core Flight System (cFS) File Manager (FM) Application Requirements Document

Version 1.5

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1.0 Introduction

1.1 Document Purpose

The core Flight Software System (cFS) File Manager Application will be developed by the Flight Software Branch (FSB) of the Software Engineering Division (SED). The purpose of this requirements specification is to define the requirements to be satisfied by the File Manager Application.

This application is developed for re-use. For this reason, several nomenclatures are used in this document to identify configurations for a mission. The cFS is specified as a multi-platform product. Mission-specific features and customization requirements which are applicable for all platforms are tagged with <MISSION_DEFINED>. Platform-specific features and customizations requirements are tagged with either "<PLATFORM_DEFINED>" or "<OPTIONAL>." Additional nomenclature is used along with the tag to specify a cFS default value for the platform-specific feature: "<PLATFORM_DEFINED, Default_Value>". Reference platforms (single processor and multi-processor architectures) are defined to supply the default cFS application configuration. These configurations define the "maximum" cFS Application deployments such that any refined deployment is a subset of a reference platform.

1.2 Document Scope

The scope of this document is limited to the specification of requirements for the File Manager software requirements. These include functional, performance, qualification, and design requirements.

1.3 Document Organization

This document is organized into three additional sections and several appendices.

Section 2 gives the File Manager context.

Section 3 documents the File Manager system design decisions and constraints.

Section 4 contains the File Manager high level functional and performance requirements.

Section 5 contains the File Manager detailed functional and performance requirements.

1.4 Relevant Documents

1.4.1 Parent Documents

cFS File Manager Application Heritage Analysis 582-2007-011

1.4.2 Reference Documents

Operating System Abstraction Layer (OSAL) Library API
cFE Application Developer's Guide 582-2007-001
cFE User's Guide

2.0 cFS File Manager Application Context

The cFS File Manager (FM) application provides a ground interface for managing onboard file systems. The application file management services to the ground include copying files, moving or renaming files, deleting files, decompressing files, concatenating files, retrieving file and directory status information, creating directories, removing directories, and retrieving directory listings.

The cFS FM context shows use of a complete cFS, presenting interfaces with other cFS applications. SCH is the cFS scheduler application that submits periodic housekeeping requests to FM. Commands come from the cFS Command Ingest application (CI). Event messages and housekeeping packets are routed to the appropriate cFS output application, the Housekeeping (HK), Telemetry Output (TO), and/or Data Storage (DS) application. All accesses to the file system(s) are through the OS API layer of the cFE.

File systems can exist on RAM and EEPROM as well as custom devices such as a Solid State Recorder (SRR). The OSAL provides the interface to the file systems on any available devices. Custom devices such as SSRs will be handled outside of FM (potentially by another application).

