Software Setup

1. Enable PCIe interface:

PCIE interface is not enabled on the Raspberry Pi 5 by default, you can add the following content to enable it at /boot/firmware/config.txt:
dtparam=pciex1

2. PCIE gen2 is the default setting, if you want to enable PCIE gen3, you need to add the following content at /boot/firmware/config.txt:

```
dtparam=pciex1_gen=3
```

3. Reboot the Pi5 after modication, and the device can be recognized.

In the picture below, the SM2263 is recognized as my SSD solid state, and the other PI5 one is the RPI chip.

```
pi@raspberrypi:~ $ lspci
0000:00:00.0 PCI bridge: Broadcom Inc. and subsidiaries Device 2712 (rev 21)
0000:01:00.0 Non-Volatile memory controller: Silicon Motion, Inc. SM2263EN/SM2263XT SSD Controller (rev 03)
0001:00:00.0 PCI bridge: Broadcom Inc. and subsidiaries Device 2712 (rev 21)
0001:01:00.0 Ethernet controller: Device 1de4:0001
```

4. Partitioning: If partitioning and formatting have already been performed on another platform, skip this step. Note: Partitioning and formatting will erase all data on the SSD, so please carefully perform this step.

```
lsblk  #see the disk (execute "sudo fdisk -l" for more details)
```

```
pi@raspberrypi:~ $ lsblk
NAME        MAJ:MIN RM   SIZE RO TYPE MOUNTPOINTS
mmcblk0     179:0    0  29.7G  0 disk
├─mmcblk0p1 179:1    0   512M  0 part /boot/firmware
└─mmcblk0p2 179:2    0  29.2G  0 part /
nvme0n1     259:0    0 119.2G  0 disk
└─nvme0n1p1 259:1    0 119.2G  0 part
```

Partition

sudo fdisk /dev/nvme0n1 #dev is the total device number, do not add "p1", it is just one partition

How do use fdisk

n New partition

q Exit without saving

p Print partition table

m Print selection menu

d Delete partition

w Save and exit

t Modify ID

Add the partition and execute "n", and then press "w" to save and exit.

5. Format:

sudo mkfs. #Then, pressing Tab will display various file extensions. Each extension corresponds to a format you may want to format the drive into

```
pi@raspberrypi:~ $ sudo mkfs.
mkfs.bfs     mkfs.cramfs  mkfs.exfat   mkfs.ext2    mkfs.ext3    mkfs.ext4    mkfs.fat     mkfs.minix   mkfs.msdos   mkfs.ntfs    mkfs.vfat
```

If I need to format it in "ext4" format, execute:

sudo mkfs.ext4 /dev/nvme0n1p1

Wait for a moment, when "done" appears for all, it means the formatting is complete.

```
pi@raspberrypi:~ $ sudo mkfs.ext4 /dev/nvme0n1p1
mke2fs 1.47.0 (5-Feb-2023)
Discarding device blocks: done
Creating filesystem with 31258368 4k blocks and 7815168 inodes
Filesystem UUID: 1a84fb29-5460-475f-afb7-0a90271ef975
Superblock backups stored on blocks:
        32768, 98304, 163840, 229376, 294912, 819200, 884736, 1605632, 2654208,
        4096000, 7962624, 11239424, 20480000, 23887872

Allocating group tables: done
Writing inode tables: done
Creating journal (131072 blocks): done
Writing superblocks and filesystem accounting information: done
```

6. Mount:

Create the mounting directory:

sudo mkdir toshiba

Mount the device

sudo mount /dev/nvme0n1p1 ./toshiba

Check disk status

df -h

Read/Write Test

Enter the directory to mount the disk:

```
cd toshiba
```

- Release the caches:

```
sudo sh -c "sync && echo 3 > /proc/sys/vm/drop_caches"
```

- Copy the Raspberry Pi memory to the hard flash driver (write).

```
sudo dd if=/dev/zero of=./test_write count=2000 bs=1024k
```

```
pi@raspberrypi:~/toshiba $ sudo dd if=/dev/zero of=./test_write count=2000 bs=1024k
2000+0 records in
2000+0 records out
2097152000 bytes (2.1 GB, 2.0 GiB) copied, 3.78947 s, 553 MB/s
```

- Copy the contents of the hard drive to the Raspberry Pi's memory (read).

```
sudo dd if=./test_write of=/dev/null count=2000 bs=1024k
```

```
pi@raspberrypi:~/toshiba $ dd if=./test_write of=/dev/null count=2000 bs=1024k
2000+0 records in
2000+0 records out
2097152000 bytes (2.1 GB, 2.0 GiB) copied, 3.53634 s, 593 MB/s
```

- Note: Different cards and environments may produce different effects on the Raspberry Pi's performance, so for accurate performance testing, it's recommended to use a PC.

