NXP MICROCONTROLLERS; SMART, SECURE, CONNECTED

GENERAL UPDATE

Q2 2016

EXTERNAL USE

SECURE CONNECTIONS
FOR A SMARTER WORLD

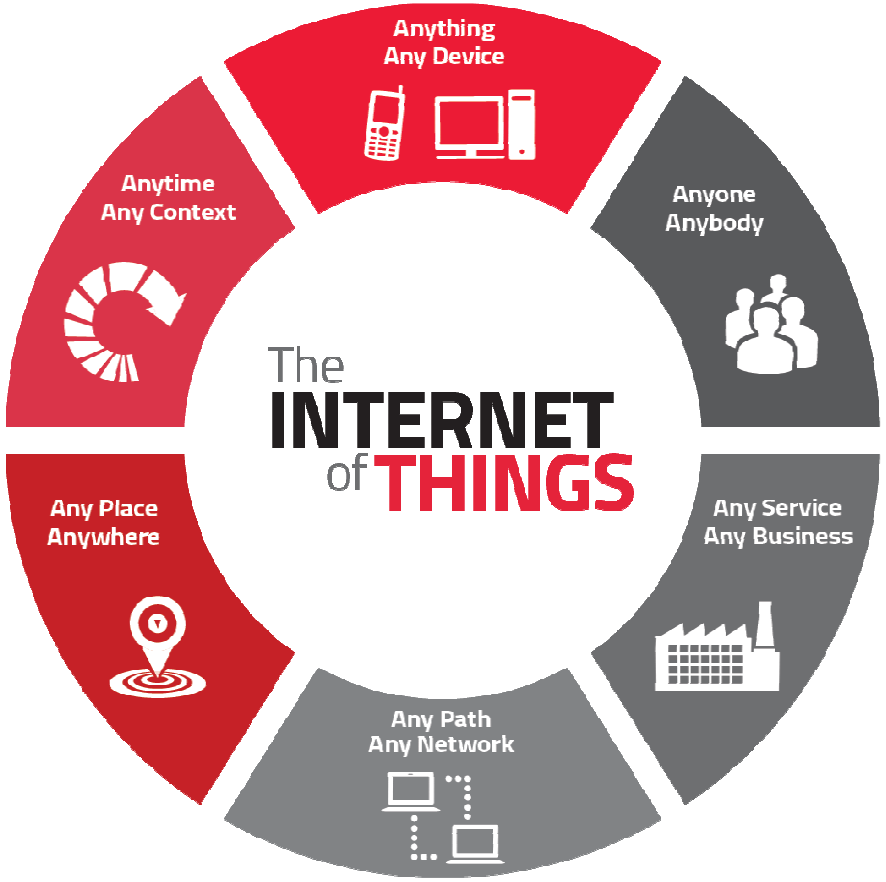
Microcontroller Solutions

Why Customers Choose Us

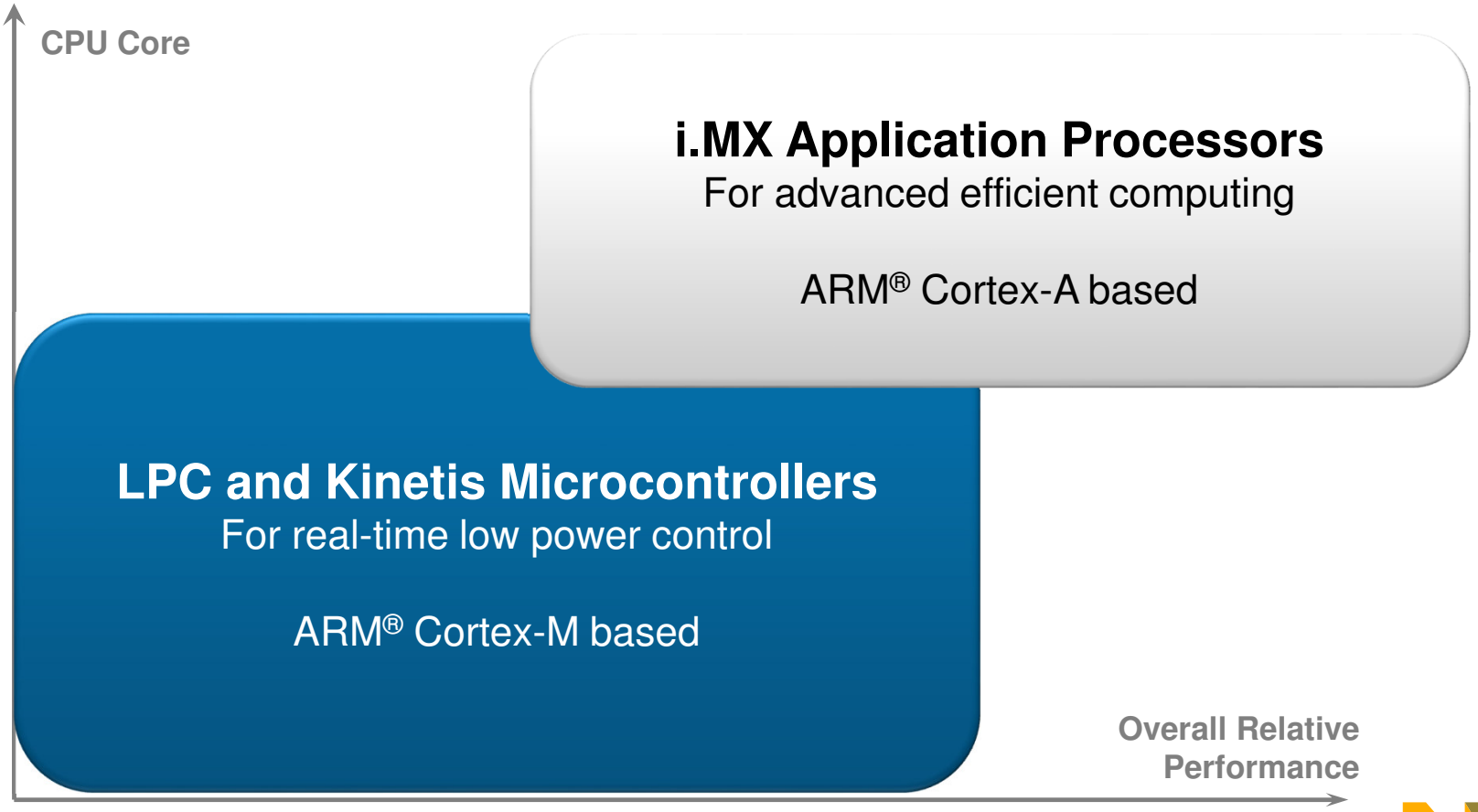
- Enabling multi product development across wide range of price performance points
- Reduction in cost of SW ownership
- Faster time to market with hardware & software solutions tightly integrated
- Services & support

IC Products		
LPC 32-bit ARM® Microcontrollers	**Kinetis 32-bit ARM® Microcontrollers**	**i.MX ARM® Applications Processors**

- Scalable performance & integration
- Power efficient Processing
- Integrated security & connectivity
- Tailored application specific solutions; HW & SW
- Product Longevity

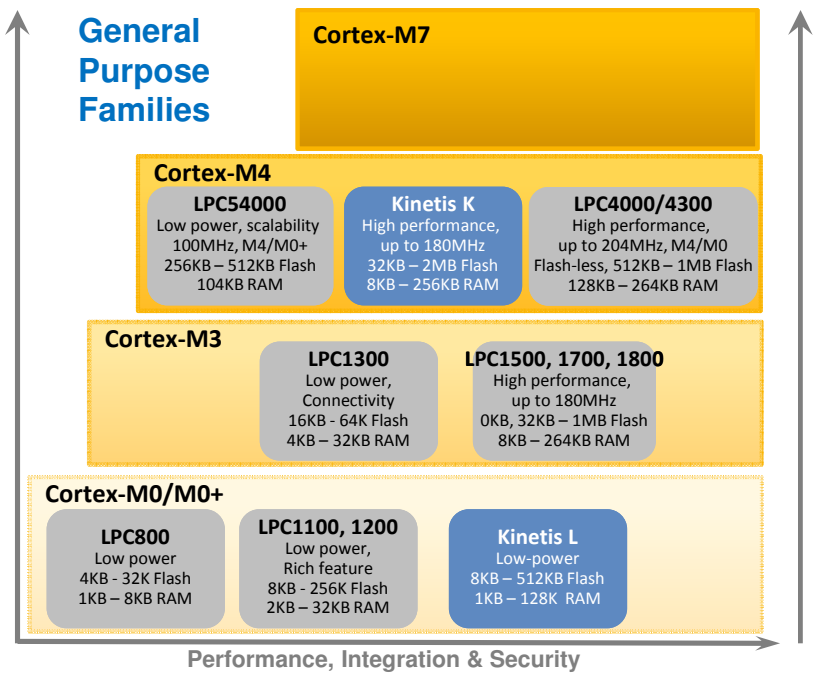


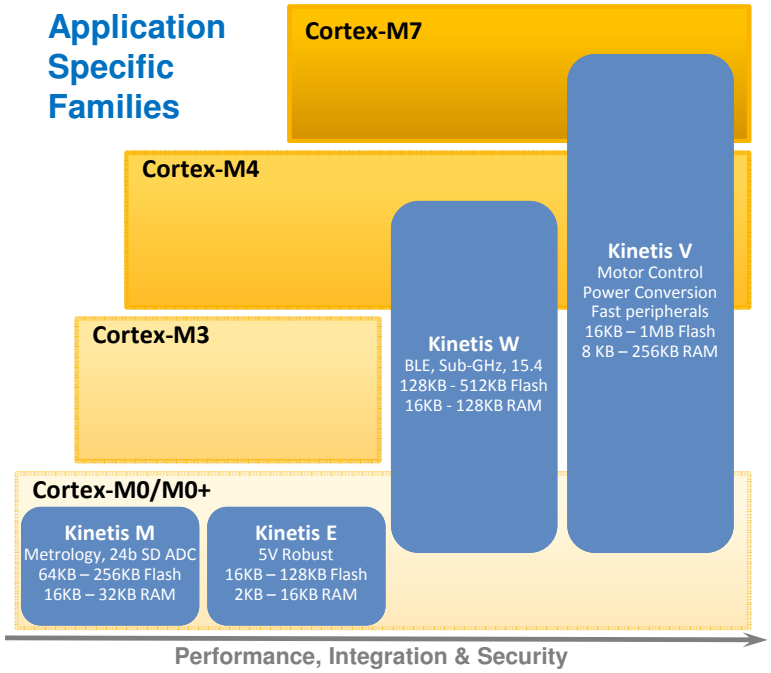
Scalable ARM based Processors and Controllers



