

IMXLXRN

i.MX Linux Release Notes

Rev. LF5.15.71_2.2.0 —
16 December 2022

Release notes

Document information

| Information | Content |
|-------------|--|
| Keywords | i.MX, Linux, LF5.15.71_2.2.0 |
| Abstract | This document contains important information about the package contents, supported features, known issues and limitations in this release. |



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 v5.15.71. Kernel upgrade and supports SoC in the i.MX 6, i.MX 7, i.MX 8 and i.MX 9 series boards that have been released before, and they have been full tested. They have been through automated testing to verify patches that were added after last GA release.

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 9 Series
 - i.MX 93 EVK board (11x11 A0 silicon)
- i.MX 8 Series
 - i.MX 8ULP EVK Board (15x15 A1, 9x9 A0.1)
 - i.MX 8M Plus EVK Board
 - i.MX 8DXL EVK Board (A1 silicon tested on LPDDR4 EVK, B0 silicon tested on LPDDR4 WEVK and DDR3L EVK)
 - i.MX 8QuadXPlus MEK Board (C0 silicon revision)
 - 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 Boards
 - i.MX 6Quad SABRE-SD Boards
 - i.MX 6DualLite SDP SABRE-SD Boards
 - i.MX 6SoloX SABRE-SD Boards
 - 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.*
- *6SoloLite stands for the i.MX 6SoloLite EVK*
- *6SoloX-SD stands for the i.MX 6SoloX SABRE-SD 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.
- 8DXL stands for the i.MX 8DualXLite EVK Platform.
- 8ULP stands for the i.MX 8ULP EVK Platform.
- i.MX 93 stands for the i.MX 93 11x11 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 |
|-------------------------|-----------------------------------|
| i.MX 93 | Beta quality. |
| 8ULP | Beta quality. |
| 8M Plus | GA quality. |
| 8DXL | GA quality. |
| 8M Quad | GA quality. |
| 8M Nano | GA quality. |
| 8M Mini | GA quality. |
| 8QuadMax | GA quality. |
| 8QuadXPlus (C0 silicon) | GA quality. |
| 7Dual/Solo | GA quality. |
| 7ULP | GA quality. |
| 6QuadPlus | GA quality. |
| 6Quad | GA quality. |
| 6DualLite | GA quality. |
| 6SoloX | GA quality. |
| 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, 8QuadPlus, 8ULP
- i.MX 8M Family: 8M Plus, 8M Quad, 8M Mini, 8M Nano
- i.MX 8X Family: 8QuadXPlus, 8DXL
- i.MX 9 Family: i.MX 93

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.
- *Harpoon User's Guide* (IMXHPUG) - Presents the Harpoon release for i.MX 8M device family.
- *i.MX Digital Cockpit Hardware Partitioning Enablement for i.MX 8QuadMax* (IMXDCHPE) - Provides the i.MX Digital Cockpit hardware solution for i.MX 8QuadMax.
- *i.MX DSP User's Guide* (IMXDSPUG) - Provides the information on the DSP for i.MX 8.
- *i.MX 8M Plus Camera and Display Guide* (IMX8MPCDUG) - Provides the information on the ISP Independent Sensor Interface API for the i.MX 8M Plus.

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 \(IMX8MPLUSQSG\)](#)

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
- i.MX 93 information is at nxp.com/imx93

1.2 Release contents

This release consists of the following:

- Pre-built images
- Manufacturing tools (UUU)
- Documentation
- Git repo open source distributions on the 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, L5.15.71 indicates that this BSP release is based on the kernel version 5.15.71).

<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 | 5.15.71 |
| U-Boot | v2022.04 |
| SD Card images | Prebuilt images used for testing to use on target i.MX reference boards |
| Manufacturing Tools (UUU) | Version: 1.4.243 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 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-4.7.2.bin | i.MX optimized Audio and Video core codec libraries |
| imx-parser-4.7.2.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-1.27.0.bin | i.MX VPU Hantro libraries for i.MX 8M Quad, 8M Mini, and 8M Plus |
| imx-vpu-hantro-vc-1.2.7.bin | i.MX VPU Hantro vc8000e Encoder libraries for i.MX 8M Plus |
| firmware-imx-8.18.bin | i.MX Firmware including firmware for VPU, DDR, EPDC, HDMI, DP (Display Port), and SDMA |
| imx-seco-5.9.0bin | i.MX SECO firmware for i.MX 8QuadMax, 8QuadXPlus, and 8DXL reference boards |
| imx-gpu-viv-6.4.3.p4.6-aarch32.bin | i.MX Graphics libraries for i.MX 6 and 7 SoC with GPU |
| imx-gpu-viv-6.4.3.p4.6-aarch64.bin | i.MX Graphics libraries for i.MX 8 |
| imx-gpu-g2d-6.4.3.p4.6-arm.bin | i.MX Graphics G2D libraries for i.MX 6 and 7 with GPU |
| imx-gpu-g2d-6.4.3.p4.6-aarch64.bin | i.MX Graphics G2D libraries for i.MX 8 |
| imx-dpu-g2d-2.1.2.bin | i.MX G2D library for i.MX 8 Auto SoCs with DPU blitter engine |
| imx-sc-firmware-1.15.0.bin | i.MX System Controller Firmware for i.MX 8QuadMax, 8QuadXPlus, and 8DXL reference boards |
| ml-security-1.0.6.bin | Machine Learning Security |
| isp-imx-4.2.2.19.0.bin | i.MX 8M Plus ISP SDK |
| imx7d-sabresd-m4-freertos-1.0.bin | i.MX 7D Cortex-M4 Demo |
| imx7ulp-m4-demo-2.11.0.bin | i.MX 7ULP Cortex-M4 Demo |
| imx8qm-m4-demo-2.9.0.bin | i.MX 8QuadMax Cortex-M4 Demo |
| imx8qx-m4-demo-2.9.0.bin | i.MX 8QuadXPlus Cortex-M4 Demo |

Table 3. BSP and multimedia standard packages...continued

| File name | Description |
|-----------------------------|-----------------------------|
| imx8mq-m4-demo-2.12.0.bin | i.MX 8M Quad Cortex-M4 Demo |
| imx8mm-m4-demo-2.12.0.bin | i.MX 8M Mini Cortex-M4 Demo |
| imx8mn-m7-demo-2.12.0.bin | i.MX 8M Nano Cortex-M7 Demo |
| imx8dxl-m4-demos-2.9.0.bin | i.MX 8DXL Cortex-M4 Demo |
| imx8mp-m7-demo-2.12.0.bin | i.MX 8M Plus Cortex-M7 Demo |
| imx8ulp-m33-demo-2.13.0.bin | i.MX 8ULP Cortex-M33 Demo |
| imx93-m33-demo-2.13.0.bin | i.MX 93 Corex-M33 Demo |
| mx93a0-ahab-container.img | i.MX 93 ELE Firmware |
| mx8ulpa0-ahab-container.img | i.MX 8ULP A0.1 |
| mx8ulpa1-ahab-container.im | i.MX 8ULP A1 |

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-4.7.2.bin | Coding Technologies AACplus decoder |
| imx-scfw-porting-kit-1.15.0.tar.gz | System Controller Firmware porting kit |
| imx-upower-porting-kit-1.1.0.tar.gz | uPower firmware porting kit |

i.MX BSP also releases open source through repos on Github.com [i.MX GitHub](https://github.com/nxp-imx). The following table lists all the repos on GitHub.

Table 5. i.MX GitHub Distributions 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 |
| imx-gst1.0-plugin | i.MX Multimedia GStreamer Plugins |
| gst-plugins-base | i.MX Multimedia GStreamer Base |

Table 5. i.MX GitHub Distributions Repos...continued

| Repo | Description |
|--|---|
| gst-plugins-bad | i.MX Multimedia GStreamer Bad |
| gst-plugins-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 Wi-Fi kernel driver |
| gtec-demo-framework | i.MX Graphics Demo Framework on NXPMicro GitHub |
| imx-firmware | i.MX Firmware for Cypress and NXP Wi-Fi and Bluetooth |
| imx-seco-libs | i.MX SECO libraries |
| imx-vpuwrap | i.MX VPU Wrapper |
| arm-computelibrary-imx | Arm compute library |
| pyarmnn-release | PyArmNN |
| tensorflow-imx | TensorFlow |
| v2xseshm | V2XSE SHM library |
| vtest | V2X test application |
| sof | Sound Open Firmware |

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-agl`: Automotive Grade Linux demo on kirkstone..
- `meta-imx-iot-gateway`: AWS and IOT Gateway demos for i.MX 6UL/6ULL.
- OTA: Note no extra layer. Third partie support over the air solutions such as Mender or Foundries.io. Contact one of these 3rd-party to integrate an 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 |
|---|---|
| <code>imx-mscodec-4.7.2.bin</code> | i.MX optimized Microsoft codec |
| <code>imx-msparser-4.7.2.bin</code> | i.MX optimized Microsoft ASF parser |
| <code>imx-real-4.7.2.bin</code> | i.MX Real Networks RMVB Decoders and Parsers |
| <code>imx-dsp-2.0.2.bin</code> | DSP firmware |
| <code>imx-dsp-codec-2.0.2.bin</code> | DSP decoders (MP2, MP3, BSAC, DRM, DABPlus, SBC, AAC) |
| <code>imx-dsp-codec-ext-2.0.2.bin</code> | DSP extra codecs |
| <code>imx-dsp-codec-aacp-2.0.2.bin</code> | DSP AACPlus decoder |
| <code>imx-ap1302-1.0.0.tar.gz</code> | Firmware Yocto recipe for Camera AP1302+AR0144. |

1.5 Instructions to get the AP1302 firmware

Perform the following steps to get the AP1302 firmware from OnSemi GitHub:

1. Download [ap1302_60fps_ar0144_27M_2Lane_awb_tuning.bin](#) from OnSemi GitHub [NXP_i.MX93_ap1302_firmware](#) by following [README.md](#).
2. Rename it as `ap1302.fw`.
3. Copy it to the target board under `/lib/firmware/imx/camera`.

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 5.15.71 with consolidated Linux Factory Kernel.

