



# NVIDIA TEGRA X1 LINUX DRIVER PACKAGE SOFTWARE FEATURES

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**Application Note**



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# Software Features

NVIDIA<sup>®</sup> Tegra<sup>®</sup> Linux Driver Package (L4T) supports the following software features, which provide users a complete package to bring up Linux on targeted NVIDIA<sup>®</sup> Tegra<sup>®</sup> X1 devices.

This release supports the NVIDIA<sup>®</sup> Jetson<sup>™</sup> TX1 developer kit and module.

**Note:** Always check the *Release Notes* for constraints related to these features.

## Boot Loaders

Boot Loader	Feature	Notes
nvboot	Boot Device	eMMC
	2 <sup>nd</sup> Stage Load Device	eMMC
U-Boot	Storage Device Support	eMMC (no CQ), SD card, USB (HS)
	Display: Console	UART
	Display: Splash/Menu	UART
	I/O Bus Support	I2C, USB (HS), USB (device)

## Toolchain

Feature	Tool Chains	Version
Kernel	gcc-arm-eabi-4.7	3.10.67
U-Boot	gcc-linaro-4.9-2014.05-01	-

## Kernel

Interface	Feature	Notes
DSI	DSI Display Support	-
	DSI Ganged Mode	-
	PWM Backlight	-
	DC Continuous Mode	-
	DC Driven Command Mode	-
	Host Write	-
	DSI One-Shot Mode	-
	Dual Display	-
	Run Time Power Management	-
HDMI	EDID Support	-
	Hot-Plug Detection Mechanism	-
	HDMI 1.4	480p, 720p, 1080p, RGB 444 4K @ 30 Hz
	Driver Suspend/Resume for Low Power	-
	HDMI as Primary Display	-
	Dual Display	-
	HDMI: 1.4b compliance	Pending certification
	HDMI: 2.0 compliance	Pending certification
	Audio Support	-
Ethernet	10/100/1000 BASE	-
	MAC Filtering	-
PWM	Speed Control from SYSPS	-
	Control from Temperature Variation	-
I2C	Master Mode	-
Wifi	802.11a/b/g/n/ac	BCM4354
Bluetooth	Bluetooth 4.0	BCM4354

# I/O

I/O Type	Feature	Notes
SPI	Max Bus Speed	SPI4: 65 MHz
		SPI1: 65 MHz
		SPI2: 65 MHz
	Chip Select	SPI4: 0
		SPI1: 0/1
		SPI2: 0/1
	Packed/Unpacked	SPI4, SPI1, SPI2
	Full Duplex Mode	SPI4, SPI1, SPI2
	Both Enable Bit	SPI4, SPI1, SPI2
	Both Enable Byte	SPI4, SPI1, SPI2
	Bi-directional	SPI4, SPI1, SPI2
	Least Significant Bit	SPI4, SPI1, SPI2
	Least Significant Byte First	SPI4, SPI1, SPI2
	Software or Hardware Chip Select Polarity Section	SPI4, SPI1, SPI2
	Supported Modes 1/2/3/4	SPI4, SPI1, SPI2
	Purpose/Client	SPI4: Touch
SPI1: Audio		
SPI2: Cam/Display		
SDMMC	I/O Speeds (Clock speed)	SDMMC1: 204 MHz
		SDMMC4: 200 MHz
		SDMMC (M.2/SDIO): 204 MHz
	Hot Plug Support	SDMMC1
	SD High Speed Mode	SDMMC1, SDMMC (M.2/SDIO)
	SDR50	SDMMC1, SDMMC4, SDMMC (M.2/SDIO)
	SDR104	SDMMC1, SDMMC (M.2/SDIO)
	HS533	SDMMC4
	HS400	SDMMC4
	HS200	SDMMC4
	DDR Mode	SDMMC1, SDMMC4, SDMMC (M.2/SDIO)
	Voltage Switching	SDMMC1, SDMMC (M.2/SDIO)
Frequency Tuning	SDMMC1, SDMMC4, SDMMC (M.2/SDIO)	
Packed Commands	SDMMC4, SDMMC (M.2/SDIO)	

