

SimpleLink™ Sub-1 GHz

Sensor to Cloud

Long Range Solution



Agenda

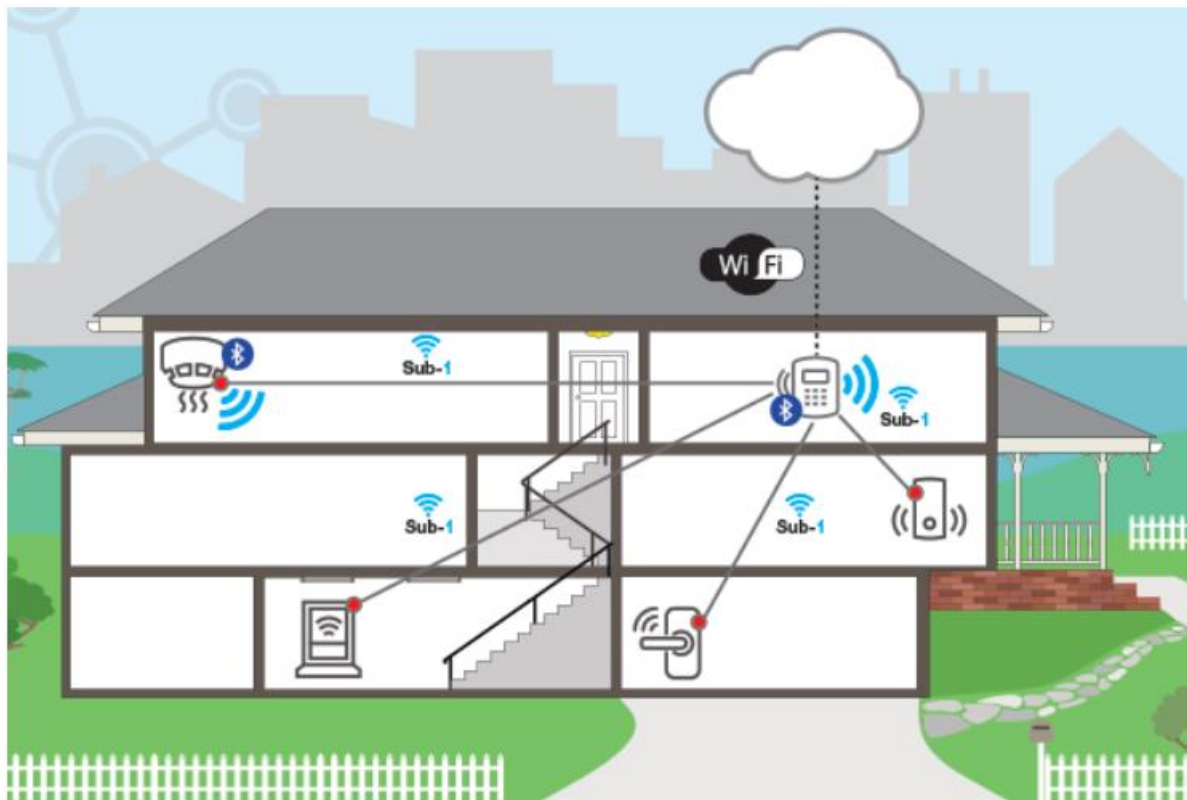
- The challenge with IoT
- Sensor to Cloud solution
- Sensor to Cloud system details
- SimpleLink™ Sub-1GHz hardware & software solution
- Getting started

The challenge with IoT

- We are trying to connect everything, everywhere
- Need a long range, low power, wireless protocol
- Security is critical, regionally regulatory compliance is required
- Sub-1GHz great technology to connect sensor nodes
 - Lacks IP internet connectivity
 - Fragmented area without a standard
- Gateway can provide internet connectivity to the end nodes
- Where do I start?

Home security example

- Trying to connect smoke, motion, & glass break detectors, door & window sensors & security panel
- Range & security are critical
- Thinking to add smartphone connectivity
- Want to monitor remotely from the cloud
- How can this be done easily?



SimpleLink Sub-1 GHz Sensor to Cloud

What is it? Why is it needed?

Fast time to market.

Long range applications to the cloud.

