



IGX Orin Software Installation Guide

Revision 1.2

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IIoT Team

Inventec Corporation



Purpose

This document supplements NVIDIA's official IGX Orin documentation regarding installation of software on Inventec's IGX Orin system.

Approval Signatures

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Revision History

Rev.	Date	Changes	Author
0.1	Oct. 1 st , 2024	<ul style="list-style-type: none">Initial version	JK Jung
1.0	Nov. 28 th , 2024	<ul style="list-style-type: none">Update dGPU installation in section 2.3	JK Jung
1.1	Jan. 20 th , 2025	<ul style="list-style-type: none">Add more information regarding dGPU installationCorrect some typos	JK Jung
1.2	Aug. 12 th , 2025	<ul style="list-style-type: none">Add firmware version information in Section 1Update various parts for SW 1.1.1	JK Jung



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1. Introduction

Official IGX Orin documentation could be found on NVIDIA web site: [NVIDIA IGX Orin - NVIDIA Docs](#). For software installation, these 2 documents should be referenced mostly: [NVIDIA IGX Orin User Guide \(Latest\)](#) and [NVIDIA IGX Orin BMC User Guide \(Latest\)](#).

On the other hand, official IGX software/firmware releases could be downloaded from NVIDIA [IGX Download Center](#). At the time of this writing, the most up-to-date IGX software release is "IGX-SW 1.1.2 Production Release [IGX Orin Latest]".

Here's a quick summary of firmware versions for each IGX-SW Production Releases:

	BMC (ERoT) Firmware	SMCU Firmware	QSPI Boot Firmware	CX7 Firmware	IGX OS Image
SW 1.0	IGXOrinBMC-2 4.04-11-v3.2 GA Release	C01 1.50.14	36.3.1-gcid-36302503 built on 2024-05-17T 04:47:03+00:00	?	IGX OS 1.0.3 BSP: 36.3.1 linux-nvidia-tegra-igx 5.15.0-1012
SW 1.1	IGX-BMC-10.10 -rc-4.1	C01 1.50.15	36.4.1-gcid-38375079 built on 11/19/2024	?	IGX OS 1.1.4 BSP: 36.4.1 linux-nvidia-tegra-igx 5.15.0-1019
SW 1.1.1	IGX-BMC-rc-4. 1.1	C01 1.50.15	36.4.5-gcid-39296390 built on 01/29/2025	28.39.3004	IGX OS 1.1.6 BSP: 36.4.5 linux-nvidia-tegra-igx 5.15.0-1020
SW 1.1.2	?	?	?	?	? BSP: 36.4.6

Readers are encouraged to read through [NVIDIA IGX Orin User Guide \(Latest\)](#) before attempting software installation/update on the IGX Orin system. Otherwise, this document provides a concise step-by-step guide to the software installation.



2. Software Installation

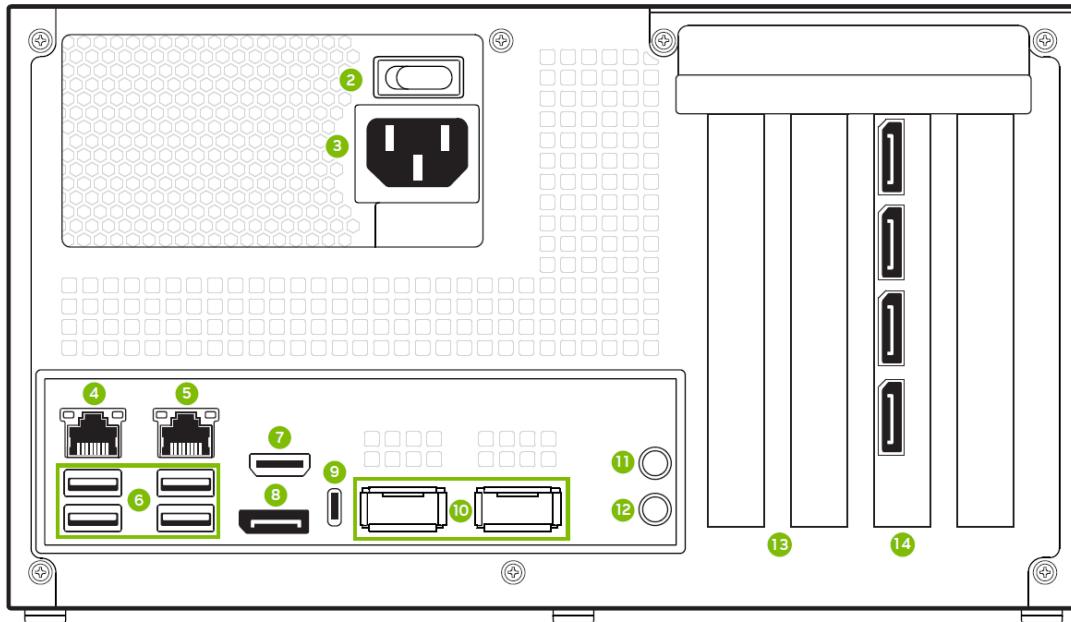
2.1. Inventec IGX Orin system

The IGX Orin systems prepared by Inventec should have either the “dGPU” or “iGPU” software and are ready for use. As such, the software installation steps in sections 2.2 and 2.3 are for reference only.

2.2. iGPU case

The following steps apply to an IGX Orin system without a discrete GPU (i.e. no RTX A6000 or RTX 6000 Ada). In other words, the steps are for an “iGPU” system.

1. Prerequisite. In addition to the IGX Orin system, the reader should prepare the following items for software installation and system bring-up:
 - A DVI display and a DVI cable, for video output of the IGX Orin system.
 - A USB keyboard and a USB mouse. It could be a good idea to prepare a USB hub as well.
 - A USB flash drive with at least 16GB of storage space.
 - Another PC (Linux preferred) for remote-logging into BMC (Baseboard Management Controller) to do firmware update and other board management tasks.
 - Ethernet cables * 2.
 - Internet connection.
2. Connect the DVI display, USB keyboard, and USB mouse to the IGX Orin system. Then power it up. Note that, for **a brand new IGX Orin board**, although the BMC module should be working but **the DVI display would be blank**. IGX Orin’s UEFI screen won’t show up until the boot firmware (QSPI) is installed.

