KINETIS WIRELESS PRODUCTS AND THREAD SOLUTION INTRODUCTION

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REGIONAL MARKETING OF MICR BL, GC

JULY, 2016

SECURE CONNECTIONS FOR A SMARTER WORLD

Accelerating Technology Trends Drive Opportunities

Secure Connections for a **Smarter World**

Everything
Connected

1B+ additional consumers online, **30B+** connected devices

Connectivity

Everything
Smart

40B+ devices with intelligence shipped in **2020**

Processing

Everything
Secure

Potential savings to economy up to **half trillion dollars**

Security

Source: Euromonitor; Gartner; ARM Holdings; UBS; Center for Strategic and International Studies; McAfee, NXP analysis, International Telecommunications Union

Explosive Growth of Smart, Connected Solutions

SMART
HOME

MCU
MPU
ANALOG
SENSORS

RF
NFC
STANDARD
PRODUCTS

SMART
HEALTHCARE

MCU
MPU
ANALOG

SENSORS
NFC
STANDARD
PRODUCTS

SMART
INDUSTRY

MCU
MPU
ANALOG
SENSORS

RF
NFC
STANDARD
PRODUCTS

WEARABLES

MCU
MPU
SENSORS

ANALOG
STANDARD
PRODUCTS

SMART
INFRASTRUCTURE

MPU
Analog
RF

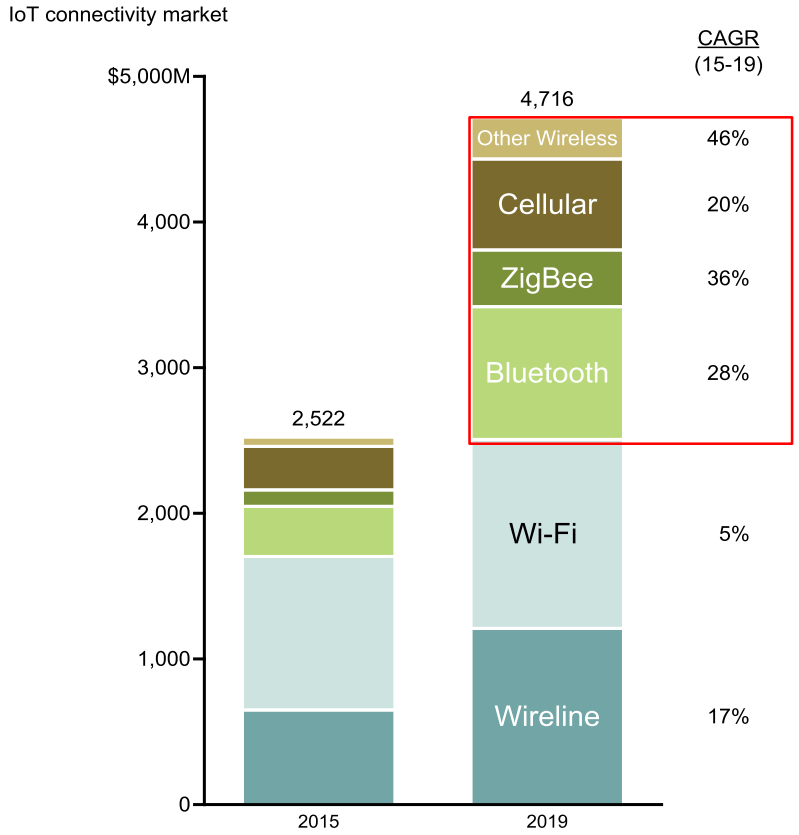
STANDARD
PRODUCTS

Low-power Wireless Connectivity Driving Growth

Connectivity is ~60% of NXP IoT SAM; a range of solutions cover different use cases

Category	Standard	Strengths	Usage
Wi Fi	**.ac**	Highest connection speed. Established standard	Gateway
	.b/.g/.n	High throughput, high power. Established standard	Endpoints
	.ah	Proposed low-power IoT standard	tbd
Bluetooth	**Classic**	High-throughput streaming. Mature standard	Legacy audio streaming
	Low Energy / Smart	Low power emerging standard	Device to smartphone comms
	Mesh	Standard in development	Collection of devices
802.15.4 ZigBee	**ZigBee Pro**	Low-throughput local area network; mesh	Commercial buildings
	Thread	New 802.15.4 standard, mesh, IP-based	Home & business automation
Cellular	**LTE-m**	Low-power LTE	Mobile IoT

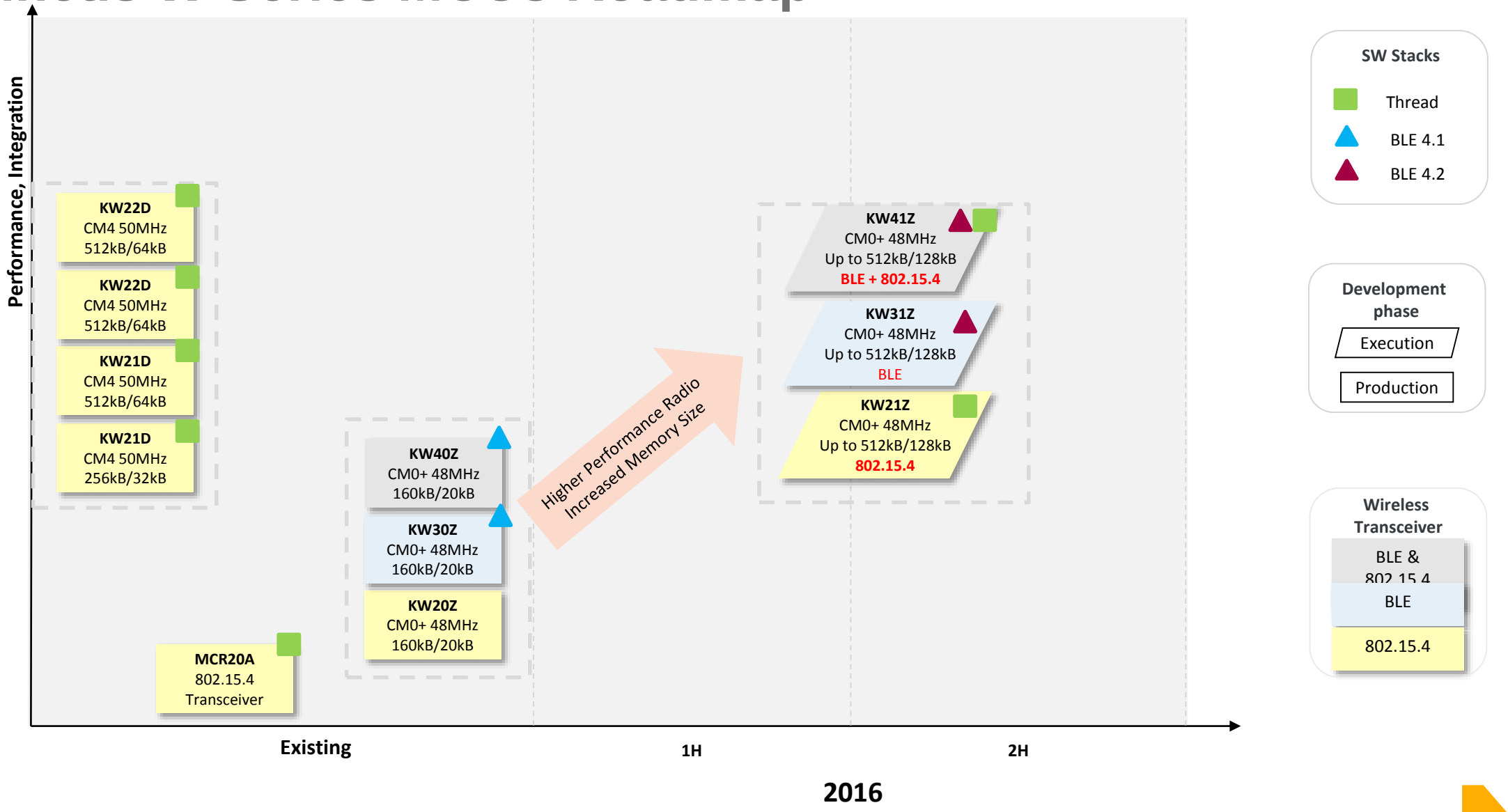
Low-power wireless to drive growth



Notes:

