

QNAP

QuTS

hero 5.1.0

Boosted performance, flexible management,
and higher security.



QuTS hero: The best Unified Hybrid Storage

Data Self-healing

Most Affordable
Hybrid Storage

ZFS on Linux

Cloud Ready



Flash
Endurance

Unified

Virtualization
Ready



65,536
Snapshots

QuTS hero Highlights



Data Integrity

- QuTS hero no longer needs file system checks (FSCK), with ZFS Mirror layer, COW (copy on Write) could keep the data integrity.



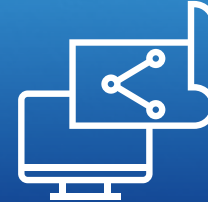
Data Protection

- The native ZFS snapshot feature allows max 65,536 snapshots (supports folder/LUN)
- SnapSync
- More RAID types available
- WORM (write once read many)
- SMB signing and Encryption AES-NI Acceleration
- **SMB Signing with GMAC**
- **Authenticator and Passwordless**



Data Efficiency

- Offers inline compression, inline compaction & inline deduplication for better storage utilization
- ZIL & L2ARC
- Write Coalescing
- Pool over provisioning
- **SMB Multichannel**
- **iSCSI Read Zero Copy**
- **Enhanced performance on encrypted LUN/folder**



Stability & Scalability

- Easily expanded to PB-level storage space.
- Provide ECC RAM supported model to reach the enterprise level stability
- **Expand/Upgrade RAID**
- Provide the service of SSD/HDD life prediction
- **Predictive Migration**



Management & Application

- Detailed ACL
- Protocols & Connection
- **Delegated Administration**
- **AMIZ cloud**
- **NFS Fixed Ports**

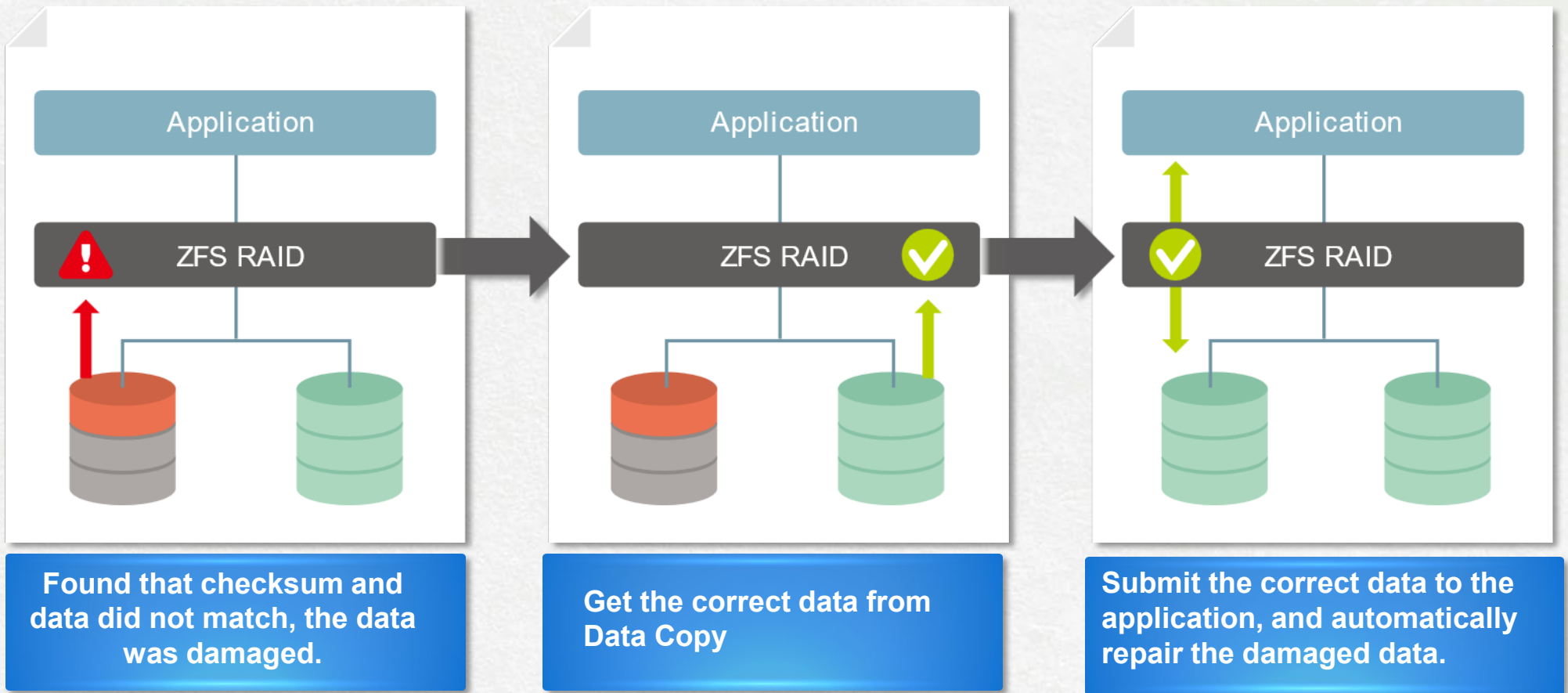
Chapter

01

DATA INTEGRITY



Data Integrity and Self Healing

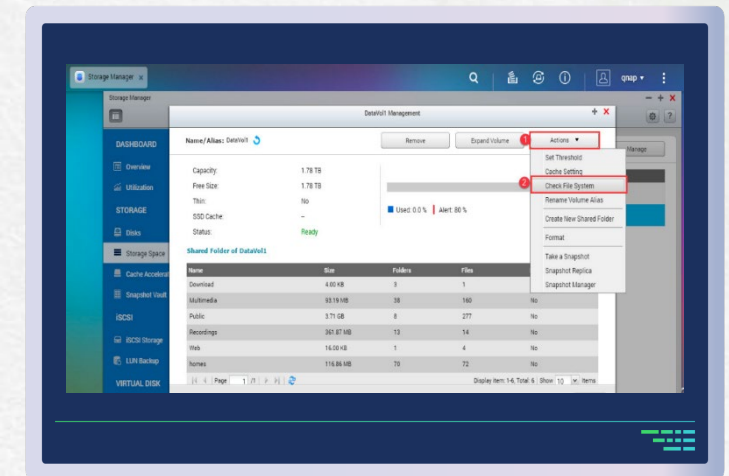
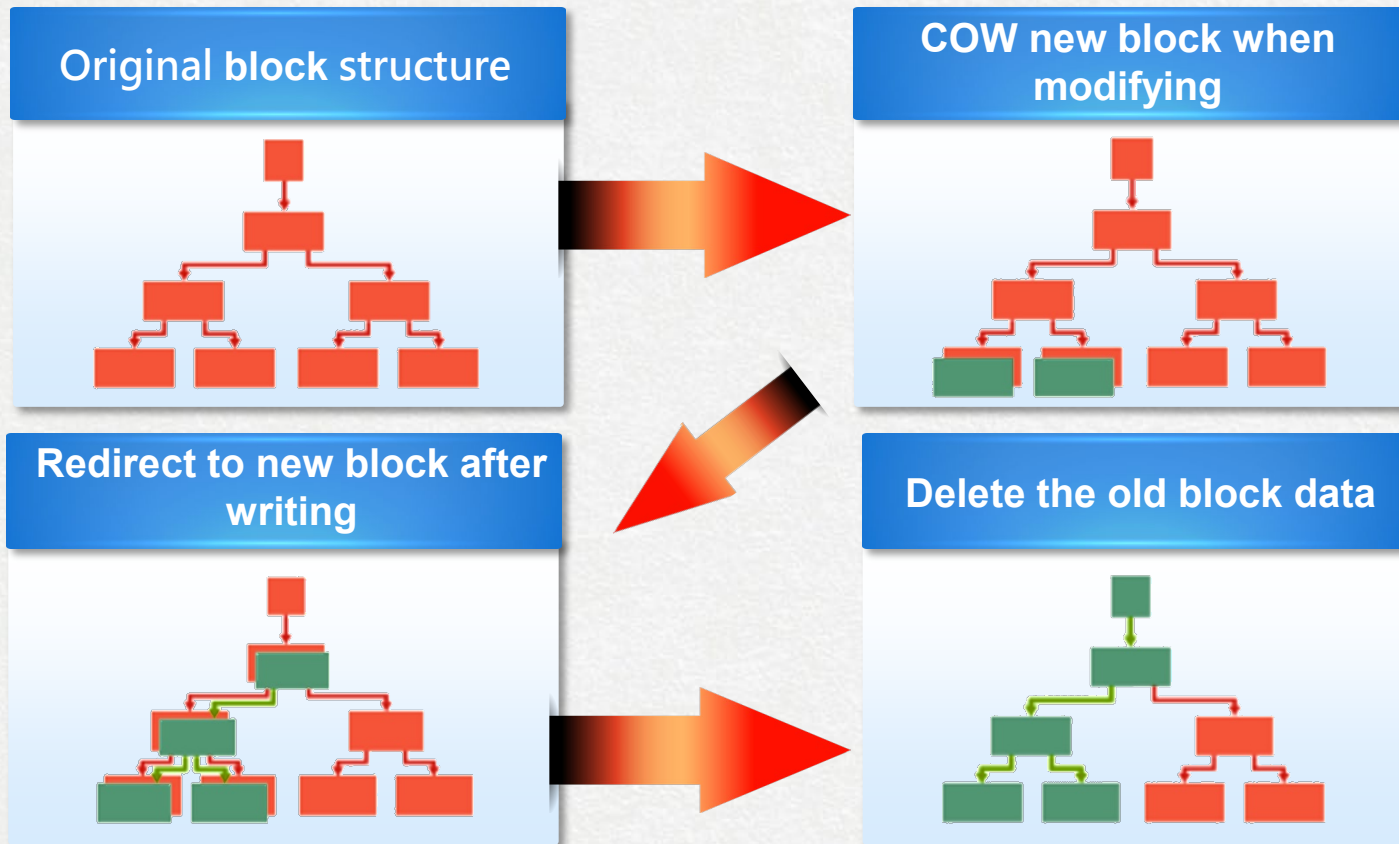


Avoid data silent corruption that occurred on running system



COW (copy on write) avoid data loss that occurred on power outage

- ZFS has no need to use traditional journal to protect metadata, because they are never updated in-place.
- COW mechanism will copy the written data to the new block and redirect the index to the new block after writing.



No more “check file system”

Chapter

02

DATA PROTECTION



Snapshot Protection (65,536)

Shared Folder Snapshot

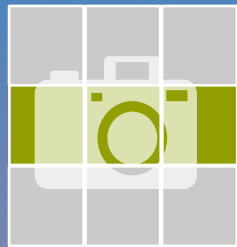
LUN Snapshot

NAS Maximum Snapshot **65,536**

Shared Folder
Snapshot



iSCSI LUN
Snapshot



Snapshot Manager is operated based on shared folder. With [Clone], [Restore] & [Folder Revert] support.

Snapshot Manager

Guaranteed Snapshot Space

Public Share
Ready

Schedule Snapshot
Take Snapshot

Daily 01:00

Snapshot location: Local | Ripple882

Day Total: 8

Name	Date Modified	Type	Size
@_thumb	2018-11-07 17:21:49	Folder	
@upload_cache	2018-11-07 17:21:47	Folder	
123	2018-12-27 15:45:25	Folder	
456	2018-12-27 15:45:29	Folder	
789	2018-12-27 15:45:32	Folder	
@Recycle	2018-11-07 17:16:54	Folder	
QZFS_1.0.0724_20181107_x86...	2018-11-07 12:03:53	qpkg	11.97 MB
TS-879_20181107-4.5.0.0725.qz...	2018-11-07 14:33:58	img	209.56 MB
TS-X31P2_20181102-4.5.0.0720...	2018-11-02 07:20:48	img	181.55 MB
TS-X77_20181106-4.3.5.0752.img	2018-11-06 08:58:52	img	211.90 MB
TS-X82_20181107-4.3.5.0753.img	2018-11-07 06:38:50	img	219.02 MB

