# Module A: Build the F1/10 Robotic Car

## Part 2. Software Installation

**References: N/A**

**Websites:**

**http://f1tenth.org; http://www.ubuntu.com;**

**http://www.ros.org; http://www.nvidia.com;**

# Part 2: Software Installation

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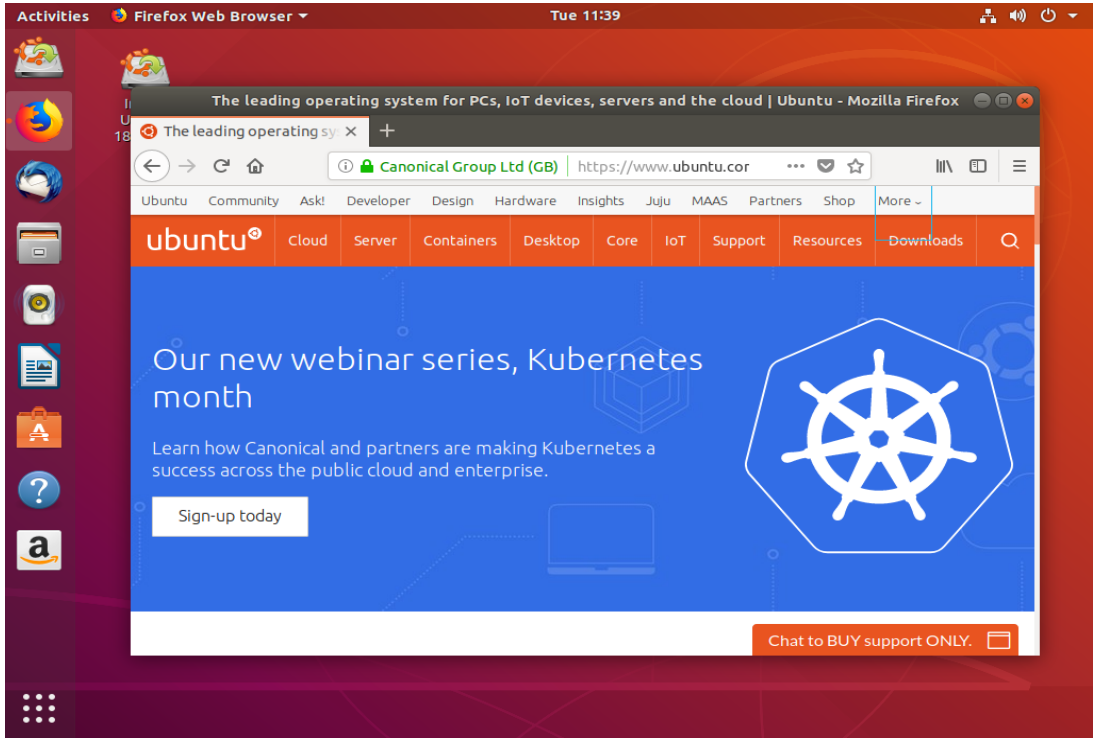
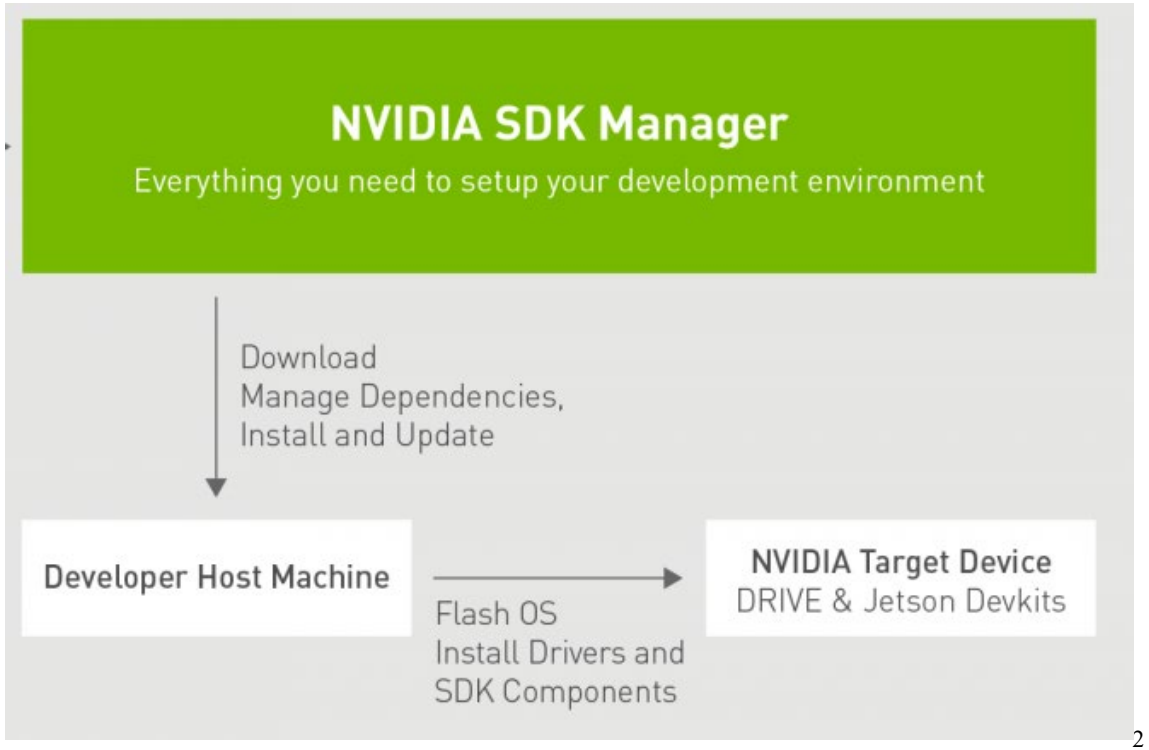
- 2.1 Prepare Ubuntu host computer
  - Install Ubuntu 18.04 on host
  - Install ROS Melodic Morenia on host
  - Install SDK Manager and JetPack on host
- 2.2 Flash Software to Jetson Device
  - Flash JetPack 4.3 and BSP on Jetson with Orbitty Carrier Board
  - Install ROS Melodic Morenia on Jetson Device



