

BC65&BC92&BC95-GR

DFOTA Upgrade Guide

NB-IoT Module Series

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About the Document

Revision History

Version	Date	Author	Description
-	2020-04-13	Fonda FANG	Creation of the document
1.0	2020-04-13	Fonda FANG	First official release
1.1	2023-10-20	Miles MA	Added the applicable module BC95-GR.
1.2	2024-09-25	Howie DONG	<ol style="list-style-type: none"> Updated the document name from "Application Note" to "Upgrade Guide". Added the chapter of DFOTA implementation and user responsibility (Chapter 1.1). Optimized the DFOTA firmware upgrade flowchart to distinguish between the user side and the Quectel side (Figure 1). 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). Updated the declaration of AT command examples (Chapter 3.2). Optimized the explanation of the parameters <HTTP_server_URL> and <HTTP_URL> (Chapter 3.3.1 and Chapter 3.3.3). Updated the URL address and related instructions in the command example (Chapter 4).

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1 Introduction

Quectel BC65, BC92 and BC95-GR modules support DFOTA (Delta Firmware Over-The-Air) feature, which allows customers to upgrade or downgrade firmware wirelessly.

In DFOTA, a delta firmware package, which only contains the differences between the current and the target firmware version, is needed. In this way, the amount of data transmitted and time consumed can be reduced.

This document describes how to upgrade the firmware of Quectel BC65, BC92 and BC95-GR modules via DFOTA.

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.