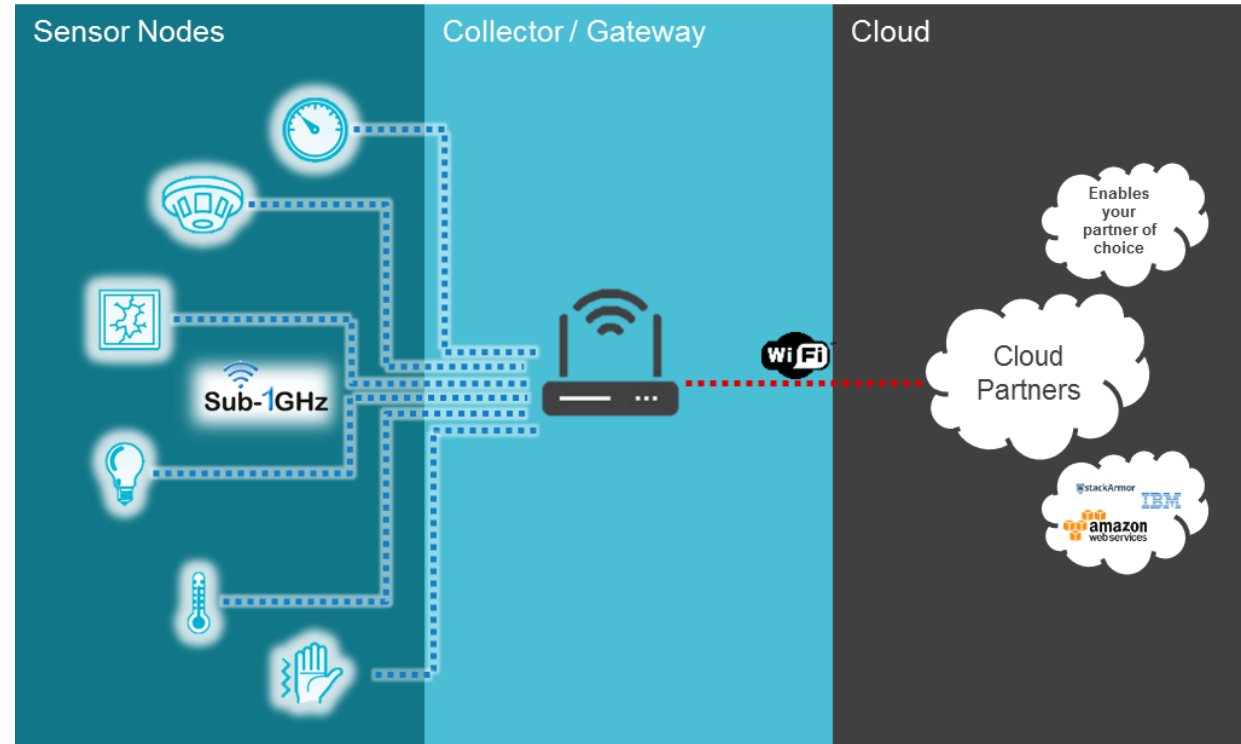
Flexible gateway solution

What is it? An end-to-end solution providing cloud connectivity for sending and receiving sensor data over a long range Sub-1 GHz network.

Why is it needed? The Sub-1 GHz band is very fragmented with no single dominant technology that provides an end-to-end solution for devices to access the cloud over a Sub-1 GHz network. The TI Sensor to Cloud is this solution.

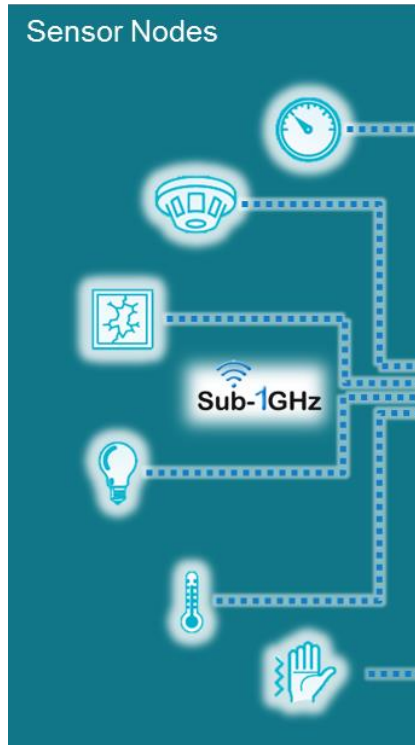
Key Features

- IEEE 802.15.4g star networking solution
- AES-128 encryption and message integrity code
- Frequency hopping enabling robustness
- Scalable cloud integration
- Certification-ready design



