NXP WIRELESS CONNECTIVITY

2.4GHZ & SUB-GHZ SOLUTIONS

NXP TECHNOLOGY DAYS AND SWT IOT TRUCK TOUR

JAKOB RIIS - FAE
CONNECTIVITY & INTERFACE
NOVEMBER 2016

NXP value proposition for IoT applications

LOW POWER

- Ultra-efficient dynamic power
- Ultra-low static power consumption with full retention
- Low-power peripherals
- Tools for low power design, e.g. the power estimation, power profiler, and consumption calculator

SECURE

- Multiple levels of scalable security for ultimate flexibility and protection
- Ensuring communications, software and physical system are protected from threats

CONNECTIVITY

- State-of-the-art RF performance
- Choice of connectivity to fit application
- Interoperable connectivity
- Integrated RF transceiver supporting: Bluetooth® Smart 4.2, IEEE802.15.4, Thread, ZigBee

EASY TO USE

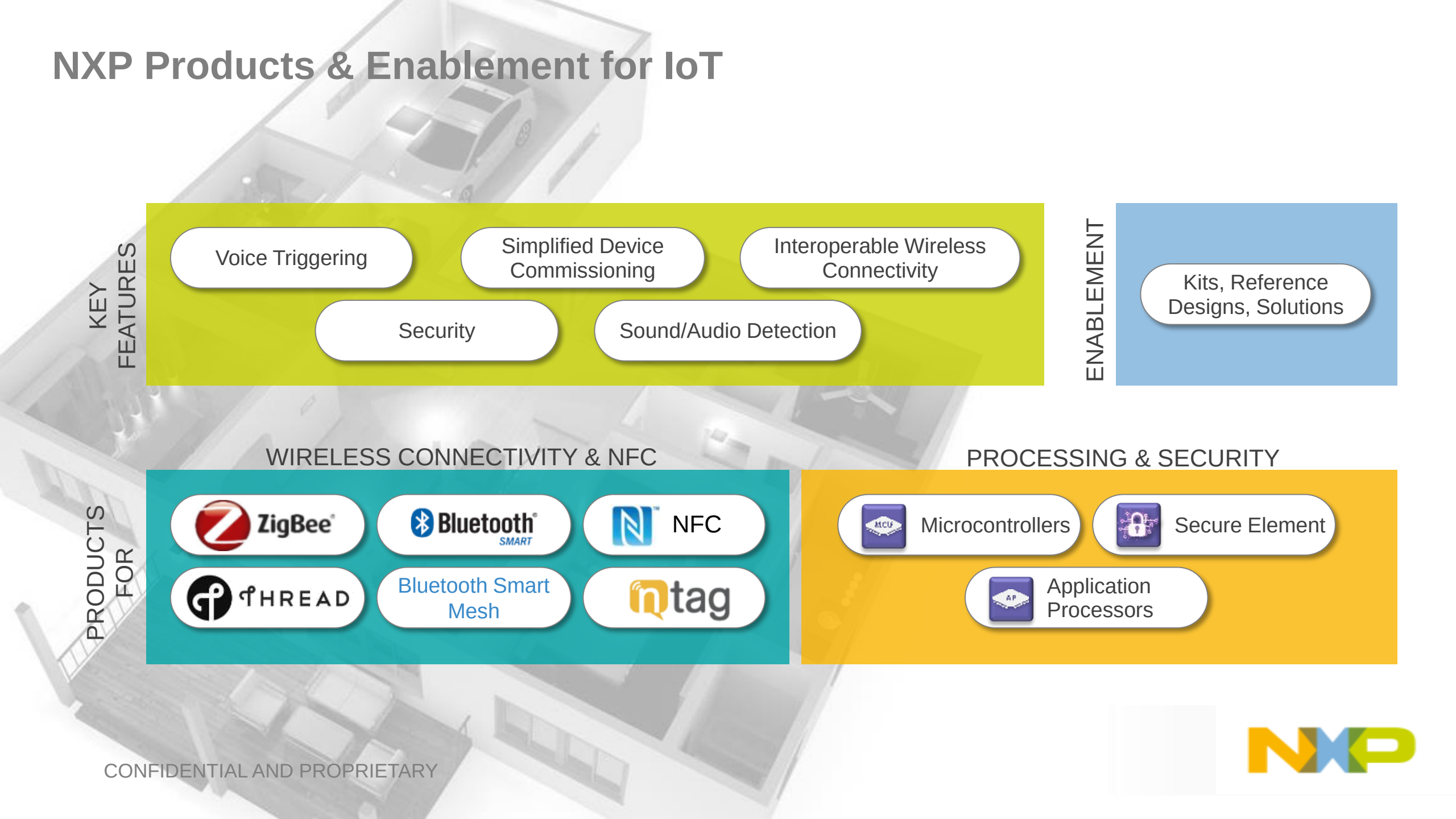
- 'Tap-N-Pair' NFC Commissioning for best-in-class consumer experience
- Bring voice detection & triggering features to wide range of products

QUICK TO MARKET

APPLICATION-IN-A-BOX

- Complete kits simplify design and lower risk – get to final product design quickly
- Full ecosystem including application software and cloud connectivity

NXP Products & Enablement for IoT



KEY FEATURES

- Voice Triggering
- Simplified Device Commissioning
- Interoperable Wireless Connectivity
- Security
- Sound/Audio Detection

ENABLEMENT

- Kits, Reference Designs, Solutions

PRODUCTS FOR

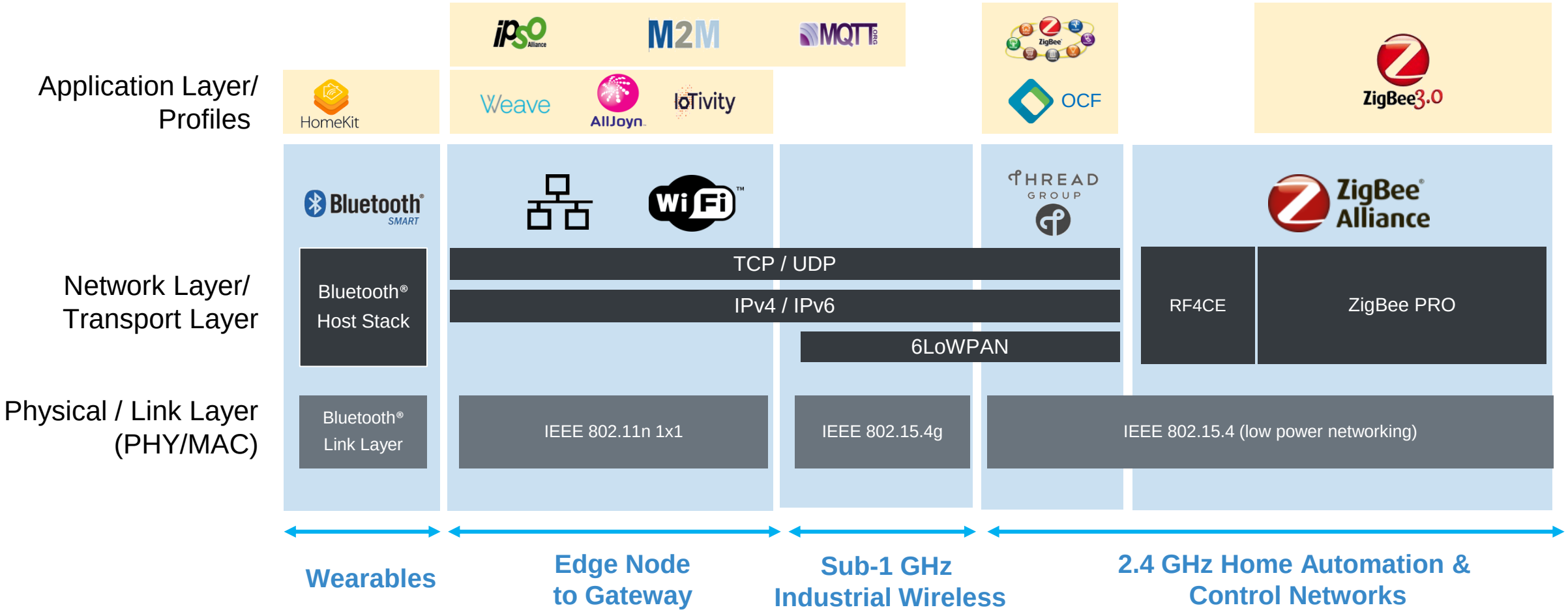
WIRELESS CONNECTIVITY & NFC

- ZigBee
- Bluetooth SMART
- NFC
- THREAD
- Bluetooth Smart Mesh
- ntag

PROCESSING & SECURITY

- Microcontrollers
- Secure Element
- Application Processors

Major Ecosystem Application Profiles Sit on Top



Networking Connectivity Technologies On The Market

	Wi-Fi 802.11 b/g/n	802.11ah (HaLow)	BT-LE	BT-LE Mesh v1	ZigBee Pro	Z-Wave Plus	Thread
Availability / Freq. Domain	LAN / 2.4GHz	✓ / Sub-GHz	PAN / 2.4GHz	✓ / 2.4GHz	WAN / 2.4GHz	✓ / Sub-GHz	✓ / 2.4GHz
Range / Topology	Long / Star	Long / Star	Short / Star	Short / Mesh	Short / Mesh	Short / Mesh	Short / Mesh
Topology	Star	✓	Star	Mesh	Mesh	Mesh	Mesh
No single point of failure	✗	✗		TBD	✗	✓	✓
Support for IPv6	✓	✓	Only 4.1+	✗	✗	✗	✓
Open Standards	✓	✓	✓	✓	✓	✗	✓
Multiple silicon vendors	✓	✓	✓	✓	✓	✗	✓
Application Layer	Multiple 3rd party options	Multiple 3rd party options	Multiple 3rd party options	Multiple 3rd party options	Native – ZCAL	Native	Multiple 3rd party options, Devices with different applications can still use each other for mesh communication
Use Cases / Benefits	Ubiquitous high-bandwidth wireless	Low power, long range, sub-gig	For devices tethered to your phone	Flood mesh, no support for IPv6, 10-byte payload	Purpose built end-to-end connectivity solution, Mission critical devices on own network		IP – based • Device-to-Device & Device to Cloud • Large base of IP-Developers Mission critical devices on own network, stable & secure for years

2.4 GHz

Sub-1GHz

Low Power, Robustness, Range

NXP

NXP Software Solutions Summary

Software Solution	Supported Platforms	Status	Solution
Thread Stack*	KW2xD, KW41Z/21Z	Beta	Pre-Certified
ZigBee Pro Stack	JN Portfolio	✓	✓ Certified
ZigBee 3.0*	JN Portfolio	Beta	On going
ZigBee Light Link	JN Portfolio	✓	✓ Certified
ZigBee Home Automation, Green Power, Smart Energy	JN and OL* Portfolios	✓	✓ Golden Unit
ZigBee RF4CE Stack and ZRCv2.0 profile	JN Portfolio	✓	✓ Golden Unit
IEEE 802.15.4 MAC with Simple Stack	JN and KW Portfolios	✓	✓ Certified
Simple MAC, SMAC (PHY level driver)	KW Portfolio	✓	N/A
BLE 4.0 Stack	QN9020	✓	✓ Certified
BLE 4.1 Stack	KW40Z/30Z	✓	✓ Certified
BLE 4.2 Stack	KW41Z/31Z	✓	✓ Certified
BLE 4.2 Stack	QN908x	Alpha	Certified (Dec'16)
Wireless Meter-Bus	OL and KW Portfolios	✓	EN13757-4:2013
SigFox	OL Portfolio	✓	✓ Certified

Bluetooth Mesh

- ✓ BLE Mesh stack available now on KW41Z/KW31Z.
- ✓ Fully compliant with the BT-SIG Mesh on KW41Z/31Z when specification gets ratified.

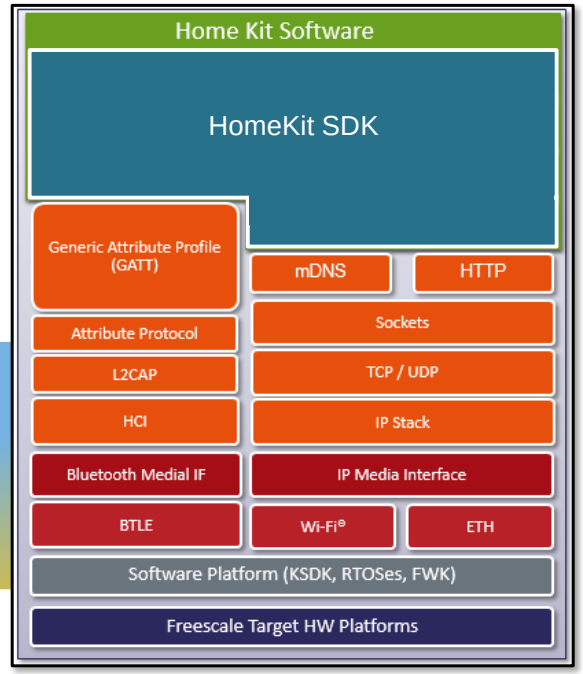
KW QN

Kinetis / i.MX HomeKit Software

HomeKit interface software including protocol stacks

Targeted Applications

- Home automation (lightning, thermostats, security, smoke detectors….)
- HomeKit end-points
- HomeKit Bridges



Key Features

- HomeKit interface software
- Support for Bluetooth® Smart (BLE):
  - Kinetis MCUs K22, K24, K26, K64, K66 with KSDK and FreeRTOS
  - BLE SoC Kinetis KW30/40 BLE SoC
- Support for IP transport (Wi-Fi® and wired Ethernet):
  - Production ready reference design with Kinetis K22F MCU and QCA4002 Wi-Fi® module
- Paid-for-download with unlimited production license
- Premium Support and Professional Services available

Target Availability

- HomeKit BLE for Kinetis MCUs: Now
- HomeKit Wi-Fi for Kinetis: Soon
- HomeKit BLE and Wi-Fi for i.MX: Soon

Products supported

			OS
Kinetis K ARM® Cortex®-M MCUs	**Wi-Fi®**	Qualcomm **QCA4002**	No OS, Free-RTOS
	BLE	Kinetis **KW3x/4x**	
i.MX 6 Series ARM® Cortex®-A9/A7 Applications processors	**Wi-Fi®**	All BSP supported	Linux
	BLE	Kinetis **KW3x/4x**	

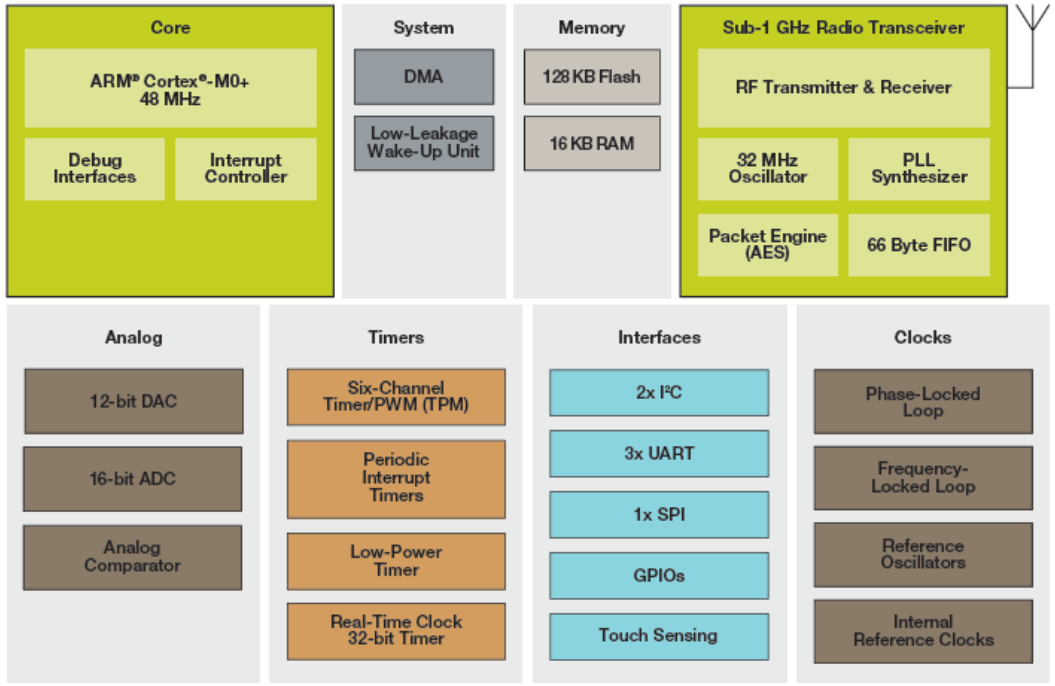
Sub-GHz MCUs

Product Features

KW01

KW01 Block Diagram |

Cortex® -M0+ w/ 128KB Flash
Integrated Sub1-GHz Radio



CPU

- 32-bit ARM® Cortex™-M0+ 48MHz Core
- 128KB Flash and 16KB SRAM

Radio Transceiver, Sub 1-GHz

- Supports 290-340MHz, 424-510MHz, and 862-1020MHz frequency bands
- FSK, GFSK, MSK, GMSK and OOK modulations up to 600kbps
- Up to -120dBm RX sensitivity @ 1.2kbps
- -18 to +17dBm TX output power in steps of 1dBm

