LE910Cx-WE866Cx LTE Bundling User Guide

1VV0301578 Rev. 10 – 2020-07-30
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1. INTRODUCTION

1.1. Scope
This document provides information required to setup and run the Telit LE910Cx + WE866Cx LTE module.

1.2. Audience
This document is intended only for Telit customers who want to set up a bundling application using LE910Cx + WE866Cx LTE module.

1.3. Contact Information, Support
For general contact, technical support services, technical questions and report documentation errors contact Telit Technical Support at:

- TS-EMEA@telit.com
- TS-AMERICAS@telit.com
- TS-APAC@telit.com
- TS-SRD@telit.com

Alternatively, use:

https://www.telit.com/contact-us

For detailed information about where you can buy the Telit modules or for recommendations on accessories and components visit:

https://www.telit.com

Our aim is to make this guide as helpful as possible. Keep us informed of your comments and suggestions for improvements.

Telit appreciates feedback from the users of our information.
1.4. Text Conventions

**Danger** – This information MUST be followed or catastrophic equipment failure or bodily injury may occur.

**Caution or Warning** – Alerts the user to important points about integrating the module, if these points are not followed, the module and end user equipment may fail or malfunction.

**Tip or Information** – Provides advice and suggestions that may be useful when integrating the module.

All dates are in ISO 8601 format, i.e. YYYY-MM-DD.
1.5. Related Documents

- WE866C3 Hardware Design Guide, 1VV0301495
- WE866C6 Hardware Design Guide, 1VV0301495
- WE866Cx M.2 Interface Adapter Hardware User Guide, 1VV0301533
- Telit Evaluation Board Hardware User Guide, 1VV0301249
- LE910Cx Multi Technology Interface Board TLB Hardware User Guide, 1VV0301508
- LE910Cx AT Command Reference Guide, 80502ST10950A
2. OVERVIEW

Telit’s WE866Cx is a low power, high bandwidth 802.11ac and Bluetooth 4.2 module with a small footprint that provides an easy and cost-effective way to achieve best possible wireless connectivity. Advanced LTE, Wi-Fi and Bluetooth coexistence dramatically reduces complexity designing cellular back haul with the LE910Cx 4G LTE module family, making the WE866Cx module ideal for a wide range of IoT applications including commercial building automation, OEM telematics, fleet management, and video surveillance.

WE866Cx powered by the Qualcomm QCA9377-3 is a perfect companion device for Telit LE910Cx cellular modules. WE866Cx supports low-power SDIO 3.0 interface for WLAN and a UART/PCM interface for Bluetooth. WE866Cx also supports BT-WLAN coexistence and uses the 2 wire ISM-LTE coexistence interface. The following diagram shows a basic connection of LE910Cx with WE866Cx module over the Wi-Fi interface.

![Figure 2-1 LE910Cx-WE866Cx Block Diagram](image-url)
3. FEATURES

3.1. Specification Overview

- Dual-Band 1x1 Wi-Fi + BT module based on QCA9377-3
- 802.11 a/b/g/n/ac
  - Up to 40MHz channel BW for 2.4G (802.11n)
  - Up to 80MHz channel BW for 5G (802.11ac)
  - Max TpT ~215Mbps
- BT4.1 + HS + BLE
- 3.3V main input
- VCCIO input for flexible interface voltage control 1.8V/3V (SDIO, UART, PCM)
- Support for AP and STA modes
- Size: 15mm x 13mm x 2.15mm
  - T&R packaging only (200 units per reel)
- Temperature Range: -40°C => 85°C
  - No reliability testing planned.

<table>
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<tr>
<th>802.11 Protocol</th>
<th>Release Date</th>
<th>Frequency (GHz)</th>
<th>Bandwidth (MHz)</th>
<th>Data Rate (Mbit/s) *SGI</th>
<th>MIMO streams</th>
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<td>27</td>
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<td>OFDM</td>
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<tr>
<td>n</td>
<td>Oct’09</td>
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<td>72.2</td>
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<tr>
<td>ac</td>
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<td>wave2</td>
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<td>ad</td>
<td>Dec’12</td>
<td>60</td>
<td>2160</td>
<td>6912</td>
<td>SISO</td>
<td>OFDM, SC, LP-SC</td>
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<td>ax</td>
<td>Jul-19</td>
<td>2.4/5</td>
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<td>143</td>
<td>8</td>
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### 802.11 PHY Specification Overview

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<td></td>
<td>160</td>
<td>1201</td>
<td></td>
<td></td>
<td>Outdoor</td>
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</table>

#### 3.2. Data Rate

- 802.11a (5GHz): 6, 9, 12, 18, 24, 36, 48, 54Mbps
- 802.11b (2.4GHz): 1, 2, 5.5, 11Mbps
- 802.11g (2.4GHz): 6, 9, 12, 18, 24, 36, 48, 54Mbps
- 802.11n (2.4GHz/5GHz):
  - 20Mhz BW: Up to 72.2Mbps using short GI (MCS0-7)
  - 40Mhz BW: Up to 144.4Mbps using short GI (MCS0-7)
- 802.11ac (5GHz):
  - HT20 (MCS0-8), VHT40 (MCS0-9), VHT80 (MCS0-9)
- 802.11a/54Mbps: 13 dbm
- 802.11b/11Mbps: 1820.5 dbm
- 802.11g/54Mbps: 158 dbm
- 802.11n/HT20 (MCS7): 157.5 dbm
- 802.11ac/HT20 (MCS0): 175.5 dbm
- 802.11ac/VHT40 (MCS9): 11.5 dbm
- 802.11ac/VHT80 (MCS9): 101.5 dbm
3.3. Wi-Fi Interface

The Wi-Fi Interface is part of the Baseband System of the cellular module. This section describes the method to connect the Wi-Fi interface to WE866Cx module. The Wi-Fi Interface is a dedicated SDIO interface that is used as a communication channel to the Modem chipset.

The tables below describe the Wi-Fi interface for the various cellular modules.

