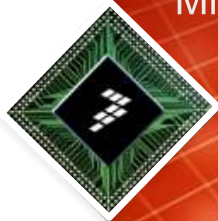




# Kinetis Microcontrollers

## EUF-IND-T0732

**Ralf Lehmann**  
Sr. Product Marketing Engineer  
Microcontrollers Group EMEA



April 2013

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# Comprehensive Portfolio Based on ARM Technology





**Kinetis Microcontrollers**  
*Design Potential. Realized*



**Vybrid Controller Solutions**  
*Rich Apps in Real Time.*



**i.MX Application Processors**  
*Your Interface to the World.*



**QorIQ Processors built on Layerscape Architecture**  
*Accelerating the Network's IQ*

Industry's most scalable ultra-low-power, mixed-signal MCU solutions based on the ARM® Cortex™-M4 and ARM® Cortex™-M0+ architectures.

-  **Consumer**
-  **Industrial**

Real-time, highly integrated solutions with best-in-class 2D graphics to enable your system to control, interface, connect, secure and scale.

-  **Consumer**
-  **Automotive**
-  **Industrial**

Industry's most versatile solutions for multimedia and display applications, with multi-core scalability and market-leading power, performance & integration.

-  **Consumer**
-  **Automotive**
-  **Industrial**

Industry's first software-aware, core-agnostic networking system architecture for the smarter, more capable networks of tomorrow – end to end.

-  **Networking**
-  **Industrial**

**Freescale has the industry's broadest range of solutions built on ARM® technology for automotive, industrial, consumer and networking applications.**

Find your ideal solution at the price, performance and power level you desire, and leverage the extensive software and tool bundles available to speed and ease your design process.



# Kinetis MCU Families

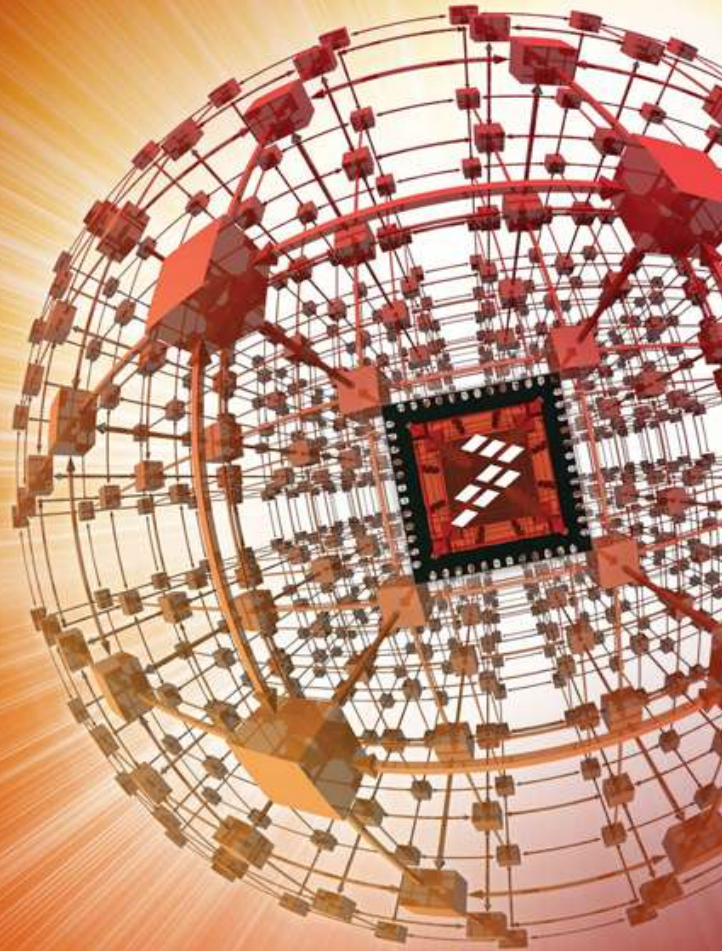


	<b>K Series</b> General Purpose	<b>L Series</b> Lowest Power/ Smallest Package	<b>M Series</b> Metering 24b Sigma Delta ADC & PGA	<b>W Series</b> Wireless Sub 1-GHz & 2.4 GHz	<b>... more to come in 2013</b>	<b>HC9S08</b> 8-bit Core Lowest Price
<b>+ Graphic LCD</b>	<b>K70</b>					
<b>+ Ethernet &amp; Crypto</b>	<b>K60</b>					
<b>+ Measurement</b>	<b>K50</b>					
<b>+ USB and LCD</b>	<b>K40</b>	<b>KL4</b>				
<b>+ LCD</b>	<b>K30</b>	<b>KL3</b>	<b>KM3</b>			
<b>+ USB</b>	<b>K20</b>	<b>KL2</b>		<b>KW20</b>		
<b>Baseline</b>	<b>K10</b>	<b>KL1</b>	<b>KM1</b>	<b>KW01</b>		
<b>Bridge to MC9S08Px</b>	<b>KL0</b>					<b>S08Px</b>

Core: ■ ARM® Cortex™-M4 ■ ARM® Cortex™-M0+ ■ Freescale HC9S08



# ARM® Cores used by Freescale Kinetis



[www.freescale.com/kinetis](http://www.freescale.com/kinetis)





# Kinetis Series powered by ARM® Cortex™

ARMv7-M architecture	<b>Cortex-M4</b>	High performance data processing & I/O control. Support hardware divide, MAC, bit field processing, DSP. Floating point unit optional (Cortex-M4F).	<b>Kinetis K Series</b>
	<b>Cortex-M3</b>	High performance data processing & I/O control. Support hardware divide, MAC (Multiply Accumulate), bit field processing.	
ARMv6-M architecture	<b>Cortex-M0+</b>	General data processing, high performance I/O control, mixed signal ASICs, replacement for 8/16-bit MCUs	<b>Kinetis L Series</b>
	<b>Cortex-M0</b>	General data processing, I/O control, mixed signal ASICs, replacement for 8-/16-bit MCUs	
	<b>Cortex-M1</b>	For FPGA designs only. Optimized for FPGA and can work in most FPGA devices	



# Kinetis: Why ARM® Cortex™-M4?

- **Backwards compatible with ARM Cortex-M3**

- Does everything the Cortex-M3 does and more but in less cycles (more energy efficient!)

- **New features**

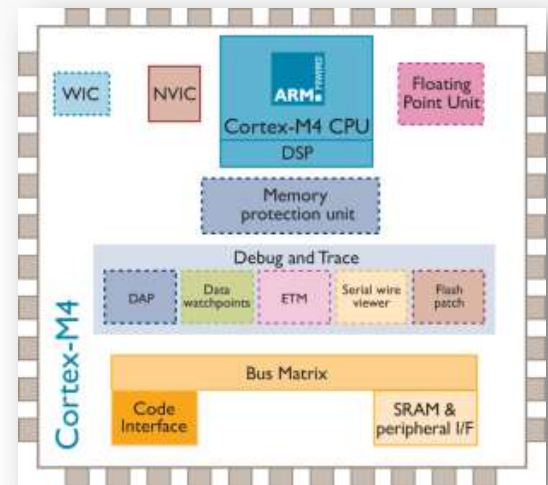
- Single cycle MAC (Up to 32 x 32 + 64 -> 64)
- DSP extensions, Single Precision Floating Point Unit

- **Freescale IP and Innovation**

- Cache, Cross-Bar and DMA for increased throughput
- MPU for system resource protection
- Low-leakage Wake-up Unit for low power operation

- **Architected for Digital Signal Processing**

- Motor Control: advanced algorithms, faster control loops, more responsive to speed commands and changing loads, increased power efficiency
- Automation: high calculation and algorithm bandwidth at a low cost
- Power management: designed for low/battery powered systems (CLK @ 0.5x ARM Cortex M3)
- Audio and Video: 5x performance improvement over software, extended battery operation



Dotted boxes denote optional blocks



# CM0+ Core & Platform Features

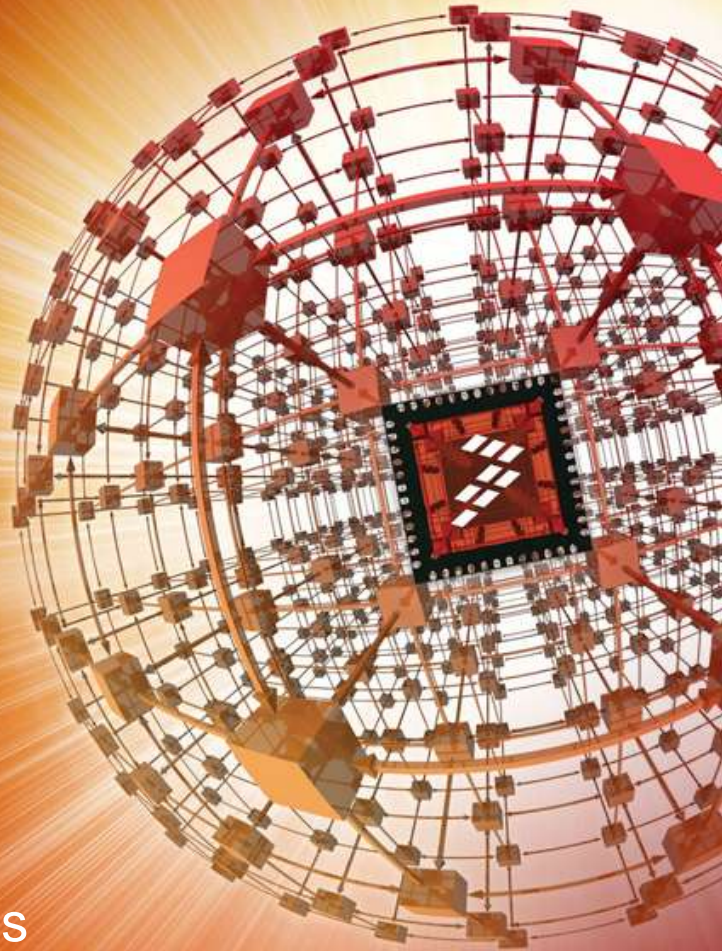


- ARM Cortex-M0+ Core
  - 100% compatible with Cortex M0
  - Efficient instruction set for low power and small code size
  - 0.95 DMIPS per MHz performance when executing from internal RAM (single cycle accesses)
  - Single cycle 32 bit x 32 bit multiply
  - NVIC with 4 priority levels and hardware preemption
  - I/O port for single cycle GPIO loads and stores
- Peripheral Bridge Crossbar (AXBS-Lite)
  - Support for concurrent accesses from DMA/CORE to memory and peripherals
- Bit Manipulation Engine (BME)
  - Decorated load and store capability for peripherals improving processing efficiency and small code size
- Flash Memory Controller (FMC)
  - 4-way, 4-set 32-bit Flash cache for improving flash access times
- Debug Facilities
  - Supports the standard ARM 2-pin serial wire debug (SWD) debug port only
  - Micro-Trace Buffer (MTB) for on-chip trace capabilities



# Kinetis K Series

*Design Potential. Realized  
with ARM® Cortex™ -M4*



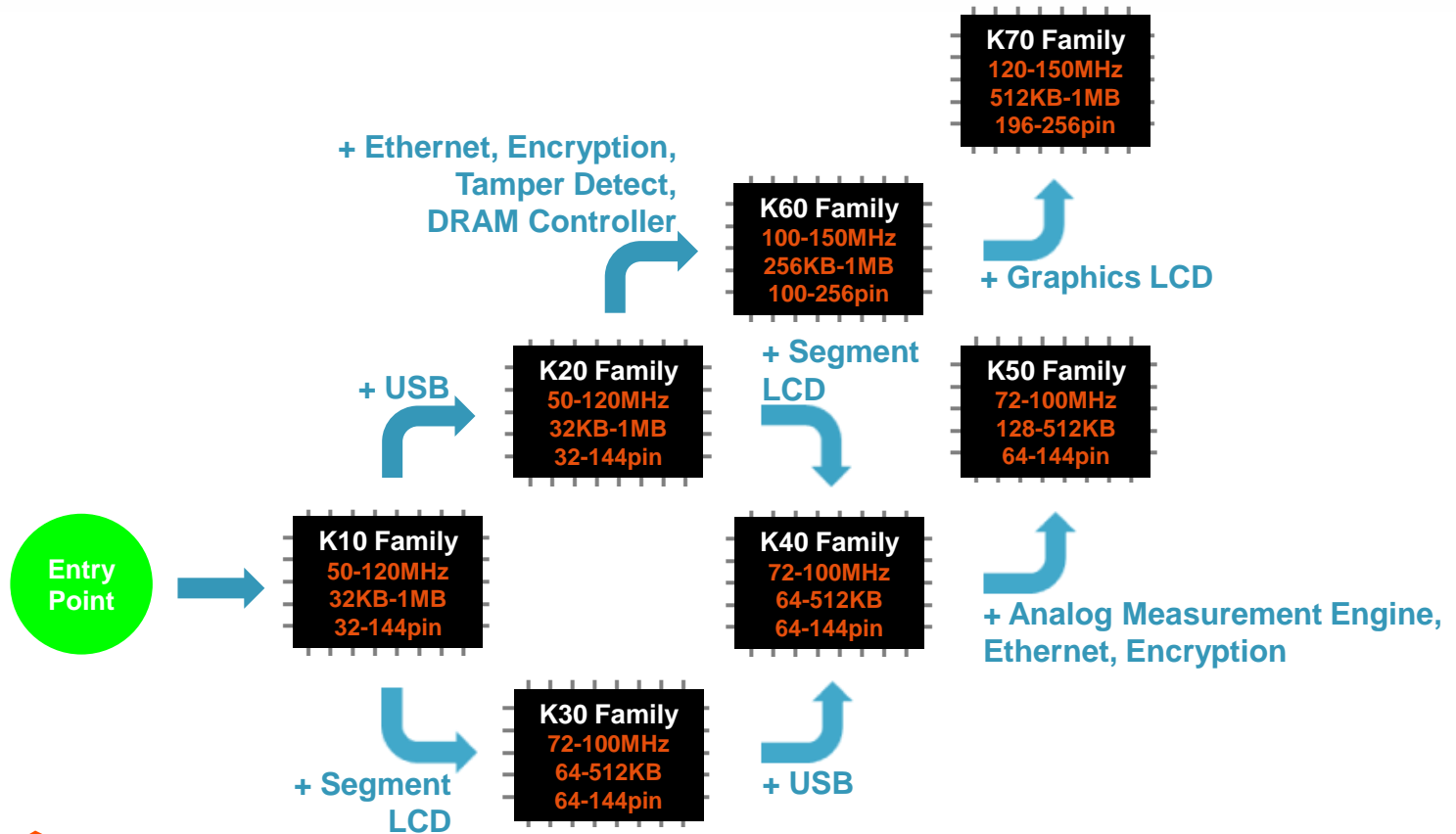
[www.freescale.com/kinetis/KSeries](http://www.freescale.com/kinetis/KSeries)



