Jetson TX1 Developer Kit

User Guide

TABLE OF CONTENTS

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The NVIDIA® Jetson™ TX1 Developer Kit is a full-featured development platform for visual computing. It is ideal for applications requiring high computational performance in a low power envelope. The Jetson TX1 Developer Kit is designed to get you up and running quickly; it comes pre-flashed with a Linux environment, includes support for many common APIs, and is supported by NVIDIA's complete development tool chain. The board exposes many standard hardware interfaces, enabling a highly flexible and extensible platform.

For software updates and the developer SDK supporting your OS image and host development platform, go to:

http://developer.nvidia.com/embedded-computing

The SDK includes an OS image for you to load onto your device, developer tools, supporting documentation, and code samples to help you get started.

Individual development efforts vary and may result in modifications to the system configuration. NVIDIA recommends that you begin with the basic system configuration (as shipped) to ensure proper system operation prior to any further development.

Prerequisites

- A Jetson TX1 Developer Kit
- Your Jetson TX1 carrier board must be cabled as follows:
  - USB peripherals such as a keyboard and mouse, a USB hub (not included in the Developer Kit) must be connected to the USB port on the carrier board.
  - An Ethernet cable is plugged into the on-board Ethernet port.
  - An HDMI cable connects the carrier board to an external HDMI display.
  - (Optional for advanced users, not included in the Developer Kit) A serial cable is plugged into the serial port on the carrier board, and connected to your host either directly or via serial-to-USB converter. The serial lines are exposed on the expansion connector and require a standard TTL-to-RS232 converter (refer to product documentation for the expansion header signals).

Powering Up

1. Connect a USB keyboard to the USB Type A connector of your device.
2. Connect an HDMI-compatible display to the HDMI connector on your device.
3. Connect the AC adapter supplied in your kit to the power connector of your device. Use the supplied AC adapter since it is appropriately rated for your device.
4. Plug the power adapter into an appropriately rated electrical outlet.
5. The system should power on. If not, press and release the power button on the device.

   Note: At room temperature and typical workloads, the fan does not turn on.

6. When prompted, enter `ubuntu` for both the user name and password.

Force Recovery Mode

To update your system, you must be in Force USB Recovery Mode so that you can transfer system software to the Jetson TX1 module. When in Force USB Recovery Mode, you are able to update system software and write to the boot loader, boot configuration table (BCT), and write partition configuration to the device.

Note: For OS-specific instructions when updating system software on your Jetson TX1, see the Developer SDK documentation.

To place system in Force USB Recovery Mode:

1. Power down the device. If connected, remove the AC adapter from the device. The device **must** be powered OFF, and **not** in a suspend or sleep state.

2. Connect the Micro-B plug on the USB cable to the Recovery (USB Micro-B) Port on the device and the other end to an available USB port on the host PC.

3. Connect the power adapter to the device.

4. With the system powered on:

    5. Press and hold the RECOVERY FORCE button.

    6. While depressing the RECOVERY FORCE button, press and release the RESET button.

    7. Wait 2 seconds and release the RECOVERY FORCE button.

Flashing the Boot Loader and Kernel

For information about flashing the Boot Loader and Kernel, see the Getting Starting chapter in the *NVIDIA Tegra Linux Driver Package Development Guide*.

JetPack

The NVIDIA$^®$ Jetson^{TM} Development Pack (JetPack) is an installer that automates installation of a development environment for the NVIDIA Jetson Embedded Platform, and makes it easy to flash your Jetson system with the latest OS images. JetPack includes host and target tools, APIs, and packages (middleware, samples, and documentation including help for compiling samples) to enable you to jumpstart your environment and begin developing.

Supported Host Operating Systems

• Ubuntu Linux x64 (v14.04)

Note: At least 10 GB of disk space is required for the complete installation of JetPack TX1.

Target Platform Requirements

• Jetson Tegra Developer Kit

- Connected as follows:

  - An USB Micro-B cable connecting the Jetson system to your Linux host for flashing.

  - (Not included in the Developer Kit) To connect USB peripherals such as a keyboard, mouse, and [optional] USB/Ethernet adapter (for network connection), a USB hub must be connected to the working USB port (J1C2 USB2) on the Jetson system.

  - An HDMI cable is plugged into the Jetson system HDMI port, which is connected to an external HDMI display.

  - An Ethernet cable is plugged into the on board Ethernet port.

JetPack Components

JetPack includes host (Ubuntu Desktop) and target (Jetson) development tools, APIs, and packages (OS images, tools, middleware, samples, and documentation) for developing on the NVIDIA Jetson Embedded platform.

OS Images

JetPack includes a sample file system derived from Ubuntu.

Libraries

JetPack includes the following libraries:

- CUDA Toolkit for Ubuntu (with cross-development support)

- CUDA Toolkit for L4T

- OpenCV for Tegra

- VisionWorks (for more information, see **https://developer.nvidia.com/embedded/visionworks**)

Developer Tools

JetPack includes the following developer tools:

Tegra Graphics Debugger

A console-grade tool that allows you to debug and profile OpenGL ES 2.0, OpenGL ES 3.0, OpenGL ES 3.1, OpenGL 4.3, OpenGL 4.4 and OpenGL 4.5, enabling game and graphics developers to get the most out of Tegra.

For more information, see:

https://developer.nvidia.com/tegra-graphics-debugger

Tegra System Profiler

A multi-core CPU sampling profiler that provides an interactive view of captured profiling data, helping improve overall application performance.

For more information, see:

https://developer.nvidia.com/tegra-system-profiler

PerfKit

A software library that provides access to OpenGL driver and GPU hardware performance counters.

