Usage Guide for AIMS CDT Clearpath Jackals

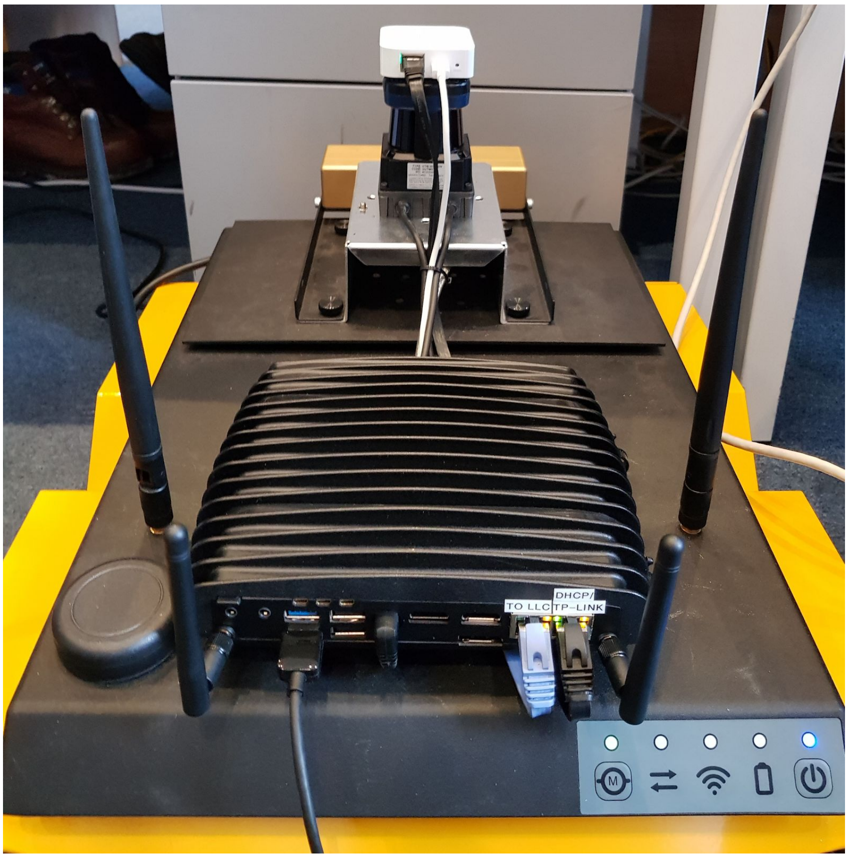
Each team will have access to a Clearpath Jackal and at least one laptop running Ubuntu 18.04 and ROS melodic.

Hardware

Each Jackal is numbered in the range 101-105. Make sure you know your number since it will be used in many of the things you do in later steps.

Robot Startup

When you are ready to use the robot press the power button. This is the button with the standard power symbol at the right of the dashboard on the back of the robot. Powering on the robot also powers on the wifi router, network switch, MVC, LLC, and sensors.



Robot Shutdown

Before powering off the robot you must cleanly shut down the MVC. Do this by sshing on to the MVC (see below) and running `sudo halt`.