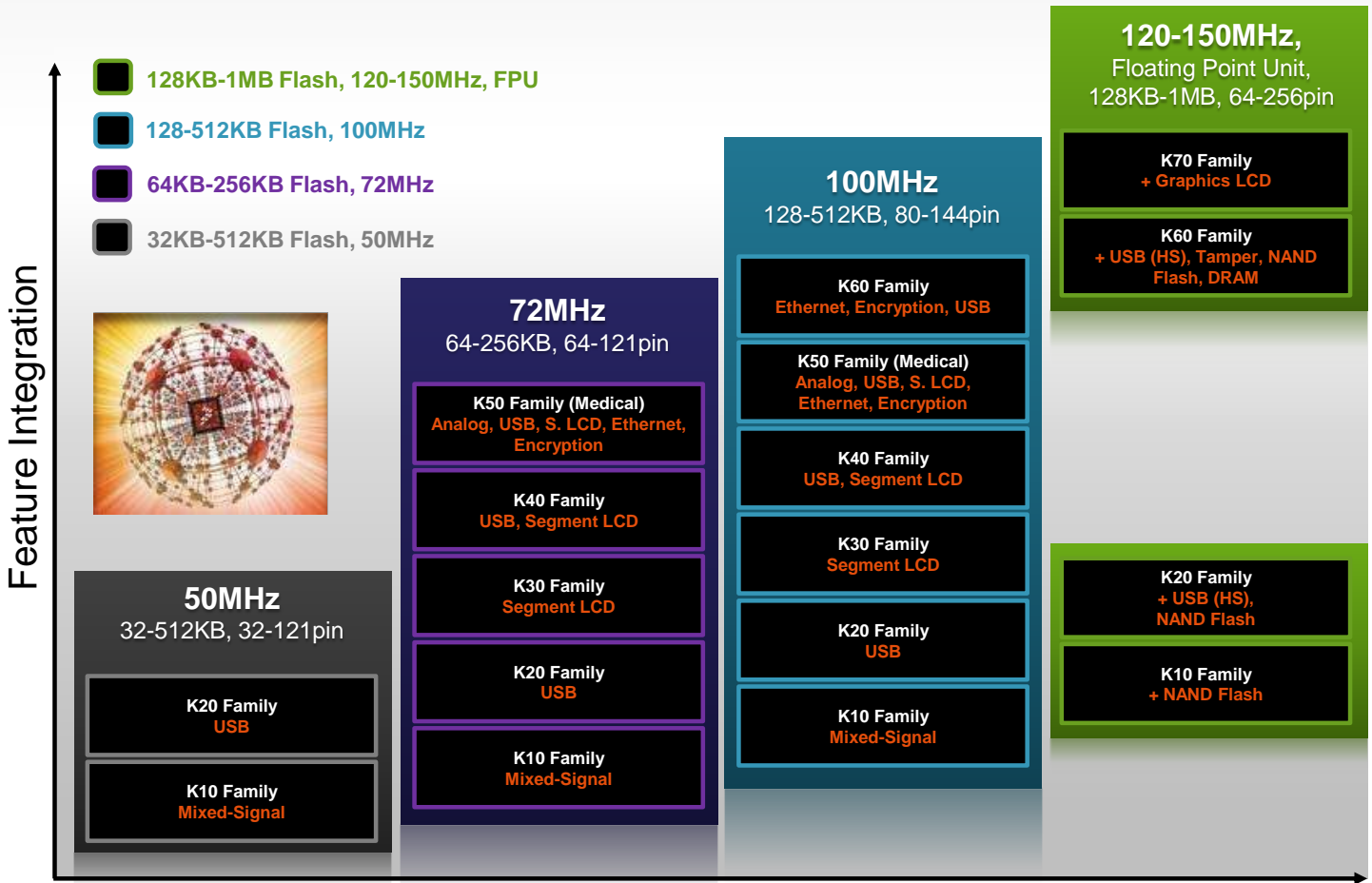


# K Series: MCU Family Compatibility

Hardware & software compatible MCU families with scalable performance, memory and feature integration

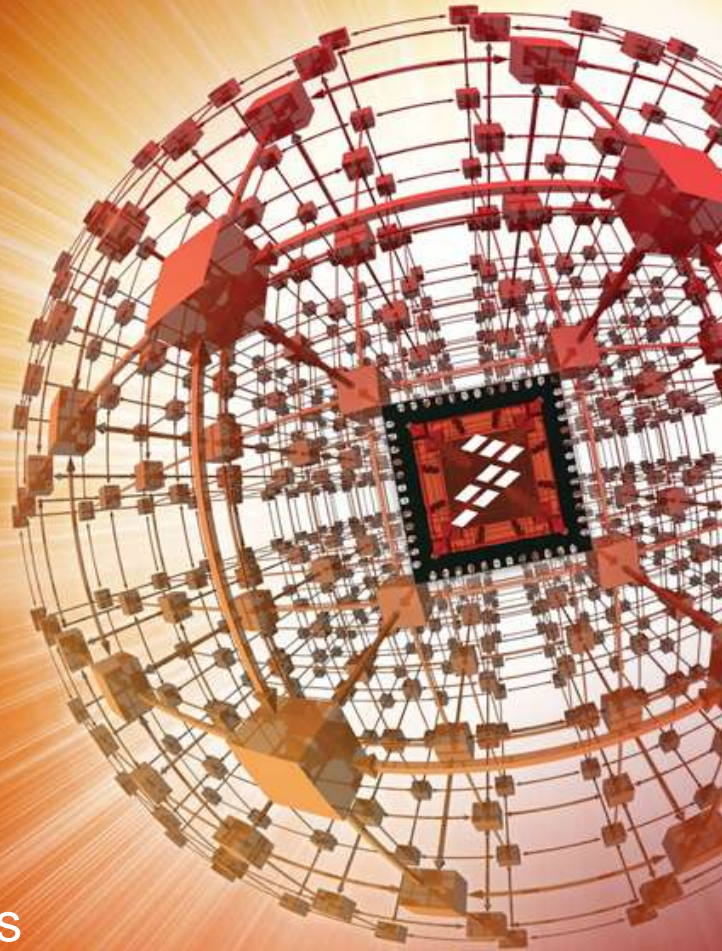


# Kinetis K-Series: four Sub-Families available



# Kinetis L Series

*Design Made Simple*  
with ARM® Cortex™ -M0+



[www.freescale.com/kinetis/LSeries](http://www.freescale.com/kinetis/LSeries)



# Why 32-bit, as 8-/16-bit can do the job already?



**Feature rich**

**Easy-to-use**

**Connectivity**

**Extended battery life**

**Sleek design**



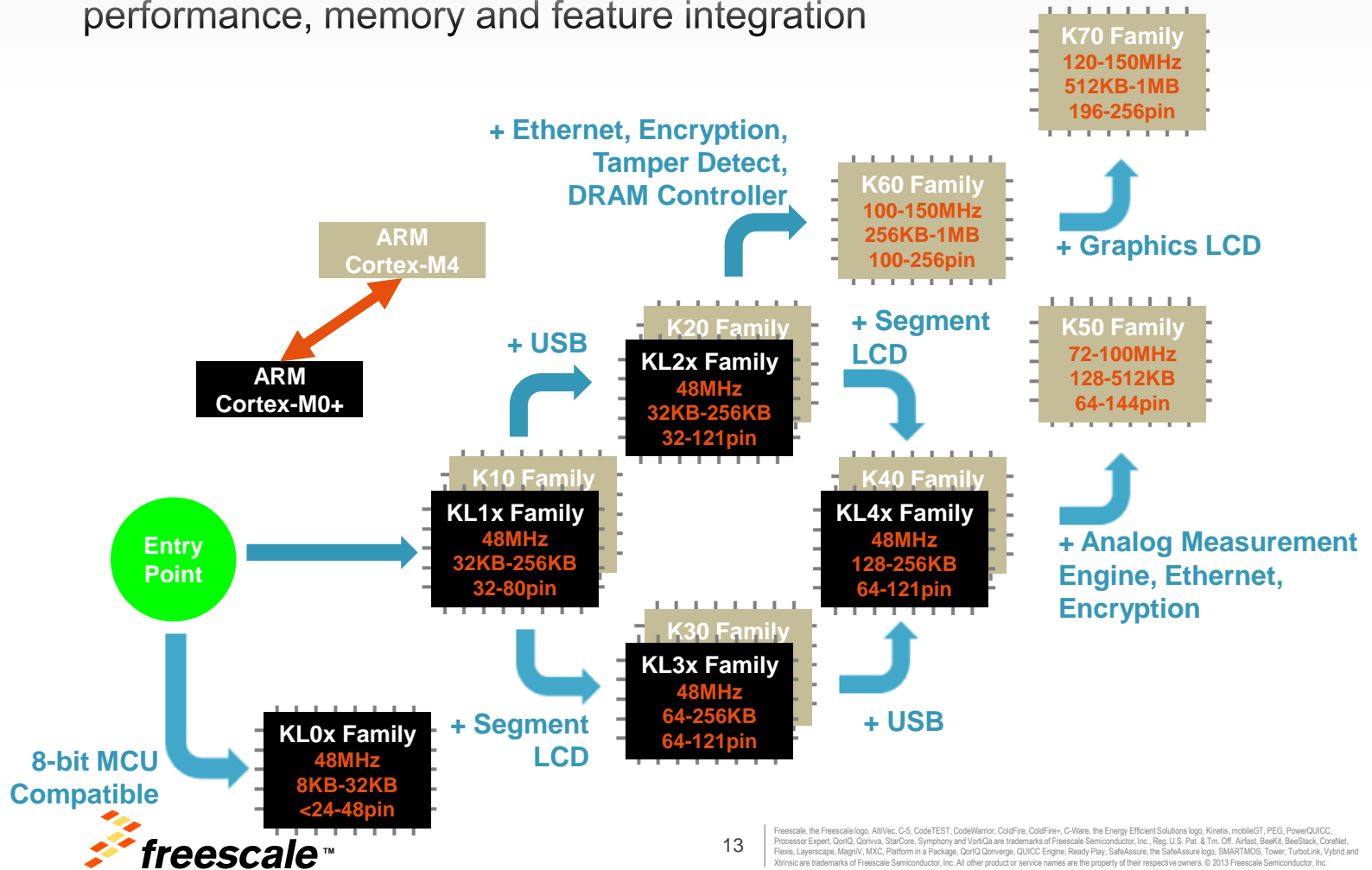
***User expectations***





# Kinetis L/K Series: MCU Family Compatibility

Hardware & software compatible MCU families with scalable performance, memory and feature integration



# Kinetis L Series: Memory & Package Scalability

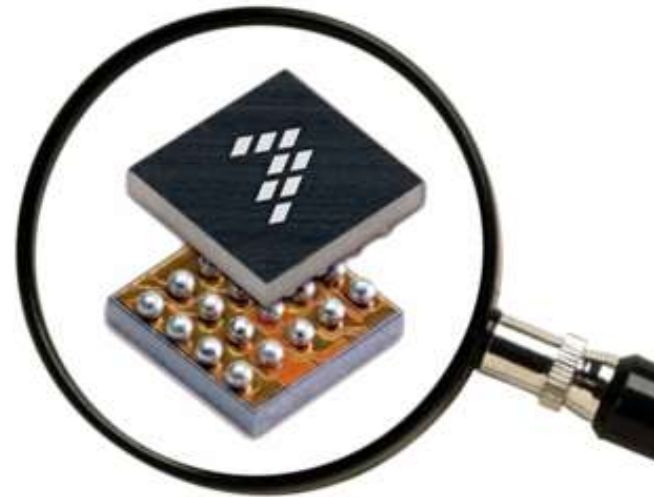




## The World's Smallest ARM® Powered MCU

### Microscopic Package. Massive Potential.

- 1.9 mm x 2.0 mm x 0.56 mm
- Advanced wafer-level chip scale package for the ultimate in PCB area reduction
- 25% smaller with 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 today with the Kinetis L series FRDM-KL05Z Freescale Freedom development platform
- Mass Production planned for June 2013

