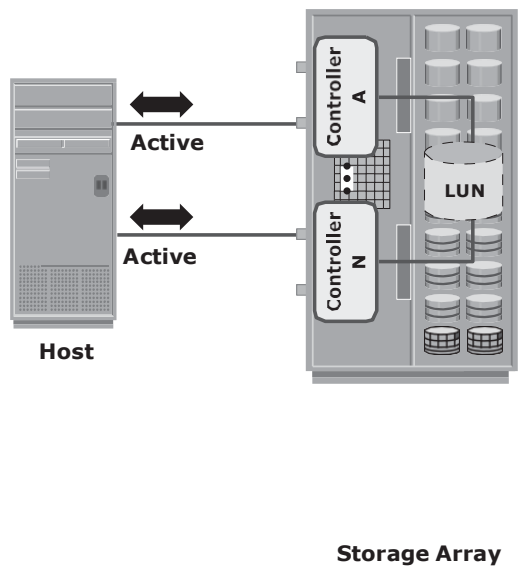

Figure 4-10: Active-active configuration

To address enterprise storage needs, these arrays provide the following capabilities:

- Large storage capacity

- Large amounts of cache to service host I/Os optimally

- Fault tolerance architecture to improve data availability
- Connectivity to mainframe computers and open systems hosts
- Availability of multiple front-end ports and interface protocols to serve a large number of hosts
- Availability of multiple back-end controllers to manage disk processing
- Scalability to support increased connectivity, performance, and storage capacity requirements
- Ability to handle large amounts of concurrent I/Os from a number of hosts and applications
- Support for array-based local and remote data replication

4.1.2 Midrange Storage Systems

- Midrange storage systems are also referred to as *active-passive arrays* and are best suited for small- and medium-sized enterprise applications.
- They also provide optimal storage solutions at a lower cost.
- In an active-passive array, a host can perform I/Os to a LUN only through the controller that owns the LUN.
- As shown in Figure 4-11, the host can perform reads or writes to the LUN only through the path to controller A because controller A is the owner of that LUN.
- The path to controller B remains passive and no I/O activity is performed through this path.

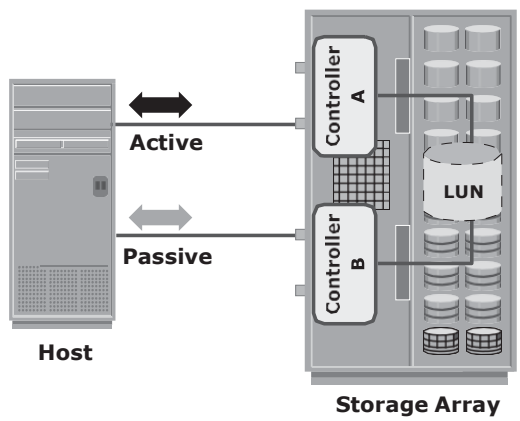

Figure 4-11: Active-passive configuration

- Midrange arrays are designed to meet the requirements of small and medium enterprise applications;
- therefore, they host less storage capacity and cache thanhigh-end storage arrays.

Chapter 5
Fibre Channel Storage Area Networks

5.1 Fibre Channel: Overview

- The FC architecture forms the fundamental construct of the FC SAN infrastructure. *Fibre Channel* is a high-speed network technology that runs on high-speed opticalfiber cables and serial copper cables.
- The FC technology was developed to meet the demand for increased speeds of data transfer between servers and mass storagesystems.
- Although FC networking was introduced in 1988, the FC standardization process began when the American National Standards Institute (ANSI) charteredthe Fibre Channel Working Group (FCWG).
- By 1994, the new high-speed computer interconnection standard was developed and the Fibre Channel Association (FCA) was founded with 70 charter member companies.
- High data transmission speed is an important feature of the FC network- ing technology.
- The initial implementation offered a throughput of 200 MB/s (equivalent to a raw bit rate of 1Gb/s), which was greater than the speeds of Ultra SCSI (20 MB/s), commonly used in DAS environments.
- In comparison with Ultra SCSI, FC is a significant leap in storage networking technology.
- The latest FC implementations of 16 GFC (Fibre Channel) offer a throughput of 3200 MB/s (raw bit rates of 16 Gb/s), whereas Ultra640 SCSI is available with athroughput of 640 MB/s.
- The FC architecture is highly scalable, and theoreti- cally, a single FC network can accommodate approximately 15 million devices.

5.2 The SAN and Its Evolution

- A SAN carries data between servers (or *hosts*) and storage devices through Fibre Channel network (see Figure 5-1).
- A SAN enables storage consolidation and enables storage to be shared across multiple servers.
- This improves the utilization of storage resources compared to direct-attached storage architecture and reduces the total amount of storage an organization needs to purchase and manage.
- SAN also enables organizations to connect geographically dispersed servers and storage.

