Core Flight Software



Version Description Document

Operating SYstem Abstraction Layer (OSAL)

Build: 4.2.0

March 4, 2016

Signatures

Submitted by:



Approved by:



Signatures – continued

Approved by:



1.0 FSW Version Description

1.1 purpose and summary

The purpose of this build is to refine the core Flight Software (cFS) Operating System Abstraction Layer (OSAL) product. This build provides various bug fixes, as well as, new features and enhancements including:

* Class A safety-critical instantiation of the VxWorks operating system abstraction
* Class A safety-critical black box test updates and added white box test suite
* Network/socket interface abstraction
* Enhanced cmake build system (in addition to classic build)
* PC-RTEMS BSP
* SPARC-VxWorks6.7 BSP
* Unit Test Assert library

There were some minor API changes to this build that may result in compiler warnings with applications/tasks built via previous OSAL releases. These API changes were made to correct and improve the function input parameter types. The changes include:

1. OS\_TaskCreate: stack pointer is **NOT** `const`
2. OS\_TaskInstallDeleteHandler: use correct function-pointer argument instead of `void \*`
3. OS\_QueuePut: source data pointer is `const`
4. OS\_ExcAttachHandler: context data pointer is `const`
5. All name arguments are now `const char\*` instead of `char\*` for all API calls
6. OS\_SymbolLookup, OS\_ModuleInfo: All integers holding memory addresses use the `cpuaddr` type instead of `uint32`

There were several API additions to:

1. Formalize common shutdown routines performed during unit testing
2. Define the network/socket API (implementation of this API will be delivered in a separate release)
3. Support alternate time references for OSAL timers

The transition from OSAL 4.1.1 to 4.2.0 should require minor effort. However, build 4.2.0 does not support backward compatibility with cFE builds 6.4.2 and later and PSP builds 1.2.0 and later. OSAL build 4.2.0 implements the list of Trac tickets listed in Attachment 1.

Functional testing has been completed and baselined on OSAL build 4.2.0 for the pc-linux and VxWorks implementations. Functional test results are included in the release package under:

/src/tests/Results

Black box unit testing was completed and baselined for the pc-linux and vxworks implementations using the test suite updates delivered and integrated by Johnson Space Center (JSC). This test suite was used by JSC’s Advanced Exploration Systems (AES) Human Exploration & Operations Mission Directorate for Class A certification of the OSAL VxWorks instantiation currently planned for use on the Orion Program backup flight control system. Black box unit test results are included in the release package under:

/src/unit-tests/Results

White box unit tests were developed for the VxWorks implementation by Johnson Space Center (JSC). This test suite will be used by JSC’s Advanced Exploration Systems (AES) Human Exploration & Operations Mission Directorate for Class A certification of CFS on the Orion platform. There are open issues with building this test suite using the “classic” build and possible errors in the tests. This test suite, as delivered in this release, should be used with caution.

In addition to the white box test suite issues, there are some outstanding issues being investigated. Resolutions to these issues may require a new release. The project CCB and community inputs will determine which Trac Tickets to include in the next release.

This distribution contains:

1. The OS Abstraction Layer API Library
2. OS implementations for POSIX, VxWorks6.x, and RTEMS
3. Tests and example applications
4. A directory structure and cmake system (or “classic” build makefiles) to manage it all.

1.2 new/Changed functionality in this VERSION

Table 1.2-1 identifies new OSAL functionality that has been implemented and is integrated into this version and the Trac tickets associated with these changes.

**Table 1.2-1 – New Functionality in this Version**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **No.** | **Trac Ticket #** | **High Level Description of Functionality** | **Component** | **Type** | **Priority** |
| 1 | #2 | Add enhanced cmake build system to OSAL | build | enhancement | major |
| 2 | #8 | Add OSAL abstraction for network/socket interface. Adds API definition for the following network operations:  - Abstraction of OS socket address (sockaddr\_in/\_in6 for IPv4 and IPv6 at least)  - Abstraction of Stream/TCP & Datagram/UDP socket creation  - Bind/Listen for TCP  - Sendto/Recvfrom for UDP  - Abstractions for the basic inet\_aton()/inet\_ntop() IP-address  Note: implementation of this API is forthcoming separately | other | enhancement | major |
| 3 | #10 | API versioning for OSAL - adds an OS\_API\_VERSION macro that application code can check | build | enhancement | major |
| 4 | #15 | Alternate time references for OSAL timers. Adds a new type of OSAL object called a "Time Base". By default a time base can be driven from the local CPU real time clock, which will mimic the current behavior of timers. However the BSP/PSP may create additional time bases and synchronize them to e.g. an external timing interrupt. The same existing "TimerSet" API can be used to set the timers against the alternate time base and it will be transparent to the app. | other | enhancement | minor |
| 5 | #28 | Do not block synchronous hardware-generated signals in pc-linux BSP. As of OSAL 4.1, all signals are blocked during execution of the OS\_Application\_Startup() call, then unblocked before entering the wait loop. The issue here is that some signals on Linux are generated by the underlying hardware and the kernel forwards these (synchronously) to the specific thread that was executing on the CPU when the actual signal was triggered. The set of hardware-generated signals: SIGSEGV, SIGILL, SIGBUS, SIGFPE should NOT be blocked at any time by any thread. The hardware-generated signals are now unblocked all the time and the RT signals are blocked all the time in the pc-linux implementation so the user-created threads can use them. | pc-linux | defect | major |
| 6 | #29 | Add pc-rtems BSP to OSAL | other | enhancement | minor |
| 7 | #31 | OSAL public/private data structure delineation. Updates to define which data structures of OSAL are intended to act as the "public" interface and which data structures are internal/private to OSAL. | os common | enhancement | minor |
| 8 | #32 | Adjust usage of feature support macros for glibc/posix. Uses "XOPEN\_SOURCE=600" across the entire build. This will enable XPG6 features. XPG6 adds some more realtime features that are likely to be useful to applications such as this, e.g. clock\_nanosleep() and some others. | os posix | defect | minor |
| 9 | #33 | API additions to formalize common routines in OSAL. Adds APIs to formalize normal shutdown procedures and provides the hooks necessary to perform shutdown cleanup. | os common | enhancement | major |
| 10 | #37 | Implement user-selectable compiler warning switches | build | enhancement | minor |
| 11 | #39 | Connect compiler warnings to test results parser | bamboo | enhancement | major |
| 12 | #57 | Import UT-Assert basics into OSAL | unit-test | enhancement | major |
| 13 | #63 | Add timebase API calls to existing OSALs for API compatibility | os common | defect | minor |
| 14 | #110 | Add JSC white box unit coverage tests | unit-test | enhancement | major |
| 15 | #112 | Integrate JSC audit of parameter and return code checking | os vxworks6 | defect | major |
| 16 | #125 | Add SPARC-VxWorks6.7 BSP | unspecified | enhancement | major |

