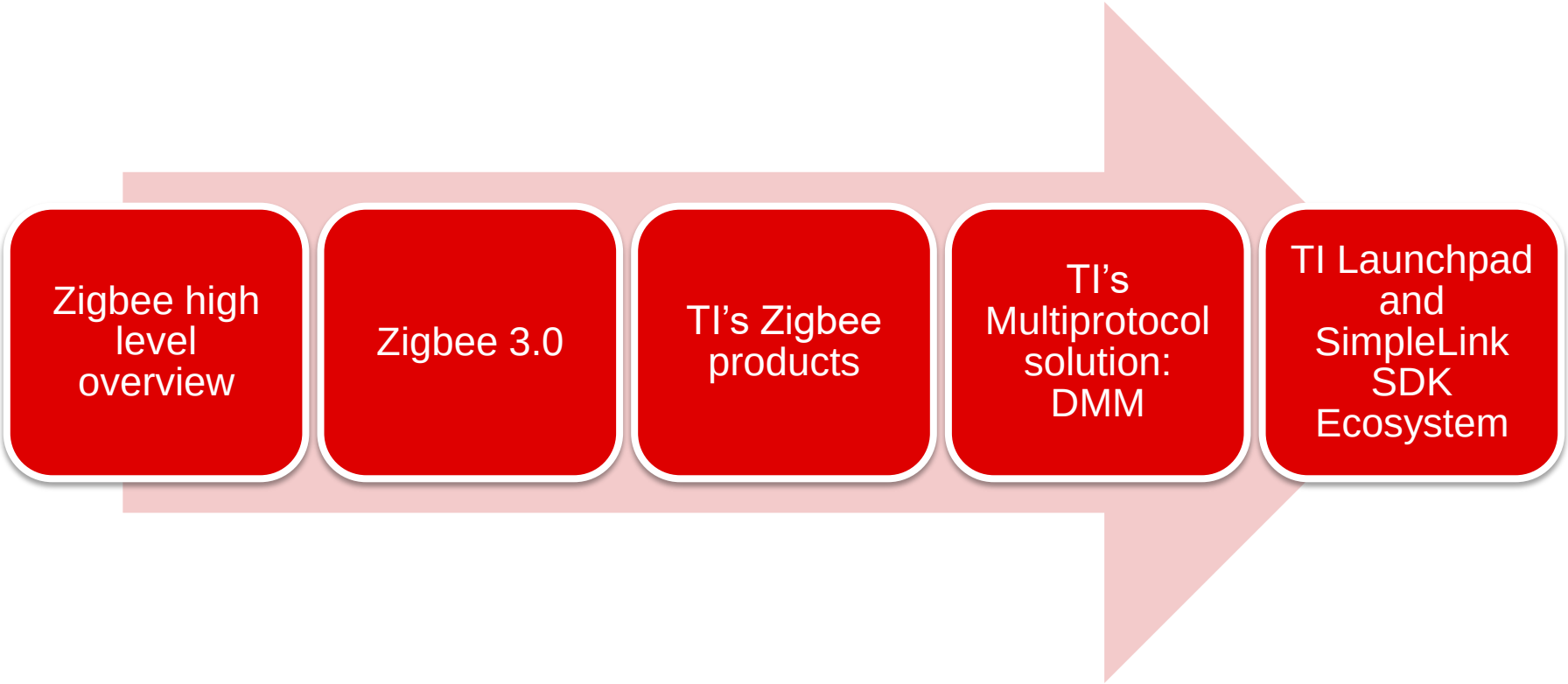
What's the Buzz Around Zigbee

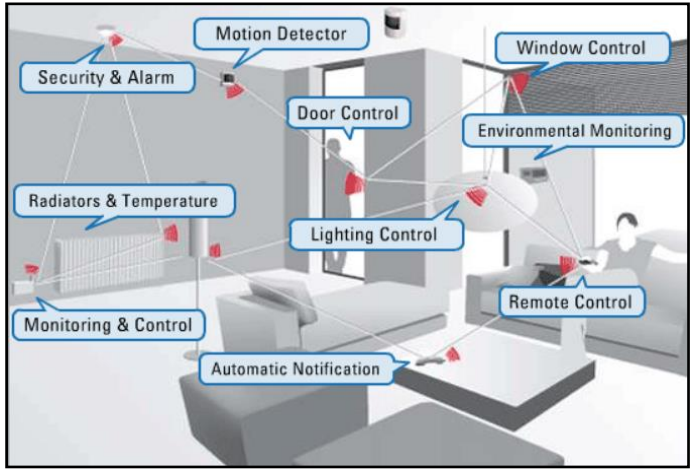
Agenda


Zigbee high level overview
Zigbee 3.0
TI's Zigbee products
TI's Multiprotocol solution: DMM
TI Launchpad and SimpleLink SDK Ecosystem

