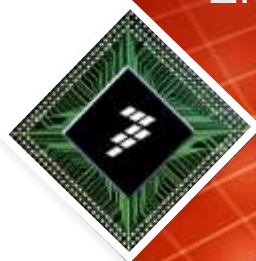


Solutions to Tackle the New Challenges of Medical Device Designs

EUF-HCR-T1235

Mickael Viot

Medical Business Development Manager
EMEA



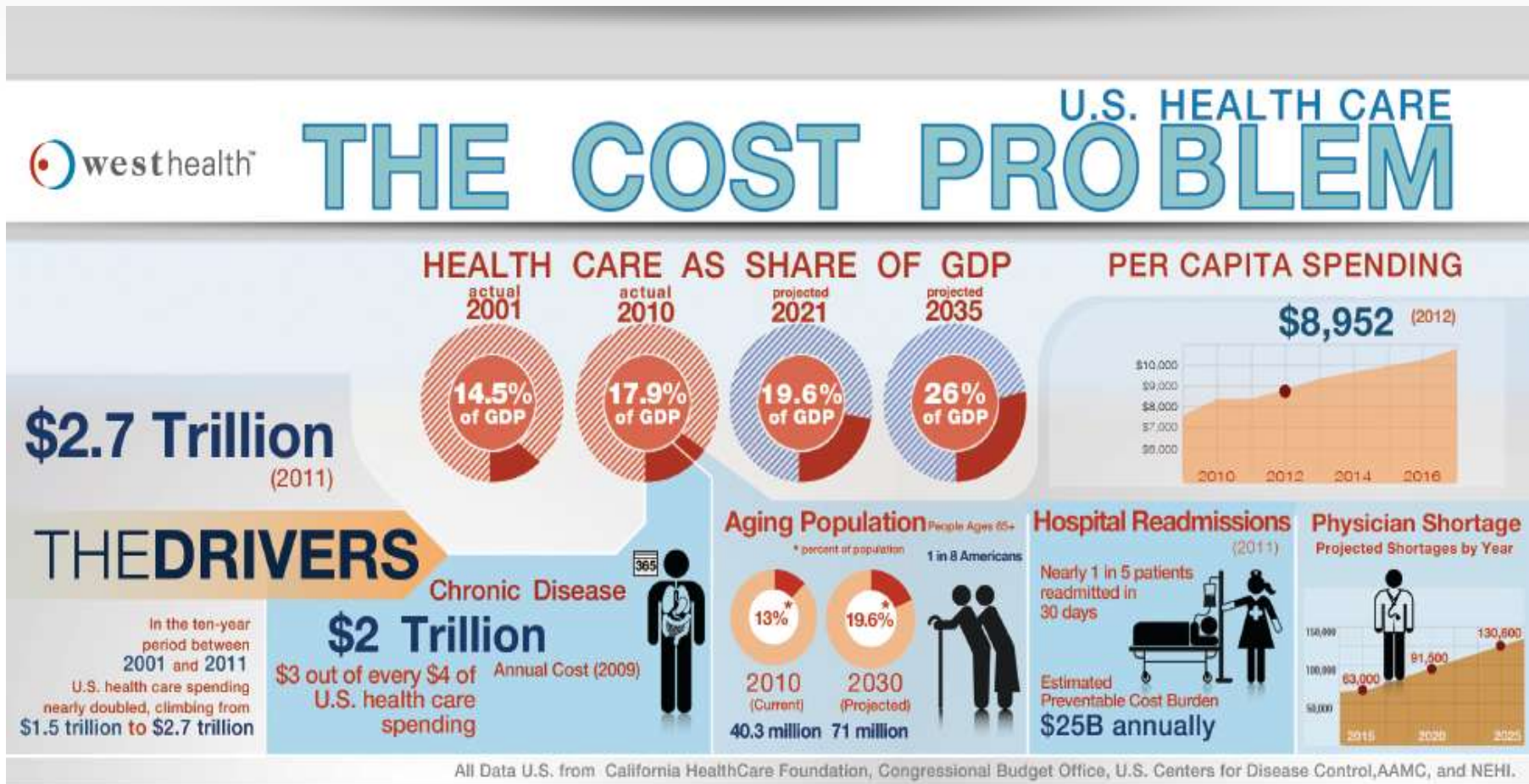
November 2013

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A composite image featuring a smiling woman and a young child, overlaid with a large white medical symbol (Caduceus) and a blue molecular structure graphic.



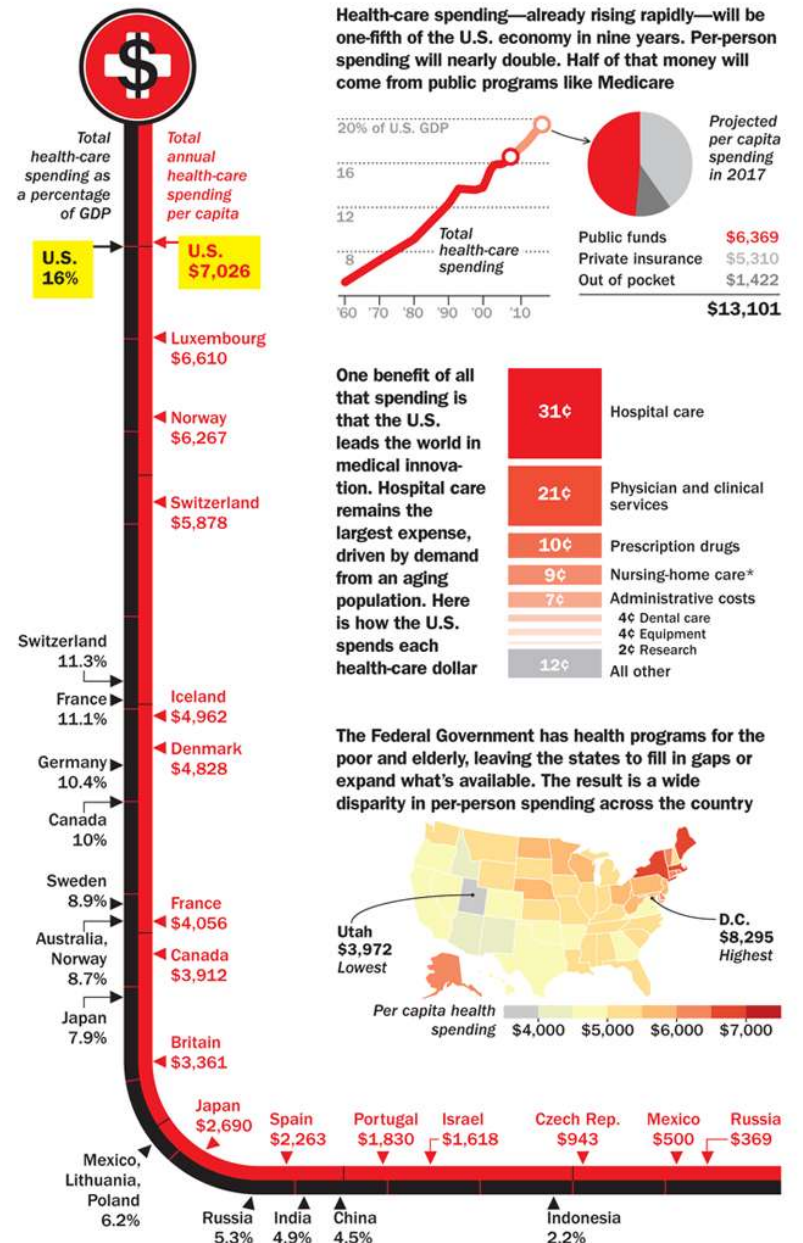
The Challenge



Source: West Health, 2013

Cost of Care in Detail

- US Healthcare spending > 18% of GDP
- Hospital care: 30% of Health Care cost
- **Physicians & Clinical: 21% of HC costs**
- Equipment: only 4% of Health Care cost



Source: World Health Organization – McKinsey, Continua Alliance, Frost & Sullivan