Low Power for Battery Operated Devices

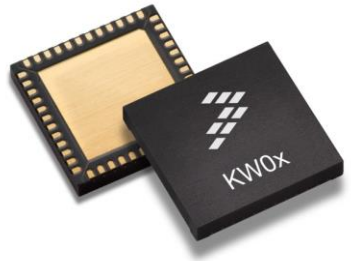
- Typical consumption
  - LISTEN mode
  - 0.1 µA sleep
  - 16 mA RX peak
  - 20 mA TX peak at 0 dBm, 33 mA at +10 dBm

System

- 16-bit ADC, Capacitive Touch Sensing, I2C, UART, SPI, Timers
- Operating Range: 1.8V to 3.6V, -40C to +85C

Orderable Part

Part Number	Description
MKW01Z128CHN	• 290–1020 MHz smart radio • 128 KB flash/16 KB RAM • 60 MAPLGA 8 mm x 8 mm • Bulk tray



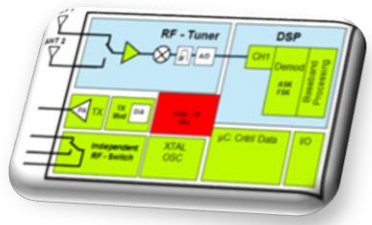
OL23XX

Complete Industrial OL23xx Sub-GHz Device Family

	OL2385	OL2361
FLASH (µC)	32kB	16kB
RAM (µC) / EEPROM	7.25 / -- kB	2 / 2
PA max	14dBm	14dBm
Transmit Current @14dBm	29mA	29mA
Rx Current	11mA	--
RF Switch (SP2T)	•	--
Receiver Inputs	2	--
Receive Streams	1	--
High sensitivity @ 10kHz BW	-125dBm FSK -124dBm ASK	--
Supply Voltage	1.9 to 5.5 V	1.8 to 3.6 V
Temperature Range	-40 to +85 °C	40 to +85 °C
Package	HVQFN 48	HVQFN 24

TRX / 1-ch RX

OL2385

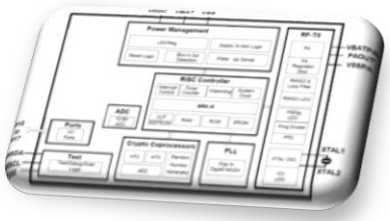


Supports multiple industry standards:

SigFox, WMBus2013
IEEE802.15.4g
ZigBee Smart Metering
UK

TX Only

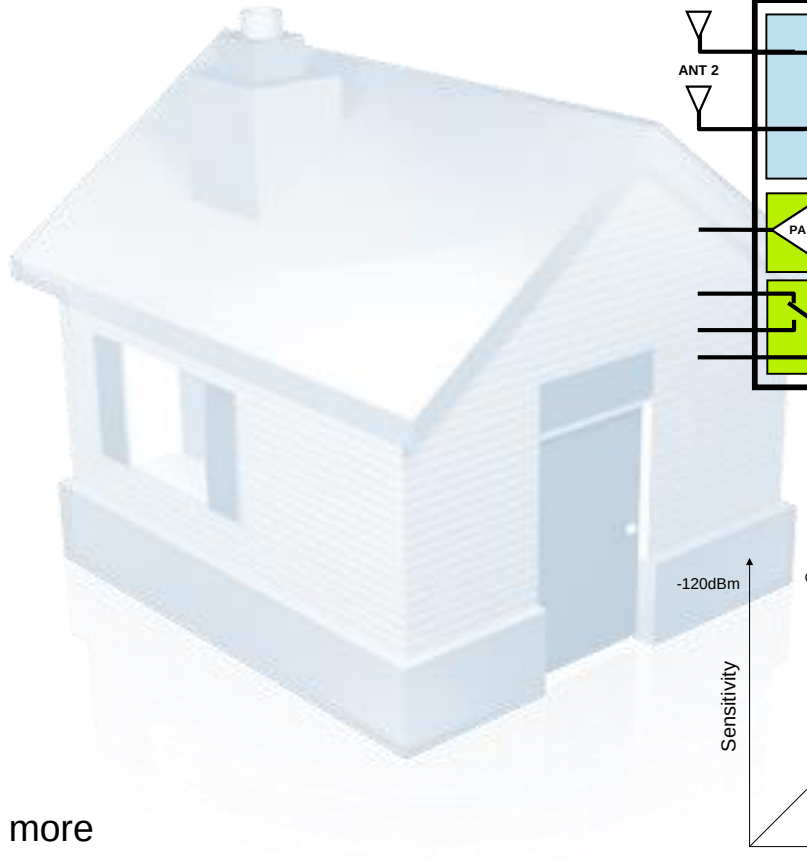
OL2361

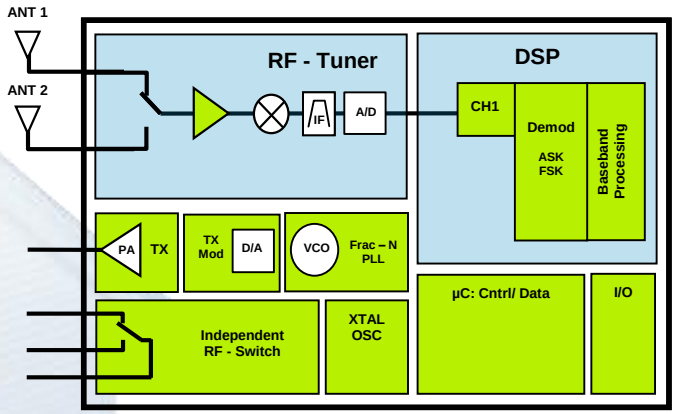


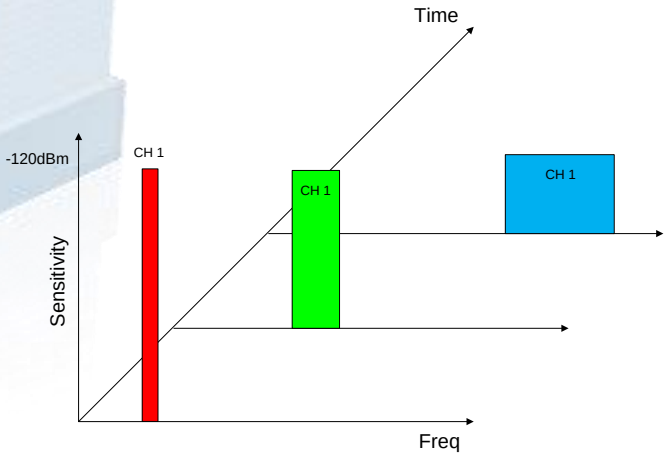
Low-Cost class 2 Tx device for SigFox applications

ASK, FSK and 4FSK Multi Band RF Transceiver – OL2385

- One channel single sub GHz IC for all markets (160 - 960 MHz)
- -124 dBm FSK sensitivity @ 10 kHz BW
- 2 antenna inputs
- Ultra low power in receive mode
  - 11 mA
- Independent RF switch (TX/RX or RX/RX)
- Supply Voltage: 1.9 V – 5.5 V
- Up to +14 dBm output power
- 26 Channel Filter BW Options (4-360 kHz)
  - Japanese (12.5 kHz) ARIB compliant
- Smart polling
- 16-bit RISC integrated µC
  - 32 kB FLASH for program code, 7.25 kB RAM
- HVQFN48 package
- Temperature Range: -40 °C to + 85 °C
- Excellent Phase Noise
- Supported Standards:
  WMBus2013, 802.15.4g, T108, Sub-GHz ZigBee, SigFox & more

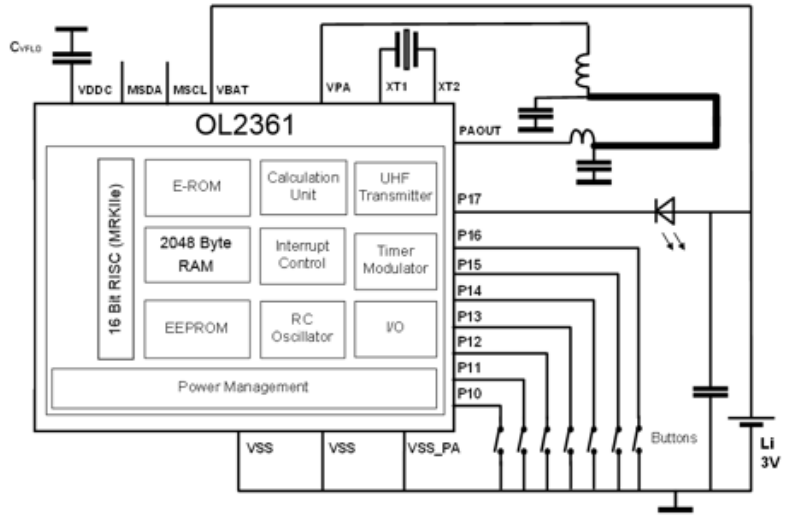






RF Transmitter – OL2361 (TX only)

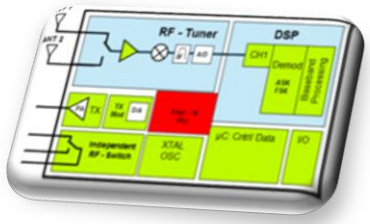
- Single-chip with on-chip multi-channel UHF Transmitter
- Carrier frequency 310 MHz – 915 MHz
- Multi Channel Fractional-N PLL
- One reference frequency (XTAL) for all bands
- Programmable FSK/ASK/OOK modulation characteristics
- Improved programmable and stabilized output power
- Low power consumption
  - TRANSMIT 868 MHz: 14 mA @10 dBm
    29 mA @14 dBm
- 16 Bit RISC Architecture
  - 16 K Byte E-ROM (FLASH), 2 K Byte RAM
  - 2048 Byte EEPROM for extended data storage
- Low power consumption
  - POWER DOWN: 0.5 µA @ 3V
- Temperature Sensor
- Temperature Range -40°C to +85°C
- Single Lithium cell operation, 1.8V to 3.6V
- 24-pin extremely compact HVQFN package (4x4mm)



Complete Industrial OL23xx Sub-GHz Device Family

TRX / 1-ch RX

OL2385

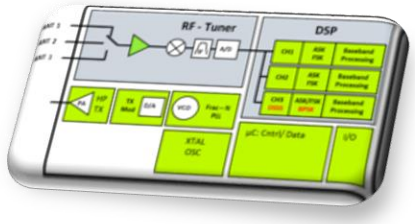


Supports multiple industry standards:

WMBus2013, SigFox, IEEE802.15.4g ZigBee Smart Metering UK Echonet Lite

TRX / 3-ch RX
2 NB & 1 DSSS

OL2323

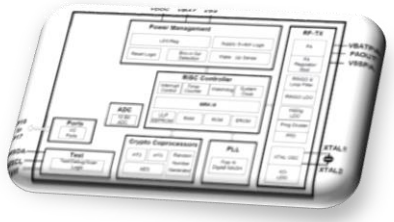


Ultra-long range / High robustness solution:

Spread Spectrum Technology

TX Only

OL2361



Low-Cost class 2 Tx device for SigFox applications (7dBm ETSI)

