

RAID Levels Explained on One Page

RAID 0 · RAID 1 · RAID 5 · RAID 6 · RAID 10: Drives, Capacity, Redundancy, Use Case

RAID 0

Striping

D

D

Min drives2

UsableN × size

Fault tol.0 drives

ReadFast

WriteFast

NO REDUNDANCY

Use case

Temp scratch space, video editing cache. Never for primary storage.

RAID 1

Mirroring

D

M

Min drives2

Usable1 × size

Fault tol.1 drive

ReadFast

WriteModerate

50% OVERHEAD

Use case

2-bay NAS, critical data mirror. Simple and resilient.

RAID 5

Striping + Parity

D

D

D

P

Min drives3

Usable(N-1) × size

Fault tol.1 drive

ReadFast

WriteModerate

HIGH REBUILD RISK

Use case

4-bay home NAS. Good capacity. Vulnerable during rebuild.

RAID 6

Double Parity

D

D

P

P

Min drives4

Usable(N-2) × size

Fault tol.2 drives

ReadFast

WriteModerate

REBUILD SAFE

Use case

Business data, large drives. Survives 2nd failure during rebuild.

RAID 10

Mirror + Stripe

D

M

D

M

Min drives4

UsableN/2 × size

Fault tol.1/mirror pair

ReadFastest

WriteFast

FAST REBUILD

Use case

Performance + redundancy. Databases, high IOPS. 50% overhead cost.

SHR: SYNOLOGY HYBRID RAID

SHR ≈ RAID 5 with mixed drive support. With identical drives, SHR and RAID 5 produce the same usable capacity. With mixed sizes, SHR creates tiers, more usable space than standard RAID 5 with mixed drives. SHR-2 ≈ RAID 6. Synology-only.

UNRAID: DIFFERENT MODEL

UnRAID is **not standard RAID**. One or two parity drives protect all data drives. Data drives can be different sizes. Rebuild time = parity drive size (not data drive count). Slower random I/O than traditional RAID, optimised for media streaming.

KEY RULES: ALL RAID TYPES

RAID is not a backup, it protects uptime, not data

CMR drives only: SMR drives fail during RAID rebuild

Capacity ≠ labelled TB, binary overhead = ~6-7% less

Rebuild = risk window, any 2nd failure = total loss (RAID 5)

Larger drives = longer rebuild = wider risk window

CALCULATE YOUR EXACT USABLE CAPACITY

Accounts for binary conversion, NAS system overhead, filesystem metadata, snapshot reserves, and recommended headroom.

needtoknowit.com.au/tools/raid-calculator/



RAID Calculator

MORE FREE NAS PLANNING TOOLS

needtoknowit.com.au/tools: RAID Calculator · RAID Rebuild Estimator · Drive Failure Risk NAS Sizing Wizard · Power Calculator · Backup Calculator

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Independent Australian storage guidance
needtoknowit.com.au

1

KNOW YOUR DATA VOLUME

Current data size:

TB

Expected 3-year growth:

TB

Target usable capacity:

TB

Most home NAS users underestimate growth.
Double your current data as a starting point.
Target usable = 1.5-2× current data size.

2

CHOOSE YOUR RAID LEVEL

RAID 1

↓

mirror

1 usable

RAID 5

↓

parity

N-1 usable

RAID 6

↓

double parity

N-2 usable

☐ 2-bay → RAID 1

☐ 4-bay Synology → SHR commonly used (supports mixed drives)

☐ 4-bay QNAP → RAID 5 commonly used

☐ 5+ bay, business-critical → RAID 6 (tolerates 2 simultaneous failures)

⚠ RAID protects uptime, not data loss, plan backup separately

3

SELECT YOUR DRIVES

☐ CMR only, avoid SMR drives in RAID

☐ NAS-rated drives (IronWolf, WD Red Plus, Toshiba N300)

☐ All drives same capacity (unless using SHR)