- IoT forecast (incl. connectivity) based on Gartner forecast for Internet of Things Endpoints, 2015
- BLE forecast based on TSR Wireless Connectivity, 1Q16; ZigBee on internal analysis
- Current SAM includes Bluetooth Low Energy, ZigBee

Kinetis W Series MCUs Roadmap



Kinetis KW41Z/31Z/21Z

Core/Memory/System
- Cortex-M0+ running up to 48 MHz
- Up to 512 kB Flash, Up to 128 kB SRAM
- Four independently programmable DMA controller channels

2.4 GHz Radio Transceiver
- Support for BLE v4.2, 802.15.4
- -96 dBm in BLE mode, -100 dBm in 802.15.4 mode
- -30 to +4 dBm programmable output power
- Increased coexistence performance
- 6.5 mA Rx & 6.5 Tx (0dBm) current target (DC-DC enabled)
- <2uA low power current
- Integrated balun (~9% board area savings)

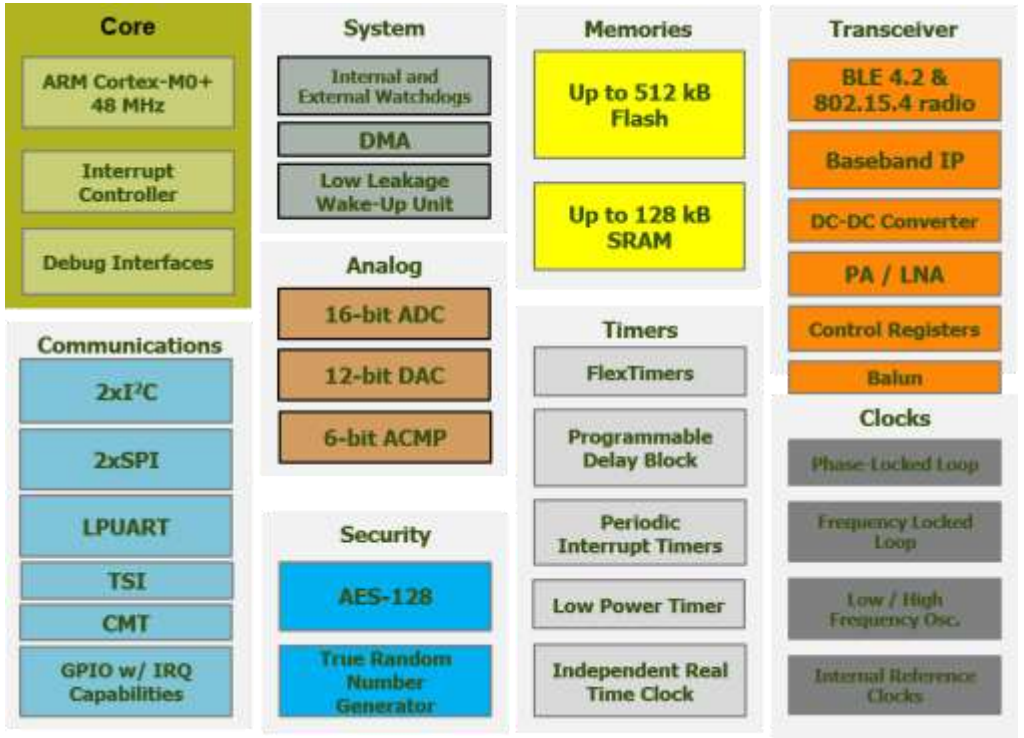
Communications/HMI/Timers
- 2xSPI, LP-UART, 2xI2C, CMT, GPIO with IRQ capability (KBI)
- Hardware Touch Sensing Inputs (TSI)
- 3xFlexTimer (TPM) with PWM & quadrature decode support
- Low Power (LPTMR), Programmable Interrupt (PIT) and RTC timers

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

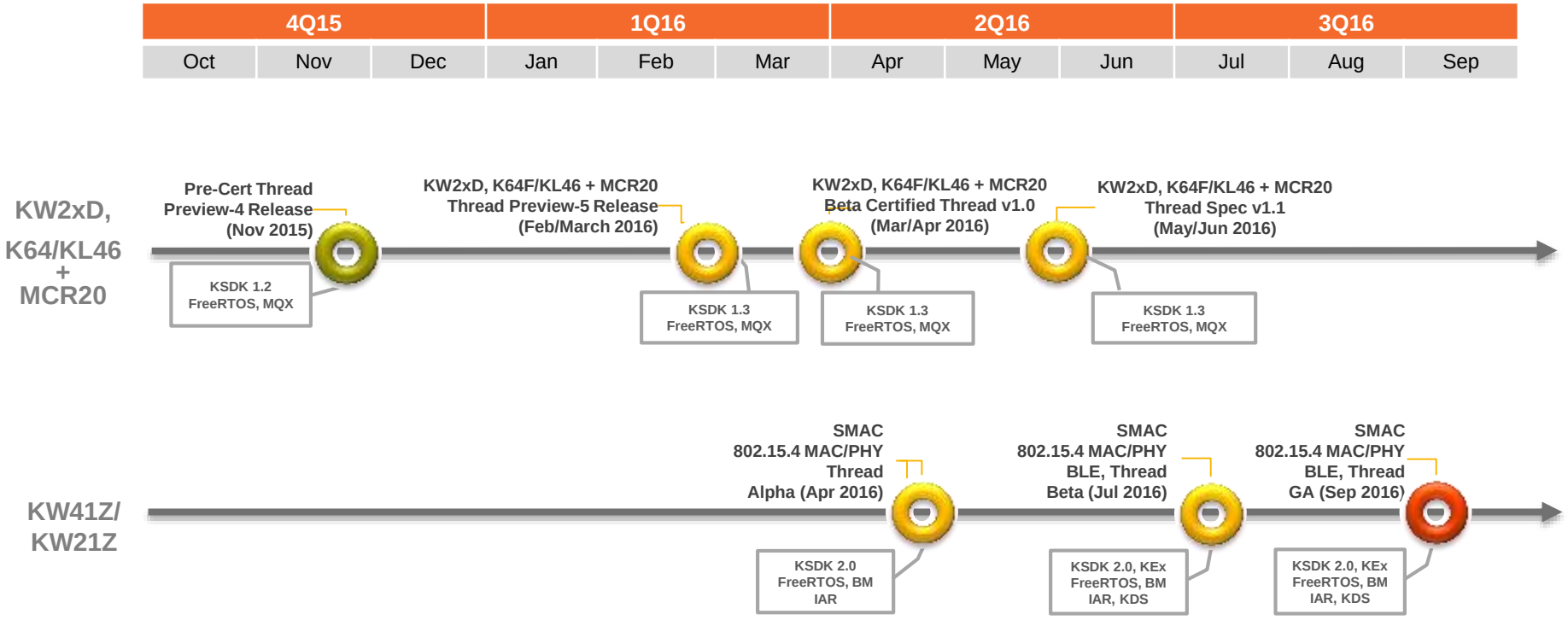
Integrated DC/DC Converter
- Normal: 1.71V to 3.6V
- Buck : 2.1V to 4.2V for coin cell operation
- Boost : 0.9V to 1.795V for single alkaline battery operation

Unique Identifiers
- 80-bit device ID programmed at factory
- 40-bit unique number can be used for Bluetooth Low Energy or IEEE 802.15.4 MAC Address



Device	Memory	Protocol	Package
MKW21Z512VHT4/R **MKW21Z256VHT4/R**	512K Flash, 128K RAM 256K Flash, 64K SRAM	802.15.4	7x7 48-pin Laminate QFN
MKW41Z512VHT4/R **MKW41Z256VHT4/R**	512K Flash, 128K RAM 256K Flash, 64K SRAM	BLE & 802.15.4	7x7 48-pin Laminate QFN WLCSP (PYW)
Features	**Description**		
Software and Protocol Stacks	Bluetooth Smart Host Stack & Profiles SMAC, IEEE 802.15.4 MAC, Thread Stack KSDK, KDS, IAR, RTOS		
Availability (subject to change)	General Availability/Production – Sep/Oct'16		