- Upgraded the U-Boot to v2022.04 with consolidated Linux Factory U-Boot.
- Updated EULA to v38 August 2022.
- Upgraded the Yocto Project to version 4.0 Kirkstone.
- Source code released on source.codeaurora.org is now released on github.com/nxp-imx.
- Supports the GCC 11.2 toolchain.
- Cortex-M33 update for 8ULP, Cortex-M7 updates for i.MX 8M Nano, i.MX 8M Plus, and Cortex-M4 update for i.MX 8M Mini.
- Security
 - OP-TEE upgraded to 3.19.0.
 - Arm Trusted Firmware updated with consolidated Linux Factory release.
 - Fixed Potential Vulnerability Discovered in Arm Trusted Firmware (domain ID is not bounded in the `imx_gpc_pm_domain_enable` function).
- Multimedia updates:
 - Gstreamer upgraded to 1.20.3
 - Supports Hantro VPU V4L2 codec interfaces, used in Gstreamer by default.
 - Upgraded Sound Open Firmware to v2.3.0
 - Audio Front-End Software nxp-afe introduced.
- Graphics updates:
 - GPU driver upgraded to 6.4.3.p4.6 with vulkan enablement, bug fixes, and performance optimizations.
 - GPU SDK upgraded to 5.0.3.
 - Chromium upgraded to 91.0.4472.114.
- Machine Learning updates:
 - OpenCV upgraded to 4.6.0.
 - Tensorflow-lite upgraded to 2.9.1 with GPU acceleration.
 - Arm NN removed.
 - Onnxruntime upgrade to 1.10.0.
 - nn-imx, which was upgraded to 1.3.0, is separated from graphics distribution and released on GitHub (version 1.1.7).
- i.MX 8ULP
 - Introduction for i.MX 8ULP as Beta quality.
- i.MX 93
 - Introduction for i.MX 93 11x11 as Beta quality.
- i.MX 8M Plus
 - Updates for ISP 4.2.2.20.
- i.MX 8DXL
 - Introduction of i.MX 8DXL B0 LPDDR4 DL1/DL2/DL3.
- NXP Wi-Fi driver enhancement
 - SD9098 chipset support with SDIO host interface.
- Arm SystemReady-IR (SR-IR) certification
 - i.MX 8M Mini EVK board has passed the Arm SR-IR certification.
 - i.MX 8M Plus EVK board has passed the Arm SR-IR certification.
 - i.MX 8M Quad EVK board has passed the Arm SR-IR certification.
 - i.MX 8M Nano EVK board has passed the Arm SR-IR certification.
- Userspace Ethernet DPDK Driver
 - Supported on i.MX 8M Mini and i.MX 8M Plus

- DPDK L2FWD and L3FWD applications supported
- The following boards are not supported in this release:
 - i.MX 8QuadXPlus B0 MEK
 - i.MX 8DualX MEK
 - i.MX 8DXL A1 DDR3L EVK
 - i.MX 6QuadPlus SABRE-AI
 - i.MX 6Quad/Dual SABRE-AI
 - i.MX 6DualLite SABRE-AI

3 SoC Feature Summary

The following table describes the SoC features summarized into groups.

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 8 Family: 8ULP 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, 8ULP i.MX 8X Family: 8QuadXPlus i.MX 8M Family: 8M Quad, 8M Mini, 8M Nano, 8M Plus |
| 2D Graphics with DPU | i.MX 8 Family: 8QuadMax i.MX 8X Family: 8QuadXPlus |
| Vulkan GPU | i.MX 8 Family: 8QuadMax, 8ULP 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 i.MX 8 Family: 8ULP |
| PXP | i.MX 6 Family: 6DualLite, 6SLL, 6UL, 6ULL, 6ULZ i.MX 7 Family: 7Dual i.MX 8 Family: 8ULP i.MX 93 |
| Frame Buffer Display | i.MX 6 Family: 6Quad, 6DualLite, 6Solo, 6SoloX, 6SLL, 6UL, 6ULL, 6ULZ i.MX 7 Family: 7Dual, 7ULP |

Table 7. SoC hardware acceleration features...continued

| Feature | SoC |
|--------------------------|--|
| DRM Display | i.MX 8 Family: 8QuadMax, 8ULP i.MX 8X Family: 8QuadXPlus, 8DualX i.MX 8M Family: 8M Quad, 8M Mini, 8M Nano, 8M Plus i.MX 93 |
| Cortex-M Core Boot | i.MX 6 Family: 6SoloX i.MX 7 Family: 7Dual, 7ULP i.MX 8 Family: 8QuadMax, 8ULP i.MX 8X Family: 8QuadXPlus, 8DX, 8DXL i.MX 8M Family: 8M Quad, 8M Mini, 8M Nano, 8M Plus i.MX 93 |
| HiFi4 DSP | i.MX 8 Family: 8QuadMax, 8ULP i.MX 8X Family: 8QuadXPlus, 8DualX i.MX 8M Family: 8M Plus |
| NXP eIQ Machine Learning | i.MX 8 Family: 8QuadMax, 8ULP i.MX 8X Family: 8QuadXPlus, 8DualX i.MX 8M Family: 8M Quad, 8M Mini, 8M Nano, 8M Plus i.MX 93 |
| V2X | i.MX 8DXL |
| NPU | i.MX 8 Family: 8M Plus i.MX 93 |

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 [Section 1](#). 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: 5.15.71 |
| 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, <ul style="list-style-type: none"> • UBIFS is used for NAND. • JFFS2/UBIFS is used for Parallel NOR, QSPI NOR. |
| Boot image | | |

Table 8. Supported features...continued

| Feature | Supported board | Comment |
|-------------------------------|--------------------------------|--|
| U-Boot | All i.MX | <p>U-Boot delivery is based on U-Boot version v2022.04. Clock, Anapop regulator, ENET, UART, MMC/SD, eMMC4.3/4.4/4.5/5.1. 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 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 400 MHz @ 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 and i.MX 9 use <code>imx-mkimage</code> to produce the <code>flash.bin</code> file that contains the i.MX 8 or i.MX 9 system controller firmware and U-Boot. The <code>flash.bin</code> file that can be flashed to the SD cards with the command: <code>dd if=<flash.bin> of=/dev/sd<x> seek=<x> bs=1k</code>. For 8M Mini, <code>seek=33</code>. For i.MX 8M Quad/Mini/Nano/Plus, U-Boot supports distro boot. For 8M mini EVK, U-Boot also supports EFI and is able to boot opensuse and Fedora. For 8M Quad, 8QuadMax A0, and 8QuadXPlus A0, <code>seek=33</code>. For 8QuadMax B0, 8QuadXPlus B0 and C0, 8M Nano, 8M Plus, 8DXL, i.MX 93 <code>seek=32</code>.</p> |
| Boot Firmware | All i.MX 8 i.MX 93 | <p>All i.MX 8 boards require Arm Trusted Firmware. 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. i.MX 8ULP requires S400 and uPower Firmware. i.MX 93 requires S401 sentinel firmware.</p> |
| OP-TEE | All i.MX | <p>OP-TEE OS is required on the boot partition with the TEE file for OP-TEE enablement.</p> |
| Jailhouse Hypervisor | All i.MX 8M 8ULP i.MX 93 | <p>Jailhouse is a Type 1 hypervisor for i.MX 8. Look for related device trees for inmate and root device trees.</p> |
| Machine-specific layer | | |

Table 8. Supported features...continued

| Feature | Supported board | Comment |
|-----------|-----------------|--|
| Arm Core | All i.MX | <p>i.MX 6 SABRE-SD, 6SLL, and 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>i.MX 8M Quad and i.MX 8M Mini support four Arm Cortex-A53 cores and one Arm Cortex-M4 core.</p> <p>i.MX 8M Nano supports four Arm Cortex-A53 cores and one Arm Cortex-M7F core.</p> <p>i.MX 8M Plus supports four Arm Cortex-A53 cores and one Arm Cortex-M7F core.</p> <p>i.MX 8ULP supports two Arm Cortex-A35 cores and one Arm Cortex-M33F core.</p> <p>i.MX 8DXL supports two Arm Cortex-A35 cores and one Arm Cortex-M4F core.</p> <p>i.MX 93 supports two Arm Cortex-A55 cores and one Arm Cortex-M33 core.</p> |
| Memory | All i.MX | <p>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.</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 8DXL supports one 16-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> <p>i.MX 8M Nano supports one 16-bit LPDDR4 channel @ 750 MHz and 25 MHz.</p> <p>i.MX 8M Plus supports one 32-bit LPDDR4 channel @ 2000 MHz and 50 MHz.</p> <p>i.MX 8ULP supports Multi-port 32-bit LPDDR4, LPDDR4x, up-to 533 MHz clock.</p> <p>i.MX 93 supports Multi-port 16-bit DDR LPDDR4, LPDDR4x, up-to 3.733 gigabyte transfers per second.</p> |
| Interrupt | All i.MX | GIC |
| Clock | All i.MX | Controls the system frequency and clock tree distribution. |

Table 8. Supported features...continued

| Feature | Supported board | Comment |
|---------------------------------|---|---|
| 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 and i.MX 9, 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 8Quad Max, i.MX 8DXL and 8QuadXPlus the system controller manages access to the IOMUX. |
| System Controller | 8QuadMax 8Quad XPlus 8DXL | Provides abstraction to the hardware features and runs on Arm Cortex-M4 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 | | |

