

2IN35 – VLSI Programming – Lab Work  
Information & Preparation

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# 1 Introduction

During the lab sessions, you will create, simulate, debug, compile and run a number of hardware designs. Creating, simulating and debugging will be done on your laptop (see section 2), compiling will be done on the ngrid server (see section 3), and running the component will be done on the Digilent Atlys-board (see section 4). The board is available during the lab sessions, but you need to bring your own laptop.

## 2 Laptop

Before you come to the labs, you need to make sure your laptop meets all the hardware requirements and contains all the software listed in this section. If not: let the instructors know as soon as possible.

### 2.1 Operating System

For this course we ask students to work on a Windows 7 operating system as it has better driver supports. Students may choose to work on an alternative operating system but will then receive limited assistance for setup and installation of the tools.

Most of the tools used in the labs for this course are available for Windows XP, Windows Vista, Windows 7 and Linux. Officially, the Linux edition of the Xilinx software is only guaranteed to work on certain versions of Red Hat Enterprise Linux; other distributions or versions may or may not work.

### 2.2 Communication ports

You need two USB ports on your system. One USB port is used for configuring the FPGA via a Xilinx platform cable (integrated on the FPGA board). The second USB port is needed for a USB to serial cable, which will be used to interact with the system. You also need a network connection to use the tools on an *ngrid* server.

### 2.3 Audio ports & headphones

You need an audio-jack output. This can be used either to send audio to the board, or to listen to audio via a headphone.

### 2.4 Storage requirements

Some software for the lab sessions has to be installed on your computer. Other software can optionally be installed or can be run from a remote machine to save some disk space. Depending on which software you install, the storage requirements are between 17 GB and 19 GB.

In addition, some storage for the installation files is required.

## 2.5 Secure shell client

A secure shell (SSH) is used to connect to an ngrid server. For Windows, the SSH client from `ssh.com` can be used, and is already installed if you have a TU/e notebook. Otherwise you can get it from: [http://w3.tue.nl/nl/diensten/dienst\\_ict/services/services\\_wins/campussoftware/ssh\\_secure\\_shell/](http://w3.tue.nl/nl/diensten/dienst_ict/services/services_wins/campussoftware/ssh_secure_shell/). For Linux, the SSH client from <http://www.openssh.com> can be used, which is probably already installed.

## 2.6 Archiver for tar

In order to install the Xilinx tools you will need an archiver that understands the tar format. Due to the size of the download, it has become impossible to use the zip format. Unfortunately WinZip, which comes with TU/e laptops, does not support the tar format.

For Windows, you can download 7zip can be downloaded from <http://www.7-zip.org/>. This archiver will allow you to open and extract the files. Linux system generally comes with tar support as a standard part of the operating system.

## 2.7 Xilinx ISE WebPACK

Xilinx Integrated Software Environment (ISE) 14.7 WebPACK is a free set of tools distributed by Xilinx for their FPGAs. ISE 14.7 WebPACK comes as part of the ISE Design Suite and can be downloaded from the Xilinx website: <http://www.xilinx.com/support/download/index.html/content/xilinx/en/downloadNav/design-tools.html>. During installation we suggest you use the default options. You can select a different installation directory, but make sure the directory name does not contain spaces.

## 2.8 Serial communication program

The system running on the FPGA can communicate with your computer via the serial port of the board. The USB-to-serial cable included with the board is used for this. You will need a communication program to connect to the board via the serial interface. The programs need to support X-modem (a protocol) transfers, and the following communication settings:

- Speed: 203400 baud
- Data: 8 bits
- Parity: None
- Stop bits: 1
- Flow control: None

For Windows XP, the Hyperterminal can be used. When installed, it is found under **Start** → **Programs** → **Accessories** → **Communications**. If it hasn't been installed yet, it can be installed from the control panel under **Add and remove programs** → **Windows setup**.

For Windows 7, teraterm-4.71 (or higher) is needed to perform serial communication. The tool can be downloaded at <http://en.sourceforge.jp/projects/ttssh2/releases/>.

## 2.9 Audio utility

The filters created during the lab will operate on samples of an audio signal. On a computer, samples are usually stored in a *container format* such as `.wav`-files for audio, which also includes meta data. The filters only need the samples, so they will have to be extracted from the container formats. The free Audacity utility version 2.0.5 (or higher) is used for this: <http://audacity.sourceforge.net/download/>.

## 2.10 Matlab

Matlab will be used to design filters and to analyze signals before and after filtering. A download is available for Windows systems only: <http://www.gepwnage.nl/new/?p=linkdump&id=3679> under the section *Software for University use*. We suggest you install the notebook version of the software. If you wish you can also select a custom installation, as long as the "Signal Processing Toolbox" is included.

