NXP® Kinetis® and LPC Microcontrollers

A Powerhouse Portfolio of MCUs based on ARM® Cortex®-M Cores

A Powerhouse Portfolio of MCUs

NXP's Kinetis and LPC MCUs offer a powerhouse portfolio representing the broadest selections of ARM-based solutions for the general market, all while delivering efficient application performance and a better developer experience. These innovation-packed devices give you the features you've come to expect from a long-time leader in ARM technology—like fast CPU speeds and best-in-class power efficiency—along with advanced levels of I/O integration. We designed these MCU solutions with great care and a true ground-up approach evident in their enhanced connectivity and control features, intelligent peripherals for added functionality and incredibly small packages. Our goal: to help save time and resources, while increasing design flexibility and lowering overall system cost. Comprehensive software and hardware enablement, as well as a broad range of performance and security options, further strengthen this powerhouse portfolio of MCUs that are key enablers for consumer and industrial applications.

A Comprehensive MCU Portfolio

ARM® Expertise	Broadest licensee of ARM cores in the industry, with 1000+ products based on ARM technology
Broad Portfolio	Most scalable portfolio with optimized performance and capabilities: scales from 20 MHz to 240 MHz with a rich mixture of cores from ARM Cortex-M0/M+ to Cortex-M7, and a robust peripheral mix including ethernet, USB and enhanced analog integration
Development Tools	Best-in-class hardware platforms and software solutions, with more than 200 development boards to jump-start your design
Ecosystem Leadership	Industry-leading partnerships for innovation and differentiation, with more than 300 solutions supporting Kinetis® and LPC MCUs from 22 global partners
Customer Focused	Experienced global support team and professional services to accelerate time-to-market

Target Applications

Wearables
- Earbuds and headphones
- Fitness, activity and wellness trackers
- Portable industrial
- Smart watches
- Wireless healthcare devices

Home and building automation
- Thermostats, security, safety, lighting
- Wireless connectivity hubs and gateways
- Wireless sensors and door locks

Smart accessories
- eReaders, tablets
- Game controllers
- Outdoor GPS devices
- Smartphone accessories

Smart home appliances
- Cookers, ovens, cooktops, microwaves
- Refrigerators, freezers, room air conditioners
- Washers, dishwashers, dryers