2 DFOTA Procedure

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

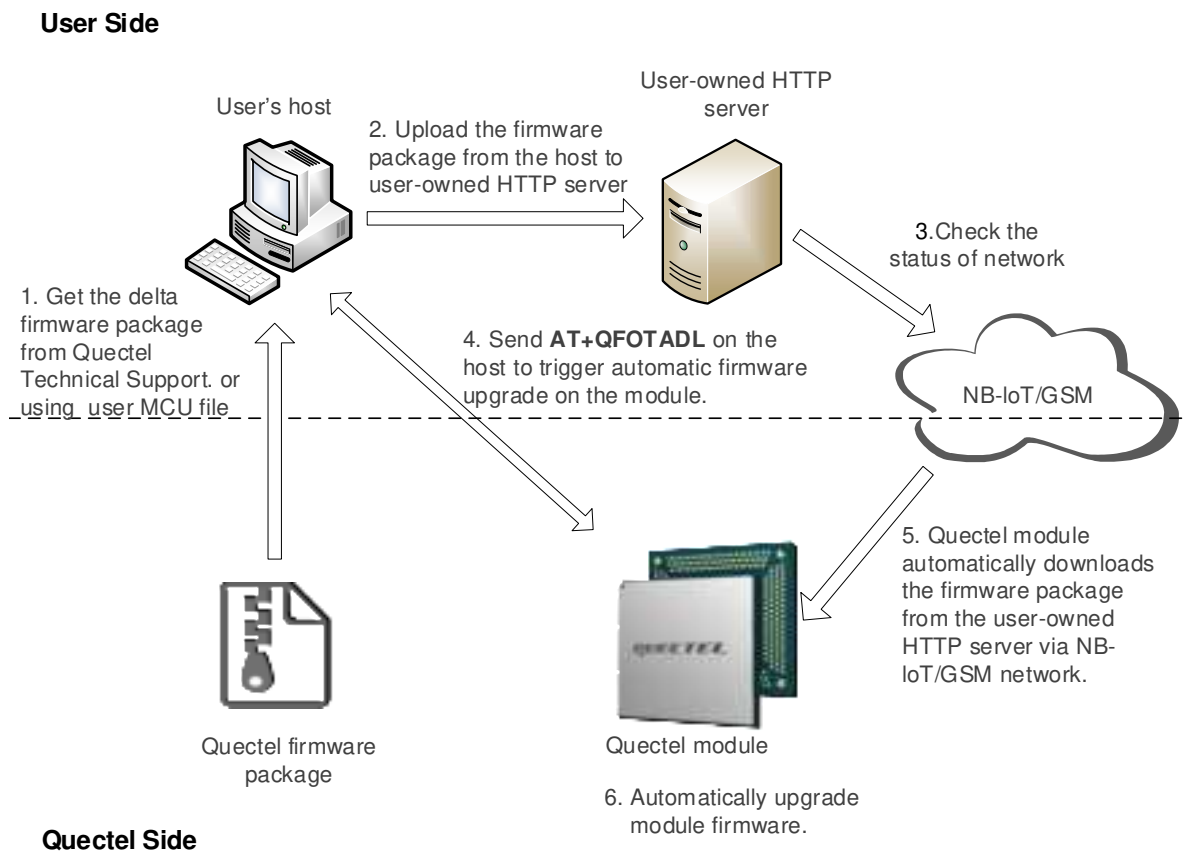


Figure 1: DFOTA Procedure

As shown in the above figure, customers only need to perform the following steps to upgrade the firmware when the firmware package is stored on an HTTP server:

- Step 1:** Acquire the delta firmware package from Quectel Technical Support or using user MCU file (see **Chapter 2.1** for details).
- Step 2:** Upload the delta firmware package from the host to your HTTP server (see **Chapter 2.2** for details).
- Step 3:** Check the status of network (see **Chapter 2.3** for details).
- Step 4:** Execute **AT+QFOTADL** on the host to trigger automatic firmware upgrade on the module (see

Chapter 2.4 for details).

Step 5: The module automatically downloads the firmware package from your HTTP server via NB-IoT network or GSM network.

Step 6: The module internally runs the updating program to automatically upgrade the module firmware.

NOTE

1. Since BC92 supports both NB-IoT and GSM networks, BC92 also supports to download upgrade files through GSM network.
2. When BC92 is under GSM network, it is needed to manually configure PDP and activate IP with the command **AT+CGDCONT** after **Step 3**.
3. Please refer to **document [1]** or **document [2]** for more details about the AT commands other than **AT+QFOTADL** in this chapter.
4. You are responsible for providing and managing the HTTP server for the firmware upgrade. Quectel does not supply the server or assist with its setup.

2.1. Acquire Delta Firmware Package

Before firmware upgrading, the current firmware version needs to be checked by executing **ATI** and the target firmware version needs to be decided. Then, customers should send the two firmware versions to Quectel Technical Support to obtain the corresponding firmware package.

2.2. Upload Delta Package to HTTP Server

Step 1: Please set up an HTTP server before using the DFOTA (Quectel does not provide such a server).

Step 2: After the delta firmware package is uploaded to the server and the HTTP path is recorded, the module will be able to acquire the delta firmware package through the HTTP path by executing the corresponding AT command.

NOTE

Please record the HTTP path (URL) to which the delta firmware package is uploaded for the **AT+QFOTADL** command in **Chapter 3**.

2.3. Check Network Status

After the module is powered on, please make sure it is registered on network before the firmware upgrading.

Relevant AT commands are listed below:

- **AT+CESQ** Query signal quality
- **AT+COPS?** Query the network type and registration status
- **AT+CGPADDR** Query allocated IP address

2.4. Execute AT Command to Upgrade the Firmware

After the network status is confirmed to be ready, execute **AT+QFOTADL** on the host to initiate the automatic over-the-air download and upgrade of module delta firmware package. For more details about the DFOTA AT commands, please refer to **Chapter 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 the 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 1: 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. DFOTA AT Commands

AT+QFOTADL command enables the automatic firmware upgrade for Quectel module via DFOTA. After the command is executed, the package will be automatically downloaded to the module from the HTTP server. After the package download completes, the module will start to upgrade its firmware automatically. If firmware is upgraded successfully, the module will reboot, otherwise it will return an error and exit from DFOTA.

3.3.1. AT+QFOTADL=<HTTP_URL> DFOTA via HTTP Server

If the delta firmware package is stored on an HTTP server, **AT+QFOTADL=<HTTP_URL>** should be executed to initiate the automatic firmware upgrade via DFOTA. Then the module will download the delta firmware package from the HTTP server wirelessly and upgrade the firmware automatically.

AT+QFOTADL=<HTTP_URL> DFOTA via HTTP Server	
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","HTTPPEND",<HTTP_err>

	<p>+QIND: "FOTA","START"</p> <p>+QIND: "FOTA","UPDATING",<percent></p> <p>+QIND: "FOTA","UPDATING",<percent></p> <p>...</p> <p>+QIND: "FOTA","END",<FOTA_err></p> <p>If there is any error: ERROR Or +CME ERROR: <HTTP_err></p>
Characteristics	The command takes effect immediately.

