i.MX 94 Applications processor family

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The multi-core design of the i.MX 94 family delivers high performance and low latency across both application and real-time domains, along with an integrated functional safety island. Supporting a wide variety of key industrial networking protocols, the on-chip 2 time-sensitive networking (TSN) switch enables highly configurable, secure communications with rich networking protocols support in industrial and automotive environments. Combining the on-chip eIQ® Neutron NPU together with NXP's first chip supporting postquantum cryptography provides a future proof edge computing platform.

Target applications

- Industrial Automation: Servo drive, Motion Control, PLCs, Industrial Gateways, CNC, robotics
- Building Control and Energy: building automation, energy meters, EV charging
- Automotive: Automotive Connectivity Domain Controller, advanced telematics, smart antenna

Performance compute engine

The multi-core i.MX 94 family of applications processors features up to four Arm® Cortex®-A55 cores capable of running Linux, along with two Cortex®-M33 cores and two Cortex®-M7 cores to offer high-performance, low latency real-time processing capability. NXP's real-time edge software framework enables developers to realize designs with an optimal combination of real-time and application-level tasks running across any of these cores. In addition, a variety of third-party purpose-built commercial

operating systems such as QNX Neutrino, VxWorks and GreenHills Integrity will be supported to harness the compute capabilities.

Time-Sensitive Networking Switch (TSN)

The i.MX 94 family includes the first i.MX applications processor to integrate a 2.5 Gbps Ethernet TSN switch, featuring fast initialization and support for low-power modes. It is optimized for software-defined networks and supports network virtualization. The ethernet controller has a virtualized host interface which makes it easy to share control between the real-time and application cores.

Industry 4.0

Industry 4.0, the fourth industrial revolution, is transforming manufacturing through smart factories, automation, and IoT-driven connectivity. A crucial aspect of this transformation is the seamless integration of machines, sensors, cloud platforms, and edge devices, enabled by both wired and wireless industrial communication protocols. The NXP i.MX 94 family, powered by real-time edge software, supports a wide range of industrial networking

standards. It seamlessly integrates traditional serial fieldbus protocols such as Profibus, Modbus, CANopen, and IO-Link, while also enabling high-speed Ethernet-based real-time networking, including Profinet, EtherCAT, Ethernet/IP and CC-Link. With built-in Time-Sensitive Networking (TSN) capabilities, fully compliant with industrial profiles, the i.MX 94 family is designed to support the latest industrial communication protocols. This includes next-generation standards like OPC-UA FX, CC-Link IE TSN, and Profinet over TSN, ensuring a scalable, future-ready solution for evolving industrial automation needs.

Designed for real-time applications

For optimal performance and efficiency, factory floor operations, especially in drive applications, require precise execution and control timing. Designed for Industry 4.0 applications, the i.MX 94 enhances real-time processing by incorporating extensive low-latency memory and synchronizing key chip components using network time synchronization clocks. This ensures deterministic execution, meeting the rigorous timing demands of advanced industrial networks.

Integrated functional safety

With functional safety becoming an increasingly important factor for modern industrial or automotive systems, the i.MX 94 applications processors family addresses this by integrating a flexible functional safety island. This island is designed to support both industrial IEC61508 standards, offering hardware integrity up to SIL2, systematic capability up to SIL3 and automotive ISO26262 ASIL-B compliance. Users can customize the safety island, via the selection of M cores and other safety relevant resources, to meet their specific requirements without compromising on safety needs.

System security

With an integrated EdgeLock® Secure Enclave (Advanced Profile), the i.MX 94 provides advanced security capabilities, including secure boot, secure debug and secure update of the processor based on post-quantum cryptography without compromising performance. It also features runtime protections, such as expelling of attacker with automatic recovery to a trusted state, or EdgeLock 2GO key management.

The i.MX 94 family is NXP's first applications processor to support post-quantum, public key cryptography, allowing to set the equipment and restore it to a trusted state at any time, withstand attacks by quantum computers, and manage security of equipment over a long lifecycle.