3-Phase motor control
- Drones
- Fans, pumps, compressors
- Home appliances
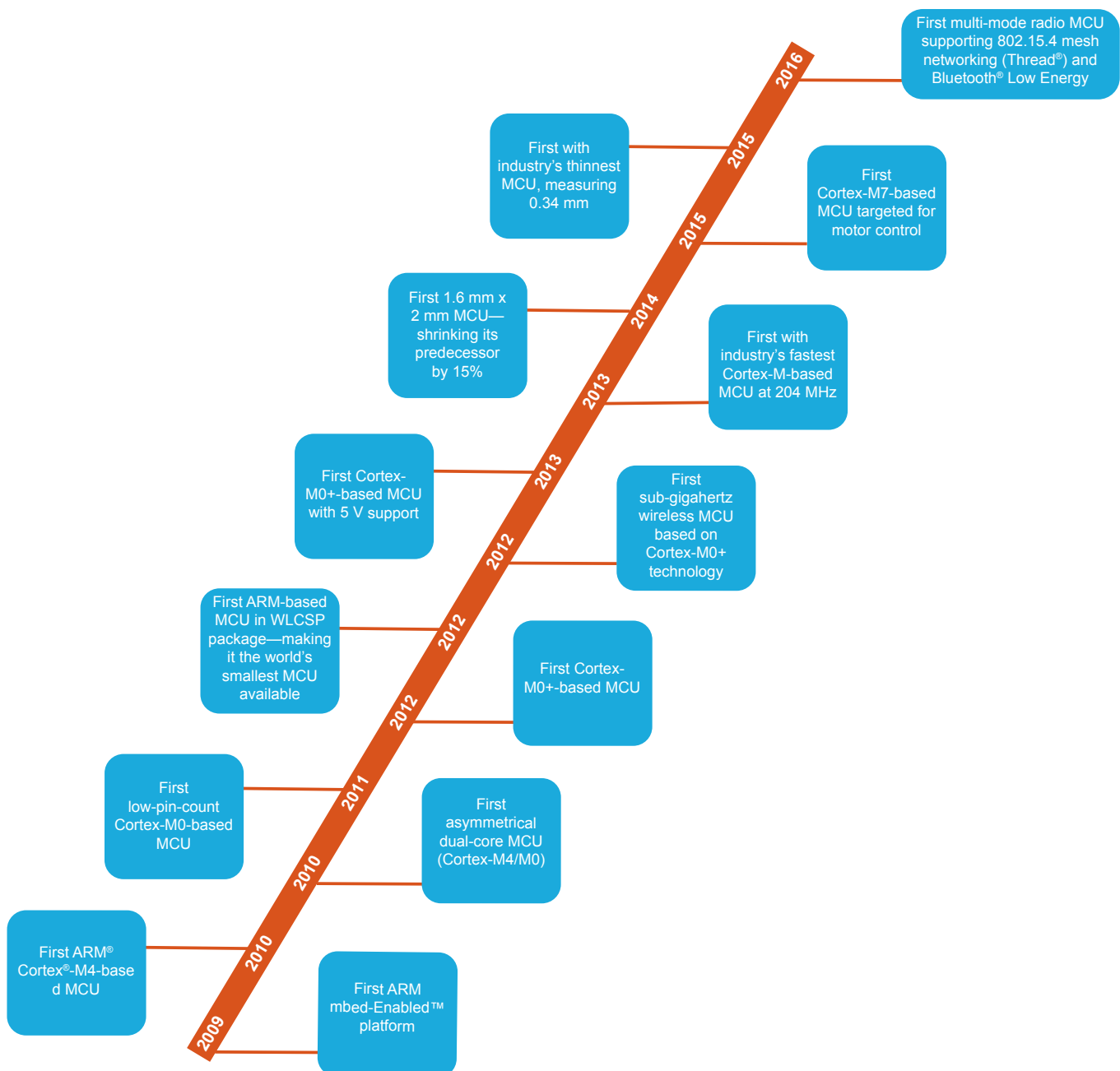- HVAC systems
- Industrial drives
- Robotics

Real-time control
- Circuit breakers
- Solar inverters, switch-mode power supplies
- LED lighting
- Industrial automation machinery
- Printers

Payment and access
- Mobile point-of-sale (POS) readers
- Traditional and portable POS readers
- PIN pads

MCU Innovation Leadership

Backed by an established record and decades of design experience, NXP has delivered a number of industry firsts based on ARM technology, including being among the first to license the Cortex-M technology:

2016 — First multi-mode radio MCU supporting 802.15.4 mesh networking (Thread®) and Bluetooth® Low Energy

2015 — First with industry's thinnest MCU, measuring 0.34 mm

2015 — First Cortex-M7-based MCU targeted for motor control

2014 — First 1.6 mm x 2 mm MCU—shrinking its predecessor by 15%

2013 — First with industry's fastest Cortex-M-based MCU at 204 MHz

2013 — First Cortex-M0+-based MCU with 5 V support

2012 — First sub-gigahertz wireless MCU based on Cortex-M0+ technology

2012 — First ARM-based MCU in WLCSP package—making it the world's smallest MCU available

2012 — First Cortex-M0+-based MCU

2011 — First low-pin-count Cortex-M0-based MCU

2010 — First asymmetrical dual-core MCU (Cortex-M4/M0)

2010 — First ARM® Cortex®-M4-based MCU

2009 — First ARM mbed-Enabled™ platform

MCU Solutions for Every Design

NXP's MCU portfolio offers a wide range of options:

▸ **General-purpose MCUs** composed of a range of devices spanning from low power consumption and small-package devices to highly integrated, high-performance devices with a range of flexible features and memory options.

▸ **Application-specific MCUs** that are designed to address particular market needs like advanced timers and high-precision analog integration for motor control, 5 V robust solutions for appliances and other industrial applications, and advanced wireless connectivity including integrated software stacks, which are important for the ever-evolving IoT market.

