



# **TIAGo Training Sessions**

## **Mobile base control and navigation**

# Introduction



# Moving the base



Take the priority with the joystick



Move the base forward and backward



Turn left and right



Increase linear speed



Decrease linear speed



Increase angular speed



Decrease angular speed

# Drive wheels control

- The lowest level control of the drive wheels is provided by the following topic:

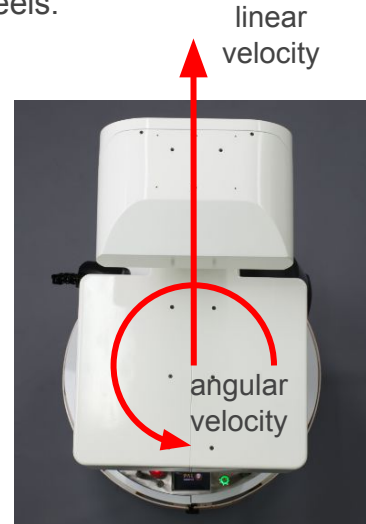
`/mobile_base_controller/cmd_vel`

which is of type [geometry\\_msgs/Twist](#), and contains the following fields:

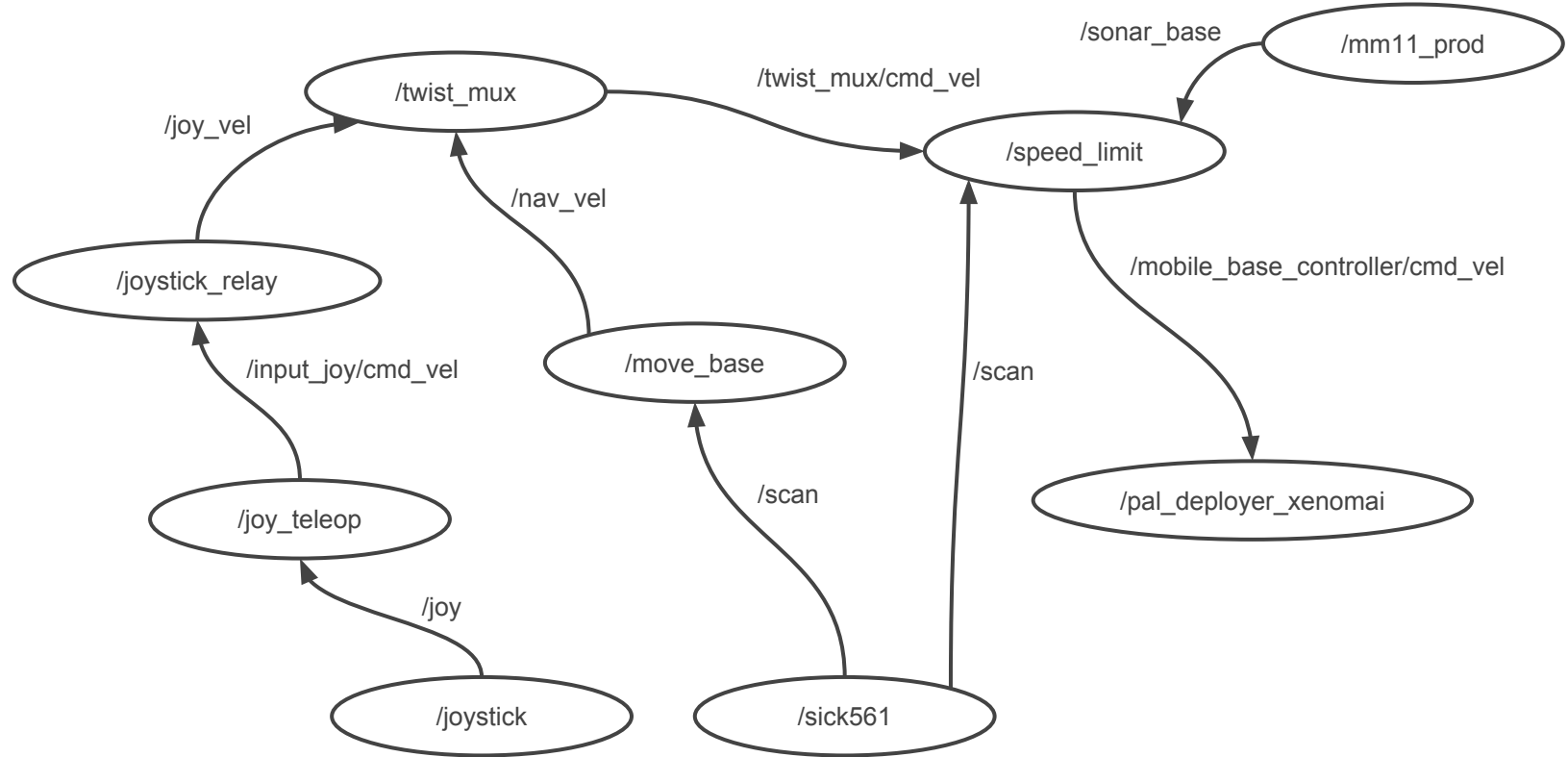
`Vector3` linear

`Vector3` angular

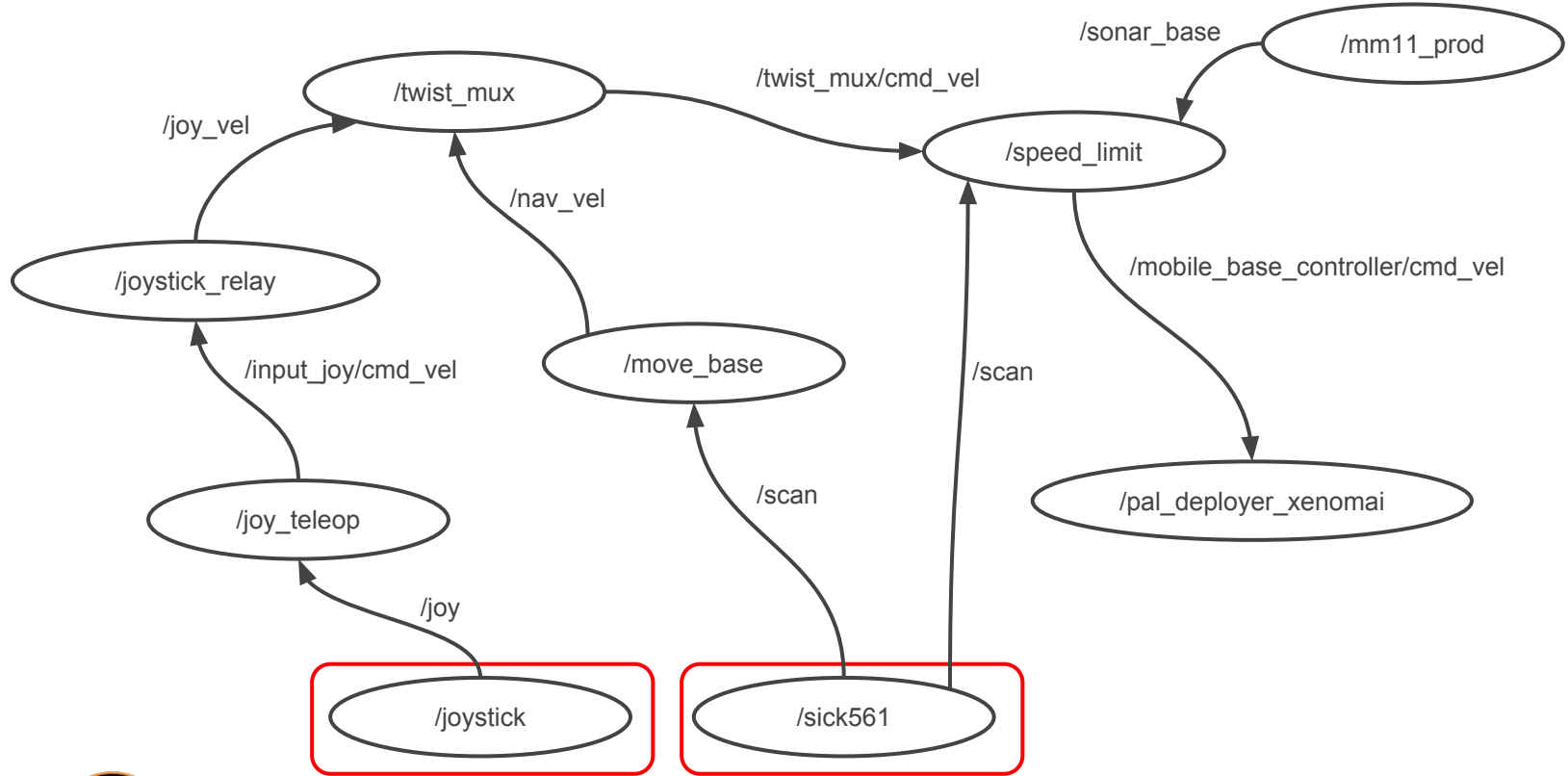
These are the desired linear and angular velocities for the mobile base, which are internally translated to the required angular velocities of each one of the two drive wheels.



