IMXLXRN
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 v5.4 Kernel upgrade and supports SoC in the i.MX 6, i.MX 7, and i.MX 8 series boards that have been released before, and they have been full tested and the production quality is GA in L5.4.70_2.3.0. They have been through automated testing to verify patches that were added after.

This document includes information for all previously released active i.MX SoCs and this can be used as context only for understanding this release. A future consolidated GA release will test and support all previously released GA i.MX SoCs listed below.

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 8M Plus EVK Board
  - i.MX 8DXL EVK Board (Proto1B with A1 only)
  - i.MX 8QuadXPlus MEK Board
  - i.MX 8DualX MEK Board
  - i.MX 8QuadMax MEK Board
  - i.MX 8M Quad EVK Board
  - i.MX 8M Mini EVK Board
  - i.MX 8M Nano 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 Boards
  - i.MX 6UltraLite EVK Board
  - i.MX 6ULL EVK Board

Contents

— 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.

- 8MP stands for the i.MX 8M Plus EVK Platform.

- 8DX stands for the i.MX 8DualX MEK Platform

- 8DXL stands for the i.MX 8DXL 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 Plus	GA quality.
8DXL	GA quality.
8M Quad	GA quality.
8M Nano	GA quality.
8M Mini	GA quality.
8QuadMax	GA quality.
8QuadXPlus	GA quality.
8DX	GA quality.
7Dual/Solo	GA quality.
7ULP	GA quality.
6QuadPlus	GA quality.

Table continues on the next page...

Table 1. Board validation and support scope (continued)

SoC	Test validation and support scope
6Quad	GA quality.
6DualLite	GA quality.
6SoloX	Automated test only.
6UltraLite	GA quality.
6ULL	GA quality.
6SLL	GA quality.
6ULZ	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 Plus, 8M Quad, 8M Mini, 8M Nano
- i.MX 8X Family: 8QuadXPlus, 8DXL, 8DualX

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) - Provides the information on installing U-Boot and Linux OS and using i.MX-specific features.
- *i.MX Yocto Project User's Guide* (IMXLXYOCTOUG) - 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 Machine Learning User's Guide* (IMXMLUG) - Provides the machine learning information.
- *i.MX Linux Reference Manual* (IMXLXRM) - Provides the information on Linux drivers for i.MX.
- *i.MX Graphics User's Guide* (IMXGRAPHICUG) - Describes the graphics features.
- *i.MX Porting Guide* (IMXXBSPPG) - Provides 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 8M Nano Evaluation Kit Quick Start Guide (8MNANOEVKQSG)

- i.MX 8QuadXPlus Multisensory Enablement Kit Quick Start Guide (IMX8QUADXPLUSQSG)

- i.MX 8QuadMax Multisensory Enablement Kit Quick Start Guide (IMX8QUADMAXQSG)

- i.MX 8M Plus Evaluation Kit Quick Start Guide (IMX8MPLUSQSG)

- i.MX 8DXL Multisensory Enablement Kit Quick Start Guide (IMX8DXLUSQSG)

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

- Git repo open source distributions on the Code Aurora i.MX Project and GitHub

- 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, "L5.4.70" indicates that this BSP release is based on the kernel version 5.4.70).

"<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	5.4.70
U-Boot	v2020.04
SD Card images	Pre-built images used for testing to use on target i.MX reference boards
Manufacturing Tools (UUU)	Version: 1.4.43 Used to burn a production image into the board
i.MX Open Source repos	i.MX open source modifications or NXP original open source

Table continues on the next page...

Table 2. Release contents (continued)

Component	Description
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 Linux User's Guide* (IMXLUG) 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-4.5.7.bin	i.MX optimized Audio and Video core codec libraries
imx-parser-4.5.7.bin	i.MX optimized core parser
imx-vpu-5.4.39.3.bin	i.MX VPU library for i.MX 6 with VPU
imx-vpu-hantro-1.20.0.bin	i.MX VPU Hantro libraries for i.MX 8M Quad, 8M Mini, and 8M Plus
imx-vpu-hantro-vc-1.3.0.bin	i.MX VPU Hantro vc8000e Encoder libraries for i.MX 8M Mini and 8M Plus
firmware-imx-8.10.bin	i.MX Firmware including firmware for VPU, DDR, EPDC, HDMI, and SDMA
imx-seco-3.7.4.bin	i.MX SECO firmware. for i.MX 8QuadMax, 8QuadXPlus, 8DX and 8DXL reference boards
imx-gpu-viv6.4.3.p1.0-aarch32.bin	i.MX Graphics libraries for i.MX 6 and 7 SoC with GPU
imx-gpu-viv-6.4.3.p1.0-aarch64.bin	i.MX Graphics libraries for i.MX 8
imx-gpu-g2d-6.4.3.p1.0.bin	i.MX Graphics G2D libraries for i.MX 6 and 7 with GPU
imx-dpu-g2d-6.4.3.p1.0.bin	i.MX Graphics G2D libraries for i.MX 8
imx-sc-firmware-1.7.0.bin	i.MX System Controller Firmware for i.MX 8QuadMax, 8QuadXPlus, 8DX and 8DXL reference boards
ml-security-1.0.3.bin	Machine Learning Security

Table continues on the next page...

Table 3. BSP and multimedia standard packages (continued)

File name	Description
imx7d-sabresd-m4-freertos-1.0.bin	i.MX 7D Cortex-M4 Demo
imx7ulp-m4-demo-2.8.0.1.bin	i.MX 7ULP Cortex-M4 Demo
imx8qm-m4-demo-2.8.0.1.bin	i.MX 8QuadMax Cortex-M4 Demo
imx8qx-m4-demo-2.8.0.1.bin	i.MX 8QuadXPlus Cortex-M4 Demo
imx8mq-m4-demo-2.8.0.1.bin	i.MX 8M Quad Cortex-M4 Demo
mx8mm-m4-demo-2.8.0.1.bin	i.MX 8M Mini Cortex-M4 Demo
mx8mn-m7-demo-2.8.0.1.bin	i.MX 8M Nano Cortex-M7 Demo
imx8dxl-m4-demos-2.9.0.bin	i.MX 8DXL Cortex-M4 Demo
mx8mp-m7-demo-2.9.0	i.MX 8M Plus Cortex-M7 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-4.5.7.bin	Coding Technologies AACplus decoder
imx-scfw-porting-kit-1.7.0.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 and GitHub. The following table lists all the repos on CAF and GitHub.

Table 5. i.MX Code Aurora Forum and GitHub 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
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

Table continues on the next page...

