

SUNIX AI Accelerator Card

User Manual

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Safety Information

1. Keep this User's Manual for future reference.
2. Always read the safety information carefully.
3. Keep this equipment away from direct sunlight, or in humid or damp places.
4. Do not place this equipment in an unstable position, or on vibrating surface before setting it up.
5. Do not use or place this equipment near magnetic fields, televisions, or radios to avoid electronic interface that affects device performance.



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1. System Requirements

Hardware:

Host system CPU Architecture

- x86 or ARM based
- 16+ GB RAM (32+ GB recommended)

Software:

Pre-requisite

- Access to Hailo Developer Zone
- Ubuntu 20.04/22.04, 64 bit
 - Hailo software package support :
 - Dataflow Compiler
 - HailoRT
 - PCIe Driver
 - pyHailoRT
 - Integration Tool
 - Model Zoo
 - TAPPAS
- Microsoft Windows 10/11, 64 bit
 - Hailo software package support :
 - HailoRT
 - PCIe Driver
 - pyHailoRT

AI frameworks support :

- TensorFlow
- TensorFlow Lite
- Keras
- PyTorch

2. Hardware Installation

The hardware installation of PCI Express AI accelerator board is easy to carry out. Before inserting the card into the PCIe bus, please follow the detailed steps given below to install the board in your computer.

**SAFETY FIRST**

To avoid damaging to the computer, make sure to remove any power connection before card installation.

Step 1: Turn your PC's power off, and shut off the power to any peripheral.

Step 2: Remove the power plug from the plug socket.

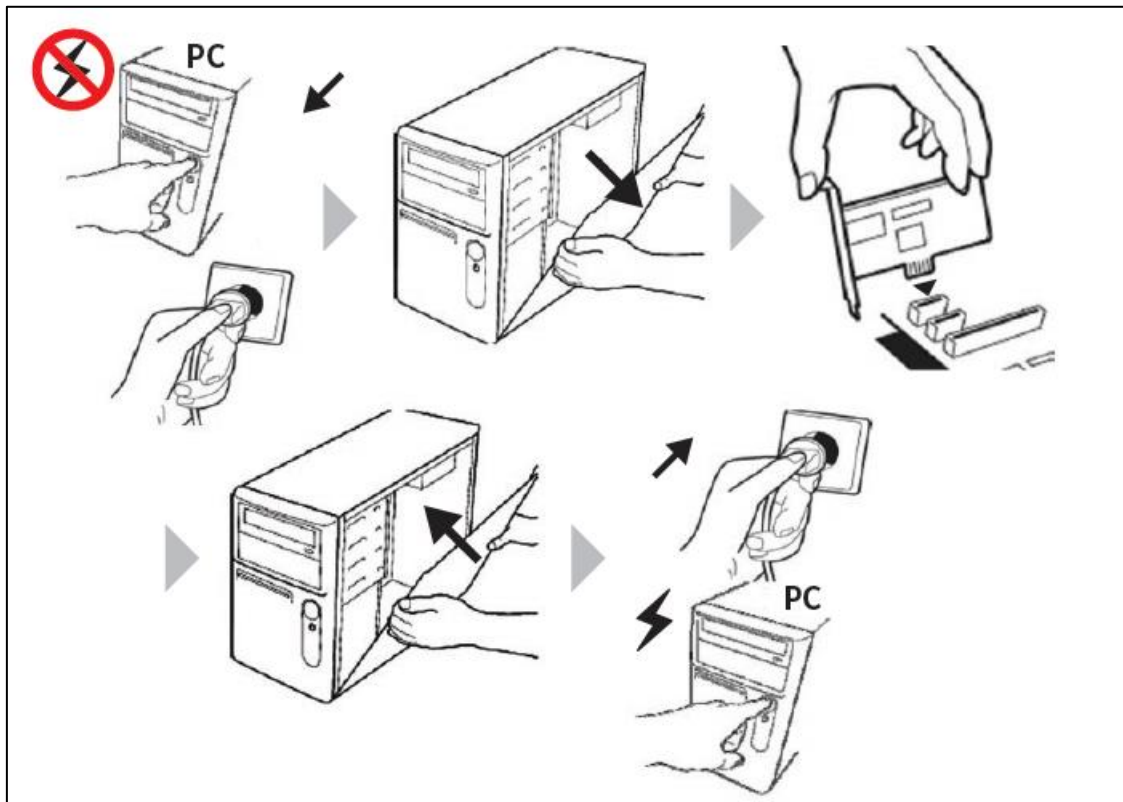
Step 3: Remove the cover from the computer case.

