



Data Centre Virtualisation

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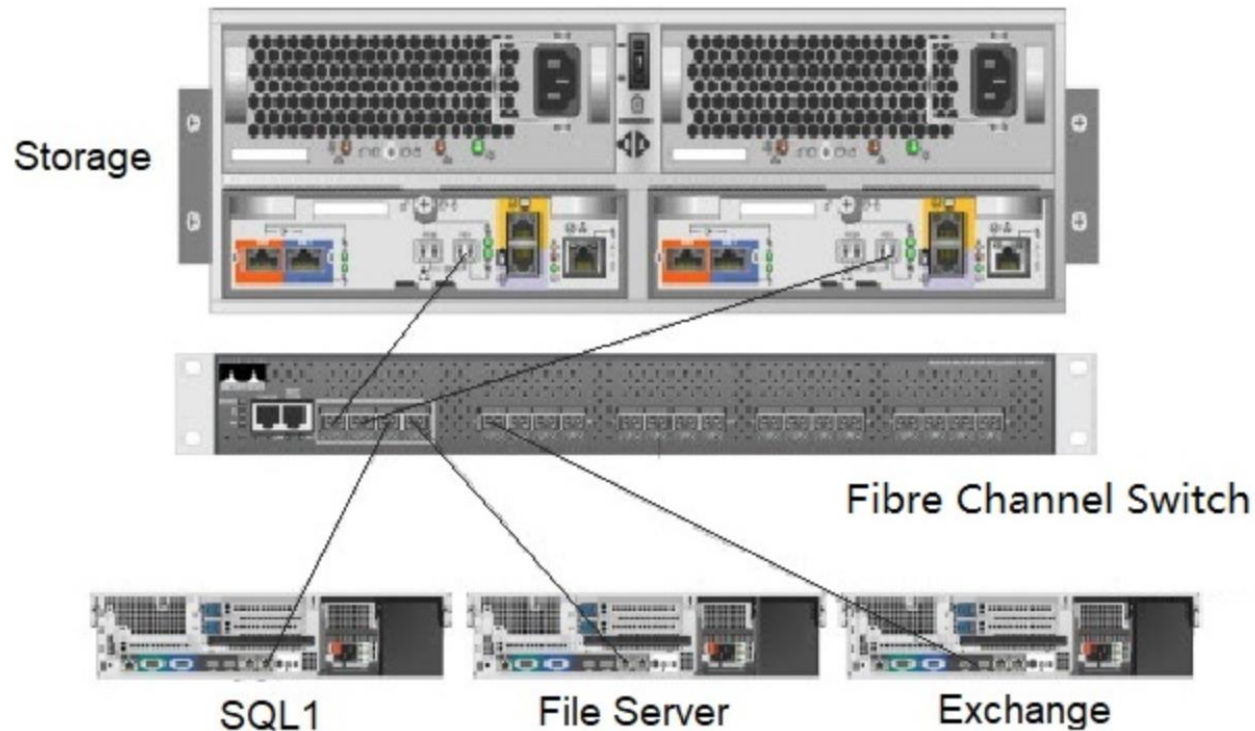
Storage area network (SAN)

A SAN (storage area network) is a network of storage devices that can be accessed by multiple servers or computers, providing a shared pool of storage space. Each computer on the network can access storage on the SAN as if this is a local disk attached to the machine directly. A SAN is made up of cabling, host bus adapters, and SAN switches that are connected to storage arrays and servers. Each switch and storage system on the SAN must be interconnected. [1]