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

Repo	Description
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-imx	i.MX Yocto Project Release Layer
armnn-imx	i.MX Armnn Fork
onnxruntime-imx	i.MX Onnxruntime Fork
nn-imx	i.MX NN Fork
mwifiex	NXP Bluetooth Wifi kernel driver
gtec-demo-framework	i.MX Graphics Demo Framework on NXPMicro github
imx-firmware	i.MX Firmware for Cypress and NXP Wifi
imx-seco-libs	i.MX SECO libraries
imx-vpuwrap	i.MX VPU Wrapper
arm-computelibrary-imx	Arm compute library
pyarmnn-release	PyArmNN
tensorflow-imx	Tensor Flow

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-edgescale - EdgeScale demos for i.MX and QorIQ.
- meta-imx-iotedge - Azure IoT Edge demo.
- meta-imx-edgescale - EdgeScale demos for i.MX 8 M Quad.
- 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 that AGL is not supported on zeus.
- 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-scfw - Layer that builds system controller firmware from the porting kit.

- OTA - Note no extra layer. Contact Mender to integrate the 3rd-party Mender OTA solution.

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-4.5.7.bin	i.MX optimized Microsoft codec
imx-msparser-4.5.7.bin	i.MX optimized Microsoft ASF parser
imx-real-4.5.7.bin	i.MX Real Networks RMVB Decoders and Parsers
imx-dsp-1.0.16.bin	DSP firmware
imx-dsp-codec-1.0.16.bin	DSP decoders (MP2, MP3, BSAC, DRM, DABPlus,SBC)
imx-dsp-codec-ext-1.0.16.bin	DSP extra codecs
imx-dsp-codec-aacp-1.0.16.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 5.4.70.

- Upgraded the U-Boot to v2020.04.

- Updated EULA to v13 June 2020.

- Upgraded the Yocto Project to version 3.1 Zeus.

    — Supports the Marvell Bluetooth/Wi-Fi driver

    — Distro updated for debian package management

- Supports the GCC 9.2 toolchain.

- Cortex-M4 Demo 2.8.0.1 upgrades for i.MX 8QuadXPlus and Cortex-M4 and Cortex Demo 2.9.0 updates for I.MX 8M Plus and i.MX 8DXL.

- Security

    — OpenSSL updated to 1.1.1g from 1.1.1d.

    — CAAM now supported on all i.MX 6, i.MX 7, and i.MX 8 devices - this release for SCFW-based silicon.

    — Addition of caamkeynotesigning tool.

    — OP-TEE upgraded to 3.10.0

- Qt upgraded to 5.15.

- Multimedia updates:

    — imx-vpuwrap released on github.

    — Gstreamer upgraded to 1.16.2.

    — Sound Open Firmware released supported for devices with a DSP.

    — imx-sw-pdm - i.MX Software PDM to PCM decimation released.

- Graphics updates:

    — GPU driver upgraded to 6.4.3.p1.0 with vulkan enablement, bug fixes, and performance optimizations.

    — i.MX 8QuadMax and 8M Plus support OpenVX 1.2 with NN extension.

    — i.MX 8QuadMax, 8QuadXPlus, 8M Plus, and 8M Quad support Vulkan 1.1.

    — GPU SDK upgraded to 5.6.2.

    — Weston upgraded to 9.0.0.

    — Chromium upgraded to 83.0.4103.116.

- Machine Learning updates:

    — OpenCV upgraded to 4.4.0.

    — Tensorflow-lite upgraded to 2.3.1 with GPU acceleration. Tensorflow not supported in 5.4 release.

    — Arm NN upgraded to 20.02 with GPU acceleration with a fork on CAF.

    — Onnx-runtime upgraded to 1.1.2 with a fork on CAF.

    — PyArmNN released on GitHub.

    — nn-imx, which was upgraded to 20.02, is separated from graphics distribution and released on CAF (version 1.1.7).

Features on i.MX 8M Mini:

- Supports the LPDDR4 EVKB board (NXP PMIC and Wi-Fi) as the default board.

Features on i.MX 8M Nano:

- Supports the i.MX 8M Nano with the Arm v8 architecture:

    — 4x Cortex-A53 and one Cortex-M7.

- Supports the DDR3L EVK board with 11x11 package.

Features on i.MX 8M Plus:

- Supports the i.MX 8M Plus with the Arm v8 architecture:

    — 4x Cortex-A53 SMP enabled and one Cortex-M7F cores.

- Supports machine learning with hardware acceleration.

- Supports LPDDR4 at 4000MTS.

- Supports low-power feature: ARM DVFS, CPU Idle, Suspend/Resume, and LPDDR4 frequency scaling.

- Supports USB 3.0, PCIe, Ethernet TSN, CAN-FD, and FlexSPI.

- Supports Display with HDMI, MIPI-DSI, and LVDS.

- Supports Camera with MIPI-DSI + OV5640.

- Supports dual and triple displays.

- Supports hardware video decoding and encoding.

- Supports multiple-channel audio transmission and receiving from DAC/ADC.

- Supports audio transmission to HDMI.

- Supports audio receiving from eARC and ARC.

- Supports audio transmission and receiveing from SPDIF.

- Supports ASRC and PDM.

- Supports audio decoders and playback with HiFi4 DSP.

- Supports audio playback/record with Sound Open Firmware on HiFi4 DSP.

- Supports graphics with 3D and 2D hardware accleration.

- Supports Jailhouse virtualization.

- Supports security booting, CAAM, CSU, RDC, and SNVS.

- Supports OP-TEE.

- Supports ISP camera.

Features on i.MX 7ULP:

- Supports the B1 and B2 Silicon on EVKB boards.

Features on i.MX 8DXL:

- Supports the i.MX 8DXL with the Arm v8 architecture:

    — 2x Cortex-A35 SMP enabled and one Cortex-M4F core.

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 8M Plus
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 8DXL i.MX 8M Family: 8M Quad, 8M Mini, 8M Nano, 8M Plus
2D Graphics with DPU	i.MX 8 Family: 8QuadMax

Table continues on the next page...

