BC66&BC66-NA

DFOTA Application Note

NB-IoT Module Series

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About the Document

Revision History

Version	Date	Author	Description
1.0	2018-08-28	Louis GU	Initial
2.0	2020-03-31	Milo WANG	1. Added applicable module BC66-NA. 2. Added the description of DFOTA over UART and examples thereof. 3. Added the description of DFOTA over CoAP and examples thereof.

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1 Introduction

Quectel BC66 and BC66-NA modules support DFOTA feature, which allows customers to update the firmware over the air.

Before firmware updating, a delta firmware package which contains only the differences between the source and the target firmware versions has to be obtained. In this way, the amount of data transmitted and the time taken can be reduced.

This document mainly describes how to update the firmware of Quectel BC66 and BC66-NA modules via DFOTA which can be implemented over HTTP, CoAP or UART port.

1.1. AT Command Syntax

AT commands are involved in the DFOTA procedures. This chapter mainly introduces the AT command types and responses as well as related definitions.

1.1.1. Definitions

- **<CR>** Carriage return character.
- **<LF>** Line feed character.
- **<...>** Parameter name. Angle brackets do not appear on command line.
- **[...]** Optional parameter of a command or an optional part of TA information response. Square brackets do not appear on command line. When an optional parameter is omitted, the new value equals its previous value or its default setting, unless otherwise specified.
- **Underline** Default setting of a parameter.

1.1.2. AT Command Syntax

The **AT** or **at** prefix must be added at the beginning of each command line. Entering **<CR>** will terminate a command line. Commands are usually followed by a response that includes **<CR><LF><response><CR><LF>**. Throughout this document, only the response **<response>** will be presented, **<CR><LF>** are omitted intentionally.

Table 1: Type of AT Commands and Responses

Test Command	**AT+<cmd>=?**	This command returns the list of parameters and value ranges set by the corresponding Write Command or internal processes.
Read Command	**AT+<cmd>?**	This command returns the currently set value of the parameter or parameters.
Write Command	**AT+<cmd>=<p1>[,<p2>[,<p3>[...]]]**	This command sets the user-definable parameter values.
Execution Command	**AT+<cmd>**	This command reads non-variable parameters affected by internal processes in the module.

2 DFOTA over HTTP

2.1. DFOTA Procedure over HTTP

The following chart illustrates the DFOTA procedure when the firmware package is stored on an HTTP server.