Taken: 2019-01-11 01:00:03

Replicated: No

Retention Policy: Time-Based

Expires After: 6 Days

Status: ✓ Ready

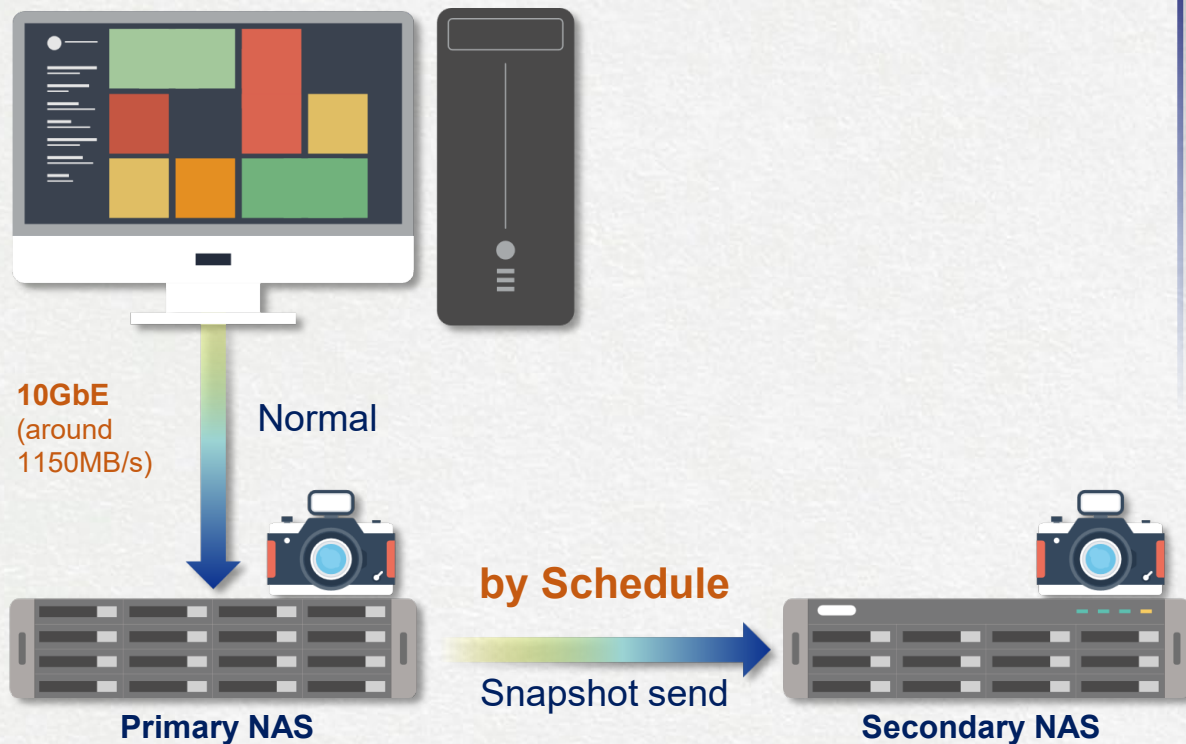
Snapshot Used: 800.00 MB

Description: No description

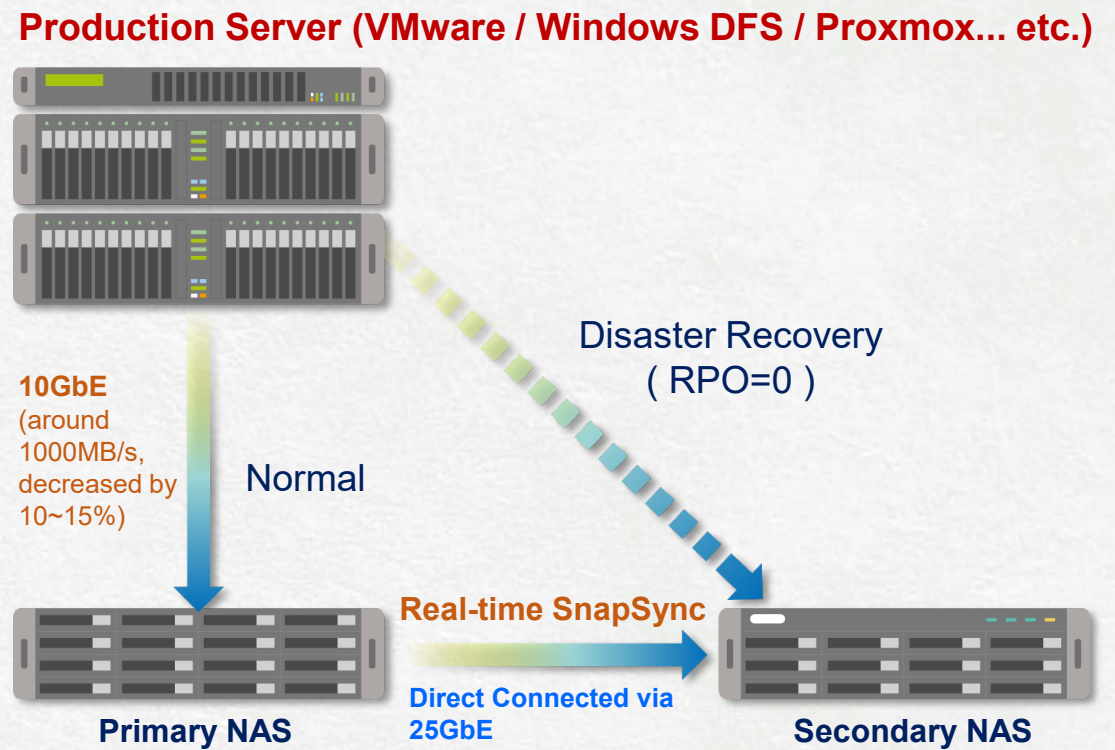
Restore Clone Revert Folder Snapshot

SnapSync – cost-effective replication solution for backup, data protection & disaster recovery

Scheduled SnapSync: 5min~60min



Realtime SnapSync: RPO=0



How to do when disasters happen

If unfortunately a disaster happens

Production Server



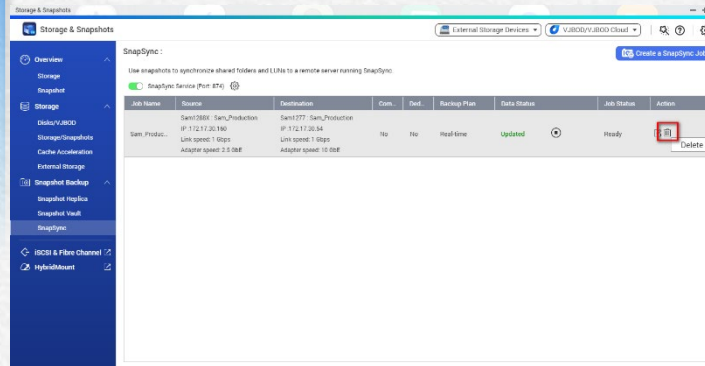
NAS (Shared Storage)

(1) Delete SnapSync task

Primary NAS
192.168.100.100



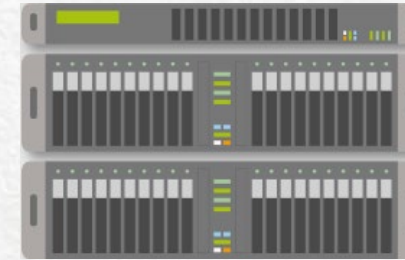
Secondary NAS
192.168.100.200



- The exclusive permissions of the folder will be removed when deleting the SnapSync task.

(2-A) Remount to secondary NAS IP

Production Server



Mount Target = 192.168.100.200

Or

(2-B) Change the secondary NAS IP as same as original primary NAS.

Secondary NAS

192.168.100.200 => 192.168.100.100

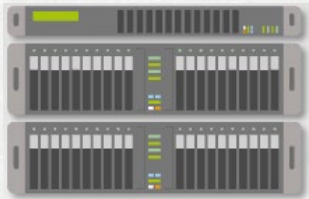


Note: Disaster Recovery automation via VMware SRM will be supported in the future.

Best Practices for the configuration of Realtime SnapSync

Before SnapSync Protection

Production Server



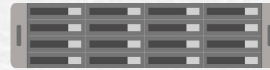
10GbE
(1150MB/s)



NAS (Shared Storage)

Best Practices for Configuration

Primary NAS



Secondary NAS



Direct Connected via 25GbE

1. The I/O performance of the secondary NAS should be the same as the primary NAS.
2. Recommended to connect the two networks directly to avoid interference and reduce latency. (If it is a long-distance transmission, the latency should be less than 5ms, and the maximum cannot exceed 10ms, otherwise you can also consider using schedule SnapSync)
3. QNAP 25GbE is recommended (slightly higher than the transfer rate of production server)

After Realtime SnapSync enabled

Production Server



10GbE performance when SnapSync enabled
(1000MB/s, decrease around 10~15%)

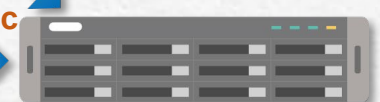
10GbE



Primary NAS

Real-time SnapSync

Direct Connected via 25GbE



Secondary NAS

QNAP Lab Test Environment:

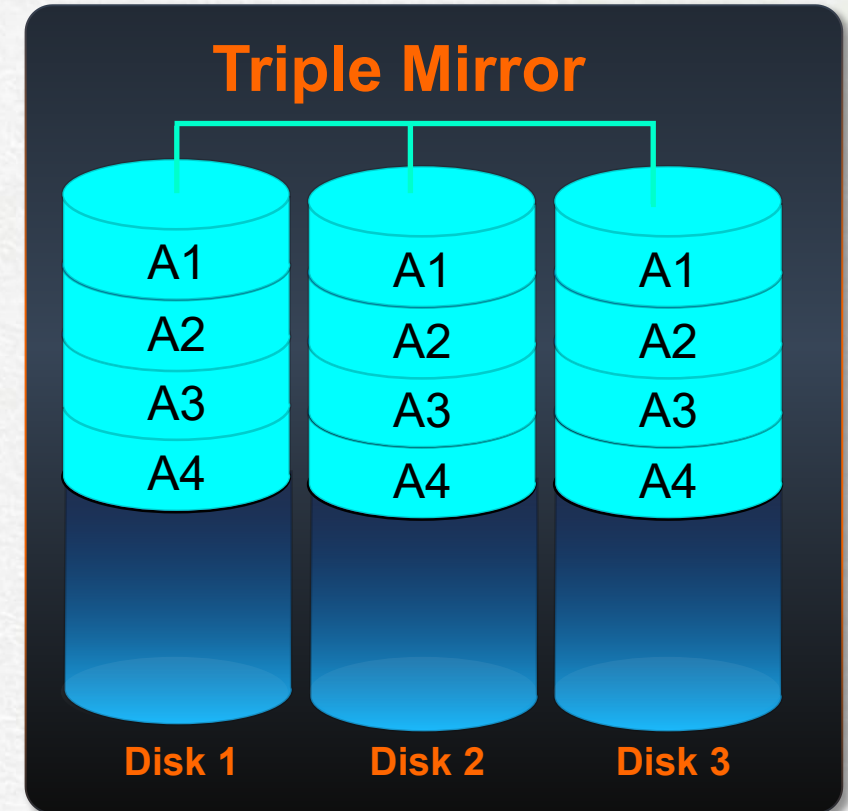
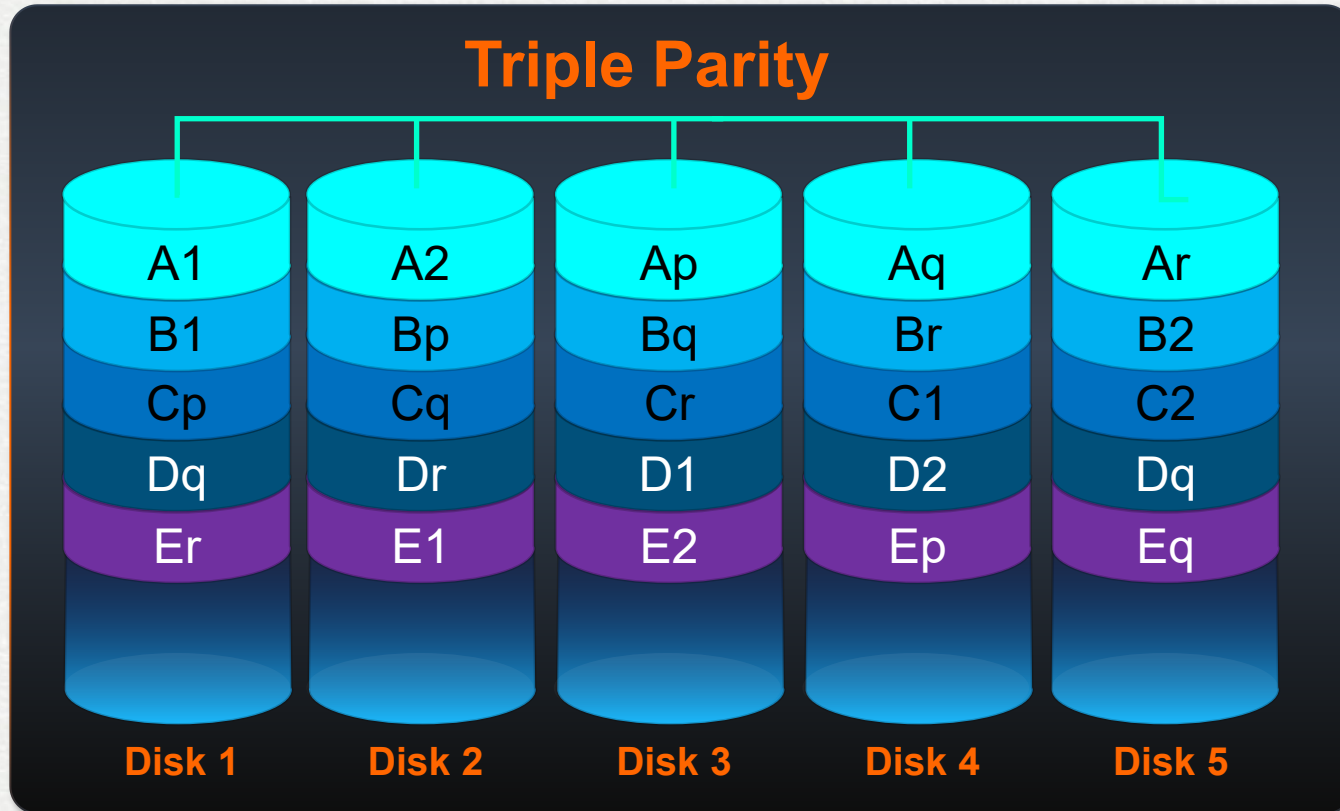
IO mode: sync = standard, Block size = 128K, Jumbo Frame (MTU) = 9000

Also supports QES NAS SnapSync to QuTS hero NAS

Safer RAID types: Triple Parity & Triple Mirror

Even if three hard disks are damaged at the same time, this RAID service can keep going (redundant tolerance of 3 sets of parity information)

3 sets of identical data for redundant tolerances, will give you 3 times the protection.



Three-layer backup solution:

Provide you the most complete data backup protection



RPO: daily / schedule



HBS 3:

File level, multi-version management



RPO: hourly



Snapshot & Replica:

Block level, multi-version management, ZFS provides the most lightweight snapshot without affecting storage performance at all.



RPO: Realtime



SnapSync:

Block level, Mirror the data copy and always kept up to date.



