



Wireless Connectivity Overview

Freescale Solutions

2015



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Agenda

- Winning Technologies in IoT Today
- Megatrends Visible Today
- Freescale Strategy and Vision
- Hardware and Software Roadmaps
- Enablement and Support

Addressing the Need for Secure, Connected Solutions



Critical Attributes

Security

Driving enhanced protection for customer IP and end customer personal information with standard on-chip cryptographic accelerators and industry-leading security mechanisms

Connectivity

Improving customer time to market with rapid and easy prototyping and development tools and software (RTOS, SDK, Design Studio IDE), turnkey designs and strategic ecosystem

Low Power

Leading innovation with an optimized ultra-low-power architecture designed for maximum flexibility with efficient ARM® cores, low-power boot capabilities, smart peripherals and various power modes

Selection Criteria

Range

Many applications have a prerequisite that forces the selection of the frequency spectrum. Home automation is a great example of an application domain where there is no 'one size fits all'!

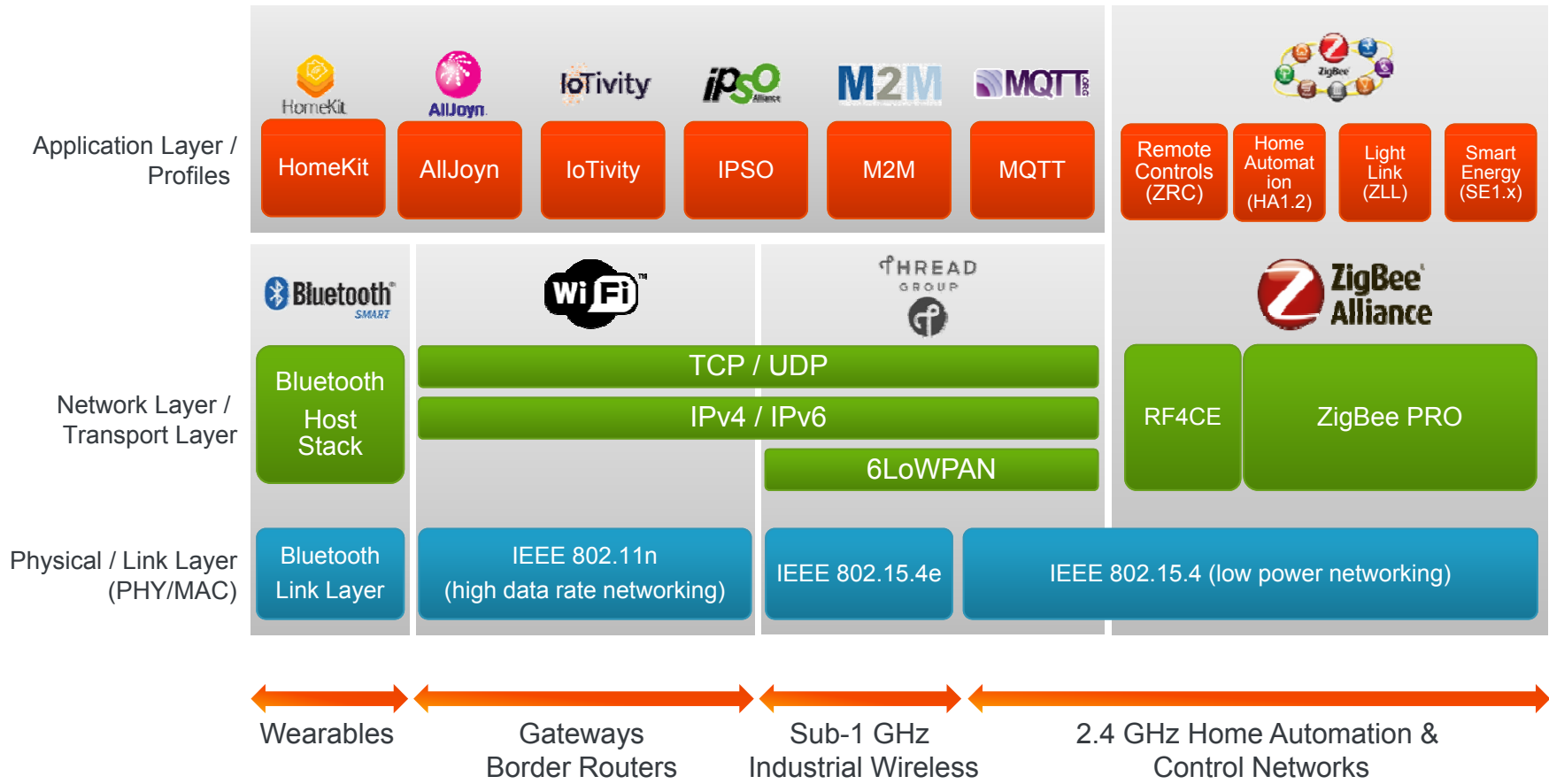
Network Topology

Point-to-point is simple. A star configuration can benefit to the power consumption of the entire system. A mesh can enable a great number of connections. A combination of everything can be a real challenge!

