Activity: Build and Start cFS

In this activity, you will build a default configuration of cFS and start executing cFS. Building for the BeagleBone's ARM architecture will expose some compatibility issues during compilation and this Activity will address those issues.

# Build cFS

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| 1 | Install cmake. | debian@beaglebone:~/cFS$ sudo apt-get install -y cmake  Reading package lists... Done  Building dependency tree  Reading state information... Done  The following packages were automatically installed and are no longer required:  bb-beaglebone-io-installer bb-johnny-five-installer  Use 'sudo apt autoremove' to remove them.  The following additional packages will be installed:  cmake-data libuv1  Suggested packages:  codeblocks eclipse ninja-build  The following NEW packages will be installed:  cmake cmake-data libuv1  0 upgraded, 3 newly installed, 0 to remove and 1 not upgraded.  Need to get 3,920 kB of archives.  After this operation, 16.4 MB of additional disk space will be used.  Get:1 http://deb.debian.org/debian stretch/main armhf cmake-data all 3.7.2-1 [1,216 kB]  Get:2 http://deb.debian.org/debian stretch/main armhf libuv1 armhf 1.9.1-3 [74.6 kB]  Get:3 http://deb.debian.org/debian stretch/main armhf cmake armhf 3.7.2-1 [2,629 kB]  Fetched 3,920 kB in 3s (1,184 kB/s)  Selecting previously unselected package cmake-data.  (Reading database ... 98728 files and directories currently installed.)  <snip>  Setting up cmake (3.7.2-1) ... |
| 2 | Copy the sample makefile and definitions. From within the cFS repository, duplicate the default makefile and target definitions. | debian@beaglebone:~/cFS$ pwd  /home/debian/cFS  debian@beaglebone:~/cFS$ ls  apps cfe osal psp README.md tools  debian@beaglebone:~/cFS$ cp cfe/cmake/Makefile.sample Makefile  debian@beaglebone:~/cFS$ cp -r cfe/cmake/sample\_defs sample\_defs  debian@beaglebone:~/cFS$ ls  apps cfe Makefile osal psp README.md sample\_defs tools |
| 3 | Set a preprocessor variable allowing cFS to run as a non-root user. | debian@beaglebone:~/cFS$ sed -i 's/undef OSAL\_DEBUG\_PERMISSIVE\_MODE/define OSAL\_DEBUG\_PERMISSIVE\_MODE/g' sample\_defs/default\_osconfig.h |
| 4 | Generate build files. | debian@beaglebone:~/cFS$ make prep  mkdir -p "build"  (cd "build/" && cmake -DCMAKE\_INSTALL\_PREFIX=/exe -DCMAKE\_BUILD\_TYPE=debug "/home/debian/cFS/cfe")  -- The C compiler identification is GNU 6.3.0  -- Check for working C compiler: /usr/bin/cc  -- Check for working C compiler: /usr/bin/cc -- works  -- Detecting C compiler ABI info  -- Detecting C compiler ABI info - done  -- Detecting C compile features  -- Detecting C compile features - done  -- Mission configuration sample automatically selected  -- OMIT\_DEPRECATED=false: Deprecated elements included in build  -- Module 'sample\_app' found at /home/debian/cFS/apps/sample\_app  -- Module 'sample\_lib' found at /home/debian/cFS/apps/sample\_lib  -- Module 'ci\_lab' found at /home/debian/cFS/apps/ci\_lab  -- Module 'to\_lab' found at /home/debian/cFS/apps/to\_lab  -- Module 'sch\_lab' found at /home/debian/cFS/apps/sch\_lab  -- Module 'cfe-core' found at /home/debian/cFS/cfe/fsw/cfe-core  -- Module 'osal' found at /home/debian/cFS/osal  -- Configuring for system arch: cpu1  -- The C compiler identification is GNU 6.3.0  -- Check for working C compiler: /usr/bin/gcc  -- Check for working C compiler: /usr/bin/gcc -- works  -- Detecting C compiler ABI info  -- Detecting C compiler ABI info - done  -- Detecting C compile features  -- Detecting C compile features - done  -- OMIT\_DEPRECATED=false: Deprecated elements included in build  -- OSAL Selection: posix  -- OSAL Compile Definitions: -Wall -D\_XOPEN\_SOURCE=600  -- OSAL Link Libraries: pthread;dl;rt  -- PSP Selection: pc-linux  -- Building App: sample\_app install=cpu1  NOTE: Selected /home/debian/cFS/apps/sample\_app/fsw/src/sample\_table.c as source for sample\_table  -- Building App: sample\_lib install=cpu1  -- Building App: ci\_lab install=cpu1  -- Building App: to\_lab install=cpu1  -- Building App: sch\_lab install=cpu1  NOTE: Selected /home/debian/cFS/apps/sch\_lab/fsw/src/sch\_lab\_table.c as source for sch\_lab\_table  -- Configuring done  -- Generating done  -- Build files have been written to: /home/debian/cFS/build/cpu1  -- Configuring done  -- Generating done  -- Build files have been written to: /home/debian/cFS/build  echo " -DCMAKE\_INSTALL\_PREFIX=/exe -DCMAKE\_BUILD\_TYPE=debug" > "build/.prep" |
| 5 | Build cFS. | debian@beaglebone:~/cFS$ make VERBOSE=1  make --no-print-directory -C "build" mission-all  /usr/bin/cmake -H/home/debian/cFS/cfe -B/home/debian/cFS/build --check-build-system CMakeFiles/Makefile.cmake 0  make -f CMakeFiles/Makefile2 mission-all  /usr/bin/cmake -H/home/debian/cFS/cfe -B/home/debian/cFS/build --check-build-system CMakeFiles/Makefile.cmake 0  /usr/bin/cmake -E cmake\_progress\_start /home/debian/cFS/build/CMakeFiles 2  make -f CMakeFiles/Makefile2 CMakeFiles/mission-all.dir/all  make -f tools/elf2cfetbl/CMakeFiles/elf2cfetbl.dir/build.make tools/elf2cfetbl/CMakeFiles/elf2cfetbl.dir/depend  cd /home/debian/cFS/build && /usr/bin/cmake -E cmake\_depends "Unix Makefiles" /home/debian/cFS/cfe /home/debian/cFS/tools/elf2cfetbl /home/debian/cFS/build /home/debian/cFS/build/tools/elf2cfetbl /home/debian/cFS/build/tools/elf2cfetbl/CMakeFiles/elf2cfetbl.dir/DependInfo.cmake --color=  Dependee "/home/debian/cFS/build/tools/elf2cfetbl/CMakeFiles/elf2cfetbl.dir/DependInfo.cmake" is newer than depender "/home/debian/cFS/build/tools/elf2cfetbl/CMakeFiles/elf2cfetbl.dir/depend.internal".  Dependee "/home/debian/cFS/build/tools/elf2cfetbl/CMakeFiles/CMakeDirectoryInformation.cmake" is newer than depender "/home/debian/cFS/build/tools/elf2cfetbl/CMakeFiles/elf2cfetbl.dir/depend.internal".  