NXP uses the same building blocks in many of its MCUs, and offers pin- and software-compatible options across product families and cores. We make it easier for you to scale and reuse your hardware and software designs, whether you're upgrading or cost optimizing functionality.

Kinetis and LPC MCUs Offer a Range of Options

		ARM® Cortex®-M0/M0+ Core		ARM Cortex-M3/M4 Core		ARM Cortex-M7 Core
General Purpose	**Performance Efficiency** Always-on devices Voice control IoT			**LPC5410x MCUs (Cortex-M4 w/ M0+)** 100 MHz power efficiency, up to 512 KB flash, 104 KB SRAM	**LPC5411x MCUs (Cortex-M4 w/ M0+)** Flex comm interfaces, voice triggering, crystal-less USB, up to 256 KB SRAM	
	Advanced Integration Industrial Control Payment Metering Wearables Display UI Printers		**Kinetis KL80/81 MCUs** Security w/crypto engine, FlexIO up to 128 KB flash, 96 KB SRAM	**Kinetis® K64/66/65 MCUs** up to 180 MHz, crypto, ENET, HS USB, up to 2 MB flash, 256 KB SRAM	**Kinetis K80/81 MCUs** Crypto, QSPI, SDRAM controller, up to 256 KB flash, 256 KB SRAM	
				LPC1800 MCUs 180 MHz, 2 x HS USB, LCD, CAN, ENET flashless, up to 1 MB flash, 200 KB SRAM	**LPC4300 MCUs (Cortex-M4 w/ M0+)** 204 MHz, 2 x HS USB, LCD, CAN, ENET flashless or up to 1 MB flash, 282 KB SRAM	
	Mainstream Consumer/gaming Accessories Wearables Home automation Data concentrators Industrial	**LPC1100 MCUs** CAN or USB options, EEPROM, up to 256 KB flash, 36 KB SRAM	**Kinetis KL28 MCUs** 72/96 MHz, FlexIO, BootROM, up to 512 KB flash, 128 KB SRAM	**LPC4000 MCUs** Graphic LCD, FS USB, ENET, CAN, up to 512 KB flash, 96 KB SRAM	**Kinetis K22/24/26 MCUs** USB crystal-less FS, USB high-speed (K26), up to 2 MB flash, 256 KB SRAM	
		Kinetis KL17 MCUs FlexIO, BootROM, up to 256 KB flash, 32 KB SRAM	**Kinetis KL27 MCUs** FlexIO, BootROM, crystal-less USB, up to 256 KB flash, 32 KB SRAM	**LPC1700 MCUs** Graphics LCD, FS USB, ENET, CAN, up to 512 KB flash, 96 KB SRAM	**LPC1500 MCUs** CAN, advanced analog, PWMs, up to 256 KB flash, 36 KB SRAM	
	Cost-Effective and Small Form Factor Wake-up unit System task/co-processor Power management Control system	**LPC81x/82x MCUs** 30 MHz, ADC, low pin count, up to 32 KB flash, 8 KB SRAM	**Kinetis KL05 MCUs** 12-bit ADC and DAC, 8–32 KB flash,1–4 KB SRAM			
			Kinetis KL02/03 MCUs Small form factor, low power 8–32 KB flash, 1–4 KB SRAM			
Application Specific	**Wireless Connectivity** Home automation Thread® BLE Apple® HomeKit™	**Kinetis KW20/30/40Z MCUs** 802.15.4/BLE 4.1 radio, DC/DC, 160 KB flash, 20 KB SRAM	**Kinetis KW21/31/41Z MCUs** 802.15.4/BLE 4.2 radio, DC/DC, balun, up to 512 KB flash, 128 KB SRAM	**Kinetis KW2xD MCUs** 802.15.4 radio, Thread, up to 512 KB flash, 64 KB SRAM		
		Kinetis KW01 MCUs Sub-GHz radio, 128 KB flash, 16 KB SRAM				
	Motor Control and Power Conversion BLDC/PMSM motors Photo voltaic Industrial controls	**Kinetis KV1x MCUs** BLDC, entry-level PMSM, Kinetis Motor Suite SW, up to 128 KB flash, 16 KB SRAM		**Kinetis KV3x MCUs** Mid-range PMSM, UPS power control, Kinetis Motor Suite SW, up to 512 KB flash, 96 KB SRAM	**Kinetis KV4x MCUs** High-perf motors, UPS, solar & mid-range AC/DC control, Kinetis Motor Suite SW, up to 256 KB flash, 32 KB SRAM	**Kinetis KV5x MCUs** Higher perf, precision analog, ENET, up to 1 MB flash, 256 KB SRAM
	5 V Robust Appliance Smart lightning	**Kinetis KE01/04/06 MCUs** ADC, CAN (KE06), 256 KB EEPROM up to 128 KB flash, 16 KB SRAM	**Kinetis KE1xZ MCUs** 72 MHz, TSI up to 256 KB flash, 32 KB SRAM	**Kinetis KE1xF MCUs** 168 MHz, ADCs, 2 x CAN up to 512 KB flash, 64 KB SRAM		

