NVIDIA Jetson Xavier NX and Jetson TX2 Series Interface Comparison and Migration

Application Note

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Document History

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Version	Date	Description of Change
0.9	November 6, 2019	Preliminary Information
1.0	April 20, 2020	• Updated Figure 1, Figure 2, and Figure 3 • Updated Table 1 • Added note regarding images for Figure 3 and Figure 4 • Updated Table 3 to reflect the change of lanes used for PCIe in Jetson Xavier NX module design • Updated "PCI Express" section • Updated "Camera" section
1.1	September 8, 2020	Corrected pin numbers for PCIe1 pins on Jetson NX in Figure 5

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Introduction

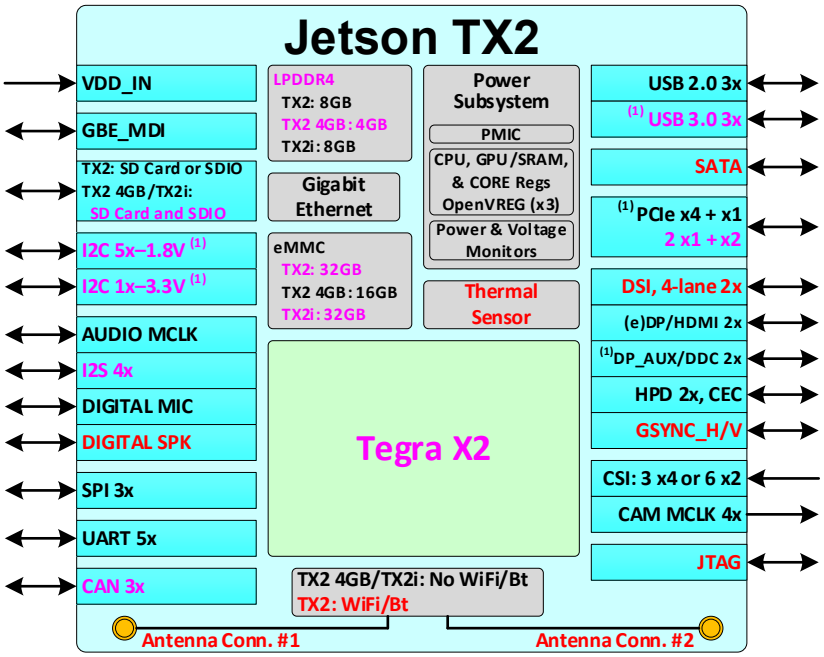
This application note compares the features and interfaces supported on the NVIDIA® Jetson Xavier™ NX and Jetson™ TX2 modules. This application note also describes the migration path for designers familiar with Jetson TX2 to design a carrier board for Jetson Xavier NX that will support the features available on Jetson Xavier NX.

Jetson Xavier NX vs. Jetson TX2

The Jetson Xavier NX and Jetson TX2 modules are not pin compatible but share many of the same features. This application note describes the differences to allow users familiar with Jetson TX2 to design a similar carrier board for Jetson Xavier NX.

The following figures show the Jetson Xavier NX and Jetson TX2 block diagrams. The interfaces or blocks that are supported only by one of the modules are highlighted in red. The interface types that are supported on both modules but where the number of lanes/instances, voltage level, or access is different are highlighted in magenta.

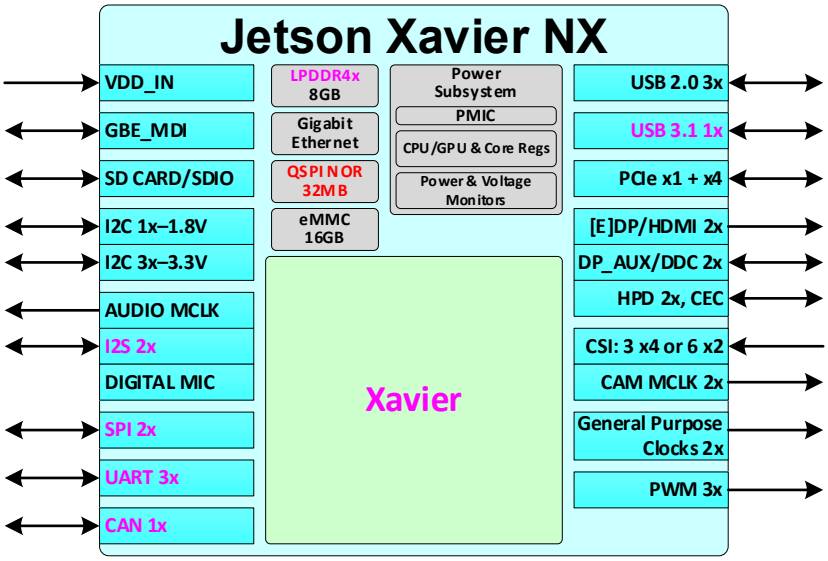
Figure 1. Jetson TX2 Block Diagram



Note:

[1]USB 3.0, PCIe, and SATA share lanes. Not all instances shown in Figure 1 can be brought out together. See the *Jetson TX2 OEM Product Design Guide* for details.

Figure 2. Jetson Xavier NX Block Diagram



Module Interface Comparisons

Table 1 lists the key system specifications, devices and interfaces that are supported on either the Jetson Xavier NX or the Jetson TX2 module.