Step 4: If fitted. Remove the metal cover plate on the rear of a free PCIe slot.

Step 5: Insert PCI Express AI accelerator board into the free PCIe slot and screw it firmly on the bracket side.

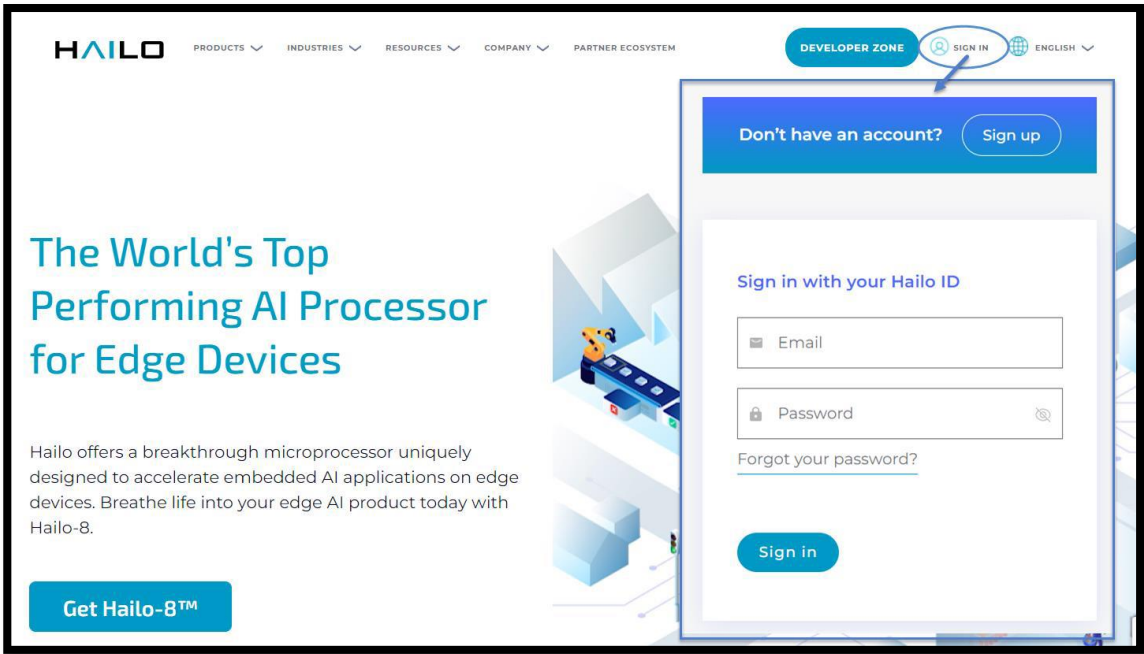
Step 6: Place the cover back onto the computer.

Step 7: Insert the plug into the plug socket.



3. Hailo Developer Zone Sign Up

Visit hailo web site : <https://hailo.ai>




Hailo Developer Zone – Choose access

The screenshot shows the Hailo Developer Zone 'Choose access' page. The header is identical to the previous screenshot. Below the header, there are three columns representing different access levels: Basic, Advanced, and Full. Each column has a 'Choose access' button. The 'Full' column is highlighted with a blue border and a blue arrow pointing to its 'Choose access' button. Below the columns is a table comparing the features and support for each access level.

	Basic	Advanced	Full
	Recommended for users who would like to get to know Hailo's offering	Recommended for users who would like to start prototyping or developing using Hailo Your product has been purchased from Partner	Recommended for users who develop commercial products using Hailo Your product has been purchased directly from Hailo
	Choose access	Choose access	Choose access
Hailo build and runtime Software documentation access	✓	✓	✓
Hailo build and runtime Software download	—	✓	✓
Use of Hailo's Model Zoo and retrain capabilities	—	✓	✓
Build your own models	—	—	✓
Hailo Hardware design integration guides and documentation access	—	—	✓
Support level	—	Limited	Full
Access approval	Immediate	Immediate*	Pending approval

*Based on purchased product ID

Hailo Developer Zone – Fill info & Submit



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Full access

Recommended for users who develop commercial products using Hailo Your product has been purchased directly from Hailo


[Need help?](#) devzone_support@hailo.ai

Contact & Company information

☐ I accept the Privacy Policy

[Submit Request](#)