Table 8. Supported features...continued

| Feature | Supported board | Comment |
|---------------------------------|--|--|
| UART | All i.MX | <p>i.MX 6 SABRE-SD supports console through internal Debug UART1.</p> <p>i.MX 6SoloX SABRE-SD supports Cortex-A9 processor through UART1 and Cortex-M4 processor through UART2.</p> <p>i.MX 7Dual SABRE-SD supports Cortex-A7 processor through UART1 and Cortex-M4 processor through UART2.</p> <p>i.MX 6UltraLite, 6ULL, and 6ULZ EVK boards support 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 Cortex-M4 through UART4.</p> <p>i.MX 8M Quad supports Cortex-A53 processor through UART1 and Cortex-M4 processor through UART2.</p> <p>i.MX 8QuadMax and 8QuasXPlus use LPUART.</p> <p>i.MX 8QuadMax and 8QuasXPlus support Cortex-A53 processor through UART0 and Cortex-M4 processor through UART2.</p> <p>i.MX 8M Nano supports Cortex-A53 through UART2 and Cortex-M7 through UART4.</p> <p>i.MX 8M Plus supports Cortex-A53 through UART2 and Cortex-M7 through UART4.</p> <p>i.MX 8DXL supports Cortex-A35 through UART0 and Cortex-M4 through M40_UART0.</p> <p>i.MX 8ULP supports Cortex-A35 through LPUART5.</p> <p>i.MX 93 supports Cortex-A55 through LPUART1.</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 8 All i.MX 9 | Supports standby mode and dormant (mem) mode on i.MX 6, i.MX 7, i.MX 8, and i.MX 93 boards. |
| Low Drive mode | i.MX 93 | The system runs at low drive mode frequency and voltage. Static boot configuration with dedicated boot image. |
| CPUIdle | All i.MX 6 All i.MX 7 All i.MX 8 | 2-level CPUIdle supported: purely WFI and WFI with wait mode enabled. |
| CPUFreq | All i.MX except for 8ULP and i.MX 93 | CPUFreq can be used for CPU frequency adjustment. The Interactive governor is added and enabled by default. |

Table 8. Supported features...continued

| Feature | Supported board | Comment |
|---------------------------|--|---|
| 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 i.MX 8M i.MX 8ULP | Supports battery charge type detection. |
| Networking drivers | | |
| ENET | All i.MX 6 7D-SABRE-SD All i.MX 8 All i.MX 9 | i.MX 6Quad/SoloX board supports AR8031 PHY, i.MX 6UltraLite EVK board supports KSZ8081 PHY, and i.MX 7Dual SABRE-SD board supports BCM54220 PHY. i.MX 6SoloX SABRE-SD, SABRE-AI, and i.MX 7Dual SABRE-SD support AVB features. i.MX 8 supports Atheros AR8031 PHY with 10/100/1000 bps mode, NXP automotive PHY TJA1100 PHY, and AVB features. |
| EQOS_TSN | i.MX 8M Plus i.MX 8DXL All i.MX 9 | 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 All i.MX 9 | 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 6SLL, 6UL, 6ULL, 6ULZ, 8M Nano, 8ULP, and i.MX 93 | 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. <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 8Quad XPlus | 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 8Quad XPlus 8M Plus All i.MX 9 | 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, and 6ULL EVK. With the platform that supports the FlexCAN module, FlexCAN supports CANFD mode. |

Table 8. Supported features...continued

| Feature | Supported board | Comment |
|-------------------------------------|---|---|
| Wi-Fi/Bluetooth wireless technology | All i.MX | <p>Supports the NXP SDIO IW612 (tested with Murata LBES5PL2EL) on i.MX 93.</p> <p>Supports the NXP SDIO 88W8801 (tested with Murata LBWA0ZZ2 DS on i.MX 8M Quad, and Murata LBWA0ZZ2DS with Murata M.2-to-usd adapter on i.MX 6ULL).</p> <p>Supports the NXP SDIO IW416 (tested with Murata LBEE5CJ1XK on i.MX 8M Quad and i.MX 8ULP, and Murata LBEE5CJ1XK with Murata M.2-to-usd adapter on i.MX 6ULL).</p> <p>Supports the NXP SDIO 88W8997 (tested with Murata LBEE5XV1 YM) on i.MX 8M Plus and i.MX 8M Quad.</p> <p>Supports the NXP PCIe 88W9098 (tested with Murata LBEE5ZZ1 XL) on i.MX 8M Plus, i.MX 8M Quad, i.MX 8QuadMax, i.MX 8Quad XPlus, and i.MX 8DXL.</p> <p>Supports the NXP SDIO 88W9098 (tested with Murata LBEE5ZZ1 XL) on i.MX 8M Plus, i.MX 8M Quad.</p> <p>Supports the NXP PCIe 88W8997 Wi-Fi/Bluetooth SoC (tested with Murata LBEE5XV1YM) on i.MX 8QuadMax, i.MX 8Quad XPlus, i.MX 8M Quad, i.MX 8DXL, and tested with Azurewave AW-CM276MA-PUR on i.MX 8M Plus.</p> <p>Supports the NXP SDIO 88W8987 Wi-Fi/Bluetooth SoC (tested with Murata LBEE5QD1ZM) on i.MX 6, i.MX 7Dual, i.MX 7ULP, and tested with Azurewave AW-CM358 on i.MX 8M Mini LPDDR4 EVK and i.MX 8M Nano LPDDR4 EVK.</p> <p>All the i.MX 6 boards require board modifications to support Bluetooth and to boot with the Wi-Fi/Bluetooth device tree.</p> <p>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:</p> <pre style="border: 1px solid black; padding: 5px; margin-top: 10px;">/usr/bin/pulseaudio --start --log-target=syslog</pre> |
| DPDK | 8M Mini 8M Plus | <p>Userspace Ethernet FEC Driver</p> <ul style="list-style-type: none"> • DPDK version 20.11 • l2fwd and l3fwd applications supported in loopback mode <p>For details on executing l2fwd and l3fwd applications, see the <code>dpdk/nxp/README</code> file.</p> |
| Security drivers | | |
| CAAM | All i.MX except for i.MX 6ULL/6ULZ/6SLL/93 | Cryptographic Acceleration and Assurance Module. |
| SNVS | All i.MX 6 except for 6ULL/6ULZ/6SLL All i.MX 7 All i.MX 8M | Secure Non-Volatile Storage. |

Table 8. Supported features...continued

| Feature | Supported board | Comment |
|--------------------------------------|---|--|
| BBSM and BBNSM | All i.MX 9 | Battery Backed Security Module for secure and non-secure storage. |
| SIMv2 | 6UltraLite 7D-SABRE-SD | Smart Card Interface. |
| EMVSIM | 8QuadMax | Smart Card Interface. |
| Sound drivers and DSP | | |
| DSP | 8Quad XPlus 8QuadMax 8M Plus 8ULP | 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 and 8M Plus. AK5552 is only supported on 8M Plus. |
| 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 8ULP | Supports playback. |
| SAI/MQS | 8QuadMax | Supports playback. |
| S/PDIF | 6SABRE-SD 6SABRE-AI 8QuadMax 8Quad XPlus 8ULP All i.MX 8M i.MX 93 | 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. |

Table 8. Supported features...continued

| Feature | Supported board | Comment |
|--------------------------|--|--|
| ASRC | 6SABRE-AI 6SoloX-SD 6UltraLite 6ULL 6ULZ 8QuadMax 8Quad XPlus 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/ CS42448 | 6SABRE-AI 8QuadMax 8Quad XPlus i.MX 93 | 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. i.MX 93 supports CS42448. |
| SAI/MQS/ WM8962 | 6SoloX-SD 7D-SABRE-SD 6UltraLite 6ULL 6ULZ 7ULP All i.MX 8M 8QuadMax 8Quad XPlus i.MX 93 | 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 8Quad XPlus | Supports 16 bit, 18 bit, 20 bit, 24 bit, and 32 bit PCM format. Supports sample rate from 8 kHz to 96 kHz for record and playback. Supports amixer alsamixer control from user space. |
| HDMI Audio | 6SABRE-SD 6SABRE-AI 7ULP 8QuadMax 8M Quad 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. |
| Audio HAT | i.MX 93 | Supports CS42448, SPDIF, PDM MIC. |

Table 8. Supported features...continued

| Feature | Supported board | Comment |
|-----------------------------|---|---|
| 8MIC-REVE | 8M Nano 8M Mini 8M Plus i.MX 93 | Supports PDM MIC recording. |
| 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 support 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. All MIPI panels on i.MX 8M support Touch. i.MX 93 supports MIPI Panel TS and LVDS panel TS. |
| 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. i.MX 93 11 EVK supports M.2 FSPI. |
| 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 8Quad XPlus 8M Quad 8M Mini 8DXL DDR3L | 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 | i.MX 6DualQuad SABRE-SD and SABRE-AI, i.MX 6 QuadPlus SABRE_SD and SABRE-AI support Serial ATA 2.0. i.MX 8Quad Max supports SATA III (6.0 GB/s). |
| USB drivers | | |

Table 8. Supported features...continued

| Feature | Supported board | Comment |
|-----------------------------------|---|--|
| 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 OTG 2.0, USB Host 2.0 for all i.MX except 8M Plus. All i.MX 8 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 8Quad XPlus 8QuadMax | Graphics Chips Details: See <i>i.MX Graphics User's Guide</i> (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: <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 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 GC7000XSVX, 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. |

Table 8. Supported features...continued

| Feature | Supported board | Comment |
|--|---|--|
| Direct Rendering Manager (DRM) Display | All i.MX 8 i.MX 93 | i.MX DPU DRM is used for i.MX 8QuadMax and 8QuadXPlus. LCDIF is used for all i.MX 8M and i.MX 93. DCSS is used for i.MX 8M Quad. DCNANO is used for i.MX 8ULP. |
| 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 i.MX 93 | 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. For i.MX 93, it supports LVDS PHY designed by NXP. |
| HDMI Display | 6SABRE-SD 6SABRE-AI 6SoloX-SD 7D-SABRE-SD 7ULP | 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. |
| HDMI/Display Port | 8M Quad 8QuadMax 8M Plus | i.MX 8QuadMax supports HDMI/Display audio and on-chip HDMI hardware. i.MX 8M Quad supports HDMI/Display through DCSS. i.MX 8M Plus only supports HDMI. |
| LVDS to HDMI | 8QuadMax 8M Plus 8QuadXPlus i.MX 93 | Uses ITE Driver IT6263. |
| MIPI to HDMI | All i.MX 8 7ULP i.MX 93 | Uses Advantec ADV7535. |
| HDCP | 6SABRE-SD i.MX 8M 8QuadMax | Supports HDCP v1.2 specifications on specific HDCP parts. i.MX 8QuadMax can support HDCP v1.4 (for TX) and HDCP v2.2 (for RX and TX). |