Table 1. Jetson Xavier NX and Jetson TX2 Feature Comparison

Feature	Jetson Xavier NX	Jetson TX2
System Specifications and Device on the Module		
GPU	NVIDIA Volta™ architecture with 384 NVIDIA® CUDA® cores and 48 Tensor cores	256 Core NVIDIA Maxwell™ (1 TFLOPs FP16)
CPU	6-core NVIDIA Carmel Armv8.2 64-bit CPU	Dual-core Denver 1.5 64-bit CPU and quad-core Arm A57 complex
DL Accelerator	2x NVDLA Engines	Not Supported
Vision Accelerator	7-Way VLIW Vision Processor	Not Supported
Memory	8 GB 128-bit LPDDR4x	TX2: 8 GB 128-bit LPDDR4 TX2 4GB: 4 GB 128-bit LPDDR4 TX2i: 8 GB 128-bit LPDDR4
Storage	16 GB eMMC	TX2: 32 GB eMMC 5.1 TX2 4GB: 16 GB eMMC 5.1 TX2i: 32 GB eMMC 5.1
Networking	10/100/1000 Mbit	
Video Encode	2x464MP/sec 2x 4K @ 30 (HEVC) 6x 1080p @ 60 (HEVC) 14x 1080p @ 30 (HEVC)	500MP/sec 1x 4K @ 60 (HEVC) 3x 4K @ 30 (HEVC) 4x 1080p @ 60 (HEVC) 8x 1080p @ 30 (HEVC)
Video Decode	2x690MP/sec 2x 4K @ 60 (HEVC) 4x 4K @ 30 (HEVC) 12x 1080p @ 60 (HEVC) 32x 1080p @ 30 (HEVC)	1000MP/sec 2x 4K @ 60 (HEVC) 4x 4K @ 30 (HEVC) 7x 1080p @ 60 (HEVC) 20x 1080p @ 30 (HEVC)

Feature	Jetson Xavier NX	Jetson TX2
System Specifications and Device on the Module		
	16x 1080p @ 30 (H.264)	
Camera	14 lanes (3x4 or 6x2) MIPI CSI-2 D-PHY (2.5 Gb/s per pair)	12 lanes (3x4 or 6x2) MIPI CSI-2 D-PHY 1.2 (2.5 Gb/s per pair)
WiFi	Requires external solution	TX2: Onboard TX2 4GB/TX2i: Requires external solution
Mechanical	69.6 mm x 45 mm 260-pin edge connector	87 mm x 50 mm 400-pin connector
Input Voltage	5V (nominal)	TX2 5.5V (min) to 19.6V (max) TX2 4GB/TX2i: 9.0V (min), 19.6V (max)
Interfaces		
USB 2.0	3x	
USB 3.x (See Note 1)	1x (3.1)	Up to 3x (3.1)
PCIe (See Note 1)	1 x1 (Gen3) + 1 x4 (GEN4). x1 is Root Port only. x4 has both Root Port and Endpoint support	1 x1 + 1 x4 or 1 x2 +2 x1 (Gen2), Root Port only.
SATA (See Note 1)	Not supported	x1
Display	Two multi-mode (e)DP 1.4/HDMI™ 2.0a	Two multi-mode DP 1.2a/eDP 1.4/HDMI 2.0a/b. Two 1x4 DSI (1.5Gbps/lane)
Audio (I2S)	2x	4x
SDIO/SD Card	1x SD Card/SDIO	TX2: 1x SD Card/SDIO TX2 4GB/TX2i: 2x SD Card/SDIO
Gigabit Ethernet	Supported	
I2C	4x	8x (see Note 2)
UART	3x	5x
SPI	2x	3x
JTAG	Not supported	Brought to module pins
Fan	PWM and Tach Input	

Notes:

1. See the USB 3.0, PCIe, and SATA interface mapping comparison tables for details on lane sharing for Jetson TX2 Series Modules.
2. Including **DP_AUX pins used as I2C.**
3. There are 2 display controllers. If both are driving DSI displays, they must be at the same resolution.

Function and Interface Difference Details

On-Module Wireless

Jetson Xavier NX as well as Jetson TX2 4GB and TX2i do not include on-module wireless functionality. Jetson TX2 does support Wi-Fi and Bluetooth®.

Supported VDD_IN Voltage Range

Jetson Xavier NX requires a nominal input voltage on VDD_IN of 5V. Jetson TX2 supports a VDD_IN range from 5.5V (min) to 19.6V (max). Jetson TX2 4GB and TX2i support a VDD_IN range from 9.0V (min) to 19.6V (max).

Mechanical Differences

Table 2 lists the mechanical differences.

Table 2. Mechanical Differences

Feature	Jetson Xavier NX	Jetson TX2
Size	69.9 mm x 45 mm	87 mm x 50 mm
Built-in Thermal Solution	None	Thermal Transfer Plate (TTP)
Thermal Solution Mounting	4 holes in PCB for screws to pass through thermal solution and Jetson Xavier NX board to connect to a metal bracket below module. Thermal solution contacts SoC (w/thermal material placed between).	Jetson TX2: 4 small threaded holes in the TTP or main mounting holes. Jetson TX2 4GB/TX2i: Main mounting holes only. Thermal solution contacts TTP.

