

BLG840F/X BLE/802.15.4 to LTE Gateways

OpenSource with Market Ready Enclosure

BLG840F/X gateways support Bluetooth 5, Thread, or Zigbee radio protocols. Both LTE-M and NB-IoT are supported on the network side. They are in market ready enclosure and pre-certified. OpenSource codes are available to expedite your firmware development.

BLG-1F Gateway Base

The host board has an M.2 connector, B-key and a 16MB SPI flash memory. An USB AC adapter and an LTE antenna are included. The 16 MB flash memory is not included in BLG-1 gateway base.



Modules for M.2 Connector

LN Series modules consist of an nRF9160 module and an nRF52840 or an nRF5340 module. A SIM card connector is on board.



BLG840F Gateway

BLG840F consists of a BLG-1 gateway base and an LN60G840F module with an external LTE antenna.

BLG840X Gateway

BLG840X consists of a BLG-1 gateway base and an LN60G840X module with an external LTE antenna. Using

BT840X with +22.9 dBm max. Range between 2 BT840X is more than 4500 meters at 125 Kbps.

BLG40F Gateway with BT40F, nRF5340

BLG40F consists of a BLG-1F gateway base and an LN60G40F module with an external LTE antenna.

Miscellaneous

- Gateway size: 60x60x22 mm.
- 2 RGB LED indicators
- One SMA mounting hole for LTE antenna
- Antenna length: 170mm.
- Includes AC adapter, USB cable, wall mount bracket.
- Certifications (pending): FCC, ISED, CE, RCM, TELEC
- Carrier certifications:

Development and Programming Kits

Hardware required to load firmware into BLG840F

- Nordic nRF9160DK for programming nRF9160 module.
- Nordic nRF534DK for BLG40F.
- Fanstel PK-BLG840F. (a) 10-pin flat cable for connecting gateway to Nordic DK (b) USB to UART bridge board and cable for monitoring LTE traffic.



LTE Gateway Summaries

	BLG840F	BLG840X	BLG40F	BLG-1F
M.2 module	LN60G840F	LN60G840X	LN60G40F	None
LTE module	nRF9160 SICA	nRF9160 SICA	nRF9160 SICA	None
BLE module	BT840F	BT840X	BT40F, nRF5340	None
Ext. flash memory	None	None	16MB	16MB
QDID	108621	108621		
Availability	Sample	Sample	05/2021 sample	05/2021 sample

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BLG840F/X BLE/802.15.4 to LTE Gateways

1. Introduction

BLG840F Series gateway integrates a BLG-M2 gateway base and an LN60G840F Series LTE-BLE module. The LN60G840F module integrates a Nordic nRF9160 SIP module and Fanstel long range Bluetooth, Thread, Zigbee module BT840F or BT840XE. All products are referred as BLG840F Series in this user's manual.

Network Interface Supports LTE-M and NB-IoT

It makes the latest low power LTE technology and advanced processing and security accessible, and easy to use, for a wide range of single device low power cellular IoT (cloT) designs.

Incorporating an Arm Cortex-M33 application processor solely for applications, a full LTE modem, RF Front End (RFFE) and power management system. The nRF9160 is the most compact, complete and energy-efficient cellular IoT solution on the market.

The integrated modem supports both LTE-M and NB-IoT and can operate globally removing any need for regional variants. All power saving features including eDRX and PSM are supported as is with IPv4/IPv6 support up to transport and security (TCP/TLS) level. The modem firmware is upgradable via secure, encrypted Firmware Over The Air (FOTA) updates.

The Arm Cortex-M33 application processor is supported by 1MB of flash and 256kB RAM making advanced application development possible in a single device solution.

A GPS receiver is integrated into the radio offering various modes of operation to suit a wide selection of applications that employ location-tracking functionality.

A broad selection of general interfaces and peripherals and are included on nRF9160 including 12-bit ADC, RTC, SPI, I²C, I²S, UARTE, PDM and PWM.

Security is best-in-class with Arm TrustZone technology for isolation and protection of normal and secure zones for firmware and elements of hardware including memory and peripherals. Arm TrustZone helps build solid and secure IoT applications that feature secure boot, trusted firmware updates and root of trust implementations without performance compromise.

Arm CryptoCell enhances security still further by offering cryptographic and security resources to help to protect your IoT applications from various attack threats. CryptoCell is designed for high performance cryptography solutions optimized for energy-constrained devices.

Gateway and beacon have a SIM connector for connection and authentication with mobile network operators.

Bluetooth, Thread, and Zigbee Interfaces

BLG840F integrates BT840F (nRF52840) module with 2300 meter range at 125 Kbps. BLG840X integrates BT840XE (nRF52840 + SKY66112 PA) with >4500 meter range at 125 Kbps.

The nRF52840 is fully multiprotocol capable with full protocol concurrency. It has protocol support for Bluetooth 5, Bluetooth mesh, Thread, Zigbee, 802.15.4, ANT and 2.4 GHz proprietary stacks.

It is built around the 32-bit ARM® Cortex™-M4 CPU with floating point unit running at 64 MHz. It has NFC-A Tag for use in simplified pairing and payment solutions. The ARM TrustZone® CryptoCell cryptographic unit is included on-chip and brings an extensive range of cryptographic options that execute highly efficiently independent of the CPU.

BLG840F/X BLE/802.15.4 to LTE Gateways

2. Hardware Description

BLG840F Series Hardware

A BLG840F Series gateway consists of the following hardware items:

- The gateway main body
- A wall mount bracket.
- An LTE antenna, not pre-installed.
- An AC adapter.
- An USB cable.

Size of gateway is 60x60x22mm.

