EC200x&EG912Y Series
FOTA Application Note

LTE Standard Module Series

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About the Document

Revision History

Version	Date	Author	Description
1.0	2019-06-14	Fitz XU/ Taya FANG	Initial
1.1	2020-06-10	Ramos ZHANG/ Galen ZHOU	1. Added applicable modules (Chapter 1). 2. Updated AT+QFOTADL to configure the download and upgrade progress URCs (Chapter 3). 3. Updated the examples of upgrading firmware via FOTA (Chapter 3.2.1.1–3.2.1.3). 4. Added AT+QFOTADL="FILE:<length>",<n> (Chapter 3.2.1.4). 5. Added matter needing attention during FOTA upgrading process (Chapter 5).

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1 Introduction

Quectel EC200x&EG912Y series modules support FOTA (Firmware Over-The-Air) function, which allows customers to upgrade the firmware over the air. With this function, the firmware can be upgraded to a new version and also reverted to the old version.

This document is applicable to the following Quectel modules:

- EC200T Series
- EC200S-CN
- EG912Y Series

2 Firmware Upgrade Procedure via FOTA

The following chart illustrates the firmware upgrade procedure via FOTA.
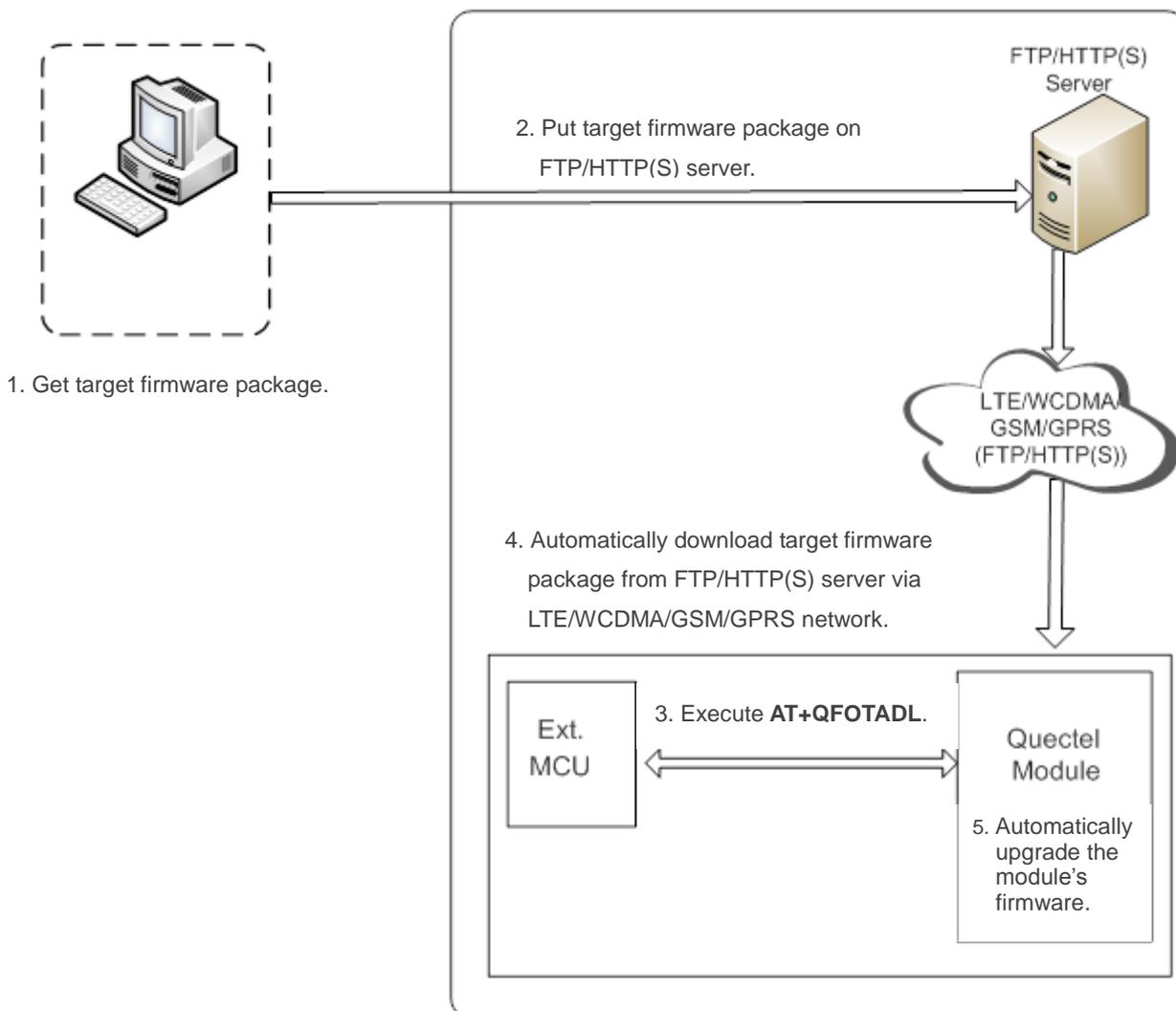
Figure 1: Firmware Upgrade Procedure via FOTA