# 2.1 Ubuntu on host computer

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- Install Ubuntu 18.04 on the host laptop
  - Need internet connection for this task and it takes quite awhile (30 min+).
  - If you are using your own laptop, download and install Ubuntu 18.04 Desktop here: https://ubuntu.com/desktop

  If running Ubuntu on Windows or MAC, then refer to https://tutorials.ubuntu.com/ for
    - Option 1:Use dual mode reboot – recommended (see slide 4)
    - Option 2: Use a bootable USB – not recommended
    - Option 3: Use Linux Virtual Machine (VM) – on your own
  - If you are using the Dell laptop/desktop provided in the lab, Ubuntu 18.04 shall be installed already. Skip slide 4.
  - Get familiar with Ubuntu 18.04 Desktop:
    - Check Ubuntu version, update software at Software Center
    - Browse internet, Browse file folders, Take a screen shoot;
    - View & Edit a document, Launch a Terminal; Search an app

- Ubuntu versions:
  - 18.04 Bionic Beaver
  - 17.10 Artful Aardvark
  - 16.04 Xenial Xerus
  - 15.10 Wily Werewolf
  - 14.04 Trusty Tahr
- ROS versions
  - V12 Melodic Morenia
    → Ubuntu Bonic and Artful
  - V10 Kinetic Kame
    → Ubuntu Xenial and Wily
  - V8 Indigo Igloo
    → Ubuntu Wily and Trusty