For more information, see:

https://developer.nvidia.com/nvidia-perfkit

Samples

NVIDIA GameWorks OpenGL samples are located at:

http://developer.nvidia.com/gameworks-opengl-samples

Downloading the Latest JetPack

- The latest version of Jetson is available in the NVIDIA Embedded Developer Zone at:

  https://developer.nvidia.com/jetson-development-pack

- All available JetPack downloads can be found at:

  https://developer.nvidia.com/jetpack-archive

Installing JetPack

You must have downloaded the latest JetPack version, `jetpack-${VERSION}.run`. `${VERSION}` refers to the version string for your installer.
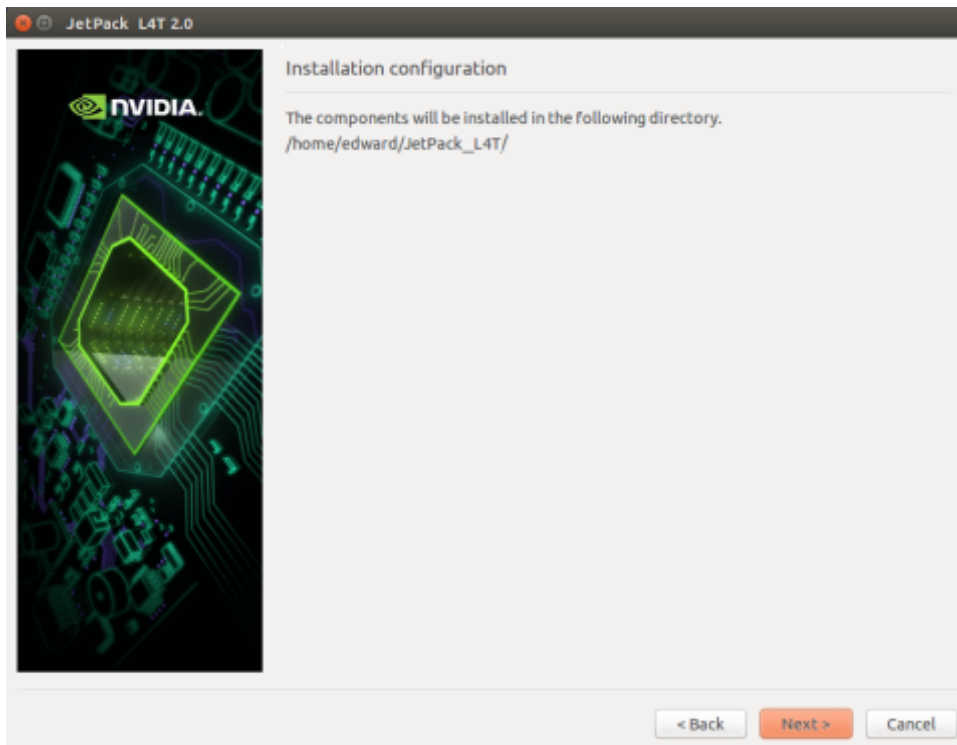
1. Add execute permissions for `jetpack-${VERSION}.run`:

   ```
   chmod +x jetpack-${VERSION}.run
   ```
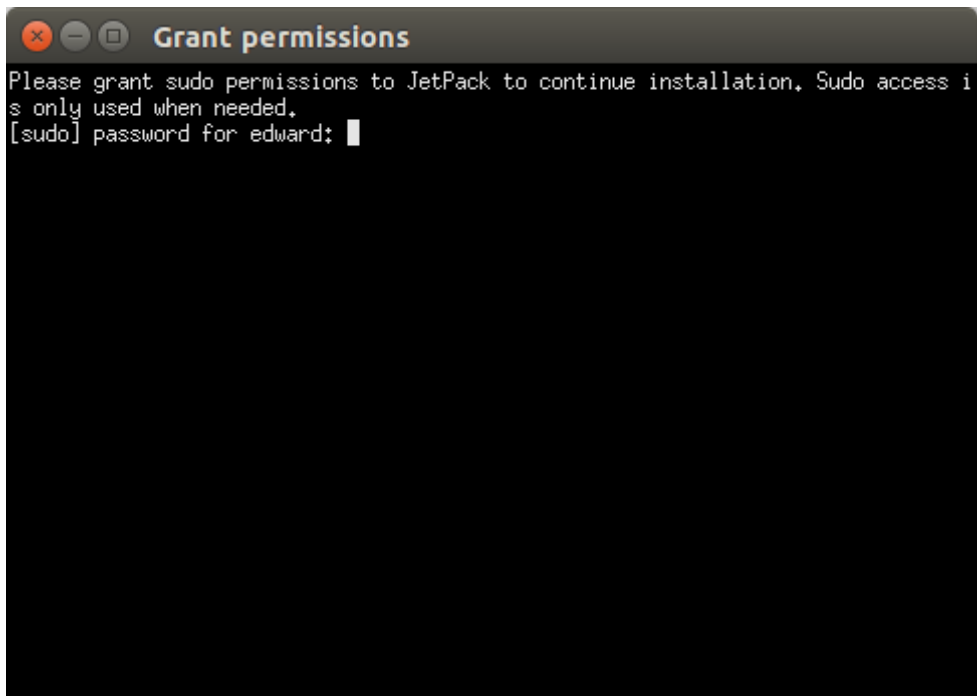
2. Run `jetpack-${VERSION}.run` in a terminal.
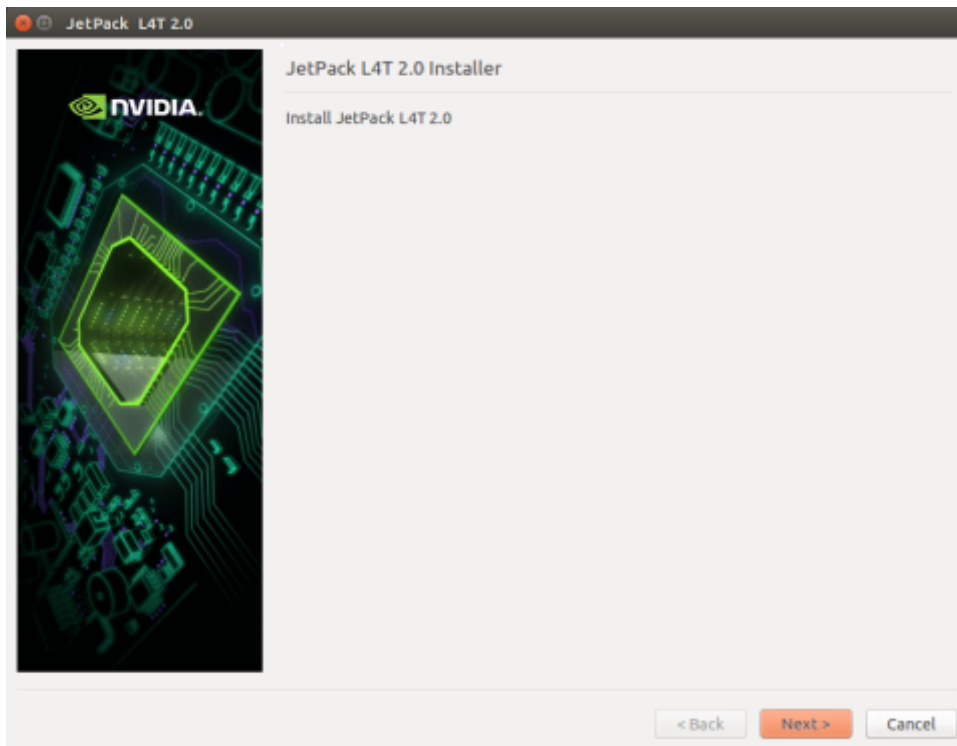
3. Next, the JetPack installer will indicate the installation directory.
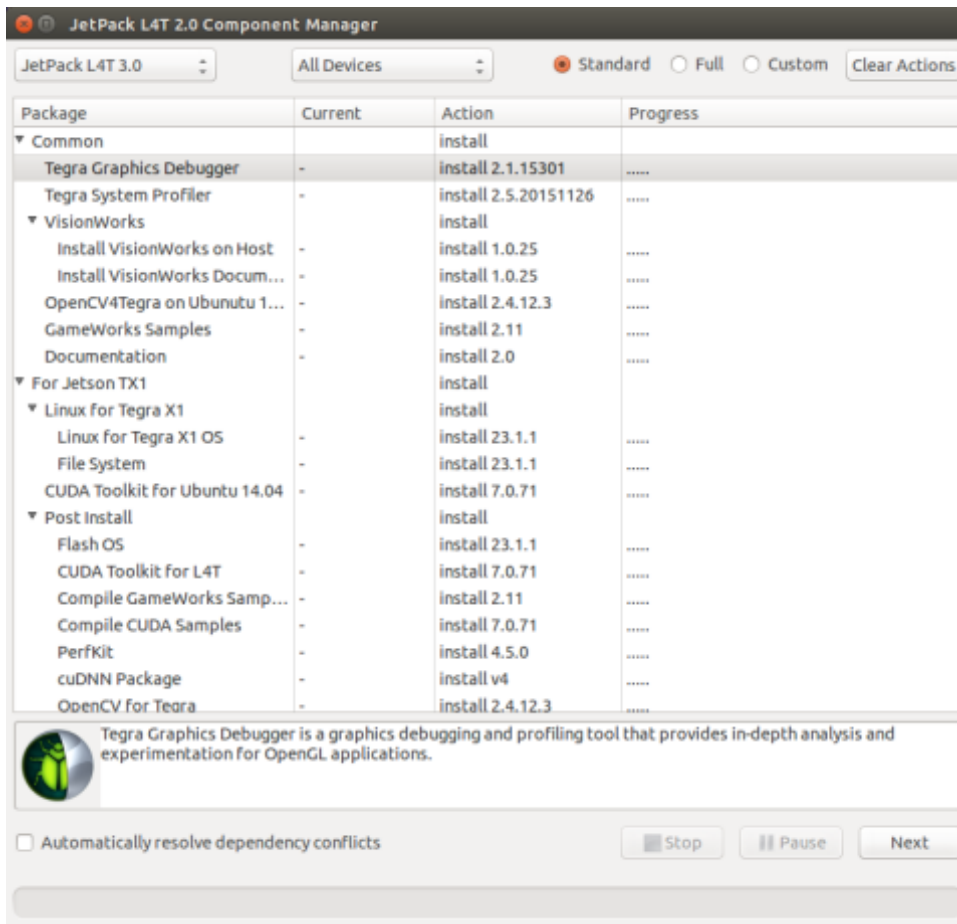

4. The JetPack installer will pop up a window to ask for `sudo` permission to use during the installation process; you must enter your `sudo` password.
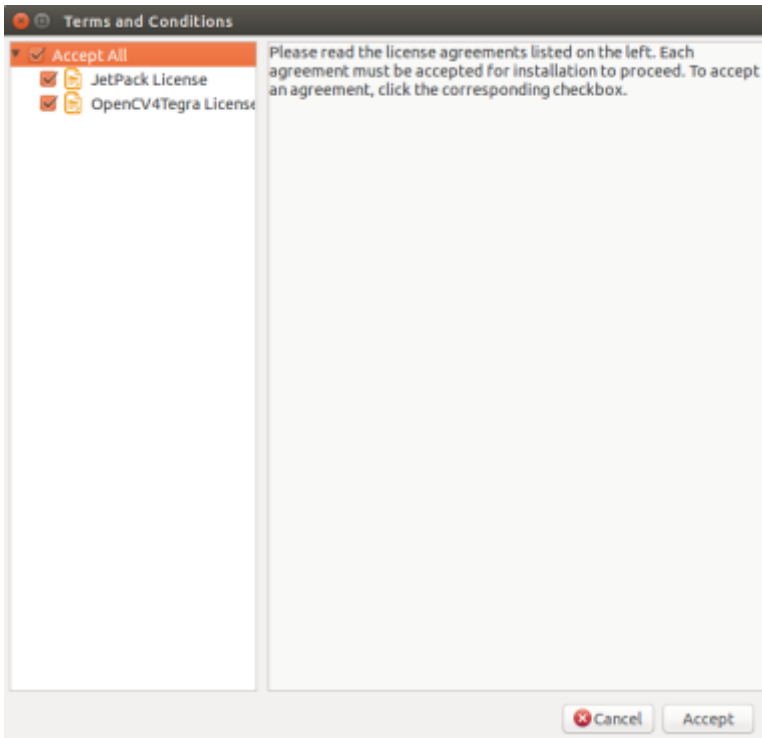
5. The Component Manager opens, which allows you to customize the components to install. Select the Jetson Developer Kit you are developing for to customize the installation components to install. Jetson TK1 Developer Kit and Jetson TX1 Developer Kit support are available.

   Note: Select Compile Samples to have JetPack automatically compile all samples.