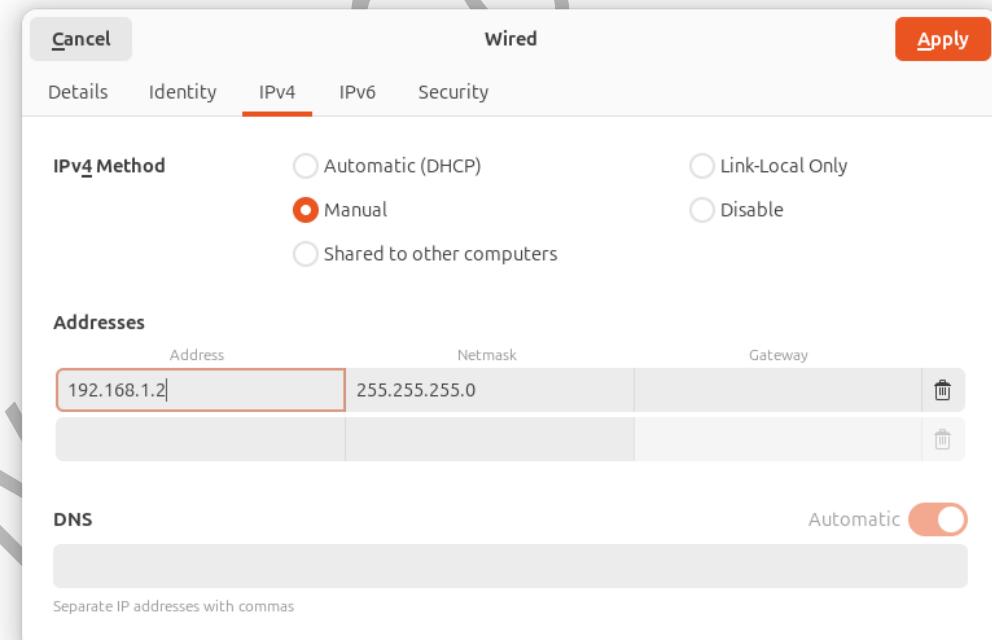
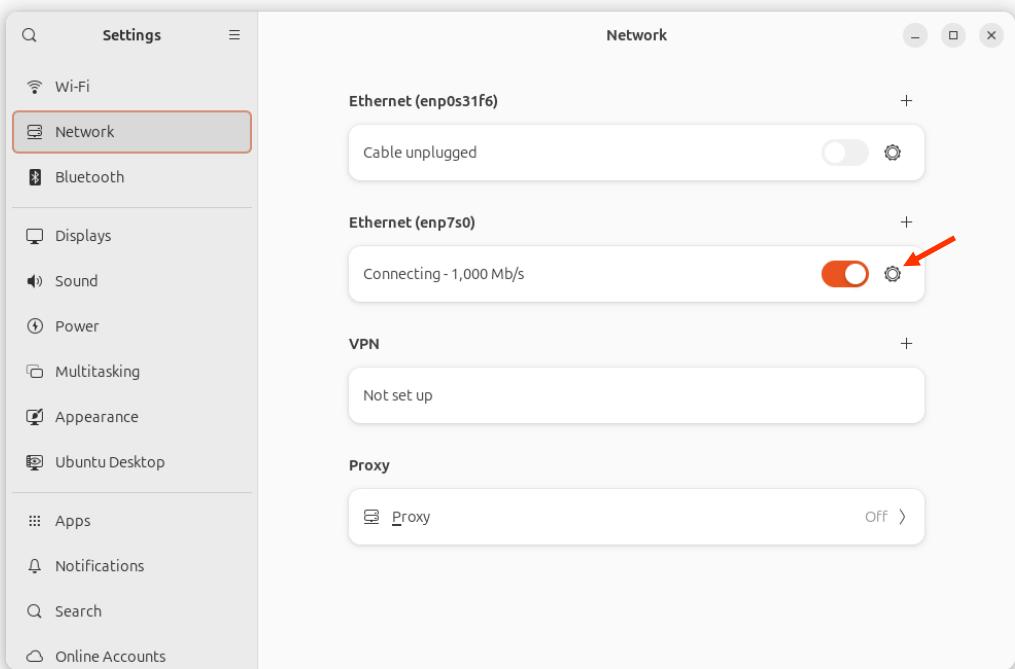


Reference: [Connect a Display to Your Dev Kit](#) and [Power Up Your Dev Kit](#).

DVI output of the IGX Orin (iGPU) is at the connector labeled "8" on the diagram.

3. Use the other PC to update BMC firmware. Reference: [Set up your host to access the BMC](#).

- Connect the remote PC and the IGX Orin's BMC (port "5") via an Ethernet cable.
- The BMC has a static IP: 192.168.1.110. So it's suggested IP address of the remote PC's Ethernet to be set as 192.168.1.2 with a netmask 255.255.255.0. Refer to the following screenshots for details.



- From the remote PC, [access the BMC over SSH](#). The default root password was "OpenBmc" ("0" is the number zero) and has been changed to "**IGX-Orin@123**" on



the Inventec IGX Orin system.

- [Update your BMC firmware](#). Note that since the Inventec IGX Orin system is an IGX Orin Board Kit, the **ERoT version of BMC firmware** should be used. **VERY IMPORTANT:** make sure to use the correct version of BMC firmware, **otherwise the BMC module would be BRICKED** and could not be recovered!
- Based on Inventec team's experience, **BMC firmware needs to be updated in 2 phases**.
 - Phase 1: Update BMC with "IGXOrinBMC-24.04-11-v3.2" (SW 1.0) firmware. Then reboot the IGX Orin system for the updated firmware to take effect.
 - Phase 2: Update BMC again with "IGX-BMC-rc-4.1.1" (SW 1.1.1) firmware. Also note that it's necessary to use the BMC firmware file (igx-bmc-apfw-erot.fwpkg) from [BMC FW and Sources \(to be used when updating using command line\)](#), instead of the WebUI firmware package. Otherwise the firmware update would likely not work.
- Sample steps (on the remote PC):

```
igx@IGX-Orin-1:~$ export bmc=192.168.1.110
igx@IGX-Orin-1:~$ export token=`curl -k \
                  -H "Content-Type: application/json" \
                  -X POST https://$bmc/login \
                  -d '{"username": "root", "password": "IGX-Orin@123"}' | \
grep token | awk '{print $2;}' | tr -d ''` 
igx@IGX-Orin-1:~$ export task_id=$(curl -k \
                  -H "X-Auth-Token: $token" \
                  -H "Content-Type: application/octet-stream" \
                  -X POST https://$bmc/redfish/v1/UpdateService \
                  -T "igx-bmc-apfw-erot.fwpkg" | jq -r ".Id") 

igx@IGX-Orin-1:~$ curl -k \
                  -H "X-Auth-Token: $token" \
                  -X GET
https://$bmc/redfish/v1/TaskService/Tasks/$task_id
igx@IGX-Orin-1:~$
```

- The BMC firmware updating process takes around 12 minutes. So be patient.
- Check out this post on NVIDIA IGX Orin Forum: [A more reliable way to update BMC firmware ERoT](#). It was reported that the BMC firmware updating process might fail without any warning or log. Repeat [update your BMC firmware](#) if that happens.



4. Connect to the BMC Web UI. From the remote PC, open <https://192.168.1.110/>, from a web browser. Log in as "root" and password "**IGX-Orin@123**".
5. Update your MCU firmware from BMC Web UI. This firmware updating process takes around 4 minutes.
 - There seems to be some ATX power supply compatibility issue for the latest "C01 1.50.15" MCU firmware (in SW 1.1.1 and SW 1.1) on Inventec IGX Orin system. The Inventec IGX Orin system does not power up properly when this version of MCU firmware is used.
 - As such, **"C01 1.50.14" MCU firmware (in SW 1.0) is used** on Inventec IGX Orin systems
6. Update your QSPI firmware from BMC Web UI. When this step is done, DVI output of the IGX Orin system would start to show UEFI boot screen.
7. Install the IGX OS Image. Specifically, create a bootable USB flash drive and install the OS image from it. Be sure to choose "Install IGX OS r36v1.1.6 (**iGPU**)" (for SW 1.1.1). The installation takes roughly 20 minutes. When finished, the IGX Orin system would reboot and enter Linux directly. If not, simply power cycle the IGX Orin system to force a reboot.