SimpleLink Sub-1 GHz Sensor to Cloud

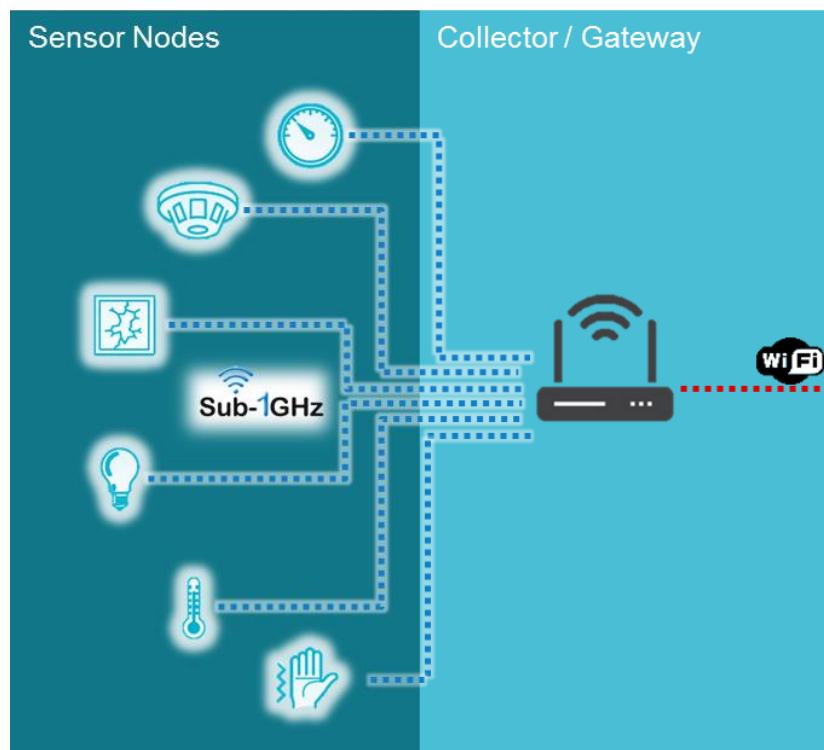
Sensor Nodes



- Ideal for thermostat, light bulb, temperature sensor, glass break detector, and more
- Sensor node example application included in TI 15.4-Stack
- Sensor nodes can be CC1310 or CC1350 devices

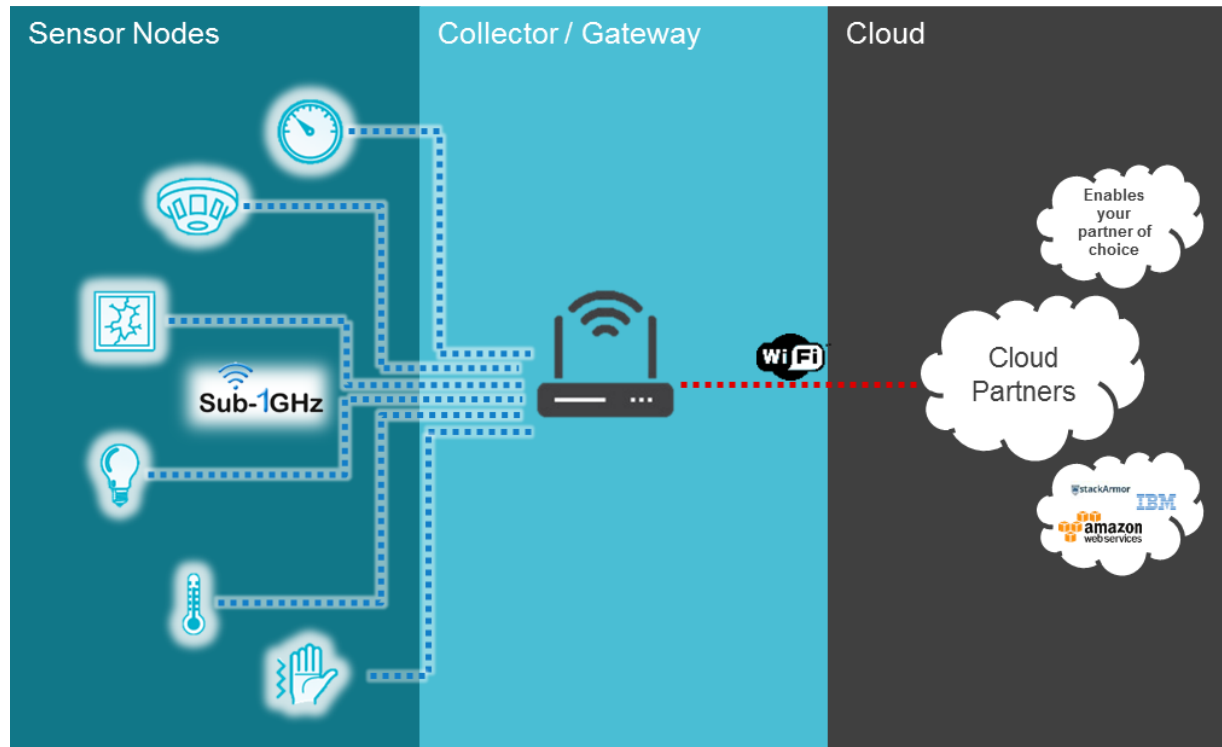
SimpleLink Sub-1 GHz Sensor to Cloud

Collector/Gateway



- Central device in the star network
- Bidirectional link between the nodes and the cloud
- Integrates advanced security features
- Flexible gateway architectures for TI-RTOS and Linux-based solutions

SimpleLink Sub-1 GHz Sensor to Cloud



- IoT Cloud Application communicates to the gateway
- Sensor data can be sent and received via cloud-based interface
- AWS and IBM Watson IoT examples are included with flexibility for any cloud partner

