Downloading to XC3S100E

PURPOSE: This lab will present a brief overview of the XC3S100E FPGA Board (of Digilent) and how to download bitstream (the result of the implementation of a design) files to it.

1. Introduction to the XC3S100E FPGA and BASYS Board

In this lab, you will become familiar with BASYS FPGA Board to which you will download your bitstream created in lab #1. It is recommended that you read the board description manual, which can be downloaded as a pdf file from the course webpage.

The BASYS board provides an ideal circuit design platform for anyone who wants to learn about FPGAs and digital circuit design. It combines the advanced features of Xilinx's Spartan-3E FPGA with straightforward power-supply and I/O circuits, making it ideal for introductory designs ranging from simple logic circuits to complex digital systems.

The four on-board 6-pin connectors can accommodate any of Digilient's low-cost "PMOD" accessory circuits making it easy to add A/D and D/A converters, motors, sensors and a variety of other devices and circuits.

The BASYS board is compatible with all versions of the Xilinx ISE tools, including the free WebPack.

Features:

- 100K-gate Xilinx Spartan 3-E FPGA that features four 18-bit multipliers, 72K bits of fast dual-port block RAM and 500MHz + operation
- JTAG + USB programming port (USB cable included)
- XCF02 Platform Flash ROM that stores FPGA configurations indefinitely
- User-settable oscillator frequency (25,50 and 100MHz), plus socket for a second oscillator
- 8 LEDs, 4 seven-segment displays, four push buttons, 8 slide switches, PS/2 port and a 3-bit VGA port
- Four 6-pin header expansion connectors
- ESD and short circuit protection on all I/O signals.

NOTE: Take a few minutes and read the manual of the X3CS100E FPGA. It can be found as a pdf document on the class webpage.

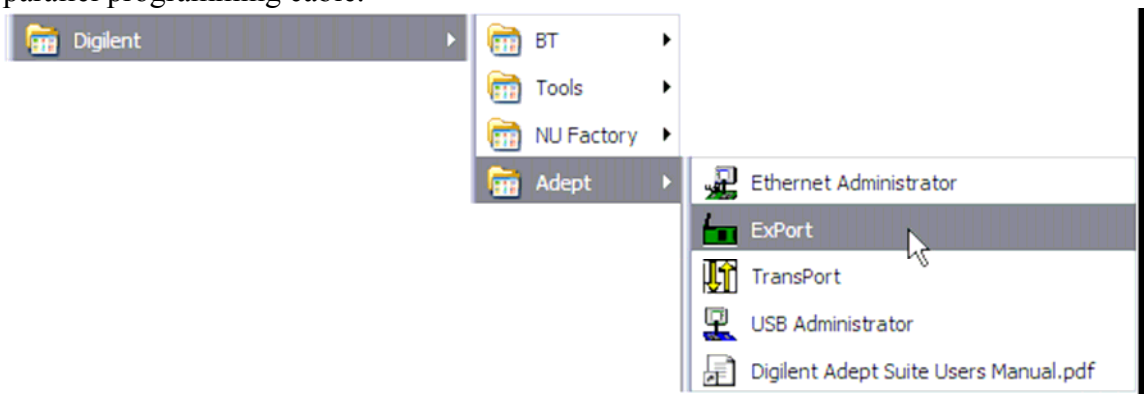
NOTE: The bitstream that you download to the FPGA is volatile, which means that the FPGA is erased every time the power is removed. The BASYS board can be reprogrammed an unlimited number of times. If you need the FPGA board to retain its bitstream even when power is removed, you need to download the bitstream to the Flash and make it "permanent", but you will not be doing this in the lab.

After a bitstream has been downloaded to the BASYS board, you need some way to test the design. You will be using the 8 DIP switches of the BASYS board as inputs a[0-3] and b[0-3] and a pushbutton as input ci for your adder. To better understand the way you will excite the inputs of your adder, use the manual of the BASYS board to see how the outputs of your adder are directed to 5 LEDs of the BASYS board. It is critical that you understand the pin assignments made in the constraint file in Lab #1 and how they work in the board. You will need this to complete Labs 5 and 6.

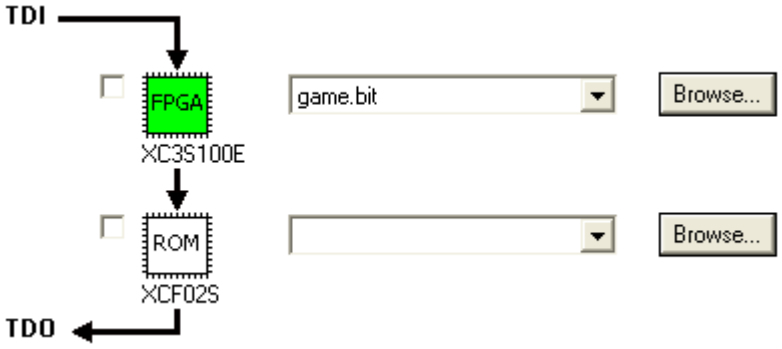
2. Downloading to the BASYS board

When you finish implementing a design, a file with an extension .bit will be created in the project directory. This is the file that will be downloaded to the BASYS board.

Before you download to the BASYS board, you need to make sure that the **board is connected to a USB port of the computer**. Now, open Diglient's Adept from Start -> All programs -> Digilent -> Adept -> Export. (Note that the exact path may be different depending on where the software is installed on the machine). This will be the software that you will be using this course to program the BASYS board. Adept offers a convenient way to program the board without having to use a JTAG3 parallel programming cable.



You now need to follow the following instructions to program the board.
i) Make sure the Auto-detect USB box is checked. To program the device, the scan chain must be initialized. Click on Initialize Chain to do this.
ii) After the scan chain has been initialized, the FPGA can be programmed, erased and verified. To program a device, assign a configuration file to the device in the pull-down box. To add a file, click on "Browse…" and navigate to the desired file.



iii) After the configuration file has been selected, click on "FPGA". It will be highlighted green indicated the device has been selected. Now, right click on it and select "Program Device". **DO NOT** play around with the "ROM". We do not want to mess around with the initial configuration of the device. Do not disturb the board when it is being programmed.
iv) An onscreen message will tell you if programming was successful. An LED near the FPGA reset button on the board will also light up if programming succeeds. If programming is not successful, check if the cables are connected properly and try again.
v) After programming, **DO NOT** remove the USB connector. The board derives its power from the USB port and detaching the cable will wipe out the configuration downloaded to the board.

3. Verifying the design

Once you have loaded the BASYS board with a configuration file using Adept, you can start verifying your adder. Use the assigned DIP switches to excite a and b input vectors and the pushbutton to excite the carry-in of your adder. Watch the corresponding LEDs (i.e., the output y and carry-out of your adder) to see the correctness of your adder. To get credit for the lab, demonstrate the working of the adder to the TA.

Take a few minutes and play with it. Try to understand completely every aspect of this verifying step.

SUMMARY – This lab was about downloading a bitstream to an FPGA mounted on the BASYS board. You should now be familiar with BASYS board and how it works.