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**Bluetooth® Smart to Wi-Fi® IoT Gateway**

**TI Designs**

TI Designs provide the foundation that you need including methodology, testing and design files to quickly evaluate and customize the system. TI Designs help you accelerate your time to market.

**Design Resources**

- **TIDC-BLE-TO-WIFI-IOT-GATEWAY**
  - TI Design Files
  - Product Folder

**CC2650**
- Product Folder

**CC3200**
- Product Folder

**TPS79601**
- Product Folder

**TPD2EUSB30**
- Product Folder

**ASK Our E2E Experts**

**WEBENCH® Calculator Tools**

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**Design Features**

- Connect *Bluetooth* Smart Devices To IoT Cloud
- USB Powered, Small Form Factor, Low-Power Wi-Fi® Connection
- USB (Over UART) Command Interface For Configuration—Works With SensorTag
- HTTP Server and Pages For Configuration
- Single-Board *Bluetooth*® Smart Wi-Fi Integrated Design
- MQTT Protocol Enabled For IoT Connectivity
- Over-The-Air (OTA) Firmware Update

**Featured Applications**

- Internet of Things (IoT)
- Social Alerts
- Health and Fitness
- Remote Tracking

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1 Key System Specifications

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SPECIFICATION</th>
<th>DETAILS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wi-Fi chip</td>
<td>A Single-Chip Wireless MCU with integrated Wi-Fi network processor and power management subsystem</td>
<td>Refer to the following link: <a href="http://www.ti.com/product/cc3200">http://www.ti.com/product/cc3200</a></td>
</tr>
<tr>
<td>Bluetooth Smart chip</td>
<td>The CC2650 is a wireless MCU targeting Bluetooth Smart, ZigBee™ and 6LoWPAN, and ZigBee RF4CE remote control applications</td>
<td>Refer to the following link: <a href="http://www.ti.com/product/cc2650">http://www.ti.com/product/cc2650</a></td>
</tr>
<tr>
<td>Power chip</td>
<td>The TPS79601 low dropout (LDO) low-power linear voltage regulator features ultralow-noise and excellent line and load transient responses in small outline, 3 x 3 VSON package</td>
<td>Refer to the following link: <a href="http://www.ti.com/product/tps79601/description">http://www.ti.com/product/tps79601/description</a></td>
</tr>
<tr>
<td>ESD chip</td>
<td>The TPD2EUSB30 are 2 channel Transient Voltage Suppressor (TVS) based Electrostatic Discharge (ESD) protection diode arrays</td>
<td>Refer to the following link: <a href="http://www.ti.com/product/TPD2EUSB30">http://www.ti.com/product/TPD2EUSB30</a></td>
</tr>
<tr>
<td>Antenna</td>
<td>2450AT18D0100 for Bluetooth Smart and 2450AT42B100 for Wi-Fi, 2.4 Ghz, ceramic chip antenna</td>
<td>Refer to the following links: <a href="http://www.johansontechnology.com/datasheets/antennas/2450AT18D0100.pdf">http://www.johansontechnology.com/datasheets/antennas/2450AT18D0100.pdf</a> <a href="http://www.johansontechnology.com/datasheets/antennas/2450AT42B100.pdf">http://www.johansontechnology.com/datasheets/antennas/2450AT42B100.pdf</a></td>
</tr>
<tr>
<td>$V_{IN}$</td>
<td>Input voltage 5 V, USB powered</td>
<td></td>
</tr>
<tr>
<td>$V_{OUT}$</td>
<td>Output voltage 3.3 V, powers the gateway</td>
<td></td>
</tr>
</tbody>
</table>

1.1 Deliverables

The Bluetooth Smart to Wi-Fi Gateway TI design comprises the following mentioned collaterals.

1.1.1 Hardware Design Files

The hardware design files help the customer design a custom board. The package includes schematics, layout, and Gerber files.

1.1.2 Software Source

The software package contains all the gateway source files. The software is modular, which makes it easier for the developer to include a particular module.

1.1.3 Collaterals

This design guide explains the usage of the gateway.
2 System Description

This Bluetooth Smart-to-Wi-Fi Gateway solution connects the Bluetooth Smart devices to the cloud over Wi-Fi. The integrated hardware solution comprises the CC3200 Wi-Fi wireless MCU and the CC2650 Wireless MCU on a single board. Customers may reuse the reference design to design their own gateway. The software and hardware design resources reduce engineering efforts, shorten time to market, and help developers and customers release their products with cloud connectivity features faster.

The CC3200 Wireless MCU is an intelligent, low-power Wi-Fi chip with an ARM® Cortex®-M4 application processor. The CC3200 contains a wireless network processor with stable and certified TCP/IP stack integrated on a single chip. The device comes with on-chip security protocols and various network application protocols (HTTP, mDNS, and others). CC3200 is the first and only chip in the world to be Wi-Fi certified by the Wi-Fi alliance at chip level.

The CC3200 SDK (Software Development Kit) facilitates easy development experience for the user. The CC3200 contains CCS, IAR and GCC toolchain support, app notes and extensive user guides. The SimpleLink™ APIs provide an easy and well abstracted access to the stack functionality. The SDK provides MQTT support (for IoT), OTA (Over The Air) download support, and numerous MCU examples, which reduces the development effort and thereby reduces the time to market. Extensive E2E support from TI helps the developers at every stage.

CC2650 is an ultralow-power wireless MCU capable of running multiple protocols (Bluetooth Smart, ZigBee, and 6LowPAN). This wireless MCU can run for years even when powered by coin-cell batteries or any energy-harvested sources.

The CC2650 platform comes ready-to-use, royalty free, and with certified wireless protocol stacks, TI RTOS, Code Composer Studio™ integrated development environment (IDE), development tools, online training, and E2E community support.

The CC3200 Wireless MCU powers the entire board and also communicates and controls the CC2650 Bluetooth Smart Wireless MCU over UART. With the support of its built-in Wi-Fi network processor, the CC3200 Wireless MCU ensures seamless connection with the remote cloud. The CC2650 Wireless MCU can connect to multiple Bluetooth Smart devices.

Two LED indicators are provided to indicate the status. Two buttons are provided to trigger various actions. A simple button is provided to switch the CC3200 to UARTLoad mode. Debugging and programming options for both CC3200 and CC2650 chips are provided by dedicated JTAG ports.

The gateway can easily be configured for the first time using the Command Line Interface (CLI). UniFlash flashes the binaries on CC3200.

A 1-MB Serial Flash (SFLASH) is provided for storing the binaries, configuration files, and http pages.

A dedicated RESET button is provided to bring the gateway out of unknown conditions during development.
2.1 CC2650—Wireless MCU

The CC2650 is a wireless-MCU-targeting Bluetooth Smart application. The device is a member of the CC26xx family of cost-effective, ultralow-power, 2.4-GHz RF devices. Very low active RF current consumption and very low MCU current consumption provide excellent battery lifetime and allows operation on small-coin cell batteries and in energy-harvesting applications. The CC2650 contains a 32-bit ARM Cortex M3 running at 48-MHz as the main processor and a rich peripheral feature set. This set includes a unique ultralow-power sensor controller, which is ideal for interfacing external sensors and collecting analog and digital data autonomously while the rest of the system is in sleep mode.