IoT Solutions In Healthcare

Clinical Medical Global Impact

Home Medical Aging Populations

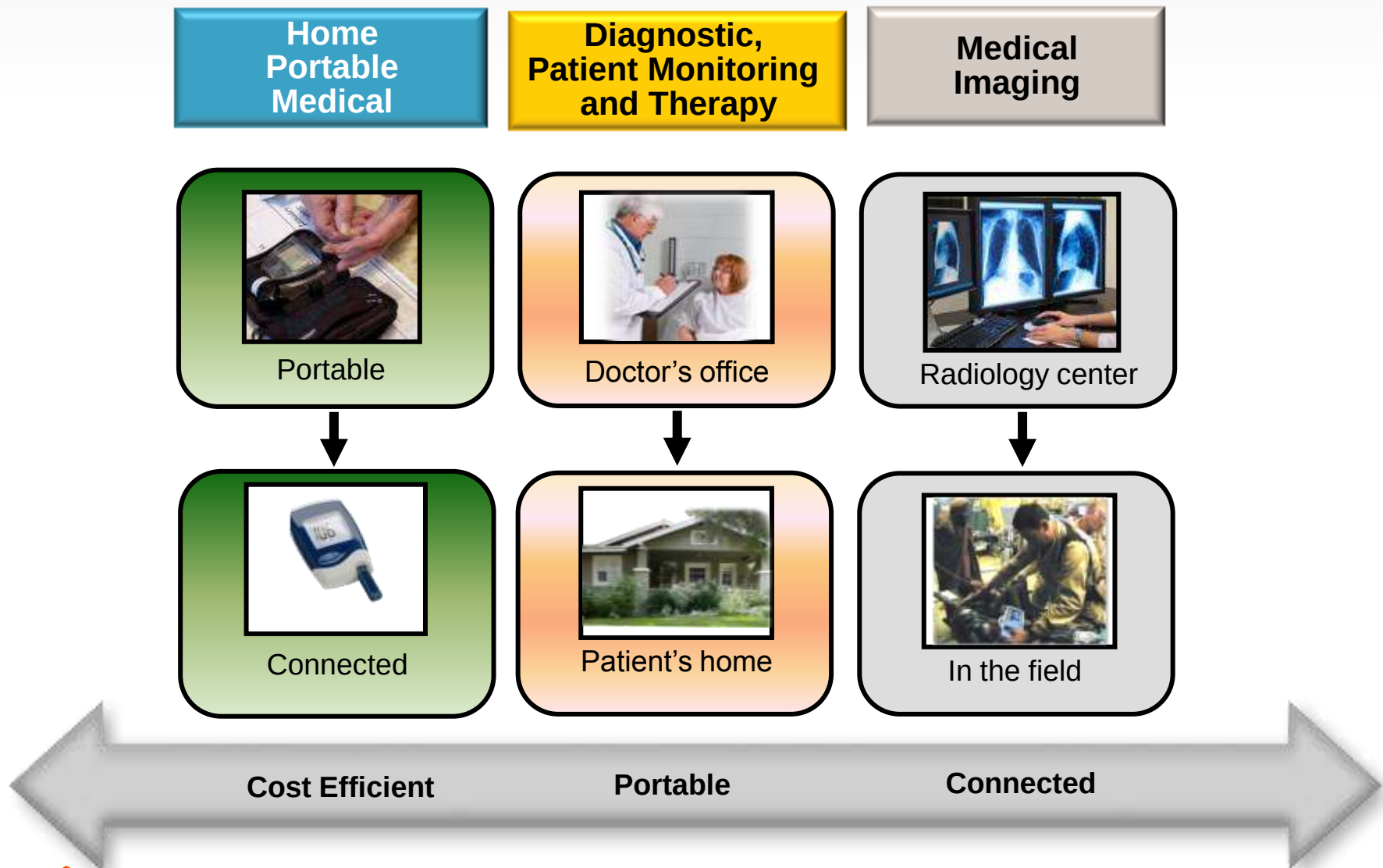


... and its Challenges

- Move from a treatment based system to prevention:
 - Educate people about their own health
 - Develop **cost effective** solutions for people to easily track their vital signs
- Patients to take ownership of their disease:
 - Develop medical devices **easily operable by the patient**
- Move from a centralized to a distributed healthcare system:
 - Develop **connected** solutions to remotely monitor patients
 - Bring hospital equipment to the Doctor's office and patients house

Source: World Health Organization – McKinsey, Continua Alliance, Frost & Sullivan

Trends for Innovation



Health Care Technology Leadership



Freescale Medical Focus

The Facts

- Dedicated Medical Vertical team
- Dr. Jose Fernandez Villasenor, Practicing Surgeon, EE, leads Freescale's Medical Center of Excellence
- Formal Longevity Program to ensure a minimum of 15 years part availability

www.freescale.com/productlongevity

- Present in FDA/CE Class I/II/III applications
- Member of the Continua Health Alliance for Medical devices interoperability

www.continuaalliance.org

- Strategic Partnerships to expand design and system capabilities:

Cactus Semiconductors

Low power Analog Mixed Signal solutions

Monebo

ECG algorithm for a complete ECG solution

To Learn More: www.freescale.com/medical



<http://s.eeweb.com/pulse/eeweb-pulse-2012-36.pdf>

Medical Market Solutions

Freescall is a trusted provider of high quality technical solutions that enable the development of breakthrough medical systems



Portable Medical

- Ultra Low-Power, Highly Integrated Mixed Signal MCUs
- High Performance Analog
- Connectivity
- Sensors



Diagnostic and Therapy

- Scalable MCU/MPU solutions for processing, display
- High Performance Analog
- Connectivity
- Sensors



Imaging

- High Performance & Multi-core DSP and MPUs for advanced processing
- High Performance Analog
- RF amplifier



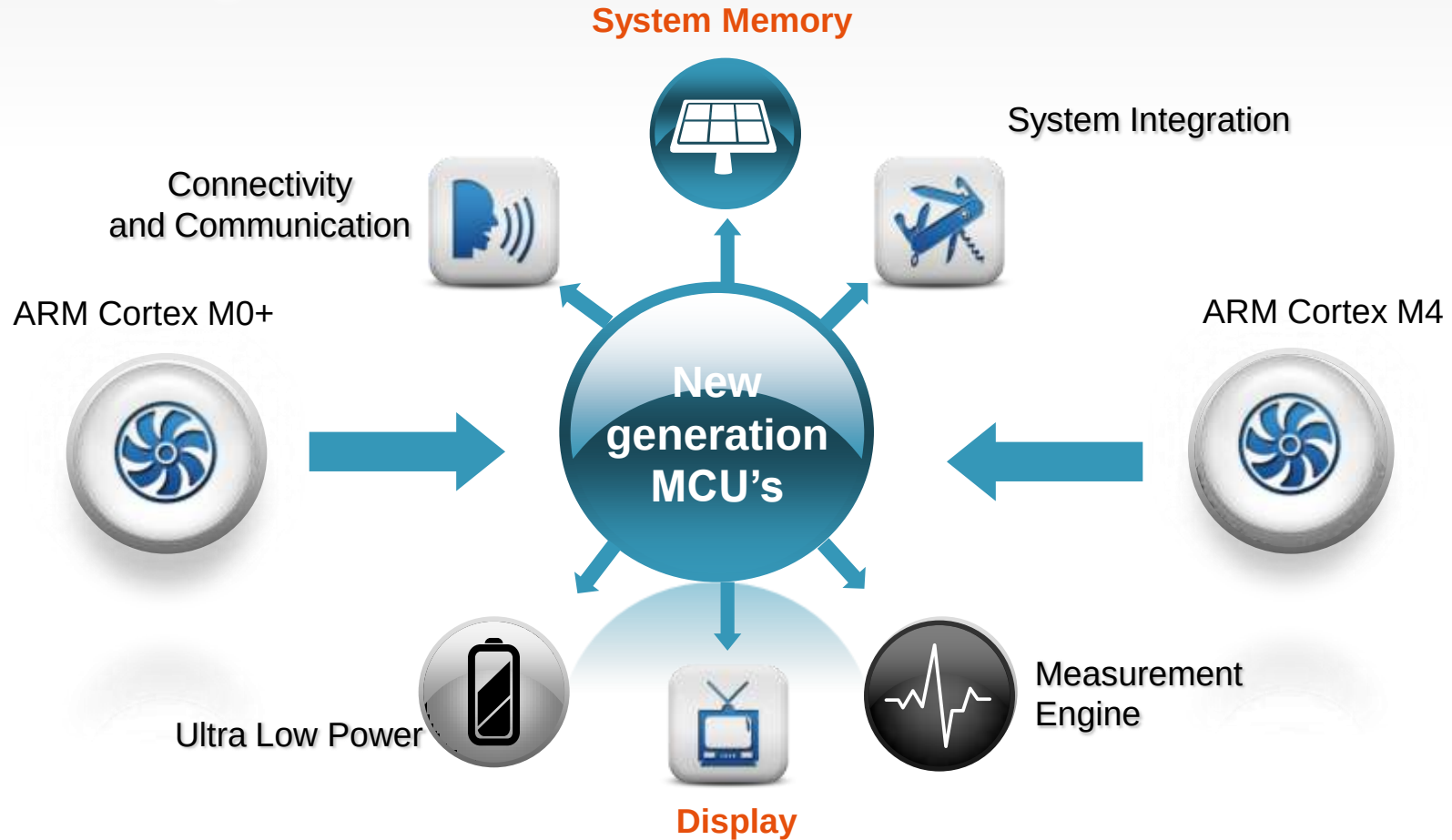
Member & Golden Unit for
802.15.4 Medical Solutions