<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal</th>
<th>I/O</th>
<th>Function</th>
<th>Type</th>
<th>Comment</th>
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<td>WLAN RESET</td>
<td>CMOS 1.8V</td>
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<td>SDIO CMD</td>
<td>CMOS 1.8V</td>
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<td>CMOS 1.8V</td>
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<td>WIFI_SD3_TGPIO18</td>
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<td>SDIO DATA 3</td>
<td>CMOS 1.8V</td>
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<td>L13</td>
<td>WIFI_SDCLK_TGPIO19</td>
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<td>SDIO CLOCK</td>
<td>CMOS 1.8V</td>
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</table>

3.4. Hardware Interface

- Single antenna port
- 4-bit SDIO3.0 for Wi-Fi host interface (up to 200Mhz)
- 4 pin UART for BT interface
- 32KHz input for Wi-Fi sleep
- LTE Coexistence interface (2 pin WCI UART)
- Control pins (Enable input, WoW Output)
- Debug UART (TX only)
4. HARDWARE
This section describes the hardware components of the LE910Cx +WE866Cx LTE module.

4.1. Telit Evaluation Board
The Telit Evaluation Board is a generic developer’s platform, which is designed to provide the complete development environment to the user and intended to be used with a new set of Telit IoT modules. The EVB is designed to carry an Interface Board (IFBD) via three 120-pin B2B connectors. The Telit module is mounted directly on the IFBD. Power supply and control interface to the IFBD module are provided from the EVB via the B2B connectors. Several power supply configurations, including battery charging, are available. In addition, all interfaces needed for the developers, such as SIM card holders, JTAG, UART, USB, audio, micro SD, and so on are available on the EVB main board.

The following image shows an example of the generic Telit Evaluation Board.

![Generic Telit EVB Board](image)

**Figure 4-1 Generic Telit EVB Board**

4.2. Multi Technology Interface Board
The MultiTech Interface Board TLB (aka MTB) is custom designed to interface the Telit module variant LE910Cx with the Telit Generic Evaluation Board (EVB) thus forming the complete Development Kit of LE910Cx which allows great flexibility for integrating WIFI, BT and GPS technologies with the LE910Cx.

The MTB provides the mapping of Telit module signals and functions into the generic EVB signals and functions.

The MultiTech Interface Board TLB design includes the following items:

- LE910Cx module.
- 3x M.2 type mini card slots.
• Programmable FPGA.
• RF SMA connectors.
• Board to Board connectors for interfacing to EVB main board
• Module specific circuitry which is not part of the generic circuitry of the EVB

Power supply and control interface for the cellular module is provided from the EVB via the B2B connectors.

To monitor the temperature, a thermistor is placed on the top GND plane, close to the module which should be representative for the module’s backside temperature.

A programmable FPGA which is included in the MTB provides options for connecting very functional modem pin to the relevant peripheral M.2 cards hence enabling the most flexible way to demo interoperability between the LE910Cx module and peripheral accessories.

A typical example of this capability is in the case where 3x M.2 cards (WIFI module, GNSS module and BT module) are plugged into the M.2 slots while the FPGA is programmed to perform the correct signals mapping between the LE910Cx and the interfaces of each of the M.2 accessories.

The following images show the MultiTech Interface Board top and bottom views:
4.3. WE866Cx M.2 Card

The M.2 card is designed to interface the Telit LE910Cx module family on an IFBD with the Telit Generic Evaluation Board (EVB) thus forming a complete Development Kit of LE910Cx.

The following image shows the top view of the M.2 card mounted with a WE866Cx module.
The WE866Cx M.2 card follows the below M.2 specification:

- SDIO based Socket 1
- 2230 size type
- Key type E

This form-factor card specification is intended to support Wireless Connectivity devices including combinations of Wi-Fi, BT, NFC, and/or GNSS.

The card includes a U. FL miniature RF connector for connecting a compatible Wi-Fi antenna.

For detailed description of the M.2 Card, refer WE866Cx M.2 Interface Adapter Hardware User Guide.

The following image shows the M.2 plugged into the MTB.

*Figure 4-5 M.2 Plugged into MTB*
The final assembly of the LE910Cx + WE866Cx module is as shown below:

*Figure 4-6 Final Assembly*
5. SET UP

5.1. Prerequisites

5.1.1. Hardware Requirements

- Telit Evaluation Board
- Multi Technology Interface Board
- M.2 Card
- One USB3.0 Micro-B port cable
- One 12V 1.25 Amps Power Adapter
- A SIM card with data connectivity.

5.1.2. Software Requirements

- WHQL Drivers
- A serial terminal such as TATC (Telit AT Controller) to communicate over the COM interface.

5.2. Installing WHQL Drivers

1. Go to URL: https://www.telit.com/evkevb-drivers/ and download the Windows Hardware Quality Labs (WHQL) drivers as shown below.

![Figure 5-1 Downloading Telit WHQL Drivers](image)

2. Unzip the “Windows10WHQLDriversInstaller_2.09.0002.zip” file and extract the windows installer package depending on your host system architecture:

   - x86: Telit WHQL Drivers x86
   - x64: Telit WHQL Drivers x64

![Figure 5-2 WHQL Driver Package](image)
3. To start the installation process, double-click and open the windows installer package and run the Installation wizard.
4. The Welcome screen displays. Click **Next** to continue.

![Figure 5-3 Telit WHQL Driver Installation](image)

5. Select a **Setup Type** and click **Next**.

![Figure 5-4 Select Setup Type](image)

6. The ready to install Telit WHQLDriversX64 dialog displays. Click **Install** to continue the installation process.
7. The progress window displays the status of the InstallShield wizard.

8. When finished, the wizard displays the Completed the TelitWHQLDriversx64 Setup Wizard dialog.
9. Upon successful software installation, following devices will be listed under Device Manager.

![Device Manager](image)

Figure 5-8 Installed Devices List in Device Manager

5.3. Installing TATC Tool

1. Go to URL: [https://www.telit.com/evkevb-drivers/](https://www.telit.com/evkevb-drivers/) and download the Telit TATC tool package as shown below.