New Backup Golden Rule

Backup 3-2-1-1-0

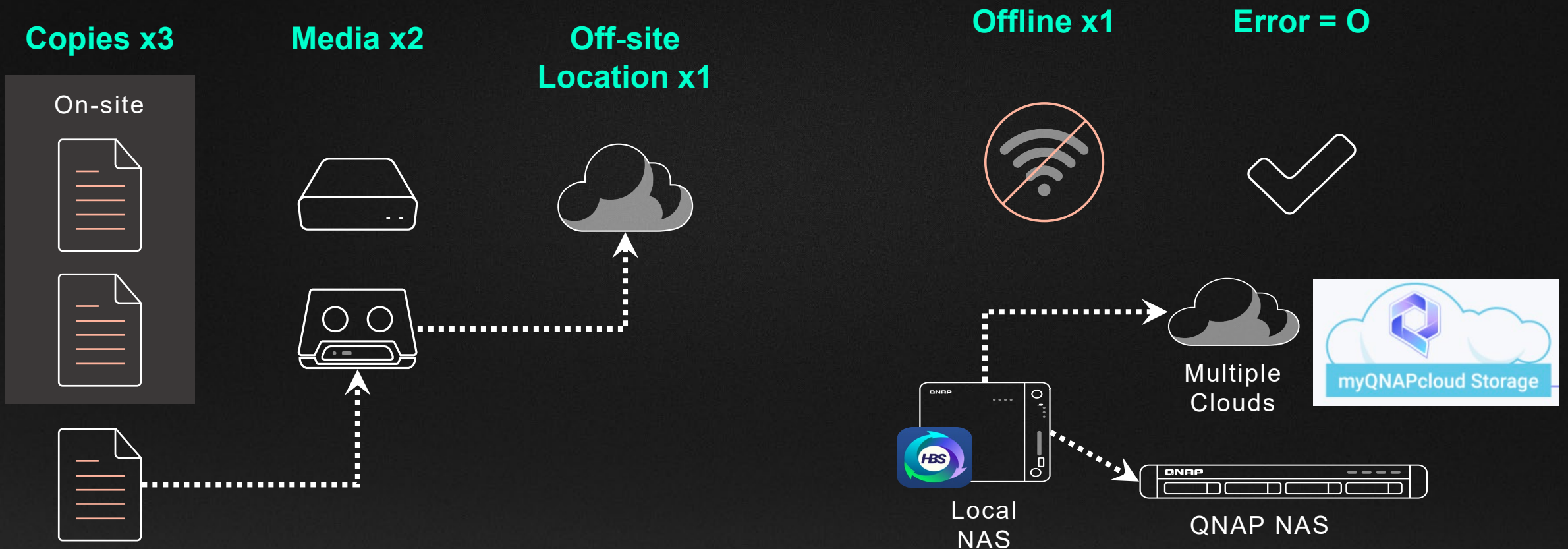
At least **3** copies of your data.

Store the backups on **2** different media.

At least **1** of the copies at an offsite location.

At least **1** of the copies offline (immutable backup).

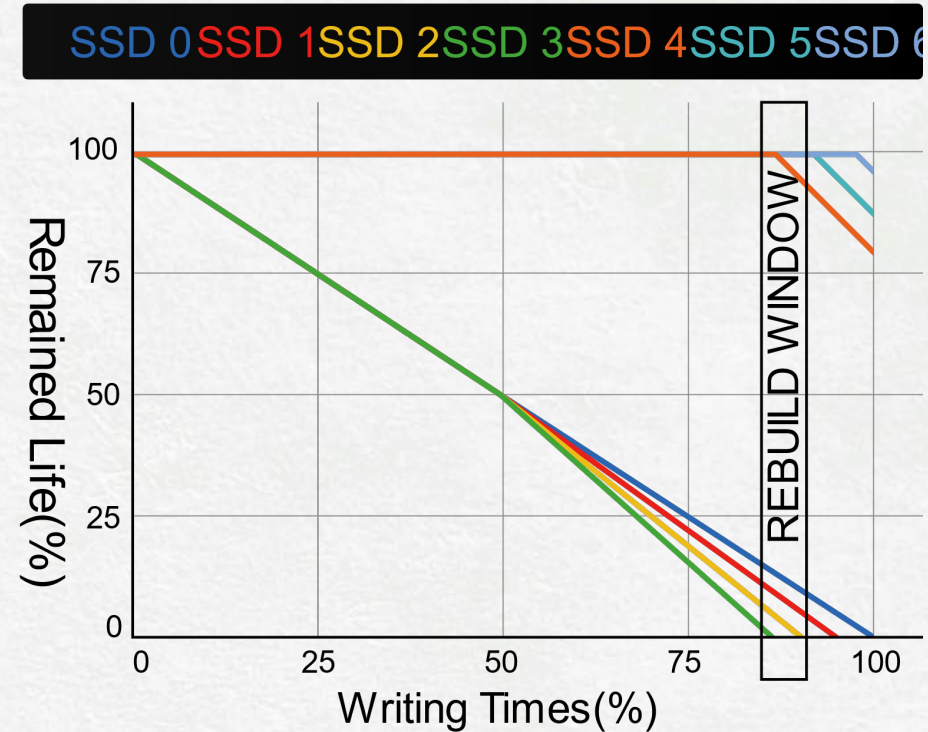
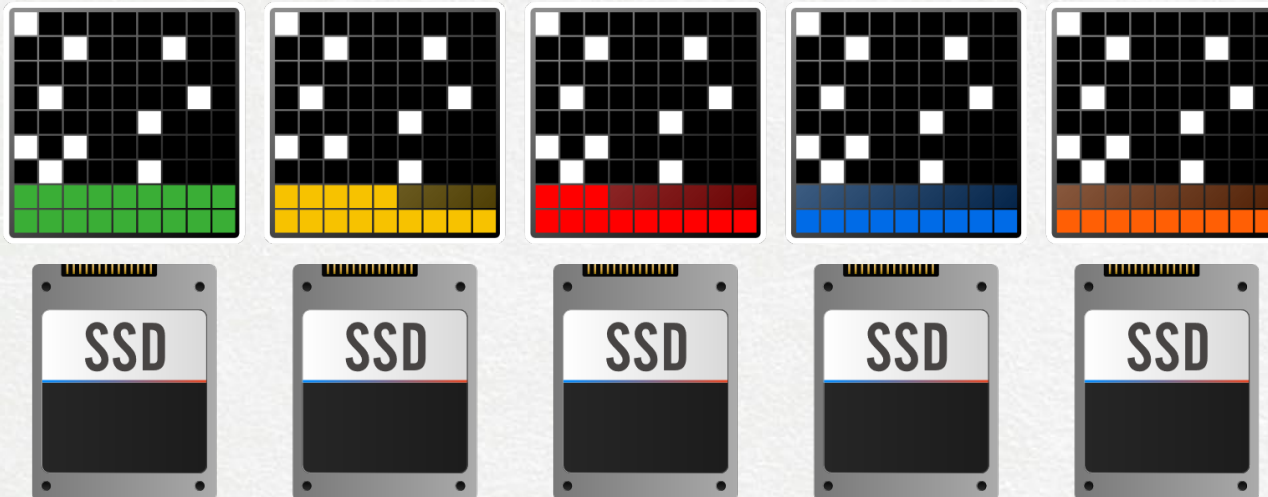
Verified backups **without** errors.



QNAP Patented QSAL technology: preventing multiple SSD malfunctioning at the same time



QSAL (QNAP SSD Anti-wear Leveling) When SSD life falls below 50%, the SSD OP would be dynamically adjusted to achieve the life control of each SSD, and to ensure that there is enough rebuild time at the end of the previous SSD life to avoid RAID damage.



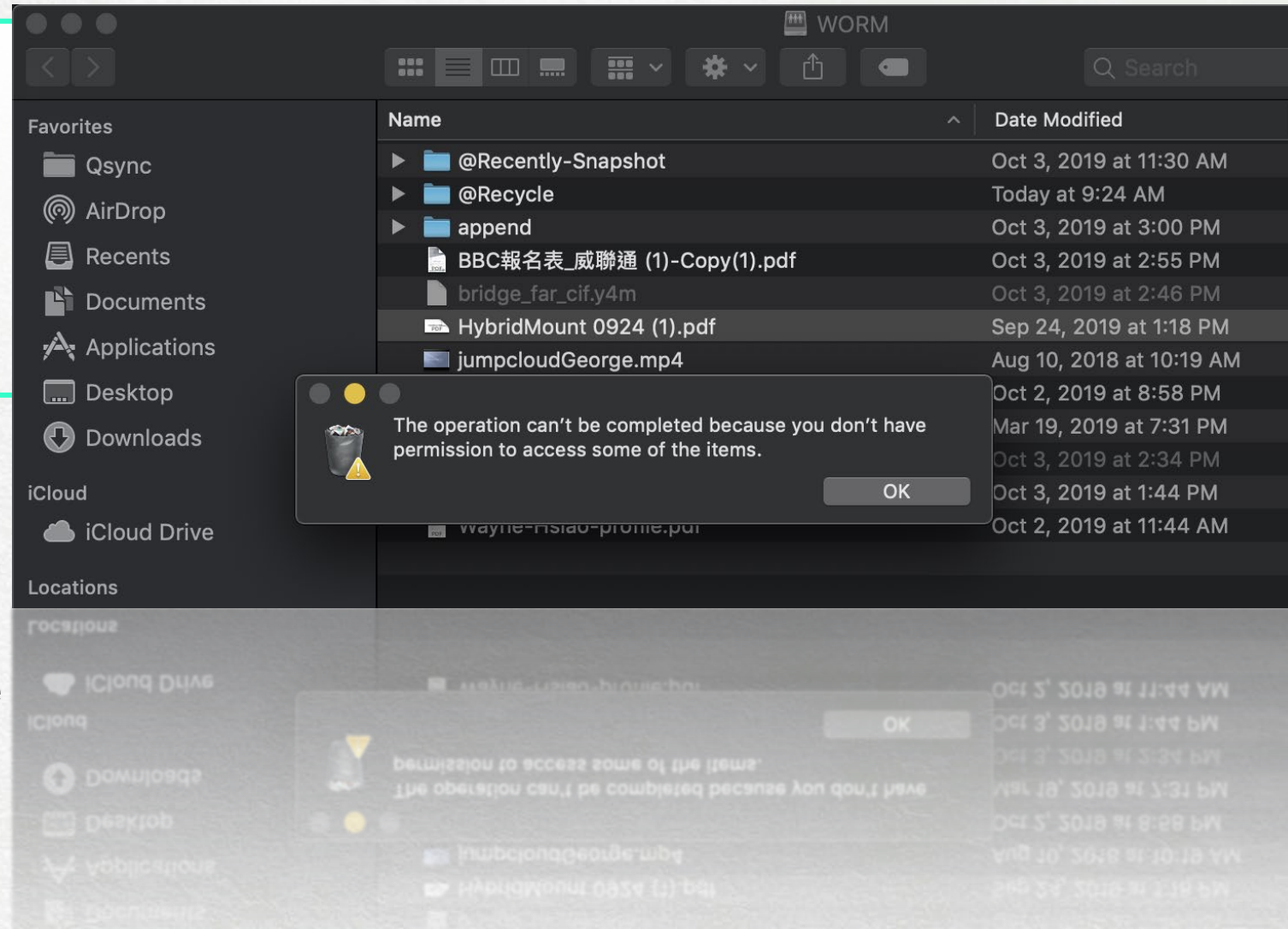
For SSD RAID 5 / 6 / 50 / 60 / TP (Triple Parity), QSAL will be enabled by default automatically.

WORM (Write Once Read Many times)

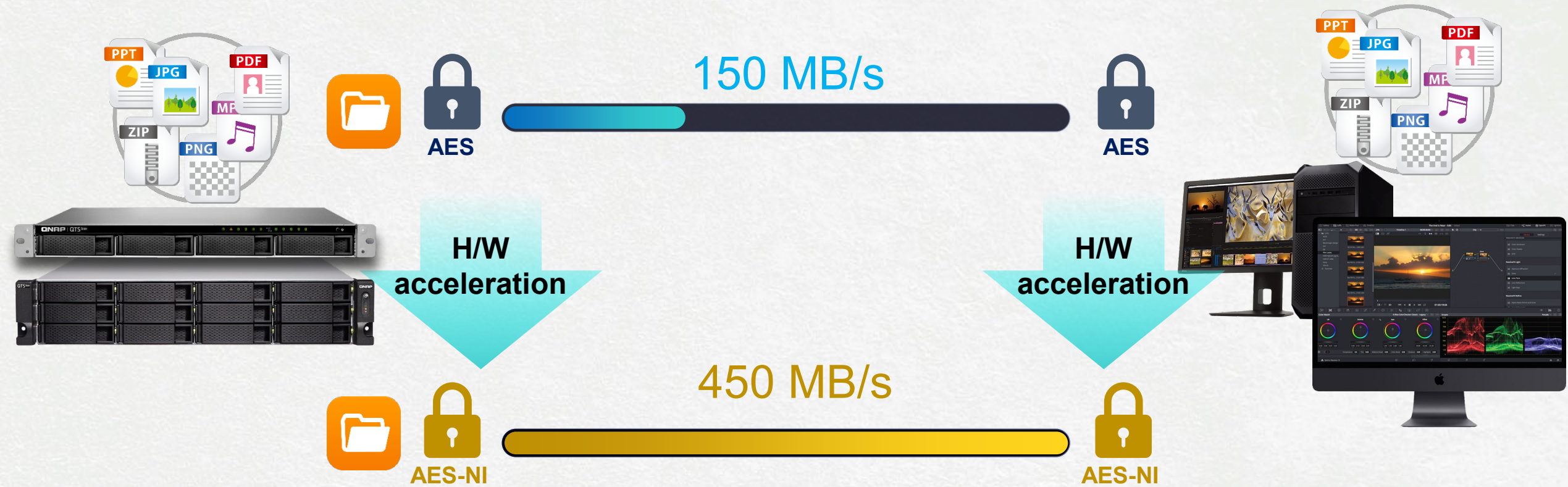
WORM is used to avoid modification of saved data. Once this feature is enabled, data in shared folders can only be read and cannot be deleted or modified to ensure data integrity.

Enterprise Mode: remove the shared folder through QuTS hero UI or SSH commands (QCLI).

Compliance Mode: Have to take the Storage Pool offline and remove the Pool if want to destroy data.



AES-NI accelerated for SMB3 Signing and Encryption



AES-NI accelerated for SMB3 Signing and Encryption

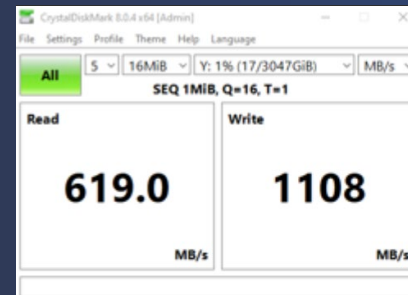
SMB Signing with GMAC: Secure and Fast!

In 10 GBs network, **AES-NI enabled CPU**, **new GMAC algorithm** outperforms the former CMAC one significantly.

