i.MX Linux® Release Notes

1 Overview

This document contains important information about the package contents, supported features, known issues and limitations in this release.

This release is a GA consolidated release for 4.14 Kernel upgrade and supports SoC in the i.MX 6, 7, 8, 8M and 8X families.

For information on changes in this release, see the manifest Readme at index: imx-manifest.git and the Change Logs at index: imx-manifest-ChangeLog.git.

i.MX reference boards

- i.MX 8 Series
  - i.MX 8QuadXPlus MEK Board
  - i.MX 8QuadMax MEK Board
  - i.MX 8M Quad EVK Board
  - i.MX 8M Mini EVK Board
- i.MX 7 Series
  - i.MX 7Dual SABRE-SD Board
  - i.MX 7ULP EVK Board
- i.MX 6 Series
  - i.MX 6QuadPlus SABRE-SD and SABRE-AI Boards
  - i.MX 6Quad SABRE-SD and SABRE-AI Boards
  - i.MX 6DualLite SDP SABRE-SD and SABRE-AI Boards
  - i.MX 6SoloX SABRE-SD and SABRE-AI Boards

Contents

- i.MX 6UltraLite EVK Board
- i.MX 6ULL EVK Board
- i.MX 6ULZ EVK Board
- i.MX 6SLL EVK Board

NOTE

In this document, the following notation is used:

- 6SABRE-SD stands for the i.MX 6Quad, i.MX 6QuadPlus, i.MX 6DualLite, and i.MX 6DualPlus SABRE-SD Platforms.
- 6SABRE-AI stands for the i.MX 6Quad, i.MX 6QuadPlus, and i.MX 6DualLite SABRE-AI Platforms.
- 6SoloLite stands for the i.MX 6SoloLite EVK
- 6SoloX-SD stands for the i.MX 6SoloX SABRE-SD Platform.
- 6SoloX-AI stands for the i.MX 6SoloX SABRE-AI Platform.
- 7D-SABRE-SD stands for the i.MX 7Dual SABRE-SD Platform.
- 6UltraLite stands for the i.MX 6UltraLite EVK Platform.
- 6ULL stands for the i.MX 6ULL EVK Platform.
- 6ULZ stands for the i.MX 6ULZ EVK Platform.
- 7ULP stands for the i.MX 7 Ultra Low Power Platform.
- 8QuadMax stands for the i.MX 8QuadMax MEK Platform.
- 8QuadXPlus stands for the i.MX 8QuadXPlus MEK Platform.
- 8M Quad stands for the i.MX 8M Quad EVK Platform.
- 8M Mini stands for the i.MX 8M Mini EVK Platform.

The following table lists the testing that was done for each SoC.

Table 1. Board Validation and Support Scope

SoC	Test Validation and Support Scope
8M Quad	Full cycle tested and GA quality.
8M Mini	Full cycle tested and GA quality.
8QuadMax	Full cycle tested and GA quality.
8QuadXPlus	Full cycle tested and GA quality.
7Dual/Solo	Full cycle tested and GA quality.
7ULP	Full cycle tested and GA quality.
6QuadPlus	Full cycle tested and GA quality.
6Quad	Full cycle tested and GA quality.
6DualLite	Full cycle tested and GA quality.
6SoloX	Full cycle tested and GA quality.
6UltraLite	Full cycle tested and GA quality.
6ULL	Full cycle tested and GA quality.
6SLL	Full cycle tested and GA quality.
6ULZ	Full cycle tested and GA quality.

1.1 References

i.MX has multiple families supported in software. The following are the listed families and SoCs per family. The i.MX Linux® Release Notes describes which SoC is supported in the current release. Some previously released SoCs might be buildable in the current release but not validated if they are at the previous validated level.

- i.MX 6 Family: 6QuadPlus, 6Quad, 6DualLite, 6SoloX, 6SoloLite, 6SLL, 6UltraLite, 6ULL, 6ULZ
- i.MX 7 Family: 7Dual, 7ULP
- i.MX 8 Family: 8QuadMax
- i.MX 8M Family: 8M Quad, 8M Mini
- i.MX 8X Family: 8QuadXPlus

This release includes the following references and additional information.

- *i.MX Linux® Release Notes* (IMXLXRN) - Provides the release information.
- *i.MX Linux® User's Guide* (IMXLUG) - Contains the information on installing U-Boot and Linux OS and using i.MX-specific features.
- *i.MX Yocto Project User's Guide* (IMXLXYOCTOUG) - Contains the instructions for setting up and building Linux OS in the Yocto Project.
- *i.MX Reference Manual* (IMXLXRM) - Contains the information on Linux drivers for i.MX.
- *i.MX Graphics User's Guide* (IMXGRAPHICUG) - Describes the graphics features.
- *i.MX BSP Porting Guide* (IMXXBSPPG) - Contains the instructions on porting the BSP to a new board.
- *i.MX VPU Application Programming Interface Linux® Reference Manual* (IMXVPUAPI) - Provides the reference information on the VPU API on i.MX 6 VPU.

The quick start guides contain basic information on the board and setting it up. They are on the NXP website.

- SABRE Platform Quick Start Guide (IMX6QSDPQSG)
- SABRE Board Quick Start Guide (IMX6QSDBQSG)
- i.MX 6UltraLite EVK Quick Start Guide (IMX6ULTRALITEQSG)
- i.MX 6ULL EVK Quick Start Guide (IMX6ULLQSG)
- SABRE Automotive Infotainment Quick Start Guide (IMX6SABREINFOQSG)
- i.MX 6SoloLite Evaluation Kit Quick Start Guide (IMX6SLEVKQSG)
- i.MX 7Dual SABRE-SD Quick Start Guide (SABRESDBIMX7DUALQSG)
- i.MX 8M Quad Evaluation Kit Quick Start Guide (IMX8MQUADEVKQSG)
- i.MX 8M Mini Evaluation Kit Quick Start Guide (8MMINIEVKQSG)
- i.MX 8QuadXPlus Multisensory Enablement Kit Quick Start Guide (IMX8QUADXPLUSQSG)

Documentation is available online at nxp.com.

- i.MX 6 information is at nxp.com/iMX6series
- i.MX SABRE information is at nxp.com/imxSABRE
- i.MX 6SoloLite EVK information is at nxp.com/6SLEVK
- i.MX 6UltraLite information is at nxp.com/iMX6UL
- i.MX 6ULL information is at nxp.com/iMX6ULL
- i.MX 7Dual information is at nxp.com/iMX7D
- i.MX 7ULP information is at nxp.com/imx7ulp
- i.MX 8 information is at nxp.com/imx8
- i.MX 6ULZ information is at nxp.com/imx6ulz

1.2 Release contents

This release consists of the following:

- Pre-built images
- Manufacturing tools (UUU)

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- Documentation
- Git repo open source distributions on the Code Aurora i.MX Project.
- Proprietary distributions on Yocto Project i.MX external mirror
- Limited access third-party distributions.

The GA releases are named "L<Kernel_version>_<x.y.z>".

"<Kernel_version>": BSP Kernel version. (For example, "L4.14.98" indicates that this BSP release is based on the kernel version 4.14.98)

"<x.y.z>": Semantic versioning specification, where X is the major version, Y is the minor version, and Z is the patch version.

The following tables list the contents included in each package.

Table 2. Release contents

Component	Description
Linux® OS Kernel and Device Trees	4.14.98
U-Boot	v2018.03
SD Card images	Pre-built images used for testing to use on target i.MX reference boards.
Manufacturing Tools (UUU)	Used to burn a production image into the board
i.MX Open Source repos	i.MX open source modifications or NXP original open source.
NXP Component downloads	System Controller Porting kit and AACPlus Decoder downloadable on nxp.com.
i.MX Proprietary on Yocto Project mirror	i.MX proprietary components for download Yocto Project mirror on nxp.com.
i.MX Limited Access	i.MX 3rd party packages requiring marketing assistance

The release packages contain the following.

- Documentation.
- Prebuilt binaries:
    - SD Card prebuilt image for the release target SoC.
    - Kernel and Device trees
    - Boot Images
    - Applicable Arm Cortex-M4 Demos if applicable to target SoC
- UUU default scripts that burn into eMMC. UUU example scripts are used as reference.

See the i.MX User's Guide for information on how to use these release contents.

The following packages are available on the NXP Yocto Project mirror. Each package is pulled into builds directly when doing a Yocto Project build but can also be retrieved using the following command on the Linux OS.

```
wget https://www.nxp.com/lgfiles/NMG/MAD/YOCTO/*file.bin*
```

Table 3. BSP and Multimedia standard packages

File name	Description
imx-codec-4.4.5.bin	i.MX optimized Audio and Video core codec libraries
imx-parser-4.4.5.bin	i.MX optimized core parser
imx-vpuwrap-4.4.5.bin	i.MX VPU wrapper for VPU libraries.
imx-vpu-5.4.38.bin	i.MX VPU library for i.MX 6 with VPU.
imx-vpu-hantro-1.11.0.bin	i.MX VPU Hantro libraries for i.MX 8M Quad and 8M Mini.
firmware-qca-2.0.3.bin	i.MX QCA Bluetooth Wi-Fi firmware.

Table continues on the next page...

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Table 3.   BSP and Multimedia standard packages (continued)

File name	Description
firmware-imx-8.1.bin	i.MX Firmware including firmware for VPU, DDR, EPDC, HDMI, SDMA, and SECO.
imx-gpu-viv-6.2.4.p4.0-aarch32.bin	i.MX Graphics libraries for i.MX 6 and 7 SoC with GPU.
imx-gpu-viv-6.2.4.p4.0-aarch64.bin	i.MX Graphics libraries for i.MX 8.
imx-gpu-g2d-6.2.4.p4.0.bin	i.MX Graphics G2D libraries for i.MX 6 and 7 with GPU.
imx-dpu-g2d-6.2.4.p4.0.bin	i.MX Graphics G2D libraries for i.MX 8.
imx-sc-firmware-1.2.bin	i.MX System Controller Firmware for i.MX 8QuadMax and 8QuadXPlus reference boards
imx7d-sabresd-m4-freertos-1.0.bin	i.MX 7D Cortex-M4 Demo
imx7ulp-m4-demo-2.5.0.bin	i.MX 7ULP Cortex-M4 Demo
imx8qm-m4-demo-2.5.1.bin	i.MX 8QuadMax Cortex-M4 Demo
imx8qx-m4-demo-2.5.1.bin	i.MX 8QXP Cortex-M4 Demo
imx8mq-m4-demo-2.3.0.bin	i.MX 8M Quad Cortex-M4 Demo
mx8mm-m4-demo-2.5.0.bin	i.MX 8M Mini Cortex-M4 Demo

NOTE
The Cortex-M MCUXpresso SDK is distributed by the MCUXpresso Web Builder tool.
To obtain the MCUXpresso SDK for the Cortex-M core of your i.MX SoC, visit http://mcuxpresso.nxp.com.

The following packages are available for download on nxp.com.

Table 4.   NXP.com packages

File name	Description
imx-aacpcodec-4.4.5.bin	Coding Technologies AACplus decoder
imx-scfw-porting-kit-1.2.tar.gz	System Controller Firmware porting kit

i.MX BSP also releases open source through repos on the Code Aurora Forum (CAF) i.MX CAF Project. The following table lists all the repos on CAF and the associated branches.

Table 5.   i.MX Code Aurora Forum Distributed Repos

Repo	Description
imx-manifest	i.MX Rocko Yocto Project Linux BSP Manifest
linux-imx	i.MX Linux Kernel
uboot-imx	i.MX U-Boot
imx-atf	i.MX Arm Trusted Firmware for i.MX 8
imx-mkimage	i.MX Mkimage boot image tool
imx-lib	i.MX Libraries
imx-test	i.MX Driver unit test applications
imx-optee-os	i.MX OP-TEE OS
imx-optee-test	i.MX OP-TEE Test

Table continues on the next page...

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Table 5. i.MX Code Aurora Forum Distributed Repos (continued)

Repo	Description
imx-optee-client	i.MX OP-TEE Client
imx-xen	i.MX Xen hypervisor
imx-gst1.0-plugin	i.MX Multimedia GStreamer Plugins
gst-plugsin-base	i.MX Multimedia GStreamer Base
gst-plugsin-bad	i.MX Multimedia GStreamer Bad
gst-plugsin-good	i.MX Multimedia GStreamer Good
gstreamer	i.MX Multimedia GStreamer Core
imx-alsa-plugins	i.MX ALSA Plugins
libdrm-imx	i.MX Graphics DRM
opencv-imx	i.MX Graphics OpenCV
weston-imx	i.MX Graphics Weston
wayland-protocols-imx	i.MX Graphics Wayland Protocols
xf86-video-imx-vivante	i.MX Graphics X.org Vivante Driver
meta-fsl-bsp-release	i.MX Yocto Project Release Layer
gtec-demo-framework	i.MX Graphics Demo Framework on NXPMicro github

An additional part of the release are Yocto Project demos that show additional use cases on different i.MX hardware. These demos are layers that work on top of a public BSP release. These are listed below and are updated within a month of each consolidated GA release. These demos are not fully tested but show how to integrate different stacks of software to use with i.MX reference boards and our BSP release.

