



Atlas Chen

# nRF51822

Accelerating Your Success™

# Agenda

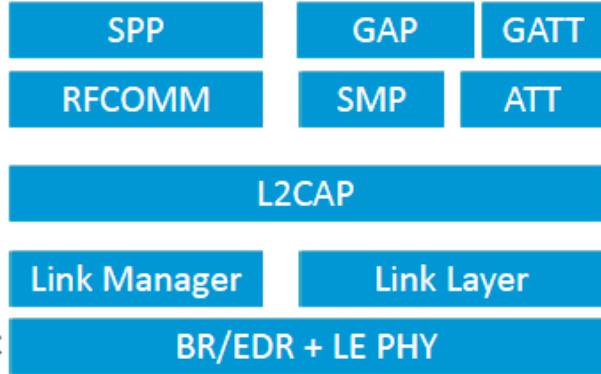
- **Hardware & Antenna Design**
- **Software Architecture**
- **Development Tools**
- **nRFgo Studio, Master Control Panel (MCP), Sniffer**
- **DTM (Direct Test Mode)**
- **PTS (Profile Test Suite)**
- **DFU (Device Firmware Update)**
- **Nordic APP**
- **SW Training**
- **Wesbite**
- **Others**



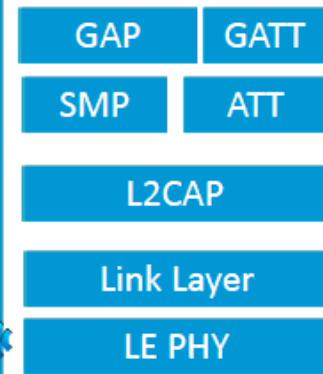
BR/EDR/HS 1.1, 2.0, 3.0



BR/EDR 4.0 Dual Mode (+LE)



LE 4.0 Single Mode



Bluetooth



# Hardware & Antenna Design

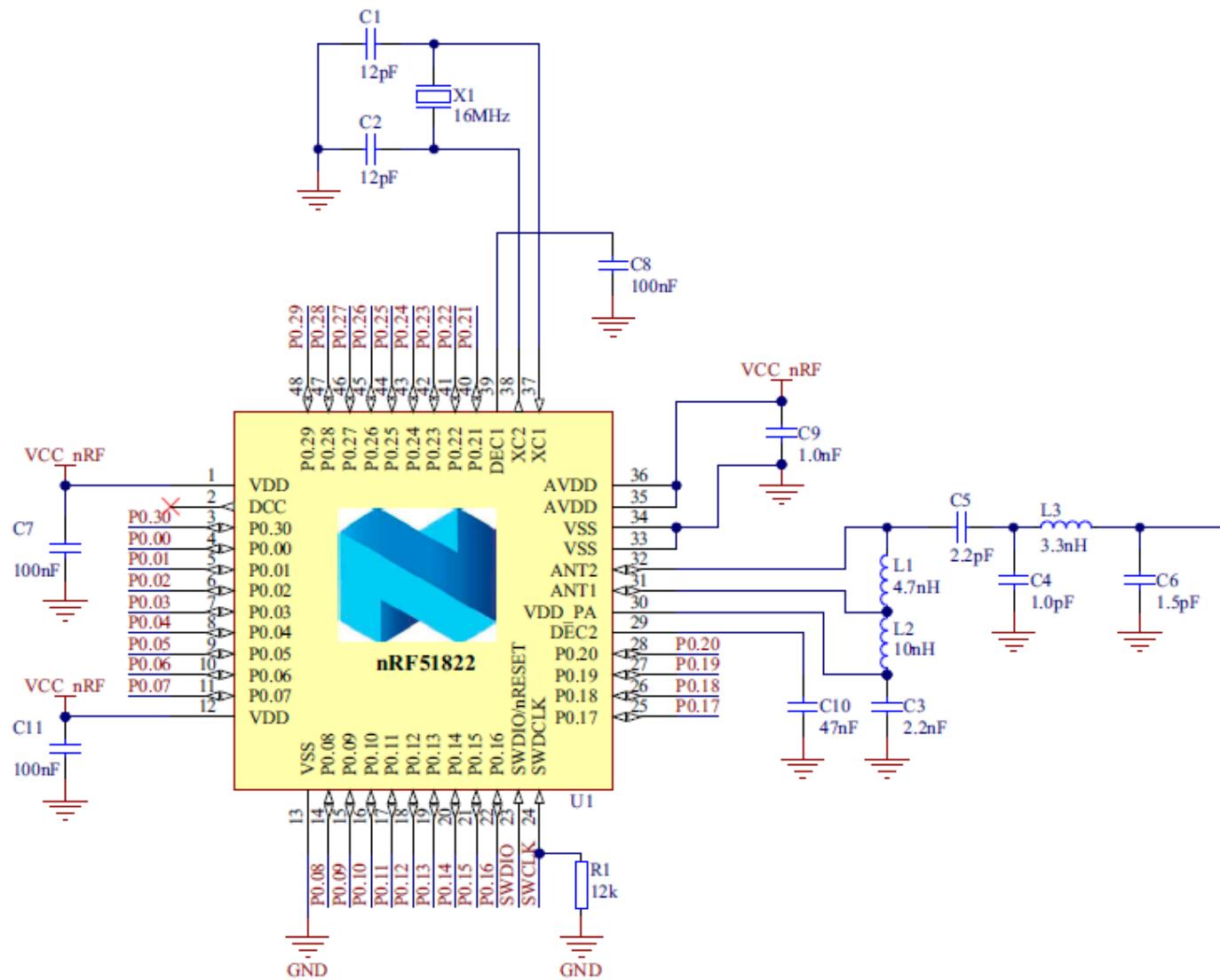
nRF51822 v3	
Microcontroller	ARM M0 – 32 bits
Protocol	S110 : BLE Slave only (MP version) S120 : BLE Master only (1 to 8 , MP version) S130 : BLE Master + Slave (1 to 3, Alpha version) Gzall : 2.4G protocol
Program memory	128K/256KB Flash
RAM	16KB/32KB RAM
Oscillators	16 MHz XO and RC (external 16MHz is necessary) 32kHz XO and RC (external 32KHz is optional)
Supply voltage	LDO : 1.8 - 3.6V DC/DC : 2.1 - 3.6V Low Voltage: 1.75 - 1.95V
Current	System Off(0.6uA), System On(based : 2.6uA)
TX output power	+4dBm, 0dBm, -4dBm, -8dBm, -12dBm, -16dBm, -20dBm
TX Peak current (LDO)	16mA, 10.5mA, 8mA, 7mA, 6.5mA, 6mA, 5.5mA
TX Peak current (DCDC)	11.8mA, 8mA, 6.3mA, 5.6mA, 5.3mA, 5mA, 4.7mA
Air data rate(s)	2 Mbps, 1 Mbps, 250kbps
Sensitivity	-85dBm(12.6mA), -90dBm(13mA), -96dBm(13.4mA) <b>(-93dBm @ BLE - 1Mbps, 13mA)</b>

nRF51822 v3	
GPIOs	31 Pins
SPI	2 Master and 1 Slave
I2C	2 Master
UART	Up to 1Mbps (Support CTS/RTS)
ADC	8, 9, 10 bits resolution, 8 In/CH
Timer	Timer 0 : 8/16/24/32 bits Timer 1 : 8/16 bits Timer 2 : 8/16 bits
RTC	2 * 24 bits
Random, Watch Dog QDEC, LPCOMP	V
Temperature Sensor	0.25c resolution
PPI	Task and Event
Link security	HW AES (128 bits)/ACC/
DFU	HCI, OTA

# nRF51822 Group

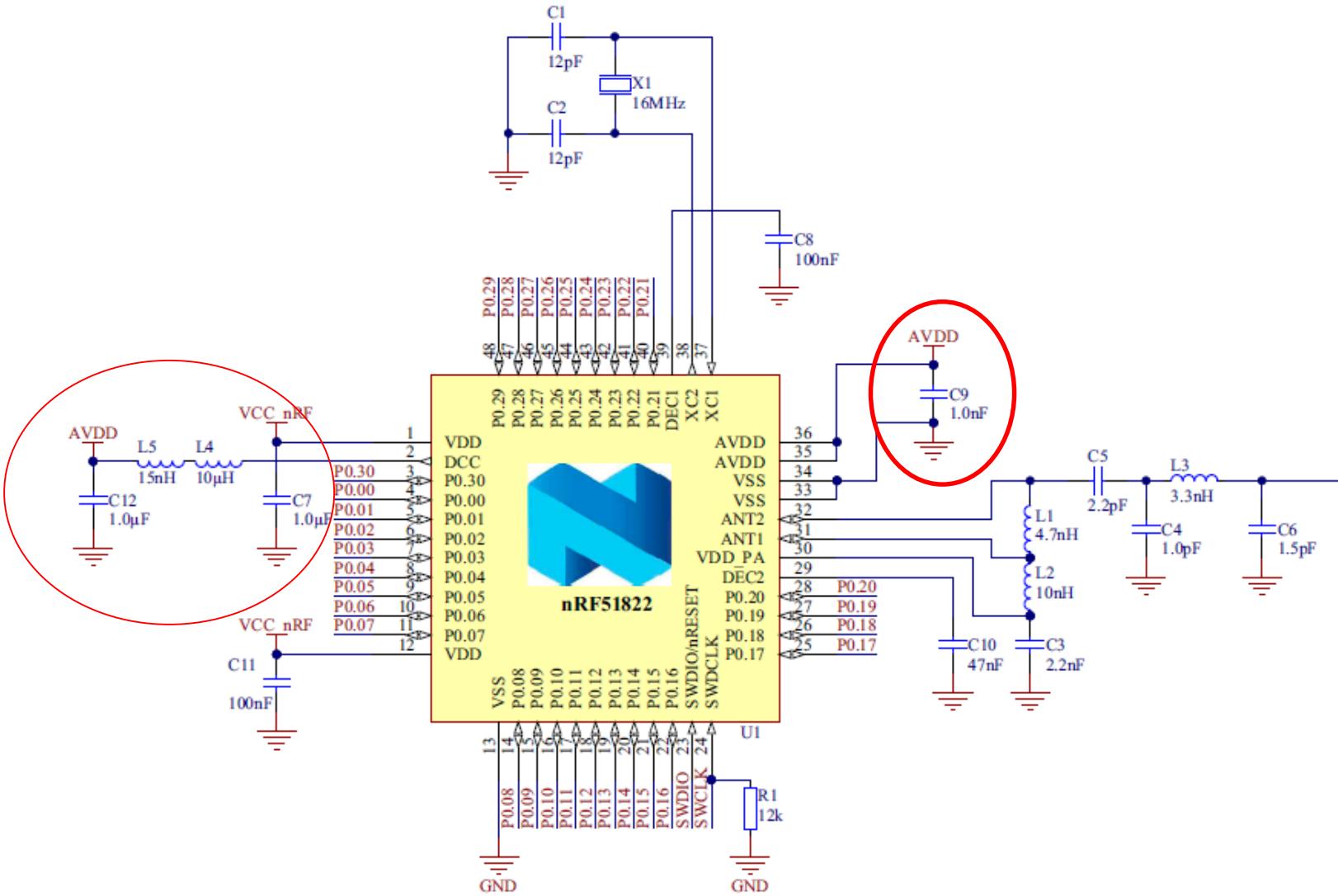
Package size (mm) (Flash * RAM)	AA (256K*16K)	AB (128K*16K)	AC (256K*32K)
QF (6*6)	●	●	●
CE (3.5*3.83)	●		
CD (3.5*3.33)		●	
CF (3.83*3.83)			●

# nRF51822 LDO 1.8 - 3.6V



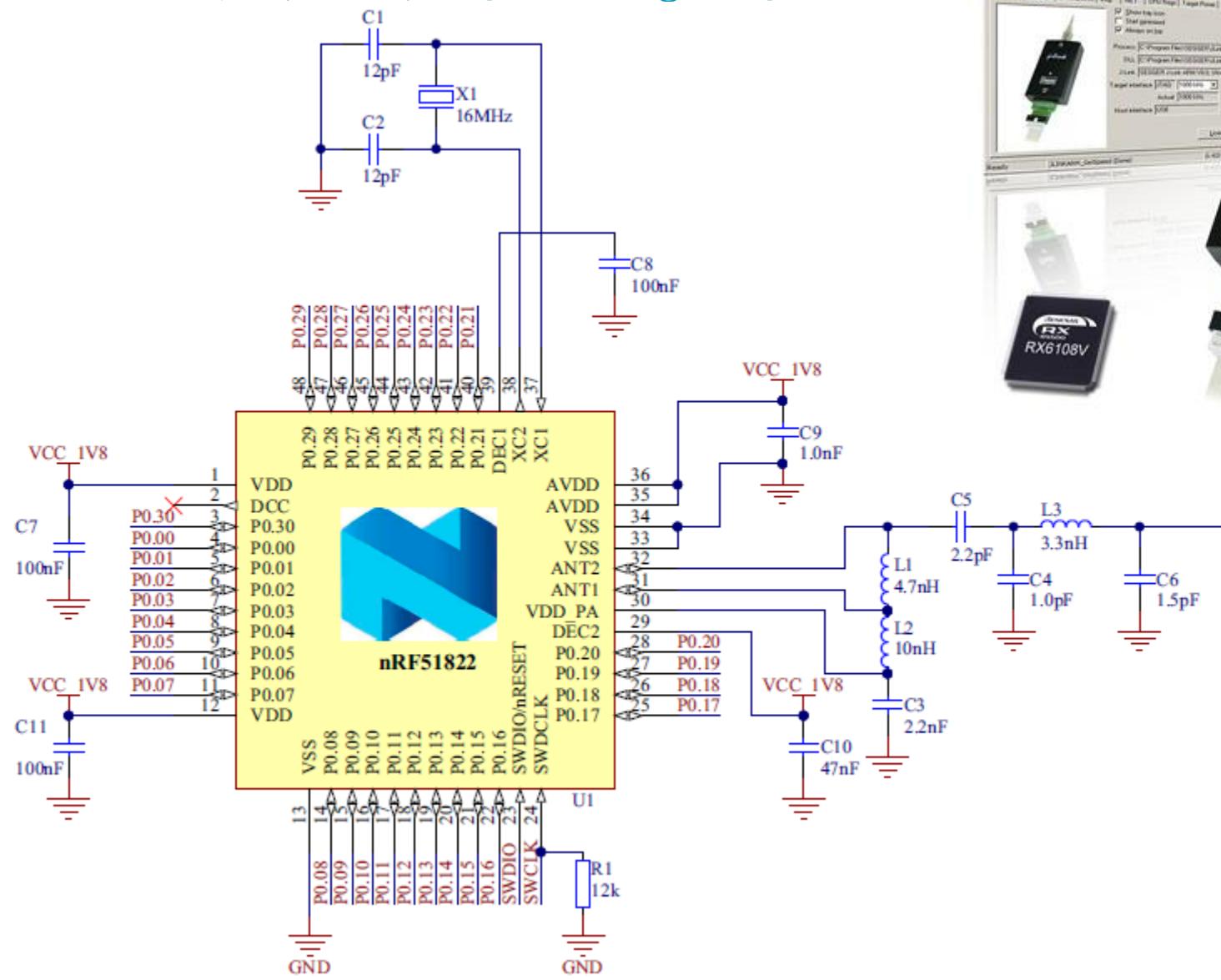
**nRF51822 DC/DC 2.1 - 3.6V (nRF51 v3 版本可用, v1, v2不建議使用)**

- 使用DCDC mode, 可以比LDO mode省下Peak current ~2mA



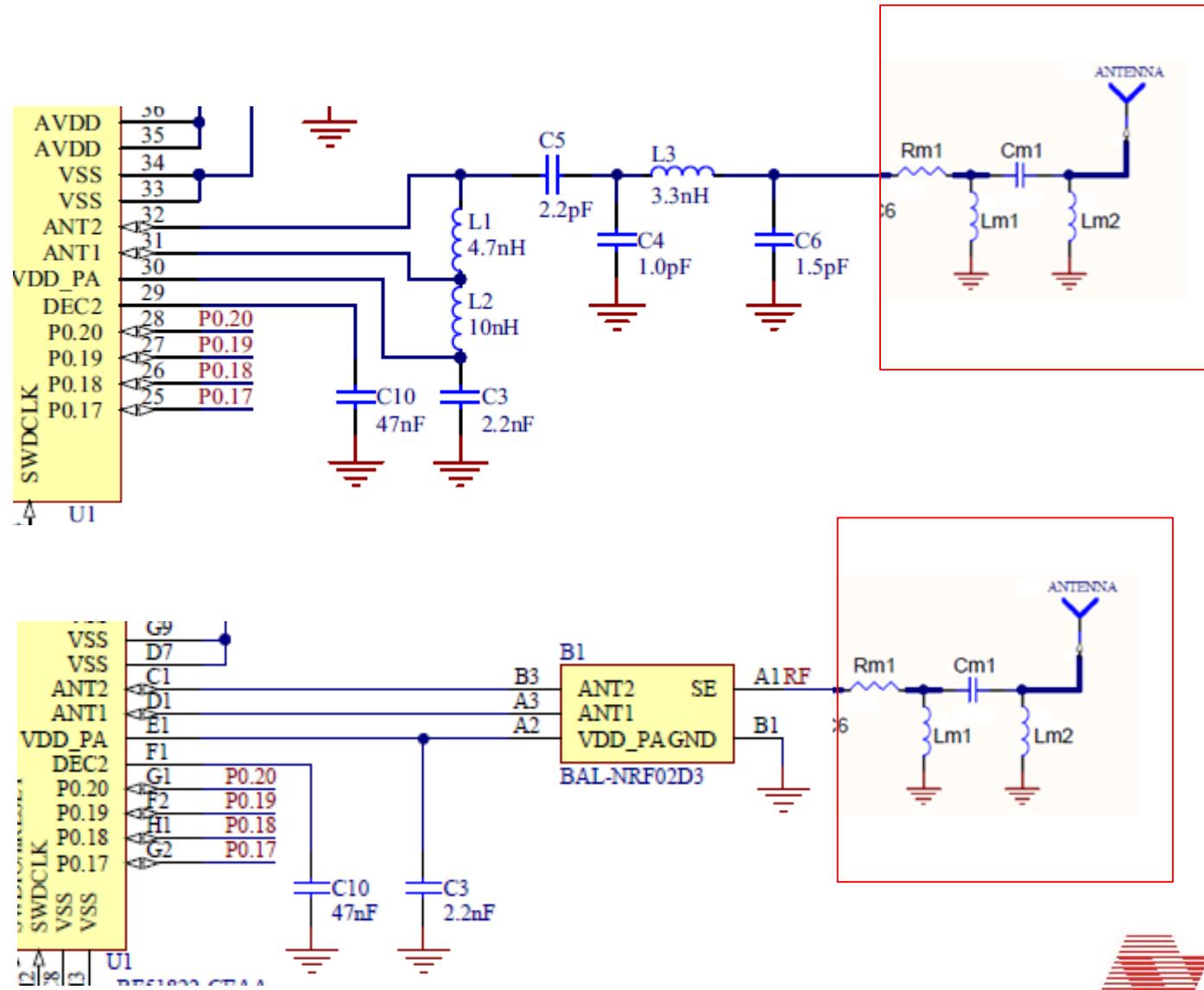
## nRF51822 Low Voltage 1.75 - 1.95V

- 使用低電壓模式，請使用萬用燒錄器Debug & 燒錄F/W



# Antenna Design

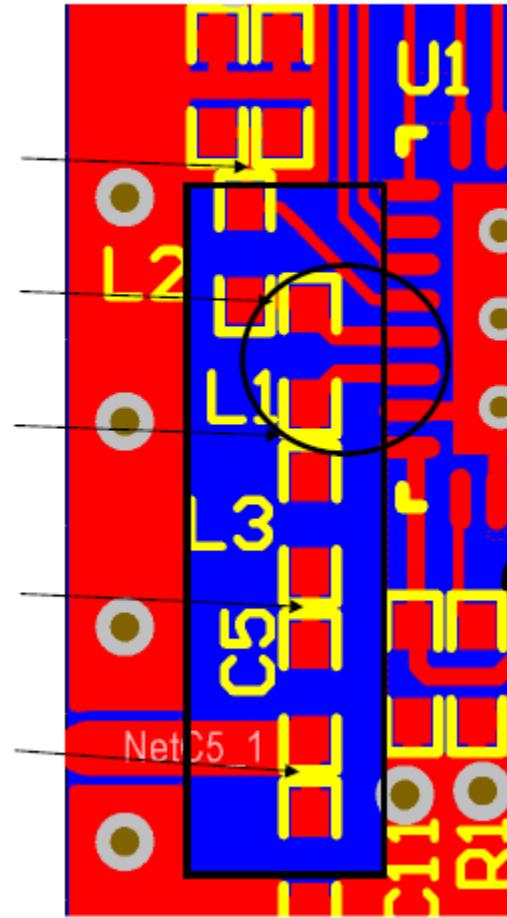
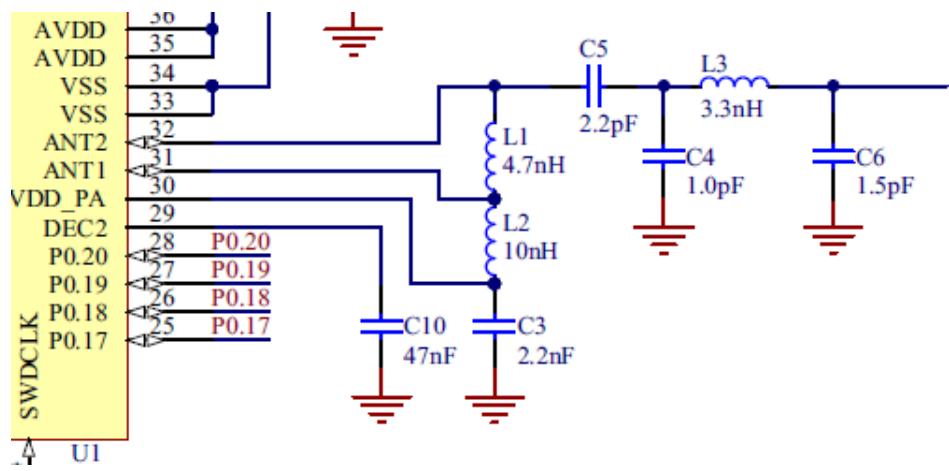
- 建議在天線部分加入Pi型電路, 方便調整50 ohm匹配, 達到最大輸出功率



