

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 consolidated release for 4.19 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 8MNano EVK Board
- i.MX 7 Series
 - i.MX 7Dual SABRE-SD Board
 - i.MX 7ULP EVKB 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

1	Overview.....	1
2	What's New?.....	7
3	SoC Feature Summary.....	8
4	BSP Supported Features.....	9
5	U-Boot and Device Trees.....	21
6	Known Issues/Limitations.....	31
7	Multimedia.....	34
8	Revision History.....	44



Overview

- 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.
- 8M Nano stands for the i.MX 8M Nano 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 Nano	Can build and has gone through automated test not production test and is not supported in this release.
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, 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* (IMXLXOCTOUG) - Describes the board support package for NXP development systems using Yocto Project to set up host, install tool chain, and build source code to create images.
- *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 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 \(IMX8QUADXPLUSQSG\)](#)
- [i.MX 8QuadMax Multisensory Enablement Kit Quick Start Guide \(IMX8QUADMAXQSG\)](#)

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 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)
- Documentation

Overview

- 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, "L4.19.35" indicates that this BSP release is based on the kernel version 4.19.35).

"<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	4.19.35
U-Boot	v2019.04
SD Card images	Pre-built images used for testing to use on target i.MX reference boards
Manufacturing Tools (UUU)	Version: 1.3.102 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 NXP 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/<package file name>
```

Table 3. BSP and Multimedia standard packages

File name	Description
imx-codec-4.5.1.bin	i.MX optimized Audio and Video core codec libraries
imx-parser-4.5.1.bin	i.MX optimized core parser
imx-vpuwrap-4.5.1.bin	i.MX VPU wrapper for VPU libraries.
imx-vpu-5.4.39.bin	i.MX VPU library for i.MX 6 with VPU.
imx-vpu-hantro-1.15.0.bin	i.MX VPU Hantro libraries for i.MX 8M Quad and 8M Mini.

Table continues on the next page...

Table 3. BSP and Multimedia standard packages (continued)

File name	Description
firmware-qca-3.0.1.bin	i.MX QCA Bluetooth Wi-Fi firmware.
firmware-imx-8.5.bin	i.MX Firmware including firmware for VPU, DDR, EPDC, HDMI, and SDMA.
imx-seco-2.3.1.bin	i.MX SECO firmware.
imx-gpu-viv-6.4.0.p1.0-aarch32.bin	i.MX Graphics libraries for i.MX 6 and 7 SoC with GPU.
imx-gpu-viv-6.4.0.p1.0-aarch64.bin	i.MX Graphics libraries for i.MX 8.
imx-gpu-g2d-6.4.0.p1.0.bin	i.MX Graphics G2D libraries for i.MX 6 and 7 with GPU.
imx-dpu-g2d-6.4.0.p1.0.bin	i.MX Graphics G2D libraries for i.MX 8.
imx-sc-firmware-1.2.7.1.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-2.6.0.bin	i.MX 7ULP Cortex-M4 Demo
imx8qm-m4-demo-2.5.2.bin	i.MX 8QuadMax Cortex-M4 Demo
imx8qx-m4-demo-2.5.3.bin	i.MX 8QXP Cortex-M4 Demo
imx8mq-m4-demo-2.3.0.bin	i.MX 8M Quad Cortex-M4 Demo
mx8mm-m4-demo-2.6.1.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-4.5.1.bin	Coding Technologies AACplus decoder
imx-scfw-porting-kit-1.2.7.1.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.

Table 5. i.MX Code Aurora Forum Distributed Repos

Repo	Description
imx-manifest	i.MX 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

Table continues on the next page...

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

Repo	Description
imx-optee-os	i.MX OP-TEE OS
imx-optee-test	i.MX OP-TEE Test
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
gststreamer	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 NXP Micro 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-iotedge](#) - Azure IoT Edge demo
- [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
- [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-mender](#) - Note no extra layer but a manifest to integrate the 3rd party Mender OTA solution
- [meta-imx-machinelearning](#) - Machine Learning for i.MX 8 for releases before 4.19. Integrated starting with 4.19 release

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-4.5.1.bin	i.MX optimized Microsoft codec
imx-msparser-4.5.1.bin	i.MX optimized Microsoft ASF parser
imx-ac3codec-4.5.1.bin	i.MX Dolby AC3 core decoder
imx-ddpcodec-4.5.1.bin	i.MX Dolby DD-plus decoder
imx-real-4.5.1.bin	i.MX Real Networks RMVB Decoders and Parsers
imx-dsp-1.0.9.bin	DSP firmware
imx-dsp-codec-1.0.9.bin	DSP decoders (MP2, MP3, BSAC, DRM, DABPlus,SBC)
imx-dsp-codec-ext-1.0.9.bin	DSP extra codecs
imx-dsp-codec-aacp-1.0.9.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 4.19.35.
- Upgraded the U-Boot to v2019.04.
- Updated EULA to v9 August 2019.
- Upgraded the Yocto Project to version 2.7 Warrior.
- Supports the GCC 8.3 toolchain.
- Hypervisor support for Xen and Jailhouse.
- Support for WIC image generation
- Cortex-M4 Demo for i.MX 7ULP and i.MX 8M Mini upgraded to 2.6.0. Cortex-M7 Demo for i.MX 8M Nano upgraded to 2.6.1
- Graphics updates:
 - GPU driver upgraded to 6.4.0.p1.0.
 - i.MX 8QuadMax supports OpenVX 1.2 with NN extension. i.MX 8QuadMax, 8QuadXPlus, and 8M Quad support Vulkan 1.1 and Tensorflow-Lite with NN acceleration.

SoC Feature Summary

- GPU SDK upgraded to 5.3.2
- Weston upgraded to 6.0.1
- This is the last release to support X11.
- Chromium browser upgraded to v75.0.3770.80. This requires Ubuntu 18.04 or newer to build.
- NXP® eIQ™ Machine Learning integration of OpenCV, Tensorflow, Tensorflow Lite, Arm-NN, Arm Compute Library, and ONNX-runtime into standard BSP imx-image-full image.
- Rename of fsl-image-validation-imx to imx-image-multimedia.
- New sound features: Audio Mixer (AMIX) support.
- New multimedia features and changes:
 - GStreamer upgraded to 1.16.0.
 - Qt upgraded to 5.12.
 - 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.
 - 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 QCA9377-3 Wi-Fi and Bluetooth for i.MX 8M Mini.
 - Supports Cypress CYW43455 Wi-Fi and Bluetooth for i.MX 6 and i.MX 8M Mini.
 - Supports Cypress CYW4339 Wi-Fi and Bluetooth for i.MX 7Dual.
 - Supports Cypress CYW4340 Wi-Fi and Bluetooth for i.MX 7ULP.