CMAC

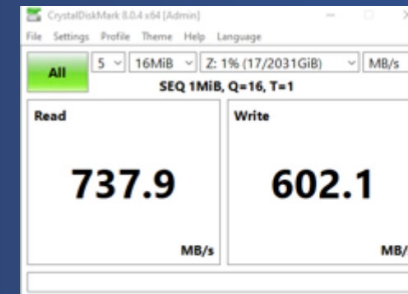
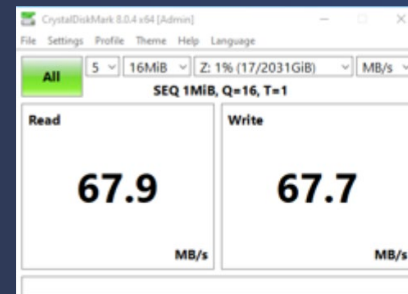
GMAC

x86



X2 Faster

ARM 64



X10 Faster

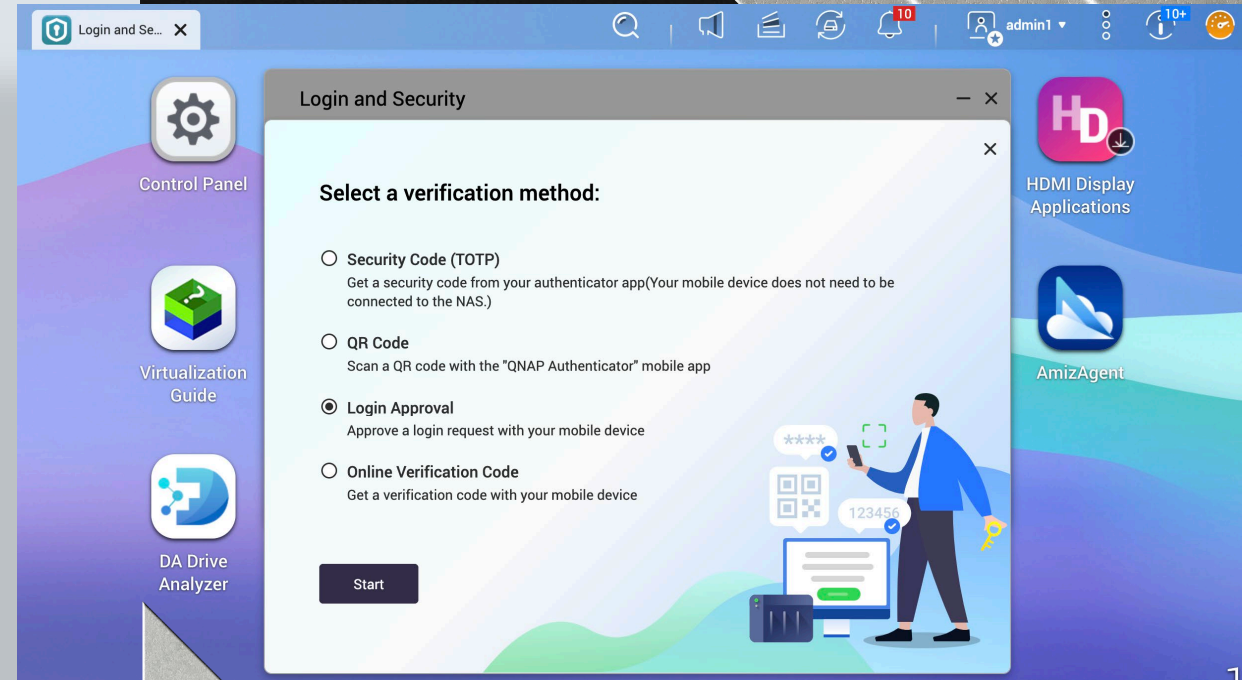
QNAP Authenticator

New 2 Step Verification

1. Password

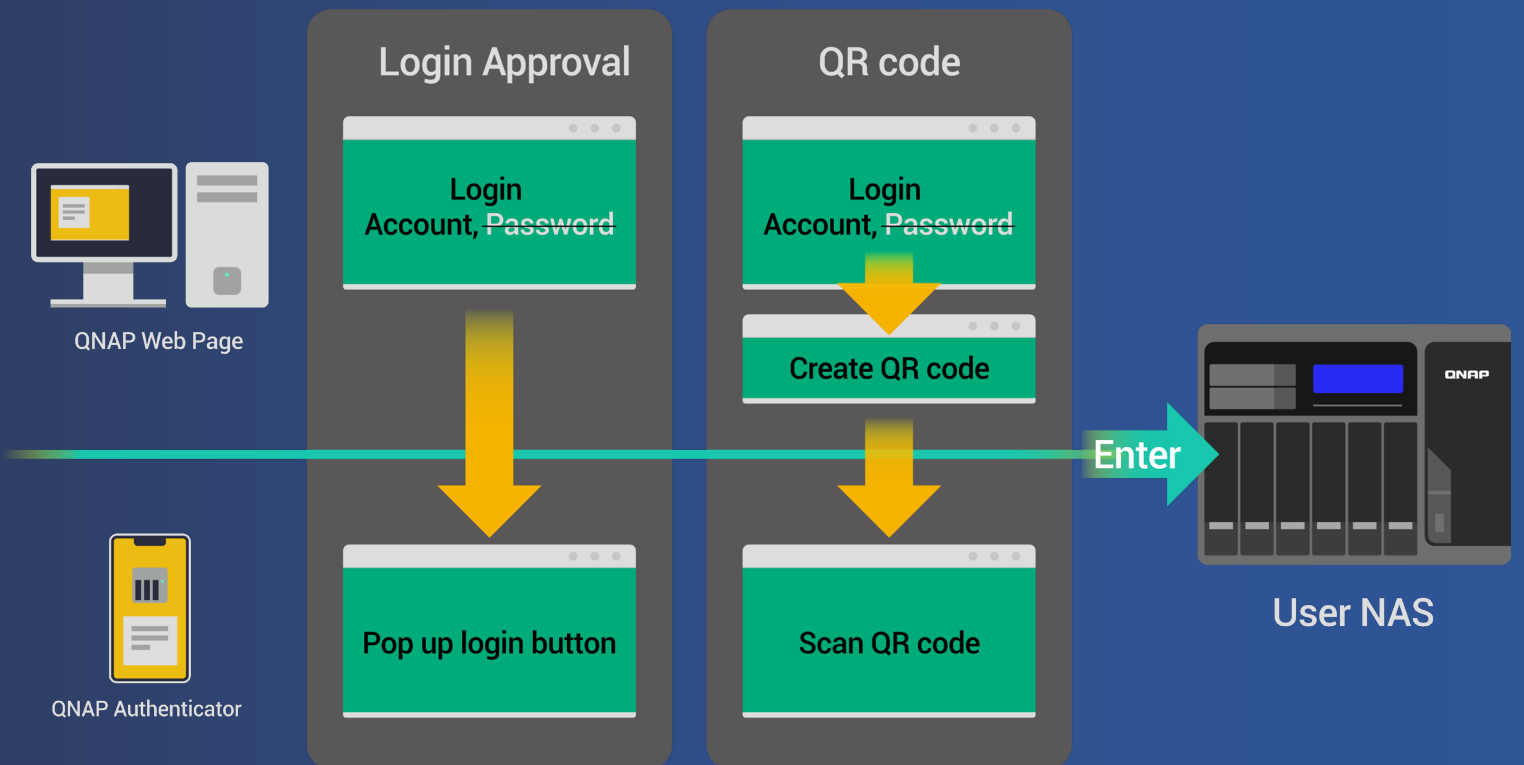
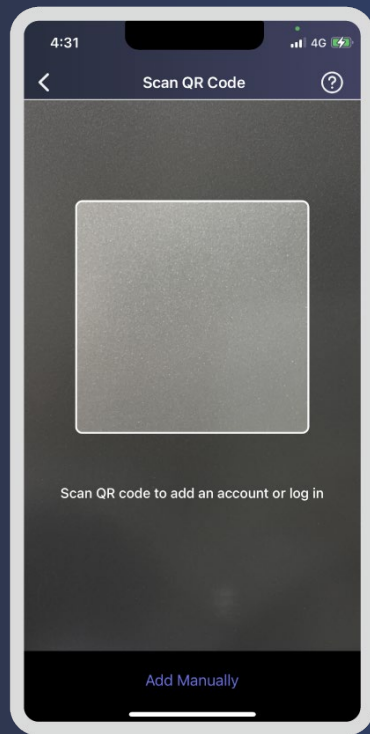
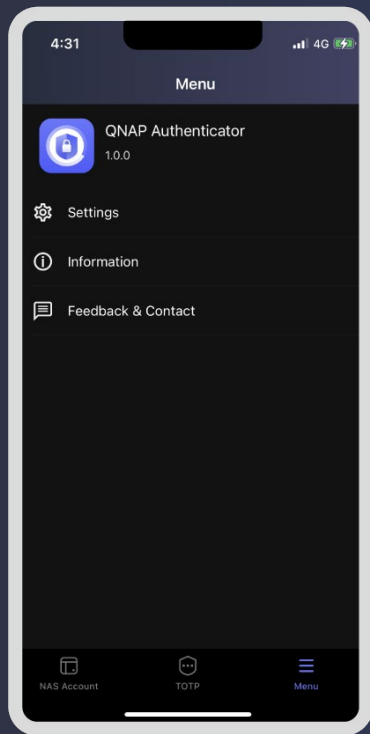
2. Options with

- Security Code (TOTP, Time-based One-Time Password; Mobile device does not need to connect to NAS)
- QR Code
- Login Approval
- Online Verification Code



QNAP Authenticator: Passwordless

If 2 Step Verification is not necessary, QNAP Authenticator can still let you not to memorize password by “Login Approval” or QR Code



Configure from “Login & Security”

The image shows a screenshot of the QNAP dashboard. At the top, there is a navigation bar with various icons and a user profile for 'admin1'. A dropdown menu is open, showing options like 'Language', 'Desktop Preferences', 'Personal Settings', 'Login and Security', 'Locate my NAS', 'Restart', 'Shutdown', and 'Logout'. The 'Login and Security' option is highlighted. To the right, a 'Login and Security' configuration window is open, showing tabs for 'Password', '2-Step Verification', 'Passwordless Login', and 'SSH Keys'. The '2-Step Verification' tab is active, displaying instructions on how to protect the account and a form to enter a recovery email address. A 'Get Started' button is visible at the bottom of the window.

myQNAPcloud App Center

DA Drive Analyzer myQNAPcloud Link

Last login time:
2023/03/22 14:15

- Language >
- Desktop Preferences >
- Personal Settings
- Login and Security**
- Locate my NAS
- Restart
- Shutdown
- Logout

Login and Security

Password 2-Step Verification Passwordless Login SSH Keys

Protect your account with 2-Step Verification

2-Step Verification (also known as two-factor authentication) adds an extra layer of protection to your account in case someone steals your password. After setting up 2-Step Verification, you will need both your password and an authenticator app on your mobile device to log in to this device.

Recovery email:

Send to my personal e-mail address

To enable this feature, you must provide your personal email address in "Profile" or specify another email address here as the recovery email address.

Get Started

[Note] to send a recovery email, the QTS should **login to QNAP ID**, or the **SMTP service** should be enabled on Notification Center

Chapter

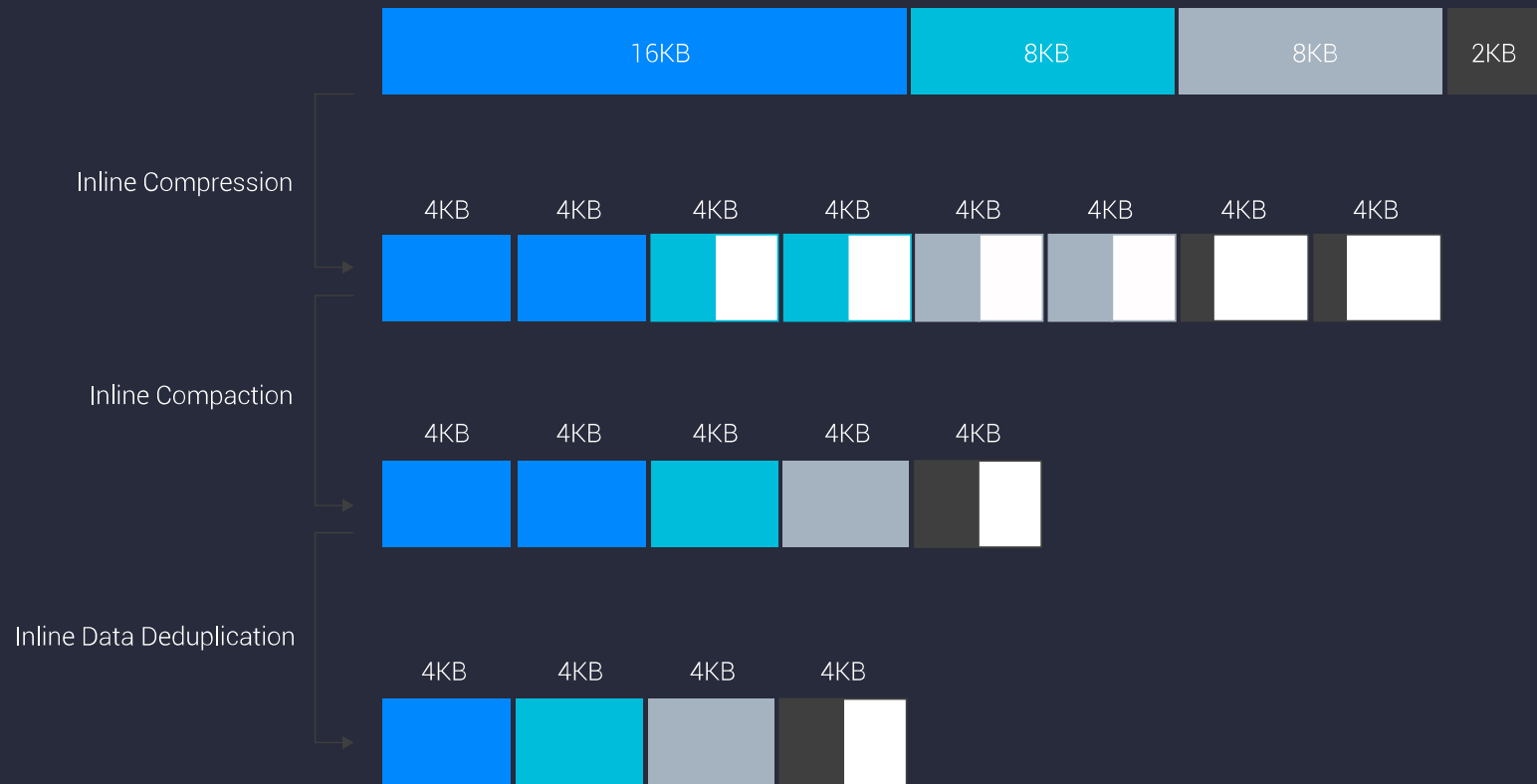
03

DATA EFFICIENCY



Data Efficiency with Powerful Data Reduction

Inline data deduplication is block-based and runs before data is written to storage. This greatly optimizes storage usage while significantly decreasing storage capacity requirements. Coupled with inline compression and inline compaction technologies, ZFS significantly reduces the overall storage footprint - especially helpful for increasing SSD storage efficiency when highly-repetitive data or massive small files are generated. All-flash solutions thus achieve higher cost efficiency while improving both random write performance and SSD lifespan.



