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Both NAS and SAN are based on storage systems with multiple hard drives, but differ in architecture and areas of application
(Source: Toshiba Electronics Europe)

NAS vs SAN: A Comparison of Storage Architectures

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Data volumes in organisations are expanding rapidly. What strategies are needed to ensure that users and systems can consistently access all information? For network-based storage, two architectures - NAS and SAN - have proven themselves, each with unique strengths and weaknesses.

Digital workflows are accelerating the surge in data across organisations, as not only people and applications but also AI-based bots, sensors, and machines generate increasing amounts of data. Storing this data is becoming more complex - not only because all information must be stored reliably and cost-effectively, but also it must remain accessible for users and systems. If access is disrupted, such as by storage failures or congested connections, critical processes may come to a standstill, often with far-reaching consequences for reputation and revenue.

Two architectures have become established for storing and providing data within organisations: NAS (Network Attached Storage) and SAN (Storage Area Network). Both have strengths and weaknesses and are suited to different requirements. Put simply, NAS is usually the better option for storing unstructured data and shar-

ing files. It is also relatively inexpensive and easy to manage. A SAN, on the other hand, does not work with files but with fixed-size data blocks that are addressed directly, which suits databases. It delivers higher, more predictable performance, not least because a dedicated network must be set up, making it the better choice for many business-critical applications. However, a SAN is more expensive than a NAS and significantly more complex, making administration more demanding and requiring more extensive expertise.

Since organisations typically have more than one use case, it is worth looking at the details to make an informed decision.

1. Advantages and Disadvantages of NAS

A NAS is a storage system that can be easily integrated into a network via a LAN cable and is comparatively simple to set up and manage thanks to intuitive management interfaces. As a result, it serves as central storage for files and backups in many households, shared offices, workgroups and small businesses, but is also suitable for enterprise use. In such cases, rack-mounted systems are usually employed instead of compact desktop devices, often accommodating a dozen or more drives. In both scenarios, a NAS provides high capacity at low cost and can be easily expanded as storage requirements grow: desktop devices through additional drives or dedicated expansion units (scale-up), and rack-mounted systems also by adding full NAS appliances (scale-out), enabling significantly greater overall capacity.

To ensure data remains available in the event of a drive failure and that staff and applications can continue accessing it, organisations should configure drives in a RAID array. Data is then mirrored (RAID 1), meaning it is stored twice, or distributed across drives along with parity information that allows lost data to be reconstructed (for example, RAID 5 and 6). Larger combinations of these RAID levels are also possible (such as RAID 10, 50 and 60). Importantly, RAID does not replace backups, as a NAS can fail entirely, malware can render data unusable, or an employee may accidentally delete important files. RAID merely improves availability and performance - how much depends on the RAID level used.

A RAID 10 configuration with four hard drives can deliver 500 to 700 MB/s, exceeding the capacity of Gigabit Ethernet (GbE), which can handle around 100 MB/s. Organisations with older networks, therefore, cannot fully utilise the transfer rates of most NAS systems. With four to ten drives, at least 10 GbE is required; with 50 HDDs or more, 100 GbE is essential to avoid network bottlenecks. Furthermore, a NAS shares the same network as clients and servers, which can potentially slow down users and applications during large data transfers.

2. Advantages and Disadvantages of SAN

In a SAN, concerns about network limitations or storage traffic affecting other LAN traffic do not arise. Here, storage systems are connected to servers via a dedicated network to ensure high and consistent performance. Traditionally, connectivity is provided via Fibre Channel (FC), which requires specialised expertise for setup and management and entails additional investment. However, iSCSI SANs using standard Ethernet hardware have also become common as a more cost-effective and easier-to-manage alternative. These cannot match FC SANs in terms of throughput and latency and are therefore used where maximum performance and minimal response times are not critical.

The storage systems in a SAN typically consist of disk and flash arrays combined into a virtual storage pool that is managed centrally. Servers require a Host Bus Adapter (HBA), similar to a network interface card for

LAN access, to connect via FC. Storage pools offer considerable flexibility in provisioning capacity for applications and can be easily expanded by adding further arrays. RAID configurations, data replication, multi-pathing and load balancing can significantly enhance data availability and performance. However, this is not suited to small implementations - if only a few applications or servers access the storage simultaneously, a SAN cannot fully demonstrate its advantages in performance, reliability and flexibility.

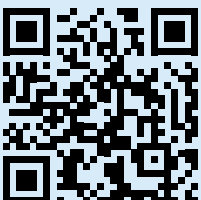
3. NAS or SAN?

Ultimately, the choice between NAS and SAN depends on specific requirements and the available budget. NAS is more affordable and ideally suited as storage for employee file shares, media archives, backup targets, repositories for unstructured IoT data, and applications with modest performance needs. SAN is more expensive but preferred for performance-intensive, business-critical applications such as databases, virtualisation, ERP and CRM systems. If in-house expertise or staffing resources for setting up and managing a SAN are lacking, an external service provider will also be required.



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