

Cosmos+ OpenSSD Board Quick Start Guide

Revision 1.1

2021. 02. 26

CRZ Technology

<http://www.crz-tech.com/>

Document History

Revision	Date	Change note
1.0	2020.04.23	First draft
1.1	2021.02.26	Supported Toshiba Nand

Table of Contents

1.	Introduction.....	4
1.1.	Aboud this guide	4
1.2.	Before starting, check list.....	4
1.2.1	Gears	4
2.	HW Setup	5
2.1.	Cosmos+ OpenSSD Environment.....	5
2.2.	Hardware Componets	6
2.3.	Steps to connect HW components	7
3.	SW Setup	12
3.1.	Vivado Installation	12
3.2.	Launch Vivado	14
4.	Operating Cosmos+ OpenSSD (Linux)	19
4.1.	Check device recognition.....	19
4.2.	Create a partition.....	21
4.3.	Check the created partition.....	21
4.4.	Format the partition	22
4.5.	Create a mount point.....	22
4.6.	Mount the partition	23
4.7.	Check the mounted partition.....	23

1. Introduction

1.1. About this guide

This document provides an introduction to using the Cosmos+ OpenSSD platform board.

This guide describes the steps to test the Cosmos+ OpenSSD platform board and check list.

It contains the following chapters:

- Chapter 1, provides general overview.
- Chapter 2, describes HW setup.
- Chapter 3, describes SW setup.
- Chapter 4, provides the steps to test the Cosmos+ OpenSSD platform board

1.2. Before starting, check list

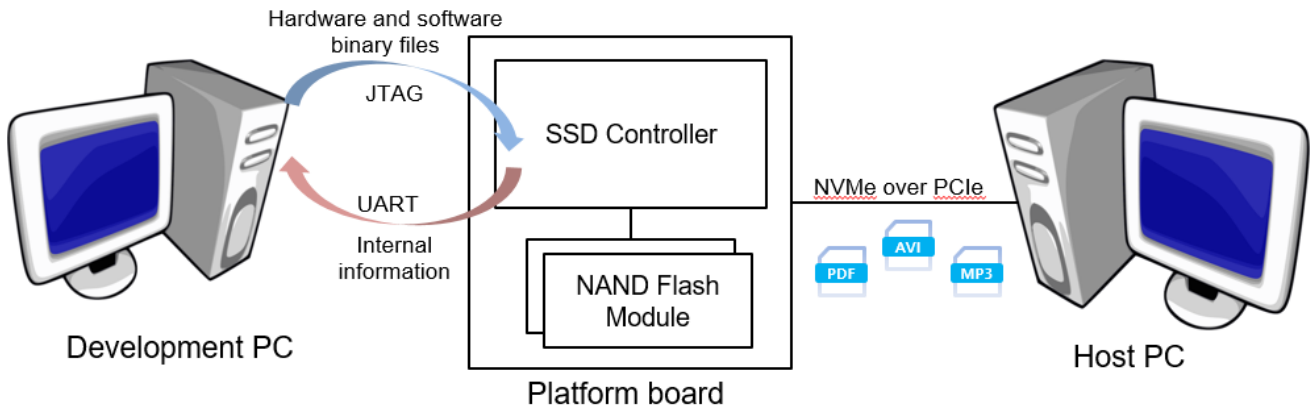
1.2.1 Gears

- Cosmos+ OpenSSD platform board
- External PCIe Adaptor
- External PCIe cable
- USB type A to USB type micro B cable (for JTAG diligent module)
- USB type A to USB type A cable (for UART)
- 1+ NAND flash modules
- 12V DC power adaptor

2. HW Setup

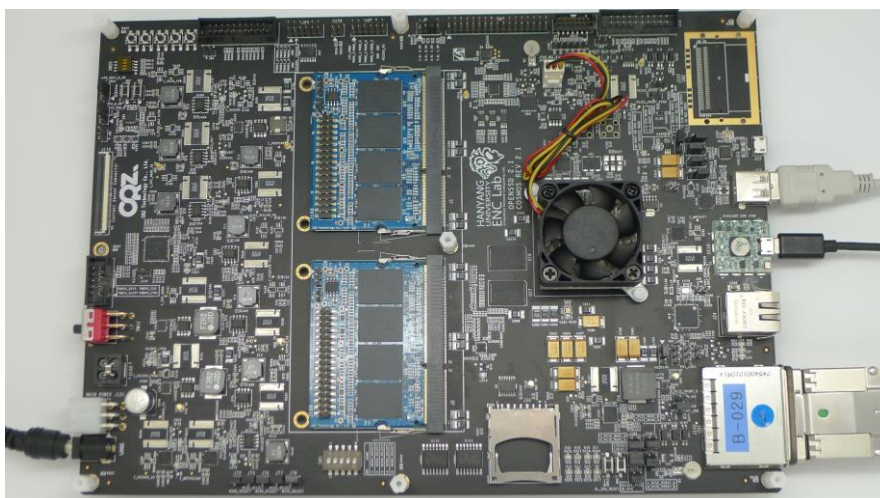
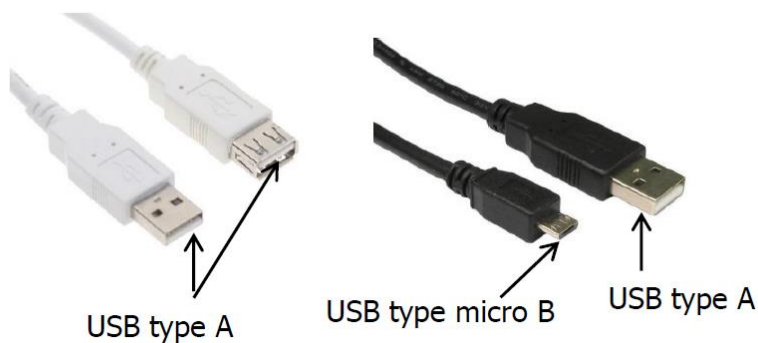
2.1. Cosmos+ OpenSSD Environment

- **1 Development PC**
 - Downloading hardware/software design (JTAG)
 - Monitoring Cosmos+ OpenSSD internals (UART)
- **1 Host PC**
 - Executing applications such as a benchmark (PCIe)
- **1 Platform board with 1+ NAND flash modules installed**
 - Working as a storage device to the host PC



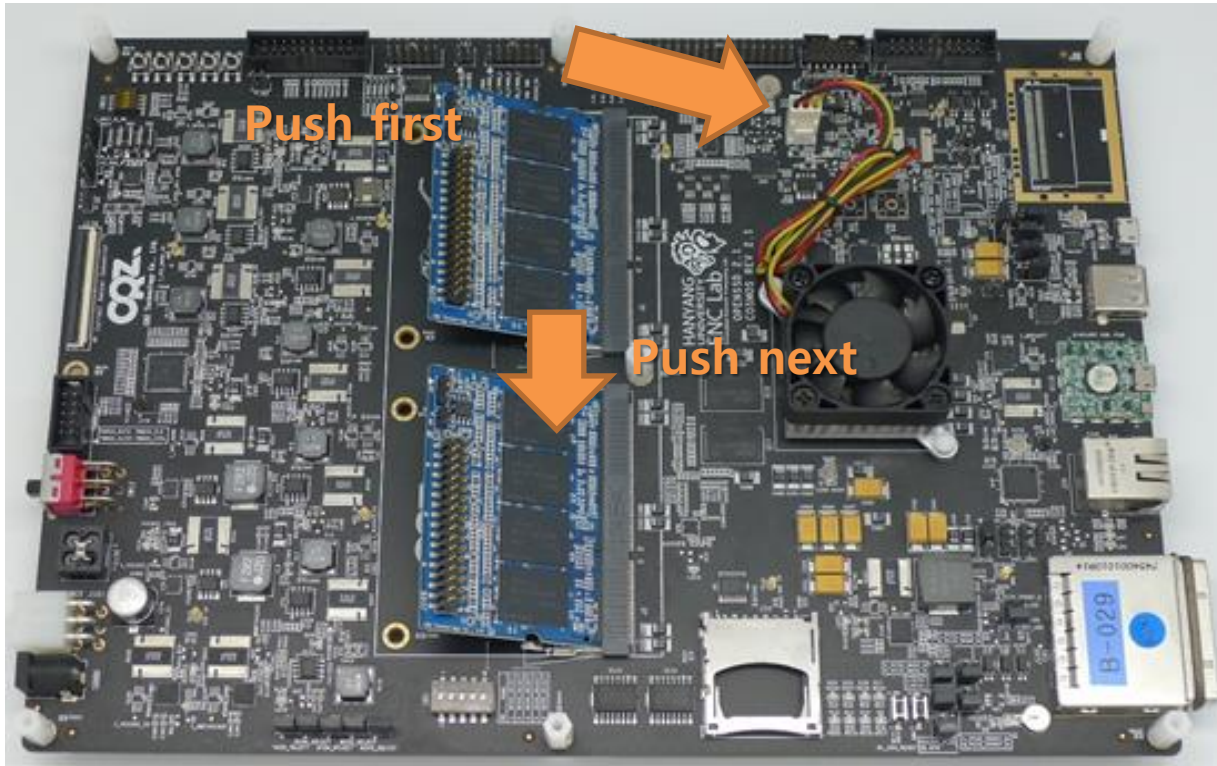
2.2. Hardware Componets

- **Cosmos+ OpenSSD platform board**
 - Consists of a Zynq FPGA and other peripherals
- **NAND flash modules**
 - Configured as multi-channel and multi-way flash array
 - Inserted into Cosmos+ OpenSSD platform board
- **External PCIe adapter and cable**
 - Connected with host PC
- **USB cables for JTAG and UART**
 - Connected with development PC
- **Power cable and adapter**
 - 12V supply voltage



