Network Storage

AN ALCATEL EXECUTIVE BRIEF

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Table of contents

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1. Introduction

Computers are amazing tools that people use everyday to produce mountains of interesting and valuable information, but for computers to be truly useful, there must be a way to save and distribute that data. Traditionally, a computer has floppy disks, hard disks, and even the modern CDR-CDRW and DVDR media for saving and storing files. Storage devices connected to a computer are called direct attached storage (DAS). Direct attached storage devices can be integrated into the computer case (for example, an internal hard drive), or they can be external (for example, an external tape drive).

Networking and the Internet have made the computer world a much smaller place and have made file sharing much easier. Vast amounts of information are transmitted across private networks, and even more is sent across the Internet. All that data must be stored, organized, and made available for access. Direct attached storage is powerful and relatively inexpensive, but its effectiveness is limited. A single server can process a finite number of requests, making the server itself a bottleneck in the network. Solutions such as RAID (redundant array of inexpensive [independent] disks), cluster servers, server load balancing, and distributed computing have all been created to help handle the huge numbers of information requests and open up the server bottleneck.

2. Network Attached Storage

Recent advances in the technology of storage devices and network appliances have led to the development of network attached storage (NAS) devices, which are relatively inexpensive storage appliances that are able to operate on IP networks. NAS devices provide file sharing and storage services and may also include advanced features such as RAID and redundant power to increase reliability.

NAS provides a centralized repository of stored data for servers and other clients and is flexible enough to support multiple operating systems simultaneously. NAS is also very scalable. Simply adding more capacity to an existing appliance or adding more units to the network increases the amount of available storage. NAS is an efficient way for enterprise networks to add storage capacity and offload general file sharing usage from servers.

NAS devices are relatively inexpensive and quality ranges from home-built units to fullfeatured commercial models. However, NAS devices lack the survivability that is often required in an enterprise network. Built-in RAID provides some

protection, but a fully meshed, redundant architecture of a storage area network may be more suitable for high demand, mission critical applications.

3. Storage Area Networks

Storage area networks (SANs) are another option for network-based storage. A SAN is a self-contained network consisting entirely of servers and storage devices. The devices in the SAN are connected by a high-speed, high-capacity network. Currently, fibre channel is the most popular technology for SAN implementations because of its high-speed nonblocking architecture, its ability to scale from 133 Mbps to 1 Gbps and beyond, and its flexibility, which allows many different high-level protocols (IP, ATM, etc.) to operate over its infrastructure. These combined strengths make fibre channel a fast, stable, and flexible technology for creating storage area networks.

4. SAN Topology

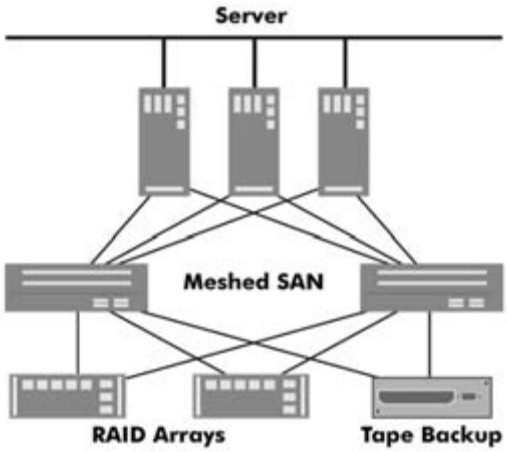
Configuration makes a large difference in the reliability, performance, and cost of a SAN. A SAN is typically based on one of two topologies, arbitrated loop or switched fabric, as explained below.

4.1 Arbitrated Loop

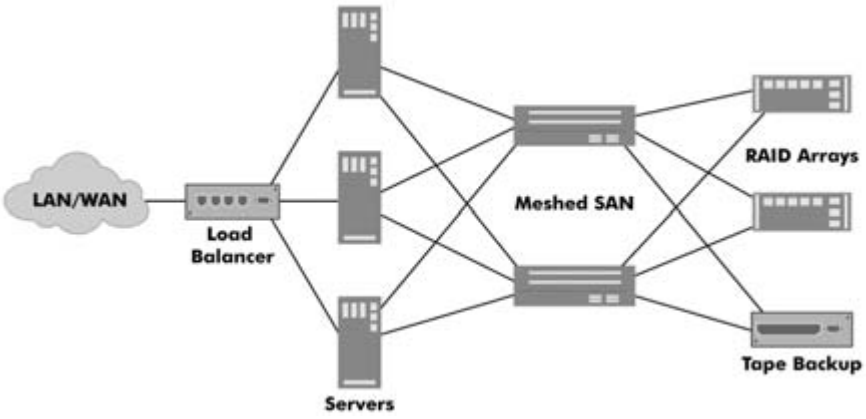
An arbitrated loop is a classic ring topology with mechanisms to manage traffic flow. Each device on the loop shares the bandwidth of the network through a fibre channel hub. An arbitrated loop is a fairly inexpensive configuration for small and medium sized SANs. However, if the number of devices gets too large, the network may become bogged down due to limitations in how data is passed and the bandwidth is shared between all devices. For large configurations, a switched fabric architecture may be a better solution.

