



JETPACK 4.1.1

November 2018
NVIDIA CORPORATION

User Documentation



Table of Contents

JetPack	3
Summary of JetPack Components.....	3
OS Image	3
Libraries	3
Developer Tools	4
Samples.....	4
Documentation	4
Release Notes	5
JetPack 4.1.1	5
Release Highlights	5
OS	5
Libraries and APIs.....	5
Developer Tools.....	5
JetPack Installer	6
Developer Preview Notes	6
How to Install JetPack	8
Download Installer to the Host Computer	8
Connect Developer Kit to the Host Computer.....	8
Put Developer Kit into Force Recovery Mode	9
Run the Installer.....	9
Step by Step Instructions.....	9
Copyright & License Notices.....	15
NVIDIA CORPORATION.....	15
NVIDIA SOFTWARE LICENSE AGREEMENT.....	15

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.

OpenCV is the leading open source library for computer vision, image processing and machine learning, and now features GPU acceleration for real-time operation.

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 AGX Xavier Developer Kit User Guide](#) for details and documentation links for these available samples in JetPack 4.1.1:

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

Documentation

For more information, see the following:

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

Release Notes

JetPack 4.1.1

Release Highlights

OS

- L4T 31.1
 - Reference filesystem derived from Ubuntu 18.04
 - Stability and security fixes

Libraries and APIs

- TensorRT 5.0.3
 - DLA support for FP16 — AlexNet, GoogleNet, ResNet-50, and LeNet for MNIST networks have been validated
 - Support for both HMMA (FP16) and IMMA (INT8) on iGPU
 - Fine grain control for scheduling layers to execute on either iGPU or DLA
 - New Caffe SSD and INT8 API samples
- cuDNN 7.3.1
 - Supports IMMA Programmability
 - Grouped convolution performance improvements for NHWC input / output and FP16 and FP32 compute
 - Strided convolution now supported by FFT tiling algorithms
 - Performance improvements for dilated convolutions and convolutions computed with Winograd transform
- CUDA 10
 - Supports IMMA Programmability — direct use of these instructions dramatically reduces kernel execution time and kernel launch latency
 - Support for CUDA-Vulkan interoperability

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](#)
 - Profiling on Jetson AGX Xavier
 - Ability to trace cuDNN, cuBLAS, and OS runtime library API calls.
- [NVIDIA Nsight Graphics 2018.6](#)
 - 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.
 - As of this release, we have added a feature to handle context level separation data collection. That is, if one is profiling one context and other contexts are in the background, data is now isolated for the context which profiling is enabled.

JetPack Installer

- JetPack 4.1.1
 - Now supports Host computer running Ubuntu 18.04 or Ubuntu 16.04.
 - JetPack installer can now share host computer's internet connection to Jetson device via USB Type C cable during install.

Developer Preview Notes

- Power and performance
 - With this Developer Preview release of JetPack, Jetson AGX Xavier offers roughly 15x the performance of our previous Jetson TX2. This will continue to improve as Jetson AGX Xavier is tuned for better power and higher performance in future releases.
- INT8 support on DLA
 - Jetson AGX Xavier includes two Deep Learning Accelerators (DLA) that can accelerate DL inference workloads with various data types. In this Developer Preview 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 AGX 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.

- Camera
 - The following camera features will be supported in a future release:
 - Support for virtual channels (enables up to 16 cameras)
 - Support for SLVS-EC
 - *Early Access* items resolved in this Developer Preview release:
 - IMX185 sensor now supported
- TensorRT
 - In this release, running 2 DLA and iGPU does not yield expected sum of performance. This will be fixed in a future release. Note that performance from running 2 DLA at the same time does sum up as expected.
 - To achieve expected performance in this release, use spin-wait based synchronization via `cudaEventDefault` flag when creating the events. For `trtexec`, use the `--useSpinWait` option. These workarounds may decrease multi-process synchronization time at the cost of additional CPU usage.
 - Python samples will be supported in a future release.
 - *Early Access* items resolved in this Developer Preview release:
 - Asynchronous DLA execution in `IEExecutionContext::enqueue()` now supported. (The calling CPU thread is not blocked while DLA work is running.)
 - Applications using TensorRT with DLA (e.g., `trtexec`) no longer require write permissions for its current working directory
- JetPack installer
 - Please use the default download and install directories provided by JetPack. Changing the directories may cause an installation error.
 - When the host and target are connected via USB, two Ethernet interfaces will appear on host. One will be used for connection with the Jetson device, but the other may go up and down, causing connectivity messages to appear. These messages can be safely disregarded.