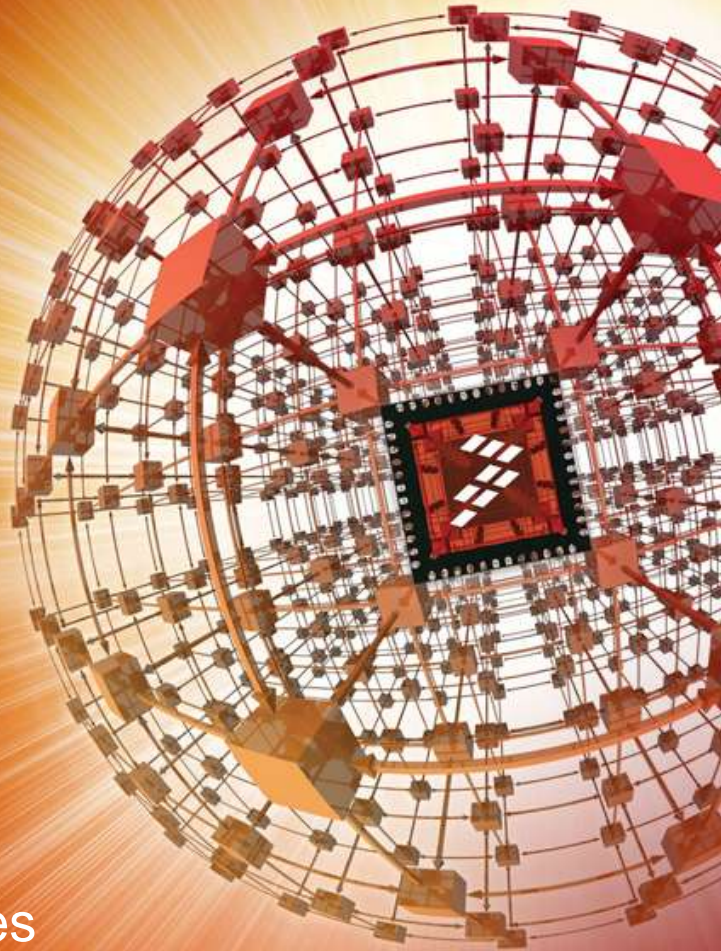


For more information, visit  
[freescale.com/Kinetis/KL02CSP](http://freescale.com/Kinetis/KL02CSP)



# Kinetis M Series

*Highest Precision & Security  
with ARM® Cortex™-M0+*



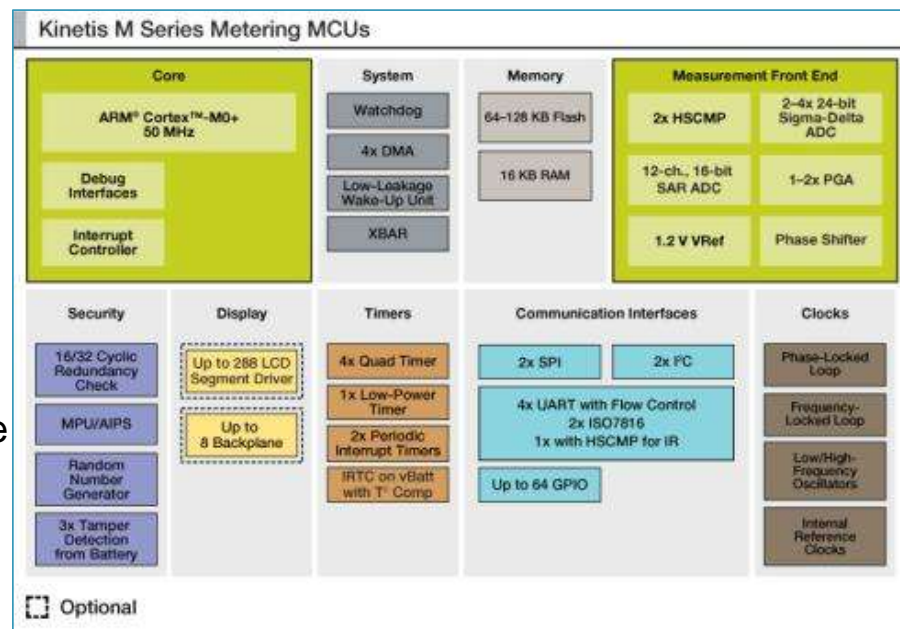
[www.freescale.com/kinetis/MSeries](http://www.freescale.com/kinetis/MSeries)





# Kinetis M - Highest precision and security

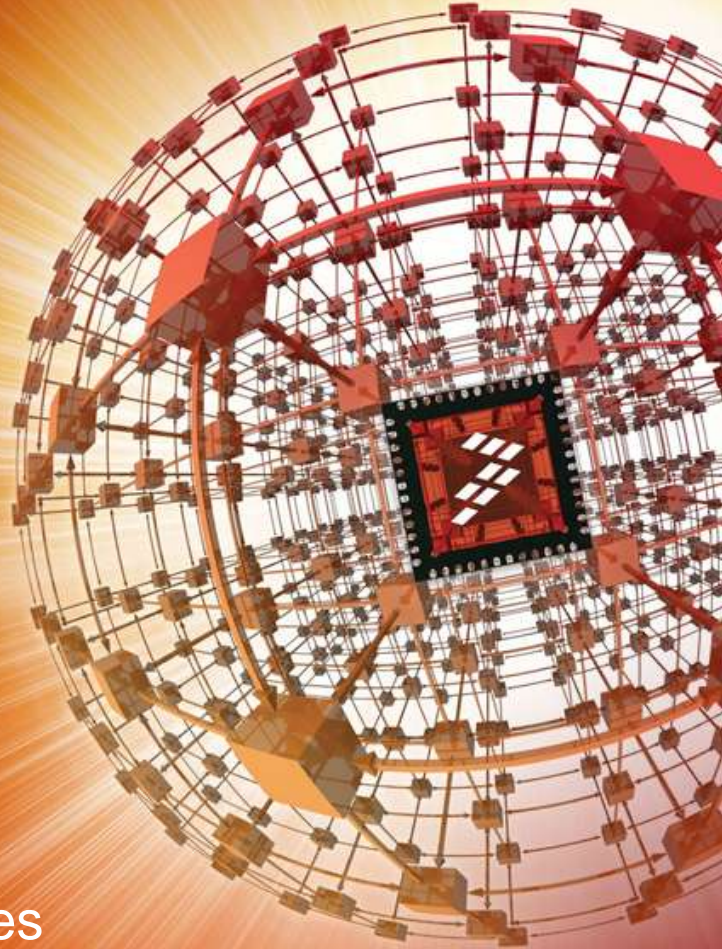
- **Up to 48 MHz Cortex™-M0+ with Ultra-Low-Power**
- **Analog Front End**
  - 24-bit sigma delta ADC with 94 dB SNR
  - Programmable gain amplifier with gains from 1 to 32 with low temperature drift
  - High precision internal voltage reference with low temperature drift
- **Security**
  - Tamper detection with time stamping
  - Random number generator, memory protection unit
- **Interfaces**
  - LCD segment driver up to 288 (8x36) segments
  - High accuracy RTC +5 ppm over temperature range
  - 4x UART, 2x SPI, 2x IIC



# Kinetis W Series

*From Antenna to Bits*

*with ARM® Cortex™ -M0+ & Cortex™ -M4*

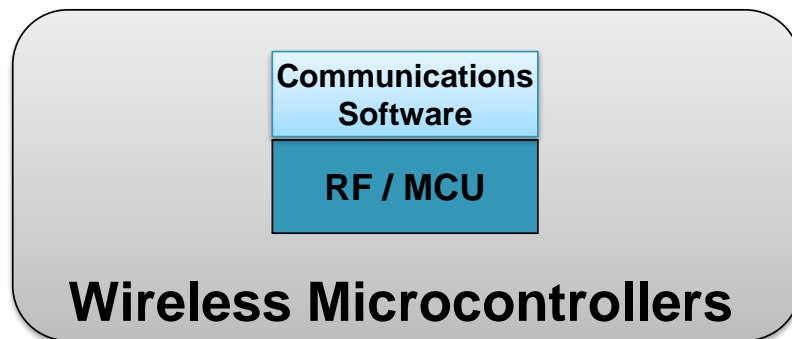


[www.freescale.com/kinetis/WSeries](http://www.freescale.com/kinetis/WSeries)



# Freescale Wireless Connectivity Strategy

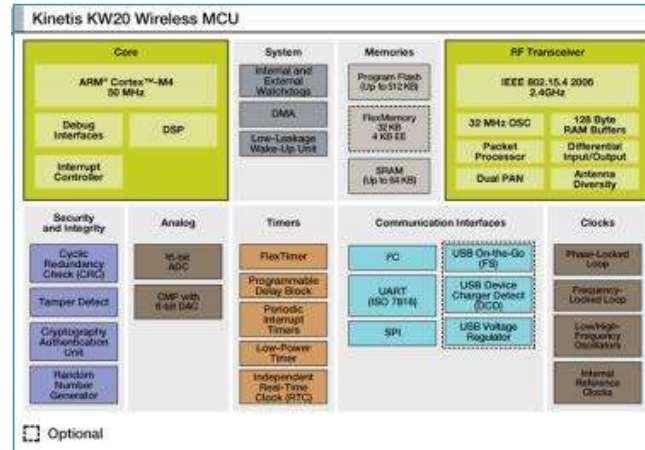
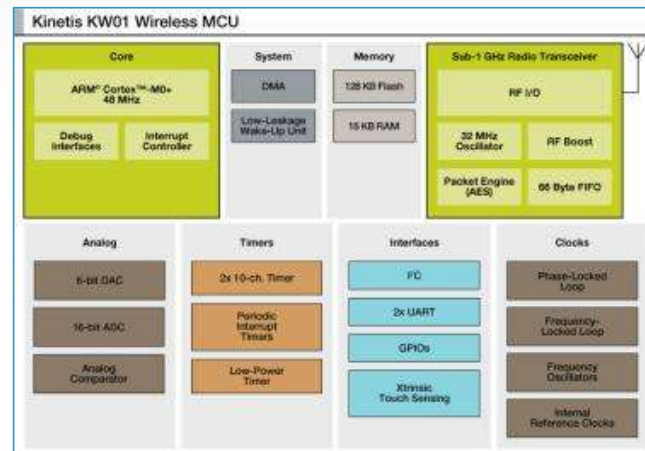
To provide all wireless solutions (from antenna to bits) required for control and monitoring applications in consumer, residential, metering, medical and industrial applications.



- All ISM frequency bands: **315 MHz, 434 MHz, 868 MHz, 915 MHz, 2.4 GHz**
- **Scalable wireless protocol:** From simple point-to-point lightweight protocol, up to full ZigBee-compliant applications.

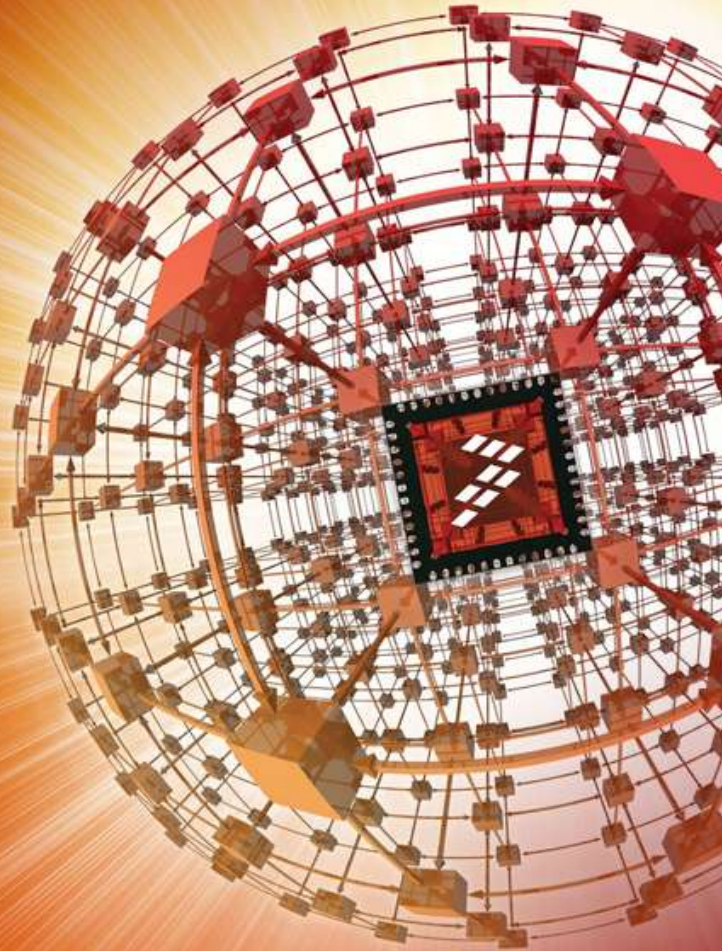
# Kinetis W – ARM® Cortex™-M & RF Transceiver

- KW01
  - Up to 48 MHz Cortex™-M0+ with Ultra-Low-Power
  - RF transceiver supports 290-340 MHz, 424-510 MHz, and 862-1020 MHz frequency bands
- KW20
  - Up to 50 MHz Cortex™-M4 with 16-channel-DMA
  - Highly integrated 2.4 GHz RF transceiver
  - 802.15.4 Packet processor





# Communication Protocol Stacks



[www.freescale.com/BeeKit](http://www.freescale.com/BeeKit)



## 2.4GHz Protocol Stack Comparison

Feature	SMAC	SynkroRF	ZigBee RF4CE	ZigBee 2007-PRO	ZigBee IP
Typical Applications	Cable Replacement	Cable Replacement	RF Remote Control	Home Automation	Smart Energy 2.0
	Wireless Toys and Games	Wireless Control	Home Entertainment and Control	Smart Energy 1.x	
			Home Automation	Building Automation	
				Health Care	
Network Stack	No	Yes	Yes	Yes	Yes
Network Profiles	No	No	Yes	Yes	Yes
Memory Requirements	4-8K	32K	<40K	80-100K	256K min
Network Topology	Point-to-Point	Co-existing Star	Co-existing Star	Tree	Tree
	Star			Mesh	Mesh
Typical # of Nodes	2-100	32 per Controlled Device	32 per Target Device	2-250 ZigBee	IP limit
				2-1000 ZigBee Pro	
Typical IC Cost	\$1-2	\$2-3	\$2-3	\$3-4	\$4-5
Typical Data Throughput	50-115K	70-100K	70-100K	30-70K	30-70K

