NVIDIA

NVIDIA TEGRA XAVIER LINUX DRIVER PACKAGE SOFTWARE FEATURES

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Application Note

TABLE OF CONTENTS

Jetson Xavier Software Features

NVIDIA® Tegra® Linux Driver Package supports these software features, which provide users a complete package to bring up Linux on targeted NVIDIA® Tegra® Jetson-Xavier devices.

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

Bootloader

Bootloader Binary	Feature	Notes
BPMP processor boot binaries (MB1 & nvtboot-bpmp)	Storage location	Cold boot: eMMC
		RCM boot: Downloaded over USB recovery port
	Next stage storage location	Cold boot: eMMC
		RCM boot: Downloaded over USB recovery port
	Next stage	CBoot
	Storage device support	eMMC
	Partition table support	GPT (with protective MBR)
	Filesystem support	None
	I/O bus support	I2C
	Console UART	
CBoot	Execution CPU	CCPLEX
	Storage location	Cold boot: eMMC
		RCM boot: Downloaded over USB recovery port
	Next stage storage location	Cold boot: eMMC
		RCM boot: Downloaded over USB recovery port
	Next stage	Kernel
	Storage device support	eMMC, SD card, & USB drive (no hub support)
	Partition table support	GPT (with protective MBR)
	Filesystem support	None
	I/O bus support	I2C
	Console	UART
	Kernel boot	
	QSPI as primary boot device	
	UFS as primary boot device	Using CBoot as CPU-BL
	RCM boot	Using nvboot-cpu as CPU-BL

	XUSB boot support (2.0, bulk only)	Reading files from GPT partition. **Note**: There is no hub driver support. The pen drive must be connected directly to the root port.
	SD Card boot support	Reading files from GPT partition
	Ethernet boot support using EQOS controller and Marvell phy	TFTP, DHCP & NFS
	Removable boot device selection based on priority	Hard-coded priority: SD card, USB, eMMC, network
	Display (text and splash images)	HDMI over HDMI connector; seamless on HDMI
	Plug-in manager support	Kernel DTB; BL DTB
	T19x CBoot source	Buildable outside of the BSP using an ARM64 toolchain
	SDMMC HS400 mode support for all boot binaries	

Toolchain

Feature	Tool Chains	Notes
Aarch64	gcc-linaro-6.4.1-2017.08-x86_64_aarch64-linux-gnu	For 64-bit Kernel and Userspace

Kernel I/O Interfaces

Interface	Feature	Notes
JTAG	JTAG Attach	Debugging capability
	JTAG Halt/Step/Go	Debugging capability
PCIe	Wake support	Applicable to all controllers
	Advanced Error Reporting (AER)	Applicable to all controllers
Camera support (CSI input support)	V4L2 Media-Controller (V4L2 API bypasses ISP)	CSI0, CSI1, CSI2, CSI3, CSI4, CSI5 Note: The media-controller driver model is adopted in the 24.1 release. the Soc_camera driver is provided, but deprecated.

LSIO

Feature	Feature	Notes
UART	PIO mode	FIFO access using CPU
	DMA mode	FIFO access using DMA
	Hardware/software based flow control	Flow control line toggling from hardware/software
	Buffer throttling	Flow control based on data in receive buffer

