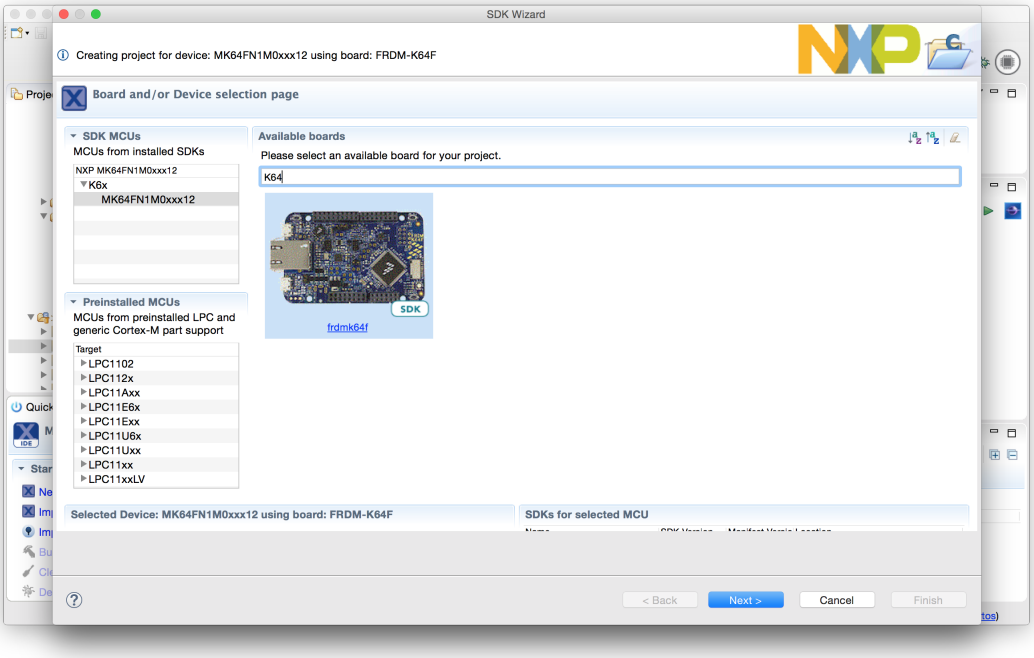
MCUExpresso Install, Setup, and Notes for use with FRDM K64F

January 12, 2019

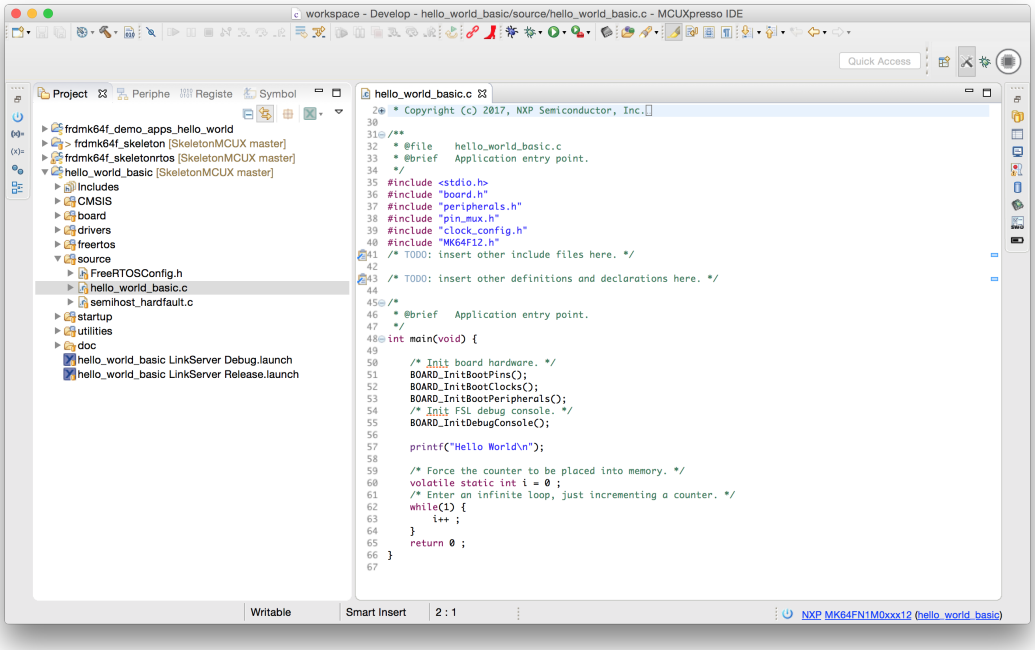
1. **Setup K64F**
   (May not be needed for some boards or if developing on mac)
   - Plug board into USB
   - If the drive is named MBED (MBED (K:), MBED (E:), etc.) then follow the directions to update the bootloader
   - https://os.mbed.com/blog/entry/DAPLink-bootloader-update/
     - Download the binary file 0244_k20dx_bootloader_update_0x5000.bin
   - Then install DAPLINK: https://armmbed.github.io/DAPLink/
     - Search K64 (select FRDM K64F).
     - The board should appear as
     - Download the binary file 0244_k20dx_frdmk64f_0x5000.bin
2. **Setup serial port**
   - Plug board into USB. It should appear as DAPLINK (K:)
   - Windows
     - Use device manager to find Ports COM#
     - Use Putty to connect to COM port from device manager with baud rate 115200
   - Mac
     - Open terminal and type: "ls /dev/tty.usbmodem*" you should see the name of the USB port which the K64F is plugged into (i.e. /dev/tty.usbmodem1412).
     - Type "screen /dev/tty.usbmodem1412 115200"
3. **Setup Git or SmartGit (a GUI for git)**
   - Setup Git (Command Line) or Smart Git (GUI Client)
     - For Smart Git: choose github as hosting provider, set master password if needed, make github acct if you don't have one, authenticate and enable synteo to access your github
   - Clone the repo `https://github.com/ucb-ee192/SkeletonMCUX`
4. **Install and setup MCUExpresso**