2.4 GHz MCUs

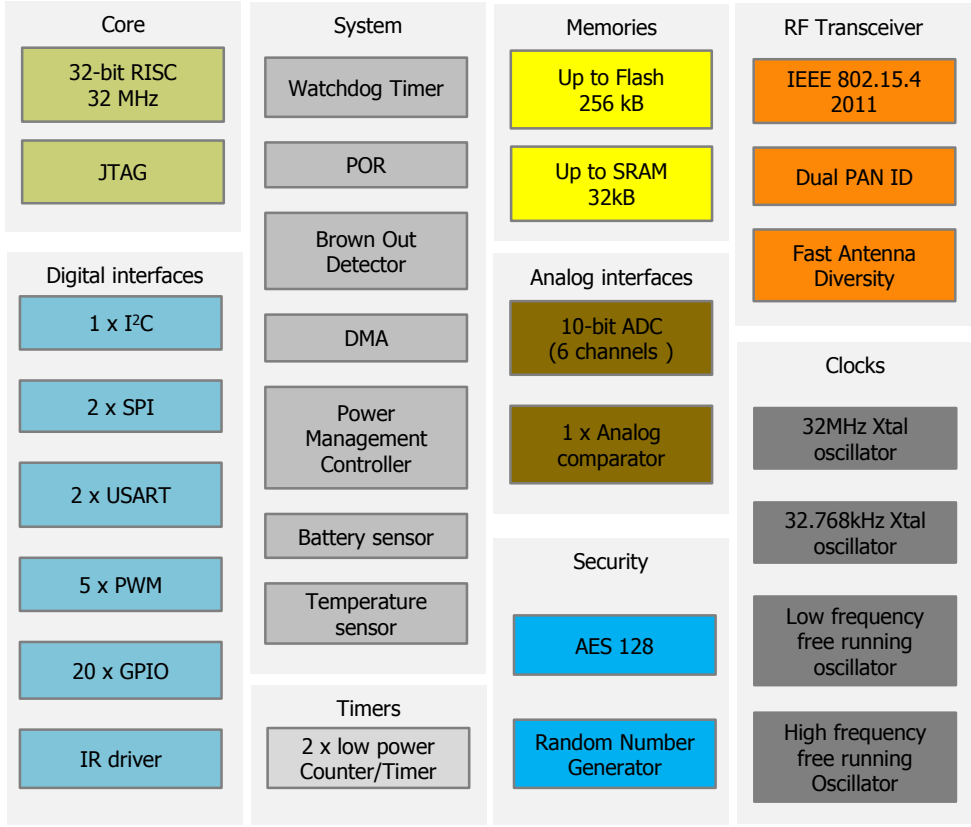
Product Features

JN51XX

JN5161/4/8 block diagram

32-bit RISC, 64/160/256 kB Flash - 8/32/32 kB RAM

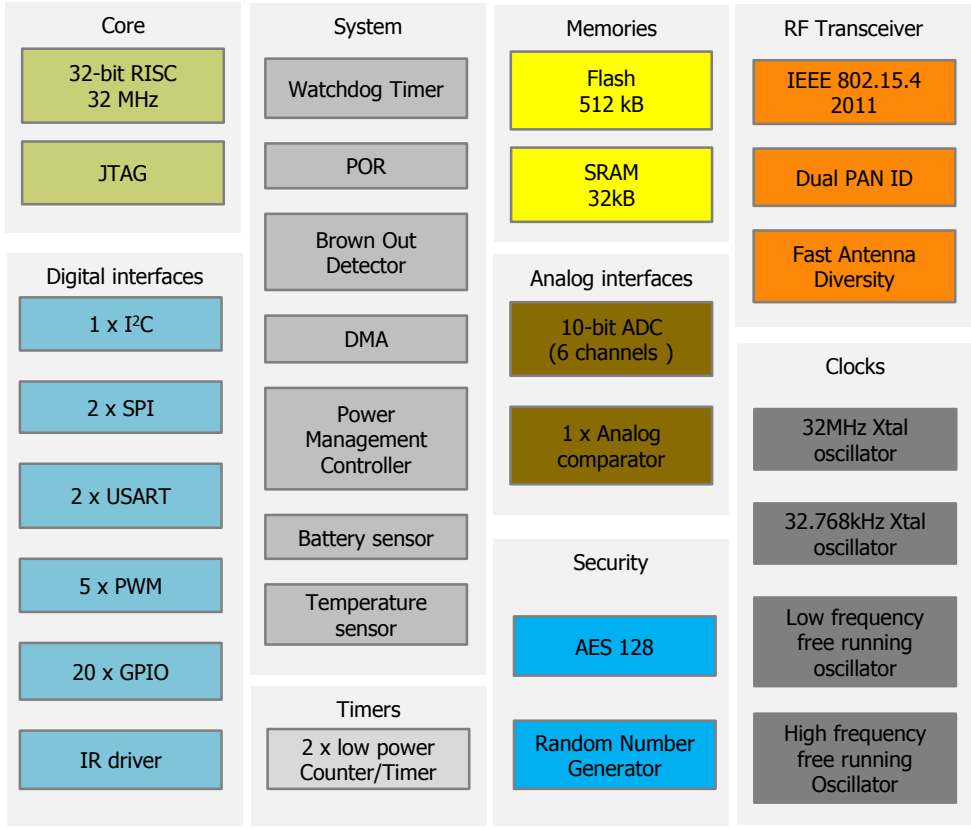
- **CPU**
  - 32 MHz, 32-bit RISC CPU core
  - Up to 256 kB Flash & up to 32kB RAM
- **2.4 GHz radio transceiver**
  - IEEE-802.15.4 compliant
  - Dual PAN support
  - Antenna diversity
  - +2,5 dBm power amplifier
  - -95 dBm RX sensitivity
  - Peak typical current:
    - 15mA TX @ +2,5dBm
    - 17mA RX
- **Security**
  - Crypto engine: AES 128-256, RNG
- **System**
  - USART, SPI, I²C, PWM, IR
  - 10-bit ADC, Analog Comparator
  - Battery operating range: 2.0V to 3.6V,
  - Ambient temperature : -40°C to +125°C
  - HVQFN40 6x6mm



JN5169 block diagram

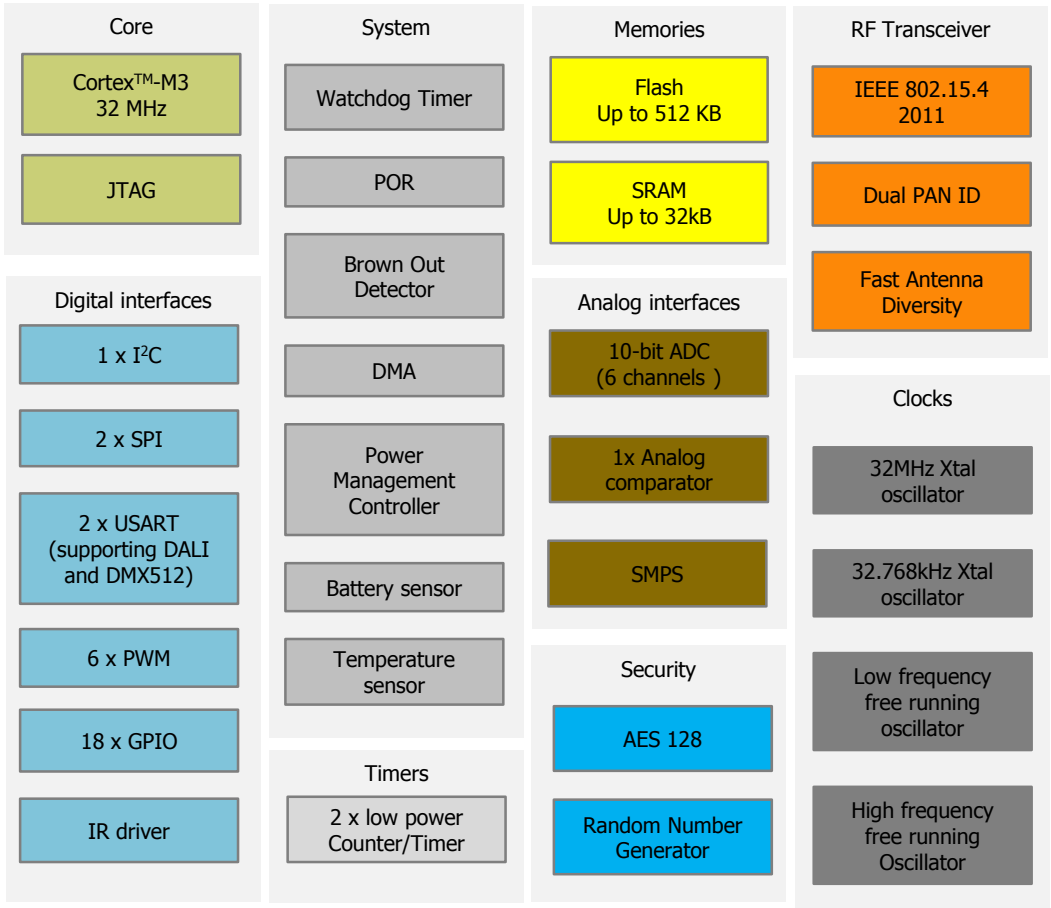
32-bit RISC, 512 kB Flash / 32 kB RAM, integrated PA

- **CPU**
  - 32 MHz, 32-bit RISC CPU core
  - 512 kB Flash & 32kB RAM
- **2.4 GHz radio transceiver**
  - IEEE-802.15.4 compliant
  - Dual PAN support
  - Antenna diversity
  - +10 dBm power amplifier
  - -96 dBm RX sensitivity
  - Peak typical current:
    - 23.3mA TX @ +10dBm, 14mA @ +3dBm
    - 14.7mA RX
- **Security**
  - Crypto engine: AES 128-256, RNG
- **System**
  - USART, SPI, I²C, PWM, IR
  - 10-bit ADC, Analog Comparator
  - Battery operating range: 2.0V to 3.6V,
  - Ambient temperature : -40°C to +125°C
  - HVQFN40 6x6mm



JN517x: Wireless MCU

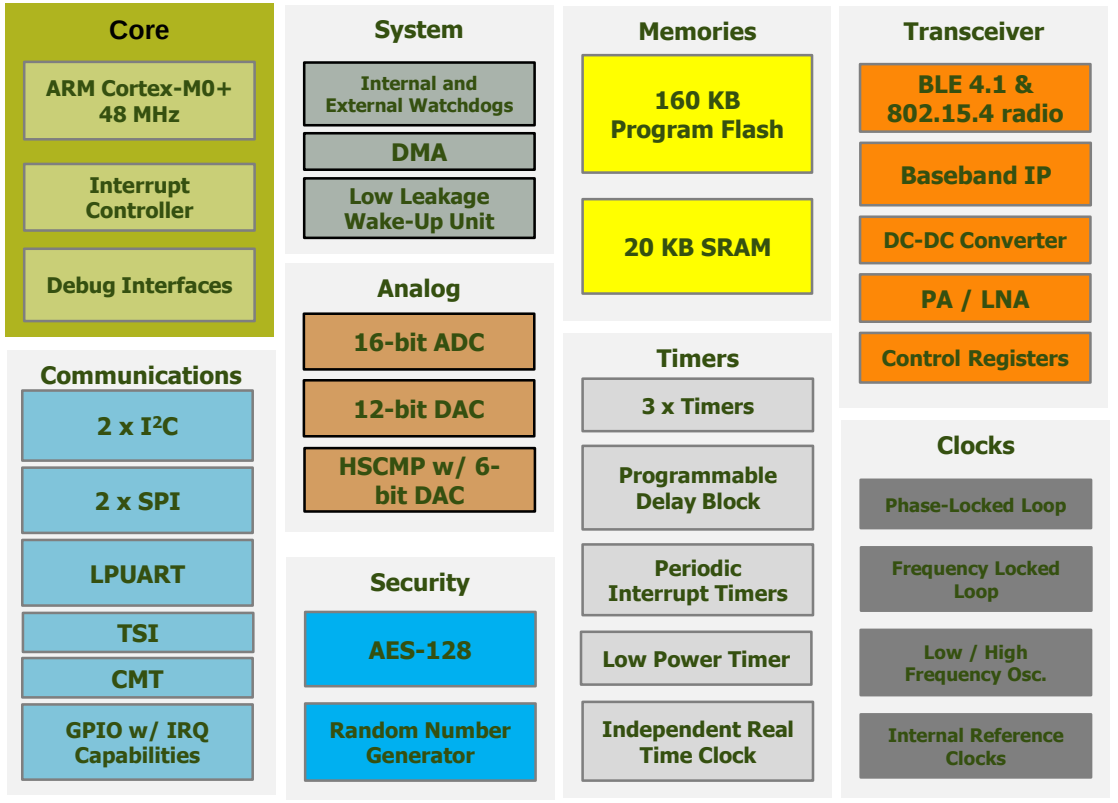
- **CPU**
  - 32 MHz ARM Cortex-M3 core
  - Up to 512 KB Flash & up to 32 KB RAM
- **2.4 GHz radio transceiver**
  - IEEE-802.15.4 2011 compliant
  - Dual PAN support
  - Antenna diversity
  - +10 dBm power amplifier
  - -96 dBm RX sensitivity
  - Peak typical current:
    - 22.5mA TX @ +10dBm, 14mA @ +3dBm
    - 14.8mA RX
- **Security**
  - Crypto engine: AES 128-256, RNG
- **System**
  - Ambient temperature: -40°C to +125°C
  - HVQFN40 6x6 mm



KWXX

KW40Z/30Z/20Z

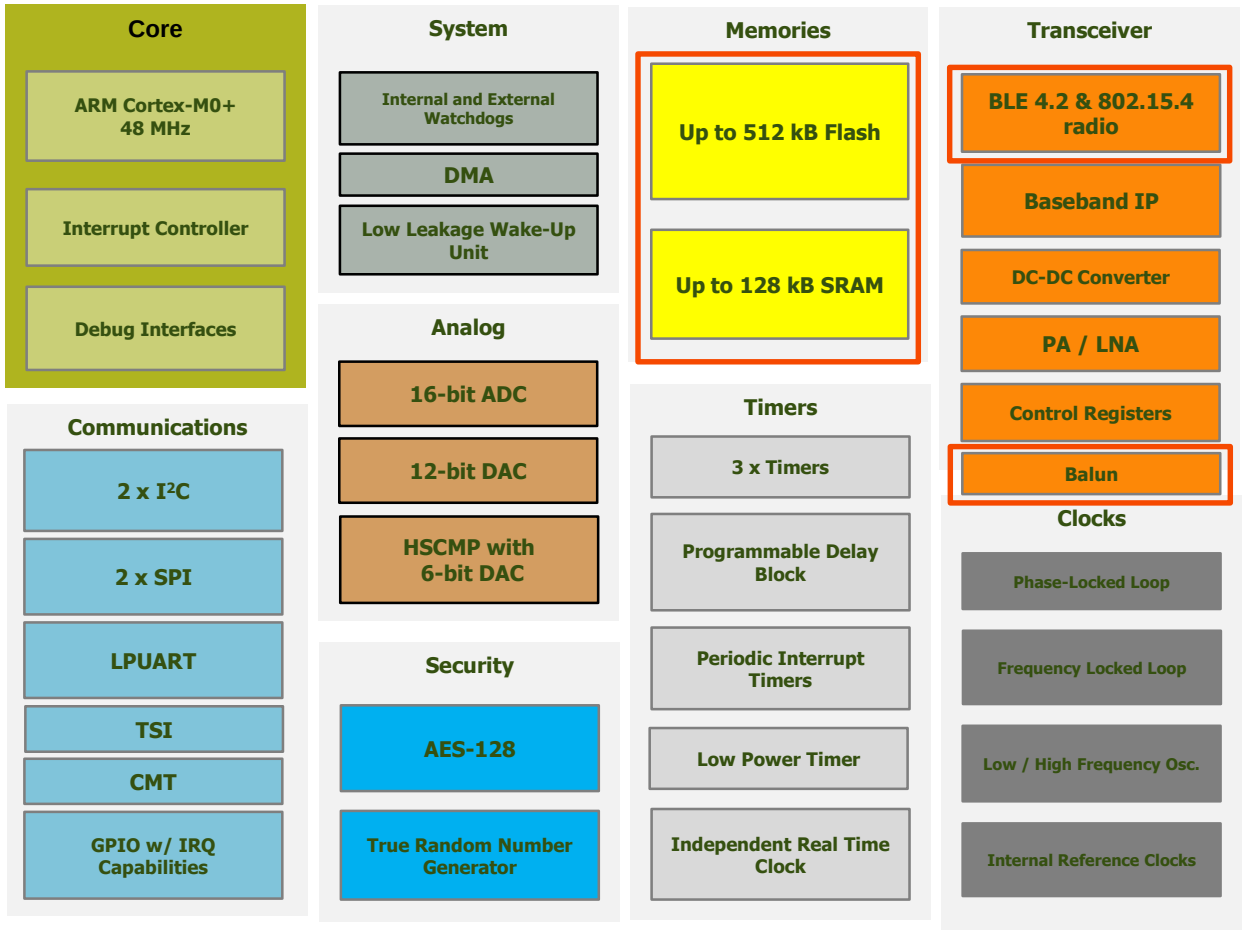
- **CPU**
  - 48 MHz ARM Cortex-M0+ core
  - 160 KB Flash & 20 KB RAM
- **2.4 GHz radio transceiver**
  - IEEE-802.15.4 2011 compliant
  - Dual PAN & Antenna diversity support
  - Bluetooth® Smart 4.1 compliant
  - Programmable output power : -18 to +5 dBm
  - -102 dBm RX sensitivity (IEEE 802.15.4)
  - -91 dBm RX sensitivity (Bluetooth Smart)
  - Peak typical current: 8.4mA TX @+0dBm and 6.5mA RX with DC/DC activated
  - IEEE 802.15.4 & Bluetooth Smart concurrent mode supported
- **Security**
  - Crypto engine: AES-128, TRNG
- **System**
  - Buck Boost DC/DC working from 0.9V to 4.2V
  - Ambient temperature: -40°C to +85°C (105°C qual. ongoing)
  - QFN 7x7mm, QFN 5x5mm



Device	Memory	Protocol	Package
MKW20Z160VHT4/R	160K Flash, 20K RAM	802.15.4 Only	7x7 48-pin Laminate QFN
MKW30Z160VHM4/R	160K Flash, 20K RAM	BLE Only	5x5 32-pin Laminate QFN
MKW40Z160VHT4/R	160K Flash, 20K RAM	BLE + 802.15.4	7x7 48-pin Laminate QFN

KW41Z/31Z/21Z

- **CPU**
  - 48 MHz ARM® Cortex®-M0+ core
  - Up to 512 kB Flash & 128 kB RAM
- **2.4 GHz radio transceiver**
  - IEEE-802.15.4 2011 compliant
  - Dual PAN & Antenna diversity support
  - Bluetooth® Smart 4.2 compliant
  - Programmable output power : -30 to +3.5 dBm
  - -100 dBm RX sensitivity (IEEE 802.15.4)
  - -95 dBm RX sensitivity (Bluetooth Smart)
  - Peak typical current: 6.1mA TX @+0dBm and 6.8mA RX with DC/DC activated
  - IEEE 802.15.4 & Bluetooth Smart concurrent mode supported
  - Integrated balun (~9% board area saving)
- **Security**
  - Crypto engine: AES-128, TRNG
- **System**
  - Buck Boost DC/DC working from 0.9V to 4.2V
  - Ambient temperature: -40°C to +105°C
  - QFN 7x7mm, WLCSP