The i.MX 94 family provides support for security standards such as IEC 62443 and ISO 21434, as well as upcoming regulations such as Cyber Resilience Act in Europe. This gives OEMs and asset owners new means to handle and recover from cyber incidents in field, preserving availability of equipment and limiting the impact of attacks.

For industrial TSN and automotive V2X applications, the i.MX 94 incorporates EdgeLock Accelerator (Prime), a crypto-accelerator enabling fast boot, and real-time authentication and encryption at 5G speeds for secure communications.

Energy flex architecture

Modern SoCs often enable safety and security through the use of hypervisors to segment compute and accelerators for specific functions. NXP energy flex architecture enables a deeper level of platform configurability through the design of real-time, flexible compute domains. The i.MX 94 family features a high-performance compute domain, a real-time domain, and a low-power or safety domain. Optimizing energy use at the chip level in all operating modes is becoming an increasingly crucial part of designing energy efficient edge systems. Additionally The EVK development platform supports power measurements on all the main supply pins.

Neural Processing Unit (NPU)

Supported by NXP's eIQ® machine learning software development environment, the i.MX 94 processor includes NXP's eIQ Neutron NPU, capable of delivering high performance acceleration of machine learning models to enable various applications from predictive maintenance and operator guidance to proactively prevent failures as well as intrusion detection and protection with machine learning-assisted cybersecurity to keep critical systems and infrastructure safe from manipulation into the future.

Display and multimedia

The i.MX 94 applications processors contain a 4-lane LVDS interface capable of supporting 1080p60 resolution. Additionally, it features a high-efficiency pixel pipeline hardware compositor to perform graphics processing to realize cost-effective GUI solutions. It is capable of image rotation (90°, 180°, 270°), image resize, color space conversion, multiple pixel format support (RGB, YUV444, YUV422, YUV420, YUV400) and standard -DMA operations.

Rich set of high-speed and memory interfaces

The i.MX 94 processors offer advanced high-speed interfaces such as PCIe3, 2.5Gbps Ethernet switch, USB 3.0 to support high bandwidth applications. The memory interfaces supported are 32-bit LPDDR4/ LPDDR5 (Inline ECC), SDIO for eMMC 5.1 and SD card and octal SPI for flash devices.

Comprehensive software support

The multi-core i.MX 94 family of applications processors features up to four Arm® Cortex®-A55 cores capable of running Linux, along with two Cortex-M33 cores and two Cortex-M7 cores to offer further real-time processing capability.

NXP's Yocto-based enablement software provides flexibility to our customers to customize the BSPs to their specific needs. NXP provides quarterly releases with the latest and greatest kernel patches and bug fixes to support the customers in their design.

NXP's real-time edge software framework enables developers to realize designs with an optimal combination of real-time and application-level tasks running across any of these cores.

The real-time processing domain can be used for deterministic or high-performance real-time applications such as SafeAssure middleware or real-time control applications. The safety or low-power domain can be used for system manager firmware or safety framework applications, running safe OS and safety checker applications to monitor fault detection hardware. Both domains feature dedicated Arm Cortex-M processors, with an M33 for safety and low power and an M7 for high performance real-time processing.

The different SW operating systems supported on i.MX 94 family are Linux, Zephyr, Debian, QNX, GreenHills, VxWorks and, FreeRTOS.

NXP also offers the 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, simplifying the development of complete system-level applications.

Hardware tools

The i.MX 94 evaluation kit (EVK) enables SoC evaluation and system prototyping. Multiple accessory boards facilitate the i.MX 94 processors' evaluation for applications such as camera modules and display panels.

The i.MX 94 will initially be available with a 19x19mm 0.75mm pitch and 15x15mm 0.5mm packages with routing channels.

NXP wireless connectivity solutions enable seamless Wi-Fi and Bluetooth capabilities for easy development and integrated platform design.