Table 8. Supported features...continued

| Feature | Supported board | Comment |
|----------------------|---|---|
| MIPI-DSI Display | 6SABRE-SD All i.MX 7 i.MX 8 i.MX 93 | 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. Supports RM67199 OLED display panel through the MIPI DSI on i.MX 8M Mini, 8M Nano, 8M Plus, 8M Quad, and i.MX 93. Supports RM68200 OLED display panel through the MIPI DSI on i.MX 8ULP. |
| Parallel-LCD Display | All i.MX 6 All i.MX 7 i.MX 93 | 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 i.MX 93 | Enables PxP Driver for EPDC. Enables PxP Driver for G2D on i.MX 93. Conforms to DMA engine framework. |

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 listed | 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 |
| LCDIFv3 | 8M Plus i.MX 93 | Supports through DRM display framework. |
| DPU | 8QuadMax 8Quad XPlus | 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. |
| DCNANO | 8ULP | Supports through DRM display framework. |
| 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. |

Table 8. Supported features...continued

| Feature | Supported board | Comment |
|------------------------------|---|--|
| 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 4 cameras on i.MX 8QuadXPlus. Supports 8 cameras on i.MX 8QuadMax. Supports 1 camera on i.MX 93. |
| MIPI Camera CSI | 6SABRE-SD 7D-SABRE-SD 7ULP All i.MX 8M 8QuadMax 8QuadXPlus i.MX 93 | Supports 2-lane CSI MIPI camera OV5640 with 720p30, 640x480@30, 320x240@30, 720x480@30, 1080p@30, 2592x1944@15, 176x144@30. 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. Supports 4-lane CSI MIPI camera OS08A20 with 4K with ISP on i.MX 8M Plus. Supports 2-lane CSI MIPI camera AP1302+AR0144 with 1080p@60, 1280x800@60, 720P@60 and 640x480@60 on i.MX 93. |
| Parallel CSI | 6SABRE-SD 6SoloX-SD 6UltraLite 6ULL 6ULZ 6SLL 8QuadXPlus i.MX 93 | Supports OV5640 camera sensor. i.MX93 does not support OV5640 camera sensor. It supports MT9M114 with 320x240@30, 640x480@30, 800x480@30, 1280x720@30. |

Table 8. Supported features...continued

| Feature | Supported board | Comment |
|------------------------|--|---|
| ISI | 8QuadMax 8Quad XPlus 8M Nano 8M Plus i.MX 93 | Supports capture through ISI controller. |
| 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. |
| I2C | All i.MX | Supports I2C master. Supports PCA9646 I2C switch on i.MX 8QuadXPlus. |
| SPI | All i.MX | Supports SPI master mode and slave mode. |
| I3C | 8ULP i.MX 93 | Supports I3C master with SDR speed. |
| Pulse Width Modulator | All i.MX | Supports the backlight driver through PWM. |
| ADC | 6SoloX-SD 7D-SABRE-SD 6UltraLite 6ULL 6ULZ 7ULP 8QuadMax 8Quad XPlus | 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. |

Table 8. Supported features...continued

| Feature | Supported board | Comment |
|----------------------|--|---|
| Accelerometer | 6SABRE-SD 6SABRE-AI 6SoloX-SD 6UltraLite 6ULL 6ULZ 7D-SABRE-SD 7ULP 8Quad XPlus | 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 8Quad XPlus i.MX 93 | 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. Supports ADP5585 and PCAL6524 on i.MX 93. |
| SNVS RTC | All i.MX 6 All i.MX 7 All i.MX 8 | SNVS is a block that interfaces with CAAM and SRTC. |
| BBNSM RTC | All i.MX 9 | - |
| Ambient Light Sensor | 6SABRE-SD 6SABRE-AI 6SoloX-SD 8QuadMax 8Quad XPlus | 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 i.MX 93 | Supports FXA2100 gyroscope sensor. |
| Pressure Sensor | 7D-SABRE-SD 8QuadMax 8Quad XPlus | 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` subdirectory.

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 imx6silevk imx6sxsabresd imx7dsabresd imx6ulevk imx6ull14x14evk imx6ullz4x14evk imx7ulpevk imx8qmmek imx8qxpmev, imx8qxp0mek imx8mqevk imx8mmevk imx8mnevk imx8mpevk imx8dxlevk, imx8dxlb0-ddr3l-evk, imx8dxlb0-lpddr4-evk imx93evk |
| 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 imx8dxlb0-ddr3l-evk |
| sata | Supports booting from SATA. | imx6qsabresd, imx6qpsabresd imx6qsabreauto, imx6qpsabreauto |

Table 9. U-Boot configurations...continued

| U-Boot configuration for Boot device | Description | Supported machine configuration |
|--------------------------------------|---|--|
| qspi | Supports booting from QSPI. Booting from the Arm Cortex-M4 processor is supported through QSPI2 and QSPI1. Use U-Boot command <code>bootaux</code> to boot the Arm Cortex-M4 processor. The booting address for QSPI2 is 0x78000000. The booting address for QPIS1 is 0x68000000. | imx6sxsabresd with QSPI2 imx7dsabresd with QSPI1 imx6ulevk with QSPI1 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 imx8qmmek imx8qxp0mek imx8dxlevk imx8mpevk imx8mmevk imx8ulpevk imx8dxlb0-lpddr4-evk imx93-11x11-evk |
| 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 imx8qxp0mek imx8qxp0mek imx8dxlb0-lpddr4-evk, imx8dxla1-lpddr4-evk imx8mmevk imx8mnevk imx8mpevk imx8ulpevk imx93evk or imx93-11x11-evk |

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 is 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 <code>imx_v7_defconfig</code> in <code>arch/arm/configs</code> . i.MX 8 and i.MX 9 Image kernel is built with <code>imx_v8_defconfig</code> in <code>arch/arm64/configs</code> . |
| DTB Descriptions | Each reference board has a standard device tree as follows: <ul style="list-style-type: none"> • <code>imx6q-sabresd.dtb</code>, <code>imx6qp-sabresd.dtb</code> • <code>imx6dl-sabresd.dtb</code> • <code>imx6q-sabreauto.dtb</code>, <code>imx6qp-sabreauto.dtb</code> • <code>imx6dl-sabreauto.dtb</code> • <code>imx6sx-sdb.dtb</code> supports the i.MX 6SoloX SABRE-SDB Rev. B board, and <code>imx6sx-sdb-reva.dtb</code> supports the SABRE-SDB Rev. A board. • <code>imx7d-sdb.dtb</code> supports the i.MX 7Dual SABRE-SDB Rev. C and Rev. D boards, and <code>imx7d-sdb-reva.dtb</code> supports the Rev. A board. • <code>imx6ul-14x14-evk.dtb</code>, <code>imx6ul-9x9-evk.dtb</code> • <code>imx6ulz-14x14-evk.dtb</code> • <code>imx6ull-14x14-evk.dtb</code> • <code>imx7ulp-evk.dtb</code> • <code>imx8mq-evk.dtb</code> • <code>imx8mm-evk.dtb</code>, <code>imx8mm-ddr4-evk</code> • <code>imx8mn-evk.dtb</code>, <code>imx8mn-ddr4-evk.dtb</code>, <code>imx8mn-ddr3l-evk.dtb</code> (for i.MX 8M NanoUltraLite) • <code>imx8mp-evk.dtb</code>: Supports single or multiple displays with HDMI, MIPI-DSI-HDMI, and LVDS-HDMI • <code>imx8dxl-evk.dtb</code> • <code>imx8qm-mek.dtb</code>: 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 <code>flash.bin</code> does not include the Cortex-M4 image. • <code>imx8qm-mek-rpmsg.dtb</code>: Supports partition reset, and supports the LVDS-HDMI or MIPI-DSI-HDMI display with the LVDS-HDMI or MIPI-DSI-HDMI converts. This requires <code>flash.bin</code> to include the Cortex-M4 image. • <code>imx8qxp-mek.dtb</code>: Supports one LVDS-HDMI through the LVDS0-CH0 on the LVDS-HDMI daughter card. It is for non-partition boot that <code>flash.bin</code> does not include the Cortex-M4 image. • <code>imx8ulpevk.dtb</code> • <code>imx8ulp-9x9-evk.dtb</code> • <code>imx93-11x11-evk.dtb</code> |

Table 10. Kernel and device tree configurations...continued

| Kernel and device tree configuration | Description |
|--------------------------------------|---|
| Audio | <p>Enables various audio device trees.</p> <ul style="list-style-type: none"> • <code>imx93-11x11-evk-aud-hat.dtb</code> • <code>imx93-11x11-evk-mqs.dtb</code> • <code>imx8ulp-evk-sof-btsco.dtb</code>: sound open firmware • <code>imx8mp-ab2.dtb</code>: audio board • <code>imx8mp-evk-sof-wm8960.dtb</code>: Sound open firmware for WM8960 audio • <code>imx8mq-evk-ak4497.dtb</code>: audio board ak4497 codec • <code>imx8mq-evk-pdm.dtb</code>: PDM microphone • <code>imx8mq-evk-audio-tdm.dtb</code>: audio board TDM • <code>imx8mm-evk-ak4497.dtb</code>: audio board ak4497 codec • <code>imx8mm-evk-ak5558.dtb</code>: audio board ak5558 codec • <code>imx8mm-evk-audio-tdm.dtb</code>: audio board TDM • <code>imx8mn-dd4-evk-ak5558.dtb</code>: audio board TDM • <code>imx7ulp-evk-wm8960.dtb</code>: Enables WM8960 audio as the default one and disables HDMI audio • <code>imx7d-sdb-reva-hdmi-audio.dtb</code>: Enables HDMI audio as the default one and disables WM8960 audio |