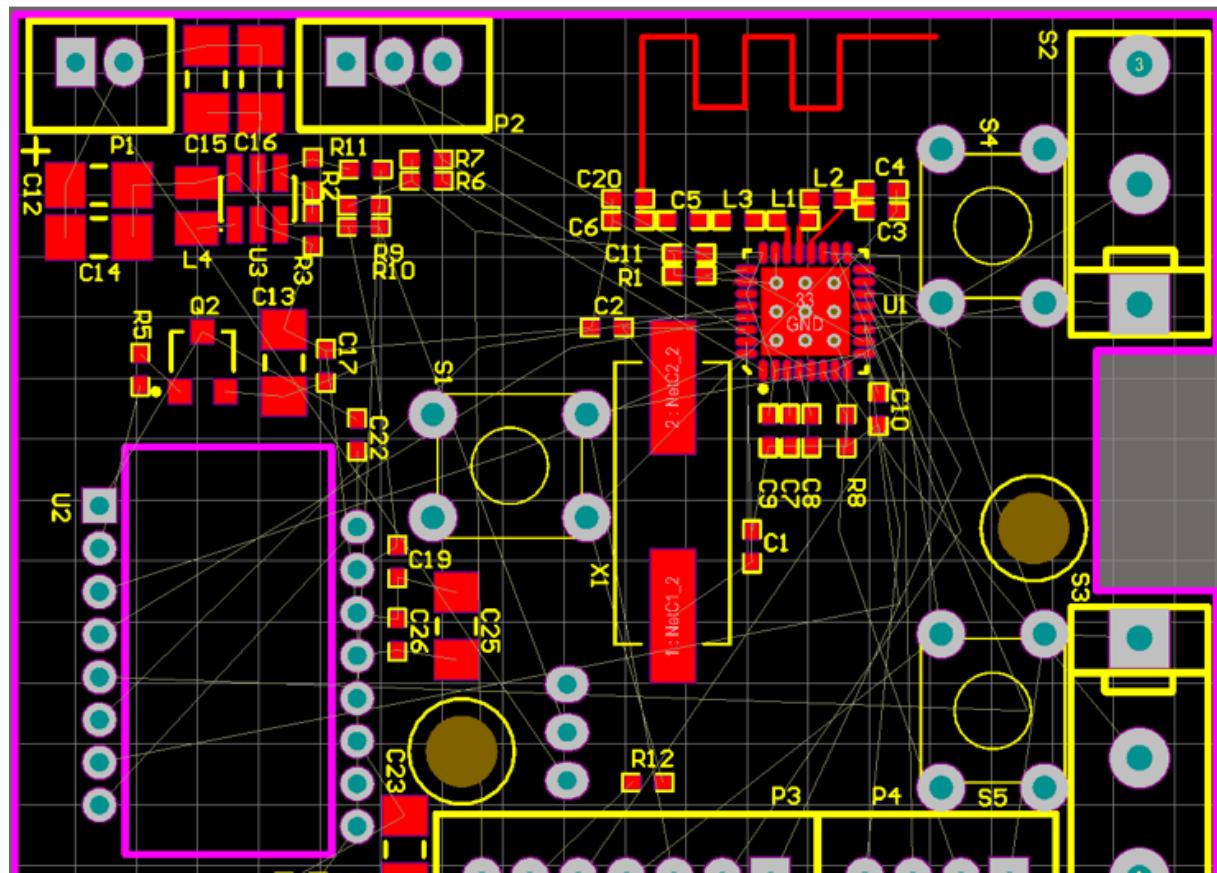
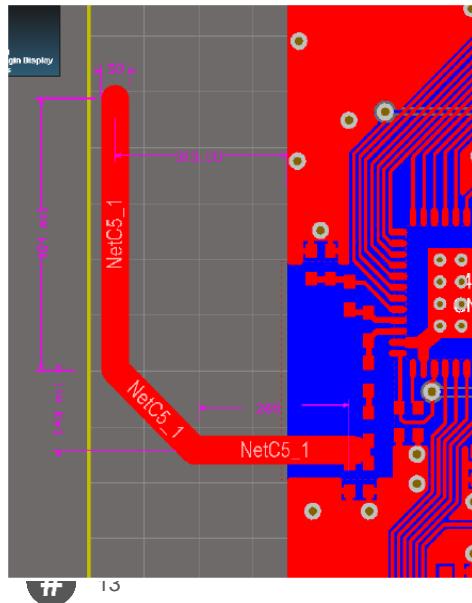
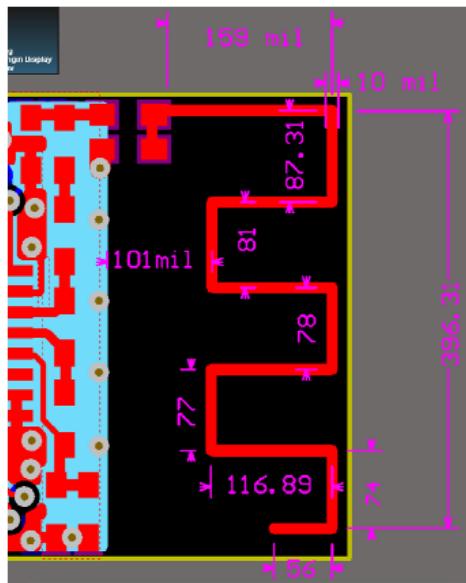
# Antenna Design

## Matching network – component placement

- Place components as close together as possible
- 1mm track = 1nH inductance
- Longer tracks increases the capacitance to ground
- L1 **must** be placed as close to the ANT pins as possible **and** with equal track length to both ANT pins (symmetrical)
- Pull back the ground plane around the components to minimize parasitic capacitance
- Do not place tracks or components under the matching network
- The layout is important because parasitic capacitance and inductance is (must be) part of the design.

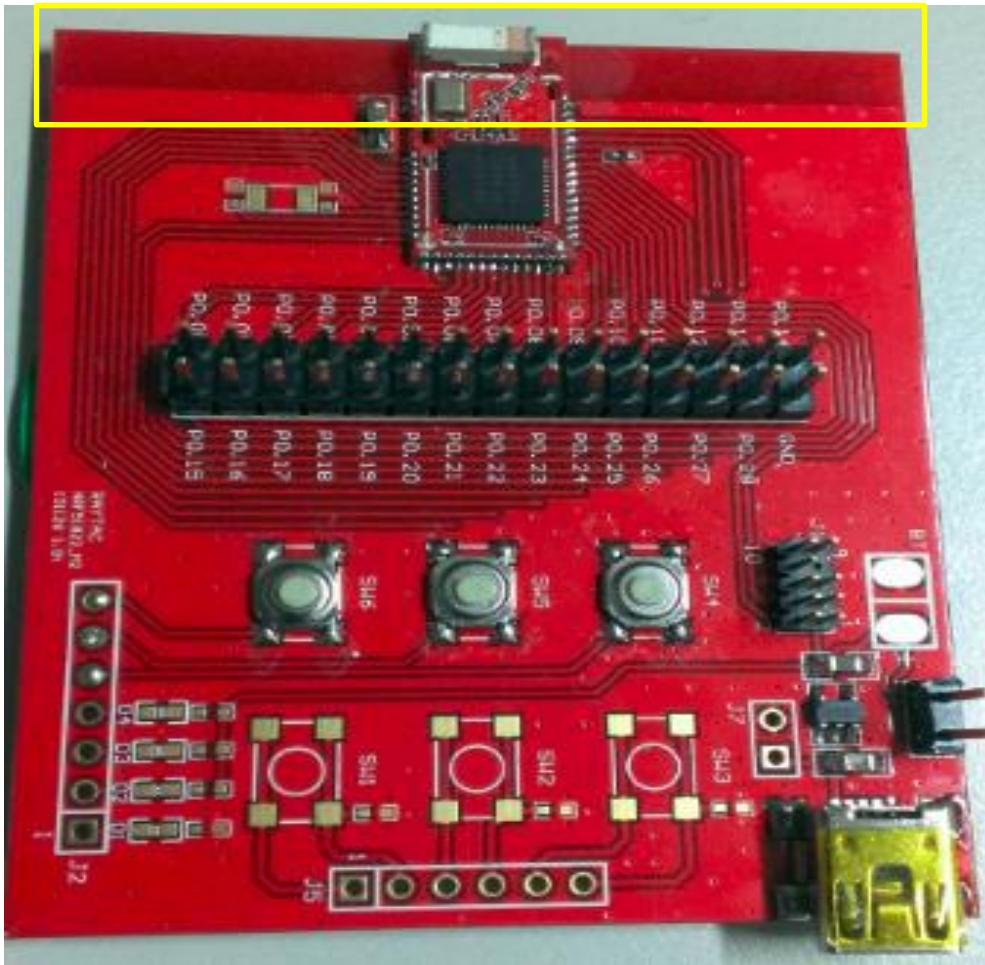


# Antenna Design



# 使用 Module 的方式

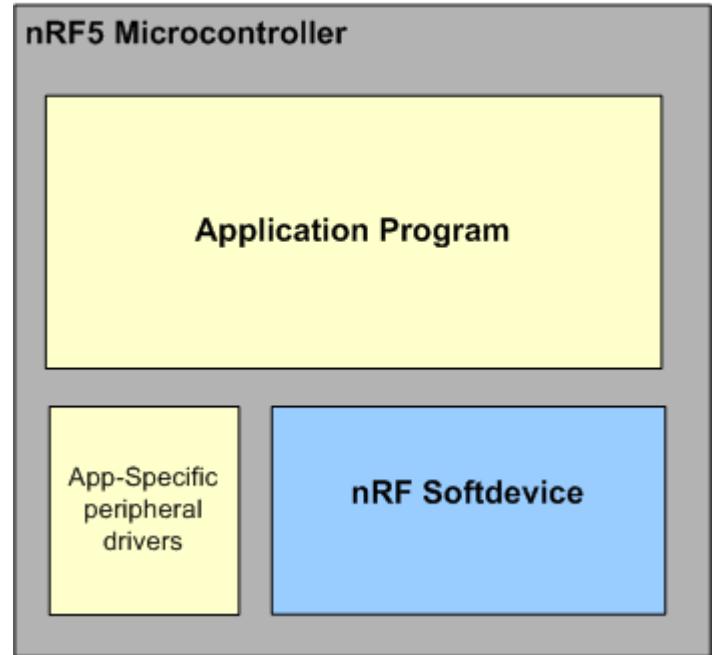
1. Module 靠板邊放置，並且避開金屬或是任何干擾天線的介質
2. Module 的正下方請勿有任何的走線，可鋪地
3. Module 天線的下方都要淨空



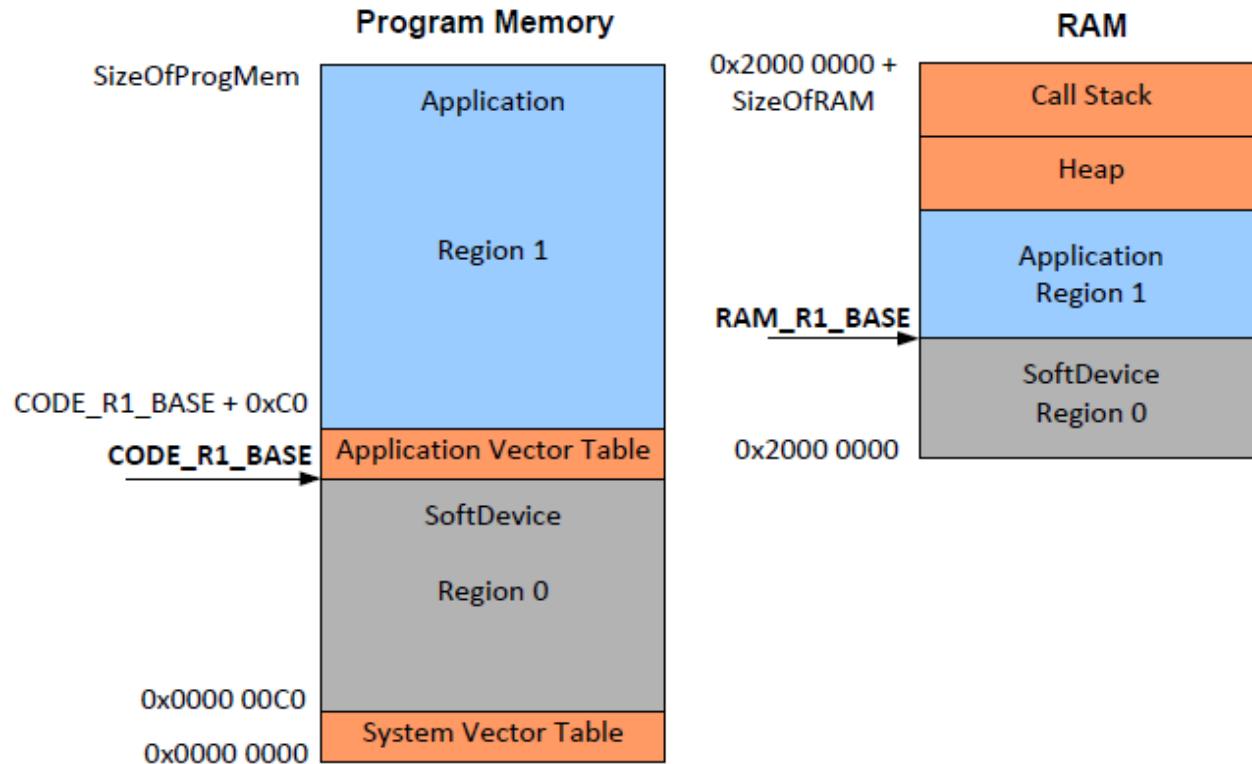
# Software Architecture

## System on Chip (SoC) Device

- A complete System-on-Chip (SoC) device consists of three top level components
  - Application program (user defined)
  - Application specific peripheral drivers (user defined)
  - nRF Softdevice (pre-compiled binary)



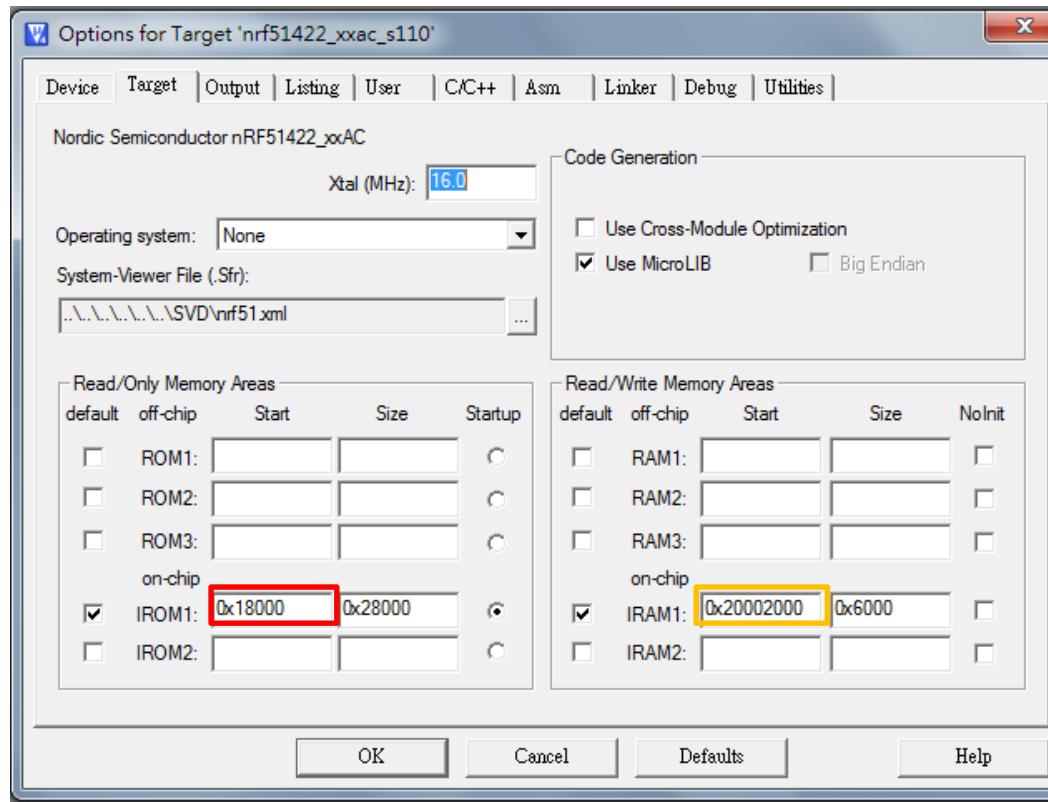
# nRF51822 Memory map



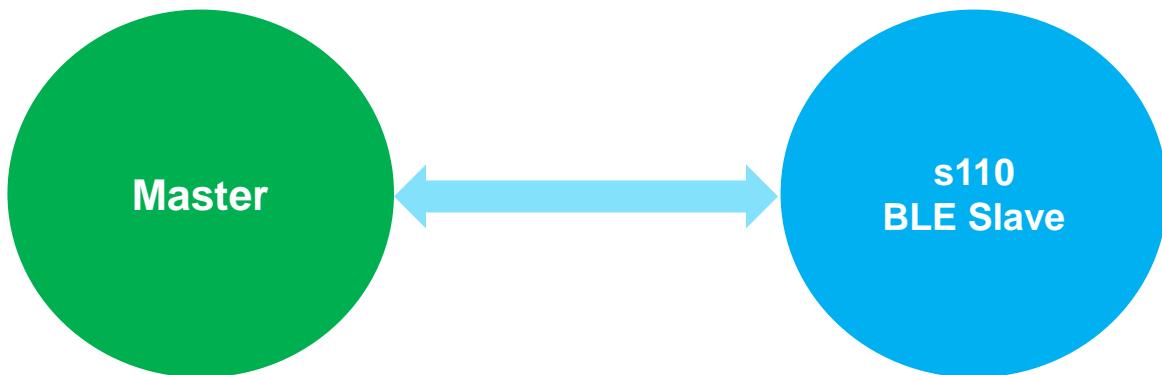
SoftDevice	Version	Code Size	RAM Size	Code R1 Base	RAM R1 Base	SD Document
S110(Slave)	v8.0.0	92K	8K	0x0001 8000	0x2000 2000	v2.0
S120(Master)	v2.0.0	116K	10K	0x0001 D000	0x2000 2800	v2.1
S130 (Slave+Master)	V1.0.0	112K	10K	0x0001 C000	0x2000 2800	V0.5

## 注意IROM1 and IRAM1的內容是否與SD datasheet相同

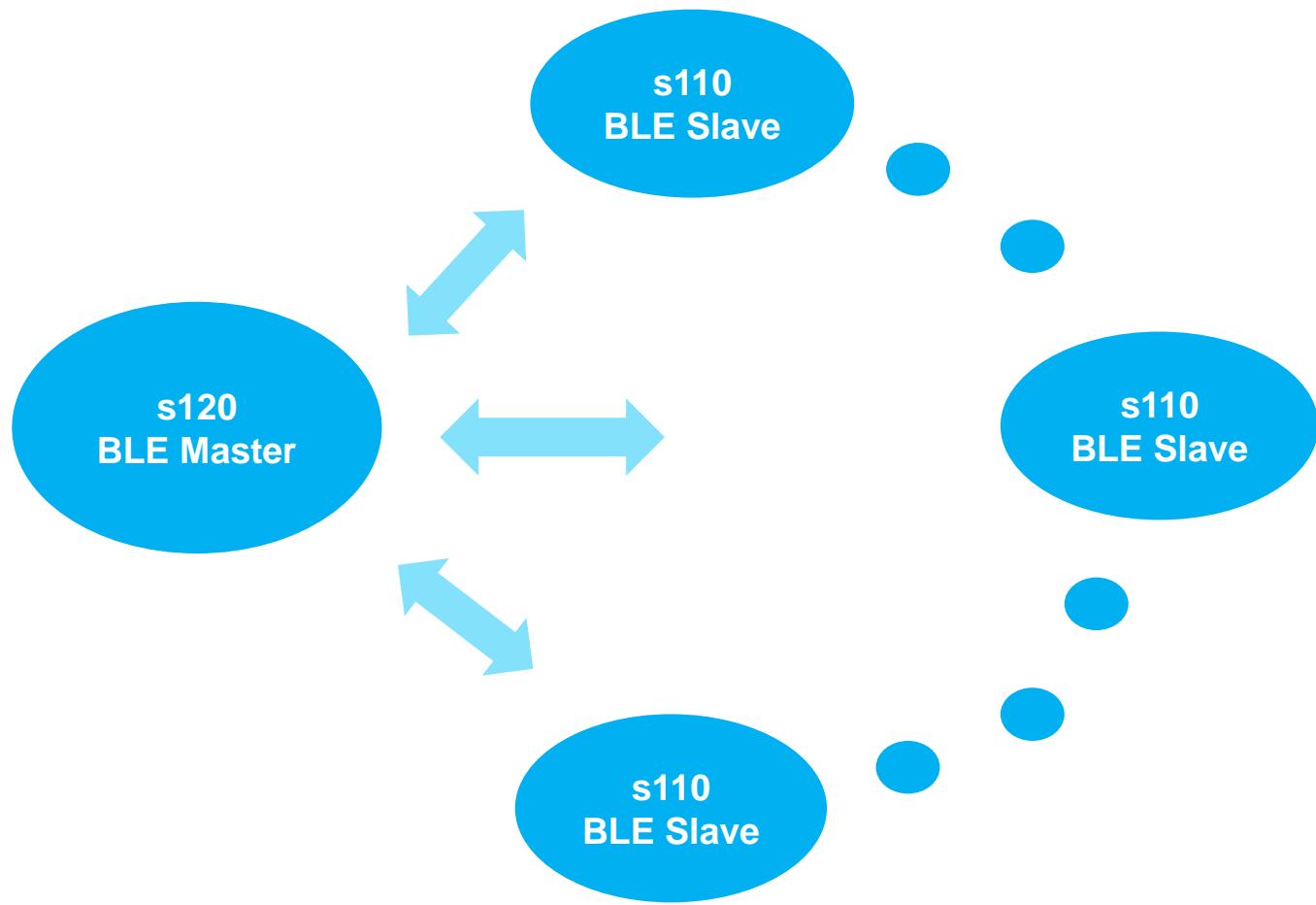
Flash	S110 Enabled	S110 Disabled
SoftDevice		92 kB
MBR	4 kB	4 kB
APP_CODE_BASE	0x00018000	0x00018000
RAM	S110 Enabled	S110 Disabled
SoftDevice	0x1900 - 4 + ATTR_TAB_SIZE <sup>2</sup> Default: 8188 (0x1900 - 4 + 0x700) Minimum: 6612 (0x1900 - 4 + 216)	4 bytes
MBR	4 bytes	4 bytes
APP_RAM_BASE	0x20001900 + ATTR_TAB_SIZE <sup>2</sup> Default: 0x20002000 Minimum: 0x200019D8 (0x2001900 + 0xD8)	0x20000008