Parameter

<HTTP_URL>	String format. The URL that the firmware package stored on the HTTP server. The maximum length is 511 bytes. It should start with "http://" in a format as follows: "http://<HTTP_server_URL>:<HTTP_port>/<HTTP_file_path>"
<HTTP_server_URL>	String type. The IP address or domain of the HTTP server owned and operated by you.
<HTTP_port>	Integer type. The port of the HTTP server. The default value is 80. The range is 1–65535.
<HTTP_file_path>	String type. The file path in the HTTP server.
<HTTP_err>	Integer type. The HTTP error code. 0 means downloaded successfully. Any other value means an error. Please refer to Chapter 5 for more details.
<percent>	Integer type. The download or upgrade progress in percentage.
<FOTA_err>	Integer type. 0 means upgraded successfully. Any other value means an error. Please refer to Chapter 5 for more details.

NOTE

If the module is powered off when it is reporting **+QIND: "FOTA","UPDATING",<percent>**, the module will automatically enter force upgrade mode when powered on next time, and continue the upgrading progress. The URC of upgrade process is shown as below:

+QIND: "FOTA","START"

+QIND: "FOTA","UPDATING",0%

```
+QIND: "FOTA","UPDATING",10%
```

```
...
```

```
+QIND: "FOTA","END",0
```

3.3.2. AT+QFOTADL=<para> Local Upgrade

If the delta firmware package already exists in the UFS directory of the module filesystem, and the name of this firmware package is “fota.pack”, the upgrade progress will be triggered by executing **AT+QFOTADL=1**. If the name of the firmware package is not “fota.pack”, please rename the firmware package with the filesystem-related AT command.

AT+QFOTADL=<para> Local Upgrade

Write Command
AT+QFOTADL=<para>

Response
OK

```
+QIND: "FOTA","START"
```

```
+QIND: "FOTA","UPDATING",<percent>
```

```
+QIND: "FOTA","UPDATING",<percent>
```

```
...
```

```
+QIND: "FOTA","END",<FOTA_err>
```

If there is any error:

ERROR

Or

```
+CME ERROR: <HTTP_err>
```

Characteristics

The command takes effect immediately.

Parameter

<para>	Integer type. 1 Local Upgrade
<percent>	Integer type. The download or upgrade progress in percentage.
<HTTP_err>	Integer type. The HTTP error code. 0 means downloaded successfully. Any other value means an error. Please refer to Chapter 5 for more details.
<FOTA_err>	Integer type. 0 means upgraded successfully. Any other value means an error. Please refer to Chapter 5 for more details.

NOTE

- Delta firmware package can be transferred to UFS directory in module with filesystem-related AT commands via AT UART port. The filename of this package must be named as "fota.pack", otherwise the upgrade process cannot be triggered correctly.
- If the module is powered off when it is reporting **+QIND: "FOTA","UPDATING",<percent>**, the module will automatically enter force upgrade mode when powered on next time, and continue the upgrading progress. The URC of upgrade process is shown as below:
+QIND: "FOTA","START"

+QIND: "FOTA","UPDATING",0%

+QIND: "FOTA","UPDATING",10%

...

+QIND: "FOTA","END",0
- Please refer to **document [3]** for the AT commands of filesystem.

3.3.3. AT+QFOTADL=<para>,<HTTP_URL>[,<filename>] Download MCU File Via HTTP Server

If a file of external MCU is uploaded to the HTTP server, it can be downloaded by executing **AT+QFOTADL=<para>,<HTTP_URL>[,<filename>]**, and will be saved in UFS directory of the module filesystem. The file name can be specified by the parameter **<filename>**, or acquired from **<HTTP_URL>**.

AT+QFOTADL=<para>,<HTTP_URL>[,<filename>] Download MCU File Via HTTP Server

Write Command	Response
AT+QFOTADL=<para>,<HTTP_URL>[,<filename>]	OK
	+QIND: "FOTA","HTTPSTART"
	+QIND: "FOTA","DOWNLOADING",<percent>
	+QIND: "FOTA","DOWNLOADING",<percent>
	...
	+QIND: "FOTA","HTTPPEND",<HTTP_err>
	If there is any error: ERROR

	Or +CME ERROR: <HTTP_err>
Characteristics	The command takes effect immediately.

