i.MX 8M PLUS APPLICATIONS PROCESSOR FAMILY

Edge intelligence, machine learning and vision for a smart world. i.MX 8M Plus applications processors excel in machine learning (ML), vision, advanced multimedia and industrial IoT applications. Elevating edge intelligence, i.MX 8M Plus processors are an excellent foundation for smart homes to smart cities, Industry 4.0 and beyond.

TARGET APPLICATIONS

- **Smart home:** AI local server, alarm hub and security systems, smart robot, access, control, home patient monitors, sound bars, AV receivers, and other home automation applications

- **Smart city:** safety and security, surveillance, crowd and traffic control, transportation and fleet management

- **Smart world:** smart retail, POS interfaces, targeted advertisement, building control, teleconferencing systems and healthcare diagnostics

- **Industrial IoT:** machine vision, robot controller, industrial gateway, HMI and computers, commercial printers and scanners, industrial tablets, smart industrial cameras and multiple factory automation applications

MACHINE LEARNING AND VISION

NEURAL PROCESSING UNIT (NPU)

The powerful i.MX 8M Plus applications processor is based on the quad-core Arm® Cortex®-A53 processor. It runs at up to 1.8 GHz with an integrated neural processing unit (NPU) that delivers up to 2.3 TOPS. As the first i.MX processor with a machine learning accelerator, the i.MX 8M Plus processor provides substantially high performance for ML inference at the edge. As the first i.MX processor with a machine learning accelerator, the i.MX 8M Plus processor delivers substantially higher performance for ML inference at the edge.
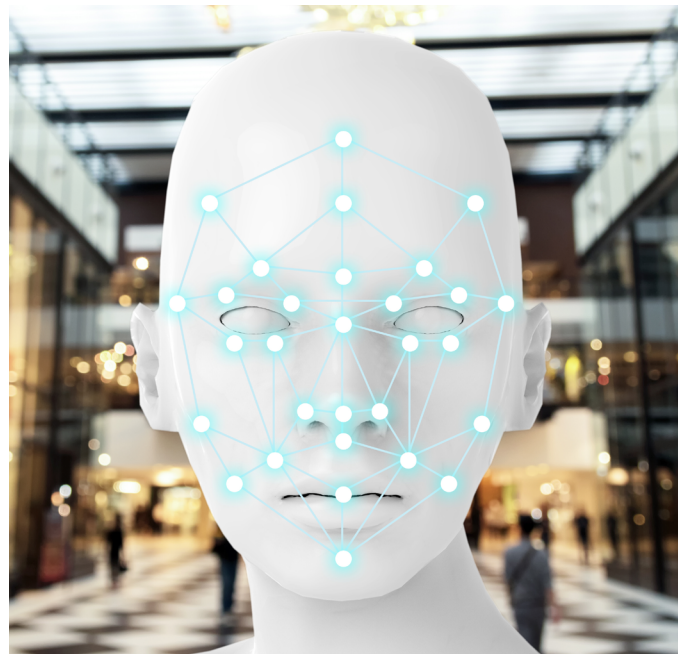
Using its integrated NPU, the i.MX 8M Plus processor simultaneously detects multiple highly complex neural network functions, including human pose and emotion detection, multi-object surveillance, and the recognition of over 40,000 English words. Moving ML inference to the edge helps remove cloud dependency and assists in preserving individual privacy while providing an exceptional user experience.

IMAGE SIGNAL PROCESSOR (ISP)

An intelligent vision system based on the i.MX 8M Plus ISP and camera interfaces with resolution up to 12 MP and is capable of an input rate of up to 375 MP/s. This vision system acts as the eyes of the i.MX 8M Plus processor. The integrated ISP brings real-time image processing to high-definition video and performs algorithms that extract the maximum image details in high-contrast scenes. A de-warp engine performs fisheye lens correction and reverses the effects of wide-angle lens distortion. It also corrects distortions from low-cost lenses and helps ensure high image quality.

ADVANCED MULTIMEDIA

VIDEO PROCESSING AND H.265 ENCODING

The i.MX 8M Plus processor features powerful video processing with an H.265 video encoder that delivers highly efficient compression for live video streaming to the cloud, as well as highly efficient local memory storage.