Product Longevity: Up to 15 Years of Assured Supply for Medical Products

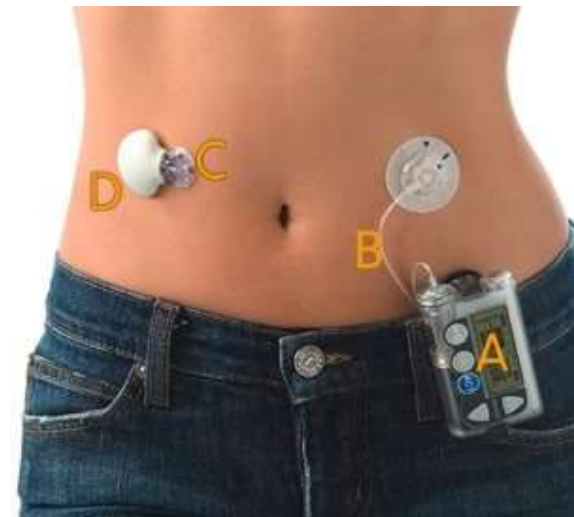
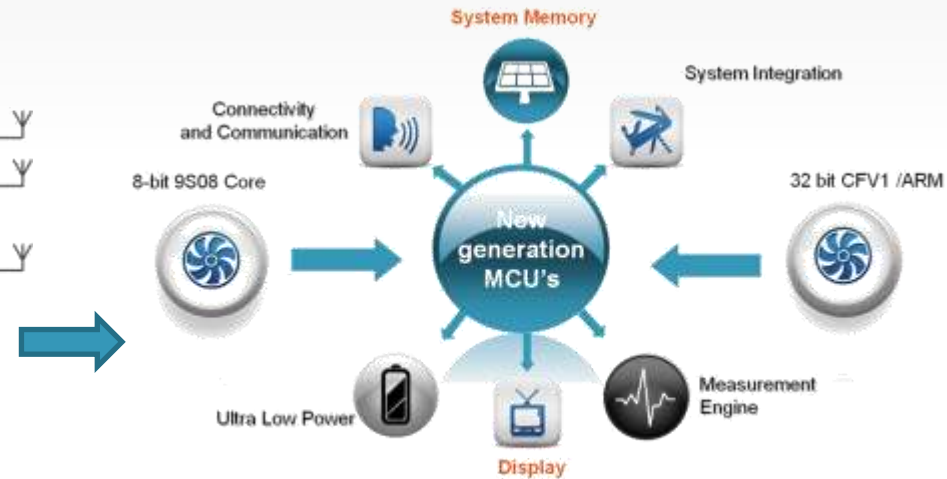
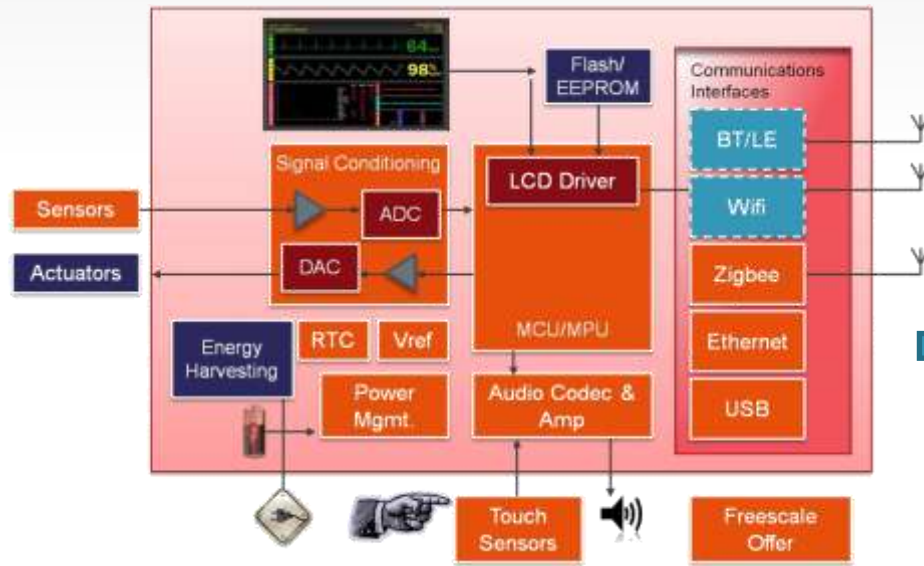


HW Integration for Cost Efficient Solutions...



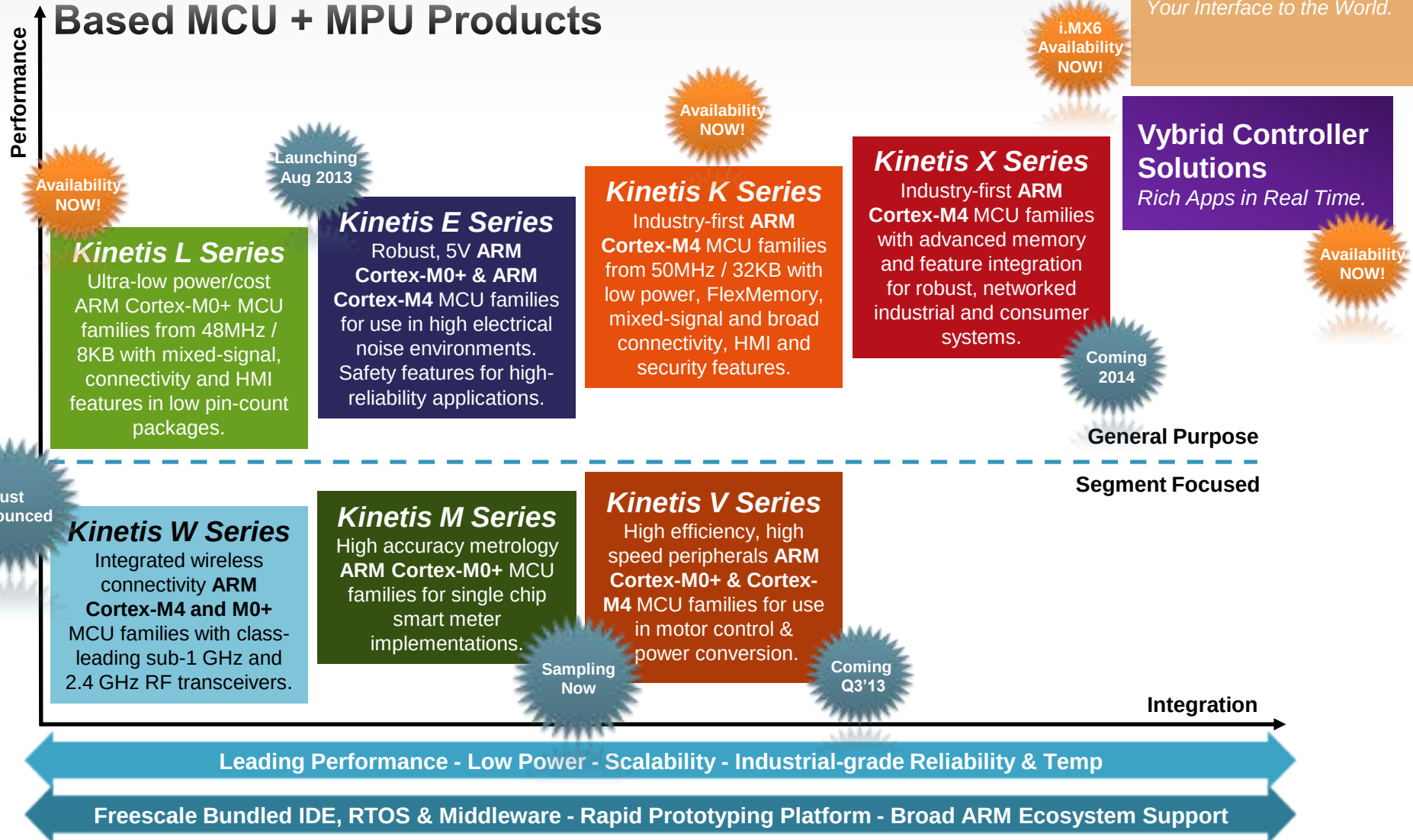
Integration reduces overall BOM, development cost and time to market

