BG95&BG77&BG600L Series
DFOTA Application Note

LPWA Module Series

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About the Document

Revision History

Version	Date	Author	Description
1.0	2020-01-15	Matt YE/ Lane HAO	Initial
1.1	2020-07-29	Matt YE	1. Added the applicable module BG600L-M3. 2. Added supported baud rates for reporting of DFOTA URCs and develop the main UART baud rate to follow the configuration by AT+IPR. 3. Updated the range of the <file_size> parameter for delta package.

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1 Introduction

Quectel BG95 series, BG77 and BG600L-M3 modules support DFOTA (Delta Firmware Upgrade Over-The-Air) feature, which allows users to update firmware wirelessly.

In DFOTA, a delta firmware package, which contains only differences between the current and the target update versions, is needed before firmware updating. Therefore, DFOTA is time-saving and can reduce unnecessary data transmission.

This document mainly introduces how to update the firmware of Quectel BG95 series, BG77 and BG600L-M3 modules via DFOTA, which can be triggered either by **AT+QFOTADL** or via LwM2M.

1.1. Applicable Modules

Table 1: Applicable Modules

Modules	Models	Description
BG95 Series	BG95-M1	Cat M1 only
	BG95-M2	Cat M1/Cat NB2
	BG95-M3	Cat M1/Cat NB2/EGPRS
	BG95-M4	Cat M1/Cat NB2, 450 MHz Supported
	BG95-M5	Cat M1/Cat NB2/EGPRS, Power Class 3
	BG95-M6	Cat M1/Cat NB2, Power Class 3
	BG95-N1	Cat NB2 Only
BG77		Cat M1/Cat NB2
BG600L-M3		Cat M1/Cat NB2/EGPRS

2 Trigger DFOTA by AT Commands

2.1. Firmware Update Procedure

The following chart illustrates the DFOTA procedure triggered by the AT command under the condition that the firmware package is stored on an HTTP(S)/CoAP(S) server.
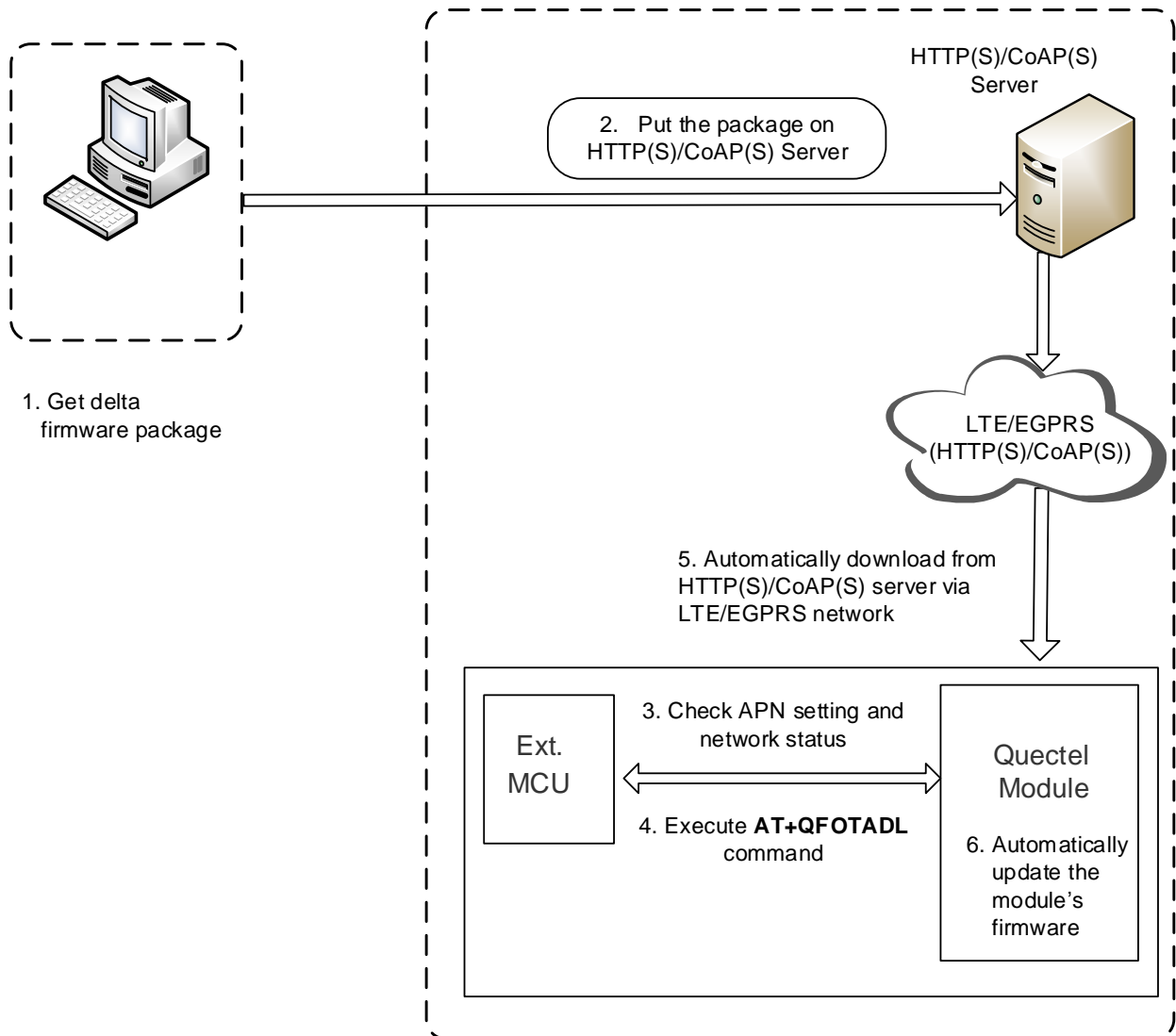