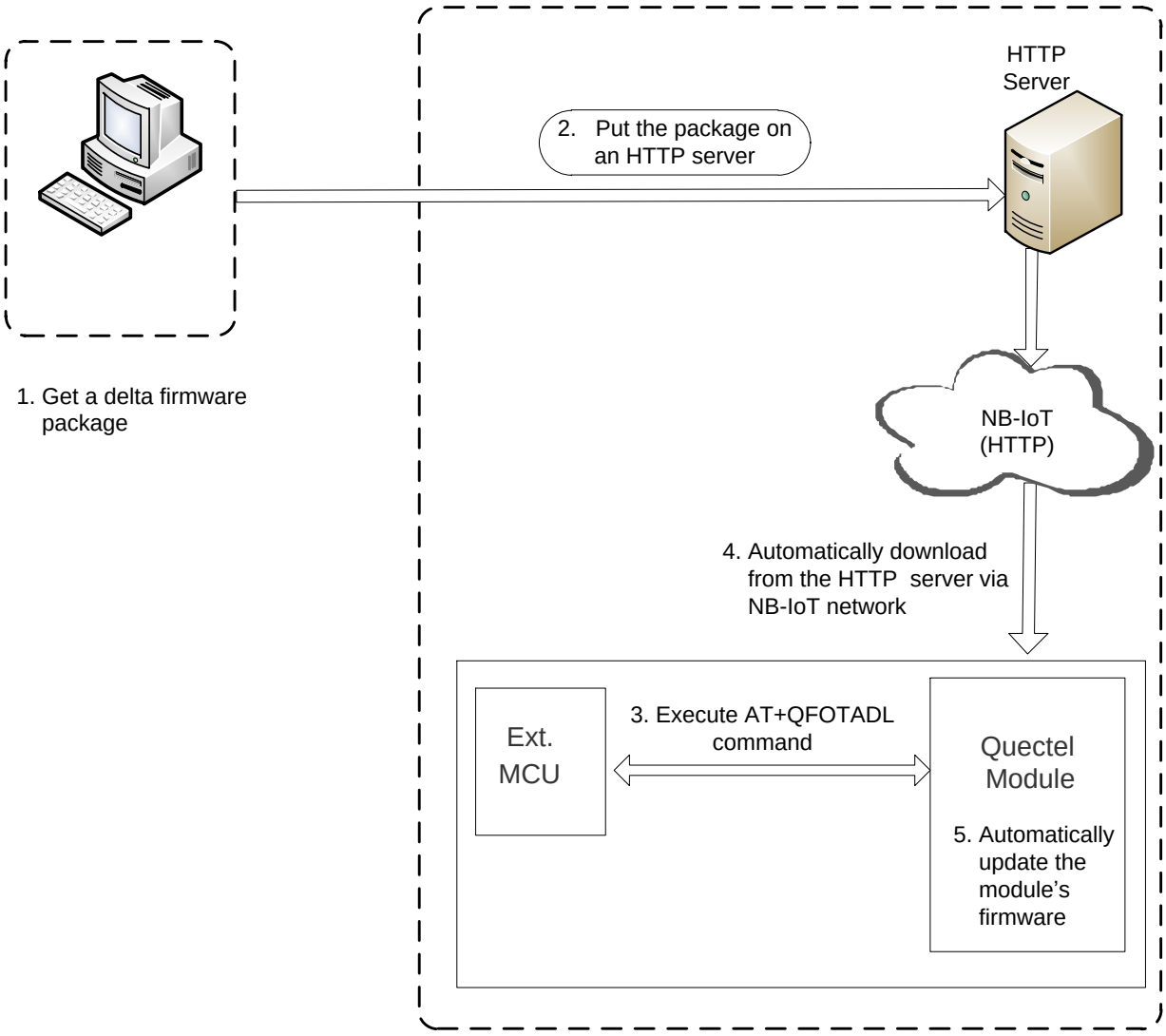

Figure 1: DFOTA Procedure over HTTP

As shown in the above figure, the following steps need to be performed to update the firmware when the firmware package is stored on an HTTP server:

Step 1: Get the delta firmware package from Quectel.
Step 2: Put the delta firmware package on an HTTP server.
Step 3: Execute **AT+QFOTADL** command.

After executing **AT+QFOTADL** command, the module will automatically download the package from the HTTP server via NB-IoT network (**Step 4**) and automatically update the firmware (**Step 5**).

2.1.1. Get Delta Firmware Package

Before updating, please check the source firmware version with **ATI** command and confirm the target firmware version, and then send the two firmware versions to Quectel or the module supplier to get a delta firmware package.

2.1.2. Put Delta firmware package on HTTP Server

Step 1: Please set up an HTTP server before using DFOTA function. (Quectel does not provide such servers.)
Step 2: Put the delta firmware package on the server, and record the storage path.
Step 3: The module acquires the delta firmware package from the path automatically after executing corresponding AT command.

2.1.3. Check Network Status

After the module is powered on, please check whether the module is registered on network before firmware updating.

The relevant AT commands are listed below:

- **AT+CESQ:** Query signal quality
- **AT+CEREG?:** Query network registration status
- **AT+CGPADDR=1:** Query the allocated IP address for the default PDN

For more details about the above commands, please refer to *Quectel_BC66&BC66-NA_AT_Commands_Manual*.

2.1.4. Execute AT Command to Update the Firmware

After the network status is ready, execute **AT+QFOTADL** command, and then the module will download the delta firmware package from the HTTP server over the air and update the firmware automatically.

2.2. DFOTA Related AT Command (over HTTP)

2.2.1. AT+QFOTADL=<HTTP_URL> Trigger Automatic DFOTA over HTTP

The write command is used to trigger the automatic firmware downloading and updating process.

When the delta firmware package is stored on HTTP server, executing **AT+QFOTADL=<HTTP_URL>** will make the module automatically download the delta firmware package from the HTTP server. If downloading is successful, the module will automatically update the firmware. When updating completes successfully, the module will reboot automatically, otherwise it will return an error, exit from DFOTA and continue to run on the source firmware version.

AT+QFOTADL=<HTTP_URL> Trigger Automatic DFOTA over HTTP	
Test Command **AT+QFOTADL=?**	Response **OK**
Write Command **AT+QFOTADL=<HTTP_URL>**	Response **OK** **+QIND: "FOTA","HTTPSTART"** **+QIND: "FOTA","DOWNLOADING",<percent>** **+QIND: "FOTA","DOWNLOADING",<percent>** **...** **+QIND: "FOTA","HTTPEND",<download_err>** **+QIND: "FOTA","START"** **+QIND: "FOTA","UPDATING",<percent>,<total_num>,<current_bin>** **+QIND: "FOTA","UPDATING",<percent>,<total_num>,<current_bin>** **...** **+QIND: "FOTA","END",<update_err>** If there is any error: **ERROR**
Maximum Response Time	300 ms

Characteristics	The command takes effect immediately. Remain invalid after deep-sleep wakeup. The configuration will not be saved to NVRAM.

Parameter

<HTTP_URL>	String type. The max length is 255 bytes. It should be started with “HTTP://”. For example: “HTTP://**<HTTP_server_URL>**:**<HTTP_port>**/**<HTTP_file_path>**”.	
	<HTTP_server_URL>	String type. The IP address or domain name of the HTTP server.
	<HTTP_port>	Integer type. The port of the HTTP server. Default value: 80. Range: 1–65535.
	<HTTP_file_path>	String type. The file path in HTTP server.
<download_err>	Integer type. The error code during downloading.	
	0	Downloaded successfully
	Others	Error code. Please refer to ***Chapter 7*** for more details.
<percent>	Integer type. The download or update progress in percentage.	
<total_num>	Integer type. Total number of programs to be updated. Currently it is always 1.	
<current_bin>	Integer type. The sequence number of the program being updated currently. Currently it is always 1.	
<update_err>	Integer type. The error code during updating.	
	0	Updated successfully
	Others	Error code. Please refer to ***Chapter 7*** for more details.

