



NVIDIA Tegra Linux Driver Package

DA_06018-001 | February 23, 2016 | R23.2 Release

Software Feature List



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Software Features

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

This release supports the NVIDIA[®] Jetson[™] 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 nd 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

| nveglglessink | nvxvimagesink | nvoverlaysink | nvhdmioverlaysink |
|---------------|---------------|---------------|-------------------|
| 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

| Input Formats | Output Formats | Notes |
|---------------|----------------|-------------|
| 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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