IoT drives Industry 4.0

物聯網與工業 4.0 發展趨勢與應用介紹

Jesse Wang, TI CMCU
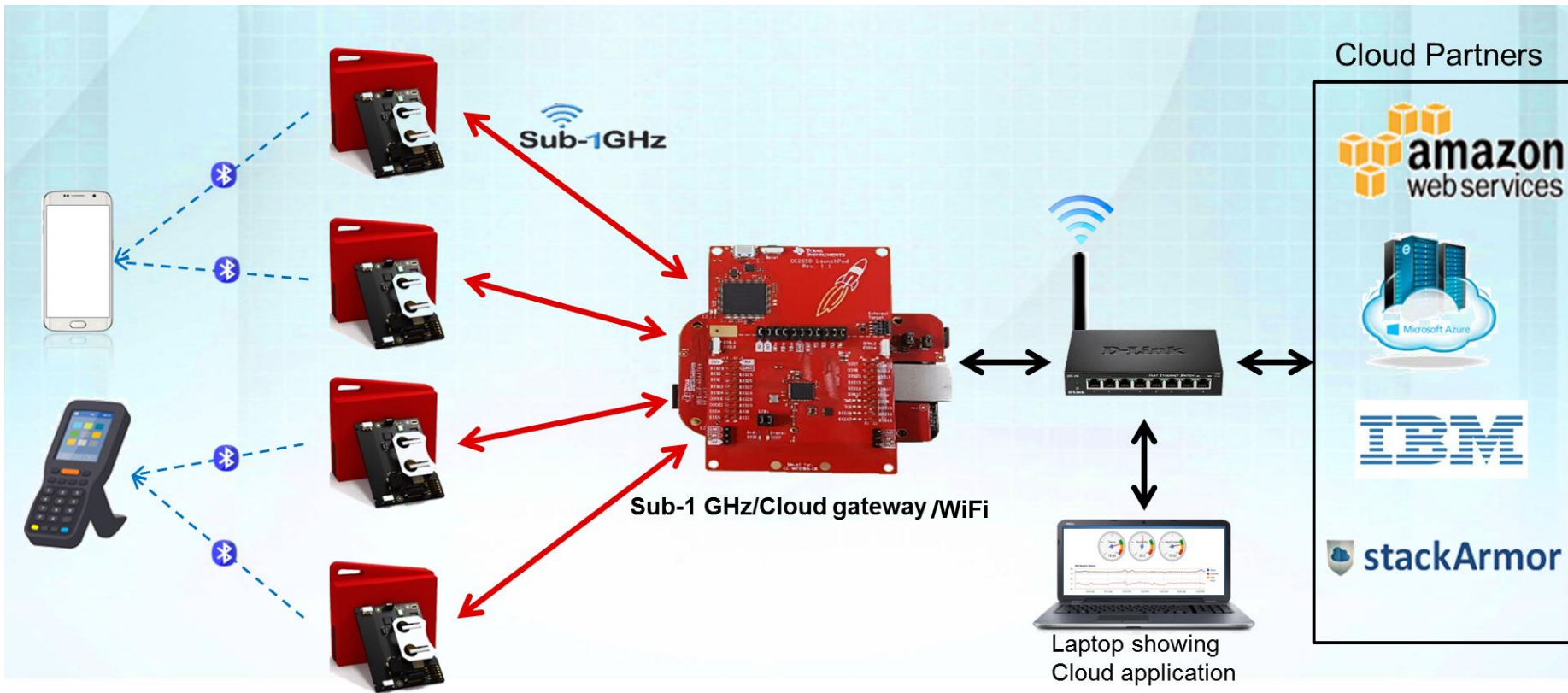
jessewang@ti.com

TEXAS INSTRUMENTS　文曄科技 股份有限公司

Agenda

- Industry 4.0 & IoT

- How Wireless Is Relevant

- TI Wireless Connectivity
  - Portfolio
  - Easy Use: SimpleLink & SensorTag Example

- TI Launchpad and TI Designs

- TI Integrated Resources and Public in Website

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A Typical IoT Application: Sensor-to-Cloud

Sub-1GHz

Cloud Partners

Sub-1 GHz/Cloud gateway /WiFi

Laptop showing
Cloud application

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30.7B *connected devices by 2020,* ***75.4B*** *by 2025*

Top IoT concerns…

| Security | Complex standards | Required expertise | Power consumption |

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Industry 4.0 or Industrial IoT for factory automation

