FTF FREESCALE TECHNOLOGY FORUM 2015

Harness the Internet of Things (IoT) to Improve Healthcare

FTF-HCW-F1110

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Chuck Parker | Lamprey Networks, Inc.

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External Use

Agenda

- The Opportunity for an IoT Solution
- The Current State of Healthcare
- Healthcare IoT Architectures
- Wireless Standards Selection
- HW / SW Selection
  - Edge Nodes
  - Gateway
- Q & A

Presenters

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Former President of the Continua Health Alliance
VP, Business Development
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Vast Connectivity

IoT is More Than M2M

The Internet of Things is about Machine to Entity (M2E):

- **Machine to Human:**
  - Automatic health monitoring for people: Connected wearables with monitoring services, or disease management via implantable electronics
- **Machine to Infrastructure:**
  - Automatic bridge monitoring: Sensing and monitoring the structural integrity of a bridge in case of flooding
- **Machine to Nature/Environment:**
  - Early detection of earthquakes: Distributed sensors to detect early tremors in specific places
- **Machine to Machine:**
  - Automatic diagnostics for cars: Automatic information collection from your car's engine management system and sending real-time alerts to drivers or service centers

Machine to Machine (M2M)
refers to technologies that allow both wireless and wired systems to communicate with other devices of the same ability

Popular View of IoT Definition

Building Automation

Smart City

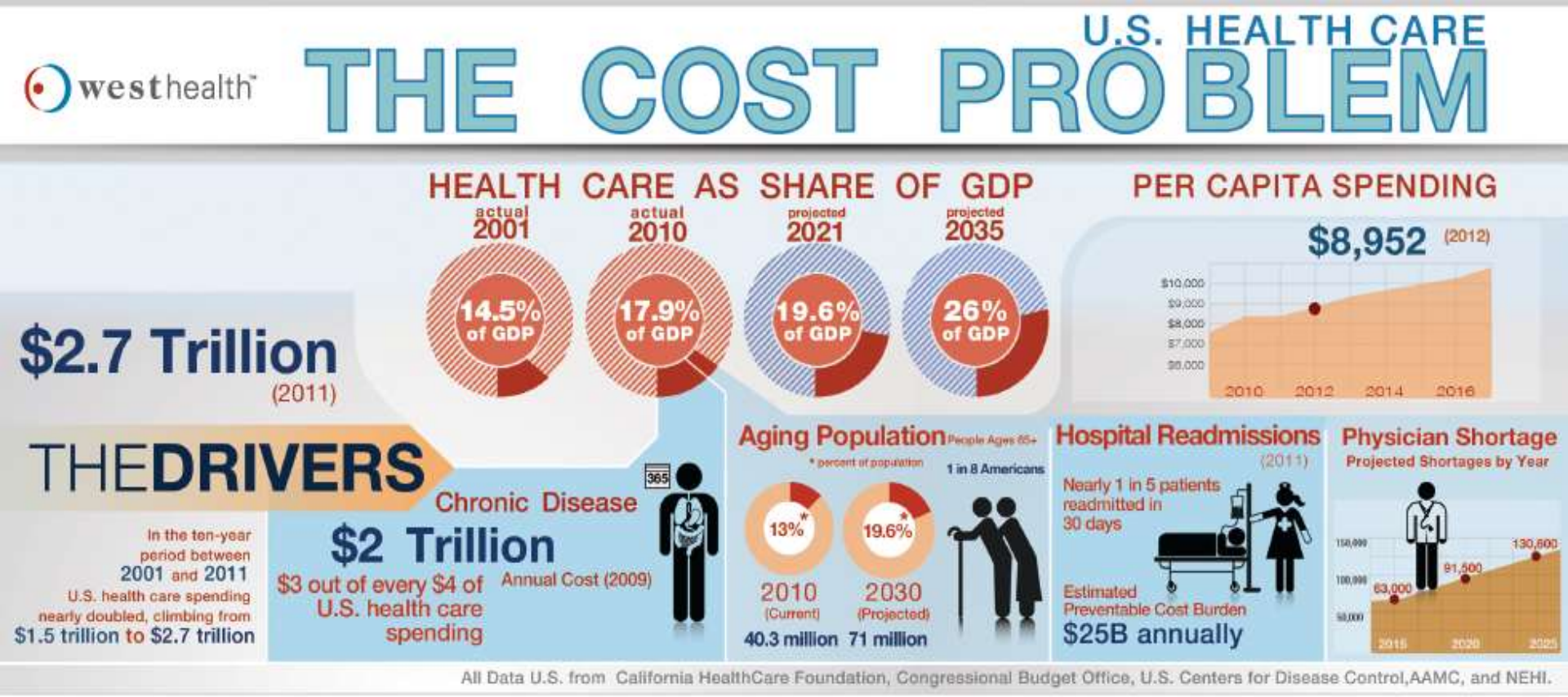
Smart Lighting

Smart Grid

Smart Health

Industrial Automation

Opportunity



Source: West Health, 2013

Solution

Enable individuals to take an active role in their own healthcare … proactive prevention of costly chronic health problems later in life