Package	Current	Action	Progress
▼ Common		install	
Tegra Graphics Debugger	-	install 2.1.15301	......
Tegra System Profiler	-	install 2.5.20151126	......
▼ VisionWorks		install	
Install VisionWorks on Host	-	install 1.0.25	......
Install VisionWorks Docum...	-	install 1.0.25	......
OpenCV4Tegra on Ubunutu 1...	-	install 2.4.12.3	......
GameWorks Samples	-	install 2.11	......
Documentation	-	install 2.0	......
▼ For Jetson TX1		install	
▼ Linux for Tegra X1		install	
Linux for Tegra X1 OS	-	install 23.1.1	......
File System	-	install 23.1.1	......
CUDA Toolkit for Ubuntu 14.04	-	install 7.0.71	......
▼ Post Install		install	
Flash OS	-	install 23.1.1	......
CUDA Toolkit for L4T	-	install 7.0.71	......
Compile GameWorks Samp...	-	install 2.11	......
Compile CUDA Samples	-	install 7.0.71	......
PerfKit	-	install 4.5.0	......
cuDNN Package	-	install v4	......
OpenCV for Tegra	-	install 2.4.12.3	......

Tegra Graphics Debugger is a graphics debugging and profiling tool that provides in-depth analysis and experimentation for OpenGL applications.

6. Accept the license agreement for the selected components.

7. The component manager proceeds with the installation. Once the host installation steps are completed, a message displays that lists the components specified (the components to be installed on the target are listed here, but have not been installed yet).
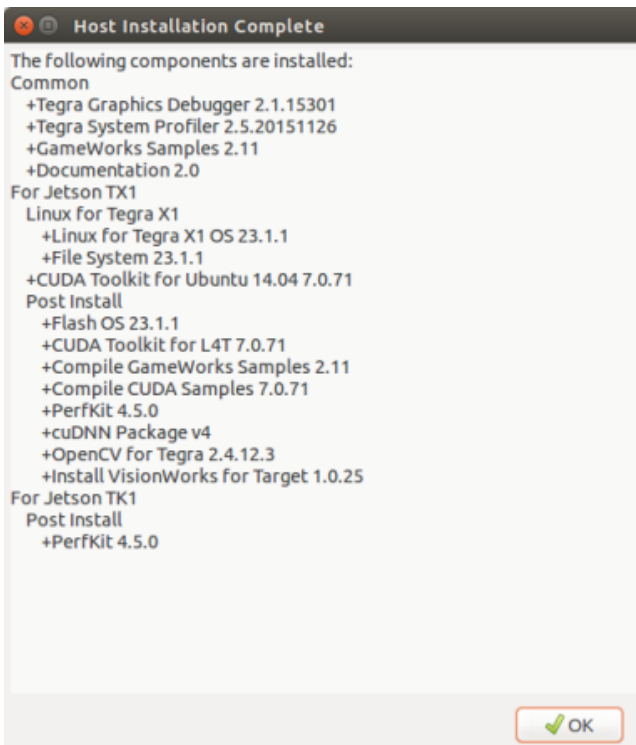
8. If you de-selected **Flash OS**, you must enter the IP address, user name, and password to set up an ssh connection to the target device.
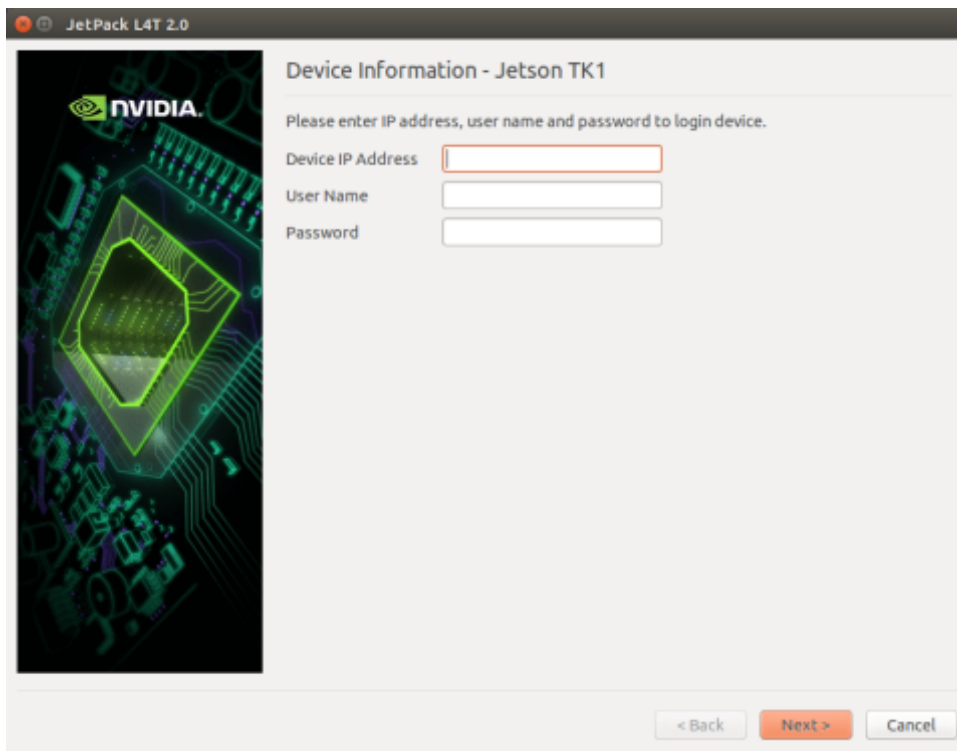
- After you enter the required information and click **Next**, JetPack will begin installing components on the target device.

