



JETPACK 4.1 DEVELOPER PREVIEW *EARLY ACCESS*

October 2018
NVIDIA CORPORATION

User Documentation



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JetPack

[NVIDIA JetPack SDK](#) is the most comprehensive solution for building AI applications. Use the JetPack installer to flash your Jetson Developer Kit with the latest OS image, to install developer tools for both Linux host PC and developer kit, and install the libraries and APIs, samples, and documentation needed to jumpstart your development environment.

Summary of JetPack Components

JetPack includes OS images, Libraries and APIs, developer tools, samples, and documentation.

OS Image

JetPack includes a sample file system derived from Ubuntu.

Libraries

JetPack includes the following libraries:

- [TensorRT](#) and [cuDNN](#) for high-performance deep learning applications

TensorRT is a high-performance deep learning inference runtime for image classification, segmentation, and object detection neural networks. It speeds up deep learning inference as well as reducing the runtime memory footprint for convolutional and deconv neural networks.

CUDA Deep Neural Network library provides high-performance primitives for deep learning frameworks. It includes support for convolutions, activation functions and tensor transformations.

- [CUDA](#) for GPU accelerated applications across multiple domains
- MultiMedia API

The Jetson Multimedia API package provides low level APIs for flexible application development.

Camera application API: libargus offers a low-level frame-synchronous API for camera applications, with per frame camera parameter control, multiple (including synchronized) camera support, and EGL stream outputs. RAW output CSI cameras needing ISP can be used with either libargus or GStreamer plugin. In either case, the V4L2 media-controller sensor driver API is used.

Sensor driver API: V4L2 API enables video decode, encode, format conversion and scaling functionality. V4L2 for encode opens up many features like bit rate control, quality presets, low latency encode, temporal tradeoff, motion vector maps, and more.

- [VisionWorks](#) and [OpenCV](#) for visual computing applications

VisionWorks is a software development package for Computer Vision (CV) and image processing. It Includes VPI (Vision Programming Interface), a set of optimized CV primitives for use by CUDA developers. The NVX library enables direct access to VPI, and the OVX library enables indirect access to VPI via OpenVX framework.

Developer Tools

JetPack includes the following developer tools:

- [CUDA tools](#): Nsight Eclipse Edition IDE, debugging and profiling tools, and toolchain for cross-compiling high-performance GPU-accelerated applications are included in the CUDA Toolkit.
- [NVIDIA Nsight Systems](#): A system trace and multi-core CPU PC sampling profiler that provides an interactive view of captured profiling data, helping improve overall application performance.
- [NVIDIA Nsight Graphics](#): A console-grade tool that allows developers to debug and profile OpenGL, OpenGL ES, and Vulkan, enabling developers to get the most out of the Jetson Platform

Samples

See the [Jetson Xavier Developer Kit User Guide](#) for details and documentation links for these available samples in JetPack 4.0 Developer Preview Early Access:

- TensorRT
- cuDNN
- CUDA
- Multimedia API
- VisionWorks
- OpenCV
- NVIDIA GameWorks Vulkan and OpenGL

Documentation

Follow these links:

- | | |
|--|--|
| ➤ JetPack Documentation | ➤ NVIDIA Nsight Graphics |
| ➤ L4T Release Notes | ➤ Multimedia API Reference |
| ➤ TensorRT Documentation | ➤ VisionWorks Documentation |
| ➤ cuDNN Documentation | ➤ OpenCV Documentation |
| ➤ CUDA Toolkit | ➤ NVIDIA GameWorks Documentation |
| ➤ NVIDIA Nsight Systems | |

Release Notes

JetPack 4.1 Developer Preview *Early Access*

Release Highlights

OS

- L4T 31.0.1
 - Reference filesystem is now derived from Ubuntu 18.04
 - Unity desktop is kept as default for this release

Libraries and APIs

- TensorRT 5.0 RC
 - Fine grain control for scheduling layers to execute on either iGPU or DLA
 - Support for both HMMA (FP16) and IMMA (INT8) on iGPU
 - "Early Access" DLA support for FP16
 - Supported networks for this release are AlexNet, googLeNet and ResNet50.
 - Capability to import Quantized INT8 networks
 - New Caffe SSD and YOLO samples have been added to available [TensorRT samples](#).
- cuDNN 7.3
 - Supports IMMA Programmability
 - Grouped convolution performance improvements for NHWC input / output and FP16 and FP32 compute
- CUDA 10
 - Supports IMMA Programmability – direct use of these instructions dramatically reduces kernel execution time and kernel launch latency
 - Support for CUDA-Vulkan interoperability
 - CUDA profiling is only supported for processes launched as root.

Developer Tools

- [CUDA tools](#)
 - Nsight Eclipse plugins edition
 - True plugins can be installed in the developer's own Eclipse environment.