	Rx and Tx DMA mode selection	DMA mode transfer on Rx and Tx or on only one path
	Interrupt mode	Data transfer complete handling through interrupt
	Polling mode	Data transfer complete handling through polling
	MCR control	Modem control access
	Baud rate/port configuration	Changing port configuration
	Baud rate adjustment	Adjusting baud rate to fall within tolerance range
I2C Master	Speed mode (Standard, FM, FM+)	Speed mode (Standard, FM, FM +)
	Repeat start	Repeat start on transfer of data
	No Start	No address cycle after repeat start
	Packet mode	Packet mode
	7-bit/10-bit addressing mode	7-bit/10-bit addressing mode
	DMA mode	APB/GPC DMA for FIFO access
	Clock gating and clock always ON	Clock control after each transfer for power saving
	Runtime PM	Runtime power management
	Dynamic clock speed change	Change speed of the bus
	Interrupt based	Transfer complete handling using interrupt
	Bit banging for data transfer	Use GPIO APIs for data transfer
	Multiple transfer request	Multiple transfer request
	Bus clear support	Bus clear handling when bus is held by device
	>64k on software based split	>64K on software based split
	Non-interruptible transfer	Non-interruptible transfer
SPI Master	Packed/unpacked	Data can be put on FIFO in packed or unpacked format. Packed format reduces the number of I/O accesses on FIFO.
	Full Duplex Mode	Device can read and write data simultaneously
	Least Significant Bit	Option to send least significant bit first from packets
	Dual SPI	SPI MISO/MOSI can act as Rx and Tx
	Least Significant Byte First	Option to send least significant byte first from packets
	Hardware based CS control and CS setup/hold time	Hardware control the CS and maintain CS setup and hold time
	Software or hardware Chip Select Polarity Section	Chip select can be active high or active low based on the external device property
	Supported Modes 0/1/2/3	SPI communication support Mode 0, 1, 2, or 3
	DMA mode	Data written/read to/from FIFO using DMA mode

	PIO (non-DMA) mode	CPU access the FIFO for read/ write
	GPIO based Chip select	CS line is controlled by the GPIO APIs
	SPI different clock rates	Set the interface clock speed based on what device can support
	Prod configuration	Platform/chip specific configuration of controller/ interface
	Clock delay between packets	Provision for delay between packets
	Clock gating and clock always ON	Dynamic clock enable/disable for power save
	Runtime PM	Runtime power management
	Interrupt based	Transfer done handling through interrupt
	Different packet bit length	Different packet bit length
	Multiple transfer request	Multiple SPI transfer request from single call
GPIO	GPIO request/free	GPIO access permission
	Pinmux integration with GPIOS	GPIO APIs call pinmux for required pin configuration
	Direction set/get	GPIO direction configuration
	Value set/get	GPIO value set/get to/from pin
	Interrupt support from all pins	Interrupt support from all pins
	Wakeup support for LP0	Wakeup support for LP0
	Wakeup support for LP1	Wakeup support for LP1
	GPIO register dump	GPIO register dump
	GPIO framework sysfs support	GPIO framework sysfs support
	Suspend/resume	Suspend/resume
Pinmux	Function configuration	Pinmux function configuration
	Pinmux config configuration	Pinmux different properties like pull up/down, input, tristate etc. configuration
	Suspend/resume	Save and restore of pinmux context
	Drive strength	Drive strength configuration of pins
	Prod setting	Prod setting
	Static pinmux configuration	Static pinmux configuration
	Dynamic pinmux configuration	Dynamic pinmux configuration
	Pinmux register dump	Pinmux register dump
	Pinmux configuration dumping	Pinmux configuration dumping
	Pinmux-GPIO integration	Pinmux-GPIO integration
APBDMA/GPCDMA	Memory to memory	Memory to memory transfer
	Memory to I/O	Memory to I/O
	I/O to memory	IO to memory
	Cyclic-once mode	Cyclic mode
	Transfer done through interrupt mode	Transfer done on interrupt
	Multiple transfer request	Queue mechanism of the transfer request

Tegra WDT	Watchdog framework support	Registration with WDT framework
	System reset on CPU hang	System reset on WDT expiry
	Suspend/resume support	Suspend/resume handling
	Watchdog interrupt support	WDT reset on ISR
	Watchdog polling/ping support	WDT start/stop/pin from user space
PWM	PWM ops	PWM registration to framework
	Clock accuracy calculation	Clock calculation
PMC	Controlling I/O PAD voltage (PWR_DETECT)	Pad voltage configuration by software
	I/O DPD configuration	Deep power down configuration
	Read/write PMC registers	PMC register access interface
	PMC config for bootrom I2C	PMC configuration for bootrom I2C/MMIO command
BPMP I2C Master	Speed mode (Standard, FM, FM+)	Bus speed configuration
	Packet mode	I2C controller configuration in packet mode
	7-bit/10-bit addressing mode	7 and 10 bit addressing
	Bus clear support	Bus clear handling when bus is held by device
SPE-UART	PIO mode	FIFO access using CPU
	Hardware flow control	Flow control line toggling from hardware/software
	FIFO mode	FIFO mode of UART controller
SPE DMA	Memory to memory	Memory to memory transfer
	Memory to I/O	Memory to I/O
	I/O to Memory	I/O to memory
	Continuous mode support	Cyclic mode
I2C SLAVE	Normal/Byte mode	I2C controller configuration on byte mode
	FIFO mode	I2C controller configuration on FIFO mode
	7-bit addressing	7-bit addressing
	10-bit addressing	10-bit addressing
	Repeat start	Repeat start on transfer of data
	Clock stretching	Clock line stretching

