

BG95-S5 File System Backup Solution Application Note

Satellite Communication Module Series

Version: 1.0

Date: 2024-11-01

Status: Released



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About the Document

Revision History

Version	Date	Author	Description
-	2024-08-21	Allen LIU	Creation of the document
1.0	2024-11-01	Allen LIU	First official release

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1 Introduction

In some usage scenarios of Quectel BG95-S5 module, such as abnormal power failure, 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-S5 module 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 you store the important data or files in UFS or EUFS (such as certificates, private keys and other key data), it is recommended to trigger a backup by AT command to avoid data loss when the file system restoration happens.

- **UFS:** User File Storage on modem side.
- **EUFS:** Extended User File Storage on application side.

2 Backup and Restore Mechanisms

Quectel BG95-S5 module have a separate NAND partition for data backup.

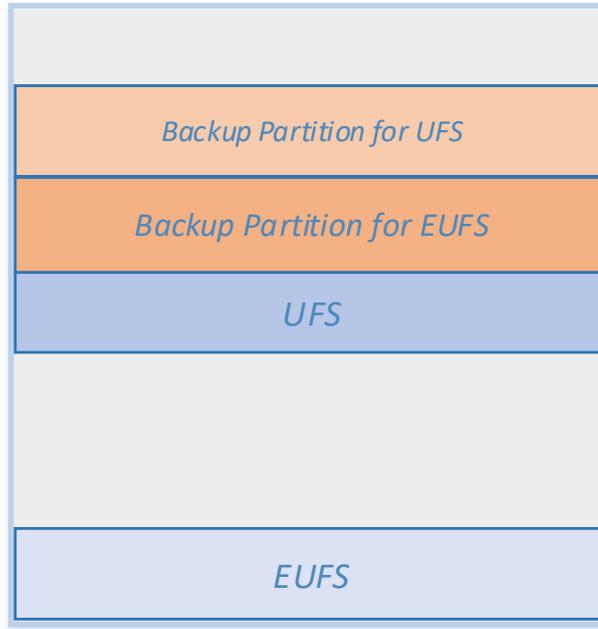


Figure 1: Module Partition (Partial)

NOTE

1. The module has two different separate partitions to back up UFS and EUFS.
The maximum partition size for backing up UFS is about 1 MB bytes (2 MB bytes for BG95-S5);
The maximum partition size for backing up EUFS is about 0.75 MB bytes.
2. The maximum partition size may vary with firmware versions.
3. Backup Partition for UFS/EUFS 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 module support two file systems: UFS and EUFS.

1. UFS stores some key parameters of the module, such as RF configuration, RF calibration, and network configuration.
2. EUFS stores USB configuration and other common parameters, such as LwM2M default configuration files, without network configuration related parameters.

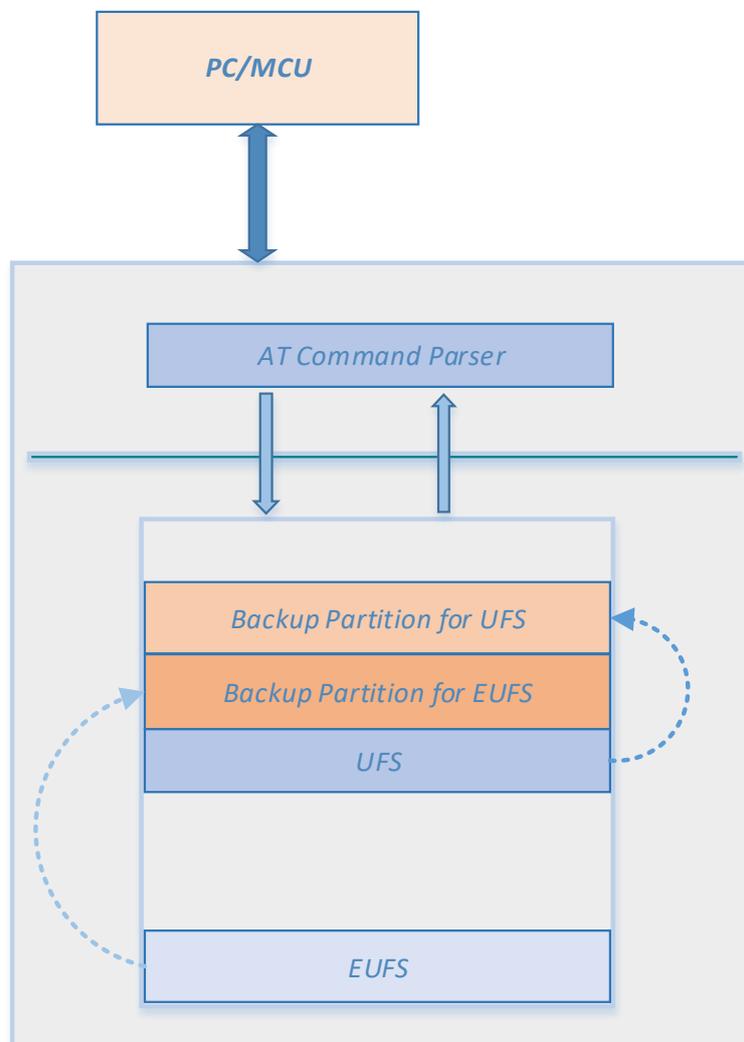


Figure 2: Backup Mechanism

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.