- Offers an all-in-one integrated environment to edit, build and debug CUDA applications.
- [NVIDIA Nsight Systems 2018.1.3](#)
 - Profiling on Jetson Xavier
 - Ability to trace cuDNN, cuBLAS, and OS runtime library API calls.
- [NVIDIA Nsight Graphics 2018.4](#)
 - Users can utilize the powerful Activities system to target their workflow for debugging and profiling.
 - The Resources view allows you to edit the default shader used to display textures, and change the data display or highlight useful characteristics of the data.
 - Improved editor capabilities including goto line and find/replace capabilities.

JetPack Installer

- Now supports Host computer running Ubuntu 18.04 or Ubuntu 16.04

Early Access Notes

- Power and performance
 - Jetson Xavier has been released to NVIDIA's registered developers who have first access to this new product. In its current early access status, it is roughly 15x the performance of our previous Jetson TX2. This will continue to improve as Jetson Xavier is tuned for better power and higher performance in future releases.
- INT8 support on DLA
 - Jetson Xavier includes two Deep Learning Accelerators (DLA) can accelerate DL inference workloads with various data types. In this early access release, FP16 is supported. INT8 will be supported in a future release which should improve inference performance by at least 2x.
- Vision Accelerator support
 - Jetson Xavier includes a 7-way VLIW Vision Accelerator (VA) for accelerating traditional computer vision workloads. Support for the VA will be included in a future release.
- Fan speed optimized for quietness over temperature
 - The heat sink of the Jetson Xavier Developer Kit may become hot to the touch (up to ~40C). This is expected behavior. The fan control has been optimized for noise over temperature. User-configurable settings will come in a future release.
- Camera
 - The following camera features will be supported in a future release

- Support for IMX185 sensor
- Support for virtual channels (enables up to 16 cameras)
- Support for SLVS-EC
- TensorRT
 - When using DLA in this release, `IEExecutionContext::enqueue()` blocks the calling CPU thread while DLA work is running. Asynchronous DLA execution in `IEExecutionContext::enqueue()` will be supported in a future release. As a workaround for running multiple devices concurrently, execution contexts can be invoked from individual CPU threads.
 - For this release, the TensorRT builder writes a file named `output.protobuf` to its current working directory when compiling a network model for DLA. This means `trtexec` or any application using TensorRT with DLA will need write permissions to its current working directory. (For example, this could be guaranteed by launching the application with `sudo` privileges.) This will be changed in the next release.
 - Python samples will be supported in a future release.
- JetPack installer
 - Please use the default download and install directories provided by JetPack. Changing the directories may cause an installation error.

How to Install JetPack

Installing JetPack 4.1 Developer Preview *Early Access* to your Jetson Xavier Developer Kit requires these steps, which are detailed in the sections below:

- Download JetPack installer to your Linux host computer.
- Connect your developer kit to the Linux host computer.
- Put your developer kit into Force Recovery Mode.
- Run JetPack installer to select and install desired components.

Download Installer to the Host Computer

You must have a Linux host computer to run the JetPack installer and flash the developer kit. Supported host operating systems are:

- Ubuntu Linux x64 Version 18.04 or 16.04

Download the latest JetPack installer to the Linux host from the [JetPack](#) page on the Jetson Developer Site.



NOTE: The installer can flash and update software on a target Jetson device, but it cannot not run directly on that device. Whether or not a Jetson device is present, you can use JetPack installer to update software on the Linux host.

Connect Developer Kit to the Host Computer

1. Use the included USB cable to connect the Linux host computer to the front USB Type-C connector on the developer kit.
2. Connect a display, keyboard, and mouse to your Jetson Xavier Developer Kit
 - Connect an external HDMI display to the developer kit's HDMI port.
 - Connect a USB keyboard and mouse.
 - Connect directly to the hybrid USB Type-A/eSATA port and use the included USB Type-C to Type-A adapter to connect to the rear USB Type-C port.
3. Connect the developer kit and Linux host computer to the same network.
 - Connect the developer kit to your local network via the Ethernet cable to the developer kit's Ethernet port.
4. Connect the included AC adapter to the developer kit's power jack.

Put Developer Kit into Force Recovery Mode

The developer kit must be in Force USB Recovery Mode (RCM) so the installer can transfer system software to the Jetson Xavier module.

1. Connect the developer kit as described above. It should be powered off.
2. Press and hold down the Force Recovery button.
3. Press and hold down the Power button.
4. Release both buttons.

Run the Installer

The JetPack installer includes a Component Manager, allowing you to choose what to install on the Linux host computer and/or the Jetson Developer Kit.

Step by Step Instructions

The following instructions assume you have downloaded the latest JetPack version, `JetPack-${VERSION}.run`, where `${VERSION}` refers to the version string for the installer you have.