   Note: The Telit TATC package consist of:
   - Telit AT Controller.Ink
   - Xfp.Ink
2. To start the installation process, double-click and open the downloaded Setup_TATC_3.4.11_XFP_4.0.5.msi file and run the TATC Setup Installation wizard.

3. The Welcome screen displays. Click Next to continue.

4. Accept the End User license agreement. Select the I agree option and click Next to continue.
5. Before proceeding further, verify the instructions as shown below.

![Figure 5-13 Verifying Installation of a New Release](image)

6. Choose the destination folder to install the TATC application file.
7. The **Confirm Installation** dialog displays. Click **Next** to start the installation process.

8. The progress window displays the status of the TATC Setup wizard.
9. When finished, the setup wizard displays the **Installation Complete** dialog. By default, the **Install Xfp** checkbox is selected. Click **Close** to Exit. Once you click **Close**, the Xfp Setup Wizard displays.

![Figure 5-16 TATC Installation in Progress](image)

10. Accept end user license agreement. Select the **I accept the agreement** and click **Next** to continue.

![Figure 5-17 TATC Installation Completed](image)
11. Choose the destination folder to install the Xfp application file and click **Next**.

12. You have an option of setting up a standard program shortcut or to select the location. Click **Next** to continue.
13. The **Ready to Install** Xfp dialog displays. Click **Install** to continue the installation process.

![Figure 5-21 Begin Xfp Installation](image)

14. When finished, the wizard displays the **Completed the Xfp Setup Wizard** dialog.

![Figure 5-22 Xfp Installation Completed](image)

15. Upon successful software installation following desktop icons are created on your desktop:
   1. Telit AT Controller.Ink
   2. Xfp.Ink
5.4. **Start Up**

1. Plug the MultiTech Board on the generic EVB and insert the WE866Cx M2 adapter and power it ON.

![Figure 5-23 LED Glowing after Successful Connection](image)

2. Connect the one end of the USB3.0 Micro-B port in EVK and other end to the USB port to your PC. This USB connection is used for establishing a UART communication to a PC over a virtual COM port.

3. Connect the power supply cable to generic EVB [6-15 V]. The two (DBG1 and D1000) Orange LED’s glows on the MTB, this indicate that the power supply is good for MTB to run.

5. Now the board is ready for Connecting AT Controller tool. Use Telit AT Controller to communicate with the WE866Cx module.
5.5. Configuring WE866Cx Module

1. Assuming all settings are set properly, you should be able to communicate with the module. The Telit AT Controller can be used to read or modify the configuration settings.

![Telit AT Controller Main Menu](image)

*Figure 5-25 Telit AT Controller Main Menu*

2. Click the **Settings** button to select the COM port (Telit USB modem) assigned to the module.

![Select COM Port](image)

*Figure 5-26 Select COM Port*
3. After successful configuration of the Telit AT Controller, press the **Connect** button to connect to the module and receive the device information.

![Telit AT Controller Device Information](image)

*Figure 5-27 Telit AT Controller Device Information*

4. Next, start the AT Terminal to communicate with the module using the AT commands.

![Communication via AT Commands](image)

*Figure 5-28 Communication via AT Commands*
5.6. Setting Cellular Data Connectivity

1. Open the Network Settings on your Windows Laptop.
2. Enable the Cellular Settings.

![Enable Cellular Settings](image1)

Figure 5-29 Enable Cellular Settings

3. Next, insert the SIM Card into EVB's Sim Slot. The Windows Laptop shows the Cellular network.

![Cellular Network Identified](image2)

Figure 5-30 Cellular Network Identified
4. Uncheck **Let Windows Manage This Connection** to disconnect the laptop from using the cellular network. This step allows cellular data connection to be used by Telit EVB rather than Windows Laptop.

![Figure 5-31 Disconnect Laptop](image)

5. Execute the following Commands to make sure the LTE connectivity is Active for the SIM.
   - AT+CMEE=2 – Error Message Information: This commands Returns the Details of Error in Verbose Mode
   - AT+COPS? - Operator Selection: Give the information about Connected Cellular Operator's network
   - AT+CPIN? - SIM PIN status: This command will return SIM PIN status; READY means device is not waiting for SIM PIN.
Figure 5-32 Execute AT Command for LTE Connectivity

Note: If cellular data is not Active for the SIM, the AT+WLANSTART=1 WLAN command returns an Error response.
6. WIRELESS OPERATIONS

This chapter describes the use cases for Wireless operations in WE866Cx module.

6.1. Wi-Fi

6.1.1. Wi-Fi HotSpot Mode

6.1.1.1. Accessing Internet through Cellular Hotspot Mode

The WE866Cx module operates in AP mode. The internet connectivity for the Wi-Fi module is provided via cellular modem.

The Host MCU uses the AT commands to access the internet through the cellular connection, whereas an external STA can connect to an AP.

Routing function for the Wi-Fi module is provided by the Linux OS and is orthogonal to the data AT commands.

---

**Figure 6-1 Accessing Internet through Cellular Modem**

The following example demonstrates how to access the internet through cellular AT commands:

**Step 1:** Prepare the WE866Cx module for AP mode by issuing the following AT commands from Host MCU.

```
AT+CGDCONT=1,"IP","Example_APN"
AT+CGDCONT=2,"IP","Example_APN"
AT#DUALAPN=1
AT#REBOOT
```

// "Example_APN" should be changed to the cellular provider’s APN. After changing DUALAPN mode, user must reboot for changes to take effect.

// The above changes are persistent and must be done only for the first time.

**Step 2:** Configure the WE866Cx module to AP mode using the following command

```
AT#WLANMODE=0
```

**Step 3:** Start the WE866Cx module
AT#WLANSTART=1

**Step 4:** Start a data connection in the modem side

AT#SGACT=2,1

The Linux and the host MCU will share the cellular data connection, and every STA connected to the device will be routed through the Linux platform.