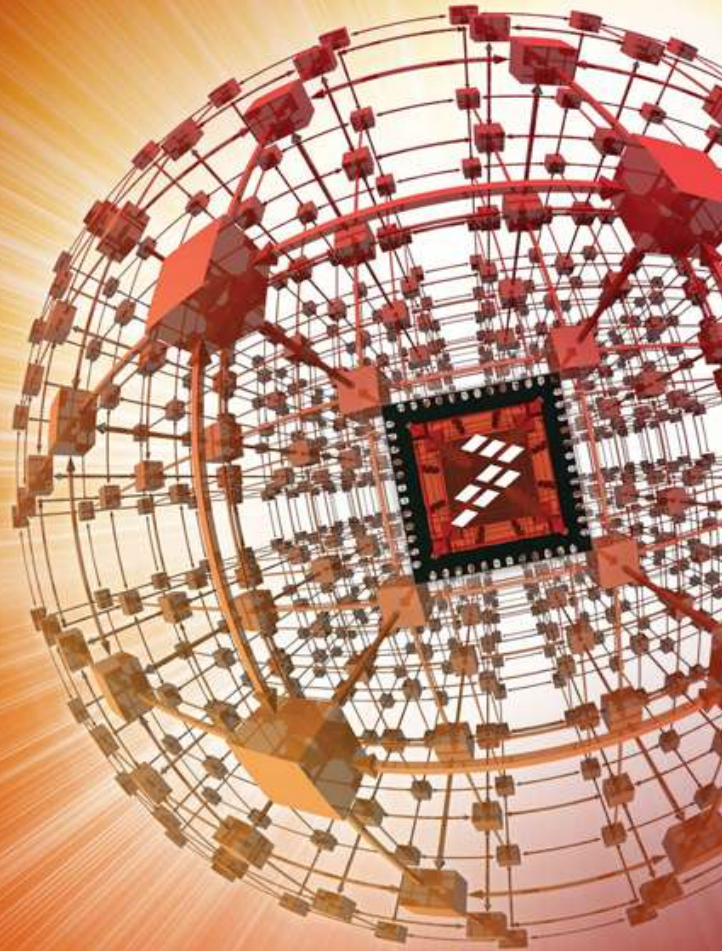


# Sub-GHz Protocol Stack Comparison

Feature	SMAC	802.15.4g	IPv6	Wireless M-Bus
Typical Application	Cable Replacement	Wireless Meter Reading	Internet of Things M2M	Wireless Meter Reading (Europe)
	Medical	Building Control		
		Medical		
Standard	Proprietary	IEEE 802.15.4	6lowPAN	EN 13757-4:2005
Network Stack	No	No	Yes	Yes
Network Profiles	No	No	No	No
Memory Requirements	4-8K	32K	128K	16-32K
Network Topology	Point to Point	Peer-to-Peer	IP	Point-to-Point
	Star	Tree		
		Mesh		
Typical # of Nodes	2-100	2-100	Not limited	2-100
Data Rate	200 Kbps	50-200 Kbps	1-600Kbps	32-100 Kbps
Protocol Stack Provider	Freescale	3 <sup>rd</sup> Party	3 <sup>rd</sup> Party	3 <sup>rd</sup> Party



# Kinetis Differentiators



[www.freescale.com/kinetis](http://www.freescale.com/kinetis)





# Kinetis Key Differentiators

- **Technology**

- **Low Power** - 90nm process technology with ten (10) flexible power-modes and wake-up logic. Supply voltage from 1.71V to 3.6V.
- **Performance** - Non-blocking bus-matrix-switch, K series with DSP extension in all sub-families, FLASH memory controller and MPU/DMA are only some features contributing, beside the ARM® Cortex™-M Core, for highest system performance in his class.
- **Flex-Memory** - FLASH- and SRAM-memory combined with a state-machine for EEPROM Emulation enables up to 10M erase/write cycles with fast access times.
- **Mixed-Signal** - 16-Bit ADCs, 12-bit DACs, High Speed comparators and additional “analog” peripherals
- **Security** - Hardware-accelerated security algorithms and tamper detection for secure communication and safe operation.
- **Touch-Sensing** - Hardware-supported capacitive touch-inputs with easy configuration through flexible touch-library.

- **Scalability**

With over 300 derivatives you will find the perfect fit for your application. Scalability is given between the series. Many common packages and functions make this an easy task.

- **Product Longevity**

Freescale guarantees longevity of selected devices. 10 years for industrial devices and 15 years for medical and automotive devices.

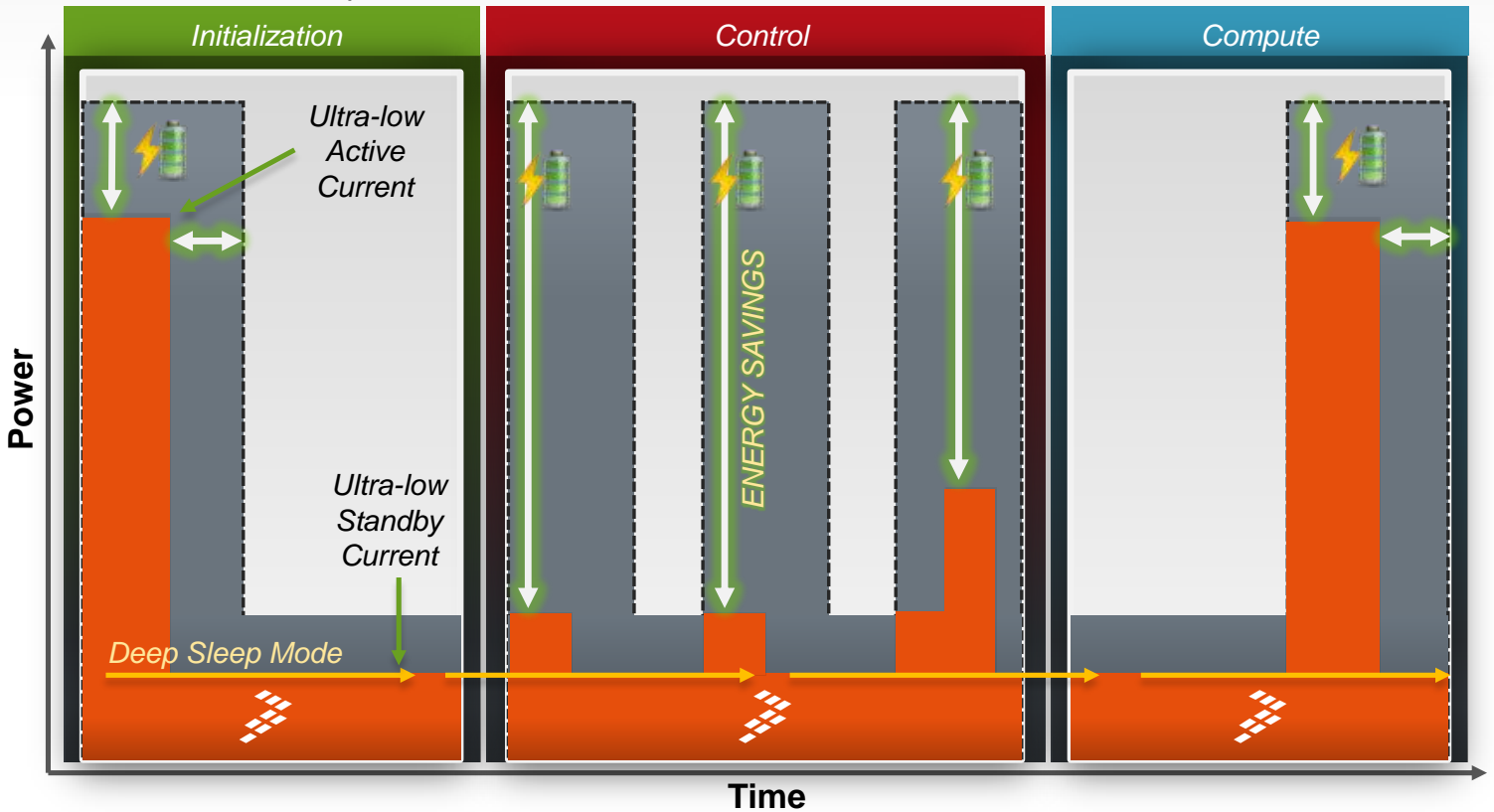


# Energy Efficiency: Energy = Power x Time

Very Low Active and Standby Power Consumption

Energy Saving Peripherals

Reduced Processing Time



RUN @3V, 48 MHz	83 uA/MHz
VLPR @3V, 4 MHz	39 uA/MHz

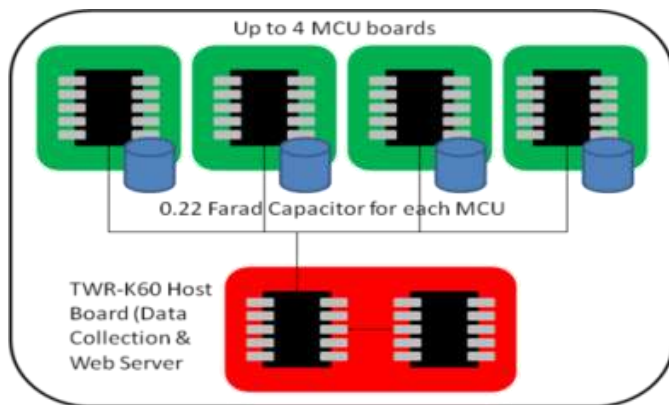
VLLS0 Deep Sleep @3V	205 nA
LLS Deep Sleep @3V	1.7 uA

CoreMark/MHz	1.77
LLS Wake-up Time	4.3 us



# Kinetis Energy Efficiency Demo

- Demonstrates energy efficiency of Kinetis devices
- Uses CoreMark benchmark
- 4 sockets available for comparison
- Each socket with own .22F Cap
- Configurable compute/sleep ratio
- Webserver interface

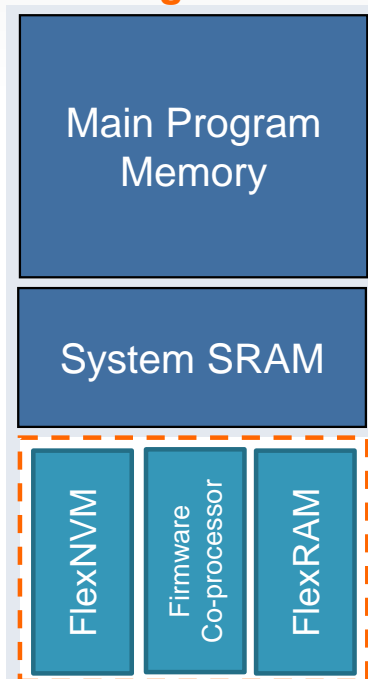


# What is FlexMemory?

## EEPROM

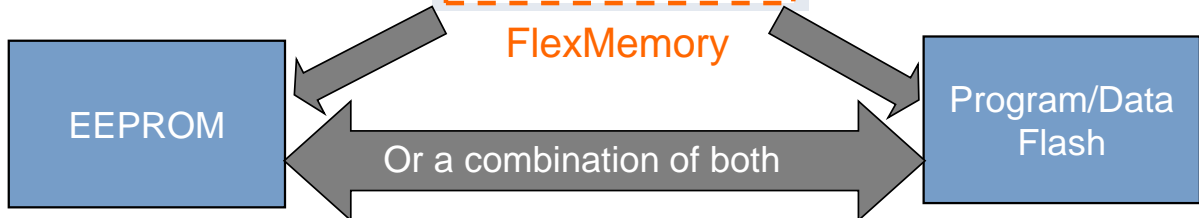
- No external EEPROMs
  - Reduced system cost
- No system resource impact
  - System performance maintained
  - No complex coding schemes
- Configurable & high endurance
  - Up to 10 Million w/e cycles
- High performance
  - Fast write time = ~100  $\mu$ Sec
  - Erase+write = 1.5 mSec
- Use cases
  - Critical data retention (power loss)
  - Frequently updated data

## User Configurable As...



## Program or Data Flash

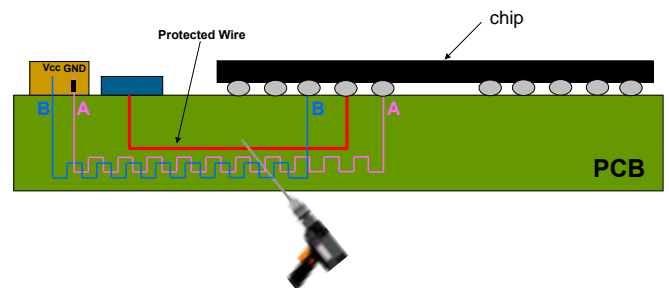
- Flexibility
  - Space for future expansion needs
  - Contiguous with main program Flash
- Efficient
  - Read-while-write with the main program Flash
- Use cases
  - Program Flash: bootloader code space
  - Data Flash: large data tables