What is Zigbee?
High level overview

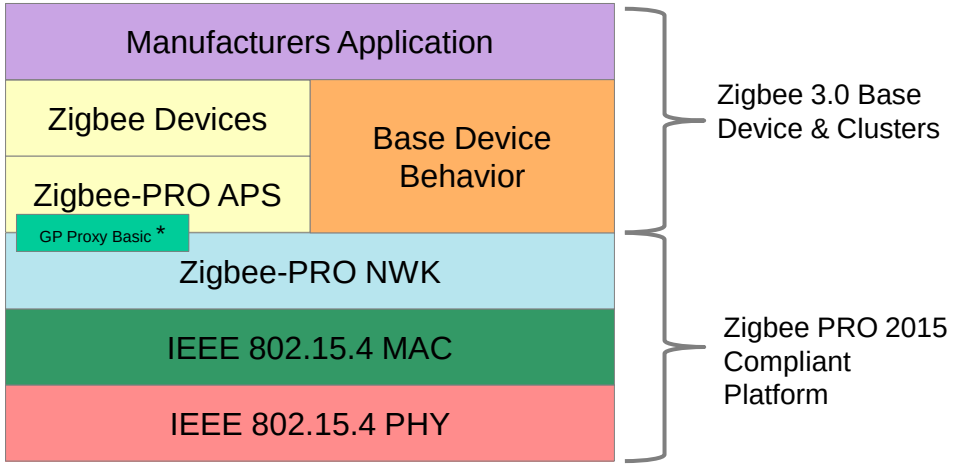
Zigbee is a low power, wireless, **mesh** networking solution that allows smart objects to work together.

- ✓ **Highly interoperable,** products undergo ZCP (Zigbee Compliant Platform) testing
- ✓ Standardized application layer via **Zigbee cluster library**
- ✓ **Self-organizing** and **self-healing** dynamic mesh networking
- ✓ Intended to support low data rate, green power applications
- ✓ Enables **over 250 devices** and provides **whole house coverage**



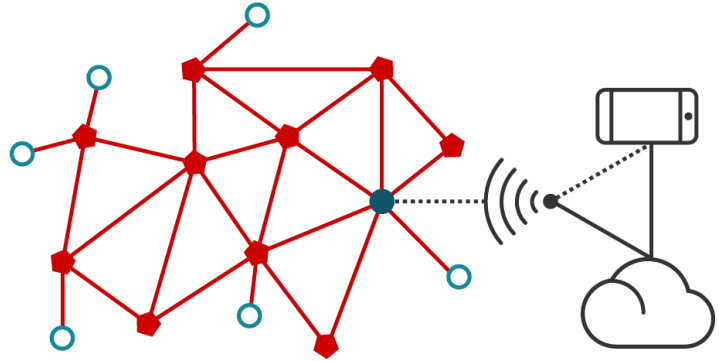
What is Zigbee?

Architecture and technical details



*Zigbee Green Power Proxy Basic is required for all routing devices

Zigbee Software Architecture



Zigbee Coordinator

- Starts the network
- Routes the packets
- Manages security
- Associates routers and end devices
- Example: Smart hub, Heating Central

Zigbee Router

- Routes packets
- Associates routers and end devices
- Example: Light

Zigbee End Device

- Battery powered
- Typically asleep
- Does not route packets
- Example: Light Switch

