FTF FREESCALE TECHNOLOGY FORUM 2014

Next Generation **Kinetis K Series** – K2, and **L** Series MCUs

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Agenda

- Kinetis Microcontroller Solutions Introduction
- General Purpose Kinetis K Product Lines
  - Kinetis K-Series
  - Kinetis K2
- General Purpose Kinetis L Product Lines
- Additional Resources
  - Enablement
  - Kinetis Minis support (CSP)

K2 the **Next Generation** of **Kinetis K Solutions**

Leadership in Cortex-M

World's Broadest, Most Scalable Portfolio…

…with Best-in-Class Tools and Software support!

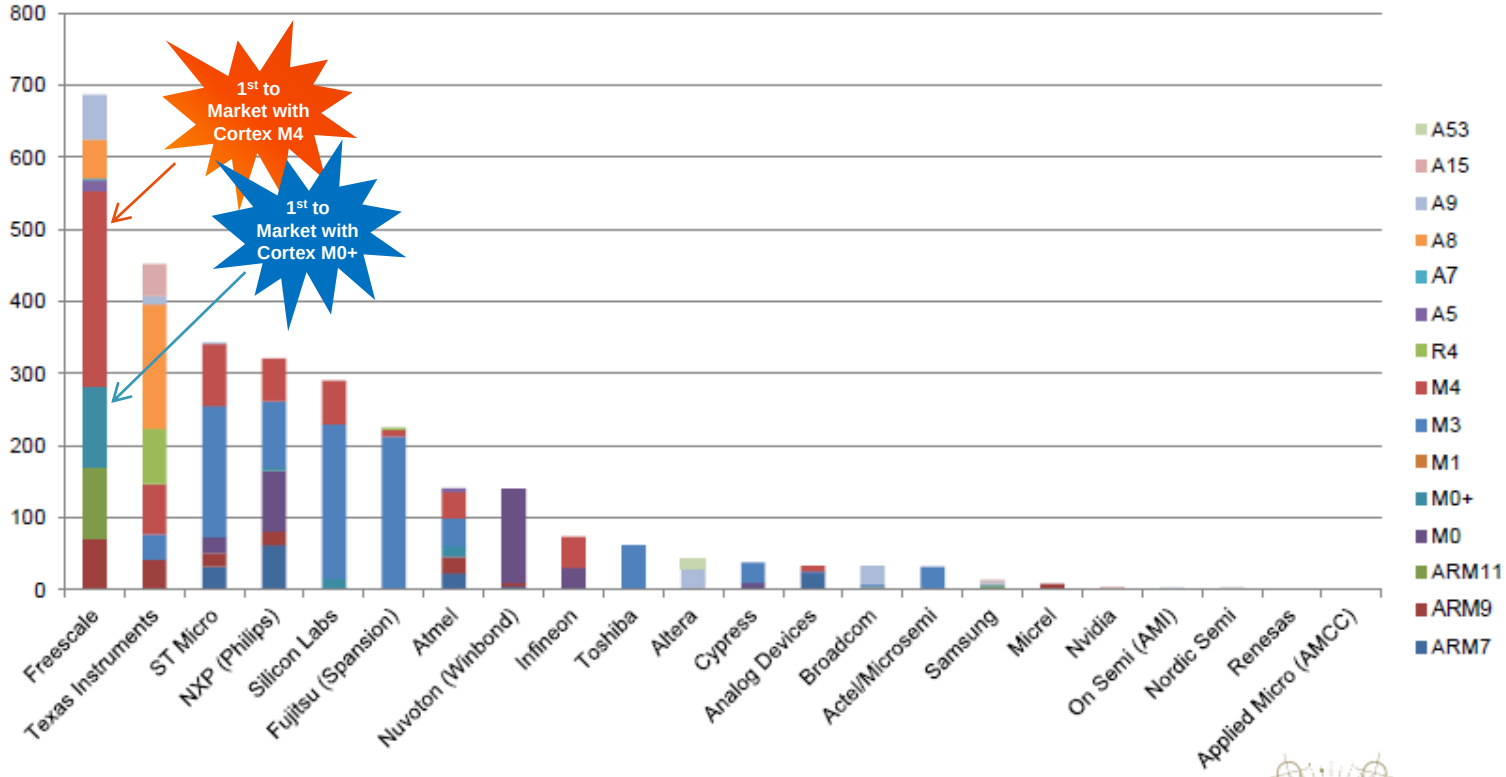
Kinetis Microcontroller Solutions Introduction

ARM SOC Portfolio's

How to Choose an ARM® Core & Supplier

ARM

Who is the Most Comprehensive ARM® Supplier?**



Five Years Out

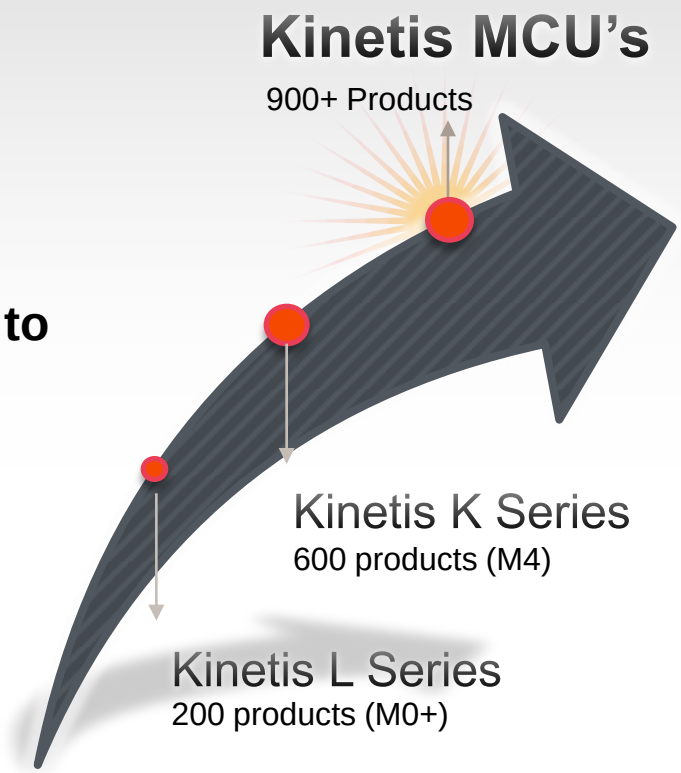
**Number of *active* product SKUs listed on website as of November 2013

Unbound Scalability from lowest-power to higher performances

1. **Higher Performances up to 180MHz with FPU –** 50% faster than previous generation with double of RAM memory

2. **Product breadth ARM® Cortex®-M0+ to M4** with 900+ code compatible product offerings, 60+ pin for pin compatible devices that span multiple families

3. **Lowest power to highest functionality** Energy efficient battery powered products to analog intensive sensing products.



General Purpose Kinetis K Product Lines

Kinetis General Purpose Product Lines

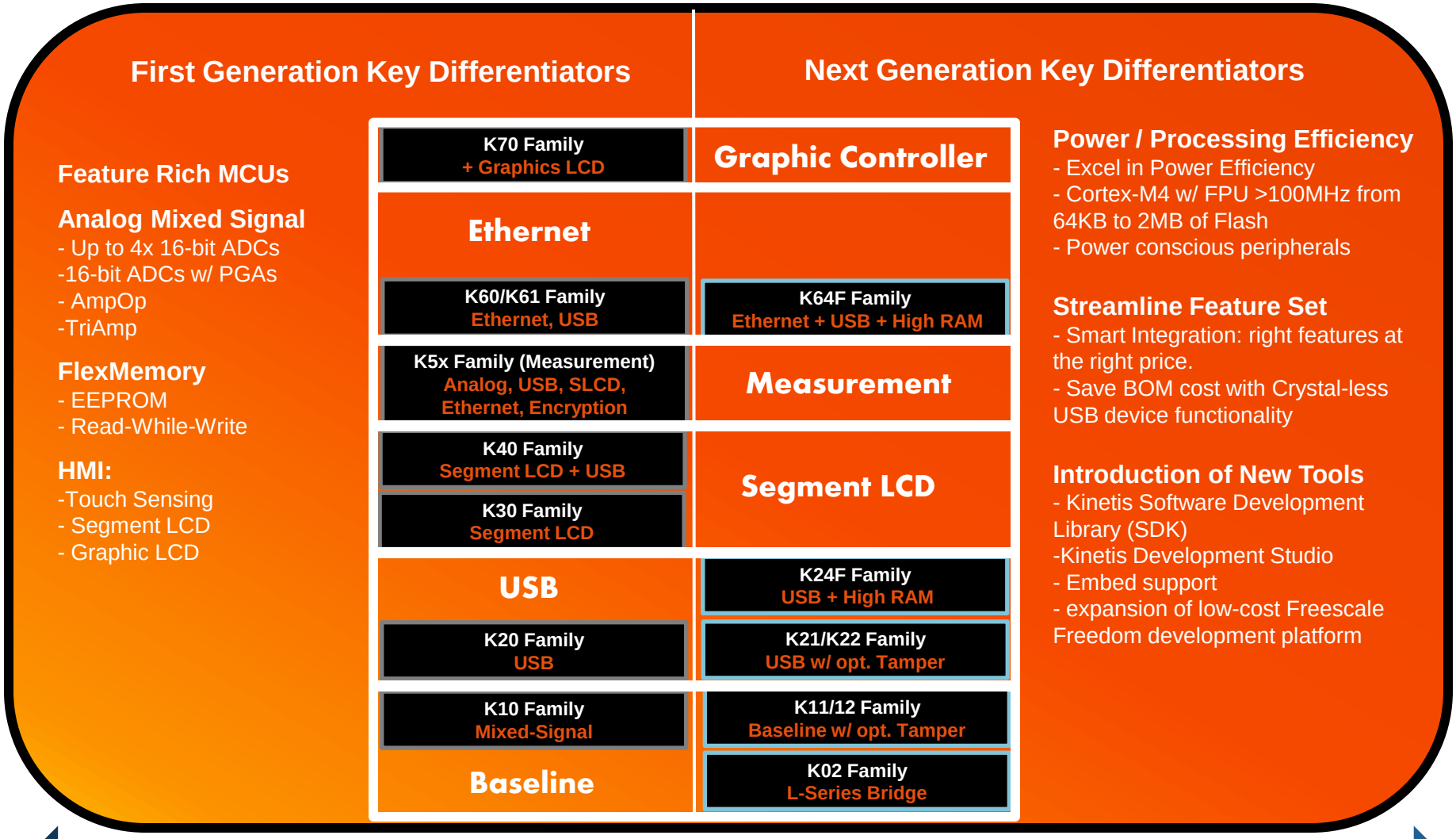
	Kinetis L Series	Kinetis E Series	Kinetis K Series
Processor	**ARM® Cortex™-M0+**	**ARM® Cortex™-M0+**	**ARM® Cortex™-M4 (with optional SPFPU)**
Performance	**Up to 48MHz**	**Up to 48MHz**	**Up to 50 / 72 / 100 / 120 / 150 / 180MHz**
Ultra Low Power	**Typical ~50uA/MHz (VLPR Mode)**	**na**	**Typical ~130uA/MHz (VLPR Mode)**
Memory	**8kB – 256kB Flash 1kB – 32kB SRAM**	**8kB – 128kB Flash 1kB – 16kB SRAM**	**32kB – 2MB Flash 8kB – 256kB SRAM**
Pin-Count	**16 – 121 Pin**	**16 – 80 Pin**	**32 – 256 Pin**
Features	**Baseline / Mixed-Signal** *and optional* **Segment LCD, USB**	**5V / EMC / Safety (CRC) Control (Flextimer)** *and optional* **Segment LCD, CAN**	**Baseline / Mixed-Signal** *and optional* **FlexMemory, USB, Segment LCD, CAN, Ethernet, Graphic LCD, DRAM-CTRL, NAND-Flash-CTRL, Crypto, Anti-Tamper**
Price	***From $0.49 (MKL02x, 8KB, 16QFN)***	***From $0.78 (MKE02x, 16KB, 32LQFP)***	***From $0.79 (MK02, 64KB, 32QFN)***
Demo Board	 **www.freescale.com/FREEDOM www.freescale.com/TOWER**		
	www.freescale.com/KINETIS		