Table 10. Kernel and device tree configurations...continued

| Kernel and device tree configuration | Description |
|--------------------------------------|--|
| Bluetooth wireless technology Wi-Fi | <p>Enables the Bluetooth wireless technology and Wi-Fi hardware.</p> <p>The followings support NXP PCIe 88W8997 chip inside:</p> <ul style="list-style-type: none"> • imx8mq-evk-pcie1-m2.dtb • imx8mp-evk.dtb • imx8qxp-mek-rpmsg.dtb • imx8dxl-evk.dtb • imx8qm-mek-rpmsg.dtb <p>The followings support NXP SDIO 88W8987 chip inside:</p> <ul style="list-style-type: none"> • imx6q-sabresd-btwifi.dtb • imx6qp-sabresd-btwifi.dtb • imx6dl-sabresd-btwifi.dtb • imx6sll-evk-btwifi.dtb • imx6sx-sabresd-btwifi.dtb • imx6ul-14x14-evk-btwifi-sdio3_0.dtb • imx6ull-14x14-evk-btwifi-sdio3_0.dtb • imx6ulz-14x14-evk-btwifi-sdio3_0.dtb • imx7ulp-evkb.dtb • imx7d-sdb-usd-wifi.dtb • imx8mm-evk.dtb • imx8mn-evk.dtb <p>The followings support NXP SDIO 88w8997 chip inside:</p> <ul style="list-style-type: none"> • imx8mq-evk-usdhc2-m2.dtb • imx8mp-evk-usdhc1-m2.dtb <p>The followings support NXP PCIe 88w9098 chip inside:</p> <ul style="list-style-type: none"> • imx8mq-evk-pcie1-m2.dtb • imx8mp-evk.dtb • imx8qm-mek-rpmsg.dtb • imx8qxp-mek-rpmsg.dtb • imx8dxl-evk-rpmsg.dtb <p>The followings support NXP SDIO 88w9098 chip inside:</p> <ul style="list-style-type: none"> • imx8mq-evk-usdhc2-m2.dtb • imx8mp-evk-usdhc1-m2.dtb <p>The followings support NXP SDIO IW416 chip inside:</p> <ul style="list-style-type: none"> • imx8mq-evk-usdhc2-m2.dtb • imx8ulp-evk.dtb • imx6ull-14x14-evk-btwifi-sdio3_0.dtb <p>The followings support NXP SDIO 88w8801 chip inside:</p> <ul style="list-style-type: none"> • imx8mq-evk-usdhc2-m2.dtb • imx6ull-14x14-evk-btwifi.dtb <p>The following supports NXP SDIO IW612 chip inside:</p> <ul style="list-style-type: none"> • imx93-11x11-evk.dtb |

Table 10. Kernel and device tree configurations...continued

| Kernel and device tree configuration | Description |
|--------------------------------------|---|
| Video Capture | <ul style="list-style-type: none"> • <code>imx8qxp-mek-ov5640.dtb</code>: Supports one MIPI OV5640 and one parallel OV5640, which indicates to support two cameras. Tested with <code>non-M4 flash.bin</code>. • <code>imx8qm-mek-ov5640.dtb</code>: Supports one or two OV5640 sensors at the same time. • <code>imx8qm-mek-hdmi-rx.dtb</code>: Supports capture from HDMI RX port. <code>hdprx_enable</code> must be set to "yes" in U-Boot environment to enable the HDMIRX firmware load. • <code>imx8mq-evk-mipi-csi2.dtb</code>: MIPI-CSI2. • <code>imx8mp-evk-basler.dtb</code>: one Basler ISP camera (AR0821), reaches up to 4K30. • <code>imx8mp-evk-dual-basler.dtb</code>: Dual Basler ISP cameras (AR0821), reaches up to 1080P60. • <code>imx8mp-evk-basler-ov5640.dtb</code>: Dual camera Basler ISP + OV5640. • <code>imx8mp-evk-os08a20.dtb</code>: Initial support for one ISP camera - OS08A20. • <code>imx8mp-evk-dual-os08a20.dtb</code>: Initial support for dual ISP cameras - OS08A20. • <code>imx8mp-evk-os08a20-ov5640.dtb</code>: Initial support for dual cameras OS08A20 + OV5640. • <code>imx6ul-14x14-evk-csi.dtb</code>: Avoids the pin conflict between SIM and CSI and enables CSI support for V4L2. • <code>imx6ul-9x9-evk-csi.dtb</code>: Avoids the pin conflict between SIM and CSI and enables CSI support for V4L2. • <code>imx93-11x11-evk.dtb</code>: Supports AP1302+AR0144. • <code>imx93-11x11-evk-mt9m114.dtb</code>: Supports parallel MT9M114 camera. |

Table 10. Kernel and device tree configurations...continued

| Kernel and device tree configuration | Description |
|--------------------------------------|--|
| Video Display | <ul style="list-style-type: none"> • imx93-11x11-evk-rm67199.dtb • imx93-11x11-evk-boe-wxga-lvds-panel.dtb • imx8ulp-evk-epdc.dtb: parallel EPDC panel. • imx8ulp-evk-rk055hdmipi4m.dtb: MIPI DSI panel. • imx8mp-evk-it6263-lvds-dual-channel.dtb: Dual-channel LVDS to HDMI converter. • imx8mp-evk-rm67191.dtb: MIPI MX8-DSI-OLED1 panel. • imx8mp-evk-rm67199.dtb: MIPI MX8-DSI-OLED1A panel. • imx8mp-evk-jdi-wuxga-lvds-panel.dtb: LVDS panel. • imx8qxp-mek-dsi-rm67191.dtb: Supports RM67191 MIPI MX8-DSI-OLED1 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. • imx8dxl-evk-lcdif.dtb: Supports the LCDIF panel. • imx8mq-evk-lcdif-adv7535.dts: LCDIF + MIPI-DSI + HDMI adapter. • imx8mq-evk-dcss-adv7535.dtb: DCSS + MIPI-DSI + HDMI adapter. • imx8mq-evk-dcss-rm67191.dtb: DCSS + MIPI-DSI + RM67191 MX8-DSI-OLED1 panel. • imx8mq-evk-dcss-rm67199.dtb: DCSS+MIPI-DSI+ RM67199 MX8-DSI-OLED1A panel. • imx8mq-evk-lcdif-rm67191.dtb: LCDIF+MIPI-DSI+ RM67191 MX8-DSI-OLED1 panel. • imx8mq-evk-lcdif-rm67199.dtb: LCDIF+MIPI-DSI+ RM67199 MX8-DSI-OLED1A panel. • imx8mq-evk-dual-display.dtb: Dual-display-to-HDMI and MIPI-to-HDMI adapter. • imx8mq-evk-dp.dtb: Display Port support (Set video_off=y in U-Boot with onboard DP connector). • imx8mq-evk-epd.dtb: Embedded Display Port support. |

Table 10. Kernel and device tree configurations...continued

| Kernel and device tree configuration | Description |
|--------------------------------------|---|
| Video Display | <ul style="list-style-type: none"> • imx8mm-evk-rm67191.dtb: RM67191 MX8-DSI-OLED1 panel. • imx8mm-evk-rm67199.dtb: RM67199 MX8-DSI-OLED1A panel. • imx8mm-ddr4-evk-rm67191.dtb: DDR4 EVK with RM67191 MX8-DSI-OLED1 panel. • imx8mn-ddr4-evk-rm67191.dtb: DDR4 EVK with RM67191 MX8-DSI-OLED1 panel. • imx8mm-ddr4-evk-rm67199.dtb: DDR4 EVK with RM67199 MX8-DSI-OLED1A panel. • imx8mn-evk-rm67191.dtb: LPDDR4 EVK with RM67191 MX8-DSI-OLED1 panel. • imx8mn-ddr4-evk-rm67199.dtb: DDR4 EVK with RM67199 MX8-DSI-OLED1A panel. • imx8mn-evk-rm67199.dtb: LPDDR4 EVK with RM67199 MX8-DSI-OLED1A 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 |
| LPSPI | <p>Enables LPSPI or LPSPI slave mode, which is disabled in the default DTB.</p> <ul style="list-style-type: none"> • imx7ulp-evkb-spi-slave.dtb • imx8dxl-evk-lpspi-slave.dtb • imx8ulp-evk-lpspi-slave.dtb • imx93-11x11-evk-lpspi.dtb • imx93-11x11-evk-lpspi-slave.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"> • 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. • imx8dxl-evk-enet0.dtb: Used for Atheros 8031 PHY by connecting IMXAI2ETH-ATH on the ENET0 port. |

Table 10. Kernel and device tree configurations...continued

| Kernel and device tree configuration | Description |
|--------------------------------------|---|
| 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 |
| Flexcan1 | <p>Enables flexcan1, which is disabled by default in standard DTB file due to pin conflicts with FEC.</p> <ul style="list-style-type: none"> • imx6q-sabreauto-flexcan1.dtb • imx6dl-sabreauto-flexcan1.dtb • imx6qp-sabreauto-flexcan1.dtb |
| Flexcan2 | <p>Enables flexcan2 which is disabled by default in standard DTB.</p> <ul style="list-style-type: none"> • imx8mp-evk-flexcan2.dtb |
| GPMI and EIM_NOR | <p>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:</p> <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, imx7d-sdb-reva-gpmi-weim.dtb • imx6ulz-14x14-evk-gpmi-weim.dtb |
| HDCP | <p>Enables the HDMI-HDCP feature. This avoids the pin conflict between the I2C2 and HDCP-DDC pins.</p> <ul style="list-style-type: none"> • imx6q-sabresd-hdcp.dtb • imx6dl-sabresd-hdcp.dtb • imx6qp-sabresd-hdcp.dtb |
| Hypervisor Jailhouse | <p>Enables the Jailhouse Hypervisor device trees.</p> <ul style="list-style-type: none"> • imx93-11x11-evk-root.dtb: DTB for root-cell • imx93-11x11-evk-inmate.dtb:DTB for inmate-cell • 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 • imx8dxl-evk-root.dtb: DTB for root-cell • imx8dxl-evk-inmate: DTB for inmate cell |