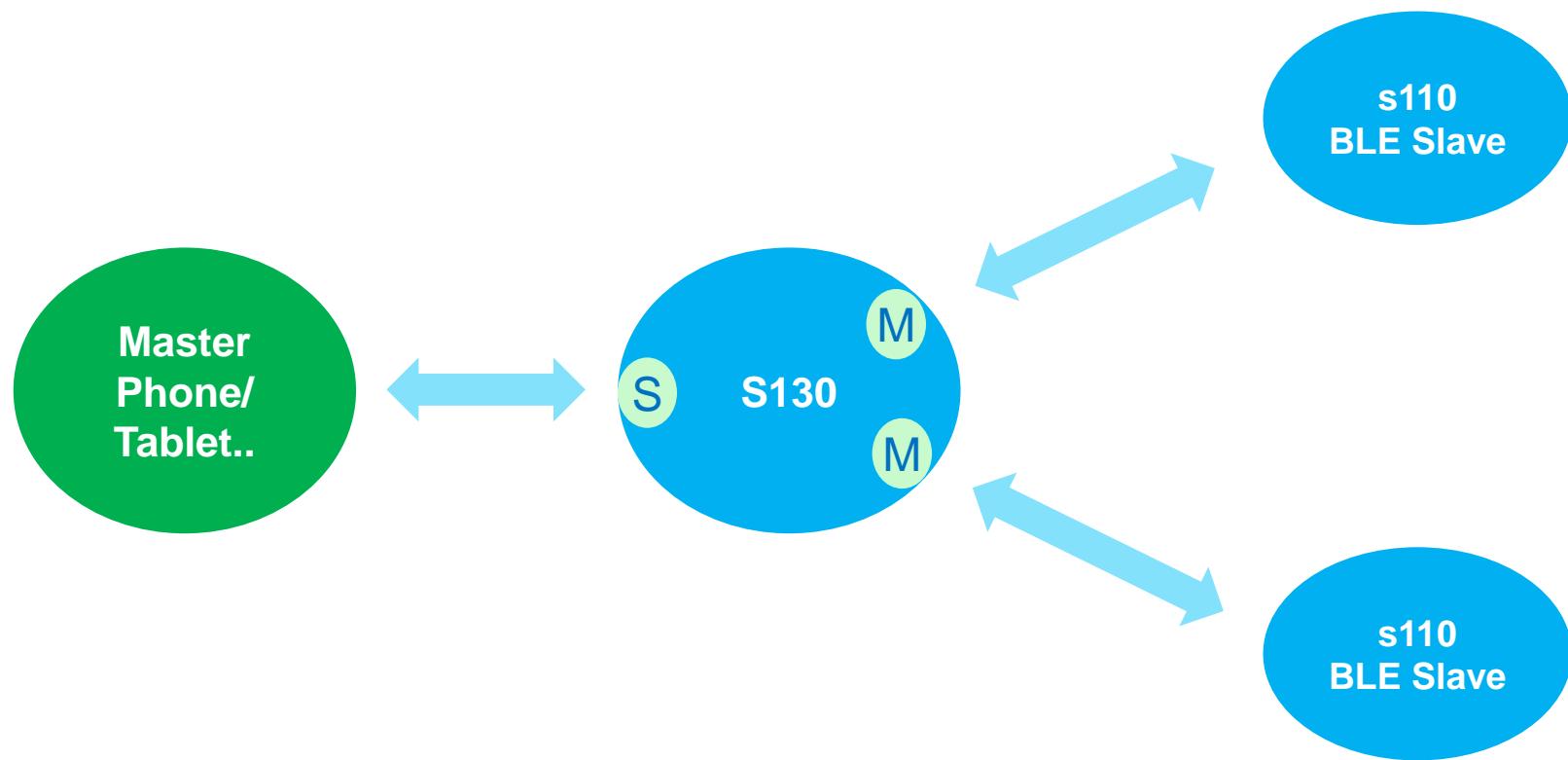
s110 是BLE Slave protocol, 可以在一個時間內和1個Master做連結



s120 是BLE Master protocol, 可以在一個時間內和8個Slave做連結



s130 是BLE Master+Slave protocol, 可以在一個時間內跟1個Master和2個Slave做連結



# Development Tools

# nRF51 DK

Low-cost, single board development kit  
Compatible with Arduino Uno shields  
Supporting ARM mbed™



For **fast, easy & flexible**  
development of Bluetooth® Smart,  
ANT, and 2.4GHz applications

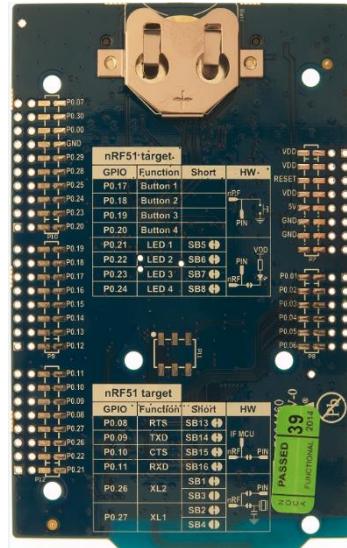
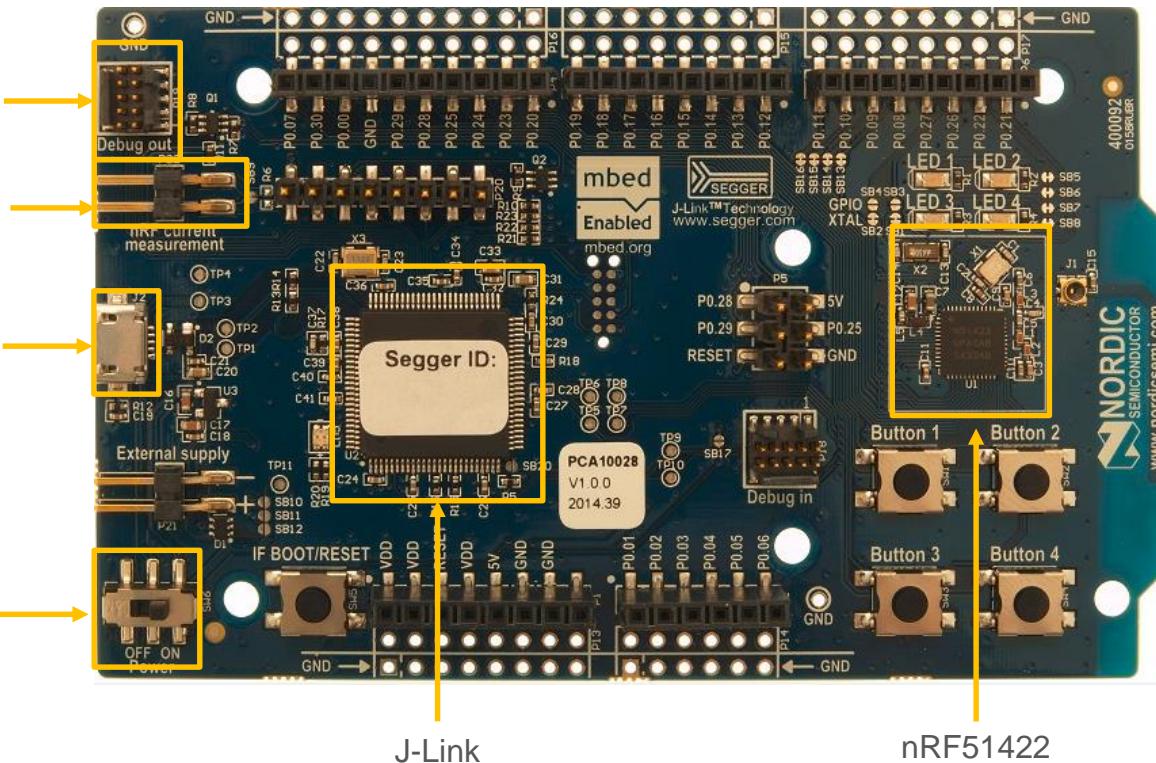
US \$69

Program external  
PCBA IC

Measure  
nRF51 IC current

USB power

Switch ON/OFF

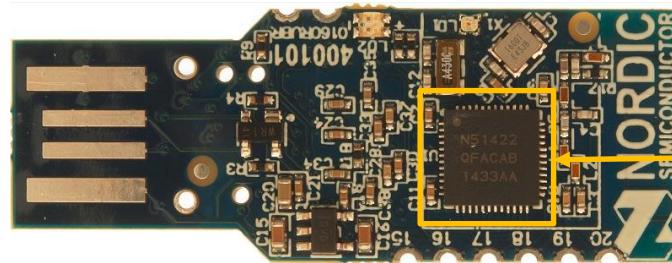


# nRF51 DK

For **fast, easy & flexible** development of Bluetooth® Smart, ANT, and 2.4GHz applications



US \$49



nRF51422



J-Link IC

# Development tools



NFC reader  
USB dongle



nRF2728 Gazell  
USB dongle



4x Energizer  
AAA batteries



nRF6927 Keyboard



Bluetooth® 4.0  
USB dongle



nRF6926 Mouse



Smart Remote base board  
(nRF2790)



Smart Remote nRF51822 Module  
(PCA20002)



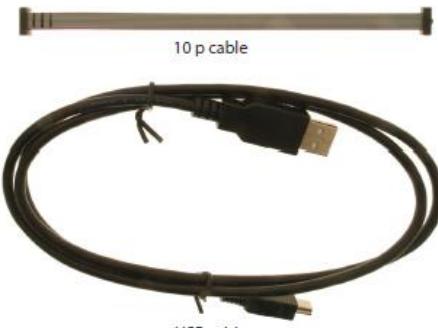
Bluetooth 4.0 USB dongle  
(GBU521)



nRF24LU1+ USB dongle  
(nRF2728)



SEGGER J-Link Lite ARM® Cortex™  
JTAG/SWD emulator



10 p cable



2 x AAA Batteries



USB cable

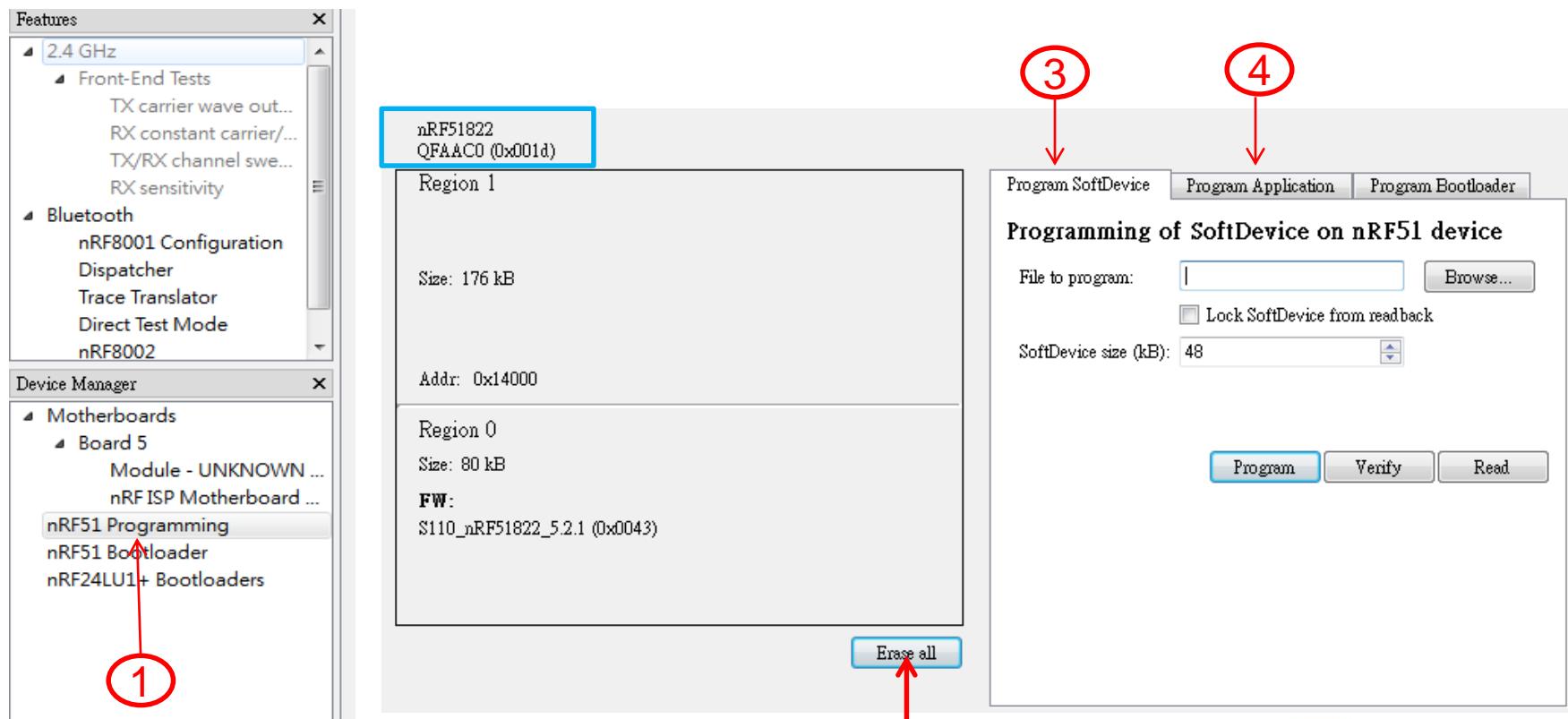
nRFReady Desktop 2

nRFReady Smart Remote 2

## nRFgo Studio & Master Control Panel (MCP)

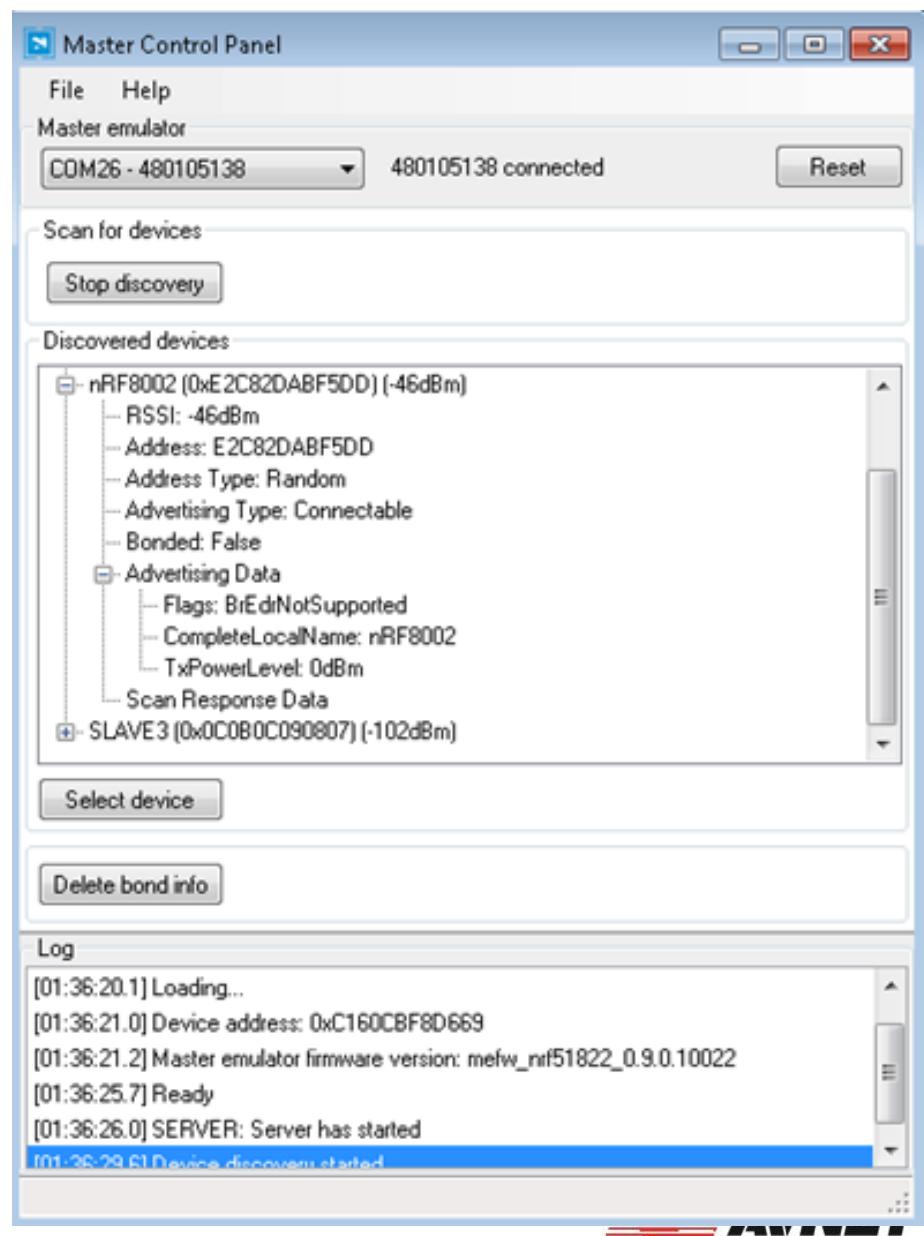
Nordic提供了nRFgo studio (v1.21.0)  
此工具可以燒錄SD, APP, Bootloader 和執行DTM 測試RF功能, 也可以看到Chipset的版本  
燒錄步驟如下:

1. Select nRF51 Programming
2. Erase all
3. Select Program Softdevice and browse SD hex file
4. Select Program Application and browse ble\_app\_xxx.hex



## Master control panel (v3.9.0)

類似手機上的APP – “LightBlue”，  
可以搜尋周邊的藍芽裝置，  
並進行Bond, Connect, 和 Service discovery,  
接收和傳送藍芽資料，  
需搭配nRF51822 BLE dongle



# Sniffer

可以監看BLE裝置在空中互傳資料的內容

PACKET LIST

No.	Time	Source	SN	NESN	event counter	RSSI (dBm)
8346	173.923743000	40:34:b0:cf:93:4f			0	-46
8347	173.925761000	F9:01:14:e3:d9:a4			1	-68
8348	174.087306000	5Y			0	-60
8349	174.114612000	5Y			0	-67
8350	174.117430000	40:34:b0:cf:93:4f			1	-77
8351	174.127131000	Master	0	0	0x0000	-47
8352	174.129652000	Slave	0	1	0x0000	-67
8353	174.144080000	Master	1	1	0x0001	-47
8354	174.146607000	Slave	1	0	0x0001	-64
8355	174.174747000	Master	0	0	0x0002	-49
8356	174.176198000	Slave	0	1	0x0002	-67
8357	174.204135000	Master	1	1	0x0003	-47
8358	174.205537000	Slave	1	0	0x0003	-64
8359	174.234357000	Master	0	0	0x0004	-46
8360	174.236465000	Slave	0	1	0x0004	-70
8361	174.264316000	Master	1	1	0x0005	-49

PACKET DETAILS

Extra packet information

NFC Frame #350 - 60 bytes on wire (480 bits), 60 bytes captured (480 bits) on interface  
Nordic BLE sniffer meta  
uart packet counter: 970233  
flags: 0x01  
.... . = encrypted: No  
.... . = direction: Slave -> Master  
.... . = CRC: OK  
channel: 39  
RSSI (dBm): -77  
delta time (us end to start): 157  
delta time (us start to start): 233

Bluetooth Low Energy

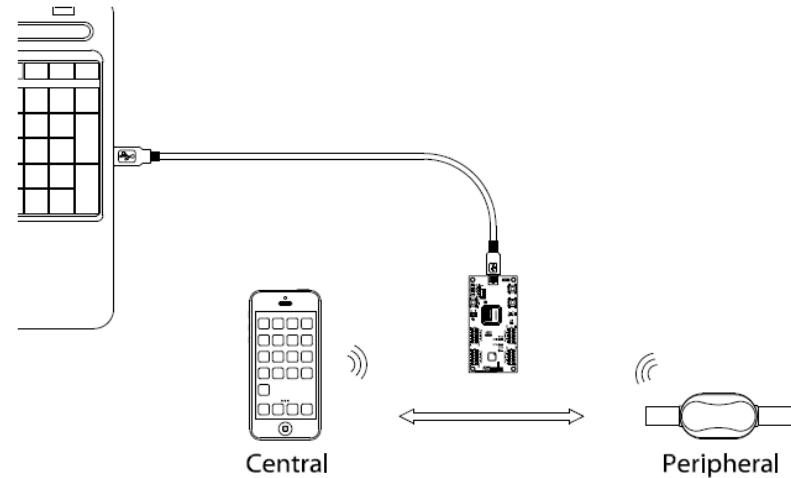
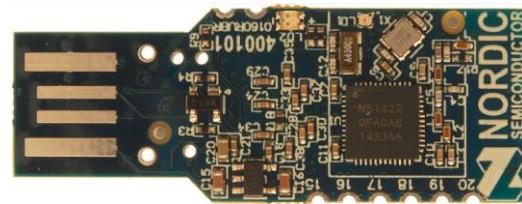
Access Address: 0x8e89bed6  
Packet Header  
Init Address: 40:34:b0:cf:93:4f (40:34:b0:cf:93:4f)  
Advertising Address: F9:01:14:e3:d9:a4 (F9:01:14:e3:d9:a4)  
Connection Request  
Connection Access Address: 0xaf9a9bde  
CRC Init: 0xc75cb2  
window size (ms): 3.75  
window offset (ms): 22.5  
Interval (ms): 30  
Latency: 0  
Timeout (ms): 720  
Channel map: ffffffff1f  
...0 1010 ... = Hop Interval: 10  
101. .... = Sleep Clock Accuracy: 31 ppm to 50 ppm (5)  
CRC: 0x3f22c3

BLE packet

PACKET BYTES

Packet info as:  
-hexadecimal (left)  
-ASCII (right)

0000	be ef 06 ff cd 0e 00 34	01 26 4d 00 00 99 00 00	.....4 .8M.....
0010	00 06 be 89 8e c5 22 4f	93 cf b0 34 40 a4 d9 #3	.....70 ..48....
0020	14 01 f9 de 9b 9a bf b2	5c c7 03 12 00 10 00 00	.....H.....
0030	00 48 dd ff ff ff 1f	aa 3f 22 c1	.....H.....