MQX-Lite +USB and Peripherals Drivers (also within Processor Expert – Code Generator)

Freescale free RTOS called MQX *www.freescale.com/MQX* including USB / Ethernet / MS File System / Peripherals Driver

Note: Availability device dependent

Kinetis K Series MCU Portfolio



Comprehensive Enablement - Hardware and Software Scalability

Introducing …

K2 The next generation of Kinetis

freescale Kinetis

freescale.com/Kinetis

K2 – The Next Generation of Kinetis Solutions

The next generation of Kinetis solutions builds on its strong history of scalability and innovation paired with an even more expansive set of enablement solutions

- Speed application development with a **comprehensive set of new tools** built upon the already strong Kinetis Enablement
- A New standard of Cortex M3/M4 power efficiency with an **unbeatable low dynamic power consumption** from 100 to 180MHz while delivering **7x lower static power** compared with the closest competitor
- **New Lower price points** with better enablement, power/performance efficiency and smart integration. Kinetis **K2 starting at $0.79** (10ku RSL) with **Cortex-M4, 100MHz, FPU and 64KB of Flash Memory**

K2 - A New High of Cortex M3/M4 power efficiency with New Lows in Prices

- **Second Generation** of **Kinetis K** devices
  - A New standard of Cortex M3/M4 power efficiency
    - 125uA/MHz in VLPR mode (4MHz)
    - 160uA/MHz in Run Compute (100MHz)
    - 170uA/MHz in Run
    - 2.6uA low power mode with full state retention, wake-up time of 6uS
    - 150nA in the Lowest mode
  - Full Series of Cost-Effective Devices
  - Total of 65 Part Number already in production, 21 more to be launch further in 2014

K2 – Break thought investment in Software Development

- **A comprehensive set of new tools** built upon the already strong Kinetis Enablement
  - Kinetis Software Development Kit (SDK)
  - Kinetis Design Studio (KDS)
  - Kinetis Bootloader
  - Addition of mbed support to the Kinetis K-Series
  - Expansion of ultra-low-cost Freedom Boards for K-Series

- New tools being launched with K2, initially based on the second generation of K-Series devices as a starting point. Will cover the full Kinetis Series with updated releases

Broad Scalability at New Price Points

- Next-generation Kinetis K series devices add to the existing large Kinetis MCU portfolio, adding new combinations of memory sizes, packaging and integration, allowing customers and even broader selection of products at even lower price points.

Preserve engineering investment
- Broad and fast-growing portfolio of more than 900 Kinetis MCU solutions with software and hardware compatibility

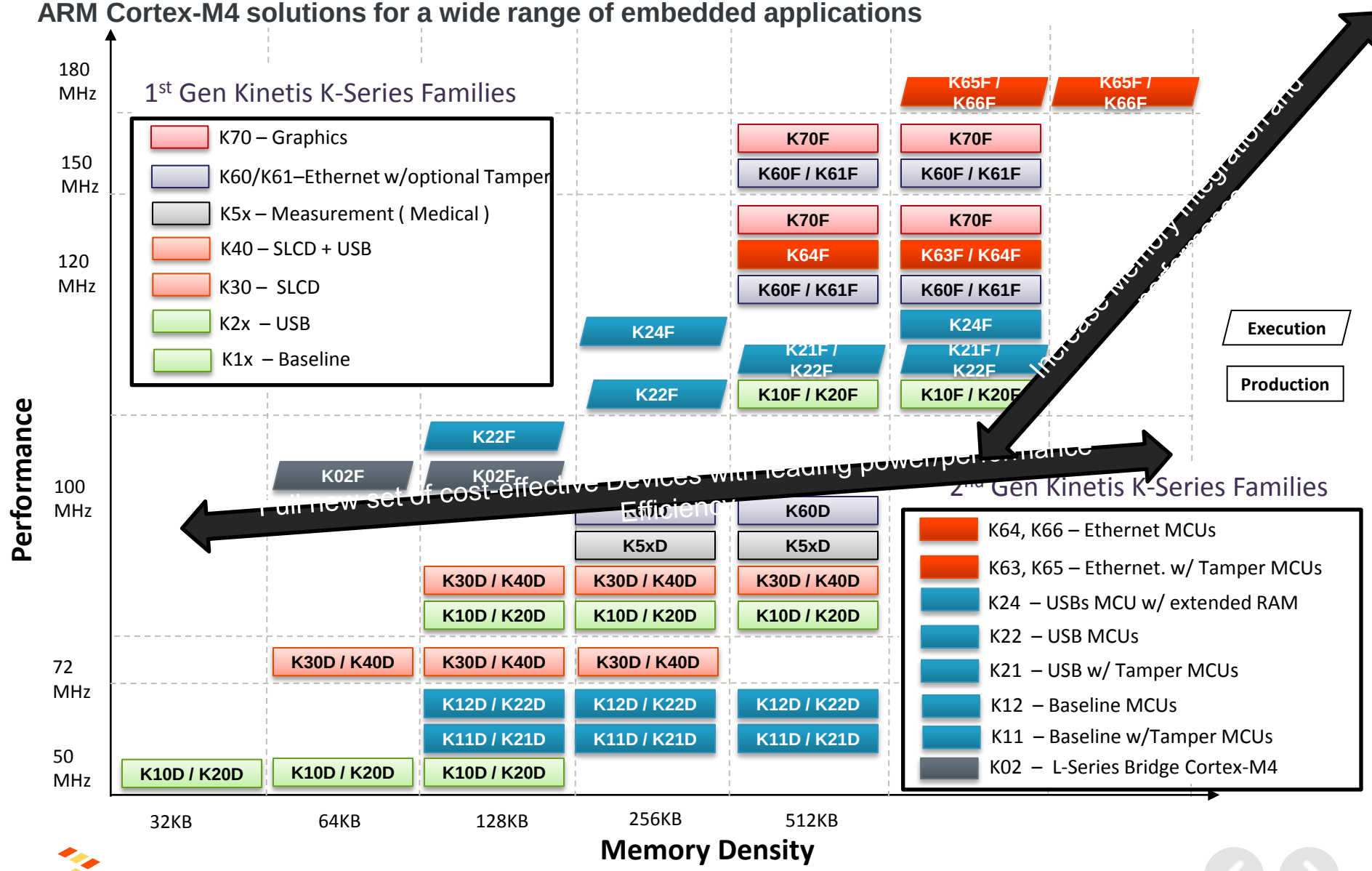
Lowest-priced ARM® Cortex®-M4-based device
- Next-generation devices start at 100 MHz with floating point unit, 64 KB Flash at just $.79 (USD)

Streamlined Feature Set
- Optimized on-chip integration with BOM-saving features such as crystal-less USB device functionality

K Series Roadmap

Kinetis K Series Portfolio

ARM Cortex-M4 solutions for a wide range of embedded applications



K24F – K64F – K63F - Market Trends and Applications

- **Market Trends**

Smarter Consumer and Industrial Devices with:
- Increased functionality
- Highly connected
- More advanced HMIs (for things like smart thermostats)
- Small form factor

- **Applications**

Consumer
- Gaming systems
- Wearables
- Smart Phone / Tablets Accessories

Metering
- Connected Meters
- Smart-Grid Concentrators

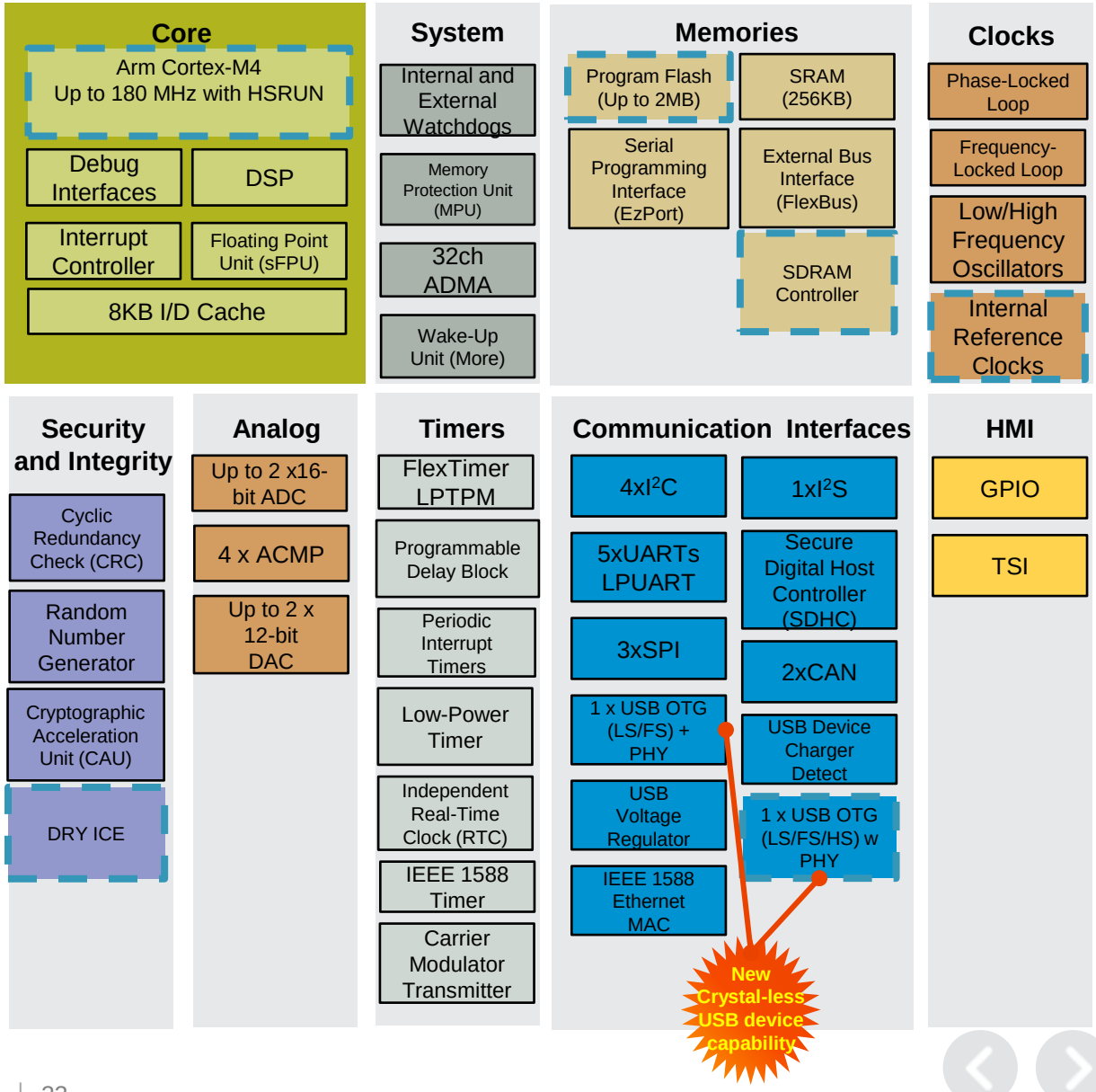
Building &Home Automation
- Connected Security & access control
- Smart Thermostats

Point of Sale &Secure Applications
Factory Automation
Portable Instrumentation

K66/K65 180MHz Devices (2MB Flash, 256KB SRAM)

Key Features:

- **Core/System**
  - Cortex-M4 @ 180 MHz with 8KB I-Cache and FPU
- **Memory**
  - up to 2MB Flash,
  - up to 256KB SRAM
- **Communications**
  - USB OTG FS/LS w/ PHY and USB Vreg.
  - USB OTG LS/FS/HS w/PHY
  - **Crystal-less USB device capability**
  - Ethernet
  - Multiple serial ports including dual CAN
- **Analog**
  - 4 x ACMP,
  - 2x 16-bit ADC, Up to 2 x 12-bit DAC
  - Analog Vref
- **Others**
  - 1.71V-3.6V; -40 to 105oC
  - **up to 105 x I/Os (3V)**
  - Tamper and Crypto acceleration
  - **144LQFP, 144BGA, 169MBGA 169WCSP**
- **Availability**
  - Samples: 1Q2014
  - Qual/Production: early 3Q2014



New K22F/K02F – 64KB to 512KB -100/120MHz:

What is Available Now?! http://compass.freescale.net/go/K22F_Alpha

✓MCU samples in inventory:

Samples Partnumber	Max. Freq.	Pin Count	Package	Flash	SRAM
PK22FN512VDC12	120MHz	121	XFBGA	512K	128KB
PK22FN512VLL12	120MHz	100	LQFP	512K	128KB
PK22FN512VLH12	120MHz	64	LQFP	512K	128KB
PK22FN256VDC12	120MHz	121	XFBGA	256K	48KB
PK22FN256VMP12	120MHz	64	BGA	256K	48KB

✓MCU offer update in the KPUR
- including 10ku/y pricing
- volume quotes contact Tactical Marketing or Business Development Team.

