

SAN

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1 Storage area networks

A storage area network provides:
hosts (servers, desktops, workstations) with access to
consolidated **block-level storage**
by means of a **fabric**.

2 Layers

SANs are traditionally broken up into conceptual layers, .

Host layer: consisting of the servers / computers that access storage provisioned through the SAN.

Fabric layer: containing the networking cabling and hardware:

- hubs
- switching
- routing
- protocol converters

Storage layer: consisting of storage appliances such as disk arrays, tape drives.

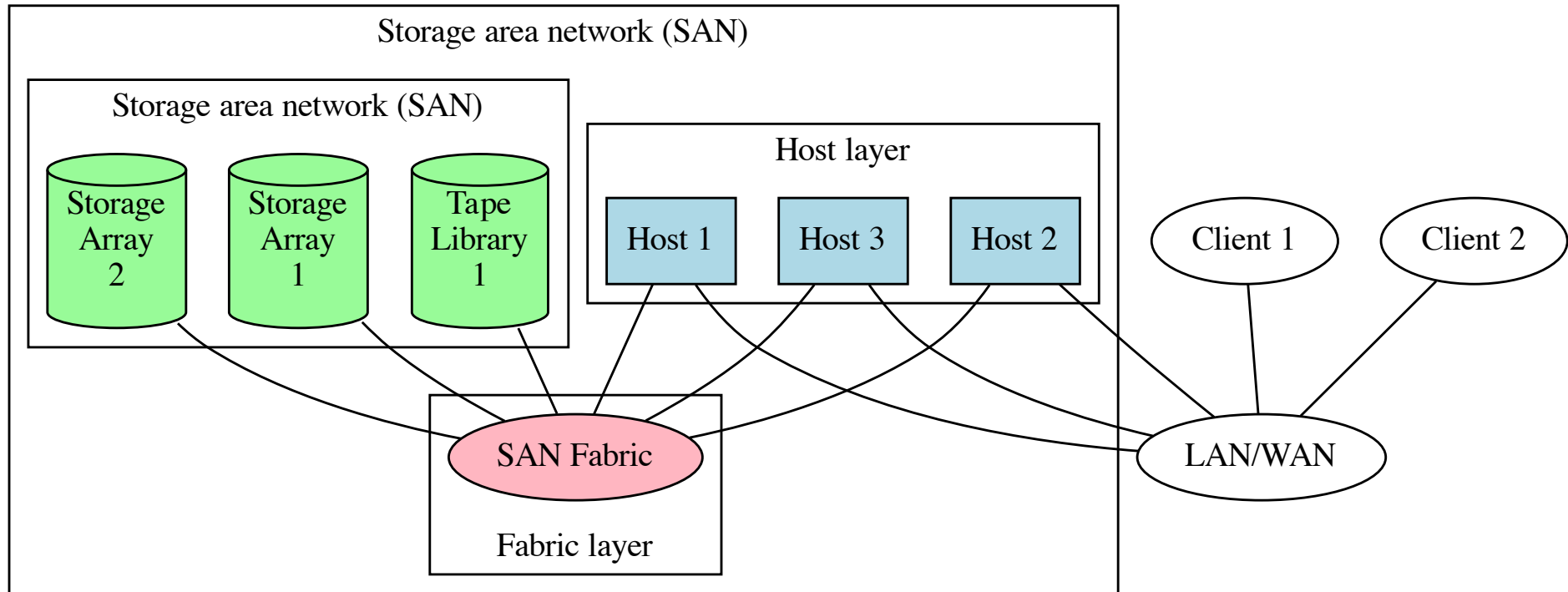


Figure 1: SAN architecture



Figure 2: SAN switch



Figure 3: Storage array

3 SCSI

Small Computer Systems Interface (SCSI) is a protocol used to connect (mainly) storage devices to a host.

Parallel SCSI using 50-pin and similar connectors

Serially-Attached SCSI (SAS) drives are often seen as direct-attached storage in servers.

Because the protocol is well standardised, it often forms the basis of SAN as it's easy to encapsulate across a network.