Sensor to Cloud target applications

Wireless foundation for a variety of sectors and end products

Home automation



Thermostat
Door locks
White goods

Smart grid



Flow Meters
E-Meters
Heat cost allocators

Alarm & security



Security alarms
Smoke/CO2 alarms
Security sensors

Retail



ESL / Price Tags
Locationing
Cold chain mgmt

Logistics



Tollroad tags
Asset Tracking

Factory automation



Monitoring sensors
Cable replacement

Agriculture



Irrigation systems
Rodent traps
Animal tracking

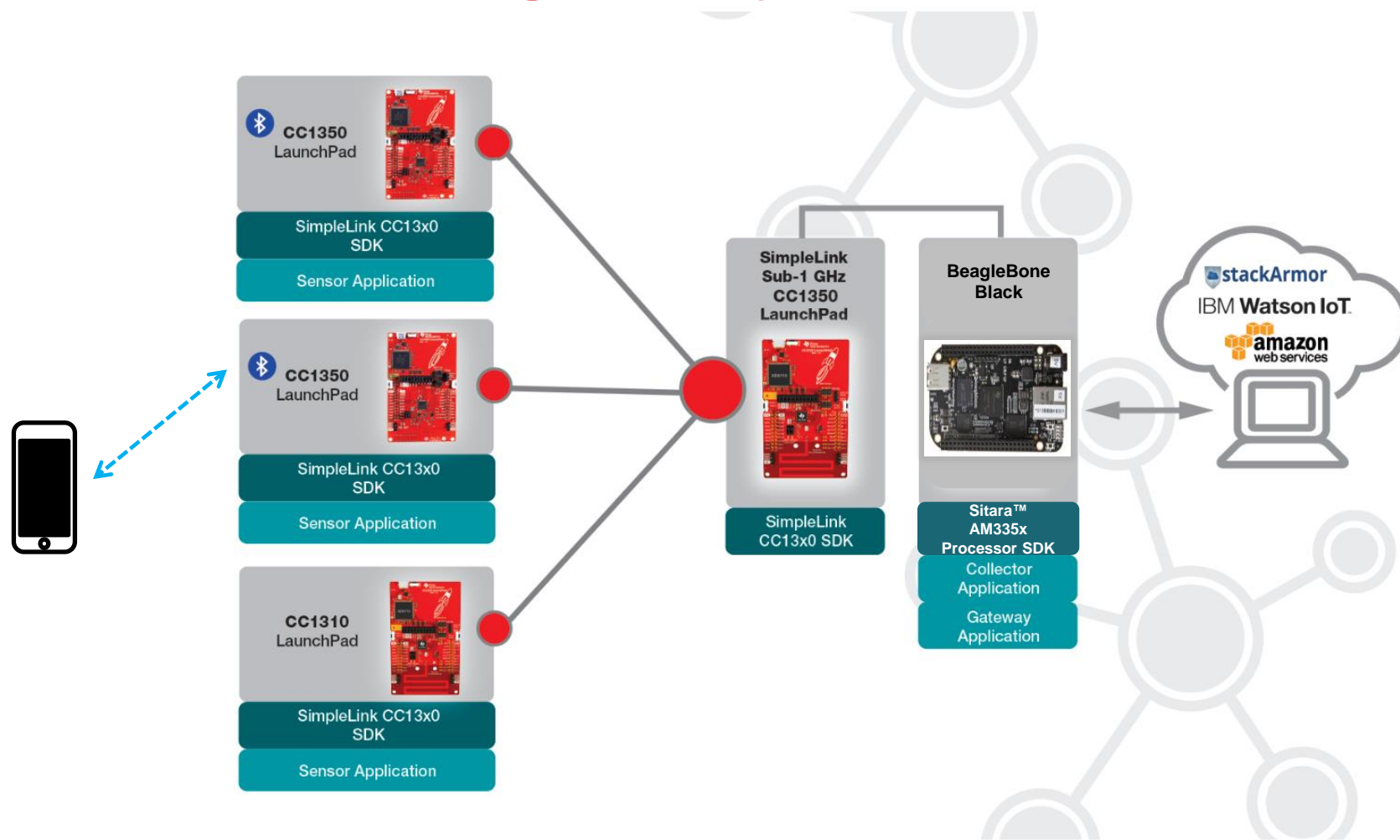
Other



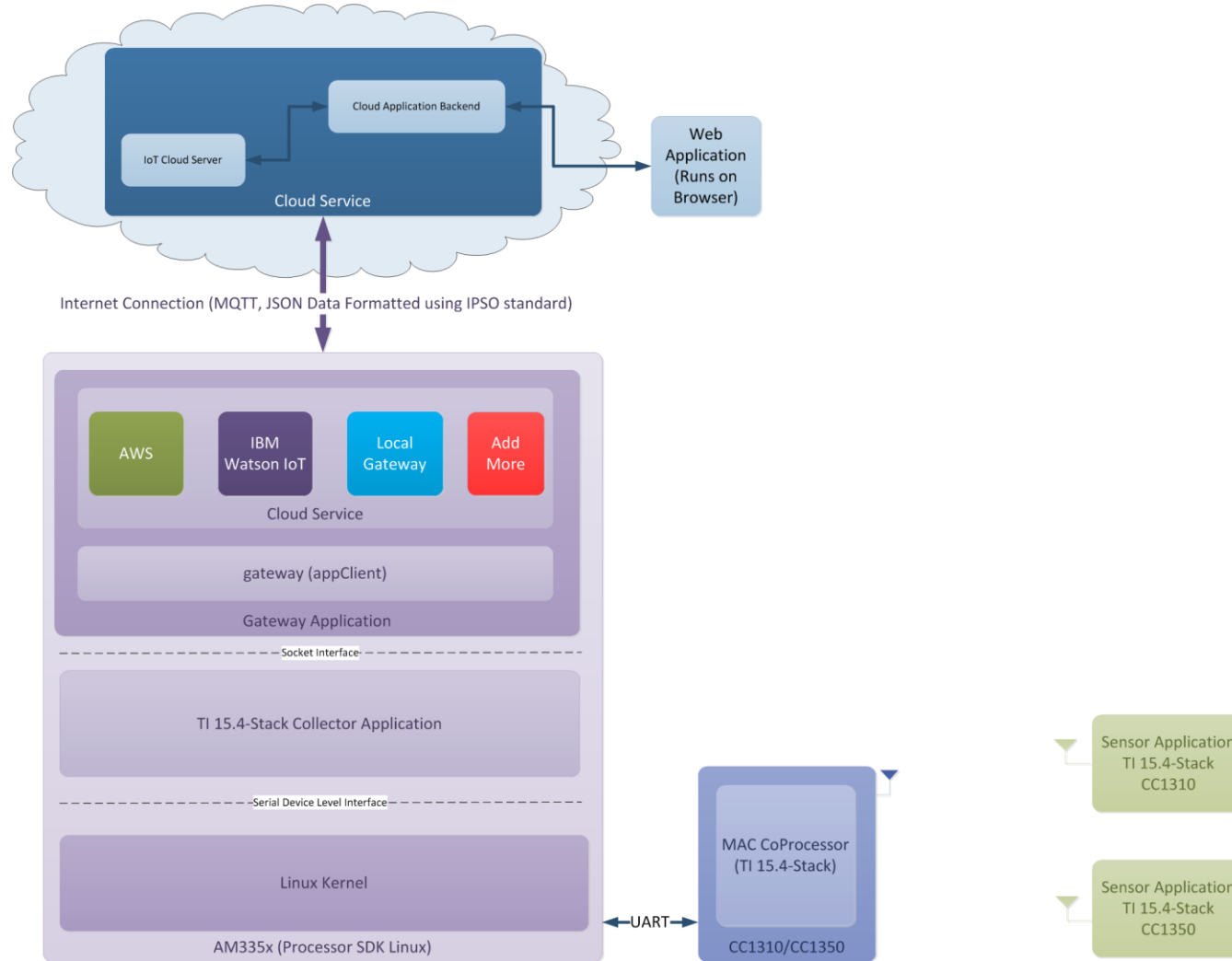
Rescue tracking
RC toys

SENSOR TO CLOUD SYSTEM DETAILS

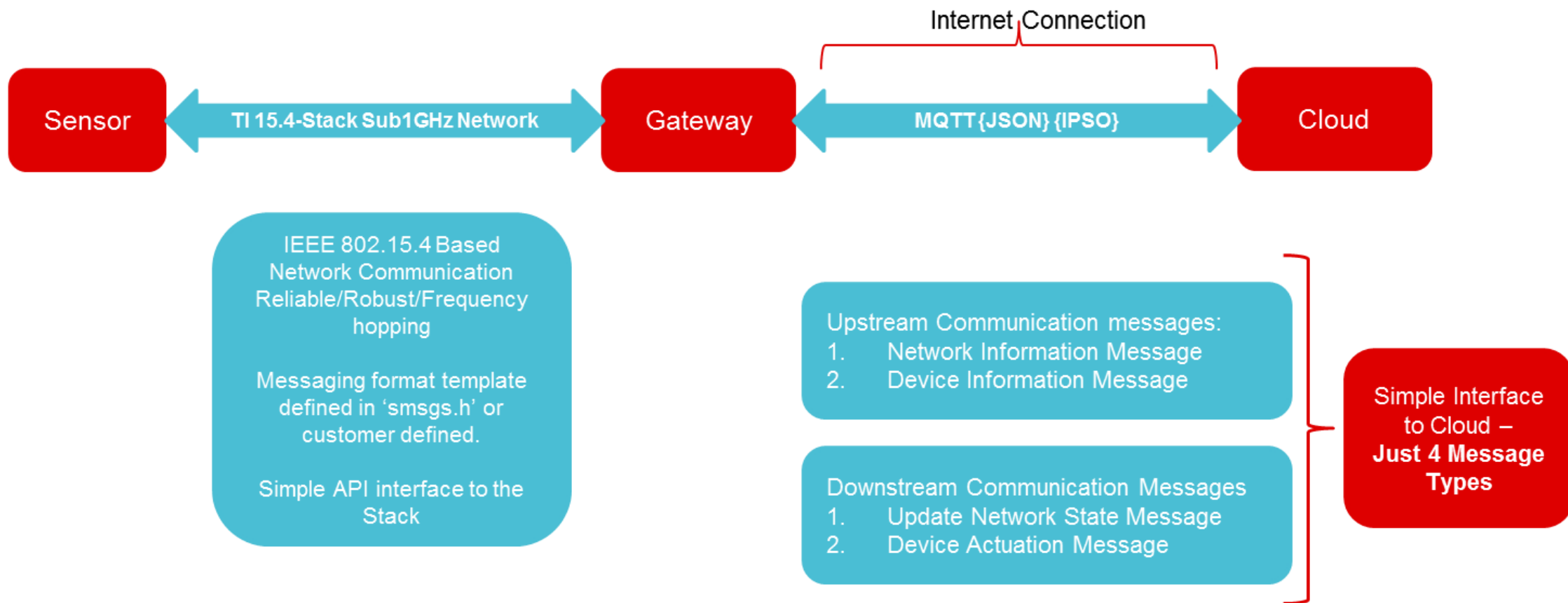