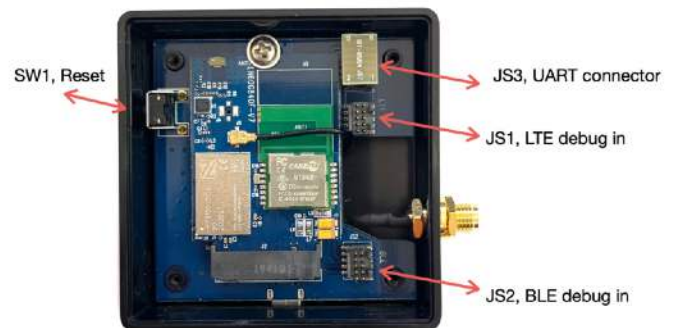


Gateway Base BLG-1 and BLG-1F

A BLG840F gateway can be built by inserting an LN Series module into the M.2 connector of gateway base. This photo shows an LN60G840F module installed.

Features of gateway base:

- 2 user definable RGB LED indicators on top side of gateway.
- SW1, reset button. It can be used to begin DFU OTA upgrade.
- An M.2 connector, B key.
- JS1, Debug-In connector for nRF9160 module.
- JS2, Debug-In connector for BT840F Series or BT40F Series module.
- JS3 connector with JS7 jumper board inserted. JS7 board can be replaced with the USB cable assembly board in PK-BLG840F to monitor traffic at the UART interface.
- SMA connector installed. LTE included, not installed.
- BLG-1F has a 16 MB flash memory. Flash memory can be used for gateway without the SKY66112 power amplifier.
- An AC adapter, an USB cable, and a wall mount bracket is included.



No LN Series M.2 module is included in the gateway base.

BLG840F/X BLE/802.15.4 to LTE Gateways

Available BLG840F Series Gateways

Available gateways in the BLG840F Series are in the following table.

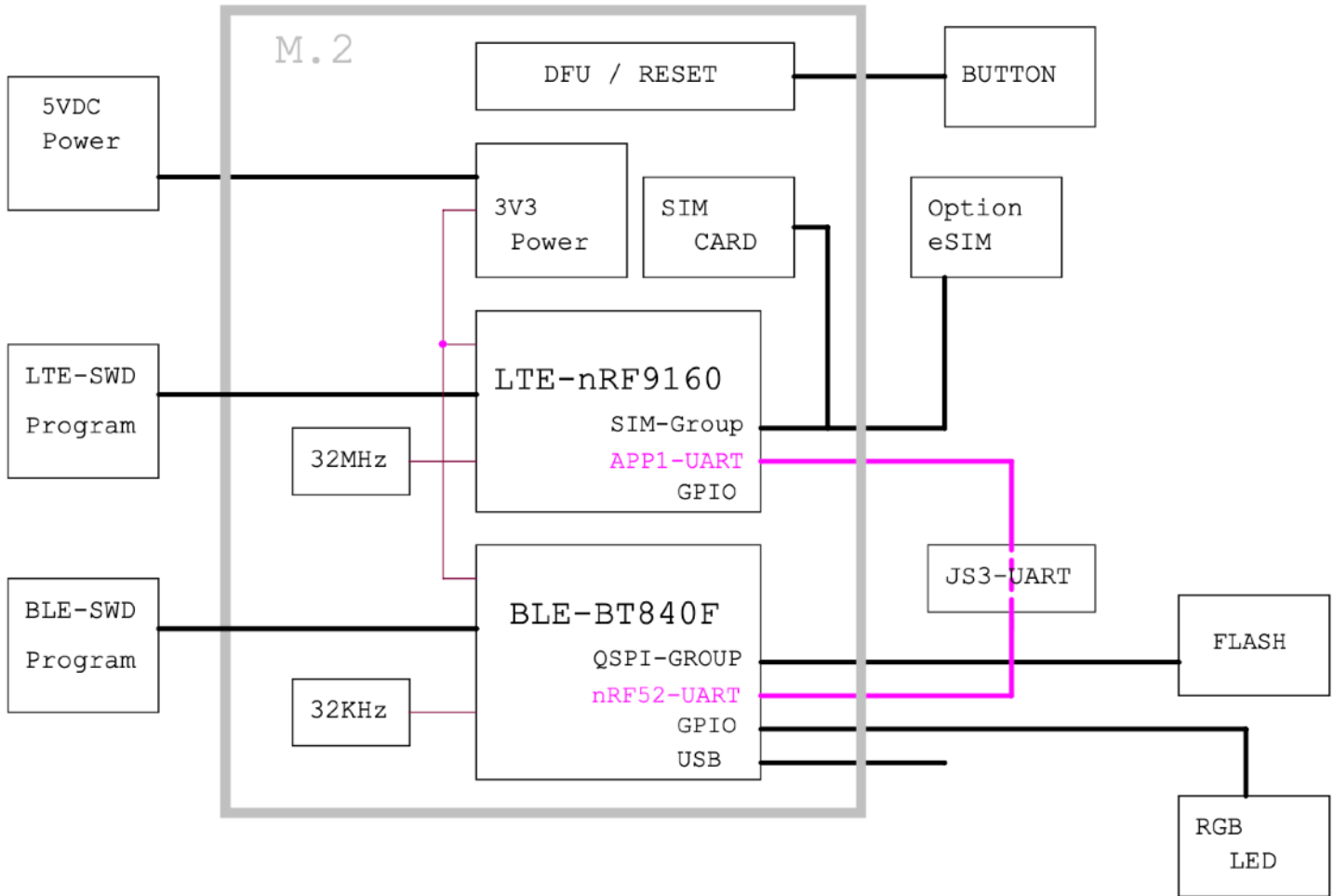
- Gateway base has 2 antenna mounting holes. SMA connector for the LTE antenna is preinstalled. SMA connector for the BLE antenna is **not** preinstalled.
- nRF9160 module needs an external LTE antenna (included).
- BT840E, BT840XE, or BT40E needs an external BLE antenna (included).
- An external GPS is **not** included.
- When both LTE and BLE antennas are required, an external GPS antenna can not be supported. No GPS feature.
- BT840X, BT840XE use SPI pins to control SKY66112 power amplifier. The external flash memory can not be supported.