How to Install JetPack

Installing JetPack 4.1.1 to your Jetson AGX 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.

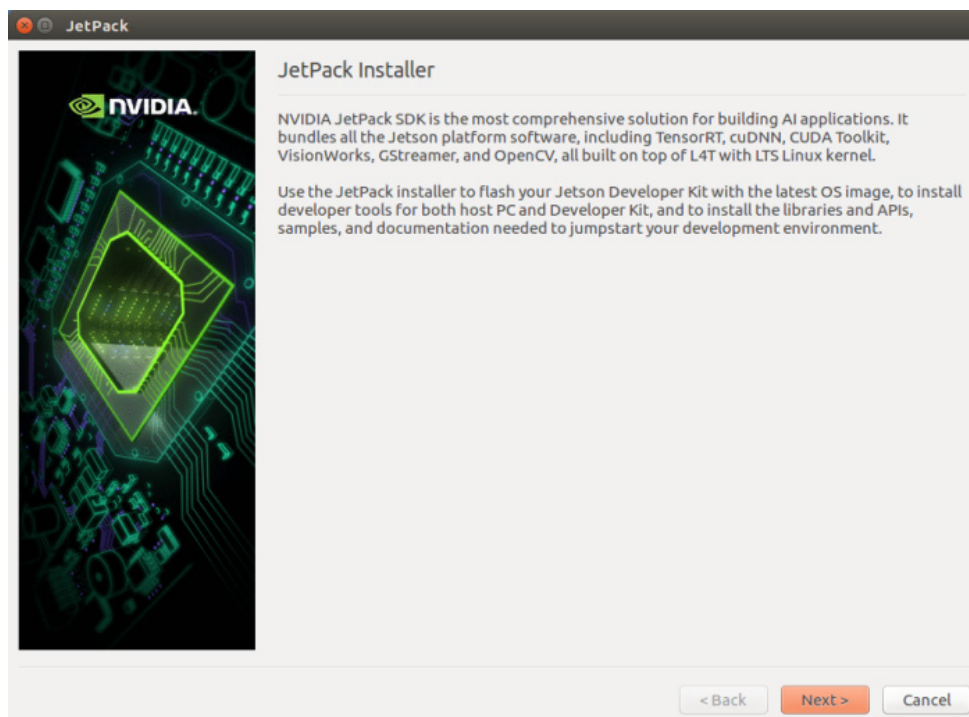
Step by Step Instructions

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.