 - Supports Cypress CYW4356/CYW4359 Wi-Fi and Bluetooth for i.MX 8QuadMax, 8QuadXPlus, 8M Quad, and 8M Mini.
- Supports CAN FD mode in FlexCAN.
- Supports MIPI DSI panel.

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 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

Table continues on the next page...

Table 7. SoC Hardware Acceleration Features (continued)

Feature	SoC
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, 6SLL, 6ULL, 6ULZ i.MX 7 Family: 7Dual
PXP	i.MX 6 Family: 6DualLite, 6SLL, 6UL, 6ULL, 6ULZ i.MX 7 Family: 7Dual
Frame Buffer Display	i.MX 6 Family: 6Quad, 6DualLite, 6Solo, 6SoloX, 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
NXP eIQ Machine Learning	i.MX 8 Family: 8QuadMax i.MX 8X Family: 8QuadXPlus i.MX 8M Family: 8M Quad, 8M Mini

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: 4.19.35
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,

Table continues on the next page...

Table 8. Supported features (continued)

Feature	Supported board	Comment
		<ul style="list-style-type: none"> • UBIFS is used for NAND. • JFFS2/UBIFS is used for Parallel NOR, QSPI NOR.
Boot Image		
U-Boot	All i.MX	<p>U-Boot delivery is based on U-Boot version v2019.04.</p> <p>Clock, Anapop regulator, ENET, UART, MMC/SD, eMMC4.3/4.4/4.5.</p> <p>High-Assurance Boot, ROM Plug-in Mode.</p> <p>SPI-NOR, Parallel NOR, SATA, NAND, FlexSPI-NOR, USB Mass Storage.</p> <p>See Table 9 "U-Boot configurations" for the U-Boot configurations supported on each board for SPI_NOR, NAND, Parallel NOR, FlexSPI-NOR. These are not supported on all boards.</p> <p>i.MX 6QuadPlus/Quad/DualLite SABRE-SD and SABRE-AI support DDR3 528 MHz @ 64 bit.</p> <p>i.MX 6SoloX SABRE-SD support LDDR3 400 MHz @ 32 bit.</p> <p>i.MX 7Dual SABRE-SD supports DDR3 533 MHz @ 32 bit and boot using L2Cache as OCRAM.</p> <p>i.MX 6UltraLite EVK supports DDR3 400 MHz @ 16 bit.</p> <p>i.MX 6ULL supports DDR3 400 MHz @ 16 bit.</p> <p>i.MX 6ULZ supports DDR3 400 MHz @ 16 bit.</p> <p>i.MX 6SLL supports LPDDR3 400Mhz @32 bit.</p> <p>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.</p> <p>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.</p> <p>For 8M Mini, 8M Quad, 8QuadMax A0, and 8QuadXPlus A0, seek=33k.</p> <p>For 8QuadMax B0, and 8QuadXPlus B0, seek=32k.</p>
Boot Firmware	All i.MX 8	<p>All i.MX 8 require Arm Trusted Firmware</p> <p>i.MX 8QuadMax and 8QuadXPlus require System Controller Firmware</p> <p>i.MX 8QuadMax and 8QuadXPlus require SECO firmware</p> <p>i.MX 8QuadMax requires signed HDMI firmware</p>
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	8QuadMax 8QuadXPlus	Xen is a Type 1 hypervisor and goes into the boot image. Look for dom0 related device trees.
Jailhouse Hypervisor	All i.MX 8M 8QuadMax 8QuadXPlus	Jailhouse is a Type 1 hypervisor for i.MX 8. Look for related device trees for inmate and root device trees.
Machine-specific layer		

Table continues on the next page...

Table 8. Supported features (continued)

Feature	Supported board	Comment
Arm® Core	All i.MX	<p>i.MX 6 SABRE-SD, 6 SABRE-AI, 6SLL, 6 SoloX-SD support the Arm Cortex-A9 processor.</p> <p>i.MX 7Dual SABRE-SD and 7ULP EVK support the Arm Cortex-A7 and Cortex-M processor.</p> <p>i.MX 6UltraLite EVK, 6ULL EVK, and 6ULZ EVK support the Arm Cortex-A7 processor.</p> <p>i.MX 8QuadXPlus processor consists of five cores:</p> <ul style="list-style-type: none"> • Four Arm Cortex-A35 • One Arm Cortex-M4F <p>i.MX 8QuadMax processor consists of eight cores:</p> <ul style="list-style-type: none"> • Four Arm Cortex-A53 cores • Two Arm Cortex-A72 cores • Two Arm Cortex-M4F cores <p>Innovative multicore architecture provides four Cortex-A53 cores, two Cortex-A72 cores, and two Cortex-M4 cores.</p> <p>i.MX 8M Quad and i.MX 8M Mini supports four Cortex-A53 cores.</p>
Memory	All i.MX	<p>On i.MX 6 and i.MX 7 SoC, the user/kernel space is split 2G/2G.</p> <p>On i.MX 8 with 64-bit configuration, the memory is not split.</p> <p>i.MX 8QuadMax supports two 32-bit LPDDR4 channels @1600 MHz.</p> <p>i.MX 8QuadXPlus supports one 32-bit LPDDR4 channel @1200 MHz.</p> <p>i.MX 8M Quad supports one 32-bit LPDDR4 channel @ 1600 MHz and 50 MHz.</p> <p>i.MX 8M Mini supports one 32-bit LPDDR4 channel @ 1500 MHz and 50 MHz.</p>
Interrupt	All i.MX	GIC
Clock	All i.MX	Controls the system frequency and clock tree distribution.
Timer	All i.MX	<p>System timer tick and broadcast timer support.</p> <p>GPT Timer used for i.MX 6 and i.MX 7.</p> <p>On i.MX 8M Quad, 8M Mini and 8QuadXPlus, system counter timer instead of GPT.</p> <p>On i.MX 8, Arm Arch timer used instead of GPT</p> <p>On i.MX 6 and i.MX 7 Enhanced Periodic Interrupt Timer (EPIT) available</p>
GPIO/EDIO	All i.MX	GPIO is initialized in earlier phase according to hardware design.
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	Conforms to the DMA engine framework.

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Table 8. Supported features (continued)

Feature	Supported board	Comment
	8M Mini	
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	<p>i.MX 6 SABRE-SD support console through internal Debug UART1.</p> <p>i.MX 6SoloX SABRE-SD support Cortex-A9 processor through UART1 and Cortex-M4 processor through UART2.</p> <p>i.MX 7Dual SABRE-SD Cortex-A7 processor through UART1 and Cortex-M4 processor through UART2.</p> <p>i.MX 6UltraLite, 6ULL and 6ULZ EVKs Cortex-A7 processor through UART1.</p> <p>i.MX 6 SABRE-AI supports console through internal Debug UART 4.</p> <p>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.</p> <p>i.MX 8M Mini EVK supports CA53 through UART2 and CM4 through UART4.</p> <p>i.MX 8 supports Cortex-A53 processor through UART0 and Cortex-M4 processor through UART2.</p>
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.