HDMI

Feature	Details
EDID support	Read and parse EDID
Hot-Plug Detection	Hot-Plug detection with HDMI monitors and TV
HDMI 1.4 (480p/720p/1080p, 4K@30Hz)	Support for HDMI1.4 with following modes 480p/720p/1080p/ 4k@30Hz
HDMI 2.0(4K @ 30HZ, 4K @ 60HZ)	Support for HDMI 2.0 with 4K @ 30 H, 4K @ 60 Hz resolution
Driver Suspend/Resume	Driver Suspend/Resume for low power
HDMI - 4K @ 60 Hz - 8-Bit - YUV 420	HDMI - 4K @ 60 Hz - 8-Bit - YUV 420
HDMI as Primary Display	Support HDMI as primary display
Dual display	Mirroring support
HDMI 1.4b compliance	HDMI 1.4b compliance

HDMI 2.0 compliance	HDMI 2.0 compliance
Seamless display	Seamless display
Deep color support (12 bits/cell RGB and YUV444)	Deep color support (12 bits/cell RGB and YUV444; 10 bits/cell RGB is not supported)
Deep color support (10/12 bits/ cell YUV422)	Deep color support (10/12 bits/cell RGB and YUV422)
Sideband information	Send sideband information to the panel during video refresh; info frames and audio data

DP

Feature	Details
EDID	Read and parse EDID
DP Hot Plug support	Hot-Plug detection with DP monitors or TV
DP 4K @ 60 frames/sec	4K mode in DP
Seamless display	Seamless display
eDP 1.4	Supports additional link rates (2.16, 2.43, 3.24, & 4.32 Gbps)
eDP @ 4K, 60 frames/sec	Support 4K mode in eDP
Native deep color support (10 and 12 bits per color)	Native output YUV deep color support
Enhanced framing	Error recovery methods
Full Link Training	Handshake signaling between host and device
HPD_IRQ event	Feedback from the panels in case of link synchronization loss
Driver Suspend/Resume	Driver suspend/resume for low power
Primary display	Support DP/eDP as primary display
Dual display	Mirroring support
Link rates 1.62, 2.7, 5.4 Gbps	Various link rates supported by the driver up to HBR2
Link rate 8.1 Gbps	HBR3 support
DP Alt Mode/Type-C	Support for outputting DP signaling over the Type-C interface
Aux link	Support DP aux link
Sideband information	Send sideband information to the panel during video refresh

PCIE

Feature	Details
Controllers with x8 link width	Max x8 link width (C0 and C5)
Controllers with x4 link width	Max x4 link width (C4)
Controllers with x1 link width	Max x1 link width (C1,C2,C3)
Legacy interrupts	Applicable to all controllers
MSI & MSI-X interrupts	Applicable to all controllers
128 byte Maximum Payload Size	Applicable to all controllers
256 byte Maximum Payload Size	Applicable to all controllers
Gen-1 speed	Applicable to all controllers
Gen-2 speed	Applicable to all controllers
Gen-3 speed	Applicable to all controllers

Gen-4 speed	Applicable to all controllers
ASPM - L0s	Applicable to all controllers
ASPM - L1	Applicable to all controllers
ASPM - L1.1	Applicable to all controllers
ASPM - L1.2	Applicable to all controllers
Wake support	Applicable to all controllers
Advanced Error Reporting (AER)	Applicable to all controllers
End Point mode support	C0,C4,C5