Figure 3. Jetson Xavier NX vs. Jetson TX2 Module Top

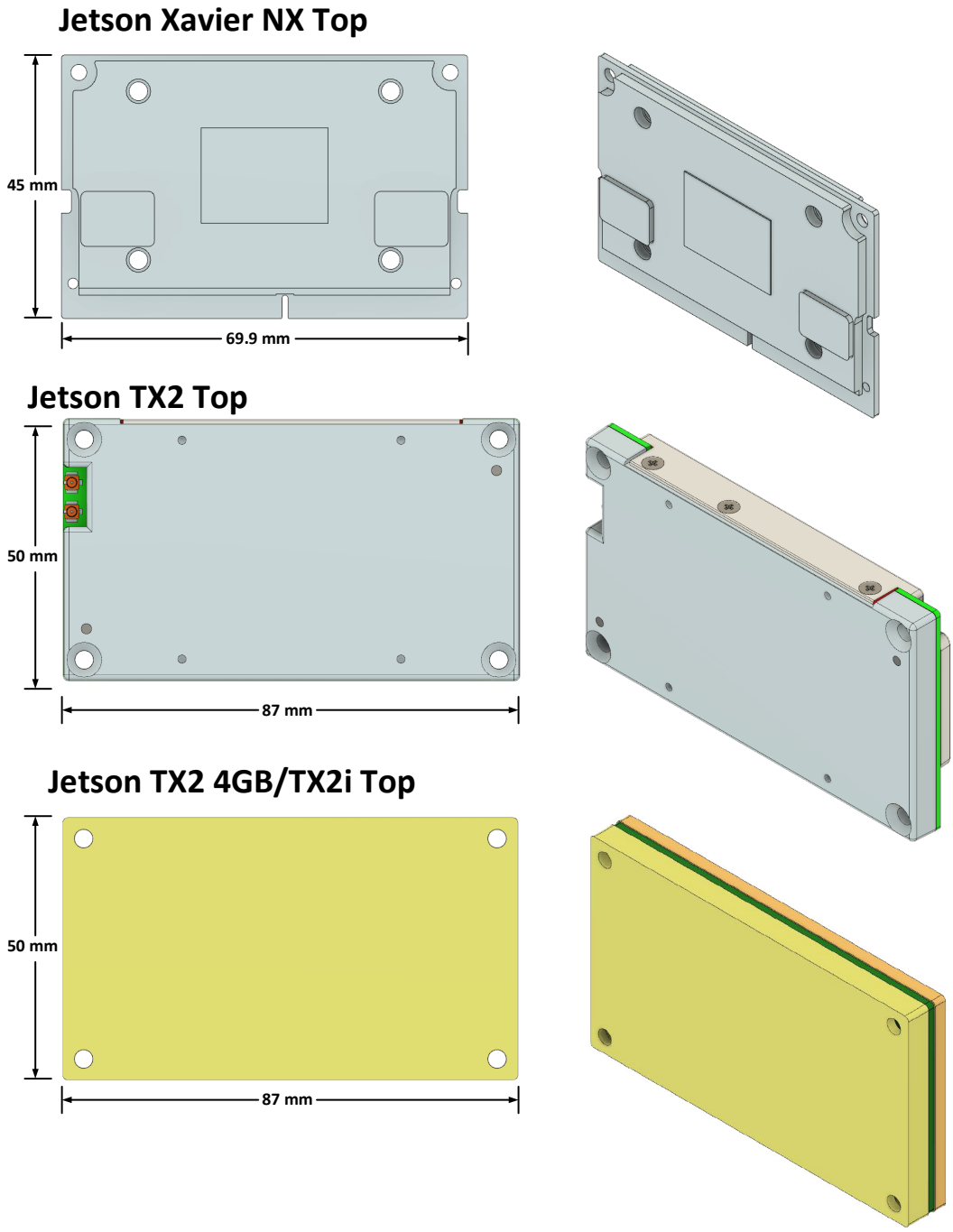
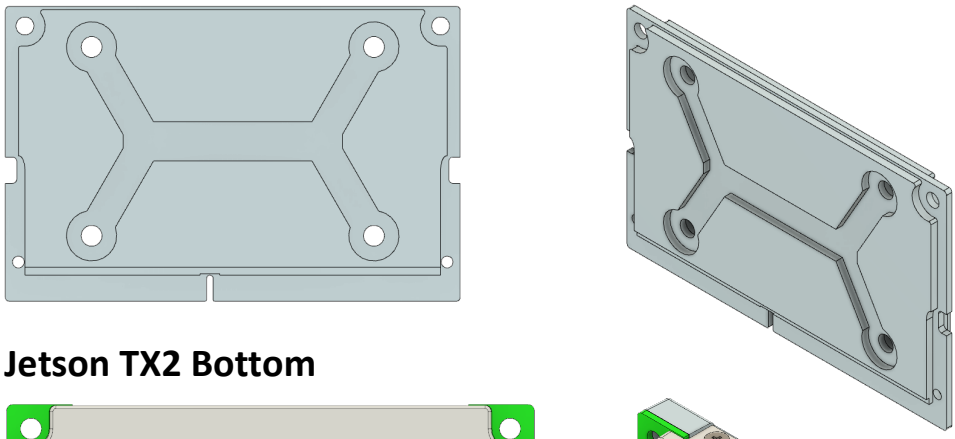
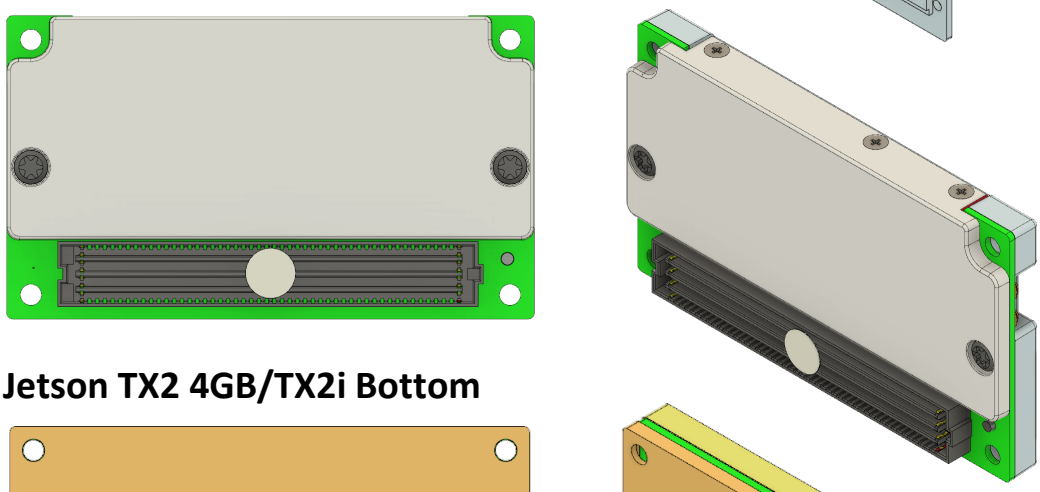


