

AN11664 QN902x Quick Start Guide Rev. 3 — 17 April 2018

Application note

Document information

Info	Content
Keywords	mini DK, SDK, installation, working mode, download, NVDS configuration, connect, GPIO configuration
Abstract	This application note discusses the use of QN9020 mini Development Kit (DK) for evaluating and developing Bluetooth Low Energy (BLE) solutions based on QN902x.



Revision history

Rev	Date	Description
3	20180417	Updated figures.
2	20160615	Added "IAR" in <u>Section 1.2.2</u> .
		 Updated <u>Section 2.2</u>, <u>Section 4.2.4</u>, <u>Section 5.1.1.3</u>, <u>Section 5.4.2</u>,
		 In <u>Section 3.3.1</u> added <u>Figure 5</u>.
		 In <u>Section 4.2</u> updated title "QBlue SDK GUI".
		 In <u>Section 5.1.1.2</u> updated <u>Figure 13</u>.
		 In <u>Section 6.2.1.1</u> added <u>Figure 34</u>.
		 In <u>Section 6.2.1.2</u> updated <u>Figure 35</u> and in <u>Section 6.2.1.3</u> updated <u>Figure 36</u>.
		 Added figure title for <u>Figure 35</u>, <u>Figure 36</u>, and <u>Figure 37</u>.
1	20150605	Initial release

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1. Introduction

1.1 Overview

The QN9020 mini Development Kit (DK) is designed for evaluating and developing Bluetooth Low Energy (BLE) solutions based on QN902x. The purpose of this document is to give an overview of hardware and software included in the QN9020 mini DK. For more detailed information on BLE technology and software platform for QN9020, refer to *"QN9020 software developers guide"*.

1.2 System requirements

1.2.1 System requirements

The QN9020 mini DK has the following system requirements:

- a computer running with Windows XP, Windows 7 or Windows 8
- a computer with a minimum of 2 USB ports

Note: OS X (Mac) is not supported.

1.2.2 External resources

- Keil MDK-ARM
- J-Link software
- IAR

2. Contents of kit

2.1 Hardware

The QN9020 mini DK contains the following hardware components:

- mini DK board
- BLE dongle
- USB cable

The hardware components are shown in Figure 1.

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Note: mini DK can also be used for software development for QN9021. There is a difference between the GPIO for QN9021 and QN9020. For details, refer to the data sheet at https://www.nxp.com/documents/data_sheet/QN902X.pdf.

2.2 Software

The Software Development Kit (SDK) is named as QN902x_SDK_xxx.zip. Latest SDK version can be downloaded from NXP web http://www.nxp.com/products/microcontrollers-and-processors/more-processors/applicati on-specific-mcus-mpus/bluetooth-low-energy-ble/ulta-low-power-ble-system-on-chip-solu tion:QN9020?fpsp=1&tab=Design_Tools_Tab.

3. Getting started

3.1 System overview

The system consists of three parts; see Figure 2:

- mini DK board: It is used for developing Bluetooth Low Energy (BLE) applications based on QN9020. It comprises of onboard RF matching circuit and antenna, power supply, GPIO connector, buttons, and LEDs. The J-Link On-Board (OB) debugger is used to bridge QN9020 SWD and UART interface to PC, download program and debug from PC.
- BLE dongle: It is a Bluetooth Low Energy (BLE) device controlled by the QTool running on a PC. It works with the mini DK as a pair for evaluation and debugging. It is connected to a PC via USB.
- QN902xStudio: It is a software tool chain to work with the mini DK and BLE dongle.

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3.2 Software installation

Before connecting the mini DK board to the computer, install Keil MDK-ARM or IAR, QN902x_SDK_xxx.exe and Setup_JLink_Vxxx.exe. Keil is used in this document to show the instructions.

3.2.1 Keil MDK-ARM

Keil MDK-ARM can be downloaded and installed from the URL: <u>https://www.keil.com/download/product/;</u> see <u>Figure 3</u>. Version 4.5 or newer is recommended.



3.2.2 QN902x_SDK_xxx.exe

Install released SDK package QN902x_SDK_xxx.exe.

3.2.3 J-Link software

Download and install Setup_JLink_Vxxx.exe (Version 4.6.6 or newer is recommended) from <u>www.segger.com</u> based on the development environment; see <u>Figure 4</u>). All mini DK boards have their individual SEGGER ID (serial number) labeled at the back.