Hailo Developer Zone – Waiting for Approval



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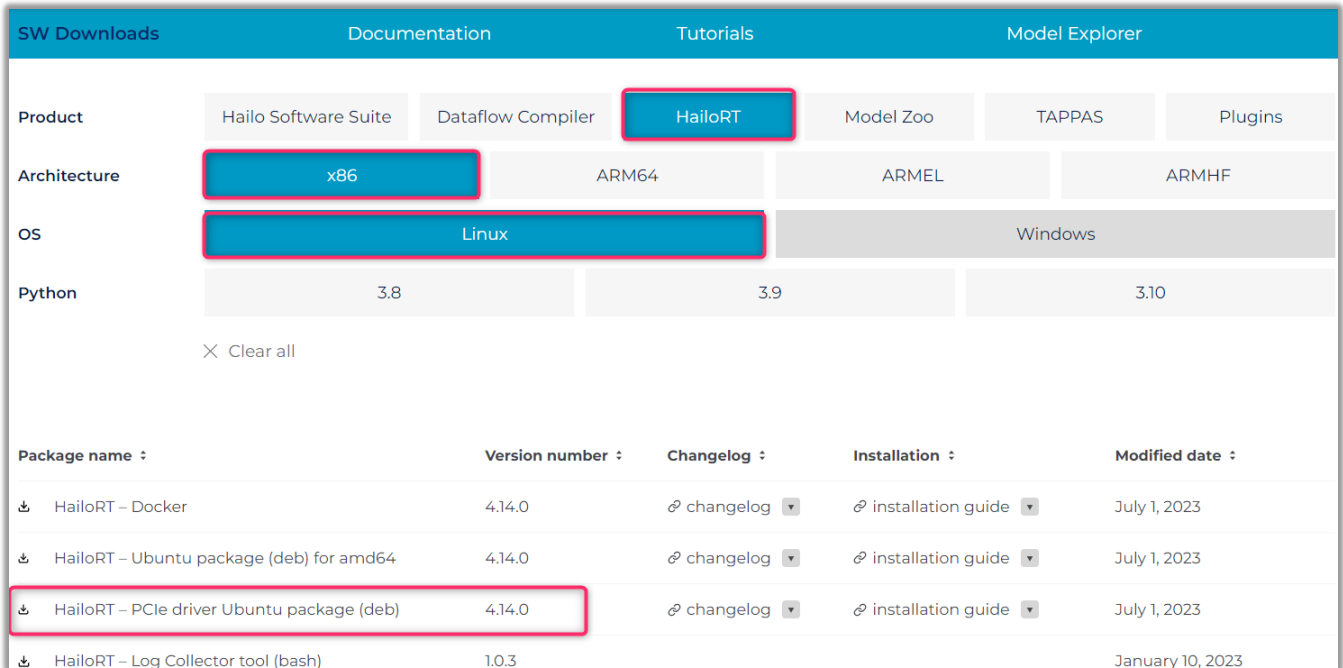
Thank you!

We received your information and will be in touch soon

(Pending approval)

4. Driver Installation

(1) HailoRT, PCIe Driver Linux Packages Download



Package name	Version number	Changelog	Installation	Modified date
HailoRT - Docker	4.14.0	changelog	installation guide	July 1, 2023
HailoRT - Ubuntu package (deb) for amd64	4.14.0	changelog	installation guide	July 1, 2023
HailoRT - PCIe driver Ubuntu package (deb)	4.14.0	changelog	installation guide	July 1, 2023
HailoRT - Log Collector tool (bash)	1.0.3			January 10, 2023

(2) HailoRT, PCI Driver Linux Installation

install required system packages

sudo apt update

sudo apt install build-essential make cmake dpkg dkms

sudo apt install linux-headers-\$(uname -r)

sudo apt install linux-image-\$(uname -r)

install driver - issuing below commands in Terminal

sudo dpkg --install hailort_pcie_driver_x.x.x_all.deb

install HailoRT x86 64 (AMD 64) version

sudo dpkg --install hailort_x.x.x_amd64.deb

reboot to apply driver installation

sudo reboot

5. Installation Verification

After successfully installing SUNIX AI Board into the network appliance, please follow the steps below to complete SUNIX PCIe enumeration verification process.

Step 1: Power ON the host system and log on to Linux.

