



TI Innovation Day France 2010

Wireless Networks Innovations

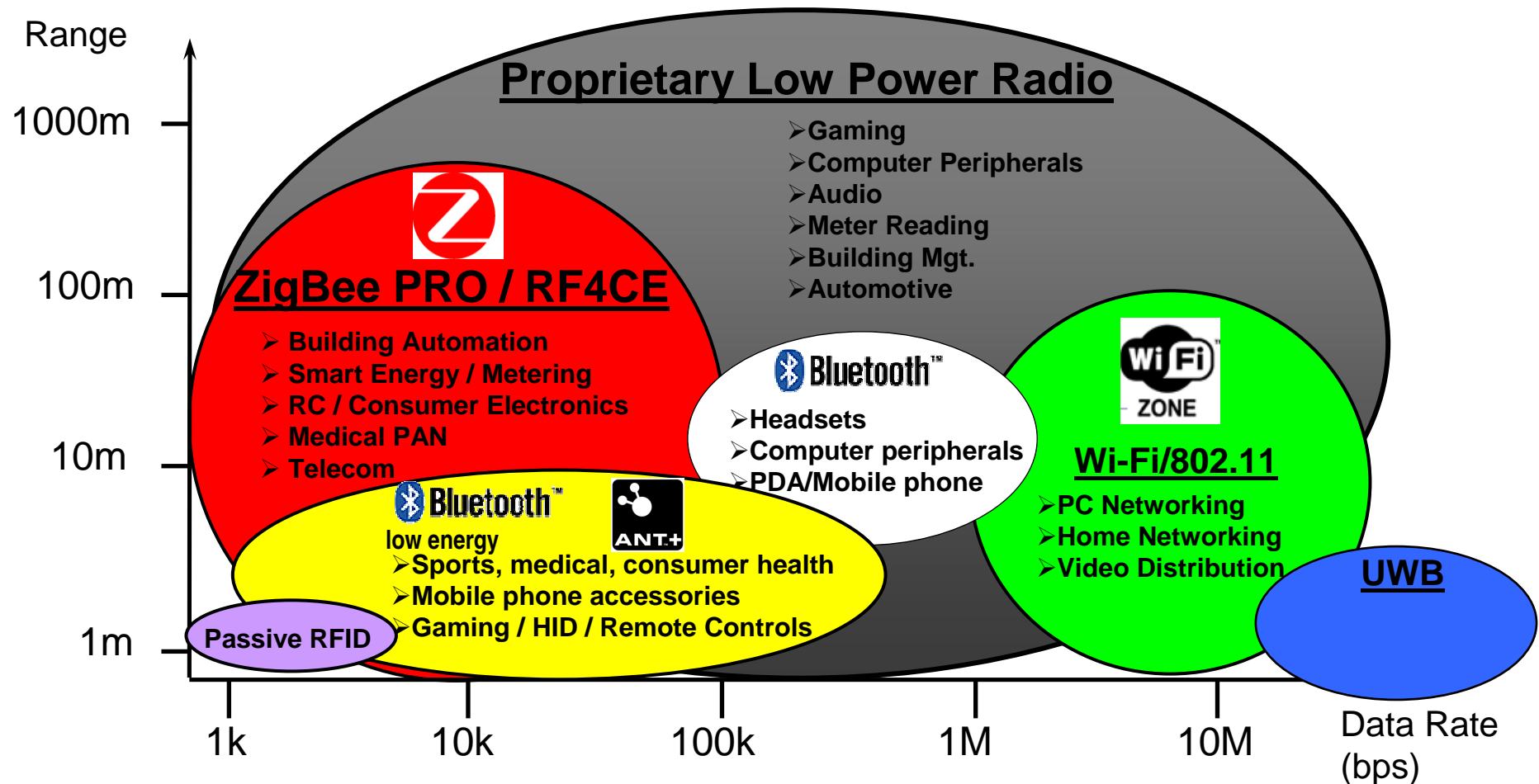
Presenter
Job title

Eric Djackam
Analog FAE

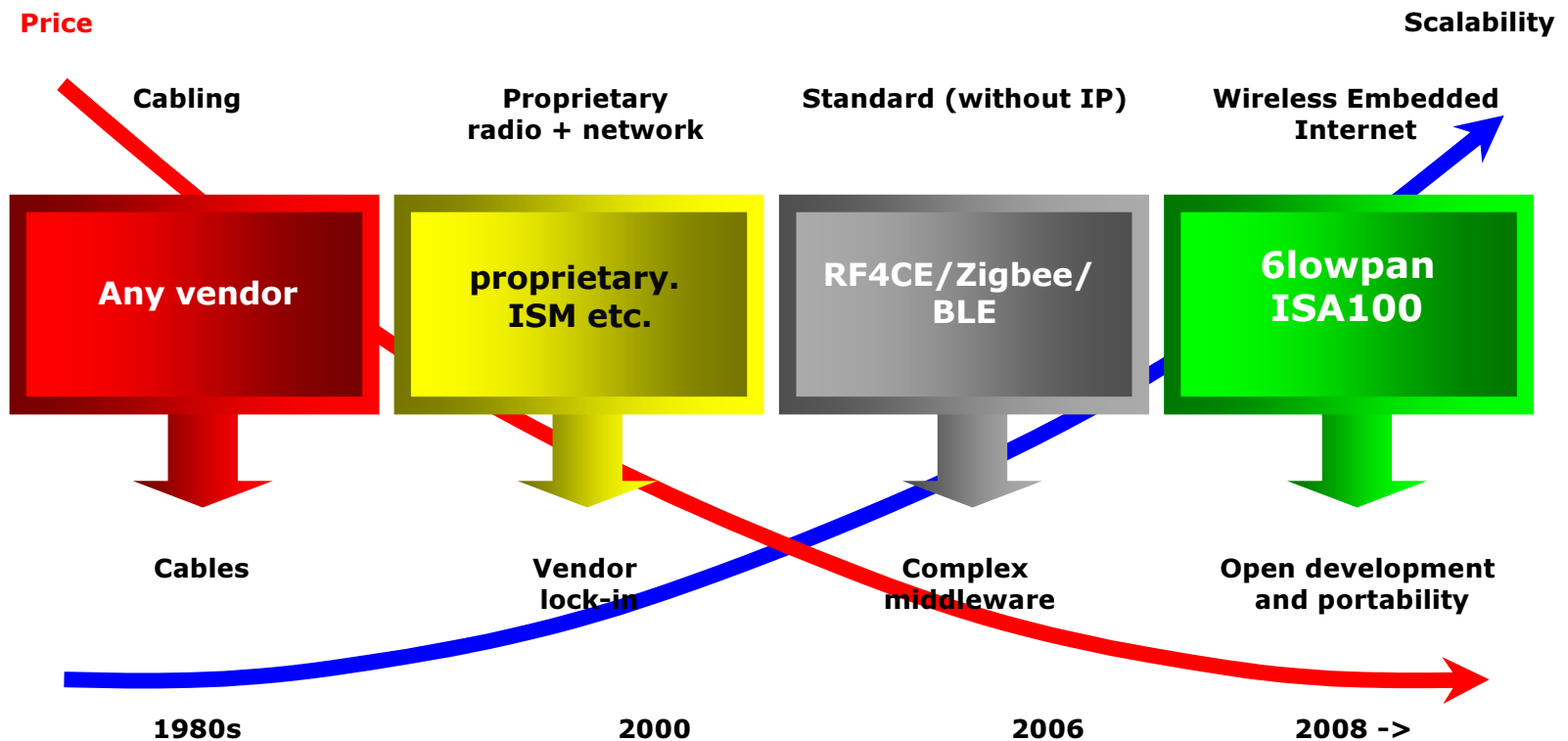
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Nicolas Rescanieres
Digital FAE

Short range communication overview



Standard Vs No Standard?