Figure 1: DFOTA Procedure (Triggered by AT Command)

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(S)/CoAP(S) server:

Step 1: Get a delta firmware package from Quectel.
Step 2: Put the delta package on the HTTP(S)/CoAP(S) server.
Step 3: Check APN setting and network status.
Step 4: Execute **AT+QFOTADL**. And the package will be downloaded to the module from the HTTP(S)/CoAP(S) server via LTE/EGPRS network (step "5" in the figure above). Then, the firmware of the module is updated automatically (step "6" in the figure above).

2.1.1. Get a Delta Firmware Package

Before updating, check the current firmware version with **AT+QGMR** command and select a target firmware version, and then send the two firmware versions to Quectel or the module supplier to get a delta package.

2.1.2. Put Delta Package on the HTTP(S)/CoAP(S) Server

Step 1: Set up the HTTP(S)/CoAP(S) server before using the DFOTA function (Quectel does not provide such servers.)
Step 2: Put the delta firmware package on the server and record its storage path.
Step 3: The module downloads the delta package through the path after the corresponding AT command is executed.

2.1.3. Check APN Setting and Network Status

Step 1: Check APN setting: check whether the APN is set properly after putting the delta firmware package on the HTTP(S)/CoAP(S) server. For instance, the APN for a Telstra (U)SIM card should be "**Telstra.internet**", and the relevant AT commands are listed below:

- Query DFOTA APN: **AT+QCFGEXT="fota_apn"**
- Set DFOTA APN: **AT+QCFGEXT="fota_apn",0,"Telstra.internet"**

Step 2: Check network status: after APN setting is confirmed, make sure that the data network is registered before firmware updating, relevant AT commands are listed below:

- **AT+CSQ**: Query signal quality
- **AT+CEREG?**: Query network registration status (Optional: **AT+CGREG?**)
- **AT+COPS?**: Query the registered operator

For more details about the above commands, see *document [1]*.

2.1.4. Execute AT Command to Update the Firmware

After the APN setting and network status are confirmed to be ready, execute **AT+QFOTADL** to download the firmware package and update the firmware. The package is downloaded to the module from the HTTP(S)/CoAP(S) server via LTE/EGPRS network. The firmware is updated automatically. For an example, refer to *Chapter 2.3*.

2.2. DFOTA Related AT Commands

2.2.1. AT Command Syntax

2.2.1.1. 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.

2.2.1.2. 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 2: 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.

2.2.2. Description of AT Command Mode and Data Mode

The COM port of BG95 series, BG77 and BG600L-M3 modules provide two working modes: AT command mode and data mode. In the AT command mode, the inputted data via COM port is treated as AT commands. In data mode, it is treated as data.

Inputting **+++** or pulling up MAIN_DTR (**AT&D1** should be set first) can make the COM port exit data mode. To prevent **+++** from being misinterpreted as data, the following sequence should be followed:

1. Do not input any character for at least 1 s before inputting **+++**.
2. Finish the input of **+++** within 1 s, and no other characters can be inputted during this time.
3. Do not input any character within 1 s after **+++** has been inputted.

When **AT+QFOTADL="COM:",<file_size>,<timeout>** is executed, the COM port enters the data mode. The port exits the data mode forcibly and the command is interrupted immediately when **+++** is inputted or MAIN_DTR is pulled up before the command response is returned.

2.2.3. AT+QFOTADL Update Firmware via DOFTA

AT+QFOTADL Update Firmware via DOFTA	
Test Command **AT+QFOTADL=?**	Response **OK**

2.2.3.1. AT+QFOTADL=<HTTP_URL> Update Firmware When the Delta Package is Stored on an HTTP(S) Server

The **AT+QFOTAD** command starts automatic firmware update for the modules via DFOTA. When the **AT+QFOTAD** command is executed, the package is automatically downloaded to the module. After the package download has been finished, the module automatically updates the firmware. The module reboots itself if the firmware is updated successfully, otherwise it returns an error and exits from DFOTA. If the delta firmware package is stored on the HTTP(S) server, **AT+QFOTADL=<HTTP_URL>** is executed to start automatic firmware update via DFOTA. The module downloads the delta package from the HTTP(S) server over the air and updates the firmware automatically.