✓Tower Boards: X-TWR-K22F120M
- with User Manual
- Design files (schematic, BOM,…)

✓IDE Support:
- IAR 7.10.1
- Keil

✓Sample Code
- With Quick Start Guide

✓MQX support - release 4.1

✓NDA Documentation
- Customer Presentation
- Product Brief
- Preliminary Datasheet's
- Preliminary Reference Manual
- Preliminary Errata

✓Questions: Paulo.K@freescale.com

Conclusion

- **K2 – The Next Generation of Kinetis Solutions**
  - Extend Kinetis Enablement with further easy-of-use
  - Introduce next level of performance, feature, and cost-effective K-Series devices
- **Kinetis K2 becomes the new Low-Power Reference for ARM Cortex-M3/4 “beyond 100DMIPS with FPU” for both dynamic and static modes**
- **‘K2’ priced aggressively for Market Share gain having a 10-20% discount over K-Series 1st generation**
- **Samples and TWR boards available now, announcement at FTF and production ramp-up through summer of 2014.**

General Purpose Kinetis L Product Lines

Kinetis L Series

- 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 Super Ease of Use

Built on the ARM Cortex-M0+ core, the Kinetis L series simplifies development with an upward migration path to Kinetis K and X series. With a comprehensive enablement bundle including low cost Tower System and Freedom Tools, Kinetis Design Studio IDE, Kinetis Software Development Kit, MQX RTOS and the ARM support ecosystem, development is super simple. 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.

Implications for Entry-Level MCUs

	8/16-bit MCUs	32-bit MCUs
Connectivity		  
User Interface		 
Power Consumption	 Ultra-low sleep/ power-down currents	 Maximum Energy efficiency (CoreMark®/mW)
Computation	+ × - ÷	$\sqrt{\ }$ $\int_x^n$ sin log $_n$
Software/Cost of Ownership	Unique platforms, MCU dependent/$$$	Scalable, reusable platforms with modern software techniques/$
Scalability	Limited choice, single source	Broad MCU portfolios, multi-source

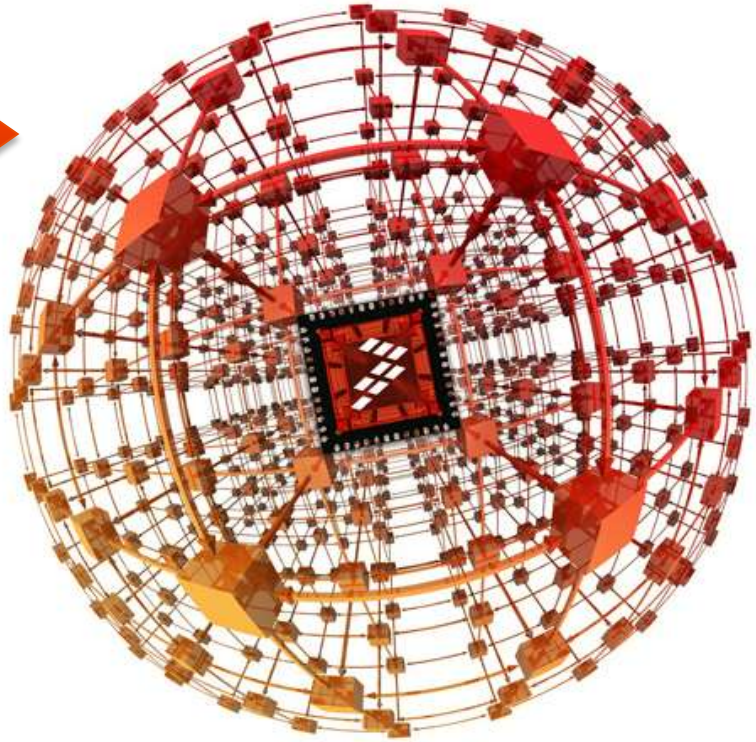
Kinetis L Series MCUs: Enabling Differentiation in Entry-Level Products

32-bit

Energy efficiency
Class-leading CoreMark/mW

Scalability and integration
Kinetis L to K Series MCUs (ARM Cortex-M0+ to Coretex-M4)

Enablement
Freescale bundle + ARM ecosystem



Kinetis L Series MCUs
The evolution of the entry-level MCU

8-bit

Ultra-low static
<1uA

Low cost
From <$0.50

Ease of use
Freedom Platform, Processor Expert and MCU Solution Advisor

Going Green

Health & Safety

Net Effect

freescale™

Kinetis L Series MCUs: Target Applications

Banking

OTP

Cash Registers

Building Control

Smoke Detector

Thermostat

Instrumentation & Medical

Mass Market

Electronic Label

ETC

Fiber Module

RFID

Energy Efficiency

Mass Market

Joy Sticks

Remote Controller

Aero Model

Scale

Shaver

Mouse

GPS Watch

Kinetis L Series MCUs Feature Overview

Common Features
System
Cortex-M0+ Core, 48/72 MHz
Multi-Low-Power Modes and Peripherals, Low-Power Boot, Clock Gating
1.71-3.6 V, –40 °C to 105 °C [1]
Memory
90 nm TFS Flash, SRAM
Internal Memory Security/Protection
Analog Peripherals
12/16-bit ADC, 12-bit DAC
High-Speed Comparator
Serial Interfaces
UART (Including 1 LPUART)
SPI, I²C
Timers
Real-Time Clock [2]
16-bit Low-Power TPMs (GP Timer/PWM)
Low-Power Timers
32-bit Periodic Interrupt Timer

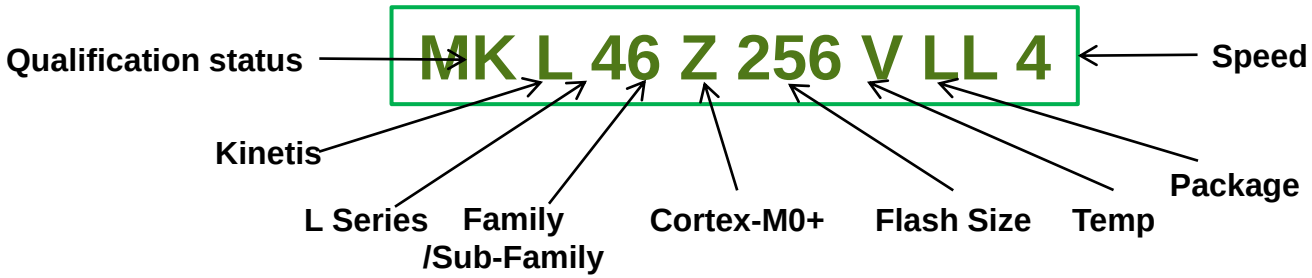
Optional Features													
Family	Flash	SRAM	Pin Count	Key Features									
				USB	SLCD	DMA	RTC	ADC	DAC	I2S	TSI	ROM	Vref	Security
KL46	128-256 KB	16-32 KB	64-121	OTG	Y	Y	Y	16-bit	12-bit	Y	Y			
KL43	128-256 KB	16-32 KB	48-64	Slave	Y	Y	Y	16-bit	12-bit	Y		Y	Y	
KL36	64-256 KB	8-32 KB	64-121		Y	Y	Y	16-bit	12-bit	Y	Y			
KL34	64 KB	8 KB	64-100		Y	Y	Y	12-bit						
KL33	32-256 KB	4-32 KB	64		Y	Y	Y	16-bit	12-bit	Y		Y	Y	
KL28	256-512 KB	128 KB	64-121	OTG		Y	Y	16-bit	12-bit	Y	Y	Y	Y	Y
KL27	32-256 KB	8-32 KB	32-64	Slave		Y	Y	16-bit	12-bit	Y		Y	Y	
KL26	32-256 KB	4-32 KB	32-121	OTG		Y	Y	16-bit	12-bit	Y	Y			
KL25	32-128 KB	4-16 KB	32-80	OTG		Y	Y	16-bit	12-bit		Y			
KL24	32-64 KB	4-8 KB	32-80	OTG		Y	Y	16-bit	12-bit					
KL17	32-256 KB	8-32 KB	32-64			Y	Y	16-bit	12-bit	Y		Y	Y	
KL16	32-256 KB	4-32 KB	32-64			Y	Y	16-bit	12-bit	Y	Y			
KL15	32-128 KB	4-16 KB	32-80			Y	Y	16-bit	12-bit		Y			
KL14	32-64KB	4-8 KB	32-80			Y	Y	16-bit	12-bit					
KL05	8-32 KB	1-4 KB	24-48			Y	Y	12-bit	12-bit		Y			
KL04	8-32 KB	1-4 KB	24-48			Y	Y	12-bit						
KL03	8-32 KB	2 KB	16-24				Y	12-bit				Y	Y	
KL02	8-32 KB	1-4 KB	16-32					12-bit						

[1] Feature not available on CSP packages
[2] For KL02, use software to support

Kinetis L Series MCUs Availability

Pricing from <$.49 SRP @ 10,000 units

Product Family	Flash Memory	10K # Suggested Resale Price	General Market Availability	Volume Production
KL46/36/34	64-256 KB	$1.71 - $2.73	Now	Now
KL43/33	64-256KB	$1.77 - $2.69	Q3 ’14	Q3’14
KL28	256-512KB	$2.85 - $3.47	Q2’15	Q2’15
KL27/17	128-256KB	$0.96 - $2.27	Q3 ’14	Q3’14
KL26/16	32-256 KB	$0.96 - $2.29	Now	Now
KL25/24	32-128 KB	$1.30 - $2.01	Now	Now
KL15/14	32-128 KB	$0.97 - $1.79	Now	Now
KL05/04	8-32 KB	$0.62 - $1.03	Now	Now
KL03	8-32KB	$0.49 - $0.93	Q2’14	Q2’14
KL02	8-32 KB	$0.49 - $0.86	Now	Now



