



NASA GSFC FLIGHT SOFTWARE SYSTEMS BRANCH

FSW VERSION DESCRIPTION DOCUMENT

CFS CHECKSUM (CS) APPLICATION

BUILD: CS 2.5.0

RELEASE DATE: 9/24/2021

1.0 FSW VERSION DESCRIPTION

1.1 PURPOSE AND SUMMARY

This build is a minor build of the Checksum (CS) application to provide compatibility with cFS Caelum. This build provides compatibility with cFS Caelum as well as some minor code cleanup.

1.2 NEW/CHANGED FUNCTIONALITY IN THIS VERSION

Table 1.2-1 identifies the DCRs that have been implemented in this FSW version. For each DCR the “Key” column shows the corresponding DCR in the GSFC cFS tracking system.

Table 1.2-1 – DCRs Implemented in this Version

Key	Summary	Description
GSFCCFS-1178	CS has static code analysis findings	In analysis on 7/10/2020, CodeSonar flagged the attached findings.
GSFCCFS-1254	CS Default Table locations need updated	The current table names are specified with "/cf/apps/xxxx" in the cs_platform_cfg.h. I believe that these should be "/cf/xxxx"
GSFCCFS-1255	Update CS to use new cFE Message Module	
GSFCCFS-1292	CS return codes need to be checked against correct error codes	When checking the return codes of framework API functions, the check should be done against the return codes of the correct API (ie. CFE, OSAL, PSP). For instance, while in practice CFE_SUCCESS and OS_SUCCESS are both 0, the value checked should match the API called. Specific instances: cs_cmds.c/CS_OneShotCmd - checking return of CFE_PSP_MemValidateRange
GSFCCFS-1293	Checksum CDS usage is inconsistent	When an individual checksum is enabled or disabled, that change is written to the CDS. If all checksumming is enabled or disabled, that change is not written to the CDS. Need to determine (1) if this behavior is intended and (2) if it is documented.
GSFCCFS-1294	CS Ensure that all variables are initialized before first use	
GSFCCFS-1295	CS - pointer arguments should be checked for NULL	For each function with pointer arguments, either check for null pointer or add comment that pointer is always valid when the function is called.
GSFCCFS-1296	CS should not pend forever on the cFE software bus	Pending forever on the software bus is no longer the preferred pattern. Should introduce a timeout, which will also require handling a timeout case.
GSFCCFS-1311	Parameter limits should be enforced in the verify.h file	cs_mission_cfg.h: - CS_DEFAULT_ALGORITHM

GSFCCFS-1313	Some CS comments have typos and inaccuracies	cs_platform_cfg.h - statement about app vs child task priority in comment on CS_CHILD_TASK_PRIORITY - typo in comment on CS_MEMORY_TBL_POWERON_STATE
GSFCCFS-1314	Remove unused definition	CS_PIPE_NAME in cs_app.c is unused. Appears to be replaced by CS_CMD_PIPE_NAME.
GSFCCFS-1315	Functions should have a single return statement	
GSFCCFS-1316	Make pipe depth a multiple of the default message limit	Currently the CS command pipe is a single pipe with no explicit limits on the 3 messages it subscribes to. While the default message limit is good enough for now, making the pipe depth a multiple of the default message limit would be more robust.
GSFCCFS-1317	Send event message if CDS restore fails	cs_app.c, line 321- If the call to CS_CreateRestoreStatesFromCDS fails, the application should send an event message
GSFCCFS-1319	Separate ground command identification from CS_AppPipe	Will enhance readability to separate out the long command code switch statement into a separate function.
GSFCCFS-1320	Store housekeeping data in packet instead of copying	
GSFCCFS-1321	All event messages should be unique	There are multiple causes for this CS_INIT_CDS_ERR_EID error message- failure of CFE_ES_RegisterCDS, CFE_ES_CopyToCDS, CFE_ES_RestoreFromCDS. Each cause should be a separate error message.
GSFCCFS-1323	CS_BackgroundCheckCmd does not update command counters	CS_BackgroundCheckCmd does not update the command counter or command error counter. It looks like CS_VerifyCmdLength should be used here.
GSFCCFS-1329	Avoid unnecessary uses of strncpy	Don't need to use strncpy to copy into a char buffer if we can just set the buffer as a const char. .
GSFCCFS-1330	Replace hardcoded values with constants where possible	Specific example - replace instances of (-1) with CS_ERROR.
GSFCCFS-1420	Migrate CS unit tests to distributed UT Assert	
GSFCCFS-1476	CS does not build with eval-cert3	CS needs updates in order to build with eval-cert3 (Caelum pre-release)
GSFCCFS-1577	CS doxygen config file should be renamed for clarity	The filename "cs_config.txt" suggests that this a configuration file for the app itself as opposed to a configuration file for doxygen.
GSFCCFS-1586	CS should use const for function arguments where possible	