AT+QFOTADL=<HTTP_URL> Update Firmware When the Delta Package is Stored on an HTTP(S) Server	
Write Command **AT+QFOTADL=<HTTP_URL>**	Response **OK** **+QIND: "FOTA","HTTPSTART"** **+QIND: "FOTA","DOWNLOADING",<percent>** **+QIND: "FOTA","DOWNLOADING",<percent>** **...** **+QIND: "FOTA","HTTPEND",<HTTP_err>** **+QIND: "FOTA","RESETTING"** **+QIND: "FOTA","START"** **+QIND: "FOTA","UPDATING",<percent>** **+QIND: "FOTA","UPDATING",<percent>** **...** **+QIND: "FOTA","END",<update_err>** If there is any error: **+CME ERROR: <err>**
Maximum Response Time	300 ms
Characteristics	The command takes effect immediately.

Parameter

<HTTP_URL>	String type. The maximum length is 700 bytes. It should be started with "HTTP://" or "HTTPS://", 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(S) server.
<HTTP_port>	Integer type. The port number of the HTTP(S) server. Default value: 80. Range: 1–65535.
<HTTP_file_path>	String type. The file name in the HTTP(S) server.
<HTTP_err>	Integer type. The HTTP(S) error code.
	0 Updated successfully.
	Any other value Error. See *Chapter 4* for more details.
<percent>	Integer type. The download or update progress in percentage.
<update_err>	Integer type.
	0 Updated successfully.
	Any other value Error. See *Chapter 4* for more details.
<err>	Error code. Refer to *Chapter 4* for more details.

> **NOTES**
>
> 1. In the DFOTA mode, only the APP works normally and the modem is not loaded. In this period, the main UART cannot receive AT commands anymore, and can only report DFOTA URCs at the baud rate configured by **AT+IPR**. Supported baud rates for the reporting of URCs are 4800, 9600, 19200, 38400, 115200, 230400, 460800 and 921600 bps. The default baud rate 115200 bps is used if any unsupported baud rate is set by **AT+IPR** for the URC reporting. Additionally, the USB port cannot be used either.
> 2. After a smooth **"DOWNLOADING"** process, the module is reset to enter the DFOTA mode. When the **"UPDATING"** process is finished, the module restarts and start up in a normal mode.
> 3. If the module is powered down during **"UPDATING"** process, the module will automatically enter the DFOTA mode and continue the previous firmware update when it is powered up next time.
> 4. (1) If SSL certificates are needed while downloading the firmware package from an HTTPS server, they should be uploaded to */datatx* in APP EFS, and must be renamed in accordance with the following rules:
>   - The root certificate is renamed as *fota_cacert.pem;*
>   - The client certificate is renamed as *fota_client_cert.pem*;
>   - The private key is renamed as *fota_client_key.pem.*
>   (2) Certificate upload methods:
>   - Quectel QEFS Explorer tool can be used to upload the certificates. For more details about the tool, refer to **document [2]**.
>   - **AT+QFUPL** command can also be used to upload the certificates. For more details about the command, see **document [3]**.

2.2.3.2. AT+QFOTADL=<CoAP_URL> Update Firmware When the Delta Package is Stored on a CoAP(S) Server

If the delta firmware package is stored on a CoAP(S) server, the **AT+QFOTADL=<CoAP_URL>** command is executed to enable automatic firmware update via DFOTA. The module downloads the delta package from the CoAP(S) server wirelessly and updates the firmware automatically.

AT+QFOTADL=<CoAP_URL> Update Firmware When the Delta Package is Stored on a CoAP(S) Server	
Write Command **AT+QFOTADL=<CoAP_URL>**	Response **OK** **+QIND: "FOTA","COAPSTART"** **+QIND: "FOTA","COAPEND",<CoAP_err>** **+QIND: "FOTA"," RESETTING"** **+QIND: "FOTA","START"** **+QIND: "FOTA","UPDATING",<percent>** **+QIND: "FOTA","UPDATING",<percent>**

	... **+QIND: "FOTA","END",<update_err>** If there is any error: **+CME ERROR: <err>**
Maximum Response Time	300 ms
Characteristics	The command takes effect immediately.

Parameter

<CoAP_URL>	String type. The maximum length is 700 bytes. It should be started with "CoAP://" or "CoAPS://", for example: **"CoAP://<CoAP_server_URL>:< CoAP_port>/< CoAP_file_path>".**
<CoAP_server_URL>	String type. The IP address or domain name of the CoAP(S) server.
<CoAP_port>	Integer type. The port number of the CoAP(S) server. Default value: 80. Range: 1–65535.
<CoAP_file_path>	String type. The file name in CoAP(S) server.
<CoAP_err>	Integer type. The CoAP(S) error code.
	0 Updated successfully.
	Any other value Error. Refer to **Chapter 4** for more details.
<percent>	Integer type. The update progress in percentage.
<update_err>	Integer type.
	0 Updated successfully.
	Any other value Error. See **Chapter 4** for more details.
<err>	Error code. See **Chapter 4** for more details.