2.3. Steps to connect HW components

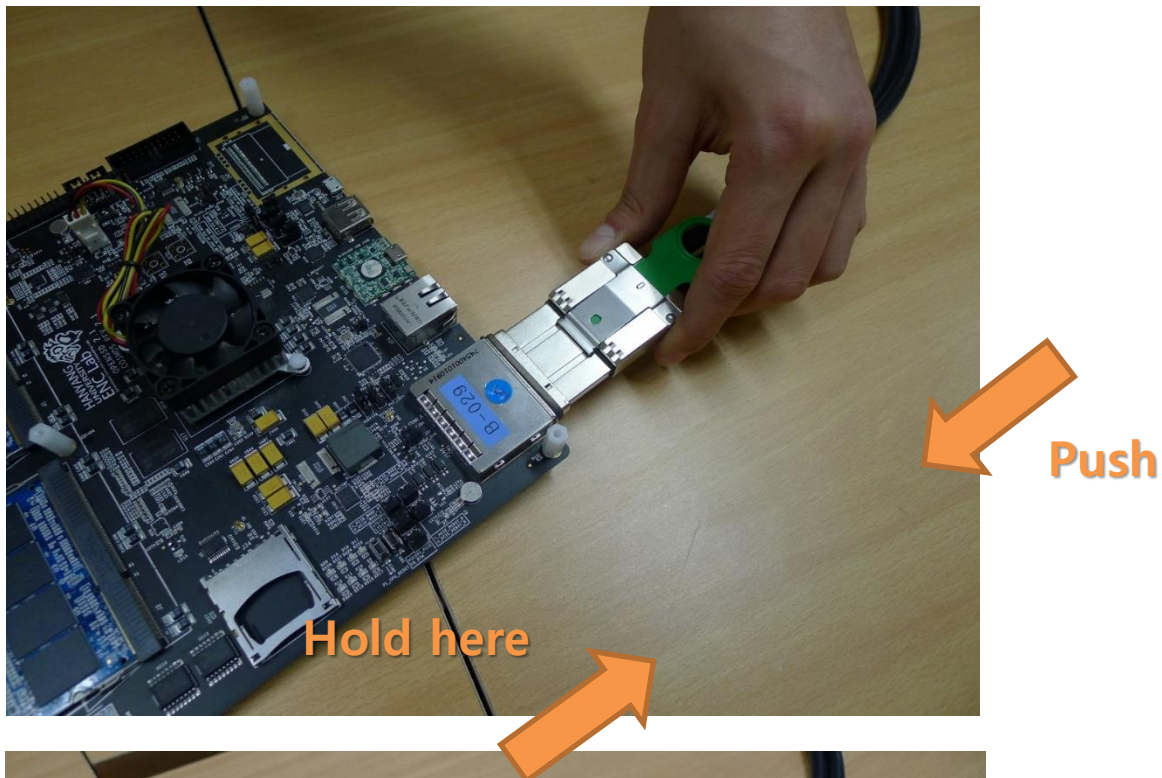
- Turn off Host PC
- Insert NAND Flash Modules



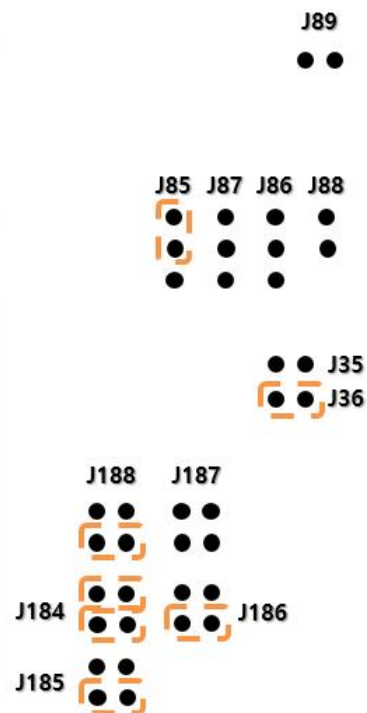
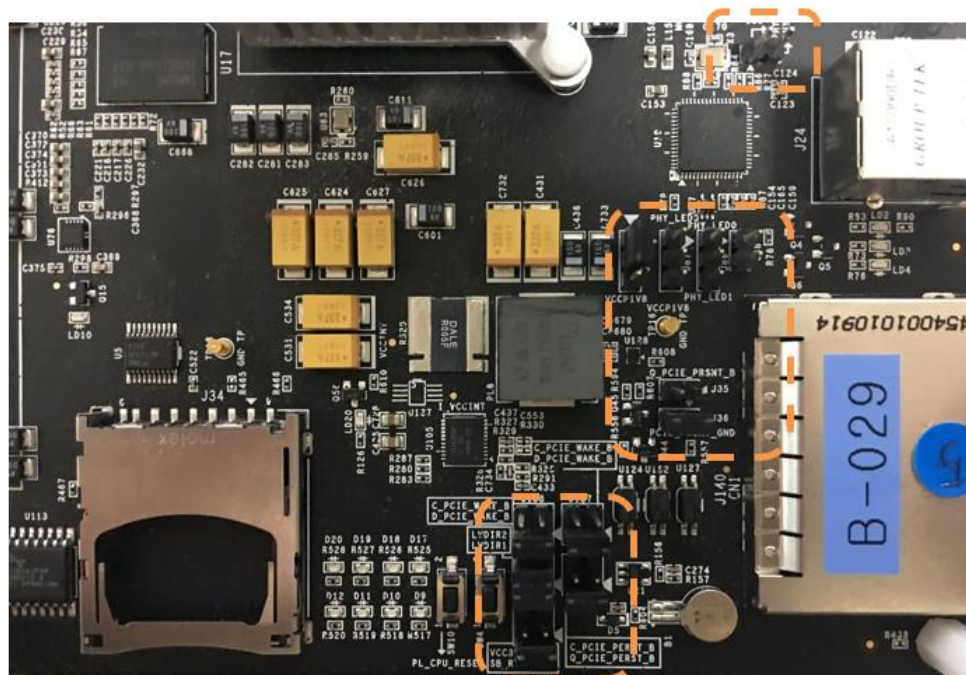
- Connect PCIe Adaptor to Host PC

Cosmos+ OpenSSD Board Quick Start Guide

- Connect PCIe Cable between Cosmos+ OpenSSD platform board and PCIe Adaptor

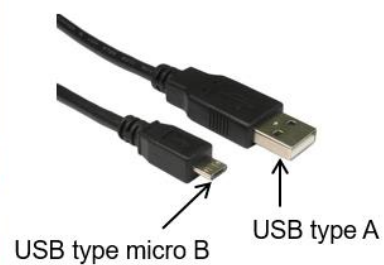
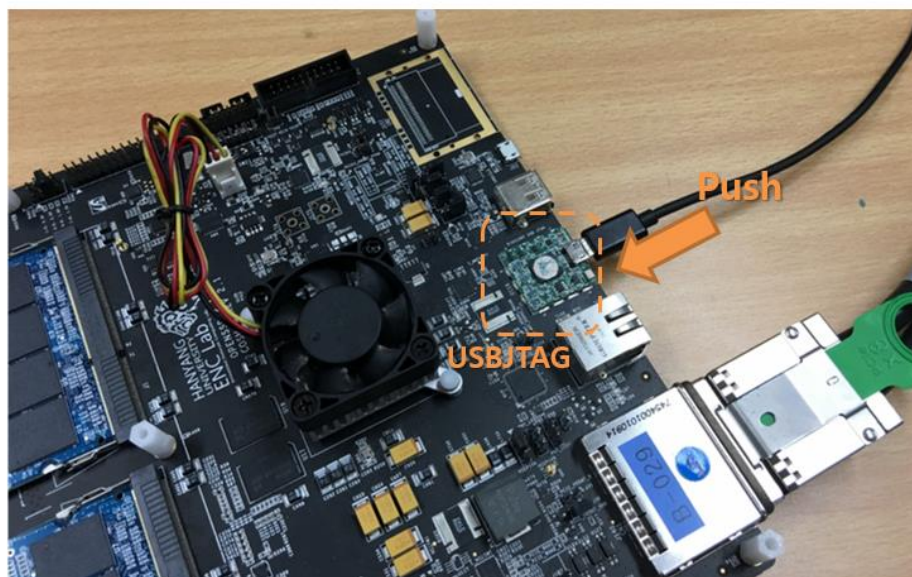


