

**QNAP**

# QuTS hero

**h 4.5.2**

Support SnapSync DR solution and prevent simultaneous multi-SSD failures with QSAL

# Agenda

**01** | The latest changes  
in h4.5.2

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**02** | Live Demo

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**03** | QuTS hero Recap

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**04** | Recommended Models



**QNAP**

# The latest changes in h4.5.2

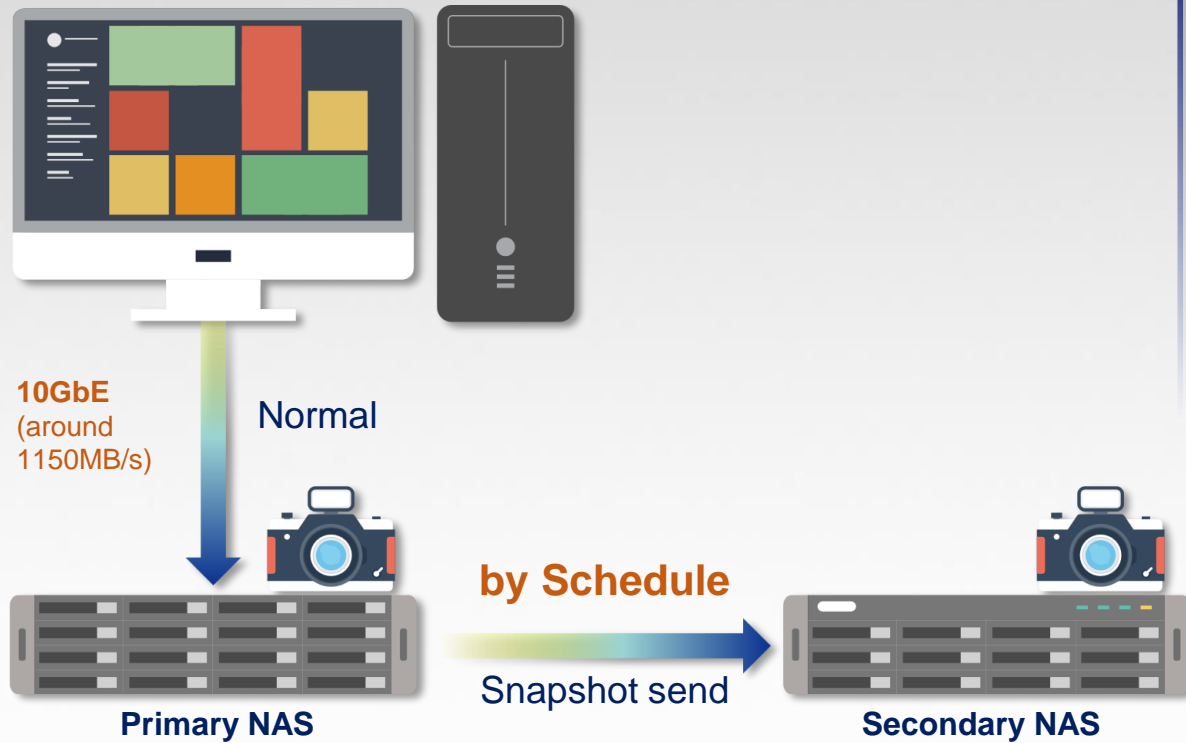
QUTS hero



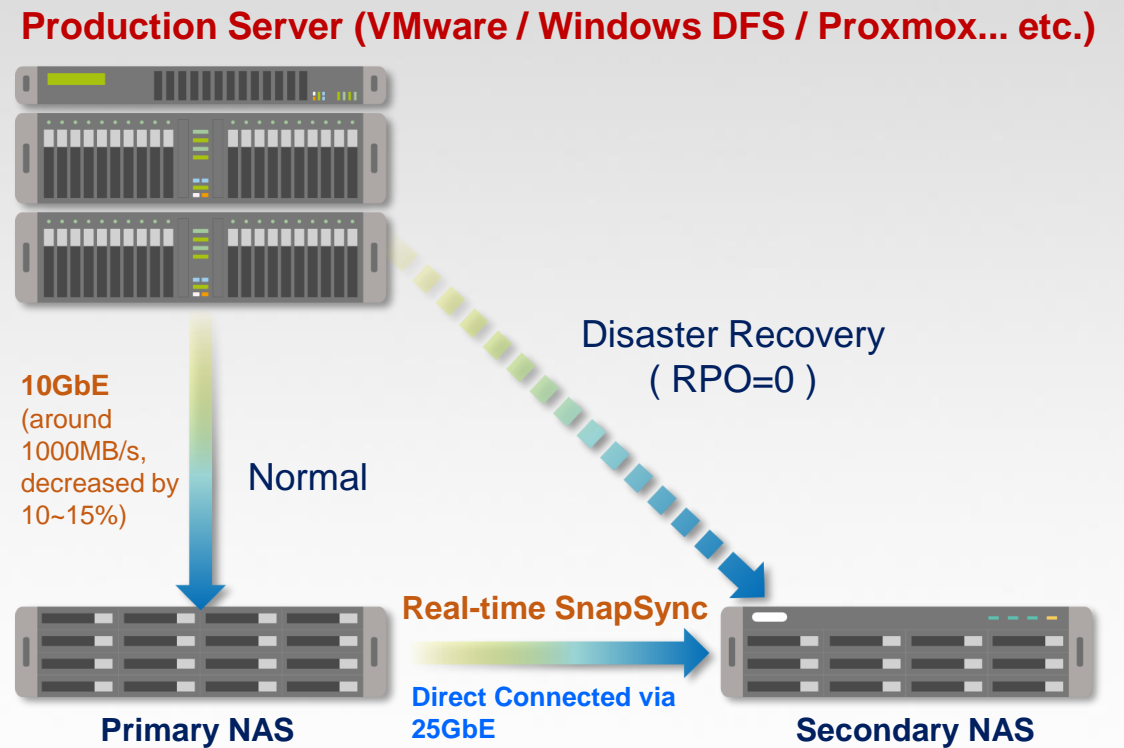
TVS-h1288X / TS-h1683XU-RP / TS-h2490FU

# 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**



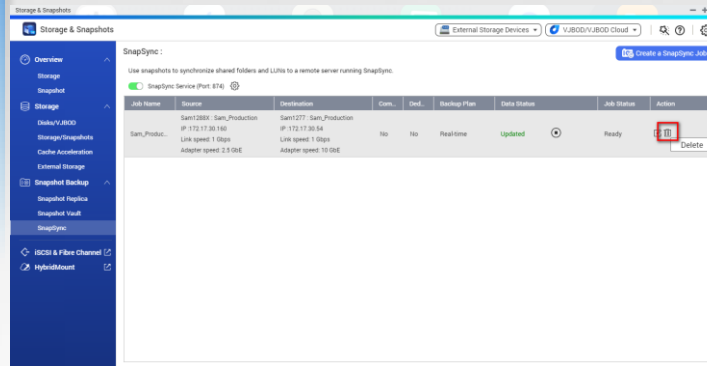
NAS (Shared Storage)

(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

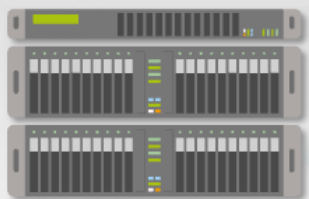


Note: Disaster Recovery automation via VMware SRM will be supported in the future.

# 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

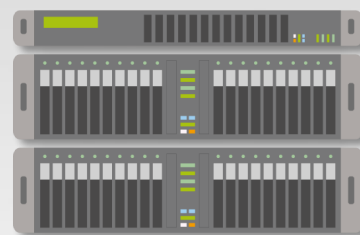


Direct Connected via 25GbE

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%)

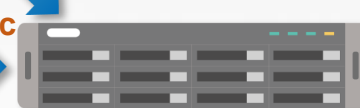
10GbE



Primary NAS

Real-time SnapSync

Direct Connected via 25GbE



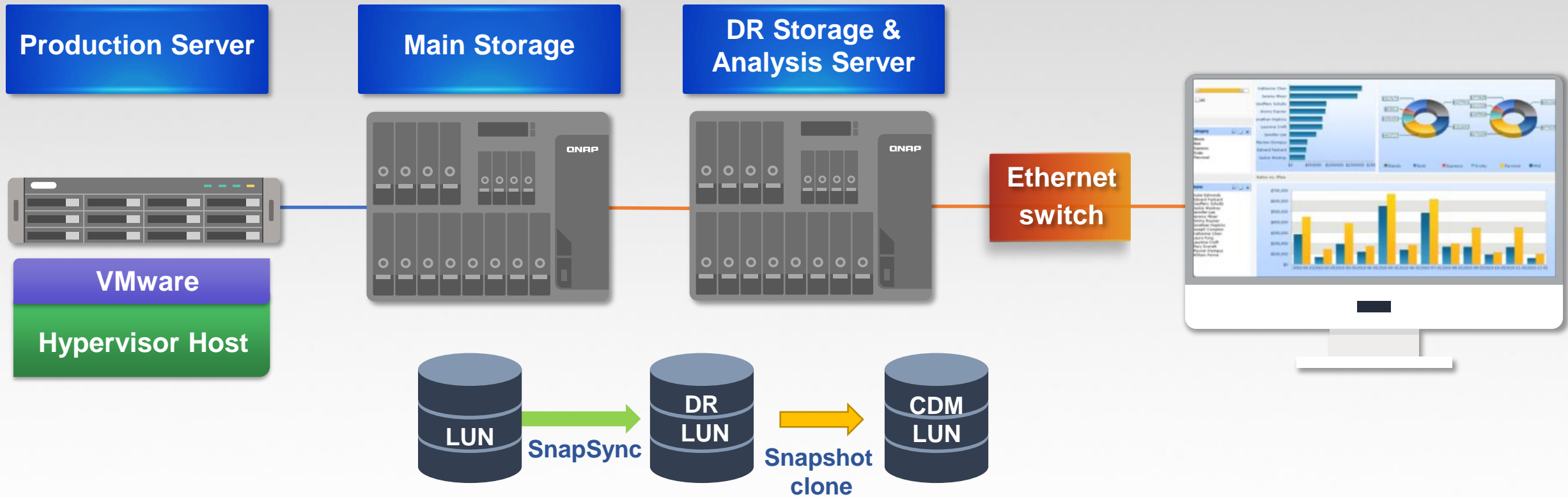
Secondary NAS

### QNAP Lab Test Environment:

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

Also supports QES NAS SnapSync to QuTS hero NAS

# DR backup and CDM (Copy Data Management)



# The benefit of SnapSync

## Cost Efficiency

Reduce Cost & Network Bandwidth: built-in compress / dedup for transmission

## Lowest RPO

Real-time replication - Reduce downtime and protect against data loss

## Flexibility & Scalability

Distribute big Amount of data easily for enterprise data migration and copy

## Reliability & Compliance

Data retention, compliance, and multi-version requirement

## Data Independence & Consistency

CDM (Copy Data Management) for data analytics, without affecting production server.

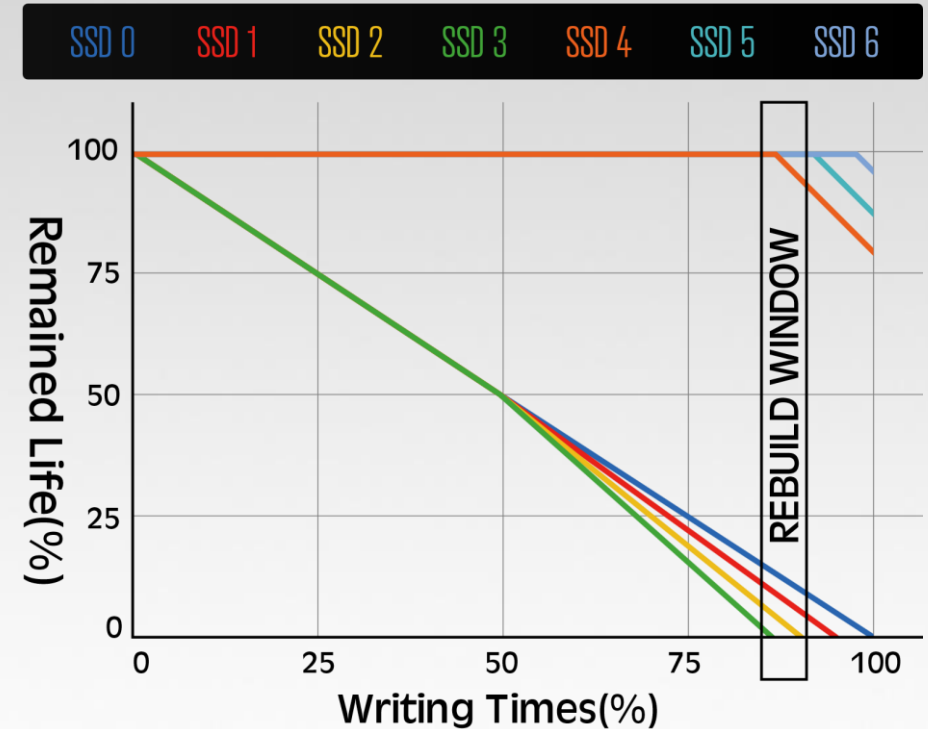
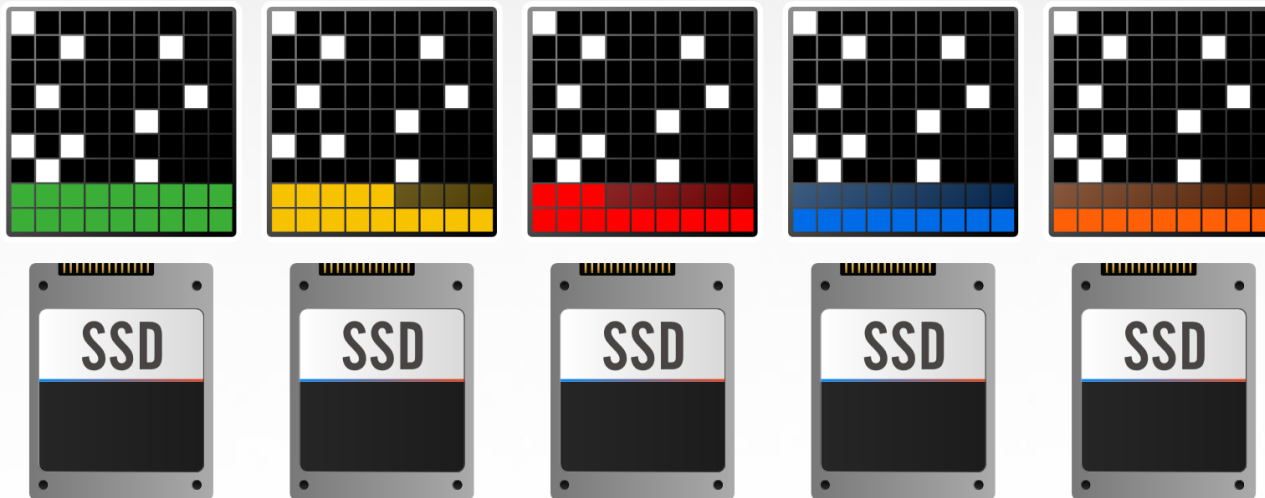
**SnapSync**