Table 1.2-2 identifies changes to OSAL functionality and bug fixes from previously delivered versions and the Trac tickets associated with these changes.

**Table 1.2-2 – Changes to Previously Delivered Functionality and Bug Fixes**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **No.** | **Trac Ticket #** | **High Level Description of Functionality/Bug Report** | **Component** | **Type** | **Priority** |
| 1 | #1 | OSAL "common\_types.h" is not completely reliable. On some systems (particularly 64-bit) the types defined in OSAL "common\_types.h" file do not always match their expected widths. | os common | defect | major |
| 2 | #6 | Make OSAL tests more autonomous. add a "script-mode" feature to the tests (in the "tests" directory, NOT "unit-test" or "unit-test-coverage") which:   * Checks for the expected conditions and maintains an error counter of any tests that did not satisfy expected conditions * Limits the time of execution and exits the test automatically (no CTRL+C) * Returns a non-zero exit code if any errors occurred (for scripting) | build | defect | major |
| 3 | #7 | Fix warnings in OSAL "unit-test" code | build | defect | major |
| 4 | #11 | Duplicate OSAL error codes and error string API. osapi-os-filesys.h has its own set of error codes that overlap with and are different from the rest of OSAL error codes. For example, "OS\_FS\_ERR\_NAME\_TOO\_LONG" is not the same as "OS\_ERR\_NAME\_TOO\_LONG". There are several codes that are redefined differently. At a minimum, this is confusing, but it can also cause real bugs if the wrong action is taken due to misinterpreting an error. Cleaned up error codes. FS error codes merged with the rest of OSAL error codes into a single set, with a single implementation of OS\_GetErrorName() to get them all. | other | defect | major |
| 5 | #13 | API prototype changes to address compiler warnings | build | defect | major |
| 6 | #16 | OS\_PEND and OS\_CHECK are backwards | os common | enhancement | minor |
| 7 | #17 | OSAL should use UT framework similar to that of CFE | os common | enhancement | major |
| 8 | #19 | Fix OSAL build when using RTEMS "pc686" BSP | os rtems | defect | major |
| 9 | #20 | TSF: osloader OS\_ModuleLoad #4. The OS\_ModuleLoad test case in the osloader unit test fails during the "test setup" loop. Once the test was augmented to report the failing module name, it was discovered that this was due to not staging the "MODULE%d.so" files to the target running the unit tests. | other | defect | minor |
| 10 | #24 | pthread\_create 3rd arg must be of right type. OS\_TaskCreate is handed an OSAL entry point, which is a pointer to a function taking no parameters and returning no return value. It passes it along to pthread\_create which is expecting a pointer to a function that takes a single void pointer parameter, and returns a void pointer return value. The code as written triggers a compiler warning. | os posix | defect | major |
| 11 | #27 | Clean up "-D" compile time macros used in pc-linux build | pc-linux | defect | major |
| 12 | #30 | Fix OSAL timer test ID usage | unit-test | defect | major |
| 13 | #51 | Fix simulataneous use of OSAL BSP + CFE PSP compiler flags | build | defect | minor |
| 14 | #52 | Fix warnings in vxworks support code | os vxworks6 | defect | minor |
| 15 | #54 | OS\_QueueCreate failures | os posix | defect | minor |
| 16 | #58 | Combine "pc-linux" and "pc-linux-ut" OSAL BSPs | unit-test | defect | major |
| 17 | #61 | osnetwork.c API discrepancies. The VxWorks osnetwork.c code differs from the OSAL Library API documentation under some conditions. Even more interesting, the posix and rtems OSAL implementations behave differently from the VxWorks as well. Added coverage tests for osnetwork.c. Switching default osnetwork.c coverage build to 32-bit. Return OS\_ERR\_NOT\_IMPLEMENTED for the "no network" case for VxWorks OSAL only. | os vxworks6 | defect | minor |
| 18 | #62 | Incorrect Logic in OS\_TimespecToUsec | os vxworks6 | defect | major |
| 19 | #67 | OS\_open: 644 is not 0644 | unspecified | defect | minor |
| 20 | #68 | OS\_open and file-api-test in conflict | os posix | defect | minor |
| 21 | #70 | Enhancements to OSAL UT stub code in osapi\_stubs | unit-test | enhancement | major |
| 22 | #73 | Fix "utbsp.h" not found failure when building on some platforms | build | defect | major |