Thread Software Timeline

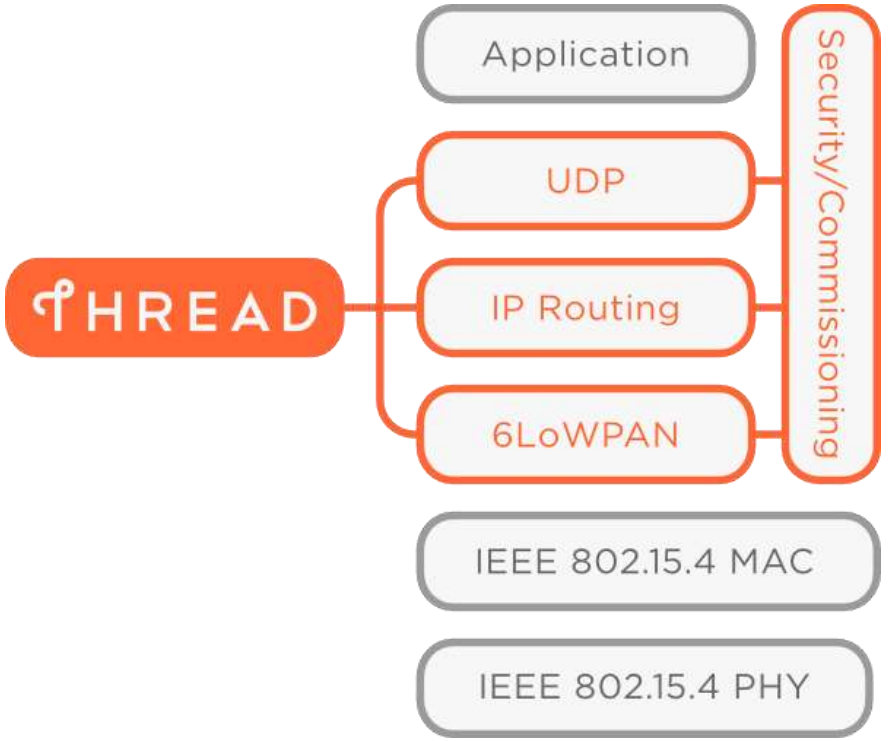


INTRO TO THREAD

What Thread delivers

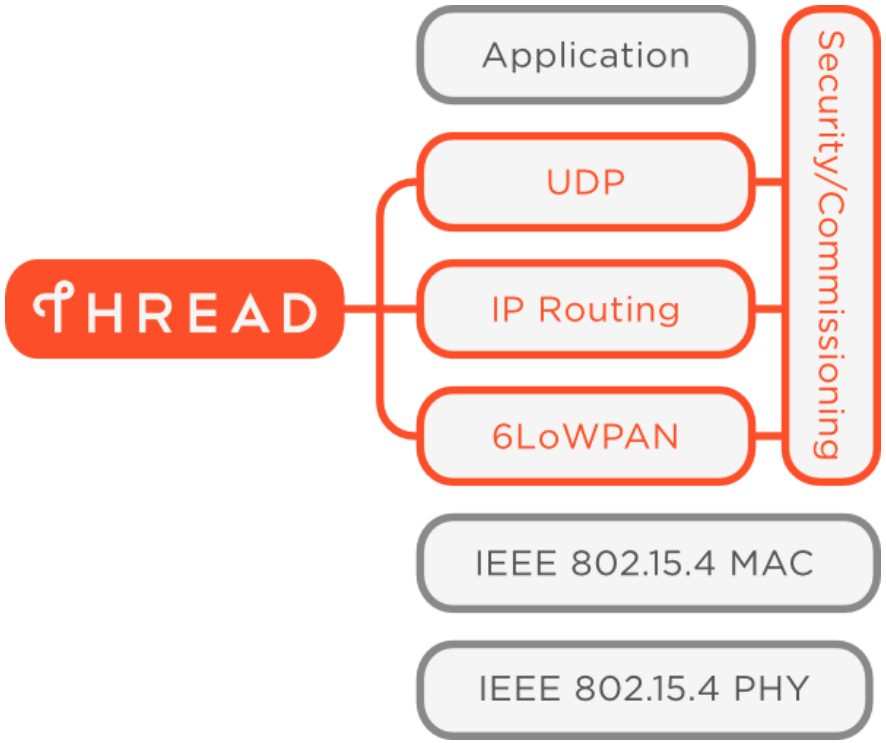
- A secure wireless mesh network for your home and its connected products
  - Built on well-proven, existing technologies
  - Uses 6LoWPAN and carries IPv6 natively
  - Runs on existing 802.15.4 silicon - product development can start today
  - Designed with a new security architecture to make it simple and secure to add and remove products
  - Supports 250+ products per network
  - Designed for very low power operation
  - Legacy-free design
- A version of Thread is shipping in products today

Thread can support many popular application layer protocols and platforms



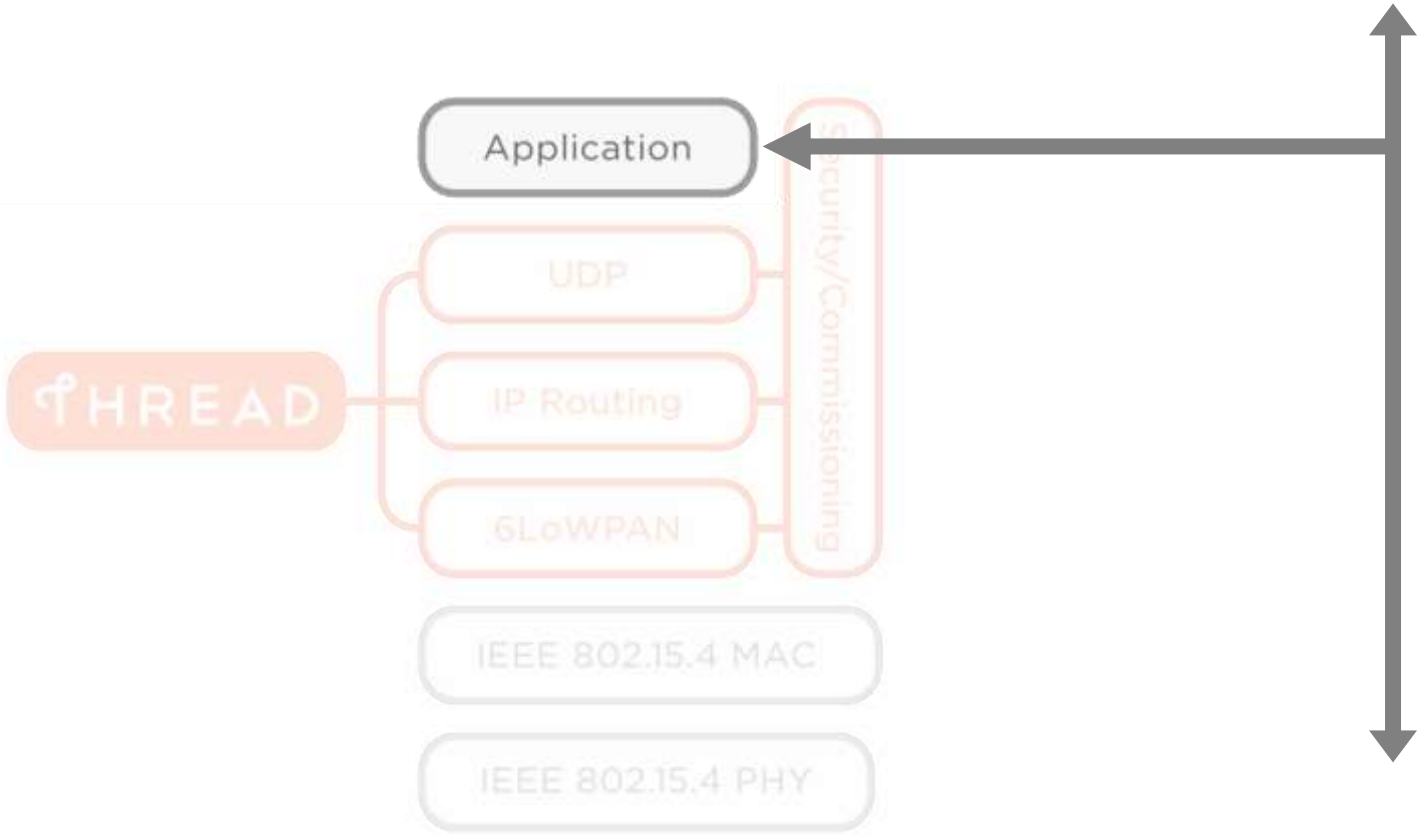
A software upgrade can add Thread to currently shipping 802.15.4 products

What can run over Thread



- Support for many application layers
  - Any low bandwidth application layer that can run over IPv6
- Some existing examples are
  - CoAP and Smart Objects
  - ZigBee Smart Energy 2.0
  - ECHONET Lite
  - Other IP based app layers like OCF