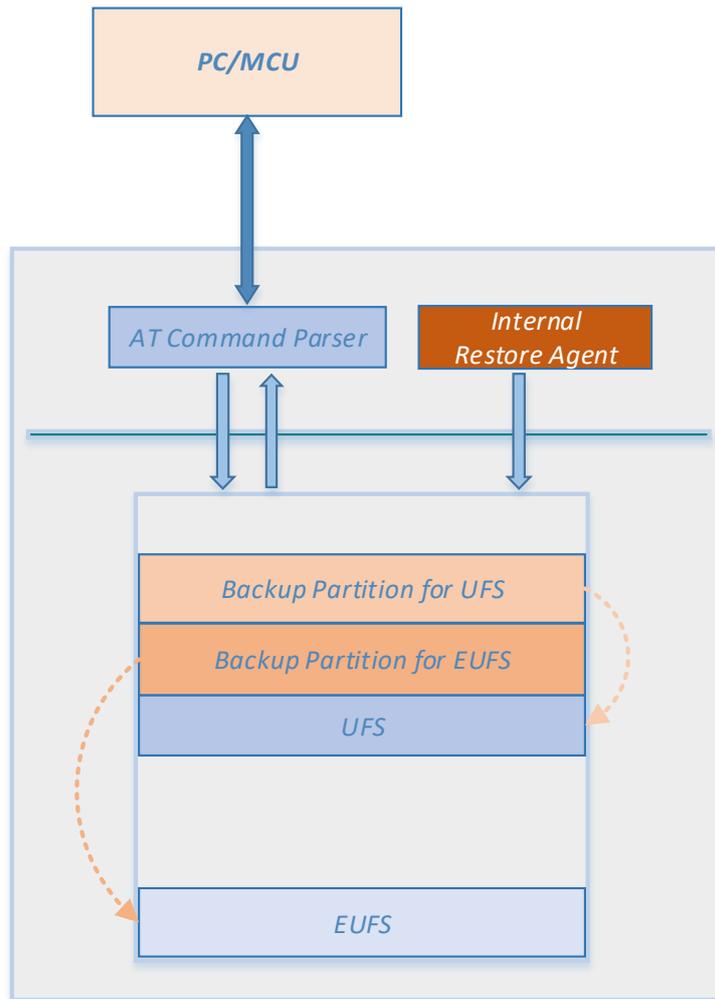


Figure 3: Restore Mechanism

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. 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.

2.3.3. AT+QPRTPARA Supports Backup and Restore Operations for UFS and EUFS

AT+QPRTPARA=1 Back Up UFS	
Write Command AT+QPRTPARA=1	Response OK If there is any error: ERROR
AT+QPRTPARA=3 Force the Restoration of UFS	
Write Command AT+QPRTPARA=3	Response OK If there is any error: ERROR
AT+QPRTPARA=4 Get Backup and Restore Information of UFS	
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 If there is any error: ERROR
AT+QPRTPARA=11 Back Up EUFS	
Write Command AT+QPRTPARA=11	Response OK If there is any error: ERROR

	ERROR
AT+QPRTPARA=13 Force the Restoration of EUFS	
Write Command AT+QPRTPARA=13	Response OK If there is any error: ERROR
AT+QPRTPARA=14 Get Backup and Restore Information of EUFS	
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 If there is any error: 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 UFS.
<CEFS_restore_cnt>	Integer type. The number of the restores for UFS, including the forced restore operation and automatic restore operation.
<page_cnt>	Integer type. The size of space currently used by UFS or EUFS (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 UFS.
<backup_valid>	Integer type. The flag to indicate whether EUFS backup is valid or not. 0 invalid 1 valid
<backup_cnt>	Integer type. The number of the backups for EUFS.
<restore_cnt>	Integer type. The number of the restores for EUFS, 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 data backup partition of modem.
<MFS_info_bad_blk>	Integer type. The number of the bad blocks in information backup partition of modem.
<AFS_data_bad_blk>	Integer type. The number of the bad blocks in data backup partition of AP.
<AFS_info_bad_blk>	Integer type. The number of the bad blocks in information backup partition of AP.