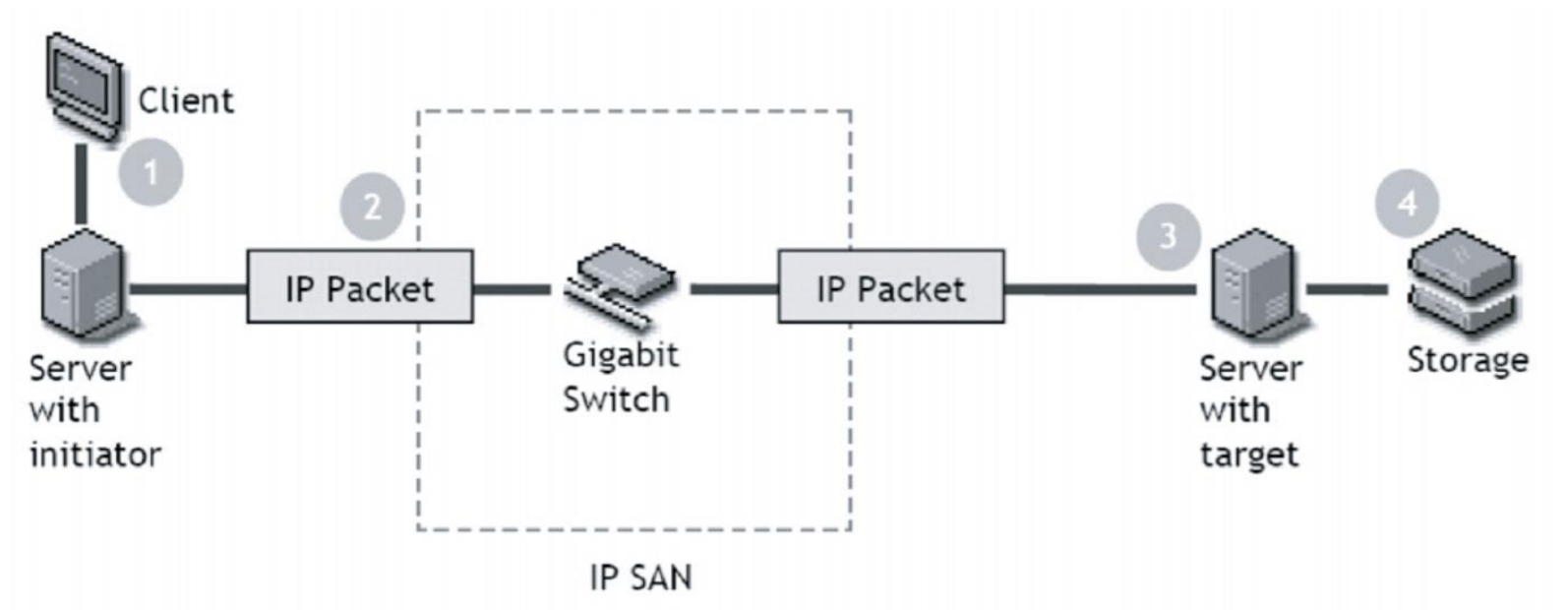
Fibre Channel

Fibre Channel (FC) is a high-speed network technology developed for storage area networks (SANs), connects computer data storage to servers through point-to-point, switching, and loop interfaces to provide in-order and accurate raw block data. An FC switch eliminates the need for every server to have a direct connection to every storage array and so reduces complexity. [3]

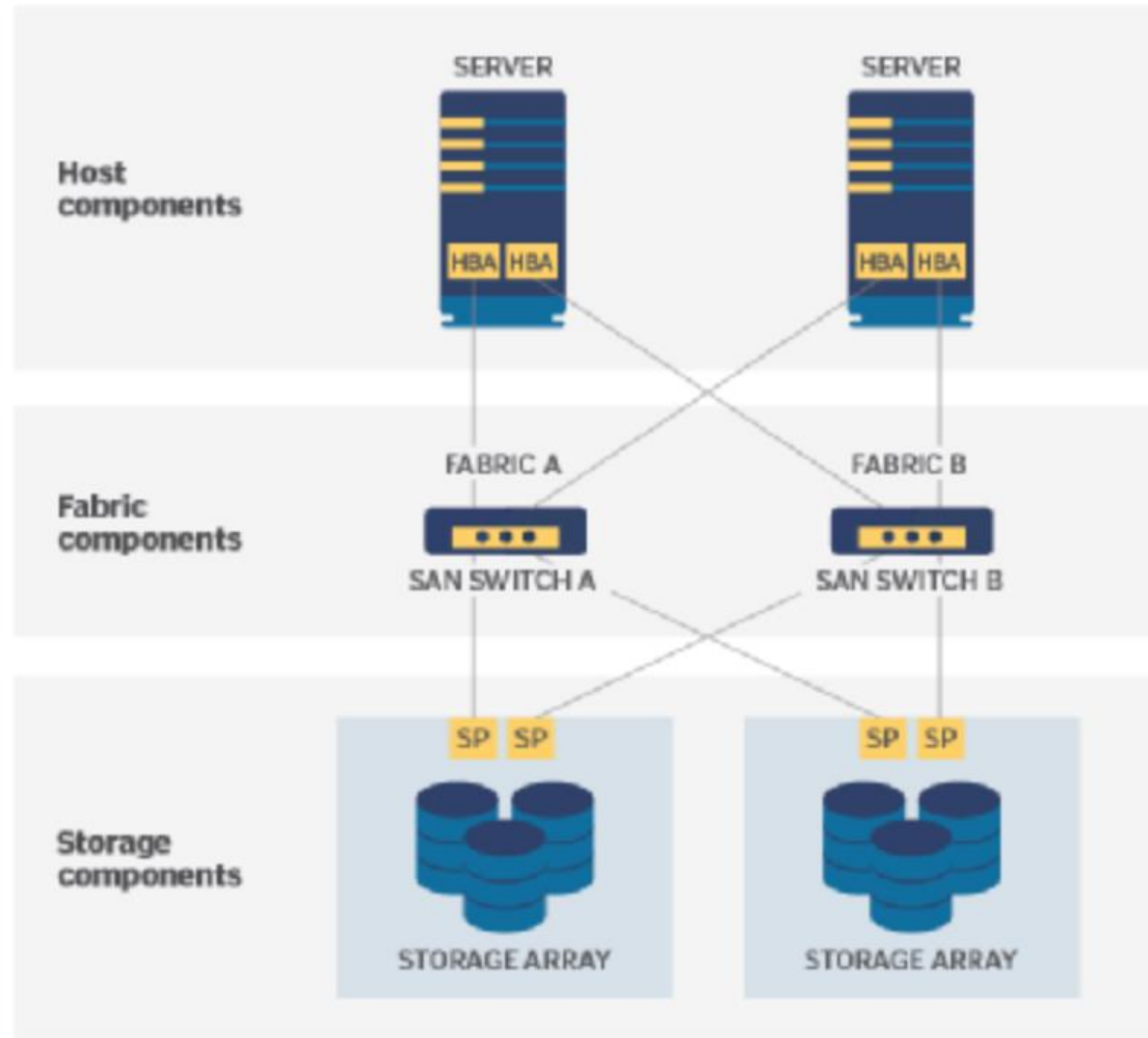


ISCSI

Another form of network that connects computing to shared storage is iSCSI. The Internet Small Computer System Interface (iSCSI) is a SCSI (Small Computer System Interface) transport protocol used to map block-oriented storage data over TCP/IP networks. It allows ordinary TCP/IP networks to provide universal access to storage devices and storage area networks (SANs). [4]



San component layers



Host Components

The servers and the components that allow the servers to be physically linked to the SAN make up the host components of a SAN.

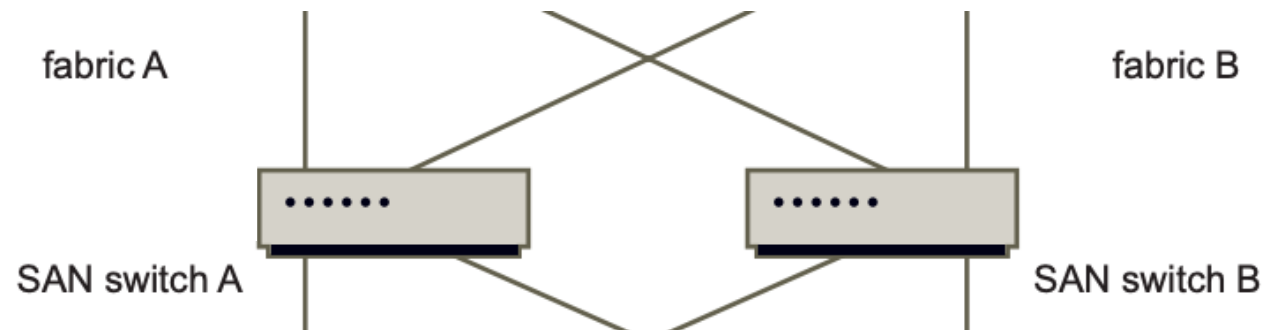
- Each host connects to the fabric ports through its HBAs. HBAs are located in the servers.
- HBA drivers on the servers allow the operating systems of the servers to communicate with the HBA.[6]



Fabric Components

The SAN fabric connects all hosts to the storage devices on the SAN. The following fabric components make up the SAN's network portion:

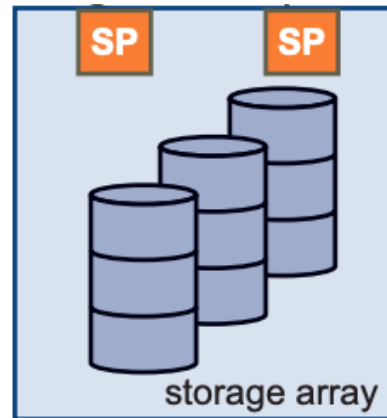
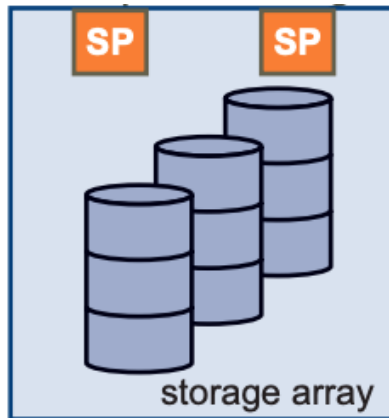
- **SAN Switches** - SAN switches connect servers, storage devices, and other switches, creating the SAN fabric's connection points.
- **Data Routers** - In the SAN, data routers act as efficient bridges between SCSI and FC devices.
- **Cables** - SAN cables are special fibre optic cables that connect all the fabric components together.
- **Communications Protocol** - Fabric components communicate using the FC communications protocol. [6]