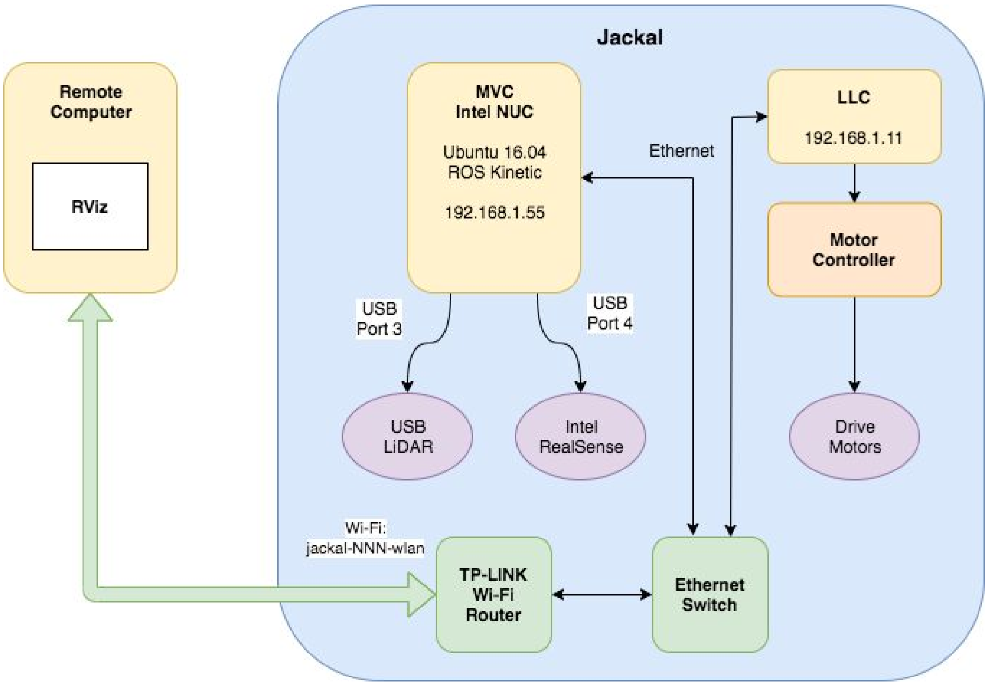
Shore Power for the Robot

If the robot is stationary, you can connect it to “shore power” (i.e. the wall) so that the battery does not

Compute and Remote Access (LLC, MVC)

The Jackal contains to computers. These are the **LLC** (low level controller) and the **MVC** (schMomething vehicle computer?). The names are a legacy from ORI’s autonomous vehicle days. The LLC is supplied by Clearpath as part of the Jackal and provides access to the firmware of the Jackal base. In practice this means it exposes the low level motor controls, joypad control, battery monitoring, and other diagnostics. The LLC should not be used for any other purpose since it is a safety-critical system. The MVC hosts the laser and camera and is also available for additional onboard compute.

The MVC and LLC are connected via ethernet. This wired network is exposed to remote access via the TP-Link wifi router mounted on the robot.



Remote Access to LLC and MVC

To access the onboard computers, you must first connect to the wifi router on the robot: **Jackal-NNN-wlan** (where NNN is the number of your robot). The password should already be set on your robot. If you need it (e.g. to connect additional laptops), ask one of the ORI helpers. Once on the wifi network, you can add the following lines to `/etc/hosts` to have memorable names for the onboard computers. They may already be set for your provided laptop.

```
192.168.1.55    ori-mvc-nuc-MMM      jackal-NNN-mvc
192.168.1.11    cpr-jackal-NNN-llc  jackal-NNN-llc
```

With this in place you can communicate with the LLC and MVC if needed, .e.g. The following should work from your laptop (with appropriate NNN substitution).

```
ping 192.168.1.11
ping jackal-NNN-llc
ping 192.168.1.55
ping jackal-NNN-mvc
```

SSH Access

The user account for the MVC is ori. The user account for the LLC is administrator. Armed with the correct password (ask ORI folks) the following should work from the control laptop:

```
ssh ori@jackal-NNN-mvc
ssh administrator@jackal-NNN-llc
```

Highly recommended: use `ssh-copy-id` to copy your laptop's public ssh key to the MVC and LLC to avoid needing passwords in the future.

Getting Code on the MVC

Since the MVC is not connected to the Internet you cannot use git to pull code on to it from an external source such as Github. Instead you should get the code on to your laptop then switch to the Jackal network and use tools like scp, rsync, sshfs to copy code across. Some pointers:

rsync (keep two file trees in sync), e.g.:

```
rsync -avP ~/jackals_ws/src/ori_jackals
ori@jackal-NNN-mvc:/home/ori/jackals_ws/src/
```

sshfs (mount a remote filesystems via sftp) - https://help.ubuntu.com/community/SSHFS

scp (copy files to a remote filesystem)

```
scp -r ~/jackals_ws/src/ori_jackals
ori@jackal-NNN-mvc:/home/ori/jackals_ws/src/
```