- meta-imx-liri - Liri Qt Desktop Demo for i.MX 8
- meta-edgescale - EdgeScale demos for i.MX and QorIQ
- meta-imx-edgescale - EdgeScale demos for i.MX 8 MQuad
- meta-imx-gpu-sdk - Additional graphics demos for i.MX 8
- meta-imx-iot-gateway - AWS and IOT Gateway demos for i.MX 6UL/6ULL
- meta-nxp-agl - Automotive Grade Linux for i.MX 6 and i.MX 8 auto boards. Note this is not supported on sumo release yet because of AGL dependencies
- meta-nxp-genivi - GENIVI demo for i.MX 6 and i.MX 8 auto boards
- meta-nxp-xbmc - Kodi demo showing a multimedia playback with a framebuffer backend on i.MX 6
- meta-imx-machinelearning - Machine Learning for i.MX 8

1.3 License

The Board Support Package (BSP) is composed of a set of packages and metadata (for Yocto Project Recipes) and each one has its own licensing. Verify the license of the target package before developing. The license can be found at the top of a recipe or a source file (such as *.c or *.h). For details, contact your NXP representative.

During the Yocto Project setup, to set up an i.MX build, accept the NXP license. This acceptance is recorded in the build configuration files so that the following proprietary binaries can be extracted during the build process. The NXP proprietary packages contain a Software Content Register (SCR) file that lists information about the package: imx-gpu-viv, imx-codec, and imx-parser.

1.4 Limited access proprietary packages

- Limited access packages listed in the following table are provided on nxp.com with controlled access because they require additional licensing by a 3rd party. Contact your sales representative for access. Each package has its own Readme file with instructions on how to build, install, and run.

Table 6. Limited access packages for Yocto project releases

Package	Description
imx-mscodec-4.4.5.bin	i.MX optimized Microsoft codec
imx-msparser-4.4.5.bin	i.MX optimized Microsoft ASF parser
imx-ac3codec-4.4.5.bin	i.MX Dolby AC3 core decoder
imx-ddpcodec-4.4.5.bin	i.MX Dolby DD-plus decoder
imx-real-4.4.5.bin	i.MX Real Networks RMVB Decoders and Parsers
imx-dsp-1.0.6.bin	DSP firmware
imx-dsp-codec-1.0.6.bin	DSP decoders (MP2, MP3, BSAC, DRM, DABPlus,SBC)
imx-dsp-codec-ext-1.0.6.bin	DSP extra codecs
imx-dsp-codec-aacp-1.0.6.bin	DSP AACPlus decoder

2 What's New?

This section describes the changes in this release, including new features and defect fixes.

2.1 New features

A summary of the main new features is as follows.

New features added for all supported boards:

- Upgraded the kernel to 4.14.98.
- Updated EULA to v5 January 2019.
- Upgraded the Yocto Project to version 2.5 Sumo.
- Supports the GCC 7.3 toolchain.
- MfgTools using UUU for both Linux and Windows command line flash tools
- Hypervisor support for Xen and Jailhouse
- Graphics updates:
    - GPU driver upgraded to 6.2.4.p4.0.
    - i.MX 8QuadMax and 8QuadXPlus support for Vulkan and OpenVX
    - GPU SDK upgraded to 5.3.0
    - Weston upgraded to 5.0
- Arm Trusted Firmware upgraded to 2.0.
- Chromium browser upgraded to v67.0.3396.99 for X11 and v64.0.3274.0 for XWayland.
- New sound features: Audio Mixer (AMIX) support.
- New multimedia features and changes:
    - GStreamer upgraded to 1.14.4
    - Qt upgraded to 5.10
    - On SoCs without hardware graphics acceleration (GPU) for Frame Buffer, X11 or Wayland graphic backends Qt 5 is handled only using Mesa software graphics, and it is not supported by NXP.

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- Supports 64-bit audio codecs and parsers for i.MX 8.
- Supports video rendering with OpenGL-ES, AV playback to multiple displays and cameras preview.
- New sound features: Audio Mixer (AMIX) support.
- Supports hardware audio decoder for AAC/HE-AAC/MP3.
- Wi-Fi and Bluetooth updates
  - Supports Qualcomm Wi-Fi and Bluetooth for i.MX 8MQuad, 8MMini, and 7ULP.
  - Supports Cypress Wi-Fi and Bluetooth for i.MX 8MQuad, 8MMini, and 7ULP.
  - Supports 1FD and 1CX Cypress/Murata for i.MX 8QuadMax, 8QuadXPlus, and 8M Quad.
- Supports CAN FD mode in FlexCAN.
- Supports suspending and resuming.
- Supports MIPI DSI panel.
- Supports USB3.0 device mode for i.MX 8.
- Bootloader features for i.MX 8QuadMax and 8QuadXPlus:
  - The System Controller Firmware (SCFW) and U-Boot are contained in imx-boot as the bootloader for i.MX 8QuadMax and i.MX 8QuadXPlus.
  - The SCFW provides an abstraction to many of the underlying features of the hardware. This feature runs on an Arm® Cortex®-M processor that executes SCFW. Features include:
    - System initialization and boot
    - Power management
    - Resource management
    - System counter
    - Pad configuration
    - One-Time-Programmable (OTP) storage
    - Temperature monitoring
    - Watchdog
- Supports OP-TEE

Features on i.MX 8QuadMax:

- Supports the i.MX 8QuadMax with the Arm v8 architecture:
  - 4x Cortex-A53 SMP enabled.
  - 2x Cortex-A72 SMP enabled.
- Supports the SMMU-500 for the IOMMU functionality.
- Supports the pin/pad, clock/power/resource management through the System Controller Unit (SCU).
- Supports LVDS-HDMI through the LVDS-HDMI Mini-SAS daughter card.
- Supports display and audio through the HDMI interface.
- Supports the RM67191 OLED display panel through the MIPI DSI interface.
- Supports the CAAM security driver.
- Supports the SAI and Audio-codec.
- Supports the 2x GC7000XSVX GPU Graphics Processing Unit (GPU).
- Supports the VPU encoder and decoder.
- Supports the SD/MMC/eMMC, FlexSPI, and LPSPI storage devices.
- Supports the ENET, USB, PCIe, CAN, and I2C connectivity.
- Supports Murata 1CQ/1FD/1CX wireless and Bluetooth.
- Supports connectivity using RPMsg with MS support to FreeRTOS.
- Supports display with triple-buffer support in PAN display API for the frame buffer.
- Supports Camera V4L TV-In through ADV7180 and V4L Camera support through Quad Camera board (3 cameras per board and parallel-in).
- Supports HiFi DSP.
- supports SIM module.

Features on i.MX 6ULZ

- Supports the i.MX 6ULZ.

Features on i.MX 8M Mini:

- Supports booting from SD, eMMC, and FlexSPI.
- Supports low-power features: CPU hot-plug, Arm DVFS, CPU idle suspend/resume, and LPDDR4 DVFS.
- Supports 1080p60 display with ADV7535 (MIPI-HDMI adapter) and MIPI panel.
- Supports 1080p30 camera with OV5640.
- Supports Wayland Weston acceleration with GPU2D.
- Supports audio capture from PDM microphone.
- Supports Audio expansion board for:

  - Multiple-channel audio receiver and transmitter
  - SPDIF receiver and transmitter
- Supports 1080p60 video playback of HEVC, H264, VP9, and VP8.
- Supports system suspend/resume.
- Supports LPDDR4/DDR4 frequency change.
- Replaced the old MfgTool with UUU. For details, see github.com/NXPmicro/mfgtools.
- Supports OLED MIPI panel and touch.
- Supports GStreamer audio and video recording.
- Supports U-Boot splash screen.
- Supports DDR4 Cypress Wi-Fi EVK board.

Features on i.MX 8M Quad:
- Supports i.MX 8M Quad TO B1 silicon.
- Supports DDR frequency chanage to 100MTS in B1 silicon.
- Supports LPDDR4 Cypress Wi-Fi EVK board

Features on i.MX 8QuadXPlus MEK:

- Supports i.MX 8QuadXPlus B0 chip.
- Supports the VPU encoder and decoder.
- GPU frequency increased from 600 MHz to 700 MHz LVDS and MIPI uses AVPLL.
- Removed A0 workaround for ESAI ADMA request.
- Added ADC support.
- Supports the i.MX 8QuadXPlus MEK with the Arm v8 architecture:
  - 4x Cortex-A35 SMP enabled.
- Supports the pin/pad, clock/power/resource management through the System Controller Unit (SCU).
- Supports the SAI/ESAI and Audio-codec.
- Supports the GC7000Lite GPU Graphics Processing Unit (GPU).
- Supports the SD/MMC, QSPI-NOR storage devices.
- Supports the ENET, USB, PCIe, CAN, and I2C connectivity.
- Supports Murata 1CQ/1FD/1CX wireless and Bluetooth.
- Supports connectivity using RPMsg with MS support to FreeRTOS.
- Supports display with triple-buffer support in PAN display API for the frame buffer.
- Supports HIFI DSP.
- Supports MIPI CSI.
- Supports MLC NAND flash dropped by the kernel community.

3 SoC Feature Summary

The following table describes the SoC features summarized into groups. In this table, common features are shown on which SoC it supports.

Table 7.   SoC Hardware Acceleration Features

Feature	SoC
2D Graphics with GPU	i.MX 6 Family: 6Quad, 6DualLite, 6Solo, 6SoloX, 6SoloLite

Table continues on the next page...

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Table 7. SoC Hardware Acceleration Features (continued)

Feature	SoC
	i.MX 7 Family: 7ULP
	i.MX 8M Family: 8M Mini
3D GPU	i.MX 6 Family: 6Quad, 6DualLite, 6Solo, 6SoloX
	i.MX 7 Family: 7ULP
	i.MX 8 Family: 8QuadMax
	i.MX 8X Family: 8QuadXPlus
	i.MX 8M Family: 8M Quad, 8M Mini
2D Graphics with DPU	i.MX 8 Family: 8QuadMax
	i.MX 8X Family: 8QuadXPlus
Vulkan GPU	i.MX 8 Family: 8QuadMax
	i.MX 8X Family: 8QuadXPlus
OpenVX	i.MX 8 Family: 8QuadMax
VPU	i.MX 6 Family: 6Quad, 6DualLite, 6QuadPlus
	i.MX 8 Family: 8QuadMax
	i.MX 8X Family: 8QuadXPlus
	i.MX 8M Family: 8M Quad, 8M Mini
EPDC	i.MX 6 Family: 6DualLite, 6SoloLite, 6SLL, 6ULL, 6ULZ
	i.MX 7 Family: 7Dual
PXP	i.MX 6 Family: 6DualLite, 6SoloLite, 6SLL, 6UL, 6ULL, 6ULZ
	i.MX 7 Family: 7Dual
Frame Buffer Display	i.MX 6 Family: 6Quad, 6DualLite, 6Solo, 6SoloX, 6SoloLite, 6SLL, 6UL, 6ULL, 6ULZ
	i.MX 7 Family: 7Dual, 7ULP
DRM Display	i.MX 8 Family: 8QuadMax
	i.MX 8X Family: 8QuadXPlus
	i.MX 8M Family: 8M Quad, 8M Mini
M4 Boot	i.MX 6 Family: 6SoloX
	i.MX 7 Family: 7Dual, 7ULP
	i.MX 8 Family: 8QuadMax
	i.MX 8X Family: 8QuadXPlus
	i.MX 8M Family: 8M Quad, 8M Mini
HiFi4 DSP	i.MX 8 Family: 8QuadMax
	i.MX 8X Family: 8QuadXPlus

4 BSP Supported Features

The following table describes the features that are supported in this BSP release. In this table, if no board is explicitly stated, the feature is shared across all boards listed in Supported Hardware in the Release contents section; otherwise, the feature is only supported on the boards listed.

Table 8. Supported features

Feature	Supported board	Comment
Kernel		
Kernel	All i.MX	Kernel version: 4.14.98
File System	All i.MX	EXT2/EXT3/EXT4 are used as the file system in MMC/eMMC/SD card.
		On i.MX 6SABRE-AI and 7D-SABRE-SD,
		• UBIFS is used for NAND.
		• JFFS2/UBIFS is used for Parallel NOR, QSPI NOR.
Boot Image		
U-Boot	All i.MX	U-Boot delivery is based on U-Boot version v2018.03.
		Clock, Anatop regulator, ENET, UART, MMC/SD, eMMC4.3/4.4/4.5.
		High-Assurance Boot, ROM Plug-in Mode.
		SPI-NOR, Parallel NOR, SATA, NAND, FlexSPI-NOR, USB Mass Storage.
		See Table 2 in Section 1.1 for U-Boot configurations supported on each board for SPI_NOR, NAND, Parallel NOR, FlexSPI-NOR. These are not supported on all boards.
		i.MX 6QuadPlus/Quad/DualLite SABRE-SD and SABRE-AI support DDR3 528 MHz @ 64 bit.
		i.MX 6SoloX SABRE-SD and SABRE-AI support LDDR3 400 MHz @ 32 bit.
		i.MX 6SoloLite EVK supports LPDDR2 400 MHz @ 32 bit and boot using L2Cache as OCRAM.
		i.MX 6SoloLite EVK supports LPDDR.
		i.MX 7Dual SABRE-SD supports DDR3 533 MHz @ 32 bit and boot using L2Cache as OCRAM.
		i.MX 6UltraLite EVK supports DDR3 400 MHz @ 16 bit.
		i.MX 6ULL supports DDR3 400 MHz @ 16 bit.
		i.MX 6ULZ supports DDR3 400 MHz @ 16 bit.
		i.MX 7ULP supports Clock, UART, MMC/SD, eMMC4.3/4.4/4.5, High-Assurance Boot, ROM Plug-in Mode QuadSPI-NOR, USB Mass Storage I2C, and SPI.
		i.MX 8 uses imx-mkimage to produce the flash.bin file that contains the i.MX 8 system controller firmware and U-Boot, and the flash.bin file that can be flashed to the SD cards with the command: dd if=<flash.bin> of=/dev/sd<x> seek=<x> bs=1k.
		For 8M Mini, 8M Quad, 8QuadMax A0, and 8QuadXPlus A0, seek=33k.
		For 8QuadMax B0, and 8QuadXPlus B0, seek=32k.
Boot Firmware	All i.MX 8	All i.MX 8 require Arm Trusted Firmware
		i.MX 8QuadMax and 8QuadXPlus require System Controller Firmware

Table continues on the next page...