Auto Mount

If there are no issues with the test and the disk is not needed as a system disk, only for expanding disk usage, set up automatic mounting.

```
sudo nano /etc/fstab


#Add the following content at the end:

/dev/nvme0n1p1  /home/pi/toshiba  ext4  defaults  0  0

#/dev/nvme0n1p1 device name, /home/pi/toshiba mount to the directory, ext4 is the file system type, defaults means using the default mounting options

#Reboot to take effect (Please make sure there are no issues before rebooting, otherwise it can not be booted without mounting)

sudo mount -a


#And then reboot

Check the device through lsblk
```

NVMe SSD Booting

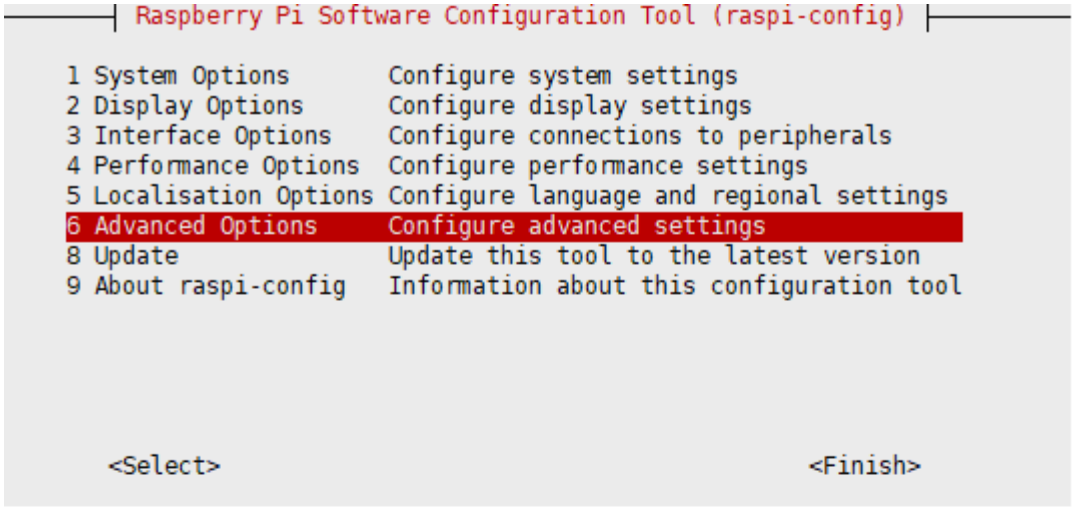
Start the Raspberry Pi using the SD card, mount, and test to ensure that the hardware is functioning properly.

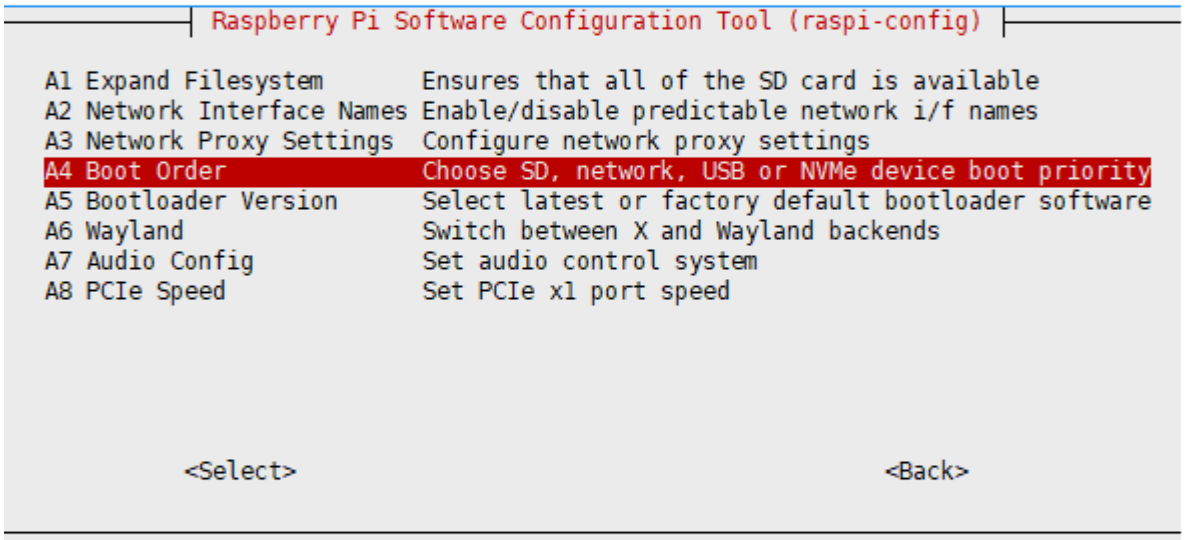
We provide two methods for you, you can select one to operate:

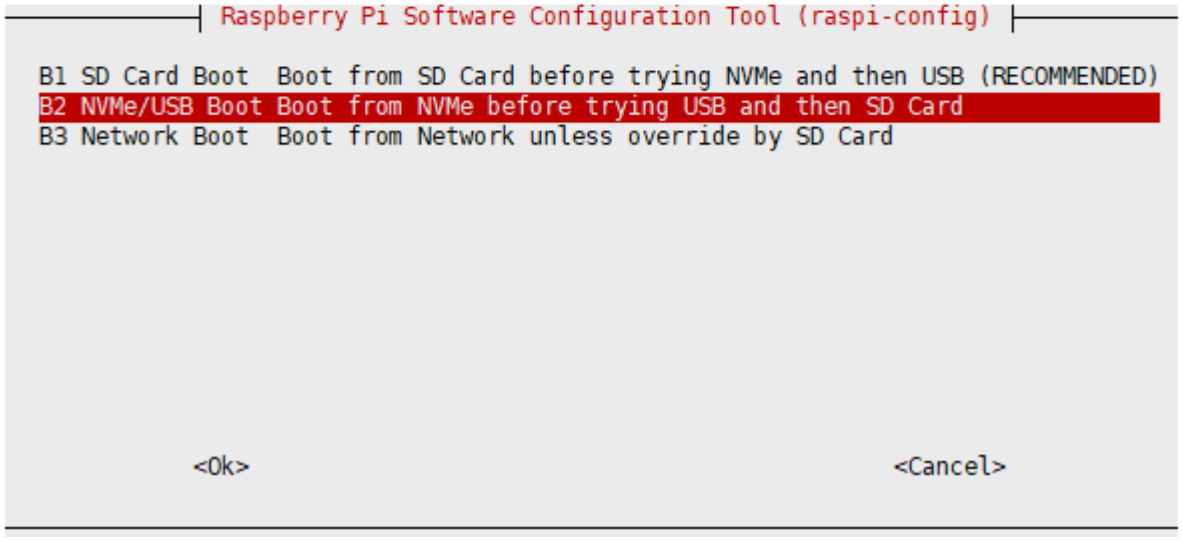
Method 1

1: Execute:

```
sudo raspi-config
```







2: Reboot the Raspberry Pi:

If you find that you can't modify the file several times, please connect to the network and modify it again (wait for the network time synchronization), or set the correct time before modifying the file.

3: Flash the system into NVME, then connect the NVME to the expansion board, remove the SD card and re-power on.

Method 2

1: Start the Raspberry Pi using the SD card and modify the BOOT_ORDER in the Raspberry Pi's bootloader configuration.

```
sudo rpi-eeprom-config --edit
```

Modify BOOT_ORDER=0xf41 as BOOT_ORDER=0xf416

Value	Mode	Description
0x0	SD CARD DETECT	Try SD then wait for card-detect to indicate that the card has changed - deprecated now that 0xf (RESTART) is available.
0x1	SD CARD	SD card (or eMMC on Compute Module 4).
0x2	NETWORK	Network boot - See Network boot server tutorial
0x3	RPIBOOT	RPIBOOT - See usbboot
0x4	USB-MSD	USB mass storage boot - See USB mass storage boot
0x5	BCM-USB-MSD	USB 2.0 boot from USB Type C socket (CM4: USB type A socket on CM4IO board). Not available on Raspberry Pi 5.
0x6	NVME	CM4 and Pi 5 only: boot from an NVMe SSD connected to the PCIe interface. See NVMe boot for more details.
0x7	HTTP	HTTP boot over ethernet. See HTTP boot for more details.
0xe	STOP	Stop and display error pattern. A power cycle is required to exit this state.
0xf	RESTART	Restart from the first boot-mode in the BOOT_ORDER field i.e. loop

For more details, please refer to BOOT_ORDER

2: Reboot the Raspberry Pi:

If you find that you can't modify the file several times, please connect to the network before modifying the file (wait for the network to time itself), or set the correct time before modifying the file.

3: Just program the system into NVME, then connect it to the expansion board, remove the SD card, and re-power it up.