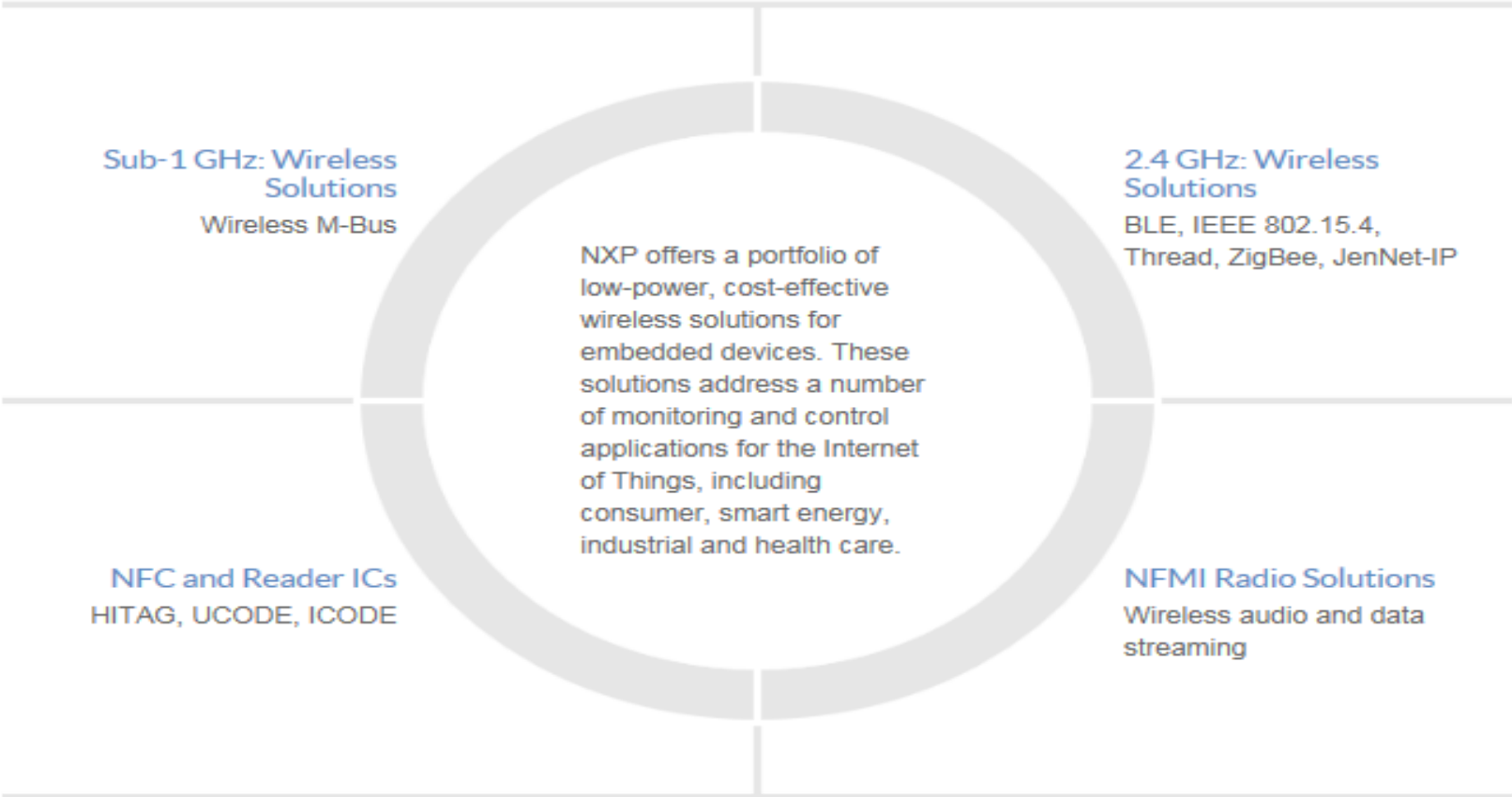
NXP'S BREADTH IN MICROCONTROLLERS

Kinetis + LPC = Broad Portfolio of Microcontroller Families





NXP Wireless Solution



Kinetis Wireless Solutions

Harness Single Platform for Application Controller & Wireless Development

- KW0x - <1GHz ISM Bands
- KW2x – 2.4GHz IEEE 802.15.4
- KW3x – 2.4GHz Bluetooth Smart
- KW4x – Multimode, Multiprotocol 2.4GHz Bluetooth Smart & 802.15.4

Core / Owned

With/Without Partners

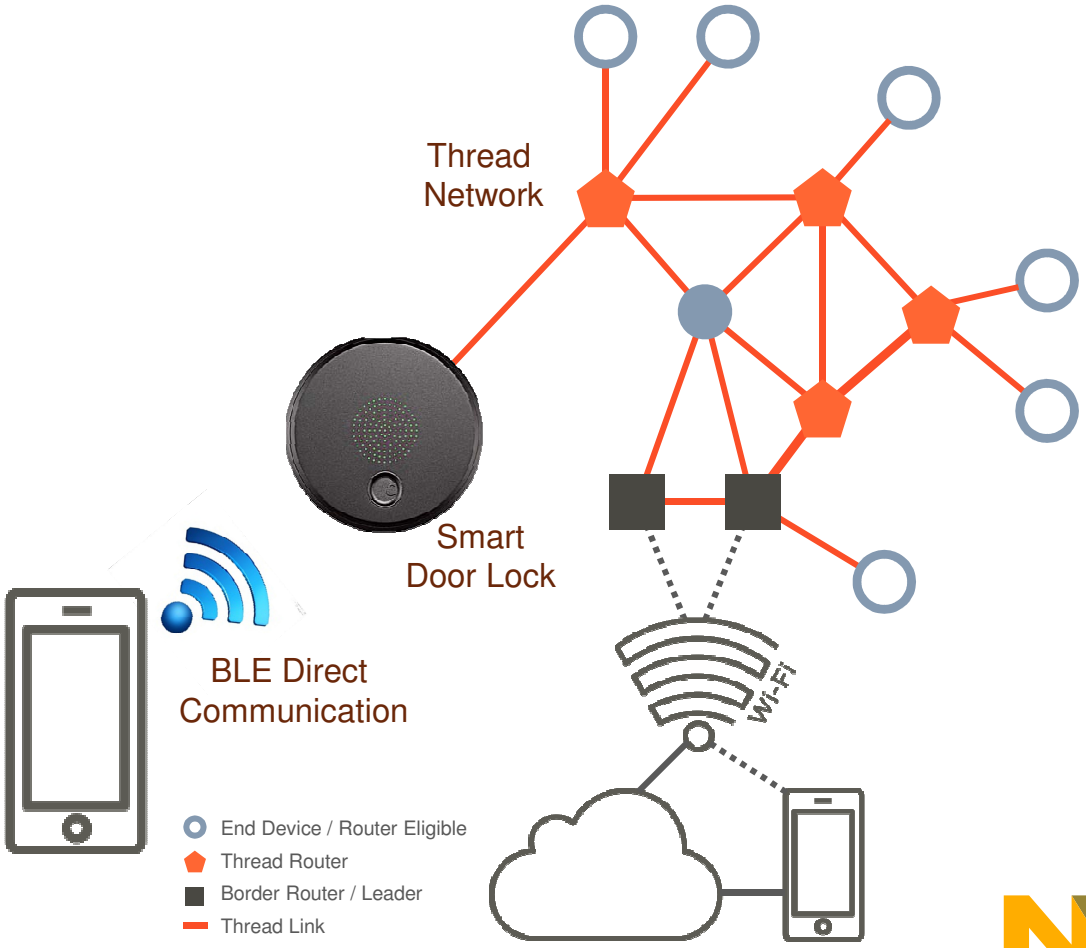
The need for more memory in connected IoT applications

Smart Door Lock needs multi protocol

- BluetoothSmart (BLE) and/or NFC to interact with phone, Smart Cards etc
- Low Power in building network to communicate with gateway and other nodes

This will enable local and remote control.

- Control locally from BLE enabled smartphone/tablet
- Control remotely using cloud connected Thread mesh network



Tools, Software & Support

Runtime Software

Drivers and Examples:

LPCOpen
- Drivers
- FreeRTOS
- USB
- TCP/IP
- Filesystem
- Graphics

Kinetis SDK
- Drivers
- System Services
- FreeRTOS
- USB
- TCP/IP
- Filesystem

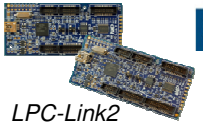
RTOS, Middleware Partners:

… and more

Software Development Tools

IDE / Toolchains:

Debug Probes



LPC-Link2

Hardware Development Tools

Evaluation Kits:

LPCXpresso

Kinetis Tower System

Kinetis Freedom

Support

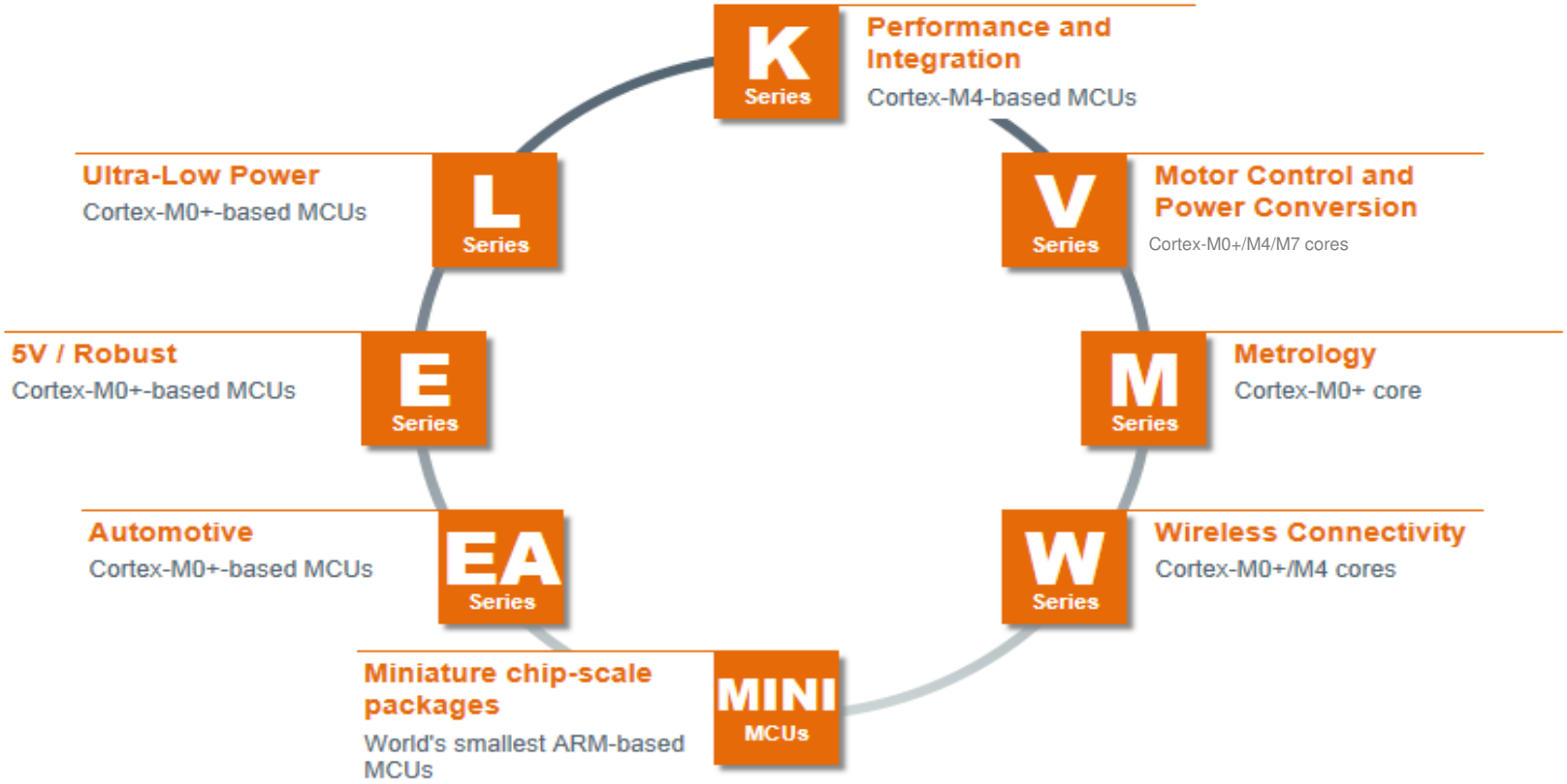
Broad Market:

- OOB Walkthroughs
- NXP Communities
- Embedded Blogs
- Kinetis Designs
- LPC Designs
- Kinetis Tutorials
- Kinetis How-Tos
- Application Notes
- Symbols & Footprints

KINETIS

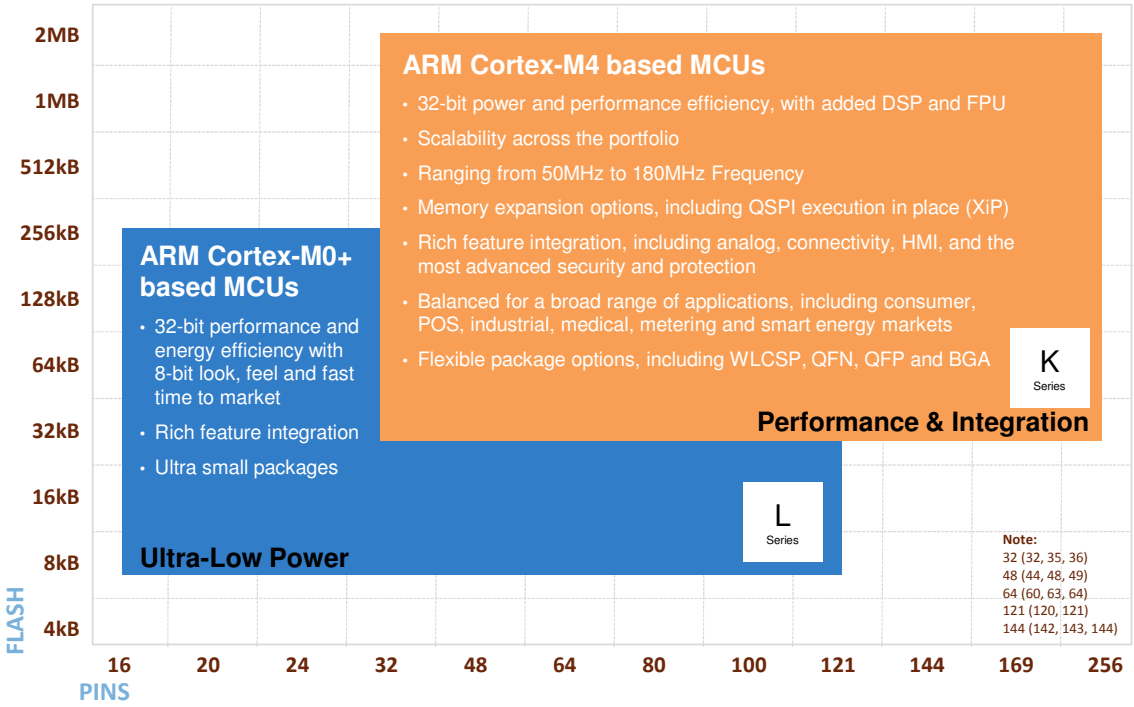
Kinetis MCU Portfolio

The right series for the application



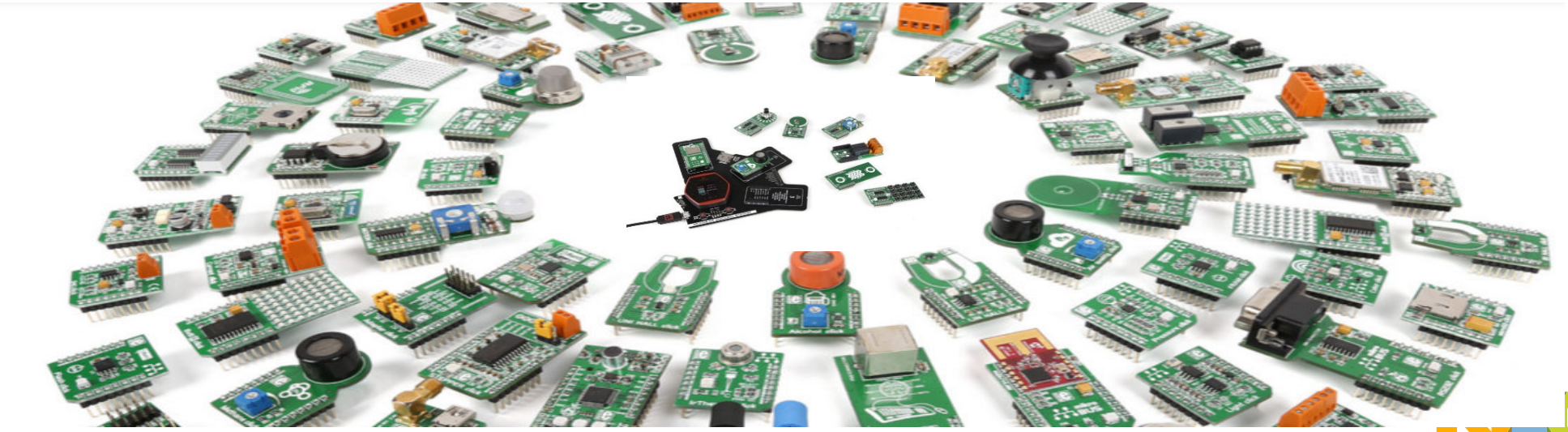
Kinetis General Purpose Portfolio Overview

Solutions for the General Embedded Market

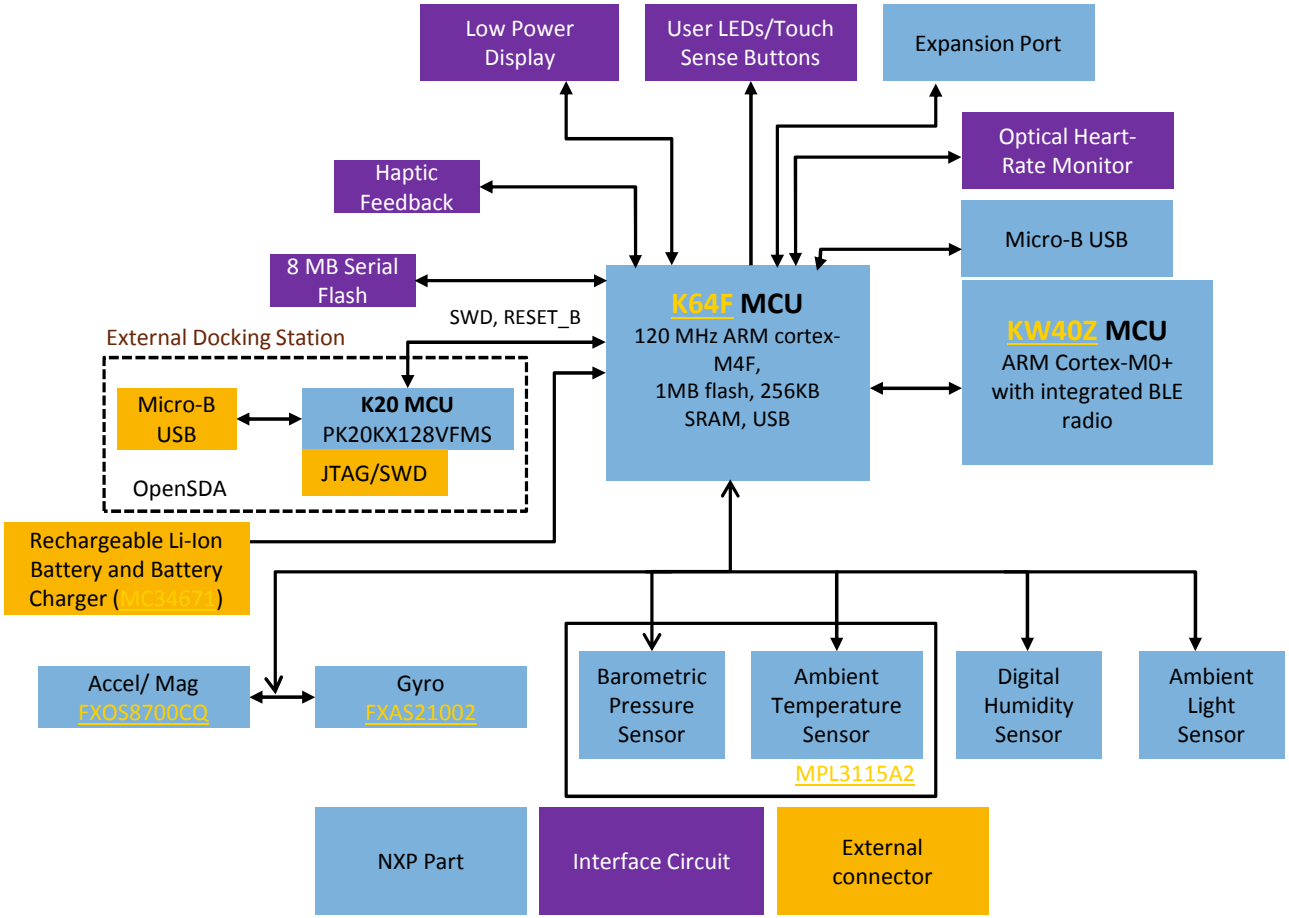


Hexiwear –Open Source Wearable & IoT Development Solution enhance by NXP
Learn more at hexiwear.com

- Ready to test platform with cloud services & apps for your smart phone
- Harnessing Kinetis MCUs, Kinetis BLE & Sensor Solutions from NXP
- Supported by Open Source GNU based development Environment to Application Development & broad range of expandable sensor boards



HexiWear Block Diagram



HexiWear Software Ecosystem

Complete open-source software package including the source code for Embedded Software, Application Examples, Android and iOS apps and out of the box cloud connectivity.

Embedded Software

- Running FreeRTOS as an embedded operating system.
- Application examples with IoT and Wearable application use cases.
- Drivers based on Kinetis SDK.
- OpenSDA as a serial and debug adapter.
- BLE communication is based on Kinetis Connectivity Software (available in binary).
- The software is available at www.nxp.com/kinetisdesigns/hexiwear

Cell Phone App

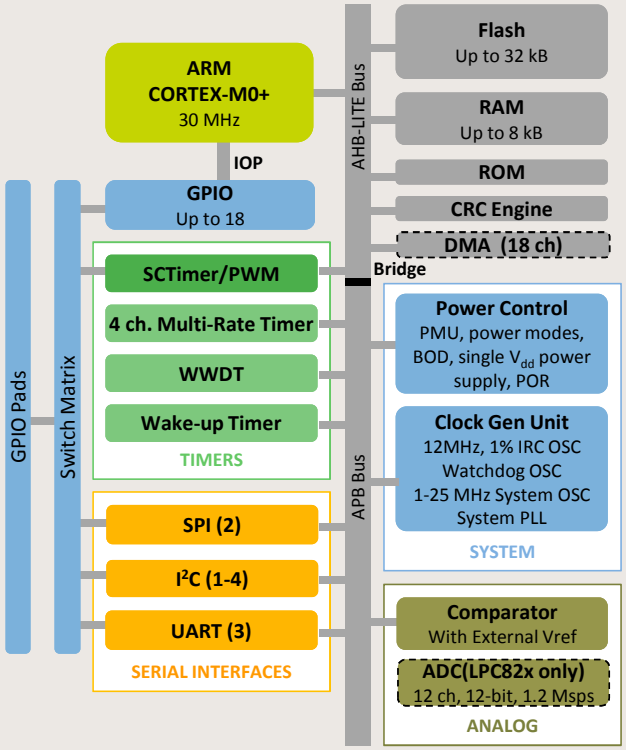
- Android app available HERE and iOS App is available HERE.

Cloud Connectivity

- Cloud connectivity integrated in Android and iOS apps.

LPC800 ENTRY POINT INTO 32BIT

LPC800 Series – Highly Configurable & Flexible



Exceptional efficiency, 8-/16-bit transition

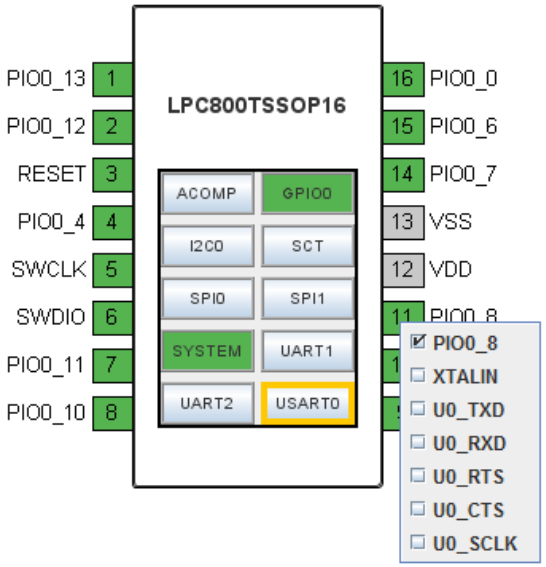
- Low-power Cortex-M0+ processor
  - Up to 30 MHz performance
  - Up to 32 kB Flash, up to 8 kB RAM
- Best energy efficiency
  - 2-stage pipeline
  - Single cycle IO access
  - <90uA / MHz in active mode
- Analog
  - 1.2 Msps ADC: 12 ch, 12-bit with flexible triggers to optimize power use(LPC82x only)
  - Comparator: four input pins, external or internal VREF
- Flexible peripherals
  - Switch matrix, SCTimer/PWM, multi-rate timer
  - Redesigned serial I/O
- All part qualified: -40 to 105 ^{0}C

	Core	RAM (kB)	Flash (kB)	SPI	UART	GPIO	ADC	Package(s)
LPC81x	Cortex-M0+	1 - 4	4 - 16	1 - 2	2 - 3	6 - 18		DIP8, TSSOP16, TSSOP20, SO20, XSON16
LPC82x	Cortex-M0+	4 - 8	16 - 32	2	3	16- 29	5-12 Ch, 12bit	TSSOP20, HVQFN33

Flexible Peripherals

Switch Matrix: Flexible I/O Pin Assignment

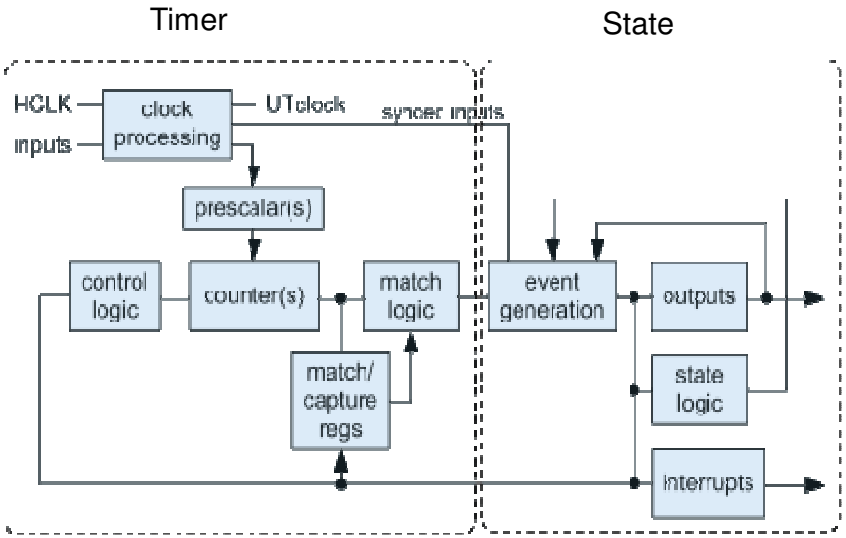
- Assign on-chip peripherals I/O to any pins
- Quickly create or change layouts, minimizing hardware design changes
- Easy to use GUI-based tool
- Available on LPC800, LPC1500



Available on LPC800

Flexible Peripherals
State Configurable Timer (SCT)

- Flexible, high-resolution, timer block for custom timing features
- Combines powerful 32-bit timer counter with configurable state machine logic
  - Up to 8 inputs,16 outputs, 16 match/ capture registers, 16 events, 32 states
  - <1ns PWM dithering
  - Low CPU overhead
- Custom timing features
  - high resolution event-controlled PWMs, ADC synchronization, dead-time control
  - complex waveforms and control signals
  - power conversion, lighting, motor control, audio/video apps
- Available on LPC1800/LPC4300 (full featured); LPC800 (streamlined); LPC1500 (four SCT)



LPC54000 DUAL CORE ALWAYS ON SENSING

Key Advantages of the LPC5411x Series

- **Scalable power and performance** NXP provides unique solutions that can deliver up to 125 DMIPS of performance without sacrificing power efficiency. The Cortex-M4F core active power consumption down to 80 µA/MHz while the Cortex-M0+ has consumption down to 60 µA/MHz

- **Flexible Design Freedom** To address a variety of always-on applications we provide support for a variety of interfaces and smart peripherals such as the Digital Microphone Subsystem, crystal-less FS USB and the FlexComm interface

- **Advanced Integration** with up to 256k of Flash, up to192k of RAM, and an optional coprocessor, designers have the ultimate in SW development flexibility

- **Portfolio Scalability** As your needs grow for more performance or integration, the LPC54000 family provides migration paths towards higher performance devices

LPC5411x Target Application
Always-on Battery Operated Device

Low Active Currents for Always-On Processing

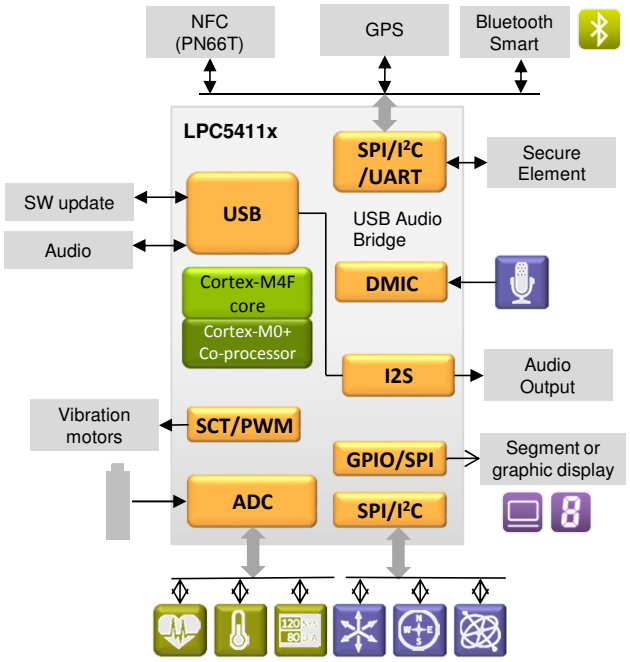
- ARM® Cortex® **M4F <85 µA/MHz** (from RAM at 48MHz)
- ARM® Cortex® **M0+ <65 µA/MHz** (from RAM at 48MHz)
- **7 uA (64kB SRAM retention)** with **19us wake-up**
- Optional co-processor for sensor interfacing, data aggregation and system task management

Optimized integration, including on-chip digital microphone (DMIC) subsystem

- Maximize battery life through ultra-low power sound detection, voice recognition and activation
- **12-bit, 5 Mbps ADC** for high-precision analog sensor interface, full spec over voltage range: 1.62 to 3.6V
- **Accurate, Low-power FRO Supporting Crystal-less FS USB**

Optimal serial interfaces and peripherals for your application

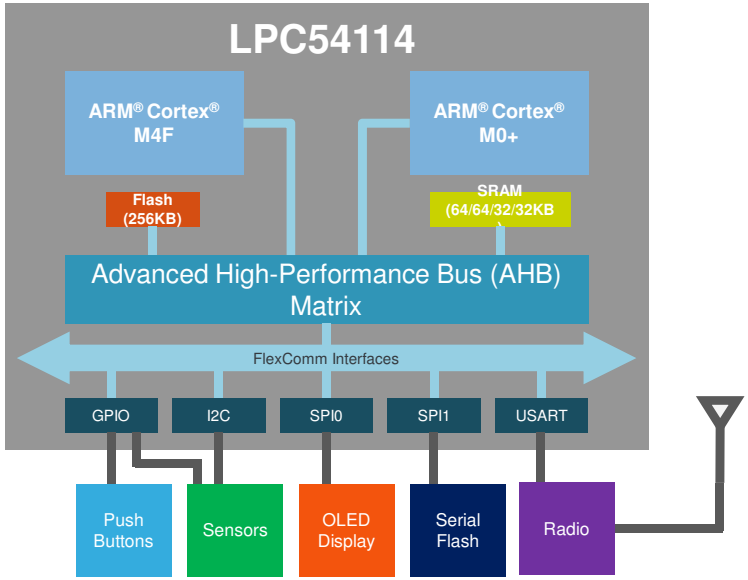
- **Select up to any eight of our FlexComm peripherals**
  - up to 8x SPI, 8x I²C, 8x UART, and 2x I²S
- Up to 48 GPIOs



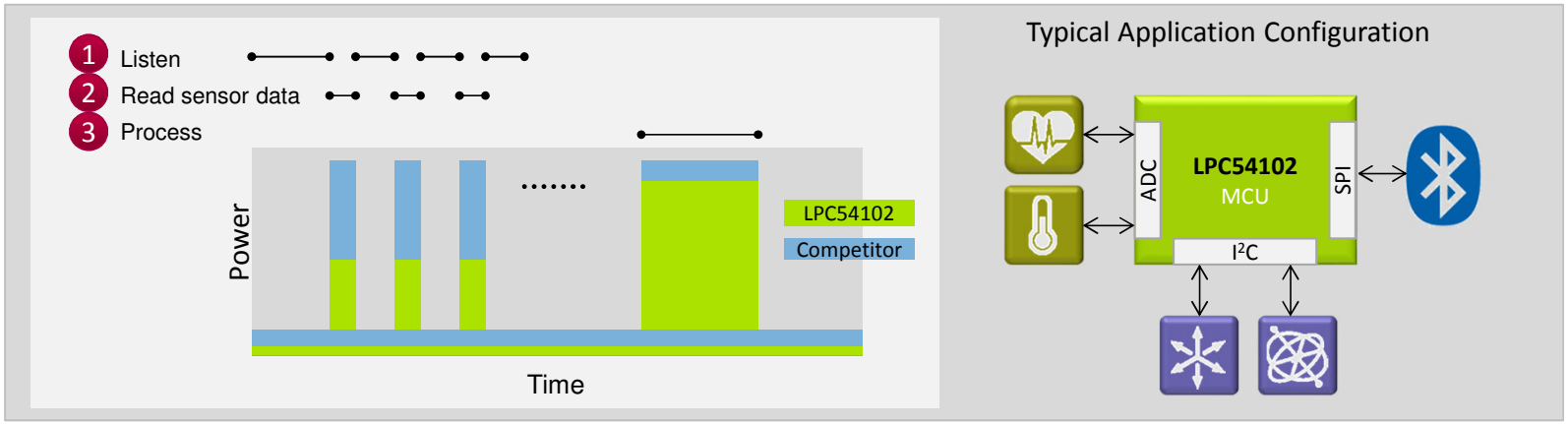
** Target Dates, Features, Specs Subject to Change*

Advantages of Designing with a Dual-Core Microcontroller

- **Ultimate in flexibility with Advanced High-Performance Matrix**
  - Segments SRAM into three contiguous independently operated banks accessible by either core
  - FlexComm is broken into two interfaces, allowing for up to 5 peripherals on one bus and 3 on another with each accessible from either core
- **Low Power Always-On Operation**
  - Provides low power always-on listening from analog and digital sensors that can wake up either core for data processing
  - Digital microphone subsystem (DMIC) provides < 50 µA listening stage that can then wake up relevant peripherals for processing
- **Second core for application specific tasks**
  - Cortex-M0+ can be leveraged for running system level tasks and the Cortex-M4F can wake up to process data intensive tasks
  - SCTimer allows for creation of complex PWM waveforms and can perform other advanced timing and control operations with minimal or no CPU intervention
- **Ease of software development**
  - Software development teams can develop code for each core independently allowing for a faster time to market

