

K-Solution Consulting Company Ltd.

A grayscale close-up photograph of a computer keyboard. The 'Enter' key is prominent in the foreground, with the word 'Enter' and a return symbol printed on it. The text 'BLE module AT-command firmware user guide' is overlaid in white on the image.

BLE module AT-command firmware user guide

version 1.3

Introduction

BLE (Bluetooth Low Energy) is a one of the major medias for IoT (Internet-of-Things) implementation. Devices with BLE feature can be easily connected to smart phone, tablet or PC. As BLE consume very low power, it is very suitable for portable or mobile device. In order to help customers to embed BLE feature, K-solution Consulting Co. Ltd (K-Solution) provides a complete solution to customers.

K-Solution provides Nordic nRF51822 core BLE modules, which is well design in hardware, and user needs not to spend any engineer resource on the BLE hardware design, and customer needs only to develop firmware for the modules. This has already helped customer's product time-to-market.

Besides the hardware convenience, K-Solution also provides a AT-Command firmware (KAT) for our modules. With KAT, there is no more software engineering resource required for BLE firmware development, and engineer can focus on APP and development.

Feature

- Suitable for Nordic nRF51822 core BLE module
- AT-command mode (AT-CMD MODE) for configuration
- UART to BLE tunneling (TRANSPARENT MODE)
- BLE connection indication
- Auto sleep mode after 3 minutes without connection for saving power
- UART speed up to 115200bps
- Flow control support

Basic structure

The following diagram describes how module with KAT works

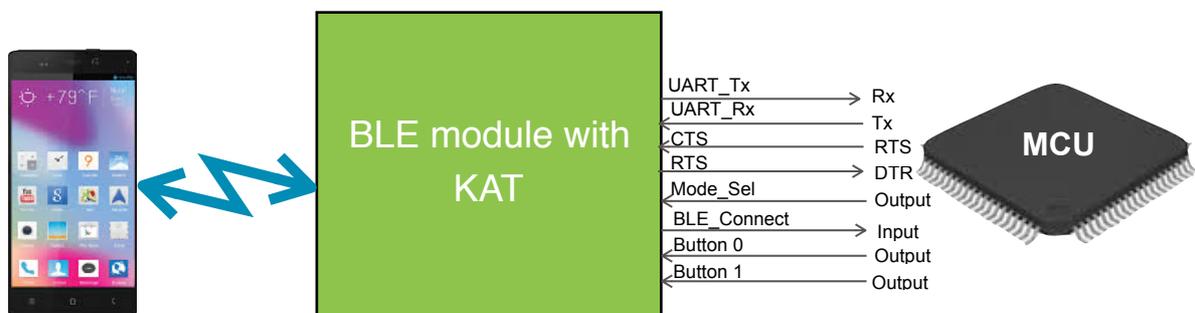


diagram 1: Basic module connection

Pin description

- UART_TX

UART port data transmission pin. Should connect to MCU's UART Rx pin. Data received from BLE will be sent to this pin under TRANSPARENT MODE.

- UART_RX

UART port data receive pin. Connect to MCU's UART Tx pin. Any data sent to this pin will automatically sent to BLE side under TRANSPARENT MODE.

- CTS, RTS

UART flow control pins. Flow control is suggested for higher serial data speed for ensuring the data to be sent/received accurately

- MODE_SEL

Status of this pin determines KAT enter AT-CMD MODE or TRANSPARENT MODE. MODE_SEL pin will be detected 3 seconds after reset: if MODE_SEL is at "low" during this time slot, the firmware goes to TRANSPARENT MODE; otherwise, it will enter AT-CMD mode.

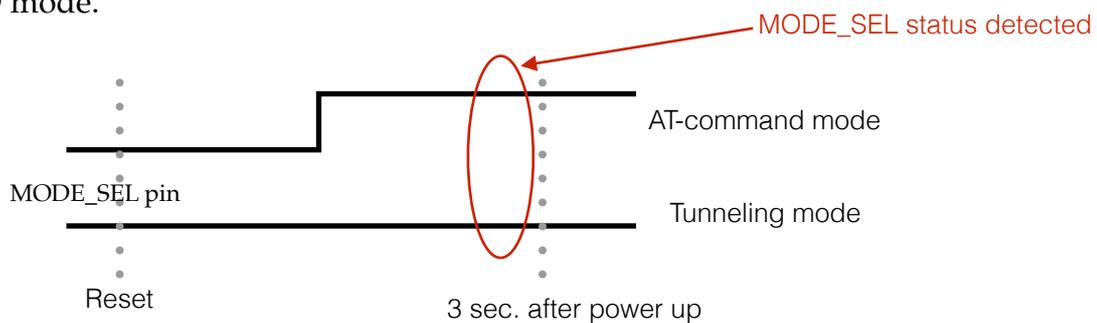


diagram 2: MOD_SEL pin description

- BLE_CONNECT

When a BLE connection is successfully built, the BLE_CONNECT pin will go low; otherwise, the pin will blink at 0.5Hz, 50% duty cycle. This pin can be current sink and can be connected to either LED or MCU. The LED connection is as following:

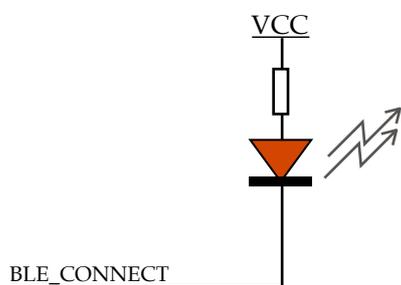


diagram 3: LED connection with BLE_CONNECT pin

LED blinking pattern:

- BLE connection build: solid
- No BLE connection: blinks at 0.5Hz, 50% duty cycle

- Button 0, Button 1

These two active low pins provide external control for BLE connection, they can either be connected to buttons or MCU. The function of these two pins are as following:

<small>status active low</small>	Advertising or scanning	Sleep	Connected
Button 0	Sleep	wake up	Disconnect (needs to hold for 2 sec)
Button 1	Turn off whitelist (needs to hold for 2 sec)	wake up and delete bond information, factory default value	N/A

Table 1: Button 0, Button 1 function table

example: when module is in Sleep mode, Button 0 pin goes down will wake up the module.

- Pin mapping

KAT is developed base on Nordic nRF51822, the table below indicates pins on nRF51822 corresponding to KAT firmware:

Nordic nRF51822 pin	KAT corresponding pin	Direction
P0.00	Button 0	Input
P0.01	Button 1	Input
P0.06	BLE_Connect	Output, current sink
P0.12	MODE_SEL	Input
P0.13	RTS	Output
P0.14	CTS	Input
P0.15	UART_RX	Input
P0.16	UART_TX	Output

Table 2: pin mapping

Operation modes

KAT provides two operation modes: AT-CMD mode and TRANSPARENT mode. In AT-CMD mode, it allows module to be configured by giving AT-command through UART port.

In TRANSPARENT mode, data can be sent and received through UART port transparently. No setting will be needed in this mode, and all data from BLE device will forward to UART_RX port; and data sent to UART_TX pin from MCU will be forward to BLE devices.

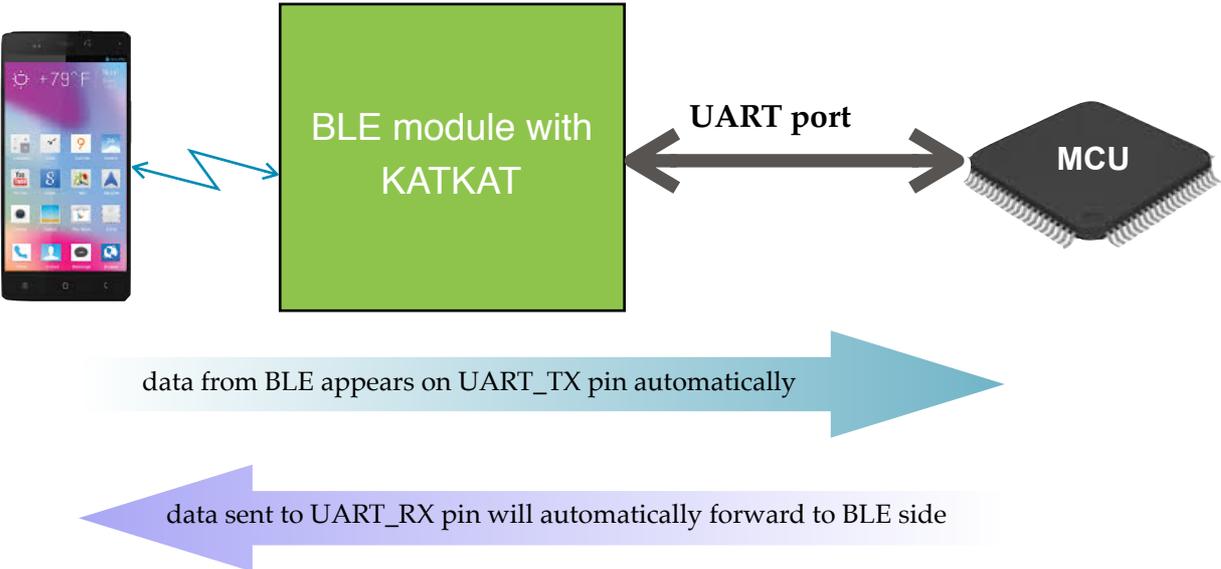


diagram 4: TRANSPARENT mode description

Both modes and the suggested work flow are illustrated as following:

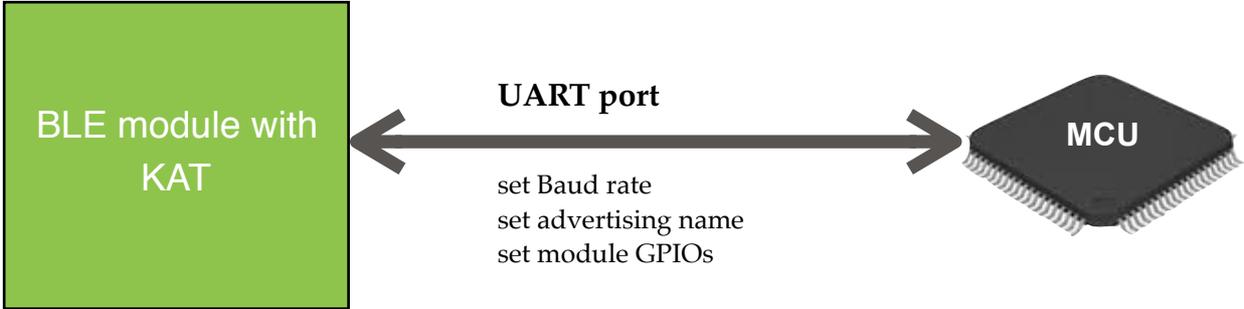


diagram 5: AT-CMD mode description

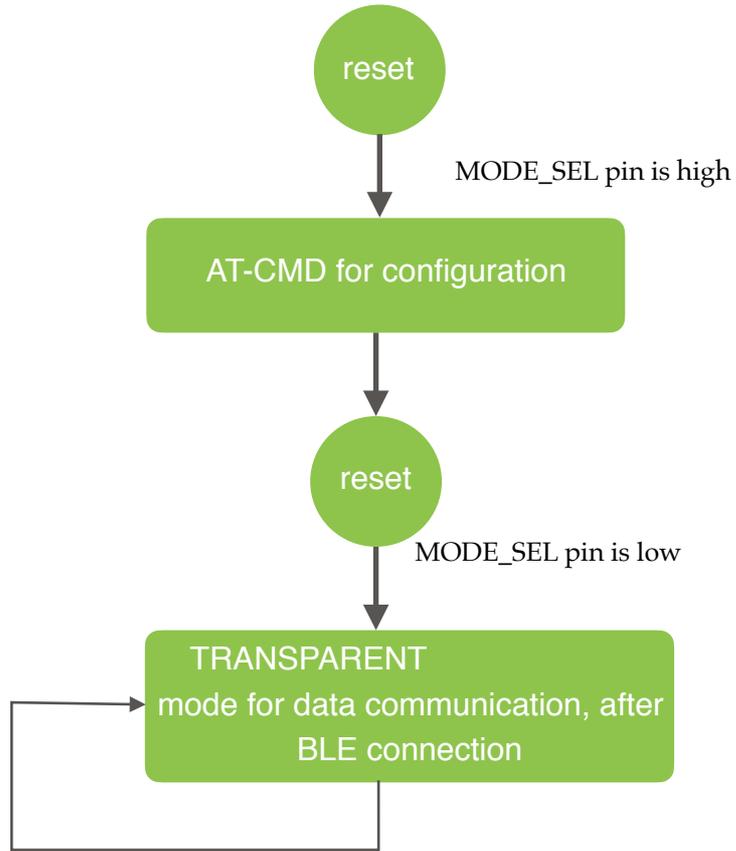


diagram 6: suggested flow for AT-CMD and TRANSPARENT mode

AT-command sets

	Action	enquiry	return value	set	return value
System	MAC addr	AT+ID?	Current address	AT+ID=ADDR	New ADDR if success,
	Help	AT+HELP	All AT commands		
	Reset	AT+RESET			
	Factory Default	AT+DEFAULT	- BAUD = 9600, TXP = 0, NAME = KSOL, Flow control disabled		
	Sleep mode	AT+SLEEP			
BLE	Change name	AT+NAME?	- current name Default:KSOL	AT+NAME= New name	
	Change PIN code	AT+PIN? (not available in 128K version)	Current PIN code	AT+PIN=New PIN AT+PIN=NULL	- new PIN //PIN MUST be 6 digit - disable PIN code
	TX power	AT+TXP ?	Current TX Power value	AT+TXP= new value value ; -40, -30, -20, -16, -12, -8, -4, 0 and 4	- new value
	Start advertising	AT+BDCS			
	Stop advertising	AT+BDCE			
UART	BAUD rate	AT+SPEED?	Current baud	AT+SPEED=BAUD, BAUD = 2400, 4800, 9600, 14400, 19200, 28800, 38400, 57600, 115200	- New BAUD if success note: data byte, parity and stop bit are fixed at 8,N,1
	CTS, RTS control pin	AT+CTRL?	- 0 : disable - 1 : enable	AT+CTRL= 0/1	- 0: disable CTS, RTS (default) - 1: enable CTS, RTS
	Send Data			AT+SEND=DATA	- no return value if success DATA length must be less than or equal to 20 bytes
	Receive Data	AT+GET?	- DATA in received buffer - NULL if received buffer is empty		
GPIO	Set Port 0 GPIO as input			AT+DPIxx=y Set P0.xx as input pin xx: 00 to 31 y: 0 - no pull up; 1- pull up enabled	- GPIO P0.xx SET INPUT w/NOPULL (or PULLUP) example: AT+DPI02=0: set Port 0.02 as input port, no internal pull up AT+DPI15 = 1: set P0.15 as input port, enable internal pull up
	Set Port 0 GPIO as output			AT+DPOxx=y Set P0.xx as output and the status is y xx: 00 to 31 y: 0 or 1	- GPIO P0.xx SET OUTPUT y example: AT+DPO02=0: set Port 0.02 as output port and the value is 0 AT+DPO15=1: set Port 0.15 as output port and the value is 1