Power of Legacy

Selecting a new protocol can be the right thing to do technically. Now other commercial considerations have their words to say.

Diversity of Connectivity Solutions



Megatrends that are Visible Today

Opportunities

Multi-protocol solutions

New interaction with the user

Power scheme optimization

Adding new security schemes

Move to IP-based networks

Connecting to the cloud

Challenges

Radio co-existence

Communication co-existence

Blind spots

Over engineering

Compatibility with legacy products

Ecosystem to enable seamless integration

Freescal Strategy and Vision

- **Differentiate through Software**
 - Deliver all our software integrated in the Kinetis MCU environment
 - Deliver all our software packaged with FreeRTOS and MQX
 - Optimize our PHY/MAC, network & transport layers

- **Deliver Compelling SoC based Solutions**
 - Implement complete convergence between our MCU and Connectivity products
 - Deliver solutions for 2.4GHz and sub-1GHz
 - Focus on multi-protocol devices

- **Provide a Complete Development Environment**
 - Re-use our MCU experience to deliver outstanding support
 - Create best-in-class connectivity tools and ref. designs
 - Work with partners when Freescale does not have the best offer

Freescalé BLE Stack Facts & Figures

- Memory footprint
 - **100 KB flash** and **12 KB RAM** for a full application and profile (including KSDK, RTOS and drivers)
 - **70 KB flash** and **4 KB RAM** just the stack itself
- Runs on a Cortex-M0+ @32MHz (20% CPU bandwidth max.)
- Pending compliance to the Bluetooth® LE v4.1 specification
- It is **RTOS agnostic** and can run in a non-preemptive mode (bare-metal). Some loop-based scheduling is still required.
- Coexists with the 802.15.4 MAC and upper network stacks in the same **dual mode firmware** for KW40Z
- Currently available with **IAR Embedded Workbench** support