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



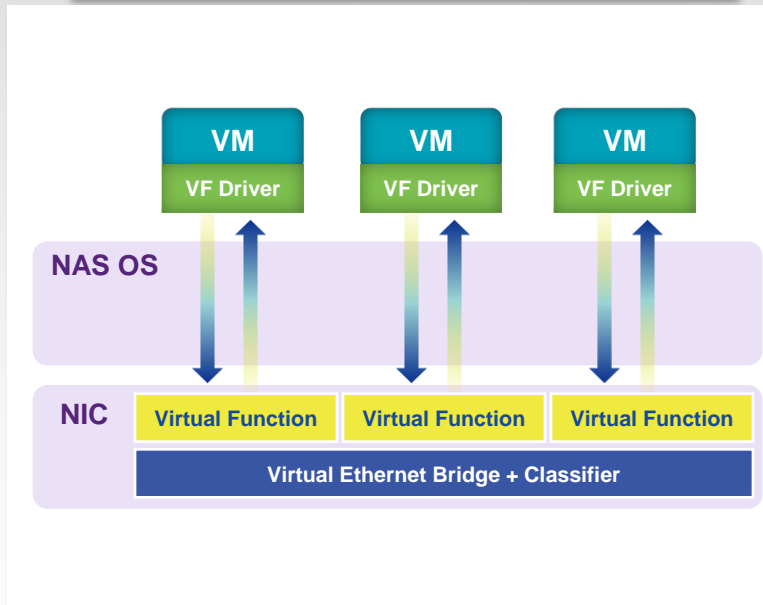
**QSAL (QNAP SSD Anti-wear Leveling)** When SSD life falls below 50%, the SSD OP would be dynamically adjusted to achieve the life control of each SSD, and to ensure that there is enough rebuild time at the end of the previous SSD life to avoid RAID damage.



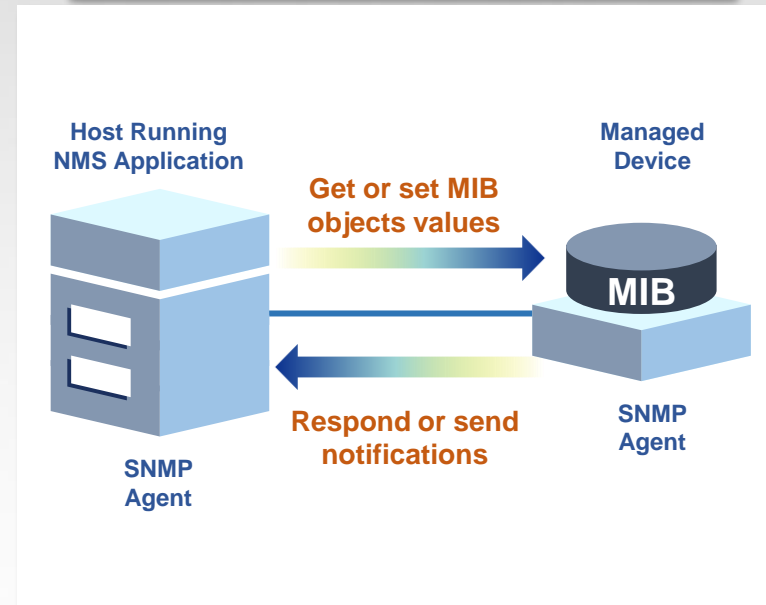
For SSD RAID 5 / 6 / 50 / 60 / TP (Triple Parity), QSAL will be enabled by default automatically.

# Like QTS, h4.5.2 also supports the new 100GbE adapter, the virtualized SR-IOV function, and the updated SNMP module.

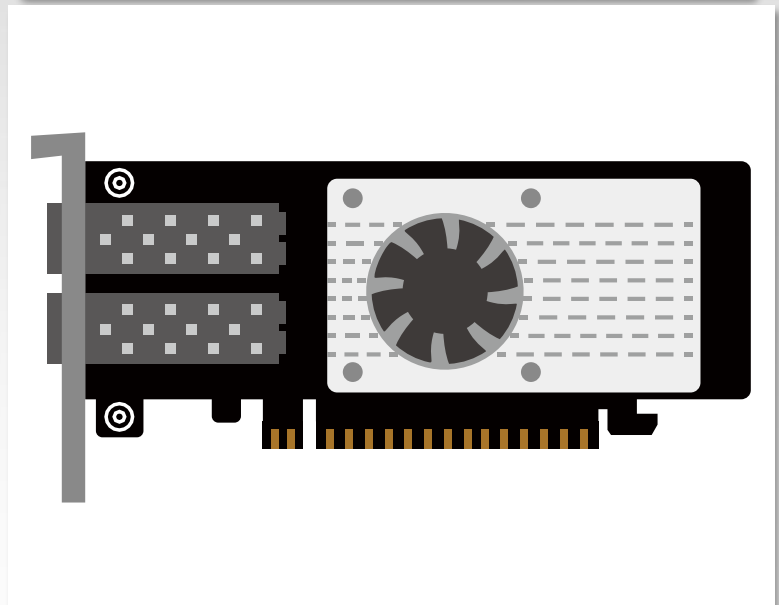
## SR-IOV virtualized network



## Updated SNMP module



## 100Gbps ultra speed network QXG-100G2SF-E810



# ZFS structure consideration:

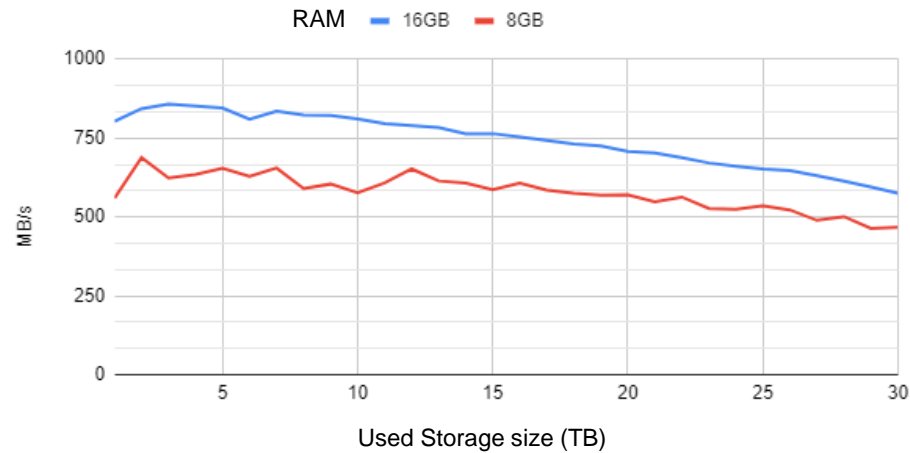
## Performance dependency between memory size and storage pools

Using entry-level model TS-973AX as a reference,

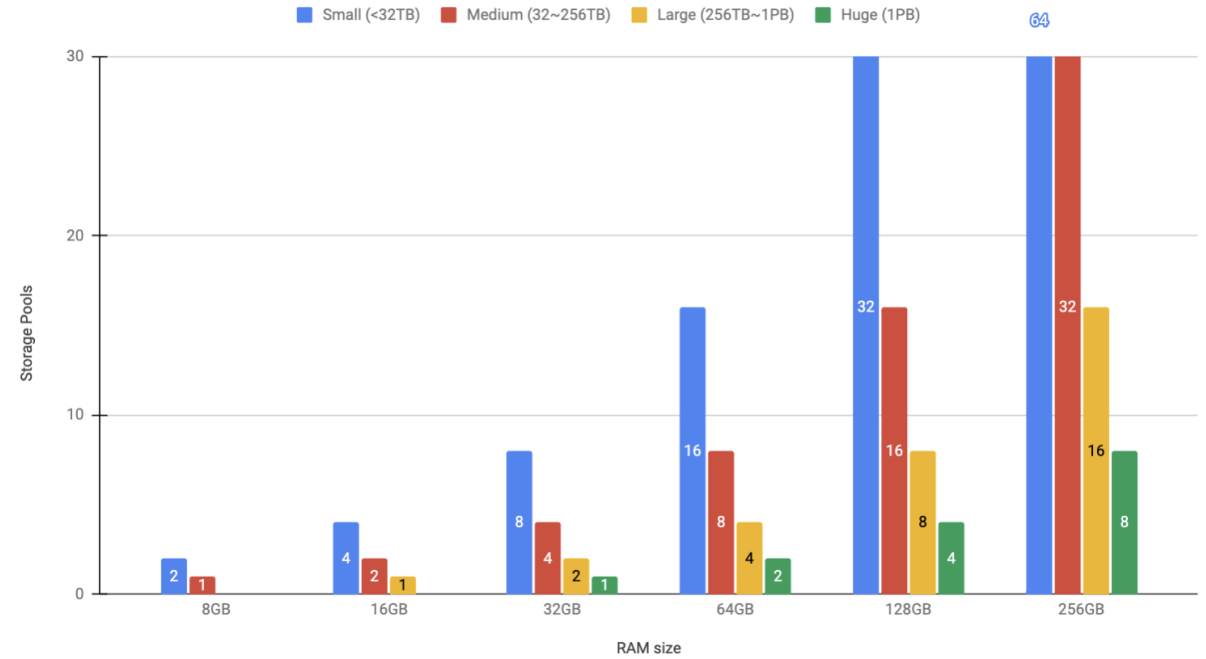
We already created one SSD pool and one HDD pool around 35TB.

The performance difference of the HDD pool is displayed

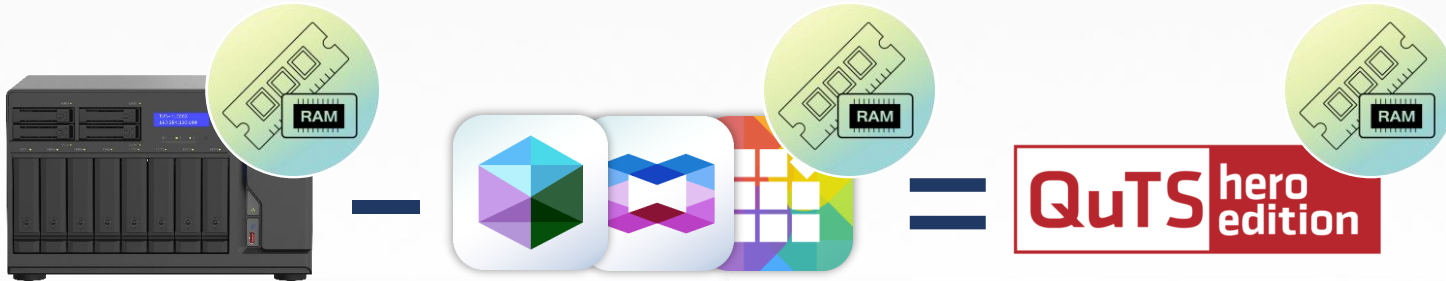
TS-h973AX-16GB vs 8GB -IO Performance (5xHDD-R0)



The Best Practices for Performance between RAM size and Pool Configuration



Choose sufficient memory for different storage configurations for better performance.