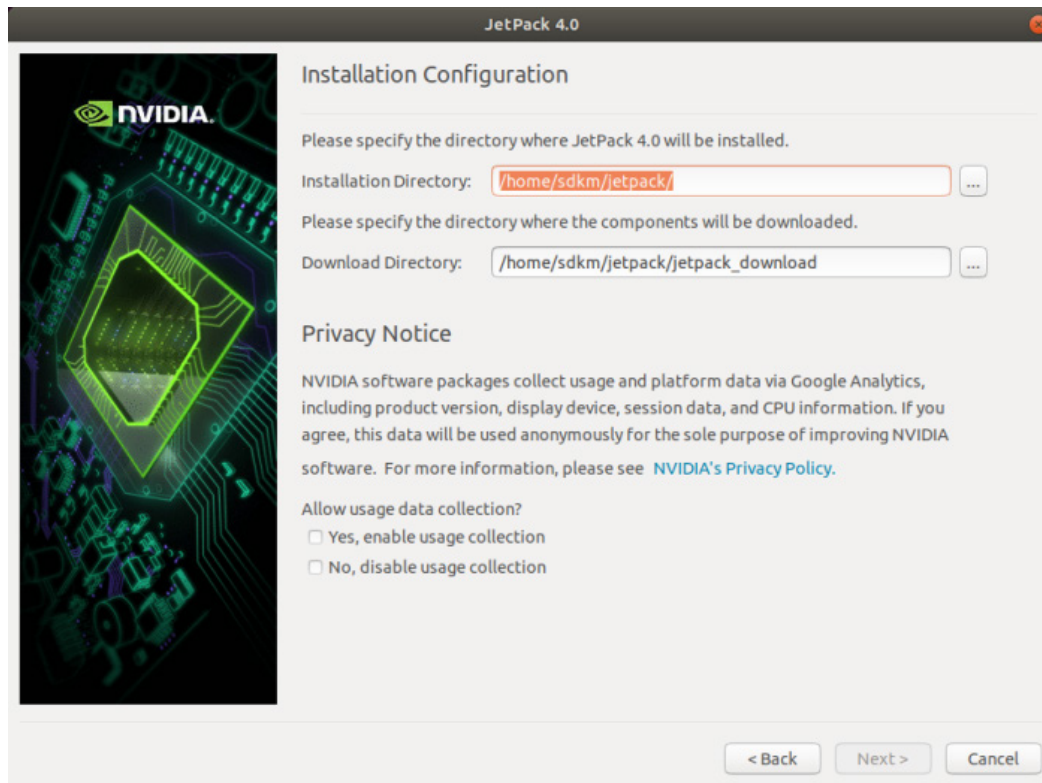
1. Add exec permission for the `JetPack-${VERSION}.run`

```
chmod +x JetPack-${VERSION}.run
```

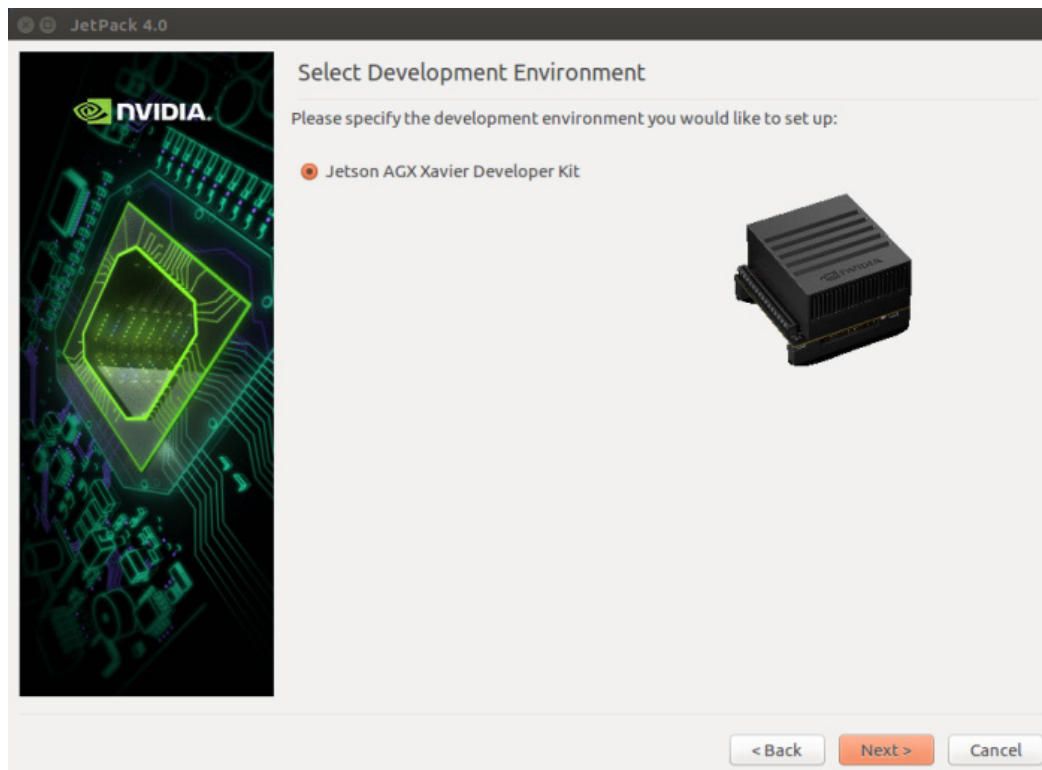
2. Run `JetPack-${VERSION}.run` in terminal on your host Ubuntu machine.