Table 7. SoC hardware acceleration features (continued)

Feature	SoC
	i.MX 8X Family: 8QuadXPlus
Vulkan GPU	i.MX 8 Family: 8QuadMax i.MX 8X Family: 8QuadXPlus i.MX 8M Family: 8M Plus
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, 8M Plus
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, 8DualX i.MX 8M Family: 8M Quad, 8M Mini, 8M Nano, 8M Plus
M Core Boot	i.MX 6 Family: 6SoloX i.MX 7 Family: 7Dual, 7ULP i.MX 8 Family: 8QuadMax i.MX 8X Family: 8QuadXPlus , 8DX, 8DXL i.MX 8M Family: 8M Quad, 8M Mini, 8M Nano 8M Plus
HiFi4 DSP	i.MX 8 Family: 8QuadMax i.MX 8X Family: 8QuadXPlus, 8DualX i.MX 8M Family: 8M Plus
NXP eIQ Machine Learning	i.MX 8 Family: 8QuadMax i.MX 8X Family: 8QuadXPlus, 8DualX i.MX 8M Family: 8M Quad, 8M Mini, 8M Nano, 8M Plus

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 Section Overview. 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: 5.4.70
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 v2020.04. 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 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. i.MX 6QuadPlus/Quad/DualLite SABRE-SD and SABRE-AI support DDR3 528 MHz @ 64 bit. i.MX 6SoloX SABRE-SD support LDDR3 400 MHz @ 32 bit. 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 6SLL supports LPDDR3 400Mhz @ 32 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, seek=32. For 8M Quad, 8QuadMax A0, and 8QuadXPlus A0, seek=33. For 8QuadMax B0, 8QuadXPlus B0 and C0, 8M Nano, 8M Plus, and 8DXL, seek=32.
Boot Firmware	All i.MX 8	All i.MX 8 boards require Arm Trusted Firmware.

Table continues on the next page...

Table 8. Supported features (continued)

Feature	Supported board	Comment
		i.MX 8QuadMax 8DXL and 8QuadXPlus require System Controller Firmware. i.MX 8QuadMax 8DXL> 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	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		
Arm$^{®}$ Core	All i.MX	i.MX 6 SABRE-SD, 6 SABRE-AI, 6SLL, and 6 SoloX-SD support the Arm Cortex-A9 processor. i.MX 7Dual SABRE-SD and 7ULP EVK support the Arm Cortex-A7 and Cortex-M processor. i.MX 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 i.MX 8M Quad and i.MX 8M Mini support four Arm Cortex-A53 cores and one Arm Cortex-M4 core. i.MX 8M Nano supports four Arm Cortex-A53 cores and one Arm Cortex-M7F core. i.MX 8M Plus support four Arm Cortex-A53 cores and one Arm Cortex-M7F core. i.MX 8DXL supports two Arm Cortex-A35 cores and one Arm Cortex-M4F core.
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. i.MX 8QuadMax supports two 32-bit LPDDR4 channels @1600 MHz. i.MX 8QuadXPlus supports one 32-bit LPDDR4 channel @1200 MHz.

Table continues on the next page...

Table 8. Supported features (continued)

Feature	Supported board	Comment
		i.MX 8DXL supports one 32-bit LPDDR4 channel @ 1200 MHz.
		i.MX 8M Quad supports one 32-bit LPDDR4 channel @ 1600 MHz and 50 MHz.
		i.MX 8M Mini supports one 32-bit LPDDR4 channel @ 1500 MHz and 50 MHz.
		i.MX 8M Nano supports one 16-bit LPDDR4 channel @ 750 MHz and 25 MHz.
		i.MX 8M Plus supports one 32-bit LPDDR4 channel @ 2000 MHz and 50 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 SoC 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.
IOMUX	All i.MX	Provides the interfaces for I/O configuration. IOMUX-V3 version is used on i.MX 6, i.MX 7, and i.MX 8M boards. For i.MX 8QuadMax and 8QuadXPlus the system controller manages access to the IOMUX.
System Controller	8QuadMax 8QuadXPlus 8DXL	Provides abstraction to the hardware features and runs on Arm Cortex executing firmware.
DMA engine		
SDMA	All i.MX 6 All i.MX 7 All i.MX 8M	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 supports console through internal Debug UART1. i.MX 6SoloX SABRE-SD supports Cortex-A9 processor through UART1 and Cortex-M4 processor through UART2. i.MX 7Dual SABRE-SD supports Cortex-A7 processor through UART1 and Cortex-M4 processor through UART2. i.MX 6UltraLite, 6ULL, and 6ULZ EVK boards support Corttex-A7 processor through UART1. i.MX 6 SABRE-AI supports console through internal Debug UART 4.

Table continues on the next page...

Table 8. Supported features (continued)

Feature	Supported board	Comment
		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 Cortex-M4 through UART4.
		i.MX 8M Quad supports Cortex-A53 processor thorugh UART1 and Cortex-M4 processor through UART2.
		i.MX 8QuadMax and 8QuasXPlus use LPUART.
		i.MX 8QuadMax and 8QuasXPlus support Cortex-A53 processor through UART0 and Cortex-M4 processor through UART2.
		i.MX 8M Nano supports Cortex-A53 through UART2 and Cortex-M7 through UART4.
		i.MX 8M Plus supports Cortex-A53 through UART2 and Cortex-M7 through UART4.
		i.MX 8DXL supports Cortex-A35 through UART0 and Cortex-M4 through M40_UART0.
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-level 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 All i.MX 8M	Supports the system bus clock frequency scaling.
Battery charging	All i.MX 6 All i.MX 7 All 8M	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.

Table continues on the next page...

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.
EQOS_TSN	i.MX 8M Plus i.MX 8DXL	i.MX 8DXL supports AR8031 PHY, i.MX 8M Plus supports RTL8211FDI. Supports Ethernet TSN features.
IEEE® 1588	All i.MX 6 All i.MX 7 All i.MX 8	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 except for 8M Nano, 6SLL, 6UL, 6ULL, and 6ULZ	With the platform that supports PCIe module. For i.MX 6 and 7, the default kernel configuration 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. • 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 8QuadXPlus	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 support MLB 25/50 only.
FlexCAN	All i.MX 6 7D-SABRE-SD 8QuadMax 8QuadXPlus 8M Plus	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, 6UltreLite EVK, and 6ULL EVK. With the platform that supports the FlexCAN module, FlexCAN supports CANFD mode.
Wi-Fi/Bluetooth wireless technology	All i.MX	Supports Azurewave CM276 (NXP 88W8997) Wi-Fi/Bluetooth on i.MX 8QuadMax, i.MX 8QuadXPlus, i.MX 8M Quad, i.MX 8DXL, and i.MX 8M Plus. **NOTE** For platforms using Azurewave CM276 (NXP 88W8997), after booting, users need to load or modprobe moal first before other operations. Otherwise, modprobe moal module may fail after suspending resumes. This is a Wi-Fi module issue still under checking. Supports Azurewave CM358 (NXP 88W8987) Wi-Fi/Bluetooth on i.MX 6, i.MX 7Dual, i.MX 7ULP, i.MX 8M Mini LPDDR4 EVK, and i.MX 8M Nano LPDDR4 EVK.

Table continues on the next page...