(Not a complete portfolio summary.)

Product Spotlight

Kinetis KW41Z Wireless MCUs

The Kinetis KW41Z MCU is an ultra-low-power, highly-integrated single-chip device that enables Bluetooth® Smart/Bluetooth® Low Energy (BLE) v4.2 and IEEE® 802.15.4-2011 RF connectivity for portable, extremely low-power embedded systems. The Kinetis KW41Z MCU is an ideal solution for true single-chip designs that require concurrent communication on both a BLE network and an 802.15.4-based network such as Thread. This multi-mode capability enables direct communication using BLE via a mobile device and participation in a mesh network for local and remote control/ monitoring. Applications include: portable healthcare devices, wearable sports and fitness devices, AV remote controls, computer keyboards and mice, gaming controllers, access control security systems, smart energy and home area networks. In addition to suppoting BLE and Thread, the Kinetis KW41Z MCU family also supports BLE Mesh, IPv6 over BLE, Generic FSK and IEEE 802.15.4 MAC/PHY. For applications that need one wireless connectivity protocol, there are pin-compatible options for BLE only (Kinetis KW31Z MCUs) and 802.15.4 only (Kinetis KW21Z MCUs).

○ Host ◇ Router □ Border Router

— Thread Network Connection
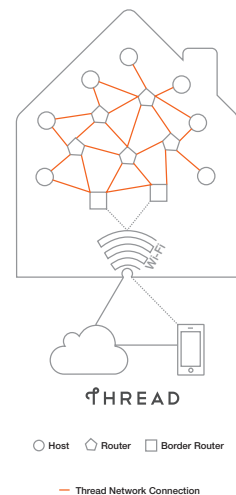
LPC5411x Dual-Core MCUs

Based on the high-performance Cortex-M4 core, LPC5411x MCUs are available with an optional Cortex-M0+ co-processor. In an always-on application, these MCUs operate in a power-down mode, listening for incoming data. When available, this data can wake either core to acquire or process the information. When these MCUs are in an active mode, developers can optimize power efficiency and throughput by choosing between the power-efficient Cortex-M0+ core for data collection, aggregation, and system task management, or the Cortex-M4 core, which can complete processor-intensive algorithms, such as sensor aggregation, and quickly help to reduce power consumed. The dedicated on-chip digital microphone (DMIC) subsystem on the LPC5411x family will also dramatically reduce power in applications that demand voice triggering and recognition, achieving the stringent power efficiencies required for always-on voice-activation in battery-operated products.

Technology

Kinetis and LPC MCUs are built with a foundation of core technologies that address various market use cases for an optimized design.

Security

Securing the IoT is a top priority and a critical element of every connected design. Leveraging years of security expertise and resources, NXP MCUs are making it easier than ever to help you protect your products from various types of attacks with a three-pronged strategy:

- Trust—On-chip flash memory with security mechanisms can disable debug ports so firmware software can be locked down on the device and will not be at risk from outside attacks.
- Cryptography—A hardware encryption accelerator blocks assist in transporting and protecting data on the way to its intended destination.
- Anti-tamper detection—A tamper module with dedicated pins to detect physical system intrusion as well as environmental changes (temperature, voltage, clocking schemes) attempting to unlock protected memory regions or expose encryption keys.