- Make sure that jumper pins on board are set as default below

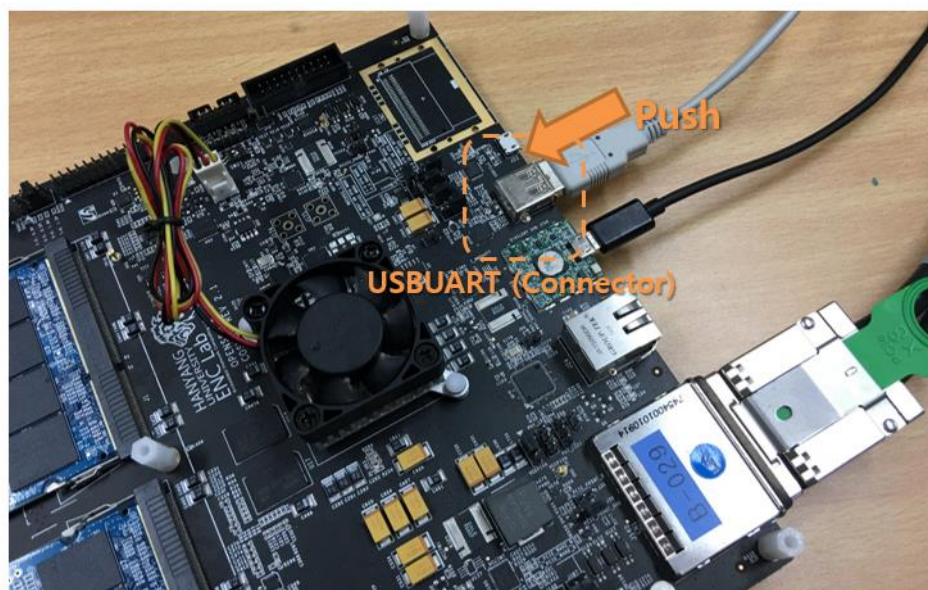


Cosmos+ OpenSSD Board Quick Start Guide

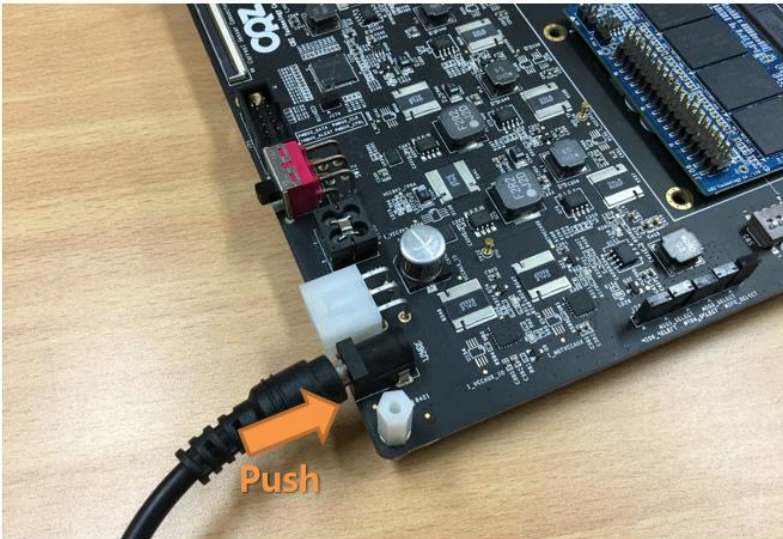
- Connect USB type A to USB type micro B cable to development PC



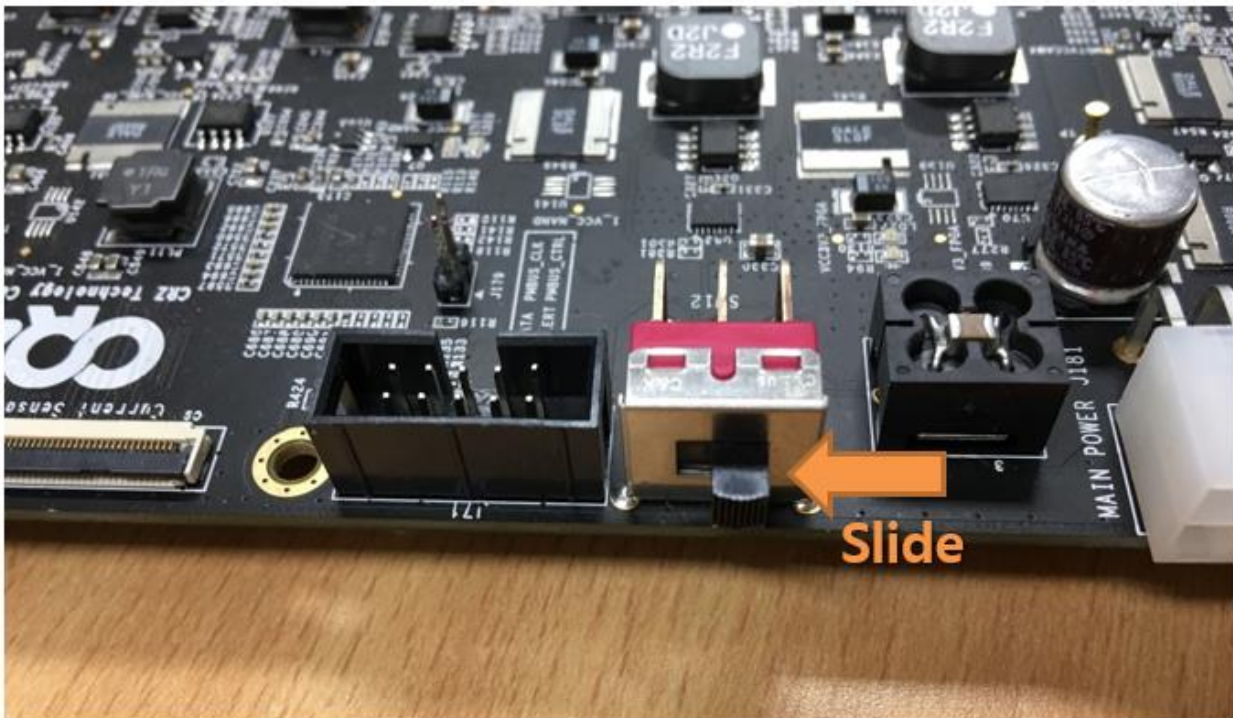
- Connect USB type A to USB type A cable to development PC



- Connect 12V DC power adaptor to Cosmos+ OpenSSD platform board(J182)



- Turn on the power of Cosmos+ OpenSSD platform board(SW12)



3. SW Setup

3.1. Vivado Installation

Install Vivado 2019.1 through below link.

<https://www.xilinx.com/support/download/index.html/content/xilinx/en/downloadNav/vivado-design-tools/2019-1.html>


Vivado Design Suite - HLx Editions - 2019.1 Full Product Installation

Important


We **strongly recommend** to use the web installers as it reduces download time and saves significant disk space.

Please see **Installer Information** for details.


Note: Download verification is only supported with Google Chrome and Microsoft Internet Explorer web browsers.

 Vivado HLx 2019.1: WebPACK and Editions - Windows Self Extracting Web Installer (EXE - 64.62 MB)

MD5 SUM Value : 743003070fb77857ad098bd6873bdf0b

 Vivado HLx 2019.1: WebPACK and Editions - Linux Self Extracting Web Installer (BIN - 115.05 MB)

MD5 SUM Value : 533000dc5324be422915eb4e93f9ce59

Download Verification 

Digests

Signature

Public Key

Download Includes

Download Type

Last Updated

Answers

Documentation

Support Forums

12

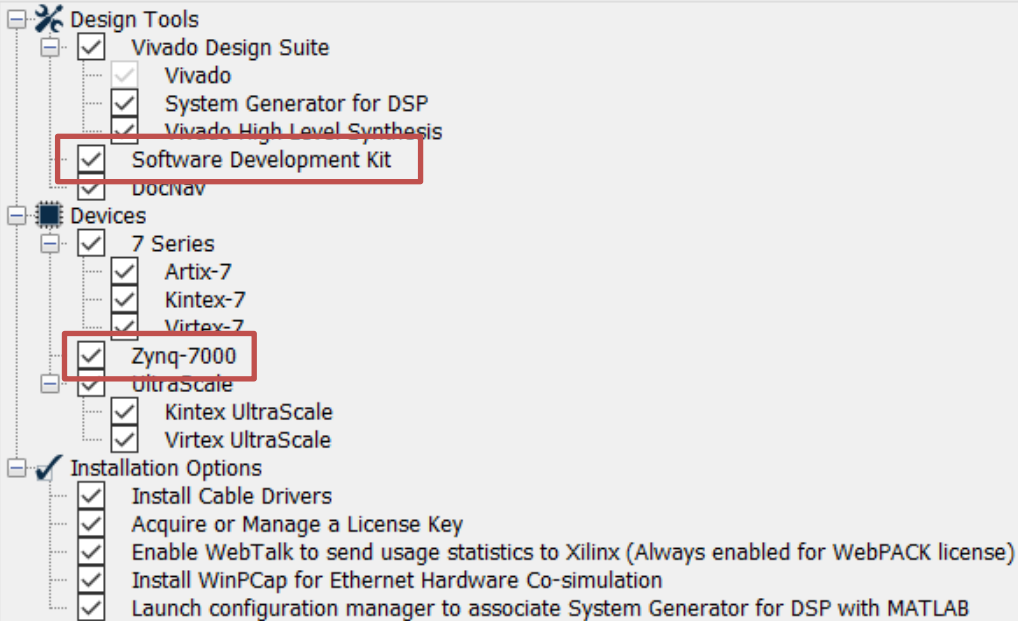
CRZ Technology

Make sure that Vivado is system edition and that "Software Development Kit" and "Zynq-7000" are checked

Vivado System Edition

Customize your installation by (de)selecting items in the tree below. Moving cursor over selections below provide additional information.

Vivado System Edition is a superset of Vivado Design Edition with the addition of Vivado High-Level Synthesis Generator for DSP. Users can optionally add Software Development Kit to this installation.