GSFCCFS-1616	CS treats updates to CS_TABLES_TABLE as critical	<p>CS treats table updates to CS_TABLES_TABLE as critical, but does not treat other table updates the same way.</p> <p>Table updates are done as part of the housekeeping cycle in CS_AppPipe. If the table update process returns an error, this in turn triggers the calling function (AppMain) to exit.</p> <p>While each of the 4 tables has an update attempt during the housekeeping cycle, only the return value of the last table (CS_TABLES_TABLE) is used to determine what is returned from CS_AppPipe.</p>
GSFCCFS-1619	CS event messages do not allow for extended message IDs	Events that print out a messageID value use the 0x04X format specifier, which does not work for longer message IDs.
GSFCCFS-1729	CS Uses Deprecated Boolean Values	<p>CS needs to be updated in the following way: `TRUE` should be `true` `FALSE` should be `false`</p> <p>This is applicable in cs_platform_cfg.h and cs_app.h where checking for CS_PRESERVE_STATES_ON_PROCESSOR_RESET. This prevents the feature from being activated in the default configuration.</p>

No new functionality was added in this build.

1.3 MISSING PLANNED FEATURES AND KNOWN PROBLEMS

Table 1.3-1 identifies currently open DCRs that are not addressed in this build.

Any workarounds that may apply are identified.

Refer to the Delivery Letter for any additional DCRs submitted after preparation of this VDD.

Table 1.3-1 – Currently open DCRs

Key	Summary	Description
GSFCCFS-1730	CS Has Unreachable Code and Branches	<p>CS has several unreachable lines of code and branch conditions.</p> <p>Unreachable code and branch in CS_AppMain lines 280 - 287: CS_CreateRestoreStatesFromCDS always returns CFE_SUCCESS.</p> <p>Unreachable branch in cs_utils.c line 709: CurrentEntryInTable is always CS_MAX_NUM_EEPROM_TABLE_ENTRIES when CS_FindEnabledEepromEntry returns false.</p> <p>Unreachable branches in cs_utils.c lines 1037, 1061, 1086: ErrorCode is always CFE_SUCCESS due to initialization.</p>

GSFCCFS-1326	Consider making the CRC size configurable	<p>There are two CRC algorithm types specified in the platform config. Are both of these using 32-bit CRC? What if we add another CRC algo later that isn't 32-bit? It might make sense to define the type that holds a CRC result in platform config as well.</p> <p>Comment is on the CS_ComputeEepromMemory function regarding the uint32 ComputedCSValue parameter.</p>
GSFCCFS-1324	Consider replacing switch statement with jump table in CS_BackgroundCheckCmd	
GSFCCFS-1322	Consolidate similar commands	<p>Several command handler functions are nearly identical. Could be consolidated.</p> <p>CS_DisableAppCmd/CS_EnableAppCmd CS_DisableNameAppCmd/CS_EnableNameAppCmd CS_DisableEepromCmd/CS_EnableEepromCmd CS_DisableMemoryCmd/CS_EnableMemoryCmd CS_DisableEntryIDMemoryCmd/CS_EnableEntryIDMemoryCmd CS_DisableTablesCmd/CS_EnableTablesCmd CS_DisableNameTablesCmd/CS_EnableNameTablesCmd</p>
GSFCCFS-1312	Configuration parameters could exist in configuration table	<p>Some parameters in cs_platform_cfg.h could be made part of a configuration table to provide more on-orbit flexibility. For instance, number of bytes per wakeup or child task delay time. .</p>
GSFCCFS-1252	CS Child Tasks are dynamically created	<p>CS creates child tasks dynamically in several command functions: --CS_RecomputeBaselineCfeCoreCmd --CS_RecomputeBaselineOSCmd --CS_OneShotCmd</p> <p>Is there any risk of cleanup issues if these commands are run too frequently? CS could be modified to create the child tasks just once and then kick them off when a command is received (perhaps using a semaphore mechanism like FM).</p>
GSFCCFS-952	Checksum errors after restarting app	<p>This description is from an email chain with members of multiple project teams describing a bug in CS with downstream impacts on HS. A short summary is included here and the full email chain is attached to this issue.</p> <ol style="list-style-type: none"> 1. Application gets an exception 2. ES restarts the application 3. There is a high probability that the application checksum has changed due to the restart. 4. Checksum is not notified to recompute the application checksum. When it finds the checksum has changed, it puts out an event message to that effect. 5. HS is monitoring for application checksum messages, and does a processor reset as a consequence.