Agenda

- **Today TI Connectivity Solution**
- **Today TI LPRF Solution**
- **Audio Networking** *Proprietary*
- **Wireless Charging** *Standard*
- **IP Mesh Network** *Standard*
- **Body Network** *Standard*
- **Quizz**
- **Demo**

TI Connectivity Solutions

TI Wireless Connectivity

Passive RF	Active RF					
134KHz & 13.56MHz	Sub 1GHz	2.4GHz			5GHz	
ISO14443 A/B ISO15693 NFC Proprietary	WM-Bus, KNX 6LoWPAN 802.14.4g Proprietary	PurePath Audio 6LoWPAN 802.15.4g Proprietary	ZigBeePRO, RF4CE, IP(6LoWPAN) 802.15.4b	Bluetooth® + Bluetooth Low Energy	WiFi 802.11 a/b/g/n + Bluetooth® + FM	GPS + Bluetooth® + FM
TMS37157 TMS3705 TRF796x TRF7970 LF Interface/ Tag LF Transceiver HDX /FSK HF Transceiver Multi-protocol Dual receive channels, RSSI Integrated Data framing Low power modes	CC1101 CC1110/11 CC430 CC1120/25 169/315/433/510/ 868,915,950MHz FSK, 4FSK. OOK/ASK, MSK 8-32K Flash, AES128 Wake-on-radio Full speed USB Low power 3rd Party Modules	CC8520 CC2500 CC2510/11 2.45 GHz band CC8520 PurePath Wireless Audio 8-32K Flash, AES128 Wake-on-radio Full speed USB Ultra Low power 3rd Party Modules	CC2533 CC2530 CC2520 RF4CE ZigBee Pro / IP 103dB link budget Low power-(26mA TX/18.5mA RX) 32-256K Flash, ADC, AES128, CC2533 IR generator USB option Best Selectivity /Co- existence 49dB) 3rd Party Modules	CC256x CC2570 CC2540 Bluetooth® 3.0, ANT Bluetooth Low Energy Sensitivity < -94dBm TX Power > 12dBm BT/BLE/ANT: 256x Single mode BLE: 2540 Integrated Host: 2540 HCI-only: 256x 3rd party module MS430 Platform Free RTOS	WL127x <small>WLAN only also Available</small> 802.11 a/b/g/n Bluetooth® 2.1+EDR FM Rx and Tx Low Power Modes <70uA Sleep FCC/IC/CE/C-Tick Certified Module BT/WLAN coexistence 3rd party module CortexA8 Platform Linux / WinCE	NL55xx <small>GPS only also Available</small> GPS +/- Bluetooth® 3.0+ EDR FM Rx and Tx Low Power Modes <20mW Tracking <130mW Acquisition Improved Sensitivity 40 Channels for TTFF -162dBm tracking ~1sec Hot Start 3rd party module CortexA8 Platform Linux / WinCE
 PaLFI Dev Kit	 2x EVM+Antenna MSP430 based	 RF4CE/ ZigBee Kits	 MSP430+ CC2560 Platform	 OMAP3 EVM		

TI Low Power RF Offer

Low-Power RF Protocol Overview

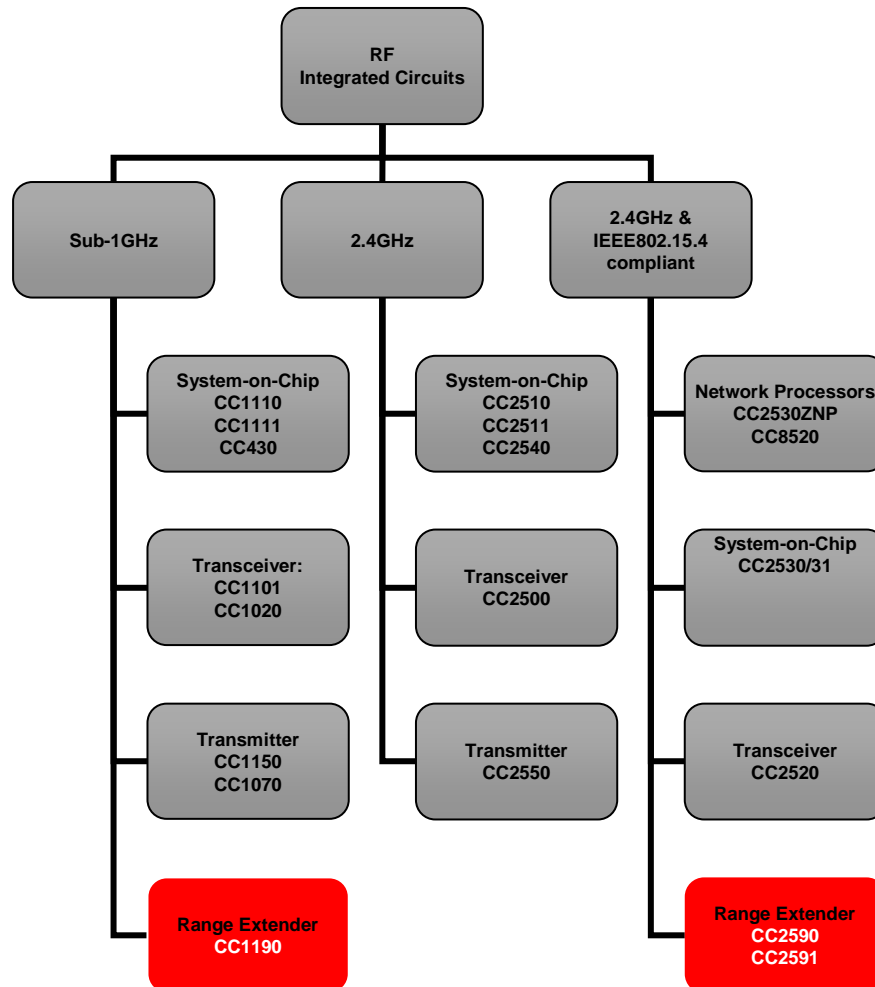
Bluetooth Low Energy	6LowPan	Zigbee / RF4CE	IEEE 802.15.4	SimpliciTI	Proprietary	Solution / Layers
Design Freedom	Design Freedom	Design Freedom	Design Freedom	Design Freedom	Design Freedom	Application
BLE Stack	Nano Stack	Z-Stack/ Remo TI	Design Freedom	Design Freedom	Design Freedom	Higher Layer Protocol
BLE MAC	6LowPan MAC	TI MAC	TI MAC	SimpliciTI	Design Freedom	Lower Layer Protocol
CC2540	CC430 CC1180NWP	CC2530 CC2530ZNP	CC2530 CC2430 MSP430+CC2520	CC111x, CC251x MSP430+CC1101 or CC2500	all LPRF devices	Physical Layer
2.4 GHz	2.4 GHz	2.4 GHz	2.4 GHz	2.4 GHz Sub 1 GHz	2.4 GHz Sub 1 GHz	RF Frequency

* ZigBee, BLE define application user profiles

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TI Low Power RF Hardware Overview