ROS Network Configuration

When the LLC starts it runs a ROS master which serves as the ROS master for your Jackal system. To work in this ROS system from a remote laptop you need to set the following environment variables:

```
jackal_rosmaster(){
    export ROS_MASTER_URI=http://192.168.1.11:11311
    export ROS_IP=192.168.1.XXX
}
```

The above is actually a bash function that can be pasted into your `.bashrc`. You can then run `jackal_rosmaster` on the command line to allow the current terminal to access the remote ROS system. The `XXX` above should be replaced with the numbers from your IP address (found via `ifconfig`). The provided laptops should already have these configured. Note that your IP address may change between reboots, so this is something to check if you have connectivity problems.

For more information see https://wiki.ros.org/ROS/NetworkSetup

ROS - Launching Sensors

To run the laser or camera sensors from the MVC, ssh to the MVC (`ssh ori@jackal-NNN-mvc`) and do one of the following:

Hokuyo lidar only: `lidar.launch`
Default topic name: `/front/scan`

```
roslaunch ori_jackals lidar.launch
```

Override topic name to: `/front/horizontal/scan`

```
roslaunch ori_jackals lidar.launch
scan_topic:=front/horizontal/scan
```

Intel RealSense camera only: `camera.launch`

```
roslaunch ori_jackals camera.launch
```

Camera and Lidar: `sensors.launch`

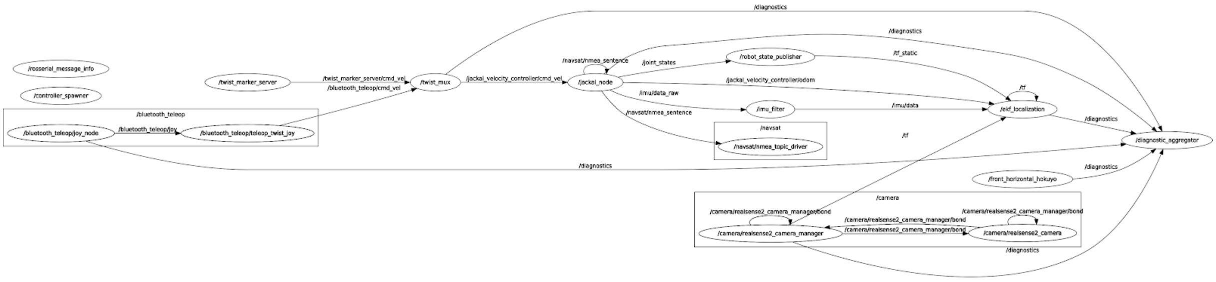
Default lidar topic name: `/front/scan`

```
roslaunch ori_jackals sensors.launch
```

Override lidar topic name to: `/front/horizontal/scan`

```
roslaunch ori_jackals sensors.launch
scan_topic:=front/horizontal/scan
```

If you have launched all the sensors, then `rqt_graph` should show the following:


/rosserial_message_info
/controller_spawner
/bluetooth_teleop
/bluetooth_teleop/joy_node
/bluetooth_teleop/joy
/bluetooth_teleop/teleop_twist_joy
/twist_marker_server
/twist_marker_server/cmd_vel
/bluetooth_teleop/cmd_vel
/twist_mux
/jackal_velocity_controller/cmd_vel
/jackal_node
/navsat/nmea_sentence
/joint_states
/robot_state_publisher
/tf_static
/jackal_velocity_controller/odom
/imu/data_raw
/imu_filter
/imu/data
/navsat/nmea_sentence
/navsat
/navsat/nmea_topic_driver
/tf
/ekf_localization
/tf
/diagnostics
/diagnostics
/diagnostics
/diagnostics
/diagnostic_aggregator
/diagnostics
/front_horizontal_hokuyo
/camera
/camera/realsense2_camera_manager/bond
/camera/realsense2_camera_manager
/camera/realsense2_camera_manager/bond
/camera/realsense2_camera_manager/bond
/camera/realsense2_camera_manager/bond
/camera/realsense2_camera
/diagnostics

You should also be able to view the TF tree for the robot in RViz: