Discover Kinetis, the Broadest Microcontroller Family in the Market based on ARM® Cortex®-M Processors - **There is Always a Kinetis for Your Application**

EUF-IND-T1570

Cyril Zarader | Business Development

J U L Y . 2 0 1 5

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Agenda

- Embedded Processing Strategy

- Microcontrollers Portfolio and Roadmap

- Development Tools

We Enable the Key Development Forces

Secure Data

Diverse Data Sources
Optimized Networks
Security, Security, Security

Small, Fast, Energy Efficient

Product Longevity
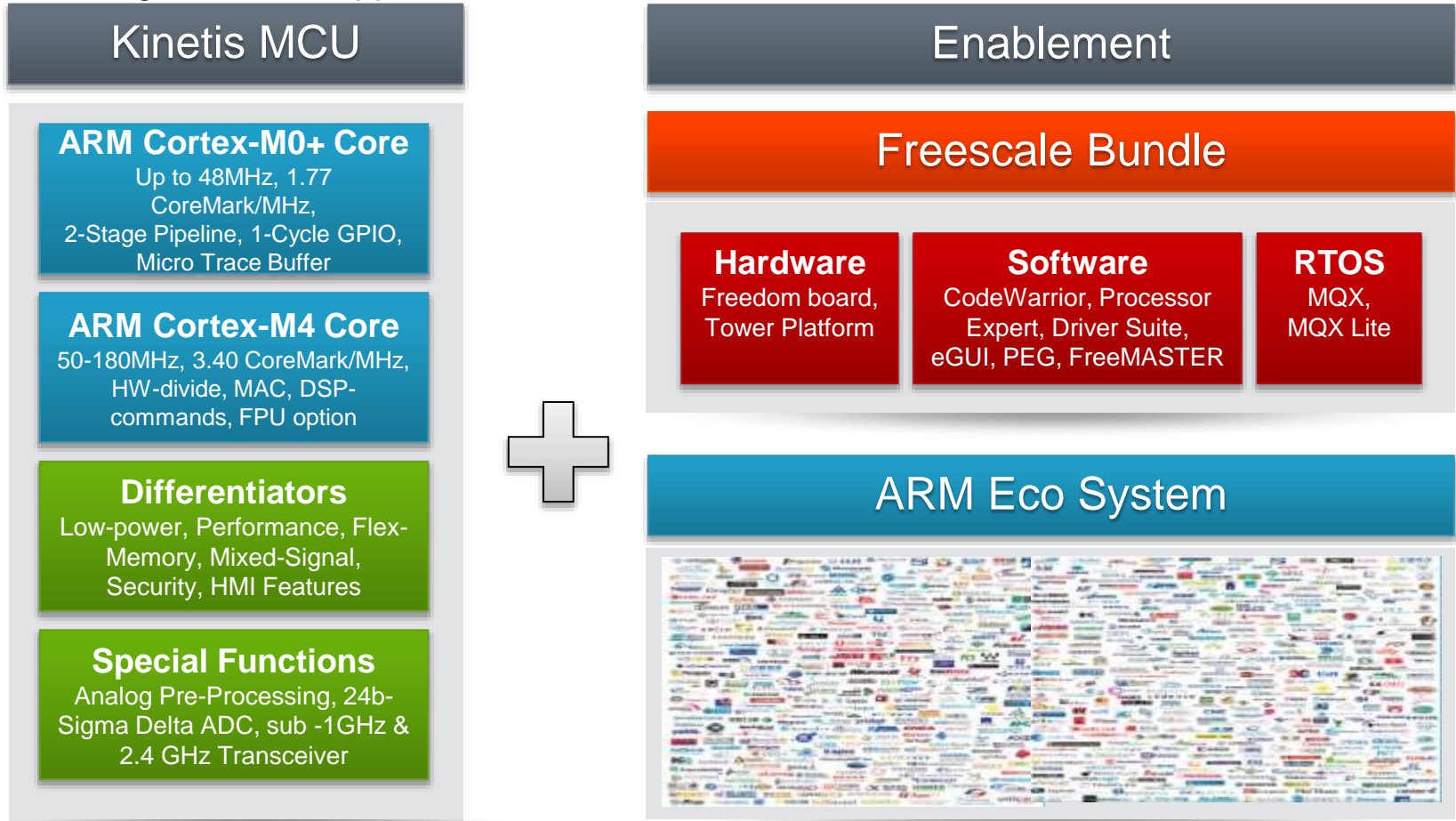Balanced Performance/Power
Shrinking Power Envelopes

Easy to Use

Integrated, Compatible, Scalable
Global Partners
Faster Time to Market

50 BILLION
CONNECTED DEVICES
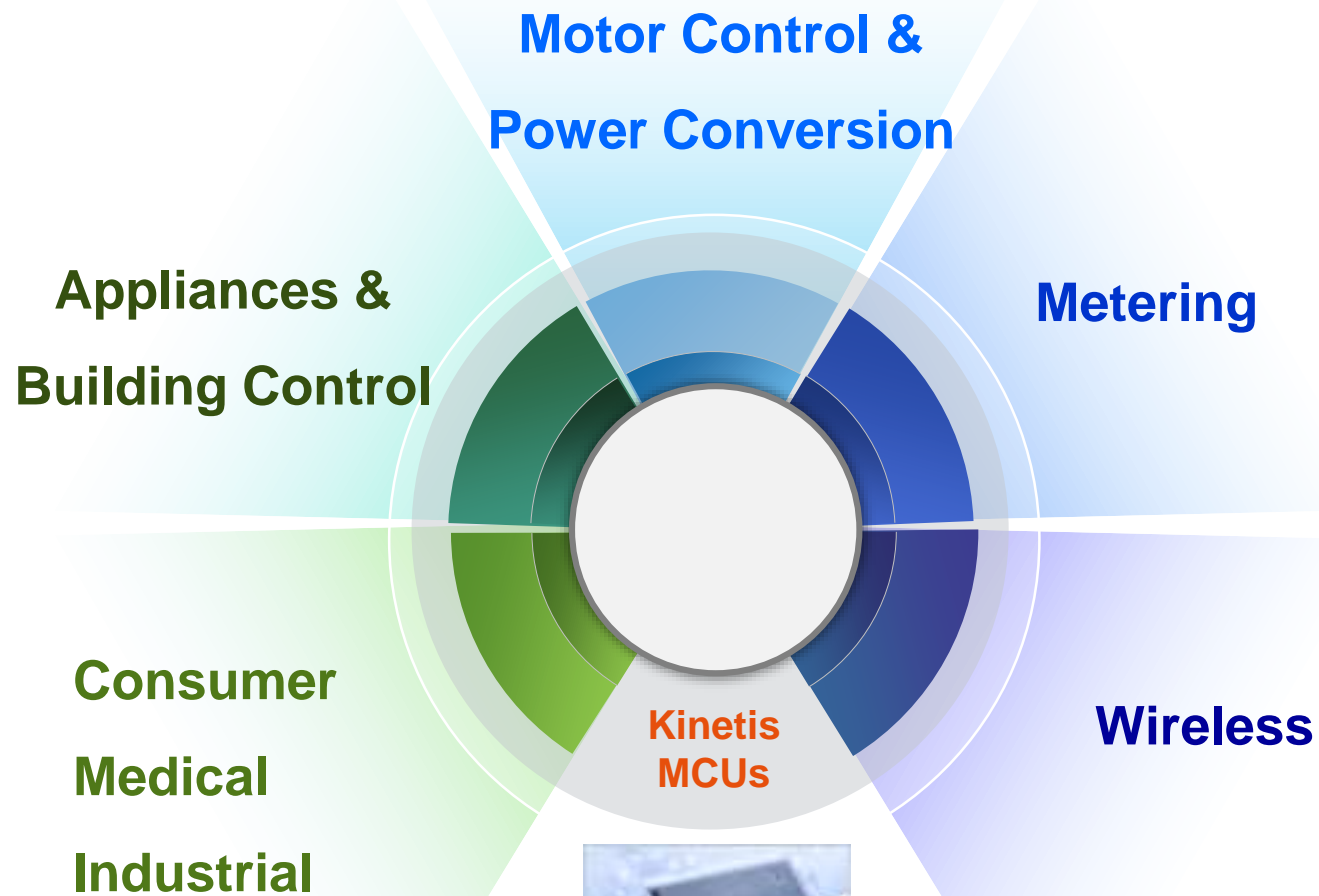by 2020

We are **Enabling** the **Next Growth Wave**

Market Trends and the Kinetis MCU Solutions & Applications

Today's market expects **increased performance** and **functionality, smarter peripherals, integrated HMI** and improved **power efficiency**. However, product advancements are not enough; software is critical to success. **Freescale understands this requirement and is delivering** to help customers bring innovative applications to market in record time.

Kinetis MCU

ARM Cortex-M0+ Core
Up to 48MHz, 1.77 CoreMark/MHz,
2-Stage Pipeline, 1-Cycle GPIO,
Micro Trace Buffer

ARM Cortex-M4 Core
50-180MHz, 3.40 CoreMark/MHz,
HW-divide, MAC, DSP-commands, FPU option

Differentiators
Low-power, Performance, Flex-Memory, Mixed-Signal,
Security, HMI Features

Special Functions
Analog Pre-Processing, 24b-Sigma Delta ADC, sub -1GHz &
2.4 GHz Transceiver

Enablement

Freescale Bundle

Hardware	Software	RTOS
Freedom board, Tower Platform	CodeWarrior, Processor Expert, Driver Suite, eGUI, PEG, FreeMASTER	MQX, MQX Lite

ARM Eco System

Kinetis MCUs: Target Applications

Motor Control & Power Conversion

Metering

Appliances & Building Control

Wireless

Consumer Medical Industrial

Kinetis MCUs

Kinetis MCUs in Production

Freescale Leadership with Kinetis MCUs

2010 Industry's first Cortex-M4-based MCU

2011 Kinetis MCUs set industry records with benchmark tests, further demonstrating leadership in product capabilities

2012 Industry's first Cortex-M0+-based MCU

2012 Industry's first sub-gigahertz wireless MCU Using the world's most energy-efficient 32-bit core

2013 New Kinetis series enable cost-Effective meters with highest level of accuracy & security

2013 World's first Cortex-M0+-based MCU with 5V support

2014 Streamlining next-generation motor control and digital power conversion with Kinetis V series MCU

2015 Delivering new levels of performance to the embedded market with early adoption of ARM Cortex-M7 core

Kinetis MCUs: World's smallest and most energy efficient ARM-based MCUs

Miniature Packages. Massive Potential.

- Industry-leading portfolio of ARM-based solutions in chip-scale packages (CSPs) that offer smaller size and greater functionality than competing solutions

- Advanced chip-scale packages for the ultimate in PCB area reduction

- Freescale offers Kinetis K mini MCUs for high performance and enhanced integration and Kinetis L mini MCUs for lowest power consumption

- Mass production now! **Over 10 million unit already shipped. New Kinetis mini MCUs continue to be added to portfolio**.
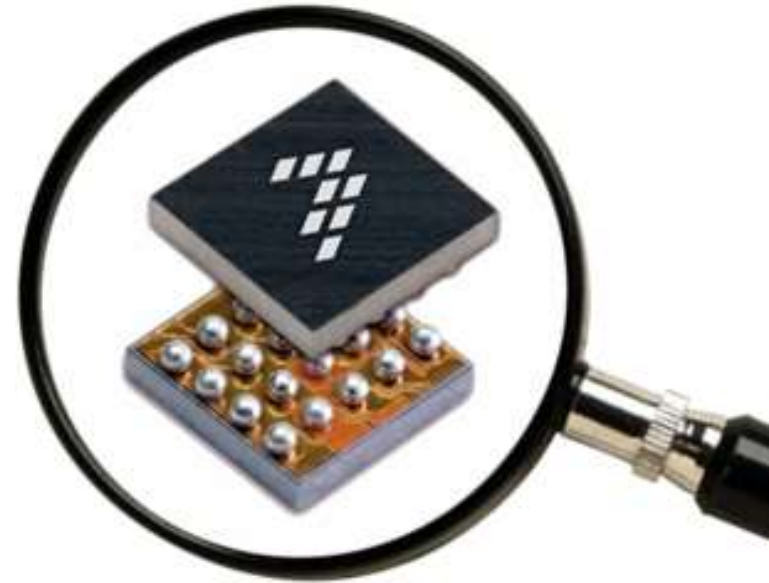
For more information, visit freescale.com/KinetisMinis

Kinetis Leadership

The Kinetis portfolio is the world's broadest MCU portfolio based on Cortex-M cores, offering more than 700 hardware- and software-compatible Cortex-M0+ and Cortex-M4 MCU families with exceptional low-power performance, memory scalability and feature integration.

