

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

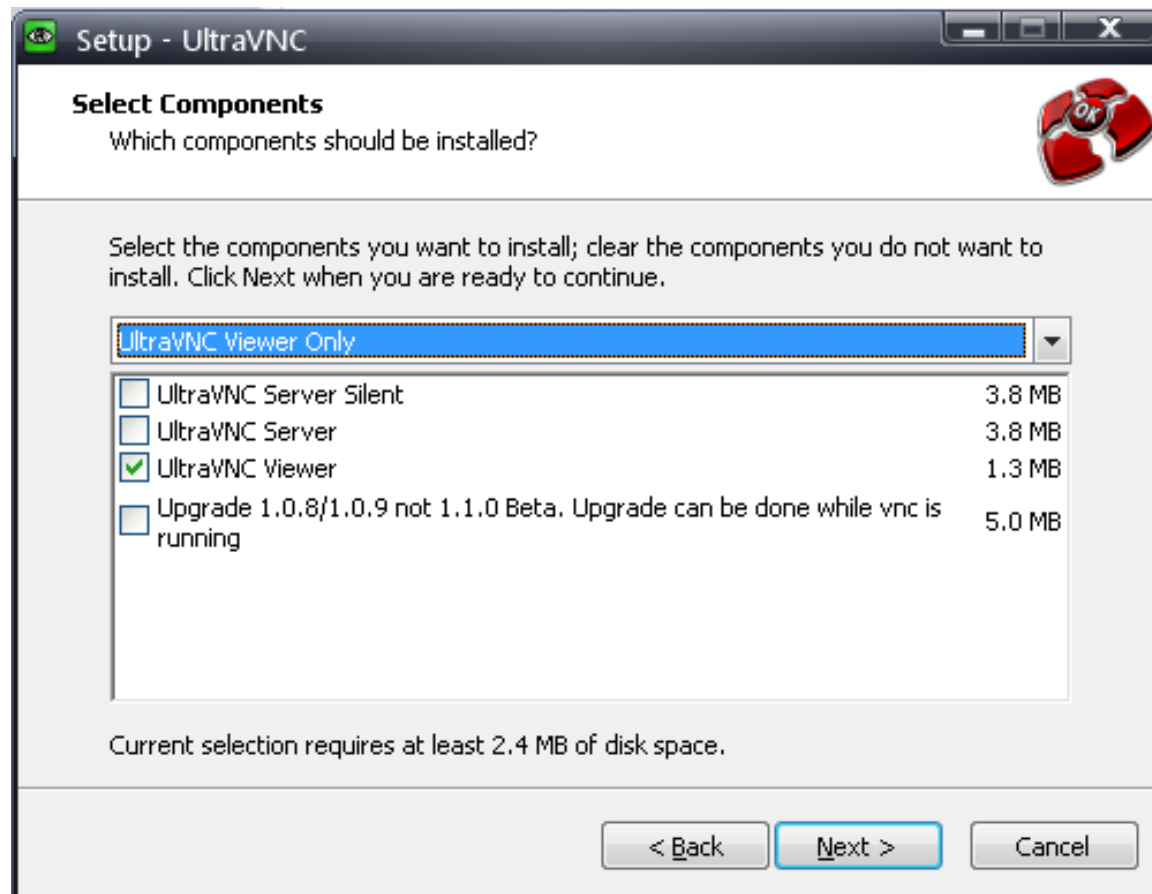


- ▶ List of materials and software:
 - Laptop or desktop running Windows (XP at least)
 - DE2i-150 development board
 - Power adapter and cord
 - Ethernet cable
 - UltraVNC
 - Download from CNET (<http://www.downloads.com>)