Parameter

<para>	Integer type. 2 Download the file to module via HTTP server.
<filename>	String type. File name. Specify the saving name of file.
<HTTP_URL>	String type. The URL that the firmware package stored on the HTTP server. The maximum length is 511 bytes. It should start with " http:// " in a format as follows: "http://<HTTP_server_URL>:<HTTP_port>/<HTTP_file_path>"
<HTTP_server_URL>	String type. The IP address or domain name of HTTP server owned and operated by you.
<HTTP_port>	Integer type. The port of the HTTP server. The default value is 80. The range is 1–65535.
<HTTP_file_path>	String type. The file path in HTTP server.
<HTTP_err>	Integer type. The HTTP error code. 0 means download successfully. Any other value means an error. Please refer to Chapter 5 for more details.
<percent>	Integer type. The download or upgrade progress in percentage.

NOTE

1. The length of file name cannot exceed 58 bytes when <para>=2, otherwise an error will be returned. In the case that <filename> is omitted, the module will first obtain the file name from the HTTP URL. If the file name is illegal, the default "mcu_update.bin" will be used to name the downloaded file. Then, please use the filesystem-related AT commands to operate it after downloading.
2. Please refer to **document [3]** for the AT commands of filesystem.

4 Examples

4.1. DFOTA via HTTP Server Under NB-IoT Network

//You can perform the firmware upgrade after storing the delta firmware package on your HTTP server.
http://192.0.2.2:3029/update.pack 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 server and firmware package).

AT+COPS? //Query network status.
+COPS: 0,2,"46011",9 //The fourth parameter **9** indicates a NB-IoT network.

OK

//Under NB-IoT network, the module will use the parameter configured by **AT+QCGDEFCONT** and automatically activate IP.

AT+CGDCONT?
+CGDCONT: 1,"IP","fast.t-mobile.com","192.0.2.2",0,0

OK

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

AT+QFOTADL="http://192.0.2.2:3029/update.pack"

OK

+QIND: "FOTA","HTTPSTART" //Download starts.

+QIND: "FOTA","DOWNLOADING",0%

+QIND: "FOTA","DOWNLOADING",10%

...

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

+QIND: "FOTA","HTTPEND",0 //The package from HTTP server is successfully downloaded.

+QIND: "FOTA","START" //Upgrade starts.

```
+QIND: "FOTA","UPDATING",0%

+QIND: "FOTA","UPDATING",10%

...

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

+QIND: "FOTA","END",0           //The firmware is successfully upgraded.
```

4.2. DFOTA via HTTP Server Under GSM Network (for BC92 Only)

//You can perform the firmware upgrade after storing the delta firmware package on your HTTP server. Upgrade firmware when delta firmware package is stored on an HTTP server. <http://192.0.2.2:3029/update.pack> 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 server and firmware package).

```
AT+COPS?           //Query network status.
+COPS: 0,2,"46000",0 //The fourth parameter 0 indicates a GSM network.
```

OK

//When BC92 is under GSM network, it is needed to configure PDP and activate IP manually before downloading.

```
AT+CGDCONT=1,"IP"           //Configure PDP type to "IP".
```

OK

```
AT+CGACT=1,1           //Activate the PDP context.
```

OK

```
AT+CGDCONT?
```

```
+CGDCONT: 1,"IP",,"192.0.2.2",0,0
```

OK

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

```
AT+QFOTADL="http://192.0.2.2:3029/update.pack"
```

OK

```
+QIND: "FOTA","HTTPSTART"           //Download starts.
```

```
+QIND: "FOTA","DOWNLOADING",0%
```

```
+QIND: "FOTA","DOWNLOADING",10%
```

```

...

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

+QIND: "FOTA","HTTPEND",0           //The package from HTTP server is successfully downloaded.

+QIND: "FOTA","START"               //Upgrade starts.

+QIND: "FOTA","UPDATING",0%

+QIND: "FOTA","UPDATING",10%

...

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

+QIND: "FOTA","END",0               //The firmware is successfully upgraded.

```

4.3. Local Upgrade Process

//The local upgrade process can be triggered by executing **AT+QFOTADL=1**. First, please make sure that the file already exists in module filesystem and its name must be "fota.pack", otherwise the module will return an error.

```

AT+QFLST                               //Check whether the file exists or not.
+QFLST: "fota.pack",20135

OK
AT+QFOTADL=1                           //Trigger the local upgrade process.
OK

+QIND: "FOTA","START"                   //Local upgrade starts.

+QIND: "FOTA","UPDATING",0%

+QIND: "FOTA","UPDATING",10%

...

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

+QIND: "FOTA","END",0                   //Upgraded successful.