CPUIidle	All i.MX 6 All i.MX 7	2 levels CPUIidle 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.
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	<p>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.</p> <p>i.MX 6SoloX SABRE-SD, SABRE-AI, and i.MX 7Dual SABRE-SD support AVB features.</p>

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Table 8. Supported features (continued)

Feature	Supported board	Comment
		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	6SABRE_SD 6SABRE_AI 6SoloX-SD 7D-SABRE-SD All i.MX 8	i.MX 6 and i.MX 7 listed support the mini PCIe interface. i.MX 8 supports M.2 interface. For EP?RC validation on i.MX 6 and 7 use two boards where one is used as RC, and the other is used as EP. For i.MX 6 and 7, the default kernel config does not enable PCIe. The i.MX 8 defconfig does enable PCIe. For EP/RC validation on i.MX 8 use a converter cable that converts from standard PCIe interface to M.2. <ul style="list-style-type: none"> • 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	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.
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, 7Dual SABRE-SD, 6UltraLite 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 6 and i.MX 8M Mini. All the i.MX 6 boards require board modifications to support Bluetooth and to boot with the Wi-Fi/Bluetooth device tree. Supports Murata 1PJ (QCA9377-3) Wi-Fi/Bluetooth on i.MX 8M Mini. Supports Murata 1DX (CYW43430) Wi-Fi/Bluetooth on i.MX 7ULP. Supports Murata TypeZP (CYW4339) Wi-Fi/Bluetooth on i.MX 7Dual. 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: <code>/usr/bin/pulseaudio --start --log-target=syslog</code>
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	Smart Card Interface.

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Table 8. Supported features (continued)

Feature	Supported board	Comment
	7D-SABRE-SD	
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 external Audio boards. Look for related device trees.
WM8524	8M Quad 8M Mini	Supports playback
WM8962/SSI WM8960/SSI	6SABRE-SD 6SoloX-SD 7D-SABRE-SD 6UltraLite 6ULL 6ULZ 6SLL 7ULP	Supports playback
SAI/MQS	8QuadMax	Supports playback.
S/PDIF	6SABRE-SD 6SABRE-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 6UltraLite 6ULL 6ULZ 8QuadMax 8QuadXPlus	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.
ESAI/CS42888	6SABRE-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.

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Table 8. Supported features (continued)

Feature	Supported board	Comment
SAI/MQS/WM8962	6SoloX-SD	Supports 16 bit, 24 bit, and 32 bit PCM format.
	7D-SABRE-SD	Supports sample rate from 8 kHz to 96 kHz for record and playback .
	6UltraLite	Supports full duplex operations.
	6ULL	Supports amixer alsamixer control from user space.
	6ULZ	Supports clock control.
	7ULP	Support MQS only on i.MX 6 and i.MX 7
	8M Quad	Supports WM8962 only on i.MX 8QuadMax
	8M Mini	
	8QuadMax 8QuadXPlus	
AMIX	8QuadMax	Supports 16 bit, 18 bit, 20 bit, 24 bit, and 32 bit PCM format.
	8QuadXPlus	Supports sample rate from 8 kHz to 96 kHz for record and playback . Supports amixer alsamixer control from user space.
HDMI Audio	6SABRE-SD	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.
	6SABRE-AI	
	7ULP	
	8QuadMax	
	8M Quad	
Input device drivers		
USB devices	All i.MX	Supports USB mouse and USB keypad through USB ports.
Touch panel	All i.MX 6	6SABRE-SD and 6SABRE-AI supports EGalaxy capacitive touch screen.
	All i.MX 7	7Dual SABRE-SD supports E Ink touch screen with a separate package download. 6SoloX SABRE-SD supports LVDS panel. 7ULP EVK supports touch through DSI panel
Keypad	6UltraLite	Supports the resistive touch panel.
	7D-SABRE-SD	
	7ULP	
Storage drivers		
FlexSPI-NOR	6SoloX-SD	i.MX 6SoloX SABRE-SD supports QSPI2.
	6UltraLite	i.MX 6UltraLite EVK supports QSPI1.
	6ULL	i.MX 7Dual SABRE-SD supports QSPI1.
	6ULZ	i.MX 8QuadXPlus, 8M Quad and 8M Mini support FlexSPI1.
	7D-SABRE-SD	i.MX 8M Mini supports NOR Flash Boot.
	All i.MX 8	
SPI-NOR	6SABRE-AI	Supports M25P32 On i.MX 6SABRE-SD Dual/Quad/DualLite there is a pin conflict for supporting SPI-NOR

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Table 8. Supported features (continued)

Feature	Supported board	Comment
NAND	6SABRE-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 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. 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 7ULP All i.MX 8	Graphics Chips Details: One GC7000-Lite on 8M Quad. One GC7000-NanoUltra and GC520I 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:

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Table 8. Supported features (continued)

Feature	Supported board	Comment
		<ul style="list-style-type: none"> • 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
Frame Buffer Display	All i.MX 6 and 7	<p>MXC Frame buffer driver for IPU V3 on i.MX 6SABRE-SD and i.MX 6SABRE-AI.</p> <p>MXC Frame buffer driver for PXP on i.MX 6SoloX SABRE-SD, i.MX 6UltraLite EVK, i.MX 6ULZ EVK i.MX 6ULL EVK and i.MX 7Dual SABRE-SD.</p>
Direct Rendering Manager (DRM) Display	All i.MX 8	<p>i.MX DPU DRM is used for i.MX 8QuadMax and 8QuadXPlus.</p> <p>LCDIF is used for i.MX 8M Quad and 8M Mini.</p> <p>DCSS is used for i.MX 8M Quad</p>
Framebuffer compression	8M Quad	<p>Supports graphic framebuffer compression with DEC400.</p> <p>Supports video framebuffer compression with DTRC.</p>
VDOA	6SABRE-SD 6SABRE-AI	Supports Video Data Order Adapter for tiling.
LVDS	6SABRE-SD 6SABRE-AI 6SoloX-SD 8QuadMax 8QuadXPlus	<p>Supports HannStar LVDS panel on i.MX 6. It is the default display if no other video option is setup. Uses the LDB controller.</p> <p>On the SABRE-AI there are 2 ports. Port 0 is the default.</p> <p>For i.MX 8, supports the Mixel controller</p>
HDMI Display	6SABRE-SD 6SABRE-AI 6SoloX-SD 7D-SABRE-SD 7ULP	<p>i.MX 6SABRE-SD, 6SABRE-AI and 7Dual support on-chip HDMI hardware.</p> <p>i.MX 6SoloX SABRE-SD support external HDMI hardware.</p> <p>i.MX 7ULP EVK supports HDMI through the MIPI pins with external HDMI hardware.</p>
HDMI/Display Port	8M Quad 8QuadMax	<p>i.MX 8QuadMax supports HDMI audio and on-chip HDMI hardware through MIPI pins.</p> <p>i.MX 8M Quad supports HDMI through DCSS.</p>
LVDS to HDMI	8QuadMax 8QuadXPlus	Uses ITE Driver IT6263
MIPI to HDMI	All i.MX 8	Uses Advantec adv7535
HDCP	6SABRE-SD i.MX 8M	Supports HDCP v1.2 specifications on specific HDCP parts.