Note: The J-Link software also contains a USB driver for J-Link-OB.

3.3 Hardware setup

3.3.1 Hardware connection

Refer "QN9020 mini DK User Guide" for instructions to use the mini DK board.



3.3.2 Driver installation

Virtual COM Port (VCP) drivers make the USB device appear as an additional COM port on the PC. Application software accesses the USB device in the same way as it would access a standard COM port.

3.3.2.1 Driver for J-Link-OB

Driver for J-Link-OB is included in J-Link software; see <u>Section 3.2.3</u>. It is installed automatically while installing the J-Link software.

3.3.2.2 Driver for BLE dongle

Refer to "*Application Note AN-104*" for detailed installation. It can be downloaded from FTDI website <u>https://www.ftdichip.com/Support/Documents/AppNotes.htm</u>

This guide helps with the installation of the Combined Driver Model (CDM) driver from FTDI for the Microsoft windows operating system.



Installed drivers can be verified by checking the device manager in windows OS; see <u>Figure 7</u>. Two COM ports are added to the list. One is the USB serial port (COM5) indicating the BLE dongle. The other is a J-Link CDC UART port (COM4) for the J-Link-OB on mini DK board. The COM port number can be different for each computer. Therefore, it is always a good practice to check the ports with regards to the hardware connected.

Note: Ensure that correct COM port number is used when downloading the code and during evaluation using QTool. COM port assignments can be checked in the device manager.

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3.4 Working mode

QN9020 provides a flexible platform for wireless applications. It supports two working modes, wireless SoC mode and network processor mode. For detailed information related to the working modes, refer to *"QN9020 software developers guide"*.

3.4.1 Wireless SoC mode

In wireless SoC mode, link layer, host protocol, profiles and application run on QN9020. Figure 8 shows how QN9020 is used in SoC mode. Application examples use SoC mode.



3.4.2 Network processor mode

In network processor mode, the link layer, host protocols and profiles run on QN9020 whereas the application runs on external processor. The two components communicate via Easy ACI (Easy Application Controller Interface) over UART, provided in QN9020 SDK. For details, refer to the *"QN9020 easy ACI programming guide"*.





4. Components of QN902x SDK

When QN902x SDK is installed and executed, it opens a GUI referred to as QN902xStudio; see Figure 12. The GUI has links to various tools, BLE example codes, driver codes and detailed software/hardware guides.

4.1 SDK folder structure

Once installed, a folder is created in the main directory. The installation folder contains various subfolders; see Figure 11.

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4.1.1 BinFiles

This folder contains all binary files for sample applications provided in SDK.

4.1.2 Documents

Documents related to QN9020 SDK are found here.

4.1.3 Projects

This folder contains source code and project file in Keil and IAR for various BLE example applications.

4.1.4 Tools

This folder contains all tools with GUI in SDK to support application development.

4.2 QN902x SDK GUI

QN902x SDK provides a GUI for users. Figure 12 shows the start page after launching QN902x Studio.

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4.2.1 Tools

- QTool: QTool is a PC tool that controls the BLE dongle. It allows the user to set up a connection between the BLE USB dongle and the other BLE device. A detailed user manual for the QTool can be found in the software documentation ("QTool User Manual").
- QN902xISPStudio: QN902xISPStudio is a tool to download application binary file, data file or NVDS configuration file into QN90xx series of BLE devices. Refer to "QN902x ISP Studio Manual" for more information.
- QN902xNVDSConfigurator: It is a tool to add, edit and delete NVDS configuration data for BLE application development based on QN9020 platform. Refer to "QN902x NVDS Configurator Manual" for details.
- QN902xDriverTool: It is a PC tool to make it easier to write peripheral driver code for BLE application development based on the QN9020 platform. Refer to "QN902x Driver Tools Manual" for further details.
- Qn9020DevDBforIDE: This tool is used to add device database for QN9020 series chip into IDE, including ARM Keil MDK-ARM and IAR. Refer to "QN9020DevDBforIDE User Manual".

4.2.2 Documents

Software Doc in the documents area leads directly to a software document folder described in <u>Section 4.1.2</u>.