STUNNING USER EXPERIENCE

A video processing unit (VPU) efficiently encodes and decodes high-definition video. A 2D/3D graphics processing unit enables stunning graphics and supports the latest interfaces such as OpenGL® ES 3.1, Vulkan®, OpenCL™ 1.2 and OpenVG™ 1.1. Apart from multiple audio interfaces, the i.MX 8M Plus processor supports Immersiv3D™ audio software with Dolby Atmos® and DTS:X®, creating cinematic user experiences.
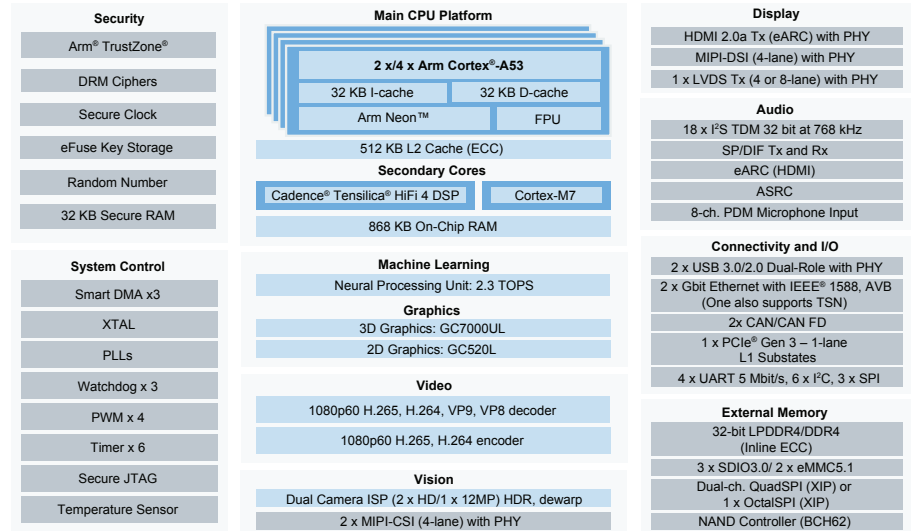
VOICE SOLUTION

Beyond traditional voice assistance solutions via the cloud, the i.MX 8M Plus processor performs local voice processing tasks such as speaker and voice recognition, and it successfully achieves user privacy and fast response times. The low-power voice coprocessor, based on a Cadence® Tensilica® HiFi 4 DSP up to 800 MHz, helps ensure low power use and high performance efficiency.

INDUSTRIAL IOT AND RELIABILITY

INTELLIGENCE ADDED TO INDUSTRIAL IOT

The industrial IoT leverages machine learning and vision systems paired with smart sensors to enable machines to inspect, measure, precisely identify, and make decisions in a manufacturing environment.

i.MX 8M PLUS BLOCK DIAGRAM

Security
- Arm® TrustZone®
- DRM Ciphers
- Secure Clock
- eFuse Key Storage
- Random Number
- 32 KB Secure RAM

System Control
- Smart DMA x3
- XTAL
- PLLs
- Watchdog x 3
- PWM x 4
- Timer x 6
- Secure JTAG
- Temperature Sensor

Main CPU Platform
- 2 x/4 x Arm Cortex®-A53
  - 32 KB I-cache | 32 KB D-cache
  - Arm Neon™ | FPU
- 512 KB L2 Cache (ECC)

Secondary Cores
- Cadence® Tensilica® HiFi 4 DSP | Cortex-M7
- 868 KB On-Chip RAM

Machine Learning
- Neural Processing Unit: 2.3 TOPS

Graphics
- 3D Graphics: GC7000UL
- 2D Graphics: GC520L

Video
- 1080p60 H.265, H.264, VP9, VP8 decoder
- 1080p60 H.265, H.264 encoder

Vision
- Dual Camera ISP (2 x HD/1 x 12MP) HDR, dewarp
- 2 x MIPI-CSI (4-lane) with PHY

Display
- HDMI 2.0a Tx (eARC) with PHY
- MIPI-DSI (4-lane) with PHY
- 1 x LVDS Tx (4 or 8-lane) with PHY

Audio
- 18 x I²S TDM 32 bit at 768 kHz
- SP/DIF Tx and Rx
- eARC (HDMI)
- ASRC
- 8-ch. PDM Microphone Input

Connectivity and I/O
- 2 x USB 3.0/2.0 Dual-Role with PHY
- 2 x Gbit Ethernet with IEEE® 1588, AVB (One also supports TSN)
- 2x CAN/CAN FD
- 1 x PCIe® Gen 3 – 1-lane L1 Substates
- 4 x UART 5 Mbit/s, 6 x I²C, 3 x SPI

