

HumAnS



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

Greg Drayer VIP Program

Human-Automation Systems Lab School of Electrical and Computer Engineering

#### 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 (<u>http://www.downloads.com</u>)



#### **UltraVNC Installation**



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

| Setup - UltraVNC   |                        |
|--|------------------------|
| Select Components<br>Which components should be installed?   | êr                     |
| Select the components you want to install; clear the components you do install. Click Next when you are ready to continue. | not want to            |
| UltraVNC Viewer Only   | •                      |
| UltraVNC Server Silent   | 3.8 MB                 |
| UltraVNC Server  | 3.8 MB                 |
| UltraVNC Viewer  | 1.3 MB                 |
| Upgrade 1.0.8/1.0.9 not 1.1.0 Beta. Upgrade can be done while vno running  | : <sup>is</sup> 5.0 MB |
| Current selection requires at least 2.4 MB of disk space.  |                        |

Georgialnstitute of Technology

# **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

| UltraVNC Viewer - Win32 1.1.9.0 🛛 🛛 🔀  |
|--|
| VNC Server: 169.254.0.2  (host:display or host::port )   |
| Quick Options       Outron (Auto select best settings)       Connect         ULTRA       (>2Mbit/s) - Experimental       Connect         LAN       (>1Mbit/s) - Max Colors       Cancel         MEDIUM       (128 - 256Kbit/s) - 256 Colors       Cancel         MODEM       (19 - 128Kbit/s) - 64 Colors       Cancel |
| SLOW       (< 19kKbit/s) - 8 Colors  |
| Use DSMPlugin No Plugin detected Config  |
| 1. 1280 × 1024 @ 0,0 - 32-bit - 60 Hz  |
| Save connection settings as default Delete saved settings  |





## **Compiling a C Program**





# **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**



Georgialns of Technol

- 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
    - 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
- 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