Differences from KW40Z/30Z/20Z

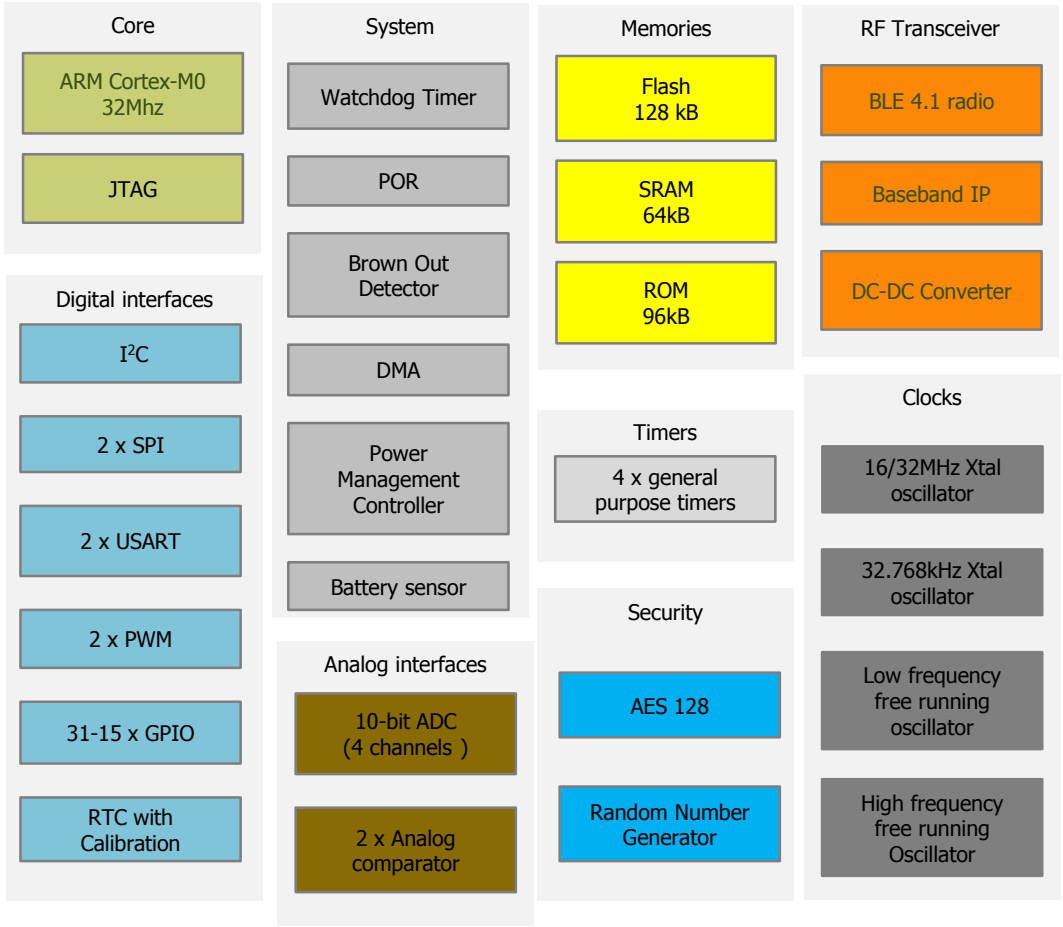
ZigBee Bluetooth SMART Cortex THREAD NXP Bluetooth Smart mesh IPv6

NXP

QN90XX

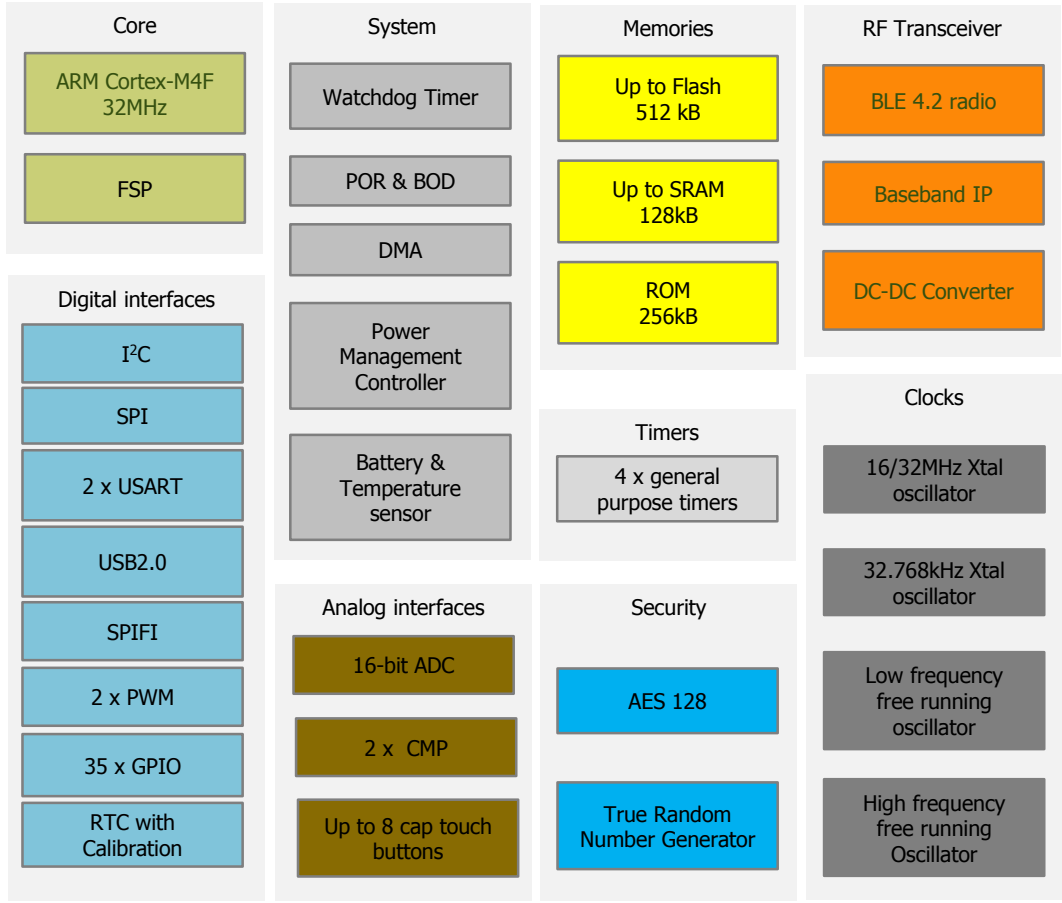
QN902x

- **CPU**
  - 32 MHz ARM® Cortex® -M0 core
  - 128 kB Flash & 64 kB RAM & 96kB ROM
- **2.4 GHz radio transceiver**
  - Bluetooth® 4.0 LE single mode
  - Support master and slave roles
  - Master can support up to 8 simultaneous links
  - Programmable output power : -20 to +4 dBm
  - -95 dBm RX sensitivity (Bluetooth® Smart)
  - Peak typical current w/ MCU: 8.8mA TX @+0dBm and 9.25mA RX with DC/DC activated
- **Security**
  - Crypto engine: AES-128, RNG
- **System**
  - DC/DC working from 2.4V to 3.6V
  - Ambient temperature: -40°C to +85°C
  - QFN48 6x6mm, QFN32 5x5mm



QN908x

- **CPU**
  - 32-bit ARM® Cortex® -M4 with FPU
  - 512 kB Flash & 128 kB RAM, 256 kB ROM
- **2.4 GHz radio transceiver**
  - Bluetooth® 4.2 LE single mode
  - Support up to 16 simultaneous links
  - Programmable output power : -20 to to +2 dBm
  - -95 dBm RX sensitivity (Bluetooth Smart)
  - Peak typical current w/ MCU: 3.4mA TX @+0dBm and 3.6mA RX with DC/DC activated
  - 1 uA deep sleep current with RAM/register retention
- **Security**
  - Crypto engine: AES-128, TRNG
- **System**
  - Fusion Signal Processor (FSP) & USB 2.0 FS
  - DC/DC working from 1.62V to 3.6V
  - Ambient temperature: -40°C to +85°C
  - QFN48 6x6mm, 3.2x3.2 WLCSP



GENERAL SIGFOX INTRODUCTION

SIGFOX: The Global Communications IoT Service Provider

- Low-Power Wide-Area (LPWA) public network
- Designed for small messages
  - Up to 140 x12bytes messages uplink per day
  - Up to 5 x 8bytes messages downlink per day
- Highly accurate and very low power budget
- Royalty free, no SIM card, low subscription cost
- Sub-GHz frequencies, on ISM bands
  - 868MHz in Europe/ETSI
  - 902MHz in the US/FCC
- Resistent to interference (safety/security applications)
- Ultra-Narrow Band (UNB) modulation
- 162dB budget link enables long range communications

SIGFOX

GLOBAL NETWORK, LOCAL DISTRIBUTORS

Australia	Luxembourg
Belgium	Malta
Brazil	Mauritius Island
Czech Republic	New Zealand
Denmark	Portugal
Finland	Spain
France	The Netherlands
Germany	The Sultanate of Oman
Ireland	The U.K
Italy	The U.S.

SIGFOX OPERATOR

aerea
NARROW NET LINKING THINGS
cellnex driving telecom connectivity
SIGFOX
rms.lu
NETROTTER CONNECTING THINGS
arqiva
IOTADENMARK
VT NETWORKS
SimpleCell
ENGIE
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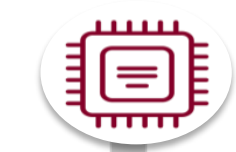
20 COUNTRIES

