BG95&BG77&BG600L Series File System Backup Solution Application Note

LPWA Module Series

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About the Document

Revision History

Version	Date	Author	Description
-	2022-11-03	Eric XIANG/ Matt YE	Creation of the document
1.0	2023-02-13	Eric XIANG/ Matt YE	First official release

Contents

Table Index

Figure Index

1 Introduction

In some usage scenarios of Quectel BG95 series, BG77 and BG600L-M3 modules, such as abnormal power failure of the module, there will be a certain risk of impacting the embedded file system of the module. Under extreme conditions, the critical start-up file of the module is damaged, causing the module bootup failure.

In view of this, Quectel BG95 series, BG77 and BG600L-M3 modules have embedded the corresponding protection mechanism, which is creating a separate area for backup data of the file system, after the file system damage is detected, it will restore from the backup area automatically.

This document gives a detailed description of the file system backup and restoration solution.

> **NOTE**
>
> If customers store the important data or files in modem or AP file system (such as certificates, private keys, QuecOpen APP and other key data), it is recommended to trigger a backup by AT command to avoid data loss when the file system restoration happens.

2 Backup and Restore Mechanisms

Quectel BG95 series, BG77 and BG600L-M3 modules have a separate NAND partition for data backup.
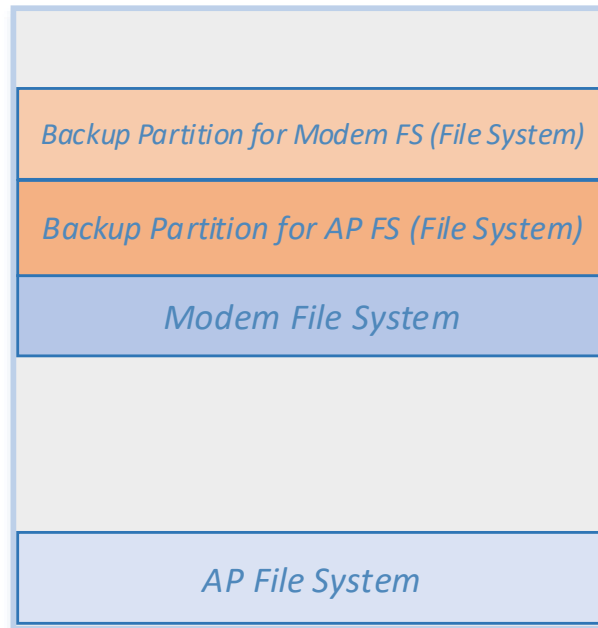
Figure 1: Module Partition (Partial)

1. The module has two different separate partitions to back up Modem FS (File System) and AP FS (File System).
2. The maximum partition size for backing up the Modem FS (File System) is about 1 MB bytes.
3. The maximum partition size for backing up the AP FS (File System) is about 0.75 MB bytes.
4. The maximum partition size may vary with firmware versions.
5. Backup Partition for Modem FS is composed of data backup area (for backing up file system) and information backup area (for saving backup and restore information).
6. Backup Partition for AP FS is composed of data backup area (for backing up file system) and information backup area (for saving backup and restore information).

2.1. Backup Mechanism

Before the module is delivered, each file system partition will be written to the corresponding backup partition by the specified AT command in production line.

The modules support two file systems: Modem file system and AP file system.

1. The Modem file system stores some key parameters of the module, such as RF configuration, RF calibration, and network configuration.

2. The AP file system stores USB configuration and other common parameters, such as LwM2M default configuration files, without network configuration related parameters.