4.2.3 Project

Project area consists of three parts namely:

- BLE example: linked to the BLE folder under the projects folder; see Section 4.1.3.
- Driver example: linked to the driver folder under the projects folder; see <u>Section 4.1.3</u>.
- Example bin files: linked to the BinFiles folder; see Section 4.1.1.

4.2.4 Support

It consists of links to get more information about QN902x and support page.

- Homepage: http://www.nxp.com/
- Contact us: http://www.nxp.com/support/communities:COMMUNITIES

5. Quick start with demo

The QN9020 mini DK board can be shipped with some pre-loaded profile. A proximity profile is used here as an example to demonstrate how to start with QN902x Studio quickly. The proximity demo enables an interactive connection with the BLE dongle acting as a BLE master and mini DK board as a slave.

Note: All mini DK boards are in a deep sleep mode when powered-up. It means that the debug ports do not respond. To debug or start advertising and eventually connect, press BUTTON1 on the mini DK.

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5.1 Download file

5.1.1 Steps to download file with QN902xISPStudio

5.1.1.1 Step 1:

Start QN902x Studio.

5.1.1.2 Step 2:

Click 'QN902xISPStudio' on QN902x Studio start page; see menu in Figure 13.

Parameters	File
	Application
Device QN902X -	Open file
Covetal I.c Milz	calData\NXP_work\svn_dir\BinFiles\BinFiles_B2 🔫
	NRC Conferencias
	NVDS Configuration
	Open file
	•
COM Port COM67 -	
	Data
Baudrate 115200 🔻	Open file
	•
App Location FLASH	Options
	Download Application File
	Download Configuration File
	Verify
Data Addr 0x10000	Flash Lock
	OTA Start
Status	
	Device is not connection

5.1.1.3 Step 3:

Select UART interface, correct COM port and baudrate. Generally, the baud rate is 115200. Use the COM port for J-Link CDC UART port.

5.1.1.4 Step 4:

To locate the bin file, click "Open file" under application, and choose "proxr.bin". The demo bin files provided in QN902x SDK are located in

C:\NXP\QN902x_SDK_1.4.0\Projects\BLE\prj_proxr\keil\bin.

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5.1.1.5 Step 5:

Click the "Start" button on QN902xISPStudio and then press the "QN_RST" button on the board; see <u>Figure 15</u>. The bin file is downloaded to board automatically, once the "QN_RST" button is released. If the download is successful, a message pops up; see <u>Figure 16</u>.





If the bin file download fails, a message pops up; see <u>Figure 17</u>. If it occurs, perform the following:

- 1. Check the USB connection and whether LED1 and LED2 are ON.
- 2. Whenever the Start button is used to download files, press and release the QN_RST button on mini DK board to switch the board into boot mode.
- 3. Make sure that the COM port setting is correct on the system. The setting can be found in device manager; see <u>Figure 7</u>.



For QN920E, bootloader support Fast boot mode which may be needed in some special application. If you want to enable fast boot mode, please config the ISP Studio before downloading. See Figure 18.

Help Options	
Par Fast boot (for QN902	2X_B4)
Device QN902X	Application Open file
Interface UART V	NVDS Configuration Open file
COM Port COM3 Baudrate 115200	Data Open file
App Location FLASH	Options Download Application File Download Configuration File Download Configuration File
Data Addr 0x10000	Verify Flash Lock OTA Start
Status	
D	evice is not connection

For more information about the QN902xISPStudio tool, refer to the "QN902x ISP Studio Manual".

5.1.2 Download file in Keil

Keil can also be used to download the compiled bin file. If QN9020 is in sleep mode while programming, press BUTTON1 or BUTTON2 to wake up the mini DK. Figure 19 and Figure 20 show the error messages that pop up when QN9020 is in sleep mode and the user is trying to program through Keil.

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<u>^</u>	Error: Flash	Download f	ailed - Targe	t DLL has bee	n cancelled
					确定

5.2 Configure BLE device

Use NVDS configurator tool and configure the BLE device address, name, etc. This configuration data is stored in the NVDS area of flash. The NVDS configurator makes it easier to add, edit and delete the configuration data. The tool is also used to burn the configuration data to target chip, or dump it from the chip. For more information on this tool, refer to the *"QN902x NVDS Configurator Manual"*.