# Wheels command diagram (I)



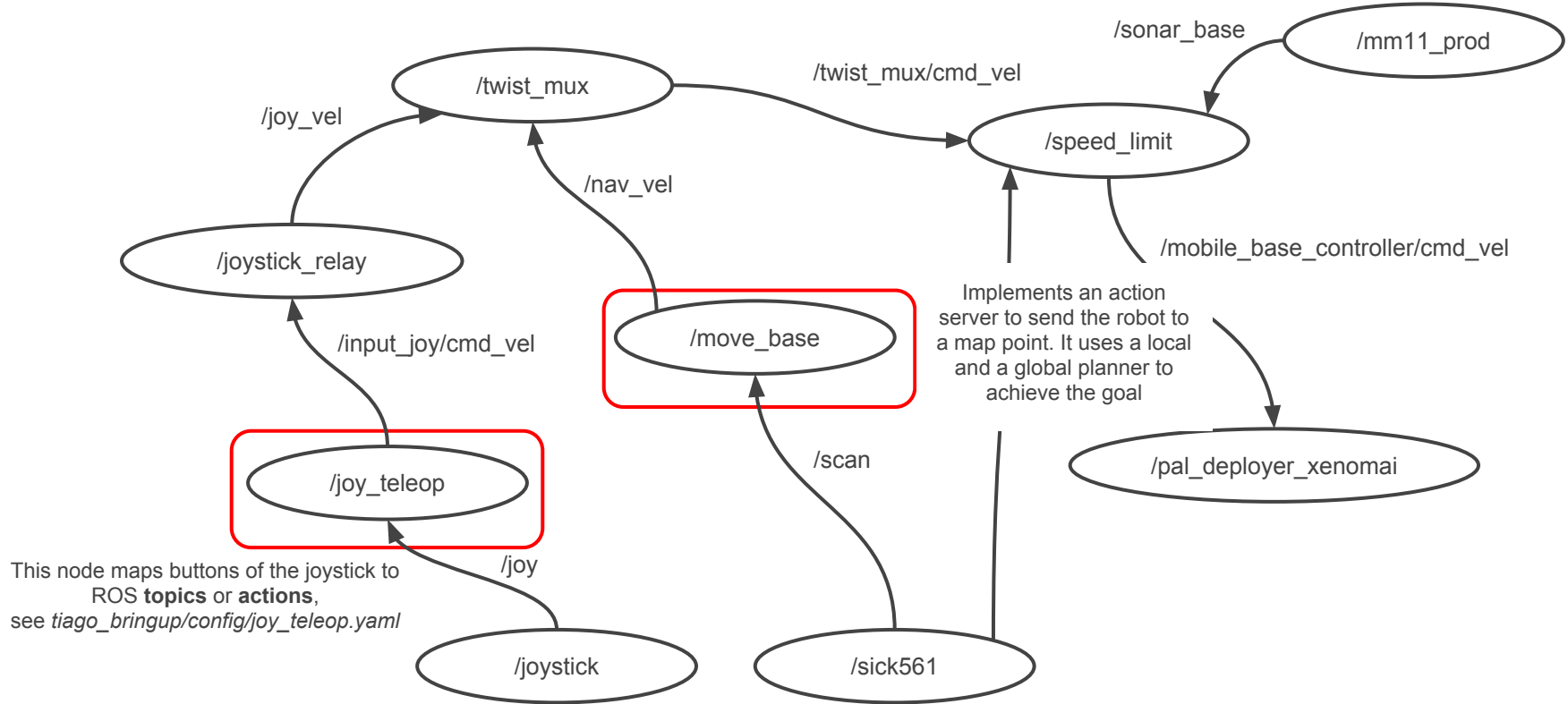
# Wheels command diagram (II)



This node provides what buttons are being pressed in the joystick

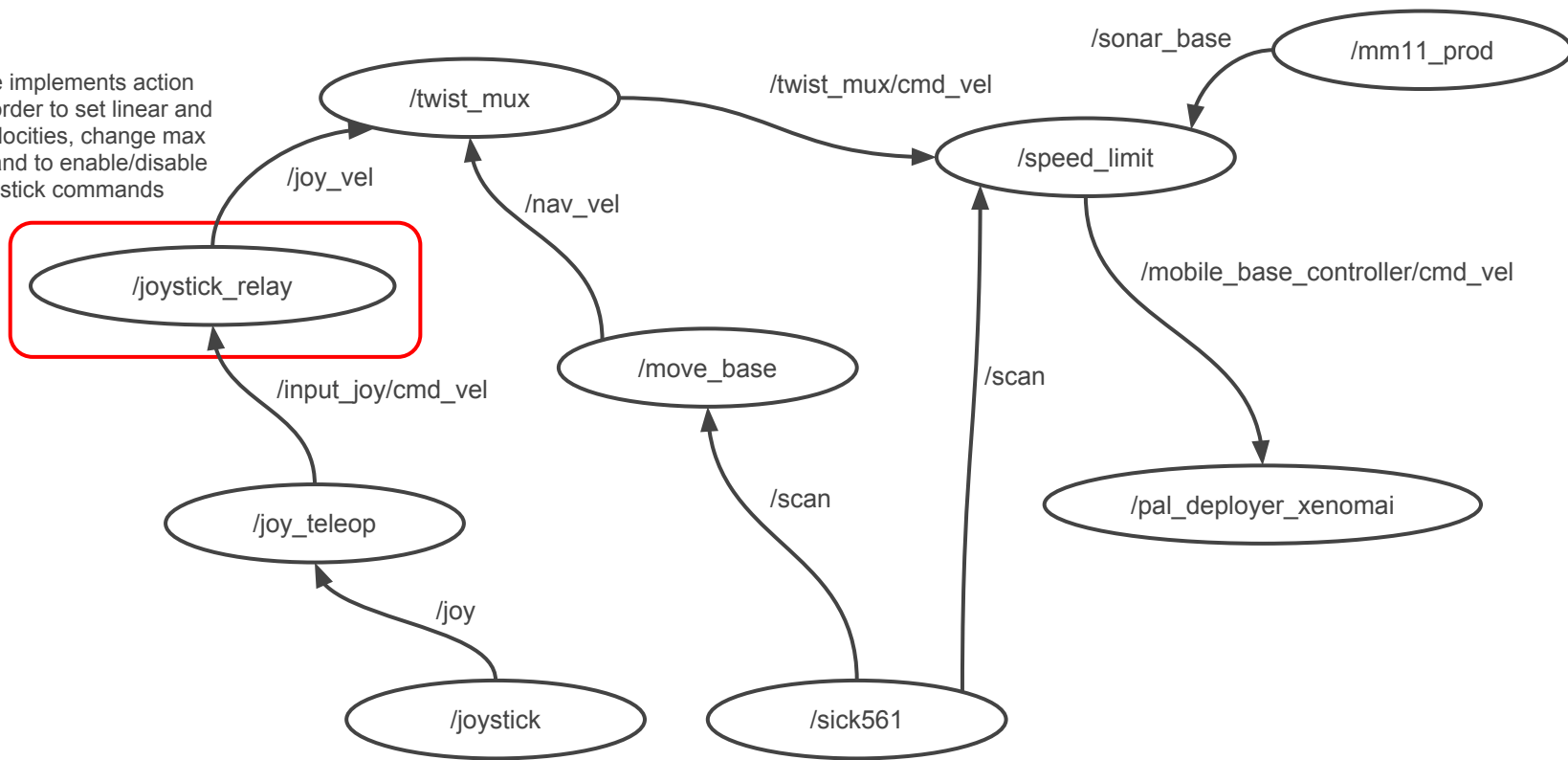
This node publishes the laser scan obtained with the laser range-finder

# Wheels command diagram (III)



# Wheels command diagram (IV)

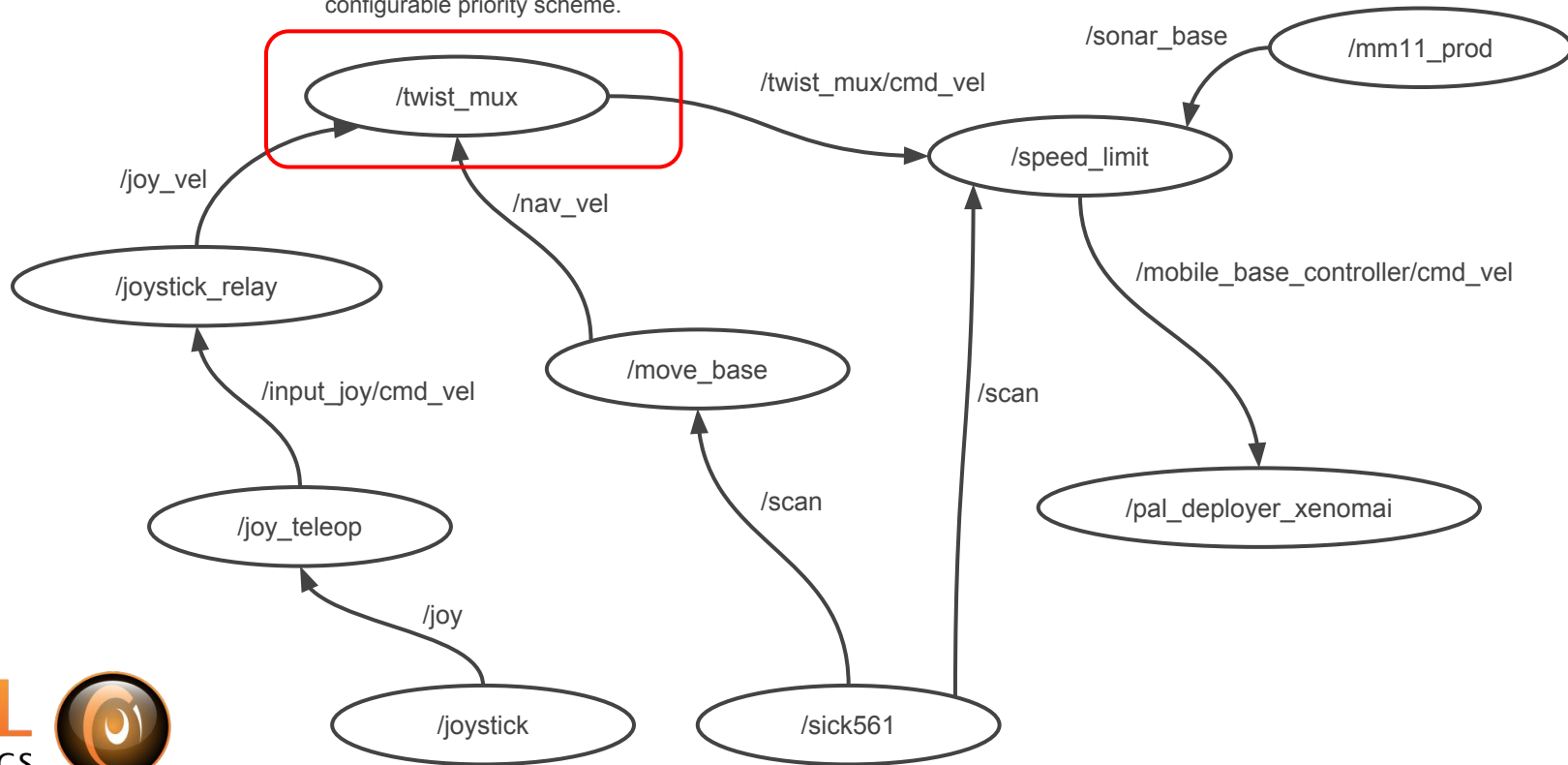
This node implements action servers in order to set linear and angular velocities, change max velocities and to enable/disable the joystick commands