☐ Compatibility confirmed
synology.com/compatibility or qnap.com/compatibility

REBUILD RISK REFERENCE

TYPE	TOLERANCE	REBUILD (4TB)	RISK
RAID 1	1 drive	~4-6 hr	LOW
RAID 5 / SHR	1 drive	~12-24 hr	HIGH
RAID 6 / SHR-2	2 drives	~18-36 hr	MEDIUM
RAID 10	1/mirror	~4-8 hr	LOW
RAID 0	None	N/A	NO REDUNDANCY

Large drives = longer rebuild time = higher risk window.
Times approximate at ~100 MB/s sustained read.

4

CALCULATE USABLE STORAGE

☐ Confirmed usable capacity using:
needtoknowit.com.au/tools/raid-calculator/

☐ Usable capacity meets 3-year target

CAPACITY QUICK CALC (4 drives)

4 × 4TB, RAID 5 = 12 TB usable

4 × 8TB, RAID 5 = 24 TB usable

4 × 8TB, RAID 6 = 16 TB usable

4 × 12TB, RAID 6 = 24 TB usable



Scan to open
RAID Calculator

5

REBUILD RISK

☐ Large drives = longer rebuild time (higher risk window)

☐ Hot spare considered if array is business-critical

☐ Drive failure risk checked:
needtoknowit.com.au/tools/drive-failure-risk/

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BACKUP PLAN

☐ RAID failure scenario identified (ransomware, controller failure, theft)

☐ Off-site backup method chosen (cloud or USB rotation)

☐ 3-2-1 rule: 3 copies, 2 media types, 1 off-site

⚠ RAID protects uptime, not data loss.

NAS Drive Cost vs Usable Storage

Cheat Sheet: RAID Overhead, Usable Capacity & Expansion Trap

▲

USABLE CAPACITY REFERENCE: WHAT YOU ACTUALLY GET (RAID OVERHEAD INCLUDED, ~10% HEADROOM)

DRIVE SIZE	RAID 5 USABLE	RAID 6 USABLE	SHR USABLE (MATCHED)	RAID 1 USABLE (2-BAY)
4 × 4 TB	~10.8 TB	~7.2 TB	~10.8 TB	-
2 × 4 TB	-	-	~3.6 TB	~3.6 TB
4 × 8 TB	~21.6 TB	~14.4 TB	~21.6 TB	-
4 × 12 TB	~32.4 TB	~21.6 TB	~32.4 TB	-
4 × 16 TB	~43.2 TB	~28.8 TB	~43.2 TB	-
4 × 20 TB	~54 TB	~36 TB	~54 TB	-

Usable capacity includes ~6% binary overhead + 10% headroom recommendation. For current AU drive pricing and live \$/TB calculation: [needtoknowit.com.au/tools/raid-calculator/](#), or check StaticICE.com.au for current NAS drive prices.

!

THE EXPANSION TRAP

Most home NAS users plan to "start small and upgrade later." Here's why that's expensive:

Standard RAID (RAID 5/6/10): To expand a 4 × 8TB RAID 5, you must replace ALL four drives one at a time with larger drives and wait for rebuild after each swap. Full 4-rebuild cycle at 12-24 hrs each = 3-4 days of risk.

SHR Exception: Synology Hybrid RAID can mix drive sizes and expand by adding one new larger drive, no full rebuild required. Better upgrade path for home users.

⚠ Buying smaller drives to "save money now" often costs more long-term, plan your final capacity first, then buy accordingly.