5.2.1 Steps to configure BLE device

5.2.1.1 Step 1:

To start NVDS configurator, Click QN902xNVDSConfigurator button on QN902x Studio start page; see Figure 21.

	Tools	Project
1. 2. 4 16 1	QN902x QTool	BLE Example
Introducing QN902x Studio, the wireless System-on-Chip for Bluetooth Smart	(ISP) QN902xlSPStudio	Driver Example
applications - Ultra low power - High performance	QN902xNVDSConfigurator	Example Bin files
Integrated 2.4GHz adio		Support
Integrated Microcontroller Compact size		🟠 Homepage
Contact us to learn more about our Qn902x Studio products for Bluetooth Smart applications.	QN902xDevDBforlDE	Contact Us
1 124	Documents	
Bluetooth	Documents	G Quit

5.2.1.2 Step 2:

Choose the corresponding UART COM port and click connect button on the "Connect" dialog; see Figure 22.

Tag ID Label	Data Type Value
Report Tax	Connect Crystal: 16MHz Interface (UART(COM3) Baudrate: 115200 Auto connect Connect Quit

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5.2.1.3 Step 3:

Press "QN_RST" button on the mini DK board and then release it to connect the board; see <u>Figure 15</u>. Once connected, it shows configurable items; see <u>Figure 23</u>.

T	Label	Data Tura	Maker
	Laber	Data Type	value
1	Bluetooth device ad	BD Addr	08 7C BE 00 00 00
2	Device name	String(NXP BLE
3	Clock Drift	Number	0x64
4	External wake-up time	Number	0x384
5	Oscillator wake-up t	Number	0x384
11	TK TYPE	Bool	False
12	ТК	String(111111
13	IRK	Array(H	01 5F E8 B4 56 07 8E 22 18 A6 7C E1 E4 BA 99 A5
14	CSRK	Array(H	02 45 30 DA 3A FC 81 48 F1 0D AD 2E 91 9D 57 7B
15	LTK	Array(H	BF 01 FB 9D 4E F3 BC 36 D8 74 F5 39 41 38 68 4C
16	XCSEL	Number	0x11
17	Temperature Offset	Number	0xFFFFFF38
18	ADC Scale	Number	0x3E8
19	ADC VCM	Number	0x1F4
Reset	Tag Reset All		Burn

Fig 23. NVDS configurator main window

The values can be changed according to specific requirement. However, the default value is recommended.

Table 1. Important labels

Labels	Description
Bluetooth device address	48-bit Bluetooth device address.
Device name	name of the BLE device to differentiate from other Bluetooth devices.
Clock drift	while using 32.768 kHz crystal oscillator, set it according to the specification of crystal used; recommended value is 100 ppm, to have margin for load variation and temperature change; while using 32 kHz RC oscillator, set it to 500 ppm.
External wake-up time/Oscillator wake-up time	900 μs (0x384) is recommended by default; while using 32 K low-power mode, it should be set as 3000 μs (0xBB8).
XCSEL	cap load of 16 MHz crystal oscillator; default value is 0x11; adjust according to the specific PCB design and crystal used in real applications.
ADC scale/ADC VCM	both parameters are for ADC and their values may be different for each chip; values are tested and calibrated while manufacturing.

5.2.1.4 Step 4:

Click value field of device name record and change the device name; see Figure 24.

Tag ID	Label	Data Type	Value
1	Bluetooth device ad	BD Addr	08 7C BE 00 00 00
2	Device name	String(NXP BLE
3	Clock Drift	Number	0x64
4	External wake-up time	Number	0x384
5	Oscillator wake-up t	Number	0x384
11	TK TYPE	Bool	False
12	ТК	String(111111
13	IRK	Array(H	01 5F E8 B4 56 07 8E 22 18 A6 7C E1 E4 BA 99 A5
14	CSRK	Array(H	02 45 30 DA 3A FC 81 48 F1 0D AD 2E 91 9D 57 7B
15	LTK	Array(H	BF 01 FB 9D 4E F3 BC 36 D8 74 F5 39 41 38 68 4C
16	XCSEL	Number	0x11
17	Temperature Offset	Number	0xFFFFFF38
18	ADC Scale	Number	0x3E8
19	ADC VCM	Number	0x1F4
Reset	Tag Reset All		Burn

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5.2.1.5 Step 5:

Click Burn button and write parameters back to QN9020; see Figure 25.