# 2.1. Install Ubuntu from a Bootable USB

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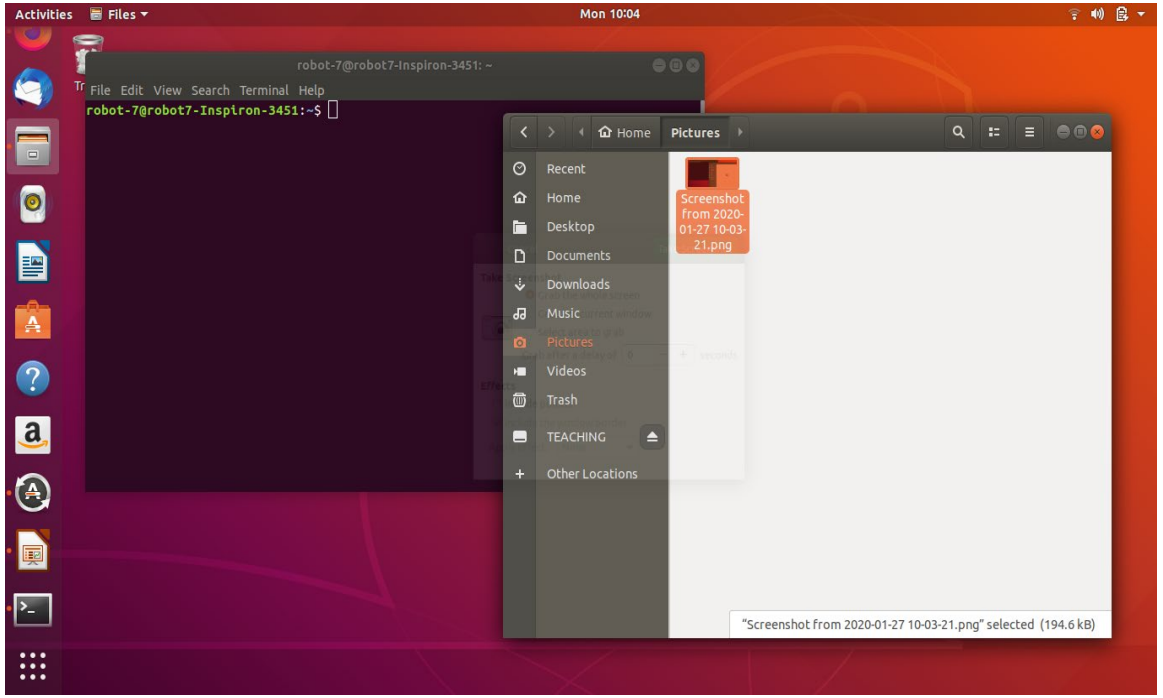
- Create a bootable USB stick (optional)
  - Use a USB stick that is 2 GB or higher (8 GB recommended); -blank, all contents will be removed;
  - Download the Ubuntu 18.04 Desktop image (ubuntu-18.04.3-desktop-amd64.iso) to a host computer or a storage device (e.g. another USB stick)
  - To create a bootable USB stick by a Ubuntu 18.04 computer, follow instructions here: https://tutorials.ubuntu.com/tutorial/tutorial-create-a-usb-stick-on-ubuntu#0
  - To create a bootable USB by a Windows 10 host computer, follow instructions on using Rufus here: https://tutorials.ubuntu.com/tutorial/tutorial-create-a-usb-stick-on-windows#0
    - Tips for windows: need to download and install VC, Rufus, etc. need to restart your computer almost every step along the way. Pretty time-consuming. May not work if some steps were missed.
- Reboot from the USB and install Ubuntu (optional)
  - Insert the bootable USB on the computer;
  - For dell laptops, hold F12 while restarting the computer
  - For other computers, check with the user manual or search online for which key to hold.
  - Follow the instructions to install Ubuntu in single or dual boot mode

# Get Familiar with Ubuntu

- Ubuntu Desktop is pretty similar to Windows
  - Firefox web browser
  - Email
  - File folders
  - Libre Word processors
  - Apps
  - Help
  - Amazon
  - Terminal
  - Search apps




- Linux Command line Tutorials
  - https://tutorials.ubuntu.com/tutorial/command-line-for-beginners#0
  - *William Shotts: the Linux Command Line book: https://sourceforge.net/projects/linuxcommand/*