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Table 8.   Supported features (continued)

Feature	Supported board	Comment
		i.MX 8QuadMax and 8QuadXPlus require SECO firmware i.MX 8QuadMax requires signed HDMI firmware
OP-TEE	All i.MX 6 All i.MX 7 All i.MX 8M	OP-TEE OS is required on the boot partition with the TEE file for OP-TEE enablement
Xen Hypervisor	All i.MX 8M 8QuadMax 8QuadXPlus	Xen is a Ring 0 supported hypervisor and goes into the boot image.
Jailhouse Hypervisor	8QuadMax 8QuadXPlus	Xen is a Ring 0 supported hypervisor and goes into the boot image. Jailhouse is a Ring 3 supported hypervisor for i.MX 8
Machine-specific layer		

Arm® Core	All i.MX	6SABRE-SD, 6SABRE-AI, 6SoloLite, 6SLL, 6SoloX-SD, and 6SoloX-AI support the Arm Cortex-A9 processor.
		
		7D-SABRE-SD, 7ULP EVK, 6UltraLite EVK, 6ULL EVK, and 6ULZ EVK support the Arm Cortex-A7 processor.
		
		i.MX 8QuadXPlus processor consists of five cores:
		
		   • Four Arm Cortex-A35
		   • One Arm Cortex-M4F
		
		i.MX 8QuadMax processor consists of eight cores:
		
		   • Four Arm Cortex-A53 cores
		   • Two Arm Cortex-A72 cores
		   • Two Arm Cortex-M4F cores
		
		Innovative multicore architecture provides four Cortex-A53 cores, two Cortex-A72 cores, and two Cortex-M4 cores.
		
		i.MX 8MQ and i.MX 8M Mini supports four Cortex-A53 cores.

Memory	All i.MX	On i.MX 6 and i.MX 7 SoC, the user/kernel space is split 2G/2G. On i.MX 8 with 64-bit configuration, the memory is not split. 8QuadMax supports two 32-bit LPDDR4 channels @1600 MHz. 8QuadXPlus supports one 32-bit LPDDR4 channel @1200 MHz. 8M Quad supports one 32-bit LPDDR4 channel @ 800 MHz and 167 MHz. 8M Mini supports one 32-bit LPDDR4 channel @ 750 MHz and 25 MHz.
Interrupt	All i.MX	GIC
Clock	All i.MX	Controls the system frequency and clock tree distribution.
Timer	All i.MX	System timer tick and broadcast timer support. GPT Timer used for i.MX 6 and i.MX 7. On i.MX 8M Quad, 8M Mini and 8QuadXPlus, system counter timer instead of GPT. On i.MX 8, Arm Arch timer used instead of GPT On i.MX 6 and i.MX 7 Enhanced Periodic Interrupt Timer (EPIT) available
GPIO/EDIO	All i.MX	GPIO is initialized in earlier phase according to hardware design.

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Table 8. Supported features (continued)

Feature	Supported board	Comment
IOMUX	All i.MX	Provides the interfaces for I/O configuration. IOMUX-V3 version is used on i.MX 6 and i.MX 7, i.MX 8M Quad, and i.MX 8M Mini boards. For i.MX 8QuadMax and 8QuadXPlus the system controller manages access to the IOMUX.
System Controller	8QuadMax 8QuadXPlus	Provides abstraction to the hardware features and runs on Arm Cortex executing firmware.
DMA engine		
SDMA	All i.MX 6 All i.MX 7 8M Quad 8M Mini	Conforms to the DMA engine framework.
APBH-Bridge-DMA	6SABRE-AI	Conforms to the DMA engine framework. This feature requires a NAND U-Boot.
Character device drivers		
UART	All i.MX	i.MX 6 SABRE-SD, and SoloLite EVK support console through internal Debug UART1. i.MX 6SoloX SABRE-SD and SABRE-AI support Cortex-A9 processor through UART1 and Cortex-M4 processor through UART2. i.MX 7Dual SABRE-SD Cortex-A7 processor through UART1 and Cortex-M4 processor through UART2. i.MX 6UltraLite, 6ULL and 6ULZ EVKs Corttex-A7 processor through UART1. i.MX 6 SABRE-AI supports console through internal Debug UART 4. i.MX 7ULP EVK supports through LPUART. There are two LPUARTs on the i.MX 7ULP EVK board. LPUART0 is connected to Arm Cortex-M4 domain and LPUART4 to Arm Cortex-A7 domain. i.MX 8M Mini EVK supports CA53 through UART2 and CM4 through UART4. i.MX 8 supports Cortex-A53 processor through UART0 and Cortex-M4 processor through UART2.
Power Management Drivers		
Anatop Regulator	All i.MX 6 All i.MX 7	Supports Anatop regulator management.
Lower Power mode	All i.MX 6 All i.MX 7 All i.MX 8M	Supports standby mode and dormant (mem) mode on i.MX 6 and i.MX 7 boards.
CPUIdle	All i.MX 6 All i.MX 7	2 levels CPUIdle supported: purely WFI and WFI with wait mode enabled.
CPUFreq	All i.MX	CPUFreq can be used for CPU frequency adjustment. The Interactive governor is added and enabled by default.
BusFreq	All i.MX 6 7D-SABRE-SD 8M Mini 8M Quad	Supports the system bus clock frequency scaling on i.MX 6 and i.MX 7D boards.

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Table 8. Supported features (continued)

Feature	Supported board	Comment
Battery charging	All i.MX 6 All i.MX 7 8M Mini 8M Quad	Supports battery charge type detection.
Networking drivers		
ENET	All i.MX 6 7D-SABRE-SD All i.MX 8	i.MX 6Quad/SoloX board supports AR8031 PHY, i.MX 6UltraLite EVK board supports KSZ8081 PHY, and i.MX 7Dual SABRE-SD board supports BCM54220 PHY. i.MX 6SoloX SABRE-SD, SABRE-AI, and i.MX 7Dual SABRE-SD support AVB features. i.MX 8 supports Atheros AR8031 PHY with 10/100/1000 bps mode, NXP automotive PHY TJA1100 PHY, and AVB features.
IEEE® 1588	All i.MX 6 All i.MX 7 8QuadMax 8QuadXPlus	Supports Linux PTP stack. Supports IPv4, IPv6, and IEEE 802.3 transport. Supports E2E, and P2P transparent clock. Supports IEEE802.1AS-2011 in the role of end station.
PCIe	All i.MX	With the platform that supports the PCIe module.
PCIe EP/RC validation system	i.MX 6Quad SD i.MX 6SoloX-SD 7D-SABRE-SD	Two of the same i.MX 6Quad SD boards, i.MX 7Dual SABRE-SD boards, or i.MX 6SoloX SDB boards. One is used as RC, and the other is used as EP. • EP can be initialized/enumerated by RC. • EP can access the memory of RC. • RC can access the memory of EP. • EP can trigger MSI, and the triggered MSI can be captured by RC.
MediaLB	6SABRE-AI 6SoloX-AI	On i.MX 6SABRE-AI, CPU1 supports MLB 150 and MLB 25/50. On i.MX 6SABRE-AI, CPU2 and i.MX 6QuadPlus SABRE-AI supports MLB 25/50 only. On i.MX 6SoloX-AI, it supports MLB 25/50.
FlexCAN	All i.MX 6 7D-SABRE-SD 8QuadMax 8QuadXPlus	Supports one CAN with the default device tree on i.MX 6SABRE-AI. Supports both CANs using the FlexCAN device tree but has a pin conflict with FEC. Supports with the default device tree on i.MX 6SoloX-SD, 6SoloX-AI, 7Dual SABRE-SD, 6UltreLite EVK, 6ULL EVK, and 6ULZ EVK. With the platform that supports the FlexCAN module, FlexCAN supports CANFD mode.
Wi-Fi/Bluetooth wireless technology	All i.MX	Supports Murata 1FD (CYW4359) Wi-Fi/Bluetooth on i.MX 8QuadMax, i.MX 8QuadXPlus, i.MX 8M Quad, and i.MX 8M Mini. Supports Murata 1CX (CYW4356) Wi-Fi/Bluetooth on i.MX 8QuadMax, i.MX 8QuadXPlus, i.MX 8M Quad, and i.MX 8M Mini. Supports Murata 1MW (CYW43455) Wi-Fi/Bluetooth on i.MX 8M Mini. Supports Murata 1PJ (QCA9377-3) Wi-Fi/Bluetooth on i.MX 7ULP and i.MX 8M Mini. Supports Murata 1CQ (QCA6174A) Wi-Fi/Bluetooth on i.MX 8QuadMax, i.MX 8QuadXPlus, i.MX 8M Quad, and i.MX 8M Mini. Supports Murata Cypress Wi-Fi/Bluetooth (BCM4339) on i.MX 6 and i.MX 7Dual. Yocto release integrates all firmwares.

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Table 8. Supported features (continued)

Feature	Supported board	Comment
		For Bluetooth A2DP, if the Yocto Project has no frame buffer, for example, the 6UltraLite G1 part chip has no LCDIF, run PulseAudio manually with the command: `/usr/bin/pulseaudio --start --log-target=syslog`
Security drivers		
CAAM	6SABRE_SD 6SABRE_AI	Cryptographic Acceleration and Assurance Module.
SNVS	All i.MX 6 All i.MX 7	Secure Non-Volatile Storage.
SIMv2	6UltraLite 7D-SABRE-SD	Smart Card Interface.
EMVSIM	8QuarMax	Smart Card Interface.
Sound drivers and DSP		
DSP	8QuadXPlus 8QuadMax	One HiFi 4 DSP
AK5558 AK4497 AK4458	8M Quad 8M Mini	Supported on Audio board.
WM8524	8M Quad 8M Mini	Supports playback
WM8962/SSI WM8960/SSI	6SABRE-SD 6SoloLite 6SoloX-SD 7D-SABRE-SD 6UltraLite 6ULL 6ULZ 7ULP	Supports playback
SAI/MQS	8QuadMax	Supports playback.
S/PDIF	6SABRE-SD 6SABRE-AI 6SoloX-AI 8QuadMax 8QuadXPlus 8M Quad 8M Mini	Supports 16 bit and 24 bit stereo playback from 32 kHz to 48 kHz sample rate. Supports 24 bit stereo record from 16 kHz to 96 kHz.
ASRC	6SABRE-AI 6SoloX-SD	Supports sample rates conversion from 5 kHz to 192 kHz and output sample rates from 32 kHz to 192 kHz. Supports ALSA plug-in library playback.

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Table 8.   Supported features (continued)

Feature	Supported board	Comment
	6UltraLite 6ULL 6ULZ 8QuadMax 8QuadXPlus	
ESAI/CS42888	6SABRE-AI 6SoloX-AI 8QuadMax 8QuadXPlus	Supports 16 bit, 24 bit PCM format, channel from 2 to 6, and sample rate from 8 kHz to 192 kHz for playback with ASRC P2P. Supports sample rate from 8 kHz to 96 kHz for record and playback without ASRC. Supports 4 channels input and 8 channels output. Supports full duplex operations. Supports amixer alsamixer control from user space.
SAI/MQS/WM8962	6SoloX-SD 7D-SABRE-SD 6UltraLite 6ULL 6ULZ 7ULP 8M Quad 8M Mini 8QuadMax 8QuadXPlus	Supports 16 bit, 24 bit, and 32 bit PCM format. Supports sample rate from 8 kHz to 96 kHz for record and playback . Supports full duplex operations. Supports amixer alsamixer control from user space. Supports clock control. Support MQS only on i.MX 6 and i.MX 7 Supports WM8962 only on i.MX 8QuadMax
AMIX	8QuadMax 8QuadXPlus	Supports 16 bit, 18 bit, 20 bit, 24 bit, and 32 bit PCM format. Supports sample rate from 8 kHz to 96 kHz for record and playback . Supports amixer alsamixer control from user space.
HDMI Audio	6SABRE-SD 6SABRE-AI 7ULP 8QuadMax 8M Quad	For i.MX 8QuadMax not supported on the reference board but able to add to custom board. i.MX 8M Quad supports audio playback through HDMI.
Input device drivers		
USB devices	All i.MX	Supports USB mouse and USB keypad through USB ports.
Touch panel	All i.MX 6 All i.MX 7	6SABRE-SD, 6SABRE-AI. Supports EGalaxy capacitive touch screen. 6SoloLite supports E Ink® touch screen on DC2/DC3 add-on card. 7Dual SABRE-SD supports E Ink touch screen with a separate package download. 6SoloX SABRE-SD and SABRE-AI support LVDS panel. 7ULP EVK supports touch through DSI panel
Keypad	6SoloLite	6SoloLite supports 4x4 keypads on DC2/DC3 add-on card.