Broadest MCU Portfolio
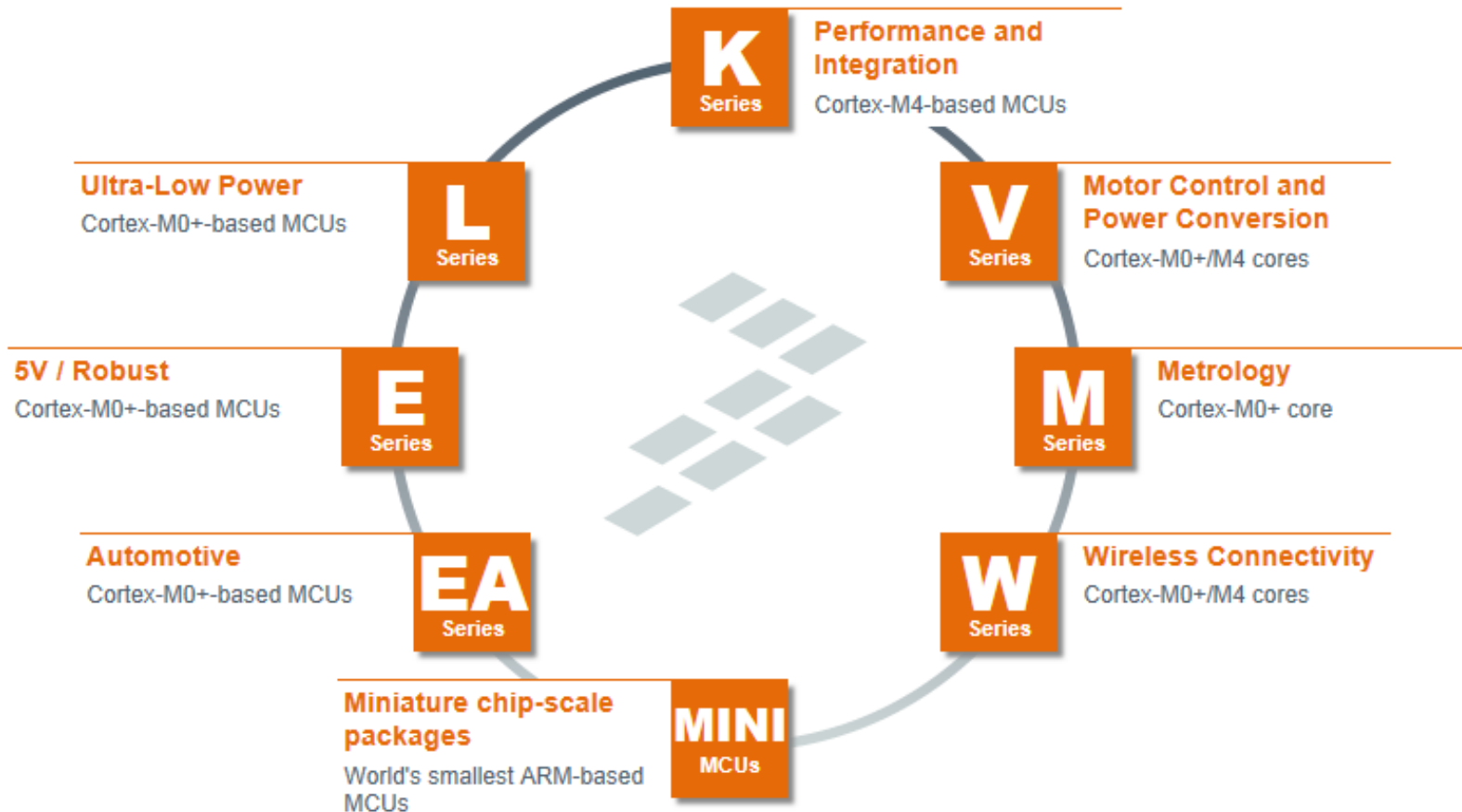**Availability**

Industry-leading
Scalability

Feature Integration
Compatibility

"The range of capabilities and the scalability offered by Freescale supports the economical development of extremely innovative, forward-looking technology."
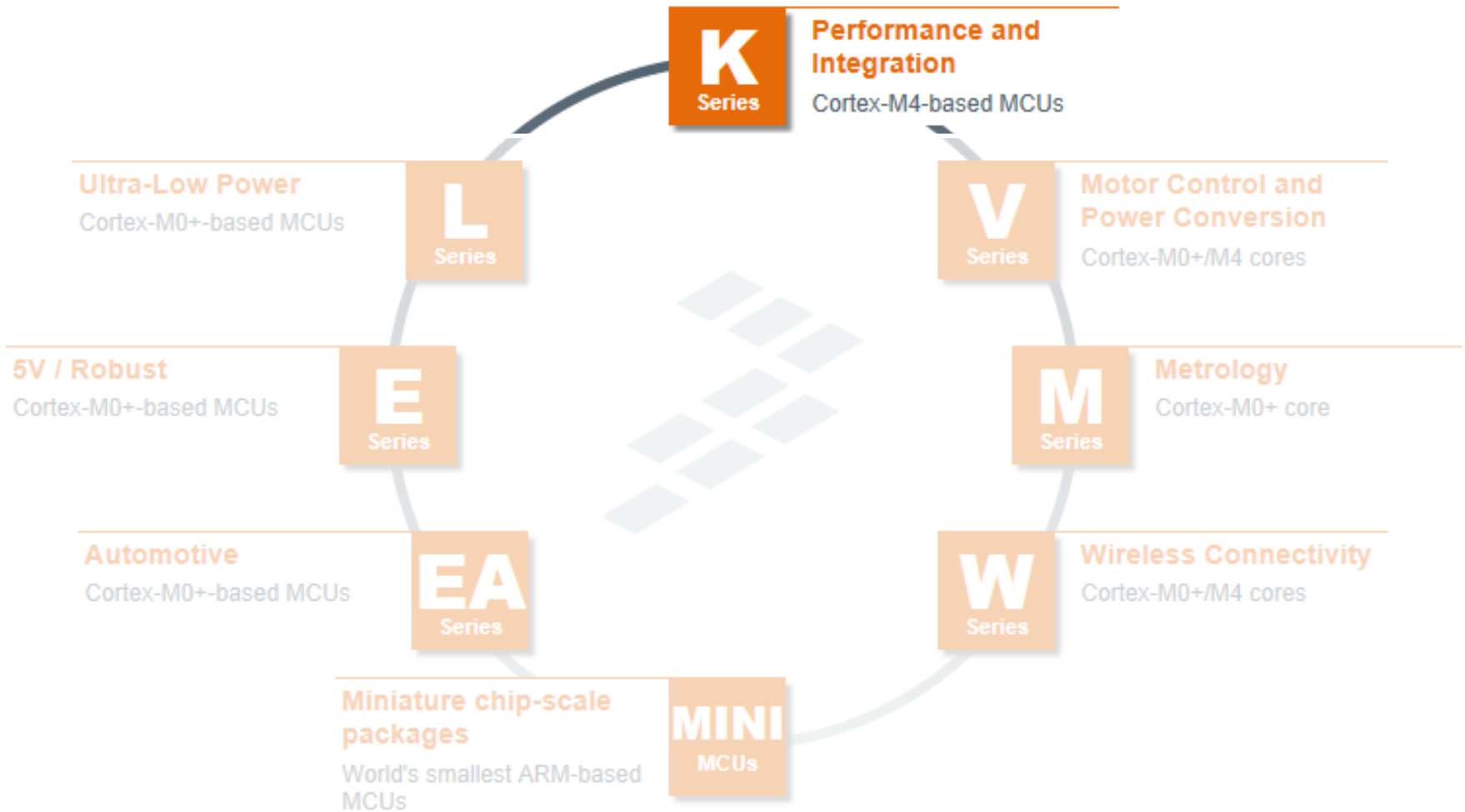-Customer

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Kinetis Availability

The Kinetis portfolio consists of several series of MCUs with general-purpose and application-specific features.

K Series — Performance and Integration
Cortex-M4-based MCUs

V Series — Motor Control and Power Conversion
Cortex-M0+/M4 cores

M Series — Metrology
Cortex-M0+ core

W Series — Wireless Connectivity
Cortex-M0+/M4 cores

MINI MCUs — Miniature chip-scale packages
World's smallest ARM-based MCUs

EA Series — Automotive
Cortex-M0+-based MCUs

E Series — 5V / Robust
Cortex-M0+-based MCUs

L Series — Ultra-Low Power
Cortex-M0+-based MCUs

Kinetis K Overview

K Series — Performance and Integration — Cortex-M4-based MCUs

L Series — Ultra-Low Power — Cortex-M0+-based MCUs

V Series — Motor Control and Power Conversion — Cortex-M0+/M4 cores

E Series — 5V / Robust — Cortex-M0+-based MCUs

M Series — Metrology — Cortex-M0+ core

EA Series — Automotive — Cortex-M0+-based MCUs

W Series — Wireless Connectivity — Cortex-M0+/M4 cores

MINI MCUs — Miniature chip-scale packages — World's smallest ARM-based MCUs

Kinetis MCUs: Industry's First Cortex-M4-Based MCU

MCU

Ease of use
C Programming
Interrupt handling
Ultra low power
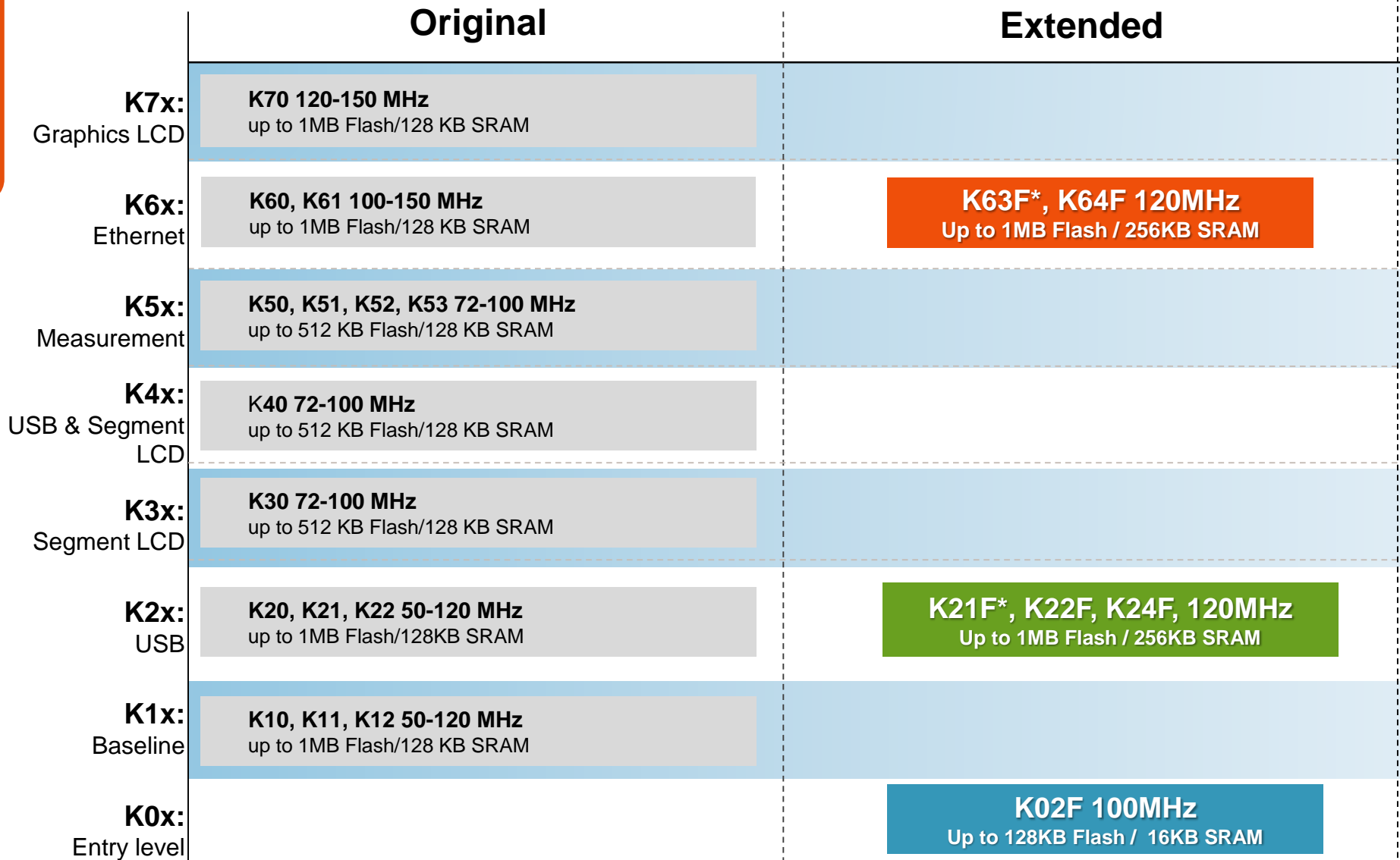
Cortex-M4

DSP

Harvard architecture
Single cycle MAC
Floating Point
Barrel shifter

The Cortex-M4 is ~2X more efficient on most DSP tasks than leading 16- and 32-bit MCU devices with DSP extensions

16-bit MCU   **32-bit MCU**   **32-bit Cortex-M4**
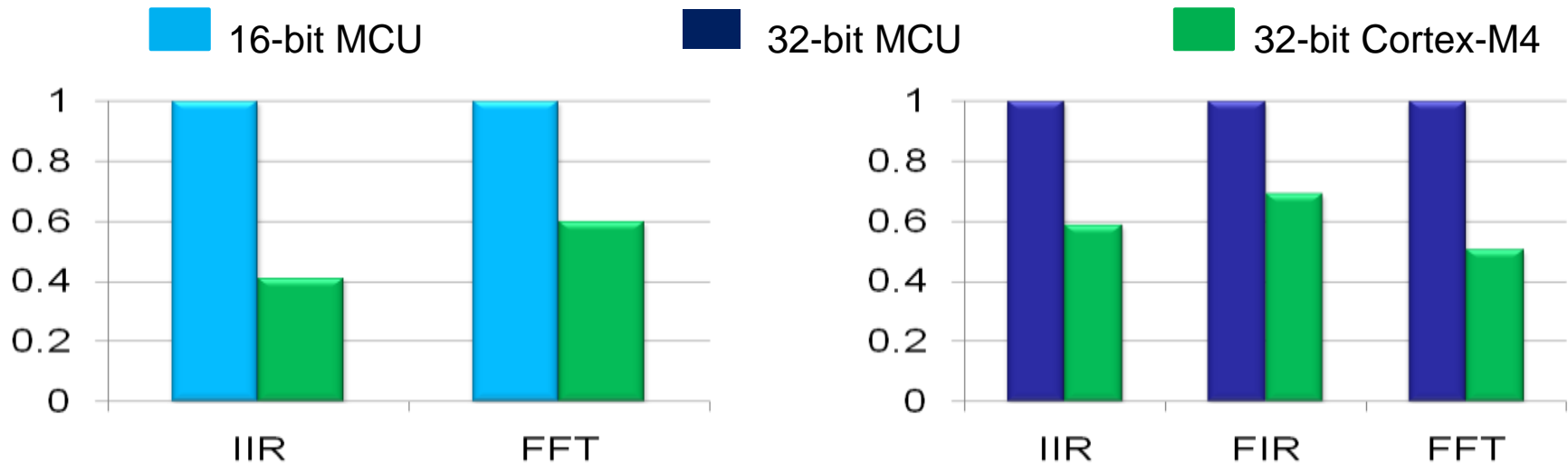
Kinetis K Portfolio

Represents Tamper Detection

Tomorrow's Portfolio

	Original	Extended
K7x: Graphics LCD	**K70 120-150 MHz** up to 1MB Flash/128 KB SRAM	
K6x: Ethernet	**K60, K61 100-150 MHz** up to 1MB Flash/128 KB SRAM	**K63F*, K64F 120MHz** Up to 1MB Flash / 256KB SRAM
K5x: Measurement	**K50, K51, K52, K53 72-100 MHz** up to 512 KB Flash/128 KB SRAM	
K4x: USB & Segment LCD	K40 72-100 MHz up to 512 KB Flash/128 KB SRAM	
K3x: Segment LCD	**K30 72-100 MHz** up to 512 KB Flash/128 KB SRAM	
K2x: USB	**K20, K21, K22 50-120 MHz** up to 1MB Flash/128KB SRAM	**K21F*, K22F, K24F, 120MHz** Up to 1MB Flash / 256KB SRAM
K1x: Baseline	**K10, K11, K12 50-120 MHz** up to 1MB Flash/128 KB SRAM	
K0x: Entry level		**K02F 100MHz** Up to 128KB Flash / 16KB SRAM

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External Use | 12

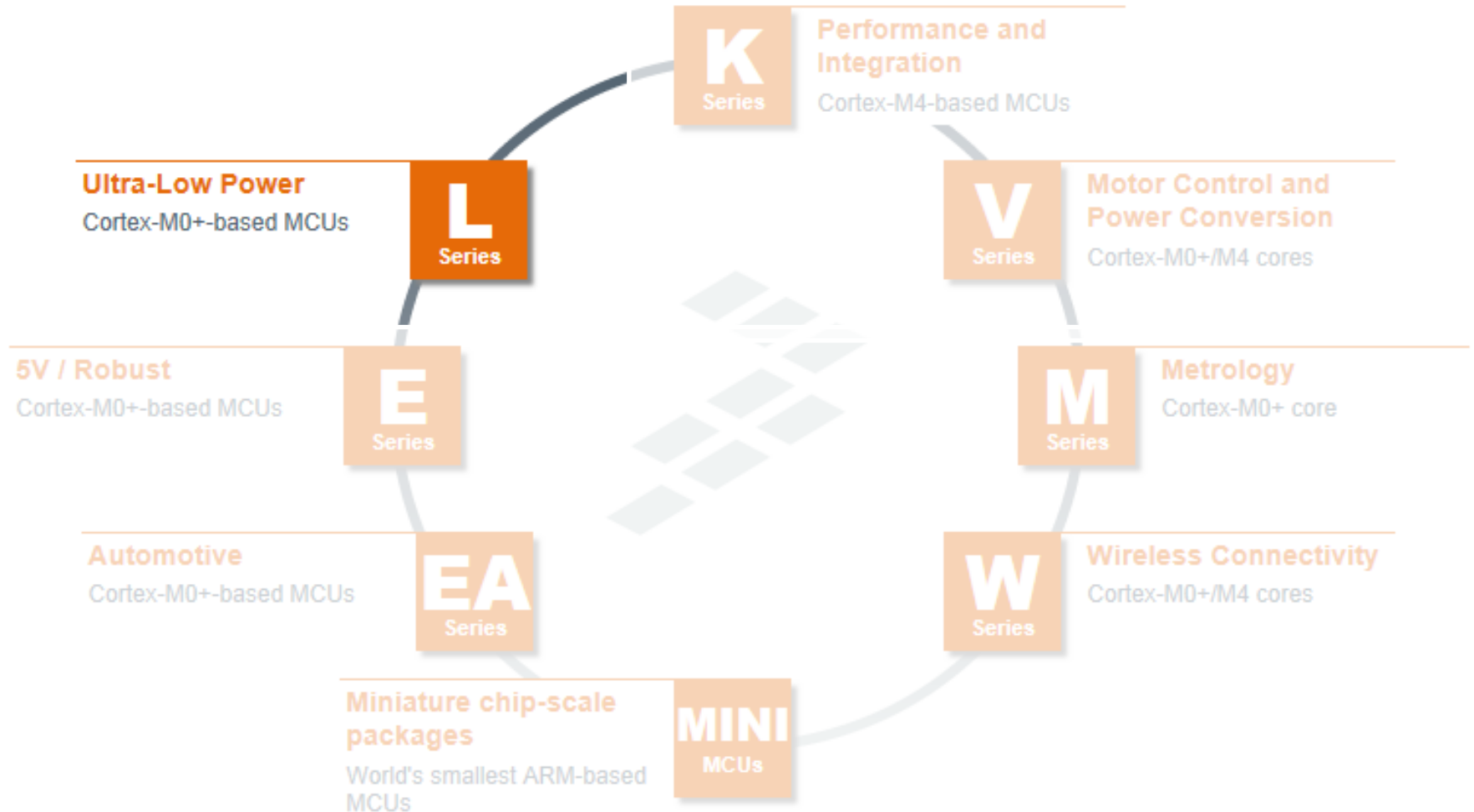# Kinetis K Series

based on the ARM Cortex-M4 core

High Performance and Integration

Designed for scalability, performance efficiency, integration, connectivity, communications, HMI and security. Kinetis K offers industry-leading low power and significant BOM savings through smart on-chip integration.