SDMMC

Feature	Notes
DDR50	eMMC interface running in DDR mode at 50 MHz
HS200	eMMC interface running in SDR mode at 200 MHz
HS400	eMMC interface running in DDR mode at 200 MHz
HS533	eMMC interface running in DDR mode at 267 MHz
HW tuning	Supports tuning in SDMMC controller
Packed Commands	Read & write commands can be packed in groups (either all read or all write) that transfer data for all commands in the group in one transfer on the bus, to reduce overhead
Cache	Similar to CPU cache, but implemented in eMMC; helps improve performance
Discard	Erases data if necessary during background erase events
Sanitize	Physically removes data from unmapped user address space
RPMB	Secure access
BKOPS	Allows execution of back ground operations when host is not being serviced
HPI	High priority interrupt to stop ongoing bkops/reliable writes
Power Off Notification	Allows device to prepare itself to power off properly and improve user experience during power-on
Sleep	Minimizes power consumption of the eMMC device
RTPM	Software feature to save power by switching off clocks when there is no transactions on the bus
Field Firmware Upgrade	Update eMMC firmware
Device Life Estimation Type A Device Life Estimation Type B	Device Health is a mechanism to get vital NAND flash program/erase cycles information as a percentage of useful flash lifespan. Type A: SLC device health information Type B: MLC device health information
PRE EOL Information	Provides indication about device lifetime reflected by average reserved blocks
Hardware Command Queue	Performed by SD/MMC controller
Enhanced Strobe Mode (ESM) in HS400 mode	Optional for devices; indicated by STROBE_SUPPORT[184] register of EXT_CSD
eMMC CQ CQIC feature	Generates coalesced interrupts when the interrupt coalescing mechanism is enabled
Suspend/resume and shutdown	

SATA

Feature	Notes
Gen1	Interface speed 1.5 Gbps
Gen2	Interface speed 3 Gbps
HIPM	Low power mode initiated by host
NCQ	Native Command Queue support
DEVSLP	Device sleep mode
Transfer mode	PIO or DMA
Port Multiplier Support	Hub for SATA
Runtime time power management	Driver can enable clock & rail only when active transactions happen with device
Bad block detection	

SATA-Marvel (over PCIe)

Feature	Notes
Gen1	Interface speed 1.5 Gbps
Gen2	Interface speed 3 Gbps
Gen3	Interface speed 6 Gbps
HIPM	Low power initiated by host
DIPM	How power initiated by device
NCQ	Native Command Queue support
DEVSLP	Device sleep mode
Transfer mode	PIO or DMA
Hot plug support	SATA drives may be removed and connected while system is active
Message Signaled Interrupts (MSI)	An alternative in-band method of signaling an interrupt
Port multiplier support	Hub for SATA
Runtime time power management	Driver can enable clock & rail only when active transactions happen with device

UFS

Feature	Notes
PWM-G1 PWM-G2 PWM-G3 PWM-G4 PWM-G5 PWM-G6	UFS (m-phy) interface runs in low performance (PWM-Gx) modes
HS-G1 HS-G2 HS-G3	UFS (m-phy) interface runs in high performance (HS-Gx) modes
Native Command Queue support	
Hibernation	Low power state
Runtime time power management	Driver issues software hibernation entry in

	runtime suspend, and hibernation exit in runtime resume
Auto hibernation	Hibernation triggered by controller
PWM SLOW modes	
PWM SLOW_AUTO modes	
HS FAST modes	
HS FAST_AUTO modes	
HS RATE_A series	
HS RATE_B series	