**QNAP**

**LIVE  
DEMO**

**QwTS hero**



TVS-h1288X / TS-h1683XU-RP / TS-h2490FU

**QNAP**

# QuTS hero Recap

QuTS hero



TVS-h1288X / TS-h1683XU-RP / TS-h2490FU

# 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



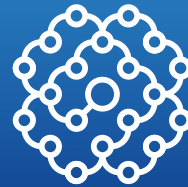
## Data Efficiency

- ◆ Offers inline compression & inline deduplication for better storage utilization
- ◆ ZIL & L2ARC
- ◆ Write Coalescing
- ◆ Pool over-provisioning



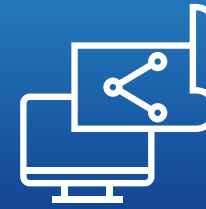
## Data Protection

- ◆ The native ZFS snapshot feature allows smart definitions of guaranteed snapshots
- ◆ A nearly unlimited number of 65,536 snapshots (supports folder/LUN)
- ◆ SnapSync
- ◆ More RAID types available
- ◆ WORM (write once read many)



## Data Integrity

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



## Stability & Scalability

- ◆ Provide ECC RAM supported model to reach the enterprise level stability
- ◆ Provide the service of SSD/HDD life prediction
- ◆ Easily expanded to PB-level storage space.



## App & Converged

- ◆ Supports all app, VMs, and containers. Users could easily deploy the vRouter/vFirewall, and use many popular packages nginx/ httpd / mangoDB / redis / ShadowSocks

Chapter

**01**

# DATA EFFICIENCY

QwTS hero



TVS-h1288X / TS-h1683XU-RP / TS-h2490FU



# Powerful Data Reduction



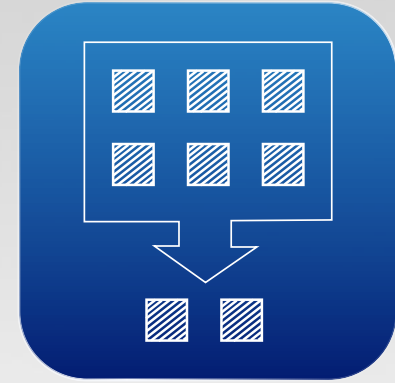
## Thin shared folder / Thin LUN

It default on Thin provisioning, and dynamically adjusts the size according to use needs to achieve the most effective space utilization.



## Inline Data Compression

Inline compression can save physical storage space and improve I/O bandwidth and memory usage which may have a positive impact on overall system performance.



## Inline Data Deduplication

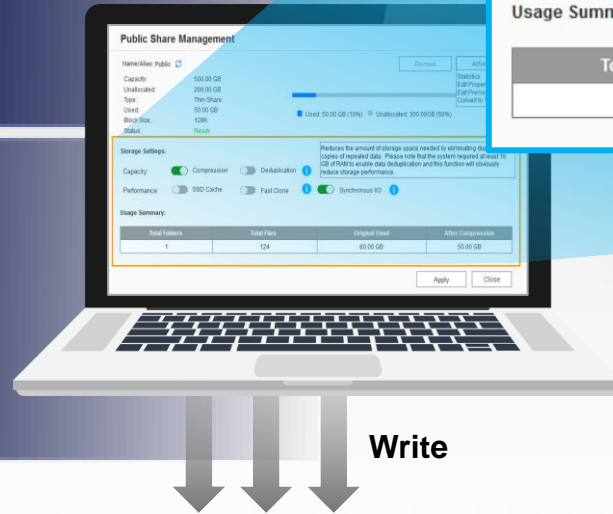
Inline deduplication is block-based and is carried out before data is written to storage. This greatly optimizes storage usage while significantly decreasing storage capacity requirements.

# Reduce writing also means to extend the SSD endurance

Only available when inline process before writing

ZFS file system with inline deduplication compression features.

It's the best choice to pair with the all-flash and SSD storage because it reduces the data size and pattern that need to be written to the SSD directly.



#### Storage Settings:

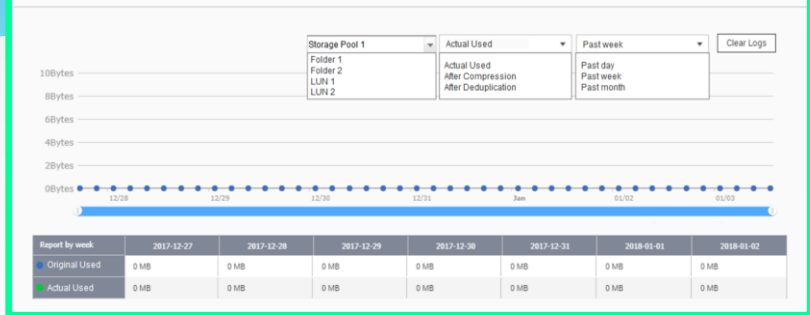
Capacity:  Compression  Deduplication i  
Performance:  SSD Cache  Fast Clone i  Synchronous I/O i

Reduces the amount of storage space needed by eliminating duplicate copies of repeated data. Please note that the system required at least 16 GB of RAM to enable data deduplication and this function will obviously reduce storage performance.

#### Usage Summary:

Total Folders	Total Files	Original Used	After Compression
1	124	80.00 GB	50.00 GB

#### Data Reduction Statistics



#### Deduplication requirement:

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



Compression

Deduplication

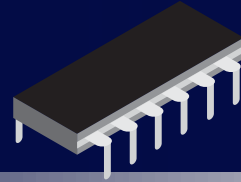
Write to drive as sequential as much as possible.

# 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



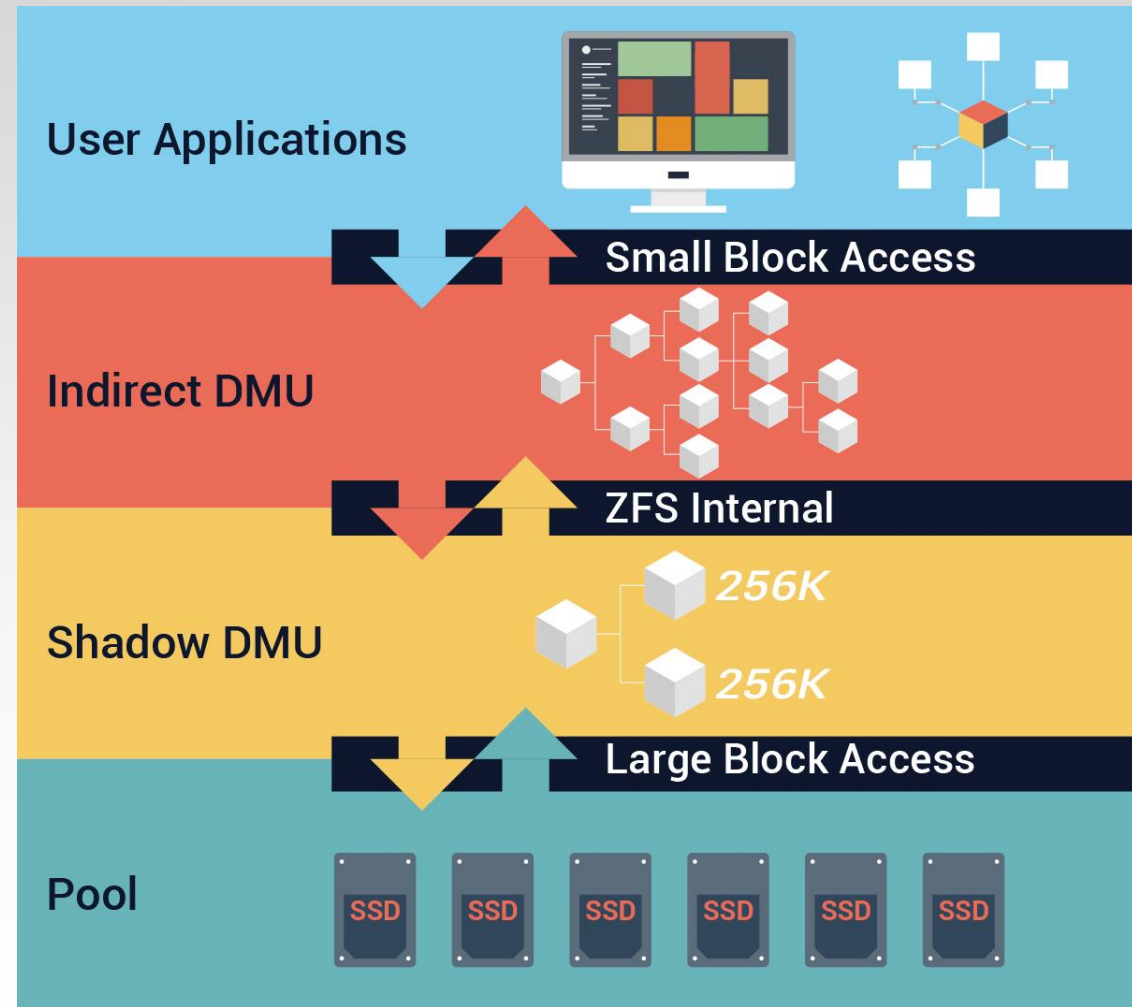
## ZFS Intent Log: (ZIL)

- ◆ 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.

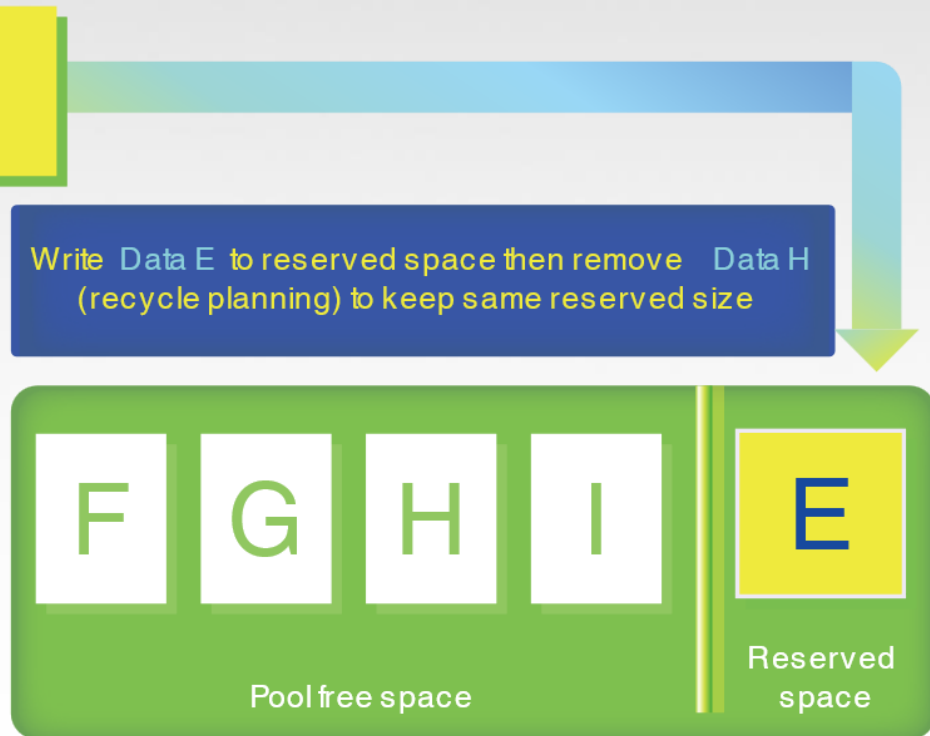
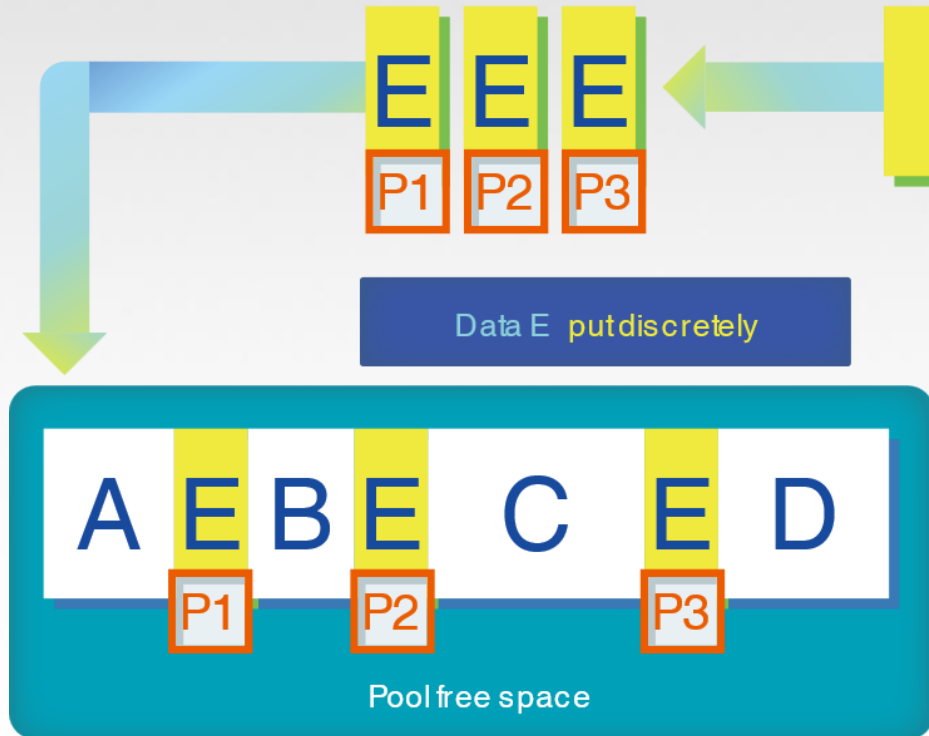