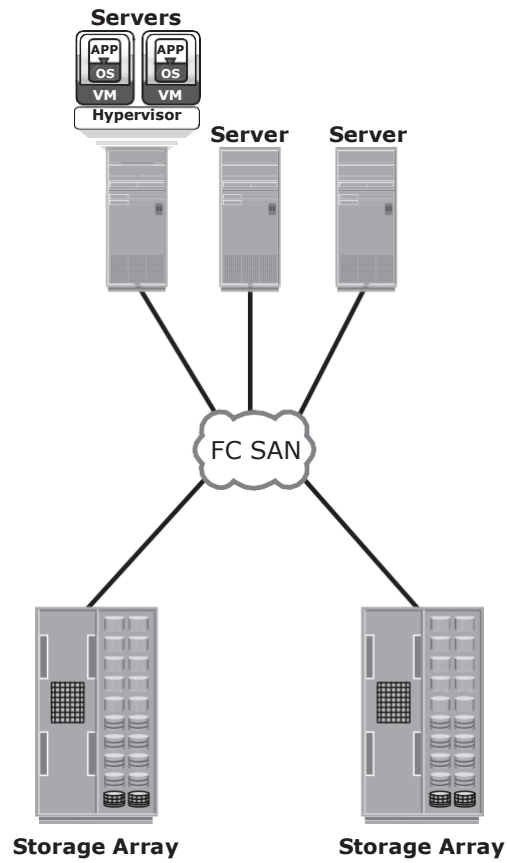

Figure 5-1: FC SAN implementation

- In its earliest implementation, the FC SAN was a simple grouping of hosts and storage devices connected to a network using an FC hub as a connectivitydevice.
- This configuration of an FC SAN is known as a *Fibre Channel Arbitrated*

Loop (FC-AL).

- Use of hubs resulted in isolated FC-AL SAN islands because hubs provide limited connectivity and bandwidth.
- The inherent limitations associated with hubs gave way to high-performanceFC *switches*.
- Use of switches in SAN improved connectivity and performance and enabled FC SANs to be highly scalable.
- Figure 5-2 illustrates the FC SAN evolution from FC-AL to enterprise SANs.

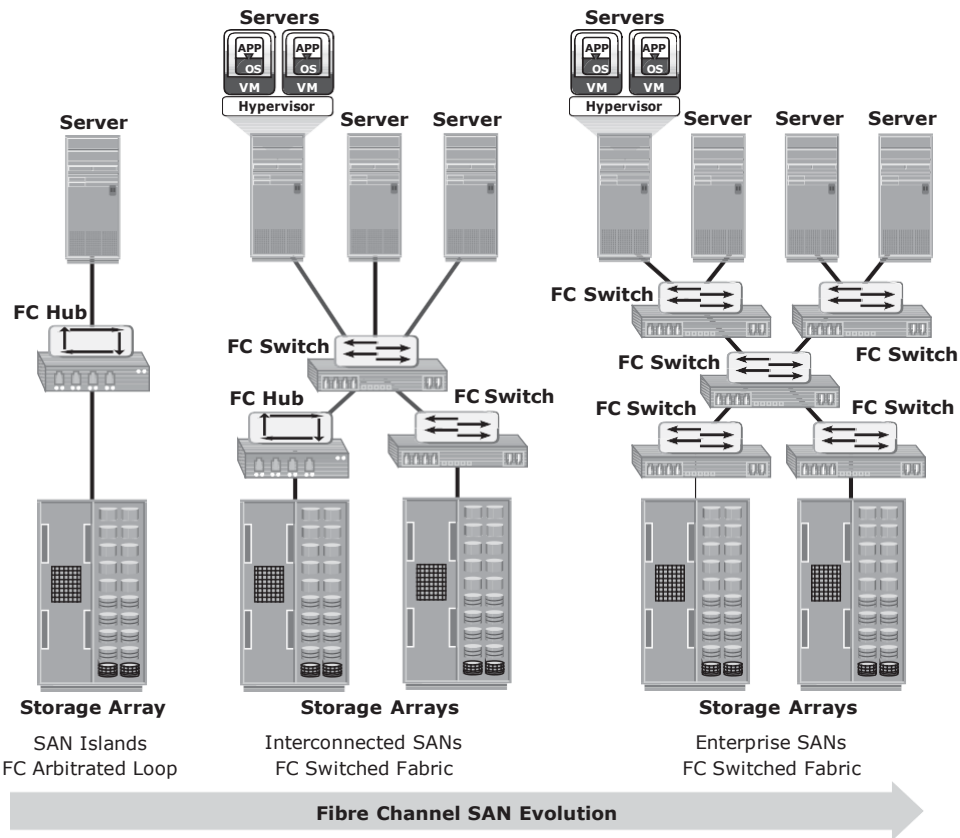

Figure 5-2: FC SAN evolution

5.3 Components of FC SAN

- FC SAN is a network of servers and shared storage devices. Servers and storageare the end points or devices in the SAN (called *nodes*).
- FC SAN infrastructure consists of node ports, cables, connectors, and interconnecting devices (such as FC switches or hubs), along with SAN management software.

