June 22, 2010

Building the Industry's Most Trusted Microcontroller Solutions

FTF-IND-F0660

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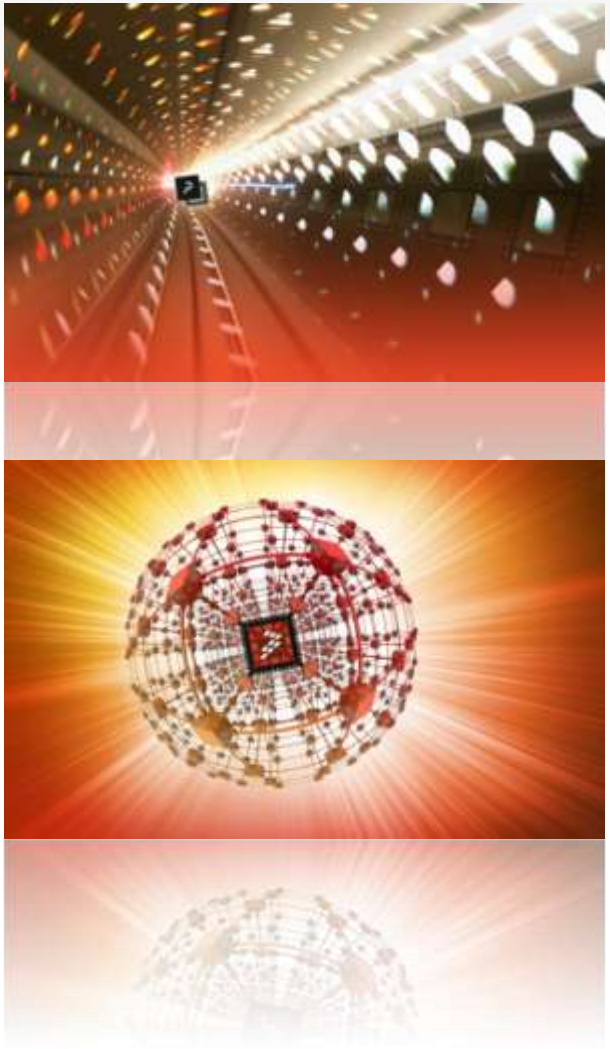
Global Launch Marketing Manager, Kinetis Brand

Agenda

- Announcement Review
- ColdFire+ Overview
- Kinetis Overview
- Enablement Solutions
- Feature Deep Dive
  - Application Use Cases
  - Competitive Landscape
- Conclusion



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... Building the Industry's **Most Trusted MCU Solutions**

1. **Extensive range** of integrated MCU products: **8-bit**, **16-bit** and **32-bit**
2. Innovative **IP roadmaps**, including TFS **flash technology** with ***FlexMemory***
3. Market-leading platforms supported by **vertical solutions** and **software enablement**
4. Outstanding **quality** and **technical support,** with 10+ years of assured supply

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MCU Portfolio: Solutions-Focused and Core Agnostic

32-bit	***Built on…*** **Power Architecture® Technology**	90nm	100-400+ MIPS	Market-leading **performance, reliability** and **software enablement** for **automotive** and **industrial** applications.
	ColdFire **ColdFire+**	NEW! 90nm	50-200 MIPS	**Application-oriented** solutions with **optimized enablement, integration** and **cost** for **appliance, metering** and **consumer** applications.
	Kinetis ***based on ARM® Cortex™-M4 core***	NEW! 90nm	50-200 MIPS	**Scalable, ultra-low-power** product families with **bundled software enablement** for **industrial** and **consumer** applications**.**
16-bit	**Digital Signal Controllers** **S12 and S12X**			**Application-oriented** solutions for **automotive, motor control** and **power conversion** applications.
8-bit	**RS08 and S08**			**Scalable cost** & **power-optimized product families** for **industrial**, **automotive** and **consumer** applications.

Giving customers an ideal solution regardless of architecture preference.

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. he Future of the Freescale Industrial and Multi-Market MCUs

New 90nm ColdFire+ Microcontrollers

Increased analog integration, ultra-low power consumption and optimized cost take ColdFire MCUs into the future

ColdFire+ *and* **Kinetis** solutions are supported by Freescale's industry-leading software enablement – CodeWarrior, MQX™ and Processor Expert

New 90nm Kinetis Microcontrollers

The most scalable portfolio of mixed-signal MCUs based on the ARM Cortex-M4 architecture in the industry

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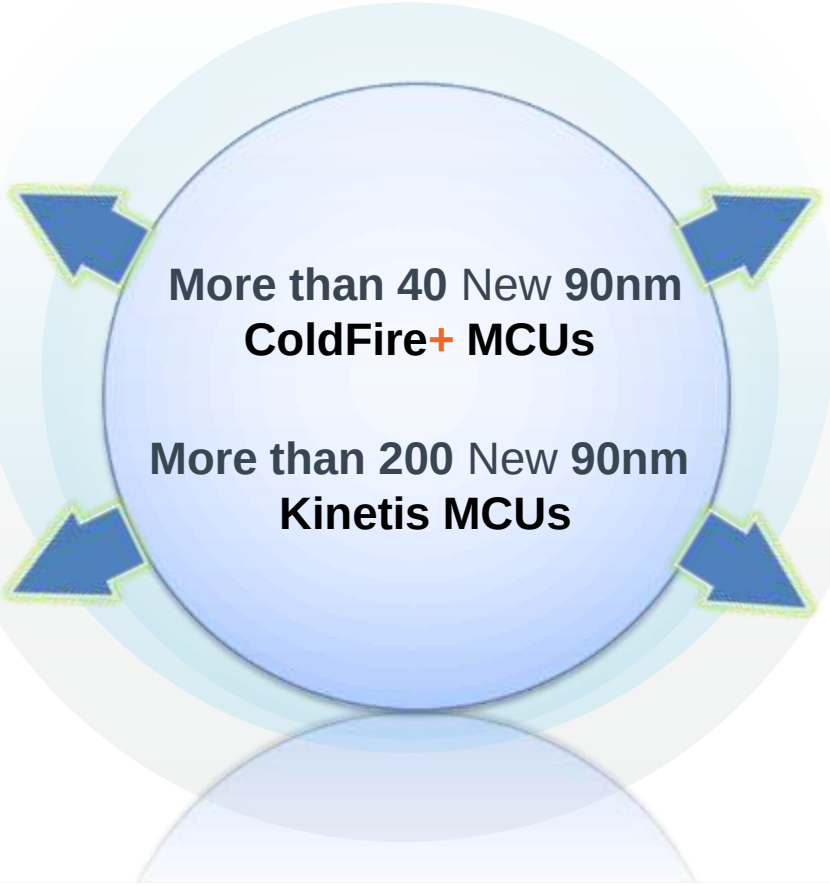
Expanding Freescale's Extensive 32-bit Solutions Portfolio

Market-leading software enablement – IDE, RTOS and initialization tools provided by Freescale and leading ARM ecosystem providers to speed time to market

Hundreds of new 32-bit **mixed-signal MCUs** with huge **performance, memory** and **feature scalability**



Innovative low-power **90nm thin film storage** flash process with **FlexMemory** EEPROM capability

Ultra-low power consumption with flexible power management to balance performance and battery life

More than **240 new 90nm 32-bit MCUs** in scalable product families

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ColdFire+ … Taking ColdFire MCUs into the Future

- **90nm Thin Film Storage Flash with FlexMemory**
  - Configurable embedded EEPROM
- **Innovative ultra-low-power capabilities**
  - Multiple power management modes, scaling down to 150uA/MHz run mode and <500nA stop current
- **Powerful analog and mixed-signal integration**
  - 16-bit ADC, 12-bit DAC, voltage regulators and hardware touch sense interface
- **Key Market Applications**
  - Integration of peripheral combinations ideal for consumer, medical, metering and appliance applications

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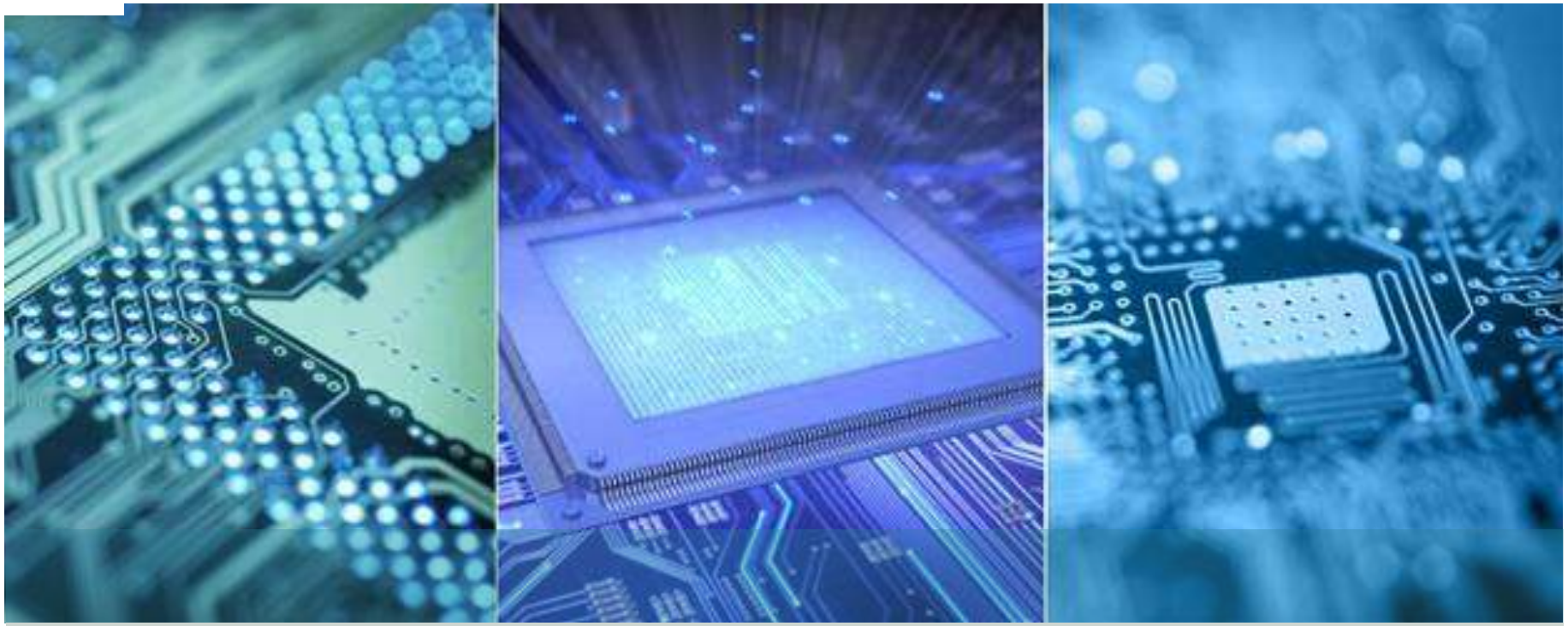


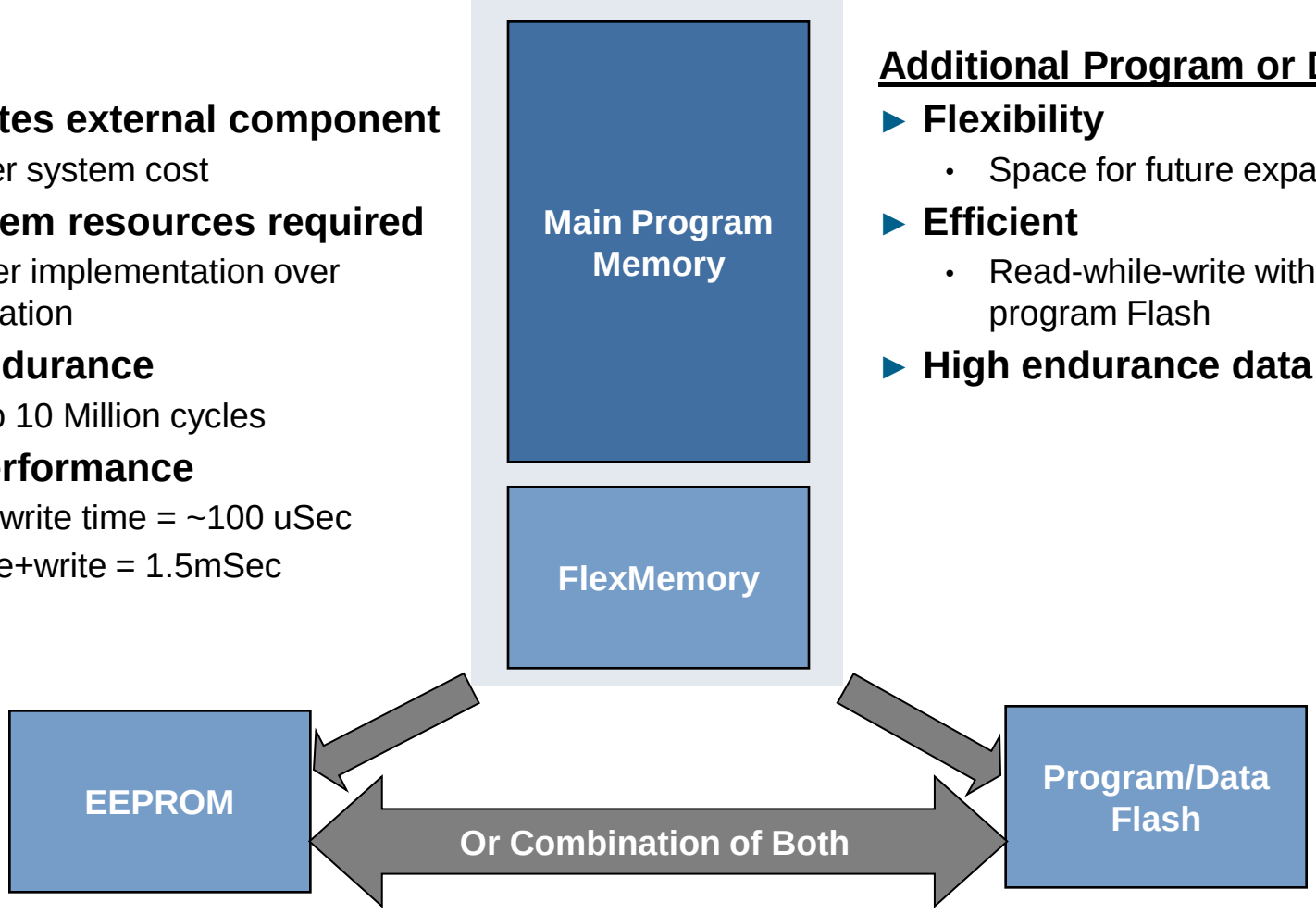
90nm Thin Film Storage (TFS) Flash with FlexMemory

What is FlexMemory?

User Configurable As…

EEPROM:

- **Eliminates external component**
  - Lower system cost
- **No system resources required**
  - Easier implementation over emulation
- **High endurance**
  - Up to 10 Million cycles
- **High performance**
  - Fast write time = ~100 uSec
  - Erase+write = 1.5mSec



Additional Program or Data Flash:

- **Flexibility**
  - Space for future expansion needs
- **Efficient**
  - Read-while-write with the main program Flash
- **High endurance data memory**

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New V1 ColdFire+ Microcontrollers

Design Innovation. Accelerated.

New V1 ColdFire+ MCUs

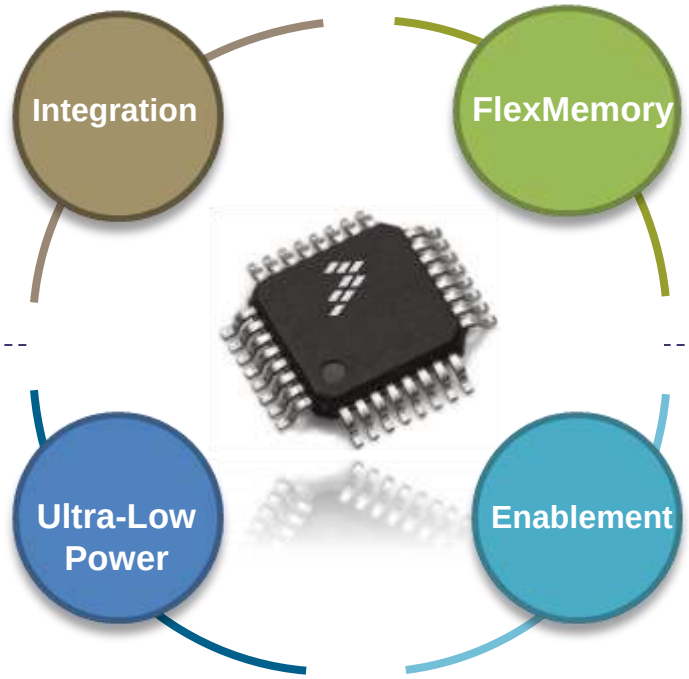
For Secure Ultra-Low-Power Consumer and Industrial Applications

The most **connectivity, security** and **analog** integration available in the market starting at **less than $1** today

*USB OTG, 16-bit ADC, touch sensing, audio, and encryption support for consumer and industrial products – **starting at less than $1!***

Innovative Low Power **90nm Thin-Film Storage** flash with **FlexMemory**

*Offers **EEPROM capability** with unprecedented programming speed and endurance, capable of over **4.4 Million cycles***



Flexible **ultra-low power consumption**, optimized for portable applications

*Incredibly low run currents down to **150uA/MHz,** wakeup times less than **4us**, and stop currents less than **500nA** extend battery life.*

One of the **most comprehensive enablement bundles** in the industry

*Including **complimentary MQX RTOS**, Eclipse-based CodeWarrior 10.0 IDE, along USB, DSP and encryption software libraries speed your time to market.*

More than **40 New** ColdFire+ MCUs
6 scalable families

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Six New V1 ColdFire+ MCU Families

V1 ColdFire+ Qx Family

An incredibly cost-effective, ultra-low-power, mixed-signal microcontroller family ideal for secure portable or battery-powered applications such as wireless sensor nodes, security control pads, or video game accessories.