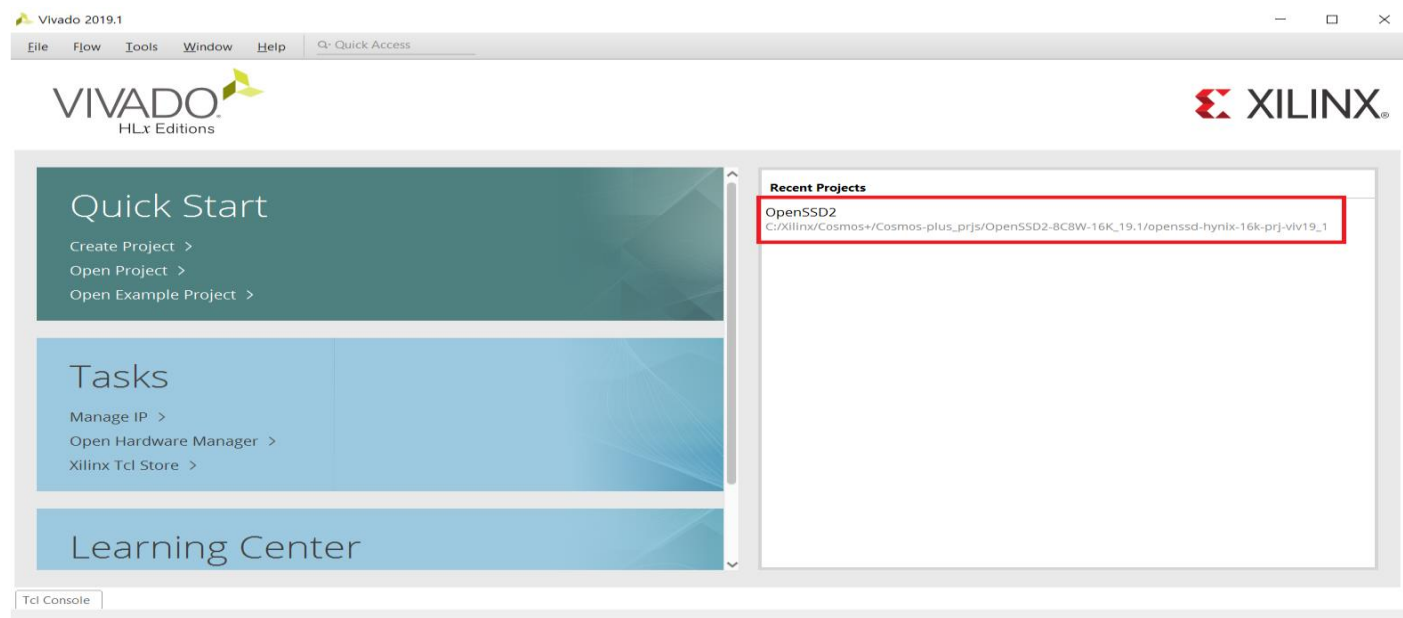
3.2. Launch Vivado

Open Cosmos+ OpenSSD Vivado project.(OpenSSD2-8C8W-16K_19.1)

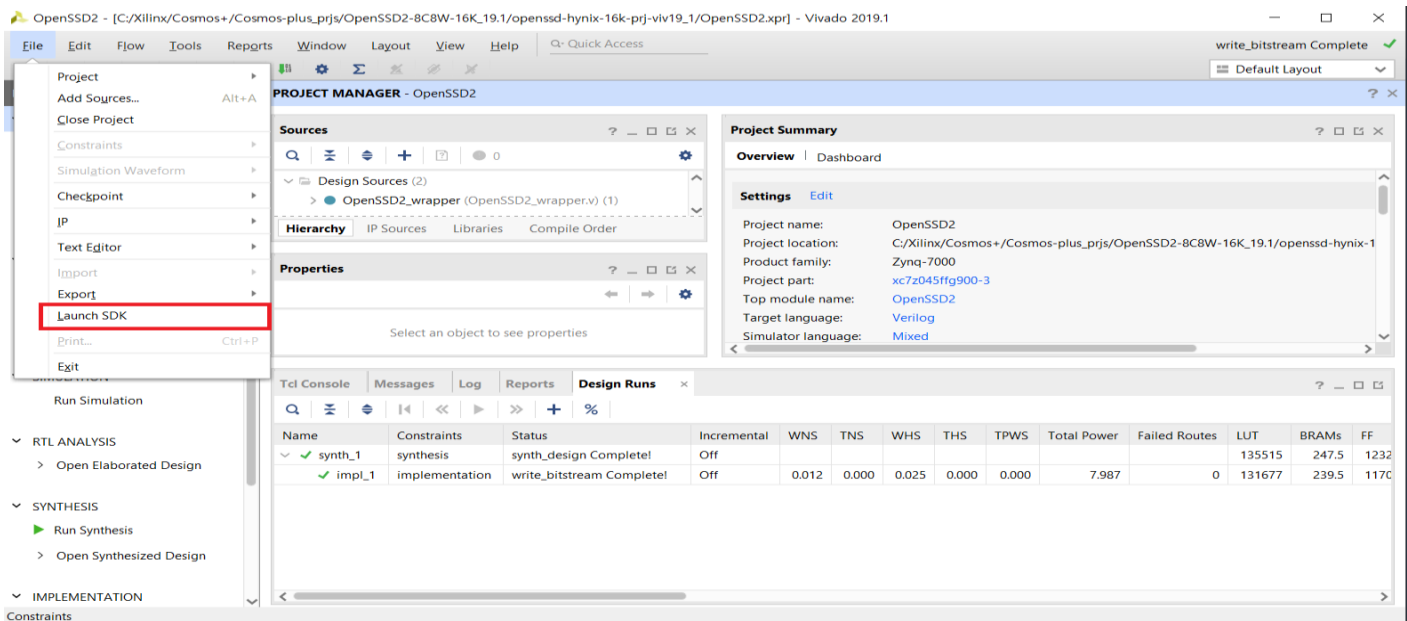
Recently new OpenSSD project design has been developed for Toshiba NAND Flash Module.

In case of Toshiba NAND Flash Module, download Vivado project from below link.

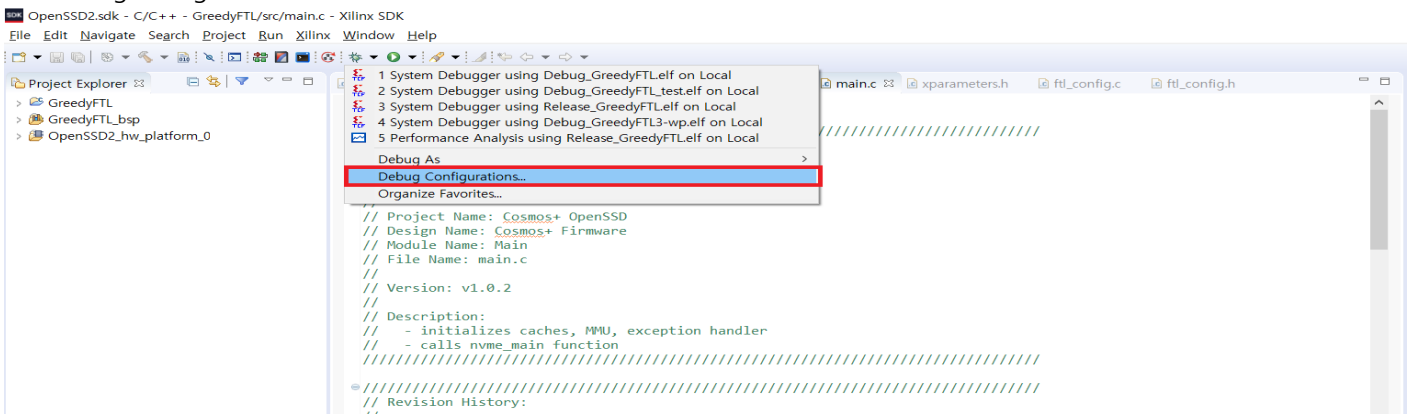
cosm-plus-pecc-167MT_20210210.7z



Launch SDK.

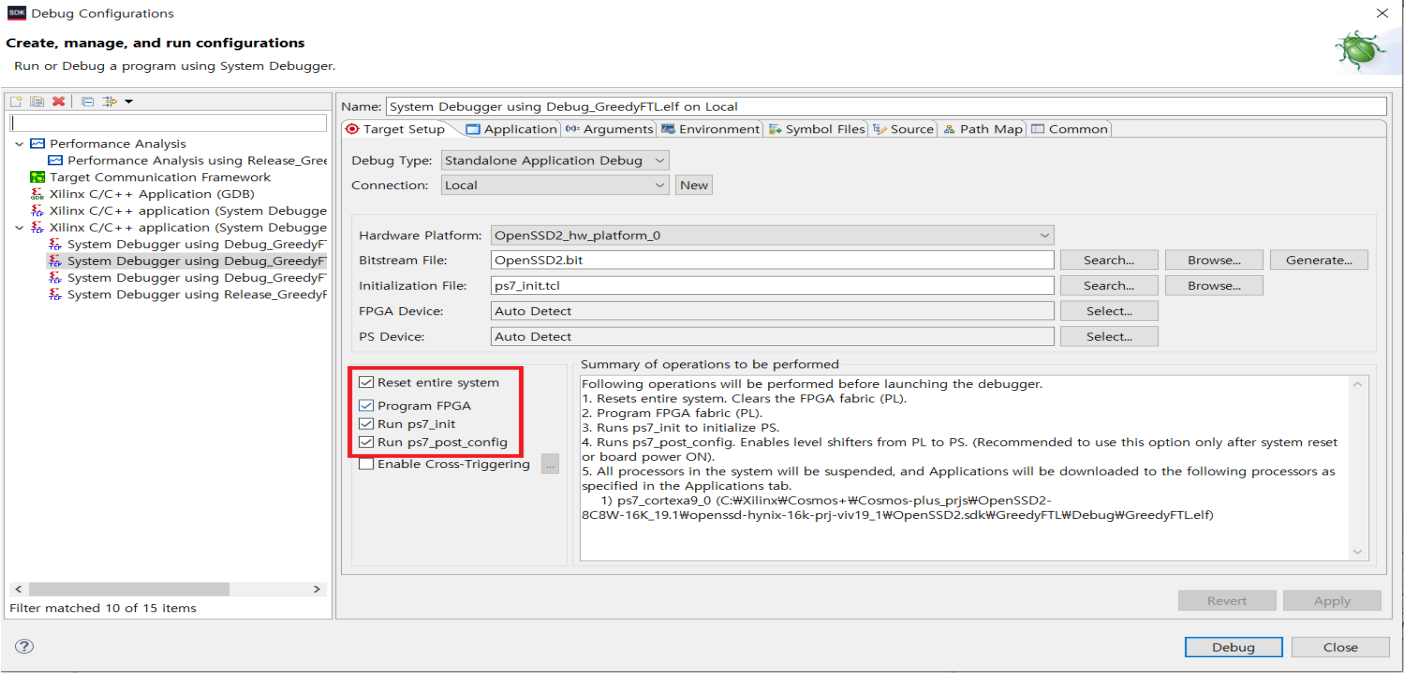


Run Debug Configuration on SDK.