| Internet of Things | Industrial Internet Consortium | Industry 4.0 |

Consumer   Building   Industrial   Manufacturing →

Real-time →

Functional Safety →

ABB Robotics: https://www.youtube.com/watch?v=i9Vbh2mPG6M

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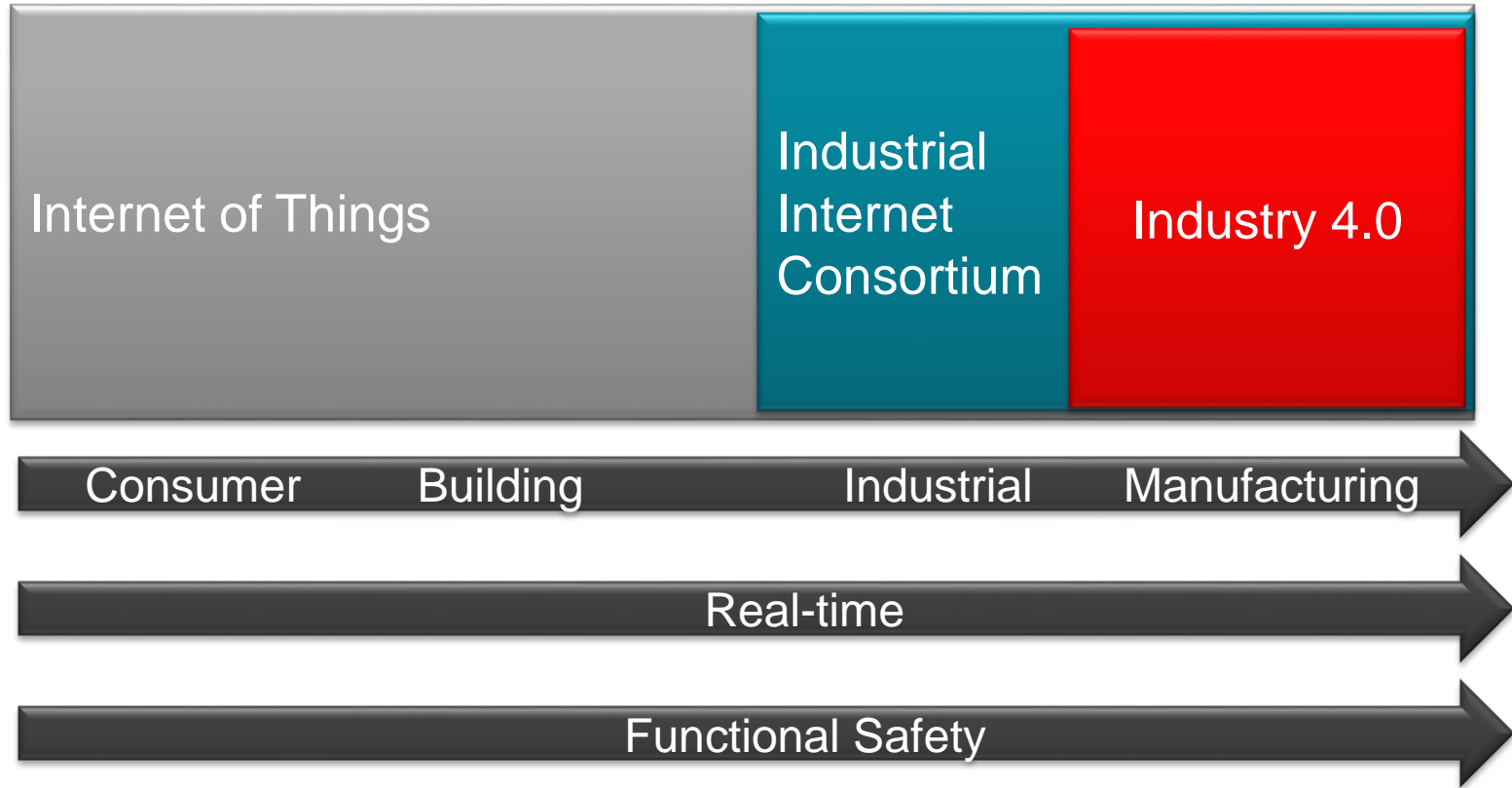
Industry 4.0 or Industrial IoT for factory automation
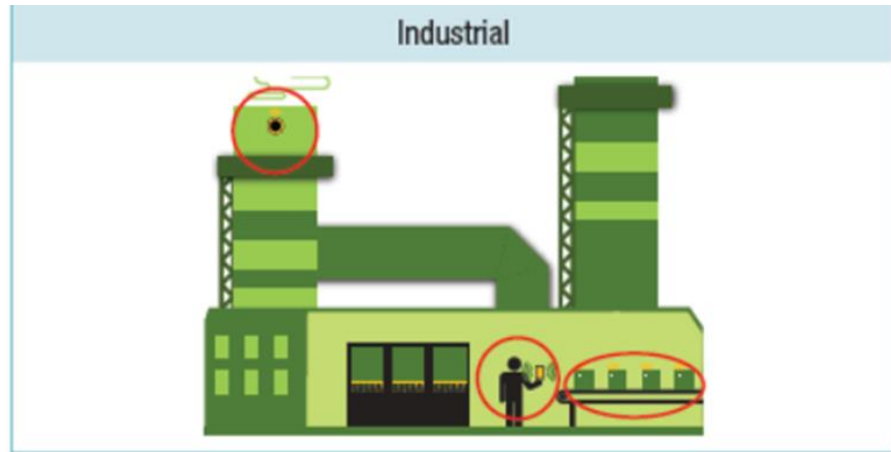
- **Industry 4.0** = a living network of machines, people and products enabling real-time optimization of the entire manufacturing flow.

- **Intelligent manufacturing**: **Flow optimization** and customization, **asset tracking**, **predictive maintenance** and **real-time** inventory **optimization**.

- Equipping machines and parts with **sensors** and **network connectivity** is the key step toward this vision. Data analytics and software platforms are also critical.

Reference: TI blog industry 4.0

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The Top 6 Challenges

Sensing a complex environment
Innovative ways to sense and deliver information from the physical world to the cloud

TI offers sensing technology that addresses a wide variety of applications

Connectivity
Variety of wired and wireless connectivity standards are required to enable different application needs

TI has the industry's broadest wireless and wired connectivity offering covering over 14 standards

Power is critical
Many IoT applications need to run for years over batteries and reduce the overall energy consumption

TI's low power devices enable years of battery operation and harvested-powered devices

Security is vital
Protecting users' privacy and manufacturers' IP; detecting and blocking malicious activity

TI devices have built-in state-of-the-art hardware security technology

IoT is complex
IoT application development needs to be easy for all developers, not just to experts

TI's IoT solutions encapsulate wireless and Internet communication and make hardware and software design simple

Cloud is important
IoT applications require end-to-end solutions including cloud services

TI's cloud ecosystem partners enable faster time to market of new products and services

http://www.ti.com/ww/en/internet_of_things/iot-challenges.html

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IoT is an enabling technology

Building & Home Automation
- Wireless environmental sensor
- Wireless lighting
- Connected appliances
- Control panels
- Gateway
- Light control
- Smart lock
- Smart thermostat
- Video doorbell

Smart Cities
- Wireless grid communication
- Surveillance cameras
- Smart combiner box
- Smart meters
- Smart street lights
- Energy harvesting
- Grid automation
- Protection relay
- Renewables
- Drones

Smart Manufacturing
- Industrial communication
- Communication module
- CPU (PLC controller)
- Hydraulic valves
- Industry 4.0
- Pneumatic valves
- Portable monitor
- Process analytics
- Field transmitter
- Robotics

Wearables & Health Care
- Augmented reality and entertainment
- Wearable fitness & activity monitor
- Telehealth gateway and aggregation
- Wireless patient monitor
- Location and tracking
- Smart watches
- Fitness

Automotive
- Level 1 & 2 EV charging station
- Level 3 EV charging station
- Engine management
- Wire replacement
- Infotainment