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Table 8. Supported features (continued)

Feature	Supported board	Comment
	6UltraLite 7D-SABRE-SD 7ULP	6UltraLite EVK , 7ULP EVK and 7D SABRE-SD support the resistive touch panel.
Storage drivers		
FlexSPI-NOR	6SoloX-SD 6SoloX-AI 6UltraLite 6ULL 6ULZ 7D-SABRE-SD All i.MX 8	i.MX 6SoloX SABRE-AI supports QSPI1. i.MX 6SoloX SABRE-SD supports QSPI2. i.MX 6UltraLite EVK supports QSPI1. i.MX 7Dual SABRE-SD supports QSPI1. i.MX 8QuadXPlus, 8M Quad and 8M Mini support FlexSPI1. i.MX 8M Mini supports NOR Flash Boot.
SPI-NOR	6SABRE-AI 6SoloLite	Supports M25P32 On i.MX 6SABRE-SD Dual/Quad/DualLite there is a pin conflict for supporting SPI-NOR
NAND	6SABRE-AI 6SoloX-AI 7D-SABRE-SD 8QuadXPlus 8M Quad 8M Mini	Normal NAND and ONFI NAND asynchronous mode with BCH40/BCH62.
Parallel NOR	6SABRE-AI 8QuadMax	Supports Parallel NOR by using the EIM interface on i.MX 6 SABRE-AI.
SATA	6SABRE-SD 6SABRE-AI 8QuadMax	Serial ATA 2.0 supports only i.MX 6DualQuad SABRE-SD and SABRE-AI and i.MX 6 QuadPlus SABRE_SD and SABRE-AI and 8QuadMax.
USB drivers		
USB Host	6SABRE-AI 6SoloLite 6SoloX 6UltraLite 6ULL 6ULZ All i.MX 7 All i.MX 8	Supports USB HOST1 and USB OTG host. i.MX 8 supports USB 3.0 ports
USB Device	All i.MX	Supports USB OTG device mode.
USB	All i.MX	Supports USB OTG2.0, USB Host2.0. i.MX 8 support USB 3.0 and Type-C ports. USB Host mode: MSC, HID, UVC, and USB audio.

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Table 8. Supported features (continued)

Feature	Supported board	Comment
		USB device mode: MSC, Ethernet, and Serial.
		USB OTG pin detect support for Dual-role switch at USB2.
Graphics and Video drivers		
GPU	6SABRE-SD 6SABRE-AI 6SoloX 6SoloLite 7ULP All i.MX 8	Graphics Chips Details: One GC7000-Lite on 8M Quad. One GC7000-NanoUltra and GC520l on 8M Mini. Two GC7000SXVX on 8QuadMax. One GC7000-Lite on 8QuadXPlus. One GC7000-NanoUltra and GC328 on 7ULP. GC2000, GC355, and GC320 on 6Dual/6Quad GC2000+, GC355, and GC320 on 6QuadPlus GC880 and GC320 on 6Solo/DualLite GC400T on 6SoloX The GPU on the chips listed above supports these features that include 2D and 3D hardware acceleration: - Supports EGL 1.5 for fbdev, X11, XWayland - Supports OpenGL ES1.1 - Supports OpenGL ES2.0 (WebGL 1.0.1 compatible on X11) - Supports OpenGL ES3.0 - Supports OpenGL ES3.1, OpenGL ES3.2, Vulkan and OpenVX on i.MX 8QuadMax - Supports OpenGL ES3.1, Vulkan on i.MX 8QuadMax and 8QuadXPlus and 8M Quad - Supports OpenVG1.1 - Supports OpenCL1.1 on GC2000 on i.MX 6Quad. - Supports OpenCL1.2 on GC7000SXVX, GC7000L and GC2000+ on i.MX 6QuadPlus, 8QuadMax, 8QuadXPlus and 8M Quad. - Supports OpenGL2.1 GC355 and GC320 on 6SoloLite, which includes only 2D hardware acceleration - Supports EGL 1.5 for fbdev, X, Wayland - Supports OpenVG1.1
Frame Buffer Display	All i.MX 6 and 7	MXC Frame buffer driver for IPU V3 on i.MX 6SABRE-SD and i.MX 6SABRE-AI. MXC Frame buffer driver for PXP on i.MX 6SoloLite, i.MX 6SoloX SABRE-SD/SABRE-AI, i.MX 6UltraLite EVK, i.MX 6ULZ EVK i.MX 6ULL EVK and i.MX 7Dual SABRE-SD.
Direct Rendering Manager (DRM) Display	All i.MX 8	i.MX DPU DRM is used for i.MX 8QuadMax and 8QuadXPlus. LCDIF is used for i.MX 8M Quad and 8M Mini. DCSS is used for i.MX 8M Quad
Framebuffer compression	8M Quad	Supports graphic framebuffer compression with DEC400. Supports video framebuffer compression with DTRC.
VDOA	6SABRE-SD 6SABRE-AI	Supports Video Data Order Adapter for tiling.

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NXP Semiconductors

Table 8. Supported features (continued)

Feature	Supported board	Comment
LVDS	6SABRE-SD 6SABRE-AI 6SoloX-SD 6SoloX-AI 8QuadMax 8QuadXPlus	Supports HannStar LVDS panel on i.MX 6. It is the default display if no other video option is setup. Uses the LDB controller. On the SABRE-AI there are 2 ports. Port 0 is the default. For i.MX 8, supports the Mixel controller
HDMI Display	6SABRE-SD 6SABRE-AI 6SoloLite 6SoloX-SD 6SoloX-AI 7D-SABRE-SD 7ULP	i.MX 6SABRE-SD, 6SABRE-AI and 7Dual support on-chip HDMI hardware. i.MX 6SoloLite and i.MX 6SoloX SABRE-SD and SABRE-AI support external HDMI hardware. i.MX 7ULP EVK supports HDMI through the MIPI pins with external HDMI hardware.
HDMI/Display Port	8M Quad 8QuadMax	i.MX 8QuadMax supports HDMI audio and on-chip HDMI hardware through MIPI pins. i.MX 8M Quad supports HDMI through DCSS.
LVDS to HDMI	8QuadMax 8QuadXPlus	Uses ITE Driver IT6263
MIPI to HDMI	All i.MX 8	Uses Advantec adv7535
HDCP	6SABRE-SD	Supports HDCP v1.2 specifications on specific HDCP parts.
MIPI-DSI Display	6SABRE-SD All i.MX 7	Supports 2 lanes through MIPI daughter card on i.MX 6 and i.MX 7-SABRE-SD. Support 2 lanes MIPI DSI with direct connection on i.MX 7ULP Supports 4 lanes driven by DPU with up to 1080p60 on i.MX 8QuadMax and 8QuadXPlus. Supports 4 lanes driven by cLCDIF with up to 720p60 on i.MX 8M Quad. Supports 4 lanes driven by eLCDIF up to 1080p60 on i.MX 8M Mini. Supports 4 lanes driven by DCSS with up to 1080p60 on i.MX 8M Quad. Supports RM67191 OLED display panel through the MIPI DSI on i.MX 8.
Parallel-LCD Display	All i.MX 6 All i.MX 7	Supports SEIKO WVGA panel. For i.MX 6UltraLite, i.MX 6ULZ, i.MX 6ULL and i.MX 7Dual SABRE-SD, it supports Embest LCD8000-43T LCD panel.
PxP	6DualLite-SD 6SoloLite 6SLL 6SoloX-SD 6SoloX-AI 7D-SABRE-SD 6UltraLite 6ULL	Enables PXP Driver for EPDC on i.MX 6SoloLite, 6SLL EVKs and 6DualLite SABRE-SD. Enables PXP driver for EPDC on i.MX 7Dual, 6ULZ, 6UltaLite and 6ULL. Conforms to DMA engine framework.

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Table 8.   Supported features (continued)

Feature	Supported board	Comment
	6ULZ	
EPDC	6DualLite-SD	Supports RGB565 frame buffer format.
	6SoloLite	Supports Y8 frame buffer format.
	6SLL	Supports full and partial EPD screen updates.
	6ULL	Supports up to 256 panel-specific waveform modes.
	6ULZ	Supports automatic optimal waveform selection for a given update.
	7D-SABRE-SD	Supports synchronization by waiting for a specific update request to complete.
		Supports screen updates from an alternate (overlay) buffer.
		Supports automated collision handling.
		Supports 64 simultaneous update regions.
		Supports pixel inversion in a Y8 frame buffer format.
		Supports posterization of the update contents (driving all pixels to either solid black or white).
		Supports use of a color map to remap Y8 frame buffer contents.
		Supports 90, 180, and 270 degree HW-accelerated frame buffer rotation.
		Supports panning (y-direction only).
		Supports three EPDC driver display update schemes: Snapshot, Queue, and Queue and Merge.
		Supports user control of the delay between completing all updates and powering down the EPDC.
		Supports dithering.
		i.MX 7Dual supports E Ink but requires a separate download. Contact Marketing representative.
VPU	6SABRE-SD	i.MX 6 Encoder: MPEG-4, H.263, H.264 (AVC/MVC), MJPEG
	6SABRE-AI	i.MX 8QuadMax Encoder: H264
	All i.MX 8	i.MX 6 Decoder: MPEG-4, H.263, H.264 (AVC/MVC), VC-1,MPEG-2, MJPEG, AVS, VP8
		i.MX 8QuadMax and 8QuadXPlus Decoder: HEVC, H.264, MPEG4, MPEG2
		i.MX 8M Quad Decoder: HEVC, VP9, H.264, VP8, RV9, AVS, MJPEG, H.263
		i.MX 8M Mini Decoder: HEVC, VP9, H.264, VP8
		i.MX 8M Mini Encoder: H.264, VP8
DPU	8QuadMax	Supports through DRM display framework and provides 2D Graphics processing.
	8QuadXPlus	Supports DPR tiling
DCSS	8M Quad	Supports display frame buffers in memory out to Ultra HD or HDTVs.
IPU	6SABRE-SD	On i.MX 6SABRE-SD and i.MX 6SABRE-AI, the IPU driver provides interfaces to access IPU V3 modules.
	6SABRE-AI	
PRE/PRG driver	6QuadPlus-SD	On i.MX 6QuadPlus provides interfaces to support prefetch linear frames or resolve tiled frames for display.
	6QuadPlus-AI	

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Table 8. Supported features (continued)

Feature	Supported board	Comment
V4L2 Output	All i.MX 6 All i.MX 7	i.MX 6SABRE-SD and i.MX 6SABRE-AI use the IPU post-processing functions for video output. i.MX 6SoloLite, i.MX 6SoloX SABRE-SD and SABRE-AI, i.MX 6UltraLite, 6ULL, 6ULZ EVKsand i.MX 7D SABRE-SD use the PXP post-processing functions for video output. i.MX 7ULP EVK uses MIPI connection for V4L2 output.
Video Capture drivers		
V4L2 Capture	All i.MX	Supports 2 cameras on i.MX 6SABRE-SD and SABRE-AI. Supports one camera on i.MX 6SoloLite EVK , 6SoloX SABRE-SD, 6UltraLite EVK, 6ULL EVK, 6ULZ EVK and 7D-SABRE-SD, and i.MX 8M Mini. Supports 2 cameras on i.MX 8M Quad and 1 camera on i.MX 8M Mini. Supports 1 camera on i.MX 8QuadXPlus. Supports 8 cameras on i.MX 8QuadMax.
MIPI Camera CSI	6SABRE-SD 7D-SABRE-SD 7ULP 8M Quad 8M Mini 8QuadMax 8QuadXPlus	Supports 2 lane CSI MIPI camera OV5640 with 720p30, 1280x800@30. Also supports CSI MIPI camera OV10635 with 720p30, 1080p30, 2592x1944@15 on i.MX 8QuadMax and 8QuadXPlus.
Parallel CSI	6SABRE-SD 6SoloLite 6SoloX-SD 6UltraLite 6ULL 6ULZ 8QuadXPlus	Supports OV5640 camera sensor.
VIU	6SoloX 7ULP	Supports capture through VIU controller.
ISI	8QuadMax 8QuadXPlus	Supports capture through ISI controller.
IPU-CSI	6SabreSD	Supports capture through IPU CSI controller.
TV-IN	6SABRE-AI 8QuadMax	Supports TV-IN through ADV7180 on the 6SABRE-AI with bt656, NTSC, and PAL. Supports TV-IN through ADV7180 on the 8QuadMax with NTSC, and PAL.
General drivers		
uSDHC	All i.MX	Supports SD2.0 and SDXC. Supports SD3.0 on all i.MX except 6SABRE-SD. Supports eMMC 1bit/4bit/8bit SDR/DDR mode. i.MX 6SABRE-SD is soldered, i.MX 6SABRE-AI uses the daughter card, and i.MX 6SoloX-SD is not soldered.

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Table 8. Supported features (continued)

Feature	Supported board	Comment
		Supports eMMC4.5 on i.MX 6SoloLite and i.MX 6SoloX-SD.
		Supports eMMC5.0 on i.MX 7Dual SABRE-SD.
		Supports eMMC5.1 on i.MX 8QuadMax, 8QuadXPlus, i.MX 8M Quad, and i.MX 8M Mini.
Watchdog	All i.MX	Supports Watchdog reset.
I^{2}C	All i.MX	Supports I^{2}C master.
		Supports PCA9646 I^{2}C switch on i.MX 8QuadXPlus.
SPI	All i.MX	Supports SPI master mode and slave mode.
Pulse Width Modulator	All i.MX	Supports the backlight driver through PWM.
ADC	6SoloX-SD 6SoloX-AI 7D-SABRE-SD 6UltraLite 6ULL 6ULZ 7ULP 8QuadMax 8QuadXPlus	Supports the ADC driver.
Temperature monitor	All i.MX	Pre-calibrated. See the "Thermal Driver" chapter in *i.MX Linux® Reference Manual* (IMXLXRM) for more information.
Accelerometer	6SABRE-SD 6SABRE-AI 6SoloLite 6SoloX-SD 6SoloX-AI 6UltraLite 6ULL 6ULZ 7D-SABRE-SD 7ULP 8QuadXPlus	Supports the MMA8451 sensor on i.MX 6SABRE and i.MX 6SoloX. Supports the MMA8450 sensor on i.MX 6SoloLite. Supports the FXLS8471Q sensor on 6UltraLite EVK, 6ULZ and 6ULL EVK. Supports the FXOS8700 sensor on the i.MX 7. Supports the FXOS8700 sensor on the i.MX 8.
GPIO Expander	6SABRE-SD 6SABRE-AI 7D-SABRE-SD 8QuadMax 8QuadXPlus	Supports the MAX7310 GPIO expander on i.MX 6 SABRE-SD and SABRE-AI. Supports the 74LV595 GPIO expander on i.MX 7Dual SABRE-SD. Supports PCA9557 and PCA6416 on i.MX 8.
SNVS RTC	All i.MX 6	SNVS is a block that interfaces with CAAM and SRTC.

