



# **NEPI ENGINE**

## **PRE-BUILT IMAGES**

### **DOWNLOAD AND INSTALLATION INSTRUCTIONS**

**Version Number: 00**  
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## Table of Contents

Disclaimer	2
<b>Introduction</b>	<b>3</b>
Carrier Boards Supported	3
<b>Prerequisites</b>	<b>3</b>
Hardware Stack Solution Parts	3
Tools Required	3
NEPI Engine Software File Downloads	4
Setup Your PC for NEPI Engine Installation	5
<b>Installation Instructions</b>	<b>5</b>
NEPI Engine GPU Module Flashing	5
SSD Module Configuration	7
Configure Your NEPI Engine Device	11

### Disclaimer

Numurus LLC makes our best effort to ensure the accuracy and content in its entirety of this user manual yet there are continuous development improvements that are in progress. As such, consider the version of this document to be accurate at the time of printing. Numurus is not subject to liability for errors, omissions or other differences between this document and future versions.

## Introduction

While the NEPI Engine software is available in source-code format and pre-installed hardware solutions from both Numurus and its edge-compute hardware partners, Numurus maintains NEPI ready software images for some of the leading edge-compute solutions on the market in order to further accelerate our customer’s journey and get them up and running in the least amount of time.

## Carrier Boards Supported

While NEPI Engine source code is deployable on any ROS-capable hardware/software platform. Numurus maintains a limited set of pre-built NEPI Engine images for some of the leading NVIDIA Jetson carrier boards on the market today. Numurus also offers NEPI deployment services if you are looking to use an unsupported board and want help getting NEPI running on that system.

Vendor	Supported Product	Link
Connect Tech	Boson Carrier Board	<a href="https://connecttech.com/product/boson-for-framos-carrier-board-for-nvidia-jetson-xavier-nx/">https://connecttech.com/product/boson-for-framos-carrier-board-for-nvidia-jetson-xavier-nx/</a>
Seeed Studios	A203 Carrier Board	<a href="https://www.seeedstudio.com/A203-Carrier-Board-for-Jetson-Nano-Xavier-NX-V2-p-5214.html">https://www.seeedstudio.com/A203-Carrier-Board-for-Jetson-Nano-Xavier-NX-V2-p-5214.html</a>
Seeed Studios	A203-MINI PC	<a href="https://www.seeedstudio.com/A203-Mini-PC-with-128GB-SSD-p-5494.html">https://www.seeedstudio.com/A203-Mini-PC-with-128GB-SSD-p-5494.html</a>

## Prerequisites

### Hardware Stack Solution Parts

The following table provides the minimal hardware required to install a pre-built NEPI Engine image.

Part*	Quantity
NVIDIA Xavier NX GPU Module	1
Xavier NX GPU Carrier Board	1
Carrier Board Compatible SSD Card (1TB+ recommended)	1
(Optional) Carrier Board Compatible Wi-Fi Hardware	1
Carrier Board and GPU compatible Fan/Heat Sink and Thermal Paste	1
Miscellaneous mounting and assembly hardware (nuts, bolts, spacers...)	1
Carrier Board Power Supply	1
Ethernet Cable	1
USB Type A to Type Micro (A203) or Type C (Boson) Cable	1

\* These parts can be purchased separately and assembled yourself, or in some cases, purchased as a pre-assembled hardware product. Offerings vary by board vendor.

### Tools Required

Tool
PC with Linux Ubuntu 18.04 or higher and internet access
(Optional) Pin Jumper*

\* While some carrier boards include a “recovery mode” button, other boards only provide a pin header option that requires a separate jumper to put the board into “recovery mode”.

## NEPI Engine Software File Downloads

Before beginning the NEPI Engine software installation and setup process, please download the following files using the provided download links in the following table to your Linux Ubuntu PC's home "Downloads" folder "~/Downloads". The instructions in this document assume all files are downloaded to this folder.