✅ **Power Efficiency**

✅ **Security**

✅ **Connectivity**

✅ **Product and Software Scalability**

Kinetis L Overview

K Series — Performance and Integration
Cortex-M4-based MCUs

L Series — Ultra-Low Power
Cortex-M0+-based MCUs

V Series — Motor Control and Power Conversion
Cortex-M0+/M4 cores

E Series — 5V / Robust
Cortex-M0+-based MCUs

M Series — Metrology
Cortex-M0+ core

EA Series — Automotive
Cortex-M0+-based MCUs

W Series — Wireless Connectivity
Cortex-M0+/M4 cores

MINI MCUs — Miniature chip-scale packages
World's smallest ARM-based MCUs

Benefits of Moving from 8/16 -bit to 32-bit Cortex-M0+

8/16-bit

Performance

•Older, slower architectures & technology

•Increased code size/complexity when performing complex math operations

Energy-Efficiency

•Low energy-efficiency

Low Cost

•6-35kgates

•Variable code density

Ease-of-Development

•Limited addressable memory

•Simplistic interrupt controllers

•Limited scalability (MHz, flash, features)

•Limited ecosystem support

32-bit Cortex-M0+

Performance

•2x to 40x more than 8/16-bit, 9% more than Cortex-M0

•Fast 32-bit math processing

•Fast single-cycle access to I/O

Energy-Efficiency

•>2x CoreMark/mA than closest 8/16-bit MCU, +30% / CM0

Low Cost

•12-35 kgates

•Excellent code density

Ease-of-Development

•Linear 4 GB address space – no need for paging

•Full-featured interrupt controller – simpler s/w architecture

•Huge scalability – h/w and s/w reuse across end products

•Huge ARM ecosystem – off-the-shelf software/tools/training

•Micro Trace Buffer – lightweight, non-intrusive trace

ARM Cortex-M0+ Processor:
Code Efficiency

- **ARMv6-M Thumb Instruction Set**
  - 32-bit performance at 16-bit density
- **32-bit Simplification**
  - 32-bit data structure
  - 32-bit Address Space (no paging)


16-bit Multiplication Example
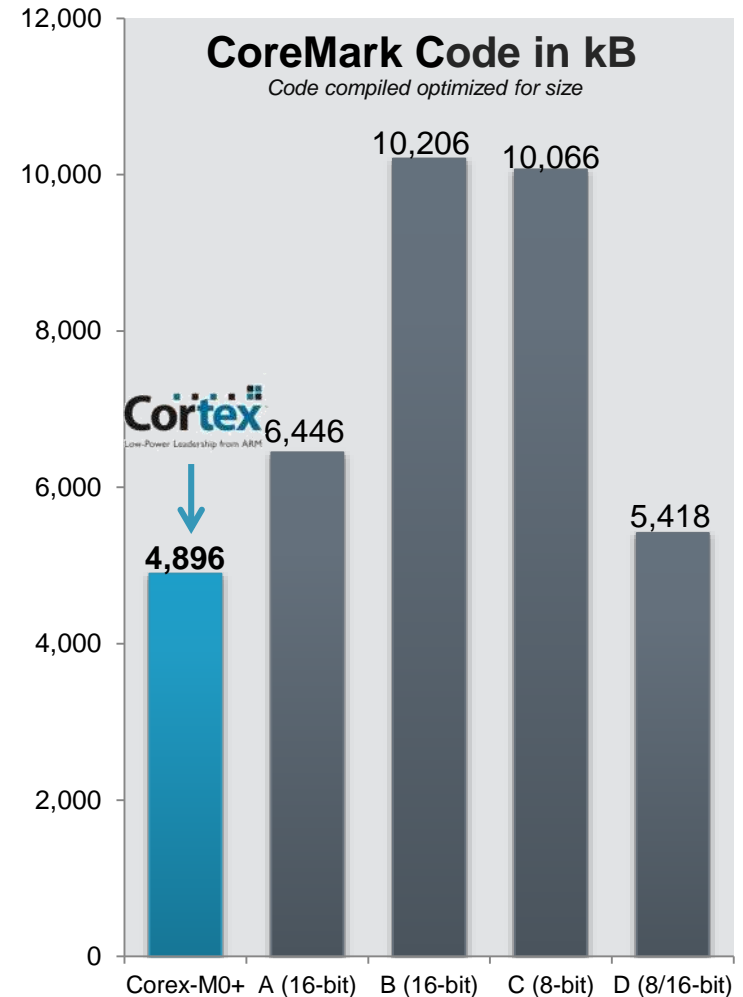
Best Energy Efficiency – Dynamic and Static Power Consumption

Mode	CPU/BUS Frequency	Description	Peripheral Clocks	Typical IDD @3V, 25C	Recovery Time
RUN	48/24 MHz	Full speed RUN mode with specified CPU/BUS frequency, flash cache enabled, clocked by 48MHz IRC, with Compute mode and peripheral clocks on/off options	Enabled	5.62mA (117uA/MHz)	-
	48/24 MHz		Disabled	4.04mA (84uA/MHz)	-
	48/- MHz		Compute Mode*	3.39mA (70uA/MHz)	-
	24/24 MHz		Disabled	2.99mA	-
VLPR	4/1 MHz	Very Low Power RUN mode with specified CPU/BUS frequency, flash cache enabled, clocked by 8/2MHz IRC, with Compute mode and peripheral clocks on/off options	Enabled	329uA (82uA/MHz)	-
	4/1 MHz		Disabled	253uA (63uA/MHz)	-
	4/- MHz		Compute Mode	229uA (57uA/MHz)	-
	2/- MHz		Compute Mode	101uA (50uA/MHz)	-
WAIT	48/24 MHz	Full CPU/BUS frequency with CPU in SLEEP mode	Disabled	1.79mA	-
VLPW	4/1 MHz	Restricted CPU/BUS frequency with CPU in SLEEP mode	Disabled	218uA	-
STOP	OFF	MCU in static state with full retention, CPU clock is off, energy-saving peripherals functional with Asynchronous DMA, Asynchronous Wake-up Interrupt Controller detects wake-up source for CPU, LVD ON	OFF	160uA	7.5uS
VLPS	OFF	Same as STOP with LVD OFF, lowest mode with ADC and pin interrupt functional	OFF	2.09uA	7.5uS
LLS	OFF	MCU in low-leakage state with full retention, Low Leakage Wake-up Unit detects wake-up source, lowest mode with full RAM and I/O retention and fast wake-up, Asynchronous DMA in static state	OFF	1.58uA	7.5uS
VLLS3	OFF	Similar to LLS mode with wake-up following reset flow	OFF	1.35uA	93uS
VLLS1	OFF	Similar to VLLS3 mode with SRAM OFF, REGFILE retained for critical data	OFF	700nA	152uS
VLLS0	OFF	Similar to VLLS1, with REGFILE OFF, LPO OFF, optional POR ON/OFF, shelf mode	OFF	76/252nA	152uS

*Compute Operation shuts off bus and system clock for lowest power core processing. Peripherals with an alternate asynchronous clock source can continue to operate.
Test result from MKL27Z64VLH4 with code in flash and flash cache on

Kinetis L Series Energy-Efficiency Benchmark Demo:
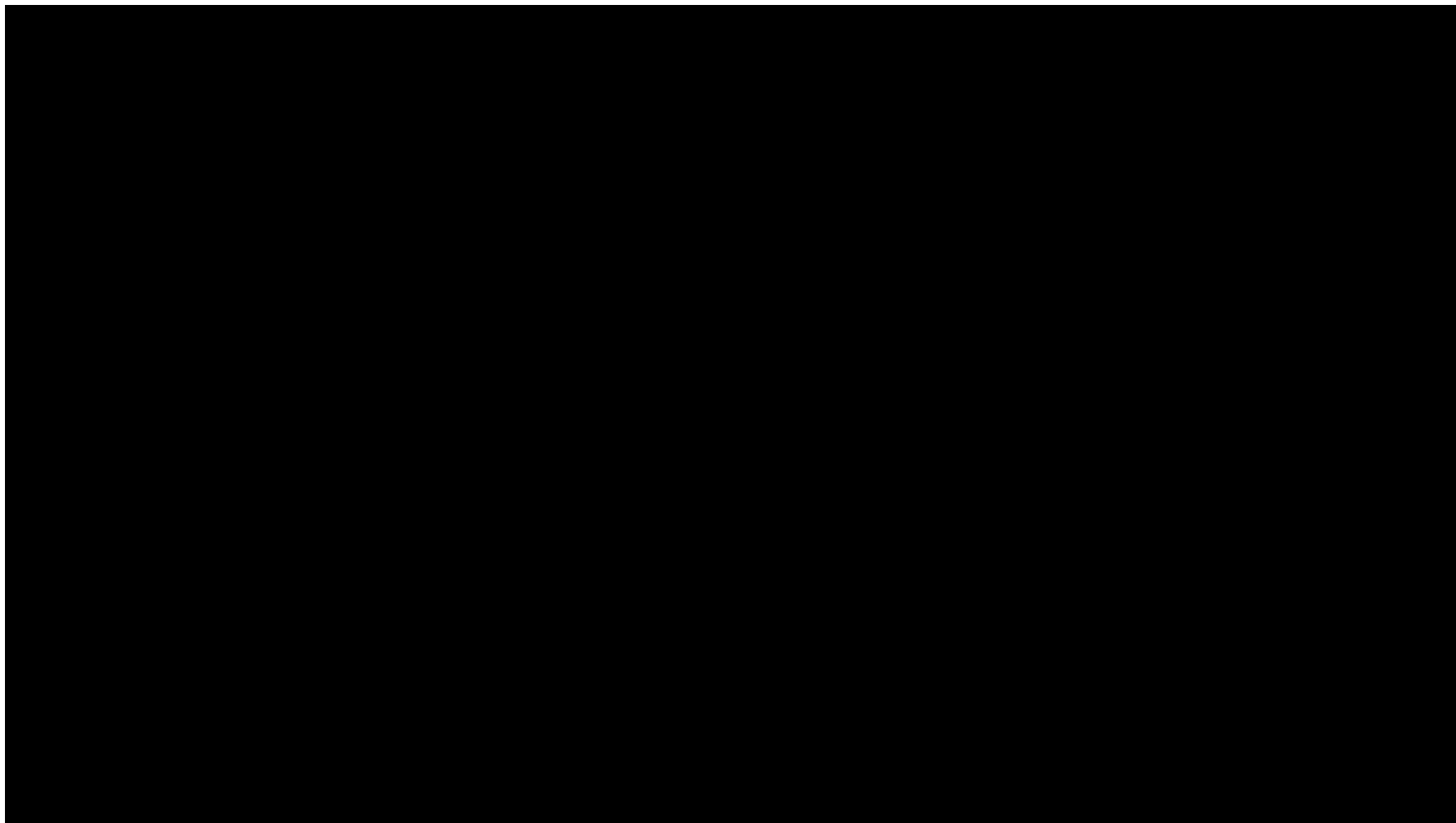## Hardware Overview
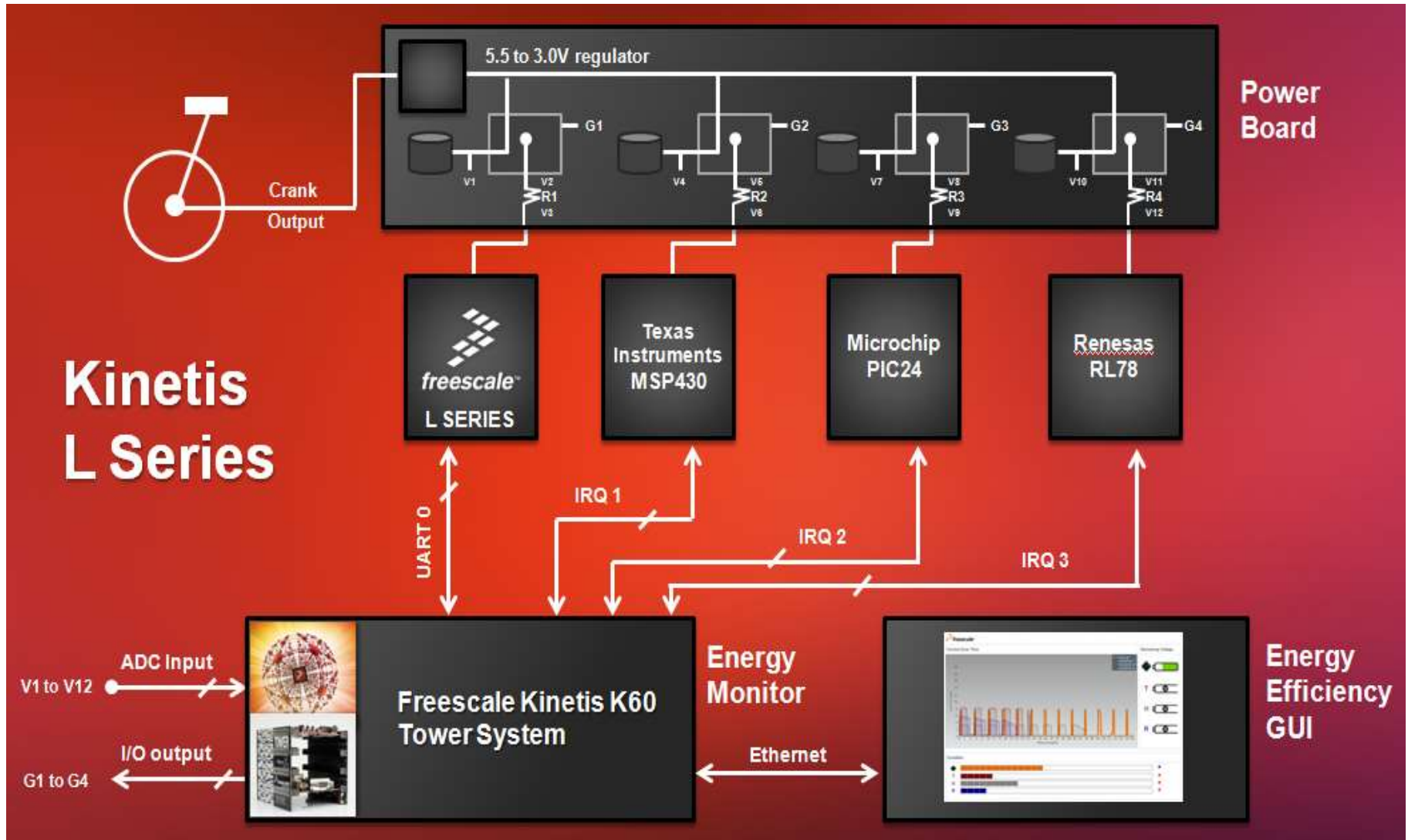
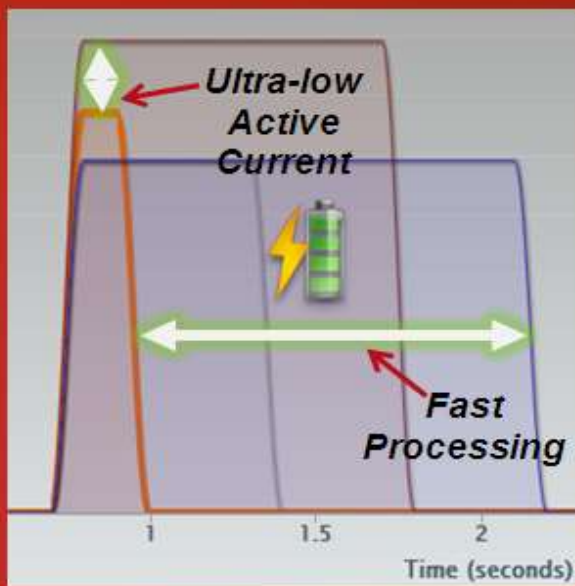# Kinetis L Series Energy-Efficiency Benchmark Demo:
Software Overview