Application layers & partnerships



ZigBee Alliance

IPSO Alliance

AllJoyn

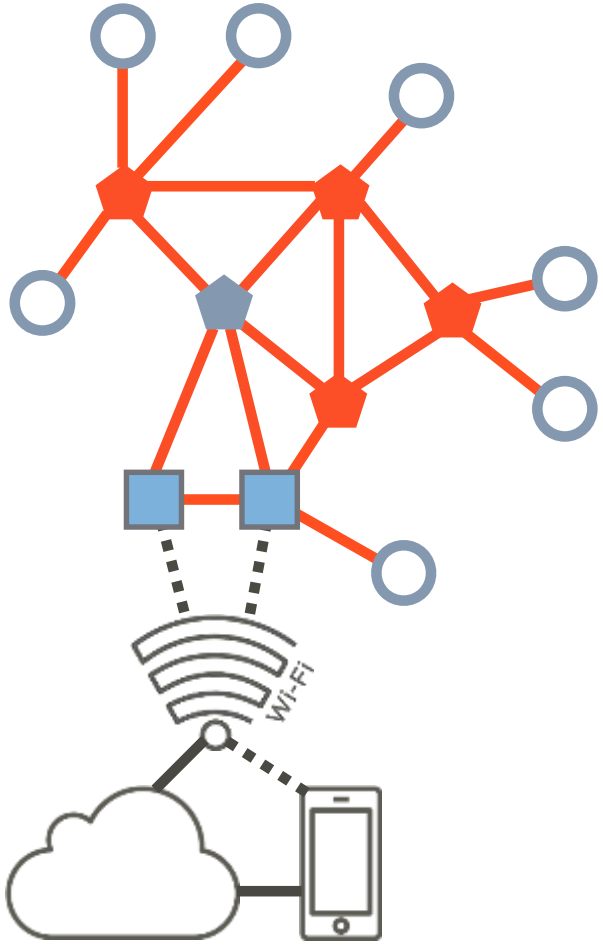
IoTivity

Nest Weave

Other IP-based Application Protocols

Example protocols

Network topology roles



End Device

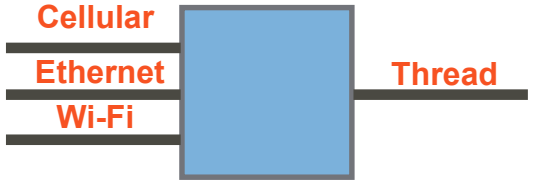
Thread Leader

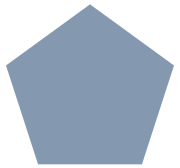
Thread Router

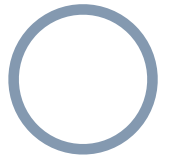
Border Router

Thread Link

Network topology roles







Border Router

Forwards data to and from cloud/other networks

Provides optional Wi-Fi connectivity

Many

+

Thread Leader

Manages network parameters

Coordinates commissioners

Makes network decisions

One

+

Thread Router

Routes traffic among devices

Form the mesh topology

Eligible to become the Leader

Up to 32

+

End Device

Designed for low power operation

May be powered or sleepy

May be router-eligible if powered

Up to 64 per Router

=

Hundreds of Devices per Network

THREAD GROUP

About Thread Group

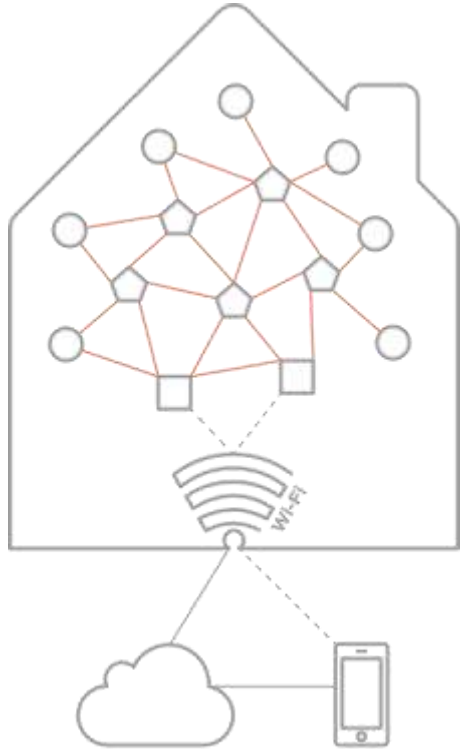
7 Founding Companies, grown to 12 Sponsor Companies, 230+ member companies

NXP founding company

A market education group offering product certification

Promoting Thread's use in connected products for the home

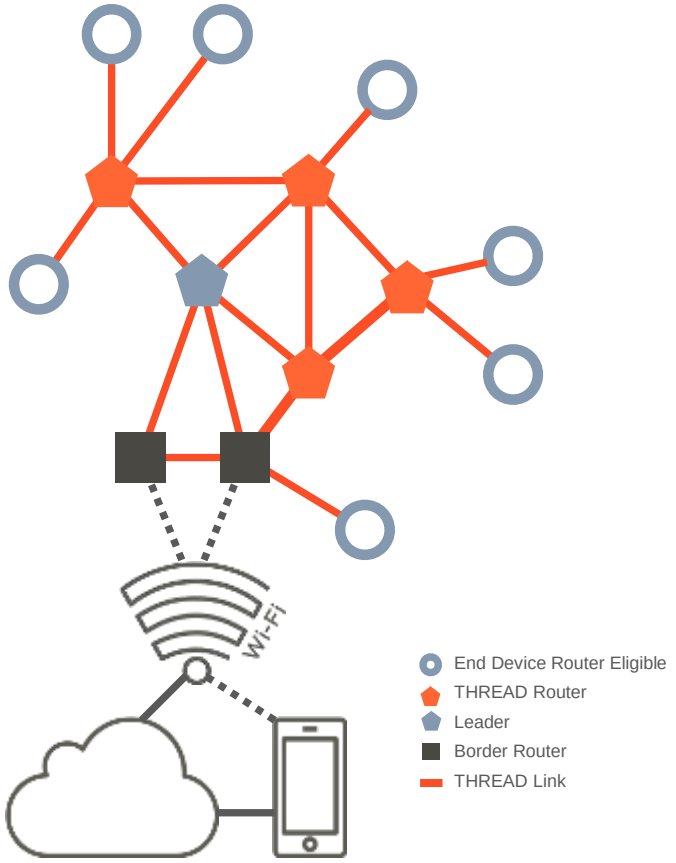
Thread will offer rigorous product certification to ensure security and interoperability



COMMISSIONING & SECURITY

Commissioning and Security

- Simple Commissioning
  - User securely authorizes devices onto the network using smart phone/tablet app or computer
  - GUI rich device already on Thread network can be used to authorize devices
- Security session established between new device and commissioning device to authenticate and provide credentials
- Once commissioning session is complete, device attaches to network
- 802.15.4 MAC security used for all messages
- Application level security may be included based on product requirements
- KWx2D can commission another device symmetrically in <10s