Security Engine

Feature	Notes
CBC-AES / Host1x	Cipher block chaining
EBC-AES / Host1x	Electronic Code Book
OFB-AES / Host1x	Output feedback
CTR-AES / Host1x	Counter mode
CMAC-AES / Host1x	Cipher-based Message Authentication Code
XTS-AES / Host1x	XEX-based tweaked-codebook mode with ciphertext stealing
DRBG (RNG) / Host1x	Deterministic random bit generator
SHA / Host1x	Secure Hash Algorithm variants: SHA1/224/256/384/512
RSA / Host1x	RSA Public Key Algorithm sizes 512/1024/1536/2048
RNG	Random number generator
TRNG	True random number generator
RSA/APB	RSA Public Key Algorithm sizes 3072/4096
Montgomery precomputation	Montgomery operations
Modular addition	Modular operations
Modular division	
Modular subtraction	
Modular inversion	
Modular reduction	
Modular multiplication	
ECC point addition	Elliptic curve cryptography operations
ECC point double	
ECC point multiplication	
ECC point verification	
Bit serial modular reduction double precision	Modular operations
ECC Shamir Trick	Elliptic curve cryptography operations
ECC-521 (Weierstrass) point multiplication	
ECC-521 (Weierstrass) point addition	
ECC-521 (Weierstrass) point double	
ECC-521 (Weierstrass) point verification	
ECC-521 (Weierstrass) Shamir’s Trick	
Non-modular multiplication	Modular operations
C25519 point multiplication	X25519 operations
C25519 modular exponentiation	
C25519 modular multiplication	

C25519 modular square	
Ed25519 point multiplication	Edwards curve operations
Ed25519 modular addition	
Ed25519 Shamir's Trick	
DH	Diffie-Hellman algorithm
ECDH	Elliptic curve Diffie-Hellman algorithm
ECDSA	Elliptic curve digital signature algorithm
EdDSA	Edwards curve digital signature algorithm

USB 3.0

Feature	Notes
Super Speed Plus Host	USB host in 3.1 Gen2 mode (10 Gbps)
Super Speed Host	USB host in 3.0 mode (5 Gbps)
High Speed Host	USB host in 2.0 mode (480 Mbps)
Full Speed Host	USB host in 2.0 or 1.2 mode (12 Mbps)
Low Speed Host	USB host in 2.0 or 1.2 mode (1.5 Mbps)
Auto Suspend	USB host suspends the port/connected device if there is no activity
Remote Wakeup	USB host resumes the port/connected device if there is wakeup triggered by the device.
Auto Resume	USB host resumes the port/connected device if there is wakeup triggered by the host
ELPG for xUSB HS partition	Engine level power gating support for xUSB HS partition
ELPG for xUSB SS partition	Engine level power gating support for xUSB SS partition
Lower power state (U3 state)	
LPM states (U1, U2 states)	
Hot Plug Support	USB drives may be removed and connected while system is active
Port multiplier support	Hub for USB
Host Mass storage	Protocol for storage devices
Host USB video class	Protocol for camera devices
Host USB ECM	Protocol for ethernet over USB
Host USB audio class	Protocol for audio over USB
Host USB Modem - NCM	NCM protocol support for modem functionality
USB HID protocol	Human interface devices
Super Speed Device (xUSB)	USB device in 3.0 mode
High Speed Device (xUSB)	USB device in 2.0 mode
BC1.2 Charging support	Support for battery charging per BC1.2 spec
Apple charger	Support for detecting Apple charger
MTP device mode	MTP protocol support for data transfer
ADB device mode	ADB protocol support for data transfer
RNDIS device mode	RNDIS protocol support for data transfer
OTG	USB host and device (cable based detection)

EQOS

Feature

Ping
Speed
LP_IDDQ Mode Support
Suspend Resume over NFS Support
NFS Boot

Power Modes (Profiles)

Feature
10W / 15W / 30W profiles provided
NVPModel interface for mode selection and custom mode creation

RTC

Feature
Alarm
Wakeup from SC7

Watchdog

Feature	Notes
Tegra Watchdog	Watchdog reboot from hang
Tegra Watchdog	Watchdog kick
PMIC Watchdog	Watchdog reboot from hang
PMIC Watchdog	Watchdog kick

System

Feature
Reboot support
Shutdown support
SC7
Cpuidle
Wake from Idle
Wake from Sleep
CPU hotplug
DVFS
CPU/GPU frequency governor
EMC Bandwidth Manager
Power Monitor
Clock & thermal management
initrd support
System boot with ATF as secure monitor

CUDA

Feature	Version

CUDA	Version 10.0.117

Graphics

Graphics APIs	Notes
OpenGL	4.6.0
OpenGL-ES	3.2.5
Vulkan	1.1.1*
EGL	1.5
GLX	
GLVnd Version of EGL	Vendor neutral dispatch library for GL†
NVDC - Direct Rendering Manager (DRM)	Compatibility with DRM 2.0
EGL Stream	
X11 ABI-24	
Wayland	1.14
Weston	3.0
API Support	**Notes**
GL + EGL, EGL without X11	Extensions supported for getting these components to work

* Vulkan loader version release 1.0.66 is verified to be working properly on this release. See **https://developer.nvidia.com/embedded/vulkan** for details.