Introducing Kinetis KW40Z Wireless MCUs

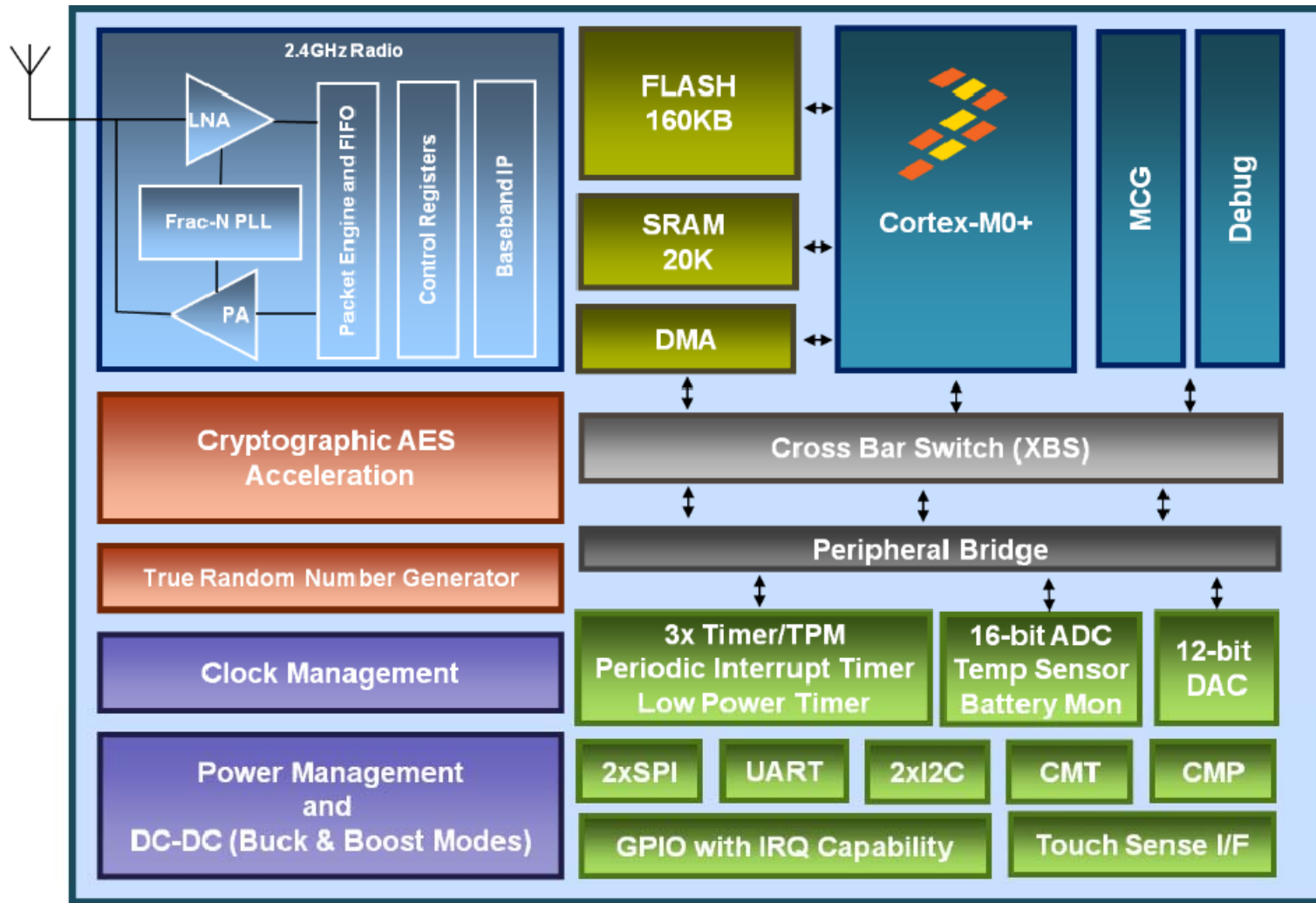
MKW40Z
CM0+ 48MHz
160kB/20kB

MKW30Z
CM0+ 48MHz
160kB/20kB

MKW20Z
CM0+ 48MHz
160kB/20kB

- **Multi-Protocol Radio** – High-performance radio supporting Bluetooth Low Energy v4.1 and IEEE 802.15.4 based standards
- **Low-Power Operation** – Low transmit, receive and standby currents help maximize battery life including standard coin-cells
- **High-precision Analog** – DC-DC Converter with Buck or Boost configuration, high precision DAC and a 16-bit ADC for highly accurate sensor measurement for wireless sensor networks
- **Robust Software Package** – Fully compliant, certified Bluetooth Low Energy, 802.15.4 MAC, Thread and ZigBee[®] protocol stacks