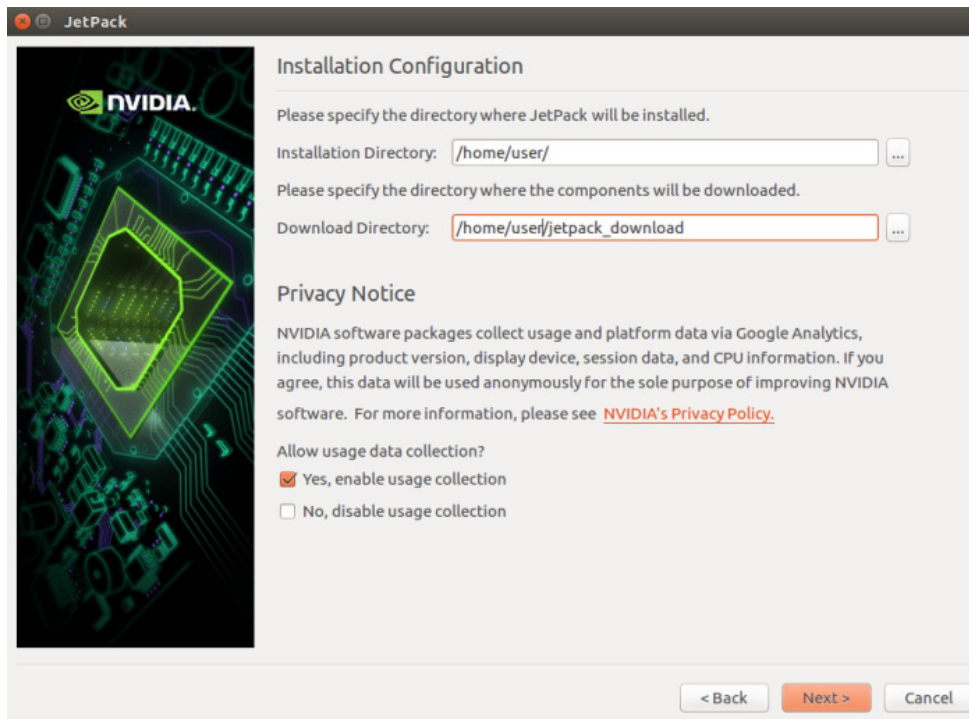
1. Add exec permission for the `JetPack-${VERSION}.run`

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

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



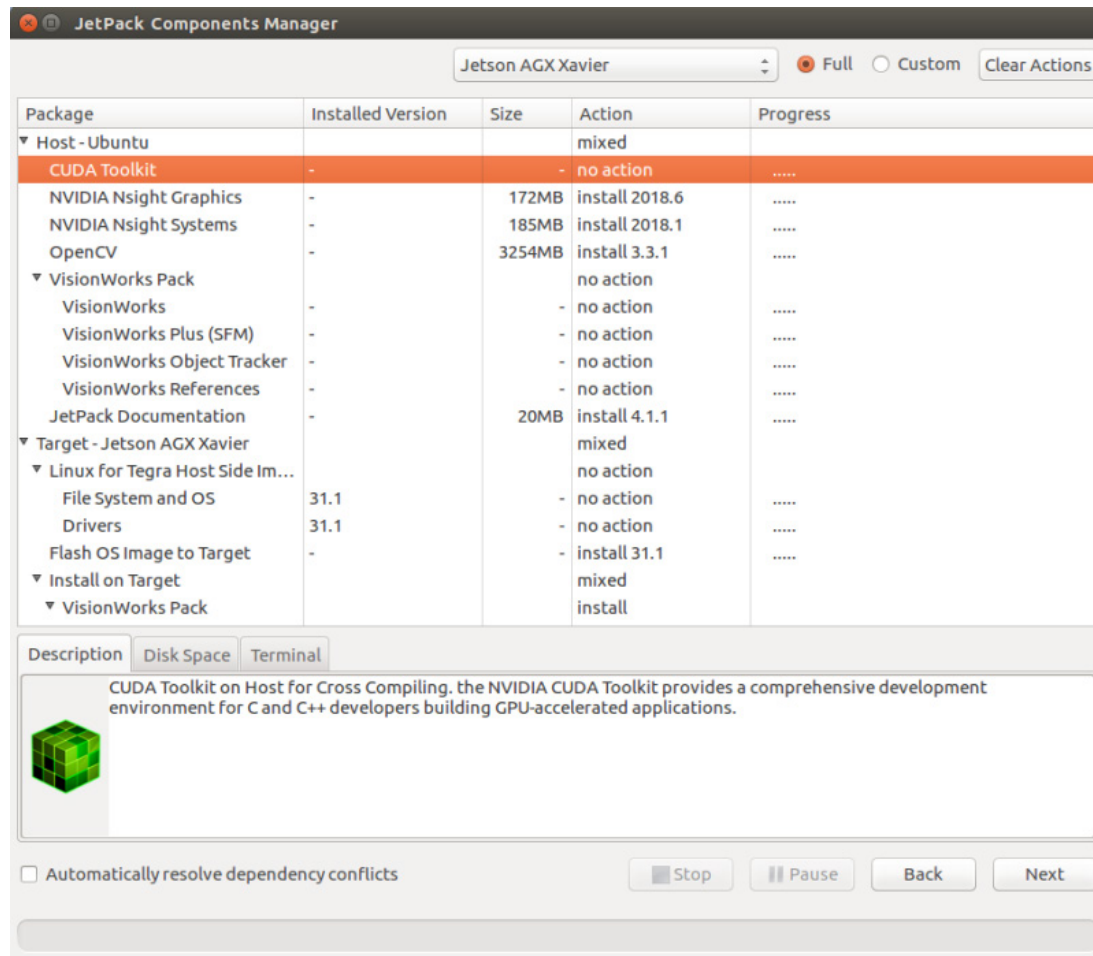
3. Next, the JetPack installer will indicate the installation directory. In the Privacy Notice section, select whether or not to enable data collection.