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 FTP/HTTP(S) server:

Step 1: Get the target firmware package from Quectel.

Step 2: Put the target firmware package on an FTP/HTTP(S) server.

Step 3: Execute **AT+QFOTADL**.

After executing **AT+QFOTADL** command, the module will automatically download the target firmware package from the FTP/HTTP(S) server over LTE/WCDMA/GSM/GPRS network (**Step 4**) and finally automatically upgrade the firmware (**Step 5**).

2.1. Get Target Firmware Package

Before upgrading, please check the source firmware version by executing **ATI** command, and also confirm the target firmware version. Then send the two firmware versions to Quectel or the agent to get a target firmware package.

2.2. Put Target Firmware Package on FTP/HTTP(S) Server

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

Step 2: Put the target firmware package on the server, and record the storage path.

Step 3: The module acquires the target firmware package from the path automatically after executing corresponding AT command.

2.3. Execute AT Command to Upgrade the Firmware

After putting the target firmware package on the FTP/HTTP(S) server, execute **AT+QFOTADL**, and then the module will download the target firmware package from the FTP/HTTP(S) server over the air and upgrade the firmware automatically. For more details, please refer to *Chapter 3*.

3 Description of FOTA AT Commands

3.1. AT Command Syntax

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

3.1.2. 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: Types 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.

3.2. AT Command Description

3.2.1. AT+QFOTADL   Upgrade Firmware via FOTA

AT+QFOTADL enables automatic firmware upgrade for module via FOTA. After executing this command, the module will automatically download the target firmware package from FTP/HTTP(S) server. After the package is successfully downloaded, the module will automatically upgrade the firmware and then reboot.

If the target firmware package is stored on external MCU, the module will wait to receive the firmware package from external MCU through the main UART and then upgrade the firmware automatically after executing the command.

For EC200T series module, if the external MCU used by customers only has UART and the UART does not support hardware flow control mechanism, executing this command can also enable protocol-download file mode to upgrade firmware via FOTA.

AT+QFOTADL Upgrade Firmware via FOTA	
Test Command **AT+QFOTADL=?**	Response **+QFOTADL: <url>,(**list of supported **<upgrade_mode>**s**),(**list of supported **<download_URC_max>**s**),(**list of supported **<update_URC_max>**s**)** **OK**
Characteristics	/

Parameter

<url>	String format. URL of the target firmware package on FTP server, HTTP server or external MCU. Maximum length: 255 bytes. Please refer to **Chapter 3.2.1.1–3.2.1.4** for details about this parameter.
<upgrade_mode>	Integer type. Upgrade mode after successfully downloading the target firmware package. 0 After successfully downloading the target firmware package, reboot the module before upgrading the firmware. 1 Upgrade the firmware immediately after the successful downloading the target firmware package.
<download_URC_max>	Integer type. URC indicating the progress of downloading target firmware package. The last URC indicates the completion of the downloading. For example, if 50 is specified, 50 download progress URCs will be reported, among which the 25th URC means half of lTE downloading is completed, and the 50th URC means the downloading is completed. 0 Disable the reporting of download progress URC.

	5–100	The maximum number of download progress URCs that can be reported.
<update_URC_max>		Integer type. URC indicating the progress of upgrading the firmware. The last URC indicates the completion of the upgrading. For example, if 50 is specified, 50 upgrade progress URCs will be reported, among which the 25th URC means half of the upgrading is completed, and the 50th URC means the upgrading is completed.
	0	Disable the reporting of upgrade progress URC.
	5–<u>100</u>	The maximum number of upgrade progress URCs that can be reported.

3.2.1.1. AT+QFOTADL=<FTP_URL> Upgrade Firmware When Target Firmware Package is Stored on FTP Server

If the target firmware package is stored on an FTP server, **AT+QFOTADL=<FTP_URL>** should be executed to enable automatic firmware upgrade via FOTA. Then the module will download the package from the FTP server over the air and upgrade the firmware automatically.