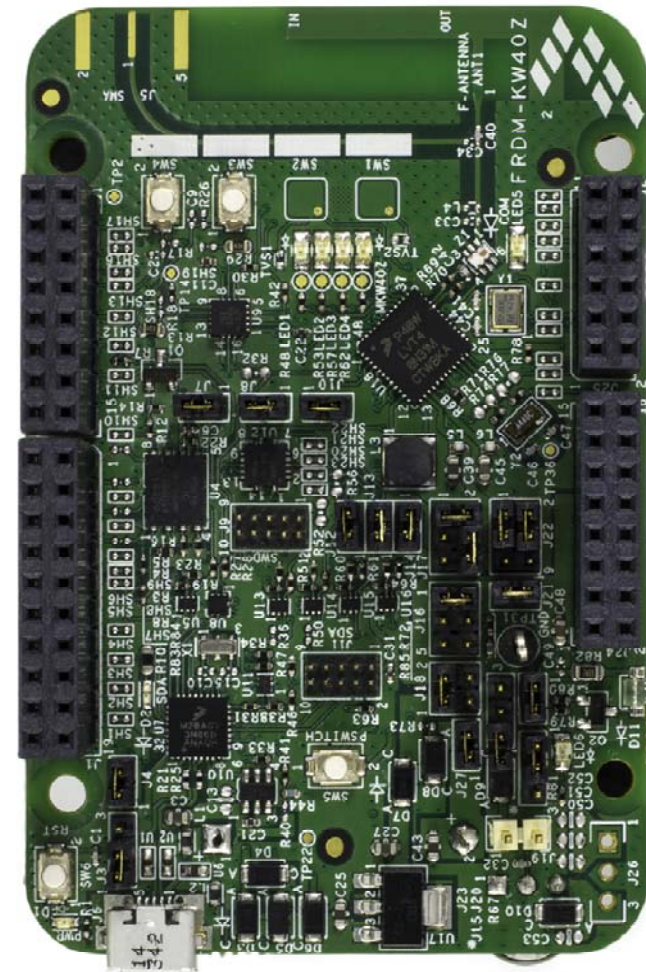
Kinetis KW40z MCU Block Diagram



Kinetis KW40 MCU Freescale Freedom Development Platform

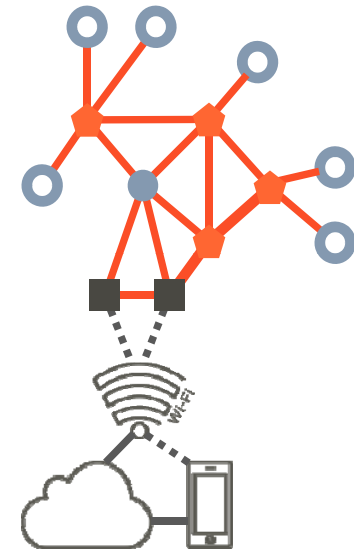
Board Features

- Compliant FCC Part15 & EN300 328
 - PCB inverted F-type antenna
 - SMA RF Connector can be jumped in
 - Minimum number of matching components and external BALUN
 - Full KSDK support
 - Complete documentation available
 - Needs to go through one cycle of tweaking in order to make it a shield
-
- Part-number: **FRDM-KW40Z**



Freescale Thread Stack Facts & Figures

- Routed mesh network based on industry standards: IEEE 802.15.4 and IETF 6LoWPAN
- **IPv6 addressability at every node**, with auto-configuration
- Scales across multiple device categories:
 - **Low-power end nodes:**
 - simple sensors or actuators, multi-year battery life
 - recommended devices: Kinetis KW20Z, Kinetis KW40Z, Kinetis+CR20A, Kinetis KW2xD
 - recommended memory configuration: 160KB-256KB flash, 12-32KB RAM
 - **Mesh routers and border routers:**
 - mains powered, act as parents for end devices, may forward to external IP networks
 - recommended devices: Kinetis KW2xD, Kinetis K64F, Kinetis+CR20A
 - recommended memory configuration: 256KB-1MB flash, 64-128KB RAM
 - **Border routers running high-level OS (Linux):**
 - advanced IP network provisioning and routing
 - advanced UI and applications (e.g.: hubs, gateways)
 - recommended devices: i.MX hosts with Kinetis-Wireless combos
- Advanced security and key exchange: AES128, elliptic curve cryptography (ECC), DTLS, J-PAKE
- Built for simple, secure commissioning of new devices via smartphone apps
- Wi-Fi and Ethernet add-ons for border routers
- Multiple interface **support for 2.4GHz and Sub 1-GHz** IEEE 802.15.4 PHYs
- Able to **concurrently run with BLE and ZigBee** stack on multi-mode and **DualPAN** Kinetis devices.