	Get GPIO status (for input only)	AT+RPxx? xx: 00 to 31	- GPIO P0.xx IS 1 (or 0) example: AT+RP03: enquire the status of P0.03, return the value of that pin		

Below is the AT-command list and description when KAT is in AT-CMD mode.

Table 3: AT command set table

AT command description

UART : AT CMD Mode // enter AT-command mode after start up
OK

System related command:

ID

This command enquires and set the ID value of the module, user can set his own ID for their end product. The default value is a random value

Syntax:

AT+ID?↵ enquire the current ID

AT+ID=ADDR↵ set a new ID

example:

AT+ID?
ADDR=fcae983d37f1 //feedback the current ID

AT+ID-1234983d37f2
ADDR SET=1234983d37f2 //confirm new ID
OK // module feedback "OK"
//confirm the command is accepted.

Help

This command returns all the command on the UART port

Syntax:

AT+HELP↵

example

AT+HELP
CMD LIST
AT+ID?/=
AT+HELP
AT+RESET
AT+DEFAULT
AT+SLEEP
AT+NAME?/=
AT+PIN?/=
AT+TXP?/= (-40, -30, -20, -16, -12, -8, -4, 0, or 4 dBm)
AT+BDCS
AT+BDCE
AT+SPEED?/=

```
AT+CTRL?/=
AT+SEND=DATA
AT+GET?
AT+DPIxx AT+DPOxx=y AT+Pxx?
OK
```

RESET

This command will reset the module, it is needed for making new value effective

Syntax:

```
AT+RESET↵
```

DEFAULT

It recovers all the setting to default configuration, including:

```
BAUD: 115200
Flow control disable
Name: KSOL
Tx Power: 0 dBm
AT+SLEEP
```

Syntax:

```
AT+DEFAULT↵
```

BLE related command:

NAME

Enquire and change BLE advertising name.

Syntax:

```
AT+NAME=?↵          enquire current name
AT+NAME=new-name↵   set a new name
```

example

```
AT+NAME?
NAME=KSOLDEMO      // show current name
OK
```

```
AT+NAME=DEMO2
NAME SET=DEMO2     // a new name set
OK
```

Note: Some APP may not update the name after the module is changed, it is because APP may use the old name base on the ID.

PIN

Enquire and change pairing password PIN code. PIN code MUST be 6 digits. This command only available on 256K version.