Storage Components

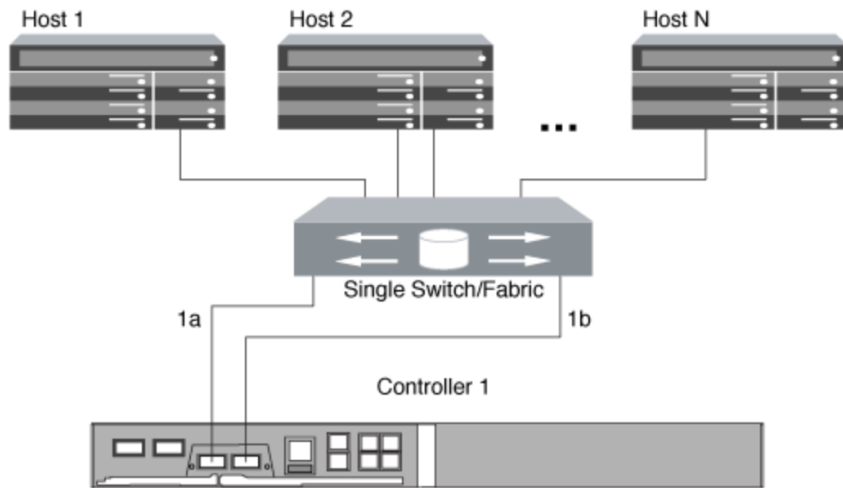
The storage components of a SAN are the storage arrays. Storage arrays include storage processors (SPs). The SPs are the front end of the storage array.

- Storage Processors - SPs provide front-side host attachments to the storage devices from the servers, either directly or through a switch.
- Storage Devices - Data is stored on disk arrays or tape devices (or both). Disk arrays are groups of multiple disk devices and are the typical SAN disk storage device.
- Tape Storage Devices - Tape storage devices are part of the SAN backup capabilities and processes. [6]

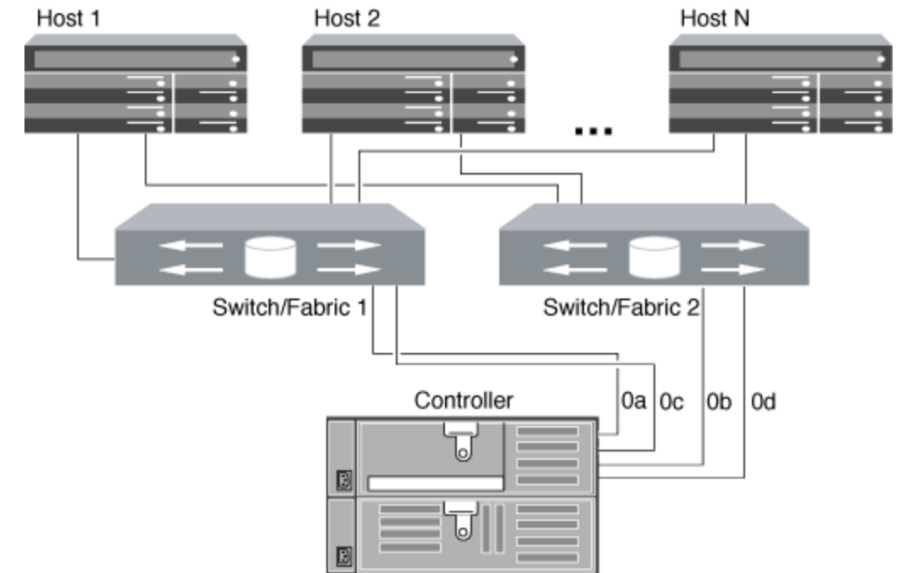


Node Ports

In a fibre channel, nodes are simply devices such as hosts, storage, and storage devices that operate as a source or destination for one or more nodes. Every node in the system has one or more ports via which it can connect with other nodes. Each node requires one or more ports in order to communicate with other nodes physically. [7]