Kinetis KW2xD MCU Block Diagram

Core Features

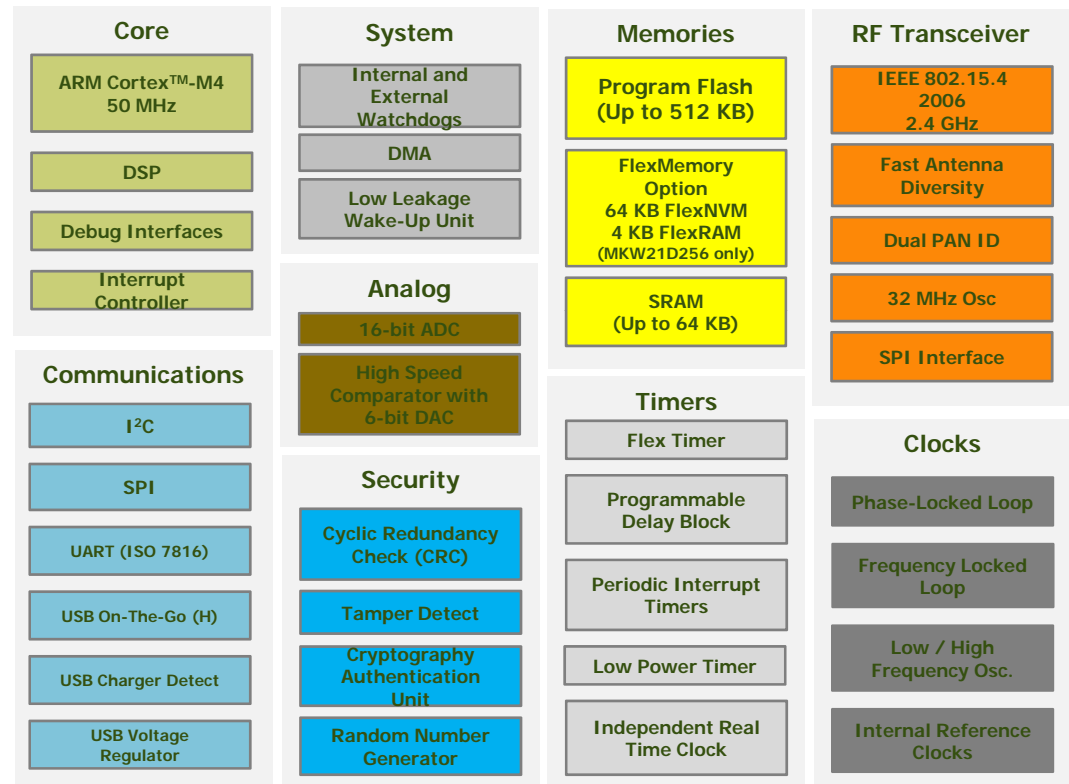
- 50 MHz Cortex M4 CPU core
- Up to 512KB Flash & up to 64KB SRAM
- Typical current: 250 uA/MHz run, 1.7uA RTC standby

RF Features

- 2.4 GHz frequency ISM band, including MBAN
- -102dBm receive sensitivity
- Up to + 8dBm programmable output power
- TX 17mA at 0dBm and RX 19mA typical
- Cryptography: DES, 3DES, AES 128-256, SHA-1, SHA-256, MD5, RNG
- Active and passive tamper detection
- Dual-PAN support (personal area network)
- Fast antenna diversity supporting 2 antennas
- Low component count for Balun & Match

System Features

- -40 °C to 105 °C
- 1.8 to 3.6 V
- 8x8 Laminate QFN 63-pin



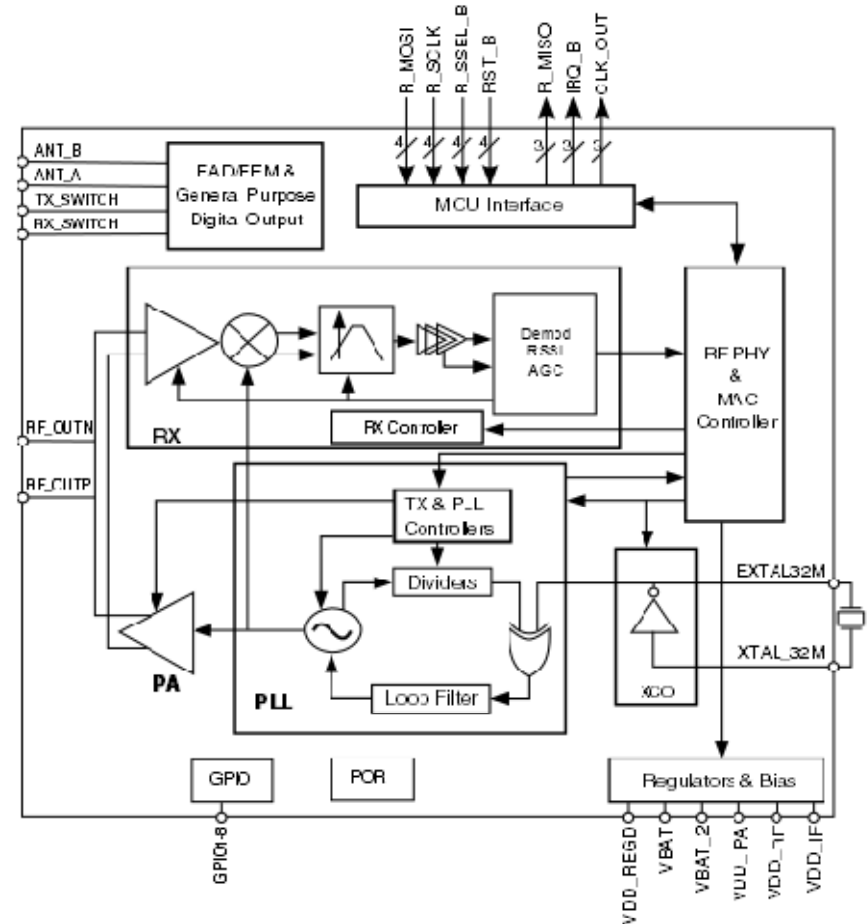
MCR20AVHM 802.15.4 Transceiver Highlights

