

# i.MX Linux® Release Notes

## Contents

## 1 Release Contents

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

This release contains the latest updates for the last general availability (GA) release. For more information on changes, see the manifest Readme at [index: fsl-arm-yocto-bsp.git](index:fsl-arm-yocto-bsp.git) and the Change Logs at [index: fsl-arm-yocto-bsp.git](index:fsl-arm-yocto-bsp.git).

### Supported hardware SoC/board

- i.MX 6QuadPlus SABRE-SD Board and Platform
- i.MX 6QuadPlus SABRE-AI Board
- i.MX 6Quad SABRE-SD Board and Platform
- i.MX 6DualLite SABRE-SD Board
- i.MX 6Quad SABRE-AI Board
- i.MX 6DualLite SABRE-AI Board
- i.MX 6SoloLite EVK Board
- i.MX 6SoloX SABRE-SD Board
- i.MX 6SoloX SABRE-AI Board
- i.MX 7Dual SABRE-SD Board
- i.MX 6UltraLite EVK Board
- i.MX 6ULL EVK Board

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**NOTE**

In this document, the following notation is used:

- 6SABRE-SD stands for the i.MX 6Quad, i.MX 6QuadPlus, and i.MX 6DualLite SABRE-SD Platforms.
- 6SABRE-AI stands for the i.MX 6Quad, i.MX 6QuadPlus, and i.MX 6DualLite SABRE-AI Platforms.
- 6SoloLite stands for the i.MX 6SoloLite EVK
- 6SoloX-SD stands for the i.MX 6SoloX SABRE-SD Platform.
- 6SoloX-AI stands for the i.MX 6SoloX SABRE-AI Platform.
- 7D-SABRE-SD stands for the i.MX 7Dual SABRE-SD Platform.
- 6UltraLite stands for the i.MX 6UltraLite EVK Platform.
- 6ULL stands for the i.MX 6ULL EVK Platform.

## 1.1 Contents

This release consists of the following package files:

- L4.1.15\_2.0.0-ga\_mfg-tools.tar.gz
- fsl-yocto-L4.1.15\_2.0.0-ga.tar.gz

The release version is named "L<Kernel\_version>\_<x.y.z>."

"<Kernel\_version>": BSP Kernel version. (For example, "L4.1.15" indicates that this BSP release is based on the kernel version 4.1.15.)

"<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 1. Release contents**

Component	Description
Linux® OS Kernel and Device Trees	4.1.15.
U-Boot	v2016.03.
SD Card images	Pre-built images for download, and image files gathering a suggestion of packages and libraries needed for the common tests.
Manufacturing Tools	MFGtools is a program used to burn a production image into the board using a set of predefined parameters, such as the target memory to be used.

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-fsl-arm and meta-fsl-bsp-release layers in the `conf/machine` sub-directory.

**Table 2. U-Boot configurations**

U-Boot configuration for Boot device	Description	Supported machine configuration
sd	This supports booting from the SD card. This is the default U-Boot configuration.	imx6qsabresd, imx6qpsabresd, imx6dlsabresd imx6qsabreauto, imx6qpsabreauto, imx6dlsabreauto

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**Table 2. U-Boot configurations (continued)**

U-Boot configuration for Boot device	Description	Supported machine configuration
		imx6slevk imx6sxsabresd imx6sxsabreauto imx7dsabresd imx6ulevk imx6ull14x14evk
spi-nor	This supports booting from SPI-NOR	imx6qsabreauto, imx6dlsabreauto imx6qpsabreauto imx6slevk
eim-nor	This supports booting from Parallel NOR.	imx6qsabreauto, imx6dlsabreauto, imx6solosabreauto imx6qpsabreauto
nand	This supports booting from NAND. Note that NAND is not populated on the i.MX 7Dual SABRESD board. Users need to populate it if needed.	imx6qsabreauto, imx6dlsabreauto, imx6solosabreauto imx6qpsabreauto imx6sxsabreauto imx7dsabresd imx6ull14x14evk
sata	This supports booting from SATA.	imx6qsabresd, imx6qpsabresd imx6qsabreauto, imx6qpsabreauto
qspi2	This supports booting from QSPI2. Booting from the ARM® Cortex®-M4 processor is supported through QSPI2. Use U-Boot command “bootaux” to boot the ARM Cortex-M4 processor. The booting address is 0x78000000.	imx6sxsabresd
qspi1	This supports booting from QSPI1. Booting from the ARM Cortex-M4 processor is supported through QSPI1. Use U-Boot command “bootaux” to boot the ARM Cortex-M4 processor. The booting address is changed to 0x68000000.	imx6sxsabreauto imx7dsabresd imx6ulevk
emmc	This supports booting from EMMC. Note that eMMC is not populated on the i.MX 7Dual and i.MX 6SoloX SABRESD boards. Users need to populate it if needed.	imx6sxsabresd imx7dsabresd imx6ull14x14evk
m4fastup	This supports booting from ARM Cortex-M4 processor by disabling QSPI2 from using ARM Cortex-M4 processor.	imx6sxsabresd
epdc	This supports EPDC splash screen in U-Boot.	imx6slevk imx7dsabresd

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

**Table 3. Kernel and device tree configurations**

Kernel and device tree configuration	Description
zImage for i.MX 6 and i.MX 7	Binary kernel image for the 4.1.15 kernel. This kernel is built with the imx_v7_defconfig for any i.MX 6 or i.MX 7 boards.
Standard	<p>Each reference board has a standard device tree as follows:</p> <ul style="list-style-type: none"> <li>• zImage-imx6q-sabresd.dtb zImage-imx6qp-sabresd.dtb</li> <li>• zImage-imx6dl-sabresd.dtb</li> <li>• zImage-imx6q-sabreauto.dtb zImage-imx6qp-sabreauto.dtb</li> <li>• zImage-imx6dl-sabreauto.dtb</li> <li>• zImage-imx6sl-evk.dtb</li> <li>• zImage-imx6sx-sdb.dtb zImage-imx6sx-sdb-reva.dtb</li> <li>• zImage-imx6sx-sabreauto.dtb</li> <li>• zImage-imx7d-sdb.dtb</li> <li>• zImage-imx6ul-14x14-evk.dtb zImage-imx6ul-9x9-evk.dtb</li> <li>• zImage-imx6ull-14x14-evk.dtb</li> </ul> <p>Note: zImage-imx6sx-sdb.dtb is used for supporting the i.MX 6SoloX SABRE-SDB Rev. B board, and imx6sx-sdb-reva.dtb is used for supporting the legacy SABRE-SDB Rev. A board.</p> <p>zImage-imx7d-sdb.dtb is used for supporting the i.MX 7Dual SABRE-SDB Rev. C and Rev. D boards, and zImage-imx7d-sdb-reva.dtb is used for supporting the legacy SABRE-SDB Rev. A board.</p>
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"> <li>• zImage-imx6dl-sabreauto-gpmi-weim.dtb</li> <li>• zImage-imx6q-sabreauto-gpmi-weim.dtb</li> <li>• zImage-imx6qp-sabreauto-gpmi-weim.dtb</li> <li>• zImage-imx7d-sdb-gpmi-weim.dtb and zImage-imx7d-sdb-reva-gpmi-weim.dtb</li> </ul>
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"> <li>• zImage-imx6q-sabresd-ldo.dtb</li> <li>• zImage-imx6qp-sabresd-ldo.dtb</li> <li>• zImage-imx6ul-9x9-evk-ldo.dtb</li> <li>• zImage-imx6dl-sabresd-ldo.dtb</li> <li>• zImage-imx6sl-evk-ldo.dtb</li> <li>• zImage-imx6sx-sdb-ldo .dtb and zImage-imx6sx-sdb-reva-ldo.dtb</li> </ul>
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"> <li>• zImage-imx6q-sabresd-hdcp.dtb</li> <li>• zImage-imx6dl-sabresd-hdcp.dtb</li> <li>• zImage-imx6qp-sabresd-hdcp.dtb</li> </ul>
ecspi	<p>Enables eCSPI, which is disabled in the default DTB.</p> <ul style="list-style-type: none"> <li>• zImage-imx6dl-sabreauto-ecspi.dtb</li> <li>• zImage-imx6q-sabreauto-ecspi.dtb</li> <li>• zImage-imx6qp-sabreauto-ecspi.dtb</li> </ul>
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"> <li>• zImage-imx6q-sabreauto-flexcan1.dtb</li> </ul>