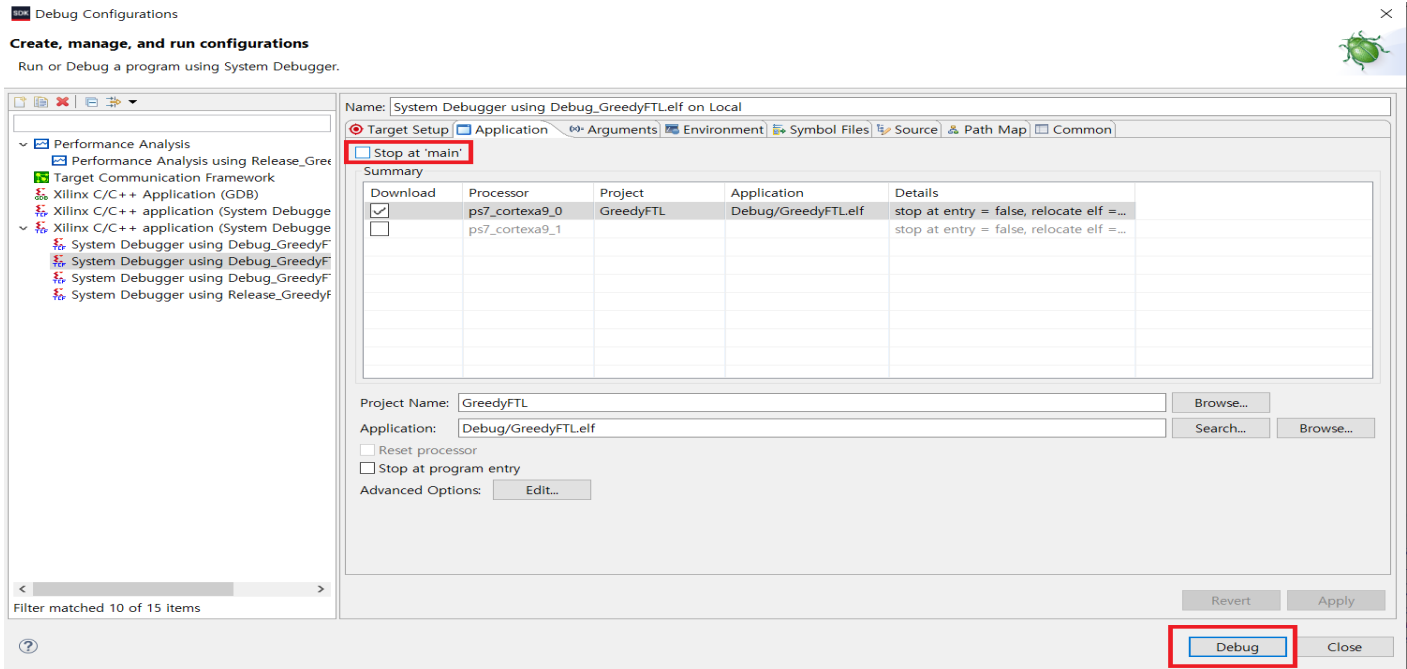


Select "Program FPGA".

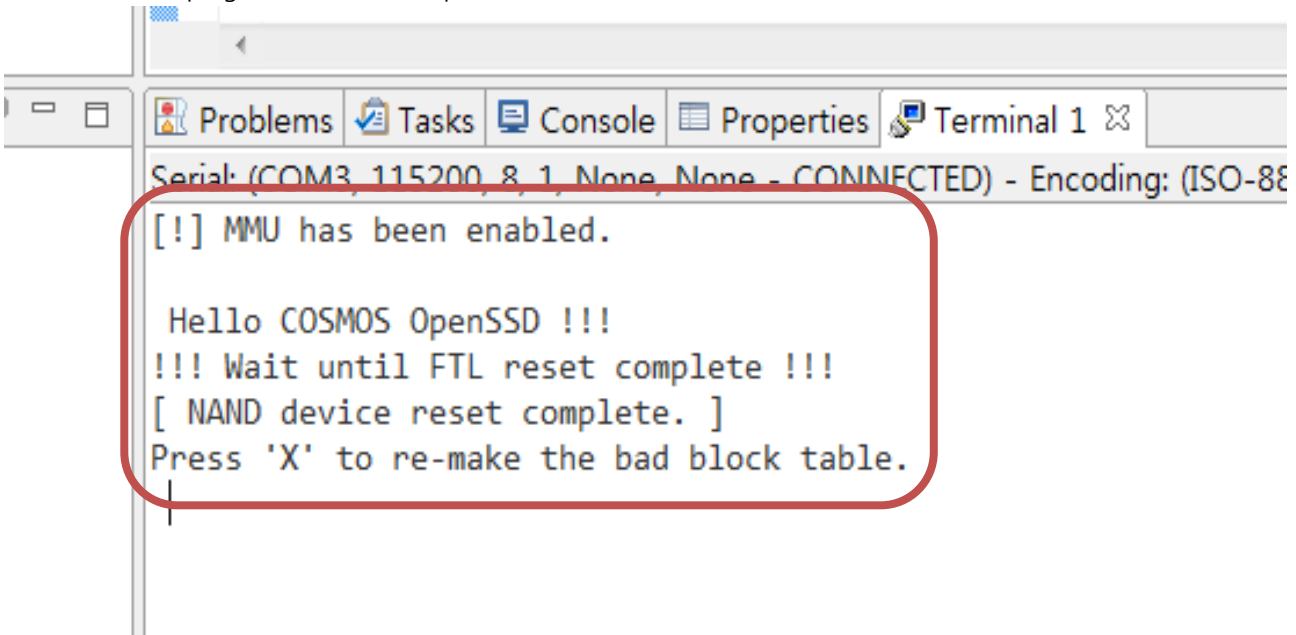
Cosmos+ OpenSSD Board Quick Start Guide



Uncheck "Stop at main" and Press "Debug".

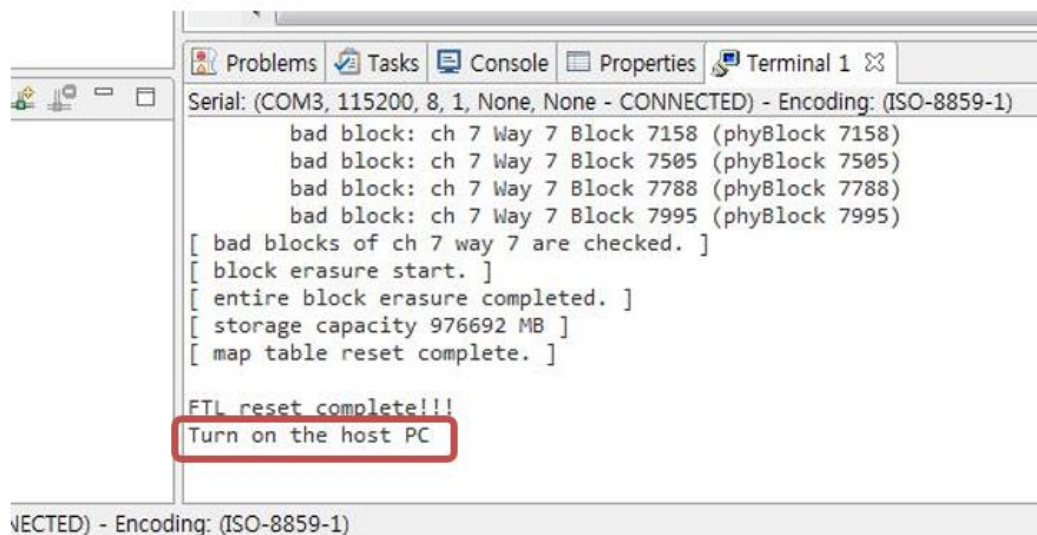


Launch terminal program on the Development PC.



Press 'n' to maintain the bad block table

Turn on the Host PC when the firmware reset is done.



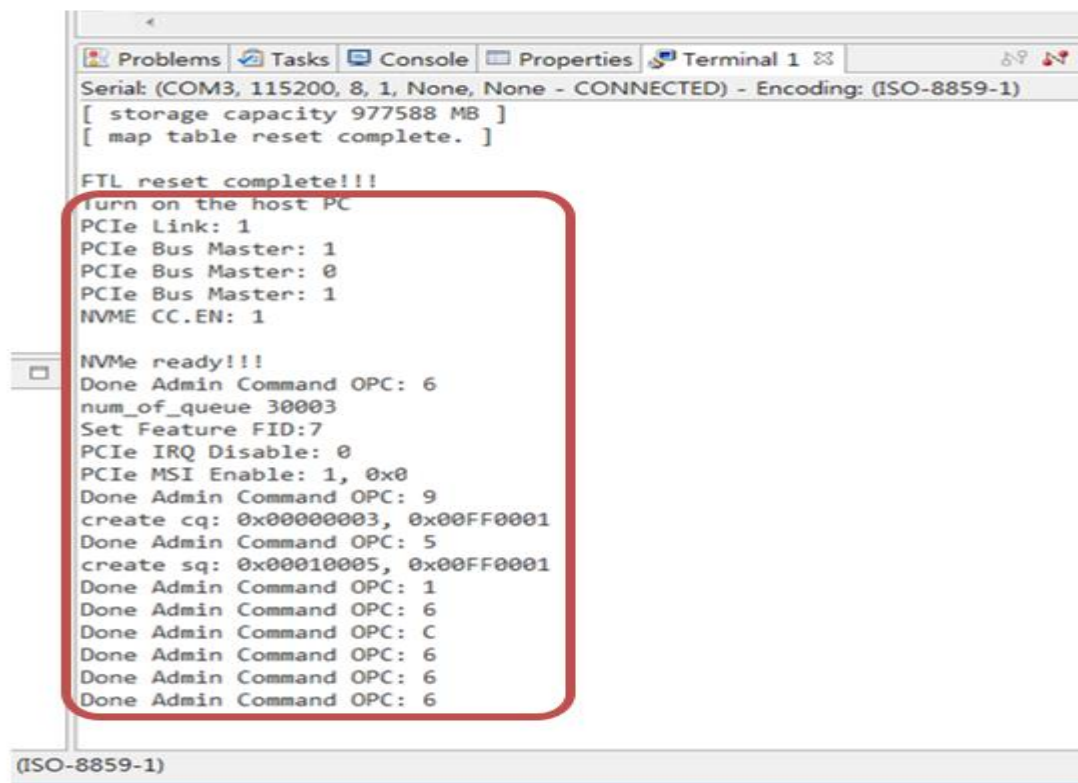
```

Serial: (COM3, 115200, 8, 1, None, None - CONNECTED) - Encoding: (ISO-8859-1)
    bad block: ch 7 Way 7 Block 7158 (phyBlock 7158)
    bad block: ch 7 Way 7 Block 7505 (phyBlock 7505)
    bad block: ch 7 Way 7 Block 7788 (phyBlock 7788)
    bad block: ch 7 Way 7 Block 7995 (phyBlock 7995)
[ bad blocks of ch 7 way 7 are checked. ]
[ block erasure start. ]
[ entire block erasure completed. ]
[ storage capacity 976692 MB ]
[ map table reset complete. ]

FTL reset complete!!!
Turn on the host PC

