Holoscan Sensor Bridge Quick Start Guide

Application Note

FPGA-AN-02096-1.0

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Inclusive Language

This document was created consistent with Lattice Semiconductor’s inclusive language policy. In some cases, the language in underlying tools and other items may not yet have been updated. Please refer to Lattice’s inclusive language FAQ 6878 for a cross reference of terms. Note in some cases such as register names and state names it has been necessary to continue to utilize older terminology for compatibility.

Contents

Abbreviations in This Document

A list of abbreviations used in this document.

Abbreviation	Definition
AI	Artificial Intelligence
EULA	End-User Licensed Agreement
FPGA	Field Programmable Gate Array
Gb	Gigabit
GbE	Gigabit Ethernet
IP	Intellectual Property
MIPI	Mobile Industry Processor Interface
OS	Operating System
PC	Personal Computer
SDK	Software Development Kit
SFP	Small Form-Factor Pluggable

1. Setup Requirements

This section of the document covers the necessary components needed to setup the Holoscan Sensor Bridge Board and run the provided MIPI Edge-AI Reference Design using an NVIDIA Holoscan Developer Kit.

- PC with Ubuntu OS installed
  - Used to flash the NVIDIA Holoscan Developer Kit
  - Recommended to use Ubuntu 18.04, 20.04 or 22.04
- Lattice Holoscan Sensor Bridge Board
  - Compatible with NVIDIA Holoscan Developer Kits, Leopard Imaging IMX274 Camera Modules and MIPI Edge-AI Reference Design.
- NVIDIA Holoscan Developer Kit (Jetson AGX Orin, IGX Orin, etc)
  - Support 10GbE for NVIDIA Hololink IP (in MIPI Edge-AI Reference Design)
- Leopard Imaging Camera Module (IMX274 Dual-Camera Module)
  - Compatible with Lattice Holoscan Sensor Bridge Board, NVIDIA Holoscan Developer Kits and MIPI Edge-AI Reference Design.
- 10 GbE SFP+ module (10GBASE-T)
  - Used to connect Lattice Sensor Bridge Board to NVIDIA Holoscan Developer Kit.
  - The Jetson AGX Orin Developer Kit requires one module for camera interface due to its single 10G Ethernet port limitation, which can only connect to a single IMX274 Dual-Camera Module at a time.
  - 2 modules are recommended for IGX Orin Developer Kit to use both ethernet ports on Lattice Sensor Bridge Board and both cameras for IMX274 Dual-Camera Module.
- Cat-6 Ethernet Cable
  - Support 10 Gbps Ethernet (10GBASE-T)
  - Recommend 5 ft – 10 ft in length.
  - The Jetson AGX Orin Developer Kit requires one cable for camera interface due to its single 10G Ethernet port limitation, which can only connect to a single IMX274 Dual-Camera Module at a time.
  - 2 cables are recommended for IGX Orin Developer Kit to use both ethernet ports on Lattice Sensor Bridge Board and both cameras for IMX274 Dual-Camera Module.
- Additional PC peripherals (Monitor, Keyboard, Mouse, DisplayPort Cable)
  - Needed to interface with NVIDIA Holoscan Developer Kit.
- Optional Lattice HW-USBN-2B Programming Cable
  - This feature is only necessary for programming custom bitstreams to the Lattice Sensor Bridge Board, specifically for custom designs targeting the Lattice Holoscan Sensor Bridge Board or modifications to the MIPI Edge-AI Reference Design.

2. Key Links

This section of the document contains important references to help users get started with a Lattice Holoscan Sensor Bridge Board and NVIDIA Holoscan Developer Kit.

- Holoscan Sensor Bridge GitHub
  - Main repository for relevant Holoscan resources
    - Holoscan SDK
    - Documentation
    - Sample Applications and Code
    - Modules and Extensions
  - Contains community-driven collection of applications, operators and tutorials
- NVIDIA SDK Manager User Manual
  - Contains detailed information to install Jetson software using the NVIDIA SDK Manager
    - Download and install of SDK components
    - Flashing of NVIDIA Holoscan Developer Kit
- Holoscan Sensor Bridge User Manual
  - Contains comprehensive information on setting up and using the Holoscan Sensor Bridge board
    - Overview of Board, its Applications and Requirements
    - Device Setup Instructions
    - Associated Software and Applications
    - Hololink FPGA IP
    - Troubleshooting
    - Example Demo Instructions/Descriptions
- MIPI Edge-AI Reference Design, Hololink FPGA IP, and Associated Bitstreams
  - Repository for FPGA-based MIPI Edge-AI Reference Design Files
    - Full Radiant Project for Reference Design (signed EULA required)
    - Hololink FPGA IP
    - Bitstreams for Reference Design

3. Getting Started

This section of the document lists the steps to setup and upgrade the Holoscan Ecosystem consisting of the NVIDIA Holoscan SDK, NVIDIA Holoscan Developer Kit, Lattice Holoscan Sensor Bridge Board, and MIPI Edge-AI Reference Design.