1,3M SQ KM

316M PEOPLE

7M CONNECTIONS

COSTS OPTIMIZED FOR DEVICE LIFE CYCLE



Simple, open, royalty free and hardware agnostic technology

No SIM card

Low integration cost: standard-based web APIs

No private network roll-out

CAPEX

Low subscription cost

Limited device maintenance

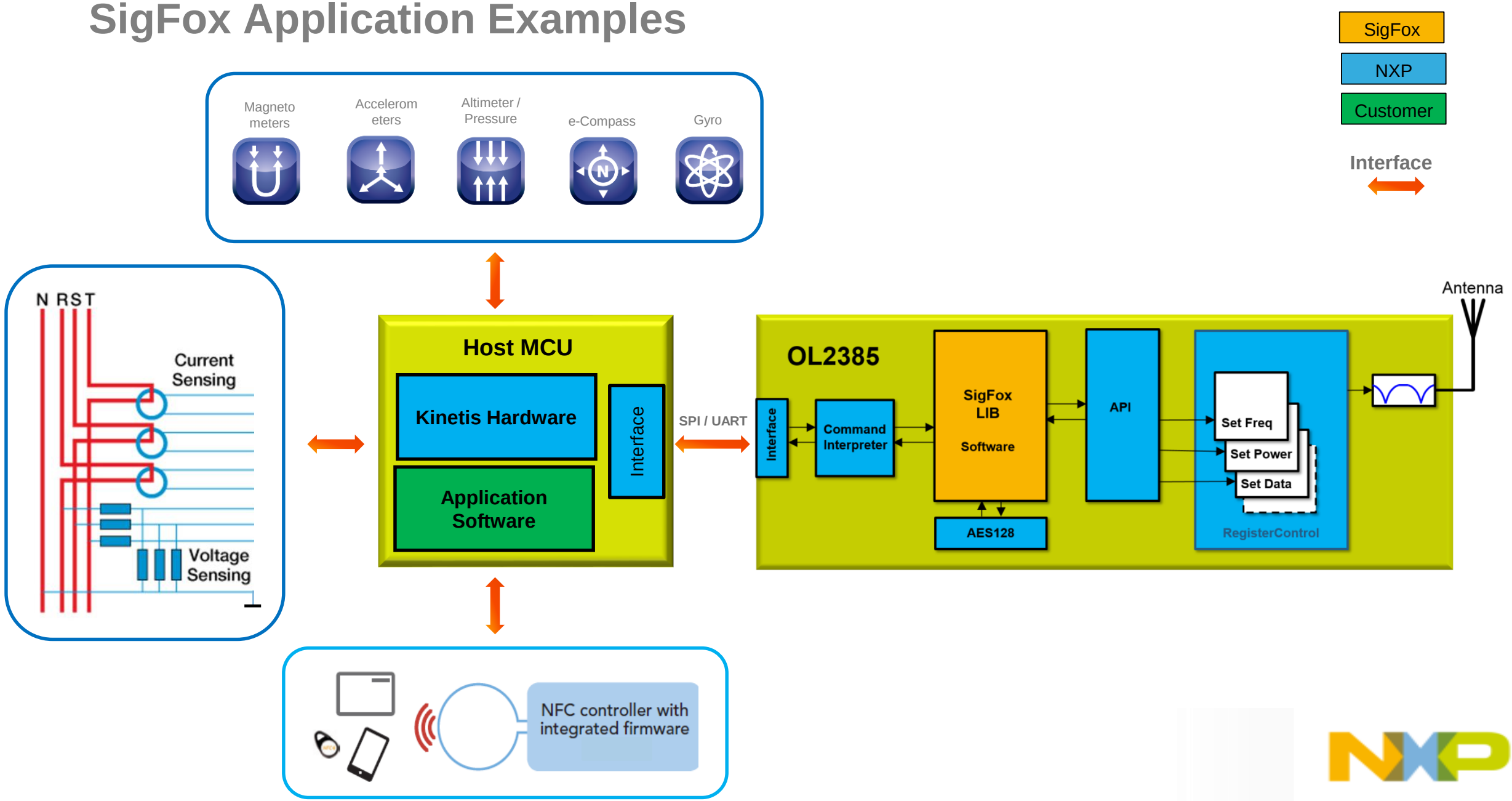
Price and service scalability

No network maintenance

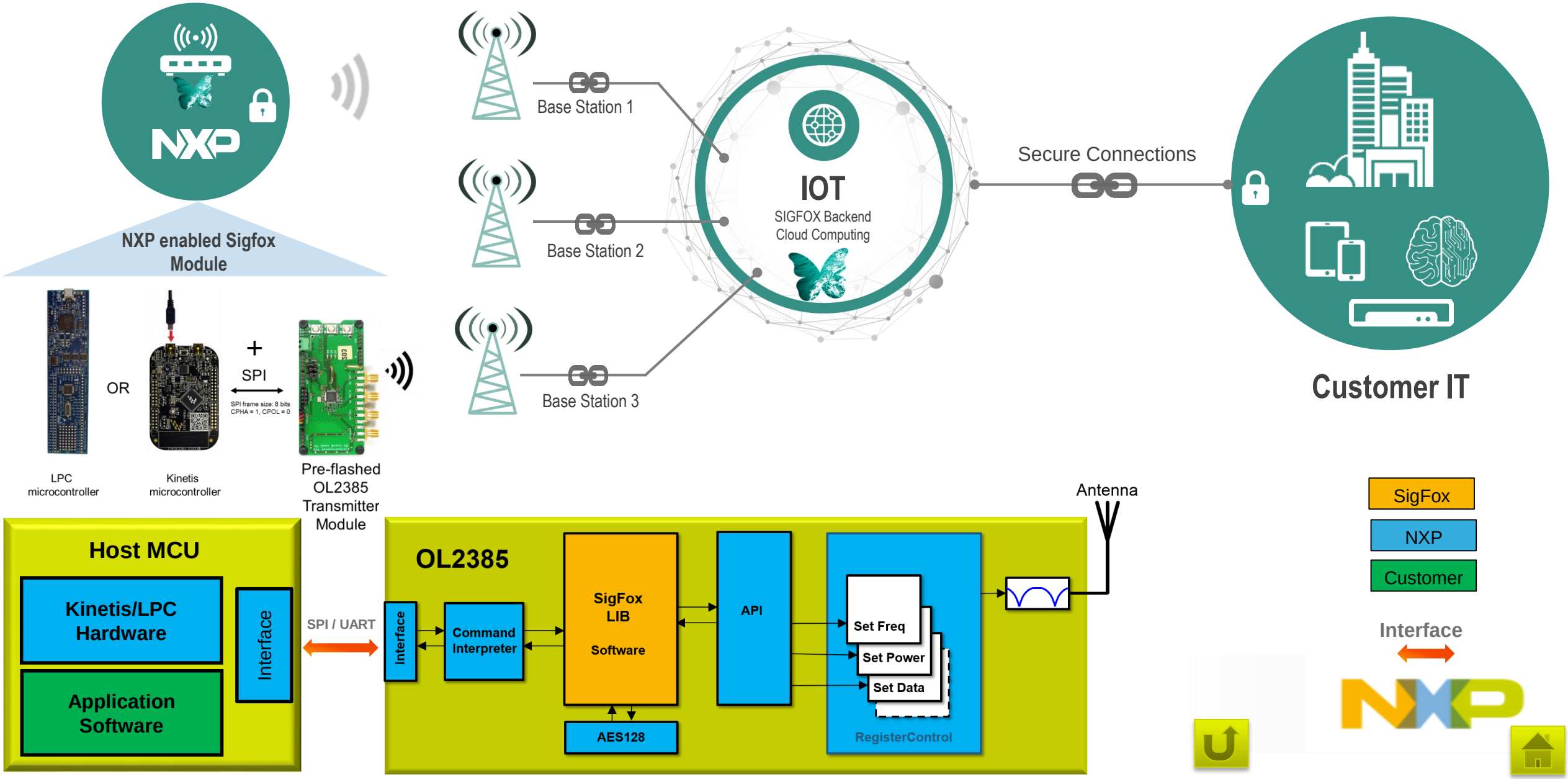
OPEX

CONFIDENTIAL – SIGFOX

SigFox Application Examples

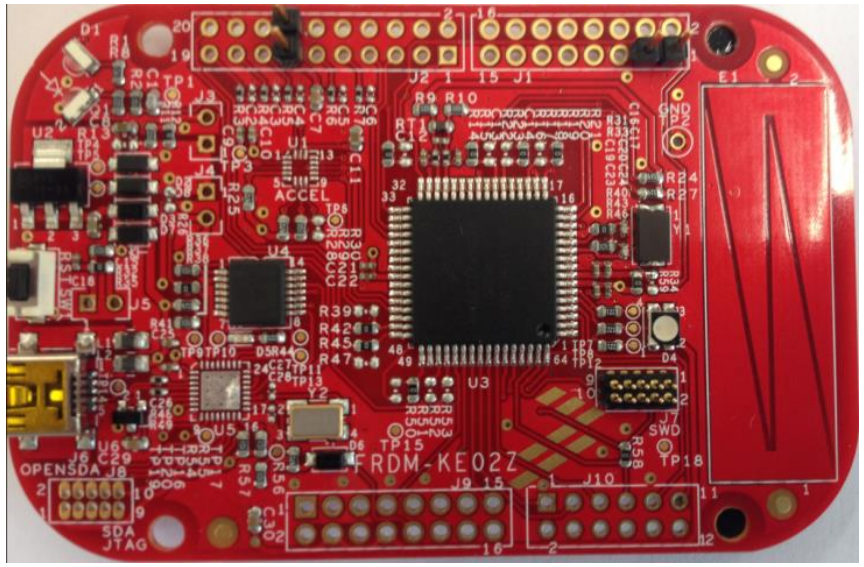


Sigfox Network Overview



Arduino Board with Shield and Ref Design for Kinetis MCUs

→ *Full Development Environment with Kinetis SW driver*



Kinetis MCU KL43
Freedom board
(or other Kinetis supported in KSDK2.0)

OL2385 with Sigfox SW
Shield board

GENERAL THREAD INTRODUCTION

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

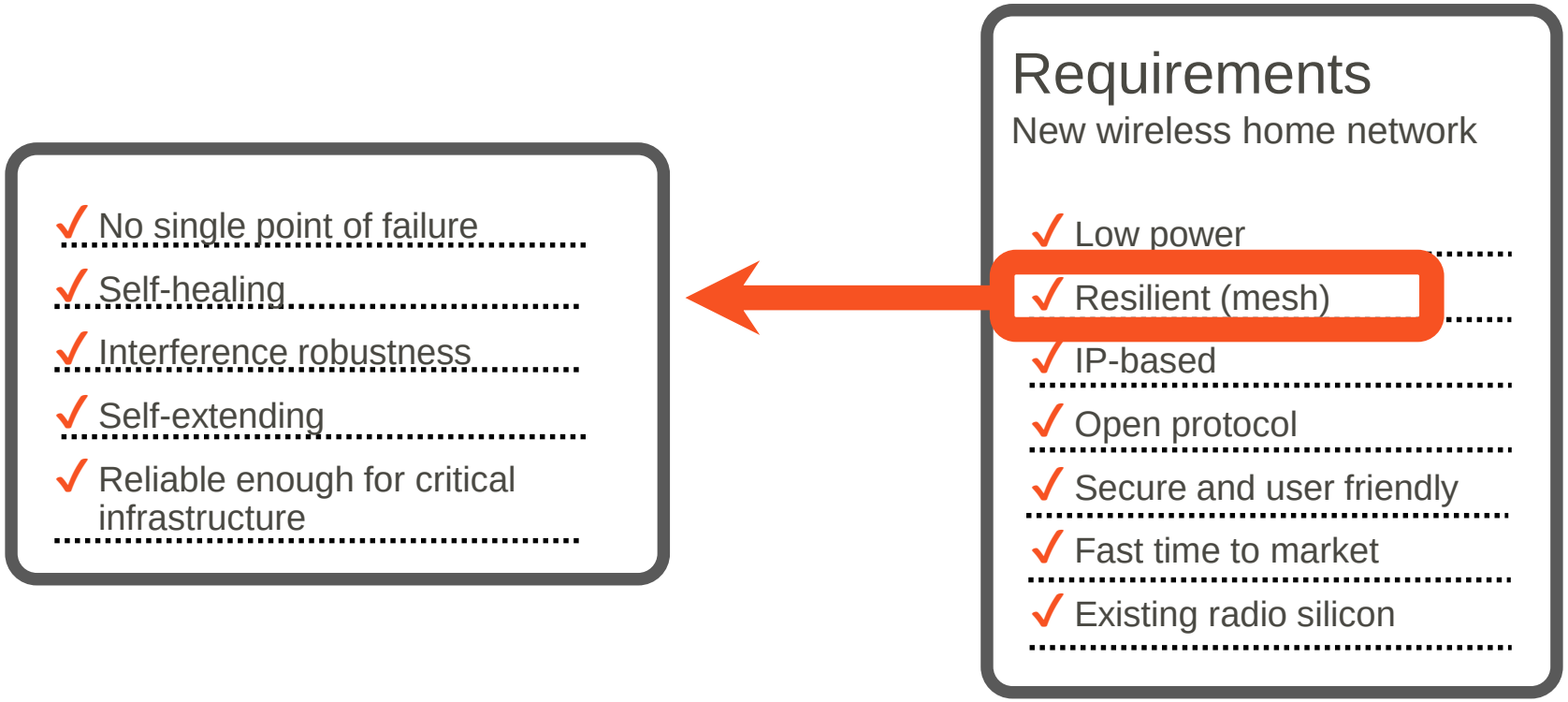
The need for a new wireless network

A new era of connected products

Existing wireless mesh protocol didn’t meet requirements

Other companies shared the same concerns

THREAD The need for a new wireless network



What is Thread?

A secure wireless mesh network for your home and its connected products

Built on well-proven, existing technologies

- Runs on existing 802.15.4 silicon
- Uses 6LoWPAN with IPv6 addressing
- UDP Transport

New mandatory security architecture

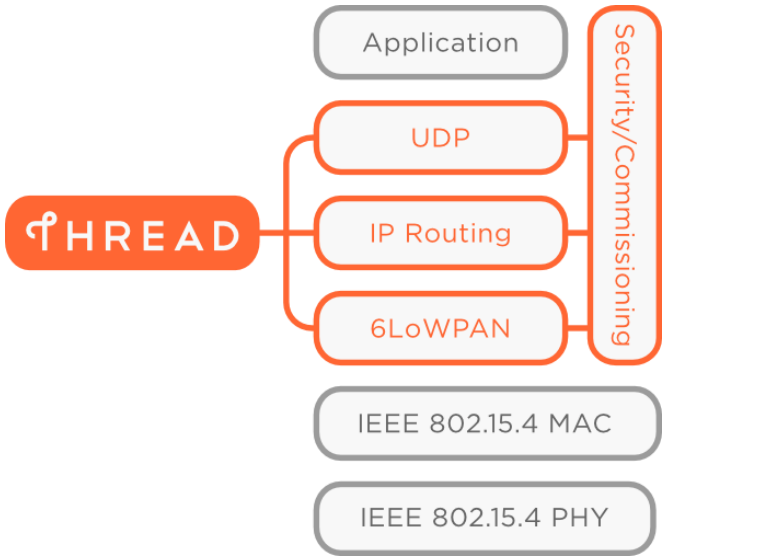
Simple and secure to add / remove products

Scalable to 250+ products per network

Designed for very low power operation

Reliable for critical infrastructure

Can support many popular
application layer protocols and platforms



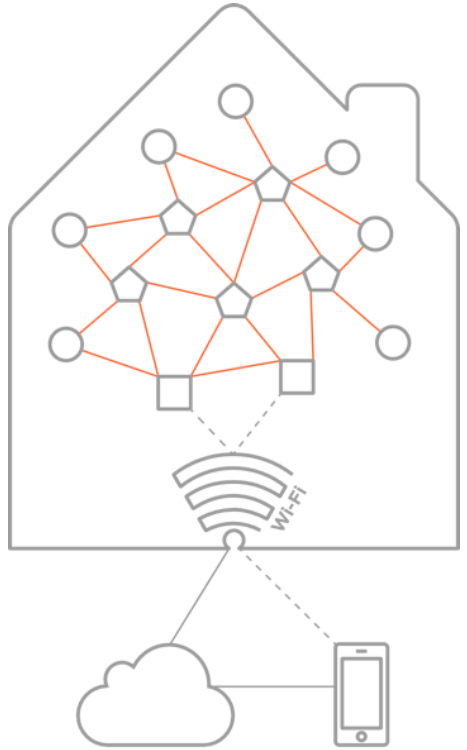
A software upgrade can add Thread to
currently shipping 802.15.4 products

Thread Specification is available to Thread Group members

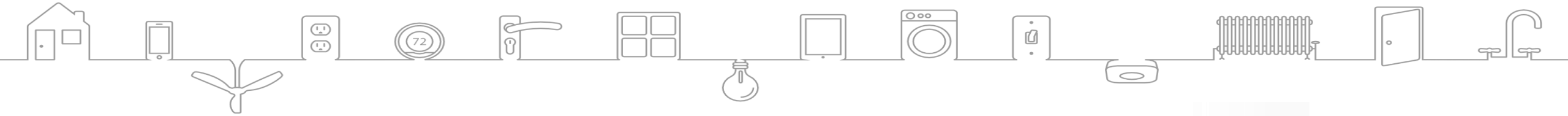
Target Applications

Thread is designed for all sorts of products in the home

- Appliances
- Access control
- Climate control
- Energy management
- Lighting
- Safety
- Security

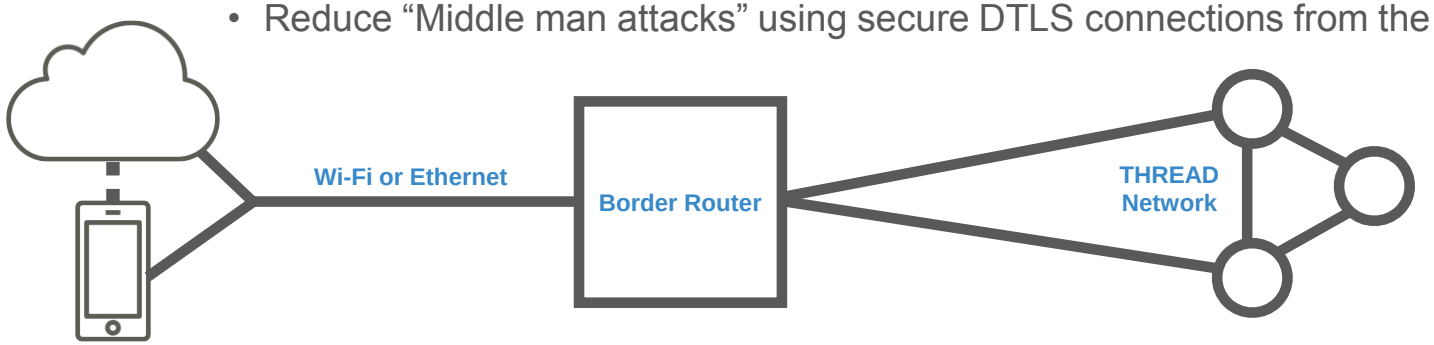


Devices working together to form a cohesive mesh network



Promise of IoT requires IP All the Way to the End Node

- Cloud Services can address devices from the Internet
- Home Network can directly address devices through Border Routers
- Devices can address local devices on HAN or off network devices using normal IP addressing
- Reduce “Middle man attacks” using secure DTLS connections from the end node to the cloud



Cloud Connectivity

For control when not at home

When within the home, phone or tablet must go direct to gateway to eliminate latency of going to the cloud

Has to be seamless to consumer

Border Router

Bridge from the Thread Network to Wi-Fi/Ethernet

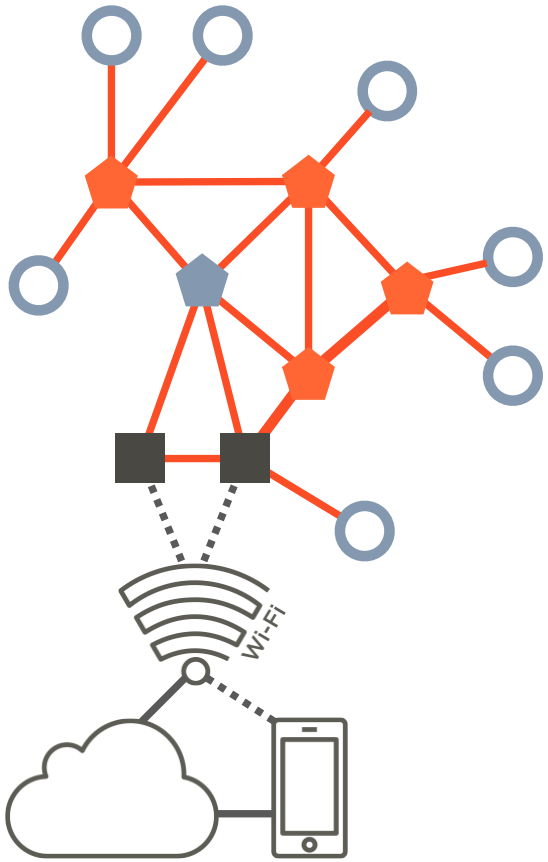
Forwards data to cloud

Provides Wi-Fi connectivity to phone, tablet or other devices in the home network.