GSFCCFS-951	ES - RegisteredTasks Counter Does Not Decrement When Child Tasks are Exited	Project team reported that the ES "RegisteredTasks" counter was not decrementing when a child task exited. The CS code was examined to ensure the needed ES API calls were being made. It was confirmed the CS child tasks make the ES API call to CFE_ES_ExitChildTask. The CFE_ES_ExitChildTask API function does decrement the RegisteredTasks counter on line 1337 however, this step is performed only if conditional checks are passed.
GSFCCFS-929	CS CRC values may lead to confusion	The CS application relies on the CFE_ES_CalculateCRC function to report the CRCs that it calculates. However, this function calculates the CRC as an int16 value and returns that value as a uint32 value. This causes the sign bit of the int16 (bit 15) to be propagated to the upper 16 bits of the uint32. If this bit is set, it can cause confusion since a CRC of 0x845E would result in the CS application having a value of 0xFFFF845E.
GSFCCFS-926	CS Suggest additional platform config options	There are some things that should probably be in the platform config file <ul style="list-style-type: none"> o Child task names (all platforms do not support the same naming convention) o Found in CS, but may apply to other apps. (We haven't done an exhaustive search.)

2.0 DELIVERED PRODUCTS

Table 2-1 identifies the locations of FSW products relevant to this FSW Build. The version or date of the Build and where the product can be located are provided. Changes from a previous VDD are identified.

Table 2-1 – Delivered Products and their Locations

Software Element	Changed with this Version?	New Version or Date	Location
Source Code of this FSW Build	Yes	2.5.0	https://github.com/nasa/cs
Doxygen Documentation	Yes	N/A	https://github.com/nasa/cs
Unit Test Data	Yes	2.5.0	https://github.com/nasa/cs
FSW Make Files	Yes	2.5.0	https://github.com/nasa/cs

3.0 INSTALLATION PROCEDURES

In order to build and install the CS application, it must be added to the cFE CMake build system. This is done by modifying the TGT1_APPLIST in the cFE targets.cmake file. This is shown in the trivial example below.

```
SET(TGT1_NAME cpu1)
SET(TGT1_APPLIST cs)
SET(TGT1_FILELIST cfe_es_startup.scr)
```

After CS is added to the targets.cmake file, it is built and installed using the standard cFE CMake build instructions. These instructions are available in cFE CMake documentation:

<https://github.com/nasa/cFE/blob/main/cmake/README.md>

4.0 CONFIGURATION SUMMARY AND VERSION IDENTIFICATION

This software can be found in the CS GitHub repository (<https://github.com/nasa/CS>) under the tag “CS-2.5.0”.

Verification of the version can be done by sending a CS NOOP command that produces an event message containing the version information. In addition, the initialization event message generated during the application startup provides the version information.

ACRONYMS

ACS	Attitude Control System
C&DH.....	Command and Data Handling
cFS.....	Core Flight System
CM	Configuration Management
CS.....	Checksum
COTS.....	Commercial Off-The-Shelf
CRC.....	Cyclic Redundancy Check
DCR	Discrepancy/Change Request
ETU.....	Engineering Test Unit
FSB.....	Flight Software Branch
FSW.....	Flight Software
H&S	Health & Safety
I&T	Integration & Test
PSP	Platform Support Package
RTOS.....	Real-Time Operating System
T&C.....	Telemetry and Command
URL.....	Universal Resource Locator
VDD	Version Description Document