| 23 | #74 | classic build broken | build | defect | major |
| 24 | #82 | vxworks osapi.c OS\_GetErrorName() missing codes | os vxworks6 | defect | minor |
| 25 | #88 | vxworks OS\_fsBlocksFree() misreports | os vxworks6 | defect | major |
| 26 | #90 | vxworks OS\_FS\_GetErrorName() errors | os vxworks6 | defect | major |
| 27 | #102 | GCOV results for "osapi" obscured. | build | defect | major |
| 28 | #111 | JSC updated API tests | unit-test | enhancement | major |
| 29 | #113 | JSC: Replace "UNINITIALIZED" macro with "OS\_UNINITIALIZED" | os vxworks6 | defect | major |
| 30 | #115 | JSC: Audit vxworks6 global table protections | os vxworks6 | defect | major |
| 31 | #116 | JSC: use fixed width types | os vxworks6 | defect | major |
| 32 | #117 | JSC: change fpu get/set mask function return code | os vxworks6 | defect | major |
| 33 | #118 | JSC: general code cleanup:   * Make all if/then/else as compound statements * Add "void" to functions that do not take parameters * Add final "else" to all "else if" constructs * Make sure all cases in switch stametents have break * Add explicit casting where the compiler may emit warnings * Add "static" and "extern" keywords where needed | os vxworks6 | defect | major |
| 34 | #119 | Fix up pointer subtraction (do not cast to integers) | unspecified | defect | major |
| 35 | #124 | resolve "-m32" OSAL classic build issues | build | defect | major |
| 36 | #128 | usleep is obsolete | unit-test | defect | minor |
| 37 | #130 | strncpy may not '\0'-terminate | os posix | defect | minor |
| 38 | #131 | unreachable flow control. cppcheck messages:  src/tests/osal-core-test/osal-core-test.h:347: style: Consecutive return, break, continue, goto or throw statements are unnecessary.  Removed duplicate return statement | unit-test | defect | minor |
| 39 | #132 | Removed tests for unsigned variable less than zero  cppcheck messages: src/os/posix/osapi.c:2273: style: Checking if unsigned variable 'sem\_initial\_value' is less than zero. src/os/posix/osapi.c:2794: style: Checking if unsigned variable 'sem\_initial\_value' is less than zero. | os posix | defect | major |
| 40 | #135 | repeated assignments without using the value (real code edition). cppcheck messages:  src/os/vxworks6/osnetwork.c:73: performance: Variable 'retval' is reassigned a value before the old one has been used. src/os/vxworks6/ostimer.c:331: style: Variable 'status' is assigned a value that is never used. | os vxworks6 | defect | major |
| 41 | #136 | Same expression on both sides of a binary operator. cppcheck message:  src/unit-tests/osfile-test/ut\_osfile\_fileio\_test.c:2537: style: Same expression on both sides of '||'. | unit-test | defect | minor |
| 42 | #137 | Uninitialized variables. cppcheck messages:  src/unit-tests/oscore-test/ut\_oscore\_queue\_test.c:552: error: Uninitialized variable: queue\_data\_out src/unit-tests/oscore-test/ut\_oscore\_queue\_test.c:562: error: Uninitialized variable: queue\_data\_out | unit-test | defect | minor |
| 43 | #144 | ostimer unit test needs non-zero stack size parameter passed to OS\_TaskCreate | unspecified | defect | major |
| 44 | #147 | posix impl should use timer\_t instead of uint32 for host\_timerid | unspecified | defect | major |
| 45 | #150 | timer-test.c has a difficult time obtaining a count for timer4 due to the start delay. | unspecified | defect | major |
| 46 | #151 | vxWorks OSAL implementation needs OS\_IdleLoop and OS\_Application\_Shutdown | unspecified | defect | major |
| 47 | #152 | ostimer unit test uses OS\_IdleLoop but not OS\_Application\_Shutdown | unspecified | defect | major |
| 48 | #156 | Allow C99 code in OSAL. | build | defect | major |

1.3 MISSING Planned FEATURES AND KNOWN PROBLEMS

Table 1.3-1 identifies the functions and known discrepancies that are absent from OSAL Version 4.2.0

Information on currently open Trac tickets is available at <https://babelfish.arc.nasa.gov/trac/cfs_osal>. Note that this is a restricted website that requires a server account. Additional Trac tickets may have been submitted after preparation of this VDD. An OSAL Trac ticket report containing a listing of open tickets is available on request for customers who do not have access to the babelfish server. Please contact Susanne Strege, susie.strege@nasa.gov.