IoT Solutions In Healthcare

Wellness/Fitness
Younger Generations

Clinical Medical

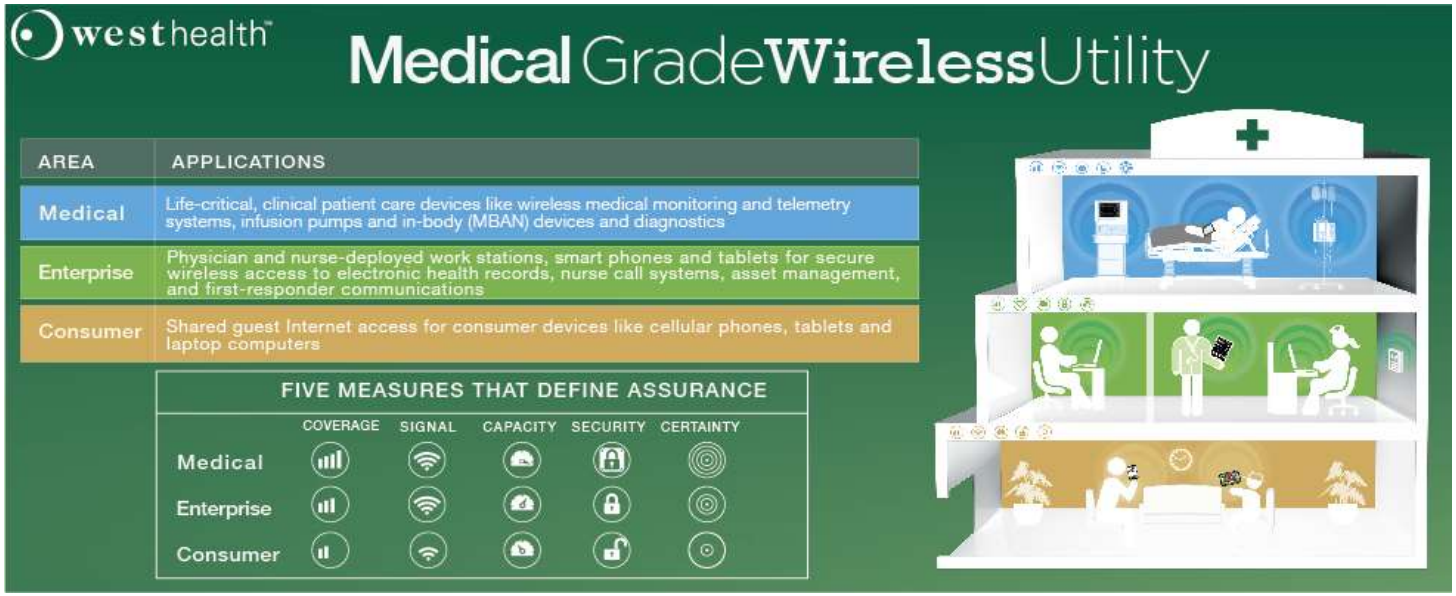
Home Medical
Aging Populations

Global Impact



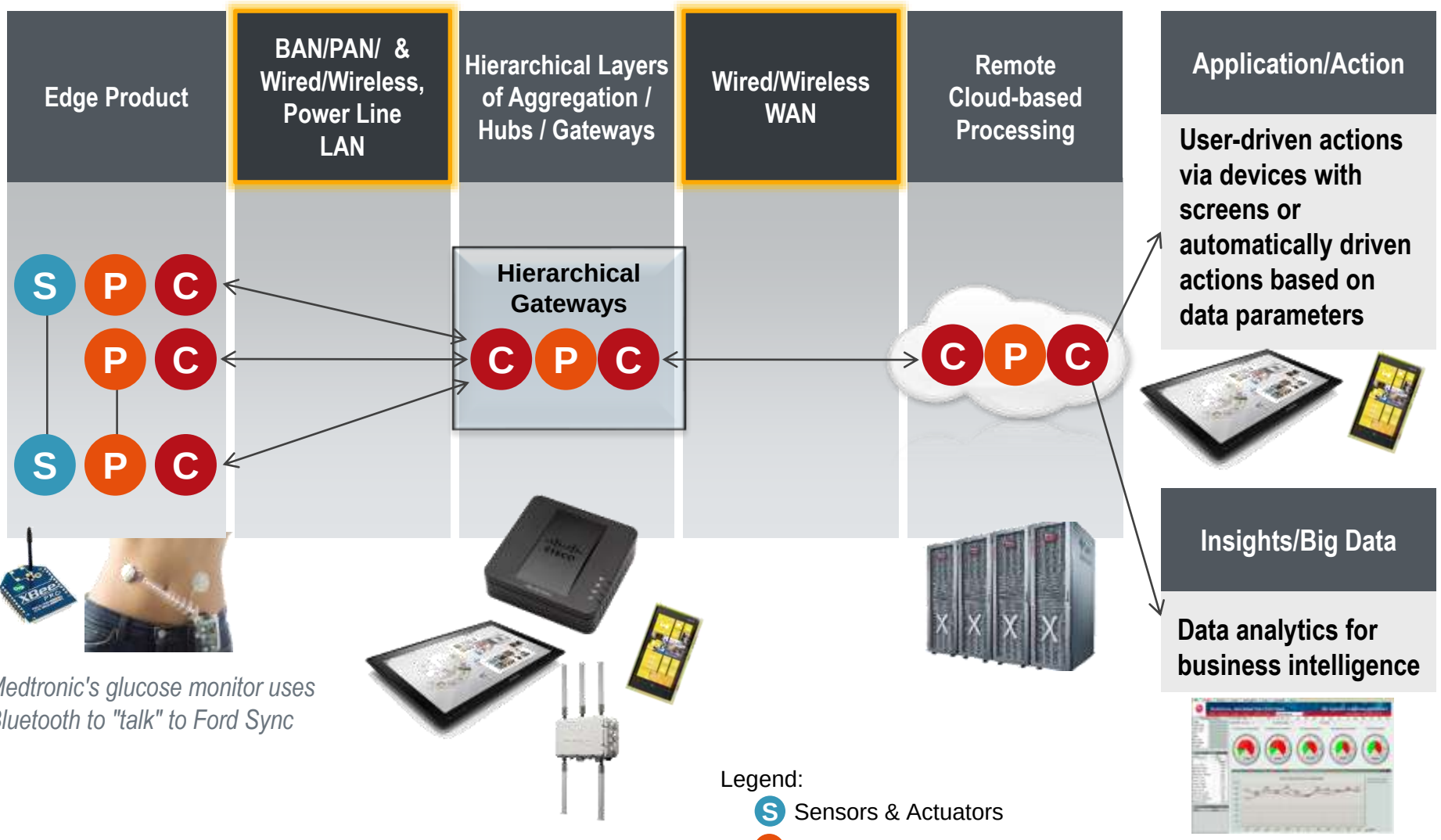


Looking at IoT Through the Lens of Healthcare

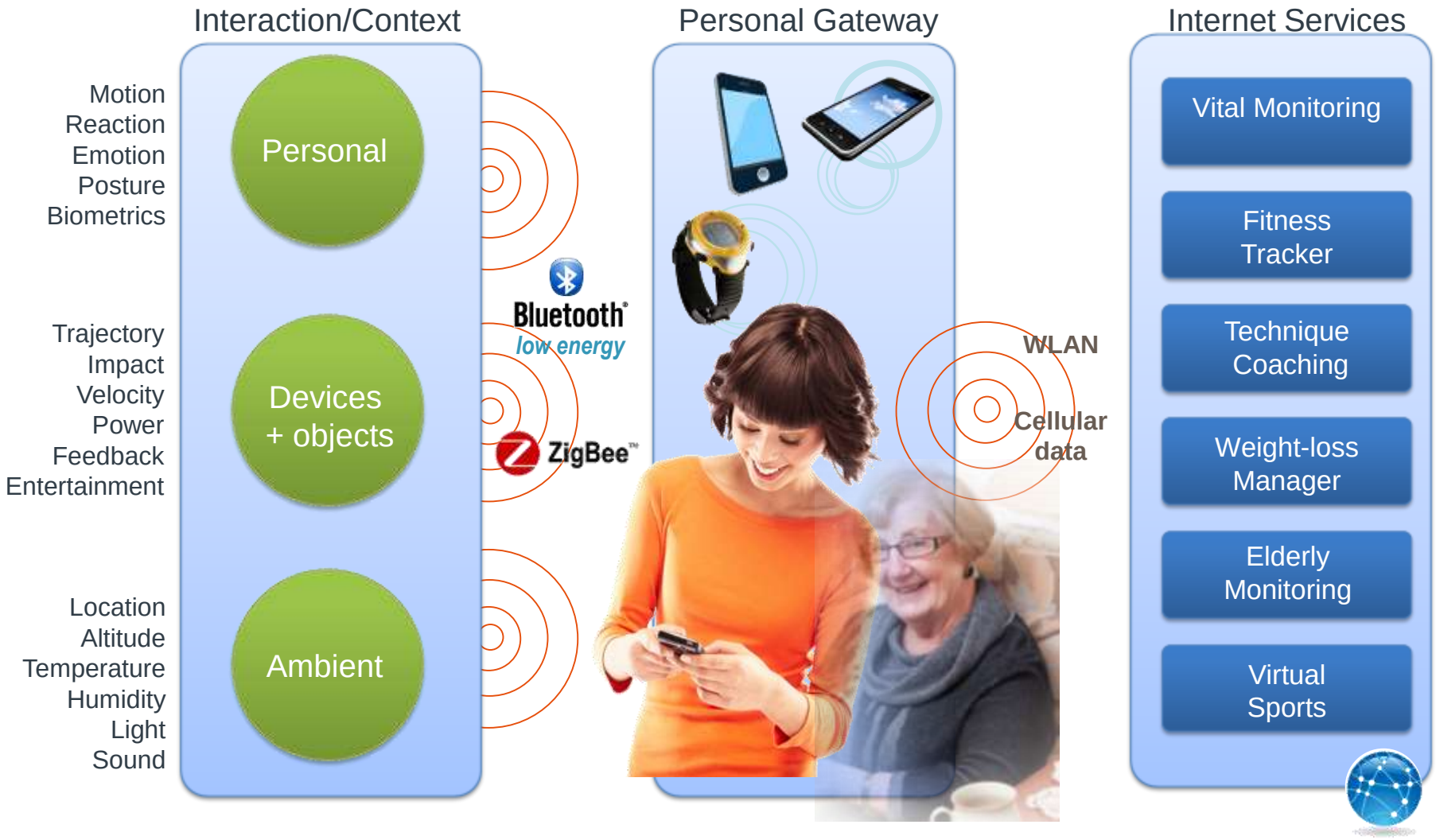


Source: West Health, 2013

IoT 'Box-Level' Product View



It’s a Connected World Fostering Quality of Life



Wireless Diabetes Care Solutions

Wireless Cardiac Care Solutions

Physician
Social Networking
Monitoring Center
Loved Ones
Social Network

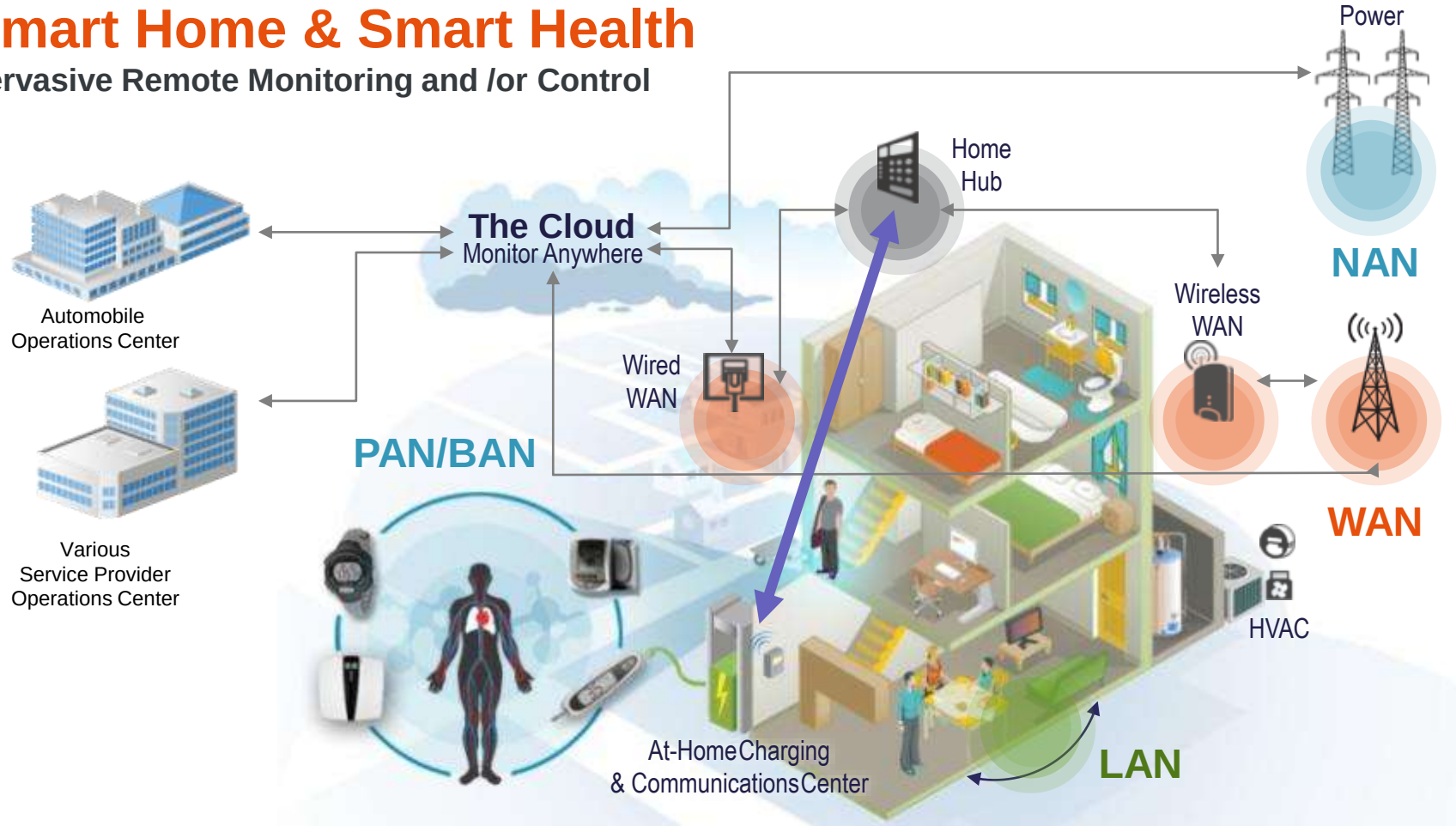
Bluetooth Communication

Cellular

Wired WAN

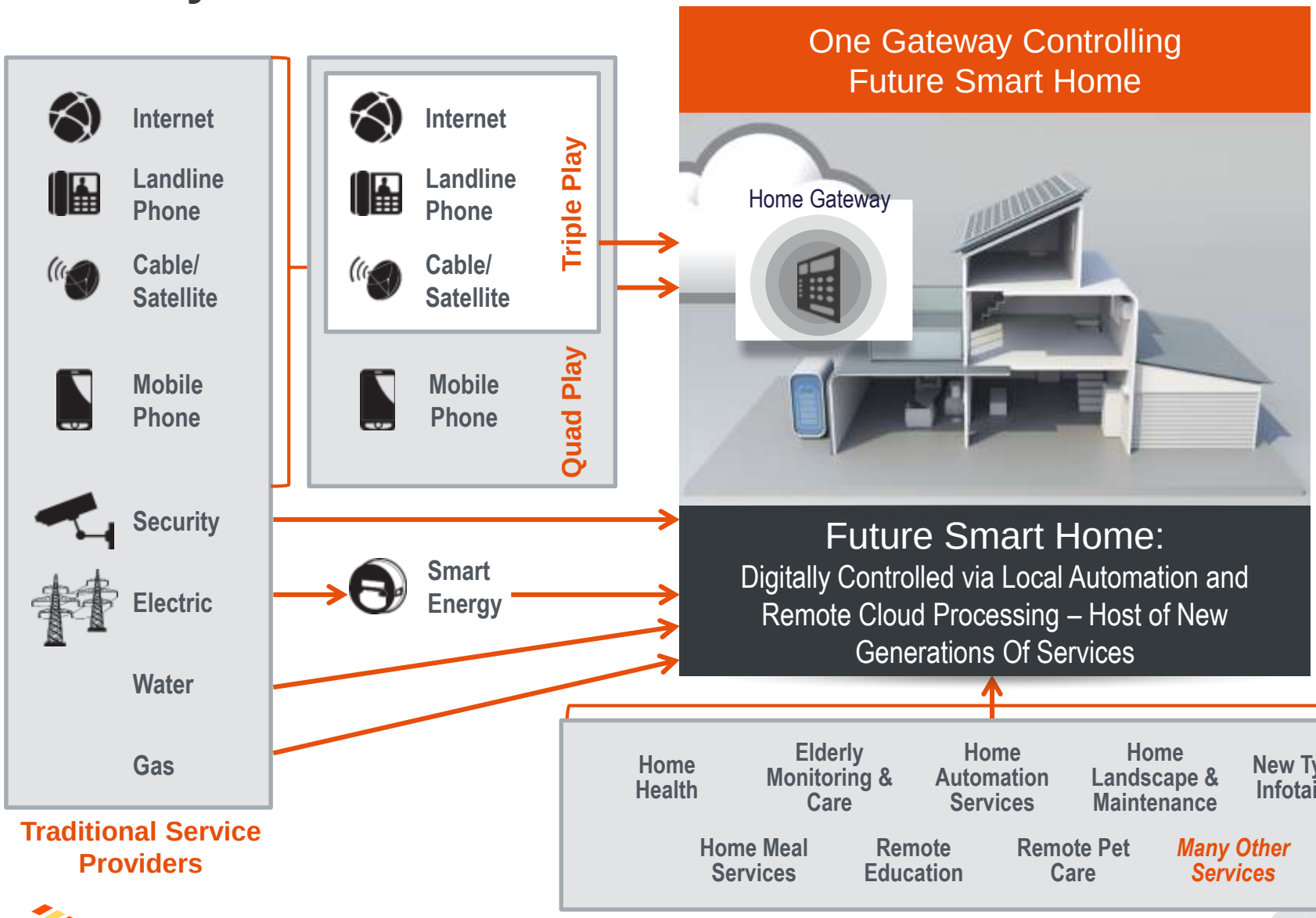
Smart Home & Smart Health

Pervasive Remote Monitoring and /or Control



- Human beings' vital statistics monitored via edge nodes communicating through body area network s(BAN) and personal area networks (PAN)
- Many other "things" in the smart home using local area network (LAN)
- All communicate with a home hub/gateway, which in turn communicates to the cloud via wide area networks (WAN)

Diversity Of Service Providers For The Smart Home

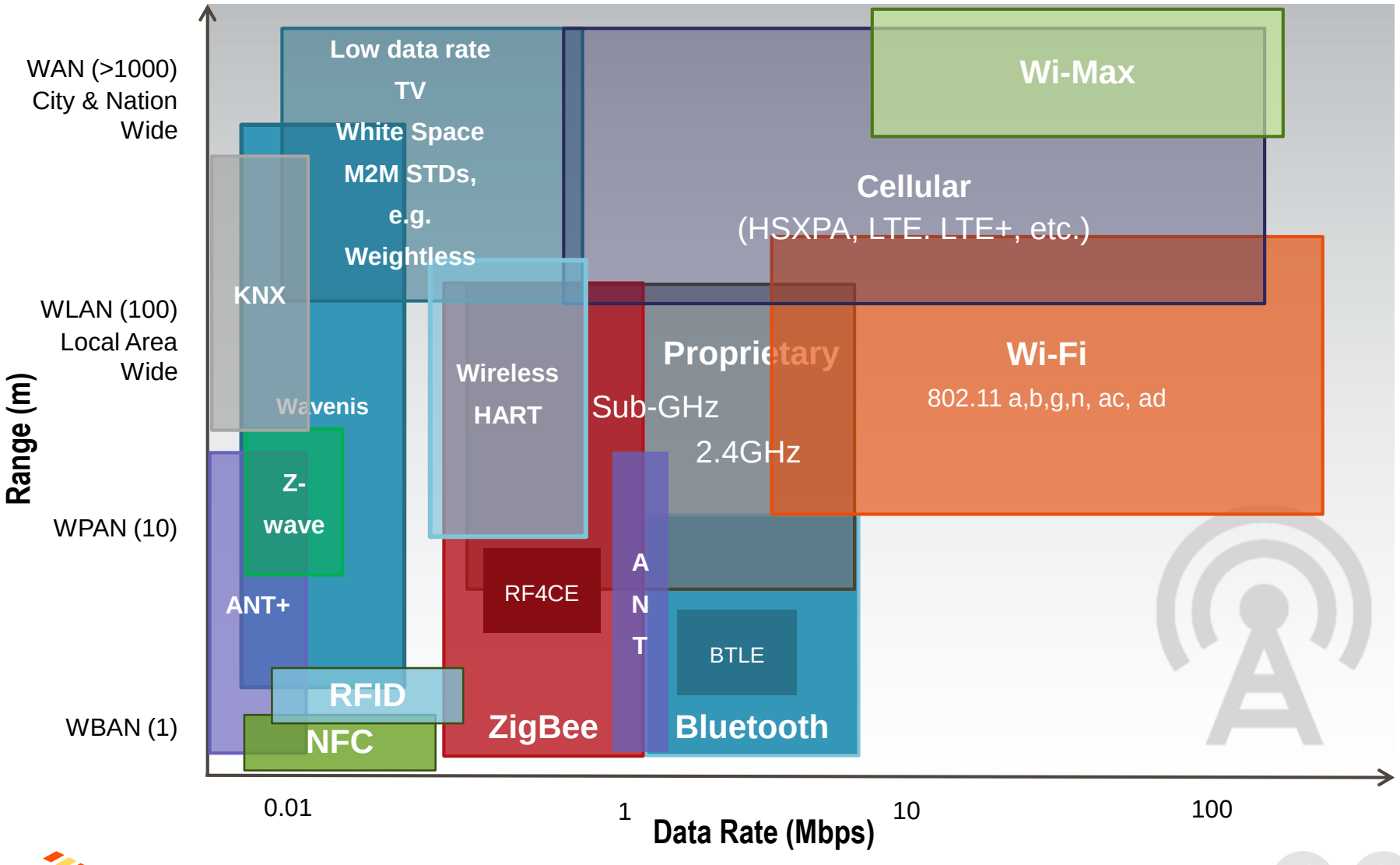


Wireless Sensor Network Requirements

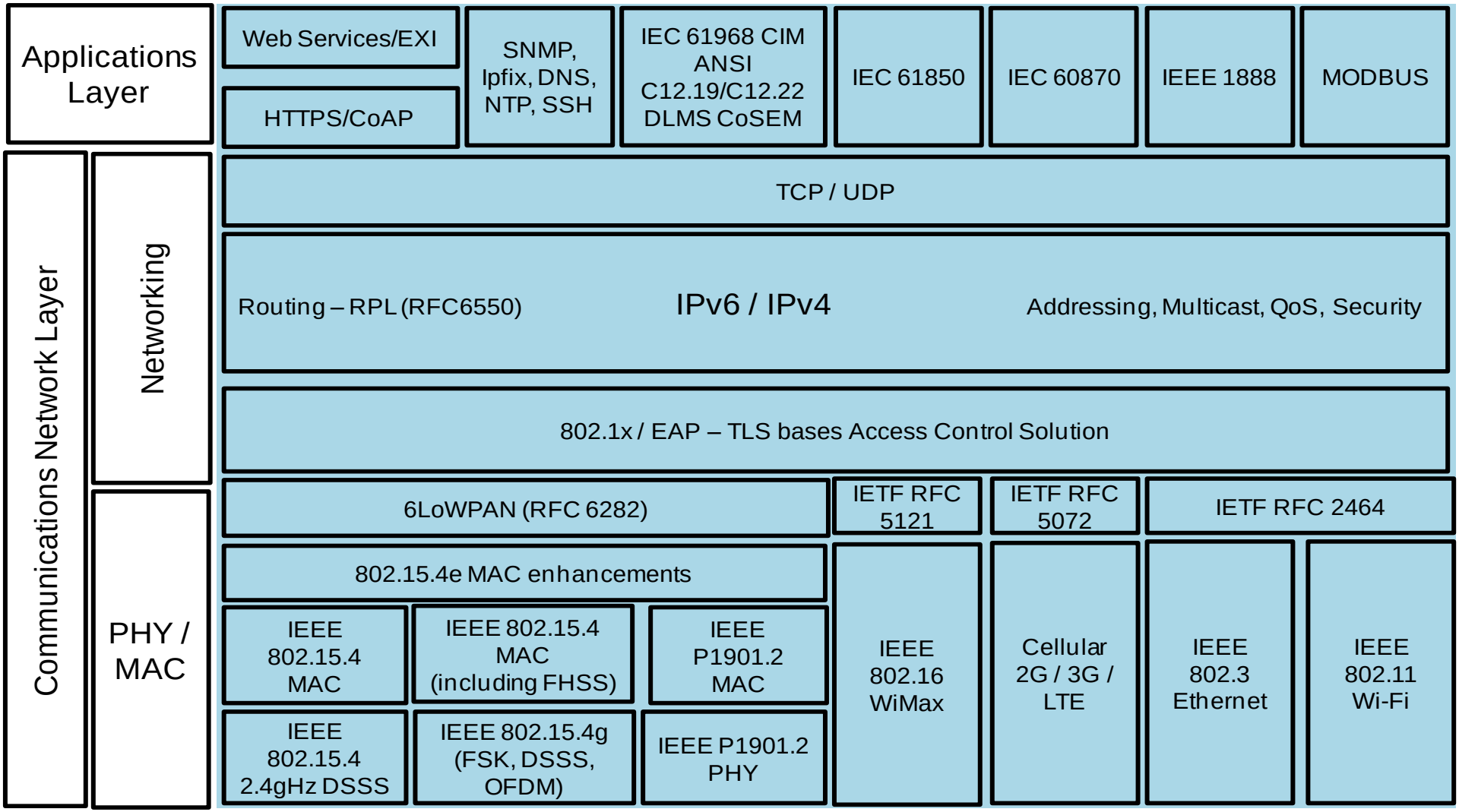
Product refresh rate of eight to 15 years, hence focus on total cost of ownership

- **Self-configuring**: Sensors assign themselves identification, recognize their neighboring sensors and establish communication paths
- **Self-maintaining and self-healing**: Reroute in case of new obstacles, reduce the cost of maintenance
- **Self-calibrating**: Maintain their own calibration reliably throughout lifetimes, reduce cost of field technician
- **Very low-power or self-powered**: Battery that lasts many years or harvest power from the ambient environment, reduce cost of field technician changing battery

Today's Wireless Landscape: Interoperability Nightmare



Example of Open Standards Reference Model



Source: Professor David E. Culler
University of California, Berkeley
CWSN Keynote, Sept. 26, 2011

Wireless Bands Available for Healthcare

- **US FCC recognizes several bands for medical applications**
  - License-only, geographically restricted (FCC Part 95)
    - 401 – 406 MHz, 608 - 614 MHz, 1395 – 1400 MHz, 1427 – 1432 MHz
    - Implantables, in-hospital therapeutic devices, wearable devices
    - 2360 – 2400 MHz band .. Quite band just below freq of Wi-Fi, Bluetooth, ZigBee

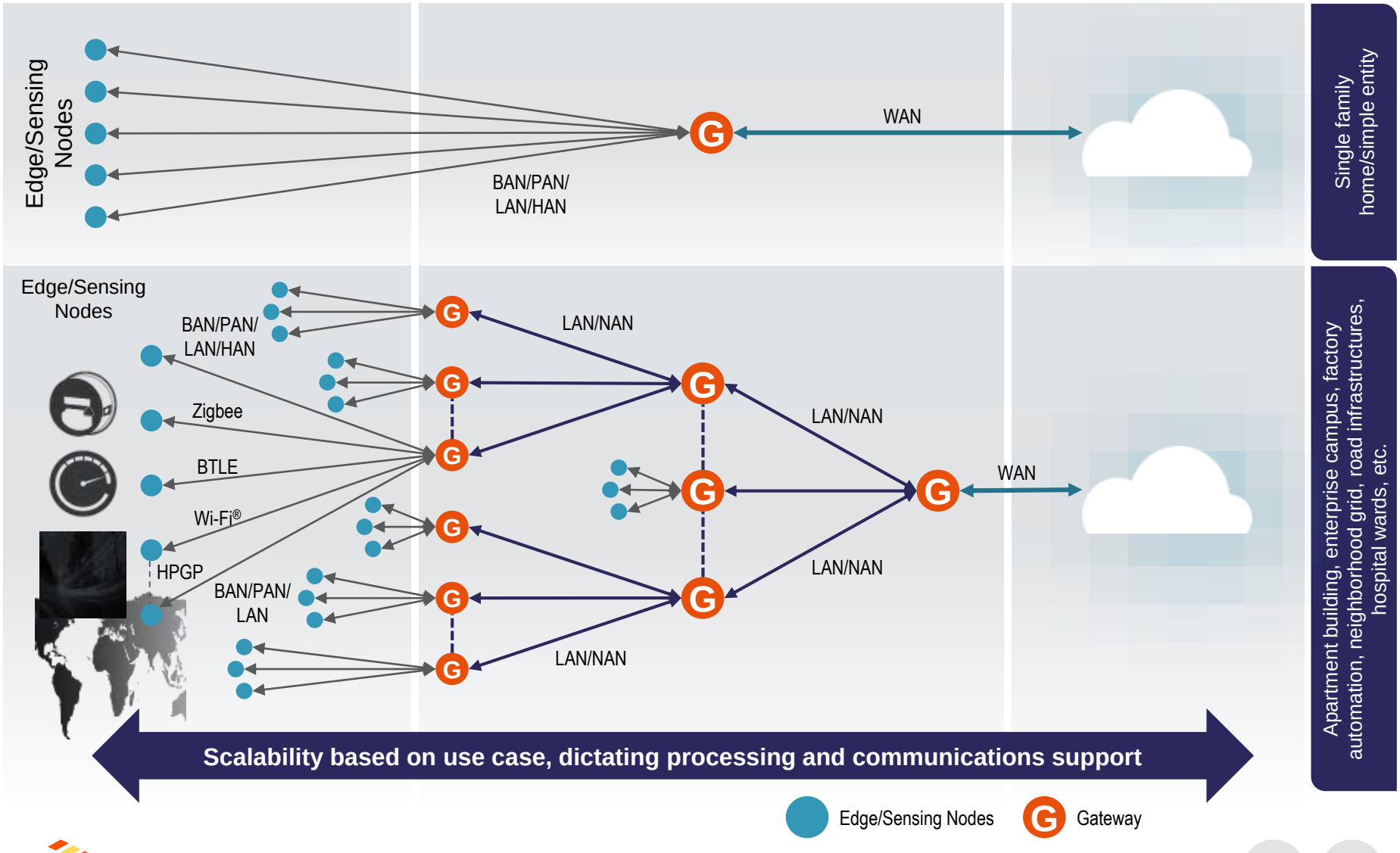
- **US FCC also provides many license free bands**
  - General Industrial, Scientific and Medical (ISM) purposes
    - 902 – 928 MHz, 2400 – 2483.5 MHz, 5725 – 5875 MHz and others

- **Standards-based approaches are targeting these bands and others**

Choices in Wireless Technology

- **Standards-based**
  - Personal area, up to ten meters
    - BT 4.0 Bluetooth and Bluetooth Low Energy (expanding healthcare profiles)
    - IEEE 802.15.6 BAN Body Area Network
    - IEEE 802.15.4j MBAN Medical Body Area Network
  - Local area, up to tens of meters
    - Wi-Fi / IEEE 802.11
    - ZigBee / IEEE 802.15.4 (ZigBee Health Care profiles)
  - Wide Area, up to many kilometers
    - Cellular: GSM, UMTS, CDMA
    - TV whitespace: vacated by analog TV (developing standard)
- **Proprietary**
  - Mostly <10m range: MICS, MEDRadio, and WMTS devices

Communication Topologies Across Hierarchies



Local and Wide Area Networks – LAN and WAN

LAN

- **Wi-Fi: IEEE 802.11**
  - Dominant in clinical care settings
  - Clinical IT staff knows how to provision, configure and maintain
  - Supports variety of data rates up to hundreds of MB/sec
  - High data security
- **ZigBee: IEEE 802.15.4**
  - Designed for M2M sensor and control networks, co-exists with Wi-Fi
  - Battery efficient, devices can sleep for months but still available in milliseconds
  - Multi-hop mesh networks from just a few to hundreds of devices
  - Communication and asset tracking
  - Deployment in major hospitals