Table 8. Supported features (continued)

Feature	Supported board	Comment
		All the i.MX 6 boards require board modifications to support Bluetooth and to boot with the Wi-Fi/Bluetooth device tree.
		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	All i.MX	Cryptographic Acceleration and Assurance Module.
SNVS	All i.MX 6 All i.MX 7 All i.MX 8M	Secure Non-Volatile Storage.
SIMv2	6UltraLite 7D-SABRE-SD	Smart Card Interface.
EMVSIM	8QuadMax	Smart Card Interface.
Sound drivers and DSP		
DSP	8QuadXPlus 8QuadMax 8MPlus	One HiFi 4 DSP
AK5558 AK4497 AK4458 AK5552	All i.MX 8M	Supported on Audio board but AK4497 and AK4458 on current audio board cannot work for i.MX 8M Nano.
WM8524 WM8960 SAI	All i.MX 8M	Supports playback.
WM8962/SSI WM8960/SSI	6SABRE-SD 6SoloX-SD 7D-SABRE-SD 6UltraLite 6ULL 6ULZ 6SLL 7ULP	Supports playback.

Table continues on the next page...

Table 8. Supported features (continued)

Feature	Supported board	Comment
SAI/MQS	8QuadMax	Supports playback.
S/PDIF	6SABRE-SD 6SABRE-AI 8QuadMax 8QuadXPlus All i.MX 8M	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 8M Nano 8M Plus	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.
SAI/MQS/WM8962	6SoloX-SD 7D-SABRE-SD 6UltraLite 6ULL 6ULZ 7ULP All i.MX 8M 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. Supports 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.

Table continues on the next page...

i.MX Linux® Release Notes , Rev. L5.4.70_2.3.0, 31 December 2020

Table 8. Supported features (continued)

Feature	Supported board	Comment
		Supports amixer alsamixer control from user space.
HDMI Audio	6SABRE-SD 6SABRE-AI 7ULP 8QuadMax 8M Quad 8M Plus	For i.MX 8QuadMax, it is not supported on the reference board but is able to add to the custom board. i.MX 8M Quad supports audio playback through HDMI.
eARC	8M Plus	i.MX 8M Plus supports audio receive from eARC.
Input device drivers		
USB devices	All i.MX	Supports USB mouse and USB keypad through USB ports.
Touch panel	All i.MX	6SABRE-SD and 6SABRE-AI supports EGalaxy capacitive touch screen. 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 7D-SABRE-SD 7ULP	Supports the resistive touch panel.
Storage drivers		
FlexSPI-NOR	6SoloX-SD 6UltraLite 6ULL 6ULZ 7D-SABRE-SD All i.MX 8	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, 8M Mini, and 8M Plus support FlexSPI1. i.MX 8M Mini supports NOR Flash Boot.
SPI-NOR	6SABRE-AI	Supports M25P32. On i.MX 6SABRE-SD Dual/Quad/DualLite, there is a pin conflict for supporting SPI-NOR.
NAND	6SABRE-AI 7D-SABRE-SD 8QuadXPlus 8M Quad	Normal NAND and ONFI NAND asynchronous mode with BCH40/BCH62.

Table continues on the next page...

i.MX Linux® Release Notes , Rev. L5.4.70_2.3.0, 31 December 2020

NXP Semiconductors

BSP Supported Features

Table 8. Supported features (continued)

Feature	Supported board	Comment
	8M Mini	
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, i.MX 6 QuadPlus SABRE_SD and SABRE-AI, and 8QuadMax.
	USB drivers	
USB Host	All i.MX	Supports USB HOST1 and USB OTG host.
USB Device	All i.MX	Supports USB OTG device mode.
USB	All i.MX	Supports USB OTG2.0, USB Host2.0 for all i.MX. All i.MX8 and i.MX 7ULP EVK boards support Type-C ports. The boards that support USB 3.0 are i.MX 8QuadMax and 8QuadXPlus MEK boards and 8M Quad and 8M Plus EVK boards. 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 8M 8QuadXPlus 8QuadMax	Graphics Chips Details: See *i.MX Graphics User's Guide* (IMXGRAPHICUG) for more details. One GC7000-Lite on 8M Quad. One GC7000-Ultra-Lite on 8M Nano. One GC7000-NanoUltra and GC320 on 8M Mini. One GC7000-Ultra-Lite and GC520I on 8M Plus. Two GC7000XSVX 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

Table continues on the next page...

Table 8. Supported features (continued)

Feature	Supported board	Comment
		• Supports OpenGL ES1.1 • Supports OpenGL ES2.0 (WebGL 1.0.1 compatible on X11) • Supports OpenGL ES3.0 on all except i.MX 6SoloX, 7ULP, and 8M Mini which support 2.0 only • Supports OpenGL ES3.1 i.MX 8QuadMax, 8QuadXPlus, 8DualX, 8M Plus, and 8M Quad • Supports OpenGL ES3.2 on i.MX 8QuadMax • Supports Vulkan 1.1 on i.MX 8QuadMax, 8QuadXPlus, 8DualX, 8M Plus and 8M Quad • Supports OpenVX on i.MX 8QuadMax and 8M Plus • 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, 8DualX, and 8M Quad. • Supports OpenGL2.1
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 6SoloX SABRE-SD, 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 all i.MX 8M. DCSS is used for i.MX 8M Quad
Framebuffer compression	8M Quad	Supports graphic framebuffer compression with DEC400.
VDOA	6SABRE-SD 6SABRE-AI	Supports Video Data Order Adapter for tiling.
LVDS	6SABRE-SD 6SABRE-AI 6SoloX-SD 8QuadMax 8QuadXPlus 8M Plus	Supports HannStar LVDS panel on i.MX 6. It is the default display if no other video option is set up. Uses the LDB controller. On the SABRE-AI there are two ports. Port 0 is the default. For i.MX 8, it supports the Mixel controller.
HDMI Display	6SABRE-SD 6SABRE-AI 6SoloX-SD	i.MX 6SABRE-SD, 6SABRE-AI, and 7Dual support on-chip HDMI hardware. i.MX 6SoloX SABRE-SD supports external HDMI hardware. i.MX 7ULP EVK supports HDMI through the MIPI pins with external HDMI hardware.

Table continues on the next page...

Table 8. Supported features (continued)

Feature	Supported board	Comment
	7D-SABRE-SD 7ULP	
HDMI/Display Port	8M Quad 8QuadMax 8M Plus	i.MX 8QuadMax supports HDMI audio and on-chip HDMI hardware through MIPI pins. i.MX 8M Quad supports HDMI through DCSS. i.MX 8M Plus only supports HDMI.
LVDS to HDMI	8QuadMax 8M Plus 8QuadXPlus	Uses ITE Driver IT6263.
MIPI to HDMI	All i.MX 8 7ULP	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 i.MX 8	Supports 2 lanes through MIPI daughter card on i.MX 6 and i.MX 7-SABRE-SD. Supports 2 lanes MIPI DSI with direct connection on i.MX 7ULP. The default display for i.MX 7ULP EVK board is HDMI. MIPI DSI supports with hardware rework. Supports 4 lanes driven by DPU with up to 1080p60 on i.MX 8QuadMax and 8QuadXPlus. Supports 4 lanes driven by LCDIF with up to 720p60 on i.MX 8M Quad. Supports 4 lanes driven by LCDIF up to 1920x1200p60 on i.MX 8M Mini, 8M Nano, and 8M Plus. 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.