Deduplication requirement:

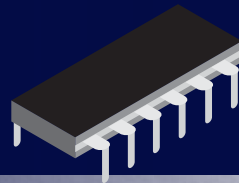
- minimum 16GB RAM
- Recommended 64GB RAM or more

L2ARC cache, and ZIL which provide power loss protection

Layer-2 Adaptive Replacement Cache: (L2ARC)

- ◆ Ideal for SSD read cache
- ◆ Large "hybrid" cache
- ◆ Read performance enhancements

RAM Read Cache



SSD Read Cache



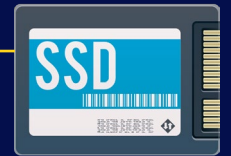
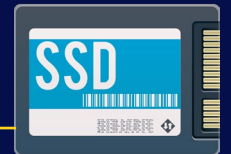
ARC

L2ARC ZIL

Disk Storage Pool

SSD write journal

RAID 1 Mirror



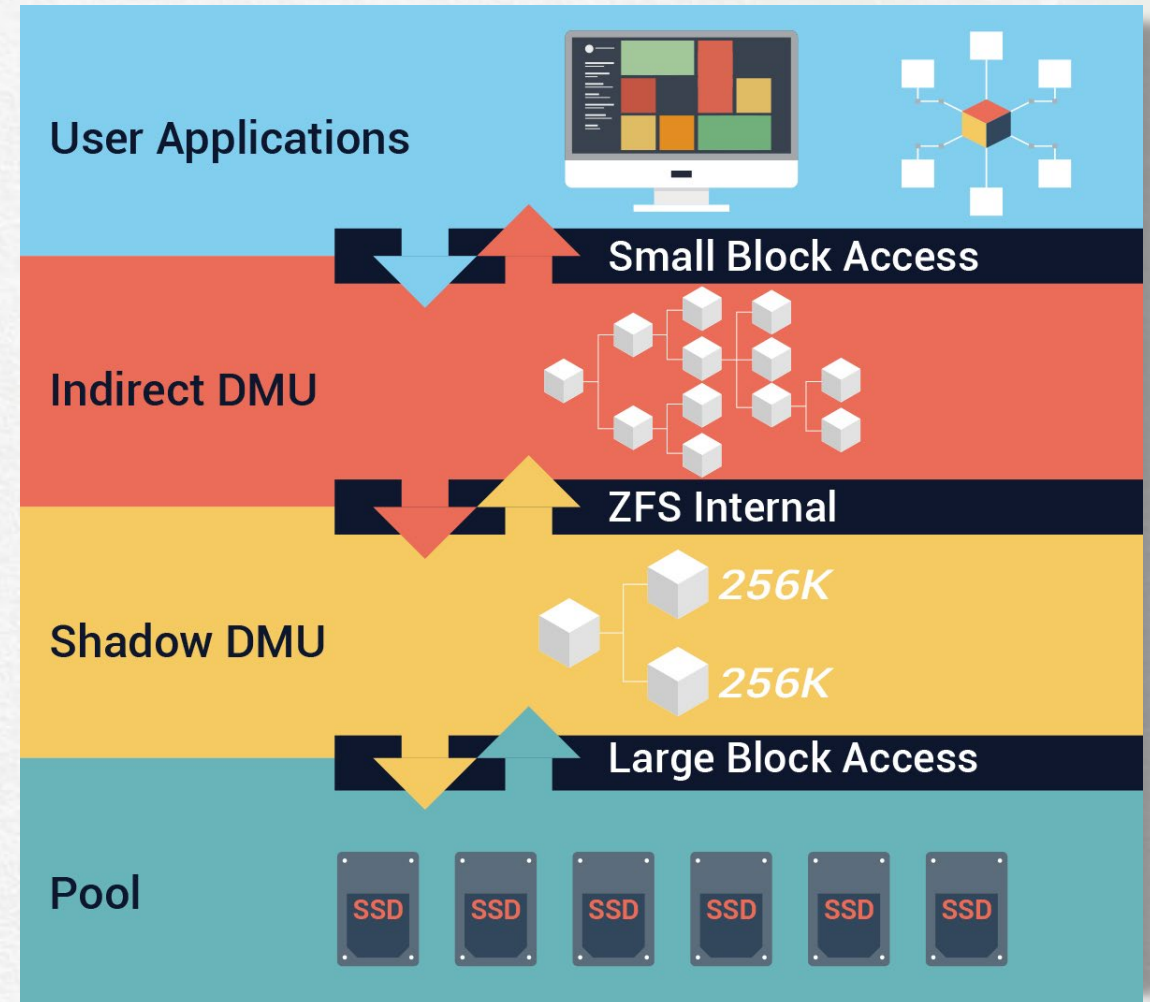
ZFS Intent Log: (ZIL)

- ◆ Ideal for SSD write log
- ◆ Write Data integrity (COW)
- ◆ Provides the **power loss protection** for writing data.



Write Coalescing: improve the random access

QNAP exclusive Write Coalescing algorithm that transform all random write to sequential writes along with reduced I/O.



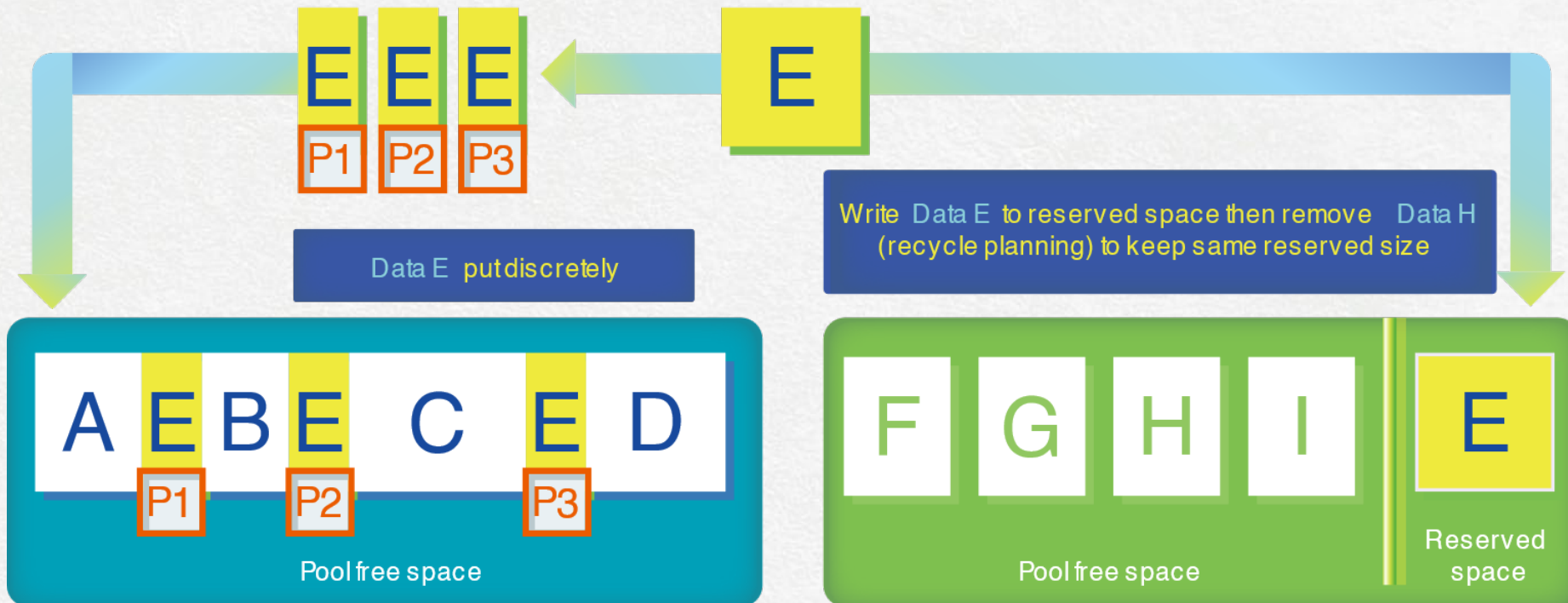
Pool over-provisioning: Improve the performance for fragmented pool

(The scenario when big block write to HDD)

w/o OP



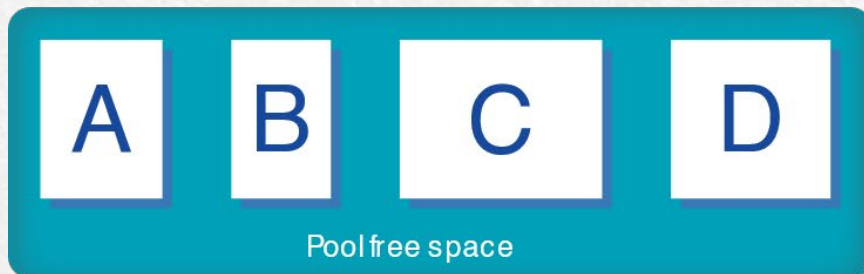
w/ OP



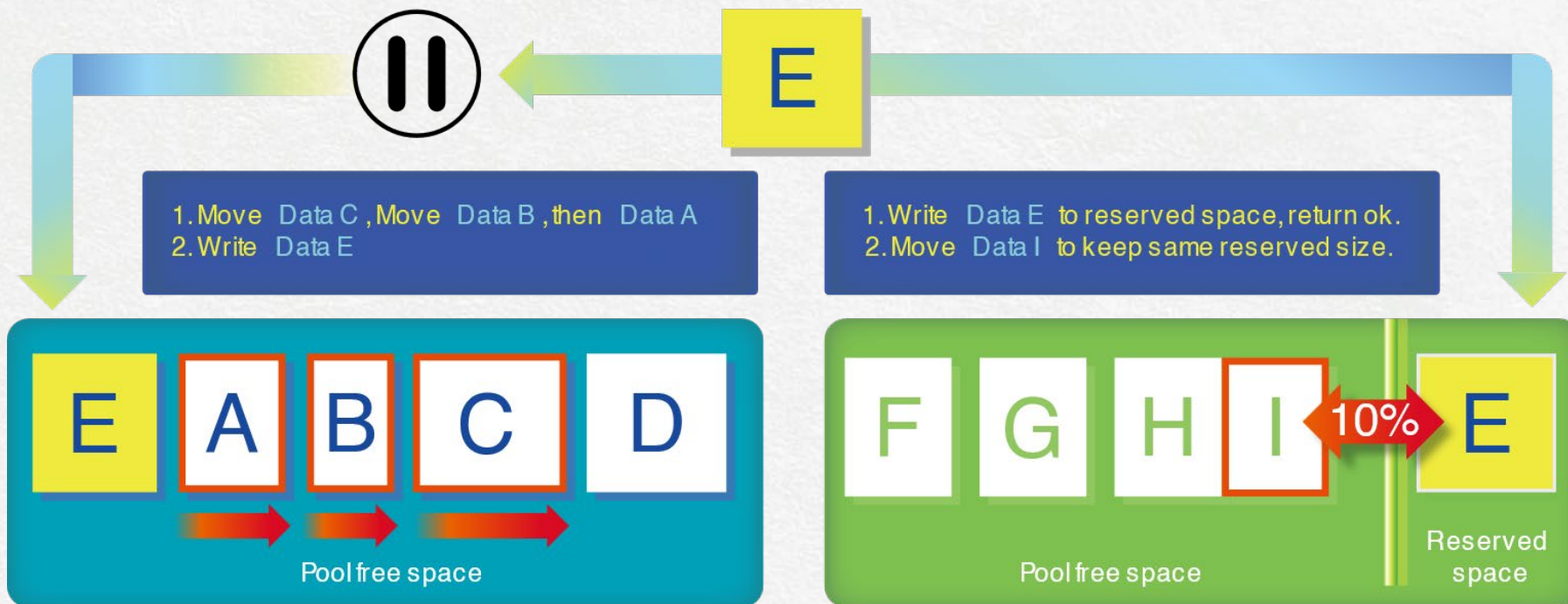
Pool over-provisioning: Improve the performance for fragmented pool