**Table 1.3-1 – Functions Absent from this Release**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **No.** | **Trac Ticket #** | **Description** | **Component** | **Status** | **Planned Delivery** | **Type** | **Priority** |
| 1 | #3 | Document available BSPs in trac wiki | wiki | accepted | Not Determined | defect | minor |
| 2 | #4 | Document available OSs in trac wiki | wiki | accepted | Not Determined | defect | minor |
| 3 | #5 | Refactor common code between VxWorks/Posix/Rtems into OSAL shared layer | os common | work  complete | Not Determined | enhancement | major |
| 4 | #9 | Add free-run tick counter API to OSAL | os common | review | Not Determined | enhancement | major |
| 5 | #12 | Make file system API work more like the rest of OSAL | other | work  complete | Not Determined | enhancement | major |
| 6 | #14 | More lenient operation when "SIMULATION" compile-time directive is defined | os posix | new | Not Determined | enhancement | major |
| 7 | #21 | OSAL PPC VxWorks "test runner" | unit-test | accepted | Not Determined | enhancement | major |
| 8 | #35 | Bogus usage of strncpy in unit tests | unit-test | on hold | Not Determined | defect | major |
| 9 | #38 | Add Xenomai OSAL | xenomai | new | Not Determined | enhancement | minor |
| 10 | #40 | Enforce Strict ASCII | other | new | Not Determined | defect | minor |
| 11 | #41 | Backtrace-tracking feature for debugging OSAL mutexes | os posix | new | Not Determined | enhancement | minor |
| 12 | #42 | OSAL: Consider Allowing Root Task (caller of OS\_API\_Init) to Register and Use OSAL Services (GSFC DCR 21564) | other | new | Not Determined | enhancement | trivial |
| 13 | #43 | OSAL: OS\_EOF Macro is Not Defined (GSFC DCR 22719) | os common | new | Not Determined | enhancement | trivial |
| 14 | #44 | Posix - optionally disable use of some realtime features for debugging | os posix | work  complete | osal-next | enhancement | major |
| 15 | #45 | POSIX - Consider using "SCHED\_RR" instead of "SCHED\_FIFO" for realtime threads | os posix | work  complete | osal-next | enhancement | major |
| 16 | #46 | Consider Adding a Timed Wait Function to the Mutex API (GSFC 22628) | os common | new | Not Determined | enhancement | major |
| 17 | #47 | OSAL Library API Document Cut and Paste Errors | docs | new | Not Determined | defect | trivial |
| 18 | #48 | Update RTEMS OS\_IntAttachHandler for the PPC (GSFC #22161) | os rtems | new | Not Determined | enhancement | minor |
| 19 | #49 | Add VxWorks RTP/Memory Protected Port (GSFC DCR 18626) | os vxworks6 | new | Not Determined | enhancement | minor |
| 20 | #50 | Add user-space message queue library to the OSAL (GSFC DCR 22160) | os common | new | Not Determined | enhancement | minor |
| 21 | #53 | OS\_check\_name\_length portability | os posix | in work | Not Determined | defect | minor |
| 22 | #56 | OS\_TaskDelete fails if the task (pthread) has already terminated on its own | os posix | assigned | Not Determined | defect | major |
| 23 | #64 | divide osconfig.h three ways | other | new | Not Determined | defect | minor |
| 24 | #65 | OS\_TimerCreate() Unterminated String | os vxworks6 | review | osal-next | defect | major |
| 25 | #71 | posix ostimer.c functions not using semaphore | os posix | new | Not Determined | defect | major |
| 26 | #72 | rtems ostimer.c functions not using semaphore | os rtems | new | Not Determined | defect | major |
| 27 | #79 | Make compiles with --std=c99 work | build | in work | Not Determined | task | minor |
| 28 | #81 | vxworks osapi.c OS\_Milli2Ticks() problems | os vxworks6 | review | osal-next | defect | minor |
| 29 | #85 | vxworks osfilesys.c functions not thread-safe | os vxworks6 | assigned | Not Determined | defect | major |
| 30 | #93 | OS\_rename() doesn't first check if a file is in use | os vxworks6 | new | Not Determined | defect | minor |
| 31 | #95 | osfilesys.c mixed return types | os vxworks6 | new | Not Determined | defect | minor |
| 32 | #97 | vxworks osapi.c utility task doesn't exit | os vxworks6 | new | Not Determined | enhancement | minor |
| 33 | #98 | Simplify Function Pointer Manipulations | other | new | Not Determined | task | minor |
| 34 | #99 | Posix message queues leak. | os posix | new | Not Determined | defect | minor |
| 35 | #100 | Standardize Version Numbering (in OSAL) | other | new | Not Determined | defect | major |
| 36 | #105 | Overwriting unused values in variables | cppcheck | new | Not Determined | defect | minor |
| 37 | #114 | JSC: add static initializers to all local variables | os vxworks6 | work  complete | osal-next | defect | major |
| 38 | #120 | Support Insertion/Integration of Third Party/Bridge Libraries | unspecified | new | Not Determined | defect | major |
| 39 | #121 | OSAL API Documentation Should Be Doxygen Based | unspecified | new | Not Determined | defect | major |
| 40 | #122 | Expand cppcheck application | cppcheck | in work | Not Determined | enhancement | major |
| 41 | #123 | cppcheck a vxworks build | cppcheck | in work | Not Determined | task | major |
| 42 | #126 | Reconcile diffs between unit test makefiles and JSC UT makefiles | unspecified | new | osal-next | enhancement | major |
| 43 | #127 | May need -rdynamic | unspecified | review | Not Determined | defect | major |
| 44 | #129 | struct/union member never used | unit-test | in work | Not Determined | defect | minor |
| 45 | #133 | readdir is not reentrant | os posix | on hold | Not Determined | defect | major |
| 46 | #134 | repeated assignments without using the value (unit test edition) | unit-test | in work | Not Determined | defect | minor |
| 47 | #138 | function declaration is not a prototype | unit-test | work  complete | osal-next | defect | minor |
| 48 | #139 | ostimer OS\_TimerSet may fail when testing on a VM | unit-test | new | Not Determined | enhancement | trivial |
| 49 | #141 | Cleanup Relative Paths Used in Makefiles | unspecified | new | Not Determined | enhancement | minor |
| 50 | #142 | UT assert library has uninitialized "UtTestDataBase" global variable | unit-test | new | Not Determined | enhancement | minor |
| 51 | #143 | stack\_size parameter should be checked for reasonable value in OS\_TaskCreate vxWorks implementation | unspecified | new | osal-next | defect | major |
| 52 | #145 | OS\_API\_Init() should be called before any OSAL calls are used in the unit tests | unit-test | new | osal-next | defect |  |
| 53 | #148 | OS\_API\_Init() does not correct cleanup resources on error | unspecified | new | Not Determined | defect | major |
| 54 | #149 | vxWorks OSAL implementation should use static initialization where possible | unspecified | new | Not Determined | enhancement | major |
| 55 | #153 | utlist can use malloc(0) and memcpy of 0 size data | unspecified | new | Not Determined | defect | major |
| 56 | #157 | Clear BSS on App Restart | other | new | Not Determined | enhancement | minor |