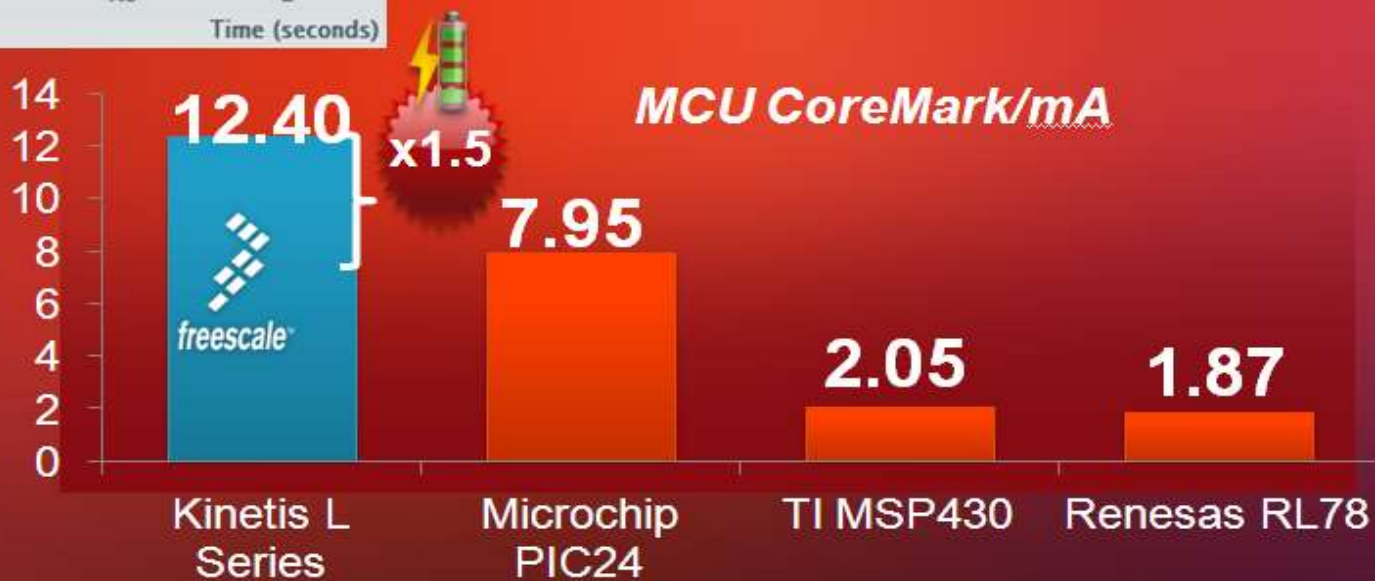# Kinetis L Series Energy-Efficiency Benchmark Demo:
Software Overview

Kinetis L Series Energy-Efficiency Benchmark Demo: Results

Kinetis **L** Portfolio

	Original **(2012/2013)**	**2014 Extended**
KL4x: USB & Segment LCD	KL46 48MHz 128-256KB Flash	**KL43 48MHz** **128-256KB Flash / FlexIO / XTAL-less USB**
KL3x: Segment LCD	KL34, KL36 48MHz 32-256KB Flash	**KL33 48MHz** **32-256KB Flash / ROM / Vref / FlexIO**
KL2x: USB	KL24, KL25, KL26 48MHz 32-256KB Flash	**KL27 48MHz** **32-256KB Flash / FlexIO / XTAL-less USB**
KL1x: Baseline	KL14, KL15, KL16 48 MHz 32-256KB Flash	**KL17 48MHz** **32-256KB Flash / ROM / Vref / FlexIO**
KL0x: Entry level	KL02, KL04, KL05 48MHz 8-32KB Flash	**KL03 48MHz** **8-32KB Flash / ROM / Vref**

Kinetis L – Upcoming Products

* Represents Tamper Detection

	Original + Extended		**New 2015 Products**
KL8x: Memory Scalability & Security			**KL80/81* 72-96 MHz** 96 KB RAM / QuadSPI
KL4x: USB & Segment LCD	**KL46** 128-256KB Flash	**KL43 48 MHz** 128-256KB Flash / ROM / Vref / FlexIO	
KL3x: Segment LCD	**KL34, KL36** 32-256KB Flash	**KL33 48 MHz** 32-256 KB Flash / ROM / Vref / FlexIO	
KL2x: USB	**KL24, KL25, KL26** 32-256KB Flash	**KL27 48 MHz** 32-256 KB Flash / ROM / Vref / FlexIO	**KL28 96 MHz** 128-512 KB Flash / ROM / Vref / FlexIO
KL1x: Baseline	**KL14, KL15, KL16** 32-256KB Flash	**KL17 48 MHz** 32-256 KB Flash / ROM / Vref / FlexIO	
KL0x: Entry level	**KL02, KL04, KL05** 8-32KB Flash	**KL03 48 MHz** 8-32 KB Flash / ROM / Vref	

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Kinetis L Series
based on the ARM Cortex-M0+ core

Ultra Low-Power

Ultra Low-Power, Ultra Small Scale, Super Easy to Use, Leading Scalability and Integration as an ideal solution for Internet of Things edge nodes

✅ **World's Most Energy Efficient ARM based Microcontroller**
Architected for power efficiency, the Kinetis L series takes advantage of ARM's ultra low power Cortex-M0+ processor and features peripherals that help you optimize power consumption. Kinetis L series provide ultra low dynamic consumption, ultra low static consumption, rich low power modes and innovative low power peripherals.

✅ **World's Smallest ARM based Microcontroller**
Built on Freescale leading technology, Kinetis L series provide rich package options from 8x8mm2 121XFBGA, 10x10mm2 100LQFP all the way down to world's smallest KL03 20WLCSP with 1.6x2mm2 ultra small scale device.
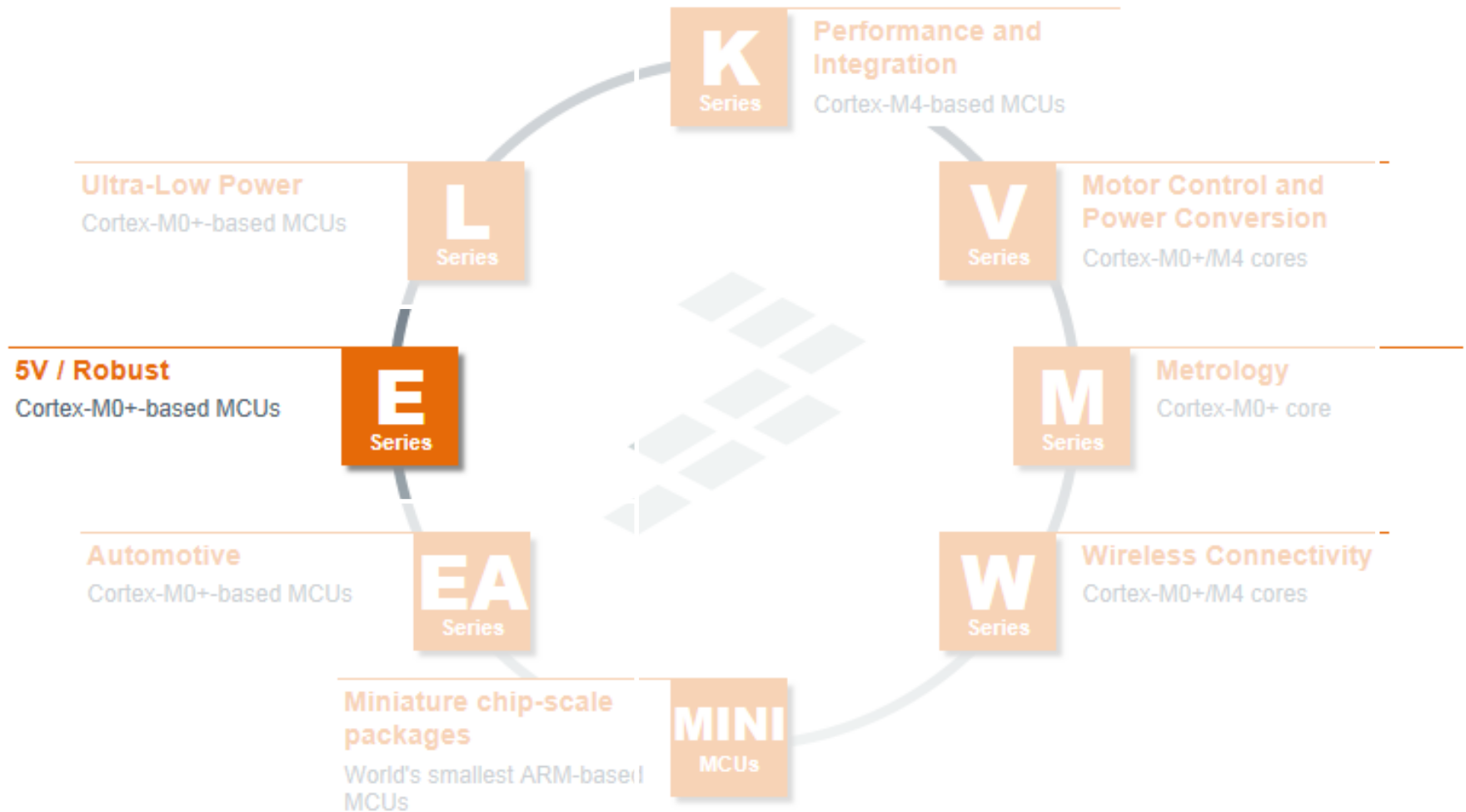
✅ **World's Leading Scalability and Integration with Ease of Use**
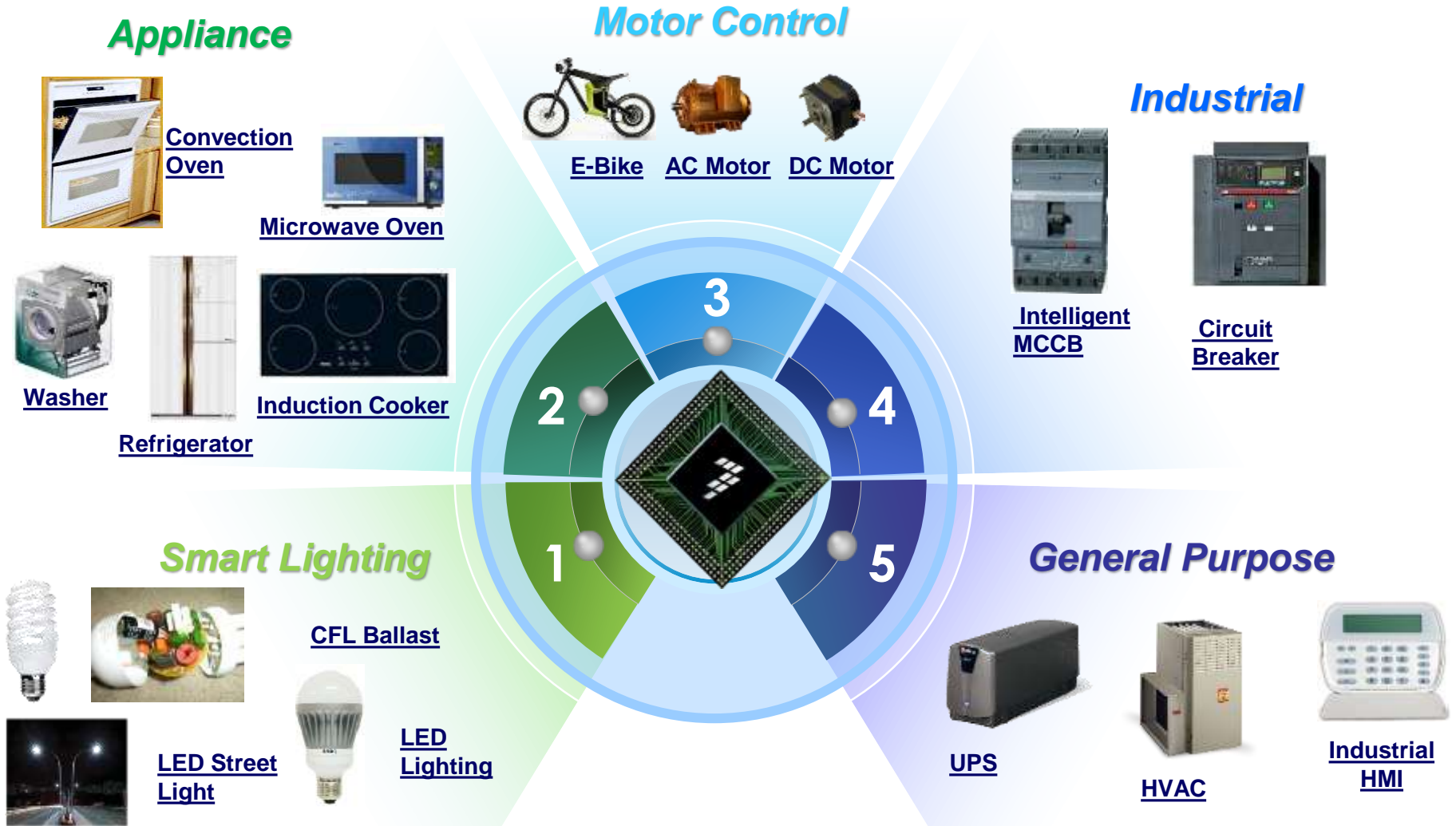Built on the ARM Cortex-M0+ core, the Kinetis L series simplifies development with an upward migration path to Kinetis K series. Expanding on well-known features of the Kinetis platform with leading scalability, best-in-class integration with rich analog features and low-power connectivity, the Kinetis L series redefines entry-level.