External Memory
- 32-bit LPDDR4/DDR4 (Inline ECC)
- 3 x SDIO3.0/ 2 x eMMC5.1
- Dual-ch. QuadSPI (XIP) or 1 x OctalSPI (XIP)
- NAND Controller (BCH62)

i.MX 8M FAMILY SCALABILITY

PRODUCT	i.MX 8M NANO	i.MX 8M MINI	i.MX 8M PLUS	i.MX 8M QUAD
Main CPU	4 x Arm® Cortex®-A53 1.6 GHz	**4 x Cortex-A53 1.8 GHz**	**4 x Cortex-A53 1.8 GHz**	4 x Cortex-A53 1.5 GHz
MCU/DSP	Cortex-M7 650 MHz	Cortex-M4 400 MHz	Cortex-M7 800 MHz **Hi-Fi4 DSP 800 MHz**	Cortex-M4 266 MHz
DDR	16-bit LPDDR4/DDR4/ DDR3L	16/32-bit LPDDR4/ DDR4/DDR3L	32-bit LPDDR4/DDR4 **(Inline ECC)**	16/32-bit LPDDR4/ DDR4/DDR3L
GPU	GC7000UL (2 shaders), **OpenGL® ES 2.0/3.0/3.1, Vulkan®, OpenCL™ 1.2**	GC NanoUltra (1 shader), OpenGL ES 2.0; GC520L (2D)	GC7000UL (2 shaders), **OpenGL ES 1.1/2.0/3.0/3.1, OpenVG 1.1, Vulkan, OpenCL 1.2;** GC520L (2D)	**GC7000Lite (4 shaders), OpenGL ES 2.0/3.0/3.1, Vulkan, OpenCL 1.2**
Security	CAAM, RDC, Arm TrustZone®	CAAM, RDC, TrustZone	CAAM, RDC, TrustZone	CAAM, RDC, TrustZone
AI/ML	OpenCL CPU, GPU: 32 GOPS	OpenCL CPU: 32 GOPS	**Neural Processing Unit 2.3 TOPS**	OpenCL CPU: 32 GOPS
Camera	1 x MIPI CSI (4-lanes)	MIPI CSI (4-lanes)	2 x MIPI CSI (4-lanes each) **2 x ISP up to 12 MP resolution**	2 x MIPI CSI (4-lanes each)
Display	MIPI DSI (4-lanes)	MIPI DSI (4-lanes)	HDMI 2.0a Tx, MIPI DSI (4-lanes) **LVDS (4/8-lanes)**	HDMI 2.0a Tx, MIPI DSI (4-lanes), **DP/ eDP**
HDR	–	–	–	**HDR10, HLG, Dolby Vision®**
Video Decode	–	1080p60 HEVC, H.264, VP9, VP8	1080p60 HEVC, H.264, VP9, VP8	**4Kp60 HEVC, VP9, 4Kp30 H.264, legacy**
Video Encode	–	1080p60 H.264, VP8	1080p60 H.265, H.264	–
Audio	12 x I²S TDM (32 b @ 384 kHz), ASRC, 8-ch. PDM DMIC input	20 x I²S TDM (32 b @ 384 kHz), ASRC, 8-ch. PDM DMIC input	18 x I²S TDM (32 b @ 384 kHz), ASRC, 8-ch. PDM DMIC input, **eARC**	20 x I²S TDM (32 b @ 384 kHz), ARC
Expansion I/O	1 x USB 2.0 with PHY	2 x USB 2.0 with PHY, 1 x PCIe® Gen 2	**2 x USB 2.0/3.0 Type C with PHY, 1 x PCIe Gen 3**	**2 x USB 3.0 Type C with PHY,** 2 x PCIe Gen 2
Network, Storage	1 x GbE, 3 x SD/ eMMC, Raw NAND	1 x GbE, 3 x SD/ eMMC, Raw NAND	**2 x GbE (1x TSN), 2x CAN/CAN FD** 3 x SD/eMMC, Raw NAND	1 x GbE, 2 x SD/ eMMC, Raw NAND
Package	14 x 14 mm 0.5 p depopulated	14 x 14 mm 0.5 p depopulated	15 x 15 mm 0.5 p depopulated	17 x 17 mm 0.65 p

INDUSTRY 4.0

The i.MX 8M Plus processor enables Industry 4.0 applications through multiple high-speed interfaces. A gigabit Ethernet MAC with Time-sensitive networking (TSN) capability provides Ethernet-connected deterministic control with precise time synchronization. A second gigabit Ethernet port supports multiple data networks and gateway applications.