- Easy to use
- System Integration
- Collaterals

TI Low Power RF Tools

Hardware



Evaluation Module Kits

2 RF EMs
2 Antennas



USB Dongles

CC1111/CC2511/CC2531



Development Kits

All the hardware you need to get started right out of the box

Software



RemoTI

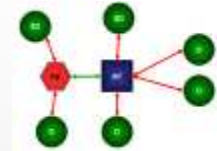
RF4CE-compliant stack

TIMAC

IEEE 802.15.4 MAC

Bluetooth low energy
Compliant protocol stack

Software Examples



SimpliciTI

Simple network protocol

Demos

eZ430-RF2480

ZigBee Network Processor



CC2510 & CC1110 Mini DK

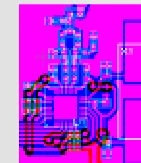
Low Cost CC1110/CC2510 kits

eZ430-RF2500

Low Cost RF development tool



Reference Designs



Reference Design

Gerber files, BOM and schematics available for all devices

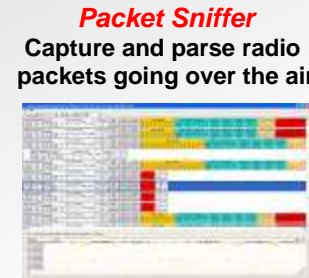
Copy and reuse as is

PC Tools



Smart RF Studio

Evaluate and configure TI RF ICs



Packet Sniffer

Capture and parse radio packets going over the air

Design Support



Online Community

Discussion Forums, videos and blogs



Application Notes & Design Notes

Technical information giving developers a head start

Training Workshops

Hands on - ranging from RF basics to software development

LPRF Developer's Network

Tools and solutions from 3rd parties

TI Low Power RF *at a glance*

2.4 GHz

Sub 1 GHz

Alarm and Security



CC111x

Sub 1 GHz SoC
32KB Flash, USB 2.0
0.3 uA sleep current



CC1101

Sub 1 GHz Transceiver
+ MSP430 MCU,
500 Kbps
-112dBm sensitivity

Remote Controls

CC2530/1/3

RF4CE
IEEE 802.15.4 compliant
System on Chip
RemoTI SW



CC2500

2.4 GHz Transceiver
+MSP430 MCU
Proprietary solution



Smart Metering



CC2530

ZigBee
System on Chip
IEEE 802.15.4 compliant
+ CC259x Range Extenders

CC1020

Narrowband
12.5 KHz channel spacing
-118dBm sensitivity

CC1190

850-950 MHz Range Extender

CC2530ZNP

Network Processor
fully certified ZigBee Pro
Software Stack



CC2431

Location Tracking
System on Chip
Solutions



Low Power RF

Wireless Audio

CC8520

PurePath™ Wireless
Coming Soon
High Quality
Wireless Audio

CC259x

2.4 GHz Range Extender



Medical, Health & HID

CC2570/1

ANT RF Network Processor
Coming 3Q10

CC2540

Bluetooth Low Energy
Coming 3Q10
BLE compliant SoC



CC251x

2.4 GHz Radio
Complete SoC,
32 KB Flash, USB



Home Automation & Lighting

PurePath Wireless / CC85XX

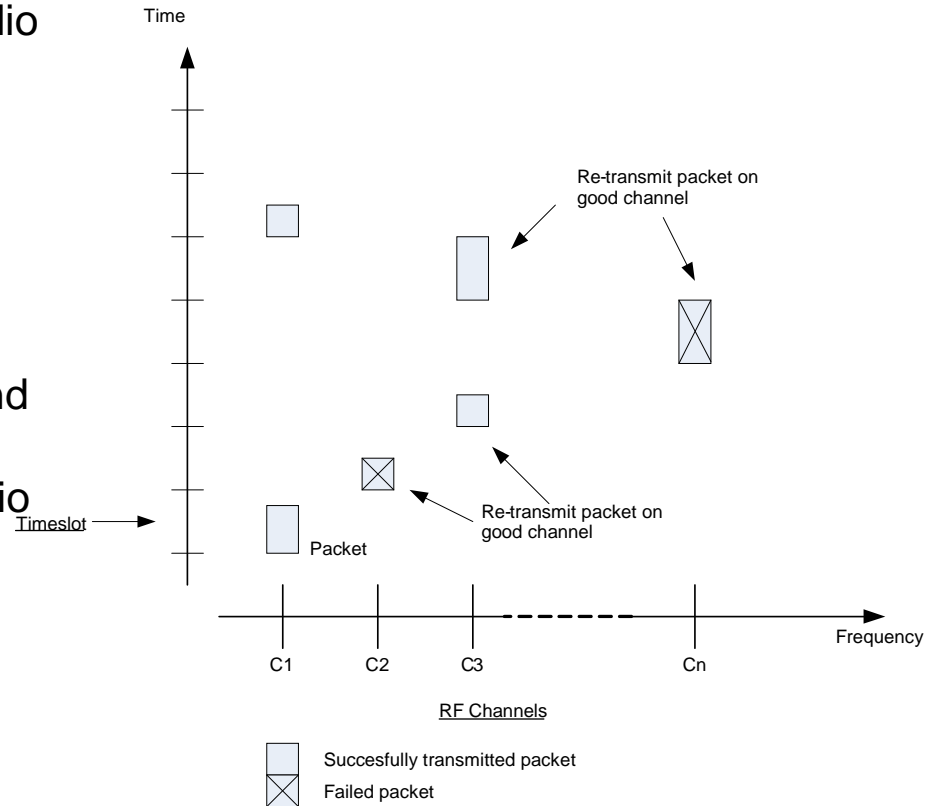
Uncompressed wireless CD quality audio streaming.



Why PurePath Wireless?

-> Robust audio link

- PPW is uniquely designed for wireless audio applications to ensure a very robust link
- Built-in RF protocol with interleaving, interpolation, forward error correction and retransmissions
- 5Mbps radio with only 3.8MHz occupied bandwidth helps achieve low duty-cycle and more RF channels to work with when transmitting audio – and a very robust audio link

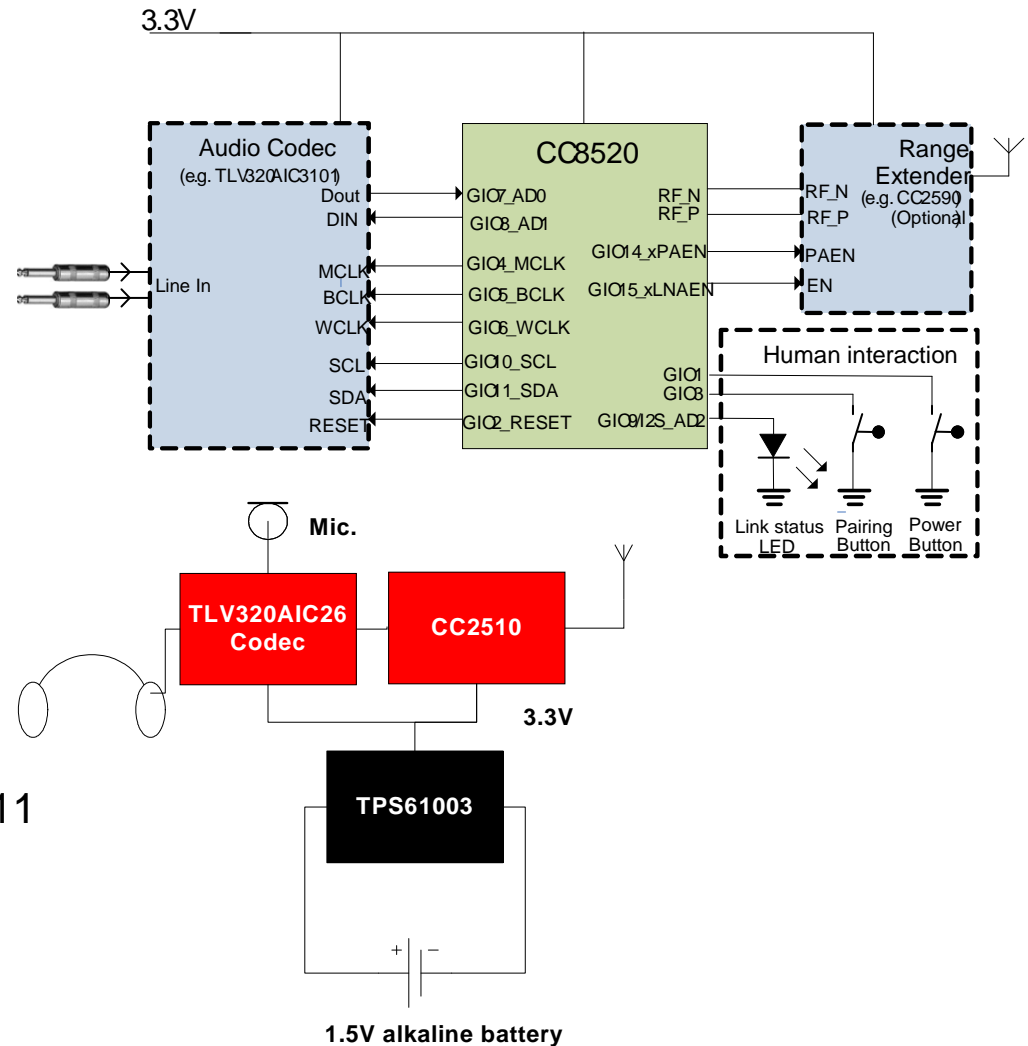


Diversity in frequency and time improves link quality in 2.4GHz band

Why PurePath Wireless?

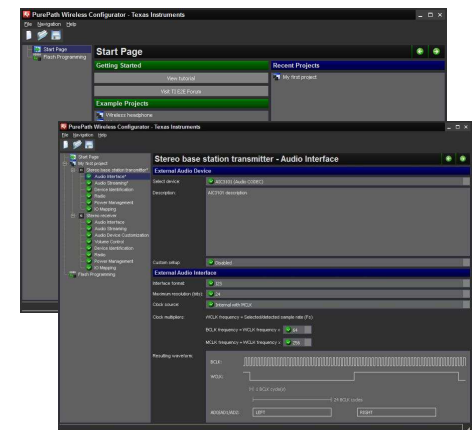
-> simple block diagram and design

- No MCU needed to make wireless audio application
- CC8520 can configure external audio devices:
 - Selected TI codecs and DSPs
 - Generic mode for custom audio device (using I2S)
- CC8520 handles human interaction:
 - Status network LED
 - Power button, volume buttons, pairing button
- Wireless Subwoofer: CC8520 +TAS5711



Application Example: 20W Stereo Wireless Subwoofer

- No software development needed
- Reference design for antenna design available from TI

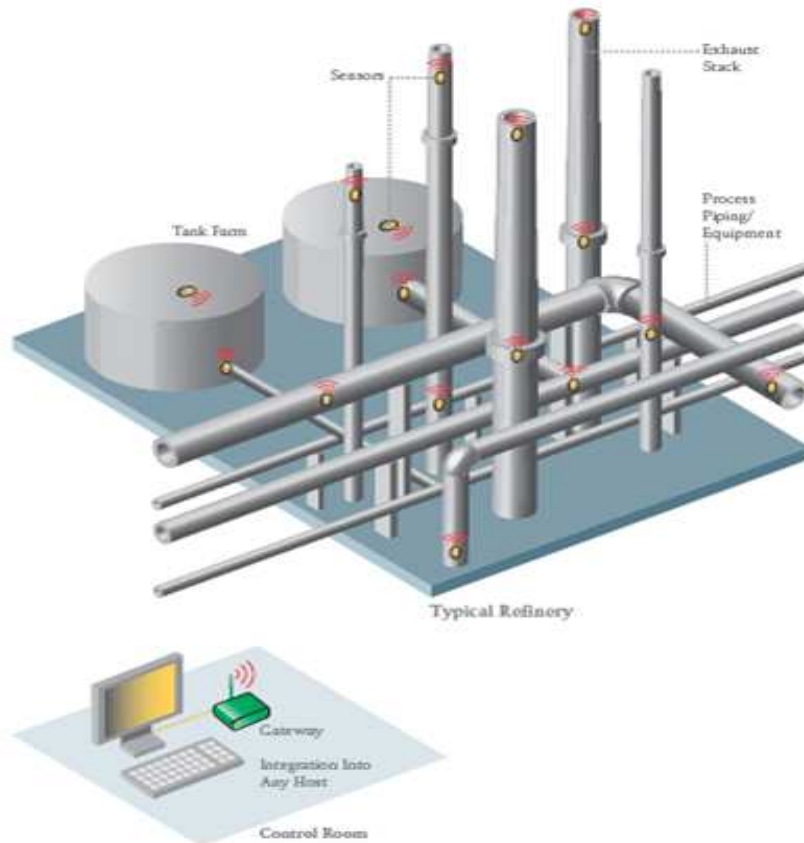


Network with Standard

- IP mesh network
 - 6LoWPAN
 - ZigbeeIP
- Body area Network
 - Our bluetooth solution
 - Bluetooth Low Energy