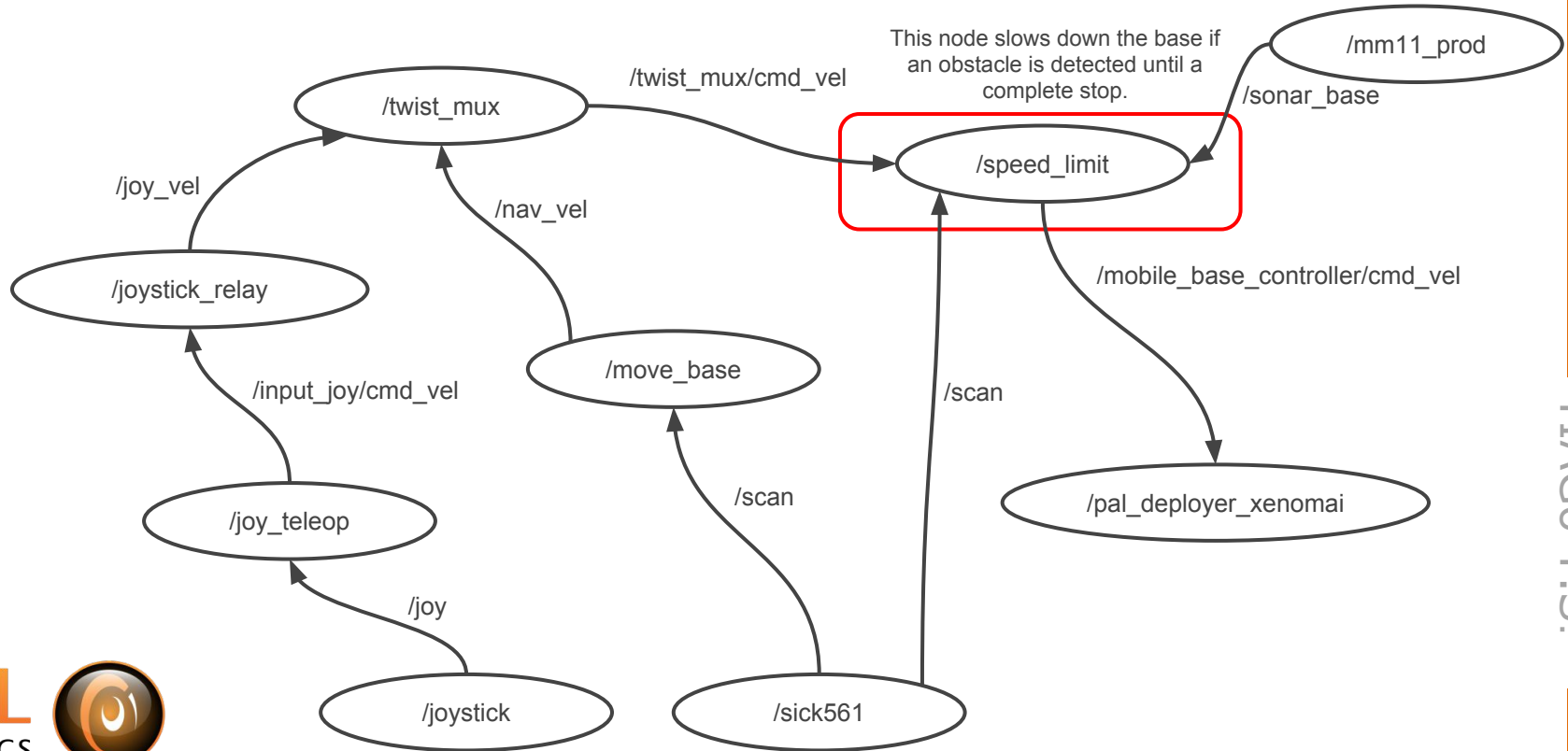


# Wheels command diagram (V)

This broker node forwards the velocities commands provided by one of its clients following a configurable priority scheme.



# Wheels command diagram (VI)



# Joystick base motion triggers

- Motion trigger example:

```
rosparam get /teleop/move -p
```

```
axis_mappings: - {axis: 1, scale: 1.0,  
target: linear.x}  
- {axis: 2, scale: 1.0, target: angular.z}  
message_type: geometry_msgs/Twist  
topic_name: cmd_vel  
type: topic
```

Default joystick triggers location:

tiago\_bringup/config/joy\_teleop.yaml



# Mapping



# Mapping (I)

- Change to **mapping mode**:

```
export ROS_MASTER_URI=http://tiago-0c:11311
```

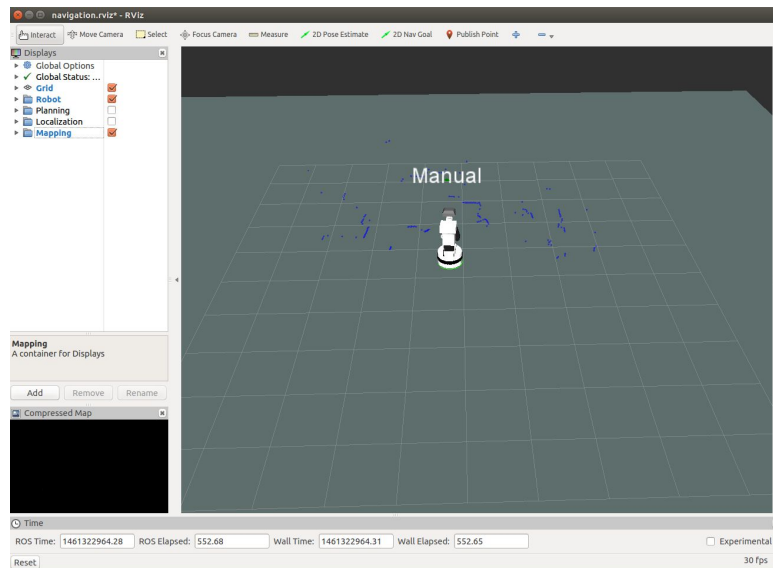
```
rosservice call /pal_navigation_sm "input: 'MAP'"
```

- In the development computer start rviz for navigation:

```
export ROS_MASTER_URI=http://tiago-0c:11311
```

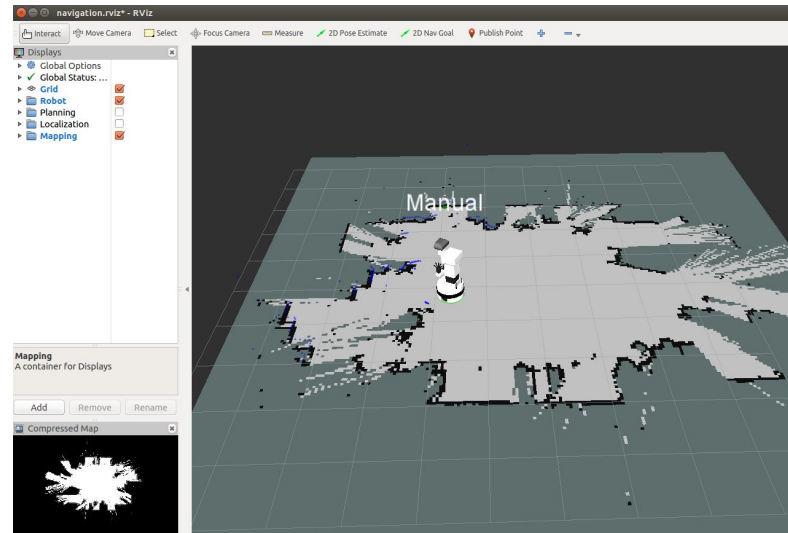
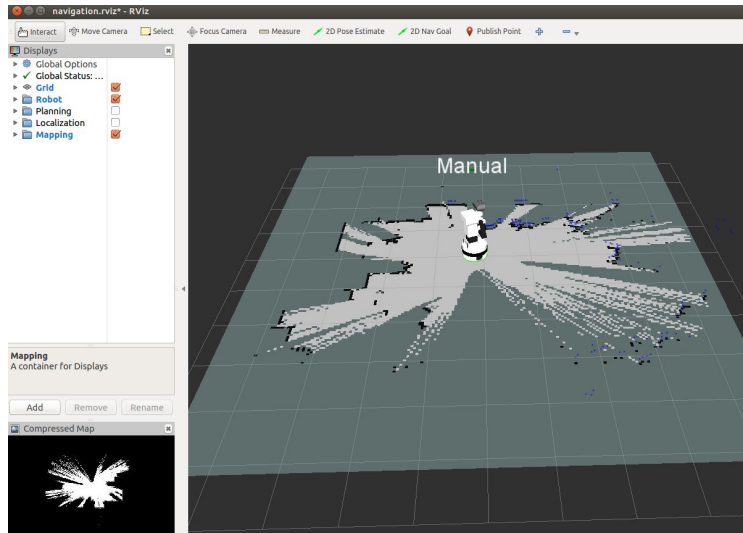
```
ROS_IP=10.68.0.128 rosrn rviz rviz -d `rospack find tiago_2dnav`/config/rviz/navigation.rviz
```