9. If you selected **Flash OS**, you must select the network layout for your specific environment.
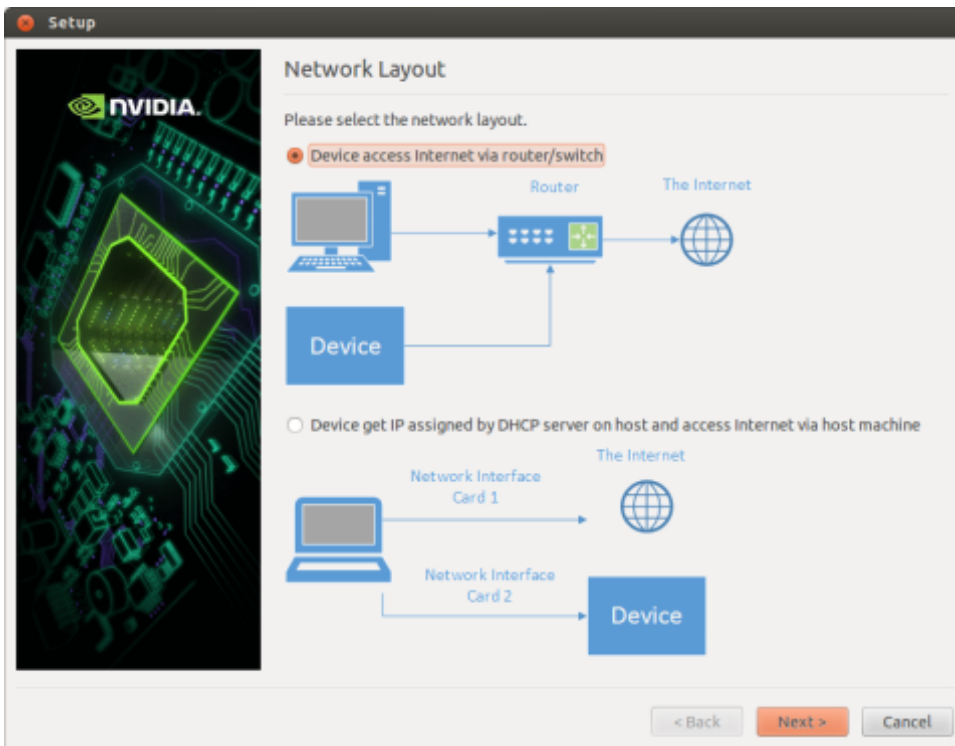
10. If you selected the **Device access Internet via router/switch** layout, you must select which interface to use for Internet access.
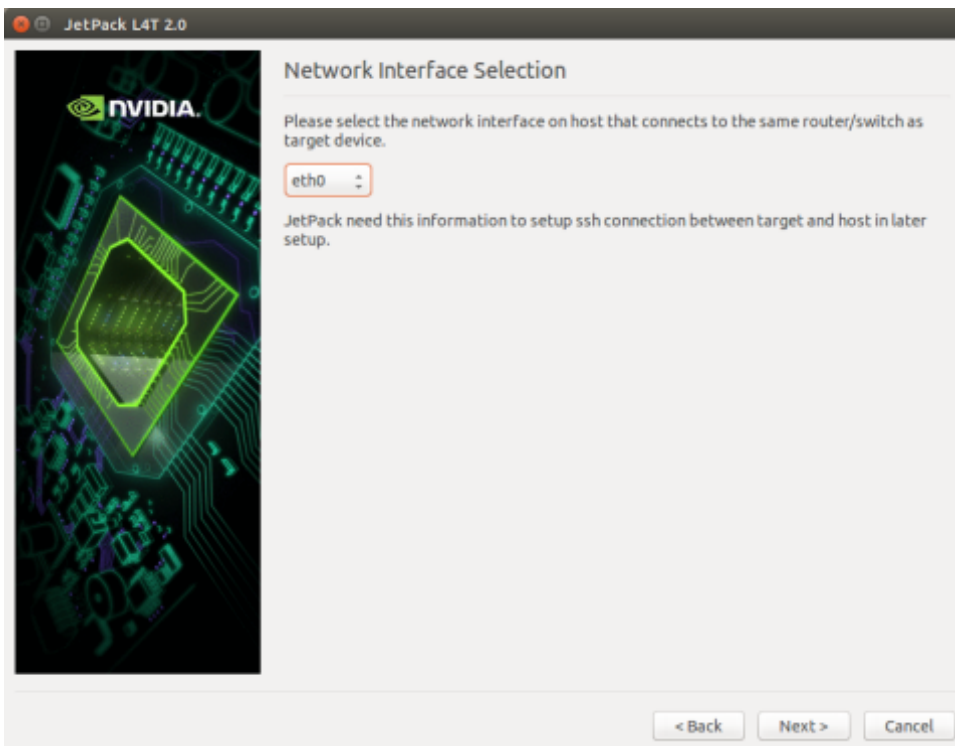
11. If you selected the **Device get IP assigned by DHCP server on host and access Internet via host**