1.4 Tested Platforms and Supported OS

OSAL version 4.2.0 includes the following OS implementations:

* POSIX
* RTEMS
* VxWorks 6.x

Table 1.4-1 identifies the platforms and development tools used to verify OSAL version 4.2.0. Functional testing of OSAL 4.2.0 has been done in a PC/Linux environment, Qemu PPC750 simulator running VxWorks 6.9, and Gaisler TSIM2 LEON3 simulator running RTEMS 4.11 and 4.12. Black box unit testing has been done in a PC/Linux environment and SPARC Leon3 ut699, running VxWorks 6.7.1.

**Table 1.4-1 – Tested Platforms and Verification**

| Test Type | Platform Information | Results Location |
| --- | --- | --- |
| Functional | VxWorks 6.9  Qemu PPC750 simulator | /src/tests/Results/pc-linux |
| Functional | Linux wirbelwind 4.3.3-gentoo  x86\_64 Intel(R) Core(TM) i7-6700K CPU @ 4.00GHz GenuineIntel GNU/Linux  gentoo linux/64bit  built with gcc-5.3 and glibc 2.21-r1 | /src/tests/Results/vxworks |
| Functional | RTEMS 4.11 and 4.12  Gaisler TSIM2 LEON3 simulator | /src/tests/Results/rtems |
| Black Box Unit Test | Linux wirbelwind 4.3.3-gentoo  x86\_64 Intel(R) Core(TM) i7-6700K CPU @ 4.00GHz GenuineIntel GNU/Linux  gentoo linux/64bit  built with gcc-5.3 and glibc 2.21-r1 | /src/unit-tests/Results/pc-linux |
| Black Box Unit Test | VxWorks 6.7.1  SPARC Leon3 ut699 development board  SPARC BSP 1.0.13  sparc-wrs-vxworks-4.1-1.0.12 | /src/unit-tests/Results/vxworks |

2.0 Delivered products

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

Table 2-1 – Delivered Products and their Locations

| Software Element | Changed with this Version? | New Version or Date | Location |
| --- | --- | --- | --- |
| Executable for this release | Yes | 4.2.0 | N/A. Executables are not delivered for the OSAL |
| Installation Procedures & Special Instructions | Yes | 1/31/16 | See OSAL Configuration Guide in /doc  babelfish.arc.nasa.gov (in git system master branch) and <http://sourceforge.net/projects/osal/> |
| Source Code of this release | Yes | 4.2.0 | babelfish.arc.nasa.gov (in git system master branch) and <http://sourceforge.net/projects/osal/> |
| Build Plan | No | N/A | None |
| Annotated S/W Detailed Design Docs | No | N/A | None |
| Ground System Scripts developed by FSB | No | N/A | See functional tests in /src/tests  babelfish.arc.nasa.gov (in git system master branch) and <http://sourceforge.net/projects/osal/> |
| Simulator and Test Data Generator Software | N/A | N/A | None |
| Executable - Ground Tools associated with FSW (tools to build OSAL implementation) | Yes | N/A | See cmake build scripts  babelfish.arc.nasa.gov (in git system master branch) and <http://sourceforge.net/projects/osal/> |
| Source Code - Ground Tools associated with FSW (tools to build stored command loads, etc.) | Yes | N/A | None |
| Unit Test Procedures | Yes | 4.2.0 | See black box tests in /src/unit\_tests and white box tests in /src/unit-test-coverage  babelfish.arc.nasa.gov (in git system master branch) and <http://sourceforge.net/projects/osal/> |
| Unit Test Data | No | N/A | None |
| Unit Test Results | Yes | 4.2.0 | Tlserver3.gsfc.nasa.gov (in MKS CM system) |
| FSW Make Files | Yes | 4.2.0 | See “classic” build makefiles  babelfish.arc.nasa.gov (in git system master branch) and <http://sourceforge.net/projects/osal/> |
| Linker & Compiler Configuration Files | No | N/A | babelfish.arc.nasa.gov (in git system master branch) and <http://sourceforge.net/projects/osal/> |

3.0 INSTALLATION PROCEDURES

Table 3-1 identifies the nominal Installation Procedure(s) for this release onto the intended target system. The procedure version identifier, the date of the procedure and where it can be located are also provided. In addition, the readme file that is included with the release provides a set of “Getting Started” instructions.