Device Communication

Device to device communication within the Thread network for operations in the home

Network Architecture



End Device or Router Eligible Device

Active Router

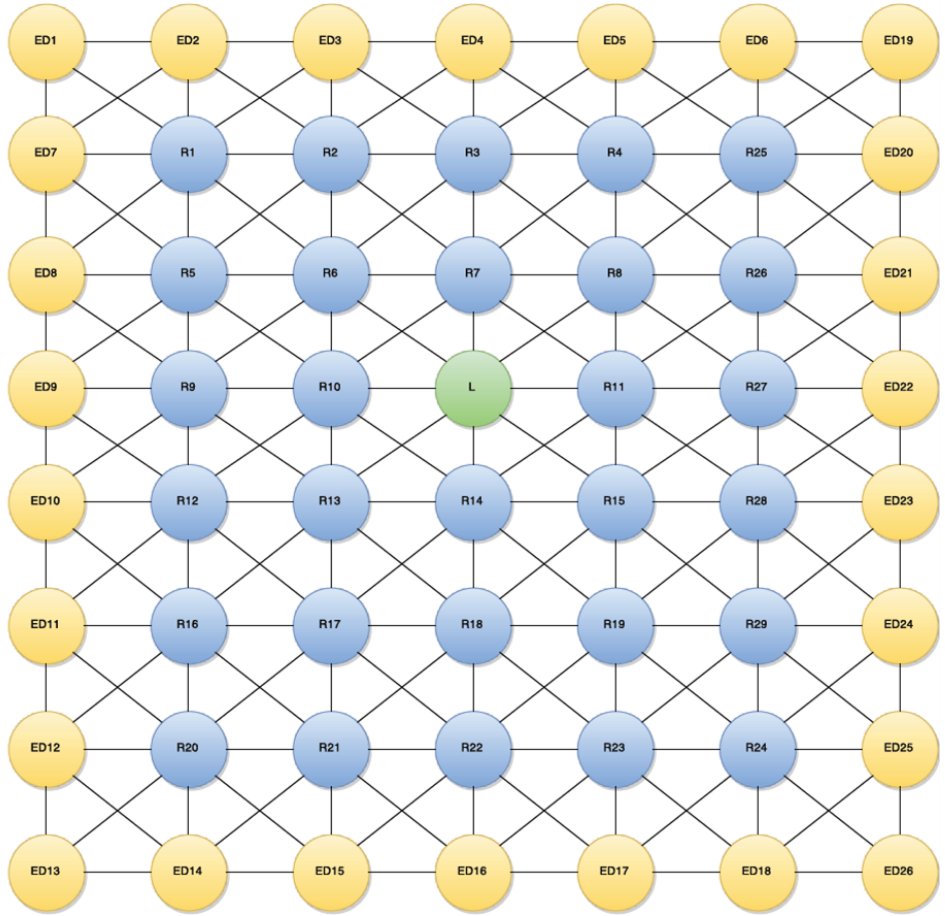
Leader

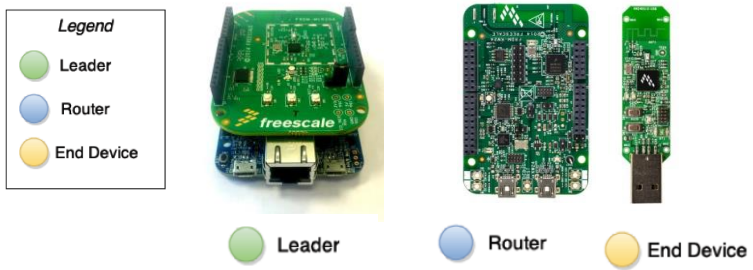
Border Router

Thread Network

Thread Large Network Testing (LNT) – 250 Nodes

- Used by R&D for large network test application development and debug.
- Various mesh network topologies are created using MAC filtering.
- Localized network in controlled environment, RF shielded rooms/boxes if needed.
- Using standard NXP Software and enablement boards.





To KW41Z Dual Mode

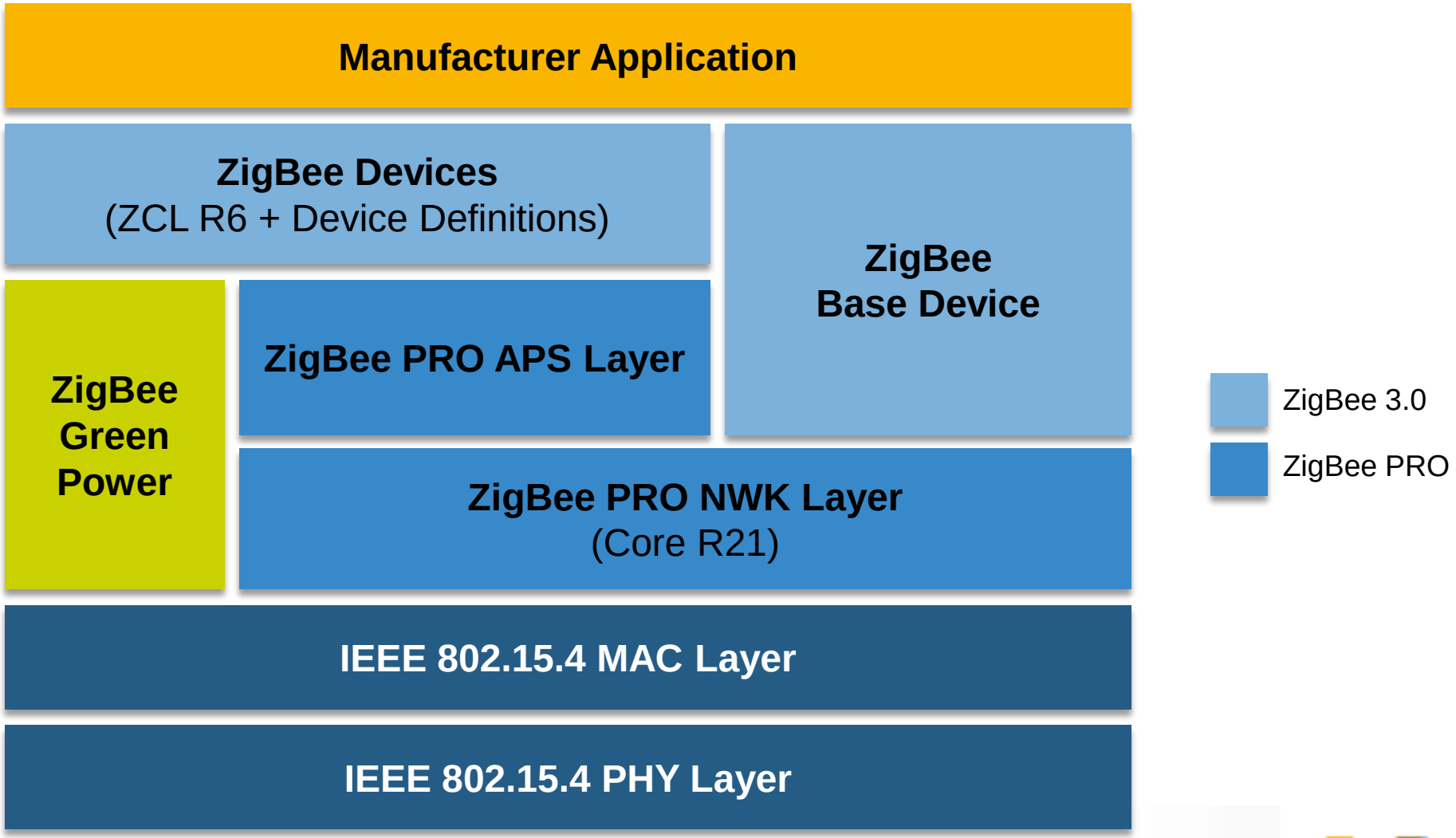
ZIGBEE 3.0 GENERAL INFORMATION

Why is ZigBee 3.0 needed?

Overcomes the following issues with former profile-based ZigBee:

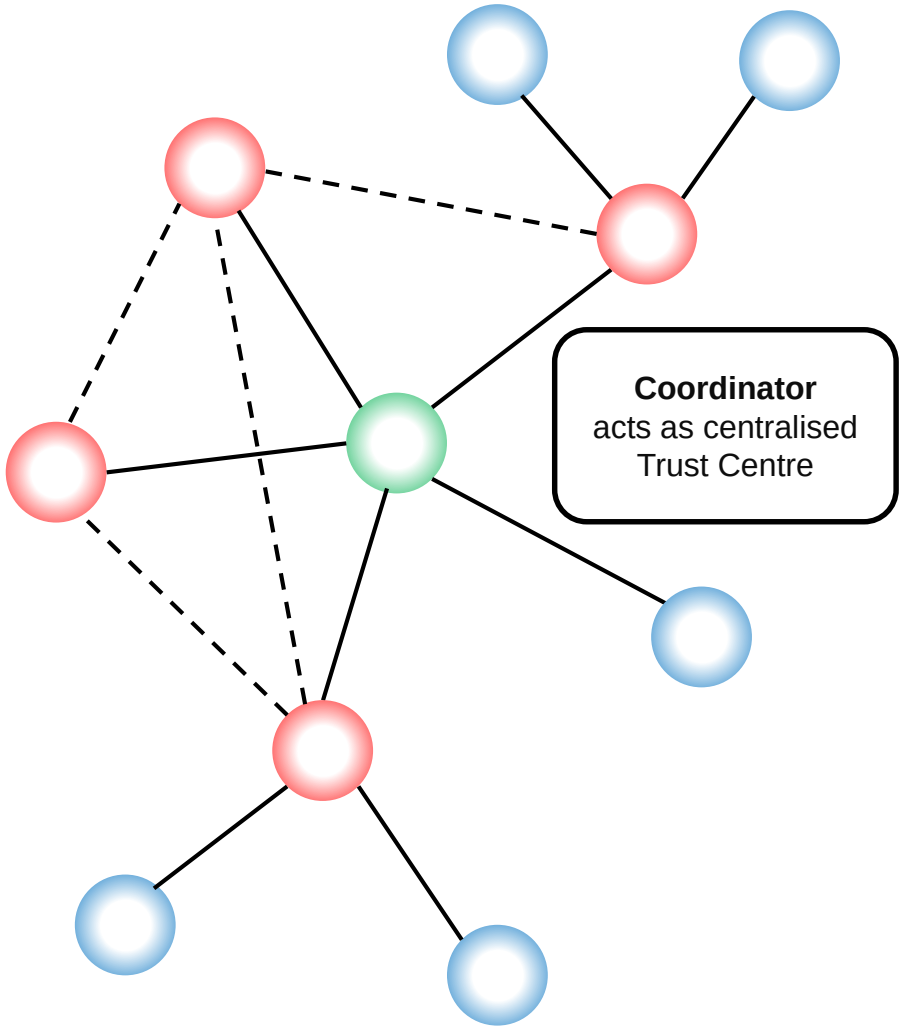
- Lack of interoperability between device manufacturers/profiles due to commissioning/discovery/normal operation
- No defined mechanism for sleepy child maintenance
- Security hole around insecure re-join and use of well-known keys
- Wider adoption of multiple ZigBee networks within the home that do not support inter-network routing

ZigBee 3.0 Stack Architecture



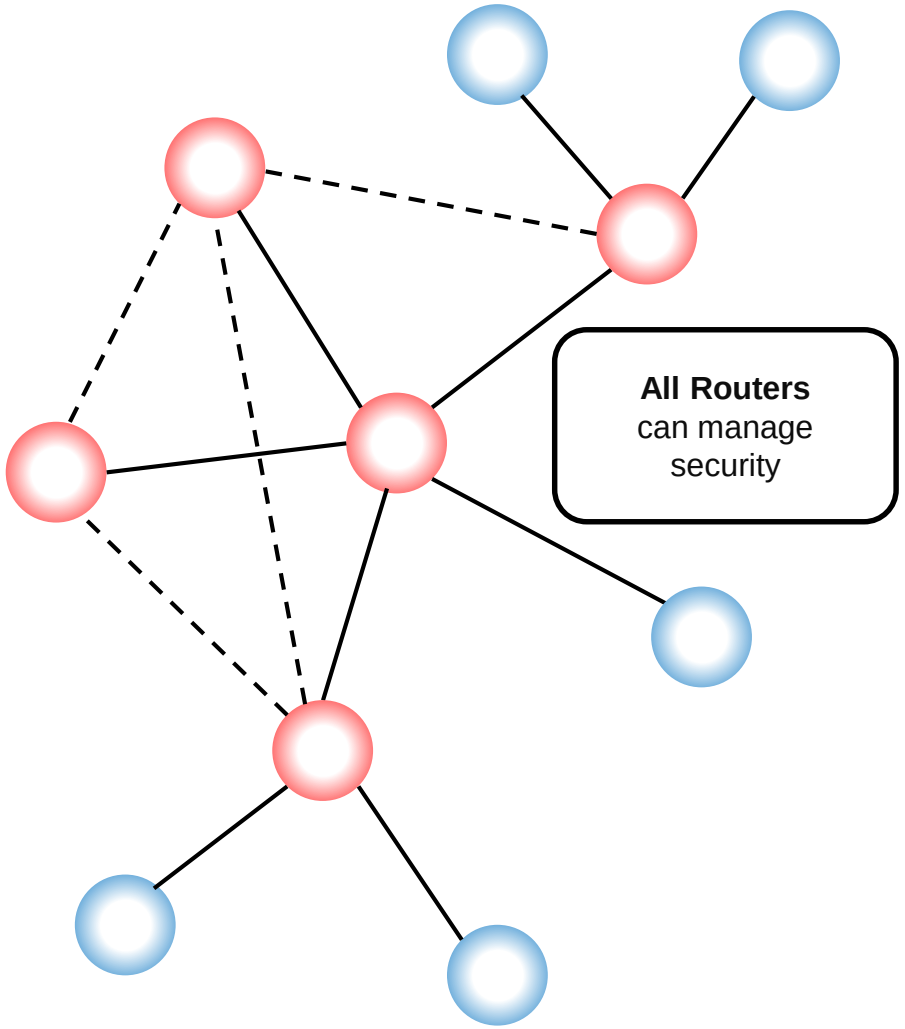
Centralised Security Network

- Always has a Coordinator
  - Needed for joining new nodes to network
  - Not needed for node re-joins
- Only one Trust Centre (usually the Coordinator)
- Trust Centre Link Key (TCLK) is supported
- Trust Centre supports unique keys, permissions and other TC policies
- Trust Centre address is unique MAC address of the Coordinator



Distributed Security Network

- No Coordinator in the network
- No single Trust Centre
- Each Router offers some Trust Centre functionality
- Trust Centre Link Key (TCLK) is not supported
- Supports following link keys:
  - Distributed Security Global Link Key
  - Touchlink Pre-configured Link Key