NOTES

1. If the module is powered off during "UPDATING" process, the module will automatically enter forced update mode. When it is powered on next time, it will continue to update. The update interface is shown as below:
   +QIND: "FOTA","START"
   +QIND: "FOTA","UPDATING",20%,1,1
   +QIND: "FOTA","UPDATING",30%,1,1
   ...
   +QIND: "FOTA","END",0
2. BC66 and BC66-NA modules do not support DFOTA over HTTPS currently.

3 DFOTA over UART

3.1. DFOTA Procedure over UART

This chapter introduces how to implement DFOTA over UART port of the module. Please follow the steps below to implement DFOTA over UART port:

Step 1: Execute **AT+QFUPLEX** to upload the delta firmware package to module through the UART port.
Step 2: Execute **AT+QFOTADL=1** to trigger automatic firmware update procedure, and then the module will complete the update procedure automatically.

3.2. DFOTA Related AT Commands (over UART)

3.2.1. AT+QFUPLEX Upload Delta Firmware Package to Module via UART

The write command writes and uploads the delta firmware package in sub-packets to the module through UART port.

AT+QFUPLEX Upload Delta Firmware Package to Module over UART	
Test Command **AT+QFUPLEX=?**	Response **AT+QFUPLEX=<blocksize>,<blocknum>[,<length>[,<timeout>]]** **AT+QFUPLEX=ESC** **OK**
Write Command **AT+QFUPLEX=<blocksize>,<blocknum>[,<length>[,<timeout>]]**	Response If the parameters are correct: **>** After **>** is responded, the module enters data mode, and then the sub-packet data can be entered. 1) When the length of the input data equals **<length>** and the data is written into flash and checked correctly: **+QFUPLEX: <writelen>**

	OK 2) When it fails to check the input data, or the length of the input data exceeds **<length>**: **ERROR** 3) When the length of inputted data is less than **<length>** when **<timeout>** reaches: **+QFUPLEX: -2,TIMEOUT** **ERROR** If the parameters are incorrect or there is any other error: **ERROR**
Write Command If no response is received after inputting data with the above write command, then this command can be used to exit data mode: **AT+QFUPLEX=ESC**	Response **+QFUPLEX: -1,ESC** **OK** Or **ERROR**
Maximum Response Time	300 ms
Characteristics	The command takes effect immediately. Remain invalid after deep-sleep wakeup. The configurations will not be saved to NVRAM.

Parameter

<blocksize>	Integer type. Length of each sub-packet in the delta firmware package. The values are 128, 256, 512, 1024, 2048, 4096 and 8192. Unit: byte.
<blocknum>	Integer type. Sequence number of the current sub-packet. The value starts from 0.
<length>	Integer type. Length of the sub-packet to be written. Unit: byte. This parameter must be used when the length of the last sub-packet does not reach **<blocksize>**, and the value should be the actual packet length plus 2. In other cases, this parameter can be omitted, and the default value will be taken if it is omitted. The default value is **<blocksize>** plus 2.
<timeout>	Integer type. The time waiting for data to be inputted to UART port. Unit: second. Default value: 6. Range: 1-60.
<writelen>	Integer type. Actual length of the written sub-packet. The value is **<length>** minus 2. Unit: byte.

NOTES

1. The DFOTA package needs to be written in sub-packets. It is necessary to add 2 bytes of CRC at the end of each sub-packet, with the checksum low byte first and high byte last. The CRC is implemented based on CCITT standard, and please refer to ***Chapter 3.3*** for the reference code.
2. It is recommended to take a fixed value for **<blocksize>** while uploading the same delta firmware package.
3. The sub-packets should be written in sequence. During data writing, if it fails to write the data and **ERROR** is returned, please re-try until the data is written successfully.
4. If no response is received after inputting data with **AT+QFUPLEX=<block_size>,<blocknum>[,<length>[,<timeout>]]**, please send **AT+QFUPLEX=ESC** to exit data mode first and then try to write the data again.

3.2.2. AT+QFOTADL=1 Trigger Automatic DFOTA over UART

AT+QFOTADL=1 is used to trigger the automatic firmware updating process after the delta firmware package is uploaded to module through UART port.

AT+QFOTADL=1 Trigger Automatic DFOTA over UART	
Test Command **AT+QFOTADL=?**	Response **OK**
Write Command **AT+QFOTADL=1**	Response **OK** **+QIND: "FOTA","START"** **+QIND: "FOTA","UPDATING",<percent>,<total_num>,<current_bin>** **+QIND: "FOTA","UPDATING",<percent>,<total_num>,<current_bin>** **...** **+QIND: "FOTA","END",<update_err>** If there is any error, response: **ERROR**
Maximum Response Time	300 ms
Characteristics	The command takes effect immediately. Remain invalid after deep-sleep wakeup. The configuration will not be saved to NVRAM.