Precision agriculture
- Power converters & chargers for agricultural equipment
- Cold chain tracking for refrigerated transport
- Sensors for agricultural equipment
- Drones

http://www.ti.com/ww/en/internet_of_things/iot-applications.html

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TI is delivering solutions for Factory Automation

Programmable Logic Controller (PLC)

- Analog Input Module
- Analog Output Module
- Communication Module
- CPU (PLC Controller)
- Digital Input Module
- Digital Output Module
- Special Function Module
- Transducer Module

Human Machine Interface (HMI)

- Industrial Monitor
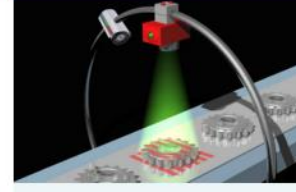- Portable Monitor

Field Transmitter

- Displacement Transmitter
- Flow Transmitter
- Level Transmitter
- Pressure Transmitter
- Process Analytics
- Temperature Transmitter

Automated Machinery

- Robotics Control

Machine Vision

- Camera
- Code Readers

Field Actuators

- Hydraulic Valves
- Pneumatic Valves
- Signage

- Wireless technologies are relevant for non time-critical applications such HMI panel interface, parameters monitoring, predictive maintenance, gateways, wireless sensor network.

http://www.ti.com/lsds/ti/processors/applications/industrial/overview.page

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Factory Automation/ industry 4.0 and wireless

Sensor Network Monitoring for maintenance	HMI Wireless Interface	Parameters Monitoring	Cables to wireless bridges Data-logging

NFC / RFID

Bluetooth

WiFi CERTIFIED

Sub-1GHz

Bluvision Beacons and IoT: https://www.youtube.com/watch?v=TFL4i6lKuZl

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TI Wireless Connectivity Portfolio

Largest wireless selection

Support for all key technologies and standards for industrial, automotive and consumer

A solution for any application. Future proof. Leverage your investment

Lowest power consumption

Use a coin cell or for multi-year, always-on operation or go battery-less with energy harvesting

Ultra-low power by design

Easiest to design with

Quickest learning-curve and development time with full broad market ecosystem

Software, tools, E2E, certified TI modules, TI Designs, SensorTag, online trainings, Cloud

Connect More with TI

TI wireless portfolio:
A solution for each industry/ applications challenge

		NFC RFID	Bluetooth® Bluetooth low energy	Proprietary 2.4 GHz	ZigBee®	Wi-Fi®	6LowPAN	Proprietary Sub-1 GHz
Network type		**Identification**	**Personal connection**	**Customizable**	**Mesh** ZigBee® Control your world	**Existing infrastructure**	**IP Mesh**	**Customizable** Sub-1GHz
Range		Proximity	Personal area networks		Local area networks			Neighborhood area networks
Key differences		**Data** • Up to 848 Kbps • No battery to coin cell	**Data or voice** • Up to 3 Mbps • Coin cell to AAA	**Data** • Up to 1 Mbps • Coin cell	**Data** • Up to 256 Kbps • Energy harvesting to AAA	**Voice or video** • Up to 100 Mbps • AA battery	**Data** • Up to 256 Kbps • Energy harvesting to AAA	**Data** • Up to 1 Mbps • Coin cell
Industrial applications		• Device configuration / Firmware upgrade	• Lighting • Wire replacement • Beaconing • Asset tracking • Factory automation	• Building and factory automation • Beaconing	• Smart energy • Building automation • Lighting networks • Industrial Internet	• Assets tracking • Remote control of machinery • Sensors • Building automation	• Smart energy • Building automation • Lighting networks • Low-power Industrial Internet-gateways	• Metering • Smart grid • Alarm and security • Environmental monitoring

TI SimpleLink Connectivity portfolio

SimpleLink™ MSP432™ Host MCU	SimpleLink™ Wi-Fi® CC3220 Wireless MCU	SimpleLink™ BLE CC2640R2F Wireless MCU	SimpleLink™ Sub-1GHz + BLE CC1350 Wireless MCU	SimpleLink™ Sub-1GHz CC1310 Wireless MCU	SimpleLink™ Wi-Fi® CC3120 Wireless Network Processor
MSP432	CC3220	CC2640R2F	CC1350	CC1310	CC3120
Host MCUs	Standalone Wireless MCUs or Network Processors				Wireless Network Processor

The SimpleLink SDKs run on TI's scalable, highly-integrated, low-power, ARM® Cortex®-M based microcontrollers spanning more than 100 different configuration options in a single development environment. The family of SimpleLink devices offers:

- Lowest power, advanced security and best-in-class analog integration
- Easy integration into your system enabling faster time to market
- Wireless MCUs to support many applications without requiring a separate host MCU
- Host MCU can add advanced analog capabilities, more memory or processing power with common SDK elements

http://www.ti.com/wireless-connectivity/simplelink-solutions/simplelink-mcu-platform.html

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TI Wireless Modules benefits

Industry-leading Performance

Lowest Power

Longest Range

Extensive qual and reliability test

Proven interoperability

High-quality module choice for many wireless technologies

Faster Development Time

Certified Modules

Antenna integrated

Free certified Software Stack

Easy access development tools

Get to market faster with TI's worldwide ecosystem

Connect More with TI

Proven and Dependable Supplier

Millions of modules shipped worldwide

World class on-time delivery performance

Continuity of supply

Easy migration to chip level design

Distributed Worldwide
Protect your production and your investment

TI store   WW Distribution

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TI *Bluetooth*® Low Energy (BLE)

Low Power, Low Latency, Low Throughput

Value Propositions

Large Tools and ref designs Ecosystem

SensorTag
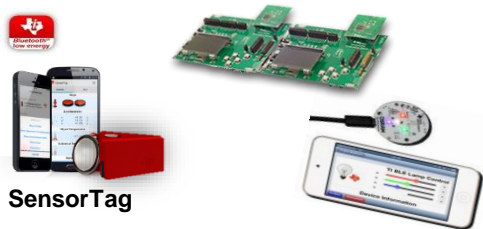
- **Easiest to design with**: Complete SW stack, wiki guides, dynamic design kits, low-cost tools, & software starting points

- **Lowest Power:** Multi-year operation on smaller coin-cell

- **The most Integrated**: single chip wireless MCU, integrated flash, small package