Table continues on the next page...

Table 8. Supported features (continued)

Feature	Supported board	Comment
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 6SABRE-AI All i.MX 8	i.MX 6 Encoder: MPEG-4, H.263, H.264 (AVC/MVC), MJPEG 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 i.MX 8M Plus Encoder: 1080p60 HEVC, H.264 i.MX 8M Plus Decoder : 1080p60 HEVC, H.264, VP9, VP8
DPU	8QuadMax 8QuadXPlus	Supports through DRM display framework and provides 2D Graphics processing. Supports DPR tiling.

Table continues on the next page...

Table 8. Supported features (continued)

Feature	Supported board	Comment
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 1 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 i.MX 8M Plus and 1 camera on i.MX 8M Mini, and 8M Nano. Supports 1 camera on i.MX 8QuadXPlus. Supports 8 cameras on i.MX 8QuadMax.
MIPI Camera CSI	6SABRE-SD 7D-SABRE-SD 7ULP All i.MX 8M 8QuadMax 8QuadXPlus	Supports 2-lane CSI MIPI camera OV5640 with 720p30, 640x480@30, 320x240@30, 720x480@30, 1080p@30, 2592x1944@15, 176x144@30. Also supports CSI MIPI camera OV10635 with 1280x800@30, ov10635 max supports 1280x800@30, and ISI does not support upscale, so 1080p, 2592x1944 cannot be supported on i.MX 8QuadMax and 8QuadXPlus. Supports 4-lane Basler CSI MIPI cameras AR0821 with 4K@30 with ISP on i.MX 8M Plus.
Parallel CSI	6SABRE-SD 6SoloX-SD 6UltraLite 6ULL 6ULZ 6SLL 8QuadXPlus	Supports OV5640 camera sensor.
ISI	8QuadMax	Supports capture through ISI controller.

Table continues on the next page...

Table 8. Supported features (continued)

Feature	Supported board	Comment
	8QuadXPlus 8M Nano 8M Plus	
ISP	8M Plus	Supports capture through ISP controller. Supports AE/AF/AWB/DEWARP/LSC/CPROC, etc.
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 8 and i.MX 8M.
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.MX Linux Reference Manual* (IMXLRM) for more information.

Table continues on the next page...

Table 8. Supported features (continued)

Feature	Supported board	Comment
Accelerometer	6SABRE-SD 6SABRE-AI 6SoloX-SD 6UltraLite 6ULL 6ULZ 7D-SABRE-SD 7ULP 8QuadXPlus	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.
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 All i.MX 8	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 8QuadMax 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, as well as 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-imx 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 imx7dsabresd imx6ulevk imx6ull14x14evk imx6ullz4x14evk imx7ulpevk imx8qmmek imx8qxpmek, imx8qxpc0mek imx8mqevk imx8mmevk imx8mnevk imx8mpevk imx8dxlevk, imx8dxmek
spi-nor	Supports booting from SPI-NOR.	imx6qsabreauto, imx6dlsabreauto imx6qpsabreauto
eim-nor	Supports booting from Parallel NOR.	imx6qsabreauto, imx6dlsabreauto, imx6solosabreauto imx6qpsabreauto
nand	Supports booting from NAND.	imx6qsabreauto, imx6dlsabreauto, imx6solosabreauto imx6qpsabreauto imx7dsabresd imx6ull14x14evk
sata	Supports booting 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.	imx6sxsabresd with QSPI2 imx7dsabresd with QSPI1 imx6ulevk with QSPI1

Table continues on the next page...

Table 9. U-Boot configurations (continued)

U-Boot configuration for Boot device	Description	Supported machine configuration
	The booting address for QSPI2 is 0x78000000. The booting address for QPIS1 is 0x68000000.	imx6ulz14x14evk 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 imx6ulz14x14evk imx7ulpevk
m4fastup	Supports booting from Arm Cortex-M4 processor by disabling QSPI2 from using Arm Cortex-M4 processor.	imx6sxsabresd
epdc	Supports EPDC splash screen in U-Boot.	imx7dsabresd
flexspi (fspi)	Supports FlexSPI boot.	imx8qmmek imx8qxpmek imx8dxlevk imx8mmmek imx8mnevk imx8mpevk

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 `imx_v8_defconfig` in `arch/arm64/configs`.
DTB Descriptions	Each reference board has a standard device tree as follows: • imx6q-sabresd.dtb, imx6qp-sabresd.dtb • imx6dl-sabresd.dtb • imx6q-sabreauto.dtb, imx6qp-sabreauto.dtb

Table continues on the next page...

Table 10. Kernel and device tree configurations (continued)

Kernel and device tree configuration	Description
	• imx6dl-sabreauto.dtb • imx6sx-sdb.dtb: Supports the i.MX 6SoloX SABRE-SDB Rev. B board, and imx6sx-sdb-reva.dtb 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 • imx8mq-evk.dtb • imx8mm-evk.dtb, imx8mm-ddr4-evk • imx8mn-evk.dtb, imx8mn-ddr4-evk.dtb • imx8mp-evk.dtb: Supports single or multiple displays with HDMI, MIPI-DSI-HDMI, and LVDS-HDMI • imx8dxl-evk.dtb • 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. It is for non-partition boot that flash.bin does not include the Cortex-M4 image. • 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. • 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. • imx8dx-mek.dtb
Audio	Enables various audio device trees. • imx8mp-ab2.dtb: audio board • imx8mp-evk-sof-wm8960.dtb: Sound open firmware for WM8960 audio • imx8mq-evk-ak4497.dtb: audio board ak4497 codec • imx8mq-evk-pdm.dtb: PDM microphone • imx8mq-evk-audio-tdm.dtb: audio board TDM • imx8mm-evk-ak4497.dtb: audio board ak4497 codec

Table continues on the next page...