† See **https://github.com/NVIDIA/libglvnd** for details on GLVnd.

EGL Details

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 1.5 specification, **Khronos Native Platform Graphics Interface (EGL 1.5 Specification)**.

GL and Vulkan Details

The OpenGL driver in this release supports OpenGL4.6, **https://www.khronos.org/registry/OpenGL/specs/gl/glspec46.core.pdf**. All details related to GL/GLX and other related specifications can be found at **https://www.khronos.org/registry/OpenGL/index_gl.php**. Conformance details are at **https://www.khronos.org/conformance/adopters/conformant-products/opengl**.

The OpenGL ES driver in this release supports OpenGL ES Common Profile Specification 3.2. For more information on OpenGL ES, see the Khronos OpenGL ES API Registry. Conformance details are at **https://www.khronos.org/conformance/adopters/conformant-products/opengles**.

The Vulkan driver in this release supports VK1.1.1.1, **https://www.khronos.org/registry/vulkan/specs/1.1/pdf/vkspec.pdf**. All details related to the specification can be found at **https://www.khronos.org/registry/vulkan/**. Conformance details are at **https://www.khronos.org/conformance/adopters/conformant-products/vulkan**.

Multimedia

The following topics list several classes of multimedia features.

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, enable-error-check, enable-frame-type-reporting
H.265	NV12, NVMM:NV12, NVMM:I420_10LE	7680 x 4320 at 30 fps Up to 240 Mbps	Full-frame, Disable-DPB, Skip-Frames, enable-error-check, enable-frame-type-reporting
JPEG	I420, NVMM:I420	600 MP/sec	-
VP8	NV12, NVMM:NV12	3840 x 2160 at 60 fps Up to 120 Mbps	Full-frame, Disable-DPB, Skip-Frames, enable-error-check, enable-frame-type-reporting
VP9	NV12, NVMM:NV12	3840 x 2160 at 60 fps Up to 160 Mbps	Full-frame, Disable-DPB, Skip-Frames, enable-error-check, enable-frame-type-reporting

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 60 fps Up to 120 Mbps	Supported features include: □ control-rate □ Bitrate □ Peak-bitrate □ Iframeinterval □ SliceIntrarefreshEnable □ Sliceintrarefreshinterval □ Bit-Packetization □ VBV-Size □ Temporal-tradeoff □ EnableMVBufferMeta □ qp-range □ MeasureEncoderLatency □ EnableTwopassCBR □ Preset-level

			▯ EnableStrimgentBitrate ▯ Insert-SPS-PPS ▯ Num-B-Frames ▯ Slice-Header-Spacing ▯ Profile ▯ insert-aud ▯ insert-vui ▯ Force-IDR
JPEG	I420, NVMM:I420	600 MP/sec	-
H.265	I420, NVMM:I420, NVMM:NV12, NVMM:I420_10LE	3840 x 2160 at 60 fps Up to 120 Mbps	Supported features include: ▯ control-rate ▯ Bitrate ▯ Peak-bitrate ▯ Iframeinterval ▯ SliceIntrarefreshEnable ▯ Sliceintrarefreshinterval ▯ Bit-Packetization ▯ VBV-Size ▯ Temporal-tradeoff ▯ EnableMVBufferMeta ▯ qp-range ▯ MeasureEncoderLatency ▯ EnableTwopassCBR ▯ Preset-level ▯ EnableStrimgentBitrate ▯ Insert-SPS-PPS ▯ Num-B-Frames ▯ Slice-Header-Spacing ▯ Profile ▯ insert-aud ▯ insert-vui ▯ Force-IDR
VP9	I420, NV12, NVMM:I420, NVMM:NV12	3840 x 2160 at 30 fps Up to 140 Mbps	Supported features include: ▯ control-rate ▯ Bitrate ▯ Peak-bitrate ▯ Iframeinterval ▯ SliceIntrarefreshEnable ▯ Sliceintrarefreshinterval ▯ Bit-Packetization ▯ VBV-Size ▯ Temporal-tradeoff ▯ EnableMVBufferMeta ▯ qp-range ▯ MeasureEncoderLatency ▯ EnableTwopassCBR ▯ Preset-level