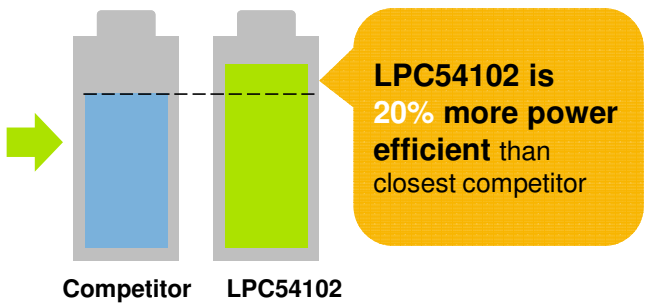


20% Power Savings in Typical Portable Fitness Device Example



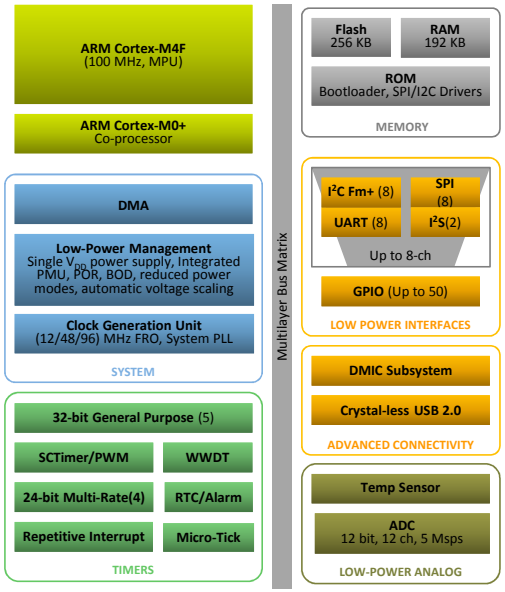
	Task	LPC54102	Competitor MCU*
1	**Listen** (power down mode; no CPU processing)	3 µA	9 µA
2	**Read (I²C & ADC)** (10 sps @ 12 MHz CPU)	55 µA/MHz (Cortex-M0+)	112 µA/MHz (Cortex-M4F)
3	**Algorithm Processing** (Once per sec @ 84 MHz CPU)	100 µA/MHz (Cortex-M4F)	112 µA/MHz (Cortex-M4F)

*datasheet spec



LPC54114: 100MHz Cortex-M4F/M0+ with 256 KB Flash

Block Diagram and Key Features



CPU

- **100MHz Cortex-M4F**
- **Cortex-M0+ Co-processor**

Memory

- 256 KB Flash, **192 KB RAM**

Interfaces for connectivity & sensors

- Stereo DMIC subsystem
  - (PDM, decimator, HW VAD)
- **8 SPI, 8 I2C, 8 UART, 2 I²S channels.** Max 8 channels
- **Crystal-less FS USB**
- Power-efficient **5.0 Msps, 12-bit ADC**: full-spec performance (1.62 to 3.6V, -40 to 105 °C)

Clocks & timers

- **12/48/96 MHz FRO**, 100 kHz-1.5MHz WDOG OSC, 32 Xtal OSC, external clock input
- Basic & advanced timers including SCTimer/PWM
- Asynchronous peripheral bus

Packages

- LQFP64 (10 x 10 mm)
- WLCSP49 (3.45 x 3.45 mm)

Other

- Operating voltage: 1.62 to 3.6V
- Temperature range: -40 to 105 °C

Availability

LPC5411x Silicon
LPCXpresso 54114 (OM13089)
LPC54114 Audio & Voice Recognition Kit (OM13090)

Limited Early Access Samples **NOW**
Market Announcement **Embedded World**
Full Market Launch **May 30, 2016**
(WLCSP MP Jul-2016)

Target Applications

Consumer / Wearable / Personal Health Mgmt

- Wearables, fitness monitoring, home healthcare, and patient monitoring

Gaming / Entertainment

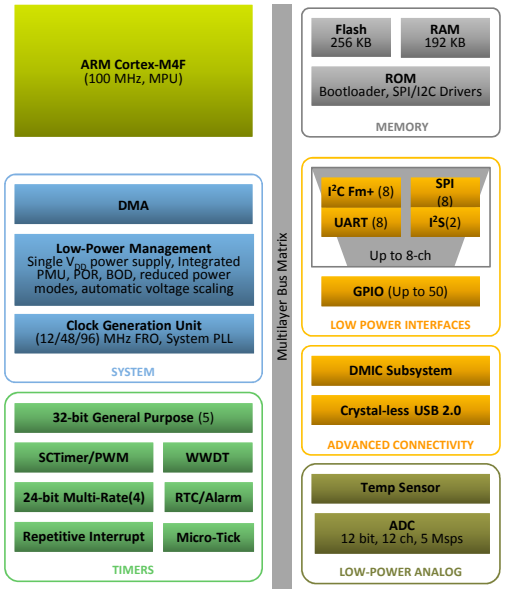
- Console / user motion control and orientation, voice and sound activation, general toys

Home / Building Automation & Control

- Access and lighting control, HVAC and smart thermostats, fire, safety and security
- UI with voice and sound activation

LPC54113: 100MHz Cortex-M4F with 256 KB Flash

Block Diagram and Key Features



CPU

- **100MHz Cortex-M4F**

Memory

- 256 KB Flash, **192 KB RAM**

Interfaces for connectivity & sensors

- Stereo DMIC subsystem
  - (PDM, decimator, HW VAD)
- **8 SPI, 8 I2C, 8 UART, 2 I²S channels.** Max 8 channels
- **Crystal-less FS USB**
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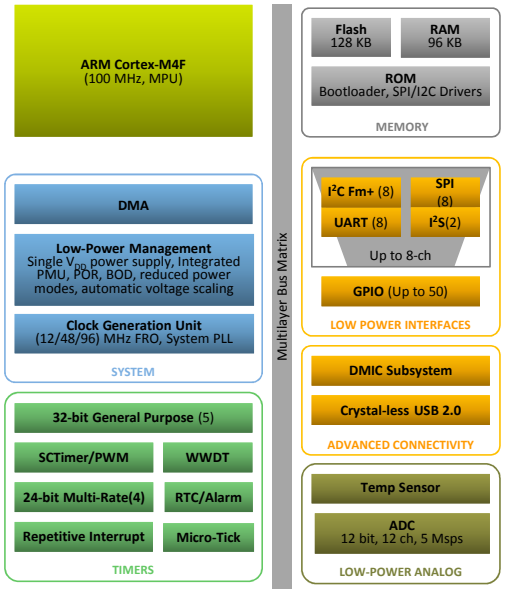
LPC54113: 100MHz Cortex-M4F with 128 KB Flash

Block Diagram and Key Features



CPU

- **100MHz Cortex-M4F**

Memory

- 128 KB Flash, **96 KB RAM**

Interfaces for connectivity & sensors

- Stereo DMIC subsystem
  - (PDM, decimator, HW VAD)
- **8 SPI, 8 I2C, 8 UART, 2 I²S channels.** Max 8 channels
- **Crystal-less FS USB**
- Power-efficient **5.0 Msps, 12-bit ADC**: full-spec performance (1.62 to 3.6V, -40 to 105 °C)

Clocks & timers

- **12/48/96 MHz FRO**, 100 kHz-1.5MHz WDOG OSC, 32 Xtal OSC, external clock input
- Basic & advanced timers including SCTimer/PWM
- Asynchronous peripheral bus

Packages

- LQFP64 (10 x 10 mm)

Other

- Operating voltage: 1.62 to 3.6V
- Temperature range: -40 to 105 °C

Availability

LPC5411x Silicon
LPCXpresso 54114 (OM13089)
LPC54114 Audio & Voice Recognition Kit (OM13090)

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Market Announcement **Embedded World**
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- Wearables, fitness monitoring, home healthcare, and patient monitoring

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- Console / user motion control and orientation, voice and sound activation, general toys

Home / Building Automation & Control

- Access and lighting control, HVAC and smart thermostats, fire, safety and security
- UI with voice and sound activation

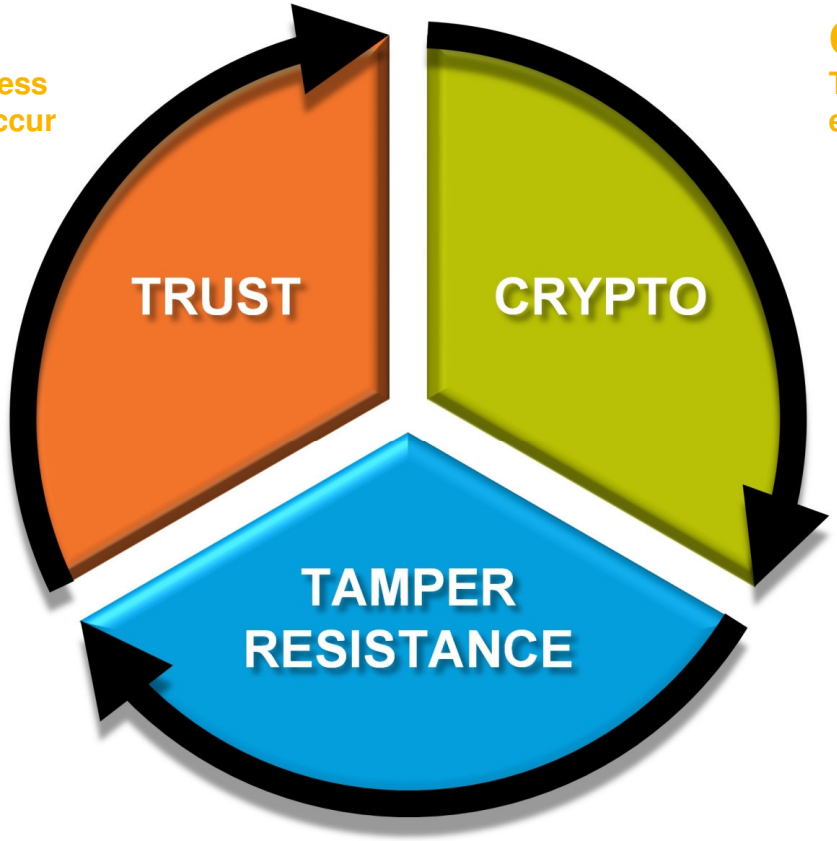
KINETIS KL & K8X SECURE ENDGE NODE SOLUTIONS

NXPs Scalable Security Integrated on MCUs & MPUs

TRUST

The assurance that only access from a reliable source will occur

- Code I/P Protection
- Debug Port Protection
- Authentication
- Secure Boot



CRYTPOGRAPHY

The science of protecting data through encoding and decoding

- Symmetric Encryption
- Asymmetric Encryption
- Hashing
- True Random Number Generation
- Security Protocols