Kinetis E Overview

Performance and Integration
Cortex-M4-based MCUs

K Series

Motor Control and Power Conversion
Cortex-M0+/M4 cores

V Series

Ultra-Low Power
Cortex-M0+-based MCUs

L Series

5V / Robust
Cortex-M0+-based MCUs

E Series

Metrology
Cortex-M0+ core

M Series

Automotive
Cortex-M0+-based MCUs

EA Series

Wireless Connectivity
Cortex-M0+/M4 cores

W Series

Miniature chip-scale packages
World's smallest ARM-based MCUs

MINI MCUs

E Series Targeted Market & Applications

Kinetis E Series: Families

Common Features
System
ARM Cortex-M0+/M4 Core
Multiple power modes, Clock Gating,
2.7V to 5.5V, -40 to 105°C
Clock Management
External OSC, 4~20MHz, 32KHz
Internal OSC
Analog Peripherals
ADC
Analog Comparators
Serial Interfaces
SCI
SPI, IIC
Timers
Real Time Clock
16bit Flex timers
32bit Periodic Interrupt Timer

Optional Features										
Family	Core	Speed	Flash	SRAM	Key Features					
					Boot ROM	ADC	DAC	CAN	TSI	SLCD
KE17F	M4	150MHz	256K-512K	32K	√	3	√	√	√	
KE16F	M4	150MHz	256K-512K	32K	√	3	√	√		
KE15F	M4	150MHz	256K-512K	32K	√	3	√		√	
KE14F	M4	150MHz	256K-512K	32K	√	3	√			
KE35Z	M0+	48MHz	32K-64K	4K-8K	√	1			√	√
KE34Z	M0+	48MHz	32K-64K	4K-8K	√	1				√
KE17Z	M0+	48MHz	16K-256K	2K-32K	√	1		√	√	
KE16Z	M0+	48MHz	16K-256K	2K-32K	√	1		√		
KE15Z	M0+	48MHz	16K-256K	2K-32K	√	1			√	
KE14Z	M0+	48MHz	16K-256K	2K-32K	√	1				
KE06Z	M0+	48MHz	64K-128K	8K-16K		1		√		
KE04Z	M0+	48MHz	8K, 64K~128K	1K, 8K~16K		1				
KE02Z	M0+	40MHz	16-64K	2-4K		1				

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Kinetis E Series
based on the ARM Cortex-M0+ core

Ultra Low-Power

The world's first 5V MCU based on the ARM Cortex-M0+ core.

- ✅ **Strong Robustness** - EMC/ESD design technology to ensure strong noise immunity performance

- ✅ **High Efficiency** – Cortex-M0+ core up to 48 MHz and 40x more than 8/16-bit MCUs

- ✅ **Low Cost** – Optimized for cost-sensitive applications offering low pin count option

Kinetis V Series
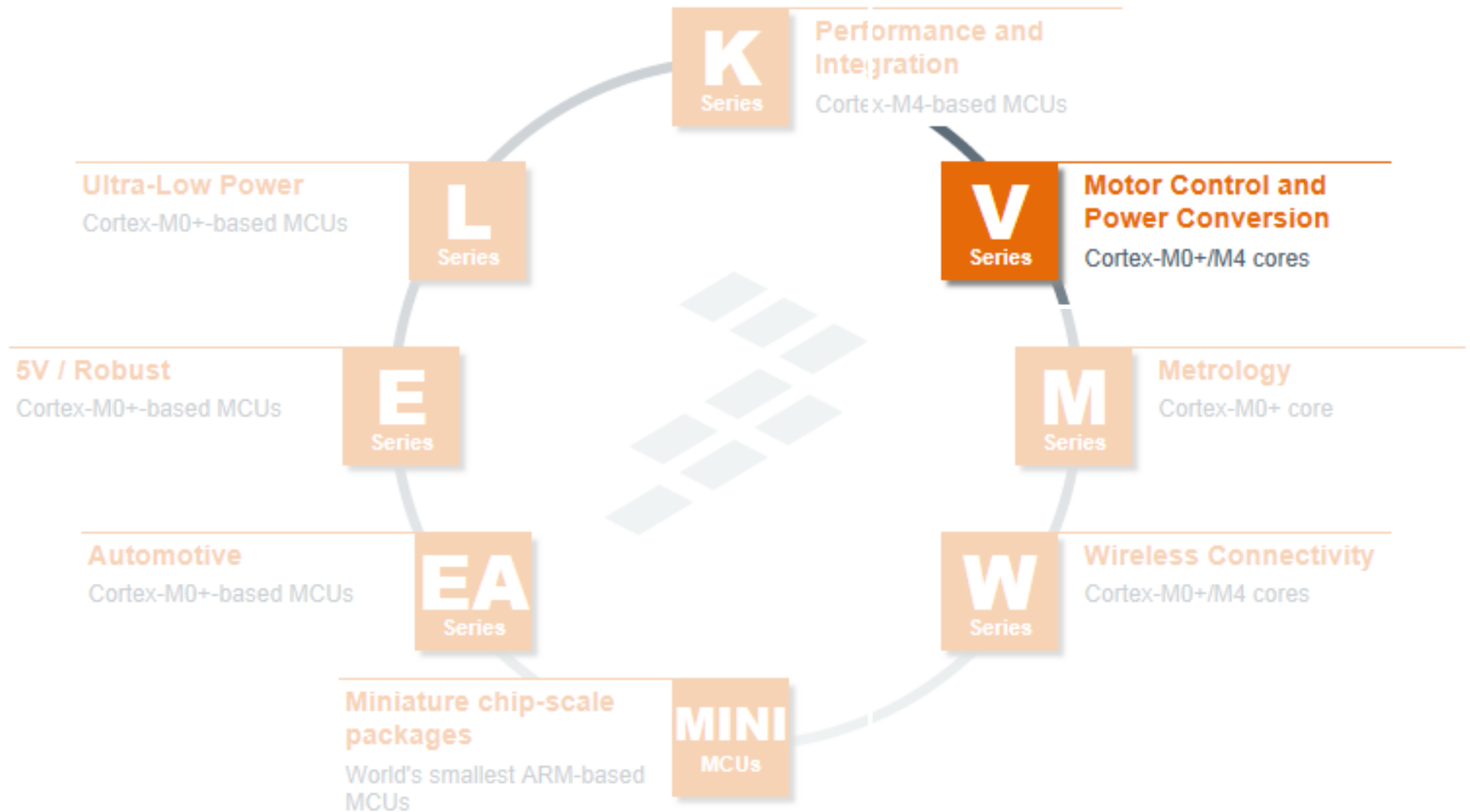## based on the ARM Cortex-M7, ARM Cortex-M4 and ARM Cortex-M0+ cores

Motor Control & Power Conversion

- ✓ Builds on Freescale's motor and power control expertise to address **NEW mass market** customers.

- ✓ Enables efficient, next generation BLDC, PMSM and ACIM designs through **optimized performance, analog and timing IP**. High speed DSC peripherals are ideal for advanced motor control and power conversion and include the **fastest ADC** in the Freescale MCU portfolio.

- ✓ Features scalable, low-power families built on ARM Cortex processors – starting with the industry's **fastest ARM Cortex-M0+ MCU.**

- ✓ Includes sophisticated enablement tools like the new, easy-to-use **Kinetis motor suite** which helps to reduce development time and cost for every customer.

Kinetis V Overview

K Series — Performance and Integration
Cortex-M4-based MCUs

Ultra-Low Power
Cortex-M0+-based MCUs — L Series

V Series — Motor Control and Power Conversion
Cortex-M0+/M4 cores

5V / Robust
Cortex-M0+-based MCUs — E Series

M Series — Metrology
Cortex-M0+ core

Automotive
Cortex-M0+-based MCUs — EA Series

W Series — Wireless Connectivity
Cortex-M0+/M4 cores

Miniature chip-scale packages
World's smallest ARM-based MCUs — MINI MCUs

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Kinetis V Series MCUs: Target Applications

Motor Control

- Sensored BLDC / PMSM
  - High Dynamic Control
- Sensored ACIM
- Sensorless FOC
  - PMSM/BLDC
  - High Dynamic Control
  - Low Dynamic Control
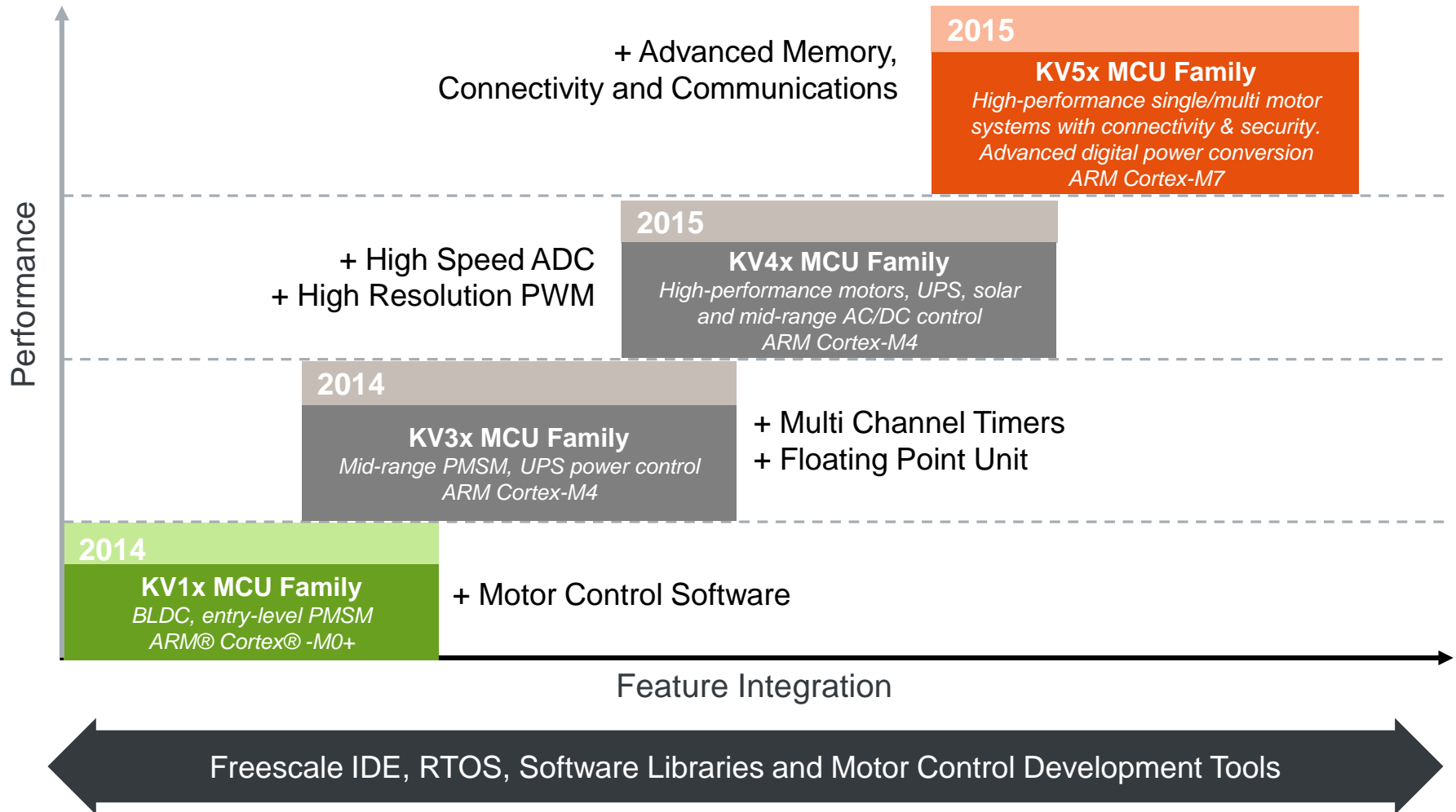- Sensorless ACIM
- Multi-Motor Control

Digital Power Conversion

- Solar Inverters
  - Grid-Tied
  - Non Grid Tied
- Power factor correction
- Switch Mode Power Supplies
  - AC/DC
  - DC/DC
- UPS
  - On-Line
  - Offline
- Inductive cooking
  - Multi cook plate

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New Levels of Performance, Reliability and Power Efficiency for Motor Control and Digital Power Conversion

Performance →

2015
KV5x MCU Family
High-performance single/multi motor systems with connectivity & security. Advanced digital power conversion ARM Cortex-M7

+ Advanced Memory, Connectivity and Communications

2015
KV4x MCU Family
High-performance motors, UPS, solar and mid-range AC/DC control ARM Cortex-M4

+ High Speed ADC
+ High Resolution PWM

2014
KV3x MCU Family
Mid-range PMSM, UPS power control ARM Cortex-M4

+ Multi Channel Timers
+ Floating Point Unit

2014
KV1x MCU Family
BLDC, entry-level PMSM ARM® Cortex® -M0+

+ Motor Control Software

Feature Integration →

Freescale IDE, RTOS, Software Libraries and Motor Control Development Tools

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Freescale's Kinetis KV5x MCU with ARM® Cortex®-M7 core drives motor control into the IoT era

Kinetis KV5x MCU Family Expands Motor Control Expertise

- Providing **safe, secure IoT functionality**, while guarding against erroneous or unsafe system inputs and conditions

- Driving **efficient, next generation BLDC, PMSM and ACIM designs** through optimized performance, analog and timing IP

- Supported by a **sophisticated suite of enablement tools** like the new, easy-to-use *Kinetis Motor Suite*, which helps to reduce development cost and time to market

Kinetis M Series
based on the ARM Cortex-M0+ core

Smart Metering & Measurement

Enabling high accuracy, secure 1-, 2- & 3-phase electricity metering solutions through a rich analog front end, hardware tamper detection and multiple low-power features in a 32-bit ARM Cortex-M0+ MCU

- ✅ High accuracy AFE with 4x24-bit Sigma Delta ADCs for simultaneous voltage and current measurements
- ✅ Security & HMI Active and passive tamper pins with auto time stamping to protect against external intrusion
- ✅ Enablement 1,2, & 3-phase regionally specified electricity meter reference designs certified to international standards

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Kinetis M Overview

K Series — Performance and Integration
Cortex-M4-based MCUs

V Series — Motor Control and Power Conversion
Cortex-M0+/M4 cores

L Series — Ultra-Low Power
Cortex-M0+-based MCUs

E Series — 5V / Robust
Cortex-M0+-based MCUs

M Series — Metrology
Cortex-M0+ core

EA Series — Automotive
Cortex-M0+-based MCUs

W Series — Wireless Connectivity
Cortex-M0+/M4 cores

MINI MCUs — Miniature chip-scale packages
World's smallest ARM-based MCUs

eMeter Security Requirements
Traditional 2-chip Solutions

- **Legally relevant** software shall run in privileged mode exclusively preventing other software functions to influence its execution

- Memory sections for **legally relevant** software, parameters and variables storage shall be protected against reading, writing and execution (R/W/E) from other software routines

- On-chip peripherals controlled by the **legally relevant** software shall not be influenced by other software routines

Legally relevant software   Legally non-relevant software
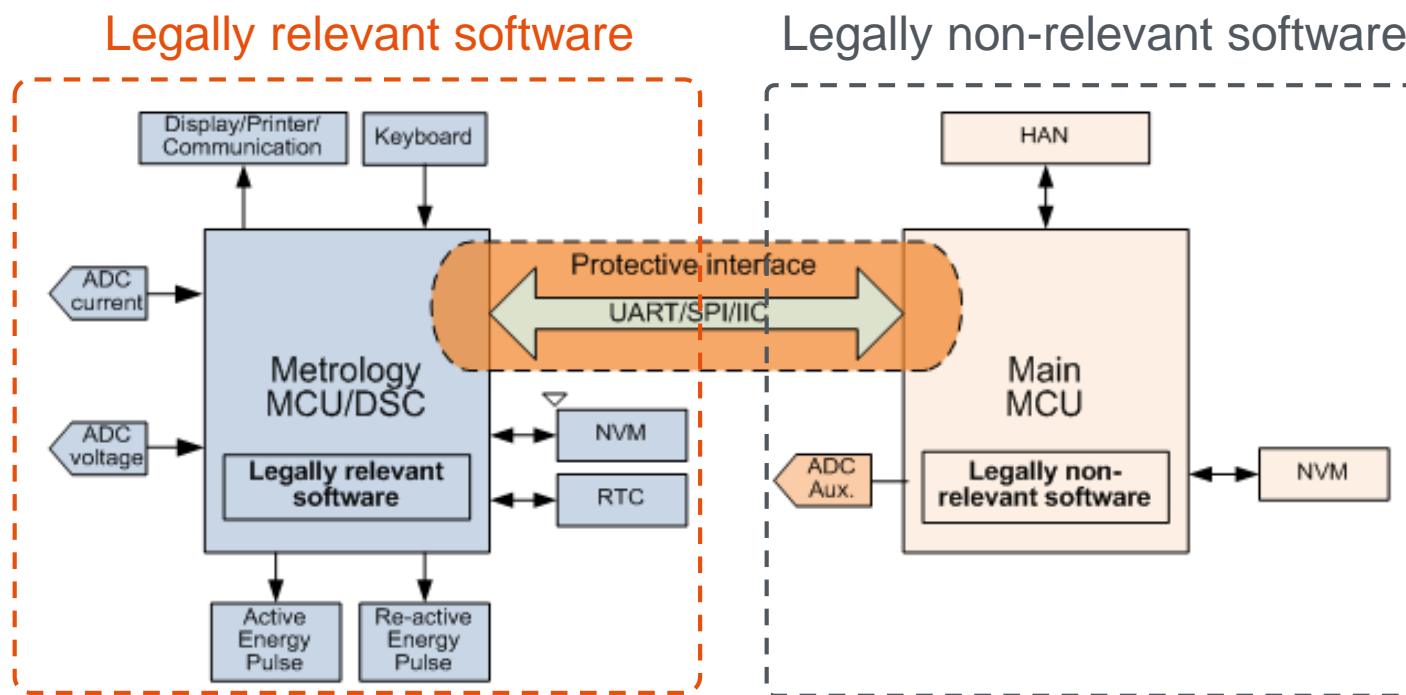
Kinetis M Series MCUs - Single Chip Solution

- Kinetis M platform supports access permissions for privileged secure, user secure and user non-secure mode. These permission attributes can be either forced on a per bus master basis or inherited from the reference.