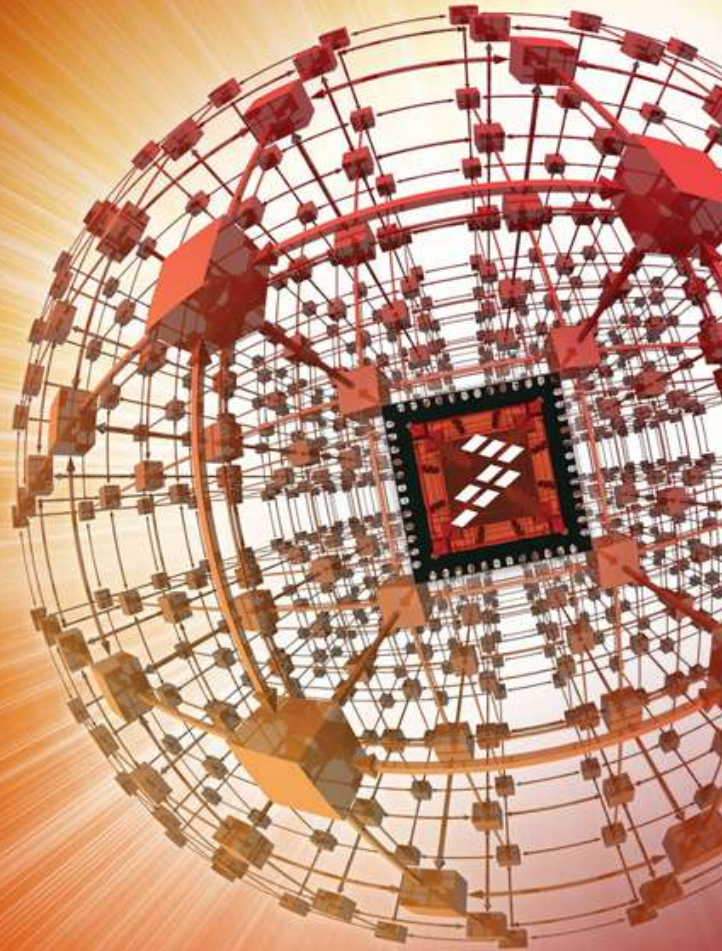
# Kinetis Security Summary

- The entire (current) Kinetis family includes enhanced Flash security, with user selectable:
  - Security bit, disables external and debug access
  - Backdoor access enable
  - Factory access enable
  - Block erase & re-program disable
  - Hardware protection against "Noise injection" attacks
  - Memory Protection Unit
  - 128-bit unique part identifier
- K21, K60 and K70 120/150 MHz parts in 256 MAPBGA packages, and K11/K21 50 MHz parts add:
  - Battery backed up Tamper detection, monitoring-
    - Supply voltage
    - Clock frequency
    - Temperature
    - External sensors
    - External physical tampering (e.g. drilling into PCB)
  - 256-bit secure user storage (key), erased on tamper
  - Secure real time clock



# Kinetis

*Scalability and  
Product Longevity*

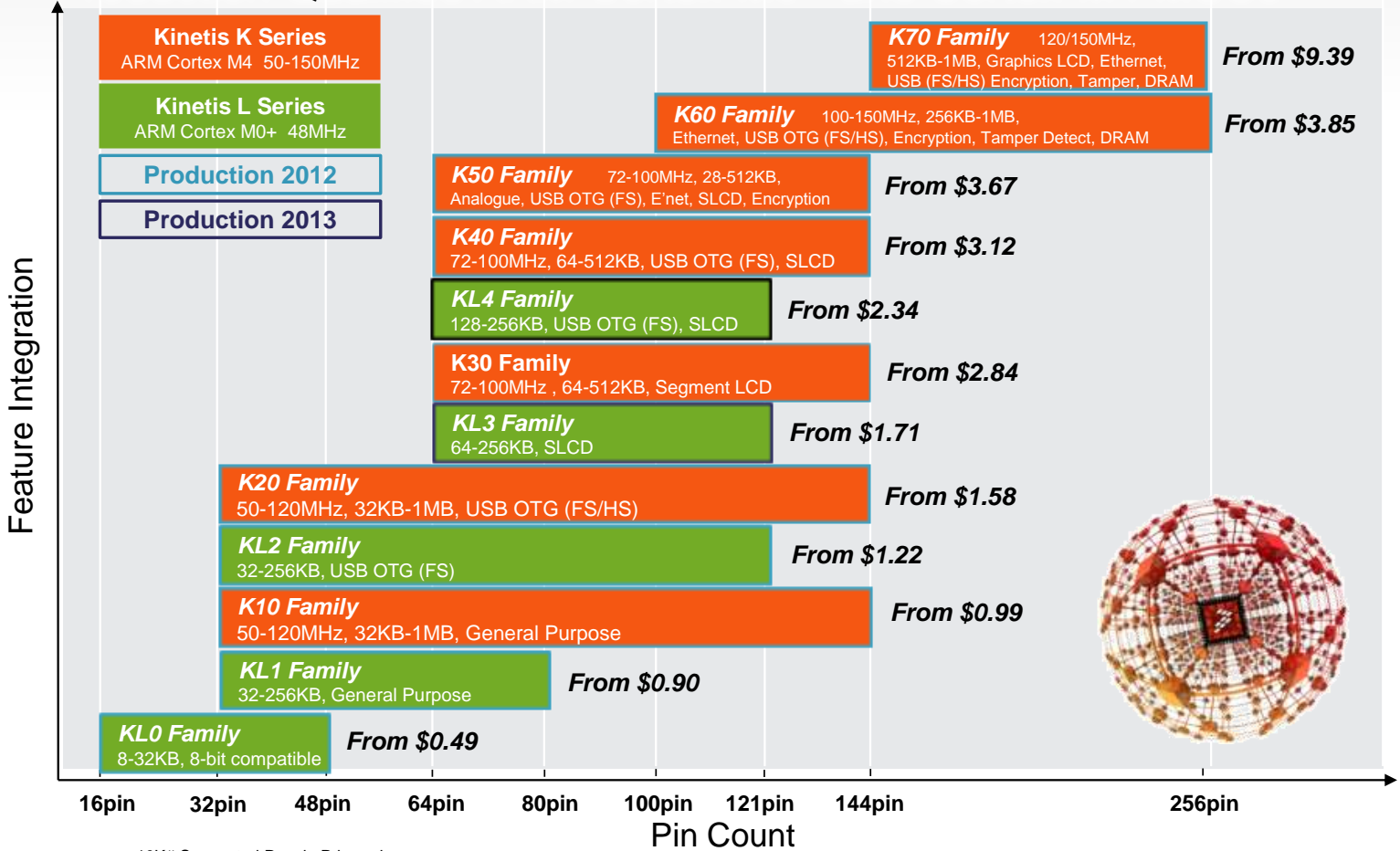


[www.freescale.com/kinetis](http://www.freescale.com/kinetis)



# Kinetis Portfolio Scalability

## Production Qualified ARM Cortex-M0+ and Cortex-M4 MCUs



10K# Suggested Resale Prices shown



**Kinetis K Series Package**  
**Kinetis L Series Package**

# Kinetis K/L Series: Packaging

## Common Packages



32QFN  
5 x 5 mm  
0.5mm pitch  
(K10/20)  
(KL0/1/2)



48QFN  
7 x 7 mm  
0.5mm pitch  
(K10/20)  
(KL0/1\*/2\*)



48LQFP  
7 x 7 mm  
0.55mm pitch  
(K10/20)  
(KL0/1\*/2\*)



64LQFP  
10 x 10 mm  
0.5mm pitch  
(K10/20/30/40/50)  
(KL1/2/3/4)



80LQFP  
12 x 12 mm  
0.5mm pitch  
(K10/20/30/40/50)  
(KL1/2/3\*/4\*)



100LQFP  
14 x 14 mm  
0.5mm pitch  
(K10/20/30/40/50/60)  
(KL3/4)



64MAPBGA  
5 x 5 mm  
0.5mm pitch  
(K10/20)  
(KL1\*/2\*/3\*/4\*)



121MAPBGA  
8 x 8 mm  
0.65mm pitch  
(K10/20/30/40/50/60)  
(KL2/3/4)

### Kinetis L Series Only



20WLCSP  
2x2x0.56 mm  
0.4mm pitch  
(KL0)



25WLCSP  
2.3x2.3x0.56 mm  
0.4mm pitch  
(KL0\*)



35WLCSP  
2.55x3x0.56 mm  
0.4mm pitch  
(KL1\*/2\*)



16QFN  
3x3x1 mm  
0.5mm pitch  
(KL02)



24QFN  
4 x4x1 mm  
0.5mm pitch  
(KL0x)



32LQFP  
7 x 7 mm  
0.8mm pitch  
(KL0)

### Kinetis K Series Only



90WLCSP  
3.9x4.4x0.56 mm  
0.4mm pitch  
(K10/20\*)



110WLCSP  
3.9x4.4x0.56 mm  
0.4mm pitch  
(K10/20\*)



120WLCSP  
5.3x5.3x0.56 mm  
0.4mm pitch  
(K10/20/60)



143WLCSP  
6.5x5.6x0.56 mm  
0.4mm pitch  
(K61)



144LQFP  
20 x 20 mm  
0.5mm pitch  
(K10/20/30/40/50/60)



144MAPBGA  
13 x 13 mm  
1.0mm pitch  
(K10/20/30/40/50/60)



256MAPBGA  
17 x 17 mm  
1.0mm pitch  
(K60/70)



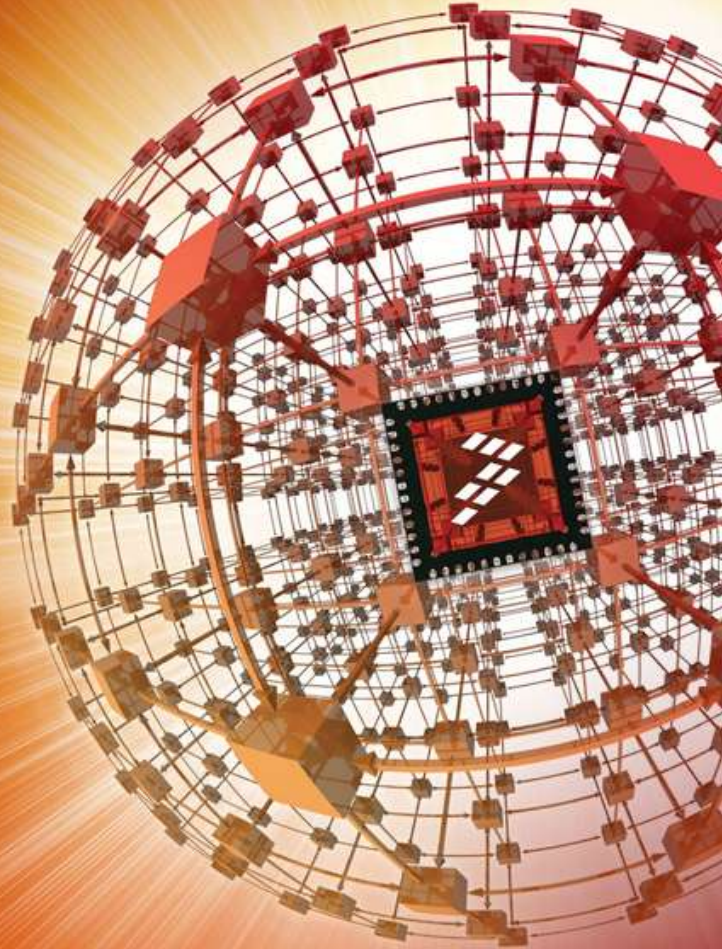


# Freescale Product Longevity Program

- 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](http://www.freescale.com/productlongevity)



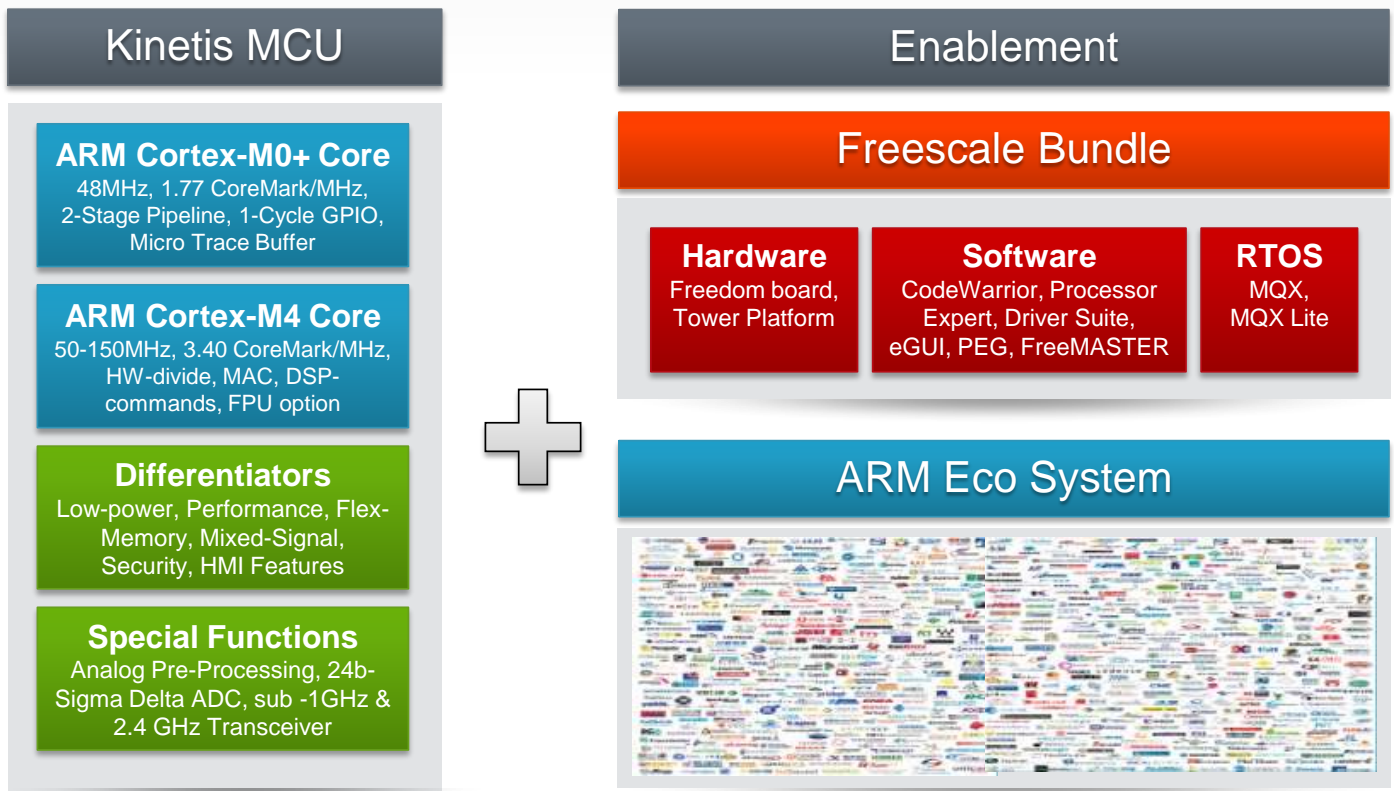
# Kinetis Enablement Overview



[www.freescale.com/kinetis](http://www.freescale.com/kinetis)