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Table 8. Supported features (continued)

Feature	Supported board	Comment
	All i.MX 7	
Ambient Light Sensor	6SABRE-SD 6SABRE-AI 6SoloX-SD 6SoloX-AI 8QuadMax 8QuadXPlus	Supports the ISL29023 sensor on i.MX 6 SABRE-SD, SABRE-AI and 6 SoloX boards. Supports the ISL29023 sensor on i.MX 8 QuadMax and i.MX 8QuadXPlus boards
Gyroscope Sensor	All i.MX 7	Supports FXA2100 gyroscope sensor
Pressure Sensor	7D-SABRE-SD 8QuadMax 8QuadXPlus	Supports MPL3115 pressure sensor
Magnetometer Sensor	i.MX 6	Supports MAG3110 magnetometer sensor on all i.MX 6 except 6SLL and 6SoloLite.
AM/FM module	6SABRE-AI	Supports the SI4763 AM/FM module. Supports FM by using the SSI interface.

5 U-Boot and Device Trees

This section describes the different U-Boots and Device trees and different kernel and boot parameters.

5.1 U-Boot configurations

In the following table, the U-Boot configurations are listed for each machine configuration. The machine configurations are provided through the Yocto Project layers in the meta-freescale and meta-fsl-bsp-release layers in the `conf/machine` sub-directory.

Table 9. U-Boot configurations

U-Boot configuration for Boot device	Description	Supported machine configuration
sd	sd supports boot from an SD card. This is the default U-Boot configuration. For boards supporting eMMC, such as i.MX 6QuadPlus/Quad/DualLite, SD boot can be flashed in eMMC for boot from eMMC instead of an SD card.	imx6qsabresd, imx6qpsabresd, imx6dlsabresd imx6qsabreauto, imx6qpsabreauto, imx6dlsabreauto imx6sllevk imx6sxsabresd imx6sxsabreauto imx7dsabresd imx6ulevk imx6ull14x14evk

Table continues on the next page...

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Table 9.   U-Boot configurations (continued)

U-Boot configuration for Boot device	Description	Supported machine configuration
		imx6ullz4x14evk
		imx7ulpevk
		imx8qmmek
		imx8mqevk
		imx8mmevk
		imx8qxpmek
spi-nor	Supports boot from SPI-NOR.	imx6qsabreauto, imx6dlsabreauto imx6qpsabreauto
		imx6slevk
eim-nor	Supports boot from Parallel NOR.	imx6qsabreauto, imx6dlsabreauto, imx6solosabreauto imx6qpsabreauto
nand	Supports boot from NAND.	imx6qsabreauto, imx6dlsabreauto, imx6solosabreauto imx6qpsabreauto
		imx6sxsabreauto
		imx7dsabresd
		imx6ull14x14evk
sata	Supports boot from SATA.	imx6qsabresd, imx6qpsabresd
		imx6qsabreauto, imx6qpsabreauto
qspi	Supports booting from QSPI. Booting from the Arm® Cortex®-M4 processor is supported through QSPI2 and QSPI1. Use U-Boot command "bootaux" to boot the Arm Cortex-M4 processor. The booting address for QSPI2 is 0x78000000. The booting address for QPIS1 is 0x68000000.	imx6sxsabresd with QSPI2
		imx6sxsabreauto with QSPI1
		imx7dsabresd with QSPI1
		imx6ulevk with QSPI1
		imx6ulz14x14evk with QSPI1
emmc	Suports boot from eMMC. eMMC is not populated on the reference boards listed. Users need to populate it if needed. For other boards supporting eMMC such as i.MX 6QuadPlus/Quad/DualLite, SD boot is used.	imx6sxsabresd
		imx7dsabresd
		imx6ull14x14evk
		imx6ulz14x14evk
		imx7ulpevk
m4fastup	Supports boot from Arm Cortex-M4 processor by disabling QSPI2 from using Arm Cortex-M4 processor.	imx6sxsabresd
epdc	Supports EPDC splash screen in U-Boot.	imx6slevk
		imx7dsabresd
flexspi (fspi)	Supports FlexSPI boot.	imx8qmmek
		imx8mmmek
		imx8qxpmek

5.2   Kernel device trees

The following table describes the kernel and device trees included in this release. A list of several device tree files are provided for each board to offer examples on how to handle different pin conflicts due to pin muxing.

Table 10.   Kernel and device tree configurations

Kernel and device tree configuration	Description
Kernel Binary Image	i.MX 6 and i.MX 7 zImage kernel is built with the imx_v7_defconfig in arch/arm/configs.
	i.MX 8 Image kernel is built with defconfig in arch/arm64/configs.
DTB Descriptions	Each reference board has a standard device tree as follows:
	• zImage-imx6q-sabresd.dtb, zImage-imx6qp-sabresd.dtb • zImage-imx6dl-sabresd.dtb • zImage-imx6q-sabreauto.dtb, zImage-imx6qp-sabreauto.dtb • zImage-imx6dl-sabreauto.dtb • zImage-imx6sx-sdb.dtb, zImage-imx6sx-sdb-reva.dtb • zImage-imx6sx-sabreauto.dtb • zImage-imx7d-sdb.dtb • zImage-imx6ul-14x14-evk.dtb, zImage-imx6ul-9x9-evk.dtb • zImage-imx6ulz-14x14-evk.dtb • zImage-imx6ull-14x14-evk.dtb • zImage-imx7ulp-evk.dtb • Image-fsl-imx8mq-evk.dtb • Image-fsl-imx8mm-evk.dtb • Image-fsl-imx8qm-mek.dtb: Support the LVDS-HDMI or MIPI-DSI-HDMI display with the LVDS-HDMI or MIPI-DSI-HDMI converts. The detection is on-the-fly by using the device-tree overlay technology. • Image-fsl-imx8qxp-mek.dtb: Supports one LVDS-HDMI through the LVDS0-CH0 on the LVDS-HDMI daughter card.
	Note: zImage-imx6sx-sdb.dtb is used for supporting the i.MX 6SoloX SABRE-SDB Rev. B board, and imx6sx-sdb-reva.dtb is used for supporting the legacy SABRE-SDB Rev. A board.
	zImage-imx7d-sdb.dtb is used for supporting the i.MX 7Dual SABRE-SDB Rev. C and Rev. D boards, and zImage-imx7d-sdb-reva.dtb is used for supporting the legacy SABRE-SDB Rev. A board.
i.MX 8 Device Trees	
8QuadXPlus DTB	• Image-fsl-imx8qxp-mek-rpmsg.dtb: The default DTB for MEK board. • Image-fsl-imx8qxp-mek-dom0.dtb: Xen Linux guest Linux DTB file. • Image-fsl-imx8qxp-mek-dsi-rm67191.dtb: Supports RM67191 MIPI OLED display panel. • Image-fsl-imx8qxp-mek-enet2.dtb: Supports ENET port on base boards. • Image-fsl-imx8qxp-mek-enet2-tja1100.dtb: ENET2 uses TJA1100 Ethernet PHY. • Image-fsl-imx8qxp-mek-it6263-lvds0-dual-channel.dtb: Supports the LVDS-HDMI display with LVDS0 dual-channel feature. • Image-fsl-imx8qxp-mek-it6263-lvds1-dual-channel: Supports the LVDS-HDMI display with LVDS1 dual-channel feature. • Image-fsl-imx8qxp-mek-inmate.dtb: Supports Jailhouse hypervisor • Image-fsl-imx8qxp-mek-ov5640.dtb: Supports one MIPI OV5640 and one parallel OV5640, which indicates to support 2 cameras.

Table continues on the next page...

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Table 10. Kernel and device tree configurations (continued)

Kernel and device tree configuration	Description
	• Image-fsl-imx8qxp-mek-jdi-wuxga-lvds1-panel.dtb: Supports the dual-channel LVDS panel, connecting the two mini-SAS ports with the LVDS1 CH0 and LVDS1 CH1. • Image-fsl-imx8qxp-mek-jdi-wuxga-lvds0-panel.dtb: Supports the dual-channel LVDS panel, connecting the two mini-SAS ports with the LVDS0 CH0 and LVDS0 CH1. • Image-fsl-imx8qxp-mek-rpmsg.dtb: Supports partition reset, RPMSG audio codec on Cortex-M4, and supports the LVDS-HDMI or MIPI-DSIHDMI display with the LVDSHDMI or MIPI-DSI-HDMI converts. This requires the flash.bin to include the Cortex-M4 image. • Image-fsl-imx8qxp-mek-root.dtb: Supports Jailhouse hypervisor. • Image-fsl-imx8qxp-mek.dtb: It is for non-partition boot that flash.bin does not include the Cortex-M4 image. On i.MX 8QuadMax, multiple partitions are supported. Due to the board design, flash.bin and the DTB need to be matched. If flash.bin includes the Cortex-M4 partition, use the x-rpmsg.dtb.
8QuadMax DTB	• Image-fsl-imx8qm-mek-rpmsg.dtb: Supports partition reset, and supports the LVDS-HDMI or MIPI-DSIHDMI display with the LVDS-HDMI or MIPI-DSI-HDMI converts. This requires flash.bin to include the Cortex-M4 image. • Image-fsl-imx8qm-mek.dtb: Supports the LVDS-HDMI or MIPI-DSI-HDMI display with the LVDS-HDMI or MIPI-DSI-HDMI converts. The detection is on-the-fly by using the device-tree overlay technology. • Image-fsl-imx8qm-mek-hdmi.dtb: Supports native HDMI TX interface on the CPU board. • Image-fsl-imx8qm-mek-jdi-wuxga-lvds1-panel.dtb: Supports the dual-channel LVDS panel, connecting the two mini-SAS ports with the LVDS1 CH0 and LVDS1 CH1. • Image-fsl-imx8qm-mek_ca53.dtb: Supports four CortexA53 cores only. • Image-fsl-imx8qm-mek_ca72.dtb: Supports two Cortex-A72 cores only. You need to build the special boot image through the imx-mkimage tools, and select the flash_ca72 build target. • Image-fsl-imx8qm-mek-8cam.dtb: Supports 8 cameras. • Image-fsl-imx8qm-mek-enet2-tja1100.dtb: Supports the tja1100 ENET daughter card. • Image-fsl-imx8qm-mek-inmate.dtb: Supports Jailhouse hypervisor. • Image-fsl-imx8qm-mek-ov5640.dtb: Supports one or two OV5640 sensors at the same time. • Image-fsl-imx8qm-mek-dom0.dtb: Supports Xen hypervisor dom0. • Image-fsl-imx8qm-mek-dom0-dpu2.dtb: Supports the Xen hypervisor dom0 dpu2. • Image-fsl-imx8qm-mek-domu.dtb: Support Xen hypervisor domu. • Image-fsl-imx8qm-mek-domu-dpu1.dtb: Supports Xen hypervisor domu-dpu1. • Image-fsl-imx8qm-mek-domu-dpu1-hdmi.dtb: Supports the Xen hypervisor domu-dpu1-hdmi. • Image-fsl-imx8qm-mek-root.dtb: Supports Jailhouse hypervisor. On i.MX 8QuadMax, multiple partitions are supported. Due to the board design, flash.bin and the DTB need to be matched. If flash.bin includes the Cortex-M4 partition, use the x-rpmsg.dtb.
8M Quad DTB	• Image-fsl-imx8mq-evk.dtb: HDMI output

Table continues on the next page...