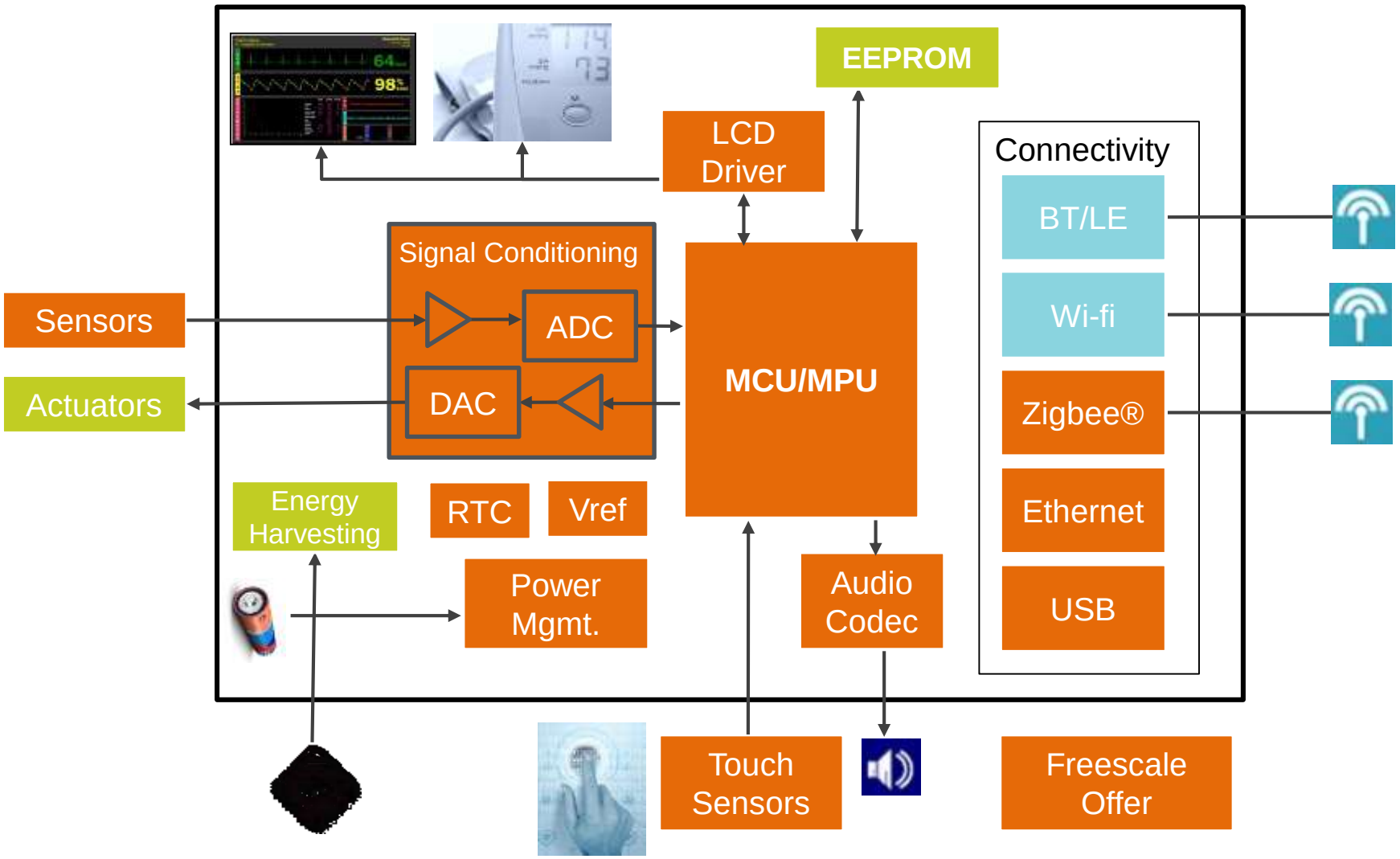
WAN

- **Cellular: GSM/UMTS and CDMA**
  - Support voice and data communication
  - Excellent transport security
  - Purpose-built modems for embedded connectivity
  - Typically powered by rechargeable source
  - Cellular networks migrating toward a more IP-based infrastructure, will increase ease of use
- **TV White Space spectrum**
  - TV whitespace: currently unused TV broadcast channels vacated by analog TV
  - Between VHF and UHF bands
  - Base station to 1000's of M2M end-nodes
  - Low cost, long range connectivity
  - Lightweight protocol using TDMA
  - A new SiG exists, Weightless, proposing proprietary open standard

Standards Based Personal Area Network - PAN

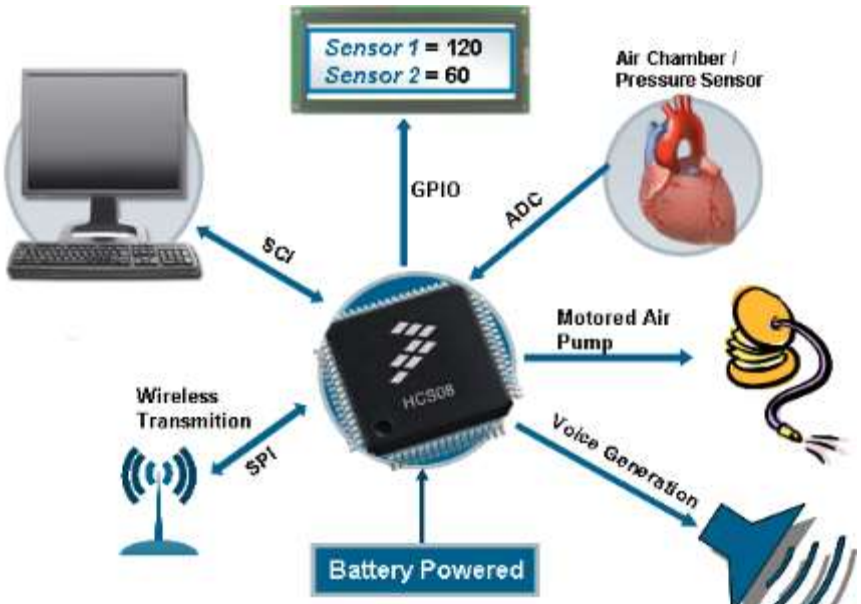
- **Bluetooth "Classic": BT1.x, 2.x, 3.0, Smart Ready 4.0**
  - Master to client networks (headset to handset, etc)
  - Well suited for cellular handset-centric applications
  - Low latency, moderate data rates
  - Good for audio from low-rate voice to streaming music
  - In billions of handsets all around the world
- **Bluetooth Low Energy (BLE): Bluetooth Smart BT4.0**
  - Master to client networks (sensing device to handset)
  - Optimized for sleepy sensor devices, improving battery life 10-20x over Bluetooth classic. 1+ on year coin-cell
  - Low latency, low data rate while connected
  - Majority handsets/tablets shipping with BLE now. Majority s/w enabled in 2015
- **BAN: Body Area Network IEEE 802.15.6**
  - Designed for use in or around human body
  - Secure and can be very low power
  - One MAC, three different PHYs
    - Narrowband in 402-2484Mhz
    - UWB in 3494-9984MHz
    - Human Body Comm in 21Mhz
  - 2360-2400MHz band is quite, sitting just below WiFi, Bluetooth, ZigBee band
- **MBAN: Medical Body Area Network IEEE 802.15.4j**
  - Wearable, portable, fixed sensors. No Implantables
  - Uses standard 802.15.4 (2006) MAC/PHY, flexible channel scheme
  - Operation limited to in- and around-hospital/care facility for 2360 – 2390 MHz
  - Operation anywhere for 2390 – 2400 MHz
  - 2360-2400MHz band is quite, sitting just below WiFi, Bluetooth, ZigBee band

Healthcare IoT End Node General Architecture

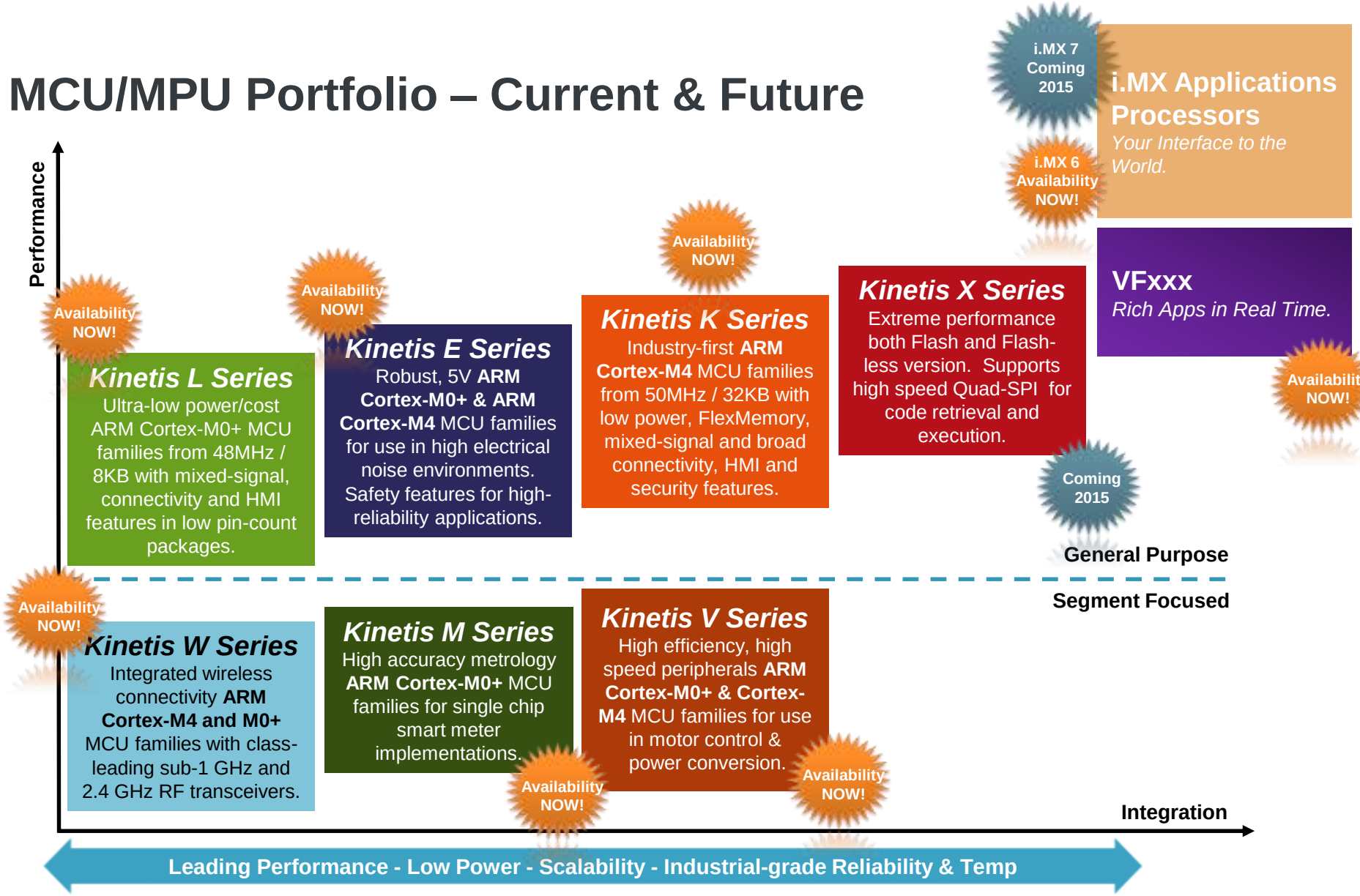


Low-Power Operation Extends Battery Life

- ***The challenge: Make the hardware as maintenance free as possible***
  - Requiring a patient to replace batteries dramatically reduces the effectiveness of the medical device.
- ***The solution: Low-power technologies***
  - Use ultra low-power microprocessors as the “brain” of the device with wireless technologies designed for low power networks.
  - Make use of various sleep modes through efficient software design.
- ***Ultra Low-Power Microcontrollers***
  - <100uA/MHz run current (MCU)
  - Stop Mode operation <50nA (MCU)
  - RTC operation in <600nA (MCU)
  - LCD Operation <500nA (MCU)
  - 4us wake up time (MCU)
- ***Ultra Low-Power Microprocessors***
  - 1600+ MIPS at <1W (MPU)
- ***Ideal solution – eliminate batteries***
  - Freescale is working to make this a reality with ultra low-power converters



MCU/MPU Portfolio – Current & Future

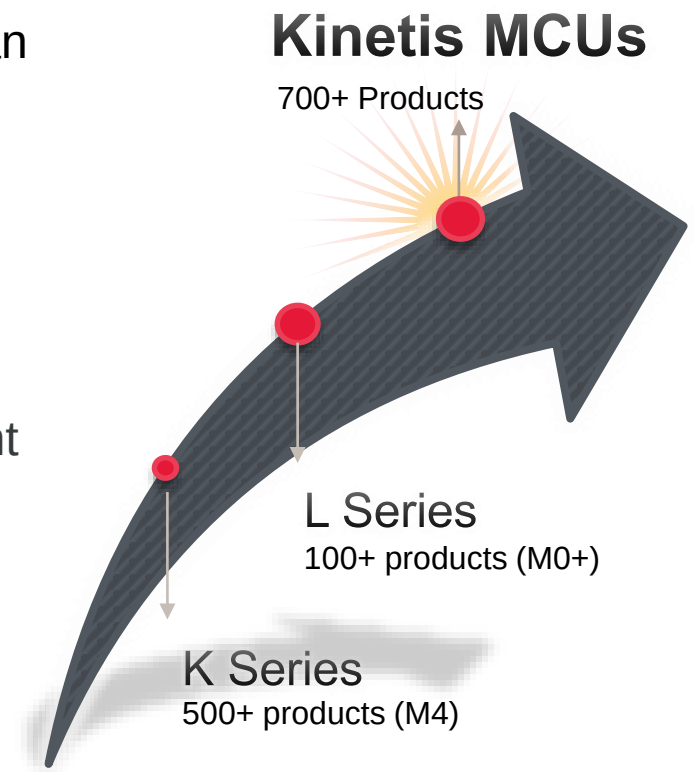


Unbound Scalability

1. **Smallest size CSP packaging technology -** 75% smaller package than the STM32F0

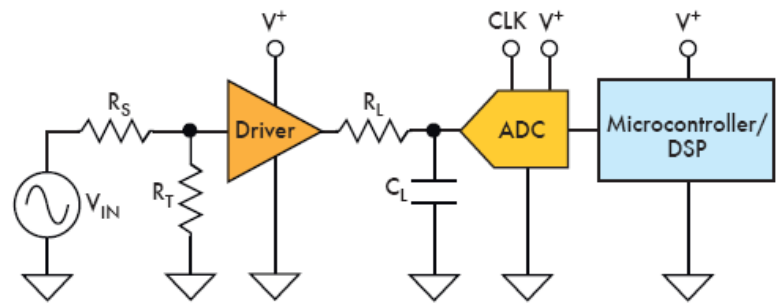
2. **Product breadth M0+ - M4** with 700+ product offerings, 60+ pin for pin compatible devices in each of 3 different packages that span 9 families

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



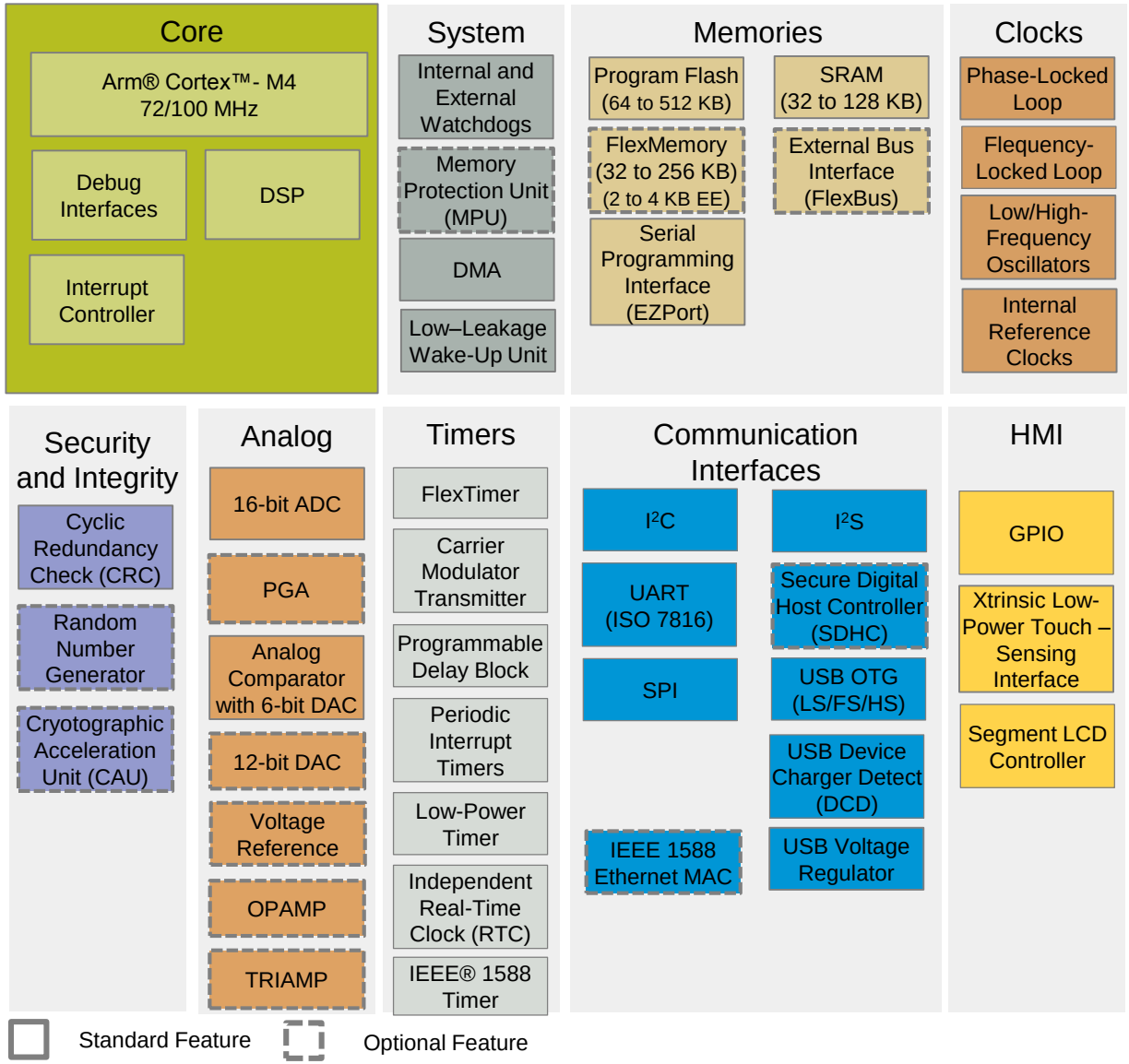
Precision Analog Improves Accuracy

- **The challenge: *Increase device accuracy without increasing cost.***
  - The FDA is requiring higher accuracy on most medical devices and changes to healthcare provide significant cost pressure.
- **The solution: *Integrated precision analog.***
  - Integrating precise analog components such as Op Amps, Tri Amps, high resolution ADC, and DACs.
- ***Ideal solution – Platforms w/ Flexible Analog***
  - Freescale offers customers fully integrated analog solutions that are pin compatible and scalable.
  - Freescale solutions contain key analog peripherals needed to connect to a custom analog ASIC.



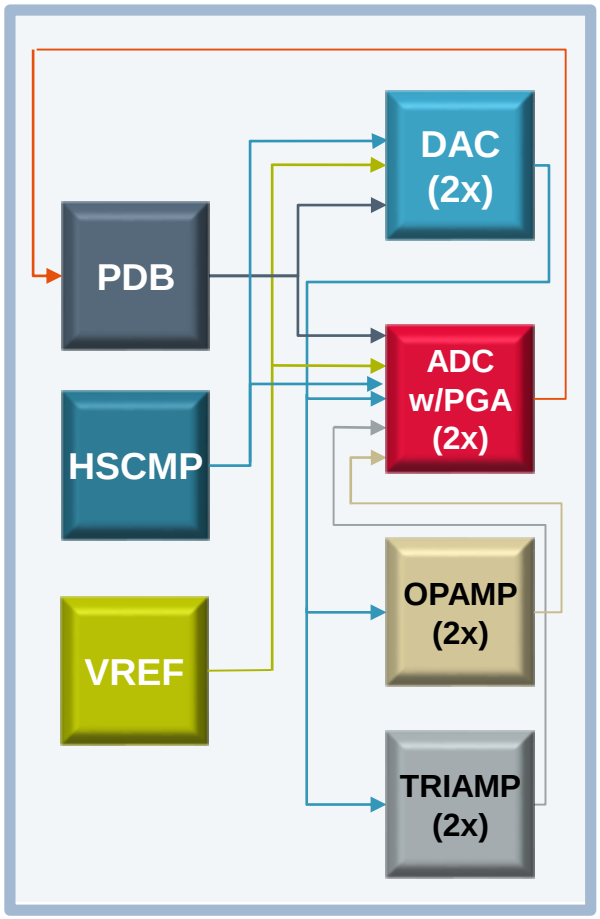
1. A typical signal path's analog front end features an op amp that drives the ADC, RC filter, and microcontroller or DSP.