Step 2: Verify that the SUNIX AI board processor is detected on the PCIe bus. From a Linux terminal, type:

Commands

(1) Check that your board is recognized by the host by running:

lspci | grep Co-processor

(2) Find Hailo virtual environment:

source hailo_platform_venv/bin/activate

(3) Verify (while in Hailo environment):

hailo fw-control identify



```
lanner@lanner-Default-string: ~/Desktop/Tappas_v3.9.0/hailo_apps
File Edit View Search Terminal Help
(hailo_apps_venv) lanner@lanner-Default-string:~/Desktop/Tappas_v3.9.0/hailo_apps$ hailo fw-control identify
(hailo) Running command 'fw-control' with 'hailortcli'
Identifying board
Control Protocol Version: 2
Firmware Version: 2.9.0 (release,app)
Logger Version: 0
Board Name: Hailo-8
Device Architecture: HAILO8_B0
Serial Number: HLUTMB0212400081
Part Number: HM210B1C2LA
Product Name: HAILO-8 AI ACCELERATOR M.2 B+M KEY MODULE

(hailo_apps_venv) lanner@lanner-Default-string:~/Desktop/Tappas_v3.9.0/hailo_apps$
```


6. Hailo software suite overview

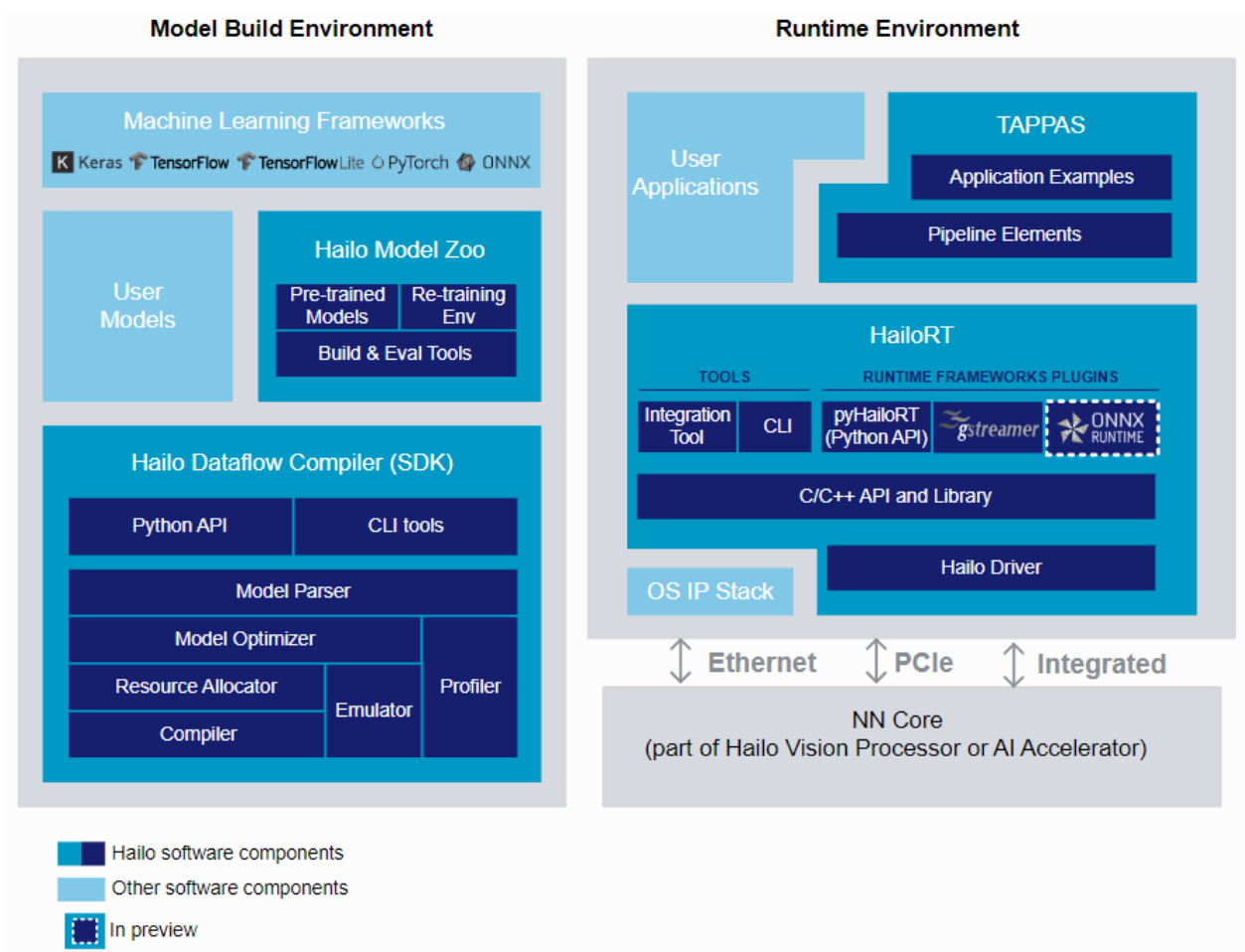
Getting Started Guide

Hailo SW products are set of frameworks and tools that enable you to compile, run and evaluate neural networks on Hailo devices:

1. **Dataflow Compiler** (Model conversion and compilation to Hailo binary format)
2. **HailoRT** (Runtime environment and driver for running networks and interacting with Hailo devices)
3. **Model Zoo** (Pre-trained models to run and evaluate on Hailo devices)
4. **TAPPAS** (Deployment framework, examples and multi-network pipelines)

Although you can install each product separately, Hailo releases a quarterly software suite in which all the product versions are aligned. Therefore, using Hailo SW Suites ensures the best compatibility.

Suite Components



Detailed block diagram of Hailo software packages

Hailo SW components are used in this manner:

➤ **On the Model build environment:**

- Hailo Dataflow Compiler is used to compile a trained model to run on Hailo devices.
- Hailo Model Zoo contains a large database of pre-trained models that are validated to work with best performance on Hailo devices. It also contains a retraining environment.

➤ **On the Runtime environment:**

- HailoRT is used to load the compiled model to Hailo device and interact with it (using the PCIe driver).
- TAPPAS includes complete examples and demos of using HailoRT to create full pipelines on top of Hailo devices.

Dataflow Compiler

The Dataflow Compiler API is used for compiling models to Hailo binaries. The input of the Dataflow Compiler is a trained Deep Learning model. The output is a binary file which is loaded to the Hailo device.

HailoRT

The HailoRT API is used for deploying the built model on the target device. This library is used by the runtime applications.

It implements a userspace C/C++ API that is called from the user's applications. It allows both to control the Hailo device and to send and receive data from it. It supports both the PCIe interface.

The HailoRT Python package wraps the C/C++ API and exposes a Python interface that allows to load models to the device and send and receive data from it.

It also includes a PCIe driver is required when working via the PCIe interface. It links the HailoRT library and the device. It also loads the device's firmware when working through this interface.

Finally, Hailo's Yocto layer allows the user to integrate Hailo's software into an existing Yocto environment. It includes recipes for the HailoRT library, Python package and the PCIe driver.

Hailo Model Zoo

Hailo Model Zoo provides pre-trained models for high-performance deep learning applications.

Using the Hailo Model Zoo you can measure the full precision accuracy of each model, the optimized accuracy using the Hailo Emulator and measure the accuracy on the Hailo-8 device.

Finally, you will be able to generate the Hailo Executable Format (HEF) binary file to speed-up development and generate high quality applications accelerated with Hailo-8. The models are optimized for high accuracy on public datasets and can be used to benchmark the Hailo model optimization scheme.

TAPPAS

TAPPAS is Hailo's set of full application examples, implementing pipeline elements and pre-trained AI tasks.

Demonstrating Hailo's system integration scenario of specific use cases on predefined systems (software and Hardware platforms). It can be used for evaluations, reference code and demos:

- Accelerating time to market by reducing development time and deployment effort
- Simplifying integration with Hailo's runtime SW stack
- Providing a starting point for customers to fine-tune their applications

For the most updated versions, please visit [Hailo developer site](#) for the latest installation manuals and software installation packages.

7. HailoRT installation

7-1 Packages download and installation





Windows OS platform

- (1) Sign in Hailo's Developer Zone => <https://developer.hailo.ai/developer-zone>
Download windows installer