Be sure to connect USB keyboard and mouse to the IGX Orin system at this point. And finish the Ubuntu Linux initial configuration set-up. The **user account and password** are set to "**igx**" and "**igx**" on the Inventec IGX Orin system.

8. Update the Connect-X 7 (CX7) Firmware.
 - Although NVIDIA documentation listed this step before Install the IGX OS Image, this should actually be done afterwards.
 - Sample steps (on the IGX Orin system):

```
igx@IGX-Orin-1:~$ sudo mount -o ro,loop
MLNX_OFED_LINUX-23.10-x.x.x-ubuntu22.04-aarch64.iso /mnt
igx@IGX-Orin-1:~$ sudo /mnt/mlnxofedinstall --fw-update-only
igx@IGX-Orin-1:~$
```
9. Connect the IGX Orin to the internet. This could be done via either Ethernet or Wi-Fi (i.e. preparing and setting up a USB Wi-Fi dongle).



10. (Optional) Install the driver and SDK for YUAN SC710N2 HDMI 2.0 video capture card.

Since the SC710N2 Linux driver is only for the stock Linux kernel (5.15.0-1012 or 5.15.0-1019), do the following to freeze kernel version on the IGX Orin system and prevent unintended updates.

For IGX-SW 1.0 Production Release:

```
igx@IGX-Orin-1:~$ sudo apt-mark hold \
linux-headers-5.15.0-1012-nvidia-tegra-igx \
linux-headers-nvidia-tegra-igx \
linux-headers-tegra-oot-igx-5.15.0-1012-nvidia-tegra-igx \
linux-image-5.15.0-1012-nvidia-tegra-igx \
linux-image-nvidia-tegra-igx \
linux-modules-5.15.0-1012-nvidia-tegra-igx \
linux-modules-extra-5.15.0-1012-nvidia-tegra-igx \
linux-modules-tegra-igpu-igx-5.15.0-1012-nvidia-tegra-igx \
linux-modules-tegra-igpu-igx-nvidia-tegra-igx \
linux-modules-tegra-oot-igx-5.15.0-1012-nvidia-tegra-igx \
linux-nvidia-tegra-igx-headers-5.15.0-1012 \
linux-nvidia-tegra-igx-tegra-igpu-igx-defaults \
linux-nvidia-tegra-igx
```

For IGX-SW 1.1 Production Release:

```
igx@IGX-Orin-1:~$ sudo apt-mark hold \
linux-headers-5.15.0-1019-nvidia-tegra-igx \
linux-headers-nvidia-tegra-igx \
linux-headers-tegra-oot-r36.4.1-5.15.0-1019-nvidia-tegra-igx \
linux-image-5.15.0-1019-nvidia-tegra-igx \
linux-image-nvidia-tegra-igx \
linux-modules-5.15.0-1019-nvidia-tegra-igx \
linux-modules-extra-5.15.0-1019-nvidia-tegra-igx \
linux-modules-tegra-igpu-r36.4.1-5.15.0-1019-nvidia-tegra-igx \
linux-modules-tegra-igpu-igx-nvidia-tegra-igx \
linux-modules-tegra-oot-r36.4.1-5.15.0-1019-nvidia-tegra-igx \
linux-nvidia-tegra-igx-headers-5.15.0-1019 \
linux-nvidia-tegra-igx-tegra-igpu-igx-defaults \
```



linux-nvidia-tegra-igx

For the rest steps of installing SC710N2 driver and SDK, please refer to the later section of this document.

11. [Install the NVIDIA AI Stack.](#)

```
igx@IGX-Orin-1:~$ sudo apt update  
igx@IGX-Orin-1:~$ sudo apt install nvidia-igx-ai  
igx@IGX-Orin-1:~$ sudo apt --fix-broken install
```

12. NVIDIA CUDA Toolkit is required to compile/build applications which uses CUDA or NVIDIA GPU. So, it's recommended to install it on the IGX Orin system as well.

```
igx@IGX-Orin-1:~$ sudo apt install nvidia-cuda-toolkit
```

13. Done!

2.3. dGPU case

This section outlines what needs to be done to add a discrete GPU, i.e., a RTX A6000 or RTX 6000 Ada, onto an IGX Orin system with "iGPU" image already installed.

1. According to NVIDIA documentation for the dGPU, "an update of the VBIOS (for Arm) is required since the NVIDIA dGPU cards come with a default x86 CPU-based VBIOS."

The reader could basically refer to [Flashing the dGPU with ARM VBIOS](#) for how to update VBIOS of the dGPU. Taking an RTX 6000 Ada dGPU as an example, the following steps show how to re-flash VBIOS on it:

- Install the RTX 6000 Ada onto the IGX Orin system. Then power up the system. Log in through SSH or UART (IGX BMC SOL console).
- Switch to non-graphical mode and remove all nvidia kernel modules. Tip: If the IGX Orin system has been set up with a network connection, these steps could be done from a remote host via ssh.

```
igx@IGX-Orin-1:~$ sudo systemctl isolate multi-user
```



```
igx@IGX-Orin-1:~$ sudo rmmod nvidia_uvm nvidia_drm nvidia_vrs_pseq
nvidia_modeset nvidia_peermem nvidia nvidia_p2p
```

- (Optional) It's a good idea to back up the original x86 VBIOS from the RTX 6000 Ada card. However, this requires the "NVFlash" tool from NVOnline, which is not publicly available.

```
igx@IGX-Orin-1:~/VBIOS/linux/aarch64$ sudo ./nvflash --save
RTX_6000_Ada_VBIOS_x86_9002590009
NVIDIA Firmware Update Utility (Version 5.865.0)
Copyright (C) 1993-2024, NVIDIA Corporation. All rights reserved.
```

Reading EEPROM (this operation may take up to 30 seconds)

```
Build GUID          : 52D4E022AE5545FA9F96E0EA98FB9ED2
Build Number       : 32718061
IFR Subsystem ID   : 10DE-16A1
Subsystem Vendor ID: 0x10DE
Subsystem ID       : 0x16A1
Version            : 95.02.59.00.09
Image Hash         : N/A
Hierarchy ID       : Normal Board
Build Date         : 04/12/23
Modification Date  : 05/04/23
UEFI Version       : 0x7000F ( x64 )
UEFI Variant ID   : 0x000000000000000B ( Unknown )
UEFI Signer(s)     : Microsoft Corporation UEFI CA 2011
                     : Microsoft Time-Stamp PCA 2010
XUSB-FW Version ID: N/A
XUSB-FW Build Time : N/A
InfoROM Version    : G133.0510.00.02
InfoROM Backup      : Present
License Placeholder: Present
GPU Mode           : Graphics
CEC OTA-signed Blob: Not Present
```

```
igx@IGX-Orin-1:~/VBIOS/linux/aarch64$ ls -la
total 16724
```



```
drwxrwxrwx 2 igx igx 4096 Nov 28 17:25 .
drwxrwxrwx 6 igx igx 4096 Oct 26 12:31 ..
-rwxrwxrwx 1 igx igx 15065244 Oct 25 12:20 nvflash
-rw-r--r-- 1 root root 2048000 Nov 28 17:25
RTX_6000_Ada_VBIOS_x86_9002590009.rom
```

- Run the "igx_6000_ADA_firmware_950259000D_update" script to flash the ARM VBIOS onto the RTX 6000 Ada. The script could be downloaded from NVIDIA [IGX Download Center](#).

```
igx@IGX-Orin-1:~$ sudo ./igx_6000_ADA_firmware_950259000D_update
NVIDIA Firmware Update Utility
```

Summary:

GPU	Status
Graphics Device	Update successful

GPU firmware successfully updated.