REAL-TIME PROCESSING

An 800 MHz Cortex-M7 processor performs local, real-time control. It can eliminate the need for an external microcontroller in the system design. The integrated Cortex-M7 core associated with the CAN FD interfaces provides a robust local control network for industrial applications.

HIGHLY RELIABLE

The i.MX 8M Plus includes error correcting code (ECC) in critical points of the system, including the DDR interface, for high reliability and support of safety integrity level (SIL) certification at the system level.

The 14 nm FinFET process provides lower soft error rates while delivering high processing speed and low power consumption.

SYSTEM SCALABILITY AND DESIGN OPTIMIZATION

EDGEVERSE™ AND HIGH SCALABILITY

The NXP EdgeVerse™ portfolio consists of industry-leading, scalable and embedded processing, security and software solutions designed to accelerate edge computing. As a member of this portfolio, the i.MX 8M Plus applications processor elevates intelligence and simplifies cognition at the edge.

The i.MX 8M Plus processor extends the i.MX 8M product family. It offers high system compatibility while adding machine learning and vision capabilities. A unified BSP supports each member of the i.MX 8M family of scalable devices with high hardware commonality.

PIN-COMPATIBLE PLATFORM OPTIONS AND DESIGN FLEXIBILITY

Scale up and down the product lineup through a pin-compatible package option that can help futureproof your design. Design your single PCB platform with build options that use different i.MX 8M Plus applications processors to meet your product needs. Build options include capabilities such as NPU, VPU or ISP.

FLEXIBILITY IN HIGH-SPEED AND MEMORY INTERFACES

The i.MX 8M Plus processor offers the latest high-speed interfaces for connectivity and fast data transfer with 2 x USB 2.0/3.0 Type C, PCIe® Gen3, 3 x SD/SDIO 3.01, 2 x Gbit Ethernet with EEE, AVB, IEEE 1588 and TSN in one port for precise, low latency control loops, in addition to 2x CAN/CAN FD interfaces.

The comprehensive memory interfaces supported are 32-bit LPDDR4/DDR4, eMMC 5.1, 8-bit NAND Flash, SPI NOR, quad/octo SPI flash, serial NOR and serial NAND flash. The memory solution is optimized for the density, performance and price point.

SYSTEM SECURITY

Security protection features such as secure boot, encrypted boot, hardware firewall and run-time integrity checker (RTIC) support the prevention of multiple security attacks. These attacks may include hardware reverse engineering, malware insertion, modifying/replacing the device image, version rollback attacks and physical attacks.

i.MX 8M PLUS PRODUCT DERIVATIVES

PART NUMBER	APPLICATION REQUIREMENTS	ARM® CPU	NPU	ISP	VIDEO	FAMILY COMMON FEATURES
MIMX8ML8xVNxZAB	Machine learning, vision and video	4 x Cortex®-A53, Up to 1.8 GHz*	2.3 TOPS	12 MP resolution Up to 375 MP/s	Decode: 1080p, h.265/4, VP9, VP8 Encode: 1080p, h.265/4	**GPU** OpenVG 1.1, G2D, OpenGL® ES 3.1 Vulkan®, OpenCL™ 1.2 FP
MIMX8ML6xVNxZAB	Vision and video	4 x Cortex-A53, Up to 1.8 GHz*	–	12 MP resolution Up to 375 MP/s	Decode: 1080p, h.265/4, VP9, VP8 Encode: 1080p, h.265/4	**Display/Camera** HDMI Tx, LVDS, MIPI-DSI 2 x MIPI-CSI **Connectivity** 2 x USB 2.0/3.0, PCIe® Gen3
MIMX8ML4xVNxZAB	Full CPU processing and interfaces	4 x Cortex-A53, Up to 1.8 GHz*	–	–	–	2 x Gb Ethernet (1 x TSN) 2x CAN/CAN FD**, 3 x SDIO **Audio** 18x I²S TDM (32 bit @ 768 kHz)
MIMX8ML3xVNxZAB	Machine learning, vision and video, lower CPU perf.	2 x Cortex-A53, Up to 1.8 GHz*	2.3 TOPS	12 MP resolution Up to 375 MP/s	Decode: 1080p, h.265/4, VP9, VP8 Encode: 1080p, h.265/4	SP/DIF RX and TX, eARC ASRC, 8-ch. PDM **Cortex-M7 @ 800 MHz low-power voice coprocessor**

* Industrial parts up to 1.6 GHz

** Industrial parts only

COMPREHENSIVE SOFTWARE SUPPORT

NXP supports Android™, Linux® and FreeRTOS commercial operating systems. NXP also offers the eIQ™ software tookit, a collection of libraries and development tools for building machine learning applications targeting NXP i.MX applications processors and MCUs. The eIQ toolkit leverages open-source technologies and is fully integrated into NXP's Yocto development environments, allowing the development of complete system-level applications with ease.