Products	Features	Applications

• SimpleLinkTM Wireless MCU
  • Flash based wireless MCU
  • CC2640R2F (Ultra Low Power)
  • CC2540 (USB interface)
  • CC2541 (I2C interface)
  • CC2540T (125°C)
• Apps developer tools
• Many TI Designs
	• Lowest Power down to 1/10th of BT Classic
	• Run BT stack and application on one single chip down to 4x4mm QFN package
	• Fully Featured BT5.0 LE Stack
	• Industrial and extended temp range: -40 to 85 C and 125 C
	• Automotive qualification option
		• UART to BLE
		• Sensors Monitoring
		• Cable replacement
		• Remote display

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Dual-mode Bluetooth (Classic + BLE)

Bluetooth connection across any end point (BLE or classic); enables bridge between BLE and classic

Value Propositions

Tools/Modules/TI Designs
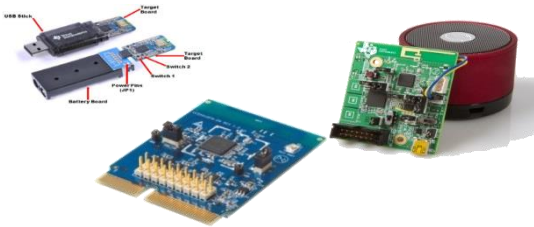
- **Best Performance**: reliable connection over a long range (100m) with optimized power consumption
- **Flexible**: connect to any host (MCU or processor)
- **Most proven solution**: 300 millions devices shipped, robust royalty free SW, solution available for broad market
- FCC, IC, CE & Bluetooth SIG Fully **Certified module**

Products

- Smart RF transceivers
  - CC2560 (Classic only)
  - CC2564 (Classic + BLE)
  - Pin-to-pin compatible
- TI modules
  - CC2564MODN
  - CC2564MODA
- 3 Parties Modules
- Audio TI Designs (sink and source)

Features

- Performance over long range (100m) with throughput up to 3Mbps
- Connect to any MCU or processor
- BT stack runs on external host
- Bluetooth 2.1 +EDR/ BT 4.2
- Fully certified module (FCC, IC, CE, Bluetooth SIG)

Applications

- Embedded audio
- Heath and medical care
- Mobile device accessories
- Toys

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Wilink™ Combo solutions
high-performance WiFi + Bluetooth/Bluetooth Low Energy

Value Propositions

Tools/modules for easy development

- **Performance and low power:** 100Mbps with the lowest power (800uA IDLE)
- **Certified and easy to use:** Pre-integrated, certified, production ready solutions, software downloadable. Open documentation (Wiki), Forums (E2E), TI and 3rd party network
- **Integrated and scalable**: single chip multi-combo with pin to pin compatible variants, consumer, industrial (85 degree C) and automotive grade (Q100)

Products

- WL18xx Combo
  - WiFi Only
  - WiFi + BT/BLE
  - WiFi + BT/BLE + GNSS
- TI Modules
  - WL1831MOD
  - WL1835MOD
  - WL1807MOD
  - WL1837MOD
- 3d Parties modules

Features

- Combo BT Dual Mode + WiFi on one single-chip
- Rock solid performance: long distance, stability, robustness, throughput and co-existence with BT 4.1
- Connect to processors(high level OS)
- Industrial temp -40 to 85 C
- 2.4GHz and 5GHz support
- Fully certified module (FCC, IC, CE, Telec)

Applications

- Security Camera
- Gateways
- Industrial Panel/ HMI
- Control Panel
- Professional Camera
- Test and measurement

SimpleLink™ Wi-Fi® platform
Lowest power, programmable wireless MCU, easiest to use

Value Propositions

- **The lowest power:** Run for over a year on two AA batteries

- **First single chip programmable Wi-Fi solution:** Add Wi-Fi to any system

- **Easiest to design with**: No Wi-Fi experience needed; HW designs, 50+ software examples, extensive documentation and TI E2E support forum all readily available

TIDesigns

Products

- CC3220 (Wireless MCU)
  - Integrated ARM Cortex-M4 MCU + Wi-Fi network processor
  - First programmable single chip Wi-Fi solution
- CC3120 (Wi-Fi network processor)
  - Embedded TCIP/IP stack
  - Connect any MCU to the Internet of Things
- CC3220MODA/CC3220MOD and CC3120MOD TI Certified modules

Features

- On-chip Internet & Wi-Fi security
- Wireless MCU separate from TCP/IP Stack, free for customer applications
- Flexible provisioning such as SmartConfig, WAC, & AP Mode
- Cloud supported
- FCC/CE/ETSI certified modules
- SDK for development with Code Composer Studio and IAR support

Applications

- Internet of Things (IoT)
- Home automation & appliance
- Thermostat, fire alarm
- Smart energy, home monitoring
- Lighting control
- Access Control
- Irrigation automation

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Sub-1 GHz

Industrial 169/315/ 433/ 470/ 868/ 915/ 920 MHz solutions

Value Propositions

- **Robust RF range** in buildings: Longer range than 2.4 GHz. Stable wireless links that go through walls

- **Most complete design support**: 15 years of accumulated knowledge documented on the web: 100+ app notes, dedicated E2E forum, SmartRF tools

- **Most optimized** Sub-1 GHz solutions: Tx, Rx, Trx, wireless MCU + small SW stack

Sub-1GHz
Low Power, Robustness, Long Range

Products

- Smart RF transceiver
  - CC110L, CC1120, CC1200, CC1125
- Wireless MCU
  - CC1310
  - CC1350
  - CC1110
  - CC430
- Wireless MCU with USB
  - CC1111
- Free software examples
  - SimpliciTI software stack

Features

- Complete solutions for 169, 315, 433, 470, 868, 915 and 920 MHz

- Flexible RF packet sniffer helps debug RF solutions quicker

- High sensitivity & narrowband support, the de facto standard for long range communication

- Lowest power Wireless MCU with CC1310 SimpleLink

- Launchpad ecosystem

Applications

- Safety and security

- Home, building and industrial automation

- Sensor Network

SimpleLink™ 6LoWPAN
IP cloud connection, lowest power, largest network

Value Propositions

- **Complete solution from silicon to Cloud:** Best-in-class performance, comprehensive and intuitive software with sample code and examples, large cloud partners to support both industrial and consumer markets

