Backblaze

The Complete NAS Guide

Contents

Overview

As your business grows, the amount of data that it needs to store and manage also grows. Storing this data on loose hard drives and individual workstations may meet your needs early on, but as you expand, an ad hoc approach becomes more frustrating, less functional, and riskier long term. You need ready data access, protection from loss, and the capacity for future growth. One of the best ways to provide all three quickly and easily is with network attached storage (NAS).

This guide outlines:

- **What NAS is and how it can be used.**

- **The benefits of upgrading to a NAS system.**

- **How to evaluate a NAS system and make a purchase decision.**

- **How and why to integrate NAS with cloud services.**

- **How to deploy a NAS system.**

Purpose

So, why do you need a guide when you're exploring NAS systems? There are a few reasons this guide may be useful for you:

1 Understanding how NAS works can help you determine if it's the right choice for you.

You might have heard that NAS can help streamline your data infrastructure, but you're not sure where to start. Having a basic understanding of what NAS does and how it's used can help you make an informed decision.

2 Knowing the benefits of NAS reinforces the business case for your investment.

If this is your first NAS purchase, knowing exactly how a NAS system can benefit your business can help you understand and justify the investment.

3 Provisioning the right NAS for your needs is relatively complex.

With a multitude of options available, making a NAS buying decision can be overwhelming. We've included a number of considerations that will help you make the best choice for your business in terms of capacity, performance, speed, and features.

4 Deploying your NAS device using best practices makes a huge difference in its utility and functionality.

A NAS device is an investment, and you need it to perform at its best. Setting it up properly can help you get the most out of your investment, ensuring you have an easy-to-use, functional system that works for years.

Investing in a NAS system is a big step for a growing company or entrepreneur. This guide is intended to make navigating the buying decision and implementation process as easy as possible.

Do I Need NAS?

Understanding whether you need a NAS system is one of the first questions to answer as you start exploring more sophisticated data storage options for your business. In this section, we'll help you answer that question by explaining what NAS is, how it can be used, the benefits of upgrading to a NAS device, and how NAS differs from other technology.

What Is NAS?

NAS is a computer connected to a network that provides file-based data storage services to other devices on the network. It's primarily used to expand storage capacity and enable file sharing across an organization. The primary strength of NAS is how simple it is to set up and deploy. NAS volumes appear to the user as network mounted volumes. The files to be served are typically contained on one or more hard drives in the system, often arranged in a RAID (redundant array of independent disks) scheme. Generally, the more drive bays available within the NAS, the larger and more flexible storage options you have. The device itself is a network node—much like computers and other TCP/IP devices, all of which maintain their own IP address—and the NAS file service uses the Ethernet network to send and receive files. Although a NAS device is usually not designed to be a general-purpose server, NAS vendors and third parties are increasingly offering other software to provide server-like functionality.

NAS devices offer an easy way for multiple users in diverse locations to access data, which is valuable when users are collaborating on projects or sharing information. NAS provides good access controls and security to support collaboration, while also enabling someone who is not an IT professional to administer and manage access to the data via an onboard web server. It also offers good fundamental data resiliency through the use of redundant data structures—often RAID—making multiple drives appear like a single, large volume that can tolerate failure of a few of its individual drives.

How Does RAID Work?

A redundant array of independent disks, or RAID, combines multiple hard drives into one or more storage volumes. RAID distributes data and parity (drive recovery information) across the drives in different ways, and each layout provides different degrees of data protection.

NAS Use Cases

The first two NAS use cases are fairly straightforward. They are exactly what NAS was built for:

File Storage & File Sharing

NAS is ideal for centralizing data storage for your business and making files available to multiple users.

Local Backups

NAS can serve as a storage repository for local backups of machines on your network. Most NAS systems have built-in software where you can configure automatic backups, including what you back up and when.

But that's not all NAS can do. With large storage capacity and a whole host of add-ons, NAS offers a lot of versatility. Here are a few additional use cases that you can take advantage of:

Host business applications

Small to medium-sized businesses find NAS useful for running shared business applications like customer relationship management software, human resources management software, messaging, and even office suites. Compared to expensive, server-based versions of these applications, they can install and run open-source versions quickly and easily on NAS. Some NAS devices may have these features built in or available on a proprietary app store.

Create a private cloud

Most NAS devices give you the ability to access your data over the public internet in addition to accessing it through your private network, essentially functioning as a cloud service. If a NAS manufacturer doesn't already have a cloud application built in, there are a number of open-source cloud applications like Nextcloud or ownCloud.

Run virtual machines

Virtualization software providers, like VMware, support running their products on NAS. With proper configuration, including potentially adding RAM to your device, you can easily spin up virtual machines using NAS.

Develop and test applications

Many NAS devices offer developer packages, including apps for different programming languages and tools like Docker and Git Server. With these add-ons, you can turn your NAS into your own private lab for developing and testing applications before moving them to a server for production.

Manage security cameras

Apps like Synology's Surveillance Station allow you to set up a security camera system yourself using IP cameras rather than paying for a more expensive, enterprise system.

Stream media

NAS is a great place to store large media files, and add-ons like Plex allow you to stream directly to a device or smart TV.

Understanding the many use cases can help you see where NAS might fit into your business. There are many ways to make your NAS device work for you and ensure you get the most out of it in the process.

The Benefits of Upgrading to a NAS System

Upgrading to NAS from direct attached storage is an investment, but one that comes with a whole host of benefits. We'll recap a few of the key advantages here.

More storage.

It's a tad obvious, but the primary benefit of a NAS system is that it will provide a significant addition to your storage capacity if you're relying on workstations and hard drives. NAS systems create a single storage volume from several drives (often arranged in a RAID scheme).

Protection from data loss.

Less obvious, but equally important, the RAID configuration in a NAS system ensures that the data you store can survive the failure of one or more of its hard drives. Hard drives fail. NAS helps to make that statement of fact less scary.

Security and speed.

Beyond protection from drive failure, NAS also provides security for your data from outside actors, as it is only accessible on your local office network and to user accounts which you can control. Not only that, but it generally works as fast as your local office network speeds.

Better data management tools.

Fully automated backups, deduplication, compression, and encryption are just a handful of the functions you can put to work on a NAS system—all of which make your data storage more efficient and secure. You can also configure sync workflows to ease collaboration for your team, enable the management of your users and groups with directory services, and even add services like photo or media management.

NAS vs. SAN

These mirror-image acronyms lend themselves to confusion, but the differences are easy enough to understand with a bit of explanation. So far we've explained what NAS is, what it can do, and how it benefits you. Now, we'll make some distinctions about what NAS isn't when compared to other technologies like a storage area network (SAN).

Both NAS (reminder: network attached storage) and SAN were developed to solve the problem of making stored data available to many users at once. Each of them provides dedicated storage for a group of users, but they couldn't be more different in their approach to achieving their mission.

NAS is a single storage device that serves files over Ethernet and is relatively inexpensive and easy to set up, while a SAN is a tightly coupled network of multiple devices that is more expensive and complex to set up and manage. From a user perspective, the biggest difference between NAS and a SAN is that NAS devices deliver shared storage as network mounted volumes and use protocols like NFS and SMB/CIFS, while SAN-connected disks appear to the user as local drives.
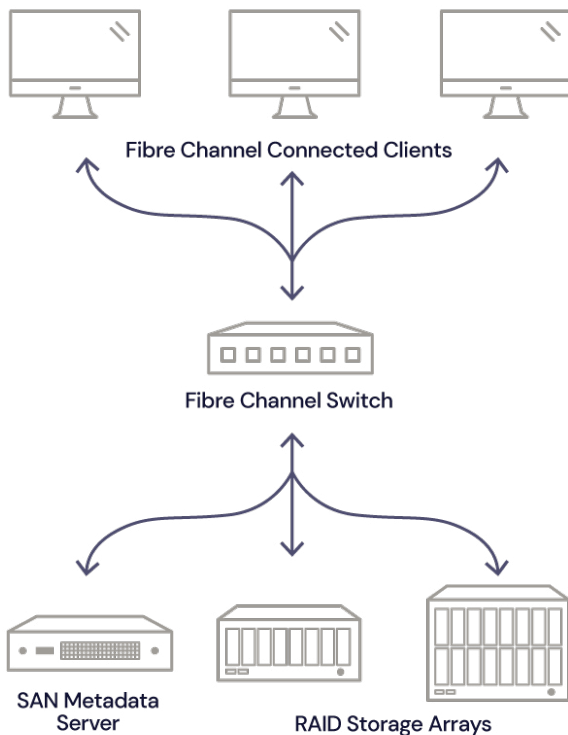
As we defined it earlier, NAS is a computer connected to a network that provides file-based data storage services to other devices on the network.