Table 10. Kernel and device tree configurations (continued)

Kernel and device tree configuration	Description
	• Image-fsl-imx8mq-evk-lcdif-adv7535.dts: LCDIF + MIPI-DSI + HDMI adaptor • Image-fsl-imx8mq-evk-dcss-adv7535.dtb: DCSS + MIPI-DSI + HDMI adaptor • Image-fsl-imx8mq-evk-dcss-rm67191.dtb: DCSS + MIPI-DSI + OLED panel • Image-fsl-imx8mq-evk-dual-display.dtb: Dual-display-to-HDMI and MIPI-to-HDMI adapter • Image-fsl-imx8mq-evk-b3.dtb: EVK Revision B3 board • Image-fsl-imx8mq-evk-dcss-adv7535-b3.dtb: B3 DCSS + MIPI-DSI + HDMI adaptor • Image-fsl-imx8mq-evk-dcss-rm67191-b3.dtb: B3 DCSS + MIPI-DSI + OLED panel • Image-fsl-imx8mq-evk-lcdif-adv7535-b3.dts: B3 LCDIF + MIPI-DSI + HDMI adaptor • Image-fsl-imx8mq-evk-dual-display-b3.dtb: B3 Dual-display-to-HDMI and MIPI-to-HDMI adapter • Image-fsl-imx8mq-evk-ak4497.dtb: audio board ak4497 codec • Image-fsl-imx8mq-evk-audio-tdm.dtb: audio board TDM • Image-fsl-imx8mq-evk-m4.dtb: RPMSG • Image-fsl-imx8mq-evk-dp.dtb: Display support • Image-fsl-imx8mq-evk-epd.dtb: Display Port support • Image-fsl-imx8mq-evk-mipi-csi2.dtb: MIPI-CSI2 • Image-fsl-imx8mq-evk-pcie1-m2.dtb: PCIE3 M2 • Image-fsl-imx8mq-evk-pdm.dtb: PDM • Image-fsl-imx8mq-evk-root.dtb: Supports Jailhouse hypervisor
8MMini DTB	• Image-fsl-imx8mm-evk.dtb: LPDDR4 EVK board • Image-fsl-imx8mm-evk-rm67191.dtb: OLED panel • Image-fsl-imx8mm-ddr4-evk.dtb: DDR4 EVK board • Image-fsl-imx8mm-ddr4-evk-rm67191.dtb: DDR4 EVK board with OLED panel • Image-fsl-imx8mm-ddr4-qca9377-evk.dtb: DDR4 EVK with QCA9377 Wi-Fi/BT • Image-fsl-imx8mm-ddr3l-val.dtb: DDR3L validation board • Image-fsl-imx8mm-evk-revb.dtb: LPDDR4 EVK Revision B board • Image-fsl-imx8mm-evk-ak4497.dtb: audio board ak4497 codec • Image-fsl-imx8mm-evk-ak5558.dtb: audio board ak5558 codec • Image-fsl-imx8mm-evk-m4.dtb: RPMSG • Image-fsl-imx8mm-evk-audio-tdm.dtb: audio board TDM • Image-fsl-imx8mm-evk-root.dtb: Supports Jailhouse hypervisor
i.MX 6 and i.MX 7 Device Trees	
GPMI and EIM_NOR	Enables the GPMI and EIM-NOR. Due to pin conflicts, the GPMI and EIM-NOR are disabled by default. See the device tree file for more details: • >zImage-imx6dl-sabreauto-gpmi-weim.dtb • zImage-imx6q-sabreauto-gpmi-weim.dtb • zImage-imx6qp-sabreauto-gpmi-weim.dtb • zImage-imx7d-sdb-gpmi-weim.dtb and zImage-imx7d-sdb-reva-gpmi-weim.dtb • zImage-imx6ulz-14x14-evk-gpmi-weim.dtb
LDO	In standard DTB file, the LDO bypass is enabled. Therefore, to use LDO device trees on configurations with CPU@1.2GHz, which does not support LDO bypass mode, it is important to enable LDO. The LDO is enabled in the following DTB files:

Table continues on the next page...

Table 10. Kernel and device tree configurations (continued)

Kernel and device tree configuration	Description
	• zImage-imx6q-sabresd-ldo.dtb • zImage-imx6qp-sabresd-ldo.dtb • zImage-imx6ul-9x9-evk-ldo.dtb • zImage-imx6dl-sabresd-ldo.dtb • zImage-imx6sx-sdb-ldo .dtb, zImage-imx6sx-sdb-reva-ldo.dtb
HDCP	Enables the HDMI-HDCP feature. This avoids the pin conflict between the I2C2 and HDCP-DDC pins. • zImage-imx6q-sabresd-hdcp.dtb • zImage-imx6dl-sabresd-hdcp.dtb • zImage-imx6qp-sabresd-hdcp.dtb
eCSPI	Enables eCSPI, which is disabled in the default DTB. • zImage-imx6dl-sabreauto-ecspi.dtb • zImage-imx6q-sabreauto-ecspi.dtb • zImage-imx6qp-sabreauto-ecspi.dtb
flexcan1	Enables flexcan1, which is disabled by default in standard DTB file due to pin conflicts with FEC. • zImage-imx6q-sabreauto-flexcan1.dtb • zImage-imx6dl-sabreauto-flexcan1.dtb • zImage-imx6qp-sabreauto-flexcan1.dtb
csi	Enables CSI support for V4L2. On i.MX 6UltraLite EVK, this device tree avoids the pin conflict between SIM and CSI. • zImage-imx6ul-14x14-evk-csi.dtb • zImage-imx6ul-9x9-evk-csi.dtb
enetirq	An example to demonstrate GPIO6 workaround for the bug where only the ENET wake-up interrupt request can wake the system from Wait mode. Since the pad GPIO6 is used by I2C3 on the board, these device trees have I2C3 disabled to enable this workaround • zImage-imx6q-sabresd-enetirq.dtb • zImage-imx6dl-sabresd-enetirq.dtb • zImage-imx6dl-sabreauto-enetirq.dtb • zImage-imx6q-sabreauto-enetirq.dtb
emmc	The eMMC chip is DNP by default. This requires hardware modifications to burn the eMMC4.5 chip on the eMMC socket on uSDHC0 and connect eMMC signals as well as disconnect BOOT SD CARD slot signals. • zImage-imx6sx-sdb-emmc.dtb • zImage-imx7ulp-evk-emmc.dtb • zImage-imx6ulz-14x14-evk-emmc.dtb
Cortex-M4	Disable the access of ADC 1 & 2, FlexCAN 1 & 2, I2C3, UART 2 and QSPI 2 from Cortex-A processor when Arm Cortex-M4 processor is running. • zImage-imx6sx-sdb-m4.dtb • zImage-imx6sx-sabreauto-m4.dtb • zImage-imx7d-sdb-m4.dtb
epdc	Pin conflict between HDMI and EPDC, disable HDMI for EPDC. • zImage-imx7d-sdb-epdc.dtb • zImage-imx7d-sdb-reva-epdc.dtb

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Table 10.   Kernel and device tree configurations (continued)

Kernel and device tree configuration	Description
qspi	Enable DDR Quad mode for Macronix QSPI chip mx25l51245g by setting Quad bit in status register. • zImage-imx7-sdb-qspi.dtb zImage-imx7-sdb-reva-qspi.dtb • zImage-imx7ulp-evk-qspi.dtb
Audio	Enable WM8960 audio as the default one and disable HDMI audio. • zImage-imx7ulp-evk-wm8960.dtb
HDMI Audio	Enable HDMI audio as the default one and disable WM8960 audio. • zImage-imx7d-sdb-reva-hdmi-audio.dtb
touch	Add tsc2046 touch screen controller support. Because the pin PENIRQ of tsc2046 conflicts with the interrupt pin of HDMI, this disables the HDMI. • zImage-imx7-sdb-reva-touch.dtb
MIPI Display	Enable MIPI-DSI. • zImage-imx7d-sdb-mipi-dsi.dtb • zImage-imx7ulp-evk-mipi.dtb
Bluetooth® wireless technology Wi-Fi	Enable the Cypress Bluetooth wireless technology and Wi-Fi hardware. • zImage-imx6q-sabresd-btwifi.dtb • zImage-imx6qp-sabresd-btwifi.dtb • zImage-imx6dl-sabresd-btwifi.dtb • zImage-imx6sll-evk-btwifi.dtb • zImage-imx6sx-sabresd-btwifi.dtb • zImage-imx6ul-14x14-evk-btwifi.dtb • zImage-imx6ul-9x9-evk-btwifi.dtb • zImage-imx6ull-14x14-evk-btwifi.dtb • zImage-imx6ulz-14x14-evk-btwifi.dtb • zImage-imx6ulz-14x14-evk-btwifi-oob.dtb
USB	Enable USB certification for i.MX 6UltraLite. • zImage-imx6ul-14x14-evk-usb-certi.dtb
LP UART	Enable LPUART. • zImage-imx7ulp-evk-lpuart.dtb
sd1	Enable sd1 on uSDHC1 on the base board. • zImage-imx7ulp-sd1.dtb

5.3   Kernel boot parameters

Depending on the booting or usage scenario, you may need different kernel boot parameters.

The following table describes different boot parameters.

To force the i.MX 6SABRE-AI board to disable SMP to remove overhead, add boot parameters "nosmp". Disabling CONFIG_SMP configuration can remove further overhead for single core.

Table 11. Common kernel boot parameters

Kernel parameter	Description	Typical value	Used when
console	Where to output the kernel logging by printk.	console=ttymxc0,115200 For 6SABRE-AI, console=ttymxc3,115200 For 6SoloX-AI, console=ttymxc0,115200 For 7ULP, console=ttyLP0, 115200 console=ttymxc0, 115200	All use cases
nosmp	A command-line option of 'nosmp' disables SMP activation entirely.	nosmp	CONFIG_SMP is defined. Use this to disable SMP activation. SMP is activated by default through the CONFIG_SMP configuration.
ip	Tells the kernel how or whether to get an IP address.	ip=none ip=dhcp ip=static_ip_address	"ip=dhcp" or "ip=static_ip_address" is mandatory in "boot from TFTP/NFS."
nfsroot	Location of the NFS server/directory.	nfsroot=<ip_address>:<rootfs path>	Used in "boot from tftp/NFS" together with "root=/dev/nfs."
root	Location of the root file system.	root=/dev/nfs or root=/dev/mmcblk0p2	Used in "boot from tftp/NFS" (that is, root=/dev/nfs); Used in "boot from SD" (that is, root=/dev/mmcblk0p2). root is set by default by U-Boot to the SD/MMC slot that U-Boot is booting from.
rootfstype	Indicates the file system type of the root file system.	rootfstype=ext4	Used in "boot from SD" together with "root=/dev/mmcblkXpY" (X is the MMC device number while Y is the rootfs partition number.)
rootwait	Waits (indefinitely) for the root device to show up.	rootwait	Used when mounting SD root file system.
mem	Tells the kernel how much memory can be used.	None or mem=864M	Note: MemTotal-<mem> - <gpu_memory> is reserved.
max17135	Configures the maximum of 17135 EPD PMIC pass number and VCOM voltage.	max17135:pass=[pass_num],vcom=[vcom_uV] For 7D-SABRE-SD (EPDC panel upgrade to DC4): max17135:pass=2,vcom=-2370000	Used when enabling EPDC. pass_num should equal 2 for all IMXEBOOKDC2 cards. vcom_uV, in microvolts, should be equal to the value printed on the cable connector that is attached the E Ink panel being used.
fec.macaddr	Tells the Ethernet MAC address.	fec.macaddr=0x00,0x04,0x9f, 0x01,0x30,0x05	Changes the FEC MAC address.
maxcpus	[SMP] Maximum number of processors that SMP kernel should use.	maxcpus=1	maxcpus=n : n >= 0 limits the kernel to using 'n' processors. n=0 is a special situation. It is equivalent to "nosmp".

Table continues on the next page...

Table 11. Common kernel boot parameters (continued)

Kernel parameter	Description	Typical value	Used when
epdc	Enables EPDC	video=mxcepdcfb:E060SCM,bpp=16 For 7D-SABRE-SD (EPDC panel upgrade to DC4): video=mxcepdcfb:ED060XC8	Adds to kernel options only if E Ink is the primary display panel. If other display panel is primary, this option may result in a pixel clock conflict and improper display function.
video on 6SABRE-SD	Tells the kernel/driver which resolution/ depth and refresh rate should be used for display port 0 or 1. See the parameter information under Documentation/fb/ modedb.txt Tells the kernel/driver which IPU display interface format should be used.	1. video=mxcfb0:dev=hdmi, 1920x1080M@60,if=RGB24 video=mxcfb1:dev=ldb,if=RGB666 2. video=mxcfb0:dev=ldb,if=RGB666 video=mxcfb1:dev=hdmi, 1920x1080M@60,if=RGB24 3. video=mxcfb0:dev=hdmi, 1920x1080M@60,if=RGB24 4. video=mxcfb0:dev=ldb,if=RGB666 5. video=mxcfb0:dev=lcd,CLAA-WVGA,if=RGB656 6. video=mxcfb0:dev=mipi_dsi,TRULY-WVGA,if=RGB24	1. Used when primarily displaying on HDMI with 1080P60 mode. Secondarily displaying on LVDS with XGA mode. 2. Used when primarily displaying on LVDS with XGA mode. Secondarily displaying on HDMI with 1080P60 mode. 3. Used when primary displaying on HDMI with 1080P60 mode. 4. Used when primary displaying on the HannStar LVDS1. 5. Used when primary displaying on the CLAA-WVGA dumb parallel LCD panel. 6. Used when primary displaying on the TRULY-WVGA MIPI DSI LCD panel. NOTE: GBR24/RGB565/YUV444 represents the display HW interface format. Typical values for certain different display devices are as follows: TVOUT: YUV444 VGA: GBR24 HDMI&DVI: RGB24 CLAA WVGA LCD: RGB565 Typical values for dev= are shown as follows: lcd: LCD interface ldb: LVDS hdmi: HDMI on chip or sii902x dvi: DVI port vga: VGA through TVE tve: TVOUT
video on 6SABRE-AI	Tells the kernel/driver which resolution/ depth and refresh rate should be used for display port 0 or 1.	1. video=mxcfb0:dev=hdmi, 1920x1080M@60,if=RGB24video=mxcfb1:dev=ldb,if=RGB666 2. video=mxcfb0:dev=ldb,if=RGB666video=mxcfb1:dev=hdmi, 1920x1080M@60,if=RGB24 3. video=mxcfb0:dev=hdmi, 1920x1080M@60,if=RGB24	1. Used when primarily displaying on HDMI with 1080P60 mode. Secondarily displaying on LVDS with XGA mode. 2. Used when primarily displaying on LVDS with XGA mode. Secondarily displaying on HDMI with 1080P60 mode.

Table continues on the next page...