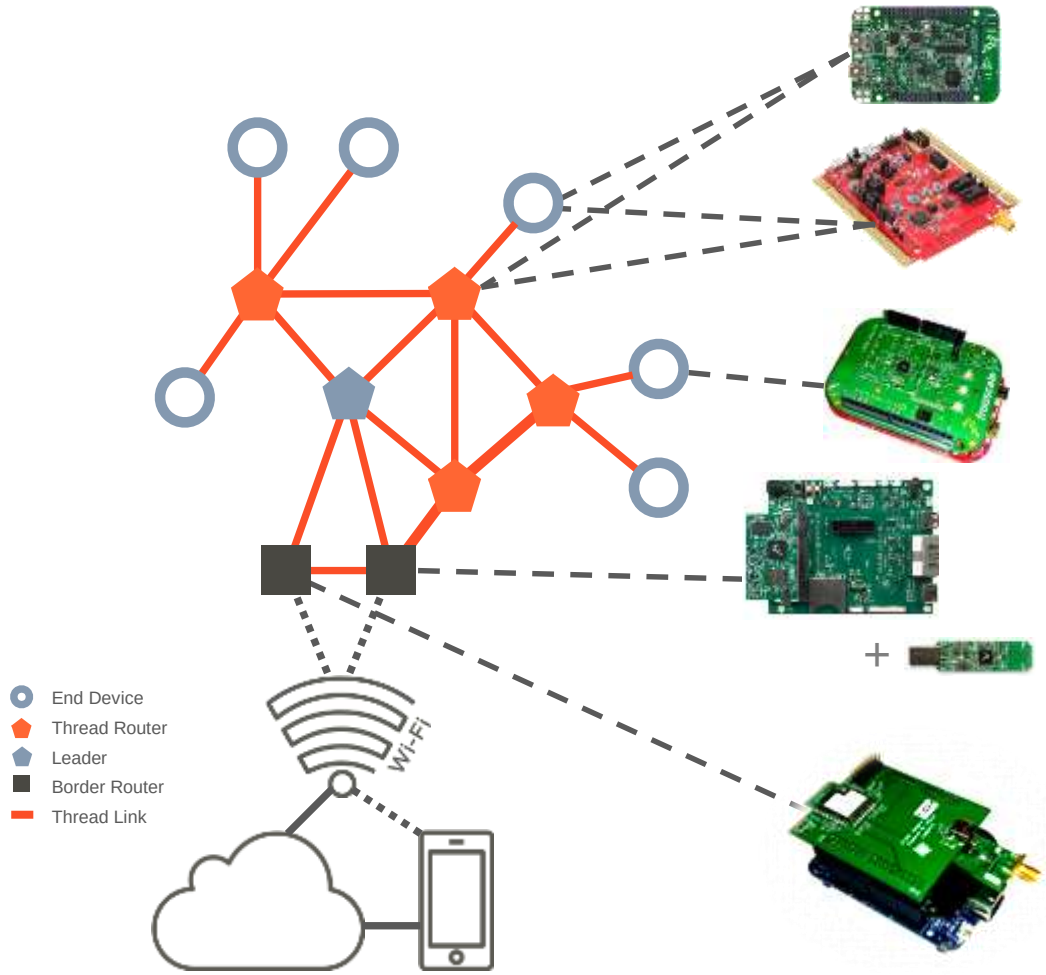


Commissioner Mobile Application

- Simple, consumer friendly method for adding devices onto a Thread network
- App uses QR Code or simple user friendly key to identify joining product
- Mobile device attaches to Thread Network through Border Router to add device to network
- Thread Group developed a sample commissioning app that is available to Thread Sponsor and Contributor members
- Available in iOS and Android

NXP'S THREAD PLATFORM

NXP’s Thread Hardware Offering



NXP Kinetis KW2xD, KW41Z (Upcoming)
Thread Router / REED / End Device
Tower Board and Freedom Board
Kinetis SDK and FreeRTOS

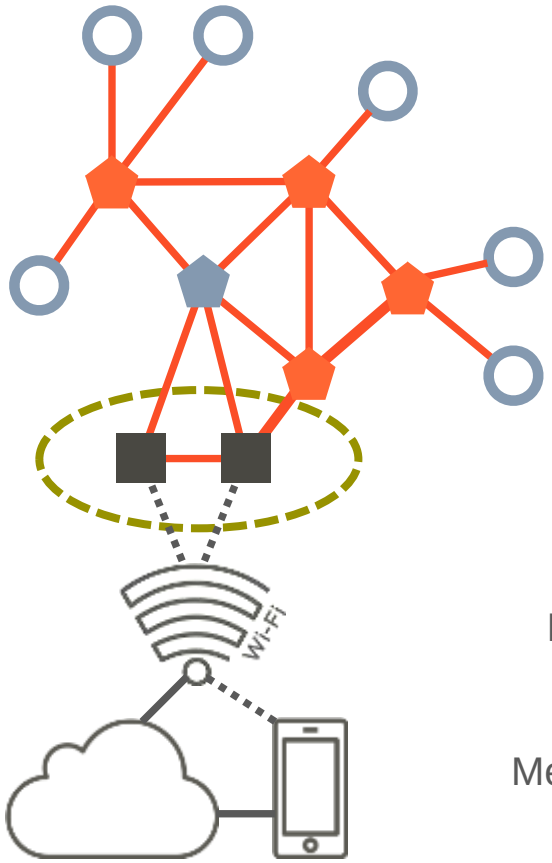
NXP Kinetis KL46 + MCR20A Transceiver
Thread End Device
Freedom Board
Kinetis SDK and FreeRTOS

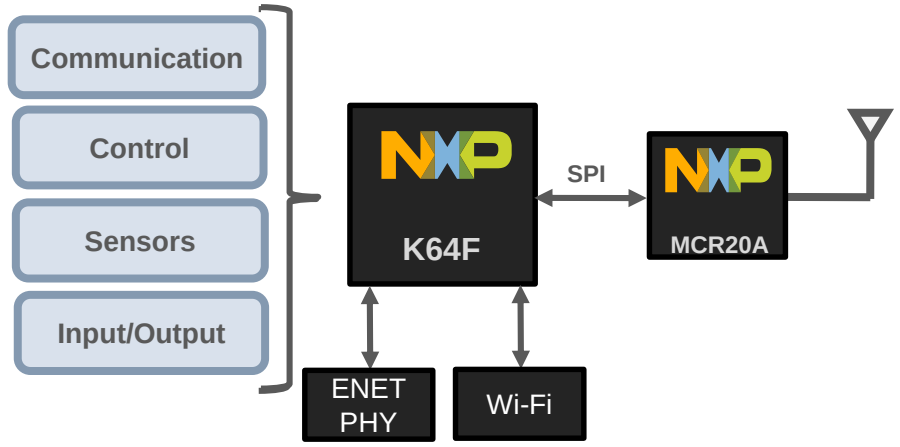
NXP i.MX6 UltraLite EVK
NXP Kinetis KW2xD USB
Thread Border Router / Cloud gateway
Provides IP data routing and infrastructure integration
i.MX6UL EVK & USB Dongle
Runs Linux operating system

NXP Kinetis K64F + MCR20A Transceiver
Border Router with Ethernet & upcoming Wi-Fi support (QCA400x)
Freedom Boards
Kinetis SDK and FreeRTOS

The most **complete** Thread end to end platform available!

Thread MCU (RTOS) Border Router





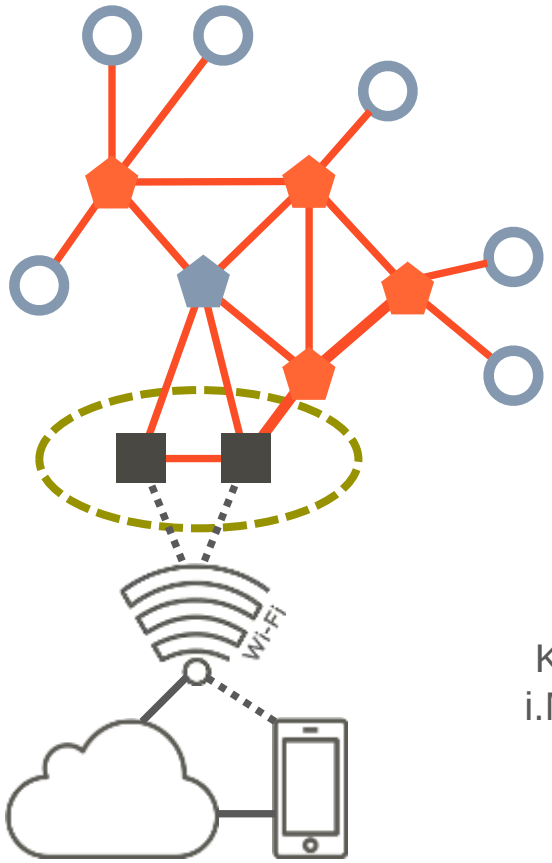
K64 is a standalone MCU with up to 1MB Flash, up to 256kB RAM and embedded Ethernet

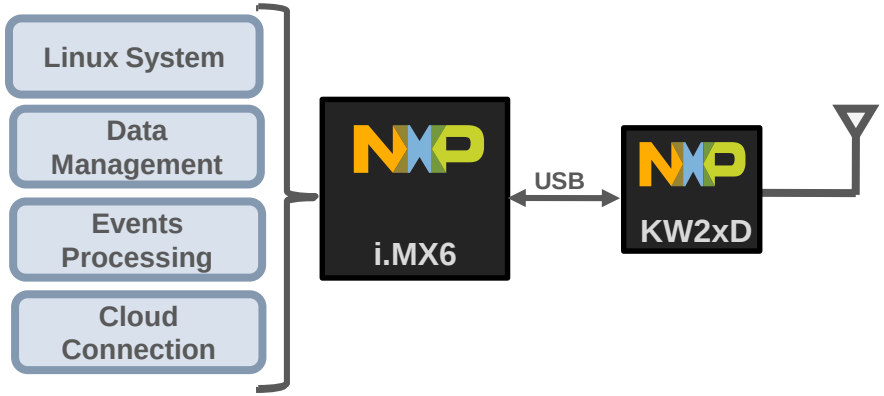
Memory configuration can support Thread stack, Ethernet stack and Application

MCR20A is a 2.4GHz 802.15.4 transceiver

Wi-Fi (Qualcomm Atheros QCA400x) support in late Q2.