CC2650 is a Network Processor in the gateway design. For more details of CC2650, see the product page.

2.2 CC3200—Wireless MCU

The CC3200 MCU subsystem contains an industry-standard ARM Cortex M4 core running at 80 MHz. The device includes a wide variety of peripherals, including a fast parallel camera interface, I²S, SD / MMC, UART, SPI, I²C, and four-channel ADC. The CC3200 family includes flexible embedded RAM for code and data, and ROM with an external serial flash bootloader and peripheral drivers.
The Wi-Fi network processor subsystem features a Wi-Fi Internet-on-a-Chip™ and contains an additional dedicated ARM MCU that completely offloads the applications MCU. This subsystem includes an 802.11 b/g/n radio, baseband, and MAC with a powerful crypto engine for fast, secure Internet connections with 256-bit encryption. The CC3200 device supports Station, Access Point, and Wi-Fi Direct modes. The device also supports WPA2 personal and enterprise security and WPS 2.0. The Wi-Fi Internet-on-a-chip includes embedded TCP/IP and TLS/SSL stacks, HTTP server, and multiple Internet protocols.

The CC3200 is the host processor in the gateway design. For more details about CC3200, see the product page.

### 2.3 TPS79601—Power IC

The TPS796 family of low-dropout (LDO), low-power linear voltage regulators features high power-supply rejection ratio (PSRR), ultralow-noise, fast startup, and excellent line and load transient responses in small-outline, 3 x 3 VSON, SOT223-6, and TO-263 packages. Each device in the family is stable with a small, 1-μF ceramic capacitor on the output. The family uses an advanced, proprietary BiCMOS fabrication process to yield extremely low dropout voltages (for example, 250 mV at 1 A). Each device achieves fast start-up times.

For more details of TPS79601, see the product page.

### 2.4 TPD2EUSB30 ESD Protection Diode

The TPD2EUSB30 is a 2-channel Transient-Voltage-Suppressor (TVS)-based Electrostatic-Discharge (ESD)-protection diode array. The TPDxEUSB30/A devices are rated to dissipate ESD strikes at the maximum level specified in the IEC 61000-4-2 international standard (Contact). These devices also offer 5-A (8 / 20 μs) peak pulse current ratings per IEC 61000-4-5 (Surge) specification.

For more details of TPD2EUSB30, see the product page.
3 System Design Theory

The Bluetooth Smart-to-Wi-Fi IoT gateway aims at addressing the problem statement “How can the data on a Bluetooth Smart device be available over the internet or on a Wi-Fi enabled device”

SensorTag is one of TI’s most popular designs. The Bluetooth Smart-enabled version is usually limited to using a phone or tablet as a gateway, which limits the use in more infrastructure-oriented applications as the phone may not always be present. Given the emergence of the Internet of Things (IoT), these devices should be connected to the Internet or a private LAN seamlessly (that is, without changing the software or design of the existing SensorTag modules).
3.1 Architecture

Figure 5. Software Architecture

The CC3200 Wireless MCU acts as a master and controls the CC26XX Bluetooth Smart Wireless MCU. The Gateway enabler application on the CC26XX brings out the Bluetooth Smart stack functionalities over the host controller interface (HCI) commands.

The application runs on the CC3200 and contains the following modules:

- Gateway module (central and database)
- TCP / IP stack (network processor)
- HTTP server and pages
- IoT stack (MQTT client stack—IBM)
- Host HCI layer
- Utilities such as CLI and JSON parser
- Over-the-air (OTA) and serial boot loader (SBL) module
3.2 Working Principle

The software is a multitask architecture. The initialization sequence spawns the tasks and executes various module-initialization functions.

![Initialization Sequence on CC3200 MCU](image)

When configured, the gateway acts as a data pipe between the Bluetooth Smart devices and the monitoring entity (on Wi-Fi). No special configuration or code change is needed on the Bluetooth Smart device to remote it to the gateway.
The gateway setup comprises of WLAN connection and Bluetooth Smart device connection. When the setup is complete, you can monitor the characteristics of the device over MQTT, HTTP, or CLI. With the software architecture, users can easily remove a particular entity from the binary (to reduce the size).

OTA download functionality is also present in the gateway. OTA can update the binary and also the Gateway Enabler binary.

4 Getting Started Hardware

The primary feature of the gateway is to make the characteristics of a connected Bluetooth Smart device available on the cloud (IoT using MQTT). The gateway can be controlled over a local LAN using HTTP pages.

Starting the gateway hardware is an easy process. To power on the gateway, connect it to a PC or a wall-mount USB adapter through the USB cable provided in the package. Connecting the gateway to a PC provides access to the command line interface on a terminal (TeraTerm or HyperTerminal®), which aids in controlling or monitoring the gateway. When connected, press the RESET button to start the gateway.
4.1 Push Buttons and LEDs

Table 2. Button Description

<table>
<thead>
<tr>
<th>REFERENCE</th>
<th>USAGE</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>RST</td>
<td>Reset</td>
<td>This button is used to reset the gateway</td>
</tr>
<tr>
<td>DNLD</td>
<td>UartLoad</td>
<td>This button, when pressed along with RST, puts the CC3200 in UARTLOAD mode. This mode updates the firmware</td>
</tr>
<tr>
<td>BTN-1</td>
<td>Scan</td>
<td>This button is used to trigger the scan for Bluetooth Smart devices</td>
</tr>
<tr>
<td>BTN-2</td>
<td>Over The Air (OTA) trigger</td>
<td>This button triggers the OTA download of binaries</td>
</tr>
</tbody>
</table>

Table 3. LED Description

<table>
<thead>
<tr>
<th>REFERENCE</th>
<th>INDICATION</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED-1</td>
<td>OFF</td>
<td>Bluetooth Smart stack is UP</td>
</tr>
<tr>
<td></td>
<td>ON</td>
<td>Bluetooth Smart stack Initialization in progress</td>
</tr>
<tr>
<td></td>
<td>SLOW BLINK (1 per sec)</td>
<td>Scanning in progress</td>
</tr>
<tr>
<td></td>
<td>FAST BLINK (2 per sec)</td>
<td>System Fatal ERROR</td>
</tr>
<tr>
<td>LED-2</td>
<td>OFF</td>
<td>AP connection success</td>
</tr>
<tr>
<td></td>
<td>ON</td>
<td>AP connection failure</td>
</tr>
<tr>
<td></td>
<td>SLOW BLINK (1 per sec)</td>
<td>SmartConfig in progress</td>
</tr>
<tr>
<td></td>
<td>FAST BLINK (2 per sec)</td>
<td>System Fatal ERROR</td>
</tr>
</tbody>
</table>