4.2 Switched Fabric

Fabric switches provide full duplex communication between all devices in the SAN. Fabric switches are considerably more expensive than an arbitrated loop hub, but in a fully meshed switched fabric configuration every device on the SAN has an independent connection to every other device, creating a non-blocking architecture as well as fully redundant network connections. However, switched fabric becomes more expensive as the SAN gets larger due to the need for redundant links and the cost of the fabric switches, and that can limit scalability.



primary benefit of the fully meshed architecture is that fibre channel provides any-to-any communication between servers and storage devices, allowing different types of servers the ability to access the same resources. With centralized data storage, less equipment is required, overall network complexity is reduced, and network and resource management is simplified. For instance, a large server farm could have a hundred servers, all of which have internal storage. Configuring, updating, and upgrading each system would be a costly nightmare. Using centralized storage allows each server to draw upon a central resource that is more reliable than regular DAS and easier to maintain because it can be monitored and configured through a single management system.



Each server will still have internal storage for the operating system, but the vital information will be contained on the SAN so if one server goes down because of a failure, or for simple maintenance, a failover mechanism like server load balancing can redirect the request to another server attached to the same SAN, and the alternate server can field the request by accessing the same information.

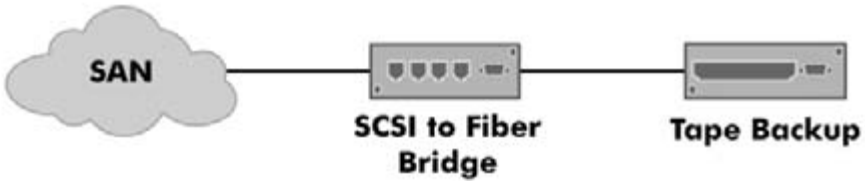
However, even in simple networks, the potential exists for systems to fail and problems to occur. Measures such as redundancy and backups can help make SANs more reliable.

5. Redundancy

The use of RAID in the individual storage devices adds to the survivability of the resources in DAS, NAS, and SAN storage devices. However, RAID may not allow for complete recovery from a failure. Redundancy in network components, such as an extra power supply, can add another level of protection, and redundant links between components can help. In some cases, mirroring a storage device may be prudent as well. Ultimately, however, in the face of an unrecoverable malfunction a full backup is the only way to recover lost data.

6. Backup

Tape backup devices are part of the storage strategy in most enterprise networks. They provide the last line of defense when a storage device fails. High-end tape backups are typically a form of SCSI (Small Computer System Interface) devices. SCSI devices make excellent DAS devices and can be configured to be NAS devices, and they can even be integrated in a SAN. SCSI-to-fibre channel bridges are available to attach any SCSI device (not just a tape backup) to a SAN. The interface does have limitations, one being bandwidth. The typical SAN operates at approximately 100 Mbps or more, while a typical bridge provides 50 to 80 Mbps of bandwidth to the SCSI device. The limitations are outweighed by advantages such as cost savings from using existing hardware and the capability to make backups of the storage devices.



7. Conclusion

Each type of storage has its place and its own strengths and weaknesses. The type of storage implemented and the level of complexity of the solution depends on factors such as capacity, reliability, and cost. Proper planning for future growth and disaster recovery should be taken into consideration as well.

The main function of enterprise-level network storage is to provide reliable, high-speed, high capacity data storage and retrieval services. It can increase overall reliability of the network storage, reduce server congestion, provide scalability, as well as simplify the management and maintenance of the storage system.

Appendix A: Abbreviations and acronyms

ATM	Asynchronous Transport Mode
CDR	compact disk recordable (one time recordable CD)
CDRW	compact disk recordable / writable (rewritable CD)
DAS	direct attached storage
DVDR	digital versatile disk recordable (one time recordable DVD)
Gbps	gigabits per second
IP	Internet Protocol
Mbps	megabits per second
NAS	network attached storage
RAID	redundant array of independent disks
SAN	storage area network
SCSI	Small Computer Systems Interface

Appendix B: Sources for further information on network storage

Storage Networking Industry Association
http://www.snia.org/home

Fibre Channel Industry Association
http://www.fibrechannel.com/