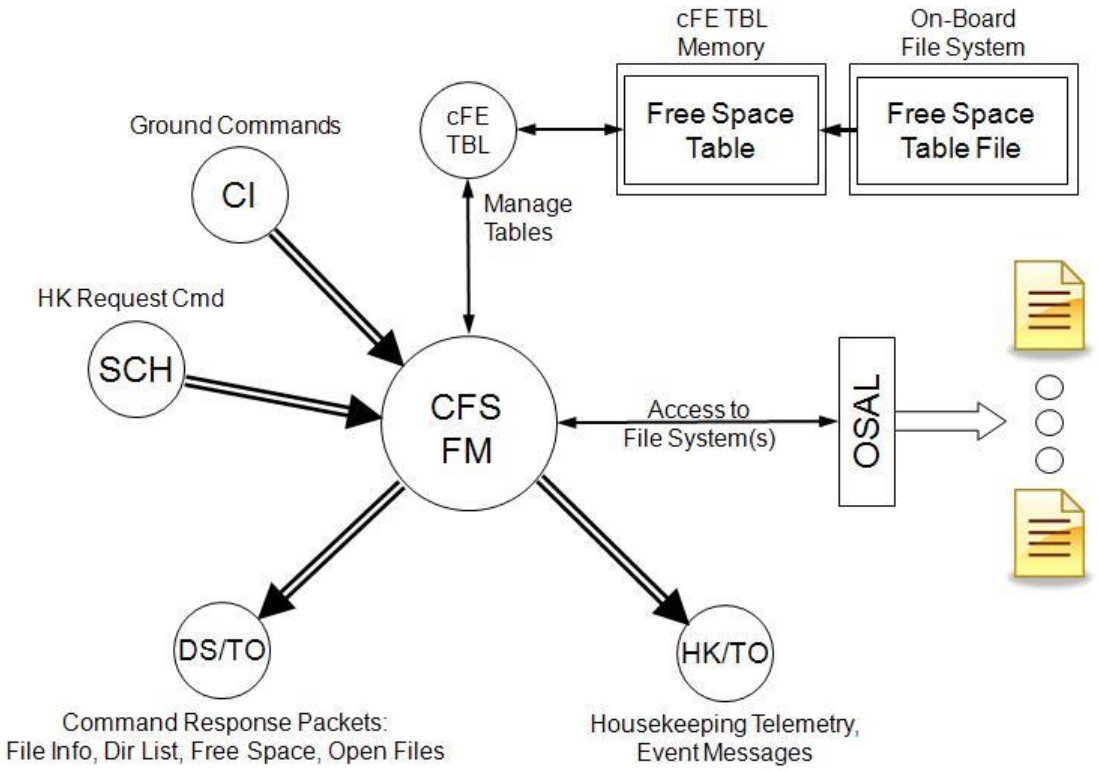

Figure 1.0 – cFS FM Context

2.1 Assumptions

The following list summarizes the assumptions made by the cFS File Manager Application:

- cFE and OSAL are being used
- All FM operations apply to file systems only (no ground-to-flight or flight-to-ground operations. Those are handled by a File Transfer Application such as CFDP.
- cFE provides the capability to specify the default CRC algorithm to use. This gives FM the flexibility to use mission specified CRC required.

3.0 Design Specifications

The File Manager Application's requirements and design are based on the results of the cFS heritage analysis effort. The results of the heritage analysis are documented in the cFS File Manager Application Heritage Analysis document.

The File Manager Application is based on the Core Flight Executive (cFE) and the OSAL. In addition, FM exists in the context of the cFS architecture

4.0 Subsystem Requirements

ID	ReqID	Text	Rational	Heritage Reference
5456	cFS-200	The cFS shall provide file/directory management commands for the on-board file system.	Ground must be able to manage the on-board file systems.	LRO

5.0 Detailed Requirements

The following are the detailed requirements for File Manager. All files must be fully-qualified (i.e. full path specified). In order to distinguish between requirements that require a filename as a parameter from those that just require a directory, the following convention is used:

- command-specified file – denotes that a fully qualified filename must be used (i.e. full path including device name, directory path and filename)
- command-specified directory – denotes that only the device and directory path is specified.

ID	ReqID	Text	Rational	Heritage Reference
		5.1 Basic Command Requirements		
5464	FM1000	Upon receipt of a No-Op command, FM shall increment the Valid Command Counter and generate an event message.	Debug command to verify application is alive	LRO, BAT, JWST

5466	FM1001	Upon receipt of a Reset Counters command, FM shall reset the following housekeeping variables to a value of zero: a) Valid Command Counter b) Command Rejected Counter	Important for testing and on-orbit in order to start with a "clean slate"	LRO, BAT, JWST
5472	FM1002	If the computed length of any FM command is not equal to the length contained in the message header, FM shall reject the command	Basic command verification in the event of SEU or memory corruption	LRO, BAT, JWST
5474	FM1003	If FM accepts any command as valid, FM shall execute the command, increment the FM Valid Command Counter and issue an event message	Operators require positive feedback from successful commands	LRO, BAT, JWST
5476	FM1004	If FM rejects any command, FM shall abort the command execution, increment the FM Command Rejected Counter and issue an error event message	Operators require notification of command failures	LRO, BAT, JWST
5478	FM1005	If the filename specified in any FM command is not valid, FM shall reject the command	If the filename is not valid then want to reject the command. non-fully-qualified filenames will be considered invalid	LRO, BAT, JWST
5480	FM1006	If the directory specified in any FM command is not valid, FM shall reject the command	If an invalid directory is specified than want to reject the command	LRO, BAT, JWST
5484	FM1008	The cFS FM FSW shall utilize full path specifications having a maximum length of <PLATFORM_DEFINED> characters for all command input arguments requiring a file or pathname.	Fully qualified filenames or paths help ensure the correct files/directories are being manipulated. This requirement is intended to prevent "assumed" pathnames from being used by cFS FM.	LRO, BAT, JWST
5486	FM1009	Upon receipt of the Set Table Entry State Command, FM will set the enable/disable state for the specified entry in the File System Free Space Table.		None
5488	FM1009.1	If the File System Free Space table has not been loaded FM will reject the command and send an event message		None
5490	FM1009.2	If the command-specified entry in the File System Free Space Table is invalid FM will reject the command and send an event message		None
5492	FM1009.3	If the command-specified state is invalid FM will reject the command and send an event message		None
5494	FM1009.4	If the command-specified entry in the File System Free Space Table is unused FM will reject the command and send an event message		None
		5.2 File Management		
5500	FM2002	Upon receipt of a File Copy command, FM shall copy the command-specified file to the command-specified destination file	Copy of a fully-qualified file to another fully-qualified file (copy a file	LRO, BAT, JWST

