

# Building 6 Bay NAS with Software RAID

- Only **Rev.B** boards are capable with M.2 to SATA adapter.

Since the new H2 marked **Rev.B** supports M.2 to SATA adapter, we are able to build a NAS with more handy looks.

Our environment is,

- ODROID-H2 **Rev.B**
- Samsung DDR4 4GB \* 2
- 64GB eMMC
- IOCREST M.2 to 4 Port SATA 6G Adapter (IO-M2F9235-4I, Marvel 88SE9235 Controller)
- WD RED 1TB HDD \* 6
- HCiPC P401-1 HCNAS(Node6) Mini-ITX Case
- Micronics Cyclone III 350W ATX Power Supply
- Basic engineering kits for DIY tasks

In this note, I will introduce to you how to set the RAID 6 system up and how the performance of this is. And will think together whether H2 is worth for NAS use with RAID-ed hard drives or not.

## Assemble Enclosure

We decided to use Mini-ITX PC case for its enclosure.

That case has to have at least 6 hard drive bays and have space for attaching a standard ATX power supply. Also having extra case fan would be good.

And definitely, it must have compact and solid looking.

So we chose this one, called **HCiPC P401-1 HCNAS(Node6) Mini-ITX**, having all of the requirements with a solid look.

But H2 onboard screw-holes ain't fit into the ITX cases. So we had to 3D-print a guide for it.

Here is the download link for the mounting adapter 3D model:

<https://www.thingiverse.com/thing:3686128>



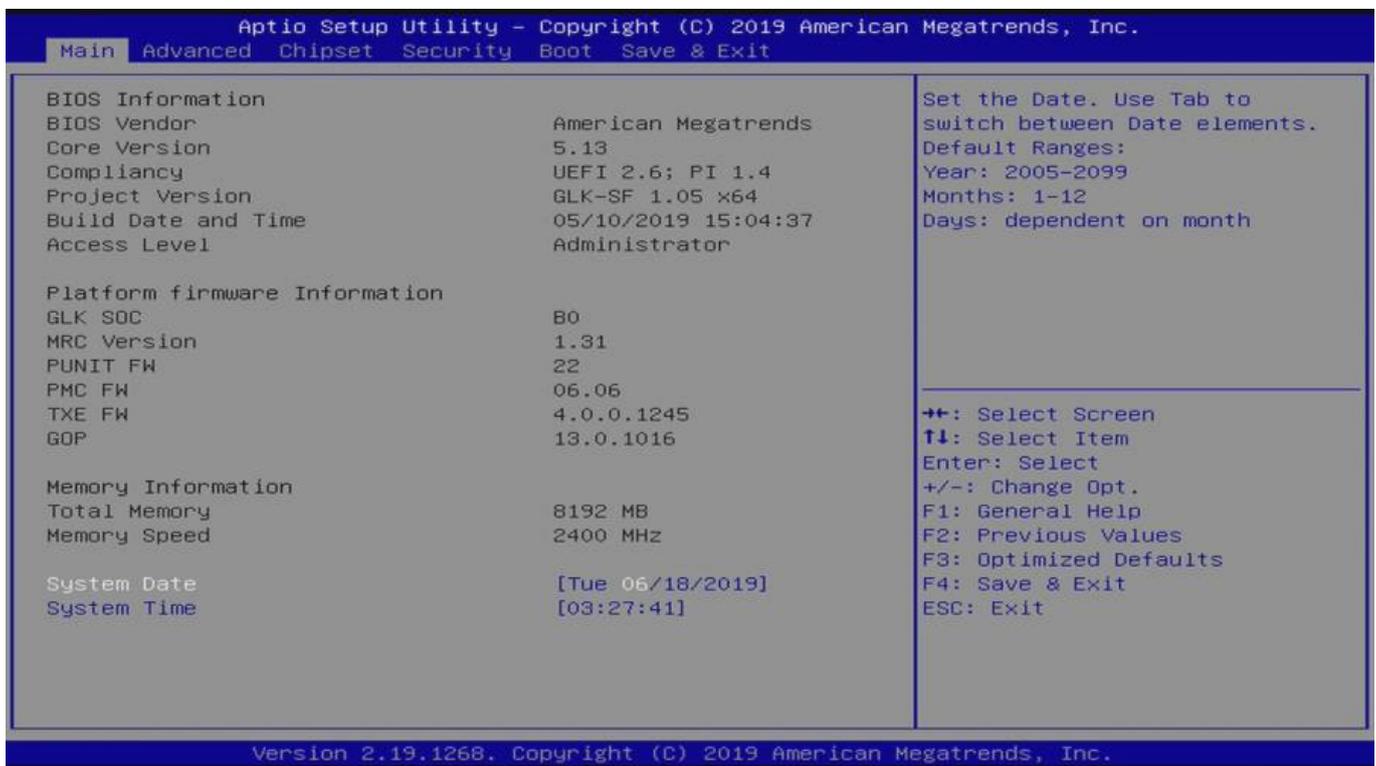
This assembly steps had been posted one by one on our forum. To see the whole assembly process, please look into this thread: <https://forum.odroid.com/viewtopic.php?f=172&t=35309>



