

NAS or iSCSI?

Selecting a storage system

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A growing market: Network storage technologies

Worldwide, over 50 petabytes (5×10^{16} bytes) of data are generated every day that have to be safely stored, economically managed, and quickly and efficiently made available to applications and users when required. In 2004, this steadily expanding data volume amounted to 1.5 exabytes (1.5×10^{18} bytes) - and it is still growing.

One storage heavyweight, for example, is the San Diego Supercomputer Center (SDSC) in the USA: Hard drives there store approximately one petabyte of data; another six petabytes are kept in a tape archive. Another example is the Deutsches Elektronensynchrotron (DESY) in Hamburg, which generates 100 terabytes of raw data with each experiment. But even in non-scientific everyday work, hundreds of terabytes of storage volume are not uncommon: The data centre of the Klinikum Oldenburg (Oldenburg Clinic), for example, has to deal with 20 gigabytes of data every month in the form of electronic patient files.

So it's no surprise that market forecasters are predicting excellent growth rates for storage. Figures from IDC's latest market research show: From 2005 to 2008, sales of **NAS** machines will increase annually by almost 15%, and sales of **iSCSI** solutions annually by an impressive 170%. At an increase of 785% over the entire period, the data volume for **NAS**- and **iSCSI**-based low-cost disk systems will increase almost eight-fold!

IDC expects the market share of **NAS/iSCSI** to grow from 13.7% of sales in 2005 to 30.2% of sales in the year 2008. In terabytes, **NAS/iSCSI**'s market share will increase from 24.9% to 42.5%!

Thanks to more powerful drives with higher capacities, the price of storage space will however decrease by 30% every year. So while sales in the low-cost disk systems market (**NAS/iSCSI**) will be growing by 190% annually between 2005 and 2008, the data volume on **NAS** will be growing by 370%, and that on **iSCSI** by a stunning 2475%!

Introduction to storage systems

DAS, **NAS** and SAN differ mainly in where they interface with the network.

There are currently three basic solutions for addressing the storage problem:

- Direct Attached Storage (DAS),
- Network Attached Storage (**NAS**) and
- Storage Area Networks (SAN).

De facto, no computer system can do without mass storage – mainly hard drives. But how these storage media are connected has changed drastically over the course of their development.

Introduction to storage systems

Direct Attached Storage

While DAS, depending on the operating system, does offer all options for storage access, be it at file or block level, the importance of DAS systems on the market is shrinking. Although the market itself is still growing by 29% annually, the need for storage is increasingly being covered by **NAS** and **iSCSI** systems. Direct Attached Storage is a system of hard drives addressed directly via system buses within the computer (IDE, SCSI); the network interface is managed by the operating system. As these buses can only bridge short distances within the decimetre range, DAS solutions are limited to the respective computer casing. Depending on the bus type, DAS systems are also restricted to a relatively small number of drives - Wide-SCSI achieves the maximum of 16 directly addressable drives.

Network Attached Storage

NAS appliances function as pure file servers controlled by their own integrated network operating system. Memory is organised by file sharing, meaning that access to data is only possible at file system level.

Storage Area Networks

Storage Area Networks (SAN), which also include **iSCSI**, are not limited to shared files. This technology, which is also known as IP-SAN or Storage over IP for storage networks, specifies how direct storage protocols can be operated natively via IP. The procedure encapsulates SCSI data into TCP/IP packets and transports them via IP networks. An SCSI router transports the encapsulated SCSI commands to the corresponding target system on the basis of existing mapping tables. So **iSCSI** allows access to the storage network via a virtual end-to-end connection without having to set up separate storage devices.

Decision support for choosing a storage system: NAS or iSCSI?

This document aims to help system administrators decide between the two storage technologies **NAS** and **iSCSI**, which includes the IP-SAN, SAN and DAS varieties. Both technologies were developed to help cover the exponentially increasing need for storage capacity by means of external, scalable storage devices that can be networked if necessary.

In any company, the use of storage solutions will depend on a number of different factors:

- the available budget
- requirements regarding powerful storage systems such as DAS, **NAS** or SAN
- requirements regarding a powerful network infrastructure
- requirements regarding data availability etc.

Within these basic considerations, system administrators must decide which technology and which products are best suited to meet their needs.

Areas of application for **NAS**

In which cases the use of **NAS** systems is advisable depends on which applications are to be used. Possible applications include:

- Near-line storage,
- disk-to-disk backup,
- cache backup,
- joint access to Office documents (document sharing),
- gateways between different operating systems such as Windows and Mac OS and
- central file servers for simple networks with no special requirements.

Advantages

NAS systems offer a number of advantages:

NAS systems require no expensive hardware. As **NAS** applications are undemanding in terms of processing power, an Intel Celeron processor will usually suffice to operate a **NAS** server.

A **NAS** appliance already provides a file server. Therefore a **NAS** appliance can easily be operated as a basic file server in a simple network. Additional servers, such as are required for **iSCSI**, are not necessary.

