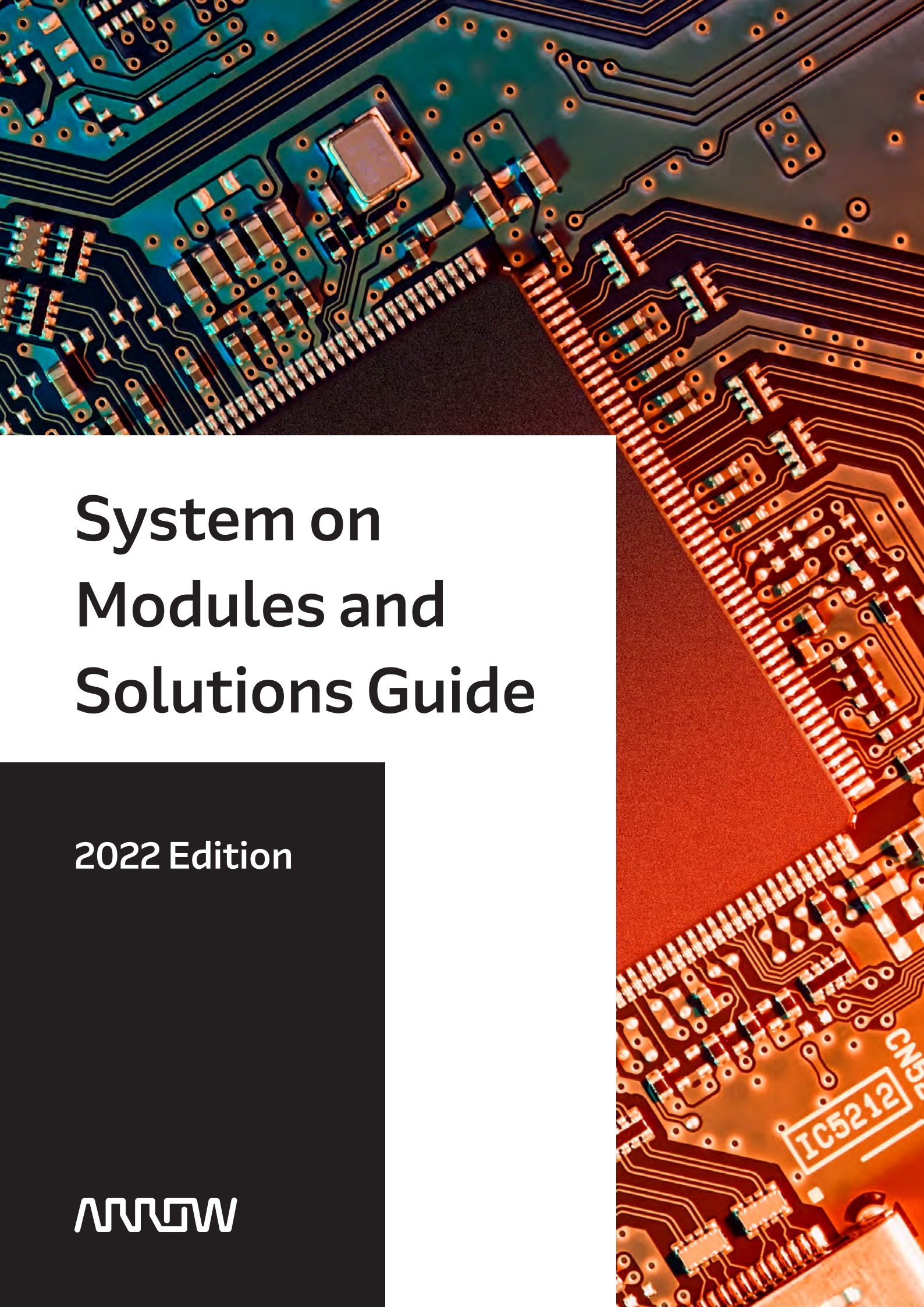
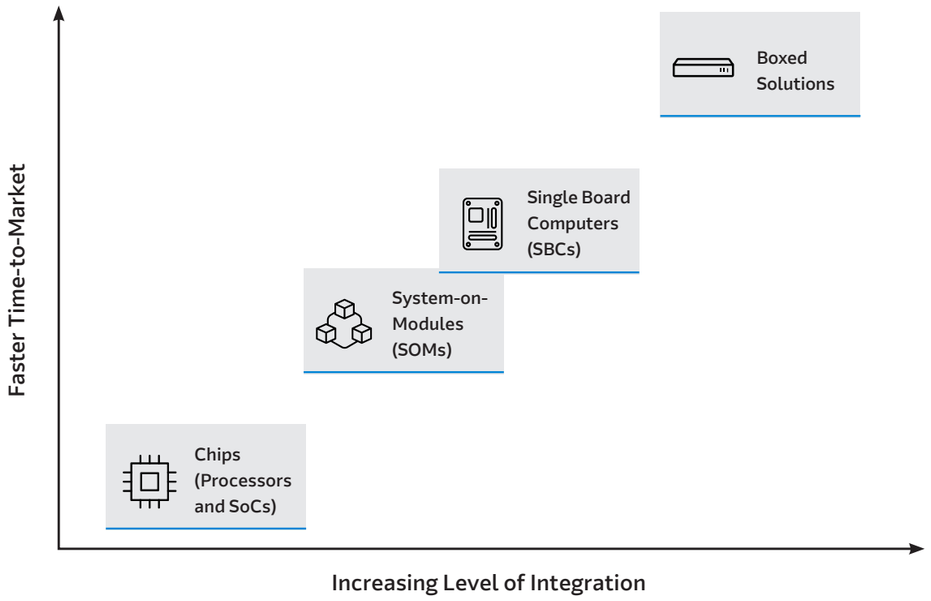


System on Modules and Solutions Guide

2022 Edition

Board (SOMs and SBCs) and Box Solutions Minimize Design Time and Risk

Arrow brings the widest range of boards and packaged products for Arm and x86-based microprocessors and FPGAs from Intel®, Microchip, NXP, Qualcomm, NVIDIA, and ST Microelectronics. By offering options with varying degrees of integration, Arrow provides the ideal starting point based on technical and business requirements. Solution options include – chip-level, boards (SOMs and SBCs) and Box solutions.



System on Modules (SOMs)

Single Board Computers (SBCs)

Boxed Solutions

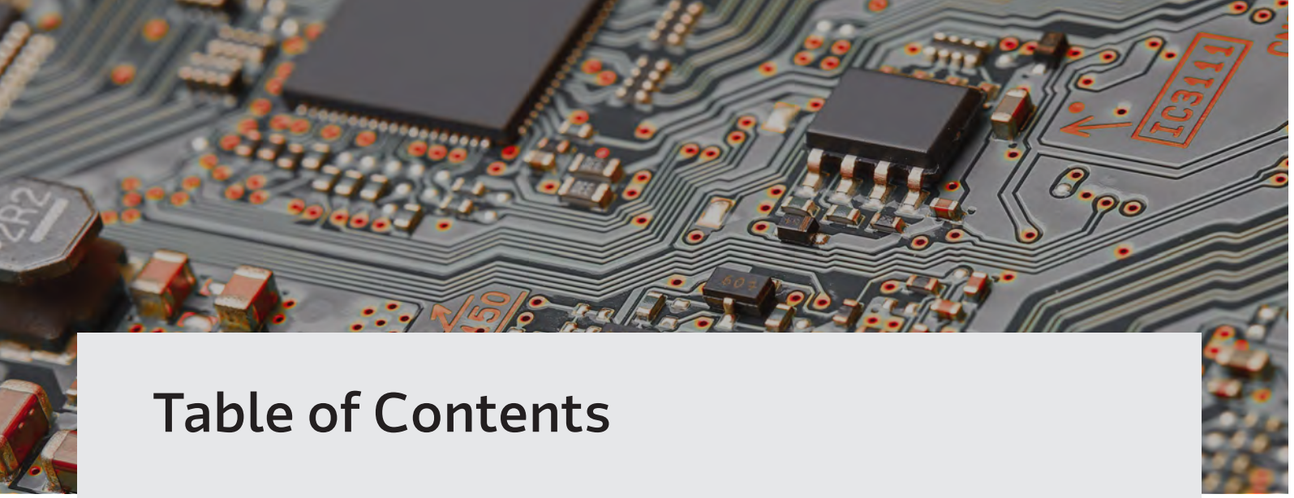
Featured Technologies and Solutions

arm
intel
EXOR EMBEDDED
iWave Embedding Intelligence
trenz electronic
Micron
Microchip
Phoenix Contact
NVIDIA
ADLINK Leading Edge Computing
Advantech Enabling an Intelligent Planet
Connect Tech Inc. Embedded Computing Experts
Geniatech
silex technology
NXP
Boundary Devices
DH electronics Your Digital Heroes
DIGI
Embedded Artists
IMDT
iWave Embedding Intelligence
kontron S&T Group
Micron
rtz Embedded Logics
SolidRun Embedded Edge Computing
variscite
Qualcomm
ADLINK Leading Edge Computing
eInfochips An Arrow Company
LANTRONIX
PENGUIN SOLUTIONS
Thundercomm
life.augmented
DH electronics Your Digital Heroes
Micron

Complementary Technologies

Memory, storage, image sensors, cellular, and security

onsemi
APPLETEC Ltd.
BASLER the power of sight
Leopard
Micron
QUECTEL
SEQUITUR LABS
timesys



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arm®

Building for the Next IoT Wave

The IoT revolution is underway. Billions of connected IoT devices shipped in 2021 alone, continuing robust growth spurred on by across-the-board innovation in sensing, connectivity, and edge processing. Who's at the forefront of this revolution? Arm, with over 70% market share of embedded devices with feature-rich operating systems.

The advantages of Arm's energy-efficient computing technology coupled with a global, dynamic ecosystem enable it to be the architecture of choice in several IoT verticals. With such pervasiveness, Arm has a driver-seat view into the direction the segment is heading. With that comes a unique perspective.

A couple of key macro trends are emerging within the industry. The first is that the industry is transitioning towards a cloud-native software development model, as opposed to device-level development. Increasingly intelligent endpoints and the massive explosion of data processed by them is driving this change. Additionally, data shows that over 60% of Arm developers use containers and an ever-increasing number of Arm containers are being downloaded. The writing on the wall is clear: "Cloud-native development is the future of IoT."

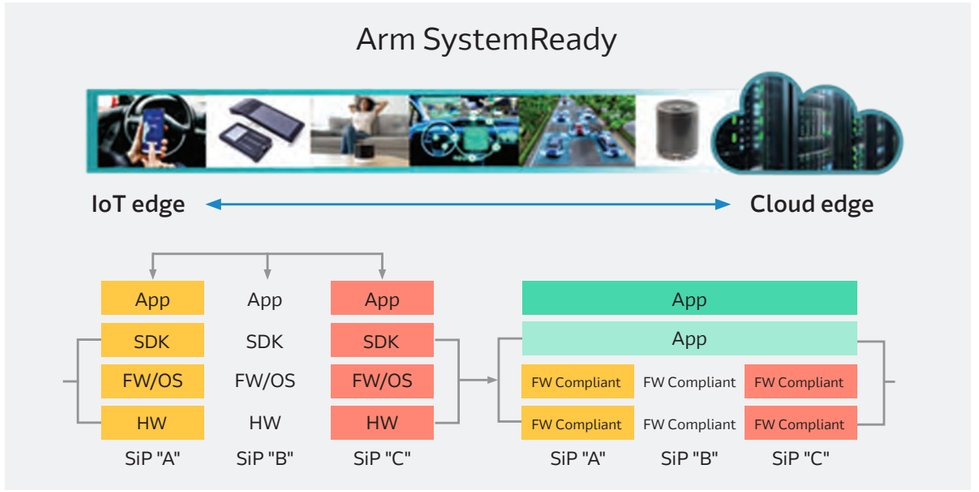
The second major trend is the fragmentation of the ecosystem, comprised of multiple combinations of silicon vendors, ODMs, OEMs, ISVs, and system integrators. With so many players, standardization becomes a challenge. For the segment to reach its potential, these trends must be understood and incorporated into business plans.

How is Arm Ecosystem Driving the Change?

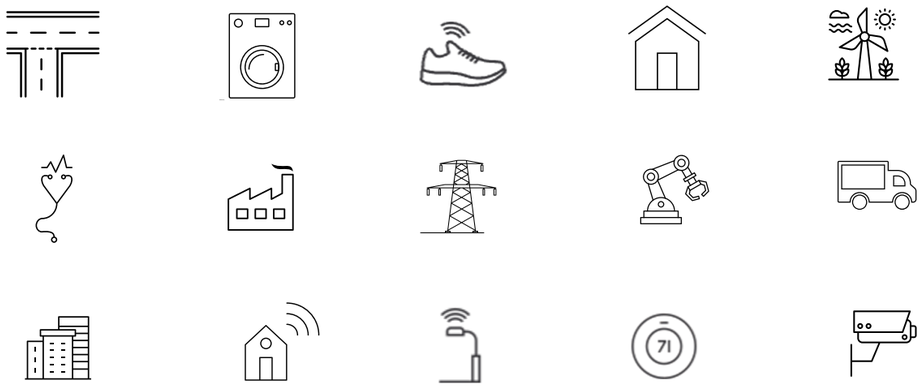
So, to recap, we know there's fragmentation in the ecosystem, but we also know that developers are moving quickly to cloud-native development. What's been Arm's response? recognizing the phenomenal potential of IoT solutions and applications, Arm's vast network of over 1,000 ecosystem partners has banded together in an industrywide collaboration called Project Cassini, a transformational effort to bring cloud-native development to edge and endpoint devices. The foundation of this project stands on three pillars: Standards, Ecosystem, and Security.

- **Standards:** Having well-defined hardware and firmware specifications will allow the software to operate seamlessly across a vibrant, diverse hardware ecosystem. This is accomplished through the Arm SystemReady Program, which not only enables software portability but also enables hardware diversity

  This industry-driven collaboration relies on partners implementing certain hardware and software elements, namely a base system architecture (BSA) for the hardware and base boot requirements specification (BBR) for firmware and market-specific supplements. Once systems are designed and certified, the embedded IoT systems work seamlessly with the off-the-shelf operating systems out of the box. Additionally, any subsequent layers of software will just work, providing a seamless experience

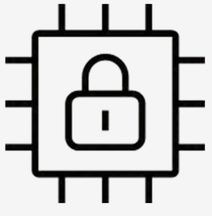


– **Ecosystem:** Project Cassini provides reference software stacks that serve as building blocks for IoT edge use cases. These cloud-native stacks for targeted IoT verticals connect the endpoints to the cloud. This effort demonstrates how elements of Project Cassini play an important role in successfully onboarding and securely managing cloud-native stacks across heterogeneous systems



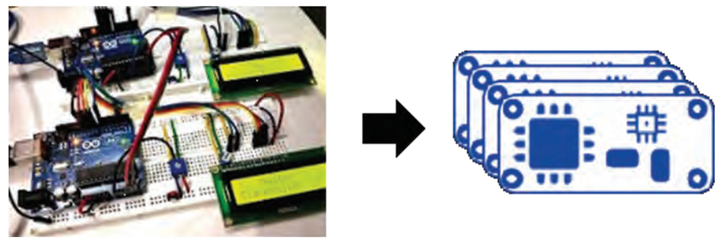
– **Security:** In addition to interoperability, a fragmented ecosystem creates several issues with the security of the overall solution. Securing a wide array of devices is a huge overhead for organizations, and the devices are only as secure as their weakest link. Hence, a standardization of security is a key element in ensuring that the devices are protected and built on trust

The PSA certified 2022 security report found that despite agreement that security is a priority across the IoT ecosystem, significant barriers to security design, and implementation remain. These include regulatory fragmentation, the perceived additional cost, and a lack of security expertise. To help overcome these challenges, 96% of tech decision-makers are interested in an industry-led framework to help guide IoT security best practices. Arm has answered the call, having spearheaded the creation of PSA certified, a global partnership providing a security framework and independent evaluation that is reducing barriers to IoT security and demonstrating a commitment to security best practices. PSA certified is the fastest-growing ecosystem in IoT, with adoption throughout the value chain from chip vendors to system software providers and endpoint device manufacturers



The Role of Virtual Hardware

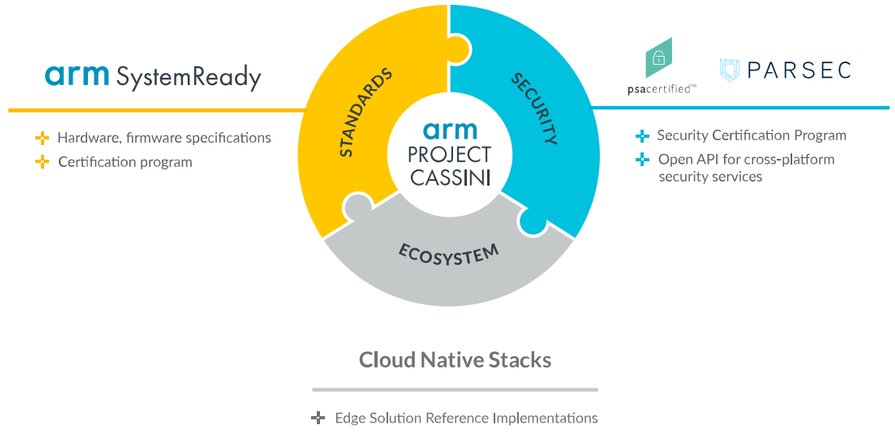
A significant amount of an embedded software developer's time is spent handling issues like board availability, configuration, debugging board stability, etc. All these can be addressed by Arm virtual hardware, a game-changing development paradigm that uses modeling for virtual replicas of the underlying hardware. This would simplify the software-development cycle by cutting down all the issues around board availability and configuration. An application developer can now develop solutions without having to wait for real hardware. This approach will dramatically accelerate the time-to-market and be a game-changer in the IoT development cycle. The vision of development on virtual hardware and deploying on real hardware is now a reality.



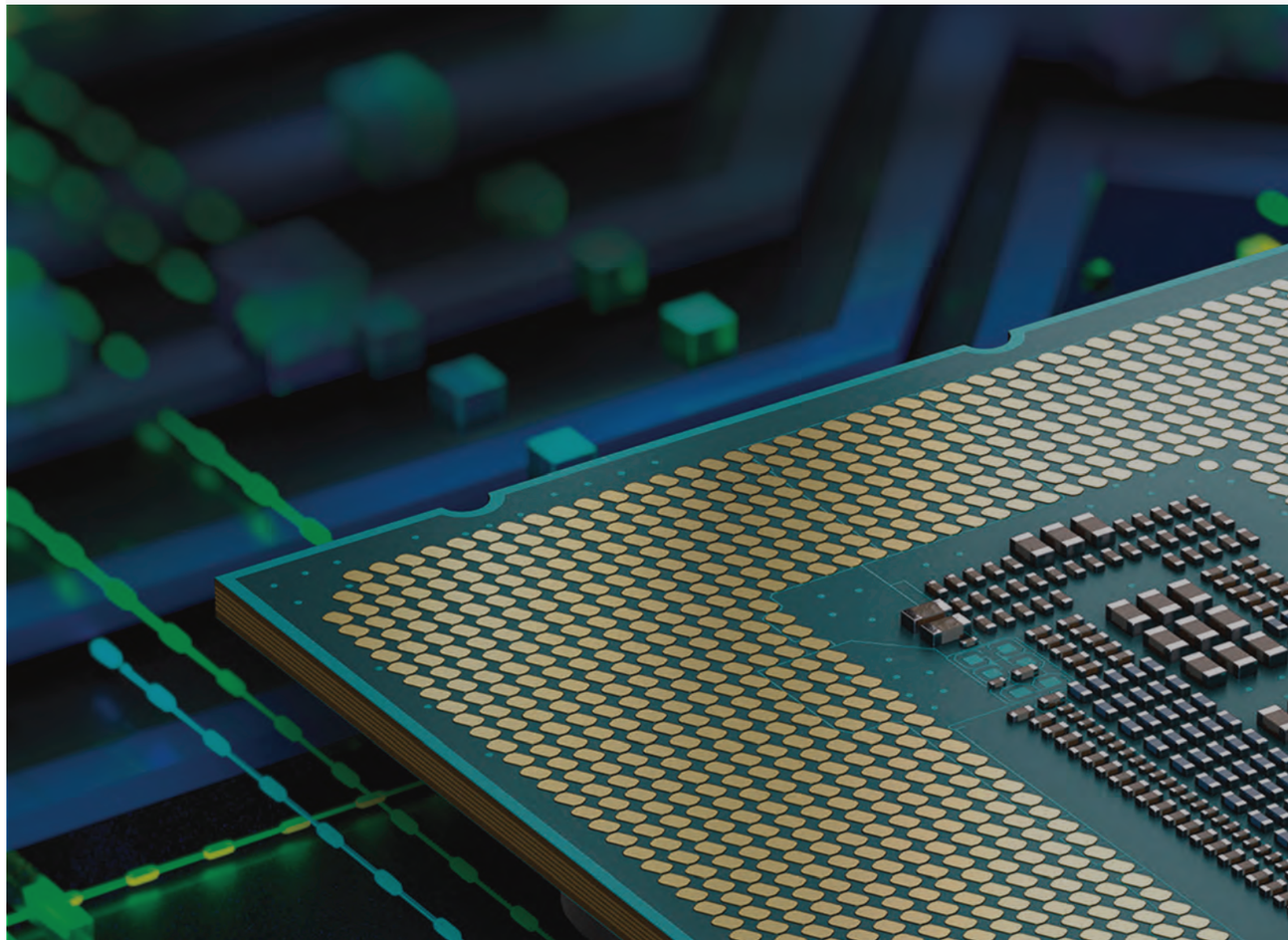
Looking into the Future

Looking ahead, it is apparent that the fundamental way of designing and deploying IoT solutions is going through a massive transformation. The good news is that all the ecosystem players can benefit from this evolution. The first major trend is secure cloud-native system development. Industry-wide initiatives lead by Arm, such as Project Cassini, have been warmly embraced in the ecosystem and paving the way for a smooth transition to cloud-native edge and endpoint development.

The other key development within the industry is application development on virtual hardware. This will accelerate the development cycles, and solutions will be deployed as soon as the hardware is available. These trends will bring about unprecedented efficiency in the ecosystem, shortening development cycles and enabling faster time to market. Join Arm in this journey and adopt the latest and greatest of what the IoT ecosystem has to offer and let us drive this market forward together.



Intel® x86 Solutions and FPGA Boards



Intel® NUC Small Form Factor PCs for Embedded and IoT Devices

Intel® NUC is a small form factor PC with a tiny footprint. Short for Next Unit of Computing, the Intel® NUC platforms squeeze a powerful processor, fast memory, and massive storage comparable to the latest full-size desktop PC. They feature the latest Intel® Core™ processors, available with integrated or discrete graphics, in either solid state drive (SSD) or hard disk drive (HDD) configurations. Some variants of the NUC offer rugged solutions for work in tough environments and IoT applications.

Intel® NUC solutions are available from ready-to-run mini PCs, barebones kits for building your own boards, and modular components for custom applications. The Intel® NUC barebones kits and boards are powerful mini PCs for projects of every scale, from custom-tuned healthcare machines to industrial applications. Intel® NUC kits and boards ship without an operating system in a range of chassis, form factors, and configurations.

Applications for Intel® NUC

Retail

Healthcare

Digital Signage

Industrial Systems

Transportation

Video Conferencing

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Intel® NUC Offerings

Intel® NUC Mini PCs

- Ready to use mini PCs
- Easy deployment
- Windows operating system option

Intel® NUC Kits

- Ready to build
- Configurable features
- Install your own memory, storage, and operating system (not included)

Intel® NUC Boards

- Ready to integrate
- Soldered-on processor
- 4x4-inch form factor
- Independent of chassis for embedded use and custom design

Intel® NUC Elements

- Family of modular components
- New way to design, build, and service systems
- Custom solutions with minimal R&D time

Intel® Laptops

- Thin, extremely light, and ultramobile design
- All-day battery, two-year warranty
- Shortened development time

Benefits of the Intel® NUC

- High-performance
- Small form-factor
- Ruggedized
- Flexible
- Energy efficient
- Customizable

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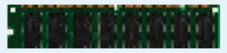
Intel® NUC — System Levels

Varying levels of integration offers easy customization of NUC systems to match application requirements.
This modular concept also enables fast development cycles and flexibility to build scalable systems.

L6, L7, L9 - NUC Kits | L10 - NUC Mini PC								
L6	 Barebone Kit**	+	 Motherboard	+		+		What's needed: Memory, HDD/SSD, and operating system (OS)
L7	 Barebone Kit**	+	 Motherboard	+	  OR RAM HDD/ SSD	+		What's needed: Memory, HDD/SSD, and operating system (OS)
L9	 Barebone Kit**	+	 Motherboard	+	  + RAM HDD/ SSD	+		What's needed: operating system (OS)
L10	 Barebone Kit**	+	 Motherboard	+	  + RAM HDD/ SSD	+	 OS	A complete system with plug-and-play capability

**Barebone kit comes with Intel® Processor, Built-in Support for Connection (Wi-Fi, Bluetooth, LAN), I/O Port (USB, Infrared, Audio-Out with Mic-in, HDMI, DisplayPort), Memory and Storage Drive Slots

Intel® NUC Elements: Modular Computing Made Easy

Intel® NUC Elements are an entirely new way to design and build embedded solutions and mini PCs. The Intel® NUC Compute Element along with a series of Intel-designed components, deliver the flexibility of modular computing. Intel® NUC Elements let you create the exact systems your clients want. Intel® NUC Elements include the Intel® NUC Compute Element, Intel® NUC Board Element, and Intel® NUC Chassis Element, allowing you to develop innovative solutions that can be deployed as embedded devices or full systems.

NUC Element Components

Intel® NUC Compute Element

- The tiny Intel® NUC Compute Element gives you the power of a PC
- Built-in and accessible I/O makes integration and customization easy
- Full range of Intel® processors

Intel® NUC Board Element

- A modular board (thermal solution optional) that's ideal for purpose-built solutions
- Compatible with all Intel® NUC Compute Elements

Intel® NUC Chassis Element

- Fanless and ventless mini PCs
- Rugged features built-in
- Configurable to each of the three rugged boards

Intel® NUC Assembly Element

- Customized cooling for unique integrations
- Small footprint
- Each is designed for specific Intel® NUC Board Element

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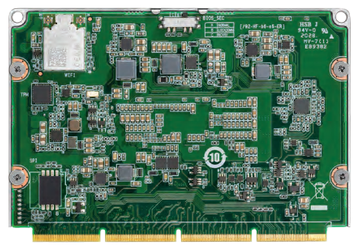
Intel® NUC 11 Compute Elements

Intel® NUC 11 Compute Element (U-Series) is a compact system-on-a-card that forms the basis of a powerful modular computer ecosystem. Each Intel® NUC 11 Compute Element comes with a processor, memory, and a suite of I/O options, in a tiny package. The NUC 11 Compute Elements are offered with a complete range of Intel® brand processors.

Intel NUC 11 Compute Element Features

- Intel® Wi-Fi 6 AX201 soldered-down, 802.11ax 2x2 2.4Gbps + Bluetooth 5.1
- 4 to 16GB soldered-down, dual-channel LPDDR4X memory on core SKUs
- Discrete TPM 2.0 device (on SKUs with Intel® vPro™ technology only)
- I/O supported by the card-edge consolidated connector: 4 x USB 3.2 Gen 2, 3 x USB 2.0, 2 x DDI (configurable as DP 1.4a or HDMI 2.0b), 1 x Type C (DDI/ TBT/USB3.1), 1 x eDP 1.4b, 1 x GbE PHY, 1 x PCIe x4/ SATA, 1 x PCIe x4 (Gen4), 1 x PCIe x1, 1 x HD Audio, eSPI (EC interface)
- Support for up to quad 4k@60Hz displays (triple DDI plus eDP interfaces) on
- Generation agnostic heat-spreader thermal interface
- Supports integration into both stationary and mobile system designs
- Module dimensions: 95 x 65 x 6 mm
- No moving parts
- Qualified for 24x7 operation
- Three-year product life cycle
- Three-year warranty



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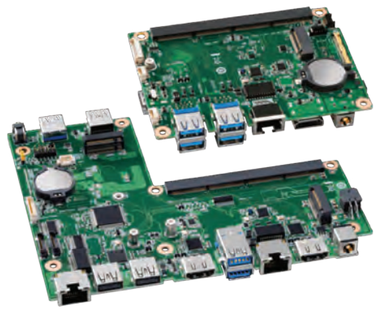
Intel® NUC 8 Rugged Chassis Element (U-Series)

The Intel® NUC Rugged Chassis Element is designed for harsh and extreme environments with one of three integrated rugged boards. Available in three chassis designs with integrated I/O board: Expandable, dual LAN, and multi HDMI.

Intel® NUC 8 Rugged Chassis Element Features:

- Requires Intel® NUC Compute Element
- Fanless, dust-resistant chassis with I/O board installed; preliminary IP50 rating
- Design implementation: Expandable (CMCR1ABA)
- Dual M.2 22x80 key M slots for PCIe x4 NVMe and SATA SSDs
- Two HDMI 2.0a ports with built-in CEC, plus internal 4-lane eDP interface
  - Support for dual 4k@60Hz via HDMI 2.0a, plus additional 4k@60 via eDP
- Intel® Optane™ Memory H10 with solid state storage ready
- Intel® i219-LM 10/100/1000 Mbps RJ45 Ethernet
- 1x front and 2x rear USB 3.2 Gen 2 type-A ports, 1x internal USB 3.2 Gen 1 header
- 1x front type A and 2x internal USB 2.0 headers
- 2x RS232 serial port headers
- Up to 7.1 multi-channel (or dual 8-channel) digital audio via HDMI
- Front panel header (with Vcc5/1A, 5Vsby2A, 3.3Vsby/1A)
- Qualified for 24x7 operation
- Delayed AC start; DC overvoltage protection
- Display emulation (headless display, virtual display, persistent displays)
- 12 — 24VDC rear jack, internal 2x2 power connector
- Metal chassis, Kensington lock with base security, 0~40^{0}C external ambient operating temperature
- Microsoft Windows* 11, Microsoft Windows* 10, Windows 10 IOT Enterprise, compatible with various Linux distros
- Individual brown-box packaging
- Three-year product life cycle
- Three-year warranty



Intel® NUC Pro Chassis Element (U-series)

The Intel® NUC Pro Chassis Element is a modular chassis built for an Intel® NUC Compute Element (U-Series). The chassis element offers the ports and performance for corporate and collaboration solutions. Available in two designs: Base for most collaboration environments and video capture and audio where more I/O is needed.

Intel® NUC Pro Chassis Element Features:

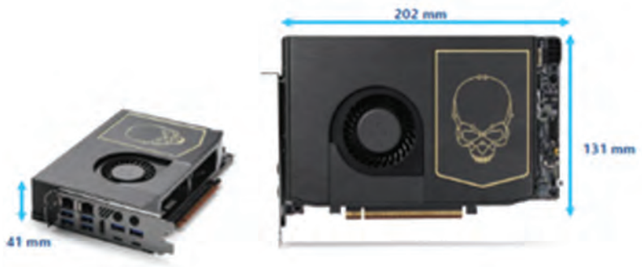
- Requires Intel® NUC Compute Element
- Actively-cooled chassis with I/O board installed
- Two design implementations: Base (CMCM2FB), video capture & audio (CMCM2FBAV)
- Dual M.2 22x80 key M slots for PCIe x4 NVMe and SATA SSDs
- Two HDMI 2.0a with built-in CEC, support for dual 4k@60Hz
- Intel® Optane™ Memory H10 with solid state storage ready
- Intel® i219-LM 10/100/1000 Mbps RJ45 Ethernet; 2nd Intel® i211-AT 10/100/1000 Mbps RJ45 Ethernet
- 1x front and 2x rear USB 3.2 Gen 2 type-A ports
- 1x front and 2x rear USB 2.0 type-A ports
- Up to 7.1 multi-channel (or dual 8-channel) digital audio via HDMI
- Qualified for 24x7 operation; delayed AC start; DC overvoltage protection
- Display emulation (headless display, virtual display, persistent displays)
- 12 — 24V_{DC} rear jack
- Metal chassis, Kensington lock with base security, 0~350C external ambient operating temperature
  - 19V_{DC} 90W power supply adapter with geo-specific AC cords (IEC C5 connector)
  - VESA mounting plate included
  - Internal Wi-Fi and Bluetooth antennas
  - Chassis dimensions: 200 x 145 x 35 mm (w/ rubber feet)
- Microsoft Windows* 11, Microsoft Windows* 10, Windows 10 IOT Enterprise, compatible with various Linux distros
- Individual brown-box packaging
- Three-year product life cycle, Three-year warranty
- Video capture & audio version additional features
- HDMI video capture up to 1080p with HDMI passthrough
- 3.5mm audio in and out jacks

Intel® NUC 12 Extreme Compute Element (H-series)

The innovative and power-packed Intel® NUC 12 Extreme Compute Element features 12th Gen Intel® Core™ processors and cutting-edge technologies including 10Gb Ethernet, Intel® Wi-Fi 6E, and Thunderbolt™. Along with the latest Intel® Core™ i9/i7 processors, the Intel NUC 12 Extreme Compute Element offers up to 64GB dual-channel memory. For the first time, 10Gb Ethernet comes standard, bringing workstation-level networking to consumer gaming.

Intel® NUC 12 Extreme Compute Element Features:

- Dual-channel DDR4-3200 SODIMMs, 1.2V, 64GB max
  - ECC RAM supported on NUC 12 Pro X SKUs
- PCIe 5.0 x16 Gold Finger
- 3 x M.2 key M slots:
  - 1 x 80 CPU-attached PCIe x4 Gen4 NVMe
  - 2 x 42/80 PCH-attached PCIe x4 Gen4 NVMe or SATA3 SSD
  - RAID-0 and RAID-1 capable
- Intel® Optane™ SSD and Intel® Optane™ Memory M10, H10, and H20 ready
- HDMI 2.0b connector
- 2 x Thunderbolt™ 4 ports
- Supports 3 x 4K displays (Intel® UHD graphics)
- Intel® 2.5Gbe LAN (i225-LM) on select SKUs
- 10Gbe LAN (AQC113)
- Intel® Wi-Fi 6E AX211, 802.11ax 2x2 2.4Gbps w/6GHz + Bluetooth v5.2, dual internal antennas
  - M.2 2230 key E slot
- 6 x USB 3.2 Gen2 type-A connectors
- Up to 7.1 multi-channel digital audio via HDMI or DisplayPort signals
- 2 x USB 3.1 headers, 2 x USB 2.0 headers
- Microsoft Windows* 11 logo, compatible w/Windows Server 2019; compatible w/various Linux distros
- Individual retail or bulk packaging
- Three-year warranty



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Intel® NUC 12 Extreme

The Intel® NUC 12 Extreme is designed to scorch the competition with 12th Gen Intel® Core™ processors and support for up to 12-inch dual-slot graphics cards — with a PCIe x16 Gen 5 slot to support next-gen discrete graphics.

Intel® NUC 12 Extreme Features:

- Pre-installed Eden Bay Compute Element:
  - Dual-channel DDR4-3200 SODIMMs, 1.2V, 64GB max
  - 3 x M.2 key M slots: 42/80 CPU-attached PCIe X4 Gen4 NVMe, 2 x 42/80 PCH-attached PCIe x4 Gen4 NVMe or SATA3 SSD, RAID-0 and RAID-1 capable
  - Intel® Optane™ SSD and Intel® Optane™ Memory M10, H10, and H20 ready
  - HDMI 2.0b connector
  - 2 x Thunderbolt™ 4 ports
  - Supports 3 x 4K displays (Intel® UHD graphics)
  - Intel® 2.5Gb (i225-LM) on select SKUs
  - 10GbE LAN (AQC113)
  - Intel® Wi-Fi 6E AX211, 802.11ax 2x2 2.4Gbps w/6GHz + Bluetooth v5.2, dual internal antennas
  - 6 x USB 3.2 Gen2 type-A connectors (rear) • Up to 7.1 multi-channel digital audio via HDMI or displayPort signals
- Dragon Canyon chassis:
  - PCIe X16 Gen5 slot with 8 pin & 2x6+2-pin PCIe power connectors, up to 350W, up to 12” card length, dual-slot capable
  - SDXC slot with UHS-II support
  - 1 x USB 3.2 Gen2 type-A (front)
  - 1 x USB 3.2 Gen2x2 type-C (front)
  - 3.5mm front stereo headset jack
  - 357 x 189 x 120 mm (~8L)
  - 650W 80+ Gold internal power supply with geo-specific C13 AC cords
- Microsoft Windows* 11 logo, compatible w/ Windows Server 2019; compatible w/various Linux distros
- Three-year warranty

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Intel® NUC 11 Enthusiast

Take gaming to the next level with the ultra-sleek, super-small Intel® NUC 11 Enthusiast mini PC and kit. Powered by an 11th Gen Intel® Core™ i7 processor with NVIDIA® GeForce RTX™ 2060 discrete graphics, these 1.3-liter systems deliver commanding performance while taking up just a sliver of desk space.

Intel® NUC 11 Enthusiast Features:

- NVIDIA® GeForce® RTX2060 discrete graphics w/6GB GDDR6
  - HDMI 2.0b port
  - Mini DisplayPort 1.4 port
  - Dual-channel DDR4-3200 SODIMMs, 1.2V, 64GB max
- M.2 22x80/110 PCIe x4 Gen3 NVMe and M.2 22x80 key M slots PCIe x4 Gen3 NVMe or SATA3 SSDs
- Intel® Optane™ Memory M10 and H10 ready
- Front and rear Thunderbolt™ 4 ports (Intel® Iris™ Xe graphics) with 5V/9V fast phone charging profiles
- Intel® 2.5Gb (i225-LM) Ethernet port
- Intel® Wi-Fi 6 AX201, 802.11ax 2x2 2.4Gbps + Bluetooth 5.2, with internal antennas
- 2 x front, 4 x rear USB 3.2 Gen2 ports, and 2 x USB 2.0 via internal headers
- SDXC slot with UHS-II support
- Up to 7.1 multi-channel digital audio via HDMI or DisplayPort signals
- 3.5mm front stereo headset jack, 3.5mm rear speaker/ TOSLINK combo jack
- Beam-forming, far-field, quad-mic array, with Alexa support
- Front consumer infrared port
- Plastic with metal inner frame, replaceable lid, Kensington lock with base security
- 221 x 142 x 42 mm (~1.3L)
- RGB-backlit top lid skull logo, with user-replaceable mask
- Microsoft Windows* 11, Microsoft Windows* 10 logo'd, compatible with various Linux distros
- Vertical stand included
- Three-year warranty

Intel® NUC 11 Pro

Intel® NUC 11 Pro mini PCs, kits, and boards are compact systems built to drive the future of business. 11th Gen Intel® Core™ processors and Intel® Iris® Xe graphics deliver breakthrough performance for edge compute, office productivity, and collaboration, plus support for up to four 4K displays.