Figure 2: Backup Mechanism

2.2. Restore Mechanism

In case of file system exception, the module will automatically trigger the protection mechanism, or the restore mechanism can 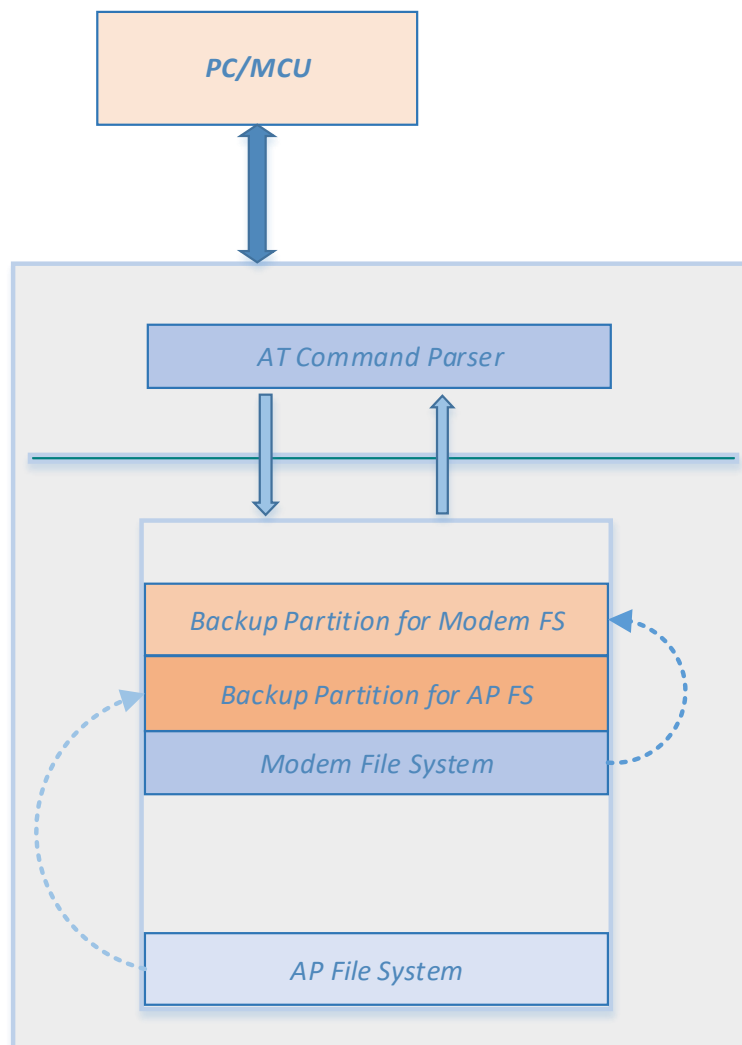be forced by the AT command. In this process, the module will directly restore the backup data and overwrite the existing file system data. After a successful restoration, the module will be restored to factory settings.
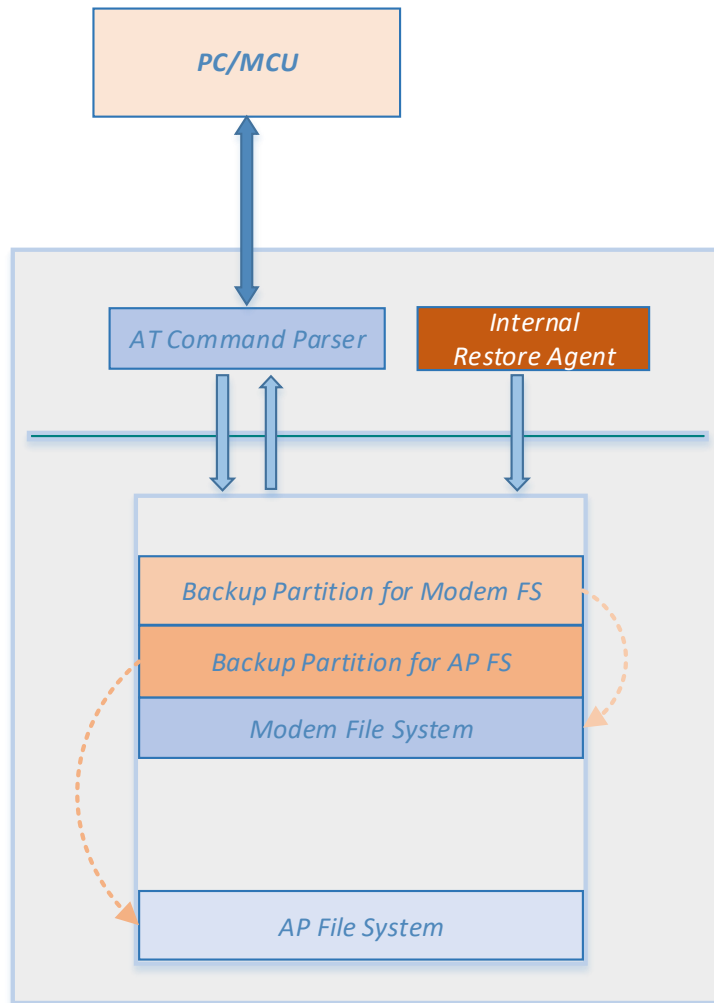

Figure 3: Restore Mechanism

2.3. Related AT Commands

2.3.1. AT Command Introduction

2.3.1.1. 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 to its previous value or the default settings, unless otherwise specified.
- **Underline**   Default setting of a parameter.