Figure 4. Jetson Xavier NX vs. Jetson TX2 Module Bottom

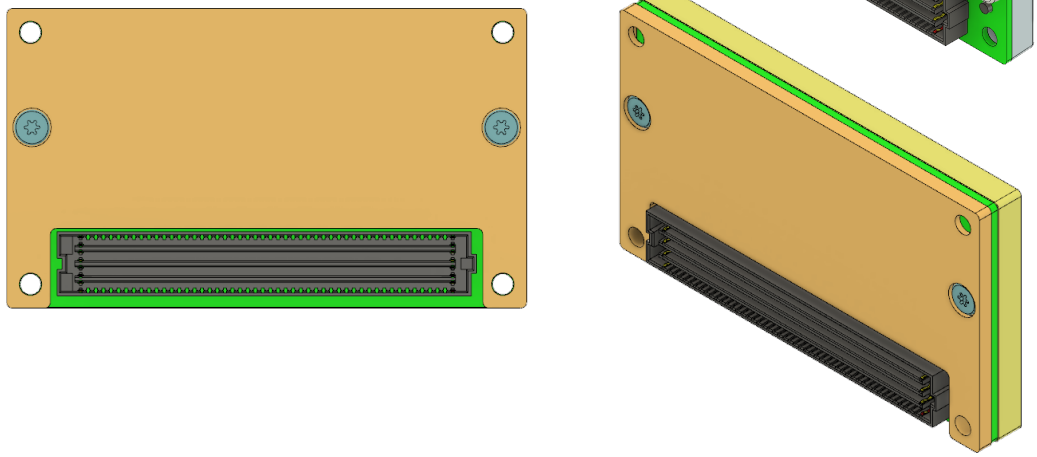
Jetson Xavier NX Bottom



Jetson TX2 Bottom



Jetson TX2 4GB/TX2i Bottom



Note: The Jetson Xavier NX images in Figure 3 and Figure 4 are taken from the 3D CAD STEP models which show only the "envelop" view which provides the maximum component heights by region instead of the individual components. See the thermal design guides for more detailed images of the module.

USB 3.x, PCI Express, and SATA Mapping

The following tables show the different options for mapping USB 3.x, PCIe, and SATA (Jetson TX2 only) to the common set of interface pins.

Table 3. Jetson Xavier NX USB 3.1, PCIe Lane Mapping Configurations

Jetson Xavier NX Pin Names		**PCIe#0, Lane 3**	**PCIe#0, Lane 2**	**PCIe#0, Lane 1**	**PCIe#0, Lane 0**	**PCIe#1, Lane 0**	**USBSS**
Xavier Lanes		**NVHS Lane 3**	**NVHS Lane 2**	**NVHS Lane 1**	**NVHS Lane 0**	**PCIe Lane 11**	**Lane 1**
USB 3.1	**PCIe**						
1	1x4 + 1x1	PCIe#0_3	PCIe#0_2	PCIe#0_1	PCIe#0_0	PCIe#1_0	USB_SS#2
Recommended Usage		PCIe x4 connector or device (i.e. M.2 Key M)				PCIe x1 conn. or device (i.e. M.2 Key E)	USB 3.1 connector, device or hub

Table 4. Jetson TX2 USB 3.1, PCIe, and SATA Lane Mapping

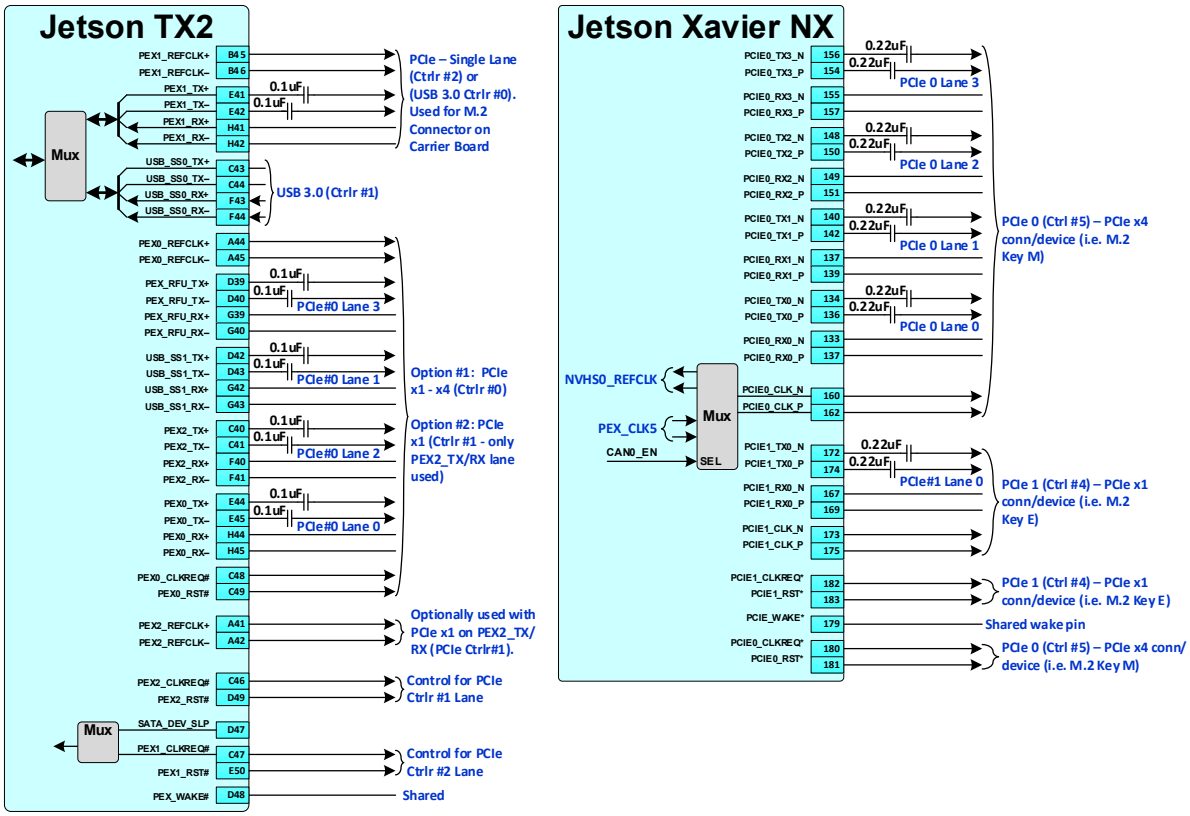
	Jetson TX2 Series Pin Names			PEX1	PEX_RFU	PEX2	USB_SS1	PEX0	USB_SS0 (see note 1)	SATA
	Tegra Lanes			Lane 0	Lane 1	Lane 3	Lane 2	Lane 4		Lane 5
	Avail. Outputs from the module									
Configs	USB 3.0	PCIe	SATA							
1	0	1x1 + 1x4	1	PCIe#2_0	PCIe#0_3	PCIe#0_2	PCIe#0_1	PCIe#0_0		SATA
2 (CB Default)	1	1x4	1		PCIe#0_3	PCIe#0_2	PCIe#0_1	PCIe#0_0	USB_SS#0	SATA
3	2	3x1	1	PCIe#2_0	USB_SS#1	PCIe#1_0	USB_SS#2	PCIe#0_0		SATA
4	3	2x1	1		USB_SS#1	PCIe#1_0	USB_SS#2	PCIe#0_0	USB_SS#0	SATA
5	1	2x1 + 1x2	1	PCIe#2_0	USB_SS#1	PCIe#1_0	PCIe#0_1	PCIe#0_0		SATA
6	2	1x1 + 1x2	1		USB_SS#1	PCIe#1_0	PCIe#0_1	PCIe#0_0	USB_SS#0	SATA
Default Usage on CB (carrier board)				Unused	X4 PCIe Connector				USB 3 Type A	SATA