Scanning dependencies of target elf2cfetbl  make -f tools/elf2cfetbl/CMakeFiles/elf2cfetbl.dir/build.make tools/elf2cfetbl/CMakeFiles/elf2cfetbl.dir/build  [ 50%] Building C object tools/elf2cfetbl/CMakeFiles/elf2cfetbl.dir/elf2cfetbl.c.o  cd /home/debian/cFS/build/tools/elf2cfetbl && /usr/bin/cc -D\_XOPEN\_SOURCE=600 -I/home/debian/cFS/build/inc -I/home/debian/cFS/osal/src/os/inc -I/home/debian/cFS/cfe/fsw/cfe-core/src/inc -g -std=c99 -pedantic -Wall -Wstrict-prototypes -Wwrite-strings -Wpointer-arith -Wcast-align -Werror -o CMakeFiles/elf2cfetbl.dir/elf2cfetbl.c.o -c /home/debian/cFS/tools/elf2cfetbl/elf2cfetbl.c  /home/debian/cFS/tools/elf2cfetbl/elf2cfetbl.c: In function ‘set\_st\_size’:  /home/debian/cFS/tools/elf2cfetbl/elf2cfetbl.c:592:57: error: format ‘%lu’ expects argument of type ‘long unsigned int’, but argument 2 has type ‘uint64\_t {aka long long unsigned int}’ [-Werror=format=]  printf("ERROR: Sym32.st\_size can not hold %lu\n", new\_value);  ^  <snip>  ^  /home/debian/cFS/tools/elf2cfetbl/elf2cfetbl.c:2284:39: error: format ‘%ld’ expects argument of type ‘long int’, but argument 2 has type ‘uint64\_t {aka long long unsigned int}’ [-Werror=format=]  printf("Size of %ld is assumed.\n", get\_st\_size(SymbolPtrs[UserObjSymbolIndex]));  ^  cc1: all warnings being treated as errors  tools/elf2cfetbl/CMakeFiles/elf2cfetbl.dir/build.make:62: recipe for target 'tools/elf2cfetbl/CMakeFiles/elf2cfetbl.dir/elf2cfetbl.c.o' failed  make[4]: \*\*\* [tools/elf2cfetbl/CMakeFiles/elf2cfetbl.dir/elf2cfetbl.c.o] Error 1  CMakeFiles/Makefile2:517: recipe for target 'tools/elf2cfetbl/CMakeFiles/elf2cfetbl.dir/all' failed  make[3]: \*\*\* [tools/elf2cfetbl/CMakeFiles/elf2cfetbl.dir/all] Error 2  CMakeFiles/Makefile2:171: recipe for target 'CMakeFiles/mission-all.dir/rule' failed  make[2]: \*\*\* [CMakeFiles/mission-all.dir/rule] Error 2  Makefile:212: recipe for target 'mission-all' failed  make[1]: \*\*\* [mission-all] Error 2  Makefile:114: recipe for target 'all' failed  make: \*\*\* [all] Error 2 |
| 6 | Address the error. How did you resolve the error? Is your solution applicable across different platforms? Different compilers?  Which of the following approaches did you pursue?   1. Modify arch\_build\_custom.cmake and/or mission\_build\_custom.cmake to eliminate the warning? 2. Modify the source files to change the format string? 3. Use inttypes.h? 4. Develop your own inttypes.h? 5. An approach other than these?   Clean up the build environment. | debian@beaglebone:~/cFS$ make distclean  rm -rf "build" |
| 7 | Generate build files. | debian@beaglebone:~/cFS$ make prep  mkdir -p "build"  (cd "build/" && cmake -DCMAKE\_INSTALL\_PREFIX=/exe -DCMAKE\_BUILD\_TYPE=debug "/home/debian/cFS/cfe")  <snip>  -- Build files have been written to: /home/debian/cFS/build  echo " -DCMAKE\_INSTALL\_PREFIX=/exe -DCMAKE\_BUILD\_TYPE=debug" > "build/.prep" |
| 8 | Build cFS. | debian@beaglebone:~/cFS$ make VERBOSE=1  make --no-print-directory -C "build" mission-all  <snip>  apps/sample\_app/CMakeFiles/sample\_app.dir/fsw/src/sample\_app.c.o  cd /home/debian/cFS/build/cpu1/apps/sample\_app && /usr/bin/gcc -D\_LINUX\_OS\_ -Dsample\_app\_EXPORTS -I/home/debian/cFS/build/inc -I/home/debian/cFS/build/cpu1/inc -I/home/debian/cFS/osal/src/os/inc -I/home/debian/cFS/psp/fsw/inc -I/home/debian/cFS/cfe/fsw/cfe-core/src/inc -I/home/debian/cFS/cfe/cmake/target/inc -I/home/debian/cFS/build/cpu1/cfe\_core\_default\_cpu1/inc -I/home/debian/cFS/apps/sample\_app/fsw/mission\_inc -I/home/debian/cFS/apps/sample\_app/fsw/platform\_inc -I/home/debian/cFS/apps/sample\_lib/fsw/public\_inc -Wall -D\_XOPEN\_SOURCE=600 -g -fPIC -std=c99 -pedantic -Wall -Wstrict-prototypes -Wwrite-strings -Wpointer-arith -Wcast-align -Werror -o CMakeFiles/sample\_app.dir/fsw/src/sample\_app.c.o -c /home/debian/cFS/apps/sample\_app/fsw/src/sample\_app.c  /home/debian/cFS/apps/sample\_app/fsw/src/sample\_app.c: In function ‘SAMPLE\_ReportHousekeeping’:  /home/debian/cFS/apps/sample\_app/fsw/src/sample\_app.c:365:25: error: cast increases required alignment of target type [-Werror=cast-align]  CFE\_SB\_TimeStampMsg((CFE\_SB\_Msg\_t \*) &Sample\_AppData.SAMPLE\_HkTelemetryPkt);  ^  /home/debian/cFS/apps/sample\_app/fsw/src/sample\_app.c:366:20: error: cast increases required alignment of target type [-Werror=cast-align]  CFE\_SB\_SendMsg((CFE\_SB\_Msg\_t \*) &Sample\_AppData.SAMPLE\_HkTelemetryPkt);  ^  cc1: all warnings being treated as errors  apps/sample\_app/CMakeFiles/sample\_app.dir/build.make:62: recipe for target 'apps/sample\_app/CMakeFiles/sample\_app.dir/fsw/src/sample\_app.c.o' failed  make[7]: \*\*\* [apps/sample\_app/CMakeFiles/sample\_app.dir/fsw/src/sample\_app.c.o] Error 1  CMakeFiles/Makefile2:263: recipe for target 'apps/sample\_app/CMakeFiles/sample\_app.dir/all' failed  make[6]: \*\*\* [apps/sample\_app/CMakeFiles/sample\_app.dir/all] Error 2  Makefile:138: recipe for target 'all' failed  make[5]: \*\*\* [all] Error 2  CMakeFiles/cpu1-all.dir/build.make:57: recipe for target 'CMakeFiles/cpu1-all' failed  make[4]: \*\*\* [CMakeFiles/cpu1-all] Error 2  CMakeFiles/Makefile2:196: recipe for target 'CMakeFiles/cpu1-all.dir/all' failed  make[3]: \*\*\* [CMakeFiles/cpu1-all.dir/all] Error 2  CMakeFiles/Makefile2:171: recipe for target 'CMakeFiles/mission-all.dir/rule' failed  make[2]: \*\*\* [CMakeFiles/mission-all.dir/rule] Error 2  Makefile:212: recipe for target 'mission-all' failed  make[1]: \*\*\* [mission-all] Error 2  Makefile:114: recipe for target 'all' failed  make: \*\*\* [all] Error 2 |
| 9 | Address the error. How did you resolve the error? Is your solution applicable across different platforms? Different compilers?  Clean up the build environment. | debian@beaglebone:~/cFS$ make distclean  rm -rf "build" |
| 10 | Generate build files. | debian@beaglebone:~/cFS$ make prep  mkdir -p "build"  (cd "build/" && cmake -DCMAKE\_INSTALL\_PREFIX=/exe -DCMAKE\_BUILD\_TYPE=debug "/home/debian/cFS/cfe")  <snip>  echo " -DCMAKE\_INSTALL\_PREFIX=/exe -DCMAKE\_BUILD\_TYPE=debug" > "build/.prep" |
| 11 | Build cFS. | debian@beaglebone:~/cFS$ make VERBOSE=1  make --no-print-directory -C "build" mission-all  <snip>  /usr/bin/cmake -E cmake\_progress\_start /home/debian/cFS/build/CMakeFiles 0  Built target mission-all  /usr/bin/cmake -E cmake\_progress\_start /home/debian/cFS/build/CMakeFiles 0 |