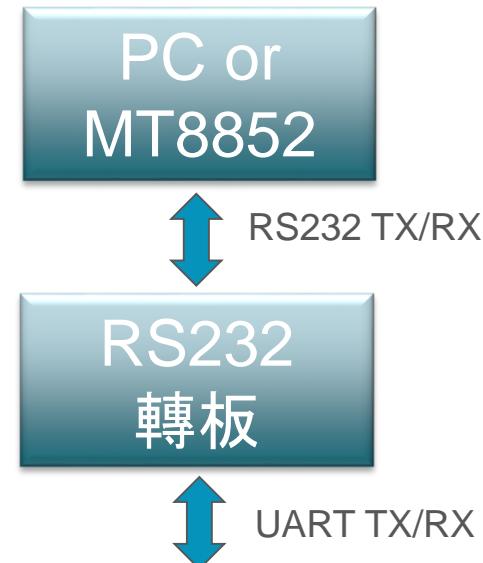


## DTM (Direct Test Mode)

藍芽協會提供測試RF特性的一個功能，  
Nordic已經將按照標準文件做出DTM F/W納入SDK中，  
客戶只需要修改Baud Rate和UART TX/RX pin即可做RF測試，  
測試廠也會要求客戶將此F/W燒錄到IC中，以便做HW BQB test

## Super terminal setting

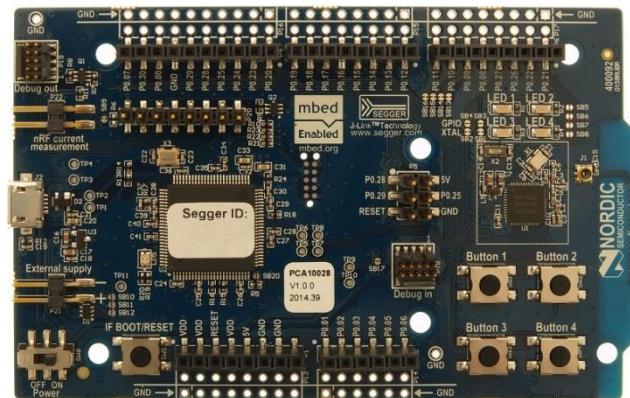
- 1 stop bit
- 8 data bits
- 19200 baud rate
- No flow control  
(meaning no RTS/CTS)
- No parity



## Pin Connect

(User can assign two pins)

GPIO	UART Pin
P0.09	TXD
P0.11	RXD



Switch SW6 to ON

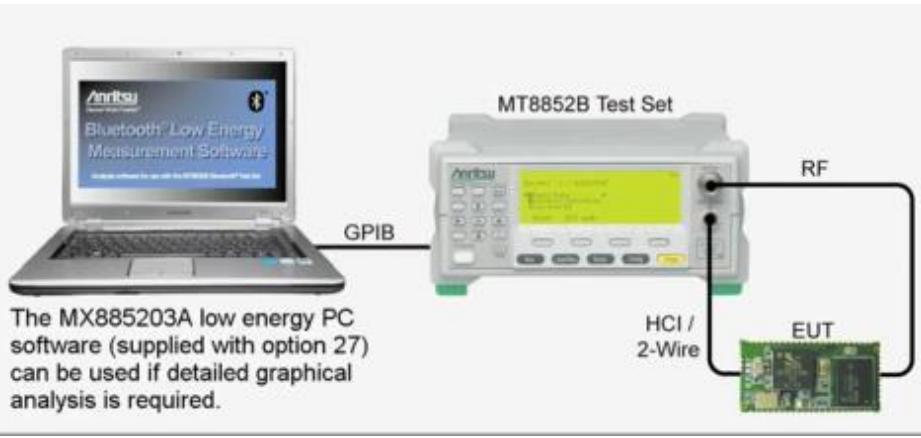
# 使用Anritsu MT8852 測試PCBA RF特性, 自動測試和產出測試報告

## Anritsu Bluetooth low energy Test Report

Test Set Serial Number: 001206006

Date: 9/18/2014

Time: 11:43:47



### Overall Result: PASSED

#### TRM-LE/C4/01/C (Output Power)

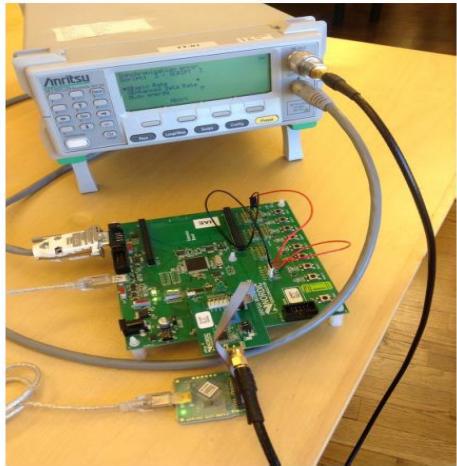
	<u>Low</u>	<u>Medium</u>	<u>High</u>	<u>Limits</u>
Average Power	2.51 dBm	2.86 dBm	2.75 dBm	< 10 dBm
Max Power	2.51 dBm	2.86 dBm	2.76 dBm	> -20 dBm
Min Power	2.51 dBm	2.85 dBm	2.75 dBm	< 3 dB
Peak to Average	0.08 dB	0.08 dB	0.09 dB	
Total Packets Failed	0	0	0	
Total Packets Tested	10	10	10	
Result	Passed	Passed	Passed	

#### TRM-LE/C4/06/C (Carrier Frequency Offset and Drift)

	<u>Low</u>	<u>Medium</u>	<u>High</u>	<u>Limits</u>
Average Frequency Offset	81.2 kHz	80.8 kHz	79.9 kHz	
Max +ve Frequency Offset	85.1 kHz	92.2 kHz	87.6 kHz	$\leq 150$ kHz
Max -ve Frequency Offset	76.6 kHz	81.4 kHz	68.5 kHz	$\leq 150$ kHz
Drift Rate / 50 $\mu$ s	6.08 kHz/50 $\mu$ s	-7.28 kHz/50 $\mu$ s	-9.89 kHz/50 $\mu$ s	$\leq 20$ kHz / 50 $\mu$ s
Max Drift	-8 kHz	-12 kHz	-17 kHz	$\leq 50$ kHz
Average Drift	-4 kHz	-9 kHz	-13 kHz	
Total Packets Failed	0	0	0	
Total Packets Tested	10	10	10	
Overall Result	Passed	Passed	Passed	

#### TRM-LE/C4/05/C (Modulation Characteristics)

	<u>Low</u>	<u>Medium</u>	<u>High</u>	<u>Limits</u>
'Favg'	252.3 kHz	247.5 kHz	251.3 kHz	$225$ kHz $\leq$ Favg $\leq$ $275$ kHz
'Fmax'	256.0 kHz	253.6 kHz	257.1 kHz	
F1 Packets Failed	0	0	0	
'F2avg'	214.8 kHz	210.1 kHz	213.2 kHz	
'F2max'	202.2 kHz	198.5 kHz	200.9 kHz	$\geq 185$ kHz
'F2max' Pass Rate	100.00 %	100.00 %	100.00 %	
F1/F2 Ratio	0.85	0.84	0.84	$\geq 0.8$
Total Packets Tested	20	20	20	
Result	Passed	Passed	Passed	



# 使用Nordic提供的nRFgo Studio可以簡單的測試RF特性

Features X

- ▲ 2.4GHz
  - ▲ Front-End Tests
    - TX carrier wave output
    - RX constant carrier/LO leakage
    - TX/RX channel sweep
    - RX sensitivity
  - ▲ Bluetooth
    - nRF8001 Configuration
    - Dispatcher
    - Trace Translator
    - Direct Test Mode**
    - nRF8002

**Direct Test Mode UART interface**

Set up on  Program

Com port **COM1**  Refresh list of com ports

Mode  Transmit  Receive

Channel  Single  Sweep

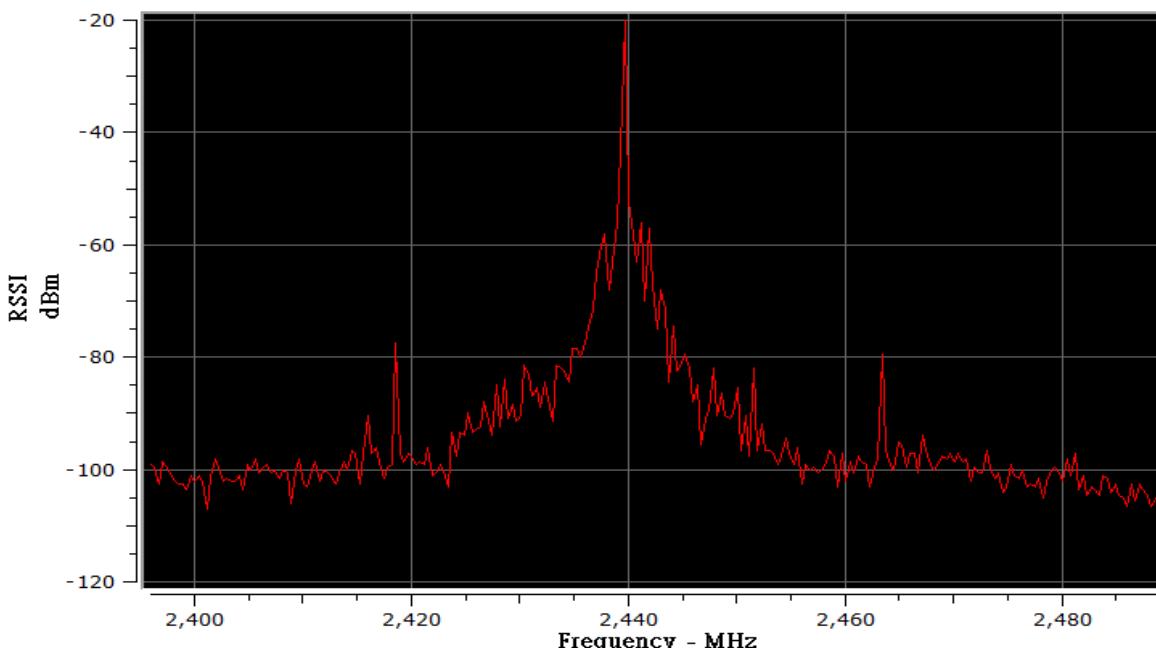
Channel **19**

Payload model **Constant carrier**

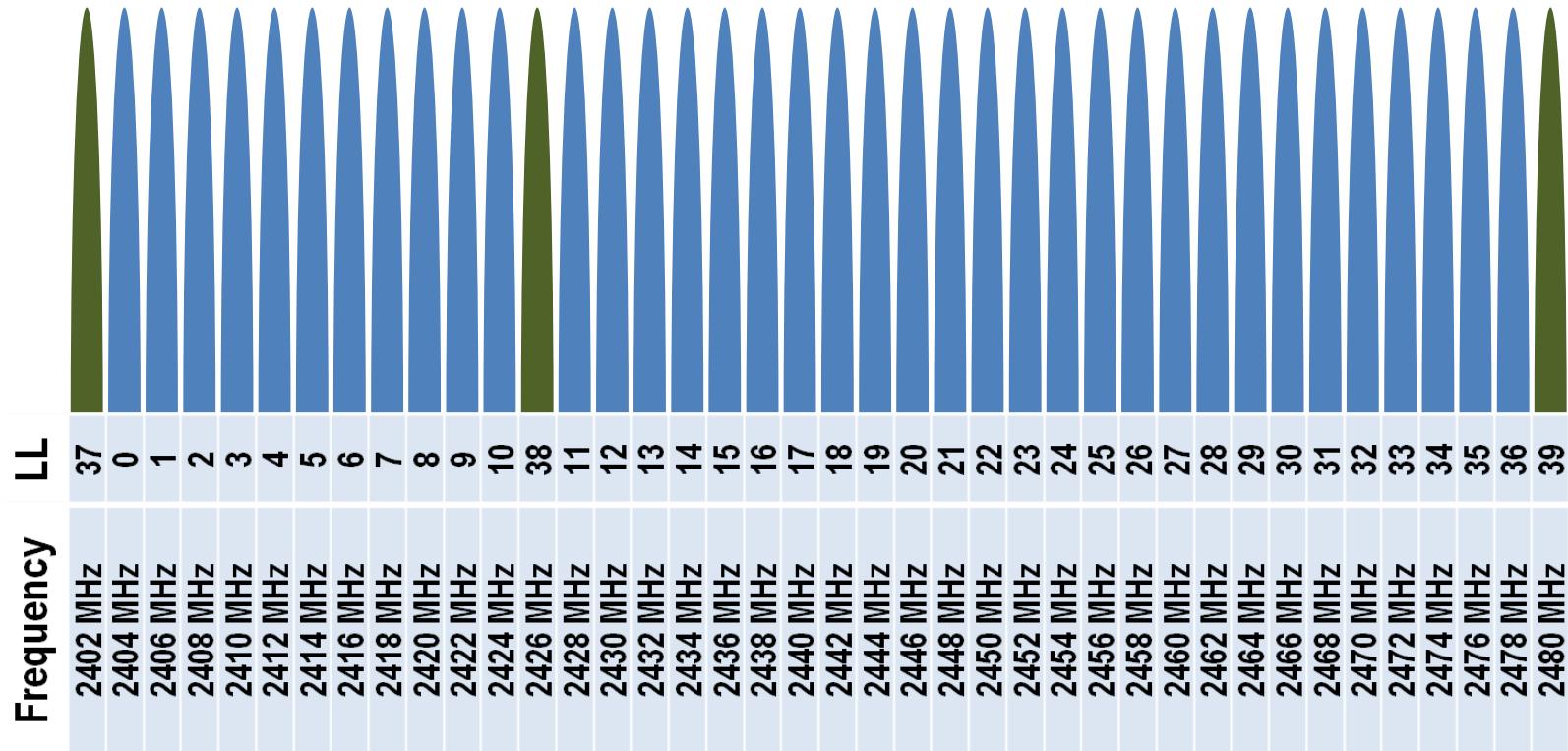
Payload length **1 bytes**

Packets received N/A

**Start test**



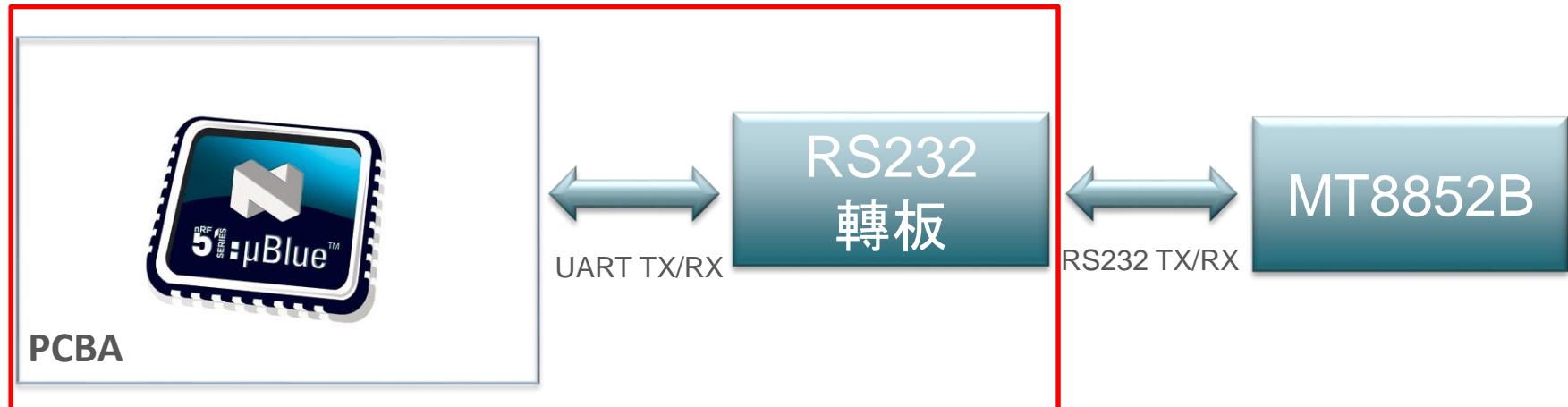
## 3 Advertising Channels and 37 Data Channels



設計PCBA時，請預留以下6 Pin, 方便之後燒錄和使用DTM



送交PCBA給測試廠測試時，請記得提供PCBA + RS232轉版



## PTS (Profile Tuning Suite)

藍芽協會提供測試Profile功能的一個軟體和PTS dongle  
客戶可以在藍芽網站自行選購PTS dongle (US \$99), 預先測試Profile功能  
節省之後送測時間和費用

## PTS dongle

選購網址: <http://bluetoothstore.org/>

## PTS 測試軟體

可以在藍芽網站免費下載

開啟時, 需要先將PTS dongle插上PC



## Profile Tuning Suite (PTS) Radio Modules



### Bluetooth PTS Dual-mode (BR/EDR and LE) Radio Module

Price: \$99.00

Quantity:  Add to Cart

The dual-mode Bluetooth radio module supports Bluetooth v4.0\* that includes both the BR/EDR and LE testing with the PTS software.\*\*

PTS - [Start Page]

New Workspace - Device Address

Click the search button to discover the devices in range or enter the Bluetooth Device Address (BD\_ADDR) of the device you will be testing.

Device BD_Addr	Device Name
4CEDDE391236	Unknown
E825196A1666	SC002 DUAL V02

IUT Device Address:

Run Device Search:

Major Device Class:

Any       Peripheral  
 Computer       Imaging  
 Phone       Wearable  
 LAN       Toy  
 Audio/Video       Health

Service Class:

None       Transfer  
 Positioning       Audio  
 Networking       Telephony  
 Rendering       Information

Profile Tuning Suite (PTS)

Help

Purchase PTS Radio Module

is a powerful, software-based testing, reducing

Radio Module Tutorial

**Product Development**

- Building with the Technology
- Learn & Get Involved
- Build Your Product
- Test Your Product
- Qualify & List Your Product
- Product Development Recommendations

**Developer Resources**

- Developer Portal 
- Developer Forums 
- Webinars 
- Download Quick Start Kit 
- Architecture 
- Profiles & Protocols 

**Upcoming Events**

- Testing Events
- UnPlugFest (UPF)
- Interoperable Prototype (IOP)
- Automotive Test Events
- Bluetooth Training Events

**Member Network**

- Qualification & Testing Services
- Test Equipment
- Product Distribution
- Product Design & Development

**Test Tools**

- Profile Tuning Suite (PTS)**
- PTS In-depth
- PTS Roadmap
- Download PTS
- Purchase PTS Radio Module 
- Issue Tracker
- Test Plan Generator (TPG)
- Interoperables Prototype (IOP) Testing
- Results Entry
- Results Summary
- PTS Release Statement

**Compliance Program**

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- Enforcement Program
- Process Experts
- Test Facilities
- Search the Listings

**Software License**


- Welcome, Atlas Chen
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- ▶ Events
- ▶ Groups
- ▶ Test Plan Generator
- ▼ **Profile Tuning Suite**
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  - ▶ Software Licensing
  - ▶ Regulatory
  - ▶ Resources
  - ▶ Report Issues

 Select Language 

Search site

## Download - Profile Tuning Suite

The following are available PTS releases and associated updates. Click a link to download.