Get your IP with  
ifconfig



# Mapping (II)

- Move the base with the joystick in order to take a tour of the area you want to map



# Map management

- Save the map as follows:

```
export ROS_MASTER_URI=http://tiago-0c:11311  
rosservice call /pal_map_manager/save_map "directory: 'pal_room'"
```

This map will be named after the provided name and saved in the configuration folder:  
`/home/pal/.pal/tiago_maps/configurations`

The map in use is the one pointed by the symbolic link:  
`/home/pal/.pal/tiago_maps/config -> /home/pal/.pal/tiago_maps/configurations/pal_room`

In order to change the active map we first need to switch to localization mode:  
`rosservice call /pal_navigation_sm "input: 'LOC'"`

Then we can select the new map as follows:  
`rosservice call /pal_map_manager/change_map "input: 'pal_room'"`

If no name is specified during the rosservice call, the map will be named after the current date and time.

# Localization

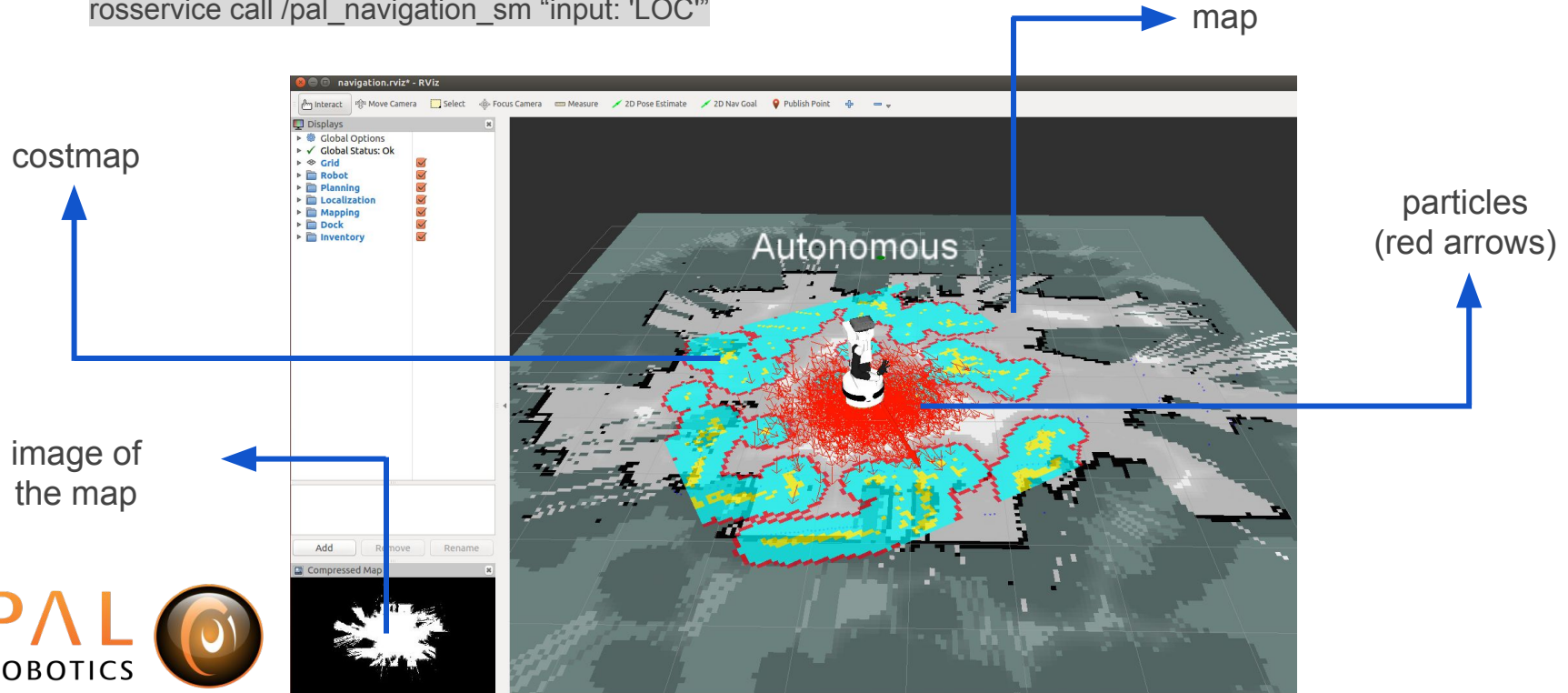




# Start localization

- Localization is provided by the ROS package [amcl](#), which implements a particle filter to track the pose of a robot against the current map. After mapping, the localization mode is enabled as follows:

```
rosservice call /pal_navigation_sm "input: 'LOC'"
```



# Global localization

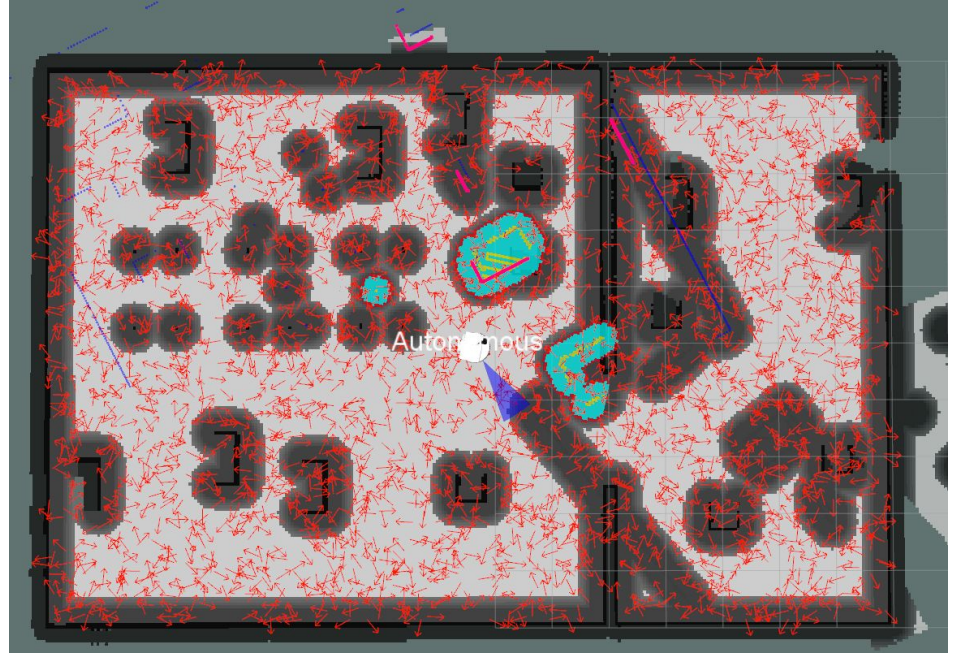
- In order to let the robot self-localize when it wakes up first run the following command:

```
rosservice call /global_localization "{}"
```

This will spread particles over the entire map.