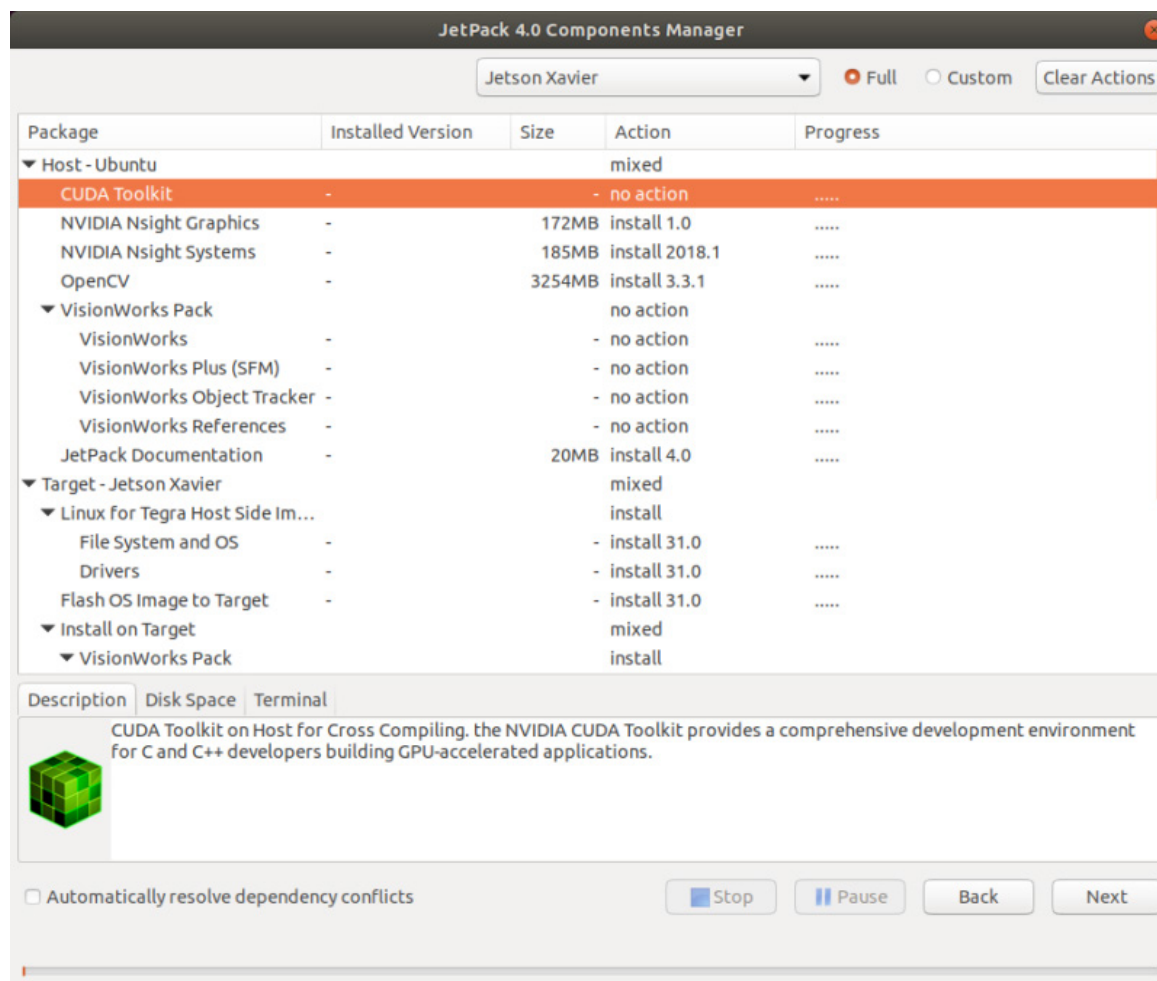
3. Next, the JetPack installer will indicate the installation directory. In the Privacy Notice section, select whether or not to enable data collection.