## Setup BIOS

With its default setup, SATA adapter on M.2 slot will not work. To use properly, we have to configure BIOS settings.

Enter to BIOS by press **delete** key during just after the power button pushed. Then you should face the screen like the below.



You have to set 2 options.

- **Chipset - South Cluster Configuration - Miscellaneous Configuration - State After G3**

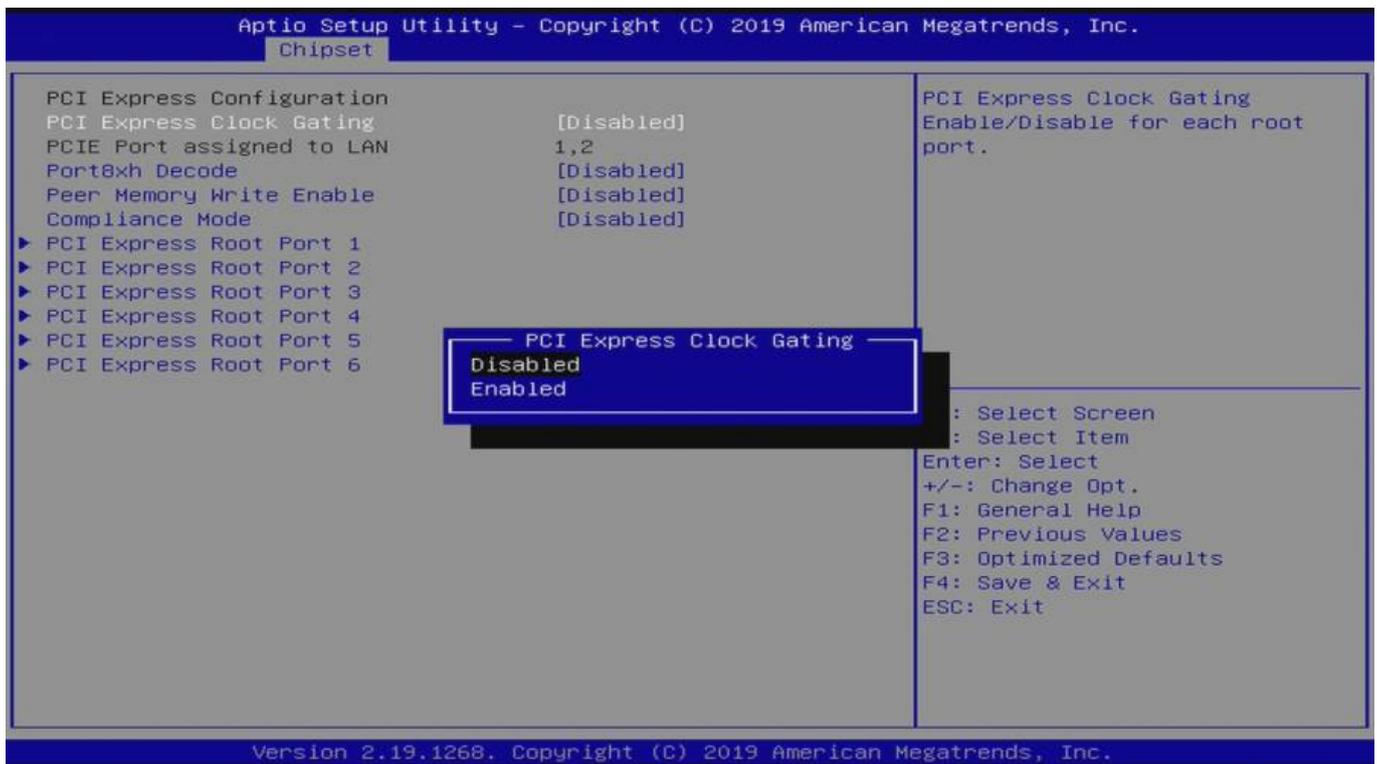
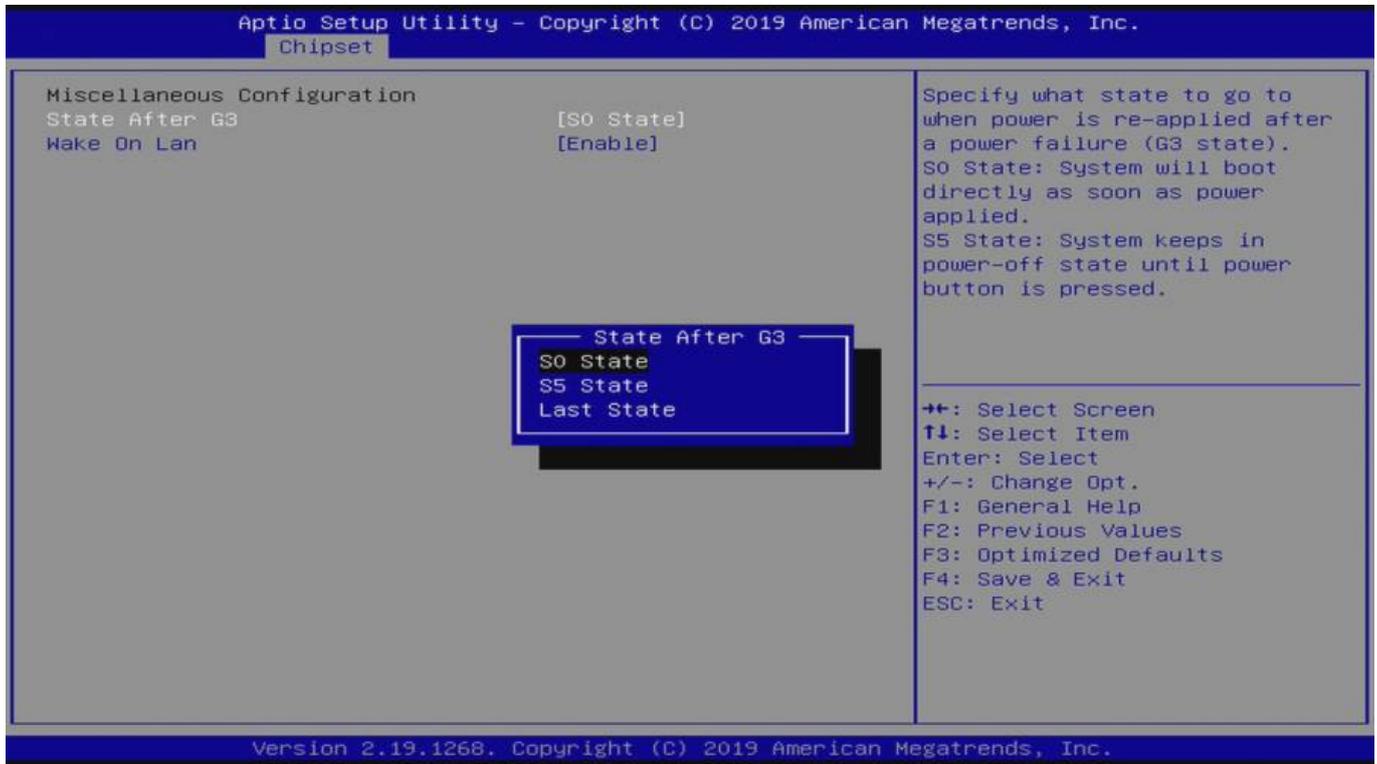
to **S0 State**

- To make it turn on automatically when the power plugged.

- **Chipset - South Cluster Configuration - PCI Express Configuration - PCI Express Clock Gating to Disabled**

- To make M.2 to SATA adapter working properly.

Move using arrow keys on the keyboard to them and set each option.



## Install Ubuntu

To its host operating system, we've decided to install Ubuntu 19.04.

Download the latest OS image from Ubuntu download page (<https://ubuntu.com/download>), and flash that image into a USB stick using Etcher. Etcher is a multi-platform flashing tool.

Plug the USB memory stick to H2 and power on. Then press **F7** to enter choosing boot media screen. If the screen shows up, select the inserted USB boot media.



Then install Ubuntu as your taste. Just be aware of selecting a hard drive when you select a root media during installation.

And make the system up-to-date is highly recommended in any case of application use, in most cases.