- Read, write and execute accesses to on-chip memories are protected by the Memory Protection Unit (MPU).

- Read and write accesses to on-chip peripherals are handled by Peripheral Bridge (AIPS-Lite). GPIO pins can also be accessed via the core's fast IOPORT (private bus supporting 1-cycle loads and stores).

Legally relevant software

Legally non-relevant software
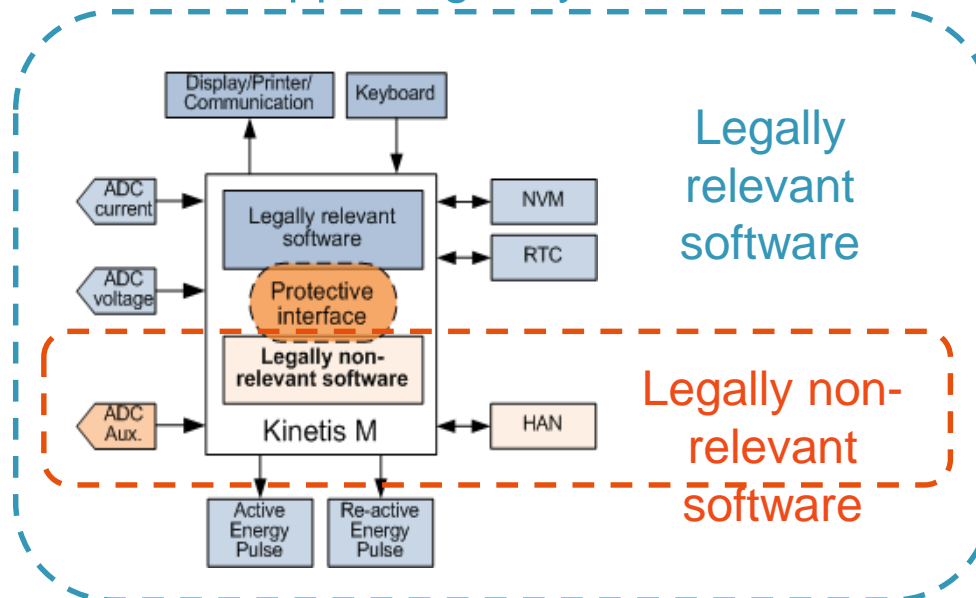
Kinetis W Series

based on the ARM Cortex-M4 and Cortex-M0+ cores

Wireless Connectivity Microcontroller Solutions

- ✅ Integrating RF functionality to the Kinetis MCU portfolio
- ✅ Flexibility Ability to integrate the right combination of memories and peripherals to meet a variety of customer demands
- ✅ Enablement Part of the Kinetis MCU ecosystem including KSDK environment using MQX and third-party support from IAR, KEIL or other ARM ecosystem providers

Wireless Connectivity Solutions

K Series — Performance and Integration
Cortex-M4-based MCUs

L Series — Ultra-Low Power
Cortex-M0+-based MCUs

V Series — Motor Control and Power Conversion
Cortex-M0+/M4 cores

E Series — 5V / Robust
Cortex-M0+-based MCUs

M Series — Metrology
Cortex-M0+ core

EA Series — Automotive
Cortex-M0+-based MCUs

W Series — Wireless Connectivity
Cortex-M0+/M4 cores

MINI MCUs — Miniature chip-scale packages
World's smallest ARM-based MCUs

freescale™

The Languages we Speak

ZigBee

- RF4CE
- ZigBee PRO
- ZigBee IP

IP Stack

IPv4/IPv6

BLE Stack

Core Stack 4.1

MAC/PHY

- Sub-GHz
- 2.4 GHz

BLE LL/PHY

- 2.4 GHz
- Bluetooth 4.1

Wireless Connectivity Solutions
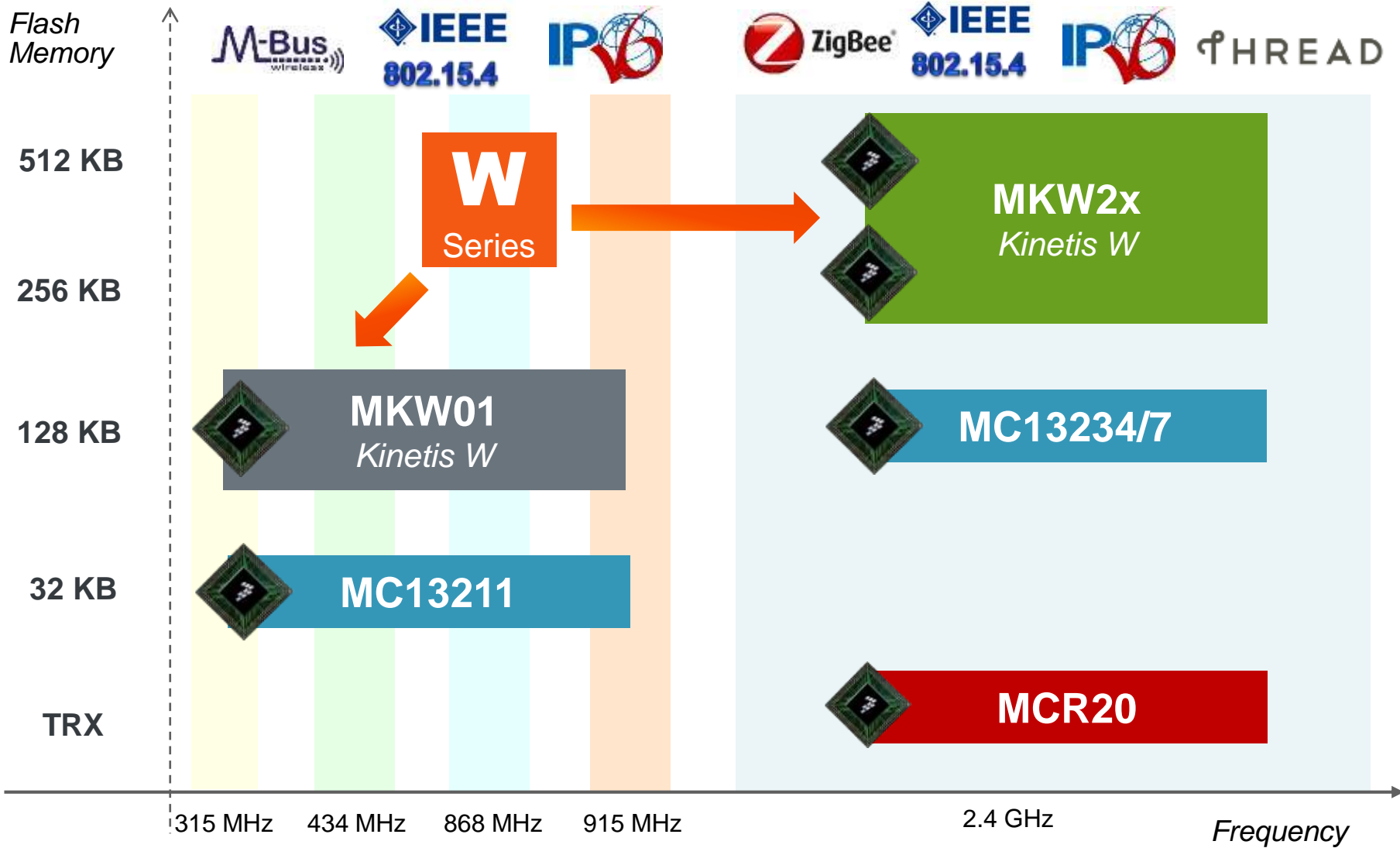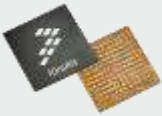
Kinetis MCUs: Compatibility
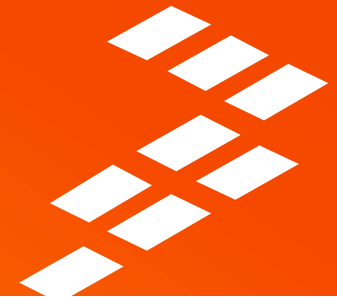
A Very Broad Portfolio of Package Options

BGA

64 MAPBGA	**121 MAPBGA**	**121 XFBGA**	144 MAPBGA	169 MAPBGA	256 MAPBGA
5x5x1.2 mm	8x8x1.5 mm	8x8x**0.5** mm	13x13x1.7 mm	9x9x1.2 mm	17x17x1.7 mm
0.5 mm pitch	0.65 mm pitch	0.65 mm pitch	1.0 mm pitch	0.65 mm pitch	1.0 mm pitch

WLCSP

49 WLCSP	64 WLCSP	80 WLCSP	142 WLCSP	120 WLCSP	169 WLCSP	143 WLCSP
2.9x3.1x0.56 mm	3.4x3.3 x 0.56 mm	4.1x3.6x0.56 mm	4.8x5.6x0.56 mm	5.3x5.3x0.56 mm	5.6x5.5x0.56 mm	6.4x5.6x0.56 mm
0.4 mm pitch	0.4 mm pitch	0.4 mm pitch	0.4 mm pitch	0.4 mm pitch	0.4 mm pitch	0.4 mm pitch

QFN

32 QFN	48 QFN
5x5x0.9 mm	7x7x0.9 mm
0.5 mm pitch	0.5 mm pitch

QFP

48 LQFP	64LQFP	80 LQFP	100 LQFP	144 LQFP
7x7x1.6 mm	10x10x1.6 mm	12x12x1.6 mm	14x14x1.7 mm	20x20x1.6 mm
0.55 mm pitch	0.5 mm pitch	0.5 mm pitch	0.5 mm pitch	0.5 mm pitch

Kinetis Development Software

IDEs

- **ARM ecosystem of IDEs**
- **Kinetis Design Studio** – Eclipse and GCC-based IDE, complimentary and unlimited for all Kinetis MCUs
- **mbed** – web-based IDE for rapid prototyping with robust community support

Development Tools

- **Processor Expert (PEx)** – configuration and code generation tool
- **SDK** - complete software framework
- **Bootloader** – in-system flash programming via serial port

Application Specific

- **PEG software** - high performance, high value tool for medium to high end MCUs with a licence fee associated
- Motor Control, Connected Audio Solutions, Wireless Charging, Sensor Fusion, and more.

RTOS

- **MQX** - free real-time operating system with USB & Ethernet stacks and file system
- **MQX Lite** - free and lightweight RTOS for small microcontrollers

Kinetis Development Hardware

Freescale Freedom Platform

- The Freescale platform for Kinetis L, K and E MCUs as well as Xtrinsic sensors
- Compatible with Arduino shields

FreescaleTower System

- The established and proven modular platform with highest flexibility and re-usability
- Over 50 peripheral modules available

Device Specific

- Evaluation boards addressing special functions and capabilities of Kinetis devices

Reference Designs

- Home Energy Gateway, 1ph Meter, 3ph Meter, pre-/post-paid Meter, Home Area Network, Home Display, …
- Available through Freescale RSM

Robust Software & Development Ecosystem

Applications

Tools, OS, Middleware

Architectures

>800 Embedded Software Engineers

Power

freescale Proprietary

freescale ColdFire

Star Core

ARM

Linaro
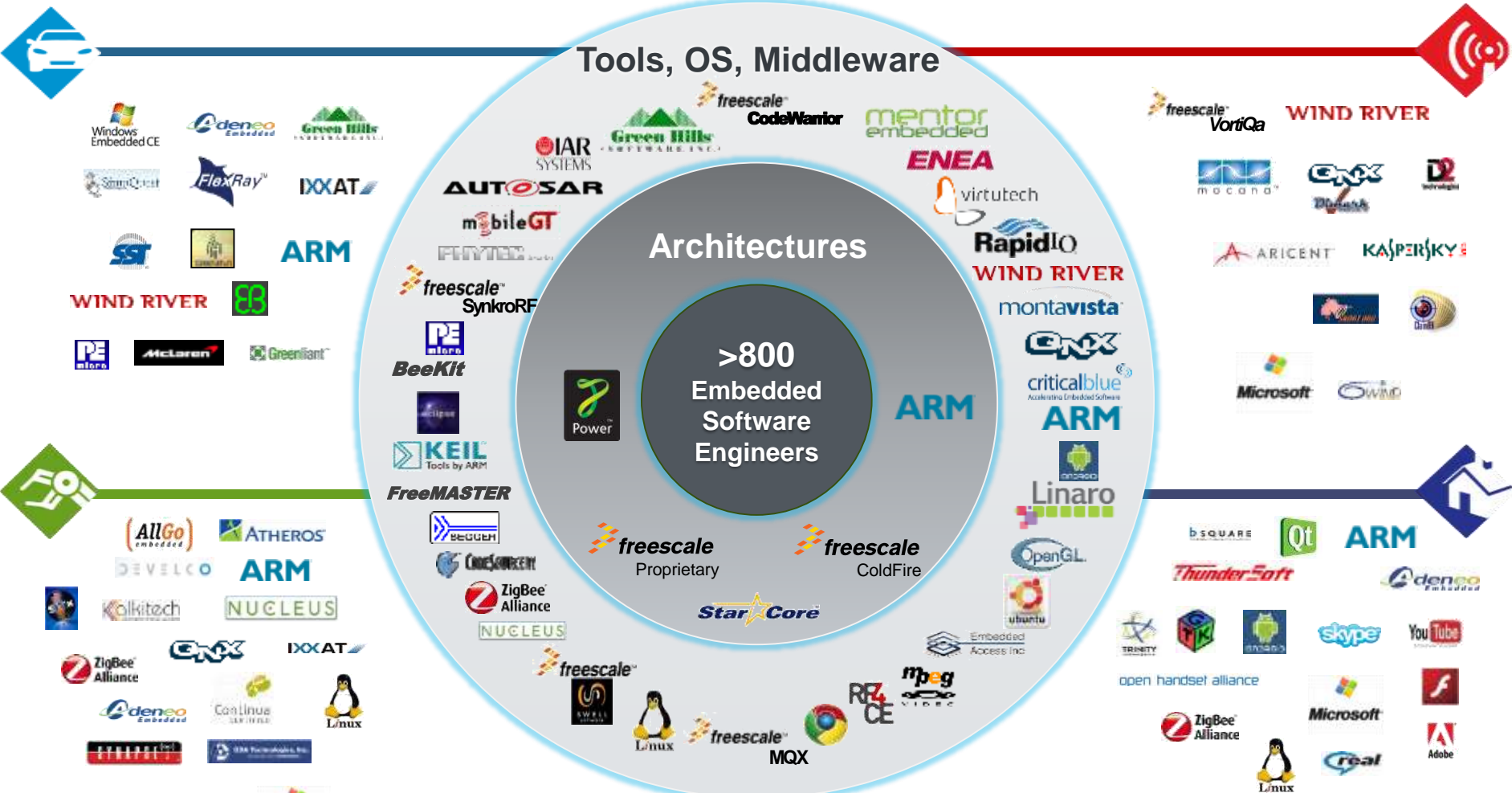
Key Software Acquisitions & Investments