MIPI-DSI Display	6SABRE-SD All i.MX 7	<p>Supports 2 lanes through MIPI daughter card on i.MX 6 and i.MX 7-SABRE-SD.</p> <p>Support 2 lanes MIPI DSI with direct connection on i.MX 7ULP</p>

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Table 8. Supported features (continued)

Feature	Supported board	Comment
	i.MX 8	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 6SLL 6SoloX-SD 7D-SABRE-SD 6UltraLite 6ULL 6ULZ	Enables PxP Driver for EPDC. Conforms to DMA engine framework.
EPDC	6DualLite-SD 6SLL 6ULL 6ULZ 7D-SABRE-SD	Supports RGB565 frame buffer format. Supports Y8 frame buffer format. Supports full and partial EPD screen updates. Supports up to 256 panel-specific waveform modes. Supports automatic optimal waveform selection for a given update. 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

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Table 8. Supported features (continued)

Feature	Supported board	Comment
	6SABRE-AI All i.MX 8	i.MX 8QuadMax and 8QuadXPlus Encoder: H.264 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 8QuadXPlus	Supports through DRM display framework and provides 2D Graphics processing. Supports DPR tiling
DCSS	8M Quad	Supports display frame buffers in memory out to Ultra HD or HDTVs.
IPU	6SABRE-SD 6SABRE-AI	On i.MX 6SABRE-SD and i.MX 6SABRE-AI, the IPU driver provides interfaces to access IPU V3 modules.
PRE/PRG driver	6QuadPlus-SD 6QuadPlus-AI	On i.MX 6QuadPlus provides interfaces to support prefetch linear frames or resolve tiled frames for display.
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 i.MX 6SoloX SABRE-SD, 6UltraLite, 6ULL, 6ULZ EVKs and 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 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 6SoloX-SD 6UltraLite 6ULL 6ULZ 6SLL	Supports OV5640 camera sensor.

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Table 8. Supported features (continued)

Feature	Supported board	Comment
	8QuadXPlus	
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. Supports eMMC4.5 on 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 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>i.MX Linux[®] Reference Manual (IMXLXRM)</i> for more information.
Accelerometer	6SABRE-SD 6SABRE-AI 6SoloX-SD 6UltraLite 6ULL 6ULZ	Supports the MMA8451 sensor on i.MX 6SABRE and i.MX 6SoloX. 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.

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Table 8. Supported features (continued)

Feature	Supported board	Comment
	7D-SABRE-SD 7ULP 8QuadXPlus	
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 All i.MX 7	SNVS is a block that interfaces with CAAM and SRTC.
Ambient Light Sensor	6SABRE-SD 6SABRE-AI 6SoloX-SD 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.
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.	imx6qsabresd, imx6qpsabresd, imx6dlsabresd

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Table 9. U-Boot configurations (continued)

U-Boot configuration for Boot device	Description	Supported machine 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.	imx6qsabreauto, imx6qpsabreauto, imx6dlsabreauto imx6sllevk imx6sxsabresd imx7dsabresd imx6ulevk imx6ull14x14evk imx6ullz4x14evk imx7ulpevk imx8qmmek imx8mqevk imx8mmevk imx8mnevk imx8qxpmev
spi-nor	Supports boot from SPI-NOR.	imx6qsabreauto, imx6dlsabreauto imx6qpsabreauto
eim-nor	Supports boot from Parallel NOR.	imx6qsabreauto, imx6dlsabreauto, imx6solosabreauto imx6qpsabreauto
nand	Supports boot from NAND.	imx6qsabreauto, imx6dlsabreauto, imx6solosabreauto imx6qpsabreauto 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 QSPI1 is 0x68000000.	imx6sxsabresd with QSPI2 imx7dsabresd with QSPI1 imx6ulevk with QSPI1 imx6ullz14x14evk with QSPI1
emmc	Supports 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 imx6ullz14x14evk 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.	imx7dsabresd

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Table 9. U-Boot configurations (continued)

U-Boot configuration for Boot device	Description	Supported machine configuration
flexspi (fspci)	Supports FlexSPI boot.	imx8qmmek imx8mmek imx8qxpmeek

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: <ul style="list-style-type: none"> imx6q-sabresd.dtb, imx6qp-sabresd.dtb imx6dl-sabresd.dtb imx6q-sabreauto.dtb, imx6qp-sabreauto.dtb imx6dl-sabreauto.dtb imx6sx-sdb.dtb: Supports the i.MX 6SoloX SABRE-SDB Rev. B board, and imx6sx-sdb-reva.dtb is supports the SABRE-SDB Rev. A board imx7d-sdb.dtb: Supports the i.MX 7Dual SABRE-SDB Rev. C and Rev. D boards, and imx7d-sdb-reva.dtb supports the Rev. A board. imx6ul-14x14-evk.dtb, imx6ul-9x9-evk.dtb imx6ulz-14x14-evk.dtb imx6ull-14x14-evk.dtb imx7ulp-evk.dtb fsl-imx8mq-evk.dtb fsl-imx8mm-evk.dtb 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. It is for non-partition boot that flash.bin does not include the Cortex-M4 image. fsl-imx8qm-mek-rpmsg.dtb: Supports partition reset, and supports the LVDS-HDMI or MIPI-DSI-HDMI display with the LVDS-HDMI or MIPI-DSI-HDMI converts. This requires flash.bin to include the Cortex-M4 image. fsl-imx8qxp-mek.dtb: Supports one LVDS-HDMI through the LVDS0-CH0 on the LVDS-HDMI daughter card. It is for non-partition boot that flash.bin does not include the Cortex-M4 image.
Audio	Enables the various audio device trees <ul style="list-style-type: none"> fsl-imx8mq-evk-ak4497.dtb: audio board ak4497 codec fsl-imx8mq-evk-pdm.dtb: PDM microphone

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Table 10. Kernel and device tree configurations (continued)

Kernel and device tree configuration	Description
	<ul style="list-style-type: none"> • fsl-imx8mq-evk-audio-tdm.dtb: audio board TDM • fsl-imx8mm-evk-ak4497.dtb: audio board ak4497 codec • fsl-imx8mm-evk-ak5558.dtb: audio board ak5558 codec • fsl-imx8mm-evk-audio-tdm.dtb: audio board TDM • imx7ulp-evk-wm8960.dtb: Enable WM8960 audio as the default one and disable HDMI audio. • imx7d-sdb-reva-hdmi-audio.dtb: Enable HDMI audio as the default one and disable WM8960 audio.