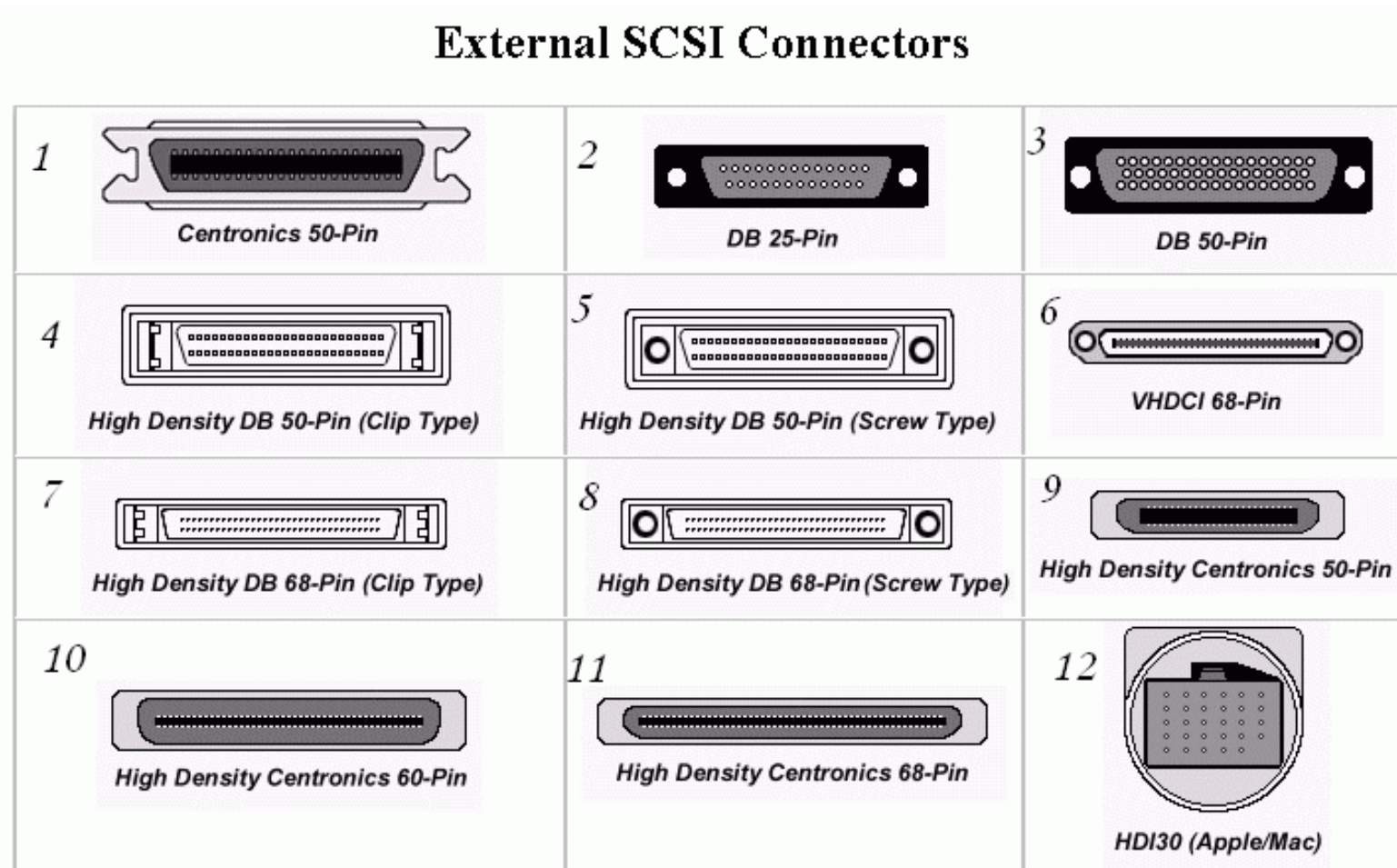


Figure 4: External SCSI connectors

4 SAN types

Fibre Channel encapsulates SCSI commands in Fibre-Channel Protocol (FCP) normally carried on optical fibre. Also Fibre-Channel Over Ethernet (FCoE) and Fibre-Channel over IP.

iSCSI encapsulates SCSI commands in iSCSI protocol on TCP/IP carried over standard IP network.

Multiheaded-SAS

5 Key concepts

- Storage appliances (like disk arrays) are set up with logical volumes. Due to historical SCSI terminology, these are called **Logical Unit Numbers (LUNs)**.
- A storage device exposes a **target** that has one or more logical block devices LUNs associated with it.
 - Nowadays, most storage appliances can expose more than one target. Helps later with access control.
- To access block storage over a SAN, a host's **initiator** connects to a specific LUN on a specific target:
 - The initiator is normally a Host-Bus Adapter. Like HBAs for DAS, HBA must match host's bus type and the type of SAN being used.
 - Can also have software-initiators for iSCSI and FCOIP.

- Although iSCSI and FCOIP are IP-based, HBA is separate to host's normal networking.
- The NIC and HBA can be combined on a single card known as a Converged Networking Adapter (CNA).

6 Usage points

- Normally, a LUN can be attached to only one host at a time.
- As a block device, the host OS is entirely in control of the LUN (e.g. formatting).
- With a SAN HBA, the host OS is unaware that the disk is not a locally-attached disk:
 - Boot-from-SAN possible with no local hard disk.
 - SAN can be transparently used on mission-critical legacy systems (like Xenix, OS/2).
- SAN can feature in backup configurations.

7 Non-shared storage

iSCSI conceptually just extends the physical disk drive cable over a network.

Just as we can't normally connect a hard disk to two computers at the same time, we can't *normally* have two initiators logged into the same LUN at the same time.

- No problem detaching a LUN from a host and attaching it to another.
- LUNs that are read-only can be simultaneously attached to multiple hosts.
- So-called clustered filesystems can permit multiple machines access to the same LUN at the same time.
- Some targets will permit only a single connection to a LUN. Others will permit multiple connections, and data corruption is bound to occur if this happens.

8 SAN vs NAS

A SAN is distinct from NAS in one key respect:

SAN \neq NAS

Specifically:

1. A **SAN** provisions a remote *block level storage* device for a host.
2. **NAS** provides a *remote file system*.

SAN and NAS are *complementary* technologies that address *different* use cases.