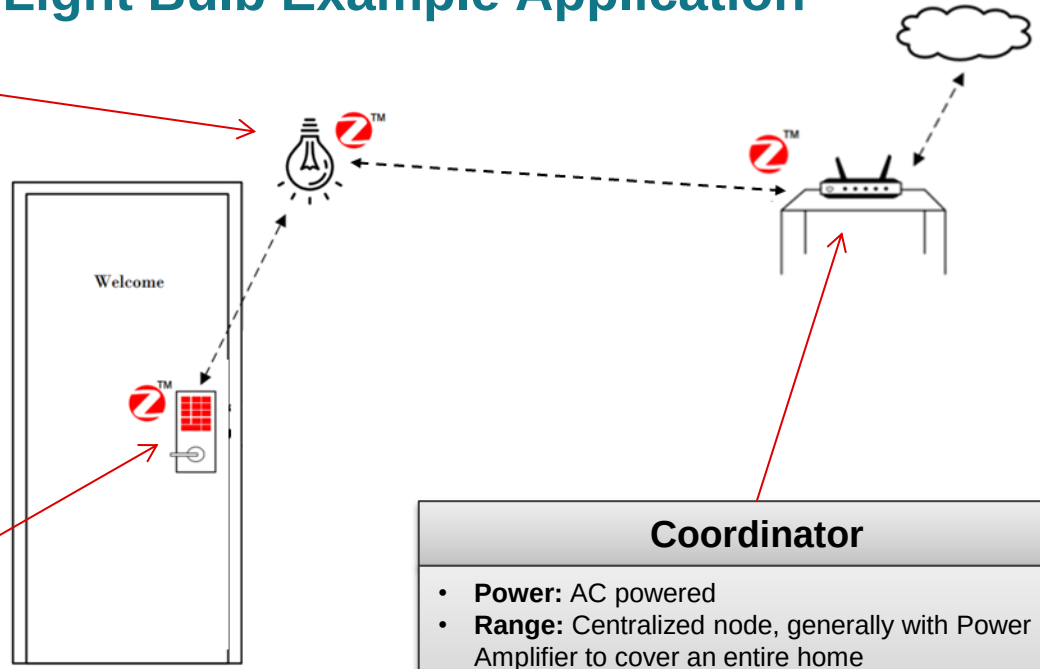
Zigbee Mesh Network Topology

Zigbee Network Design

Electronic Door Lock and Light Bulb Example Application

Router

- **Power:** Typically AC powered
- **Range:** Specific to application, AC powered routers more likely to have Power Amplifier
- **Memory:** Needs a reasonable amount of flash for containing routing information of neighbors.
- **Application: Range extender, light bulbs, any nodes that are AC powered.**



End Device

- **Power:** Battery powered
- **Range:** Varies, with nearby coordinators range can be short. When no router is nearby, Power Amplifier can be used to span longer ranges.
- **Memory:** Does not need abundance of flash, RAM can be application specific
- **Application: Sleepy sensor nodes, devices that run on batteries.**

Coordinator

- **Power:** AC powered
- **Range:** Centralized node, generally with Power Amplifier to cover an entire home
- **Memory:** Flash and RAM appropriate for size of network
- **Application: Gateway or smart hub.**

Why use Zigbee?

Benefits
Interoperable
Secure
Years of operation on single coin cell battery
Robust
Complete Protocol stack
Scalable
Full-house coverage
Half a billion devices sold worldwide

Zigbee 3.0: The Latest Standard

Unification of application segments

- Single certification mark
- Backward compatibility with legacy Home Automation, Green Power, Lighting, Retail and Building Automation profiles

Simplified device on-boarding

- Commissioning
- Service discovery
- Security policy harmonization across legacy profiles

Enhanced security

- Install Codes eliminate the use of well-known keys via out-of-band scheme
- Well-defined security procedures to request and change keys

Unified approach for interoperability

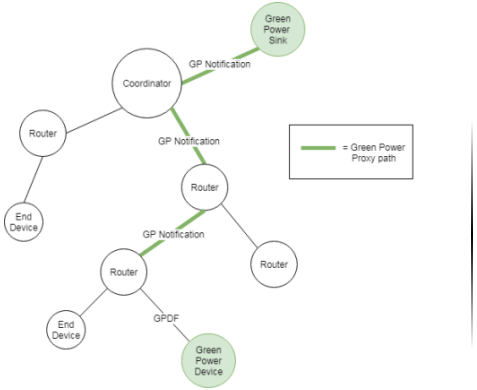
- Unified testing tool-set distributed by the ZigBee Alliance
- Certified testing lab