<b>Release 5.2.0</b>	Released: 07/03/2014	<a href="#">Release Notes</a>	<a href="#">PTS_Release_Statement_5_2.pdf</a>
(No Updates for this release)			

**Please note:** For older versions, please see our [PTS Archive Page](#).

# 測試文件的填寫

## Bluetooth PRD v2.1 Qualification and Listing Information Sheet

Your Bluetooth Project name: \_\_\_\_\_

Expected Qualification Date: \_\_\_\_\_

Product/Design Name: \_\_\_\_\_

Member Company: \_\_\_\_\_

Product Model Number: \_\_\_\_\_

Hardware Version Number: \_\_\_\_\_

Software Version Number: \_\_\_\_\_

Product/Design Description: \_\_\_\_\_

Audit Location Address: \_\_\_\_\_

Company Member who will accompany the audit: \_\_\_\_\_

Core Version:  4.0(Low Energy only)  4.0(dual mode)  4.0+HS  3.1  3.1+HS

3.0+HS  3.0(EDR)  3.0(without EDR)  2.1+EDR  2.1  2.0+EDR  2.0

WiFi Certification No. (For design naming including +HS): N/A \_\_\_\_\_

Classic Controller Power Class:  Class I  Class II  Class III

Antenna Gain:  Lower then 0.0 dBi  If over 0.0 dBi → Please declare: \_\_\_\_\_ dBi

Product Type:  End Product  Component (Tested)  Component (Non-Tested)

Host Subsystem  Controller Subsystem  Profile Subsystem

\* If any pre-tested components (Within 3 years) are designed to use in the EUT, QD I.D. (Could be more than one) as follows:

RF/PHY:

QD ID (for PRD v2.1) \_\_\_\_\_

Core Controller (BB,LMP,802.11,PAL,LL):

QD ID (for PRD v2.1) \_\_\_\_\_

Core Host (L2CAP,SDP,GAP,A2MP):

QD ID (for PRD v2.1) \_\_\_\_\_

Profiles:

QD ID (for PRD v2.1) \_\_\_\_\_

Temperature range for RF extreme test: Max. \_\_\_\_\_ Min. temperature \_\_\_\_\_

### Supported LE Profiles: Please mark for support features

ANP-Client<sup>v</sup>  FMP-Target<sup>v</sup>  HOGP-HID Device<sup>v</sup>  PXP-Reporter<sup>v</sup>

ANP-Server<sup>v</sup>  FMP-Locator<sup>v</sup>  HOGP-Report Host<sup>v</sup>  PXP-Monitor<sup>v</sup>

ANS<sup>v</sup>  GLP-Sensor<sup>v</sup>  HOGP-Boot Host<sup>v</sup>  SCPP-Client<sup>v</sup>

BAS<sup>v</sup>  GLP-Collector<sup>v</sup>  HIDS<sup>v</sup>  SCPP-Server<sup>v</sup>

BLP-Collector<sup>v</sup>  HTP-Thermometer<sup>v</sup>  LLS<sup>v</sup>  SCPS<sup>v</sup>

BLP-Blood<sup>v</sup>  HTP-Collector<sup>v</sup>  NDCS<sup>v</sup>  TIP-Client<sup>v</sup>

Pressure Sensor<sup>v</sup>  HTS<sup>v</sup>  PASP- Client<sup>v</sup>  TIP-Server<sup>v</sup>

GLS<sup>v</sup>  HRP-Sensor<sup>v</sup>  PASP- Server<sup>v</sup>  TPS<sup>v</sup>

DIS<sup>v</sup>  HRP-Collector<sup>v</sup>  PASS<sup>v</sup>  JAS<sup>v</sup>

GRS<sup>v</sup>  HRS<sup>v</sup>  RTUS<sup>v</sup>  RTUS<sup>v</sup>



# QDID Search

<https://www.bluetooth.org/tpg/listings.cfm>

The screenshot shows a web browser window for 'The Official Bluetooth SIG Member Website' at 'Bluetooth.com'. The left sidebar includes the Bluetooth logo, navigation links for Events, Resources (selected), FAQ, Qualified Listings (highlighted), List of BQTFs, Member Directory, and Report Issues. The main content area has a 'Select Language' dropdown and a search bar. Below is a 'Listings Search' section with a note about help files and feedback. Two identical search forms are displayed side-by-side, each with a red arrow pointing to the 'Search:' input field.

**Search:** Nordic

**Search In:**

- Qualifications & Declarations
- End Product List (EPL)
- Qualified Products List (PRD 1.0)

**Rows Per Page:** 50

**Search** **Reset**

[Advanced Search >>](#)

**Note:** If no search criteria are selected, search result

**QD ID** ▾ | **QDL?** ▾ | **Declaration ID** ▾ | **Name** ▾

**Search:** Nordic

**Search In:**

- Qualifications & Declarations
- End Product List (EPL)
- Qualified Products List (PRD 1.0)

**Rows Per Page:** 50

**Search** **Reset**

[Advanced Search >>](#)

**Note:** If no search criteria are selected, search results will be limited to e

QD ID	QDL?	Declaration ID	Name	Product(s)	Company	Product Type(s)	Spec Name	Date
<a href="#">57648</a>	Yes	<a href="#">D023985</a>	CLARC	CLARC	Tunstall Nordic AB	End Product	4.1	25-Aug-2014
<a href="#">58616</a>	Yes	<a href="#">D023138</a>	nRF51x22 QFN package peripheral device	nRF51x22 QFN with Sx10 v7.0	Nordic Semiconductor ASA	End Product	4.1	10-Jul-2014
<a href="#">58540</a>	Yes	<a href="#">D023139</a>	nRF51x22 CE package peripheral device	nRF51x22 CE with Sx10 v7.0	Nordic Semiconductor ASA	End Product	4.1	10-Jul-2014
<a href="#">56948</a>	Yes	<a href="#">D023137</a>	Sx10_nRF51xxx host layer	Sx10 host layer	Nordic Semiconductor ASA	Component (Tested)	4.1	27-Jun-2014
<a href="#">56760</a>	Yes	<a href="#">D023136</a>	Sx10_nRF51xxx link layer	Sx10 link layer	Nordic Semiconductor ASA	Component (Tested)	4.1	24-Jun-2014
<a href="#">56426</a>	Yes	<a href="#">D022436</a>	nRF51xxx QFN package Central device	nRF51xxx IC with QFN package - Central	Nordic Semiconductor ASA	End Product	4.1	02-May-2014
<a href="#">56425</a>	Yes	<a href="#">D022437</a>	nRF51xxx CE package Central device	nRF51xxx CE package Central device	Nordic Semiconductor ASA	End Product	4.1	02-May-2014
<a href="#">52910</a>	Yes	<a href="#">D022435</a>	Sx20_nRF51xxx Host	Sx20 host for nRF51xxx	Nordic Semiconductor ASA	Component (Tested)	4.1	23-Apr-2014
<a href="#">54056</a>	Yes	<a href="#">D022379</a>	Sx20_nRF51xxx link layer	Sx20 link layer for nRF51xxx	Nordic Semiconductor ASA	Component (Tested)	4.1	11-Mar-2014

[<< Go Back <<](#)[>> DISPLAY ICS DETAILS >>](#)

**Member Company** Nordic Semiconductor ASA

**Declaration ID** D023137

**QD ID** 56948 | [Export ICS](#)

**PRD 1.0 ID (QP ID)**

**Wi-Fi® Certification ID**

Subsetted Projects	Date Created	Type	ICS
	Apr 30, 2014	Main	<a href="#">ICS</a>

**Design Name** Sx10\_nRF51xxx host layer

**Design Model Number** Sx10 Host layer

**Hardware Version Number** n/a

**Software Version Number** v 7.xx

**Qualification Assessment Date** June/27/2014

**Listing Date** June/27/2014

**Design Description** Host layer for the Nordic Sx10 SoftDevices. Designed to be combined as a tested component with nRF51xxx series devices and matching Sx10 link layer. This stack layer is qualified to the Bluetooth 4.1 specification

**Product Type** Component (Tested)

**Specification Name** 4.1

# DFU

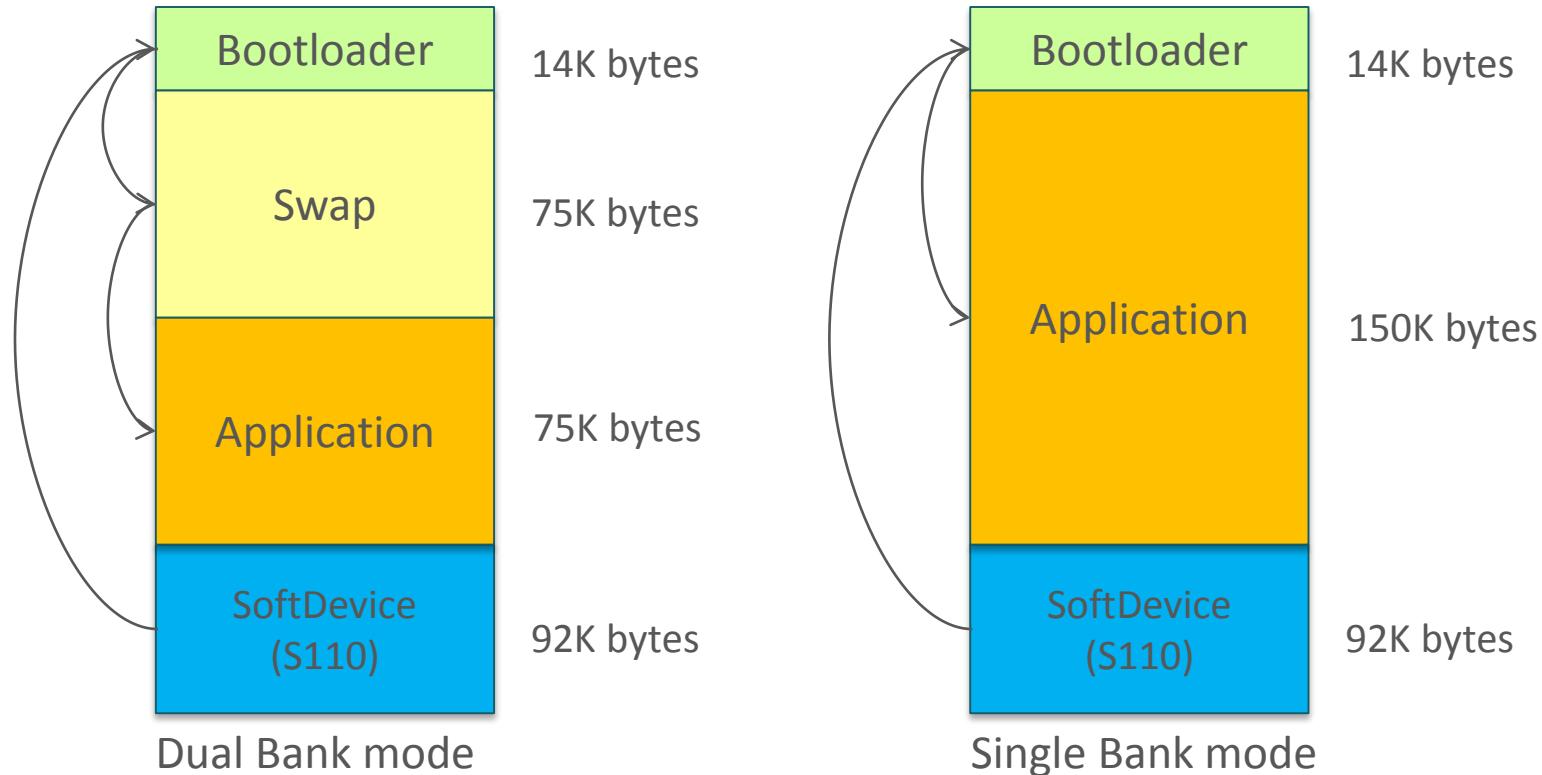
## (Device Firmware Update)

## DFU - OTA & HCI

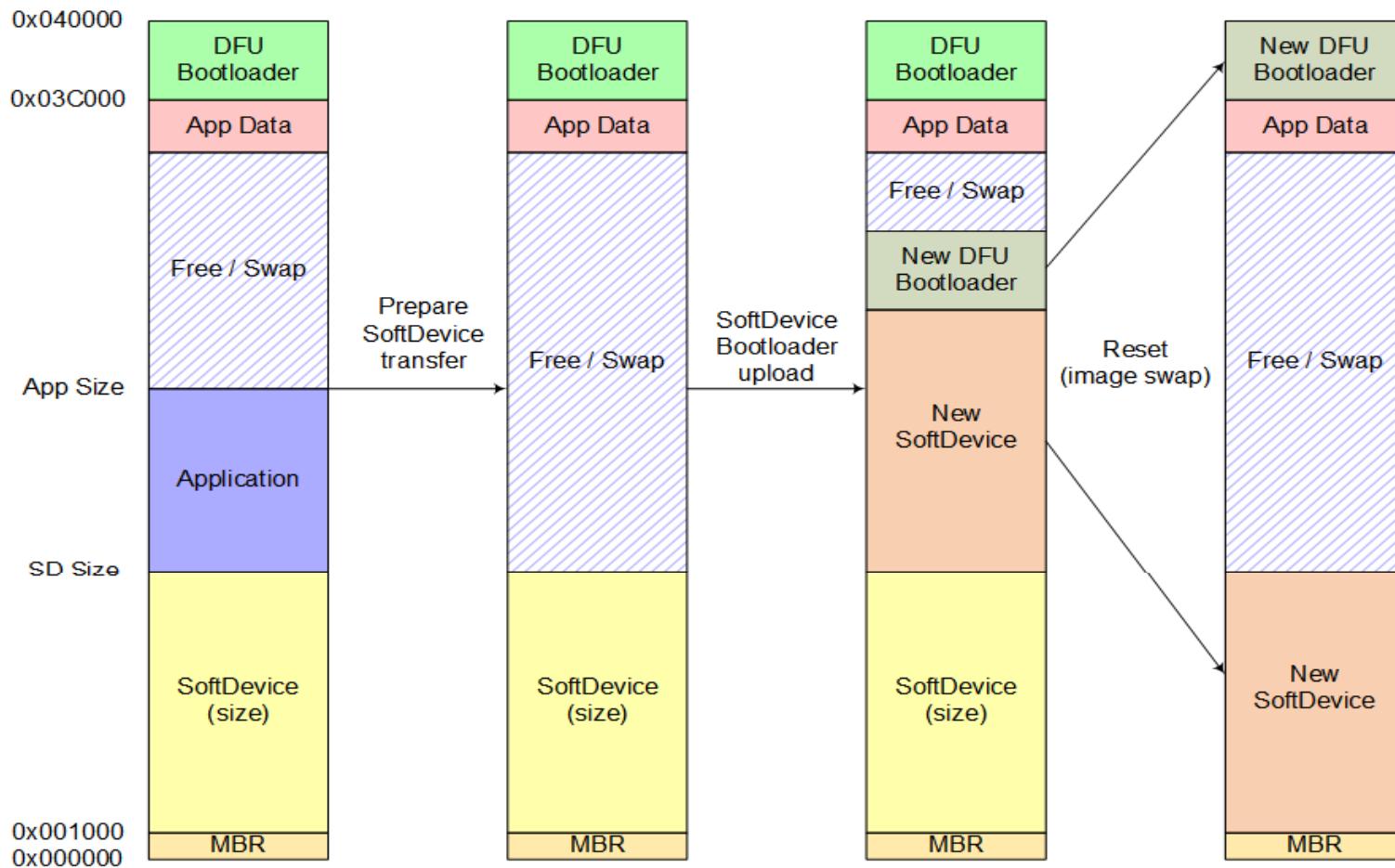
除了使用J-Link更新FW之外, Nordic另外提供DFU的兩種方式更新FW

OTA: 透過BLE Service的方式更新FW, 只有Dual Bank 模式

HCI : 透過Full UART更新FW, 有Dual Bank or Single Bank兩種模式



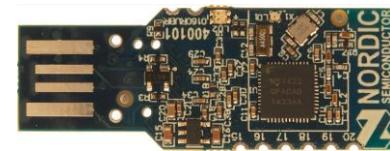
1. 目前的DFU 可以支援更新Softdevice 和Bootloader
2. 需使用S110 v7.0 和SDK v6.1以上版本



DFU - OTA 的部分可以透過APP DFU 或是 MCP 來更新F/W



The screenshot shows the Master Control Panel window. At the top, it displays 'Master emulator' connected to 'COM20 - 480100011' with the status '480100011 connected'. Below this, 'Device info' shows 'Device address: FA1BFC0E1FA6' and 'Bonded: False'. Under 'Actions', there are five buttons: 'Service discovery', 'Bond', 'Connect', 'Enable services', and 'DFU'. The 'DFU' button is highlighted with a red box. The main area is titled 'Service Discovery' and lists several service declarations and characteristics. A specific entry for a Primary Service is highlighted with a red box, showing its UUID as '0x00001530-1212-EFDE-1523-785FEABCD123'.

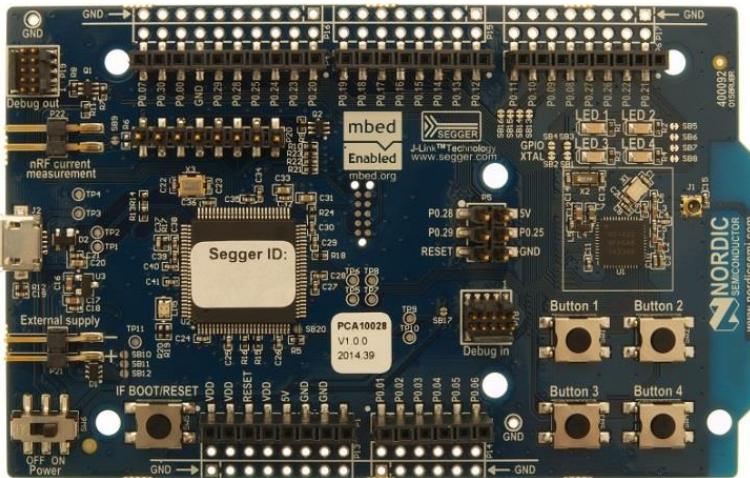


DFU - HCI 的部分可以透過nRFgo Studio來更新F/W

硬體接法如下

1. P0.08 -> RTS
2. P0.09 -> TXD
3. P0.10 -> CTS
4. P0.11 -> RXD
5. SW6 切為On

The screenshot shows the nRFgo Studio software interface. The left pane, titled 'Features', lists various test and configuration options for nRF8001 and nRF8002 modules, including 'Front-End Tests', 'Bluetooth' configuration, and 'nRF51 Programming'. The right pane, titled 'Device Manager', shows a tree view of 'Motherboards' and selected 'Board 5' which includes 'nRF51 Bootloader'.



### DFU using serial bootloader

Application to program: /Users/909954/Desktop/Hex/DFU\_hci\_4.4.2/ble\_app\_hrs.hex

Select COM port: COM4 (Prolific)

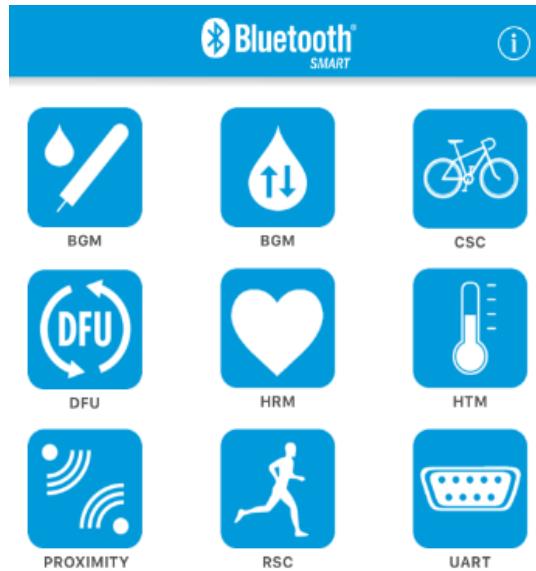
Select baudrate: 38400

Use flowcontrol  Program

# Nordic APP

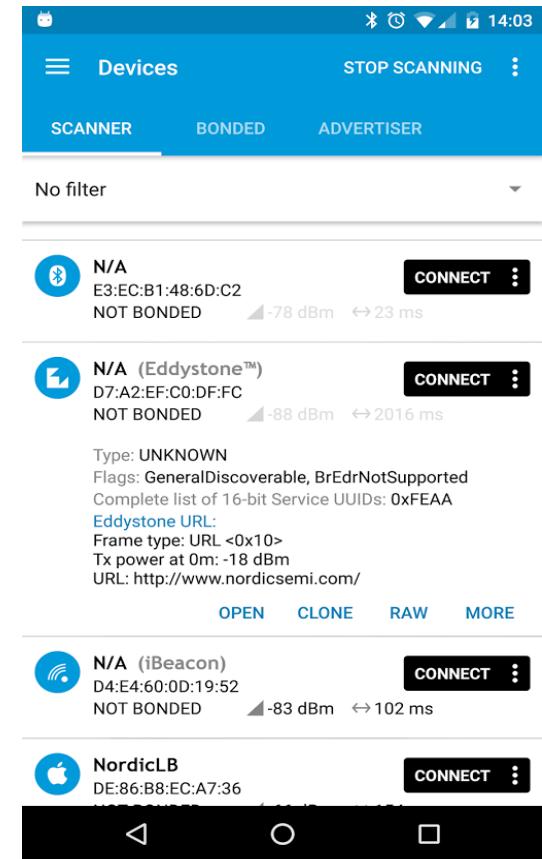
## nRF Toolbox

目前已經在iOS & Android 上架, 支援各類的應用, 且有Source code 讓開發者使用



## nRF Master Control Panel

MCP 目前在Android上架, 可以搜尋到周邊藍芽裝置, 並可觀看藍芽裝置的訊息與連線傳輸資料, 無Source code



# 藍芽簡介

# 藍芽定義

BLE只是BT4.0的一部分，

以下圖架構來看，BT4.0同時包含了BT3.0和BLE的部分

因此BT4.0可以相容於BLE與BT3.0，但是BLE無法相容於BT3.0之前的版本

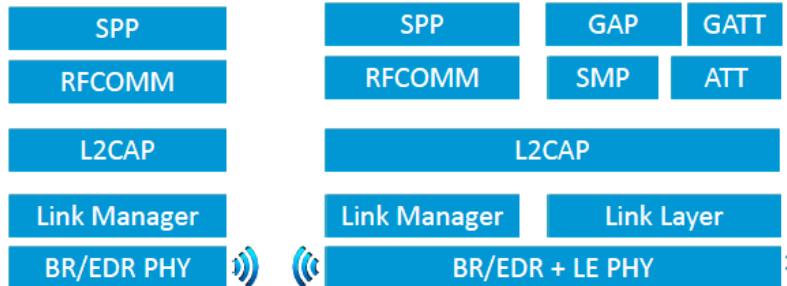
Profiles Layer：通常是屬於應用程式，例如HID, HR....profile