```

NVMe SSD initialization steps are on going



```

Serial: (COM3, 115200, 8, 1, None, None - CONNECTED) - Encoding: (ISO-8859-1)
[ storage capacity 977588 MB ]
[ map table reset complete. ]

FTL reset complete!!!
Turn on the host PC
PCIe Link: 1
PCIe Bus Master: 1
PCIe Bus Master: 0
PCIe Bus Master: 1
NVME CC.EN: 1

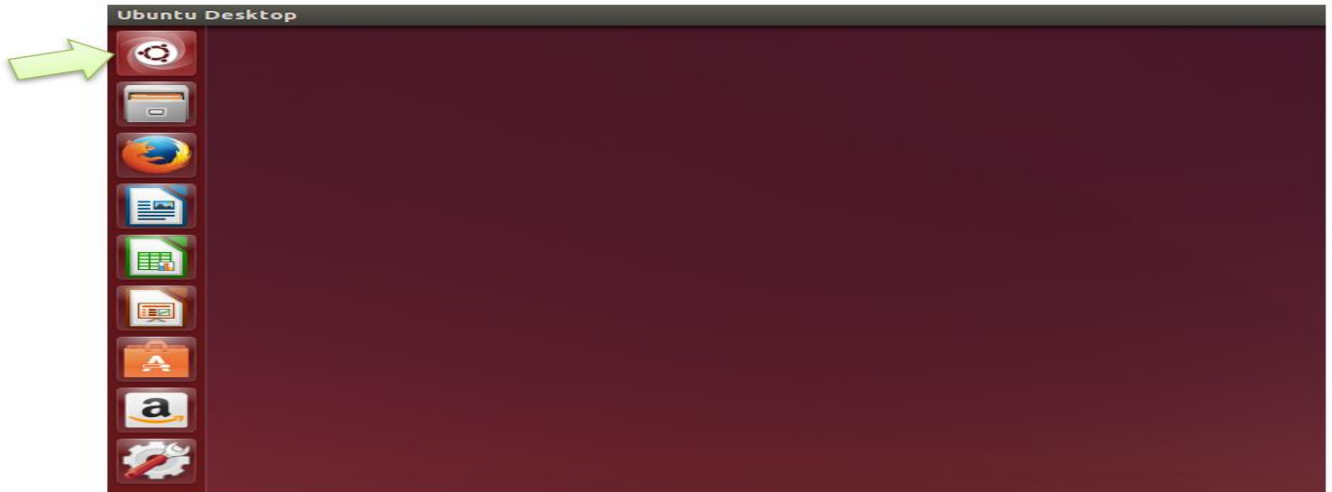
NVMe ready!!!
Done Admin Command OPC: 6
num_of_queue 30003
Set Feature FID:7
PCIe IRQ Disable: 0
PCIe MSI Enable: 1, 0x0
Done Admin Command OPC: 9
create cq: 0x00000003, 0x00FF0001
Done Admin Command OPC: 5
create sq: 0x00010005, 0x00FF0001
Done Admin Command OPC: 1
Done Admin Command OPC: 6
Done Admin Command OPC: C
Done Admin Command OPC: 6
Done Admin Command OPC: 6
Done Admin Command OPC: 6

```

4. Operating Cosmos+ OpenSSD (Linux)

4.1. Check device recognition

- Click the pointed icon



- Click the terminal icon



Cosmos+ OpenSSD Board Quick Start Guide

- Types "lspci" -> press ENTER -> check "Non-Volatile memory controller: Xilinx Corporation Device 7028" on the PCI device list

```
Terminal
enclab@enclab-desktop: ~$ lspci
00:00.0 Host bridge: Intel Corporation Xeon E3-1200 v2/3rd Gen Core processor DRAM Controller (rev 09)
00:01.0 PCI bridge: Intel Corporation Xeon E3-1200 v2/3rd Gen Core processor PCI Express Root Port (rev 09)
00:02.0 VGA compatible controller: Intel Corporation Xeon E3-1200 v2/3rd Gen Core processor Graphics Controller (rev 09)
00:14.0 USB controller: Intel Corporation 7 Series/C210 Series Chipset Family USB xHCI Host Controller (rev 04)
00:16.0 Communication controller: Intel Corporation 7 Series/C210 Series Chipset Family MEI Controller #1 (rev 04)
00:1a.0 USB controller: Intel Corporation 7 Series/C210 Series Chipset Family USB Enhanced Host Controller #2 (rev 04)
00:1b.0 Audio device: Intel Corporation 7 Series/C210 Series Chipset Family High Definition Audio Controller (rev 04)
00:1c.0 PCI bridge: Intel Corporation 7 Series/C210 Series Chipset Family PCI Express Root Port 1 (rev c4)
00:1c.4 PCI bridge: Intel Corporation 7 Series/C210 Series Chipset Family PCI Express Root Port 5 (rev c4)
00:1c.5 PCI bridge: Intel Corporation 7 Series/C210 Series Chipset Family PCI Express Root Port 6 (rev c4)
00:1c.6 PCI bridge: Intel Corporation 7 Series/C210 Series Chipset Family PCI Express Root Port 7 (rev c4)
00:1c.7 PCI bridge: Intel Corporation 7 Series/C210 Series Chipset Family PCI Express Root Port 8 (rev c4)
00:1d.0 USB controller: Intel Corporation 7 Series/C210 Series Chipset Family USB Enhanced Host Controller #1 (rev 04)
00:1f.0 ISA bridge: Intel Corporation Z77 Express Chipset LPC Controller (rev 04)
00:1f.2 SATA controller: Intel Corporation 7 Series/C210 Series Chipset Family 6-port SATA Controller [AHCI mode] (rev 04)
00:1f.3 SMBus: Intel Corporation 7 Series/C210 Series Chipset Family SMBus Controller (rev 04)
01:00.0 PCI bridge: PLX Technology, Inc. Device 8749 (rev ca)
01:00.1 System peripheral: PLX Technology, Inc. Device 87d0 (rev ca)
01:00.2 System peripheral: PLX Technology, Inc. Device 87d0 (rev ca)
01:00.3 System peripheral: PLX Technology, Inc. Device 87d0 (rev ca)
01:00.4 System peripheral: PLX Technology, Inc. Device 87d0 (rev ca)
02:08.0 PCI bridge: PLX Technology, Inc. Device 8749 (rev ca)
02:09.0 Non-Volatile memory controller: Xilinx Corporation Device 7028
04:00.0 SATA controller: ASMedia Technology Inc. ASM1062 Serial ATA Controller (rev 01)
06:00.0 Ethernet controller: Broadcom Corporation NetLink BCM57781 Gigabit Ethernet PCIe (rev 10)
08:00.0 USB controller: Etron Technology, Inc. EJ168 USB 3.0 Host Controller (rev 01)
09:00.0 PCI bridge: PLX Technology, Inc. PEX 8605 PCI Express 4-port Gen2 Switch (rev aa)
0a:01.0 PCI bridge: PLX Technology, Inc. PEX 8605 PCI Express 4-port Gen2 Switch (rev aa)
0a:02.0 PCI bridge: PLX Technology, Inc. PEX 8605 PCI Express 4-port Gen2 Switch (rev aa)
0a:03.0 PCI bridge: PLX Technology, Inc. PEX 8605 PCI Express 4-port Gen2 Switch (rev aa)
0d:00.0 PCI bridge: ASMedia Technology Inc. ASM1083/1085 PCIe to PCI Bridge (rev 03)
0e:02.0 FireWire (IEEE 1394): VIA Technologies, Inc. VT6306/7/8 [Fire II(M)] IEEE 1394 OHCI Controller (rev c0)
enclab@enclab-desktop:~$
```

- Types "ls /dev" -> press ENTER -> check "nvme0n250262528" on the device list

```
Terminal
enclab@enclab-desktop: ~$ ls /dev
autofs          fw2             loop0           port            ram9            tty11           tty3            tty4
block           hidraw0         loop1           ppp             random          tty12           tty30           tty4
bsg             hidraw1         loop2           psaux           rfskill         tty13           tty31           tty5
btrfs-control  hidraw2         loop3           pts             rtc             tty14           tty32           tty5
bus             hpet           loop4           ram0            sda             tty15           tty33           tty5
char            hwrng          loop5           ram1            sda1            tty16           tty34           tty5
console         i2c-0          loop6           ram10           sda2            tty17           tty35           tty5
cpu             i2c-1          loop7           ram11           sda5            tty18           tty36           tty5
cpu_dma_latency i2c-2          loop-control    ram12           sg0             tty19           tty37           tty5
cuse           i2c-3          mapper          ram13           shm             tty2            tty38           tty5
disk          i2c-4          mcelog          ram14           snapshot        tty20           tty39           tty5
dri           i2c-5          mei0            ram15           snd             tty21           tty4            tty5
ecryptfs      i2c-6          mem             ram2            stderr          tty22           tty40           tty5
fb0           i2c-7          memory_bandwidth ram3            stdin           tty23           tty41           tty6
fd            i2c-8          net             ram4            stdout          tty24           tty42           tty6
full          input          network_latency ram5            tty             tty25           tty43           tty6
fuse          kmsg           network_throughput ram6            tty0            tty26           tty44           tty6
fw0           kvm            null            ram7            tty1            tty27           tty45           tty6
fw1           lightnvm       nvme0           ram8            tty10           tty28           tty46           tty7
enclab@enclab-desktop:~$ nvme0n250262528
```