Table 10. Kernel and device tree configurations...continued

| Kernel and device tree configuration | Description |
|--------------------------------------|--|
| Hypervisor Xen | <p>Enables the Xen Hypervisor device trees</p> <ul style="list-style-type: none"> • <code>imx8qxp-mek-dom0.dtb</code>: Xen Linux guest Linux DTB file. • <code>imx8qm-mek-dom0.dtb</code>: Supports Xen hypervisor dom0. • <code>imx8qm-mek-dom0-dpu2.dtb</code>: Supports the Xen hypervisor dom0 dpu2. • <code>imx8qm-mek-domu.dtb</code>: Supports Xen hypervisor domu. • <code>imx8qm-mek-domu-dpu1.dtb</code>: Supports Xen hypervisor domu-dpu1. • <code>imx8qm-mek-domu-dpu1-hdmi.dtb</code>: Supports the Xen hypervisor domu-dpu1-hdmi. |
| LDO | <p>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:</p> <ul style="list-style-type: none"> • <code>imx6q-sabresd-ldo.dtb</code> • <code>imx6qp-sabresd-ldo.dtb</code> • <code>imx6ul-9x9-evk-ldo.dtb</code> • <code>imx6dl-sabresd-ldo.dtb</code> • <code>imx6sx-sdb-ldo.dtb</code>, <code>imx6sx-sdb-reva-ldo.dtb</code> |
| LP UART | <p>Enables LPUART.</p> <ul style="list-style-type: none"> • <code>imx93-11x11-evk-lpuart.dtb</code> • <code>imx93-11x11-evk-lpuart.dtb</code> • <code>imx7ulp-evk-lpuart.dtb</code> |

Table 10. Kernel and device tree configurations...continued

| Kernel and device tree configuration | Description |
|--------------------------------------|--|
| Multi-Core, M-core, and RPMSG | <p>Enables the M-Core and RPMSG</p> <ul style="list-style-type: none"> • <code>imx8mp-evk-rpmsg.dtb</code>: RPMSG. • <code>imx8dx1-evk-rpmsg</code>: RPMSG. • <code>imx8qxp0-mek-rpmsg</code> and <code>imx8qxp-mek-rpmsg</code> with RPMSG • <code>imx8qxp-mek-rpmsg.dtb</code>: Supports partition reset, RPMSG audio codec on Cortex-M4, and supports the LVDS-HDMI or MIPI-DSI-HDMI display with the LVDS-HDMI or MIPI-DSI-HDMI converts. This requires the <code>flash.bin</code> to include the Cortex-M4 image. • <code>imx8qm-mek-rpmsg.dtb</code>: Supports partition reset, and supports the LVDS-HDMI or MIPI-DSI-HDMI display with the LVDS-HDMI or MIPI-DSI-HDMI converts. This requires <code>flash.bin</code> to include the Cortex-M4 image. • <code>imx8qm-mek_ca53.dtb</code>: Supports four CortexA53 cores only. • <code>imx8qm-mek_ca72.dtb</code>: Supports two Cortex-A72 cores only. You need to build the special boot image through the <code>imx-mkimage</code> tools, and select the <code>flash_ca72</code> build target. • <code>imx8qm-mek-enet2-tja1100.dtb</code>: Supports the tja1100 ENET daughter card. • <code>imx8mq-evk-rpmsg.dtb</code>: RPMSG. • <code>imx8mm-evk-rpmsg.dtb</code>: RPMSG. • <code>imx8mn-evk-rpmsg.dtb</code> and <code>imx8mn-ddr4-evk-rpmsg.dtb</code>: RPMSG. • <code>imx6sx-sdb-m4.dtb</code>: Disables the access of ADC 1 and 2, FlexCAN 1 and 2, I2C3, UART 2 and QSPI 2 from Cortex-A processor when Arm Cortex-M4 processor is running. • <code>imx6sx-sabreauto-m4.dtb</code>: Disables the access of ADC 1 and 2, FlexCAN 1 and 2, I2C3, UART 2 and QSPI 2 from Cortex-A processor when Arm Cortex-M4 processor is running. • <code>imx7d-sdb-m4.dtb</code>: Disables the access of ADC 1 and 2, FlexCAN 1 and 2, I2C3, UART 2, and QSPI 2 from Cortex-A processor when Arm Cortex-M4 processor is running. • <code>imx8qxp-mek-sof-wm8960.dtb</code>, <code>imx8qm-mek-sof-wm8960.dtb</code>: Enables playback/record using Sound Open Firmware for HiFi4 DSP with WM8960 codec. • <code>imx8qm-mek-sof-cs42888.dtb</code>, <code>imx8qm-mek-sof-cs42888.dtb</code>: Enables playback/record using Sound Open Firmware for HiFi4 DSP with CS42888 codec. <p>On i.MX 8QuadMax and 8QuadXPlus, multiple partitions are supported. Due to the board design, <code>flash.bin</code> and the DTB need to be matched. If <code>flash.bin</code> includes the Cortex-M4 partition, use <code>x-rpmsg.dtb</code>.</p> |
| Qspi | <p>Enables DDR Quad mode for Macronix QSPI chip <code>mx25l51245g</code> by setting Quad bit in status register.</p> <ul style="list-style-type: none"> • <code>imx7-sdb-qspi.dtb</code>, <code>imx7-sdb-reva-qspi.dtb</code> • <code>imx7ulp-evk-qspi.dtb</code> |
| SD1 | <p>Enables <code>sd1</code> on <code>uSDHC1</code> on the base board.</p> <ul style="list-style-type: none"> • <code>imx7ulp-sd1.dtb</code> |
| Touch | <p>Adds <code>tsc2046</code> touch screen controller support. Because the pin <code>PENIRQ</code> of <code>tsc2046</code> conflicts with the interrupt pin of HDMI, this disables the HDMI.</p> <ul style="list-style-type: none"> • <code>imx7-sdb-reva-touch.dtb</code> |
| USB | <p>Enables USB certification for i.MX 6UltraLite.</p> <ul style="list-style-type: none"> • <code>imx6ul-14x14-evk-usb-certi.dtb</code> |

Table 10. Kernel and device tree configurations...continued

| Kernel and device tree configuration | Description |
|--------------------------------------|--|
| DPDK | <ul style="list-style-type: none"> imx8mm-evk-dpdk.dtb, imx8mp-evk-dpdk.dtb: DTB file to export FEC Ethernet port to Userspace DPDK "enetfec" driver. |
| I3C | Enables I3C, which is not used in the default DTB. <ul style="list-style-type: none"> imx8ulp-evk-i3c.dtb imx8ulp-9x9-evk-i3c.dtb imx93-11x11-evk-i3c.dtb |
| FlexIO | Enables FlexIO I2C master, which is not used in the default DTB. <ul style="list-style-type: none"> imx8ulp-evk-flexio-i2c.dtb imx93-11x11-evk-flexio-i2c.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 |
|----------------------|---|---|--|
| <code>console</code> | Where to output the kernel logging by <code>printk</code> . | For i.MX 6 SABRE-SD, <code>console=ttymxc0, 115200</code> For i.MX 6 SABRE-AI, <code>console=ttymxc3, 115200</code> For i.MX 7ULP, <code>console=ttyLP0, 115200</code> For i.MX 8QuadMax and i.MX 93 11x11 EVK, <code>console=ttyLP0, 115200</code> <code>earlycon</code> | All use cases |
| <code>nosmp</code> | A command-line option of <code>nosmp</code> disables SMP activation entirely. | <code>nosmp</code> | <code>CONFIG_SMP</code> is defined. Use this to disable SMP activation. SMP is activated by default through the <code>CONFIG_SMP</code> configuration. |
| <code>ip</code> | Tells the kernel how or whether to get an IP address. | <code>ip=none</code> <code>ip=dhcp</code> <code>ip=static_ip_address</code> | <code>ip=dhcp</code> or <code>ip=static_ip_address</code> is mandatory in boot from TFTP/NFS. |
| <code>nfsroot</code> | Location of the NFS server/directory. | <code>nfsroot=<ip_address>:<rootfs path></code> | Used in "boot from tftp/NFS" together with <code>root=/dev/nfs</code> . |

Table 11. Common kernel boot parameters...continued

| Kernel parameter | Description | Typical value | Used when |
|------------------|--|--|---|
| 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. |
| 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. |

Table 11. Common kernel boot parameters...continued

| Kernel parameter | Description | Typical value | Used when |
|--------------------|--|--|---|
| video on 6SABRE-SD | <p>Tells the kernel/driver which resolution/depth and refresh rate should be used for display port 0 or 1.</p> <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> | <ol style="list-style-type: none"> video=mxcfb0:dev=hdmi, 1920x1080M@60, if=RGB24 video=mxcfb1:dev=ldb, if=RGB666 video=mxcfb0:dev=ldb, if=RGB666 video=mxcfb1:dev=hdmi, 1920x1080M@60, if=RGB24 video=mxcfb0:dev=hdmi, 1920x1080M@60, if=RGB24 video=mxcfb0:dev=ldb, if=RGB666 video=mxcfb0:dev=lcd, CLAA-WVGA, if=RGB656 video=mxcfb0:dev=mipi_dsi, TRULY-WVGA, if=RGB24 | <ol style="list-style-type: none"> Used when primarily displaying on HDMI with 1080P60 mode. Secondly displaying on LVDS with XGA mode. Used when primarily displaying on LVDS with XGA mode. Secondly displaying on HDMI with 1080P60 mode. Used when primary displaying on HDMI with 1080P60 mode. Used when primary displaying on the HannStar LVDS1. Used when primary displaying on the CLAA-WVGA dumb parallel LCD panel. 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 VGA: GBR24 HDMI&DVI: RGB24 CLAA WVGA LCD: RGB565</p> <p>Typical values for dev= are shown as follows:</p> <p>lcd: LCD interface ldb: LVDS hdmi: HDMI on-chip or sii902x dvi: DVI port vga: VGA through TVE tve: TVOUT</p> |

Table 11. Common kernel boot parameters...continued

| Kernel parameter | Description | Typical value | Used when |
|----------------------|---|--|---|
| 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. | <ol style="list-style-type: none"> video=mxcfb0:dev=hdmi, 1920x1080 M@60,if=RGB24 video=mxcfb1:dev=ldb,if=RGB666 video=mxcfb0:dev=ldb,if=RGB666 video=mxcfb0:dev=hdmi, 1920x1080M@60, if=RGB24 video=mxcfb0:dev=ldb,if=RGB666 video=mxcfb0:dev=hdmi, 1920x1080M@60, if=RGB24 | <ol style="list-style-type: none"> Used when primarily displaying on HDMI with 1080P60 mode. Secondly displaying on LVDS with XGA mode. Used when primarily displaying on LVDS with XGA mode. Secondly displaying on HDMI with 1080P60 mode. Used when primary displaying on HDMI with 1080P60 mode. Used when primary displaying on the HannStar LVDS0. Used when enabling HDMI 1080P60 mode and LVDS0. To enable second display, run <code>echo 0 > /sys/class/graphics/fb2/blank</code>. <p>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</p> <p>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</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. |