BLG840F	LN60G840F	BT840F, nRF9160, integrated GPS antenna
BLG840X	LN60G840X	BT840X, nRF9160, integrated GPS antenna
BLG40F	LN60G40F	BT40F, nRF9160, integrated GPS antenna
BLG840E	LN60G840E	BT840E, nRF9160, integrated GPS antenna
BLG840XE	LN60G840XE	BT840XE, nRF9160, integrated GPS antenna
BLG40E	LN60G40E	BT40E, nRF9160, integrated GPS antenna
BLE840F	LN60E840F	BT840F, nRF9160, external GPS antenna (not included)
BLE840X	LN60E840X	BT840X, nRF9160, external GPS antenna (not included)
BLE40F	LN60E40F	BT40F, nRF9160, external GPS antenna (not included)
BLE840E	LN60E840E	BT840E, nRF9160, GPS not supported
BLE840XE	LN60E840XE	BT840XE, nRF9160, GPS not supported
BLE40E	LN60E40E	BT40E, nRF9160, GPS not supported
BLG-1	none	Gateway base without an LN module
BLG-1F	none	Gateway base with flash memory, without an LN module

BLG840F/X BLE/802.15.4 to LTE Gateways

BLG840F Block Diagram

Block diagram of BLG840F is below.



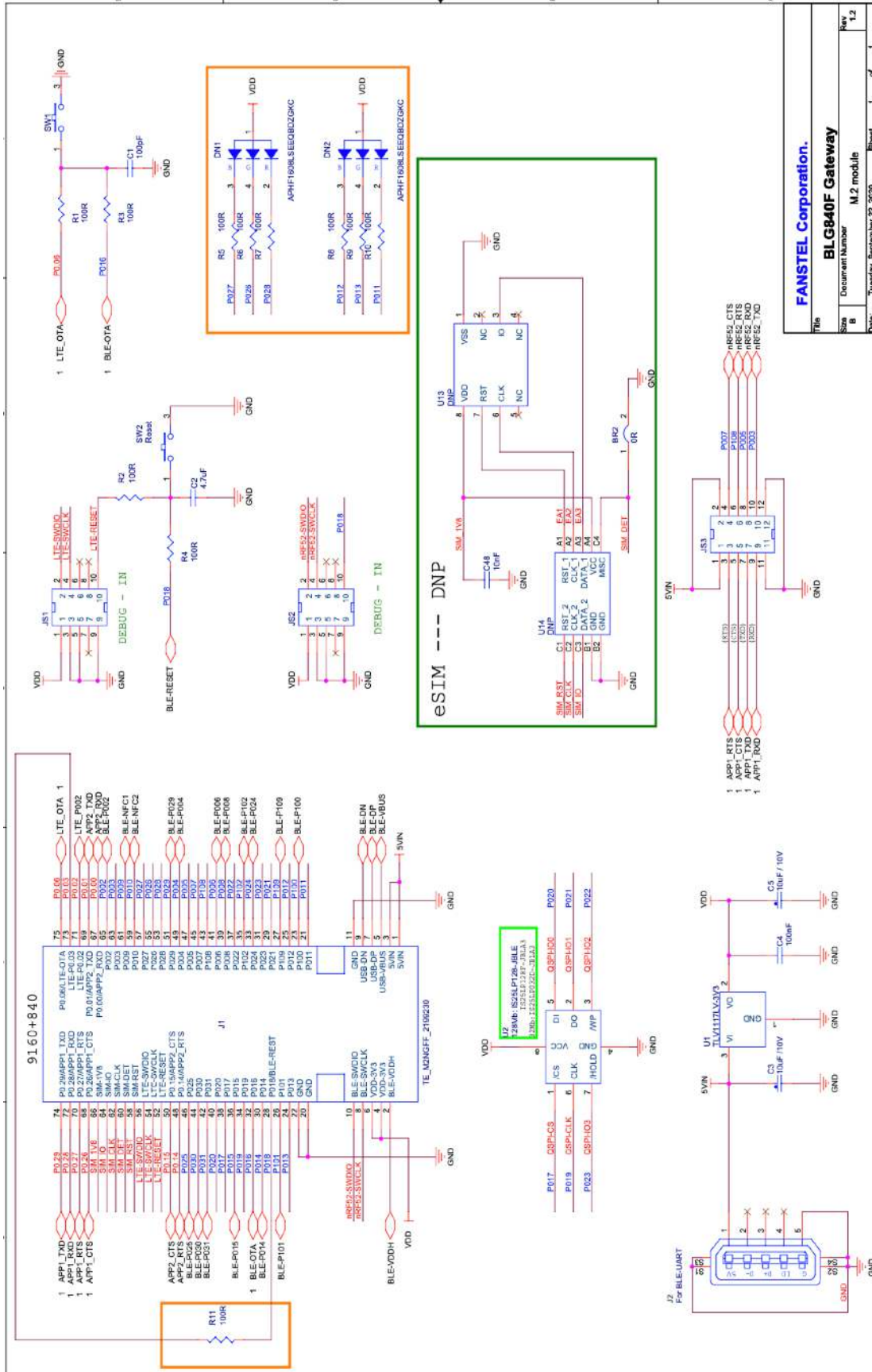
BLG840F BLOCK

- Gray rectangle is the boundary of M.2 module. In this example, an LN60G840F is installed.
- Nordic nRF9160 SICA is used in a M.2 LTE module.
- LN60G840F has GPS receiver amplifier and antenna on board. Some LN module has an u.FL connector for external GPS antenna.
- A connector for nano SIM card is on board. External eSIM is possible for M.2 module. It is not supported in BLG840F.
- BLE features can be supported by an nRF52840 or nRF5340 module with or without power amplifier.
- To monitor data traffic at LTE interface, insert UART-USB bridge board into JS3-UART connector. An UART-USB bridge board and an USB cable are included in PK-BLG840F Programming Kit.
- An SPI flash memory can be supported for BLE module without power amplifier. SPI interface pins are used to control SKY66112 power amplifier.
- Two RGB LEDs are available as indicators.
- To program BLE module, a Nordic nRF52840DK or nRF5340DK is needed. A 10-pin flat cable included in PK-BLG840F is required to connect a Nordic DK to the corresponding module.