### 6.1.1.2. Exchanging Data between MCU and Wi-Fi Station

The following example demonstrates how to exchange data between MCU and Wi-Fi Station:

**Step 1:** Boot up the board

**Step 2:** Select USB composition as:

- AT#USBCFG=13 or
- AT#USBCFG=14

**Step 3:** Run the WE866Cx Connection Manager using the following AT command

```
AT#CONNMGRSTART=1,0
```

**Step 4:** Enable WLAN using the following AT command

```
AT#WLANMODE=0 (Set WLAN mode AP)
AT#WLANSTART=1 (Enable WLAN interface and start AP)
```

**Step 5:** Start TCP server on remote device with IP Address: 192.168.43.105 and Port: 8000

**Step 6:** Start TCP client on LE910Cx WLAN interface using following command,

```
AT#SD=101,0,8000,"192.168.43.105",0,9000,1,0,0
```

**Note:** Connection IDs – 101 to 106 are for WLAN Interface

**Step 7:** Send data using following command

```
AT#SSEND=101
```
Enter data when prompted and press **Ctrl-Z**

**Step 8:** Stop the WE866Cx Connection Manager using the following commands

```
AT#CONNMGRESTART=0
```

**Step 9:** To disable the WLAN, issue the following command

```
AT#WLANSTART=0
```

For more details regarding USB composition selection for WE866Cx Connection Manager, refer **Chapter 7 Appendix**.

6.1.2. Wi-Fi STA Mode

6.1.2.1. Exchanging Data with Cloud through Wi-Fi

![Figure 6-3 Exchanging Data with Cloud through Wi-Fi](image)

The following example demonstrates how to exchange data in Wi-Fi Station mode:

**Step 1:** Boot up the board

**Step 2:** Select USB composition as:

```
AT#USBCFG=13 or,
AT#USBCFG=14
```

**Step 3:** Run the WE866Cx Connection Manager using the following AT command

```
AT#CONNMGRESTART=1,0
```

**Step 4:** Enable WLAN using the following AT command

```
AT#WLANMODE=1 (Set WLAN mode)
AT#WLANSTART=1 (Enable WLAN interface)
AT#WLANCONNECT=<SSID>,1,<PASSPHRASE> (Connect to the Access Point)
```

**Step 5:** Start TCP server on remote device with IP Address: 192.168.43.105 and Port: 8000

**Step 6:** Start TCP client on LE910Cx WLAN interface using following command,

```
AT#SD=101,0,8000,"192.168.43.105",0,9000,1,0,0
```

**Note:** Connection IDs – 101 to 106 are for WLAN Interface
Step 7: Send data using following command

AT#SSEND=101

Enter data when prompted and press Ctrl-Z

Step 8: Stop the WE866Cx Connection Manager using the following commands

AT#CONNMGRSTART=0

Step 9: Disable the WLAN

AT#WLANSTART=0

For more details regarding AT Commands, refer to LE910Cx AT Command Reference.

6.1.3. Wi-Fi Concurrent Mode (Dual AP)

The WE866Cx module is a dual band 2.4 and 5GHz enterprise Wi-Fi module that supports the WLAN concurrent dual AP mode of operation. In this mode, the application starts two AP interfaces simultaneously: one AP interface operating in 2.4GHz frequency band and another AP interface operating in 5GHz band.

The Concurrent dual AP mode is supported via AT commands. The host MCU sends AT commands to start/stop the two AP interfaces and to switch between these AP interfaces. Both the AP interfaces operate as hotspots and provide internet connectivity to their respective BSS stations.

The following steps are required to configure and use the dual AP mode:

Step 1: Prepare the WE866Cx module for AP mode by issuing the following AT commands from Host MCU

AT+CGDCONT=1,"IP","Example_APN"
AT+CGDCONT=2,"IP","Example_APN"
AT#DUALAPN=1
AT#REBOOT

// "Example_APN" should be changed to the cellular provider's APN. After changing DUALAPN mode, user must reboot for changes to take effect.

// The above changes are persistent and must be done only for the first time.

Step 2: Configure WE866Cx module to WLAN dual AP mode using the following command

AT#WLANMODE =3

Step 3: Enable WLAN start using the following command

AT#WLANSTART=1

Two AP mode interfaces with different BSSID will be started simultaneously: one AP interface operating in 2.4GHz frequency band and another AP interface operating in 5GHz band.

Step 4: Bring up a data connection in the modem side

AT#SGACT=2,1

Step 5: Select the AP interface to which further AT commands should be applied

• To select AP interface with 2.4GHz band, issue the following AT command

AT#WLANCMIFSEL=0
- To select second AP interface (5GHz band), issue the following AT command
  AT#WLANCMIIFSEL=1

**Step 6:** Configure the selected AP interface using the following commands (Optional)

- AT#WLANSSID=<SSID>
- AT#WLANSECURITY= =[[<wpa>],[<key_mgmt>,<pairwise>,<key>]]
- AT#WLANPC=<mode>,<channel>

**Note:** These commands must be issued after issuing AT#WLANCMIIFSEL command.

**Step 7:** To view the selected AP interface BSS details, issue the following commands

- AT#WLANMAC
- AT#WLANAPCLIST

**Step 8:** To disable the WLAN, use the following command

- AT#WLANSTART=0

For more details regarding AT Commands, refer to LE910Cx AT Command Reference.
6.2. Bluetooth Low Energy (BLE)

This section describes the use cases for BLE operations in WE866Cx module.

6.2.1. Exchanging Data between host MCU to BLE Devices

6.2.1.1. Exchanging Data between WE866Cx Peripheral Mode and BLE Central Device

6.2.1.1.1. Prerequisites

- LE910Cx and WE866Cx MI Card (Peripheral Device)
- Android/iOS Smartphone with nRF Connect Application installed from Google Play Store/App store (Central Device)

The following example demonstrates the steps required to exchange data between LE910Cx peripheral mode and BLE central device.

