Application Brief

Wireless MCUs Designed to Meet Complex IoT Requirements

Rogerio Almeida

Introduction

As the world becomes more interconnected through the prevalence of IoT devices, design engineers need wireless MCUs that meet their key system requirements, such as:

- Low-power consumption
- Security
- In-field upgradability
- Scalability

This article discusses how the CC13x4/CC26x4 family of SimpleLink™ wireless MCUs helps designers overcome these challenges and get their IoT devices to market faster.

There are multiple devices and configurations in the SimpleLink CC13x4/CC26x4 family that were designed to meet the different applications and design requirements since there is no one-size-fits-all approach to design. However, before you explore each device in this family, discuss how these devices can help streamline IoT design.

Low Power

Many applications have many sensors spread across a building and charging the sensors regularly would make the deployment unfeasible. This drives the requirement for low power standby and low power operation of modern IoT devices. Ideal IoT devices should work on small batteries, and they should last for several years.

Microcontrollers (MCU) are normally the “brain” used in the IoT devices and they are responsible for a good portion of the power consumption. Depending on the MCU technology, the power consumption can vary greatly with the temperature, meaning, higher temperature will make the devices drain the energy of the batteries and cause a shorter operational life of the final product.

TI’s technology addresses both issues: very low power and stable low power consumption across temperature range, see Figure 1.

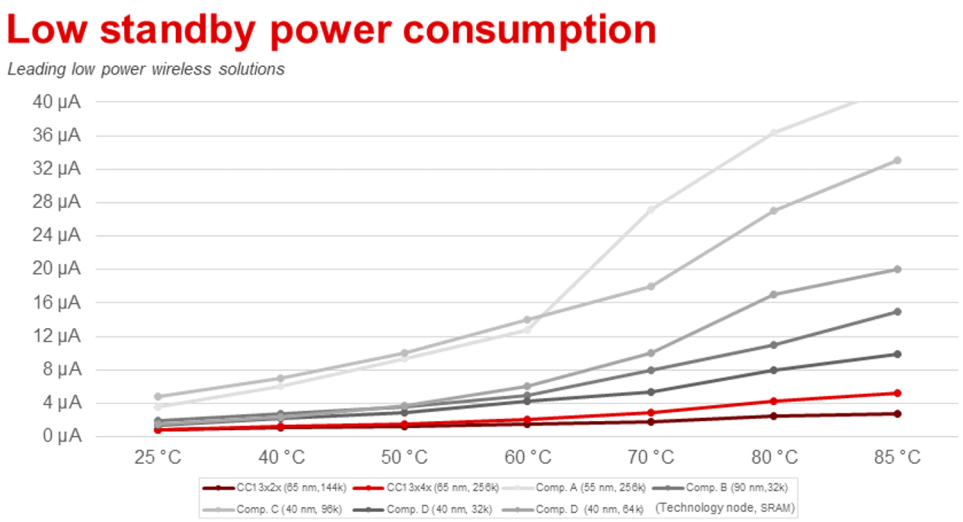

Figure 1. Low Standby Power Consumption

Figure 1 shows a typical standby current for a TI wireless MCU in comparison with some competitors. While TI device remains stable across the range from 25°C to 85°C, visibly you can see that devices from competition do not behave in the same way.

You may think “well, my product is for an indoor application that has AC and it will not reach high temperatures”. Consider this example, the customer had an HVAC thermostat that is installed in a wall that is facing the sun. The HVAC unit servicing that area was working constantly while the units servicing other areas were not. The customer discovered that because there were no blinds, the sun was shining directly on the thermostat and the temperature indication was affect. Once blinds where added, the problem was solved. Without knowing where end customers will be installing IoT devices, all units must be ready for high temperatures.

Some numbers from our data sheet highlights the low power of the CC13x4/CC26x4 family:

- 3.67 mA active mode, running CoreMark® at 48 MHz
- 76 µA/MHz running CoreMark at 48 MHz
- 0.98 µA standby mode while keeping Real-Time Clock running and holding 256KB SRAM with data
- 0.17 µA shutdown mode, wake-up on pin

To save even more power, this family of wireless MCUs has a block called Sensor Controller. It can be used to monitor external events and the dedicated ultra-low power 16 bits MCU used in Sensor Controller can be used to handle analog and digital sensors while the main MCU is sleeping. Since it can be configured to work on different clock speeds, you have flexibility to select the mode that is a better fit for the final application.

Table 1. Some Typical Applications of Sensor Controller

SPI Reading Wake Ups Per Second	Cortex-M33, 48 MHz	Sensor Controller, 24 MHz	Sensor Controller, 2 MHz
1	2.4 µA	1.5 µA	1.0 µA
20	25.4 µA	4.0 µA	1.4 µA
100	119 µA	15.6 µA	3.0 µA

To illustrate the benefits of our sensor controller, consider an application where it is necessary to read 18 bytes from a digital sensor using SPI (see Table 1). A typical M-33 MCU running at 48 MHz would consume 2.4 µA if it is waking up once every second, 25.4 µA if it is waking up 20 times per second and 119 µA in case of 100 times per second. Using TI sensor controller block, designer can leave the main MCU sleeping and just use the sensor controller, and depending on the clock (24 MHz or 2 MHz per the example above) you can see how significant the reduction in power consumption would be.

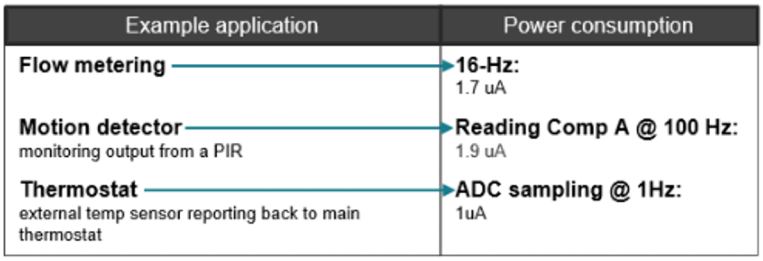

Figure 2. Power Consumption in Typical Applications Using Sensor Controller

Figure 2 shows three typical applications, Flow Metering (Industrial Smart Grid), Motion Detector (For Home and Commercial Building Automation) and Thermostat (For Home and Commercial Building Automation) where the Sensor Controller can help engineers to extend the battery life of products. Depending on the application, WMCU power consumption can be reduced 40 times when using Sensor Controller versus performing the same tasks with the main MCU.

For more details on how to better use the Sensor Controller, see Ultra-Low Power Designs With the CC13x2 and CC26x2 Sensor Controller.

Security

The proliferation of wireless products has resulted in increased attention to these products by hackers. To enable designers to meet the resulting challenges, the main MCU used in the new generation of TI wireless MCUs is the Arm® Cortex®-M33 with TrustZone® technology. The Arm M33 is an MCU designed to combine Low Power and Security features at a very affordable cost.

This approach allows for applications to execute security critical functions in a secure partition, that is isolated from the rest of the application executed in a non-secure partition. This trusted execution environment provides increased security for security functions and assets, including cryptographic keys/operations and private information by preventing malicious to access them from the non-secure environment.

This device also features an anti-rollback protection to prevent old firmware version (and potentially unsafe) to be installed once a new firmware version is uploaded.

In-Field Upgradability

Manufacturers may see the need to update the firmware inside their products for different reasons, like adding new functionality, improving the security and so on.

TI wireless MCUs have on-chip over the air update capabilities to allow manufacturers to easily updated their product. But one important question is: does the wireless MCU has memory enough to allow a new version to be downloaded while the current version is running?

The CC13x4/CC26x4 family of wireless MCUs comes with 1 MB of Flash Memory and up to 296 KB of SRAM. The amount of memory available on these devices can support protocols like Amazon Sidewalk, Wi-SUN™, Matter, Thread, Zigbee® and mioty.

Scalability

There are two aspects to consider: hardware and software. It is understood how important it is for our customers to preserve their investment in the developing products for Simplelink platform.

The CC13x4/CC26x4 family of wireless MCUs helps engineers continue using this platform through pin-to-pin compatibility with previous SimpleLink wireless MCUs with 7x7 packages, as well as API compatibility.

Figure 3 shows the compatibility from devices with 32KB of Flash up to 1 MB Flash.