ZigBee HA / ZLL / ZigBee 3.0 Large Network Testing (LNT) – 250 Nodes

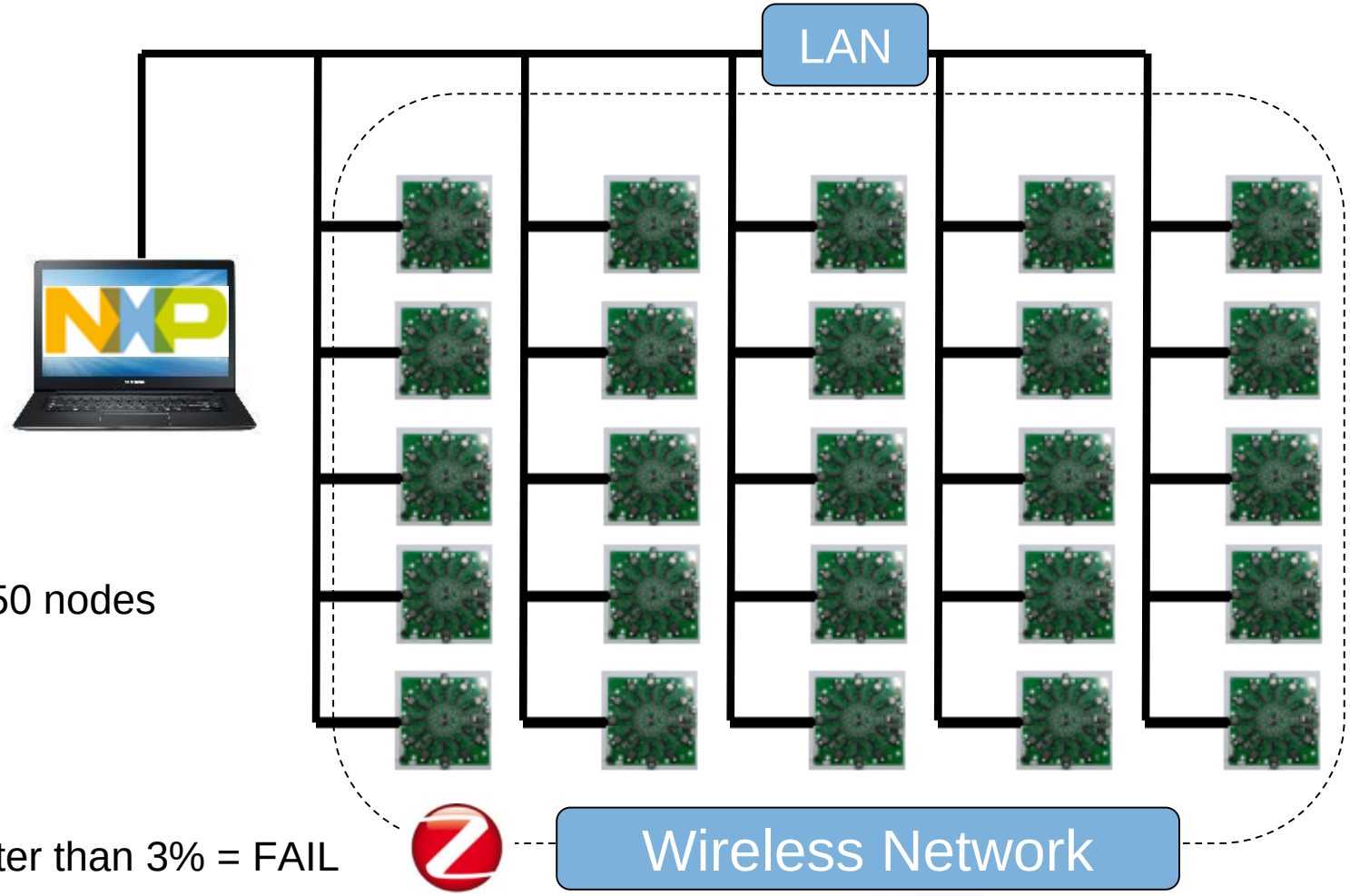
ZigBee Certification is a small component within our device verification

Verification Components

- Unit Tests
- Stack Regression
- Cluster Regression
- LNT

R&D Activity

- Application Acceptance



The current benchmark for the ZigBee LNT is ~250 nodes

The network must be stable for two weeks

Any single device with a packet error rate of greater than 3% = FAIL

Sniffer Logs are also analysed for anomalies

GENERAL BLE INTRODUCTION

NXP BLE MCUs High-Level

	NXP QN9020/21/22	NXP KW40Z/KW30Z	NXP KW41Z/KW31Z	NXP QN908x
Core	32MHz Cortex-M0	48MHz Cortex-M0+	48MHz Cortex-M0+	32MHz Cortex-M4F
Memory (Flash / RAM / ROM)	128kB / 64kB / 96kB * (ext SPI Flash, NA on QN9022)	160kB / 20kB	512kB / 128kB 256kB / 64kB	512kB / 128kB / 256kB 256kB / 128kB / 256kB
Radios	BLE 4.1, ANT+, Generic FSK (250k/500k/1Mbps)	BLE 4.1 & 802.15.4	BLE 4.2, ANT+, Generic FSK (250k/500k/1Mbps) & 802.15.4	BLE 4.2, ANT+, Generic FSK (250k/500k/1Mbps)
Radio Tx Output Power	+4dBm at antenna connector	+5dBm (w/o balun)	+3.5dBm at antenna connector	+2dBm at antenna connector
Radio Rx Sensitivity	-95dBm (w/o DC-DC) -93dBm (w/ DC-DC)	-91 dBm (BLE) -102 dBm (15.4, KW40Z only)	-95 dBm (BLE) -100 dBm (15.4, KW41Z only)	-95dBm (w/o DC-DC) -93dBm (w/ DC-DC)
Radio Power Consumption (Rx / Tx @ 0dBm)	9.25mA / 8.8mA (w/ DC-DC)* 13.6mA / 13.3mA (w/o DC-DC)*	6.5mA / 8.4mA (w/ DC-DC) 15.4mA / 18.5mA (w/o DC-DC)	•Master can support up to 8 simultaneous links	3.6mA / 3.4mA (w/ DC-DC)* 7.6mA / 6.5mA (w/o DC-DC)*
Connectivity Stacks	BLE 4.0, BLE Mesh*	BLE 4.1 & 802.15.4 (KW40Z only)	BLE 4.2, BLE Mesh*, 1Mbps GFSK PHY & 802.15.4 (KW41Z only)	BLE 4.2, BLE Mesh*
IDE / OS	Keil, IAR / Scheduler	IAR / Bare-metal, FreeRTOS	IAR, KDS / Bare-metal, FreeRTOS, uCOSII	Keil, IAR, RedEye* / Scheduler, FreeRTOS
Development Tools	MiniDK, USB Dev. Boards Module (partner)	FRDM, USB Dev Boards Module (partner)	FRDM, USB Dev Boards Modules (partner)	DK, USB Dev. Boards Module (NXP)
Package	QFN48/32/40 6x6/5x5/5x5 mm	QFN32 5x5 mm	QFN48 7x7 mmm, WLCSP	QFN48 6x6mm, WLCSP 3.28x3.2mm
Supply Voltage	2.4 - 3.6 V (QN9020/21) 1.8 - 3.6 V (QN9022)	0.9 - 4.2 V (Buck & Boost)	0.9 - 4.2 V (Buck & Boost)	1.62 - 3.6 V

Kinetis Bluetooth® LE Host Stack Software

Low Memory Footprint

- KW30Z BLE v4.1
  - **100 kB Flash** and **12 kB RAM** (including KSDK, RTOS and drivers)
  - **70 kB Flash** and **4 kB RAM** (just the stack itself)
  - ~60-90 kB Flash and ~8-16 kB RAM available for application
- KW31Z BLE v4.2
  - **130 kB Flash** and **18 kB RAM** (including KSDK, RTOS and drivers)
  - **90 kB Flash** and **10 kB RAM** (just the stack itself)

BLE Mesh 1.0 for KW31Z (Q3'16)*

- **130 kB Flash and 20 kB RAM** (including KSDK, RTOS and drivers)
- ~126/382 kB Flash and ~44/108 kB RAM available for application

Broad range of the most common BLE GATT profiles (25+) and demo applications

Kinetis SDK 1.3 for KW30Z BLE and 2.0 for KW31Z BLE v4.2

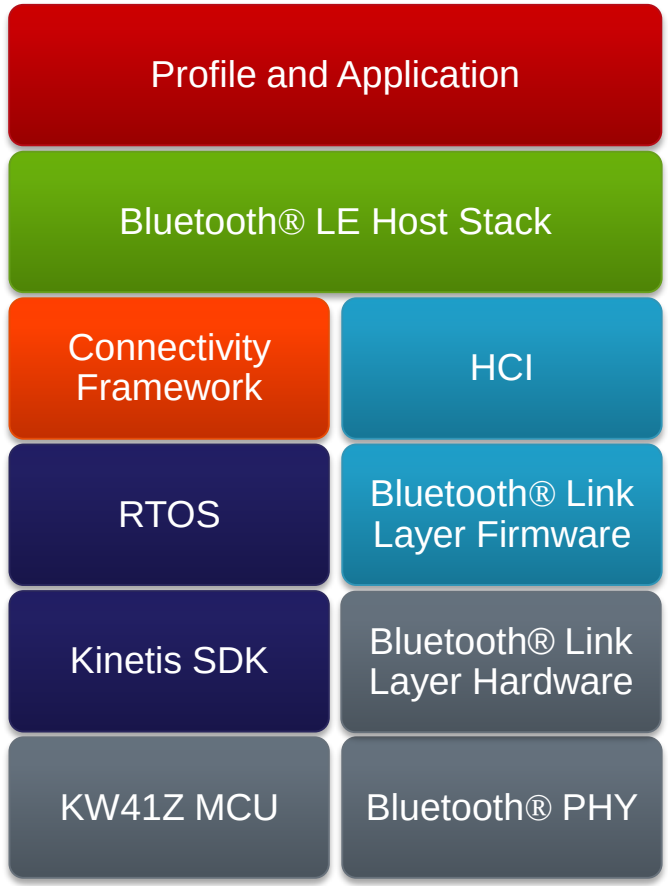
Runs on a Cortex™ M0+ @32MHz (20% CPU bandwidth max.)

Bluetooth® LE v4.1 certified and compliant to v4.2

RTOS agnostic and can run in a non-preemptive mode (bare-metal) as well as FreeRTOS and uCOS/II (KW31Z only)

Coexists with the 802.15.4 MAC and upper network stacks in the same dual mode firmware

KW30 available with IAR Embedded Workbench support, KW31 adds KDS support



Kinetis: Supported Bluetooth® Low Energy Profiles

Standard GATT Profiles/Services

A4WP - Wireless Power Profile*
ANP - Alert Notification Profile
ANS - Alert Notification Service
BAS - Battery Service
BLP - Blood Pressure Profile
BLS - Blood Pressure Service
CPP - Cycling Power Profile
CPS - Cycling Power Service
CSCP - Cycling Speed & Cadence Profile
CSCS - Cycling Speed & Cadence Service
CTS - Current Time Service
DIS - Device Information Service
FMP - Find Me Profile
GLP - Glucose Monitor Profile
GLS - Glucose Monitor Service
HIDS - Human Interface Device Service
HOGP - HID over GATT Profile
HRP - Heart Rate Profile
HRS - Heart Rate Service
HTP - Health Thermometer Profile
HTS - Health Thermometer Service
IAS - Immediate Alert Service
IPSP - Internet Protocol Support Profile
LLS - Link Loss Service
PASS - Phone Alert Status Service
POP - Pulse Oximeter Profile*
PXP - Proximity Profile
RSCP - Running Speed & Cadence Profile
RTUS - Reference Time Update Service
TIP - Time Profile
TPS - Transmit Power Service
UDS - User Data Service

Proprietary GATT Profiles

OTAP - NXP/FSL Proprietary Over the Air Programmer Profile

Wireless UART - NXP/FSL Proprietary serial port transfer profile

Temperature Sensor – NXP/FSL Low-Power Proprietary profile

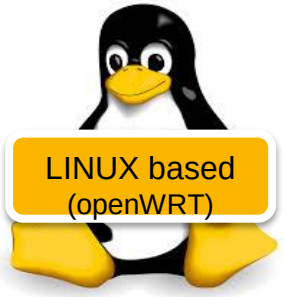

Evaluation
Kits & Boards
SECURE CONNECTIONS
FOR A SMARTER WORLD

EK-004 – 802.15.4 with NFC Commissioning

- Two base boards with integrated NFC tag (NT3H1101)
- NFC reader expansion board for raspberry Pi
- Two expansion boards with sensors and buttons
- Two JN5169 USB dongles
- Raspberry Pi single board computer
- One WiFi dongle compatible with raspberry Pi
- Complete software development kit (SDK)
  - GNU-based toolchain
  - C compiler
  - Flash programmer
  - Eclipse IDE
  - Microcontroller and peripheral libraries

Evaluation Kit EK004
Hardware

- Easy development of ZigBee and IEEE802.15.4 applications with NFC
- All necessary hardware components to demonstrate, evaluate and develop ZigBee solution with NFC commissioning
- All firmware preloaded for both nodes and gateway



IoT Gateway

- Raspberry Pi
- NFC reader (PN7120)
- Wi-Fi USB dongle
- Zigbee USB dongle (JN5169)

Smart node

- Generic PCBs with Zigbee module (JN5169) and NFC connected tag (NTAG I²C) including NFC antenna
  - Generic expansion board
  - Lighting/Sensor generic expansion board

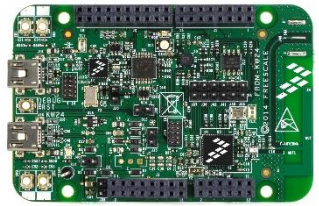
Tools

- ZigBee remote control
- Cable for Power supply (gateway and nodes)
- Programming cables
- Ethernet cable
- SD card

Wireless Connectivity Portfolio - HW

Dev boards

FRDM-Shield	FRDM-Board	Board & Shield	Board & Shield
FRDM-MCR20	FRDM-KW24D	FRDM-KW40Z	FRDM-KW019032
	USB-KW24D	USB-KW40Z	USB-KW019032

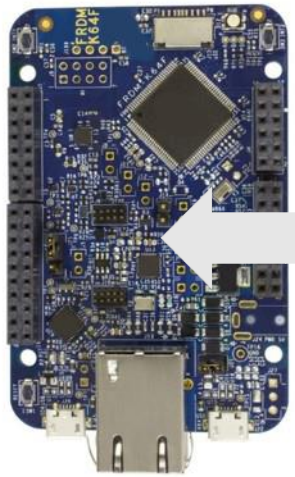


Part no

MCR20AVHM	MKW21D256VHA5 MKW21D512VHA5 MKW22D512VHA5 MKW24D512VHA5	MKW40Z160VHT4 MKW30Z160VHM4 MKW20Z160VHT4	MKW01Z128CHN

Target Development Systems: Gateways/Border Routers

K64F
RTOS Border Router
(PN512)



KW2x

i.MX6UL
Linux Gateway/Border Router
(PN7120)

K64F Freedom Board

- 120 MHz Cortex-M4F
- Up to 1 MB Flash, up to 258 KB RAM
- Integrated Ethernet
- Thread and ZigBee
- Launching Oct. 6

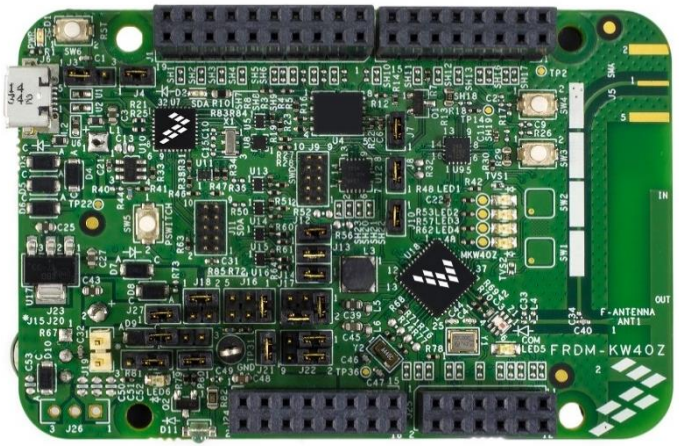
i.MX6Ul EVK

- 528 MHz Cortex-A7 CPU
- 4 GB DDR3L DRAM memory
- 256 MB Quad SPI Flash
- Arduino/Freedom connector
- Launching Oct 6th

Kinetis KW40Z Tools and Software

will follow the same strategy for the KW41Z

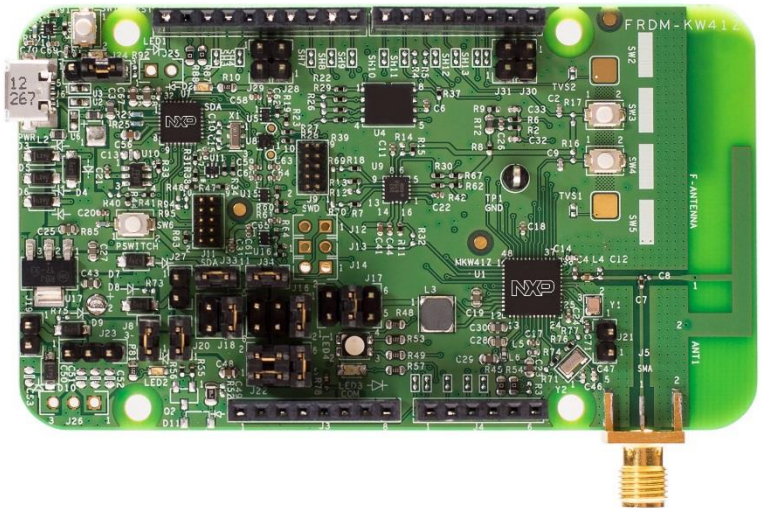
- **Easy-to-use Hardware**
  - **FRDM-KW40Z**: Freescale Freedom Development Platform
  - **USB-KW40Z**: Ideal for BLE/802.15.4 sniffer or connection to PC/Tablet