Network Connected Clients

Network Switch
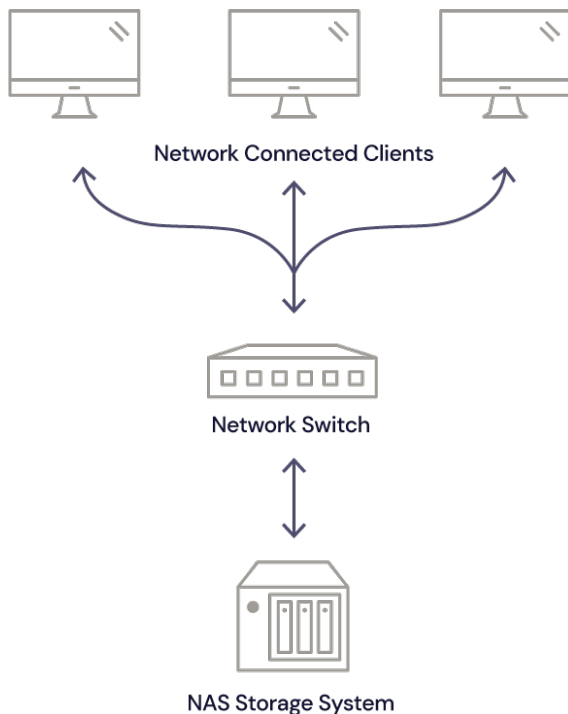
NAS Storage System

The NAS system and clients connect via your local network—all file service occurs via Ethernet.

A SAN, on the other hand, is built from a combination of servers and storage over a high speed, low latency interconnect that allows direct Fibre Channel connections from the client to the storage volume to provide the fastest possible performance. The SAN may also require a separate, private Ethernet network between the server and clients to keep the file request traffic out of the Fibre Channel network for even more performance.

A SAN is a flexible way to deliver shared storage for a number of users in demanding applications, like video editing or multiple application servers. By joining together the clients, SAN server, and storage on a Fibre Channel network, the SAN volumes appear and perform as if they were a directly connected hard drive. Storage traffic over Fibre Channel avoids the TCP/IP packetization and latency issues, as well as any local area network congestion, ensuring the highest access speed available for media and mission–critical stored data.

Because it's considerably more complex and expensive than NAS, a SAN is typically used by large corporations and requires administration by an IT staff. For some applications, such as video editing, it's especially desirable due to its high speed and low latency.

The primary strength of a SAN is that it allows simultaneous shared access to shared storage that becomes faster with the addition of storage controllers. For example, hundreds of video editors can use 10s of gigabytes per second of storage simultaneously. For this reason, a SAN is widely used in collaborative video production environments.

Fibre Channel Connected Clients

Fibre Channel Switch

SAN Metadata Server

RAID Storage Arrays

The SAN management server, storage arrays, and clients all connect via a Fibre Channel network—all file serving occurs over Fibre Channel.

The Main Differences Between NAS and a SAN

NAS	SAN
Often used in homes and small to medium-sized businesses.	Often used in professional and enterprise environments.
Less expensive.	More expensive.
Easier to manage.	Requires more administration.
Data accessed as if it were a network-attached drive.	Servers access data as if it were a local hard drive.
Speed dependent on local TCP/IP Ethernet network, typically 1GbE to 10GbE, and affected by the number of other users accessing the storage at the same time. Generally slower throughput and higher latency due to the nature of Ethernet packetization, waiting for the file server, and latency in general.	High speed using Fibre Channel, most commonly available in 16 Gb/s to 32 Gb/s. Fibre Channel can be delivered via high speed Ethernet such as 10Gb or 40Gb+ networks using protocols such as FCoE and iSCSI.
SMB/CIFS, NFS, SFTP, and WebDAV.	Fibre Channel, iSCSI, and FCoE.
Lower-end not highly scalable; high-end NAS scales to petabytes using clusters or scale-out nodes.	Can add more storage controllers, or expanded storage arrays allowing SAN admins to scale performance, storage, or both.
Simply connects to your existing Ethernet network.	Requires dedicated Fibre Channel connections for clients, servers, and storage, and often a separate, dedicated Ethernet network for file request traffic.
Entry level systems often have a single point of failure, e.g., power supply.	Fault tolerant network and systems with redundant functionality.
Subject to general Ethernet issues.	Behavior is more predictable in controlled, dedicated environments.
A central place from which to back up or sync user files.	A place from which to archive files not immediately needed.

When considering NAS or a SAN, you might find it helpful to think of it this way: NAS is simple to set up, easy to administer, and great for general purpose applications. Meanwhile, a SAN can be more challenging to set up and administer, but it's often the only way to make shared storage available for mission-critical and high-performance applications.

NAS vs. Cloud Storage

NAS can give you the ability to create your own private cloud, but what are the advantages and disadvantages of using NAS versus just using public cloud storage?

Both NAS and cloud storage give you more data storage capacity, the ability to access files anywhere, and a way to enable collaboration between your team. However, there are some key differences as outlined below.

The Main Differences Between NAS and Cloud Storage

NAS	Cloud Storage
Bigger up-front expense.	Ongoing monthly expense.
Can be more complicated and time-consuming to set up.	Quick setup—start storing data in minutes.
Issues like encryption and deduplication must be handled yourself.	A third party handles things like encryption and deduplication.
Ongoing maintenance of the device, including drive replacement.	No device to maintain.
Space limited by number of drive bays and size of hard disk drives.	Inherently scalable.
Speed is dependent on your local network.	Speed is dependent on your internet connection and other factors.
Physical security is a risk.	Data is stored in a physically secure data center.
Can be physically disconnected from your network and destroyed.	Data deletion is dependent on a third party.

Fortunately, it's not an either/or question—using NAS with cloud storage in a hybrid cloud setup is an ideal way to get the most out of your NAS and ensure data is safely backed up. We'll explain the benefits of a hybrid cloud in the next section.
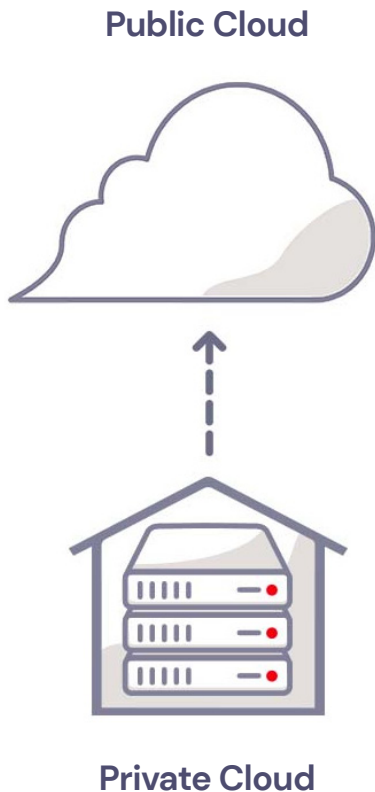
NAS + Cloud Storage: A Hybrid Cloud Strategy

When you pair cloud storage with your NAS in a hybrid cloud strategy, you gain access to features that complement the security of your data and your ability to share files both locally and remotely. In this section, we'll look at how you can achieve a hybrid cloud strategy with NAS and cloud storage.

What Is Hybrid Cloud?

A hybrid cloud strategy uses a private cloud and public cloud in combination. To expand on that a bit, we can say that the hybrid cloud refers to a cloud environment made up of a mixture of typically on-premises, private cloud resources combined with third-party public cloud resources that use some kind of orchestration between them. A private cloud doesn't necessarily need to live on-premises—some companies rent space in a data center to host the infrastructure for their private cloud—the important defining factor is that a private cloud is dedicated to only one "tenant" or organization.

In this case, your NAS device serves as the on-premises private cloud, as it's dedicated to only you or your organization, and then you connect it to the public cloud.

Public Cloud

Private Cloud

What Are the Benefits of Hybrid Cloud?

To start with, cloud storage provides off-site backup protection. This aligns your NAS setup with the industry standard for data protection: a 3-2-1 backup strategy—which ensures that you have three copies of your data on two different media (read: devices) with one stored off-site. When using NAS and the cloud in a hybrid strategy, you have three copies of your data—the source data and two backups. One of those backups lives on your NAS and one is stored off-site in the cloud. In the event of data loss, you can restore your systems directly from the cloud even if all the systems in your office are knocked out or destroyed.

While data sent to the cloud is encrypted in-flight via SSL, you can also encrypt your backups so that they are only openable with your team's encryption key. The cloud can also give you advanced storage options for your backup files, like Object Lock. Object Lock allows you to store data with a Write Once, Read Many (WORM) model. Once you set Object Lock and the retention timeframe, your data stored with Object Lock is unchangeable for a defined period of time. You can also set custom data lifecycle rules at the bucket level to help match your ideal backup workflow.