Sensor to Cloud gateway connections



System block diagram – Linux gateway



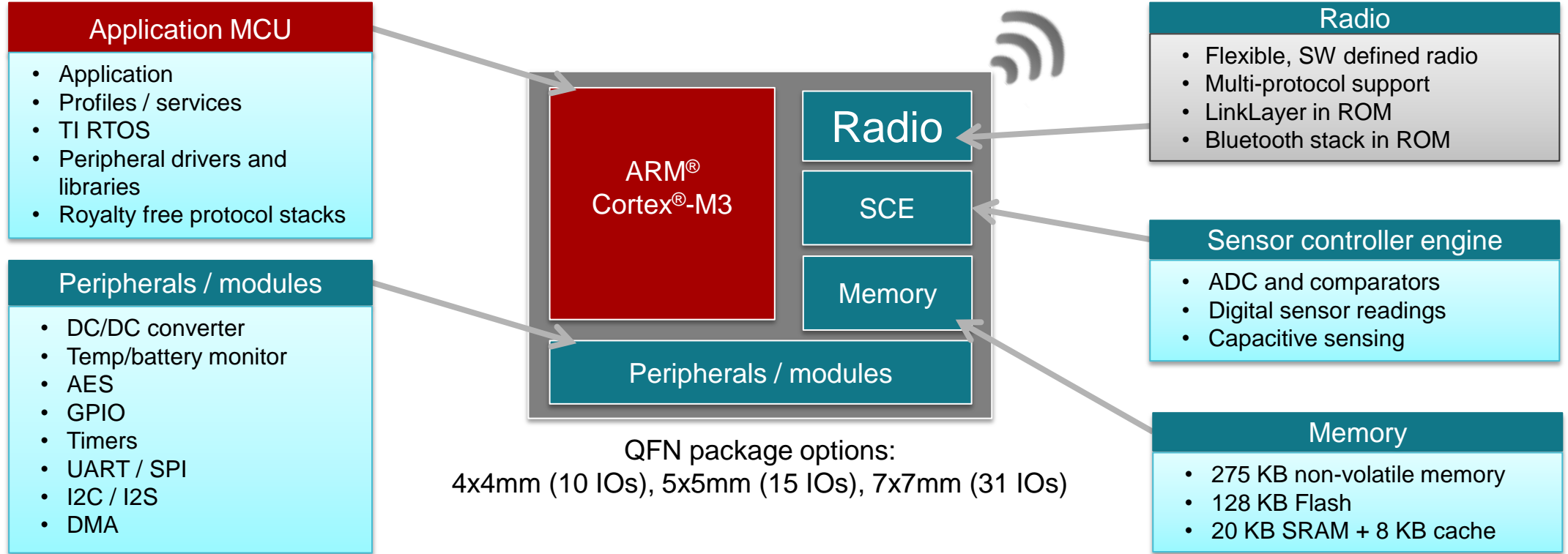
Sensor to Cloud – Deeper Dive



SIMPLELINK SUB-1GHZ HARDWARE & SOFTWARE SOLUTION

SimpleLink CC13x0 wireless MCU

Sub-1 GHz CC1310, Dual-band CC1350



Sub-1GHz



What are key components of a Sub-1 GHz network?