NAS appliances provide excellent support for a wide range of file access protocols, so they greatly simplify data exchange in heterogeneous networks.

NAS appliances are very easy to use. They are simple to administrate, even remotely, i.e. from another location.

NAS appliances already include integrated mechanisms for backup, data synchronisation and data replication.

Areas of application for NAS

Disadvantages

The main disadvantages of **NAS** systems are listed below:

NAS systems are not 100% compatible with Microsoft Access Control Lists (ACL).

With the exception of SQL, most database systems, such as Oracle or Microsoft Exchange, cannot work with filers, i.e. file servers, such as **NAS** appliances constitute.

Data backup and replication are only ever possible on a file basis with **NAS** devices.

Areas of application for iSCSI

iSCSI stands for Internet Small Computer System Interface, a technology that extends the Internet Protocol to Storage Area Networks (SAN).

Due to its ability to address storage media at block level, **iSCSI** technology can directly replace hard drives, e.g. for diskless workstations or thin clients. However, **iSCSI** is not an economic alternative to general DAS systems.

Particularly for small and medium-sized businesses however, **iSCSI** represents a more affordable technology that offers similar advantages to fibre channel. Firstly, **iSCSI** allows small and medium-sized businesses to remain in their familiar TCP/IP Ethernet environment. The technology is less complex than fibre channel, the protocols, hardware, suppliers and management tools are already familiar, and in addition connections over IP are possible to any location, no matter how remote.

iSCSI enables applications that were previously only possible with fibre channel - for example disk-to-disk backups, clustering or storage replication. This means it even allows centralised backup and recovery of data at locations connected online – although licence fees must be paid for the necessary software. The flexibility in allocating memory and the associated higher storage resource utilisation of a storage network should not be underestimated. While a SAN will have a utilisation of 70 to 85 percent, DAS will only reach 30 percent. The added value of a storage network is far greater than that of DAS because it prevents the uncontrolled growth of systems with high but unused capacity.

Of course **NAS** systems can also be implemented via **iSCSI**, but from a financial point of view this only makes sense if an **iSCSI**-based storage solution is to be set up anyway. On the other hand, **iSCSI** targets can also extend the storage capacity of a **NAS** server - although this requires an **iSCSI** initiator on the **NAS** server.

Areas of application of iSCSI

A striking advantage: Within an operating system - here Windows XP - iSCSI displays storage space on the network as a local drive, and also allows it to be used like one as far as network performance permits.

Advantages

The main advantages of iSCSI systems are most apparent in their flexibility when used in large system environments:

iSCSI storage appliances can be seamlessly integrated into existing SAN environments,

iSCSI can be used for high availability and high performance clusters,

iSCSI can also be configured as a particularly flexible DAS system – the local SCSI bus is so to speak extended by the network.

Areas of application for iSCSI

Advantages

iSCSI even works with database applications such as Oracle or Microsoft Exchange,

iSCSI allows easy data mirroring over an IP network (as does SCSI itself),

iSCSI offers integrated MPIO (Multi-Path I/O) characteristics,

iSCSI is fully compatible with the respective operating system it uses, and

iSCSI allows the creation of huge storage pools with volumes in the range of several tera- or petabytes.

Disadvantages

The main disadvantage of iSCSI lies in its significant hardware requirements:

The demands of accommodating SCSI commands and SCSI data packets in TCP/IP packets require extensive hardware resources: CPU performance should be at least that of a 3 GHz Pentium processor, Gigabit Ethernet (GbE) should accordingly be used as a network interface, and the RAM requirement is also significant.

As opposed to NAS technology, iSCSI technology is not available in stand-alone appliances. It rather requires either an additional server or specific (client) software for shared data access, for example Melio FS by Sanbolic, Tivoli SANergy by IBM, StorNext FS by Adic, InfiniteStorage Shared Filesystem CXFS by SGI, or the PolyServe or DataPlow file sharing tools.

The file system used by an iSCSI system depends on the operating system it runs on; shared file access over the network therefore requires an additional software instance for clients with other operating systems.

Another disadvantage are the costs of licensing fees that arise for the additionally required file sharing or management software.

Summary

Network Attached Storage (NAS) is the obvious choice of storage solution wherever the main focus is on storing and archiving files and joint access to these over a network – even from different client operating systems. Small and medium-sized businesses, typing pools, legal or agency offices, and even end users with large amounts of multimedia files will find an affordable storage solution for their needs in NAS.

For storing database systems - other than SQL-based database systems - on a network, Network Attached Storage is however not a feasible solution. For requirements of this type the industry has developed the Storage Area Network (SAN) technology, which can often be implemented using iSCSI components. Advantages of iSCSI: An IP-based SAN allows administrators to use their familiar management tools and security mechanisms and rely on their existing know-how. However, iSCSI only makes sense in connection with a fast LAN infrastructure: At a throughput of approximately 120 Mbyte/s, the performance of a 1 Gbit Ethernet will be sufficient for database applications for approximately 100 users (data volume: approx. 15 MByte/s). Only high-end storage systems will require a 10 GbE infrastructure.

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