Using Run-From-Flash Mode with the Excalibur Bootloader

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Introduction

The Excalibur™ bootloader is one of the system integration tools included with the Quartus® II software. This tool, invoked using the **makeprogfile** utility, creates all the software necessary to boot from flash memory and configure Excalibur devices. The **makeprogfile** utility merges the hardware design, the software design, and the embedded stripe configuration data to create a single bootable image. The Excalibur bootloader can also load memory such as SDRAM or on-chip SRAM with user-application software plus a branch to that section of code. In most cases, this is advantageous because executing code from flash is generally much slower than other types of memory.

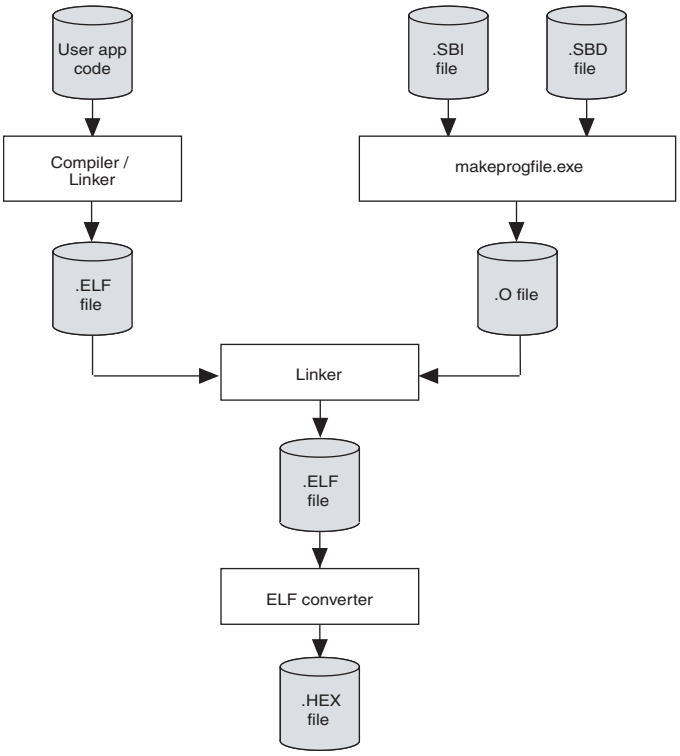
Run-from-Flash Mode

In some circumstances, you might want to run application code from flash memory. For example, where a non-speed-critical system has no SDRAM, or in a system where the application code copies itself to the appropriate destination in memory, and then branches to it. In cases such as these, it is beneficial to use run-from-flash mode.

Procedure

Figure 1 on page 2 shows the procedure for using run-from-flash mode with the Excalibur bootloader.

Figure 1. Using Run-from-Flash Mode with the Excalibur Bootloader



There are three steps involved in running application code from flash memory using the Excalibur bootloader:

1. At the beginning of the application code, define the symbol `___altera_user_start`. This is where the bootloader will branch after it has completed configuring the system.

2. Compile, assemble, and partially link the application software code to create the application .**elf** file.

3. Create the bootloader object file by running the `makeprogfile` utility: specify the project's .**sbd** file and the .**sbi** hardware image.

   It is not necessary to submit an .**sbi** hardware image file to the **makeprogfile** utility. If a .**sbi** file is not specified, the bootloader will not configure the FPGA, although it will set up the embedded stripe configuration registers as specified in the .**sbd** file.

Do not specify a .**hex** file, because the presence of a .**hex** filename instructs **makeprogfile** to generate memory-loading routines that are not required if you want to run the application from flash memory.

4. Link the bootloader object file with the application .**elf** file to create an .**elf** file that comprises both the bootloader and application code.

5. Convert the final .**elf** file to a bootable .**hex** file using a conversion utility such as **fromelf** or **elf-objcopy**. The hex file can be programmed into a flash memory and executed. When the bootloader has finished configuring the system, it branches to `___altera_user_start` and begins to execute the application software code.

Command Sequence Example

The following examples demonstrate how a simple assembly file is integrated using the Excalibur bootloader in run-from-flash mode. The first uses the GNUPro Tools for ARM; the second uses the ARM ADS assembler and linker, but any software development suite that supports the ARM922T™ processor can be used.

Using the GNUPro Tools for ARM

The source code below demonstrates how GNUPro tools are used to integrate a simple assembly file using the Excalibur bootloader in run-from-flash mode.

```
#### - Run C Pre-Processor on Assembly - ####
arm-elf-cpp  my_soft_app.s -o my_soft_app.i

#### - Assemble Source - ####
arm-elf-as --MD my_soft_app.d --gdwarf2 -L -EL -marm920t -o my_soft_app.o my_soft_app.i

#### - Link Source - ####
arm-elf-ld -p -EL -r -o my_soft_app.elf my_soft_app.o

#### - Create Bootloader object file - ####
makeprogfile -b my_bootdata.o my_system.sbd my_system.sbi

#### - Link Source with Bootloader - ####
arm-elf-ld -p -EL -T armelf.x -entry=___altera_entry -o my_bootable_system.elf my_soft_app.elf
my_bootdata.o %QUARTUS_ROOTDIR%\libraries\software\boot\libboot_xa_ads.a

#### - Convert .ELF file to an Intel-format .HEX file - ####
arm-elf-objcopy -O ihex my_bootable_system.elf my_bootable_system.hex
```

Using the ADS Tools

The source code below demonstrates how ADS tools are used to integrate a simple assembly file using the Excalibur bootloader in run-from-flash mode.

```
#### - Assemble Source - ####
armasm -g my_soft_app.s my_soft_app.o

#### - Link Source - ####
armlink my_soft_app.o -partial -o my_soft_app.elf

#### - Create Bootloader object file - ####
makeprogfile -b my_bootdata.o my_system.sbd my_system.sbi

#### - Link Source with Bootloader - ####
armlink my_soft_app.elf my_bootdata.o
%QUARTUS_ROOTDIR%\libraries\software\boot\libboot_xa_ads.a -ro 0 -o my_bootable_system.elf

#### - Convert .ELF file to an Intel-format .HEX file - ####
fromelf -i32 -o my_bootable_system.hex my_bootable_system.elf
```

101 Innovation Drive
San Jose, CA 95134
(408) 544-7000
http://www.altera.com
Applications Hotline:
(800) 800-EPLD
Literature Services:
lit_req@altera.com