... And reduced form factors



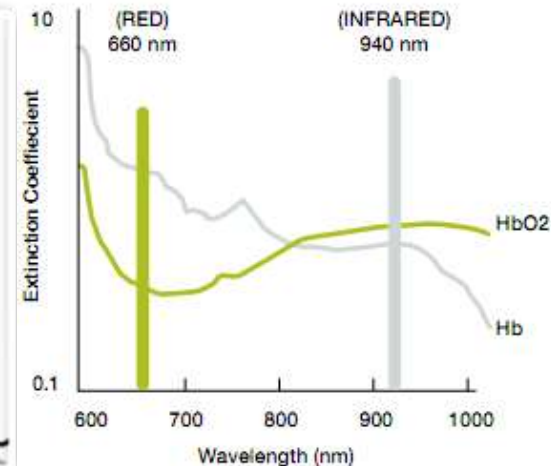
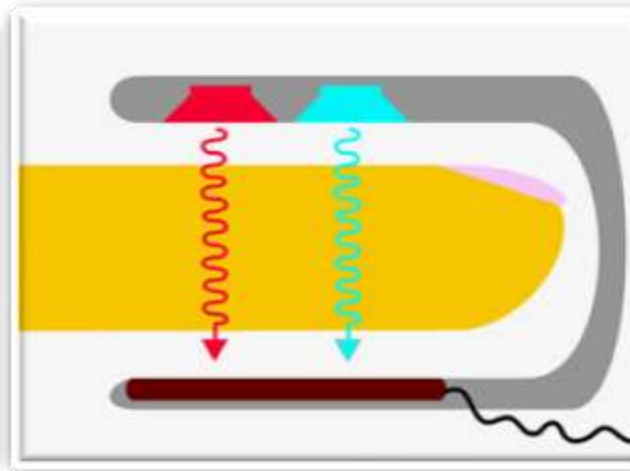
NXP Fully Refreshed And Expanded

Portfolio: Industry's Widest Portfolio of ARM Based MCU + MPU Products



...NOW the Application Pulse Oximeter

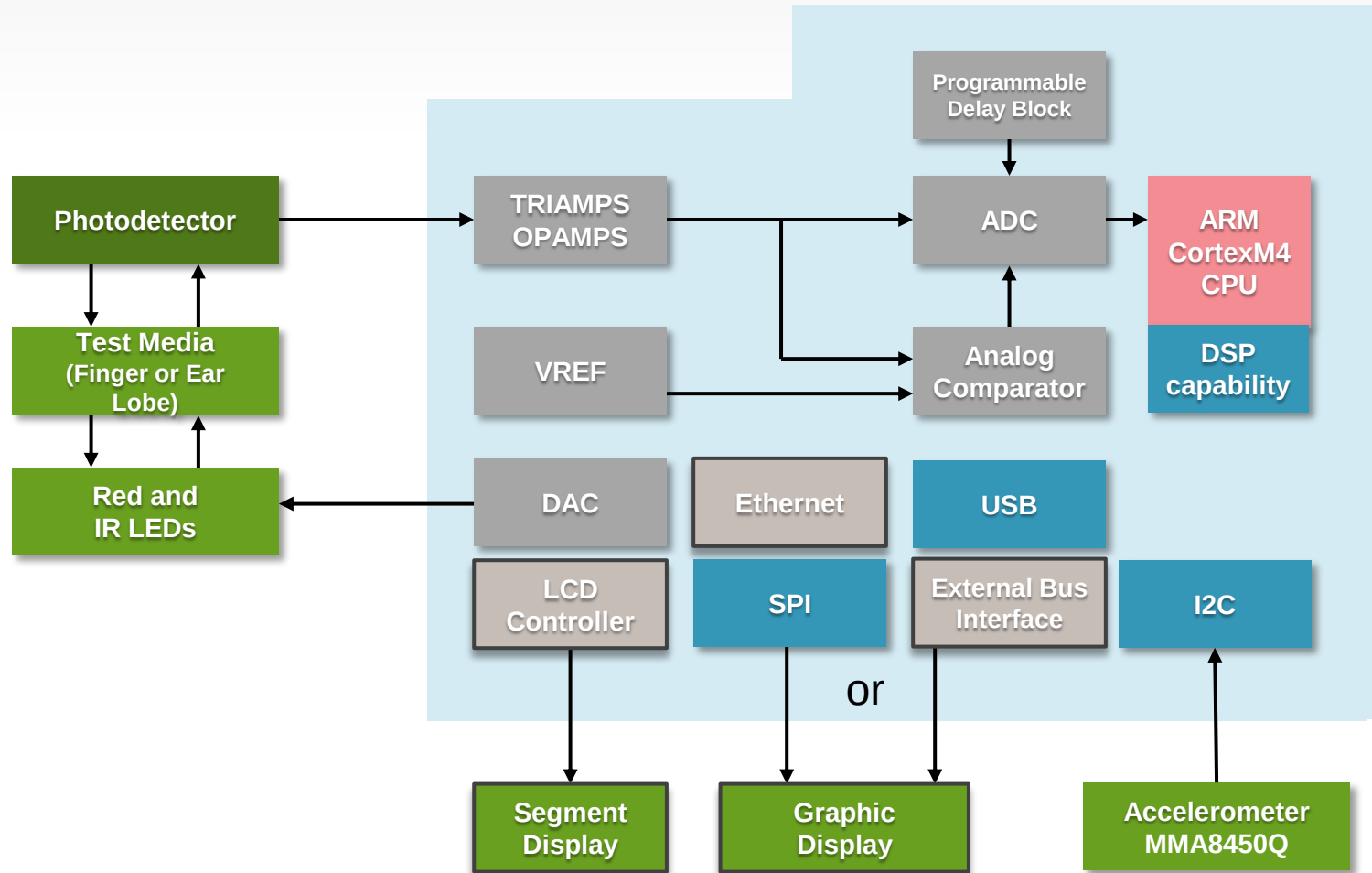
- The light intensity will decrease logarithmically with path length according to the Beer-Lambert Law
- When the light attenuated by body tissue is measured, DC components and AC components will indicate absorption by the arteries



Design Challenges Pulse Oximeter

Problem	Solution
Measurement accuracy	Increase the ADC resolution
Battery oriented	Extreme low power consumption specially
Finger misplaced	Analog comparator to setup thresholds
Calibration	Stable voltage reference on the whole temp. and voltage Range
Connectivity	Wires and/or wireless communication capability
Low cost	BOM reduction, hardware design optimization
Finger motion	Accelerometer
Room light	Differential analog inputs
Appropriate display	Segment or graphic LCD display capability