| 12 | Install cFS. | debian@beaglebone:~/cFS$ make install  make --no-print-directory -C "build" DESTDIR="/home/debian/cFS/build" mission-install  [100%] Built target elf2cfetbl  [100%] Built target mission-version  [100%] Built target mission-prebuild  Scanning dependencies of target cpu1-install  [ 29%] Built target osal  [ 47%] Built target psp-pc-linux  [ 50%] Built target sample\_app  [ 51%] Built target sampleTable\_tables  [ 53%] Built target sample\_lib  [ 56%] Built target ci\_lab  [ 58%] Built target to\_lab  [ 60%] Built target sch\_lab  [ 61%] Built target sch\_lab\_table\_tables  [ 97%] Built target cfe\_core\_default\_cpu1  Scanning dependencies of target core-cpu1  [ 98%] Building C object cpu1/CMakeFiles/core-cpu1.dir/src/target\_config.c.o  [100%] Linking C executable core-cpu1  [100%] Built target core-cpu1  Install the project...  -- Install configuration: "debug"  -- Installing: /home/debian/cFS/build/exe/cpu1/cf/cfe\_es\_startup.scr  -- Installing: /home/debian/cFS/build/exe/cpu1/cf/sample\_app.so  -- Installing: /home/debian/cFS/build/exe/cpu1/cf/sample\_table.tbl  -- Installing: /home/debian/cFS/build/exe/cpu1/cf/sample\_lib.so  -- Installing: /home/debian/cFS/build/exe/cpu1/cf/ci\_lab.so  -- Installing: /home/debian/cFS/build/exe/cpu1/cf/to\_lab.so  -- Installing: /home/debian/cFS/build/exe/cpu1/cf/sch\_lab.so  -- Installing: /home/debian/cFS/build/exe/cpu1/cf/sch\_lab\_table.tbl  -- Installing: /home/debian/cFS/build/exe/cpu1/core-cpu1  [100%] Built target cpu1-install  Scanning dependencies of target mission-install  [ 42%] Built target cmdUtil  [ 71%] Built target elf2cfetbl  [100%] Built target cfe\_ts\_crc  Install the project...  -- Install configuration: "debug"  -- Installing: /home/debian/cFS/build/exe/host/cmdUtil  -- Installing: /home/debian/cFS/build/exe/host/elf2cfetbl  -- Installing: /home/debian/cFS/build/exe/host/cfe\_ts\_crc  Built target mission-install |

# Start cFS

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| 1 | Start cFS.  Observe the output.  Look for the text, “CFE\_ES\_Main entering OPERATIONAL state”.  Looking for warnings, errors, or other text indicating an issue. | debian@beaglebone:~/cFS$ cd build/exe/cpu1/  debian@beaglebone:~/cFS/build/exe/cpu1$ ./core-cpu1  CFE\_PSP: Default Reset Type = PO  CFE\_PSP: Default Reset SubType = 1  CFE\_PSP: Default CPU ID = 1  CFE\_PSP: Default Spacecraft ID = 42  CFE\_PSP: Default CPU Name: cpu1  CFE\_PSP: Starting the cFE with a POWER ON reset.  CFE\_PSP: Clearing out CFE CDS Shared memory segment.  CFE\_PSP: Clearing out CFE Reset Shared memory segment.  CFE\_PSP: Clearing out CFE User Reserved Shared memory segment.  2030-049-16:05:54.62515 POWER ON RESET due to Power Cycle (Power Cycle).  2030-049-16:05:54.62528 ES Startup: CFE\_ES\_Main in EARLY\_INIT state  CFE\_PSP: CFE\_PSP\_AttachExceptions Called  2030-049-16:05:54.62538 ES Startup: CFE\_ES\_Main entering CORE\_STARTUP state  2030-049-16:05:54.62542 ES Startup: Starting Object Creation calls.  