4.2 Prerequisites

1. Bluetooth Smart to Wi-Fi IoT gateway hardware
2. Micro-USB cable
3. Access point with internet uplink available. The gateway must be connected to this access point.
4. Laptop or PC
   • Connected to the Internet for MQTT (Internet)
   • Connected to the same AP as the gateway for HTTP (LAN)
5. SensorTag (at least one) with default pre-programmed software
   • CC26XX SensorTag

4.3 Setup

Figure 9. Setup Diagram
4.3.1 Laptop / PC Installations

- Download and install UniFlash (to flash CC3200 binaries and service pack) from the link here: http://www.ti.com/tool/uniflash
- Download and install TeraTerm: http://download.cnet.com/Tera-Term/3000-20432_4-75766675.html
- Download and install the latest Silabs™ virtual COM port driver for the CP2104 USB bridge IC (based on the OS) from the link here: http://www.silabs.com/products/mcu/Pages/USBtoUARTBridgeVCPDrivers.aspx.
  - The gateway COM ports appear in the device manager of the PC as Silicon Labs Standard COM CP210x USB to UART Bridge: Enhanced COM Port
- Download and install the latest CC3200 SDK and service packs from the link here: http://www.ti.com/tool/cc3200sdk

4.3.2 Access Point (AP) Configuration

Configure the access point in Open or WPA mode. If the AP is configured in WPA mode, write down the security key.
4.3.3 Steps

A typical usage of the gateway contains following steps:
1. Install the mentioned software on the laptop or PC
2. Connect the gateway to the laptop or PC using the USB cable
3. Configure the access point either in Open or WPA mode
4. Reset/Power on the gateway by pressing the Reset button
5. Connect the gateway to a Wi-Fi access point
6. Connect the gateway to SensorTag (using CLI or MQTT or HTTP)
7. View, read, and write the capabilities of the SensorTag (using CLI or MQTT or HTTP)

5 Getting Started Firmware

Download and install the binary package from TIDC-BLE-TO-WIFI-IOT-GATEWAY.

5.1 Flashing the Binaries

The binary package contains these files:
- blefi.bin—The Bluetooth Smart to Wi-Fi IoT Gateway application that runs on CC320
- CC26xx.bin (gateway-enabler)—This application runs on CC2650.
- HTTP pages
- CC2650 SensorTag.sch [Schema files]
- Blefi.usf file (UniFlash Configuration file)

Follow these steps when using BleFi for the first time.
1. Format the BleFi SFLASH
2. Download the Network Processor Service Pack
3. Download the binaries (open BleFi.usf and click program)

The TI UniFlash tool is used to format and download the gateway SFLASH. Refer to the UniFlash for more details.

5.1.1 SFLASH Formatting

Follow these steps:
1. Connect the gateway to laptop or PC equipped with UniFlash.
2. Change the COM PORT to the desired port number.
4. Keep the DNLD button pressed and toggle the RST button on the gateway.
5. The previous procedure triggers the bootloader mode in CC3200, and the format should start.
6. The Successful Format message should appear on UniFlash.
5.1.2 Service Pack Download

The servicepack_1.0.0.1.2 service pack is provided through CC31xx_CC32xx_ServicePack-1.0.0.1.2-windows-installer.exe downloadable from http://www.ti.com/tool/cc3200sdk or http://www.ti.com/tool/cc3100sdk.

1. Download and install the service pack version servicepack_1.0.0.1.2.bin on a laptop or PC.
2. Connect the gateway to a laptop or a PC where UniFlash is installed.
3. Change the COM PORT to the desired port number.
5. Point to the path of the service pack binary in your computer.
6. Gateway—Keep DNLD button pressed and toggle the RST button.
7. The above procedure triggers the bootloader mode in CC3200, and the service pack programming should start.
8. The Successful message should appear on UniFlash.

5.1.3 Binary Download

1. Connect the gateway to a laptop or PC where UniFlash is installed.
2. Go to the folder where the binary package is present.
3. Double click on the blefi.usf file—This opens UniFlash.
4. Change the COM PORT to Desired Port Number
5. Press Program on UniFlash Tool.
6. Gateway—Keep DNLD button pressed and toggle the RST button.
7. The previous procedure triggers the bootloader mode in CC3200 and the download should start.
8. The Successful Download message should appear on UniFlash.

5.2 Building Source Code

This section describes the steps involved in building the blefi.bin, which executes on the CC3200 and the cc26xx.bin, which then executes on the CC2650.

5.2.1 Source Build (for CC3200 MCU)

1. Install Code Composer Studio IDE from the link here.
2. Install the gateway installer.
3. By default, the package installs to the c:\ti folder.
4. Open Code Composer Studio and the following projects from the BleFi package.
   - blefi
   - cli
   - gateway
   - mqtt_app
   - npi
   - oslib
   - schema
   - ti_rtos_config
   - json
   - mqtt
   - ota
   - simplelink
5. Build these projects in sequence:
   - ti_rtos_config
   - oslib
   - simplelink
   - ota
   - mqtt
   - json
   - schema
   - npi
   - gateway
   - cli
   - mqtt_app
   - blefi

6. Upon successful build, the blefi.bin will be found in the blefi/ccs/Release folder.

5.2.2 CC26xx Source Build (gw_enabler) Using CCS

3. Change the Radio settings in bleUserConfig.h in C:\ti\simplelink\ble_cc26xx_2_01_00_44423\Projects\ble\ICall\Include\bleUserConfig.h.

   

   #elif defined( CC2650EM_5XD ) || defined( CC2650EM_4XD )
   #define RF_FE_MODE_AND_BIAS ( RF_FE_DIFFERENTIAL | RF_FE_INT_BIAS )
   #elif defined( CC2650EM_4XS )

4. Change RAM boundary address in Linker Configuration file in C:\ti\simplelink\ble_cc26xx_2_01_00_44423\Projects\ble\HostTest\CC26xx\CCS\Config\CCSLinkerDefines.cmd --define=ICALL_RAM0_ADDR=0.
5. Open CCS and import the HostTestApp project (both HostTest and HostTestStack) as described in [CC2640 Bluetooth low energy Software Developer’s Guide (SWRU393)](http://www.ti.com/ble-stack) in section 2.5.3.
6. Check the Copy Project files to workspace option.
7. In CCS, open the Project Properties for the Application.
8. Change the board type in the last line of the Include Options under the CCS Build at workspace_v6_1\HostTest\FlashROM "${TI_RTOS_DRIVERS_BASE}/ti/boards/SRF06EB/CC2650EM_5XD.
9. Select Projects->Build All options to build both the projects.
10. Find the HostTest.hex file under $CCS_WORKSPACE$\workspace_v6_1\HostTest\FlashROM.
11. Find the HostTestStack.hex under $CCS_WORKSPACE$\workspace_v6_1\HostTestStack\FlashROM.
12. Refer to Section 5.2.4 to merge the hex files and to convert them into cc26xx.bin.
5.2.3 CC26xx Source Build (gw-enabler) Using IAR

1. Install the IAR IDE from the link.
2. Install the latest CC26xx SDK from the link.
3. Open HostTest project from the IAR IDE, choose CC2650 App, right click on the project name → options → C/C++ Compiler, select “Preprocessor” tab, and make below changes.
4. In “Additional include directories” section, make the following changes:
   (a) Remove $TI_RTOS_DRIVERS_BASE$\ti\boards\SRF06EB\CC2650EM_7ID
   (b) Add $TI_RTOS_DRIVERS_BASE$\ti\boards\SRF06EB\CC2650EM_5XD
5. In “Defined Symbols” section, make below changes, add the preprocessor CC2650EM_5XD
6. Make changes to the “bleUserConfig.h”, found in the location of the installed SDK. The file can be found at C:\ti\simplelink\ble_cc26xx_2_XX_XX\Projects\ble\ICall\Include
7. In ble_cc26xx_2_XX_XX\Projects\ble\ICall\Include\bleUserConfig.h Change
   #define RF_FE_MODE_AND_BIAS (RF_FE_DIFFERENTIAL | RF_FE_EXT_BIAS)
   To
   #define RF_FE_MODE_AND_BIAS (RF_FE_DIFFERENTIAL | RF_FE_INT_BIAS)
8. Compile the “Host Test App” Project (both application and stack). Two hex files are generated for application and stack.
9. Refer Section 5.2.4 to merge the hex files and convert them into cc26xx.bin.

5.2.4 Merging the Hex Files to CC26xx.bin

To create the binary file in the following procedure, a USB cable, SmartRF06 board, and a CC2650EM board are required.
1. Connect the SmartRF06+CC2650EM board to a PC where Flash Programmer 2 is installed using the USB cable.
2. Open Flash Programmer 2.
3. Connect to the SmartRF06+CC2650EM board.
5. Program Stack hex image.
6. Program App hex image.
7. Navigate to Edit tab of the Flash Programmer.
8. Read the entire flash contents.
9. Navigate to 0x1ffd8
10. Change the contents of 0x1ffd8, 0x1ffd9, 0x1ffda, and 0x1ffdb to c5, 03, fe, and c5, respectively (for the Serial Bootloader).
11. Click the write button.
12. Click Save to File button.
13. Save as cc6xx.bin.
5.3 **WLAN Connection**

The gateway must be connected to a Wi-Fi Access Point (AP), which has cloud connectivity, to realize the IoT functionality. This Wi-Fi connection can also be used for HTTP configuration.

CC3200 maintains Wi-Fi Profiles, which helps in automatic connections to an AP during the boot up. The user should not need to make an AP connection in every power cycle.

---

**Figure 10. WLAN Connection Process During Initialization**
The AP connection may not be successful during the bootup due to one of these reasons:

- No WLAN profile present
- AP not switched on before the gateway is reset
- The Smartconfig application was not available or was not successful

Post initialization, use the CLI command (wlan_connect; refer to Section 6.1) to connect to the AP. Ensure the AP is on while using this command. Upon successful connection, this configuration is stored as a WLAN profile. During subsequent power-cycles, this profile is checked if an auto connection is possible.

5.4 Bluetooth Smart Device Connection

A Bluetooth Smart device can be connected to the gateway using various UI commands (Refer to Section 6). When connected, the device is paired with the gateway, and the subsequent power cycle of the gateway does not need a UI command to be entered for connection.

**NOTE:** Only Just Works bonding is supported, and no Passkey support is present while connecting to Bluetooth Smart devices.

The CLI commands to connect to a Bluetooth Smart device are scan and linke. Scan is used to scan the devices that are advertising in the vicinity of BleFi. Linke connects to a desired device. The parameter of the linke command is the <scan id>.

For example,

G:>scan
.
.
G:>linke 0

5.4.1 Schema File

Typically, the characteristic in a Bluetooth Smart device is addressed using a handle. The handle is a numeric value and is not user friendly. The schema file mechanism in gateway maps the numeric handle to a human-readable string. This string can be used while monitoring the respective characteristic or while changing the value of the characteristic.

For example, to access the temperature data of the connected Bluetooth Smart Device,

G:>get 0 /Temp/Data
is used instead of
G:>get 0 15
Where 15 is the handle value.

**NOTE:** If schema file is not present, then default strings will be mapped (Example: char1).

To avail this facility, the user must create and download a schema file to the gateway. The schema file format is a human-readable JSON format and can be generated using any JSON editor. The SensorTag schema files in the package are created using https://www.jsoneditoronline.org/.

The name of the schema file is same as the device name that it publishes while advertising. An extension .sch must be added before downloading.
Example: SensorTag.sch
5.4.1.1 Schema File Format

```json
{  
    "Service_1 UUID": [  
        {  
            "Service_1.Characteristic_1 UUID": "Service_1.Characteristic_1 Name"  
        },  
        {  
            "Service_1.Characteristic_2 UUID": "Service_1.Characteristic_2 Name"  
        }  
    },  
    "Service_2 UUID": [  
        {  
            "Service_2.Characteristic_1 UUID": "Service_2.Characteristic_1 Name"  
        },  
        {  
            "Service_2.Characteristic_2 UUID": "Service_2.Characteristic_2 Name"  
        }  
    ]
}
```

6 Gateway Usage

This section assumes that the binaries are flashed in the gateway and the WLAN connection is also successful. For more information on the setup, refer to Section 4.3.

Typical gateway usage contains

- WLAN connection
- Connection to a Bluetooth Smart device
- Data monitoring over MQTT/CLI/HTTP

The gateway can be controlled or monitored using the UIs (User Interfaces)

- Command Line Interface (CLI) over UART
- Message Queue Telemetry Transport (MQTT) from a remote client
- Hypertext Transfer Protocol (HTTP) from a local machine
Table 4 summarizes the various control and monitoring capabilities of the UIs.

### Table 4. Gateway UI Capabilities

<table>
<thead>
<tr>
<th>ACTION</th>
<th>CLI</th>
<th>HTTP</th>
<th>MQTT</th>
</tr>
</thead>
<tbody>
<tr>
<td>WLAN Connect</td>
<td>✓</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>WLAN Disconnect</td>
<td>✓</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Bluetooth Smart Device Scan</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>List Bluetooth Smart Devices</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Bluetooth Device Connect</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Bluetooth Device Disconnect</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>List Bluetooth Device Characteristics</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Read Bluetooth Device Characteristics</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Write to Bluetooth Device Characteristics</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Remove Pairing Information</td>
<td>✓</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Reset MCU</td>
<td>✓</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>OTA Configuration</td>
<td>✓</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Reset MQTT Client</td>
<td>✓</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

#### 6.1 CLI

The gateway can be controlled or monitored using the CLI over UART. To start CLI, open any terminal application on the laptop or PC that is connected to the gateway.

**Terminal Setup:**
1. In your terminal application, open the serial port Silicon Labs CP210x USB to UART bridge [COM100].
2. Setup the serial port with baud rate 115200 as shown in Figure 11.

![Figure 11. Serial Port Setup for CLI](image)

The following sections describe the commands available in CLI.
6.1.1 HELP Command

NAME
help

SYNOPSIS
help

PARAMETERS
None

DESCRIPTION
help is used to display the CLI commands supported and their description.

EXAMPLES
   help

6.1.2 SCAN Command

NAME
scan

SYNOPSIS
scan

PARAMETERS
None

DESCRIPTION
scan is used to discover Bluetooth Smart devices which are advertising.

EXAMPLES
   scan
6.1.3  LIST Command

NAME
list

SYNOPSIS
list

PARAMETERS
None

DESCRIPTION
list is used to list the scanned and connected Bluetooth Smart devices.

EXAMPLES
  list

6.1.4  LINKE Command

NAME
linke

SYNOPSIS
linke [device scan id]

PARAMETERS
[device scan id] – scan Id of the scanned Bluetooth Smart device to be connected to. Please use the list command to find the scan ID of the device

DESCRIPTION
linke is used to connect to one of the scanned Bluetooth Smart devices.

EXAMPLES
  linke 1
6.1.5 **LINKT Command**

**NAME**
linkt

**SYNOPSIS**
linkt [device connection id]

**PARAMETERS**

[device connection id] - connection Id of the connected Bluetooth Smart device to be disconnected from. Please use the `list` command to know the connection ID of the device.

**DESCRIPTION**

`linkt` is used to disconnect from one of the connected Bluetooth Smart devices.

**EXAMPLES**

```
linkt 0
```
6.1.7 GET Command

NAME
get

SYNOPSIS
get [device connection id] [Charstring]

PARAMETERS
[device connection id] – connection Id of the connected Bluetooth Smart device. Please use the list command to know the connection ID of the device.
[Charstring] - Name of the characteristic to be get

DESCRIPTION
get is used to read the value of the characteristic of one of the connected Bluetooth Smart devices.

EXAMPLES
- get 0 /Acc/Data
- get 0 char18

6.1.8 SET Command

NAME
set

SYNOPSIS
set [device connection id] [Charstring] [length of value in bytes] [value]

PARAMETERS
[device connection id] – connection Id of the connected Bluetooth Smart device. Please use the list command to know the connection ID of the device.
[Charstring] - Name of the characteristic to be set
length of value in bytes] – length of the value to be written in bytes
[value] – value of the characteristic to be written

DESCRIPTION
set is used to write to the value of the characteristic of one of the connected Bluetooth Smart devices.

EXAMPLES
- set 0 /Acc/Cfg 1 1
- set 0 char18 1 1
6.1.9  WLAN_CONNECT Command

NAME
   wlan_connect

SYNOPSIS
   wlan_connect [ssid] {key}

DESCRIPTION
   wlan_connect is used to connect to an AP. Upon successful connection, a WLAN profile will be added. BleFi can be connected to two kinds of AP
      □ Open
      □ WPA
   The Open AP connection does not need the key parameter. If the key parameter is present, then a WPA connection will be tried.

PARAMETERS
   ssid – string value, ssid of the AP that the connection has to be tried to.
   key – security password for AP connection (only in case of WPA)

EXAMPLES
   □ wlan_connect open_ap_1
   □ wlan_connect wpa_ap password123

6.1.10 WLAN_DISCONNECT Command

NAME
   wlan_disconnect

SYNOPSIS
   wlan_disconnect

DESCRIPTION
   wlan_disconnect is used to disconnect the WLAN connection to AP

PARAMETERS
   None

EXAMPLES
   □ wlan_disconnect
6.1.11  MQTTST Command

NAME
mqttst

SYNOPSIS
Mqttst

PARAMETERS
None

DESCRIPTION
mqttst is used to reset the mqtt client in blefi.

EXAMPLES
mqttst

6.1.12  RESET Command

NAME
reset

SYNOPSIS
reset

PARAMETERS
None

DESCRIPTION
reset is used to reset the blefi.

EXAMPLES
reset
6.1.13  OTA Configuration Command

NAME
  addotameta

SYNOPSIS
  addotameta [metadatastring]

PARAMETERS
  metadatastring – meta data string of the associated Dropbox account where the blefi OTA (Over The Air) files are stored.

DESCRIPTION
  addotameta is used to config the dropbox meta data string information used for OTA in blefi.

EXAMPLES
  addotameta HNFGT_m-65YJJADDGGGBs7y8FwDvgBAbnVFzVUdhVJHu7ung9dSFsc_dHO45

6.1.14  Bluetooth Smart Update Command

NAME
  bleupdate

SYNOPSIS
  bleupdate

PARAMETERS
  None

DESCRIPTION
  This command is used to update the CC26xx firmware. The update takes effect after a reboot of blefi hardware.

EXAMPLES
  bleupdate
### 6.1.15 MQTT Gateway Mode Command

**NAME**

mqttgwmode

**SYNOPSIS**

mqttgwmode mode servername

**PARAMETERS**

- **[mode]** – 0 for demo mode OR 1 for quickstart mode.
- **[servername]** – url or ip address of the server

**DESCRIPTION**

This command is used to reset the MQTT mode in quickstart or Demo mode. In Demo mode, a server name needs to be specified.

**EXAMPLES**

- `mqttgwmode 0 "192.84.45.44"`

### 6.1.16 MQTT Device Mode Command

**NAME**

mqttdevmode

**SYNOPSIS**

mqttdevmode mode servername

**PARAMETERS**

- **[mode]** – 0 for demo mode OR 1 for quickstart mode.
- **[servername]** – url or ip address of the server

**DESCRIPTION**

This command is used to set the MQTT Device mode to quickstart or Demo mode. In Demo mode, a server name needs to be specified.

**EXAMPLES**

- `mqttdevmode 1`

### 6.1.17 Load Default Command

**NAME**

loaddefault

**SYNOPSIS**

loaddefault

**PARAMETERS**

None

**DESCRIPTION**

This command is used to put BleFi board in default mode.

**EXAMPLES**

- `loaddefault`
6.1.18  Auto Scan Command

NAME
autoscan

SYNOPSIS
autoscan [Time in seconds]

PARAMETERS
Time in seconds. If less than 30, then autoscan will be disabled

DESCRIPTION
This command is used to set the autoscan duration of BleFi.

EXAMPLES
  - autoscan 60

6.1.19  Display Auto-Connect List Command

NAME
autoconlist

SYNOPSIS
autoconlist

PARAMETERS
None

DESCRIPTION
This command is used to display the list of Bluetooth Smart devices that are privileged to autoconnect with BleFi.

EXAMPLES
  - pairlist

6.1.20  Remove Auto Connection Command

NAME
rmautocon

SYNOPSIS
rmautocon

PARAMETERS
None

DESCRIPTION
This command is used to disable the auto-connection privilege of a previously connected BleFi device.

EXAMPLES
  - unpair
6.1.21 Auto-Connect Command

NAME
  autocon

SYNOPSIS
  autocon

PARAMETERS
  1 or 0

DESCRIPTION
When enabled, a pre-connected Bluetooth Smart device will automatically connect to BleFi.
This command is used to enable or disable this feature in BleFi.

EXAMPLES
  autocon 1

6.1.22 Trigger OTA Command

NAME
  triggerota

SYNOPSIS
  triggerota

PARAMETERS
  None

DESCRIPTION
This command is used to start the OTA process of the BleFi.

EXAMPLES
  triggerota

6.2 MQTT—Enabling IoT

MQTT (Message Queue Telemetry Transport) protocol is an extremely lightweight machine-to-machine connectivity protocol. MQTT protocol is based on the publish-and-subscribe messaging model and is designed to be used on top of TCP/IP protocol.

The key point of this protocol includes small code footprint and low network bandwidth requirements. Other features include faster response time, low power requirement, and ease of scalability. All these advantages make it an ideal candidate for communication protocol in embedded devices intended to implement IoT (internet of things) applications. More information regarding MQTT protocol can be obtained from the latest MQTT protocol specification.

A simple MQTT infrastructure contains a broker (like a central hub) connected to multiple clients, each of which has the capability of publishing on any topic (token). The broker sends the message published on any topic to all the subscribers of that topic, as shown in Figure 12.
More detailed info on MQTT can be found in the following links:

- [http://mqtt.org/faq](http://mqtt.org/faq)

### 6.2.1 Connection

The gateway should be connected to an AP (with Internet connection) for MQTT to work. Refer to Section 5.3 for more details.

The gateway connects to the IBM MQTT server during initialization. These prints on the CONSOLE (CLI) confirm the connection.

```
[MQTT] : Success: conn to Broker
[MQTT] : Client subscribed on following topics:
/blefi/find
/blefi/5c313e032287/scan
/blefi/5c313e032287/linke
/blefi/5c313e032287/linkt
```
If these prints do not appear on CONSOLE, one of the following issues may have occurred:

- Gateway-AP connection is not successful
- AP is not connected to internet
- IBM MQTT server is not responding

NOTE: The 5c313e032287 is the MAC address of the gateway. This address is just an example and will be different for different gateway devices.

6.2.2 MQTT Clients

The gateway supports two kinds of MQTT clients: a gateway client and device clients. The gateway client is created when the gateway powers up. By default, the gateway client is connected to an MQTT demo server of IBM.

The device clients are created when a CC2650 SensorTag is connected to the gateway (over Bluetooth Smart). There can be a maximum of 3 CC2650 SensorTag device clients. By default, the CC2650 SensorTag device clients are connected to the QuickStart server of IBM®.

6.2.3 MQTT Device Client

Quickstart mode is enabled when CC2650 SensorTags connect to the gateway and device clients are created.

This mode provides an intuitive feel of the entire platform, with richness of live sensor data of CC26xx SensorTags connected to the gateway, being streamed and displayed on the cloud from a remote location.

Procedure:
1. Connect the CC2650 SensorTags using CLI or MQTT (Gateway client—see Section 6.2.4).
3. Type the BD address of the CC26xx SensorTag as the device ID, which is scanned and displayed on the CLI.
4. Click the Go button.

Figure 13. MQTT Device Quickstart
5. When connected, the device displays its status as “Connected” with the time.

![Device Connected](image)

6. The device also displays live sensor data of the connected CC26xx SensorTag.

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Reading</th>
<th>Sparkline</th>
</tr>
</thead>
<tbody>
<tr>
<td>air_pressure</td>
<td>911</td>
<td></td>
</tr>
<tr>
<td>ambient_temp</td>
<td>24</td>
<td></td>
</tr>
<tr>
<td>humidity</td>
<td>71</td>
<td></td>
</tr>
<tr>
<td>light</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>object_temp</td>
<td>19</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 14. Device Connected**

6.2.4 MQTT Gateway Client

The gateway acts as an MQTT client and connects to the messagesight.demos.ibm.com MQTT server. To access the gateway, open an MQTT client from a laptop or PC and connect to the IBM MQTT server.

1. Open an Internet browser (Chrome®, Internet Explorer™, Firefox®, or others)
2. Go to this link: [http://m2m.demos.ibm.com/mqttclient/](http://m2m.demos.ibm.com/mqttclient/)
3. Type messagesight.demos.ibm.com in the server text box and click Connect.
4. When the connection is successful, the client can communicate with the gateway.

5. Subscribe to desired topics one by one by typing the topic name and pressing Subscribe. For the list of topics that the gateway publishes, refer to Section 6.2.6.

6. To send MQTT commands to the gateway, use the Publish section of the MQTT client. Enter the topic to be published and the parameter in the Message box, and press Publish. For the list of topics that the gateway responds to, refer to Section 6.2.6.
7. Once the topic is published, the gateway responds to the topic within seconds (depending on the Internet speed). The response from the gateway displays in the Log section of the MQTT client.
6.2.5 MQTT—Remote Access of the Gateway

MQTT works on a subscription-publish mechanism. The gateway, as an MQTT client subscribes to numerous topics. These subscribed topics act as a command to the gateway. A remote client may publish one of these topics with proper parameters as a command to the gateway. As a response to the command, the gateway publishes some topics. To receive the response, the remote client must have subscribed to these topics. The below sequence diagram depicts the working of MQTT on the gateway.

![MQTT Sequence Diagram](image)

- The gateway processes the command and prepares the RESPONSE TOPIC.
- Gateway receives the command as it is already subscribed to it.
- Publish the respective response topic with message response.
- There may be one or more responses.
- Remote client receives the topic and displays it to user.

Figure 19. MQTT Sequence Diagram

The gateway maintains two different contexts while connecting to the MQTT server. From external client point of view, there is no difference while accessing the topics related to either of the contexts.

1. Gateway Context (1 number)—This context is the default context and is created during initialization. gateway context contains the topics that are related to gateway and not specific to a Bluetooth Smart device.
2. Device Context (0 to 3 numbers)—A device context is created when a Bluetooth Smart device gets connected to the gateway. The maximum number of device contexts that can be created in the gateway is three.

6.2.6 Command Topics (Available Only in Demo Mode)

The command topic is an MQTT topic subscribed by the gateway, and can be used by remote MQTT clients to command gateway.
6.2.6.1 Find the Gateway Device

TOPOLOGY
/blefi/find

PARAMETERS
None

DESCRIPTION
This topic is used to find a BleFi device in the Cloud.

RESPONSE
To capture the response, remote client should have subscribed to /blefi/find before publishing the command. BleFi responds to this command by publishing /blefi/find topic, with its mac-address. This mac-address is helpful in building other topics, such as scan, linke and linkt.