TAMPER RESISTANCE

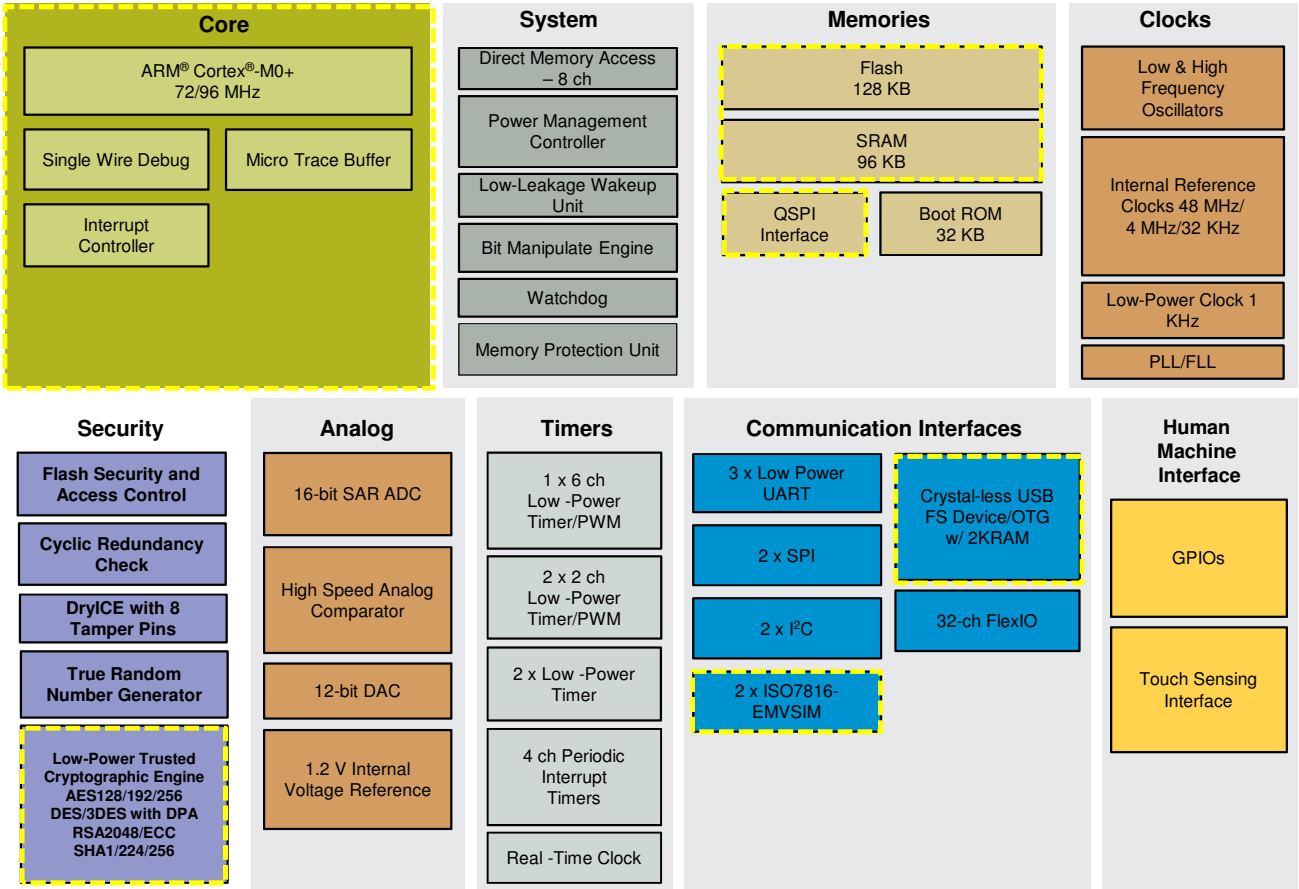
Proactive monitoring of physical and environmental system attacks

- Tamper Detection
  - Physical
  - Environmental
- Secure Storage / Secure Keys

LPC, Kinetis & iMX: Scalable Security

Family	Trust										Tamper Resistance		
	Code Protection	Debug Port Protection	Physical Anti Cloning Functions	Authentication	Secure Boot						Security Protocols	Tamper Detection	Secure Storage
LPC	All Families	All Families	-	All Families	All Families	Some Families	-		Some Families	Some Families	-	-	Some Families
Kinetis	All Families	All Families	Some Families	All Families	All Families	Many Families	Some Families	Some Families	Many Families	Many Families	Some Families	Same Families	Some Families
iMX	All Families	All Families	Some Families	All Families	All Families	Many Families	Some Families	Some Families	Many Families	Many Families	Some Families	Some Families	Some Families

Kinetis KL81



Packages

121MAPBGA 8 x 8 x 1.4/0.65 mm
80LQFP 12 x 12 x 1.4/0.5mm

Temperature

-40-105˚C

Features Highlight

Cortex-M0+
MTB , BME
up to 128 KB Flash,
up to 96 KB SRAM
QSPI Flash interface
True Random Number Generator
160-bit (32-bit + 128-bit) Secure RAM for key storage
Enc. engine (DES/3DES/AES/RSA)

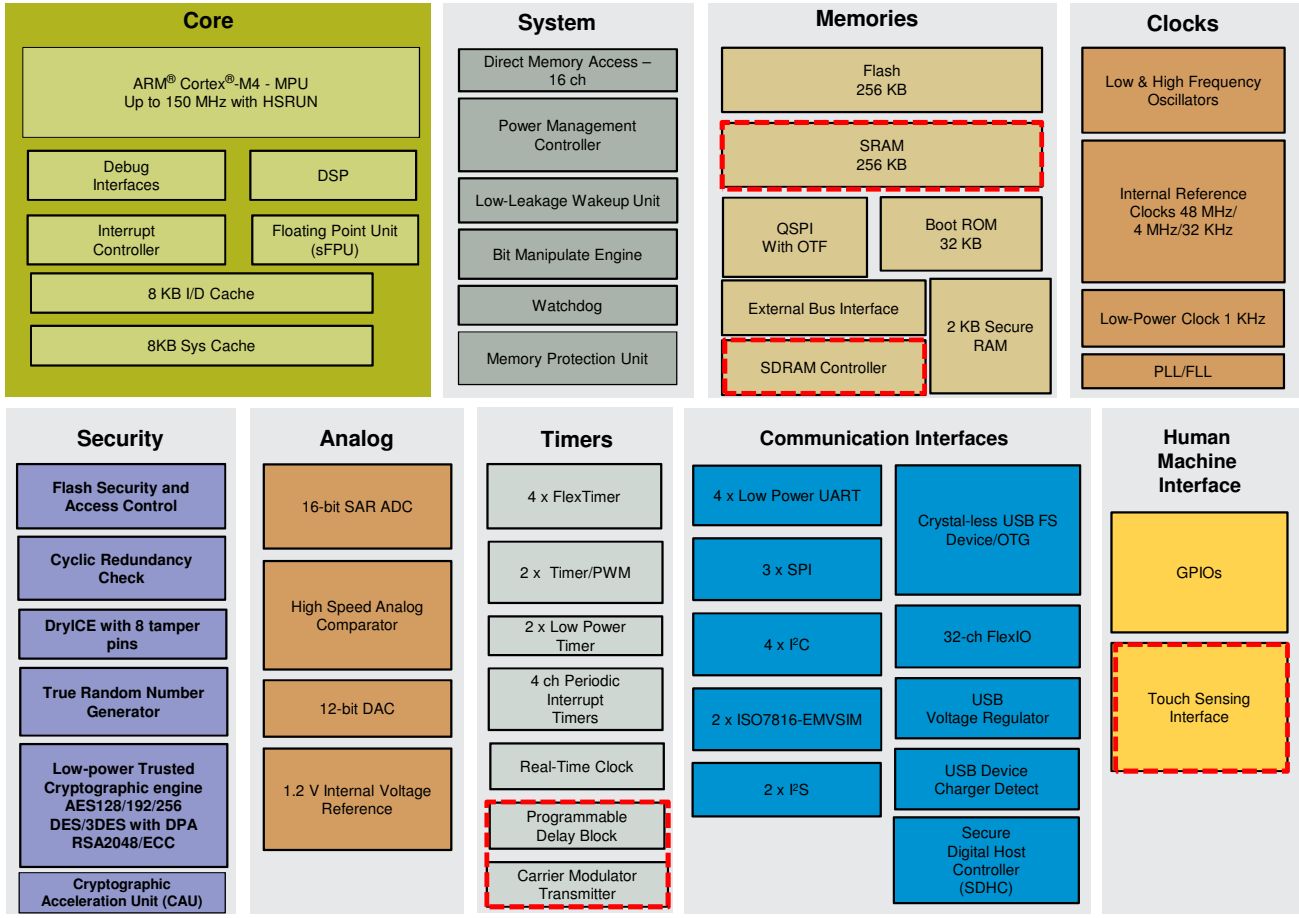
- RSA2048 support (3 decrypt and 1 encrypt <750 ms)
- ECC: ECDSA and ECDH for up to P256
- DES/3DES with HW DPA
- AES256/192/128 with DPA
- SHA1/224/256

Up to **8** tamper pins
Independent real-time clock (RTC)
2 x EMV compatible ISO7816-3 interfaces
Crystal-less USB device w/2 K dedicated USB RAM
32-ch FlexIO

Availability

Sample now, production Nov. 2015

Kinetis K81



Packages
121MAPBGA 8 x 8 x 1.4/0.65mm
100LQFP 14 x 14 x 1.4/0.5mm

Temperature
-40-105˚C

Features Highlight
Cortex-M4 with 8 KB I/D-cache
FPU and MPU, BME
up to 256KB Flash,
up to 256KB SRAM
QSPI Flash interface
QSPI Flash interface with OTF
True Random Number Generator
Crypto acceleration MMCAU
160B(32B+128B) Secure RAM for Key storage
Enc. Engine (DES/3DES/AES/RSA)
- RSA2048 support (3 decrypt and 1 encrypt <750 ms)
- ECC: ECDSA and ECDH for up to P256
- DES/3DES with HW DPA
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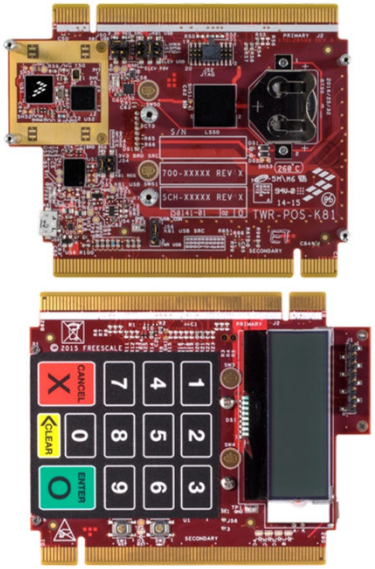
Up to **8** tamper pins
Independent real-time clock (RTC)
2x EMV compatible ISO7816-3 interfaces
Crystal-less USB Device
32-ch FlexIO

Availability
Sample Now, Production Oct 2015

TWR-POS-K81

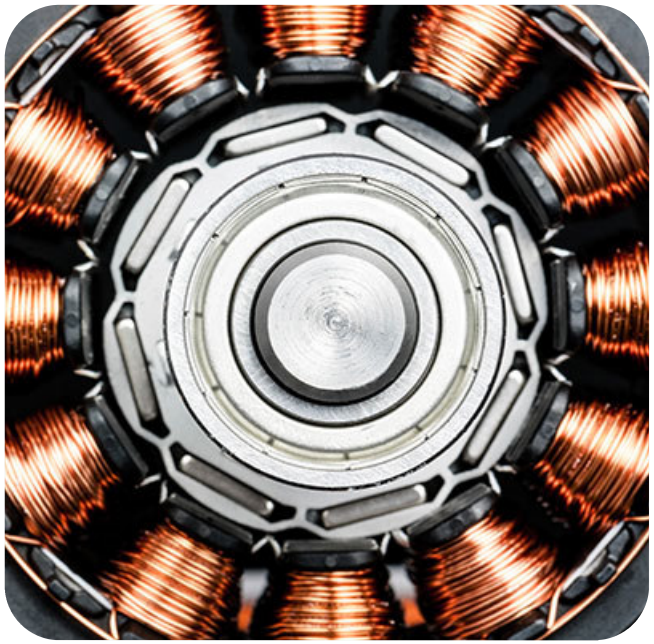


- Point of Sale Pin Pad
  - Utilizing Kinetis K81 MCU
  - Tower Form factor
    - Expandable with tower ecosystem
  - Monochrome character LCD for display
  - Reference design to obtain Payment Card Industry (PCI) certifications
    - Uses K81 Security features
      - Tamper pins for secure mesh
      - Chip security
      - Kinetis SDK for cryptographic drivers
    - Available for NDA customers starting in Q2’14

KINETIS MTOTOR SUITE & KINETIS V SERIES

Kinetis V series MCUs based on ARM® Cortex® cores

For Motor Control & Digital Power Conversion



- Freescale's extensive motor and power control expertise and the latest ARM Cortex-M0+, M4 and M7 cores bring secure, connected, high efficiency motor control and power conversion to the mass market
- Efficient, next generation BLDC, PMSM and ACIM designs are enabled by optimized MCU performance and high speed/resolution analog and timing peripherals. High resolution eFlexPWMs support digital power conversion
- Performance and feature scalable MCU families from entry-level 75MHz MCUs, to advanced 220MHz MCUs, maximize hardware & software reuse and end product flexibility
- Enablement including Freescale Tower and Freedom development boards, Embedded Software Libraries and Kinetis motor suite reduce motor control learning curve and speed time to market

