Building an Applications Tutorial

September 25, 2007

1 Objective

The goal of this tutorial is to explain how to make an Application that will run on the FPGA's PowerPC. This is a C program which will use the Embedded Development Kit's (EDK) cross-compiler. This assumes you have a base system built and have XPS opened. If you do not, refer back to the Base System Builder Tutorial.

2 Building An Application Tutorial

In XPS on the left side of the program notice there are 3 tabs: *Project, Applications, and IP Catalog*. We will cover the Project Files and the IP Catalog in future tutorials. For now we will focus on Applications. Click the **Appilcations** tab. We are going to create our own application which will be written in C and run on one of the PowerPC 405 processors on the FPGA.

- Double Click **Add Software Application Project...**

- Name the Project (For example HelloWorld)

- Click OK

This creates the Project: HelloWorld under the Appilcations Tab. Expand the Processor and Compiler Options to view all of the options.

- Linker Script: This will be generated by the tools when you build the application; however, it is recommended to verify that the address ranges, heap and stack sizes are all valid.

- Sources: We must add a New File

    Right Click on Sources and Select **Add New File...**

    Create a New Folder (For example hello.c)

    When saving the file it is recommended to create subfolder to hold your source and executable (.elf). Common convention is to name the folder the name of the Application. (For example, I would create a folder called HelloWorld and then save my hello.c and executable.elf inside it).

    If you already have source file(s) then instead of Adding a New File you can simply Add An Existing file.

- By default the Executable and Linkable Format (.elf) is created as *executable.elf* and is located in our Application Project Folder (for example HelloWorld).

Now you can open your source file(s) and write the C program that solves your problem. You can either do this in XPS or you can open your favorite Text-Editor (cough Emacs!) and modify it there. For demonstration purposes we will explain how to use XPS and add a simple program to print "Hello Wolrd" to the Screen.

- Expand Sources and Double Click on hello.c

    This will open an empty file to which we will add our program

- To begin we must include a few headers needed by Xilinx

```
#include ``xparameters.h''
#include ``xutil.h''
#include ``stdio.h''
int main(void) {
   xil_printf(``Hello World'');
   return 0;
}
```

- Save your changes

In order for the PowerPC to run our program by default we must load our program into memory. We do this by:

- Right Click on Project: HelloWorld and Select **Mark to Initailize BRAMs**

- We also need to make sure none of the other Applications are set to **Mark to Initialize BRAMs**. You may see an error if you have multiple Applications marked. The Bootloops, for example, are commonly marked if no Application is included in the Base System Builder. Make sure to unmark them before proceeding.

Finally, we can build (compile) the program (and create the executable.elf) by:

- Right Click on Project: HelloWorld and Select **Build Project**

In the Output Window you should see the compilation output. If you have any syntax errors (like missing ;) it will return print an Error message. Otherwise, if you do not have any errors you will see that HelloWorld/executable.elf was created.

2.1 Adding Additional Applications

It is possible to add more than one appliation to your project following the same steps described above. One important note, when you add a new application, if you want to run the application you must remember to 'uncheck "Mark to Initailize BRAM" for the previous application and "Mark to Initialize BRAM" for the new application. Now you will be able to Initialize the BRAMs and generate the ace file as described in this and the next tutorials.