4. Select the development environment to setup.

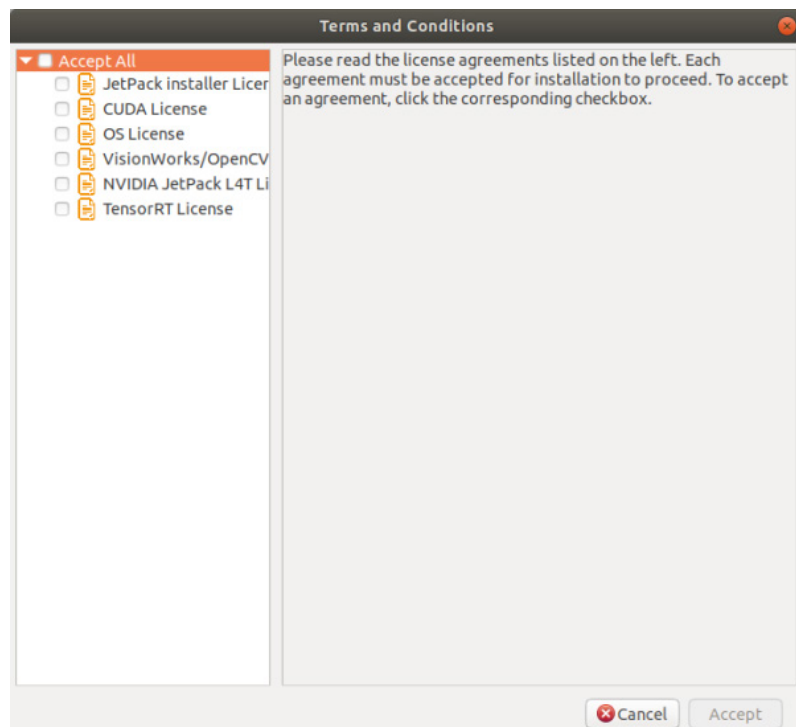


5. The JetPack installer will pop up a window to ask for permission to use during the installation process; you will need to enter your sudo password here.
6. The Component Manager opens, which allows you to customize which components to install. Select the Jetson Developer Kit you would like to develop for to customize the installation components for each device.



NOTE: To run a standalone Ubuntu install, deselect Jetson target specific entries.

7. Accept the license agreement for the selected components.



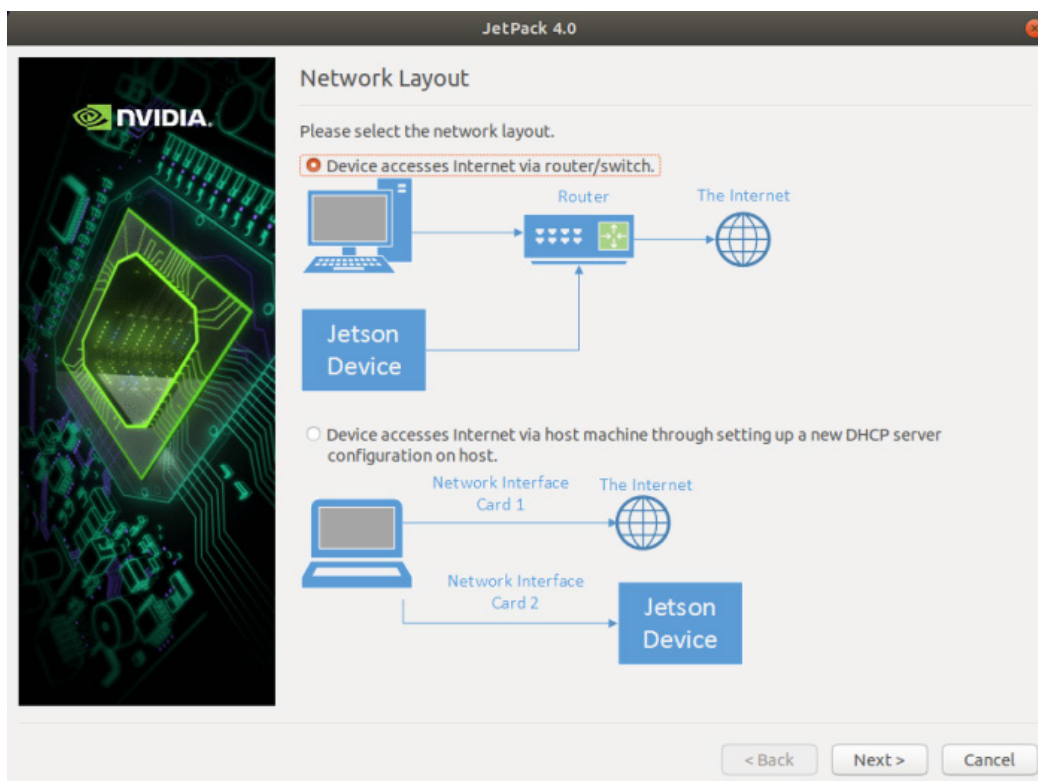
8. The Component Manager will proceed with the installation. Once the host installation steps are completed, click the Next button to continue with the installation of target components.

NOTE: JetPack will now proceed with setting up the Jetson Developer Kit target, if the corresponding components were selected (i.e., flashing the OS and pushing components to the Jetson Developer Kit target).