Select SKUs feature Intel vPro® technology for remote manageability, hardware enhanced security features, and platform stability. And every system is tested by Intel for 24x7 sustained operation and features a three-year warranty and three-year product lifecycle to deliver years of nonstop business performance.

Features:

- Intel® Iris® Xe graphics or Intel® UHD graphics
- Up to 64GB of ultra-fast dual-channel DDR4-3200 memory
- Intel® i225-LM Ethernet for speeds up to 2.5 Gbps Intel® Wi-Fi 6 AX2011
- Up to quad extended displays via dual HDMI with built-in CEC per port, and dual DisplayPort via Thunderbolt™ ports
- M.2 22x80 M-key slot for up to Gen 4 NVMe SSD and M.2 22x42 B-key slot for SATA SSD, PCIe x1 or USB 3.2 expandability
- Tolerates 0-40° C external ambient operating temperature
- 3-year product availability

Intel® NUC 11 Pro

Intel® NUC 11 Pro mini PCs, kits, and boards are compact features systems built to drive the future of business. There are more choices than ever before, from fully built mini PCs to customizable kits powered by the full range of 11th Gen Intel® Core™ processors. All are designed to deliver the performance businesses need for edge compute, office productivity, and collaboration.

Intel® NUC 11 Pro Features:

- Up to quad extended displays:
  - Dual HDMI 2.0b (4K@60Hz), with built-in CEC per port
  - Dual Thunderbolt™ ports (incl. DP 1.4a and USB 4) via back panel type-C connectors (select SKUs only)
- M.2 22x80 key M slot for PCIe x4 Gen 4 NVMe SSD
- M.2 22x42 key B slot for PCIe x1 Gen 3, USB 3.2 Gen 2, USB 2.0 and SATA SSD expandability
- Intel® i225-LM 10/100/1000/2500 Mbps RJ45 Ethernet
- Support for 2nd LAN (Intel® 2.5GbE) and 2x additional USB 2.0 ports via internal expansion option (tall kits only) [2nd LAN/USB expansion module to be available separately, not included with NUC]
- Intel® Wi-Fi 6 AX201 vPro (i7 vPro and i5 vPro kits), non-vPro (other kits) on M.2 slot
- Dual-channel DDR4-3200 SODIMMs, 1.2V, 64GB max.
- 2 x front and 1 x rear USB 3.2 Gen 2 type-A ports
- 1 x RS232 serial port header
- Up to 7.1 multi-channel (or 8-channel) digital audio on HDMI and DP type-C ports (select SKUs only)
- Front panel header (with Vcc5/1A, 5Vsby2A, 3.3Vsby/1A)
- Qualified for 24x7 operation
- Delayed AC start; auto CMOS reset; DC transient voltage suppression
- Display emulation (headless display, virtual display, persistent displays) via HDMI
- 12 – 20V_{DC} ±5% (reduced from 24V_{DC}) DC input on rear jack, internal 2x2 power connector, with OVP/UVP
- Matte textured chassis, replaceable lid, Kensington lock with base security, Cable locking arm
  - Tall kit only: 2.5" drive bay (7mm), and internal expansion bay via back panel (DB9 punched bracket, or 2nd LAN and 2 x additional USB 2.0 ports on expansion card)
- "Tall" H chassis: 117 x 112 x 54 mm; "Slim" K chassis: 117 x 112 x 37mm; Board: 104 x 102 mm
- Microsoft Windows 11, Windows 10 (logo'd), Windows 10 IOT Enterprise
- Compatible with various Linux distros
- Three-year availability, three-year warranty

Intel® NUC 11 Performance

With their boundary-breaking performance, modern design, and cutting-edge features, Intel® NUC 11 Performance mini PCs and kits usher in the new age of small-compute innovation.

Small and attractive, the Intel NUC 11 Performance mini PCs and kits feature a range of 11th Gen Intel® Core™ processors to accelerate everyday home theater and home office tasks. Revolutionary Intel® Iris® Xe graphics make every experience more immersive and fun — from binging shows in 4K UHD to playing arcade games, creating content, and multitasking across up to four screens.

Intel® NUC 11 Performance Features:

- Dual-channel DDR4-3200 SODIMMs, 1.2V, 64GB max
- M.2 22x80 key M slot, PCIe x4 Gen4 NVMe or SATA3 SSDs
- HDMI 2.0b, mini displayport 1.4 ports
- Quad display and 8K support
- Front and rear Thunderbolt™ 3 ports with 5V/9V fast phone charging profiles
- Intel® 10/100/1000/2500 Mbps (i225-V) ethernet port
- Intel® Wireless-AX 201, 802.11ax 2x2 2.4Gbps + Bluetooth 5.2, with internal antennas
- 2x front, 2x rear USB 3.2 Gen2 ports, USB 3.2 Gen1, USB 2.0 ports via internal headers
- SDXC slot with UHS-II support
- Up to 7.1 multi-channel digital audio via HDMI, displayPort, or Thunderbolt™ 4 signals
- 3.5mm front stereo headset jack
- Front consumer infrared port
- Plastic with metal inner frame, replaceable lid, Kensington lock with base security
- "Tall" H chassis: 117 x 112 x 51 mm, w/2.5" 7mm SATA3 bay and port
- 19VDC input, 120W (Core™ i7, i5) or 90W power supply with geo-specific C5 AC cords
- Microsoft Windows* 11, Microsoft Windows* 10 logo'd, compatible with various Linux distros
- Three-year warranty

Intel® NUC 11 Essential

Intel® NUC 11 Essential mini PCs, kits, and boards are the essential, everyday solution for kiosks, collaboration and streaming, and digital signage. Powered by Intel® Pentium® Silver or Celeron® processors, these systems deliver Intel reliability and quality in a slim, cost-efficient design.

Intel® NUC 11 Essential Features:

- Dual-channel DDR4-2933 SODIMMs, 1.2V, 32GB maximum
- 1x HDMI 2.0b and 1x displayport 1.4, both ports support HDCP 2.2
- Supports 2 x 4K displays
- M.2 22x80 key M slots for PCIe x2 NVMe and SATA SSDs
- Select SKUs with 64GB eMMC storage
- 10/100/1000 Mbps ethernet
- Intel® Wireless-AC 9462 m.2 card, dual-band 1x1 w/ diversity + Bluetooth v5.1, internal antennas
- 2x front USB 3.2 Gen 1, 2x rear USB 3.2 Gen 2, and 2x rear USB 2.0
- Up to 7.1 multi-channel digital audio via HDMI
- 3.5mm front stereo jack, 3.5mm front microphone jack
- Plastic with metal inner frame, kensington lock with base security
- 135 x 115 x 36 mm
- $19V_{DC}$ 65W power supply with geo-specific C5 AC cords
- Microsoft Windows* 11 logo'd; compatible with various Linux distros
- External 9-pin font panel header
- Mounting options: picture frame keyholes, mounting indentations for cable ties, mounting to VESA bracket (not included)
- Three-year product life cycle
- Three-year warranty

Intel® NUC P14E Laptop Element

The Intel® NUC P14E Laptop Element is the first with modular compute, so you can sell at your pace, based on supply and demand, to reduce inventory costs and meet customer demand.

Simply add an Intel® NUC 11 Compute Element with your choice of Intel® processors to the laptops, along with OS and storage. When it's time to upgrade or refurbish, it's easy and inexpensive to integrate the next generation of Intel® NUC Compute Element.

Intel® NUC P14E Laptop Element Features:

- 13.9" CNC anodized aluminum chassis in dark gray
- Narrow bezel IPS 3:2 ratio, 3000x2000 pixel, 400nit, 100% sRGB, w/ touch
- Up to 11th generation Intel® Core™ i7-1185G7 processor (from Elk Bay)
- Up to 12th generation Intel® Core™ i7-1265U processor (from Hard Bay)
- Dual-channel 4GB to 16GB LPDDR4x dual-channel memory (from Elk Bay)
- Dual-channel 8GB to 32GB LPDDR5 dual-channel memory (from Hard Bay)
- 1 M.2 22x80 slot for PCIe x4 Gen4 NVMe
- Full-Size HDMI 2.0b port and mini DP displayport 1.4a
- 1 Thunderbolt™ 4/USB 4 type-C port
- Wired gigabit ethernet (RJ45)
- Intel® Wi-Fi 6 AX201, 802.11ax 2x2 2.4Gbps + Bluetooth 5.2 (from Elk Bay)
- Intel® Wi-Fi 6E AX211, 802.11ax 2x2 2.4Gbps w/6GHz + Bluetooth 5.2 (from Hard Bay)
- 2 USB 3.2 Gen2 type-A ports
- Intel® HD premium audio
- Fingerprint reader
- Membrane backlit keyboard w/pointing stick
- RGB light bar with support for personal assistant
- Glass click pad with Microsoft* precision drivers
- 77Whr battery with fast charging support
- 16.5 mm thin, 1.5kg
- L4 SKUs — requires compute element, storage, and OS
- Microsoft Windows* 11, Microsoft Windows* 10
- Compact 65W USB-C power adapter with USB-IF certification and geo-specific C5 AC cords
- MIL-STD-810G tested
- Two-year warranty (One-year battery warranty)

Support for Intel® NUC Compute Element (U-series)
All Elk Bay and Hard Bay Compute Elements are supported in Camden County
(Core i7 vPro, Core i7, Core i5 vPro, Core i5, Core i3, Celeron)

EXOR Embedded concentrates in Embedded Computer Systems based on Arm architecture which are used in many different professional environments. As one of the most innovative suppliers in the field, we offer our customers know-how and expertise in the areas of electronic system development with BSP, Linux, Yocto, and Codesys, system integration with support for protocol integration, and cloud connectivity, and the production of final almost-finished electronic products.

Services

- Hardware design
- FPGA and software development
- Cloud and application

Key Strengths and Value Proposition

- From hardware to cloud tailored solutions
- Arm, FPGA, and x86 hardware design
- BSP and software customizations

FPGA and x86 System on Modules platform. Linux BSP, communication protocols, QT app, cloud

Product Category	Processors Supported	Product Family Names	Software/Firmware Available
System on Modules	ARM, FPGA, x86	US, nS, GS	Linux, Yocto/Jmobile/Codesys
Single Board Computers	ARM, FPGA, x86	OPenHMI SBC	Linux, Yocto/Jmobile/Codesys
Boxed Products	ARM, FPGA, x86	eXware, eX7xx	Linux, Yocto/Jmobile/Codesys
Development Kits	ARM, FPGA, x86	EE16EK family	Linux, Yocto/Jmobile/Codesys

Featured Solutions

gS02 System on Module

- Dimensions 81.6 x 54 x 4.9 mm
- Temperature range -20°C to 70°C
- CPU Intel® Elkhart Lake™ X6427FE Quad-core
- FPGA Intel® Cyclone® 10 GX up to 220 KLE
- DDR LPDDR4 up to 16 Gbytes for CPU and DDR3 up to 2 Gbytes for FPGA
- Flash memory up to 64 Gbytes eMMC Flash for CPU, 1 Gbit QSPI Flash for FPGA

GS02-0001

eX707AI — Industrial AI Gateway

Powerful Industrial EXOR Edge AI device based on Intel® Apollo Lake E3940 4 Core and Intel® Cyclone® 10 GX FPGA. Ideal for computation-intensive edge applications where Corvina Edge Field Analytic and Machine Learning are requirements, as well as Factory orchestration of microservice architecture, virtualized edge logic (PLC), and Corvina Edge Visualization. Supports also OPC UA over TSN. In addition, using Jmobile software, the product can integrate with most industrial devices thanks to its 200 brownfield protocols. It has an HTML interface and powerful gateway functions and IEC 61131 PLC that can integrate with networked I/O, public cloud, and Corvina Cloud secure remote connection.

eX707AI

iWave Systems, a global leader in embedded computing platforms has been enabling companies across the globe in product development journey. With an extensive portfolio of system on modules, single board computers and ODM Solutions and a strategic focus in the automotive, industrial, medical and avionics verticals, iWave is driven by the mission to be a trusted embedded technology partner.

Services

- Carrier board design, software and hardware customization
- Product lifecycle management
- Manufacturing and production – procurement/supply chain, production control
- Certifications: CE, FCC, UL, RoHS, REACH, KOMINFO, GCH, E-MARK

Key Strengths and Value Proposition

- Vast portfolio of system on modules and single board computers
- Experience engineering team and a dedicated support ecosystem
- Product longevity and lifecycle management

Core Offerings

System on Modules, Single Board Computers, Thermal Solutions, Telematics & HMI Solutions, FPGA IP Cores

Product Category	Processors Supported	Product Family Names	Software/Firmware Available
System on Modules	Stratix® 10 SX850 to SX2800, Stratix® 10 GX850 to GX2800 Agilex™ AGI027, AGI022, AGF027, AGF022 Arria® 10 SX270 to SX660, Arria® 10 GX270 to GX1150	Custom	Linux, Quartus
Development Kits	Stratix® 10 SX850 to SX2800, Stratix® 10 GX850 to GX2800 Agilex™ AGI027, AGI022, AGF027, AGF022 Arria® 10 SX270 to SX660, Arria® 10 GX270 to GX1150	Custom	Linux, Quartus

Featured Solutions

Stratix® 10 SX & GX Series System On Modules

- Quad Core 64bit Arm® Cortex-A53 with MPU
- SX/GX - 850, SX1100, SX1650, SX2100, SX2500, SX2800
- Up to 2753K logic elements & 9,33,120 ALMs
- 8GB DDR4 for HPS & 2 x 8GB DDR4 for FPGA, 32GB eMMC
- 16 GXT transceiver channels up to 28.3Gbps
- 32 GX transceiver channels up to 17.4Gbps
- FPGA IO's – Up to 114LVDS/229SE

iW-RainboW-G45M

Arria® 10 SX & GX Series System On Modules

- Arm® Cortex-A9
- SX 270, SX320, SX480, SX570, SX660
- GX270, GX320, GX480, GX570, GX660, GX900, GX1150
- High speed transceivers x 24 @ 17.4 Gbps
- 2GB DDR4 for HPS & 4GB DDR4 for FPGA
- ULPI transceiver
- Gigabit Ethernet, USB2.0 OTG, SPI, etc.

iW-G24M-CU2F-4E002G-S008G-BEI (SX 480)
iW-G24M-CU2F-4E002G-S008G-BIK (SX660)

We operate as a provider of development services for the electronics industry since 1992. Our service includes design-in support as well as turnkey designs which typically covers all steps from product specification, hard- and software design up to prototyping and production. Many of our products are compatible with some widespread form factors. We are also specialized in customization.

Services

- Rapid prototyping
- Engineering expertise focused on embedded systems in industrial environments
- Extended device life cycle

Key Strengths and Value Proposition

- Custom electronic design service
- FPGA and SoC modules
- Electronic manufacturing service

Core Offerings

Product Category	Processors Supported	Product Family Names	Software/ Firmware Available
System on Modules	Intel® MAX 10, Intel® Cyclone® 10 LP, Cyclone® 5 (SoC), Cyclone® 10 GX, Stratix® 10 (SoC), Intel® Agilex™	TEIxxxx	Yes

Featured Solutions

Entry Level Stratix® 10 FPGA - System on Module

- Stratix® 10 FPGA: 1SG040HH3F35I3VG size 378kLE, DSP, multiplier
- PCIe Gen3 x16
- High Performance IOs: 96 (48 LVDS)
- High Voltage IOs: 48, HPS/CPU IOs: 48
- Gigabit Transceiver: 18 @17.4Gbps
- Gigabit Transceiver clocks: 6
- DDR4 32 Bit – 8Gbit
- SPI Flash
- 3 x 240 BGA connector
- Industrial temperature range
- Mechanical size*: ~6 cm x 8 cm

Stratix 10 SoM - TEI1000*

* Photo show similar SoM, features/size tbc.

MAX1000 with Intel® MAX® 10 FPGA

- Intel® MAX® 10 FPGA: 8 kLE, 378 Kb block memory, 18 x 18 multipliers -> 24, integrated boot flash, internal ADC
- 8 MByte SDRAM
- 2 MByte flash
- LIS3DH 3-axis sensor
- 21 I/O Arduino MKR compatible headers
- Pmod: 2x6 pin support
- 8 x user LEDs, 1 x user push button
- 5.0 V single power supply with on-board voltage regulators
- Onboard Arrow USB-Programmer2

MAX1000

CYC1000 with Intel® Cyclone® 10 LP FPGA

- Intel® Cyclone® 10 LP FPGA: 25 kLE, 66 memory blocks (9K), 594 memory blocks (Kb), 18 x 18 multipliers -> 66
- 8 MByte SDRAM
- 2 MByte flash (EPCQ16A)
- LIS3DH 3-axis sensor
- 21 I/O Arduino MKR compatible headers
- Pmod: 2x6 pin support
- 8 x user LEDs, 1 x user push button
- 5.0 V single power supply with on-board voltage regulators
- Onboard Arrow USB-Programmer2

TEI0003

CYC5000 with Intel® Cyclone® V FPGA

- Intel® Cyclone® V FPGA: 25 kLE, 176 memory blocks (M10k), 18 x 18 multipliers -> 50, hard memory controller
- 8 MByte SDRAM
- 2 MByte flash
- 21 I/O Arduino MKR compatible headers
- CRUVI HS standard connector: 12 LVDS lanes + 12 IOs
- 8 x user LEDs, 1 x user push button
- Onboard Arrow USB-Programmer2

TEI0050

Micron® Flash Memory Support for Intel® FPGA Platforms

Save yourself time and money — Micron memory comes *validated* on Intel FPGA platforms

		Code and Data Storage						Configuration		
Micron Flash		SPI NOR		NAND		e.MMC		SPI NOR[1]	Parallel NOR[2]	NAND[2]
	Family	MT25QL	MT25QU	MT29F		MTFC		MT25Q	MT28EW	MT29F
	Density	128MB-1GB	128MB-2GB	1GB-32GB		2GB-128GB		128MB-2GB	128MB-1GB	1GB
	Voltage	3V	1.8V	3V	1.8V	3V		1.8V or 3V	1.8V, 3V	1.8V, 3V
	Read Speed	Up to 133 MHz	166 MHz	Asynch		4.41/4.51/5.0/5.1 SDR/ DDR 52 MHz, HS200, HS400		166/133 MHz	Random Access 75ns/70ns	Read Cycle Time 20ns
	Width	x1, x2, x4		x8		x1, x4, x8		x1, x2, x4	x8, x16	x8
	Temperature/Grade	Industrial, Automotive				Automotive, Industrial, Wireless		Industrial, Automotive		
	Packages	S08W, S016, DFN, BGA		TSOP, BGA		100/153/169-ball BGA		S08W, S016, DFN, BGA	TSOP, BGA	
Intel FPGA Family	**Intel® Agilex™**									
	Intel® Agilex™ FPGA							√		
	Intel® Agilex™ SoC		√		√	√		√		
	Stratix®									
	Intel® Stratix® 10 FPGA							√	√	√
	Intel® Stratix® 10 SoC		√		√[3,4]	√		√	√	
	Arria®									
	Intel® Arria® 10 FPGA							√	√	√
	Intel® Arria® 10 SoC		√		√[4]	√				

Please verify exact configuration and specification with your Intel or Micron representative.
P. Pending validation.
1. Active or passive configuration; see Note 2 for passive configuration details.
2. Passive configuration only; PFL + CPLDs (Max II and Max V devices).
3. Also supports x16. 4. On-die ECC disabled.

Micron® DRAM Memory Support for Intel® FPGA Platforms

Save yourself time and money — Micron memory comes *validated* on Intel FPGA platforms

		DDR4	DDR3	DDR3L[1]	DDR2		LPDDR2	LPDDR3	RLDRAM®3	RLDRAM®2
Micron DRAM	Family	MT40A	MT41J	MT41K	MT47		MT42	MT52	MT44	MT49
	Density	8GB/16GB	1GB, 2GB, 4GB	1GB, 2GB, 4GB/8GB	1GB, 2GB		512MB, 1GB, 2GB, 4GB, 8GB, 16GB	8GB, 16GB, 32GB	576MB, 1GB	288MB, 576MB
	Voltage (Core)	1.2V	1.5V	1.35V/1.5V	1.5V		1.2V		1.35V	1.8V
	Speed[2]	625-1600 MHz	400-1066 MHz	400-1066 MHz	200-533 MHz		333-400 MHz	800-933 MHz	800-1066 MHz	300-533 MHz
	Width	x8, x16					x32		x18, x36	
	Temperature/Grade	Commercial, Industrial, Automotive					Commercial, Industrial, Automotive	Wireless (-30°C to 85°C)	Commercial, Industrial	
	Packages/Modules	UDIMM, RDIMM, LRDIMM, SODIMM, BGA					BGA, PoP		BGA	
Intel FPGA Family	**Intel® Agilex™**									
	Intel® Agilex™ FPGA	√							√	
	Intel® Agilex™ SoC	√							√	
	Stratix®									
	Intel® Stratix® 10 FPGA	√[3]	√[3]	√[3]					√	
	Intel® Stratix® 10 SoC	√	√	√					√	
	Arria®									
	Intel® Arria® 10 FPGA	√[3]	√[3]	√[3]			√	√	√	
	Intel® Arria® 10 SoC	√	√	√					√	

Please verify exact configuration and specification with your Intel or Micron representative.
P. Pending validation.
1. DDR3L is compatible with operation at 1.5V. Note that some density and speed combinations may be available only as 1.35V part numbers, but these meet the specification for operation at 1.5V.
2. The maximum memory speed is dependent on the maximum frequency supported by the FPGA family. See the FPGA family data sheet for the maximum speeds.
3. x4 width supported.

Micron® DRAM Memory Support for Intel® IoT Platforms

Save yourself time and money — Micron memory comes *validated* on Intel IoT platforms

	Form Factor	Density	Memory Configuration
Intel Atom® Processor			
Intel Atom® x6000E Series/Intel® Pentium® and Celeron® N and J Series Processor — **Elkhart Lake**	FBGA (memory down)*	8GB, 16GB, 32GB	LPDDR4x-4266 x32
	FBGA (memory down)*	8GB, 16GB	DDR4-3200 x16
Intel® Core™ i5 and Core™ i7 Processors			
11th Generation Intel® Core™ Processor — **Tiger Lake**	FBGA (memory down)*	16GB–128GB	LPDDR4x-4266 x32
		4GB, 8GB, 16GB	DDR4-3200 x8, x16
	SODIMM* UDIMM	4GB, 8GB, 16GB	DDR4-3200

Please verify exact configuration and specification with your Intel or Micron representative.
* These devices have lifecycles supported for 5 to 10+ years.

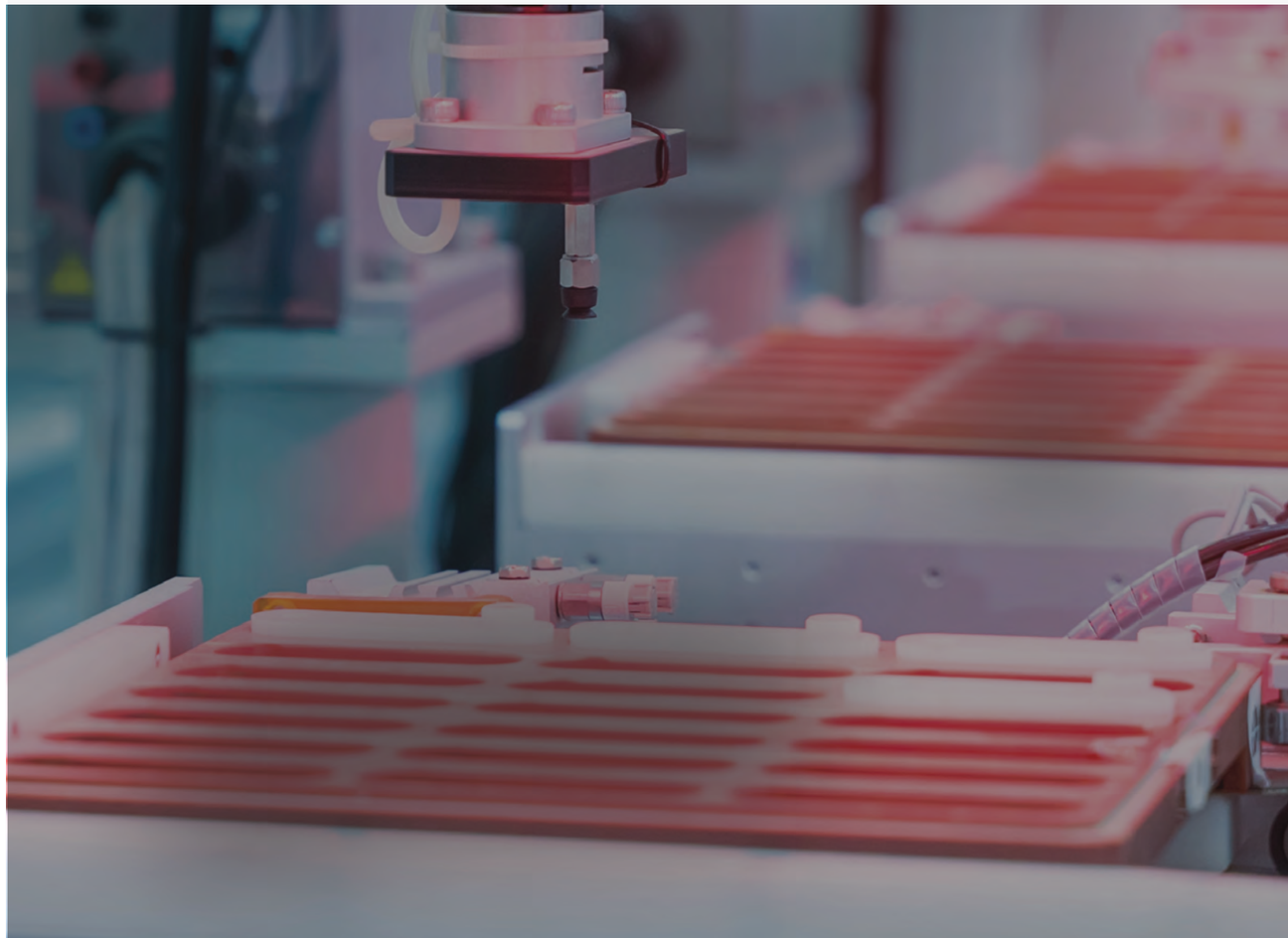
Micron® Flash Memory Support for Intel® IoT Platforms

Save yourself time and money — Micron memory comes *validated* on Intel IoT platforms

Micron Flash	SPI NOR		Managed NAND		
Family	MT25Q[1]	MT25Q-C (RPMC)	MTFC		2100AI
Density	128MB-2GB	128MB	16GB-128GB	2GB-8GB	64GB-1TB
Voltage	3V/1.8V		3V/1.8V		3V
Speed	108/133/166 MHz		eMMC 5.1[1]	eMMC 5.0/4.51/4.41	PCIe Gen3
Width	x1, x2, x4		x1, x4, x8		x4
Temperature/Grade	Industrial, Automotive		Industrial, Automotive, Wireless		Industrial, Automotive
Packages	SO8W, SO16, DFN, BGA	SO16, DFN, BGA, CSP	153/100-ball BGA	153/100/169-ball BGA	M.2, 16x20 BGA
Intel Atom® Processor					
Intel Atom® x6000E Series/Intel® Pentium® and Celeron® N and J Series Processor — **Elkhart Lake**			√		
Intel® Core™ i5 and Core™ i7					
11th Generation Intel® Core™ Processor — **Tiger Lake**	√	√			√

Please verify exact configuration and specification with your Intel or Micron representative.
1. EOL pending; please contact your Micron representative for details.
2. These devices have lifecycles supported for 5 to 10+ years.

Microchip FPGA, Security and Single-Pair Ethernet Solutions



TOC ⟶

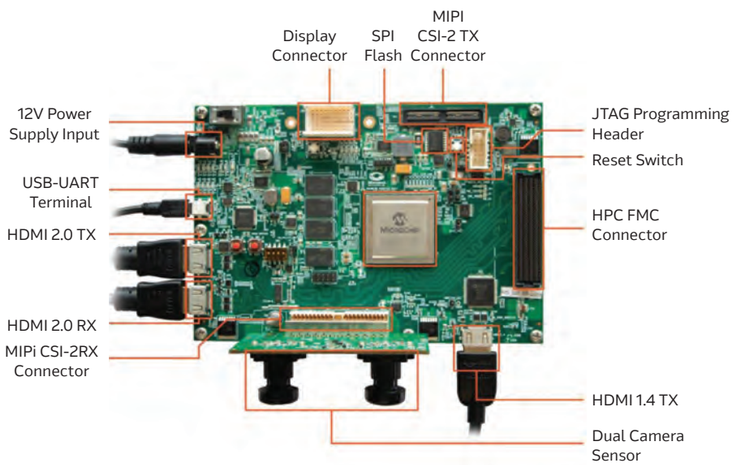
Imaging and Video Solutions for Smart Embedded Vision

As artificial intelligence moves to the edge, algorithms are required to be processed locally on a hardware device. Computation at the edge requires a device that can handle a sufficient workload, while maintaining low power because of thermal constraints.

Microchip provides FPGA imaging and video solutions to enable the evaluation of multiple protocols and the development of a host of image and video processing applications. As a best-in-class imaging and video platform, Microchip's solutions come with a complete ecosystem, including comprehensive application-specific hardware, optimized intellectual property suite for image processing, sample reference designs, demonstration designs and collateral.

PolarFire™ Video Kit (MPF300T-VIDEO-KIT-NS)

PolarFire™ Video Kit uses its numerous display interfaces and dual camera sensors to open new possibilities to implement systems that rely on visual data to make decisions across a broad spectrum of applications. Drones, Machine Vision, Thermal Imaging, Gaming, and Video Surveillance are all applications were having the ability to evaluate 4K image processing while maintaining low power can come in handy. The kit's interfaces e.g., MIPI CSI-2 TX, MIPI CSI-2RX, HDMI 1.4Tx help to make prototyping effortless in imaging and video spaces.



Features Include:

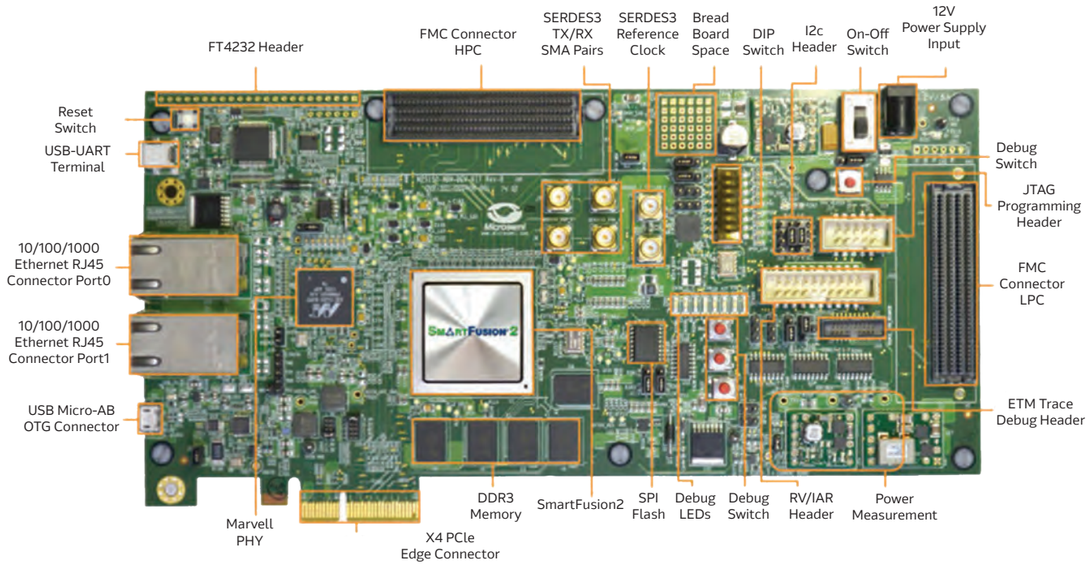
- 300K LE PolarFire FPGA in an FCG1152 package
- Sony dual camera sensor for stereo vision applications
- MIPI CSI2-RX @ 1.0 Gbps
- MIPI CSI2-TX @ 800 Mbps
- 4GB DDR4 @ 1.6 GBps
- HDMI 2.0 (4K @ 60fps), HDMI 1.4 (UHD @ 60fps)
- 3G/HD SDI, DSI, CSI-2 TX connector

Extensive Demonstrative Designs

- Picture-in-picture with two cameras
- Edge detection
- Alpha blending, brightness, contrast, colour balance ISP
- 4K resolution with third-party HDMI2.0 IP

SmartFusion®2 Advanced Development Kit

- SmartFusion®2 SoC FPGA 150K LE M2S150TS-1FCG1152
- MIPI CSI-2 sensor FMC: VIDEO-DC-MIPI
- Parallel sensor FMC: VIDEO-DC-PRL



Comprehensive IP Suite

The IP suite supports PolarFire™, SmartFusion®2, IGLOO®2 and radiation tolerant RTG4 product families.

- Sensor interface — MIPI CSI-2, Parallel
- Display control (LVDS and parallel RGB-HDMI)
- Source code in Verilog and VHDL* (requires licensing fee)

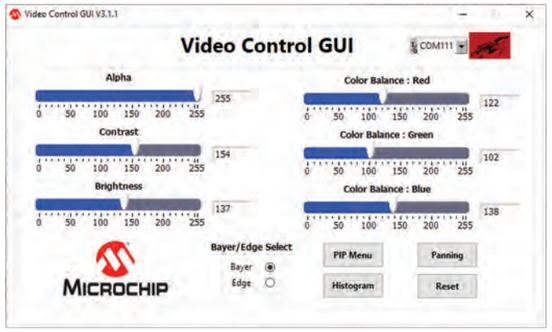
Available from our partners: HDMI2.0, HDCP 2.2, Display Port 1.4, SLVS, H.264, JPEG 2000, JPEG and JPEG-LS compression and CODEC cores.

*Verilog is only supported on source code for the SmartFusion®2/IGLOO®2 based solution.

Intuitive Software GUI

Enables video and audio configurations

- Source selectable picture-in-picture menu
- Alpha blending and overlay
- Image edge detection and enhancements - colour balance, brightness, contrast brightness, contrast



Which Device Family Best Suits Your Imaging Application?

Feature	PolarFire™	SmartFusion®2/IGLOO®2
Performance	– Transceivers@12.7G, DDR4@1.6G, CSI-2 Rx@1.0G, LVDS@1.6G – 1657 GMAC/s Max DSP performance	– Transceivers@5G, DDR2/3@0.667G, LVDS@0.7G – Targets lower resolutions
Resolution	Up to 4K (3840 x 2160)	Up to HD (1280 x 720)
Protocol Support	MIPI CSI-2 (RX, TX), HDMI 2.0, 3G SDI, DSI	MIPI CSI-2 (RX), HDMI 1.4
Speed and Frame Rate	– MIPI: RX at 4.8 Gbps (4 x 1.0 Gbps), TX at 3.2 Gbps (4 x 800 Mbps) – 4k @ 30 fps	– MIPI: RX only up to 700 Mbps, HS mode only – HD @ 30 fps

Ordering Information

Microchip Video and Imaging Solution	Product Order Code
PolarFire™ Video Kit	MPF300-VIDEO-KIT
SmartFusion®2 Advanced Development Kit	M2S150-DEV-KIT
Imaging and Video card with MIPI CSI-2 sensor module	VIDEO-DC-MIPI
Imaging and Video card with parallel sensor module	VIDEO-DC-PRL
Imaging and Video IP Suite RTL source	VDSOLCores-RM and VDSOLCores-RMFL

Use Microchip's non-volatile FPGAs to fulfil AI/ML & Embedded Vision needs

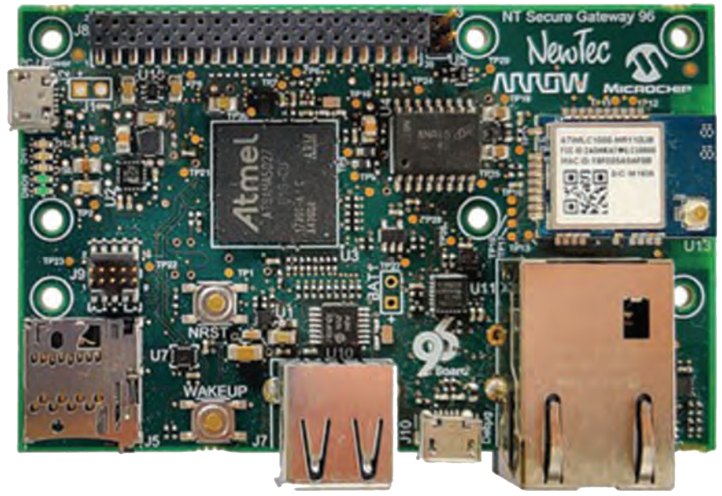
Shield96 Development Boards

Advanced Hardware Security for IoT at Scale

The Shield96 board is based on the Microchip devices and is available in two different forms. The shield 96 standard board and the shield 96 Trusted Platform.

The Shield96 Standard reference platform provides a secure solution applicable across all IoT verticals. This trusted Linux turn-key solution addresses hardware security by design. This hardware allows users the ability to design a solution as needed to fit their custom needs.

The Shield96 Trusted Platform comes preloaded with the EmSPARK™ Security Suite software by Sequitur Labs. This provides a secure platform applicable across all IoT verticals to enable secure end point solutions and protect firmware, keys, and data throughout the lifecycle of a product. EmSPARK™ is the essential software companion suite complementing the Microchip hardware providing a cost-effective secure solution appropriate for every connected device built with the Microchip 32-bit ATSAMA5D2 processor. Engineers can leverage this reference design for digital transformation built on trust extracting the full value of the advanced embedded security features of the ATSAMA5D2.