Please restart your PC for the new firmware to take effect.

```
igx@IGX-Orin-1:~$
```

- The "Update successful" message above indicates the re-flashing has completed successfully. Go to the next step and reboot the system.

Additional reference:

- [dGPU not operational after reflashing - blank screen](#)
- Connect the display to one of the Display Port (DP) connectors on the dGPU (RTX 6000 Ada) this time around and reboot the system. Reference: [Connect a Display to Your Dev Kit](#).
- NOTE: Most likely there would be no video output from the IGX Orin system at this point, neither from the DP port on the dGPU nor from the DP port on the IGX Orin motherboard. The reader should perform the next step.
- [Connect to the BMC Web UI](#) (referring to steps 3 and 4 in section 2.2). Do [Update your QSPI firmware](#) (as described in step 6 in section 2.2). Then reboot the system. IGX Orin



display output should come up (from the DP output of the dGPU) and show UEFI splash screen now.

4. [Install the IGX OS Image](#). Choose “Install IGX OS r36v1.1.6 (**dGPU**)” (for SW 1.1.1).
5. [Resizing BAR1 Address Range](#) of the dGPU, if necessary.
6. Follow steps 9~12 in section 2.2 to install video capture software and NVIDIA AI Stack.
 - Note that installing the video capture card (YUAN SC710N2) would cause dGPU’s PCIe enumeration to change on the IGX Orin system. It would result in this issue: [Can’t start X service when \(some\) PCIe capture card is attached](#). It was suggested that /etc/X11/xorg.conf needs to be modified to resolve the issue. Inventec team has not verified the solution since the customer does not need the video capture on the IGX Orin system.
 - Also note that the [Install the NVIDIA AI Stack](#) commands for iGPU and dGPU are slightly different. And again, it’s recommended to install NVIDIA CUDA Toolkit on the IGX Orin system.

```
igx@IGX-Orin-1:~$ sudo apt update
igx@IGX-Orin-1:~$ sudo apt install nvidia-igx-ai-rm
igx@IGX-Orin-1:~$ sudo apt --fix-broken install
igx@IGX-Orin-1:~$
igx@IGX-Orin-1:~$ sudo apt install nvidia-cuda-toolkit
```

7. Done!



3. Video Capture Card

The Inventec IGX Orin system comes with a YUAN SC710N2 HDMI 2.0 video capture card. This chapter illustrates how to install the corresponding device driver and SDK.

Please contact Inventec team to get the driver and SDK package: "SC710N2.zip", which is confidential under NDA.

3.1. SC710N2 driver and SDK

The reader could find the following documents once unpacking the SC710N2.tar.gz file. They are documentation from YUAN and for reference only.

- "Using Yuan's Capture Card V2.0.0_2.pdf"
- "GPUDirect.pdf"

It's suggested that the reader follows the following step-by-step guide to install SC710N2 driver and SDK on the IGX Orin system.

1. Prerequisite: Make sure step #10 (freezing Linux kernel version) in section 3.2 has been performed on the IGX Orin system. Otherwise, the SC710N2 driver might fail to work due to kernel version mismatch.
2. Unpack the package and install the driver. Note: Linux kernel version must be 5.15.0-1019-nvidia-tegra-igx (for IGX OS 1.1) or 5.15.0-1012-nvidia-tegra-igx (for IGX OS 1.0).

```
igx@IGX-Orin-1:~$ tar xvf SC710N2.tar.gz
igx@IGX-Orin-1:~$ cd SC710N2
igx@IGX-Orin-1:~/SC710N2$
```

For iGPU:

```
igx@IGX-Orin-1:~/SC710N2$ sudo dpkg -i
driver/lxv4l2d-sc0400-sc0710_v1361-igx-sw-igpu-5.15.0-1019-nvidia-tegra-igx_
aarch64.deb
```



For dGPU:

```
igx@IGX-Orin-1:~/SC710N2$ sudo dpkg -i  
driver/lxv4l2d-sc0400-sc0710_v1361-igx-sw-dgpu-5.15.0-1019-nvidia-tegra-igx_  
aarch64.deb
```

Then reboot the system.

```
igx@IGX-Orin-1:~/SC710N2$ sudo reboot
```

3. After the system reboots, install the SDK.

```
igx@IGX-Orin-1:~$ cd SC710N2  
igx@IGX-Orin-1:~/SC710N2$ sudo dpkg -i  
QCAP/qcap-sdk_1.88.7-igx-r36.1.0_aarch64.deb  
igx@IGX-Orin-1:~/SC710N2$ sudo cp QCAP/yuan-qcap.conf /etc/ld.so.conf.d/  
igx@IGX-Orin-1:~/SC710N2$ sudo ldconfig
```

4. Verify installation of the video capture card driver. The SC710N2 video capture has 2 HDMI input ports. They are enumerated as /dev/video0 and /dev/video2 on the IGX Orin system respectively.

The following example show that HDMI video input signal has been detected on /dev/video0 (video input 0 status is ok).

```
igx@IGX-Orin-1:~$ sudo apt install -y v4l-utils  
igx@IGX-Orin-1:~$ v4l2-ctl -d 0 -DVI  
Driver Info:  
    Driver name      : LXV4L2D_SC0710  
    Card type       : SC0710:RAW 00.00 0002f717  
    Bus info        : PCI Bus 0005:08 12ab0710  
    Driver version   : 13.3.0  
    Capabilities    : 0x84220001  
          Video Capture  
          Audio
```



```

        Streaming
        Extended Pix Format
        Device Capabilities
Device Caps      : 0x04220001
        Video Capture
        Audio
        Streaming
        Extended Pix Format
Video input : 0 (HDMI/TVI/GMSL/SDVOE INPUT(0)): ok)
Format Video Capture:
        Width/Height      : 1920/1080
        Pixel Format      : 'BGR3' (24-bit BGR 8-8-8)
        Field             : None
        Bytes per Line   : 5760
        Size Image        : 6220800
        Colorspace        : Rec. 709
        Transfer Function : Default (maps to Rec. 709)
        YCbCr/HSV Encoding: Default (maps to Rec. 709)
        Quantization     : Default (maps to Full Range)
        Flags             :
igx@IGX-Orin-1:~$
```