3.1. Setting Up the Holoscan Development Ecosystem

This section provides the steps to perform initial install and setup of the Holoscan SDK, NVIDIA Holoscan Developer Kit and Lattice Holoscan Sensor Bridge Board, and running of the provided MIPI Edge-AI Reference Design.

1. Create an NVIDIA account and register for the Developer Program.
2. On a Ubuntu OS computer, download the SDK Manager.
   - Follow steps under the *Get Started* section
     - Refer to *Download and Install* and *Launch* subsections

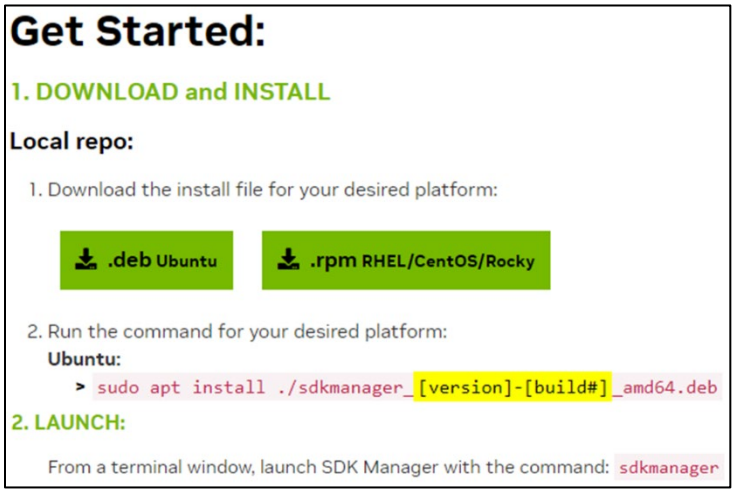

Figure 3.1. Downloading and Installing the SDK

3. Once the SDK Manager has been successfully launched, follow the steps outlined in NVIDIA SDK Manager User Manual to flash the NVIDIA Holoscan Developer Kit.
   - Follow steps under the Install Jetson Software with SDK Manager section
     - Refer to *Step 1 – Step 4* subsections

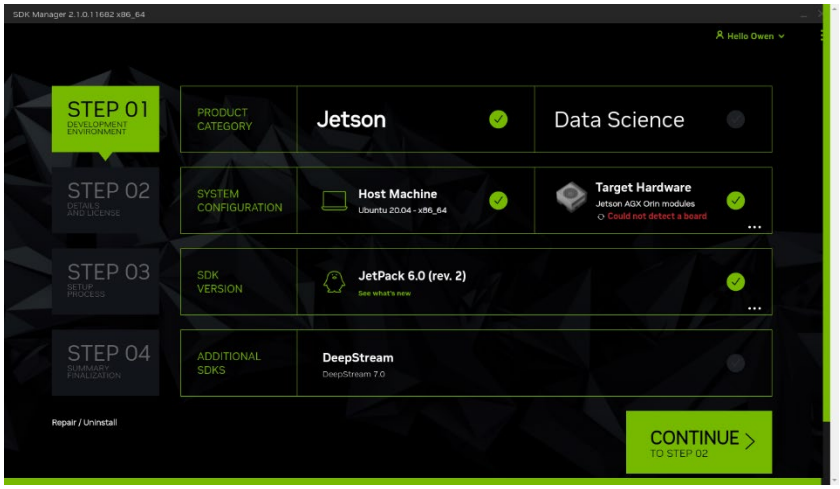

Figure 3.2. Flashing the NVIDIA Holoscan Developer Kit

4. Once the device has been successfully flashed, connect a monitor, keyboard, and mouse to the NVIDIA Holoscan Developer Kit.
5. Power-on and log into the NVIDIA Holoscan Developer Kit.
   - Use Username and Password credentials setup during *Step 3* of the NVIDIA SDK Manager User Manual
6. Once successfully logged into the NVIDIA Holoscan Developer Kit, follow the steps outlined in the NVIDIA Holoscan Sensor Bridge User Manual to download and setup the Holoscan Sensor Bridge Docker.
   - Refer to the *Host Setup* subsection

```
agx1@ubuntu:~/holoscan-sensor-bridge$ sh docker/build.sh --igpu
+ realpath docker/build.sh
+ SCRIPT=/home/agx1/holoscan-sensor-bridge/docker/build.sh
+ dirname /home/agx1/holoscan-sensor-bridge/docker/build.sh
+ HERE=/home/agx1/holoscan-sensor-bridge/docker
+ realpath /home/agx1/holoscan-sensor-bridge/docker/..
+ ROOT=/home/agx1/holoscan-sensor-bridge
+ cat /home/agx1/holoscan-sensor-bridge/VERSION
+ VERSION=1.0.0
+ CONTAINER_TYPE=dgpu
+ [ 1 -ne 0 ]
+ CONTAINER_TYPE=igpu
+ docker build --network=host --build-arg CONTAINER_TYPE=igpu -t hololink-prototype:1.0.0 -f
```