BLG840F/X BLE/802.15.4 to LTE Gateways

Draft Ver 0.91 Mar. 2021

BLG-1F Schematics

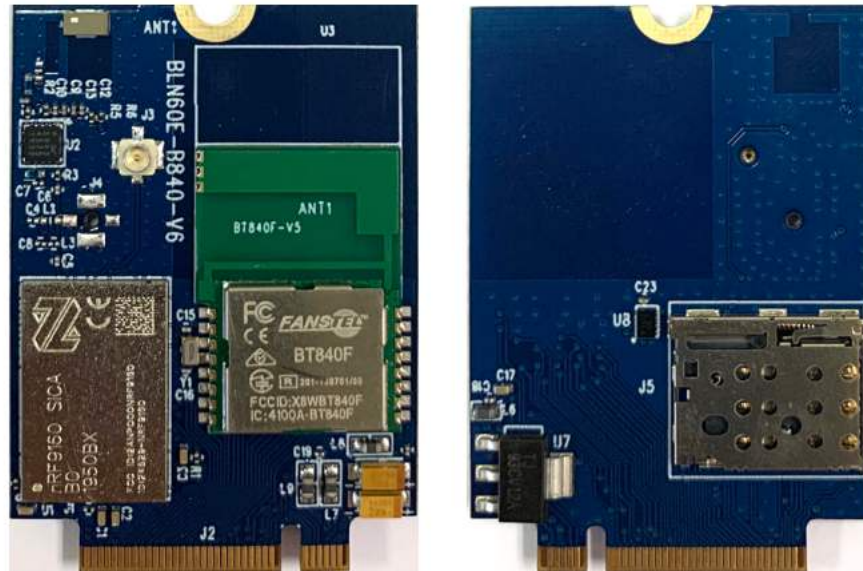


FANSTEEL Corporation.	
Title: BLG840F Gateway	
Size: B	Document Number: M.2 module
Date: Tuesday, September 22, 2020	Sheet: 1 of 1
Rev: 1.2	

BLG840F/X BLE/802.15.4 to LTE Gateways

LN Modules

The following is a photo of both top and bottom sides of LN60G840F module. It integrates a Fanstel BT840F BLE module with a Nordic nRF9160 SICA LTE/NB-IoT module. There is a nano SIM card connector on the bottom side of module.



A partial list of available LN LTE modules are below.

Module	LN60G40F	LN60E40E	LN60E840E	LN60G840F	LN60G840X	LN60G840XE
BLE module	BT40F	BT40E	BT840E	BT840F	BT840X	BT840XE
BLE antenna	Integrated	u.FL	u.FL	Integrated	Integrated	PA + u.FL
LTE module	nRF9160 SICA	nRF9160 SICA	nRF9160 SICA	nRF9160 SICA	nRF9160 SICA	nRF9160 SICA
LTE antenna	u.FL	u.FL	u.FL	u.FL	u.FL	u.FL
GPS antenna	Integrated	u.FL	u.FL	Integrated	Integrated	Integrated
Certifications						
QDID			108621	108621	108621	108621
Availability	04/21	04/21	Sample	Sample	Non-stock	Non-stock

BLG840F/X BLE/802.15.4 to LTE Gateways

3. Establishing Cloud and Sensor Connection

PK-BLG840F, the LTE Monitor Board

PK-BLG840F can be used:

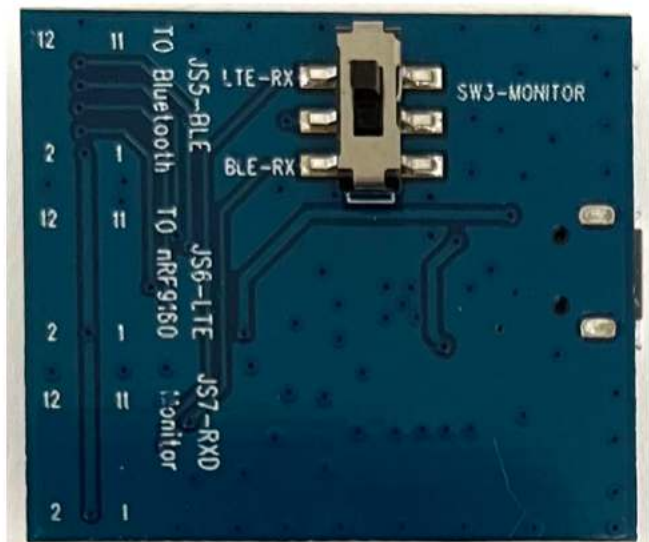
- to interface with the BLE module or the LTE module in BLG840F Series gateways.
- To monitor UART data traffic to the LTE module or the BLE module.

It contains:

- an UART to USB bridge board, called **LTE Monitor** board,
- a 10-pin flat cable,
- and an USB cable.

There are three 12-pins square connectors on the **LTE Monitor** board.

- JS5-BLE for connection to the BLE module in BLG840F gateway.
- JS6-LTE for connection to the LTE module in BLG840F gateway.
- JS7-RXD for monitor UART data to the receiver of the BLE or the LTE module. It can be selected by the SW3 switch on the back side.



BLG840F/X BLE/802.15.4 to LTE Gateways

BLG840F

The BLG840F is pre-loaded with Nordic modem mfw_nrf9160_1.2.0 and MQTT application.

MQTT tool or MQTT APP<->MQTT broker <-> LN60E40F <->BLE Sensor

The default application is for NB IoT. If you need to run CAT M. Please download the HEX file from Fanstel website.

The BLG840F preloaded firmware will send the temperature and humidity preset data to Fanstel MQTT server. One can use Fanstel MQTT PC tool or mobile APP to monitor data.

Download and set up Basic Software tools for LN60G840F.

nRF command line tool 10.2.1 or newer.

<https://www.nordicsemi.com/Software-and-Tools/Development-Tools/nRF-Command-Line-Tools/Download>

nRF Connect desktop 3.2.0 or newer.