- Install MCUExpresso Version 10.1.0 **here**
  - Version 10.1.0 is not the latest build. Navigate to the "previous" tab and download 10.1.0
- Download The K64F SDK zip file **here** (use your Berkeley email address for access)
- Start MCUExpresso
- Drag the K64F zip file into the "Installed SDK's" subwindow and click okay. This will install the K64F SDK
- Check that the K64F SDK installed correctly. Try File→ New→ Project→ MCUExpresso IDE→ New C/C++ Project. Search K64- you should see the K64F as an option.



5. **Import HelloWorld and FreeRTOS examples**

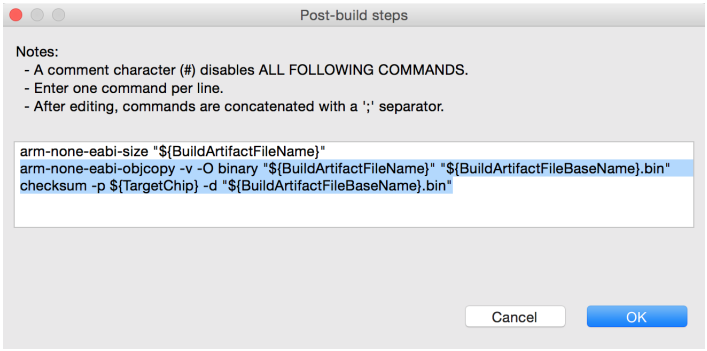
- File → Open Projects from File System
- Select SkeletonMCUX folder you cloned from github
- projects: frdmk64_skeletonrtos, hello_world_basic
- Hello World
  - Open the hello_world_basic folder in the left project explorer
  - The main file is in hello_world_basic → source → hello_world_basic.c



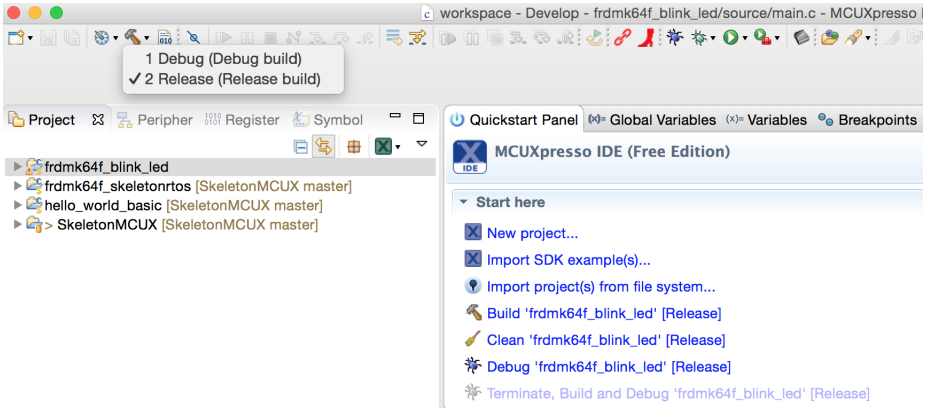
  - To build select Debug 'hello_world_basic' [Debug] (in the quick start menu or the blue bug on the top toolbar).
  - Ignore any firewall requests that might occur (windows machines)
  - Probes Discovered window: should show CMSIS-DAP. → OK
  - Hello World should print. The program will then increment a counter in an infinite loop.
  - You can exit by clicking the red square on the top tool bar

- FreeRTOS Example
  - The main file is in frdm64f_skeletonrtos → source → main.c
  - To build select Debug 'frdm64f_skeletonrtos' [Debug] (in the quick start menu or the blue bug on the top toolbar).
  - It should print EE192 Spring 2018 16 Dec 2017 v0.0 then blink the onboard LED

- Release Build in MCUXpresso (Note: use PRINTF not printf)
  - Configure MCUXpresso to build a .bin file for drag & drop flash programming
    * Select the project.
    * Navigate to Project → Properties → C/C++ Build → Settings → Build Steps
    * Select edit on "Post-Build steps". Uncomment the lines with commands "arm-none-eabi-objcopy" and "checksum".