Select your system components

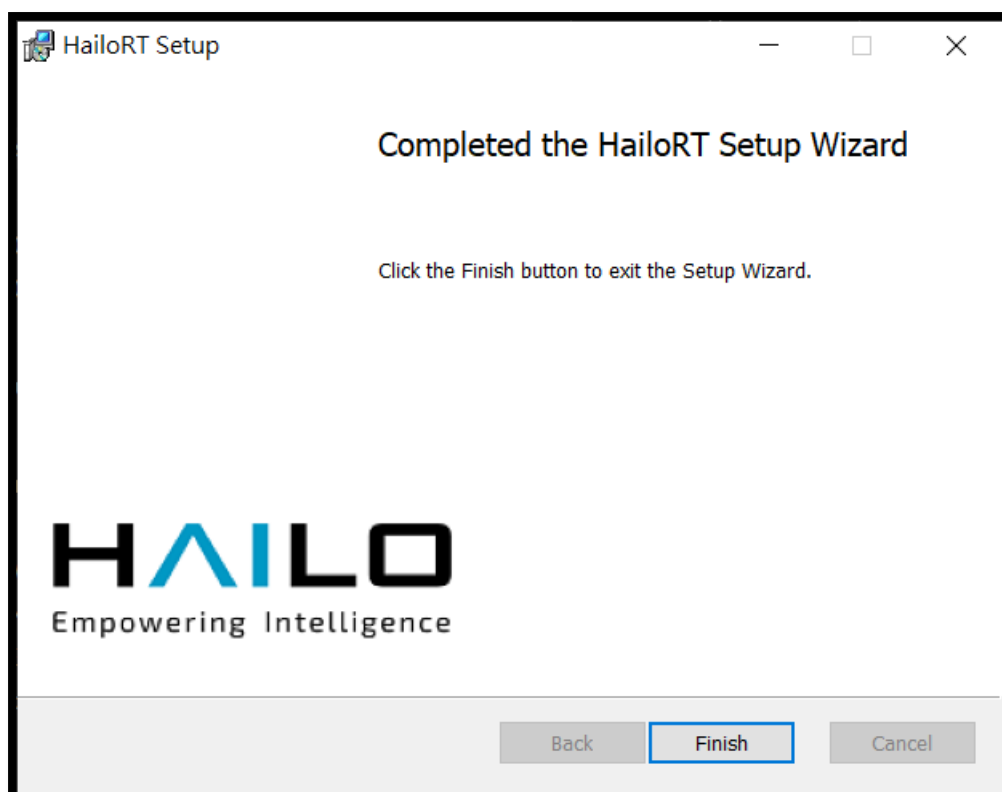
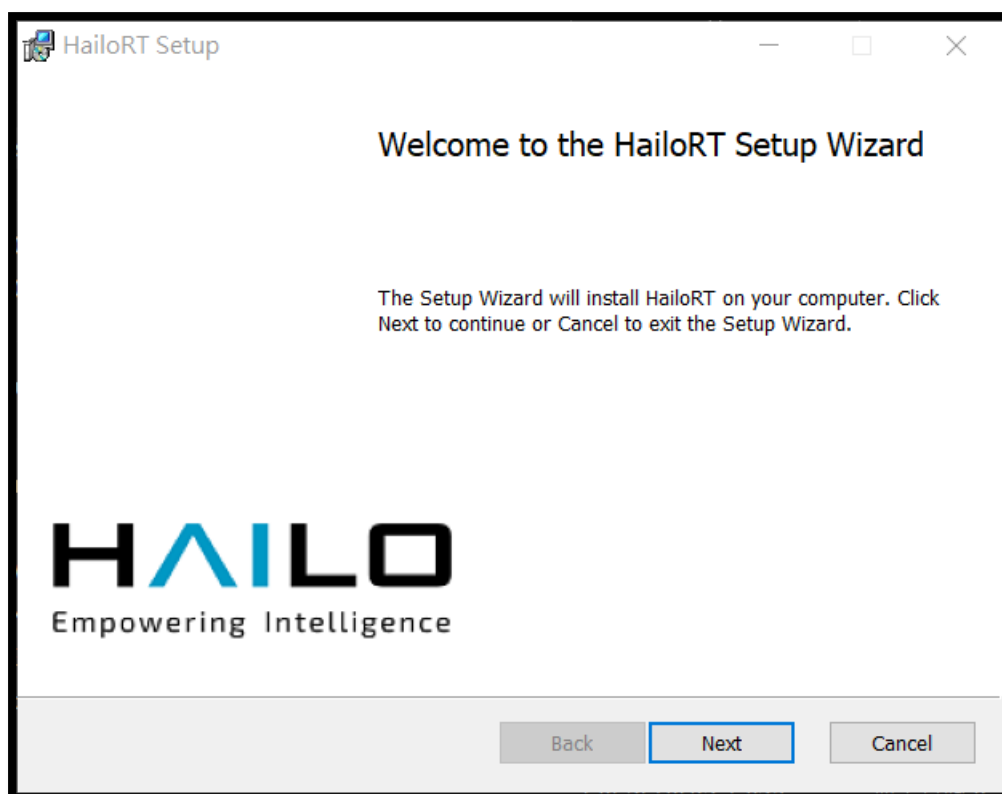
Product	Hailo Software Suite	Dataflow Compiler	HailoRT	Model Zoo	TAPPAS	Plugins
Architecture	x86		ARM64	ARMEL	ARMHF	
OS	Linux			Windows		
Python	3.8		3.9	3.10		