- **Lowest power**: Use a coin cell for multi-year, always-on operation or go battery-less with energy harvesting

- **Large and secure mesh network:** Connect up to 1000s of nodes
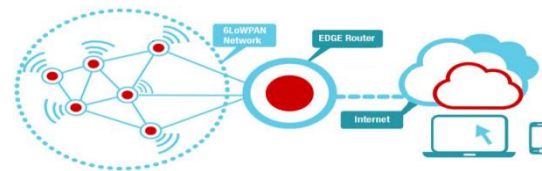
Products

SimpleLink 6LoWPAN/ZigBee
- CC2630 (Ultra low-power 2.4GHz)
- CC2538 (High performance 2.4GHz)

SimpleLink Range Extender
- CC2592 (2.4GHz extend up to 4x range)

Contiki Software: Open source solution

Features

- An edge router connects the 6LoWPAN network to IP Applications. No gateway needed

- Mesh routing that is robust and self-healing

- Can achieve multi-year operation on a coin-cell battery

Applications

- Home and building automation

- Low-power sensor networks

- Internet of Things (IoT)

- Safety and security

Home Automation and Monitoring

TEXAS INSTRUMENTS
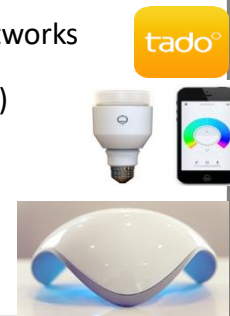
ZigBee®
Lowest power, large secure mesh network, easiest to use

Value Propositions

- **The lowest power**: Multi-year operation on small coin-cell

- **Robust and standardized mesh network**: Connect up to 100s of nodes in industrial settings

- **Easiest to design with**: Proven and robust 'copy-paste' kits, reference designs together with Golden Unit software stack
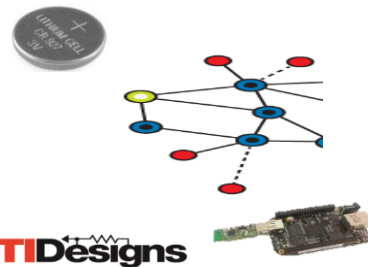
Products

- **Wireless MCUs**
  - CC2630 (Ultra low-power Wireless MCU)
  - CC2530/1 (Wireless MCU)
  - CC2538 (High performance, large memory)
- **Range extender**
  - CC2592 (Extends up to 7x range)
- Z-Stack: Robust and Proven TI ZigBee stack

Features

- Run Z-Stack and application on one single chip
- Secure Over-the-air software update capability
- Industrial temp range:
  -40 to 125 C
- Certified ZigBee Golden Unit
- USB support

Applications

- Home automation
  - Comfort
  - Security
  - Energy efficiency
- Lighting networks
  - Lights
  - Switch/sensor
- Generic mesh
- IP-to-ZigBee gateways

SimpleLink ULP CC1310/50 Platform

Full Production today

New

CC1310: Sub-1 GHz only

- Pin-to-pin compatible with SimpleLink ULP Platform
- Various flash sizes: 32KB, 64KB, 128KB
- Ultra-low power, long range networks up to 15 km
- Operation in 315 MHz, 433 MHz, 470 MHz, 500 MHz, 868 MHz, 915 MHz and 920 MHz ISM bands
- Software: 6LoWPAN, wM-Bus, GFSK, TI-15.4MAC

CC1350: Dual-band

- Most versatile & integrated radio for 2.4 GHz and Sub-1 GHz operation on the same chip
- Enables ultra-low power long range Sub-1 GHz networks utilize Bluetooth Smart for easy cloud connectivity
- Supports: Sub-1 GHz, Bluetooth Smart, 6LoWPAN, & GFSK modes up to 4Mbps

Sub-1GHz

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Top 3 Wireless Connectivity Technologies

Bluetooth™

BLE

- **Easiest to use, Low power, Integration**
- Control applications through smartphone/tablet
- Moving to industrial, automotive markets, extended temp

Dual-Mode

| CC2540/41 | CC2540T | CC2640R2F | CC2650 | CC2560/4C | CC2564MODN | CC2564MODA |

WiFi CERTIFIED

- **Integrated ARM® Cortex®-M MCU, Easiest to use, Low Power**
- Home and enterprise, audio. wearable, Internet of Things (IoT), home automation, security

| CC3120 | CC3220 | WL180x/3x | WL1807/37 |

Sub-1GHz

- **Longest Range, Robust, Low Power**
- Proprietary and open protocols (e.g. 6LoWPAN)
- Metering, security systems, home automation

| CC1200 | CC1120 | CC1310 | CC1350 |

TEXAS INSTRUMENTS
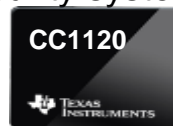
Easy-to-use: Software, support and more

Software

Common software
Across all SimpleLink™ ULP products:
- TI-RTOS operating system
- Code Composer Studio™ integrated development environment
- IAR Embedded Workbench for ARM®

Royalty-free network stacks
Robust, certified and proven stacks:
- BLE-Stack with OTA support
- Z-Stack supporting various ZigBee applications

Support

Comprehensive
Development documentation, guides and wikis available online

Design support
Online community – answers at your fingertips from engineers

Training
Online videos and other resources to learn more about the parts and tools

And more...

TIDesigns
TI reference designs online

TI IoT cloud ecosystem

TIstore 24/7
Silicon & kit sales & samples on TI Store

TI CCS Cloud Tool: https://dev.ti.com/

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Get started fast: Development kits
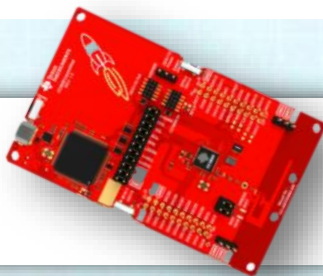
SensorTag
- Sensor to the cloud evaluation tool
- 10 sensors to the cloud in 3 min
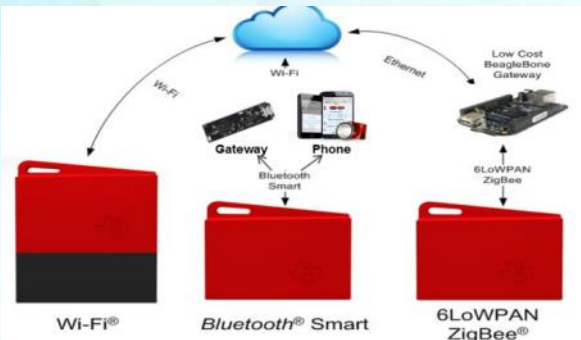
$29 on TI Store