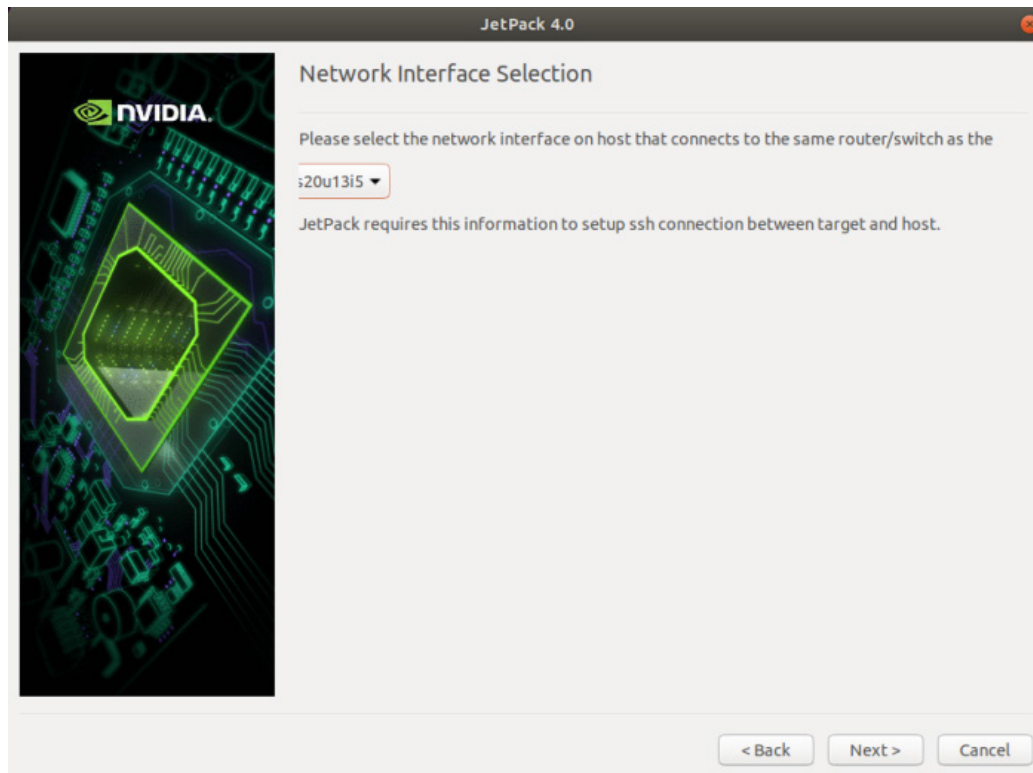
9. If you de-selected **Flash OS** in the [Component Manager](#), you will need to enter the IP address, user name, and password to set up an ssh connection to the target device.

After you enter the required information and click **Next**, JetPack will begin installing components on the target device.

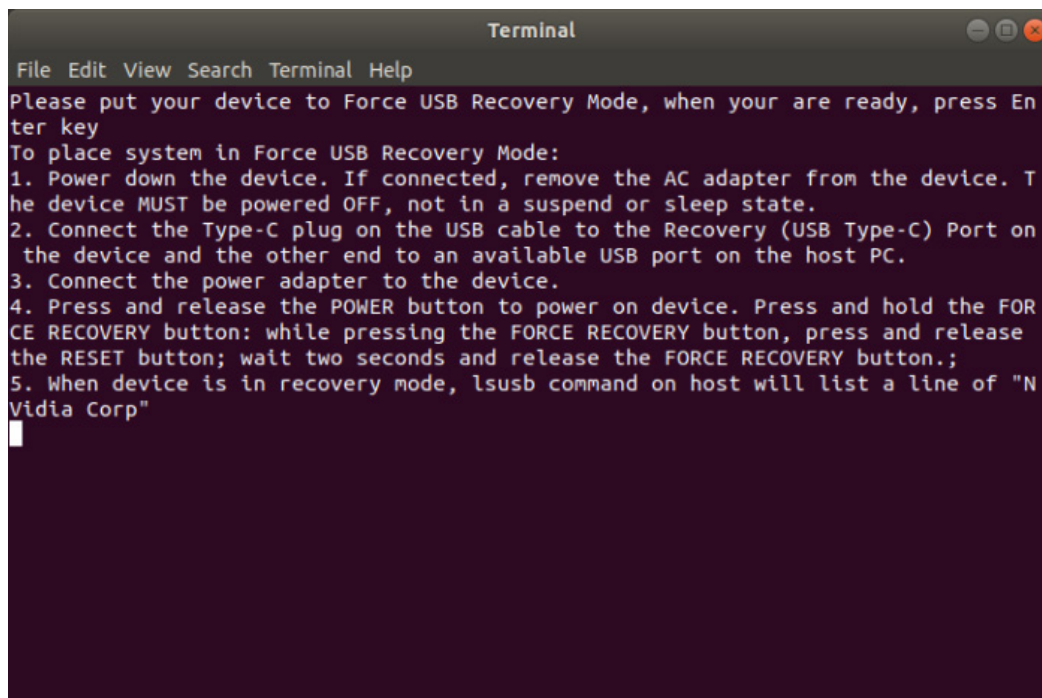
10. If you selected **Flash OS** in the [Component Manager](#), you will need to select the network layout for your specific environment.