Table 10. Kernel and device tree configurations (continued)

Kernel and device tree configuration	Description
	• imx8mm-evk-ak5558.dtb: audio board ak5558 codec • imx8mm-evk-audio-tdm.dtb: audio board TDM • imx8mn-dd4-evk-ak5558.dtb: audio board TDM • imx7ulp-evk-wm8960.dtb: Enables WM8960 audio as the default one and disables HDMI audio • imx7d-sdb-reva-hdmi-audio.dtb: Enables HDMI audio as the default one and disables WM8960 audio
Bluetooth® wireless technology Wi-Fi	Enables the Bluetooth wireless technology and Wi-Fi hardware. The followings support Azurewave CM276 with NXP 88w8997 chip inside: • imx8mq-evk-pcie1-m2.dtb • imx8mp-evk.dtb • imx8dx-mek-rpmsg.dtb • imx8qxp-mek-rpmsg.dtb • imx8dxl-evk.dtb • imx8qm-mek-rpmsg.dtb The followings support Azurewave CM358 with NXP 88w8987 chip inside: • imx6q-sabresd-btwifi.dtb • imx6qp-sabresd-btwifi.dtb • imx6dl-sabresd-btwifi.dtb • imx6sll-evk-btwifi.dtb • imx6sx-sabresd-btwifi.dtb • imx6ul-14x14-evk-btwifi.dtb • imx6ul-9x9-evk-btwifi.dtb • imx6ull-14x14-evk-btwifi.dtb • imx6ulz-14x14-evk-btwifi.dtb • imx7ulp-evkb.dtb • imx7d-sdb-usd-wifi.dtb • imx8mm-evk.dtb • imx8mn-evk.dtb
Video Capture	• imx8qxp-mek-ov5640.dtb: Supports one MIPI OV5640 and one parallel OV5640, which indicates to support two cameras. Tested with non-M4 flash.bin. • imx8qm-mek-ov5640.dtb: Supports one or two OV5640 sensors at the same time.

Table continues on the next page...

Table 10. Kernel and device tree configurations (continued)

Kernel and device tree configuration	Description
	• imx8mq-evk-mipi-csi2.dtb: MIPI-CSI2. • imx8mp-evk-basler.dtb: ISP camera. • imx8mp-evk-basler-ov5640.dtb: Dual camera Basler ISP + OV5640. • 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	• imx8mp-evk-it6263-lvds-dual-channel.dtb: Dual-channel LVDS to HDMI converter. • imx8mp-evk-rm67191.dtb: OLED panel. • imx8mp-evk-jdi-wuxga-lvds-panel.dtb: LVDS panel. • imx8qxp-mek-dsi-rm67191.dtb: Supports RM67191 MIPI OLED display panel. Tested with non-M4 flash.bin. • imx8qxp-mek-it6263-lvds0-dual-channel.dtb: Supports the LVDS-HDMI display with LVDS0 dual-channel feature. Tested with non-M4 flash.bin. • imx8qxp-mek-it6263-lvds1-dual-channel: Supports the LVDS-HDMI display with LVDS1 dual-channel feature. Tested with non-M4 flash.bin. • 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. • 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. • 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. • imx8qm-mek-hdmi.dtb: Supports native HDMI TX interface on the CPU board. • 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. • imx8mq-evk-lcdif-adv7535.dts: LCDIF + MIPI-DSI + HDMI adaptor. • imx8mq-evk-dcss-adv7535.dtb: DCSS + MIPI-DSI + HDMI adaptor. • imx8mq-evk-dcss-rm67191.dtb: DCSS + MIPI-DSI + OLED panel. • imx8mq-evk-dual-display.dtb: Dual-display-to-HDMI and MIPI-to-HDMI adapter. • imx8mq-evk-dp.dtb: Display Port support.

Table continues on the next page...

Table 10. Kernel and device tree configurations (continued)

Kernel and device tree configuration	Description
	• imx8mq-evk-epd.dtb: Embedded Display Port support. • imx8mm-evk-rm67191.dtb: OLED panel. • imx8mm-ddr4-evk-rm67191.dtb: DDR4 EVK board with OLED panel. • imx8mn-ddr4-evk-rm67191.dtb, imx8mn=evk-rm67191: 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	Enables eCSPI, which is disabled in the default DTB. • imx6dl-sabreauto-ecspi.dtb • imx6q-sabreauto-ecspi.dtb • imx6qp-sabreauto-ecspi.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. • imx6sx-sdb-emmc.dtb • imx7ulp-evk-emmc.dtb • imx6ulz-14x14-evk-emmc.dtb
ENET2	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: • imx8qxp-mek-enet2.dtb: Supports ENET port on base boards. • imx8qxp-mek-enet2-tja1100.dtb: ENET2 uses TJA1100 Ethernet PHY. • imx8qm-mek-enet2-tja1100.dtb: ENET2 uses TJA1100 Ethernet PHY.
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. • imx6q-sabresd-enetirq.dtb • imx6dl-sabresd-enetirq.dtb • imx6dl-sabreauto-enetirq.dtb • imx6q-sabreauto-enetirq.dtb

Table continues on the next page...

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. • imx6q-sabreauto-flexcan1.dtb • imx6dl-sabreauto-flexcan1.dtb • imx6qp-sabreauto-flexcan1.dtb
Flexcan2	Enables flexcan2 which is disabled by default in standard DTB. • imx8mp-evk-flexcan2.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: • 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. • imx6q-sabresd-hdcp.dtb • imx6dl-sabresd-hdcp.dtb • imx6qp-sabresd-hdcp.dtb
Hypervisor Jailhouse	Enables the Jailhouse Hypervisor device trees. • imx8qxp-mek-root.dtb: DTB for root-cell • imx8qxp-mek-inmate.dtb: DTB for the inmate cell • imx8qm-mek-root.dtb: DTB for root-cell • imx8qm-mek-inmate.dtb: DTB for the inmate cell • imx8mq-evk-root.dtb: DTB for root-cell • imx8mq-evk-inmate.dtb: DTB for the inmate cell • imx8mm-evk-root.dtb: DTB for root-cell • imx8mm-evk-inmate.dtb: DTB for the inmate cell • imx8mq-evk-root.dtb: Supports Jailhouse hypervisor • imx8mm-evk-root.dtb: Supports Jailhouse hypervisor • imx8mn-evk-root.dtb: Supports Jailhouse hypervisor • imx8mn-evk-inmate.dtb: DTB for the inmate cell • imx8mp-evk-inmate.dtb: DTB for the inmate cell • imx8mp-evk-root.dtb: DTB for root-cell

Table continues on the next page...