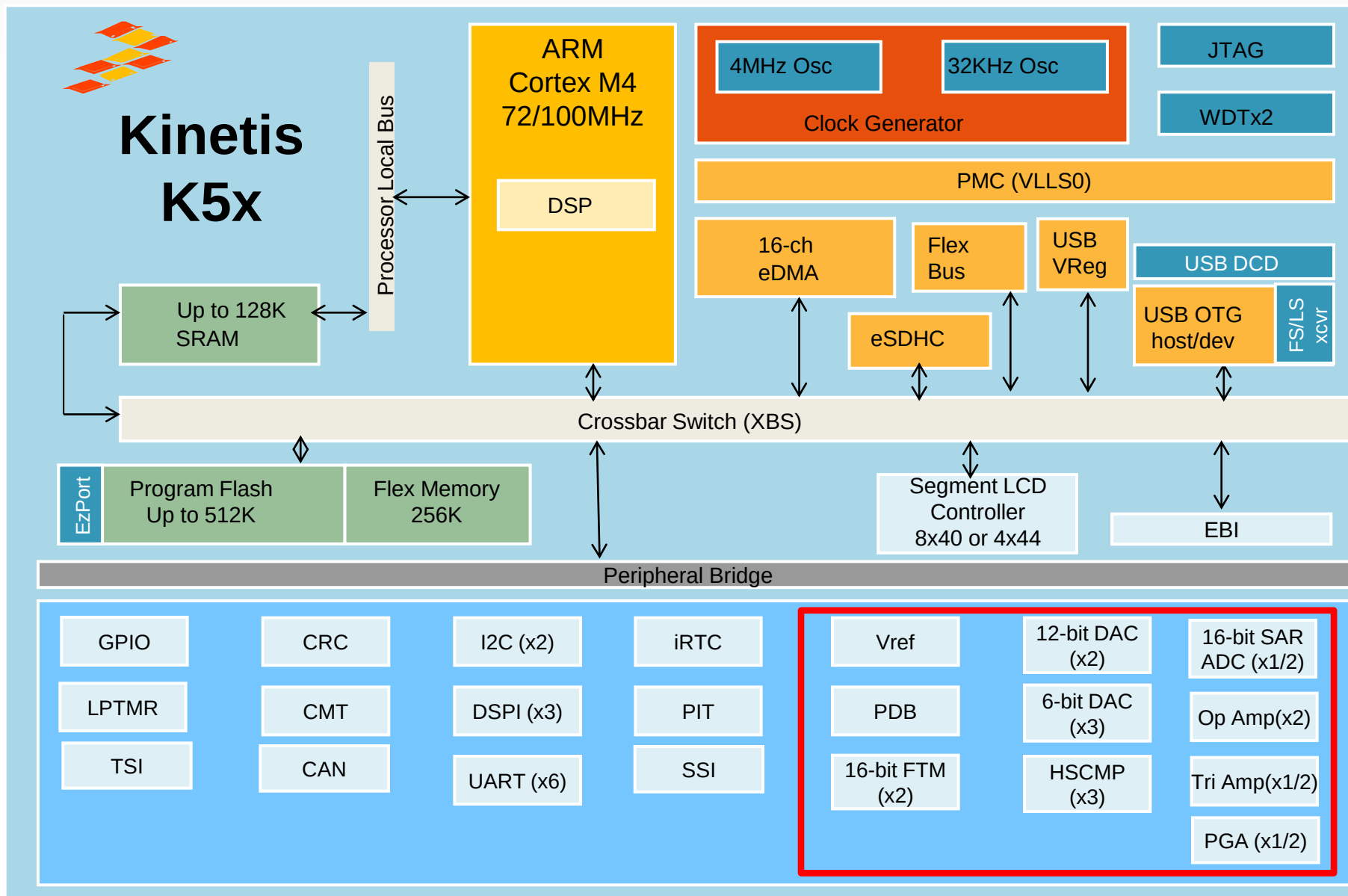
Pulse Oximeter Block Diagram



■ Analog ■ Sensors ■ Peripherals □ Optional ■ Internal Modules



...Integrated Analog for BGM, SPO2, ECG, ... applications



System Integration for Quicker Time to Market



- **Easy and quick prototyping**
- **Detailed AN for each application**
- **SW, schematics, ... for free**

To Learn More: www.freescale.com/medical



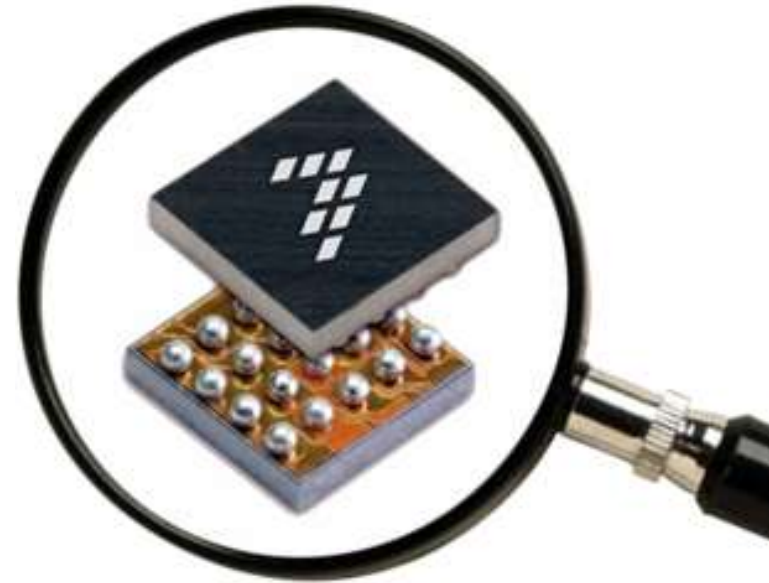


One Step Beyond: The World's Smallest ARM[®] Powered MCU

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



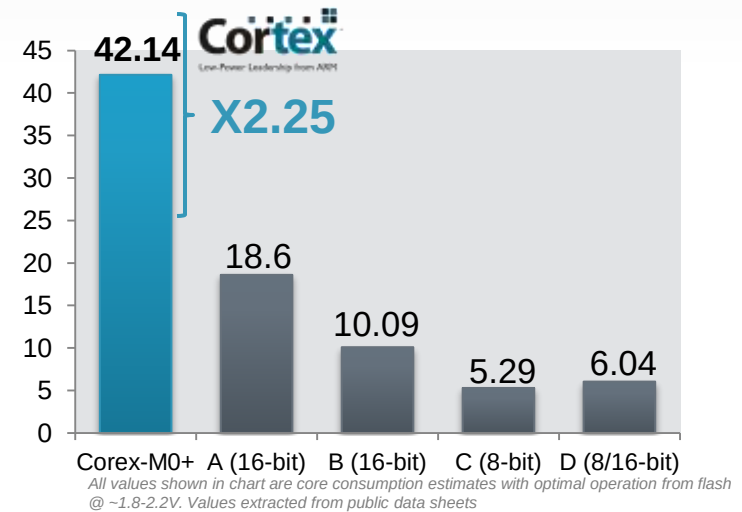
Designing Mobile solutions

[illegible]

Low Power Operation for Mobile devices

- **The challenge: *Small form factor and long battery life***
- **The solution: *Low power technologies & Integration***
 - Ultra-efficient Cortex-M0+ & M4 processors
 - Ultra-low power modes
 - Energy-saving architecture

Processor Energy Efficiency in CoreMark/mA



Kinetis Power Modes (e.g. K Series)

Typical Power Modes in an embedded system	Cortex M4 Power Modes	Kinetic Extended Power Modes	Recovery Time	“Typical” Idd Range
Run	Run	Run	-	From 270uA/MHz
		VLPR	-	From 710uA
Wait	Sleep	Wait	-	Wait from 6.5 mA
		VLPW	4us	VLPW From 450uA
Stop	DeepSleep	Stop	4us	From 302 uA
		VLPS	4us	From 5.1uA
Freescaler Adds Low Leakage Wake-up Unit ▶ 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		LLS	4us	2.1 uA - 10uA
		VLLS3	35us	1420 nA - 8uA
		VLLS2	35us	1420 nA - 4uA
		VLLS1	100us+EE restore	690nA – 2uA
		VLLS0		190 nA

The Blood Glucose Monitor Use Case



Prepare your tools



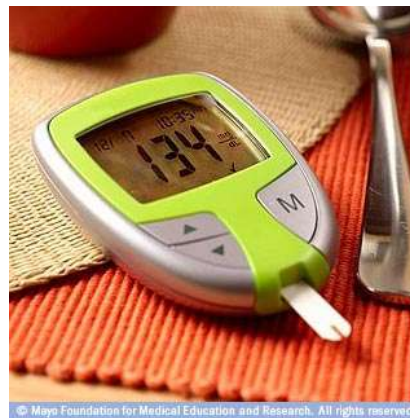
Insert Test Strip



Pick your finger



Apply blood on Test Strip



Read the results

The Blood Glucose Monitor Use Case (Cortex M4)

	STANDBY	BUTTON WAKE UP	POLLING (2-5min)	MEASUREMENT (5s)	DISPLAY DATA
BGM ACTIONS	NONE	LCD BLINKS INSERT STRIP	LCD BLINKS PLACE BLOOD	LCD DISPLAYS MEASUREMENT	LCD DISPLAYS MEASUREMENT
FUNCTIONS NEEDED	RTC PIN WAKEUP	RTC PIN WAKEUP (STRIP)	RTC ADC COMPARE MODE ANALOG	RTC ANALOG CPU/DSP	RTC CPU/DSP
FREESCALE MCU MODE	VLLS0	VLLS1 with LCD ENABLED	VLPS with ANALOG ENABLED	VLPR mode with ANALOG ENABLED	VLLS1 with LCD ENABLED
FSL SYSTEM POWER	750nA	<4.0uA	160uA – 1.0mA	<3.5mA	<4.0uA
EXIT CONDITION	USER PRESSES BUTTON	STRIP INSERTED	BLOOD DETECTED	MEASUREMENT COMPLETE	TIMEOUT

Battery life extended from 0.9 year to 1.6 year (CR2032, 240mAh)

