EC2x&EG2x&EG9x&EM05 Series

DFOTA Upgrade Guide

LTE Standard Module Series

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Quectel Wireless Solutions Co., Ltd.
Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai 200233, China
Tel: +86 21 5108 6236
Email: info@quectel.com

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About the Document

Revision History

Version	Date	Author	Description
1.0	2018-01-12	Ramos ZHANG/ Demi QU	First official release
1.1	2021-05-31	Ramos ZHANG/ Carlton XU	Added the applicable modules: EG2x-G.
1.2	2023-05-16	Damon LI/ Ramos ZHANG/ Carlton XU	1. Updated the applicable modules: ● Added EG21-GL and EG25-GL. ● Updated EC20 R2.1 to EC20-CE. 2. Updated the note about DFOTA upgrade process (Chapter 4.2).
1.3	2024-09-26	Mount ZHONG	1. Updated the document name from "Application Note" to "Upgrade Guide". 2. Added the chapter of DFOTA implementation and user responsibility (Chapter 1.1). 3. Optimized the DFOTA firmware upgrade flowchart to distinguish between the user side and the Quectel side (Figure 1). 4. Optimized the description of the DFOTA firmware upgrade steps and added relevant notes to distinguish between the user side and the Quectel side (Chapter 2). 5. Updated the declaration of AT command examples (Chapter 3.2). 6. Updated the description of AT+QFOTADL (Chapter 3.3). 7. Optimized the explanation of the <ftpURL> parameter and updated the URL address and related instructions in the command example (Chapter 3.3.1). 8. Optimized the explanation of the <httpURL> parameter and updated the URL address and

		related instructions in the command example (Chapter 3.3.2). 9. Updated the description of AT+QFOTADL=<file_name> and the explanation of <file_name> (Chapter 3.3.3).

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1 Introduction

Quectel EC2x family, EG2x family, EG9x family and EM05 series modules support DFOTA (Delta Firmware Over-The-Air) function.

With this function, you can upgrade the module firmware to a new version or revert the firmware to an old version. The delta firmware package only contains the difference between the original firmware version and the target firmware version, with the amount of data transmission greatly reduced and the transmission time greatly shortened.

1.1. DFOTA Implementation and User Responsibility

Quectel follows industry best practices with regard to firmware updates for its modules by enabling users to offer DFOTA updates. Please note that Quectel does not have the ability to unilaterally push updates to users' devices. Quectel hands full control over the DFOTA process to users. In the process, Quectel solely provides the updated firmware but cannot initiate DFOTA updates on users' devices.

Users can determine when to push the update to the Quectel modules using the DFOTA mechanism by configuring corresponding parameters for the update that the users host on their own infrastructures.

1.2. Applicable Modules

Table 1: Applicable Modules

Module Family	Module
EC2x	EC20-CE
	EC21 Series
	EC25 Series
EG2x	EG21-G
	EG25-G
	EG21-GL
	EG25-GL
EG9x	EG91 Series
	EG95 Series
-	EM05 Series

2 Firmware Upgrade via DFOTA

The following chart illustrates the procedures of firmware upgrade via DFOTA.