machine layout, you must select which interface to use for Internet access and which to use for the target interface.
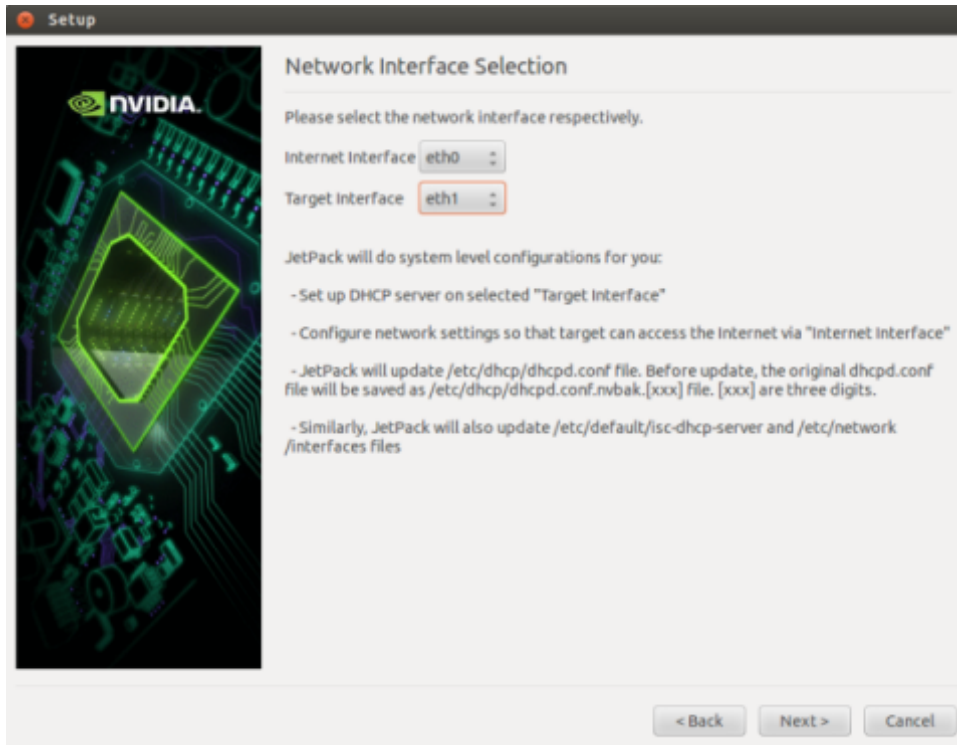
12. A pop-up window instructs you to put your device into Force USB Recovery Mode to flash the OS.
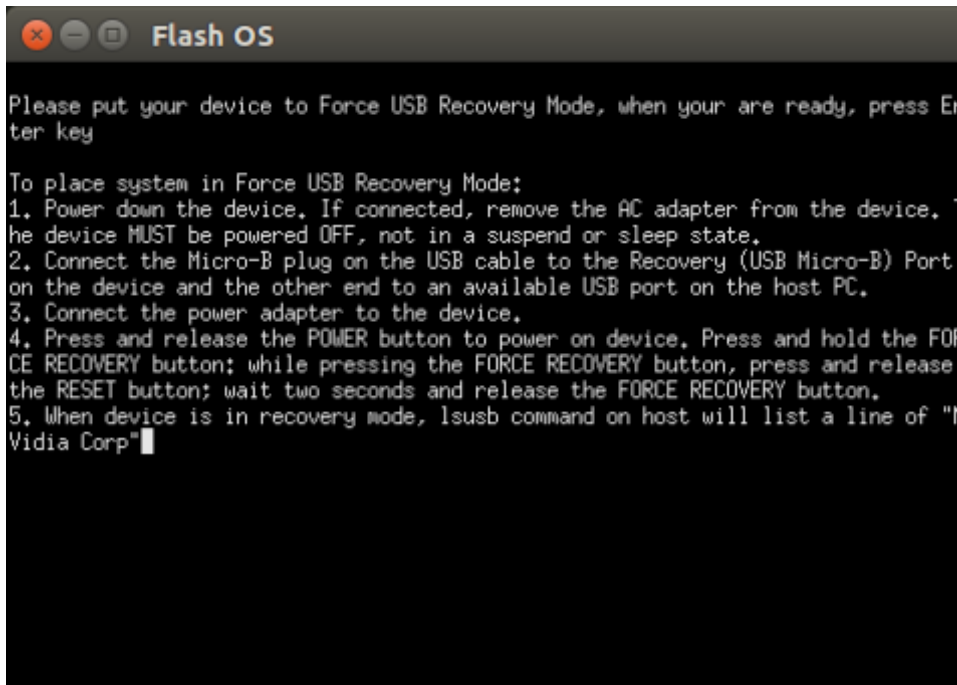
13. You are prompted to install components on the specific target machine, and to compile samples.
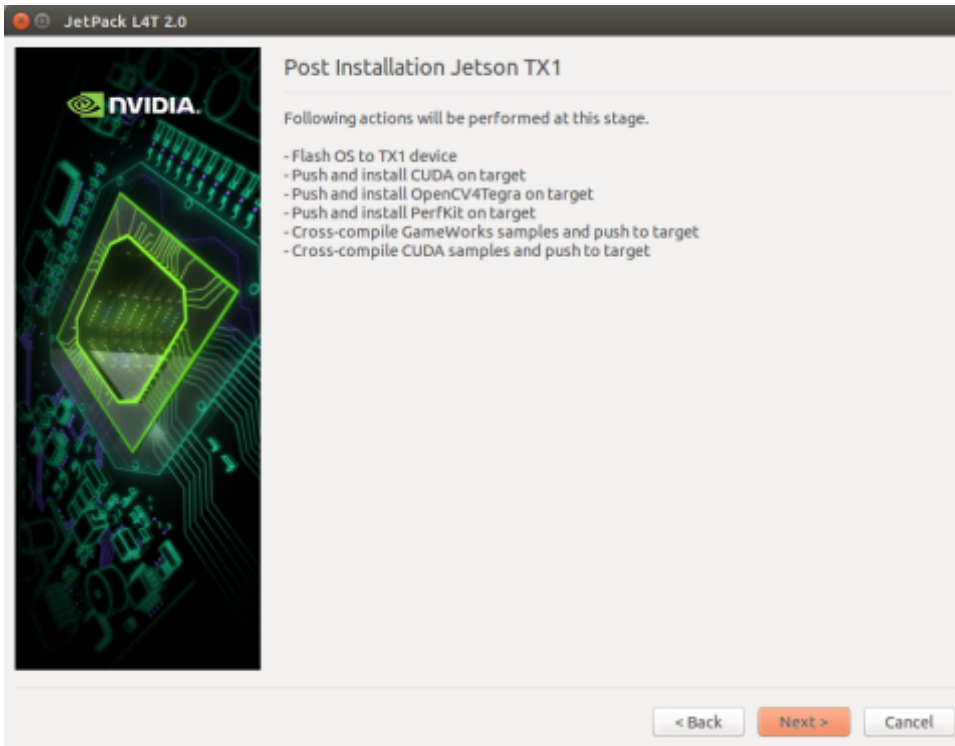
14. After the post installation tasks have been completed, the installation will be complete.
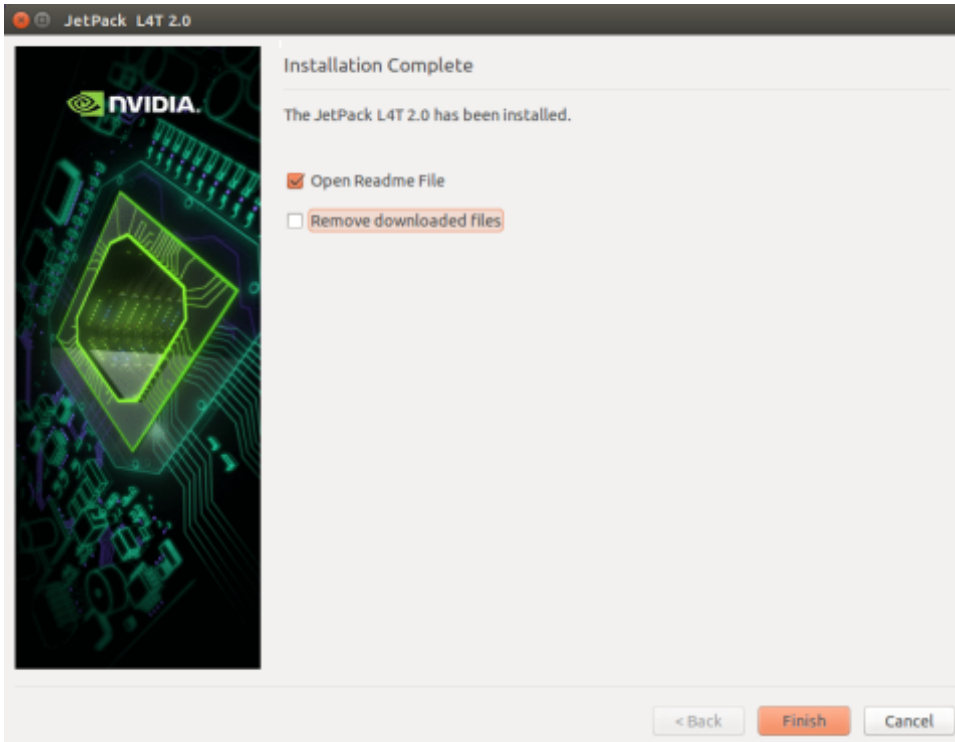
Compiling