Kinetis K50 MCU Family

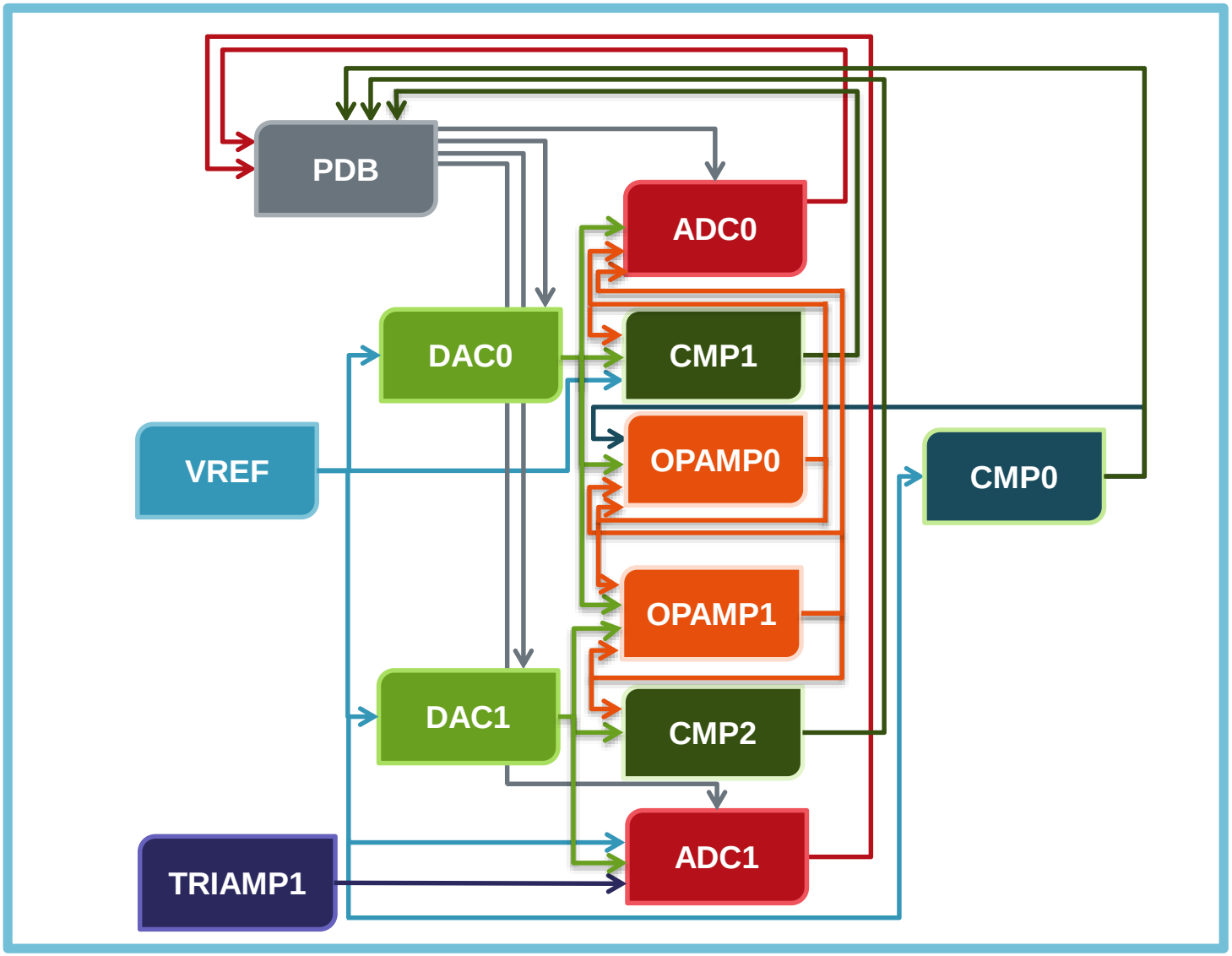


Kinetis Analog Measurement Engine (K50 Series)

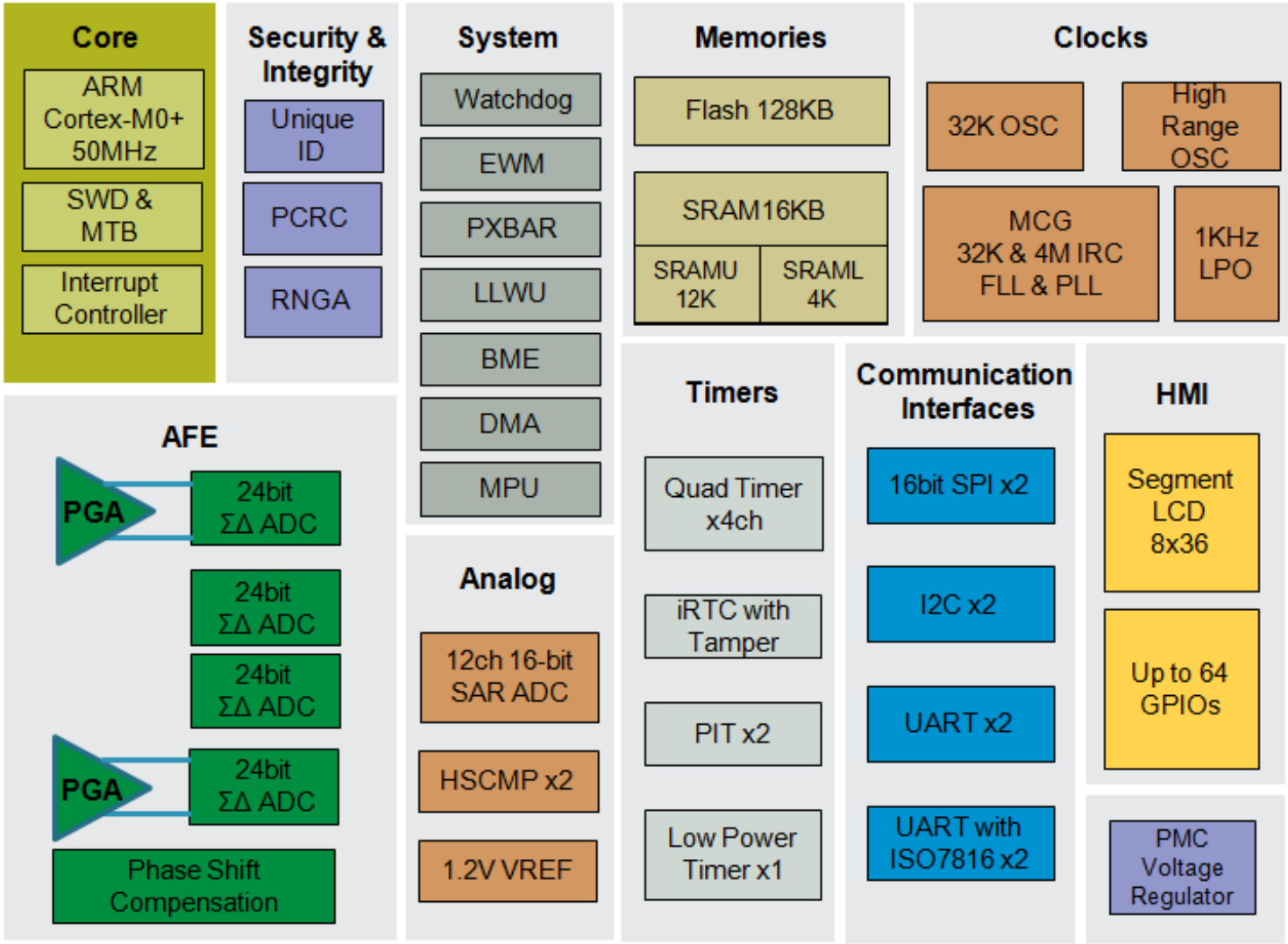
- Measurement Engine Functions
  - Static and dynamic biasing of sensor
  - Signal conditioning
  - Accurate measurements
- Measurement Engine Features
  - 16b Analog-Digital Converter
    - SAR type; typical 14b accuracy
  - 12b Digital-Analog Converter
    - 1ms settling time (min)
  - Programmable Delay Block
    - Synchronizes ADC and DAC operations
  - 1.2 V Trimmable Voltage Reference
  - General Purpose Operational Amplifier
    - Customizable function – filter, PGA
  - Trans-Impedance Amplifier
    - 300 pA input bias current operation
  - Analog Comparator with Prog. Reference
    - Low power wakeup on analog threshold



Analog Modules Interconnections



Kinetis M Series MCUs



+/-250mV analogue I/O pads with **6kV** PESD

Interoperability and Communication Standards

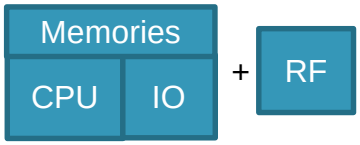
- **The challenge: Crossing the chasm**
  - Adding communications functionality to medical devices that will “play nice” with other medical devices
- **The solution: Personal Connected Health Alliance (ie Continua Health Alliance)**
  - Creating guidelines for wireless and wired data transport between monitoring devices and healthcare providers
  - Guidelines are applicable to familiar, basic devices and more sophisticated devices
- **Continua and IEEE certified software stacks**
  - Support for BLE and a number of Healthcare profiles
  - Ease of use reduces time to market
- **Wireless solutions that have climbed the S-curve including BLE, ANT+, ZigBee and 802.15.4**

BLE Options

Monolithic SoC

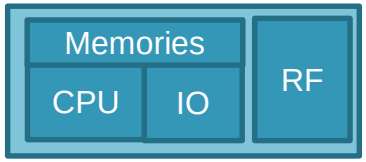
- Single chip solution
- Lowest cost offering
- Smallest footprint
- Lowest flexibility
- Limited on chip memory (some consumed by BLE stack)
- Radio steals cycles from CPU, limiting system performance

MCU + Radio 2-chip



- Most Flexibility
- Radio steals cycles from CPU, limiting system performance
- Large footprint
- More expensive

MCU + Radio System in Package



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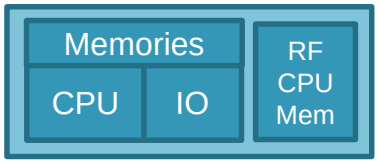
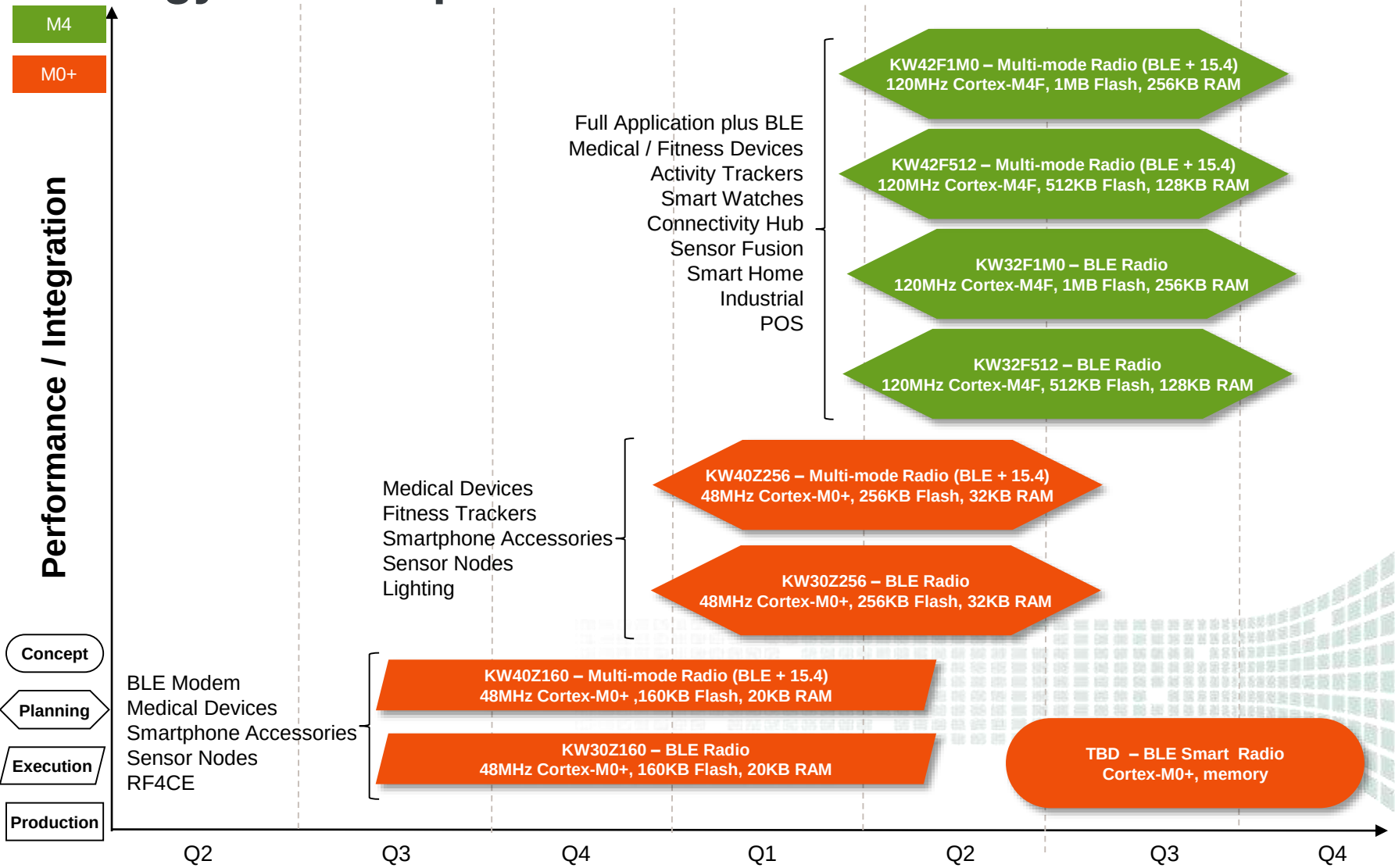


- Single chip solution
- More MCU options easily explored
- Optimized footprint
- More expensive than monolithic SoC
- Radio steals cycles from CPU, limiting system performance

- Single chip solution
- More MCU options easily explored
- Dedicated core and memory for radio (CPU performance and memory not affected)
- Optimized footprint
- Most expensive option

Kinetis W Series MCU Bluetooth Low Energy Roadmap



Kinetis KW30Z / KW40Z

Core/Memory/System
- Cortex-M0+ running up to 48 MHz
- 160 KB or 256 KB Flash
- 20 KB or 32 KB SRAM
- Four independently programmable DMA controller channels

Radio
- Support for BLE v4.1, 802.15.4-2011, 802.15.4j-2013, ZigBee PRO/IP, RF4CE, FSL FlexIP Stack
- -94 dBm in BLE mode, -102 dBm in 802.15.4 mode
- -20 to +5 dBm programmable output power
- 13.5 mA Rx & Tx (0dBm) current target (DC-DC bypass)
- <7mA Rx & Tx (0dBm) current target (DC-DC enabled)
- <2uA low power current

Communications/HMI/Timers
- 2xSPI, LP-UART, 2xI2C, CMT, GPIO with IRQ capability (KBI)
- Hardware Touch Sensing Inputs (TSI)
- 3xFlexTimer (TPM) with PWM & quadrature decode support
- Low Power (LPTMR), Programmable Interrupt (PIT) and RTC timers

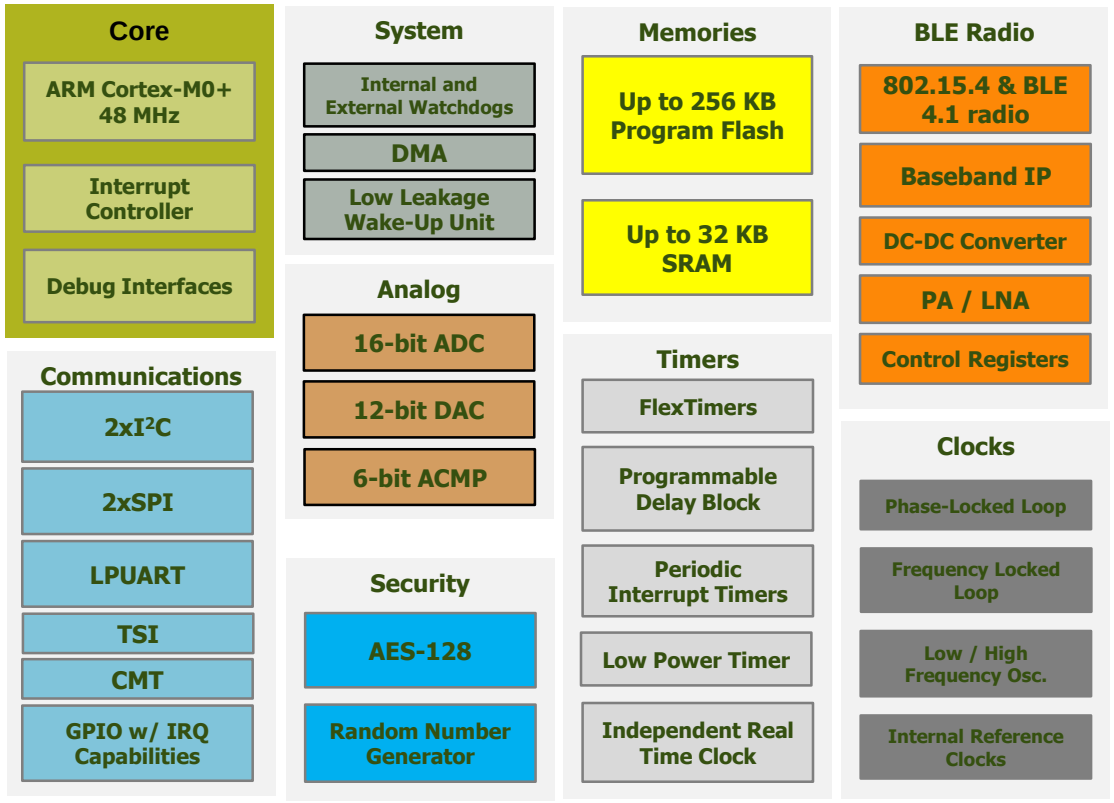
Analog
- 16-bit ADC with integrated temperature sensor and battery monitor
- 12-bit DAC and 6-bit High-speed Comparator

Security
- AES Accelerator and True Random Number Generator

Integrated DC/DC Converter
- Normal: 1.71V to 3.6V
- Buck : 2.1V to 4.2V for coin cell operation
- Boost : 0.9V to 1.8V for single alkaline battery operation

Unique Identifiers
- 80-bit device ID programmed at factory
- 48-bit and 64-bit 802.15.4 MAC address programmed at factory