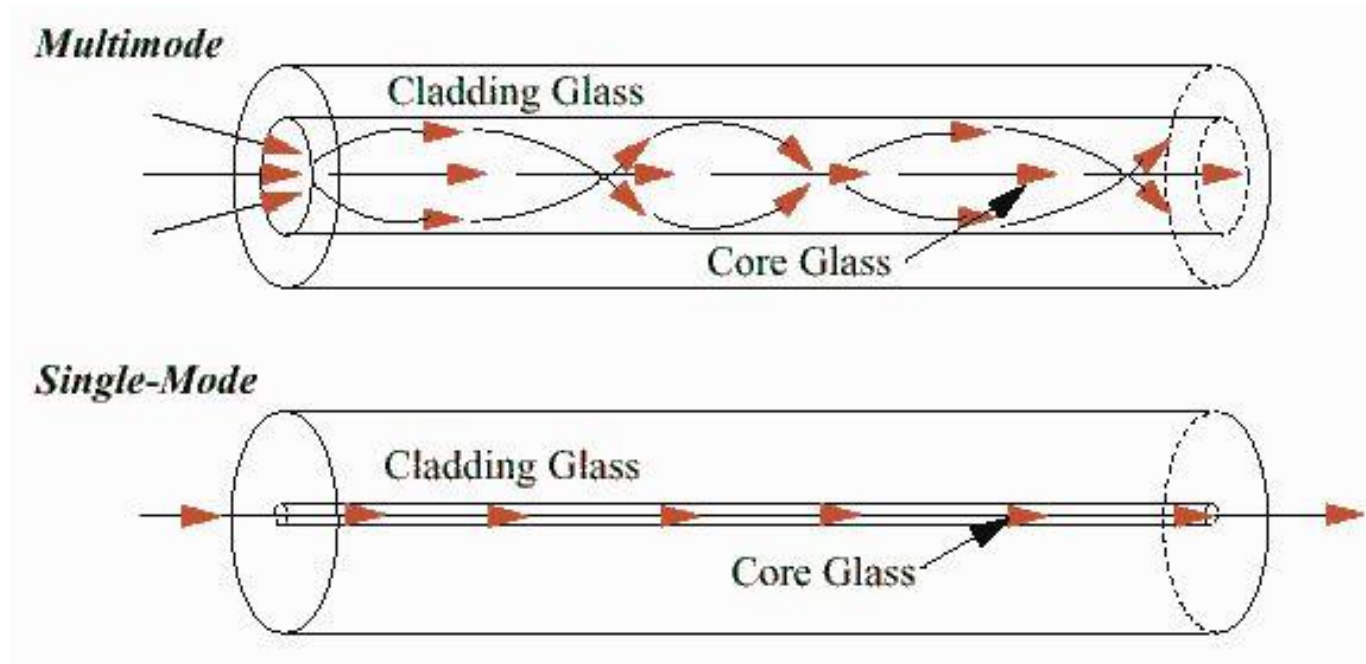
Single-fabric single-node configurations



Multifabric single-node configurations

Cabling

- Optical fiber cabling is used in the implementation of a Storage Area Network (SAN). Optical fiber cables, transport data in the form of light and are divided into two types: multi-mode optical cables and single-mode optical cables.
- Single-mode fiber (SMF) carries a single ray of light projected at the center of the core, whereas multi-mode fiber (MMF) carries many beams of light projected at different angles continuously onto the core of the cable. [8]