Green Power

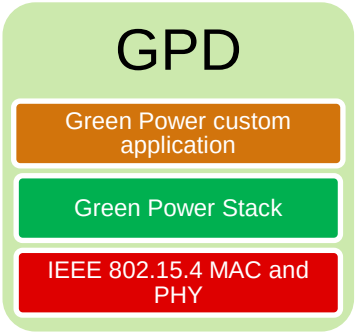
- Designed to work with energy harvesting and ultra-low power products
- All routing devices required to implement Green Power proxy assuring green power support

Zigbee 3.0 – Green Power

Try TI's Zigbee Green Power Examples for Battery-less Devices



Green Power Device Network



Green Power Device Software Architecture

Energy Harvesting Applications

- Zigbee Green Power allows battery-less Zigbee products such as sensors, switches and more to securely join a network.
- How it works:
  - Energy for communication can be captured by often wasted energy from switches, dimmers, and more.
  - Green Power Devices implement secure Green Power commands using a minimalistic stack footprint.
  - The "Sink" commissions devices and executes Green Power commands.
  - The "Proxy" forwards Green Power Commands.
- Compatible with any Zigbee 3.0 certified device network.

Zigbee with TI – Did You Know?

Texas Instruments Zigbee 3.0 Solutions

	CC2530	New! CC2652R	New! CC1352P
Description	Industry Proven, Cost Effective Zigbee Solution	Ultra-low power 2.4GHz SimpleLink Multi-Standard Wireless MCU for Zigbee, Thread, Bluetooth and more	World's lowest power Wireless MCU with integrated PA, 2.4 and Sub-1GHz Multi-Band operation
CPU	High Performance, Low-Power 8051	ARM® Cortex M4F	ARM® Cortex M4F
Max TX Output Power	+4.5dBm	+5dBm	+20dBm
RX Sensitivity	-97dBm	-100dBm	-101dBm
2.4GHz TX Current Consumption (0dBm)	28.7mA (+1dBm)	7.5mA	6.3mA, **79mA @ 20dBm** 20mA @ 10dBm
RX Current Consumption	24mA	6.9mA	6.9mA
Memory	256kB Flash, 8kB RAM	352kB Flash, 256kB ROM, 80kB RAM	352kB Flash, 256kB ROM, 80kB RAM
SimpleLink MCU Platform Compliant	✘	✓	✓
Zigbee Certification	Zigbee 3.0/Zigbee PRO 2015 (R21)	Zigbee 3.0 Compliant Stack with SDK available today. Certification available upon RTM: April 2019	

Gen 1

\+

Featured CC2592 Range Extender for CC2530:

- Seamless Interface to TI's 2.4-GHz Low-Power RF Devices
- +22-dBm Output Power
- Low-Transmit Current Consumption: 155 mA at 3 V for +22 dBm

Texas Instruments | zigbee

CC1352P

Industry’s lowest power PA

TEST CONDITIONS	TYP	UNIT
Radio TX, high power PA, 868/915 MHz 20-dBm output power	60	mA
Radio TX, high power PA, 2.4 GHz 20-dBm output power	78	mA

Competitor (integrated)