# 2.1 Install ROS on host computer

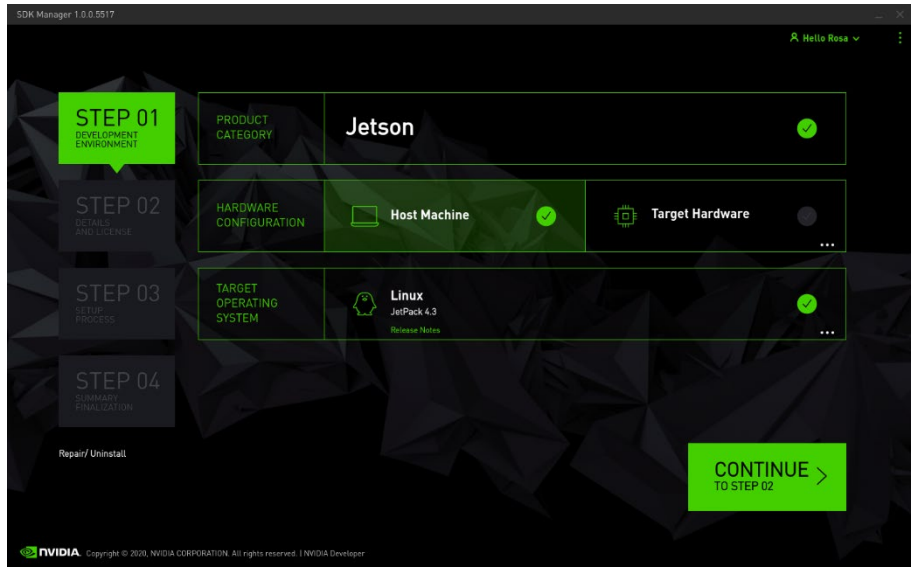
- Go to http://ros.org and click Melodic Morenia Download → Ubuntu
- Follow the instructions at http://wiki.ros.org/melodic/Installation/Ubuntu
  - Go through Steps 1.1 to 1.7. All commands are run in a Terminal.
  - When copy a command from web browser to the terminal, use Ctrl-C for Copy, then middle/right mouse click for Paste.
  - Summary of commands for Steps 1.2 – 1.7:

```
sudo sh -c 'echo "deb http://packages.ros.org/ros/ubuntu $(lsb_release -sc) main" >
    /etc/apt/sources.list.d/ros-latest.list'
sudo apt-key adv --keyserver 'hkp://keyserver.ubuntu.com:80' --recv-key
    C1CF6E31E6BADE8868B172B4F42ED6FBAB17C654
sudo apt update
sudo apt install ros-melodic-desktop-full
sudo rosdep init
rosdep update
echo "source /opt/ros/melodic/setup.bash" >> ~/.bashrc
source ~/.bashrc
sudo apt install python-rosinstall python-rosinstall-generator python-wstool build-essential
```


  - Check out the ROS tutorial at http://wiki.ros.org/ROS/Tutorials

# 2.1 Install SDKM and JetPack on host

- Go to nvidia.com and create a user account for yourself
- Download NVIDIA SDK Manager for "All Jetson Developer Kits" and run SDKM: https://developer.nvidia.com/nvidia-sdk-manager
- On host computer, extract and launch SDK Manager: https://docs.nvidia.com/sdk-manager/install-with-sdkm-jetson/index.html




- Jetson hardware Versions:
  - Jetson Nano
  - Jetson AGX Xavier
  - Jetson TX2 (our version)
  - Jetson TX1 (discontinued)
- JetPack versions

  (L4T = Lunix4Tegra)
  - JetPack 4.3 - OS L4T 32.3.1

  (works w/ Ubuntu Melodic 18.04)
  - JetPack 3.2 - OS L4T 28.3.1

  (Works w/ Ubuntu Xenial 16.04)

  JetPack 2.4 - OS L4T 24.2.3

  (old version OK for TX1)

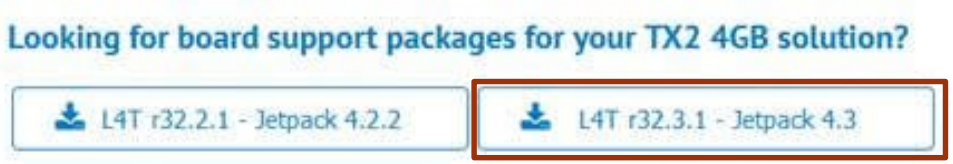
# 2.1 Install Software on host computer

- Install JetPack 4.3 (L4T 32.3.1) on host computer with NVIDIA SDK Manager:

https://docs.nvidia.com/sdk-manager/install-with-sdkm-jetson/index.html

  - Step 1: in Hardware Configuration: choose Host Machine, select Target Hardware → TX2
  - Step 2: If your window does not display all information, press Tab to scroll down, or use a bigger monitor.
  - Step 3: Follow instructions in SDKM, skip the steps of "Flash the TX2";
  - If running into errors, close and relaunch SDKM, then choose repair/uninstall under the STEP 4 button.

- Download and install BST for Orbitty Carrier board on host computer
  - http://connecttech.com/support/resource-center/nvidia-jetson-tx2-tx1-product-support/
  - On "Board Support Packages" tab, under "Looking for board support packages for your TX2 4GB solution?", select the Jetpack 4.3 to download.
  - The file name is CTI-L4T-TX2.32.3.2-V001.tgz.