▶

RECOMMENDED STARTING SIZES

USE CASE	BAY COUNT	STARTING DRIVE	SWEET SPOT
Home backup	2-bay	4 TB × 2	~3.6 TB
Home + media	4-bay	8 TB × 4	~21 TB
Power user / Plex	4-bay	12 TB × 4	~32 TB
Small business	4-6 bay	12-16 TB × N	Scale to need
Video editing	6+ bay	16+ TB × N	10GbE required



RAID Calculator

☐ Verify your exact usable capacity: [needtoknowit.com.au/tools/raid-calculator/](#)

MORE FREE NAS PLANNING TOOLS

[needtoknowit.com.au/tools](#): RAID Calculator · Drive Failure Risk · NAS Sizing Wizard
Power Calculator · Backup Calculator · Transfer Speed Estimator

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Independent Australian storage guidance
[needtoknowit.com.au](#)

How NAS Data Actually Gets Lost

Even With RAID: 5 Real Scenarios + What Actually Protects You

WHAT RAID ACTUALLY PROTECTS

SCENARIO	RAID HELPS?
Single drive hardware failure	YES
Drive failure mid-rebuild (2nd drive)	RAID 6 only
Ransomware / file encryption	NO
Accidental file deletion	NO
Controller / NAS hardware failure	NO
Fire, flood, theft	NO
Bit rot / silent data corruption	ZFS/btrfs only
User error (wrong format, overwrite)	NO
Software/firmware bug data corruption	NO

⚠ RAID is uptime insurance, not data insurance.

5 REAL DATA LOSS SCENARIOS

- 1 Ransomware**
Encrypts every mounted share. RAID replicates the encrypted data across all drives instantly.
Fix: air-gapped off-site backup + versioning
- 2 Second Drive Fails During Rebuild**
RAID 5 is fully vulnerable during the rebuild window (12-36 hrs). Any second failure = total loss.
Fix: RAID 6, or a hot spare
- 3 NAS Controller Dies**
Proprietary RAID metadata may make drives unreadable in a different enclosure or brand.
Fix: backup independent of NAS hardware
- 4 Accidental Deletion / Overwrite**
Deleted files sync instantly to all drives and any connected cloud sync.
Fix: versioned snapshots + separate backup
- 5 Theft or Physical Disaster**
NAS + all drives taken or destroyed together. No RAID level survives this.
Fix: off-site backup, cloud or USB rotation

3 THE 3-2-1 BACKUP RULE

3
COPIES OF
YOUR DATA

2
DIFFERENT
MEDIA TYPES

1
COPY STORED
OFF-SITE

Example: NAS (live) + external USB (local) + Backblaze B2 (cloud)

NAS counts as 1 copy, even with RAID 6, it is one logical copy.

Cloud sync ≠ backup: Dropbox/OneDrive propagate deletions instantly.

BACKUP PLANNING CHECKLIST

- ☐ Off-site backup destination chosen
Backblaze B2, Wasabi, or USB drive kept off-site
- ☐ Backup schedule set (daily minimum for active data)
- ☐ Versioning enabled, how many versions retained?
Minimum 30 days to catch ransomware incubation
- ☐ Restore tested, actually recovered a file
Untested backups are not backups
- ☐ Drive failure risk assessed:
needtoknowit.com.au/tools/drive-failure-risk/
- ☐ Backup capacity sized:
needtoknowit.com.au/tools/backup-calculator/



MORE FREE NAS PLANNING TOOLS

needtoknowit.com.au/tools: RAID Calculator · Drive Failure Risk · Backup Calculator
Power Calculator · NAS Sizing Wizard · Transfer Speed Estimator · UPS Runtime Estimator

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NAS Hardware Planning Checklist

Workload · Users · Network · Drives · Enclosure: Before You Buy

1 WORKLOAD PROFILE

PRIMARY USE (TICK ALL THAT APPLY)

- ☐ File storage and backup
- ☐ Plex / Jellyfin media server
Note: 4K direct play needs ≥ quad-core CPU (no transcode)
- ☐ Surveillance / NVR cameras
- ☐ Virtualisation (VMs / Docker)
Needs ≥ 8 GB RAM, SSD cache strongly recommended
- ☐ Video editing workstation
10GbE + SSD cache required for 4K/ProRes workflows
- ☐ Remote access / VPN host
- ☐ Database / business applications
- ☐ Local AI model hosting
Requires GPU passthrough or separate compute node