MCF51QH 16-bit ADC	**MCF51QM** Encryption 16-bit ADC
MCF51QU 12-bit ADC	**MCF51QF** Encryption 12-bit ADC

V1 ColdFire+ Jx Family

Perfect for portable consumer devices, the Jx Family adds USB OTG capability and a Serial Audio Interface to the Qx family, enabling secure, low-power iPod accessories, USB-audio bridges, PC-Peripherals and high-end remote controls.

MCF51JU USB OTG 12-bit ADC	**MCF51JF** USB OTG 12-bit ADC Encryption

A Comprehensive Enablement Bundle

1. TOWER Rapid-Prototyping Hardware Development System
2. Complimentary MQX RTOS with USB stack and USB Audio Support
3. Eclipse-based CodeWarrior 10
4. Processor Expert Rapid Application Development Tool
5. Encryption and DSP Libraries

All Six Families are **Pin Compatible**

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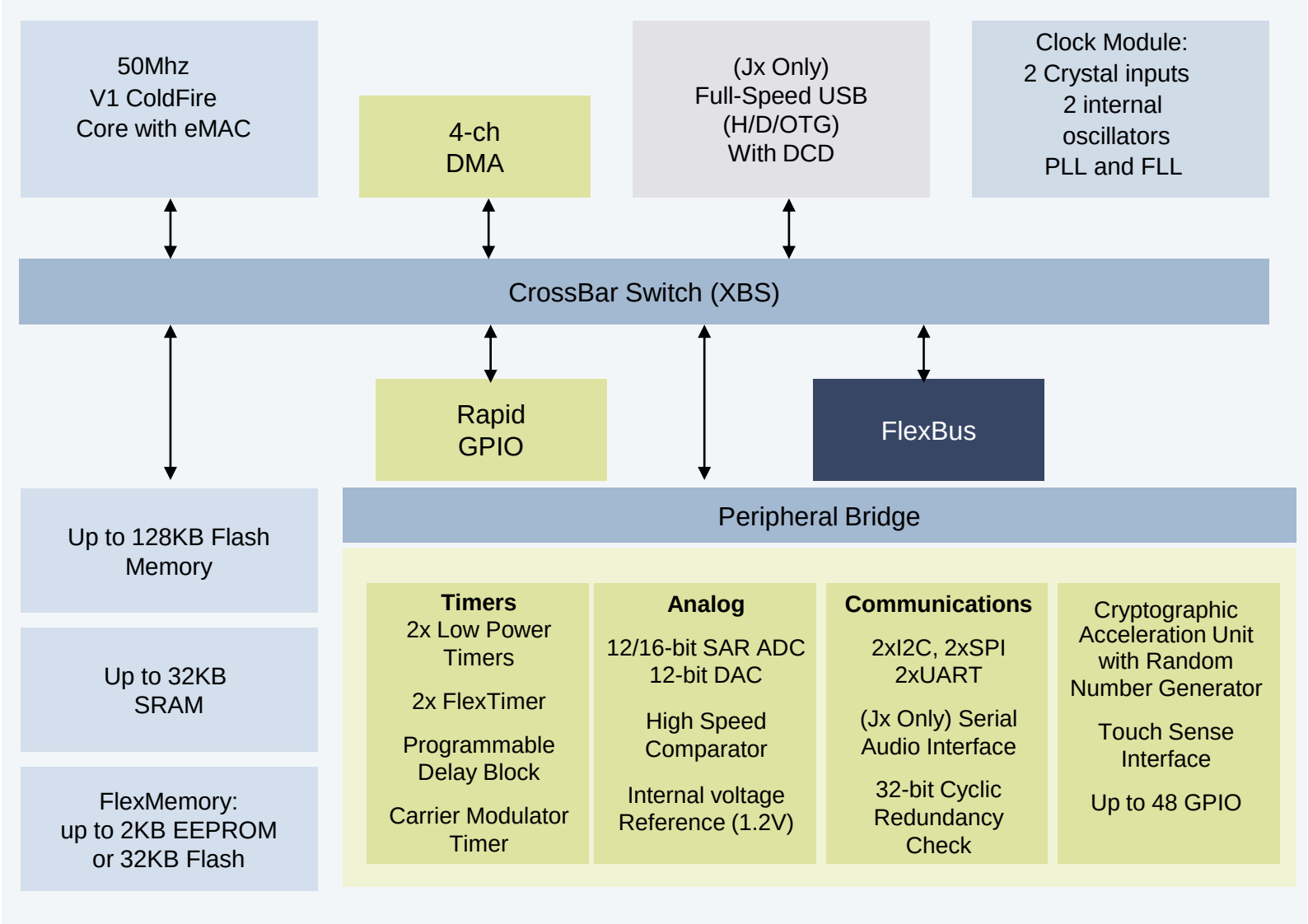
V1 ColdFire+ Qx and Jx Family Block Diagram



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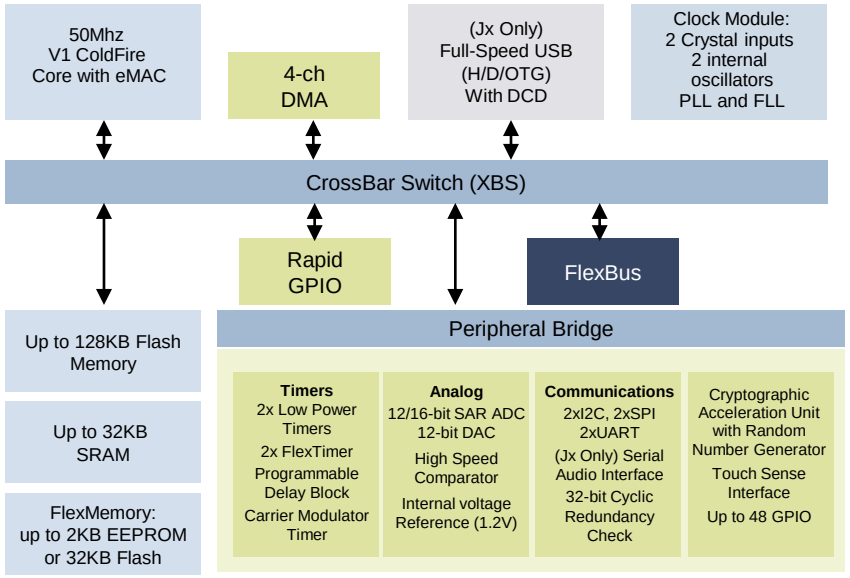
V1 ColdFire+ Qx and Jx Family Overview

- **Innovative FlexMemory: Configurable EEPROM**
  - Eliminates the need for external EEPROM with over 4.4M write/erase cycles
  - User configurable as either EEPROM or Flash
- **10 Flexible Ultra-Low Power Modes**
  - Run current down to 150uA/MHz in Very Low Power Run Mode
  - 2 Low Power Timers functional in lowest stop mode
  - 4us Wakeup Time
  - Stop currents <500nA
- **Security and Reliability Acceleration**
  - Crypto Acceleration Unit (CAU) and Random Number Generator (RNG) accelerate secure communication and device authentication
  - 32-bit Hardware CRC included for system/software reliability
- **Integrated Capacitive Touch Sensing and Display Support**
  - Low-power Touch Sensing Interface (TSI) allows wakeup from touch in lowest power modes
  - External bus interface to seamlessly connect to graphical displays

32KB Flash in 32 pin package starting at $0.99 for 10K SRP



Enablement Bundle

TOWER development system
Complementary MQX RTOS with USB Stack/USB-Audio
Eclipse-Based CodeWarrior 10.0 IDE
Processor Expert Rapid Application Development Tool
DSP and Encryption libraries

Family	CAU and RNG	ADC	Full Speed USB (H/D/OTG)
MCF51QU		12-bit	
MCF51QH		16-bit	
MCF51QF	X	12-bit	
MCF51QM	X	16-bit	
MCF51JU		12-bit	X
MCF51JF	X	12-bit	X

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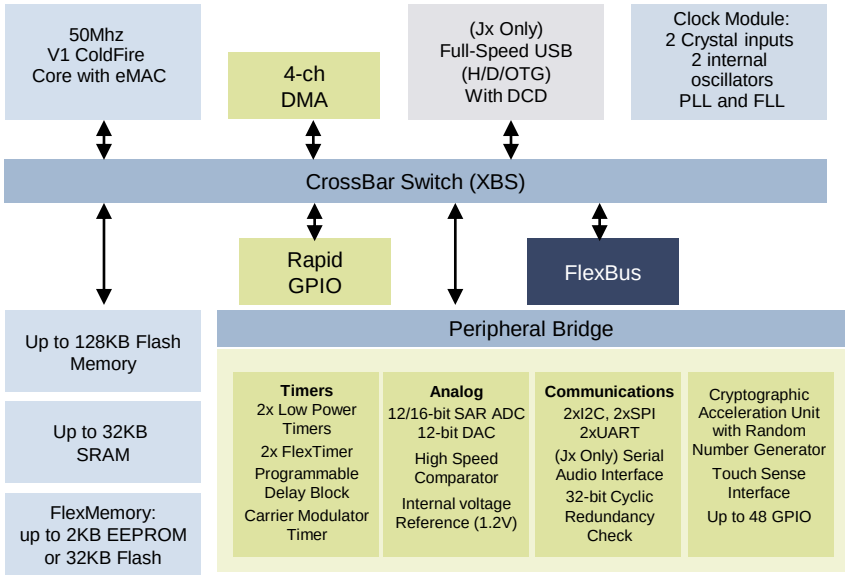
V1 ColdFire+ Qx and Jx Family Overview

- **(Jx Only) Connect via USB AND charge a battery**
  - Integrated USB 2.0 Full-Speed Device/Host/OTG Controller with integrated transceiver
  - Includes Device Charge Detector (DCD) and Regulator to supports battery charging via USB for Portable Devices
- **(Jx Only) Enable Audio in Your Application**
  - Serial Audio Interface provides direct interface to codecs and to I2S audio devices.
  - 48-bit Enhanced Multiply Accumulate (EMAC) unit offers powerful signal processing capability
- **Flexible and Powerful Mixed Signal Capability**
  - 16-bit ADC enables high resolution measurements for instrumentation, metering and medical devices.
  - Integrated 12-bit DAC, High-Speed Comparator, and Voltage Reference to reduce system costs
- **Package sizes as small as 5x5mm for space constrained applications**



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Family	CAU and RNG	ADC	Full Speed USB (H/D/OTG)
MCF51QU		12-bit	
MCF51QH		16-bit	
MCF51QF	X	12-bit	
MCF51QM	X	16-bit	
MCF51JU		12-bit	X
MCF51JF	X	12-bit	X

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Kinetis Microcontrollers

Design Potential. Realized.

New Kinetis MCUs

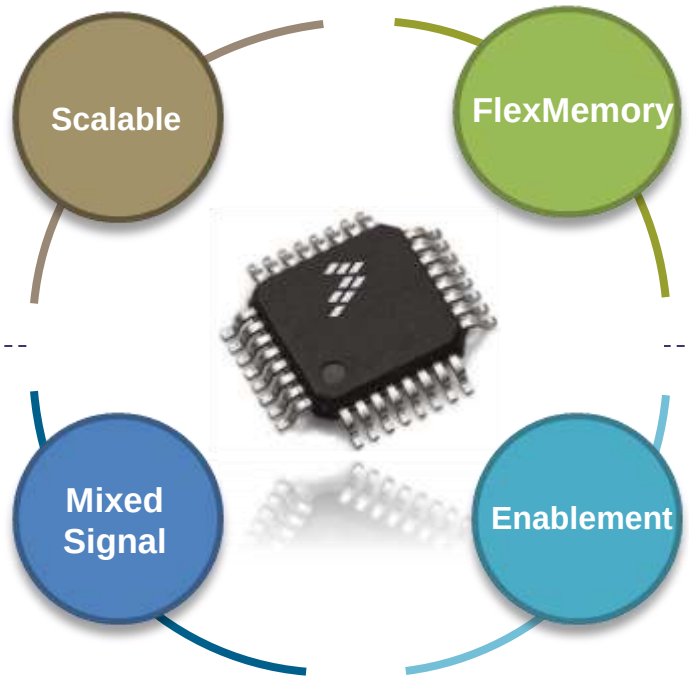
Scalable Mixed-Signal Consumer and Industrial Microcontroller Families

The most **scalable** portfolio of **low-power ARM Cortex-M4** MCUs available today

*Over **200** hardware and software compatible ARM Cortex-M4 devices with high performance **signal processing capability** and run currents of **<200uA/MHz***

Innovative Low Power **90nm Thin-Film Storage** Flash with **FlexMemory**

*Offers **EEPROM capability** with unprecedented programming speed and endurance, capable of over **10 Million cycles***



Exceptional **mixed-signal** integration

*Flexible, High-speed, high-precision 16-bit **ADCs**, 12-bit **DACs**, Programmable Gain **Amplifiers**, Voltage References, and Hardware **Touch Sensing** lower system costs.*

One of the most **comprehensive ARM® enablement** portfolios

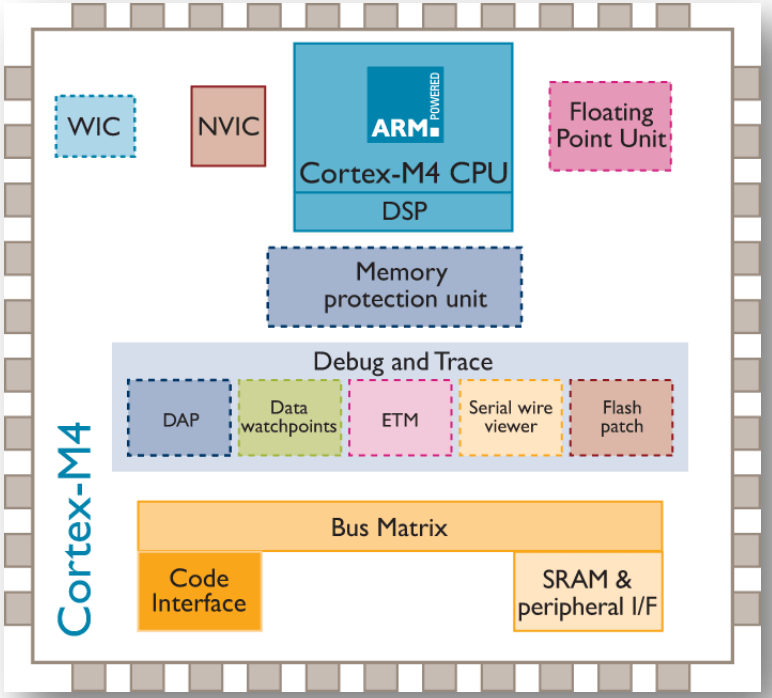
***Complimentary Freescale MQX RTOS** and **Eclipse-based CodeWarrior** 10.0 IDE, as well as **IAR, KEIL** and other ARM ecosystem providers help speed time to market*

More than **200 New** Parts
7 scalable families

First available broad-market MCU samples based on ARM Cortex-M4!

ARM Cortex-M4 Processor Microarchitecture

- **Backwards compatible with ARM Cortex-M3**
- **New features**
  - Single cycle MAC (Up to 32 x 32, with 32-bit result)
  - DSP and SIMD extensions
  - Single Precision Floating Point Unit
- **Freescale IP and Innovation**
  - On-chip cache for instructions and data
  - Cross-Bar Switch for concurrent multi-master/slave accessing
  - On-chip DMA for CPU off-load
  - Low-leakage Wake-up Unit adds flexibility for low power operation
- **Architected for Digital Signal Processing**
  - **Motor Control** - advanced algorithms, longer lifespan, power efficiency
  - **Automation** - high calculation and algorithm bandwidth at a low cost
  - **Power management** – designed for low/battery powered systems
  - **Audio and Video** – 5x performance improvement over software, making batteries last longer



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Kinetis Product Family Features

MCU Family	USB OTG (FS & HS)	LCD (Segment/Graphics)	NAND Flash Controller	Floating Point Unit	Ethernet (IEEE 1588)	Encryption (CAU+RNG)	Dual CAN	Hardware Tamper Detect	DRAM Controller
K70 Family 512KB-1MB, 196-256pin	●	●	●	●	●	●	●	●	●
K60 Family 256KB-1MB, 100-256pin	●		●	●	●	●	●	●	●
K50 Family 128-512KB, 64-144pin	●	●			●	●			
K40 Family 64-512KB, 64-144pin	●	●					●		
K30 Family 64-512KB, 64-144pin		●					●		
K20 Family 32KB-1MB, 32-144pin	●		●	●			●		
K10 Family 32KB-1MB, 32-144pin			●	●			●		

Common System IP	Common Analog IP	Common Digital IP	Development Tools
32-bit ARM Cortex-M4 Core w/ DSP Instructions	16-bit ADC	CRC	Bundled IDE w/ Processor Expert
Next Generation Flash Memory High Reliability, Fast Access	Programmable Gain Amplifiers	I^2C	Bundled OS USB, TCP/IP, Security
FlexMemory w/ EEPROM capability	12-bit DAC	SSI (I^2S)	Modular Tower H/ware Development System
SRAM	High-speed Comparators	UART/SPI	Application Software Stacks, Peripheral Drivers & App. Libraries (Motor Control, HMI, USB)
Memory Protection Unit	Low-power Touch Sensing	Programmable Delay Block	Broad 3rd party ecosystem
Low Voltage, Low Power Multiple Operating Modes, Clock Gating (1.71V-3.6V with 5V tolerant I/O)		External Bus Interface	
DMA		Motor Control Timers	
		eSDHC	
		RTC	