4. Select the development environment to setup.

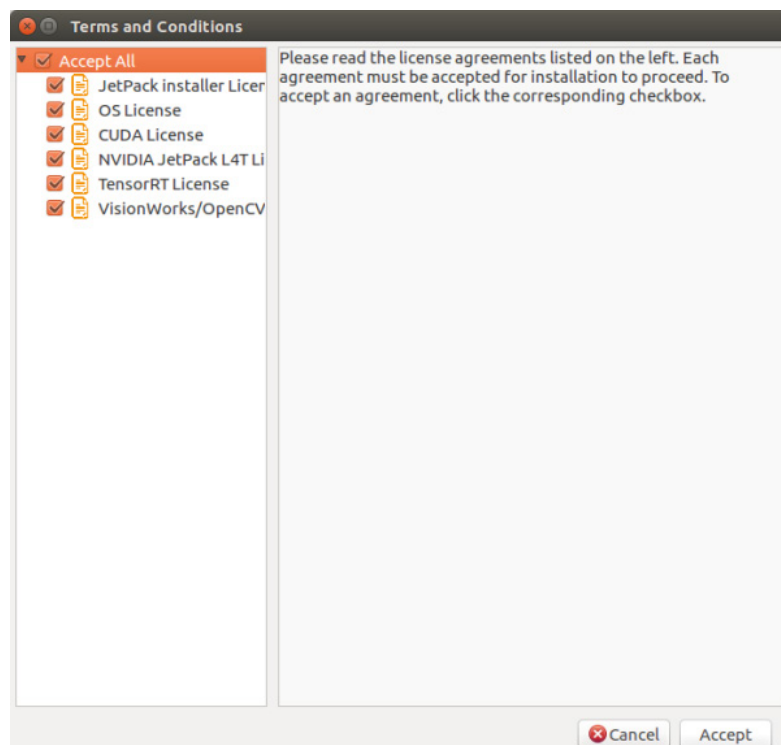


5. The JetPack installer will pop up a window to ask for permission to use during the installation process; you will need to enter your sudo password here.
6. The Component Manager opens, which allows you to customize which components to install. Select the Jetson Developer Kit you would like to develop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