-40ºC to +105ºC



Device	Memory	Protocol	Package
MKW30Z160VHM4/R **MKW30Z256VHM4/R**	160K Flash, 20K RAM 256K Flash, 32K RAM	BLE Only	5x5 32-pin LGA
MKW40Z160Vxx4/R **MKW40Z160VHT4/R**	160K Flash, 20K RAM	BLE + 802.15.4/ZigBee	~3.5x3.5 xx-pin CSP 7x7 48-pin LGA
MKW40Z256Vxx4/R **MKW40Z256VHT4/R**	256K Flash, 32K RAM		~3.5x3.5 xx-pin CSP 7x7 48-pin LGA

Features	Description
Software and Protocol Stacks	BLE Stack & Profiles ZigBee RF4CE & PRO & Profiles
Availability (subject to change)	160K Flash - Samples 2Q'15, Production 4Q'15 512/256K Flash - Samples 4Q'15, Production 2Q'16

Kinetis KW32F/KW42F

Core/Memory
- Cortex-M4F @120 MHz, 8KB I-Cache and FPU
- 1 MB or 512 KB Flash with SWAP
- 256 KB or 128 KB SRAM
- External Bus Interface (optional)

Transceiver Execution Engine
- ARM Cortex-M0+ core @ 48 MHz
- Support for BLE v4.1, 802.15.4-2011, 802.15.4j-2013, ZigBee PRO/IP, RF4CE, IP Stack
- -94 dBm in BLE mode, -102 dBm in 802.15.4 mode
- -20 to +5 dBm programmable output power
- 13.5 mA Rx & Tx (0dBm) target (DC-DC bypass)
- <6mA Rx & Tx (0dBm) target (DC-DC enabled)
- <2uA low power current
- Fast Antenna Diversity & Dual-PAN

Communications/HMI
- 4xLP-SPI, 6xLP-UART, 3xLP-I2C, 1xI2S
- Flex-IO, Hardware Touch Sensing Inputs (TSI)
- USB OTG LS/FS w/ PHY and USB Vreg
- USB XTAL-less support

Analog
- 16-bit ADC with integrated temperature sensor and battery monitor
- 12-bit DAC and 6-bit High-speed Comparator
- Analog 1.2V Vref

Security
- AES, DES, 3DES, MD5, SHA-1, SHA-256
- NIST-compliant True Random Number Generator

Integrated DC/DC Converter
- Normal: 1.71V to 3.6V
- Buck : 2.1V to 4.2V for coin cell operation
- Boost : 0.9V to 1.8V for single alkaline battery operation

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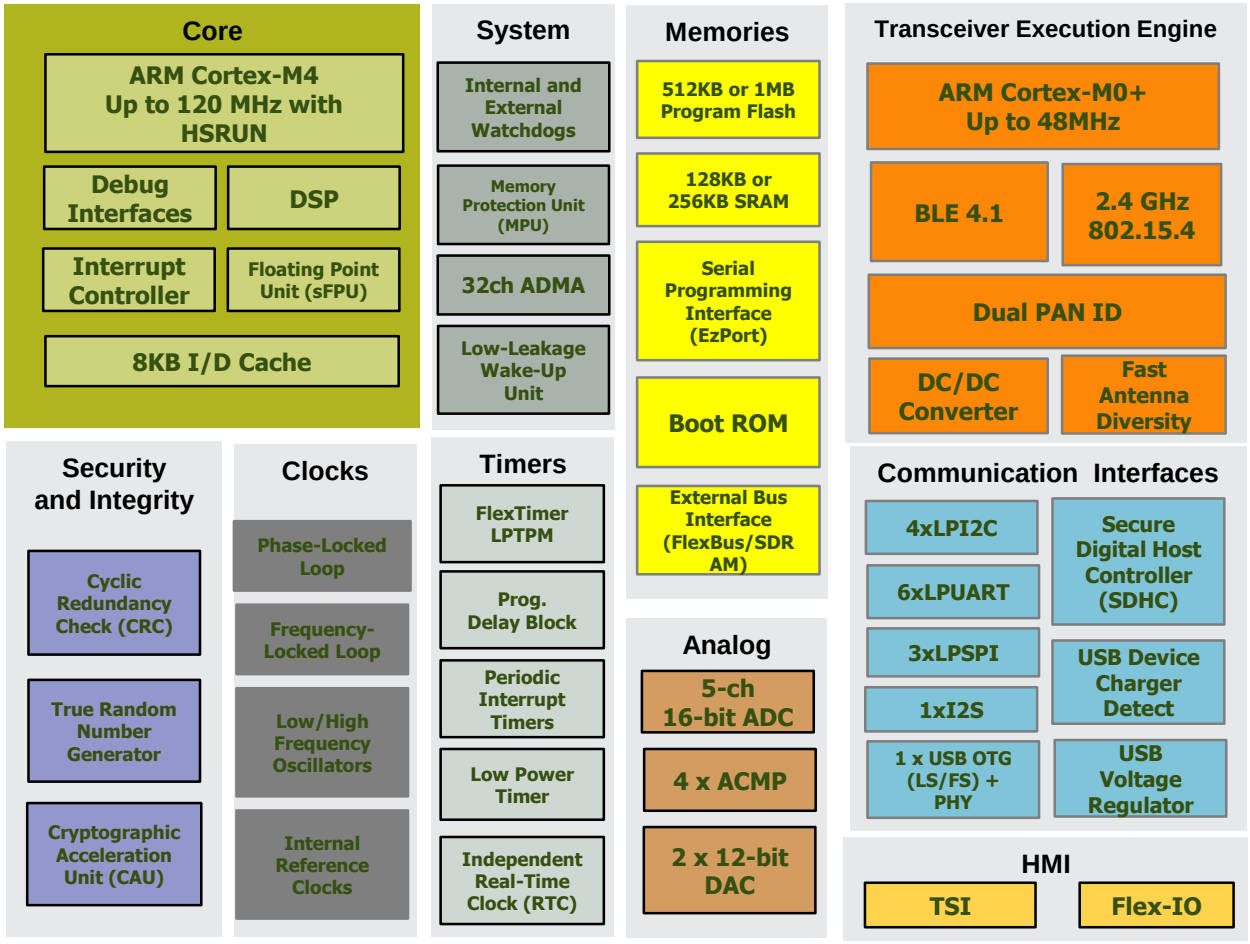


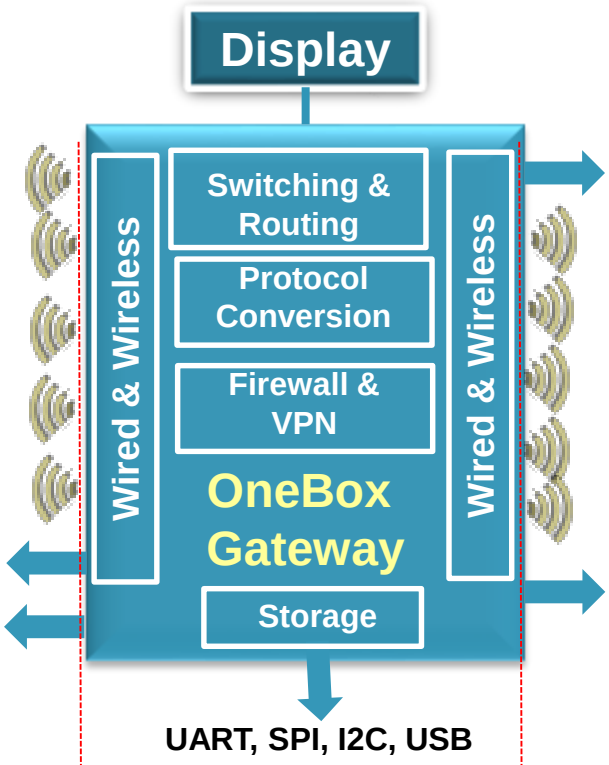
Device	Protocol	Package
MKW32F1M0VMC12	BLE	8x8 121-pin BGA
MKW42F1M0VMC12 MKW42F1M0VHT12	BLE & 15.4	8x8 121-pin BGA 7x7 48-pin LGA
Features	**Description**	
Availability (subject to change)	Samples 1H'16 Production 4Q'16	

IoT Gateway – Single Box Example

BAN/PAN/LAN/HAN Side

Standards

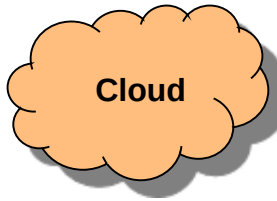
- Bluetooth
- ZigBee, 802.15.4
- Wi-Fi, DASH7, ISA100
- Wireless HART, EnOcean
- Wireless MBus
- Ethernet, EtherCAT, Profinet, Modbus, IS485
- HPGP
- Etc.



NAN/WAN Side

Standards

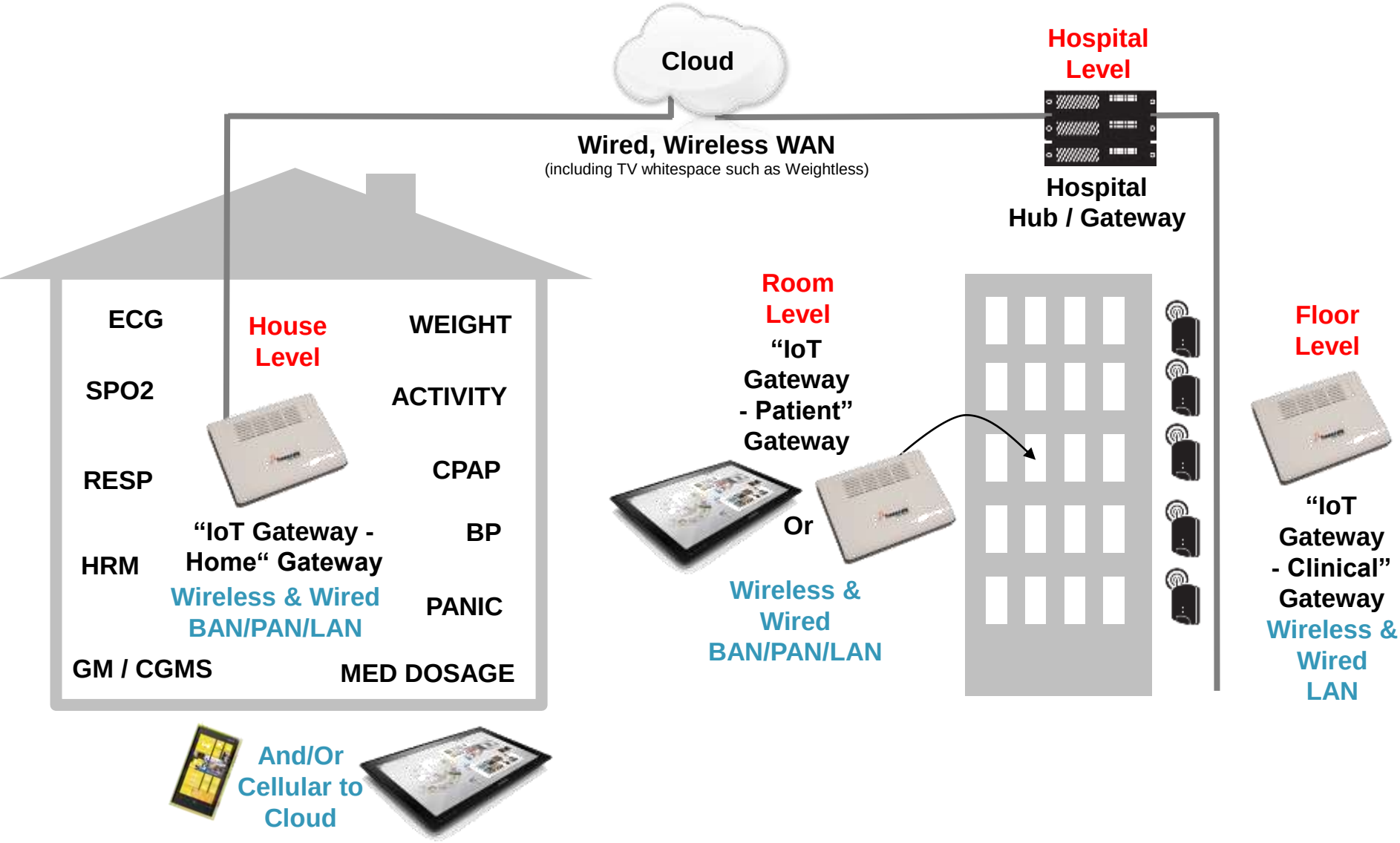
- Ethernet / Fiber
- Weightless
- 802.11ah
- Cellular
- Sub Gig
- Satellite
- PLM/PLC (G3, Prime, etc.)
- Etc.



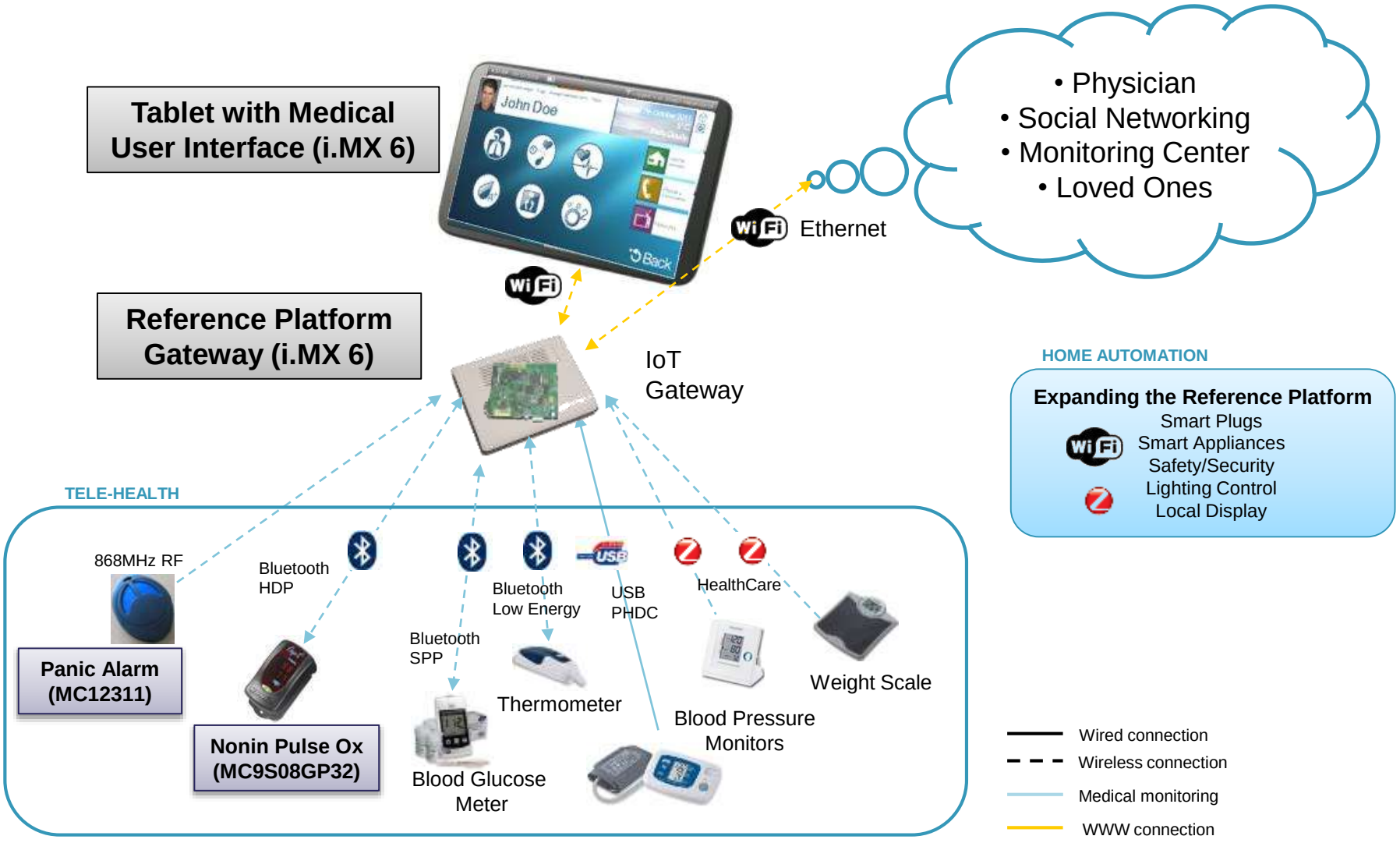
What devices to monitor/ control | **What short-range device access link** | Targeting CPE | **What Cloud access link**

Need to optimize the communications, processing, and storage requirements of all stakeholders (i.e. teleco providers, security, utility, energy, automation, control, and other future service providers), @Home, @Factory, @Hospital, or other target facilities / environments

