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Tutorial on Embedded Systems - Module II: Programming C in a Yocto Environment

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VIP Program

Outline

- This module presents the following content:
  - Getting started – materials and software
  - UltraVNC installation
  - Setting up VNC access to the board
  - Compiling a C program in Yocto
  - Installing the PCIe driver
  - Running the C application
  - Uninstalling the PCIe driver
  - Safe shutdown
  - Summary

Objectives

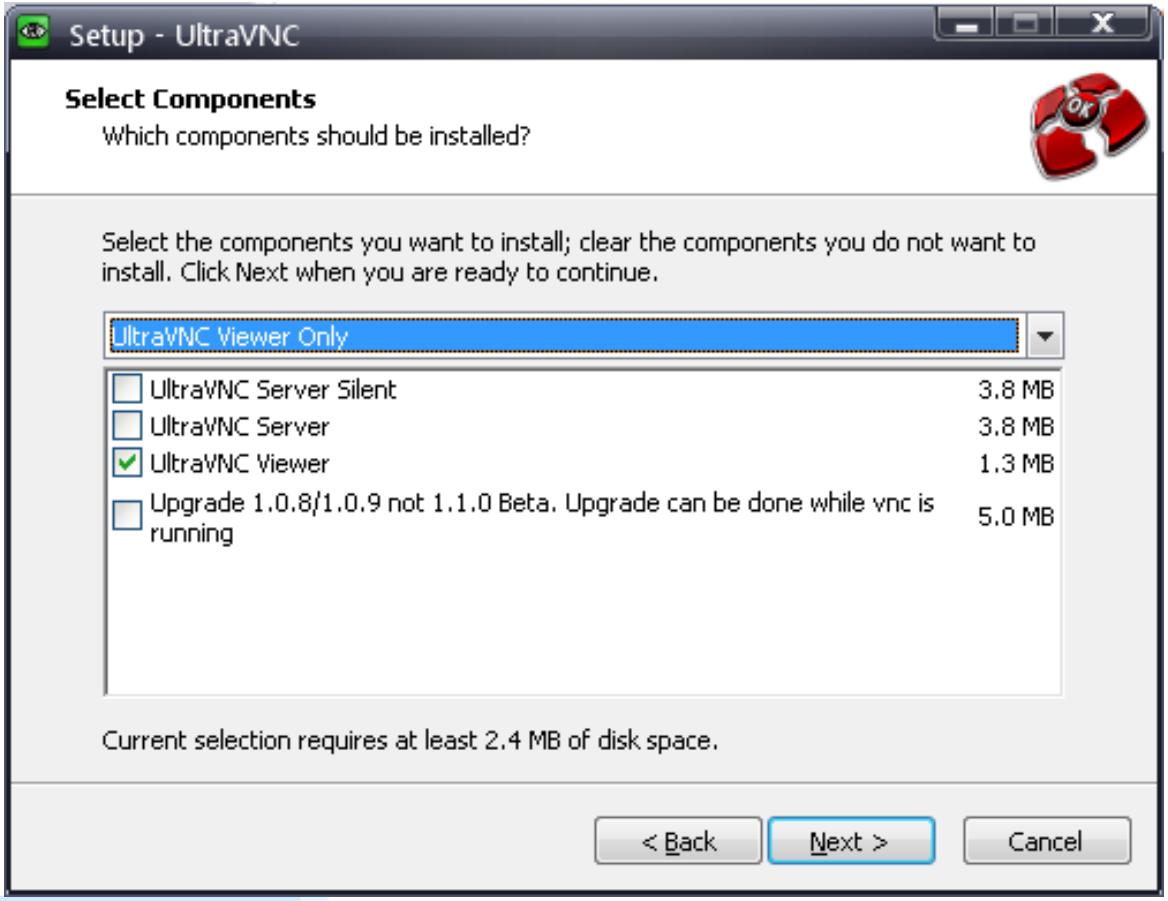
- By the end of this module, you will:
  - have installed a VNC client to access VNC server on the board from your laptop
  - installed a PCIe driver for high-speed communication between the Intel Atom N2600 and the Altera Cyclone IV FPGA
  - compiled and run a C program in a Yocto environment

Getting Started

- List of materials and software:
  - Laptop or desktop running Windows (XP at least)
  - DE2i-150 development board
  - Power adapter and cord
  - Ethernet cable
  - UltraVNC
    - Download from CNET (http://www.downloads.com)

UltraVNC Installation

- Make sure you only install the VNC viewer (also known as VNC client)