# 2.2 Install Orbitty BSP on Host

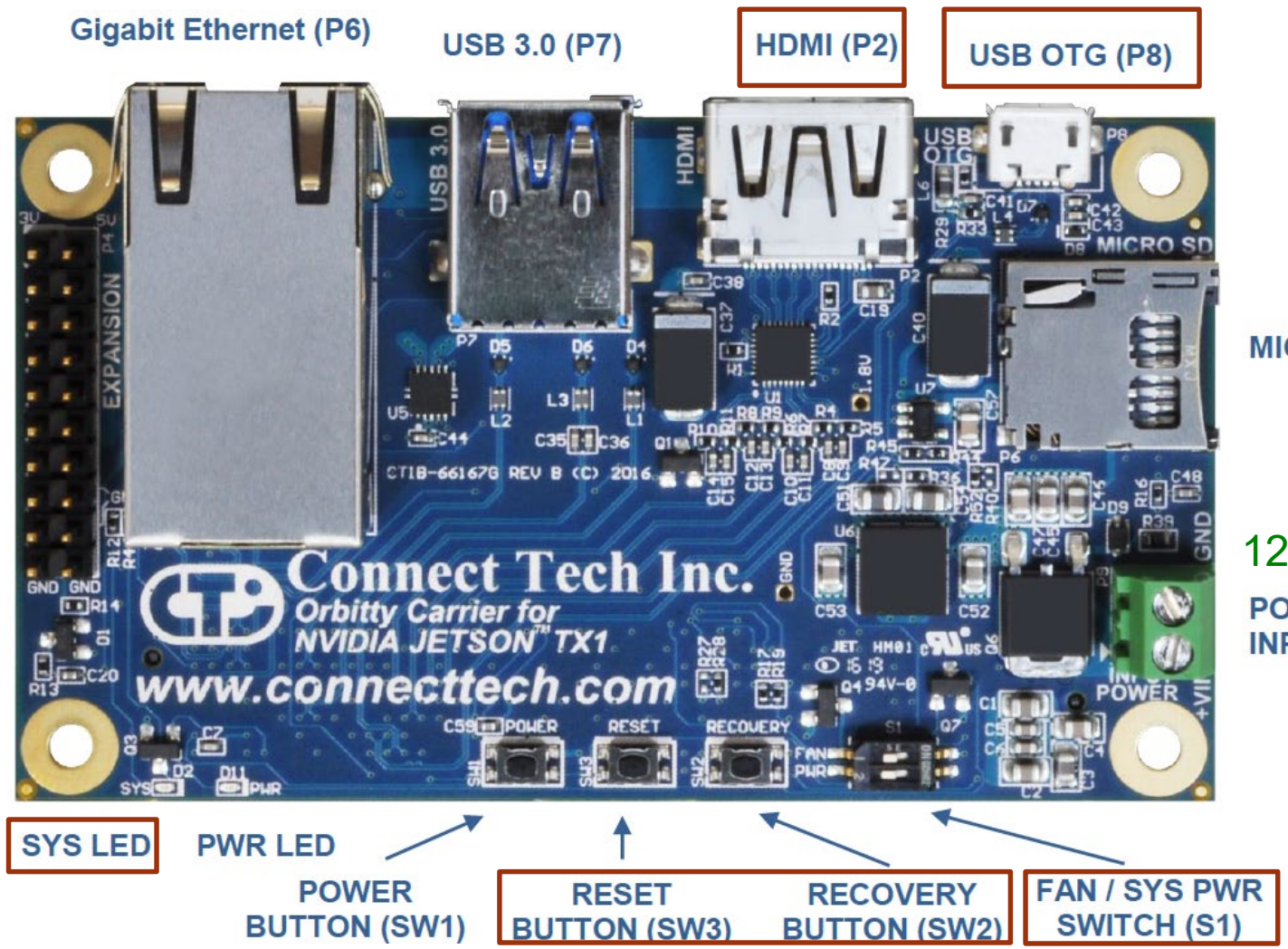
- Follow instructions in readme.txt:
  0. Extract the .tgz file and find readme.txt in the folder; read the instructions and go through steps 1-4.
  1. Make sure the sdk manager is installed under $home/nvidia/nvidia_sdk
  2. Copy the CTI-L4T-TX2-32.3.1-V001.tgz into (create the folder if you don't have it) $home/nvidia/nvidia_sdk/JetPack.3_Linux_GA_P3310/Linux_for_Tegra/
  3. Extract the BSP by double clicking it or by running commands in Terminal under the correct dir:

     tar –xzf CTI-L4T-TX2-32.3.1-V001.tgz

     cd ..
  4. In the Terminal, under $home/nvidia/nvidia_sdk/JetPack.3_Linux_GA_P3310/, run

     sudo ./install.sh
- Make sure you have attached the Jetson module on Orbitty:
  - Detach the Jetson TX2 Module from the Developer kit, then attach the Orbitty carrier board to the Jetson module: http://connecttech.com/flashing-nvidia-jetson-tx2-tx1-module/ watch first 2 minutes