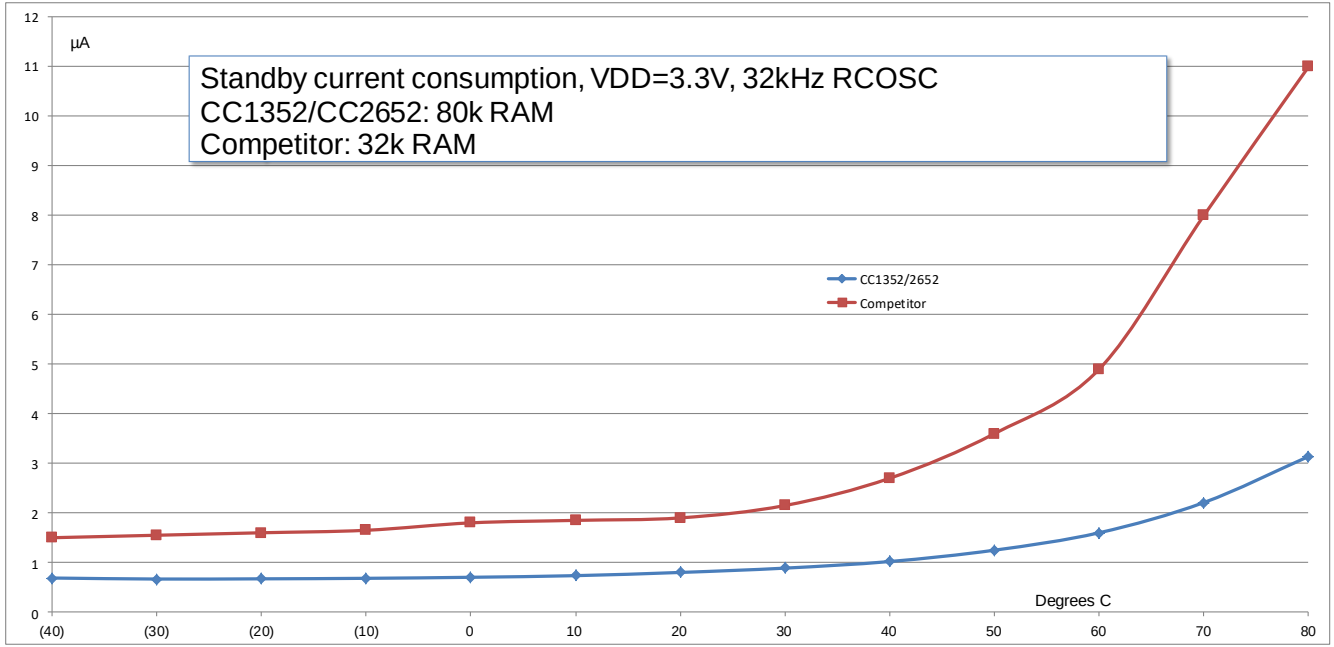
Test Condition	Min	Typ	Max	Unit
F = 868 MHz, CW, 20 dBm match, PAVDD connected directly to external 3.3V supply	—	79.7	106.7	mA
F = 2.4 GHz, CW, 19.5 dBm output power, PAVDD connected directly to external 3.3V supply	—	131	—	mA

Dedicated PA

Test Condition	Min	Typ	Max	Units
P_{OUT} = +20 dBm, high-efficiency 2.4 GHz		90		mA

SimpleLink Zigbee

Excellent Standby current over temperature



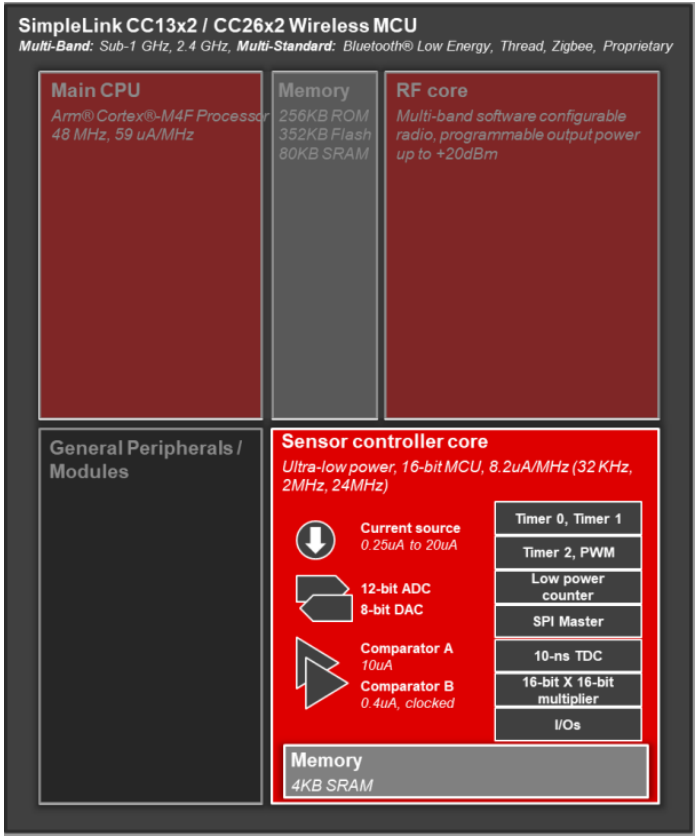
SimpleLink Sensor controller

The Sensor Controller is an Ultra-low power, 16-bit CPU core that runs independently of the rest of the system (Arm Cortex-M4F and RF core)