Healthcare Examples of Hierarchical Gateways

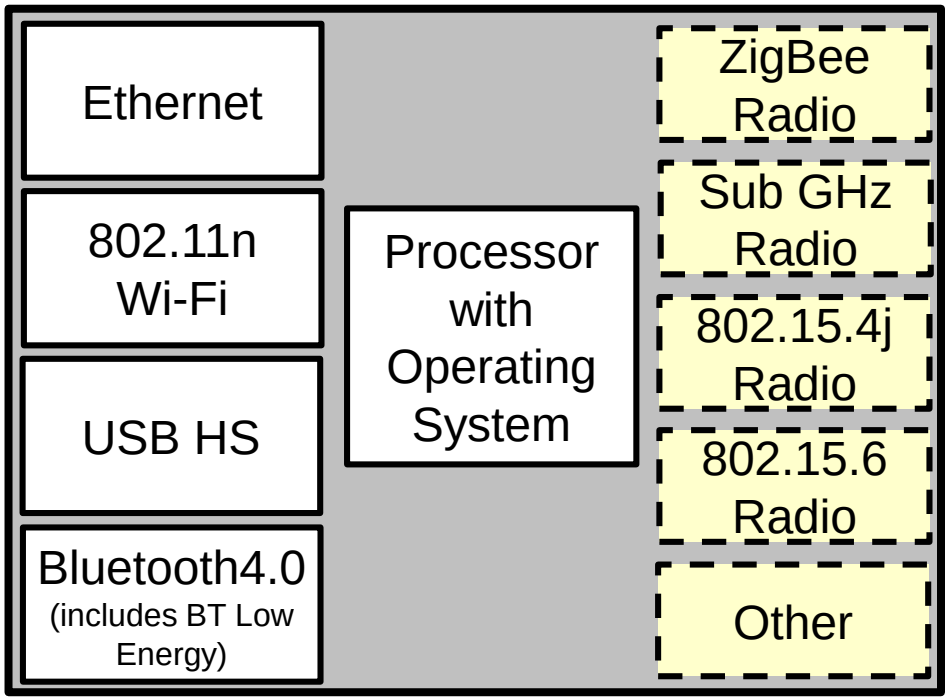


Gateway Healthcare Deployment Example



IoT Gateway Platform…. Have it Your Way… Home/Patient/Clinical

Configurable IoT Gateway



i.MX Application Processors Core Values

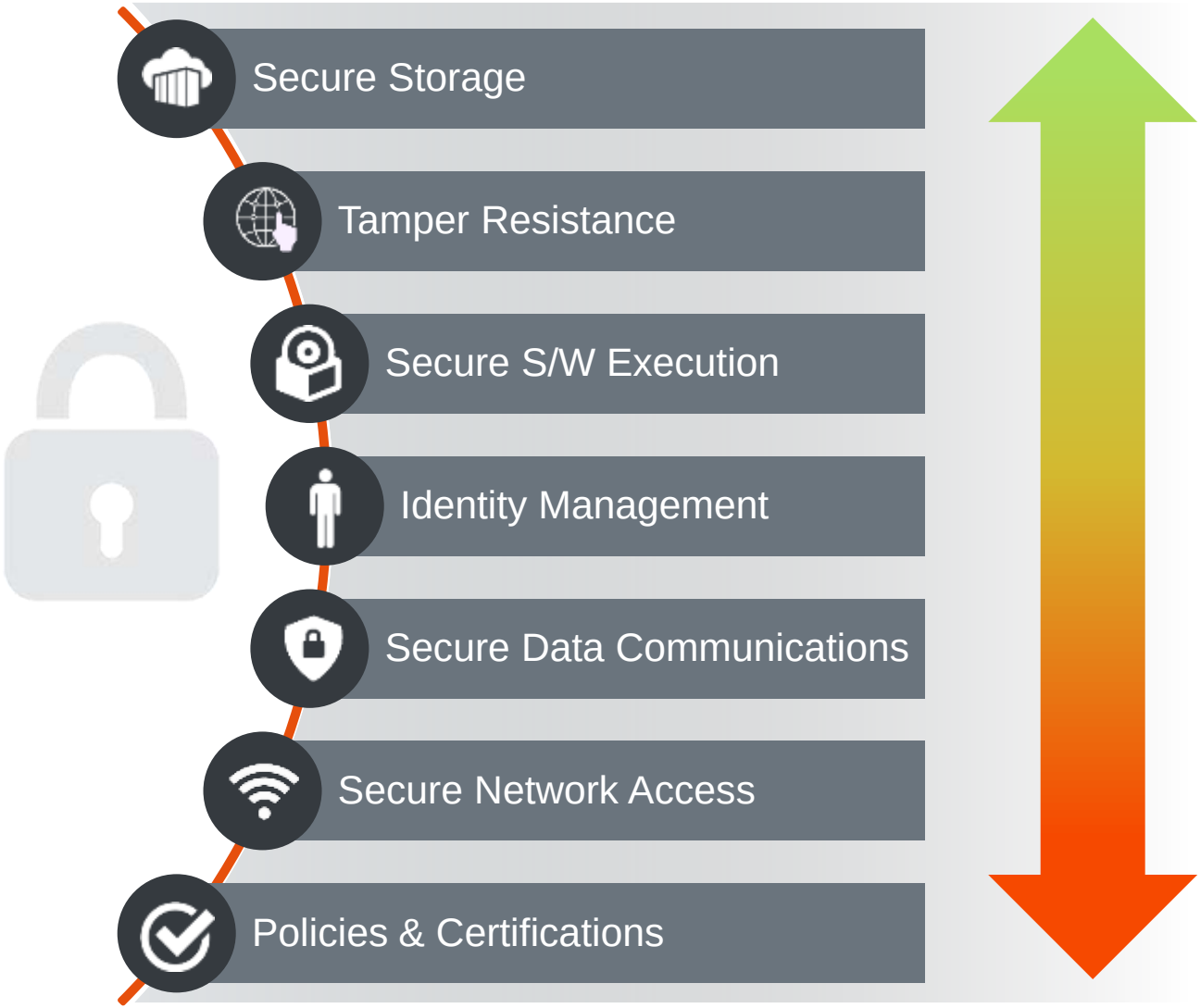
Scalability
- CPU (single/dual/quad, asymmetric), GPU, IO
- Software: Linux, Android, QNX, Windows Embedded, RTOS
- Industry Leading Ecosystem and Partnerships

Integration
- Automotive/Industrial/Consumer peripheral sets
- Packaging to Meet Market Requirements
- Qualifications: AEC-Q100, JEDEC Industrial and Consumer

Trust
- Longevity: Minimum of 10-15 years in all markets
- Consistency of Supply, Accessibility
- Quality, Robustness, Zero-defect methodology
- Security and Safety

Ease of Adoption
- Communities, Innovation, Support
- Design Collateral, Distribution
- System Solutions: SoC, Sensors, PMIC, IoT Comms, SBC

Leadership Security – i.MX Hardware Enablement



In-Line Encryption (Memory)

Manufacturing Protection

Authenticated debug & Field returns

Run-time integrity

Trust Zone

Secure Storage

Zeroizable RAM

Root of trust

Cryptographic Acceleration

Symmetric & Asymmetric accl.

Random Number Generator

Attack Protection

Active Tamper Detection (Physical)

DPA Protection (Side Channel)

Secure S/W Execution

Resource Domain Control

System Memory Protection Unit

On-the-fly Decryption (code)

Leadership Software - i.MX Linux Enablement

- Silver Member of Linux Foundation
- AGL Working Group Bronze Member (in progress)

THE LINUX FOUNDATION
Silver Member

yocto PROJECT PARTICIPANT

GENIVI

Over the past 15 years shipping i.MX application processors…

39,000+ Linux Downloads

Multiple i.MX 6 series customer engagements are using GENIVI Solutions

Freescale has more compliant platforms than ANY semiconductor vendor

Reference: http://www.genivi.org/compliant-products

i.MX **Android Leadership**

Commitment: **10** Android OS versions released over past **7** years

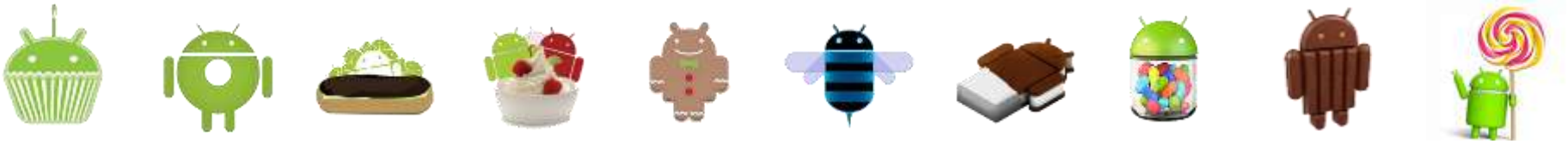
Broad Acceptance: **25,000+ downloads** of BSP to date

Fast Development: **~4 months** from development start to production release on multiple Android versions

Cross market robustness: **Automotive, Industrial, Consumer**

Continued support: New OS releases for **2 years** after silicon production qual

Leadership: i.MX – only Android system shipping in a **top 5 OEM infotainment platform** today



2008 2009 2010 2011 2011 2012 2012 2013 2014 2015

iMXCommunity.org – Connect Collaborate Share

Greater than **4,000 members**
3500 **new content** added **every year**
Support and enablement for i.MX processors and software – **share** tips, **ask** questions, **spark ideas**
Federated **search capability** integrated with Freescale.com
Forums – Discussions – Groups – Blogs Posts – News – Multimedia Gallery – Training

i.MX 6 Series: Supreme Scalability and Flexibility

Leverage One Design Into Diverse Product Portfolio

Scalable series of **NINE** ARM-based SoC Families

i.MX 6UltraLite Family	i.MX 6SoloLite Family	i.MX 6SoloX Family	i.MX 6Solo Family	i.MX 6DualLite Family	i.MX 6Dual Family	i.MX 6DualPlus Family	i.MX 6Quad Family	i.MX 6QuadPlus Family

Pin-to-pin Compatible

Software Compatible

Expanded series for performance, power efficiency and lower BOM

i.MX 6 SoloX Advantages

- **Heterogeneous architecture with smart system power**
  - Single Cortex-A9 paired with a Cortex-M4
  - Enables concurrent execution of multiple software environments to provide high performance with real time responsiveness, allowing for smart system power.

- **Optimized Power**
  - Maintain a system aware and power efficient state with complete shut down of the Cortex-A9 core, with the Cortex-M4 still active and performing low-level system monitoring tasks.

Energy Efficient Solutions by Freescale

- **Optimized integration for design flexibility**
  - Dual Gb Ethernet with hardware AVB support for fast reliable communication
  - PCIe for high-speed connectivity (e.g. Wi-Fi)
  - 2D and 3D hardware graphics acceleration for performance optimized UI
  - Memory controller supports low-power LPDDR2 and cost-effective DDR3/DDR3L

- **Secure solutions for optimized performance efficiency**
  - On-chip resource domain controller providing a centralized programming model to configure isolation and sharing of system resources.
  - Advanced security supporting high assurance (secure) boot, cryptographic cipher engines and random number generator.

i.MX 6SoloX

Specifications:

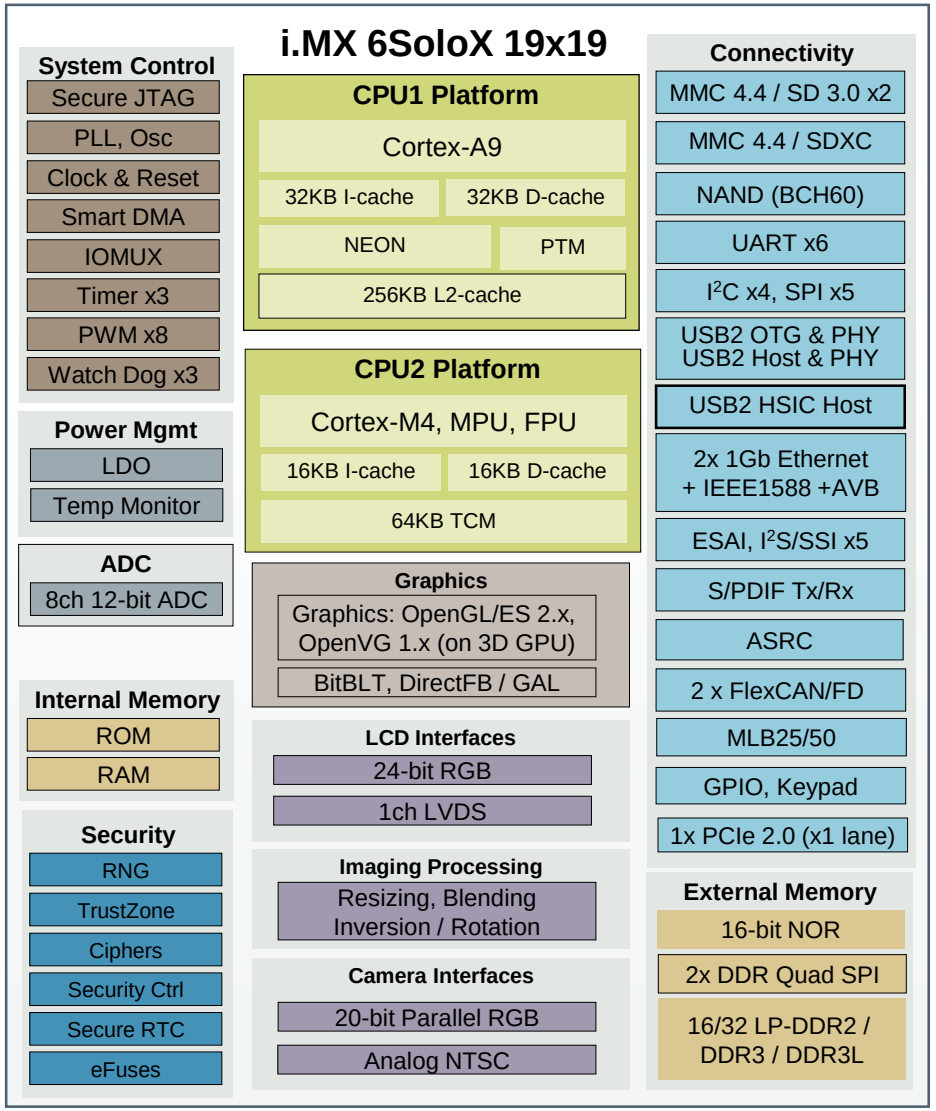
- **Process:** 40nm
- **Core Voltage**: 1.1V
- **Package**: 19x19 VM, 0.8mm pitch, 529 pin MAPBGA

Key Features and Advantages

- 1x ARM® Cortex™-A9 up to 1 GHz
- 1x ARM® Cortex™-M4 up to 200 MHz
- GPU 2D/3D – Vivante GC400T
- Camera Interface – 20 bit parallel CMOS interface
- Parallel 24-bit RGB / LVDS
- 16-bit LP-DDR2, DDR3/LV-DDR3
- 16-bit Parallel NOR FLASH / PSRAM
- Dual-channel QuadSPI NOR FLASH
- 8-bit Raw NAND FLASH with 62-bit ECC
- 4x MMC 5.0/SD 3.0/SDIO Port
- 3x USB 2.0 OTG, HS/FS, Device or Host with PHY
- Audio Interfaces include I2S/SSI, S/PDIF Tx/Rx
- 10/100/1000 Ethernet with IEEE 1588 x 2
- Security Block: RNG, Crypto Engine (AES/TDES/SHA/RSA with DPA), Tamper Monitor, Secure Boot
- Partial PMU Integration

Enablement

- Linux BSP from Freescale



Easy Migration from i.MX 6SoloX to i.MX 6UL

Maximum i.MX IP Reuse

i.MX 6SoloX IP reused in i.MX 6UL

- Memory:
  - DDR (16-bit wide)
  - QuadSPI, NOR flash, Raw NAND
  - SDIO/MMC
  - On-chip RAM, ROM
- Multimedia: LCD, PxP, CSI (no MIPI)
- Peripherals and Timers:
  - 10/100 Ethernet (no AVB)
  - USB (no HSIC)
  - UART, I2C, SPI
  - Audio: I2S, SPDIF
  - PWM, ADC, GPIO
  - CAN
  - WEIM parallel bus

+

Other IP

- ARM Cortex-A7
- Security (from i.MX 7)
- DryIce anti-tamper (minor change from Vybrid)

=

Easy Migration to i.MX 6UL

- Same ARMv7-A instructions as ARM Cortex-A9 (i.MX 6SoloX)
- Correctly structured application binary can run on both i.MX 6SoloX and i.MX 6UL
- Same Linux BSP as i.MX 6SoloX
- Same Yocto build environment
- Same dev tools

i.MX 6 UltraLite Advantages

- **Lowest cost and smallest i.MX 6 member**
- ARM Cortex- A7 @ 528 MHz

- The 14x14 289 MAPBGA with 0.8mm pitch for simple and low cost PCB design.

- The 9x9 289 MAPBGA with 0.5mm pitch for space constrained applications.

- **Most Power efficient Applications Processor**
  - Integrated power management module that reduces the complexity of external power supply and simplifies power sequencing.

"It provides up to 20% more single thread performance than the Cortex-A5 and provides similar performance to mainstream Cortex-A9 based smartphones in 2012 while consuming less power."
www.arm.com/products/processors/cortex-a/cortex-a7.php

- **Connectivity optimized for Industrial and IoT applications**
  - 2x high-speed USB on-the-go with PHY
  - Multiple expansion card ports (high-speed)
  - 2x 12-bit ADC modules (up to 10 input channels)
  - 2x smart card interfaces compatible with EMV Standard v4.3 and a variety of other popular interfaces
  - 2x CAN ports

- **Advanced Security**
  - Hardware-enabled security features that enable secure e-commerce, digital rights management (DRM), information encryption, On-The-Fly DRAM encryption, secure boot and secure software downloads

i.MX 6UL-3 Industrial Processor

Specifications

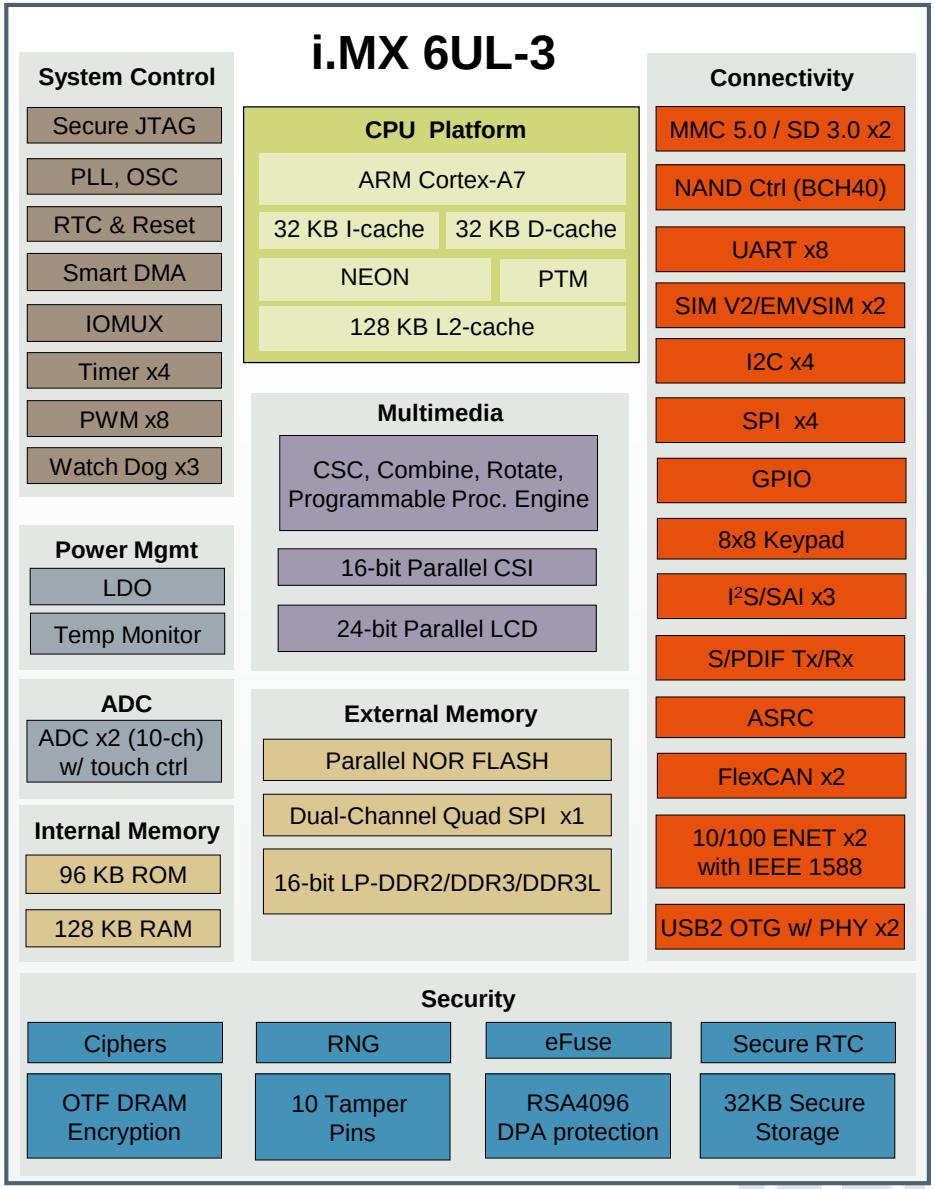
- **Process**: TSMC 40LP
- **Core Voltage**: 1.1V
- **Package**: 289 MAPBGA (14x14, 0.8 mm pitch)
- **Temperature**: -40C to 105C (Tj)

Key Features and Advantages

- ARM Cortex-A7 @ 528 MHz, 128 KB L2 cache
- LCD Display up to WXGA (1366x768)
- 8-bit/10-bit/16-bit Parallel Camera Sensor Interface
- 16-bit LP-DDR2, DDR3/LV-DDR3
- 16-bit Parallel NOR FLASH / PSRAM
- Dual-channel QuadSPI NOR FLASH
- 8-bit Raw NAND FLASH with 40-bit ECC
- 2x MMC 5.0/SD 3.0/SDIO Port
- 2x USB 2.0 OTG, HS/FS, Device or Host with PHY
- Audio Interfaces include I2S/SSI, S/PDIF Tx/Rx
- 10/100 Ethernet with IEEE 1588 x 2
- **Security Block: TRNG, Crypto Engine (AES/TDES/SHA/RSA with DPA), Tamper Monitor, Secure Boot, SIMV2/EVMSIM X 2, OTF DRAM Encryption, PCI4.0 pre-certification**
- Partial PMU Integration