Kinetis KL03

Packages

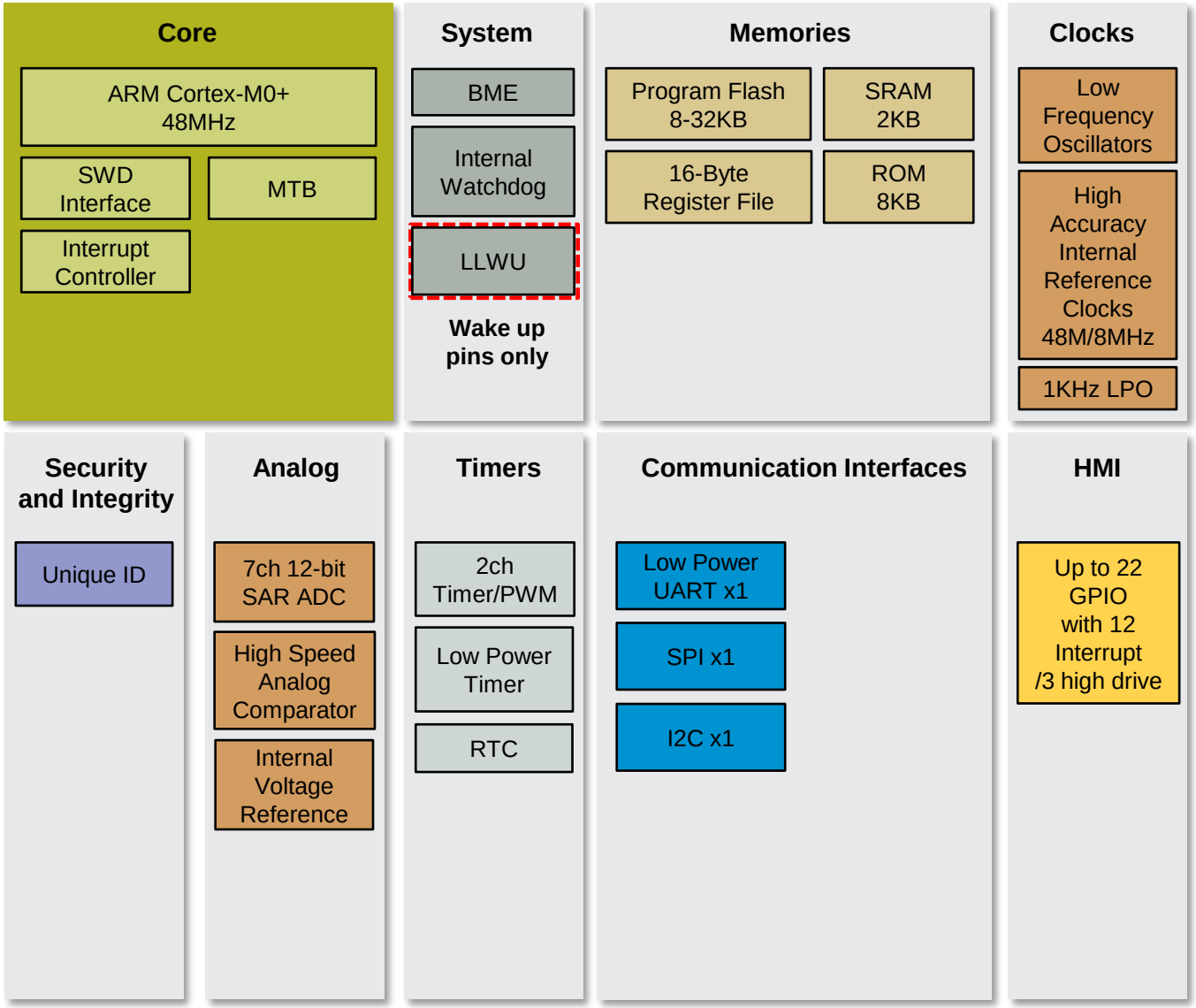
- 24QFN 4x4x0.65/0.5mm
- 16QFN 3x3x0.65/0.5mm
- 20WLCSP 1.6x2.0x0.56/0.4mm

Features Highlight

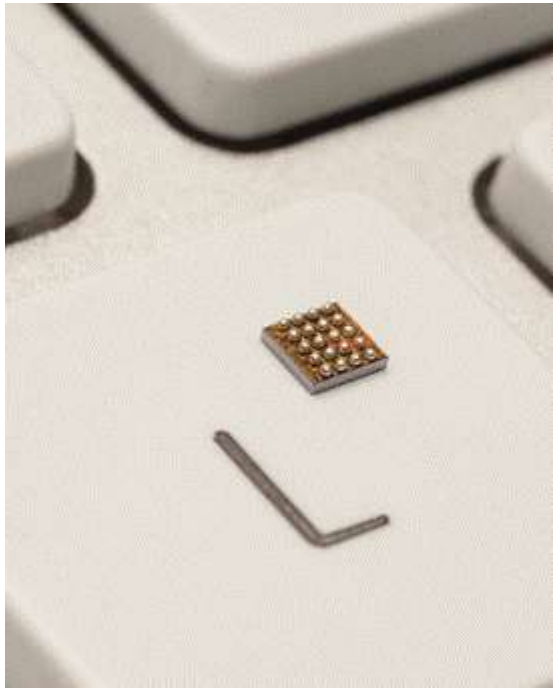
- ROM boot loader for easy flash upgrade
- High Speed I2C up to 1Mbps
- Embedded 1.2V voltage reference for ADC
- 35uA/MHz VLPR and 1uA sleep
- (50uA/MHz, 2uA)

Availability

- Sample: Mar'14
- Production: Jul'14



KL03 New Family Summary



- Packages
  - 24QFN, 16QFN, 20WLCSP
- New Features
  - ROM with Boot Loader
  - 1.2V Internal Voltage Reference
  - High Speed I2C
- Availability
  - PK samples of all packages available NOW!
  - X-FRDM-KL03Z available NOW!
  - Market launch and production (24QFN) on 25-July!

Kinetis KL43/33

Packages

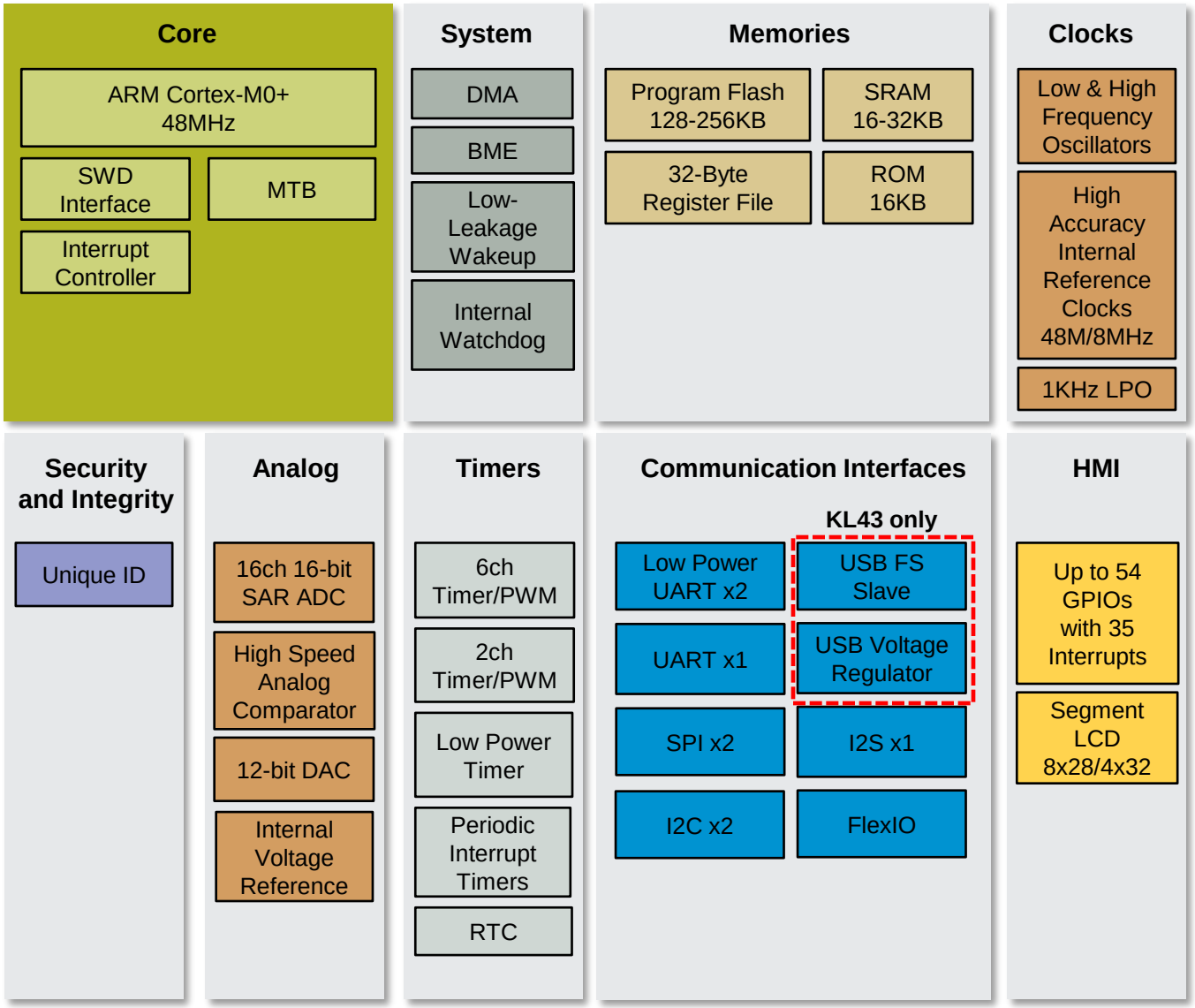
- 64LQFP 10x10x1/0.5mm
- 64MAPBGA 5x5x1/0.5mm

Features Highlight

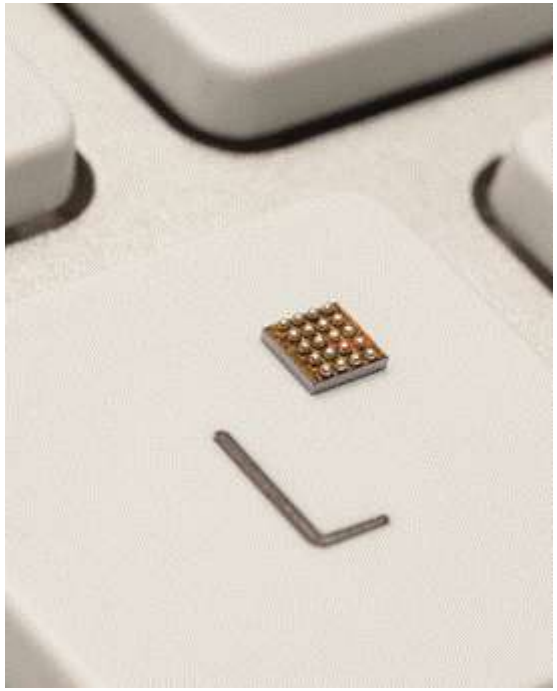
- ROM boot loader for easy flash upgrade
- Crystal-less USB Slave
- High Speed IIC up to 1Mbps
- Embedded 1.2V voltage reference for ADC
- FlexIO module
- 60uA/MHz VLPR and 1.5uA sleep

Availability

- Sample: NOW
- Production: July'14



KL43/33 New Family Summary



- Packages
  - 64LQFP, 64MAPBGA
- New Features
  - ROM with Boot Loader
  - 1.2V Internal Voltage Reference
  - High Speed I2C
  - Crystal-less USB
  - FlexIO
- Availability
  - PK samples (64LQFP) available NOW!
  - X-FRDM-KL43Z and X-TWR-KL43Z48M available on 25-May!
  - Market launch and production (64LQFP) on 1-July!