# Pool over-provisioning: Improve the performance for fragmented pool (The scenario when big block write to HDD)

w/o OP



w/ OP



# Pool over-provisioning: Improve the performance for fragmented pool

(The scenario when big block write to HDD)

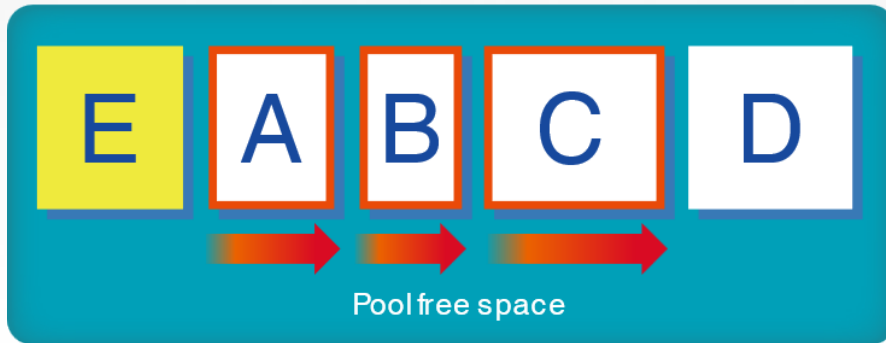
w/o OP



w/ OP



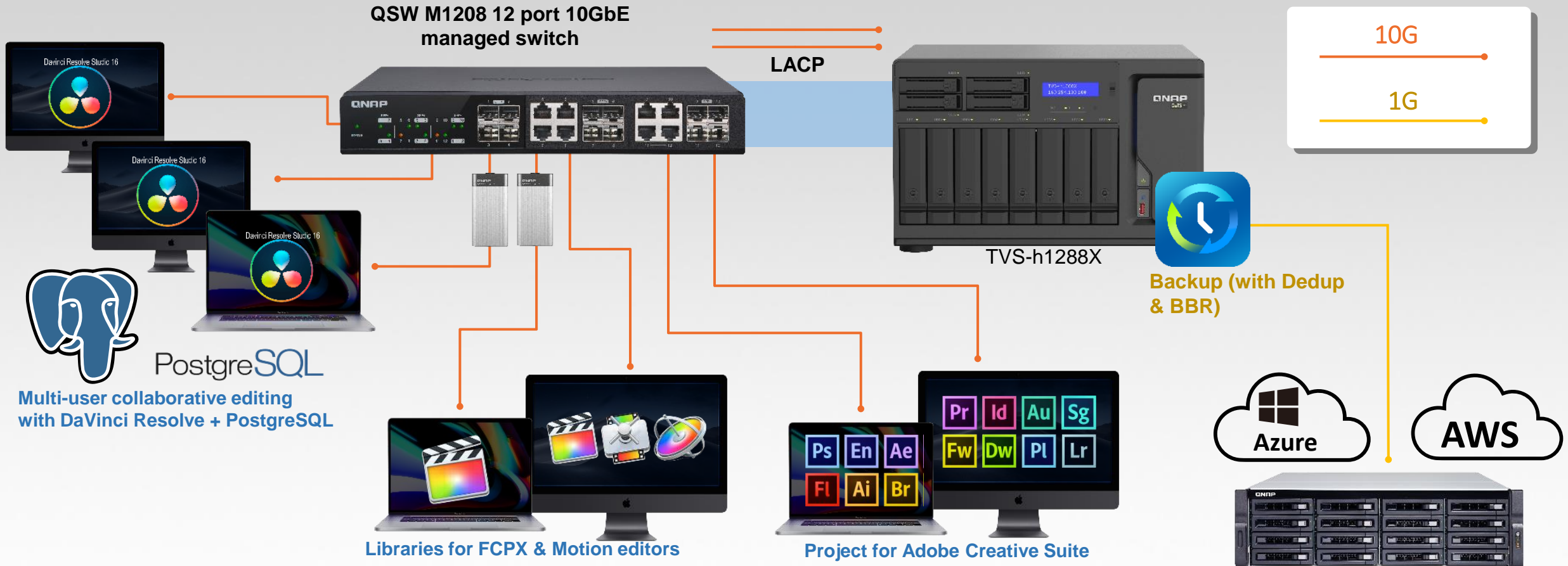
1. Move Data C, Move Data B, then Data A  
2. Write Data E



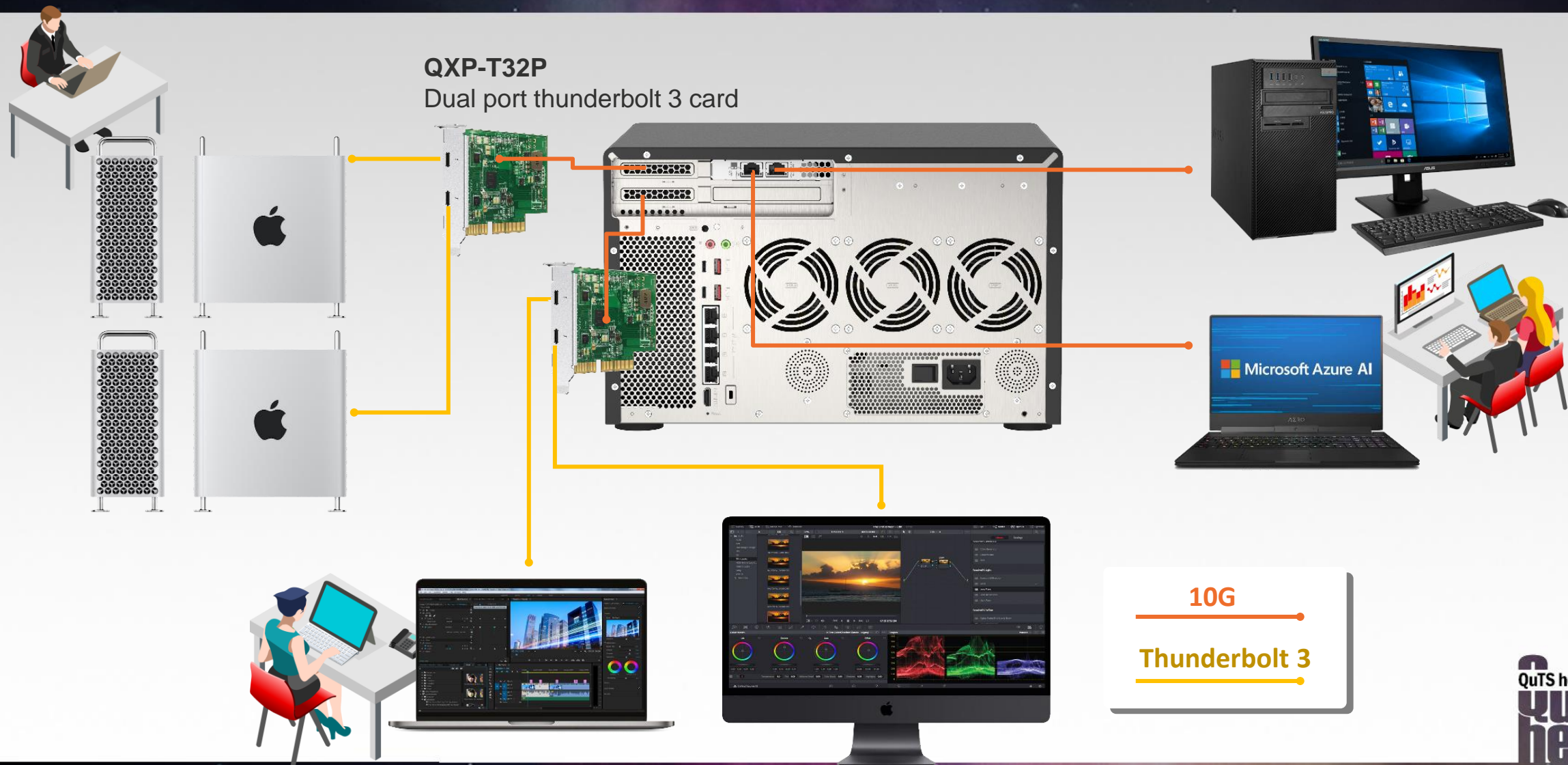
1. Write Data E to reserved space, return ok.  
2. Move Data I to keep same reserved size.



# Supports multi-editors collaboration



# Multiple users can also directly connect to NAS for file sharing and video editing





Chapter

**02**

# DATA PROTECTION

**QuTS hero**



TVS-h1288X / TS-h1683XU-RP / TS-h2490FU

# Create Storage Pool with new RAID

Create Storage Pool Wizard

Introduction Select Disk(s) Configure Summary

Select and configure disks:  
Enclosure Unit [Total: 1 Unit(s)]: NAS Host [available disk(s): 3/8]

Create SED secure storage pool

<input checked="" type="checkbox"/>	Disk	Manufacturer	Model	Type	Bus Type	Capacity	Status
<input checked="" type="checkbox"/>	Disk 1	TOSHIBA	MQ01ABD0...	HDD	SATA	298.09 GB	Good
<input checked="" type="checkbox"/>	Disk 2	TOSHIBA	MQ01ABD0...	HDD	SATA	298.09 GB	Good
<input checked="" type="checkbox"/>	Disk 3	TOSHIBA	MQ01ABD0...	HDD	SATA	298.09 GB	Good

Selected: 3 Estimated Capacity: 577.18 GB

RAID Type: RAID 5

- RAID 0
- RAID 1
- RAID 5
- RAID 6
- RAID 10
- Advanced >

Triple Mirror  
RAID-TP  
RAID 50  
RAID 60

Triple Mirror can be selected when selected disk is 3 or the multiple of 3. every three disks contain the same data for failure protection. You will lose two-thirds of the total storage space in exchange for high failure protection.

Cancel Back Next

Static Volume is not supported in QuTS hero.

Storage Pool is a must for advance RAID types to be available.



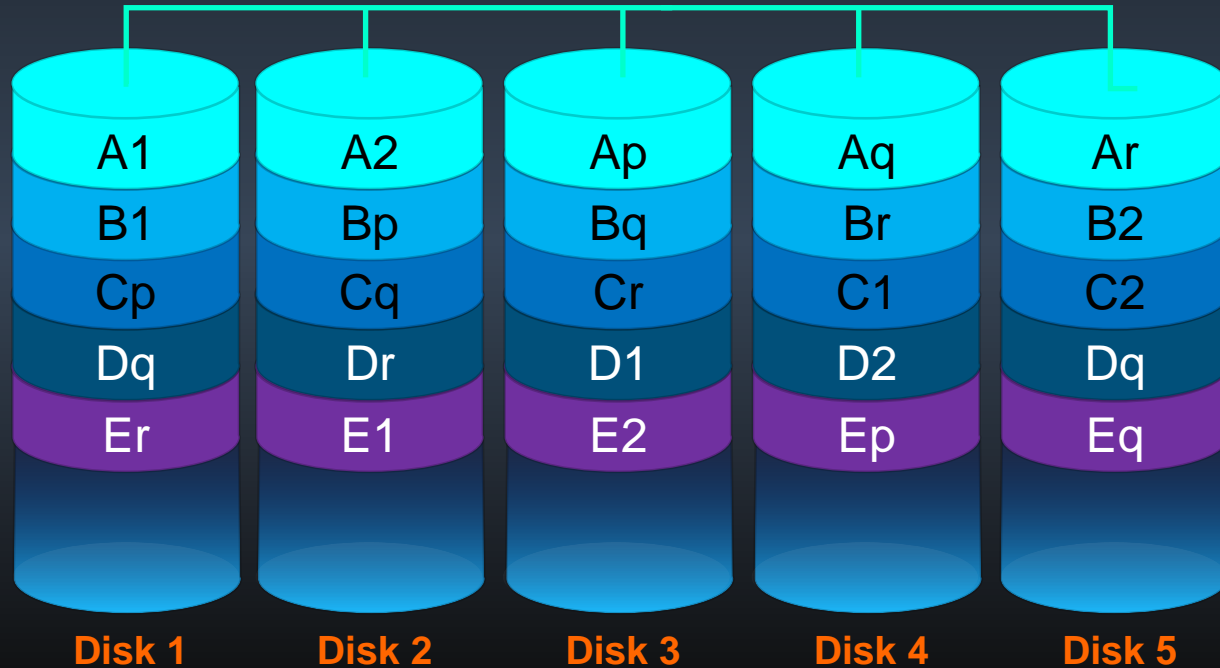
Here RAID 5 = ZFS RAIDz1, RAID 6 = ZFS RAIDz2, TP = Triple Parity = ZFS RAIDz3

# Safer RAID types: Triple Parity & Triple Mirror

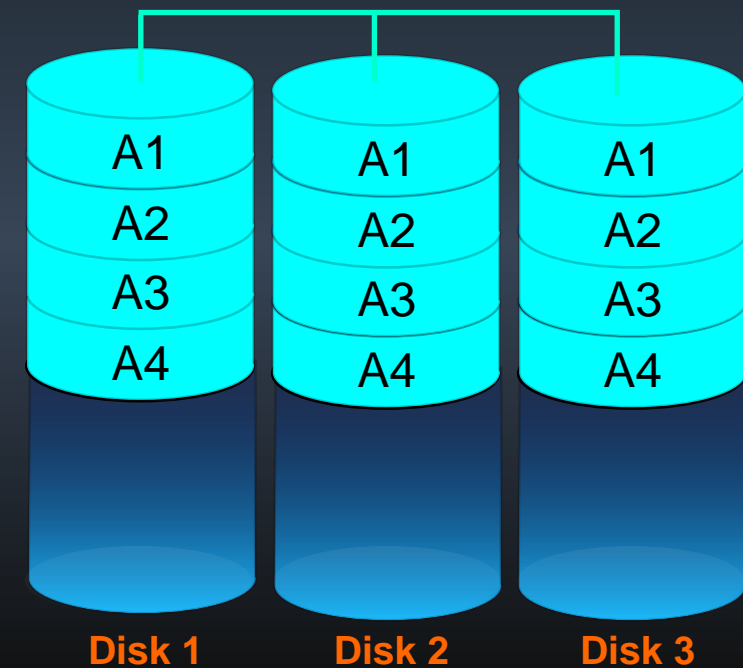
Even if three hard disks are damaged at the same time, this RAID service can keep going (redundant tolerance of 3 sets of parity information)

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

## Triple Parity



## Triple Mirror



# The difference of the method of capacity upgrade

- QuTS hero's ZFS RAID expansion method is different than QTS EXT4, cannot add disk to online expansion
- 1~2 empty bays/slots only can be used as hot spare
- Reserve multiple slots to add the entire set of RAID at once, and build a Striped RAID to expand the overall capacity.