Enablement

- Linux BSP from Freescale

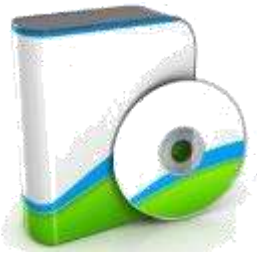


Wi-Fi for Medical Devices

Technical & Regulatory Support

Hardware

silex technology



Software

Quality Manufacturing

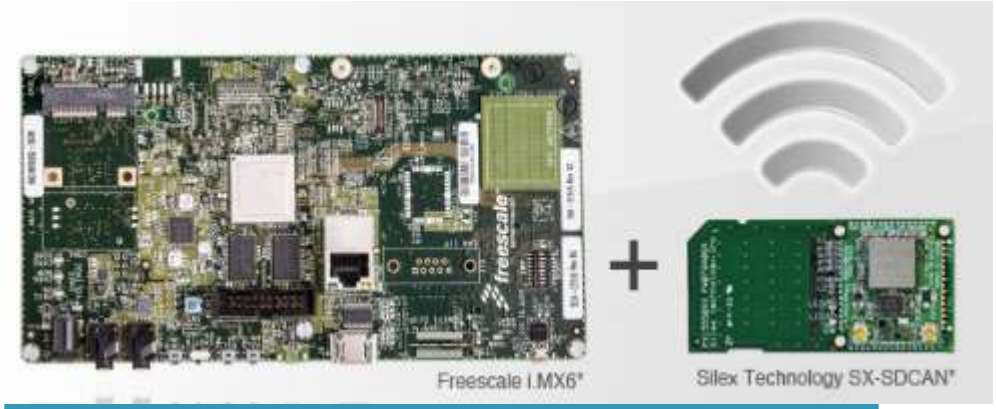
Key Advantages

- Qualcomm Atheros Partnership
- High Quality (Reliability & Connectivity)
- “Enterprise” Feature Set
  - Dual Band
  - Security (802.1X)
  - Enhanced Roaming
- Extended Product Lifecycle Support
- FIPS Experience
- 10 years experience in medical device connectivity

Freescale i.MX 6 – Silex SDCAN Partnership

- 802.11a/b/g/n WLAN SDIO card based on Qualcomm Atheros AR6003 technology
- Wi-Fi driver pre-integrated with various i.MX 6 development systems
- Low-power design ideal for portable battery operated device applications
- Family of production "ready" hardware options available

More information at www.silexamerica/freescale



SPECIFICATIONS:	
Product Name	SX-SDCAN-2830
Chipset	Qualcomm Atheros AR6233
Wireless	IEEE 802.11a/b/g/n
Host Interface	SDIO v2.0
Operating Voltage	3.30VDC +/- 5%
Operating Temperature	-10 to + 70 degrees C
Regulatory Approvals	FCC/IC (US/Canada) R&TTE (EU), TELEC (Japan)
Solution Partner	**Silex Technology (US/Europe/Japan)**

Embedded Wireless Products

Intelligent Embedded Radio Modules

SX-580/SX-570
IEEE 802.11a/b/g/n
Intelligent Communication Module

Certified SDIO Radio Modules and Cards

SX-SDMAN
802.11a/b/g/n+BT
SMT or Connector
Module

SX-SDMGN
802.11b/g/n
Connector
Module

SX-SDCAN
802.11a/b/g/n+BT
SDIO Card

SDIO Radio SIP (System in Package)

SX-SDPAN
802.11a/b/g/n+BT

SX-SDPBN
802.11b/g/n

Mini-PCI and Mini-PCI Express

SX-PCEAN
802.11a/b/g/n
Mini PCI-Express

SX-10WAN
802.11a/b/g/n
Mini-PCI

Qualcomm ATHEROS

Silex Technology is a Qualcomm Atheros Authorized Design Center (ADC) partner, providing various levels of wireless technology implementation support for the popular Atheros chipsets.

Murata – Wi-Fi/BT4.0 for Medical Devices

- Broadcom WLAN/BT source code integrated into i.MX 6/i.MX 7 BSPs

- To enable i.MX 6 series customers, Murata has implemented specific hardware to interface standard modules to existing i.MX 6 reference platforms: i.MX 6SoloX, i.MX 6SoloLite, SABRE for Auto and Smart Devices

- Upcoming i.MX 7D platform with Murata Type ZP Module

Type 1BW: IEEE802.11a/b/g/n + BT/BLE

1. W-LAN + Bluetooth + FM Rx Module

- Chipset : Broadcom / BCM43340
- Module Size : **8.0 x 7.5 x 1.13(max.) mm**
- W-LAN : IEEE802.11a/b/g/n
- Bluetooth : ver.4.0 (BLE)
- Interface
  - > W-LAN : SDIO
  - > : UART

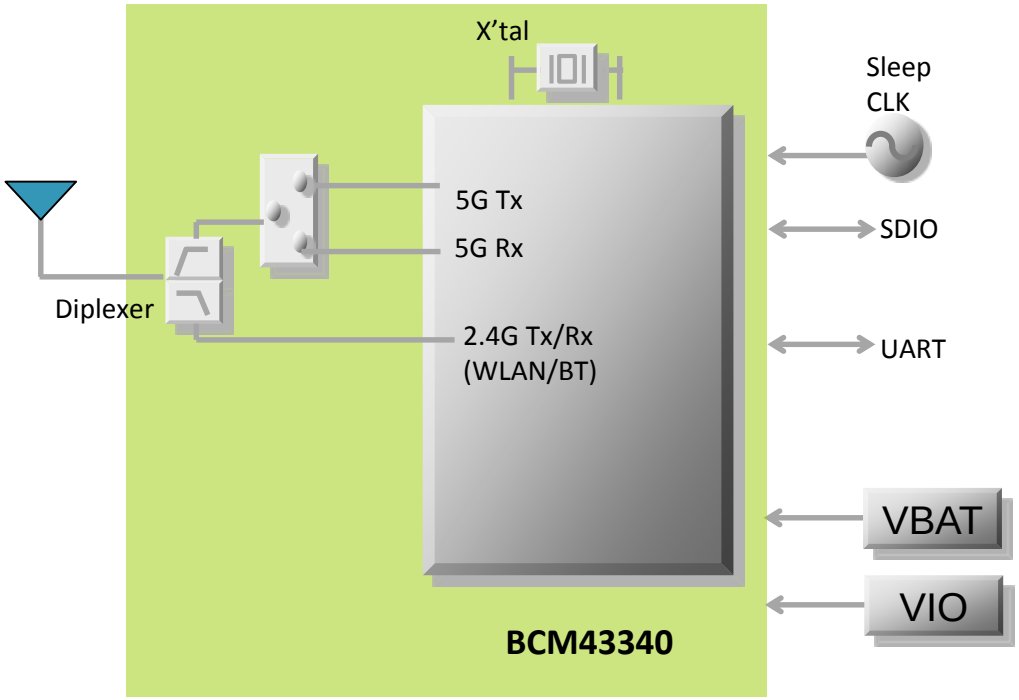
Bluetooth

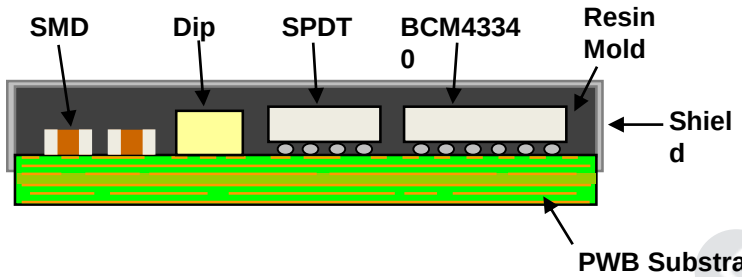
2. Characteristics

- Operating Temp. : TBD
- Supply Voltage : 3.0 to 4.8V for VBAT
- Host I/F Voltage : 1.8V or 3.3V for VIO

3. Sample Part Number

- Module Sample : **LBEH5DU1BW-TEMP**
- EVK : LBEH5DU1BW-TEMP-D





Type 1DX: IEEE802.11b/g/n + BT/BLE

1. W-LAN Module

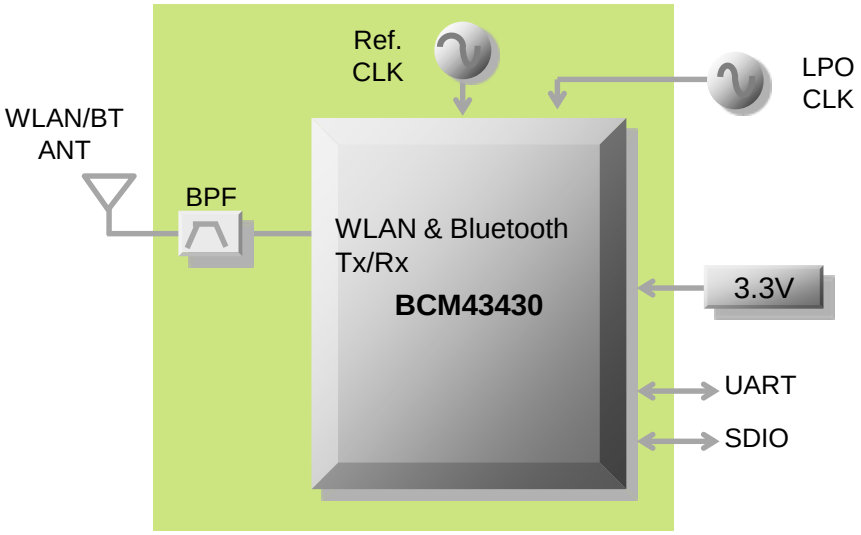
- Chipset : Broadcom / BCM43430
- Module Size : 7.0 x 6.0 x 1.2(max.) mm (T.B.D)
- W-LAN : IEEE802.11b/g/n compliant
- Bluetooth : BT4.1 support
- Interface : SDIO(WLAN) UART(BT)
- Ref.CLK Embedded

2. Characteristics

40 nm process with low power consumption
Integrated PA & LNA

3. Sample Part Number

- Module sample LBEE1**1DX-TEMP
- EVK LBEE1**1DX-TEMP-D

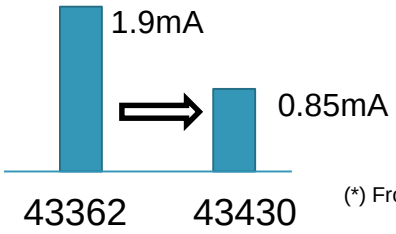


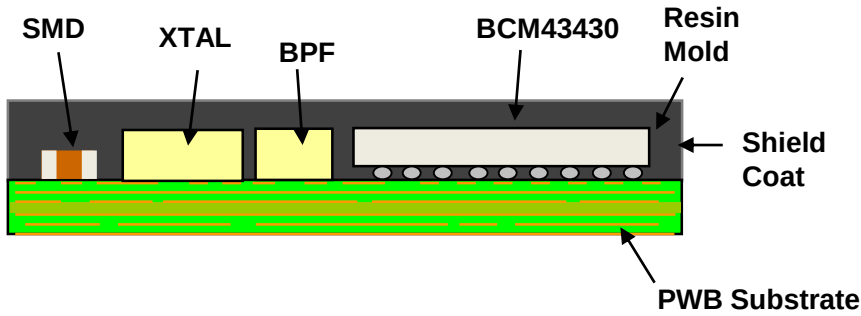
Schedule

MP	April/15

Sleep current (*)

(IEEE Power Save DTIM1)





