NXP i.MX 952 applications processor family for AI-powered vision processing

The i.MX 952 applications processor, part of NXP's i.MX 9 series, is designed for automotive and industrial vision and display applications. Specifically, for in-cabin sensing systems, leveraging the integrated eIQ® neutron neural processing unit (NPU), the i.MX 952 intelligently combines sensor inputs to enhance driver monitoring, child presence detection and other in-cabin safety features. This AI-powered sensor fusion technology not only improves safety but also offers additional value such as health monitoring and personalization. In industrial settings, the i.MX 952 provides real-time analysis and anomaly detection, ensuring rapid identification and response to issues, making it ideal for AI-powered surveillance, environmental sensing and HMI systems. With its low power, cost-effective solutions, the i.MX 952 can meet the regulatory requirements for the next generation of vehicles and modern industrial environments.

The i.MX 952 SoC is also the world's first automotive and industrial processor with integrated support for local dimming, enabling in-cabin LCD panels and HUDs to use less energy and deliver higher contrast, as well as enhancing outdoor HMI panels by dynamically adjusting brightness for optimal visibility in harsh lighting conditions. This helps to reduce power consumption, as well as eliminate the need for additional components. By reducing screen wash-out in direct sunlight, this can also help improve visibility for 2-wheelers and other open-air vehicles, as well as outdoor HMI panels.

Target applications

- **Automotive:**
  In-cabin sensing, driver/occupant monitoring systems, two-wheeler digital connected clusters, IVI display systems including surround-view/park assistance
- **Industrial and IoT:**
  Ruggedized HMI, factory automation, building and home automation

High-performance compute

The i.MX 952 family capabilities include a multi-core application domain with up to four Arm® Cortex®-A55 cores, as well as two independent real-time domains for safety/low-power, and high-performance real-time use, consisting of high-performance Arm Cortex-M7 and Arm Cortex-M33 CPUs, combining low-power, real-time, high-performance processing. The i.MX 952 family is designed to enable ISO 26262 ASIL B and SIL 2 IEC 61508 compliant platforms, with the safety domain serving as a critical capability for many automotive and industrial applications. Platforms based on i.MX 952 serve to ensure safety-related alerts in a vehicle, like voice warnings, instrumentation, and cameras to meet high reliability standards set by automotive OEMs. Similarly, in industrial factory automation platforms, the functional safety domain ensures that an industrial control system always returns to a predetermined state, even when the rest of the system fails.

Machine vision capabilities

The i.MX 952 family enables machine vision through its integrated image signal processor (ISP) and eIQ neutron NPU as part of a vision processing pipeline for use with multiple camera sensors or network attached smart cameras. A rich, vibrant graphics experience for the user is enabled by Arm Mali GPU capabilities, scaling from multi-display automotive infotainment centers to industrial and IoT HMI based applications. The i.MX 952 applications processors contain a 4-lane MIPI-DSI capable of supporting 1x 2880x1080p60 resolution, a 2x 4-lane or 1x 8-lane LVDS display interface capable of 1080p60 resolution.

High speed connectivity

The next generation of edge platforms for Industry 4.0, automotive connectivity domain controllers, and IoT smart home gateways will benefit from the integrated 2.5 gigabit Ethernet plus two 1 gigabit Ethernet ports, with TSN capabilities. Adding wireless connectivity such as Wi-Fi®, Bluetooth® LE, satellite radio or 5G, is simple thanks to the PCIe Gen 3.0 port, two USB 2.0 ports and integrated BSP-level drivers for NXP's wide array of wireless connectivity solutions. With expansive capabilities and robust processing, next-generation platforms based on i.MX 952 family application processors will be capable of securely processing local and network data.

Energy flex architecture

The i.MX 952 family is designed to be configurable and scalable, with multiple heterogenous processing domains. This includes an application domain with up to 4 Arm Cortex A55 cores, a high-performance real-time/safety domain with Arm Cortex M7, and low-power/safety domain with Arm Cortex M33, each able to access interfaces including CAN FD, 2.5GbE networking, PCIe Gen 3x1 interfaces, and accelerators such as V2X and VPU.