## Check the Hard Drive Recognized

To check whether the hard drives installed or not, you can look into the outputs of **dmesg**.

```
odroid@ODROID-H2:~$ dmesg | grep scsi
[ 2.067831] scsi host0: ahci
[ 2.068684] scsi host1: ahci
[ 2.080796] scsi host2: ahci
[ 2.080964] scsi host3: ahci
[ 2.084816] scsi host4: ahci
[ 2.084976] scsi host5: ahci
[ 2.548364] scsi :::: Direct-Access          ATA          WDC WD10EFRX-68F 0A82
PQ: ANSI: 5
```

```
[ 2.549029] sd :::: Attached scsi generic sg0 type
[ 2.549321] scsi 1::: Direct-Access ATA WDC WD10EFRX-68F 0A82
PQ: ANSI: 5
[ 2.549627] sd 1::: Attached scsi generic sg1 type
[ 2.563013] scsi 2::: Direct-Access ATA WDC WD10EFRX-68F 0A82
PQ: ANSI: 5
[ 2.563292] sd 2::: Attached scsi generic sg2 type
[ 2.563497] scsi 3::: Direct-Access ATA WDC WD10EFRX-68F 0A82
PQ: ANSI: 5
[ 2.563693] sd 3::: Attached scsi generic sg3 type
[ 2.563875] scsi 4::: Direct-Access ATA WDC WD10EFRX-68F 0A82
PQ: ANSI: 5
[ 2.564070] sd 4::: Attached scsi generic sg4 type
[ 2.564268] scsi 5::: Direct-Access ATA WDC WD10EFRX-68F 0A82
PQ: ANSI: 5
[ 2.564444] sd 5::: Attached scsi generic sg5 type
```

This shows that those 6 drives are recognized normally. If yours ain't, you should check the hardware connection or BIOS settings.

## Setup Hard Drives

### Partition Hard Drives

Check the installed hard drives using the following commands.

```
odroid@ODROID-H2:~$ sudo fdisk -l | grep sd
Disk /dev/sda: 931.5 GiB, 1000204886016 bytes, 1953525168 sectors
Disk /dev/sdb: 931.5 GiB, 1000204886016 bytes, 1953525168 sectors
Disk /dev/sdc: 931.5 GiB, 1000204886016 bytes, 1953525168 sectors
Disk /dev/sdd: 931.5 GiB, 1000204886016 bytes, 1953525168 sectors
Disk /dev/sde: 931.5 GiB, 1000204886016 bytes, 1953525168 sectors
Disk /dev/sdf: 931.5 GiB, 1000204886016 bytes, 1953525168 sectors
```

Then create a partition using **parted** tool.

You can use **fdisk** to partition them but **GPT** partition table should be created in order to use more than 2TB hard drive.

Partition the disks respectively referring to the following procedures.

```
odroid@ODROID-H2:~$ sudo parted /dev/sda
GNU Parted 3.2
Using /dev/sda
Welcome to GNU Parted! Type 'help' to view a list of commands.
(parted) mklabel gpt
(parted) print free
```

```
Model: ATA WDC WD10EFRX-68F (scsi)
Disk /dev/sda: 1000GB
Sector size (logical/physical): 512B/4096B
Partition Table: gpt
Disk Flags:
```

Number	Start	End	Size	File system	Name	Flags
	17.4kB	1000GB	1000GB	Free Space		

```
(parted) mkpart primary 1M 1000GB
```

```
(parted) p
```

```
Model: ATA WDC WD10EFRX-68F (scsi)
Disk /dev/sda: 1000GB
Sector size (logical/physical): 512B/4096B
Partition Table: gpt
Disk Flags:
```

Number	Start	End	Size	File system	Name	Flags
1	1049kB	1000GB	1000GB		primary	

```
(parted) q
```

```
Information: You may need to update /etc/fstab.
```

Check the changes applied.

```
odroid@ODROID-H2:~$ lsblk | grep sd
sda          8:      931.5G  disk
└─sda1       8:1      931.5G  part
sdb          8:16     931.5G  disk
└─sdb1       8:17     931.5G  part
sdc          8:32     1 931.5G  disk
└─sdc1       8:33     1 931.5G  part
sdd          8:48     1 931.5G  disk
└─sdd1       8:49     1 931.5G  part
sde          8:64     1 931.5G  disk
└─sde1       8:65     1 931.5G  part
sdf          8:80     1 931.5G  disk
└─sdf1       8:81     1 931.5G  part
```

We can see each all hard drive has one partition.