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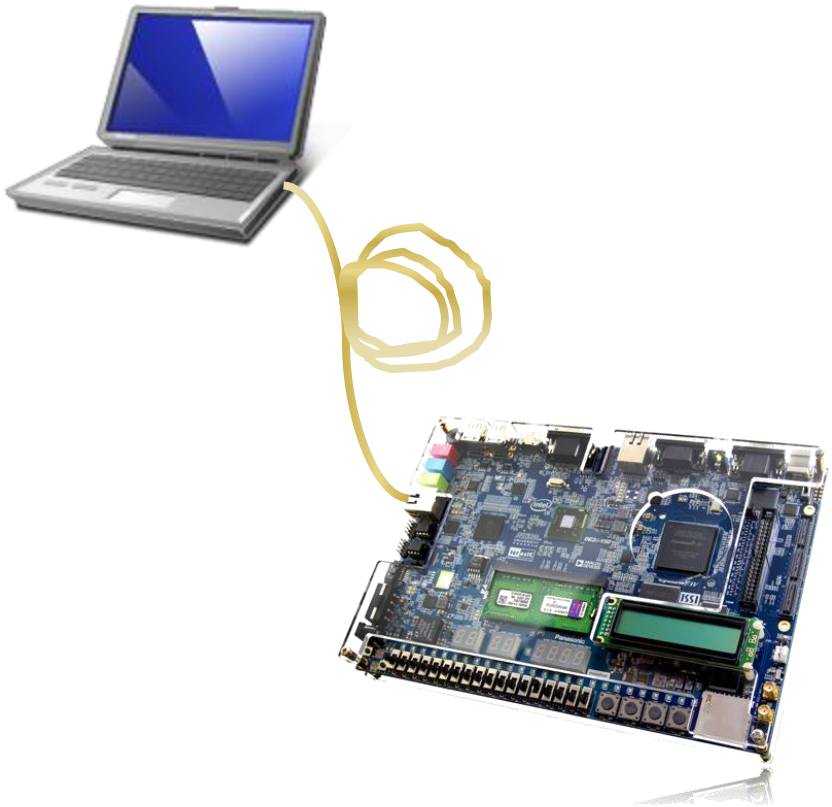
Setting up VNC Access

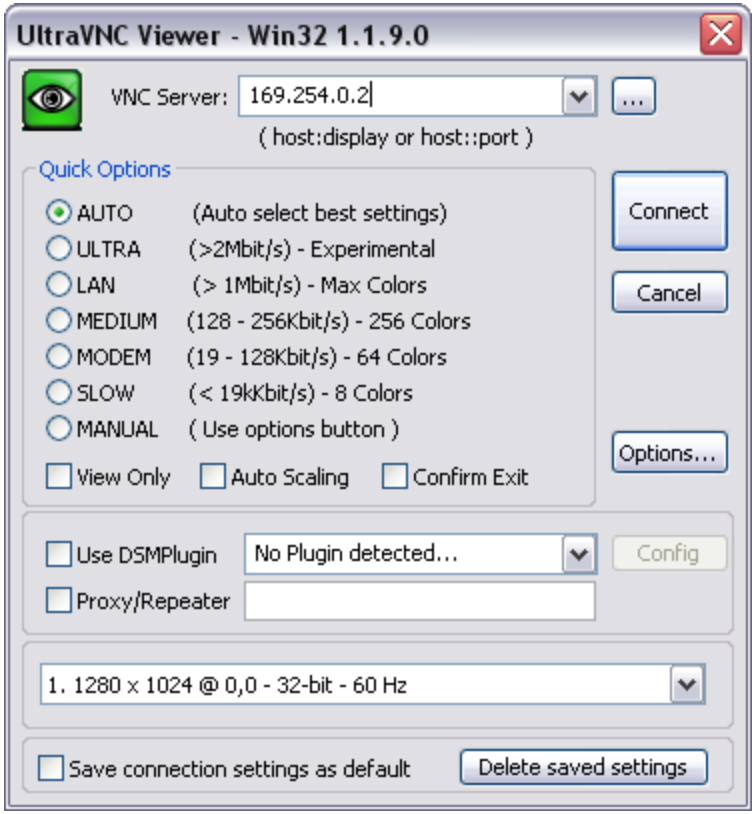
- Connect the ethernet cable between your laptop and the board



- Power up the board
  - Your laptop ethernet network should display “Limited or no connectivity”

Setting up VNC Access

- Connect using UltraVNC
  - Start the UltraVNC on your laptop
  - Set the target VNC server to 169.254.0.2
  - Click on the “Connect” button
  - A window should open showing the Yocto desktop environment