# 2.2 Orbitty Board Settings




- Turn the SYS PWR switch S1 to the left.
- Connect the Orbitty Carrier board with a monitor via HDMI (P2);
- Connect the host computer with Orbitty P8 by a USB-miniUSB cable;
- Connect a USB hub to P7 and connect keyboard and mouse to USB hub (needed after flashing)
- Supply 12V DC to the power block connectors (P9);
- Turn the power on. The monitor shall display some text in a terminal window.

# 2.2 Flash Jetson with Orbitty Carrier

- Put the Orbitty board and Jetson in to RECOVERY mode:
  - Press and hold the RECOVERY key, then press the RESET button, the SYS LED shall be off;
  - Release the RESET button, wait 2 seconds and release the RECOVERY button. The monitor shall display nothing now. The Jetson and Orbitty are in RECOEVERY mode;
- On host computer, manually flash the boards by:

  $sudo ./flash.sh  cti/tx2/orbitty mmcblk0p1

  It takes ~10 min to finish flashing and the host terminal shall display:

  ***The target t186ref has been flashed successfully.***

  Reset the board to boot from internal eMMC.

  Note: CTI assisted flash does not work. (i.e.  $sudo ./cti-flash.sh  (error message "flash.sh requires root privilege" if no sudo), then choose 3 (Orbitty) in Menu 1 and  1 or 3 in Menu 2.  error message saying "failed flashing t186ref"
- Turn the SYS PWR switch (S1) to the right. Press the PWR button on Orbitty. The monitor on Orbitty shall display CTI-L4T welcome screen.

# 2.2 Working on Jetson TX2

- Follow instructions on screen to finish setting up CTI-L4T on Jetson. Need keyboard and mouse now.
  - When asked to join the wifi network, Team 0-4 join JadeOak, Team 5-9 join MegantaRabit.
  - When asked your name: enter Jetson-# where # is your team number. Choose your password.
  - When the set up is finished, the screen shall display login screen.
  - Log in with your username (Jetson-#) and go to the Ubuntu/nvidia desktop.
- Install ROS Melodic Morenia on Jetson following the same procedure as on Slide 6;
  - If you are tired of entering all those commands again, then download the installation script installROS.sh here (https://github.com/jetsonhacks/installROSTX2 ) and adapt it for the new ROS version. Similarly, you may modify setupCatkinWorkspace.sh for the new Ubuntu+ROS versions.
- Safely turn off the Jetson: while logged in on the Device under desktop:
  - Option 1: Go to settings icon on top right corner, and select shutdown (also valid when logged out);
  - Option 2: In a terminal, run this command: sudo shutdown -h now

# 2.3 Setting Up Wireless Link

- If host computer has WiFi capability, then there are two ways to set up wireless connection between Jetson on the car and your host computer:
  - Option 1: both connect to a wireless router which reserves a static IP address for Jetson;
  - Option 2: Set up Jetson as wireless host spot, and host computer connect to Jetson;
- If host computer has no WiFi capability, then connect host computer to a WiFi router via Ethernet cable, connect Jetson on the car to the same router via WiFi.