Network Management



- Formation, Discovery
- Joining, Leaving

Security

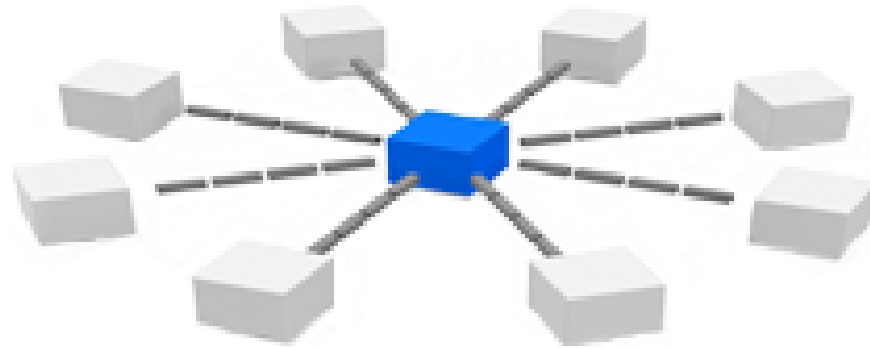


- Encryption
- Message Integrity

MAC




- Medium access
- Addressing
- Packeting
- Frequency Hopping
- Regulatory compliance



What is the TI 15.4-Stack?

Robust, Easy to use, Ultra-low power

A standards-based Sub-1 GHz wireless networking solution




Network Management

- Formation, Discovery
- Joining, Leaving



Network Management

- TI 15.4-Stack Link Management layer



Security

- Encryption
- Message Integrity




Security

- AES-128 Encryption
- Message Integrity Code



MAC

- Medium access
- Addressing
- Packeting
- Frequency Hopping
- Regulatory compliance



MAC

- 802.15.4 standard CSMA\CA
- 802.15.4 standard addresses
- 802.15.4 standard packeting
- WiSun based frequency hopping
- ETSI/ FCC compliant

Key Resources

- [15.4-Stack Video](#)
- [CC13x0 SDK](#)
- [TI 15.4-Stack Linux SDK](#)
- [SDK Overview](#)

What is TI 15.4-Stack ?

Star networking solution based on IEEE standard

Robust



- Supports **sub-1 GHz band**: avoid crowded 2.4GHz spectrum + **Long Range**
- **Frequency Hopping**
- Built-in **acknowledgments and retries**
- **Secure operation**: supports AES encryption and MIC
- **WW support**: 915MHz FCC & 868MHz ETSI and 433MHz

Uncompromised robustness

Easy



- Feature **rich Out of the Box Example Applications**
- Sensor to cloud solutions with **IoT agent reference design**
- Radio resource & **network management**
- **Supports** large networks
- **Dual Band**: Sub1Ghz + BLE support

Accelerate your time to market

Ultra-low power



- Best-in-class CC13xx platform
 - **<6 mA** peak RX current
 - **0.6 uA** sleep current (RTC)
 - Autonomous **sensor controller**
- Protocol designed around **sleepy devices with low protocol overhead**

Very long battery life or energy harvesting

TI 15.4-Stack network configurations

Beacon Enabled Mode



- Coordinator sends out periodic beacon messages
- Networked devices synchronize with beacon and only communicate during the active communication period.
- Beacon contains information on the data pending for the different nodes of the network.

Target Applications:
Large Network Deployments such as
ESL, Large Industrial Sensor
Controller Networks, Asset Tracking

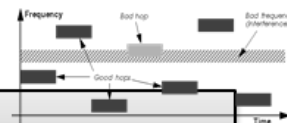
Non Beacon Mode



- Network devices request parent beacon for procedures such as association
- Network devices are free to communicate (using CSMA/CA rules) at any time

Target Applications:
Home Automation, Industrial
Automation, Low Data Traffic
Applications

Frequency Hopping



- Compliant to frequency hopping scheme defined by WiSUN specification
- Always on Devices maintain their hopping sequence which is known to neighbors. Transmitter talks on receivers frequency of operation.
- Sleepy devices sync to PAN-Coordinator Frequency sequence

Target Applications:
Home Automation, Industrial
Automation, Low Data Traffic,
Requiring robustness against
Interference

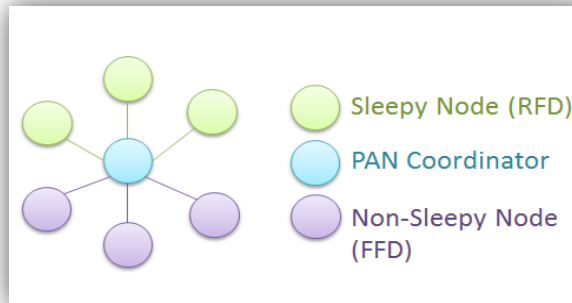
TI 15.4-Stack Example Applications

Collector Application

- Creates a TI 15.4-Stack Low Power Network by starting the device as a PAN-Coordinator.
- Allows new devices to join the network.
- Configures the joining devices for how often to report the sensor data. For sleepy devices it also configures the sleepy node on how often to poll for data.
- Tracks if the devices are active/inactive in the network. It achieves this by sending the tracking request messages to network devices.
- Actuation Example: Demonstrates actuation by sending toggleLed Request message for actuation demo.