(*) From Broadcom datasheet

Health@home Hub
The Home Health Connectivity





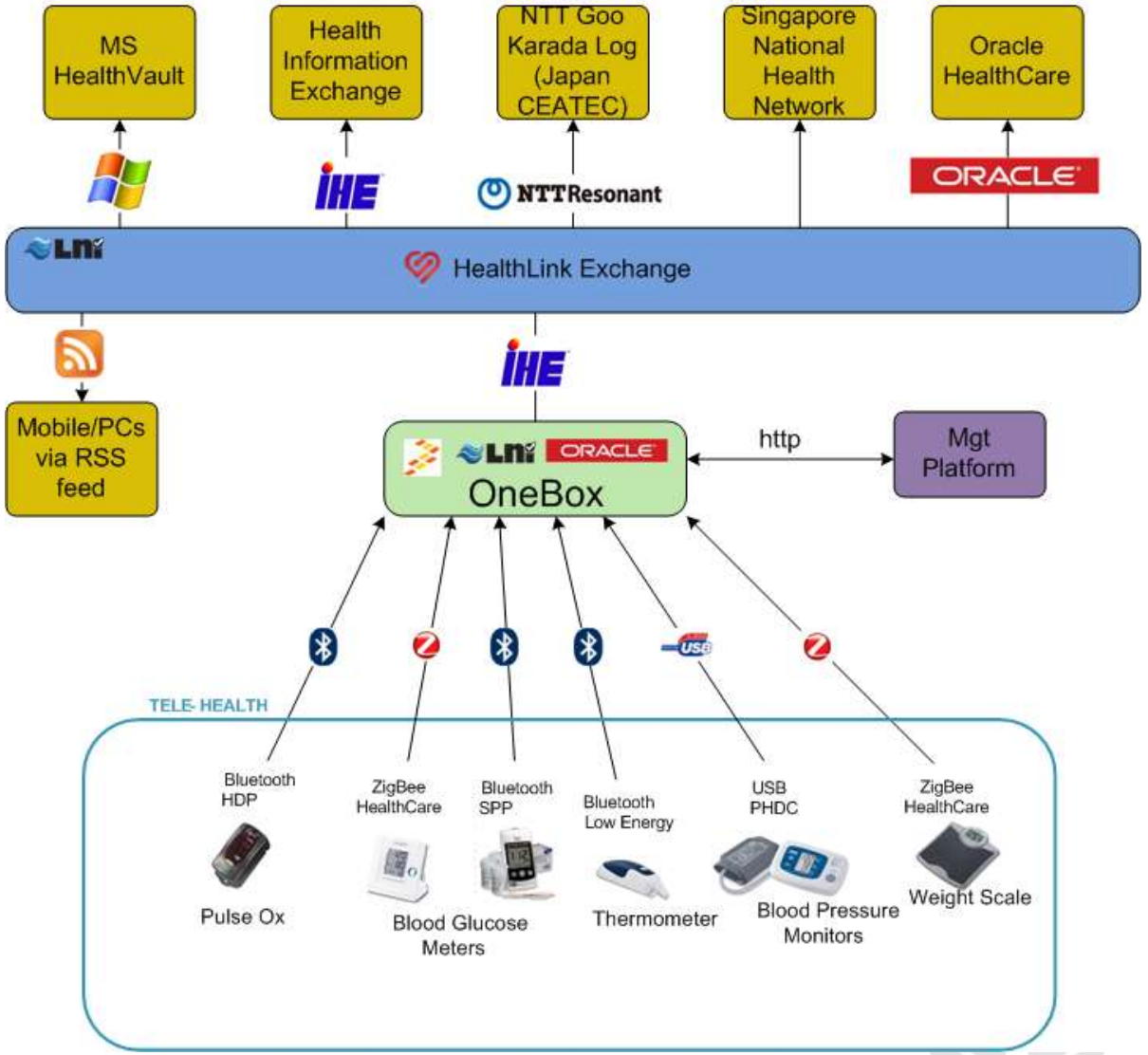

Health@home Hub

Clinically Acceptable

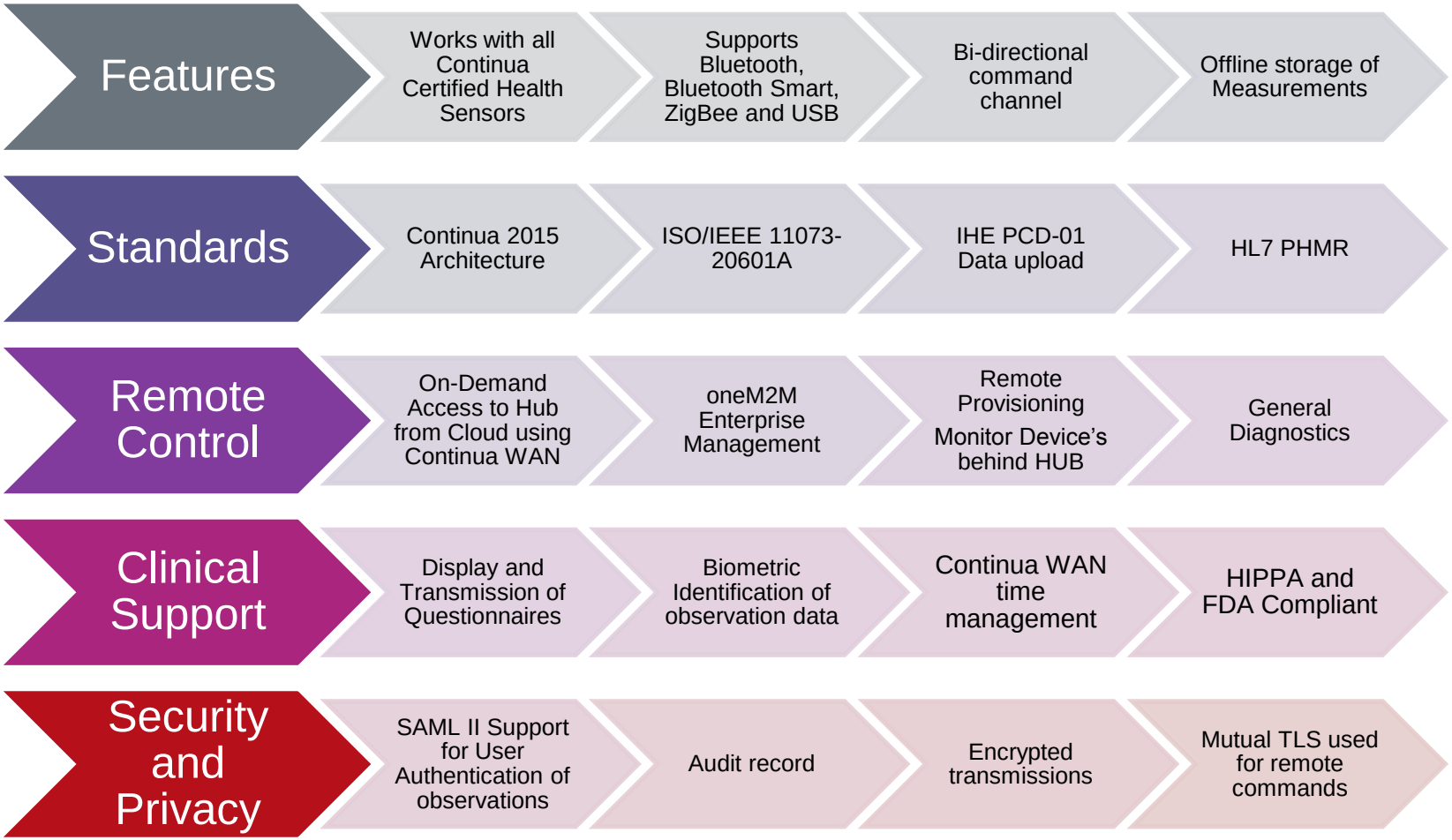
Standards Based

HIPAA Compliant

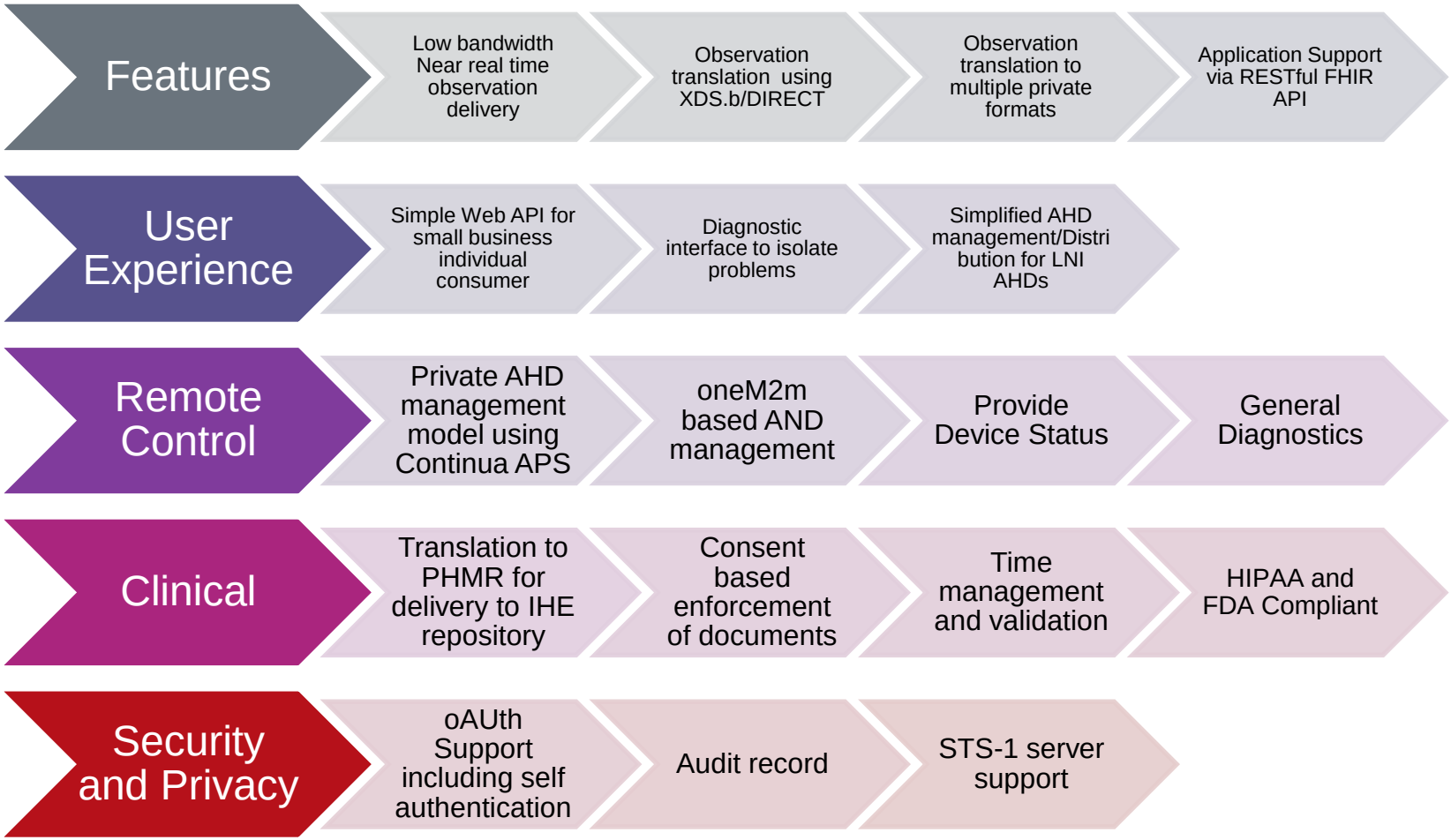
Software SDK for Health connectivity



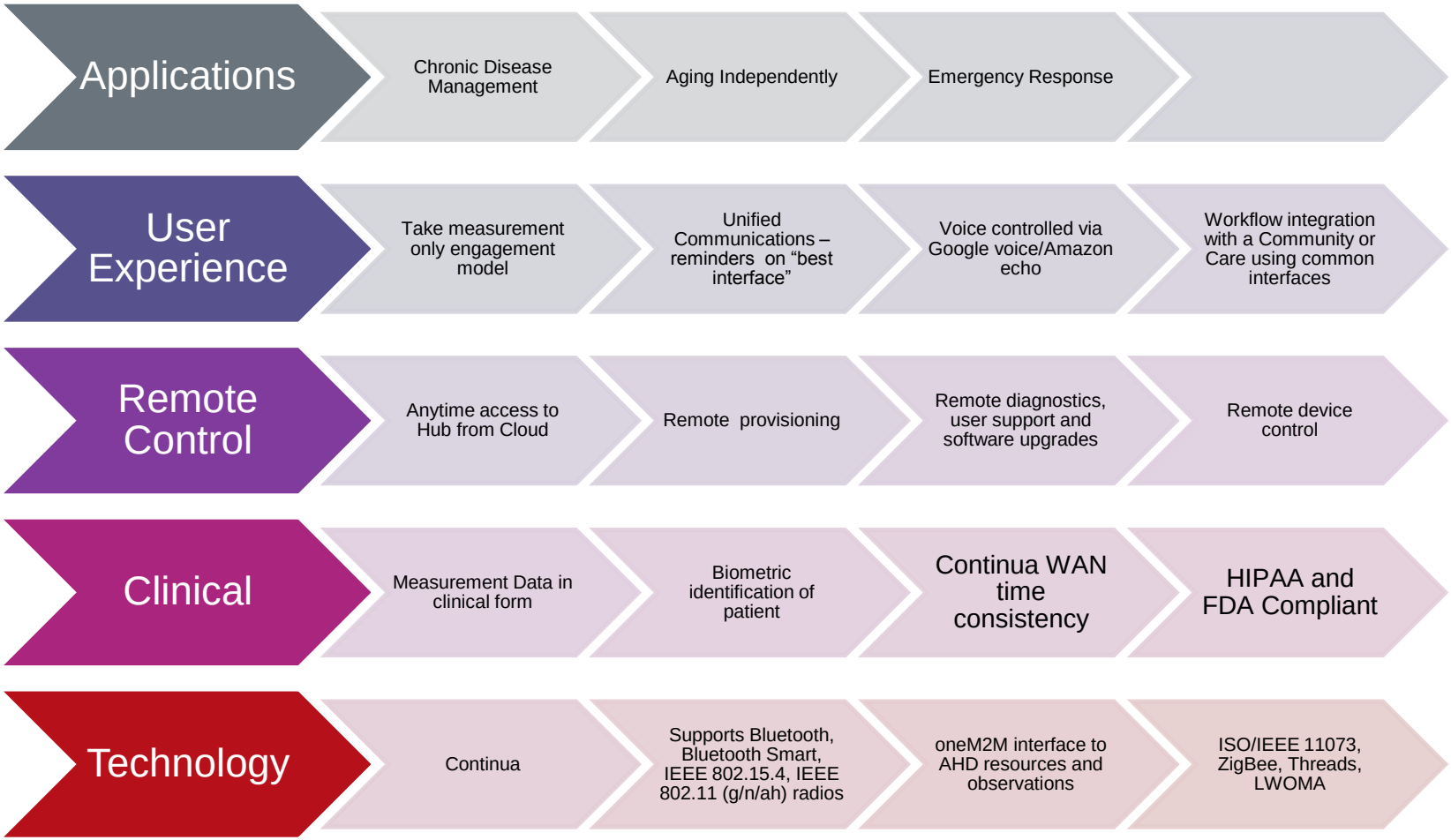
HealthLink Hub



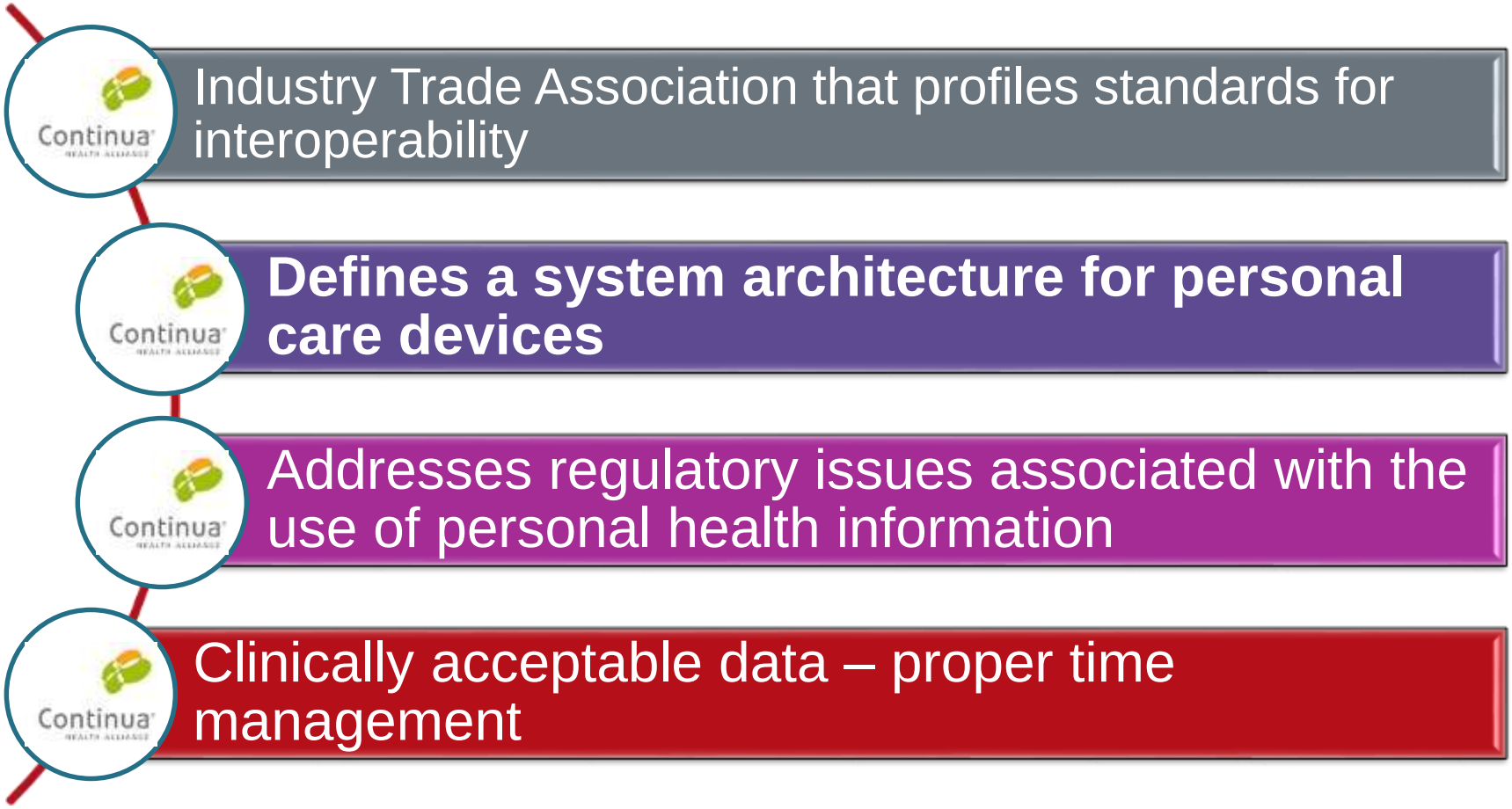
Health@Home Exchange



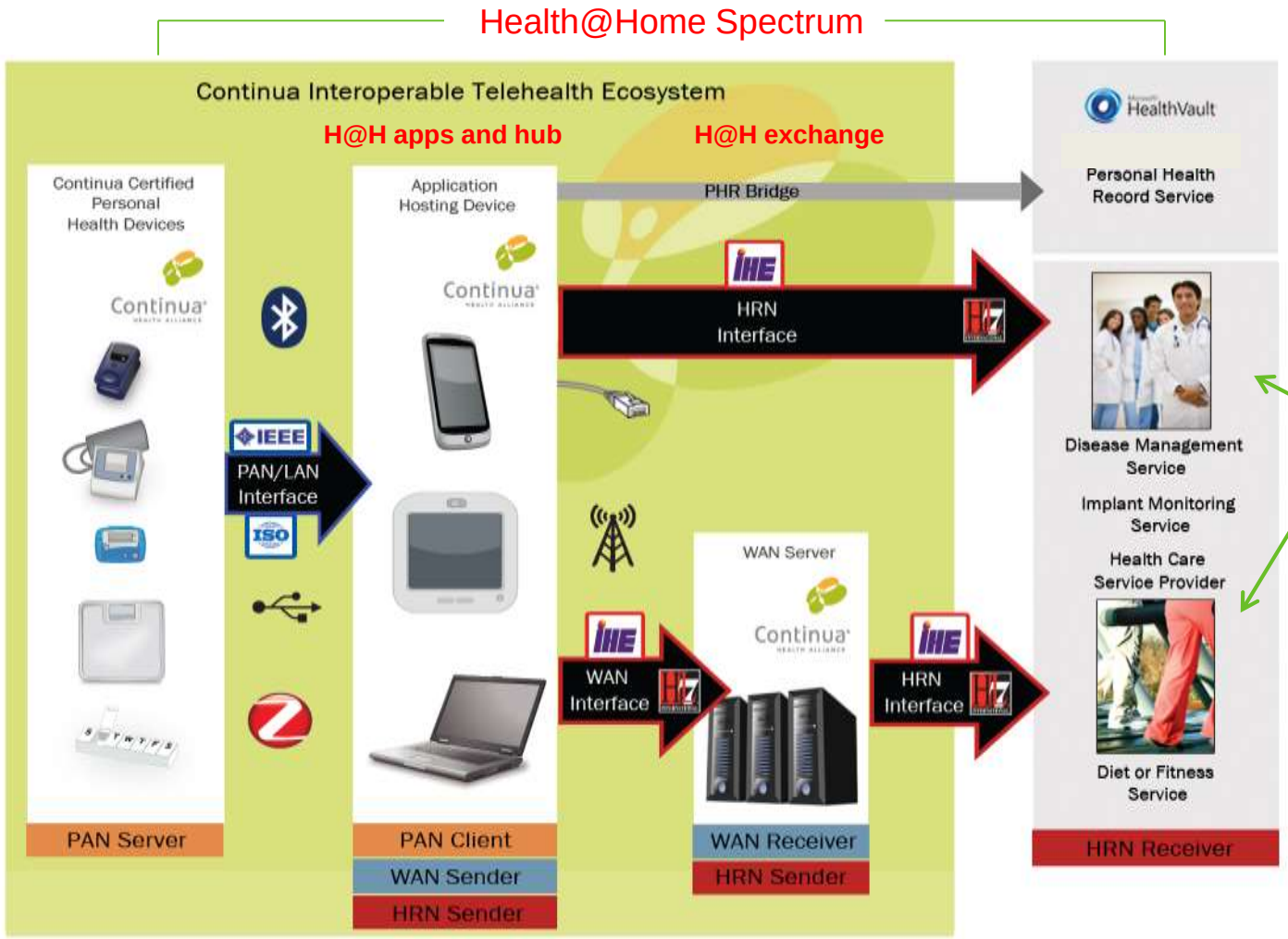
Health@Home V2 Summary



Continua Health Alliance



LNI: End-to-end Architecture



H@H Analytics

Provides data visualization and real-time reporting on sensor measurements for teleheath service centers or physician offices

Technology

Leader in Health Remote Monitoring System

Standards Based Plug and Play Healthcare Data Networks

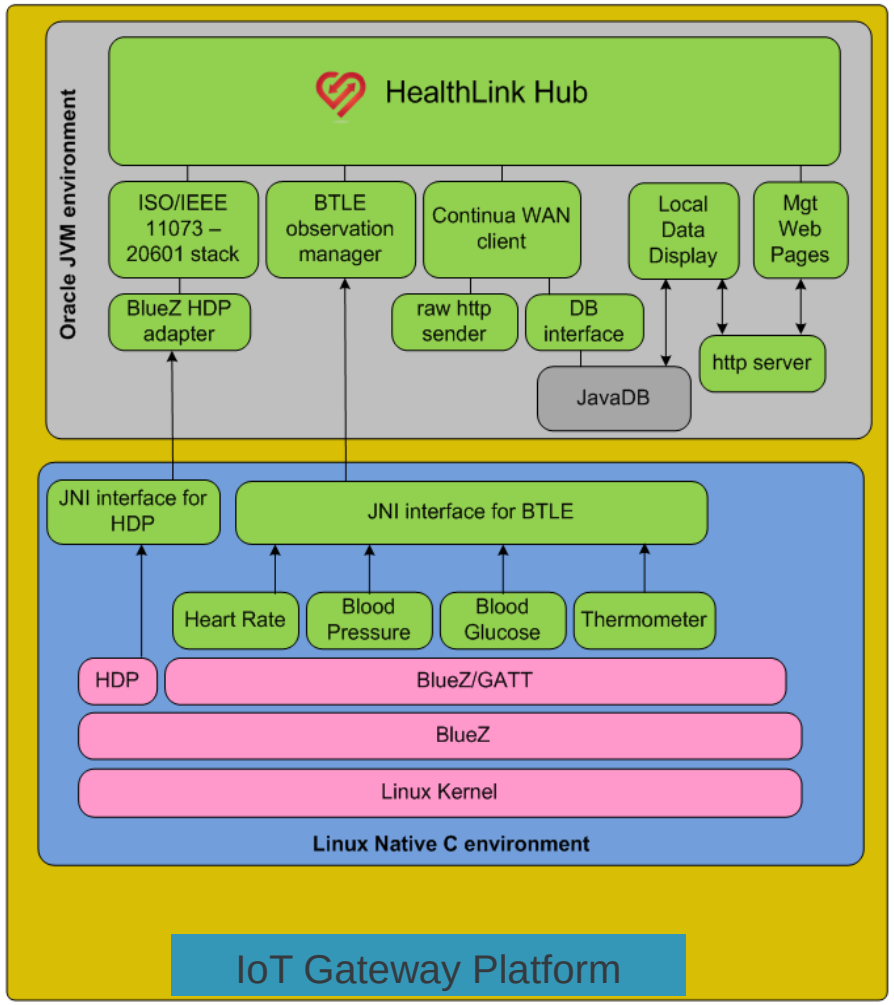
Interoperability leader with oneM2M, Continua, and DLNA

Engineering standards hardware

Custom services and coding for interoperability

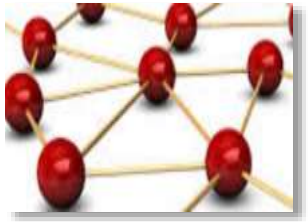
Plug & Play → Standards Based Interoperability → E2E Data Connectivity

Software Architecture



- Application runs in Oracle JVM
- Includes implementations of four BTLE standard in C
- JNI interface for HDP
- JNI interface for BTLE

Health@home - Freedom to Scale



PLUG & PLAY	INTEROPERABILITY	E2E CONNECTIVITY	ENGINEERING
Clinically acceptable, Plug and Play Healthcare Data Networks	Seamless interoperability between PAN Devices and HRN System	*End-to-End Data Connectivity*	*Custom solutions to bring interoperability to legacy systems*

Health@home Solution

Summary

- Healthcare costs higher than ever
- Unprecedented opportunity for IoT
- IoT is more than M2M
- Hierarchical Gateway benefits include flexibility, more bandwidth, enables coin-cell powered sensors, adds security
- Cell-based Gateways leverage installed base, foster mobility
- Many wireless standards, but only a handful best for healthcare
- Freescale is one of the few silicon providers that can enable both healthcare edge node devices as well as gateway solutions.
- Solutions providers like Lamprey Networks are available to speed time to market for these complex systems.
  - More info at www.freescale.com/healthcare

www.Freescale.com