2.3.1.2. 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.

2.3.2. 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.

2.3.3. AT+QPRTPARA Supported Backup and Restore Operations of the Modem File System and AP File System

AT+QPRTPARA=1 Back Up Modem File System	
Write Command **AT+QPRTPARA=1**	Response **OK** Or **ERROR**

AT+QPRTPARA=3 Force the Restoration of Modem File System	
Write Command **AT+QPRTPARA=3**	Response **OK** Or **ERROR**

AT+QPRTPARA=4 Get Backup and Restore Information of Modem File System	
Write Command **AT+QPRTPARA=4**	Response **+QPRTPARA: <CEFS_backup_cnt>,<CEFS_restore_cnt>,<page_cnt>,<1_cnt>,<2_cnt>,<3_cnt>,<4_cnt>,<5_cnt>,<6_cnt>,<7_cnt>,<8_cnt>,<9_cnt>,<10_cnt>,<CEFS_bad_block>** **OK** Or **ERROR**

AT+QPRTPARA=11 Back Up AP File System	
Write Command **AT+QPRTPARA=11**	Response **OK** Or **ERROR**

AT+QPRTPARA=13 Force the Restoration of AP File System	
Write Command **AT+QPRTPARA=13**	Response **OK**

Or
ERROR

AT+QPRTPARA=14 Get Backup and Restore Information of AP File System	
Write Command **AT+QPRTPARA=14**	Response **+QPRTPARA: <backup_valid>,<backup_cnt>,<restore_cnt>,<1_cnt>,<2_cnt>,<3_cnt>,<4_cnt>,<5_cnt>,<6_cnt>,<7_cnt>,<8_cnt>,<9_cnt>,<10_cnt>,<page_cnt>,<bad_blk_cnt>,<MFS_data_bad_blk>,<MFS_info_bad_blk>,<AFS_data_bad_blk>,<AFS_info_bad_blk>** **OK** Or **ERROR**
Maximum Response Time	/
Characteristics	The command takes effect immediately. (Backup operation) The command takes effect after the module is rebooted. (Restore operation) The configuration is saved automatically.

Parameter

<CEFS_backup_cnt>	Integer type. The number of the backups for the Modem file system.
<CEFS_restore_cnt>	Integer type. The number of the restores for the Modem file system, including the forced restore operation and automatic restore operation.
<page_cnt>	Integer type. The size of space currently used by the Modem/AP file system (2 KB/page).
<1_cnt>	Integer type. The number of file system restores that occurred at probe point 1.
<2_cnt>	Integer type. The number of file system restores that occurred at probe point 2.
<3_cnt>	Integer type. The number of file system restores that occurred at probe point 3.
<4_cnt>	Integer type. The number of file system restores that occurred at probe point 4.
<5_cnt>	Integer type. The number of file system restores that occurred at probe point 5.
<6_cnt>	Integer type. The number of file system restores that occurred at probe point 6.
<7_cnt>	Integer type. The number of file system restores that occurred at probe point 7.
<8_cnt>	Integer type. The number of file system restores that occurred at probe point 8.

<9_cnt>	Integer type. The number of file system restores that occurred at probe point 9.
<10_cnt>	Integer type. The number of file system restores that occurred at probe point 10.
<CEFS_bad_block>	Integer type. The number of bad blocks in Modem file system.
<backup_valid>	Integer type. The flag to indicate AP file system backup is valid or not.
	0 AP file system backup is invalid
	1 AP file system backup is valid
<backup_cnt>	Integer type. The number of the backups for the AP file system.
<restore_cnt>	Integer type. The number of the restores for the AP file system, including the forced restore operation and automatic restore operation.
<bad_blk_cnt>	Integer type. The number of the bad blocks in backup partition of modem and AP.
<MFS_data_bad_blk>	Integer type. The number of the bad blocks in modem data backup partition.
<MFS_info_bad_blk>	Integer type. The number of the bad blocks in modem information backup partition.
<AFS_data_bad_blk>	Integer type. The number of the bad blocks in AP data backup partition.
<AFS_info_bad_blk>	Integer type. The number of the bad blocks in AP information backup partition.