Name	Description	Download Link
NEPI Engine Init FS Image File	GPU module image that includes boot file system	See the following table "Init File Image Links for Specific Hardware" for NEPI init file Image links for specific GPU carrier boards
NEPI Engine Root FS Image File	SSD module image that includes the root file system	See the following table "Init File Image Links for Specific Hardware" for NEPI root file Image links for specific GPU carrier boards
NEPI Engine SSH Key	Default Private SSH Key for access to NEPI Engine File System	<a href="https://www.dropbox.com/scl/fo/pjtoga7vi6za4yu3ymv5x/h?rlkey=i7riagxjo9eujkud4h6v912s8&amp;dl=0">https://www.dropbox.com/scl/fo/pjtoga7vi6za4yu3ymv5x/h?rlkey=i7riagxjo9eujkud4h6v912s8&amp;dl=0</a>
NEPI Engine User Partition Files*	Demo AI models and Automation Scripts. (Download the entire folder)	<a href="https://www.dropbox.com/scl/fo/c7qap49hftrmi13ku49tg/h?rlkey=kbufq3lv04y9c2etc17kotk0j&amp;dl=0">https://www.dropbox.com/scl/fo/c7qap49hftrmi13ku49tg/h?rlkey=kbufq3lv04y9c2etc17kotk0j&amp;dl=0</a>

\* The top-level user partition files folder contains the NEPI Engine user partition demo files for the latest NEPI Engine release version, with older versions available in the "Archive" folder within this folder. Each folder contains a three number version identifier such as "2.0.2".

### GPU Init File Image Links for Specific Hardware

Vendor	Supported Product	NEPI Init File Image Download Link*
Connect Tech	Boson Carrier Board	<a href="https://www.dropbox.com/scl/fo/4ivcyy3sdmh77v7zsyebd/h?rlkey=n9s5qdbps6mc1qi8c6dvdhtln&amp;dl=0">https://www.dropbox.com/scl/fo/4ivcyy3sdmh77v7zsyebd/h?rlkey=n9s5qdbps6mc1qi8c6dvdhtln&amp;dl=0</a>
Seed Studios	A203 Carrier Board and A203-MINI PC	<a href="https://www.dropbox.com/scl/fo/4ivcyy3sdmh77v7zsyebd/h?rlkey=n9s5qdbps6mc1qi8c6dvdhtln&amp;dl=0">https://www.dropbox.com/scl/fo/4ivcyy3sdmh77v7zsyebd/h?rlkey=n9s5qdbps6mc1qi8c6dvdhtln&amp;dl=0</a>

\* Each top-level folder contains the latest NEPI Engine init file release version for a particular board, with older image versions available in the "Archive" folder within these folders. Each image file contains a NVIDIA Jetpack version identifier such as "jp4.6.1".

### SSD Root File Image Links for Specific Hardware

Vendor	Supported Product	NEPI Root File Image Download Link*
Connect Tech	Boson Carrier Board	<a href="https://www.dropbox.com/scl/fo/z24ahrn2ik71lo0swtxbd/h?rlkey=m1bh7gaqm82b3akvccnd9inpk&amp;dl=0">https://www.dropbox.com/scl/fo/z24ahrn2ik71lo0swtxbd/h?rlkey=m1bh7gaqm82b3akvccnd9inpk&amp;dl=0</a>
Seed Studios	A203 Carrier Board and A203-MINI PC	<a href="https://www.dropbox.com/scl/fo/b77jirhc3ivf68vlh38la/h?rlkey=8raqw1z8kclrezgt0zprav5ck&amp;dl=0">https://www.dropbox.com/scl/fo/b77jirhc3ivf68vlh38la/h?rlkey=8raqw1z8kclrezgt0zprav5ck&amp;dl=0</a>

\* Each top-level folder contains the latest NEPI Engine root file release version for a particular board, with older image versions available in the "Archive" folder within these folders. Each image file contains a three number version identifier such as "2.0.2". We recommend downloading the latest version.

## Setup Your PC for NEPI Engine Installation

The following instructions assume you have downloaded all of your NEPI Engine Software Files to the “Downloads” folder of your home drive “~/Downloads”. If using a different folder, replace this text with the path to your downloaded files in the following instructions.

1. Install a compatible “Chrome” browser on your PC.
2. Install Unzip on your PC by opening a terminal and typing

```
sudo apt-get install unzip
```

3. Install Rsync on your PC by opening a terminal and typing

```
sudo apt-get install rsync
```

4. Configure your PC’s Ethernet (built-in or adapter) port networking settings to be on the same subnet as the GPU device.