Cloud storage provides valuable access to your data and documents from your NAS through sync capabilities. In case anyone on your team needs to access a file when they are away from the office, or as is more common now, in case your entire team is working from home, they'll be able to access the files that have been synced to the cloud through your NAS's secure sync program. You can even sync across multiple locations using the cloud as a two-way sync to quickly replicate data across locations. For employees collaborating across great distances, this helps to ensure they're not waiting on the internet to deliver critical files: They're already on-site.

Additionally, two of the biggest advantages of the hybrid cloud are flexibility and cost savings. Provisioning an additional device to store backups and physically separating it from your production data is time consuming and costly. The cloud eliminates the need to provision and maintain additional hardware while keeping your data protected with a 3-2-1 strategy, and it can be scaled up or down flexibly as needed.

With NAS on-site for fast, local access combined with the cloud for off-site backups and storage of less frequently used files, you get the best of both worlds.

What's the Difference Between Cloud Sync, Cloud Backup, and Cloud Storage?

Sync services allow multiple users across multiple devices to access the same file. Backup stores a copy of those files somewhere remote from your work environment, oftentimes in an off-site server—like cloud storage. It's important to know that a "sync" is not a backup, but they can work well together when properly coordinated.

How to Set up a Hybrid Cloud With NAS

Some cloud providers are already integrated with NAS systems. (Backblaze B2 Cloud Storage is integrated with NAS systems from Synology and QNAP, for example.) Check if your preferred NAS system is already integrated with a cloud storage provider to ensure setting up cloud backup, storage, and sync is as easy as possible.

Your NAS should come with a built-in backup manager, like Hyper Backup from Synology or Hybrid Backup Sync from QNAP. Once you download and install the appropriate backup manager app, you can configure it to send backups to your preferred cloud provider. You can also fine-tune the behavior of the backup jobs, including what gets backed up and how often.

Now, you can send backups to the cloud as a third off-site backup and use your cloud instance to access files anywhere in the world with an internet connection.

Evaluating and Buying a NAS System

With a better understanding of NAS and what it can do for you, you can make an informed decision about investing in a NAS device.

Maybe you were already considering buying a NAS device, or you purchased one that you've already grown out of, or this could be your first time looking at your options. No matter where you're starting, the number of choices and features NAS systems offer today are overwhelming, especially when you're trying to buy something that will work now and in the future.

The following section will help you navigate the options you'll need to choose from, including:

- **Storage capacity.**

- **Drive capacity.**

- **Processor, controllers, and memory.**

- **Network and connections.**

How do you evaluate the differences between different NAS vendors? Or even within a single company's product line? This tour of the major components of a NAS system will help you to develop a checklist for the sizing and features of a system that will fit your needs.

How your NAS performs is dictated by the components that make up the system and capability of future upgrades. Let's walk through the different system components you need.

NAS Storage Capacity:
How Many Bays Do You Need?

One of the first ways to distinguish between different NAS systems is the number of drive bays a given system offers, as this determines how many disks the system can hold. Generally speaking, the larger the number of drive bays, the more storage you can provide to your users and the more flexibility you have around protecting your data from disk failure.

In a NAS system, storage is defined by the number of drives, the shared volume they create, and their striping scheme (e.g., RAID 0, 1, 5, 6, etc.). For example, one drive gives no additional performance or protection. Two drives allow the option of simple mirroring. Mirroring is also referred to as RAID 1, when one volume is built from two drives, allowing for the failure of one of those drives without data loss. Two drives also allow for striping—referred to as RAID 0—when one volume is "stretched" across two drives, making a single, larger drive that also gives some performance improvement, but increases risk because the loss of one drive means that the entire volume will be unavailable.

Three drives are the minimum for RAID 5, which can survive the loss of one drive, though four drives are a more common NAS system configuration. Four drives allow for RAID 6, which can survive the loss of two drives. Six to eight drives are very common NAS configurations that allow more storage, space, performance, and even drive sparing—the ability to designate a stand-by drive to immediately rebuild a failed drive.

Many believe that if you're in the market for a NAS system with multiple bays, you should opt for capacity that allows for RAID 6, if possible. RAID 6 can survive the loss of two drives, and delivers performance nearly equal to RAID 5 with better protection.

It's understandable to think: Why do I need to prepare in case two drives fail? Well, when a drive fails and you replace it with a fresh drive, the rebuilding process to restore that drive's data and parity information can take a long time. Though it's rare, it's possible to have another drive fail during the rebuilding process. In that scenario, if you have RAID 6, you're likely going to be okay. If you have RAID 5, you may have just lost data.

Commonly Used RAID Levels

RAID Level	How It Works	Uses and Notes
JBOD (*Just a Bunch of Drives*)	Depending on the host system, this RAID level either presents all drives individually or collects them into a single volume that spans all drives.	JBOD volumes can be created quickly, so they are sometimes used to temporarily hold data.
RAID 0	Drive striping: The creation of a single volume that spans or stripes across two disks.	Drive striping is used where higher performance is needed, and the risk of less reliability is acceptable. The failure of either drive brings the entire volume offline.
RAID 1	Drive mirroring: The creation of a single volume that reads and writes to two drives at once.	Drive mirroring is used to give more redundancy. The volume can lose one of its drives yet still be available.
RAID 0+1	Drive striping and mirroring.	By combining striping and mirroring, a striped volume can have more redundancy. You may want to choose this arrangement if your testing shows that you get faster performance than RAID 5.
RAID 5	A single volume across at least three drives that spreads both data and parity across all drives and can sustain the loss of one drive.	RAID 5 commonly offers the best mix of performance and maximum formatted storage size and is very popular for four and five bay NAS systems.
RAID 6	A single volume across at least four drives that spreads both data and parity across all drives and can sustain the loss of two drives.	RAID 6 offers the best mix of performance and storage durability and is very popular for five bay NAS systems and larger.

Buyer's Note: Some systems are sold without drives. Should you buy NAS with or without drives? That decision usually boils down to the size and type of drives you'd like to have.

When buying a NAS system with drives provided:

- The drives are usually covered by the manufacturer's warranty as part of the complete system.

- The drives are typically bought directly from the manufacturer's supply chain and shipped directly from the hard drive manufacturer.

If you choose to buy drives separately from your NAS:

- The drives may be a mix of drive production runs, and have been in the supply chain longer. Match the drive capacities and models for the most predictable performance across the RAID volume.

- Choose drives rated for NAS systems—NAS vendors publish lists of supported drive types.

- Check the warranty and return procedures, and if you are moving a collection of older drives into your NAS, you may also consider how much of the warranty has already run out.

Buyer Takeaway

Choose a system that can support RAID 5 or RAID 6 to allow a combination of more storage space, performance, and drive failure protection. But be sure to check whether the NAS system is sold with or without drives.

NAS System Examples (Enclosures Without Drives)

System	Example	Price Range
Four Bay System The smallest recommended NAS system for individual users or file sharing for small teams.	 **QNAP TS–453D Four Bay NAS Enclosure** Four 3.5" drive bays, Celeron processor, 8GB of RAM, and two 2.5GigE ports.	About $400–600, not including hard drives.
Eight Bay System A good choice for small teams with high performance applications like video editing, or for file sharing for larger teams. The expansion ports allow adding 10GigE cards inexpensively.	 **Synology DiskStation DS1821 + Eight Bay NAS Enclosure** Eight 3.5" drive bays, two M.2 SSD slots, 2.2 GHz AMD Ryzen processor, 4GB RAM, and four 1GigE ports.	About $800–1,400, not including hard drives or M.2 storage.
16 Bay System Offers very good performance, high-end server processing power, and large storage size for small to medium-sized businesses with redundant power supplies.	 **Synology RackStation RS4021xs + 16 Bay NAS Enclosure** 16 3.5" drive bays, 2.1 GHz Xeon eight core processor, two 10GigE, and four 1GigE ports.	About $2,800–8,000, not including hard drives.

Selecting Drive Capacity for the NAS: What Size of Drives Should You Buy?

You can quickly estimate how much storage you'll need by adding up the sizes of hard drives and external drives of all the systems you'll be backing up in your office, adding the amount of shared storage you'll want to provide to your users, and factoring in any growing demand you project for shared storage.

If you have any historical data under management from previous years, you can calculate a simple growth rate. But, include a buffer as data growth accelerates every year. Generally speaking, price out systems at two or four times the size of your existing data capacity. Let's say that the hard drives and external drives you need to back up, plus any additional shared storage you'd like to provide your users, add up to 20TB. Double that size to get 40TB to account for growth, then divide by a common hard drive size, such as 10TB. With that in mind, you can start shopping for four bay systems and larger.

Calculating How Much NAS Storage You Need

Storage Sizing Formula:
*((Number of NAS Users * Hard Drive Size) + Shared Storage) * Growth Factor = NAS Storage Needed*

Example: There are six users in an office that will each be backing up their 2TB workstations and laptops. The team will want to use another 6TB of shared storage for documents, images, and videos for everyone to use. Multiplied times a growth factor of two, you'd start shopping for NAS systems that offer at least 36TB of storage.