Note – Make sure the FPGA Switch Position on the Bundling EVK is at position 1.
Step 1: Boot up the board
Step 2: Select USB composition as:
   AT#USBCFG=13
Step 3: Enable WLAN
   AT#WLANSTART=1 (Enable WLAN interface)
Step 4: Run the WE866Cx Connection Manager on MODEM1 using the following AT command
   AT#CONNMGRSTART=1,0
If you are using MODEM2 with USB composition 13, use the following AT command
   AT#CONNMGRSTART=1,1
Step 5: Enable Linux network stack
   AT#ISEL=1
Step 6: Enable BLE
   AT#BI=1,1
Note: The EVK boards without an AUX port makes use of the alternate UART port by enabling AUX Port Parameter on the BI Command.
Step 7: Add a new BLE service, using the following command
   AT#BATTRIB="pserv","uuid=1234"
Make sure to add the services before the start of first advertisement. If advertisement has already been started, disable and enable BLE before proceeding to add a new service.
   • To add characteristics in a service, use the following commands
     AT#BATTRIB="char","prop=1A","uuid=12A1"
     AT#BATTRIB="charval","perm=0011","len=1","val=59"
     #BATTRIB:"CHARID:53"
     Where, 53 is the characteristic ID
     Once the characteristics are added, start the services using the following command
     AT#BATTRIB ="complete"
     #BATTRIB:"SRVID:51"
     Where, 51 is the service ID.
   • To change the value of characteristic (CHARID:53) in the service (SRVID:51) use the following commands
     AT#BSRVDATAEX=51,53,"61"
     Where, 61 is the new value of the characteristic (CHARID:53) in the service (SRVID:51)
Step 8: Now, set the BLE device name using the following command
   AT#BNAME="LE910-BLE"
**Step 9:** Start advertisement using the following commands

AT#BADVE=1 (with custom advertisement data)
AT#BADVE=0 (without custom advertisement data)

**Step 10:** Scan for device name “LE910-BLE”, and connect to LE910 peripheral using nRF connect app on your smartphone.

**Step 11:** Once the central BLE device is successfully connected to LE910 peripheral, read and write operations can be performed.

**Step 12:** To stop advertisement, use the following commands

AT#BADVE=3
AT#BADVE=2 (reserved for future use)

**Step 13:** To disable BLE

AT#BI=0

**Step 14:** To disable WLAN

AT#WLANSTART=0

6.2.1.2. Exchanging Data between LE910Cx Central Mode and BLE Peripheral Device

6.2.1.2.1. Prerequisites

- LE910Cx and WE866Cx MI Card (Central Device)
- Android/iOS Smartphone with nRF Connect Application installed from Google Play Store/App store (Peripheral Device)

The following example demonstrates the steps required to exchange data between LE910Cx Central Mode and BLE Peripheral device.

**Step 1:** Boot up the board

**Step 2:** Select USB composition as:

AT#USBCFG=13

**Step 3:** Enable WLAN

AT#WLANSTART=1 (Enable WLAN interface)

**Step 4:** Run the WE866Cx Connection Manager on MODEM1 using the following AT command

AT#CONNMGRSTART=1,0
If you are using MODEM2 with USB composition 13, use the following AT command

AT#CONNMGRSTART=1,1

**Step 5:** Enable Linux network stack

AT#ISEL=1

**Step 6:** Enable BLE

AT#BI=1,1

**Note:** The EVK boards without an AUX port makes use of the alternate UART port by enabling AUX Port Parameter on the BI Command.
Step 7: Scan for peripheral device using the following command
   AT#BSCAN (To scan all the nearby devices)
   AT#BSCAN="008025D1D7B2" (To scan device with MAC address 008025D1D7B2)

Step 8: Now, connect the device using the following command
   AT#BCONNECT="008025D1D7B2","t2"
   Where, 008025D1D7B2 is the MAC address of the peripheral device and,
   “t2” is the type of the device (t2: public address, t3: random address)

Note: While initiating a connection to random address, perform a scan first. The device
must appear in the scan result.

Once the connection is successful, a connection ID is displayed. For example, “#BCONNECT: 5”

Step 9: To discover the services of the connected peripheral devices:
   - Discovery of all primary services in the connected device with connection ID
     AT#BSRVD=5,,
     #BSRVD:UUID:1800
     #BSRVD:UUID:1801
     #BSRVD:UUID:180A
     #BSRVD:UUID:1234
     OK
   - Discovery characteristics of the primary service “1234”
     AT#BSRVD=5,"1234",
     #BSRVD:UUID:1234
     CHARUUID:3456
     CHARHNDL:23
     CHARPROP:3E
     CHARUUID:3457
     CHARHNDL:26
     CHARPROP:08
     OK

Step 10: To read on a characteristic, use the following command
   AT#BREAD=5,23
   #BREAD:5,23,"6162"
   OK
   Where, 23 is the characteristic handle

Step 11: To write on a characteristic, use the following command
   AT#BWRITE=5,23,"7172"
   Where, 23 is the characteristic handle and “7172” is the new value

Step 12: To disconnect the connected device, use the following command
   AT#BDISCONNECT=4
Where, 4 is the connection ID

**Step 13:** To disable BLE

AT#BI=0

**Step 14:** To disable WLAN

AT#WLANSTART=0

### 6.2.2. GATT Setup

#### 6.2.2.1. Exchanging Data between LE910Cx Peripheral Mode and BLE Central Device using Android nRF Connect Application

The following example demonstrates the steps required to setup GATT using an android nRF Connect Application.

#### 6.2.2.1.1. Prerequisites

- LE910C1-EU Bundling EVK Board (Peripheral Device)
- Android/iOS Smartphone with nRF Connect Application installed from Google Play Store/App store (Central Device)

**Step 1:** Boot up the board

**Step 2:** Select USB composition as:

AT#USBCFG=14

**Step 3:** Change the WLAN mode

AT#WLANMODE=1

**Step 4:** Run the WE866Cx Connection Manager on MODEM1 using the following AT command

AT#CONNMGSTART=1,0

**Step 5:** Enable Linux network stack

AT#ISEL=1

**Step 6:** Enable BLE

AT#BI=1,1

**Note:** The EVK boards without an AUX port makes use of the alternate UART port by enabling AUX Port Parameter on the BI Command.