Table 11. Common kernel boot parameters...continued

| Kernel parameter | Description | Typical value | Used when |
|--|---|---|---|
| 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 (user) | When to enable NAND. The partition: 16m (boot), 46m (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 |
|-----|------------|----------|--|---|
| 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 <code>connmanctl</code> 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 |
|---------------------------------|------------|----------|--|---|
| i.MX 7 family and i.MX 8 family | Kernel/BSP | Software | After getting IP address for WLAN 0, the Ethernet is down and loses IP address with the SD card image. | Use <code>connmanctl</code> to set up WLAN 0 instead of directly calling UDHCP. 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 |
|----------------|------------|----------|--|--|
| i.MX 8M Nano | ONNX | Software | <code>onnx_test_runner</code> with <code>inception_v4_299</code> meets GPU core hanging when testing with <code>vsi_npu</code> execution provider. | It will be fixed in next release. |
| i.MX 8DXL | Kernel/BSP | Software | System suspends/resumes hang-up if <code>init_debug=yes</code> and the USB cable is kept connected after UUU burns image to SD/eMMC. | It will be fixed in next release. |
| i.MX 8Quad Max | Kernel/BSP | Software | RTC Kernel hangs during the suspend resume stress test. | Use a longer wake-up time. |
| i.MX 8M Plus | PCIe | Software | When PCIe is supported, there is no EP (end point) device connected on the PCIe port. | Add <code>pcie_cz_enabled=yes</code> to the kernel command line. The PCIe clocks and power supplies should be kept on. Refer to the workaround of one erratum (Erratum ERR051128). |
| i.MX 8ULP | Bootloader | Software | The eMMC fastboot does not support warm reboot. eMMC fastboot only supports 4 bit SDR setting. | No issue on A1 part (i.MX 8ULP EVK), but existing on A0.1 part (i.MX 8ULP 9x9 EVK). |

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

| SoC | Module | Source | Description | Workaround |
|--------------------------------|---|----------|---|---|
| i.MX 8ULP | SOF | Software | SOF only supports 8K Sample rate. | It is a limitation. |
| i.MX 8ULP | Kernel/BSP | Software | In Linux OS, data cannot be transmitted by FlexIO 100% correctly. | It is a limitation. |
| i.MX 8ULP | Kernel/BSP | Software | In linux OS, sometimes Ethernet fails to probe when booting up using DTB of FlexIO I2C. | It is a limitation. |
| i.MX 8ULP | PM | Software | A core cannot resume after A/M enters deep power down mode. | No issue on A1 part (i.MX 8ULP EVK), but existing on A0.1 part (i.MX 8ULP 9x9 EVK). |
| i.MX 8M Mini, 8M Nano, 8M Plus | Low power audio playback with Cortex-M core | Software | As the LPA needs large buffer size, which exceeds the default size in ALSA, the LPA sound card probe fails with the default boot command. | Add the parameter <code>snd_pcm.max_alloc_per_card=134217728</code> in boot command when booting with <code>*-rpmsg.dtb</code> on these platforms. |
| i.MX 8M Plus, i.MX 8MQuad | Wi-Fi | Hardware | System cannot get into suspend while loading Wi-Fi modules for Murata LBEE5XV1YM SDIO8997. | Murata will fix this hardware issue in next release. |
| i.MX 8M Plus | 8MIC-REVE board | Software | 8MIC-REVE board pin conflicts with UART3 for REVA3, REVB, and higher revision EVK board. | Disable UART3 node in DTS when 8MIC-REVE board is used with REVA3/REVB or higher. |
| i.MX8M Plus, i.MX 8DXL | Kernel/BSP | Software | Bridge mode on EQoS module does not work. | See https://community.nxp.com/t5/i-MX-Processors-Knowledge-Base/Workaround-for-issue-Bridge-mode-on-EQoS-module-will-not-work/ta-p/1559302 . |

Table 15. Known issues and workarounds for i.MX 9 Family SoC

| SoC | Module | Source | Description | Workaround |
|---------|---------------------|----------|---|--|
| i.MX 93 | Headphone detection | Hardware | Headphone detection does not work on the first batch of the REV. B board. | Do hardware rework: Remove R1203, R1204. Jump wire between R1203.2 and R1204.2. Jump wire between R1204.1 and R132.1. |
| i.MX 93 | PDM MIC | Hardware | Recording cannot be heard at the default volume. | Trivo will improve the process in next version. |

Table 15. Known issues and workarounds for i.MX 9 Family SoC...continued

| SoC | Module | Source | Description | Workaround |
|---------|-------------------|----------|---|---|
| i.MX 93 | Kernel/BSP | Software | Bridge mode on EQoS module does not work. | See https://community.nxp.com/t5/i-MX-Processors-Knowledge-Base/Workaround-for-issue-Bridge-mode-on-EQoS-module-will-not-work/ta-p/1559302 . |
| i.MX 93 | Audio Hat CS42448 | Hardware | CS42448: The playback has an issue with channel swap. | For old SCH-50567, REV A reversion: add an audio cable and swap L/R channel from the cable. For a new board, reversion already has this rework by default. |
| i.MX 93 | LVDS Touchscreen | Hardware | LVDS touchscreen cannot report events after touching for several times. | Do hardware rework: remove R131, and install R181 with 0Ω/0402. |

7 Multimedia

This chapter provides the information on the 4.7.2 multimedia component of the BSP.

The GStreamer version in this release is 1.20.3.

7.1 i.MX GStreamer plugins

Table 16. 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 data into compress audio. Parses IEC958 data into PCM audio or compress audio. |
| Audio decoder | beepdec: unified audio decoder plugin Supports MP3, AAC, AAC+, WMA, AC3, Vorbis, DD+, AMR, RA |
| Audio encoder | lamemp3enc: MP3 encoder plugin |

Table 16. i.MX GStreamer 1.0 plugins...continued

| Plugin | Features |
|---------------|--|
| Video decoder | <p>i.MX 6 family:</p> <ul style="list-style-type: none"> • vpudec: VPU-based video decoder plugin <p>i.MX 8QuadXPlus or 8QuadMax:</p> <ul style="list-style-type: none"> • v412h265dec: V4L2 H.265 Decoder • v412h264dec: V4L2 H.264 Decoder • v412mpeg4dec: V4L2 MPEG4 Decoder • v412xviddec: V4L2 XVID Decoder • v412mpeg2dec: V4L2 MPEG2 Decoder • v412vc1dec: V4L2 VC1 Decoder • v412h263dec: V4L2 H.263 Decoder • v412vp8dec: V4L2 VP8 Decoder • v412jpegdec: V4L2 JPEG Decode <p>i.MX 8M Mini and i.MX 8M Plus:</p> <ul style="list-style-type: none"> • v412h265dec: V4L2 H.265 Decoder • v412h264dec: V4L2 H.264 Decoder • v412vp8dec: V4L2 VP8 Decoder • v412vp9dec: V4L2 VP9 Decoder <p>i.MX 8M Quad:</p> <ul style="list-style-type: none"> • v412h263dec: V4L2 H.263 Decoder • v412h264dec: V4L2 H.264 Decoder • v412h265dec: V4L2 H.265 Decoder • v412mpeg4dec: V4L2 MPEG4 Decoder • v412mpeg2dec: V4L2 MPEG2 Decoder • v412jpegdec: V4L2 JPEG Decode • v412avsdec: V4L2 AVS Decode • v412vp8dec: V4L2 VP8 Decoder • v412vp9dec: V4L2 VP9 Decoder • v412rvdec: V4L2 RMVB Decoder • v412vc1dec: V4L2 VC1 Decoder <p>i.MX all:</p> <ul style="list-style-type: none"> • Software video decoder plugins: uses <code>gst-libav</code> plugins |
| Video encoder | <p>i.MX 8M Plus:</p> <ul style="list-style-type: none"> • v412h264enc: VPU-based AVC/H.264 video encoder • v412h265enc: VPU-based HEVC video encoder <p>i.MX 8M Mini:</p> <ul style="list-style-type: none"> • v412h264enc: VPU-based AVC/H.264 video encoder • v412vp8enc: VPU-based VP8 video encoder <p>i.MX 8QuadXPlus or 8QuadMax:</p> <ul style="list-style-type: none"> • v412h264enc: V4L2 H.264 encoder • v412jpegenc: 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 |

Table 16. i.MX GStreamer 1.0 plugins...continued

| Plugin | Features |
|---------------------|---|
| 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 and i.MX 93:</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, and so on.</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 |
| 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+, 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`.*
- *For i.MX 8QuadXPlus or 8QuadMax, VP6, RealVideo, and Sorenson Spark Video decoder plugins are dropped since L5.15.52_2.1.0. From the L5.15.52_2.1.0 release, Amphion VPU switches to use the upstream driver, and these formats are not supported in upstream.*

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 17. 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 metadata (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 8 platforms, which have a VPU hardware encoder.

This API set can provide the following functions.

Table 18. 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. |

Table 18. Recording engine functions...continued

| Function | Feature |
|-------------------|---|
| 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 19. 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 |
| 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 | - |

Table 19. Parser/Demuxer supported audio/video...continued

| | Demuxer feature | ASF | AVI | MP4 | OGG | FLV | MPG2 | MKV | RMVB |
|--|-----------------|-----|-----|-----|-----|-----|------|-----|------|
| | 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 [Section 4](#) to determine if your board supports VPU with software decoder.