After partitioning all of the drives, now it's time to set RAID 6 up on our NAS.

## Configure RAID 6

Here are 2 big facts why **RAID level 6** we are going to use.

- It is more robust than RAID 5, because it uses one more disk for parity.
- So there will be no data loss even after 2 disk fails. We can rebuild it after replacing the failed disk.

But it also has its kind of overhead. Double parity can verify its stability but also comes with poor writing performance.

And minimum 4 disks required to build with RAID 6. Since we have 6 hard drives which have 1TB capacity each, we can build using RAID 6 and there will be 4TB capacity we can use.

To setup RAID without physical RAID controller on Linux system, we have to use **mdadm** tool. It is provided by package manager on each Linux distros.

Install **mdadm** using apt.

```
odroid@ODROID-H2:~$ sudo apt install mdadm
```

We already know that those 6 drives are allocated as **/dev/sda** to **/dev/sdf**.

Create an array using the following command.

```
odroid@ODROID-H2:~$ sudo mdadm --create /dev/md0 --level=6 --raid-devices=6  
/dev/sda1 /dev/sdb1 /dev/sdc1 /dev/sdd1 /dev/sde1 /dev/sdf1  
mdadm: Defaulting to version 1.2 metadata  
mdadm: array /dev/md0 started.
```

Then **/dev/md0** device file will be created.

You should use that device like as a one hard drive partition. E.g, if you about to mount that array to a directory, you just can mount with that device file.

Do format that partition and mount to the **/media/storage**.

```
odroid@ODROID-H2:~$ sudo mkfs.ext4 /dev/md0  
mke2fs 1.44.6 (5-Mar-2019)  
Creating filesystem with 976628736 4k blocks and 244162560 inodes  
Filesystem UUID: 100a470d-96f1-47d2-8cf0-a211c010e8b9  
Superblock backups stored on blocks:  
    32768, 98304, 163840, 229376, 294912, 819200, 884736, 1605632, 2654208,  
    4096000, 7962624, 11239424, 20480000, 23887872, 71663616, 78675968,  
    102400000, 214990848, 512000000, 550731776, 644972544  
  
Allocating group tables: done  
Writing inode tables: done  
Creating journal (262144 blocks): done  
Writing superblocks and filesystem accounting information: done  
  
odroid@ODROID-H2:~$ sudo mkdir /media/storage  
odroid@ODROID-H2:~$ sudo mount /dev/md0 /media/storage/
```

Check if it mounted properly.

```
odroid@ODROID-H2:~$ cat /proc/mounts | grep md0  
/dev/md0 /media/storage ext4 rw,relatime,stripe=512
```

You also can see the RAID configurations.

```
odroid@ODROID-H2:~$ sudo mdadm --detail /dev/md0
/dev/md0:
    Version : 1.2
  Creation Time : Mon Jun 17 18:08:26 2019
    Raid Level : raid6
    Array Size : 3906514944 (3725.54 GiB 4000.27 GB)
  Used Dev Size : 976628736 (931.39 GiB 1000.07 GB)
    Raid Devices : 6
  Total Devices : 6
    Persistence : Superblock is persistent

    Intent Bitmap : Internal

    Update Time : Mon Jun 17 18:27:08 2019
      State : active, resyncing
  Active Devices : 6
 Working Devices : 6
 Failed Devices :
 Spare Devices :

    Layout : left-symmetric
   Chunk Size : 512K

Consistency Policy : bitmap

Resync Status : 8% complete

    Name : ODR0ID-H2: (local to host ODR0ID-H2)
   UUID : d4759dbb:65fd2b07:d5f4f9c3:0fba55cc
  Events : 253
```

Number	Major	Minor	RaidDevice	State	
	8	1		active sync	/dev/sda1
1	8	17	1	active sync	/dev/sdb1
2	8	33	2	active sync	/dev/sdc1
3	8	49	3	active sync	/dev/sdd1
4	8	65	4	active sync	/dev/sde1
5	8	81	5	active sync	/dev/sdf1

Since this RAID array is just created, **resync** process that makes synchronized with the other devices is performed at the very first time.