Parameter

<download_err>	Integer type. The error code during downloading.	
	0	Updated successfully
	Others	Error code. Please refer to ***Chapter 7*** for more details.
<percent>	Integer type. The download or update progress in percentage.	
<total_num>	Integer type. Total number of programs to be updated. Currently it is always 1.	
<current_bin>	Integer type. The sequence number of the program being updated currently. Currently it is always 1.	
<update_err>	Integer type. The error code during updating.	
	0	Updated successfully
	Others	Error code. Please refer to ***Chapter 7*** for more details.

NOTE

If the module is powered off during "UPDATING" process, the module will automatically enter forced update mode. When it is powered on next time, it will continue to update. The update interface is shown as below:

+QIND: "FOTA","START"
+QIND: "FOTA","UPDATING",20%,1,1
+QIND: "FOTA","UPDATING",30%,1,1
...
+QIND: "FOTA","END",0

3.3. CRC-16-CCITT Reference Code

```
const unsigned short CRC16_CCITT_table[256]={

0x0,0x1021,0x2042,0x3063,0x4084,0x50a5,0x60c6,0x70e7,0x8108,0x9129,0xa14a,0xb16b,0xc18c,0xd1ad,0xe1ce,0xf1ef,

0x1231,0x210,0x3273,0x2252,0x52b5,0x4294,0x72f7,0x62d6,0x9339,0x8318,0xb37b,0xa35a,0xd3bd,0xc39c,0xf3ff,0xe3de,

0x2462,0x3443,0x420,0x1401,0x64e6,0x74c7,0x44a4,0x5485,0xa56a,0xb54b,0x8528,0x9509,0xe5ee,0xf5cf,0xc5ac,0xd58d,

0x3653,0x2672,0x1611,0x630,0x76d7,0x66f6,0x5695,0x46b4,0xb75b,0xa77a,0x9719,0x8738,0xf7df,0xe7fe,0xd79d,0xc7bc,

0x48c4,0x58e5,0x6886,0x78a7,0x840,0x1861,0x2802,0x3823,0xc9cc,0xd9ed,0xe98e,0xf9af,0x8948,0x
```

```
9969,0xa90a,0xb92b,

0x5af5,0x4ad4,0x7ab7,0x6a96,0x1a71,0xa50,0x3a33,0x2a12,0xdbfd,0xcbdc,0xfbbf,0xeb9e,0x9b79,0x8b58,0xbb3b,0xab1a,

0x6ca6,0x7c87,0x4ce4,0x5cc5,0x2c22,0x3c03,0xc60,0x1c41,0xedae,0xfd8f,0xcdec,0xddcd,0xad2a,0xbd0b,0x8d68,0x9d49,

0x7e97,0x6eb6,0x5ed5,0x4ef4,0x3e13,0x2e32,0x1e51,0xe70,0xff9f,0xefbe,0xdfdd,0xcffc,0xbf1b,0xaf3a,0x9f59,0x8f78,

0x9188,0x81a9,0xb1ca,0xa1eb,0xd10c,0xc12d,0xf14e,0xe16f,0x1080,0xa1,0x30c2,0x20e3,0x5004,0x4025,0x7046,0x6067,

0x83b9,0x9398,0xa3fb,0xb3da,0xc33d,0xd31c,0xe37f,0xf35e,0x2b1,0x1290,0x22f3,0x32d2,0x4235,0x5214,0x6277,0x7256,

0xb5ea,0xa5cb,0x95a8,0x8589,0xf56e,0xe54f,0xd52c,0xc50d,0x34e2,0x24c3,0x14a0,0x481,0x7466,0x6447,0x5424,0x4405,

0xa7db,0xb7fa,0x8799,0x97b8,0xe75f,0xf77e,0xc71d,0xd73c,0x26d3,0x36f2,0x691,0x16b0,0x6657,0x7676,0x4615,0x5634,

0xd94c,0xc96d,0xf90e,0xe92f,0x99c8,0x89e9,0xb98a,0xa9ab,0x5844,0x4865,0x7806,0x6827,0x18c0,0x8e1,0x3882,0x28a3,

0xcb7d,0xdb5c,0xeb3f,0xfb1e,0x8bf9,0x9bd8,0xabbb,0xbb9a,0x4a75,0x5a54,0x6a37,0x7a16,0xaf1,0x1ad0,0x2ab3,0x3a92,

0xfd2e,0xed0f,0xdd6c,0xcd4d,0xbdaa,0xad8b,0x9de8,0x8dc9,0x7c26,0x6c07,0x5c64,0x4c45,0x3ca2,0x2c83,0x1ce0,0xcc1,

0xef1f,0xff3e,0xcf5d,0xdf7c,0xaf9b,0xbfba,0x8fd9,0x9ff8,0x6e17,0x7e36,0x4e55,0x5e74,0x2e93,0x3eb2,0xed1,0x1ef0
};

void crc16_ccitt_cal(uint8_t *aData, uint16_t  aSize, uint8_t *Higher, uint8_t *Lower)
{
    uint16_t i;
    uint16_t nAccum = 0;
    for ( i = 0; i < aSize; i++ )
        nAccum = ( nAccum << 8 ) ^ ( unsigned short )CRC16_CCITT_table[(( nAccum >> 8 ) ^ *aData++)&0xff];
    *Higher = (uint8_t)((nAccum>>8) & 0xff);
```

```
    *Lower = (uint8_t)((nAccum) & 0xff);
}
```