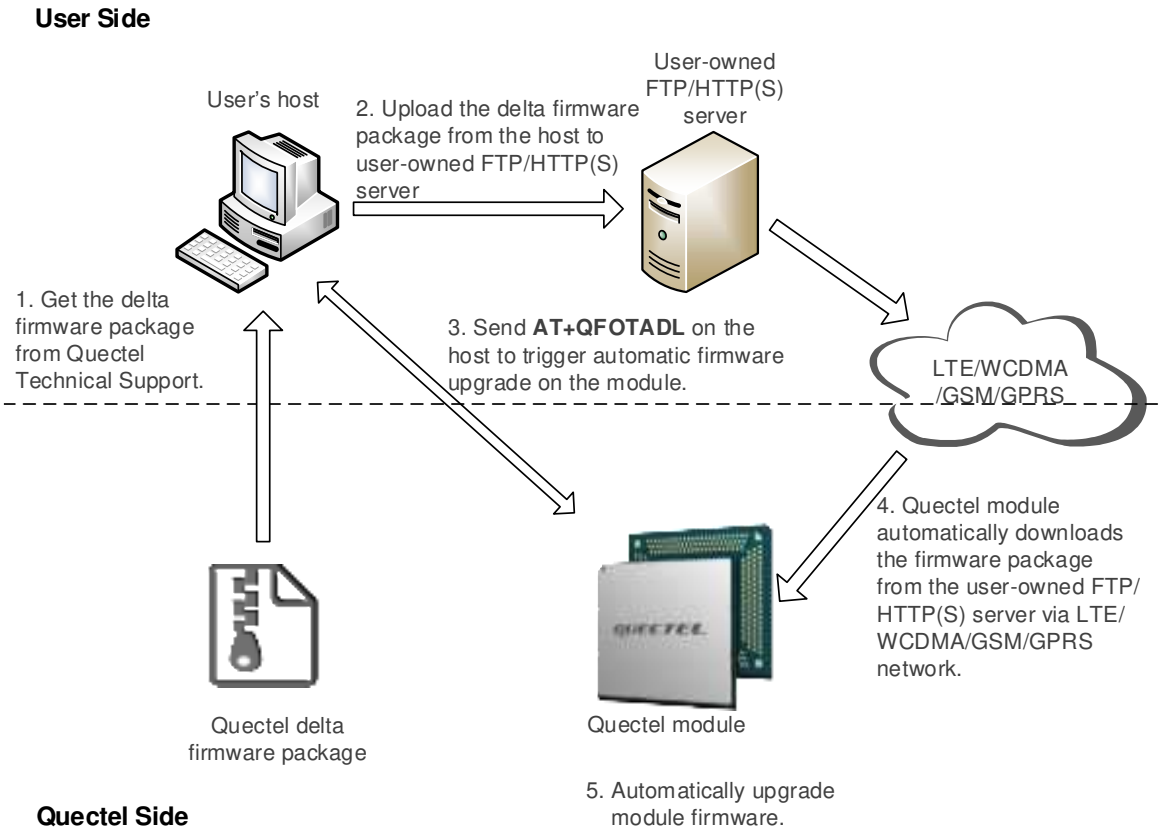

Figure 1: Firmware Upgrade via DFOTA

As shown in the above figure, the following steps need to be performed to upgrade the firmware when the delta firmware package is stored on an FTP/HTTP(S) server:

Step 1: Get the delta firmware package from Quectel Technical Support (see ***Chapter 2.1*** for details).
Step 2: Upload the delta firmware package from the host to your FTP/HTTP(S) server (see ***Chapter 2.2*** for details).
Step 3: Execute **AT+QFOTADL** on the host to trigger automatic firmware upgrade on the module (see ***Chapter 2.3*** for details.
Step 4: The module automatically downloads the firmware package from your FTP/HTTP(S) server via LTE/WCDMA/GSM/GPRS network.
Step 5: The module internally runs the updating program to automatically upgrade the module firmware.

NOTE

You are responsible for providing and managing the FTP/HTTP(S) server for the firmware upgrade. Quectel does not supply the server or assist with its setup.

2.1. Get Delta Firmware Package

Before firmware upgrading, check the original firmware version name with ATI and confirm the target firmware version, and then send the two firmware versions to Quectel Technical Support to obtain the corresponding delta firmware package.

2.2. Upload Delta Firmware Package to FTP/HTTP(S) Server

Step 1: Please set up an FTP/HTTP(S) server before using the DFOTA function. (Quectel does not provide such servers.)

Step 2: After completing the server setup, upload the delta firmware package to your server, and save the storage path.

2.3. Execute AT Command to Upgrade the Firmware

After uploading the delta firmware package to the FTP/HTTP(S) server, execute **AT+QFOTADL** on the host to initiate the automatic over-the-air download and upgrade of module delta firmware package. For more details, see ***Chapter 3***.

NOTE

The module supports firmware upgrades via both the FTP/HTTP(s) server and the local file system. For more information on the firmware upgrades via the local file system, see ***Chapter 3.3.3***.

3 Description of DFOTA AT Commands

3.1. AT Command Introduction

3.1.1. 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 the command line. When an optional parameter is not given in a command, the new value equals its previous value or the default settings, unless otherwise specified.
- **Underline** Default setting of a parameter.