(The scenario when big block write to HDD)

w/o OP



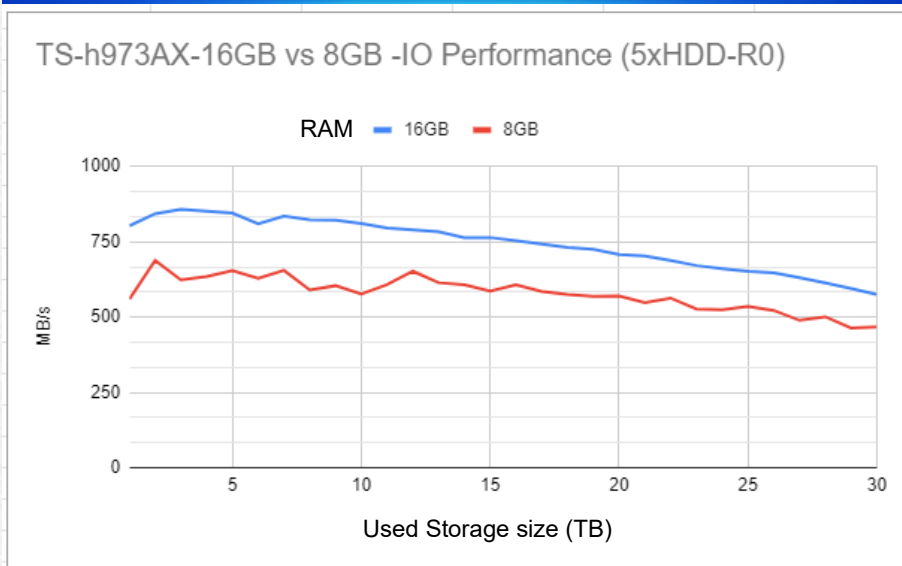
w/ OP



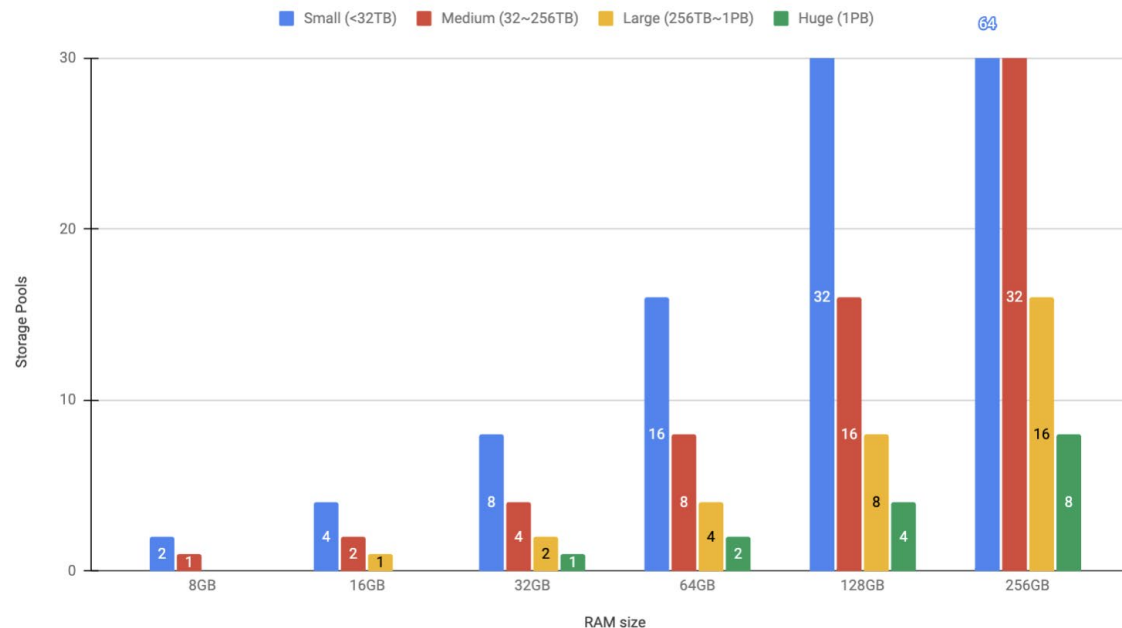
ZFS structure consideration:

Performance dependency between memory size and storage pools

Using entry-level model TS-973AX as a reference,
 We already created one SSD pool and one HDD pool around
 35TB. The performance difference of the HDD pool is displayed



The Best Practices for Performance between RAM size and Pool Configuration

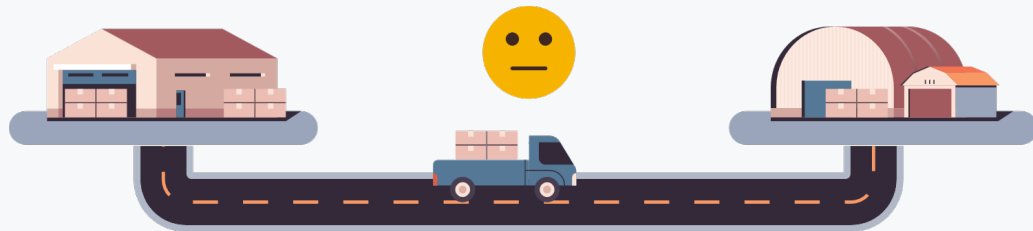


Choose sufficient memory for
 different storage configurations
 for better performance.

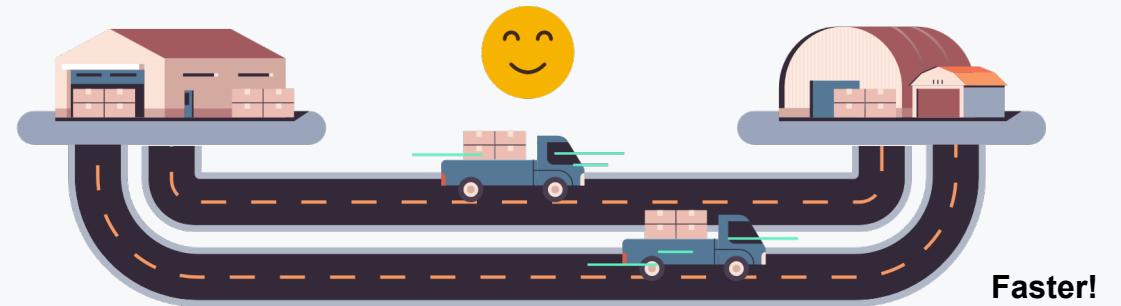
SMB Multichannel

A SMB 3 client automatically establishes multiple connections to the SMB server for single SMB session, and with the multiple connections achieves bandwidth aggregation and network fault tolerance.

Without Multichannel



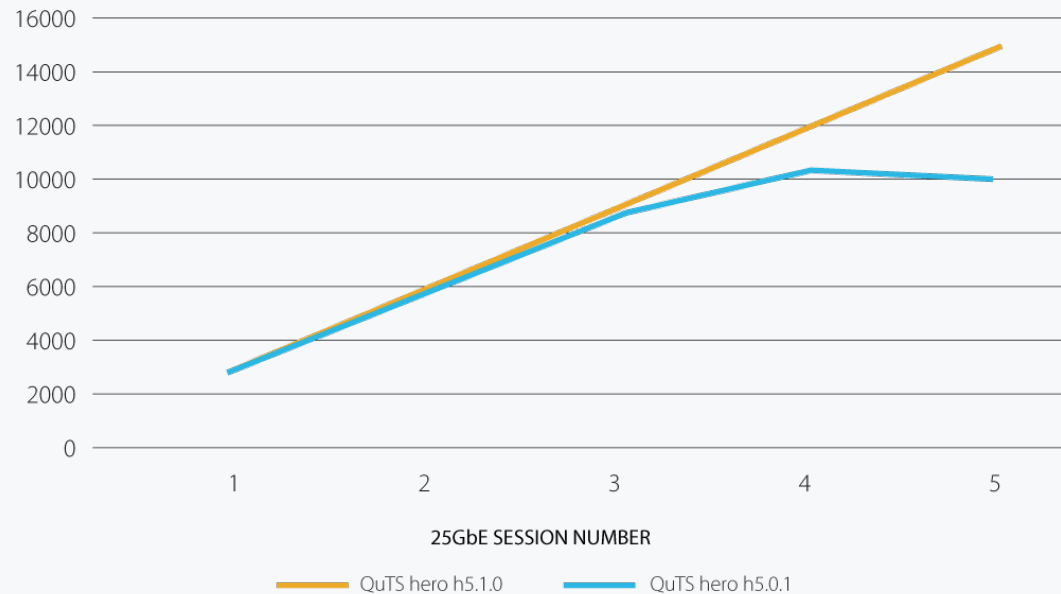
With Multichannel



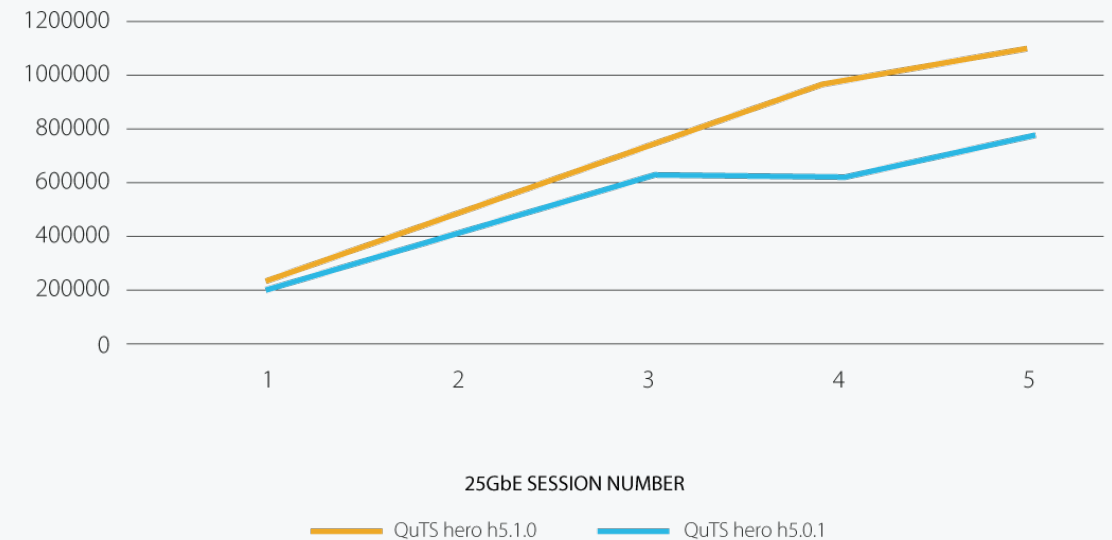
Improved iSCSI read performance by socket zero-copy

In high-speed data transmission, iSCSI performance is possibly affected by CPU overhead. QuTS hero 5.1 supports socket zero-copy technology that significantly offloads CPU resources, thus improving read performance for iSCSI LUN.

Sequential Read Throughput (MB/s)



Random Read IOPS



Enhance the performance of encrypted folders/LUNs

You can encrypt the contents of specific shared folders and LUNs to prevent unauthorized access. From QuTS h5.1, the performance of encrypted shared folders and LUNs has been greatly enhanced.

QuTS hero h5.1

Sequential Read

1120 MB/s

Sequential Write

945 MB/s

QuTS hero h5.0

Sequential Read

809 MB/s

Sequential Write

565 MB/s

Test environment:

Crystal Disk Mark 32GB pattern size

Client: Windows Server 2022 (AMD EPYC 7232P 3.0GHz, DDR4 128GB) with 1 x 25GbE NIC

NAS: TVS-h474, QuTS hero h5.1, M.2 SSDx2 Raid1 Pool / share folder / encrypt share folder

Chapter

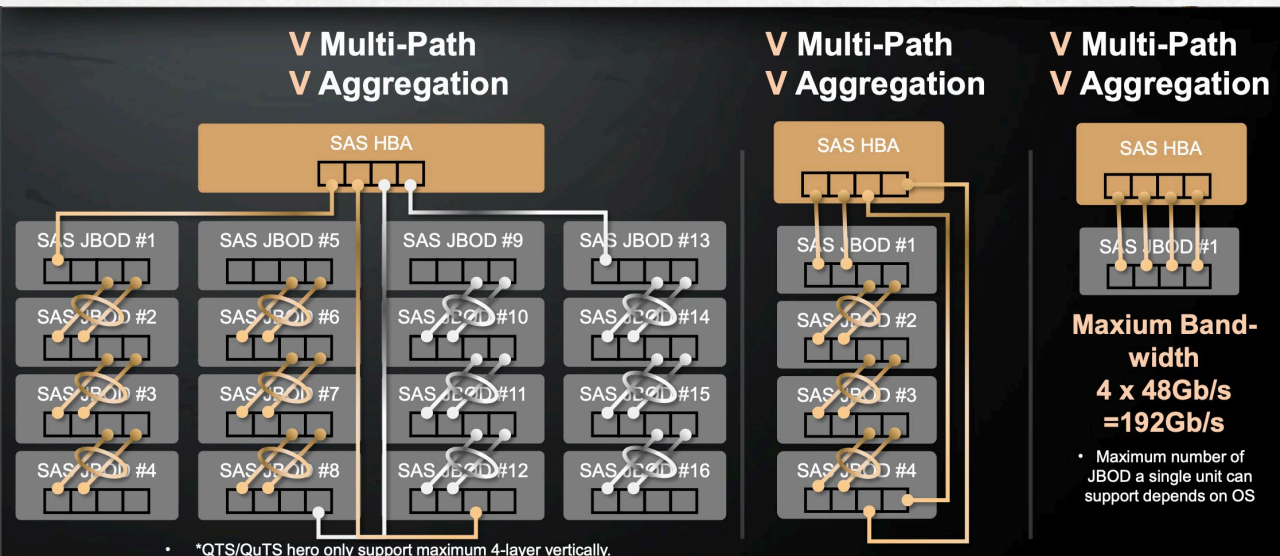
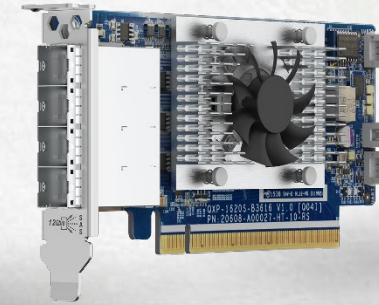
04