Security Features

- Secure firmware update
- Secure storage
- Tamper detection
- Managed key store and certified authority store
- Unique device ID, immutable, bound to the HWRoT
- Crypto engine in secure domain with OpenSSL adaptor
- AWS Greengrass Certified

Hardened Security Simplified

- Pre-configured to use ATSAMA5D2 security architecture
- Secure boot
- Strong domain partitioning
- On-the-fly memory encryption/decryption
- Hardware crypto engines
- Simple abstraction APIs for the hardware security features and preloaded keys and certificates
- Hardware enforced domain isolation (Arm® TrustZone®) for security related tasks, keystore and certificate management
- Secure provisioning provides firmware packaging for manufacturing and secure provisioning in non-secure facilities

Advanced Security Capabilities. Delivered.

- **Trusted boot** – Integrity and confidentiality assurance from the entire boot chain from bootloader to TEE to Linux kernel
- **Firmware protection** – Encryption of embedded firmware and execution of authenticated firmware
- **Trusted device ID** – Unique device certificate securely constructed through provisioning, protected by TrustZone
- **Secure storage** – Encrypted storage for application data and key material
- **Secure communications** – Strong security for TLS/SSL stack and mutual authentication
- **Secure firmware updates** – Predefined firmware update function complementing the trusted boot architecture

Software Package

- Single uSD-card image for getting started
- Based on Microchip Yocto BSP
- Linux-4.19
- Instant Wi-Fi hotspot
- SSH server, nginx web server, python3, docker and many more

Arrow Secure Programming and Provisioning Technology

Arrow's secure programming and provisioning technology is based on a highly secure and reliable chain of trust. Arrow electronics has the infrastructure, technology, and knowledge to enable customers of all sales and demand profiles to take full advantage of silicon-based security features. Provisioning of secure elements and crypto hardware enables precise identification and authentication of devices as well as excellent anti-counterfeiting and brand protection.

Fast Track to Single-Pair-Ethernet

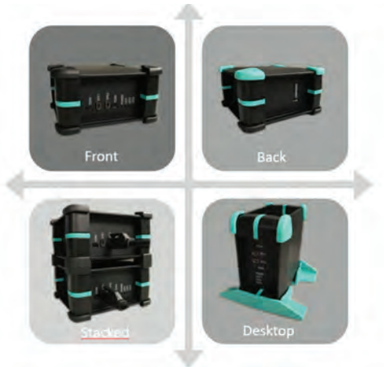
What Is Single Pair Ethernet?

Single Pair Ethernet (SPE) is an Ethernet network implementation that uses a unique physical layer (PHY) transceiver over a single pair of wires. SPE reduces system cost, weight and wiring complexity when compared to traditional Ethernet multi-pair CAT5 cabling. OSI network layers 2 to 7 remain the same across all the Ethernet physical layer types, eliminating additional software modification to implement SPE.

SPE enables continuous IP communication between server and cloud as well as power supply in complex IIoT solutions. SPE represents the next milestone in network technology and will revolutionize the market with reliable sensor-to-cloud communication.

Single-Pair-Ethernet: USB-To-10Base-T1S Kit

Arrow along with our partners Microchip and Phoenix contact, have developed a unique plug and play USB-To-Single Pair Ethernet Evaluation Kit. This kit is suitable for end applications such as Embedded PCs, Single Board Computers as well as industrial applications to communicate SPE (10Base-T1S) and for fast evaluation of 10Base-T1S Multidrop Technology.



Kit Contents

- USB Connector
- 10BaseT1S Phy Technology - LAN8670
- IEC 63171-2 SPE connectors - SPE-T1-STRM-90
- 1m SPE cable - SPE-T1-CCP-SF/1,0/AWG22/CCP-SF

UCS Enclosure

- Robust enclosure made of polycarbonate
- Enclosure part of the UCS enclosure system

UCS Accessories

- Wall mount
- Stands — desk top use
- Stackable

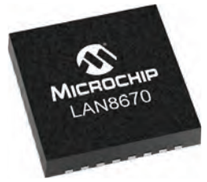
Driver Support

- Windows and Linux support

10BASE-T1S Single Pair Ethernet PHY

The Microchip LAN8670 is a compact, low power, and cost-effective single-port 10BASE-T1S Ethernet physical layer transceiver designed according to the IEEE

Std 802.3cg-2019TM specification. The device provides 10 Mbit/s half-duplex transmit and receive capability over single-balanced pair medium such as Unshielded Twisted Pair (UTP) cable. The LAN8670 is designed for use in applications requiring extended temperature range (-40°C to +125°C). The device is also compliant to industrial EMC and EMI requirements. The single power supply and simple analog front end simplifies its integration into small form factor applications.



SPE PCB connector — SPE-T1-STRM-90

SPE PCB connector, type: IEC 63171-2, degree of protection: IP20, number of positions: 2, 1 Gbps, CAT B (ISO/IEC 63171), connection method: THR solder connection, Single Pair Ethernet

Arrow Board and Box-level Solutions Powered by the NVIDIA Jetson Platform

Edge AI Use Cases Accelerates Digital Transformation

Artificial Intelligence (AI) infrastructure and the Internet of Things (IoT) are proliferating and evolving rapidly. IoT generates large quantities of data that are key to AI-based insights. These insights create new avenues for business transformation. Traditionally, complex AI computations have been performed in the cloud by aggregating data from end devices. The emergence of embedded AI is moving these compute loads from the cloud to the devices themselves.

The implementation of AI models on graphics processing units (GPUs) at the edge reduces the dependence on the cloud for data processing and ushers in a new paradigm of instantaneous insight. While data is still aggregated in the cloud for deep learning and model development, AI insights can be generated locally for more effective and timely actions.

Mass-Market Edge Systems Need AI

Edge computing is rapidly emerging as a technology innovation that can be widely adopted across industries. Edge meets local computing requirements as data is processed in micro-data centers. Applications that are process-intensive, involving advanced technologies like AI, ML, and IoT, have and continue to witness rapid development.

These applications consume huge loads of data for performing large-scale algorithms, creating a strong demand growth scenario for localized data storage, and computer network resources. IoT, IIoT, and increased adoption of technologies like AI and ML are thus supporting strong growth of edge computing. A growing number of smart city initiatives in countries across the world are also promoting growth for edge computing.

Network Video Recorder
200 million 1080p streams

Machine Vision/AOI
1 trillion product units per year require visual inspection

Home/Service Robots
175 billion hours per year on household chores (US)

AIOT
80% of Enterprise IoT projects will use AI by 2022

Global market for edge computing estimated at US$4 Billion in the year 2020, is projected to reach a revised size of US$17.8 Billion by 2026, growing at a CAGR of 27%.

The NVIDIA® Jetson™ Family

The Jetson family of modules all use the same NVIDIA CUDA-X™ software, and support cloud-native technologies like containerization and orchestration to build, deploy, and manage AI at the edge. With Jetson, customers can accelerate all modern AI networks, easily roll out new features, and leverage the same software for different products and applications. NVIDIA® Jetson™ brings accelerated AI performance to the Edge in a power-efficient and compact form factor. Together with NVIDIA JetPack™ SDK, these Jetson modules open the door for you to develop and deploy innovative products across all industries.

The NVIDIA® Jetson™ Family

For AI at the Edge and Autonomous Machines

Next Gen Jetson

Jetson Orin™ NX Series
100 TOPs (INT8)

10 - 25W
8GB/16GB
45mm x 70mm

Jetson AGX Orin™ Series
275 TOPs (INT8)

15 - 60W
32GB/64GB
100mm x 87mm

Entry	Mainstream		Autonomous Machines
Jetson NANO™ 0.5 TFLOPS (FP16)	**Jetson™ TX2 Series** 1.3 TFLOPS (FP16)	**Jetson Xavier™ NX Series** 6 TFLOPS (FP16) 21 TOPS (INT8)	**Jetson AGX Xavier™ Series** 11 TFLOPS (FP16) 32 TOPS (INT8)
			
5 - 10W 45mm X 70mm	7.5 - 15W* 45mm x 70mm 50mm x 87mm	10 - 20W 8GB/16GB 45mm x 70mm	10 - 30W** 32GB/64GB 100mm x 87mm

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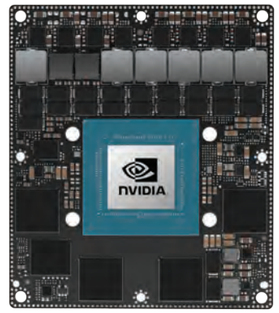
NVIDIA® Jetson AGX Orin™ Developer Kit

NVIDIA® Jetson AGX Orin™

Server-Class AI Performance at the Edge

Bring your next-gen products to life with the world's most powerful AI computer for energy-efficient autonomous machines. With up to 275 TOPS and 8X the performance of the last generation for multiple concurrent AI inference pipelines, plus high-speed interface support for multiple sensors, NVIDIA Jetson Orin™ modules provide the ideal solution for a new age of robotics.

- Up to 275 INT8 TOPS powered by Ampere GPU +DLA
- Up to 12x A78 ARM CPU
- Up to 64 GB memory, 204 GB/s
- Production modules will be available in Oct 2022
- Get started developing for AGX Orin series with AGX Orin Developer kit



Jetson AGX Orin™ Series
275 TOPs (INT8)
15W - 60W
32GB/64GB
100mm x 87mm

NVIDIA® Jetson AGX Orin™ Developer Kit

Next-Level AI Performance for Next-Gen Robotics

Get started developing with the NVIDIA® Jetson AGX Orin™ Developer Kit. It includes a high-performance, power-efficient Jetson AGX Orin™ module and can emulate the entire family of Jetson Orin modules. With up to 275 TOPS for running the NVIDIA AI software stack, this developer kit lets you create advanced robotics and edge AI applications for manufacturing, logistics, retail, service, agriculture, smart city, healthcare, and life sciences.

Emulation Mode

- The AGX Orin developer kit can emulate the performance of the AGX Orin Series and the Orin NX Series
- Developers can get started with their development of all four modules today!

Developer Kit Contents

- Jetson AGX Orin™ module with heat sink and reference carrier board
- 802.11ac/abgn wireless network interface controller
- Power adapter and USB Type-C cord
- USB Type-C to USB Type-A cord
- Quickstart and support guide

Jetson AGX Orin™ Developer Kit*
15W - 60W
275 TOPS (INT8)
110mm x 110mm x 71.65mm
$1999

* The Jetson AGX Orin™ Developer Kit will be available with 32 GB of memory.

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ADLINK manufactures edge hardware and develops edge software for embedded, distributed, and intelligent computing — where failure is not an option — to connect people, places, and machines. From powering medical PCs in intensive care units to building the world's first high-speed autonomous race car — thousands of customers around the world trust ADLINK for mission-critical success.

Key Strength and Value Proposition

At ADLINK, we help build and deploy Edge AI solutions to connect people, places, and things faster. Our leading-edge software, hardware, and services have been at the cutting edge of embedded computing and innovative technology for over 25 years, helping enterprise to remain competitive.

Services

- Edge AI devices provider

Edge AI Devices for Robotics, AI Vision, 5G Infra, Healthcare as well as Transportation Vertical Markets

Product Category	Processors Supported	Product Family Names	Software/Firmware Available
Boxed Products	Jetson Xavier™ AGX Jetson Xavier™ NX Jetson Xavier™ TX2 NX Jetson Xavier™ Nano	NEON-2000-JNX SERIES EOS-JNX DLAP-211-JNX SERIES AVA-RAGX ROScube	NVIDIA Jetpack SDK ADLINK EVA SDK
Development Kits	Jetson Xavier™ Nano Jetson Xavier™ NX	DLAP-211 carrier board ROSCube carrier board	NVIDIA Jetpack SDK ADLINK EVA SDK

Featured Solutions

NEON-2000-JNX SERIES/EOS-JNX/ROScube

- EOS-JNX: NVIDIA® Jetson Xavier™ NX Edge AI vision inference system
- NEON-2000-JNX SERIES: NVIDIA® Jetson Xavier™ NX-based industrial AI smart camera for the edge
- ROScube: Embedded robotic controller powered by NVIDIA® Jetson AGX Xavier™ module

NEON-2000-JNX SERIES

ROScube

EOS-JNX

AVA-AGX/DLAP-211-JNX SERIES

- DLAP-211-JNX SERIES: Jetson Xavier™ NX Edge inference platform
- AVA-RAGX: Fanless AIoT video analytics platform with NVIDIA® Jetson AGX Xavier™ for railway

AVA-RAGX

DLAP-211-JNX SERIES

Advantech is a global leader in the fields of IoT intelligent systems and embedded platforms. To embrace the trends of IoT, big data, and artificial intelligence, Advantech integrated IoT Solutions include everything from board-level products to complete systems, sensor nodes, gateways, and IoT platform software to assist business partners, and clients in connecting their industrial chains.

Key Strength and Value Proposition

- Global but local (Sales and technical support in many European countries)
- Very large product portfolio
- Able to serve all verticals with appropriate certification

Services

- Full custom design capabilities in Germany and/or Taiwan
- Integration services in Poland and in the Netherlands
- RMA center in Poland
- Stock capabilities in the Netherlands

Core Offerings

Product Category	Processors Supported	Product Family Names	Software/Firmware Available
Boxed Products	NVIDIA® Jetson™	AIR-020 EBC-R7200	Linux, WISEPaaS

Featured Solutions

Ready-to-use Barebones PC

EPC-R7200 with a production carrier board and thermal reference design is compatible with all Jetson family modules and JetPack™ SDK, enabling developers to easily prototype and mass-deploy for edge AI applications.

Industrial Grade Design

Wide operating temperatures, power input, and high vibration tolerance (-40 ~ 85 ºC/-40 ~ 185 ºF; 9 ~ 24VDC; 3.0Grms) supports to reduce the development time and resources required for system integration and verification.

Fanless Ultra-compact Footprint

An ultra-compact design of only 152 × 137 × 42 mm enable AI developers easily deploy the PC in diverse applications without sacrificing space considerations.

Expandable I/O Design

Equipped with reliable I/Os, such as 2 x 2-lane MIPI-CSI2, 2 x GbE LAN, and 2 x M.2 slots, for camera devices, wireless connectivity. Further accept application-oriented UIO40-Express I/O expansion boards to fulfill multi-function flexibility.

EBC-R7200
AIR-020

Connect Tech Inc.
Embedded Computing Experts

With 37 years of embedded computing experience, Connect Tech's range of proven technology includes complete embedded systems, carrier boards, thermal solutions, embedded Ethernet switches, and more. As an NVIDIA® Elite partner, we are dedicated to providing commercial-off-the-shelf and custom solutions for the NVIDIA® Jetson™ community as well as the embedded Quadro audience.

With in-house design and manufacturing services, Connect Tech can provide fast turn-around of custom design services. Whether you choose from our COTS solutions or custom design Connect Tech will take you from development to deployment in record time.

Custom Design Services

In-house Jetson design team, on-site technical support engineers, and product integration.

Key Strength and Value Proposition

- NVIDIA® Jetson™ largest eco-system hardware partner
- Extensive line of commercial-off-the-shelf offerings
- Jetson experts on staff, easily accessible for your support needs whether hardware, BSP, or vision-related
- Partnerships with key vision partners including Allied Vision, e-con, Framos, Leopard Imaging, Basler, and more

Product Category	Processors Supported	Product Family Names	Software/Firmware Available
System on Modules	Full line of NVIDIA® Jetson™ Modules, COM Express, and SMARC	Forge, Rogue, Boson, Quark, Photon	Current version of NVIDIA Jetpack/L4T
Single Board Computers	Full line of NVIDIA® Jetson™ Modules, COM Express, and SMARC	Forge, Rogue, Boson, Quark, Photon	Current version of NVIDIA Jetpack/L4T
Boxed Products	Full line of NVIDIA® Jetson™ Modules, COM Express, and SMARC	Rudi-AGX | Sentry-X | Rudi-NX	Current version of NVIDIA Jetpack/L4T

Featured Solutions

Forge Carrier for NVIDIA® Jetson AGX Orin™

Forge is Connect Tech's first carrier board for the all-new NVIDIA® Jetson AGX Orin™ system-on-module. Forge's design includes Dual 10 Gigabit Ethernet, NVMe expansion, USB 3.2, a single DisplayPort Video output and a 16-Lane MIPI CSI Expansion Connector. Jetson AGX Orin™ contains 8x the performance of the previous generation for multiple concurrent AI inference pipelines, plus high-speed interface support for multiple sensors, Jetson AGX Orin™ modules provide the ideal solution for a new age of robotics. Jetson AGX Orin™ features NVIDIA® Ampere™ architecture with up to 2048 NVIDIA® CUDA® cores and up to 64 Tensor Cores.

AGX201

Rudi-AGX

Rudi-AGX unleashes the full potential of the Jetson AGX Xavier™ module, capable of running AI programs at Maximum Performance (MAX-N) while maintaining a safe operating temperature. Rudi-AGX is the edge device designed to seamlessly deploy the next generation of autonomous vehicles, smart city applications, and intelligent video solutions. With an AGX Xavier SoM embedded, Rudi-AGX features a Volta GPU with 512 CUDA® cores, 64 Tensor Cores, and is able to achieve an AI performance of 32 TOPs. This feature rich edge device also comes equipped with 6x GPIO, 4x USB 3.0, 2x UART, 2x I²C, 2x SPI, and an RS-485 connector. Rudi-AGX is ready for instant field deployment with any program developed using NVIDIA's JetPack SDK or deep learning toolkit application.

ESG610

Subscribe to our Newsletter for updates on Rudi-AGX Orin. Coming Q4 2022!

Geniatech

Geniatech is vertically integrated design and manufacturing OEM/ODM. We offer software and hardware design, industrial and mechanical design, tooling design, tooling integration, global regulatory and certifications needs, packaging design, and packaging production and of course world class quality manufacturing. From inception to completion Geniatech is well positioned to handle each and every aspect of your product needs.

Services

- OEM/ODM including - ID design, MD design, packaging design, kernel driver, Linux, and Android BSP, cloud software, APPs for IOS, Android, Linux

Key Strength and Value Proposition

Multi-ARM SoC, various of product form-factors. Software and hardware ODM, small volume to big volume, quick time to market, add-on supply chain service.

Core Offerings

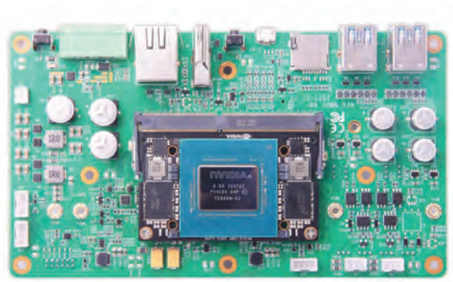
Complete product portfolio & design manufacturing services from SOM plus carrier board to finished products, vertical ODM/OEM services including ID/MD/Tooling/PCBA/assembling and artwork, scalable manufacturing from small to giant volume, fast time to market, rich experience on Linux, Android, software driver, and cloud software, focus on SOM/SBC/ARM PC/HMI/Touch panel/Gateway and other ARM-based devices for commercial and industrial applications, main SoC including NXP, Rockchip, Qualcomm, Renesas, and Amlogic.

NVJ100AI and NVJ100AIX Standard

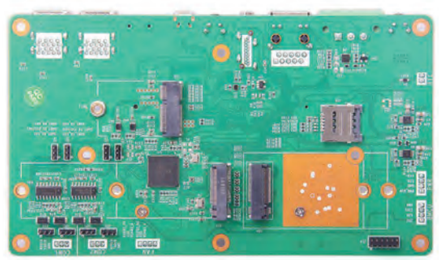
Featured Solutions

- Supports NVIDIA Jetson® NANO embedded and NVIDIA Jetson® Xavier™ NX SoC
- Support 4K video 4K@60fps and HD video and 7*1080p*60fps playback
- Supports H.264/H.265 cameras
- 10/100/1000M LAN interface, supports 4G network
- Built-in Wi-Fi (2.4G/5.8G) /BT (4.2/5.0 optional)
- Video output: 1*HDMI
- USB3.0 interface (compatible with USB2.0 standard)
- Provide RS232 and RS485 interface
- Linux OS with BSP (board support package)
- Supports deep learning trained models
- Rich interfaces help ease development
- Wide operating temperature range

NVJ100AI and NVJ100AIX Carrier Boards



NVJ100AIX



NVJ100AI

Silex transforms your products into secure, reliable wireless devices, and machines that deliver a completely connected, always-on experience. We are a Japanese connectivity provider, taking proven Qualcomm technology, combining hardware, software, and services to bring reliable connectivity to your device.

Services

- Driver and BSP development
- Interoperability testing (DVT)
- Regulatory certification

Key Strength and Value Proposition

Silex has 20 years of Wi-Fi and Bluetooth expertise and provides “when it absolutely must connect” quality Wi-Fi solutions.

Wi-Fi 6E - 802.11ax: Turbocharged Wi-Fi for Medical, Industrial, Imaging, and Video Applications

Product Name	SX-PCEAX-M2	SX-PCEAX-HMC	SX-PCEAX-SMT
Form Factor	M.2 card type 2230-S3-A-E	Mini PCIe card half size	M.2 LGA type 1418
Dimensions	22.0 × 30.0 × 2.7mm	29.85 × 26.65 × 2.9mm	14.0 × 1 8.0 × 1.90mm
Host Interface	WLAN: PCIe 3.0/Bluetooth: USB1.1		
Chipset	Qualcomm® QCA2066 “Verona”		

Silex Wi-Fi 6E for NVIDIA® Jetson™

Silex SX-PCEAX Series

The SX-PCEAX is one of the industry’s first Tri-band Wi-Fi 6E modules and extends the benefits that Wi-Fi 6 provides in the 2.4 and 5 GHz bands to 6 GHz and helps increase overall capacity and performance.

- Wi-Fi 6E: IEEE 802.11a/b/g/n/ac/ax, 2.4GHz + 5GHz + 6GHz
- Bluetooth 5.2 (BR/EDR/HS/LE compliant)
- 2x2 MIMO support, 2x U.FL/MHF4 antenna connectors
- Operating temperature: -20 to 65°C
- Latest Wi-Fi security (WPA3)
- Linux driver support
- Modular certifications: CE/FCC/ISED/TELEC

NVIDIA® Jetson™ + Silex SX-PCEAX

- Add Wi-Fi 6E connectivity to your NVIDIA Jetson-based applications — supported NVIDIA platforms
- JETSON NANO; JETSON TX2 series; JETSON Xavier™ NX; JETSON AGX Xavier™ series; Orin Support coming soon

Silex Technology's Wi-Fi Embedded Modules

SX-PCEAX-M2 SX-PCEAX-HMC SX-PCEAX-SMT

Silex SX-PCEAX Series

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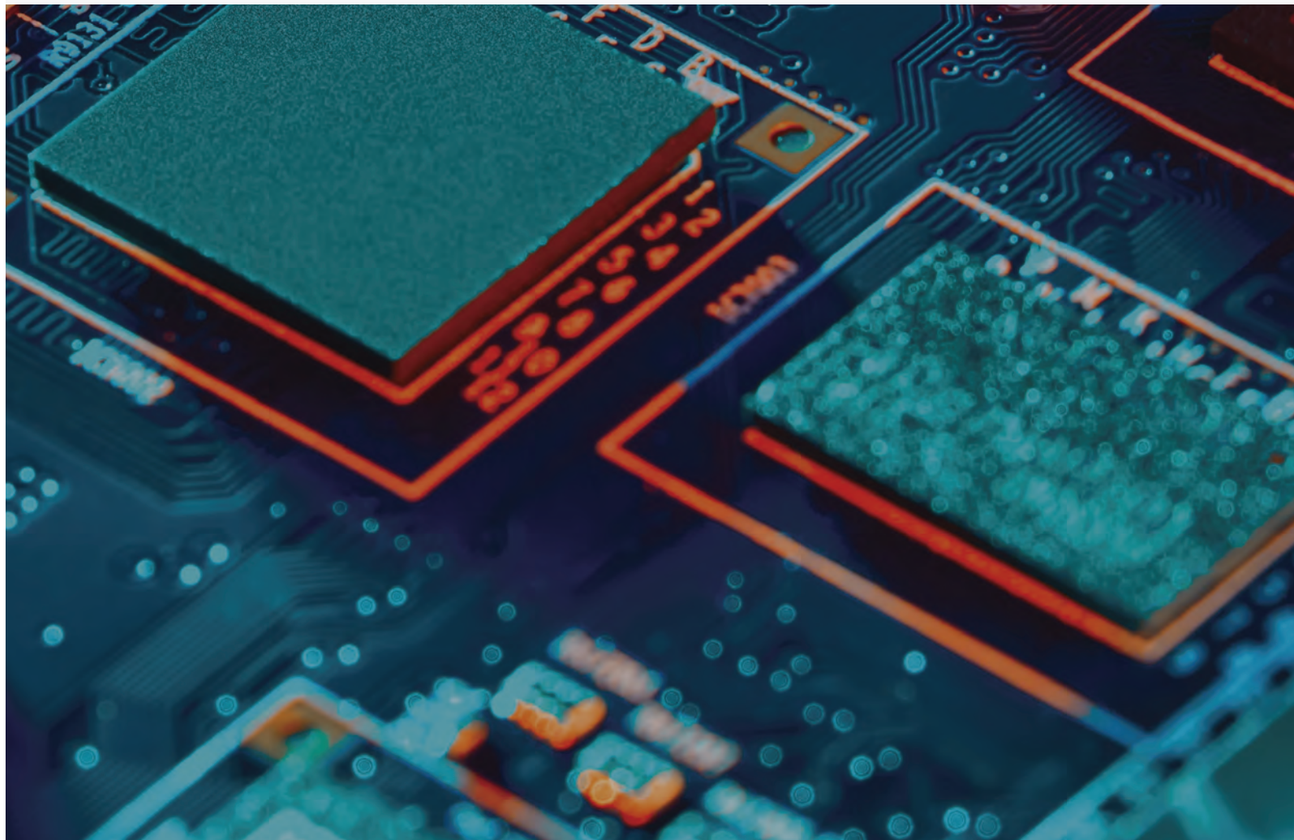
Arrow NXP-Based Board and Box-Level Solutions



i.MX 8 Series Application Processors

Performance, Power, Scalability, Security, Longevity

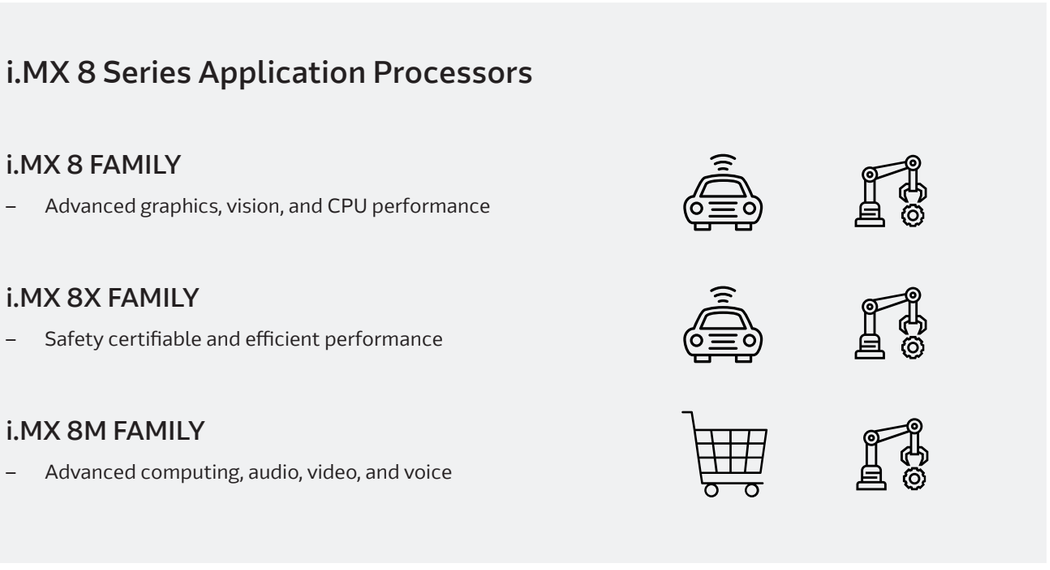
The new i.MX 8 processor series builds on 15+ years of cutting-edge technology, robust software, and broad ecosystem support to continue the NXP tradition of helping customers find the right balance between performance and power, all while offering solutions that are scalable, safe, and secure. The high-quality i.MX application processors provide secure, long-lasting solutions with a product longevity of 10-15 years minimum. This series includes the i.MX 8M, i.MX 8X, and i.MX 8 families which are software-compatible and supported by Android, Linux®, QNX, Green Hills, FreeRTOS, and other third-party commercial operating systems.

Technologies

- Advanced security
- AI, machine learning, and vision
- HMI solutions
- Industrial automation
- Infotainment

Target Applications

- Building control
- Consumer electronics
- Healthcare
- Instrument clusters
- Multi-media devices
- Streaming audio and video
- Voice assist/control
- Automotive electronic cockpit



i.MX 8 Family with Dual A72 Cores, Dual GPU

High-Performance up to 1.6 GHz with Dual A72 Cores, Dual GPU

The i.MX 8 family supports media processing and can run processing-intensive machine learning algorithms. Built with advanced media processing, secure domain partitioning, and innovative vision processing, the i.MX 8 applications processor family will revolutionize multiple-display automotive applications, industrial systems, vision, HMI, and single-board computers.

Feature	i. MX 8QuadMax	i. MX 8QuadPlus
Arm® Core	2 x Arm Cortex-A72	1 x Cortex-A72
Arm® Core	4 x Cortex-A53	4 x Cortex-A53
Arm® Core	2 x Cortex-M4F	2 x Cortex-M4F
DSP Core	Tensilica® HiFi 4	Tensilica® HiFi 4
DDR	LPDDR4, DDR4	LPDDR4, DDR4
GPU	2 x GC7000XSVX	2 x GC7000Lite/XSVX
PCIe 3.0	1 x PCIe (2-lane)*	1 x PCIe (2-lane)*

* Can be used as two PCIe 3.0 controllers one-lane with independent operation

i.MX 8X Applications Processor Family

High Reliability and Safety; Efficient, Certifiable Performance

Built with a high-level of integration, the i.MX 8X family supports graphics, video, image processing, audio, and voice functions. This is the ideal processor family for safety-certifiable and efficient performance requirements. The i.MX 8X family includes the i.MX 8QuadXPlus, i.MX 8DualXPlus, and i.MX 8DualX.

Feature	i.MX 8DualXPlus/i.MX 8QuadXPlus	i.MX 8DualX
Arm® Core	2 x Cortex-A35 (i.MX 8DualXPlus) 4 x Cortex-A35 (i.MX 8QuadXPlus)	2 x Cortex-A35
Arm® Core	1 x Cortex-M4F	1 x Cortex-M4F
DSP Core	Tensilica® HiFi 4	Tensilica® HiFi 4
DDR Interface	32-bit DDR3L (ECC option)/ 32-bit LPDDR4 (no ECC)	16-bit DDR3L (no ECC) 16-bit LPDDR4 (no ECC)
GPU	1 x GC7000Lite performance optimized	1 x GC7000Lite power optimized
VPU	4k h.265 dec, 1080p h.264 enc/dec	1080p h.264 enc/dec
Ethernet	2 x Gigabit with AVB	1 x Gigabit with AVB 1 x 10 /100
USB with PHY	1 x USB 3.0 (can be used as USB 2.0) 1 x USB 2.0	2 x USB 2.0

i.MX 8M Applications Processor Family

Industry-Leading Scalable Audio, Voice, and Video Processing

The i.MX 8M family combines high-performance computing with industry-leading audio, voice, and video capabilities. Devices in this family enable up to 4K high definition (HD) video streaming, 1080p video encode and decode, professional audio quality, speech recognition, Al, machine vision, machine learning, and edge computing. The i.MX 8M family uses advanced technology such as the 14LPC FinFET process presenting great power efficiency and enhanced system reliability.

Subsystem	i.MX 8M Quad	i.MX 8M Mini Quad
Main CPU	2 x or 4 x Cortex-A53 @ 1.5 GHz, 1 MB L2	1 x, 2 x or 4 x A53 @ 1.6 - 1.8 GHz, 512 KB L2 cache
Microcontroller	Cortex-M4 266 MHz	Cortex-M4 400 MHz
DDR	32-bit/16-bit LPDDR4/DDR4/DDR3L	
GPU	3D, 2D (4 shaders) — OpenGL ES 2.0/3.0/3.1, Vulkan, OpenCL 1.2/machine learning	3D, 2D (1 shader) OpenGL ES 2.0/ 1080p media UI
Display Interfaces	1 x MIPI-DSI, HDMI 2.0a Tx (ARC) + eDP	1 x MIPI-DSI
Video Decode	4Kp60 HEVC H.265, VP9, H.264	1080p60 HEVC H.265, VP9, H.264, VP8
Video Encode	-	1080p60 H.264, VP8
Audio Interface	6 x SAI (10Tx + 14Rx external I2S lanes)	5 x SAI (12Tx + 16Rx external I2S lanes), DSD512, PDM input
Camera Interface	2 x MIPI-CSI (4-lanes each)	1 x MIPI-CSI (4-lanes)
USB	2 x USB3.0 type-C	2 x USB2.0
PCIe	2 x PCIe 2.0	1 x PCIe 2.0
Ethernet	1 x GbE	
SDIO/eMMC	2 x SDIO/eMMC	3 x SDIO/eMMC

i.MX 9 Applications Processors

Building on the market-proven i.MX 6 and i.MX 8 series, i.MX 9 series applications processors bring together higher performance applications cores, an independent MCU-like real-time domain, Energy Flex architecture, state-of-the-art security with EdgeLock® secure enclave, and dedicated multi-sensory data processing engines (graphics, image, display, audio, and voice). The i.MX 9 series, part of the EdgeVerse™ edge computing platform, integrates hardware neural processing units across the entire series for acceleration of machine learning applications at the edge.

Key Technologies

Power Efficiency

Energy efficiency extends beyond wearable and portable devices. Optimizing performance and power efficiency is becoming a critical design-in requirement for many IoT devices. i.MX 9 series processors are built with NXP's Energy Flex architecture and a focus on use cases for optimum power efficiency for customers' critical requirements. Fine-grained power control is built into i.MX 9 series applications processors to optimize energy efficiency helping enable customers to reduce their carbon footprint or offer longer battery life.

Edge-Aware

When it comes to machine learning at the edge, customers need a balanced combination of sensor interfaces, media processing, and neural net acceleration to deliver the optimum end-equipment solution. Our i.MX 9 series is built from the ground-up to optimize inferences per second and performance per Watt, providing efficient machine learning acceleration to enable next-generation use cases in embedded systems, improving privacy, latency, and bandwidth.

Security

i.MX 9 raises the bar on security, with EdgeLock® secure enclave, integrating the advanced architecture that delivers state-of-the-art threat protection as well as updated cryptographic protocol support. For security that spans from the edge to the cloud, specific families of the i.MX 9 series will be Microsoft Azure Sphere-certified.

i.MX 9 Series Products

Product Family	Processors					LPDDR4x (with ECC)	LPDDR4 (with ECC)	Key Interfaces
	Cortex-A55	Cortex-M33	DSP	NPU	GPU			
i.MX 93 ML Acceleration, Power Efficient MPU for Automotive, Consumer and Industrial IoT	2	1	-	1	2D	√	√	1080p60 MIPI DSI (4-lane),720p 60 LVDS (4-lane), 18-bit parallel RGB, 1080p 60 MIPI CSI (2-lane), 8-bit parallel YUV/ RGB (camera resolution and interfaces), SDI O(3), USB 2.0 (2), Gigabit Ethernet – 2 with 1x TSN, CAN- FD (2), UART (8), Flex-IO – 2 x 32-bit, Audio - 7x I2S, SPDIF, PDM mic, MQS output, 4-ch 12-bit ADC, 8x I^2C, 2x I^3C, 8x SPI

Edge Computing

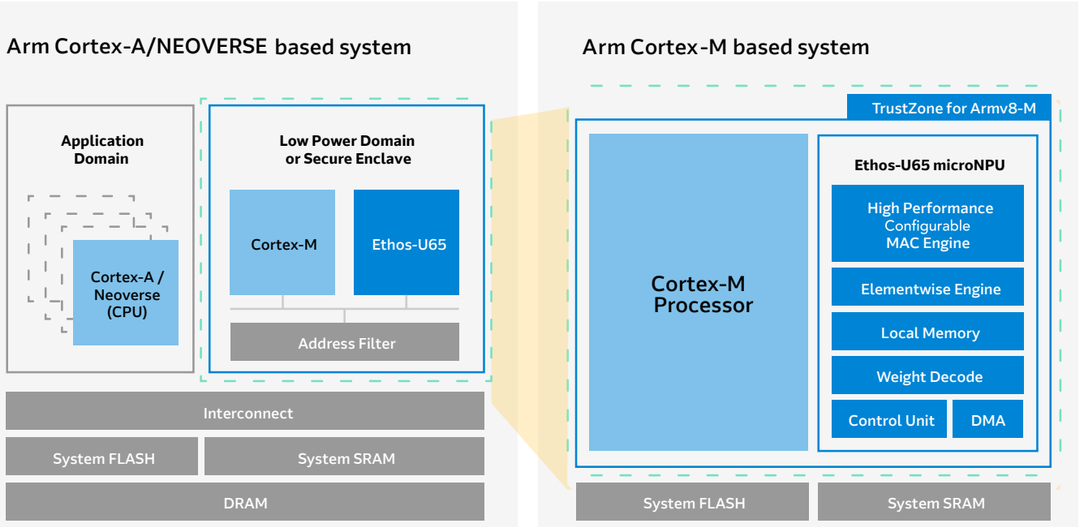


Figure 1: An NPU for Edge ML Processing

Edge processing SoCs contain multiple processing elements including one or more of the types mentioned previously. These processing elements can be used independently or together to perform ML at the edge. Various optimized ML pipelines can be designed to efficiently leverage the available processing power of the SoC. Edge ML computing is a system-level optimization exercise for which multiple processing elements on a SoC (see Figure 2) can be used and enabled properly to support advanced real-time edge ML processing.