**Table 3-1 Installation Procedure(s)**

| Destination  (Target System) | Filename | Version and Date | Location |
| --- | --- | --- | --- |
| Procedure is generic for each OS and CPU | OSAL-Configuration-guide.pdf | 4.2.0 | babelfish.arc.nasa.gov (in git system master branch) and <http://sourceforge.net/projects/osal/>  in the /doc directory |

4.0 Configuration summary and version identification

OSAL Build 4.2.0 can be found on babelfish.arc.nasa.gov and is provided as open source on sourceforge.net:

<http://sourceforge.net/projects/osal/>

OSAL version information is documented in the following source file: /src/os/inc/osapi-version.h.

5.0 Release History

Table 5.0-1 provide the release notes from previous OSAL releases.

**Table 5.0-1 Release History Notes**

|  |  |  |
| --- | --- | --- |
| **Version** | **Release Date** | **Release Notes** |
| 4.1.1 | April 28, 2014 | This release fixes two issues:   1. The posix port OS\_QueueCreate ( posix message queue version ) was hardcoding the queue depth rather than using the passed in parameter. 2. A bug was introduced in 4.1.0 in OS\_open that caused a zero length file to be created when a file is opened with the OS\_READ\_ONLY flag and it does not exist. The original change was intended to create a new file if one did not exist, but only if the file was opened as READ/WRITE or WRITE ONLY. |
| 4.1.0 | January 31, 2014 | This release contains one new function, and one slightly altered function:  The new function OS\_GetFsInfo returns information about the file systems including:   * Number of mounted/mapped volumes * Maximum number of mounted/mapped volumes * Number of open files * Maximum number of open files   OS\_QueueGet has a slightly modified behavior. The size passed is the size of the buffer that the message is supposed to be copied into. If the size of the buffer passed in is smaller than the maximum size of the message specified when the queue was created, then the call will return an OS\_INVALID\_SIZE error. This will prevent buffer overflow errors. Previous versions of OS\_QueueGet required the size of the buffer to match the exact size of the Queue and message being received. This works fine for a system with fixed size messages, but will not work for a system that uses variable sized messages.  This release adds a suite of unit tests developed primarily by Tam Ngo of NASA/JSC. The tests run on Linux and use gcov to provide code coverage information.  This release fixes a number of bugs and adds a number of improvements:   * Fixed issues reported by static analysis tool * Implemented signal mask improvements on POSIX port * Improved OS\_TaskDelay on POSIX port * Added additional parameter checks in osloader ports * Fixed the priority and scheduler selection on the POSIX port ( priorities were being ignored ) * Removed error printfs in POSIX port * Fixed incorrect table reference in CountSemCreate POSIX port * Fixed minor bugs in POSIX osfilesys and osfileapi functions * Fixed POSIX OS\_TimerCreate * Fixed divide by zero bug in OS\_Milli2Ticks * Improved POSIX mutex lock by masking signals * Improved Queue handling by allowing variable size messages and preventing buffer overflows on RTEMS queue receive * Updated common\_types.h include file to include ARM and x86\_64 * Added C++ extern "C" keywords in include files |
| 4.0.0 | January 16, 2013 | This release contains no new API functionality. This release focuses on improving documentation and fixing bugs.  This release removes support for OS X and Cygwin as OSAL targets. Support for OS X and Cygwin was out of date and incomplete. Due to limited resources and the ease of deploying linux virtual machines on OS X and Windows, it was decided to focus on Linux.  Documentation fixes: cleaned up call restrictions, return codes, and flags that were documented but not in the code.  The "apps" directory has been removed and replaced with "examples" and "tests". New tests have been added to test the semaphores. Expect additional tests in future releases.  Overhaul of the binary and counting semaphores on all 3 ports. The posix port now uses pthread condition variables and mutexes for a more robust implementation. The vxworks and rtems ports use the native binary and counting semaphores and no longer try to maintain counters in the OSAL. The result is a faster and more robust implementation.  Fixed incorrect comments in vxWorks OS\_TaskCreate function header  Removed unused variable in RTEMS port  Fixed define in OS\_API\_Init in posix port  Fixed timer structure initialization in posix port  Fixed use of size\_copied parameter in RTEMS OS\_QueueGet  Fixed use of access and mode parameters for OS\_open and OS\_creat in all ports  Fixed mutex protection in OS\_TaskCreate  Fixed OS\_FDGetinfo to use correct return codes  Removed second "close" call in OS\_close functions  Close file descriptor in vxworks OS\_unmount to remove memory/fd leak  Use posix statfs on vxworks OS\_fsBytesFree instead of FIONFREE64 ioctl  Fixed OS\_mv in rtems and vxworks to work across volumes and be consistant |
| 3.5.0 | April 18, 2012 | Incorporated suggestions from RTEMS port code walkthrough. Mostly Cosmetic changes, but there were a few semaphore fixes.  Inhibit output from OS\_printf if called from an ISR ( RTEMS only )  Added OS\_printf\_enable and OS\_printf\_disable API  Added OS\_USED macro to common\_types.h for the GNU "used" attribute  Fixed error in OSAL API Document for OS\_QueueGet |