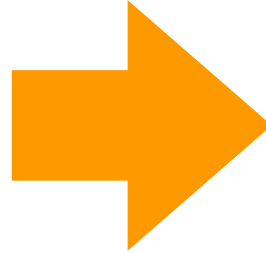
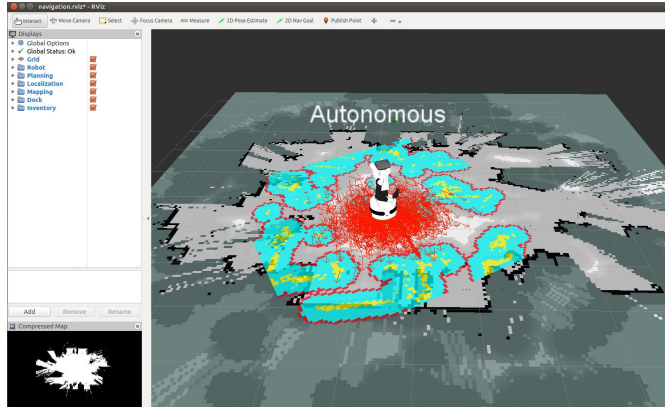
Then clear the costmaps:

```
rosservice call /move_base/clear_costmaps "{}"
```

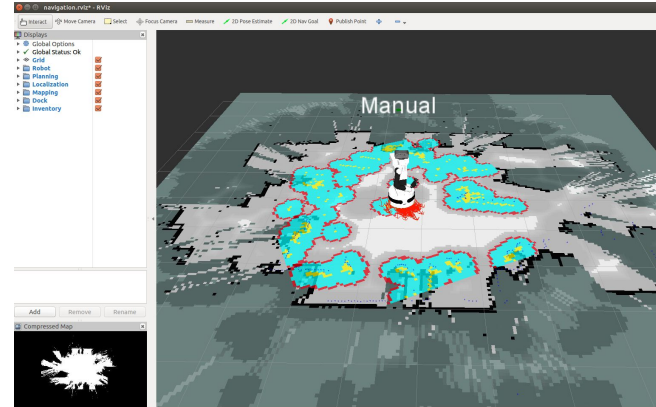


# Reduce localization uncertainty

- In some cases the particles are spread in a large area → the localization is uncertain (for example when turning on the robot)
- The uncertainty reduces when the robot moves