Advanced security, simplified

Security is an essential foundation for edge applications. The i.MX 952 family integrates a secure enclave to simplify implementation of security critical functions like secure boot, cryptography, trust provisioning, run-time attestation and post-quantum cryptography (PQC) services. Combined with NXP's EdgeLock® 2GO key management services, manufacturers can securely provision i.MX 952 SoC-based products for secure remote management of devices deployed in the field, including secure over-the-air updates (OTA). The i.MX 952 platform features a dedicated cryptographic engine with support for a wide range of standards to enable next-generation automotive V2X applications, and more.

Display and multimedia

The Arm Mali GPU supports OpenGL® ES 3.2, Vulkan® 1.2, and OpenCL 3.0 to enable rich graphical experiences or compute acceleration. The independent 2D GPU is part of the real-time domain and can blend graphics overlays for conveying critical information in safety or real-time applications. Additionally, the display controller enables two independent display output streams. It is capable of image rotation (90°, 180°, 270°), image resize, color space conversion, copy, blend, ROP, scale, rotate, warp/de-warp, affine transformations, linear light and offers multiple pixel format support (GPU-Tile, Super-Tile, VPU-tile, RGB, YUV, RGBA), plus standard 2D-DMA operations.

Enhanced reliability

The i.MX 952 platform contains error correcting codes (ECC) in most of the internal memories such as L1, L2, L3 caches of the Arm Cortex-A55, the TCM of the Cortex-M33, Cortex-M7, and internal on-chip memory as well as in-line memory correction on the LPDDR interface for enhanced reliability of key application memory regions. On-the-fly memory encryption enables secure data processing to ensure privacy and security in a wide range of applications.

Rich set of high-speed and memory interfaces

The i.MX 952 processors offer high-speed interfaces for connectivity and fast data transfer with USB 2.0, 3x SD/SDIO 3.01, 1x 2.5 gigabit Ethernet and 2x 2.5 gigabit Ethernet, each with EEE, AVB, IEEE 1588 and TSN for precise, low latency control loops, in addition to 3x CAN FD interfaces. The memory interfaces supported are 32-bit LPDDR5/LPDDR4X and eMMC 5.1.

Automotive edge

In-cabin sensing systems must become more advanced, driven by global legislation and standards such as Euro NCAP, determining driver attention levels, ensuring airbags are properly calibrated and detecting a child left alone in a car. The i.MX 952 applications processor leverages AI to fuse inputs from different sensors to deliver a more robust, scalable and cost-efficient interior cabin sensing solution for improved safety and ease of use and to meet the regulatory requirements for the next generation of vehicles.

Industry 4.0

The i.MX 952 family of applications processors are optimized for machine vision with high-performance graphics and scalable connectivity with support for pre-emption and TSN. Featuring a flexible architecture with safety domain and real-time domain, command and control of automated production lines is enabled with ruggedized HMI featuring multiple displays, touch-screen control, and real-time critical alerts.

Comprehensive software support

NXP's software enablement package includes Linux® and Android™ support to provide flexibility for our customers to customize the BSPs to their specific needs. NXP provides regular releases with the latest kernel patches and bug fixes to support customers in their designs. NXP also provides precompiled packages for all advanced IPs to enable a seamless experience for customers while porting and integrating their applications and offloading their workloads to these IPs. Additionally, NXP also supports FreeRTOS and a plethora of commercial RTOS from partners to address real-time customer applications enabling developers a quick and easy migration path. Join fellow i.MX developers online at NXP i.MX community. NXP eIQ neutron NPU and machine learning application development are supported by the award-winning eIQ® ML software development environment, a collection of libraries and development tools for building machine learning applications targeting 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 952 evaluation kit (EVK) will enable SoC evaluation and system prototyping. Multiple accessory boards are planned to facilitate i.MX 952 processors evaluation for applications such as camera modules and display panels. NXP wireless connectivity solutions enable seamless Wi-Fi and Bluetooth capabilities for easy development and integrated platform design.