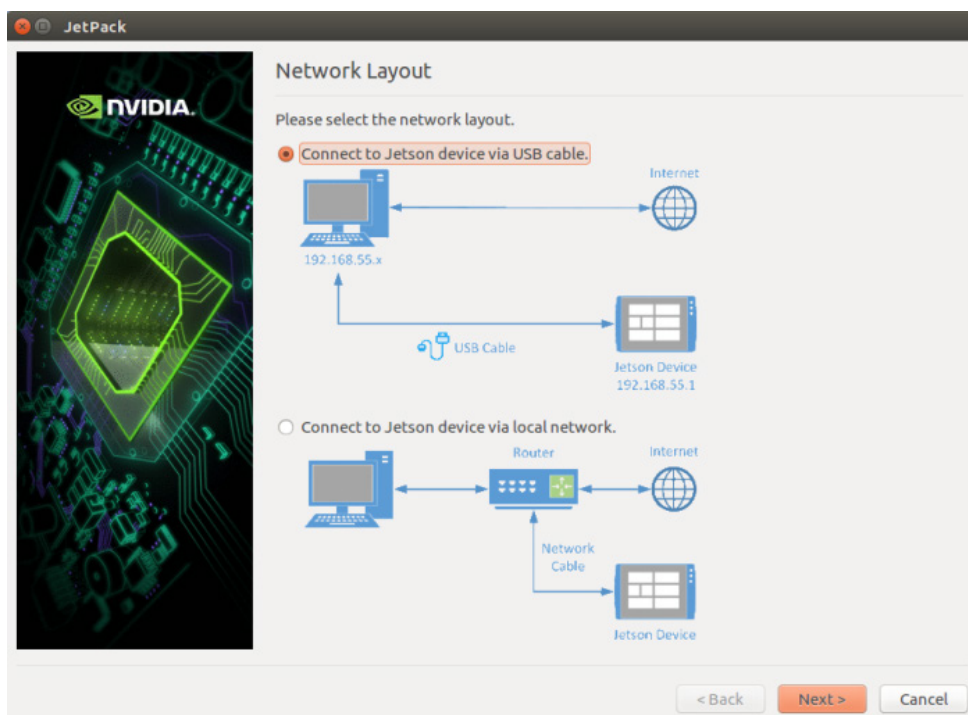
8. The Component Manager will proceed with the installation. Once the host installation steps are completed, click the Next button to continue with the installation of target components.

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).

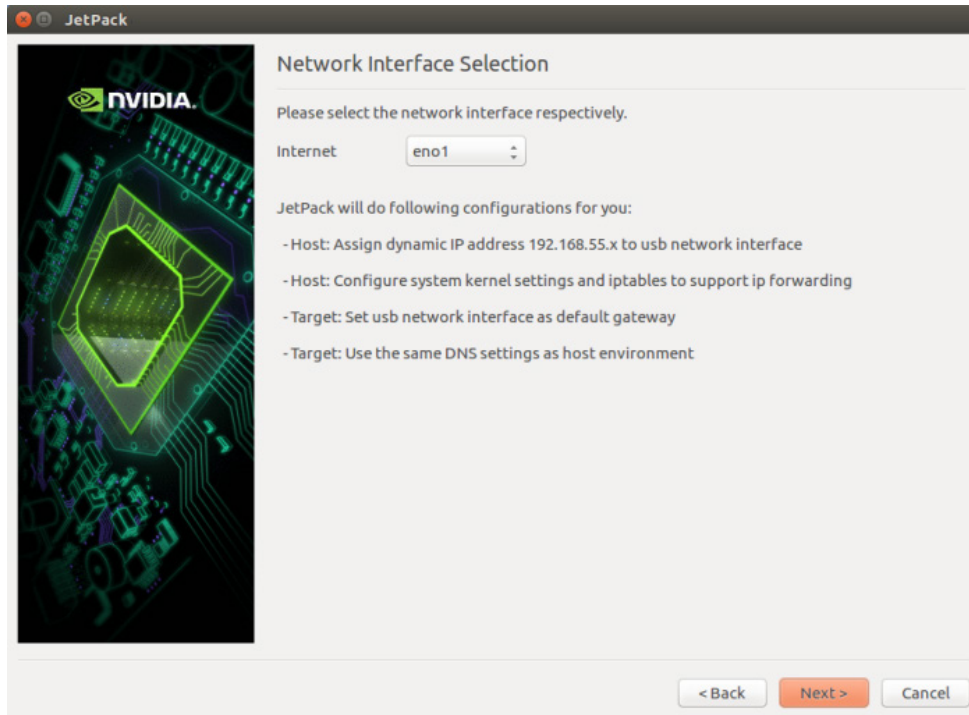
9. If you de-selected **Flash OS** in the [Component Manager](#), you will need to enter the IP address, user name, and password to set up an ssh connection to the target device.