✕ Clear all

Package name :	Version number :	Changelog :	Installation :	Modified date :
 Hailo Integration Tool – Windows package for x86_64	1.15.0			October 9, 2023
 HailoRT – Windows installer	4.15.0	 changelog	 installation guide	October 8, 2023

SW Products	Windows
HailoRT	Windows Installer
PCIe Driver pyHailoRT(*preview)	

(2) Execute [hailort_x.x.x_windows_install.msi](#) to install.



Linux OS platform

- (1) Sign in Hailo's Developer Zone => <https://developer.hailo.ai/developer-zone>
Download HailoRT & PCIe-driver packages

Select your system components

Product	Hailo Software Suite	Dataflow Compiler	HailoRT	Model Zoo	TAPPAS	Plugins
Architecture	x86	ARM64	ARMEL	ARMHF		
OS	Linux			Windows		
Python	3.8	3.9	3.10			

✕ Clear all

Package name	Version number	Changelog	Installation	Modified date
HailoRT - Docker	4.15.0	changelog	installation guide	October 8, 2023
HailoRT - Ubuntu package (deb) for amd64	4.15.0	changelog	installation guide	October 8, 2023
HailoRT - PCIe driver Ubuntu package (deb)	4.15.0	changelog	installation guide	October 8, 2023

- (2) HailoRT, PCI-Driver : Linux Installation

install required system packages

`sudo apt update`

`sudo apt install build-essential make cmake dpkg dkms`

`sudo apt install linux-headers-$(uname -r)`

`sudo apt install linux-image-$(uname -r)`

install driver-issuing below commands in Terminal

`sudo dpkg --install hailort-pcie-driver_x.x.x_all.deb`

install HailoRT x86 64 (AMD 64) version

`sudo dpkg --install hailort_x.x.x_amd64.deb`

reboot to apply driver installation

`sudo reboot`

After boot, continue next slice to verify the HailoRT & Driver installation

7-2 Device scan & identify

(1) HailoRT, Driver : Check The Installation

verify the driver installation

`lspci | grep Co-processor`



```
65:00.0 Co-processor: Hailo Technologies Ltd. Hailo-8 AI Processor (rev 01)
```

Figure 4: Results if PCIe IDs are up to date

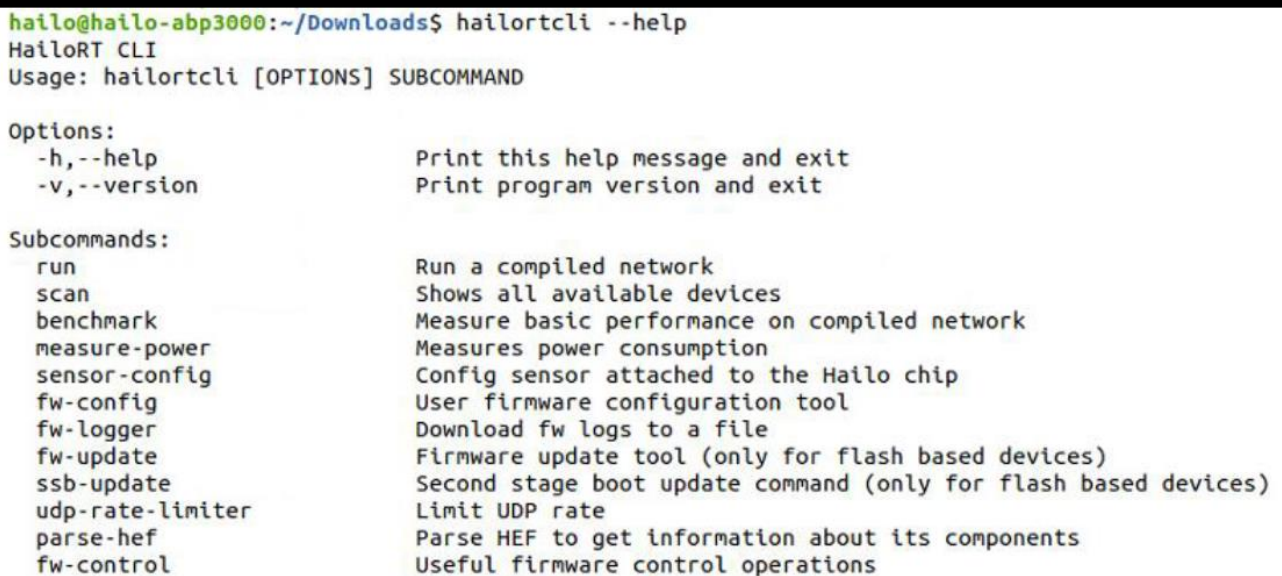


```
04:00.0 Co-processor: Device 1e60:2864 (rev 01)
```