**Step 7:** Add a new BLE service, using the following command

AT#BATTRIB="pserv","uuid=1234" AT#BATTRIB="char","prop=1A","uuid=12A1"

AT#BATTRIB="charval","perm=0011","len=1","val=59" AT#BATTRIB ="complete"

**Step 8:** Now, set the BLE device name using the following command

AT#BNAME="LE910-BLE"

**Step 9:** Start advertisement using the following commands

AT#BADVE=1

**Note:** Once the USBCFG value is set on the bundling EVK, the COM port gets disconnected. The user must select the new COM port by searching in device manager.
**Step 10:** Scan for device name “LE910-BLE”, and connect to LE910 peripheral using nRF connect app on your smartphone.

**Step 11:** Once the connection is established, bond the bundling EVK to the smartphone using the below AT Command

```
AT#BSSPCONF="Smartphone Address","t2",1 1
```

A pin confirmation is received on the EVK for a bonding request.

**Note:** As per the BLE SIG Standard, the default Command Timeout value is 30 seconds. If no connection is established during this connecton timeout period, the connection procedure gets terminated and the user has to initiate the process from the start.

### 6.2.2.2.2 Exchanging Data between LE910Cx Central Mode and BLE Peripheral Device with GATT Attributes

The following example demonstrates the steps required to setup GATT to read the Attributes and Services using a BLE Peripheral device.

#### 6.2.2.2.2.1 Prerequisites
- LE910 Bundling EVK Board (Central Mode)
- BlueMod+S50 module (Peripheral Device)

**Step 1:** Boot up the Board

**Step 2:** Select USB composition as:

```
AT#USBCFG=14
```

**Step 3:** Change the WLAN mode

```
AT#WLANMODE=1
```

**Step 4:** Run the WE866Cx Connection Manager on MODEM1 using the following AT command

```
AT#CONNMGSTART=1,0
```

**Step 5:** Enable Linux network stack

```
AT#ISEL=1
```

**Step 6:** Enable BLE

```
AT#BI=1,1
```

**Note:** The EVK boards without an AUX port makes use of the alternate UART port by enabling AUX Port Parameter on the BI Command.

**Step 7:** Next, enable GATT Attributes on BlueMod +S50 Peripheral device using the following command

```
ATI99
AT+BOAD
AT+BNDDEL=*  
AT&F1
AT&W
AT+RESET
AT+LEROLE=0
```
AT+LEADE=1
AT+LEATTRIB=pserv,uuid=180F
AT+LEATTRIB=char,prop=12
AT+LEATTRIB=charval,uuid=2A19,perm=0001,len=1
AT+LEATTRIB=COMPLETE

**Step 8:** After the GATT service setup is completed, initiate a scan for the peripheral device on the LE910 EVK

\[ \text{AT}\#\text{BSCAN} \] (To scan all the nearby devices)

**Step 9:** Once the BlueMod+S50 EVK is visible on the scan list, initiate a connection to the BLE EVK

\[ \text{AT}\#\text{BCONNECT} = \text{"Peripheral BLE Address"}, \text{"t2"} \]

Where, “t2” is the type of the device (t2: public address, t3: random address)

Once the connection is successful, a connection ID is displayed on the LE910 (central).

**Step 10:** To discover the services of the connected peripheral devices, use the below commands.

\[ \text{AT}\#\text{BSRVD} = \text{<CONNECT ID>}, \text{<UUID>} \]

\[ \text{AT}\#\text{BREAD} = \text{CONNECT ID}, \text{CHAR \ HANDLE} \]

**Step 12:** To disconnect the connected device, use the following command

\[ \text{AT}\#\text{BDISCONNECT} = 4 \]

Where, 4 is the connection ID

**Step 13:** To disable BLE

\[ \text{AT}\#\text{BI} = 0 \]

**Step 14:** To disable WLAN

\[ \text{AT}\#\text{WLANSTART} = 0 \]

6.2.3. **BLE Web Provisioning**

The following steps are required to perform BLE web provisioning.

**Step 1:** Boot up the board

**Step 2:** Select USB composition

\[ \text{AT}\#\text{USBCFG} = 13 \]

**Step 3:** Enable WLAN

\[ \text{AT}\#\text{WLANSTART} = 1 \] (Enable WLAN interface)

**Step 4:** Run the WE866Cx Connection Manager on MODEM1 using the following AT command

\[ \text{AT}\#\text{CONNMRGSTART} = 1,0 \]

If you are using MODEM2 with USB composition 13, use the following AT command

\[ \text{AT}\#\text{CONNMRGSTART} = 1,1 \]
Step 5: Enabling Linux network stack
AT#ISEL=1

Step 6: Enable BLE
AT#BI=1

Step 7: Set the device name using the following command
AT#BNAME="we866cx_445566"
Where, 445566 is the last part of your MAC address.

Step 8: Start BLE web provisioning using the following command
AT#BWNWEBPROV=2

Step 9: Now, open the provisioning app on the phone and scan for devices.
Once the “we866cx_445566” device appears in the scan list, connect to device.

Step 10: Upon successful connection, the App initiates scan and the LE910 device reports
the Wi-Fi scanned networks to the App.

Step 11: On the App, select the network to be connected. If prompted, enter the required
credentials.
The App will send the Wi-Fi AP details to the LE910 device. Upon successful reception of
the details, the device connects to the selected Wi-Fi network and reports the status
(success/failure).

If the provisioning fails using the Android Application, remove the
Bluetooth cache files from phone’s internal system settings. Once the
cache is cleared, the provisioning will be successful.

6.3. HTTP
This section describes the use cases for HTTP command operations in an WE866Cx
Connection Manager application.

6.3.1. HTTP Mode Commands

Step 1: Configure HTTP profile, for basic HTTP operations
AT#HTTPCFG=100,“server_addr”,“server_port”,0,,0,120,1,0
This command configures a basic HTTP profile, without any server authentication.
The HTTP commands support three profile IDs, range between 100-102. The server
address input can be given as IPv4 address or Domain name of the HTTP server.

Note: <cid> parameter is mandatory, but it is not used.

Step 2: Receive data from HTTP server, using GET method
AT#HTTPQRY=100,0,"/resource_path/"
#HTTPRING message will be sent to host MCU, when response is received from HTTP server.