*Table continues on the next page...*

**Table 3. Kernel and device tree configurations (continued)**

Kernel and device tree configuration	Description
	<ul style="list-style-type: none"> <li>• zImage-imx6dl-sabreauto-flexcan1.dtb</li> <li>• zImage-imx6qp-sabreauto-flexcan1.dtb</li> </ul>
csi	<p>Enables CSI support for V4L2.</p> <p>On i.MX 6UltraLite EVK this device tree avoids the pin conflict between SIM and CSI.</p> <ul style="list-style-type: none"> <li>• zImage-imx6sl-evk-csi.dtb</li> <li>• zImage-imx6ul-14x14-evk-csi.dtb</li> <li>• zImage-imx6ul-9x9-evk-csi.dtb</li> </ul>
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.</p> <p>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"> <li>• zImage-imx6q-sabresd-enetirq.dtb</li> <li>• zImage-imx6dl-sabresd-enetirq.dtb</li> <li>• zImage-imx6dl-sabreauto-enetirq.dtb</li> <li>• zImage-imx6q-sabreauto-enetirq.dtb</li> </ul>
emmc	<p>The eMMC chip is DNP by default. This requires hardware modifications to burn the eMMC4.5 chip on the eMMC socket on uSDHC4 and connect eMMC signals as well as disconnect BOOT SD CARD slot signals.</p> <ul style="list-style-type: none"> <li>• zImage-imx6sx-sdb-emmc.dtb</li> </ul>
Cortex-M4	<p>Disables ADC 1 &amp; 2, flexcan 1 &amp; 2, I2C3, UART 2 and QSPI 2 when ARM Cortex-M4 processor is running.</p> <ul style="list-style-type: none"> <li>• zImage-imx6sx-sdb-m4.dtb</li> <li>• zImage-imx6sx-sabreauto-m4.dtb</li> <li>• zImage-imx7d-sdb-m4.dtb</li> </ul>
epdc	<p>Pin conflict between HDMI and EPDC, disable HDMI for EPDC.</p> <ul style="list-style-type: none"> <li>• zImage-imx7d-sdb-epdc.dtb</li> <li>• zImage-imx7d-sdb-reva-epdc.dtb</li> </ul>
qspi	<p>Enable DDR quad mode for Macronix qspi chip mx25l51245g by setting Quad bit in status register.</p> <ul style="list-style-type: none"> <li>• zImage-imx7-sdb-qspi.dtb</li> <li>• zImage-imx7-sdb-reva-qspi.dtb</li> </ul>
Audio	<p>Enable WM8960 audio as default one and disable HDMI audio.</p> <ul style="list-style-type: none"> <li>• zImage-imx7d-sdb-reva-wm8960.dtb</li> </ul>
HDMI Audio	<p>Enable HDMI audio as default one and disable WM8960 audio.</p> <ul style="list-style-type: none"> <li>• zImage-imx7d-sdb-reva-hdmi-audio.dtb</li> </ul>
touch	<p>Add tsc2046 touch screen controller support. Due to the pin PENIRQ of tsc2046 is conflict with the interrupt pin of HDMI, so disable the HDMI.</p> <ul style="list-style-type: none"> <li>• zImage-imx7-sdb-reva-touch.dtb</li> </ul>
MIPI Display	<p>Enable MIPI-DSI, because they use the same LCDIF.</p>
Bluetooth® wireless technology Wi-Fi	<p>Enable Broadcom Bluetooth wireless technology and Wi-Fi hardware.</p> <ul style="list-style-type: none"> <li>• zImage-imx6q-sabresd-btwifi.dtb</li> <li>• zImage-imx6qp-sabresd-btwifi.dtb</li> <li>• zImage-imx6dl-sabresd-btwifi.dtb</li> <li>• zImage-imx6l-evk-btwifi.dtb</li> <li>• zImage-imx6sx-sabresd-btwifi.dtb</li> </ul>

Table continues on the next page...

**Table 3. Kernel and device tree configurations (continued)**

Kernel and device tree configuration	Description
	<ul style="list-style-type: none"> <li>• zImage-imx6ul-14x14-evk-btwifi.dtb</li> <li>• zImage-imx6ul-9x9-evk-btwifi.dtb</li> <li>• zImage-imx6ull-14x14-evk-btwifi.dtb</li> </ul>
USB	Enable USB certification for i.MX 6UltraLite <ul style="list-style-type: none"> <li>• zImage-imx6ul-14x14-evk-usb-certi.dtb</li> </ul>

The release package contains the following pre-built images.

**Table 4. Pre-built images**

Package	Description
X11 SDCard	This release provides the following SD card images. These images include a GUI with X11 backend. The imx6qdsolo image works on all i.MX 6 SABRE-S, i.MX 6 and i.MX 7Dual SABRE-AI SABRE-SD boards with U-Boot and device tree changes. To change U-Boot and the device tree, see the <i>i.MX Linux® User's Guide</i> (IMXLUG). <ul style="list-style-type: none"> <li>• fsl-image-validation-x11-imx6qdsolo.sdcard</li> <li>• fsl-image-validation-x11-imx6ulevk.sdcard</li> <li>• fsl-image-validation-x11-imx6ull14x14evk.sdcard</li> <li>• fsl-image-validation-x11-imx6slevk.sdcard</li> <li>• fsl-image-validation-x11-imx6sx_all.sdcard</li> <li>• fsl-image-validation-x11-imx7dsabresd.sdcard</li> </ul>
Frame Buffer SDCard	This release provides the following SD card images for the Frame Buffer backend. <ul style="list-style-type: none"> <li>• fsl-image-qt5-validation-fb-imx6qdsolo.tar.bz2, fsl-image-validation-fb-imx6qdsolo.sdcard.bz2</li> <li>• fsl-image-qt5-validation-fb-imx6sx_all.tar.bz2, fsl-image-validation-validation-fb-imx6sx_all.sdcard.bz2</li> <li>• fsl-image-validation-fb-imx6slevk.tar.bz2, fsl-image-qt5-fb-imx6slevk.sdcard.bz2</li> </ul>
XWayland SDCard	This release provides the following SD card images for the XWayland backend with the Weston compositor. <ul style="list-style-type: none"> <li>• fsl-image-qt5-xwayland-imx6qdsolo.sdcard.bz2, fsl-image-validation-xwayland-imx6qdsolo.sdcard.bz2</li> <li>• fsl-image-validation-xwayland-imx6sx_all.sdcard.bz2, fsl-image-qt5-xwayland-imx6sx_all.sdcard.bz2</li> <li>• fsl-image-validation-xwayland-imx6slevk.sdcard.bz2, fsl-image-qt5-xwayland-imx6slevk.sdcard.bz2</li> </ul>
Kernel	Kernel and device trees as specified in Table 3.
U-Boot	U-Boot files as specified in Table 2.
mfgtools_with_rootfs.tar.gz	No MFGTool support the i.MX 8DV. Manufacturing tools are supported with the manufacturing tools kernel.

**Table 5. fsl-yocto-L4.1.15-2.0.0-ga.tar.gz content**

File name	Description
README	README for L4.1.15_2.0.0-ga
/doc	i.MX Linux® BSP Release Notes, User's Guide, and Reference Manual

**Table 6. Multimedia standard packages**

File name	Description	Comment
imx-gst1.0-plugins-4.1.4.tar.gz	GStreamer plugins	i.MX GStreamer plugins
imx-codec-4.1.4.bin	i.MX codecs	i.MX optimized A/V core codec
imx-parser-4.1.4.bin	i.MX parser	i.MX optimized core parser
imx-vpuwrap-1.0.68.bin	i.MX VPU wrapper	i.MX VPU wrapper for VPU library
imx-qtapplications-1.0.9.bin	i.MX Qt applications	i.MX Qt applications

Contact a marketing representative to get access to the following controlled packages.

**Table 7. Controlled access packages**

File name	Description	Comment
imx-aacpcodec-4.1.4.bin	AACplus decoder	i.MX optimized AACplus decoder
imx-mscodec-4.1.4.bin	Microsoft codecs	i.MX optimized Microsoft codecs
imx-msparser-4.1.4.bin	Microsoft parser	i.MX optimized Microsoft ASF parser
imx-ac3codec-4.1.4.bin	AC3 decoder	i.MX optimized Dolby audio AC3 decoder
imx-ddpcodec-4.1.4.bin	DDplus decoder	i.MX optimized Dolby audio DDplus decoder
imx-real-4.1.4.bin	Real Networks codecs and parser	i.MX optimized Real Networks real audio decoder, real media parser, and real video firmware
eink-waveform-firmware-1.0.1.bin	E Ink	E Ink REGAL/-D waveform for associated E Ink panels.
firmware-bcmdhd-1.0.4.bin	Broadcom Bluetooth® firmware and Wi-Fi firmware	Broadcom Firmware for Wi-Fi and Bluetooth wireless technology.

## 1.2 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.

The following components are released as binary files on the Yocto Project Mirror and have Freescale Proprietary Licenses. During the Yocto Project setup, to set up an i.MX build, accept the Freescale license. This acceptance is recorded in the build configuration files so that the following proprietary binaries can be extracted during the build process. The Freescale proprietary packages contain a Software Content Register (SCR) file that lists information about the package

- imx-gpu-viv
- imx-gpu-sdk
- imx-vpu
- imx-qtapplications
- firmware-imx
- imx-codec
- imx-parser
- imx-vpuwrap

## 1.3 Proprietary Licensing Packages

i.MX packages can be found in two locations:

- Standard packages are provided on the NXP mirror. They are accessed automatically by the Yocto Project scripts as needed.
- Limited Access packages listed in the following table are provided on [nxp.com](http://nxp.com) with controlled access. Contact your sales representative for access. They are listed in the following table. These include codecs to support WMA, WMV, RMVB, AAC+, AC3, DD+ decoding, encoding, WMA, Broadcom firmware, and E Ink firmware. Each package has its own Readme file with instructions on how to build, install, and run.

**Table 8. Limited access packages for Yocto project releases**

Name	Package	Comment
AACPlus Decoder	imx-aacpcodec-[version].bin	i.MX AACplus core decoder
Microsoft Codec	imx-mscodec-[version].bin	i.MX optimized MS codec
Microsoft Parser	imx-msparser-[version].bin	i.MX optimized ASF parser
AC3 Decoder	imx-ac3codec-[version].bin	i.MX AC3 core decoder
DDplus Decoder	imx-ddpcodec-[version].bin	i.MX DD-plus decoder
RMVB Decoders and Parser	imx-real-[version].bin	i.MX Real Networks
E Ink Waveform	firmware-eink-[version].bin	E Ink REGAL/-D waveform for i.MX 7D SABRE-SD
Broadcom Firmware	firmware-bcmd-[version].bin	Broadcom Bluetooth wireless technology and Wi-Fi firmware
Broadcom Bluetooth Applications	BSA-ServerAndClientsApps-0107.00.16.bin	Broadcom Bluetooth wireless technology applications

## 1.4 References

This release includes the following references and additional information.