LaunchPad™
- Low-cost MCU development kit
- Leverages existing TI tool ecosystem
- www.ti.com/launchpad
- Add-on features with many booster-packs

$29 on TI Store

CC antenna development kit
- PCB and chip antenna design
- Coin cell design for CC1310
- Antennas for following frequencies:
  - 2.4 GHz
  - 169 MHz
  - 315 MHz
  - 433 MHz
  - 868 MHz
  - 915 MHz

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TI SensorTag – IoT Made Easy

- Access Sensor data in the cloud in 3 minutes

- Connected thanks to
  TI SimpleLink^{TM} Ultra Low Power Wireless MCU

- 10 low-power sensors

- Complete designs at www.ti.com/tidesign
  - Including 3D files
  - Print your own SensorTag

- $29 Complete IoT development kit

Buy Now

Download for Android

Download on the App Store

TEXAS INSTRUMENTS

Multi Standard TI SensorTag
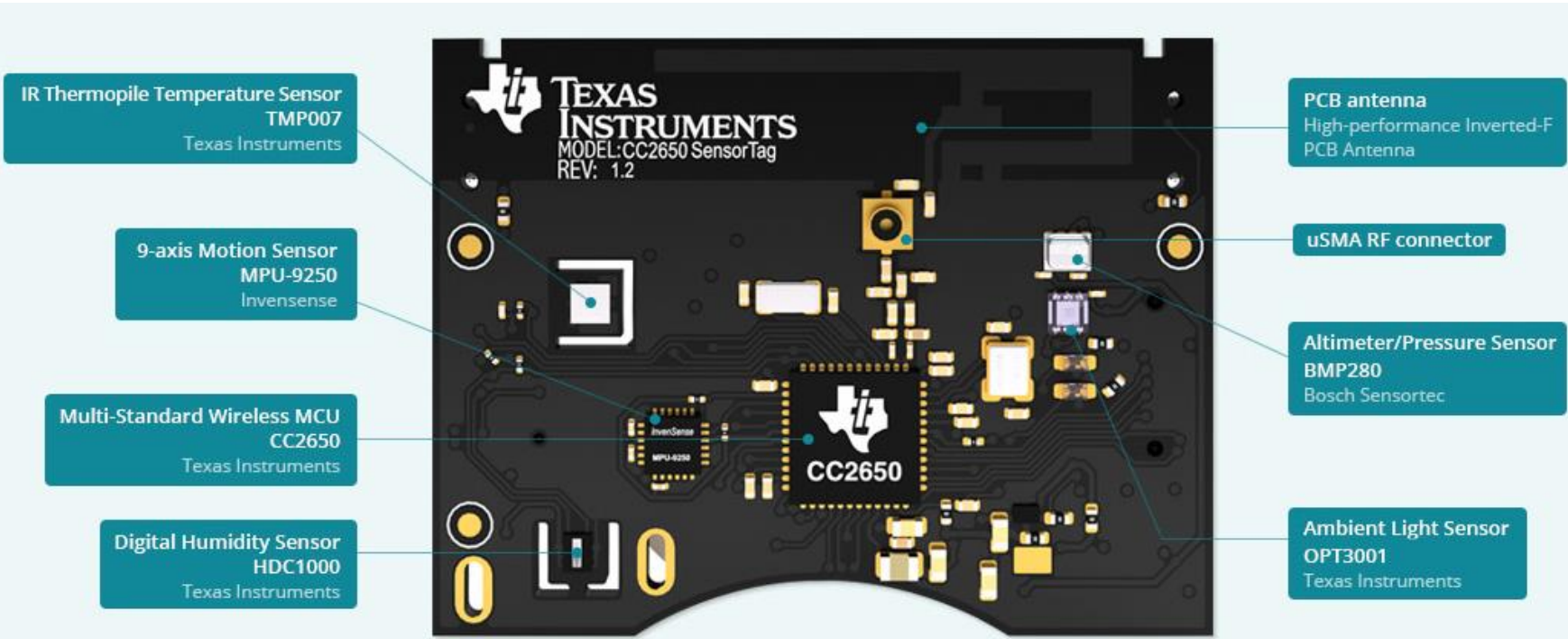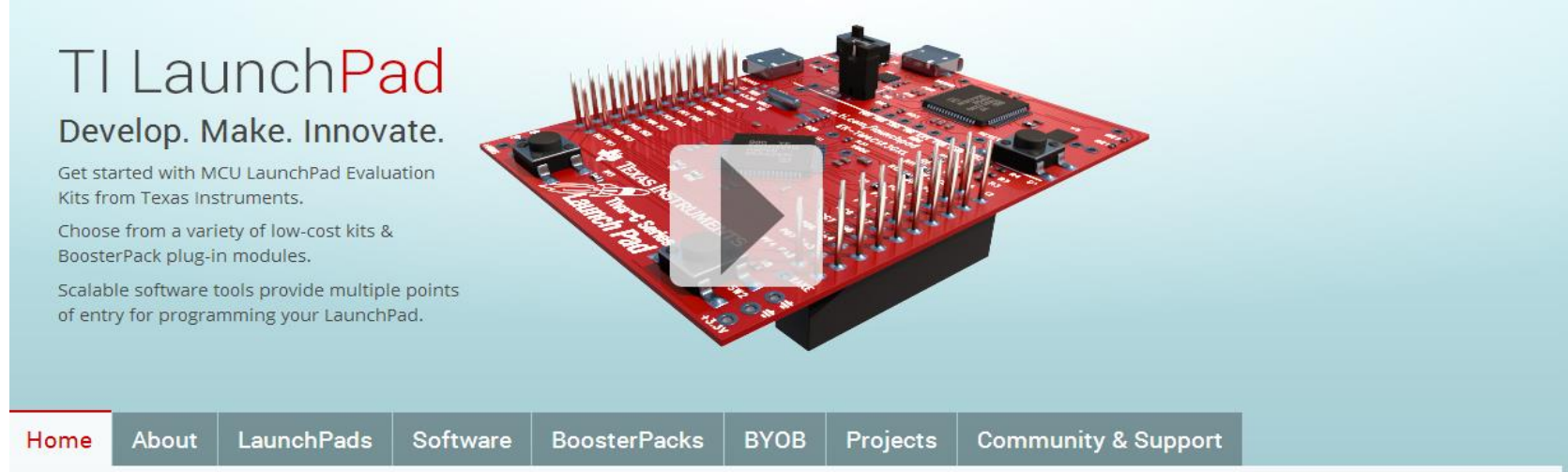
TI Overall IoT ecosystem
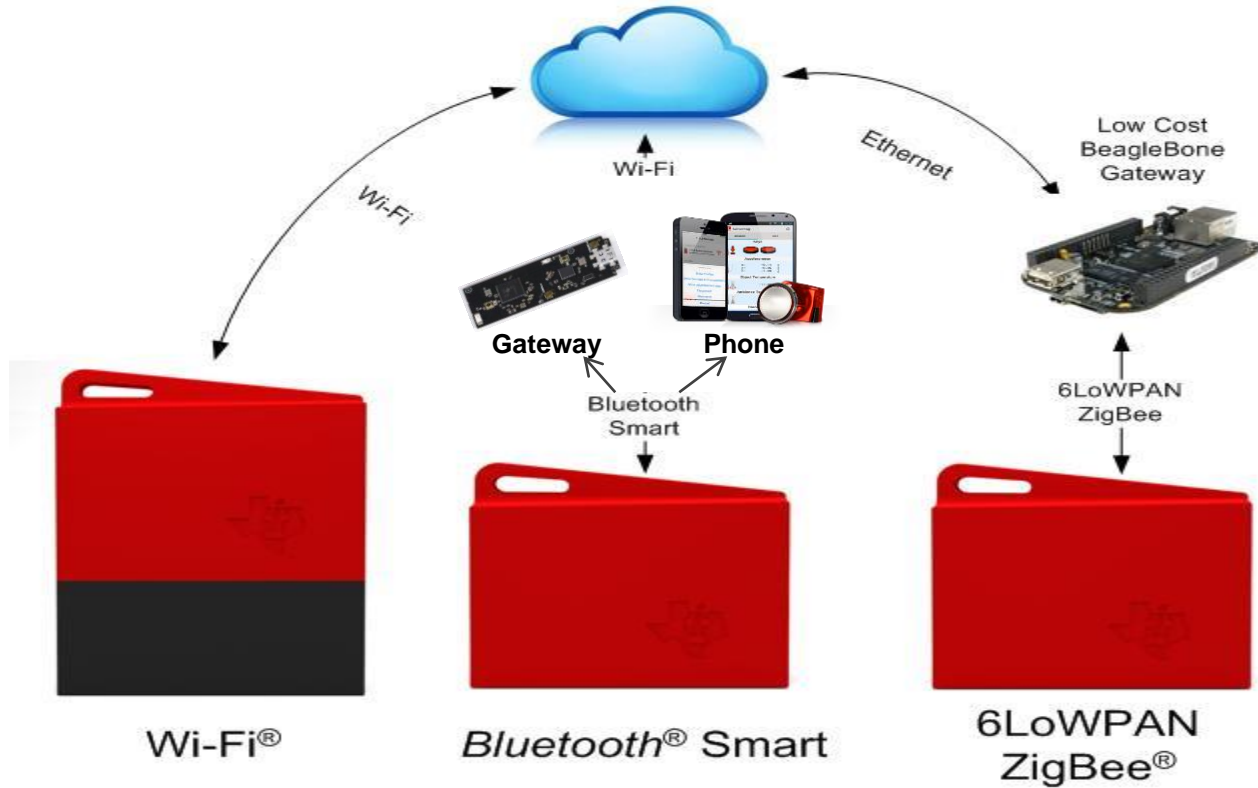
Where to go next: www.ti.com/launchpad