You should reserve enough disk slots to facilitate future capacity expansion needs, or consider the expansion JBOD to meet the demand for increased capacity.

Capacity Upgrade	QuTS hero	QTS
Add disk to online expansion	X	✓
Add entire RAID to Storage Pool	✓	✓
Replace Disks one by one	✓	✓
JBOD expansion	✓	✓

# Snapshot Protection (65,536)

Shared Folder Snapshot

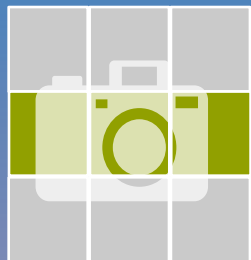
LUN Snapshot

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.

The screenshot shows the Snapshot Manager web interface. At the top, it displays 'Public Share' with a 'Ready' status. Below this, there's a file list for the selected snapshot (GMT+08\_2019-01-11\_0100). The file list includes folders like '@\_thumb', '@upload\_cache', and files like '123', '456', '789', and various image files. On the right side, there are details for the snapshot, including 'Taken: 2019-01-11 01:00:03', 'Replicated: No', 'Retention Policy: Time-Based', 'Expires After: 6 Days', and 'Status: Ready'. At the bottom, there are buttons for 'Restore', 'Clone', and 'Revert Folder Snapshot'.

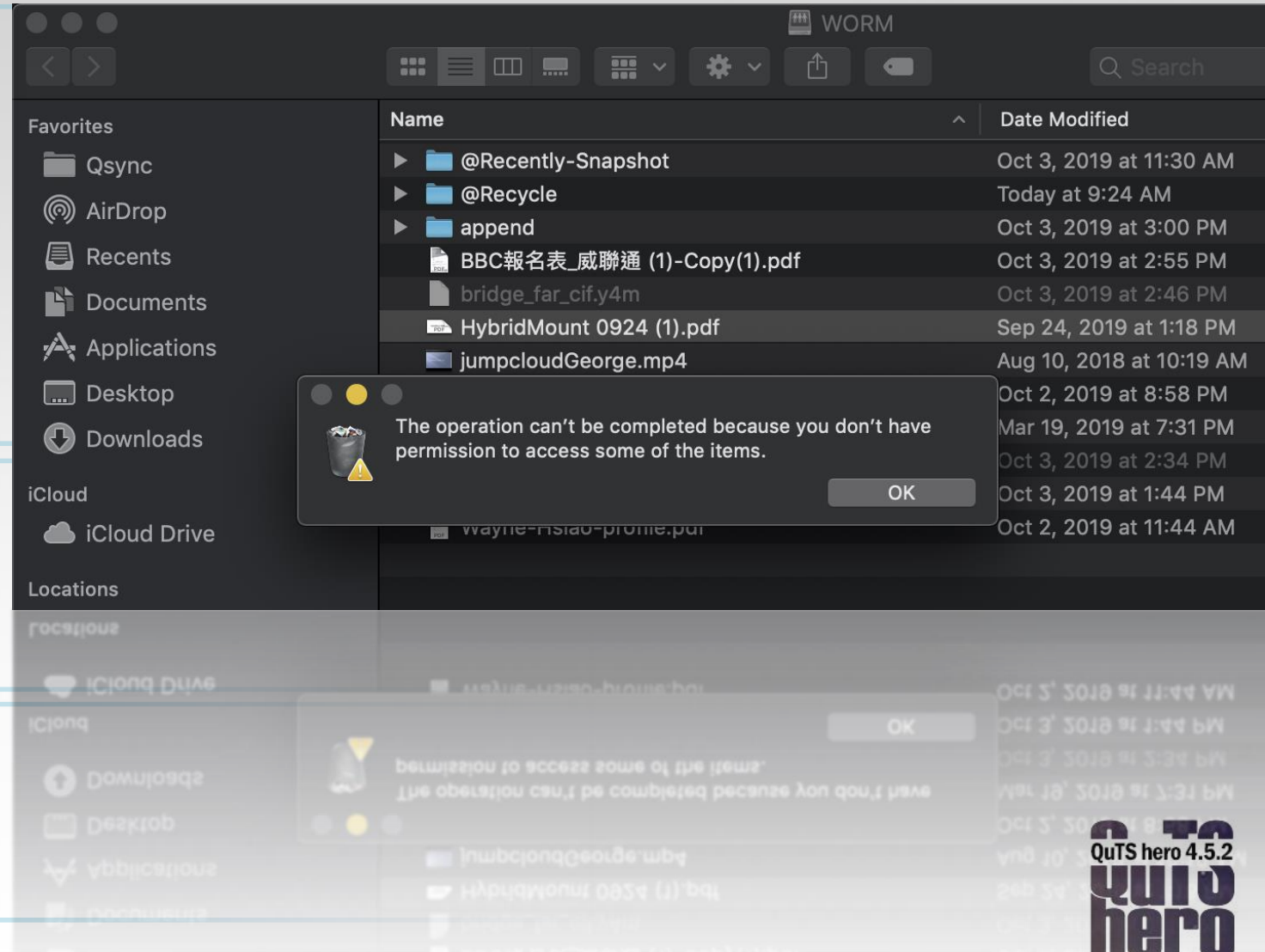
Name	Date Modified	Type	Size
@_thumb	2018-11-07 17:21:49	Folder	
@upload_cache	2018-11-07 17:21:47	Folder	
123	2018-12-27 15:45:25	Folder	
456	2018-12-27 15:45:29	Folder	
789	2018-12-27 15:45:32	Folder	
@Recycle	2018-11-07 17:16:54	Folder	
QZFS_1.0.0724_20181107_x86_...	2018-11-07 12:03:53	qpkg	11.97 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

# 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.

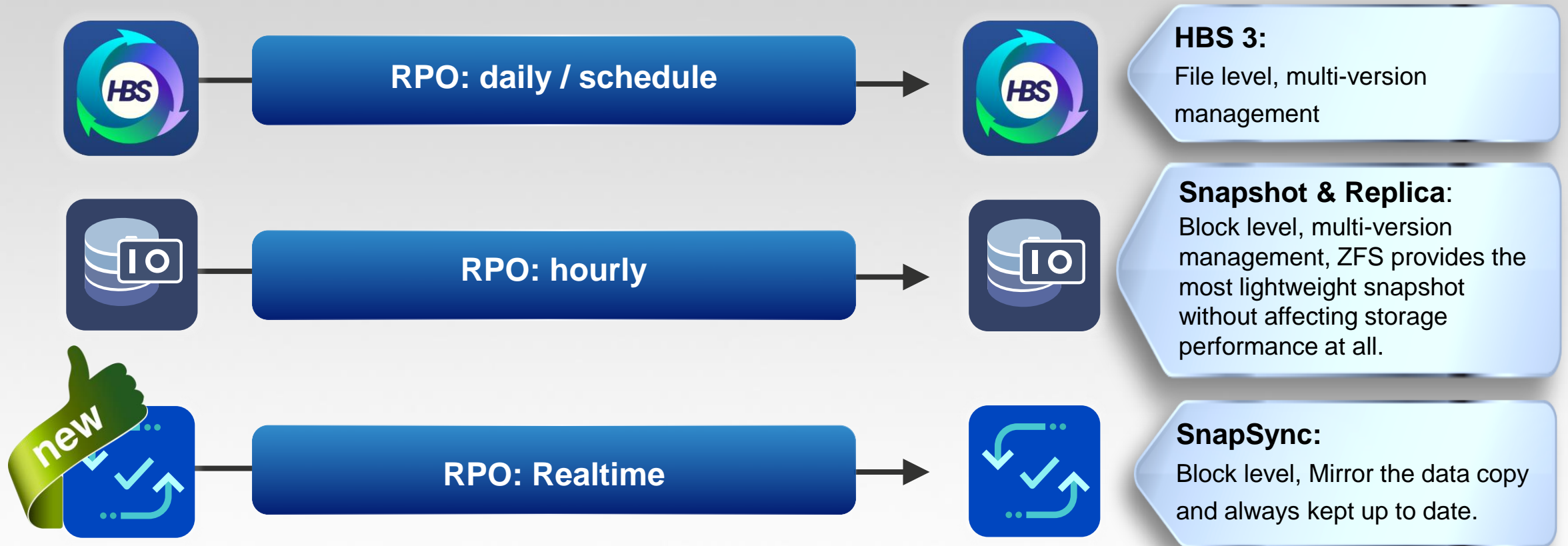
**Enterprise Mode:** remove the shared folder through QuTS hero UI or SSH commands (QCLI).