- Linksys E1200 WiFi Router


Linksys EA7300 WiFi router

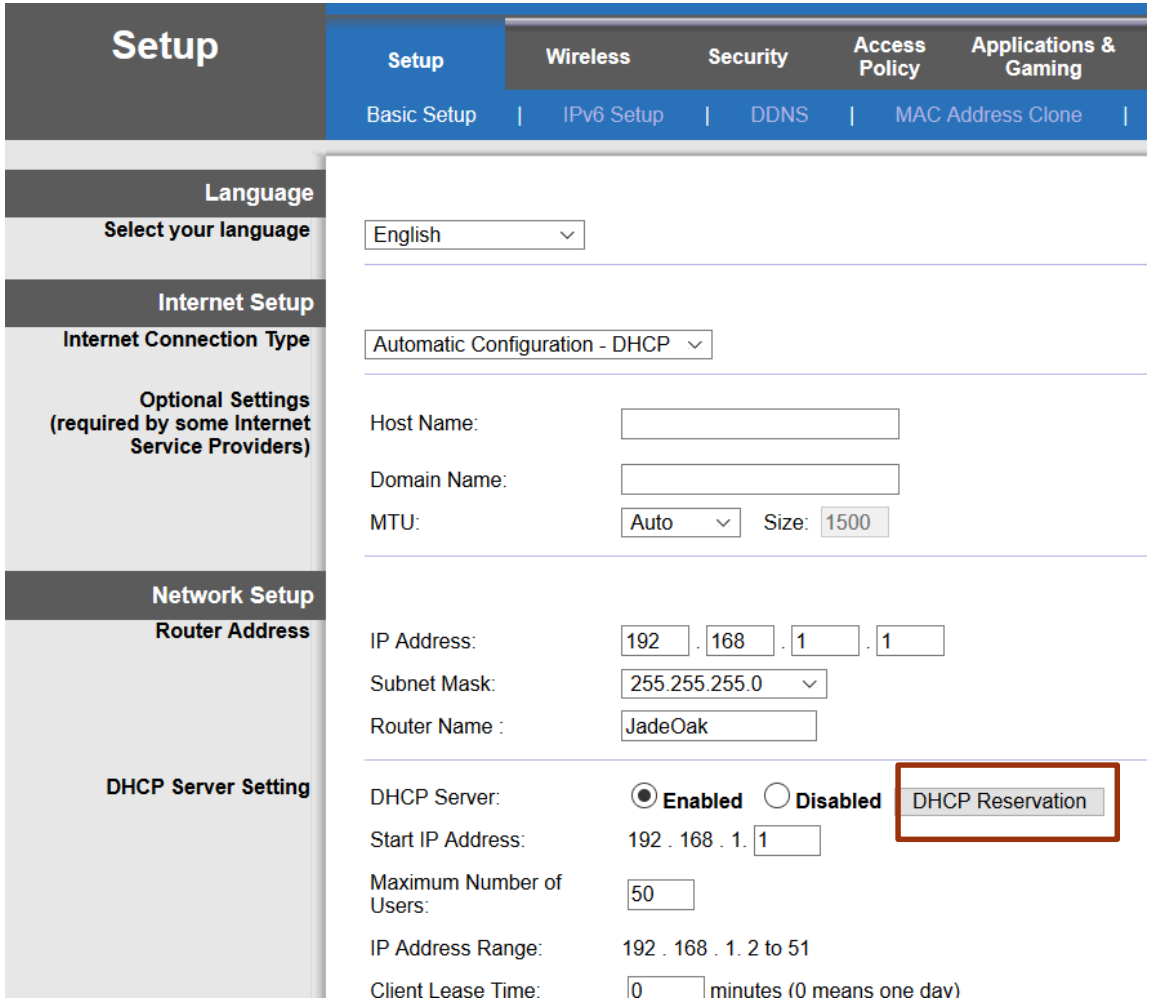
# 2.3 Setting Up WiFi on Jetson

- Connect Jetson to WiFi with reserved static IP address:
  - Click on wireless icon on top-right corner of Ubuntu Desktop, connect to the allocated WiFi network, then go to Edit Connection;
  - In Network Connections, double click the network name (JadeOak), a new window opens as "Editing JadeOak". Go to "IPv4 Settings", under "Additional static address", click "Add".
  - Type in the reserved IP address for your team. For example, 192.168.1.105 for Team 5. Enter Netmask 255.255.255.0, Gateway: 192.168.1.1; Additional DNS servers: 192.168.1.1.
  - Save, then go to a website on a browser to verify that the WiFi network is connected.
- Host computer: repeat the same process with IP address = 192.168.1.20# for Team #
- Host computers remotely access (SSH) Jetson: In a terminal on host computer, run $ssh jetson-5@192.168.1.105 (replace 5 by your team number) then $lsusb or $ip a
- (Option 2) Set up hotspot on Jetson: refer to http://f1tenth.org/build.html#settingupwirelesshotspotonjetson

# 2.3 Setting Up Wireless Router (TA)

- refer to documentation on the CD or https://www.linksys.com/us/p/P-E1200/ :

1. Connect the N300 router yellow internet port to an Ethernet jack on the wall, plug an Ethernet (blue) port to a Windows or MAC computer that has a CD/DVD drive, then plug in power for the router;
2. Run Setup.exe on the CD; follow instructions on screen to finish setup. Select network names (JadeOak or MegantaRabbit) and passwords (Endura512, GetLost2020);
3. Go to a web browser and enter 192.168.1.1 to run the Cisco Connect Utility. This can be done on any computer and without the CD drive. Login with Router name and password. In Setup tab, locate DHCP Server Setting section: click DHCP Reservation.