			to another directory and rename it)	
5502	FM2002.1	If the command-specified destination file exists and the command-specified overwrite flag is set to FALSE, FM shall reject the command	Want to prevent files from being overwritten. Users must explicitly request file to be overwritten.	
5508	FM2004	Upon receipt of a Move command, FM shall move the command-specified file to the command-specified destination file.	Creates a new destination file, move the contents of the source file into the destination file, and then delete the source file.	LRO, BAT, JWST
5510	FM2004.1	If the command-specified destination file exists and the command-specified overwrite flag is set to FALSE, FM shall reject the command	Want to prevent files from being overwritten. Users must explicitly request file to be overwritten.	
5514	FM2005	Upon receipt of a Rename command, FM shall rename the command-specified file to the command-specified destination file.	Rename can work faster than move command because the entire contents of the file don't need to be moved, only the name gets changed. If there happen to be a situation where memory was very low, the move command may not be possible due to the fact that a new source file is created before the old one is deleted.	LRO (as of 11/13/07), BAT, JWST
5516	FM2005.1	If the command-specified destination file exists, FM shall reject the command.	Want to prevent files from being overwritten. Users must delete the file first before performing this operation.	
5522	FM2007	Upon receipt of a Delete All Files command, FM shall delete all the files in the command-specified directory.	Typical delete *.* command	LRO, BAT
5524	FM2007.1	If the command-specified directory contains an open file, FM shall not delete the open file.	The command was a success, however, want to notify the ground that there were files that were not deleted	
5526	FM2007.1.1	For any open files that are not deleted, FM shall issue one event message.		
5528	FM2007.2	If the command-specified directory contains a subdirectory, FM shall not delete the subdirectory.	This requirement protects against accidental deletion of	

			subdirectories. Operator may want to remove files in directories and subdirectories but leave the directory structure in place. Operators should use the Delete Directory command in order to delete a directory.	
5530	FM2007.2.1	For any subdirectories are not deleted, FM shall issue one event message.		
5532	FM2008	Upon receipt of a Delete command, FM shall delete the command-specified file.	Command file operation	LRO, BAT
5536	FM2008.1	If the command-specified file is open, FM shall reject the command to delete the file.		LRO, BAT
5538	FM2008.2	If the command-specified file is a directory, FM shall reject the command.	This requirement protects against accidental deletion of a directory. Operators should use the Delete Directory command in order to delete a directory.	
5540	FM2009	Upon receipt of a Decompress command, FM shall decompress the command-specified file to the command-specified file.	Need to be able to decompress compressed files. Full-qualified path must be specified. Should prevent the case where user tries to uncompress to file of same name?	LRO, JWST
5542	FM2009.1	If the command-specified destination file exists, FM shall reject the command.	Want to prevent files from being overwritten. Users must delete the file first before performing this operation.	
5544	FM2010	Upon receipt of a Concatenate command, FM shall concatenate the command-specified file with the second command-specified file, copying the result to the command-specified destination file.	Concatenates 2 files together, producing a 3rd file. Assumes fully qualified paths	LRO
5546	FM2010.1	If the command-specified destination file exists, FM shall reject the command	Want to prevent files from being overwritten. Users must delete the file first before performing this operation.	
5548	FM2011	Upon receipt of a File Info command, FM shall generate a message containing the following for the command-specified "file:"	Basic file information	LRO, BAT, JWST