((Six users * 2TB each) + 6TB shared storage) * growth factor of two = 36TB

Calculating How Many Bays You Need

NAS Drive Bay Formula:
((NAS Storage Needed / Hard Drive Size) + Two Parity Drives) = Drive Bays Needed

Example: Continuing the example above, when looking for a new NAS system using 12TB drives, accounting for two additional drives for RAID 6, you'd look for NAS systems that can support five or more drive bays of 12TB hard drives.

((36TB / 12TB) + two additional drives) = Five drive bays and up

Capacity Considerations

If your budget allows, opting for larger drives and more drive bays will give you more storage overhead that you'll surely grow into over time. Factor in, however, that if you go too big, you're paying for unused storage space for a longer period of time. And if you use GAAP accounting, you'll need to capitalize that investment over the same time window as a smaller NAS system which will hit your bottom line on an annual basis.

If your cash budget is tight, you can always purchase a NAS system with more bays but smaller drives, which will significantly reduce your up-front pricing. You can then replace those drives in the future with larger ones when you need them. Hard drive prices generally fall over time, so they will likely be less expensive in the future. You'll end up purchasing two sets of drives over time, which will be less cash-intensive at the outset, but likely more expensive in the long run.

Similarly, you can partially fill the drive bays. If you want to get an eight bay system, but only have the budget for six drives, just add the other drives later. One of the best parts of NAS systems is the flexibility they allow you for right-sizing your shared storage approach.

SSD Drive Bays

Network Ports

Memory
(inside)

Drive Carrier

CPU and Storage Controller
(inside)

Buyer Takeaway

Estimate how much storage you'll need, add the amount of shared storage you'll want to provide to your users, and factor in growing demand for shared storage—then balance long-term growth potential against cash flow.
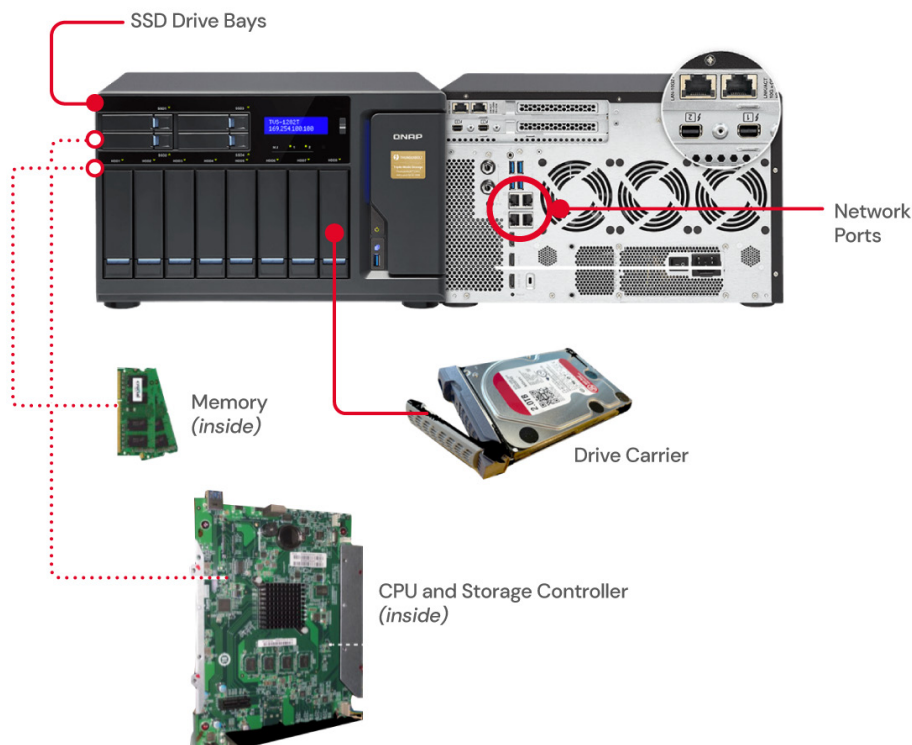
Processor, Controllers, and Memory: What Performance Levels Do You Require?

Is it better to have big on-board processors or controllers? Smaller, embedded chips common in smaller NAS systems provide basic functionality, but might bog down when serving many users or crunching through deduplication and encryption tasks, which are options with many backup solutions. Larger NAS systems typically stored in IT data center racks usually offer multiple storage controllers that can deliver the fastest performance and even failover capability.

- **Processor**
  Provides compute power for the system operation, services, and applications.

- **Controller**
  Manages the storage volume presentation and health.

- **Memory**
  Improves speed of applications and file serving performance.

Adding memory modules to your NAS can be a simple performance upgrade.

ARM and Intel Atom chips are good for basic systems, while larger and more capable processors such as the Intel Corei3 and Corei5 are faster at NAS tasks like encryption, deduplication, and serving any on-board apps. Xeon server class chips can be found in many rack-mounted systems, too.

So if you're just looking for basic storage expansion, the entry-level systems with more modest, basic chips will likely suit you just fine. If deduplication, encryption, sync, and other functions many NAS systems offer as optional tools are part of your future workflow, this is one area where you shouldn't cut corners.

If you have the option to expand the system memory, this can be an easy performance upgrade. Generally, the higher the ratio of memory to drives will benefit the performance of reading and writing to disk and the speed of on-board applications.

Buyer Takeaway
Entry-level NAS systems provide good basic functionality, but you should ensure your components are up to the challenge if you plan to make heavy use of deduplication, encryption, compression, and other functions.

Network and Connections: What Capacity for Speed Do You Need?

A basic NAS system will have a Gigabit Ethernet connection, which you will often find listed as 1GigE. This throughput of 1 Gb/s in network speeds is equivalent to 125 MB/s coming from your storage system. That means that the NAS system must fit storage service to all users within that limitation, which is usually not an issue when serving only a few users. Many systems offer expansion ports inside, allowing you to purchase a 10GigE network card later to upgrade your NAS.

Some NAS vendors offer 2.5 Gb/s, or 5 Gb/s connections on their systems—these will give you more performance than 1GigE connections, but usually require that you get a compatible network switch, and possibly, USB adapters or expansion cards for every system that will connect to that NAS via the switch. If your office is already wired for 10GigE, make sure your NAS is also 10GigE. Otherwise, the more network ports in the back of the system, the better. If you aren't ready to get a 10GigE capable system now, but you think you might be in the future, select a system that has expansion capability.
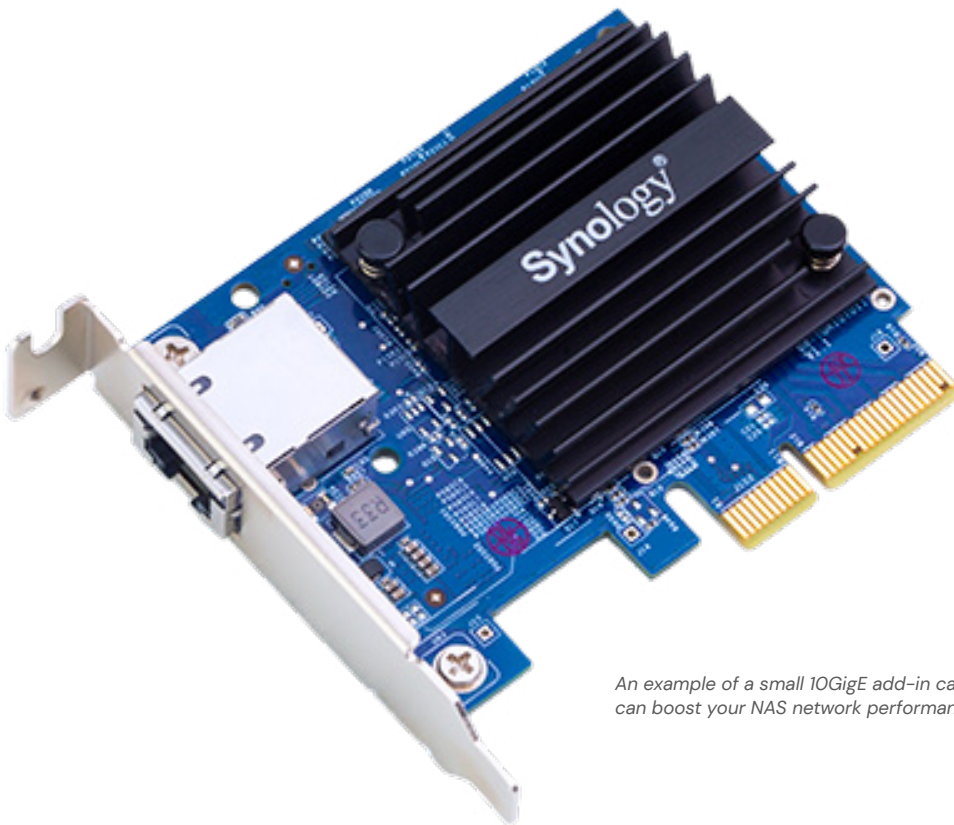
An example of a small 10GigE add-in card that can boost your NAS network performance.