**YOU WILL NEED TO ENSURE THAT THE TARGET COMPUTER’S ETHERNET INTERFACE IS CONFIGURED WITH A STATIC IPV4 ADDRESS ON THE 192.168.179.0/24 SUBNETWORK. FOR EXAMPLE: IP Address: 192.168.179.5 Netmask: 255.255.255.0**

5. Configure your NEPI Engine private SSH key: Open a terminal on your PC and type the following:

```
mkdir ~/ssh_keys
```

```
mv ~/Downloads/nepi_engine_private_ssh_key ~/ssh_keys/
```

```
sudo chmod 600 ~/ssh_keys/nepi_engine_private_ssh_key
```

```
ssh-keygen -f ~/ssh_keys/nepi_engine_private_ssh_key -R "192.168.179.103"
```

## Installation Instructions

The NEPI Image installation instructions are split into three main steps: 1) Xavier-NX Module Flashing, 2) SSD Module Configuration, and 3) Device Configuration. The following sections provide clear instructions for each of these installation steps.

### NEPI Engine GPU Module Flashing

1. Unzip the NEPI Engine Init Image file you downloaded for your particular GPU carrier board hardware. Open a terminal and type:

```
unzip ~/Downloads/<The NEPI Engine Init Image file you downloaded>
```

examples:

```
unzip ~/Downloads/nepi_xavier_nx_boson_jp4.6.1_ssd_init_rootfs.img.raw.zip
```

```
unzip ~/Downloads/nepi_xavier_nx_a203_jp4.6.1_ssd_init_rootfs.img.raw.zip
```

2. Install NVIDIA Jetpack and Board Support Package (BSP) per the manufacture’s instructions, ensuring that the Jetpack and BSP versions you install match the NVIDIA Jetpack version identifier number in the NEPI Init Image you downloaded

Example: “nepi\_xavier\_nx\_boson\_jp4.6.1\_ssd\_init\_rootfs.img.raw” should use Jetpack 4.6.1

The tables below provide links to NEPI supported NVIDIA Jetpack SDK software packages and GPU board installation instructions from support carrier board vendors. Numurus recommends flashing Jetpack OS components via the NVIDIA flash.sh script – the Boson “Preferred approach” and A203 “Flashing JetPack OS via Command Line” installation instructions from the links below should be used.

#### Manufacture NVIDIA Jetpack Installation Instruction Links for Supported Boards

Vendor	Supported Product	NEPI Init File Image Download Link*
Connect Tech	Boson Carrier Board	<a href="https://connecttech.com/ftp/Drivers/L4-T-Release-Notes/Jetson-Xavier-NX/XAVIER-NX-32.6.1.pdf">https://connecttech.com/ftp/Drivers/L4-T-Release-Notes/Jetson-Xavier-NX/XAVIER-NX-32.6.1.pdf</a>
Seeed Studios	A203 Carrier Board and A203-MINI PC	<a href="https://wiki.seeedstudio.com/reComputer_A203_Flash_System/#flashing-jetpack-os-via-command-line">https://wiki.seeedstudio.com/reComputer_A203_Flash_System/#flashing-jetpack-os-via-command-line</a>

The NVIDIA *flash.sh* script will report success or failure following the flashing step. But you may also optionally verify successful flashing by power cycling your flashed Hardware Stack and observing (with HDMI monitor attached to hardware stack) an Ubuntu splash screen and setup page. You do not need to complete these graphical setup steps.

- Put the Jetson in “Recovery Mode” button/jumper again as you did in step 2. You may verify your Jetson is in recovery mode by typing the following in a terminal window on your USB connected PC:

*lsusb*

You should see an Nvidia entry in the list. If you do not, try again. Generally, you will also hear the fan spin up. Your screen should look similar to the below:

```
engineering@numurus-vnc:~$ lsusb
Bus 002 Device 003: ID 0b95:1790 ASIX Electronics Corp. AX88179 Gigabit Ethernet
Bus 002 Device 001: ID 1d6b:0003 Linux Foundation 3.0 root hub
Bus 001 Device 003: ID 413c:301a Dell Computer Corp.
Bus 001 Device 002: ID 413c:2113 Dell Computer Corp.
Bus 001 Device 007: ID 0955:7e19 NVidia Corp.
Bus 001 Device 005: ID 8087:0026 Intel Corp.
Bus 001 Device 004: ID 0bda:0129 Realtek Semiconductor Corp. RTS5129 Card Reader Controller
Bus 001 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub
Bus 004 Device 001: ID 1d6b:0003 Linux Foundation 3.0 root hub
Bus 003 Device 001: ID 1d6b:0002 Linux Foundation 2.0 root hub
```