1999: Metrowerks

2002: AMC, Lineo

2008: Intoto

2009: MQX Runtime Platform

2010: Processor Expert, Chipwerks, Swell

Kinetis MCU Design Studio

No-cost integrated development environment (IDE) for Kinetis MCUs

Eclipse and GCC-based IDE for C/C++ editing, compiling and debugging

Customer Application

Software and Hardware Evaluation & Dev Tools

Stacks (TCP/IP, USB)

Middleware

Application Specific

Libraries (DSP, Math, Encryption)

Operating System

BSP, Drivers & HAL

Bootloader

MCU Hardware
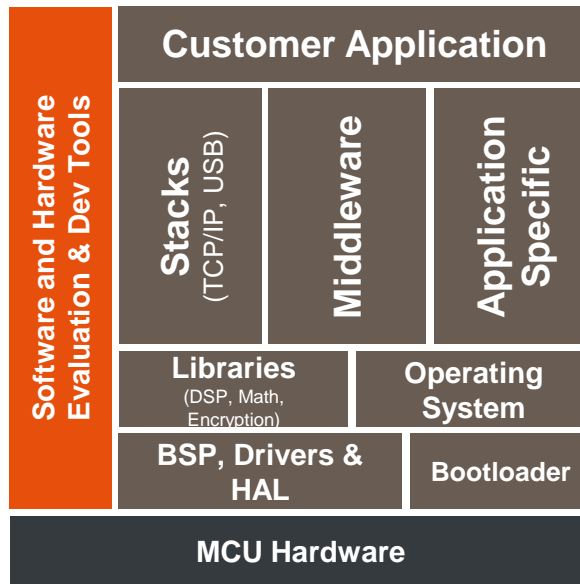
Product Features

- A free of charge and unlimited IDE for Kinetis MCUs
- A basic IDE that offers robust editing, compiling and debugging
- Based on Eclipse, GCC, GDB and other open-source technologies
- Includes Processor Expert (PEx) with Kinetis SDK integration
  - Supports all existing Kinetis devices via PEx and new project wizard
  - All new Kinetis devices will also feature the Kinetis SDK with PEx configurability
- Host operating systems:
  - Windows 7/8 (32 and 64-bit)
  - Linux (Ubuntu, Redhat, Centos)
  - Mac OS X (coming Q3 2014)
- Support for SEGGER, P&E and Open SDA/CMSIS-DAP debugger targets
- Support for Eclipse plug-ins including RTOS-awareness (i.e. MQX, FreeRTOS)

ARM® mbed™ Platform for Freescale Freedom Development Platforms

mbed servers
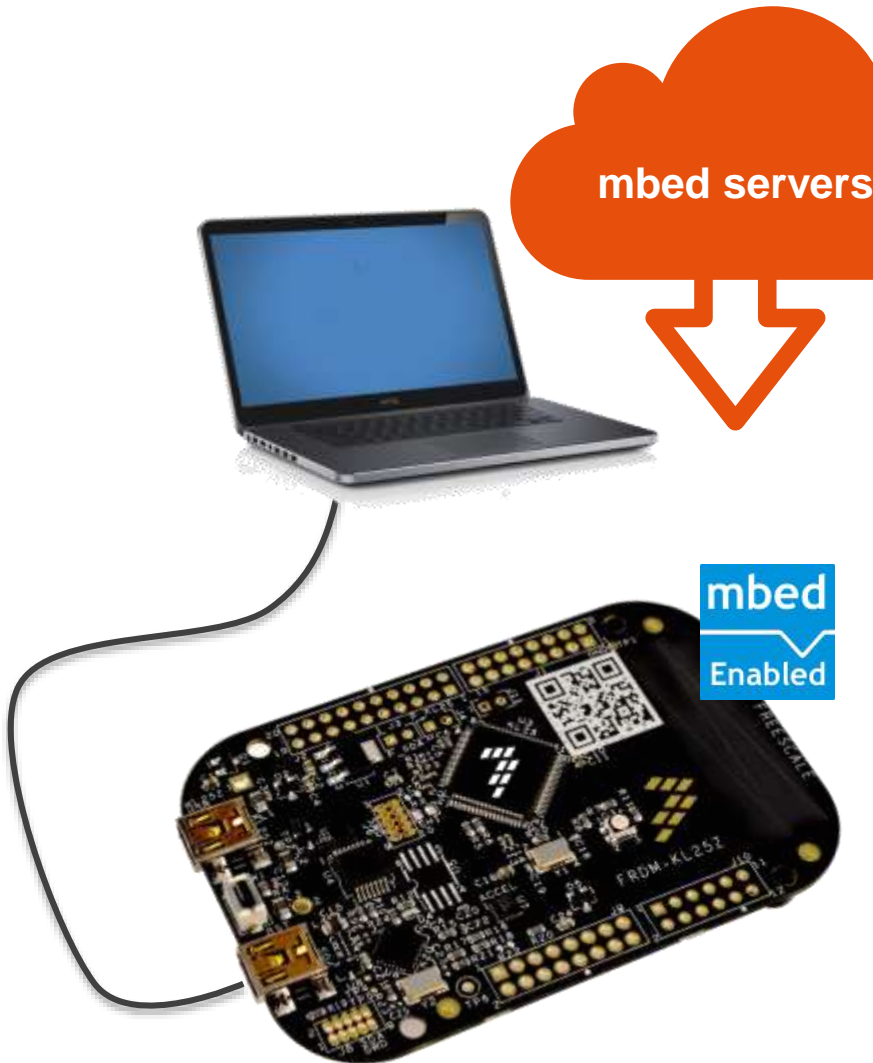
Tool for Rapid Prototyping with ARM Microcontrollers

Web-based Development:

- Online IDE
- Software Libraries
- Robust Community

mbed
Enabled

OpenSDA on Freedom Development Platforms running mbed interface:

- Serial Communications
- Flash Programming
- Run-control debug

Learn more at: www.freescale.com/mbed

Freescale Processor Expert Software
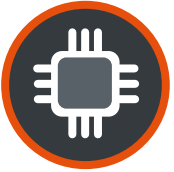
Create, configure, generate software and drivers for Freescale microcontrollers.

Master complex peripherals with a few mouse clicks, without the need to read thousands of data sheet pages.

Software and Hardware Evaluation & Dev Tools

Customer Application
Stacks (TCP/IP, USB) / **Middleware** / **Application Specific**
Libraries (DSP, Math, Encryption) / **Operating System**
BSP, Drivers & HAL / **Bootloader**
MCU Hardware
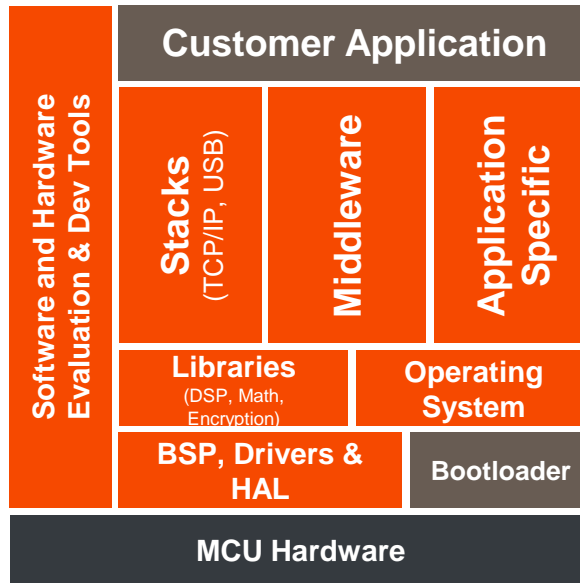
Product Features

- Standalone and integrated for
  - Eclipse based IDE's
  - Freescale CodeWarrior
  - IAR Embedded Workbench
  - Keil MDK
- Easy configuration of Kinetis SDK with Processor Expert Components
- Supports Kinetis, S08, S12, S12Z, ColdFire, DSC and Power Architecture with reusable software components
- Knowledge base of pins, registers, muxing, clocks and dependencies
- Initialization and driver code generation with design time consistency checking
- Bare Metal and RTOS drivers
- On-chip and Off-chip Device Drivers
- Middleware and Stacks: RTOS, TSS libraries and communication stacks
- Component Development Environment (CDE) to create and distribute own components

Kinetis MCU Software Development Kit (SDK)

SDK

A complete software framework for developing applications across all Kinetis MCUs

HAL, peripheral drivers, libraries, middleware, utilities, and usage examples; delivered in C source

Customer Application		
Stacks (TCP/IP, USB)	Middleware	Application Specific
Libraries (DSP, Math, Encryption)		Operating System
BSP, Drivers & HAL		Bootloader
MCU Hardware		

(left vertical label: Software and Hardware Evaluation & Dev Tools)

Open Source Initiative

CMSIS COMPLIANT
ARM® Cortex® Microcontroller
Software Interface Standard

Product Features

- Open source hardware abstraction layer (HAL) provides APIs for all Kinetis hardware resources
- BSD-licensed set of peripheral drivers with easy-to-use C-language APIs
- Comprehensive HAL and driver usage examples and sample applications for RTOS and bare-metal
- GUI configurable projects and peripheral drivers using Processor Expert
- CMSIS-CORE compatible startup plus CMSIS-DSP library and examples
- RTOS Abstraction Layer (OSA) with support for Freescale MQX, FreeRTOS, Micrium uC/OS, and bare-metal
- Integrates new Freescale unified USB stack, open source TCP/IP stack (lwIP), open source FAT file system, encryption math/DSP libraries, and more and
- Support for multiple toolchains including GNU GCC, IAR, Keil, and Kinetis Design Studio

The OSI logo trademark is the trademark of Open Source Initiative.
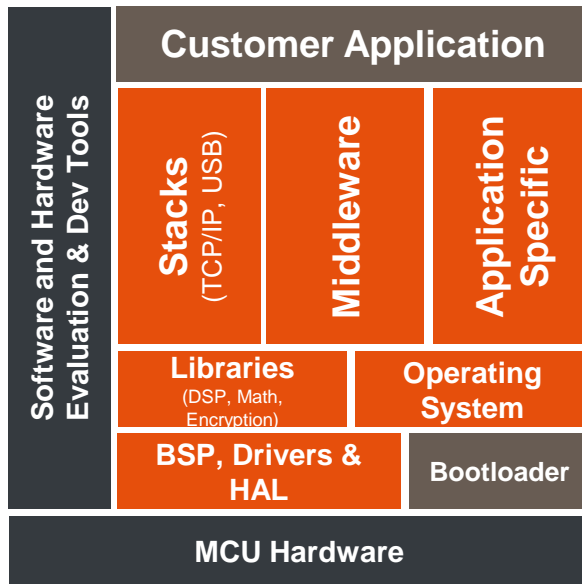
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Kinetis Bootloader

⚡ In-system flash programming over a serial connection: erase, program, verify

💬 ROM, flash or RAM based bootloader with open-source software and host-side programming utilities.

Software and Hardware Evaluation & Dev Tools

Customer Application

Stacks (TCP/IP, USB) | **Middleware** | **Application Specific**

Libraries (DSP, Math, Encryption) | **Operating System**

BSP, Drivers & HAL | **Bootloader**

MCU Hardware

Open Source Initiative ®

Product Features

- A common bootloader for all Kinetis MCUs
- C/C++ Source code provided under a permissive BSD open source license
- Serial communications with a host via UART, SPI, I2C, and USB HID
  - Active peripheral detection
  - Common packet-based protocol for all peripherals
- Packet error detection and retransmission
- Configurable options for executing bootloader at startup or application runtime
- Command-line and GUI tools provided for Windows, Linux and Mac hosts
- Designed to be flash, ROM or RAM resident
  - ROM based on many future Kinetis devices
  - Pre-programmed into flash (on devices without a dedicated ROM) and executed from RAM for built-in factory programming capabilities
  - Fully customizable for use in customer applications providing reliable field updates
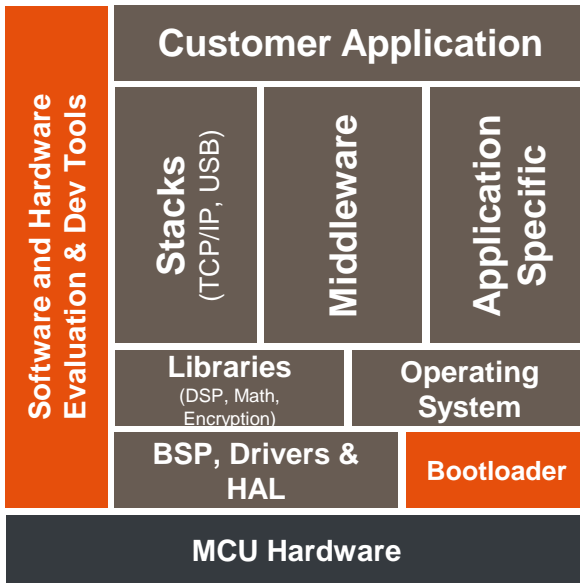
The OSI logo trademark is the trademark of Open Source Initiative.