NOTE

The modules support two security modes for CoAP over DTLS: certificates mode and pre-shared key (PSK) mode.

- In certificates mode, certificates are necessary while downloading the firmware package from CoAP server. They should be uploaded to */datatx/ssl* in APP EFS, and must be renamed in accordance with the following rules:
  - The root certificate is renamed as *coap-cert.pem;*
  - The client certificate is renamed as *coap-cacert.pem*;
  - The private key is renamed as *coap-key.pem*.
- In PSK mode, the PSK is required by server. The PSK key file should be renamed to *coap_fota.psk* and uploaded into the /datatx/ssl folder.

2.2.3.3. AT+QFOTADL="COM:",<file_size>,<timeout>   Upload a Delta Package to Flash

The command is used to upload a delta package to the NAND flash. If a delta package has existed in the NAND flash, it will be overwritten when a new package is uploaded.

After this command is executed and **CONNECT** is returned, the module switches to the data mode. When the uploaded data reaches **<file_size>**, or there is no any data inputted when **<timeout>** reaches, it exits from the data mode automatically. During data transmission, inputting **+++** or pulling up MAIN_DTR can make the module exit from the data mode, and more details are provided in *Chapter 2.2.1*.

AT+QFOTADL="COM:",<file_size>,<timeout> Upload a Delta Package to Flash	
Write Command **AT+QFOTADL="COM:",<file_size>[,<timeout>]**	Response **CONNECT** TA switches to the data mode (transparent access mode), and the delta package in the binary form can be inputted. When the total size of the inputted data reaches **<file_size>**, TA returns to the command mode and replies with the following codes: **+QFOTADL: <upload_size>,<check_sum>** **OK** If there is any error: **+CME ERROR: <err>**
Maximum Response Time	300 ms
Characteristics	The command takes effect immediately.

Parameter

<file_size>	Integer type. The file size expected to be uploaded. Unit: byte.
<timeout>	Integer type. The time waiting for data to be inputted to USB/UART. Default value: 5. Unit: s.
<upload_size>	Integer type. The file size that has been uploaded. Unit: byte.
<check_sum>	The checksum of the uploaded data.
<err>	Error code. Refer to *Chapter 4* for more details.

NOTES

1. **<file_size>** is limited by the flash space for the delta package. The maximum flash spaces of the modules are:
   - 7040 KB in BG95-M1

- 7168 KB in BG77, BG95-M2, BG95-M4, BG95-M6 and BG95-N1
- 7296 KB in BG95-M3 and BG600L-M3

2. **<check_sum>** is a 16-bit checksum based on bitwise Exclusive-OR (XOR).

   If the number of the characters is odd, set the last character as the high 8 bit, and the low 8 bit to 0, and then use an XOR operator to calculate the checksum. **+++** sequence causes TA to end the command and switch to the command mode. However, the data previously uploaded is preserved into the file.

3. When executing the command, the data must be entered after **CONNECT** is returned.

2.2.3.4. AT+QFOTADL=<para1>,[<para2>]   Extended DFOTA Functions

This command supports several extended functions with different parameters, such as trigger DFOTA update operation with a local DFOTA firmware package, get DFOTA firmware package information, and delete a DFOTA firmware package.

AT+QFOTADL=<para1>[,<para2>] Extended DFOTA Functions	
Write Command **AT+QFOTADL=<para1>[,<para2>]**	Response If **<para2>** is omitted and **<para1>**=3, the command returns the current DFOTA update trigger mode. **+QFOTADL: <para1>,<para2>** **OK** If **<para2>** is omitted and **<para1>**=4, the command returns the size of a local DFOTA package. **+QFOTADL: <para1>,<para2>** **OK** If **<para2>** is omitted and **<para1>**=5, the command deletes the DFOTA package. **OK** If **<para2>** is present and **<para1>**=3, the command configures the DFOTA update trigger mode. **OK** If there is any error related to ME functionality: **+CME ERROR: <err>** If there is any other error: **ERROR**

Maximum Response Time	10 s
Characteristics	The command takes effect immediately. The configuration is not saved.

Parameter

<para1>	Integer type.
	1 Start update
	2 Reserved
	3 Configure whether to trigger DFOTA update automatically after the DFOTA package is download
	4 Get the size of the local DFOTA package
	5 Delete the local DFOTA package
<para2>	If **<para1>**=3,
	0 Trigger DFOTA update with **AT+QFOTADL=1**.
	1 Trigger DFOTA update automatically when the package is downloaded.
	If **<para1>**=4, **<para2>** represents the size of the local DFOTA package. Unit: Byte.
<err>	Error code. Refer to **Chapter 4** for more details.