- Backup the original “system.img.raw” file in your Jetpack SDK folder on your PC, then copy the uncompressed NEPI Engine Init Image file to that same folder and rename it to “system.img.raw” by typing the following in a terminal window on your PC:

```
mv <path/to/your/Linux_for_Tegra>/bootloader/system.img.raw
   <path/to/your/Linux_for_Tegra>/bootloader/system.img.raw.orig
mv ~/Downloads/<The unzipped NEPI Engine Init Image file you downloaded>
   <path/to/your/Linux_for_Tegra>/bootloader/system.img.raw
```

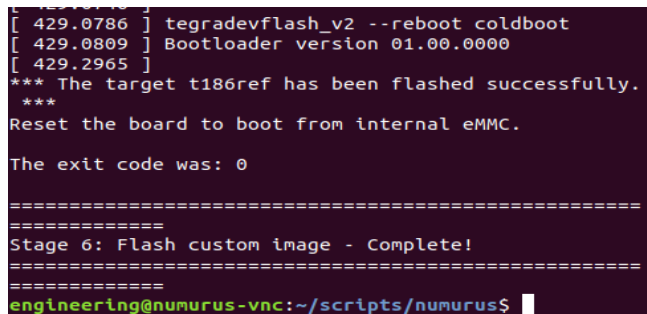
example:

```
mv ~/Applications/Jetpack_4.6.1_Xavier_NX/Linux_for_Tegra/bootloader/system.img.raw
~/Applications/Jetpack_4.6.1_Xavier_NX/Linux_for_Tegra/bootloader/system.img.raw.orig
mv ~/Downloads/nepi_xavier_nx_boson_jp4.6.1_ssd_init_rootfs.img.raw
~/Applications/Jetpack_4.6.1_Xavier_NX/Linux_for_Tegra/bootloader/system.img.raw
```

5. Flash the NEPI Engine Init Image by typing the following in terminal on your PC:

```
sudo <path/to/your/Linux_for_Tegra>/flash.sh -r -k APP jetson-xavier-nx-devkit-emmc
mmcblk0p1
```

You should see the following message when image flashing is complete



```
[ 429.0786 ] tegradevflash_v2 --reboot coldboot
[ 429.0809 ] Bootloader version 01.00.0000
[ 429.2965 ]
*** The target t186ref has been flashed successfully.
***
Reset the board to boot from internal eMMC.

The exit code was: 0

=====
=====
Stage 6: Flash custom image - Complete!
=====
=====
engineering@numurus-vnc:~/scripts/numurus$
```

## SSD Module Configuration

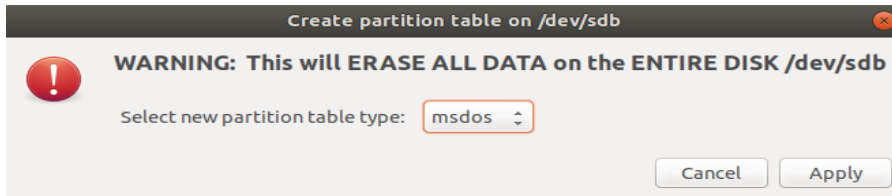
Both the NEPI Engine file system and user data storage locations reside on an SSD card installed on your Hardware Stack. The following instructions cover configuring the SSD card’s partitions, flashing the NEPI Engine root file systems (main and backup), and setting up NEPI user partition folder structure.