Tag ID	Lahel	Data Type	Value
1	Plustooth device ad	DD Addr	08 3C PE 04 04 04
2	Douico namo	String(NYP OTA
2	Clock Drift	Sumper.	0x64
4	External wake-up time	Number	0/284
7 C	Occillator wake-up time	Number	0x304
11		Rool	Ealco
12	TV	String(111111
12	TRK	Array(H	01 5E E8 P4 56 07 8E 22 18 46 7C E1 E4 PA 00 45
14	CSRK	Array(H	02 45 30 DA 3A EC 81 48 E1 0D AD 2E 91 9D 57 7B
15	ITK	Array(H	RE 01 ER 0D 4E E3 RC 36 D8 74 E5 30 41 38 68 4C
16	XCSEL	Number	0x8
17	Temperature Offset	Number	0xEEEEE78
18	ADC Scale	Number	0x3E3
10	ADC VCM	Number	0x1E2
15	ADC VON	Humber	UNITE .
			\sim
Reset	Tag Reset All		Burn

Fig 25. Burn configuration

5.3 Connection

When the mini DK board is powered-on or reset, it is in deep sleep mode. In this mode, LED2 is ON. The following are the LED indications:

- LED1 ON: It indicates that the application is connected. If it is flickering, it means that it is advertising.
- LED2 ON: It indicates that QN9020 is in the deep sleep state.

5.3.1 Steps to set up the connection between the mini DK board and BLE dongle

5.3.1.1 Step 1:

To switch the board into advertising mode and make it discoverable, press BUTTON1 as shown in <u>Figure 26</u>. The LED1 now starts flickering. The flashing frequency depends on the advertising interval. For the first 30 seconds, the application uses a short advertising interval. After 30 seconds, LED1 flashing frequency will be lower as the advertising interval has increased to around 1 sec. If BUTTON1 is pressed again, the application stops advertising and LED1 stops flashing. The application is back to deep sleep state.



5.3.1.2 Step 2:

Step 2: Start QTool from QN902x Studio start page. <u>Figure 27</u> shows the message that pops up for communication setting.

Seria	Port :	Settings			
Seria	al:	COM3	•	Update	
Baud	Irate:	230400	•	Update	
		Close current	t used port	Open	

5.3.1.3 Step 3:

Select the correct COM port for BLE dongle. It can be checked with the device manager. Press "Open" button in the dialog box. Figure 28 shows the resultant window. The device representing BLE dongle would be in idle state by default.

5.3.1.4 Step 4:

Select the item in "Devices". It shows the "Settings" area.

5.3.1.5 Step 5:

To switch to advertising mode, press BUTTON1 on mini DK board and press scan button shown in <u>Figure 28</u>. The discovered devices are now shown in "Devices" area.

Ve QN902x QTool	In							x
	iμ							
Address 087cbe040404	Name NXP_OTA	Address Type Public	State Idle	Role Undefined	Authentication	Enc	Settings Generic Mode Local ATT White List Server Discovery Mode: General • Device Found: 0 Scan Cant	icel
Local Device Traces	III I					•		

5.3.1.6 Step 6:

To initiate a connection, select the mini DK from the scan result and click the "Connect" button in settings block (see Figure 29).

ile Device Help										
Devices						Settings				
vddress	Name	Address Type	State	Role	Auti ^	Connection to peer	Peer ATT	Security	Client	
087cbe040405	NXP BLE	Public	Idle	Undefined		Connection Settings				
45f91feac87f		Random	Advertising	Undefined	Disa =	Min Connection Interv	al(6-3200):	24	\$	* 1.25ms = 30.00ms
8c859037d979		Public	Advertising	Undefined	Disa	Max Connection Interv	al(6-3200):	40		* 1.25ms = 50.00ms
5ba407e49d2c		Random	Advertising	Undefined	Disa					
087cbe040404		Public	Advertising	Undefined	Disa	Slave Latency(0-499):		0		
4632b04a6ce4		Random	Advertising	Undefined	Disa 🚽	Supervision Timeout(10-3200):	2000	۵	* 10ms = 20000.00ms
	III				+					Update
Local Device Traces						Establish Link				
743 L (PARAMS) Sta	tus: 0x11				*	Minimum CE length:	0			Maximum CE length: 65535
145 T(1700405) 50	tus. oniti								1	
744 +						White List			(Connect Cancel

The role of BLE dongle changes to master and the mini DK board acts as slave. The state of both devices is connected as shown in Figure 30.