- *i.MX Linux® Release Notes (IMXLXRN)* - Provides the release information.
- *i.MX Linux® User's Guide (IMXLUG)* - Contains the information on installing U-Boot and Linux OS and using i.MX-specific features.
- *i.MX Yocto Project User's Guide (IMXLXOCTOUG)* - Contains the instructions for setting up and building Linux OS in the Yocto Project.
- *i.MX Linux® Reference Manual (IMXLXRM)* - Contains the information on Linux drivers for i.MX.
- *i.MX 6 Graphics User's Guide (IMX6GRAPHICUG)* - Describes the graphics used.
- *i.MX BSP Porting Guide (IMXXBSPPG)* - Contains the instructions on porting the BSP to a new board.
- *i.MX VPU Application Programming Interface Linux® Reference Manual (IMXVPUAPI)* - Provides the reference information on the VPU API.

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 \(IMX6ULTRALITEQSG\)](#)



- [SABRE Automotive Infotainment Quick Start Guide \(IMX6SABREINFOQSG\)](#)
- [i.MX 6SoloLite Evaluation Kit Quick Start Guide \(IMX6SLEVKQSG\)](#)

Documentation is available online at [nxp.com](http://nxp.com).

- i.MX 6 information is at [nxp.com/iMX6series](http://nxp.com/iMX6series)
- i.MX SABRE information is at [nxp.com/imxSABRE](http://nxp.com/imxSABRE)
- i.MX 6SoloLite EVK information is at [nxp.com/6SLEVK](http://nxp.com/6SLEVK)
- i.MX 6UltraLite information is at [nxp.com/iMX6UL](http://nxp.com/iMX6UL)
- i.MX 6ULL information is at [nxp.com/iMX6ULL](http://nxp.com/iMX6ULL)
- i.MX 7Dual information is at [nxp.com/iMX7D](http://nxp.com/iMX7D)

## 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:

- Updated EULA to v14 August 2016.
- Yocto Project is upgraded to version 2.1 Krogoth.
- U-Boot is upgraded to 2016.03
- GStreamer is upgraded to 1.8.1.
- Supports the GCC 5.3.0 toolchain.
- New graphics update for i.MX 6 with GPU v5.0.11p8.6.
- New multimedia features and changes:
  - Qt 5 works on SoCs without hardware graphics for Frame Buffer and X11 graphic backends only using mesa software graphics, but it is not supported.
- Broadcom WIFI and Bluetooth update

### 2.2 Power management supported features

The following common power management features are supported on i.MX 6 and i.MX 7:

- CPU/GPU frequency throttle for SoCs with GPU
- GPU dynamic power management for SoCs with GPU
- CPU idle framework with two working levels: pure WFI and WFI with wait mode enabled
- Low power mode: standby and dormant (mem) mode
- Thermal temperature

Power management features supported on 6SoloLite, 6SABRE-SD, and 6SABRE-AI:

- LDO bypass
- CPUFreq driver: CPU frequency adjusted based on the CPU loading and Interactive governor
- VPU/GPU dynamic power management for SoCs with VPU and GPU
- LDO bypass
- Bus frequency support
- SD3.0 dynamic clock management
- USB remote wake-up and USB charger

## 2.3 Graphics

This section describes new features and bug fixes for the graphics provided in this release.

Graphics Changes are now available in the following locations

- Changes for i.MX 6 with GPU are documented on <http://git.freescale.com/git/cgit.cgi/imx/fsl-arm-yocto-bsp.git/tree/GraphicsChangeLog?h=imx-4.1-krogoth>

## 3 BSP Supported Features

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

**Table 9. Supported features**

Feature	Supported board	Comment
<b>Kernel</b>		
Kernel	All i.MX	Kernel version: 4.1.15
File System	All i.MX	EXT2/EXT3/EXT4 are used as the file system in MMC/SD Hard Disk. On i.MX 6SABRE-AI and 7D-SABRE-SD, <ul style="list-style-type: none"> <li>• UBIFS is used for NAND.</li> <li>• JFFS2/UBIFS is used for Parallel NOR, QSPI NOR.</li> </ul>
<b>Bootloader</b>		
U-Boot	All i.MX	U-Boot delivery is based on U-Boot version v2016.03. Clock, Anapop regulator, ENET, UART, MMC/SD, eMMC4.3/4.4/4.5. High-Assurance Boot, ROM Plug-in Mode. SPI-NOR, Parallel NOR, SATA, NAND, QuadSPI-NOR, USB Mass Storage. See Table 2 in Section 1.1 for U-Boot configurations supported on each board for SPI_NOR, NAND, Parallel NOR, QuadSPI-NOR, and SATA. These are not supported on all boards. i.MX 6QuadPlus/Quad/DualLite SABRE-SD and SABRE-AI support DDR3 528 MHz @ 64 bit. i.MX 6SoloX SABRE-SD and SABRE-AI support LPDDR3 400 MHz @ 32 bit i.MX 6SoloLite EVK supports LPDDR2 400 MHz @ 32 bit and boot using L2Cache as OGRAM i.MX 7Dual SABRE-SD supports DDR3 533 MHz @ 32 bit and boot using L2Cache as OGRAM i.MX 6UltraLite EVK supports DDR3 400 Mhz @ 16 bit i.MX 6ULL support DDR3 400 Mhz @ 16 bit
<b>Machine-specific layer</b>		
ARM® Core	All i.MX	6SABRE-SD, 6SABRE-AI, 6SoloLite, 6SoloX-SD, and 6SoloX-AI support the ARM Cortex-A9 processor.

*Table continues on the next page...*

**Table 9. Supported features (continued)**

Feature	Supported board	Comment
		7D-SABRE-SD supports the ARM Cortex-A7 processor. 6UltraLite EVK supports the ARM Cortex-A7 processor. 6ULL EVK, 6UltraLite EVK, and 7D-SABRE-SD support the ARM Cortex-A7 processor. Supports reboot and power-off except the i.MX 8DV.
Memory	All i.MX	On i.MX 6 and i.MX 7 SoC, the user/kernel space is split 2G/2G.
Interrupt	All i.MX	GIC.
Clock	All i.MX	Controls the system frequency and clock tree distribution.
Timer (GPT)	All i.MX	System timer tick and broadcast timer support.
GPIO/EDIO	All i.MX	GPIO is initialized in earlier phase according to hardware design.
IOMUX	All i.MX	Provides the interfaces for I/O configuration. IOMUX-V3 version is used on i.MX 6 and i.MX 7 boards.
<b>DMA engine</b>		
SDMA	All i.MX	Conforms to the DMA engine framework.
APBH-Bridge-DMA	6SABRE-AI	Conforms to the DMA engine framework. This feature requires a NAND U-Boot.
<b>Character device drivers</b>		
MXC UART	All i.MX	i.MX 6 SABRE-SD, and SoloLite EVK support console through internal Debug UART1. i.MX 6SoloX SABRE-SD and SABRE-AI support Cortex-A9 processor through UART1 and Cortex-M4 processor through UART2. i.MX 7Dual SABRE-SD Cortex-A7 processor through UART1 and Cortex-M4 processor through UART2. i.MX 6UltraLite EVK and i.MX 6ULL Cortex-A7 processor through UART1. i.MX 6 SABRE-AI supports console through internal Debug UART 4.
<b>Power Management Drivers</b>		
Anatop Regulator	All i.MX	Supports Anatop regulator management.
Lower Power mode	All i.MX 6 and 7	Supports standby mode and dormant (mem) mode on i.MX 6 and i.MX 7 boards.
CPUIidle	All i.MX 6 and 7	2 levels CPUIidle supported: purely WFI and WFI with wait mode enabled.
CPUFreq	All i.MX 6 and 7	CPUFreq can be used for CPU frequency adjustment. The Interactive governor is added and enabled by default.
BusFreq	All i.MX 6 and 7	Supports the system bus clock frequency scaling on i.MX 6 and i.MX 7 boards.
Battery charging	All i.MX 6 and 7	-
<b>Networking drivers</b>		
ENET	All i.MX	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.
IEEE® 1588	All i.MX	Supports Linuxptp stack.

*Table continues on the next page...*

**Table 9. Supported features (continued)**

Feature	Supported board	Comment
		Features: <ul style="list-style-type: none"> <li>• Supports IPv4, IPv6, and IEEE 802.3 transport.</li> <li>• Supports E2E, and P2P transparent clock.</li> <li>• Supports IEEE802.1AS-2011 in the role of end station.</li> </ul> Note: Linuxptp stack is open source. Command instance: <pre>ptp4l -A -4 -H -m -i eth0</pre>
PCIe	All i.MX	With the platform that supports the PCIe module.
PCIe EP/RC validation system	i.MX 6Quad SD i.MX 6SoloX-SD 7D-SABRE-SD	Two of the same i.MX 6Quad SD boards, i.MX 7Dual SABRE-SD boards, or i.MX 6SoloX SDB boards. One is used as RC, and the other is used as EP. <ul style="list-style-type: none"> <li>• EP can be initialized/enumerated by RC.</li> <li>• EP can access the memory of RC.</li> <li>• RC can access the memory of EP.</li> <li>• EP can trigger MSI, and the triggered MSI can be captured by RC.</li> </ul>
MediaLB	6SABRE-AI 6SoloX-AI	On i.MX 6SABRE-AI, CPU1 supports MLB 150 and MLB 25/50. On i.MX 6SABRE-AI, CPU2 and i.MX 6QuadPlus SABRE-AI supports MLB 25/50 only. On i.MX 6SoloX-AI, it supports MLB 25/50.
FlexCAN	All i.MX	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 default device tree on i.MX 6SoloX-SD and i.MX 6SoloX-AI. Supports with the default device tree on i.MX 7Dual SABRE-SD. Supports with default device tree on i.MX 6UltraLite EVK. Supports with default device tree on i.MX 6ULL EVK.
<b>Security drivers</b>		
CAAM	All i.MX 6 and 7 except 6SoloLite and 6ULL	Security drivers
SNVS	All i.MX 6 and 7	Secure Non-Volatile Storage
SIMv2	6UltraLite EVK 7D-SABRE-SD	Smart Card Interface
<b>Sound drivers</b>		
WM8962/SSI WM8960/SSI	6SABRE-SD 6SoloLite 6SoloX-SD 7D-SABRE-SD 6UltraLite EVK 6ULL EVK	Supports playback.
S/PDIF	6SABRE-SD	Supports 16 bit and 24 bit stereo playback from 32 KHz to 48 KHz sample rate.