TI's official LaunchPad portal

TI LaunchPad

Develop. Make. Innovate.

Get started with MCU LaunchPad Evaluation Kits from Texas Instruments.

Choose from a variety of low-cost kits & BoosterPack plug-in modules.

Scalable software tools provide multiple points of entry for programming your LaunchPad.

| Home | About | LaunchPads | Software | BoosterPacks | BYOB | Projects | Community & Support |

Get specs, order hardware, find software tools, and download datasheets and design files

TI E2E™ Community

Sign up for a myTI account!

myTI

Launch Pad / Booster Pack Eco System

Isolated Thermocouple with HMI, IO-Link & BLE Wireless Interface

CC2650 Evaluation Module

Sharp® Memory LCD Booster Pack

EM Adapter Booster Pack

Thermocouple AFE with RTD CJC, TIDA-00168

292 TIDesigns from Factory Automation and Control team

IO-Link Device with SPI Sensor IF TIDA-00339

Isolated Power & Data Transmission Booster Pack, TIDA-00459
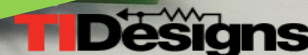
Data Isolation for loop powered applications TIDA-00245

Ultra Low Power Isolated DCDC with Schottky Diodes TIDA-00349

http://www.ti.com/launchpad

TEXAS INSTRUMENTS
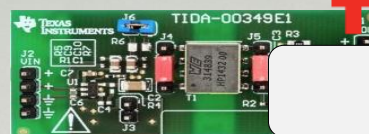
Getting started with a cloud solution

1 Purchase a TI EVM and follow its getting started guide

2 Download and install a cloud SDK for the TI device from the cloud service provide

3 Sign up for free evaluation account in the cloud provider web site

4 Register your EVM on-line in the cloud provider web site

5 Connect your EVM to the cloud and explore the new world of IoT

TEXAS INSTRUMENTS

Wireless Connectivity TI Designs per Technology

Bluetooth® Low Energy / Bluetooth® Dual Mode
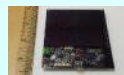
RS-485	Haptic Feedback	Gas Sensor	Keyfob
Light Harvesting	BLE Light	Postage Stamp	Long Range
Mini Broadcaster	BLE to Wi-Fi gateway	USB Dongle	SensorTag
Heart Monitor	Body Composition	Audio Sink	Display
Optical Heart Rate	Weight Scale	Audio Source	Led Audio
Pulse Oximeter	SensorTag iBeacon	CC256x EM	UART to BLE
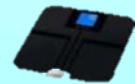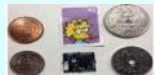
WiFi®