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

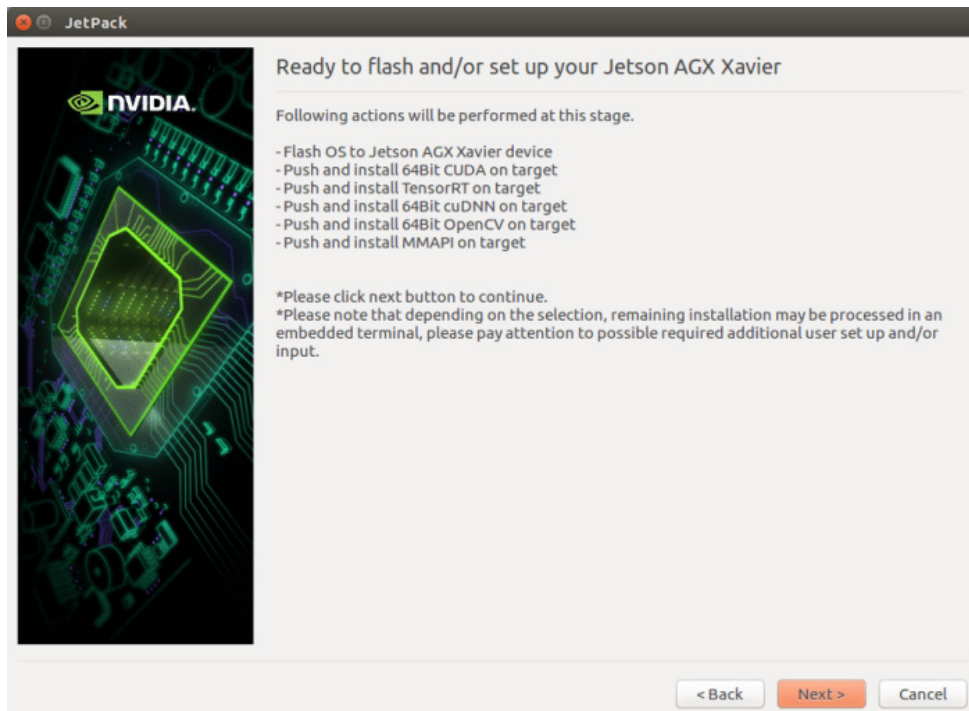
10. If you selected **Flash OS** in the [Component Manager](#), you will need to select the network layout for your specific environment.