Note: 1. PCIe interface #2 can be brought to the PEX1 pins, or USB 3.0 port #1 to the USB_SS0 pins on Jetson modules depending on the setting of a multiplexor on the module.

PCI Express

Jetson Xavier NX supports two PCIe interfaces. A x1 lane interface and a x4 lane interface (can be x2 or x1 instead) at the module pins. Jetson TX2 can support the same 1 x1 lane and 1 x4 lane configuration or 2 x1 lane and 1 x2 lane interfaces (Configuration #5 in Table 4) at the module pins. Jetson Xavier NX supports both Root Port and Endpoint operation on the x4 interface up to Gen4. The x1 interface supports only Root Port and only up to Gen3. Jetson TX2 only supports Root Port operation up to Gen2.

Figure 5. Jetson Xavier NX and Jetson TX2 PCIe Block Diagram



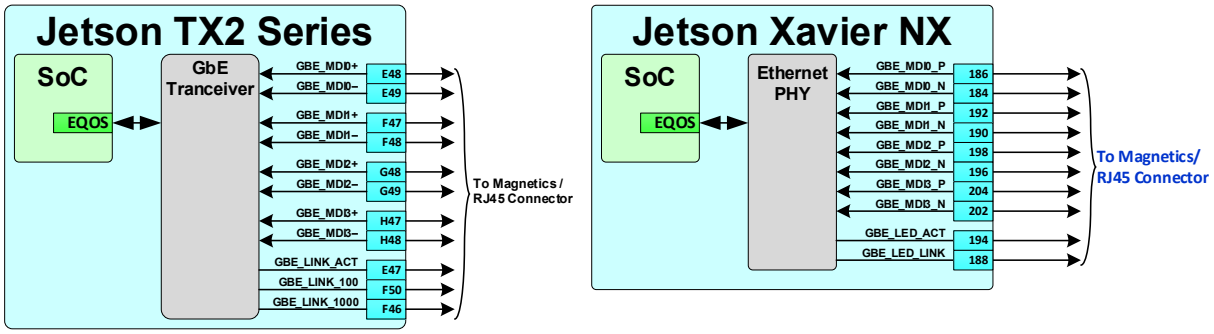
SATA

SATA is only supported on the Jetson TX2 Series modules. Jetson Xavier NX does not support this feature.

Ethernet

Both Jetson TX2 Series and Jetson Xavier NX modules have Gigabit Ethernet PHYs on the module and output the MDx interface. Jetson TX2 has an additional Link control pin.

Figure 6. Jetson Xavier NX and Jetson TX2 Ethernet Block Diagram



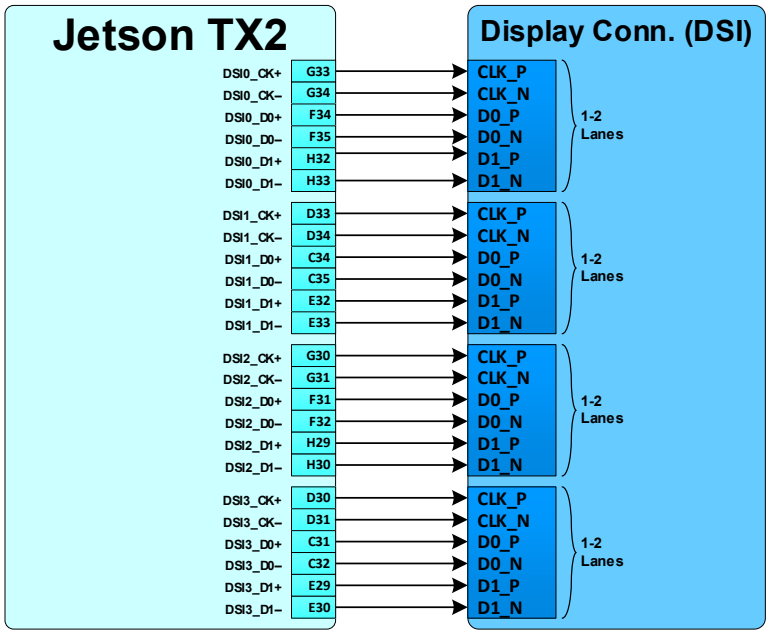
Display

Jetson TX2 support DSI, Vesa® DisplayPort™ (DP), embedded DisplayPort (eDP), and HDMI as described in this section. Jetson Xavier NX does not support DSI but does support DisplayPort (DP), embedded DisplayPort (eDP), and HDMI.