Figure 3.3. Building the Demo Container

7. Once the software loopback tests run successfully, setup is complete.
   - Follow the steps outlined in the NVIDIA Holoscan Sensor Bridge User Manual and refer to the *Running Holoscan Sensor Bridge Examples* section to run provided example applications.

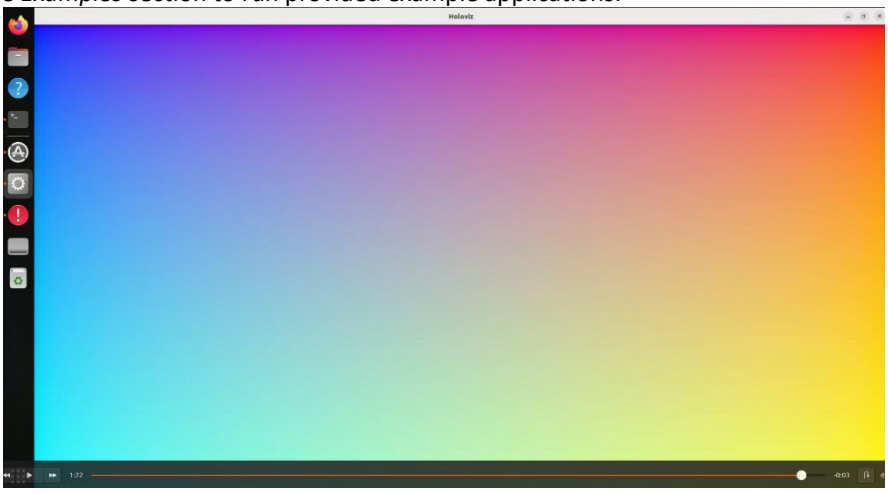

Figure 3.4. Running Software Loopback Tests

8. Refer to the Debug and Troubleshooting section of this Quick Start Guide for additional help during the setup of the SDK or running of the example applications.

3.2. Updating the Holoscan Development Ecosystem

This section of the document covers the necessary steps to upgrade the version of Jetpack on the NVIDIA Holoscan Developer Kit and updating of firmware on the Lattice Holoscan Sensor Bridge Board. It is important to keep these versions up to date as it may introduce errors when trying to run the MIPI Edge-AI Reference Design if the OS version on the Developer Kit and image version on the Lattice Holoscan Sensor Bridge Board are not compatible.

3.2.1. Updating the NVIDIA Holoscan Developer Kit

To upgrade the Holoscan Developer Kit OS version, refer to Steps 2–3 in the Getting Started section of this Quick Start Guide. If a newer version of Jetpack is available, then proceed with the remaining steps in the Getting Started section of this document.

3.2.2. Updating the Lattice Holoscan Sensor Bridge Board

To upgrade the Holoscan Sensor Bridge Board image, there are two methods:

- Via Ethernet (specific to MIPI Edge-AI Reference Design with no custom modifications)
- Via Lattice HW-USBN-2B Programming Cable (supports custom bitstreams or modifications to MIPI Edge-AI Reference Design)

The first method is done over ethernet and is only applicable for updating the image associated with the MIPI Edge-AI Reference Design. To update the image on the Holoscan Sensor Bridge Board, follow the steps outlined in the NVIDIA Holoscan Sensor Bridge User Manual, under the *Holoscan Sensor Bridge FPGA Firmware Update* section.

The second method requires users to connect the Lattice HW-USBN-2B cable to the Holoscan Sensor Bridge Board JTAG headers. This method is required to program custom bitstreams to the Holoscan Sensor Bridge Board and can also be used if the method over Ethernet fails for the MIPI Edge-AI Reference Design. For instructions and details on how to program the board via JTAG, refer to the *Board Programming* section of the CertusPro-NX Sensor to Ethernet Bridge Board User Guide (FPGA-EB-02069).

4. Debug and Troubleshooting

This section of the document covers common issues you may encounter while setting up the Holoscan Development Ecosystem.

4.1. Downloading the SDK

If the Holoscan SDK is unable to install or launch, when performing Step 2 in the Getting Started section of this Quick Start Guide, make sure to download the Debian file (.deb) since the OS on the PC should be Ubuntu. The Debian file download can be found under the *Get Started* and *Download and Install* sections of the SDK Manager webpage.