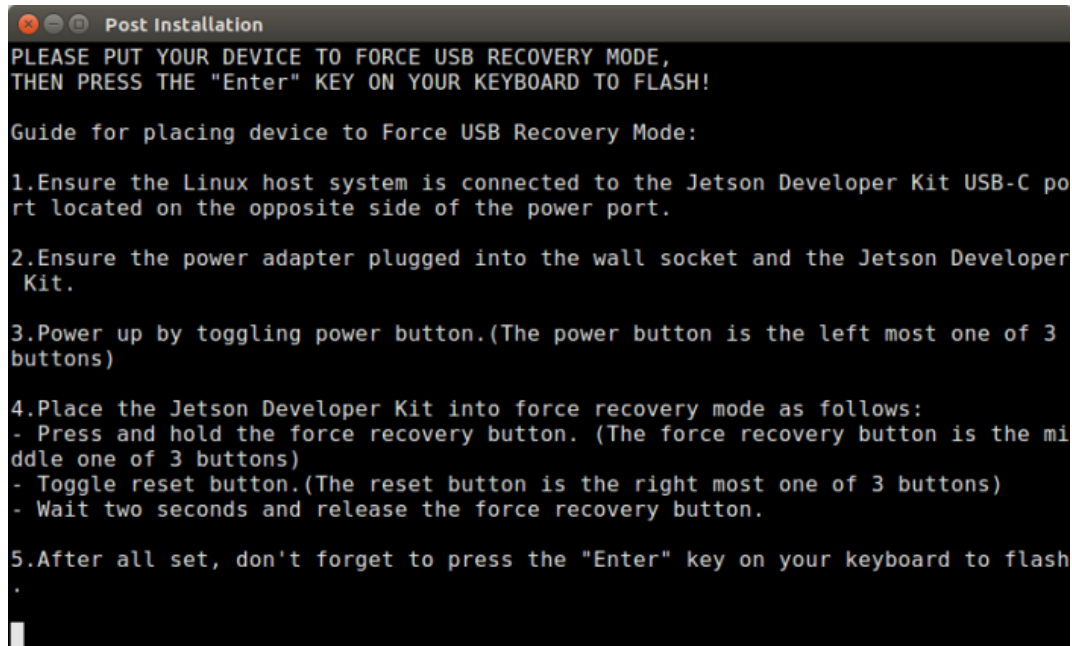
11. If you selected the **Device access Internet via router/switch** layout, you will be asked to select which interface to use for Internet access.



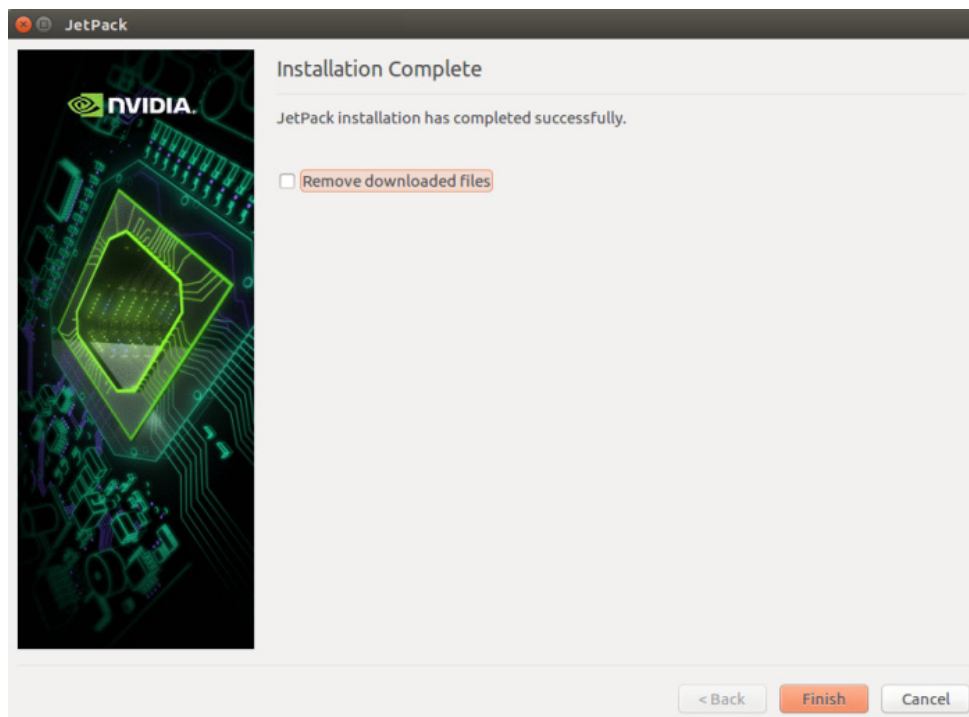
12. If you selected the **Device get IP assigned by DHCP server on host and access Internet via host machine** layout, you must select which interface is to be used for Internet access, and which is to be used for the target interface.
13. Next, you will be prompted to install components on the specific target machine, and to compile samples.



14. 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.



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



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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.

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