Kinetis KL27/17

Packages

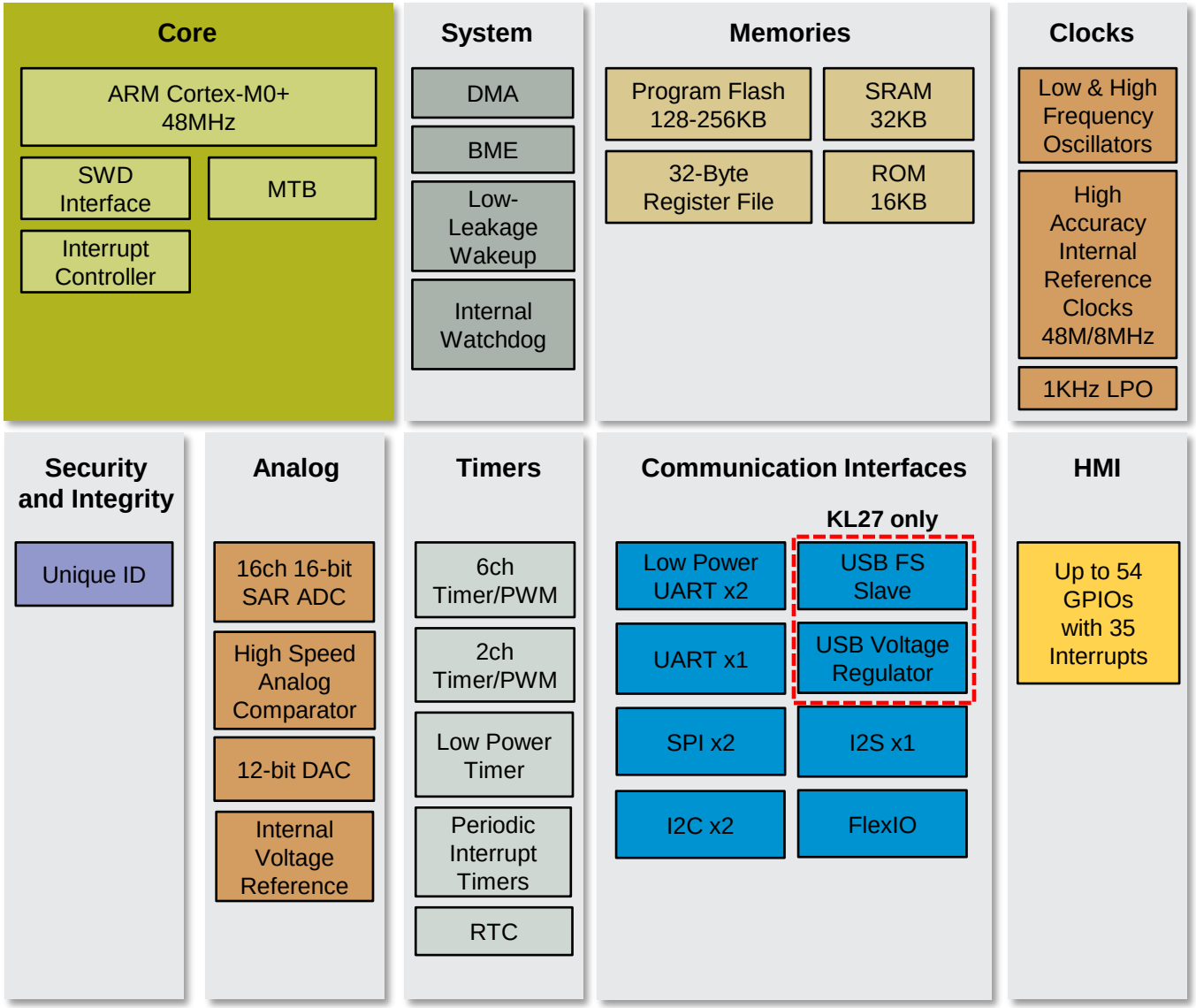
- 64LQFP 10x10x1/0.5mm
- 64MAPBGA 5x5x1/0.5mm
- 48QFN 7x7x0.65/0.5mm
- 32QFN 5x5x0.65/0.5mm

Features Highlight

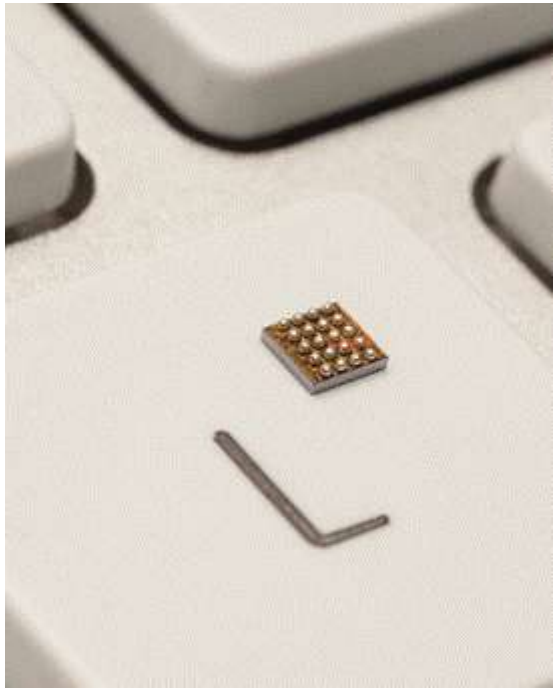
- ROM boot loader for easy flash upgrade
- Crystal-less USB Slave
- High Speed IIC up to 1Mbps
- Embedded 1.2V voltage reference for ADC
- FlexIO module
- 60uA/MHz VLPR and 1.5uA sleep

Availability

- Sample: NOW
- Production: July'14



KL27/17 New Family Summary



- Packages
  - 64LQFP, 64MAPBGA, 48QFN, 32QFN
- New Features
  - ROM with Boot Loader
  - 1.2V Internal Voltage Reference
  - High Speed I2C
  - Crystal-less USB
  - FlexIO
- Availability
  - PK samples (64LQFP) available NOW!
  - X-FRDM-KL43Z and X-TWR-KL43Z48M available on 25-May!
  - Market launch and production (64LQFP) on 1-July!

Kinetis KL27/17

Packages

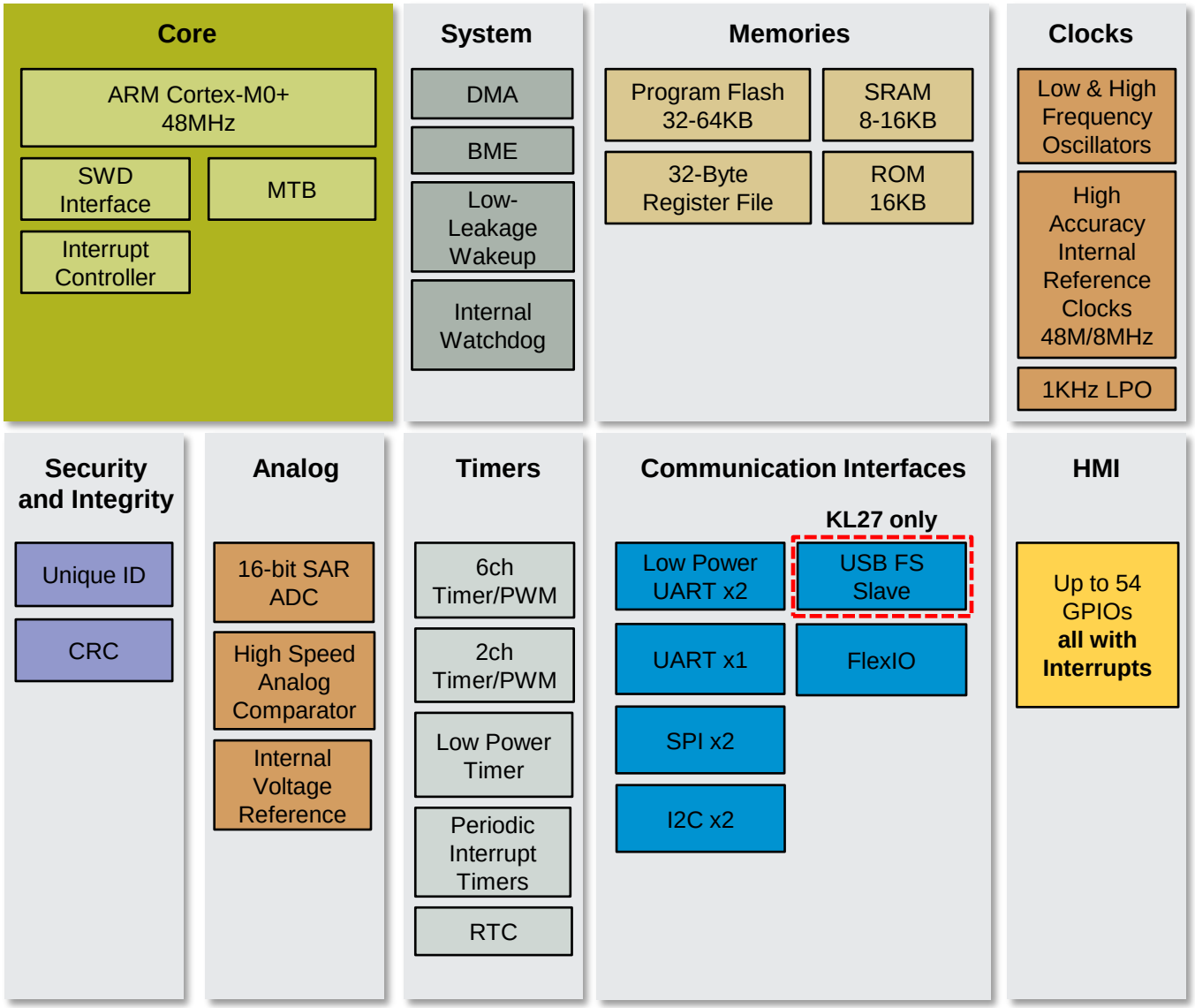
- 64LQFP 10x10x1/0.5mm
- 36XFBGA 3.5x3.5x0.5/0.5mm
- 64MAPBGA 5x5x0.5/0.5mm
- 36WLCSP 2.3x2.3x0.5/0.35mm
- 48QFN 7x7x0.65/0.5mm
- 32QFN 5x5x0.65/0.5mm

Features Highlight

- ROM boot loader for easy flash upgrade
- Crystal-less USB Slave
- High-speed I2C up to 1Mbps
- FlexIO module
- CRC for data correction
- 40uA/MHz in VLPR and 1uA in sleep (with RTC and RAM retention)
- USB connection keep alive in sleep mode

Availability

- Sample: 30-Aug'14 (64LQFP), 18-Sept'14 (36XFBGA)
- Production: 31-Oct'14 (64LQFP), 30-Dec'14 (36XFBGA)



Kinetis KL28/28S

Packages

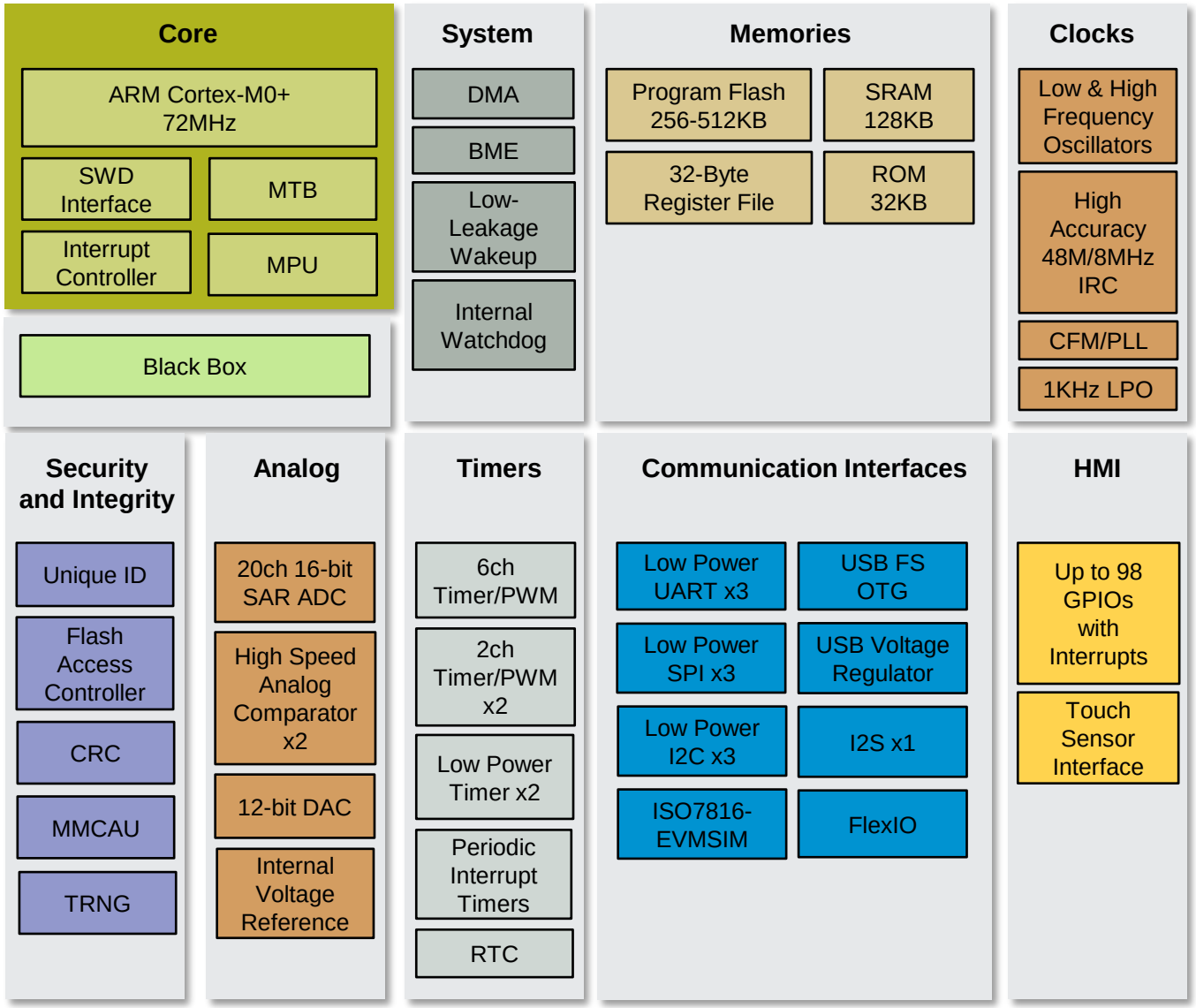
- 121XFBGA 8x8x1/0.65mm
- 100LQFP 14x14x1/0.5mm
- 64MAPBGA 5x5x0.65/0.5mm
- 64LQFP 10x10x1/0.5mm
- WLCSP - TBD