Consider the ISP shown in Figure 2 camera-based systems always include image signal processor (ISP) functionality, though sometimes it can be either integrated into a camera module or embedded in an applications processor and potentially hidden to the user. ISPs typically conduct many types of image enhancement along with their key purpose: converting the one-color component per pixel output of a raw image sensor into the RGB or YUV images that are more commonly used elsewhere in the system.

Applications processors without ISPs work well in vision-based systems when the camera inputs are coming from network or web cameras that are typically connected to the applications processor by Ethernet or USB. For these applications, the camera can be up to 100m away from the processor. The camera itself has a built-in ISP and processor to convert the image sensor information and encode the video stream before sending it over the network.

For relatively low-resolution cameras, applications processors without ISPs also work well. At resolutions of 1 megapixel or below, image sensors often feature an embedded ISP and can output RGB or YUV images to an applications processor, so an ISP is not needed in the processor.

But at a resolution of around 2 megapixels (1080p) or higher, most image sensors do not have an embedded ISP; instead, they rely on an ISP somewhere else in the system. This may be a stand-alone ISP chip (which works but adds power and cost to the system) or an ISP integrated in the applications processor as shown in Figure 2.

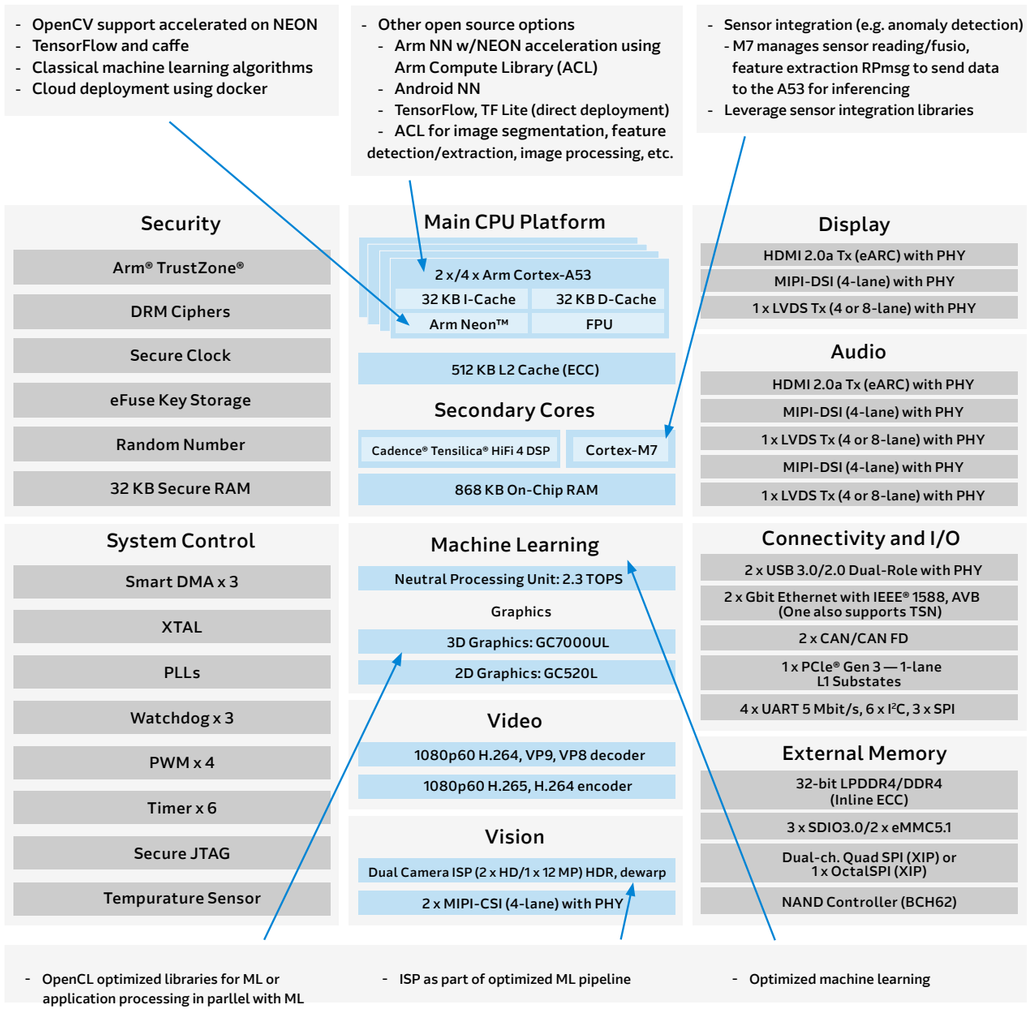


Figure 2: Edge Processing SoC with NPU for ML Acceleration

With the combination of an ML accelerator and an ISP, the edge SoC processor can perform embedded vision system applications at the edge, whether they be for smart homes, smart buildings, smart cities, or industrial IoT applications. With its embedded ISP, the edge SoC processor can be used to create high image quality optimized systems connected directly to local image sensors. It even can be used to feed this image data to the latest ML algorithms, all offloaded in the local ML accelerator.

A More Generic ML Development Approach for Edge Processing Includes These Steps:

- Define the use case and the corresponding type of machine learning and model
- Use a ML framework that is self-contained and does not rely on the underlying hardware
- Prototype the chosen ML paradigms with the framework on a PC, cloud, or higher-end embedded device
- Characterize the network model in terms of memory and computational overhead
- Choose a hardware platform while considering the memory and computational constraints
- Then cross-compile the network for the specific embedded device
- Train the model on a higher-end machine and transfer the weights over to the embedded device (the weights do not change, so they can be stored as a constant array in memory)
- Perform relevant network optimizations (pruning, quantization, precision reduction)
- Perform relevant hardware optimizations (alignment, SIMD instructions)
- Test the performance of the deployed network model and determine whether this implementation can be iterated over after deployment

Edge Processing Also Can be Implemented on Low-End Microcontrollers.

A Possible Development Flow for ML on Low-End MCU Includes These Steps:

- Upload the labeled data to a PC. You can use a universal asynchronous receiver-transmitter (UART), Secure Digital, or an SD card
- Experiment with the data and an ML toolkit using tools such as scikit-learn. Make sure an off-the-shelf method can produce superior results before moving forward
- Experiment with feature engineering and selection. Try to achieve the smallest feature set possible to save resources
- Write an ML method to use on the embedded system (perceptron's or decision trees are good because they do not need a lot of memory). If no floating-point unit is available, integers and a fixed-point unit can be used
- Implement the normal training procedure. Use cross-validation to find the best tuning parameters, integer bit widths, radix positions, etc.
- Run the final trained predictor on your holdout testing set
- If the trained predictor performance is satisfactory on the testing set, move the code that calculates the predictions and the model trained (for example weights) to the MCU. The model weights will not change, so they can be stored in nonvolatile flash memory such as a constant array

Optimizing ML Pipelines for Edge Devices

Embedded edge devices are growing more complex and powerful as they incorporate more hardware components such as CPUs, GPUs, DSPs, and ML accelerators to perform various forms of ML. However, these complex hardware components must be used efficiently. Edge devices with dedicated accelerators such as GPUs and NPUs can perform matrix multiplication significantly faster than CPUs. ML frameworks can efficiently leverage these hardware components. For example, TensorFlow Lite interpreters use the concept of "delegates" that can hand over the compute intense operations to the dedicated hardware for acceleration. Software architectures to support ML can optimize the execution flow of ML in the SoC to provide high-performance, low-power solutions.

The application-specific processing pipeline shown in Figure 3 is designed in multiple stages with multiple steps in the pipeline that can be leveraged for ML processing. Key application segments include:

Vision pipelined for object/face detection/recognition

Voice and audio pipeline for speech analysis

Series data processing pipeline for anomaly detection

Processing pipelines and flexible software architectures provide out-of-the-box SoC and application-type optimized run-time support. This facilitates complete exploitation of heterogeneous SoC capabilities for ML and maximizes component reuse. Key benefits of this approach include improved out-of-box experience (OOBE) and ease of use; comprehensive SoC and hardware resource usage, with configurability over I/O interfaces; acceleration option configuration for different use cases; processing domains for easier customization; scalability across SoCs; and the use of open-source and other community components.

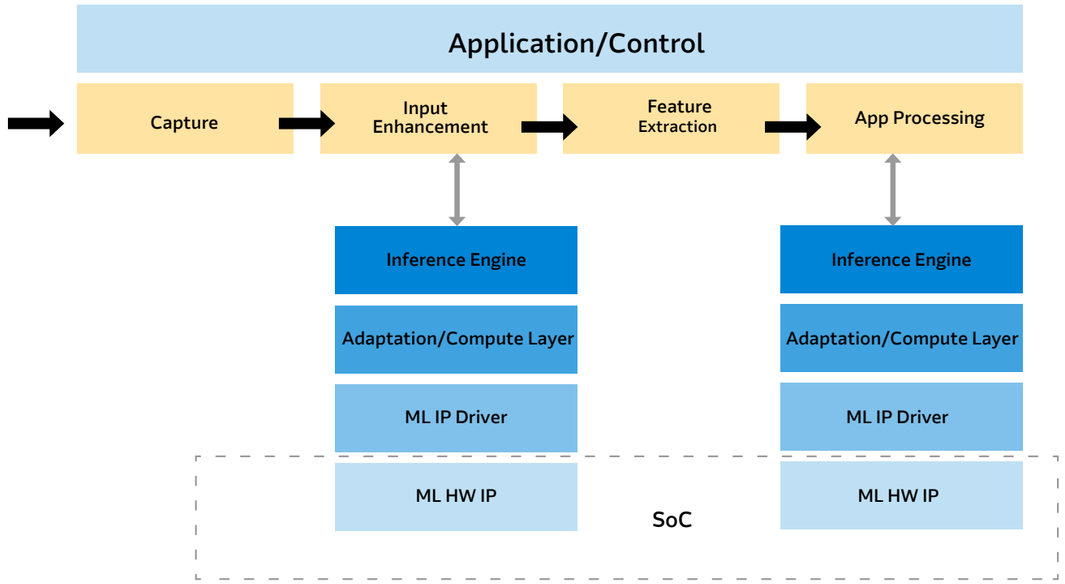


Figure 3: Edge Device Optimized ML Pipeline

As an example of an ML-optimized pipeline in Figure 3, consider the growing demand for video intelligence (industrial inspection, face/person/object detection, and classification, action recognition). This intelligence has pushed the vision paradigm to quickly incorporate ML-based techniques. The traditional vision techniques based on handcrafted feature extraction and usage are still greatly used, but the emergence of powerful hardware to run inference engines combined with the widely available ML frameworks and vision-based models lowered the barriers to fully (or almost fully) using ML to address machine vision use cases.

A capable edge SoC for ML processing in this application must first be chosen. The device in Figure 2 embeds an NPU, 2D and 3D GPUs, a dual-image signal processor, and two camera inputs for an effective advanced vision system. This SoC has all the hardware elements required to address complex ML-based vision use cases.

- Video streams and image processing from the Linux® kernel drivers to the de facto standard media stream framework GStreamer. These software components enable local and remote camera capture, local and remote video stream, and picture presentation, and hardware-accelerated single picture processing (scaling, rotation, color space conversion)
- Adaptation and optimization of the major natural language frameworks (TensorFlow Lite, ONNX, Arm NN, Glow) to run efficiently on the SoC NPU, GPU, and (coming soon) DSP
- GStreamer plug-ins to provide a vendor-agnostic neural network integration framework that eases the integration and connection of the different hardware and software components involved in a machine vision use case. This framework, NNStreamer, an open-source technology, supports the major ML frameworks (TensorFlow Lite, Arm NN, Caffe2) and features the following:
  - Neural network framework connectivity (TensorFlow, Caffe, etc.) — Stream frameworks like GStreamer
  - AI project streaming — Apply efficient and flexible stream pipelines to neural networks
  - Intelligent media filters — Use a neural network model as a media filter/converter
  - Composite models — Apply multiple neural network models in a single stream pipeline instance
  - Multimodal intelligence — Use multiple sources and stream paths for neural network models
- Methods to construct media streams with neural network models using the de facto media stream framework, GStreamer. GStreamer users can apply neural network models as if they were just another media filter. Neural network developers can manage media streams easily and efficiently
- Real-time performance profiling of the full pipeline (CPUs, GPUs, NPUs, DSPs, and memory profiling)

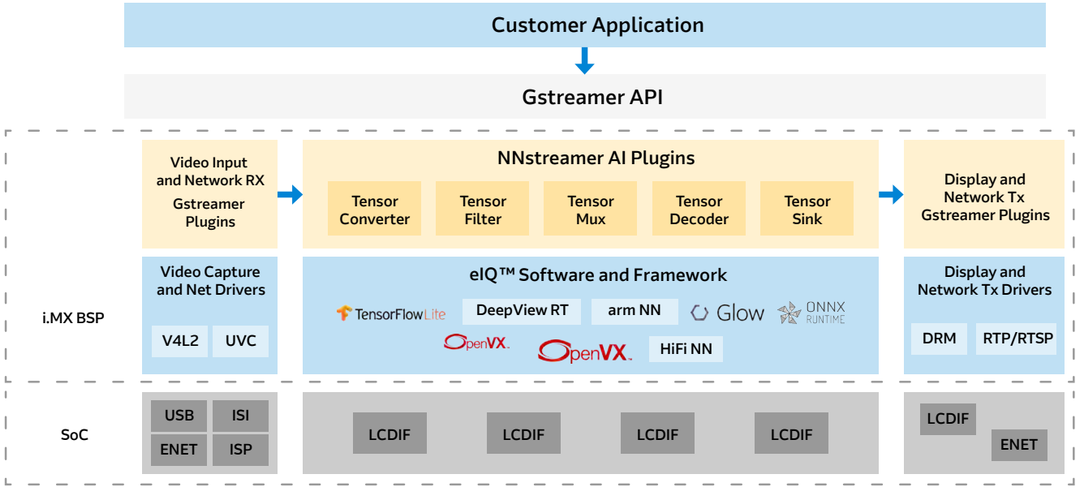


Figure 4: NXP eIQ ML Development Environment Supports Optimized Machine Learning at the Edge

This concept can be expanded further by conducting the parallel processing of ML algorithms on a single SoC. Figure 5 shows a voice and audio ML pipeline configured to run on an Arm Cortex-M core on top of a real-time OS while a vision ML pipeline executes on the Arm Cortex-A core on top of a rich OS such as Linux®.

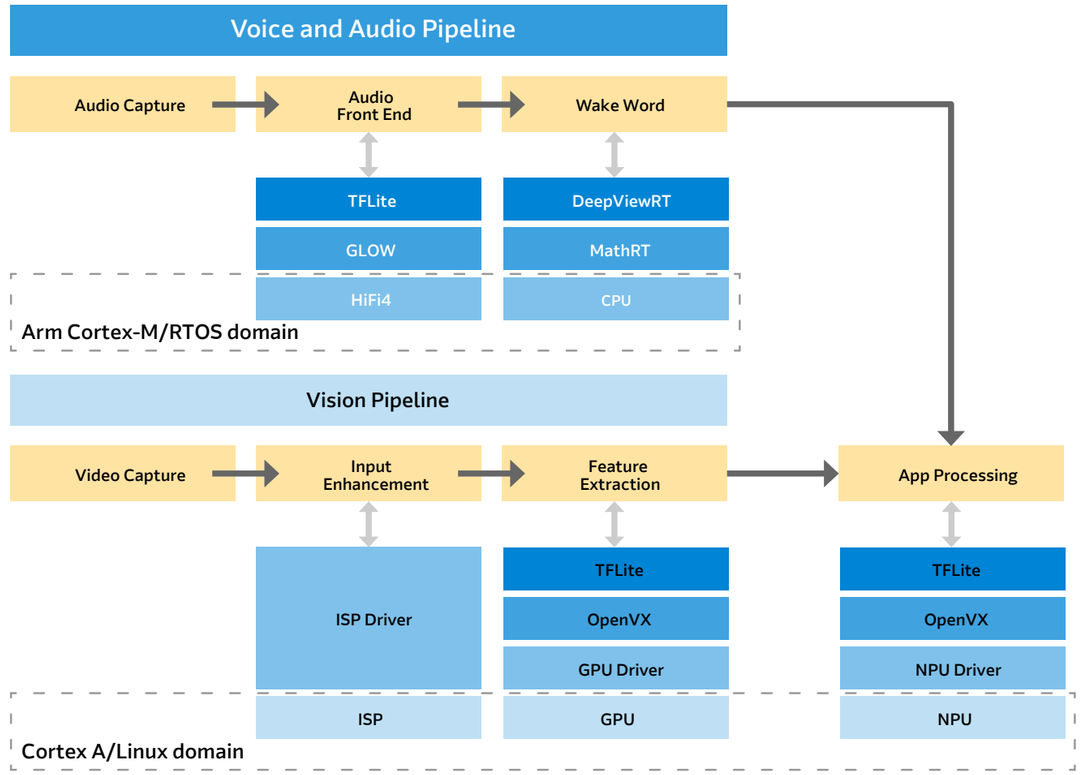


Figure 5: Application Run Time Simultaneously Leveraging Voice and Vision Pipelines on an NXP i.MX 8M Plus Edge Computing SoC

In summary, running ML at the edge requires an awareness of the compute and memory resources available. It also requires modifications to the ML models and the process flow to fit the resource profile. In return, running ML at the edge has many advantages such as improved privacy, reduced, or no dependency on a network connection, reduced power dissipation, and the capability to make real-time low-latency decisions.

Boundary Devices is a leading supplier of Arm-based SOMs, SBCs, and Custom SBCs for the general embedded market.

Pick the right hardware and get your product to market faster with Boundary Devices. Boundary Devices provides hardware, software, manufacturing, and support for embedded electronics.

Boundary Devices Nitrogen Platform Overview

SBCs, SOMs, Carriers, and **custom** designs based on NXP's i.MX 6/7/8/9

Product Category	Processors Supported	Product Family Names	Software/Firmware Available
System on Modules	NXP i.MX 8M and i.MX 9 Applications Processors	Nitrogen8M Nano, Nitrogen8M Plus, and Nitrogen8M, Nitrogen8M Mini, Nitrogen9	Linux, Android, Debian/Ubuntu, Yocto, Buildroot, FreeRTOS, and many more
Single Board Computer	NXP i.MX 8M Applications Processors	Nitrogen8M, Nitrogen8M Mini, Nitrogen8M Plus	
Custom Single Board Computer	NXP i.MX 8M and i.MX 9 Applications Processors	Custom Part Number with IO, memory, PCBA, and software tailored to the specification	

Featured Solutions

Nitrogen8M Plus SoM

The Nitrogen8M Plus System on Module (SoM) is the latest in our line of i.MX based Nitrogen platforms, leveraging the recently released i.MX 8M Plus processors from NXP. The RAM (2-4GB) and eMMC (16-128) can be modified to fit your requirements. The Nitrogen8M Plus SoM is designed for mass production use with a guaranteed 10-year lifespan, FCC pre-scan results, and a stable supply chain. Industrial temperature and conformal coating options are available. The Nitrogen8M Plus carrier boards can be found on the accessories tab of the product page. Altium design files for the carriers and design reviews can be provided at no cost with volume purchase. Beyond SoMs and carriers, we provide a selection of displays, cameras, cellular, and enclosures for quick prototyping and production.

Nitrogen8M Mini SBC

The Nitrogen8M_Mini SBC is the latest in our line of i.MX based Nitrogen platforms, leveraging the recently released i.MX 8M Mini family of applications processors from NXP. It includes an accessory kit option with a 5V power supply, 16GB microSD card with Linux OS, battery, and serial console cable. The Nitrogen8M_Mini is designed for mass production use with a guaranteed 10-year lifespan, FCC pre-scan results, and a stable supply chain. Industrial temperature and conformal coating options are available. It can be modified by de-populating unused components and can be fully customized for cost reduction.

DH electronics offers standard and customized embedded solutions from one hand, especially for building and industrial automation. Our modular concept enables a fast time-to-market at low cost and risk. We guarantee long-term availability, trust in open source, and build know-how in core technologies such as AI and robotics.

Key Strength and Value Proposition

- Expert for individual embedded solutions for more than 30 years
- Customized solderable & pluggable SOMs based on CPUs by ST and NXP
- Awarded as TOP-innovator 2021/2019
- We care about openness and honesty

Services

- As full-service provider we support customers from the first idea to the finished product including hardware and software development, production and lifecycle management
- Technical support from our RND team
- Mainline Linux support (Debian, Yocto)
- Workshops and trainings

Core Offerings

Product Category	Processors Supported	Product Family Names (DHSOM with DHCOM and DHCOR)	Software/Firmware Available
System on Modules	NXP i.MX8M Plus, i.MX6 S/D/DL/Q*, and i.MX6ULL application processors	DHCOM i.MX25, DHCOM i.MX8M Plus, DHCOM i.MX6, DHCOM i.MX6UL(L), DHCOR i.MX6UL(L)	Yes
Boxed Products	Touch Panel Computer, IoT Gateway	DHMI 4.3" / 7" / 8" / 10.1, IoT Gateway DRC	Yes
Development Kits	Devkit for all DHCOM, picoITX standard	Premium development kit (PDK), picoITX Carrier board	Yes

DHCOM = pluggable, DHCOR = solderable, DRC = Din Rail Controller
*Solo, Dual, DualLite, Quad

Featured Solutions

DHMI: Touch Panel Computers

- Touch Panel Computers with resistive or capacitive touch from 4.3" to 10.1" designed for industrial applications
- Thanks to a modular system, HMIs can be customized fast and cost-efficiently with low risk and the included SOM can be changed for higher performance without a redesign
- Web browser with kiosk mode and tab view available
- Support of open-source graphics driver

DHMI family

DHCON: IoT Gateways

- Modular IoT Gateway based on our DHCOM SOMs
- Connects sensors, IoT modules, and smart devices to the cloud
- For data filtering, visualization, and analytics in IIoT applications
- Mounted on a DIN rail, energy-efficient, available 10+ years
- Interfaces can be flexibly adapted to customer needs
- Exchange of the SOM enables scalability without redesign

DHCON family

TOC ⟶

DIGI

With over 30 years of experience, Digi International is a Global Leader in the supply of finished products (e.g., cellular routers), embedded devices (RF modules & SoMs), and software (remote management platforms) for IoT applications, with an emphasis on quality, longevity of supply, security & ease of integration.

Services

- DRM (Digi Remote Management) software for fast deployment, management, and maintenance of large IoT networks
- WDS (Wireless Design Services) consultancy to aid in turnkey bespoke IoT solutions for customers

Key Strengths and Value Proposition

- IoT security with Digi's TrustFence®
- Longevity of supply: Minimum 10 years
- 3 years warranty on many products

ConnectCore®: Embedded Wired/Wireless Connect SoM's Based on NXP i.MX Processors

XBee®: Digi's footprint compatible RF modules supporting cellular, sub-GHz & 2.4GHz technologies

Product Category	Processors Supported	Product Family Names	Software/Firmware Available
System on Modules	i.MX 8 Series and i.MX 6 Series	ConnectCore®	Linux & Android BSP
Single Board Computers	i.MX 8 Series and i.MX 6 Series	ConnectCore®	Linux & Android BSP
Boxed Products	n/a	IX15 RF Gateway	MicroPython
Development Kits	i.MX 8 Series and i.MX 6 Series	ConnectCore®	Linux & Android BSP

Featured Solutions

Digi ConnectCore® System-on-Modules

Digi SoM solutions provide a highly integrated hardware and software platform designed for rapid development and time-to-market, along with a full suite of tools and resources for scalability of design and ease of maintenance. With robust, industrial system-on-modules, integrated Digi TrustFence® security, sophisticated open systems software, and device management tools, Digi's embedded solutions reduce total cost of ownership and help catapult OEMs to market success.

CC-MX-FR6D-ZN - Digi ConnectCore® 8M Nano

Single Board Computers

Versatile off-the-shelf SBCs

Digi's line of compact, cost-effective, and versatile off-the-shelf SBC computer platforms (SBCs) offer significantly reduced time-to-market by virtually eliminating the traditional risk, effort, and complexity of custom board designs without sacrificing flexibility or capabilities. Digi SBCs support ARM, NXP, Rabbit processors and multiple wireless interfaces.

CC-SBP-WMX-JN58 - Digi ConnectCore® 6UL SBC Pro

TOC ⟶

Embedded Artists focus on lowering the thresholds of developing embedded systems - The Art of Embedded Systems Development – Made Easy™. We provide on stable, proven, and easy-to-use i.MX embedded systems - with crossover microcontrollers as well as application processors.

Core Offerings

Product Category	Processors Supported	Product family names
System on Modules	i.MX 8M Mini i.MX 8M Nano i.MX RT1176	iMX 8M Mini uCOM iMX 8M Nano uCOM iMX RT1176 uCOM
Development Kits	i.MX 8M Mini i.MX 8M Nano i.MX RT1176	iMX 8M Mini Developer's Kit iMX 8M Nano Developer's Kit iMX RT1176 Developer's Kit

Key Strengths and Value Proposition

- 20+ years in business with expert knowledge – Gold Partner to NXP
- Our Computer-on-Modules are off-the-shelf component with long-term availability
- Get shorter time to market – accelerate your development

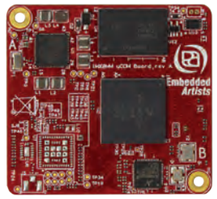
Services

- Free technical support, directly from our engineers.
- Extensive documentation in the form of tutorials and guides.
- Partner network to support our customers development needs.

Featured Solutions

iMX8M Mini/Nano uCOM

- Up to Quad 1.8/1.5GHz i.MX 8M Mini/Nano Cortex-A53 Plus 400/750MHz Cortex-M co-processor
- 1GByte LPDDR4/DDR4 SDRAM/8GByte eMMC
- Gigabit Ethernet Phy, HQ audio in/out, USB2
- i.MX 8M Mini: 1080p60 video encode/decode and PCIe
- Optional Murata Wi-Fi/BT module, based on NXP chipset
- -40 to 85°C Industrial temperature range
- Mounting options for more/less memory
- iMX8M Mini/Nano Developer's Kit gets you up-and-running immediately



EAC00336/EAC00349/
EAC00357/EAC00358

iMX RT1176 uCOM

- Up to 1.0GHz i.MX RT1176 Cortex-M7 Plus 400MHz Cortex-M4 co-processor
- 32MByte SDRAM/16MByte QSPI flash
- Gigabit Ethernet Phy, USB2
- Optional Murata Wi-Fi/BT module, based on NXP chipset
- -40 to 85°C Industrial temperature range
- Mounting options for more/less memory, w/wo Phy
- iMX RT1176 Developer's Kit gets you up-and-running immediately

EAC00381

TOC ⟶

IMDT is a British-Israeli company that was founded in 2017. IMD Technologies specializes in developing and manufacturing advanced and complex products in the fields of medical, robotics, smart city, smart home, and industrial.

Services

- System and architecture design
- Developing embedded software and high-level applications
- HW-high speed designs, complex system
- Production-electronic and mechanical manufacturing

Key Strengths and Value Proposition

- Complex system design specialized in video processing and AI applications
- Computer vision IP's and 3D industrial measurements

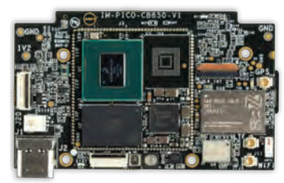
Core Offerings

Product Category	Processors Supported	Product Family Names	Software/Firmware Available
System on Modules	i.MX 8M Plus	PICO SoM	Linux, Android
Single Board Computers	i.MX 8M Plus	PICO SBC	Linux, Android
Boxed Products	i.MX 8M Plus	PICO Camera	Linux, Android
Development Kits	i.MX 8M Plus	PICO EVK	Linux, Android

Featured Solutions

Machine Learning Applications

- Face detection and recognition — property security, access control
- License plate recognition — car park monitoring, gate security
- Advanced driver/Rider assistance system — collision detection and avoidance, driver monitoring



IM-SCB-0853

3D Calculation

- High accuracy 3D calculation process
- Based on stereoscopic image captures
- Very fast implementation, using IMDT's patented algorithms

IM-CAM-0001

TOC ⟶

iWave Systems, a global leader in embedded computing platforms has been enabling companies across the globe in product development journey. With an extensive portfolio of system on modules, single board computers and ODM Solutions and a strategic focus in the automotive, industrial, medical and avionics verticals, iWave is driven by the mission to be a trusted embedded technology partner.

Key Strengths and Value Proposition

- Vast portfolio of system on modules and single board computers
- Experience engineering team and a dedicated support ecosystem
- Product longevity and lifecycle management

Services

- Carrier board design, software, and hardware customization
- Product lifecycle management
- Manufacturing and production – procurement/supply chain, production control
- Certifications: CE, FCC, UL, RoHS, REACH, KOMINFO, GCH, E-MARK

Core Offerings

System on Modules, Single Board Computers, Thermal Solutions, Telematics & HMI Solutions, FPGA IP Cores

Product Category	Processors Supported	Product Family Names	Software/Firmware Available
System on Modules	i.MX 9 Series, i.MX 8 Series, and i.MX 6 Series, Layerscape Processors	OSM, SMARC, Qseven, SODIMM	Linux, Buildroot, Android Ubuntu, QNX
Single Board Computers	i.MX 9 Series, i.MX 8 Series, and i.MX 6 Series	Pico ITX	Linux, Buildroot, Android Ubuntu, QNX
Boxed Products	i.MX 9 Series, i.MX 8 Series, and i.MX 6 Series	Telematics Control Unit, V2X Solutions, Rugged HMI Solutions	Linux, Android
Development Kits	i.MX 9 Series, i.MX 8 Series, and i.MX 6 Series, Layerscape Processors	Pico ITX, Nano ITX, Custom	Linux, Buildroot, Android Ubuntu, QNX

Featured Solutions

NXP System on Modules and Single Board Computers

i.MX 8MPlus OSM & SMARC System on Module

- Quad/ QuadLite/ Dual - Arm® Cortex-A53, Arm® Cortex-M7
- 8GB LPDDR4, 16GB eMMC (Expandable)
- NPU with up to 2.3 TOP/s Neural network performance
- Wi-Fi a/b/g/n/ac/ax & BT 5.0
- 2 x LVDS, 2 x RGMII/ GbE, HDMI, PCIe, USB3.0, MIPI CSI, MIPI DSI, etc.

iW-G40M-OLPQ-4L004G-E016G-BIA (OSM)
iW-G40M-SCPQ-4L002G-E016G-BIA (SMARC)

i.MX 8QM/QP SMARC System on Module and Single Board Computer

- QuadMax/ QuadPlus - Arm® Cortex-A53, Arm® Cortex-A72,
- Arm® Cortex-M4F, Arm® v8 64-bit
- 8GB LPDDR4, 16GB eMMC (Expandable)
- Wi-Fi a/b/g/n/ac/ax & BT 5.0
- 2 x GbE, HDMI TX & RX, LVDS, MIPI CSI, MIPI DSI, etc.

iW-G27M-SCQM-4L008G-E032G-BIG (SMARC)
iW-G27S-SCQM-4L008G-E032G-BIC (SBC)

TOC ⟶

Kontron Electronics GmbH, based in Germany is a full-service provider in the field of electronics, development and manufacturing services. From the idea to development and production to the finished product we are there to support you. Our team has long-standing experience in developing product ideas and solution concepts – we are your reliable partner.

Key Strengths and Value Proposition

- Full-service company
- Engineering in Germany, made in Europe
- ARM® Cortex® M/L and Cortex® A solutions

Services

- SOMs and SOM based SBC
- Development (variants and full custom)
- Production (own products and ODM/EMS)

Core Offerings

Product Category	Processors Supported	Product Family Names	Software/Firmware Available
System on Modules (SOM)	i.MX6 UL(L), i.MX8M Mini, STM32 MP157	OSM/SL (SOM Line)	U-Boot, Yocto, Qt
Single Board Computers	Like SOM + RPI CM3+/CM4	BL (Board-Line)	Like SOM + Codesys
Boxed Products	Like SBC	AL (Automation Line)	Like SBC
Development Kits	Like SBC + Display	DK (Development kit)	Like SBC

Featured Solutions

OSM-S i.MX8M Mini

- OSM size S (30x30 mm)
- 4x ARM® Cortex®-A53 @1,6 GHz + 1x ARM® Cortex® M4@400 MHz
- Up to 4GB RAM and 64GB eMMC
- 1x GBE, 2x USB 2.0 OTG, 1x MIPI DSI (4-lane)
- 4x UART, 2x I²C, 24 GPIO, 1x PCIe x1, 2x SDIO, 1x CSI
- 5V DC ± 5% Linux running < 1 W, max 3.5 W
- -25°C ... +85°C

40099 231: OSM-S i.MX8M Mini Quad 4GB/32GB

AL/BL i.MX8M Mini

BL: Board-Line SBC (105,5 x 67mm) based on OSM/SOM

- 2x LAN (1x GBE + 1x 10/100 Mbit/s)
- 2x 2.0 Host, 1x 2.0 OTG
- 1x CAN 2.0, 1x RS232, 1x RS485
- 1x HDMI, 1x LVDS (1920 x 1080 @60fps)
- 24 V DC ± 20% , Linux running < 2 W

AL: Automation-Line with stainless steel DIN rail housing

40099 220: BL i.MX8M Mini Quad 4GB/32GB
50099 068: AL i.MX8M Mini Quad 4GB/32GB

TOC ⟶

RBZ Robot Design is an engineering company with experience in the development of hardware and software solutions with strong experience in the design of microprocessor and microcontroller systems with focus on connected devices. Our engineering services have been expanded through the SIMPLIA SOMs family.

Services

- Schematics review
- Software support
- Custom carrier design
- Custom SOM design

Key Strengths and Value Proposition

- Small size SOMs
- iMXRT on board
- Wireless connectivity

Core Offerings

Product Category	Processors Supported	Product Family Names	Software/Firmware Available
System on Modules	RT1052	Compact, Connect	Yes, on GitHub
Development Kits	RT1052	KIT	Yes, on GitHub

Featured Solutions

COMPACT IMXRT 1052

- COMPACT IMXRT 1052 Module is a M.2 2230 format board based in an IMXRT 1052 processor with a plug and trust device to provide a root of trust at IC level
- Multiple interfaces such as LCD, USB, CSI, SD and RMII
- Different options for RAM/FLASH
- Camera and display support

AABXXX0

CONNECT IMXRT 1052 WIFI

- COMPACT IMXRT 1052 Module is a M.2 2230 format board based in an IMXRT 1052 processor with a Plug and Trust device to provide a root of trust at IC level
- Multiple interfaces such as LCD, USB, CSI, SD and RMII
- Different options for RAM/FLASH
- Camera and display support
- On board 2.4GHz Wi-fi module

BABXXX0

SolidRun is a global leading developer of embedded systems and network solutions, focused on a wide range of energy-efficient, powerful, and flexible products. Our innovative compact embedded solutions are based on ARM and x86 architecture and offer a variety of platforms including SOMs (System-on-Module), SBCs (Single Board Computer), and industrial miniPCs.

Core Offerings

Product Category	Processors Supported	Product Family Names	Software/Firmware Available
System on Modules	i.MX 8 Series and i.MX 6 Series, Layerscape LX2160A, TI AM64x	i.MX8M Plus, i.MX8XLite, i.MX6, i.MX8M Mini, LX2162A, LX2160A Express type 7, TI AM64x	Linux, Debian, Yocto, Build a root, Android, DPDK, Ubuntu
Single Board Computers	i.MX 8 Series and i.MX 6 Series, TI AM64x	HummingBoard i.MX8, HummingBoard i.MX6, HummingBoard i.MX 8XLite, i.MX8M Nano, HummingBoard AM64x	DPDK, Yocto, Ubuntu
Boxed Products	i.MX 8 Series and i.MX 6 Series	SolidSense N6 Indoor, SolidSense N8 Compact, CuBox-i, CuBox-M, HummingBoard i.MX8 HummingBoard i.MX6 HummingBoard i.MX 8XLite, HoneyComb LX2 1U Server	Debian, Yocto, Build a root, Android, Kura, Kapua, BLE, Wirepas
Development Kits	i.MX 8M Family	– i.MX8M Plus – Starter Kit – i.MX8M Plus – Camera Kit | US Plug – ClearFog LX2160A – i.MX8M Mini Starter Kit	Linux, Debian, Yocto, Build a root, Android

Networking System on Modules (SOMs)

Low power ARM-based application-ready platforms for Telecom, networking, and security solution providers.

ARM Servers & Networking Platforms

SolidRun offers modular, low-cost building blocks to develop commercial off-the-shelf (COTs) solutions that can run a variety of applications such as SmartNic, SD-WAN, Firewall, DPI, etc.

IoT & Industrial System on Modules (SOMs)

All Embedded Industrial & IoT modules are ready to deploy, feature-rich, and multicore scalable based on NXP Arm® Cortex® architecture.

Edge Gateways, SBC & Fanless Computers

SolidSense Edge Gateway is a family of enterprise Internet of Things gateways designed for servicing a local network of IoT devices with a range of solutions and business applications. Fanless Industrial computers and PCs support automation, video, IoT, and AI at the distributed edge.

Variscite design, develop and manufacture trusted System on Modules, giving professional engineers the confidence to create the future. Variscite is a worldwide leading System on Module provider, setting the bar for embedded solutions since 2003 with high-quality modules. The company provides the broadest ARM-based SoM portfolio in the embedded market with a wide range of configuration options that cover an entire embedded product and application range.

Hardware

- High-quality System on Module
- Scalable pin-compatible product families
- Customized SoM configuration

Key Strengths and Value Proposition

- Attractive cost/ performance
- Experience short lead time & stable supply
- Enjoy robust longevity of up to 15 years for hardware & software
- Direct support by the R&D team in multiple time zones

Core Offerings

Product Category	Processors Supported	Product Family Names	Software/Firmware Available
System on Modules	NXP i.MX 8QM/ QP, i.MX 8X, i.MX 8M Plus, i.MX 8M Mini, i.MX 8M Nano, i.MX 6UL/ULL/ULZ, i.MX 6	VAR-SOM Pin2Pin family	Linux, Android, FreeRTOS
System on Modules	NXP i.MX 8M Plus, i.MX 8M, i.MX 8M Mini	DART Pin2Pin family	Linux, Android, FreeRTOS
System on Modules	NXP i.MX 8QM/ QP, i.MX 6UL/ULL/ULZ, i.MX 7	Stand-alone modules	Linux, Android, FreeRTOS
Development Kits	A related kit is available for all modules based on a single carrier board for each product family.	Development Kits	Pre-installed with an OS of your choice.