RF Features

- 2.4 GHz frequency ISM band, including MBAN
- -102dBm receive sensitivity
- Up to + 8dBm programmable output power
- TX 17 mA at 0dBm and RX 19 mA typical
- AES Hardware encryption/decryption
- True Random Number Generator
- Dual-PAN support (personal area network)
- Fast antenna diversity supporting 2 antennas
- Low component count for Balun & Match

System Features

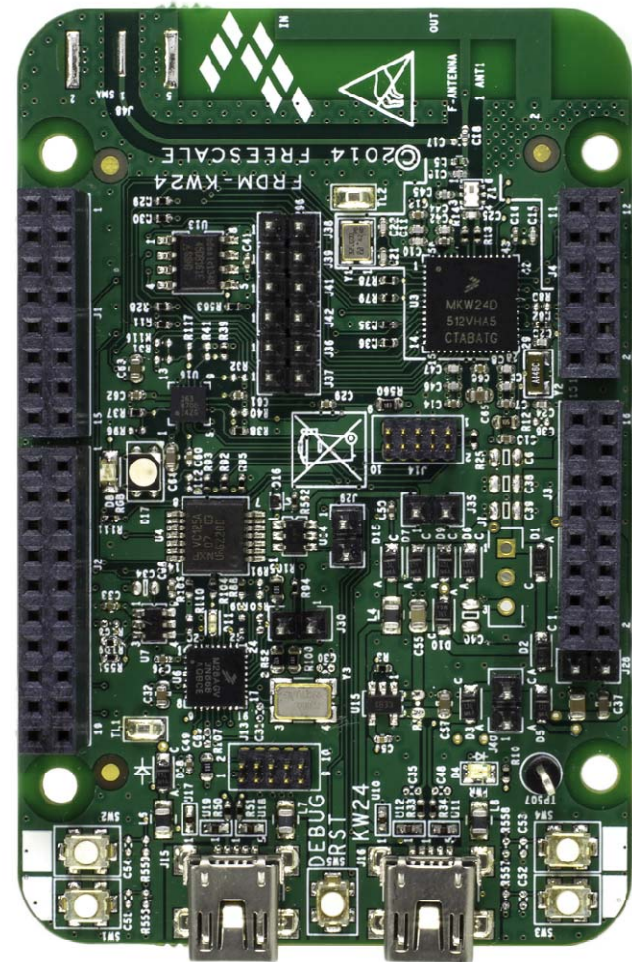
- -40 °C to 105 °C
- 1.8 to 3.6 V
- 5x5 Laminate QFN 32-pin



Kinetis KW2xD MCU Freescale Freedom Development Platform

Board Features

- Compliant FCC Part15 & EN300 328
- PCB inverted F-type antenna
- SMA RF Connector can be jumped in
- Minimum number of matching components and external BALUN
- Full KSDK support
- Complete documentation available
- Is moving to volume production right now



- Part-number: **FRDM-KW24D512**

Freescale Freedom Development Platform

Board Features

- Compliant FCC Part15 & EN300 328
- PCB inverted F-type antenna
- SMA RF Connector can be jumped in
- Minimum number of matching components and external BALUN
- 1 RGB LED indicator
- 2 push button switches
- Arduino compatible
- 2-Layer metal, 0.062 inch thick board
- Full KSDK support
- Complete documentation available



- Orderable using **FRDM-CR20A**
- Can be directly connected to the FRDM-K64F & FRDM-KL46

Support Available for You Now!

- <https://community.freescale.com/community/wireless-connectivity>



- CATEGORIES
- <1GHz
 - 2.4 GHz
 - Bluetooth Low Energy
 - IPv6 / 6LoWPAN
 - Thread
 - Wireless M-Bus
 - ZigBee & RF4CE

- <https://community.freescale.com/community/iot-center>



The Best Solution is the One that Works!

- ✓ Clear trend towards **IP-based** solutions
- ✓ **Software** is a key selection criteria
- ✓ Understanding **system- and SoC-level security** will impact both hardware and software
- ✓ **Partnering** with **external companies** is required for the Internet of Things





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