CC3200MOD LaunchPad

CC3100MOD BoosterPack

Smart Electric Meter

Smart Plug

Wi-Fi Camera

Audio Streaming

CC3200 Battery Power

Smart Plug

Sub-1 GHz

ETSI Cat. 1 Receiver

RF Layout Reference Design for 420-470 MHz

RF Layout Reference Design for 868-930 MHz

Home network

ZigBee®
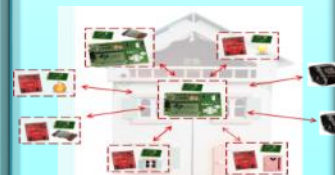
Network Range Extender

Home Automation Gateway

Light Link Development Kit

Low End In-Home Display

CC2538 EM

http://www.ti.com/general/docs/refdesignsearchresults.tsp

TEXAS INSTRUMENTS

New SimpleLink™ MCU platform
One environment, unlimited potential

Microcontroller

Wireless Microcontrollers

Wireless Network Processor

100% code reuse SDK **Common software**

TEXAS INSTRUMENTS

SimpleLink™ SDK code portability
100% code reuse

TEXAS INSTRUMENTS
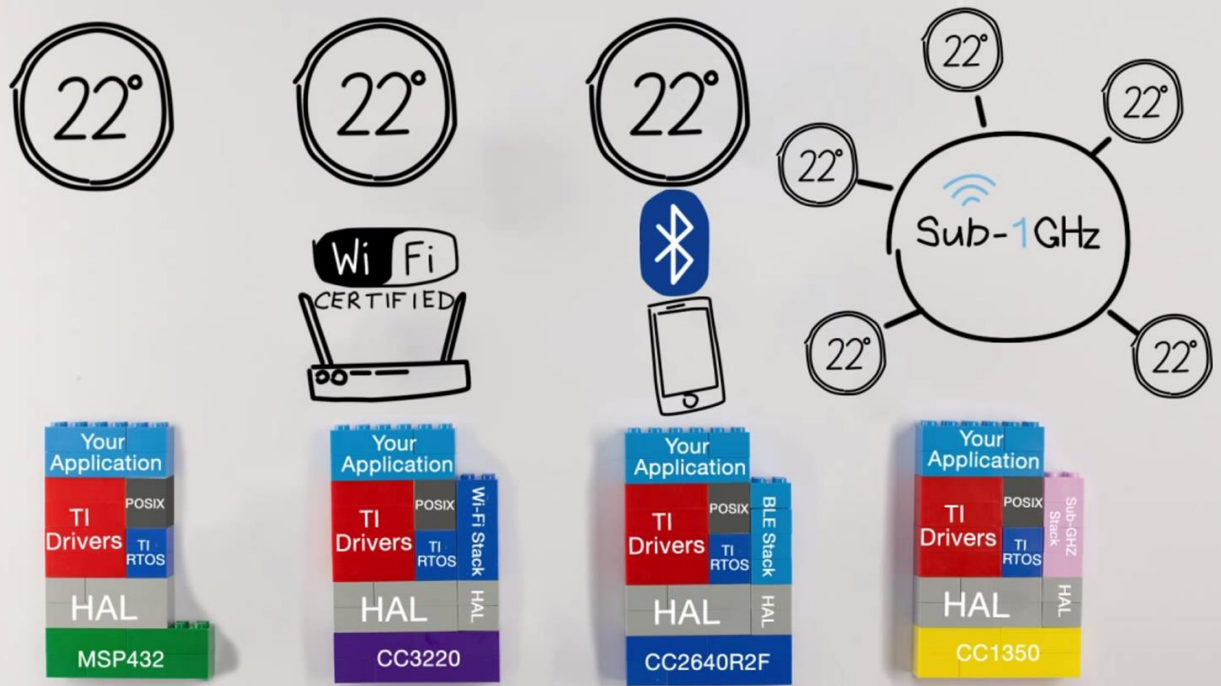
End-to-end development resources
Start your design today

Wired & wireless ARM®-based MCUs

Common software

Development Kits

TI Resource Explorer
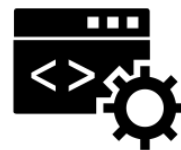
Code Composer Studio™ IDE

SimpleLink Academy

35

TI Cloud Tools

https://dev.ti.com/

TI Resource Explorer

http://dev.ti.com/tirex/#/

SimpleLink Academy

- Available at: SimpleLink Academy link

- Gets «anybody» up to speed on SW development for CC2640

- Integrated with CCS Desktop via separate installer

- Continuous roll-out of new labs and features.

- Richly formatted lab instructions
- Theory of operation
- Interactive quiz
- Learning by doing
- Quick links to further documentation

TEXAS INSTRUMENTS

Summary

- TI has all the ingredients for the industry 4.0

- Wireless Connectivity has a role to play and TI has the largest portfolio supporting more than 15 standards and technologies

- BLE, Wi-Fi and Sub 1-GHz are gaining traction today

- Many tools and TIDesigns available to start from today

- Large solution ecosystem including cloud solution

TEXAS INSTRUMENTS

Resources – get more information

www.ti.com/iot
www.ti.com/wireless

SLYY050B
www.ti.com/automation

SZZY004

TEXAS INSTRUMENTS

Recommended links for more information

TI wireless connectivity solutions landing page http://www.ti.com/lsds/ti/wireless_connectivity/overview.page

TI wireless connectivity solutions brochure http://www.ti.com/lit/ml/swrb035/swrb035.pdf

Understanding Wireless Solutions for Industrial eBook http://www.ti.com/ww/en/internet_of_things/iot-whats_new.html

TI Internet Of Things solutions landing page http://www.ti.com/ww/en/internet_of_things/iot-overview.html

TI SimpleLink Wireless connectivity portfolio www.ti.com/simplelink

TI's official LaunchPad portal www.ti.com/launchpad

TI SimpleLink Academy http://software-dl.ti.com/lprf/simplelink_academy/overview.html

TI Cloud Tools https://dev.ti.com/

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