*Table continues on the next page...*

**Table 9. Supported features (continued)**

Feature	Supported board	Comment
	6SABRE-AI 6SoloX-AI	Supports 24 bit stereo record from 16 KHz to 96 KHz.
ASRC	6SABRE-AI 6SoloX-SD 6UltraLite EVK 6ULL EVK	Supports sample rates conversion from 5 KHz to 192 KHz and output sample rates from 32 KHz to 192 KHz. Supports ALSA plug-in library playback.
ESAI/CS42888	6SABRE-AI 6SoloX-AI	Supports 16 bit, 24 bit PCM format, channel from 2 to 6, and sample rate from 8 KHz to 192 KHz for playback with ASRC P2P. Supports sample rate from 8 KHz to 96 KHz for record and playback without ASRC. Supports 4 channels input and 8 channels output. Supports full duplex operations. Supports amixer alsamixer control from user space.
SAI/MQS	6SoloX-SD 7D-SABRE-SD 6UltraLite EVK 6ULL EVK	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.
HDMI Audio	6SABRE-SD 6SABRE-AI 7D-SABRE-SD	Supported on the i.MX 6Dual/Quad and i.MX 6DualLite for SABRE-SD and SABRE-AI. Supported on the i.MX 7Dual SABRE-SD board.
<b>Input device drivers</b>		
USB devices	All i.MX	Supports USB mouse and USB keypad through USB ports.
Touch panel	All i.MX except 8DV	6SABRE-SD, 6SABRE-AI. Supports EGalaxy capacitive touch screen. 6SoloLite supports E Ink® touch screen on DC2/DC3 add-on card. 7Dual SABRE-SD supports E Ink® touch screen with a separate package download. 6SoloX SABRE-SD and SABRE-AI support LVDS panel.
Keypad	6SoloLite	6UltraLite EVK and 7D SABRE-SD support the resistive touch panel. 6SoloLite supports 4x4 keypads on DC2/DC3 add-on card.
<b>MTD driver</b>		
QuadSPI-NOR	6SoloX-SD 6SoloX-AI 7D-SABRE-SD 6UltraLite EVK 6ULL EVK	i.MX 6SoloX SABRE-AI supports QSPI1. i.MX 6SoloX SABRE-SD supports QSPI2. i.MX 6UltraLite EVK supports QSPI1. i.MX 7Dual SABRE-SD supports QSPI1.
SPI-NOR	6SABRE-AI 6SoloLite	Supports M25P32 On i.MX 6SABRE-SD DualQuad/DualLite there is a pin conflict for supporting SPI-NOR
NAND	6SABRE-AI	Normal NAND and ONFI NAND asynchronous mode with BCH40.

*Table continues on the next page...*

**Table 9. Supported features (continued)**

Feature	Supported board	Comment
	6SoloX-AI 7D-SABRE-SD	
Parallel NOR	6SABRE-AI	Supports Parallel NOR by using the EIM interface on i.MX 6 SABRE-AI.
SATA	6SABRE-SD 6SABRE-AI	Serial ATA 2.0 supports only i.MX 6DualQuad SABRE-SD and SABRE-AI and i.MX 6 QuadPlus SABRE_SD and SABRE-AI.
<b>USB drivers</b>		
USB Host	6SABRE-AI 6SoloLite 6SoloX-SD 6SoloX-AI 7D-SABRE-SD 6UltraLite EVK 6ULL EVK	Supports USB HOST1 and USB OTG host.
USB Device	All i.MX	Supports USBOTG device mode.
USB	All i.MX	Supports USB OTG2.0 and USB Host2.0 ports. USB Host mode: MSC, HID, UVC, and USB audio. USB device mode: MSC, Ethernet, and Serial. USB OTG pin detect support for HNP and SRP on OTG.
<b>Graphics drivers</b>		
GPU	6SABRE-SD 6SABRE-AI 6SoloX 6SoloLite	Graphics Chips Details 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"> <li>• Supports EGL 1.4 for fbdev, X11, XWayland</li> <li>• Supports OpenGL ES1.1</li> <li>• Supports OpenGL ES2.0 (WebGL 1.0.1 compatible on X11)</li> <li>• Supports OpenGL ES3.0</li> <li>• Supports OpenVG1.1</li> <li>• Supports OpenCL1.1</li> <li>• Supports OpenGL2.1</li> </ul> GC355 and GC320 on 6SoloLite, which includes only 2D hardware acceleration <ul style="list-style-type: none"> <li>• Supports EGL 1.4 for fbdev, X, Wayland</li> <li>• Supports OpenVG1.1</li> </ul>
Frame Buffer Driver	All i.MX	MXC Frame buffer driver for IPU V3 on i.MX 6SABRE-SD and i.MX 6SABRE-AI. MXC Frame buffer driver for PXP on i.MX 6SoloLite, i.MX 6SoloX SABRE-SD/SABRE-AI, i.MX 6UltraLite EVK i.MX 6ULL EVK and i.MX 7Dual SABRE-SD.
VDOA	6SABRE-SD	Supports Video Data Order Adapter.

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**Table 9. Supported features (continued)**

Feature	Supported board	Comment
	6SABRE-AI	
LVDS	6SABRE-SD 6SABRE-AI 6SoloX-SD 6SoloX-AI	Supports HannStar LVDS panel. It's the default display if no other video option is setup. On the SABRE-AI there are 2 ports. Port 0 is the default.
HDMI	6SABRE-SD 6SABRE-AI 6SoloLite 6SoloX-SD 6SoloX-AI 7D-SABRE-SD	i.MX 6SABRE-SD and SABRE-AI support on-chip DesignWare HDMI hardware module. i.MX 7D-SABRE-SD supports on-chip DesignWare HDMI hardware module. i.MX 6SoloLite and i.MX 6SoloX SABRE-SD and SABRE-AI support external HDMI.
HDCP	6SABRE-SD	Supports HDCP v1.2 specifications.
WVGA panel	All i.MX 6 and 7	Supports SEIKO WVGA panel. For i.MX 6UltraLite, i.MX 6ULL and i.MX 7Dual SABRE-SD, it supports Embest LCD8000-43T LCD panel.
PxP	6DualLite-SD 6SoloLite 6SoloX-SD 6SoloX-AI 7D-SABRE-SD 6UltraLite EVK 6ULL EVK	Enables PXP Driver for EPDC on i.MX 6SoloLite and i.MX 6DualLite SABRE-SD. Enables PXP driver for EPDC on i.MX 7Dual SABRE-SD i.MX 6UltraLite EVK and i.MX 6ULL EVK. Conforms to DMA engine framework.
MIPI Display	6SABRE-SD 7D-SABRE-SD	Supports MIPI DSI driver through MIPI daughter card.
EPDC	6DualLite-SD 6SoloLite 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.

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**Table 9. Supported features (continued)**

Feature	Supported board	Comment
		<p>Supports panning (y-direction only).</p> <p>Supports three EPDC driver display update schemes: Snapshot, Queue, and Queue and Merge.</p> <p>Supports user control of the delay between completing all updates and powering down the EPDC.</p> <p>Supports dithering.</p> <p>i.MX 7Dual supports E Ink® but requires a separate download. Contact Marketing representative.</p>
<b>Multimedia Drivers</b>		
IPU V3 driver	6SABRE-SD 6SABRE-AI	On i.MX 6SABRE-SD and i.MX 6SABRE-AI provides interfaces to access IPU V3 modules.
PRE/PRG driver	6QuadPlus-SD 6QuadPlus-AI	On i.MX 6QuadPlus provides interfaces to support prefetch linear frames or resolve tiled frames for display.
V4L2 Output	All i.MX	<p>i.MX 6SABRE-SD and i.MX 6SABRE-AI use the IPU post-processing functions for video output.</p> <p>i.MX 6SoloLite, i.MX 6SoloX SABRE-SD and SABRE-AI, i.MX 6UltraLite EVK and i.MX 7D SABRE-SD use the PXP post-processing functions for video output.</p>
V4L2 Capture	All i.MX	<p>Supports dual cameras on i.MX 6SABRE-SD and SABRE-AI.</p> <p>Supports single camera on i.MX 6SoloLite and i.MX 6SoloX SABRE-SD, i.MX 6UltraLite EVK, i.MX 6ULL EVK, and 7D-SABRE-SD.</p>
VPU	6SABRE-SD 6SABRE-AI	<p>i.MX 6 Encoder: MPEG-4, H.263, H.264(AVC/MVC), MJPEG</p> <p>i.MX 6 Decoder: MPEG-4, H.263, H.264(AVC/MVC), VC-1, MPEG-2, MJPEG, AVS, VP8.</p>
MIPI	6SABRE-SD 7D-SABRE-SD	Supports 2 lanes CSI and DSI. Supports OV5640 camera sensor.
Parallel CSI	6SABRE-SD 6SoloLite 6SoloX-SD 6UltraLite EVK 6ULL EVK	i.MX 6 Supports OV5640 camera sensor.
TV-IN	6SABRE-AI	Supports TV-IN through ADV7180 on the 6SABRE-AI with bt656, NTSC, and PAL.
<b>General drivers</b>		
uSDHC	All i.MX	<p>Supports SD2.0 and SDXC.</p> <p>Supports SD3.0 on all i.MX except 6SABRE-SD.</p> <p>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.</p> <p>Supports eMMC4.5 on i.MX 6SoloLite and i.MX 6SoloX-SD.</p> <p>Supports eMMC5.0 on i.MX 7Dual SABRE-SD.</p>
Watchdog	All i.MX	Supports Watchdog reset.
I2C	All i.MX	Supports I2C master.