2.2.4. AT+QCFGEXT="fota_apn" Configure IP Family and APN for DFOTA

This command configures the IP family and APN for DFOTA.

AT+QCFGEXT="fota_apn" Configure IP Family and APN for DFOTA	
Write Command **AT+QCFGEXT="fota_apn",<iptype>,<apn>[,<username>,<password>]**	Response If the optional parameters are omitted, the command queries the current setting: **+QCFGEXT: "fota_apn",<iptype>,<apn>[,<username>,<password>]** **OK** If any of the optional parameters is specified, the command sets the IP family and APN for DFOTA: **OK** If there is any error: **ERROR**
Maximum Response Time	300 ms
Characteristics	The command takes effect immediately. The configurations are saved automatically.

Parameter

\<iptype\>	Integer type. IP family.
	<u>0</u> IPv4 address family
	1 IPv6 address family
	2 IPv4 and IPv6 address family
\<apn\>	String type. Access point name.
\<username\>	String type. Username of the selected APN.
\<password\>	String type. Password of the selected APN.

2.3.   Example

Update Firmware from an HTTPS Server by DFOTA.

```
//The delta firmware package has already been stored on an HTTPS server.
//The HTTPS server address is "https://www.quectel.com:100/update.zip".
AT+CSQ;+CEREG?;+CGREG?;+COPS?    //Query network status.
+CSQ: 26,99

+CEREG: 0,1

+CGREG: 0,4

+COPS: 0,0,"Telstra Mobile Telstra",8

OK
//Execute AT+QFOTADL command to enable automatic firmware update via DFOTA, and then the
module starts to download the delta package and update firmware automatically.
AT+QFOTADL="https://www.quectel.com:100/update.zip"
OK
+QIND: "FOTA","HTTPSTART"
+QIND: "FOTA","DOWNLOADING",5%
…
+QIND: "FOTA","HTTPEND",0           //Finish downloading the package from the HTTPS server.
+QIND: "FOTA","RESETTING"           //The module is reset and then enters DFOTA mode.
+QIND: "FOTA","START"
+QIND: "FOTA","UPDATING",1%
+QIND: "FOTA","UPDATING",2%
...
+QIND: "FOTA","UPDATING",100%
+QIND: "FOTA","END",0                //Finish updating the firmware.
```

3 Trigger DFOTA with LwM2M

3.1. Firmware Update Procedure

OMA defines the application layer communication protocol between a LwM2M server and a LwM2M client, which is located in a LwM2M device. For the modules, the LwM2M protocol is used to manage device provisioning and is a trigger of a DFOTA procedure. For the DFOTA update on the modules, a firmware update object is provided by the LwM2M specification.

The following are the routine DFOTA steps with LwM2M:

1. Write "Package"/"Package URI" to trigger the downloading of a firmware image, so that the DFOTA application downloads the firmware image from LwM2M server automatically.
2. Post "Update" to trigger firmware update on the modules, so that the DFOTA application finishes firmware update automatically with the candidate firmware image.

The LwM2M client is notified about the new firmware by the LwM2M server using CoAP(S). The client sends indication to a registered DFOTA application. The DFOTA application downloads the firmware delta package from the server and stores it on the file system of BG95 series, BG77 and BG600L-M3 modules.