| 3.4.1 | January 17, 2012 | Quick fix: The OS X port had a compilation error:  - added -m32 to OS X link rule |
| 3.4.0 | December 5, 2011 | Added OS\_rewinddir API  Removed OS\_MEM\_TABLE\_SIZE from osconfig.h -- no longer used  Changed the RTEMS volatile/ram disk from NVRAM disk to the regular RTEMS RAM disk for efficiency  Completed the implementation of the RTEMS shell command API. It works with RTEMS 4.10+ to execute a shell command and return the results.  Improved the error handling in some of the example programs  Protected internal data structures in Counting Semaphore APIs in all host OSs  Fixed OS\_creat in RTEMS where it was not overwriting an existing file |
| 3.3.0 | May 31, 2011 | Added an API to close a file given the original filename/path  Added an API to close all files opened by the OSAL  Changed OS\_stat to not look at the length of a directory segment as a file ( length restriction )  Added permissions to vxworks6/OS\_creat so it will work on an NFS volume  In vxworks6, replaced xbdBlkDev calls with "sync" versions to allow the xbd volumes to be created without a hard-coded delay after the call.  Implemented symbol table dump function on vxworks6 and RTEMS ( RTEMS using the GSFC static loader )  Removed the -fvolatile compiler option from the PPC vxWorks makefiles. This is no longer needed for vxWorks 6.x  Added semaphore protection around the file system functions in RTEMS. RTEMS does not provide protection in it's high level file system calls  Fixed RTEMS OS\_cp error  Fixed vxworks6 OS\_BinSemTimedWait - It was incrementing the incorrect counter.  Improved posix message queue and semaphore pends. Now pends that were interrupted by a signal are continued.  Improved posix message queue port to create unique message queue names for each process. This allows multiple OSAL apps to run on one machine  Simplified posix file system path mapping. Now the path mapping does not try to create or delete directories on the running system. The OSAL path to host path translation is a simple 1 to 1 mapping. For example: OSAL path "/cf/apps" can translate to "/media/compactFlash0/apps". The OSAL will not try to create "ramdev0" etc.  Cleaned up the documentation, code comments and OSAL code with regard to return codes. The return codes are consistent with the  API guide and each port conforms to the documentation much better. There are still a few instances where functions are not implemented on one of the ports. |
| 3.2.0 | November 15, 2010 | Various bug fixes in the RTEMS port. There were left over internal posix mutexes and a couple of cut and paste errors with the internal muteness.  Added a new API: OS\_FileOpenCheck  Removed special symbols from source code (the copyright symbol). This was causing some debuggers and editors trouble.  Updated some of the make rules for RTEMS 4.10 |
| 3.1.0 | March 10, 2010 | Removed the "arch" directory which had the porting layer for the OSAL. This has been simplified and turned into the "bsp" directory. This is where the OSAL port to a particular board/OS is done. For example, under the old "arch" directory structure we had: src/arch/ppc/mac/osx and src/arch/x86/mac/osx. These ports were nearly identical, yet they had a bunch of code that has to be maintained and tested. The new "bsp" directory structure has "bsp/mac-osx" which can be used to make the OSAL run on an intel mac. It could be used for a PPC mac with a few changes. Overall, another move for simplicity and ease of maintenance.  Consolidated the "osx" and "linux" ports into "posix". We had considered dropping OS X, but it is close enough to warrant a single "posix" port with a few "ifdefs" to make it work. This removed over 3k lines of code from the OSAL.  Verified Cygwin operation using Cygwin version 1.7.1. Cygwin 1.7.1 works almost identical to Linux for the OSAL. Earlier versions of Cygwin are not supported.  Removed all POSIX code from the "rtems" port. This makes the rtems port more consistent and, in my opinion cleaner.  Added support for the CEXP and a static loader in RTEMS. Neither one are included, but it is possible to do dynamic loading in RTEMS. Eventually RTEMS will have its own native dynamic loader.  Added support for creating a RAM disk in RTEMS using the NVRAM disk device and the RFS file system. These are new features in RTEMS 4.10.  Added an API to return the free bytes in a file system (required a 64 bit data type)  Various fixes for warnings  Various bug fixes  Future releases:  - Still would like a Win32 port. Preferably using the MinGW32 compiler.  - Need to make sure the OSAL works correctly on 64 bit OSs. |
| 3.0.0 |  | Removed the hardware API. Now the OSAPI is more focused on the Operating System abstraction and not trying to abstract hardware. One of the main reasons for doing this was that the hardware platforms were just not being maintained and updated as they should. For NASA, we split these functions out of the OSAL and incorporated them into our cFE platform support package (where they were being copied anyway). The end result is that the OSAL project is just trying to do one thing: abstract the RTOS.  Various bug fixes |