Expert package design for simplified system design

The i.MX 952 family will have two package offerings:

- 19 x 19 mm, 0.7 mm pitch
- 15 x 15 mm, 0.5 mm pitch

Extended industrial, consumer and automotive qualified

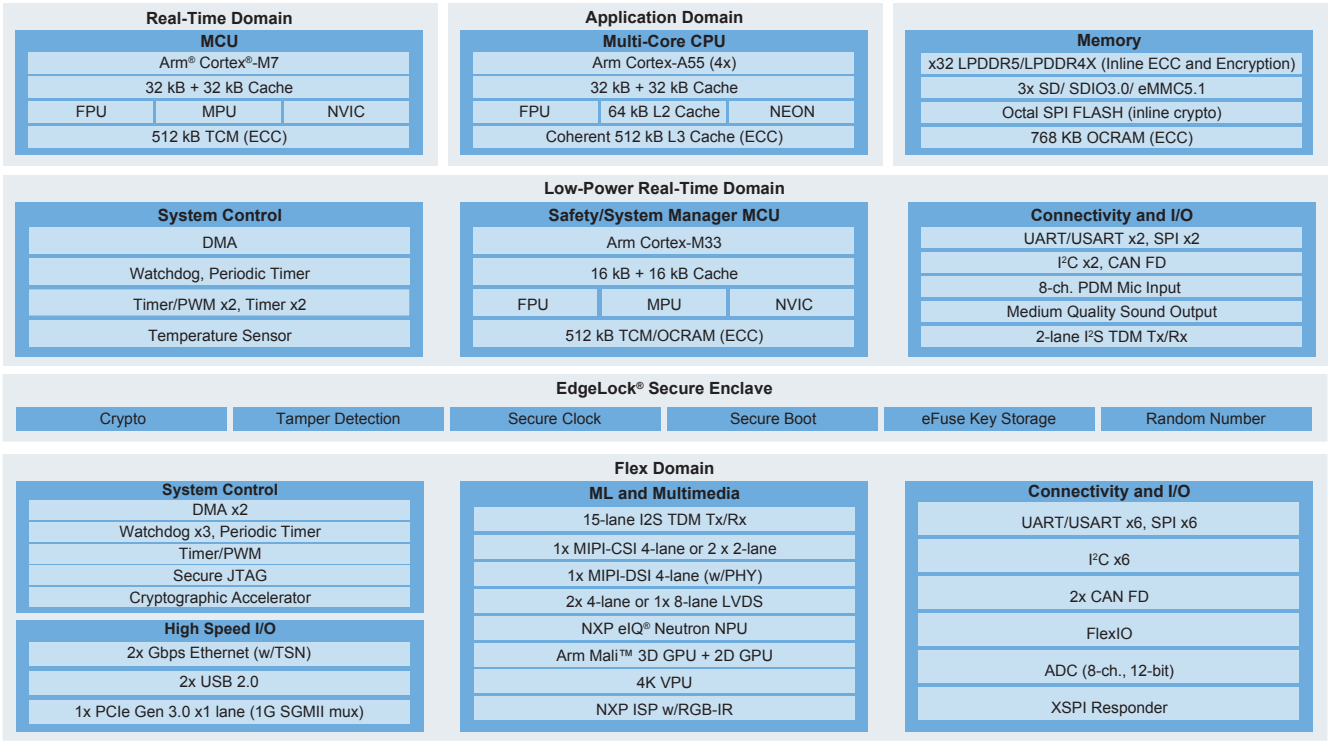
i.MX 952 applications processors supports the following qualifications:

- Automotive temperature range (-40 °C to 125 °C Tj)
- Consumer application temperature range (0 °C to 95 °C Tj)
- Extended industrial temperature range (-40 °C to 125 °C Tj)
- Standard industrial temperature range (-40 °C to 105 °C Tj)

Supply longevity

i.MX 952 processors will be part of the NXP Product Longevity program ensuring supply continuity and preserves your engineering investment for embedded designs a minimum of 15 years.

Block diagram



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