UltraVNC Installation



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



Setting up VNC Access



- ▶ Connect the ethernet cable between your laptop and the board

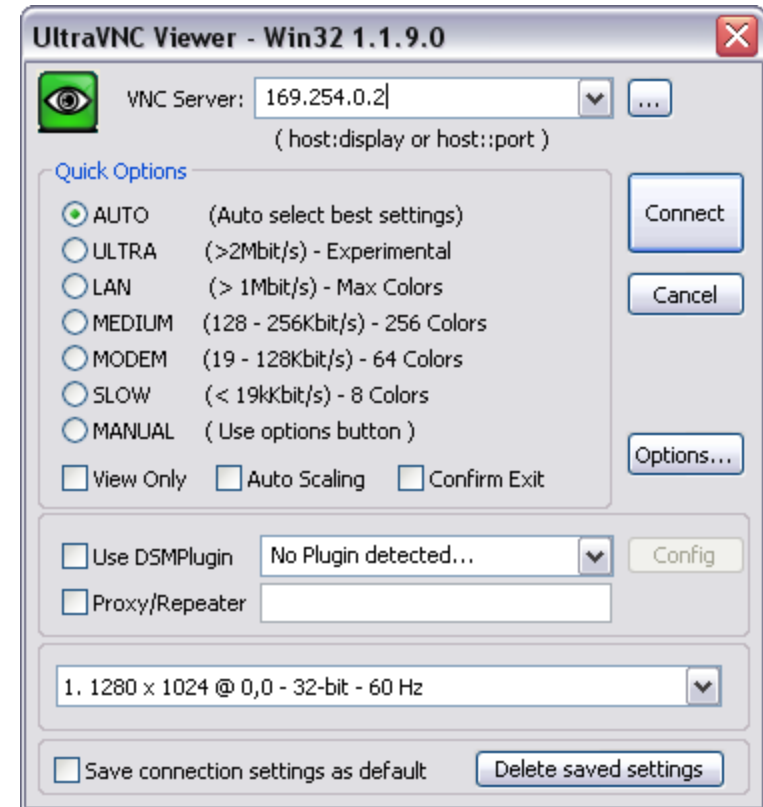


- ▶ Power up the board
 - Your laptop ethernet network should display “Limited or no connectivity”

Setting up VNC Access



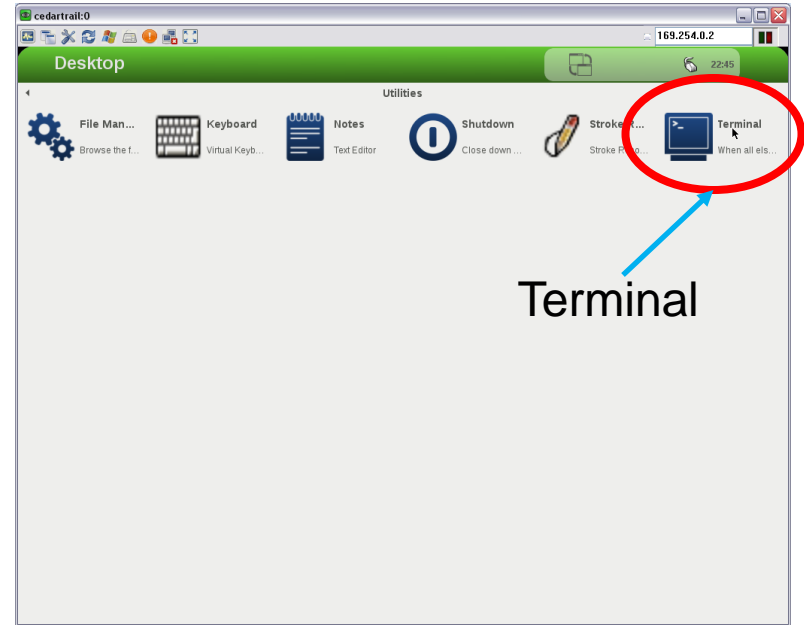
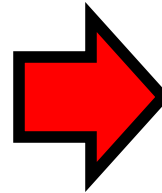
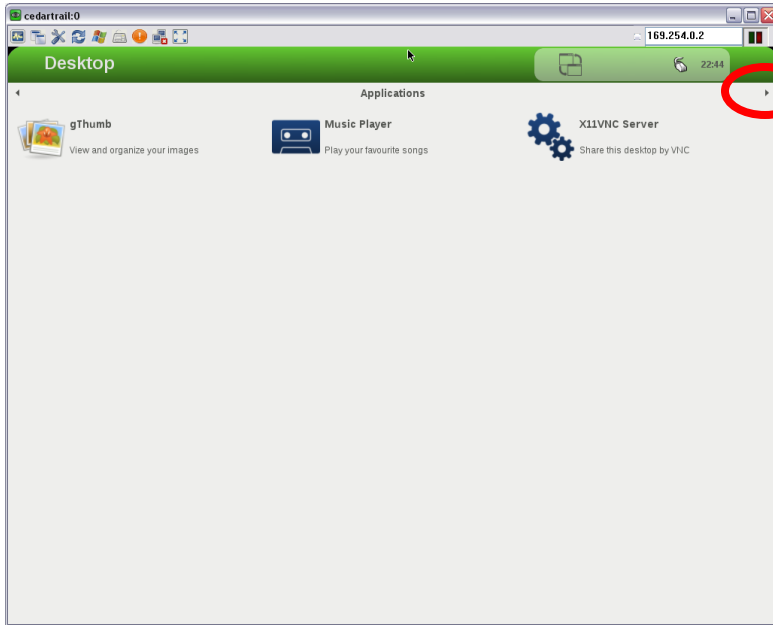
- ▶ Connect using UltraVNC
 - Start the UltraVNC on your laptop
 - Set the target VNC server to 169.254.0.2
 - Click on the “Connect” button
 - A window should open showing the Yocto desktop environment



Compiling a C Program



Click for the next screen



Terminal

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

Uninstalling the PCIe Driver



- ▶ Unload the `terasic_qsys_pcie` driver
 - Type
 - `rmmmod 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 environment through a pre-loaded FPGA bitstream