			☐ EnableStrimgentBitrate ☐ Insert-SPS-PPS ☐ Num-B-Frames ☐ Slice-Header-Spacing ☐ Profile ☐ insert-aud ☐ insert-vui ☐ Force-IDR

Note: **Use the gst-inspect-1.0 utility to understand feature details. For example, the `gst-inspect-1.0 omxh264enc` command provides feature details of the H.264 encoder.**

Display Outputs

nveglglessink		nvoverlaysink	nvoverlaysink
X11 Backend	**Wayland Backend**		
X11 window	Wayland-Weston window	Panel overlay	Panel 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, interpolation-method, crop, format conversion
UYVY	UYVY	Flip-method, interpolation-method, crop, format conversion
YUY2	YUY2	Flip-method, interpolation-method, crop, format conversion
YVYU	YVYU	Flip-method, interpolation-method, crop, format conversion
NV12	NV12	Flip-method, interpolation-method, crop, format conversion
GRAY8	GRAY8	Flip-method, interpolation-method, crop, format conversion
BGRx	BGRx	Flip-method, interpolation-method, crop, format conversion
RGBA	RGBA	Flip-method, interpolation-

		method, crop, format conversion
NVMM:I420	NVMM:I420	Flip-method, interpolation-method, crop, format conversion
NVMM:I420_10LE	NVMM:I420_10LE	Flip-method, interpolation-method, crop, format conversion
NVMM:NV12	NVMM:NV12	Flip-method, interpolation-method, crop, format conversion
NVMM:RGBA	NVMM:RGBA	Flip-method, interpolation-method, crop, format conversion

CSI and USB Camera Formats

Camera	Options	Notes
gst-nvarguscamerasrc	NVMM: NV12	
	num-buffers	
	Whitebalance Mode	
	Saturation	
	Sensor-id	
	gainRange	
	exposureTimeRange	
	ispdigitalgainrange	

BPMP I2C Master

Feature	Notes
Speed mode (Standard, FM, FM+)	Bus speed configuration
Packet mode	I2C controller configuration on packet mode
7-bit/10-bit addressing mode	
Bus clear support	Bus clear handling when bus is held by device

SPE-UART

Feature	Notes
PIO mode	FIFO access using CPU
Hardware flow control	Flow control line toggling from hardware/software
FIFO mode	FIFO mode of UART controller

SPE DMA

Feature	Notes
Memory to memory	Memory to memory transfer
Memory to I/O	Memory to I/O transfer
I/O to memory	I/O to memory transfer
Continuous mode support	Cyclic mode

I2C Slave

Feature	Notes
Normal/Byte mode	I2C controller configuration on byte mode
FIFO mode	I2C controller configuration on FIFO mode
7-bit addressing	
10-bit addressing	
Repeat start	Repeat start on transfer of data
Clock stretching	Clock line stretching

CAN

Feature	Notes
CAN 2.0 A	Basic or Standard CAN with 11 bit message identifiers, originally specified to operate at a maximum frequency of 250 Kbps. Maximum signal frequency: 1 Mbps.
CAN FD	CAN FD increases the maximum data throughput to ~3.7 Mbps. 10 Mbps over 10 meters. Maximum signal frequency: 15 Mbps.
TTCAN	Conforms with CAN protocol version 2.0 part A, B and ISO 11898-1, -4. CAN FD with up to 64 data bytes supported.

Audio

Feature	Notes
HDA Audio for HDMI/DP	
DMIC Support	
DSPK Support	
I2S Support	

Legal Information

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