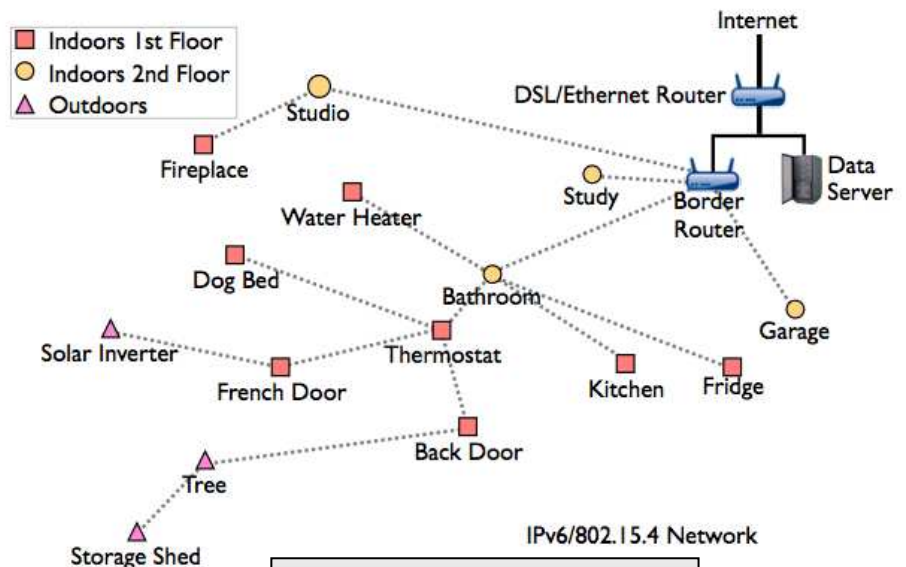
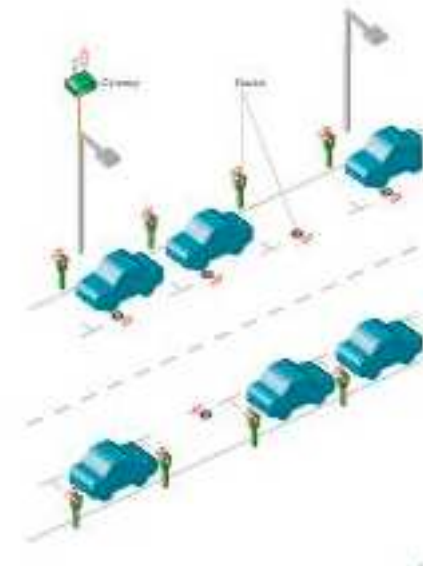
IP Mesh Network

Mesh network



Industrial process monitoring

Smart-Cities



Home-Automation

Why IP?

Low power mesh network of sensors will feed all the existing systems with quantity of data we have never known

- IP is a standard robust, known by lots of engineers
- IP is the hart of internet and our high tech society
- Data processing (database, software) seats over networking tech.
- Internet is a mesh network
- All our SW infrastructures is based on IP and networking

Which IP?

- IPv4 address range is already full

32 bits address -> 4 Billion addresses

We need more!!