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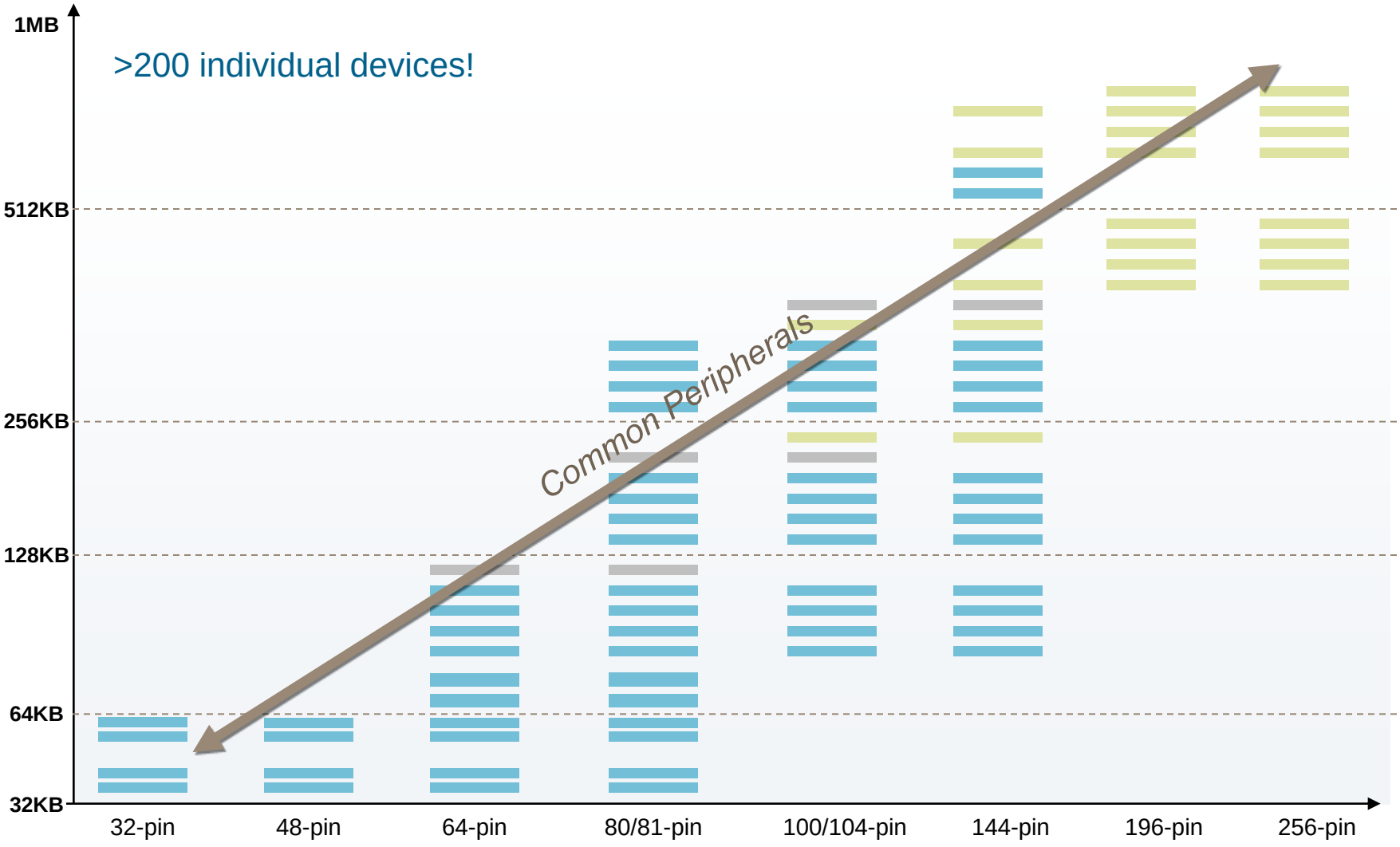
An Unmatched Range of ARM Cortex-M4 Microcontrollers



Multiple compatible families with scalable performance, memory and peripherals

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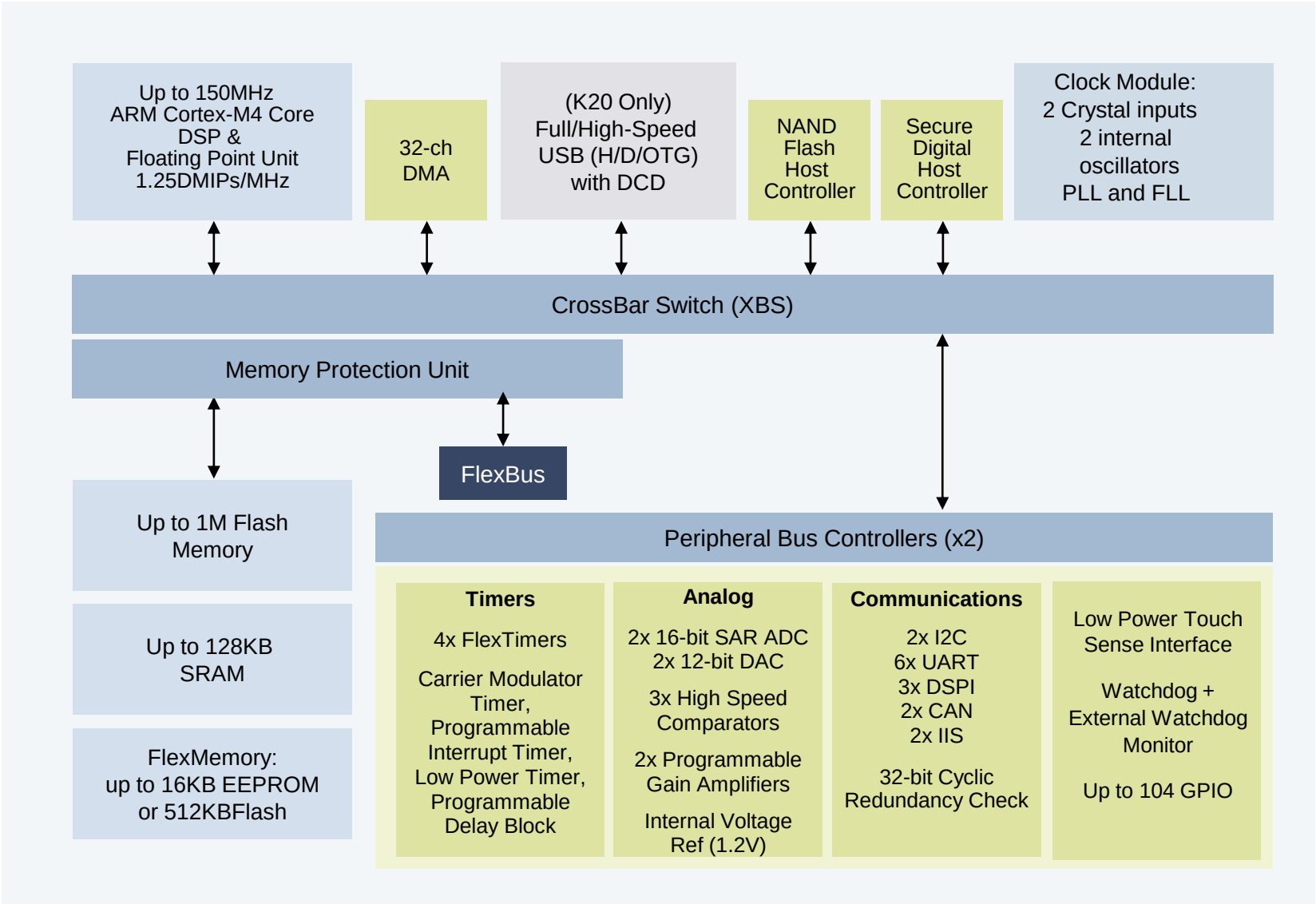
K10/K20 Family Block Diagram

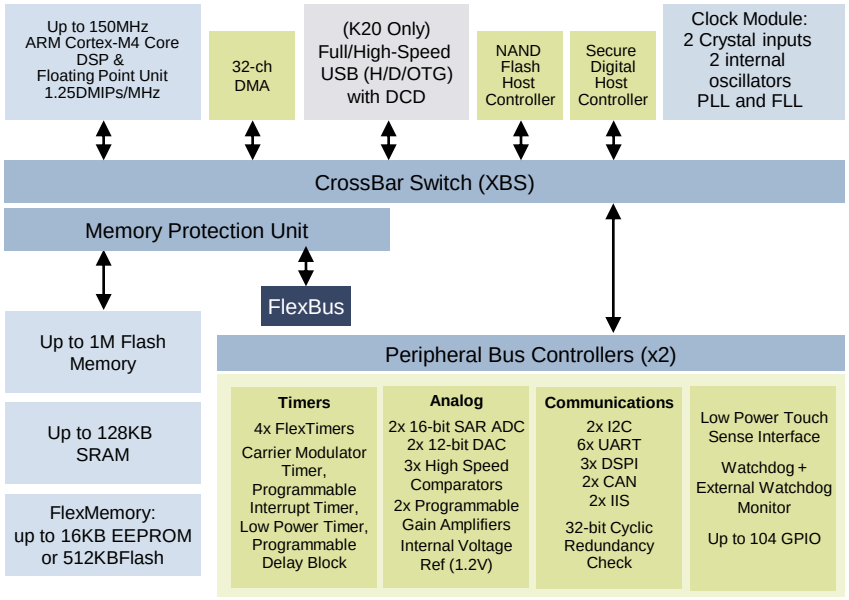


K10/K20 Family Overview

High Integration Mixed-Signal MCUs

- **Processing Performance and FlexMemory**
  - Direct Memory Access, Cross Bar Switch, and on-chip Cache maximize bus bandwidth and Flash execution
  - FlexMemory provides on-chip, high-endurance configurable EEPROM and/or additional Flash memory
- **(K20 Only) Connect via USB AND charge a battery**
  - USB 2.0 Full-Speed Device/Host/OTG Controller with integrated transceiver, HS via ULPI interface
  - Includes Device Charge Detector (DCD) and Regulator to supports battery charging via USB for Portable Devices
- **Flexible and Powerful Mixed Signal Capability**
  - 16-bit ADC enables small signal capture for medical/sensing applications, or high speed conversions for motor control.
  - 12-bit DAC, High-Speed Comparator, and Voltage Reference on-chip reduces system cost
- **Ultra-low power with 1.71V operation**
  - Multiple low power modes and Flash & analog operation down to 1.71V – power profile optimization and prolonged battery life
  - Stop Currents <500nA, run currents <200uA/MHz

32KB Flash in 32 pin package starting at $0.99 for 10K SRP

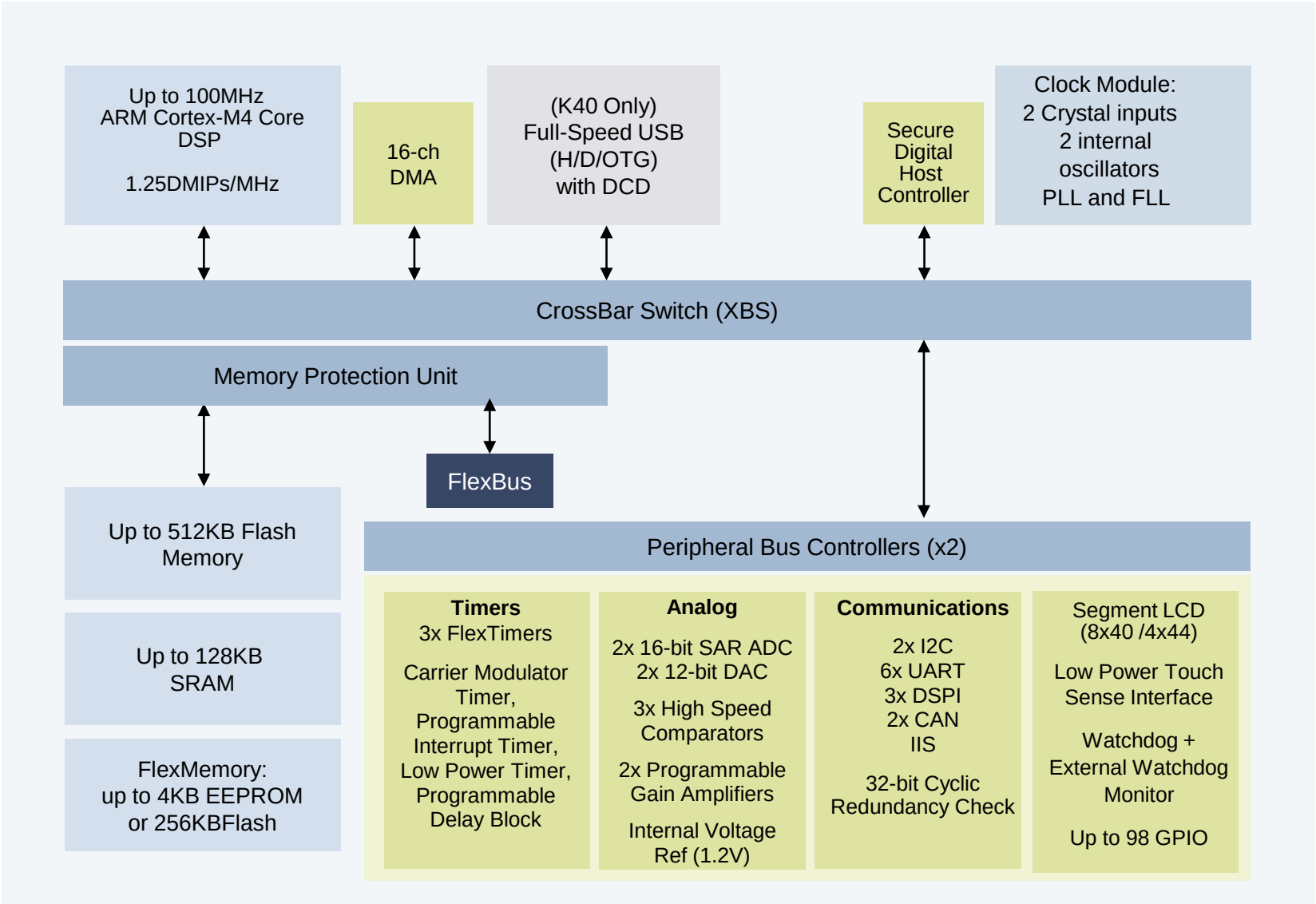


Enablement Bundle

TOWER development system
Complementary MQX RTOS with USB Stack
Eclipse-Based CodeWarrior 10.0 IDE
Processor Expert Rapid Application Development Tool
IAR, Keil and full ARM Ecosystem Support
Motor Control and DSP Libraries

Family	USB OTG + DCD
K10	-
K20	X

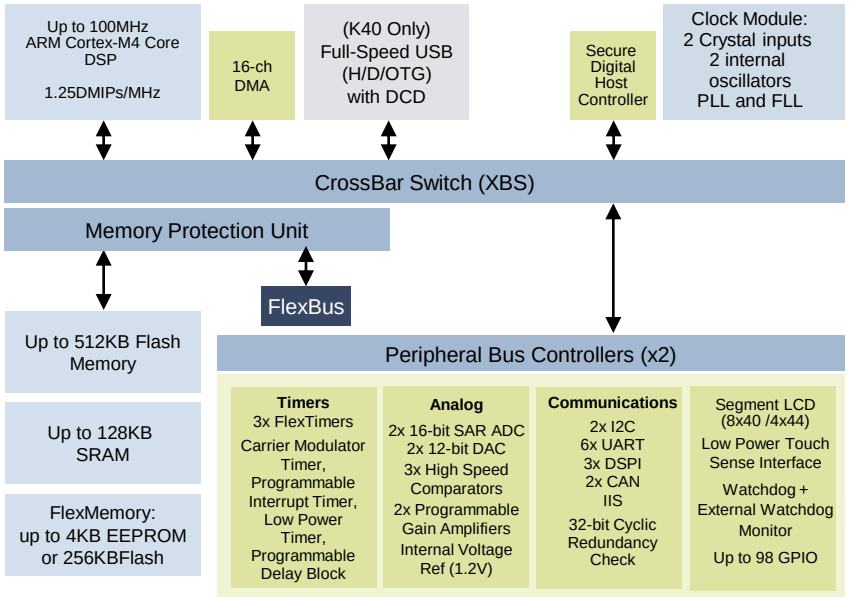
K30/K40 Family Block Diagram



K30/K40 Family Overview

For Segment LCD HMI Applications

- **Flexible, low power LCD Interface**
  - Segment LCD Blink mode lowers average power
  - Segment Fail Detect prevents erroneous readouts and reduces LCD test cost
  - Front/back plane reassignment provides pin-out flexibility and allows configuration changes in firmware
- **Diverse communications suite**
  - A multitude of serial interfaces, with UART support for ISO7816 SIM/Smart Cards & IrDA interfaces
  - Dual CAN for industrial network bridging
- **System reliability & safety**
  - Hardware Cyclic Redundancy Check safeguards memory contents and communication data
  - Memory Protection Unit – increase SW reliability
  - Independently-clocked watchdog prevents code runaway for fail-safe applications e.g. IEC60730
- **Hardware and software compatibility**
  - Common packages & peripherals across families enable rapid feature growth with minimal hardware & software disruption



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Processor Expert Rapid Application Development Tool
IAR, Keil and Full ARM Ecosystem Support
Motor Control Software Library, IEC60730 test routines