1. Using an appropriate USB adapter for your SSD card, connect it to your PC, open a terminal window, and type the following:

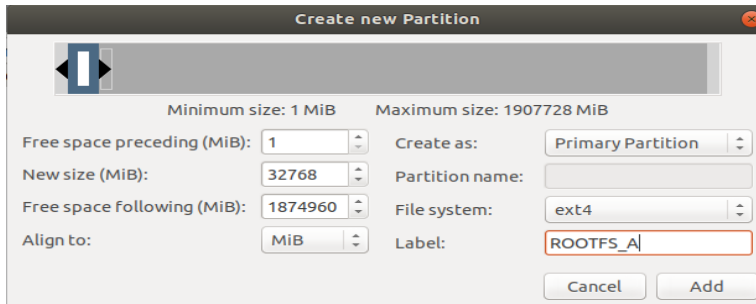
```
sudo gparted
```

\*If *gparted* is not installed, you may need to install it first with  
*sudo apt-install gparted*

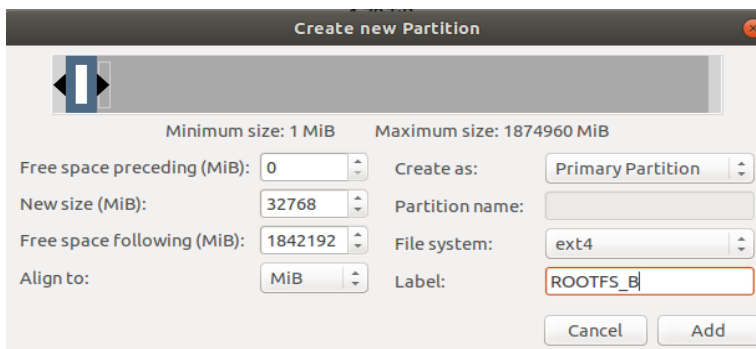
2. On the upper right side of the *gparted* application screen, select the /dev filesystem identifier associated with your USB SSD adapter, which will vary depending on your PC storage configuration. You can determine which identifier it is by looking for a new entry in this list after plugging the adapter into your PC. **Beware, selecting the wrong identifier here can cause major harm to your Linux installation. Double check your selection!**
3. You will need to create three partitions on the SSD. To do that, select “Create Partition table” from the Device menu at the top and select “msdos” as the new partition table type as in the screenshot below:



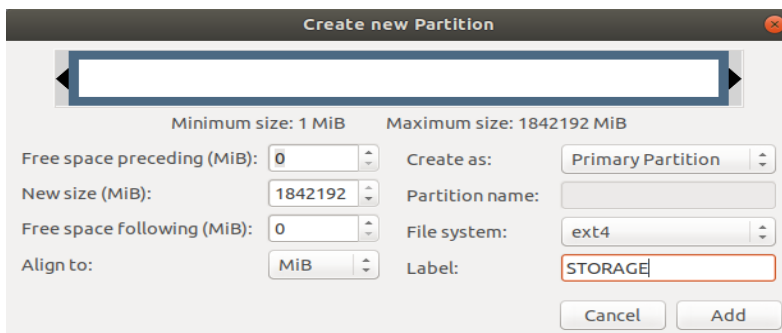
4. Create the first partition by right clicking on the “unallocated” partition and select New. Fill out the settings as per the screenshot below.



5. Create the second partition by right clicking on the unallocated partition and select New. Fill out the dialog as in the screenshot below.

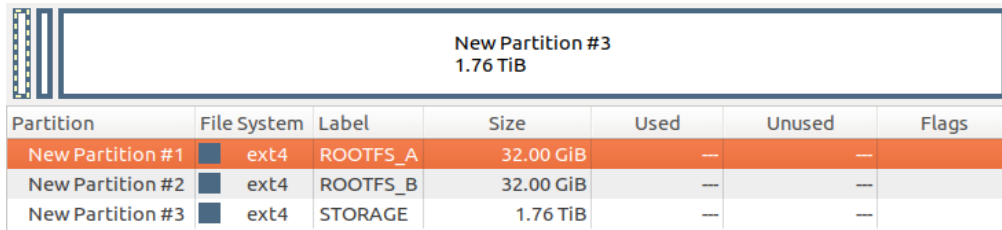


6. Create the third partition by right clicking on the unallocated partition and select New. The label should be STORAGE and the new size should be all remaining space on the drive, similar to the below:





7. Select Edit → Apply All Operations
8. With all that done, your screen should look like the below. Click the green checkmark at the top to apply the operations.