And the following example shows that no signal is detected for /dev/video2.

```

igx@IGX-Orin-1:~$ sudo apt install -y v4l-utils
igx@IGX-Orin-1:~$ v4l2-ctl -d 2 -DVI
Driver Info:
        Driver name      : LXV4L2D_SC0710
        Card type        : SC0710:RAW 01.00 0002f717
        Bus info         : PCI Bus 0005:09 12ab0710
        Driver version   : 13.3.0
        Capabilities    : 0x84220001
        Video Capture
        Audio
        Streaming
        Extended Pix Format
```



```

        Device Capabilities
Device Caps      : 0x04220001
                  Video Capture
                  Audio
                  Streaming
                  Extended Pix Format
Video input : 0 (HDMI/TVI/GMSL/SDVOE INPUT(0): no signal, no hsync lock)
Format Video Capture:
Width/Height     : 1920/1080
Pixel Format     : 'YUYV' (YUYV 4:2:2)
Field            : None
Bytes per Line   : 3840
Size Image       : 4147200
Colorspace       : SMPTE 170M
Transfer Function: Default (maps to Rec. 709)
YCbCr/HSV Encoding: Default (maps to ITU-R 601)
Quantization     : Default (maps to Limited Range)
Flags            :
igx@IGX-Orin-1:~$
```

5. Build the QCAP sample code and test the video capture card. The reader needs to prepare HDMI video sources and have them plugged into either (or both) HDMI input connectors on the SC710N2 video capture card.

```

igx@IGX-Orin-1:~$ sudo apt install build-essential qtcreator qtbase5-dev
qt5-qmake cmake
igx@IGX-Orin-1:~$ sudo apt install libva2 libva-drm2 libva-x11-2 libopengl-dev
igx@IGX-Orin-1:~$ cd SC710N2/SC710N4.QT
igx@IGX-Orin-1:~/SC710N2/SC710N4.QT$ qmake
igx@IGX-Orin-1:~/SC710N2/SC710N4.QT$ make
igx@IGX-Orin-1:~/SC710N2/SC710N4.QT$
```

Make sure the make command above succeed without error. Then run the demo app.

```
igx@IGX-Orin-1:~/SC710N2/SC400N4.QT$ ./SC400N4.QT
```



6. Try the holohub demo. Please refer to YUAN's documentation: "Using Yuan's Capture Card V2.0.0_2.pdf" for more details.
7. If the reader would like to know more about applying GPUDirect with the video capture card, refer to YUAN's documentation: "GPUDirect.pdf".

Inventec Confidential



4. System Information and Related Software Tools

This chapter describes how to check system information of the IGX Orin system, as well as some of the software tools.

4.1. CPU, system information and temperature sensors

The reader could use certain Linux commands to check CPU information, overall system information, and temperature sensor information on the IGX Orin system, as illustrated below.

`sudo dmesg` could be used to check kernel boot messages and logs.

```
igx@IGX-Orin-1:~$ sudo dmesg
[    0.000000] Booting Linux on physical CPU 0x0000000000 [0x410fd421]
[    0.000000] Linux version 5.15.0-1012-nvidia-tegra-igx
(buildd@bos03-arm64-031) (gcc (Ubuntu 11.4.0-1ubuntu1~22.04) 11.4.0, GNU ld (GNU
Binutils for Ubuntu) 2.38) #12-Ubuntu SMP Wed Apr 24 15:57:28 UTC 2024 (Ubuntu
5.15.0-1012.12-nvidia-tegra-igx 5.15.148)
[    0.000000] Machine model: NVIDIA IGX Orin Development Kit
[    0.000000] efi: EFI v2.70 by EDK II
.....
igx@IGX-Orin-1:~$
```

`cat /proc/cpuinfo` could show more information about the CPU.

```
igx@IGX-Orin-1:~$ cat /proc/cpuinfo
processor      : 0
BogoMIPS       : 62.50
Features       : fp asimd evtstrm aes pmull sha1 sha2 crc32 atomics fphp asimdhfp
cpuid asimdrdm lrcpc dcpop asimddp uscat ilrcpc flagm paca pacg
CPU implementer : 0x41
CPU architecture: 8
CPU variant    : 0x0
CPU part       : 0xd42
CPU revision   : 1
```



```
.....
igx@IGX-Orin-1:~$
```

`sudo lspci -tv` could be used to list all PCIe devices in the system. Or `sudo lspci -vvv` could be used to display more detailed information about each PCIe device.

Here's an example of iGPU case.

```
igx@IGX-Orin-1:~$ sudo lspci -tv
-+-[0007:00]---00.0-[01-ff]---00.0  Marvell Technology Group Ltd. 88SE9235 PCIe
2.0 x2 4-port SATA 6 Gb/s Controller
 +-[0005:00]---00.0-[01-ff]---00.0-[02-09]---00.0-[03]---00.0  Mellanox
Technologies MT2910 Family [ConnectX-7]
 |
 |                               \--00.1  Mellanox
Technologies MT2910 Family [ConnectX-7]
 |
 +-01.0-[04-06]---00.0-[05-06]---08.0-[06]--
 |
 \-02.0-[07-09]---00.0-[08-09]---00.0-[09]--
 +-[0004:00]---00.0-[01-ff]---00.0  Sandisk Corp WD Blue SN550 NVMe SSD
 +-[0001:00]---00.0-[01-ff]---00.0-[02-fc]---01.0-[03-34]---00.0  Realtek
Semiconductor Co., Ltd. RTL8111/8168/8411 PCI Express Gigabit Ethernet Controller
 |
 |                               +-02.0-[35-66]---00.0  Realtek
Semiconductor Co., Ltd. RTL8111/8168/8411 PCI Express Gigabit Ethernet Controller
 |
 |                               +-03.0-[67-98]---00.0  Device
1c00:3450
 |
 |                               +-04.0-[99-ca]---00.0-[9a]---00.0
ASPEED Technology, Inc. ASPEED Graphics Family
 |
 |                               \-02.0
ASPEED Technology, Inc. Device 2603
 |
 |                               \-05.0-[cb-fc]--
\-[0000:00]-
igx@IGX-Orin-1:~$
```

And here's an example of the dGPU case.



```
igx@IGX-Orin-2U-2:~$ sudo lspci -tv
+-[0007:00]--00.0-[01-ff]---00.0 Marvell Technology Group Ltd. 88SE9235 PCIe
2.0 x2 4-port SATA 6 Gb/s Controller
+-[0005:00]--00.0-[01-ff]---00.0-[02-09]--+00.0-[03]---00.0 Mellanox
Technologies MT2910 Family [ConnectX-7]
|
|           \-00.1 Mellanox
Technologies MT2910 Family [ConnectX-7]
|
+-01.0-[04-06]---00.0-[05-06]---08.0-[06]--
|
\-02.0-[07-09]---00.0-[08-09]---00.0-[09]--+00.0 NVIDIA Corporation Device
26b1
|
\-00.1 NVIDIA Corporation Device 22ba
+-[0004:00]--00.0-[01-ff]---00.0 Sandisk Corp WD Blue SN550 NVMe SSD
+-[0001:00]--00.0-[01-ff]---00.0-[02-fc]--+01.0-[03-34]---00.0 Realtek
Semiconductor Co., Ltd. RTL8111/8168/8411 PCI Express Gigabit Ethernet Controller
|
|           +-02.0-[35-66]---00.0 Realtek
Semiconductor Co., Ltd. RTL8111/8168/8411 PCI Express Gigabit Ethernet Controller
|
|           +-03.0-[67-98]---00.0 Device
1c00:3450
|
|           +-04.0-[99-ca]---00.0-[9a]--+00.0
ASPEED Technology, Inc. ASPEED Graphics Family
|
|           \-02.0
ASPEED Technology, Inc. Device 2603
|
|           \-05.0-[cb-fc]--
\-[0000:00]-
igx@IGX-Orin-2U-2:~$
```

