core Flight System (cFS) Housekeeping (HK) Application Requirements Document

Version 1.1

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1.0 Introduction

1.1 Document Purpose

The Core Flight Software System (CFS) Housekeeping Application will be developed by the Flight Software Systems Branch (FSB) of the Software Engineering Division (SED). The purpose of this requirements specification is to define the requirements to be satisfied by the Housekeeping 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 Housekeeping 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 Housekeeping context.

Section 3 documents the Housekeeping system design decisions and constraints.

Section 4 contains the Housekeeping functional and performance requirements.

Appendix A contains a list of abbreviations and acronyms used in this document.

1.4 Relevant Documents

1.4.1 Parent Documents

CFS Housekeeping Application Heritage Analysis 582-2007-029

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 Housekeeping Application Context

The Housekeeping (HK) component of the Core Flight System (CFS) is responsible for building and sending combined telemetry messages from individual system applications. Combining messages is performed in order to minimize downlink telemetry bandwidth. Combining certain data from multiple messages into one message eliminates the message headers that would be required if each message was sent individually. HK provides the capability to generate multiple combined packets so that data can be organized and output at different rates (e.g. a fast, medium and slow packet).

Figure 1 shows the context diagram for the CFS Housekeeping (HK) Application. During initialization, HK subscribes to housekeeping messages from other applications. The Scheduler Application (SCH) sends periodic commands to HK. Ground commands come from the Command Ingest task (CI). Combined output messages, and events messages are routed to the appropriate task(s) by the cFE SB Application. The copy table defines the output message formats. HK learns of ground updates to the copy table through the cFE Table Services application.

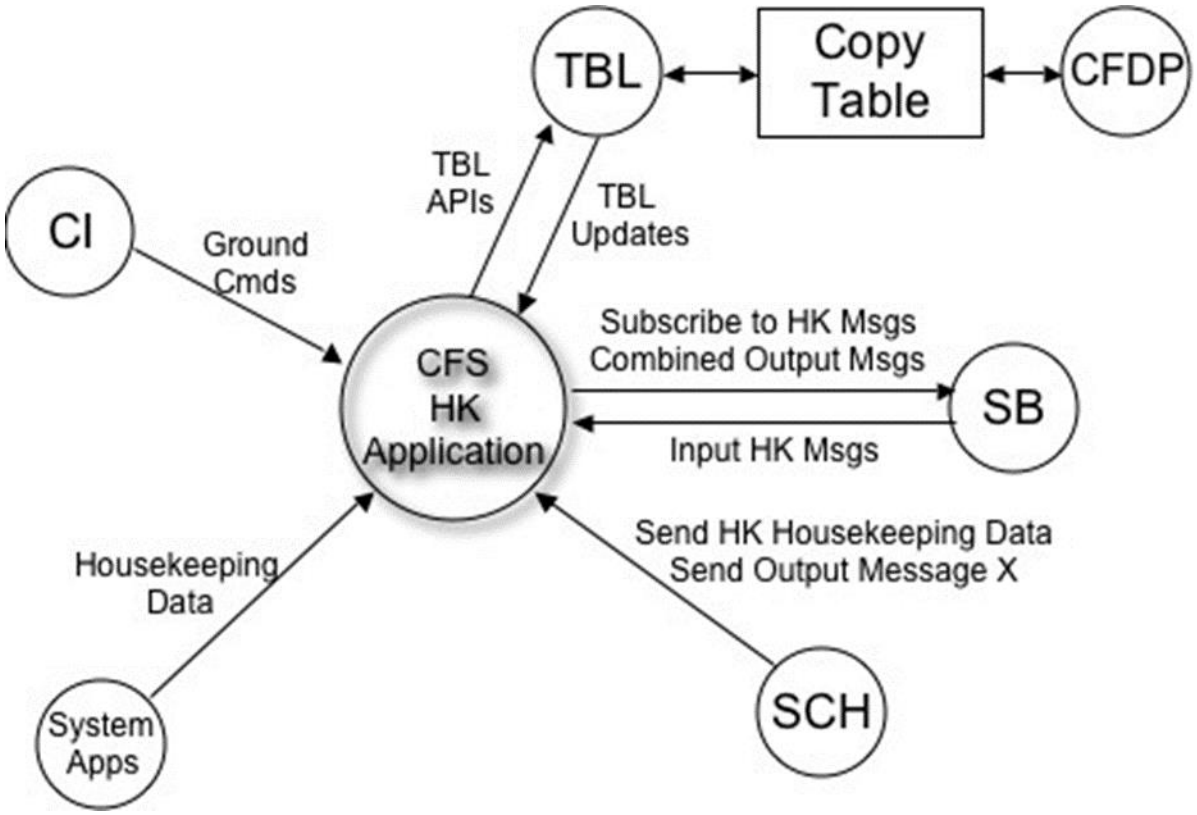

Figure 1.0 – cFS HK Context

2.1 Assumptions

The following list summarizes the assumptions made by the CFS Housekeeping Application:

- A scheduler or similar application will send out a housekeeping request at a periodic rate.
- A scheduler or similar application will send commands to inform HK to send the output messages.

- cFE API's are available for use.
- OSAL API's are available for use.
- Housekeeping is not responsible for uploading or downloading files. Files generated by or loaded for Housekeeping are transferred using a file transfer application such as CFDP.