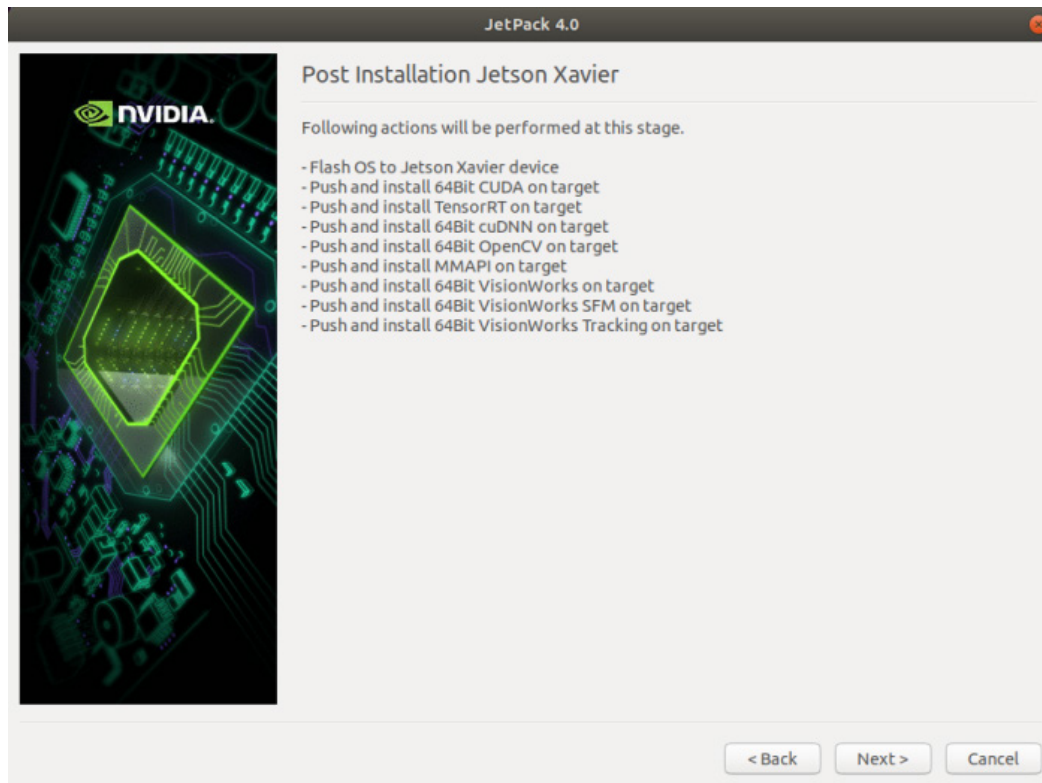
11. If you selected the **Device access Internet via router/switch** layout, you will be asked to select which interface to use for Internet access.



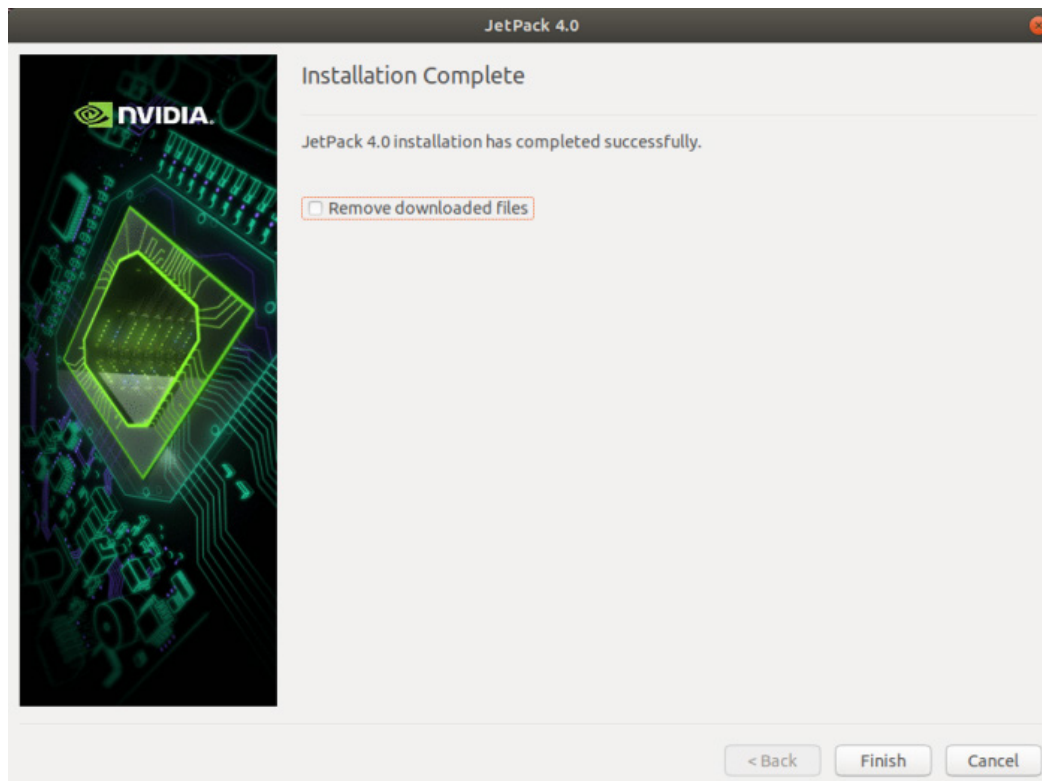
12. If you selected the **Device get IP assigned by DHCP server on host and access Internet via host machine** layout, you must select which interface is to be used for Internet access, and which is to be used for the target interface.
13. In case you have not already done so, a pop-up window will instruct you to put your device into Force USB Recovery Mode, so you can flash the OS.