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



# Three-layer backup solution:

Provide you the most complete data backup protection



# DATA INTEGRITY

**QuTS hero**

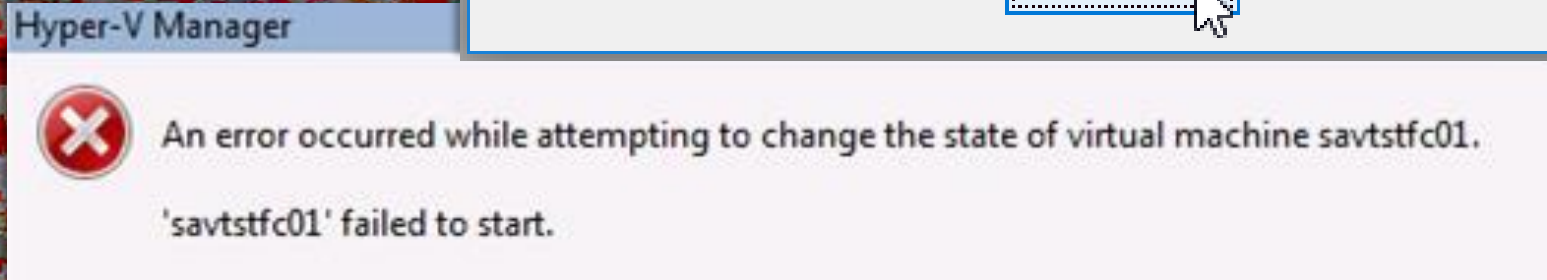


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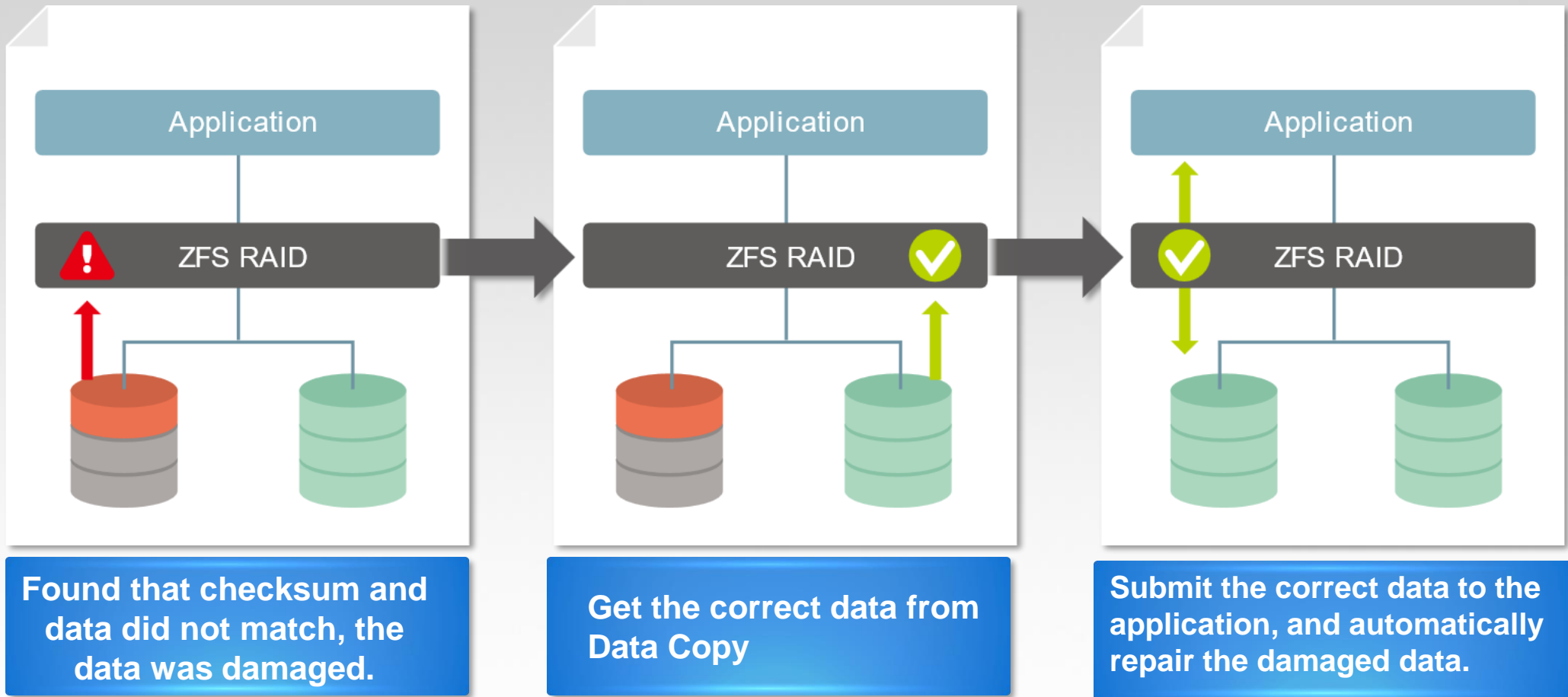


# Data is weaker than you think

Everything looks good but...



# Silent Data Corruption & Data self-healing (Checksum)

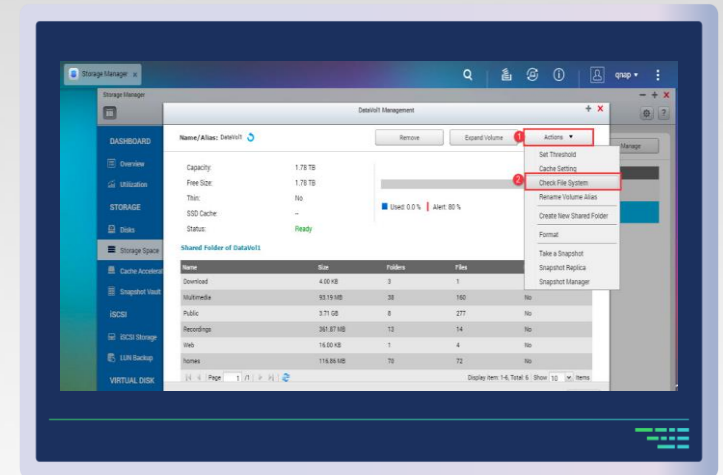
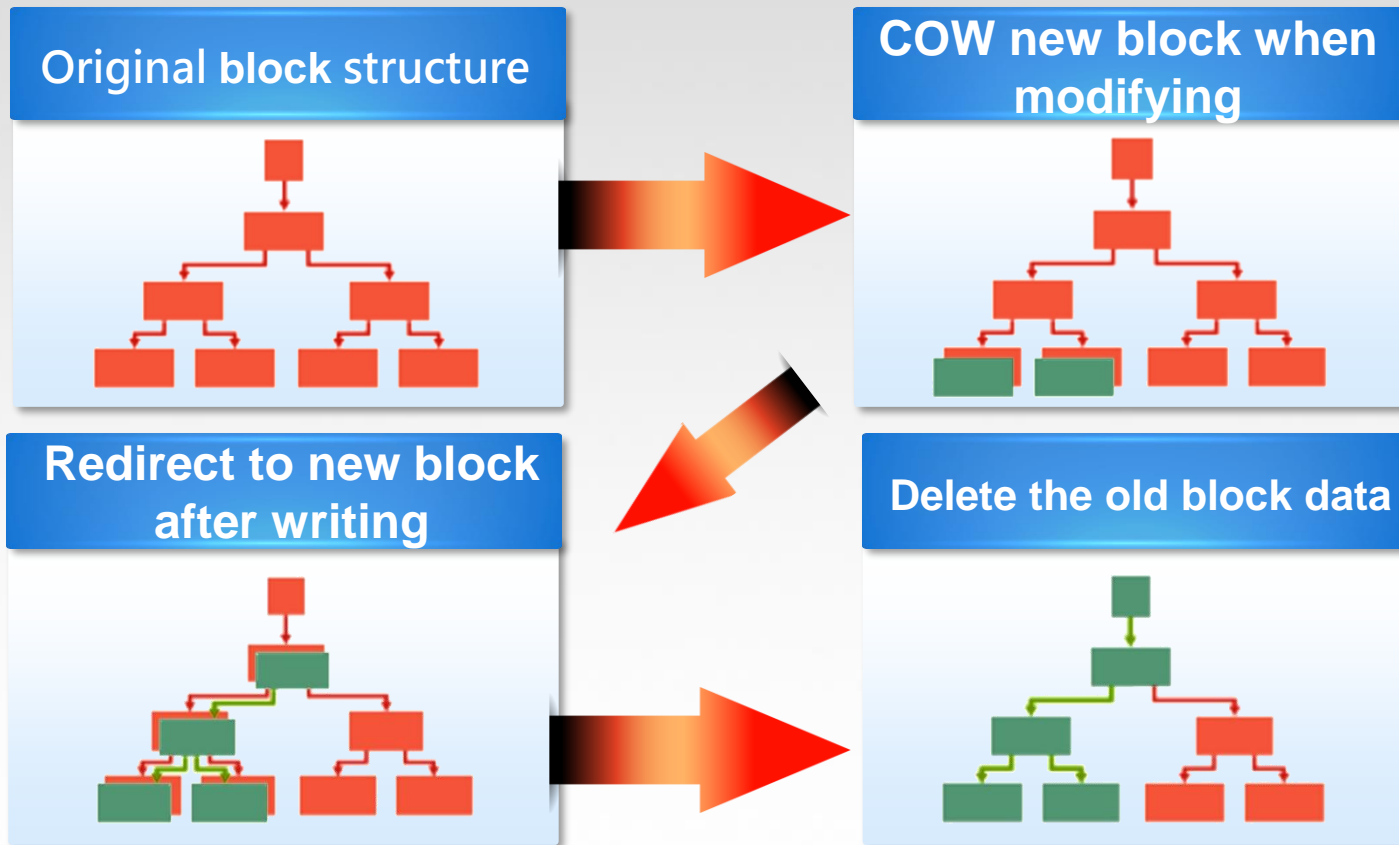


Avoid data silent corruption that occurred on running system



# 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

**04**

# STABILITY & SCALABILITY

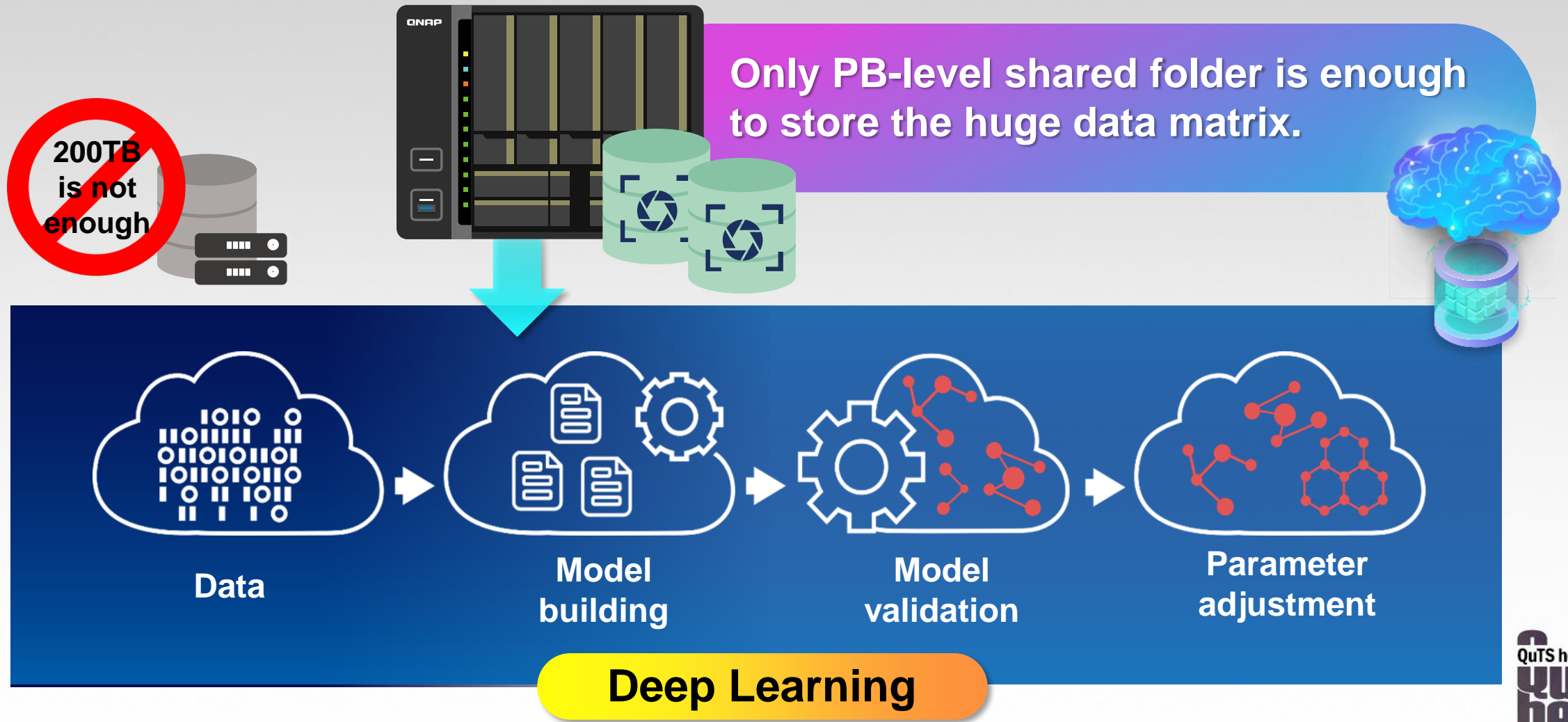
# QwTS hero



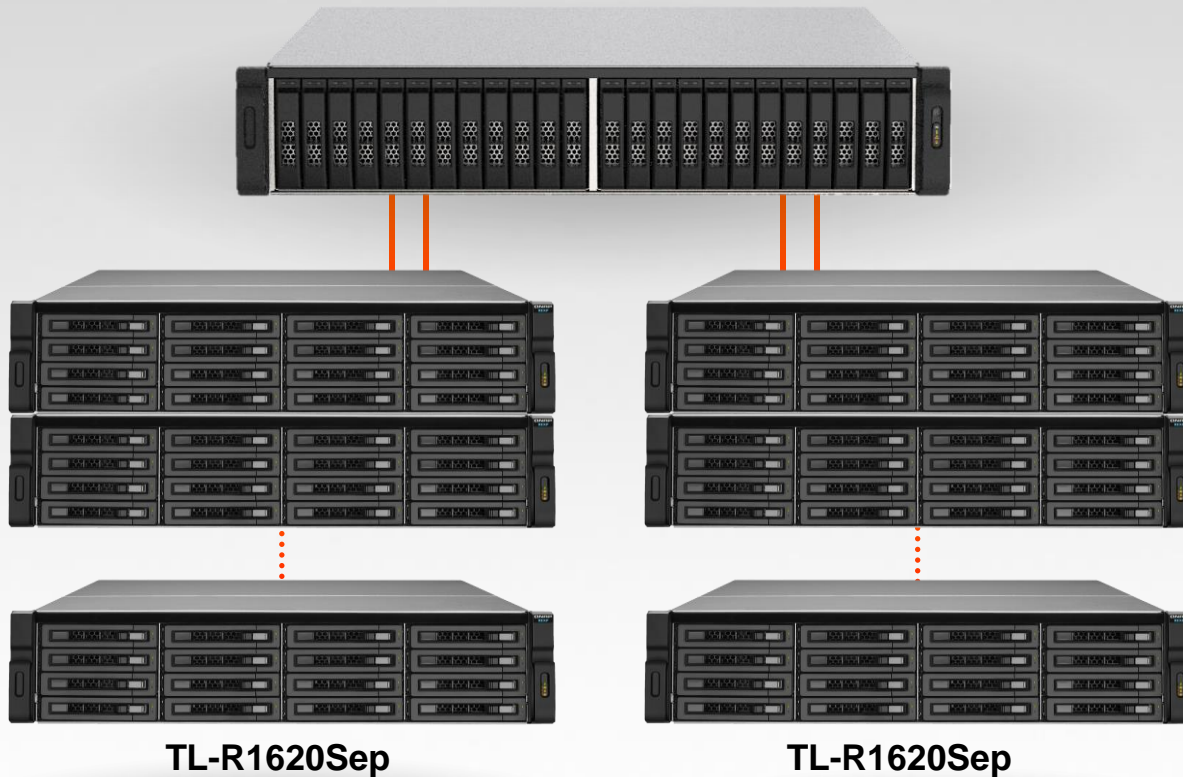
TVS-h1288X / TS-h1683XU-RP / TS-h2490FU

# Amazing massive storage:

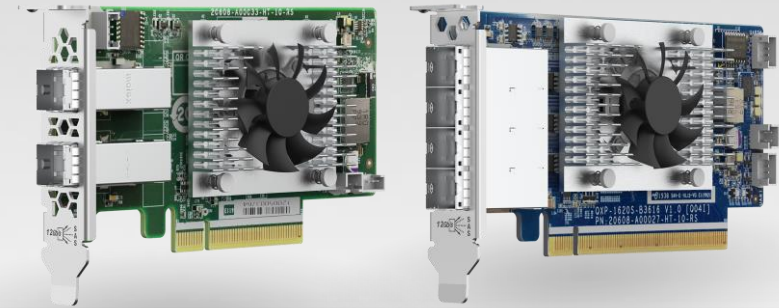
The best data carrier of big data analysis/edge computing/AI inference