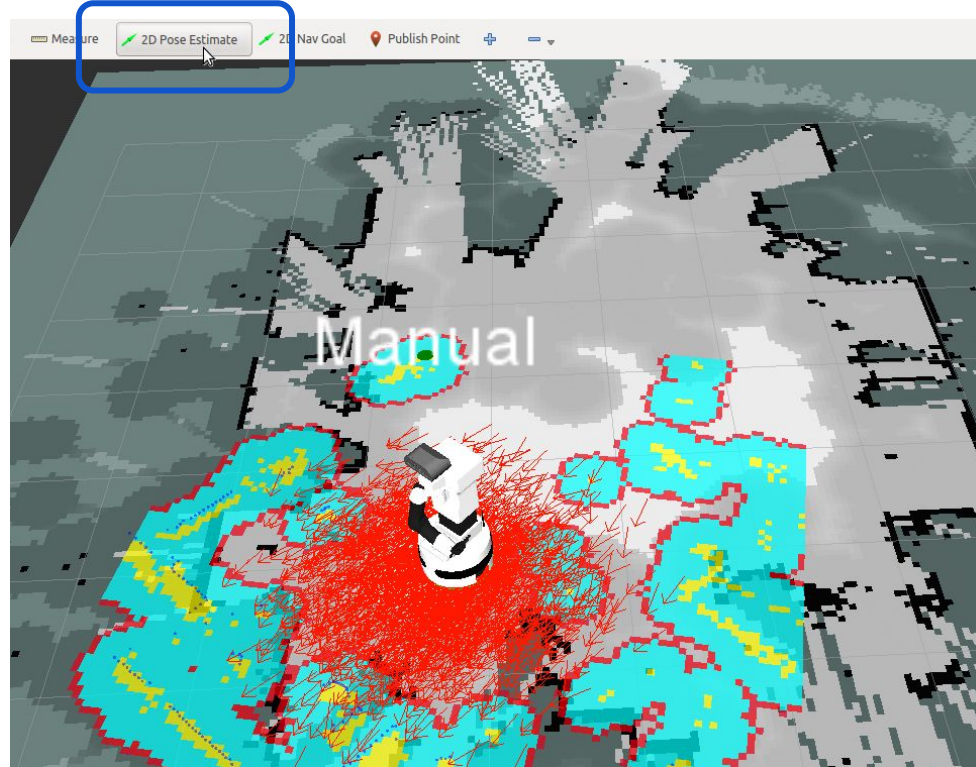


rotate and  
translate  
robot



# Force localization initial guess (I)

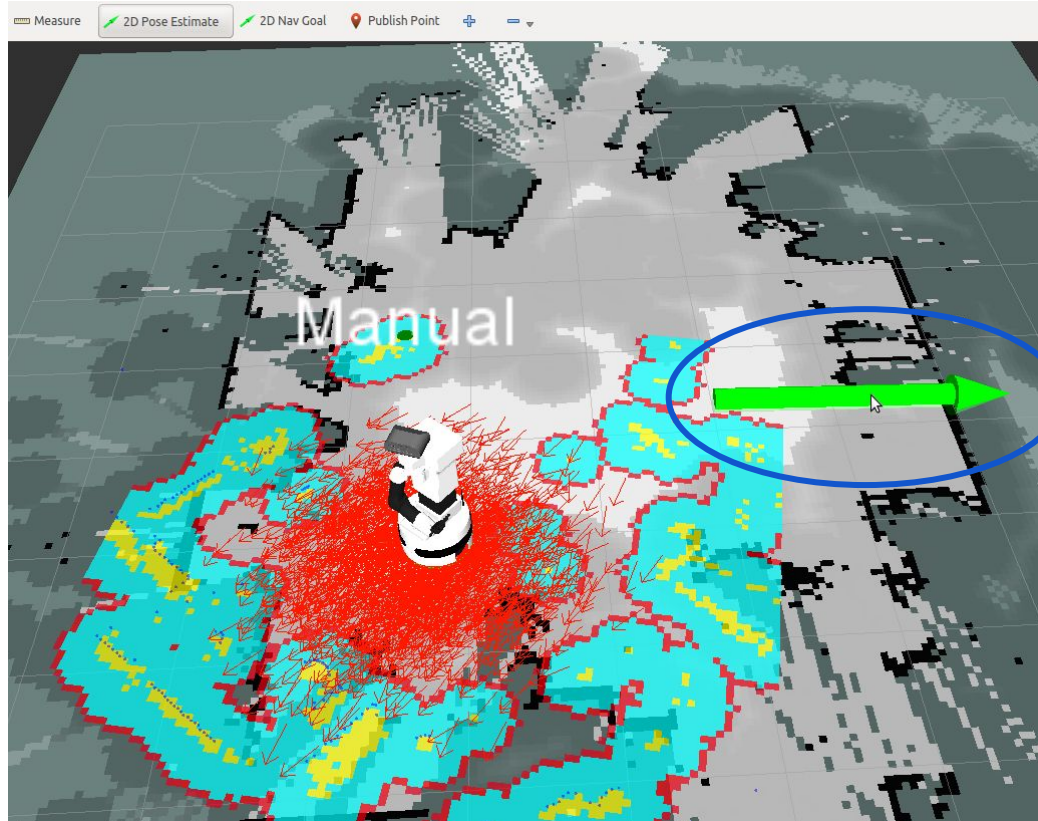
- If for any reason (e.g. turning the robot on after moving it) the robot is mislocalized the user may force spreading the filter particles around a given pose in the map.





# Force localization initial guess (II)

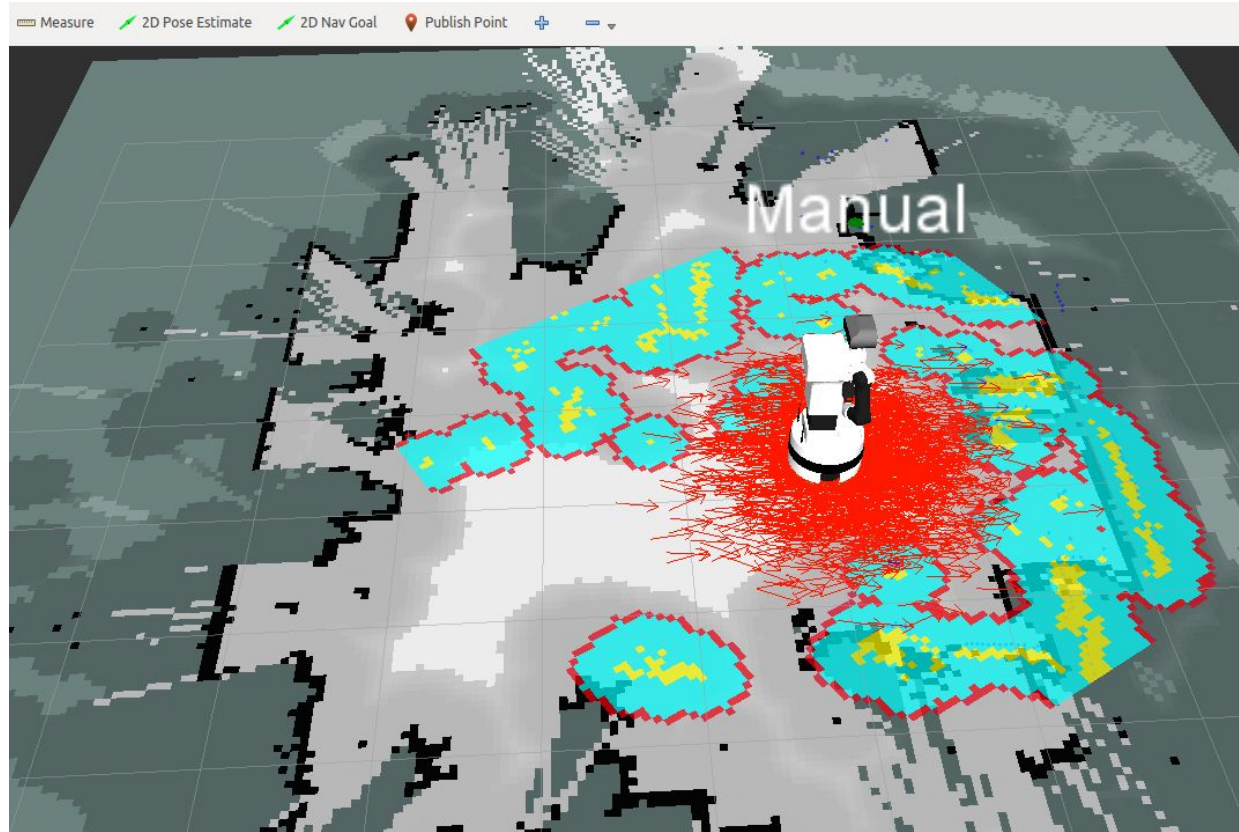
- Select the pose in the map corresponding approximately to the actual robot pose.



The arrow indicates our guess about the robot pose (position and orientation)

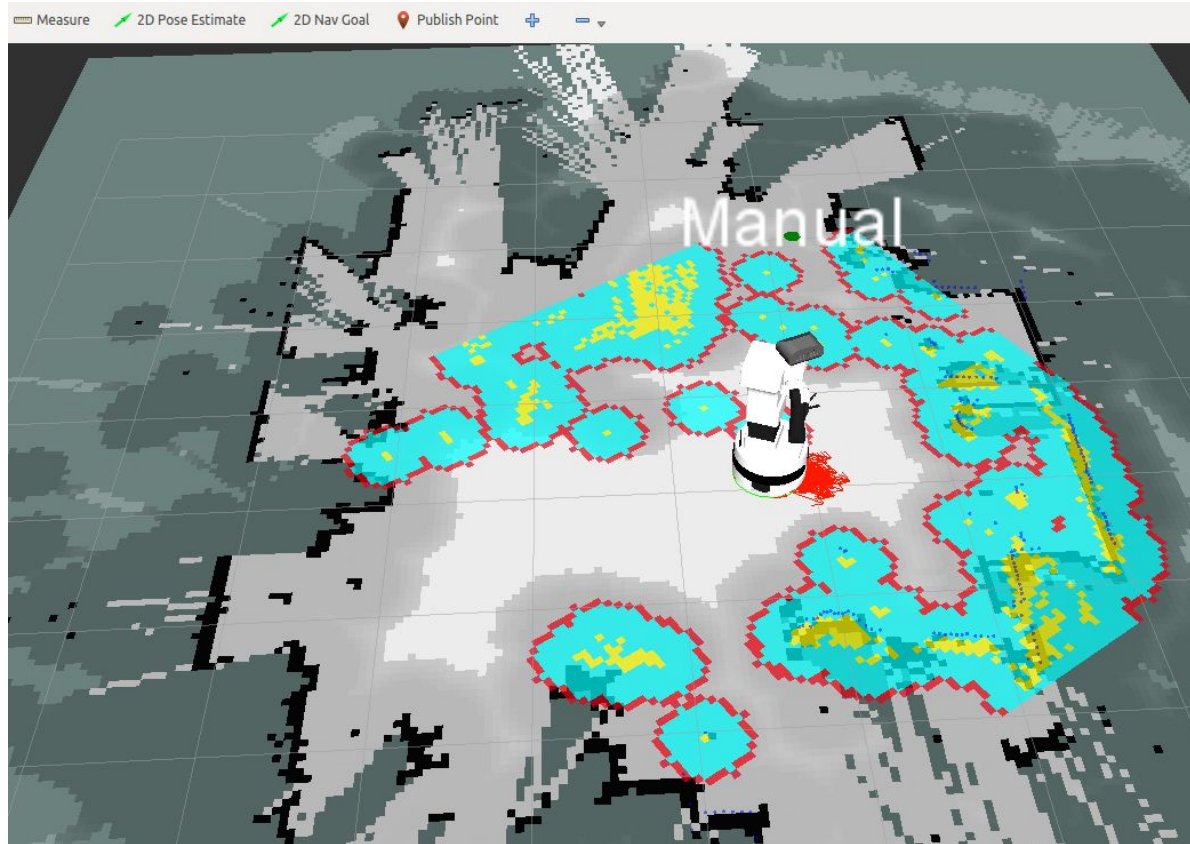
# Force localization initial guess (III)