**Note:** `<extra_header_line>` parameter is not used

**Step 3:** Read data received from the HTTP server

```
AT#HTTPRCV=100,0
```

<maxByte> can specify the number bytes to be read

**Step 4:** Send data to HTTP server, using POST method

```
AT#HTTPSEND=101,0,"/resource_path/",2048
```

**Note:** `<post_param>` and `<extra_header_line>` parameters are not used.

### 6.3.2. HTTPS Mode Commands

**Step 1:** Configure the HTTPS profile with server CA certificate validation

```
AT#HTTPCFG=101,"server_addr","server_port",0,,,1,120,1,1
```

**Note:** For WE866Cx Connection Manager, `<UNUSED1>` parameter can be set to 0 or 1. `<UNUSED1>` parameter is considered as a new HTTP configuration “<ssl_verify>”, and is used to enable/disable CA certificate validation.

**Step 2:** Enable SSL security configuration

```
AT#SSLEN=101,1
```

SSL commands support only one `<SSId>` value, that is 101.

**Step 3:** Store HTTPS server Root CA certificate

```
AT#SSLSECDATA=101,1,1,4096
```

**Note:** CA certificates in “.PEM” format only are supported.

Issuing ESC char does not ensure discarding partial inputs. Thereby, it is advised to delete the previous CA certificate, before storing another CA certificate.

**Step 4:** Configure system time by issuing the below command

```
AT+CCLK="19/12/06,08:52:00+12"
```

**Note:** `+CCLK` command supports only local time zone. The Network Time synchronization is NOT supported.

Once the HTTPS profile is configured, the GET and POST methods can be tested as explained in section 6.3.1 HTTP Mode Commands.

### 6.3.3. HTTP/HTTPS Server Authentication

To enable the basic server authentication, configure the HTTP/HTTPS profile using the below command

```
AT#HTTPCFG=102,"server_addr","server_port",1,"username","password",0,120,1
```

Once the profile is configured successfully with server authentication credentials, the GET and POST methods can be tested as explained in sections 6.3.1 HTTP Mode Commands and 6.3.2 HTTPS Mode Commands.
7. APPENDIX

7.1. WE866Cx Connection Manager

WE866Cx Connection Manager is a Linux application running on apps processor enabled for bundling Wi-Fi features. It is supported on USB compositions 13 and 14.

- In USB compositions 13, WE866Cx Connection Manager is supported on MODEM1 and MODEM2.

![USB Composition-13 Selection for WE866Cx Connection Manager](image1)

- In USB composition 14, WE866Cx Connection Manager is supported only on MODEM1. MODEM2 is used only for cellular commands.

![USB Composition-14 Selection for WE866Cx Connection Manager](image2)
• When WE866Cx connection manager is started, the SOCAT pipe is broken and the AT commands issued through MODEM ports are intercepted and data is sent through the selected interface.

AT#CONNIMG=1,0

Figure 7-3 Connection established via WE86CC3 Connection Manager

• When WE866Cx connection manager is killed, the SOCAT link is re-established.

AT#CONNIMG=0,1

Figure 7-4 Connection Established via SOCAT Links
7.1.1. Enabling WE866Cx Connection Manager

Perform the following steps to enable the WE866Cx Connection Manger:

1. Select the USB composition
   AT#USBCFG=13 or, 
   AT#USBCFG=14

2. Run the connection Manager
   - To run the connection manager on MODEM1, issue the following commands
     AT#CONNMGRRSTART=1,0
   - To run the connection manager on MODEM2, using USB Composition 13 issue the following commands
     AT#CONNMGRRSTART=1,1

7.1.2. Disabling WE866Cx Connection Manager

To stop running the WE866Cx Connection Manager issue the following commands
AT#CONNMGRRSTART=0

7.2. Firmware Update

WE866Cx manager can be updated using existing FOTA solution, either through MCU or directly from LE910Cx.

To update WE866Cx manager, please refer to the existing FOTA solution AT commands.

7.3. Limitations and Known Issues

7.3.1. AT Commands

Following is the list of NOT Supported AT Commands:

<table>
<thead>
<tr>
<th>AT command</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATS2</td>
<td></td>
</tr>
<tr>
<td>ATS3</td>
<td></td>
</tr>
<tr>
<td>ATS4</td>
<td></td>
</tr>
<tr>
<td>ATS5</td>
<td></td>
</tr>
<tr>
<td>ATS7</td>
<td></td>
</tr>
<tr>
<td>ATS12</td>
<td></td>
</tr>
<tr>
<td>ATS30</td>
<td></td>
</tr>
<tr>
<td>AT#PKTSZ</td>
<td></td>
</tr>
<tr>
<td>AT#DSTO</td>
<td></td>
</tr>
<tr>
<td>AT#BCONNECT</td>
<td>If the device that we are trying to connect is not present in Scan list, the BLE stack crashes.</td>
</tr>
<tr>
<td><strong>AT command</strong></td>
<td><strong>Remarks</strong></td>
</tr>
<tr>
<td>----------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>AT#BSCAN</td>
<td>For filtered scan to show results each time, the advertising interval should be set low on the peripheral device.</td>
</tr>
<tr>
<td>AT#BATTRIB</td>
<td>After BLE initialization, once the advertisement is started the service cannot be added. All services must be defined before starting advertisement.</td>
</tr>
</tbody>
</table>

### 7.3.2. Features

Following is the list of NOT supported features:

<table>
<thead>
<tr>
<th><strong>Features/Items</strong></th>
<th><strong>Related AT Command</strong></th>
<th><strong>Parameter</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Base64 encoding/decoding of socket sent/received data</td>
<td>AT#BASE64</td>
<td></td>
</tr>
<tr>
<td>Adjusting a time interval for series of UDP data packets</td>
<td>AT#SD</td>
<td>&lt;txTime&gt;</td>
</tr>
<tr>
<td>Viewing data with UDP datagram information</td>
<td>AT#SCFGEXT</td>
<td>&lt;srMode&gt;</td>
</tr>
<tr>
<td>Send and receive data in Hexadecimal format</td>
<td>AT#SCFGEXT</td>
<td>&lt;dataMode&gt;</td>
</tr>
<tr>
<td>Abort Connection attempt</td>
<td>AT#SCFGEXT2</td>
<td>&lt;abortConnAttempt&gt;</td>
</tr>
<tr>
<td>NO CARRIER indication</td>
<td>AT#SCFGEXT2</td>
<td>&lt;noCarrierMode&gt;</td>
</tr>
<tr>
<td>BLE IO capabilities</td>
<td>AT#BIOCAP</td>
<td></td>
</tr>
<tr>
<td>BLE FixPin</td>
<td>AT#BFIXPIN</td>
<td></td>
</tr>
</tbody>
</table>