14. Next, you will be prompted to install components on the specific target machine, and to compile samples.



15. After the post installation tasks have been completed, the installation will be complete.



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8.1 AGREEMENT, Licenses and Services. This SLA shall become effective upon the Effective Date, each Supplement upon their acceptance, and both this SLA and Supplements shall continue in effect until your last access or use of the Licensed Software and/or services hereunder, unless earlier terminated as provided in this "Term and Termination" section. Each Licensed Software license ends at the earlier of (a) the expiration of the applicable license term, or (b) termination of such license or the AGREEMENT. Each service ends at the earlier of (x) the expiration of the applicable service term, (y) termination of such service or the AGREEMENT, or (z) expiration or termination of the associated license and no credit or refund will be provided upon the expiration or termination of the associated license for any service fees paid.

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9. CONSENT TO COLLECTION AND USE OF INFORMATION.

You hereby agree and acknowledge that the Software may access and collect data about your Enterprise computer systems as well as configures the systems in order to (a) properly optimize such systems for use with the Software, (b) deliver content through the Software, (c) improve NVIDIA products and services, and (d) deliver marketing communications. Data collected by the Software includes, but is not limited to, system (i) hardware configuration and ID, (ii) operating system and driver configuration, (iii) installed applications, (iv) applications settings, performance, and usage data, and (iv) usage metrics of the Software. To the extent that you use the Software, you hereby consent to all of the foregoing, and represent and warrant that you have the right to grant such consent. In addition, you agree that you are solely responsible for maintaining appropriate data backups and system restore points for your Enterprise systems, and that NVIDIA will have no responsibility for any damage or loss to such systems (including loss of data or access) arising from or relating to (a) any changes to the configuration, application settings, environment variables, registry, drivers, BIOS, or other attributes of the systems (or any part of such systems) initiated through the Software; or (b) installation of any Software or third party software patches initiated through the Software. In certain systems you may change your system update preferences by unchecking "Automatically check for updates" in the "Preferences" tab of the control panel for the Software.

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Each party acknowledges and agrees that the other is an independent contractor in the performance of the AGREEMENT, and each party is solely responsible for all of its employees, agents, contractors, and labor costs and expenses arising in connection therewith. The parties are not partners, joint ventures or otherwise affiliated, and neither has any authority to make any statements, representations or commitments of any kind to bind the other party without prior written consent.

Neither party will be responsible for any failure or delay in its performance under the AGREEMENT (except for any payment obligations) to the extent due to causes beyond its reasonable control for so long as such force majeure event continues in effect.

The AGREEMENT will be governed by and construed under the laws of the State of Delaware and the United States without regard to the conflicts of law provisions thereof and without regard to the United Nations Convention on Contracts for the International Sale of Goods. The parties consent to the personal jurisdiction of the federal and state courts located in Santa Clara County, California. You acknowledge and agree that a breach of any of your promises or agreements contained in the AGREEMENT may result in irreparable and continuing injury to NVIDIA for which monetary damages may not be an adequate remedy and therefore NVIDIA is entitled to seek injunctive relief as well as such other and further relief as may be appropriate. If any court of competent jurisdiction determines that any provision of the AGREEMENT is illegal, invalid or unenforceable, the remaining provisions will remain in full force and effect. Unless otherwise specified, remedies are cumulative.

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GLOSSARY OF TERMS

Certain capitalized terms, if not otherwise defined elsewhere in this SLA, shall have the meanings set forth below:

- a. “Affiliate” means any legal entity that Owns, is Owned by, or is commonly Owned with a party. “Own” means having more than 50% ownership or the right to direct the management of the entity.
- b. “AGREEMENT” means this SLA and all associated Supplements entered by the parties referencing this SLA.
- c. “Authorized Users” means your Enterprise individual employees and any of your Enterprise’s Contractors, subject to the terms of the “Enterprise and Contractors Usage” section.
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- m. “Software” means the NVIDIA software programs licensed to you under the AGREEMENT including, without limitation, libraries, sample code, utility programs and programming code.
- n. “Supplement” means the additional terms and conditions beyond those stated in this SLA that apply to certain Licensed Software licensed hereunder.