- IPv6 proposes 128bits addresses

Address range : 3.4028236692093846346337460743177e+38

340 billion of billion of billion of billion addresses

IPv6 addressing versus payload

Example : I want to transmit 1 byte



Uncompressed IPv6 + UDP header

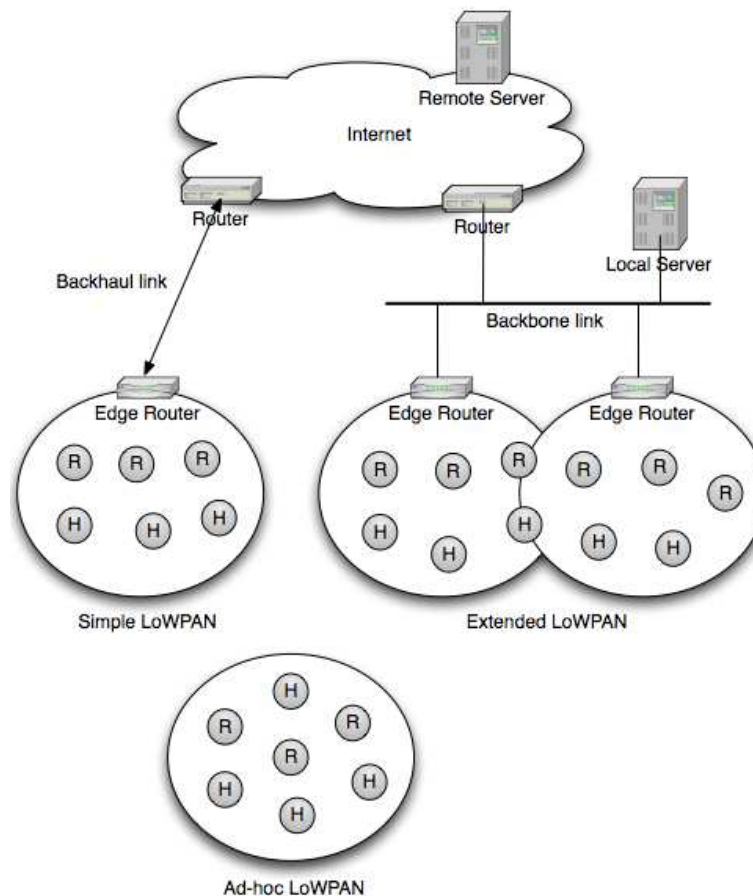


Compressed 6LoWPAN + UDP header

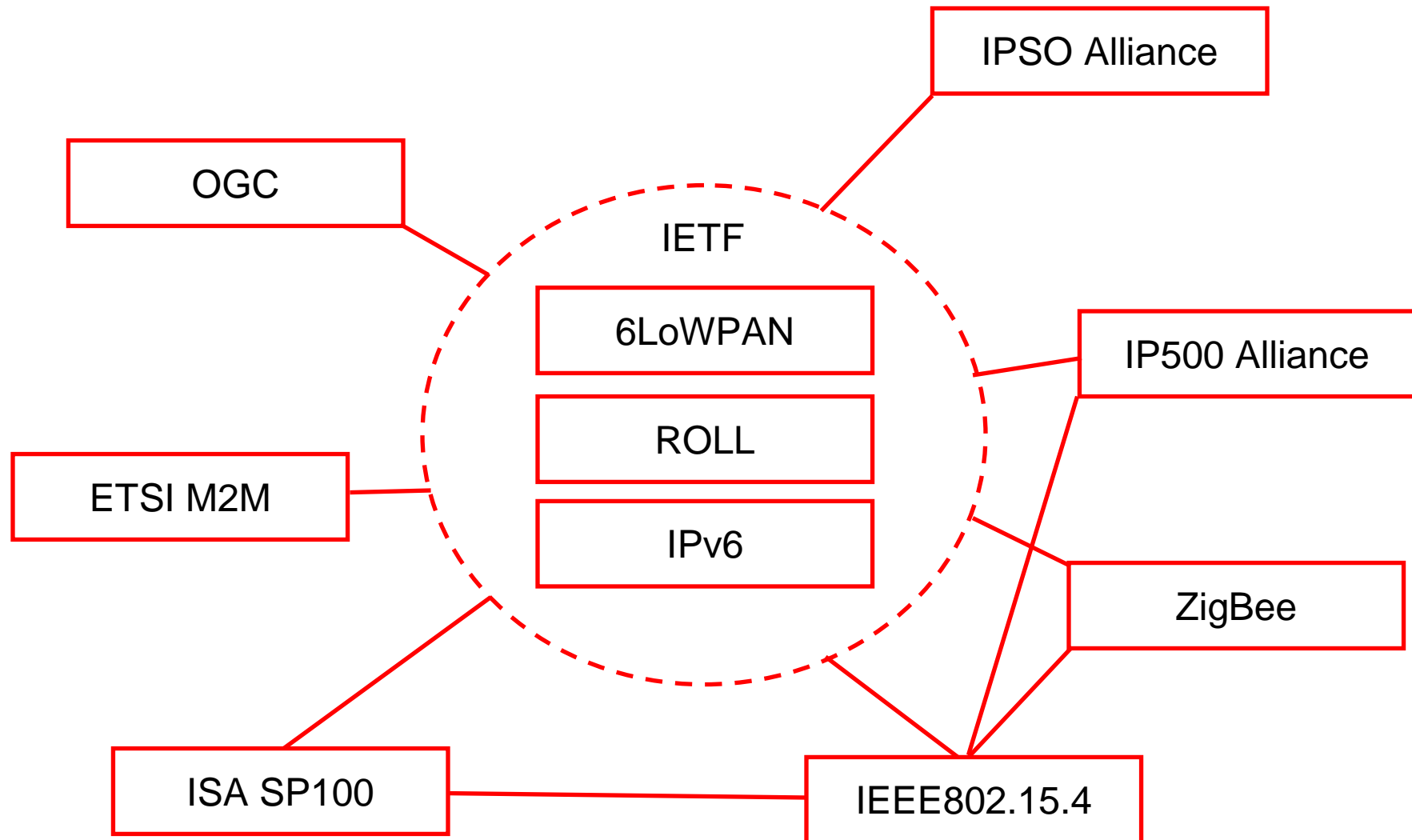
6LoWPAN

How to root over RF mesh network?

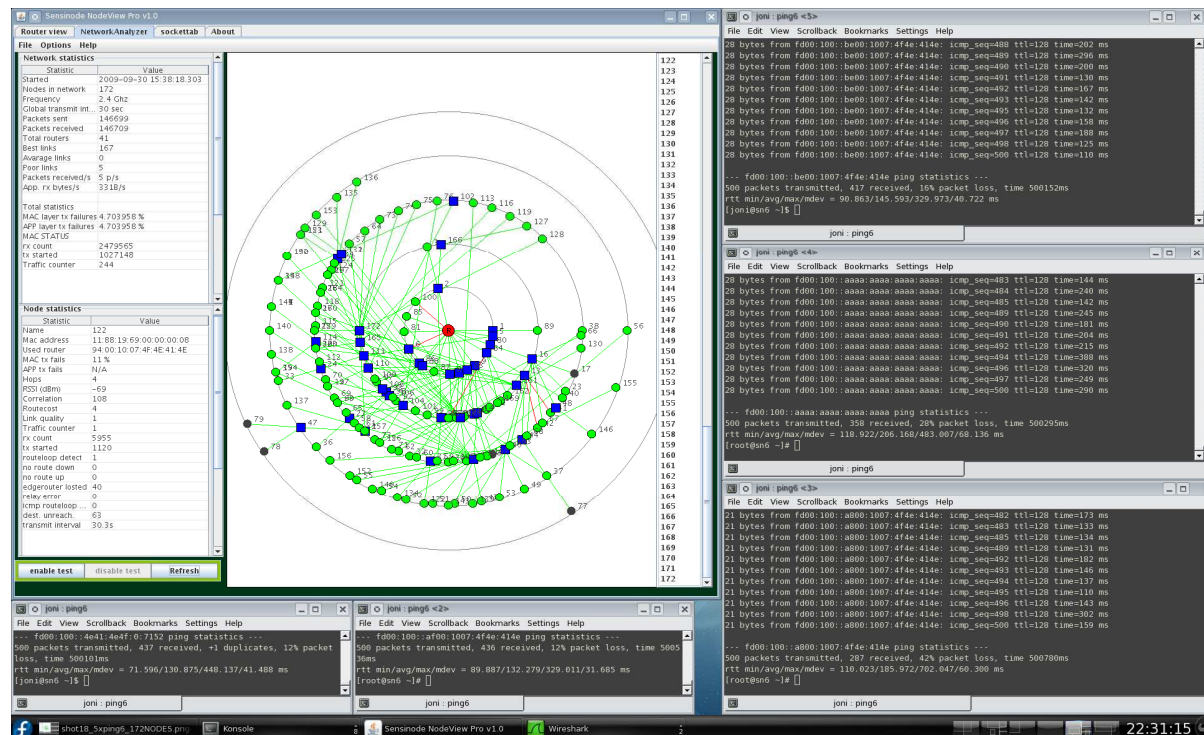
- Need to invent a new routing mechanism taking into account availability of nodes, quality of radio linked, : ROLL and RPL



Synthesis

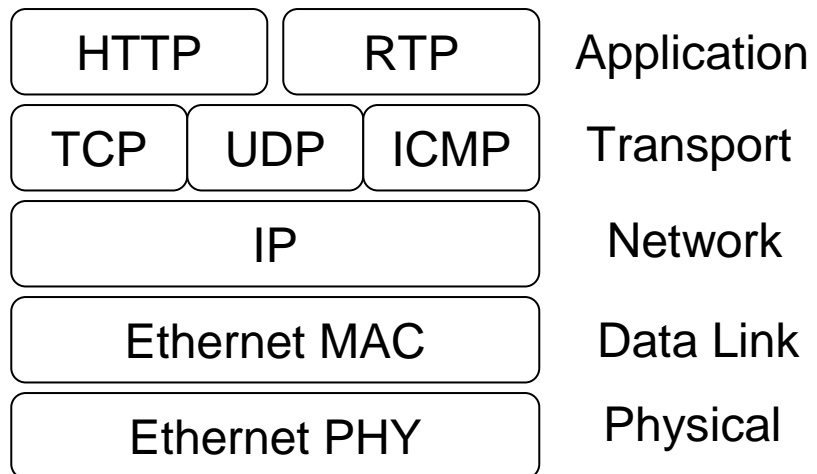


TI 6LoWPAN offering

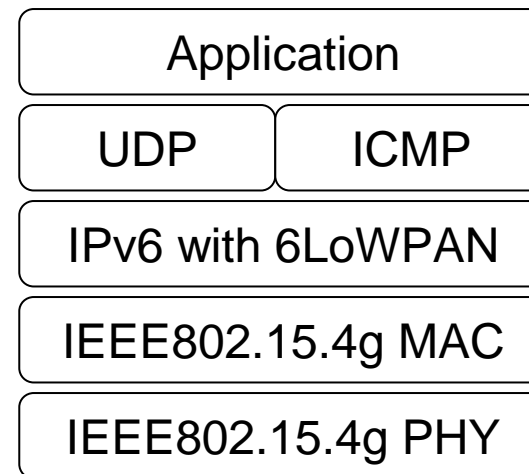


TI 6LoWPAN Network

TCP/IP Protocol Stack



6LoWPAN Protocol Stack



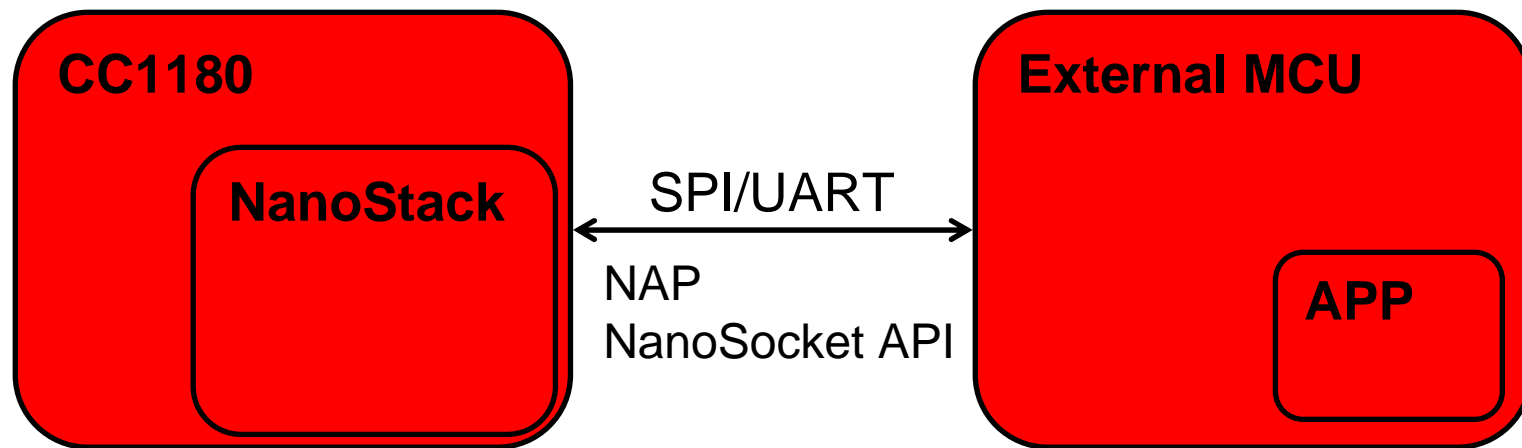
TI 6LoWPAN socket API

- The Socket API provides access to data communications for applications
- Well-known interface for handling data flow and buffer management via socket
- Supports also control messages to protocols
- Commands include:
 - socket, bind, send, read, close etc.