Thread MPU (OS) Border Router





KW2xD device runs the Thread Border Router functionality while the i.MX6 Linux system handles Data Management and Analytics, Events Processing and Cloud Connection

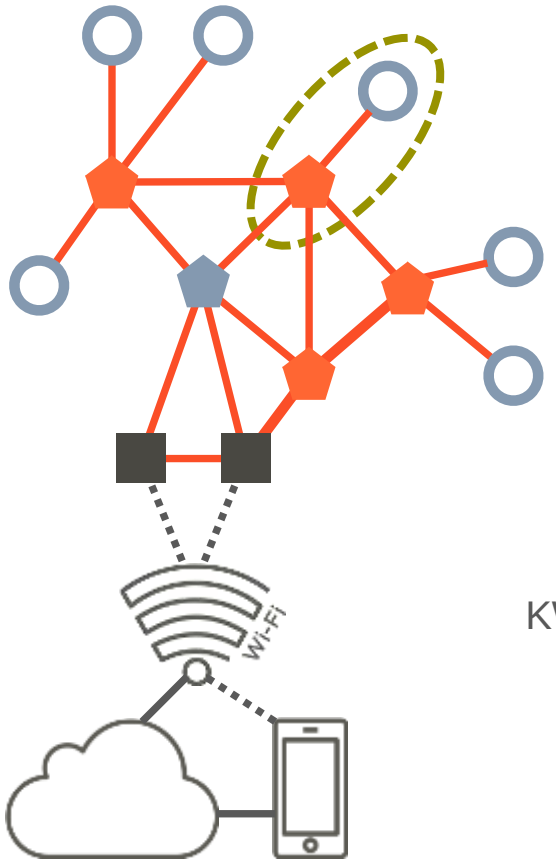
NXP MPU Border Router Development Hardware

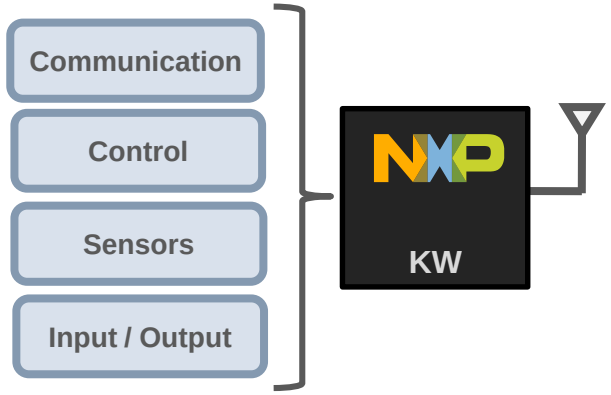
i.MX6UL

FRDM-KW24D512

THREAD MPU Linux Border Router (ETH, Wi-Fi)

Thread Router and End Device

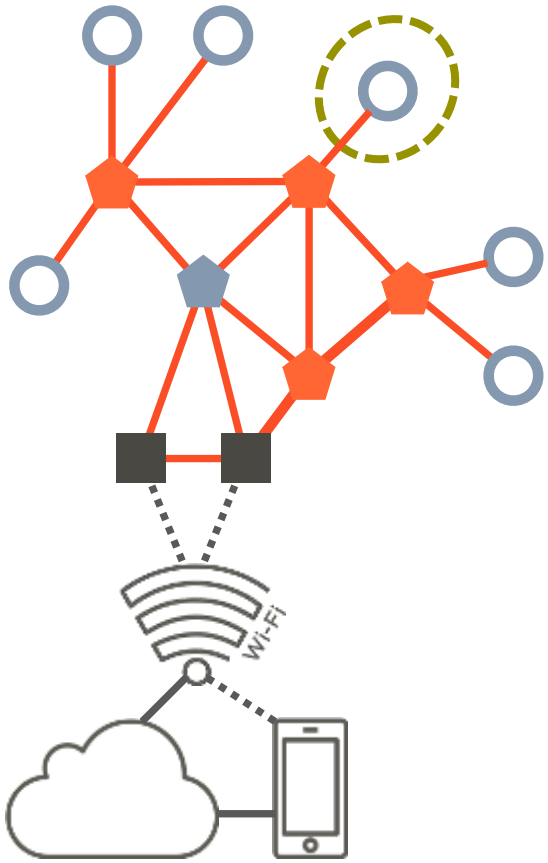


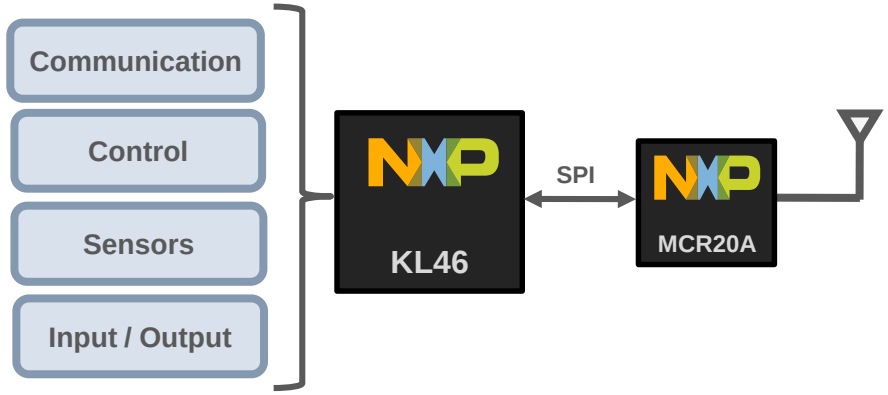


KW devices with 512kB Flash and 64k RAM can run Border Router or Router Eligible Device configurations with an Application

KW devices with 32kB RAM can run Thread End Device configurations with an Application