<https://www.nordicsemi.com/Software-and-Tools/Development-Tools/nRF-Connect-for-desktop>

Fanstel MQTT PC tool to test default firmware.

https://www.dropbox.com/s/27xzy1kytb8t918/MQTT_PC_Tool190916.rar?dl=0

Fanstel LTE PC tool to test default firmware.

https://www.dropbox.com/s/beyhbh78lowlzal/LTE_PC_Tool190718.rar?dl=0

Establishing an LTE Connection to a Cloud Server

The following example establishes a connection between the nRF9160 in BLG840F gateway and Fanstel development server. You will enter artificial temperature and humidity data for uploading to the Fanstel MQTT server.

Assuming the nRF9160 only HEX code is programmed. You don't need to open the enclosure.

- Connect the external antenna.
- The small JS7 board is pre-installed. If not, insert it to JS-LTE connector.
- Connect the micro USB port to an AC adapter with an USB cable.



BLG840F/X BLE/802.15.4 to LTE Gateways

- Open Fanstel LTE monitor and MQTT listener PC tools.
- Select the COM port.
- Reset the BLG840F, the log appears.
- Configure Publish ID and artificial temperature.

LTE AT tool190611

LTE MQTT

Disconnect Clr Log

Server: Fanstel

temperature: 23
2 Bytes

Publish ID: 000123
Setup 6 Bytes ID then reset the EVB

humidity: 65
2 Bytes

Data updated

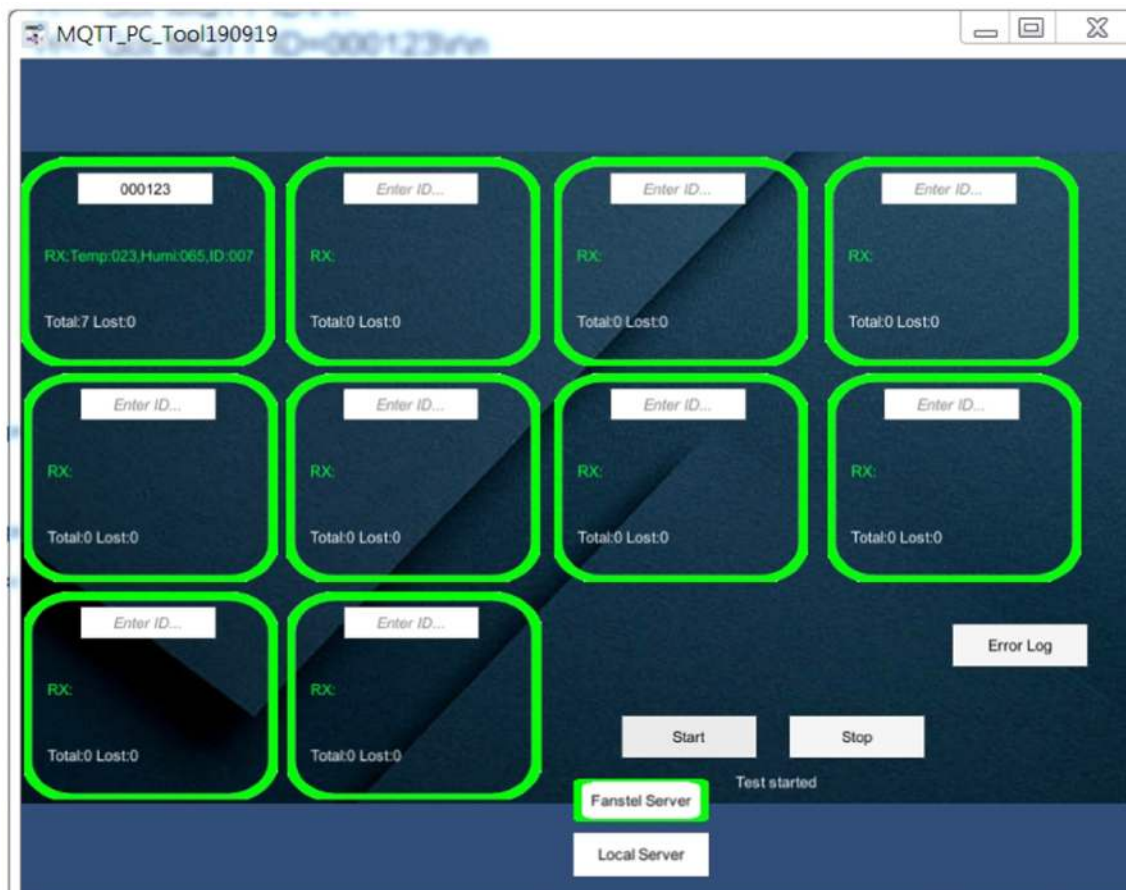
```
H<- ***** Booting Zephyr OS v1.14.99-ncs2 *****\r\nH<- The Fanstel MQTT 190904 \r\nH<- UART enabled\r\nH<- Waitting for MQTT ID!\r\nH<- LTE Link Connecting ... \r\n\r\nH-> SetID=000123\r\n\r\nH-> RawData=023,065\r\n
```

BLG840F/X BLE/802.15.4 to LTE Gateways

When nRF9160 module is connected to the MQTT server, you will see the temperature and humidity data uploaded.

```
H<- IPv4 Address found 59.124.228.194\r\nH<- Got MQTT ID\r\nH<- Got MQTT ID=000123\r\nH<- AT+MQTT=1\r\nH<- Subscribing to: /my/9160_sub len 12\r\nH<- Publishing: Temp:023,Humi:065,ID:001\r\nH<- to topic: esp32_000123/Odemo len: 18\r\nH<- [mqtt_evt_handler:267] SUBACK packet id: 1234\r\nH<- Publishing: Temp:023,Humi:065,ID:002\r\nH<- to topic: esp32_000123/Odemo len: 18
```

- Open the MQTT PC tool and enter the same Publish ID you just setup.
- Press start icon.
- The data from nRF9160 is displayed.



BLG840F/X BLE/802.15.4 to LTE Gateways

Relaying Sensor Data to a Cloud Server

This application example relays temperature and humidity sensor data from Fanstel sensors through a LTE connection to the Fanstel cloud server.