Furthermore, this is an example of the dGPU case with a YUAN SC710N2-L HDMI 2.0 video capture card.

```
igx@IGX-Orin-2U-2:~$ sudo lspci -tv
+-[0007:00]--00.0-[01-ff]---00.0 Marvell Technology Group Ltd. 88SE9235 PCIe
2.0 x2 4-port SATA 6 Gb/s Controller
+-[0005:00]--00.0-[01-ff]---00.0-[02-0c]--+00.0-[03]---00.0 Mellanox
```



```

Technologies MT2910 Family [ConnectX-7]
|
Technologies MT2910 Family [ConnectX-7]
|
+-01.0-[04-09]----00.0-[05-09]----08.0-[06-09]----00.0-[07-09]---+01.0-[08]--
--00.0 YUAN High-Tech Development Co., Ltd. Device 0710
|
\02.0-[09]----00.0 YUAN High-Tech Development Co., Ltd. Device 0710
|
\02.0-[0a-0c]----00.0-[0b-0c]----00.0-[0c]---+00.0 NVIDIA Corporation Device
26b1
|
\00.1 NVIDIA Corporation Device 22ba
+-[0004:00]---00.0-[01-ff]----00.0 Sandisk Corp WD Blue SN550 NVMe SSD
+-[0001:00]---00.0-[01-ff]----00.0-[02-fc]---+01.0-[03-34]----00.0 Realtek
Semiconductor Co., Ltd. RTL8111/8168/8411 PCI Express Gigabit Ethernet Controller
|
+02.0-[35-66]----00.0 Realtek
Semiconductor Co., Ltd. RTL8111/8168/8411 PCI Express Gigabit Ethernet Controller
|
+03.0-[67-98]----00.0 Device
1c00:3450
|
+04.0-[99-ca]----00.0-[9a]---+00.0
ASPEED Technology, Inc. ASPEED Graphics Family
|
ASPEED Technology, Inc. Device 2603
|
\05.0-[cb-fc]--
\-[0000:00]-
igx@IGX-Orin-2U-2:~$
```

hardinfo could be used to check overall system information, including CPU, RAM, disk, PCIe/USB devices, Linux system, and thermal sensors, etc.

- Installation: `sudo apt install hardinfo`
- Execution: `hardinfo`

The hardinfo screenshots below show CPU and temperature sensor information on the IGX Orin system.



System Information

Information View Help

Refresh Generate Report Copy to Clipboard

Computer

- Summary
- Operating System
- Kernel Modules
- Boots
- Languages
- Filesystems
- Display
- Environment Variables
- Development
- Users
- Groups

Devices

- Device Tree
- Processor
- Memory
- PCI Devices
- USB Devices
- Printers
- Battery
- Sensors
- Input Devices

Computer → Summary

Operating System
Ubuntu 22.04.4 LTS

CPU
(Unknown)
12x ARM 0xd42 r0p1 (AArch64)

RAM
56106196 KiB

Motherboard
NVIDIA IGX Orin Development Kit

Graphics
1920x1080
(Unknown)
The X.Org Foundation

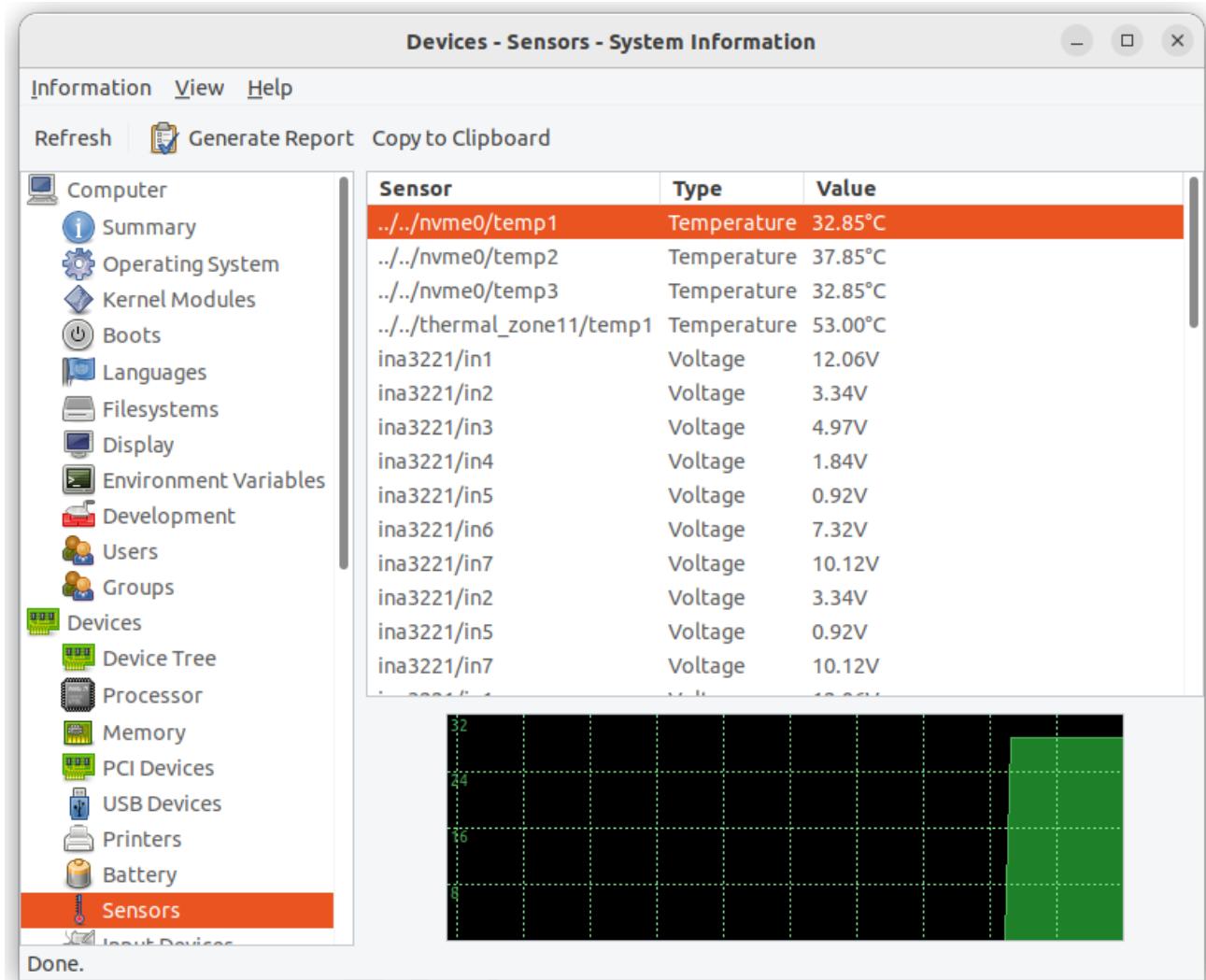
Storage

Printers

Audio
USB-Audio - USB2 Controller Hub

Done.