Family	USB OTG + DCD	Segment LCD
K30	-	X
K40	X	X

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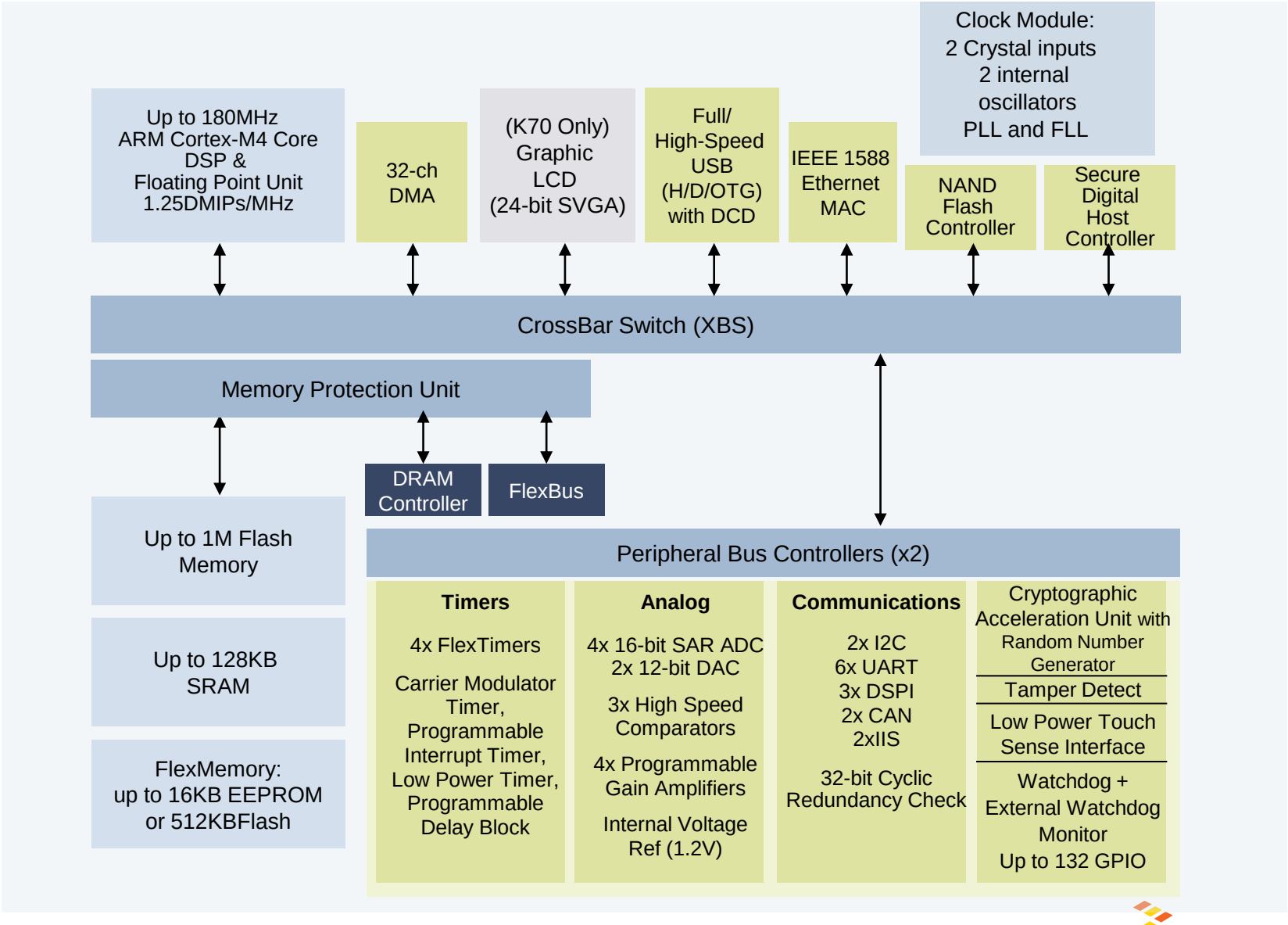
K60/K70 Family Block Diagram



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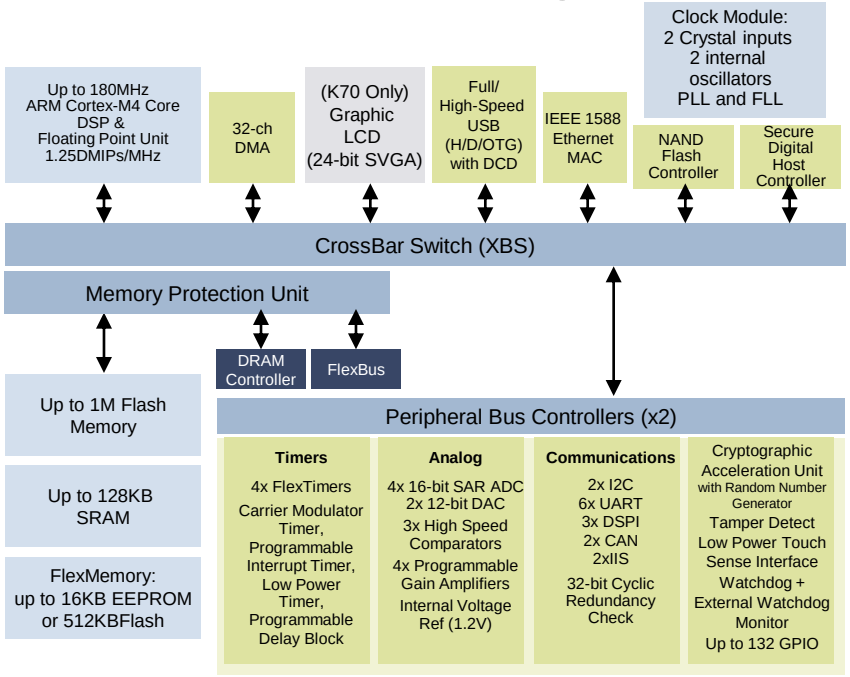
K60/K70 Family Overview

Higher Performance, Security, & Connectivity

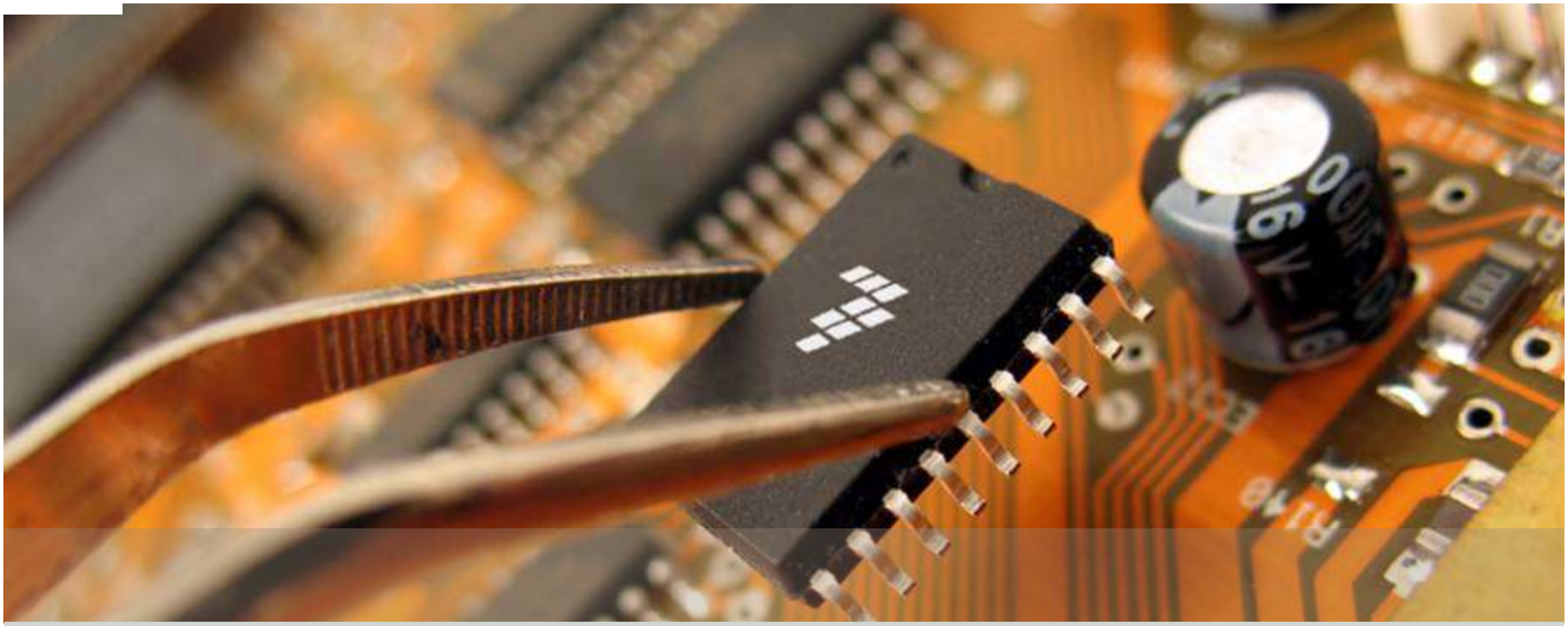
- **Real-time Ethernet for precision automation**
  - IEEE 1588 hardware time stamping & clock synchronization enables accurate, deterministic control over Ethernet networks
- **(K70 only) Graphical LCD for advanced user interfaces**
  - Single-chip QVGA support possible, allowing use of lower-cost displays without Chip-on-Glass capability
  - Up to 24-bit SVGA with external memory support
- **Robust system security with tamper detection**
  - Tamper detection with voltage, frequency, and temperature monitoring. External sensor support for physical attack detection
- **Hardware Encryption for secure data transfer & storage**
  - Significantly faster than software implementations while consuming minimal system resources.
  - Supports numerous algorithms with hardware assisted software routines – SSH, SSL, IPSec, etc



Enablement Bundle

TOWER development system
Complementary MQX RTOS with TCP/IP & USB Stack
Eclipse-Based CodeWarrior 10.0 IDE
Processor Expert Rapid Application Development Tool
IAR, Keil and Full ARM Ecosystem Support
Graphics LCD and Encryption libraries

Family	Graphics LCD Controller	IEEE 1588 Ethernet / Encryption / Tamper Detect
K60	-	X
K70	X	X

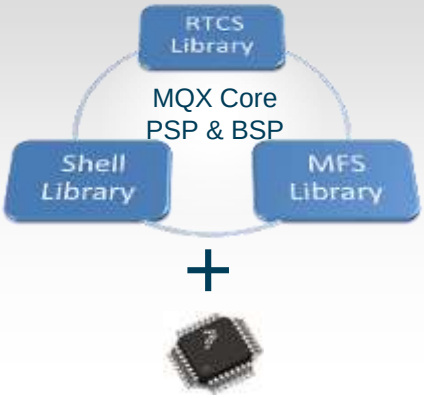


Enablement: Software and Hardware Tools

Freescale's Microcontroller Enablement Bundle

Freescale MQX + MCU

Complimentary MQX RTOS



- Full-featured, scalable, proven RTOS
- Simplifies HW management, streamlines SW development
- Reduces development costs while speeding time to market

Comprehensive solution for embedded control and connectivity

+ Tower System

- Modular, expandable and cost-effective development platform for 8/16/32-bit MCUs and MPUs
- Rapid eval and prototyping with maximum HW reuse.
- Supported by a diverse range of MCU and peripheral plug-in boards and a growing web community

Open source hardware platform for prototyping application development

+ CodeWarrior *IDE*

- Eclipse environment
- Processor Expert code generation wizard
- Build, debug and flash tools
- Software analysis
- Kernel-aware debug
- Host platform support

Visual and automated framework to accelerate development time

Save time, cost, and effort.

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Trends

- **Peripherals are more complex ex: RS232 → Ethernet, USB**
  - **Solution**: Full-Featured MQX RTOS, USB, BSP Drivers, 3rd party and more
- **Customers need an easier way to manage stacks and software**
  - **Solution**: Real-time operating system manages the time of a MCU/MPU
  - Features of an RTOS:
    - Allows multi-tasking, scheduling of the tasks with priorities
    - Synchronization of the resource access
    - Inter-task communication
    - Time predictable
    - Interrupt handling
- **Customers need higher quality of code**
  - **Solution**: Backed by Freescale Global FAE, TIC, AE and software developers
- **60% of a team's resources are spent on software**
  - **Solution**: MQX allows customers to focus on "Special Sauce" instead of stacks, drivers etc.
- **32-bit devices require a higher need for re-use →** 89% of our customers say they reuse code from a previous project
  - **Solution**: An RTOS allows reuse of application on different processors and boards.
- **Customers face the challenge of reducing costs while speeding time to market**
  - **Solution**: Freescale provides complimentary MQX RTOS, USB, TCP/IP, MFS

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Freescale MQX RTOS Solution

- Scalable, fully-featured and proven RTOS bundled with 32-bit MCUs
  - Full-featured and powerful
    - BSPs incorporate tightly integrated RTOS, Middleware (USB, TCP/IP stacks), file system, and I/O drivers
    - Designed for speed and size efficiency
  - Market proven
    - MQX has been available on Freescale processors for > 15 years
    - MQX has been used in millions of products including Medical and Heavy Industrial areas
  - Simple and scalable
    - Can be as small as ~10KB for smallest implementation, or scale up to support sophisticated networking and threading
    - Intuitive API & modular architecture enables straight-forward feature fine-tuning
    - Production source code provided
  - Similar to other "pay-for" software OS

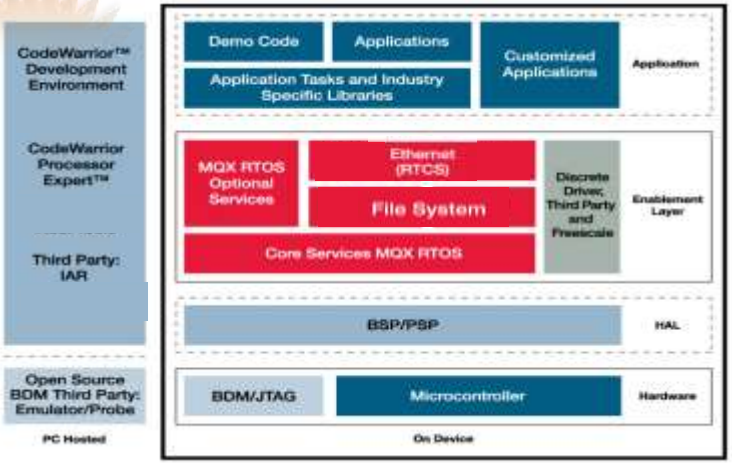
THREADX NUCLEUS Green Hills SOFTWARE INC.

MQX Software speeds time to market with support from Freescale

Software Integration headache

$95,000 of software bundled with Freescale MCUs!

Integrated MQX Solution



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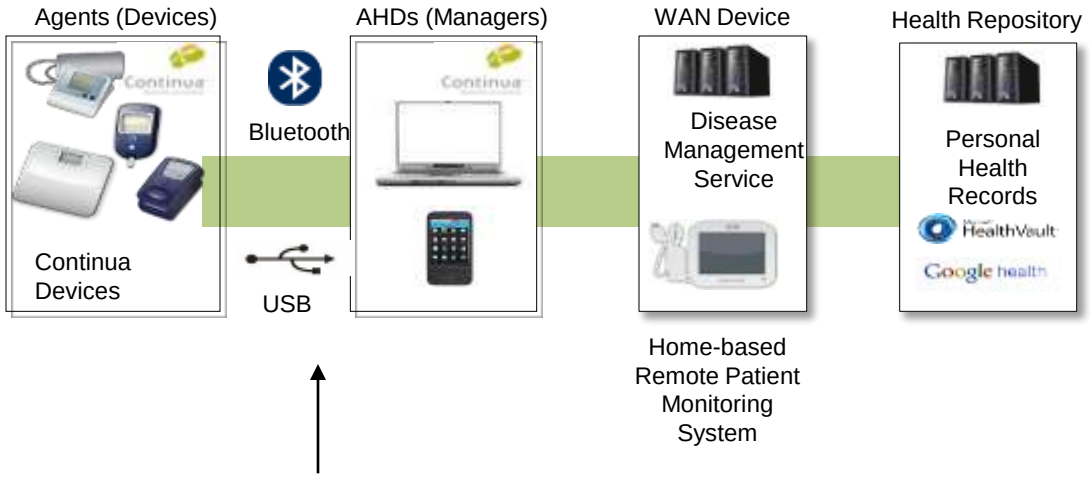
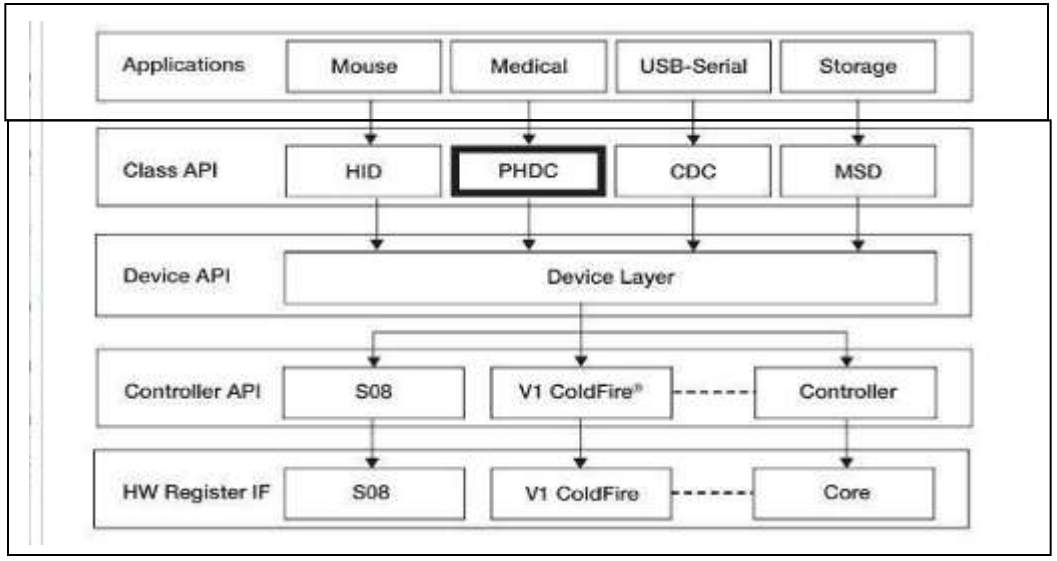
Freescale MQX USB





Medical Connectivity Stack

- IEEE-11073, provide the standard communication interface that next-generation medical devices require
- Comply with medical industry standards such as the Continua Health Alliance

USB Stack

- Bare-Metal (Non- OS) & MQX RTOS
- Compatible API
- Classes: (Device and Host)
  - HID
  - PHDC -"Continua Ready" personal health care – Device Only
  - CDC
  - MSD
  - and more…

Bare Metal Supported: S08, V1, Kinetis

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NanoSSL™/ NanoSSH™ for Freescale MQX
Security options with significant cost savings

►**Secure Shell (SSH)** encrypts communications between hosts over an insecure network, and it's great for logging into and executing commands on networked computers. It's also useful for tunneling, port-forwarding and secure file transfers using the SFTP protocol.