3.1.2. AT Command Syntax

All command lines must start with **AT** or **at** and end with **<CR>**. Information responses and result codes always start and end with a carriage return character and a line feed character: **<CR><LF><response><CR><LF>**. In tables presenting commands and responses throughout this document, only the commands and responses are presented, and **<CR>** and **<LF>** are deliberately omitted.

Table 2: Types of AT Commands

Command Type	Syntax	Description
Test Command	**AT+<cmd>=?**	Test the existence of the corresponding command and return information about the type, value, or range of its parameter.
Read Command	**AT+<cmd>?**	Check the current parameter value of the corresponding command.
Write Command	**AT+<cmd>=<p1>[,<p2>[,<p3>[...]]]**	Set user-definable parameter value.
Execution Command	**AT+<cmd>**	Return a specific information parameter or perform a specific action.

3.2. Declaration of AT Command Examples

The AT command examples in this document are provided to help you learn about the use of the AT commands introduced herein. The examples, however, should not be taken as Quectel's recommendations or suggestions about how to design a program flow or what status to set the module into. Sometimes multiple examples may be provided for one AT command. However, this does not mean that there is a correlation among these examples, or that they should be executed in a given sequence. The URLs, domain names, IP addresses, usernames/accounts, and passwords (if any) in the AT command examples are provided for illustrative and explanatory purposes only, and they should be modified to reflect your actual usage and specific needs.

3.3. AT+QFOTADL Upgrade Firmware via DFOTA

This command enables automatic firmware upgrade for module via DFOTA. After executing the corresponding command, the module will automatically download or load the delta package from FTP/HTTP(S) server or local file system. After the package is successfully downloaded or loaded, the module will automatically check whether the package version is correct. If the delta package is correct, the module will reboot automatically and then enter into recovery mode to upgrade the firmware. After the firmware is upgraded successfully, the module will reboot and work normally.

AT+QFOTADL Upgrade Firmware via DFOTA	
Test Command **AT+QFOTADL=?**	Response **OK**
Maximum Response Time	-
Characteristics	-

3.3.1. AT+QFOTADL=<ftpURL> Upgrade Firmware over FTP Server

If the delta package is stored on an FTP server, execute **AT+QFOTADL=<ftpURL>** to initiate automatic firmware upgrade via DFOTA. Then the module will download the delta package from the FTP server over the air and upgrade the firmware automatically.

AT+QFOTADL=<ftpURL> Upgrade Firmware over FTP Server	
Write Command **AT+QFOTADL=<ftpURL>**	Response **OK** **+QIND: "FOTA","FTPSTART"** **+QIND: "FOTA","FTPEND",<ftp_err>**

	+QIND: "FOTA","START" **+QIND: "FOTA","UPDATING",<percent>** **+QIND: "FOTA","UPDATING",<percent>** **...** **+QIND: "FOTA","END",<err>** If there is any error: **ERROR**
Maximum Response Time	300 ms
Characteristics	This command take effect immediately.

Parameter

<ftpURL>	String type. The URL that the delta package stored on the FTP server. The maximum length is 255 bytes. It should be started with "FTP://". For example: "FTP://<user_name>:<password>@<serverURL>:<port>/<file_path>". <username> String type. The username for authentication. The maximum length is 50 bytes. <password> String type. The password for authentication. The maximum length is 50 bytes. <serverURL> String type. The IP address or domain name of the FTP server owned and operated by you. The maximum length is 50 bytes. <port> Integer type. The port of the FTP server. Range: 1–65535. Default value: 21. <file_path> String type. The file path on FTP server. The maximum length is 50 bytes.
<ftp_err>	Integer type. The FTP error code. 0 means upgraded successfully. See ***Chapter 5*** for details.
<percent>	Integer type. The upgrade progress in percentage.
<err>	0 means upgraded successfully. Any other value means an error. See ***Chapter 5*** for details.