		a) the file size b) last modification time c) file status (Open, Closed, or Non-existent) d) <MISSION_DEFINED> CRC e) the file mode (permissions), as a 4-byte value f) command-specified filename		
5550	FM2012	Upon receipt of a List Open Files command, FM shall generate a message containing: a) the number of open files b) Up to <PLATFORM_DEFINED> names/paths (of each open file) and the application name that has opened the file	Provides operators info about open files - Files that are open should not be deleted or downlinked. If too many files are open at once, the system could run slower than expected, or decline another file from being opened. Note that the <MISSION_DEFINED> limit is imposed in support of fixed size telemetry messages.	LRO
145948	FM2013	Upon receipt of a Set File Permissions command, FM shall set the command-specified file's permissions to the command-specified mode. Note: The mode is defined as a 4-byte value	Basic file operations. Provides operators with the ability to change the read, write, execute permissions of a file.	
		5.3 Directory Management		
5554	FM3000	Upon receipt of a Create Directory command, FM shall create the command-specified directory on the command-specified file system.	Create directories and subdirectories on the file system.	LRO, BAT, JWST
5556	FM3001	Upon receipt of a Delete command, FM shall remove the command-specified directory from the command-specified file system.		LRO, BAT, JWST
5558	FM3001.1	If the specified directory contains at least one file or subdirectory, the command shall be rejected	Require operators to explicitly remove all files before deleting the directory. Protection against accidentally deleting of a non-empty directory.	LRO, BAT, JWST
5560	FM3002	Upon receipt of a Directory Listing To File command, FM shall write the contents of the command-specified directory on any of the on-board file systems to the command-specified file. The following shall be written: a) Directory name b) file size in bytes of each file c) last modification time of each file	Get a directory listing and pipe it to a file for downlink. Note that the modification time format is specified by a cFE configuration parameter (TAI or UTC)	LRO, BAT, JWST

		d) Filename of each file e) Mode (permissions), as a 4-byte value, of each file		
5562	FM3002.1	FM shall issue an event message that reports: a) The number of filenames written to the specified file b) The total number of files in the directory c) The command-specified file's filename		LRO, BAT, JWST
5564	FM3002.2	FM shall use the <PLATFORM_DEFINED> default filename if a file is not specified	cFS standard. Want to provide flexibility to either use the same filename every time you get a directory listing or specify a new filename.	
145989	FM3002.3	If the command-specified GetSizeTimeMode flag is set to FALSE, FM shall initialize following values to Zero: b) file size in bytes of each file c) last modification time of each file e) Mode (permissions), as a 4-byte value, of each file Note: the lettering of the listed values is kept in sync with parent requirement	Obtaining file size, time, and permissions may be CPU intensive	GPM, NICER
5566	FM3003	Upon receipt of a Directory Listing command, FM shall generate a message containing the following for up to <PLATFORM_DEFINED> consecutive files starting at the command specified offset: a) Directory name b) file size in bytes of each file c) last modification time of each file d) Filename of each file e) Mode (permissions), as a 4-byte value, of each file	Similar to FM3002 command, however, the directory listing is output in a message instead of a file. May make it easier for the ground to view (one step process). In addition, if there is a problem with the file system, writing to a file (as FM3002 does) is not reliable. The command specified offset is used since there is a maximum number of files that can be downlinked (offset into the file list). Note that the modification time format is specified by a cFE configuration parameter (TAI or UTC)	LRO
145987	FM3003.1	If the command-specified GetSizeTimeMode flag is set to FALSE, FM shall initialize the following values to Zero:	Obtaining file size, time, and permissions may be CPU intensive	GPM, NICER

		b) file size in bytes of each file c) last modification time of each file e) Mode (permissions), as a 4-byte value, of each file Note: the lettering of the listed values is kept in sync with parent requirement		
		5.4 Status Reporting		
5570	FM4000	FM shall generate a housekeeping message containing the following: a) Valid Command Counter b) Command Rejected Counter c) For each file system: Total number of open files		LRO, BAT, JWST
5572	FM4001	Upon receipt of a Report Device Free Space command, FM shall generate a message containing for each enabled device in the FM device table the amount of available free space.		
		5.5 Initialization Requirements		
5576	FM5000	Upon initialization of the FM Application, FM shall initialize the following data to Zero: a) Valid Command Counter b) Command Rejected Counter	No information is preserved across an FM initialization. Note that the file system is preserved by the cFE across a processor reset.	LRO, BAT, JWST