NXP supported solutions:

- PMIC – PF53
- PMIC - PF9455
- Analog Front-End
- MCU - i.MX RT1180
- Wireless - IW612
- Wireless - AW693

Extended industrial, commercial and automotive qualified

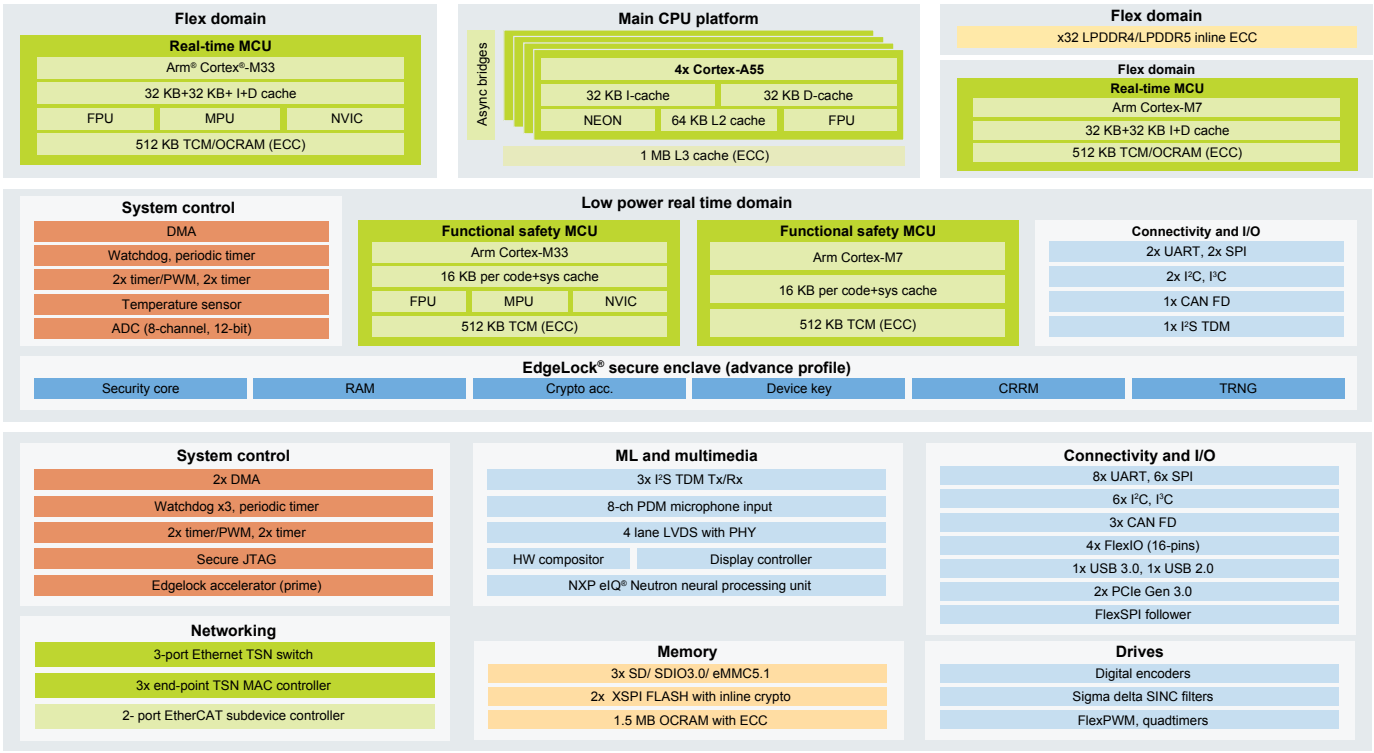
i.MX 94 applications processors supports the following qualifications:

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

Supply longevity

i.MX 94 processors will be part of NXP Product Longevity program ensuring supply continuity and preserves your engineering investment for embedded designs for 15 years.

i.MX 94 family block diagram



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