Designing User Friendly Solutions



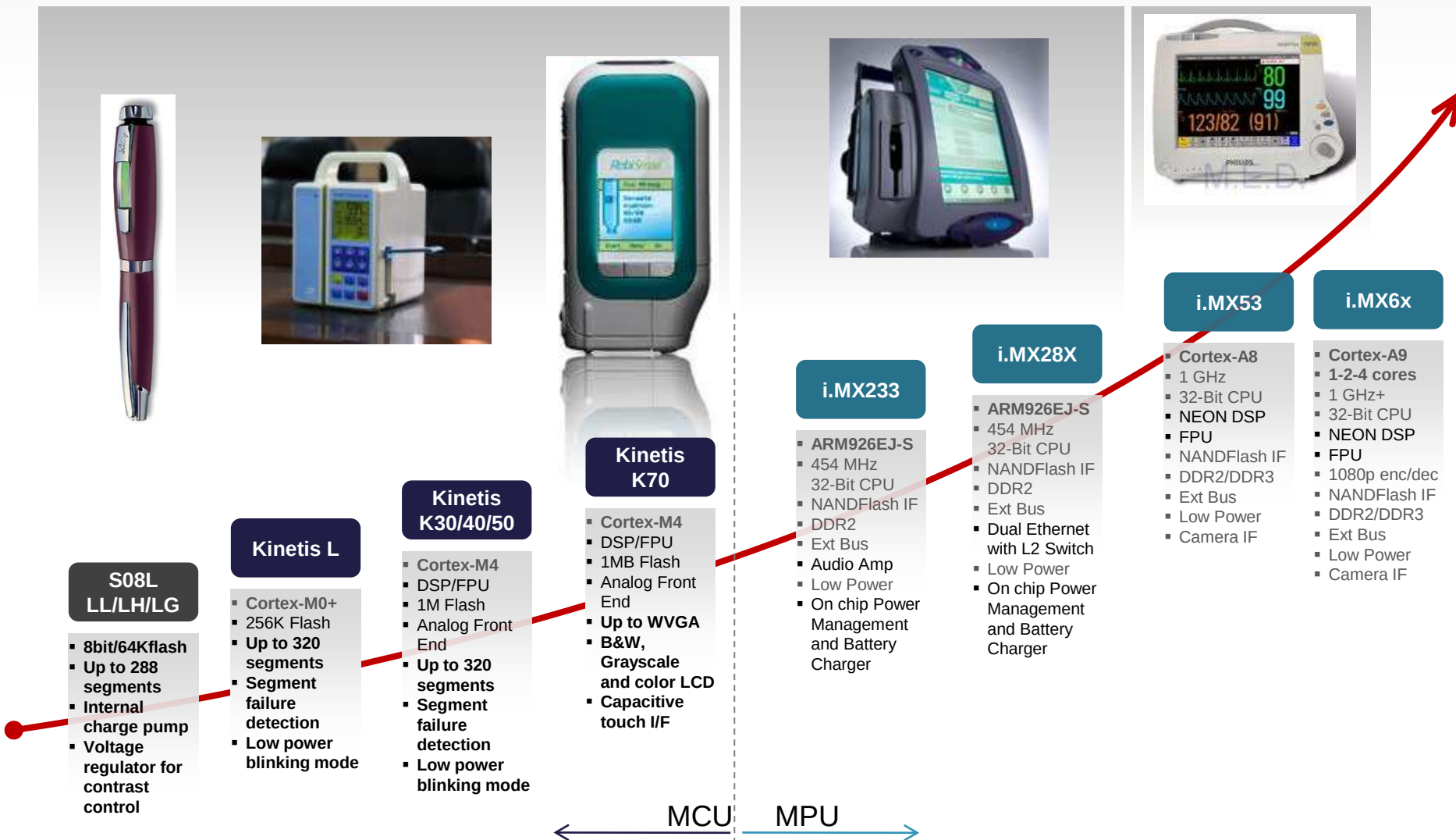
The Cost of Non-Compliance

- According to a meta-analysis published in the *Annals of Internal Medicine*, Americans are failing to comply with medication prescriptions for a variety of reasons -- and it's costing them anywhere between \$100 billion to \$289 billion a year.
- Why patients are not compliant:
 - Cost of treatment
 - **Difficulty of the regimen: life invasive, complexity to take treatment, ...**
 - **Pain of the therapy**
 - Denial of the problem
 - ...

-



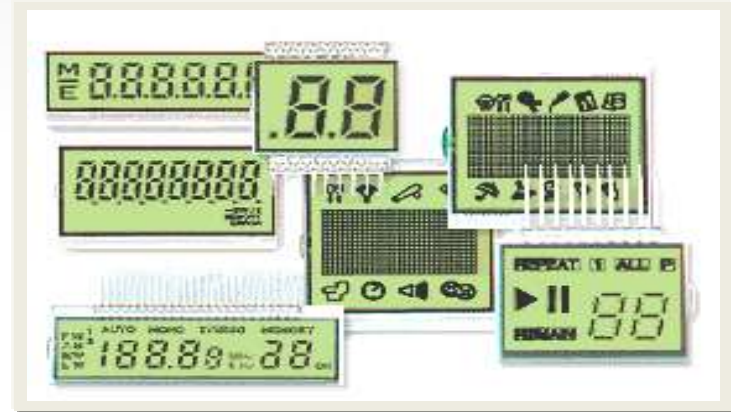
Freescade LCD Medical HMI Solution Roadmap



Segment LCD Controller

- **Segment fault detection capability**
 - Hardware support for segment LCD display errors
 - Essential when displayed data is safety critical
 - Automates factory test for end product
 - **Up to by 8 multiplexing**
 - Fewer pins required to drive LCD segments
 - Kinetis: 48 pins needed to drive 320 segments
 - Competition: 80 pins needed to drive 320 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 or GPIO function
 - Assist in vertical scrolling on dot-matrix displays
 - **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
 - Drive for 3V or 5V LCD glass
- 

Support for up to 320 segments!!

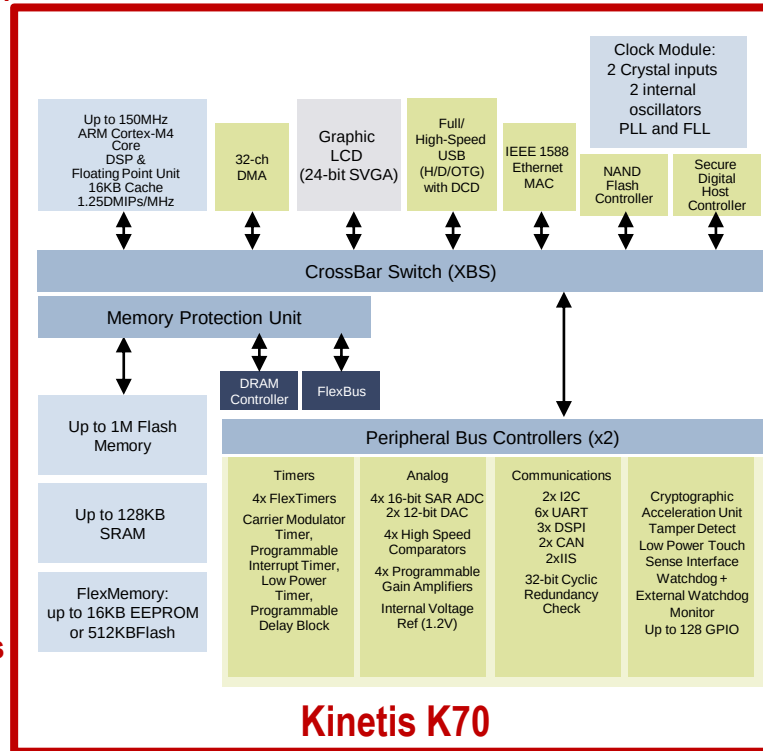
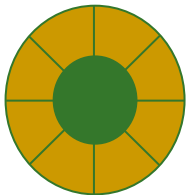
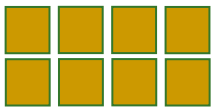


Integrated & Low cost, High end Application MCU for advanced UI

High End ARM Cortex-M4 with FPU
For animated Graphics, 6 times faster!



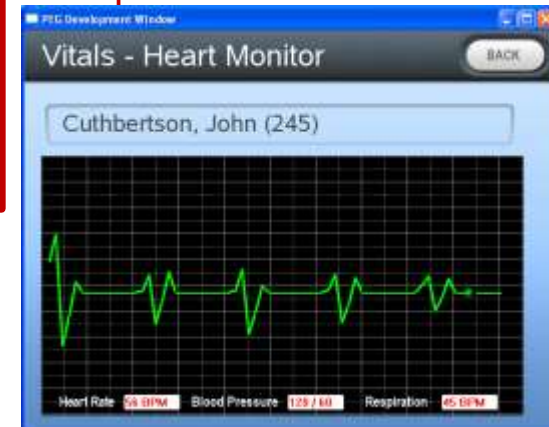
16 input capacitive touch sensing pins



Ethernet
USB including Continua profile



Graphics LCD controller on-chip
Up To SVGA





Breaking the Hurdle For Connected Designs

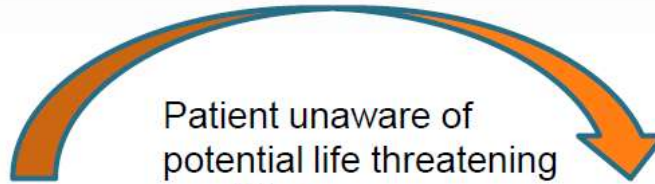


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Case Case: Patient with Hypertension and Diabetes type 2

Biometric Data:

1. Systolic/Diastolic pressure
2. Heart Rate/ Activity Monitor
3. Electrocardiography
4. Glucose
5. Weight and body composition.