	Cache Control	SDMMC4
	Discard	SDMMC4
	Sanitize	SDMMC4
	RPMB	SDMMC4
	HPI	SDMMC4
	BKOPS	SDMMC4
	Power Off Notification	SDMMC4
	Sleep	SDMMC4
	Field Firmware Upgrade	SDMMC4
	CMD Queuing	-
	Device Life Estimation Type A	SDMMC4
	Device Life Estimation Type B	SDMMC4
	PRE EOL Information	SDMMC4
	Power Management	SDMMC1, SDMMC4, SDMMC (M.2/SDIO)
SATA	Speed	GEN1
		GEN2
	AHCI Mode	1.3.1
	SATA Specification	3.1
	HIPM	-
	DIPM	-
	NCQ	-
	Port Multiplier Support	CBS
	Link Power Management States	Partial
		Slumber
	Device Power Management States	D0
		D1
		D2
Runtime Time Power Management	-	
S.M.A.R.T	-	
ATA Error Logging	-	
I2C	Master	I2C GEN1, I2C GEN2, I2C GEN3, I2C DDC, I2C PWR, I2C6
		Speeds 400 kHz (FM)
		10-bit addressing
		Lost arbitration detect
		Packet mode
		7-bit
		DMA mode
		Bus clear support

USB 2.0	Device Mode	USB0
	OTG Mode	USB0
	Host Mode	USB0, USB1
	Host - Low Speed Devices	USB0
	Host - Full Speed Devices	USB0
	Host - High Speed Devices	USB0, USB1
	Host - Auto Suspend Support	USB0
USB 3.0	Speeds	USB0: HS/480 Mbps
		USB1: SS/5 Gbps
	Lanes	USB1: pex5
	USB 3.0 Support	USB1
	Connector	USB0: Micro AB
		USB1: TYPE A
	USB 2.0 Support	USB0, USB1
	Remote Wakeup Support	USB0: USB 2.0
		USB1: USB 2.0/3.0
	Host - Auto Suspend Support	USB0, USB1
	OTG Support	USB0
	Class Support	Mass storage (USB0, USB1)
		USB video class (USB0, USB1)
HID (USB0, USB1)		
USB audio class (USB0, USB1)		
MTP (USB0, USB1)		
CDC - NCM/ECM (USB0, USB1)		
GPIO	Pinmux Configuration	-
	GPIO Configuration And Programming	-
	GPIO Interrupt Support	-
UART	Speed	UART0: 115200
		UART2: 921600
		UART3: 3000000
	Hardware Flow Control	UART2, UART3
	PIO Mode	UART0, UART2, UART3
	DMA Mode	UART0, UART2, UART3
	FIFO Mode	UART0, UART2, UART3
PCIe	Speed	PCIe 0: Gen1/Gen2
		PCIe 1: Gen1/Gen2
	Lane Width	PCIe 0: x1
		PCIe 1: x1, x2, x4

Host Controller Features	Lanes Xbar config (X4_X1, X2_X1)	
	Extended Config Space	
	Hardware Clock Gating	
	Deep Power Down (DPD)	
PCI Features	Message Signaled Interrupts	
	Vendor Specific Messages	
	PCI Express	
	MSI-X	
PCIe Device Capabilities	Max Payload	
	Extended Tag Field Support	
	Role-Based Error Reporting	
	Maximum Link Speed; Supports Up to Gen2 Speeds	
	Maximum Link Width; Supports Up to X4 Link Width	
	ASPM Support (L0s and L1)	
	L1 Clock Power Management	
	Data Link Layer Link Active Reporting Capable	
	Link Bandwidth Notification Capability	
	Link Control	Read Completion Boundary
Root Control	System Error on Correctable Error	
	System Error on Non-Fatal Error	
	System Error on Fatal Error	
	PME Interrupt Enable	
Extended Capabilities	Advanced Error Reporting (AER)	
	Latency Tolerance Reporting (LTR)	
L1 PM Substates	L1.1	
	L1.2	
Misc Features	Dynamic Voltage Frequency (DVFS)	
	Tegra Low Power Mode (LP0)	
	Runtime PM	
JTAG	JTAG Attach	-
	JTAG Halt/Step/Go	-



## CUDA

Feature	Version
CUDA	Version 7 with FP16 support

## Graphics

Graphics APIs	Notes
OpenGL	4.5
OpenGL-ES	3.1
EGL	1.4
API Support	Notes
GL + GLX	-
GL + EGL	-
GL-ES + EGL	-
X11 ABI	Through version 19

## EGL and OpenGL ES Support

EGL is an interface between Khronos rendering APIs, such as OpenGL ES, and the underlying native platform window system. It handles graphics context management, surface/buffer binding, and rendering synchronization. EGL enables high-performance, accelerated, mixed-mode 2D and 3D rendering using other Khronos APIs.