5.3.1 Node Ports

- In a Fibre Channel network, the end devices, such as hosts, storage arrays, andtape libraries, are all referred to as *nodes*.
- Each node is a source or destination ofinformation.
- Each node requires one or more ports to provide a physical interfacefor communicating with other nodes.
- In an FC environment a port operates in full-duplex data transmission mode with a *transmit* (Tx) link and a *receive* (Rx) link (see Figure 5-3).

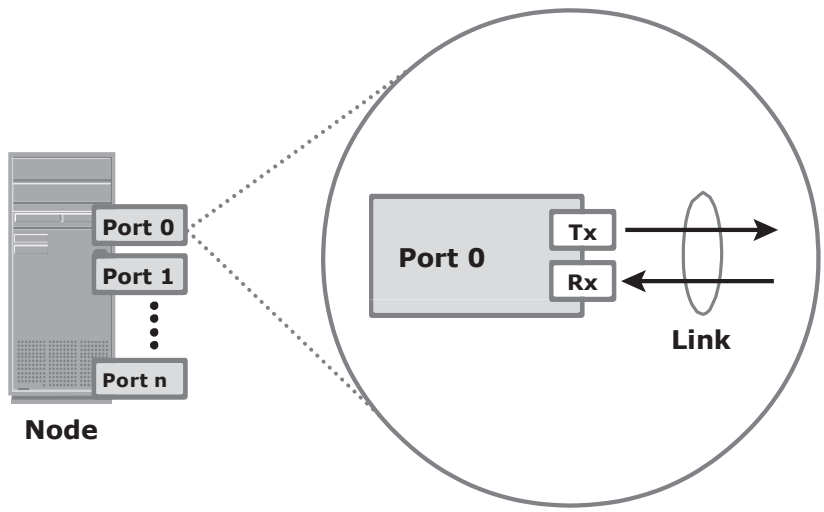

Figure 5-3: Nodes, ports, and links

5.3.2 Cables and Connectors

- SAN implementations use optical fiber cabling.
- Copper can be used for shorterdistances for back-end connectivity because it provides an acceptable signal-to- noise ratio for distances up to 30 meters.
- Optical fiber cables carry data in theform of light.
- There are two types of optical cables: multimode and single-mode.
- *Multimode fiber* (MMF) cable carries multiple beams of light projected at differ-ent angles simultaneously onto the core of the cable (see Figure 5-4 [a]).
- In an MMF transmission,multiple light beams traveling inside the cable tend to disperse and collide.
- This collision weakens the signal strength after it travels a certain distance

- aprocess known as *modal dispersion*.
- An MMF cable is typically used for short distances because of signal degradation (attenuation) due to modal dispersion.
- *Single-mode fiber* (SMF) carries a single ray of light projected at the center of the core(see Figure 5-4 [b]). These cables are available in core diameters of 7 to 11 microns;
- In an SMF transmission, a single light beam travels in a straight line through the core of the fiber.
- Among all types of fiber cables, single- mode provides minimum signal attenuation over maximum distance (up to 10km).
- A single-mode cable is used for long-distance cable runs, and distance usually depends on the power of the laser at the transmitter and sensitivity of the receiver.

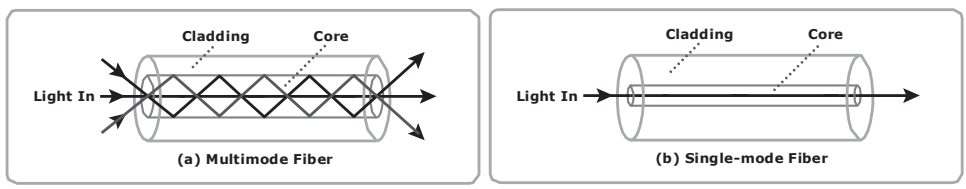

Figure 5-4: Multimode fiber and single-mode fiber

5.3.3 Interconnect Devices

- FC hubs, switches, and directors are the interconnect devices commonly usedin FC SAN.
- *Hubs* are used as communication devices in FC-AL implementations.
- Hubsphysically connect nodes in a logical loop or a physical star topology.
- *Switches* are more intelligent than hubs and directly route data from one physical port to another.
- Therefore, nodes do not share the bandwidth. Instead,each node has a dedicated communication path.
- *Directors* are high-end switches with a higher port count and better fault- tolerance capabilities.
  des in a director usually have more than one ASIC for higher throughput.

5.3.4 SAN Management Software

- SAN management software manages the interfaces between hosts, intercon-

nect devices, and storage arrays.

- The software provides a view of the SAN environment and enables management of various resources from one central console.
- It provides key management functions, including mapping of storage devices, switches, and servers, monitoring and generating alerts for discovered devices, and *zoning*

QUESTION BANK - 10 MARKS

1. Explain Types Of Intelligent System
2. With Neat Diagram Explain San And It's Evolution
3. Explain Components Of Fc San