Bluetooth® wireless technology Wi-Fi	<p>Enable the Bluetooth wireless technology and Wi-Fi hardware.</p> <ul style="list-style-type: none"> • fsl-imx8mq-evk-pcie1-m2.dtb: PCIe M2 to support Murata 1CQ QCA6174 • fsl-imx8mm-ddr4-qca9377-evk.dtb: DDR4 EVK with QCA9377 Wi-Fi/BT • imx6q-sabresd-btwifi.dtb: Support for Cypress Bluetooth and Wi-Fi • imx6qp-sabresd-btwifi.dtb: Support for Cypress Bluetooth and Wi-Fi • imx6dl-sabresd-btwifi.dtb: Support for Cypress Bluetooth and Wi-Fi • imx6sll-evk-btwifi.dtb: Support for Cypress Bluetooth and Wi-Fi • imx6sx-sabresd-btwifi.dtb: Support for Cypress Bluetooth and Wi-Fi • imx6ul-14x14-evk-btwifi.dtb: Support for Cypress Bluetooth and Wi-Fi • imx6ul-9x9-evk-btwifi.dtb: Support for Cypress Bluetooth and Wi-Fi • imx6ull-14x14-evk-btwifi.dtb: Support for Cypress Bluetooth and Wi-Fi • imx6ulz-14x14-evk-btwifi.dtb: Support for Cypress Bluetooth and Wi-Fi • imx6ulz-14x14-evk-btwifi-oob.dtb
Video Capture	<ul style="list-style-type: none"> • fsl-imx8qxp-mek-ov5640.dtb: Supports one MIPI OV5640 and one parallel OV5640, which indicates to support 2 cameras. Tested with non-M4 flash.bin. • fsl-imx8qm-mek-ov5640.dtb: Supports one or two OV5640 sensors at the same time. • fsl-imx8mq-evk-mipi-csi2.dtb: MIPI-CSI2 • imx6ul-14x14-evk-csi.dtb: Avoids the pin conflict between SIM and CSI and enables CSI support for V4L2. • imx6ul-9x9-evk-csi.dtb: Avoids the pin conflict between SIM and CSI and enables CSI support for V4L2.
Video Display	<ul style="list-style-type: none"> • fsl-imx8qxp-mek-dsi-rm67191.dtb: Supports RM67191 MIPI OLED display panel. Tested with non-M4 flash.bin. • fsl-imx8qxp-mek-it6263-lvds0-dual-channel.dtb: Supports the LVDS-HDMI display with LVDS0 dual-channel feature. Tested with non-M4 flash.bin. • fsl-imx8qxp-mek-it6263-lvds1-dual-channel: Supports the LVDS-HDMI display with LVDS1 dual-channel feature. Tested with non-M4 flash.bin. • 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. Tested with non-M4 flash.bin. • 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. Tested with non-M4 flash.bin. • 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.

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Table 10. Kernel and device tree configurations (continued)

Kernel and device tree configuration	Description
	<ul style="list-style-type: none"> • fsl-imx8qm-mek-hdmi.dtb: Supports native HDMI TX interface on the CPU board. • 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. • fsl-imx8mq-evk-lcdif-adv7535.dts: LCDIF + MIPI-DSI + HDMI adaptor • fsl-imx8mq-evk-dcss-adv7535.dtb: DCSS + MIPI-DSI + HDMI adaptor • fsl-imx8mq-evk-dcss-rm67191.dtb: DCSS + MIPI-DSI + OLED panel • fsl-imx8mq-evk-dual-display.dtb: Dual-display-to-HDMI and MIPI-to-HDMI adapter • fsl-imx8mq-evk-dp.dtb: Display Port support • fsl-imx8mq-evk-epd.dtb: Display Port support • fsl-imx8mm-evk-rm67191.dtb: OLED panel • fsl-imx8mm-ddr4-evk.dtb: DDR4 EVK board • fsl-imx8mm-ddr4-evk-rm67191.dtb: DDR4 EVK board with OLED panel • imx7d-sdb-epdc.dtb: Pin conflict between HDMI and EPDC, disable HDMI for EPDC. • imx7d-sdb-reva-epdc.dtb: Pin conflict between HDMI and EPDC, disable HDMI for EPDC. • imx7d-sdb-mipi-dsi.dtb: Enable MIPI-DSI. • imx7ulp-evk-mipi.dtb: Enable MIPI-DSI.
eCSPI	<p>Enables eCSPI, which is disabled in the default DTB.</p> <ul style="list-style-type: none"> • imx6dl-sabreauto-ecspi.dtb • imx6q-sabreauto-ecspi.dtb • imx6qp-sabreauto-ecspi.dtb
eMMC	<p>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.</p> <ul style="list-style-type: none"> • imx6sx-sdb-emmc.dtb • imx7ulp-evk-emmc.dtb • imx6ulz-14x14-evk-emmc.dtb
ENET2	<p>A second ENET port is supported with these device trees. Also the TJA1100 daughter cord enabled a 2nd Ethernet port enabled with TJA device trees listed below.</p> <ul style="list-style-type: none"> • fsl-imx8qxp-mek-enet2.dtb: Supports ENET port on base boards. • fsl-imx8qxp-mek-enet2-tja1100.dtb: ENET2 uses TJA1100 Ethernet PHY. • fsl-imx8qm-mek-enet2-tja1100.dtb: ENET2 uses TJA1100 Ethernet PHY.