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**Table 9. Supported features (continued)**

Feature	Supported board	Comment
SPI	All i.MX	Supports SPI master mode.
PWM	All i.MX	Supports the backlight driver through PWM.
ADC	6SoloX-SD 6SoloX-AI 7D-SABRE-SD 6UltraLite EVK 6ULL EVK	Supports the ADC driver.
Temperature monitor	All i.MX	Pre-calibrated. See the "Thermal Driver" chapter in <i>i.MX Linux® Reference Manual (IMXLXRM)</i> for more information.
Accelerometer	6SABRE-SD 6SoloLite 6SoloX-SD 6SoloX-AI 7D-SABRE-SD 6UltraLite EVK 6ULL EVK	Supports the MMA8451 sensor on i.MX 6SABRE-SD, i.MX 6SoloX-SABRE-SD, and SABRE-AI. Supports the MMA8450 sensor on i.MX 6SoloLite. Supports the FXLS8471Q sensor on 6UltraLite EVK and 6ULL EVK. Supports the FXOS8700CQR1 sensor on 7D-SABRE-SD.
Wi-Fi	6SABRE-SD 6SoloLite 6SoloX-SD 7D-SABRE-SD 6UltraLite EVK 6ULL EVK	Supports the Broadcom/Murata BCM4339 Bluetooth/Wi-Fi module. Supports the WL_HOST_WAKE (OOB) feature for all the listed boards except i.MX 6UL/ULL EVK, which requires hardware rework. The CONFIG_BCM4339 performance optimization option is not enabled by the default kernel. Users can enable it manually to gain big performance improvement. NOTE: i.MX 6SoloLite EVK does not support enabling CONFIG_BCM4339 due to the known Wi-Fi driver limitation.
Bluetooth wireless technology	6SABRE-SD 6SoloX-SD 7D-SABRE-SD 6UltraLite EVK 6ULL EVK	Supports Broadcom BCM4339 Bluetooth module on i.MX 6 boards. The default Bluetooth software stack is BlueZ, but Broadcom provides a Bluetooth stack that supports additional Bluetooth profiles if using Broadcom hardware. For Bluetooth A2DP, if Yocto project has no frame buffer, for example, the 6UltraLite G1 part chip has no LCDIF, run the pulseaudio manually with the command:  <code>/usr/bin/pulseaudio --start --log-target=syslog</code>
GPIO Expander	6SABRE-SD 6SABRE-AI 7D-SABRE-SD	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.
SNVS RTC	All i.MX 6 and 7	Low-power section only.
Ambient Light Sensor	6SABRE-SD 6SABRE-AI 6SoloX-SD 6SoloX-AI	Supports the ISL29023 sensor on i.MX 6 boards.
Magnetometer Sensor	6SABRE-SD	Supports the MAG3110FCR2 sensor on i.MX 6 boards. Supports the FXLS8471 sensor on i.MX 6UltraLite EVK board.

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**Table 9. Supported features (continued)**

Feature	Supported board	Comment
	6SABRE-AI 6SoloX-SD 6SoloX-AI 6UltraLite EVK 7D-SABRE-SD	Supports MPL3115A2, FXOS8700CQR1, and FXAS21002CQR1 sensors on the i.MX 7Dual SDB board.
AM/FM module	6SABRE-AI	Supports the SI4763 AM/FM module. Supports FM by using the SSI interface.

## 4 Kernel Boot Parameters

Depending on the booting/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 10. Common kernel boot parameters**

Kernel parameter	Description	Typical value	Used when
console	Where to output the kernel logging by printk.	console=ttyMXC0,115200 For 6SABRE-AI, console=ttyMXC3,115200 For 6SoloX-AI, console=ttyMXC0,115200	All use cases
nosmp	A command-line option of 'nosmp' disables SMP activation entirely.	nosmp	CONFIG_SMP is defined. Use this to disable SMP activation. SMP is activated by default through the CONFIG_SMP configuration. Disabling the CONFIG_SMP can remove further overhead.
ip	Tells the kernel how or whether to get an IP address.	ip=none ip=dhcp ip=static_ip_address	"ip=dhcp" or "ip=static_ip_address" is mandatory in "boot from TFTP/NFS."
nfsroot	Location of the NFS server/directory.	nfsroot=<ip_address>:<rootfs path>	Used in "boot from tftp/NFS" together with "root=/dev/nfs."
root	Location of the root file system.	root=/dev/nfs or root=/dev/mmcblk0p2	Used in "boot from tftp/NFS" (that is, root=/dev/nfs); Used in "boot from SD" (that is, root=/dev/mmcblk0p2). root is set by default by U-Boot to the SD/MMC slot that U-Boot is booting from.

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Table 10. Common kernel boot parameters (continued)

Kernel parameter	Description	Typical value	Used when
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.
video on 6SABRE-SD	Tells the kernel/driver which resolution/depth and refresh rate should be used for display port 0 or 1.  See the parameter information under Documentation/fb/modedb.txt  Tells the kernel/driver which IPU display interface format should be used.	<ol style="list-style-type: none"> <li>1. video=mxcfb0:dev=hdmi,1920x1080M@60,if=RGB24 video=mxcfb1:dev=ldb,if=RGB666</li> <li>2. video=mxcfb0:dev=ldb,if=RGB666 video=mxcfb1:dev=hdmi,1920x1080M@60,if=RGB24</li> <li>3. video=mxcfb0:dev=hdmi,1920x1080M@60,if=RGB24</li> <li>4. video=mxcfb0:dev=ldb,if=RGB666</li> <li>5. video=mxcfb0:dev=lcd,CLAA-WVGA,if=RGB656</li> <li>6. video=mxcfb0:dev=mipi_dsi,TRULY-WVGA,if=RGB24</li> </ol>	<ol style="list-style-type: none"> <li>1. Used when primarily displaying on HDMI with 1080P60 mode. Secondly displaying on LVDS with XGA mode.</li> <li>2. Used when primarily displaying on LVDS with XGA mode. Secondly displaying on HDMI with 1080P60 mode.</li> <li>3. Used when primary displaying on HDMI with 1080P60 mode.</li> <li>4. Used when primary displaying on the HannStar LVDS1.</li> <li>5. Used when primary displaying on the CLAA-WVGA dumb parallel LCD panel.</li> <li>6. Used when primary displaying on the TRULY-WVGA MIPI DSI LCD panel.</li> </ol> <p>NOTE: GBR24/RGB565/YUV444 represents the display HW interface format. Typical values for certain different display devices are as follows: TVOUT: YUV444</p>

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**Table 10. Common kernel boot parameters (continued)**

Kernel parameter	Description	Typical value	Used when
			VGA: GBR24 HDMI&DVI: RGB24 CLAA WVGA LCD: RGB565 Typical values for dev= are shown as follows: lcd: LCD interface ldb: LVDS hdmi: HDMI on chip or sii902x dvi: DVI port vga: VGA through TVE tve: TVOUT
video on 6SABRE-AI	Tells the kernel/driver which resolution/depth and refresh rate should be used for display port 0 or 1.  See the parameter information under Documentation/fb/modedb.txt  Tells the kernel/driver which IPU display interface format should be used.	<ol style="list-style-type: none"> <li>video=mxcfb0:dev=hdmi, 1920x1080M@60,if=RGB24video=mxcfb1:dev=ldb,if=RGB666</li> <li>video=mxcfb0:dev=ldb,if=RGB666video=mxcfb1:dev=hdmi, 1920x1080M@60,if=RGB24</li> <li>video=mxcfb0:dev=hdmi, 1920x1080M@60,if=RGB24</li> <li>video=mxcfb0:dev=ldb,if=RGB666</li> <li>video=mxcfb0:dev=hdmi, 1920x1080M@60,if=RGB24</li> </ol>	<ol style="list-style-type: none"> <li>Used when primarily displaying on HDMI with 1080P60 mode. Secondly displaying on LVDS with XGA mode.</li> <li>Used when primarily displaying on LVDS with XGA mode. Secondly displaying on HDMI with 1080P60 mode.</li> <li>Used when primary displaying on HDMI with 1080P60 mode.</li> <li>Used when primary displaying on the HannStar LVDS0.</li> <li>Used when enabling HDMI 1080P60 mode and LVDS0. To enable second display, run "echo 0 &gt; /sys/class/graphics/fb2/blank"</li> </ol> <p>NOTE: GBR24/RGB565/YUV444 represents the display HW interface format. Typical values for certain different display devices are shown as follows:</p> <p>TVOUT: YUV444                      VGA: GBR24                      HDMI&amp;DVI: RGB24                      CLAA WVGA LCD: RGB565</p> <p>Typical values for dev= are shown below:</p> <p>lcd: LCD interface                      ldb: LVDS                      hdmi: HDMI on chip or sii902x                      dvi: DVI port                      vga: VGA through TVE</p>

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Table 10. Common kernel boot parameters (continued)

Kernel parameter	Description	Typical value	Used when
			tve: TVOUT
video on 6SoloLite	Tells the EPDC FB driver which E Ink panel is in use and what bpp should be used for the Frame Buffer.	video=mxcepdcfb:E060SCM,bpp=16	Used when enabling EPDC to select the correct E Ink panel parameters to use.  bpp=16 selects RGB565 FB pix format bpp=8 selects Y8 FB pixel format
video on 6SoloLite	Tells the ELCDIF FB driver which LCD panel is in use and which bpp should be used for the Frame Buffer.	video=mxcelcdif_fb:SEIKO-WVGA,bpp=16	Used when enabling LCDIF to select the correct panel parameters to use.  bpp=16 selects RGB565 FB pix format  Note: if only use EPDC FB, then turn off ELCDIF FB by "video=mxcelcdif_fb:off"
video on 7D SABRE-SD	Tells the ELCDIF FB driver which LCD panel is in use and which bpp should be used for the Frame Buffer.	video=mxcfb0:dev=mipi_dsi,TRULY-WVGA,if=RGB24	Used when primary displaying on the TRULY-WVGA MIPI DSI LCD panel.
dmfc	Tells the kernel/driver how to set the IPU DMFC segment size.	None Or dmfc=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.
mtddparts on 6SABRE-AI	Tells the kernel mtd partition information.	mtddparts=gpmi-nand:16m(boot), 16m(kernel),1024m(rootfs),-(user)	When to enable NAND. The partition: 16m (boot),16m (kernel),1024m (rootfs) is an example, you can change it according to your needs.
uart clock from osc for 6SoloX low power idle and scenario of Linux OS and FreeRTOS running together	Chooses the UART's clock parent.	uart_from_osc	This is necessary for low power idle and all use cases with the FreeRTOS running on ARM Cortex-M4 processor. When setting this parameter, UART sources clock from OSC instead of PLL3_80M, and then all PLLs can be off in low power idle.