- Remove BLG840F PCBA from the enclosure.
- Programming mqtt9160NB_210115.HEX code.
- Remove the small JS7 board from JS3 connector. The JS3 silkscreen is covered by the LN60G840F module when installed.
- Insert the JS7-RXD connector of the **LTE Monitor** board (the USB to UART bridge board included in PK-BLG840F) to JS3 connector of BLG840F board.
- Use SW3 on the **LTE Monitor** board to select monitoring the UART data to the BLE or to the LTE receiver.
- Check both nRF9160 and nRF52840 UART logs, running normally.

You can use this set up to monitor traffic at the UART interface when developing your own code.

After checking the log, insert the small JS7 board back to JS3 connector.

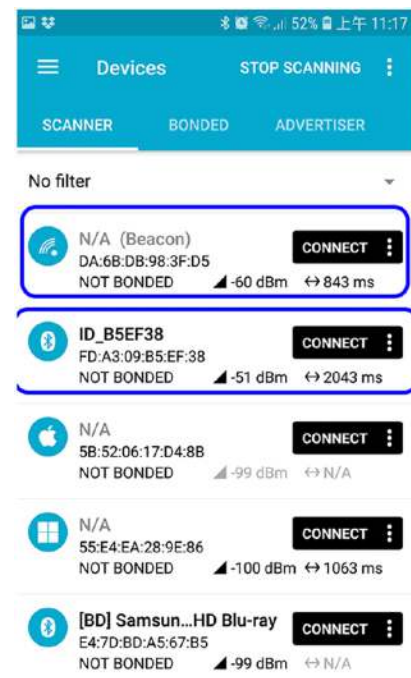


Using Android OS

Download and install nRF Connect mobile App.

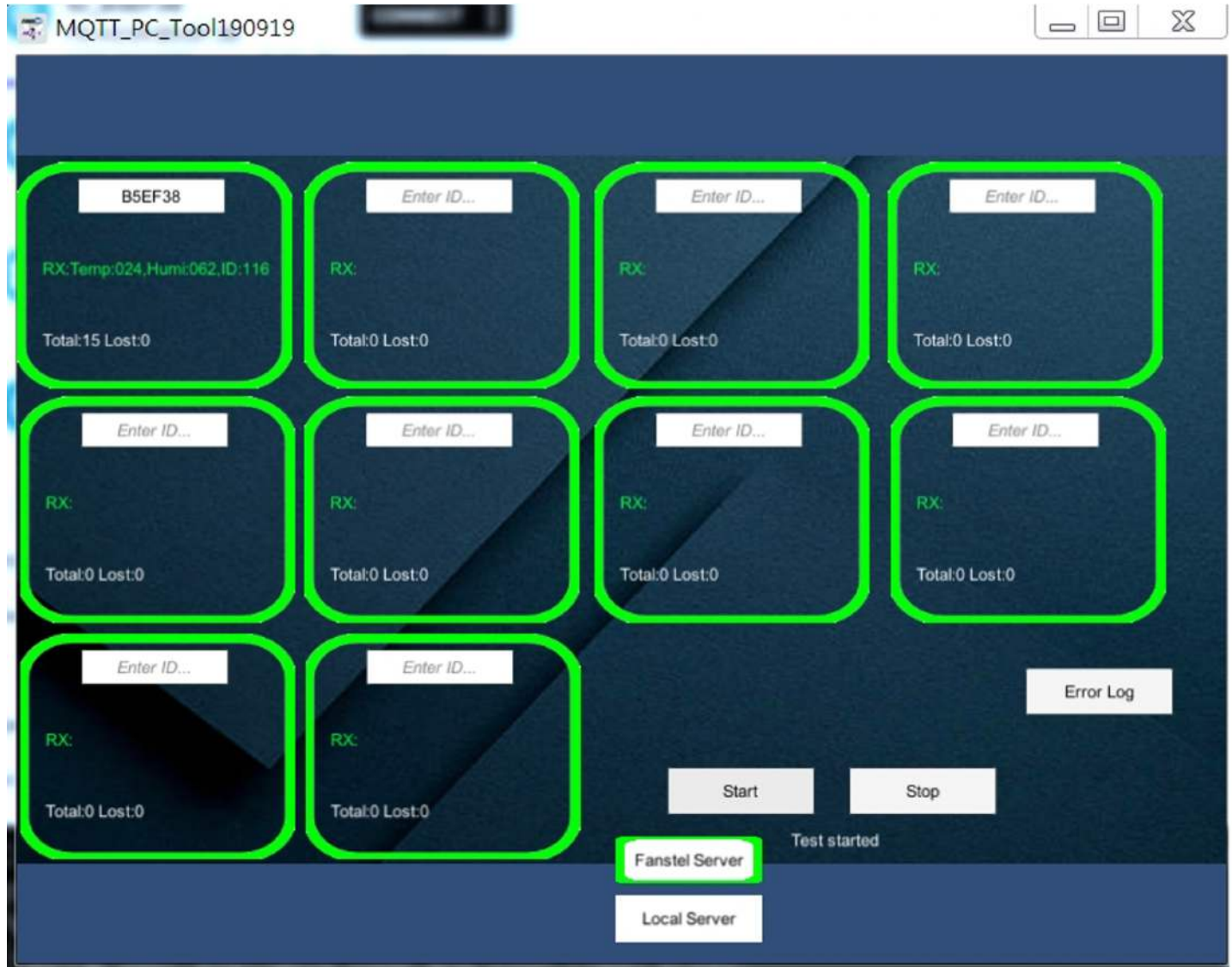
<https://play.google.com/store/apps/details?id=no.nordicsemi.android.mcp&hl=zh-TW>

Open the nRF Connect mobile App when a Fanstel sensor is powered up nearby. The sensor is advertising the 6 bytes ID.



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Enter the sensor ID into Fanstel MQTT tool. The real sensor data are displayed on the tool.