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 QN902x 	QTool										l	- 0 - X
File Devi	ice Help											
Devices							Settings					
Address		Name	Address Type	State	Role	Auth ^	Connection to peer	Peer ATT	Security Client			
4 087cbe	040405	NXP BLE	Public	Connected	Master		Connection Settings					
087	7cbe040404		Public	Connected	Slave	Disal =	Min Connection Inter	val(6-3200):	24		* 1.25ms = 30	.00ms
f45	c89b1296a		Public	Advertising	Undefine	d Disal	Max Connection Inter	val(6-3200):	40	-	* 1.25ms = 50	.00ms
508	a407e49d2c		Random	Advertising	Undefine	d Disal	Slave Latency(0-499)	:	0			
400	71436fbc9		Random	Advertising	Undefine	d Disa	Supervision Timeout	10-22001-	2000		* 10me - 200	0.00me
4							Supervision rimeou	10 5200).	2000		20113 - 2001	
												Update
1212 {P, 1213 {P, 1214 + 1215 + 1216 Ch	ARAMS} Ran ARAMS} Add	idom Addre: dress Type: (ress Request	ss: 087cbe040404 0x00 				White List	. U 💌			Connect	Cancel
4218 <tx< td=""><td><> <nxp ble<="" td=""><td>> CMD(SMF</td><td>C_CHK_BD_ADDF</td><td>REQ_RSP)</td><td></td><td></td><td>Connection Handle: Remote Information</td><td>0x0000</td><td></td><td></td><td></td><td>Disconnect</td></nxp></td></tx<>	<> <nxp ble<="" td=""><td>> CMD(SMF</td><td>C_CHK_BD_ADDF</td><td>REQ_RSP)</td><td></td><td></td><td>Connection Handle: Remote Information</td><td>0x0000</td><td></td><td></td><td></td><td>Disconnect</td></nxp>	> CMD(SMF	C_CHK_BD_ADDF	REQ_RSP)			Connection Handle: Remote Information	0x0000				Disconnect
4220 {P	ARAMS} Con	nection Inde	ex: 0x00				Version: Company ID:					
4221 {P	ARAMS} Stat	tus - Found o	pr Not: 0				Features:					Road
1000 1100	ARAMS3 Link	Security Sta	atus: 0x00									rvead

5.4 Function operation

Various interactions between mini DK board and BLE dongle can be performed when connected.

5.4.1 Find me

Steps to simulate "to find the mini DK board" are discussed below.

5.4.1.1 Step 1:

Click "Client" tab and "PROXM" tab in settings area (see Figure 31).

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ile Device Help														
Devices							Settings			-	~			
Address	Name	Address Type	State	Role	Authentication	E *	Connection to peer	Peer AT	T Sec	urity Clie	nt)	-	8	
087cbe040405	NXP BLE	Public	Connected	Master			DISC BASC	BLPC F	INDL	GLPC HIN	C HTPC	PROXM	SCPPC T	IPC ANPC
087cbe04040 f45c89b1296a 5ba407e49d2	4 1	Public Public Random	Connected Advertising Advertising	Slave Undefined	Disable Disable		Proximity Monitor							Enable
6e32f1411402 40c71436fbc9	2	Random Random	Advertising Advertising	Undefined Undefined	Disable Disable	с с.	Link Loss Service Alert Level:	w.					Read	Write
Local Device Traces	Ш					F	Tx Power Service Tx Power Value:	0						Read
1212 {PARAMS} Ri 1213 {PARAMS} A	andom Address: ddress Type: 0x	087cbe040404 00					Immediate ALert Se Alert Level: No Alert	T						Write
214 *					*									

5.4.1.2 Step 2:

To make discovered services editable, click the "Enable" button.

5.4.1.3 Step 3:

Set the alert level in the "Immediate Alert Service" area to medium or high.

5.4.1.4 Step 4:

Click "Write" button. The mini DK board sounds an alert with the help of a buzzer. Proximity alerts are indicated using the buzzer. The volume of the buzzer indicates the type of alert.

5.4.2 Disconnect

There are two options to disconnect the RF link between two devices.