Some systems provide another option of Thunderbolt connections in addition to Ethernet connections. These allow laptops and workstations with Thunderbolt ports to directly connect to the NAS and offer much higher bandwidth—up to 40GigE (5 GB/s)—and are good for systems that need to edit large files directly on the NAS, such as is often the case in video editing. If you'll be directly connecting systems that need the fastest possible speeds, select a system with Thunderbolt ports, one per Thunderbolt-connected user.

Buyer Takeaway
It's best to have more network ports in the back of your system. Or, select a system with network expansion card capability.

Some NAS systems offer not only multiple network ports, but faster connections as well, such as Thunderbol.

NAS Buyer's Guide Checklist

As you approach your NAS buying decision, it can be helpful to consolidate all the information you need into one document. Use this checklist as a reference as you evaluate different options.

Preferred RAID level: _____

Storage capacity needed: _____

- Storage Sizing Formula:
  ((Number of NAS Users * Hard Drive Size)
  + Shared Storage) * Growth Factor =
  NAS Storage Needed

- Generally speaking, price out systems
  at a growth factor of two or four times
  the size of your existing data capacity.

Drive bays needed: _____

- NAS Drive Bay Formula: ((NAS Storage
  Needed / Hard Drive Size) + Two Parity
  Drives) = Drive Bays Needed

Preferred processor: _____

- Provides compute power for the system
  operation, services, and applications.

Preferred controller: _____

- Manages the storage volume presentation
  and health.

Memory needed: _____

- Improves speed of applications and file
  serving performance.

Preferred network speed: _____

Preferred network connection: _____

- 1 GigE.

- 10 GigE.

- Thunderbolt port.

Number of ports: _____

Adding Cloud–enabled Functionality to NAS for Additional Benefits

Cloud services enhance your NAS device with more functionality—management features, native apps, backup, and sync. Here, we'll walk through some options for cloud–enabled services.

Caching and Hybrid Drive Features: How Fast Do You Need to Serve Files?

Many of the higher–end NAS systems can complement standard 5.25" hard drives with higher performing, smaller form factor SSD or M.2 drives. These smaller, faster drives can dramatically improve the NAS file serving performance by caching files in most recent, or most frequently requested files. By combining these different types of drives, the NAS can deliver both improved file serving performance and large capacity.

As the number of users you support in each office grows, these capabilities will become more important as a relatively simple way to boost performance. Like we mentioned earlier, you can purchase a system with these slots unpopulated and add them in later.

Additionally, some NAS systems allow you to create a hybrid drive, extending the size of your local storage to cloud storage. Doing so allows you to combine a fast but size–limited local drive with the unlimited size of cloud storage, unlocking the best features of each system.

Buyer Takeaway
Combine different types of drives, like smaller form factor SSD or M.2 storage with 5.25" hard drives to gain improved file serving performance.

Operating System: What Kind of Management Features Do You Require?
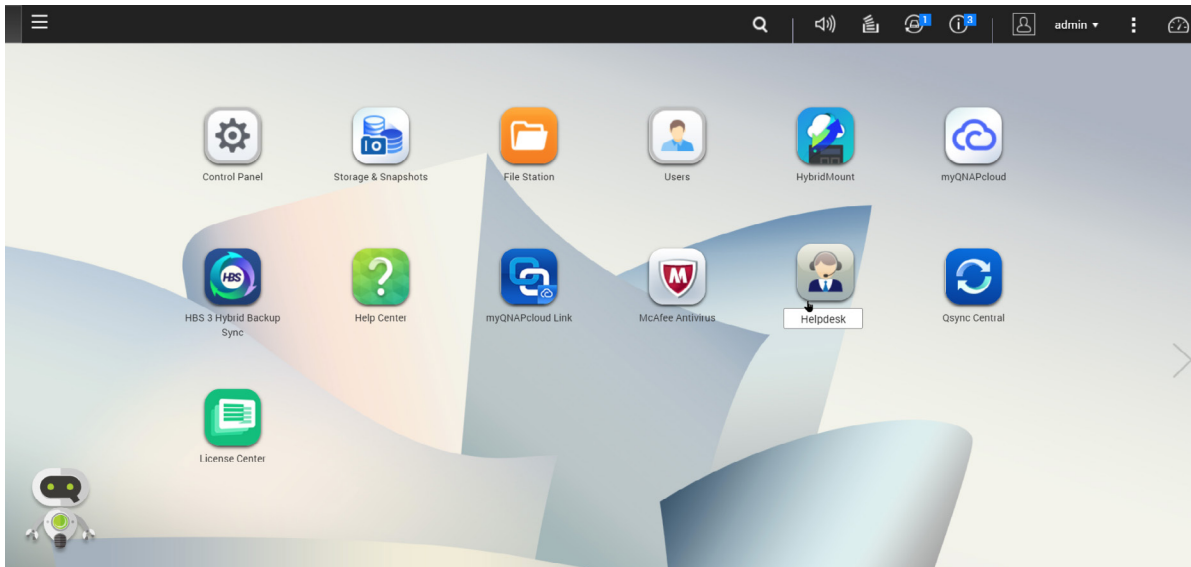
The NAS operating systems of the major vendors generally provide the same services in an OS–like interface delivered via an on–board web server. By simply typing in your NAS's IP address, you can sign in and manage your system's settings, create and manage the storage volumes, set up groups of users on your network who have access, configure and monitor backup and sync tasks, and more.

If there are specific user management features in your IT environment that you need, or want to test how the NAS OS works, you can test them by spinning up a demonstration virtual machine offered by some NAS vendors. You can test service configuration and get a feel for the interface and tools, but obviously as a virtual environment you won't be able to manage hardware directly.

Buyer Takeaway
The on–board NAS OS looks similar to a Mac or PC operating system to make it easy to navigate system setup and maintenance and allows you to manage settings, storage, and tasks.

Added Services: What Added Solutions Do You Require?

While the on-board processor and memory on your NAS are primarily for file service, backup, and sync tasks, you can also install other solutions directly onto it. For instance, QNAP and Synology—two popular NAS providers—have app stores accessible from their management software where you can select applications to download and install on your NAS. You might be interested in a backup and sync solution such as Archiware, or CMS solutions like Joomla or Wordpress.

However, beyond backup solutions, you'd benefit from installing mission-critical apps onto a dedicated system rather than on your NAS. For a small number of users, running applications directly on NAS can be a good temporary use or a pathway to testing something out. But if the application becomes very busy, it could impact the other services of the NAS. Big picture, native apps on your NAS can be useful, but don't overdo it.

Buyer Takeaway

The main backup and sync apps from the major NAS vendors are excellent—give them a good test drive, but know that there are many excellent backup and sync solutions available as well.
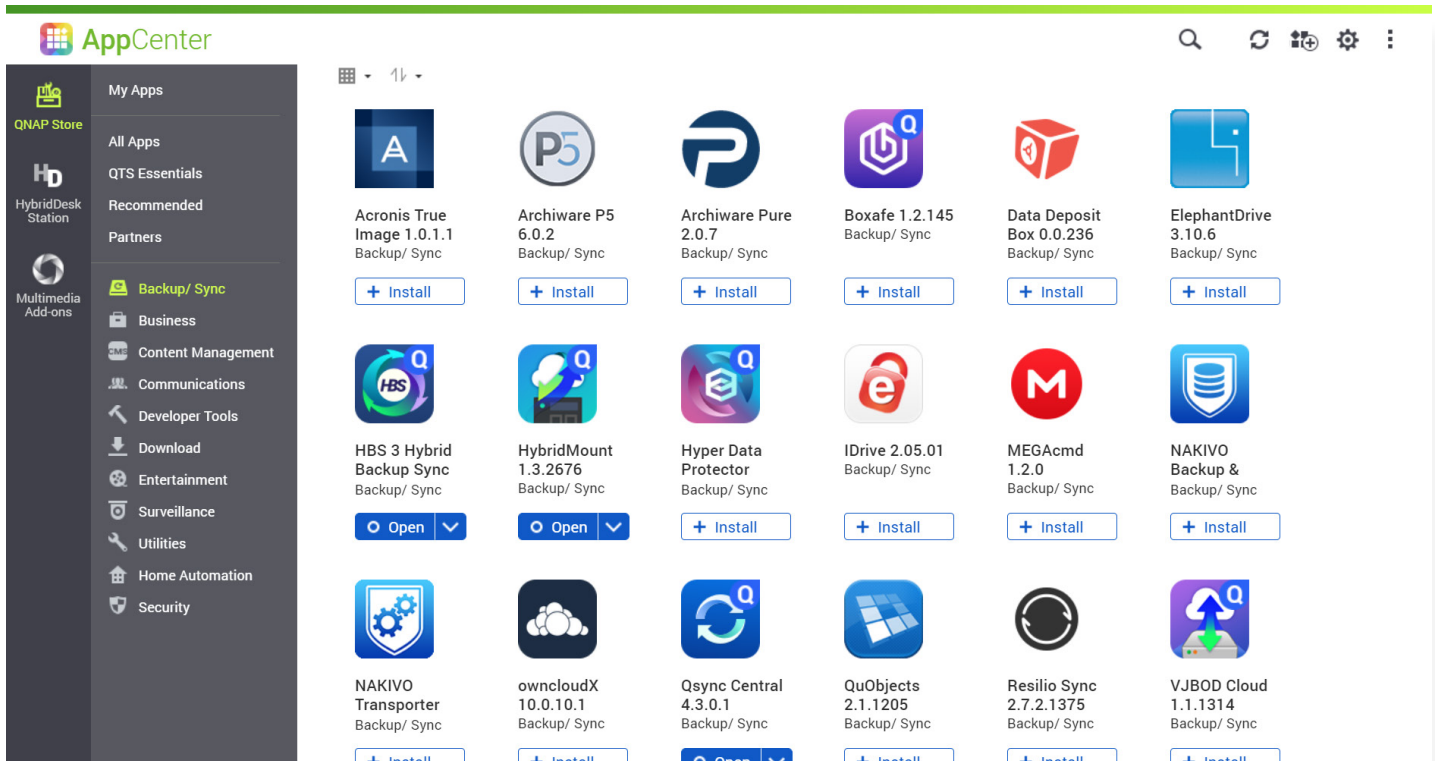
Applications available to install directly within some NAS vendors' management systems.