2030-049-16:05:54.62545 ES Startup: Calling CFE\_ES\_CDSEarlyInit  2030-049-16:05:54.62620 ES Startup: Calling CFE\_EVS\_EarlyInit  2030-049-16:05:54.62630 Event Log cleared following power-on reset  2030-049-16:05:54.62633 ES Startup: Calling CFE\_SB\_EarlyInit  2030-049-16:05:54.62695 SB internal message format: CCSDS Space Packet Protocol version 1  2030-049-16:05:54.62706 ES Startup: Calling CFE\_TIME\_EarlyInit  1980-012-14:03:20.00000 ES Startup: Calling CFE\_TBL\_EarlyInit  1980-012-14:03:20.00103 ES Startup: Calling CFE\_FS\_EarlyInit  1980-012-14:03:20.00144 ES Startup: Core App: CFE\_EVS created. App ID: 0  EVS Port1 42/1/CFE\_EVS 1: cFE EVS Initialized. cFE Version 6.7.6.0  EVS Port1 42/1/CFE\_EVS 14: No subscribers for MsgId 0x808,sender CFE\_EVS  1980-012-14:03:20.05187 ES Startup: Core App: CFE\_SB created. App ID: 1  1980-012-14:03:20.05198 SB:Registered 4 events for filtering  EVS Port1 42/1/CFE\_SB 1: cFE SB Initialized  EVS Port1 42/1/CFE\_SB 14: No subscribers for MsgId 0x808,sender CFE\_SB  1980-012-14:03:20.10236 ES Startup: Core App: CFE\_ES created. App ID: 2  EVS Port1 42/1/CFE\_ES 1: cFE ES Initialized  EVS Port1 42/1/CFE\_SB 14: No subscribers for MsgId 0x808,sender CFE\_ES  EVS Port1 42/1/CFE\_ES 2: Versions:cFE 6.7.6.0, OSAL 5.0.6.0, PSP 1.4.4.0, chksm 26787  EVS Port1 42/1/CFE\_SB 14: No subscribers for MsgId 0x808,sender CFE\_ES  EVS Port1 42/1/CFE\_ES 91: Mission 6.7.3-bv-18-gdf9606d-dirty.sample, CFE: 6.7.3-bv-45-g3356da6-dirty, OSAL: 5.0.3-bv-31-g8239eb5  EVS Port1 42/1/CFE\_SB 14: No subscribers for MsgId 0x808,sender CFE\_ES  EVS Port1 42/1/CFE\_ES 92: Build 202002191602 debian@beaglebone  1980-012-14:03:20.15320 ES Startup: Core App: CFE\_TIME created. App ID: 3  EVS Port1 42/1/CFE\_TIME 1: cFE TIME Initialized  1980-012-14:03:20.20363 ES Startup: Core App: CFE\_TBL created. App ID: 4  EVS Port1 42/1/CFE\_TBL 1: cFE TBL Initialized. cFE Version 6.7.6.0  1980-012-14:03:20.25382 ES Startup: Finished ES CreateObject table entries.  1980-012-14:03:20.25389 ES Startup: CFE\_ES\_Main entering CORE\_READY state  1980-012-14:03:20.25403 ES Startup: Opened ES App Startup file: /cf/cfe\_es\_startup.scr  1980-012-14:03:20.25685 ES Startup: Loading shared library: /cf/sample\_lib.so  SAMPLE Lib Initialized. Version 1.1.1.0  1980-012-14:03:20.26018 ES Startup: Loading file: /cf/sample\_app.so, APP: SAMPLE\_APP  1980-012-14:03:20.26143 ES Startup: SAMPLE\_APP loaded and created  EVS Port1 42/1/SAMPLE\_APP 1: SAMPLE App Initialized. Version 1.1.3.0  1980-012-14:03:20.26469 ES Startup: Loading file: /cf/ci\_lab.so, APP: CI\_LAB\_APP  1980-012-14:03:20.26650 ES Startup: CI\_LAB\_APP loaded and created  EVS Port1 42/1/CI\_LAB\_APP 6: CI: RESET command  EVS Port1 42/1/CI\_LAB\_APP 3: CI Lab Initialized. Version 2.3.1.0  1980-012-14:03:20.27001 ES Startup: Loading file: /cf/to\_lab.so, APP: TO\_LAB\_APP  1980-012-14:03:20.27103 ES Startup: TO\_LAB\_APP loaded and created  EVS Port1 42/1/TO\_LAB\_APP 1: TO Lab Initialized. Version 2.3.0.0 Awaiting enable command.  1980-012-14:03:20.27405 ES Startup: Loading file: /cf/sch\_lab.so, APP: SCH\_LAB\_APP  1980-012-14:03:20.27509 ES Startup: SCH\_LAB\_APP loaded and created  SCH Lab Initialized. Version 2.3.3.0  1980-012-14:03:20.32579 ES Startup: CFE\_ES\_Main entering APPS\_INIT state  1980-012-14:03:20.32609 ES Startup: CFE\_ES\_Main entering OPERATIONAL state  EVS Port1 42/1/CFE\_TIME 21: Stop FLYWHEEL |