Table 10. Kernel and device tree configurations (continued)

Kernel and device tree configuration	Description
Hypervisor Xen	Enables the Xen Hypervisor device trees • imx8qxp-mek-dom0.dtb: Xen Linux guest Linux DTB file. • imx8qm-mek-dom0.dtb: Supports Xen hypervisor dom0. • imx8qm-mek-dom0-dpu2.dtb: Supports the Xen hypervisor dom0 dpu2. • imx8qm-mek-domu.dtb: Supports Xen hypervisor domu. • imx8qm-mek-domu-dpu1.dtb: Supports Xen hypervisor domu-dpu1. • 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: • 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	Enables LPUART. • imx7ulp-evk-lpuart.dtb
Multi-Core, M4 and RPMSG	Enables the M-Core and RPMSG • imx8mp-evk-rpmsg.dtb: RPMSG. • imx8dxl-evk-rpmsg: RPMSG. • imx8qxpc0-mek-rpmsg and imx8qxp-mek-rpmsg with RPMSG • 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. • imx8dx-mek-rpmsg.dtb • imx8dx-mek-dsp.dtb • 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. • imx8qm-mek_ca53.dtb: Supports four CortexA53 cores only.

Table continues on the next page...

Table 10. Kernel and device tree configurations (continued)

Kernel and device tree configuration	Description
	• 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. • imx8qm-mek-enet2-tja1100.dtb: Supports the tja1100 ENET daughter card. • imx8mq-evk-rpmsg.dtb: RPMSG. • imx8mm-evk-rpmsg.dtb: RPMSG. • imx8mn-evk-rpmsg.dtb and imx8mn-ddr4-evk-rpmsg.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. • imx8qxp-mek-sof-wm8960.dtb, imx8qm-mek-sof-wm8960.dtb: Enables playback/record using Sound Open Firmware for HiFi4 DSP with WM8960 codec. • imx8qm-mek-sof-cs42888.dtb, imx8qm-mek-sof-cs42888.dtb: Enables playback/record using Sound Open Firmware for HiFi4 DSP with CS42888 codec. 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 `x-rpmsg.dtb`.
Qspi	Enables DDR Quad mode for Macronix QSPI chip mx25l51245g by setting Quad bit in status register. • imx7-sdb-qspi.dtb imx7-sdb-reva-qspi.dtb • imx7ulp-evk-qspi.dtb
SD1	Enables sd1 on uSDHC1 on the base board. • imx7ulp-sd1.dtb
Touch	Adds tsc2046 touch screen controller support. Because the pin PENIRQ of tsc2046 conflicts with the interrupt pin of HDMI, this disables the HDMI. • imx7-sdb-reva-touch.dtb
USB	Enables USB certification for i.MX 6UltraLite. • 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.

Table continues on the next page...

Table 11. Common kernel boot parameters (continued)

Kernel parameter	Description	Typical value	Used when
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".
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

Table continues on the next page...

Table 11. Common kernel boot parameters (continued)

Kernel parameter	Description	Typical value	Used when
			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. 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=RGB24video= mxcfb1:dev=ldb, if=RGB666 2. video=mxcfb0:dev=ldb,if=RGB666vi deo=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=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. 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

Table continues on the next page...

Table 11. Common kernel boot parameters (continued)

Kernel parameter	Description	Typical value	Used when
			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 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=3	"dmfc=1" means DMFC_HIGH_RESOLUTION_DC. "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.

Table continues on the next page...

Table 11. Common kernel boot parameters (continued)

Kernel parameter	Description	Typical value	Used when
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
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 UDHCPC. See https://wiki.archlinux.org/ index.php/ConnMan#Wi-Fi.
i.MX 6SoloLite	Audio	Software	Bluetooth cannot control the music player any more after the first play.	It will be fixed in next release.
i.MX 6SoloX	HWRNG	Software	HWRNG performance drops by 84.6% after suspending/ resuming.	It will be fixed in next release.

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

SoC	Module	Source	Description	Workaround
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 UDHCPC. See https://wiki.archlinux.org/ index.php/ConnMan#Wi-Fi.
i.MX 7ULP	CAAM	Software	Standby mode suspending fails with CAAM error when using non-optee U-Boot.	It will be fixed in next release.

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

SoC	Module	Source	Description	Workaround
i.MX 8M Plus/8M Quad	Wi-Fi	Hardware	With AW-CM276MA Wi-Fi card: modprobe module fails after suspending/resuming.	Hardware rework needs to be applied on the V4 AW-CM276MA Wi-Fi card.
i.MX 8M Plus	ISP	Software	V4L2-CTL full auto test meets the RCU stall issue with Basler camera after the PM test.	It will be fixed in next release.
i.MX 8M Nano	ONNX	Software	onnx_test_runner with inception_v4_299 meets GPU core hanging when testing with vsi_npu execution provider.	It will be fixed in next release.
i.MX 8DXL	OP-TEE	Software	OP-TEE does not work on Rev.A1.	This is due to Rev.A1 LSIO software workaround. It will be fixed in next release.
i.MX 8M Plus	ISP	Software	video_test FPS is only about 2 FPS with Basler camera.	This is caused by the application software using software CSC instead of hardware. It will be fixed in next release.

7 Multimedia

This chapter contains the information on the 4.5.7 multimedia component of the BSP.

The GStreamer version in this release is 1.16.2.

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 spdifdemux: Parses IEC937 file into compressed audio
Audio decoder	beepdec: unified audio decoder plugin Supports MP3, AAC, AAC+, WMA, AC3, Vorbis, DD+, AMR, RA
Audio encoder	lamemp3enc: MP3 encoder plugin
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

Table continues on the next page...

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

Plugin	Features
	• v4l2h264dec: V4L2 H.264 Decoder • v4l2mpeg4dec: V4L2 MPEG4 Decoder • v4l2xviddec: V4L2 XVID Decoder • v4l2mpeg2dec: V4L2 MPEG2 Decoder • v4l2vc1dec: V4L2 VC1 Decoder • v4l2h263dec: V4L2 H.263 Decoder • v4l2vp6dec: V4L2 VP6 Decoder • v4l2vp8dec: V4L2 VP8 Decoder • v4l2rvdec: V4L2 RMVB Decoder • v4l2spkdec: V4L2 SPK Decoder • v4l2jpegdec: V4L2 JPEG Decode • v4l2video1jpegdec: V4L2 JPEG Decoder i.MX all: • Software video decoder plugins: uses gst-libav plugins
Video encoder	i.MX 8M Plus: • vpuenc_h264: VPU-based AVC/H264 video encoder • vpuenc_hevc: VPU-based HEVC video encoder i.MX 8M Mini: • vpuenc_h264: VPU-based AVC/H.264 video encoder • vpuenc_vp8: VPU-based VP8 video encoder i.MX 8QuadXPlus or 8QuadMax: • v4l2h264enc: V4L2 H.264 encoder • v4l2jpegenc: V4L2 JPEG 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}`

Table continues on the next page...

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

Plugin	Features
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} ``` tinycompresssink: Tinycompress Audio Direct Sink Note: Audio sink is based on tiny compress API for low power audio playback.
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

Table continues on the next page...