You can see the status of the resync process.

```
odroid@ODROID-H2:~$ cat /proc/mdstat
Personalities : [linear] [multipath] [raid0] [raid1] [raid6] [raid5] [raid4]
 [raid10]
md0 : active raid6 sdf1[5] sde1[4] sdd1[3] sdc1[2] sdb1[1] sda1[]
      3906514944 blocks super 1.2 level 6, 512k chunk, algorithm 2 [6/6]
```

```
[UUUUUU]
[=>.....] resync = 9.6% (93909272/976628736)
finish=120.2min speed=122360K/sec
bitmap: 8/8 pages [32KB], 65536KB chunk

unused devices: <none>
```

If the resync process has been done, you can see that message on **dmesg**.

```
odroid@ODROID-H2:~$ dmesg | grep resync
[ 199.311304] md: resync of RAID array md0
[10093.988694] md: md0: resync done.
```

And you also would set your system environment. Adding an entry to **/etc/fstab** and configure SAMBA or SFTP server to share your data by using that RAID-ed hard drives.

There are many management guides for further use of RAID built system including adding spare drives or dealing with failed devices. But this guide will not handle it.

## Benchmark

I performed **iozone3** to evaluate its performance of the H2 with RAID level 6 on 6 hard drives.

I had been checked that the resync process is done successfully.

```
odroid@ODROID-H2:/media/storage$ sudo iozone -e -I -a -s 100M -r 4k -r
16384k -i -i 1 -i 2
sudo iozone -e -I -a -s 100M -r 4k -r 16384k -i -i 1 -i 2
Iozone: Performance Test of File I/O
Version $Revision: 3.429 $
Compiled for 64 bit mode.
Build: linux-AMD64
```

```
Contributors:William Norcott, Don Capps, Isom Crawford, Kirby Collins
Al Slater, Scott Rhine, Mike Wisner, Ken Goss
Steve Landherr, Brad Smith, Mark Kelly, Dr. Alain CYR,
Randy Dunlap, Mark Montague, Dan Million, Gavin Brebner,
Jean-Marc Zucconi, Jeff Blomberg, Benny Halevy, Dave Boone,
Erik Habbinga, Kris Strecker, Walter Wong, Joshua Root,
Fabrice Bacchella, Zhenghua Xue, Qin Li, Darren Sawyer,
Vangel Bojaxhi, Ben England, Vikentsi Lapa.
```

```
Run began: Tue Jun 18 10:03:49 2019
```

```
Include fsync in write timing
O_DIRECT feature enabled
Auto Mode
File size set to 102400 kB
```

```

Record Size 4 kB
Record Size 16384 kB
Command line used: iotzone -e -I -a -s 100M -r 4k -r 16384k -i -i 1 -i 2
Output is in kBytes/sec
Time Resolution = 0.000001 seconds.
Processor cache size set to 1024 kBytes.
Processor cache line size set to 32 bytes.
File stride size set to 17 * record size.

random
random      bkwd      record      stride
              kB  reclen  write  rewrite  read  reread  read
write      read  rewrite  read  fwrite frewrite  fread  freread
102400      4      9241   14364  27027  29648  15326
4404
102400  16384  208414  209245  521260  669540  731096
177565

iotzone test complete.

```

Amazing. Since the 6 hard drives linked each other, its performance is far better than from the results with the only 1 hard drive.

	One Disk	RAID 6 with 6 Disks
<b>4K R/Read</b>	979	27027
<b>4K R/Write</b>	1937	9241
<b>16M S/Read</b>	147202 (147 MB/s)	521260 (521 MB/s)
<b>16M S/Write</b>	132406 (132 MB/s)	208414 (208 MB/s)

RAID 6 uses double parity but 6 hard drives perform like a kind of multiprocessing in CPU literally. So the overall speed can be hugely increased. If with RAID level 5, the performance would be a little bit better than this since RAID 5 uses single parity.

Therefore, there's no reason to do not use RAID 6 when you have more than 4 hard drives.

Especially, this also clear that H2 is powerful host hardware for NAS use.

With its reasonable price, without something being lazy tasks such as buying a Mini-ITX case and DIY-ing it, H2 with software RAID configuration is worth. Furthermore, H2 has two numbers of Gigabits LAN ports.

## References

- <https://forum.odroid.com/viewtopic.php?f=172&t=35309>
- <https://www.tecmint.com/create-raid-6-in-linux/>
- <https://askubuntu.com/questions/350266/how-can-i-create-a-raid-array-with-2tb-disks>

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2019/08/01 08:19 odroid-h2:application\_note:6\_bay\_nas\_with\_sw RAID [http://wiki.odroid.com/odroid-h2/application\\_note/6\\_bay\\_nas\\_with\\_sw RAID](http://wiki.odroid.com/odroid-h2/application_note/6_bay_nas_with_sw RAID)

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