Low power

Design without compromise using the ultra-low-power Kinetis L and LPC800 series or the power-efficient Kinetis K and LPC54000 series of products. NXP MCUs help system designers optimize power consumption through five key low-power technologies:

1. Low-power boot
2. Intelligent clocking
3. Ultra-efficient processing
4. Flexible low-power modes
5. Autonomous, low-power peripherals

Wireless connectivity

NXP offers the world's most integrated, robust, reliable, and easy-to-use wireless and RF IC solutions available in the market today. By using mixed-signal ICs designed in standard CMOS from NXP, designers are able to eliminate discrete components and use fewer external components. Customers can focus on value-added features and speed time-to-market with Thread, Bluetooth Low Energy, Sub-GHz, and 2.4 GHz proprietary wireless solutions from NXP. For Wi-Fi® connectivity requirements, NXP supports module solutions through partners for Kinetis and LPC MCUs.

Wired connectivity

NXP MCUs make it easy to implement industry-standard connectivity options. They include features such as 10/100 Mbit/s Ethernet with an IEEE 1588® precision time protocol (PTP) transceiver including Ethernet and USB connectivity, full-speed and hi-speed controllers and crystal-less USB. The FlexIO and Flexcomm features provide the ultimate flexibility for connectivity requirements because they enable you to configure various serial communication protocols according to your application needs.

Memory

NXP MCUs boast a unique expandable memory architecture for tailoring cost and memory size to the application. The expandable memory architecture, with its SPI flash interface (SPIFI) and 8-/16-/32-bit external memory controller (EMC) with SDRAM support, enables powerful options for scaling memory to your application requirements. In addition, flashless options with SPIFI or QSPI with execute-in-place capabilities lower BOM cost and maximize internal SRAM.

Multicore

NXP designed the world's first asymmetrical dual-core digital signal controller architecture, featuring Cortex-M4 and Cortex-M0 core technology. These NXP Cortex-M4-based MCUs with optional Cortex-M0 or Cortex-M0+ co-processors bring the advantage of developing digital signal processor (DSP) and MCU applications within a single architecture and development environment. Multi-core architectures allow efficient application partitioning and/or scalable power performance. Designers can offload tasks and improve power efficiency by taking advantage of the heterogeneous multicore processing that NXP offers. NXP provides simplified programmability and debugging by leveraging the same tools for both cores.

Analog integration

Advanced analog peripherals such as ADCs, DACs, programmable gain amplifiers and comparators are integrated in the broad portfolio of NXP microcontroller products. More advanced analog integration within the Kinetis V series supports high-end, real-time control applications with features such as high-resolution PWMs with 260 picosecond resolution and multiple 12-bit ADCs sampling at 5 megasamples per second (MS/s). These features enable precision timing and control for BLDC, PMSM and ACIM motors as well as power control applications. For applications that deal with tough environments, the Kinetis E series provides enhanced noise and immunity protection with a 5 V solution.

Graphics

NXP MCUs drive a wide range of color and monochrome LCD displays without loading the CPU.

This highly optimized peripheral features:

- Resolutions up to 1024 x 768 and support for 24 bpp (up to 16 M colors)
- Ability to drive single and dual TFT panels
- Dedicated LCD DMA controller
- Support for hardware cursor
- Free emWin graphics libraries
- Integrated options for expanding external memory to support higher resolutions