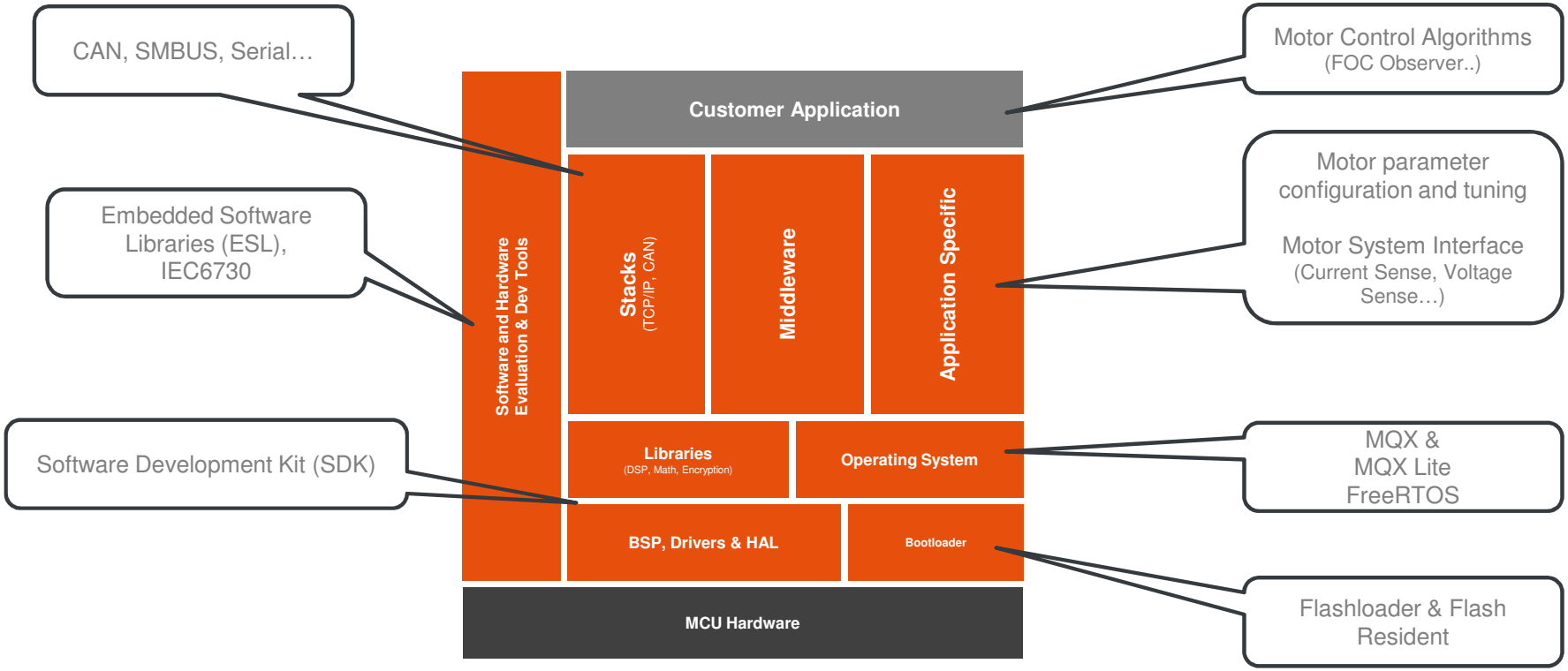
Kinetis V Series: Performance and Feature Scalability

Key Peripherals for Motor and Power Control Applications

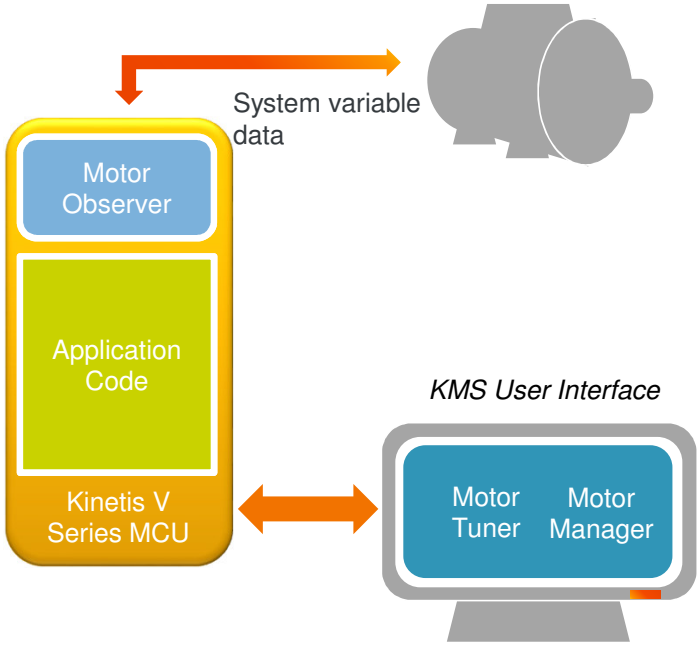
MCU Family	Core	Memory	Motor Control Timers: Flextimer	Motor Control Timers: eFlexPWM	ADC	DAC	ACMP	Comms.	Packages
KV5x	240MHz CM7 DSP + FPU	512kB-1MB Flash	2 x 8ch 1x 2ch FlexTimer	2 x 12ch eFlexPWM + Nano-Edge	4 x 12bit 5Msps, 1 x 16bit	1x 12-bit	4x ACMP with 6-bit DAC	Ethernet, 3 x CAN	144 pin 100 pin
KV4x	160MHz CM4 DSP + FPU	64-256kB Flash	2 x 8ch 1x 2ch FlexTimer	12ch eFlexPWM + Nano-Edge	2x 12bit 4.1Msps / 1.9Msps	2x 12-bit	4x ACMP with 6-bit DAC	2 x CAN	100 pin 64 pin 48 pin
KV3x	100/120MHz CM4 DSP + FPU	64-512kB Flash	2x 8ch 2x 2ch FlexTimer	-	2x 16-bit 1.2Msps	2x 12-bit	2x ACMP with 6-bit DAC	-	100 pin 64 pin 48 pin 32 pin
KV1x	75MHz CM0+ H/W DIV & SQRT	16 - 128 KB Flash	1x 6ch 2x 2ch FlexTimer	-	2x 16-bit 1.2Msps	1x 12-bit	2x ACMP with 6-bit DAC	1 x CAN	64 pin 48 pin 32 pin

Scalable performance, timing and analog functionality based on application need

Kinetis V Series Motor Control Software System Solution



New Kinetis Motor Suite
Simply Development. Reduce Cost of Software Ownership



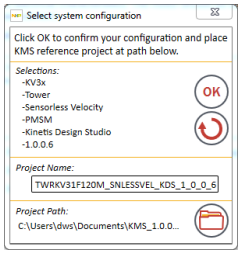
Black box solutions ready for 3Ph PMSM & BLDC. ACIM in development

- **Simply Evaluation & Testing**
  - Kinetis off-the-shelf HW (Freedom, Tower or High Voltage Boards)
  - KMS Running on MCU + KMS UI on your PC allows rapid testing/evaluation.
  - Application code is generated in normal Kinetis Ecosystem and State Machine Builder within KMS.
- **Reduce Cost of SW Ownership**
  - KMS provides the embedded intelligence to driver & monitor the motor in the application, automatically compensating for incorrect behaviour.
  - NXP can provide programming services to remove any complexity
  - No man resource requirement to develop, optimize & maintain SW Libraries. Focus on the application

Design a new application in just 6 Steps !!

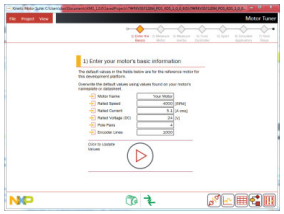
1 Configure your KMS

- Choose your preferred platform, IDE, and control type



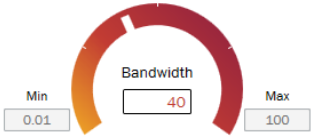
2 Identify motor & inertia

- Use basic datasheet values to trigger automatic measurement



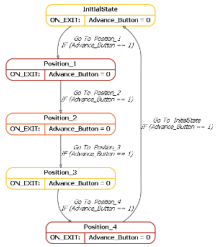
3 Easily tune your system

- Adjust single dial to control speed and position



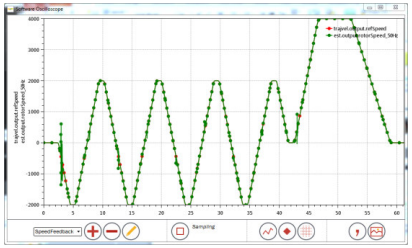
4 Plan your motion sequence

- Define your application's operating states & transitions



5 Optimize your settings

- Visually assess performance across the operating range



6 Build application

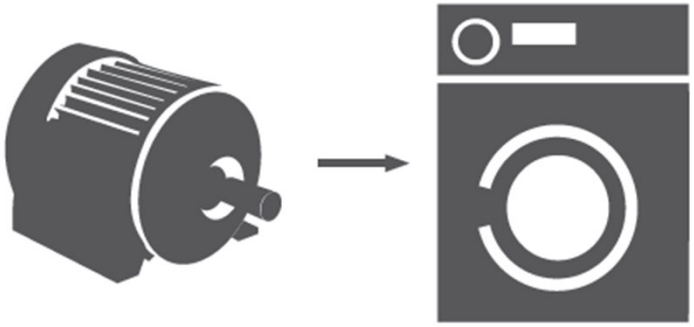
- Hook your application code into the flexible firmware

Application Development Timeline

Target Applications

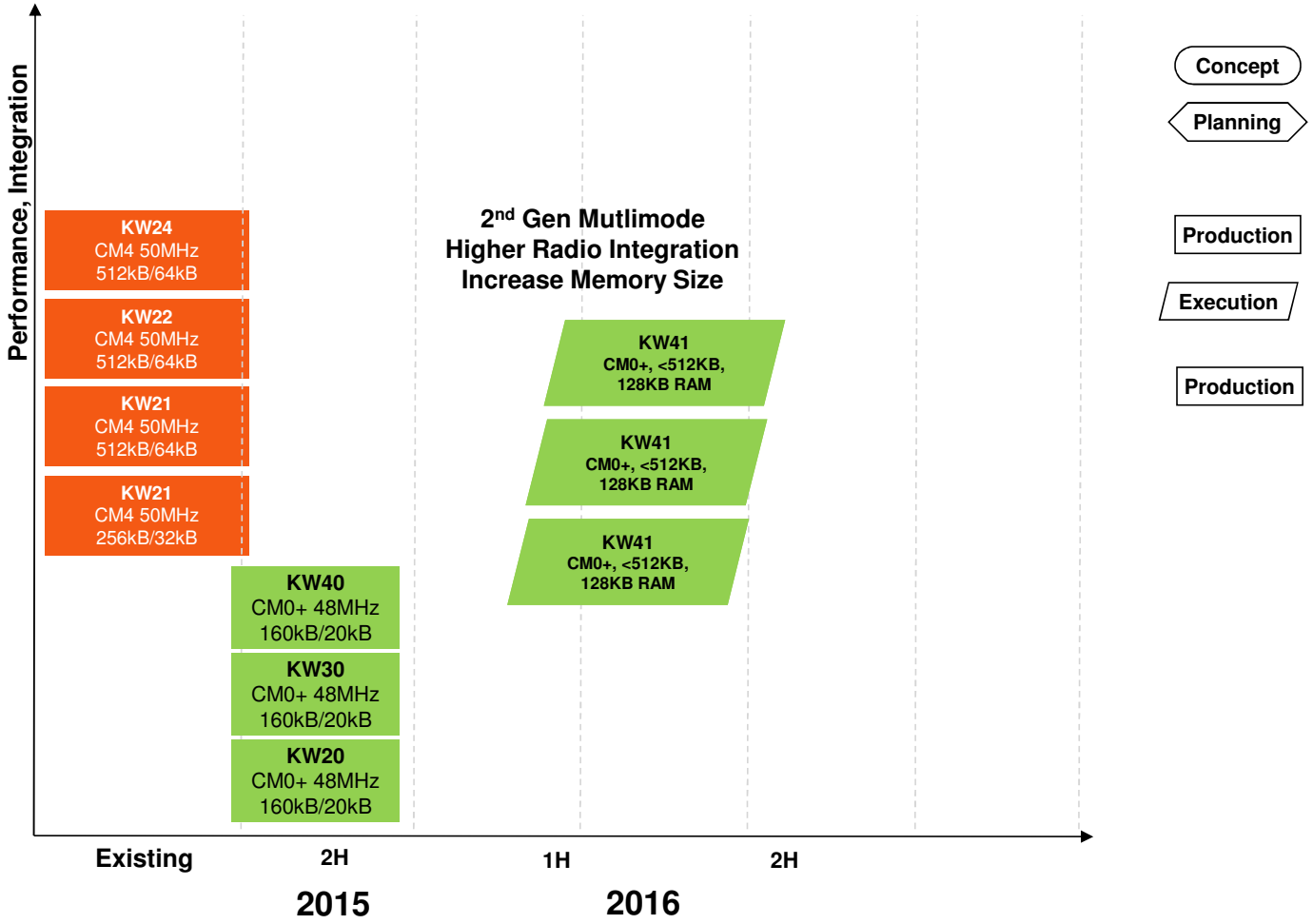
- Fans
- Pumps
- Compressors
- HVAC
- Appliances
- Blenders
- Dishwasher
- Air Filters
- Power Tools
- Robotics
- Pick-and-place
- Conveyor Belts
- Factory Automation
- Winders
- CNC Machines
- 3-D Printers
- Wind Power