Enetirq	<p>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</p> <ul style="list-style-type: none"> • imx6q-sabresd-enetirq.dtb • imx6dl-sabresd-enetirq.dtb • imx6dl-sabreauto-enetirq.dtb • imx6q-sabreauto-enetirq.dtb

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Table 10. Kernel and device tree configurations (continued)

Kernel and device tree configuration	Description
Flexcan1	Enables flexcan1, which is disabled by default in standard DTB file due to pin conflicts with FEC. <ul style="list-style-type: none"> imx6q-sabreauto-flexcan1.dtb imx6dl-sabreauto-flexcan1.dtb imx6qp-sabreauto-flexcan1.dtb
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: <ul style="list-style-type: none"> imx6dl-sabreauto-gpmi-weim.dtb imx6q-sabreauto-gpmi-weim.dtb imx6qp-sabreauto-gpmi-weim.dtb imx7d-sdb-gpmi-weim.dtb and imx7d-sdb-reva-gpmi-weim.dtb imx6ulz-14x14-evk-gpmi-weim.dtb
HDCP	Enables the HDMI-HDCP feature. This avoids the pin conflict between the I2C2 and HDCP-DDC pins. <ul style="list-style-type: none"> imx6q-sabresd-hdcp.dtb imx6dl-sabresd-hdcp.dtb imx6qp-sabresd-hdcp.dtb
Hypervisor Jailhouse	Enables the Jailhouse Hypervisor device trees <ul style="list-style-type: none"> fsl-imx8qxp-mek-root.dtb: dtb for root-cell fsl-imx8qxp-mek-inmate.dtb: dtb for the inmate cell fsl-imx8qm-mek-root.dtb: dtb for root-cell fsl-imx8qm-mek-inmate.dtb: dtb for the inmate cell fsl-imx8mq-evk-root.dtb: dtb for root-cell fsl-imx8mq-evk-inmate.dtb: dtb for the inmate cell fsl-imx8mm-evk-root.dtb: dtb for root-cell fsl-imx8mm-evk-inmate.dtb: dtb for the inmate cell fsl-imx8mq-evk-root.dtb: Supports Jailhouse hypervisor fsl-imx8mm-evk-root.dtb: Supports Jailhouse hypervisor
Hypervisor Xen	Enables the Xen Hypervisor device trees <ul style="list-style-type: none"> fsl-imx8qxp-mek-dom0.dtb: Xen Linux guest Linux DTB file. fsl-imx8qm-mek-dom0.dtb: Supports Xen hypervisor dom0. fsl-imx8qm-mek-dom0-dpu2.dtb: Supports the Xen hypervisor dom0 dpu2. fsl-imx8qm-mek-domu.dtb: Support Xen hypervisor domu. fsl-imx8qm-mek-domu-dpu1.dtb: Supports Xen hypervisor domu-dpu1. fsl-imx8qm-mek-domu-dpu1-hdmi.dtb: Supports the Xen hypervisor domu-dpu1-hdmi.
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: <ul style="list-style-type: none"> imx6q-sabresd-ldo.dtb imx6qp-sabresd-ldo.dtb imx6ul-9x9-evk-ldo.dtb imx6dl-sabresd-ldo.dtb imx6sx-sdb-ldo .dtb, imx6sx-sdb-reva-ldo.dtb
LP UART	Enable LPUART. <ul style="list-style-type: none"> imx7ulp-evk-lpuart.dtb

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Table 10. Kernel and device tree configurations (continued)

Kernel and device tree configuration	Description
Multi-Core, M4 and RPMSG	<p>Enables the M4 and RPMSG</p> <ul style="list-style-type: none"> • 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. • 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. • fsl-imx8qm-mek_ca53.dtb: Supports four CortexA53 cores only. • 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. • fsl-imx8qm-mek-enet2-tja1100.dtb: Supports the tja1100 ENET daughter card. • fsl-imx8mq-evk-m4.dtb: RPMSG • fsl-imx8mm-evk-m4.dtb: RPMSG • imx6sx-sdb-m4.dtb: Disables 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. • imx6sx-sabreauto-m4.dtb: Disables 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. • imx7d-sdb-m4.dtb: Disables 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. <p>On i.MX 8QuadMax and 8QuadXPlus, 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.</p>
Qspi	<p>Enable DDR Quad mode for Macronix QSPI chip mx25I51245g by setting Quad bit in status register.</p> <ul style="list-style-type: none"> • imx7-sdb-qspi.dtb imx7-sdb-reva-qspi.dtb • imx7ulp-evk-qspi.dtb
SD1	<p>Enable sd1 on uSDHC1 on the base board.</p> <ul style="list-style-type: none"> • imx7ulp-sd1.dtb
Touch	<p>Add tsc2046 touch screen controller support. Because the pin PENIRQ of tsc2046 conflicts with the interrupt pin of HDMI, this disables the HDMI.</p> <ul style="list-style-type: none"> • imx7-sdb-reva-touch.dtb
USB	<p>Enable USB certification for i.MX 6UltraLite.</p> <ul style="list-style-type: none"> • imx6ul-14x14-evk-usb-certi.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.	For i.MX 6 SABRE-SD, console=ttyMXC0,115200 For i.MX 6 SABRE-AI, console=ttyMXC3,115200 For i.MX 7ULP, console=ttyLP0, 115200 For i.MX 8QuadMax, console=ttyLP0,115200 earlycon	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".

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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.	<ol style="list-style-type: none"> 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 	<ol style="list-style-type: none"> 1. Used when primarily displaying on HDMI with 1080P60 mode. Secondly displaying on LVDS with XGA mode. 2. Used when primarily displaying on LVDS with XGA mode. Secondly 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. <p>NOTE: GBR24/RGB565/YUV444 represents the display HW interface format. Typical values for certain different display devices are as follows:</p> <p>TVOUT: YUV444</p> <p>VGA: GBR24</p> <p>HDMI&DVI: RGB24</p> <p>CLAA WVGA LCD: RGB565</p> <p>Typical values for dev= are shown as follows:</p> <p>ldb: LVDS</p> <p>hdmi: HDMI on chip or sii902x</p> <p>dvi: DVI port</p> <p>vga: VGA through TVE</p> <p>tve: TVOUT</p>
video on 6SABRE-AI	Tells the kernel/driver which resolution/depth and refresh rate should be used for display port 0 or 1.	<ol style="list-style-type: none"> 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 	<ol style="list-style-type: none"> 1. Used when primarily displaying on HDMI with 1080P60 mode. Secondly displaying on LVDS with XGA mode. 2. Used when primarily displaying on LVDS with XGA mode. Secondly displaying on HDMI with 1080P60 mode.

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Table 11. Common kernel boot parameters (continued)

Kernel parameter	Description	Typical value	Used when
	<p>See the parameter information under Documentation/fb/modedb.txt</p> <p>Tells the kernel/driver which IPU display interface format should be used.</p>	<p>4. video=mxcfb0:dev=ldb,if=RGB666</p> <p>5. video=mxcfb0:dev=hdmi, 1920x1080M@60,if=RGB24</p>	<p>3. Used when primary displaying on HDMI with 1080P60 mode.</p> <p>4. Used when primary displaying on the HannStar LVDS0.</p> <p>5. Used when enabling HDMI 1080P60 mode and LVDS0. To enable second display, run "echo 0 > /sys/class/graphics/fb2/blank"</p> <p>NOTE: GBR24/RGB565/YUV444 represents the display HW interface format. Typical values for certain different display devices are shown as follows:</p> <p>TVOUT: YUV444</p> <p>VGA: GBR24</p> <p>HDMI&DVI: RGB24</p> <p>CLAA WVGA LCD: RGB565</p> <p>Typical values for dev= are shown below:</p> <p>ldb: LVDS</p> <p>hdmi: HDMI on chip or sii902x</p> <p>dvi: DVI port</p> <p>vga: VGA through TVE</p> <p>tve: TVOUT</p>
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.	<p>None</p> <p>Or</p> <p>dmfc=3</p>	<p>"dmfc=1" means DMFC_HIGH_RESOLUTION_DC.</p> <p>"dmfc=2" means DMFC_HIGH_RESOLUTION_DP.</p> <p>"dmfc=3" means DMFC_HIGH_RESOLUTION_ONLY_DP.</p> <p>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.</p>

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Table 11. Common kernel boot parameters (continued)

Kernel parameter	Description	Typical value	Used when
mtddparts on 6SABRE-AI	Tells the kernel MTD partition information.	mtddparts=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_hugepage	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 6 Family SoC

SoC	Module	Source	Description	Workaround
6Quad	FB	Software	The system hangs when pressing Ctrl+C during GPU galcore module load or unload.	The issue will be fixed in the next release.