```

4.4. Download MCU File from HTTP Server Under NB-IoT Network

```

AT+COPS?                                     //Query network status.
+COPS: 0,2,"46011",9                          //The fourth parameter 9 indicates a NB-IoT network.

OK

//The module will automatically active the default PDN, which set by AT+QCGDEFCONT in NB-IoT
network.
AT+CGDCONT?
+CGDCONT: 1,"IP","fast.t-mobile.com","192.0.2.2",0,0

OK

//Execute AT+QFOTADL=2,<HTTP_URL> to download the MCU upgrade file from the HTTP server and
store it in the module. After the download is complete, the corresponding filesystem AT command can be
used to operate this MCU upgrade file.
.
//The URL of the MCU file on the HTTP server is "http://192.0.2.2:3029/test.bin"(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.)
AT+QFOTADL=2,"http://192.0.2.2:3029/test.bin"      //Trigger the process.
OK

+QIND: "FOTA","HTTPSTART"                      //Download starts.

+QIND: "FOTA","DOWNLOADING",0%

+QIND: "FOTA","DOWNLOADING",10%
...

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

+QIND: "FOTA","HTTPEND",0                      //The MCU file is successfully downloaded.
AT+QFLST                                       //List the files in the module filesystem.
+QFLST: "test.bin",93368

OK

```

4.5. Download MCU File from HTTP Server Under GSM Network (for BC92 Only)

```

AT+COPS? //Query network status.
+COPS: 0,2,"46000",0 //The fourth parameter 0 indicates a GSM network.

OK
//When the BC92 is under a GSM network, please manually configure the PDP and activate the IP before
downloading.
AT+CGDCONT=1,"IP" //Configure PDP type to "IP".
OK
AT+CGACT=1,1 //Active the PDP context.
OK
AT+CGDCONT?
+CGDCONT: 1,"IP",,"192.0.2.2",0,0

OK
//Execute AT+QFOTADL=2,<HTTP_URL> to download the MCU upgrade file from the HTTP server and
store it in the module. After the download is complete, the corresponding filesystem AT command can be
used to operate this MCU upgrade file.
//The URL of the MCU file on the HTTP server is "http://192.0.2.2:3029/test.bin" (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).
AT+QFOTADL=2,"http://192.0.2.2:3029/test.bin"
OK

+QIND: "FOTA","HTTPSTART" //Download starts.

+QIND: "FOTA","DOWNLOADING",0%

+QIND: "FOTA","DOWNLOADING",10%

...

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

+QIND: "FOTA","HTTPPEND",0 //The MCU file is successfully downloaded.
AT+QFLST //List the files in the module filesystem.
+QFLST: "test.bin",93368

OK

```

5 Summary of Error Codes

The error code indicates an error related to mobile equipment or network. The details about <FOTA_err> and <HTTP_err> are described in the following tables.

Table 2: Summary of <HTTP_err> Codes

<HTTP_err>	Description
0	Downloaded successfully
6500	Unknown mistake
6501	Illegal parameter
6502	Upgrade package is too large
6503	Download failed
6504	Upgrade package not found
6505	Upgrade package failed to write flash
6506	There are no differential packages in the module file system
6507	Differential packet verification error
6509	Allocate memory failed

Table 3: Summary of <FOTA_err> Codes

<FOTA_err>	Description
0	Upgraded successfully
6508	Upgrade failed

6 Appendix References

Table 4: Related Documents

Document Name
[1] Quectel_BC65&BC95-GR_AT_Commands_Manual
[2] Quectel_BC92_AT_Commands_Manual
[3] Quectel_BC65&BC92&BC95-GR_FileSystem_Application_Note

Table 5: Terms and Abbreviations

Abbreviation	Description
DFOTA	Delta Firmware Over-The-Air
GSM	Global System for Mobile Communication
HTTP(S)	Hyper Text Transport Protocol (Secure)
IP	Internet Protocol
MCU	Microcontroller Unit
NB-IoT	Narrowband Internet of Things
PDP	Packet Data Protocol
UFS	User File Storage
URL	Uniform Resource Locator