Features Highlight

- 72MHz core speed with large memory size
- ROM boot loader for easy flash upgrade
- Black Box
- Crystal-less USB Slave
- High-speed I2C up to 1Mbps
- Embedded 1.2V voltage reference for ADC
- FlexIO module
- 75uA/MHz run and 4uA sleep

Availability

- Sample: Q4'14
- Production: Q2'15



L Series Technical Differentiators

Kinetis L Series MCUs: Energy Efficiency

Ultra-efficient processing

- Cortex-M0+ processor
- 90 nm low-power flash technology
- Bit manipulation engine
- <40 uA/MHz, 4.8 CM/mW
- Peripheral bridge crossbar
- Zero wait state Flash memory controller

Ultra-low-power modes

- 90nm low-leakage flash technology
- Multiple **run**, **wait** and **stop** modes
- 4 us wake-up from deep sleep modes
- Clock & power gating, low-power boot options
- 2 uA deep sleep Idd with register retention, LVD active and 4.3 us wake-up

Energy-saving peripherals

- Smart peripherals function in deep sleep modes and can make intelligent decisions and process data without waking up the core—ADMA, UART, timers, ADC, segment LCD, touch sensing...

INSIGHT AWARDS UBM TECHINSIGHTS WINNER

Most Innovative Process Technology
Kinetis ARM Cortex-M4 MCUs

Kinetis L Series

Peripherals : Asynchronous DMA (ADMA)

Inter-module-connection with aDMA

Peripheral	Wakeup source
Touch Sense Interface	End of scan Scan out of range
CMP	Compare detected
I2S	Receive data ready Transmit data needed
LPUART	Receive data ready Transmit data needed
LPTPM	Compare/capture detected Counter overflow
Port Control and Interrupts	External edge detected
ADC	Conversion complete

- Kinetis L-Series devices support DMA operation in low power modes
- Stop modes can be entered with the System Clock enabled
- Allows peripherals with STOP mode functionality to trigger asynchronous DMA request
- The MCU will wake from STOP mode to WAIT, process the DMA request and then re-enter the STOP mode with no CPU intervention
- The MCU can be placed in a Compute mode with peripherals configured for STOP.
  In this mode, the CPU can continue to process data at very low dynamic power Peripherals with STOP mode functionality can continue to operate and trigger DMA transfers

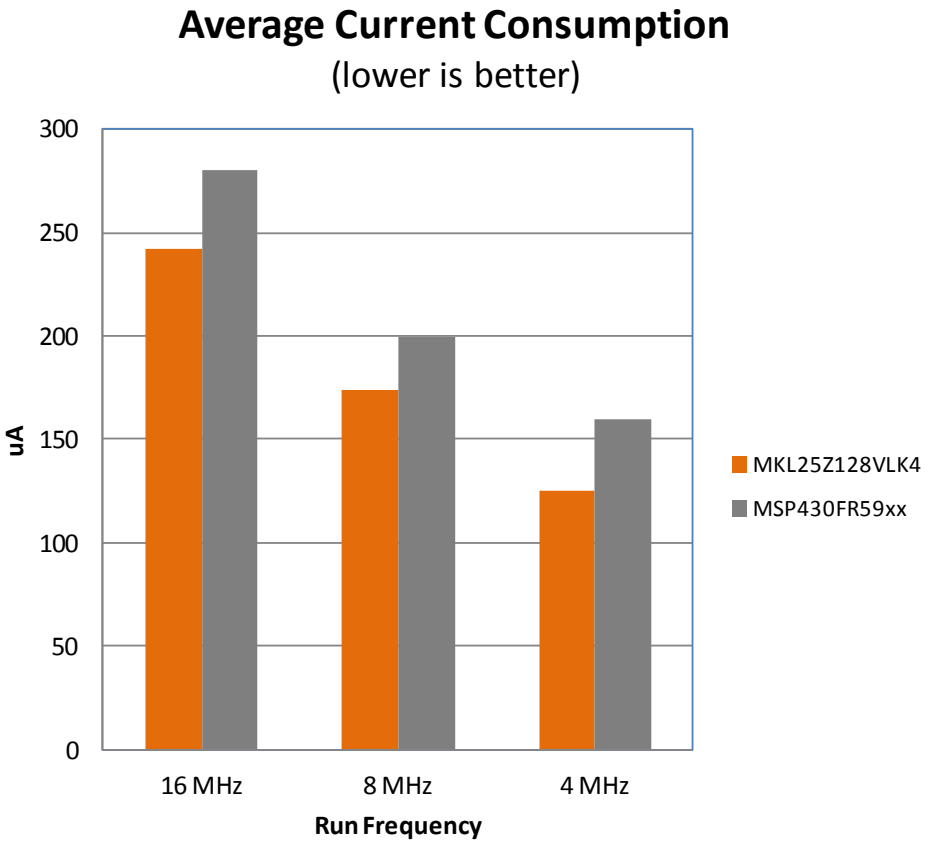
Use Case: ADC performing conversions, DMA transferring conversion results into RAM buffer and CPU processing/filtering the data all done with minimal power ~ 300uA at 4MHz Core speed

Note: Availability device dependent

Power Consumed in a “Typical” Application

Use Case Wolverine Whitepaper

“Given that ultra-low-power devices spend 99.9 percent of the time in standby mode, leakage current has become a key factor in determining power efficiency in smaller process geometries.”



Use Case Details:

- 99.9% of time in standby with RTC active
  - Kinetis L—VLLS1+RTC
  - Wolverine—LPM3 + RTC

Conclusions:

- Running at same frequency, Kinetis L consumes 15–20% less average current.
- However, Kinetis L delivers nearly 2x the work or can do the same work at roughly half the frequency.
- In this case, **Kinetis delivers on the “typical use case” at nearly 40% less average current.**

Kinetis L Series MCUs: Entry-Level Enablement

Hardware

Freescale *Freedom Development Platform*

FRDM-KL02Z
FRDM-KL05Z
FRDM-KL25Z
FRDM-KL26Z
FRDM-KL46Z

- Low-cost/power platform for entry-level developers **($12.95/€10 SRP)**
- Integrates a fully featured debugger that works with all featured tool chains

Freescale *Tower System*

TWR-KL46Z48M
TWR-KL25Z48M

- Modular, open source development platform with reusable peripheral modules offering connectivity, analog, graphics LCD and motor control functionality

IDE & Code Generation

Freescale & Third-Party IDEs

- Freescale CodeWarrior v10.3: ***free*** 64KB
- Keil MDK: free 32 KB
- IAR EWARM: free 32 KB
- Atollic TrueStudio: free 8 KB
- GCC ARM Embedded via Launchpad.net
- Additional tool support from Code Red and others in Q412

Freescale *Processor Expert* Code Generator

- ***Free*** software generation tool for device drivers/start-up code
- Seven steps from project creation to debug – dramatically reduces development time
- Available within CodeWarrior or as a standalone plug-in for IAR/Keil/GNU IDEs

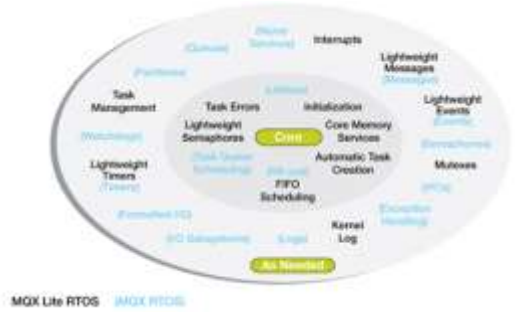
CodeWarrior
IAR SYSTEMS
KEIL
Rowley
atollic
GNU

Run-Time Software & Product Selector

Freescale *MQX Lite* RTOS

www.freescale.com/mqx

- ***Free***, lightweight MQX kernel customised for small resource MCUs
- Packaged as a Processor Expert component
- Upwards compatible with MQX RTOS



Solution Advisor

www.freescale.com/sa

- Web-based interactive MCU selector
- Filters for operating characteristics, packaging, memory configuration and peripherals. Verifies muxing compatibility.
- Save, download and print summary reports and pin muxing configurations.

Additional Resources / Information

Kinetis Solution Overview

Kinetis MCU

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

ARM Cortex-M4 Core
50-150MHz, 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
Freedom board, Tower Platform

Software
CodeWarrior, Processor Expert, Driver Suite, eGUI, PEG, FreeMASTER

RTOS
MQX, MQX Lite

ARM Eco System

The Growing Importance of Software

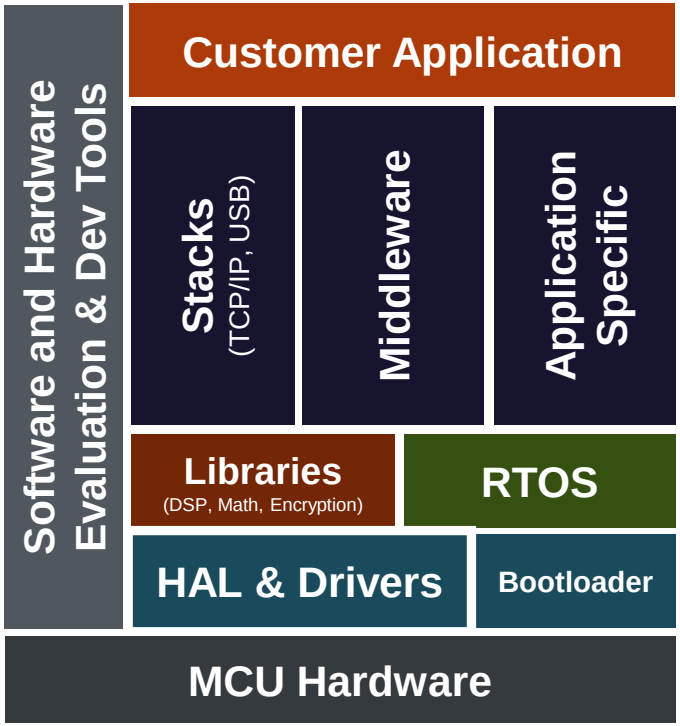
Average MCU Flash size grew x8 in the last decade

+

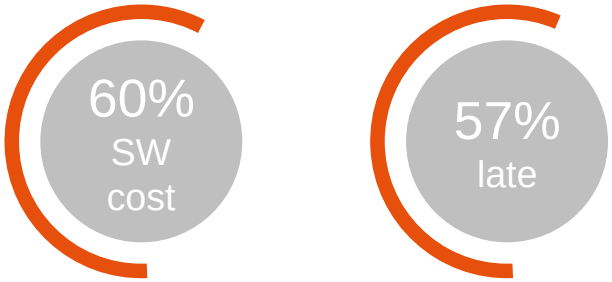
Software now accounts for 60+% of embedded project costs*

+

57% of projects are late, primarily due to software*



Firmware is our customers' **BIGGEST** pain point



*2013 Embedded Market Study, UBM Tech

Freescale's Microcontroller Enablement Bundle

Solution Advisor Part Selector

Find best-fit processors and tools with web-based interactive product selector

Development Platforms

Tower System

Freedom Development Platform

Low cost hardware platforms for prototyping application development

Development Tools

Partner Ecosystem & Kinetis Design Studio

ARM KEIL Microcontroller Tools · Green Hills Software · IAR Systems · atollic

Processor Expert

Visual and automated framework to accelerate development time, deliver software components