6QuadPlus	Video I/O	Hardware	The primary display turns to be messy when running video playback for a while with Weston start.	The issue will be fixed in the next release.
6Quad/6QuadPlus	Kernel	Hardware	The system hangs during the power state mode test with peripherals connected.	The issue will be fixed in the next release.
6QuadPlus	Kernel	Hardware	The system hangs during the low bus frequency suspend/resume test.	The issue will be fixed in the next release.

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Table 12. Known issues and workarounds for i.MX 6 Family SoC (continued)

SoC	Module	Source	Description	Workaround
6QuadPlus	Connectivity	Hardware	PCIe USB error message is displayed during the suspend and resume test and then the PCIe USB is disconnected.	The issue will be fixed in the next release.
6QuadPlus	FB	Software	Many test cases fail in the FB GLES multiple-conformance test.	The issue will be fixed in the next release.
6QuadPlus	Tool	Software	Bad Linux Arm zImage magic is reported during boot-up after burning is successful.	The issue will be fixed in the next release.
6DualLite	Audio	Software	Machine hw_params fails during the unit test.	The issue will be fixed in the next release.
6DualLite/6Solo	Connectivity	Hardware	No event is generated when touching the EPDC panel.	The issue will be fixed in the next release.
6SoloX	Wayland	Hardware	Plenty of dump and report "[galcore]: Stop driver to keep scene" occur during the thermal test.	The issue will be fixed in the next release.
6SoloX	Security	Hardware	Reading the protected ocram memory causes the system hung.	The issue will be fixed in the next release.
6DualLite/6Quad	Tool	Hardware	The GPU top tool occupancy mode test fails.	The issue will be fixed in the next release.
All	Kernel/BSP	Software	After getting IP address for WLAN 0, the Ethernet is down and loses IP address with the SD card image.	Use connmanctl to set up WLAN 0 instead of directly calling UDHCP. See https://wiki.archlinux.org/index.php/ConnMan#Wi-Fi .

Table 13. Known issues and workarounds for i.MX 7 Family SoC

SoC	Module	Source	Description	Workaround
7ULP	Kernel	Hardware	Fails to access the Internet through Chromium	The issue will be fixed in the next release.
7ULP	Bootloader	Software	eMMC U-Boot does not support burning the Cortex-M4 image to QSPI-NOR.	The issue will be fixed in the next release.
7Dual	Connectivity	Hardware	PCIe USB error message is displayed during the suspend and resume test and then the PCIe USB is disconnected.	The issue will be fixed in the next release.
All	Kernel/BSP	Software	After getting IP address for WLAN 0,	Use connmanctl to set up WLAN 0 instead of directly calling UDHCP.

Table 13. Known issues and workarounds for i.MX 7 Family SoC

SoC	Module	Source	Description	Workaround
			the Ethernet is down and loses IP address with the SD card image.	See https://wiki.archlinux.org/index.php/ConnMan#Wi-Fi .

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

SoC	Module	Source	Description	Workaround
8QuadXPlus	Video	Hardware	There is an error "error: alloc_dma_buffer() dma buffer alloc size (120000) fail!" during 8 HEVC multi-instance decode.	The issue will be fixed in the next release.
8QuadXPlus	OpenCV	Hardware	The process is stuck and the GPU hangs during the test case "opencv_perf_core".	The issue will be fixed in the next release.
8QuadXPlus	Wayland	Software	The galcore hangs for Vulkan SDK TextureCompression_Wayland.	The issue will be fixed in the next release.
8QuadXPlus	Video I/O	Hardware	The display always prints "imx-dpu-crtc imx-dpu-crtc.0: flush - wait for content shld done timeout" after gplay stress test.	The issue will be fixed in the next release.
8QuadXPlus	OpenCV	Hardware	The GPU hangs during the OpenCV stress test "opencv_test_core".	The issue will be fixed in the next release.
8QuadXPlus	Tools	Hardware	The GPU top tool occupancy mode test fails.	The issue will be fixed in the next release.
8QuadXPlus	Security	Hardware	The rfc4106(gcm(aes)) (rfc4106-gcm-aes-caam) decryption cannot work.	The issue will be fixed in the next release.
8QuadXPlus	Storage	Hardware	Running MLB causes the system kernel panic.	The issue will be fixed in the next release.
8QuadXPlus	Video	Software	H.264-BP and H.264-HP multi-instance fails.	The issue will be fixed in the next release.
8QuadXPlus	Video	Hardware	The kernel dump andVPU decode stop during 8 HEVC multi-instance decode.	The issue will be fixed in the next release.
8M Quad	Video I/O	Hardware	Sony KD-49X7066D and Sony KLV-32J400A) authentication fails.	The issue will be fixed in the next release.
8M Quad	Video I/O	Hardware	Dell P2414Hb (max. to 1080p) DP monitor and LG-27UD68 DP monitor have no display after boot-up.	The issue will be fixed in the next release.
8M Quad	Video I/O	Hardware	The 720x480@60 mode test with all formats display has dislocation and flicker.	The issue will be fixed in the next release.
8M Quad	Wayland	Software	The error "EGL: errno=22 (Invalid argument)" occurs during the multiple-CTS stress test.	The issue will be fixed in the next release.

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

SoC	Module	Source	Description	Workaround
8M Quad/ 8QuadXPlus	OpenCV	Hardware	The process is stuck and the GPU hangs during the OpenCV test case "opencv_perf_gapi".	The issue will be fixed in the next release.
8M Quad/ 8QuadXPlus	Wayland	Software	The multiple math OpenCL stress test fails.	The issue will be fixed in the next release.
8M Quad/ 8QuadMax	Wayland	Software	Fails to pass the Vulkan CTS test.	The issue will be fixed in the next release.
8M Quad/ 8QuadMax/ 8QuadXPlus	TensorFlow-Lite	Software	Fails to pass Android NN CTS.	The issue will be fixed in the next release.