AT+QFOTADL=<FTP_URL> Upgrade Firmware When Target Firmware Package is Stored on FTP Server	
Write Command **AT+QFOTADL=<FTP_URL>[,<upgrade_mode>[,<download_URC_max>[,<update_URC_max>]]]**	Response **OK** **+QIND: "FOTA","FTPSTART"** **[+QIND: "FOTA","DOWNLOADING",<percent>** **+QIND: "FOTA","DOWNLOADING",<percent>** **…]** **+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**
Characteristics	/

Parameter

<FTP_URL>	String format. Maximum length: 255 bytes. It should be started with "FTP://". For example:

"FTP://<user_name>:<password>@<serverURL>:<port>/<file_path>".

<username>	String type. User name for authentication. Maximum length: 50 bytes.
<password>	String type. Password for authentication. Maximum length: 50 bytes.
<serverURL>	String type. IP address or domain name of FTP server. Maximum length: 50 bytes.
<port>	Integer type. Port of FTP server. Range: 1–65535. Default: 21.
<file_path>	String type. Target firmware package name on FTP server. Maximum length: 50 bytes. Currently only root path is supported.
<upgrade_mode>	Integer type. Upgrade mode after successfully downloading the target firmware package.
	0 After successfully downloading the target firmware package, reboot the module before upgrading the firmware.
	<u>1</u> Upgrade the firmware immediately after the successful downloading the target firmware package.
<download_URC_max>	Integer type. URC indicating the progress of downloading target firmware package. The last URC indicates the completion of the downloading. For example, if 50 is specified, 50 download progress URCs will be reported, among which the 25th URC means half of the downloading is completed, and the 50th URC means the downloading is completed.
	<u>0</u> Disable the reporting of download progress URC.
	5–100 The maximum number of download progress URCs that can be reported.
<update_URC_max>	Integer type. URC indicating the progress of upgrading the firmware. The last URC indicates the completion of the upgrading. For example, if 50 is specified, 50 upgrade progress URCs will be reported, among which the 25th URC means half of the upgrading is completed, and the 50th URC means the upgrading is completed.
	0 Disable the reporting of upgrade progress URC.
	5–<u>100</u> The maximum number of upgrade progress URCs that can be reported.
<FTP_err>	Integer type. FTP error code. 0 indicates successful downloading. Please refer to ***Chapter 4*** for details.
<percent>	Integer type. Download or upgrade progress.
<err>	Integer type. 0 indicates successful upgrade, while any other value indicates an error. Please refer to ***Chapter 4*** for details.

Example

//Upgrade firmware when the target firmware package is stored on an FTP server.
//The FTP server address is "FTP://test:test@124.74.41.170:21/EC200TCNTCNMAR02A02M16.bin".
//Configure the PDP context, and PDP context 2 is used in this example.
AT+QICSGP=2,1,"cmnet","","",1   //Configure PDP context ID to 2, the APN to "cmnet" (which
                  means China Mobile), username and password to null, and the

	authentication type to PAP.
OK	
AT+QFOTA="fota/cid",2	//Set the PDP context ID to 2.
OK	
AT+QIACT=2	//Active the PDP context.
OK	

//Execute **AT+QFOTADL** to enable automatic firmware upgrade via FOTA, and then the module will start to download the target firmware package and upgrade firmware automatically.

AT+QFOTADL="ftp://test:test@124.74.41.170:21/EC200TCNTCNMAR02A02M16.bin",1,50
OK
+QIND: "FOTA","FTPSTART"
+QIND: "FOTA","DOWNLOADING",1
+QIND: "FOTA","DOWNLOADING",2
...
+QIND: "FOTA"," DOWNLOADING",50
+QIND: "FOTA","FTPEND",0   //Finish downloading the package from FTP server.
//Upgrade Firmware via FOTA immediately after downloading the target firmware package.
+QIND: "FOTA","START"
+QIND: "FOTA","UPDATING",1
+QIND: "FOTA","UPDATING",2
...
+QIND: "FOTA","UPDATING",100
+QIND: "FOTA","END",0   //Finish upgrading the firmware.

3.2.1.2. AT+QFOTADL=<HTTP_URL>   Upgrade Firmware When Target Firmware Package is Stored on HTTP(S) Server

If the target firmware package is stored on an HTTP(S) server, **AT+QFOTADL=<HTTP_URL>** should be executed to enable automatic firmware upgrade via FOTA. Then the module will download the package from the HTTP(S) server over the air and upgrade the firmware automatically.