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Table 11. Common kernel boot parameters (continued)

Kernel parameter	Description	Typical value	Used when
	See the parameter information under Documentation/fb/modedb.txt Tells the kernel/driver which IPU display interface format should be used.	4. video=mxcfb0:dev=ldb,if=RGB666 5. video=mxcfb0:dev=hdmi, 1920x1080M@60,if=RGB24	3. Used when primary displaying on HDMI with 1080P60 mode. 4. Used when primary displaying on the HannStar LVDS0. 5. Used when enabling HDMI 1080P60 mode and LVDS0. To enable second display, run "echo 0 > /sys/class/graphics/fb2/blank" NOTE: GBR24/RGB565/YUV444 represents the display HW interface format. Typical values for certain different display devices are shown as follows: TVOUT: YUV444 VGA: GBR24 HDMI&DVI: RGB24 CLAA WVGA LCD: RGB565 Typical values for dev= are shown below: lcd: LCD interface ldb: LVDS hdmi: HDMI on chip or sii902x dvi: DVI port vga: VGA through TVE tve: TVOUT
video on 6SoloLite	Tells the EPDC FB driver which E Ink panel is in use and what bpp should be used for the Frame Buffer.	video=mxcepdcfb:E060SCM,bpp=16	Used when enabling EPDC to select the correct E Ink panel parameters to use. bpp=16 selects RGB565 FB pix format bpp=8 selects Y8 FB pixel format
video on 6SoloLite	Tells the ELCDIF FB driver which LCD panel is in use and which bpp should be used for the Frame Buffer.	video=mxc_elcdif_fb:SEIKO-WVGA,bpp=16	Used when enabling LCDIF to select the correct panel parameters to use. bpp=16 selects RGB565 FB pix format Note: if only use EPDC FB, then turn off ELCDIF FB by "video=mxc_elcdif_fb:off"
video on 7D SABRE-SD	Tells the ELCDIF FB driver which LCD panel is in use and which bpp should be used for the Frame Buffer.	video=mxcfb0:dev=mipi_dsi,TRULY-WVGA,if=RGB24	Used when primary displaying on the TRULY-WVGA MIPI DSI LCD panel.
dmfc	Tells the kernel/driver how to set the IPU DMFC segment size.	None Or	"dmfc=1" means DMFC_HIGH_RESOLUTION_DC.

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Table 11.   Common kernel boot parameters (continued)

Kernel parameter	Description	Typical value	Used when
		dmfc=3	"dmfc=2" means DMFC_HIGH_RESOLUTION_DP. "dmfc=3" means DMFC_HIGH_RESOLUTION_ONLY_ DP. DMFC_HIGH_RESOLUTION_ONLY_ DP can only be set by the command line. It is recommended to set this when no IPU connects the two panels. When it is set, each IPU can only connect one panel.
mtdparts on 6SABRE-AI	Tells the kernel MTD partition information.	mtdparts=gpmi-nand:16m(boot), 16m(kernel),1024m(rootfs),-(user)	When to enable NAND. The partition: 16m (boot),16m (kernel),1024m (rootfs) is an example, you can change it according to your needs.
uart clock from osc for 6SoloX low power idle and scenario of Linux OS and FreeRTOS running together	Chooses the UART's clock parent.	uart_from_osc	This is necessary for low power idle and all use cases with the FreeRTOS running on ARM Cortex-M4 processor. When setting this parameter, UART sources clock from OSC instead of PLL3_80M, and then all PLLs can be off in low power idle.
transparent_hug epage	Controls the default behavior of the system with respect to transparent hugepages. See Documentation/ admin-guide/kernel- parameters.txt for details.	always, madvise, never	THP has big impact for the CMA allocation that cannot be isolated from the CMA region, which leads to CMA allocation failure under some conditions. Users can disable the THP by this kernel command line by setting it to 'never' or 'madvise' according to system requirement.

NOTE

For full command line list, see kernel source tree Documentation/Kernel-parameter.txt.

6   Known Issues/Limitations

Read through all hardware-related reference material and ensure that the necessary hardware modifications are made before using the software.

The following tables list some key known issues.

Table 12. Known issues and workarounds for i.MX 8 Family SoC

SoC	Module	Source	Description	Workaround
8QuadMax	PCIe	Hardware	PCIe Gen2 is not stable under Linux kernel due to the hardware Jitter issue.	The issue will be fixed in the next release with refgen update in SCFW.
8QuadMax	SATA	Hardware	SATA Gen1/2/3 are not stable under Linux kernel and U-Boot due to hardware Jitter issue. U-Bootis affected when Gen3 is powered on and connected with the board.	The issue will be fixed in the next release with refgen update in SCFW.
8QuadMax	GPU	Software	galcore hangs on 8QuadMax and some shaders fail on 8MQuad using the latest glslsandbox.	The issue will be fixed in the next release.

Table 13. Known issues and workarounds for i.MX 8X Family SoC

SoC	Module	Source	Description	Workaround
8QuadXPlus	VPU	Software	Kernel panic occurs sometimes during 8 multi-instance decoding.	The issue will be fixed in the next release.
8QuadXPlus	VPU	Software	Buffer error is reported during multi-instance decoding or encoding test.	The issue will be fixed in the next release.
8QuadXPlus 8QuadMax	GPU	Software	GPU core hangs up when the Vulkan Sascha application is doing the stress test.	The issue will be fixed in the next release.
8QuadXPlus 8QuadMax	GPU	Software	galcore hangs on 8QuadMax and some shaders fail on 8MQuad using the latest glslsandbox.	The issue will be fixed in the next release.

Table 14. Known issues and workarounds for i.MX 8M Family SoC

SoC	Module	Source	Description	Workaround
8M Quad	MIPI-DSI+DCSS	Software	The DRM mode test fails with no display when setting mode continuously, and no desktop after restarting the Weston service.	The issue will be fixed in the next release.
8M Quad	MIPI CSI	Software	MIPI CSI prompts lots of "Rx fifo overflow" messages when running dual captures and video playback simultaneously.	The issue will be fixed in the next release.
8M Quad	HDCP	Software	Some Sony TV Authentications of HDCP 1.4/2.2 fail.	The issue will be fixed in the next release.
8M Quad	DP	Software	LG DP monitor has no display and system boot-up stops at DP initialization.	The issue will be fixed in the next release.

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Table 14. Known issues and workarounds for i.MX 8M Family SoC (continued)

SoC	Module	Source	Description	Workaround
8M Quad	DP	Software	Dell P2414Hb (maximum to 1080p) DP monitor has no display and system boot-up stops at DP initialization nearby.	The issue will be fixed in the next release.
8M Quad	GPU	Software	Multiple math OpenCL stress test fails.	Low impact on real product application.
8M Quad	GPU	Software	galcore hangs on 8QuadMax and some shaders fail on 8MQuad using the latest glslsandbox.	The issue will be fixed in the next release.
8M Quad	UUU	Software	SPL NAND UUU burns successfully on Linux OS and Windows 10 OS, but all boot-up fails.	The issue will be fixed in the next release.

7 Multimedia

This chapter contains the information on the 4.4.5 multimedia component of the BSP.

The GStreamer version in this release is 1.14.4.

7.1 i.MX GStreamer plugins

Table 15. i.MX GStreamer 1.0 plugins

Plugin	Features
Demux	aiurdemux: aiur universal demuxer plugin supporting Supports AVI, MKV, MP4, MPEG2, ASF, OGG, FLV, WebM, RMVB
Audio decoder	beepdec: unified audio decoder plugin Supports MP3, AAC, AAC+, WMA, AC3, Vorbis, DD+, AMR, RA
Audio encoder	avenc_mp2: MP3 encoder plugin from gst-libav
Video decoder	i.MX 8M or i.MX 6 family: • vpudec: VPU-based video decoder plugin i.MX 8QuadXPlus or 8QuadMax: • v4l2h265dec: V4L2 H.265 Decoder • v4l2h264dec: V4L2 H.264 Decoder • v4l2mpeg4dec: V4L2 MPEG4 Decoder • v4l2mpeg2dec: V4L2 MPEG2 Decoder i.MX all: • Software video decoder plugins: uses gst-libav plugins
Video encoder	i.MX 8M Mini: • vpuenc_h264: VPU-based AVC/H.264 video encoder • vpuenc_vp8: VPU-based VP8 video encoder

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Table 15. i.MX GStreamer 1.0 plugins (continued)

Plugin	Features
	i.MX 8QuadXPlus or 8QuadMax: • v4l2h264enc: V4L2 H.264 encoder i.MX 6 family: • vpuenc_h264: VPU-based AVC/H.264 video encoder • vpuenc_h263: VPU-based H.263 video encoder • vpuenc_mpeg4: VPU-based MPEG4 video encoder • vpuenc_jpeg: VPU-based JPEG video encoder

Audio Source	pulsesrc: PulseAudio Audio Source
	
	Note: The default audio source may not be the expected one. You can set the desired default one:
	
	`pactl list sources`
	`pacmd set-default-source {source number}`

Audio Render	pulsesink: PulseAudio Audio Sink
	
	Note: The default audio sink may not be the expected one. You can set the desired default one:
	
	`pactl list sinks`
	`pacmd set-default-sink {sink number}`

Video render	i.MX 8 family: • waylandsink: video sink based on Wayland interfaces i.MX 8M: • kmssink: video sink based on the DCSS KMS driver, only for the second display in dual-display case i.MX 6 Family: • overlaysink : G2D-based video sink plugin • imxv4l2sink: V4L2-based video sink plugin i.MX with GPU3D: • glimagesink: video sink based on EGL
Video source	i.MX 8 Family: • v4l2src: V4L2-based camera source plugin i.MX 6 Family: • imxv4l2src: V4L2-based camera source plugin
Video convert	i.MX 2D hardware based video convert plugins to perform video color space conversion, resize, rotate, etc. • imxvideoconvert_g2d: GPU2D-based video convert plugin • imxvideoconvert_ipu: IPU-based video convert plugin • imxvideoconvert_pxp: PXP-based video convert plugin
Video compositor	i.MX 2D hardware based video compositor plugins can compose multiple videos into one, support color space conversion, resize, rotate, alpha, z-order, and keep aspect ratio feature at the same time while composition. • imxcompositor_g2d: GPU2D-based video compositor plugin • imxcompositor_ipu: IPU-based video compositor plugin • imxcompositor_pxp: PXP-based video compositor plugin
OpenGL (ES) Plugins	• gleffects: GL Shading Language effects plugin • gldeinterlace: video deinterlacing based on shaders • glvideomixer: compositing multiple videos together

Table 15. i.MX GStreamer 1.0 plugins

Plugin	Features
	• glcolorconvert: video color space convert based on shaders • glcolorbalance: adjusting brightness, contrast, hue, and saturation on a video stream

NOTE
- To support WMA, AAC+, AC3, DD+, and RA decoding, install separate packages.
- vpudec plugins are only for SoCs with the VPU hardware.
- Enable video framebuffer compression (DTRC) by using: kmssink force-hantrotile=true.

7.2 i.MX playback example

i.MX provides an example gplay-1.0 application based on GStreamer's high-level API GstPlayer. The example provides the following functions.

Table 16. i.MX playback engine example

Function	Feature
Playback	• Play, Stop • Pause, Resume • Fast seek, Accurate seek • Playback rate control (fast forward, fast rewind, slow forward)
Media Info	• Media meta data (artist, year, etc.) • Video Thumbnail • Audio Album Art
Subtitle	• Supports internal and external subtitle
Track Selection	• Audio Track Selection • Video Track Selection • Subtitle Selection
Display Control	• Resize

7.3 i.MX recording engine API

i.MX provides a high-level API set for camera-related applications based on the GStreamer framework. This API set is based on the camerabin, which is from the gst-plugins-bad package.

This API can be found at gst1.0-fsl-plugin/tools/grecorder/recorder_engine.h.

This API is only supported in i.MX 6 and i.MX 8M Mini platforms, which have a VPU hardware encoder.

This API set can provide the following functions.

Table 17. Recording engine functions

Function	Feature
Image capture	Captures images from the camera with different resolutions and saves them to JPEG files.
Video recording	Records audio and video into various file formats, supporting (MP3) x (H264, MPEG4, H263, MJPEG) x (MP4, MKV, AVI, FLV, TS)
Meta data	Adds the time and date information to the captured image or recorded video.
Endless recording	Records to multiple file segments and specifies the total file segment count and each file's maximum size. It can record a file endlessly, saving to file segments in a loop. This function can only work with the TS file format.
Web camera	Records audio and video and sends them out through RTP. This function can only work with the TS file format.
Graphic effect	Supports adding the graphic effect in the video and record into the file.
Device selection	Supports selecting different camera and audio sources.

NOTE

This recording engine is only available in platforms with VPU.

7.4 Multimedia feature matrix

This section provides feature matrix details of various codecs used for playback.

7.4.1 Parser/Demuxer specifications

The demuxer support of a particular audio or video type requires the availability of the codec.