Example

```
//You can perform the firmware upgrade after storing the delta package on your FTP server.

//"ftp://test:test@192.0.2.2:21/Jun/update-v12-to-v13.zip" is used as an example URL below. (The URL is provided for illustrative purpose only. Please replace it with a valid URL that corresponds to your FTP server and firmware package.)

//Execute the following command to initiate automatic firmware upgrade via DFOTA, and then the module downloads the delta firmware package and upgrades firmware automatically.

AT+QFOTADL="ftp://test:test@192.0.2.2:21/Jun/update-v12-to-v13.zip"
```

```
OK

+QIND: "FOTA","FTPSTART"          //Start to download the delta firmware package from FTP server.
+QIND: "FOTA","FTPEND",0          //Finish downloading the delta firmware package.

//The module will reboot automatically and the USB port will be re-initialized. If the current port is USB port, the host should close and reopen it.

+QIND: "FOTA","START"             //Start to upgrade the firmware.
+QIND: "FOTA","UPDATING",1
+QIND: "FOTA","UPDATING",2
...
+QIND: "FOTA","UPDATING",100
+QIND: "FOTA","END",0             //Finish upgrading the firmware.
```

3.3.2. AT+QFOTADL=<httpURL> Upgrade Firmware over HTTP(S) Server

If the delta package is stored on an HTTP(S) server, execute **AT+QFOTADL=<httpURL>** to initiate automatic firmware upgrade via DFOTA. Then the module will download the delta package from the HTTP(S) server over the air and upgrade the firmware automatically.

AT+QFOTADL=<httpURL> Upgrade Firmware over HTTP(S) Server	
Write Command **AT+QFOTADL=<httpURL>**	Response **OK** **+QIND: "FOTA","HTTPSTART"** **+QIND: "FOTA","HTTPEND",<http_err>** **+QIND: "FOTA","START"** **+QIND: "FOTA","UPDATING",<percent>** **+QIND: "FOTA","UPDATING",<percent>** **...** **+QIND: "FOTA","END",<err>** If there is any error: **ERROR**
Maximum Response Time	300 ms
Characteristics	This command take effect immediately.

Parameter

<httpURL>	String type. The URL that the firmware package stored on the HTTP(S) server. The maximum length is 255 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 owned and operated by you. <http_port> Integer type. The port of the HTTP(S) server. Range: 1–65535. Default value: 80. <http_file_path> String type. The file path in HTTP(S) server.
<http_err>	Integer type. The HTTP(S) error code. 0 means upgraded successfully. See ***Chapter 5*** for more details.
<percent>	Integer type. The upgrade progress in percentage.
<err>	0 means upgraded successfully. Any other value means an error. See ***Chapter 5*** for more details.

Example

```
//You can perform the firmware upgrade after storing the delta firmware package on your HTTP(S) server.

//"http://www.example.com:100/update.zip" is used as an example URL below. (The URL is provided for illustrative purpose only. Please replace it with a valid URL that corresponds to your HTTP(S) server and firmware package.)

//Execute the following command to initiate automatic firmware upgrade via DFOTA, and then the module downloads the delta package and upgrades the firmware automatically.

AT+QFOTADL="http://www.example.com:100/update.zip"
OK

+QIND: "FOTA","HTTPSTART"          //Start to download the delta firmware package from the HTTP(S) server.
+QIND: "FOTA","HTTPEND",0          //Finish downloading the delta firmware package.

//The module will reboot automatically and the USB port will be re-initialized. If the current port is USB port, the host should close and reopen it.

+QIND: "FOTA","START"              //Start to upgrade the firmware.
+QIND: "FOTA","UPDATING",1
+QIND: "FOTA","UPDATING",2
...
+QIND: "FOTA","UPDATING",100
+QIND: "FOTA","END",0              //Finish upgrading the firmware.
```

3.3.3. AT+QFOTADL=<file_name> Upgrade Firmware over Local File System

If the delta package has already been stored in the module’s file system, **AT+QFOTADL=<file_name>** should be executed to initiate automatic firmware upgrade via DFOTA. Then the module will load the delta firmware package from the local file system and upgrade the firmware automatically.

AT+QFOTADL=<file_name>	Upgrade Firmware over Local File System
Write Command **AT+QFOTADL=<file_name>**	Response **OK** **+QIND: "FOTA","START"** **+QIND: "FOTA","UPDATING",<percent>** **+QIND: "FOTA","UPDATING",<percent>** **...** **+QIND: "FOTA","END",<err>** If there is any error: **ERROR**
Maximum Response Time	-
Characteristics	-

Parameter

<file_name>	String type. The path of the delta firmware package on the local file system. The maximum length is 90 bytes. It should be started with "/data/ufs/" or "/usrdata/ufs/" in UFS.
<percent>	Integer type. The upgrade progress in percentage.
<err>	0 means upgraded successfully. Any other value means an error. See ***Chapter 5*** for more details.