JetPack automatically compiles all samples if Compile Samples is checked during the components selection.

- If you selected CUDA components, CUDA samples are located at:

```
<JetPack_Install_Dir>/NVIDIA_CUDA-<version>_Samples
```

You can recompile the samples by running:

```
OPENMPDIR=/usr/arm-linux-gnueabihf/lib EXTRA_LDFLAGS=--unresolved-symbols=ignore-
in-shared-libs ARMv7=1 GCC=arm-linux-gnueabihf-g++ make
```

- If you selected GameWorks OpenGL samples, GameWorks OpenGL samples are available at:

```
<JetPack_Install_Dir >/GameWorksOpenGLSamples
```

You can cross compile them by running the `make` command under the following subfolder:

```
samples/build/linux-arm32
```

Running JetPack Samples

The CUDA samples directory is copied to the home directory on the device by JetPack. The built binaries are in the following directory:

```
/home/ubuntu/NVIDIA_CUDA-<version>_Samples/bin/armv7l/linux/release/gnueabihf/
```

Run the samples at the command line or by double-clicking on them in the file browser. For example, when you run the `oceanFFT` sample, the following screen is displayed.
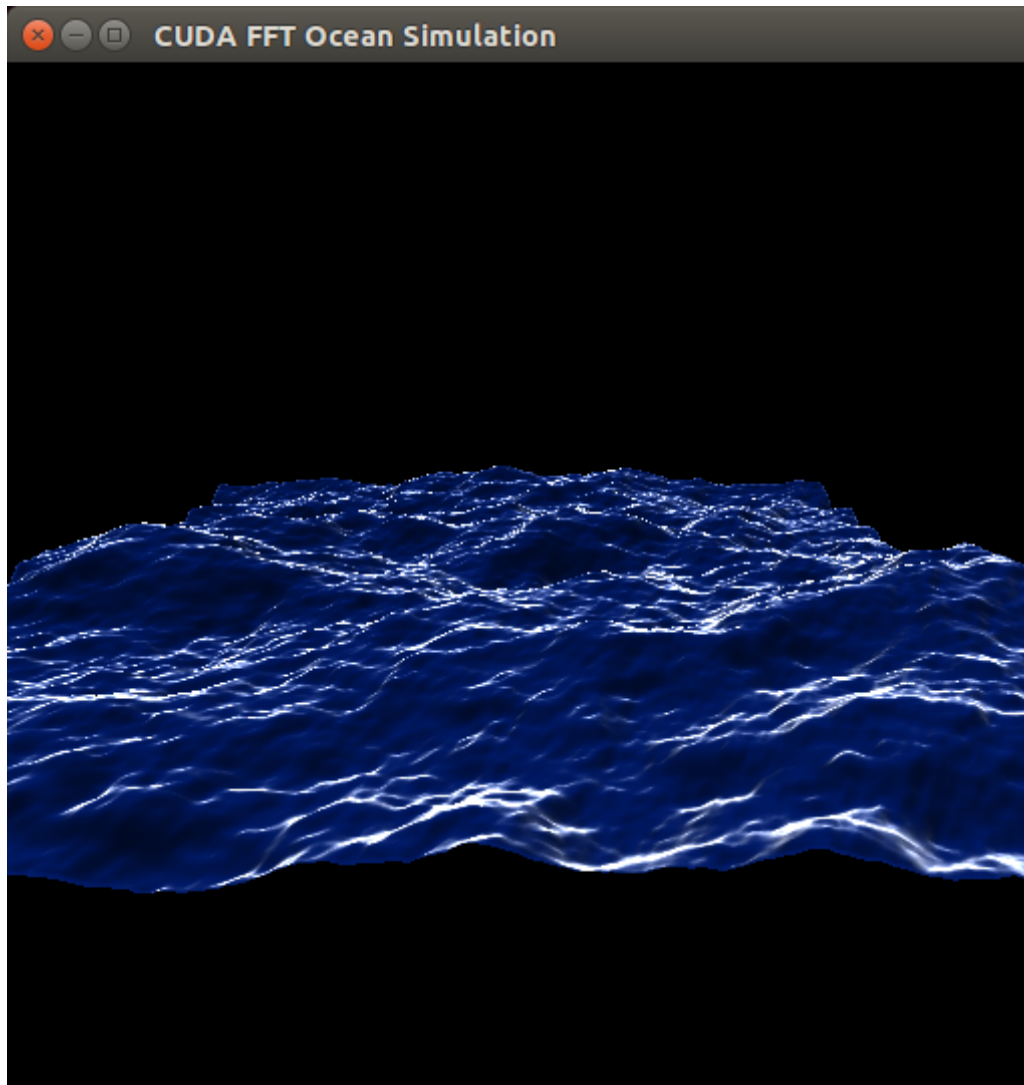
GameWorks OpenGL samples are copied to the home directory on the device. The built binaries are located in the following directory:

```
/home/ubuntu/GameWorksOpenGLSamples/samples/bin/linux-arm32
```