DSI

Jetson Xavier NX does not support DSI. Jetson TX2 supports up to a dual-link DSI configuration which includes two sets of four data lanes, each with a clock lane.

Figure 7. Jetson TX2 DSI Block Diagram



eDP, DP, and HDMI

Both Jetson Xavier NX and Jetson TX2 can support eDP, DP, and HDMI displays. Two interfaces are provided which can support any of the display types listed.

Table 5. eDP, DP, and HDMI Display Support

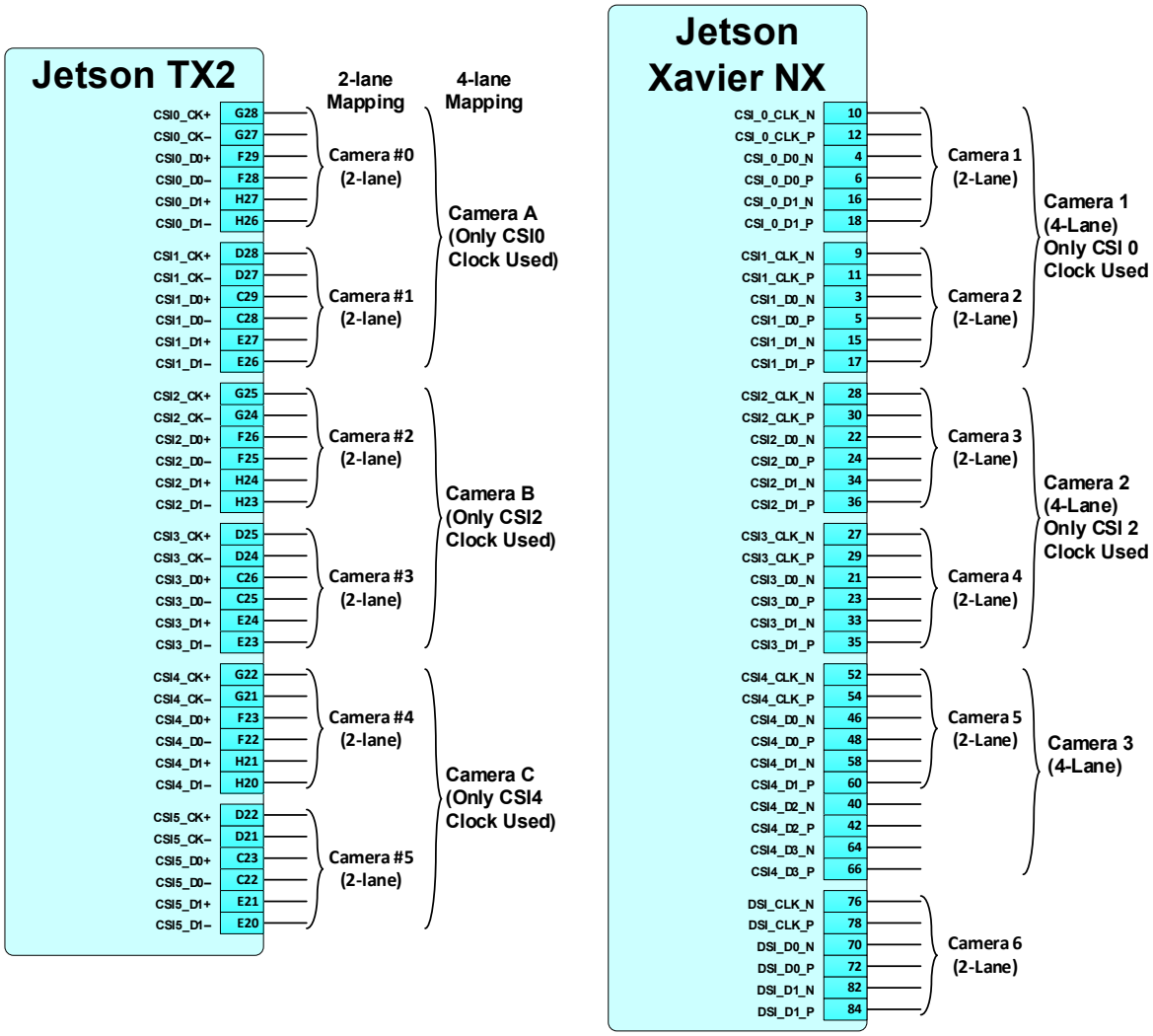
Feature	Jetson Xavier NX or TX2 Series
eDP/DP/HDMI	DP[1:0]_TXD[3:0]_P/N, DP[1:0]_AUX_P/N, DP[1:0]_HPD

Camera

Jetson TX2 has 12 CSI data lanes. Jetson Xavier NX has 14 total data lanes although only 12 can be used in a design. Both Jetson Xavier NX and Jetson TX2 can support the following configurations to cameras or serializers:

- 3 x4
- 2 x4 + 2 x2
- 1 x4 + 4 x2
- 6 x2

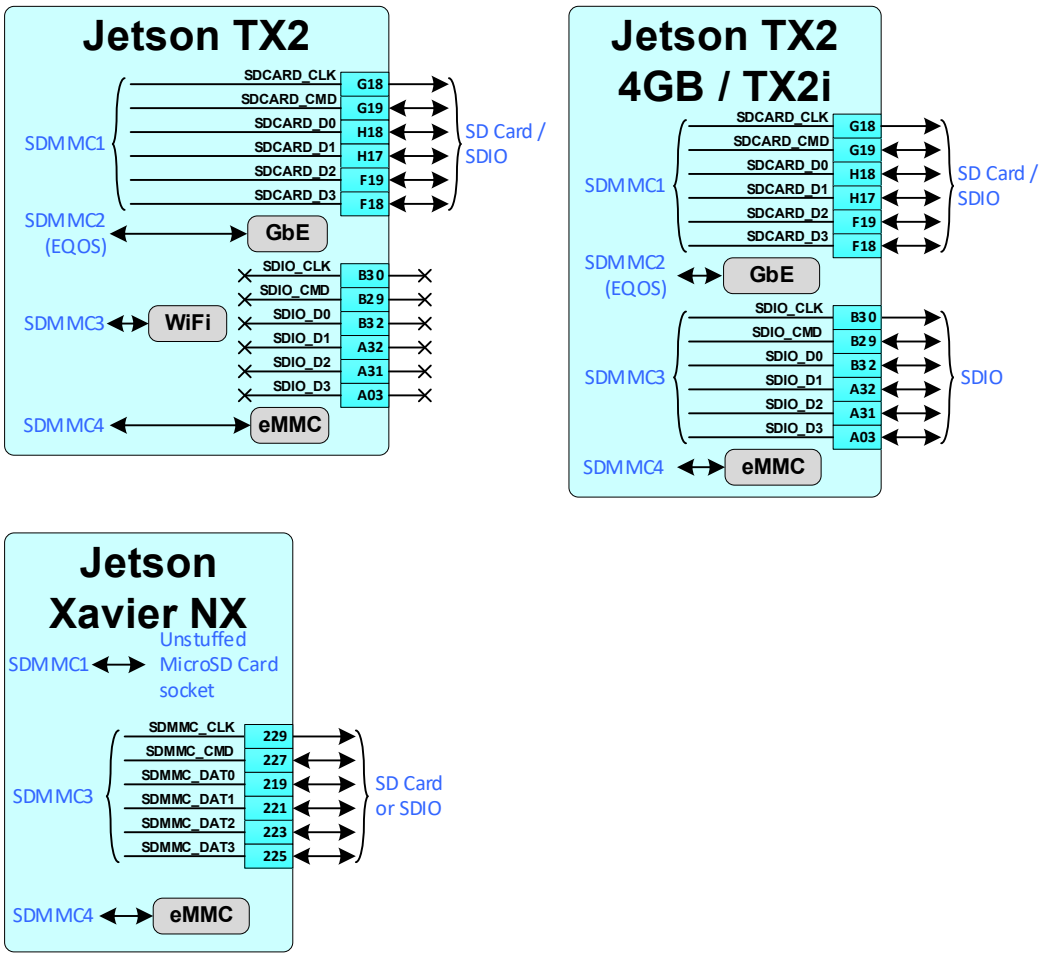
Figure 8. Jetson Xavier NX and Jetson TX2 CSI Block Diagrams



SDIO and SD Card

Jetson TX2 4GB and Jetson TX2i bring two SDMMC interfaces to the module pins (SDCARD pins supporting SD Card or SDIO and SDIO pins supporting SDIO). Other SDMMC interfaces are used on-module for eMMC and Wi-Fi/BT. Jetson TX2 and Jetson Xavier NX bring one SDMMC interface to the module pins. This can be used for SD Card or SDIO. Two of the other SDMMC interfaces are unused and the last is used for eMMC on the module.

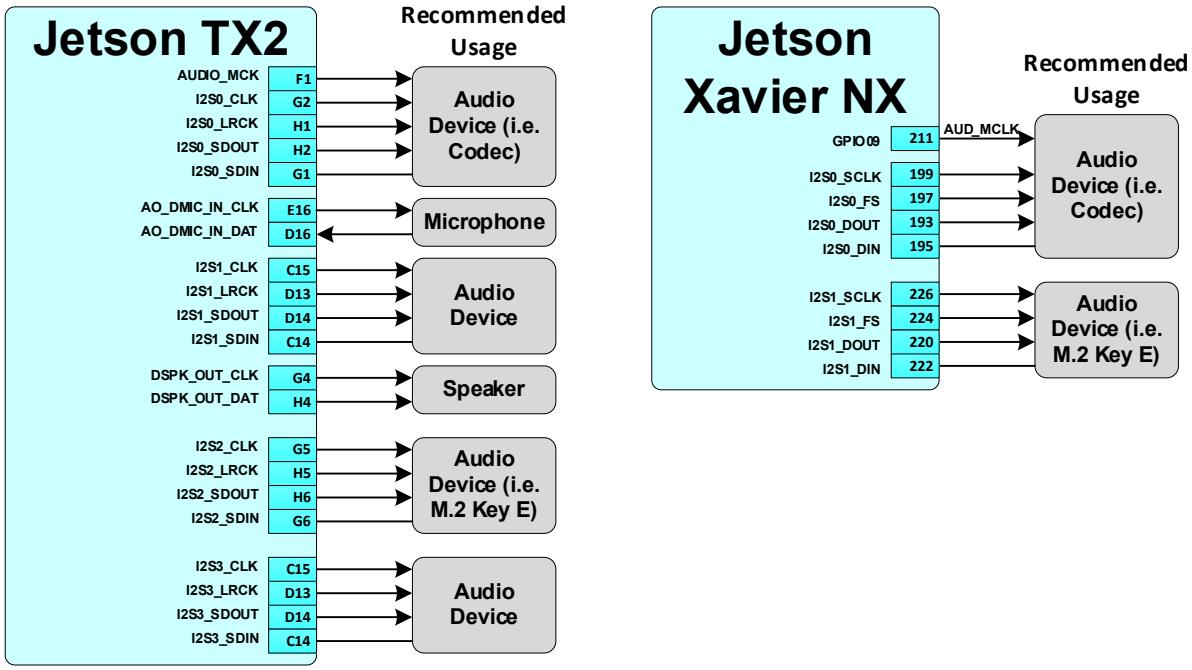
Figure 9. Jetson Xavier NX and Jetson TX2 Series SDIO/SD Card Block Diagrams



Audio

Jetson TX2 Series modules bring four I2S interfaces and a master audio MCLK to the module pins. In addition, a digital microphone and digital speaker interface are also supported. Jetson Xavier NX brings two I2S and an audio MCLK to the module pins.