Deploying a NAS System

After provisioning the right NAS for your needs, you'll want to get the most out of your investment. Configuring your NAS correctly can mean the difference between enjoying a functional storage system that will serve you well for years and spending what might feel like years on the phone with support.

Let's talk about the right way to configure your NAS using storage deployment best practices.

In this section, we'll cover:

- **Where to locate your NAS and how to optimize networking.**

- **How to set up your file structure and assign administrator and user access.**

- **How to configure NAS software and backup services.**

Disclaimer: This advice will work for almost all NAS systems aside from the very large and complex systems typically installed in data center racks with custom network and power connections. For that, you've probably already advanced well beyond NAS 101.

Setup Logistics: Where and How

Choosing a good location for your NAS and optimizing your network are critical first steps in ensuring the long-term health of your system and providing proper service to your users.

Where to Keep Your NAS

Consider the following criteria when choosing where in your physical space to put your NAS. A good home for your NAS should be:

- **Temperature controlled**
  If you can't locate your NAS in a specific, temperature-controlled room meant for servers and IT equipment, choose a place with good airflow that stays cool to protect your NAS from higher temperatures that can shorten component life.

- **Clean**
  Dust gathering around the fans of your NAS is a sign that dust could be entering the device's internal systems. Dust is a leading cause of failure for both system cooling fans and power supply fans, which are typically found under grills at the back of the device. Make sure your NAS's environment is as dust-free as possible, and inspect the area around the fans and the fans themselves periodically. If you notice dust buildup, wipe the surface dust with a static-free cloth and investigate air handling in the room. Air filters can help to minimize dust.
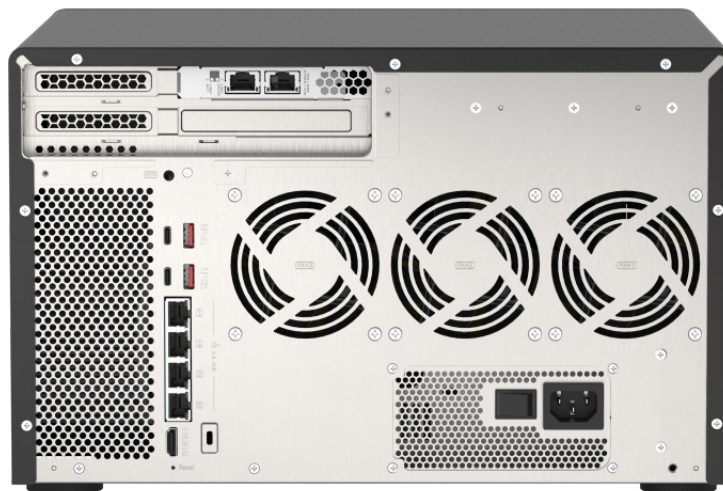
Dust-free fans are happy fans.

- **Stable**
  You'll want to place your system on a flat, stable surface. Try to avoid placing your NAS in rooms that get a lot of traffic. Vibration tends to be rough on the hard drives within the NAS device—they value their quiet time.

- **Secure**
  A locked room would be best for a physical asset like a NAS system, but if that's not possible, try to find an area where visitors won't have easy access.

Finally, your NAS needs a reliable, stable power supply to protect the storage volumes and data stored therein. Unexpected power failure can lead to loss or corruption of files being copied. A quality surge protector is a must. Better yet, invest in an uninterruptible power supply (UPS) device. If the power goes out, a UPS device will give you enough time to safely power down your NAS or find another power source. Check with your vendor for guidance on recommended UPS systems, and configure your NAS to take advantage of that feature.

How to Network Your NAS

Your NAS delivers all of its file and backup services to your users via your network, so optimizing that network is key to enhancing the system's resilience and reliability. Here are a few considerations when setting up your network:

- **Cabling**
  Use good Ethernet cabling and network router connections. Often, intermittent connectivity or slow file serving issues can be traced back to faulty Ethernet cables or ports on aging switches.

- **IP addresses**
  If your NAS has multiple network ports (e.g., two 1GigE Ethernet ports), you have a few options to get the most out of them. You can connect your NAS to different local networks without needing a router. For example, you could connect one port to the main internal network that your users share and a second port to your internet connected cameras or IoT devices—a simple way to make both networks accessible to your NAS. Another option is to set one port with a static or specific IP address and configure the second port to dynamically retrieve an IP address via DHCP to give you an additional way to access the system in case one link goes down. A third option, if it's available on your NAS, is to link multiple network connections into a single connection. This feature (called 802.3AD Link Aggregation, or port bonding) gets more network performance than a single port can provide.

- **DNS**

  Your NAS relies on domain name servers (DNS) that the NAS system can query to help translate users' web server requests to IP addresses to provide its services. Most NAS systems will allow you to set two DNS entries for each port. You might already be running a DNS service locally (e.g., so that staging.yourcompany.local goes to the correct internal-only server), but it's a good practice to provide a primary and secondary DNS server for the system to query. That way, if the first DNS server is unreachable, the second can still look up internet locations that applications running on your NAS will need. If one DNS entry is assigned by your local DHCP server or internet provider, set the second DNS entry to something like Cloudflare DNS (1.1.1.1 or 1.0.0.1) or Google DNS (8.8.8.8 or 8.8.4.4).
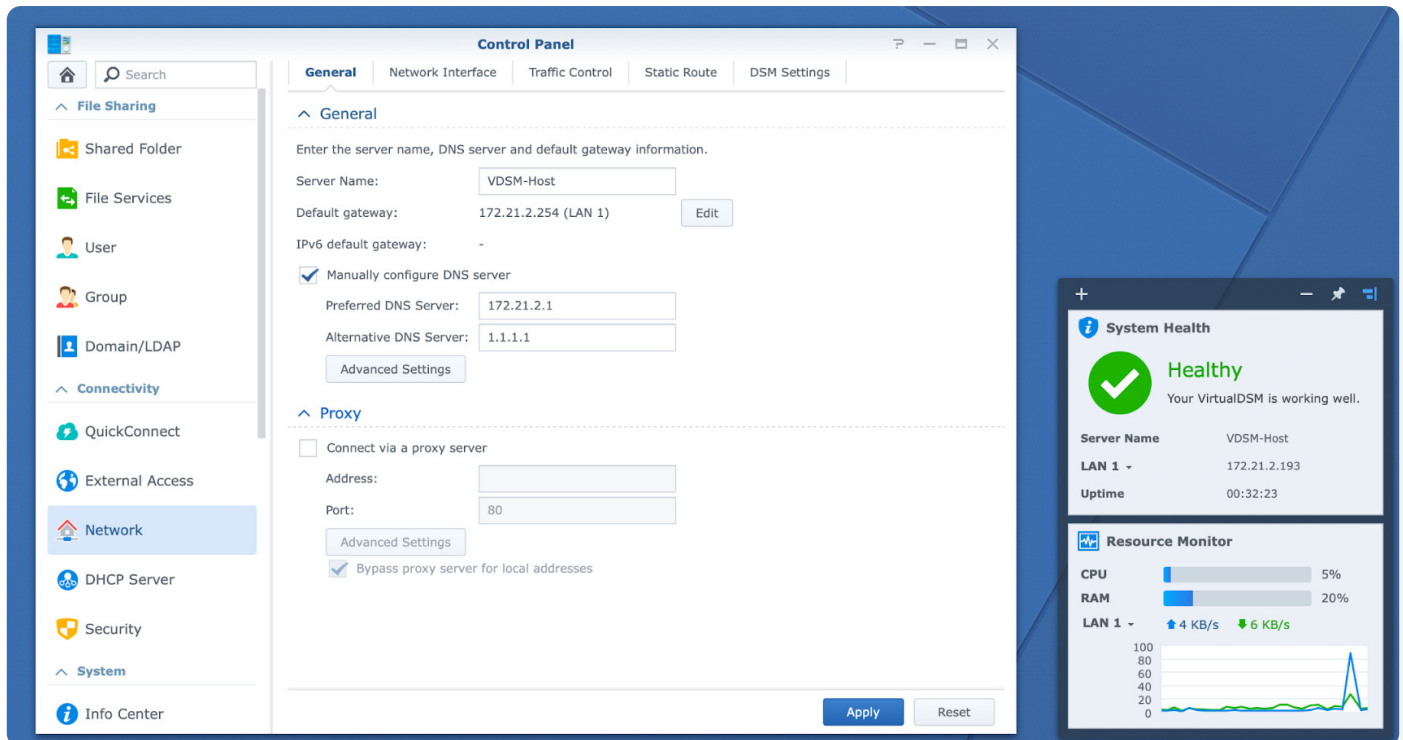
A typical network configuration interface. In this case, we've added Cloudflare DNS in addition to the DNS entry provided by the main internet gateway.