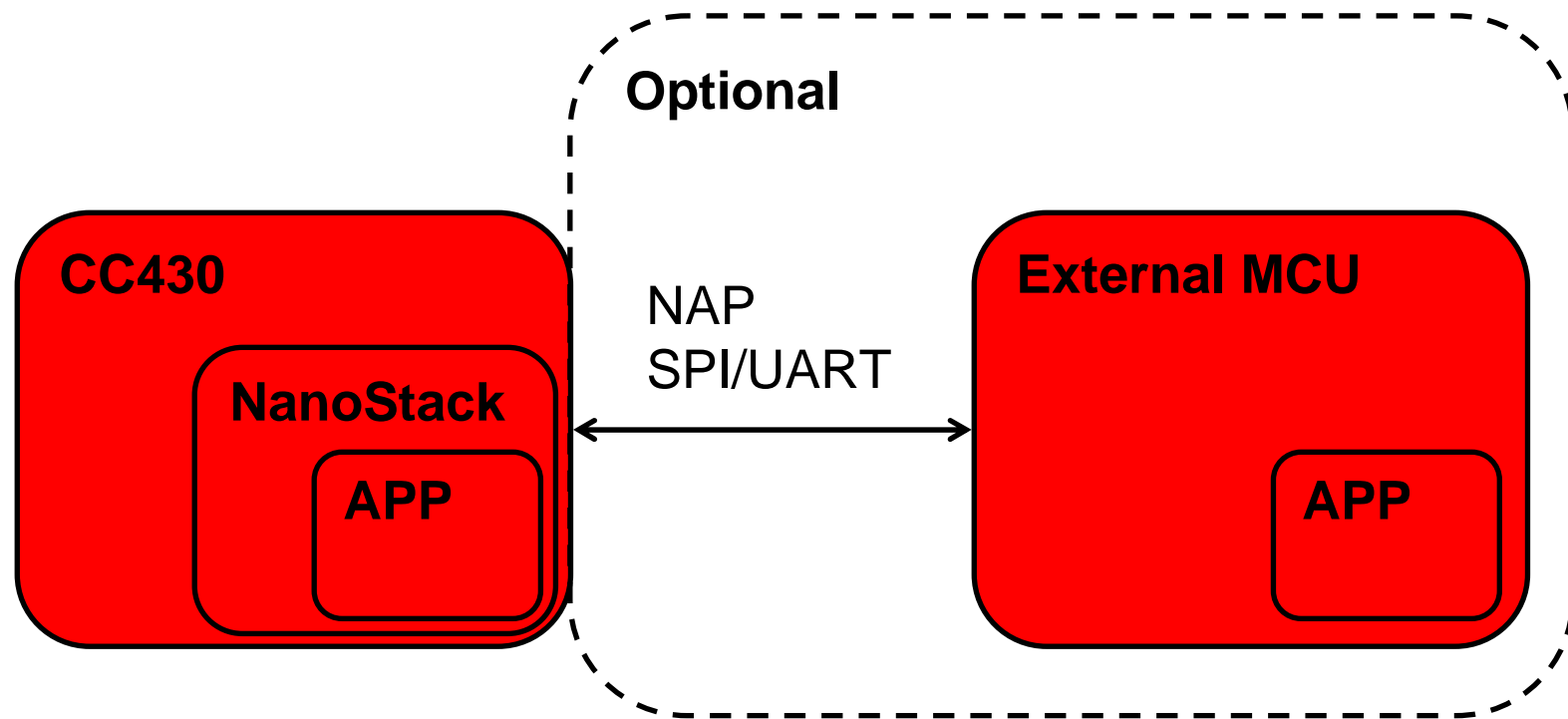
TI 6LoWPAN Solution

- The TI sub-GHz 6LoWPAN solution is based on the widely adopted CC1101 radio technology
- TI will initially support two use models
 - Single chip system with CC430 running both stack and application
 - CC1180 Wireless Network Processor (WNP) system where the WNP handles all protocol related tasks with the application running on a dedicated host MCU e.g MSP430x
- Both models have the same simple API (socket approach) and are fully interoperable
- Release of CC-6LOWPAN-DK-868 kit demonstrating both use models
- Kit out-of-the-box experience:
 - Power up network nodes
 - Connect Edge Router (Gateway) to your network (Ethernet)
 - Ping wireless nodes + run simple demo application