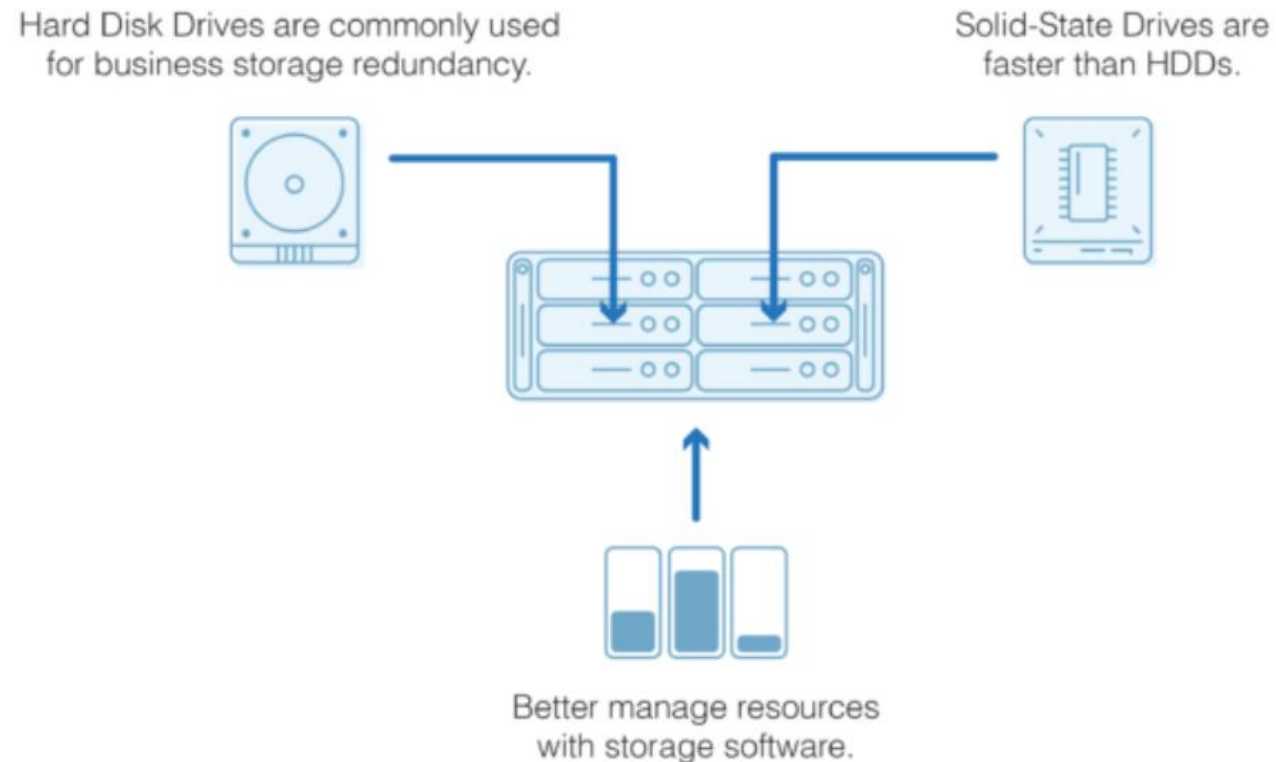
Interconnect Devices

Hubs, switches, and directors are the interconnect devices commonly used in SAN.

- ❑ Hubs are used as communication devices in FC-AL (Fibre Channel Arbitrated Loop) implementations. Hubs physically 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.
- ❑ Directors are larger than switches and are deployed for data center implementations. The function of directors is like that of FC switches, but directors have higher port count and fault tolerance capabilities. [9]