Development Software

Complimentary MQX RTOS

MQX/MQX-Lite
Software Stacks and Libraries
PEG GUI Solutions
Application Notes

Kinetis SDK

Open Source Initiative

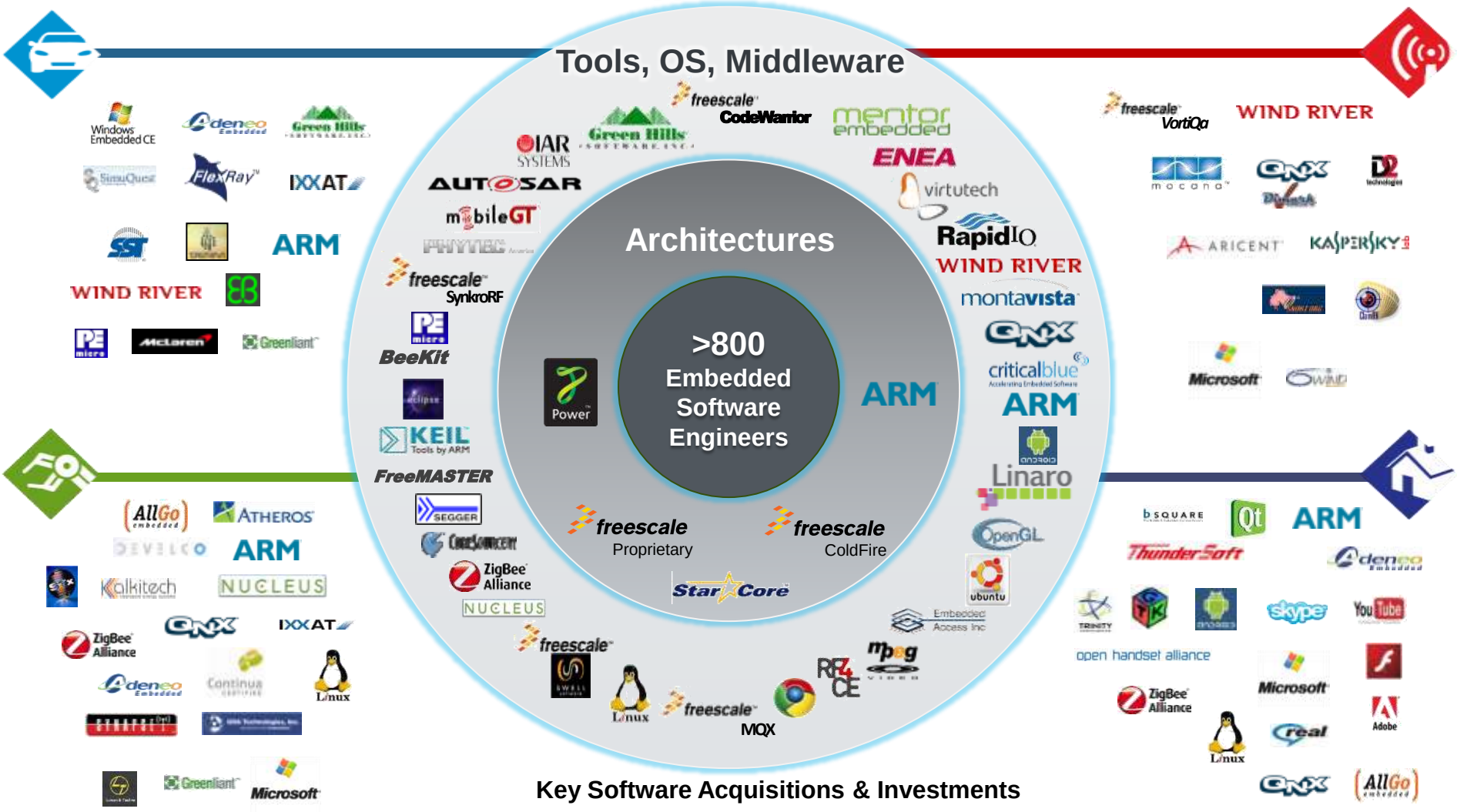
Comprehensive solution for embedded control and connectivity

Online Enablement

Cloud enablement through freely available online design tools, communities, part selectors

Robust Software & Development Ecosystem

Applications



Key Software Acquisitions & Investments

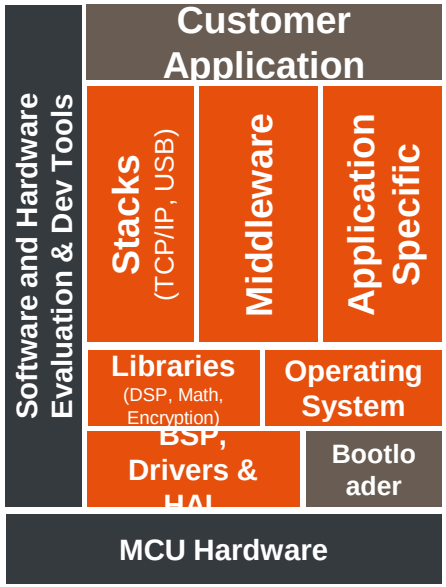
1999: Metrowerks
2002: AMC, Lineo
2008: Intoto
2009: MQX Runtime Platform
2010: Processor Expert, Chipwerks, Swell

Learn more at: www.freescale.com/KSDK
(coming April 2014)

Kinetis Software Development Kit (SDK)

A complete software framework for developing applications across all Kinetis MCUs

HAL, peripheral drivers, libraries, middleware, utilities, and usage examples.



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.
- CMSIS-CORE compatible startup and drivers plus CMSIS-DSP library and examples
- RTOS Abstraction Layer (OSA) with support for Freescale MQX, FreeRTOS, Micrium uC/OS, bare-metal and more
- Integrates USB and TCP/IP stacks, touch sensing software, encryption and math/DSP libraries, and more
- Support for multiple toolchains including GNU GCC, IAR, Keil, and Kinetis Design Studio

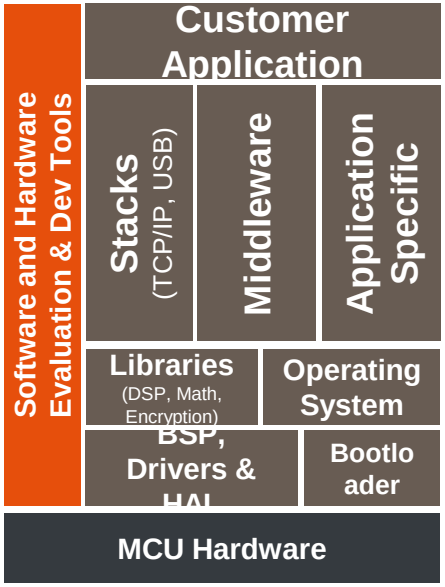
The OSI logo trademark is the trademark of Open Source Initiative.

Learn more at: www.freescale.com/KDS
(coming April 2014)

Kinetis Design Studio

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

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



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 with Kinetis Platform SDK integration
- Host operating systems:
  - Windows 7/8
  - Linux (Ubuntu, Redhat, Centos)
  - Mac OS X
- Support for SEGGER, P&E and Open SDA/CMSIS-DAP debugger targets
- Support for Eclipse plug-ins including RTOS-awareness (i.e. MQX, FreeRTOS)
- CodeWarrior project importer

Kinetis Bootloader

Learn more at: www.freescale.com (coming April 2014)

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

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

Product Features

- A common bootloader for all Kinetis MCUs
- Source code provided under a permissive BSD open source license
- ROM based on select Kinetis devices
- Pre-programmed into flash (on devices without a dedicated ROM) for built-in factory programming capabilities
- Fully customizable for use in customer applications providing reliable field updates
- Serial communications with a host via UART, SPI, I2C, USB HID, or CAN
  - Active peripheral detection
  - Common command protocol for all peripherals.
- Command-line and GUI tools provided for Windows, Linux and Mac hosts

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

Kinetis K2 Tools Solutions (Addition to existing Kinetis Enablement)

✓mbed Support – Expanding to Kinetis K-Series Families

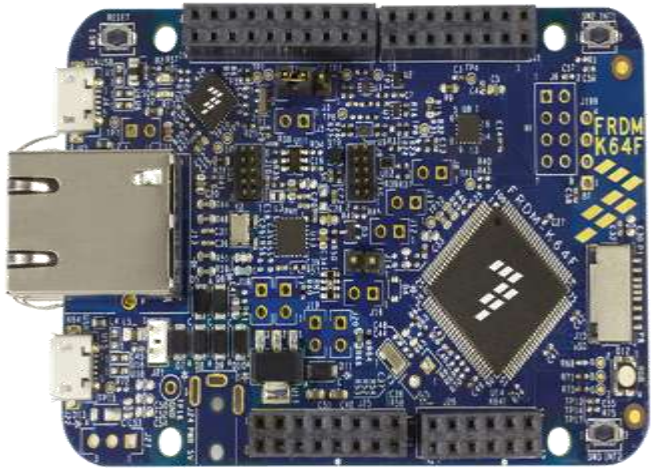
Rapid and easy Kinetis prototyping and development through the global **mbed Developer Community** providing free software libraries

✓Expand Offer of K-Series Freedom Boards

Ultra low-cost/low-power development platform

Enables quick application prototyping and demonstration of Kinetis MCU families

FRDM-K64F: Freescale Freedom Development Platform



Software

C/C++ Programs

mbed Components Database
Accelerometer, GPS, 802.15.4/6LoWPAN, Cellular, Compass, ...

mbed SDK
Runtime, Memory Model, Peripheral APIs, STDIO, RTOS, Networking, Platform features

Low Level Driver Libraries | Toolchain C library | RTOS

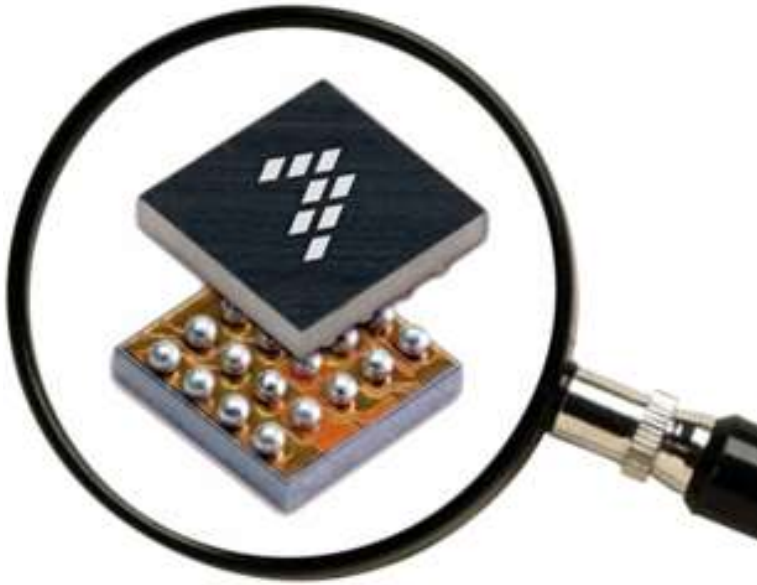
CMSIS-CORE

Freescale Kinetis Minis

Freescale Kinetis L combined with WLCSP packing brings the next World's Smallest ARM® Powered MCU

Microscopic Package. Massive Potential.

- 1.6 mm x 2.0 mm x 0.56 mm
- Advanced wafer-level chip scale package for the ultimate in PCB area reduction
- 35% less PCB area, yet delivers 60% more GPIO than the next competing solution
- 32-bit ARM® Cortex™-M0+ core with high density feature integration: 32 KB flash, precision analog, ultra low power and more
- Start developing with the Kinetis L series Freescale Freedom development platform
- Sampling in April 2014!



For more information, visit
freescale.com/Kinetis/KL03CSP

Freescale CSP Packaging Overview for 32-bit Kinetis MCUs

- **What is Wafer Level CSP?**
  - Wafer Level Chip Scale Package refers to the technology of packaging an integrated circuit at the wafer level, instead of the traditional process of assembling individual units in packages after dicing them from a wafer.