L4T supports the EGL 1.4 specification, **Khronos Native Platform Graphics Interface (EGL 1.4 Specification)**.

The OpenGL ES driver in this release supports the following OpenGL ES specifications:

- **OpenGL ES Common Profile Specification 23.0**
- **OpenGL 4.5**

For more information on OpenGL ES, see the **Khronos OpenGL ES API Registry**.

## Video Decoders

Video Decode	Output Formats	Sampling Frequency and Bit rate/Frame rate	Notes
H.264	NV12, NVMM:NV12	3840 x 2160 at 60 fps Up to 120 Mbps	Full-frame, Disable-DPB, Skip-Frames
H.265	NV12, NVMM:NV12	3840 x 2160 at 60 fps Up to 160 Mbps	Decode Support in Gstreamer 1.4.5 and later
JPEG	I420, NVMM:I420	600 MP/sec	-
VP8	NV12, NVMM:NV12	3840 x 2160 at 60 fps Up to 140 Mbps	-
VP9	NV12, NVMM:NV12	3840 x 2160 at 60 fps Up to 120 Mbps	-

## Video Encoders

Video Encode	Input Formats	Sampling Frequency and Bit rate/Frame rate	Notes
H.264	I420, NV12, NVMM:I420, NVMM:NV12	3840 x 2160 at 30 fps Up to 120 Mbps	RC-Mode, Bitrate, Iframeinterval, Quality- Level, Low-Latency, Sliceintrarefreshinterval, Bit-Packetization, VBV- Size, Insert-SPS-PPS, No- B-Frames, Slice-Header- Spacing, Profile, Force- IDR
JPEG	I420, NVMM:I420	600 MP/sec	-
H.265	I420, NVMM:I420, NVMM:NV12	3840 x 2160 at 30 fps Up to 100 Mbps	-
VP8	I420, NV12, NVMM:I420, NVMM:NV12	3840 x 2160 at 30 fps Up to 120 Mbps	RC-Mode, Bitrate, Iframeinterval, Quality- Level

## Display Outputs

<b>nveglglessink</b>	<b>nvxvimagesink</b>	<b>ncoverlaysink</b>	<b>nvhdmioverlaysink</b>
X11 Window	X11 Window	Panel Overlay	HDMI Overlay
-	-	Overlay	Overlay
-	-	Overlay-Depth	Overlay-Depth
-	-	Overlay-X	Overlay-X
-	-	Overlay-Y	Overlay-Y
-	-	Overlay-W	Overlay-W
-	-	Overlay-H	Overlay-H

## Conversion, Scaling, and Rotation Formats

<b>Input Formats</b>	<b>Output Formats</b>	<b>Notes</b>
I420	I420	Flip-Method
UYVY	UYVY	Flip-Method
NV12	NV12	Flip-Method
GRAY8	GRAY8	Flip-Method
NVMM:I420	NVMM:I420	Flip-Method
NVMM:NV12	NVMM:NV12	Flip-Method

## CSI and USB Camera Formats

Output Format	Options	Notes
NVMM:I420	Scene-Mode	-
	Color-Effect	-
	Auto-Exposure	-
	Flicker	-
	Contrast	-
	Saturation	-
	TNR-Strength	-
	TNR-Mode	-
	Edge-Enhancement	-
	Intent	Still, Video, Video snapshot, Preview
	Sensor-ID	-
	Enable-EXIF	-
	aeRegion	-
	wbRegion	-
	fpsRange	-
	Exposure-Time	-
	wbManualMode	-
	wbGains	-
	Embedded Metadata	Precision timestamping, DCT-NR, V4L2 interface for sensor driver, Gyro service for L4T for VSTAB and AF
	ARGUS	-
	RAW capture	-
	EGL producer	-
	Face detection	-
	HDFX	-
Simultaneous Multi-Camera	Pluggable/replacable 3A, 12- and 14-bit sensors, DPCM sensors	
VSTAB support	AF2.8 support, Auto Iris	
Image De-Warping and Distortion Correction	Global Shutter	
Coordinated Multi-Camera Support	-	



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