AT+QFOTADL=<HTTP_URL> Upgrade Firmware When Target Firmware Package is Stored on HTTP(S) Server	
Write Command **AT+QFOTADL=<HTTP_URL>[,<upgrade _mode>[,<download_URC_max>[,<upd ate_URC_max>]]]**	Response **OK** **+QIND: "FOTA","HTTPSTART"** **[+QIND: "FOTA","DOWNLOADING",<percent>** **+QIND: "FOTA","DOWNLOADING",<percent>** **…]** **+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**
Characteristics	/

Parameter

<HTTP_URL>	String format. Maximum length: 255 bytes. It should be started with "http://" or "https://".
<HTTP_err>	Integer type. HTTP(S) error code. 0 indicates successful downloading. Please refer to *Chapter 4* for details.
<upgrade_mode>	Integer type. Upgrade mode after successfully downloading the target firmware package. 0 After successfully downloading the target firmware package, reboot the module before upgrading the firmware 1 Upgrade the firmware immediately after the successful downloading the target firmware package.
<download_URC_max>	Integer type. URC indicating the progress of downloading target firmware package. The last URC indicates the completion of the downloading. For example, if 50 is specified, 50 download progress URCs will be reported, among which the 25th URC means half of the downloading is completed, and the 50th URC means the downloading is completed. 0 Disable the reporting of download progress URC. 5–100 The maximum number of download progress URCs that can be reported.
<update_URC_max>	Integer type. URC indicating the progress of upgrading the firmware. The last URC indicates the completion of the upgrading. For example, if 50 is specified, 50 upgrade progress URCs will be reported, among which the 25th URC means half of the upgrading is completed, and the 50th URC means the upgrading is completed. 0 Disable the reporting of upgrade progress URC. 5–100 The maximum number of upgrade progress URCs that can be reported.
<percent>	Integer type. Download or upgrade progress.
<err>	Integer type. 0 indicates successful upgrade, while any other value indicates an error. Please refer to *Chapter 4* for details.

Example

//Upgrade firmware when the target firmware package is stored on an HTTP(S) server.
//The HTTP(S) server address is "http://www.quectel.com:100/EC200TCNTCNMAR02A02M16.bin".

```
//Configure the PDP context, and PDP context 2 is used in this example.
AT+QICSGP=2,1,"cmnet","","",1          //Configure PDP context ID to 2, the APN to "cmnet" (which
                                         means China Mobile), username and password to null, and the
                                         authentication type to PAP.
OK
AT+QFOTA="fota/cid",2                  //Set the PDP context ID to 2.
OK
AT+QIACT=2                             //Active the PDP context.
OK
//Execute AT+QFOTADL to enable automatic firmware upgrade via FOTA, and then the module will start to
download the target firmware package and upgrade firmware automatically.
AT+QFOTADL="http://www.quectel.com:100/EC200TCNTCNMAR02A02M16.bin",1,50
OK
+QIND: "FOTA","HTTPSTART"
+QIND: "FOTA","DOWNLOADING",1
+QIND: "FOTA","DOWNLOADING",2
...
+QIND: "FOTA","DOWNLOADING",50
+QIND: "FOTA","HTTPEND",0          //Finish downloading the package from HTTP(S) server.
//Upgrade Firmware via FOTA immediately after downloading the target firmware package.
+QIND: "FOTA","START"
+QIND: "FOTA","UPDATING",1
+QIND: "FOTA","UPDATING",2
...
+QIND: "FOTA","UPDATING",100
+QIND: "FOTA","END",0                  //Finish upgrading the firmware.
```

3.2.1.3. AT+QFOTADL="FILE:<length>"   Upgrade Firmware When Target Firmware Package is Stored on External MCU

If the target firmware package is stored on external MCU, **AT+QFOTADL="FILE:<length>"** should be executed to start firmware upgrade. The module will wait to receive the firmware package from external MCU through the main UART and then upgrade the firmware automatically.

Before sending **AT+QFOTADL="FILE:<length>"**, hardware flow control needs to be set. If not, the speed of firmware package sending on the host should be limited (for module using NOR Flash, the speed should be limited to 15 KB/s). Also, each firmware package sent needs to be controlled within 32 bytes.