Host Layer：即為Softdevice的部分

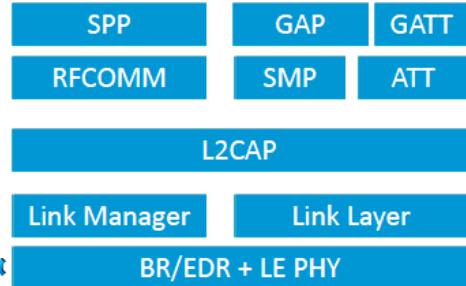
Controller：即為硬體的部分



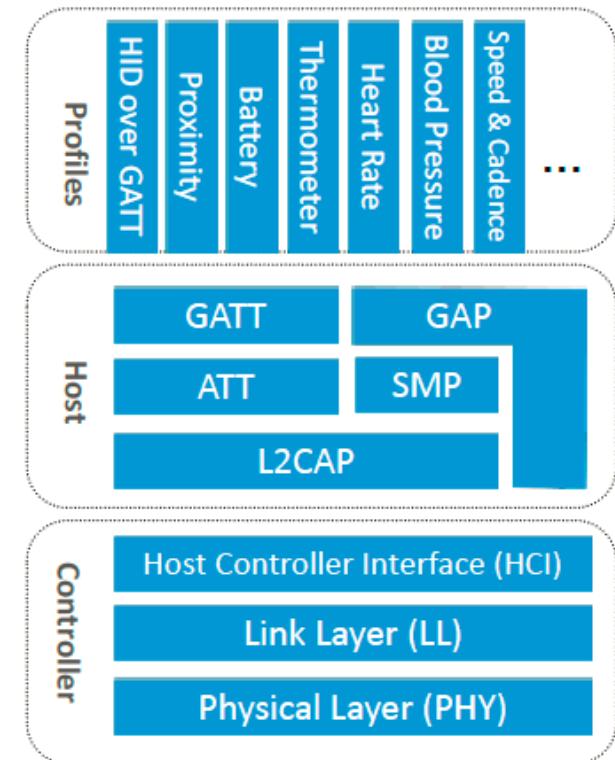
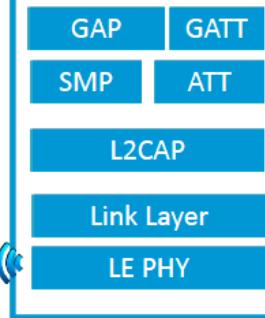
BR/EDR/HS 1.1, 2.0, 3.0



BR/EDR 4.0 Dual Mode (+LE)



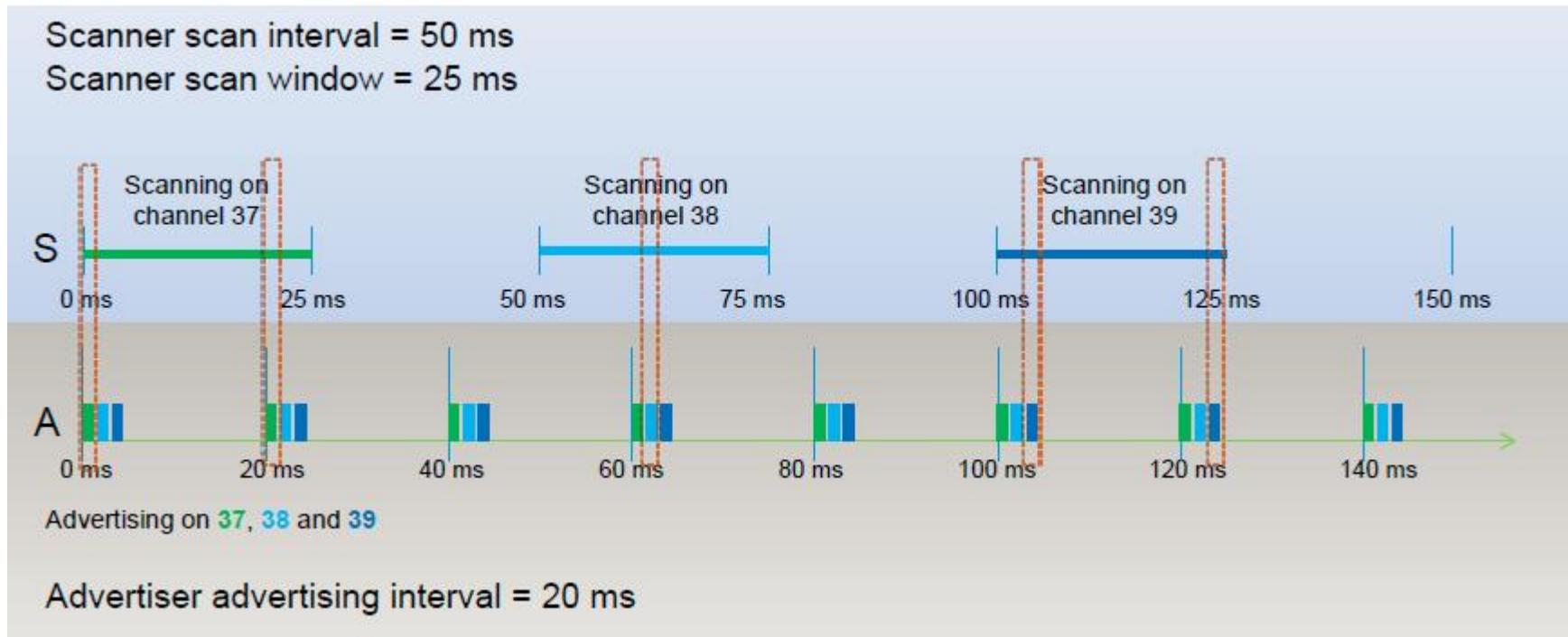
LE 4.0 Single Mode



Acronyms and Abbreviations	Meaning
AD	Advertising Data
BR/EDR	Basic Rate / Enhanced Data Rate
GATT	Generic Attribute Profile
LE	Low Energy
UUID	Universally Unique Identifier
L2CAP	Logical Link Control and Adaption Protocol
PSM	Protocol Service Multiplex
ATT	Attribute Protocol
SDP	Service Discovery Protocol

# Scan & Advertising : 掃描和廣播

1. Scan 指的是Master端在掃描周邊的藍芽裝置,通常會設定Scan Interval (掃描週期)  
Advertising指的是Device端廣播訊息讓Master端掃描到,通常會設定Advertising Interval (廣播週期)
2. Interval時間越長,越省電,反之越耗電
3. 設定Time out時間,避免長期Scan或是Advertising造成產品耗電



## Connect : 連結

在兩個BLE設備建立連接以後，所有的通信都是在Connection Event進行通訊，設備建立連線的大部份時間，都是處於Idle狀態，並且在此時耗電量很低，這也是BLE省電的主要原因。

另外在每次的Connection Event開始時，會由Master發起通訊要求，然後由Slave回覆。

**Connect Interval**：每個Connect Event的起始與結束，即為Connect Interval，每次傳遞資料，需要在此Connect Interval內傳送完畢，(標準為7.5ms ~ 4s)

Device需要設定Min connect interval, Max Connect Interval，由Master決定需要用多少Interval的時間來做通訊  
(iOS Con. Interval : 20ms~2s)

**Slave Latency**：為了節省Slave的電源，當Slave沒新的事件要傳給Master時，最多可忽略幾個Master發起的通訊要求。

**Supervision Timeout**：設定當多久沒有收到任何通訊要求時，中斷連線。

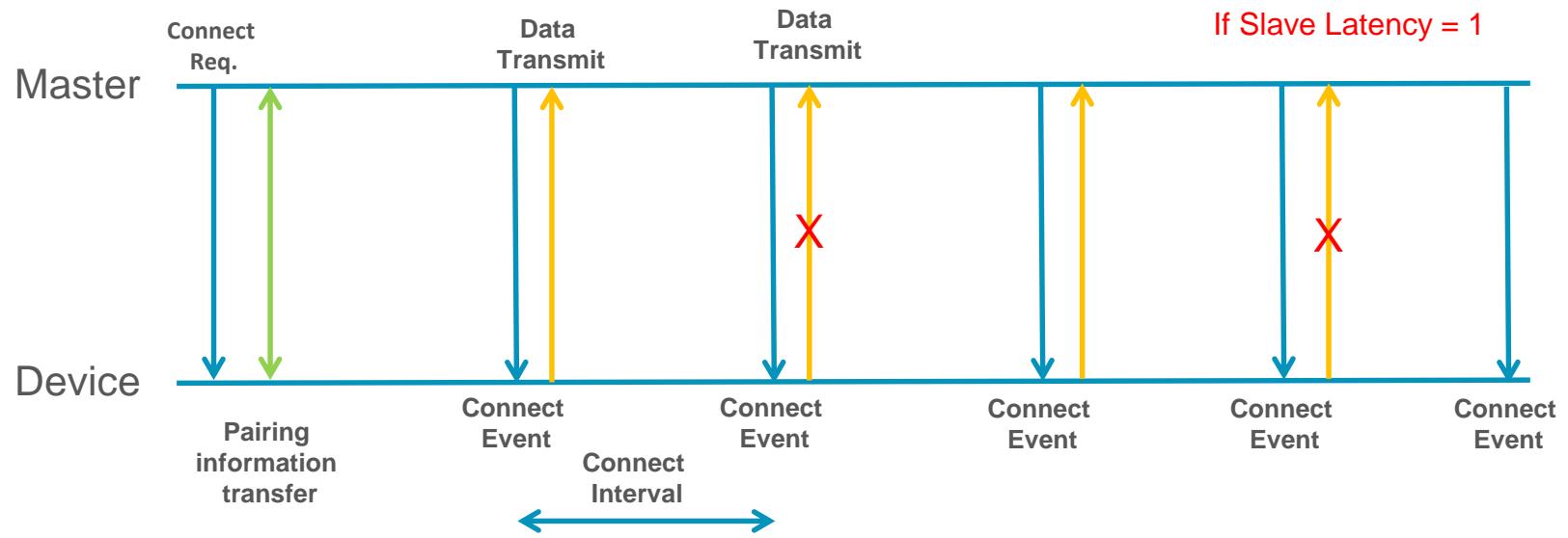
程式中會有四個定義，提供給設計者初始化

**MIN\_CONN\_INTERVAL**

**MAX\_CONN\_INTERVAL**

**SLAVE\_LATENCY**

**CONN\_SUP\_TIMEOUT**



## 3.6 Connection Parameters

The accessory is responsible for the connection parameters used for the Low Energy connection. The accessory should request connection parameters appropriate for its use case by sending an L2CAP Connection Parameter Update Request at the appropriate time. See the *Bluetooth 4.0* specification, Volume 3, Part A, Section 4.20 for details. The connection parameter request may be rejected if it does not comply with all of these rules:

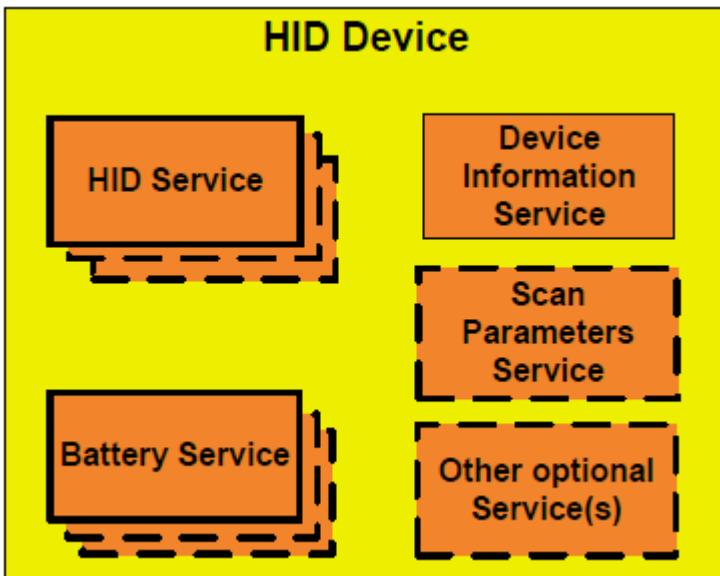
- $\text{Interval Max} * (\text{Slave Latency} + 1) \leq 2 \text{ seconds}$
- $\text{Interval Min} \geq 20 \text{ ms}$
- $\text{Interval Min} + 20 \text{ ms} \leq \text{Interval Max Slave Latency} \leq 4$
- $\text{connSupervisionTimeout} \leq 6 \text{ seconds}$
- $\text{Interval Max} * (\text{Slave Latency} + 1) * 3 < \text{connSupervisionTimeout}$

If Bluetooth Low Energy HID is one of the connected services of an accessory, connection interval down to 11.25 ms may be accepted by the Apple product.

The Apple product will not read or use the parameters in the Peripheral Preferred Connection Parameters characteristic. See the *Bluetooth 4.0* specification, Volume 3, Part C, Section 12.5.

# BLE Profile

1. BLE Profile是由多個BLE Service 所組成，  
產品使用到標準的Profile時，開發者需要參考SIG所制定的Profile文件來規劃，  
有一些Service屬於Option選項，開發者可以自行決定是否加入專案中
2. 下圖是 HOGP (HID Over GATT Profile)包含的Service，  
其中有HIDS, DIS, BAS是HOGP的主要Service, 不可省略  
而Scan Parameters Service是屬於Option, 由開發者自行決定是否加入



Service	Requirement
HID Service	M
Battery Service	M
Device Information Service	M
Scan Parameters Service	O
Other optional Service(s)	

# BLE Service

1. BLE Service 是由多個特徵(Characteristics)組成，  
產品使用到標準的Service時，開發者需要參考SIG所制定的Service文件來規劃，  
有一些特徵屬於Option選項，開發者可以自行決定是否加入專案中
2. 每一個特徵皆有其對應的UUID (通用唯一識別碼)，  
Device跟Master溝通時，會依照此UUID來辨別是哪一個特徵傳送和接收資料

Characteristic Name	Requirement	Mandatory Properties	Optional Properties	Security Permissions
Protocol Mode	C.4	Read / WriteWithoutResponse		None
Report	O			
Report: Input Report Type	C.1	Read/Notify	Write	None
Report: Output Report Type	C.1	Read/Write/Write Without Response		None
Report: Feature Report Type	C.1	Read/Write		None
Report Map	M	Read		None
Boot Keyboard Input Report	C.2	Read/Notify	Write	None
Boot Keyboard Output Report	C.2	Read/Write/Write Without Response		None
Boot Mouse Input Report	C.3	Read/Write		None
HID Information	M	Read		None
HID Control Point	M	WriteWithoutResponse		None
C.1: Mandatory to support at least one Report Type if the Report characteristic is supported C.2: Mandatory for HID Devices operating as keyboards, else excluded. C.3: Mandatory for HID Devices operating as mice, else excluded. C.4: Mandatory for HID Devices supporting Boot Protocol Mode, otherwise optional.				

Table 2.1: HID Service Characteristics

# UUID (唯一特徵識別碼)

Bluetooth SIG UUID format : (16 bits UUID)

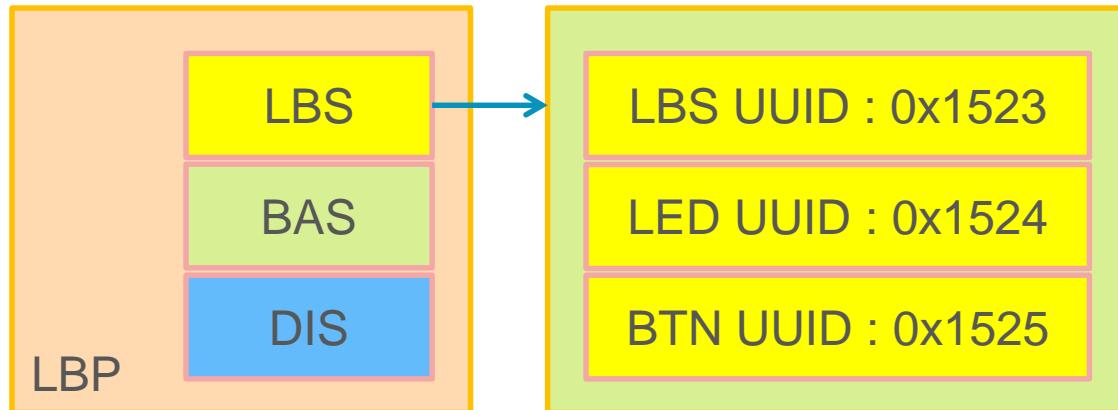
0x0000xxxx-0000-1000-8000-00805F9B34FB

以SIG - Heart rate measurement UUID (0x2A73)來說, 0x2A73即為16 bits的UUID  
而完整的GATT128bits UUID即為

0x00002A73-0000-1000-8000-00805F9B34FB

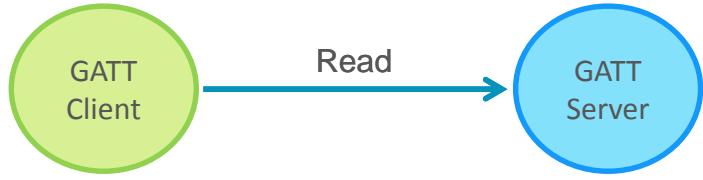
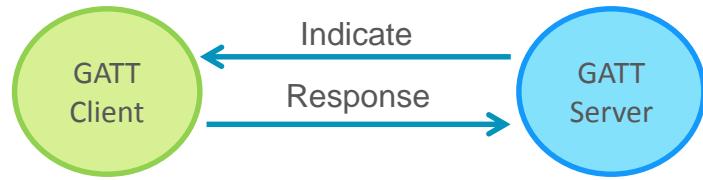
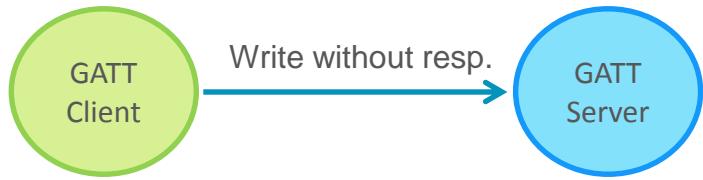
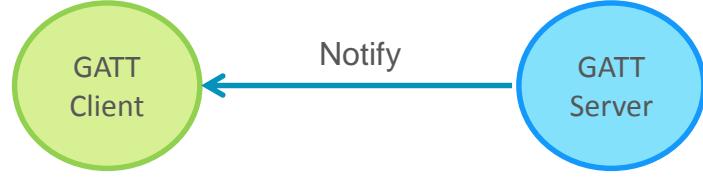
當開發者規劃自己的Service時, 就必須重新規劃128 bits的UUID,  
例如LED Button Sample code中的128 bits UUID

0x0000xxxx-**1212-EFDE-1523-785FEABCD123**



## 特徵的屬性

Write , Write without response  
Read  
Notify, Indicate



# SW Training

# Restricted, Block and Open

Access	Definition
Restricted	Used by the SoftDevice. Application has limited access through the SoftDevice API.
Blocked	Used by the SoftDevice. Application has no access.
Open	Not used by the SoftDevice. Application has full access.