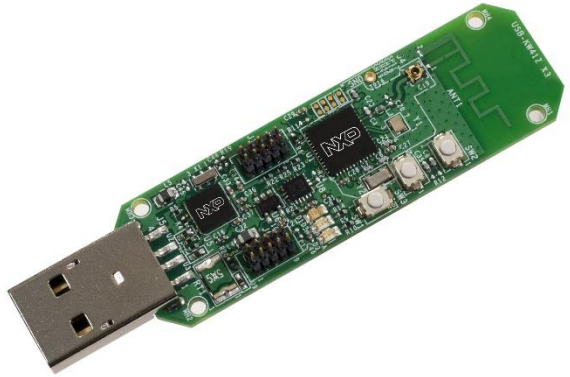
- **Robust Software**
  - Royalty-free NXP BLE host stack with 20 GATT profiles, fully compliant to the BLE 4.1 spec
  - 802.15.4 MAC layer, as the foundation for ZigBee 3.0 and the highly anticipated Thread IP-based mesh networking protocol
  - All stacks support over-the-air firmware updates
  - Fully integrated into the Kinetis Software Development Kit (SDK) with support for multiple RTOS options, including FreeRTOS and bare-metal solutions

KW41Z Development Hardware

- **FRDM-KW41Z** Freedom Development Hardware
  - Can be configured as Host or Shield for connection to Host Processor
  - Supports all DC-DC configurations
  - PCB inverted F-type antenna
  - Minimum number of matching components
  - FCC Part15 & EN300 328 compliant
  - Serial Flash for OTA firmware upgrades
  - On board NXP FXOS8700CQ digital sensor, 3D Accelerometer (±2g/±4g/±8g) + 3D Magnetometer
  - OpenSDA and JTAG debug
  - Full KSDK support
  - Resale $145 (2 boards/kit)

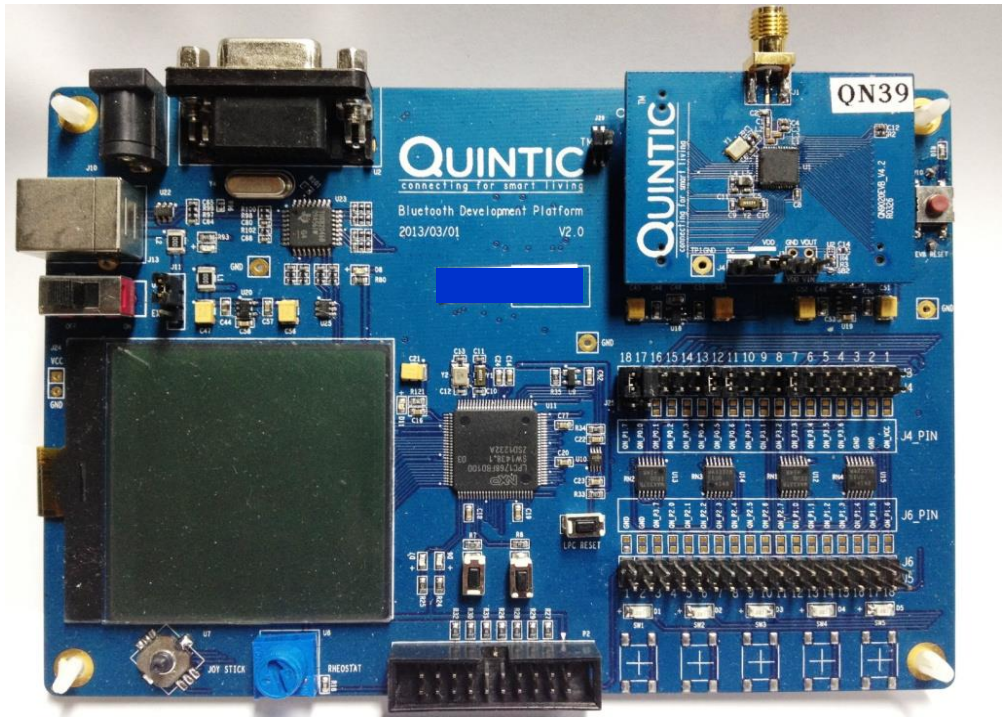


- **USB-KW41Z** USB Dongle
  - Ideal for BLE/802.15.4 sniffer or connection to PC/Tablet
  - FCC Part15 & EN300 328 compliant
  - Resale $60



QN902x Evaluation And Design Kits

- **Full Software Package**
  - SDK and API, Support Keil or IAR
  - Full BT Profile offering
  - Software application package for OTA and QPP



Evaluation board
for full RF performance evaluation

Mini Design Kit with USB adapter
For customer application development

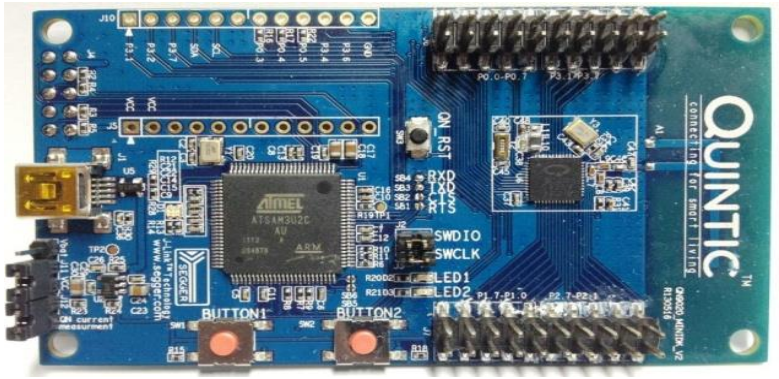
QN9020 Family ECO System: MINI DK Demo Board QN9020DK

Features

- Contains Jlink-OB offering SWD and UART interfaces for QN9020 debug and communication
- Mini USB port for power and communication port
- Power source select jumper used for power source selection
- Current measurement jumpers used for measuring the QN9020 device power consumption
- Button1/2 used as input
- LED1/2 used as output to indicate QN9020 status
- Extended QN9020 GPIO Port used for interface extension
- UART interface used as communication port for QN9020 device

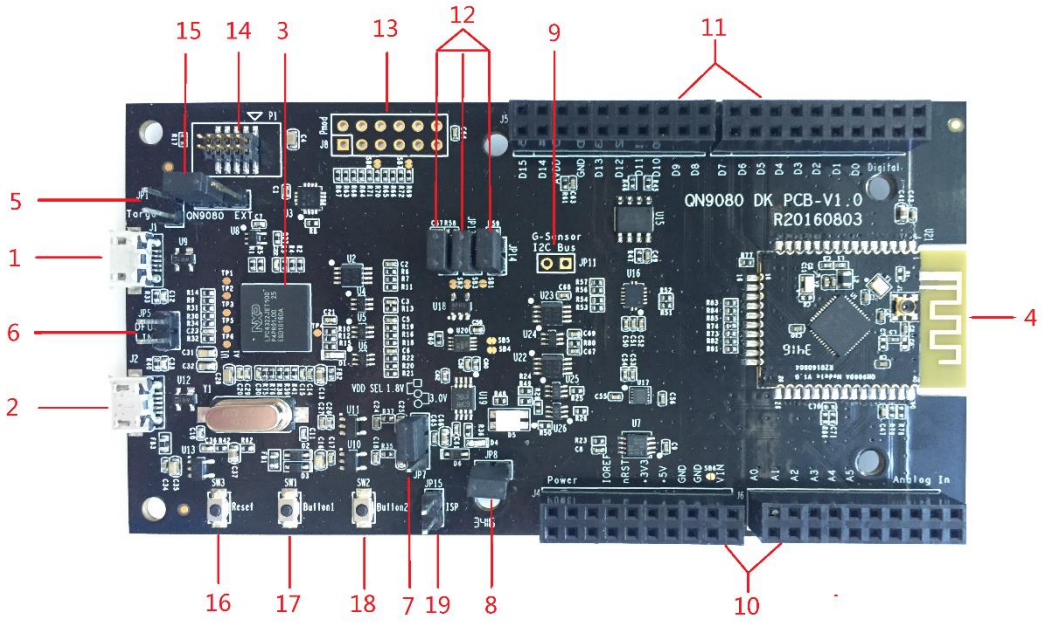
Kit Contains

- QN9020 DK Board
- QN9020 USB dongle
- USB cable



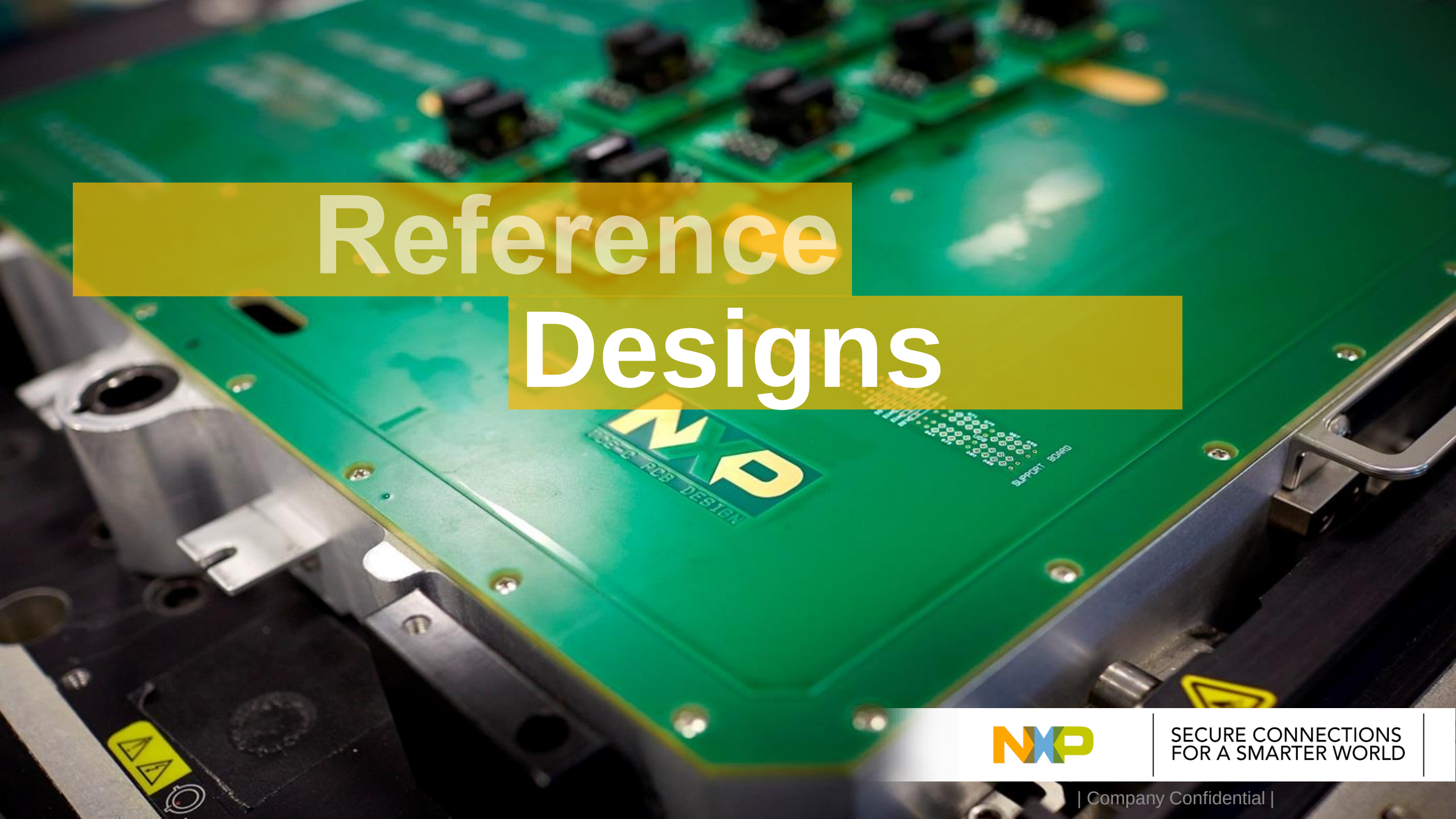
QN908x Evaluation And Design Kits

- **Full Software Package**
  - SDK and API, Support Keil & IAR & MCUX
  - Full BT Profile offering
  - Software application package for OTA and QPP



Evaluation board
for full RF performance evaluation

USB adapter
For customer application development


Reference
Designs
SECURE CONNECTIONS
FOR A SMARTER WORLD
| Company Confidential |

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	NXP Design	Description	Quick Links
	Hexiwear - Complete IoT Development Solution	Next generation IoT development platform designed to reduce time to market. Comes in compact form factor with on-boards MCUs, BLE Connectivity, sensors, OLED display, battery. Open source software package includes embedded software, cellphone apps and cloud connectivity. Expandable with 200 additional click boards™	Fact Sheet Buy Software Schematic Design Files Bill of Material (BOM) iOS App Android App
	Quadcopter Drone	The powerful Electronic Speed Controller (ESC) solution combines four separate ESC boards into one and controlled by with a single Kinetis KV4x or Kinetis KV5x MCU.	Software Schematic Design Files Bill of Material (BOM) Application Notes
	Internet Radio Audio Streaming	Demonstrate an easy-to-use internet-radio application.	Software Application Note Brochure
	BLE Controlled Robot	The Bluetooth® Low Energy (BLE) controlled robot brings the robot control to your cellphone. Develop your own smart robot using FRDM-KW40 board and Pololu Zumo Robot.	Software Schematic Design Files Bill of Material (BOM) Application Notes and

NXP Modular Gateway Solution Platform v1.0

Value Proposition:

- Reduce time to market and development costs via modular design for Thread and ZigBee Gateway/Border Router customers
- Reduce project risk and uncertainty associated with wireless connectivity

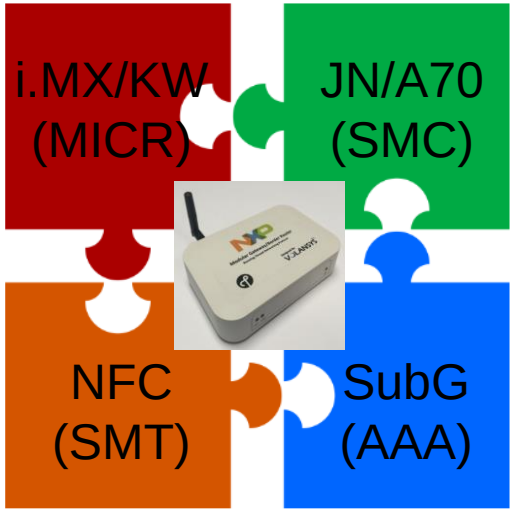
Key NXP Content:

- Hardware, software & services, including all drivers, protocol stacks, and Linux BSP support
  - i.MX 6UL SOM
  - Kinetis KW22D512/KW41Z Module, JN5169/JN5179 Module
  - Kinetis KW41Z Module (TBD)
  - PN7120 NFC, A70CM Sec Elelement
  - Professional Support and Services

Target Segments/Applications:

- Commercial Building/Lighting
- Low Power WAN

Availability: Launch Nov 2016 (electronica)



Cross-PL Core Of NXP IoT

Key Features/Capabilities:

- Thread, ZigBee, WiFi, ENET
- Large Node Networks (>255 nodes)
- Over the Air Programming via Multicast
- Commissioning (BLE Demo, NFC Demo, Smart App)
- WiFi and Ethernet to Cloud
- Smart Phone Apps
- FCC/CE/IC*

SECURE CONNECTIONS
FOR A SMARTER WORLD