Sensor Application

- Joins a TI 15.4-Stack Network
- Reports sensor data at configured interval
- If sleepy, polls for any buffered data from the PAN-Coordinator at configured interval
- Responds to the tracking request messages
- Can be battery powered



GETTING STARTED

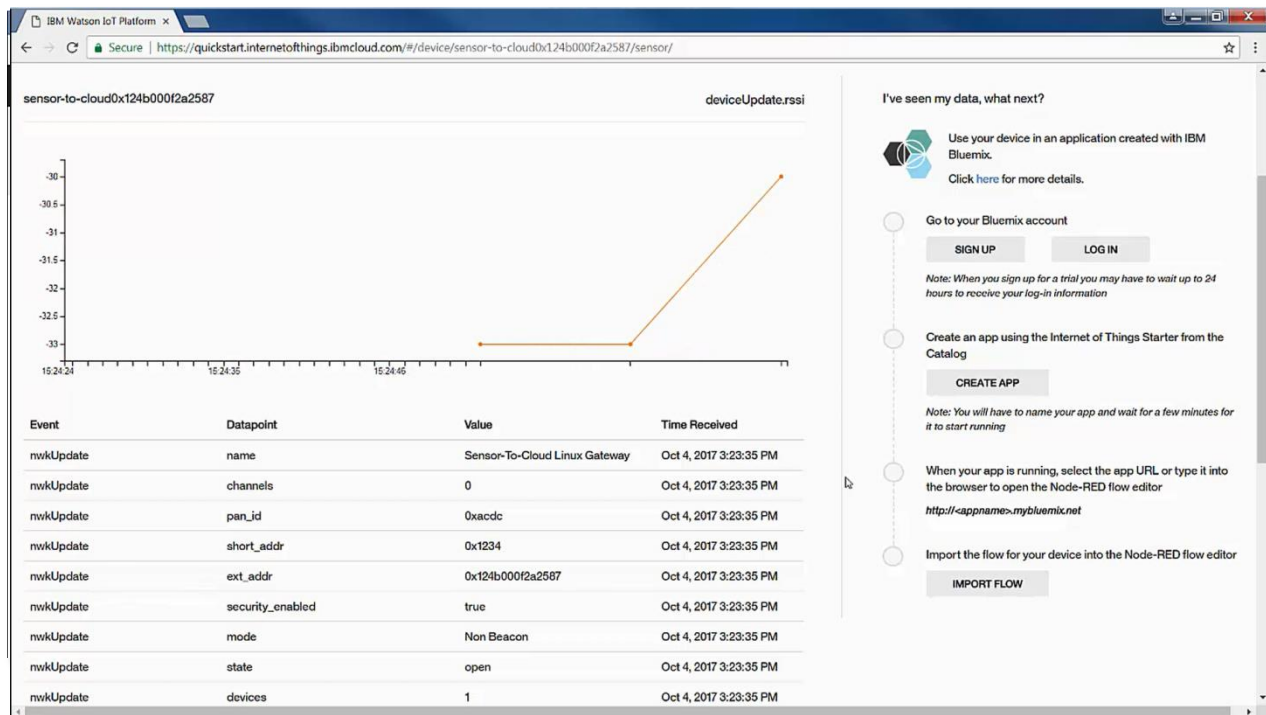
Easily get started

- Out of box ready SimpleLink Sub-1 GHz Sensor to Cloud kit available from element14
- Explore local and cloud gateway options
- Minimize your development time



Simply collect data

- Measure sensor data through web interface
- Real time RSSI data charted using cloud services
- Flexible interface to multiple cloud providers
- Industrial IoT gateway reference design available on ti.com
- Out of box video coming soon!



Resources

SimpleLink MCU Platform

[Overview](#)

SimpleLink LPRF CC13xx Wireless MCU

[CC1310 Overview](#)

[CC1310 LaunchPad](#)

[CC1350 Overview](#)

[CC1350 LaunchPad](#)

[Sub-1 GHz Overview](#)

[BLE overview](#)

SimpleLink SDK featuring Sub-1 GHz TI 15.4-Stack, BLE, and Dual-Band

[SimpleLink CC13x0 SDK](#)

[TI 15.4-Stack Linux](#)

SimpleLink Sensor to Cloud

[Web](#) [Video](#) [Blog](#) [TI-RTOS-based design](#) [Linux-based design](#) [Motion sensor design](#)

Sensor to Cloud kit

[Element14 kit for US](#)

Support and Training

[Training](#)

[TI E2E Support Forum](#)

Ultra-low power. Longer range. Tiny size.