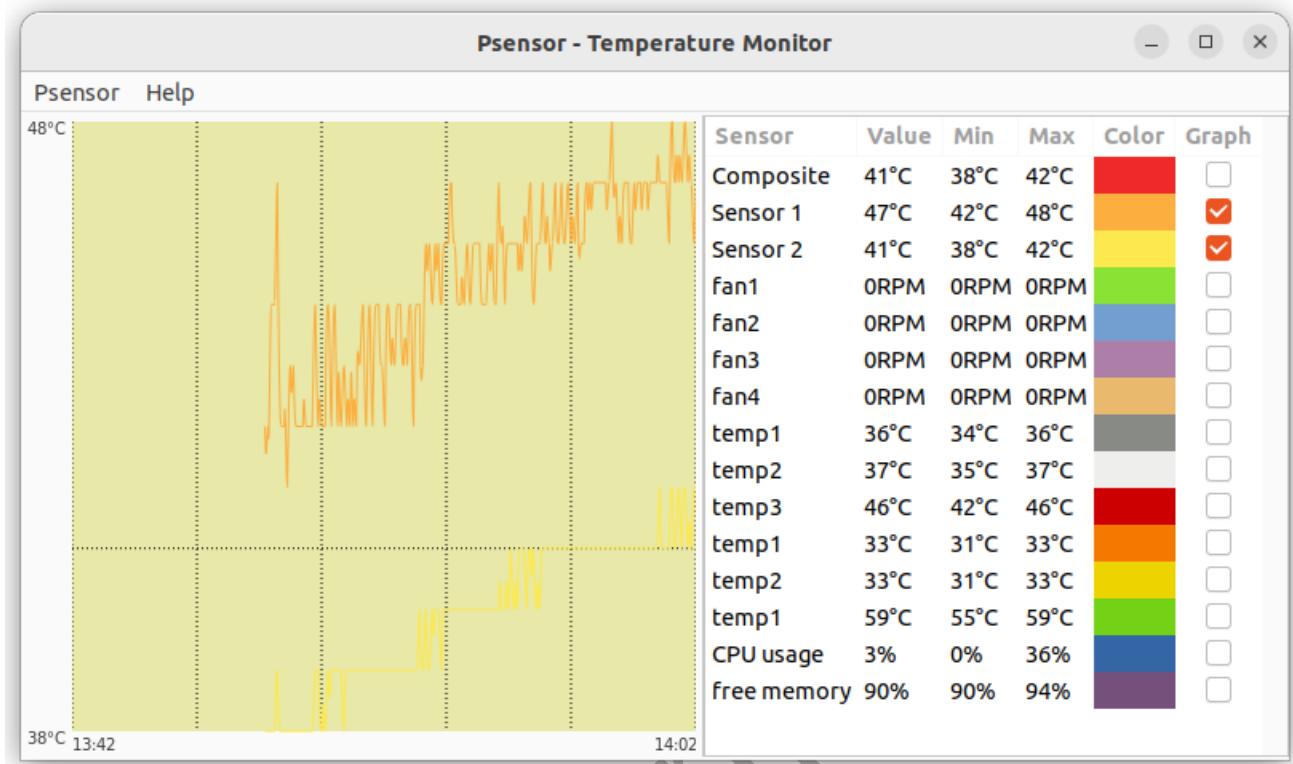
The screenshot shows the 'System Information' application window. The left sidebar has a tree view with 'Computer' and 'Devices' sections. The 'Computer' section is expanded, showing options like Summary, Operating System, Kernel Modules, etc. The 'Devices' section is also expanded, showing options like Device Tree, Processor, Memory, etc. The main right panel is titled 'Computer → Summary' and lists system components with their details. A red arrow points to the 'CPU' entry, which shows '(Unknown)' and '12x ARM 0xd42 r0p1 (AArch64)'. Another red arrow points to the 'Motherboard' entry, which shows 'NVIDIA IGX Orin Development Kit'. Other listed components include RAM (56106196 KiB), Graphics (1920x1080, Unknown, The X.Org Foundation), Storage, Printers, and Audio (USB-Audio - USB2 Controller Hub). At the bottom left, there's a watermark 'Inventec' diagonally across the screen.



psensor could also be used to monitor temperature sensors on the IGX Orin system. More specifically, the reader could check current value, minimum and maximum (over the monitoring period) of the temperature sensor reading from the GUI.

- Installation: `sudo apt install psensor`
- Execution: `psensor`

Here's an example screenshot.



4.2. GPU information

`tegrastats` could be used to monitor CPU/GPU clock frequencies, usage, power consumption, and temperature.

- Installation: none
- Execution: `tegrastats`
- Documentation: [tegrastats Utility](#)

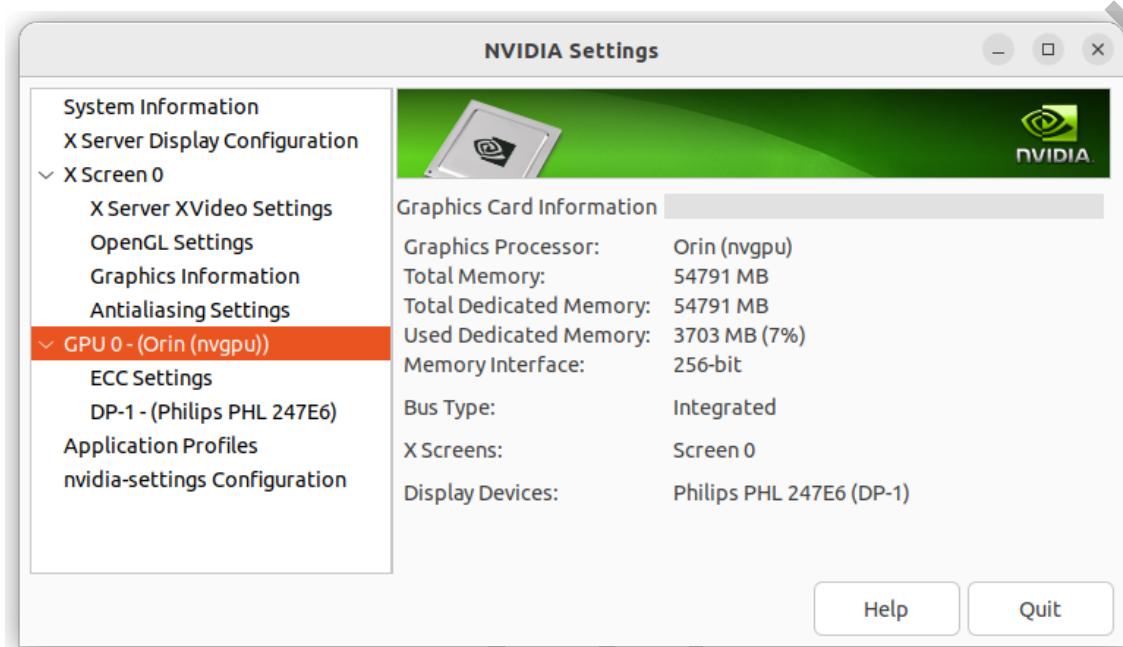
```
igx@IGX-Orin-1:~$ tegrastats
10-15-2024 13:57:49 RAM 2854/54791MB (lfb 4x4MB) SWAP 0/27396MB (cached 0MB) CPU [0%@883,1%
@883,0%@883,0%@729,0%@729,1%@729,0%@729,0%@729,0%@729,0%@729] GR3D FREQ 0%
cpu@45.656C tboard@32.125C soc2@39.843C tdiode@32.375C soc0@45.375C gpu@41.875C tj@48.312C
mlx5@58C soc1@48.343C VDD GPU SOC 5297mW/5297mW VDD CPU CV 240mW/240mW VIN_SYS_5V0 8279mW
/8279mW VDDQ_VDD2_1V8A0 985mW/985mW CVB_ATX_12V 11340mW/11340mW CVB_ATX_3V3 1538mW/1538mW
CVB_ATX_5V 18311mW/18311mW channel1 6082mW/6082mW
^C
igx@IGX-Orin-1:~$
```

`nvidia-settings` could be used to check various information about the NVIDIA GPU and



driver.