- 1. Click "disconnect" button in "Connection to peer" tab; see <u>Figure 30</u>. The device disconnects with no response.
- 2. If the two devices are moved away from each other, the RF link may break. In such a case, the mini DK board responds with an alert.

5.4.3 Others

When buzzer is ON, press BUTTON2 to turn-off the buzzer.

6. Advanced application development

According to specific requirement, it may be necessary to add some peripheral functions such as button, LED, and buzzer. Useful tools are provided to help with implementation. It is easier to implement specific functions observing the sample codes in QN902x SDK.

6.1 Add driver file

Suppose that it is required to implement button control, which needs GPIO definition. It is easy to implement it by using the Keil development tool. By default, there is a folder named "driver" at *C:\NXP\QN902x_SDK_x.x.x\Projects\BLE\src*. All peripheral function source codes are included here. The relevant driver files can be added to the project in Keil, as shown in Figure 32.

Project		Ф		📋 app	_qpps_
.	🗋 app_ga	tt_task.c	▲	1 6]/**
.	app_sm	np.c		2	***
.	app_sm	np_task.c		3	*
.	app_dis	SS.C		4	* la
.	app dis	ss task.c		6	* @
		DS.C		7	*
		ps task.c		8	* C
+	app of	as task c		9	* A
	profiles	as_cashe		10	*
	drivers			11	* Ş
	uar 🔊	Options for Group 'd	lrivers'	Alt	+F7
) gpi	Add New Item to Gr	oup 'dri	vers'	
.	🗋 slee 📒	Add Existing Files to	Group '	drivers'	_
.) sys	Remove Group 'drive	ers' and	its Files	
±) wd	Open Build Log			
.	🗅 tim 🙀	Rebuild all target files			
.	🗋 rtc. 🚟	Build Target	2		E7
.	🗋 seri	build rarget			
.	🗋 ado 📥	Manage Project Item	S		
+	🗋 rng 🗸	Show Include File De	penden	cies	
e	lib			25	***
	🖕 qn_ota	_b2.lib		26	*/
] qn_ota	_b4.lib		21	#inc
	👌 qn9020	b2_lib_peripheral_v4		29	#THC
	👌 qn9020	b2_lib_peripheral_v4		30 E]#if
	👌 qn9020	b4_lib_peripheral_v4		31	#inc
	an9020	b4 lib peripheral v		32	

To study how to use the peripheral functions, open the dedicated peripheral driver files, typically located in "C:\NXP\QN902x_SDK_x.x.x\Projects\Driver". Open the required project and directly download to the mini DK board. Modify it according to the specific requirements.

Organize • Include i	902x_SDK_1.4.0\Projects\Driver\gpio\keil n library ▼ Share with ▼ New fol	der
Favorites Favorites Cesktop Cownloads Central OneDrive Recent Places	Name gpio.uvopt gpio.uvproj	Date modified 2018/4/10 11:09 2018/4/10 11:09
Fig 33. Adding a driver fi	e	

Double-click "gpio.uvproj" and open it using Keil; see Figure 34.

	- Sho-rember
Project: gpio	46
🖻 🕶 gpio	47 uint32_t result;
🗆 😂 startup	48 enum gpio_level result_level;
) startup s	49
- startupis	50 /* Main Program */
🖯 🛥 system	51 int main (void)
I system.c	52 甲 (
🖃 😂 driver	53
III adc.c	54 SystemInit();
	55
analogic	56 /* Initialize GPIO */
dma.c	57 gpio_init(cb_gpio);
gpio.c	58
⊕-□ i2c.c	59 ##if GPIO_INTERRUPT_EXAMPLE == TRUE
e Down.c	60 /* set P1.4 and P1.5 to pull up */
	61 gpio_pull_set(GPIO_P14, GPIO_PULL_UP);
	62 gpio_pull_set(GPIO_P15, GPIO_PULL_UP);
	63
∃ sleep.c	64 /* set P1.4 and P1.5 direction to input*/
⊕ 🖵 spi.c	65 gpio_set_direction_field(GPIO_P14 GPIO_P15, (uint32_t)GPIO_INPUT);
B- Syscon c	66
a D timera	67 /* set P0.1 and P0.2 direction to output*/
a a umeric	68 gpio_set_direction_field(GPIO_P01 GPIO_P02, (uint32_t)GPIO_OUTPUT);
. uart.c	69
	70 /* set P0.1 and P0.2 to output low level*/
🖂 🔤 lib	71 gpio_write_pin_field(GPIO_P01 GPIO_P02, GPIO_LOW);
on902xb2 lib lite.lib	72
	73
- D	74 /* set P1.5 interrupt to rising edge*/
gpio_example.c	75 gpio_set_interrupt(GPIO_P14, GPIO_INT_RISING_EDGE);
	76
	77 /* set P1.5 interrupt to falling edge*/
	78 gpio_set_interrupt(GPIO_P15, GPIO_INT_FALLING_EDGE);
	79