# 2.3 Setting Up Wireless Router (TA)

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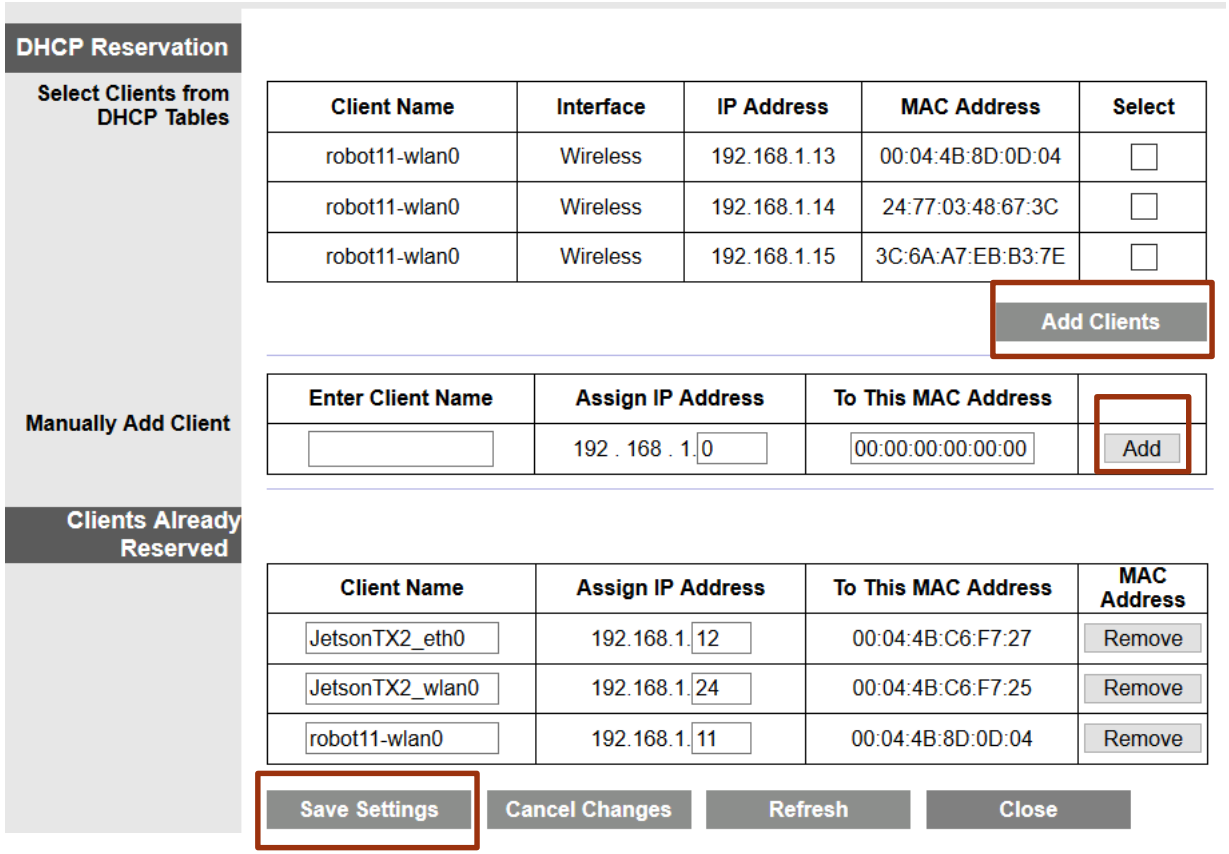
- Reserve IP address for Jetson Modules

4. In the new DHCP Reservation window, "Select DHCP Clients from DHCP Tables" may display some devices name, interface, IP address, MAC address; Locate the MAC addresses on the Jetson Developer kit and find the matching ones. The last one of the three is the 2.4 GHz wlan MAC address. Select them and click Add Clients;
5. In the "Clients Already Reserved" section, change the client name to Jetson#-wlan0, under the "Assign IP Address" column, enter the #+100 to the last part of the IP address, then click Save Settings;




6. Ask all Jetson modules to connect to the WiFi router, then repeat step 4-5. Alternatively, add client manually by typing in the MAC addresses shown on their Jetson Developer kit or found on the Jetson terminal by typing $ip a.