BLG840F/X BLE/802.15.4 to LTE Gateways

4. BLG840G Firmware Development

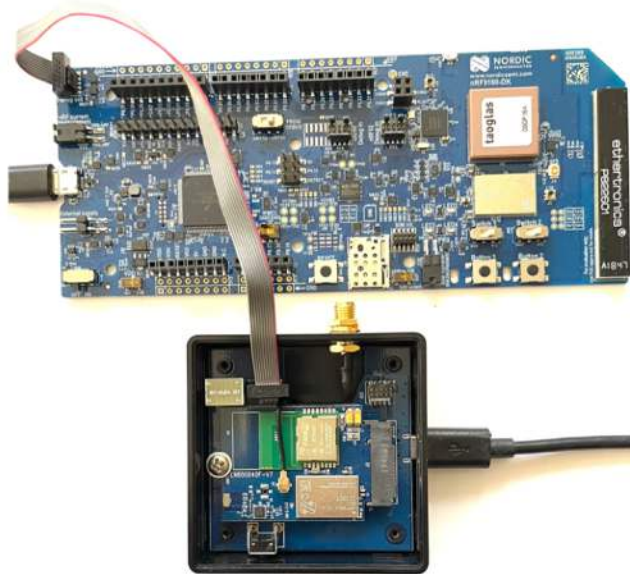
The following hardware is required to program a BLG840F Series gateway.

- A Nordic nRF9160-DK to program the nRF9160 module and an nRF52840 module (BT840F, BT840X, BT840XE).
- A Nordic nRF5340-DK to program an nRF5340 module, e.g., BT40F, BT40E, or BT40X.
- A 10-pin flat cable included in PK-BLG840F, Programming Kit.

Programming nRF9160

To program the nRF9160 module:

1. Use the 10-pin flat cable to connect nRF9160-DK **Debug out** to the connector marked **LTE** on the BLG840F board.
2. Set the **PROG/DEBUG** slide switch **SW10** to nRF91.
3. Set the **VDD** slide switch **SW9** to 3V.
4. Connect the nRF9160 DK **External supply** connector to a PC or Mac USB port.
5. Use the included USB AC adapter to power up BLG840F.
6. Use Nordic nRF Connect software tools to program the nRF9160 module.

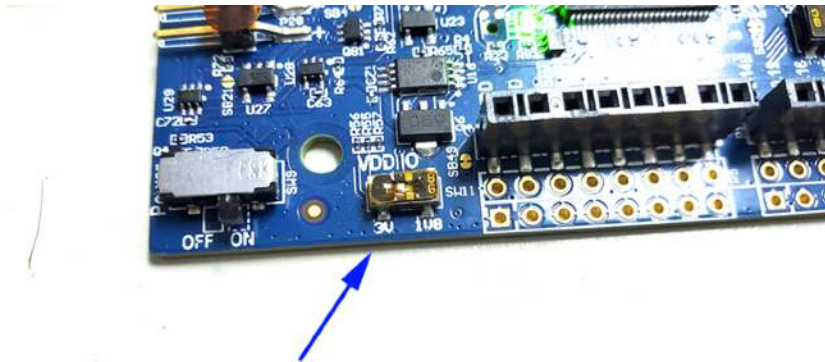


- Open the command line and go to the folder where the HEX file located.
- Execute the programming command
"nrfjprog --program mqtt9160NB_190904.hex --chiperase -f nrf91 --reset"

```
C:\Users\Administrator\Desktop\Nordic Firmware\LTE9160_MQTT190904>nrfjprog --pro
gram mqtt9160NB_190904.hex --chiperase -f nrf91 --reset
Parsing hex file.
Erasing user available code and UICR flash areas.
Applying system reset.
Checking that the area to write is not protected.
Programming device.
Applying system reset.
Run.
```

BLG840F/X BLE/802.15.4 to LTE Gateways

Note: The voltage supported by external debugging/programming is the VDD voltage. This voltage can be selected to 1.8 V or 3 V using slide switch SW11. Make sure the voltage level of the external board matches the VDD of the nRF9160 DK. Please select 3V if programming the BLG840F gateway.



Programming the nRF9160 with nRF Connect for desktop.
Upgrade modem.

nRF Connect v3.4.1 - Programmer

000960015245

nRF9160

Device is connected
Press READ button to read the memory

Drag & drop one or more HEX files here

Log

09:49:16.749	Programming 1 of 1 segments.
09:49:16.974	Programming finished.
09:49:16.977	Programming file 1 of 2 files.
09:49:17.889	Programming 1 of 32 segments.
09:49:18.760	Programming 2 of 32 segments.
09:49:20.420	Programming 3 of 32 segments.
09:49:22.100	Programming 4 of 32 segments.

Cellular Modem

Update modem

BLG840F/X BLE/802.15.4 to LTE Gateways

Upgrade application

The screenshot shows the nRF Connect v3.4.1 Programmer interface. The main window is titled "nRF9160" and displays "Device is connected" and "Press READ button to read the memory". To the right, the "File memory layout" window shows a memory map with a green section at the bottom and an orange section below it. The right sidebar contains "File" and "Device" sections with various actions like "Add HEX file", "Erase all", "Write", and "Read". The bottom "Log" window shows the following entries:

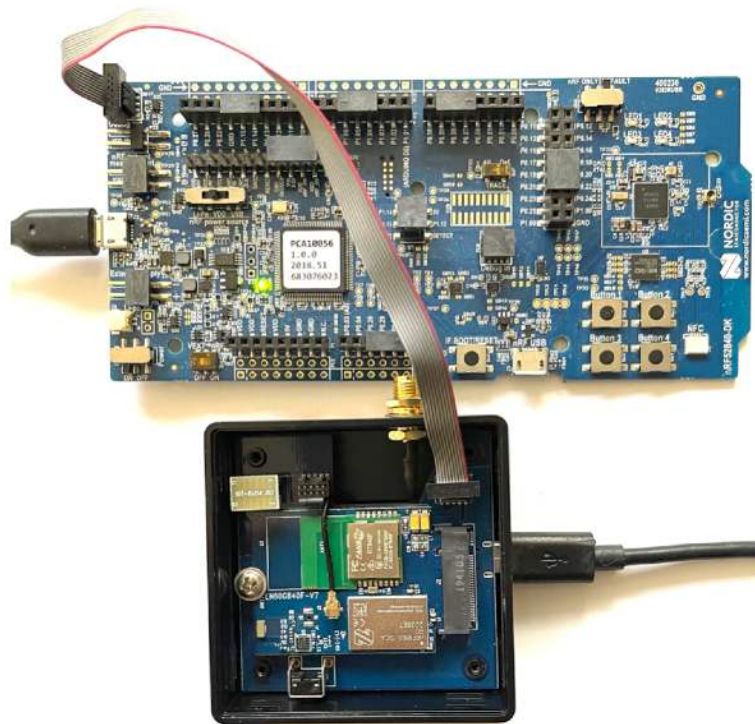
Time	Message
09:53:18.993	Segger version: J-Link OB-R22-Nordicsemi compiled Jan 21 2020 17:33:01
09:53:19.000	Core probed: 960015245.
09:53:19.000	Core RAM: 256KiB.
09:53:19.000	Core ROM: 1024KiB in pages of 4KiB.
09:53:19.316	Model: NRF9160_xxAA_REV1.
09:53:20.090	Core0: Reading device non-volatile memory. This may take a few seconds.
09:53:20.290	Core0: UICR has been read. Click read button to read full non-volatile memory.

BLG840F/X BLE/802.15.4 to LTE Gateways

Programming BT840F

You can use an nRF9160-DK to program the nRF52840 module:

1. Use the 10-pin flat cable to connect nRF9160-DK **Debug out** to the connector marked **BLE** on the BLG840F board.
2. Set the **PROG/DEBUG** slide switch **SW10** to nRF52.
3. Set the **VDD** slide switch **SW9** to 3V.
4. Connect the nRF52840 DK **External supply** connector to a PC or Mac USB port.
5. Use the included USB AC adapter to power up BLG840F.
6. Use Nordic nRF Connect software tools to program the nRF52840 module.



BLG840F/X BLE/802.15.4 to LTE Gateways

Open nRF connect programmer and load the HEX code.
Execute Erase & Write.
The log will show write success.

The screenshot displays the nRF Connect v3.2.0 Programmer interface. The top bar shows the device ID 000960015245. The main area is divided into two panels: 'nRFS2840' and 'File Memory Layout'. The 'nRFS2840' panel shows 'Device is connected' and 'Press READ button to read the memory'. The 'File Memory Layout' panel shows a memory map with a yellow bar and a blue bar. The right sidebar contains 'File' (Add HEX file, Reload files, Clear files), 'Device' (Erase all, Erase & write, Save as file, Reset, Write, Read, Auto read memory), and 'Cellular Modem'. The bottom 'Log' panel shows the following output:

Time	Message
11:32:15.208	segger version: J-Link OB-K22-Nordicsemi compiled Feb 14 2019 14:03:18
11:32:15.240	Probed: 960015245.
11:32:15.240	Model: NRF52840_xxAA_REV2.
11:32:15.240	RAM: 256KIB.
11:32:15.240	Flash: 1024KIB in pages of 4KIB.
11:32:16.921	Reading device non-volatile memory. This may take a few seconds.
11:32:17.118	SoftDevice detected, id 0xB6 (S140 v6.1.1)

BLG840F/X BLE/802.15.4 to LTE Gateways

Nordic Development Environment

Nordic Semiconductor provides a complete range of hardware and software development tools for the nRF52 Series devices. nRF52 DK board is recommended for firmware development. Document and Software development tools can be downloaded by the following links.

Get start with Nordic chip and all online documents.

http://infocenter.nordicsemi.com/index.jsp?topic=/com.nordic.infocenter.nrf52/dita/nrf52/development/nrf52_dev_kit.html&cp=1_1

Nordic SDK with many example projects.

https://developer.nordicsemi.com/nRF5_SDK/

Nordic development zone. You can search or ask a question there.

<https://devzone.nordicsemi.com/tutorials/b/getting-started/posts/development-with-gcc-and-eclipse>

Programming the Nordic chip

Download and install Nrf5x-Command-Line Tools

<https://www.nordicsemi.com/eng/nordic/Products/nRF52840/nRF5x-Command-Line-Tools-Win32/58850>

Download and install nRF Connect

https://www.nordicsemi.com/?sc_itemid={B935528E-8BFA-42D9-8BB5-83E2A5E1FF5C}

Firmware Development

Pre-loaded modem firmware supports both LTE-M and NB-IoT. Pre-loaded non-secure application is AT command. Additional AT command information is available at:

https://infocenter.nordicsemi.com/topic/ref_at_commands/REF/at_commands/intro.html?cp=2_1

To develop nRF91 firmware please download **nRF Connect for Desktop** and install **Getting Started Assistant**.

https://www.nordicsemi.com/?sc_itemid=%7B49D2264D-62FD-4C16-811F-88B477833C5D%7D

A Nordic nRF9160-DK and Fanstel PK-BLG840F are needed to program gateway.

LTE Link Monitor of nRF Connect is not compatible, please download and use Fanstel LTE PC tool for testing.

<https://www.fanstel.com/download-opensource>

Nordic nRF52 Development Environment

Nordic nRF52 development environment and nRF52840DK are used to develop BT840F/X codes. Open source codes are available

<http://www.fanstel.com/download-opensource/>

Firmware to Control Power Amplifier in BLG840X

The following codes are used to set up and control power amplifier SKY66112 in BT840X. Codes can be downloaded from:

<https://www.fanstel.com/download-document>

Additional instructions for controlling SKY66112 are in BT840F product specifications, downloadable from the same webpage.

BLG840F/X BLE/802.15.4 to LTE Gateways

Revision History

- Jan 2021, Ver. 0.90: draft release
- March 2021, Ver 0.91: add available gateway models.

BLG840F/X BLE/802.15.4 to LTE Gateways

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