## 5 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 11. Common known issues and workarounds**

Module	Source	Description	Workaround
Thermal	Hardware	The Temperature Monitor should only be enabled for chips that have undergone proper thermal sensor calibration. MC marked devices have undergone temperature calibration.	Ensure proper temperature calibration before using the temperature monitor. See the "Thermal Driver" Chapter in the <i>i.MX Linux® Reference Manual (IMXLXRM)</i> .

**Table 12. Known issues and workarounds for i.MX 6 SABRE-SD and i.MX 6 SABRE-AI**

Module	Source	Description	Workaround
ARM core	Software	smp_wmb performance is very low.	This is the common side-effect of SMP. No fix plan.
IPU	Software	The framebuffer driver and V4L2 output driver share the same fb device. For example, /dev/video16 also uses the /dev/fb0 to do video playback.	Frame Buffer operations should be banned during video playback on the same FB device.
IPU	Hardware	Currently, only supports 4-stripe and 2-stripe split mode. When doing large ratio up-scaling from low resolution frames to high resolution frames, for example, 64x64 to 1920x1080, the requirement cannot be covered by the current split mode solution, that is, each stripe would exceed 1024 pixels for width. Therefore, the video cannot display a full screen.	No.
IPU	Hardware	CSI_SMFC_MEM capture channel cannot support 32 pixel IDMAC burst size for non-interleaved and partial-interleaved YUV pixel formats with non-16byte-aligned UV stride line. Little horizontal stripes can be seen on the capture frames.	The current workaround is to change 32 pixel burst size to 16 pixel burst size, which would bring considerable capture performance penalty.
PRE	Hardware	When the software write (hw_pre_ctrl_pio_write) and the hardware write (hw_pre_ctrl_enable_enable ) are in the same clock cycle, the hardware write is ignored, because the software write has a higher priority. It causes the PRE to stop working unless the whole PRE+PRG + IPU corresponding channel is restarted. This issue is tracked by the PDM ticket TKT275991. The relevant framebuffer pan display or set par operations may	Currently no workaround.

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**Table 12. Known issues and workarounds for i.MX 6 SABRE-SD and i.MX 6 SABRE-AI (continued)**

Module	Source	Description	Workaround
		cause the PRE to stop working due to accidentally triggering the hardware bug.	
GPU	Software	There are some errors with the webgl conformance test. This is a Chrome application problem, which does not pass down the correct parameters to the GPU driver, and does not handle the application error correctly.	Upgrade the Chrome application to the stable version with V52.
GPU	Software	Xwayland is not displayed when running the VDK ES11 application with the retrace tool. This is not the GPU driver problem. It only has impact on the ES11 VDK use case on the Xwayland platform, no impact on the typical usage in general. The fix is available in mainline already.	Apply the new GPU patch release after 5.0.11.p8.6.
PCIe	Hardware/Software	To pass the PCIe compliance tests, external OSC should be used as the PCIe REF clock. Therefore, to import the external OSC to PCIe, the PLL6_ENET should be set to bypass mode. Then, the ENET/SATA cannot work simultaneously.	Add one extra DTB file to support PCIe to pass the compliance tests. For example, "imx6qp-sabresd-ldo-pcie-cert.dtb" used by iMX 6QuadPlus SABRE-SD board to pass the PCIe compliance tests.
Memory Management	Software	The system reports page allocation failure: order:9, mode:0xd0 when the system does not have sufficient physical continuous memory to allocate.	This may be caused by the kernel page reclaiming issue. One workaround for this: echo 1 > /proc/sys/vm/drop_caches before you run the application.
HDMI	Software	ENGR00290866 HDMI cannot be set to 1080p@60hz with kernel configuration settings.	Use the <code>xrandr</code> application to configure the HDMI resolution from user-space.
ASRC	Hardware	Two ASRC M2M instances and one P2P instance conversion simultaneously meet serious noise on 176 K and 192 K sampling rates.	When there are three instances, the total MIPS consumption should not exceed the ASRC master clock (132 M). In this situation, the total MIPS consumption is more than 120 M, and it is close to the threshold (132 M) in theory. Therefore, this is a capability issue of ASRC, and the noise is expected.

**Table 13. Known issues and workarounds for i.MX 6 SABRE-SD**

Module	Source	Description	Workaround
SPI NOR boot	Hardware	SPI NOR boot is not supported by the SABRE-SD board.	Current SD board uses KEY relative PINs as SPI interface. However, this set of PINs are not supported by ROM. Therefore, SPI NOR boot is not supported by the SABRE-SD board.

*Table continues on the next page...*

**Table 13. Known issues and workarounds for i.MX 6 SABRE-SD (continued)**

Module	Source	Description	Workaround
CPU hotplug	Software	System hangs after conducting CPU hot plug many times during heavy interrupt.	Known ARM Linux OS limitation. No workaround as of yet.
VPU	Software	Cannot support the "-x 1" option for unit test program mxc_vpu_test.out, because the IPU library is removed.	To avoid this issue, do not use "-x 1", since "-x 1" means enable for IPU library.
IPU	Hardware	Currently, only supports 4-stripe and 2-stripe split mode. When doing large ratio up-scaling from low resolution frames to high resolution frames, for example, 64x64 to 1920x1080, the requirement cannot be covered by the current split mode solution, that is, each stripe would exceed 1024 pixels for width. Therefore, the video cannot display a full screen.	No.

**Table 14. Known issues and workarounds specifically for i.MX 6Dual/6Quad SABRE-SD**

Module	Source	Description	Workaround
SATA Boot	Hardware	The system cannot boot from SATA on the Rev.B board.	Remove R7.
Boot	Hardware	The system cannot boot sometimes when it is powered on the Rev. B board for the first time.	Add 2.2M ohm resistor to 24M OSC.
Suspend/Resume	Hardware/Software	Suspend/Resume failure if board rework "Add 2.2M ohm resistor to 24M OSC".	Remove rework.

**Table 15. Known issues and workarounds specifically for i.MX 6Solo/6DualLite SABRE-SD**

Module	Source	Description	Workaround
PMIC	Hardware	The i.MX 6DualLite SD board depopulates the resistor R30 and takes away the ability of the processor to turn off the PMIC in hardware.	i.MX 6DualLite uses dumb mode by default.
EPDC	Software	Enabling E Ink Auto-update mode (Device Drivers > Graphics Support > E Ink Auto-update Mode Support) causes E Ink panel updates to be distorted and flaky.	Disable the E Ink Auto-update Mode feature in the menuconfig.
EPDC	Hardware	The three boards cannot boot with EPDC DC2 attached while they boot normally without DC2 daughter cards.	This occurs when the SW3 (KEYPAD_LOCK) switch on the EBOOK DC2 board is switched "ON", which affects the boot bin "EIM_DA7" (BT_CFG1_7). You need to set the SW3 in DC2 board to "OFF."



**Table 16. Known issues and workarounds for i.MX 6Dual/6Quad SABRE-AI**

Module	Source	Description	Workaround
ARM core	Software	CONFIG_SMP should be disabled for the i.MX 6Solo chip.	To remove overhead caused by SMP for better performance, CONFIG_SMP is expected to be disabled for single core. Complete support with SMP disabled is provided with future Linux BSP release.
IPU	Hardware	Default 24bpp on the second display used by HDMI. IPU keeps printing error for hardware bandwidth limitation as described in CR ENGR00293432.	No.
eCompass	Hardware	eCompass cannot work after EIM-NOR or SPI-NOR are enabled on the kernel.	No.
USB	Software	USB OTG and USB host cannot work after EIM-NOR or SPI-NOR are enabled on kernel.	No.
TV-IN	Software	Error messages may be expected along with bad quality at first frames on the TV-IN interface. This may occur on a hot plug connection.	No.
U-Boot	Hardware	ENGR00236878: eMMC 4.4 fails to boot on SABRE-AI boards.	No.
MLB	Software	The SYNC mode cannot work stably in the test.	No
SDIO3.0	Software	No available device to do the SDIO 3.0 test.	-

**Table 17. Known issues and workarounds specifically for i.MX 6QuadPlus**

Module	Source	Description	Workaround
PRE	Hardware	<p>When the software write(hw_pre_ctrl_pio_write) and the hardware write(hw_pre_ctrl_enable_enable ) are in the same clock cycle, the hardware write is ignored, because the software write has a higher priority. It causes the PRE to stop working unless the whole PRE +PRG + IPU corresponding channel is restarted.</p> <p>This issue is tracked by the PDM ticket TKT275991. The relevant framebuffer pan display or set par operations are likely to cause the PRE to stop working due to accidentally triggering the hardware bug.</p>	Currently no workaround.