Syntax:

AT+PIN?↵ enquire current PIN code

AT+PIN=new-pin↵ set a new PIN code

example:

```
AT+PIN?  
PIN=123456 // shows current PIN code  
OK
```

```
AT+PIN=NULL  
PIN CODE DISABLED //PIN code disable  
OK
```

```
AT+PIN=654321  
PIN SET=654321 // new PIN is set  
OK
```

TXP

Enquire and change RF TX power

Syntax:

AT+TXP?↵ enquiry current Tx Power

AT+TXP=new-power↵ set new Tx Power

new-power must:

-40 (dBm), -30, -20, -16, -12, -8, -4, 0 or 4. any

other value will return ERR

example:

```
AT+TXP?  
TXP=0 // current TX power is 0dBm
```

```
AT+TXP=4  
TXP SET=4 // set the Tx power to 4dBm  
OK
```

BDCS

Start advertising

note: in 128k version, BDCS command is needed for enabling advertising in AT-CMD mode; but in 256K version, it is automatically enabled in AT-CMD mode. In Transparent mode, advertising mode is enabled by default in both version.

Syntax:

AT+BDCE↵

BDCE

Stop advertising

Syntax:

AT+BDCE↵

UART related command:

SPEED

Enquiry and set the UART speed

Syntax:

AT+SPEED?↵

enquiry current UART speed

AT+SPEED=new-speed↵

set a new UART speed

new-speed must be 2400, 4800, 9600, 14400,
19200, 28800, 19200, 28800, 38400, 57600, 115200

example:

AT+SPEED?

SPEED=115200bps

//current BAUD is 115200

AT+SPEED=9600

SPEED SET=9600

//new BAUD is 9600

OK

CTRL

Enquire and set UART flow control(RTS/CTS). It is suggested to be enable when the BAUD is over 9600, however, it also depends on the data package length, therefore, customer need to determine to enable this feature depends on their own situation.

Syntax:

AT+CTRL=?↵

enquiry the current flow control status

AT+CTRL=1(or 0)↵

enable or disable flow control

example:

AT+CTRL?

CTRL=DISABLED

//No flow control in current setting

AT+CTRL=1

CTRL SET=ENABLED

//Enable flow control

OK

```
AT+CTRL=0
CTRL SET=DISABLED //Disable flow control
OK
```

SEND

Send data from UART to send buffer, data in buffer will be sent to BLE side if it is connected

Syntax:

```
AT+SEND=DATA↵ send the DATA to send buffer, DATA length
must be not over 20 bytes
```

example:

```
AT+SEND=123456
OK // Data reflects on the smart phone
```

GET

Retrieve data from buffer which are sent from BLE side.

Syntax:

```
AT+GET?↵ data in buffer will be returned.
```

example:

```
AT+GET?
GET=End // "End" is data in Rx buffer
NULL // when buffer empty, it return NULL
```

GPIO related command:

DPIxx

Set Port P0.xx as input pin, and enable/disable internal pull up

Syntax:

```
AT+DPIxx=y↵ set Port P0.xx as input pin; y determines the
internal pull up, 0: disable; 1: enable
```

example:

```
AT+DPO24=1
GPIO P0.24 SET OUTPUT 1 // GPIO0.24 is set as output and status is high
OK
```

```
AT+DPO24=0
GPIO P0.24 SET OUTPUT 0 // GPIO0.24 is set as output and status is low
OK
```

DPOxx

Set Port P0.xx as output pin, and set the output status as well

Syntax:

```
AT+DPOxx=y↵ set Port P0.xx as output pin; y is the output
                status (1 or 0)
```

example:

```
AT+DPI24=0
GPIO P0.24 SET INPUT w/NOPULL //GPIO0.24 is set as input, and no internal pull up
OK
```

```
AT+DPI24=1
GPIO P0.24 SET INPUT w/PULLUP //GPIO0.24 is set as input, with pull up
OK
```

RPxx

Get the status of P0.xx, only valid if that port is set as input

Syntax:

```
AT+RPxx=?↵ get P0.xx status, return value will be 1 or 0
```

example:

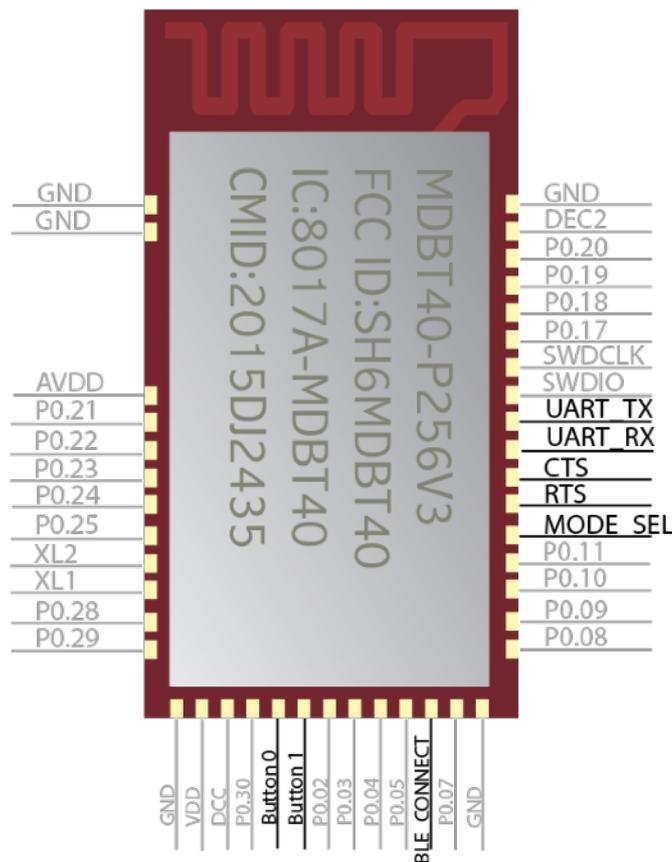
```
AT+RP24?
GPIO P0.24 IS 1 //GPIO 0.24 is at HIGH
OK
GPIO P0.24 IS 0 //GPIO0.24 is at LOW
OK
```

Module pin assignment (with KAT)



Note: KAT for GWBMD01 (128K Flash version) has removed the AT+PIN command due to memory constraint.

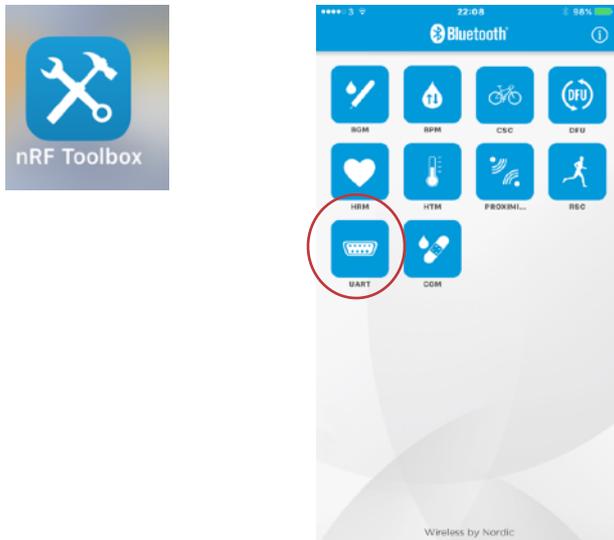
Gigawit GWBMD0x BLE module



Raytac MDBT40 BLE module

APP development

Since Serial Port Protocol (SPP) has not yet standardised, each chip manufacturer's SPP is different from others and not compatible, therefore KAT only works with APP that base on Nordic serial solution. User can simply download Nordic's nRF Tool for the testing the KAT. User can select UART to connect and communicate with module with KAT.



User can also download the APP's reference source code from Nordic web site for their APP development, they are located at the following URL:

iOS: <https://www.nordicsemi.com/eng/Products/Nordic-mobile-Apps>

Android : <https://www.nordicsemi.com/eng/Products/Nordic-mobile-Apps>

K-Solution may provide some APP development service for customer with NRE, however, customers needs to define the layout design, APP architecture and provide all the material needed (i.e. Icon design, graphic, logo...etc.)

Reference

1. Bluetooth SIG (<https://www.bluetooth.com>)
2. Nordic web site (<https://www.nordicsemi.com/eng/Products/Bluetooth-low-energy>)
3. Nordic developer zone (<https://devzone.nordicsemi.com/questions/>)
4. Nordic nRF5 SDK (http://infocenter.nordicsemi.com/topic/com.nordic.infocenter.sdk/PLUGINS_ROOT/com.nordic.infocenter.sdk5.v12.2.0/index.html)

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Revision:

1. Correction on MODE_SEL pin definition
2. update the BLE_CONNECTION indication pattern
3. update on AT-Command listing with example
4. Adding APP development section
5. Adding Reference section
6. Adding note for 128k version