. . .or anywhere there is a 3ph motor



KINETIS W WIRELESS CONNECTIVITY

Kinetis 2.4GHz Wireless Connectivity Portfolio



Kinetis KW41Z/31Z/21Z
Sampling Q2'16/Production Q4'16

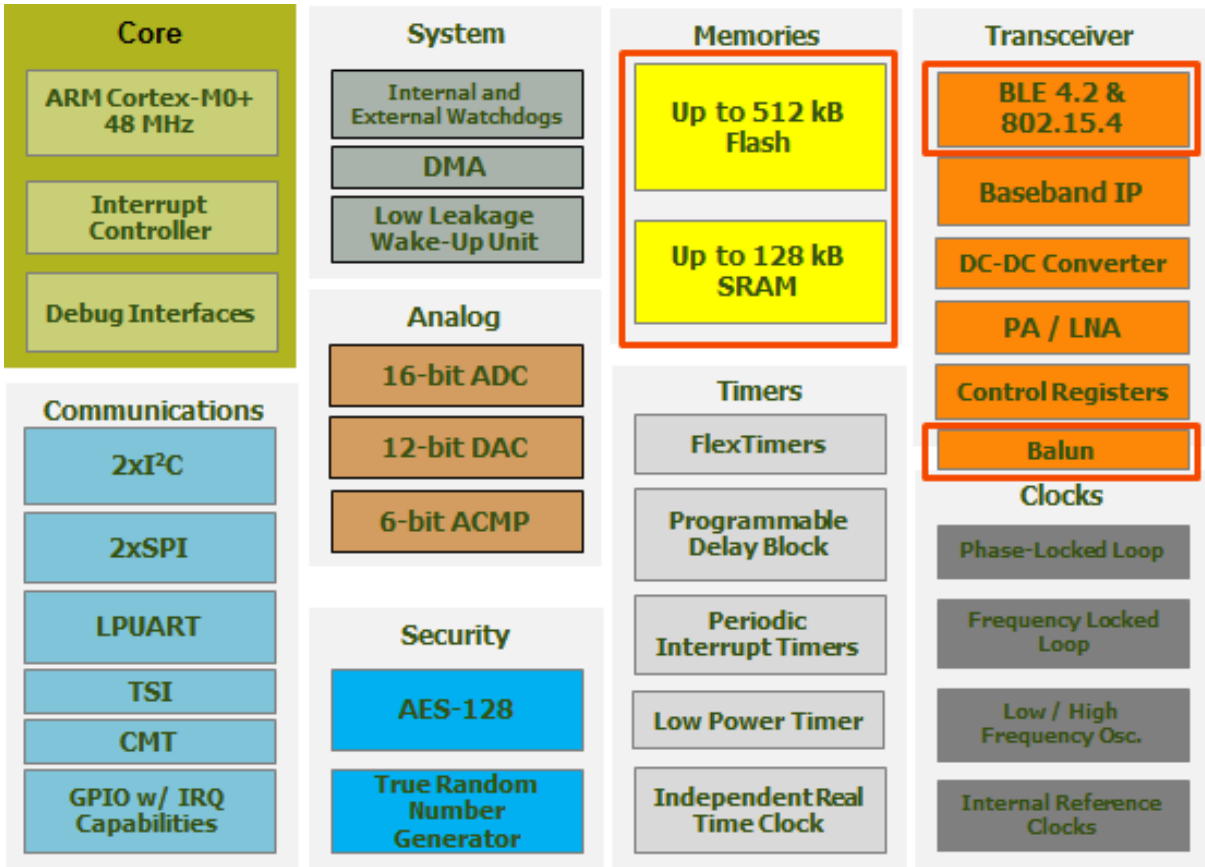
Extended Memories
- Up to 512 kB Flash
- Up to 128 kB SRAM

Highly Integrated Multimode Radio
- Support for BLE v4.2 & 802.15.4-2011
- -96 dBm in BLE mode, -102 dBm in 802.15.4 mode
- -20 to +4 dBm programmable output power
- Increased coexistence performance
- Improved Power Comsumption on BLE RX/TX
- <2uA low power current
- Integrated balun (~9% board area savings)

Security
- Unique ID & Device IDs
- AES Accelerator and True Random Number Generator

Integrated DC/DC Converter
- Normal: 1.71V to 3.6V
- Buck : 2.1V to 4.2V for coin cell operation
- Boost : 0.9V to 1.795V for single alkaline battery operation

-40ºC to +105ºC



We are BluetoothSmart 4.1 compliant
4.2 stack will be certified in line with full production launch in Q4’16

Bluetooth.o

Bluetooth SPECIAL INTEREST GROUP

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- Events
- Resources
  - Knowledge Base
  - Qualified Listings
  - List of BQTFs
  - Member Directory
- Report Issues

Listing Details

<< Go Back << >> DISPLAY ICS DETAILS >>

Member Company	Freescale Semiconductor, Inc.
Declaration ID	D028546
QD ID	74031 | Export ICS
PRD 1.0 ID (QP ID)	
Wi-Fi® Certification ID	
Subsetted Projects	Date Created: Sep 9, 2015; Type: Main; ICS: ICS
Design Name	Kinetis KW40Z/30Z BLE 4.1 Controller
Design Model Number	Kinetis KW40Z/30Z BLE 4.1 Controller
Hardware Version Number	Kinetis KW40Z/30Z
Software Version Number	1.1.x
Qualification Assessment Date	September/29/2015
Listing Date	September/29/2015
Design Description	Controller component designed for Freescale Kinetis KW40Z/30Z devices, qualified based on Bluetooth 4.1 specification.
Product Type	Component (Tested)
Specification Name	4.1
Product List	

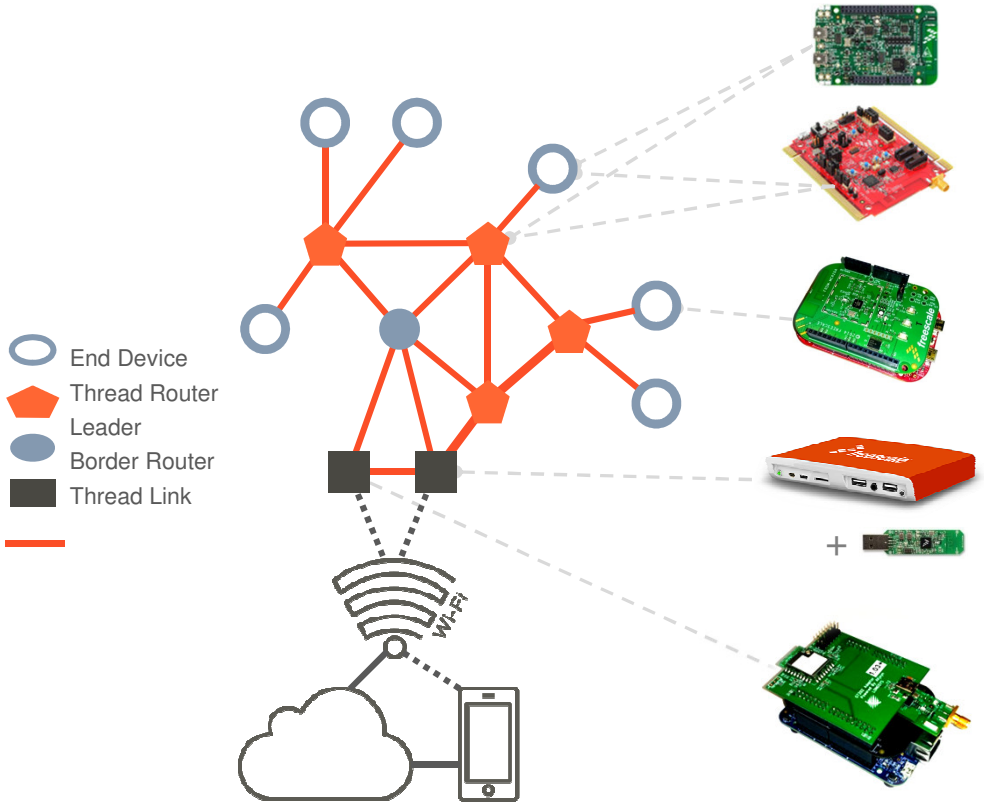
Brand	Model	URL	Description	Subset ID	Publish Date
Freescale Semiconductor, Inc.	Kinetis KW40Z/30Z BLE 4.1 Controller	www.freescale.com/ble	The KW40Z/30Z/20Z (KW40Z) is an ultra, low-power, highly-integrated single-chip family of devices that enables Bluetooth® Smart/Bluetooth® Low Energy (BLE) v4.1 and/or IEEE® 802.15.4-2011 RF connectivity for portable, extremely low-power embedded systems. Applications include portable health care 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.		Sep 29, 2015

Listed By	Roxana Dragomir
BQE	Noemi Perez Dans

Referenced QDID Profile Information

> QDID: 74031

NXP Solutions for Thread – Edge node to Cloud



NXP Kinetis KW2x
Mesh Network Router / End Device
Thread and IEEE 802.15.4 compliant
Tower Board and Freedom Board coming up soon
Runs FreeRTOS and MQX for Kinetis SDK

NXP Kinetis KL46 + MCR20A Transceiver
Mesh Network End Device
Thread and IEEE 802.15.4 compliant
Freedom Board format
Runs MQX for Kinetis SDK

NXP i.MX6 IoT Gateway with Kinetis KW2x USB
Border Router / Cloud gateway
Provides IP data routing and infrastructure integration
Runs Linux operating system

NXP Kinetis K64F + MCR20A Transceiver + WiFi
Border Router with Ethernet and WiFi support
Thread and IEEE 802.15.4 compliant
Freedom Board format
Runs FreeRTOS and MQX for Kinetis SDK

WRAP UP & SUMMARY

NXP Microcontrollers
Kinetis & LPC MCUs. Smart. Secured. Secure, Connected.

Smart

Increasing performance, reducing space & power budgets to deliver more power efficient & intelligent edge node processing

Secure

Delivering scalable security across the families to facilitate secure edge node processing at right price/performance rations

Connected

Providing all key wired & in-home wireless connectivity backbones while facilitating reduced cost of ownership for

SECURE CONNECTIONS
FOR A SMARTER WORLD