►**Secure Sockets Layer/Transport Layer Security (SSL/TLS)** - authenticates endpoints and encrypts channels to provide session privacy and security on the Internet. The standard operates at a higher level in the OSI stack than IPsec, and supports peer negotiation for algorithm selection, public key based exchange of secret session keys and X.509 certificates.

- Ultra-small at less than **one fifth the size** of a typical SSL/SSH client.
- Minimal impact on device performance
- Minimal impact on flash ROM utilization

► **Freescale's super-fast, super-small embedded SSH/SSL client by Mocana**

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MQX Training

- **Freescale offers → www.freescale.com/mqx**
  - MQX Hands On Labs/App Notes/Documentations
  - Videos
  - Global Support from FAE Community
  - Public Community: forums.freescale.com/

- **Embedded Access (EAI) offers customizable training designed for individuals or companies**
  - 2 Day - MQX RTOS Course (Covers the API of the RTOS with hands-on labs)
  - 1 Day - RTCS TCP/IP Stack (Overview of protocols, Initializing RTCS, Socket API
  - ½ Day – USB (Overview of USB, USB Host Stack, USB Device Stack)
  - ½ - 2 Day - Application Development
  - Contact for pricing: www.embedded-access.com/training.html

Embedded Access Inc

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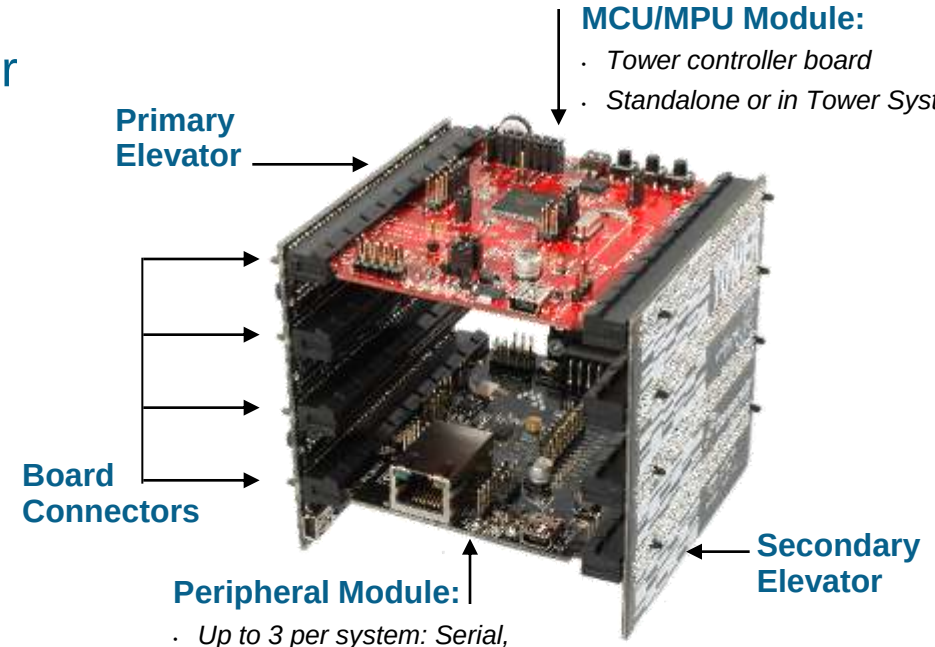
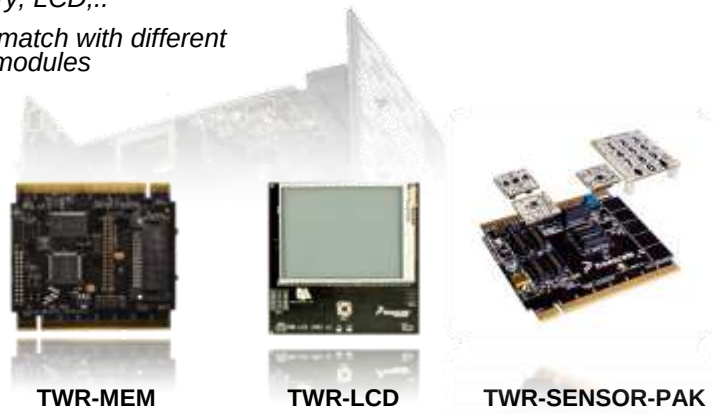
The Freescale Tower System

- A modular development platform for 8/16/32-bit MCUs & MPUs
  - Quickly combine Tower Modules to build a prototype of your application
  - Modules sold individually or in kits
  - Open Source: Build your own Tower Module to integrate your IP
  - Cost-optimized hardware
  - Software support from Freescale and Third Parties
  - Growing community of Third Party hardware support
  - On-line community: www.towergeeks.org



Rapidly build a prototype of your end application

Support for all ColdFire+ and Kinetis MCUs!



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CodeWarrior Development Studio for Microcontrollers v10.1

- **Integrated development tool suite for ColdFire, Kinetis and S08 architectures based on the Eclipse open development platform**
  - Project Wizard creates a new project in as few as 9 clicks
  - MCU Change Wizard retargets a project to a new processor in as few as 6 clicks
  - CodeWarrior optimizing C/C ++ compilers for ColdFire and Kinetis Microcontrollers included
  - Extensions to Eclipse CDT to provide sophisticated features to troubleshoot and repair embedded applications
  - Processor Expert combines easy-to-use component-based application creation with an expert knowledge system
  - Trace and profile support for on-chip trace buffers to provide emulator-like debug capability without additional hardware
  - Kernel-aware debug for MQX, Linux and OSEK
  - CodeWarrior Special Edition is a complimentary version up to 128KB code size

Accelerate the development of the most complex embedded applications

www.freescale.com/codewarrior
to download

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IAR Embedded Workbench

- The most widely used tool chain for ARM MCUs
- A consistent tool chain for ColdFire+ and Kinetis devices
- Completely integrated development environment
- Highly optimized IAR C/C++ Compiler
- Powerful IAR C-SPY Debugger
- MQX integration
- Ready-made example projects

More on www.iar.com/freescale

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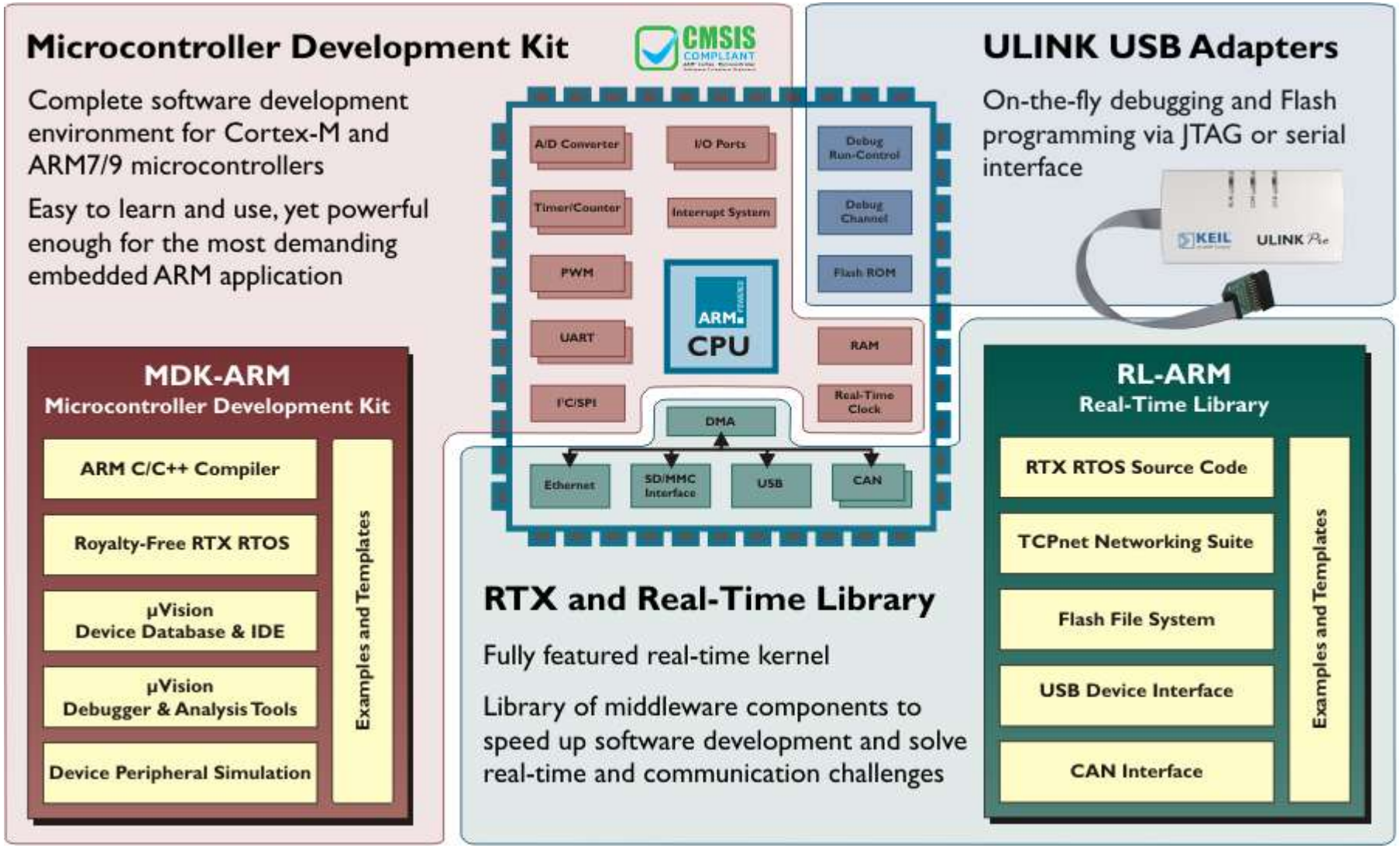
Keil Software Development Tools



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Choose Your Partner: The Freescale Microcontroller Ecosystem

Run-Time Software: RTOS, Stacks, File System

Embedded Access Inc
SEGGER
freeRTOS
Green Hills Software
µd Micro Digital
IXXAT
Quadros Systems Inc.
freescale semiconductor
expresslogic
Micrium
Mentor Graphics
CMX SYSTEMS
eCOS
IAR SYSTEMS
CMSIS COMPLIANT

HW BDM Debugger/Emulators

PE micro

IAR SYSTEMS
SEGGER
RAISONANCE
Rowley Associates
KEIL An ARM® Company





SIGNUM SYSTEMS

IDE: Tools Compliers, Debuggers

CodeWarrior
CodeSourcery
IAR SYSTEMS
KEIL An ARM® Company

GNU Tools
Green Hills Software

MQX Support / Design Services

EAI

Audio/Video Codecs

alvaview
AllGo embedded

GUI Graphical

SEGGER
SWELL

Security / Medical

mocana
monebo

EVBs & System Design

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AXIOM

Ind. Protocol Stacks

IXXAT

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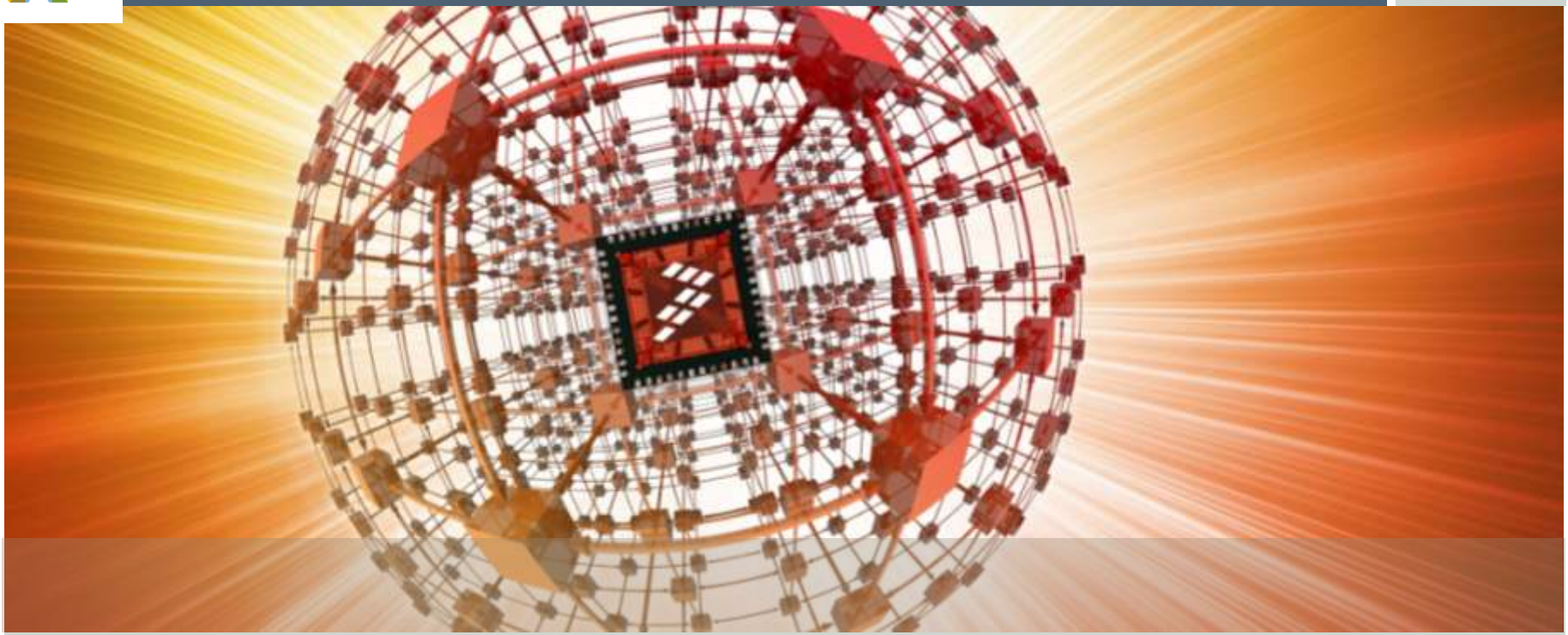
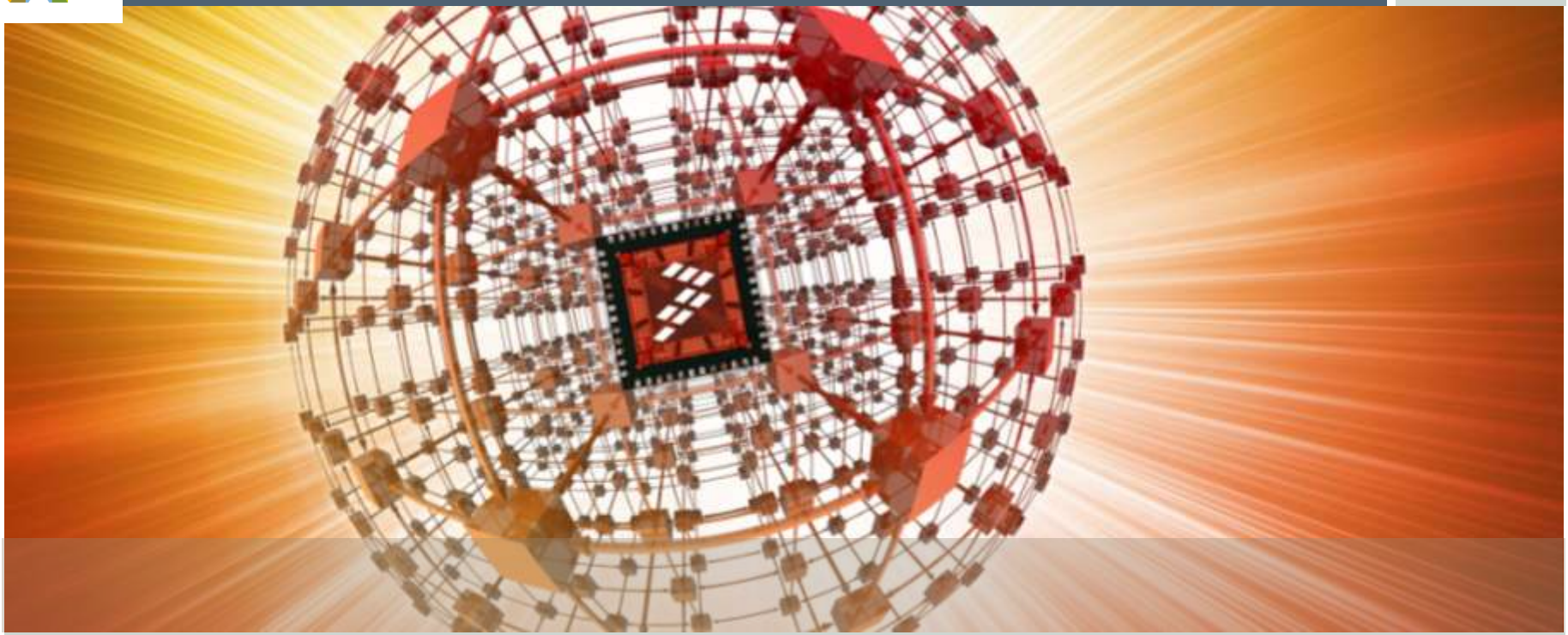
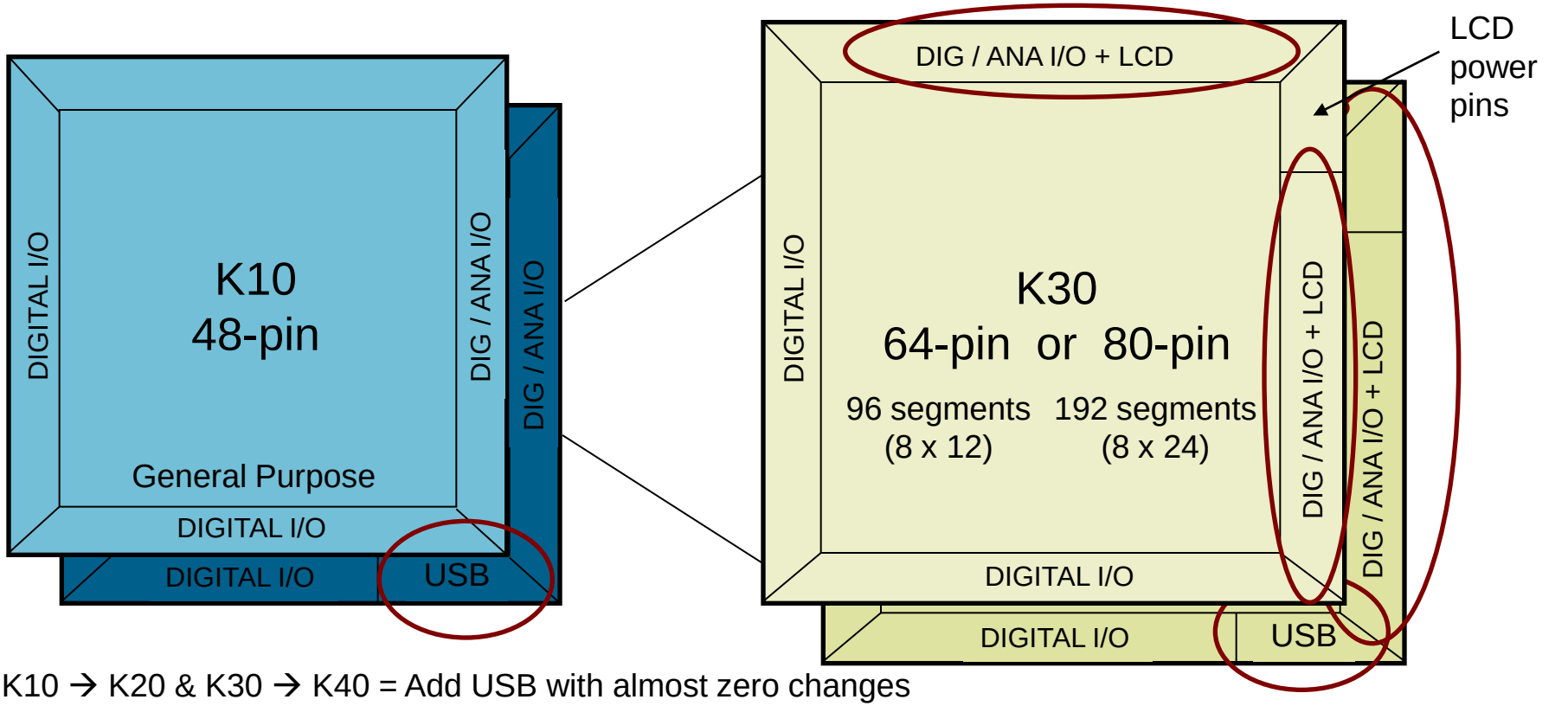