4.2. Create a partition

- Type "sudo fdisk /dev/nvme0nxxxx", press ENTER -> type your password, press ENTER -> type "n", press ENTER -> type "p", press ENTER -> type "1", press ENTER -> type "4096", press ENTER

```

Terminal
enclab@enclab-desktop: ~
enclab@enclab-desktop:~$ sudo fdisk /dev/nvme0n250262528
[sudo password for enclab:
Note: sector size is 4096 (not 512)
Device contains neither a valid DOS partition table, nor Sun, SGI or OSF
Building a new DOS disklabel with disk identifier 0xfdd4e220.
Changes will remain in memory only, until you decide to write them.
After that, of course, the previous content won't be recoverable.

Warning: invalid flag 0x0000 of partition table 4 will be corrected by w(rite)

Command (m for help): n
Partition type:
   p   primary (0 primary, 0 extended, 4 free)
   e   extended
Select (default p): p
Partition number (1-4, default 1): 1
First sector (256-250262527, default 256): 4096
  
```

4.3. Check the created partition

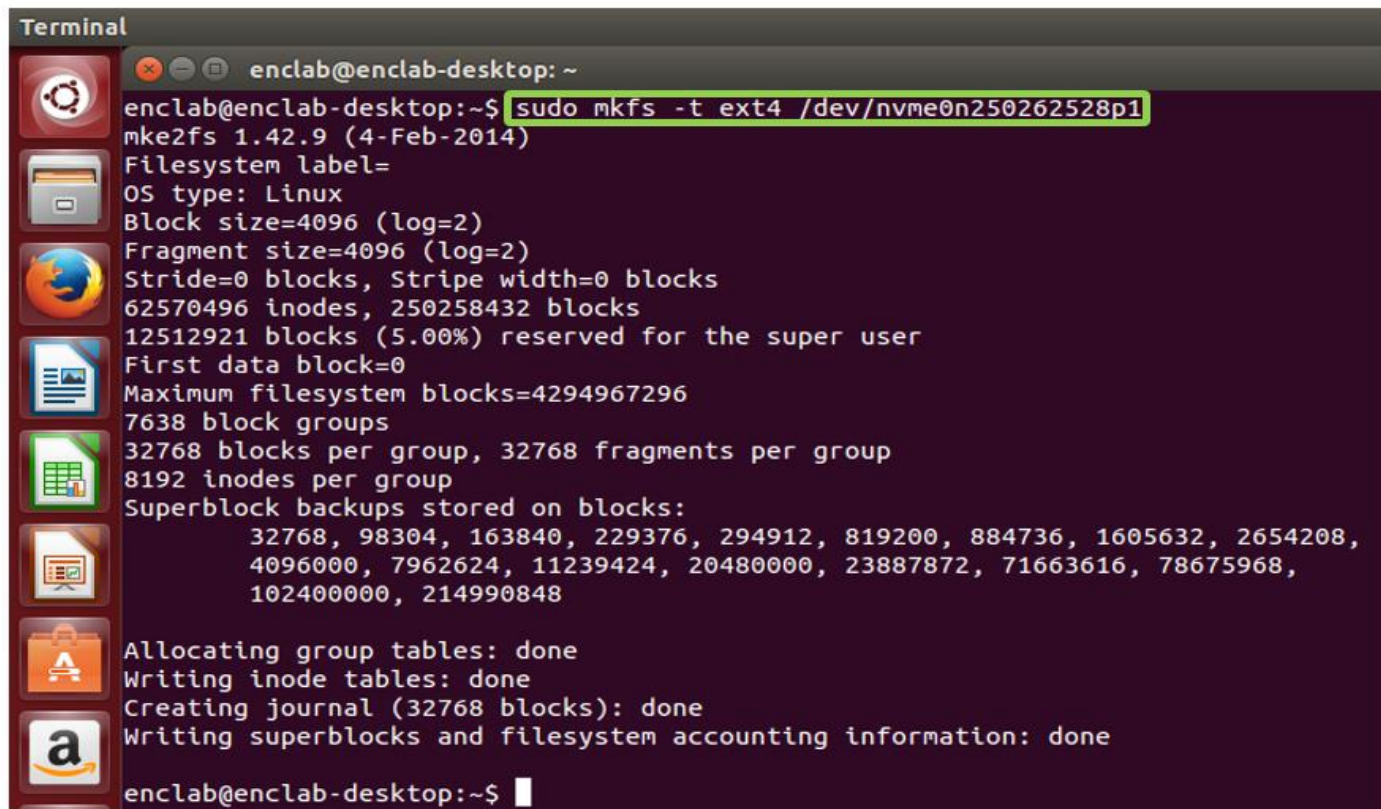
- Types "ls /dev" -> press ENTER -> check "nvme0nxxxxp1" on the device list

```

Terminal
enclab@enclab-desktop: ~
enclab@enclab-desktop:~$ ls /dev
autofs          hidraw1         loop4           ram0            sda2           tty2            tty4           tty6           ttyS20         usb
block           hidraw2         loop5           ram1            sda5           tty20          tty40          tty60          ttyS21         userio
bsg             hpet           loop6           ram10           sg0            tty21          tty41          tty61          ttyS22         vcs
btrfs-control   hwrng          loop7           ram11           shm            tty22          tty42          tty62          ttyS23         vcs1
bus             i2c-0          loop-control    ram12           snapshot       tty23          tty43          tty63          ttyS24         vcs2
char            i2c-1          mapper          ram13           snd            tty24          tty44          tty7           ttyS25         vcs3
console         i2c-2          mcelog          ram14           stderr          tty25          tty45          tty8           ttyS26         vcs4
core            i2c-3          mei0            ram15           stdin           tty26          tty46          tty9           ttyS27         vcs5
cpu             i2c-4          mem             ram2            stdout          tty27          tty47          ttyprintk      ttyS28         vcs6
cpu_dma_latency i2c-5          memory_bandwidth ram3            tty            tty28          tty48          ttyS0          ttyS29         vcsa
cuse            i2c-6          net             ram4            tty0            tty29          tty49          ttyS1          ttyS3          vcsa1
disk            i2c-7          network_latency ram5            tty1            tty3           tty5           ttyS10         ttyS30         vcsa2
dri             i2c-8          network_throughput ram6            tty10           tty30          tty50          ttyS11         ttyS31         vcsa3
ecryptfs        input          null            ram7            tty11           tty31          tty51          ttyS12         ttyS4          vcsa4
fb0             kmsg           nvme0           ram8            tty12           tty32          tty52          ttyS13         ttyS5          vcsa5
fd              kvm            nvme0n250262528 ram9            tty13           tty33          tty53          ttyS14         ttyS6          vcsa6
full            lightnvm       nvme0n250262528p1 random          tty14           tty34          tty54          ttyS15         ttyS7          vfio
fuse            log            port            rfc            tty15           tty35          tty55          ttyS16         ttyS8          vga_arbiter
fw0             loop0          ppp             rtc            tty16           tty36          tty56          ttyS17         ttyS9          vhci
fw1             loop1          psaux           rtc0           tty17           tty37          tty57          ttyS18         uhid           vhost-net
fw2             loop2          ptmx            sda            tty18           tty38          tty58          ttyS19         uinput        zero
hidraw0         loop3          pts            sda1           tty19           tty39          tty59          ttyS2          urandom
  