Access Management: Who and What

Deciding who has access to what is entirely unique to each organization, but there are some best practices that can make management easier. Here, we share some methods to help you plan for system longevity regardless of personnel changes.

Configuring Administrator Access

Who has the keys to the kingdom? What happens when that person moves departments or leaves the company? Planning ahead for these contingencies should be part of your NAS setup. We recommend two practices to help you prepare:

1 Designate multiple trusted people as administrators.

Your NAS system probably comes with a default admin name and password which you should, of course, change, but it's beneficial to have at least one more administrator account. If one admin isn't available, a backup admin can still log in. Additionally, using an organization-wide password manager like Bitwarden for your business is highly recommended.

2 Use role-based emails for alerts.

You'll find many places in your NAS system configuration to enter an email address in case the system needs to send an alert —when power goes out or a disk has failed, for example. Instead of entering a single person's email, use a role-based email instead. People change, but will never leave you. Role-based emails are often implemented as a group email, allowing you to assign multiple people to the account and increasing the likelihood that someone will be available to respond to warnings.

Configuring User Access

With a NAS system, you have the ability to easily manage how your users and groups access the shared storage needed for your teams to work effectively. Easy collaboration was probably one of the reasons you purchased the NAS in the first place. Building your folder system appropriately and configuring access by role or group helps you achieve that goal. Follow these steps when you first set up your NAS to streamline storage workflows:

Step 1: Define your folders.

Your NAS might come pre-formatted with folders like "Photo," "Video," "Web," etc. This structure makes sense when only one person is using the NAS. In a multi-user scenario, you'll want to define the folders you'll need, for example, by role or group membership, instead.
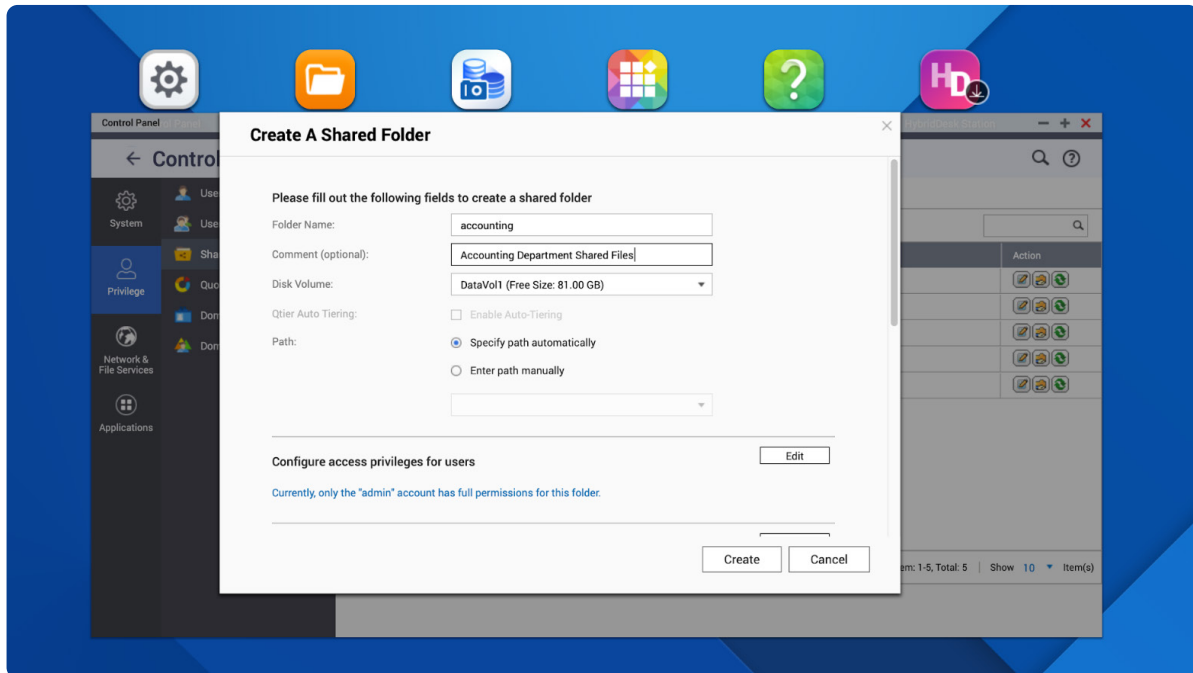
Creating a shared folder.

Example Folder Structure

Here is an example folder structure you could start with:

- **Local Backups:** A folder for local backups, accessible only by backup software. This keeps your backup data separate from your shared storage.

- **Shared Storage:** A folder for company-wide shared storage accessible to everyone.

- *Group Folders:* Accounting, training, marketing, manufacturing, support, etc.

Step 2: Integrate with directory services.

If you use a directory service like Active Directory or other LDAP services to manage users and privileges, you can integrate it with your NAS to assign access permissions. Integrating with directory services will let you use those tools to assign storage access instead of assigning permissions individually. Check your NAS user guide for instructions on how to integrate those services.

Step 3: Use a group or role-based approach.

If you don't use an external user management service, we recommend setting up permissions based on groups or roles. A senior-level person might need access to every department's folders, whereas a person in one department might only need access to a few folders. For example, for the accounting team's access, you can create a folder for their files called "Accounting," assign every user in accounting to the "Accounting" group, then grant folder access for that group rather than for each and every user. As people come and go, you can just add them to the appropriate group instead of configuring user access permissions for every new hire.
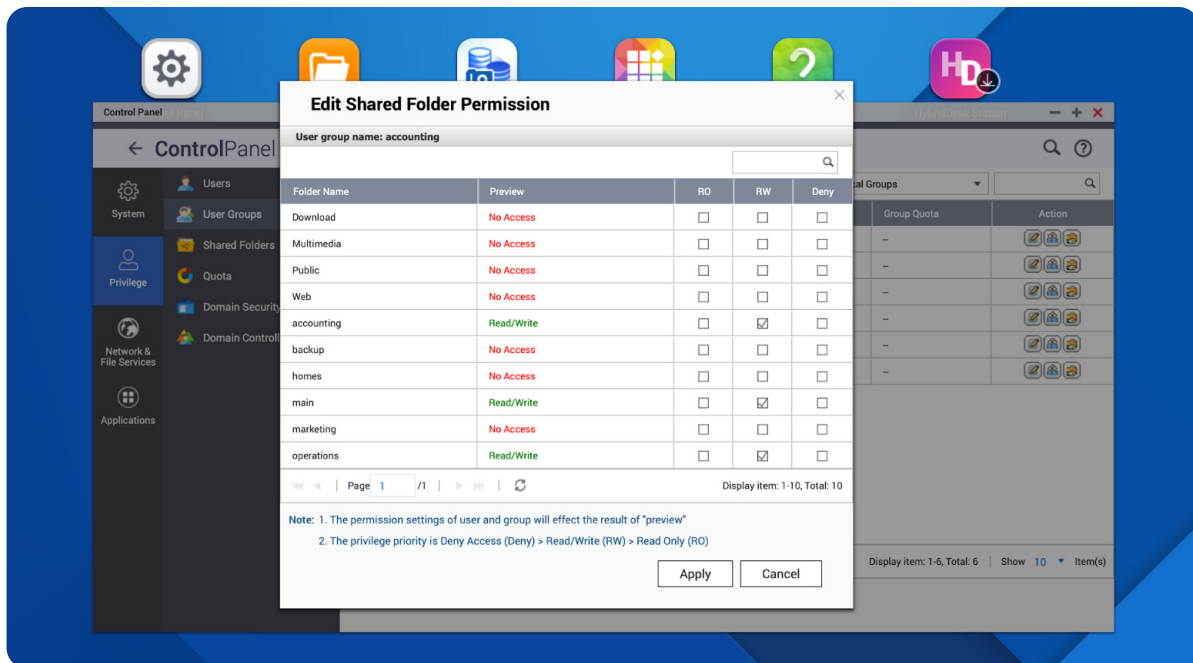

Applying group-level permissions to a shared folder. In this case, the permissions include the main folder open to all employees, the accounting folder, and the operations folder. Any user added to this user group will automatically inherit these default permissions.