ID	Base address	Instance	Access (S110 enabled)	Access (S110 disabled)
0	0x40000000	POWER	Restricted	Open
0	0x40000000	CLOCK	Restricted	Open
1	0x40001000	RADIO	Blocked	Open
2	0x40002000	UART0	Open	Open
3	0x40003000	SPIM0 / 2W0	Open	Open
4	0x40004000	SPIM1 / 2W1	Open	Open

SoftDevice Disabled (default)	SoftDevice Enabled
<code>NVIC_EnableIRQ(ADC_IRQn)</code>	→ <code>nrf_nvic_EnableIRQ(ADC_IRQn)</code>
<code>NRF_PPI-&gt;CH0_EEP = &amp;(NRF_TIMER1-&gt;EVENTS_COMPARE[0])</code>	→ <code>nrf_ppi_channel_assign(0, &amp;(NRF_TIMER1-&gt;EVENTS_COMPARE[0]), &amp;(NRF_GPIOTE-&gt;TASKS_OUT[0]))</code>
<code>NRF_PPI-&gt;CH0_TEP = &amp;(NRF_GPIOTE-&gt;TASKS_OUT[0])</code>	
<code>NRF_TIMER1-&gt;TASKS_CLEAR = 1;</code>	→ <code>NRF_TIMER1-&gt;TASKS_CLEAR = 1;</code>

可以用API - sd\_softdevice\_is\_enable()來判斷目前softdevice的狀態為何

```
static void ppi_init(void)
{
    uint8_t is_sd_enable = 0;

    sd_softdevice_is_enabled(&is_sd_enable);

    if(is_sd_enable)
    {
        sd_ppi_channel_assign(0, &(NRF_TIMER2->EVENTS_COMPARE[0]), &(NRF_GPIOTE->TASKS_OUT[0]));
        sd_ppi_channel_enable_set(0);
    }
    else
    {
        // Configure PPI channel 0 to toggle GPIO_OUTPUT_PIN on every TIMER1_COMPARE[0] match,
        NRF_PPI->CH[0].EEP = (uint32_t)&NRF_TIMER1->EVENTS_COMPARE[0];
        NRF_PPI->CH[0].TEP = (uint32_t)&NRF_GPIOTE->TASKS_OUT[0];
        // Enable PPI channel 0
        NRF_PPI->CHEN = (PPI_CHEN_CH0_Enabled << PPI_CHEN_CH0_Pos);
    }
}
```

Softdevice Enable 之後, Radio本身是Block狀態, 仍可以設定RADIO的成員 - TX Power,  
但是此API需要放在softdevice enable之後才是有效的使用

```
uint32_t ble_stack_handler_init(.....)
{
    .....

    err_code = sd_softdevice_enable(clock_source, softdevice_assertion_handler);
    if (err_code != NRF_SUCCESS)
    {
        return err_code;
    }

    sd_ble_gap_tx_power_set(RADIO_TXPOWER_TXPOWER_Pos4dBm);

    // Enable BLE event interrupt (interrupt priority has already been set by the stack)
    return sd_nvic_EnableIRQ(SWI2_IRQn);
}
```

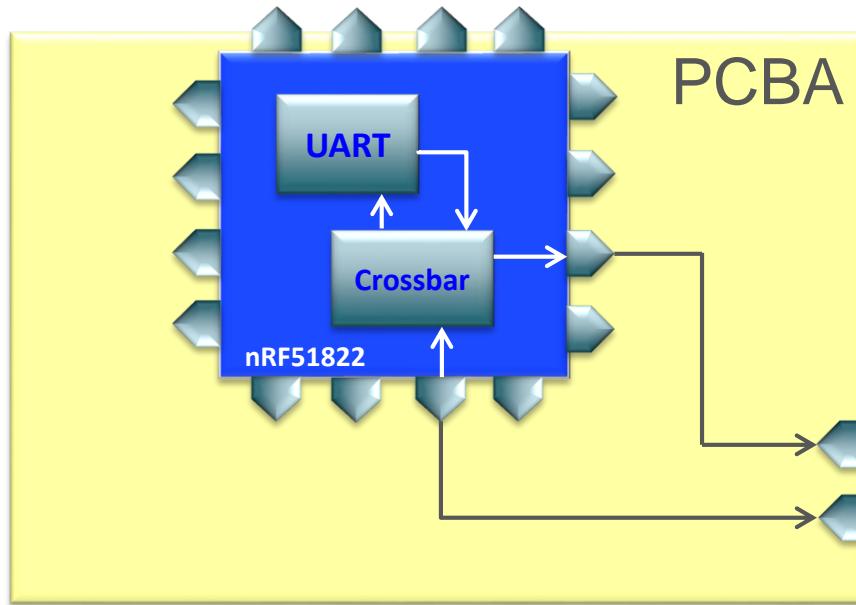
Nordic晶片出廠時都會有一組Random的BT Address, 客戶也可以自行設定自己的BT Address  
以下是Get和Set的API

```
SVCALL(SD_BLE_GAP_ADDRESS_SET, uint32_t, sd_ble_gap_address_set(ble_gap_addr_t const * const p_addr);)
SVCALL(SD_BLE_GAP_ADDRESS_GET, uint32_t, sd_ble_gap_address_get(ble_gap_addr_t * const p_addr);)
```

所有的GPIO都可以拿來設定I2C, UART, SPI, 除了ADC有固定的Pin (P00~P07)  
為了是方便開發人員設計電路圖, 不用再穿板跳線

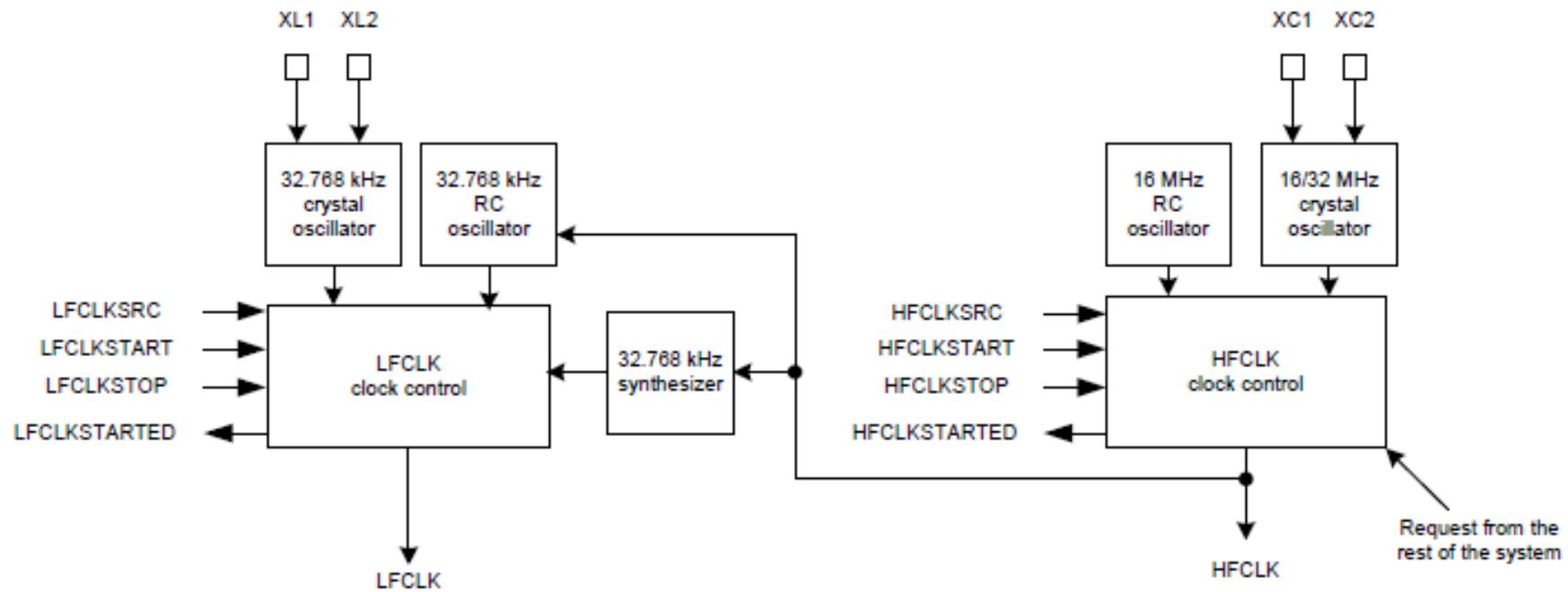
```
#define GPIO_LED_CONFIG(PIN_NO)
#define GPIO_BUTTON_CONFIG(PIN_NO)
```

```
#define GPIO_LED_CONFIG(PIN_NO) \
do \
{ \
    GPIO_PIN_CONFIG(PIN_NO, \
                    GPIO_PIN_CNF_DIR_Output, \
                    GPIO_PIN_CNF_INPUT_Disconnect, \
                    GPIO_PIN_CNF_PULL_Disabled, \
                    GPIO_PIN_CNF_DRIVE_S0S1, \
                    GPIO_PIN_CNF_SENSE_Disabled); \
} while (0)
```



# 振盪器

需要外掛16MHz振盪器，提供給RF使用，之後內部除頻產生32KHz  
也可以外掛32MHz振盪器，但是內部仍會轉為16MHz，由客戶自行決定



32.768KHz 振盪器是提供給Softdevice使用，  
 如果沒有外掛32.768KHz振盪器，以下程式記得要改變為內部RC 32.768KHz振盪器的設定  
 目前建議是用 "NRF\_CLOCK\_LFCLKSRC\_RC\_250\_PPM\_4000MS\_CALIBRATION"  
 精準度會比較符合外部振盪器，耗電約比外部32.768KHz 多10uA

```
static void ble_stack_init(void)
{
    BLE_STACK_HANDLER_INIT(NRF_CLOCK_LFCLKSRC_RC_250_PPM_4000MS_CALIBRATION,
                           BLE_L2CAP_MTU_DEF,
                           ble_evt_dispatch,
                           false);
}
```

## Nrf\_sdm.h

```
'-----'
enum {
    NRF_CLOCK_LFCLKSRC_RC_250_PPM_500MS_CALIBRATION, /*< LFCLK RC oscillator, 500ms calibration interval.*/
    NRF_CLOCK_LFCLKSRC_RC_250_PPM_1000MS_CALIBRATION, /*< LFCLK RC oscillator, 1000ms calibration interval.*/
    NRF_CLOCK_LFCLKSRC_RC_250_PPM_2000MS_CALIBRATION, /*< LFCLK RC oscillator, 2000ms calibration interval.*/
    NRF_CLOCK_LFCLKSRC_RC_250_PPM_4000MS_CALIBRATION, /*< LFCLK RC oscillator, 4000ms calibration interval.*/
    NRF_CLOCK_LFCLKSRC_RC_250_PPM_8000MS_CALIBRATION, /*< LFCLK RC oscillator, 8000ms calibration interval.*/
    NRF_CLOCK_LFCLKSRC_SYNTH_250_PPM, /*< LFCLK Synthesized from HFCLK.*/
    NRF_CLOCK_LFCLKSRC_XTAL_500_PPM, /*< LFCLK crystal oscillator 500 PPM accuracy.*/
    NRF_CLOCK_LFCLKSRC_XTAL_250_PPM, /*< LFCLK crystal oscillator 250 PPM accuracy.*/
    NRF_CLOCK_LFCLKSRC_XTAL_150_PPM, /*< LFCLK crystal oscillator 150 PPM accuracy.*/
    NRF_CLOCK_LFCLKSRC_XTAL_100_PPM, /*< LFCLK crystal oscillator 100 PPM accuracy.*/
    NRF_CLOCK_LFCLKSRC_XTAL_75_PPM, /*< LFCLK crystal oscillator 75 PPM accuracy.*/
    NRF_CLOCK_LFCLKSRC_XTAL_50_PPM, /*< LFCLK crystal oscillator 50 PPM accuracy.*/
    NRF_CLOCK_LFCLKSRC_XTAL_30_PPM, /*< LFCLK crystal oscillator 30 PPM accuracy.*/
    NRF_CLOCK_LFCLKSRC_XTAL_20_PPM, /*< LFCLK crystal oscillator 20 PPM accuracy.*/
};
```

## Timer setting

$$f_{\text{TIMER}} = \frac{HFCLK}{2^{\text{PRESCALER}}}$$

Prescaler	Bitmode	Resolution	Overflow
0	8 bit	62.5 ns	16 µs
0	16 bit	62.5 ns	4096 µs
0	24 bit	62.5 ns	104.85 ms <sup>1</sup>
0	32 bit	62.5 ns	268.43 s <sup>1</sup> .
4	8 bit	1 µs	256 µs
4	16 bit	1 µs	65.53 ms <sup>1</sup> .
4	24 bit	1 µs	16.77 s <sup>1</sup> .
4	32 bit	1 µs	4294.96 s <sup>1</sup> .
9	8 bit	32 µs	8192 µs
9	16 bit	32 µs	2097.15 ms <sup>1</sup> .
9	24 bit	32 µs	536.87 s <sup>1</sup> .
9	32 bit	32 µs	38.17 hours <sup>1</sup> .

1. Values to two decimal places.

```
NRF_TIMER1->MODE = TIMER_MODE_MODE_Timer;
NRF_TIMER1->BITMODE = TIMER_BITMODE_BITMODE_16Bit;
// (Prescaler = 9 : 32us)->(32us * 31.25 = 1ms)->(1ms * 1000 = 1s)
NRF_TIMER1->PRESCALER = 9;           // 31.25kHz    32us tick
NRF_TIMER1->TASKS_CLEAR = 1;         // Clear the timer
NRF_TIMER1->CC[0] = (1000 * 31);     // CC[0] occurs at 1000 ms from START (31.25 * 32us )
NRF_TIMER1->CC[0] += (1000 / 4);

NRF_TIMER1->TASKS_START = 1;
```

## 6.4 Programmable Peripheral Interconnect (PPI)

When the SoftDevice is enabled, the PPI is restricted with only some PPI channels and groups available to the application. *Table 6* shows how channels and groups are assigned between the application and SoftDevice.

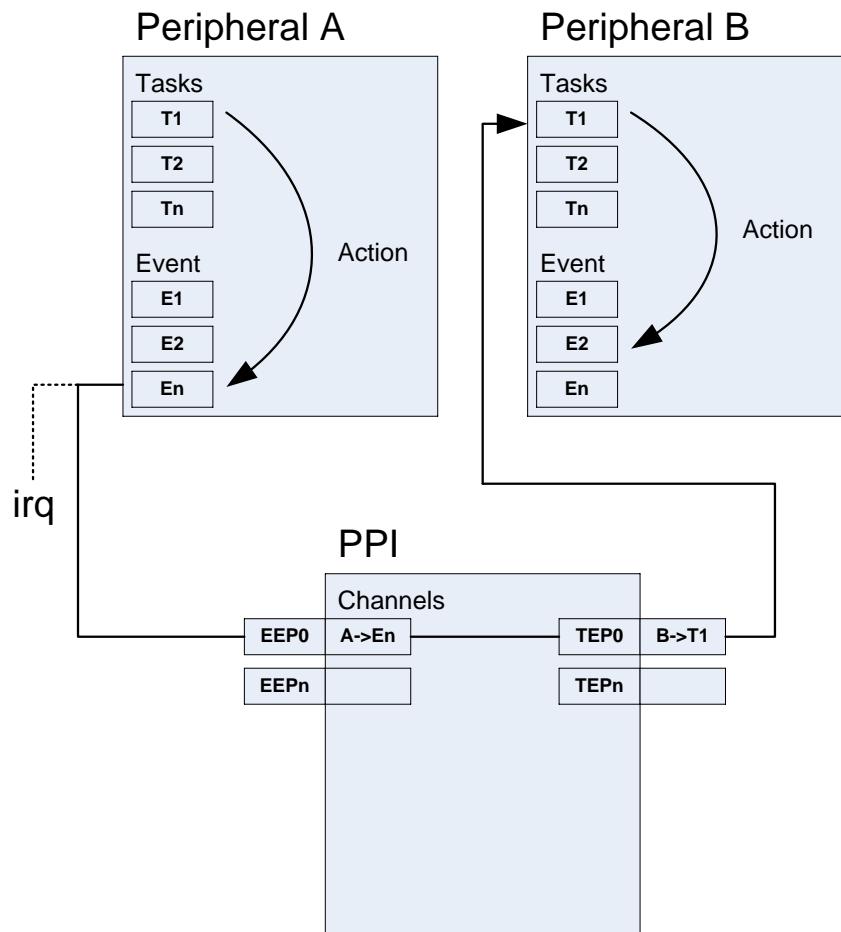
**Note:** All PPI channels are available to the application when the SoftDevice is disabled.

PPI channel allocation	S110 enabled	S110 disabled
Application	Channels 0 - 7	Channels 0 - 15
SoftDevice	Channels 8 - 15	-

PPI group allocation	S110 enabled	S110 disabled
Application	Groups 0 - 1	Groups 0 - 3
SoftDevice	Groups 2 - 3	-

- PPI Channel
  - Task End-Point (TEP)
  - Event End-Point(EEP)
  - Connect A.EVENT\_En to B. TASK\_Tn
- Interrupt (irq)
  - Generated by event
  - Independent of PPI Channel
  - Can be used to set/update next event that should trigger a task



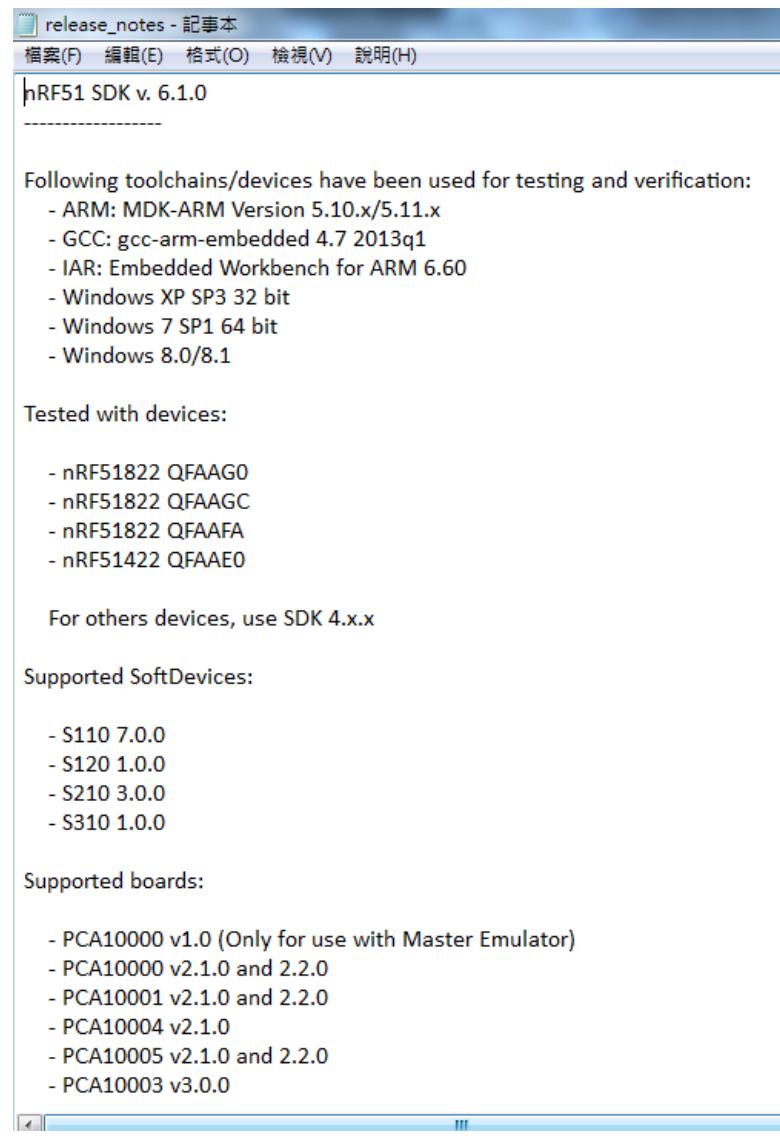
相關Sample code都可以在以下Document找到說明  
C:\Keil\ARM\Device\Nordic\Documentation\index.html

The screenshot shows a Microsoft Internet Explorer window with the following details:

- Title Bar:** nRF51 SDK - S110 SoftDevice: BLE Peripheral - Windows Internet Explorer provided by Avnet, Inc.
- Address Bar:** C:\Keil\ARM\Device\Nordic\Documentation\s110\html\index.html
- Toolbar:** 檔案(F) 編輯(E) 檢視(V) 我的最愛(A) 工具(T) 說明(H)
- Menu Bar:** 網頁快訊圖庫
- Content Area:**
  - NORDIC SEMICONDUCTOR logo**
  - nRF51 SDK - S110 SoftDevice**
  - Navigation Tabs:** Home, Related Pages, API Reference, Data Structures
  - Search Bar:** Search
  - Left Sidebar (nRF51 SDK - S110 SoftDevice):**
    - Introduction
    - Getting Started
    - Hardware Drivers
    - Libraries
    - Examples
      - BLE Peripheral
        - Bootloader/DFU - SoftDevice update support
        - Direct Test Mode
        - Hardware Peripheral Examples
        - Nordic proprietary protocols
      - User Guides
      - API Reference
      - Data Structures
  - Main Content:** See ble\_sdk\_apps\_seq\_diagrams for illustrations showing the flow of events for various application scenarios, both with and without the Scheduler.  
Examples:
    - Heart Rate Application
    - Heart Rate Application for Eval Board
    - Multiprotocol Application
    - Blood Glucose Application
    - Cycling Speed and Cadence Application
    - Blood Pressure Application
    - Alert Notification Application
    - HID Keyboard Application
    - HID Mouse Application
    - Health Thermometer Application
    - Proximity Application

Generated on Fri Aug 29 2014 16:26:34 for nRF51 SDK - S110 SoftDevice by doxygen 1.8.3.1

可以在以下路徑和文件, 找到目前安裝的SDK版本和對應的開發工具版本  
C:\Keil\ARM\Device\Nordic\Documentation\release\_notes.txt



release\_notes - 記事本

檔案(F) 編輯(E) 格式(O) 檢視(V) 說明(H)

nRF51 SDK v. 6.1.0

-----

Following toolchains/devices have been used for testing and verification:

- ARM: MDK-ARM Version 5.10.x/5.11.x
- GCC: gcc-arm-embedded 4.7 2013q1
- IAR: Embedded Workbench for ARM 6.60
- Windows XP SP3 32 bit
- Windows 7 SP1 64 bit
- Windows 8.0/8.1

Tested with devices:

- nRF51822 QFAAGO
- nRF51822 QFAAGC
- nRF51822 QFAAFA
- nRF51422 QFAAE0

For others devices, use SDK 4.x.x

Supported SoftDevices:

- S110 7.0.0
- S120 1.0.0
- S210 3.0.0
- S310 1.0.0

Supported boards:

- PCA10000 v1.0 (Only for use with Master Emulator)
- PCA10000 v2.1.0 and 2.2.0
- PCA10001 v2.1.0 and 2.2.0
- PCA10004 v2.1.0
- PCA10005 v2.1.0 and 2.2.0
- PCA10003 v3.0.0

請看範例程式介紹

## 安裝步驟

1. Keil C (ARM version : v5.0)
2. nRFgo Studio (v1.21.1), 安裝好之後會立刻安裝nRF Tools (J-Link Driver)
3. nRF v11.0.0 (解壓縮即可使用) 並安裝nRF5x\_MDK\_8\_5\_0\_Keil4.msi
4. Master Control Panel (MCP : v3.10.0)
5. Wireshark for Sniffer (Option)
6. nRFready Desktop 2 (Option)
7. Smart Remote 2 (Option)

# Website

## Nordic Website

- 新聞發布和分享訊息
- 註冊User name & Password, 之後就可以在官網下載檔案和發問問題

The screenshot shows the official website of Nordic Semiconductor. At the top, there is a navigation bar with links for "Site map" and "Login / Register". Below the navigation, there is a search bar with a "SEARCH" button. The main content area features the Nordic Semiconductor logo and the text "ULTRA LOW POWER WIRELESS SOLUTIONS". A banner for "Bluetooth Europe" is displayed, with the text "WHERE THE INTERNET OF THINGS CONNECTS" and "The place to experience the convergence of wireless technology with the Internet of Things (IoT)". A "REGISTER NOW" button is also present. The page includes sections for "Products" and "Applications", and a "MyPage Login" section which is highlighted with a red border.