NOTE

1. Do not power off when executing **AT+QPRTPARA=1/11**. If this is done, please re-backup again.
2. AT+QPRTPARA=1/3/4 must be executed after **RDY** report**,** AT+QPRTPARA=11/13/14 must be executed after APP **RDY** report.
3. Generally, **AT+QPRTPARA=3/13** are used for test purpose. Customer does not need to execute this command in actual use.
4. Due to the limitation of the NAND flash lifespan, please do not execute **AT+QPRTPARA=1/11** too frequently.
5. When **AT+QPRTPARA=1/11**, the maximum response time is 4 s.
   When **AT+QPRTPARA=3/4/13/14**, the maximum response time is 600 ms.
   The above are the common maximum response time of this command. In actual tests, the maximum response time will vary with the size of the file system or different firmware

Example

```
RDY

APP RDY

AT+QPRTPARA=1
OK
```

AT+QPRTPARA=4
+QPRTPARA: 16,0,268,0,0,0,0,0,0,0,0,0,0,0

OK
AT+QPRTPARA=11
OK
AT+QPRTPARA=14
+QPRTPARA: 1,1,0,0,0,0,0,0,0,0,0,0,0,258,0,0,0,0,0

OK

AT+QPRTPARA=4
+QPRTPARA: 16,0,268,0,0,0,0,0,0,0,0,0,0,0

2.4. Auxiliary Test

This chapter provides some test examples to help you determine whether the current file system backup or restore operation is successful or not.

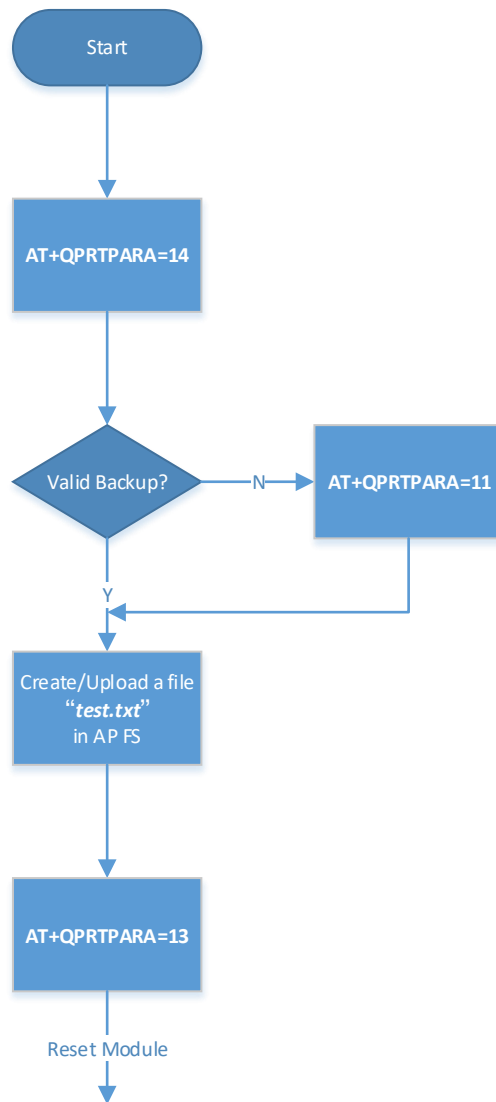1. The restore operation will remove the file without backup.

Figure 4: Test Case 01

Expected outcome: The file *test.txt* will be removed after the module resets because the module will restore the file system with the backed up data.