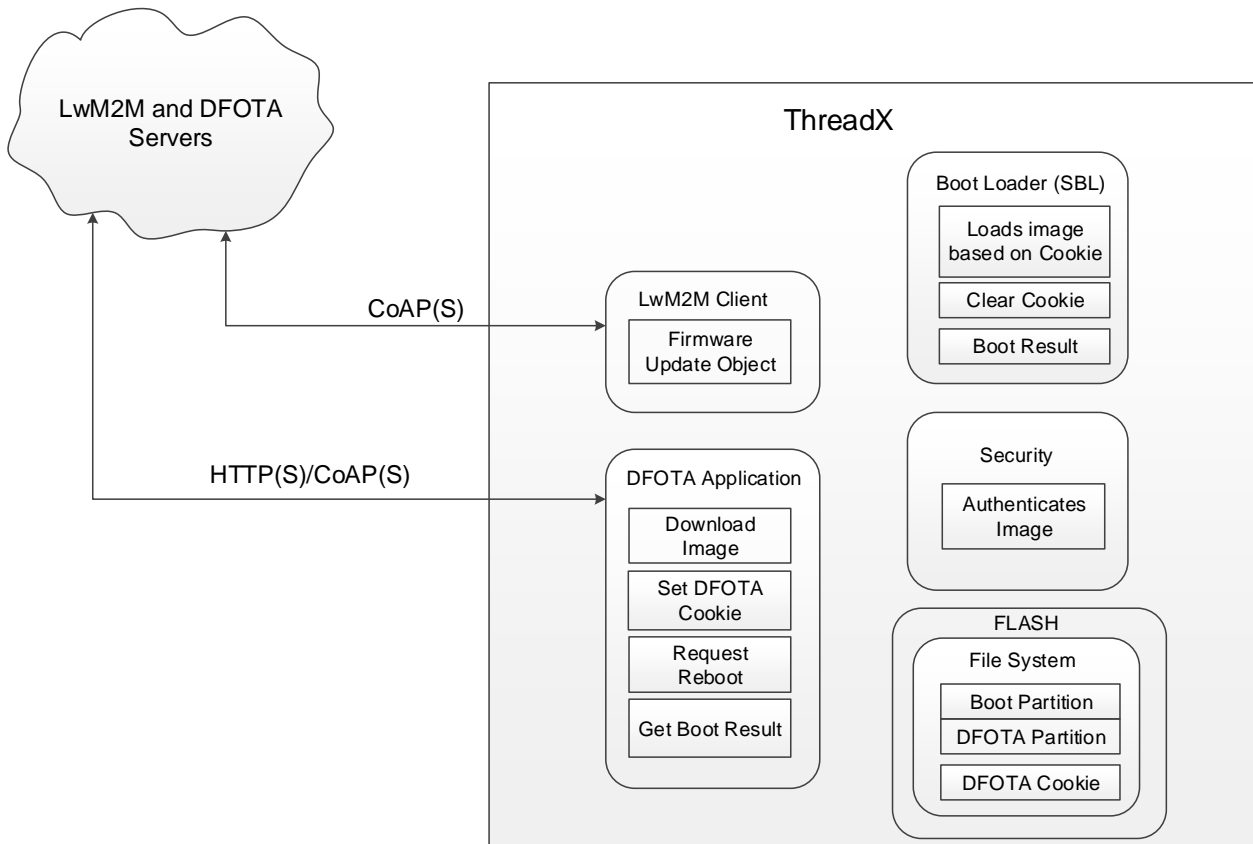The following figure shows key components involved in the LwM2M DFOTA process on the modules.

Figure 2: LwM2M Firmware Image Download

3.1.1. Download a Firmware Image

About "Firmware Update Object" in LwM2M, the detailed interaction process between LwM2M client and LwM2M server is described as below.

The LwM2M client should register and observe the "Package URI" resource in the Firmware Update Object, which is shown in the server when the client is registered successfully.
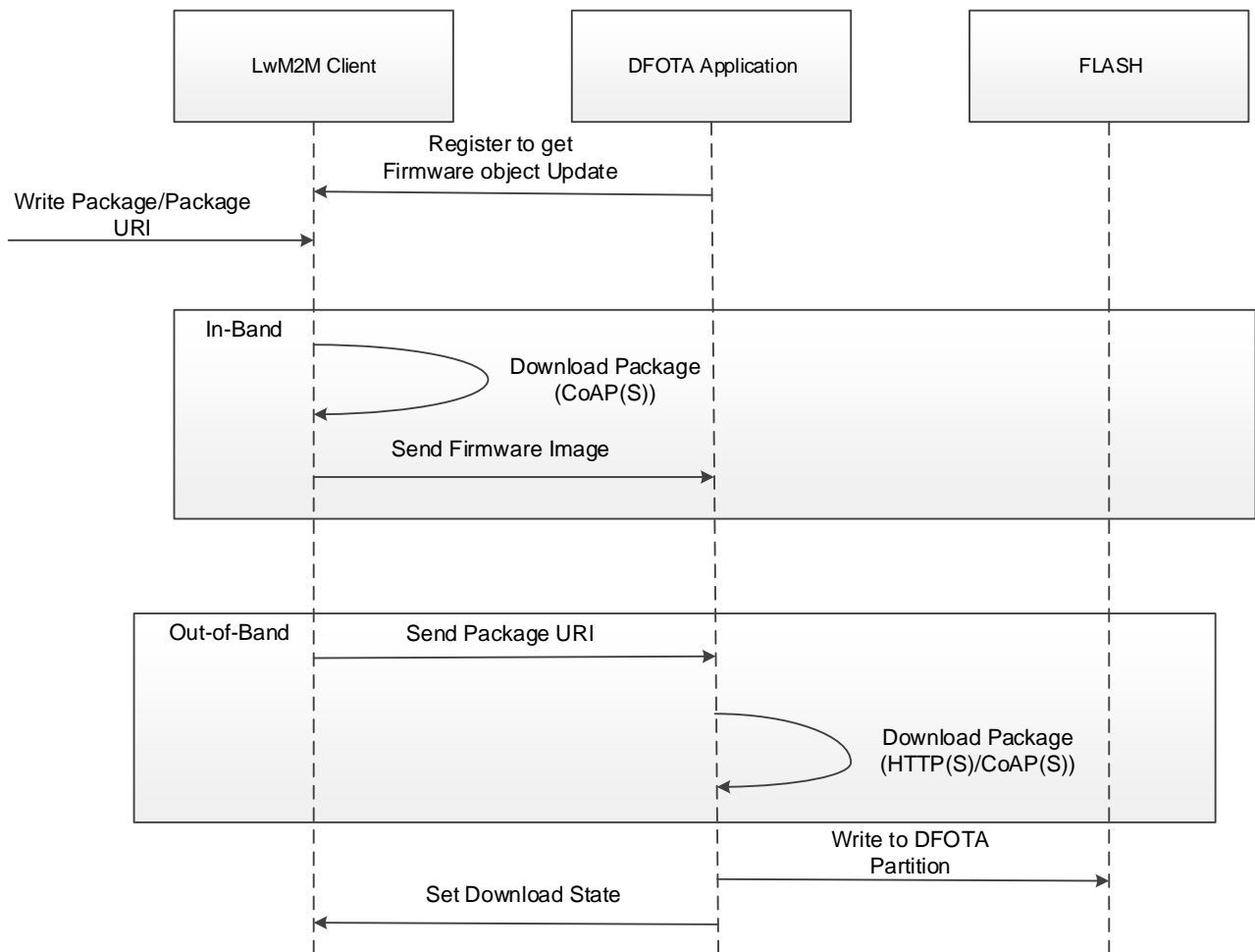
Figure 3: Call Flow of Package URI Observing and Firmware Downloading