4 DFOTA over CoAP

4.1. DFOTA Procedure over CoAP

While implementing DFOTA over CoAP, a LwM2M server is necessary to trigger the downloading of a delta firmware package through CoAP protocol. The steps are listed below:

Step 1: Register to a LwM2M Server.
Step 2: Observe to update status and issue URI.
Step 3: Wait for the download to complete.
Step 4: Use the LwM2M server to trigger the update.
Step 5: Wait for the update to complete.
Step 6: Connect the LwM2M server so that it can read the update results.

The interaction flowchart is illustrated in the chapter below.

4.2. Interaction Flowchart of DFOTA over CoAP

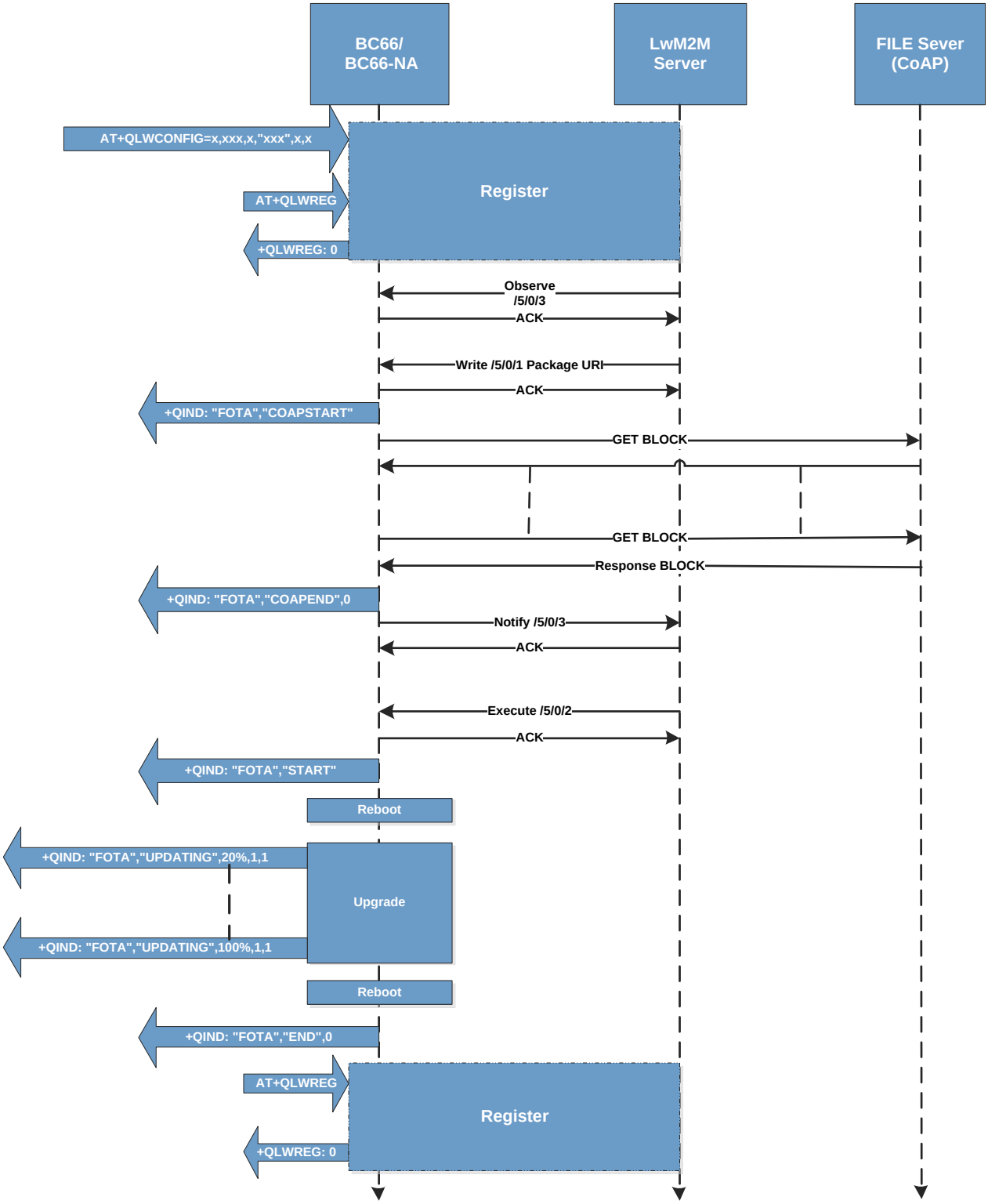

Figure 2: Interaction Flowchart of DFOTA over CoAP

4.3. DFOTA Related AT Commands (over CoAP)

For more details of the AT commands mentioned in the procedure/flowchart above, please refer to *BC66&BC66-NA_LwM2M_Application_Note*.