Freescale MQX™ Software Solutions

Commercial-grade MCU software platform at no cost with optional support packages

Enabling the development of connected and intelligent applications of the future

Customer Application		
Stacks (TCP/IP, USB)	**Middleware**	**Application Specific**
Libraries (DSP, Math, Encryption)		Operating System
BSP, Drivers & HAL		Bootloader
MCU Hardware		

Software and Hardware Evaluation & Dev Tools (vertical left bar)
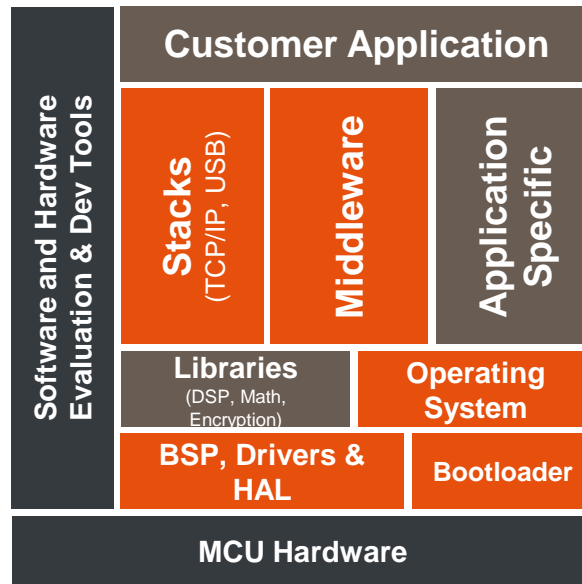
Product Features

- MQX™ Real Time Operating System Kernel
  - Deterministic multi-tasking preemptive scheduler
  - Extensive inter-task synchronization, message passing, and much more
- MQX™ Real Time Communication Suite
  Now with optional IPv6 add-on package
  - Broad networking protocol support (TCP,UDP, ICMP, HTTP, DHCP, FTP, Telnet, …)
  - Fully re-entrant, responsive, designed for embedded systems
- MQX™ File System
  - Embedded FAT file system compatible with FAT-12, FAT-16, or FAT-32 file systems
- Nand Flash File System (FFS)
- MQX™ USB Host/Device Stack
  - USB 1.0/2.0; low-/full-/high-speed
- Board Support Packages
  - Pre-configured MQX Kernel, stacks, and peripheral drivers for Freescale HW

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Freescale MQX™ Lite RTOS

Very light MQX™ kernel for Kinetis MCUs

Easy to configure – packaged as a Processor Expert component

Software and Hardware Evaluation & Dev Tools	Customer Application		
	Stacks (TCP/IP, USB)	Middleware	Application Specific
	Libraries (DSP, Math, Encryption)		Operating System
	BSP, Drivers & HAL		Bootloader
	MCU Hardware		
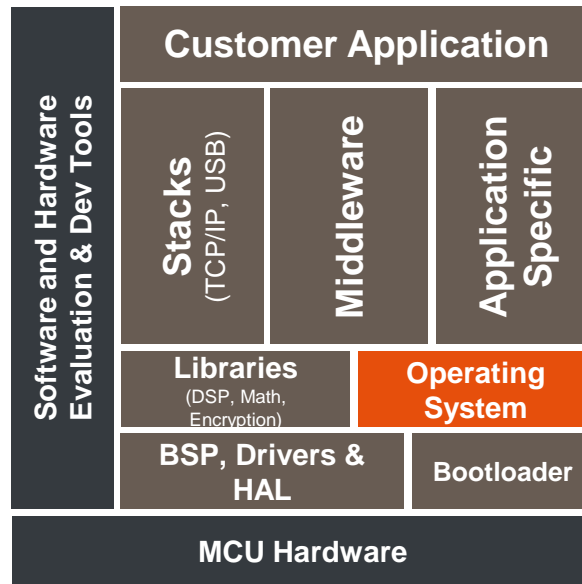
Product Features

- MQX™ Real Time Operating System Kernel
  - Lite configuration of MQX™ Kernel requiring less than 4 KB RAM
  - All lightweight components
  - Static memory allocation
- Packaged as a Processor Expert (PEx) component
- Get started in minutes – Just drop in the MQX™ Lite RTOS component to your project
- I/O capability provided by Processor Expert
- Upward code migration – MQX™ Lite RTOS is a true subset of the full MQX™ RTOS

- Available for all Kinetis K, L series devices and select E-series devices

- Get now within Processor Expert Driver Suite and CodeWarrior Development Studio for MCUs

Freescale MQX™ RTOS for Kinetis SDK

Beta Available Now
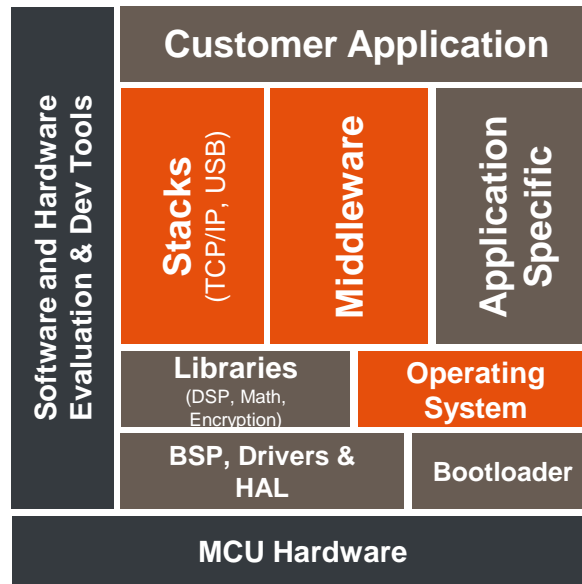
Powerful MQX™ RTOS, stacks, and middleware built on top of Kinetis SDK

Essential extensions of Kinetis SDK framework for connected and intelligent embedded products

Software and Hardware Evaluation & Dev Tools	Customer Application		
	Stacks (TCP/IP, USB)	**Middleware**	**Application Specific**
	Libraries (DSP, Math, Encryption)	**Operating System**	
	BSP, Drivers & HAL	**Bootloader**	
	MCU Hardware		

Product Features

- All the components of MQX™ Software Solutions available pre-integrated and tested with Kinetis Software Development Kit (SDK)
  - MQX™ RTOS
  - MQX™ Real Time Comm. Suite (TCP/IP)
  - MQX™ File System
  - MQX™ USB Host/Device Stack
- Leverages Kinetis SDK for hardware abstraction layer (HAL) and peripheral drivers
- Builds on common software framework for Kinetis MCUs to enhance flexibility and extendibility

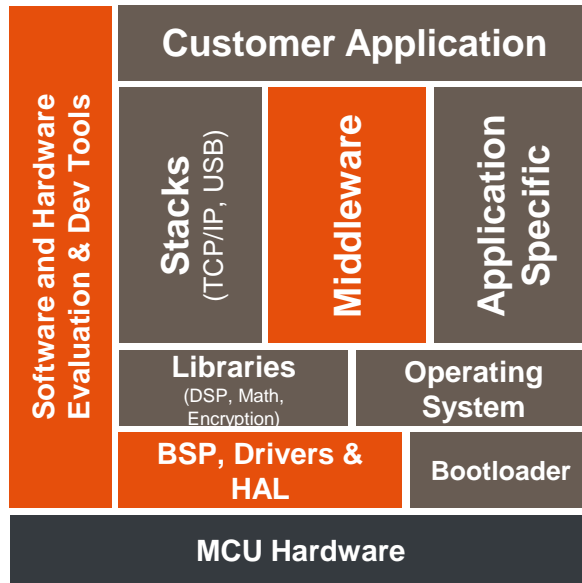|	Downloads	Description
1	**MQX RTOS Kernel** for Kinetis SDK	**MQX RTOS Kernel add-on** (Requires prior install of KSDK)
2	**MQX RTOS Pre-Integrated Package** for Kinetis SDK	**MQX RTOS Kernel, TCP/IP, MFS, USB, and KSDK** in one install (Prior install of KSDK not required)

PEG Graphics Software

Flexible graphics software targetable to Any RTOS, Any LCD

WYSIWYG Editor and Code Generator with Image Conversion and Font Creation

Customer Application

Software and Hardware Evaluation & Dev Tools

Stacks (TCP/IP, USB)

Middleware

Application Specific

Libraries (DSP, Math, Encryption)

Operating System

BSP, Drivers & HAL

Bootloader

MCU Hardware

Product Features

- Graphical user interface (GUI) solutions for embedded devices:
  – PEG Lite – Basic GUI, free on Freescale
  – PEG Plus – Professional GUI, flexible framework
  – PEG Pro – Higher performance GUI development
- Meets widely varying power, performance and memory requirements.
- Flexible PEG hardware drivers are capable of targeting any RTOS or OS and interfacing with any display type supported by the processor.
- PEG WindowBuilder development tool automatically generates C++ source code that is ready to be compiled and linked into any application.
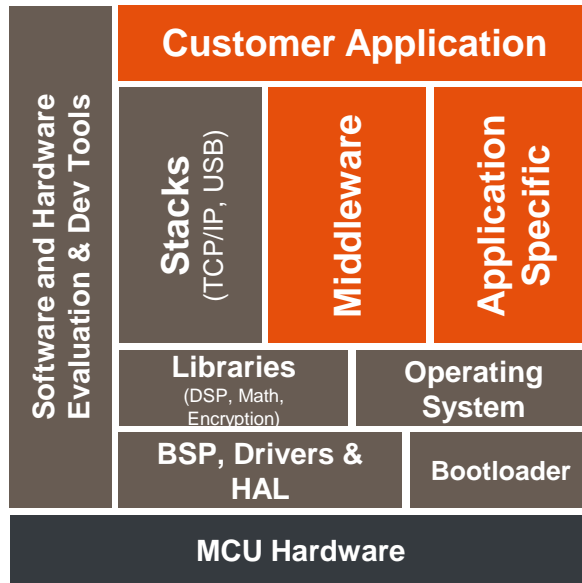
Freescale Connected Audio Software

Integrated framework with consistent API to enable rapid development of audio software

Implements industry standard audio decoders, encoders, audio post processing libraries, and connectivity

Software and Hardware Evaluation & Dev Tools	Customer Application		
	Stacks (TCP/IP, USB)	Middleware	Application Specific
	Libraries (DSP, Math, Encryption)	Operating System	
	BSP, Drivers & HAL	Bootloader	
MCU Hardware			

Product Features

- A highly configurable and integrated audio solution

- An integrated solution based on industry standard audio decoders, encoders, audio post processing libraries, and popular consumer electronics connectivity

- Architected to meet the needs of low-end to high-end solutions with consistent implementation across all ARM based microcontroller product lines
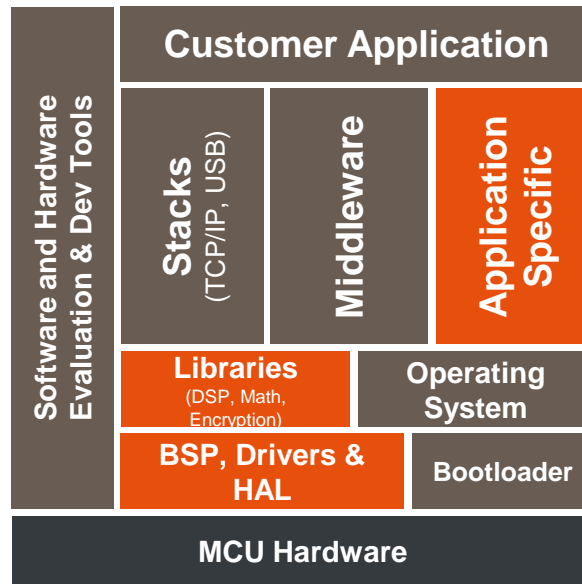
Freescale Touch Sensing Software

Integrated touch solution, allowing reduced system complexity

Innovative features such as noise filtering, advanced detection algorithms, and water tolerance

Customer Application

Software and Hardware Evaluation & Dev Tools

Stacks (TCP/IP, USB)

Middleware

Application Specific

Libraries (DSP, Math, Encryption)

Operating System

BSP, Drivers & HAL

Bootloader

MCU Hardware

Product Features

- Support for Kinetis MCUs with Touch Sensing Interface (TSI) capabilities
- Easy integration with:
  - MQX RTOS
  - Kinetis SDK
  - Processor Expert
- Advanced Filtering and Integrating Detection (AFID)
- TSI Noise mode
- Water tolerant
- Proximity and shielding electrode(s)
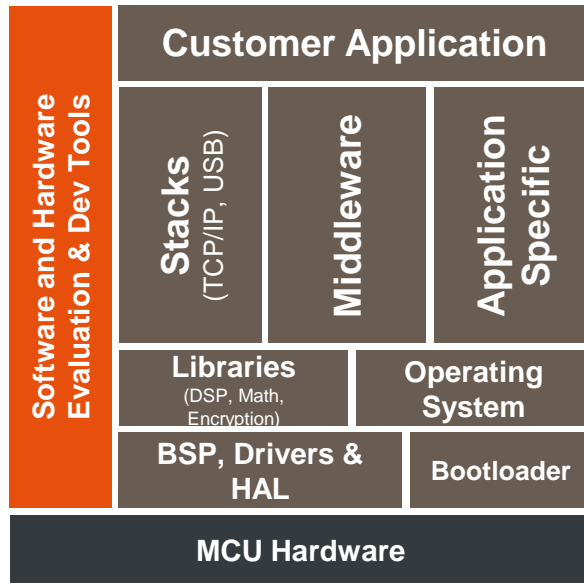- Analog decoder algorithms

Tower System Modular Development Platform

Modular development platform for 8-, 16- and 32-bit processors

Enables advanced development through rapid evaluation and prototyping

Software and Hardware Evaluation & Dev Tools

Customer Application		
Stacks (TCP/IP, USB)	Middleware	Application Specific
Libraries (DSP, Math, Encryption)		Operating System
BSP, Drivers & HAL		Bootloader
MCU Hardware		

Product Features

- Modular and Expandable
  - Controller modules provide easy-to-use, reconfigurable hardware, can be used stand-alone
  - Interchangeable peripheral modules add functionality and make customization easy
  - Open-source hardware and standardized specifications promote customization
  - >80 modules to choose from
- Speeds Development Time
  - Open source hardware and software allow quick development with proven designs
  - Integrated debugging interface allows for easy programming and run control via standard USB cable
- Cost Effective
  - Sold individually and in complete kits, typically starting at $69 USD.
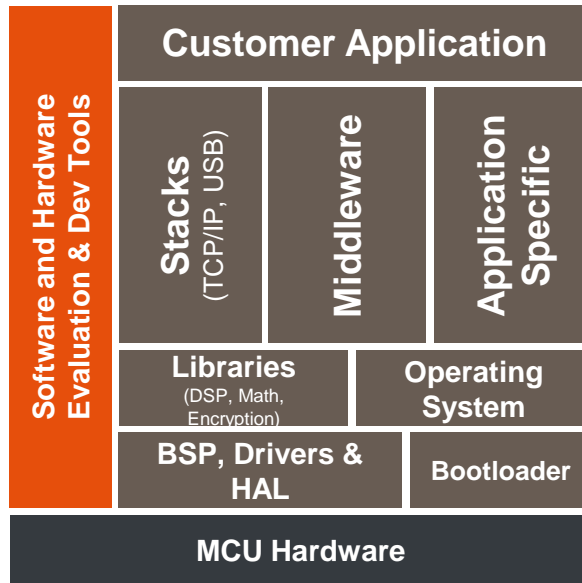 - Tool re-use through interchangeable modules eliminates need to purchase redundant hardware

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Freedom Development Platforms

Low-cost/low-power development hardware

Enables quick application prototyping and demonstration of Kinetis MCU families

Software and Hardware Evaluation & Dev Tools	Customer Application		
	Stacks (TCP/IP, USB)	Middleware	Application Specific
	Libraries (DSP, Math, Encryption)		Operating System
	BSP, Drivers & HAL		Bootloader
	MCU Hardware		

Product Features

- Low–cost (starting at $12.95 USD)
- Designed in an industry-standard compact form factor (Arduino R3)
- Easy access to the MCU I/O pins
- Integrated open-standard serial and debug interface (OpenSDA)
- Compatible with a rich-set of third-party expansion boards

FRDM-KL46Z:

freescale™
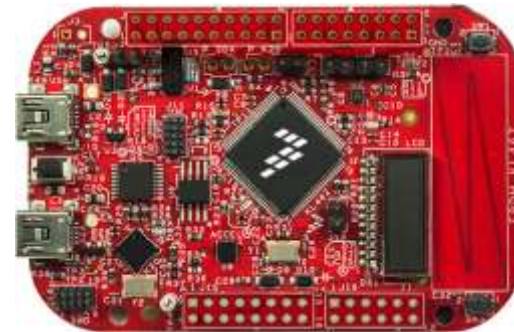
Kinetis MCUs

✅ **Availability**

  – World's broadest ARM-based MCU portfolio from 32KB ARM Cortex-M0+ to high performance 2MB Cortex-M4 based devices and a roadmap with the Cortex-M7 core

✅ **Scalability**

  – New product innovation driving secure embedded processing solutions for the Internet of Tomorrow

✅ **Compatibility**

  – Industry-leading compatibility across the portfolio with an extensive series of hardware and software enablement

freescale ™

Freescale Product Longevity Program

- The embedded market needs **long-term product support**

- Freescale has a longstanding track record of **providing long-term production support** for our products

- Freescale is pleased to introduce a formal **product longevity program** for the market segments we serve

    - For the automotive and medical segments, Freescale will make a broad range of program devices available for a minimum of **15 years**

    - For all other market segments in which Freescale participates, Freescale will make a broad range of devices available for a minimum of **10 years**

    - Life cycles begin at the time of launch

- For terms and conditions and to see a list of participating **Freescale products** available under this program: www.freescale.com/productlongevity

freescale™

www.Freescale.com