**Table 18. Known issues and workarounds specifically for i.MX 6Solo/6DualLite SABRE-AI**

Module	Source	Description	Workaround
Hardware manufacture	Hardware	HDMI, SD3 card detection, and eGalax touch screens are found to fail on some boards.	This is because some PINs are not soldered well. If any basic feature, which is announced to be supported, does not work on your board, check the board.
CPU hotplug	Software	System hangs after conducting CPU hot plug many times during heavy interrupt.	Known ARM Linux OS limitation. No workaround as of yet.
VPU	Software	Cannot support "-x 1" option for unit test program mxc_vpu_test.out, because IPU library is removed.	To avoid this issue, do not use "-x 1", because "-x 1" means enabled for IPU library.

**Table 19. Known issues and workarounds for i.MX 6SoloLite**

Module	Source	Description	Workaround
EPDC	Software	Enabling E Ink Auto-update mode (Device Drivers > Graphics Support > E Ink Auto-update Mode Support) causes E Ink panel updates to be distorted and flaky.	Disable the E Ink Auto-update Mode feature in the menuconfig.
System	Hardware	Reboot may not work on the EVK board.	Reboot function should be always okay if the hardware can trigger PMIC reset, which ensures RESET key and watchdog reset can control PMIC_ON_REQ pin.
CSI/EPDC	Hardware	Cannot be used simultaneously, because these two modules share the same pins on the EVK board.	The board file in BSP configures these pins for proper function through DTS. Use imx6sl-evk.dts for EPDC, and imx6sl-evk-csi.dts for CSI.
X-Acceleration	Hardware/ Software	Out of memory error during the x11perf test.	It is a system limitation since the x11perf needs a lot of memory. No work-around on the EVK board (only with LPDDR2 memory of 512 MB). Users may use a larger memory to work around this issue.
Mfgtool2	Software	Mfgtool2 may fail to execute the <code>frf</code> command if there is no <code>send</code> or <code>pipe</code> command executed prior to it.	Remove the <code>frf</code> command from <code>ucl2.xml</code> to fix this issue.
FUSE for RTC	Hardware	SEC_CONFIG[0] fuse bit is not burned, which leads the RTC not to be functional.	In U-Boot prompt, run the command "imxotp blow --force 4 0x2".
SDIO3.0	Software	No available device to do the SDIO 3.0 test.	
HDMI	Software	ENGR00298771, i.MX 6SoloLite EVK: on some special resolutions, such as 1400x1050, the Yocto Project GUI display on HDMI is distorted. This is caused by <code>xrandr</code> and tries to expand the frame buffer size to 1408x1050 to align with 16 bytes. However, i.MX 6SoloLite ELCDIF does not support stride buffer and cannot crop 1400x1050 from the buffer 1408x1050, which then causes distortion.	No. Only found on 1400x1050 mode until now.
WiFi/BCMDHD	Software	i.MX 6SoloLite EVK does not support enabling CONFIG_BCM4339 to optimize performance due to known Wi-Fi driver limitation.	This release does not support CONFIG_BCM4339.

**Table 20. Known issues and workarounds for i.MX 6SoloX**

Module	Source	Description	Workaround
Video	Software	The video display has a green line at bottom during <code>gplay</code> .	No workaround.
CAAM	Software	The system reboots after the CAAM RNG test is suspended and resumed.	There is hardware function conflict between the Mega/Fast mix off feature and CAAM. To use CAAM after kernel bootup, the user should enable the CAAM wakeup function to avoid

Table continues on the next page...

**Table 20. Known issues and workarounds for i.MX 6SoloX (continued)**

Module	Source	Description	Workaround
			Mega mix off in DSM. Workaround: echo enabled > /sys/bus/platform/devices/2100000.aips-bus/2100000.caam/2101000.jr0/power/wakeup
VADC	Software	Sometimes VADC cannot correctly detect the video standard. CSI works in NTSC mode but the VADC input is PAL.	The VADC auto standard detect function is not required. VADC input device does not change in product. Hard code VADC input standard in the VADC driver.
MLB	Software	SYNC mode is not stable.	No workaround.
QSPI-NOR	Hardware	PMIC needs to be reset to reset the QSPI-NOR flash on the board to the default 3 bytes mode.	The hardware workaround is required.
PCIe	Hardware/ Software	When the extremely power save mode is enabled on i.MX 6SoloX PCIe, the i.MX 6 SoloX PCIe phy/controller would be powered off completely, all the TLPs on the PCIe link would be discarded, and link would be down in suspend. The i.MX 6 SoloX PCIe and the PCIe link would be re-initialized completely during resume operations. There is one known issue when the pcie2usb device is used during suspend/resume. The development node of the pcie2usb device maybe changed, since the pcie2usb device is reset when the i.MX 6SoloX PCIe is re-initialized during resume.	No.
MMC	Software	Hynix eMMC times out when the rootfs automatically mounts the RPMB partition on i.MX 6SoloX SD.	Rootfs should not automatically mount the RPMB partition, because it is a secure partition.
CSI/LCD	Hardware	CSI and LCD cannot be used simultaneously since the two modules share the same pins on the i.MX 6SoloX SABRE-SD board.	No.
UART	Hardware	UART cannot wake up with the RTS pin programmed with hard flow control enabled. And there is limitation of the framesize to about 16.	No.

**Table 21. Known issues and workarounds for i.MX 6UltraLite and 6ULL EVKs**

Module	Source	Description	Workaround
EMMC/SD/ SDIO	Hardware	For i.MX 6ULL, the existing errata ERR010450, EMMC HS200, and SD/SDIO 3.0 SDR104 at 1.8 V can only work below or equal to 150 MHz. EMMC DDR52 and SD/SDIO DDR50 at 1.8 V can only work below or equal to 45 MHz.	No.

**Table 22. Known issues and workarounds for i.MX 7Dual SABRE-SD**

Module	Source	Description	Workaround
EPDC	Software	EPDC does not function for REGAL/-D due to license issue.	Ask for FAE/AE support to get the proper waveform.
HDMI	Software	HDMI supports only one startup resolution mode 1280x720 when booting to X backend rootfs.	For i.MX 7Dual, it cannot port Vivante or Freescale EXA driver to it, because the EXA driver depends on Vivante's 2D library and there is no GPU hardware on i.MX 7Dual. Therefore, a default software version driver (FBDEV) is used for i.MX 7Dual. The FB video mode is changed by FB command, but the UI cannot get the video mode changed event, because i.MX 7Dual has no GPU hardware and still draws the UI to original video mode. No workaround.
HDMI	Software	After booting up, it connects to the HDMI cable. The X backend desktop cannot display.	i.MX 7Dual, it cannot port Vivante or Freescale EXA driver to it, because the EXA driver depends on Vivante's 2D library and there is no GPU hardware on i.MX 7Dual. Therefore, a default software version driver (FBDEV) is used for i.MX 7Dual. It is expected, because FB video mode is changed after the HDMI cable is plugged in, and the UI cannot handle the HDMI cable plugin event or change the UI to new video mode. No workaround.
Wi-Fi	Software	Wi-Fi does not support suspend/resume when doing IPERF.	BroadCom Wi-Fi is not supported.
PCIe	Hardware	Cannot probe up PCIe devices on Rev. C board.	Hardware rework is required. Rework: Change C459&C458 caps to 0 ohm resistors.
eMMC	Software	eMMC fast boot fails with plug-in U-Boot.	<ol style="list-style-type: none"> <li>1. Use U-Boot SPL to replace the plug-in boot, which supports the uSDHC driver. SPL can read the remaining U-Boot from eMMC by itself without using ROM's API.</li> <li>2. Plug-in implements its own eMMC read routine to read the remaining U-Boot.</li> </ol>
Low power	Hardware	TKT291710 low-power idle stress test fails in the Linux OS kernel, with identical hardware settings. CPU #0 runs into exception, and CPU #1 is successful.	-

## 6 Multimedia

This chapter contains the information on the 4.1.1 multimedia component of the BSP.

The GStreamer version in this release is 1.8.1.

## 6.1 i.MX GStreamer plugins

**Table 23. i.MX GStreamer 1.0 plugins**

Plugin	Features
Audio decoder	beepdec: unified audio decoder plugin Supports MP3, AAC, AAC+, WMA, AC3, Vorbis, DD+, AMR, RA
Audio encoder	avenc_mp2: MP3 encoder plugin from gst-libav
Video decoder	<ul style="list-style-type: none"> <li>vpudec: VPU-based video decoder plugin</li> <li>Software video decoder plugins: use gst-libav plugins</li> </ul>
Video encoder	<ul style="list-style-type: none"> <li>vpuenc_h264: VPU-based AVC/H264 video encoder</li> <li>vpuenc_h263: VPU-based H263 video encoder</li> <li>vpuenc_mpeg4: VPU-based MPEG4 video encoder</li> <li>vpuenc_jpeg: VPU-based JPEG video encoder</li> </ul>
Demux	aiurdemux: aiur universal demuxer plugin supporting Supports AVI, MKV, MP4, MPEG2, ASF, OGG, FLV, WebM, RMVB
Video render	<ul style="list-style-type: none"> <li>imxv4l2sink: V4L2-based video sink plugin</li> <li>overlaysink : G2D-based video sink plugin</li> </ul>
Video source	imxv4l2src: V4L2 based camera/TVin source plugin
Video convert	<ul style="list-style-type: none"> <li>imxvideoconvert_g2d: GPU2D-based video convert plugin, to perform video color space conversion, resize, rotate</li> <li>imxvideoconvert_ipu: IPU-based video convert plugin, to perform video color space conversion, resize, rotate, deinterlacing</li> <li>imxvideoconvert_pxp: PXP-based video convert plugin, to perform video color space conversion, resizing, and rotation</li> </ul>
OpenGL (ES) Plugins	<ul style="list-style-type: none"> <li>gimagesink: OpenGL (ES)-based video sink plugin, supported in X11, Wayland, and FB backends</li> <li>gleffects: GL Shading Language effects plugin</li> <li>gldeinterlace: video deinterlacing based on shaders</li> <li>glvideomixer: compositing multiple videos together</li> <li>gcolorconvert: video color space convert based on shaders</li> <li>gcolorbalance: adjusting brightness, contrast, hue, and saturation on a video stream</li> </ul>
Video compositor	<ul style="list-style-type: none"> <li>imxcompositor_g2d: GPU2D-based video compositor plugin</li> <li>imxcompositor_ipu: IPU-based video compositor plugin</li> <li>imxcompositor_pxp: PXP-based video compositor plugin</li> <li>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</li> </ul>

### NOTE

- To support WMA, WMV, AAC+, AC3, DD+, RA decoding, and WMA encoding, install special and excluded packages.
- vpudec plugins are only for SoCs with the VPU hardware.
- imxvideoconvert\_g2d can only perform color space converting to RGB space.
- OpenGL (ES) plugins are from the gst-plugins-bad package, accelerated with Vivante private APIs.
- Video overlay composition meta (meta:GstVideoOverlayComposition) is supported in i.MX video sinks, convert and compositor. This feature accelerates the text image (such as subtitle, timestamp) blending with video in these plugins with hardwares.