Feature Deep Dive



Compatibility & Scalability

Pin Compatibility Across Families



K10 → K20 & K30 → K40 = Add USB with almost zero changes
- ✓The only difference will be 4 extra USB pins and 4 less digital I/O pins

K10 → K30 & K20 → K40 = Add Segment LCD with minimal board layout changes
- ✓Digital & Analog I/O signals maintain placement order
- ✓Segment LCD signals are muxed with existing Digital & Analog I/O signals
- ✓Most Digital I/O signals muxed with Segment LCD signals become available on added pins by larger package

K20 → K60 = Add Ethernet with NO changes
- ✓All Ethernet signals are muxed with existing Digital & Analog I/O signals

DIGITAL I/O = UART, SPI, I2C, CAN, TIMER, etc.	ANALOG I/O = OSC, ADC, CMP, etc.

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Power Management

Low Power Capabilities

- **Flexible power modes**
  - **10** Run, Wait & STOP modes – customise power usage to application requirements
- **Industry leading 90nm process node**
  - **1/3** dynamic power reduction vs. existing technologies
  - Intelligent power management controller reduces dynamic and leakage currents
- **Low power design techniques**
  - Clock gating: only leakage currents are incurred
  - Power gating: shuts down un-used modules reducing leakage
  - Back biasing: mitigates leakage currents in low power run and sleep states
- **Ultra fast wake up times**
  - **4us** wake up from LOW LEAKAGE STOP mode

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Kinetis Available Power Modes

Typical Power Modes in an embedded system	Cortex M4 Power Modes	Extended Power Modes	Recovery Timer	"Typical" Idd Range
Run	Run	Run	-	Starting @ <200uA/MHz
		VLPR	-	Starting @ <200uA/MHz
Wait	Sleep	Wait	-	
		VLPW	4us	
Stop	DeepSleep	Stop	4us	
		VLPS	4us	
		LLS	4us	1.2uA - 7uA
		VLLS3	35us	1uA - 5uA
		VLLS2	35us	750nA - 2uA
		VLLS1	100us+EE restore	500nA – 1.5uA

Freescale Adds Low Leakage Wake-up Unit

- Standard on all 90nm TFS products, including ColdFire+
- Enables complete shut-down of core logic, including WIC, further reducing leakage currents in all low power modes
- Supports 16 external input pins and 8 internal modules as wakeup sources
- Wakeup inputs are activated in LLS or VLLS modes

Definition of Power Modes

Mode	Definition
Run	MCU can be run at full speed.
Wait	Allows peripherals to function, while CPU goes to sleep reducing power consumption.
VLP Run	CPU and peripheral clock maximum frequency is restricted. CPU/Platform clock is restricted to 2 MHz Flash access is restricted to 1 MHz LVD is off.
VLP Wait	Similar to VLP Run, with CPU in sleep to further reduce power.
Stop	MCU is in static state. Lowest power mode that retains all registers while maintaining LVD protection.
VLP Stop	MCU is in static state with LVD operation off. Lowest power mode with ADC, LPT, RTC, LCD, HSCMP, DAC, and pin interrupts functional.
LL Stop	MCU is in low leakage state retention power mode. LLWU controls wakeup sources including LPT, RTC, LCD, HSCMP, DAC and select pin interrupts.
VLL Stop 3	MCU is placed in a low leakage mode powering down most internal logic. All system RAM contents are retained and I/O states held. LLWU controls wakeup sources including LPT, RTC, LCD, HSCMP, DAC and select pin interrupts.
VLL Stop 2	Similar to VLL Stop 3, with only partial system RAM retention. FlexRAM contents can optionally be retained.
VLL Stop 1	Similar to VLL Stop 3, with only 32 byte register file retention.

90nm Thin Film Storage (TFS) Flash with FlexMemory

TFS Competitive Comparison

Market Need	Other 90nm NVM Technologies	90nm TFS
High area efficiency and reliability	▶ Erase times 50-90% higher than TFS ▶ Floating gate bit cells susceptible to charge loss when subject to even microscopic defects	▶ Very high-density arrays ▶ Nanocrystal charge storage technology provides exceptional redundancy and reliability
Lower stop and run currents	▶ Read, program and erase down to ~2.0V ▶ 3x greater run current and 5-10x greater standby currents	▶ Read/program/erase down to 1.71V ▶ <1mA operation at low frequency
EEPROM capability	▶ No integrated EEPROM capability ▶ Off-chip EEPROM has slower erase + write times (5-10 mSec) ▶ Off-chip EEPROM has lower endurance	▶ FlexMemory user-configurable as EEPROM and/or program flash ▶ Write time: ~100usec ▶ Erase + write time: 1.5ms
Scalability	▶ Area efficiency limited by cell construction	▶ Excellent area efficiency (low-voltage charge pump for programming) ▶ Array and analog area efficiency allow cost-competitive low- and high-density products with single technology

TFS is **lower power**, more **area-efficient**, more **flexible** and more **scalable**

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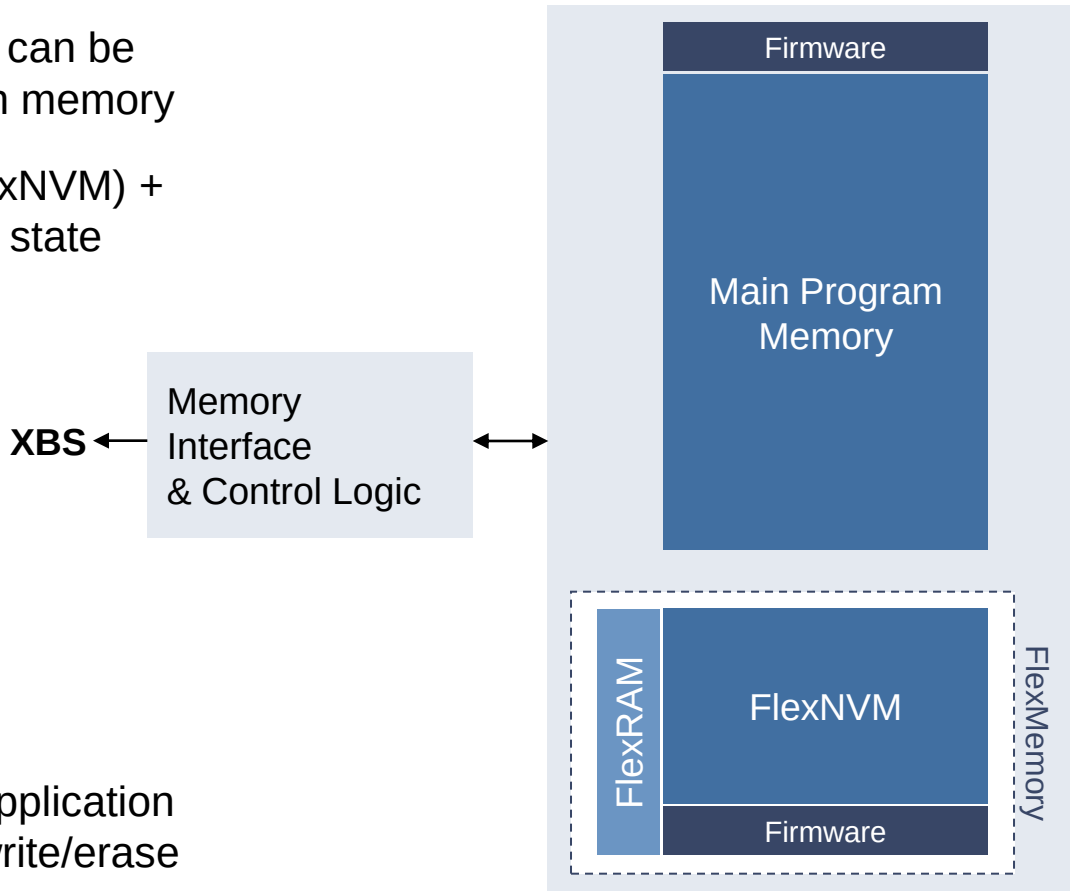
Providing Design Flexibility

- FlexMemory is a memory block that can be configured as EEPROM and/or flash memory
- Combination of TFS flash array (FlexNVM) + SRAM block (FlexRAM) + hardware state machine
- Fully embedded in the MCU
  – avoids software complexity and eliminates system resource impact on CPU/flash/RAM of EEPROM emulation schemes
- Can be accessed simultaneously with the main program memory
- Can be used for storing additional application program code, data tables or byte write/erase system data



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Freescale FlexMemory vs. Traditional EEPROM

Attribute	Traditional Embedded EEPROM	FlexMemory
Read-while-write with program memory	Yes	Yes
Granularity	Byte write/erase	Byte write/erase
Write time	~1-5msec (byte write only)	~100usec (word or byte program, brown-outs w/o loss or corruption of data)
Erase + write time	~5-10 mSec	~750 uSec + ~750 uSec (1.5 mSec)
Endurance	50-300K cycles (fixed)	SoC implementation and user configurable, can exceed 10M cycles
Minimum write voltage	≥ 2.0V	1.71V
Flexibility	Fixed by part number	Programmable trade-off - quantity vs. endurance

Programming and Debug Options

JTAG/cJTAG

- Debugger interfaces with programming capability for convenient field re-programming

EzPort

- Simple serial factory programming interface provides fast programming times

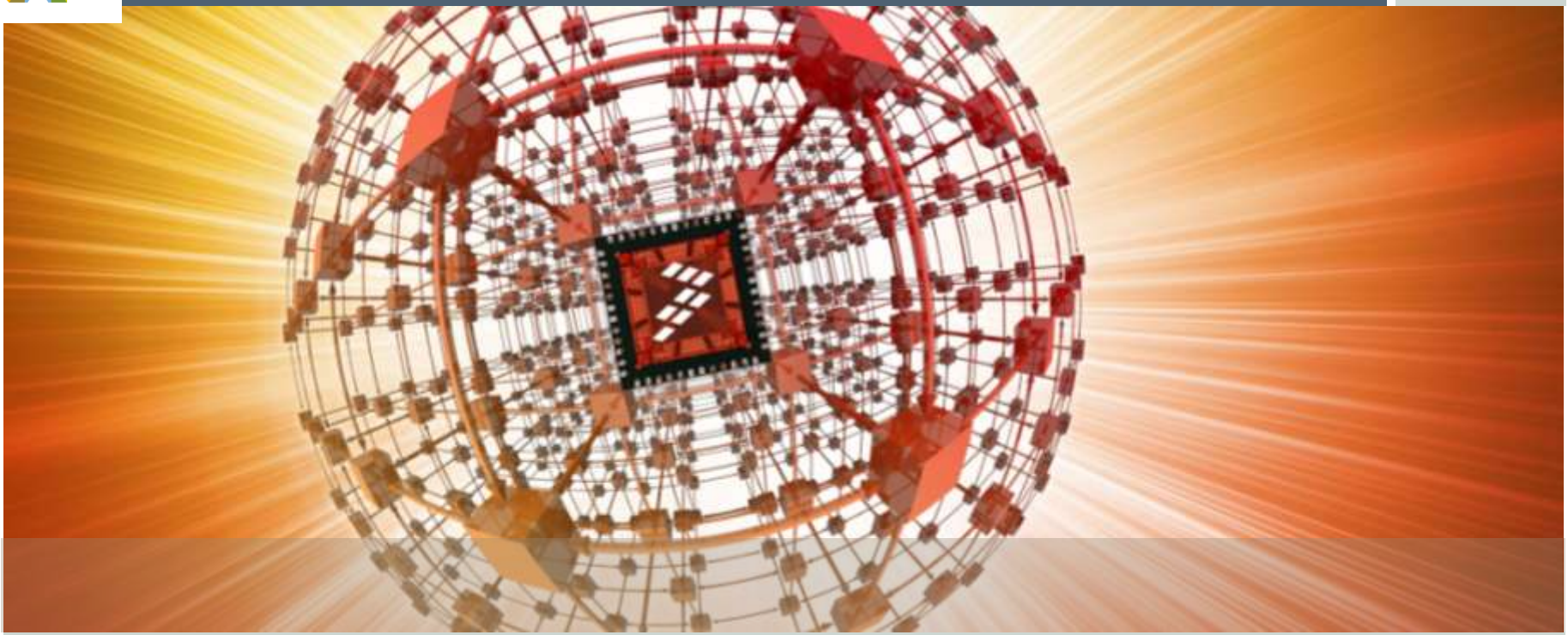
Software

- Resident flash programming routines useful for firmware updates in the field via communication interfaces

ARM Serial Wire Debug (SWD)

Trace

- Port Interface Unit with 5-pin/3-pin/1-pin Modes
- 8 Breakpoints and Flash Patches
- 4 Address and Data Watchpoints
- Software Instrumentation Messaging + Simple Data Trace Messaging + Watchpoint Messaging
- ETM supports instruction trace with 2KB memory mapped buffer used to store trace data.