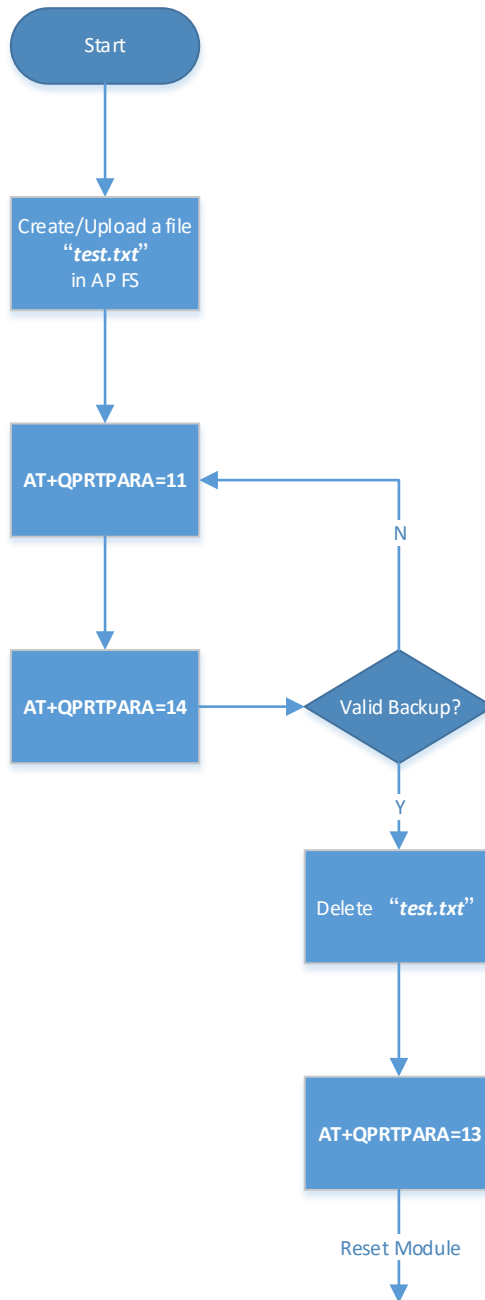2. The restore operation will restore the backed up file to the file system.

Figure 5: Test Case 02

Expected outcome: The file *test.txt* will be restored in file system after the module is reset, because the module will restore the file system with the backed up data. The file has already been backed up before it is deleted.

3 QuecOpen Solution

With the BG95 series, BG77 and BG600L-M3 QuecOpen solutions, your application can be stored in the AP file system or a dedicated partition in NAND flash. For the application stored on NAND flash, there is no risk of application loss. So, there is no need to do the following normal backup and FOTA backup. For application stored in AP file system, it is strongly recommended to do the following normal backup and FOTA backup.

3.1. Normal Backup

Suppose your application is stored in the AP file system. When the module is powered on, kernel module loader will read the image file from the AP file system, then load and run it in the RAM space. Due to the aforementioned file system risk, it is recommended to add backup operations before the module is delivered. Back up the QuecOpen application and the corresponding configuration files to the backup partition, so that even if the module triggers the restore operation, it will have no obvious impact on the whole system.

3.2. FOTA Backup

BG95 series, BG77 and BG600L-M3 in QuecOpen solution support application upgrade mechanism through OTA. Consistent with normal backup, it is recommended to manually trigger the backup mechanism after OTA upgrade is successful for reducing the impacts of subsequent restore operations on the equipment system.
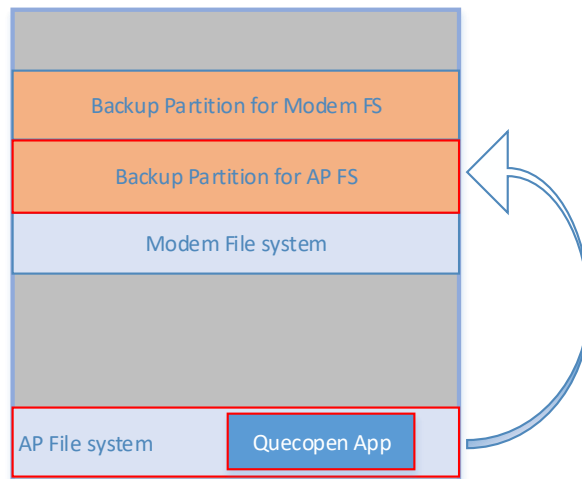

Figure 6: QuecOpen App Backup

4 Appendix References

Table 2: Related Documents

Document Name
[1] Quectel_BG95&BG77&BG600L_Series_AT_Commands_Manual
[2] Quectel_BG95&BG77&BG600L_Series_QuecOpen_Application_Note

Table 3: Terms and Abbreviations

Abbreviation	Description
AFS	Andrew File System
AP	Application Processor
FOTA	Firmware Over-The-Air
FS	File System
LwM2M	Lightweight M2M
NAND	NON-AND
OTA	Over-the-air programming
RAM	Random Access Memory
RF	Radio Frequency
USB	Universal Serial Bus