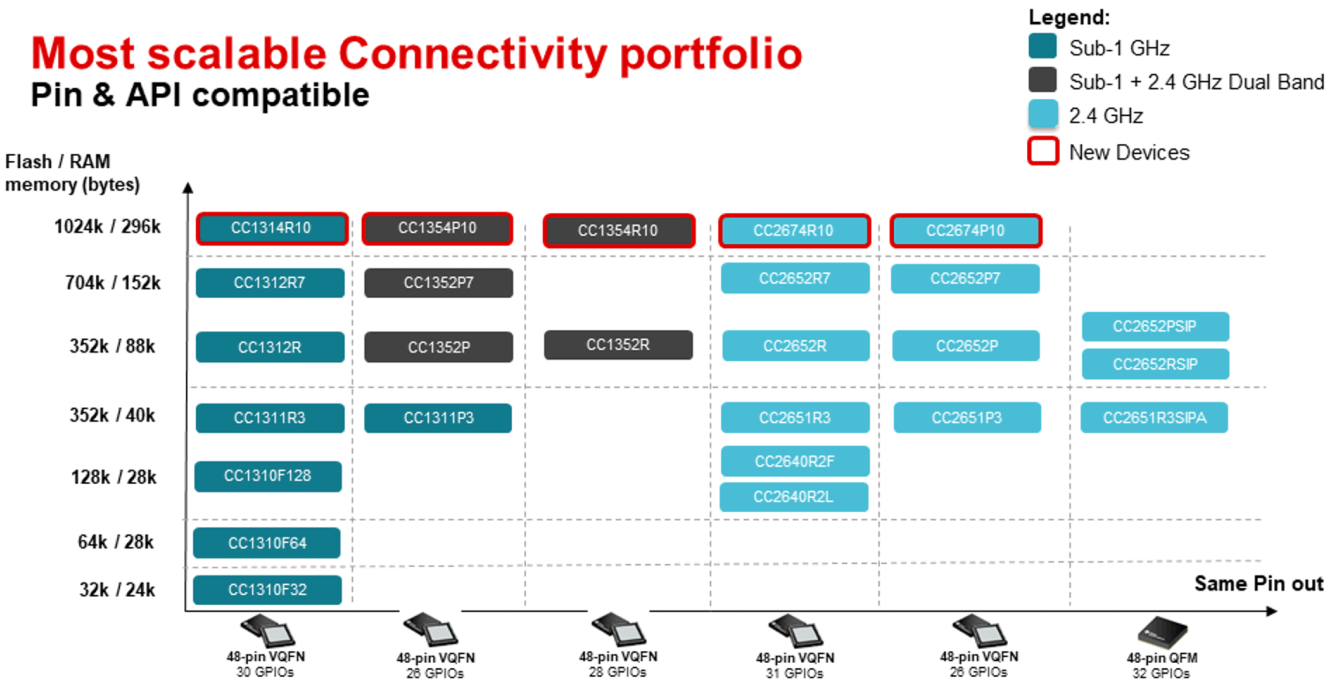

Figure 3. Pin and API Compatibility

- CC1314R10 – Sub1GHz WMCU supporting Wi-SUN, Amazon Sidewalk, mioty, Wireless M-Bus, IEEE 802.15.4, 6LoWPAN, proprietary protocols including TI 15.4 2.4 GHz stack
- CC1354R10 – Dual band WMCU supporting Wi-SUN, Amazon Sidewalk, mioty, Wireless M-Bus, Thread, Zigbee, *Bluetooth*® 5.2 LE, Matter, IEEE 802.15.4, 6LoWPAN, proprietary protocols including TI 15.4 stack, and Concurrent Multiprotocol Manager DMM
- CC1354P10 – Dual band WMCU with integrate Power Amplifier (+20dBm) supporting Wi-SUN, Amazon Sidewalk, mioty, Wireless M-Bus, Thread, Zigbee, Bluetooth 5.2 LE, Matter, IEEE 802.15.4, 6LoWPAN, proprietary protocols including TI 15.4 stack, and Concurrent Multiprotocol Manager DMM
- CC2674R10 – 2.4 GHz WMCU supporting Thread, Zigbee, Bluetooth 5.2 LE, IEEE 802.15.4, 6LoWPAN, proprietary systems including TI 15.4 2.4 GHz stack, and Concurrent Multiprotocol Manager DMM
- CC2674P10 – 2.4 GHz WMCU supporting Thread, Zigbee, Bluetooth 5.2 LE, IEEE 802.15.4, 6LoWPAN, proprietary systems including TI 15.4 2.4 GHz stack, Concurrent Multiprotocol Manager DMM and high power integrated 20 dBm PA

Now that you are familiar with the overall features and benefits of our CC13x4/CC26x4 family, download the free SDK and order one of the evaluation boards. You will be ready to start your new development.

Remember that challenges always exist, and Texas Instruments innovative products are here to help you to make your dreams a reality.

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Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265