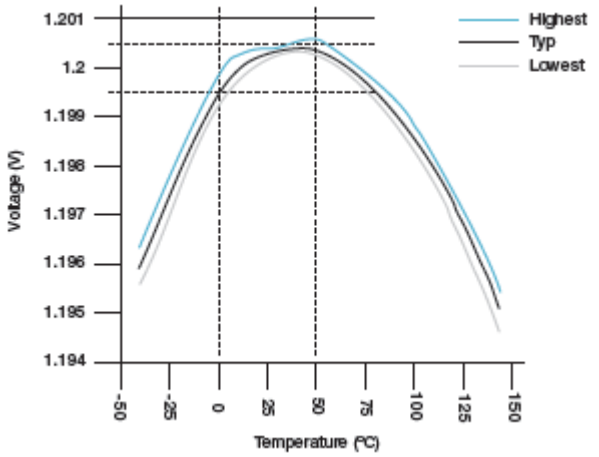


Mixed Signal

Kinetis Mixed Signal (Analog)

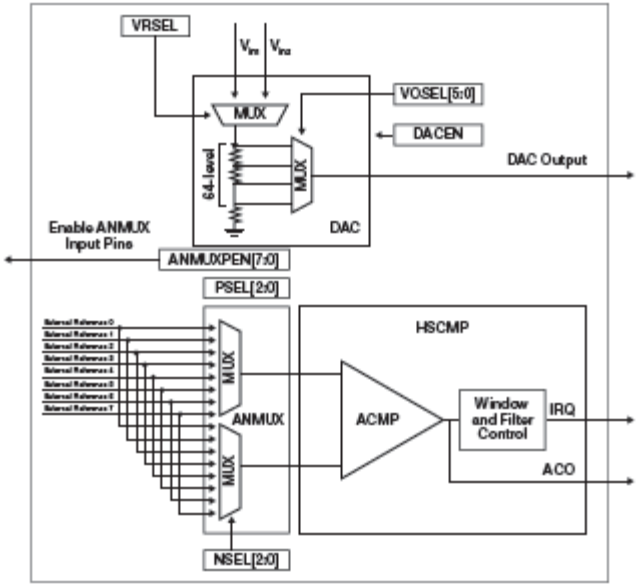
▶ 16-bit SAR ADC

- 1.15V minimum reference
- Differential or Single Ended
- Averaging by 1, 4, 8, 16, or 32
- Automatic Compare Function
- Triggering synchronization w/ DAC
- Configurable sample time, speed/power
- Up to 20 input channels per converter



▶ 12-bit DAC

- 16 word DAC FIFO
- Hardware or software trigger



▶ Voltage Reference (VREF)

- 1.15V Output, high power mode for external use
- Trimmable
- < 33mV/ºC temp variation (In critical 0°-50°C temp) range

▶ High Speed Comparators

- Programmable hysteresis control, and interrupt trigger
- Selectable inversion on comparator output
- Integrated 6-bit DAC for reference

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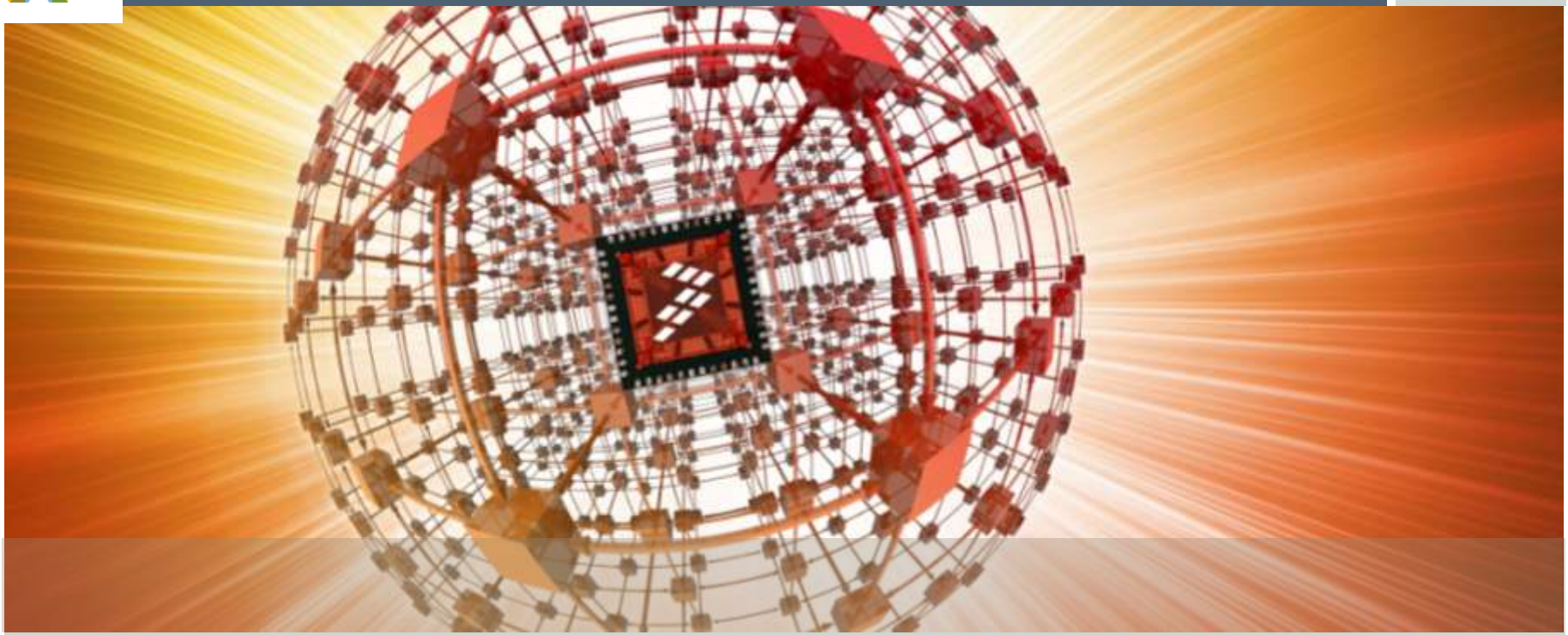
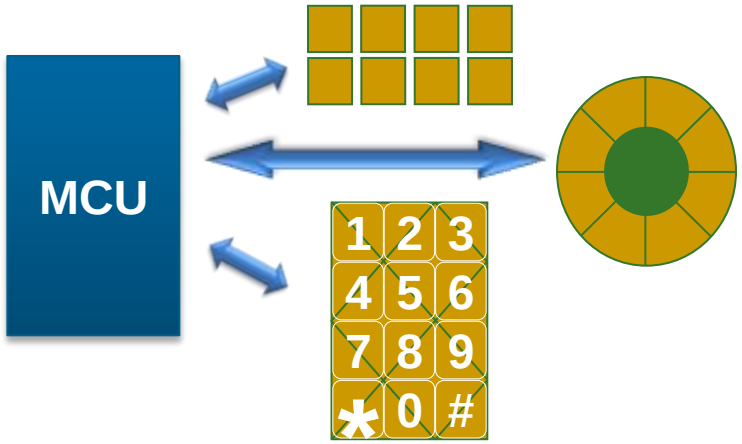


Human Machine Interface (HMI)

TSI / Segment LCD / Graphics LCD

Touch Sensor Interface Features

- **Capacitive touch sensing detection across all low power modes**
  - Automatic periodic scan with configurable duty cycle
  - Low power mode current adder can be <1uA
- **16 input capacitive touch sensing pins**
  - Each with individual result registers
  - Automatic detection of Electrode Capacitance Change with programmable upper and lower threshold
- **TSI interrupts**
  - End of Scan, Out of Range, pad short or conversion overrun



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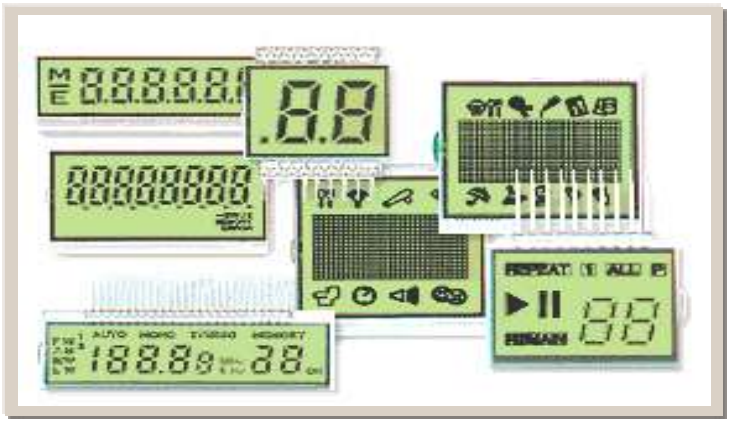

Segment fault detection capability

- Hardware support for segment LCD display errors

Up to by 8 multiplexing

- Fewer pins required to drive LCD segments

Low power blinking mode

- LCD glass blink capability in low power modes
- Alternate display feature can be activated to display alternate data (i.e. blink temperature and time

Front and back plane re-assignment

- Any LCD pin can be a frontplane or backplane pin

Internal charge pump provides voltage required to power LCD glass

- Internally regulated voltage for constant contrast across MCU VDD
- Trim register for software contrast control

Graphics LCD Controller

- **Compatible IP to Freescale's i.MX portfolio**
- **Interface to passive and active color panel (TFT)**
- **Supports timing requirements for Sharp 240 × 320 HR-TFT panel**
- **Hardware-generated cursor with blink, color, and size programmability**
  - Logical operation between color hardware cursor and background
  - Hardware panning (soft horizontal scrolling)
  - Graphic window color keying for graphical hardware cursor
- **8-bit pulse-width modulator for software contrast control**
- **Graphic window support for viewfinder function in color display**
- **256 transparency levels for alpha blending between graphic window and background plane**

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Kinetis Application Examples

Motor Control Use Case

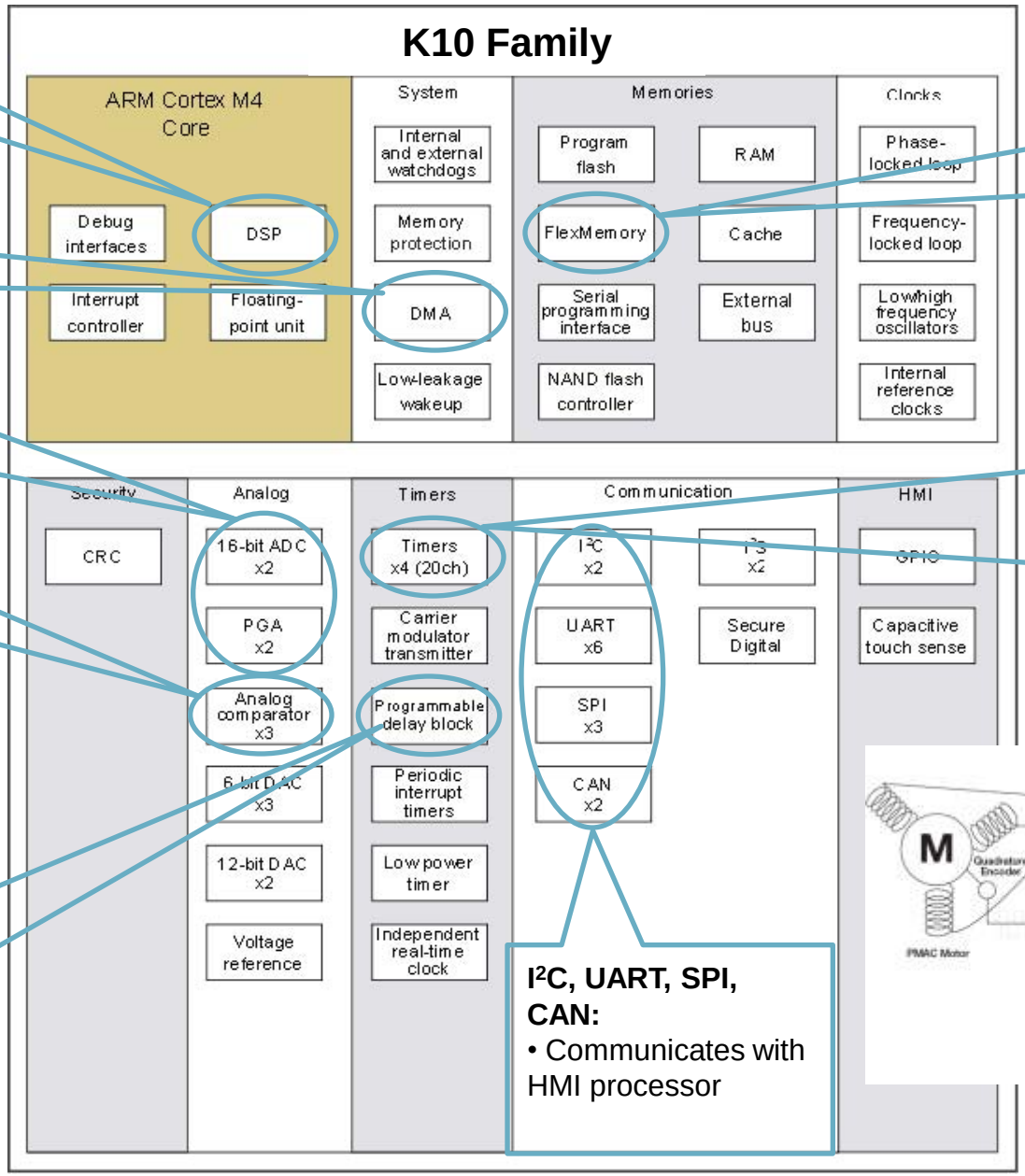
DSP hardware:
► Accelerates motor control calculations

DMA:
► Off loads CPU from repetitive data transfers

16-bit ADC & PGA:
► Measures 3 phase bridge current and voltage

Analog Comparator:
► Detects back EMF
►Monitors over current

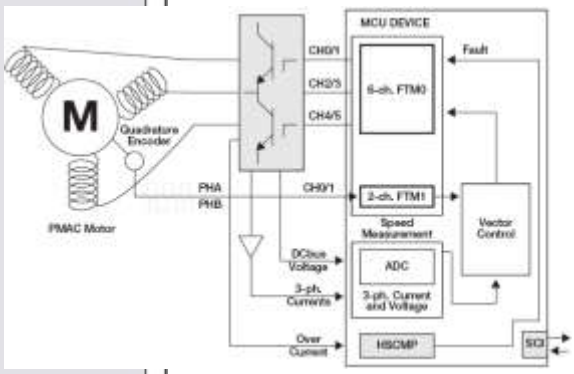
Programmable delay block:
► Schedules delayed ADC conversions relative to Timer triggers



I²C, UART, SPI, CAN:
• Communicates with HMI processor

FlexMemory:
► Saving motor calibration data
• Remote update bootloader

Timers:
► Drives various motor types including stepper, BLDC, and PMAC motors with sensor or sensorless algorithms
► Built-in quadrature decoder detects motor speed



Thermostat Use Case

FlexMemory:
► Saves user defined schedule
► Remote update bootloader
► Stores display menus and graphics
► Logs usage

Low-Leakage Wakeup:
► Deep sleep wakeup controller

16-bit ADC & PGA:
► Samples temperature sensor

Voltage reference:
► Accurate voltage reference for sensor

RTC:
► Clock source with optional independent battery supply

Periodic interrupt timers:
• Periodically triggers ADC conversion on sensor

I²S:
► Audio interface for voice

Capacitive touch sense:
► Keypad buttons
► Wake up source

Segment LCD:
► Drives up to 320 segments of 3V or 5V custom LCD glass
► Conducts segment failure self-test

USB Subsystem:
► Firmware updates

Factory Automation Use Case

Cortex-M4 core with DSP and FPU:
- ► Signal filtering
- ►Motor control
- ►Complex real time control algorithms

Low-Leakage Wakeup:
- ► Deep sleep wakeup controller

Mixed Signal:
- ► Sensor monitoring
- ►Load control
- ►Voltage and current measurement

System security:
- ► IP protection
- ►Communication protection
- ►Tamper protection

RTC:
- ► Clock source with optional independent battery supply

Timers:
- ► Motor control for up to two BLDC motors
- ►Signal measurement
- ►Load control

FlexMemory:
- ► Equipment configuration & calibration
- ► Remote update bootloader

External Bus:
- ► FPGA for custom logic

NAND flash controller:
- ► External storage for data logging

Capacitive touch sense:
- ► Robust keypad
- ►Robust slider input

Comprehensive Industrial Connectivity:
- ► 10/100 Ethernet with 1588
- ►UARTs with RS485 and CAN for legacy protocols
- ►USB otg
- ►SPI and I2C for peripheral systems
- ►SDIO for wireless adaptors

Kinetis Competition

New Kinetis MCUs

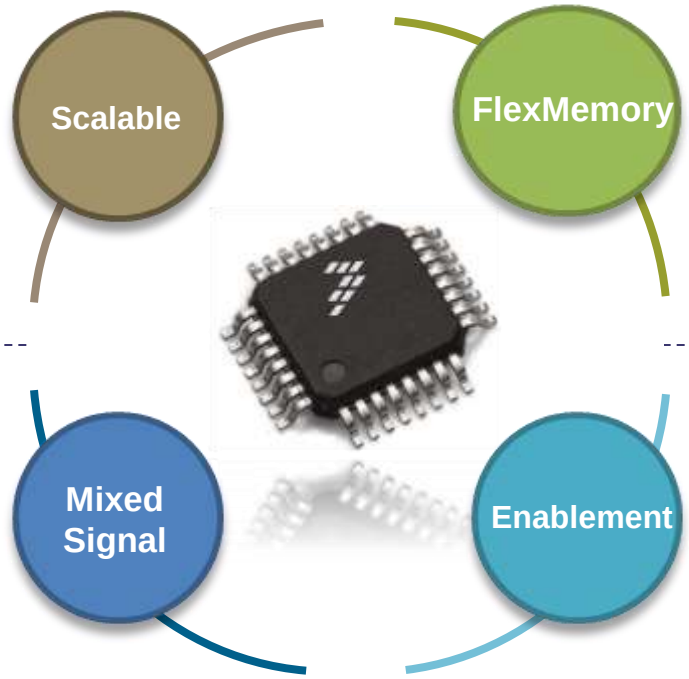
Scalable Mixed-Signal Consumer and Industrial Microcontroller Families

The most **scalable** portfolio of **low-power ARM Cortex-M4** MCUs available today

*Over **200** hardware and software compatible ARM Cortex-M4 devices with high performance **signal processing capability** and run currents of **<200uA/MHz***

Innovative Low Power **90nm Thin-Film Storage** Flash with **FlexMemory**

*Offers **EEPROM capability** with unprecedented programming speed and endurance, capable of over **10 Million cycles***



Exceptional **mixed-signal** integration

*Flexible, High-speed, high-precision 16-bit **ADCs**, 12-bit **DACs**, Programmable Gain **Amplifiers**, Voltage References, and Hardware **Touch Sensing** lower system costs.*

One of the most **comprehensive ARM® enablement** portfolios

***Complimentary Freescale MQX RTOS** and **Eclipse-based CodeWarrior** 10.0 IDE, as well as **IAR, KEIL** and other ARM ecosystem providers help speed time to market*

More than **200 New** Parts
7 scalable families

First available broad-market MCU samples based on ARM Cortex-M4!