HARDWARE TOOLS

The i.MX 8M Plus evaluation kit (EVK) enables SoC evaluation and system prototyping.

Multiple accessory boards are available to facilitate i.MX 8M Plus processor evaluation for applications such as camera modules and display panels.

EXPERT PACKAGE DESIGN FOR SIMPLIFIED SYSTEM DESIGN

NXP engineers have defined package options that simplify hardware design and provide overall system cost benefits depending on the application. Reference hardware designs are available to help get customers started fast.

INDUSTRIAL AND CONSUMER QUALIFIED

An industrial temperature range (-40 °C to 105 °C Tj) supports always-on operation for more than 10 years. A consumer application temperature range (0 °C to 95 °C Tj) presents higher processing frequency.

SUPPLY LONGEVITY

NXP's Product Longevity program ensures supply continuity and preserves your engineering investment for embedded designs for 10 to 15 years.

https://www.nxp.com/products/product-information/product-longevity:PRDCT_LONGEVITY_HM

i.MX 8M PLUS FEATURES AND BENEFITS

	CAPABILITY	FEATURE	BENEFITS
Machine Learning	Machine Learning	Neural processing unit (NPU) up to 2.3 TOPS	• Edge inference and intelligence • No cloud dependency, privacy, better user experience
	Vision System	Up to 2 x camera (2 x MIPI-CSI), up to 4Kp30	• 4K vision/1080p stereo vision • HDR extracts the maximum image details in high-contrast scenes
		Dual Camera ISP (2 x HD/1x 12MP) HDR, dewarp	• Dewarp: Fisheye lens correction, reduction of overall optical system cost
	Voice	Low-power voice accelerator, 8-ch. PDM digital microphone input	• Voice systems processed at the edge • Privacy, better user experience, no cloud dependency • Low noise and cost-effective microphone system
Advanced Multimedia	HD Video	1080p60 video decoding, (H.265, H.264, VP9, VP8) 1080p60 video encoding, (H.265, H.264)	• High-resolution video compression for cloud upload or local storage • Effective compression with H.265, about twice as effective than H.264
	3D/2D Graphics	OpenVG™ 1.1, OpenGL® ES 3.1, Vulkan®, OpenCL™ 1.2 FP	• 3D and 2D graphics for rich HMI and user experience • Vulkan support for Android™ 10 onwards
	Advanced Audio	18 x I²S TDM, DSD512, SP/DIF Tx + Rx, 8-ch. PDM HDMI 2.0b Tx + eARC, ASRC	• Latest audio technology, including Immersiv3D™ audio software • eARC for high quality audio for cost-optimized soundbars
Industrial Network and Reliability	Industrial Network	2 x Gigabit Ethernet (1 x with TSN), 2 x CAN FD	• Low latency industrial network for precise control and Industry 4.0 support • Robust local industrial control network • Gateway application with dual Ethernet
	Memory Reliability	ECC on L2-cache, In-line ECC on DDR bus 14 nm FinFET process	• High industrial system reliability for safety industrial level • Low SER rates
	Real-Time Processing	Arm® Cortex®-M7 @ 800 MHz	• High real-time processing power • Cortex-A complex off loading • Potential for eliminating an external MCU
Performance and Connectivity	High Performance, Low Power	2 x or 4 x Cortex-A53 @ 1.8 GHz, 14 nm FinFET, low power, high performance	• Up to 21,600 DMIPS • Applications running < 2.0 W deep sleep mode < 20 mW
	Display Interfaces	MIPI-DSI, HDMI 2.0b, LVDS 4/8-lane; supports up to 2x1080p60 or 1x4kp30	• Multiple display interface options capable to operate simultaneously
	High-Speed Interfaces	2 x USB 2.0/3.0 (5 Gbit/s each), PCIe® 3.0 (8 Gbit/s), 3 x SDIO 3.0 800 Mbit/s	• Fast connections to Wi-Fi®, FPGAs, coprocessors • Fast data transfer, e.g., media files