STABILITY & SCALABILITY



SAS 12Gb/s JBOD Expansion

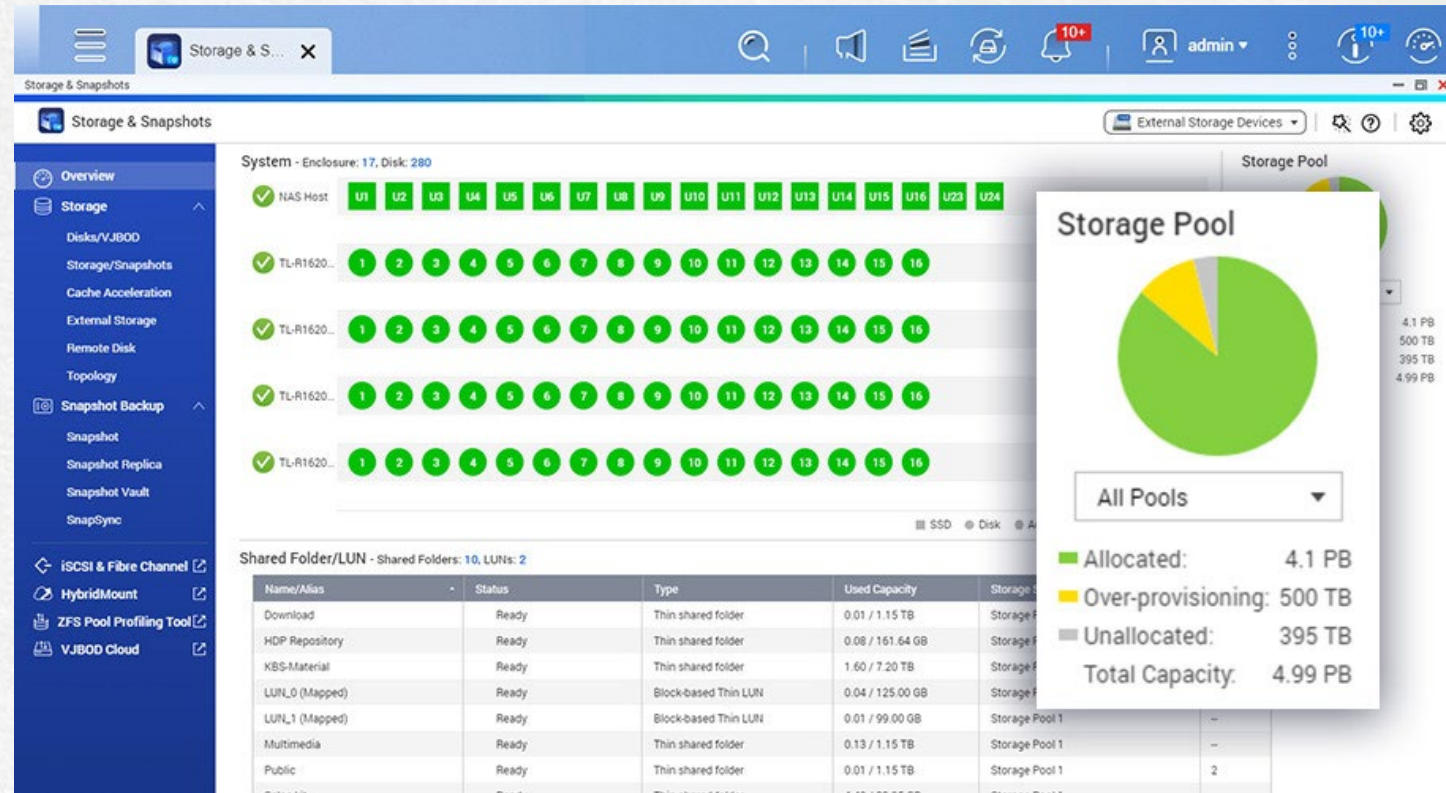
QXP-1620S SAS HBA (Optional)



- Each NAS can connect up to **16 JBODs** (REXP/TL-R1220Sep/TL-R1620Sep)
- Each NAS supports **256 HDD Drives** for **4.6PB** of raw capacity

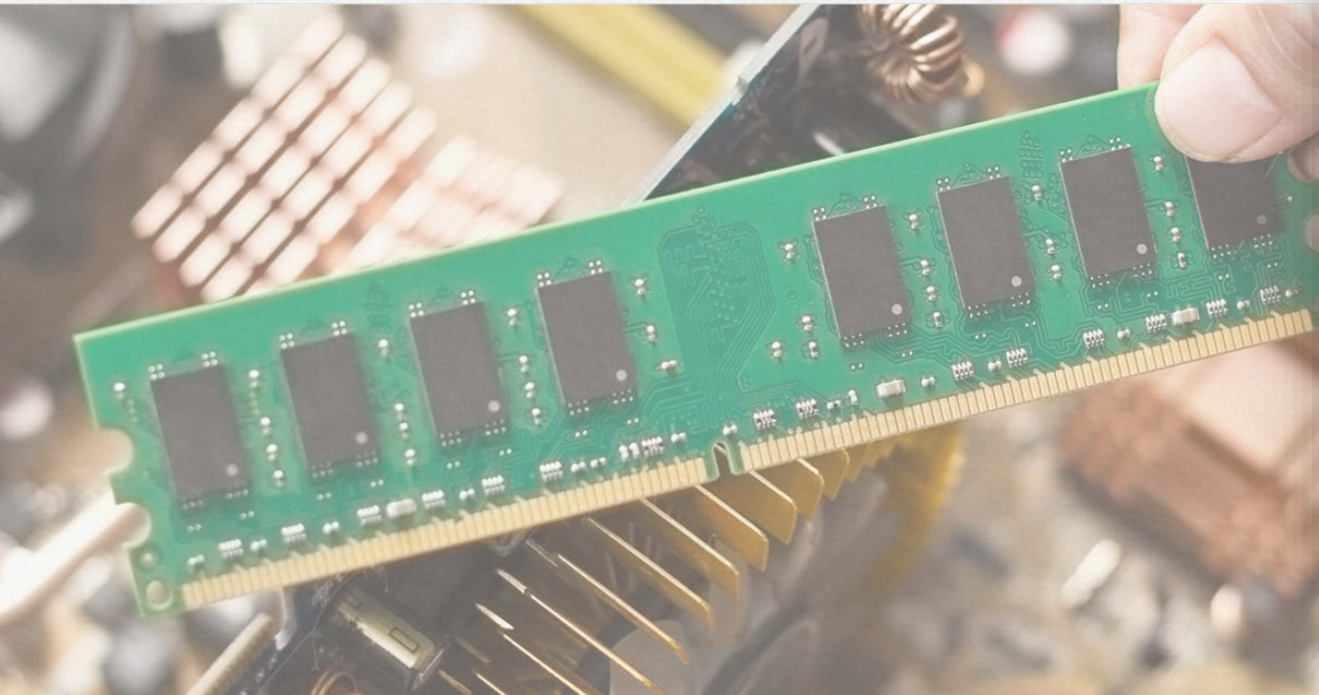
Up to 5 petabytes capacity per shared folder

The 128-bit ZFS filesystem has huge capacity potential and supports native handling of standard RAID levels and additional ZFS RAID layouts (RAID Z). ZFS-based QNAP storage solutions provide up to 5 PB capacity for individual shared folders, enabling enterprises to tackle storage-demanding applications including Big Data analysis, edge computing, and AI. Designed to deal with petabytes of data, RAID Z quickly handles creating ready-to-use high-capacity RAID.



Recommended to use ECC Memory (Error Correcting Code)

ECC Higher reliability and data integrity



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4GB DDR3 ECC RAM, 1600 MHZ, LONG-DIMM




Price: US\$130.00
Model:RAM-4GDR3EC-LD-1600
Category: 4GB DDR3 ECC RAM Module
Description: QNAP 4GB DDR3-1600 ECC LONG-DIMM RAM Module
EAN: 4712511124545
UPC: 885022004515
Applied Model: TS-EC879U-RP, TS-EC1279U-RP, TS-EC1679U-RP, TS-EC1279U-SAS-RP, TS-EC1679U-SAS-RP

Qty:

Click to enlarge

Additional Images

There are no additional images for this product.



Order more RAM on QNAP website

The NAS supports ECC memory for auto error correction. ECC is not mandatory for ZFS. It's just a really, really good idea. It allows ZFS to make its data integrity guarantees that it claims to make. Any data storage on any filesystem will benefit from ECC RAM.

Expand ZFS RAID-Z capacity



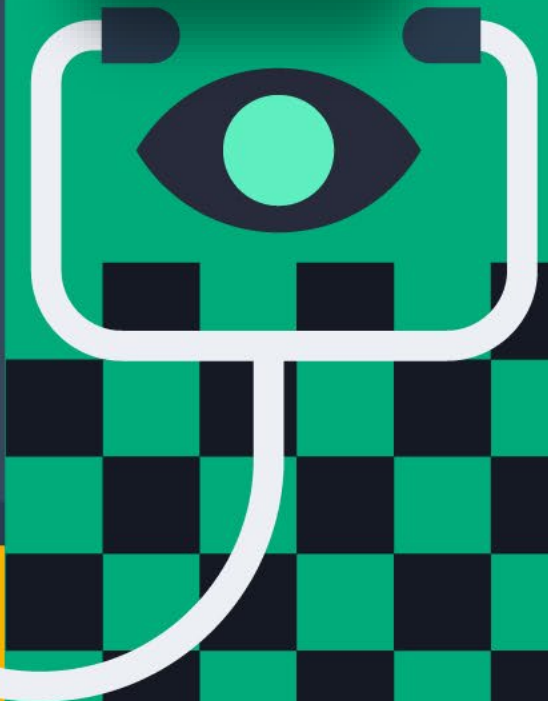
Expanding the capacity of a ZFS RAID-Z previously required adding another RAID group. Now, you can simply add a single disk to an existing RAID-Z for storage expansion, or conveniently add 2 to 3 disks for upgrading RAID level with Parity.

The minimum number of disks for expanding RAID capacity:

Current RAID level	New RAID level	Minimum disks required
RAID 5 (Z)	RAID 6 (Z2)	2
RAID 5 (Z)	RAID TP (Z3)	3
RAID 6 (Z2)	RAID TP (Z3)	2
RAID 5 (Z)	RAID 5 (Z)	1
RAID 6 (Z2)	RAID 6 (Z2)	1
RAID 1	RAID Triple Mirror	1 (only 1 disk can be added)

AI Prediction for Drive Health - DA Drive Analyzer

Prevent the long service down time or data loss because of the sudden failure of the drive. New improvement to arrive!



Predictive Migration

Depending on the drive health analytical tools, selected conditions can trigger data migration to the spare disk.

- S.M.A.R.T.
- WDDA
- IHM
- DA Drive Analyzer
- SSD Estimated remaining life

The screenshot displays the 'Storage & Snapshots' management interface. The left sidebar shows a navigation menu with categories like Overview, Storage, Snapshot Backup, and iSCSI & Fibre Channel. The main content area is titled 'Global Settings' and contains a section for 'Predictive Migration'. This section includes a toggle switch that is turned on and a table of trigger events and their corresponding results.

Trigger Event	Result
S.M.A.R.T.	Warning
WDDA	Warning
IHM	Warning
DA Drive Analyzer	Warning
SSD Estimated remaining life	Ignore this test result

Below the table, there is a field for 'S.M.A.R.T. polling time (minutes)' set to 5. At the bottom of the settings window, there are 'Apply' and 'Close' buttons.

Predictive Migration: Protect Your Data Before Drive Fails.



- When a drive has failed, RAID will rebuild its data to the new drive. Depending on the CPU or Drive bottlenecks, RAID rebuild can take days to weeks to complete, due to the process of heavy calculation.
- On the other hand, before a drive fails, when the system can detect the risk of drive failing, it may start to migrate the data to the spare drive. Such process should complete within hours, because it copies the files and synchronizes without calculating from the RAID strips.

Chapter

05

Management & Application



More detailed Access Control

14 Windows ACL Permission

Edit Shared Folder Permission

使用者與群組權限 共用權限

NAS-221

- Volume01
- Download
- Home
- Multimedia
- Music
- Movie
- Public
- Recordings
- Usb
- Web
- Volume02

\\NAS253pro\share folder\multimedia

Basic Permission Windows Permission

Add User 關閉繼承權限

Permissions	Type	Full cont...	Modify	Read & ...	List folder
Aaaaaa	Allow Deny	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Bbbbbbb	Allow Deny	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ccccccc	Allow Deny	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Ddddddd	Allow	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Edit Principal

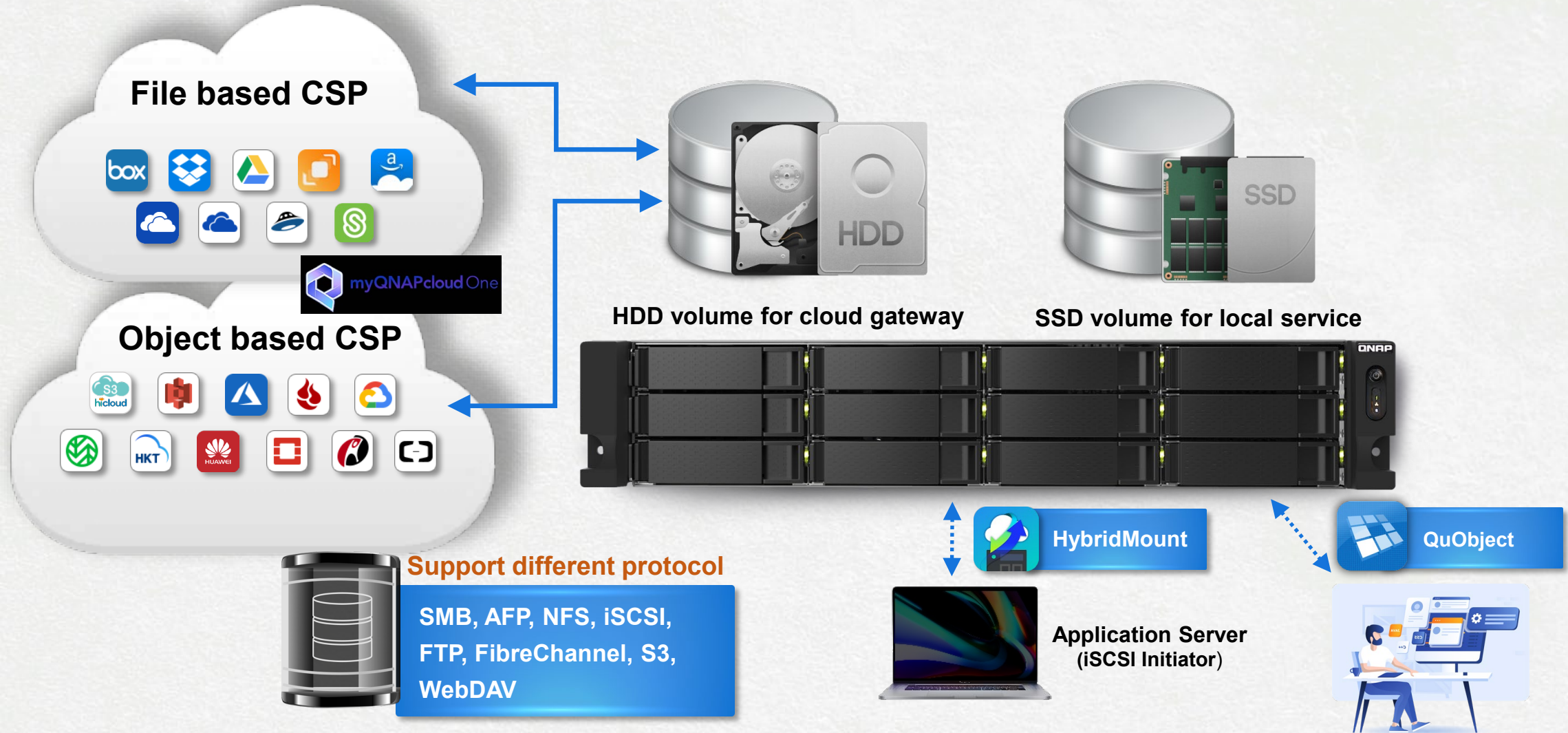
Principal	Type	Applies to
Jeremy	Allow	This folder,subfolders and files

- Full control
- Traverse folder / execute file
- List Folder / read data
- Read attributes
- Read extended attributes
- Create files / write data
- Create folders / append data
- Write attributes
- Write extended attributes
- Delete subfolders and files
- Delete
- Read permissions
- Change permissions
- Take ownership

Apply

Cancel

Convert your local storage to public cloud with different protocols



Delegated Administration

- Administrator group users have the highest privileges including access sensitive data.
- User group users have almost none administrative privileges.