New Kinetis MCUs vs. *Competitor "A"*

Attribute	Competitor "A" ARM Solution	Kinetis
Scalability	• **Lacks** portfolio compatibility → **Higher cost** to upgrade/expand designs in the future	• 200+ compatible devices from 32K to 1MB of flash and 50 to 180MHz
Mixed-Signal Integration	• Limited mixed-signal integration → **Higher system cost**	• Rich mixed-signal integration is standard in Kinetis: 16-bit ADC, 12-bit DAC with Vref, PGA, • Includes hardware touch sense
Flexible Memory	• **NO EEPROM offered** • Emulation difficult since flash blocks are 4KB and 32KB in size • Flash endurance to only 10K cycles	• FlexMemory provides option for EEPROM and/or additional flash • Emulation not needed, no lost system resources or • EEPROM endurance up to 10M W/E cycles
Enablement	• NO complimentary RTOS • NO internal integrated development environment (IDE)	Internal Freescale Options: • MQX RTOS is complimentary • CodeWarrior IDE is complimentary
Low Power	• **Slow wake-up** time from sleep consumes more power in the end-application	• Wake-up time from sleep in 4uS, with additional functionality in low power modes, including touch sensing and LCD operation

Freescale's Value = MQX RTOS+CodeWarrior and mixed-signal integration

Competitor "A" lacks internal software solution and mixed-signal integration

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New Kinetis MCUs vs. *Competitor "N"*

Attribute	Competitor "N" ARM Solution	Kinetis
Scalability	• **Lacks** portfolio compatibility → Different operating voltage for each family • Pin options only to 100-pin	• 200+ compatible devices from 32K to 1MB of flash and 50 to 180MHz • Pin options to 256-pin
Mixed-Signal Integration	• Only 12-bit ADC and 10-bit DAC • Incompatible timer modules • NO PGA, NO hardware touch sense, NO USB regulator	• 16-bit ADC with operation over full voltage range • 12-bit DAC with Vref • Additional standard mixed-signal features include: PGA, high speed comparators • Hardware touch sense is standard
Flexible Memory	• Flash and EEPROM program only at 2-3.6V • Long erase/program times and higher currents • Limited to 10K write/erase cycles	• Programming and option of all memories and peripherals across the full 1.71 to 3.6V range • 1.5mS erase + write times • EEPROM endurance up to 10M W/E cycles
Enablement	• **NO complimentary RTOS** • NO motor control libraries	• MQX RTOS is complimentary, along with stacks for USB, Ethernet, etc • Motor control libraries available complimentary

Freescale Value Proposition = Scalability and mixed-signal integration

Competitor "N" lacks portfolio compatibility and mixed-signal integration

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New Kinetis MCUs vs. *Competitor "R"*

Attribute	Competitor "R" 32-bit Solution	Kinetis
Scalability	• Different voltage ranges and timers in different families → Lack compatibility in their MCUs • I/O functionality changes from pin-to-pin on the RX family	• All devices in a single technology and voltage input range • Pin options to 256-pin, consistent I/O location and functionality
Mixed-Signal Integration	• Lack of on-chip high precision analog capabilities requires off-chip solutions that COST MORE, consume MORE POWER, require a LARGER footprint, COMPLICATE design, and EXTEND development time	• 16-bit ADC with operation over full voltage range and 21 channels • Common timer modules across all Kinetis families • Integrated PGA, DAC, high-speed comparators and hardware touch sense interface
Flexible Memory	• Inferior data flash with 30K cycles, 8K erase sizes, and 2ms program times	• Byte write-/erase-able EEPROM with up to 10M W/E cycles and 1.5mS erase + write times
Enablement	• Lack complimentary runtime software • Limited trace capability • Outside of ARM ecosystem	• MQX RTOS is complimentary, along with stacks for USB, Ethernet, etc • Full trace capability • ARM ecosystem of 3rd party
Low Power	• 500uA/MHz current consumption – not designed for battery applications	• Operation at 200uA/MHz in run mode, low power operation with 10 flexible power modes,

Freescale Value Proposition = Low power, integration, and scalability

Competitor "R" slows time to market and lacks portfolio compatibility

New Kinetis MCUs vs. *Competitor "S"*

Attribute	Competitor "S" ARM Solution	Kinetis
Scalability	• Portfolio spread across 3 different technologies → Different voltage ranges • Pin options only to 144-pin • Limited to 120MHz and 96KB RAM	• All devices in a single technology • Pin options to 256-pin • Up to 180MHz and 128KB RAM
Mixed-Signal Integration	• Only 12-bt ADC with narrow voltage range and fewer channels • Incompatible timer modules • NO PGA, NO HW touch sense, NO USB regulator	• 16-bit ADC with operation over full voltage range and 21 channels • Common timer modules across all Kinetis families • Integrated PGA, TSI, USB regulator
Flexible Memory	• Flash and EEPROM program only at 2-3.6V • Long erase/program times and higher currents • Limited to 10K write/erase cycles	• Programming and option of all memories and peripherals across the full 1.71 to 3.6V range • 1.5mS erase + write times • EEPROM endurance up to 10M W/E cycles
Enablement	• **NO complimentary RTOS** • Limited stack support, less flexible motor control • **NO on-chip trace buffer**	• MQX RTOS is complimentary, along with stacks for USB, Ethernet, etc • Full trace capability

Freescale Value Proposition = Scalability and mixed-signal integration

Competitor "S" lacks portfolio compatibility and mixed-signal integration

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New Kinetis MCUs vs. *Competitor "T"*

Attribute	Competitor "T" ARM Solution	Kinetis
Scalability	• Pin options only to 100-pin • Sub-100MHz with 256K flash and 96KB RAM	• Scalable package options to 256-pin • Up to 180MHz with 1MB flash and 128KB RAM
Mixed-Signal Integration	• PWMs/A/Ds are not standard • All Ethernet options include PHY → unable to accommodate new features • NO LCD controller not offered at all • NO touch sensing	• 16-bit ADC and timer modules standard across all Kinetis families + Integrated PGA, D/A, Vref, and high-speed comparators • Hardware touch sensing is standard
Flexible Memory	• **Lack EEPROM** on chip – single bank of flash limits emulation capability	• EEPROM endurance up to 10M W/E cycles → lower system cost no performance lost to emulation
Enablement	• **NO complimentary RTOS** • Point solution development boards • **NO on-chip trace buffer**	• MQX RTOS is complimentary, along with stacks for USB, Ethernet, etc • Tower system allows rapid prototyping and high re-use • Full trace capability
Low Power	• ***Lack flexible low-power modes*** • Operation only at 3V	• Operation across full 1.71 to 3.6V, including for programming and peripherals

Freescale Value Proposition = Mixed-signal integration and low-power

Competitor "T" lacks mixed-signal integration and low-power

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Building the Industry's **Most Trusted MCU Solutions**

- Freescale offers leadership in the 32-bit MCU space
  1. 200 scalable devices from 32KB to 1MB of flash and up to 180MHz performance
  2. FlexMemory enables on-chip EEPROM
  3. Incredible mixed-signal integration
  4. Low-power capability
  5. Complete enablement
     - Complimentary MQX RTOS
     - Complimentary CodeWarrior IDE
     - Tower system for rapid prototyping

- **Kinetis by Freescale is the clear choice for your MCU needs**

Schedule and Roadmap

Milestones for New ColdFire+ and Kinetis MCU Families

Product Family	Public Announcement	Alpha Sampling	Production
MCF51JF	June 8, 2010	Q4 2010	1H 2011
MCF51JU			
MCF51QM			
MCF51QF			
MCF51QH			
MCF51QU			
K60 Family	June 22, 2010	Q3 2010	1H 2011
K40 Family			
K30 Family			
K20 Family			
K10 Family			

First available broad-market MCU samples based on ARM Cortex-M4!

ColdFire+ **Kinetis**

*Dates Subject to change

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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 offers 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
- A list of participating **Freescale products** is available at: www.freescale.com/productlongevity

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Building the Industry's **Most Trusted MCU Solutions**

- Freescale's extensive range of integrated MCUs continues to grow with the addition of over 240 new V1 ColdFire+ and Kinetis Microcontrollers sampling in the second half of 2010
- Built using Freescale's innovative IP, flash technology and platform design capability
- Bundled with market-leading vertical solutions and software enablement

For More Information:
www.freescale.com/coldfire+
www.freescale.com/kinetis

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Building the Industry's **Most Trusted MCU Solutions**

Additional Sessions:

- MQX
  - FTF-ENT-F0719 Tues 14:00 (1hr) – Tower+MQX
  - FTF-ENT-F0720 Tues 15:00 (3hr – hands-on) – Getting Started
  - FTF-ENT-F0723 Wed 14:00 (1hr) – Mocana Nano SSL/SSH
  - FTF-ENT-F0721 Wed 15:00 (3hr – hands-on) – Drivers/BSPs
  - FTF-ENT-F0722 Thurs 9:00 (3hrs – hands-on) – Connectivity
  - FTF-ENT-F0758 Thurs 9:00 (3hrs – hands-on) – Graphic Libs
- CodeWarrior
  - FTF-ENT-F0385 Tues 10:30 (2hr)
  - FTF-ENT-F0653 Tues 12:45 (1hr) – Processor Expert
  - FTF-ENT-F0517 Tues 14:00 (1hr) – Processor Expert
  - FTF-ENT-F0669 Wed 10:15 (1hr) – v10.0 Overview
  - FTF-ENT-F0648 Wed 14:00 (1hr)
  - FTF-ENT-F0654 Wed 16:15 (2hr) – HW abstraction
  - FTF-ENT-F0382 Thurs 9:00 (3hr) – Hands-on Component Wizard
  - FTF-ENT-F0667 Thurs 9:00 (3hr) – Hand-on v10.0
- FTF-IND-F0880 – ARM – Tues 16:15 (1hr) - SWD
- FTF-ENT-F0911 – IAR – Wed 14:00 (1hr)
- FTF-IND-F0872 – Avnet – MCUs for signal processing


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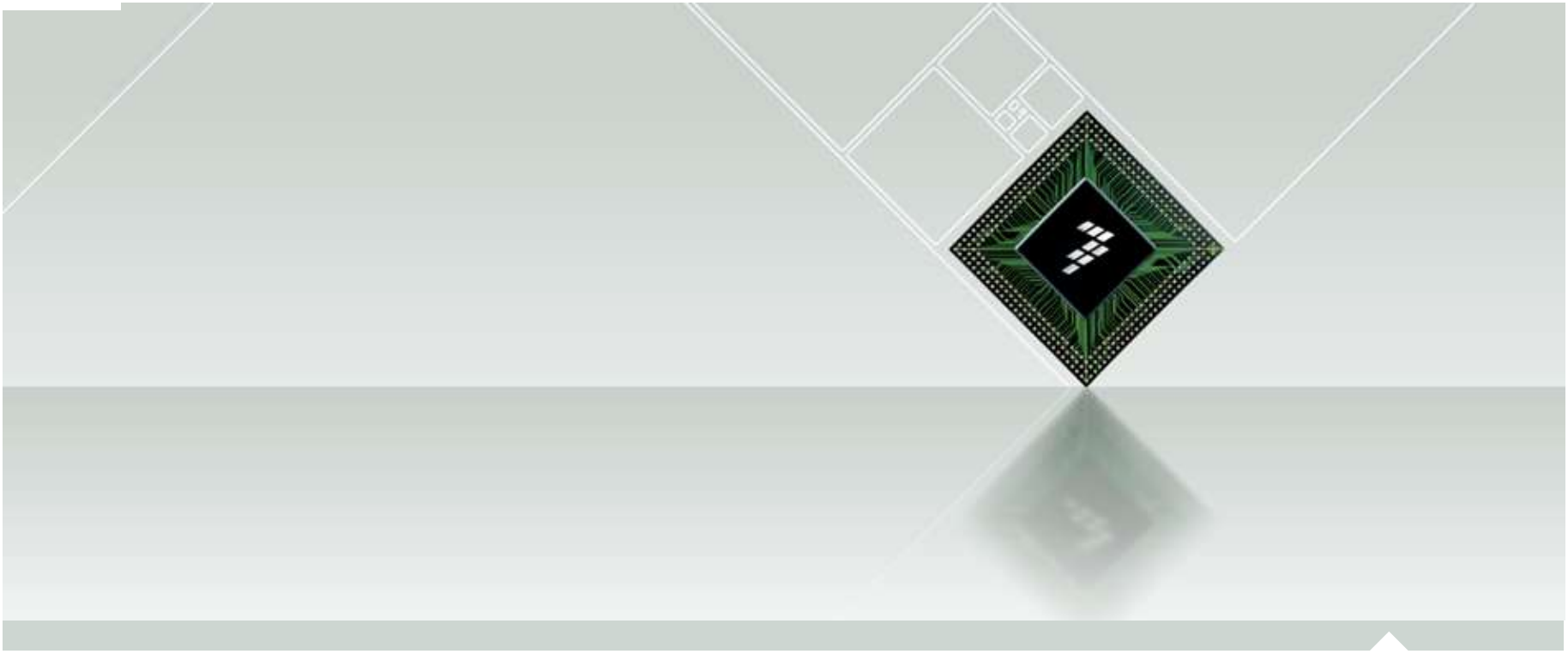

BACK-UP

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Universal Remote Control Use Case

FlexMemory:
►Saving user defined settings
►Remote update bootloader
►Stores display menus and graphics

Low-Leakage Wakeup:
►Deep sleep wakeup controller

16-bit ADC:
►Touch screen
►USB Vbus monitoring for smart charger

RTC:
►Clock source with optional independent battery supply

CMT:
• Carrier wave for Infrared

External Bus:
►Smart Display

NAND flash controller:
►External storage for additional graphics

I²C:
►Controls smart charger IC

Capacitive touch sense:
►Keypad buttons
►Wake up source

USB Subsystem:
►Configuration & charging port to host PC
►Detects type of charger and controls battery charger IC
►Firmware updates
►Regulates 3.3V from USB Vbus

Bicycle Trip Computer Use Case

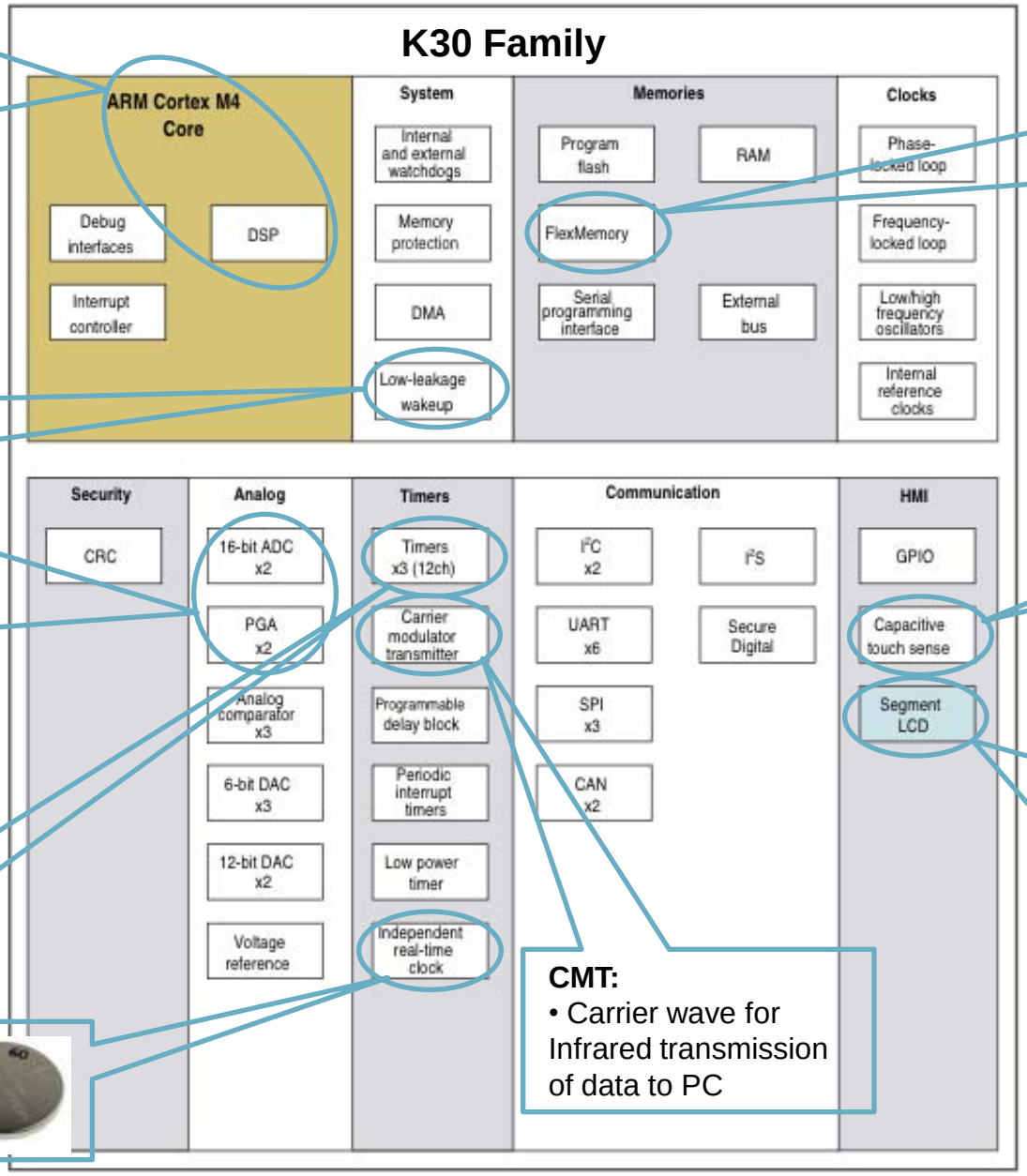
Cortex-M4 core with DSP support:
►Signal processing for heart rate monitoring
►32-bit power for real time calorie burn calculation

Low-Leakage Wakeup:
►Deep sleep wakeup controller

16-bit ADC and PGA:
►Pulse/Heart rate sensor input
►Ambient temperature sensor
►Body temperature sensor
►Compass sensor
►Altitude sensor

Timers:
►For Speed and Cadence measurement

RTC:
► Very low power time of day clock



FlexMemory:
►Saving bicycle configuration
►Saving user exercise data

Capacitive touch sense:
►Keypad buttons
►Wake up source

Segment LCD:
►Up to 320 segments
►Low power “Blink” mode

CMT:
• Carrier wave for Infrared transmission of data to PC