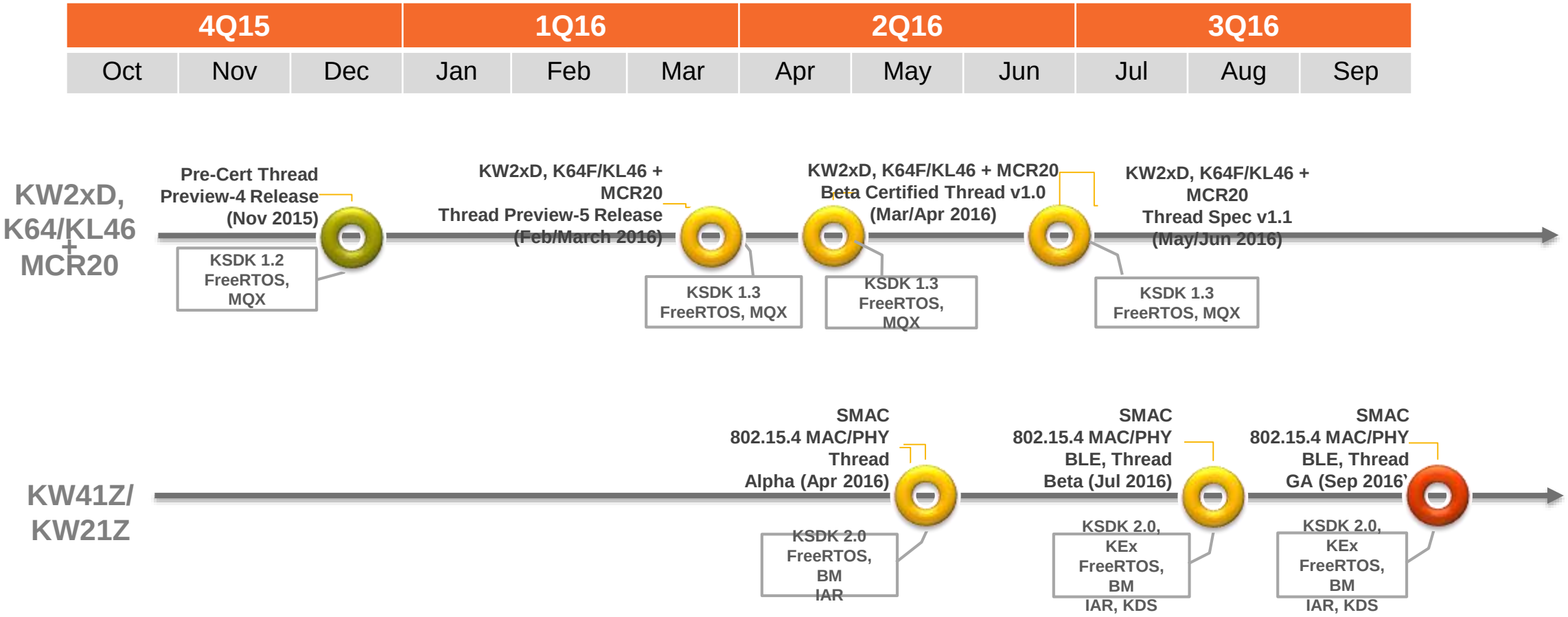
Thread Low Power End Device



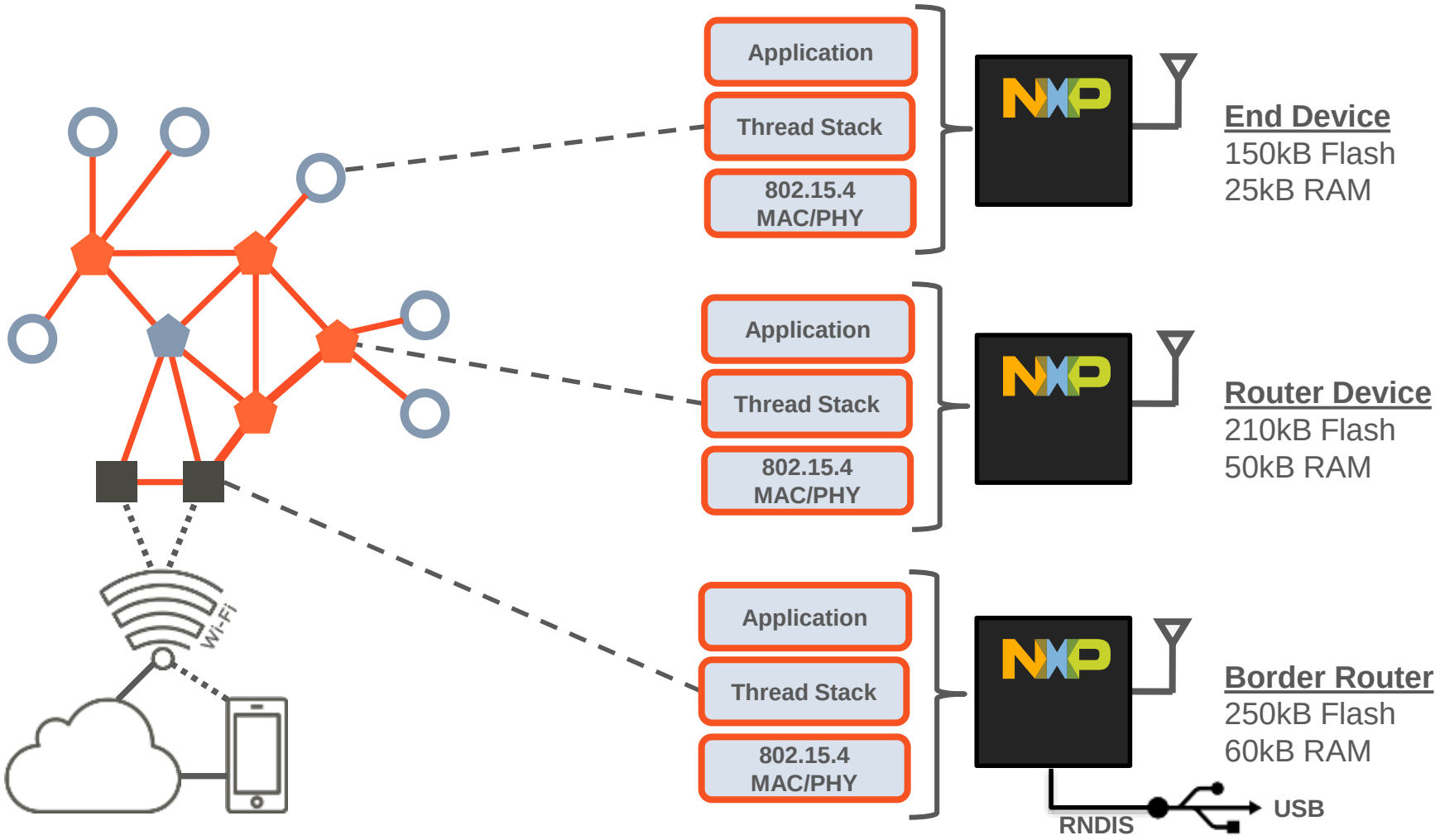


Kinetis L devices with 32kB RAM can run 802.15.4 MAC/PHY, Thread Network and Application as an End Device when paired with the MCR20A 2.4GHz Transceiver