All	Kernel/BSP	Software	After getting IP address for WLAN 0, the Ethernet is down and loses IP address with the SD card image.	Use connmanctl to set up WLAN 0 instead of directly calling UDHCPD. See https://wiki.archlinux.org/index.php/ConnMan#Wi-Fi .

7 Multimedia

This chapter contains the information on the 4.5.1 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: <ul style="list-style-type: none"> vpudec: VPU-based video decoder plugin i.MX 8QuadXPlus or 8QuadMax: <ul style="list-style-type: none"> v4l2h265dec: V4L2 H.265 Decoder v4l2h264dec: V4L2 H.264 Decoder v4l2mpeg4dec: V4L2 MPEG4 Decoder v4l2mpeg2dec: V4L2 MPEG2 Decoder v4l2vc1dec: V4L2 VC1 Decoder v4l2h263dec: V4L2 H263 Decoder v4l2vp6dec: V4L2 VP6 Decoder v4l2vp8dec: V4L2 VP8 Decoder

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

Plugin	Features
	<ul style="list-style-type: none"> v4l2rvdec: V4L2 RMVB Decoder v4l2jpegdec: V4L2 JPEG Decode <p>i.MX all:</p> <ul style="list-style-type: none"> Software video decoder plugins: uses gst-libav plugins
Video encoder	<p>i.MX 8M Mini:</p> <ul style="list-style-type: none"> vpuenc_h264: VPU-based AVC/H.264 video encoder vpuenc_vp8: VPU-based VP8 video encoder <p>i.MX 8QuadXPlus or 8QuadMax:</p> <ul style="list-style-type: none"> v4l2h264enc: V4L2 H.264 encoder v4l2jpegenc: V4L2 JPEG Encoder <p>i.MX 6 family:</p> <ul style="list-style-type: none"> 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	<p>pulsesrc: PulseAudio Audio Source</p> <p>Note: The default audio source may not be the expected one. You can set the desired default one:</p> <pre>pactl list sources pacmd set-default-source {source number}</pre>
Audio Render	<p>pulsesink: PulseAudio Audio Sink</p> <p>Note: The default audio sink may not be the expected one. You can set the desired default one:</p> <pre>pactl list sinks pacmd set-default-sink {sink number}</pre>
Video render	<p>i.MX 8 family:</p> <ul style="list-style-type: none"> waylandsink: video sink based on Wayland interfaces <p>i.MX 8M:</p> <ul style="list-style-type: none"> kmssink: video sink based on the DCSS KMS driver, only for the second display in dual-display case <p>i.MX 6 Family:</p> <ul style="list-style-type: none"> overlaysink : G2D-based video sink plugin imxv4l2sink: V4L2-based video sink plugin <p>i.MX with GPU3D:</p> <ul style="list-style-type: none"> glimagesink: video sink based on EGL
Video source	<p>i.MX 8 Family:</p> <ul style="list-style-type: none"> v4l2src: V4L2-based camera source plugin <p>i.MX 6 Family:</p> <ul style="list-style-type: none"> imxv4l2src: V4L2-based camera source plugin
Video convert	<p>i.MX 2D hardware based video convert plugins to perform video color space conversion, resize, rotate, etc.</p> <ul style="list-style-type: none"> imxvideoconvert_g2d: GPU2D-based video convert plugin imxvideoconvert_ipu: IPU-based video convert plugin imxvideoconvert_pxp: PXP-based video convert plugin

Table continues on the next page...

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

Plugin	Features
Video compositor	<p>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.</p> <ul style="list-style-type: none"> • imxcompositor_g2d: GPU2D-based video compositor plugin • imxcompositor_ipu: IPU-based video compositor plugin • imxcompositor_pxp: PXP-based video compositor plugin
OpenGL (ES) Plugins	<ul style="list-style-type: none"> • gleffects: GL Shading Language effects plugin • gldeinterlace: video deinterlacing based on shaders • glvideomixer: compositing multiple videos together • 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	<ul style="list-style-type: none"> • Play, Stop • Pause, Resume • Fast seek, Accurate seek • Playback rate control (fast forward, fast rewind, slow forward)
Media Info	<ul style="list-style-type: none"> • Media meta data (artist, year, etc.) • Video Thumbnail • Audio Album Art
Subtitle	<ul style="list-style-type: none"> • Supports internal and external subtitle
Track Selection	<ul style="list-style-type: none"> • Audio Track Selection • Video Track Selection • Subtitle Selection
Display Control	<ul style="list-style-type: none"> • 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	-

Table continues on the next page...

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

	Demuxer feature	ASF	AVI	MP4	OGG	FLV	MPG2	MKV	RMVB
	Theora	-	-	-	Y	-	-	-	-
	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 VPU with 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	-

Table continues on the next page...

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

	Format	Platform	Profile	Min. resolution	Max. resolution	Frame rate	Bitrate	Comment
		i.MX 6	HP/MP/BP	64 x 64	1920 x 1080	60 fps	50 Mbps	-
	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	-	48 x 48	1920 x 1080	60 fps	60 Mbps	-
		i.MX 8QuadXPlus	-	64 x 64	1920 x 1080	60 fps	60 Mbps	-
		i.MX 8QuadMax	-	64 x 64	1920 x 1080	60 fps	60 Mbps	-
		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 8QuadXPlus	P0/P3	64 x 64	1920 x 1080	60 fps	-	-
		i.MX 8QuadMax	P0/P3	64 x 64	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 8QuadXPlus	AP/MP/SP	64 x 64	1920 x 1080	60 fps	-	-

Table continues on the next page...

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

	Format	Platform	Profile	Min. resolution	Max. resolution	Frame rate	Bitrate	Comment	
		i.MX 8QuadMax	AP/MP/SP	64 x 64	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 8QuadXPlus	-	64 x 64	1920 x 1080	60 fps	-	-	
		i.MX 8QuadMax	-	64 x 64	1920 x 1080	60 fps	-	-	
		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 8QuadXPlus	8/9/10	64 x 64	1920 x 1080	60 fps	-	-	
		i.MX 8QuadMax	8/9/10	64 x 64	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	-
			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)	stereo/mono	<= 48	8 - 448	8QuadXPlus supports H/W.	-

Table continues on the next page...

Table 20. Audio codec specification (continued)

Decoder	Feature/Profile	Channel	Sample rate (kHz)	Bit rate (kbps)	H/W or S/W	Comment
	MPEG-2 (Layer-1/ Layer-2/Layer-3) MPEG-2.5 (Layer-3)				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	-
	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

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
L4.14.98_2.0.0_ga	04/2019	i.MX 4.14 Kernel upgrade and board updates
L4.19.35_1.0.0	07/2019	i.MX 4.19 Beta Kernel and Yocto Project Upgrades
L4.19.35_1.1.0	10/2019	i.MX 4.19 Kernel and Yocto Project Upgrades

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