# SAS 12Gb/s JBOD Expansion



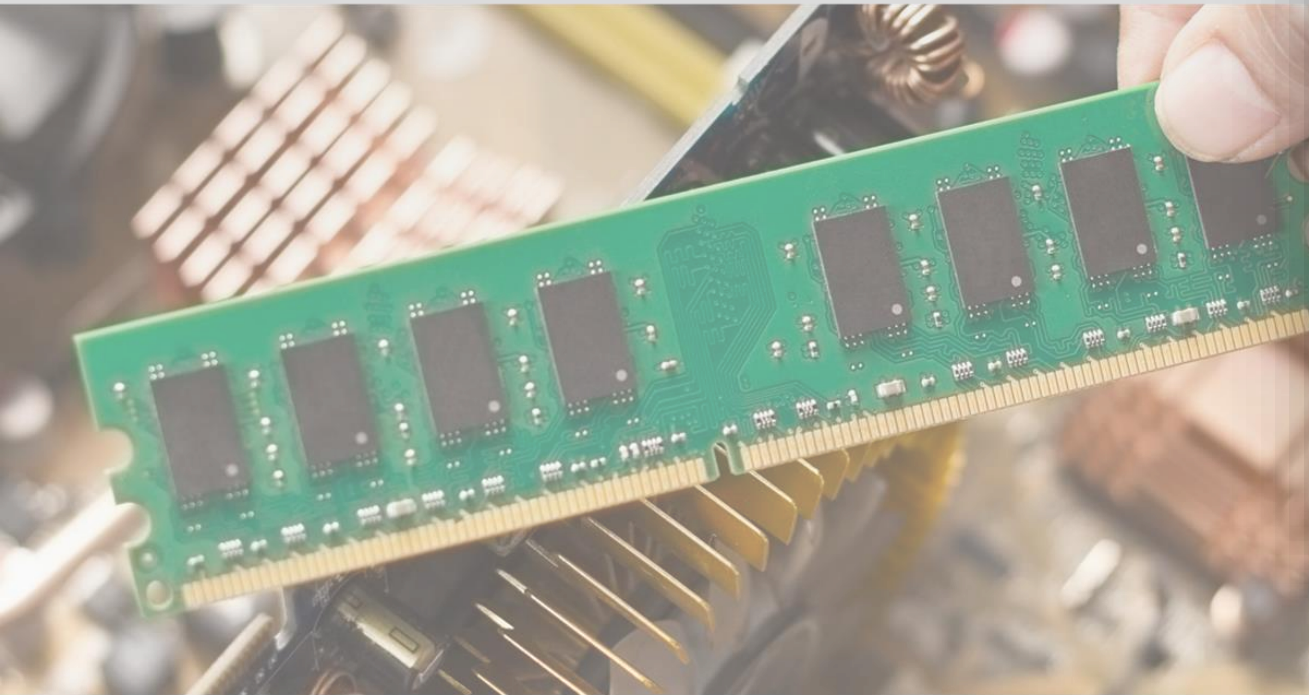
## QXP-820S/1620S SAS HBA (Optional)



- 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

# Recommended to use ECC Memory (Error Correcting Code)

**ECC** Higher reliability and data integrity



**QNAP** Products QTS 4.4 Surveillance Solutions Support Buy QIoT

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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.

# SSD / HDD Life Prediction



Powered by ULINK, DA Drive Analyzer leverages cloud-based AI to protect against server downtime and data loss by recommending replacing drives before they fail.



DA Drive Analyzer

## Predict Drive Failure and Minimize Downtime

**DA Drive Analyzer**

Overview

DA Drive Analyzer

Drive enclosures: 1, Drives: 7 (HDD: 7, SSD: 0, NVMe drives: 0)

Email alert: Deactivated

**Faulty** 1  
Defective drive detected.  
Replace the drive.

**Critical** 1  
90% risk of failure  
Replace the drive as soon as possible.

**Warning** 1  
70% risk of failure  
Start planning for a drive replacement.

**Normal** 2  
Drive(s) are functioning normally.

**Data Analysis in Progress** 1  
Analyzing data for 10 more day(s)  
Data Analysis in Progress

**Important: Review Drive Status**  
Drives: 3 (Faulty: 1, Critical: 1, Warning: 1)

Drive (Drive Enclosure)	Severity Level	Drive Manufacturer	Drive Capacity
Disk8 (NAS Host)	Warning	Seagate	931.51 GB
Disk10 (NAS Host)	Critical	Seagate	931.51 GB
Disk11 (NAS Host)	Faulty	Seagate	298.09 GB

**License**

License plan: BETA

Valid until: 2021-04-07

**DA Drive Analyzer**

Drive Prediction

Host NAS

3.5" Slots

- Slot 1: Empty
- Slot 2: Empty
- Slot 3: Empty
- Slot 4: Empty
- Slot 5: Empty
- Slot 6: Empty
- Slot 7: HDD
- Slot 8: HDD
- Slot 9: Empty
- Slot 10: HDD
- Slot 11: HDD
- Slot 12: HDD(10 data training d...
- Slot 13: HDD
- Slot 14: HDD

**Drive Information**

Host NAS(TVS-1282)  
10.24.65.127

Drive location: 3.5" Slot 10  
Drive manufacturer: Seagate  
Drive model number: ST10000M010-2EP102  
Drive serial number: W9AD8T5H  
Drive capacity: 931.51 GB  
Drive type: SATA

**Drive Life Prediction Score**

**Critical**  
90% risk of failure  
Prediction score: 2  
Replace the drive as soon as possible.  
We strongly recommend drive replacement. The prediction test shows that approximately 90% of...

Extra Cloud Report



Chapter

**05**

# APP & CONVERGED

**QwTS hero**



TVS-h1288X / TS-h1683XU-RP / TS-h2490FU

# More detailed Access Control

## 14 Windows ACL Permission

The image shows a Windows File Explorer window with the 'Edit Shared Folder Permission' dialog open. The dialog is split into 'Basic Permission' and 'Windows Permission' tabs. The 'Windows Permission' tab is active, showing a table of permissions for the folder ':\NAS253pro\share folder\multimedia'. The table has columns for 'Permissions', 'Type', 'Full cont...', 'Modify', 'Read & ...', 'List folder', and 'Read'. The permissions listed are Aaaaaaa, Bbbbbbb, Cccccc, and Ddddd. The 'Cccccc' entry is selected, and the 'Edit Principal' dialog is open over it.

The 'Edit Principal' dialog shows the following configuration:

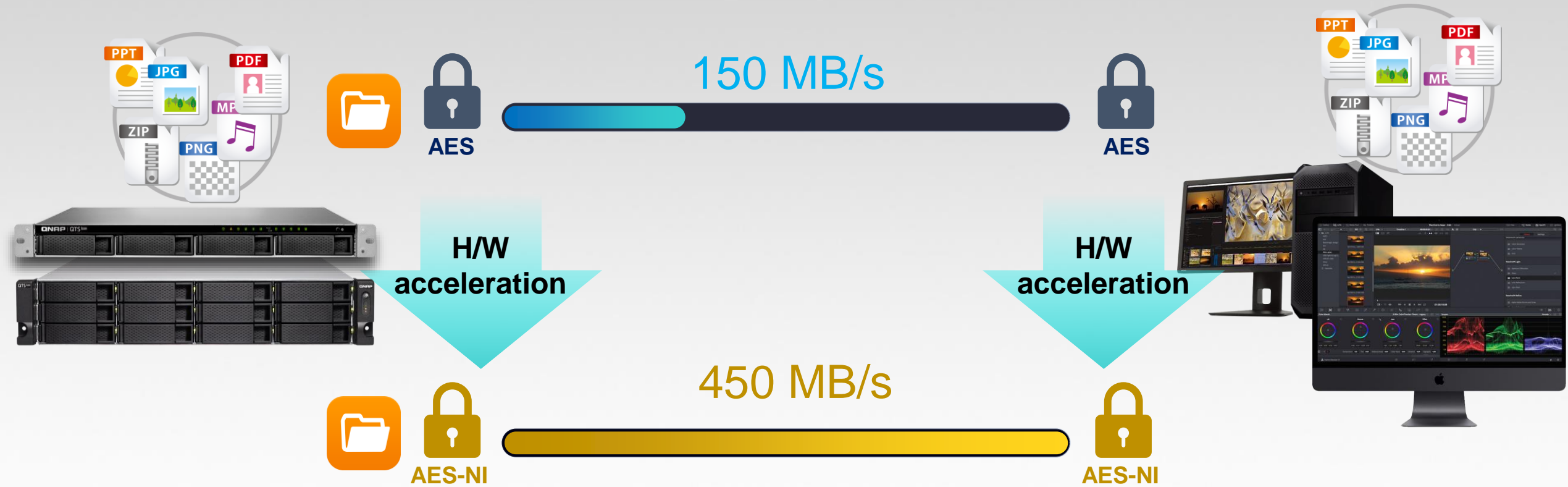
Principal	Type	Applies to
Jeremy	Allow	This folder,subfolders and files

Below the table, there are two columns of permissions with checkboxes:

- 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

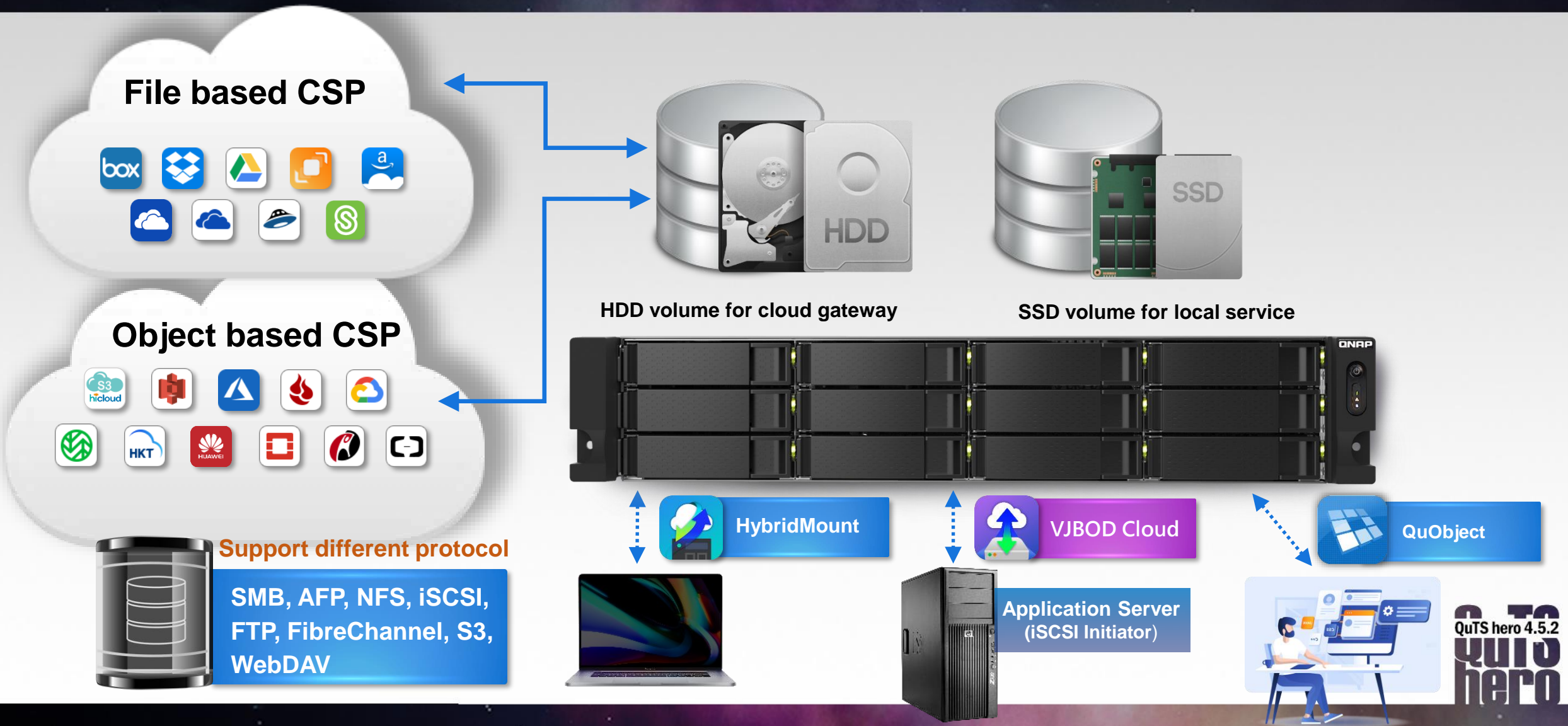
At the bottom of the dialog are 'Apply' and 'Cancel' buttons.