Featured Solutions

VAR-SOM-MX8M-PLUS/DART-MX8M-PLUS SoM

- Two form factor options based on the two Pin2Pin product families
- Up to 1.8GHz Quad Cortex-A53 & 800MHz Cortex-M7
- AI/ML NPU acceleration 2.3 TOPS
- 2x USB3.0, 2x GbE, PCIe, HDMI
- Up to 4 GB LPDDR4, 64GB eMMC
- 1080p H265/H264 encode/decode, HD 2D/3D GPU
- Built-in certified dual-band 802.11 ac/a/b/g/n Wi-Fi + BT/BLE
- 2x CAN-FD, SPI, and UART, 2x GbE (one with TSN support)
- -40 to 85°C Industrial temperature range

SOMs PN: VAR-SOM-MX8M-PLUS / DART-MX8M-PLUS
Kits PN: VAR-STK-VS8M-PLUS, VAR-DVK-VS8M-PLUS
VAR-STK-DT8M-PLUS, VAR-DVK-DT8M-PLUS

VAR-SOM-MINI/DART-MX8M-MINI SoM

- Two form factor options based on the two Pin2Pin product families
- Up to Quad 2GHz i.MX 8M Mini Cortex-A53 & 400MHz Cortex-M4
- LVDS, DSI, Vivante GC320/GC Nano Ultra 2D/3D accelerator
- 1080p60 video encode/decode and HQ audio in/out
- Gigabit Ethernet, USB2, PCIe
- Built-in certified dual-band 802.11 ac/a/b/g/n Wi-Fi + BT/BLE
- Up to 4 GB DDR4, 64GB eMMC
- CAN/CAN-FD, audio codec, touch, camera in
- -40 to 85°C Industrial temperature range

SOMs PN: VAR-SOM-MX8M-MINI / DART-MX8M-MINI
Kits PN: VAR-STK-VS8M-MINI, VAR-DVK-VS8M-MINI
VAR-STK-DT8M-MINI, VAR-DVK-DT8M-MINI

VAR-SOM-MX8/SPEAR-MX8 SoM

- Two form factor options based on the VAR-SOM Pin2Pin product family and a stand-alone option with board-to-board connectors
- i.MX 8 with up to Dual 1.8GHz Cortex-A72, Quad 1.2GHz Cortex-A53 & 2x 266MHz Cortex-M4F
- Up to 8GB LPDDR4, 64GB eMMC
- GC7000VX high-performance 2D/3D GPU, 4K video decode, FHD video encode, HDMI in, dual CSI, audio in/out
- HDMI 2.0, LVDS, DSI, eDP, 2 x GbE, 2 x USB 3.0, PCI-E, CAN Bus, Keypad, UART, SPI, I2C, SD/MMC, Touch
- Built-in certified dual-band 802.11 ac/a/b/g/n Wi-Fi + BT/BLE
- -40 to 85°C Industrial temperature range

SOM PN: VAR-SOM-MX8 / SPEAR-MX8
Kit PN: VAR-STK-MX8, VAR-DVK-MX8
VAR-STK-SP8, VAR-DVK-SP8

VAR-SOM-6UL/DART-6UL SoM

- Two form factor options based on the VAR-SOM Pin2Pin product family and a small size 25x50x4 mm option
- Up to 900MHz i.MX 6UltraLite/ ULL/ ULZ Cortex-A7 with integrated security features
- 2D pixel acceleration engine (PxP), 24bits parallel LCD/ 18bits LVDS display, camera in, audio in/out
- 1GB DDR3L, 512MB NAND/ 64GB eMMC
- 2x 10/100Mbps Ethernet with IEEE 1588, 2x USB, CAN Bus, UART, SPI, I2C, SD/MMC, Touch, PWM, ADC
- Built-in certified dual-band 802.11 ac/a/b/g/n Wi-Fi + BT/BLE
- -40 to 85°C Industrial temperature range

SOMs PN: VAR-SOM-6UL, DART-6UL
Kits PN: VAR-STK-VS6UL, VAR-DVK-VS6UL
VAR-STK-6UL, VAR-DVK-6UL

Micron® Memory Support for NXP® i.MX 8M Platforms

Save yourself time and money — Micron memory comes *validated* on NXP Platforms

Micron Memory		i.MX 8M Processor Memory				i.MX 8M Processor Memory		
		i.MX 8M Quad/Qual Lite i.MX 8M Dual/Dual Lite				i.MX 8M Plus		
DRAM	Type	DDR3L	DDR4	LPDDR4		DDR3L	DDR4	LPDDR4
	Family	MT41K	MT40A	MT53		MT41K	MT40A	MT53
	Density	1, 2, 4, 8GB	4, 8, 16GB	4, 8, 16, 24, 32GB		1, 2, 4GB	8, 16GB	4, 8, 16, 24, 32, 48GB
	Configuration	x16	x16	x32		x16	x16	x32
	Package	96-ball TFBGA	96-ball TFBGA	200-ball FBGA		96-ball TFBGA	96-ball TFBGA	200-ball FBGA
	Validated PN[1]	MT41K256M16TW-107	MT40A512M-16LY-075:E	MT53E128M32D2DS-053 MT53E768M32D4DT-053 MT53D512M32D2DS-053 MT53D1024M32D4DT-053			MT40A1G16KD-062E IT:E	MT53B768M32D4NQ-062 WT:B MT53D1024M32D4DT-053 AIT:D MT53E1G32D2FW-046 IT:A MT53E1536M32D4DT-046 WT:A MT53E2G32D4DT-046 WT:A
	Recommended PN	MT41K256M16 MT41K512M16	MT40A512M16 MT40A1G16	MT53E128M32D2 MT53E256M32D2 MT53E384M32D2 MT53D512M32D2 MT53E512M32D2 MT53D768M32D2 MT53D1024M32D4		MT41K256M16 MT41K512M16	MT40A512M16 MT40A1G16	MT53E128M32D2 MT53E256M32D2 MT53E384M32D2 MT53D512M32D2 MT53E512M32D2 MT53D768M32D2 MT53D1024M32D4
	Qty/Board	2	2	1		2	2	1
NAND/ e.MMC	Type	e.MMC				e.MMC	Parallel NAND	Serial NAND
	Density	8, 16, 32, 64, 128GB				8, 16, 32, 64, 128GB	16, 64, 128, 256, 512GB	1GB
	Configuration	x8				x8	x8	x1
	Package	153-ball VFBGA				153-ball VFBGA	132-ball VFBGA, 48 TSOP	24-ball TBGA
	Validated PN[1]	MTFC16GAPALBH-IT					MT29F16G08CBACAWP:C MT29F128G08CBCEBJ4-37ITR:E MT29F128G08CFABBWP-12IT:B	MT29F1G01ABBFD12-AAT:F
	Recommended PN	MTFC8GAMALBH MTFC16GAPALBH MTFC32GAPALBH MTFC64GAPALBH MTFC128GAPALBH				MTFC8GAMALBH MTFC16GAPALBH MTFC32GAPALBH MTFC64GAPALBH MTFC128GAPALBH	MTF29 (L05B, L84A, L72A)	
SPI-NOR	Type	Quad SPI				Quad SPI		
	Family	MT25Q				256MB		
	Density	256MB				24-ball BGA (8mm x 6mm)		
	Package	24-ball BGA (8mm x 6mm)				MT25QU256ABA1EW7-0SIT		
	Validated PN[1]	MT25Q256ABA1EW9-0SIT[2]				MT25QU		
	Recommended PN	MT25Q				MT25QU		

1. The Micron part numbers specified are the ones validated on the board. Not all parts may be available currently. Please contact your local Micron sales representative for part availability or replacement parts if currently not available.
2. This Micron part is EOL'ed. Please contact Micron sales representative for replacement parts.

Micron® Memory Support for NXP® i.MX 8M Platforms

Save yourself time and money — Micron memory comes *validated* on NXP Platforms

Micron Memory		i.MX 8M Processor Memory					i.MX 8M Processor Memory		
		i.MX 8M Mini					i.MX 8M Nano		
DRAM	Type	DDR3L	DDR4	LPDDR4	LPDDR4		DDR3L	DDR4	LPDDR4
	Family	MT41K	MT40A	MT53	MT53		MT41K	MT40A	MT53
	Density	4, 8GB	8, 16GB	4, 8, 16, 32GB	4, 8, 12, 16, 24, 32GB		4GB	8, 16GB	4, 8, 16, 32GB
	Configuration	x16	x16	x16	x32		x16	x16	x16
	Package	96-ball TFBGA	96-ball TFBGA	200-ball FBGA	200-ball FBGA		96-ball TFBGA	96-ball TFBGA	200-ball FBGA
	Validated PN[1]	MT41K256M-16TW-107	MT40A512M-16LY-075:E	MT53D512M16D1DS-046 MT53E256M16D1DS-046 MT53E128M16D1DS-053	MT53D512M32D2DS-053		MT41K256M16TW-107	MT40A1G16RC-062E:B MT40A1G16KD-062E:E	
	Recommended PN	MT41K256M16 MT41K512M16	MT40A512M16 MT40A1G16	MT53E128M16D1 MT53E256M16D1 MT53D512M16D1 MT53E1G16D1	MT53E128M32D2 MT53E256M32D2 MT53E384M32D2 MT53D512M32D2 MT53E512M32D2 MT53D768M32D2 MT53D1024M32D4		MT41K256M16	MT40A512M16 MT40A1G16	MT53E128M16D1 MT53E256M16D1 MT53D512M16D1 MT53E1G16D1
	Qty/Board	2	1/2	1	1		1	1	1
NAND/ e.MMC	Type	e.MMC					e.MMC		
	Family	MTFC					MTFC		
	Density	8, 16, 32, 64, 128GB					8, 16, 32, 64, 128GB		
	Configuration	x8					x8		
	Package	153-ball VFBGA					153-ball VFBGA		
	Validated PN[1]								
	Recommended PN	MTFC8GAMALBH MTFC16GAPALBH MTFC32GAPALBH MTFC64GAPALBH MTFC128GAPALBH					MTFC8GAMALBH MTFC16GAPALBH MTFC32GAPALBH MTFC64GAPALBH MTFC128GAPALBH		
SPI-NOR	Type	Quad SPI					Quad SPI		
	Family	MT25Q					MT25Q		
	Density	256MB					256MB		
	Package	24-ball BGA (8mm x 6mm)					24-ball BGA (8mm x 6mm)		
	Validated PN[1]	MT25QU256ABA1EW7-0SIT					MT25QU256ABA1EW9-0SIT		
	Recommended PN	MT25QU					MT25QU		

1. The Micron part numbers specified are the ones validated on the board. Not all parts may be available currently. Please contact your local Micron sales representative for part availability or replacement parts if currently not available.
2. This Micron part is EOL'ed. Please contact Micron sales representative for replacement parts.

Micron® Memory Support for NXP® i.MX 8XLite Platforms

Save yourself time and money — Micron memory comes *validated* on NXP Platforms

Micron Memory		i.MX 8XLite Processor Memory			i.MX 8XLite Processor Memory
		i.MX 8XLite Dual/Solo			i.MX 8XLite Dual/Solo
DRAM	Type	DDR3L	DDR4		LPDDR4
	Family	N/A	N/A		MT53
	Density				8GB, 16GB
	Configuration				x16
	Package				96-ball TFBGA
	Validated PN[1]				MT53D512M16D1DS-046 AAT:D MT53E1G16D1FW-046 AAT:A
	Recommended PN				MT53D512M16 MT53E1G16
	Qty/Board				1
NAND/ e.MMC	Type	e.MMC			e.MMC
	Density	32GB			32GB
	Configuration	x8			x8
	Package	100-ball LBGA, 153-ball VFBGA			100-ball LBGA, 153-ball VFBGA
	Validated PN[1]	MTFC32GAPALGT-AIT MTFC32GAPALGT-AAT			MTFC32GAPALGT-AIT MTFC32GAPALGT-AAT
	Recommended PN	MTFC32GAPALNA MTFC32GAPALHT MTFC32GAZAQDW MTFC32GAZAQHD			MTFC32GAPALNA MTFC32GAPALHT MTFC32GAZAQDW MTFC32GAZAQHD
SPI-NOR	Type	Quad SPI			Quad SPI
	Family	MT25Q			MT25Q
	Density	128MB, 256MB, 512MB, 1GB, 2GB			128MB, 256MB, 512MB, 1GB, 2GB
	Package	8-WPDFN, 16-SOIC, 24-ball BGA			8-WPDFN, 16-SOIC, 24-ball BGA
	Validated PN[1]	MT25QU512ABB8ESF-0AAT			MT25QU512ABB8ESF-0AAT
	Recommended PN	MT25QU MT25QL			MT25QU MT25QL

1. The Micron part numbers specified are the ones validated on the board. Not all parts may be available currently. Please contact your local Micron sales representative for part availability or replacement parts if currently not available.

Micron® Memory Support for NXP® i.MX 8M Platforms

Save yourself time and money — Micron memory comes *validated* on NXP Platforms

Micron Memory		i.MX 8 Processor Memory		i.MX 8 Processor Memory	
		i.MX 8 Quad Max, i.MX 8 Quad Plus, i.MX 8 Quad		i.MX 8 Quad X Plus, i.MX 8 Dual X Plus, i.MX 8 Dual X	
DRAM	Type	LPDDR4		LPDDR4	DDR3
	Family	MT53B		MT53B	MT41K
	Density	32GB		32GB	4GB
	Configuration	512 Meg x 32		512 Meg x 32	256 Meg x 16
	Package	200-ball FBGA		200-ball FBGA	96-ball FBGA
	Validated PN	MT53D1024M32D4DT-046 AAT:D		MT53D1024M32D4DT-046 AAT:D	MT41K256M16TW-093
	Qty/Board	2		1	3
NAND/ e.MMC	Type	e.MMC (5.0)		e.MMC (5.0)	
	Family	MTFC		MTFC	
	Density	32GB		32GB	
	Package	153-ball VFBGA		153-ball VFBGA	
	Validated PN	MTFC32GAKAEEF-AIT		MTFC32GAKAEEF-AIT	
NOR	Type	Xccela™ Flash (Octal SPI), Serial (Quad SPI)		Xccela™ Flash (Octal SPI), Serial (Quad SPI)	
	Family	MT35X, MT25T, MT25Q		MT35X, MT25T, MT25Q	
	Density	512MB		512MB	
	Package	25-ball BGA (8mm x 6mm)		25-ball BGA (8mm x 6mm)	
	Validated PN	MT35XU512ABA1G12-0AAT		MT35XU512ABA1G12-0AAT	

*MT41K family supports both 1.5V and 1.35V power supply and is backward compatible with MT41J family.

Qualcomm® IoT Application Processors and Board Solutions

Qualcomm IoT Application Processors are products of Qualcomm Technologies, Inc. and/or its subsidiaries.

Qualcomm

Qualcomm IoT Application Processors

Make the Next Generation of Devices more Aware, Connected, and Interactive

Qualcomm Technologies application processors are driving innovation beyond the smartphone and powering the next generation of high-tech devices for the Internet of Things, making them more aware, connected, intelligent & interactive.

- **AI for differentiated user experiences:** On-device machine learning through the Qualcomm® AI Engine can support AI use cases including face detection, face recognition, object detection/tracking, and people counting
- **Integrated audio and camera support:** Purpose-built for the unique requirements of the IoT and optimized for multiple applications with support for camera, audio, voice UI, and hardware-based security
- **Integrated connectivity:** Integrated wireless Bluetooth and Wi-Fi connectivity make Qualcomm Technologies application processors ideal for innovative IoT applications. Purpose-built for a variety of uses including smart cameras, smart displays, and smart appliances, plus robotics, digital signage, industrial handhelds, and POS payment devices
- **Low power, high-performance:** These platforms are optimized for high-performance computing — built to power today's demanding IoT products with a low-power architecture by balancing the workload across internal components for long battery life

Members of the Qualcomm® Advantage Network Program

ADLINK LEADING EDGE COMPUTING

eInfochips An Arrow Company

LANTRONIX

PENGUIN SOLUTIONS

Thundercomm

Compare Qualcomm IoT Application Processors

	Processor	CPU Clock Speed	CPU Cores	CPU Architecture	DSP Technology	Wi-Fi Standards	Bluetooth® Version		GPU	Camera	Video	OS	Size	Extended Life	Applications
Premium Tier	Qualcomm® QCS8250	Up to 2.84 GHz	8x Qualcomm® Kryo™ 585 CPU	64-bit	Qualcomm® Hexagon™ V66Q DSP	2x2 802.11ax MIMO	5.1		Qualcomm® Adreno™ 650 GPU	64 MP	4K120	Android	1099 MPSP (LPDDR5) 14.0 x 12.4 x 0.56 mm 0.35mm pitch	✓	Connected cameras, digital Signage/shelf labels, retail
	Qualcomm® QRB5165	Up to 2.84 GHz	8x Kryo 585 CPU	64-bit	Hexagon 698 DSP	2x2 802.11ax MIMO	5.1		Adreno 650 GPU	64 MP	4K120	Linux/Ubuntu	1099 MPSP (LPDDR5) 14.0 x 12.4 x 0.56 mm 0.35mm pitch	✓	Robotics
High Tier	Qualcomm® QCS610	Up to 2.2 GHz	8x Kryo 360 CPU	64-bit	Hexagon 685 DSP	1x1 802.11ac	5.0		Adreno 612 GPU up to 845 MHz	24 MP	4K30	Linux	806 PSP 11.1 × 12 × 0.92 mm 0.35 mm pitch	✓	Robotics, connected cameras, smart assistants, retail, kiosks/vending machines, control panels/ industrial panels
Mid Tier	Qualcomm® QCS4290	Up to 2.0 GHz	8x Kryo 260 CPU	64-bit	Hexagon 683 DSP	1x1 802.11ac 11ax ready	5.1		Adreno 610 GPU up to 950 MHz	48 MP	1080p60	Android	752 NSP 12.0 × 12.4 × 0.91 mm; 0.4 mm pitch	✓	Robotics, connected cameras, retail, control panels/industrial panels, industrial handheld scanners
	Qualcomm® QCS410	Up to 2.2 GHz	4x Kryo 360 CPU	64-bit	Hexagon 683 DSP	1x1 802.11ac	5.0		Adreno 612 GPU up to 845 MHz	21 MP	1080p30	Linux	806 PSP 11.1 × 12 × 0.92 mm 0.35 mm pitch	✓	Robotics, connected cameras, smart assistants, retail, kiosks/vending machines, control panels/ industrial panels
Entry Level	Qualcomm® QCS2290	Up to 2.0 GHz	4x Arm Cortex A53 CPU	64-bit	Hexagon V66 DSP	1x1 802.11ac	5.0		Adreno 702 GPU up to 845 MHz	25 MP	1080p30	Android	752 NSP 12.0 x 12.4 x 0.91 mm 0.4 mm pitch	✓	Connected cameras, retail, control panels/industrial panels

Qualcomm

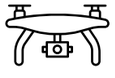
Application Processors

IoT Product Segments and Use Cases

Robotics

- In-store service robots to provide directions and product information to customers
- Inventory robots track shelving stock and even grab objects for customers
- Delivery robots bring the store to the customer autonomously
- Companion robots to keep an eye on the kids while playing in the yard and send alerts in case of unusual activities
- Household robots to vacuum, clean, and perform other shores around the house

- QRB5165
- QCS610
- QCS4290
- QCS410



Connected Cameras

- Intelligent motion detection can analyze video in real-time and detects valid motion in a scene. It filters out “noise” such as lighting changes, natural tree movements, water movements, small animals, and even small video artifact noise
- Object tracking tracks objects of interest and draws bounding boxes around them
- Camera tamper detection identifies any event that significantly changes the field of view of the camera
- Face detection and recognition detects and recognizes people from an on-device database
- Body cams, dash cams, sports cameras, surveillance
- Collaboration systems, such as conference systems with high-quality video/audio and AI

- QCS8250
- QCS610
- QCS4290
- QCS2290
- QCS410

Digital Signage/Shelf Labels

- More targeted signage with analytics through facial recognition, edge processing, and AI
- Enhanced interactive and bonding experience by integrating touch, voice, gestures, location and camera
- Display standards-based bi-directional, secure communication, driving display and sensors
- Camera customer engagement/counting via anonymous edge processing

- QCS8250

Smart Assistants

- Connected device that responds to voice commands and displays relevant information, including reminders, alerts, to-do lists, stream music and video
- Integrated camera for face detection, recognition, gesture commands, while supporting video calling
- Integrated sensors for temperature and light control as well as other appliances

- QCS610
- QCS410

Retail

- Handheld POS, electronic cash registers
- Eliminate overstocks and out of stocks
- Adjusting prices
- Product organization on shelves with multimedia video ads
- In-store assistance — cashier v. customer view
- Predict and influence customer behavior
- Self-service kiosk & checkout — cashier-free stores

- QCS8250
- QCS610
- QCS4290
- QCS410
- QCS2290

Kiosks/Vending Machines

- Product locator, price checking, way finding
- Advertising, ordering and checkout, store pickup
- Magic mirror (Augmented Reality)
- Vending machines with camera, facial detection, and recognition

- QCS610
- QCS410

Smart Appliances

- Connected appliance that can be triggered to start, pause and stop remotely
- Connected appliance that can be operated with voice commands
- Smart fridge with integrated smart assistant and internal cameras to look up recipes, jot down notes, and send them to family members' phones (and vice versa), peak at the contents inside the fridge, control other devices and perform general searches or stream music

Control Panels/Industrial Panels

- Automation control
- Remote operation, set-up, and control including ability to see what’s going on at home or place of business
- Monitor and control devices such as safety lights, doors, and other sensors
- Program alerts
- Monitor and control power consumption, temperature, access, schedules and collaboration

- QCS610
- QCS4290
- QCS410
- QCS2290

Industrial Handheld Scanners

- Superior bar code scanning and image capture in low light.
- Fast scanning/returns
- Enhanced picture quality with low-power usage
- Inventory management which is accurate and real-time
- Staff collaboration

- QCS4290
- QCS2290

QCS8250 Application Processor

The premium-tier QCS8250 processor is designed to help you deliver maximum performance for compute-intensive camera and Edge AI applications with Wi-Fi 6 and 5G for the Internet of Things (IoT).

Features

- Adreno GPU 650 with improved GFx benchmark and perf/W Native 8-bit integer support for efficient GPU DNN
- Native 8-bit integer support for efficient GPU DNN
- Hexagon DSP with Quad Hexagon Vector Extensions (HVX) V66Q, 1.5 GHz, for machine learning, integrated DNN for advanced VA and Qualcomm® Neural Processing SDK framework
- Kryo 585 CPU with 4x Kryo Gold (2.85GHz) + 4x Kryo Silver (1.8 GHz) w/ 4MB L3 cache
- Camera: Dual 14-bit Qualcomm Spectra™ 480 ISP support 64MP single camera capture
- Support for up to 24 cameras or seven concurrent cameras
- Superior image quality in zzHDR, video denoising, mid/low-frequency denoising, lens shading correction, video super-resolution
- Supports triple 4K display
- Video/display: Concurrent UHD encode/decode, 3X display port, MIPI-DSINPU
- Option for long term support with extended life hardware and software support through 2025

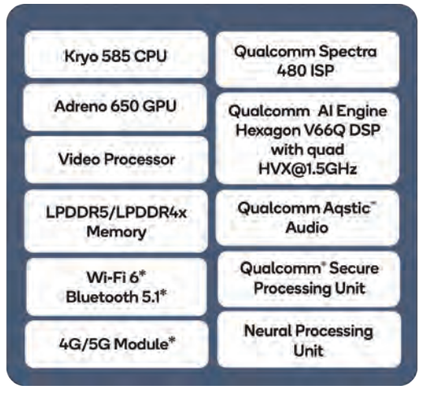
Target Applications

- Connected cameras
- Retail self checkout
- Video collaboration
- Digital signage
- Fleet management
- Healthcare

QCS8250 Specifications

	QCS8250
Process Node/Package	7 nm FFP, 12.4 x 12.7mm LP4, 12.4 x 14mm LP5 MEP
CPU	Kryo 585 CPU, octa-core 64-bit Arm V-8 compliant
Memory	Quad-channel PoP high-speed LPDDR5/LPDDR4x SDRAM up to 2750 MHz (LPDDR5)
Camera	Dual ISP: 64 MP @ 30fps ZSL
Video	Decode : 8K60/4K120; Encode : 8K30/4K120
GPU	Adreno 650 GPU
Compute DSP	Hexagon DSP with Quad HVX V66Q, 1.5 GHz
Machine Learning	Dedicated NPU 230
Modem	5G modem attach with support for sub-6GHZ and mmWave
I/O Storage	UFS 3.0 gear 4 (2 lane) + UFS 2.1, SD 3.0, Two USB 3.1 ports, support Type-C with display port v1.4 in one port
Wireless Connectivity	WLAN 2 x 2 802.11ax with DBS, Bluetooth® 5.1
Display	Adreno 995 DPU, supports up to three 4K display, 2x 4-Lane DSI, display port, and miracast support.
Location	GPS, Glonass, BeiDou, Galileo, QZSS, and SBAS
Security	Dedicated SPU with Improved Crypto
Operating System	Android

QCS8250 Block Diagram



*Supported with a companion module

Ordering Information

- **Product:** QCS8250 SoC
- **Part Number*:** QCS-8250-0-MPSP1099

* Part numbers are subject to change. Please check with the distributor for most accurate ordering information.

Commercial Modules and Development Tools

eInfochips QCS8250 SoM
by eInfochips

Open-Q™ QCS8250 SoM
by Lantronix

COMING SOON

TurboX™ C865 SoM
by Thundercomm Technology

eInfochips QCS8250 Dev Kit
by eInfochips

Qualcomm® HDK865 Dev Kit
by Qualcomm® Technologies

TurboX™ C865 Dev Kit
by Thundercomm Technology

QRB5165 Application Processor

The premium-tier QRB5165 processor is designed to help you build smarter and powerful consumer, enterprise, or industrial robots with on-device AI and 5G connectivity, and more.

Features

- Qualcomm Spectra 480 image signal processor designed to deliver a premium camera experience that can process 2 Gigapixels per second with high-performance capture of 200-megapixel photos, 8K video recording, and 4K HDR video capture
- Adreno 650 visual processing subsystem delivers quality graphics for larger-than-life immersive experiences using the Adreno graphics processing unit (GPU) and video processing unit (VPU)
- Hexagon 698 DSP with HVX, Hexagon Tensor Accelerator (HTA), and Hexagon Scalar Accelerator to support sophisticated, on-device AI processing and delivers mobile-optimized computer vision (CV) experiences for wide array of use cases
- Kryo 585 CPU: Manufactured in 7nm process node, optimized across four high-performance Kryo Gold cores and four low-power Kryo Silver cores
- Qualcomm Secure Processing Unit offers vault-like security that is designed to help safeguard your facial data, iris scan, and other biometric data. It supports hardware root of trust, Qualcomm® Trusted Execution Environment (TEE), secure boot, and camera security
- Option for long term support with extended life hardware and software support through 2029

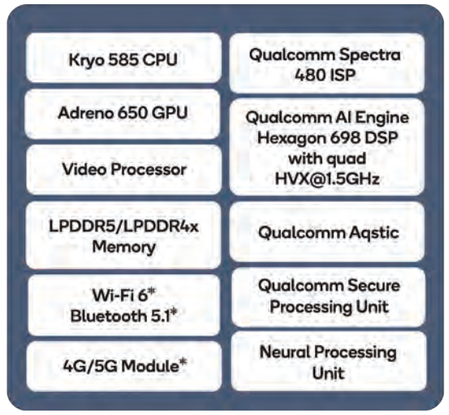
Target Applications

- Autonomous delivery vehicles
- Edge AI Box
- Commercial & enterprise drones
- CoBots & intelligent machines

QRB5165 Specifications

	QRB5165
Package	12.4x12.7mm LP4, 12.4x14mm LP5 MEP
CPU	Kryo 585 CPU, 64-bit, up to 2.84 GHz
ISP	Qualcomm Spectra 480 ISP with Dual 14-bit image signal processing
Camera	Dual ISP: 64 MP @ 30fps ZSL, Support for 12 cameras by D-PHY & 18 cameras by C-PHY (7 concurrent)
Video	Decode: 8K60/4K120; Encode: 8K30/4K120
GPU	Adreno 650 GPU w/ support for Open GL ES & Open CL
Compute DSP	Hexagon 698 DSP with HVX, HTA, and Hexagon Scalar Accelerator
Memory	LPDDR5 up to 2750 MHz, LPDDR4X up to 2133 MHz; Memory Density: up to 16 GB
Wireless Connectivity	WLAN 2 x 2 802.11ax with DBS, Bluetooth 5.1
Audio	Qualcomm Aqstic audio technology
Security	Camera security, crypto engine, cryptographic accelerator, Qualcomm TEE, secure boot, Qualcomm® Crypto Engine Core is FIPS 140-2 certified
Operating System	Ubuntu, Linux

QRB5165 Block Diagram



*Supported with a companion module

Ordering Information

- **Product:** QRB5165 SoC
- **Part Number*:** QRB-5165-0-MPSP1099

* Part numbers are subject to change. Please check with the distributor for most accurate ordering information.

Commercial Modules and Development Tools

eInfochips QRB5165 SoM
by eInfochips

Open-Q™ 5165RB SoM
by Lantronix

TurboX™C5165 SoM
by Thundercomm Technology

eInfochips QRB5165 Dev Kit
by eInfochips

Open-Q™ 865 Dev Kit
by Lantronix

Qualcomm® Robotics RB5 Platform Dev Kit
by Thundercomm Technology

Thundercomm EB5 AI Box
by Thundercomm Technology

Qualcomm TEE, Qualcomm Crypto Engine Core, Qualcomm Robotics RB5, Platform Dev Kit are products of Qualcomm Technologies, Inc. and/or its subsidiaries.

Qualcomm

QCS610/QCS410 Application Processor

QCS610 and QCS410 11nm SoCs are purpose-built to deliver high-performing, power-efficient edge computing for next-gen smart cameras and smart enterprise/home applications for the mid-tier segment.

Features

- Dual 14-bit Qualcomm Spectra 250L ISP capable of supporting up to dual sensors. 24 MP @ 30 fps with dual ISPs; each ISP capable of 16 MP
- Fabricated using the advanced 11nm FinFET process for exceptional thermal and power efficiency
- Adreno 612 GPU with 64-bit addressing @ up to 845MHz
- with dual HVX, 1.1Ghz for running DNN models, and advanced Qualcomm Neural Processing SDK support
- Up to eight Kryo 460 CPU cores optimized for power and DMIPS
- Qualcomm AI Engine designed to support on-device machine learning
- Low-power sensor core helps support always-on use cases at reduced power levels
- Option for long term support with extended life hardware and software support through 2025

Target Applications

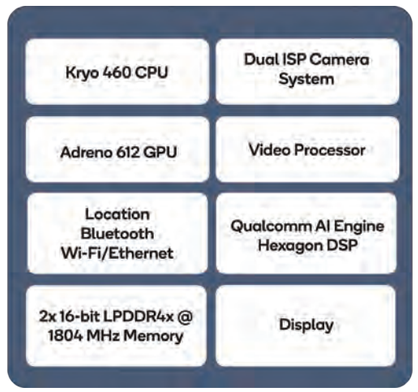
- Service/companion robots
- Industrial panels
- Enterprise surveillance camera/AI gateway
- Vending machines/kiosks
- Dash/body cameras
- Collaboration devices/ video conferencing

QCS610/QCS410 Specifications

		QCS410	QCS610
Technology/Package		11nm LPE, , 12x11.1 mm2 non-PoP	
CPU		Kryo 460 CPU: 64-bit quad-cores, 2x Gold (2.2GHz) + 2x Silver (1.8GHz)	Kryo 460 CPU: 64-bit octa-cores, 2x Gold (2.2GHz) + 6x Silver (1.8GHz)
Memory		2x 16-bit LPDDR4.x 1804MHz; eMMC 5.1, UFS 2.1 Gear3 1-lane, SD 3.0	
Location		GPS/GLONASS, BeiDou, Galileo	
Connectivity		Ethernet RGMII, Integrated 1x1 802.11a/b/g/n/ac, Bluetooth 5.0, FM	
PMIC		Qualcomm® PM6150 + Qualcomm® PM6150L	
Display	Resolution	2520x1080 60 fps + 1920x1200 60 fps (External)	
	Interface	1x4 lane DSI DPHY 1.2 support + DP over USB-C (external)	
Camera	performance	21MP (2x ISP/16+16MP), 1080p30 IQ improvement: MCTF, TNR, sHDR, EIS, Dewarp, Zoom	24MP (2x ISP/16+16MP), 4K30 IQ improvement: MCTF, TNR, sHDR, EIS, Dewarp, Zoom
	Interface	CSI 4+4+4 lane (or 4+4+2+1), DPHY1.2, CPHY 1.0	
Video	Decode	1080p 8-bit: HEVC/VP9	4K30 8-bit: HEVC/VP9
	Encode	1080p 8-bit HEVC	4K30 8-bit HEVC
GPU		Adreno 612 GPU @ up to 845MHz	
Audio	Analog	Integrated Qualcomm® WCD9370/ Qualcomm® WCD9341 codec + Qualcomm® WSA8810/ Qualcomm® WSA8815 speaker amplifier	
	Playback	Hi-Res/192kHz, Native 44.1kHz, audio on dedicated DSP	
Compute DSP		Hexagon DSP with dual HVX, 1.1Ghz	
Sensor DSP		Hexagon DSP based	
Peripherals		1x USB3.1 Type-C with display port and USB 2.0	
Operating System		Linux	

Qualcomm

QCS610/QCS410 Block Diagram



Ordering Information

- **Product:** QCS610 SoC, QCS410SoC
- **Part Number*:**
  QCS-610-0-PSP806
  QCS-410-0-PSP806

* Part numbers are subject to change. Please check with the distributor for most accurate ordering information.

Commercial Modules and Development Tools

eInfochips QCS610/QCS410 SoM
by eInfochips

Open-Q™ 610 µSoM
by Lantronix

TurboX™ C610/C410 SoM
by Thundercomm Technology

Open-Q™ 610 µSoM Dev kit
by Lantronix

eInfochips QCS610/QCS410 Dev kit
by eInfochips

TurboX™ C610/C410 Open Kit
by Thundercomm Technology

QCS4290 Application Processor

The QCS4290 application processor delivers greater performance, better AI Engine, and broader connectivity options compared to previous generations and delivers powerful performance, dynamic camera capabilities, and Wi-Fi 6-ready connectivity, ideal for industrial and commercial IoT applications.

Features

- Kryo 260 CPU, octa-core CPU architecture for increased[1] and sustained speeds
- 11 nm process technology for improved performance and lower[1] power consumption
- Dual frequency GNSS (L1 and L5) and support for India's NavIC satellite system
- Qualcomm® FastConnect™ 6100 system provides the Wi-Fi 6-ready subsystem, integrated with Bluetooth 5.1 and FM
- Dedicated Hexagon 683 compute DSP with dual Hexagon HVX at 1.0 GHz
- Qualcomm® Universal Bandwidth Compression with display and GPU
- Display support: FHD+, four hardware layers, 10-bit end-to-end, and Qualcomm® True Palette Display feature
- One 4-lane DSI D-PHY 1.2 at 1.5 Gbps per lane, split link supported
- 3x ISP (13 MP + 13 MP)/(25 MP + 5 MP) at 30 fps
- Three 4-lane CSIs (4/4/4 or 4/4/2/1) D-PHY 1.2 at 2.5 Gbps per lane or C-PHY 1.0 at 10 Gbps (3.42 Gbps/trio)
- Support for USB 3.1 Type-C
- Option for long term support with extended life hardware and software support through 2027

Target Applications

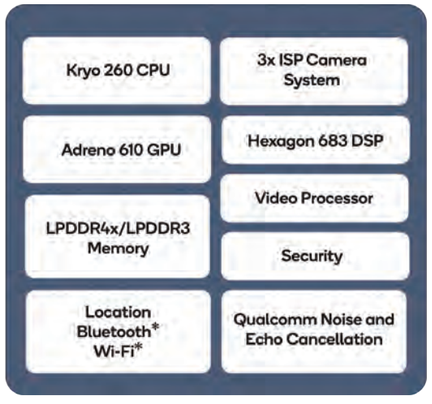
- Industrial handheld
- Security panels
- Cameras
- Robotics

QCS4290 Specifications

	QCS4290
Package	752 NSP, 12.0 × 12.4 × 0.91 mm; 0.4 mm pitch
CPU	8x Kryo 260 CPU from 1.8 up to 2.0 GHz
Memory & Storage	Dual channel, non-PoP high-speed memory: LPDDR4x SDRAM @ 1866 MHz clock (2 x 16 bit); LPDDR3 SDRAM @ 933 MHz clock (1 x 32 bit), eMMC5.1, SD3.0
Connectivity	WLAN 1 × 1 802.11a/b/g/n/ac, Bluetooth 5.0, and FM with Qualcomm® WCN3950 or Qualcomm® WCN3988 (1x1 ax ready)
Location	GPS, GLONASS, NavIC, BeiDou, Galileo, QZSS, and SBAS
GPU	Adreno 610 GPU @ 950 MHz with support for Open GL ES 3.2, Open CL 2.0, Vulkan 1.1
DSP	Hexagon 683 compute DSP with dual HVX @ 1.0 GHz
Display Support	Adreno 921 DPU
Camera Support	13 MP + 13 MP/25 MP + 5 MP at 30 fps or 16 MP + 16 MP at 24 fps
Multimedia	1080p60 8-bit decode for H.264/H.265/VP9, 1080p60 8-bit encode for H.264/H.265
Audio	Integrated low-power island (LPI) for voice UI, Qualcomm® Noise and Echo Cancellation, Qualcomm® Voice Suite
Security Features	Secure boot, crypto engines, key provisioning security, Qualcomm TEE, Qualcomm® Content Protection (Widevine), secure periphery, debug security
Operating System	Android

1 All comparisons to previous generations

QCS4290 Block Diagram



*Supported with a companion module

Ordering Information

- **Product:** QCS4290 SoC
- **Part Number*:** QCS-4290-0-NSP752

* Part numbers are subject to change. Please check with the distributor for most accurate ordering information.