Table 2: DFOTA Related AT Commands (over CoAP)

SN	AT Command	Description
[1]	AT+QLWCONFIG	Configure Registration Parameters of LwM2M Server
[2]	AT+QLWREG	Send a Register Request

5 DFOTA Related URCs

5.1. +QIND: "FOTA","HTTPSTART" Notify Start of HTTP Download

+QIND: "FOTA","HTTPSTART" Notify Start HTTP Download	
+QIND: "FOTA","HTTPSTART"	The URC notifies that the download over HTTP starts.

5.2. +QIND: "FOTA","DOWNLOADING" Notify HTTP Download Progress

+QIND: "FOTA","DOWNLOADING" Notify HTTP Download Progress	
+QIND: "FOTA","DOWNLOADING",<percent>	The URC notifies the HTTP download progress.

Parameter

<percent>	Integer type. The download progress in percentage.

5.3. +QIND: "FOTA","HTTPEND" Notify HTTP Download Result

+QIND: "FOTA","HTTPEND" Notify HTTP Download Result	
+QIND: "FOTA","HTTPEND",<download_err>	The URC notifies the HTTP download result.

Parameter

<download_err>	Integer type. The error code during HTTP downloading.	
	0	Downloaded successfully
	Others	Error code. Please refer to ***Chapter 7*** for more details.

5.4. +QIND: "FOTA","COAPSTART" Notify Start of CoAP Download

+QIND: "FOTA","COAPSTART" Notify Start of CoAP Download	
+QIND: "FOTA","COAPSTART"	The URC notifies that the download over CoAP starts.

5.5. +QIND: "FOTA","COAPEND" Notify CoAP Download Result

+QIND: "FOTA","COAPEND" Notify CoAP Download Result	
+QIND: "FOTA","COAPEND",<download_err>	The URC notifies the CoAP download result.

Parameter

<download_err>	Integer type. The error code during CoAP downloading.	
	0	Downloaded successfully
	Others	Error code. Please refer to ***Chapter 7*** for more details.

5.6. +QIND: "FOTA","START" Notify Start of Update

+QIND: "FOTA","START" Notify Start of Update	
+QIND: "FOTA","START "	The URC notifies the start of update.

5.7. +QIND: "FOTA","UPDATING" Notify Update Progress

+QIND: "FOTA","UPDATING" Notify Update Progress	
+QIND: "FOTA","UPDATING",<percent>,<total_num>,<current_bin>	The URC notifies the update progress.

Parameter

<percent>	Integer type. The update progress in percentage.
<total_num>	Integer type. Total number of programs to be updated. Currently it is always 1.
<current_bin>	Integer type. The sequence number of the program being updated currently. Currently it is always 1.

5.8. +QIND: "FOTA","END" Notify Update Result

+QIND: "FOTA","END" Notify Update Result	
+QIND: "FOTA","END",<update_err>	The URC notifies the update result.

Parameter

<update_err>	Integer type. The error code during updating.	
	0	Updated successfully
	Others	Error code. Please refer to ***Chapter 7*** for more details.

6 Examples

6.1. DFOTA over HTTP

```
//Update firmware when the delta firmware package is stored on HTTP server.
//The HTTP server address is “http://www.quectel.com:100/update.bin".
AT+CESQ;+CEREG?;+CPIN?;+COPS?          //Query signal quality and network registration status.
+CESQ: 47,6,255,255,0,54

+CEREG: 0,1

+CPIN: READY

+COPS: 0,2,"46011",9

OK

//Execute AT+QFOTADL command to enable automatic DFOTA over HTTP, and then the module will start to download the delta firmware package and update firmware automatically.
AT+QFOTADL="http://www.quectel.com:100/update.bin"
OK

+QIND: "FOTA","HTTPSTART"              //Start download

+QIND: "FOTA","DOWNLOADING", 1%        //Download progress

+QIND: "FOTA","DOWNLOADING", 2%

…

+QIND: "FOTA","DOWNLOADING", 100%

+QIND: "FOTA","HTTPEND",0              //Finish downloading the package from HTTP server.

+QIND: "FOTA","START"                  //Start update

F1: 0000 0000                          //First reboot
```

```
V0: 0000 0000 [0001]
00: 0006 000C
01: 0000 0000
U0: 0000 0001 [0000]
T0: 0000 00B4
Leaving the BROM

+QIND: "FOTA","UPDATING",20%,1,1          //Update progress

+QIND: "FOTA","UPDATING",21%,1,1

…

+QIND: "FOTA","UPDATING",100%,1,1

F1: 0000 0000                             //Second reboot
V0: 0000 0000 [0001]
00: 0006 000C
01: 0000 0000
U0: 0000 0001 [0000]
T0: 0000 00B4
Leaving the BROM

RDY

+CFUN: 1

+QIND: "FOTA","END",0                     //Updated successfully

+CPIN: READY

+IP: 100.75.72.128
```