Table 18. Parser/Demuxer supported audio/video

	Demuxer feature	ASF	AVI	MP4	OGG	FLV	MPG2	MKV	RMVB
Video	H264	-	Y	Y	-	Y	Y	Y	-
	MPEG2	-	Y	-	-	-	Y	Y	-
	MPEG4	Y	Y	Y	-	-	-	Y	-
	H263	-	Y	Y	-	Y	-	Y	-
	MJPEG	-	Y	Y	-	-	-	Y	-
	VC1	Y	Y	-	-	-	-	Y	-
	DivX	Y	Y	Y	-	-	-	Y	-
	Xvid	-	Y	-	-	-	-	Y	-
	VP8	-	-	-	-	-	-	Y	-
	VP6	-	-	-	-	Y	-	Y	-
	Theora	-	-	-	Y	-	-	-	-

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Table 18. Parser/Demuxer supported audio/video (continued)

	Demuxer feature	ASF	AVI	MP4	OGG	FLV	MPG2	MKV	RMVB
	RV	-	-	-	-	-	-	Y	Y
Audio	AAC	-	Y	Y	-	Y	Y	Y	Y
	MP3	Y	Y	Y	-	Y	Y	Y	-
	WMA	Y	Y	-	-	-	-	Y	-
	AC3	-	Y	Y	-	-	Y	Y	-
	PCM/ADPCM	Y	Y	Y	-	Y	Y	Y	-
	AMR	-	-	Y	-	-	-	Y	-
	Vorbis	-	Y	Y	Y	-	-	Y	-
	SPEEX	-	-	-	Y	Y	-	Y	-
	DTS	-	-	-	-	-	Y	Y	-
	FLAC	-	-	-	Y	-	-	Y	-
	DD+	Y	-	Y	-	-	Y	Y	-
	RA	-	-	-	-	-	-	-	Y

7.4.2 Video codec specifications

The tables in this section show the video codec specifications with and without VPU acceleration. Check Section BSP Supported Features to determine if your board supports VPUwith software decoder.

Table 19. Video codec specification for hardware with VPU acceleration

	Format	Platform	Profile	Min. resolution	Max. resolution	Frame rate	Bitrate	Comment
Video Decoder	HEVC	i.MX 8M Quad	main/main 10	144 x 144	4096 x 2160	60 fps	160 Mbps	-
		i.MX 8M Mini	main/main 10	144 x 144	1920 x 1080	60 fps	100 Mbps	-
		i.MX 8QuadXPlus	main	144 x 144	4096 x 2160	30 fps	100 Mbps	-
		i.MX 8QuadMax	main	144 x 144	4096 x 2160	60 fps	100 Mbps	-
	H.264	i.MX 8M Quad	HP/MP/BP	96 x 48	4096 x 2160	30 fps	60 Mbps	-
		i.MX 8M Mini	HP/MP/BP	48 x 48	1920 x 1080	60 fps	60 Mbps	-
		i.MX 8QuadXPlus	HP/MP/BP	64 x 64	4096 x 2160	30 fps	50 Mbps	-
		i.MX 8QuadMax	HP/MP/BP	64 x 64	4096 x 2160	30 fps	50 Mbps	-
		i.MX 6	HP/MP/BP	64 x 64	1920 x 1080	60 fps	50 Mbps	-

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Table 19. Video codec specification for hardware with VPU acceleration (continued)

	Format	Platform	Profile	Min. resolution	Max. resolution	Frame rate	Bitrate	Comment
	VP9	i.MX 8M Quad	profile 0, 2	96 x 72	4096 x 2160	60 fps	100 Mbps	-
		i.MX 8M Mini	profile 0, 2	72 x 72	1920 x 1080	60 fps	100 Mbps	-
	VP8	i.MX 8M Quad	-	48 x 48	1920 x 1080	60 fps	60 Mbps	-
		i.MX 8M Mini						
		i.MX 6Quad	-	64 x 64	1920 x 1080	30 fps	20 Mbps	-
		i.MX 6DualLite	-	64 x 64	1280 x 720	30 fps	20 Mbps	-
	MPEG4	i.MX 8M Quad	SP/ASP	48 x 48	1920 x 1080	60 fps	-	-
		i.MX 8QuadXPlus	SP/ASP	64 x 64	1920 x 1080	60 fps	-	-
		i.MX 8QuadMax	SP/ASP	64 x 64	1920 x 1080	60 fps	-	-
		i.MX 6	SP/ASP	64 x 64	1920 x 1080	30 fps	40 Mbps	-
	MPEG2	i.MX 8M Quad	MP	48 x 48	1920 x 1080	60 fps	-	-
		i.MX 8QuadXPlus	MP	64 x 64	1920 x 1080	60 fps	-	-
		i.MX 8QuadMax	MP	64 x 64	1920 x 1080	60 fps	-	-
		i.MX 6	MP	64 x 64	1920 x 1080	30 fps	50 Mbps	-
	H.263	i.MX 8M Quad	P3	48 x 48	1920 x 1080	60 fps	-	-
		i.MX 6	P3	64 x 64	1920 x 1080	30 fps	20 Mbps	-
	VC1	i.MX 8M Quad	AP/MP/SP	48 x 48	1920 x 1080	60 fps	-	-
		i.MX 6	AP/MP/SP	64 x 64	1920 x 1080	30 fps	45 Mbps	-
	MJPEG	i.MX 8M Quad	-	48 x 48	1920 x 1080	60 fps	180 Mpixl	-
		i.MX 6	-	64 x 64	1920 x 1080	30 fps	120 Mpixl	-
	RV	i.MX 8M Quad	9	48 x 48	1920 x 1080	60 fps	-	-
		i.MX 6	8/9/10	64 x 64	1920 x 1080	30 fps	40 Mbps	-
Video Encoder	H.264	i.MX 8M Mini	HP/MP/BP	132 x 96	1920 x 1080	60 fps	40 Mbps	-

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Table 19. Video codec specification for hardware with VPU acceleration (continued)

	Format	Platform	Profile	Min. resolution	Max. resolution	Frame rate	Bitrate	Comment
		i.MX 8QuadXPlus	HP/MP/BP	64 x 64	1920 x 1080	30 fps	-	-
		i.MX 8QuadMax	HP/MP/BP	64 x 64	1920 x 1080	30 fps	-	-
		i.MX 6	BP	64 x 64	1920 x 1080	30 fps	20 Mbps	-
	VP8	i.MX 8M Mini	-	132 x 96	1920 x 1080	30 fps	60 Mbps	-
Software Video Decoder	-	i.MX All	-	-	According to system performance	According to system performance	According to system performance	Supported with FFmpeg

7.4.3 Audio codec specification

Table 20. Audio codec specification

Decoder	Feature/Profile	Channel	Sample rate (kHz)	Bit rate (kbps)	H/W or S/W	Comment
MP3	MPEG-1 (Layer-1/ Layer-2/Layer-3) MPEG-2 (Layer-1/ Layer-2/Layer-3) MPEG-2.5 (Layer-3)	stereo/mono	<= 48	8 - 448	8QuadXPlus supports H/W. 8QuadMax does not support H/W audio decoder.	-
AACLC	MPEG-2 AACLC MPEG-4 AACLC	<= 5.1	8 - 96	8 - 256	8QuadXPlus supports H/W. 8QuadMax does not support H/W audio decoder.	For H/W, it only supports mono and stereo channels.
HE-AAC	HE-AAC V1 HE-AAC V2	stereo/mono	8 - 96	Mono: 8 - 384 stereo: 16 - 768	S/W	-
WMA10 Std	L1 @ QL1	stereo/mono	44.1	64 - 161	S/W	-
	L2 @ QL1	stereo/mono	<= 48	<= 161	S/W	-
	L3 @ QL1	stereo/mono	<= 48	<= 385	S/W	-
WMA10 Pro	M0a @ QL2	stereo/mono	<= 48	48 - 192	S/W	-
	M0b @ QL2	stereo/mono	<= 48	<= 192	S/W	-
	M1 @ QL2	<= 5.1	<= 48	<= 384	S/W	-

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Table 20. Audio codec specification (continued)

Decoder	Feature/Profile	Channel	Sample rate (kHz)	Bit rate (kbps)	H/W or S/W	Comment
	M2 @ QL2	<= 5.1	<= 96	<= 768	S/W	-
	M3 @ QL2	<= 7.1	<= 96	<= 1500	S/W	-
WMA 9 Lossless	N1	stereo/mono	<= 48	<= 3000	S/W	-
	N2	<=5.1	<= 96	<= 3000	S/W	-
	N3	<=7.1	<= 96	<= 3000	S/W	-
AC-3	-	<=5.1	<= 48	32 - 640	S/W	-
FLAC	-	<=7.1	8 - 192	-	N/A	-
BSAC	-	<=5.1	<= 48	64 per channel	N/A	Core codec only
Ogg Vorbis	q1 - q10	Stereo	8 - 192	<= 500	S/W	-
DD-plus	-	<=7.1	32, 44.1, 48 64, 88.2, 96	<= 6.144 Mbps	S/W	-
RA	cook	stereo/mono	8k, 11.025k, 22.05k, 44.1k	-	S/W	-

NOTE
- The bitrate (bps) supported for MP3 encoder: 32 k, 48 k, 56 k, 64 k, 80 k, 96 k, 112 k, 128 k, 160 k, 192 k, 224 k, 256 k, 320 k
- The sample and supported bitrate (bps) combinations for WMA8 encoder:
    - For mono output:
        - 22050 Hz: 20 k, 16 k, 22 k, 17.6 k
        - 32000 Hz: 20 k, 22 k
        - 44100 Hz: 32 k, 35.2 k, 48 k, 52.8 k
    - For Stereo output:
        - 22050 Hz: 35.2 k, 32 k, 22 k, 20 k
        - 32000 Hz: 52.8 k, 48 k, 44 k, 40 k, 35.2 k, 32 k
        - 44100 Hz: 211.2 k, 192 k, 176 k, 160 k, 140.8 k, 128 k, 105.6 k, 96 k, 88 k, 80 k, 70.4 k, 64 k
        - 48000 Hz: 211.2 k, 192 k, 176 k, 160 k, 140.8 k, 128 k

7.4.4 Image codec specification

Table 21. Image codec specification

	Feature	Profile	Max. resolution	H/W or S/W
Image decoder	JPEG	Baseline	Memory-related	S/W
	PNG	N/A	Memory-related	S/W
	GIF	N/A	Memory-related	S/W
	BMP	N/A	Memory-related	S/W
Image encoder	JPEG	Baseline	Memory-related	S/W

7.4.5 Speech codec specification

Table 22. Speech codec specification

	Feature	Sample rate	Bit rate (kbps)	H/W or S/W
Speech codec	G.711	8 kHz	64	S/W
	G.723.1	8 kHz	5.3, 6.3	S/W
	G.726	8 kHz	16, 24, 32, 40	S/W
	G.729ab	8 kHz	8	S/W
	AMR_NB	8 kHz	12.2, 10.2, 7.9, 7.4, 6.7, 5.9, 5.15, 4.75	S/W
	AMR_WB	16 kHz	23.85, 23.05, 19.85, 18.25, 15.85, 14.25, 12.65, 8.85, 6.6	S/W

7.4.6 Streaming protocol specification

Table 23. Streaming protocol specification

Protocol	Feature
HTTP	HTTP progressive streaming
RTSP	RTP, SDP
RTP/UDP	RTP/UDP MPEGTS streaming

7.4.7 RTSP streaming server specification

To support the RTSP server, the gst-rtsp-server open source package needs to be installed. See Section "RTSP Streaming Server" in the *i.MX Linux® User's Guide* (IMXLUG) for information on how to build and install it.

Table 24. RTSP streaming server specification

Demux feature		AVI	MP4	FLV	MKV	MP3	AAC
Video	H264	Y	Y	Y	Y	-	-
	MPEG4	Y	Y	-	Y	-	-
Audio	MP3	Y	Y	Y	Y	Y	-
	AAC	Y	Y	Y	Y	-	Y

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7.4.8 Subtitle specification

Table 25. Subtitle specification

Internal/External	Subtitle format
Internal	SRT, SSA, ASS
External	SRT

7.5 Known issues and limitations for multimedia

Issues seen on GStreamer 1.x:

- As the maximum buffer size of the playbin multiqueue is 2 MB, problems may be seen with some long audio or video interleaved streams. You can enlarge this buffer size to support these special use cases.
- AAC decoder: The ADIF format does not support seek mode nor FF/FB.
- Playing recorded AVI file on i.MX with VPU (MPEG4 (vpu) + AVI (avimux)) fails because the AVIMUX mark MPEG4 video to DIVX is not supported.
- Rotation on i.MX 6 with VPU is not supported for interlaced streams whose width or height is larger than 968 x 968 when enabled deinterlacing due to a driver limitation.
- Rewind may report an EOS when using libav for video decoding.
- Accurate seek mode may take a longer time delay.
- For clips with no index table in containers (or video with only very few key frames), seeking is not supported.
- Audio-only clips do not support FB.
- For PulseAudio, it automatically starts with X11 backend. For others, users need to manually start the daemon.

8 Revision History

This table provides the revision history.

Table 26. Revision history

Revision number	Date	Substantive changes
L4.9.51_imx8qxp-alpha	11/2017	Initial release
L4.9.51_imx8qm-beta1	12/2017	Added i.MX 8QuadMax
L4.9.51_imx8mq-beta	12/2017	Added i.MX 8M Quad
L4.9.51_8qm-beta2/8qxp-beta	02/2018	Added i.MX 8QuadMax Beta2 and i.MX 8QuadXPlus Beta
L4.9.51_imx8mq-ga	03/2018	Added i.MX 8M Quad GA
L4.9.88_2.0.0-ga	05/2018	i.MX 7ULP and i.MX 8M Quad GA release
L4.9.88_2.1.0_8mm-alpha	06/2018	i.MX 8M Mini Alpha release
L4.9.88_2.2.0_8qxp-beta2	07/2018	i.MX 8QuadXPlus Beta2 release
L4.9.123_2.3.0_8mm	09/2018	i.MX 8M Mini GA release
L4.14.62_1.0.0_beta	11/2018	i.MX 4.14 Kernel Upgrade, Yocto Project Sumo upgrade
L4.14.78_1.0.0_ga	01/2019	i.MX6, i.MX7, i.MX8 family GA release

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Table 26. Revision history (continued)

Revision number	Date	Substantive changes
L4.14.98_2.0.0_ga	04/2019	i.MX 4.14 Kernel upgrade and board updates

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