| 2.12.0 | September 5, 2008 | Finished Memory Range API  Progress on the Loader and Symbol API: The vxWorks, linux, and RTEMS APIs are complete with the exception of the dump symbol table API. This will probably never work on the linux/OSX/Cygwin ports. The RTEMS Loader and Symbol API had to be left incomplete for this release due to time constraints. This will be finished in version 2.13 (hopefully before the end of 2008). The RTEMS port will rely on the CEXP dynamic loader.  Broke apart the osapiarch.c file into osmemeeprom.c, osmemport.c, osmemram.c, osmemrange.c and osmemutils.c. This was done to make the differences between platforms easier to deal with. Also, since all of this code is generic on the existing platforms, I created a src/arch/common directory with only one copy of these files. If you need to customize one of them, copy the file and put it in the arch/<cpu>/<platform>hal directory. The makefile will pick it up from there first.  Created an OS timer API -- This is documented in the API reference. The vxWorks, Linux, and RTEMS timer APIs are complete for this release. The OS X timer API will be complete on the next release, but it will probably not be too pretty :) OS X lacks the POSIX timer API, so the timer code has to be handled with one timer interrupt. Also, cygwin support is unknown at this point. That will be addressed in the next release as well  Added a timer test and a memory range test sample to the apps. |
| 2.11.0 | February 14, 2008 | Update OS X BSP to support 10.5  Fix queue timeout implementation in OS X and Linux in the socket queue implementation. It now uses select instead of a wait loop.  Fix bug in OS\_open and OS\_creat for all ports regarding path length #define used  Fixed Application link rule in Cygwin  Added POSIX message queue implementation in Linux. Linux can use the message queues rather than UDP sockets.  Updated binary and counting semaphore implementations for all ports to not be able to have a semaphore 'give' and increment its value beyond its maximum value  Added a way to get the value of a binary or counting semaphore through OS\_\*SemGetInfo return structure.  Added a function for remapping the OSAL priorities to the underlying OS's. The priority levels are now completely abstracted.  Added a task delete hook handler for a task to clean up its own non OSAL resources.  Fixed task create problem in cygwin  Added valid memory range checking API -- The implementation is not complete, and will be in version 2.12  New dynamic load/ symbol table lookup API -- The implementation is not complete, and will be in version 2.12  All sample programs ( example1, test1, and test2 ) work on Linux, OS X, Cygwin, vxWorks-6.4, and RTEMS |
| 2.10.0 | October 25, 2007 | A Counting Semaphore API was added.  All OS APIs have corresponding delete APIs ( delete tasks, queues, semaphores, etc )  Many bugs have been fixed. The OSAPI internal data structures are now all gaurded by mutexes.  The OS\_printf API has been added along with a utility task that buffers the output, rather than dumping it to stdout.  New interrupt functions have been added to correspond to vxWorks intLock and intUnlock.  Additional file system APIs have been added: OS\_initfs, OS\_GetPhysDriveName, OS\_cp, OS\_mv, OS\_FDGetInfo, OS\_rmfs  The File system API now uses its own file descriptor, rather than passing the system file descriptor through.  The Makefile/build system has been re-done. Now all of the OSAL code and example programs are built in a separate directory  Obsolete OSs and architectures have been removed. The following OSs are supported: Mac OS X, Linux/Cygwin, RTEMS, and vxWorks 6.x  The following platforms are supported in this release: Generic PPC/vxWorks 6.4, x86 Linux, x86 and PPC Mac OS X, Coldfire/RTEMS  Other Platforms and Architectures should be easy to add (i.e. Sparc/LEON RTEMS, ARM/RTEMS, x86 works, etc.) |
| 2.0.0 – 2.9.0 |  | Nicholas Yanchik, NASA/GSFC, Code 582  - Version 2 API coding  - Documentation  - Tests and examples  - ( just about everything in version 2 )  Jacob Hageman, NASA/GSFC, Code 582  - Testing/updating Linux version to run on Cygwin |
| 1.0.0 |  | Alan Cudmore, NASA/GSFC, Code 582  - Original design and coding  - POSIX based ports  - Directory structure and makefiles  J-P Swinski, NASA/GSFC, Code 582  - Coding/vxWorks port  Ezra Yeheskeli, NASA/GSFC, RSC  - Design and coding  - RTEMS Port  - Documentation |

Acronyms

AES………………………………………...…………………………………………….Advance Exploration Systems

API………………………………………...…………………………………………….Application Program Interface

cFE Core Flight Executive

C&DH Command and Data Handling

cFS…………………………………………………………………………………………………Core Flight Software

CM Configuration Management

CPM CFS Performance Monitor

COTS Commercial Off-The-Shelf

DCR Discrepancy/Change Request

ES Executive Services

ETU Engineering Test Unit

FSB Flight Software Branch

FSW Flight Software

JSC Johnson Space Center

I&T Integration & Test

MMS Magnetospheric Multiscale Mission

OSAL……………………………………………………………………….……Operating System Abstraction Layer

POSIX Portable Operating System Interface

RTOS Real-Time Operating System

SPARC Scalable Processor Architecture

TBL……………………………………………………………………………………………………………..……Table

T&C Telemetry and Command

URL Universal Resource Locator

UTF…………………………………………………………………………………………….….Unit Test Framework

VDD Version Description Document