- Can read and process sensor data while the rest of the system sleeps
- Is user-programmable and executes code from a dedicated 4KB of RAM
- Has access to analog and digital peripherals
- Can read / write values to dedicated memory (4KB SRAM) and notify the main MCU to read the data on wake-up
- Can perform advanced tasks like capacitive touch and inductive sensing

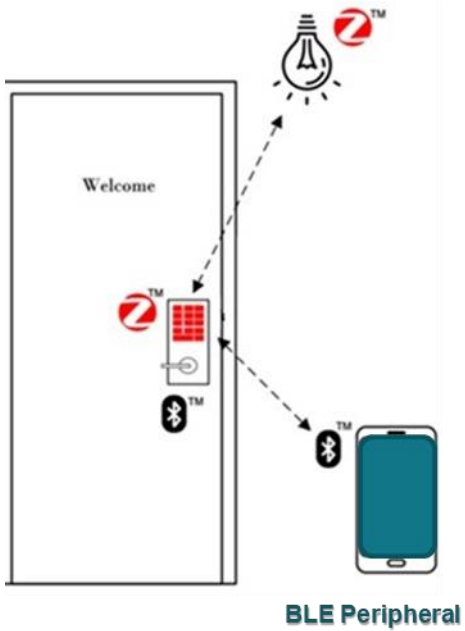
Power numbers for various applications:

- 1-Hz ADC sampling: **1 uA**
- SPI (20 reads / second): **1.4 uA**
- 100-Hz comparator reading: **1.5 uA**
- Inductive sensing for flow meter (16-Hz): **1.7uA**
- Capacitive touch (two buttons @33-Hz): **9uA**

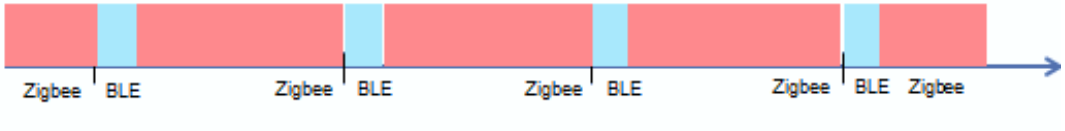


Zigbee + BLE: 1 chip, Multi-protocol Solution

Introducing the DMM: The Dynamic Multi-protocol Manager



- Using TI's multi-protocol solution, the DMM can allow Zigbee and BLE to run concurrently on a single chip.
- For example, adding a light switch into a Zigbee home network becomes highly simplified by using a BLE interface.
- With a Zigbee end device, you can add BLE connectivity to your phone. This end device will be in RX most of the time, and BLE will have periodic connection events.



Free SimpleLink Zigbee 3.0 SDK

Numerous examples and projects

Z-Stack 3.2.0 User's Guide

- Comprehensive user's guide for customers developing Zigbee Devices

SimpleLink Academy Labs

- Zigbee Fundamentals
- Project Zero: Light and Switch
- Designing a Custom Certifiable Project