NOTE

1. Do not power off when executing **AT+QPRTPARA=1/11**. If it happens, please back it up again.
2. **AT+QPRTPARA=1/3/4** must be executed after **RDY** is returned, **AT+QPRTPARA=11/13/14** must be executed after **APP RDY** is returned.
3. Generally, **AT+QPRTPARA=3/13** are used for test purpose. You do not need to execute these commands 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: 16,0,268,0,0,0,0,0,0,0,0,0,0,0,0

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

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.

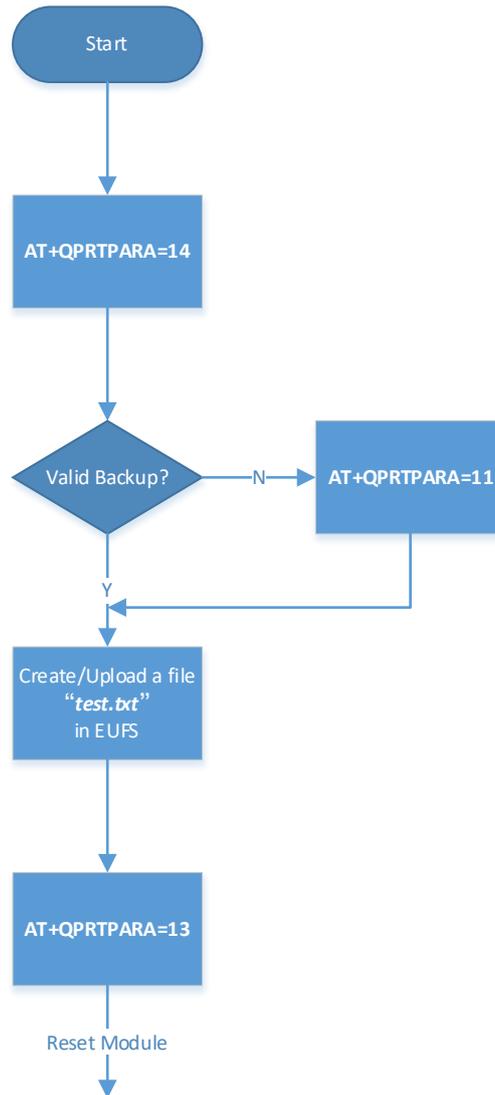


Figure 4: Test Case 01

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

- The restore operation will restore the backup file to the file system.

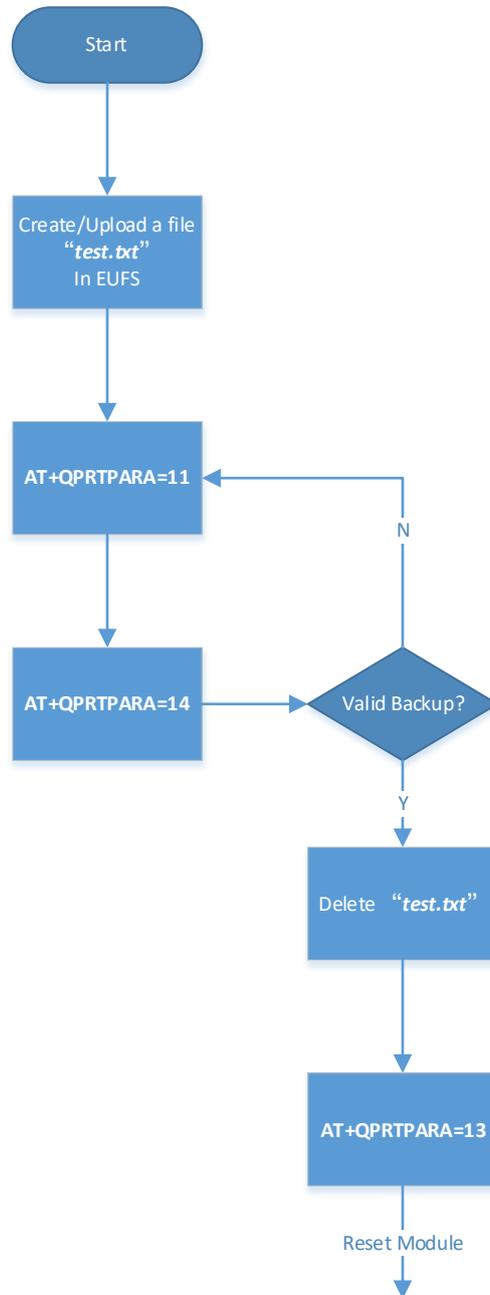


Figure 5: Test Case 02

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 backup data. The file has already been backed up before it is deleted.

3 Appendix References

Table 2: Related Documents

Document Name
[1] Quectel_BG95-S5_AT_Commands_Manual

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