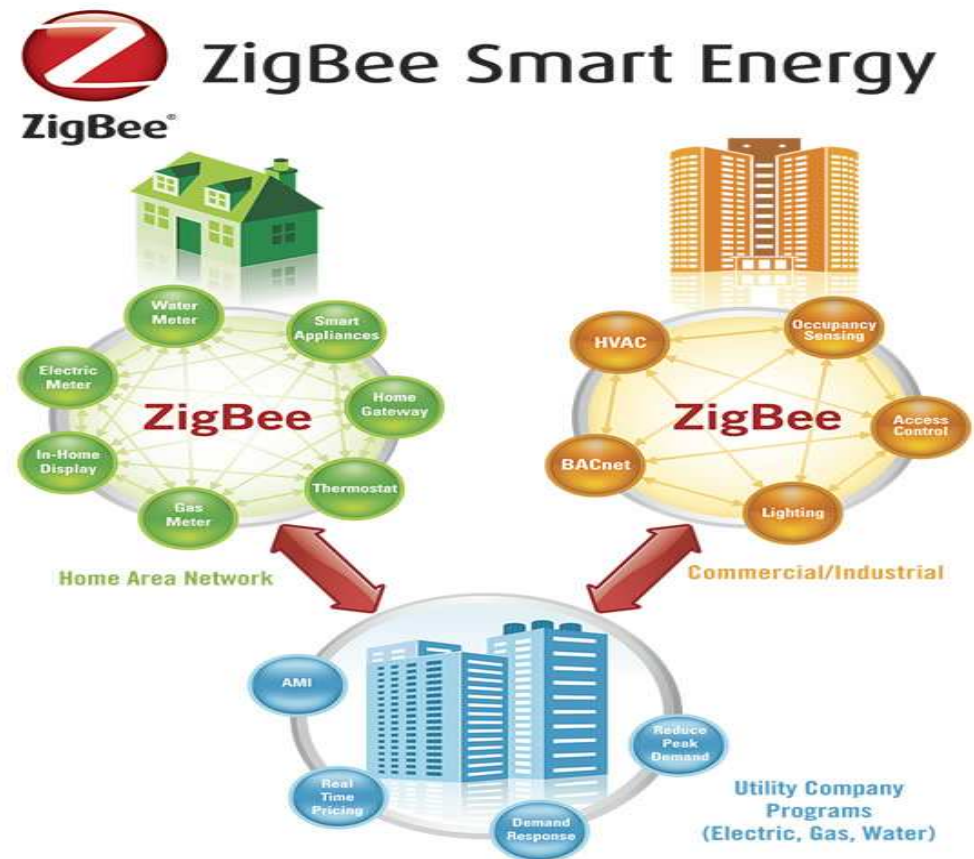
Using CC1180 WNP



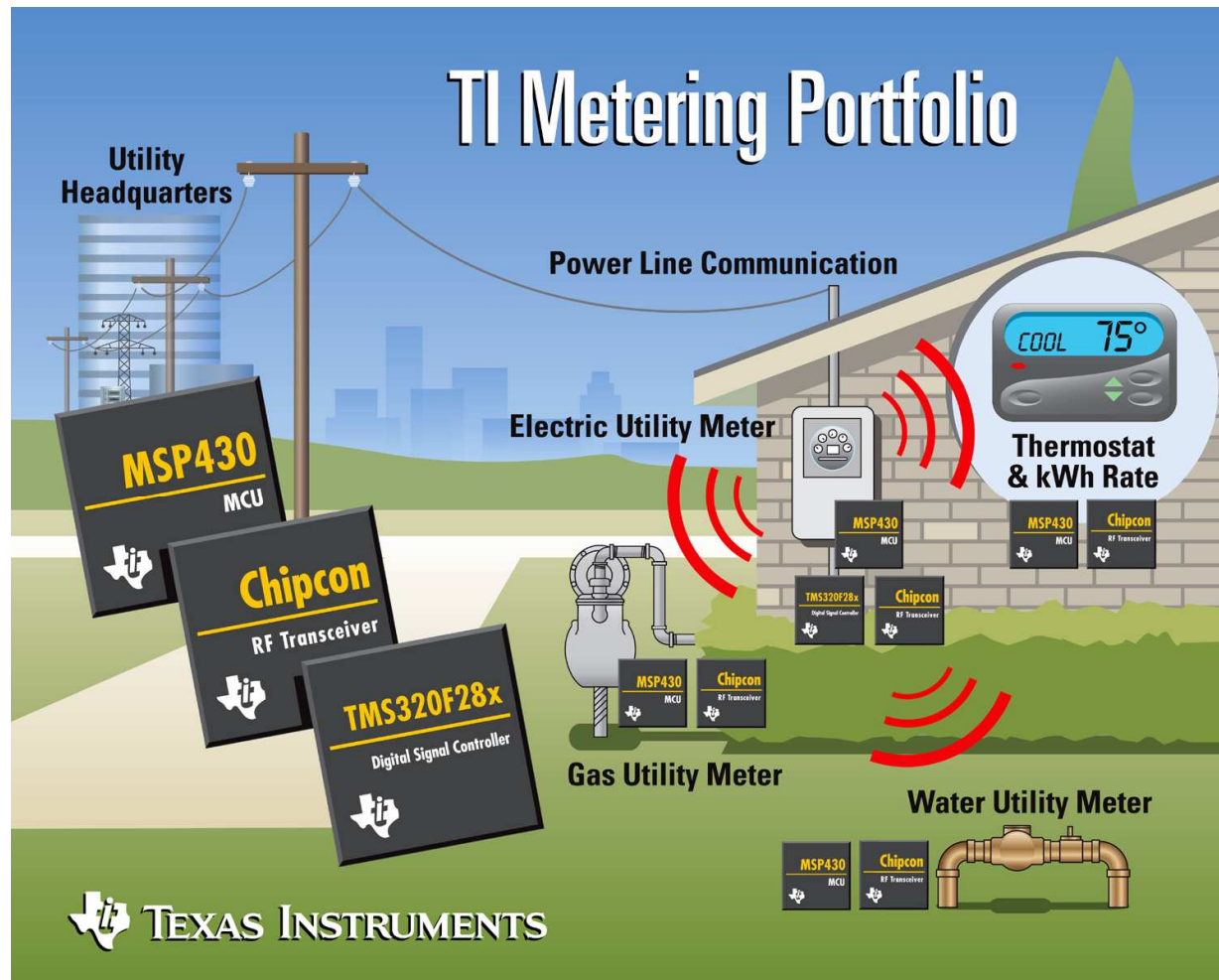
Using CC430 library



TI Zigbee IP offering



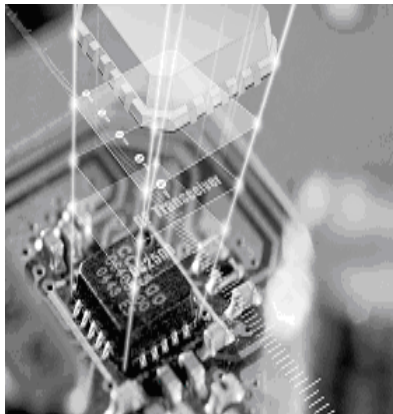

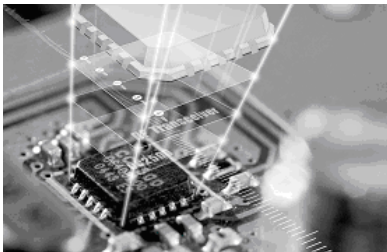

Zigbee dedicated to targeted application



ZigbeeIP features

- Targeted for SmartEnergy applications but expected to be deployed in other ZigBee applications as well
- Network stack based on IETF protocols
 - 802.15.4-2006
 - 6lowpan adaption layer
 - UDP / IPv6
 - ROLL routing protocol
 - Security

Hardware

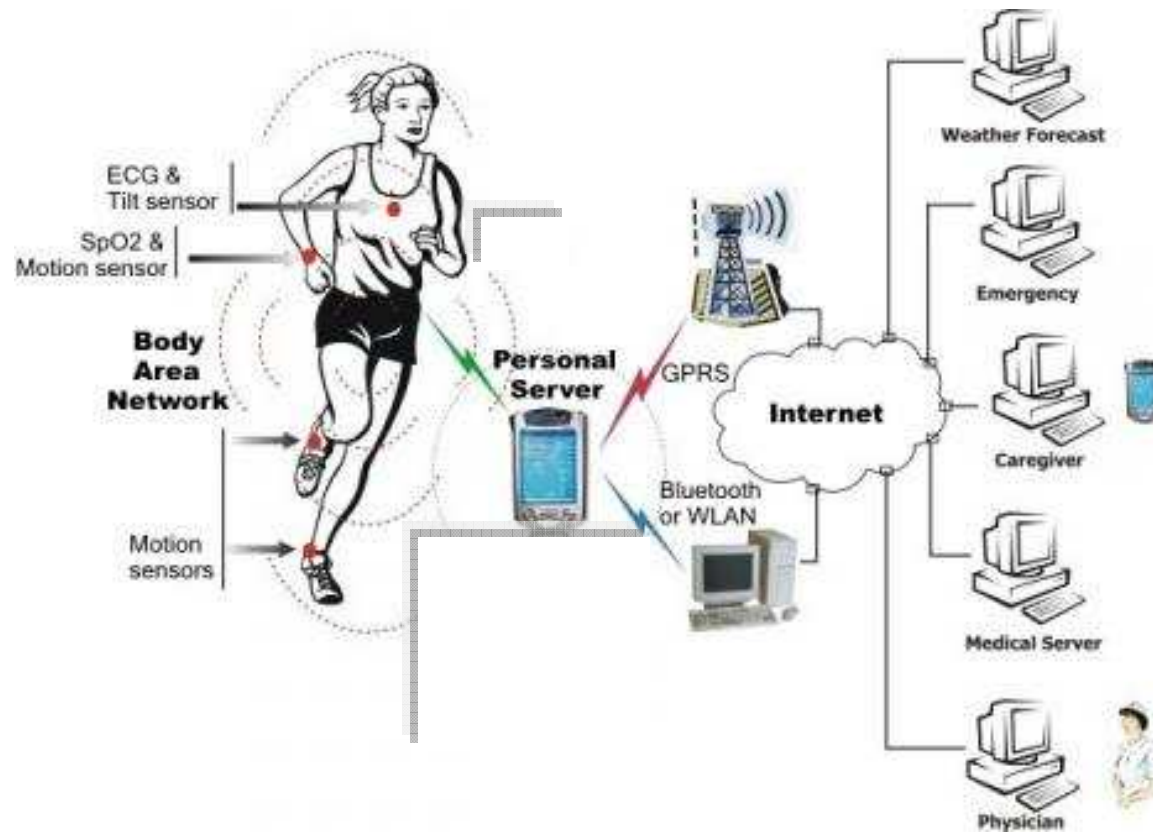
	SoC <i>small footprint, high integration, low cost</i>	Co-processor <i>flexible, easy to use and reduced time to market</i>	Dual-chip <i>ultra low power or high performance</i>
Application	CC2530	Any Processor (e.g. MSP430 or Stellaris ARM)	MSP430 or Stellaris ARM
Protocol stack		 CC2530 based co-processor with embedded stack and uart/spi/usb interface 	
Radio			CC2520
RF front end (optional)	CC2590 / CC2591	CC2590 / CC2591	CC2590 / CC2591

Software

	ZigBee Pro	ZigBee RF4CE	ZigBee IP
Applications	Home Automation Building Automation Healthcare	Remote controls CE devices (TV, Set top box, etc...) Point-to-point controls	SmartEnergy (meters, in-home displays, thermostats etc.) Building Automation Healthcare
Topology	Large RF mesh networks	Point-to-point and point-to-multipoint controls	Large RF mesh networks based on IP protocols
Product	Z-Stack 2.2.0 (ti.com/z-stack) Available now	RemoTI 1.0 (ti.com/rf4ce) Available now	Zigbee 2.0
Hardware	CC2530, CC2520 / MSP430, Stellaris (upcoming)	CC2530	CC2530,CC2531 CC2520 / MSP430, Stellaris (upcoming)

Body Area Networking

Body Area Network



What Is Bluetooth?

- **Bluetooth Is a Short range wireless protocol:**
 - A short-range 2.4GHz wireless technology aimed at simplifying communications among electronic products and creating Personal Area Network (PAN).
 - Enable users to automatically and easily connect a wide range of computing and telecommunication devices;
 - Laptops
 - PDA
 - Cell phone
 - Printer
 - Keyboards
 - Use spread spectrum modulation techniques.
 - Enable point-to-point or multipoint network.
 - Handle both data and voice/audio transfer.
- **Bluetooth protocol driven by Bluetooth SIG (Special Interest Group)**
 - Founding members are Ericsson, Nokia, IBM, Intel and Toshiba.



Bluetooth Profiles

- Profile represents a Bluetooth user model.
- Each user model describes a number of user scenarios where Bluetooth performs the radio transmission.
- The concept of profiles is used to reduce the risk of interoperability problems.



Sports & Fitness



Healthcare



Home & Entertainment



Office & Mobile Accessories



Automotive



Watch

What is Bluetooth low energy (BLE)?

