

Embedded Programming with Free and Open Source Software Tools

Robert Emanuele
Crystalfontz America, Inc.
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Embedded Programming

- Small Systems: microcontrollers or system-on-a-chip
- Little or no Operating System
- Tight constraints for resources such as memory (program and data), CPU speed, limited peripherals
- Limited upgrade paths

The Tools

- Binutils
- GCC
- Newlib
- ulibc
- FreeRTOS
- Linux
- eCos
- Platform Library
- OpenOCD
- GDB
- Redboot
- Others

Host to Target

- You need a toolchain (binutils, gcc)
- Host: where you are doing the build
- Target: what platform you're building for
- Examples: avr, Blackfin, arm-*-elf, arm-*-eabi, m68k-*-*, mips-*-*, x86
- Usually the target identifier looks like: processor_core - OS - binary_format

GNU Binutils: Binary Utilities

- Creates the binary code to run on your system
- gas (as)
- ld
- ar
- objcopy
- Binary File Descriptor Library

GCC: GNU Compiler Collection

- C, C++, Fortran, etc.
- Requires Binutils (BFD) for your platform
- Might require some libc headers to build properly

LibC

- Core functions you know and love (reads, writes, mathematics, etc.)
- Bare metal needs a board support package (BSP sometimes known as libgloss)
- ulibc (Micro LibC)
- Newlib (maintained by redhat)

Operating Systems if needed

- Linux: uLinux, OpenWRT, Snapgear
- FreeRTOS
- eCos
- Others....

Platform Library

- Provided by the chip manufacturer
- Configure the chip
- I/O
- Interrupts

Where's the executable?

- Compile
- Link
 - Linker Script
 - Start files: crt.0 or something more custom
- objcopy to a hex file
- Flash?
- Bootloader?

Debugging

- OpenOCD: Open On Chip Debugger
 - Controls the hardware debugging functions of a chip (sometimes limited)
 - JTAG connection to the chip in some cases
 - Debug console
 - GDB Server
- GDB
 - Target specific
 - Remote Debugging

Go Build Something

- Pre-made Toolchains:
 - Windows
 - *nix
 - OS X
- Roll your own
 - You can do it, we can help

Thanks and more Questions

Me and the slides: <http://www.darktones.com>

My Employer: <http://www.crystalfontz.com>