INTENSITY

- ☐ Sequential workload (large file streaming) → HDD adequate
- ☐ Random I/O (databases, VMs) → SSD required or SSD cache

2 USERS & NETWORK

USER COUNT

Concurrent users: _____ users

Peak simultaneous streams: _____ streams

Off-site users (remote access): _____ users

NETWORK REQUIREMENTS

- ☐ 1GbE sufficient (1-2 users, file storage)
- ☐ 2.5GbE (3-5 users, Plex, modern default)
- ☐ 10GbE required (video editing, 6+ streams)
- ☐ Switch upgraded to match NAS port speed
- ☐ Client machines have matching NIC
2.5GbE NAS + 1GbE client → 1GbE effective
- ☐ Network speed modelled:
needtoknowit.com.au/tools/transfer-speed-estimator/

3 DRIVE SELECTION

DRIVE TYPE

- ☐ CMR drives only (avoid SMR in RAID)
- ☐ NAS-rated HDDs for primary storage
IronWolf, WD Red Plus, Toshiba N300
- ☐ SSD cache considered for VM / random I/O workloads
- ☐ Compatibility confirmed on vendor list
synology.com/compatibility or qnap.com/compatibility

DRIVE SIZING

Drive size chosen: _____ TB

Drive count: _____ drives

RAID level: _____

- ☐ Usable capacity verified:
needtoknowit.com.au/tools/raid-calculator/

4 ENCLOSURE & POWER

ENCLOSURE REQUIREMENTS

- ☐ Bay count: minimum bays + 2 growth buffer
- ☐ CPU adequate for transcoding (if Plex)
Synology: check DSM transcoding compatibility list
- ☐ RAM adequate: 4 GB min, 8 GB for VMs/Docker
- ☐ M.2 NVMe slots for SSD cache (if needed)
- ☐ PCIe slot available (for 10GbE NIC if needed)

POWER & PROTECTION

- ☐ Power draw estimated:
needtoknowit.com.au/tools/power-calculator/
- ☐ UPS runtime calculated:
needtoknowit.com.au/tools/ups-runtime-estimator/
- ☐ UPS connected: NAS shutdown on battery low



All NTKIT
Tools

⚠ Budget 20-30% above drive cost for enclosure, UPS, and network gear.

MORE FREE NAS PLANNING TOOLS

needtoknowit.com.au/tools: RAID Calculator · Power Calculator · UPS Runtime Estimator
NAS Sizing Wizard · Transfer Speed Estimator · Drive Failure Risk · Backup Calculator

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NAS Network Speed Planning Worksheet

File Size · Transfer Time · Real-World Speeds · Bottleneck Checklist

1 YOUR WORKLOAD

Typical file size: _____ GB

Files transferred at once: _____ files

Total transfer size: _____ GB

Desired transfer time: _____ minutes

Simultaneous users: _____ users

Plex streams (4K): _____ streams

Required speed (MB/s) = Transfer size (MB) ÷ Time (seconds)
Example: 50 GB ÷ 300s = **~167 MB/s** → needs 2.5GbE

REAL-WORLD NAS TRANSFER SPEEDS

CONNECTION	THEORETICAL	LARGE FILES	SMALL FILES	4K STREAMS
1GbE Standard gigabit	125 MB/s	80-110 MB/s	10-40 MB/s	~3-4
2.5GbE Modern NAS default	312 MB/s	200-280 MB/s	20-80 MB/s	~8-10
5GbE Mid-range upgrade	625 MB/s	400-550 MB/s	40-150 MB/s	~15-20
10GbE Professional / video	1,250 MB/s	600-1,100 MB/s	80-300 MB/s	30+

Small file performance dominated by IOPS, not link speed. 4K Plex streams ≈ 40-80 Mbps each (direct play). Real speeds limited by slowest component, see bottlenecks.