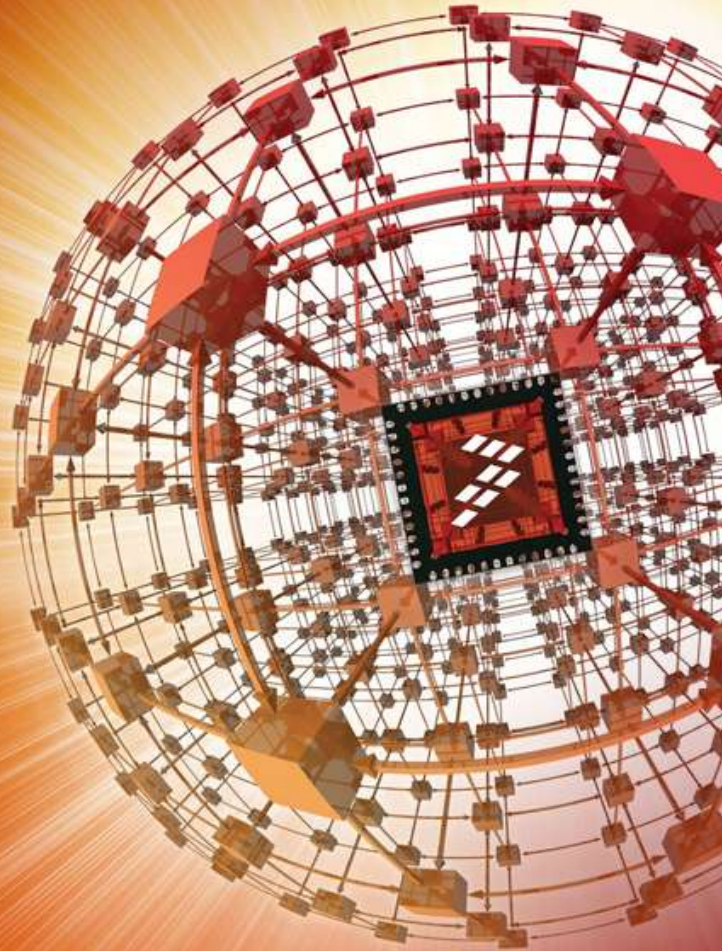


# Kinetis Enablement Overview





# Kinetis Development Hardware



[www.freescale.com/kinetis](http://www.freescale.com/kinetis)





## Freedom Platform

- small, low-power, cost-effective evaluation and development system
- quick application prototyping and demonstration
- Low-cost (\$10–15 MSRP)
- Designed in an industry-standard compact form factor
- 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-KL02Z\*

FRDM-KL26Z\*

FRDM-KL05Z

FRDM-KL46Z\*

FRDM-KL25Z

FRDM-K20D50M\*



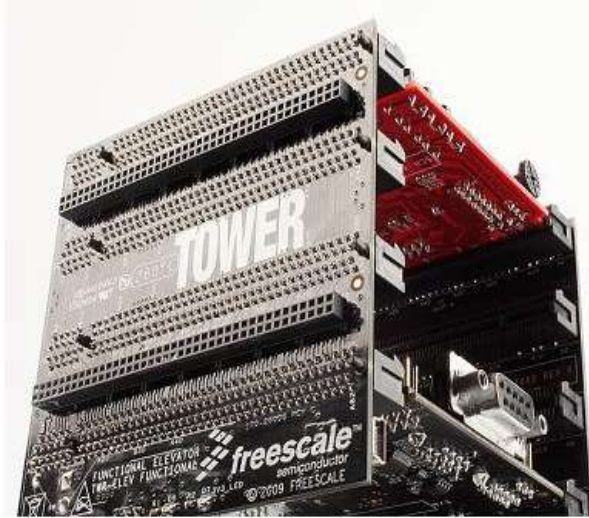
\*coming soon

37

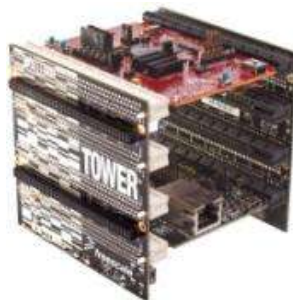
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# Freescale Tower System

- Modular development platform
- Also for rapid prototyping
- Interchangeable and reusable modules
- Open source design files
- Easy to customize
- Reduced low level design effort
- Sold in kits or as individual modules
- Processor modules with debug interface and stand-alone operation.
- Cost effective



[www.freescale.com/tower](http://www.freescale.com/tower)



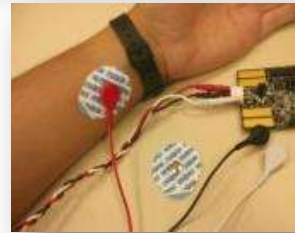
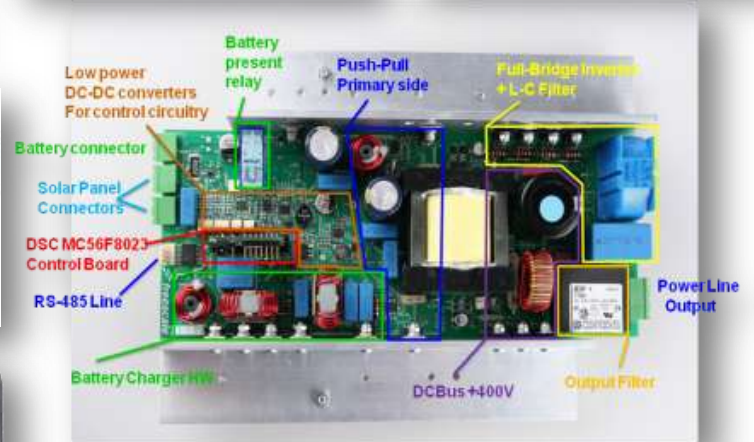
# Device Specific Evaluation Boards

- Evaluation boards addressing special functions and capabilities of Kinetis devices.





# Reference Designs



# Kinetis tools by our Channel Partners

## Avnet WiGo

- Freedom Add-on board
- WiFi-Module & LiPo Battery
- Many sensors accessible through web-server



## Future - Intersil

- Intersil high-precision analog & power devices
  - Pressure/Strain
  - Thermocouple
  - Power
- Freedom add-on board



## Arrow Cloud Connect

- Free online tool chain
- Supports Freedom Platform
- Code library & knowledge base
- iDigi Internet of Things Interface





# The ARM® Eco System

Use the broad support for ARM® microcontroller by many companies.

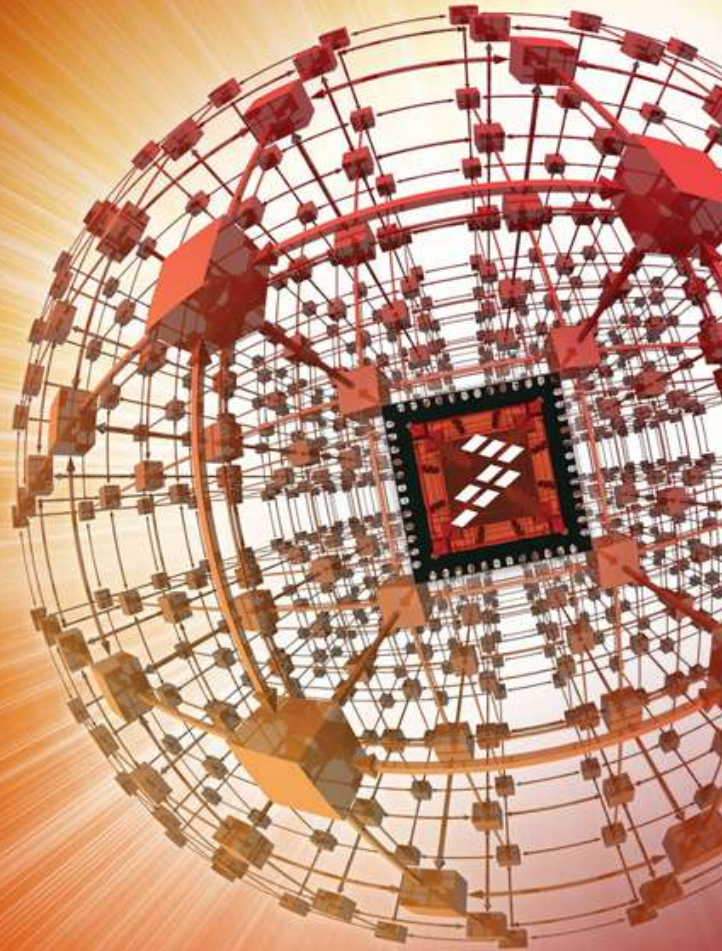
- Re-use your existing debugger and programmer for Freescale Kinetis.



Rowley Associates



# Kinetis Development Software



[www.freescale.com/kinetis](http://www.freescale.com/kinetis)

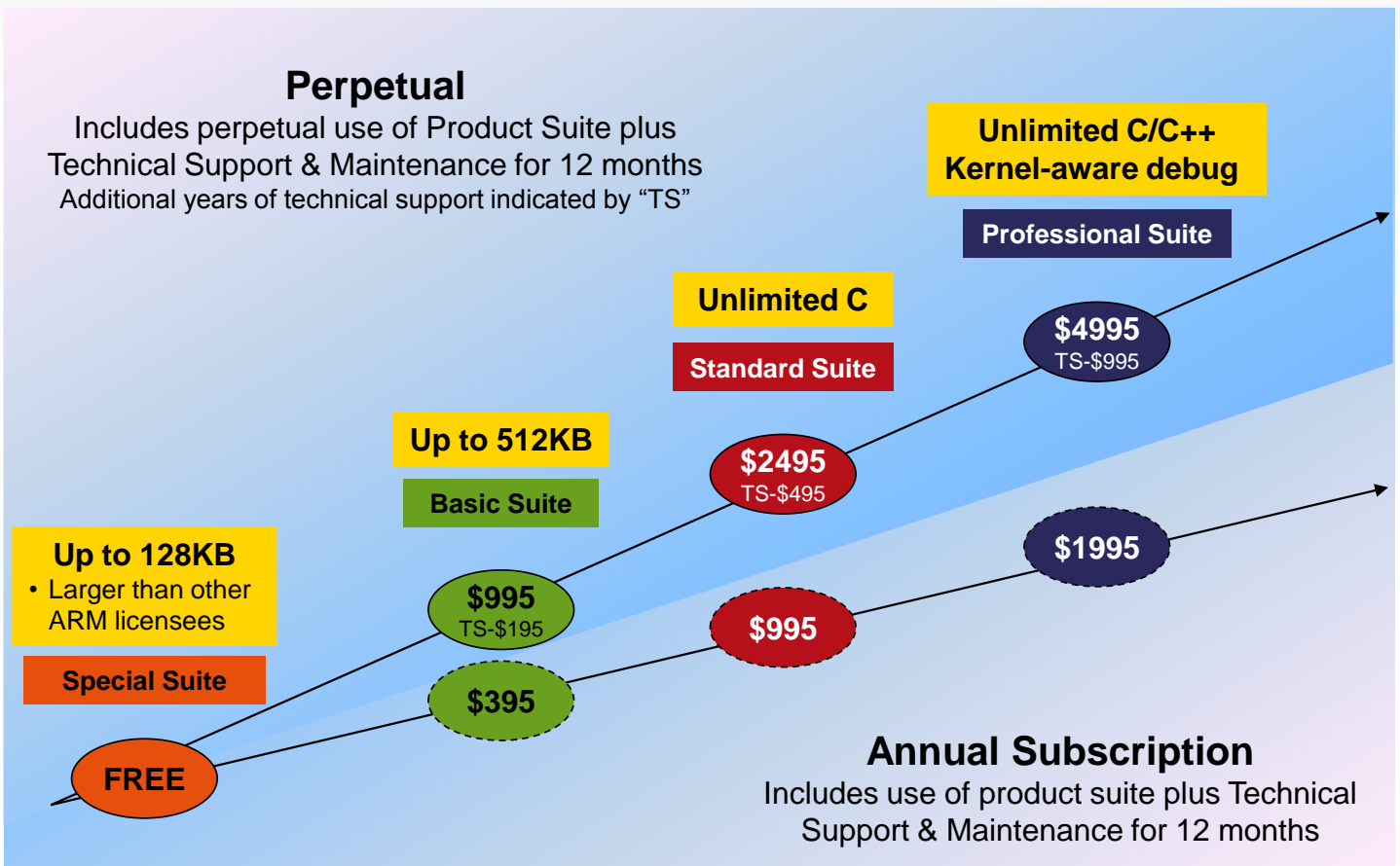


# Overview CodeWarrior

- Freescale's design environment
- CW for Microcontrollers from 10.x on is Eclipse based
- Different versions available Basic, Standard, Professional
- Free „Special Suite“ with 64k (CM0+) / 128k (CM4) code size limit
- Adds GCC 4.7.3 in CodeWarrior version 10.3 update 1.0.0