- Installation: none
- Execution: `nvidia-settings`



`nvidia-smi` could be used to query the dGPU and corresponding driver information.

- Installation: none
- Execution: `nvidia-smi`



```

igx@IGX-Orin-1:~$ nvidia-smi
Tue Oct 15 13:56:53 2024
+-----+
| NVIDIA-SMI 540.3.1           Driver Version: N/A          CUDA Version: 12.2 |
+-----+
| GPU  Name        Persistence-M  Bus-Id      Disp.A  Volatile Uncorr. ECC |
| Fan  Temp     Perf            Pwr:Usage/Cap | Memory-Usage | GPU-Util  Compute M.  |
|          |          |          |          |          |          |          |          |
| 0  Orin (nvgpu)   N/A          N/A / N/A    Not Supported  N/A       N/A       N/A |
|          |          |          |          |          |          |          |          |
+-----+
| Processes:                               GPU Memory |
| GPU  GI  CI      PID  Type  Process name        Usage  |
|          ID  ID
+-----+
| No running processes found
+-----+
igx@IGX-Orin-1:~$ 

```

`nvidia-smi` could also be used to check VBIOS version of the dGPU.

```

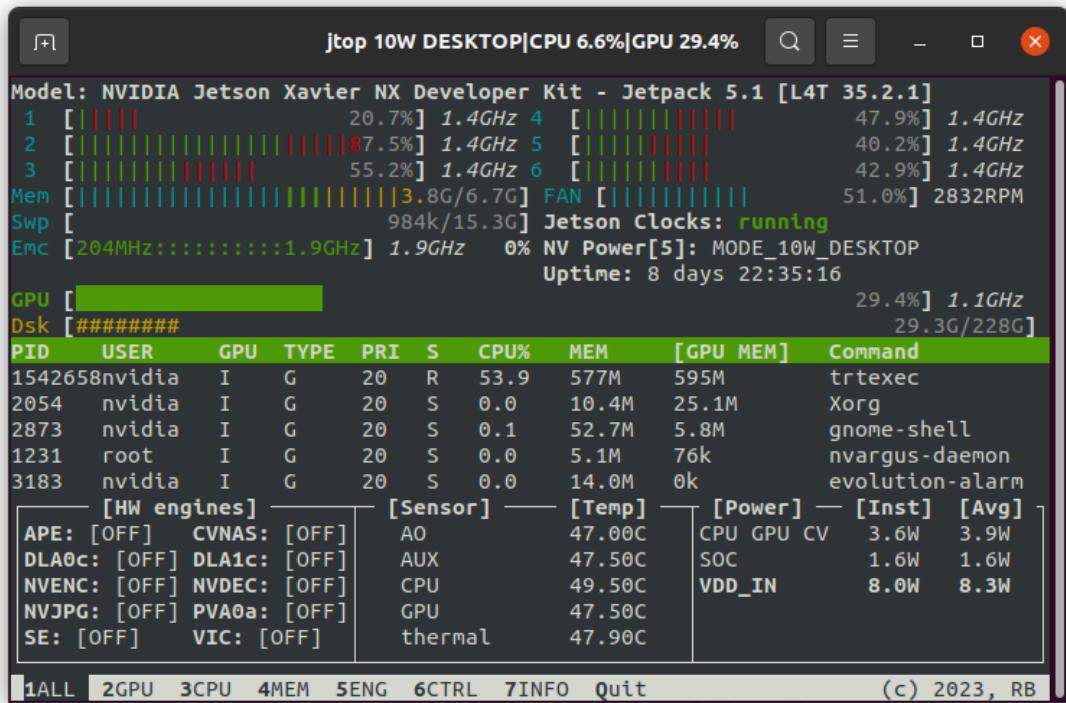
igx@IGX-Orin-1:~$ nvidia-smi --query-gpu=vbios_version --format=csv
vbios_version
XX.XX.XX.XX.XX
igx@IGX-Orin-1:~$ 

```

`jtop` might be used to monitor and control the IGX Orin system. More specifically, it monitors system stats and update information on the screen in real-time. The displayed information includes CPU utilization, status of various devices, memory status, swap status, system clock information, and performance/power settings, etc..

- Installation: `sudo apt install jetson-stats`
- Reference: https://rnext.it/jetson_stats/
- Execution: `jtop`

Although `jtop` works for NVIDIA AGX Orin, it doesn't seem to work on IGX Orin based on Inventec team's testing. For installation, please refer to this GitHub link: [setup.py #88](#). In addition, the python code needs to be tweaked a little otherwise it crashes on IGX Orin. As such, this paragraph is here for reference only.



4.3. Stress testing

`s-tui` could be used to stress test the CPU and memory on the IGX Orin system. This tool could also be used to generate CPU workloads for thermal testing. `s-tui` displays CPU utilization and temperature during stress tests.

- Installation: `sudo apt install s-tui stress`
- Execution: `s-tui`

The reader could select "Stress" (under "Modes") to start the CPU/memory stress tests, and then select "Quit" (under "Control Options") to stop the tests.



gpu-burn could be used to stress test the GPU on the IGX Orin system. This tool could also be used to generate GPU workloads for thermal testing. (TODO: Double check this gpu-burn tool...)

Installation:

```
igx@IGX-Orin-1:~$ mkdir -p tests
igx@IGX-Orin-1:~$ cd tests/
igx@IGX-Orin-1:~/tests$ git clone https://github.com/wilicc/gpu-burn.git
igx@IGX-Orin-1:~/tests$ cd gpu-burn/
igx@IGX-Orin-1:~/tests/gpu-burn$ make
..... (compilation with some warnings)
```



```
igx@IGX-Orin-1:~/tests/gpu-burn$
```

Execution: `./gpu_burn <test time in seconds>`

Please note the executable file name is with an underscore “_” instead of a hyphen “-”. The following example shows how to run `gpu_burn` continuously for 1 hour (3600 seconds). The reader could hit **Ctrl-C** to terminate `gpu_burn` prematurely.

A screenshot of a terminal window titled "igx@IGX-Orin-1: ~/tests/gpu-burn". The window contains the following text:

```
igx@IGX-Orin-1:~/tests/gpu-burn$ ./gpu_burn 3600
Using compare file: compare.ptx
Burning for 3600 seconds.
GPU 0: Orin (nvgpu) (UUID: 713dc7c9-d390-5ab8-ad10-e45d1971cc95)
^C
```