Example

```
//Upgrade firmware when delta firmware package is stored on local file system.

AT+QFOTADL="/data/ufs/update-v12-to-v13.zip"
OK

+QIND: "FOTA","START"                  //Start to upgrade the firmware.
+QIND: "FOTA","UPDATING",1
+QIND: "FOTA","UPDATING",2
...
+QIND: "FOTA","UPDATING",100
+QIND: "FOTA","END",0                  //Finish upgrading the firmware.
```

4 Abnormalities and Important Notes

4.1. Abnormalities

4.1.1. Wrong Delta Firmware Package

Execute **AT+QFOTADL** and the module will automatically download the package. When the package is downloaded successfully, the module will reboot automatically and then enter into recovery mode. Then the module will check the upgrade package first. If there is something wrong with the package, the URC (**+QIND: "FOTA","END",<err>**) of an error code (504 or 510) will be reported. Then the module will reboot automatically, and enter into recovery mode and re-check the package five times at most. If the package is still wrong after five retries, the module will reboot and work normally. In such case, please confirm whether the delta package is correct; if not, re-upload the correct package to your FTP/HTTP(S) server.

4.1.2. Failure of Firmware Upgrade

If the delta package is correct, the module will start to upgrade firmware. If it fails to upgrade the firmware, the URC (**+QIND: "FOTA","END",<err>**) of an error code (502, 511, 520-530 or 540-546) will be reported. Then the module will reboot automatically, and enter into recovery mode and retry to upgrade five times at most. If upgrade is still unsuccessful after five retries, the module will stop firmware upgrade and restore to the original version.

NOTE

During the upgrading process, once the delta package is downloaded, the module will check and upgrade automatically. If the check or firmware upgrade fails, the delta package checksum and firmware upgrade can be retried up to 5 times.

As mentioned in ***Chapter 1***, it is a completely automatic process after executing **AT+QFOTADL**. Therefore, any **+QIND: "FOTA","END",<err>** URCs sent from the module to the host can be ignored.

4.2. Important Notes

The following lists some important notes for upgrading:

1. The URC of **+QIND: "FOTA","START"** indicates the firmware upgrade process really starts. If the host receives this URC after executing **AT+QFOTADL**, please do not power off the module until the firmware is upgraded successfully and **+QIND: "FOTA","END",0** is received. Then the module will automatically reboot and work normally.
2. During upgrading process, if the host does not receive any other URCs in four minutes after the last URC is returned, the module can be rebooted.
3. Meanwhile, it is recommended to set a flag on the host to mark the task of the firmware upgrading, and clean it after successful upgrading.

NOTE

It is recommended not to power off the module during the DFOTA upgrade process.

5 Summary of Error Codes

This chapter introduces the err code related to mobile equipment or network. The details about **<ftp_err>**, **<http_err>** and **<err>** are described as follows.

Table 3: Summary of Error Codes

<ftp_err>	Description
0	Successful FTP download operation
601	FTP unknown error
<http_err>	**Description**
0	Successful HTTP(S) download operation
701	HTTP(S) unknown error
<err>	**Description**
0	Successful DFOTA upgrade
502	The upgrade process exits for some unpredictable errors
504	Something wrong with the upgrade package file
510	The patch does not match the source file in the module, need to check whether the delta firmware package is wrong
511	The file system has no enough space for upgrading
520–530, 540–546	Firmware upgrading failed

6 Appendix References

Table 4: Related Document

Document Name	
[1]	Quectel_EC2x&EG9x&EG2x-G&EM05_Series_AT_Commands_Manual

Table 5: Terms and Abbreviations

Abbreviation	Description
DFOTA	Delta Firmware Upgrade Over-The-Air
FTP	File Transfer Protocol
GPRS	General Packet Radio Service
HTTP	Hypertext Transfer Protocol
HTTP(S)	Hyper Text Transport Protocol Secure
LTE	Long-Term Evolution
UFS	User File System
URC	Unsolicited Result Code
URL	Uniform Resource Locator
WCDMA	Wideband Code Division Multiple Access