If main UART is used, the following steps should be performed to upgrade firmware:

Step 1: MCU opens the UART, and sets the hardware flow control.
Step 2: Send **AT+IFC=2,2**.

Step 3: Select the target firmware package.
Step 4: Send **AT+QFOTADL="FILE:<length>",<upgrade_mode>,<download_URC_max>,<update_URC_max>**.
Step 5: Send the target firmware package.

If Quectel USB port for AT command communication is used, the following steps should be performed to upgrade firmware:

Step 1: Select and open the Quectel USB port for AT command communication, and then set the hardware flow control.
Step 2: Send **AT+QCFG="usbifc",2,2**.
Step 3: Select the target firmware package.
Step 4: Send **AT+QFOTADL="FILE:<length>",<upgrade_mode>,<download_URC_max>,<update_URC_max>**.
Step 5: Send the target firmware package.

AT+QFOTADL="FILE:<length>" Upgrade Firmware When Target Firmware Package is Stored on External MCU	
Write Command **AT+QFOTADL="FILE:<length>"[,<upgrade_mode>[,<download_URC_max>[,<update_URC_max>]]]**	Response **OK** **+QIND: "FOTA","FILESTART"** **[+QIND: "FOTA","DOWNLOADING",<percent>** **+QIND: "FOTA","DOWNLOADING",<percent>** **…]** **+QIND: "FOTA","FILEEND",<file_err>** **+QIND: "FOTA","START"** **[+QIND: "FOTA","UPDATING",<percent>** **+QIND: "FOTA","UPDATING",<percent>** **...]** **+QIND: "FOTA","END",<err>** If there is any error: **ERROR**
Characteristics	/

Parameter

<length>	Integer type. Length of the target firmware package.
<file_err>	Integer type. File error code. 0 indicates successful downloading. Please refer to **Chapter 4** for details.
<percent>	Integer type. Download or upgrade progress.
<err>	Integer type. 0 indicates successful upgrade, while any other value

	indicates an error. Please refer to *Chapter 4* for details.
<upgrade_mode>	Integer type. Upgrade mode after successfully downloading the target firmware package.
	0 After successfully downloading the target firmware package, reboot the module before upgrading the firmware
	<u>1</u> Upgrade the firmware immediately after the successful downloading the target firmware package.
<download_URC_max>	Integer type. URC indicating the progress of downloading target firmware package. The last URC indicates the completion of the downloading. For example, if 50 is specified, 50 download progress URCs will be reported, among which the 25th URC means half of the downloading is completed, and the 50th URC means the downloading is completed.
	<u>0</u> Disable the reporting of download progress URC.
	5–100 The maximum number of download progress URCs that can be reported.
<update_URC_max>	Integer type. URC indicating the progress of upgrading the firmware. The last URC indicates the completion of the upgrading. For example, if 50 is specified, 50 upgrade progress URCs will be reported, among which the 25th URC means half of the upgrading is completed, and the 50th URC means the upgrading is completed.
	0 Disable the reporting of upgrade progress URC.
	5–<u>100</u> The maximum number of upgrade progress URCs that can be reported.

NOTE

Hardware flow control is needed if target firmware package is stored on external MCU when upgrading firmware.

Example

```
//Upgrade firmware when firmware package is stored on external MCU.
AT+QCFG="USBIFC",2,2                          //Open hardware flow control.
OK
AT+QCFG="USBIFC"
+QCFG: "usbifc",2,2

OK
AT+QFOTADL="FILE:4884688",1,50                //The length of firmware package is 4884688 bytes.
OK

+QIND: "FOTA","FILESTART"
//Wait for external MCU to send firmware package through the serial port tool to module.
```

```
+QIND: "FOTA","DOWNLOADING",1
+QIND: "FOTA","DOWNLOADING",2
...
+QIND: "FOTA","DOWNLOADING",50
+QIND: "FOTA","FILEEND",0
//Upgrade Firmware via FOTA immediately after downloading target firmware package.
+QIND: "FOTA","START"
+QIND: "FOTA","UPDATING",1
+QIND: "FOTA","UPDATING",2
...
+QIND: "FOTA","UPDATING",100
+QIND: "FOTA","END",0                    //Finish upgrading the firmware.
```

3.2.1.4. AT+QFOTADL="FILE:<length>",<n>   External MCU Upgrades Firmware With Local File Through UART that Does Not Support Hardware Flow Control

If the external MCU customers used only has UART and the UART does not support hardware flow control mechanism, please execute this command to enable protocol-download file mode, which is a special method firmware upgrade with local file via FOTA. For more details, please contact Quectel Technical Supports.