Partition	File System	Label	Size	Used	Unused	Flags
New Partition #1	ext4	ROOTFS_A	32.00 GiB	--	--	
New Partition #2	ext4	ROOTFS_B	32.00 GiB	--	--	
New Partition #3	ext4	STORAGE	1.76 TiB	--	--	

9. Close the gparted application window.
10. Scan the list for entries that end in ROOTFS\_A, ROOTFS\_B, and STORAGE.

For example:

```
/dev/sdb1 32G 24K 30G 1% /media/engineering/ROOTFS_A
/dev/sdb2 32G 24K 30G 1% /media/engineering/ROOTFS_B
/dev/sdb3 171G 28K 162G 1% /media/engineering/STORAGE
```

11. Now we need to flash the custom NEPI image to the ROOTFS\_A partition on the SSD, using the drive mappings revealed with the `df -h` command we just ran. This is likely to just be `/dev/sdb1` as in the example below the following, but if you get an error, you will need to replace `/dev/sdb1` with whatever your host's device mapping is. In your terminal window, type the following, replacing `<image_name>` with the name of the latest image from Dropbox:

```
sudo dd if=~Downloads/<image_name> of=/dev/sdb1 bs=64M status=progress
```

For example:

```
sudo dd if=~Downloads/nepi_2.0.2_s2x_bxn.img.raw of=/dev/sdb1 bs=64M
status=progress
```

12. In similar fashion, flash the custom NEPI image to the ROOTFS\_B partition, likely located at `/dev/sdb2` (but again, modify this if your host's drive mappings are different). In your terminal window, type the following, replacing `<image_name>` with the name of the latest image from Dropbox:

```
sudo dd if=~Downloads/<image_name> of=/dev/sdb2 bs=64M
status=progress
```

For example:

```
sudo dd if=~Downloads/nepi_2.0.2_s2x_bxn.img.raw of=/dev/sdb2
bs=64M status=progress
```

13. Now we need to populate the data partition with latest AI and Automation scripts.

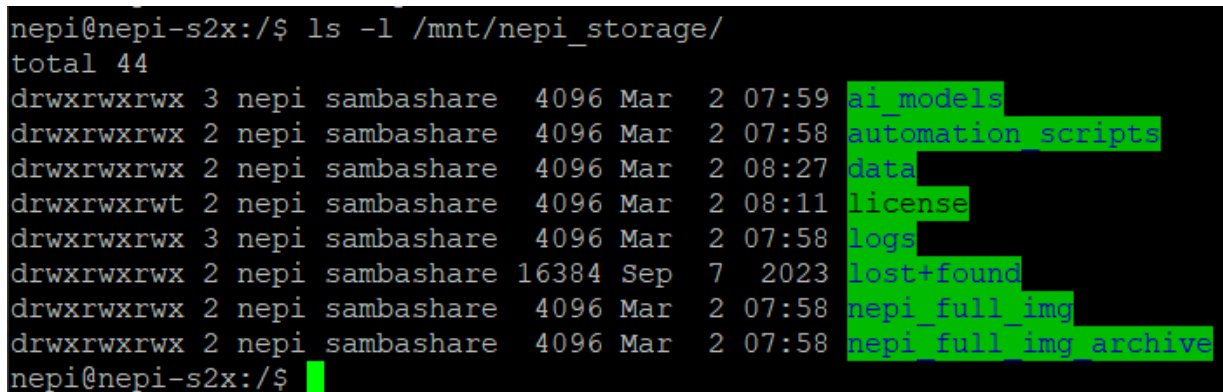
14. First unplug and reinsert the SSD adapter to get the new partitions mounted on the host.]
15. Clean up user\_partition folders

SSH into your S2X system from a terminal or putty and enter the following commands

```
sudo mkdir /mnt/nepi_partition/license
sudo chown -R nepi:sambashare /mnt/nepi_storage
sudo chmod -R a+rw /mnt/nepi_storage
```