```

4.4. Format the partition

- Type "mkfs -t ext4 /dev/nvme0nxxxxxp1", press ENTER

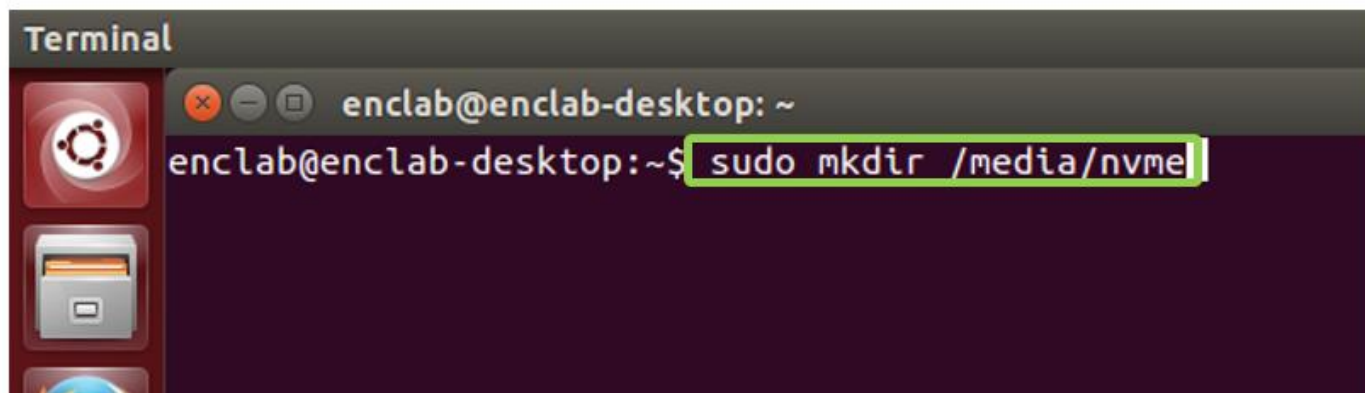


The screenshot shows a terminal window titled "Terminal" with the prompt "enclab@enclab-desktop: ~". The command "sudo mkfs -t ext4 /dev/nvme0n250262528p1" is entered and highlighted with a green box. The output of the command is displayed below, showing the version of mke2fs (1.42.9) and various filesystem parameters. The command "mkfs" is also highlighted with a green box. The output includes: "mkfs 1.42.9 (4-Feb-2014)", "Filesystem label=", "OS type: Linux", "Block size=4096 (log=2)", "Fragment size=4096 (log=2)", "Stride=0 blocks, Stripe width=0 blocks", "62570496 inodes, 250258432 blocks", "12512921 blocks (5.00%) reserved for the super user", "First data block=0", "Maximum filesystem blocks=4294967296", "7638 block groups", "32768 blocks per group, 32768 fragments per group", "8192 inodes per group", "Superblock backups stored on blocks:", followed by a list of block numbers: "32768, 98304, 163840, 229376, 294912, 819200, 884736, 1605632, 2654208, 4096000, 7962624, 11239424, 20480000, 23887872, 71663616, 78675968, 102400000, 214990848". The output continues with "Allocating group tables: done", "Writing inode tables: done", "Creating journal (32768 blocks): done", and "Writing superblocks and filesystem accounting information: done". The prompt "enclab@enclab-desktop:~\$" is shown at the bottom.

```
enclab@enclab-desktop: ~$ sudo mkfs -t ext4 /dev/nvme0n250262528p1
mkfs 1.42.9 (4-Feb-2014)
Filesystem label=
OS type: Linux
Block size=4096 (log=2)
Fragment size=4096 (log=2)
Stride=0 blocks, Stripe width=0 blocks
62570496 inodes, 250258432 blocks
12512921 blocks (5.00%) reserved for the super user
First data block=0
Maximum filesystem blocks=4294967296
7638 block groups
32768 blocks per group, 32768 fragments per group
8192 inodes per group
Superblock backups stored on blocks:
    32768, 98304, 163840, 229376, 294912, 819200, 884736, 1605632, 2654208,
    4096000, 7962624, 11239424, 20480000, 23887872, 71663616, 78675968,
    102400000, 214990848
Allocating group tables: done
Writing inode tables: done
Creating journal (32768 blocks): done
Writing superblocks and filesystem accounting information: done
enclab@enclab-desktop:~$
```

4.5. Create a mount point

- Type "sudo mkdir /media/nvme", press ENTER

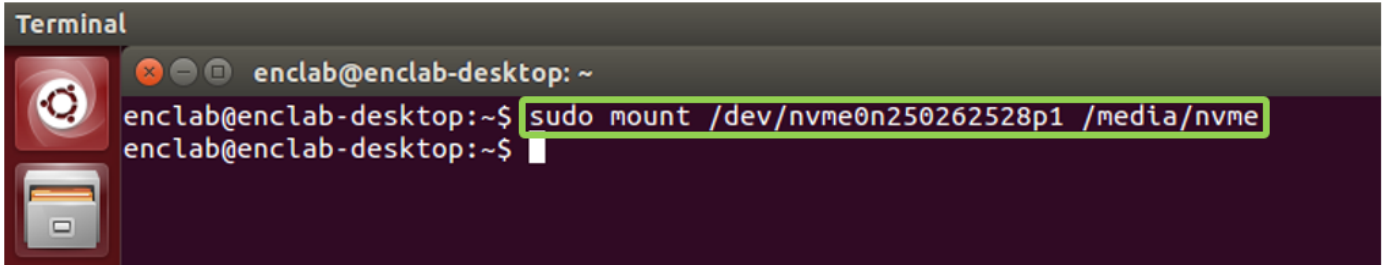


The screenshot shows a terminal window titled "Terminal" with the prompt "enclab@enclab-desktop: ~". The command "sudo mkdir /media/nvme" is entered and highlighted with a green box. The prompt "enclab@enclab-desktop:~\$" is shown at the bottom.

```
enclab@enclab-desktop: ~$ sudo mkdir /media/nvme
enclab@enclab-desktop:~$
```


4.6. Mount the partition

- Type "sudo mount /dev/nvme0nxxxxxp1 /media/nvme", press ENTER

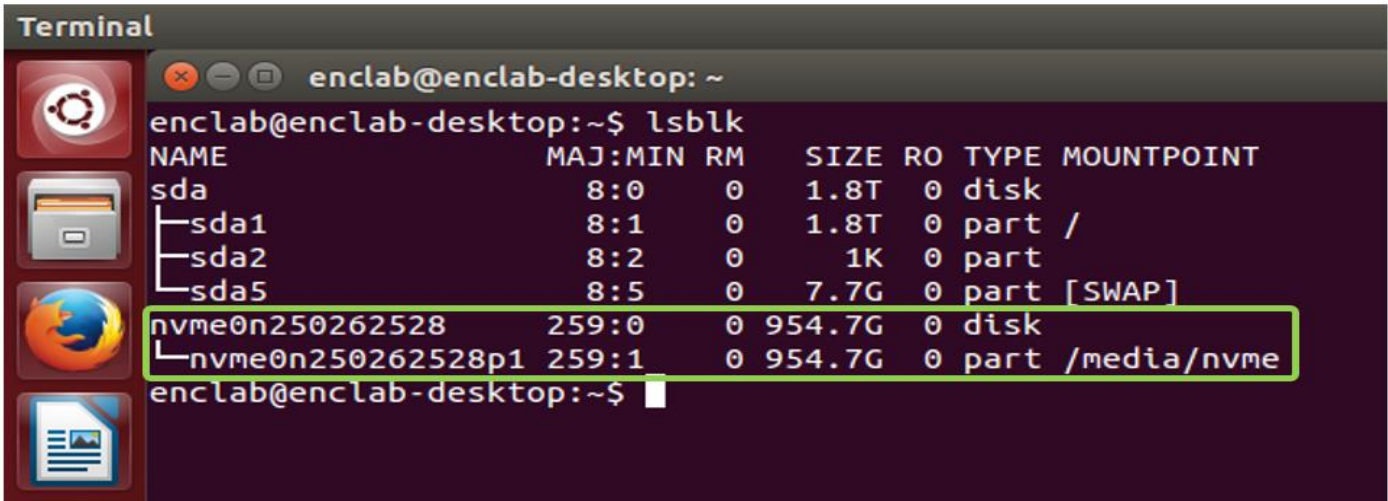


```

Terminal
enclab@enclab-desktop: ~
enclab@enclab-desktop:~$ sudo mount /dev/nvme0n250262528p1 /media/nvme
enclab@enclab-desktop:~$
  
```

4.7. Check the mounted partition

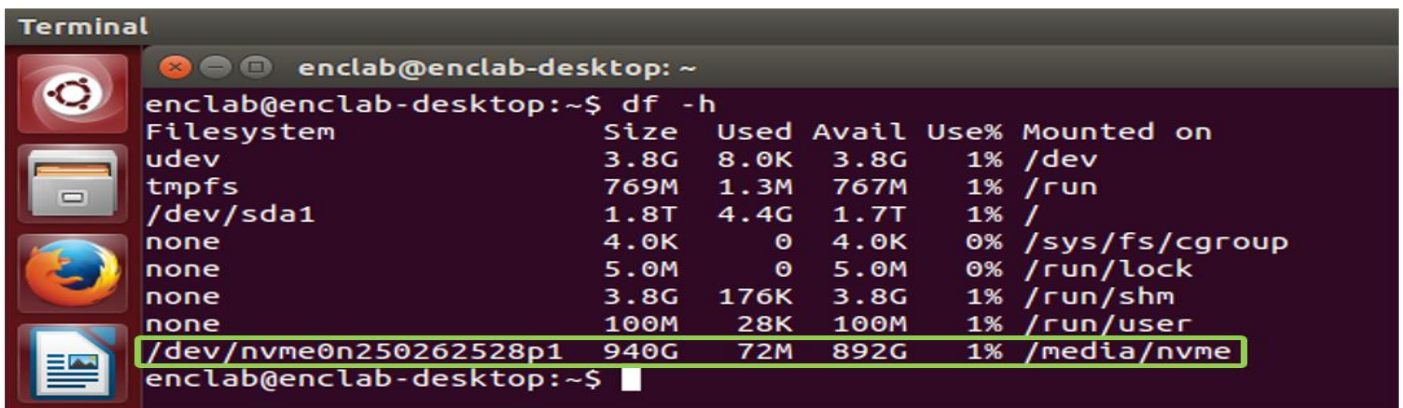
- Type "lsblk", press ENTER -> check the mounted partition on the block device list



```

Terminal
enclab@enclab-desktop: ~
enclab@enclab-desktop:~$ lsblk
NAME                                MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
sda                                  8:0    0   1.8T  0 disk
├─sda1                              8:1    0   1.8T  0 part /
├─sda2                              8:2    0     1K  0 part
└─sda5                              8:5    0   7.7G  0 part [SWAP]
nvme0n250262528                    259:0    0 954.7G  0 disk
└─nvme0n250262528p1                259:1    0 954.7G  0 part /media/nvme
enclab@enclab-desktop:~$
  
```

- Type "df -h", press ENTER -> check the mounted partition on the storage list



```

Terminal
enclab@enclab-desktop: ~
enclab@enclab-desktop:~$ df -h
Filesystem      Size  Used Avail Use% Mounted on
udev            3.8G   8.0K  3.8G   1% /dev
tmpfs           769M   1.3M  767M   1% /run
/dev/sda1       1.8T   4.4G  1.7T   1% /
none            4.0K     0   4.0K   0% /sys/fs/cgroup
none            5.0M     0   5.0M   0% /run/lock
none            3.8G  176K   3.8G   1% /run/shm
none            100M   28K   100M   1% /run/user
/dev/nvme0n250262528p1 940G   72M  892G   1% /media/nvme
enclab@enclab-desktop:~$
  
```