Thread Software Timeline

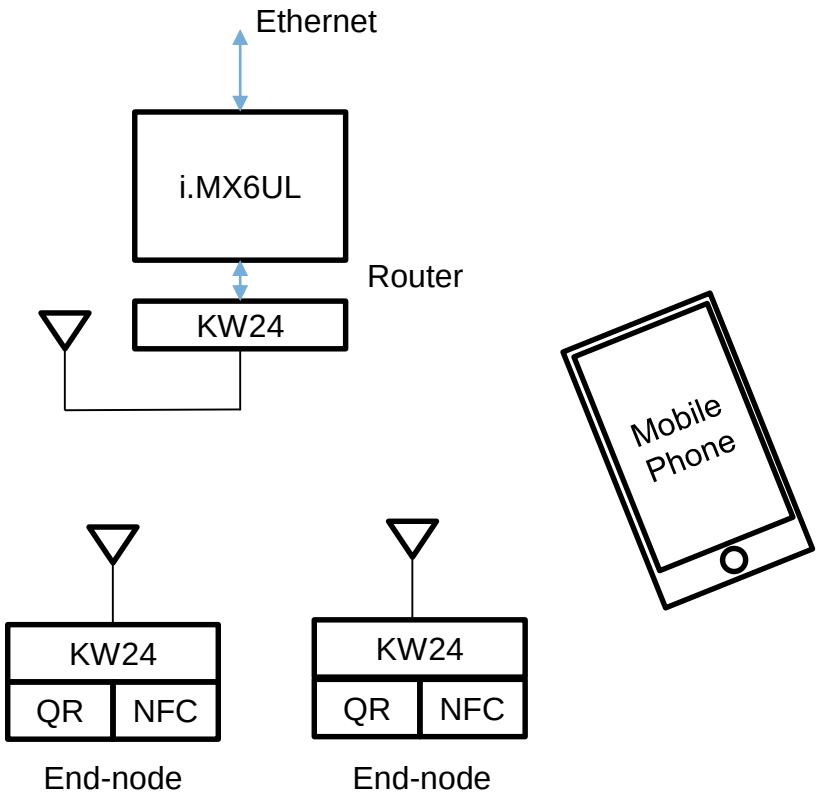


Thread Device Type Code Estimates

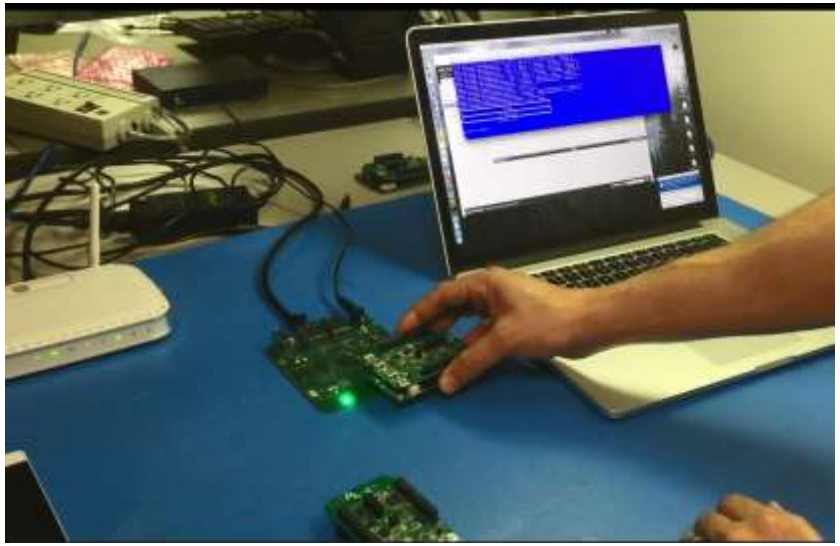


NXP THREAD DEMO

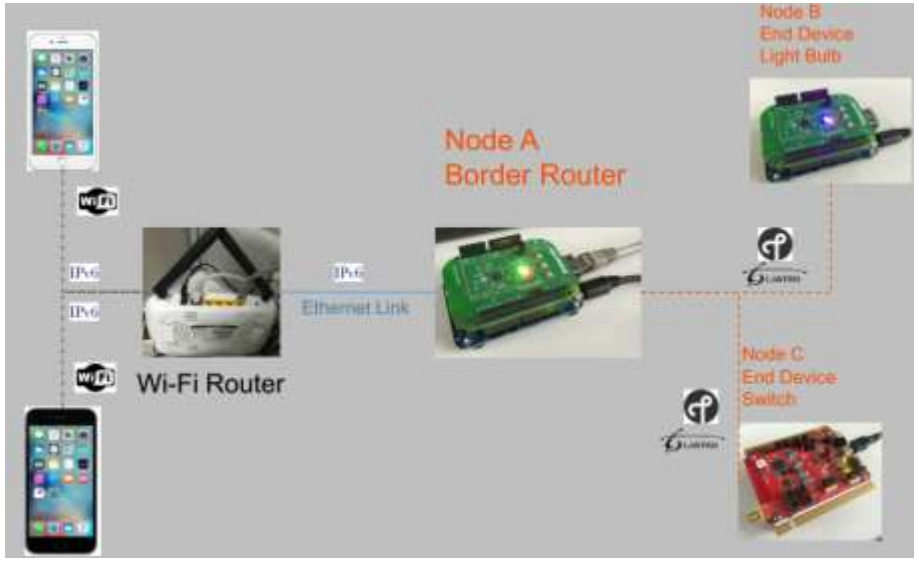
NXP Thread demo #1

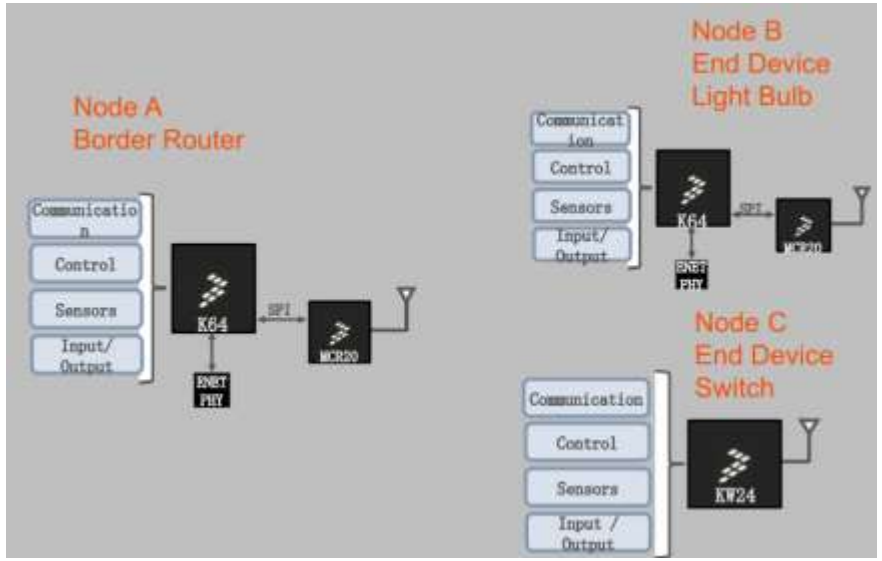


NXP Thread demo #2



NXP Thread demo #3



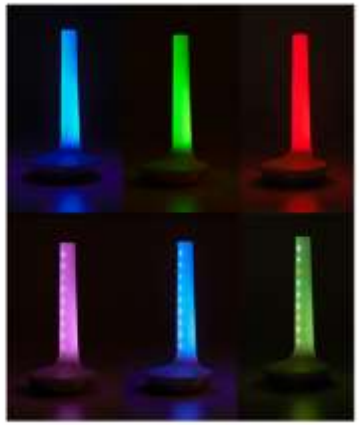


NXP-BASED THREAD PRODUCTS

Smart Air Freshener

- Smart air fresher with mobile app for personalization of scent experience
  - Setup different experiences for each room
- Integrated into “Works with Nest” ecosystem
  - Uses Nest Thermostat to more evenly disperse scent in your room.
- Based on NXP KW2x

Smart Community-based Candlestick

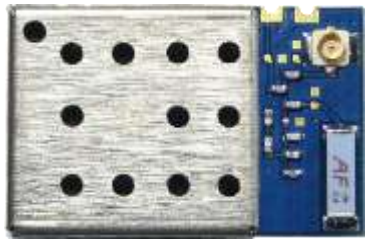


- Home energy and well-being manager. A solution designed for smart grids and smart cities.
- Hemis cloud solution based on AI designed to minimize building energy consumption which maximizing occupants well-being
- Connect smart IoT objects
- Based on NXP KW2x

3G Smart Plug by iSocket

- Smart plug with 3G modem for connectivity with or without an internet connection
- Thread Border Router
- Alert you to problems in your home: power failure, break-in, temperature increasing or falling down, gas leakage, flooding, etc
- Based on NXP KW2x

Thread Components



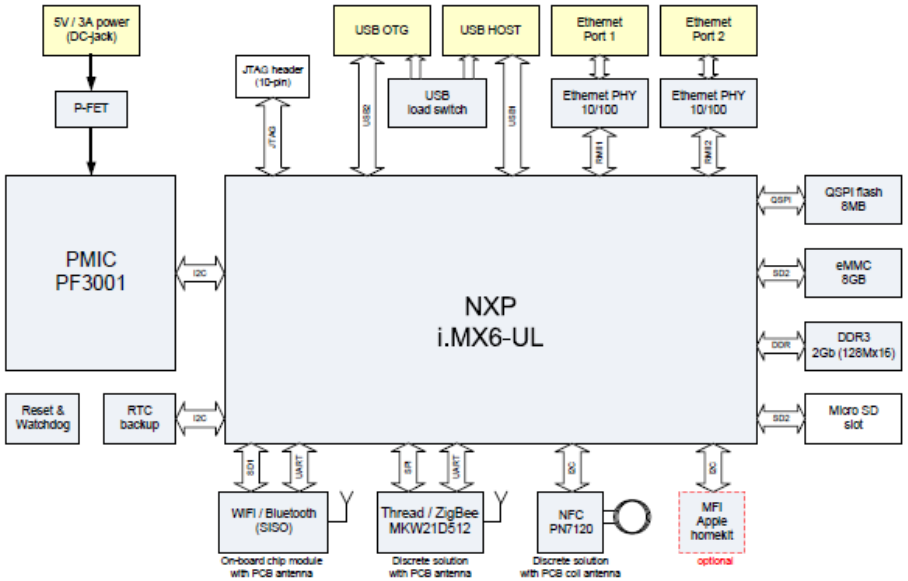
- Thread Modules and Border Router
- Small form factor Thread modules with multiple RF output options to speed time to market of Thread enabled products.
- Cost optimized turnkey Microcontroller based Thread Border Router with Ethernet interface to connect to home or enterprise access points.
- Based on NXP KW2x, K64F, MCR20A.

Thread Module, Border Router and Gateway

- Thread Module, Border Router and Gateway
- Integrates MMB’s RapidConnect connectivity platform, a drop-in software platform that allows device vendors to rapidly add interoperable and multi-platform connectivity to their products.
- MMB offers turnkey solutions and development tools as well as hardware and software design services.
- Based on NXP i.MX6UL, KW2x K64F, MCR20A.

Thread Gateway

NXP gateway i.MX6-UL



- Thread Gateway with integrated Thread radio, NFC, Wi-Fi, BT and Ethernet.
- Thread Border Router
- Based on NXP i.MX6UL, KW2x and NFC.

SECURE CONNECTIONS
FOR A SMARTER WORLD