Table 20. 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 2304 | 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 8Quad XPlus | 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 | 48 x 48 | 4096 x 2304 | 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 8Quad XPlus | HP/MP/BP | 64 x 64 | 4096 x 2160 | 30 fps | 50 Mbps | - |
| | | i.MX 8QuadMax | HP/MP/BP | 64 x 64 | 4096 x 2160 | 30 fps | 50 Mbps | - |
| | | i.MX 6 | HP/MP/BP | 64 x 64 | 1920 x 1080 | 60 fps | 50 Mbps | - |
| | VP9 | i.MX 8M Quad | profile 0, 2 | 144 x 144 | 4096 x 2304 | 60 fps | 100 Mbps | - |
| | | i.MX 8M Plus i.MX 8M Mini | profile 0, 2 | 144 x 144 | 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 | - | |

Table 20. Video codec specification for hardware with VPU acceleration...continued

| Format | Platform | Profile | Min. resolution | Max. resolution | Frame rate | Bitrate | Comment |
|------------|------------------|----------|-----------------|-----------------|------------|-----------|---------|
| | i.MX 8Quad XPlus | - | 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 8Quad XPlus | 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 8Quad XPlus | 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 8Quad XPlus | 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 8Quad XPlus | 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 8Quad XPlus | - | 64 x 64 | 1920 x 1080 | 60 fps | - | - |

Table 20. Video codec specification for hardware with VPU acceleration...continued

| | Format | Platform | Profile | Min. resolution | Max. resolution | Frame rate | Bitrate | Comment |
|------------------------|--------|------------------|----------------|-----------------|---------------------------------|---------------------------------|---------------------------------|-----------------------|
| Video Encoder | RV | i.MX 8QuadMax | - | 64 x 64 | 1920 x 1080 | 60 fps | - | - |
| | | i.MX 6 | - | 64 x 64 | 1920 x 1080 | 30 fps | 120 Mpixl | - |
| | | i.MX 8M Quad | 9 | 48 x 48 | 1920 x 1080 | 60 fps | - | - |
| | | i.MX 6 | 8/9/10 | 64 x 64 | 1920 x 1080 | 30 fps | 40 Mbps | - |
| | H.264 | i.MX 8M Plus | HP/MP/BP | 144 x 144 | 1920 x 1080 | 60 fps | 40 Mbps | - |
| | | i.MX 8M Mini | HP/MP/BP | 144 x 96 | 1920 x 1080 | 60 fps | 40 Mbps | - |
| | | i.MX 8Quad XPlus | HP/MP/BP | 64 x 64 | 1920 x 1080 | 30 fps | - | - |
| | H.265 | i.MX 8M Plus | main / main 10 | 136 x 136 | 1920 x 1080 | 60 fps | - | - |
| VP8 | | i.MX 8M Mini | - | 144 x 96 | 1920 x 1080 | 30 fps | 60 Mbps | - |
| | | i.MX 6 | BP | 64 x 64 | 1920 x 1080 | 30 fps | 20 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 21. 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 Quad XPlus i.MX 8Quad Max i.MX 8ULP | 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 | - |

Table 21. Audio codec specification...continued

| | Platform | Feature/ Profile | Feature/ Profile | Channel | Sample rate (kHz) | Bit rate (kbps) | Comment |
|-----------|--|------------------|------------------------------|---|-------------------|--|---|
| | i.MX 8M Plus i.MX Quad XPlus i.MX 8Quad Max i.MX 8ULP | AACLC | MPEG-2 AACLC MPEG-4 AACLC | i.MX 8ULP: stereo/mono others: <=5.1 | 8-96 | - | Bit rate depends on both the sample rate and the number of channels |
| | i.MX 8M Plus i.MX Quad XPlus i.MX 8Quad Max | Ogg Vorbis | q1 - q10 | Stereo | 8-192 | <= 500 | - |
| | i.MX 8M Plus i.MX Quad XPlus i.MX 8Quad Max | WMA STD | L1 @ QL1 | stereo/mono | 44.1 | 64-161 | - |
| L2 @ QL1 | | | <= 48 | | <= 161 | - | |
| L3 @ QL1 | | | <= 48 | | <= 385 | - | |
| | i.MX 8M Plus i.MX Quad XPlus i.MX 8Quad Max | WMA Pro | M0a @ QL2 | stereo/mono | <= 48 | 48-192 | - |
| M0b @ QL2 | | | <= 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 Quad XPlus i.MX 8Quad Max | WMA Lossless | N1 | stereo/mono | <= 48 | <= 3000 | - |
| N2 | | | <=5.1 | | <= 96 | <= 3000 | - |
| N3 | | | <= 7.1 | | <= 96 | <= 3000 | - |
| | i.MX 8M Plus i.MX Quad XPlus i.MX 8Quad Max | 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 | - |

Table 21. Audio codec specification...continued

| | Platform | Feature/Profile | Feature/Profile | Channel | Sample rate (kHz) | Bit rate (kbps) | Comment |
|------------------------|----------|-----------------|------------------------------------|--|-------------------|-------------------------------|---------|
| Software Audio Decoder | i.MX All | MP3 | MPEG-1 (Layer-1/ Layer-2/ Layer-3) | stereo/ mono | <=48 | 8-448 | - |
| | | | MPEG-2 (Layer-1/ Layer-2/ Layer-3) | | | | |
| | | | MPEG-2.5 (Layer-3) | | | | |
| | | 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 | - | | |

Table 21. Audio codec specification...continued

| | Platform | Feature/Profile | Feature/Profile | Channel | Sample rate (kHz) | Bit rate (kbps) | Comment |
|--|----------|-----------------|-----------------|---------|-------------------|--|-----------------|
| | | 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 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 |

7.4.5 Streaming protocol specification

Table 23. Streaming protocol specification

| Protocol | Feature |
|------------|---|
| HTTP/HTTPS | HTTP/HTTPS progressive streaming |
| RTSP | RTP, SDP |
| RTP/UDP | RTP/UDP MPEGTS streaming |
| HLS | HTTP live streaming |
| MPEG-DASH | MPEG Dynamic Adaptive Streaming over HTTP |

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 24. RTSP streaming server specification

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

Table 24. RTSP streaming server specification...continued

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

7.4.7 Subtitle specification

Table 25. Subtitle specification

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

7.4.8 Sound Open Firmware

Sound Open Firmware updated to v1.9 and contains following new features:

- Support for i.MX 8ULP platform
- Equalizer support based on IIR and FIR filters
- Dynamic Range Compress support

7.4.9 Chromium

Chromium is updated to 101.0.4951.54 and VPU is integrated with V4L2VDA to accelerate Chromium video decoding on i.MX 8 series platforms with VPU hardware.

Table 26. Chromium supported hardware video codec

| Chromium video codec | MP4 | | WEBM | |
|----------------------|------|-------|------|-----|
| | HEVC | H.264 | VP8 | VP9 |
| i.MX 8M Mini | Y | Y | Y | Y |
| i.MX 8M Plus | Y | Y | Y | Y |
| i.MX 8M Quad | Y | Y | Y | Y |
| i.MX 8Quad XPlus | Y | Y | - | Y |
| i.MX 8Quad Max | Y | Y | - | Y |

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.

Issues seen on Chromium:

- As Chromium disables auto spawning of the PulseAudio, users need to manually start PulseAudio with `pulseaudio --start` before running Chromium command if needed.
- Streams with out of order frames like H.264 with b-frames have video flicker.

8 Revision History

This table provides the revision history.

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 8Quad XPlus 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.MX 6, i.MX 7, i.MX 8 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 |
| LF5.4.3_1.0.0 | 03/2020 | i.MX 5.4 Kernel and Yocto Project Upgrades |
| 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 8M Plus and i.MX 8DXL |

Revision history...continued

| Revision number | Date | Substantive changes |
|-----------------|---------|--|
| L5.4.70_2.3.0 | 01/2021 | Updated the command lines in Section "Running the Arm Cortex-M4 image" |
| LF5.10.9_1.0.0 | 03/2021 | Upgraded to Yocto Project Gatesgarth and the kernel upgraded to 5.10.9 |
| LF5.10.35_2.0.0 | 06/2021 | Upgraded to Yocto Project Hardknott and the kernel upgraded to 5.10.35 |
| LF5.10.52_2.1.0 | 09/2021 | Updated for i.MX 8ULP Alpha and the kernel upgraded to 5.10.52 |
| LF5.10.52_2.1.0 | 10/2021 | Updated the Arm SR-IR certification |
| LF5.10.52_2.1.0 | 11/2021 | Updated Table 3 "BSP and multimedia standard packages" |
| LF5.10.72_2.2.0 | 12/2021 | Upgraded the kernel to 5.10.72 and updated the BSP |
| LF5.15.5_1.0.0 | 03/2022 | Upgraded to the 5.15.5 kernel, Honister Yocto, and Qt6 |
| LF5.15.32_2.0.0 | 06/2022 | Upgraded to the 5.15.32 kernel, U-Boot 2022.04, and Kirkstone Yocto |
| LF5.15.52_2.1.0 | 09/2022 | Upgraded to the 5.15.52 kernel, and added the i.MX 93. |
| LF5.15.71_2.2.0 | 12/2022 | Upgraded to the 5.15.71 kernel. |

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Contents

| | | |
|----------|---|-----------|
| 1 | Overview | 2 |
| 1.1 | References | 3 |
| 1.2 | Release contents | 5 |
| 1.3 | License | 8 |
| 1.4 | Limited access proprietary packages | 9 |
| 1.5 | Instructions to get the AP1302 firmware | 9 |
| 2 | What's New? | 9 |
| 2.1 | New features | 9 |
| 3 | SoC Feature Summary | 11 |
| 4 | BSP Supported Features | 12 |
| 5 | U-Boot and Device Trees | 29 |
| 5.1 | U-Boot configurations | 29 |
| 5.2 | Kernel device trees | 30 |
| 5.3 | Kernel boot parameters | 40 |
| 6 | Known Issues/Limitations | 44 |
| 7 | Multimedia | 47 |
| 7.1 | i.MX GStreamer plugins | 47 |
| 7.2 | i.MX playback example | 50 |
| 7.3 | i.MX recording engine API | 50 |
| 7.4 | Multimedia feature matrix | 51 |
| 7.4.1 | Parser/Demuxer specifications | 51 |
| 7.4.2 | Video codec specifications | 52 |
| 7.4.3 | Audio codec specification | 54 |
| 7.4.4 | Speech codec specification | 57 |
| 7.4.5 | Streaming protocol specification | 57 |
| 7.4.6 | RTSP streaming server specification | 57 |
| 7.4.7 | Subtitle specification | 58 |
| 7.4.8 | Sound Open Firmware | 58 |
| 7.4.9 | Chromium | 58 |
| 7.5 | Known issues and limitations for multimedia ... | 58 |
| 8 | Revision History | 59 |
| 9 | Legal information | 61 |

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