Patient unaware of potential life threatening conditions.



Prevention of **acute complications**:

Heart attack

50% deaths occur the first hour after the attack.

Renal Failure

Leading to dialysis.

studies have suggested that tight control can reverse damage.

Hyperglycemia/ hypoglycemia

Could lead to coma or death.

Therapy adjustment



Corrective and preventive actions

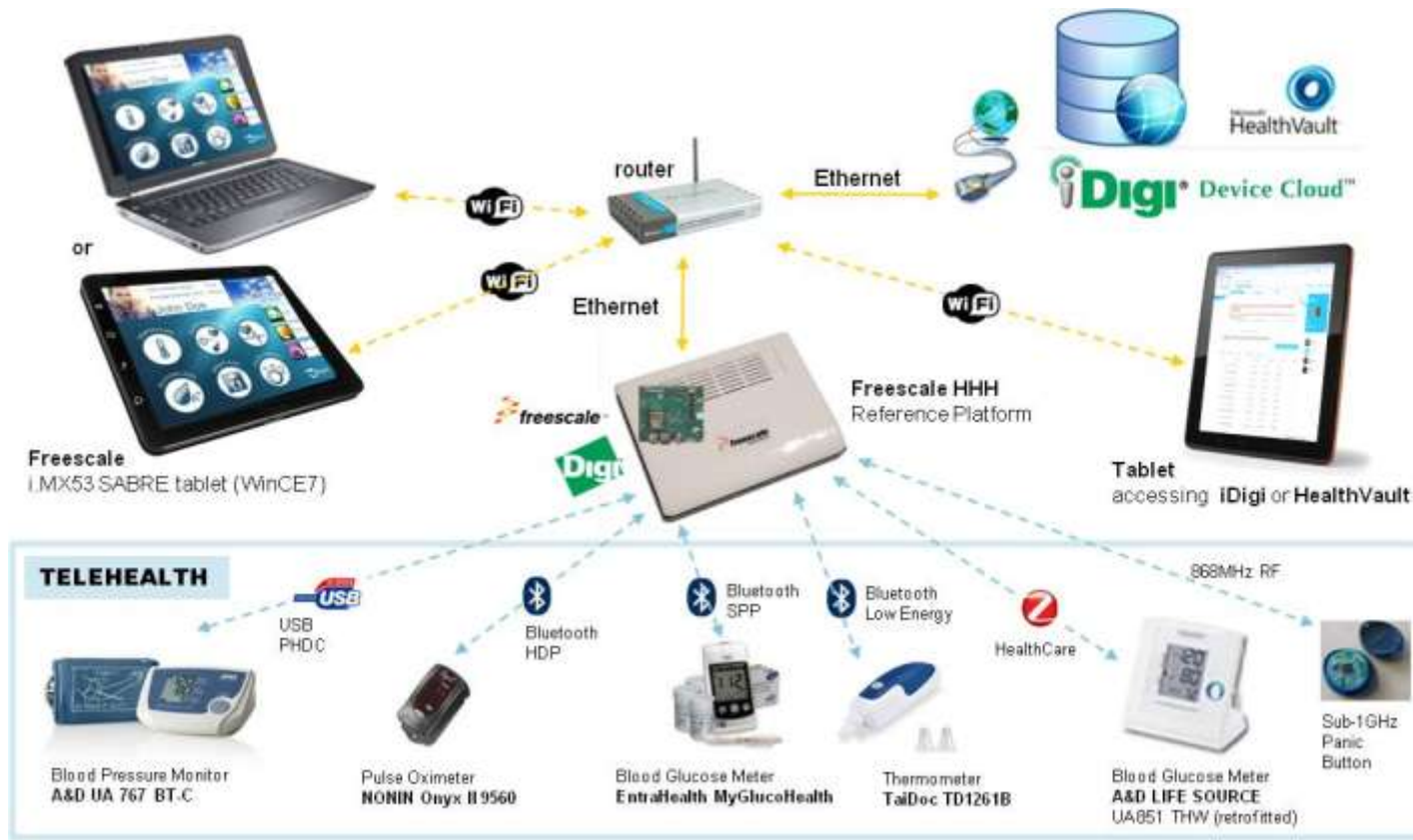
Raise patient awareness
and ownership



Connected HC: The Home Health Hub concept...

- **Home Health Hub Reference Platform :
out-of-the box experience**

**Physician
Monitoring Center,
Loved One's
Social Network**

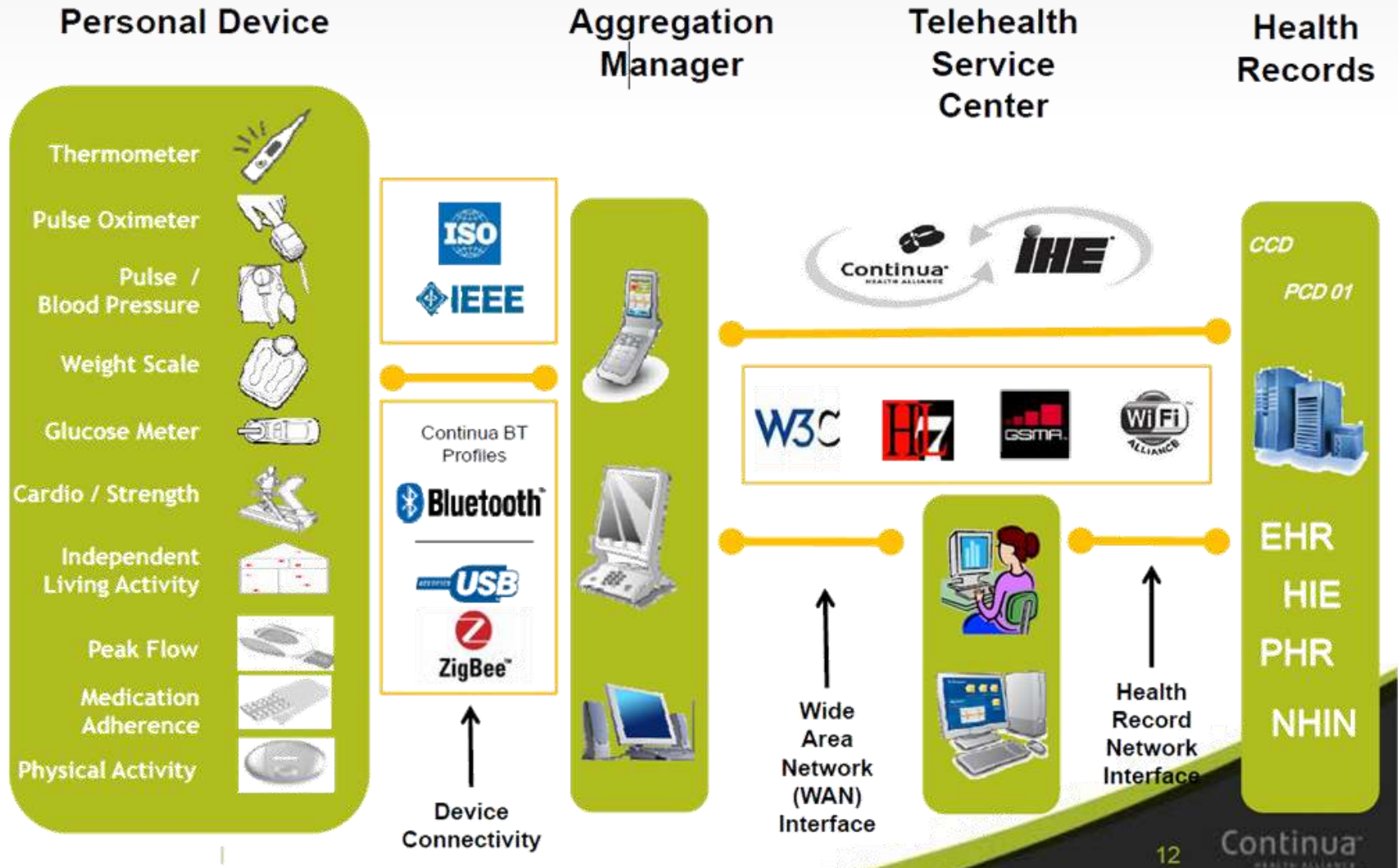


HOME AUTOMATION Expansion Capabilities

- Smart Plugs
- Smart Appliances
- Safety/security
- Lighting Control
- Local Display