NAS Software and Backup Management

Once you've found a suitable place for your NAS, connected it to your network, structured your folders, and configured access permissions, the final step is choosing what software will run on your NAS, including software to ensure your systems and your NAS itself are backed up. As you do so, keep the following in mind:

- **Prioritize the services you need.**
  When prioritizing your services, adopt the principle of least privilege. For example, if a system has many services enabled by default, it makes sense to turn some of them off to minimize the system load and avoid exposing any services that are unnecessary. Then, when you are ready to enable a service, you can thoughtfully implement it for your users with good data and security practices, including applying the latest patches and updates. This keeps your NAS focused on its most important services—for example, file system service—first, so that it runs efficiently and optimizes resources. Depending on your business, this might look like turning off video-serving applications or photo servers and turning on things like SMB for file service for Mac, Windows, and Linux; SSH if you're accessing the system via command line; and services for backup and sync.
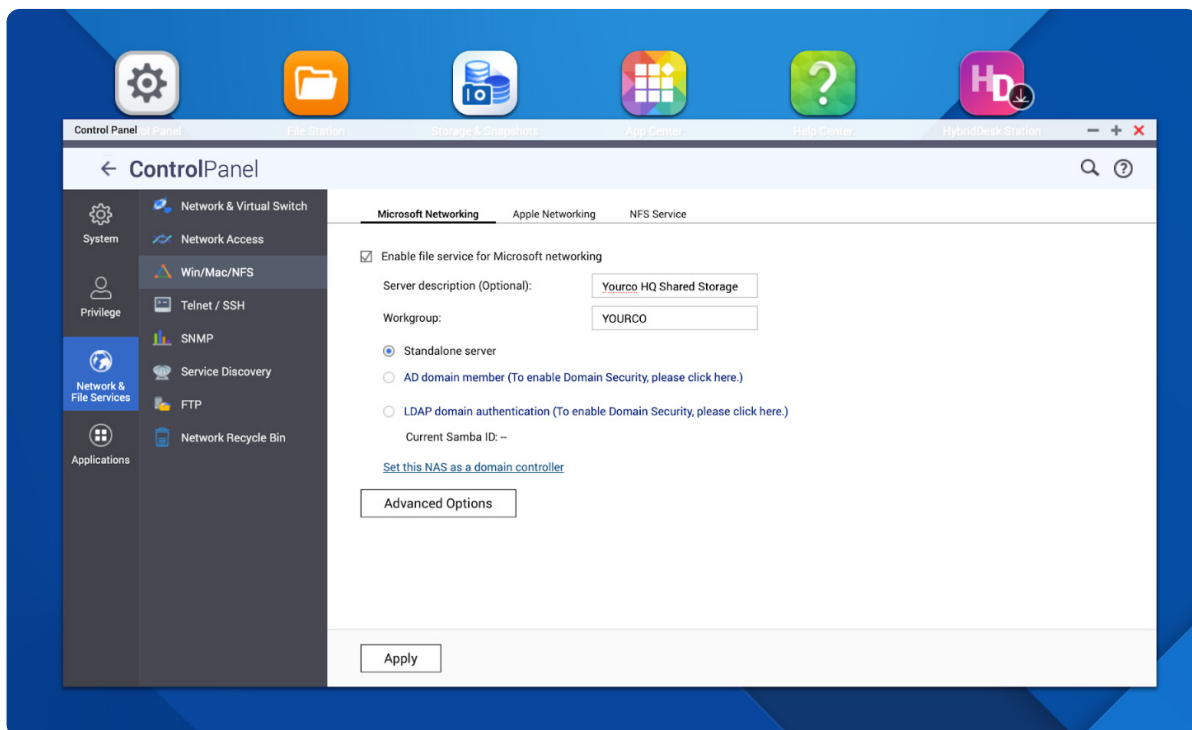

Enabling priority file services—in this case, SMB service for Mac and Windows users.

- **Back up local systems to your NAS.**
  Your NAS is an ideal local storage target to back up all systems in your network—your servers, desktops, and laptops. For example, QNAP and Synology systems allow you to use your NAS as a Time Machine backup for your Mac users. Windows users can use QNAP NetBak Replicator, or Active Backup Suite on Synology devices.

- **Back up your NAS to cloud storage.**
  Once local systems are backed up to your NAS, backing up your NAS to off-site cloud storage will complete a 3-2-1 backup strategy with three copies of your data on two different media and one off-site. To protect your NAS data in Backblaze, for example, you can use Hybrid Backup Sync on QNAP and Hyper Backup on Synology systems.
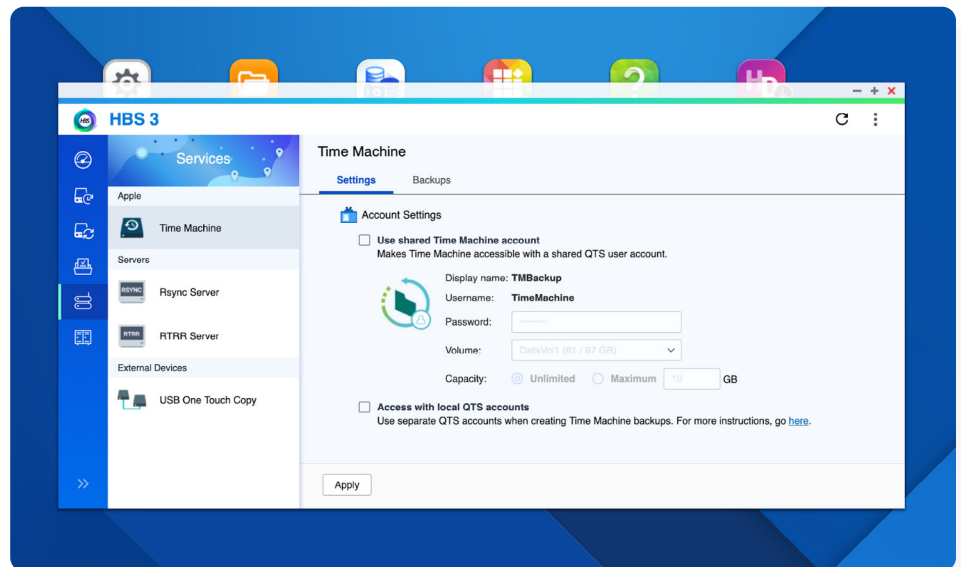
Setting a NAS device to accept Time Machine backups from local Mac systems.

Common Services for Your NAS

- **SMB:** The most common storage access and browsing protocol to "talk" to modern OS clients. It allows these systems to browse available systems, authenticate to them, and send and retrieve files.

- **AFP:** An older protocol that serves files for older Mac clients that do not work well with SMB.

- **NFS:** A distributed file system protocol used primarily for UNIX and Linux systems.

- **FTP and SFTP:** File serving protocols for multiple, simultaneous users, common for large directories of files that users will need occasional access to, like training or support documents. SFTP is more secure and highly preferred over FTP. You will likely find that it's easier to create and manage a folder on your NAS with read-only access instead.

- **rsync:** A file protocol for backups, allowing systems to easily connect to and back up their systems using the rsync file transfer and sync utility. If your local servers or systems back up to your NAS via rsync, this service will need to be enabled on the NAS device.

Key Takeaways

With this guidance, you can feel confident in your understanding of NAS, including sizing a system for your important data and growing business, and making sure it's configured to run at its best. To summarize, here are the major takeaways to remember when investing in a NAS system:

01
NAS is a computer connected to a network that provides file-based data storage services to other devices on the network. It's primarily used to expand storage capacity and enable file sharing across an organization.

02
Before shopping for NAS, consider how much storage you'll need for both local backup and for shared user storage.

03
Look for a system with three to five drive bays at minimum and opt for a system that lets you upgrade the memory and network options.

04
Coupled with cloud storage in a hybrid cloud model, you gain necessary backup protection and restoration from the cloud, as well as the capability to sync across locations.

05
Keep your NAS in a cool, safe, clean location.

06
Plan for ease of use and longevity when it comes to folder structure and access management.

07
Prioritize the software and services you need when first configuring your NAS.