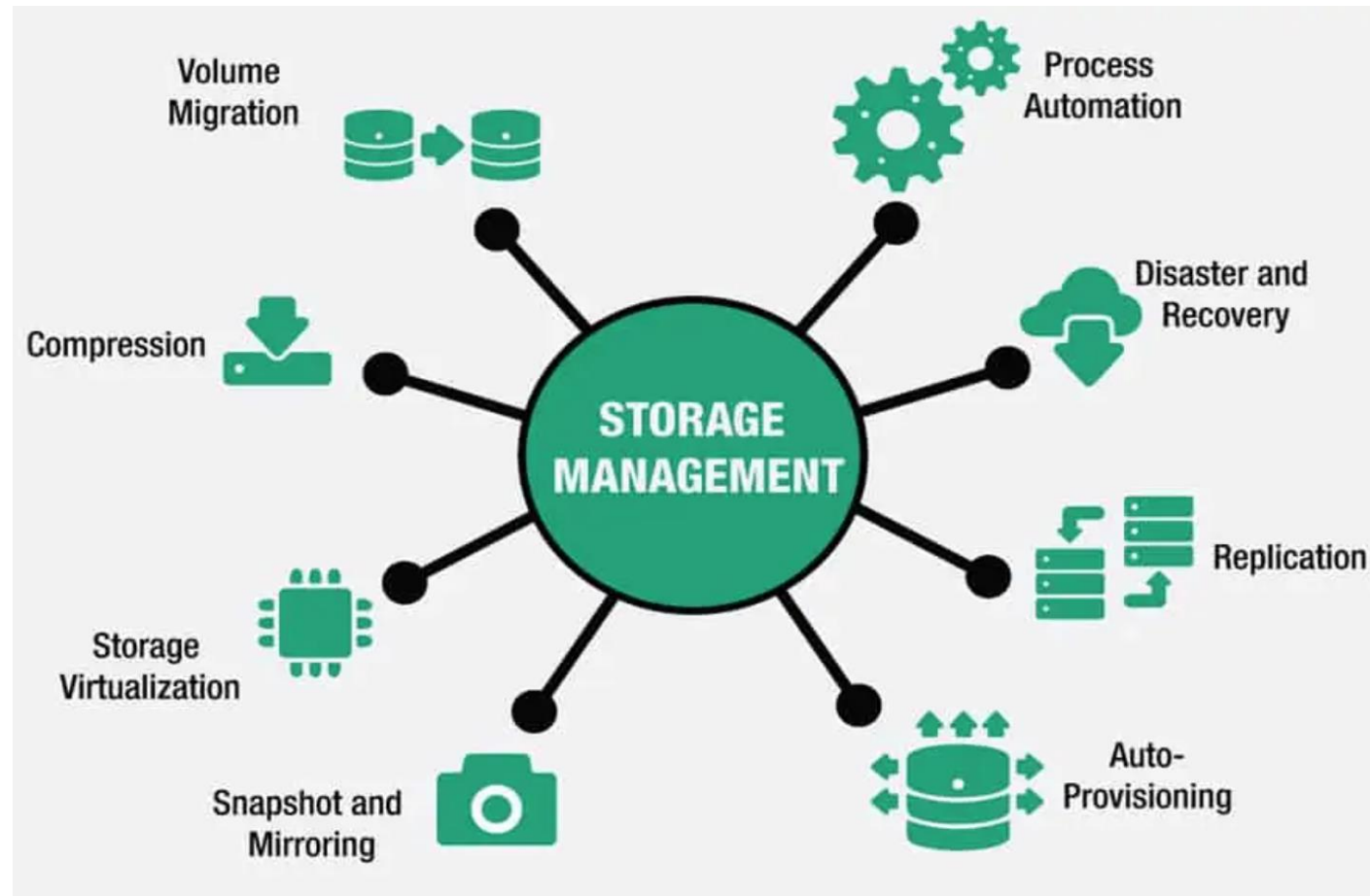
Storage array

A data storage system for block-based storage, file-based storage, is known as a storage array, sometimes known as a disc array. Instead of keeping data on a server, storage arrays employ a collection of many discs that can store a large quantity of data and are administered by a central management system.[9]



SAN Management Software

Storage Management Software is a system that manages and secures a data storage device and the data it store. [9]



Storage Performance Monitoring Tools

SolarWinds Storage Resource Monitor

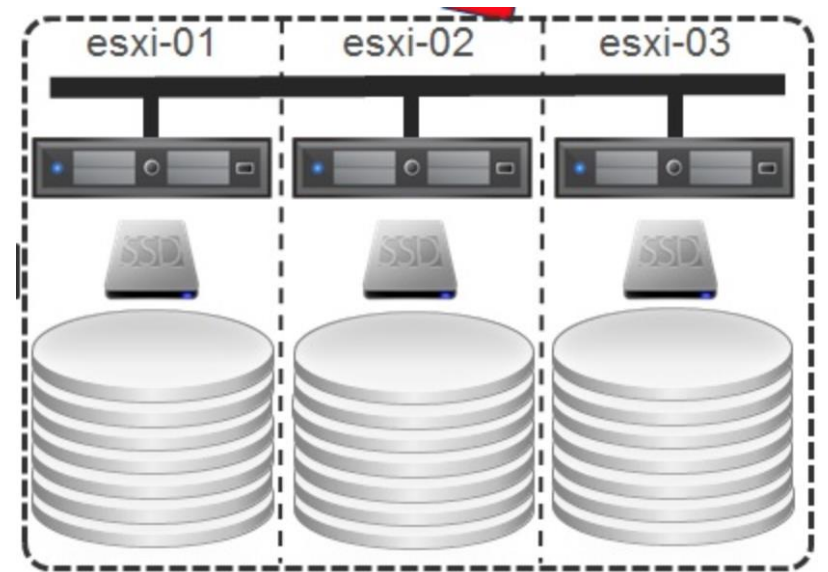
- SolarWinds Storage Resource Monitor software includes a user-friendly interface that delivers real-time storage monitoring for a variety of vendors. It can manage a large variety of virtual and physical storage devices.

IntelliMagic Vision for San

- Health information is one of the most important components of IntelliMagic Vision for San. This is an Intelligence system that keeps track of how SAN structures are being used in order to avoid them running out of space. A range of realtime storage performance data are displayed on the monitor's screen. Processing times, port activity, and throughput limits are just a few of the things to consider. If there is a rush in data transfers that exceeds normal patterns of activity, this system will raise warnings and alarms.