Run the samples at the command line or by double-clicking on them in the file browser. For example, when you run `FeedbackParticlesApp`, you see smoke particles rising.
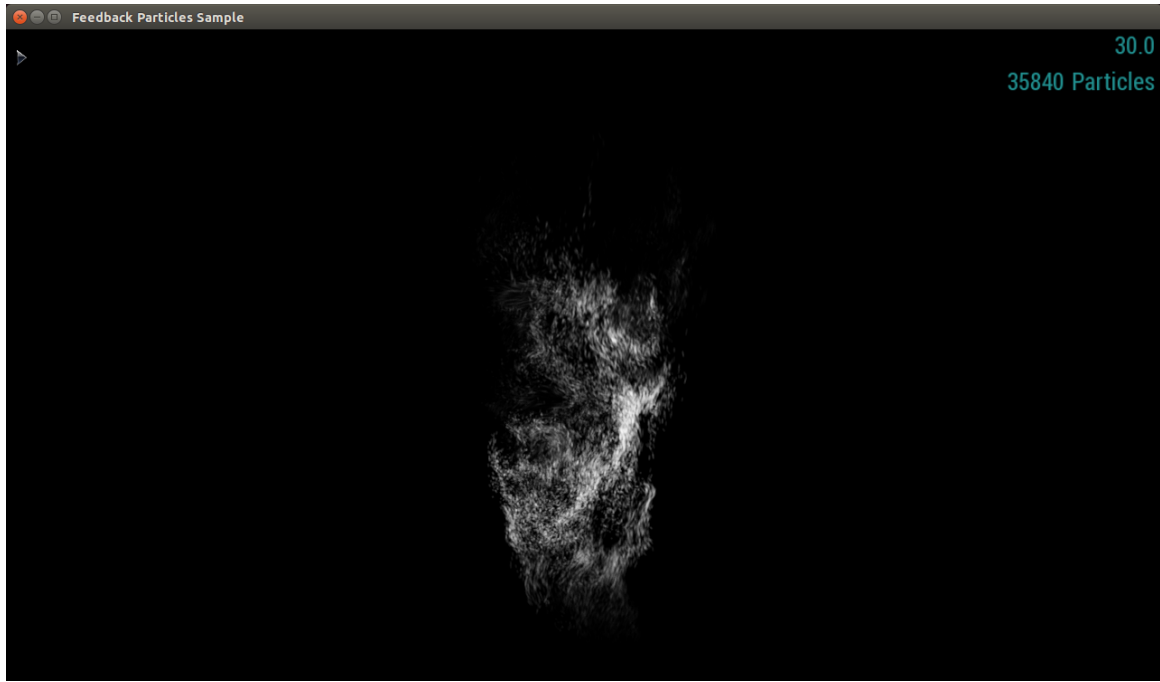
Compliance

The NVIDIA® Jetson TX1 Developer Kit is compliant with the regulations listed in this section. Compliance marks, including the FCC and IC ID numbers, can be found at **http://developer.nvidia.com/embedded-computing**

United States

Federal Communications Commission (FCC)

FCC ID: VOB-P2180

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including any interference that may cause undesired operation of the device.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.

- Increase the separation between the equipment and receiver.

- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

- Consult the dealer or an experienced radio/TV technician for help.

FCC Warning: The FCC requires that you be notified that any changes or modifications to this device not expressly approved by the manufacturer could void the user's authority to operate the equipment. Only those antennas with same type and lesser/equal gain filed under this FCC ID number can be used with this device.

Caution: Within the 5.15 to 5.25 GHz band (5 GHz radio channels 34 to 48) this device is restricted to indoor operations to reduce any potential for harmful interference to co-channel Mobile Satellite System (MSS) operation

RF Radiation Exposure Statement

This equipment complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This

equipment should be installed and operated with a minimum distance of 20 centimeters between the radiator and your body.

Underwriters Laboratories (UL)

I.T.E E204896

Canada

Industry Canada (IC)

IC: 7361A-P2180

CAN ICES-3(B)/NMB-3(B)

This device complies with *Industry Canada's licence-exempt RSSs* of the Industry Canada Rules. . Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

5150–5250 MHz is only for indoor use to reduce the potential for harmful interference to co-channel mobile satellite systems;

Ce dispositif est conforme à la norme RSS-247 d'Industrie Canada applicable aux appareils radio exempts de licence. Son fonctionnement est sujet aux deux conditions suivantes: (1) le dispositif ne doit pas produire de brouillage préjudiciable, et (2) ce dispositif doit accepter tout brouillage reçu, y compris un brouillage susceptible de provoquer un fonctionnement indésirable.

RF Radiation Exposure Statement:

Jetson Dev Kit has been tested and complies with IC RSS 102 RF radiation exposure limits set forth for an uncontrolled environment when used with the NVIDIA accessories supplied or designated for this product. To satisfy IC exposure requirements, a separation distance of at least 20 cm must be maintained between the antenna of this device and persons during device operation. The use of any other accessories may not ensure compliance with IC RSS 102RF exposure guidelines.

Déclaration d'exposition aux radiations:

La Jetson Dev Kit a ete testee conformemment aux normes d'exposition d'emission RF de la IC RSS 102 pour un environement non controle lors d'utilisation avec les accessoires fournis or recommendes par NVIDIA. Pour satisfaire aux exigences d'exposition IC, une distance de séparation d'au moins 20 cm doit être maintenue entre l'antenne de cet appareil et des personnes pendant le fonctionnement de l'appareil. L'utilisation d'accessoires autres que ceux recommendes par NVIDIA ne guarantis pas la compatibilite avec les normes d'emission RF de la IC RSS 102.

Australia and New Zealand

Australian Communications and Media Authority (RCM)

This product meets the applicable EMC requirements for Class B, I.T.E equipment and applicable radio equipment requirements

Notice

Trademarks