## 6.2 i.MX playback engine API

i.MX provides a high-level API set for easier-making playback-related applications based on the GStreamer framework. This API set is based on playbin, it can be found from `gst1.0-fsl-plugin/tools/gplay/playengine.h`. This API set can provide the following functions.

**Table 24. i.MX playback engine API functions**

Function	Feature
Playback	<ul style="list-style-type: none"> <li>• Play, Stop</li> <li>• Pause, Resume</li> <li>• Fast seek, Accurate seek</li> <li>• Playback rate control (fast forward, fast rewind, slow forward)</li> </ul>
Media Info	<ul style="list-style-type: none"> <li>• Media meta data (artist, year, etc.)</li> <li>• Video Thumbnail</li> <li>• Audio Album Art</li> </ul>
Subtitle	Supports internal and external subtitle
Track Selection	<ul style="list-style-type: none"> <li>• Audio Track Selection</li> <li>• Video Track Selection</li> <li>• Subtitle Selection</li> </ul>
Display Control	<ul style="list-style-type: none"> <li>• Resize</li> <li>• Rotate</li> </ul>

## 6.3 i.MX recording engine API

i.MX provides a high-level API set for easier-making 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 from `gst1.0-fsl-plugin/tools/grecorder/recorder_engine.h`.

This API set can provide the following functions.

**Table 25. Recording engine functions**

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

**NOTE**

This recording engine is only available in platforms with VPU.

## 6.4 i.MX Qt Applications

The following applications based on Qt demonstrate the multimedia features on the X11 backend.

**Table 26. Qt applications**

Application	Feature
IMXPlayer	Based on the playback engine, it provides all the features supported in the playback engine.
IMXCamera	Based on the recording engine, it provides all the features supported in the recording engine.

**NOTE**

The demo applications are only available in platforms with VPU and in an X11 environment.

## 6.5 Multimedia feature matrix

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

### 6.5.1 Parser/Demuxer specifications

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

**Table 27. 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	-

*Table continues on the next page...*

**Table 27. Parser/Demuxer supported audio/video (continued)**

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

## 6.5.2 Video codec specifications

The tables in this section show the video codec specs with and without VPU acceleration. Check Section [BSP Supported Features](#) to determine if your board supports VPU.

**Table 28. Video codec specification for hardware with VPU acceleration**

-	Feature	Profile	Max. resolution	Min. resolution	Max. framerate	H/W or S/W	Bitrate	Comment
Video decoder	MPEG2	MP	1920 * 1080	64 * 64	30 fps	H/W	50 Mbps	-
	MPEG4	SP	1920 * 1080	64 * 64	30 fps	H/W	40 Mbps	-
	MPEG4	ASP	1920 * 1080	64 * 64	30 fps	H/W	40 Mbps	-
	H.263	P3	1920 * 1080	64 * 64	30 fps	H/W	20 Mbps	-
	H.264	BP	1920 * 1080	64 * 64	30 fps	H/W	50 Mbps	-
	H.264	MP	1920 * 1080	64 * 64	30 fps	H/W	50 Mbps	-
	H.264	HP	1920 * 1080	64 * 64	30 fps	H/W	50 Mbps	-
	VC-1	SP	1920 * 1080	64 * 64	30 fps	H/W	45 Mbps	-
	VC-1	MP	1920 * 1080	64 * 64	30 fps	H/W	45 Mbps	-
	VC-1	AP	1920 * 1080	64 * 64	30 fps	H/W	45 Mbps	-
	VP8	-	1280 * 720	64 * 64	30 fps	H/W	20 Mbps	i.MX 6DualLite
	VP8	-	1920 * 1080	64 * 64	30 fps	H/W	20 Mbps	i.MX 6Quad
	MJPEG	-	1920 * 1080	64 * 64	30 fps	H/W	120 Mpixl	-
	RV	8/9/10	1920 * 1080	64 * 64	30 fps	H/W	40 Mbps	-



**Table 29. Video codec specification for hardware without VPU acceleration**

	Feature	Profile	Max. resolution	Min. resolution	Max. framerate	H/W or S/W	Comment
Video decoder	H.264	BP/MP/HP	720 * 480	64 * 64	30 fps	S/W	Supported with gst-libav

GStreamer 1.x uses the gst-libav plugin, which is not included in the release image and needs to be build into the image separately. For how to include it, see the *i.MX Linux® User's Guide (IMXLUG)*.

### 6.5.3 Audio codec specification

**Table 30. Audio codec specification**

Decoder	Feature/Profile	Channel	Sample rate (KHz)	Bit rate (kbps)	H/W or S/W	Comment
MP3	MPEG-1 (Layer-1/ Layer-2/Layer-3) MPEG-2 (Layer-1/ Layer-2/Layer-3) MPEG-2.5 (Layer-3)	stereo/mono	<= 48	8 - 448	S/W	-
AACLC	MPEG-2 AACLC MPEG-4 AACLC	<= 5.1	8 - 96	8 - 256	S/W	-
HE-AAC	HE-AAC V1 HE-AAC V2	stereo/mono	8 - 96	Mono: 8 - 384 stereo: 16 - 768	S/W	-
WMA10 Std	L1 @ QL1	stereo/mono	44.1	64 - 161	S/W	-
	L2 @ QL1	stereo/mono	<= 48	<= 161	S/W	-
	L3 @ QL1	stereo/mono	<= 48	<= 385	S/W	-
WMA10 Pro	M0a @ QL2	stereo/mono	<= 48	48 - 192	S/W	-
	M0b @ QL2	stereo/mono	<= 48	<= 192	S/W	-
	M1 @ QL2	<= 5.1	<= 48	<= 384	S/W	-
	M2 @ QL2	<= 5.1	<= 96	<= 768	S/W	-
	M3 @ QL2	<= 7.1	<= 96	<= 1500	S/W	-
WMA 9 Lossless	N1	stereo/mono	<= 48	<= 3000	S/W	-
	N2	<=5.1	<= 96	<= 3000	S/W	-
	N3	<=7.1	<= 96	<= 3000	S/W	-
AC-3	-	<=5.1	<= 48	32 - 640	S/W	-
FLAC	-	<=7.1	8 - 192	-	N/A	-
BSAC	-	<=5.1	<= 48	64 per channel	N/A	Core codec only
Ogg Vorbis	q1 - q10	Stereo	8 - 192	<= 500	S/W	-
DD-plus	-	<=7.1	32, 44.1, 48 64, 88.2, 96	<= 6.144 Mbps	S/W	-
RA	cook	stereo/mono	8k, 11.025k, 22.05k, 44.1k	-	S/W	-

**NOTE**

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

### 6.5.4 Image codec specification

**Table 31. Image codec specification**

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

### 6.5.5 Speech codec specification

**Table 32. 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

## 6.5.6 Streaming protocol specification

**Table 33. Streaming protocol specification**

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

## 6.5.7 RTSP streaming server specification

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

**Table 34. RTSP streaming server specification**

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

## 6.5.8 Subtitle specification

**Table 35. Subtitle specification**

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

## 6.6 Known issues and limitations for multimedia

Issues seen on Gstreamer 1.x:

- As the maximum buffer size of the playbin multiqueue is 2 MB, problems may be seen with some long audio or video interleaved streams. You can enlarge this buffer size to support these special use cases.
- AAC decoder: The ADIF format does not support seek mode nor FF/FB.
- Playing recorded AVI file (MPEG4 (vpu) + AVI (avimux)) fails because the AVIMUX mark MPEG4 video to DIVX is not supported.
- The accurate seek mode may have a longer time delay.
- Because the stream container does not have an index table, seeking is not supported.
- Fast rewind of audio does not support audio-only streams.
- Pulseaudio is only available for the X11 backend.

## Revision History

- Rotation 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.

## 7 Revision History

This table provides the revision history.

**Table 36. Revision history**

Revision number	Date	Substantive changes
L3.14.52_1.1.0_ga	01/2016	Updated for Yocto Project Fido
L4.1.15-1.0.0_ga	04/2016	Updated for i.MX 6QuadPlus, i.MX 6UltraLite, and Yocto Project Jethro
L4.1.15_1.1.0_ga	07/2016	Updated for i.MX 6UltraLite
L4.1.15_1.2.0_ga	08/2016	Added i.MX 7Dual
L4.1.15_2.0.0_ga	10/2016	Added i.MX 6ULL and updates to Yocto Project Krogoth

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