- The downloaded file should be similar to: **sdkmanager_2.1.0-11682_amd64.deb**
  - In this case the version number corresponds to *2.1.0* and the build number corresponds to *11682*
- When running the **sudo apt install** command, point to the downloaded Debian file with the appropriate version and build numbers specified.
  - For example: sudo apt install ./sdkmanager_2.1.0-11682_amd64.deb

4.2. Detecting the Developer Kit

When preparing to the flash the Holoscan Developer Kit during *Step 3* in the Getting Started section of this Quick Start Guide, follow the steps outlined in the NVIDIA SDK Manager User Manual. To enable proper detection of the Developer Kit, ensure the Ubuntu PC and AGX Orin Developer Kit are connected accordingly:

- Ubuntu PC (USB-A or USB-C port) to AGX USB-C Port 10
- Connect Power to AGX USB-C Port 4

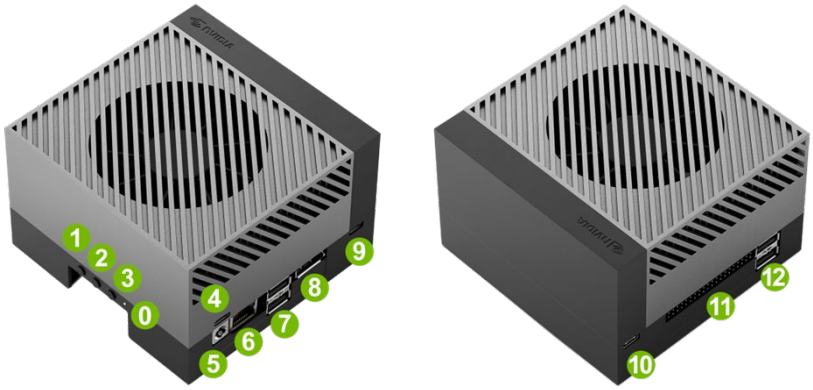

Figure 4.1. AGX Developer Kit Ports

- If connecting the Developer Kit during *Step 1* of the NVIDIA SDK Manager User Manual, ensure Jetson AGX Orin **[64GB Developer Kit Version]** is selected.
- During *Step 3* of the NVIDIA SDK Manager User Manual, users will be prompted to connect the AGX Orin Developer Kit
  - If the Developer Kit is already connected to the Ubuntu PC, disconnect the USB-C cable from Port 10 on the AGX and then reconnect it
  - Follow instructions to set the AGX into recovery mode by pressing Button 1 and Button 2
  - Note that flashing can take around 30 minutes – you can monitor the installation progress

4.3. Setting Up the AGX (Post-Flash)

Once the AGX is successfully flashed, all PC peripherals (monitor, keyboard, mouse) should be connected to the AGX system. All steps following flashing the AGX system should be completed from the AGX (Ubuntu PC is no longer needed).

- Connect Monitor via DisplayPort to AGX Port 8
- Connect Keyboard/Mouse to AGX USB-A Port 7 or Port 12

During setup, files and models may need to be downloaded as indicated in the Holoscan Sensor Bridge User Manual. If issues are encountered trying to download the required files/models, it could potentially be tied to network permissions. As a workaround, consider using an unrestricted network, such as a mobile phone hotspot.

4.4. Running MIPI Edge-AI Reference Design Example Demos

If you encounter a black window when running the IMX274 Player example, the docker container on the AGX Developer Kit must be rebuilt as this will affect all other examples.

- You should follow the steps under *Host Setup* section in the Holoscan Sensor Bridge User Manual
  - Refer to the Build the Demo Container subsection

For example, when running the TAO PeopleNet and Body Pose for the first time, it may take several minutes to convert the models.

- After running the **python3** commands to run these examples, the model conversion process will take a place when the *This could take a couple minutes depending on model size or GPU!* message appears on screen
- If the visualizer window opens and still, after several minutes, a visual does not appear, the docker container must be rebuilt
  - Follow the steps under *Host Setup* section in the Holoscan Sensor Bridge User Manual
  - Refer to the Build the Demo Container subsection

Reference

- CertusPro-NX web page.
- CertusPro-NX Sensor to Ethernet Bridge Board User Guide (FPGA-EB-02069)
- Lattice Insights web page for Lattice Semiconductor training courses and learning plans.

Technical Support Assistance

Submit a technical support case through www.latticesemi.com/techsupport.

For frequently asked questions, refer to the Lattice Answer Database at www.latticesemi.com/Support/AnswerDatabase.

Revision History

Revision 1.0, October 2024

Section	Change Summary
All	Initial release.

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