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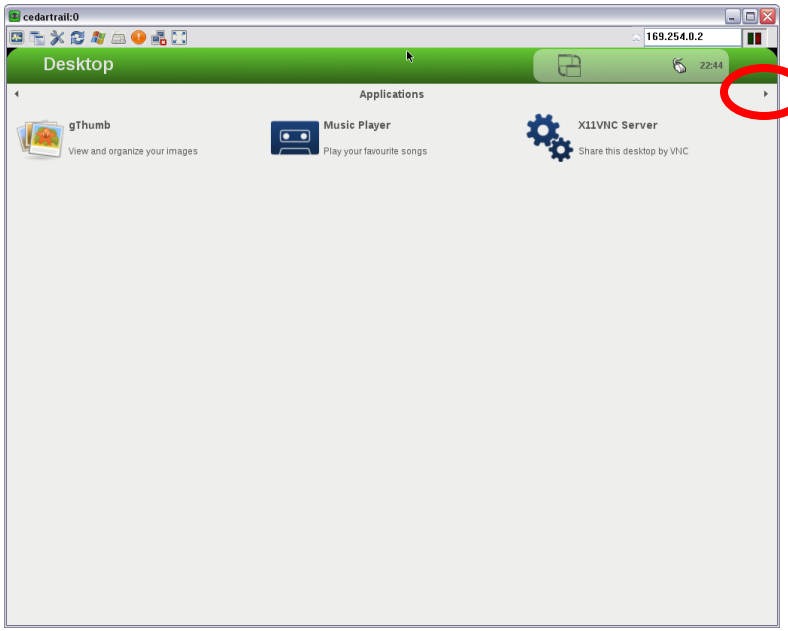
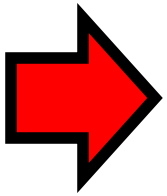
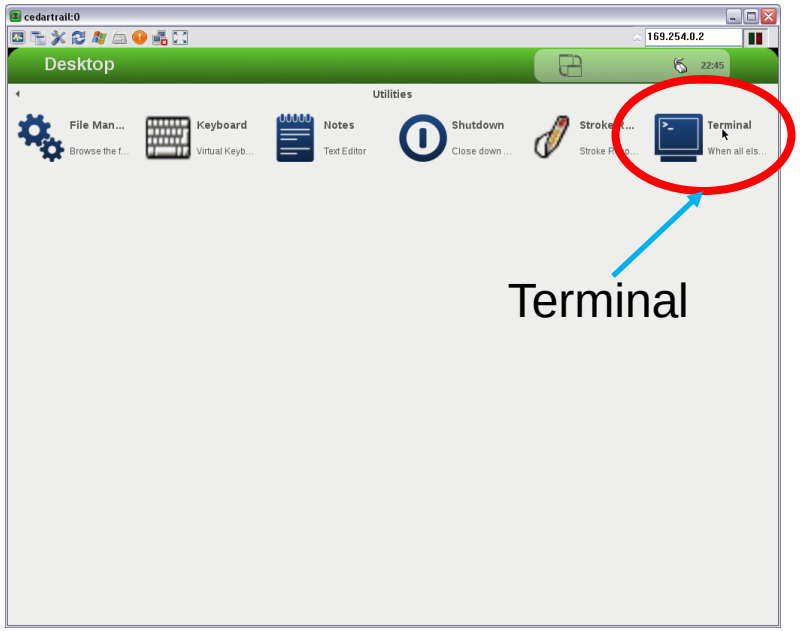
Compiling a C Program

Click for the next screen







Compiling a C Program

- Go to /home/root/Projects/linux_app
  - Type the following on the command line of the Terminal window
    - `cd /home/root/Projects/linux_app`
- Try to compile the app.c program
  - Type the following on the command line
    - `g++ app.c -o app`
    - Errors should appear; notice undefined references (need driver libraries!)
- Compile by executing the Makefile
  - Type the following
    - `make`

Installing the PCIe Driver

- Go to /home/root/BoardSetup/linux/PCIe_DriverInstall
  - Type
    - `cd /home/root/BoardSetup/linux/PCIe_DriverInstall`
- Load the PCIe driver
  - Type
    - `sh ./load_terasic_qsys_pcie_driver.sh`
    - The message “Matching Device Found” should appear
- Verify the driver is loaded
  - Type
    - `lsmod`
    - You should see a list of the kernel modules loaded, including the “terasic_qsys_pcie” driver

Running the C Application

- Go back to the application folder
  - Type
    - `cd /home/root/Projects/linux_app`
- Execute the application compiled
  - Type
    - `./app`
- Explore the various options
  - Interact with the inputs and outputs on the board
    - LED's
    - Buttons
    - Memory
  - If the application does not respond, press `Ctrl-C` and start type `./app` again
- Exit the application
  - Select the option `99` from the menu

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Uninstalling the PCIe Driver

- Unload the terasic_qsys_pcie driver
  - Type
    - `rmmod terasic_qsys_pcie`
- Verify that the driver has been unloaded
  - Type
    - `lsmod`
    - You should not see the terasic_qsys_pcie driver on the list

Safe Shutdown

1) Type exit on the Terminal window

2) Close the UltraVNC window

3) Press and hold the power button until the board shuts down completely

4) Store the parts in the bags and boxes for the next class

Summary

- In this session you have:
  - accessed the Yocto desktop environment on the board from your laptop as a VNC client
  - compiled and run a C program on the DE2i-150 Development Board
  - loaded a PCIe driver for high-speed communication between the Intel Atom processor and the Altera Cyclone IV FPGA
  - interacted with the inputs (buttons) and outputs (LED's) of the board from the Yocto enviroment through a pre-loaded FPGA bitstream