6.2. DFOTA over UART

```
AT+QFUPLEX=4096,0,4098
>
636F7265 …… 07BE723390          //Enter delta firmware package sub-packet data and CRC validation value

+QFUPLEX: 4096
```

```
OK
AT+QFUPLEX=4096,1,4098
>
000048BA …… 029017CCF0        //Enter delta firmware package sub-packet data and CRC validation value

+QFUPLEX: 4096

OK
…..
AT+QFUPLEX=4096,2,1082
>
98603BF2 …… EE7ED2A5F0        //Enter delta firmware package sub-packet data and CRC validation value

+QFUPLEX: 1080

OK
AT+QFOTADL=1
OK

+QIND: "FOTA","START"

F1: 0000 0000
V0: 0000 0000 [0001]
00: 0006 000C
01: 0000 0000
U0: 0000 0001 [0000]
T0: 0000 00B4
Leaving the BROM

+QIND: "FOTA","UPDATING",20%,1,1                    //Update progress

+QIND: "FOTA","UPDATING",21%,1,1

……

+QIND: "FOTA","UPDATING",100%,1,1

F1: 0000 0000
V0: 0000 0000 [0001]
00: 0006 000C
01: 0000 0000
U0: 0000 0001 [0000]
```

```
T0: 0000 00B4
Leaving the BROM

RDY

+CFUN: 1

+QIND: "FOTA","END",0                    //Updated successfully

+CPIN: READY

+IP: 100.86.71.166
```

6.3. DFOTA over CoAP

Leshan Server (https://leshan.eclipse.org) is an open source LwM2M server. It provides support for some standard LwM2M objects.

6.3.1. Manually Register to LwM2M Server

```
+IP: 100.80.69.49                        //Report local IP

//Set the domain name and registration mode of Leshan server
AT+QLWCONFIG=0,"leshan.eclipse.org",5683,"867725030029312",50,3
OK
AT+QLWREG                                //Start to register to Leshan server
OK

+QLWREG: 0                               //Successfully registered to Leshan server

AT+QLWUPDATE=0,50                        //Update lifetime
+QLWUPDATE: 15675

OK

+QLWUPDATE: 0,15675                      //Updated successfully
```

6.3.2. Observe to Update Status and Issue URI

1. Open the Leshan server and find the device on the client list interface. Here the IMEI number is used as the endpoint name.

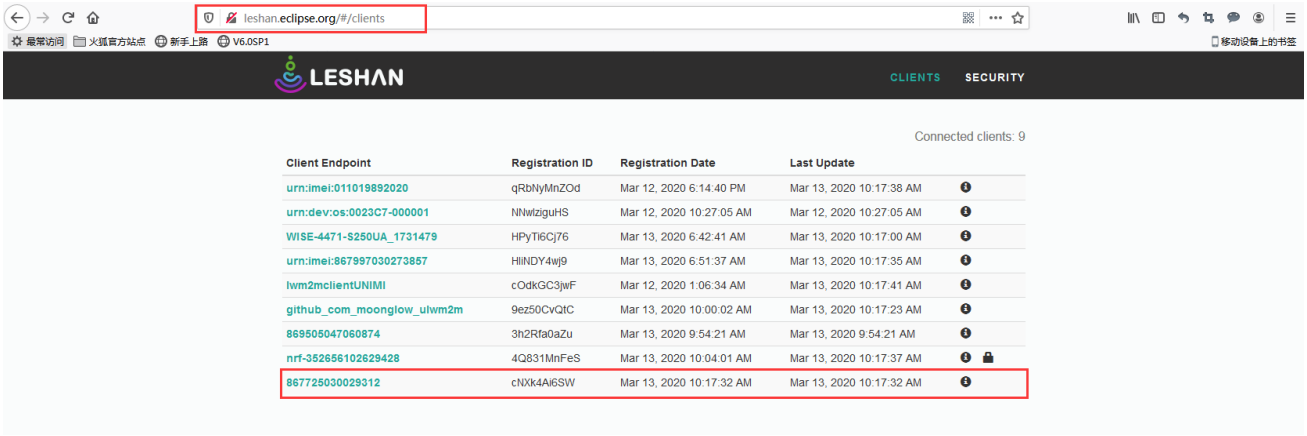

Figure 3: Client List

2. Click "**Observe**" to subscribe to the "/5/0/3" and "/5/0/5" resources as soon as the module is registered to the LwM2M server.

Figure 4: Subscribe /5/0/3 and /5/0/5

3. In the case where the "/5/0/3" state is 0, the delta firmware package URI can be issued. Click "**Write**" at the right side of "/5/0/1", then a dialog box shown as blow will pop up. Enter the URI of the delta firmware package in the input box, click "**Update**" button to issue the URI.