Packaging

NXP MCUs are available in a broad range of packages. From ultra-small 1.6 x 2.0 mm² chip-scale packages (CSPs) for area-constrained applications to large pitch and high-pin-count 20 x 20 mm² quad flat packages (QFPs) for single- or dual-layer printed circuit board (PCB) designs, and over 20 different packages in between, including MAPBGA and QFN package options in various sizes and pin counts. NXP also offers thin packages in BGA and WLCSP format for designs with height restrictions.
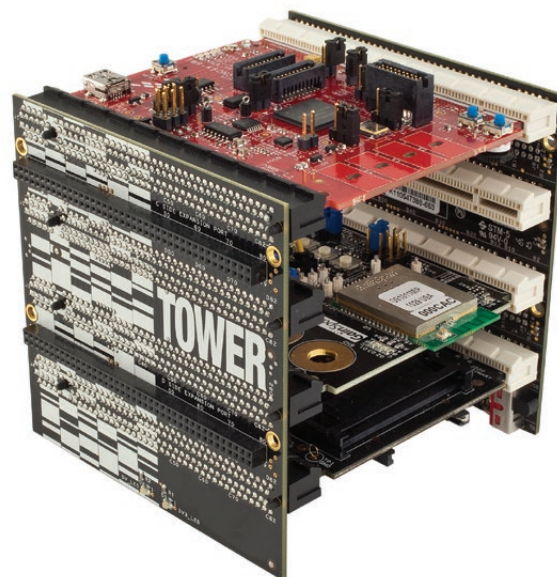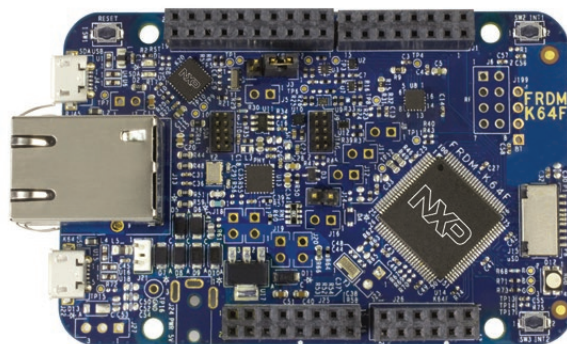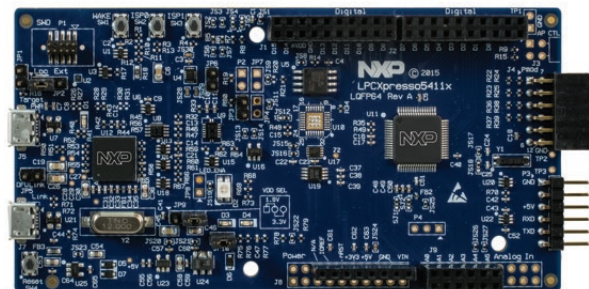
Enablement

Comprehensive NXP and third-party hardware and software enablement solutions support all NXP MCUs, reducing development costs and time-to-market.

Development Boards

NXP offers several rapid prototyping and evaluation platforms for its MCUs, including Freedom, LPCXpresso, and Tower® System development boards. These platforms offer cost-effective options that speed your time-to-market.

- **LPCXpresso development boards** have a small form factor, are cost effective and are designed for rapid protoyping and evaluation with LPC MCUs. The latest LPCXpresso boards include Arduino® Uno and Pmod™ connectors with free pads for easy prototyping.

- **Freedom development boards** have a small, low-power, are cost-effective evaluation platforms perfect for quick application prototyping with Kinetis MCUs. These boards include an easy-to-use mass storage device mode flash programmer, a virtual serial port, classic programming and run-control capabilities, and are form-factor compatible with the Arduino R3 pin layout.

- **Tower System boards** offer modular development tools for designing with various NXP controllers and processors. Interchangeable and reusable development boards, along with open-source design files, make it easy to create a comprehensive development platform for entry-level to advanced MCU development.

MCUXpresso software and tools

Developed as a cohesive set of software development tools, MCUXpresso software and tools bring together the best of NXP's software enablement into one platform for a shared software experience across NXP's powerhouse portfolio. This common toolkit supports Kinetis and LPC MCUs with a software development kit (SDK), an integrated development environment (IDE), and configuration tools. The common software framework found in MCUXpresso software and tools further streamlines end application development and enables easy migration and scalability for your future design needs. For more information, visit **www.nxp.com/ MCUXpresso**.