- Sole administrator may cause heavy workloads and poor responsiveness.
- Many administrators may cause improper authority and pose the risk of data leakage.

New 8 Roles delegatable to the User group users

Administrator

Have full authority of the NAS, and the only role who can delegate roles.

System Management

Have the most administrative capability under Administrator including all privilege of other delegated roles.

Backup Management

Manage and monitor backup jobs of the NAS.

Backup Operation

Execute backup jobs of specified shared folders.

User and Group Management

Create or delete local accounts for individual users and groups.

Shared Folder Management

Manage shared folders and grant access rights for users or groups.

Application Management

Install, update, and manage apps in the App Center.

Access Management

Manage overall accessibility of the NAS.

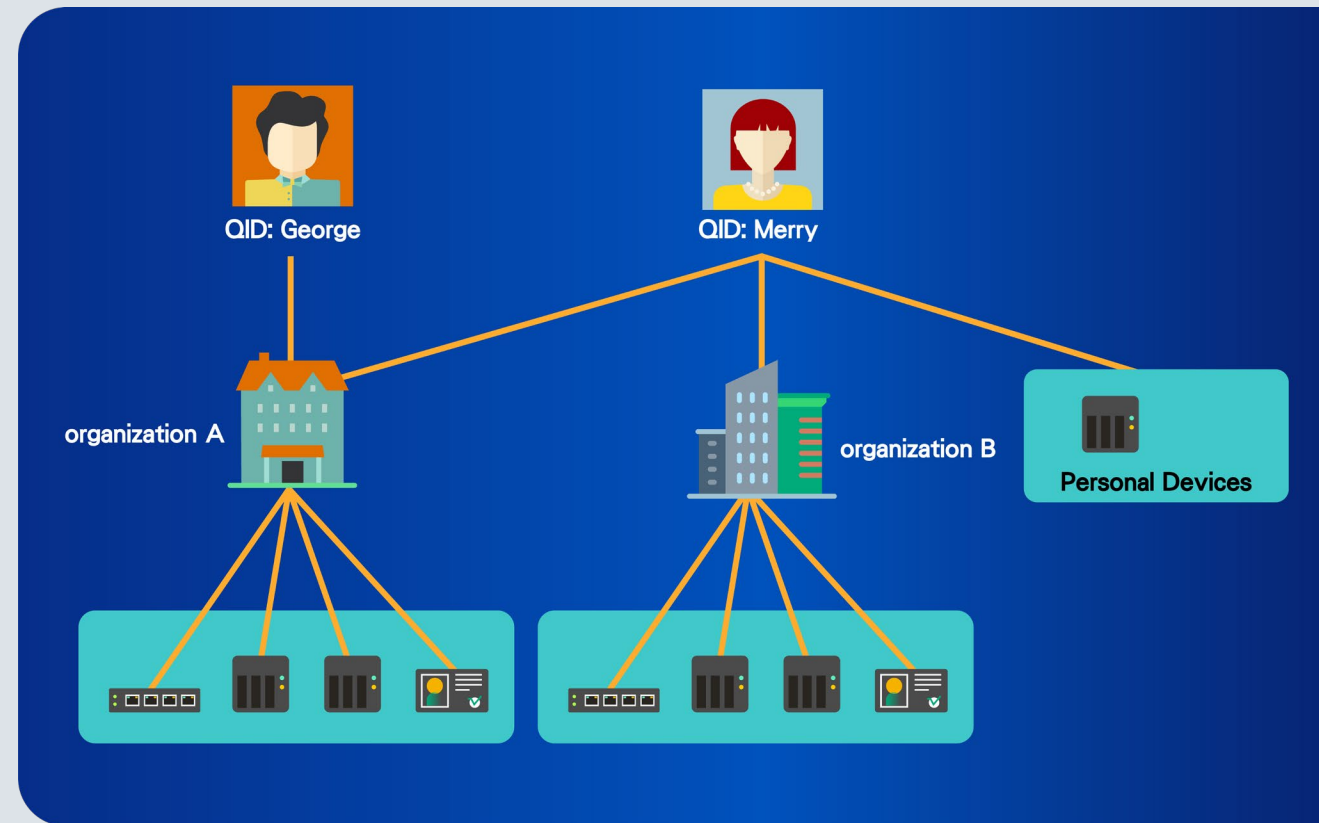
System Monitoring

Oversee utilization of NAS system and storage resources.

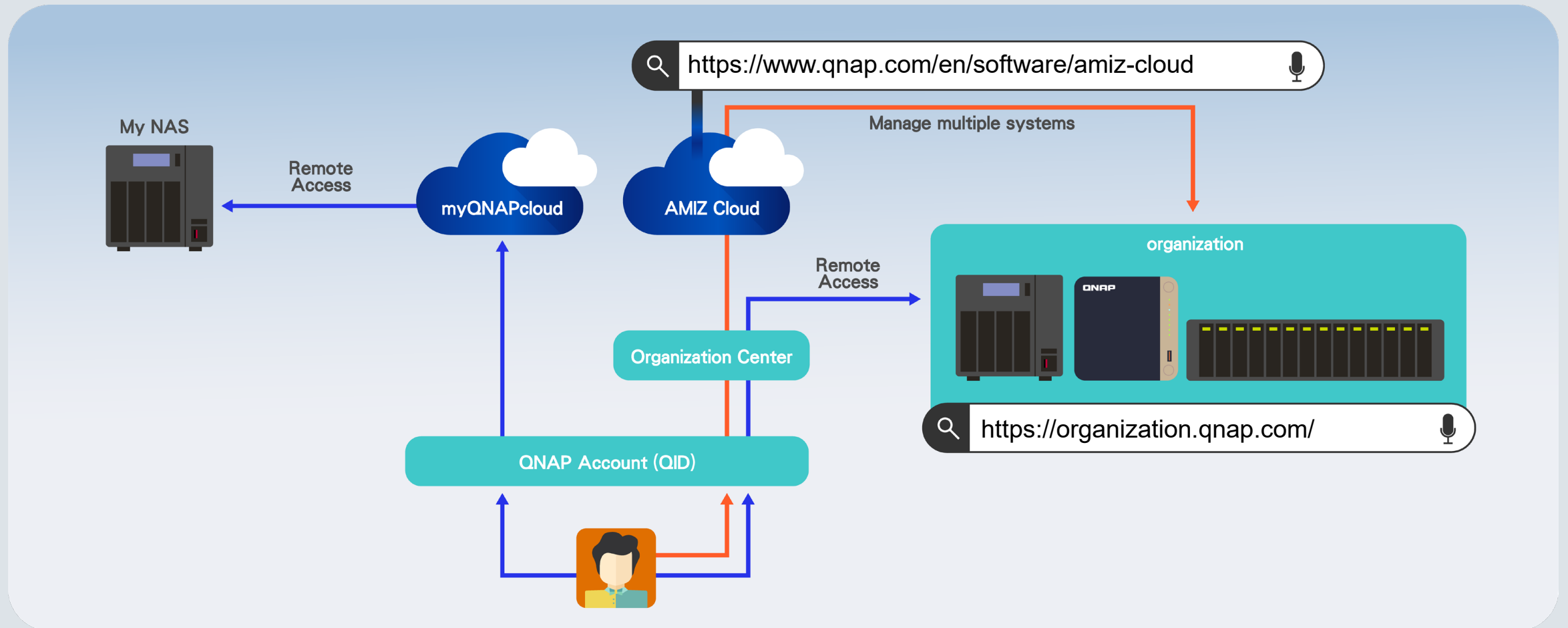


AMIZ Cloud

- One portal, multiple systems.
- Organized management (via Organization Center).
- Dashboard of system health
- Customized threshold alerts with various notification methods
- Central App management
- Basic system management

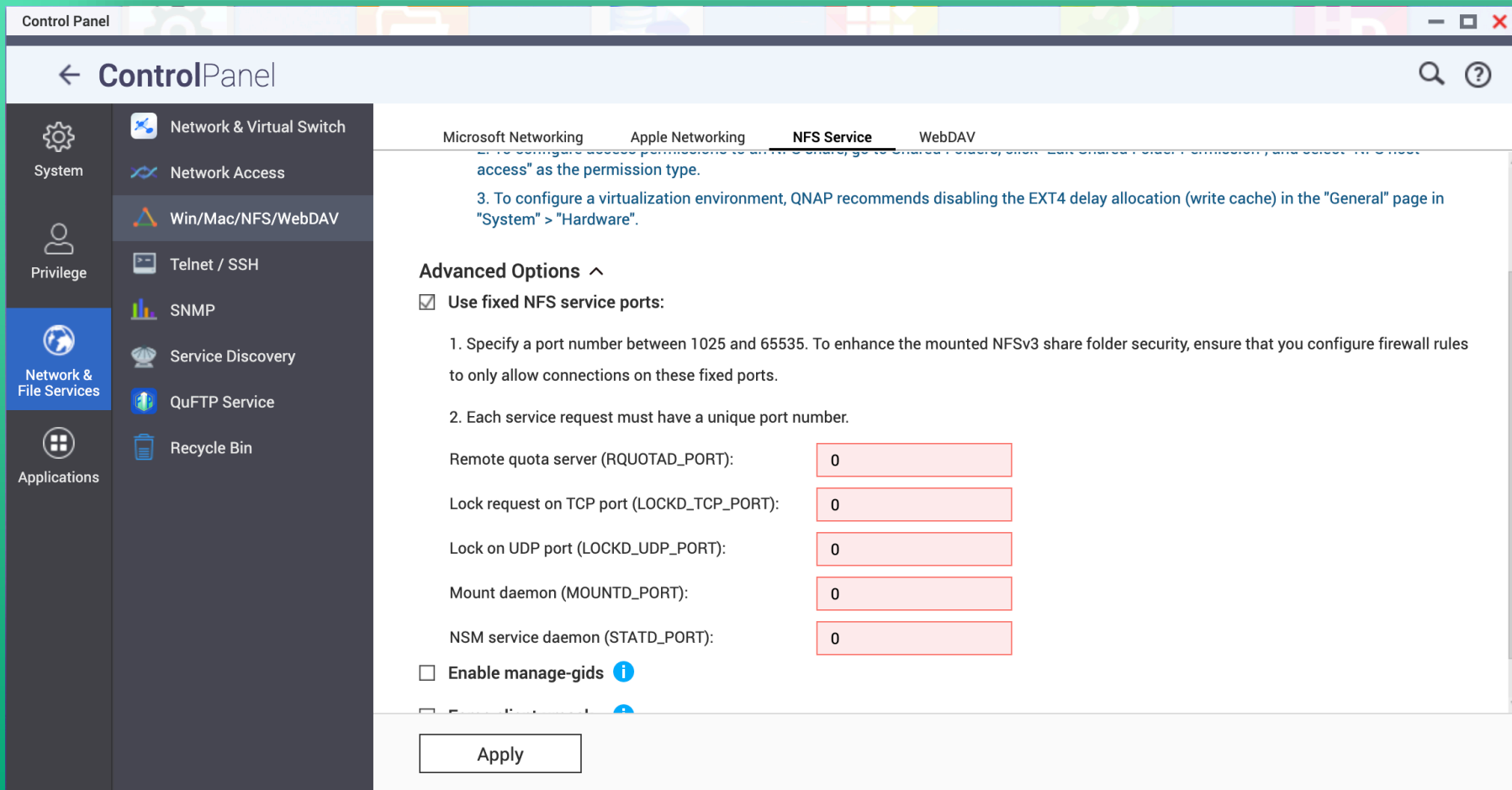


Grouped by Organization Center, Managed in Amiz Cloud



Option for Fixed NFS Service Ports

NFS dynamically assigns service ports which can cause problem of firewall configuration. New advanced option to set the static ports saves the trouble of firewall reconfiguration when NFS restarts.



The screenshot shows the QNAP Control Panel interface. The left sidebar contains navigation options: System, Privilege, Network & File Services (selected), and Applications. The main content area is titled 'ControlPanel' and shows the 'NFS Service' configuration page. The 'Advanced Options' section is expanded, and the checkbox for 'Use fixed NFS service ports' is checked. Below this, there are instructions and input fields for setting fixed ports:

- 1. Specify a port number between 1025 and 65535. To enhance the mounted NFSv3 share folder security, ensure that you configure firewall rules to only allow connections on these fixed ports.
- 2. Each service request must have a unique port number.

The following ports are currently set to 0:

- Remote quota server (RQUOTAD_PORT): 0
- Lock request on TCP port (LOCKD_TCP_PORT): 0
- Lock on UDP port (LOCKD_UDP_PORT): 0
- Mount daemon (MOUNTD_PORT): 0
- NSM service daemon (STATD_PORT): 0

There is also an unchecked checkbox for 'Enable manage-gids'.

An 'Apply' button is located at the bottom of the configuration page.

Recommended Models



TS-h2490FU



TS-h1290FX



TS-h3087XU-RP



TVS-h874T



TBS-574TX

QNAP

QUTS

h e r o 5.1.0

Boosted performance, flexible management, and higher security.

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