AT+QFOTADL="FILE:<length>",<n> External MCU Upgrades Firmware With Local File Through UART That Does Not Support Hardware Flow Control	
Write Command **AT+QFOTADL="FILE:<length>",<n>**	Response **010003** If there is any error: **ERROR**
Characteristics	/

Parameter

<length>	Integer type. Length of the target firmware package.
<n>	Integer type.
	2 Enable protocol-download file mode to upgrade firmware via FOTA.

NOTE

Currently this command is only supported by EC200T series modules.

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4 Summary of Error Codes

The error code indicates an error related to mobile equipment or network. The details about **<FTP_err>**, **<HTTP_err>**, **<file_err>** and **<err>** are described as follows.

4.1. Summary of <FTP_err> Codes

Detailed information about **<FTP_err>** is listed as follows.

Table 2: Summary of <FTP_err> Codes

<FTP_err>	Meaning
0	FTP download operation successful
601	FTP unknown error
602	FTP service blocked
603	FTP service busy
604	DNS parse failed
605	Network error
606	Control connection closed
607	Data connection closed
608	Socket closed by peer
609	Timeout error
610	Invalid parameter
611	Failed to open file
612	File position invalid

613	File error
614	Service not available, closing control connection
615	Failed to open data connection
616	Connection closed, transfer aborted
617	Requested file action not taken
618	Requested action aborted: local error in processing
619	Requested action not taken: insufficient system storage
620	Syntax error, command unrecognized
621	Syntax error in parameters or arguments
622	Command not implemented
623	Bad sequence of commands
624	Command parameter not implemented
625	Failed to login FTP
626	Need account for storing files
627	Requested action not taken
628	Requested action aborted: page type unknown
629	Requested file action aborted
630	Requested file name invalid

4.2. Summary of <HTTP_err> Codes

Detailed information about **<HTTP_err>** is listed as follows.

Table 3: Summary of <HTTP_err> Codes

<HTTP_err>	Meaning
0	HTTP(S) download operation successful
701	HTTP(S) unknown error
702	HTTP(S) timeout
703	HTTP(S) busy
704	HTTP(S) UART busy
705	HTTP(S) does not get/post request
706	HTTP(S) network busy
707	HTTP(S) network open failed
708	HTTP(S) network not configured
709	HTTP(S) network deactivated
710	HTTP(S) network error
711	HTTP(S) URL error
712	HTTP(S) URL empty
713	HTTP(S) IP address error
714	HTTP(S) DNS error
715	HTTP(S) socket creation error
716	HTTP(S) socket connection error
717	HTTP(S) socket read error
718	HTTP(S) socket write error
719	HTTP(S) socket closed

720	HTTP(S) data encode error
721	HTTP(S) data decode error
722	HTTP(S) read timeout
723	HTTP(S) response failed
724	Incoming call busy
725	Voice call busy
726	Input timeout
727	Wait data timeout
728	Wait HTTP(S) response timeout
729	Allocate memory failed
730	Invalid parameter

4.3. Summary of <file_err> Codes

Detailed information about **<file_err>** is listed as follows.

Table 4: Summary of <file_err> Codes

<HTTP_err>	Meaning
0	File download operation successful
500	File download error

4.4. Summary of <err> Codes

Detailed information about **<err>** is listed as follows.

Table 5: Summary of <err> Codes

<HTTP_err>	Meaning
0	FOTA upgrade successful
504	FOTA upgrade failed
506	FOTA firmware MD5 check error

5 Matter Needing Attention

During the process of upgrading firmware via FOTA, it is very important to ensure the module is powered; otherwise, the upgrade will be failed and cannot be restored.

6 Appendix A References

Table 6: Reference Documents

SN	Document Name	Remark
[1]	Quectel_EC2x&EG9x&EM05_DFOTA_User_Guide	DFOTA user guide for Quectel EC25, EC21, EG91, EG95, EM05 series and EC20 R2.1 modules

Table 7: Terms and Abbreviations

Abbreviation	Description
FOTA	Firmware Over-The-Air
FTP	File Transfer Protocol
GSM	Global System for Mobile Communications
GPRS	General Packet Radio Service
HTTP	Hyper Text Transfer Protocol
HTTPS	Hyper Text Transfer Protocol Secure
LTE	Long Term Evolution
SD	Secure Digital
UFS	User File System
WCDMA	Wideband Code Division Multiple Access