iOS/Android^{TM}-Based Firmware Updates for SimpleLink^{TM} Devices

Part 1: Introduction

SimpleLink MCU SDK

Customer Applications

SDK Plugins

Delivered by TI Resource Explorer

Middleware

| Graphics | Sub-1GHz/802.15.4 | BLE/WiFi |

TI Drivers

POSIX

DriverLib (HAL)

OS Kernel

Examples

TI SimpleLink MCU SDK

TI SimpleLink™ MCUs

| MSP432 | CC2640R2F | CC3220 | CC13xx |

SDK Components

Drivers:
- **TI Drivers** provide portable, feature-rich access to peripherals.
- **DriverLib** provide Hardware Abstraction Layer (HAL) access for device-specific optimization
- Future support for TI Drivers without kernel.

OS/Kernel:
- Real-time, multi-tasking operating system
- POSIX-compliant API set enables use of a variety of RTOS kernels (validated with TI-RTOS & FreeRTOS)
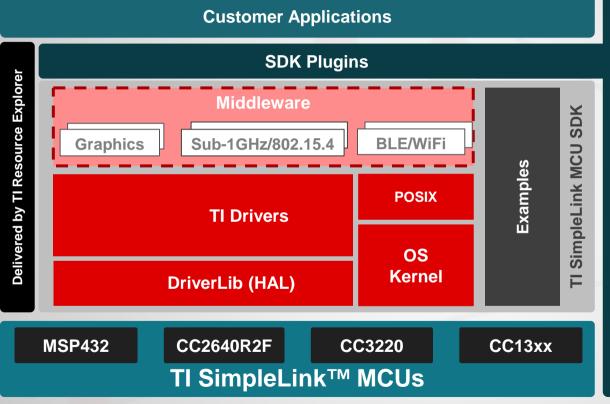
Middleware:
- Communication stacks
- Common libraries (e.g., graphics, CapTouch, FatFs)

Examples and documentation:
Large number of examples, documentation, and training make it easy to start developing applications.

TEXAS INSTRUMENTS

SimpleLink MCU SDK plugins

Customer Applications

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TI SimpleLink™ MCUs

SDK Plugins

Extend functionalities with external components and software:

- **Connectivity stacks on external components:**
  - BLE with MSP432+CC2640,
  - WiFi with MSP432 + CC3120

- **Sensors**: Temperature, motion, ambient light, ultrasonic, and more

- **Actuators:** LCD, DAC, LED drivers, and more
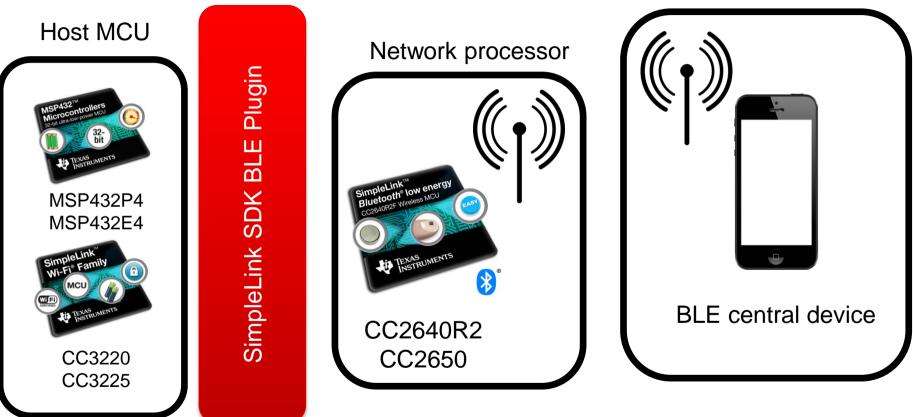
- **More**: Cloud/IoT services, algorithms, etc.

Code portability across SimpleLink MCU devices:

- Built on top of **TI Drivers** Available from **TI and 3rd parties**.

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SimpleLink SDK BLE plugin

Host MCU

MSP432P4
MSP432E4

CC3220
CC3225

SimpleLink SDK BLE Plugin

Network processor

CC2640R2
CC2650

Client device

BLE central device

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SimpleLink MSP432 + Bluetooth CC2640R2F

Bluetooth Low-energy Solution	CC2640R2F + MSP432		
Memory	256kB - 2.2MB Flash 96kB - 288kB RAM		
Packages	2.7 x 2.7mm BGA34 + 5x5 BGA80		
IOs	94		
Analog	14-bit 1 MSPS ADC, 2x Analog Comparator		
Wireless Standards	Bluetooth® 4.0/4.1 / 4.2, **Bluetooth® 5 (BLE)**		
Max Throughput	2Mbps		
Peak Current TX	6.1 mA		
Sleep Current	680 nA		
Timers	2x 32 bit, 6x 16 bit		
Com Ports	6x UART or SPI 4x I2C or SPI		
Security	TRNG, AES128, 196, 256, CRC16, CRC32		
SimpleLink Stacks	BLE, BLE HomeKit, GrLib, Voice Recognizer		
Software	**SimpleLink MCU SDK**		

- Industry's lowest power BLE solution

- Industry's best integrated ADC (Up to 16 ENOB)

- First Bluetooth 5.0 radio in production

- Scalable portfolio, pin-to-pin, from 128kB to 2MB of flash memory
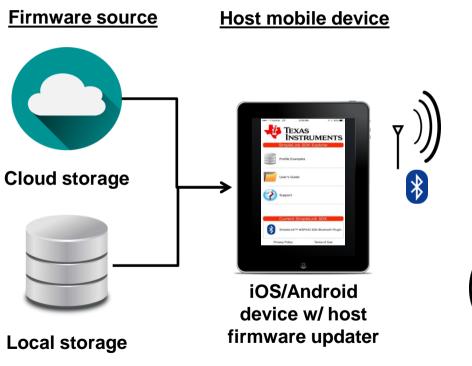
- Hardware security accelerators

Simple Application Library (SAP)

- Application code is written using high-level SAP APIs that abstract out low-line communication.

- All application-level code and logic is handled on host MCU, leveraging large memory footprint and enhanced peripherals.

- Low-level serial interaction is abstracted away by higher level application libraries.

- Interface utilizes TI-Drivers and POSIX layer to promote portability across SimpleLink devices.

- BLE code running on CC26XX is "black box" implementation that is generic across host application.

- BLE code is maintained and provided as source within the CC2640R2 and CC26XX SDKs.

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Over-the-Air Download (OAD): Firmware updates

Firmware source

Host mobile device

Cloud storage

Local storage

iOS/Android
device w/ host
firmware updater

OAD example features:
- Provides ability to update both firmware on MSP432 and CC26XX image
- Supports both MSP432P401R (256K) and MSP432P41111 (2MB) variants
- Available on TI-RTOS and FreeRTOS via use of POSIX/TI drivers
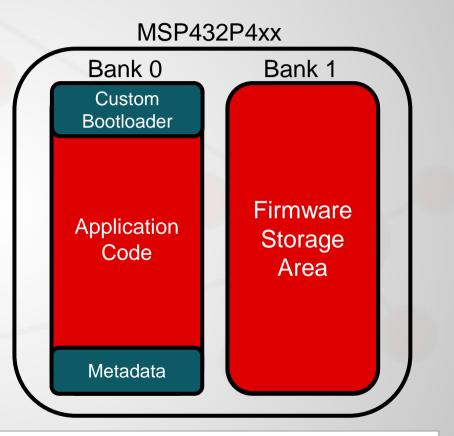
**BLE-enabled
End Equipment**

SimpleLink™
MSP432™
Host MCUs

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INSTRUMENTS

SimpleLink™
Wireless
MCUs

TEXAS
INSTRUMENTS

**MSP432P4 Host MCU w/
CC2640R2 BLE radio**

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Over-the-Air Download (OAD): Application update

1. Mobile application sends metadata and negotiates the start of the OAD.
2. Once metadata is accepted, firmware is downloaded to the flash Bank 1 storage area.
3. After firmware download is complete, the application does the following:
   - Verifies the image is valid
   - Sets flag
   - Saves image information
   - Reboots device
4. The custom bootloader – recognizing the flag and that a new image exists – programs the application code.
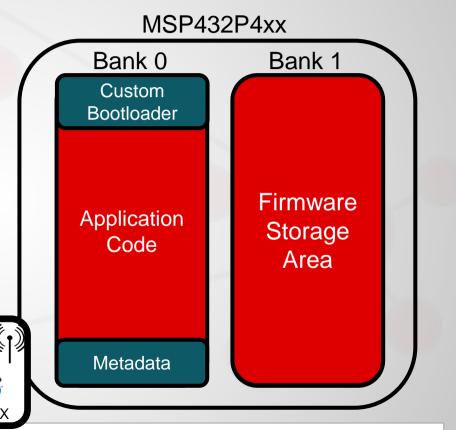5. After programming is complete, the device resets and the new firmware is run.

MSP432P4xx

Bank 0

Custom Bootloader

Application Code

Metadata

Bank 1

Firmware Storage Area

Over-the-Air Download (OAD): CC26XX update

1. Mobile application sends metadata and negotiates the start of the OAD.
2. Once metadata is accepted, the CC26xx image is downloaded to the flash Bank 1 storage area.
3. After the image download is complete, the application does the following:
   - Verifies the image is valid
   - Disconnects BLE
   - Invokes ROM UART bootloader on CC26XX device
4. The new network processor image is programmed to CC26XX via UART.
5. After programming is complete, the MSP432 resets both itself and the network processor.

MSP432P4xx

Bank 0 — Custom Bootloader / Application Code / Metadata

Bank 1 — Firmware Storage Area

CC26XX

TEXAS INSTRUMENTS

Host programming tools

Python OAD Programmer

- Compiled Python binary for Windows/Linux/OSX
- Utilizes USB-connected CC26XX device for BLE radio

SimpleLink SDK Explorer

- Multi-feature Android/iOS application for various SimpleLink SDK products
- Demonstrates numerous facets of SimpleLink SDK products

MSP432 BLE Firmware Updater

Placeholder Image

- Targeted reference application for OAD firmware updates
- Architected as lightweight and easy to reuse for end-customer applications

MSP432 BLE Firmware Updater

Placeholder Image

The MSP BLE Firmware Updater is a lightweight mobile application designed specifically as a reference for customers to pick up and integrate into their own designs:

- Supports both Android and iOS platforms
- Utilizes native BLE core libraries on iOS and Android and does not require any third-party middleware or development platforms
- Source code provided in entirety with BSD licensing to foster easy modification and redistribution
- Provided by Texas Instruments on both Google Play and Apple AppStore as examples for convenience to developers

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For more information

- SimpleLink Solutions: http://www.ti.com/simplelink

- SimpleLink Academy: http://www.ti.com/simplelink-academy

- SimpleLinkT Bluetooth® Low Energy (BLE): http://www.ti.com/ble

- MSP430 ultra-low-power sensing & measurement MCUs: http://www.ti.com/mcu430

- CC2640 SimpleLink MCU for BLE: http://www.ti.com/CC2640

- For questions about this training, refer to the E2E Community Forums at http://e2e.ti.com