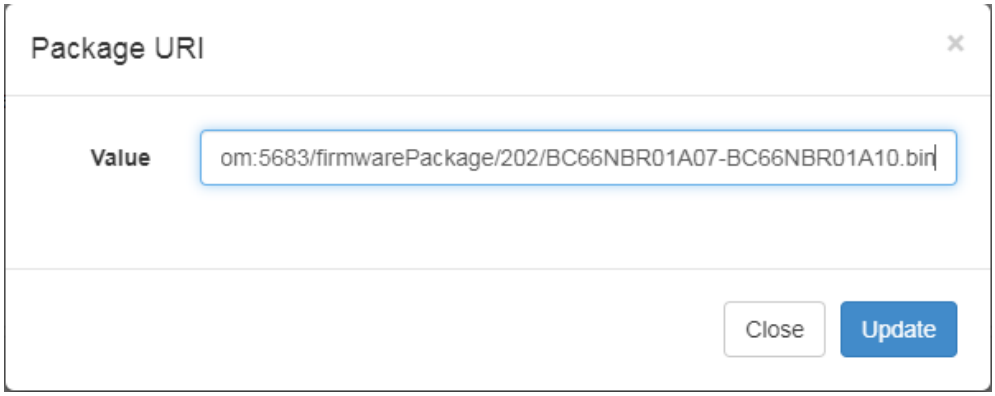

Figure 5: Package URI Input Box

NOTE

After updating the resource, the module will begin to download the delta firmware package via CoAP. The download time is related to the network quality and the package size. Normally a typical delta firmware package of 76 KB takes 5 to 10 minutes.

4. If the value of resource "/5/0/3 is updated successfully, the "**Write**" button turns green and "/5/0/3" state turns to **1**.

Figure 6: Successfully Issued URI

6.3.3. Wait for the Download to Complete

```
"FOTA","COAPSTART"                  //Start download over CoAP
+QLWURC: "report",38299
+QLWURC: "report",38301

+QIND: "FOTA","COAPEND",0           //Download completes successfully
+QLWURC: "report",38303
```

After the delta firmware package is downloaded successfully, "/5/0/3" state turns to **2**.

Figure 7: Downloaded Successfully

6.3.4. Use LwM2M Server to Trigger Update

After the download is successful, click the "**Exec**" button of "/5/0/2" to trigger automatic firmware update. If the update is triggered successfully, the "**Exec**" button will turn green, and "/5/0/3" state will turn to **3**.

Figure 8: Update Triggered Successfully

6.3.5. Wait for the Update to Complete

```
F1: 0000 0000
V0: 0000 0000 [0001]
00: 0006 000C
01: 0000 0000
U0: 0000 0001 [0000]
T0: 0000 00B4
Leaving the BROM
```

```
+QIND: "FOTA","UPDATING",20%,1,1          //Update progress

+QIND: "FOTA","UPDATING",21%,1,1

……

+QIND: "FOTA","UPDATING",100%,1,1

F1: 0000 0000
V0: 0000 0000 [0001]
00: 0006 000C
01: 0000 0000
U0: 0000 0001 [0000]
T0: 0000 00B4
Leaving the BROM

RDY

+CFUN: 1

+QIND: "FOTA","END",0                     //Updated successfully

+CPIN: READY

+IP: 100.85.71.159

AT+QLWREG                                 //Register to the LwM2M server again
OK

+QLWREG: 0
```

6.3.6. Connect LwM2M Server

After successful update, the LwM2M server reads “/5/0/3” and “/5/0/5”. “/5/0/3” value turns to **0** and “/5/0/5” value turns to **1**.

Figure 9: Connect LwM2M Server

7 Summary of Error Codes

This chapter introduces the error codes related to Quectel modules or network. The details about **<download_err>** and **<update_err>** are described in the following tables.

Table 3: Summary of <download_err> Codes

<download_err>	Description
0	Downloaded successfully
12	Download failed
13	Network deactivated
20	Network activating

Table 4: Summary of <update_err> Codes

<update_err>	Description
0	Updated successfully
1	Unknown error
2	DFOTA is busy
254	Delta firmware package mismatch
255	Delta firmware package invalid

8 Appendix A References

Table 5: Related Documents

SN	Document Name	Remark
[1]	Quectel_BC66&BC66-NA _AT_Commands_Manual	AT Commands Manual for BC66 and BC66-NA
[2]	Quectel_BC66&BC66-NA_LwM2M_Application_Note	LwM2M Application Note for BC66 and BC66-NA

Table 6: Terms and Abbreviations

Abbreviation	Description
CoAP	Constrained Application Protocol
DFOTA	Delta Firmware Upgrade Over-the-Air
HTTP	Hyper Text Transport Protocol
ID	Identification
IMEI	International Mobile Equipment Identity
LwM2M	lightweight Machine to Machine
NB-IoT	Narrow Band Internet of Things
URC	Unsolicited Result Code
URI	Uniform Resource Identifier
URL	Uniform/Universal Resource Locator