Software development kits

NXP's Kinetis and LPC MCUs are supported by the MCUXpresso software development kit (SDK) that includes system startup, peripheral drivers, USB and connectivity stacks, middleware, and real-time operating system (RTOS) kernels. Usage examples and demo applications are included with the free SDK download, and allow you to leverage toolchains from NXP, ARM Keil®, IAR, and other widely used IDEs.

Integrated development environments (IDE)

Software enablement for Kinetis and LPC MCUs includes NXP's highly-integrated open-source Eclipse-based software toolchains, including the widely used Kinetis Design Studio and LPCXpresso IDEs and the new MCUXpresso IDE (available March 2017). Featuring industry-standard GNU Compiler Collection (GCC) and GNU Debugger (GDB), among others; these IDEs make it easy to develop high-quality embedded applications.

Pins tool

Kinetis and LPC MCUs are supported by MCUXpresso configuration tools, including a graphical pins tool to configure the muxing, electrical properties and routing of pins. This tool provides real-time feedback of I/O conflicts and code generation of pin muxing source and header files.

Kinetis Motor Suite

Kinetis Motor Suite (KMS) is a highly intuitive motor control development tool that enables the design of sensored and sensorless BLDC and PMSM motor control applications quickly and efficiently, allowing those of all experience levels to develop an application. KMS consists of four main components—motor tuner, motor manager, motor observer and an open-source reference solution that improves overall motor system performance using the SpinTAC™-enabled motion controller. KMS simplifies the design process and accelerates time-to-market with its friendly graphical user interface and close integration with the Kinetis Design Studio IDE. Development can also be completed by directly controlling the function blocks via the natural API interface after initial motor tuning and configuration. Learn more about KMS at **www.nxp.com/KinetisMotorSuite**.

ARM mbed™

The ARM mbed IoT device platform provides free software libraries, hardware designs, tools and a developer ecosystem for professional developing of IoT devices and solutions based on ARM technology. The platform includes a standards-based C/C++ SDK, a microcontroller HDK with supported development boards, support for the industry's most popular compilers, and developer collaboration tools. NXP and ARM partnered to introduce the first mbed Enabled™ board based on the LPC1768 microcontroller, and the portfolio now includes options for more than 30 boards based on NXP MCUs, including the very popular FRDM-K64F Freedom and LPC1768 (OM11043) development boards.

Did you know the Kinetis KV5x MCU can control all four motors in a drone simultaneously, while also providing flight control? Learn more about the NXP quadcopter drone reference design at **www.nxp.com/NXPDesigns**.

NXP Designs

NXP Designs is an online resource that provides comprehensive, open-source reference design files, making it easier for engineers to address common design challenges such as security, power consumption, and connectivity. NXP Designs offers one of the most comprehensive sets of reference design packages in the market today. Bill of materials, schematics, PCB layout, software snippets, how-to documentation, and user guides are all available at no cost. Download and reuse all parts of the design to jump-start your own. For more information, visit: **www.nxp.com/NXPDesigns**.

Programs and Partners

Product Longevity

The NXP Product Longevity Program ensures a stable supply of products for your embedded designs. Participating products are available for a minimum of 10 to 15 years from product launch, and are supported by standard end-of-life notification policies.

For a complete list of participating products, visit, **www.nxp.com/productlongevity**.

Our Ecosystem Partners

Collaboration with ecosystem partners is the best way to provide you with innovative options in developing your NXP MCU applications, while helping you get to market faster. NXP relationships with third-party experts have yielded a long list of ground-breaking solutions, from our revolutionary, low-entry-cost evaluation boards to our feature-packed development platforms and application-specific design tools. Toolchains are the cornerstone of MCU software development, and we recognize that one size does not fit all needs. Our third-party partners help us tailor our offerings for specific applications, so you always get the best options for developing and debugging software on your chosen NXP MCU. We also work with middleware solution providers and other key partners such as module vendors for our wireless solutions. Training and independent design houses extend the partnership with knowledge sharing and expertise for turnkey solutions. This collaboration creates more ways for you to save time, so you can focus on the features that set your product apart. For more information, please visit: **www.nxp.com/partners**.

Explore the NXP portfolio of powerhouse MCUs to find the right fit for your next design by visiting **www.nxp.com/ARM**.