# CodeWarrior Pricing and Packaging Model





# Processor Expert Concept

- **Processor Expert**
  - Provides features that fully support design time configuration
- **Configuration of Whole Device**
  - Configuration of selected CPU
  - Configuration of components selected by user needed in application
- **Code Generator**
  - Able to generate both:
    - Drivers code
    - Required configuration files
  - Settings are reflected in generated code
    - Changing settings requires re-generate the code
- **Basic Element of the Processor Expert is Embedded Component**
  - Components can be seen as objects that represents design time configuration and run time code (methods and events)





# Embedded Components

- **Component**

- Building block of an application
- Functionality separated into small objects
- Components have interface (similar way classes have in object-oriented programming)

- **Properties**

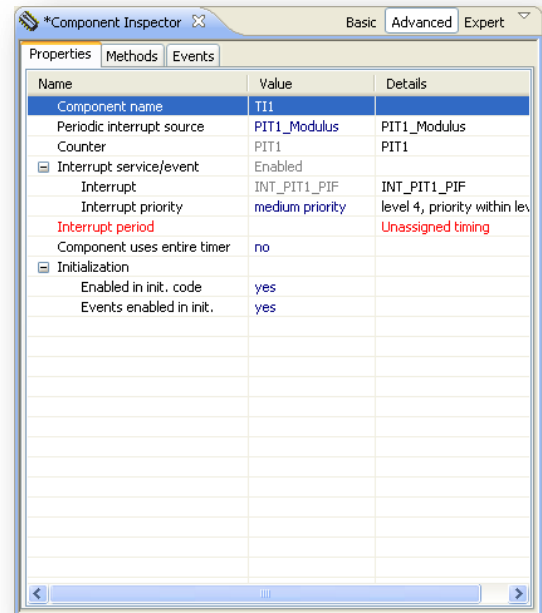
- Modify/Customize object behavior
- Set during design-time

- **Methods**

- Procedures that can be executed
- Function calls

- **Events**

- Indication of state changing
- Usually implementation of ISRs



# Processor Expert: On-line Training

CodeWarrior version

Microcontroller Driver Suite  
(Standalone / 3<sup>rd</sup> party version)



[Processor Expert: Introduction \(CodeWarrior\)](#)



[Processor Expert: Working with Components \(CodeWarrior\)](#)



[Processor Expert: The Code Model \(CodeWarrior\)](#)



[Processor Expert: Creating an MQX Lite Project \(CodeWarrior\)](#)



[Processor Expert: An MQX Lite Example \(CodeWarrior\)](#)



[Processor Expert: Exporting and Importing Templates \(CodeWarrior\)](#)



[Processor Expert: Introduction \(Driver Suite\)](#)



[Processor Expert: Working with Components \(Driver Suite\)](#)



[Processor Expert: The Code Model \(Driver Suite\)](#)



[Processor Expert: Creating an MQX Lite Project \(Driver Suite\)](#)



[Processor Expert: An MQX Lite Example \(Driver Suite\)](#)



[Processor Expert: Exporting and Importing Templates \(Driver Suite\)](#)



[Processor Expert: Integrating with IAR Embedded](#)



[Processor Expert: Integrating with Keil Microvision](#)



# mbed.org – What is it?

mbed

## Tool for Rapid Prototyping with Microcontrollers

mbed servers

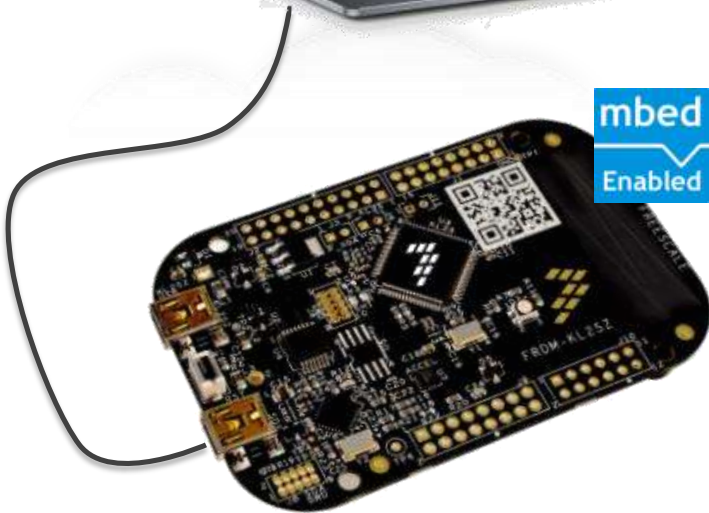


- **Web-based Development:**

- Online IDE
- Software Libraries
- Robust Community

- **OpenSDA on FRDM-KL25Z running mbed interface:**

- Serial Communications
- Flash Programming
- Run-control debug



[www.mbed.org](http://www.mbed.org)

# CooCox.org

- **4 steps to build an APP in CoIDE**
  - Select device, Add & Configure code components, Build, Debug & Download
- **Specially customized and simplified Eclipse CDT**
  - according to the conventional using habits of embedded developers
- **CoX library consists of 15 code components**
  - GPIO, UART, SPI, I2C, Timer, PWM, RTC, WDT, ADC, ACMP...
- **At least 1 example for each on-chip peripheral**
- **Detailed help documentation in Doxygen format**
- **Free and timely technical support**

# CooCox

Efficient Software Tools

Open Source RTOS & Drivers



[www.CooCox.org](http://www.CooCox.org)

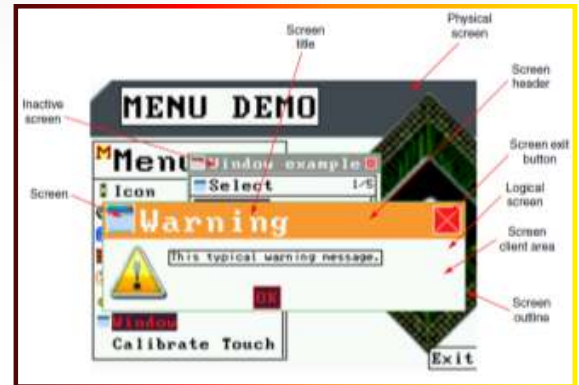


# eGUI: Free Graphics LCD Driver

- Lightweight software component allowing graphics LCD panels to be driven from small microcontrollers
- Structure of driver brings complete software solution for applications needing a LCD screen
- Very light RAM and FLASH footprint
- The Freescale eGUI can be used stand alone or integrated into the MQX operating system.

## • Features

- Multiple platforms supported: S08, HCS12, ColdFire.
- Extremely low flash and RAM footprint so that it can easily be used in a small MCU system.
- Smart support for screen oriented structure of user code.
- Supports LCD displays up to 1/4 VGA for MCU and larger for MPUs supported.
- Touch screen support.
- Tower LCD board supported.
- Easily ported to new display/controller combinations



 **freescale**™ [www.freescale.com/egui](http://www.freescale.com/egui)



# Portable Embedded GUI (PEG)

## PEG Pro™

Support for touchscreen displays, multi-layer alpha-blended graphics, high color depths and open GL support

## PEG+™

Most portable graphics software package for high-performance embedded displays

## C/PEG™

One of the smallest footprint solutions available for embedded GUIs



- Screen transitions
- Multiple alpha-blended windows
- True anti-aliasing
- Gradient manager
- Open GL support
- Written in C++

**Starting 225KB**  
**Typical 225-250KB**



- Multiple window updates
- Alpha-blended images
- Run-time image decoders & language resources
- Custom widget integration
- Dynamic themes
- Written in C++

**Starting at 128KB**  
**Typical 160-175KB**



- Designed for:
  - Small LCDs (QVGA)
  - Low colour-depth
- Very small footprint
- Single window update
- Multi-language capable
- Written in ANSI C

**Starting at 64KB**  
**Typical 90-110KB**

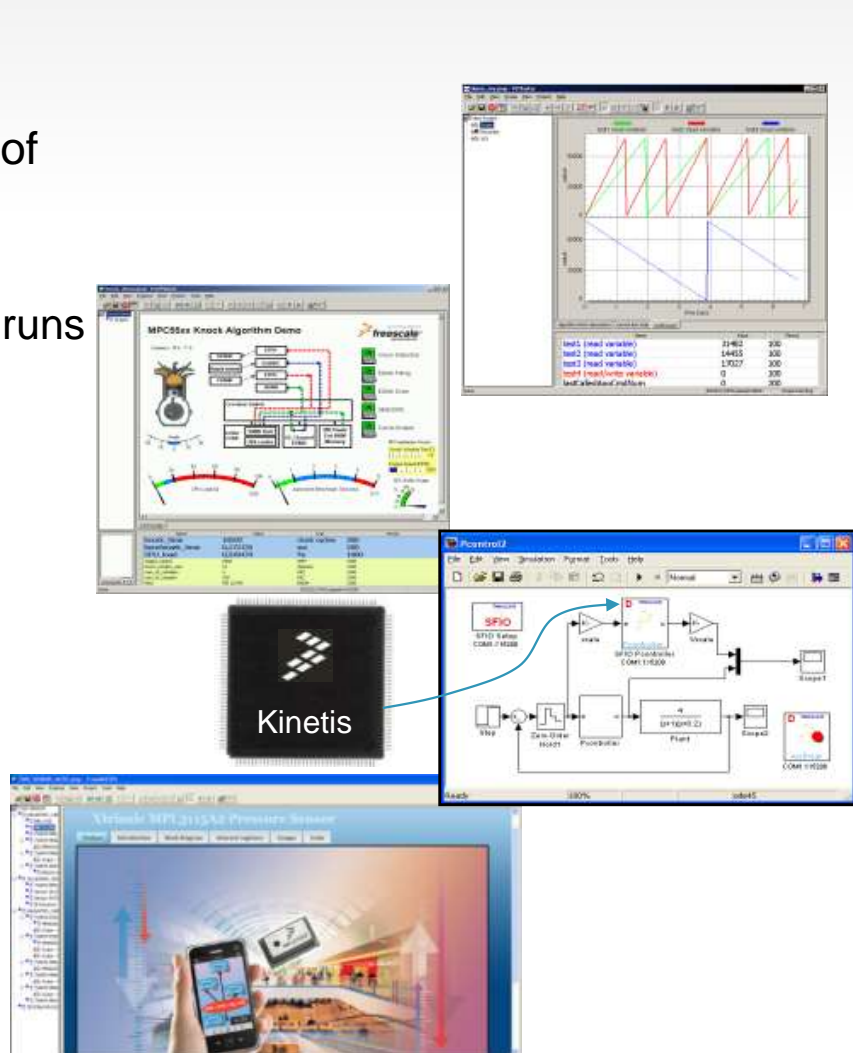


[www.freescale.com/PEG](http://www.freescale.com/PEG)

# FreeMASTER

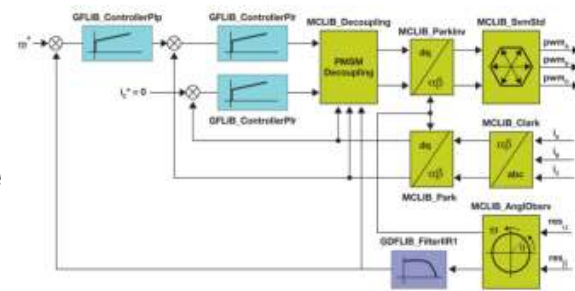
- Real-time monitor and control of an app
  - Track your variables
  - Modify them while the system runs
- Data visualization
  - Design your own dashboard
- Data streaming – e.g...
  - Send it to MATLAB® via FreeMASTER
- Demonstration platform
  - A product packaging tool

[www.freescale.com/FreeMASTER](http://www.freescale.com/FreeMASTER)



# Embedded Software and Motor Control Libraries

- Wide group of algorithms
  - basic mathematics, logic, controllers, modulations, transformations up to advanced observers
- Tool for beginners as well as for professionals
  - motor control, power conversion, UPS etc.
- Libraries are optimized, tested and easy to use
- Implemented with C-callable function interface
- Implemented Algorithms
  - Sine , Cosine , Tangent , Arcus Sine, Arcus Cosine, Arcus Tangent, Arcus Tangent, Shifted Arcus Tangent, Square Root, Ramp, Limiter, Hysteresis, Signum, Look-up Table, PI Controller ,
  - Clarke Transformation, Inverse Clarke Transformation, Park Transformation, Inverse Park Transformation, Space Vector Modulation, Vector Limiter, PMSM Decoupling, DC Bus Ripple Elimination
  - IIR filter, Moving avg. filter



## Embedded Software and Motor Control Libraries

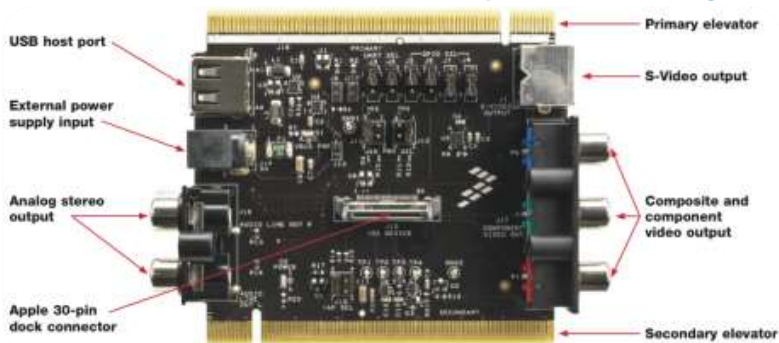




# Freescale's Made For iPod (MFi) Solutions

## Freescale's MFi solutions are based on the TWR-DOCK peripheral module

- TWR-DOCK supports development and rapid prototyping of electronic accessories for iPod, iPhone and iPad devices
  - Available to MFi licensees on the MFi portal for \$139
  - Direct 30-pin dock connection
  - USB A receptacle for USB to 30-pin dock or Lightning™ cable connection
  - Analog audio and video signals with standard RCA and S-Video connectors
  - Digital audio streaming in both directions over USB
  - Control and communication with various devices
- Includes free interface software
- TWR-DOCK concentrates all MFi controlled items on one Tower module, without including any processors or other Freescale products
- TWR-DOCK may be used with a wide range of Tower System MCU/MPU, peripheral, sensor and communication modules
- Kinetis-based demos are available
- *Vybrid support planned for early 2013*
- ***A new TWR-DOCKx is in development for direct Lightning dock connection***



[www.freescale.com/MFi](http://www.freescale.com/MFi)

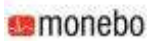
# The ARM® Eco System

Use the broad support for ARM® microcontroller by many companies.