Z-Stack Projects

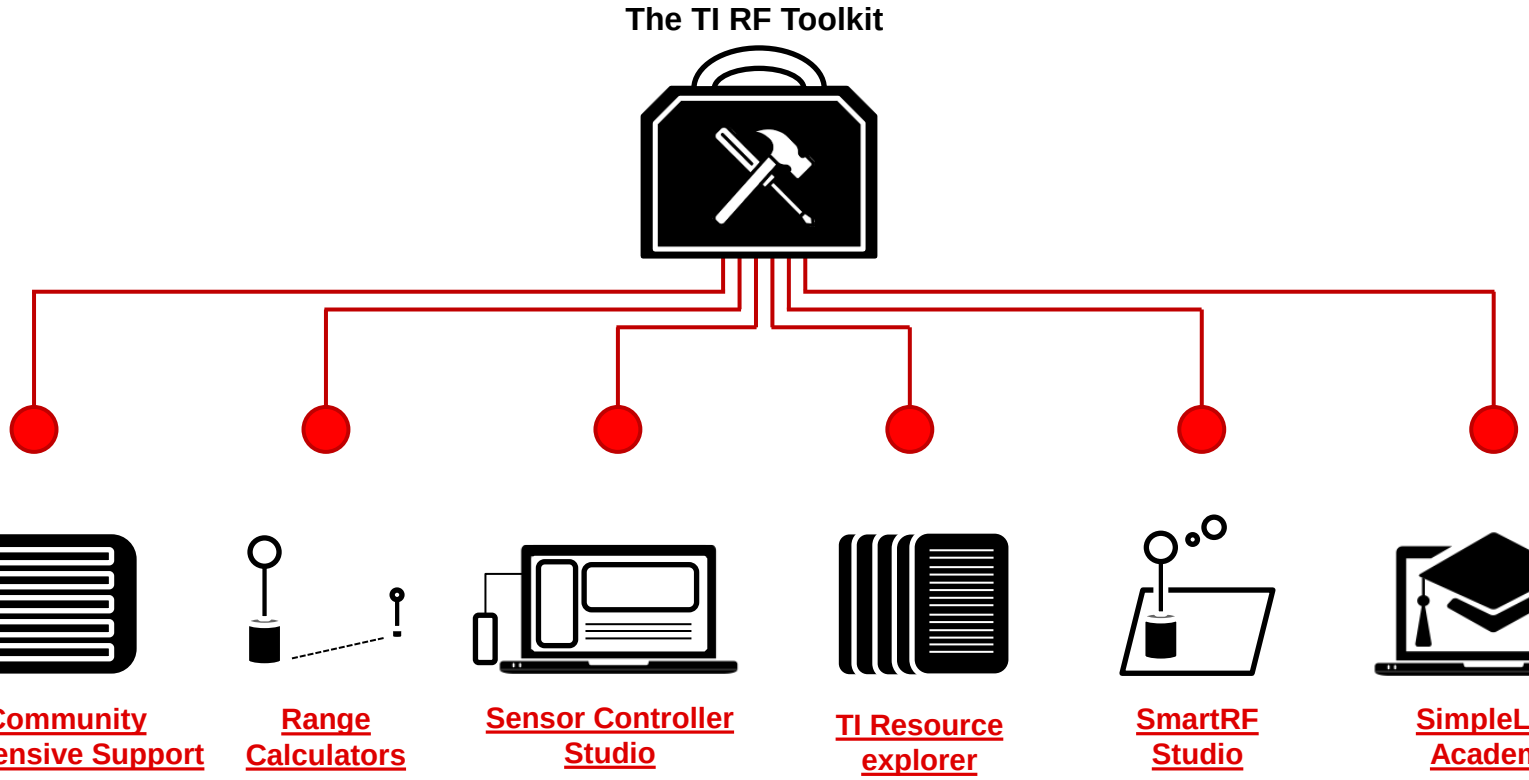
- Home automation examples
  - Light and switch
  - Door lock and controller
  - Thermostat and temperature sensor
- Green Power sink and device examples
  - Light and switch
  - Thermostat and temperature sensor
- OTA cluster server and client examples
- Bare-bones generic application
- Zigbee Network Processor (ZNP)

Example Projects Memory Footprint

Project	Flash (kB)	RAM (kB)	Comment
ZC Generic App	162	34.3	No UI or Zigbee clusters implemented, only commissioning and factory reset functionality
ZC Light	182	35.1	UART UI, On/Off and Level Control clusters
ZED Switch	140	33.5	UART UI, On/Off cluster
ZC Light Sink	187	35.3	GP light sink for GP source switch device
GPD Switch	62.7	30.1	TIMAC implementation, does not include full Z-Stack
ZC OTA Server	169	36.0	UART control and OTA cluster
ZED OTA Switch	202	36.5	OTA cluster, BIM, download and application memory segments

*Total 352 kB Flash and 80 kB RAM per device

The TI RF Development Toolkit



Start Development Today!
Scalable Development with the TI LaunchPad Ecosystem

Step 1: Purchase a LaunchPad Development Kit

Step 2: Download the TI SimpleLink SDK

CC26x2 SDK | CC13x2 SDK

Step 3: Reference our documentation on TI resource explorer

TI Resource Explorer