Commercial Modules and Development Tools

TurboX™ C4290 SoM
by Thundercomm Technology

Open-Q™ QCS4290 SoM
by Lantronix

COMING SOON

Open-Q™ QCS4290 Dev Kit
by Lantronix

COMING SOON

TurboX™ C4290 Development Kit
by Thundercomm Technology

COMING SOON

QCS2290 Application Processor

The robust entry-level QCS2290 System-on-Chip delivers enhanced GPS and advanced camera features. It enables reliable performance and power conservation with upgraded features and memory support for low-power consumption.

Features

- Customized 64-bit Arm Cortex-A53 quad-core applications processor at up to 2.0 GHz
- Dedicated DSP shared between sensor core and low-power audio subsystem
- Adreno 702 GPU @ 845 MHz, 3D graphics accelerator with 64-bit addressing
- Qualcomm Universal Bandwidth Compression with GPU
- Display support: HD+, 720 × 1680 at 60 Hz, 10 bit end-to-end, and up to four hardware layer composition. Features Qualcomm® Low-power Picture Enhancement and Qualcomm True Palette Display
- One 4-lane DSI D-PHY 1.2 at 1.5 Gbps per lane, split link supported
- 2x ISP (13 MP + 13 MP or 25 MP) at 30 fps ZSL
- Two 4-lane CSIs (4/4 or 4/2/1) D-PHY 1.2 at 2.5 Gbps per lane or C-PHY 1.0 at 10 Gbps (3.42 Gbps/trio)
- Support for USB 3.1 Type-C/micro USB
- Always-on subsystem with RPM for power management
- Option for long term support with extended life hardware and software support through 2028

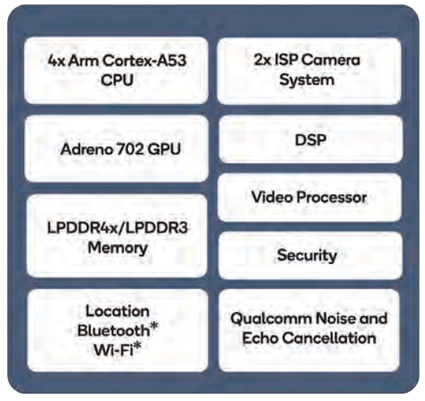
Target Applications

- Retail POS
- Industrial handheld
- Asset tracking
- Camera

QCS2290 Specifications

	QCS2290
Package	752 NSP, 12.0 × 12.4 × 0.91 mm; 0.4 mm pitch
CPU	4x Arm Cortex-A53 @ up to 2.0 GHz
Memory & Storage	Dual channel, non-PoP high-speed memory: LPDDR4x SDRAM @ 1804 MHz clock (2 x 16 bit); LPDDR3 SDRAM @ 933 MHz clock (1 x 32 bit)
Connectivity	WLAN 1×1 802.11a/b/g/n/ac, Bluetooth 5.0, and FM with WCN3950 or Qualcomm® WCN3910 (802.11b/g/n)
Location	GPS, GLONASS, NavIC, BeiDou, Galileo, QZSS, and SBAS
GPU	Adreno 702 GPU @ 845 MHz with support for Open GL ES 3.1, Open CL 2.0, Vulkan 1.1
DSP	Hexagon V66 DSP
Display Support	Adreno 920 DPU
Camera Support	13 MP + 13 MP or 25 MP at 30 fps ZSL
Multimedia	1080p30 8-bit decode for H.264/H.265/VP9, 1080p30 8-bit encode for H.264/H.265
Audio	Integrated Low-Power Island (LPI) DSP for voice UI, Qualcomm Noise and Echo Cancellation, Qualcomm Voice Suite
Security Features	Secure boot, secure debug, secure key provisioning, TrustZone, Qualcomm TEE
Operating System	Android

QCS2290 Block Diagram



*Supported with a companion module

Ordering Information

- **Product:** QCS2290 SoC
- **Part Number*:** QCS-2290-0-NSP752

* Part numbers are subject to change. Please check with the distributor for most accurate ordering information.

Commercial Modules and Development Tools

Open-Q™ QCS2290 SoM
by Lantronix

COMING SOON

Inforce QCS2290 SoM
by SMART Wireless

COMING SOON

TurboX™ CM2290/C2290 SoM
by Thundercomm Technology

Open-Q™ QCS2290 Dev Kit
by Lantronix

COMING SOON

Inforce QCS2290 Dev Kit
by SMART Wireless

COMING SOON

TurboX™ CM2290/C2290 Dev Kit
by Thundercomm Technology

ADLINK manufactures edge hardware and develops edge software for embedded, distributed, and intelligent computing — where failure isn't an option — to connect people, places, and machines. From powering medical PCs in intensive care units to building the world's first high-speed autonomous race car — thousands of customers around the world trust ADLINK for mission-critical success.

Key Strength and Value Proposition

At ADLINK, we help build and deploy Edge AI solutions to connect people, places, and things faster. Our leading-edge software, hardware, and services have been at the cutting edge of embedded computing and innovative technology for over 25 years, helping enterprises to remain competitive.

Services

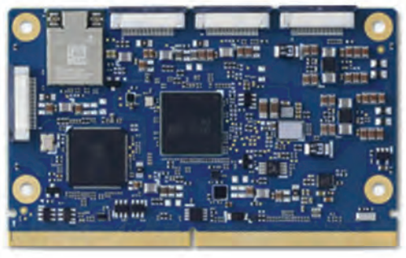
- EDGE AI devices provider

Core Offerings

Product Category	Processors Supported	Product Family Names	Software/Firmware Available
System on Modules	QRB5165	LEC-RB5	Canonical Ubuntu Yocto Linux Android (on request)

Featured Solutions for LEC-RB5

The ADLINK LEC-RB5 is a SMARC module powered by the QRB5165 SoC with 8 Arm® Cortex™-A77 cores and up to 15 TOPS Hexagon Tensor Accelerator. The module is designed for robotics and drone applications and integrates several IoT technologies in a single solution. The LEC-RB5 SMARC module provides on-device artificial intelligence (AI) capabilities, support for up to 6 cameras, and low-power consumption. It is capable of powering robots and drones in consumer, enterprise, defense, industrial, and logistics sectors.



Part Number	Description/Configuration
LEC-RB5-4G-64G-ER	SMARC 2.1 short size module with octo-core QRB5165, 4 GB LPDDR4, 64 GB UFS, -20°C to +85°C
LEC-RB5-4G-128G-ER	SMARC 2.1 short size module with octo-core QRB5165, 4 GB LPDDR4, 128 GB UFS, -20°C to +85°C
LEC-RB5-8G-128G-ER	SMARC 2.1 short size module with octo-core QRB5165, 8 GB LPDDR4, 128 GB UFS, -20°C to +85°C
LEC-RB5-8G-256G-ER	SMARC 2.1 short size module with octo-core QRB5165, 8 GB LPDDR4, 256 GB UFS, -20°C to +85°C
LEC-RB5-4G-64G-CT	SMARC 2.1 short size module with octo-core QRB5165, 4 GB LPDDR4, 64 GB UFS, 0°C to +60°C
LEC-RB5-4G-128G-CT	SMARC 2.1 short size module with octo-core QRB5165, 4 GB LPDDR4, 128 GB UFS, 0°C to +60°C
LEC-RB5-8G-128G-CT	SMARC 2.1 short size module with octo-core QRB5165, 8 GB LPDDR4, 128 GB UFS, 0°C to +60°C
LEC-RB5-8G-256G-CT	SMARC 2.1 short size module with octo-core QRB5165, 8 GB LPDDR4, 256 GB UFS, 0°C to +60°C

eInfochips (An Arrow Company) is a full-service design house, providing services across the product stack. With over 500+ products developed and 40M deployments in 140 countries, eInfochips continues to fuel technological innovations in multiple verticals. eInfochips is a licensee of Qualcomm Technologies processors and offers SoMs, development kits, and custom designs for companies to accelerate their time-to-market.

Key Strength and Value Proposition

- 25+ years of engineering excellence
- 30+ Qualcomm Technologies' designs; 15+ successfully deployed
- Design to manufacturing expertise
- State-of-the-art lab & infrastructure
- Experts in wearable, AI/ML & robotics

Services

- Hardware and firmware engineering
- Industrial and mechanical engineering
- AI/ML (Edge/Cloud), image tuning
- Cloud and DevOps, QA

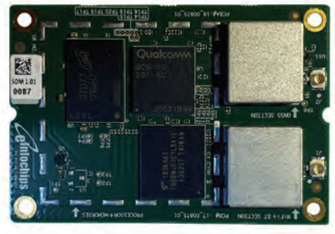
Core Offerings

Product Category	Processors Supported	Product Family Names	Software/Firmware
System on Modules	QCS610, QCS410, QCS8250, QRB5165, Qualcomm® SD820, Qualcomm® SD624 Upcoming: QCS4290, QCS2290, Qualcomm® QRB4210, Qualcomm® QCS404, Qualcomm® QCS405	eInfochips QCS610, eInfochips QCS8250, SD for IoT QRB for robotics	Android/Linux
Single Board Computers	Qualcomm® SDA660	eInfochips 660	Android/Linux
Boxed Products	Camera QCS610, Qualcomm® QCS603	AI vision kit	Android/Linux
Development Kit	QCS610, QCS410, QCS8250, QRB5165, Qualcomm® SDA845, Qualcomm® SDA855, Qualcomm® SM8250 Upcoming: QCS4290/QCS2290, QRB4210, QCS404/QCS405	eInfochips QCS610, SDA, SM for IoT, QRB for robotics	Android/Linux

eInfochips QCS610 Modules and Kits

eInfochips has launched System-on-Module and the kit is based on the QCS610 SoC. The module offers multiple connectivity solutions with integrated Wi-Fi 802.11a/b/g/n/ac and Bluetooth 5.0. The design is also pin-compatible and software compatible with QCS410 in addition to SoM, eInfochips also offers a development kit that supports wide range of codecs (HEVC, AVC, MJPEG)

- Dimension: 39mm x 58mm
- 2GB LPDDR4, 16GB eMMC 5.1
- Video encode and decode up to 4K30
- 3x 4-Lane MIPI CSI camera
- Qualcomm® Wi-Fi Technology (WCN3980) 802.11a/b/g/n/ac; Bluetooth 5.0

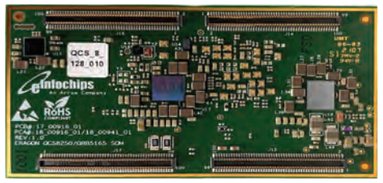


Part #:
SoM: EIC-QCS610-200
Development Kit: EIC-QCS610-210

eInfochips QCS8250 Modules and Kits

High-performance module based on QCS8250. It integrates the advanced 7 nm Fin FET process, 64-bit octa-core Kryo 585 CPU, Hexagon DSP, Adreno 650 GPU, Qualcomm Spectra 480 image signal processors, sensor core, secure processing unit, and neural processing unit. Multiple cameras with six 4-lane CSI input interfaces

- Dimension: 59.7mm x 32.2mm
- 8GB LPDDR5 (PoP); 64GB UFS 3.1
- Wi-Fi, Wi-Fi 6 (Wi-Fi 802.11 a/b/g/n/ac/ax) and Bluetooth 5.1
- 4K120/8K30 encode and decode



Part #:
SoM: EIC-QCS8250-200

Lantronix Inc. (NASDAQ: LTRX) is a global provider of secure turnkey solutions for intelligent IT and the Internet of Things (IoT) market. Lantronix enables its customers to provide reliable and secure IoT Intelligent Edge and OOBM solutions while accelerating time to market.

Services

In addition to our production-ready Edge AI computing solutions, Lantronix has an experienced multidisciplinary engineering team that can complete all aspects of IoT product development.

- Camera development
- Hardware and software engineering
- Mechanical engineering

Embedded IoT Solutions — Compute SoMs and Development Kits

Product Category	Processors Supported	Product Family Names	Software/ firmware Available
System on Modules	QRB5165	Open-Q™ (based on Qualcomm Technologies chipsets)	Linux based on Yocto Thud — kernel v4.14, Android™ 10
Development Kit	QCS610	Open-Q™ (based on Qualcomm Technologies chipsets)	Linux based on Yocto Thud — kernel v4.14, Android™ 10

Key Strength and Value Proposition

- Lantronix offers embedded solutions for the development, connectivity, and production of high-performance and innovative Internet of Things (IoT) products
- Device makers and developers can start with Lantronix's versatile development kits to jumpstart their product development, or a vertical market-specific solution for applications in drones, robotics, wearables, automotive, smart cities, and more!
- With cutting-edge technology and solutions, Lantronix's robust portfolio of embedded servers and gateways simplifies and streamlines OEMs smart connected products to market

Open-Q™ 5165RB SoM (System on Module)

Production-ready SoM based on the QRB5165 SoC with Ubuntu Linux OS

- Kryo 585 octa-core CPU
- Adreno 650 GPU & Hexagon 698 DSP
- Dimensions 50 mm x 29 mm

Part #: QRB5165-SoM-A

Open-Q™ 610 µSoM (Micro System on Module)

Production-ready SoM (System on Module) based on the QCS610 SoC

- Kryo 460 octa-core CPU, Adreno 612 GPU, Hexagon DSP
- Dimensions 50 mm x 25 mm
- Yocto Linux connected camera SDK

Part #: QC-DB-V10003P

PENGUIN SOLUTIONS

Penguin Solutions, a manufacturer based in Newark, CA, is a fast-growing developer of high-performance production-ready ARM® ISA-based embedded computing platforms for IoT applications. Enhanced by key collaborations with Qualcomm Technologies Inc, Penguin Solutions designs and manufactures Snapdragon processor-based hardware platforms.

Key Strength and Value Proposition

- Global footprint & logistics
- Customized support plans
- Long supply life & fast time-to-market

Services

- Manufacturing
- Custom hardware & software design flexible lifecycle & engineering support

Qualcomm Technologies Processor-Based SoMs, SBCs, Application-Specific Platforms, and Development Kits

Product Category	Processors Supported	Product Family Names	Software/ Firmware Available
System on Modules	QCS410, QCS610, SDA660, SD820, SD845, QCS8250/Qualcomm® SD865	IFC63XX, IFC64XX, IFC65XX, IFC66XX, IFC67XX, IFC68XX	Android/Linux
Single Board Computers	Qualcomm® SD410, SDA660, SD820	IFC6309X, IFC6560, IFC6640	Android/Linux
Boxed Products	Qualcomm® SD450, SD820, SD845	IFC6310, IFC6620, IFC6720	Android/Linux
Development Kit	Same as SoMs	Same as SoMs	Same as SoMs

Inforce 68A1 Micro SoM

- The Inforce 68A1 Micro SoM is a high-performance System on Module (SoM) solution for embedded systems designers
- Based on Qualcomm Technologies' custom octa-core 64-bit Kryo (585) CPU (QCS8250) processor for IoT applications.
- The plug-and-play Inforce 68A1 micro SoM comes in a small form factor of 35mm x 53mm
- Includes Adreno 650 GPU + Hexagon 690 DSP + Qualcomm Spectra 480 ISP + Adreno DPU995 display engine

SoM: IFC68A1-00-P1
Dev Kit: SYS68A1-00-P1

Inforce 6403 Nano SoM

- Inforce 6403 is a small-sized production-ready Nano SoM of just 1398 mm sq that enables concurrent 4K@30 fps camera to encode and 4K@30 fps display output
- Designed exclusively to drive power-efficient use cases that need integrated connectivity and machine learning such as Industrial IoT, body cams, and dash cams
- Based on Qualcomm Technologies' customized 64-bit octa-core ARM® V-8 compliant Kryo 460 CPU
- Includes Adreno 612 GPU + Hexagon 685 DSP

SoM: IFC6403-10-P1
Dev Kit: SYS6403-10-P1
Dev Kit w/ Cellular: SYS6403-11-P1

Thundercomm

As a global IoT technology and solution provider, Thundercomm is working with variety of partners together including semiconductor, operating system (OS), AI, camera/optical, audio/acoustic, etc. to provide comprehensive end-to-end solutions for OEM/ODM, enterprises, and developers in a wide range of industries including smart camera, robotic/drone, VR/AR, wearable, smart audio, and industrial IoT to accelerate the process from the product prototype to mass production.

Key Strength and Value Proposition

- SoM, Linux/Android/RTOS, IoT cloud system, computer vision/AI
- Our value proposition: Full-stack IoT product and solution provider

Services

- PCBA design/production
- OS customization/ optimization
- CV algorithm dev/image quality Tuning
- AI algorithm dev/model training
- Cloud system customization/ deployment

Core Offerings

Product Category	Platforms	Product Family Names	Software/ Firmware Available
System on Modules	Qualcomm IoT application processors	TurboX	Yes
5G Modules	Snapdragon X55, Snapdragon X62, Snapdragon X65	TurboX	Yes
CV/AI Algorithm	Processors		Yes
Edge Box	Qualcomm® AIC100, QRB5165, QCS610, QCS410	EB-x	Yes
White Label Camera	QCS610, QCS410	Blink	Yes
IoT Cloud System	AWS, Azure, Aliyun, Customer Private Cloud	IoT harbor, model farm	No

TurboX Edge Box

- Software-defined edge computing system
- Intelligent video analysis*
- Advanced 5G connectivity
- Edge-cloud synergy

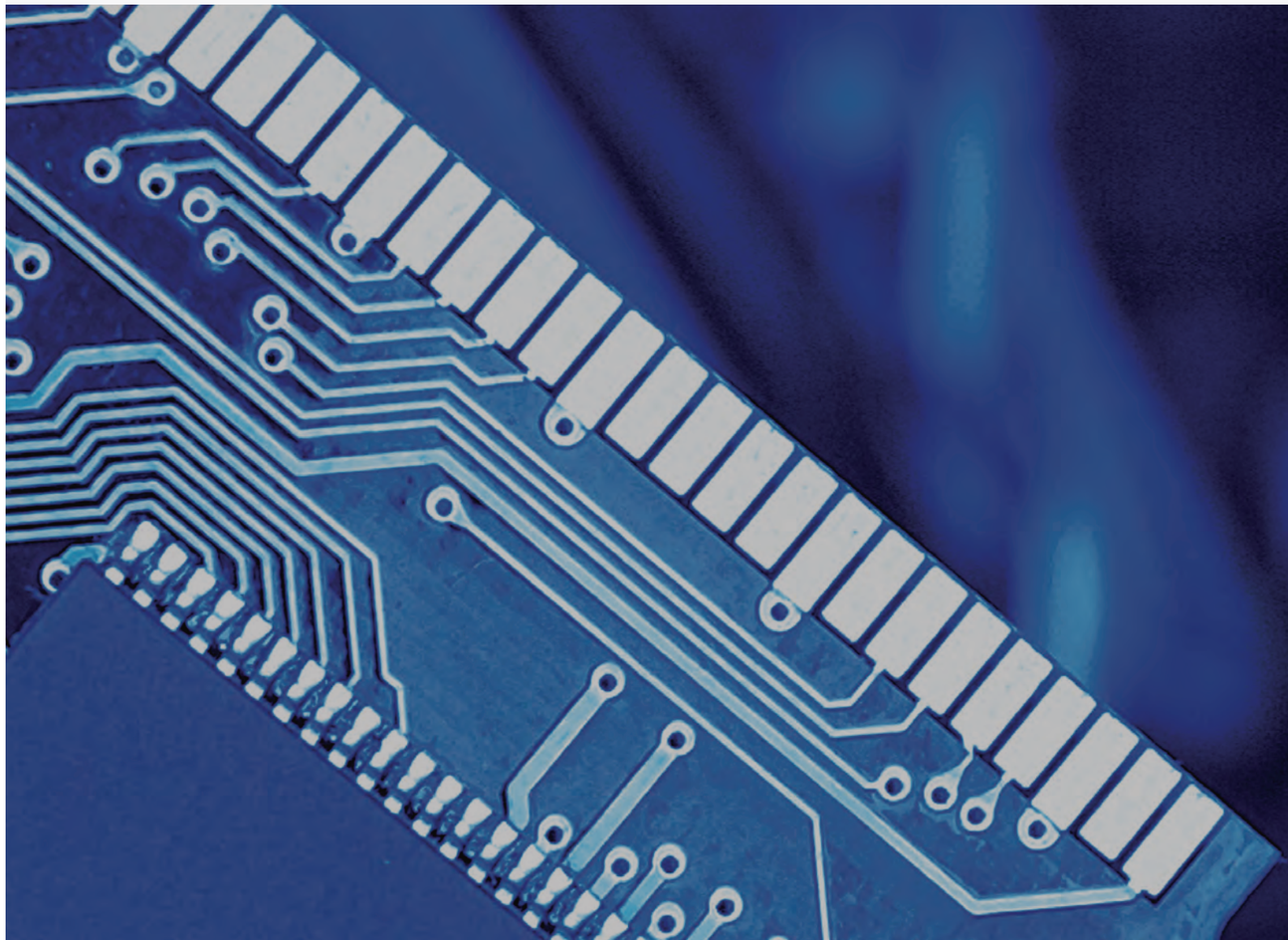
*__Rich AI Algorithms:__ Face detection, face recognition, object recognition, license plate recognition, fire detection, boundary detection, fall detection etc.

TurboX EB6

Smart Video Conference Solution

- Thundercomm is a total solution supplier for our customers. Based on our SoM platform, we are willing to help our customer or their ODM partner on not only the PCBA design and manufacture but also the whole software solution
- Besides BSP and OS systems, we are experienced in camera flow design, audio/video latency optimization, camera algorithm, and also AI algorithms (people counting, auto-framing, speaker tracking, etc
- Thundercomm has rich experiences in supporting our customers to pass MSFT teams certification

Arrow STMicroelectronics Board and Box-Level Solutions



TOC ⟶

STM32MP1 Microprocessor Series with Dual Arm® Cortex®-A7 and Cortex®-M4 Cores

A general-purpose microprocessor portfolio enabling easy development for a broad range of applications, the STM32MP1 series is based on a heterogeneous single or dual Arm Cortex-A7 and Cortex-M4 cores architecture, strengthening its ability to support multiple and flexible applications, achieving the best performance and power figures at any time. The Cortex-A7 core provides access to open-source operating systems (Linux/Android) while the Cortex-M4 core leverages the STM32 MCU ecosystem.

The STM32MP1 comes with many benefits including a rich development ecosystem:

- Mainlined open-source Linux distribution with Android support available via partners
- STM32Cube firmware and embedded software libraries for Cortex-M4 core
- An optional 3D graphics processing unit (GPU) provides for advanced HMI development
- Rich set of digital and analog peripherals
- Advanced security features
- Optimized bill of materials (BOM) thanks to: High integration, packages compatible with low-cost PCB technologies (down to 4-layer plated-through hole (PTH) PCBs), and dedicated Power Management IC (PMIC)
- Advanced tools from ST a++nd partners
- Best-in-class local and online support
- Worldwide distribution channels
- Rolling 10-year longevity commitment renewed every year

Targeted Applications

- Industrial
- Home
- Consumer
- Health and Wellness

Core

- Arm® Dual Cortex®-A7 up to @ 800 MHz
- Arm® Cortex®-M4 core @ 209 MHz

External Memories Support

- DDR3, DDR3L, LPDDR2, LPDDR3
- SLC NAND, SPI NAND
- eMMC, SD card, Quad-SPI NOR

Internal Memories

- System RAM 256kb
- MCU RAM 484kb

Analog

- 2x 16-bit ADCs
- 2x 12-bit DACs

Graphics

- 3D GPU OpenGL ES 2.0
- LCD-TFT controller
- MIPI-DSI 2 lanes

Security

- TrustZone
- AES 256, TDES
- SHA-256, MD5, HMAC
- Secure boot, RAMs & Peripherals

Other

- Up to 176 GPIOs
- Up to 125°C supported as maximum junction temperature

STM32 Ecosystem with Support for Open-Source Operating Systems

Developers familiar with the Cortex®-M4 MCU environment will easily find their marks as they will be able to use the same STM32Cube toolset including GCC-based IDEs, STM32CubeProgrammer, and STM32CubeMX, which includes the DRAM interface tuning tool for easy configuration of the DRAM subsystem.

When developing for the Arm® Cortex®-A7 core, ST helps eliminate potential roadblocks through the development of its mainlined open-source OpenSTLinux Distribution to ensure that porting application software is fast and easy.

An extensive third-party ecosystem is available to help developers thanks to the ST partner program.

Flexible Architecture

The single or dual Cortex-A7 cores are dedicated to open-source operating systems while the Cortex-M4 core is dedicated to real-time and low-power tasks.

- Dual Cortex®-A7 cores running at 800 MHz
  - 32-Kbyte L1 instruction cache
  - 32-Kbyte L1 data cache
  - 256-Kbyte level 2 cache
- Cortex®-M4 core running at 209 MHz
  - A single-precision floating-point unit (FPU)
  - A full set of digital signal processor (DSP) instructions
  - Memory protection unit for enhanced application security

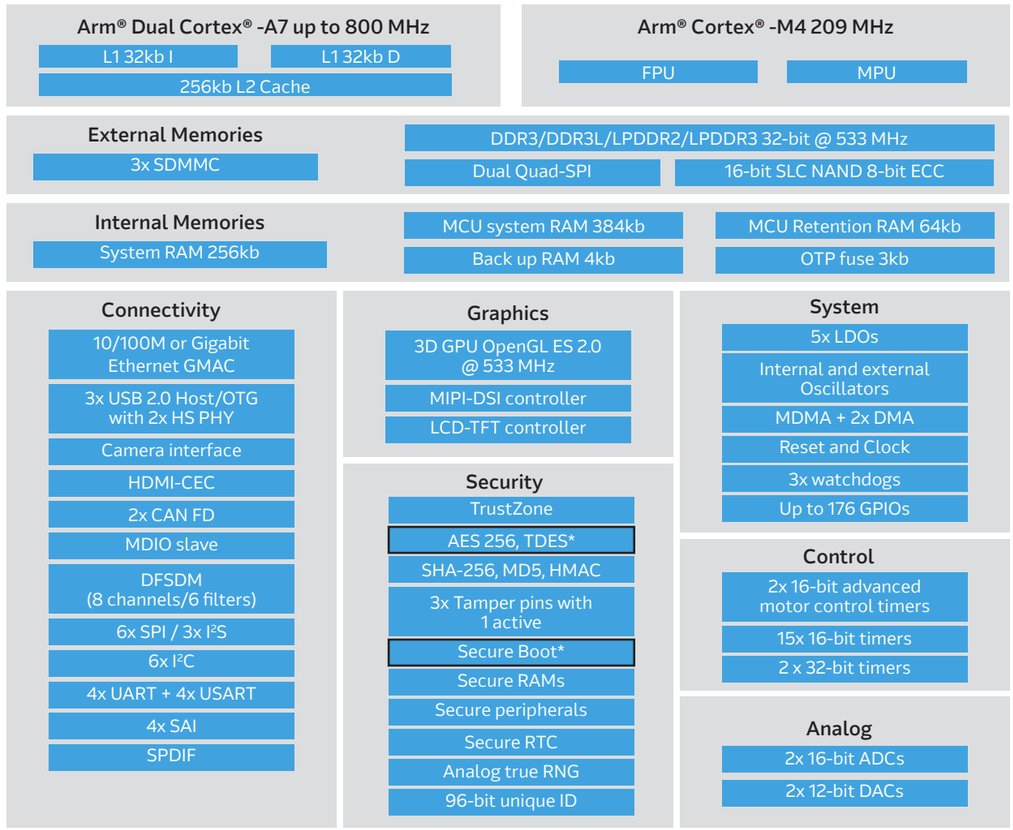
The Cortex-M4 core benefits from an embedded SRAM (448 Kbytes) to run purely deterministic code. For instance, a customer currently using an STM32 MCU based on STM32Cube firmware, could transparently fully re-use his code on the Cortex-M4 core's 448 Kbytes of SRAM, and add the Linux application (for instance an HMI) running on the Cortex-A7 core(s).

To meet a broad range of application requirements, most peripherals can be allocated to either the Cortex-A7 or Cortex-M4 cores.

Power Efficiency

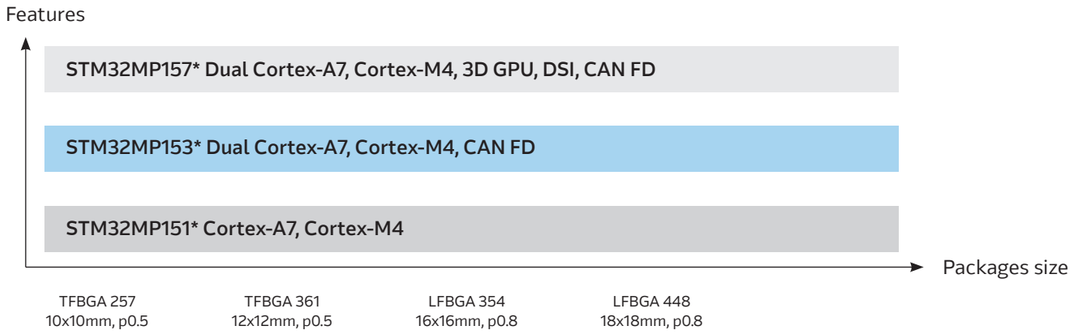
- Dynamic efficiency: the Cortex-A7 and Cortex-M4 cores can be run or stopped independently to achieve the best power efficiency for each processing and real-time application requirement.
- Low-power modes: Multiple low-power modes are available including:
  - Standby mode: Down to 36 µW.
  - V_{BAT} mode: Down to 4.5 µW. In this mode, it is possible to keep track of time using the real-time clock while keeping the system secure thanks to the tamper detect feature.

STM32MP157 Block Diagram



*Available for STM32MP157C and STM32MP157F only

STM32MP1 Portfolio



Packages can support low-cost PCB down to 4-layers PTH
*With or without HW crypto and secure boot

Expanding the STM32MP1 Portfolio now 48 Part Numbers

MPU @ 800 MHz	STM32 MP151D	MP151F	STM32 MP153D	MP153F	STM32 MP157D	MP157F
	1520 + 260 DMIPS 800 MHz Cortex-A7 209 MHz Cortex-M4	- - - Security	3040 + 260 DMIPS 800 MHz 2x Cortex-A7 209 MHz Cortex-M4 CAN FD	- - - Security	3040 + 260 DMIPS 800 MHz 2x Cortex-A7 209 MHz Cortex -M4 CAN FD -3D GPU -DSI	- - - Security
MPU @ 650 MHz	STM32 MP151A	MP151C	STM32 MP153A	MP153C	STM32 MP157A	MP157C
	1235 + 260 DMIPS 650 MHz Cortex-A7 209 MHz Cortex-M4	- - - Security	2470 + 260 DMIPS 650 MHz 2x Cortex-A7 209 MHz Cortex-M4 CAN FD	- - - Security	2470 + 260 DMIPS 650 MHz 2x Cortex-A7 209 MHz Cortex-M4 CAN FD -3D GPU –DSI	- - - Security

All references are available in **4 Packages**

TFBGA257 10x10mm p0.5 (4 layers PTH PCB) — smallest package for dual Cortex-A GP MPU
TFBGA361 12x12mm p0.5 (4 layers PTH + Laser via PCB)
LFBGA354 16x16mm p0.8 (4 layers PTH PCB)
LFBGA448 18x18mm p0.8 (6 layers PTH PCB)

All parts are software and pin to pin compatible

Arm® Cortex® Core | Cortex-A7 + Cortex-M4 | Dual Cortex-A7 + Cortex-M4

STM32MP1 Embedded Software Distribution Includes:

– Linux® distribution based on Yocto, running on the Arm® Cortex®-A processor(s): OpenSTLinux Distribution

– STM32Cube MPU Package, running on the Arm® Cortex®-M processor: STM32CubeMP1 Package

Hardware Tools

A full set of evaluation boards enables flexible prototyping as well as full STM32MP1 evaluation

STM32MP157A-EV1
STM32MP157F-EV1
2 Evaluation boards

STM32MP157A-DK1
STM32MP157C-DK2
2 Discovery Kits

Software Tools

STM32MP1 Series come with enhanced STM32CubeMX, Multi-Core IDE solutions (including STM32CubeIDE for device tree management) and STM32CubeProgrammer.

Dedicated Power Management IC for the STM32MP1 Series

ST completes the chipset with the STPMIC1, a dedicated Power-Management IC (PMIC) that integrates four DC/DC buck converters, six LDOs, a DC/DC boost converter, and USB VBUS and general-purpose power switches, creating a space and BOM savings to supply all required power rails for the STM32MP1 and for other components on the board. Using power-consumption optimization, the STPMIC1 is an ideal companion chip for the STM32MP1 Series in battery-powered applications.

DH electronics offers standard and customized embedded solutions from one hand, especially for building and industrial automation. Our modular concept enables a fast time-to-market at low cost and risk. We guarantee long-term availability, trust in open source, and build know-how in core technologies such as AI and robotics.

Services

- As full-service provider we support customers from the first idea to the finished product including hardware and software development, production and lifecycle management
- Technical support from our RND team
- Mainline Linux support (Debian, Yocto)
- Workshops and trainings

Key Strength and Value Proposition

- Expert for individual embedded solutions for more than 30 years
- Customized solderable & pluggable SOMs based on CPUs by ST and NXP
- Awarded as TOP-innovator 2021/2019
- We care about openness and honesty

Core Offering

Product Category	Processors Supported	Product Family Names (DHSOM with DHCOM and DHCOR)	Software/Firmware Available
System on Modules	STM32MP15x	DHCOM STM32MP15 DHCOR STM32MP15	Yes
Boxed Products	Touch Panel Computer, IoT Gateway	DHMI 4.3" / 7" / 8" / 10.1, IoT Gateway DRC	Yes
Development Kits	Avenger96 boards, Devkit for all DHCOM, picoITX standard	Avenger96 Development Board, Premium Development Kit (PDK), picoITX Carrier Board	Yes

DHCOM = pluggable, DHCOR = solderable, DRC = Din Rail Controller

DHCOR STM32MP15

Reference design for our Avenger96 Development Board.

- Solderable system on the module in postage stamp size with only 29 x 29 x 3.2 mm
- Solder-on module enables cost-effective, automated assembly
- Optimal for motor control due to PWM synchronized AC timer
- Suitable for powerful graphical user interfaces
- Avenger96 as a reference design
- Guaranteed long-term availability of 10+ years

Applications

Automation · Metrology · eMobility · Engineering · Health

Specifications

Board Name	Solderable SOM
CPU Details	2x ARM Cortex-A7 up to 800 MHz, 1x ARM Cortex-M4 up to 209 MHz
CPU Type	Arm Cortex-A7, Cortex-M4
Number of Cores	1 or 2
GPU Type	3D GPU Vivante® @533 MHz - OpenGL® ES 2.0
PMIC	STPMIC1A
BSP	**BSP:** Linux (Debian, Yocto)
Dimensions	29.0 x 29.0 x 3.2 mm
Memory	**DDR3 DRAM:** 266/512/1024 MB, SPI NOR flash: 2 MB, **EEPROM:** 256 Byte
Power Supply and Typ. Power Consumption	**Power Supply:** 5.0 VDC and **Power Consumption:** 1.0 W
Storage and Operating Temperature	**Storage Temperature:** -40 to +85 °C and **Operating Temperature:** -40 to +85 °C

DHCOM STM32MP15

Now new in the 800 MHz variant for even more performance.