2 TRANSFER TIME REFERENCE

FILE / DATASET SIZE	1GBE (~100MB/S)	2.5GBE (~250MB/S)	10GBE (~900MB/S)
1 GB	~10 sec	~4 sec	~1 sec
10 GB	~1.7 min	~40 sec	~11 sec
50 GB	~8 min	~3.5 min	~56 sec
100 GB	~17 min	~7 min	~2 min
500 GB	~1.4 hrs	~33 min	~9 min
1 TB	~2.8 hrs	~67 min	~19 min
4 TB	~11 hrs	~4.5 hrs	~75 min

☐ Model exact speeds for your setup:
needtoknowit.com.au/tools/transfer-speed-estimator/

! BOTTLENECK CHECKLIST

- 1

NAS Storage Type
HDD arrays cap at ~100-200 MB/s sequential. SSD cache or all-SSD needed for 10GbE saturation.
- 2

Client Drive Speed
Laptop HDD writing at 80 MB/s caps your transfer regardless of network speed.
- 3

Switch / Cable
A 1GbE switch between a 2.5GbE NAS and client caps at 1GbE. All ports must match the target speed.
- 4

Protocol Overhead
SMB encryption (AES-256-GCM) costs ~15-30% throughput on older CPUs. SMB 3.0+ multichannel helps.
- 5

File Size Mix
Thousands of small files hit IOPS limits, not bandwidth. 1GbE often adequate for document storage.



Transfer Speed Estimator

⚠ Upgrading to 10GbE without SSD cache often yields <200 MB/s: HDD is the real bottleneck.

MORE FREE NAS PLANNING TOOLS

needtoknowit.com.au/tools: Transfer Speed Estimator · Network Upgrade ROI · NAS Sizing Wizard
RAID Calculator · Power Calculator · Backup Calculator

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NAS Storage Growth Planner (3-5 Year)

Data Categories · Annual Growth · 5-Year Capacity Projection

1 CURRENT DATA INVENTORY

DATA CATEGORY	CURRENT SIZE	ANNUAL GROWTH
Photos / videos (personal)	TB	TB/yr
Video/film projects	TB	TB/yr
Media library (Plex/Jellyfin)	TB	TB/yr
PC / Mac backup (Time Machine, etc.)	TB	TB/yr
Work / documents / projects	TB	TB/yr
Virtual machines / containers	TB	TB/yr
Surveillance / NVR footage	TB	TB/yr
TOTAL	TB	TB/yr

TYPICAL ANNUAL GROWTH RATES

USE CASE	TYPICAL GROWTH	PROFILE
Personal photos/docs only	0.1-0.3 TB/yr	Low
Family + smartphone backup	0.3-1 TB/yr	Moderate
Home + media library (Plex)	1-3 TB/yr	Medium
Content creator / video	2-10 TB/yr	High
Small business / surveillance	2-20 TB/yr	Very High

Planning rule: Target usable capacity = (Current total + Annual growth × 5) × 1.3
The 1.3× buffer accounts for RAID overhead variance, filesystem reserves, and headroom.

⚠ Most home users underestimate by 50%. Plan for 5 years, not 2.

2 5-YEAR CAPACITY PROJECTION

Fill in your totals from Step 1, then project forward using your annual growth rate.

YEAR	DATA USED	+ RAID OVERHEAD	+ 20% HEADROOM	RAW CAPACITY NEEDED
Now				
Year 1				
Year 2				
Year 3				
Year 4				
Year 5				

3 FINAL NAS SIZING

5-year raw capacity needed: TB

Drive size chosen: TB

Bay count needed: bays

RAID type chosen:



RAID Calculator

Bay count rule of thumb:
5yr need ÷ (drive size × RAID efficiency)
= drives needed
Add 1-2 bays for growth buffer.