- Previously **Ultra-low power Bluetooth (ULP)** and **Wibree**
 - Leveraging the existing Bluetooth ecosystem
 - Dual-Mode, supporting BL and BLE, to be in virtually all cell phones / PC's
- Targets **low-cost, low power short range** RF connectivity
 - Sensors / Actuators running on coin-cells for months / years
 - Low bandwidth devices transmitting periodically or infrequently
- Main target markets
 - Mobile phone accessories
 - Sports / leisure / medical equipment
 - Gaming / HID / remote controls
 - "Proximity" applications – security or other spatially aware apps
- The CC2540 is TI's solution for a **single-mode** device; supporting Bluetooth low energy (CC2540 does **not** support BR/EDR Bluetooth)
- BLE was launched in Bluetooth 4.0, which was adopted in July 2010



TI Bluetooth Offering

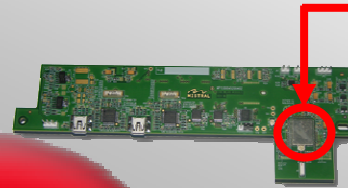
AM37x/DM37x + WL1271 development platform

Features



- 802.11b/g/n & Bluetooth® 2.1+EDR
- Market-leading Bluetooth/WLAN Co-existence
- Best-in-class performance

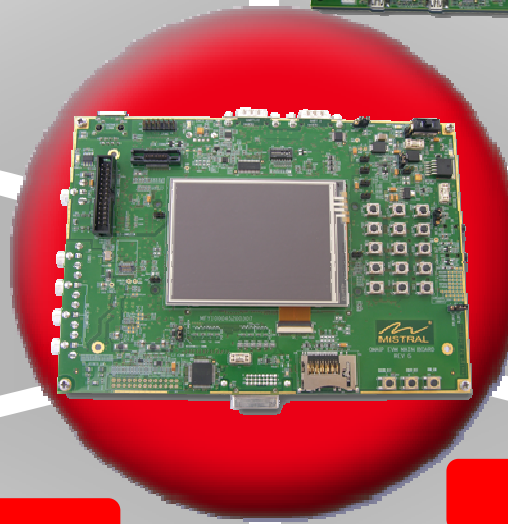
Wireless Connectivity Card



- WL1271 module based adapter
- Ships with the AM37x EVM Kit
- Chip antenna
- Plugs into EVM expansion connector

Advantages

- Stable 6th Gen WLAN & BTH IP
- Market-leading BTH/WLAN coexistence
- High throughput, low power consumption
- Broad-market availability
- Pre-integrated & validated
- Upgrade path to BLE and ANT features
- Pre-certified module



Out of the Box

- WLAN and *Bluetooth*® demo applications
 - Web browsing
 - Play music to a headset
 - And others



Software

- Open Source Linux 2.6.x drivers
 - Pre-integrated with TI SDK now



Windows CE

- Windows® CE 6.x drivers
 - Pre-integrated with WinCE SDK
 - Beta Release Q1,2011



Linux System Integrator



WL1271 Module Supplier



WinCE System Integrator

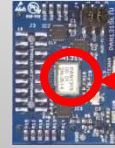
MSP430BT5190+CC2560 *Bluetooth*® development platform

Features

- Serial link *Bluetooth* applications on MSP430BT5190
- *Bluetooth* 2.1+EDR
- *Bluetooth* Low Energy (BLE) upgradable
- Pre-integration into the MSP430 platform



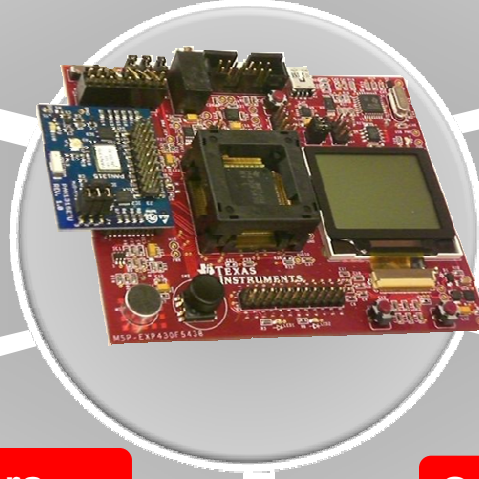
Bluetooth® PAN1315ETU card



- PAN1315 (CC2560-based) module
- Chip antenna
- Plugs into MSP430F5438 Experimenter Board

Benefits

- Best-in-class RF performance & low power consumption
- Fast and easy application development on MSP430 with *Bluetooth*
- Robust and proven *Bluetooth* technology
- No NRE, royalty-free (SPP solution only)



Out of the box

- *Bluetooth* sample applications (source code format)
 - Accelerometer-based game
 - RF link parameters
 - Thermometer readings

Platform partners



PAN1315 (CC2560-based)
Module supplier



System Integrator & *Bluetooth* /
BLE Stack Supplier

Software

CC2540DK-MINI

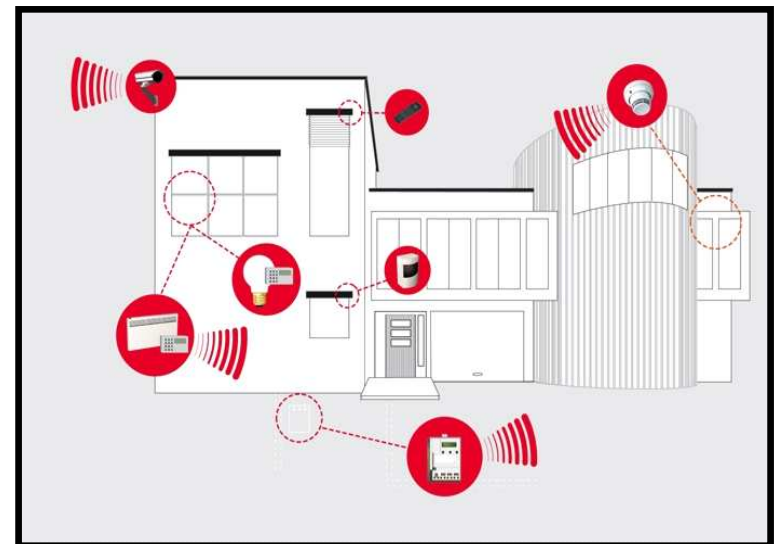
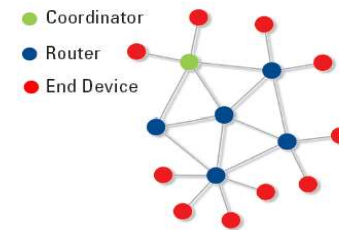
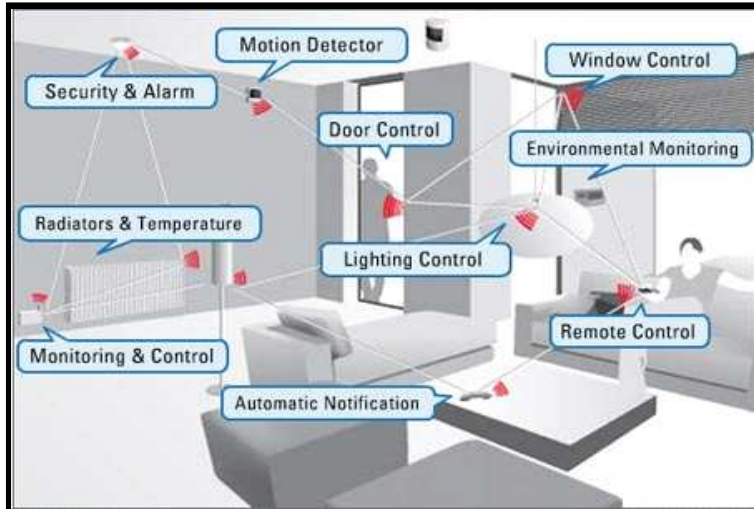


- **Key Fob** operates on a single CR2032 coin cell battery, and contains a two-colored LED, a buzzer, an accelerometer, and two buttons.
- **USB Dongle** is the device that will be acting as the BLE Master
- **CC Debugger**

DEMOS

Quizz

Guess the best protocol



CC2520, CC2530/31

Guess the best protocol



IR/RF programmable remote



Audio remote



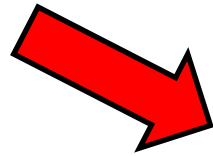
iPod remote

CC2533

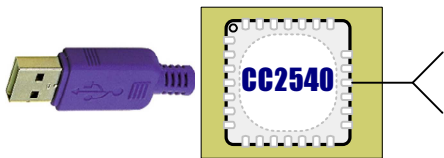
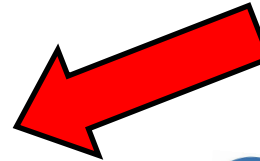
Guess the best protocol



Caller ID, alerts



Sports sensors



Single-mode Bluetooth LE dongle

USB Interface



Proximity tags, Keyfobs etc.



CC2540

Take Away

- TI is part of main standardization associations
- TI propose also proprietary breaking technology
- TI has a complete HW and SW portfolio
- Pure-Path Wireless enables transmission of high quality audio over low power wireless network
- TI solutions cover a large variety of applications: Home Automation and Lighting, Smart Energy, Wireless Audio, Medical

Think Connectivity

Think TI

Questions