- Dual Core ARM Cortex-A7 CPU with Cortex-M4 subsystem
- Mainline open-source Linux with Etnaviv GPU driver support
- Advanced hardware encryption and Secure Boot
- Dual Band WiFi and dual mode Bluetooth 5
- Compatible with other modules from the DHCOM family (SODIMM-200 socket)
- Guaranteed long-term availability of 10+ years

Applications

Automation **Metrology** **eMobility** **Engineering** **Health**

Specifications

Board Name	Pluggable SOM
CPU Details	Dual ARM Cortex-A7 up to 800 MHz, Single ARM Cortex-M4 up to 209 MHz
Number of Cores	1 or 2
CPU Type	Arm Cortex-A7, Cortex-M4
BSP	**BSP:** Linux (Debian, Yocto)
Debug Interface	JTAG interface on module
Dimensions	67.6 x 36.7 x 6.5 mm
Memory	**DDR3 DRAM:** 266/512/1024 MB, **SPI NOR flash**: 2 MB, **EEPROM:** 256 Byte
Bluetooth Version	Bluetooth® v5.0 (BR/EDR/BLE), PCB and U.FL antenna connector
WiFi Version	WiFi IEEE 802.11b/g/n, 802.11j (hosted mode) with dual band
Power supply and Typ. Power Consumption	**Power Supply:** 3.3 or 5 VDC and **Power Consumption:** 1.0 to 1.5 W
Storage and Operating Temperature	**Storage Temperature:** -40 to +85 °C and **Operating Temperature:** -40 to +85 °C

Featured Solutions

DHMI: Touch Panel Computers

- Touch Panel Computers with resistive or capacitive touch from 4.3” to 10.1” designed for industrial applications
- Thanks to a modular system, HMIs can be customized fast and cost-efficiently with low risk and the included SOM can be changed for higher performance without a redesign
- Web browser with kiosk mode and tab view available
- Support of open-source graphics driver

DHMI family

DHCON: IoT Gateways

- Modular IoT Gateway based on our DHCOM SOMs
- Connects sensors, IoT modules, and smart devices to the cloud
- For data filtering, visualization, and analytics in IIoT applications
- Mounted on a DIN rail, energy-efficient, available 10+ years
- Interfaces can be flexibly adapted to customer needs
- Exchange of the SOM enables scalability without redesign

DHCON family

Micron® Memory Support for STMicroelectronics® Chipsets

Save yourself time and money — Micron memory comes *validated* on STM32 microcontroller and microprocessor chipsets

Micron		DRAM				DRAM			
		LPDDR2	LPDDR3	LPSDRAM		LPSDRAM	SDRAM		DDR3
	Family	MT42L	MT52L256M32	MT48H		MT48H	MT4LC		MT41K
	Voltage	1.2V	1.2V	1.8V		1.8V	3.3V		1.35V
	Width	x32	x32	x16		x32	x8, x16	x32	x16
	Recommended PN	MT42L family	MT52L family	MT48H32M-16LFBxxx		MT48H16M-32LFBxxx	MT48LCxM16xx/8xx	MT48LCxM32xx	MT41KxxM16xx
STM Chipsets (STM32 Series)	**STM32 H7**								
	STM32H7x3xx - STM32H750xx			√		√	√	√	
	STM32H757xI - STM32H747xI/G - STM32H755xI - STM32H745xI/G			√		√	√	√	
	STM32H7B3xI - STM32H7A3xI/G			√		√	√	√	
	STM32H742xI/G - STM32H743xI/G - STM32H753xI			√		√	√	√	
	STM32H735xG - STM32H725xE/G STM32H733VG - STM32H733ZG STM32H723VE STM32H723VG STM32H7B0xB STM32H730AB -STM32H730IB - STM32H730VB - STM32H730ZB STM32H723ZE - STM32H723ZG			√		√	√	√	
	STM32 MP1								
	STM32MP15xx	√	√						√
	STM32 F7								
	STMF745xx - STMF765xx - STMF746xx - STMF756xx - STMF768xx - STMF769xx - STMF779xx - STMF777xx - STMF767xx - STMF778xx - STMF722xx - STMF732xx - STMF7x3xx - STMF7x0x8 - STMF750x8 - STMF730x8			√		√	√	√	
	STM32 F4								
	STM32 F479xx - STM32 F469xx			√		√	√	√	
	STM32 F429xx-F427xx - STM32 F439xx - STM32 F437xx			√		√	√	√	
	STM32 F446			√			√		
	STM32 F407xx - STM32 F417xx - STM32 F405xx - STM32 F415xx			√			√		

Micron® Memory Support for STMicroelectronics® Chipsets

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		NAND		NOR			NOR			e.MMC
		SLC NAND	SPI NAND	Q-SPI NOR			Parallel NOR		Xccela™ Octal NOR	
Micron	Family	MT29F	MT29F	MT25	MT25T		MT28EW	M58BW	MT35X	MTFC
	Voltage	3.3-1.8V	3.3-1.8V	3.3-1.8V	3.3-1.8V		3.3-1.8V	3.3-1.8V	3.3-1.8V	3.3V
	Width	x8, x16	x8	x4	x8		x8, x16	x32	x8	-
	Recommended PN	MT29FxG08xx/16xx	MT29F family	MT25 family	MT25L family		MT28EWxx family	MT58BWxx family	MT35X family	MTFCxx family
STM Chipsets (STM32 Series)	**STM32 H7**									
	STM32H7x3xx - STM32H750xx	√		√	√		√	√		√
	STM32H757xI - STM32H747xI/G - STM32H755xI - STM32H745xI/G	√		√	√		√	√		√
	STM32H7B3xI - STM32H7A3xI/G	√		√	√		√	√	√	√
	STM32H742xI/G - STM32H743xI/G - STM32H753xI	√		√	√		√	√		√
	STM32H735xG - STM32H725xE/G STM32H733VG - STM32H733ZG STM32H723VE STM32H723VG STM32H7B0xB STM32H730AB -STM32H730IB - STM32H730VB - STM32H730ZB STM32H723ZE - STM32H723ZG	√		√	√		√	√	√	√
	STM32 MP1									
	STM32MP15xx	√	√	√	√		√			√
	STM32 F7									
	STMF745xx - STMF765xx - STMF746xx - STMF756xx - STMF768xx - STMF769xx - STMF779xx - STMF777xx - STMF767xx - STMF778xx - STMF722xx - STMF732xx - STMF7x3xx - STMF7x0x8 - STMF750x8 - STMF730x8	√		√	√		√	√		√
	STM32 F4									
	STM32 F479xx - STM32 F469xx	√			√		√	√	√	√
	STM32 F429xx-F427xx STM32 F439xx - STM32 F437xx	√						√	√	√
	STM32 F446	√			√		√	√		√
	STM32 F407xx - STM32 F417xx STM32 F405xx - STM32 F415xx	√						√		√
	STM32 F412xx - STM32 F423xx - STM32 F413xx				√		√	√		√
	STM32 F3									
	STM32 F302xD - F302xE - STM32 F303xD - F303xE - STM32 F398	√					√			√
	STM32 F2									
	STM32 F215xx - F217xx - STM32 F205xx - F207xx	√					√			√

Micron® Memory Support for STMicroelectronics® Chipsets

Save yourself time and money — Micron memory comes *validated* on STM32 microcontroller and microprocessor chipsets

Micron		NAND		NOR			NOR		e.MMC
		SLC NAND	SPI NAND	Q-SPI NOR			Parallel NOR	Xccela™ Octal NOR	
	Family	MT29F	MT25F	MT25	MT25T		MT28EW	MT35X	MTFC
	Voltage	3.3-1.8V	3.3-1.8V	3.3-1.8V	3.3-1.8V		3.3-1.8V	3.3-1.8V	3.3V
	Width	x8, x16	x8	x4	x8		x8, x16	x8	-
	Recommended PN	MT29FxG08xx/16xx	MT29F family	MT25 family	MT25L family		MT28EWxx family	MT35X family	MTFCxx family
STM Chipsets (STM32 Series)	**STM32 F1**								
	STM32F100xC - STM32F100xD - STM32F100xE						√		√
	STM32F101xF - STM32F101xG - STM32F101xC - STM32F101xD - STM32F101xE - STM32F103xG - STM32F103xF -STM32F103xC - STM32F103xD - STM32F103xE	√					√		√
	STM32 G4								
	STM32G491xC - STM32G4A1xE- STM32G491xE				√				√
	STM32G483xE - STM32G473xB - STM32G473xC - STM32G484xE - STM32G474xB STM32G474xC STM32G474xE STM32G473xE	√		√	√		√		√
	STM32 L1								
	STM32L151xD - STM32L152xD - STM32L162xD						√		√
	STM32 L4								
	STM32L486xx - STM32L476xx- STM32L496xx - STM32L4A6xx - STM32L471xx - STM32L475xx	√		√			√	√	√
	STM32L433xx - STM32L443xx - STM32L432xx - STM32L442xx - STM32L452xx - STM32L462xx - STM32L412xx - STM32L422xx - STM32L451xx - STM32L431xx			√	√				√
	STM32 L4+								
	STM32L4Rx - STM32L4Sx - STM32L4P5xx - STM32L4Q5xx	√		√	√		√	√	√
	STM32 L5								
	STM32L5x2	√		√	√		√	√	√
	STM32 U5								
	STM32U585xx - STM32U575xx	√		√	√		√	√	√
	STM32 WB55xG								
	STM32WB55xG			√	√				√

Chip, Module and Board-level Image Sensing Solutions

Designing Image Sensing Solutions

Engineers have the choice to assemble various components of the system themselves by procuring individual components or buying modules. Time-to-market, in-house expertise, and the risk of failure drive the choice. Building a system has the advantage of offering the greatest flexibility of customization and can be very cost-effective for high-volume applications. However, building a system can involve high upfront development costs and pose project risks. Also, future-proofing the system and integration with other aspects of the manufacturing process will require additional effort and constant upkeep.

In contrast, modules offer a high level of integration and limit customization. Fully integrated systems that come with smart cameras are small, compact, all-in-one vision systems that incorporate lens, image sensors, system storage, and processors into a single device. These are increasingly popular as they take away the hassle of assembling all the components. Fast time-to-market and low risk are additional benefits accrued by buying a pre-built system.

Chip-Down Design

Pros

- Design flexibility and customization to fit application needs
- Cost-efficient for high-volume applications

Cons

- Slow time-to-market, multiple design cycles and increased chances for design failure
- Resource and expertise intensive
- Low ROI for small volume applications

Module-Based Design

Pros

- Fast development and ease of design reuse
- Faster time to market and lowered design risk, especially for small form-factor applications

Cons

- Less design flexibility
- Design must fit module
- The product size may be limited

Finished Product

Pros

- Extremely fast time-to-market
- Zero hardware design required. Focus on software, configuration, and application

Cons

- Limited hardware flexibility for customizations
- Low ROI for high-volume applications

Image Sensors for Chip-down Designs

onsemi leverages the most advanced CCD and CMOS imaging technologies to provide the broadest, most capable portfolio of image sensors for industrial, automotive, and consumer applications. onsemi's image sensing portfolio ranges from VGA to over 50 MP (megapixel) resolution, and from 4 to over 800 fps (frames per second). The broad portfolio enables flexibility in configuration and combines optimal performance characteristics, such as high speed, high sensitivity, and high image quality to match specific application requirements. It also provides an easy upgrade path for existing customers and allows OEMs to leverage a single camera design to support multiple products to accelerate time-to-market.

Industrial	Machine Vision & Intelligent Traffic Systems		Edge AI	Machine Vision Everywhere
High-speed, scalable portfolio	Performance, price, speed 29 x 29 mm cameras, system solutions		Small sensors, low power NIR optimized	Event detection very low power, flexible states
PYTHON 25K 25MP 4.5um	XGS 32000 32MP 3.2um	XGS 45000 45MP 3.2um	AR0234 2MP 3.0um GS	
PYTHON 16K 16MP 4.5um	XGS 20000 20MP 3.2um	XGS 30000 30MP 3.2um	AR0135 1MP 3.75um GS	ARX3A0 VGA 2.2um pGS
PYTHON 5000 5MP 4.8um	XGS 12000 12MP 3.2um	XGS 16000 16MP 3.2um	AR0144 1MP 3.0um GS	
PYTHON 2000 2MP 4.8um	XGS 8000 8MP 3.2um	XGS 9400 9MP 3.2um	AR1335 13MP 1.1um RS	LiDAR/SiPM R Series
PYTHON 1300 1.3MP 4.8um	XGS 3000 3MP 3.2um	XGS 5000 5MP 3.2um	AR0821 8MP 2.1um RS	
PYTHON 480 VGA 4.8um	XGS 2000 2MP 3.2um		AR0522 AR0521 5MP 2.2um RS	SPAD Arrays Pandion

Appletec Compact Camera Module (CCM) Offerings for Small Form-factor Applications

Introducing a family of camera modules based on sensor technology from onsemi. The modules provide original equipment manufacturers (OEMs) with a simple and cost-effective path to incorporating a wide range of camera functionalities in their products. All camera modules comply with onsemi IAS standard and have the same connector and pinout, providing compatibility with the popular 96boards development ecosystem. Arrow has partnered with Timesys for Linux drivers.

AP-Vision-ARX3A0-55

onsemi ARX3A0 Sensor

- 1/10.3" 560 x 560 Mono +NIR
- 0.3Mp @ 360fps
- Fixed-focus 49° FOV
- F# 2.0
- Length: 21.95 mm

Target Applications:

- IoT applications
- Super low power applications
- Machine vision
- Artificial intelligence
- Eye tracking

AP-Vision-AR1335-74

onsemi AR1335 Sensor

- 1/3.2" 4208 x 3120 color
- 13Mp @ 30fps
- Auto-focus 64° FOV
- F# 2.0
- Length: 18.49 mm±0.2 mm

Target Applications:

- Digital still cameras
- Drone cameras
- AI vision
- Body camera
- Sports camera

AP-Vision 8MP Module

Coming Soon

onsemi 8MP Sensor

- 8Mp @ 30fps
- Fixed-focus 68° FOV
- F# 1.8
- Length: TBD mm

Target Applications:

- Video conferencing endpoints
- Webcams
- Machine vision cameras
- Video doorbells
- Retail in-store cameras, bodycams, etc.
- 3D and stereo cameras

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Development Resources for Appletec CCM Modules

Arrow worked with Shiratech Solutions to create camera mezzanine cards compliant with the 96boards specification. Compatibility with the 96boards open platform enables customers to rapidly start implementation of new imaging designs and to optimize systems once operational. The mezzanine board has the onsemi AP1302 image signal processor (ISP). The ISP offloads core functions like sensor configuration and calibration, image format conversation, basic transformations, and autofocus from the processor.

Appletec CCM Module on Shiratech Mezzanine Board Includes an onsemi AP1302 ISP

Options for Processor Platforms. 96boards Development Platforms can be Used for Testing and Verification

Appletec CCM Modules Compatible with onsemi Demo3 System and DevWareX

The modules are compatible with onsemi's Demo3 EVK system and DevWareX software which allows for many possibilities for testing, debugging, and analysis.

- Generate initialization files
- Log register changes when setting modes
- Save or load images for analysis
- Watch specific registers
- Manual white balance adjustments

Image Analytics

- Intensity graphs
- Noise measurements
- Image histograms
- Vectorscope graphs

TOC ⟶

Basler is a leading international manufacturer of high-quality imaging components for computer vision applications. In addition to classic area scan and line scan cameras, lenses, frame grabbers, light modules, 3D products, and software, the company offers embedded vision solutions, that comprise consulting services, customer-specific software development as well as customized products. Basler's products are used in a variety of markets and applications, including factory automation, medical, logistics, retail, and robotics. They are characterized by high reliability, an excellent price/performance ratio, and long-term availability.

Embedded Vision Solutions

- Embedded vision technology
- Application software
- Comprehensive vision applications

Services

- Solution design, development, and mass production

Core Offerings

Product Category	Processors Supported	Product Family Names	Software/Firmware Available
Development Kits	– NXP i.MX 8 Application Processor Series – NVIDIA Jetson Family	– NVIDIA® Jetson™ Nano Developer Kit – NXP i.MX 8M Mini Evaluation Kit	yes

Featured Solutions

NVIDIA® Jetson Nano™ Developer Kit

- This Embedded Vision Kit is a development kit with a Basler dart BCON for MIPI camera module and an NVIDIA® Jetson™ Nano SoM.
- It contains a dart camera module with S-mount lens, a NVIDIA Jetson Nano developer board as well as a special adapter board, and cabling to connect these components. Additionally, it includes all necessary drivers, system software as well as a power supply and thus offers a complete plug and play design-in package for rapid prototyping of computer vision applications — be it AI-based or traditional.
- The software comes pre-installed on a MicroSD card.

NXP i.MX 8M Mini Evaluation Kit

- Development kit with a Basler dart BCON for MIPI camera module and Linux support for NXP's i.MX 8M Mini SoC on a Variscite SoM
- This Basler dart BCON for MIPI development kit is a kit for integrating a Basler dart camera with a BCON for MIPI interface. It contains a dart camera module, a Variscite SoM with Linux drivers as well as additional accessories and thus offers a complete plug and play design-in package for dart BCON for MIPI camera modules.

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Leopard Imaging is a global leader that provides high definition (HD) embedded cameras and AI-based camera solutions — focusing on core technologies that improve image processing in autonomous vehicles, drones, IoT, robotics, and healthcare devices. As an NVIDIA Elite Partner, Microsoft Partner, AWS Partner Network member, and a long-term partner of SONY, OmniVision, onsemi, Leopard Imaging has established its reputation working with the most well-known technology companies.

Core Offerings

- Embedded video solutions and AI edge computing devices in autonomous driving, drones, IoT, Robotics, AR/VR, machine vision, AI edge devices

Product Category	Processors Supported	Software/ Firmware Available
System on Modules	NVIDIA Jetson and ROS platforms	Camera driver available
Boxed Products	NX box, TX2 Box	Camera driver available
Development Kits	NVIDIA Jetson Developer Kits	Camera driver available

Key Strengths and value Proposition

- 14 years of experience in camera design and manufacturing with a strong imaging technology portfolio of one-stop-shop customization
- Silicon Valley Headquarter with early access to most advanced technology from partners
- Mass production capabilities both in U.S.A and offshore

Services

- Original equipment manufacturer (OEM) and original design manufacturer (ODM)
- Mass production in the U.S. and offshore
- Full SDK support, sensor driver, image tuning, and support
- A most complete selection of camera modules based on different platforms and sensor suppliers
- Industrial grade camera modules
- Domain-specific appliances

Featured Solutions

Driver Monitoring System (DMS) and Occupant Monitoring System (OMS) Camera

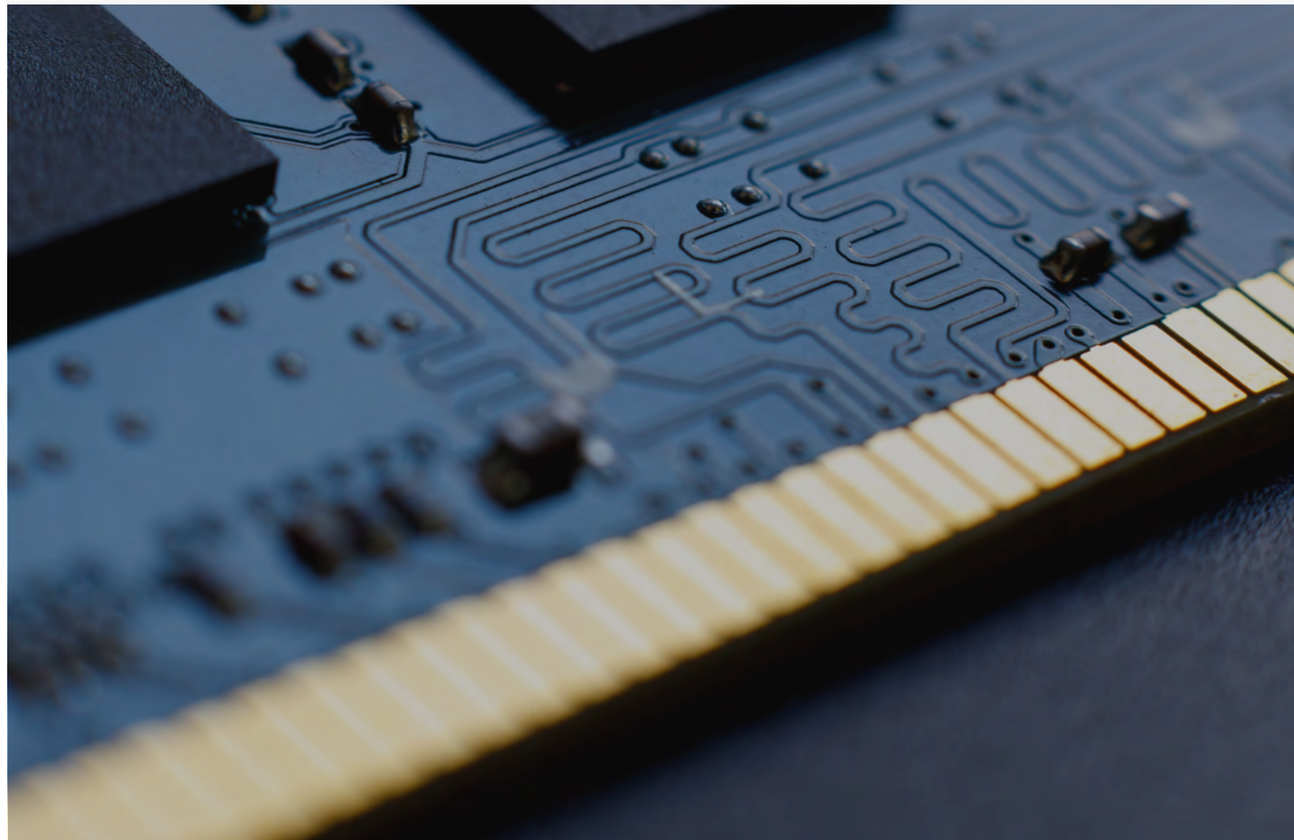
- Leopard Imaging driver monitoring system (DMS) cameras and occupant monitoring system (OMS) cameras provide a real-time evaluation of the presence and the state of the driver and occupants.
- DMS cameras can help alert the driver and intervene to manage the control of the vehicle when there is a potential danger from the driver being distracted with tiredness or the cell phone. The driver monitoring system ensures that the driver is prepared to take control of the vehicle when the situation dictates.

Time-of-Flight (ToF) Camera

Leopard Imaging has a wide range of imaging solutions and a strong track record of developing 3D ToF cameras. With the NVIDIA Jetson platform, Leopard Imaging ToF cameras empower autonomous driving, robotics, IoT, drones, and other edge AI related industries. Leopard Imaging's ToF cameras developed in collaboration with NVIDIA, are available on Jetson AGX Xavier and will be available on Jetson AGX Orin in the second quarter of 2022. Delivering 275 TOPS, NVIDIA Jetson AGX Orin is one of the most powerful AI computers for energy-efficient autonomous machines.

TOC ⟶

Complementary Technologies and Arrow Engineering Services



Winning the Race to the IoT Edge

The IoT Edge — Enabling the Connected Enterprise

With billions of industrial IoT devices expected to be connected to the cloud, the IoT edge will bridge enterprise and industrial systems in markets such as factory automation, oil and gas, smart cities, surveillance, health care, and many others[1]. IoT edge solutions will bring compute and artificial intelligence (AI) closer to the source of the data, incorporating new software paradigms and introducing new business models that will inspire traditional OEMs and IoT platform providers to develop strategies to win the race to the IoT edge.

Evolving Architectures

IoT edge solutions will continue to evolve as compute and storage demands are expected to increase, leading to a need for:

- Data aggregation and connectivity in real-time
- Multicore processor systems that support deep learning inference and higher compute requirements
- Embedded local storage for on-premises data management
- New software middleware and APIs to support containers for microservices

As a result, memory size for code and data will increase to support new software cloud agents, middleware, and edge management. Processors will require higher DRAM performance with wider bus width for more efficient machine learning execution. And embedded storage size will increase as more endpoints are managed by a single edge device.

Authenta™ Technology (Simple, Integrated, Secure)

With upcoming US and EU heightened security requirements facing OEMs supporting critical infrastructure, industrial automation, and other industries; simplify your secure boot implementation. QSPI NOR (up to 256MB) & e.MMC (16GB & 32GB) Authenta families coming soon. Launch updates coming next year.

Micron Intelligence Accelerated at the IoT Edge

As the leader in industrial and automotive applications, Micron offers the industry's broadest memory and storage solutions to support the essential demands of the IoT edge:

- High-performance DRAM/ LPDRAM and modules for computing and deep learning at the edge
- Broad NOR/NAND portfolio for code and data storage versatility
- Multichip package (MCP) solutions for space-constrained applications and cellular IoT modules
- Industrial grade e.MMC, PCIe NVMe™ flash storage SSD and SD/microSD solutions for on-premise storage

Enterprise Data Center	IoT Edge	Real-Time Sensing
– Big data – Training/AI – Cloud storage – Expert insights	– Data aggregator – Protocol converter – Data normalizing – Local storage – Machine learning inference	– Data ingestion – Position/condition – Metadata

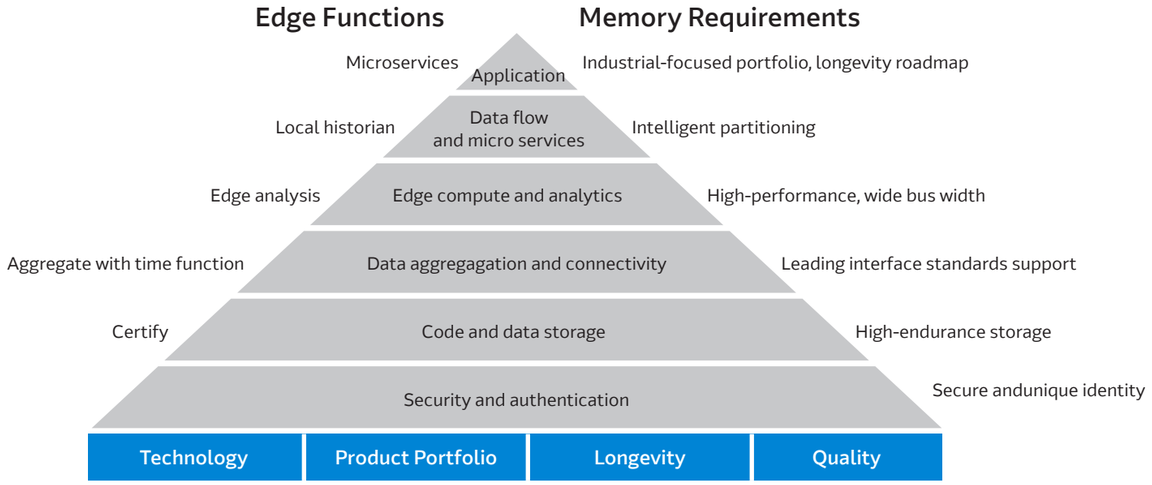
[1]The global edge computing market size was valued at US$4.68 billion in 2020 and grew to US$6.29 billion in 2021, with projections of revenue generation of US$61.14 billion by 2028. -Grand View Research

Micron Memory Solutions

DRAM, e.MMC, xLC NAND, uSD, Secure NOR/NAND, SSD, e.MCP, LPDRAM

Memory and Storage Requirements for the IoT Edge

The new breed of edge devices will require high-performance DRAM to support deep learning inference acceleration, managed NAND solutions with features and densities to support code size and complex OS functions, and high endurance storage for on-premises data logging and historian systems.



Complete Edge Essentials

DRAM Solutions

- DDR4/DDR5 and LPDDR4: market-proven, best system cost/performance tradeoff, and long-term support
- LPDDR5x: data rates up to 8.5 GB/s; improved power efficiency; up to x64 bus width-packaged solutions enable high bandwidth interface for AI/ML workloads
- Variety of DRAM modules from high-performance SODIMMs to high-density LRDIMMs

Multichip Packages (MCPs)

- The broad range of NAND MCP, e.MCP density combinations
- Low 1.8V power; small package size/ball count solutions
- Vertical stacking at die level; minimize BOM for simplified manufacturing and cost savings

Industrial and Automotive-Grade Storage

- Micron 2100AI, 2100AT 3D TLC SSDs
- SLC partitioning; trusted computing group (TCG) Opal self-encrypting drives (SED)-compliant
- 64GB-1TB densities, BGA and M.2 form factors:
  2100AI: Tcase -40 °C to 95 °C operating temperature
  2100AT: Tcase -40 °C to 105 °C operating temperature

NOR/NAND Portfolio

- SLC NAND with adaptive FTL: on-die ECC, industrial temperature range, OTP data protection
- Xccela© Flash: x8 (Octal SPI) SDR/DDR JEDEC xSPI standard-compliant; up to 2GB full-featured flash, supports direct code execution and parametric data storage with up to 400 MB/s reads, reducing pin count 5X compared with parallel NOR devices
- e.MMC with internal NAND management for simplifying development
- Up to 1TB uSD removable storage optimized for industrial applications

Security and Trust

- Authenta technology adds secure element functionality into standard flash memory providing code and data integrity through memory protection and attestation
- The Authenta™ cloud platform enables simple activation credentials and identities based on trusted computing group standards
- Features support zero-touch onboarding, secure boot in flash, and secure OTA update process for device management

Micron® DRAM Module Form Factors Quick Reference Guide

Accelerate your time-to-market with quality DRAM modules rigorously tested for reliability in a wide range of applications. From the cost-sensitive needs of consumer computing to the extreme temperature and performance needs of industrial applications to the exacting specifications of enterprise systems, we have the right solution for your design.

Form Factor	Available[1] Technologies		Available[1] Densities	Bus Width[2]	Data Rate (MT/s)
UDIMM (unbuffered DIMM) ECC- and non-ECC-supported systems with no size constraints	DDR3, DDR4, DDR5		4GB to 32GB	x64/x72	1600 to 6400
SODIMM (small outline DIMM) ECC- and non-ECC-supported, space-sensitive systems	DDR3, DDR4, DDR5		2GB to 32GB	x64/x72	1600 to 6400
RDIMM (registered DIMM) ECC-supported networking, enterprise servers, and workstations	DDR3, DDR4, DDR5		4GB to 128GB	x72/x80	1600 to 6400
LRDIMM (load-reduced DIMM) Highest-density enterprise server and DDR3/DDR4 networking systems	DDR4		64GB to 128GB	x72	1600 to 2933
VLP RDIMM (very low profile registered DIMM) Blade servers and networking ATCA height-compatible systems requiring ECC modules	DDR3, DDR4		8GB to 32GB	x72	2666 to 3200
VLP UDIMM (very low profile unbuffered DIMM) Blade servers and networking ATCA height-compatible systems requiring ECC modules	DDR4		8GB to 32GB	x72	1333 to 3200
Mini-RDIMM (mini registered DIMM) Networking and other size-constrained systems requiring ECC modules	DDR4		8GB	x72	3200
VLP Mini-RDIMM (very low profile mini registered DIMM) Networking ATCA height-compatible and other size-constrained systems requiring ECC modules	DDR4		8GB	x72	3200

[1]Available = sampling or in production

[2]All x72 modules are ECC-enabled

Micron® DRAM Module Form Factors Quick Reference Guide

Device and Form Factor		Density	Pin Count	Width		Voltage	Data Rate	RoHS	PCB Dimensions
DDR5	UDIMM	16GB to 32GB	288	x64		1.1V	4800 to 6400 MT/s	Green	133.35mm L x 31.25mm H
	EUDIMM	16GB to 32GB	288	x72		1.1V	4800 to 6400 MT/s	Green	133.35mm L x 31.25mm H
	SODIMM	16Gb to 32GB	262	x64/x72		1.1V	4800 to 6400 MT/s	Green	69.6mm L x 30mm H
	RDIMM	16GB to 96GB	288	x72/x80		1.1V	4800 to 6400 MT/s	Green	133.35mm L x 31.25mm H
DDR4	UDIMM	4GB to 32GB	288	x64		1.2V	2666 to 3200 MT/s	Green	133.35mm L x 18.75-31.25mm H
	EUDIMM	16GB	288	x72		1.2V	2666 MT/s	Green	133.35mm L x 31.25mm H
	SODIMM	4GB to 32GB	260	x64/x72		1.2V	2666 to 3200 MT/s	Green	69.60mm L x 30mm H
	RDIMM	4GB to 256GB	288	x72		1.2V	2666 to 2933 MT/s	Green	133.35mm L x 31.25mm H
	LRDIMM	32GB to 128GB	288	x72		1.2V	2666 to 2933 MT/s	Green	133.35mm L x 31.25mm H
	VLP RDIMM	8GB to 32GB	288	x72		1.2V	2666 to 3200 MT/s	Green	133.35mm L x 18.75mm H
	VLP UDIMM	8GB to 32GB	288	x72		1.2V	2666 to 3200 MT/s	Green	133.35mm L x 18.75mm H
	Mini-RDIMM	8GB	288	x72		1.2V	3200 MT/s	Green	80.0mm L x 30mm H
	VLP Mini-RDIMM	8GB	288	x72		1.2V	3200 MT/s	Green	80.0mm L x 18.75mm H
	VLP Mini-UDIMM	8GB	288	x72		1.2V	3200 MT/s	Green	80.0mm L x 18.75mm H
DDR3	EUDIMM	4GB	240	x72		1.35V	1600 MT/s	Green	133.35mm L x 30mm H
	ECC SODIMM	8GB	204	x72		1.35V	1600 MT/s	Green	67.6mm L x 30mm H
	SODIMM	8GB	204	x64		1.35V	1600 MT/s	Green	67.6mm L x 30mm H
	RDIMM	8GB	240	x72		1.35V	1333 to 1866 MT/s	Green	133.35mm L x 30mm H

Micron® Automotive and Industrial SSDs

Thrive in Extreme Conditions Using Solid State Storage

Boost the performance and reliability of leading-edge automotive electronics systems and industrial-grade applications with Micron® 2100AI/AT SSDs. Combining the benefits of a low-latency PCIe®/NVMe™ interface with the density of triple-level cell (TLC) 3D NAND technology, the 2100AI/AT SSDs are ideal for dynamic data, with the option to switch to single-level cell (SLC) mode for applications with a lot of static data. Improve performance, reliability, and durability using advanced NVMe features, like mixed namespace configurations.

Ruggedized M.2/BGA Form Factor

Family	Part Number	Density	Form Factor	Sequential Read/Write Performance	Endurance (TBW)	Encryption	Operating Temperature	Mean Time to Failure	Uncorrectable Bit Error Rate (UBER)	Vibration Value
2100AI	MTFDHBL064TDP-1AT12AIYY	64GB	BGA	Up to 550/ 250 MB/s	30TB	256-bit AES, Opal 2.0	Tcase = -40°C to 95°C	3 million hours	<1E -16	N/A
	MTFDHBK064TDP-1AT12AIYY		M.2 2230							20G @ 7-2000Hz
	MTFDHBL128TDP-1AT12AIYY	128GB	BGA	Up to 1100/ 500 MB/s	60TB					N/A
	MTFDHBK128TDP-1AT12AIYY		M.2 2230							20G @ 7-2000Hz
	MTFDHBL256TDP-1AT12AIYY	256GB	BGA	Up to 2000/ 1000 MB/s	120TB					N/A
	MTFDHBK256TDP-1AT12AIYY		M.2 2230							20G @ 7-2000Hz
	MTFDHBL512TDP-1AT12AIYY	512GB	BGA	Up to 2000/ 1700 MB/s	240TB					N/A
	MTFDHBK512TDP-1AT12AIYY		M.2 2230							20G @ 7-2000Hz
	MTFDHBM1T0TDP-1AT12AIYY	1TB	BGA	Up to 2000/ 1800 MB/s	480TB					N/A
	MTFDHBK1T0TDP-1AT12AIYY		M.2 2230							20G @ 7-2000Hz
2100AT	MTFDHBL064TDQ-1AT12ATYY	64GB	BGA	Up to 550/ 250 MB/s	30TB	256-bit AES, Opal 2.0	Tcase = -40°C to 105°C	3 million hours	<1E -16	N/A
	MTFDHBL128TDQ-1AT12ATYY	128GB	BGA	Up to 1100/ 500 MB/s	60TB					N/A
	MTFDHBL256TDQ-1AT12ATYY	256GB	BGA	Up to 2000/ 1000 MB/s	120TB					N/A
	MTFDHBL512TDQ-1AT12ATYY	512GB	BGA	Up to 2000/ 1700 MB/s	240TB					N/A
	MTFDHBM1T0TDQ-1AT12ATYY	1TB	BGA	Up to 2000/ 1800 MB/s	480TB					N/A
	MTFDHBK1T0TDQ-1AT12ATYY		M.2 2230							20G @ 7-2000Hz

Which Applications are the Best Fit?

Automotive: In-vehicle infotainment (IVI), navigation and driver information, adaptive driver assistance systems, black box applications.

Industrial: Factory automation, robotics, transportation, medical, defense, retail, industrial networking, video security systems.

Micron® 7450 SSD with NVMe™

The World's Most Advanced 176-Layer NAND Data Center SSD: Sub-2ms QoS Latencies, Extensive Capacity and Deployment Options[1]

The Micron 7450 SSD with NVMe™ enables a wide variety of workloads for flexible deployment in hyper-scale, cloud, data center, OEM, and system integrator designs. It is the SSD for the infrastructure you are building right now — and for the infrastructure you will build tomorrow.

Our 7450 SSD offers the industry's broadest range of PCIe® Gen4 SSD form factors[2] and enables several storage use cases, including boot, cache, and main data storage. It also features Micron's unique secure execution environment[3] to help keep your data secure.

Designed as a mainstream solution, the 7450 SSD balances performance and density. Our offering includes a PCIe Gen4, M.2, 22 x 80mm with power-loss protection[4] and a 7.68TB E1.S that delivers industry-leading capacity[5].

U.3: 7mm and 15mm

E1.S: 5.9mm, 15mm and 25mm

M. 2: 22x80mm and 22x110mm

Micron® 7450 SSD: Key Benefits

- **176-layer NAND improves storage performance for data center workloads**
  Industry-leading 176-layer NAND, coupled with Micron CMOS-under-array (CuA) technology and PCIe Gen4, enables the 7450 SSD to yield faster read and write speeds, up to 1 million IOPS, enabling faster booting and application responsiveness[6]
- **2ms and below QoS latency enables impressive responsiveness in data center workloads**
  The 7450 SSD delivers 2ms and below 99.9999% read latency[7]. This low and consistent latency can improve performance in latency-sensitive data center applications, including databases like Microsoft SQL Server, Oracle, MySQL, RocksDB, Cassandra, and Aerospike, among others
- **Capacity, form factor, and security options fit a wide variety of data center workloads**
  The 7450 SSD delivers an impressive array of capacities, from 400GB to 15.36TB[9], and has the industry's broadest variety of form factors, including U.3, M.2, and E1.S. It is the only PCIe Gen4 U.3 SSD in the industry available in both 15mm and 7mm[8], plus there is an industry-leading 7.68TB E1.S option. These capacity and form factors choices help meet rapidly evolving power and thermal needs in your data center. Security features like the Micron-unique secure execution environment, self-encrypting drives (SEDs), and Microsoft eDrive options tailor security to deployment requirements and help improve your data security

1. Based on similar use SSDs with NVMe are available on the open market as of the date of this document's publication. The Micron 7450 SSD offers a broader range of form factors combined with industry-leading Micron 176-layer NAND.

2. Refers to the combination of form factors, capacities, and endurance classes available.

3. An isolated security processor within the SSD controller. No hardware, software, or system can provide absolute security under all conditions. Micron assumes no liability for lost, stolen, or corrupted data arising from the use of any Micron products, including those products that incorporate any of the mentioned security features.

4. Based on the comparison of similar, commonly available, open-market SSDs.

5. Unformatted. 1GB = 1 billion bytes. Formatted capacity is less.

6. Additional information is available here: www.micron.com/176. Faster read and write based on comparison to Micron 7400 SSD with NVMe.

7. Up to queue depth = 32 for 4KB, 100% random, 70% read workload.

8. Based on similar use SSDs with NVMe available on the open market as of the date of this document's publication.

Micron Data Center SSD Recommendations for 2022

	2022 NVME	
	7450 (mainstream)	Next Gen (performance)
Capacities	400GB – 15.36TB TLC	3.2TB – 30.72TB TLC
PCIe Gen	Gen 4	Gen 4
U.3 M.2 E1.S E1.L	7mm, 15mm 22x80mm, 22x110mm 5.9mm, 15mm, 25mm -	15mm - - -
Seq Reads (MB/s)[1] Seq Writes (MB/s)[1] Random Reads (K IOPS)[2] Random Writes (K IOPS)[2] Endurance (DWPD)[3]	6,800 5,600 1,000 400 1 & 3 (random IO)	6,800 6,800 1,500 450 1 & 3 (random IO)
Security Features	All 7400 security features, plus – SHA-512, 384, 256 – RSA 3072b & 4096b key strength – RSA secure boot over SMBus – Device identify & measurement	– AES 256-bit encryption – Secure signed firmware with boot capability
NVMe Features	All 7400 NVMe features, plus – 128 namespaces – SRNS (option)	All 9300 NVMe features, plus – 128 namespaces – Sanitize – NVMe-MI over SMBus
Storage Features	-	-

	2022 SATA
	5400 (mainstream)
Capacities	240GB – 7.68TB TLC
2.5-Inch M.2	7mm 22x80
Seq Reads (MB/s)[1] Seq Writes (MB/s)[1] Random Reads (K IOPS)[2] Random Writes (K IOPS)[2]	540 520 95 65
Endurance (DWPD)[3]	1 & 3 RDWPD
Security Features	All 5300 security features
SATA Features	All 5300 SATA features

Micron® Industrial Multimarket Application Memory

Industrial IoT and Industry 4.0 are transforming the world of manufacturing — extending automation and connectivity beyond traditional factory walls and driving strong demand for more data acquisition, communication, real-time analytics, and data-driven decisions across a wide range of industry verticals.