- ☐ Verify exact usable capacity:
needtoknowit.com.au/tools/raid-calculator/
- ☐ Right-size with NAS Sizing Wizard:
needtoknowit.com.au/tools/nas-sizing-wizard/

MORE FREE NAS PLANNING TOOLS

needtoknowit.com.au/tools: RAID Calculator · NAS Sizing Wizard · Backup Calculator
Drive Failure Risk · Power Calculator · Transfer Speed Estimator

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NBN Remote Access Decision Tree

Can I access my NAS from outside my home network?

STEP 1: DIAGNOSE YOUR CONNECTION

Q1

Check your router's WAN IP address. Is it in the range **100.64.x.x** to **100.127.x.x**?

YES: You're on CGNAT

Q2: ASK YOUR PROVIDER

Ask your provider for a public IP address (a CGNAT opt-out). See the questions to ask →

NO: You have a public IP

Q2: DOES YOUR IP CHANGE?

Is it a dynamic (changes on reconnect) or static IP?

QUESTIONS TO ASK YOUR PROVIDER

1. Is my service behind CGNAT?
2. Can I get a public IPv4 address, and is there a fee?
3. Is a static IP available on my plan?
4. What is the upload speed on my plan and connection type?

Provider CGNAT policies change without notice, so this guide does not list them. Check your setup: needtoknowit.com.au/tools/nbn-remote-access-checker/

STEP 2: SELECT YOUR PATH

CGNAT PATHS, IN ORDER OF PREFERENCE

PATH A: Opt Out

Call your ISP

Ask your provider for a public IPv4 address. Whether it is offered, and whether it costs extra, varies by provider and plan.

→ Port forward works
→ Best outcome

PATH B: VPN Mesh

Tailscale / ZeroTier

Works on any ISP. Free tier covers home use. Punches through CGNAT.

→ No ISP call needed
→ Recommended default

PATH C: Relay

QuickConnect / QNAP ID

Synology & QNAP built-in relay. Slower. Depends on vendor cloud uptime.

→ Works through CGNAT
→ Speed limited by relay

HOW TO CHECK IF YOU'RE ON CGNAT

- 01 Log into your router admin panel (usually **192.168.0.1** or **192.168.1.1**)
- 02 Find WAN IP or Internet IP address
- 03 If it starts with **100.64** to **100.127** → you're on CGNAT
- 04 Compare to your IP at whatismyip.com . If different, CGNAT confirmed

PUBLIC IP PATHS

DYNAMIC IP

Use DDNS

Synology DDNS, DuckDNS, or No-IP. Your domain tracks your changing IP automatically.

→ Port forward + DDNS
→ Free options available

STATIC IP

Port Forward Direct

Simplest setup. Open ports 5000/5001 (Synology) or 8080/8443 (QNAP) on your router.

→ Most reliable remote access
→ Use HTTPS + strong password

CGNAT WORKAROUNDS RANKED

1. **Tailscale**
Free VPN mesh. Install on NAS + devices. Works through any CGNAT. Best AU option.
tailscale.com → [free tier](#)
2. **Synology QuickConnect**
Built into DSM. Enable in Control Panel. No router config needed.
Synology only: [relay speed varies](#)
3. **QNAP myQNAPcloud**
QNAP equivalent of QuickConnect. Works through CGNAT.
QNAP only: [enable in App Center](#)
4. **WireGuard VPN**
Run on a low-cost VPS. Full performance. Requires config skill.
Best performance, most setup work

▲ AU NBN UPLOAD REALITY CHECK

Remote access speed is capped by your **upload** speed at home, not your download. Your upload speed depends on your plan and connection type, so check your provider's plan details. As a guide, a 20 Mbps upload moves about 2.5 MB/s, and one remote 4K stream needs roughly 25 Mbps of upload.

Need more? Ask your provider which plans on your connection type offer a higher upload.

Confirm CGNAT, public IP and upload details with your provider before you sign up. Mobile (4G/5G) home broadband and satellite services commonly use CGNAT. Check with your provider. This guide covers NBN fixed-line connections only.