EXAMPLES
/c149 /blefi/find

6.2.6.2 Scan Bluetooth Smart Devices

TOPOLOGY
/blefi/<mac-address>/scan

PARAMETERS
None

DESCRIPTION
This topic is used to scan the devices that are advertising in the vicinity of BleFi indicated by <mac-address>. The mac-address is found in the response to /blefi/find.

RESPONSE
To capture the response, remote client should have subscribed to /blefi/<mac-address>/scanres before publishing the command. BleFi starts a scan process to find the devices that are advertising in its vicinity. Once the scan is complete, BleFi responds to this command by publishing /blefi/<mac-address>/scanres topic. The message of the response topic contains information of the Bluetooth Smart devices scanned. This command is typically followed by /blefi/<mac-address>/linke command.

EXAMPLES
/c149 /blefi/<mac-address>/scan
6.2.6.3 Establish Link to a Bluetooth Smart Device

**TOPIC**
/blefi/<mac-address>/linke

**PARAMETERS**
device-index

**DESCRIPTION**
This command is used to establish a link between BleFi and Bluetooth Smart device, indicated by the device-index.

**RESPONSE**
To capture the response, remote client should have subscribed to /blefi/<mac-address>/linkeres before publishing the command. Once the link is successful, BleFi responds to this command by publishing /blefi/<mac-address>/linkeres topic with success indication. Upon successful link establishment, BleFi creates a “device-context” for this device. This command is typically followed by /<bd-address>/list, <bd-address> identifies the Bluetooth Smart device connected to BleFi.

**EXAMPLES**
- /blefi/<mac-address>/linke 1

6.2.6.4 Terminate Bluetooth Smart Device Link

**TOPIC**
/blefi/<mac-address>/linkt

**PARAMETERS**
device-index

**DESCRIPTION**
This command is used to terminate a link between BleFi and Bluetooth Smart device, indicated by the device-index.

**RESPONSE**
To capture the response, remote client should have subscribed to /blefi/<mac-address>/linktres before publishing the command. Once the link is terminated, BleFi responds to this command by publishing /blefi/<mac-address>/linktres topic with success indication. Upon termination of link, BleFi deletes the “device-context” of this device.

**EXAMPLES**
- /blefi/<mac-address>/linkt 0
6.2.6.5  **List Characteristics of Bluetooth Smart Device**

**TOPIC**

`/<bd-address>/list`

**PARAMETERS**

None

**DESCRIPTION**

This command is used to list all the characteristics of a connected Bluetooth Smart Device. The bd-address is found in the response to `/blefi/linke`.

**RESPONSE**

To capture the response, remote client should have subscribed to `/<bd-address>/listres` before publishing the command. The response lists all the characteristics of Bluetooth Smart device. The list is an array of strings with the read/write permission enabled per characteristic. The response would be fairly lengthy. This command is typically followed by `/<bd-address>/set` or `/<bd-address>/get` command.

**EXAMPLES**

- `/<bd-address>/list`

6.2.6.6  **Read Value of a Characteristic**

**TOPIC**

`/<bd-address>/get`

**PARAMETERS**

<character string>

**DESCRIPTION**

This command is used to read the value of a character of the Bluetooth Smart device. The character string is found in the response to `/<bd-address>/list` command. The bd-address is found in the response to `/blefi/linke`.

**RESPONSE**

To capture the response, remote client should have subscribed to the response to particular character (Ex: `/<bd-address>/Temp/Data`) before publishing the command. The response contains the value of the character.

**EXAMPLES**

- `/<bd-address>/get Temp/Data`
### 6.2.6.7 Write a Characteristic Value

**TOPIC**

`/<bd-address>/set`

**PARAMETERS**

`<character string>`

**DESCRIPTION**

This command is used to write the value of a character of the Bluetooth Smart device. The character string is found in the response to `/<bd-address>/list` command. The bd-address is found in the response to `/blefi/linke`

**RESPONSE**

To capture the response, remote client should have subscribed to `/<bd-address>/setres`.

**EXAMPLES**

- `/<bd-address>/set Temp/Cfg 1`

### 6.2.7 Response Topics (Available Only in Demo Mode)

The gateway responds to the commands from remote client by publishing the response topics. Remote clients should have subscribed to these topics before publishing the respective commands. The usage of these topics is explained in Section 6.2.6.

Here is a summary of all the response topics.

<table>
<thead>
<tr>
<th>RESPONSE TOPICS</th>
<th>RESPECTIVE COMMAND</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>/blefi/found</code></td>
<td><code>/blefi/find</code></td>
<td>This message of this response contains <code>&lt;mac-addr&gt;</code>, which is useful to subscribe other topics</td>
</tr>
<tr>
<td><code>/blefi/&lt;mac-addr&gt;/scanres</code></td>
<td><code>/blefi/&lt;mac-addr&gt;/scan</code></td>
<td>This message contains a list of all advertising and connected devices</td>
</tr>
<tr>
<td><code>/blefi/&lt;mac-addr&gt;/linkeres</code></td>
<td><code>/blefi/&lt;mac-addr&gt;/linke</code></td>
<td>This message contains the <code>&lt;bd-addr&gt;</code>, which is useful for device-context-topic subscription</td>
</tr>
<tr>
<td><code>/blefi/&lt;mac-addr&gt;/linktres</code></td>
<td><code>/blefi/&lt;mac-addr&gt;/linkt</code></td>
<td>Response to link termination</td>
</tr>
<tr>
<td><code>/&lt;bd-addr&gt;/listres</code></td>
<td><code>/&lt;bd-addr&gt;/list</code></td>
<td>Multiple messages with array of character strings</td>
</tr>
<tr>
<td><code>/&lt;bd-addr&gt;/&lt;char-string&gt;</code></td>
<td><code>/&lt;bd-addr&gt;/get</code></td>
<td>Message contains the value of the character</td>
</tr>
<tr>
<td><code>/&lt;bd-addr&gt;/setres</code></td>
<td><code>/&lt;bd-addr&gt;/set</code></td>
<td></td>
</tr>
</tbody>
</table>

### 6.3 HTTP

The gateway runs an HTTP server and hosts pages. Users can interact with the device using a web browser. The HTTP pages can be used for the following purposes:

- Scanning for any available Bluetooth Smart device
- Establishing or terminating link with a Bluetooth Smart device
- Reading and writing the characteristics of the Bluetooth Smart device
6.3.1 **Bluetooth Smart Dashboard**

1. The HTML pages are part of the installer. These pages should be downloaded onto SFLASH of the gateway.

2. Run the gateway application. When connected to the AP, the acquired IP is displayed in the CLI as shown in Figure 20.

![Figure 20. IP Address Displayed on CLI](image)

3. Open the browser and type `<ipaddr>/ble_dashboard.html`
   - For example, type `192.168.1.100/ble_dashboard.html` in browser URL field
   - Browser shows the Bluetooth Smart dashboard page

   The Bluetooth Smart dashboard page contains two tabs:
   - **Connection**—Users can scan all the advertising Bluetooth Smart devices in the gateway vicinity using this tab. This tab contains controls to establish and terminate link to a Bluetooth Smart device
   - **Data**—This tab is used to show all the characteristics of a connected Bluetooth Smart device. Based on the permissions, the characteristic value can be read from or written to, using this tab
6.3.2 Bluetooth Smart Connection Page

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6.3.2.1 Scanning a Bluetooth Smart Device

1. Select the Connection tab.
2. Press the Scan button to start scanning for available Bluetooth Smart devices.
3. Wait for 5 seconds for the command to be completed.
4. Press the Refresh button to show the list of scanned devices.