---

NOTE

In the in-band mode, the module downloads a firmware package from the LwM2M server directly via the CoAP(S) protocol and sends the downloaded package to the DFOTA application. All "firmware update" actions are done in the application. But in the out-of-band mode, the module downloads a firmware package from the HTTP(S)/CoAP(S) server to the module.

3.1.2. Update the Firmware

The LwM2M server should observe the "State" resource in the Firmware Update Object. If the "State" has changed to "Downloaded", "Update" resource is executed to trigger the firmware update process.
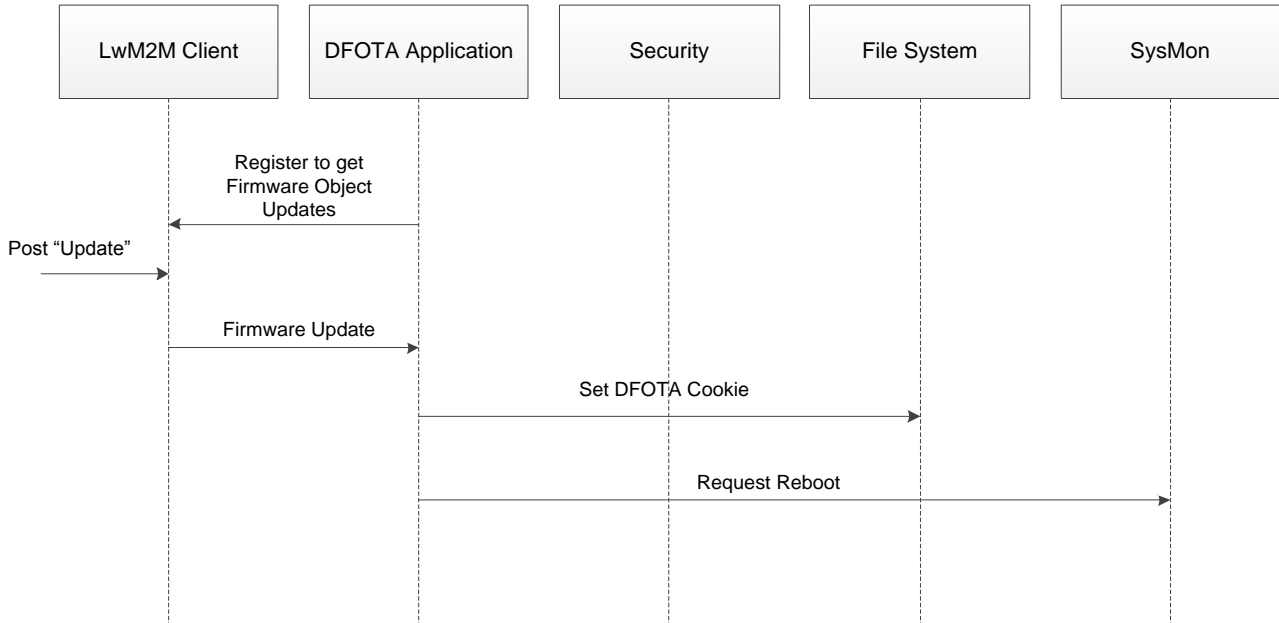
Figure 4: Call Flow of "Update" Resource Observing and Update Event Processing

3.2. URC of Firmware Update with LwM2M

3.2.1. Download Progress URCs

3.2.1.1. In-Band Mode

When the DFOTA firmware update is triggered in the LwM2M in-band mode, the following URCs are outputted to notify the download progress.