– Change the build settings to “Release” by clicking the hammer on the top toolbar and selecting “Release”



– Build the release project (from quickstart panel or by clicking the hammer)
– Plug in your K64f board. It should appear as DAPLINK
– Copy the file “Project_Location/Project_Name/Release/project_name.bin” to DAPLINK drive
– A green light will blink rapidly as the program is flashed to the MCU
– After the green light stops blinking the program has been succesfully flashed. Hit the reset button to run it

Random Notes

1. There is already a running debug session for the launch.
    - Use task manager (windows) or "kill" command line utility on Mac/Linux to kill any tasks called:
        - redlinkserv
        - arm-none-eabi-gdb
        - crt_emu_*
    - Close and reopen project
    - Stop on console view?
    - Reopen MCUExpresso
    - Unplug and Replug in K64F board
2. To see queue in FreeRTOS View Queues
    - vQueueAddToRegistry(log_queue, "PrintQueue");
3. Watch out for printf, fragmenting memory
    - Section 12.4 Inappropriate Use of printf() and sprintf(). printf() and sprintf() may call malloc(), which might be invalid if a memory allocation scheme other than heap_3 is in use. See section 2.2, Example Memory Allocation Schemes, for more information.
    - Add printf-stdarg.c instead. Note: use
    - Printf-stdarg.c does not handle floating point. Need to use malloc intensive floating point printf (builtin).
4. FreeRTOS notes: use FreeRTOS → TaskList to show memory usage
    - If running out of stack in FreeRTOSConfig.h change:
    - #define configMINIMAL_STACK_SIZE ((unsigned short)128)
    - // changed for larger idle task- watch heap size...
    - #define configTOTAL_HEAP_SIZE ((size_t)(16 * 1024))
    - Task runtime with percentage value. Both configUSE_TRACE_FACILITY and configGENERATE_RUN_TIME_STATS need to be set to 1, except requires bunch of other enables...
    - How to add watch to stack pointer?
5. Memory view: Use debug view instead of develop view. Memory will appear in console

Advanced Setup

1. Change pins if needed to enable LEDs: (See Lab 3 Getting started with MCUXpresso **here**)
    - right click project name → MCUXpresso config tools → Open pins
    - Go to pins and turn on all LEDS. Add 33/PTE26, PTB21, PTB22
    - export to board directory, refresh and recompile.
2. change FreeRTOSConfig.h to be 1 KHz instead of 200
3. Quick settings → Set Floating point type → Enable hardware floating point
4. Quick Settings → Set Library Header type → NewlibNano (semihost)
5. NewlibNano: If your codebase does require floating point variants of printf/scanf, then these can be enabled by going to:
    - Project → Properties → C/C++ Build → Settings → MCU Linker → Managed Linker Script and selecting the " Enable printf/scanf float" tick box.
    - (Library selection can be reset by quick settings..., so do Newlib-Nano last)
    - Note: Quick settings: → SDK Debug Console → UART (changes to redlib...)
    - A further alternative is to put an explicit reference to the required support function into your project codebase itself. One way to do this is to add a statement such as: asm (".global_printf_float");
    - Unfortunately, as redlib does not support C++, we must use newlib for modern C++ projects.
    - PRINTF uses UART, printf uses semihost console.
6. Add timer component. Manage SDK Components, add driver: pit.c
    - (Note in general should be able to right click project name → MCUX-presso config tools → peripherals. However PIT module is missing, so needed to be added manually.)
7. Add explicit idle top level loop (non-real time)
    - configUSE_IDLE_HOOK must be set to 1 in FreeRTOSConfig.h for the idle hook function to get called.
    - /* Idle hook functions MUST be called vApplicationIdleHook(), take no parameters, and return void. */
8. To check stack usage etc, use FreeRTOS → Task List or FreeRTOS → Heap Usage

CAUTION NOTES TO BE ADDED

For reliability, smaller embedded systems typically don't use dynamic memory, thus avoiding associated problems of leakage, fragmentation, and resulting out-of-memory crashes. In Nadler & Associates smaller embedded projects, we've historically avoided any runtime use of dynamic memory (enforced by deleting malloc-family routine's object files from the runtime libraries) printf-stdarg.c distributed in the FreeRTOS Lab TCPIP example; this one only uses stack storage but does not implement floating point.

https://community.nxp.com/thread/441637