San Scalability

- Storage scalability is the ability to provide satisfied capabilities including storage capacity, performance and fault tolerance when a storage system is increased in size in order to meet the data requirements.
- The major advantages of using a SAN are increased flexibility and scalability. SANs allow multiple hosts to access disk storage within a single array through a single port, thereby reducing waste and increasing return on investment. [11]



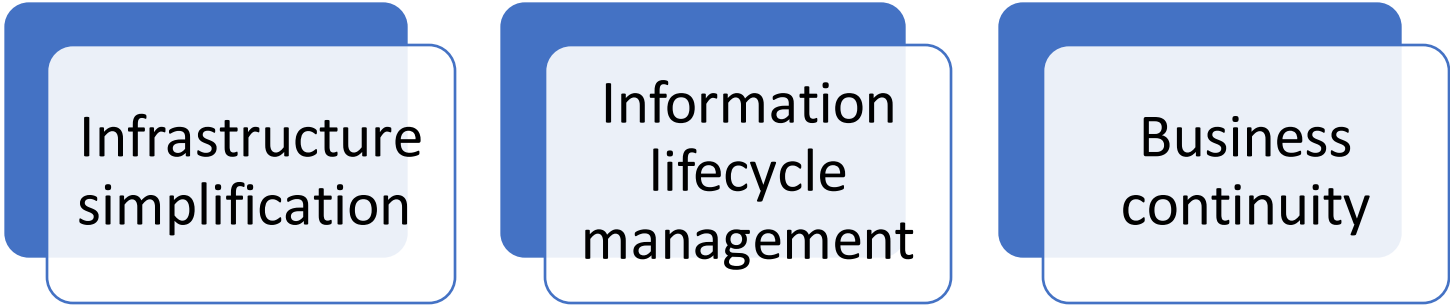
San security

Storage security is the fusion of storage, networking, and security disciplines, technologies, and approaches for the protection and security of digital assets. [11]

Some of the techniques used for securing a SAN infrastructure include:

- Encrypting data at rest when stored on a SAN infrastructure or storage drives;
- Isolating users/departments/organizations using a virtual SAN;
- Securing network and communication interfaces;
- Implementing an access control list (ACL) and digital certificates within the switch to ensure only authenticated switches join a SAN fabric;
- Removing and resolving single points of failure;
- Mitigating network-based vulnerabilities such as Simple Network Management Protocol (SNMP), which is vulnerable to Denial of Service (DoS) attack;

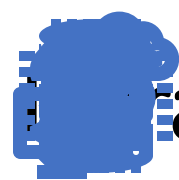
Key benefits



Infrastructure
simplification

Information
lifecycle
management

Business
continuity



Infrastructure simplification

Consolidation

Concentrating the systems and resources into locations with fewer, but more powerful, servers and storage pools can help increase IT efficiency and simplify the infrastructure.

Virtualization

Storage virtualization helps to make complexity nearly transparent.

Automation

Choosing storage components with autonomic capabilities can improve availability and responsiveness, and can help protect data as storage needs grow.

Integration

Integrated storage environments simplify system management tasks and improve security.



Information lifecycle management

Information lifecycle management (ILM) is a method of managing data across its life cycle, from creation to destruction. The ILM technique organizes this data in such a way that it saves space while yet providing a high level of accessibility at a cheap cost.

A SAN implementation makes it easier to manage the information lifecycle because it integrates applications and data into a single-view system, in which the information resides. This single-view location can be managed more efficiently.

Business continuity

- The business environment is increasingly competitive in today's on-demand era. Clients, employees, suppliers, and IBM Business Partners all want to be able to access their data from anywhere on the world at any time.
- Continuous business operations are no longer a luxury; they are a necessity for achieving success and keeping a competitive edge. Businesses must also be more sensitive to problems of customer privacy and data security in order to protect their critical information assets. [12]



NAS vs. SAN

	NAS	SAN
Fabric	Uses TCP/IP networks, most commonly Ethernet	Runs on high speed Fibre Channel networks
Data processing	Processes file-based data	Processes block data
Protocols	Connects directly to an Ethernet network Can use several protocols to connect with servers including NFS, SMB/CIFS, and HTTP	Uses SCSI protocol to communicate with servers
Performance	Generally has lower throughput and higher latency because of its slower file system layer	A higher performer for environments that need high-speed traffic
Scalability	Entry level and NAS devices are not highly scalable, High-end NAS systems scale to petabytes using clusters or scale-out nodes	Scalability is a major driver: its network architecture enables admins to scale performance and capacity in scale-up or scale-out configurations
Ease of management	Easier to manage: device easily plugs into the LAN and offers a simplified management interface	Requires more administration time than NAS
Price	In general NAS is less expensive to purchase and maintain, although a high-end NAS will cost more than an entry-level SAN	SANs are more complex to manage with FC SANs on top of the complexity heap

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