- **What will it mean for me as a customer buying and mounting CSP package into my system**
  - The cost will be higher. Handling is more complex and thus cost of both handling and soldering process more expensive
  - More information on Freescale recommended handling is available in an Application Note see AN3846

- **CSPs are not targeted at low volume customers.** For 2014, only High Touch accounts backed by Business Development Marketing will be supported.

Alternative to CSPs

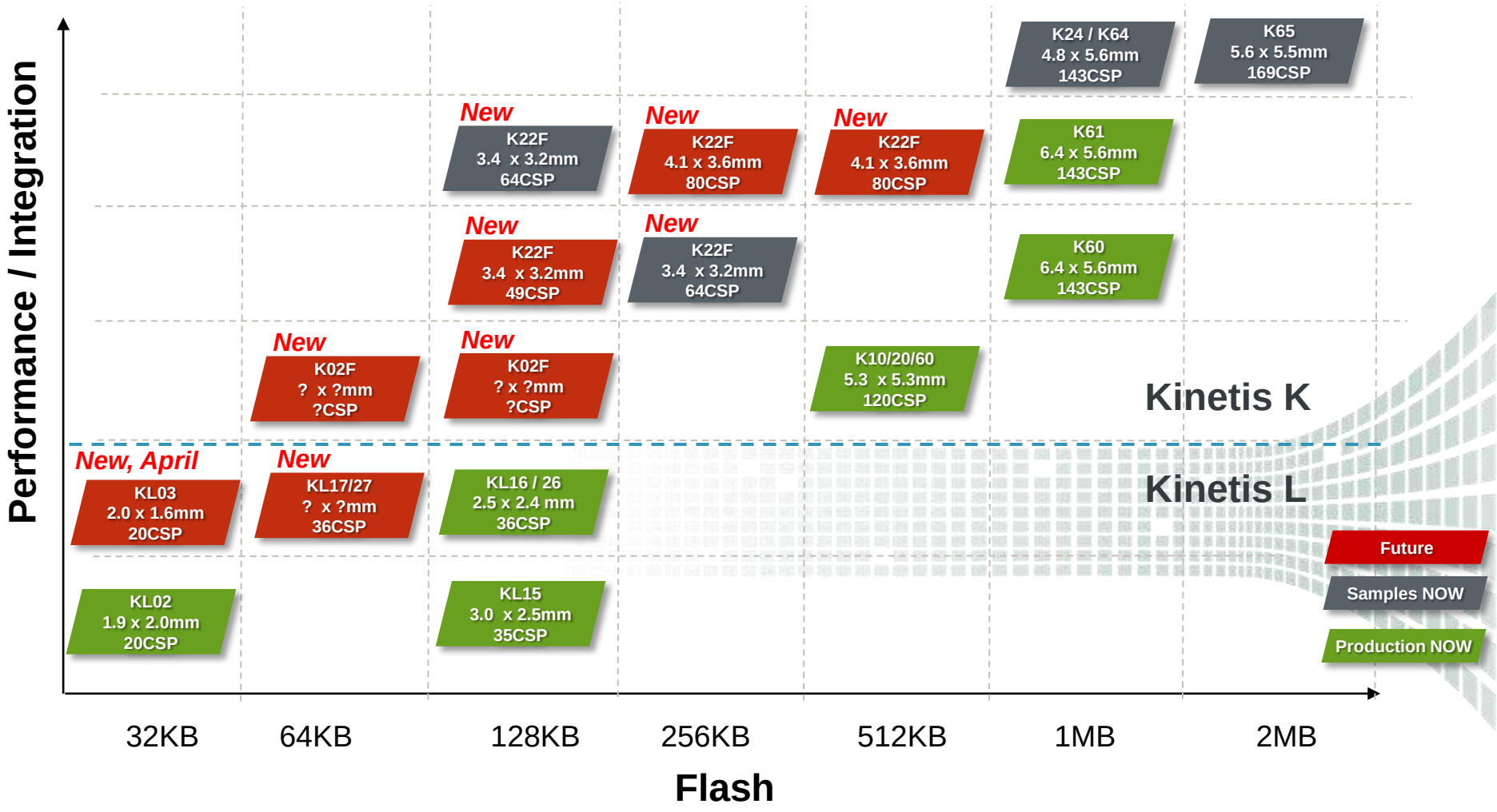
- With the higher cost of CSP and difficult handling, customers should consider some alternative options before selecting a CSP.

- If the customer requirement is only for a very thin package, and area is not a major concern, customers should consider the new 121 pin Ultra Fine BGA packages being supported on new products.
  - The use of the ultra fine BGA will lead to a lower cost PCB than that which utilizes a CSP.

- Other alternatives to CSP:
  - 24, 32 or 48 QFN
  - 64, 121 & 144MAPBGA

Kinetis WLCSP Portfolio

The World's Smallest ARM Powered MCUs – From ultra low power to high performance



CSP options on Kinetis – Qualified

Device	Part #	Flash	Speed Grade	Temp range	Package	Dimensions (mm)	Comment
KL02	MKL02Z32CAF4R KKL02Z32CAF4R	32KB	48MHz	Max Ambient = -40 to 85oC	20WLCSP	1.994 x 1.94 x 0.563*	
KL15	MKL15Z128CAD4R KKL15Z128CAD4R	128kB	48MHz		35WLCSP	2.37 x 2.46*	18wk lead-time for Production
KL16	MKL16Z128CAL4 KKL16Z128CAL4	128kB	48MHz		36WLCSP	2.5 x3 x 0.528**	0.35mm ball pitch
KL26	MKL26Z128CAL4 KKL26Z128CAL4	128kB	48MHz		36WLCSP	2.5 x3 x 0.528**	0.35mm ball pitch
K60 K20	MK60DN512ZCAB10R KK60DN512ZCAB10R MK20DN512ZCAB10R KK20DN512ZCAB10R	512KB	100MHz		120WLCSP	5.29 x 5.28 x 0.563*	
K60	SCK60FN1MGCAA12R	1MB	120MHz		143WLCSP	6.44 x 5.55x 0.563*	
K61	MK61FN1M0CAA12R KK61FN1M0CAA12R	1MB	120MHz		143WLCSP	6.44 x 5.55x 0.563*	
K10	MK10DN512ZAB10R	512KB	100MHz	Max Ambient = 0 to 70oC	120WLCSP	5.29 x 5.28 x 0.563*	

* +/- 0.035mm
** +/- 0.03mm

CSP options on Kinetis – Pipeline

Device	Part #	Flash	RAM	Speed	Number of balls (pitch)	Temp range	Size (mm)	PK Samples *	Qual *	Production *
K24 / K64	MK24FN1M0CAJ12R MK64FN1M0CAJ12R	1MB	256Kb	120MHz	142 (0.4mm)	Max Ambient = -40 to 85oC	4.8 x 5.6 x 0.563*	Now	TBD by Customer demand	18wk lead-time
K65	MK65FN2M0CAC18R MK65FX1M0CAC18R	2MB	256Kb	180MHz	169 (0.4mm)		5.6 x 5.5 x 0.563*	Now	May'14	July '14
KL03	MKL03Z32xxx4	32kB	4Kb	48MHz	20 (0.4mm)		2.0 x 1.6 x 0.563*	April '14	June'14	July'14
K22F	MK22FN256CAH12 MK22FN128CAH12	256kb or 128kB	48Kb	120MHz	64 (0.4mm)		3.4 x 3.2 x 0.563*	Now	TBD by Customer demand	18wk lead-time
K22F	MK22FN512CAP12 MK22FN256CAP12	512kb or 256kB	128Kb	120MHz	80 (0.4mm)		4.12 x 3.56 x 0.563*	TBD	TBD	TBD
K22F	K22FN128CAK10	128kB	24Kb	100MHz	49 (0.4mm)		TBD x 0.563*	TBD	TBD	TBD
K02	K02FN128Cxx10 K02FN64Cxx10	12kB or 64kB	16Kb	100MHz	TBD		TBD	TBD	TBD	TBD

* Dates subject to change

Typical WLCSP Milestones - TBC

- **Mechanical samples: 4 - 6 weeks after silicon validation (confidence)**
  - Mechanical Samples – WLCSP samples are not tested. Part configurations and IP trims not programmed. Parts can be used to validate the RDL (re-distribution layer) and the case outline.

- **Pre-bump probe only, limited test samples: + 6 weeks after CSP mask design**
- **Ball map must be agreed by customer and RDL feasibility is complete**
  - Probe-only (Limited Test) Samples – WLCSP sample are tested with appropriate part configurations, IP trims, and NVM initialized. However, parts are not tested or validated after bump processing. These can be shipped to customers for development purposes, but there is risk without validating the functionality of the parts after bump processing prior to shipment.

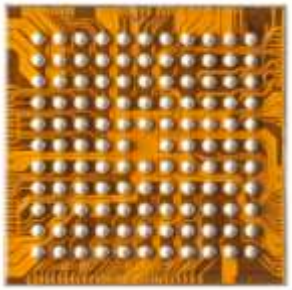
- **Full test samples (@room temp): + 5 weeks (Post Bump)**
  - Room-Temp Samples – WLCSP sample are tested with appropriate part configurations, IP trims, and NVM initialized. Parts are 100% tested after bump processing. These can be shipped to customers for development purposes, with low risk of failure for yield issues.

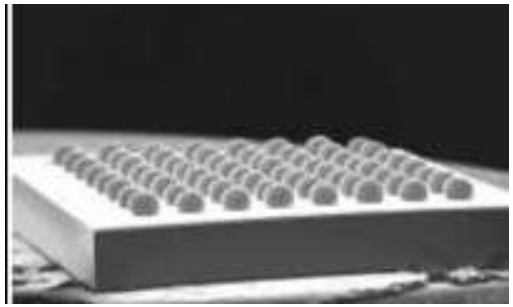
- **Qualification: + 6 weeks**
  - Qualification – generally, die itself is already qualified in standard package, additional testing and stressing to confirm WLCSP package qualification.

- **Production ramp: + 12 weeks after official design WIN (+6 weeks after qual)**
  - Production ramp – high volume customer orders can be filled (pending appropriate lead times). Range in schedule dependent on production hardware availability or creation.

Wafer Level Chip Scale Packaging

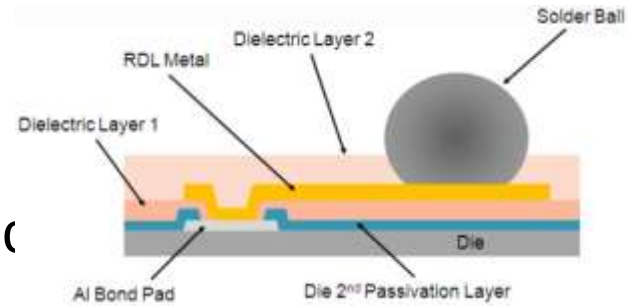
- Packaging of microcontroller assembled at the wafer level
- The package is of the same size as the die
- Interconnections from the die to the PCB are accomplished by solder balls
- No bond wires or interposer connections are required





Key Advantages:

- It allows the miniaturization of embedded applications
- The die to PCB inductance is minimized
- Enhanced thermal conduction characteristic



PCB Layout Application Note: AN3846, Wafer Level Chip Scale Package

Kinetis Chip Scale Package Portfolio

The World's Smallest ARM Powered MCUs – From ultra low power to high performance

- World's smallest ARM powered MCU (1.9x2.0mm^2)
  - Kinetis L-series, KL02 20pin CSP
    - 25% less area, 60% more GPIO than next nearest competitor
    - Ultra low power Cortex-M0+

- World's smallest 128KB Flash MCU (2.4x2.5mm^2)
  - Kinetis L-series, KL16 36pin CSP
  - Ultra low power Cortex-M0+

- 512KB Flash, 128KB RAM, USB, ENET (5.3x5.3mm^2)
  - Kinetis K-series, K60 120pin CSP
  - High performance Cortex-M4

- 1MB Flash, 128KB RAM, USB, ENET (6.5x5.6mm^2)
  - Kinetis K-series, K61 143pin CSP
  - High performance Cortex-M4

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

Designing with Freescale

Tailored live, hands-on training in a city near you

2014 seminar topics include

- QorIQ product family update
- Kinetis K, L, E, V series MCU product training

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