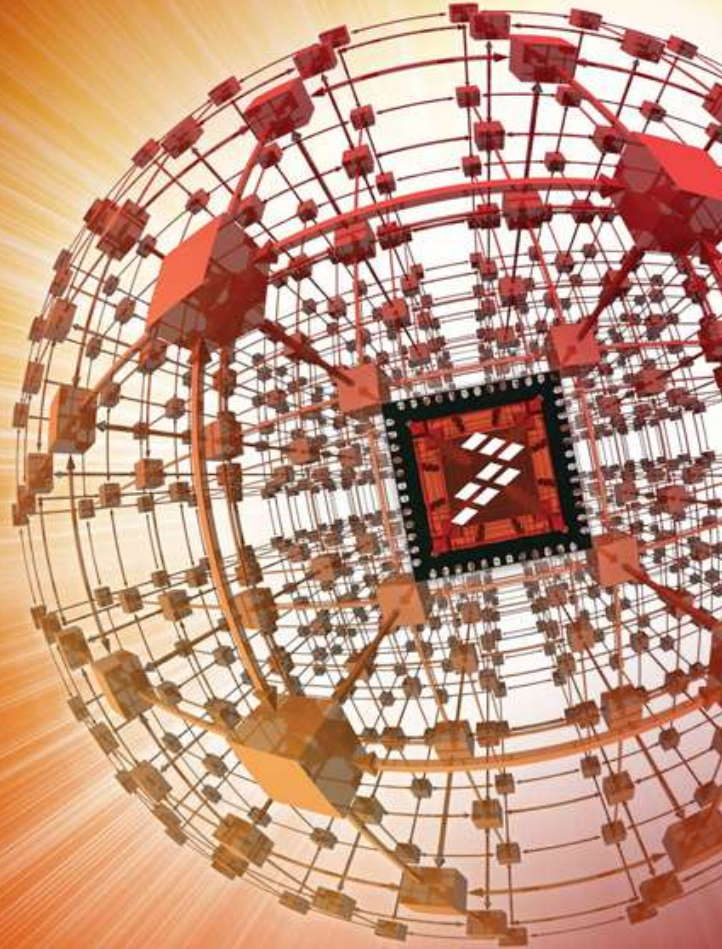
- Re-use your existing IDE and Middleware for Freescale Kinetis.



GNU Tools



# Kinetis Operating Systems



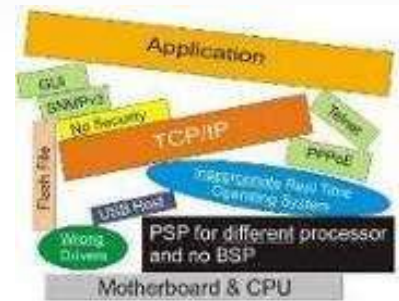
[www.freescale.com/MQX](http://www.freescale.com/MQX)



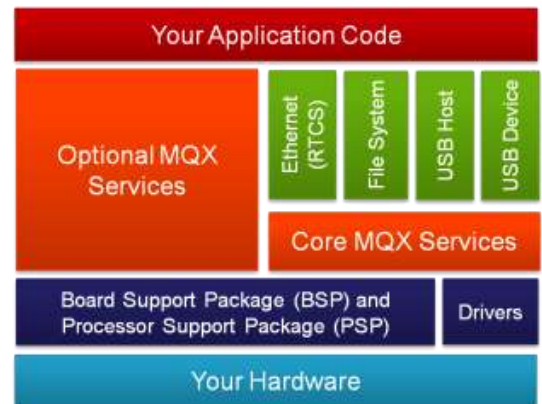


# Why MQX™?

- MQX is a run-time library of functions that programs use to become real-time multi-tasking applications.
- The main features are its scalable size, component-oriented architecture, and ease of use.
- MQX supports multi-processor applications and can be used with flexible embedded I/O products for networking, data communications, and file management



Past Customer Problem



MQX, the Solution





# MQX Lite RTOS - Overview

- **Very light MQX kernel for resource-limited MCUs**
  - Targeted at the Kinetis L family initially
  - Packaged as a Processor Expert component
- **I/O capability provided by Processor Expert**
  - USB via FSL bare-metal stack, also a Processor Expert component
  - No POSIX-like drivers or file access
- **Programming model allows upward code migration**
  - A true subset of the full MQX RTOS
  - Code built with MQX Lite will move to full MQX RTOS easily
  - Same task templates, same API – some very minor differences
- **Available as a component within the following Freescale s/ware offerings:**
  - Processor Expert software, MCU driver suite – Supports IAR, Keil, and GCC compilers / build chains
  - CodeWarrior Development Studio V10.3



# MQX Lite RTOS - Benefits

- ✓ **Easy to configure**
  - ✓ Packaged as a Processor Expert component; with configurable options: set name of task function, priority, stack size (all the same parameters as an MQX task)
- ✓ **Easy to add existing application**
  - ✓ Just drop in the MQX Lite RTOS component, and get started in minutes
- ✓ **Very light-weight**
  - ✓ Minimal app (Hello task, idle task, interrupt stack) – less than 4 KB RAM; optimized for resource-limited MCUs like Kinetis L Series family
- ✓ **I/O capability provided by Processor Expert software**
  - ✓ Take advantage of the broad spectrum of MCU logical device drivers; with access to libraries/stacks like USB Processor Expert component
- ✓ **Real-time, priority-based pre-emptive task switching**
  - ✓ Threads execute in order of priority, allowing high-priority threads to meet their deadlines consistently, no matter how many other threads are competing for CPU time
- ✓ **Programming model allows upward code migration**
  - ✓ MQX Lite RTOS is a true subset of the full MQX RTOS: code built with MQX Lite RTOS will easily move to the full MQX RTOS

## MQX Lite with CodeWarrior Processor Expert



[Processor Expert: Creating an MQX Lite Project \(CodeWarrior\)](#)



[Processor Expert: An MQX Lite Example \(CodeWarrior\)](#)

## MQX Lite with Microcontroller Driver Suite Processor Expert



[Processor Expert: Creating an MQX Lite Project \(Driver Suite\)](#)

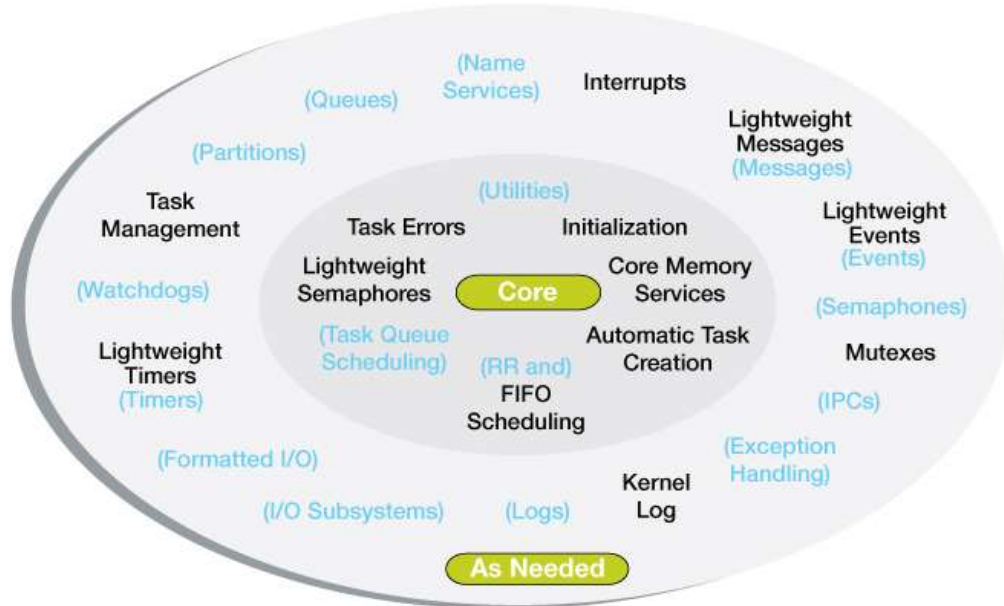


[Processor Expert: An MQX Lite Example \(Driver Suite\)](#)



# MQX vs. MQX Lite

Attribute	MQX RTOS	MQX Lite RTOS
Delivery Mechanism	Traditional installer with full source for Kernel, services and BSPs	Processor Expert (PEX) Kernel and services component, configurable software generated by PEX
I/O Drivers	MQX POSIX compatible drivers with option for using PEX drivers	PEX drivers only
Configurability	User selects needed services from full or lightweight versions	Reduced services available; lightweight options only



MQX Lite RTOS (MQX RTOS)



# The ARM® Eco System

Use the broad support for ARM® microcontroller by many companies.

- Re-use your existing RTOS know how for Freescale Kinetis.





# MCU Solution Advisor web application

[www.freescale.com/SolutionAdvisor](http://www.freescale.com/SolutionAdvisor)



The **Solution Advisor** helps you quickly identify best-fit processor solutions from the following portfolios:

- 8-bit MCU (microcontroller)
- Kinetis K Series MCU
- Kinetis L Series MCU
- PX Series MCU
- Freescale DSC (digital signal controller)

**Interactive MCU selector guide based on:**

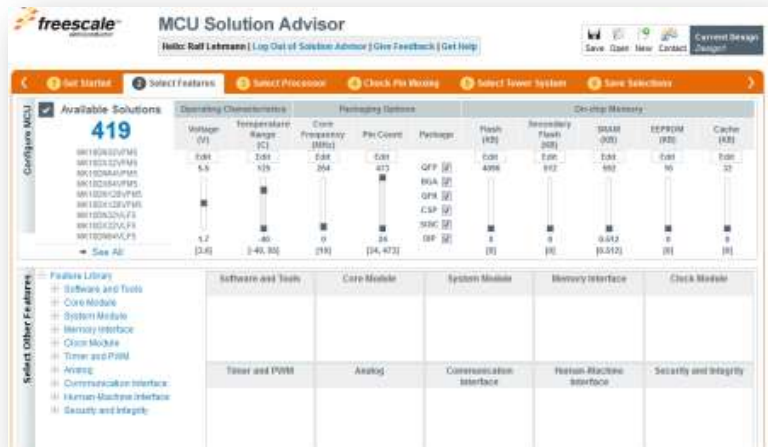
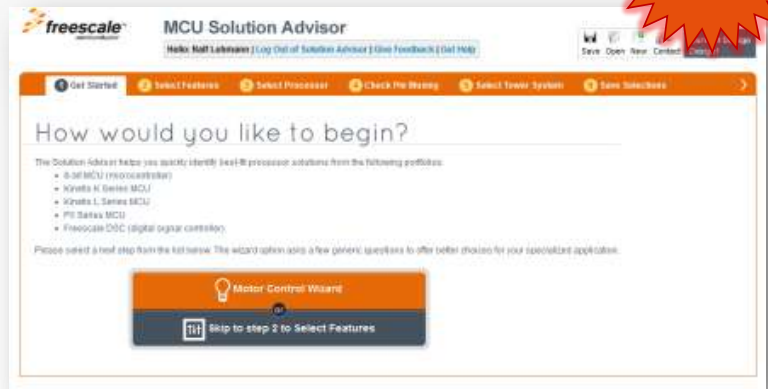
- operating characteristics
- packaging options
- memory and FlexMemory requirements
- a library of configurable hardware modules

Dynamic, sortable, downloadable solution matrix

**Pin Muxing verification and suggested placement**  
(Full functionality will be restored soon)

**Session and Contact Management**  
Save, restore, invite, and share

**Generates session summary reports**



# KINETIS SERIES

## DESIGN POTENTIAL. REALIZED



Ultra-Scalable	Mixed Signal	Energy Efficiency
<p>Market's most scalable portfolio of low-power ARM Cortex-M0+ and ARM Cortex-M4 MCUs with over 300 hardware and software compatible devices</p>	<p>Exceptional integration with fast 16-bit ADCs, DACs, PGAs and more. Powerful, cost-effective signal conversion, conditioning and control</p>	<p>The world's most energy-efficient and scalable MCU Series with power optimized peripherals and flexible power modes</p>
<p align="center"><b>Comprehensive Enablement</b>                      Freescale MQX RTOS, Tower System and Eclipse-based CodeWarrior IDE, as well as Kinetis support from most ARM ecosystem providers</p>		