The main function is in gpio_example.c.

6.2 GPIO MUX configuration

The GPIO pins are shared with digital or analog peripherals such as SPI, UART, I²C, and ADC. The function of IO can be configured in QN902xDriverTool, which generates the source code for the specific assignment of GPIO pins.

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6.2.1 Change GPIO function

6.2.1.1 Step 1:

Open "QN902xDriverTool" and select the right device; see Figure 35.

	Please Select Device	
	Please select device QN9020 (6x6mm Bluetooth 4.0) QN9021 (5x5mm Bluetooth 4.0)	
	ОК	
Fig 35. Device selection	on	

6.2.1.2 Step 2:

Choose IO icon; see Figure 36.

	QN902x Driver Tool - QnDriver1 - QN9020 (6x6mm Bluetooth 4.0)
	File Edit View Peripherals Window Help
	🗋 🚰 🛃 🐰 🐚 🕵 🚺 🏟 🕢 🗸
	QnDriver1 - QN9020 (6x6mm Bluetooth 4.0)
).	QN902xDriverTool

6.2.1.3 Step 3:

Select P2.6 and P2.6 as PWM function. To switch to P2.6, check the box at the left of pwml and click the refresh icon.



6.2.1.4 Step 4:

After the setting is completed, click OK button at the bottom right of the "QN902xDriverTools" window. The source code is generated automatically; see <u>Figure</u> 38.



6.2.2 Add PWM function to project

Open "system.c" which is at "C:\NXP\QN902x_SDK_x.x.x\Projects\BLE\prj_proxr\ src" by default.

Find "P26_GPIO_22_PIN_CTRL" in function "SystemIOCfg" and replace it with "P26_PWM1_PIN_CTRL". Save this file.

After adding above code to current project, compile the project, and download it to mini DK board to confirm the functionality.

Note:

1. For more information about how to enable related module, refer to example code at "C:\NXP\QN902x_SDK_1.4.0\Projects\Driver\adc\keil"

2. For more information on "QBlueDriverTools", refer to "QN902x Driver Tools Manual".

7. Trouble shooting

- 1. Bin file download failed while using QN902xISPStudio; see Section 5.1.1.5.
- 2. Bin file download failed while using Keil: Set the board in active mode and download again; see Section 5.1.2.
- 3. Error messages pop up while downloading application to mini DK board: To wake up the board and download again, press BUTTON1 or BUTTON2; see <u>Section 5.1.2</u>.

8. Abbreviations

Table 2. Abbreviations	
Acronym	Description
ACI	Application Control Interface
BLE	Bluetooth Low Energy
DK	Development Kit
EACI	Easy Application Control Interface
GPIO	General Purpose Input Output
ISP	In System Programming
SDK	Software Development Kit
SMP	Security Management Protocol
SoC	System-on-Chip
SPI	Serial Port Interface
SWD	Serial Wire Debug
UART	Universal Asynchronous Receiver Transmitter
USB	Universal Serial Bus

9. References

[1] QN9020 Easy ACI Programming Guide — Programming guide [11] http://www.keil.com — Keil website

- [2] QN902x QTool User Manual User manual
- [3] QN902x ISP Studio Manual Manual
- [4] QN902x NVDS Configuration Manual Configuration manual
- [5] QN902x Driver Tools Manual Tools manual
- [6] QN902xDevDBforIDE User Manual User manual
- [7] QN902x Software Developers Guide Developers guide
- [8] QN9020_mini_DK_User_Guide User guide
- [9] <u>http://www.keil.com/uvision/debug.asp</u> Keil website
- [10] http://www.segger.com Segger website

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Application note

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