## 2.11 Board drivers

The drivers for the Xilinx platform USB cable are included with the ISE WebPack. To download the program from your computer to FPGA boards, we also need to install a tool called ADEPT2 (Adept System, version 2.10.2 or higher, 32/64-bit Windows), which is available at <http://www.digilentinc.com/Products/Detail.cfm?Prod=ADEPT2>

## 3 ngrid server

All of the designs for this course require the Xilinx Embedded Development Kit (EDK) to compile, of which there is no free version available to put on your laptop. Therefore, the EDK has been installed on one of the ngrid servers ("ngrid1.win.tue.nl" up to "ngrid16.win.tue.nl"). Whenever you need to compile a design, you need to upload all required files, run some commands, and download the compiled design upon completion. This is done using a secure shell (SSH). The username and password for this server will be handed out to you before the first lab session.

## 4 Digilent Atlys board

During the labs you will work with the Digilent Atlys board to run your hardware designs on, see figure 1. This board contains a Xilinx Spartan-6 LX45 FPGA, 128 MB DDR2 SDRAM, and lots of I/O interfaces: audio, video, keyboard, mouse, serial, usb, ethernet, etc.

The board comes in a box, containing the following additional material:

- A power cable with transformer to power the board.
- A USB to serial cable, which is used to communicate with the designs that run on the FPGA. The serial plug must be connected to the board, while the USB plug must be connected to the computer.

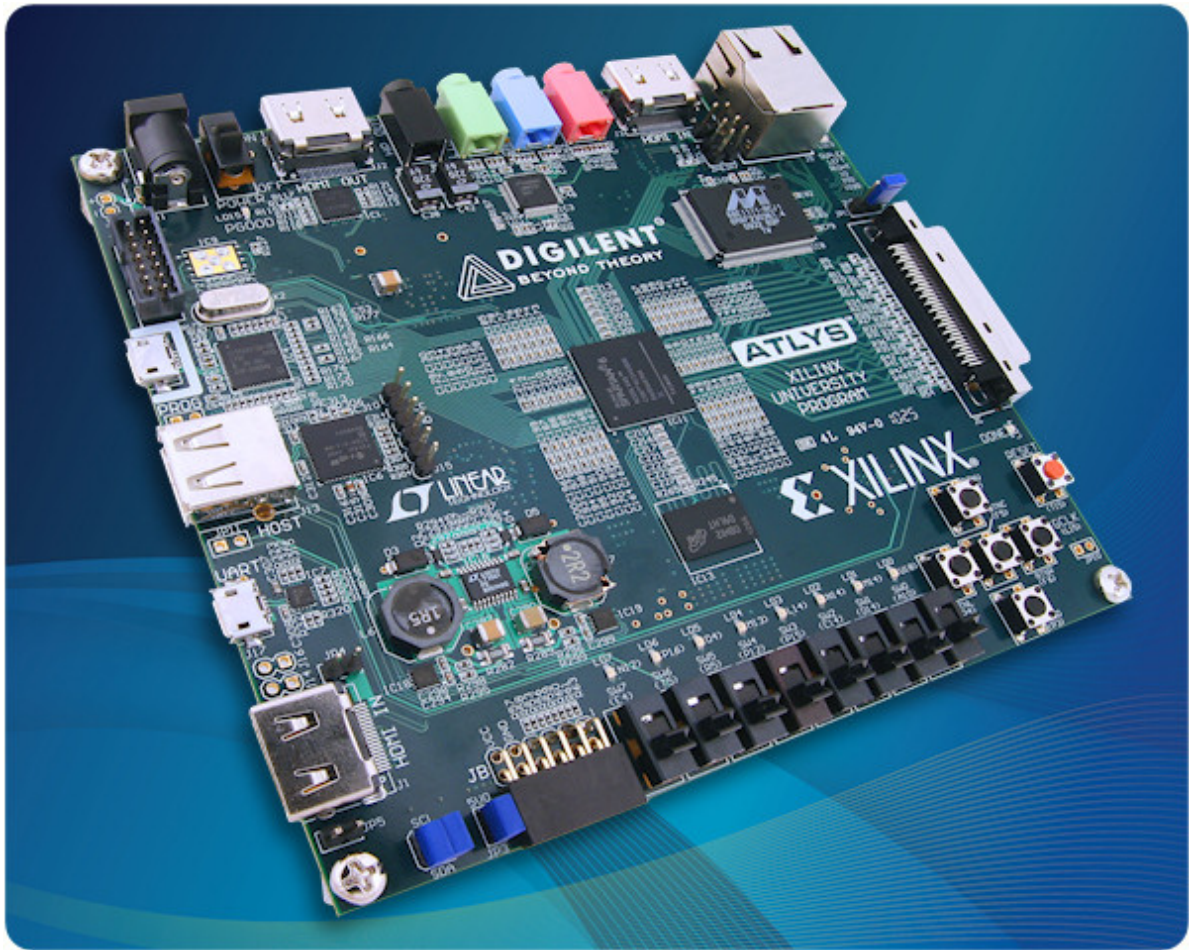


Figure 1: The Digilent Atlys board containing the Xilinx Spartan-6 FPGA

Along with the box, we also provide an extra USB cable to program the Spartan-6 FPGA from a computer.

During the lab sessions you will work in groups of two persons. Each FPGA board has to be shared by 2 groups. The boards will be handed out at the beginning of each lab session. Everything needs to be handed back in at the end of each lab session.

Headphones are not provided with the board; please bring your own.