Figure 5: Results if PCIe IDs are not up to date

get help from hailortcli

`hailortcli --help`



```
hailo@hailo-abp3000:~/Downloads$ hailortcli --help
HailoRT CLI
Usage: hailortcli [OPTIONS] SUBCOMMAND

Options:
  -h, --help            Print this help message and exit
  -v, --version          Print program version and exit

Subcommands:
  run                    Run a compiled network
  scan                   Shows all available devices
  benchmark              Measure basic performance on compiled network
  measure-power          Measures power consumption
  sensor-config          Config sensor attached to the Hailo chip
  fw-config              User firmware configuration tool
  fw-logger              Download fw logs to a file
  fw-update              Firmware update tool (only for flash based devices)
  ssb-update             Second stage boot update command (only for flash based devices)
  udp-rate-limiter       Limit UDP rate
  parse-hef              Parse HEF to get information about its components
  fw-control             Useful firmware control operations
```

(2) HailoRT, Driver : Check The Installation (cont.)

show all available devices & the BDF (PCI Domain:Bus:Device.Function)

`hailortcli scan`

```
abp3000@abp3000-lpc:~$ hailortcli scan
Hailo PCIe Devices:
[-] Device BDF: 0000:02:00.0
[-] Device BDF: 0000:03:00.0
abp3000@abp3000-lpc:~$
```

display device info (if only single device installed)

`hailortcli fw-control identify`

```
hailo@hailo-abp3000:~/Downloads$ hailortcli fw-control identify
Identifying board
Control Protocol Version: 2
Firmware Version: 4.8.1 (release,app)
Logger Version: 0
Board Name: Hailo-8
Device Architecture: HAIL08_B0
Serial Number: HLLWM20205200498
Part Number: HM218B1C2FA
Product Name: HAILO-8 AI ACCELERATOR M.2 M KEY MODULE
```


8. Compiling HailoRT

(1) Compiling from Sources-HailoRT (runtime library)

install git and build packages

```
sudo apt update
```

```
sudo apt install build-essential make cmake dpkg dkms git curl
```

download HailoRT

```
git clone https://github.com/hailo-ai/hailort.git
```

compiling HailoRT source

```
cd hailort/
```

```
cmake -H. Bbuild -DCMAKE_BUILD_TYPE=Release -DHAILO_BUILD_EXAMPLES=1
```

```
sudo cmake --build build --config release --target install
```

back to installation directory for HailoRT PCIe Driver installation

```
cd ../
```

(2) Compiling from Sources-HailoRT-PCI Driver

install git and build packages (skipped if continue from previous slice)

```
sudo apt update
```

```
sudo apt install build-essential make cmake dpkg dkms git curl
```

download HailoRT PCI driver

```
git clone https://github.com/hailo-ai/hailort-drivers.git
```

compiling PCI Driver source

```
cd hailort-drivers/ linux/pcie
```

```
make all && sudo make install
```

```
sudo modprobe hailo_pci
```

```
sudo cp 51-hailo-udev.rules /etc/udev/rules.d
```

```
sudo udevadm control --reload-rule && sudo udevadm trigger
```

reboot system to apply the driver installation

```
sudo reboot
```

(3) Compiling from Sources-HailoRT Example Codes

changing directory to libhailort /examples

```
cd hailort/hailort/libhailort/examples
```

compiling HailoRT example codes

```
cmake -H. -Bbuild
```

```
cmake --build build
```

Start from vstreams_example.c or vstreams_example.cc

Find more example code detail in HailoRT User Guide

5.1 . C inference tutorial

5.2 . C++ inference tutorial