# AES-NI accelerated for SMB3 Signing and Encryption



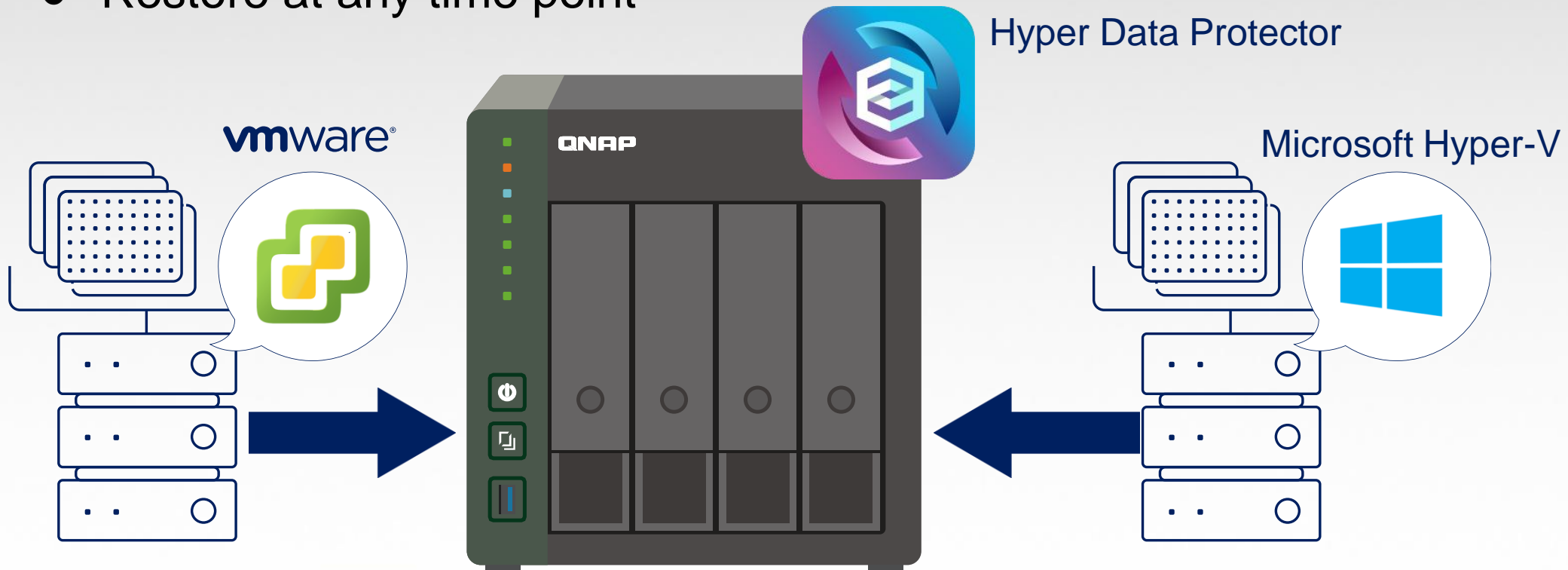
AES-NI accelerated for SMB3 Signing and Encryption

# Convert your local storage to public cloud with different protocols



# Hyper Data Protector: All-in-one active backup solution for virtual machines

- Supports VMware, Microsoft Hyper-V
- Unlimited VM backups and license-free
- Active backup solution
- Restore at any time point



# All-in-one server to host virtual machines and containers

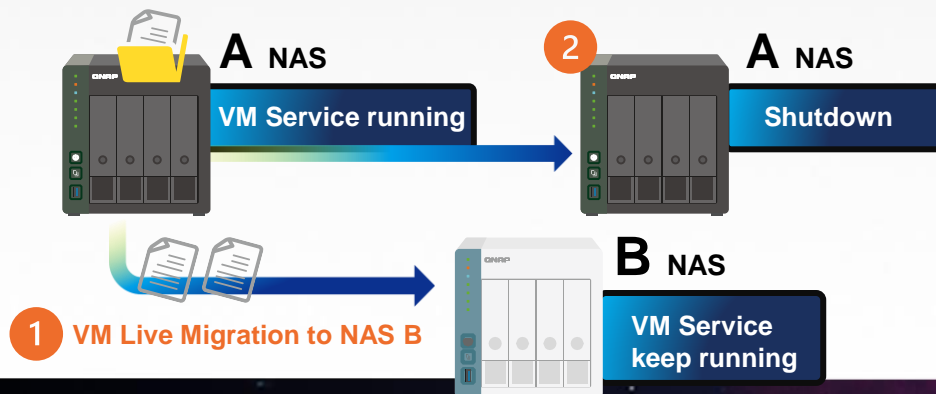


## Virtualization Station

- Supports to run the Virtual machine such as Windows, Linux®, UNIX® and Android.

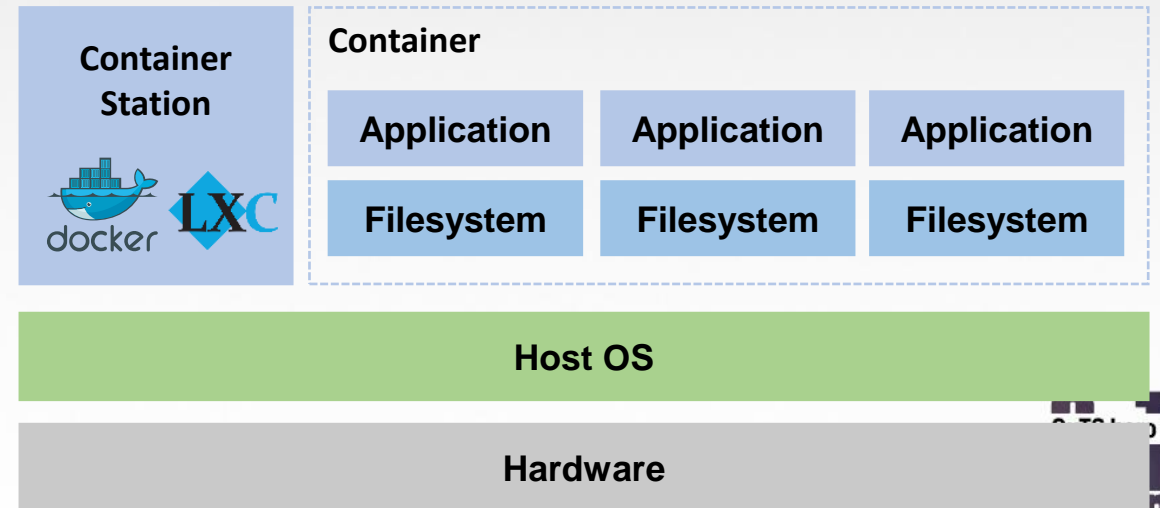


- Supports VM Live Migration



## Container Station

- QNAP's Container Station exclusively integrates LXC and Docker lightweight virtualization technologies, allowing you to download apps from the built-in Docker Hub Registry.



**QNAP**

**QuTS** hero  
edition

# Recommended Models

QuTS hero



TVS-h1288X / TS-h1683XU-RP / TS-h2490FU

# Recommended Models

The best flagship of Desktop

## TVS-h12/1688X

- 12/16 bay (4 x 2.5" + 8/12 x 3.5")
- Intel® Xeon® W-1250 6-core 3.3 GHz
- Max 128GB RAM
- Supports Thunderbolt Expansion card

QuTS hero edition



The most cost-effective choice for large-capacity

## TS-h1683XU

- 16 bay (16 x 3.5")
- Intel® Xeon® E-2236 6-core 3.3 GHz
- Max 128GB RAM

QuTS hero edition  
TS-h1683XU-RP

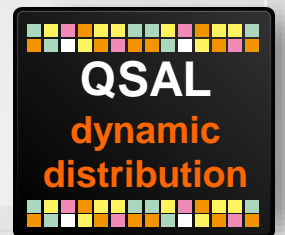


The best AFA model for 10000 connections / Virtualized / AI

## TS-h2490FU

- 24 bay (24 x 2.5")
- AMD EPYC 7302P 16-core 3.3 GHz
- Max 4TB RAM

QuTS hero edition



4.5.2

QuTS hero



# Comparison between QTS and QuTS hero

	QuTS hero	QTS
Filesystem	<b>ZFS</b>	Ext4
SSD Cache	Read cache	<b>R/W cache</b> / Read cache / <b>Write cache</b>
Inline Compression	<b>Yes</b> (LZ4 compression, ideal for RAW & documents)	N/A
Inline Deduplication	<b>Yes</b> (At least 16 GB RAM or more)	N/A
Offline Deduplication (QuDedup)	Yes (HBS)	Yes (HBS)
Power Failure Protection (Hardware)	UPS	UPS
Power Failure Protection (Software)	<b>ZIL</b> <b>Copy-on-Write</b> (Service continues after power recovery)	N/A (Risk of file system-level corruption on power-loss and system downtime required for " <b>Check File System</b> ")
Permission Management	<b>Rich ACL (14 types)</b>	POSIX ACLs (3 types) + certain special permissions
Capacity Upgrade Method	Add entire RAID / Replace Disks / JBOD Expansion	<b>Add Single Disk</b> / Add entire RAID / Replace Disks / JBOD Expansion
Data Integrity (Safety)	<b>Better (Self-Healing &amp; COW)</b>	Standard
Overall Performance	Requires higher-performance CPU and more memory	<b>Better</b>
Pool Limitation	<b>1PB</b> (Need more memory to handle the metadata if big pool or multiple pools)	300TB
Recommendation SSD Configuration for Video Editing Applications	Use SSD Pools  Note: Set the block size 128K when creating Folders/LUNs, and select All I/O mode.	Editing (from original/RAW files): Use SSD Pools Post Production: Enable Read/Write cache  Note: Set the block size to 32K or 64K when creating Volumes, and choose "All I/O" for cache mode.

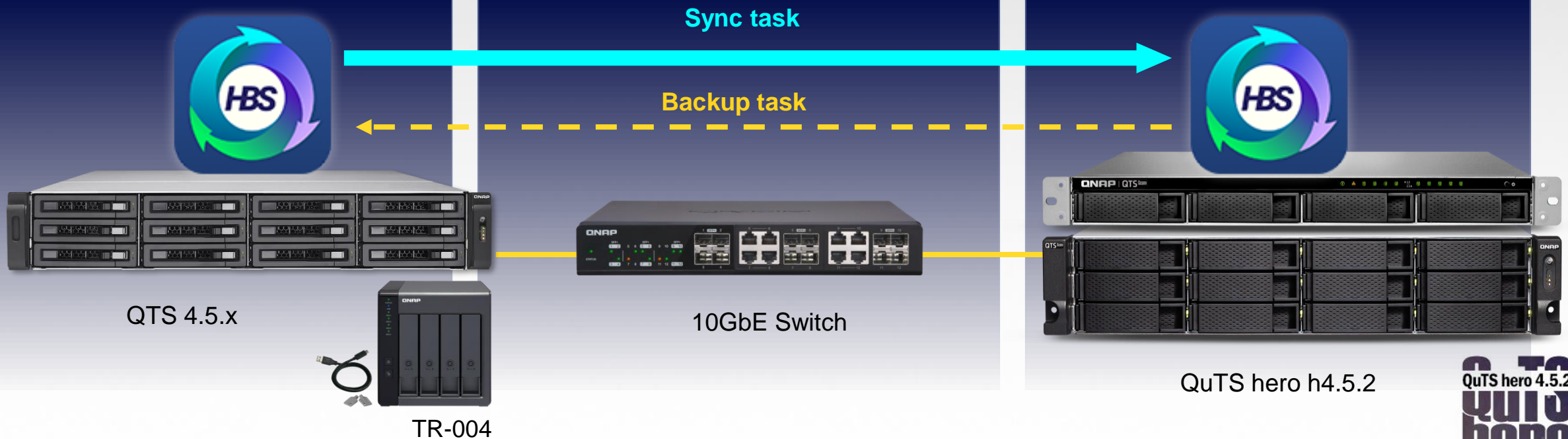
# Migrate data from QTS to QuTS hero

Use HBS to run sync task

Use [Import/Export Users] to migrate the user settings from QTS NAS to QuTS hero NAS.

Use HBS to sync data to TS-004/TR-002 (external mode) and then the copy data to the QuTS hero NAS

After data migration, QTS can be used as backup storage.



**QNAP**

# QuTS hero

**h 4.5.2**

**QuTS hero**

Is your best choice!