Figure 10. Jetson Xavier NX and Jetson TX2 Audio Block Diagram

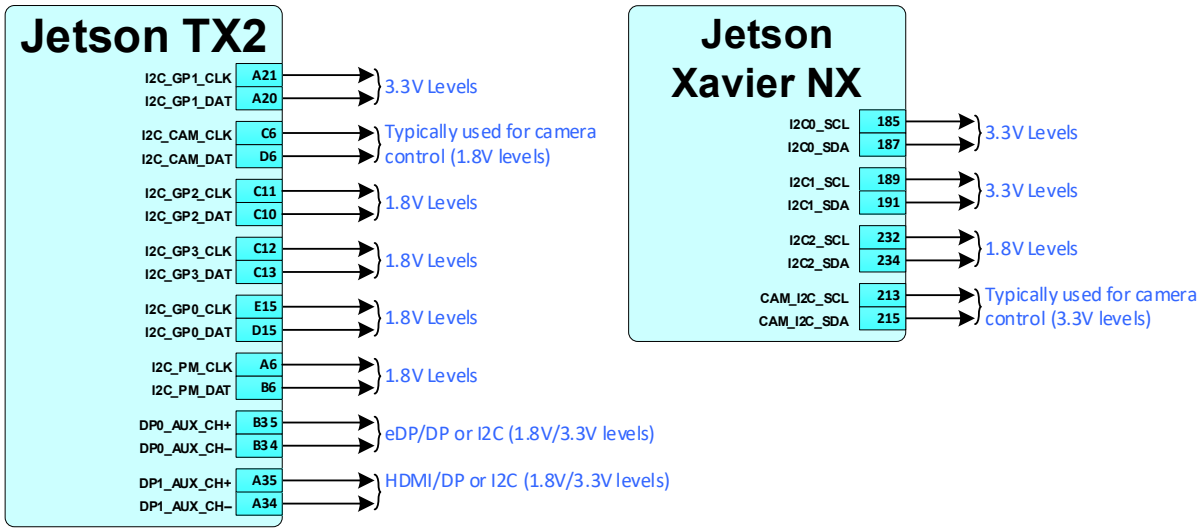


I2C

Jetson TX2 supports eight I2C interfaces when DP[1:0]_AUX interfaces are included. Jetson Xavier NX support up to four I2C interfaces at the module pins.

- For Jetson TX2, two of the interfaces are the DP_AUX interfaces that are used for eDP/DP/HDMI support, but can be used as I2C interfaces if available. These pins do not have on-module pull-ups and can be pulled to either 1.8V or 3.3V on the carrier board.
- The Jetson **TX2 I2C_PM, I2C_CAM, I2C_GP0, I2C_GP2** and **I2C_GP3** pins have pull-ups to 1.8V on the module so support 1.8V signal levels. Jetson Xavier NX has pull-ups to 1.8V on I2C2 only (1.8V signal levels).
- The Jetson TX2 **I2C_GP1** pins have on-module pull-ups to 3.3V, so support 3.3V signal levels. On Jetson Xavier NX, **I2C0, I2C1,** and **CAM_I2C** have on-module pull-ups to 3.3V (3.3V signal levels).

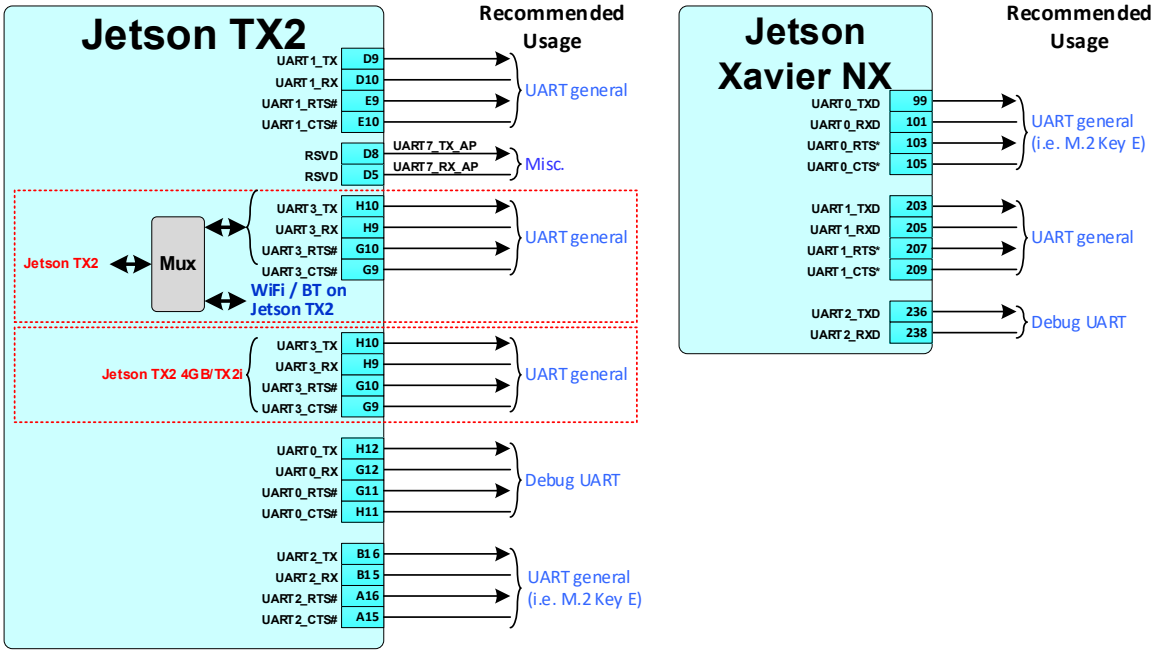
Figure 11. Jetson Xavier NX and Jetson TX2 I2C Block Diagrams



UART

Both Jetson TX2 and Jetson Xavier NX bring 3 UARTs to the module pins. On Jetson TX2, all three are 4-pin UARTs (include RTS/CTS). On Jetson Xavier NX, one of the UARTs supports only TX and RX (2-pin only).

Figure 12. Jetson Xavier NX and Jetson TX2 UART Block Diagrams



Debug

Jetson TX2 brings the JTAG interface to the module pins and provides a UART (UART0) for debug. Jetson Xavier NX provides UART2 for debug purposes. JTAG support is not provided for Jetson Xavier NX.

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