It is estimated 20 billion+ new smart connected devices will be deployed over the next decade.

The best equipment will be those that enable businesses to run more efficiently, require the least amount of maintenance, and enable the least possible downtime.

Micron memory and storage solutions are the top choices for Industrial PC and embedded solutions across IIoT verticals like factory automation, surveillance, M2M, retail, digital signage, smart grid, transportation/fleet management, healthcare, and aerospace and defense applications.

Micron has been a trusted advisor to our industrial customers for more than 25 years. We understand the unique needs of this market and we bring a mindset to deliver sustainable value to our customers — because we firmly believe that IQ matters to our customers' success in IIoT.

Because IQ matters to the success of your industrial IoT designs.

What is Micron's Industrial Quotient (IQ)?

We bring to market a mindset and portfolio that deliver sustainable value to our customers with:

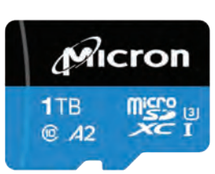
- **Application-Specific Tuning:** Extensive collaboration with global customers to develop an in-depth understanding of application use cases and deliver products and features to meet those specific application needs
- **Ruggedized Products:** Product enhancements that enable consistent performance across extreme environments: extended temperature, thermal cycling, shock, humidity, etc.
- **High Reliability:** Design and testing processes that add a high-level of endurance and reliability to align with needs of long-lifecycle embedded applications
- **Extensive Quality Testing:** Rigorous testing to deliver consistent performance across products and processes necessary in embedded and mission-critical applications
- **Product Longevity:** Extended lifecycle support for eligible products via our product longevity program, which goes a step beyond standard lifecycle support to suit long-life applications
- **Security by Design:** Integrating the latest Micron Authenta™ technology in memory to provide platform — and solution-level values that translate to reliable, safety conscious solutions with best-in-class time to market

Micron® Industrial microSD Cards

Growing Edge Storage in Video Surveillance Applications Requires Industrial-Quality Memory

Edge storage technology — the recording of video and storing it in the camera instead of in a centralized recording facility across the network — is quickly gaining acceptance and is being more broadly adopted into IP video surveillance applications.

Selecting a microSD card specifically designed for IP video surveillance cameras can bring more value and enhance system performance by providing recording redundancy and optimizing network load reduction. In addition, it's enabling the deployment of NVR-less architectures with lower TCO benefits.



Why Micron Industrial microSD Cards for Edge Storage Applications

- High endurance (32GB to 1TB) support for 3 years of high-quality, continuous 24/7 video recording
- Outstanding recording performance optimized firmware provides stable performance for 24x7 high-quality video recording with minimal frame drops
- Industrial quality reliable, high-quality with 2 million hours mean time to failure (MTTF) or an annualized failure rate of 0.44%; 2X the reliability of surveillance HDDs used in NVRs today
- Smart tool for health monitoring feature for IP camera integration reports card usage and lifetime remaining and can be integrated into system software to alert end users

Family	Model	Part	Density	Package	Interface	Performance	Endurance	Operating Temperature
Industrial microSD Card	i200	MTSD032AQC6MS-1WT	32GB	microSD	SD 3.0 UHS-I	UA, A1, Class 10	24/7; 3 years*	-25 °C to 85 °C
		MTSD064AQC6MS-1WT	64GB					
	i300	MTSD128AKC7MS-1WT	128GB			U1, A2, Class 10		
		MTSD256AKC7MS-1WT	256GB					
		MTSD512AKC7MS-1WT	512GB			U3, A2, Class 10		
		MTSD1T0AKC7MS-1WT	1TB					

*Based on specific bit rate for each capacity (see data sheet for more details)

Micron® Memory Supporting Medical Device Manufacturers

The integration of technology in healthcare practices has made patient care more advanced, reliable, and patient-centric. Conventional techniques of diagnosis and the resulting therapies are becoming less invasive and more effective. Intelligent, connected portable devices are helping patients stay out of hospitals, allowing them to be monitored in the comfort of their own homes.

It is estimated that more than 8 billion new medical devices will be deployed over the next five years[1]. The best devices will be those that enable reliable patient care, protect patient data, require the least amount of maintenance, and enable healthcare providers to run hospitals and clinics efficiently.

Micron memory and storage solutions support medical device manufacturers who provide products such as consumer medical equipment, portable telehealth monitoring systems, clinical diagnostics, medical imaging, and medical robotics solutions.

Micron has been a trusted advisor to our industrial customers for more than 25 years. We understand the unique needs of this market and bring a mindset to deliver sustainable value to our customers — because we firmly believe that IQ matters to our customers' success in the medical devices market.

Because IQ matters to the success of your medical device designs.

What is Micron's Industrial Quotient (IQ)?

We bring to market a mindset and portfolio that deliver sustainable value to our customers with:

- **High Reliability**
  Design and testing processes that add a high-level of endurance and reliability to align with needs of long-lifecycle embedded applications
- **Security by Design**
  Integrating the latest Micron Authenta™ technology in memory to provide platform- and solution-level values that translate to reliable, safety-conscious solutions with best-in-class time to market
- **Extensive Quality Testing**
  Rigorous testing to deliver consistent performance across products and processes necessary in embedded and mission-critical applications
- **Product Longevity**
  Extended lifecycle support for eligible products via our product longevity program, which goes a step beyond standard lifecycle support to suit long-life applications
- **Ruggedized Products**
  Product enhancements that enable consistent performance across extreme environments: extended temperature, thermal cycling, shock, humidity, etc.
- **Application-Specific Tuning**
  Extensive collaboration with global customers to develop an in-depth understanding of application use cases and deliver products and features to meet those specific application needs

1. Databeans, Inc. 2020 IND-Medical report

Micron® Memory Supporting Medical Device Manufacturers

Product Family	Voltage	Bus Width	Performance		Density Range	Temp Range[2]	Package Options
DRAM and Modules							
DDR5 (MT60)	1.1V	x8, x16	4800MT/s -6400MT/s		16GB; 16GB - 96GB	IT	BGA
DDR4 SDRAM (MT40)	1.2V	x8,x16	2133–3200 MT/s		8-16GB; 4-64GB	IT, AT	BGA, ECC SODIMM,ECC UDIMM, RDIMM
DDR3 SDRAM (MT41)	1.35V	x8, x16	1600-1866 MT/s		1–8GB; 8GB	IT, AT	BGA, SODIMM, ECC SODIMM, UDIMM, ECC UDIMM, RDIMM
DDR2 SDRAM (MT47)	1.8V	x8, x16	800 MT/s		512MB–2GB; 512MB–2GB	IT, AT	BGA
DDR (MT46)	2.5V	x8, x16	400MT/s		256MB, 512MB	IT	TSOP, BGA
SDRAM (MT48)	3.3v	x16, x32	133-167 MT/s		64-256MB	IT, AT	BGA, TSOP
LOW POWER DRAM							
LPDDR5 (MT62)	0.5V	x32, x64	2750MHz-4266MHz		16–128GB	WT, IT, AIT, AAT, AUT	BGA
LPDDR4 SDRAM (MT53)	1.1V	x16, x32, x64	1866MHz-2133MHz		4–128GB	WT, IT, AT,AUT	BGA, PoP
LPDDR3	1.2v	x32	933MHz-1067MHz		8–32GB	WT	BGA
LPDDR2 SDRAM	1.2V	x32	533MHz		512MB-2GB	IT, AT	BGA
eMCPs and MCPs							
e.MMC + LPDDR4 MCPs	3.3v	x8 e.MMC,x32 LPDDR4	1866-2133MHz		8GB + 16GB; 32GB + 16GB	IT	BGA
NAND + LPDDR4 MCPs	1.8V	x8 NAND,x16 LPDDR4	2133 MHz 8-bit ECC		4GB 100K SLC NAND, 2–4GB LPDDR4	IT	BGA
NAND + LPDDR2 MCPs	1.8V	x8 NANDx16, x32 LPDDR2	533 MHz 4-bit ECC		1–4GB 100K SLC NAND, 512MB–4GB LPDDR2	IT	BGA
SLC NAND							
Serial SLC NAND LP/VLP	1.8V, 3V	x1, x2, x4	Up to 133 MHz, on die (zero) ECC		1–256GB 100K SLC NAND	IT	DFN, BGA, wafer
Parallel SLC NAND LP/VLP	1.8V, 3V	x8, x16	8-bit or on-die (zero) ECC		1–8GB 100K SLC NAND	IT	TSOP, BGA, wafer
Parallel NOR Flash							
MT28EW	3V	x8, x16	Async		128MB–2GB	IT	TSOP, BGA
Serial NOR Flash							
MT35X Xccela™ Flash	1.8V, 3V	x1, x8	200 MHz DDR		256MB–2GB	IT, AT, UT	BGA
MT25Q	1.8V, 3V	x1, x2, x4	108-166 MHz		128MB–2GB	IT, AT, UT	BGA, CSP, DFN,SOIC
MT25Q Authenta™ Flash	1.8V, 3V	x1, x2, x4	133-166 MHz		128MB - 256MB	IT, UT	DFN, BGA, SOIC, CSP
Storage							
SSDs	3.3/1.2/ 0.9V	x4	PCIe Gen3		64GB–1TB	AI	BGA
	3.3V	x4	PCIe Gen3		64GB–1TB	AI	M.2 (Type 2230)
Memory cards	3.3V	x4	SD3.0 UHS-I,U1/U3, A1/A2,Class 10		32GB–1TB	WT	microSD
e.MMC	3V	x1, x4, x8	MMC v5.1		2–128GB MLC, TLC	WT, IT	BGA
UFS3.1	3.3v	x8	UFS3.1		128GB, 256GB, 512B	WT, IT	BGA

Quectel is a global IoT solutions provider, offering a broad portfolio of IoT modules, antennas, and connectivity services. We exist to connect devices and people to networks and services, powering digital innovation and helping to build a smarter world. Our products and services help make life more convenient, efficient, comfortable, prosperous and secure.

Key Strength and Value Proposition

- Smart Module (System on Module) with computing capability, **Multimedia**, 5G, 4G, 3G, 2G connection capability, **Wi-Fi/BT, GNSS, USB...abundant Interfaces**
- Android or Linux OS
- Global certifications

Services

- Software development
- Certification
- Antenna

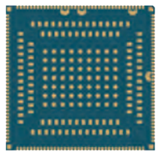
Core Offerings

Product Category	Processors Supported	Product Family Names	Software/Firmware
Smart Module	Qualcomm® QCM4290	SC680A	Yes
Smart Module	Qualcomm® QCS8250	SG865W	Yes

Smart modules

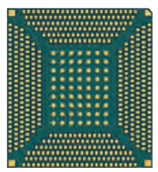
SC680A Series

- **LTE CAT6, Form-factor and dimensions:** LCC+LGA 43.0mm x 44.0mm x 2.85mm
- **CPU:** Qualcomm QCM4290 4 x Kryo™ Gold 260@2.0GHz, 4 x Kryo™ Silver 260@1.8GHz Adreno™ 610@950MHz
- **OS:** Android 12, 13/14 under planning
- **Multimedia:** DSIx1: FHD + (1080 x 2520), ISPx2: Max 25M, Video: En/De: 1080p60, H.264, H.265
- Wi-Fi/BT5.0/BLE, GNSS: GPS, GLONASS, BDS, Galileo
- **Memory:** 4GB+64GB



SG865W Series

- **Form-factor and dimensions:** LCC+LGA 42.0mm x 46.0mm x 2.95mm
- **CPU:** Qualcomm QCS8250 1 x Kryo™ 585 Gold prime @2.842 GHz 3 x Kryo™ 585 Gold@2.419GHz 4 x Kryo™ 585 Silver@1.805GHz, Adreno™ 650@587MHz, NPU230
- **OS:** Android 10
- **Multimedia:** DSIx2:4K (5040 x 2160) + DP, ISPx2+Lite ISPx2: Max 64M, Video: En/De: 4K120/8K30, H.264, H.265
- Wi-Fi/BT5.0/BLE
- **Memory:** 8GB+64GB or 8GB+256GB



TOC ⟶

Sequitur Labs develops chip-to-cloud software and lifecycle management SaaS to ensure security in a connected world. With the Sequitur security platform, developers of intelligent devices can deliver safe and secure products while protecting AI models at the edge.

Key Strength and Value Proposition

- Chip-to-cloud security for embedded devices
- Turnkey solution ensuring safe & secure products, with reduced development time and risk
- Protection of AI models at the Edge

Services

- Engineering services
- Device lifecycle management SaaS

Core Offerings

Product Category	Processors Supported	Product Family Names	Software/Firmware
System on Modules	– MCHP SAMA5D2 SOM – NVIDIA Jetson – Variscite VAR-SOM-MX8M-PLUS		
Development Kit	– MCHP SAMA5D2 – NXP i.MX6/7/8, 8MPlus – ST Micro STM32MP1 – NVIDIA Jetson	EmSPARK™ security suite EmPOWER™ lifecycle management	Yes

Featured Solutions

EmSPARK™ Security Suite

Sequitur Labs' EmSPARK™ security suite is a collection of firmware, integration tools, and APIs that provides complete chip-to-cloud security for MPUs.

EmPOWER™ Lifecycle Management Platform

EmPOWER™ is a SaaS solution that provides the lifecycle management platform needed to secure, provision, and update intelligent edge devices.

Arrow Shield96 Single Board Computer

The Shield96 Standard reference platform provides a secure solution applicable across all IoT verticals. This trusted Linux turn-key solution addresses hardware security by design. This hardware allows users the ability to design a solution as needed to fit their custom needs.

The Shield96 Trusted Platform comes preloaded with the EmSPARK™ security suite software by Sequitur Labs. This provides a secure platform applicable across all IoT verticals to enable secure endpoint solutions and protect firmware, keys, and data throughout the lifecycle of a product. EmSPARK™ is the essential software companion suite complementing the Microchip hardware providing a cost-effective secure solution appropriate for every connected device built with the ATSAMA5D2 processor. Engineers can leverage this reference design for digital transformation built on trust extracting the full value of the advanced embedded security features of the ATSAMA5D2.

TOC ⟶

VigiShield Secure by Design

Build security into the design of your device by utilizing our embedded experts to implement core security features. This includes secure boot/chain of trust, device encryption and secure key storage, over-the-air (OTA) software updates, hardening, and security audits.

Implementing security early in the design of your device is key to managing its security:

- Reduce the attack surface of your device
- Avoid production delays by securing your software supply chain

In today's heightened cyber threat environment, connected embedded systems for industrial controls, transportation, navigation, communications, aerospace, military applications, healthcare devices, logistics systems, and many others require uncompromising security at deployment and throughout their product lifecycles.

What We Can Implement

Secure Boot/Chain of Trust: (Prevent Firmware Tampering)

Ensure your device is not running tampered software by verifying its authenticity before execution. Establish software authenticity all the way from the bootloader to user applications. Our secure boot/chain of trust services help implement:

- Verified bootloader (NXP i.MX / QorIQ, Qualcomm Snapdragon, TI Sitara, Atmel SAMA5, Xilinx Zynq, NVIDIA® Jetson™, STM32MP1, Intel® x86 and Atom™, etc.) integrated with Yocto, Buildroot, and more
- Linux kernel verification (FIT image, SoC specific mechanisms)
- Root filesystem verification (dm-verity, IMA/EVM, FIT image)

Device Encryption and Secure Key Storage: (Keep Your IP and User Information Safe)

You can protect IP and sensitive user information by encrypting data/software. It is also critical to protect the key used for encryption using a secure storage mechanism. Additionally, software that handles confidential data should run from within a hardware/software-isolated environment. We provide solutions and services that span:

- Anti-cloning (IP and Data protection)
- Key management and secure key storage
- Data protection using encryption — In use, in motion, and at rest
- Trusted platform module (TPM)
- Trusted execution environment (TEE) using Arm TrustZone and OP-TEE
- Device identity and authentication

OTA Software Updates: (Keep Your Updates Safe)

Our security services can help you determine how to update/deploy software securely and deny unauthorized software installs. We can implement:

- Over-the-air (OTA) updates of the software on your embedded system
- Package updates
- Full OS updates
- Signing of packages and images
- Server authentication

Hardening: (Lock It Down)

Our Linux kernel hardening service focuses on system configurations needed to reduce your product's attack surface, decrease risk of compromise, and minimize breach impacts including:

- Access and authorization
- Vulnerabilities
- Logging of all user access
- Logging of access level changes by any program
- Disabling unused services and ports
- Addressing issues from penetration testing reports
- Security-oriented configurations for packages and kernel

Software Supply Chain Security: (Know Where Your Software Comes From and Stay Resilient)

VigiShield Secure by Design helps you gain visibility into your software supply chain and secure it by:

- Choosing the right open-source software
- Implementing end-to-end framework for supply chain integrity
- End-to-end review of system security
- Managing supply chain risks leveraging detailed SBOM

OTA Software Updates: (Keep Your Updates Safe)

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- Package updates
- Full OS updates
- Signing of packages and images
- Server authentication

How It Works: Secure by Design Projects

Scoping Phase

- Questionnaire for requirement gathering
- Statement of Work (SOW) for customization and add-on services

Development Phase

- Execution and delivery per SOW
- Integration and Testing on your custom hardware

Completion/Acceptance Phase

- Code and documentation delivery via shared private GitLab

Post-Delivery/Support Phase (Optional)

- Post-delivery handover training
- Optional: Vigiles Cybersecurity vulnerability monitoring and mitigation
- Optional: Long-term OS maintenance engagement

Vigiles Vulnerability Monitoring and Management Tool

Manage the growing tsunami of new CVEs (Common Vulnerabilities and Exposures). Detect, filter, triage, and remediate vulnerabilities with the industry's first Software Composition Analysis (SCA) and CVE monitoring tool optimized for embedded Linux and usable for all open-source software.

- Drastically reduce your workload
- Produce an accurate Software Bill of Materials (SBOM)

Best-in-class vulnerability monitoring and remediation tool that combines a curated CVE database, continuous security feed based on your SBOM, powerful filtering, and easy triage tools so you don't get blindsided by vulnerabilities.

How It Works

SBOM Generation and Integration: (Use Accurate Device Information)

Vigiles supports all major Linux build system integrations including Yocto, Buildroot, PetaLinux, Wind River Linux, PTXdist, OpenWrt, and Timesys Factory for more accurate SBOM generation.

- Captures your kernel and U-Boot configuration for better mapping of package names to CVE naming, package version, and applied patches
- Automatic scan of your SBOM against our curated vulnerabilities database creates an immediate CVE report
- Manage software supply chain risks leveraging detailed SBOM
- Intuitively track and manage SBOMs across various products and releases

Timesys Curated Database: (Start with a Better List of CVEs)

Vigiles provides up to 40% accuracy improvement over the National Vulnerability Database (NVD) with Timesys' curated CVE/CPE database.

- **More accurate data:** Timesys Vigiles team manually analyzes incorrect CVEs and updates in our system
- **Optimized for embedded:** Intelligent curation algorithms for the Linux kernel and U-Boot run daily
- **Get alerts earlier:** We minimize reporting delays by up to four weeks by pulling data from multiple feeds

Your Build + Our Database = Accurate Results: (See Only Applicable CVEs)

Vigiles only pulls the data for the CVEs that correspond to your SBOM, giving you a curated list to review.

- Drastically reduce your workload
- 85% fewer CVEs to analyze
- 95% fewer false positives

Identify Top Vulnerabilities Based on Your Risk Analysis: (Filter the Shortlist Quickly)

Powerful filters allow you to quickly identify the CVEs that you want to fix.

- Filter CVEs by: package affected, patch or fix availability, CVE severity, custom scoring, affected platforms, notes/comments, and kernel and U-Boot configuration options
- Identify CVEs you want to ignore by actively whitelisting

Document Your Decisions and Coordinate Responses: (Keep Your Remediation Team in Sync)

Streamline vulnerability management and mitigation with easy-to-use collaboration tools.

- Share manifests with other team members so they can add notes to CVEs, whitelist them, and more
- Connect Vigiles with Jira for seamless issue tracking

See the Remediation Options with One Click: (Stop Searching and Start Patching)

For every CVE found in your scanned SBOM, Vigiles will let you know if there is a fix and give you the patch, minimum version, and/or config option information needed to remediate the vulnerability.

- Easily identify remediation options with resources included in your report
- Make quick fixes with links to available patches, workarounds for remediation when a patch is not available, and links for recreating the CVE exploit for testing

Use Shareable Reports and Diff-Like Comparisons Tools: (Enjoy Easier Regulatory Compliance)

Comparing reports and viewing report history enables you to more efficiently manage cybersecurity vulnerabilities affecting your product throughout its product lifecycle and comply with government and regulatory security standards.

- Track changes between releases and automatically create a summary report for release notes
- View side-by-side manifest comparison with searchable manifest and CVE sections
- Export your SBOM in SPDX format, an official international open standard for SBOMs

Set up Your Security Feed and Alerts with Emailed Reports: (Keep Your Product Secure with Continuous Monitoring)

Vigiles securely maintains current manifests of your products and continuously rescans and tracks vulnerabilities for all versions even after your product is released and in production.

- Stay on top of new vulnerabilities with periodic rescans and reports
- Keep your device secure in the field, for full product lifecycle

You Could Try Another Tool, But Why Would You?

- **SCA optimized for embedded** - build system integration, kernel/u-boot filters, and platform filters for 85% fewer CVEs to analyze
- **Superior curated data accuracy** - 95% fewer false positives plus more coverage and earlier reporting
- **Fits into software development life cycle workflow** - CI/CD, Jira integration, APIs, team collaboration
- **Streamline compliance** - SBOM generation, license and vulnerability policy, and documentation
- **Efficient triaging and remediation** - Email alerts, intelligent filtering, links to fixes
- **ROI in as little as 3 months** - with time saved

Streamline Your Process with a Workflow Backbone that will Pay for Itself

Vigiles gives you the complete process to track, triage, remediate, and document CVEs affecting your device. With more accurate data and powerful filters, Vigiles pays for itself in time saved in as little as three months.

Linux OS and BSP Maintenance

Keep your device secure while in the field with long-term security updates and maintenance. Offload the complex, time-consuming work of OS/BSP maintenance to embedded Linux security experts.

- 60%+ cost reduction for BSP maintenance
- Updates based on your schedule, as often as you need them
- Long-term support for up to ten years and beyond

The outdated strategy of “freeze and release” — freezing a device’s software at product launch with no plan or process to update it in the field — puts devices at high risk of security compromise. Whether you use Yocto Project, Buildroot, or Timesys Factory build system, regular upgrades are needed to ensure device security, to apply bug fixes, and to support newer hardware and technologies.

What Linux OS and BSP Maintenance Gets You:

Linux OS/BSP maintenance subscription service provides long-term security updates and maintenance of your Linux OS/BSPs. It is available for Yocto Project, Buildroot and Timesys Factory build systems.

Expertise You Can Trust: (Embedded Linux Security Experts)

Timesys has decades of experience with embedded Linux.

- Our Linux experts utilize decades of experience and purpose-built tools to keep your device updated and secure
- We provide regular updates that include bug fixes, support for new end-of-life parts, and new package features
- Validated Linux OS/BSP on your hardware so there are no surprises

Results That Don’t Break Your Budget: (Half the Cost of Doing It Yourself)

Maintaining your OS and BSP to stay ahead of security threats is complex and time-consuming, and expensive if you do it yourself.

- Linux OS/BSP maintenance service is less than ½ the cost of a junior engineer
- Free up your resources to work on next-gen products

CVE Monitoring with Our Best-In-Class Tool, Vigiles: (Boost Compliance with a Continuous Security Feed)

Vigiles provides vulnerability alerts, monitoring, and remediation with on-demand reports for easy documentation.

- Superior data accuracy pulls only the data for CVEs that correspond to your SBOM
- Automated documentation of fixed vulnerabilities between releases to boost industry compliance

Collaborative Triage and Development for Releases: (Seamless Workflow Integration)

Work together to quickly identify the CVEs you want us to fix.

- Joint review and analysis to identify CVEs that pose the highest risk
- We take action against the largest threats by deploying patches

Update Cadence That Meets Your Product Security Policy

With Linux OS/BSP maintenance, you’re in control of the update schedule.

- Choose the cadence and number of updates (1-4) you require each year
- Includes updates to Linux kernel, file system, and the bootloader
- One emergency release provided in case of a zero-day vulnerability

How It Works

Set up baseline - Your custom board is set up in our embedded board farm and your BSP code is added to a private Timesys Git repo.

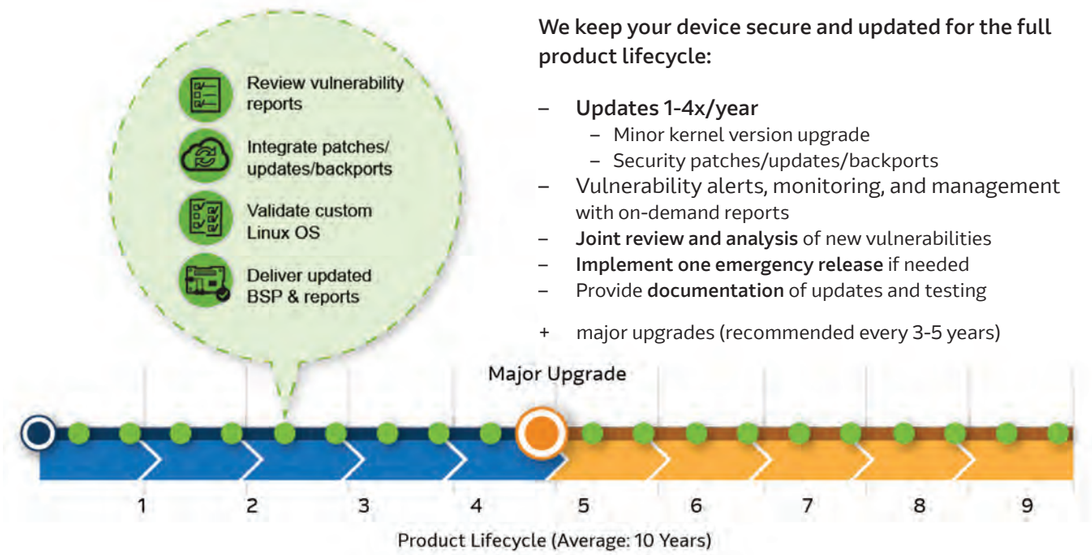
Review reports - We provide monthly vulnerability reports, and on a regular basis we jointly review them to determine what updates and patches you want us to apply.

Integrate patches/updates/backports - We integrate security patches/package updates and backports for your BSP as per the quarterly review.

Validate custom Linux OS - After integrating patches/updates, we validate the BSP by comparing the driver tests against the baseline.

Deliver updated BSP and reports - We deliver updated BSP and validation reports for comparison with the previous report.

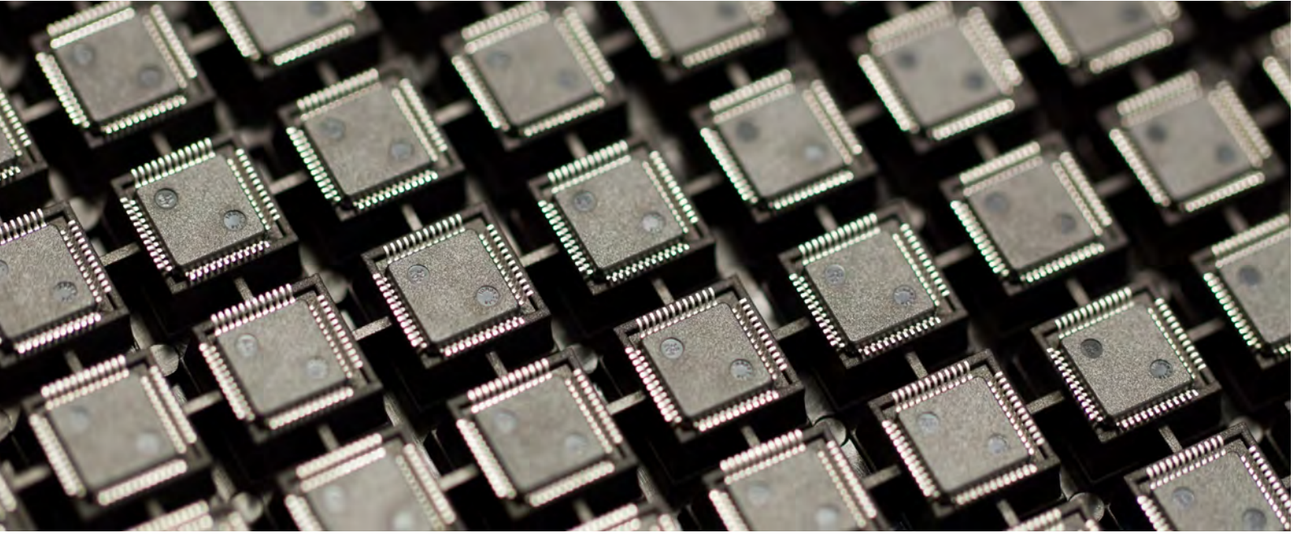
What Takes Place Each Year



We keep your device secure and updated for the full product lifecycle:

- **Updates 1-4x/year**
  - Minor kernel version upgrade
  - Security patches/updates/backports
- Vulnerability alerts, monitoring, and management with on-demand reports
- **Joint review and analysis** of new vulnerabilities
- **Implement one emergency release** if needed
- Provide **documentation** of updates and testing

\+ major upgrades (recommended every 3-5 years)



Arrow Engineering Services

Our broad portfolio that spans the entire technology landscape helps customers create, make and manage forward-thinking products that make the benefits of technology accessible to as many people as possible. Minimize design cycles and speed time-to-market by engaging Arrow Engineering Services.

Our technology portfolio includes semiconductors, passives, electromechanical, connectors, power suppliers, embedded systems, software, and cloud.

Hardware Services

- Embedded and IoT hardware design
- Wireless and certifications
- Most certified with all key suppliers
- Design from scratch or off-the-shelf board customizations
- Industrial/mechanical designs

Software Expertise

- Linux, Android™, and Windows®
- Machine vision, camera integration, and HMI
- ADAS
- High-performance computing
- Hardware and software secuity
- Cloud and application design support

Production Services

- Programming
- Manufacturing
- White-labelling and kitting
- Integration

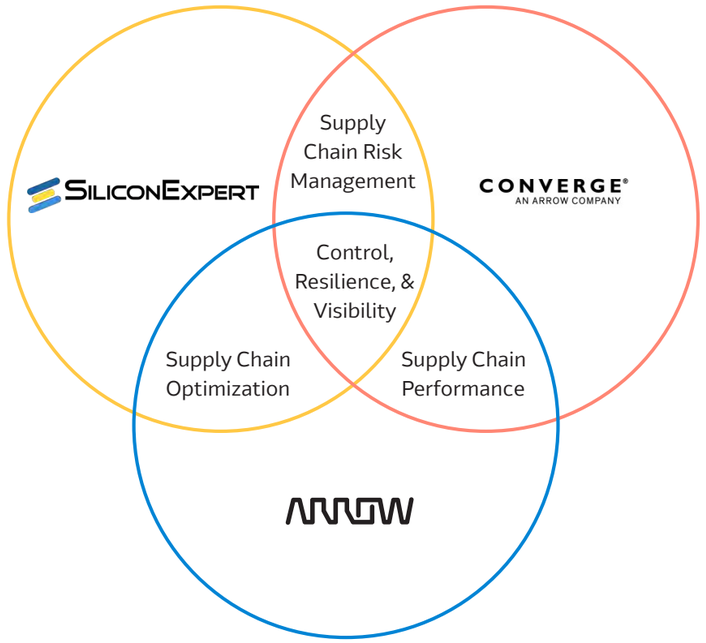
Minimize design cycles and speed time-to-market by engaging Arrow early in your design cycle

Supply Chain Services

We accelerate your direct electronics supply chain into the future by leveraging Arrow's seasoned industry experts, best-in-class processes, world-class systems and infrastructure, extensive global footprint and reach, and the orchestrator of the electronics partner ecosystem.

Our supply chain services offer:

- Full-service supply chain management (forecasts, orders, inventory, logistics, AR/AP, and returns)
- Best-in-class customer service and global program management
- Industry-leading processes and systems backbone
- Secure warehouses located optimally around the world, supported by a global logistics network
- 50 branches across EMEA to serve local customer needs
- One Global ERP System – visibility and access to all Arrow inventories
- State-of-the-art warehouse automation brings efficiency and quality



Arrow Value-Added Services

Programming Services

- Device programming includes support for EPROM and EEPROM, FPGAs and PLDs, Microprocessors, flash memory, and NAND Flash
- Shorter total cycle times, inventory reduction and reduced material handling optimizing the total cost of ownership
- Pre-programming parts before manufacturing helps improve customers' IP protection

Secure Provisioning Services

- Enables precise identification and authentication of devices
- High-level of security and excellent anti-counterfeiting & brand protection
- Arrow supports devices from leading manufacturers of secure elements including Cypress, Infineon, Microchip, NXP, Silicon Labs and many others

Tape & Reel Services

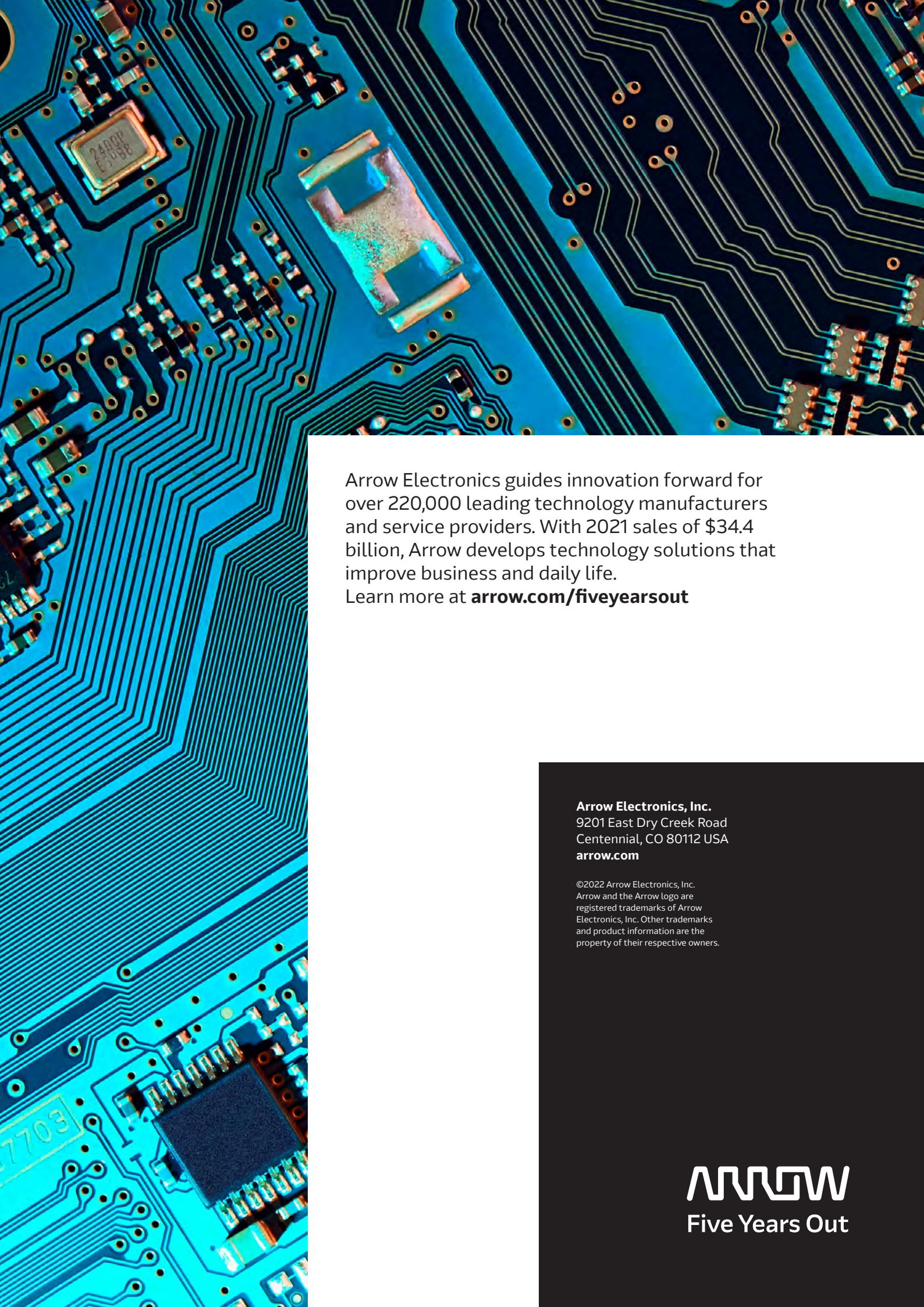
- Quick, high-quality tape and reel service prior to shipment so they arrive production-ready
- Reliable, fast, and flexible tape and reel services that support a wide range of surface-mount and radial components
- Offered as a complement to our programming services or on a stand-alone basis

Supply Assurance

- Factory-direct, genuine parts with full certificates of compliance
- Ensure counterfeit mitigation and costly redesigns
- State-of-the-art Nitrogen storage facilities at our primary distribution centre

Financial Services

- 0% and low- rate financing options
- First payment deferrals of 30, 60, 90 days
- 12 to 60-month terms
- Monthly, quarterly, annual payments



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