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

Plugin	Features
	• 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+, 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 8 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 (H.264, MPEG4, H.263, MJPEG, HEVC, VP8) 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	-	-	-	-
	RV	-	-	-	-	-	-	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
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 Plus 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 Plus 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	1920 x 1080	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 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	-
VP9	i.MX 8M Quad	profile 0, 2	96 x 72	4096 x 2160	60 fps	100 Mbps	-
	i.MX 8M Plus 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 Plus 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/ XVID	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	-

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
	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	-	-
		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	-
	Sorenson Spark	i.MX 8QuadXPlus	-	64 x 64	1920 x 1080	60 fps	-	-
		i.MX 8QuadMax	-	64 x 64	1920 x 1080	60 fps	-	-
Video Encoder	H.264	i.MX 8M Plus	HP/MP/BP	132 x 96	1920 x 1080	60 fps	40 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 8M Mini						
		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	-
	H.265	i.MX 8M Plus	main / main 10	64 x 64	1920 x 1080	60 fps	-	-
	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

	Platform	Feature/ Profile	Feature/ Profile	Channel	Sample rate (kHz)	Bit rate (kbps)	Comment
DSP Audio Decoder	i.MX 8M Plus i.MX QuadXPlus i.MX 8QuadMax	MP3	MPEG-1 (Layer-1/ Layer-2/ Layer-3)	stereo/mono	<= 48	32-448	-
			MPEG-2 (Layer-1/ Layer-2/ Layer-3)		<= 24	8-256	-
			MPEG-2.5 (Layer-3)		<= 12	8-160	-
	i.MX 8M Plus i.MX QuadXPlus i.MX 8QuadMax	AACLC	MPEG-2 AACLC MPEG-4 AACLC	<=5.1	8-96	-	Bit rate depends on both the sample rate and the number of channels
	i.MX 8M Plus	Ogg Vorbis	q1 - q10	Stereo	8-192	<= 500	-

Table continues on the next page...

Table 20. Audio codec specification (continued)

	Platform	Feature/ Profile	Feature/ Profile	Channel	Sample rate (kHz)	Bit rate (kbps)	Comment
	i.MX QuadXPlus i.MX 8QuadMax						
	i.MX 8M Plus i.MX QuadXPlus i.MX 8QuadMax	WMA STD	L1 @ QL1	stereo/mono	44.1	64-161	-
			L2 @ QL1		<= 48	<= 161	-
			L3 @ QL1		<= 48	<= 385	-
	i.MX 8M Plus i.MX QuadXPlus i.MX 8QuadMax	WMA Pro	M0a @ QL2	stereo/mono	<= 48	48-192	-
			M0b @ QL2	stereo/mono	<= 48	<= 192	-
			M1 @ QL2	<= 5.1	<= 48	<= 384	-
			M2 @ QL2	<= 5.1	<= 96	<= 768	-
			M3 @ QL2	<= 7.1	<= 96	<= 1500	-
	i.MX 8M Plus i.MX QuadXPlus i.MX 8QuadMax	WMA Lossless	N1	stereo/mono	<= 48	<= 3000	-
			N2	<=5.1	<= 96	<= 3000	-
			N3	<= 7.1	<= 96	<= 3000	-
	i.MX 8M Plus i.MX QuadXPlus i.MX 8QuadMax	AMR_NB	-	-	8	12.2, 10.2, 7.9, 7.4, 6.7, 5.9, 5.15, 4.75	-
		AMR_WB	-	-	16	23.85, 23.05, 19.85, 18.25, 15.85, 14.25, 12.65, 8.85, 6.6	-
Software Audio Decoder	i.MX All	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	-

Table continues on the next page...

Table 20. Audio codec specification (continued)

	Platform	Feature/ Profile	Feature/ Profile	Channel	Sample rate (kHz)	Bit rate (kbps)	Comment
		AACLC	MPEG-2 AACLC MPEG-4 AACLC	<=5.1	8-96	8-368	-
		HE-AAC	HE-AAC V1 HE-AAC V2	stereo/mono	8-96	Mono: 8-384 stereo: 16-768	-
		Ogg Vorbis	q1-q10	stereo	8-192	<= 500	-
		WMA STD	L1 @ QL1	stereo/mono	44.1	64-161	-
			L2 @ QL1		<= 48	<= 161	-
			L3 @ QL1		<= 48	<= 385	-
		WMA Pro	M0a @ QL2	stereo/mono	<= 48	48-192	-
			M0b @ QL2	stereo/mono	<= 48	<= 192	-
			M1 @ QL2	<= 5.1	<= 48	<= 384	-
			M2 @ QL2	<= 5.1	<= 96	<= 768	-
			WMA Pro	<= 7.1	<= 96	<= 1500	-
		WMA Lossless	N1	stereo/mono	<= 48	<= 3000	-
			N2	<=5.1	<= 96	<= 3000	-
			N3	<=7.1	<= 96	<= 3000	-
		RA	cook	stereo/mono	8, 11.025, 22.05, 44.1	-	-
		AMR_NB	-	-	8	12.2, 10.2, 7.9, 7.4, 6.7, 5.9, 5.15, 4.75	-
		AMR_WB	-	-	16	23.85, 23.05, 19.85, 18.25, 15.85, 14.25, 12.65, 8.85, 6.6	-
		BSAC	-	<=5.1	<=48	64 per channel	Core codec only

7.4.4 Speech codec specification

Table 21. Speech codec specification

	Feature	Sample rate	Bit rate (kbps)	H/W or S/W
Speech codec	G.711	8 kHz	64	S/W

Table continues on the next page...

Table 21. Speech codec specification (continued)

	Feature	Sample rate	Bit rate (kbps)	H/W or 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

7.4.5 Streaming protocol specification

Table 22. Streaming protocol specification

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

7.4.6 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 23. 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

7.4.7 Subtitle specification

Table 24. 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 10 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.

8 Revision History

This table provides the revision history.

Table 25. 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
L5.4.3_1.0.0	03/2020	i.MX 5.4 Kernel and Yocto Project Upgrades

Table continues on the next page...

Table 25. Revision history (continued)

Revision number	Date	Substantive changes
L5.4.3_2.0.0	04/2020	i.MX 5.4 Alpha release for i.MX 8M Plus and 8DXL EVK boards
L5.4.24_2.1.0	06/2020	i.MX 5.4 Beta release for i.MX 8M Plus, Alpha2 for 8DXL, and consolidated GA for released i.MX boards
L5.4.47_2.2.0	09/2020	i.MX 5.4 Beta2 release for i.MX 8M Plus, Beta for 8DXL, and consolidated GA for released i.MX boards
L5.4.70_2.3.0	12/2020	i.MX 5.4 consolidated GA for release i.MX boards including i.MX 8MPlus and i.MX 8DXL.