6.3.2.2 Establishing Link with a Bluetooth Smart Device

1. Among the list of scanned devices, Select the Radio Button of the desired Bluetooth Smart device.
2. Press the Establish Link button.
3. Wait for 5 seconds for the command to be completed.
4. Press the Refresh button to show the list of connected devices.

---

Figure 21. Bluetooth Smart Dashboard Page
6.3.2.3 **Terminating Link from a Bluetooth Smart Device**

1. Among the list of connected devices, Select the Radio Button of the desired Bluetooth Smart device.
2. Press the Terminate Link button.
3. Wait for 2 seconds for the command to be completed.
4. Press Refresh button to show the updated list of connected devices.

6.3.3 **Bluetooth Smart Data Page**

![Bluetooth Smart Data Page](image-url)

Figure 22. **Bluetooth Smart Data Page**

6.3.3.1 **Display Characteristics of a Connected Bluetooth Smart Device**

1. Select the Data tab.
2. Select the radio button of the desired Bluetooth Smart device from the Connected Devices table.
3. Press the Display Characteristics button to show the characteristics of the selected Bluetooth Smart device.
6.3.3.2 Read or Write Characteristic Value

1. In the Device Characteristics table, select the radio button of the characteristic to be read or written.
2. To read a characteristic, select the Get radio button and press the Enter button.
3. The characteristic value read will be displayed adjacent to the Get button.
4. To write to a characteristic value, select the Set radio button, enter the value to be written in the text box adjacent to the Set button, and press the Enter button.
5. If the write is completed successfully, the SUCCESS message is shown.

6.4 OTA

The Over-The-Air (OTA) update is the wireless delivery of new software updates and/or configurations to embedded devices and with the concept of Wireless Sensor Network and Internet of Things, OTA is an efficient way of distributing firmware updates or upgrades.

The application binary (blefi.bin) and the gateway enabler binary (cc26xx.bin) files can be updated over the air (OTA). This feature requires the user to create a Dropbox account and load the files in the account.

6.4.1 Creating a Dropbox API Application

1. Create an account with Dropbox and log in.
3. Choose “Files and Datastores” and “Yes, my app only needs access to files it creates”.
4. Provide a suitable name for the app and click the Create APP button.
5. You will be redirected to Apps setting page. Scroll down to “Generated access token” and click generate. Copy and save the generated token. This token needs to be stored in the gateway using the “otaconfig” command in CLI.
7. Click on the application name.
8. Create a new folder and name it in the following format: TI_BleFi_v<version number> (for example: TI_BleFi_v01). The version name is found on the CLI Banner.

![CLI Banner Showing Version Number](image)

9. Rename “blefi.bin” as “f80_sys_mcuimgA.bin”. Rename “ble_gateway_enabler.bin” as “f80_cc26xx.bin” and copy these files to the newly created folder in the Dropbox account.
10. Power on the gateway, then connect to an AP (that has internet access) after initialization.
11. “Waiting for OTA Trigger” on the CONSOLE indicates that the OTA can be performed.
12. Press the BTN-1 to start the OTA process.
13. Once the OTA download is completed, the gateway restarts itself.
7 Test Data
This section describes the tests performed on the gateway.

7.1 CLI Snapshot

Figure 24. CLI Snapshot
7.2 Module Test Matrix

Table 6. Module Test Matrix

<table>
<thead>
<tr>
<th>SL NUMBER</th>
<th>TESTS</th>
<th>RESULT</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Endurance Test</td>
<td>PASS</td>
<td>48 hours, 3 Sensor tags connected, MQTT Enabled</td>
</tr>
<tr>
<td>2</td>
<td>MQTT</td>
<td>PASS</td>
<td>Gateway Context—Demo mode, Device Context—Quickstart mode</td>
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<tr>
<td>3</td>
<td>CLI</td>
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<td>PASS</td>
<td>Bluetooth Smart configuration pages</td>
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<td>5</td>
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<td>Data bridging between WLAN and Bluetooth Smart</td>
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<td>6</td>
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<td>7</td>
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<td>8</td>
<td>Bluetooth Smart Connections</td>
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<td>Up to three 2650 sensor tags.</td>
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<td>9</td>
<td>OTA Update</td>
<td>PASS</td>
<td>Update Gateway Binary and CC26xx Binary</td>
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<td>10</td>
<td>OS Functionality</td>
<td>PASS</td>
<td>TI-RTOS</td>
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8 Design Files

8.1 Schematics
To download the schematics, see the design files at TIDC-BLE-TO-WIFI-IOT-GATEWAY.

8.2 Bill of Materials
To download the bill of materials (BOM), see the design files at TIDC-BLE-TO-WIFI-IOT-GATEWAY.

8.3 Layer Plots
To download the layer plots, see the design files at TIDC-BLE-TO-WIFI-IOT-GATEWAY.

8.4 Altium Project
To download the Altium project files, see the design files at TIDC-BLE-TO-WIFI-IOT-GATEWAY.

8.5 Layout Guidelines
To download the layout guidelines, see the design files at TIDC-BLE-TO-WIFI-IOT-GATEWAY.

8.6 Gerber Files
To download the Gerber files, see the design files at TIDC-BLE-TO-WIFI-IOT-GATEWAY.

8.7 Assembly Drawings
To download the assembly drawings, see the design files at TIDC-BLE-TO-WIFI-IOT-GATEWAY.

8.8 Software Files
To download the software files, see the design files at TIDC-BLE-TO-WIFI-IOT-GATEWAY.
9 References

1. CC3200 SimpleLink™ Wi-Fi® and Internet-of-Things solution, a Single-Chip Wireless MCU ([CC3200](#))
2. SimpleLink™ multi-standard 2.4 GHz ultra-low power wireless MCU ([CC2650](#))
3. Ultralow-Noise, High PSRR, Fast, RF, 1-A Low-Dropout Linear Regulators ([TPS79601](#))
4. 2-Channel ESD Solution for SuperSpeed USB 3.0 Interface ([TPD2EUSB30](#))
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## Revision History

**Changes from A Revision (September 2015) to B Revision**

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NOTE: Page numbers for previous revisions may differ from page numbers in the current version.
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