- The particles will spread around the selected pose so that the robot looks towards the arrow's head.



# Force localization initial guess (IV)

- Moving the robot with the joystick will cause the particles to focus in the actual pose of the robot



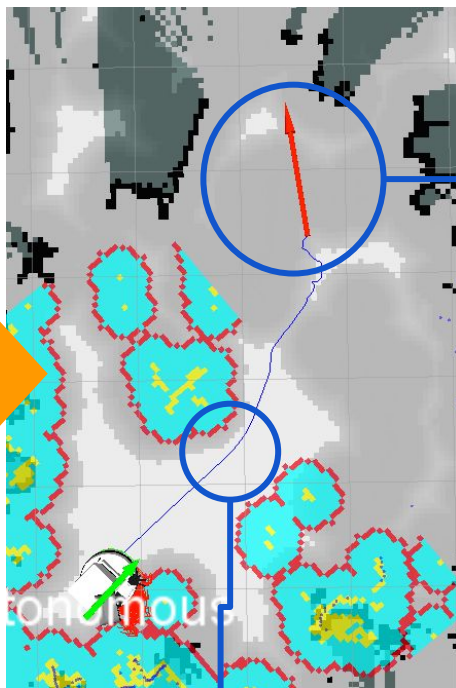
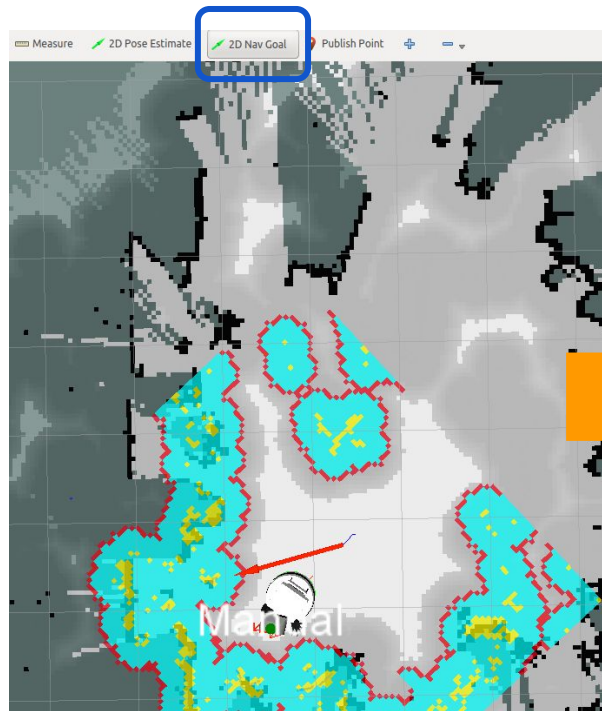
# Autonomous navigation





# Autonomous navigation

- Sending the robot to a map point using the **2D Nav Goal** button



Clicking on a map point will publish the map coordinates in the following topic:

```
pal@tiago-0c:~$ rostopic echo /move_base_simple/goal
header:
  seq: 5
  stamp:
    secs: 1461336857
    nsecs: 999692300
  frame_id: map
pose:
  position:
    x: 0.284426689148
    y: -0.665684938431
    z: 0.0
  orientation:
    x: 0.0
    y: 0.0
    z: -0.609778695113
    w: 0.792571727344
---
```

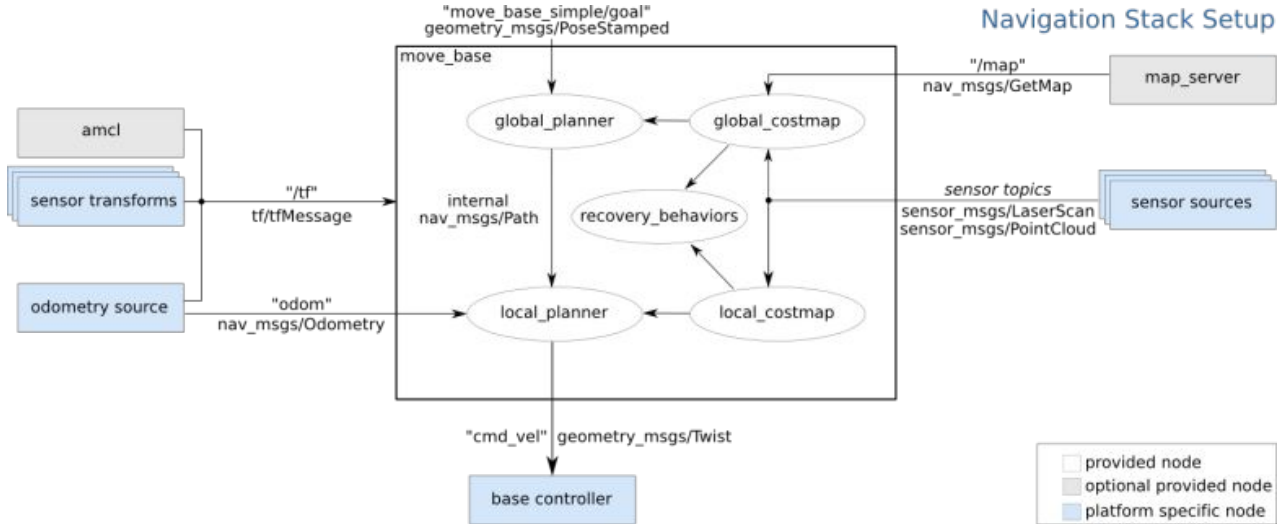
a **path** to the destination point is dynamically **planned** avoiding obstacles

publish goal to action server  
**/move\_base**

TIAGO T.S.



# Navigation internals (II)



Extensive documentation about navigation functioning and parameters can be found at:

[http://wiki.ros.org/move\\_base](http://wiki.ros.org/move_base)



# Questions?