3.0 Design Specifications

The Housekeeping Application's requirements and design is based on the results of the CFS heritage analysis effort. The results of the heritage analysis are document in the CFS Housekeeping Application Heritage Analysis document. The Housekeeping Application is based on the Core Flight Executive (cFE) and the OSAL. In addition, HK exists in the context of the CFS architecture.

The Housekeeping application does most of its processing based on the contents of the Copy Table. The Copy Table is made up of a list of entries. Each entry includes five items, input message id, input message offset, output message id, output message offset and number of bytes to copy.
During initialization, the Housekeeping application subscribes to the system application housekeeping messages (input message ids) that are listed in the Copy Table. When the system application housekeeping messages are received by HK, the entire Copy Table is scanned to determine where the data in the received message is to be copied. When the Housekeeping application does not receive an expected message from an application, HK will increment the missing data counter and send an event message to the ground.

4.0 Subsystem Requirements

ID	ReqID	Text	Rational	Heritage Reference
5339	CFS-100	The CFS shall provide the capability to combine housekeeping data from system applications into output messages	Reduces bandwidth by using one msg header for tlm from multiple apps. Also makes subscribing to tlm simpler.	LRO, BAT, SDO

5.0 Detailed Requirements

ID	ReqID	Text	Rational	Heritage Reference
		5.1 Basic Command Requirements With the exception of the No-op and Reset command requirements, the following requirements apply to all Housekeeping commands. Rather than repeating these requirements for each applicable requirement, they have been grouped together to cover all requirements.		

5367	HK1000	Upon receipt of a No-Op command, HK shall increment the HK Valid Command Counter and generate an event message.	Debug command to verify application is alive	LRO, SDO, BAT
5369	HK1001	Upon receipt of a Reset command, HK shall reset the following housekeeping variables to a value of zero: a) HK Valid Command Counter b) HK Command Rejected Counter c) Number of Output Messages Sent d) Missing Data Counter	Important for testing and on-orbit flight operations in order to start with a "clean slate"	LRO, SDO, BAT
5381	HK1002	For all HK commands, if the length contained in the message header is not equal to the expected length, HK shall reject the command.	Basic command verification in the event of SEU or memory corruption	LRO, SDO, BAT
5383	HK1003	If HK accepts any command as valid, HK shall execute the command, increment the HK Valid Command Counter and issue an event message	Provides basic verification of each HK command (i.e. HK command parameters are acceptable)	LRO, SDO, BAT
5385	HK1004	If HK rejects any command, HK shall abort the command execution, increment the HK Command Rejected Counter and issue an error event message	Provides indicator or erroneous command	LRO, SDO, BAT
		5.2 Operational Requirements		
5393	HK2000	HK shall collect flight software housekeeping data from table-specified input messages	SCH sends the request and HK receives the housekeeping data. Use of tables makes it easier to modify/maintain	LRO, BAT
5395	HK2001	HK shall output table-defined messages, at the scheduled rate, by combining input message data starting at the table-defined offset and table-defined number of bytes to the table-defined offset in the output message.	Useful to group telemetry from multiple apps into a single message	LRO, BAT
5397	HK2001.1	Upon a table update, HK shall update the output message formats specified in the table during normal execution.	Supports the capability of adding and removing applications at runtime (or modifying messages)	LRO, BAT
5399	HK2001.2	If the <PLATFORM_DEFINED> parameter Discard Combo Packets is set to NO and HK does not receive a message from an application, HK shall use all values associated with last received message for that application in the combined message for that telemetry collection period.	Zeroing data could have undesirable effects.	None/was accomplished by task checkin, which is now part of HS not HK
5401	HK2001.3	If HK does not receive a message from an application, HK app shall increment the missing data counter and send an event specifying the message ID for the missing message	Important to inform the ground of any failure detection. Missing data counter incremented when any message not	None

			received. In addition, Debug event message sent to inform ground.	
5405	HK2001.5	If the <PLATFORM_DEFINED> parameter Discard Combo Packets is set to NO and the input message offset + bytes for any input message specified in the HK table is greater than the received message length then HK shall use the last received data associated with that message and issue no more than one event message per input message.	Prevents reading past the end of message (If there is an error in the HK table where the offset + bytes for a specific message exceeds the total message length)	None
5407	HK2001.6	If the <PLATFORM_DEFINED> parameter Discard Combo Packets is set to YES and HK does not receive a message from an application, HK shall discard the combined message containing the values associated with the missing application message for that telemetry collection period.	Prevents ground processing of combination packets containing stale data.	None
5409	HK2001.7	If the <PLATFORM_DEFINED> parameter Discard Combo Packets is set to YES and the input message offset + bytes for any input message specified in the HK table is greater than the received message length then HK shall discard the combined message containing the values associated with the illegal length application message for that telemetry collection period.	Prevents reading past the end of message (If there is an error in the HK table where the offset + bytes for a specific message exceeds the total message length). Prevents ground processing of combination packets containing stale data.	None
		### 5.3 Status Reporting		
5417	HK3000	HK shall generate a housekeeping message containing the following: a) Valid Command Counter b) Command Rejected Counter c) Number of Output Messages Sent d) Missing Data Counter		Derived
		### 5.4 Initialization Requirements		
5433	HK4000	Upon initialization of the HK Application, HK shall initialize the following data to Zero: a) Valid Command Counter b) Command Rejected Counter c) Number of Output Messages Sent d) Missing Data CounterZero	HK does not preserve data across any type of reset.	Derived