### 7.3.3. Others

- Echo configuration display does not reflect the actual configuration.
- For UDP sockets, IPv6 connection is NOT supported.
- For UDP Listen mode Sockets, AT#SS command (status command) will display “Local IP” as all zeros.
- Socket Info command (AT#SI) displays the parameter <ack waiting> as zero.
- Socket Last Closure command (AT#SLASTCLOSURE) displays zero when socket is closed.
- HTTP methods HEAD, DELETE, PUT are NOT supported.
- #HTTPSND <data_len> parameter supports maximum data length of 2048 characters.
- #HTTTPRING <content-type> parameter is always "text/html; charset=UTF-8".
- #SSLSECCFG commands are NOT supported.
- #SSLSECDATA command supports only CA certificates in “.PEM” format.
- After terminating #SSLSECDATA command using ESC char, delete certificate command should be issued.
• +CCLK command supports local time zone only.
# 8. ACRONYMS

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLE</td>
<td>Bluetooth Low Energy</td>
</tr>
<tr>
<td>EVB</td>
<td>Evaluation Board</td>
</tr>
<tr>
<td>FOTA</td>
<td>Firmware Over-the-Air</td>
</tr>
<tr>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>GPS</td>
<td>Global Positioning System</td>
</tr>
<tr>
<td>HTTP</td>
<td>HyperText Transfer Protocol</td>
</tr>
<tr>
<td>HTTPS</td>
<td>Hypertext Transfer Protocol Secure</td>
</tr>
<tr>
<td>IFBD</td>
<td>Interface Board</td>
</tr>
<tr>
<td>JTAG</td>
<td>Joint Test Action Group</td>
</tr>
<tr>
<td>MTB</td>
<td>MultiTech Interface Board</td>
</tr>
<tr>
<td>PCM</td>
<td>Pulse-Coded Modulation</td>
</tr>
<tr>
<td>LTE</td>
<td>Long-Term Evolution</td>
</tr>
<tr>
<td>SDIO</td>
<td>Secure Digital Input Output</td>
</tr>
<tr>
<td>SSL</td>
<td>Secure Sockets Layer</td>
</tr>
<tr>
<td>TATC</td>
<td>Telit AT Controller</td>
</tr>
<tr>
<td>UART</td>
<td>Universal Asynchronous Receiver/Transmitter</td>
</tr>
<tr>
<td>USB</td>
<td>Universal Serial Bus</td>
</tr>
<tr>
<td>WHQL</td>
<td>Windows Hardware Quality Labs</td>
</tr>
<tr>
<td>WLAN</td>
<td>Wireless Local Area Network</td>
</tr>
</tbody>
</table>
## 9. DOCUMENT HISTORY

<table>
<thead>
<tr>
<th>Revision</th>
<th>Date</th>
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<tbody>
<tr>
<td>0</td>
<td>2019-01-11</td>
<td>First issue</td>
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<td>2019-02-25</td>
<td>Modified description for the following AT Commands</td>
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<td>• AT#WLANSECURITY</td>
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<td>• AT#WLANMACMODE</td>
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<td>AT#WLANPC</td>
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<td>2019-03-29</td>
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<td>• AT#WLANSWV</td>
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<td>3</td>
<td>2019-05-07</td>
<td>Modified Chapter 6 Wireless Operations to add new enhancement and other features.</td>
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<td></td>
<td>Replaced Chapter 7 AT Commands with Appendix</td>
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<td>2019-05-15</td>
<td>Added information related to AT#SENDUDPEXT command under section 7.2 Limitations and Known Issues.</td>
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<td>Corrected Connection ID for WLAN interface under section 6.1.2 Exchanging Data between MCU and Wi-Fi Station and 6.2.1 Exchanging Data with Cloud through Wi-Fi</td>
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<td>2019-05-17</td>
<td>Corrected AT#CONNMGRSTART command value for disabling WLAN under the following sections:</td>
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<td></td>
<td>6.1.2 Exchanging Data between MCU and Wi-Fi Station</td>
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<td></td>
<td>6.2.1 Exchanging Data with Cloud through Wi-Fi</td>
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<td>7.1.2 Disabling WE866Cx Connection Manager</td>
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<td>Updated sections 7.3.2 Features and 7.3.3 Others</td>
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<td>2019-10-25</td>
<td>Added Wi-Fi concurrent mode details</td>
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<td>Corrected Product Applicability Table</td>
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<td>6.3 HTTP</td>
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<td></td>
<td>7.2 Firmware Update</td>
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<tr>
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<td></td>
<td>Updated section 7.1 WE866Cx Connection Manager with SOCAT connection information</td>
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<tr>
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<td></td>
<td>Updated section 7.3 Limitations and Known Issues with BLE and HTTP limitations</td>
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### Version History

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<td>5.2 Installing WHQL Drivers</td>
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<td>5.3 Installing TATC Tool</td>
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<tr>
<td></td>
<td>Setting Cellular Data Connectivity</td>
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<tr>
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<td>Updated sections 5.1 Prerequisites, 5.4 Start Up, and 5.5 Configuring WE866Cx Module</td>
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<tr>
<td></td>
<td>Changed the document name to &quot;LE910Cx-WE866Cx LTE Bundling User Guide&quot; to incorporate the WE866C6 module.</td>
</tr>
<tr>
<td>2020-07-30</td>
<td>Added section 6.2.2 GATT Setup</td>
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<tr>
<td></td>
<td>Added prerequisites under section 6.2.1 Exchanging Data between host MCU to BLE Devices.</td>
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</tbody>
</table>
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