+LWM2M: "FOTA","DOWNLOADING" Notify the Download Progress	
URC Format: **+LWM2M: "FOTA","DOWNLOADING","START"**	Download process started.
URC Format: **+LWM2M: "FOTA","DOWNLOADING","COMPLETED"**	Download process completed.

3.2.1.2. Out-of-Band HTTP(S) Mode

When the DFOTA firmware update is triggered in the LwM2M out-of-band HTTP(S) mode, the following URCs are outputted to notify the download progress.

+QIND: "FOTA","HTTP" Notify the Download Progress	
URC Format: **+QIND: "FOTA","HTTPSTART"**	Download process started.
URC Format: **+QIND: "FOTA","DOWNLOADING",<percent>** **...**	Download progress in percentage.
URC Format: **+LWM2M: "FOTA","DOWNLOADED",<HTTP_err>**	Download operation result.

Parameter

<percent>	Integer type. The download progress in percentage.
<HTTP_err>	Integer type. The HTTP(S) error code.
	0 Downloaded successfully.
	Any other value Error.
	Refer to *Chapter 4* for more details.

3.2.1.3. Out-of-Band CoAP(S) Mode

When the DFOTA firmware update is triggered in the LwM2M out-of-band CoAP(S) mode, the following URCs are outputted to notify the download progress.

+QIND: "FOTA","COAP" Notify the Download Progress	
URC Format: **+QIND: "FOTA","COAPSTART"**	Download process started.
URC Format: **+LWM2M: "FOTA","DOWNLOADED",<CoAP_err>**	Download operation result.

Parameter

<CoAP_err>	Integer type. The CoAP(S) error code.
	0 Downloaded successfully.
	Any other value Error.
	Refer to *Chapter 4* for more details.

3.2.2. Update Progress URCs

3.2.2.1. +QIND: "FOTA","START"   Updating Started

+QIND: "FOTA","START" Updating Started	
URC Format: **+QIND: "FOTA","START"**	Notify the start of the updating.

3.2.2.2. +QIND: "FOTA","UPDATING",<percent>   Updating Progress

+QIND: "FOTA","UPDATING",<percent> Updating Progress	
URC Format: **+QIND: "FOTA","UPDATING",<percent>**	Notify the updating progress in percentage.

Parameter

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

3.2.2.3. +QIND: "FOTA","END",<err>   Updating Finished

+QIND: "FOTA","END",<err> Updating Finished	
URC Format: **+QIND: "FOTA","END",<err>**	Notify the completion of updating.

Parameter

<err>	Error code. See *Chapter 4* for more details.

4 Summary of Error Codes

These error codes indicate errors related to mobile equipment or network. The details about **<HTTP_err>**, **<CoAP_err>**, **<update_err>** and **<err>** are described in the following tables.

Table 3: Summary of <HTTP_err>/<CoAP_err> Codes

<HTTP_err>/<CoAP_err>	Meaning
0	Download successful
701	Unknown error
702	Server connection failed
703	Request failed
704	Download timeout
705	URL error
706	File not exist
707	Write data to file failed
708	Downloaded file is too large
710	Downloaded package check failed

Table 4: Summary of <update_err> Codes

<update_err>	Meaning
0	Updated successfully
504	Firmware update failed
505	Update package not exist
506	Update package check failed

| 511 | Package is mismatched with the current firmware |
| 512 | DFOTA unknown error |

Table 5: Summary of <err> Codes

<err>	Meaning
590	Input parameter invalid
591	DFOTA is ongoing

5 Appendix A References

Table 6: Related Documents

SN	Document Name	Remark
[1]	Quectel_BG95&BG77&BG600L_Series_AT_Commands_Manual	AT commands manual for BG95 series, BG77 and BG600L-M3 modules
[2]	Quectel_BG95&BG77&BG600L_Series_QEFS_Explorer_User_Guide	User guide for QEFS Explorer tool
[3]	Quectel_BG95&BG77_FILE_Application_Note	FILE application note for BG95 series, BG77 and BG600L-M3 modules

Table 7: Terms and Abbreviations

Abbreviation	Description
AP	Application Processor
APN	Access Point Name
bps	Bit(s) Per Second
CoAP(S)	Constrained Application Protocol (Secure)
DFOTA	Delta Firmware Upgrade Over-the-Air
EFS	Embedded File System
EGPRS	Enhanced General Packet Radio Service
FOTA	Firmware Over-the-Air
HTTP(S)	Hyper Text Transport Protocol (Secure)
IP	Internet Protocol
IPv4	Internet Protocol Version 4
IPv6	Internet Protocol Version 6
KB	Kilobytes

LTE	Long Term Evolution
LPWA	Low Power Wide Area
LwM2M	Lightweight Machine to Machine
NAND	Not And
OMA	Open Mobile Alliance
SSL	Secure Sockets Layer
URC	Unsolicited Result Code
URI	Uniform Resource Identifier