Continua Health Alliance



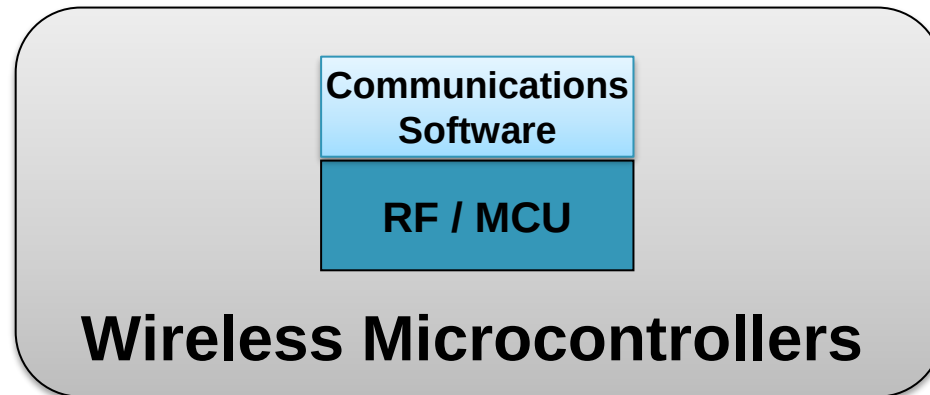
To learn more: <http://www.continuaalliance.org>

Continua Promoter Members



Freescal Wireless Connectivity Strategy

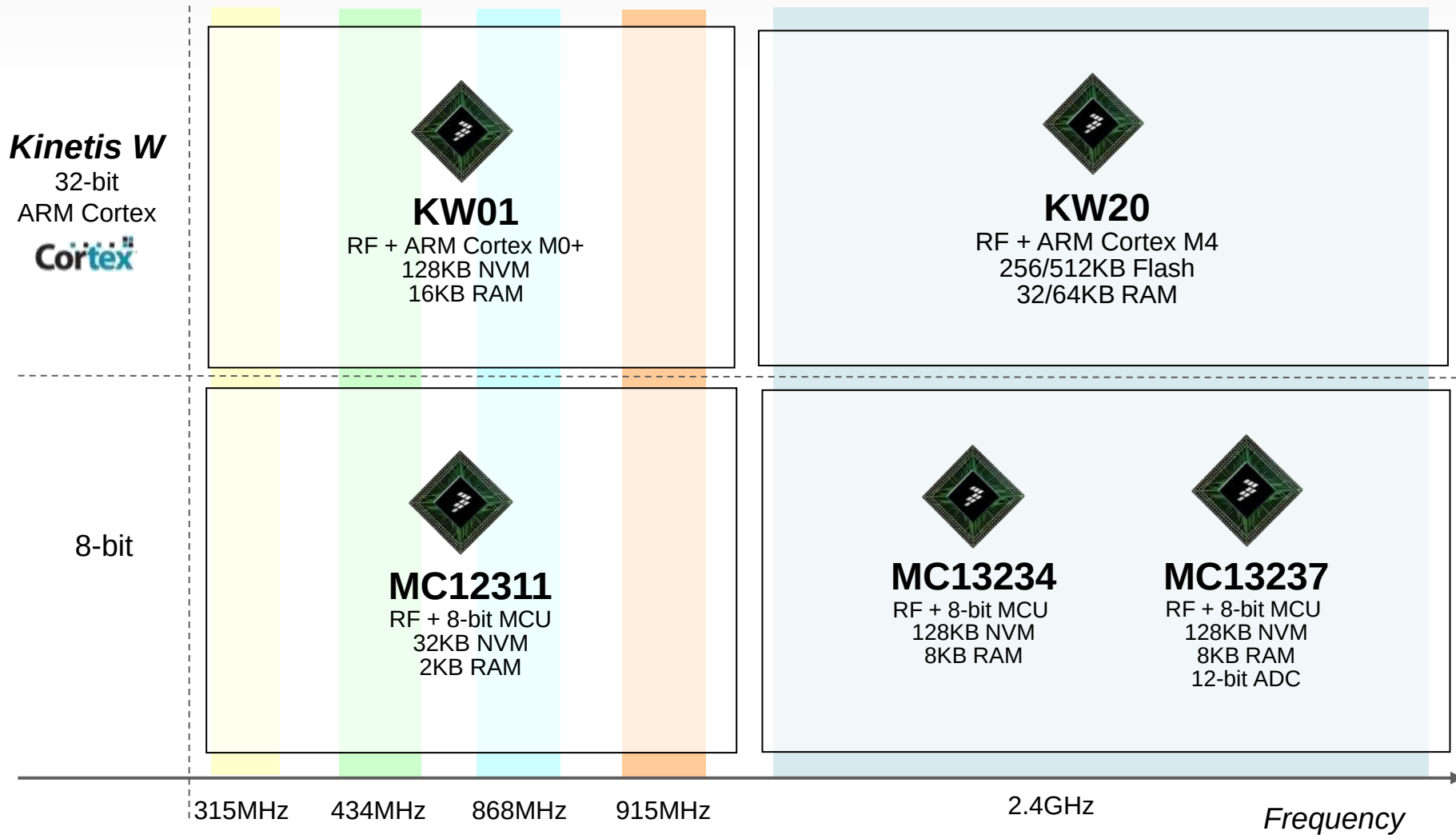
To provide all wireless solutions (from antenna to bits) required for control and monitoring applications in consumer, residential, metering, medical and industrial applications.



- 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.



Wireless Microcontrollers Portfolio





Low Cost, Easy to Use and Wearable Insulin Pump

Insulet Omnipod®

- **Challenge:**

- Create a low-cost, disposable wireless insulin pump for continuous delivery.

- **Solution:**

- Custom MCU, RF Radio, Analog SoC and application processor.

- **Benefit:**

- Discrete, durable, wireless, low-cost, disposable, and easy-to-use

Freescale Technology

i.MX: Applications Processor (PDM)

Custom ASIC: MCU, Analog, Wireless connectivity (Pod)

Powered by Freescale's i.MX Series MPU and a Wireless 8-bit MCU

Up to 90 Days of Data Storage

Built-in food library

Large color LCD Screen

Powered by a Freescale Wireless 8-bit MCU

Watertight Packaging

Built-in FreeStyle® blood glucose meter

Built-in infusion set with automated inserter

To Learn More: www.freescale.com/omnipod

Withings Vital signs monitoring solutions

The Cool Factor

- **Challenge:** Create a complete line of easy-to-use, connected health monitoring devices that offers a sleek, consumer friendly design.
- **Solution:** Withings health devices rely on the Freescale Kinetis microcontroller family to enable advanced functionality in a low profile, low power package.
- **Benefit:** The unique combination of low power, performance, cloud connectivity and attractive design makes Withings healthcare devices more than appealing to today's active, health-conscious consumer. The availability of a wide range of capabilities within the Kinetis family of microcontrollers makes designing new devices more efficient and cost-effective for Withings.

Freescale Technology

Kinetis Cortex M4 family



Orcam – See For yourself

- **Challenge:** Create a portable solution for the visually impaired that allows them to access activities that most people take for granted but which pose tremendous challenges for them – riding the bus, shopping for groceries, reading the newspaper.
- **Solution:** The OrCam solution employs sophisticated visual computing algorithms run by Freescale's high performance and energy efficient i.MX6 Quad processor to interpret visual inputs and communicate their meaning in real time to the person wearing the technology.
- **Benefit:** For people whose visual impairments prevent them from easily interacting with the world around them, OrCam offers a wearable, affordable intuitive solution for those who have trouble seeing faces and objects.



To Learn More

Available now

- **FSL Medical website**
 - www.freescale.com/medical
- **Reference Designs / Demos**
 - Intelligent Hospital
 - Medical Suit Case
 - Continua USB PHDC software
 - Home Health Hub
- **Application Notes:**
 - ECG, BGM, SPO2, Spirometer, BPM
 - Digital Stethoscope
- **Beyond Bits Magazine**
 - Health & Safety focus
 - Collection of technical / medical articles authored by FSL and physicians
- **Medical Brochure**
 - <http://www.freescale.com/files/industrial/doc/brochure/BRMEDICAL.pdf>
- **Medical Applications Guide**
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