Check that all the folders and permissions are correct by typing

```
ls -l /mnt/nepi_storage/
```



```
nepi@nepi-s2x:/$ ls -l /mnt/nepi_storage/
total 44
drwxrwxrwx 3 nepi sambashare 4096 Mar  2 07:59 ai_models
drwxrwxrwx 2 nepi sambashare 4096 Mar  2 07:58 automation_scripts
drwxrwxrwx 2 nepi sambashare 4096 Mar  2 08:27 data
drwxrwxrwt 2 nepi sambashare 4096 Mar  2 08:11 license
drwxrwxrwx 3 nepi sambashare 4096 Mar  2 07:58 logs
drwxrwxrwx 2 nepi sambashare 16384 Sep  7 2023 lost+found
drwxrwxrwx 2 nepi sambashare 4096 Mar  2 07:58 nepi_full_img
drwxrwxrwx 2 nepi sambashare 4096 Mar  2 07:58 nepi_full_img_archive
nepi@nepi-s2x:/$
```

16. Install the latest demo AI and Automation files

Download the latest nepi user\_partition (for example “nepi\_2.0.2\_user\_partition folder”) from dropbox here:

[www.dropbox.com/scl/fo/c7qap49hfrmi13ku49tg/h?rlkey=kbufq3lv04y9c2etc17kotk0j&:dl=0](https://www.dropbox.com/scl/fo/c7qap49hfrmi13ku49tg/h?rlkey=kbufq3lv04y9c2etc17kotk0j&:dl=0)

Unzip this file on your PC

Open a file manager on your PC with the S2X connected and powered up.

Windows: [\\192.168.179.103\nepi\\_storage](\\192.168.179.103\nepi_storage)

Linux: `smb://192.168.179.103/nepi_storage`

Delete and replace the “ai\_models” folder with the one in you just downloaded.

Delete and replace the “automation\_scripts” folder with the one in you just downloaded.

17. Reboot the NEPI device and test the demo file installation success by logging into the system's RUI user interface. Open the chrome browser on your PC and navigate to <http://192.168.179.103:5003/> . Once in the RUI navigate to the Applications/AI tab and check that your AI models are available in the "Image Classifier" dropdown menu. Next, navigate to the Applications/Automation tab and check that your automation scripts are available in the automation script list.

## Configure Your NEPI Engine Device

1. SSH into your NEPI Engine's file system: Connect your NEPI Engine installed Hardware Stack to your PC with an Ethernet cable and power the GPU hardware. Open a terminal on your PC and type the following to initiate an SSH connection to the device's NEPI Engine file system:

```
ssh -o StrictHostKeyChecking=no -i ~/.ssh_keys/nepi_engine_private_ssh_key  
nepi@192.168.179.103
```

2. If you would like to give your NEPI device a unique serial number and device name, do the following from the ssh connected terminal window:

```
cd /opt/nepi/  
vi sys_env.bash
```

Within the vi editor, press the Insert key to enter edit mode and change the serial number on the appropriate line. Save your edits by pressing the ESC key followed by ":wq" (without quotes). If you make a mistake, you can always type ESC followed by ":q!" (again without quotes)

3. If you plan to use your NEPI enabled device to upload data and download software to a remote server running Numurus' NEPI Connect software, you will first need to create a NEPI Unique ID (NUID) number and corresponding public SSH key that NEPI Connect software will use for device setup and authentication. The following instructions will walk you through the setup from the ssh connected terminal window:

```
cd /opt/nepi/nepi_link/nepi-bot/devinfo  
python3 change_identity.py -n <Your 10 digit NUID>
```

For security reasons, it is recommended that you use some random number generator to generate a random 10 digit NUID value. For example:

```
python3 change_identity.py -n 3989789099
```

Press enter twice to skip a passphrase and press p to print out the key.

4. For any configuration changes to take effect, you must reboot your NEPI device:  

```
sudo reboot
```
5. Test the serial number and NUID setup success by logging into the systems RUI user interface. Open the chrome browser on your PC and navigate to <http://192.168.179.103:5003/> . Once in

the RUI navigate to the Dashboard tab and check that the serial number has been updated. Next, navigate to the Application/CONNECT tab, enable NEPI Connect if disabled, and verify that your NUID has been updated.

6. For security reasons, it is highly recommended that you replace the default SSH key and Samba network drive credentials on our your NEPI device following the instructions in these links:  
<https://askubuntu.com/questions/1042739/how-to-replace-the-ssh-private-public-key-pair>  
<https://ubuntuforums.org/showthread.php?t=1687199>