**NORDIC SEMICONDUCTOR**

ULTRA LOW POWER WIRELESS SOLUTIONS

SEARCH ▶

Site map | Login / Register

關於我們 | CAREER | 產品 | 應用 | 支援 | 最新消息 | 投資者關係 | 線上購物 | 活動 | 開發人員專區

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μBlue™ Bluetooth low energy ICs/solutions

ANT™ 單晶片 ANT™ IC/解決方案

應用

運動和健身  
用於運動和健身監視器及感測器的 ANT™ 和 Bluetooth® 低功耗解決方案

PC 周邊產品  
用於麥克風、鍵盤、遙控器和 USB 硬體鎖的 ULP 無線解決方案

MYPAGE LOGIN

Username:  LOG IN

Password:

Forgot your password?  
Create a Nordic MyPage account  
Why become a member?

# 76

# Nordic Website – Product

- 可以在此網頁下載文件, HW/SW reference design....

關於我們 | CAREER | 產品 | 應用 | 支援 | 最新消息 | 投資者關係 | 線上購物 | 活動 | 開發人員專區

Home / 產品 / Bluetooth® 低功耗 / nRF51822

**產品**

**Bluetooth® 低功耗**  
μBlue™ Bluetooth low energy ICs/solutions

**ANT™**  
單晶片 ANT™ IC/解決方案

**2.4GHz RF**  
超低功耗 2.4GHz RF IC/解決方案

**Sub 1-GHz RF**  
低功耗 sub 1-GHz RF IC/解決方案

**nRF51822**  
藍牙低功耗和 2.4GHz 專利 SoC  
Active

**Replacement products** ▾  
+ Add to My Products

**OVERVIEW** **SPECIFICATION** **DEVELOPMENT TOOLS AND SOFTWARE** **REFERENCE DESIGNS** **DOWNLOADS**

**DESCRIPTION**

nRF51822 是功能強大、高靈活性的多協議 SoC，非常適用於 Bluetooth® 低功耗和 2.4GHz 超低功耗無線應用。nRF51822 根據配備 256kB flash + 16kB RAM 的 32 位元 ARM® Cortex™ M0 CPU 而建構。嵌入式 2.4GHz 收發器支援藍牙低功耗及 2.4GHz 連作，其中 2.4GHz 模式與 Nordic Semiconductor 的 nRF24L 系列產品無線相容。

nRF51822 還具備豐富的類比和數位周邊產品，可以在無需 CPU 參與的情況下透過可程式化周邊介面 (PPI) 系統進行互動。靈活的 31 針腳 GPIO 映射方案可使 I/O (例如序列介面、PWM 和正弦解調器) 根據 PCB 需求指示映射到任何設備針腳。這可在關於針腳位置與功能方面，達成完全的設計靈活性。

nRF51822 支援 S110 藍牙低功耗協定堆疊及 2.4GHz 協定堆疊 (包括 Gazzel)，這兩種協定堆疊在 nRF518 軟體開發套件中均免費提供。nRF51822 需要單獨供電，如果供電範圍在 1.8-3.6V 之間，使用者可選擇使用晶片上的線性整流器，如果供電範圍在 2.1-3.6V 之間，可以選擇直流 1.8V 模式和晶片上的 DCDC 變壓器。DC-DC 變壓器的使用可在工作期間動態控制，並使 nRF51822 運行期間的射頻峰值電流低於 10 mA @ 3V 供電 (TX @ 0 dBm & RX)。

nRF51822 具有 6x6mm 48 針腳 QFN 封裝和 3.5x3.8mm 64 球形直接晶片構裝之晶圓級封裝 (WLCSP)。

nRF51822 提供 256k 或 128kB Flash 容量的不同版本。

**Data sheet**  
**PDF**

## Nordic Website - MyPage

- 可以在此網頁詢問任何技術問題, 通常24Hr內會由Nordic AE回覆  
<http://www.nordicsemi.com/>



The screenshot shows the 'My page' section of the Nordic Semiconductor website. On the left, a sidebar menu includes 'MY PAGE' (selected), 'EDIT MY PROFILE', 'MY SUPPORT CASES', 'REGISTER NEW CASE' (highlighted with a red box), 'MY PRODUCTS ( 73 NEW )', 'MY KEYS', and 'MY DOWNLOADS ( 2 NEW )'. The main content area displays a welcome message for 'Atlas Chen' and a list of features available through the account. It also provides instructions for adding a product key and downloading resources.

MY PAGE

Atlas Chen

[Edit profile](#)

Welcome to your My Page account from where you can:

- Contact our technical support team (see MY CASES below to track your support cases that are currently being resolved, or REGISTER NEW CASE to the left).
- Get automatic updates on specific products (see MY PRODUCTS below).
- Get automatic updates on technical documents you have downloaded plus an archive of all previous downloads (see MY DOWNLOADS below).
- Give colleagues read access to your support cases.
- Get exclusive access to product-related downloads that are not available to unregistered users.
- Subscribe to Nordic's ULP Wireless Quarter (go to EDIT MY PROFILE).

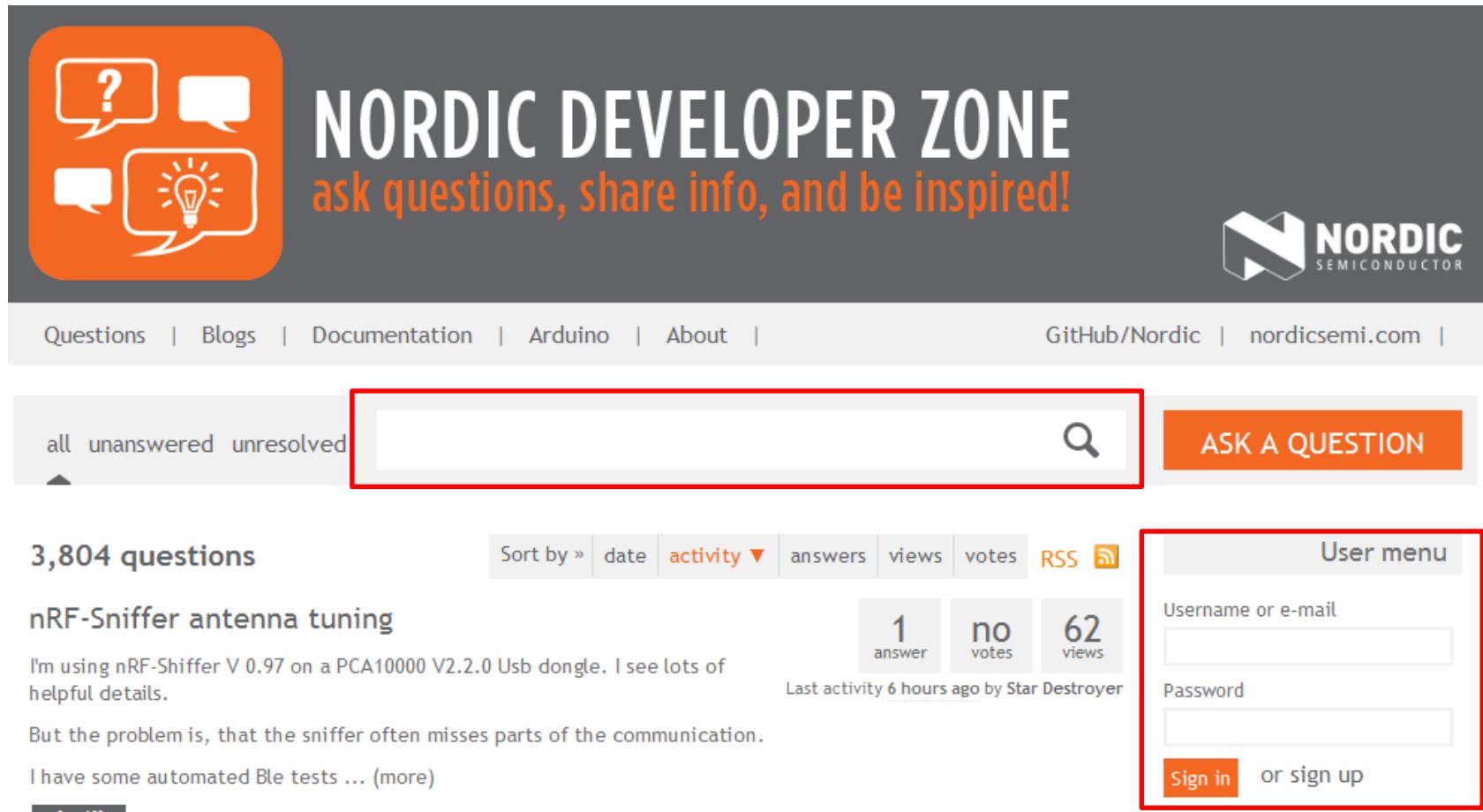
By purchasing a development kit from Nordic Semiconductor, a product key is given to access relevant downloads.

Procedure for adding a Product key and downloading resources:

1. Click My Keys in the left menu.
2. Enter the product key in the Product key field and click Add. (The product key is printed on your kit package)
3. Click My Products in the left menu.

## Nordic Website – Developer Zone

- 可以在此網頁尋找相關問題和發問，更能有效的解決較急的問題  
<https://devzone.nordicsemi.com/questions/>



The screenshot shows the homepage of the Nordic Developer Zone. At the top left is an orange icon containing four white speech bubbles: one with a question mark, one with a checkmark, one with a lightbulb, and one with a plus sign. To the right of the icon is the text "NORDIC DEVELOPER ZONE" in large white letters, followed by "ask questions, share info, and be inspired!" in orange. On the far right is the Nordic Semiconductor logo. Below the header, there's a navigation bar with links for "Questions", "Blogs", "Documentation", "Arduino", "About", "GitHub/Nordic", "nordicsemi.com", and "ASK A QUESTION". A search bar is positioned below the navigation, with a red box drawn around it. To the left of the search bar is a dropdown menu showing "all unanswered unresolved". Below the search bar are sorting options: "Sort by » date activity ▼ answers views votes RSS". To the right of the search bar are statistics: "1 answer", "no votes", and "62 views". A note says "Last activity 6 hours ago by Star Destroyer". On the far right, there's a "User menu" section with fields for "Username or e-mail" and "Password", and buttons for "Sign in" and "or sign up".

<https://www.bluetooth.org/en-us>



English | 日本語 | 한국어 | 简体中文

Search...



Members News & Events Bluetooth Brand Marketing Work Groups Specification Test & Qualification Training Resources Help & Support

A large banner for the UnPlugFest 49 event. On the left is a photograph of the Brandenburg Gate in Berlin, illuminated with green lights. Overlaid text reads: "UnPlugFest 49", "27-30 October 2014", and "Berlin, Germany". A circular badge for the "Breakthrough Awards 2015" is visible. A dark overlay bar at the bottom contains the text "Registration Now Open — [Learn More](#)".

Registration Now Open — [Learn More](#)

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- [Marketing Forum Webinar](#)  
1 October 2014
- [UnPlugFest 49](#)  
Berlin, Germany

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## SIG的Core 4.2和Profile/Service文件

<https://www.bluetooth.org/en-us/specification/adopted-specifications>

### Bluetooth Qualification Test Requirements

If you are looking for more information about the Bluetooth Qualification Testing Requirements, please visit the [Qualification Test Requirements](#) page.

### Adopted Bluetooth Core Specifications

Specification	Date Adopted	Status	Date Deprecated	Date Withdrawn
Core Version 4.2	02 December 2014	Active		
Core Specification Supplement (CSS) v5	02 December 2014	Active		

### Adopted Bluetooth Profiles, Services, Protocols and Transports

To view the structure of definitions that are used in the adopted GATT profiles, services, and characteristics use the [XML Definition Browser](#). You can also download the definitions in an XML format.

GATT-Based Specifications					
Profile Specification		Version	Status	Date Adopted	Date Deprecated
ANP	Alert Notification Profile	1.0	Active	13 September 2011	
ANS	Alert Notification Service	1.0	Active	13 September 2011	
BAS	Battery Service	1.0	Active	27 December 2011	
BCS	Body Composition Service	1.0	Active	21 October 2014	
BLP	Blood Pressure Profile	1.0	Active	25 October 2011	
BLS	Blood Pressure Service	1.0	Active	25 October 2011	

# Others

# 如何辨別IC Build code

○ N51822  
 QFAAH0  
 YYWWLL

N51 — nRF51 Series  
 822 — Part code  
 QF — Package code  
 AA — Variant code  
 H0 — Build code  
 YY — Year  
 WW — Week  
 LL — Wafer lot code

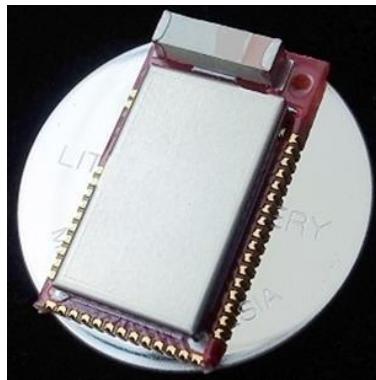
nRF51822 IC revision	Device marking			Package	Flash [kB]	RAM [kB]
	Packet/ Variant	Build code	HWID			
1	QF AA	CA	001D	QFN48	256	16
		Co	001D			
	QF AB	AA	0026		128	
		Ao	0027			
	CE AA	BA	0020	WLCSP	256	
		Bo	002F			
2	QF AA	FA0	002A	QFN48	256	16
		GCo	0044			
		Gx0 <sup>a</sup>	003C			
	QF AB	Bx0 <sup>a</sup>	004C		128	
		CA0	0040	WLCSP	256	
		DA0	0047			
3	CE AA	Dx0 <sup>a</sup>	004D			
		Hx0 <sup>a</sup>	0072	QFN48	256	16
		Cx0 <sup>a</sup>	007B		128	
	QF AC <sup>b</sup>	Ax0 <sup>a</sup>	0083		256	32
		CD AB <sup>c</sup>	Ax0 <sup>a</sup>	WLCSP	128	16
		CE AA	Ex0 <sup>a</sup>		256	
	CF AC <sup>b</sup>	Ax0 <sup>a</sup>	0087			32

## IC版本與SD, SDK版本對照表

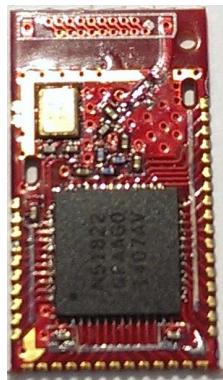
nRF51 IC revision	Chip	Documentation						Reference design files			
		Product Specification		Reference Manual		Product Anomaly Notice		Product Change Notification <sup>a</sup>			
1	nRF51422	nRF51422 PS v1.2		nRF51 RM v1.1		nRF51422-PAN v2.3					
	nRF51822	nRF51822 PS v1.3				nRF51822-PAN v2.4					
2	nRF51422	nRF51422 PS v2.1		nRF51 RM v2.1		nRF51422-PAN v2.3		PCN-084 v1.0		2.4	1.3
	nRF51822	nRF51822 PS v2.0				nRF51822-PAN v2.4		PCN-082 v1.0			
3	nRF51422	nRF51422 PS v3.1		nRF51 RM v3.0		nRF51422-PAN v3.0		PCN-093 v1.1		2.4	1.3
	nRF51822	nRF51822 PS v3.1				nRF51822-PAN v3.0		PCN-092 v1.1			

nRF51 IC rev.	nRF51 SDK	SoftDevices									
		nRF51422/nRF51822						nRF51422			
		S110		S120		S130		S210		S310	
		SD	SDS	SD	SDS	SD	SDS	SD	SDS	SD	SDS
1	4.4.2	5.2.1 <sup>a</sup>	1.1	-	-	-	-	2.0.0 <sup>b</sup>	1.0	-	-
2	4.4.2	5.2.1	1.1	-	-	-	-	3.0.0	1.2	-	-
	5.2.0	6.0.0 6.2.1	1.2					3.0.0	1.2	1.0.0	1.0
	6.1.0	7.0.0 7.1.0	1.3	1.0.1	1.1			3.0.0	1.2	1.0.0	1.0
	-	8.0.0	2.0	2.0.0	2.1			4.0.1	2.0	2.0.1	2.0
	6.1.0	7.1.0	1.3	1.0.1	1.1	0.5.0-1 alpha	0.5	3.0.0	1.2	1.0.0	1.0
3	7.0.1							4.0.1	2.0	-	-
	7.1.0							4.0.1	2.0	2.0.1	2.0
	7.2.0							4.0.1	2.0	-	-
	8.0.0										
	8.1.0							0.9.0-1 alpha	0.5		
								1.0.0	1.0		

18 x 10 x 3.2



8.6 x 8 x 1.5



**(First Certification Application)**

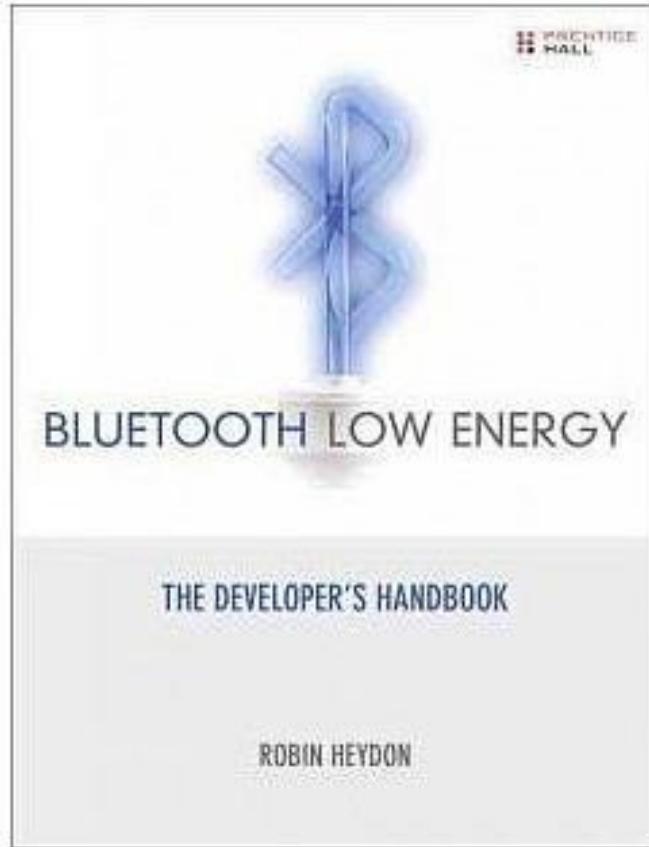
	Chip-on-board Built Up Product	Apply Raytac Module MDBT40 to Build Product	Raytac Module Saving
Declaration ID	US\$8,000	US\$8,000	
BQB Test	US\$7,000	US\$2,000 (*Note 1)	
USA FCC Test for BT4.0	US\$3,600	US\$0	
Japan Telec Test for BT4.0	US\$5,500	US\$0	
CE RF Certification	US\$4,500	US\$0	
IC (Canada) Certificate	US\$3,600	US\$0	
SRRC (China) Certificate	US\$8,500	US\$0	
Taiwan NCC	US\$3,600	US\$0	
CE & FCC Part 15B EMC Testing	US\$1,800	US\$1,800	
<b>Total</b>	<b>US\$46,100</b>	<b>US\$11,800</b>	<b>US\$34,300</b>

**(2nd and Later Series Product Certification Application)**

	Chip-on-board Built Up Product	Apply Raytac Module MDBT40 to Build Product	Raytac Module Saving
Declaration ID	US\$8,000	US\$0	
BQB Test	US\$7,000	US\$0	
USA FCC Test for BT4.0	US\$3,600	US\$0	
Japan Telec Test for BT4.0	US\$5,500	US\$0	
CE RF Certification	US\$4,500	US\$0	
IC (Canada) Certificate	US\$3,600	US\$0	
SRRC (China) Certificate	US\$8,500	US\$0	
Taiwan NCC	US\$3,600	US\$0	
CE & FCC Part 15B EMC Testing	US\$1,800	US\$1,800	
<b>Total</b>	<b>US\$46,100</b>	<b>US\$1,800</b>	<b>US\$44,300</b>
<b>Note:</b>	1. BQB test based on single profile 2. Declaration ID cost based on Adopter Membership	1. FCC & Telec applicant is Raytac (For the case of copy report to change the applicant, the cost is about US\$1800 for FCC & US\$2,800 for Telec)	

- Nordic Website : <http://www.nordicsemi.com/>
- Nordic InfoCenter : <http://infocenter.nordicsemi.com/index.jsp>
- Nordic Develop Zone : <https://devzone.nordicsemi.com/questions/>
- Nordic SDK : [https://developer.nordicsemi.com/nRF51\\_SDK/](https://developer.nordicsemi.com/nRF51_SDK/)
- Nordic Sample code : <https://github.com/NordicSemiconductor>
- SIG Website : <https://www.bluetooth.org/en-us>

# 參考書籍 (天瓏書局 1500)



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# Thank You !