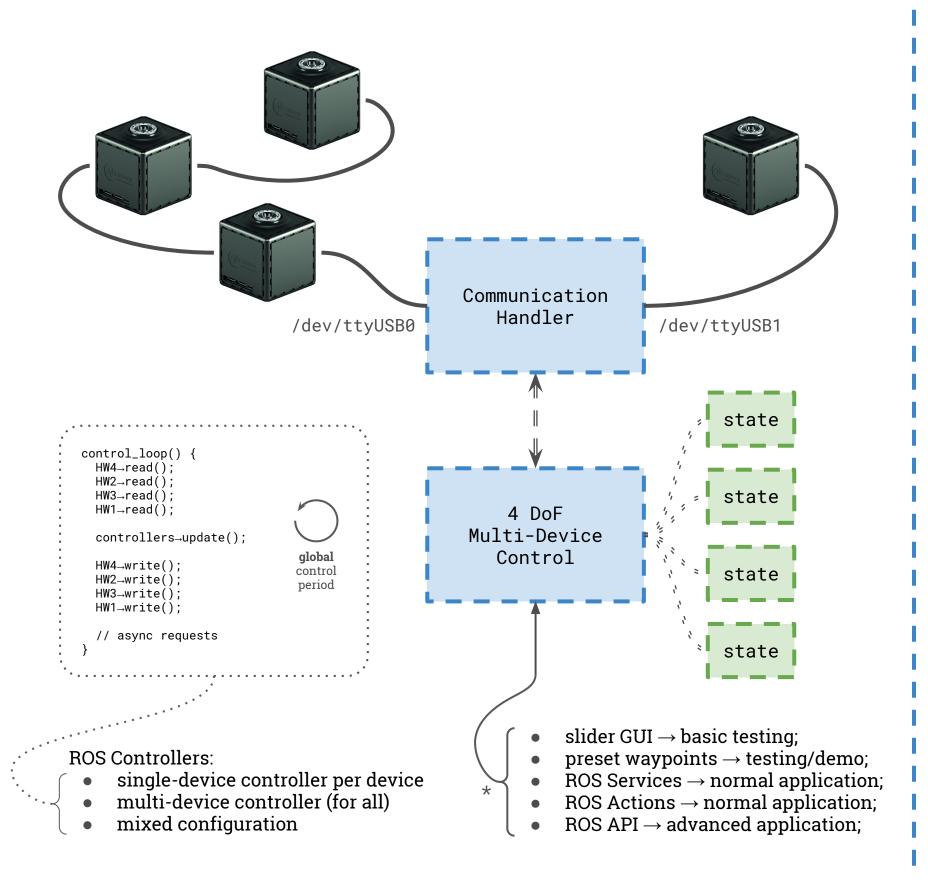
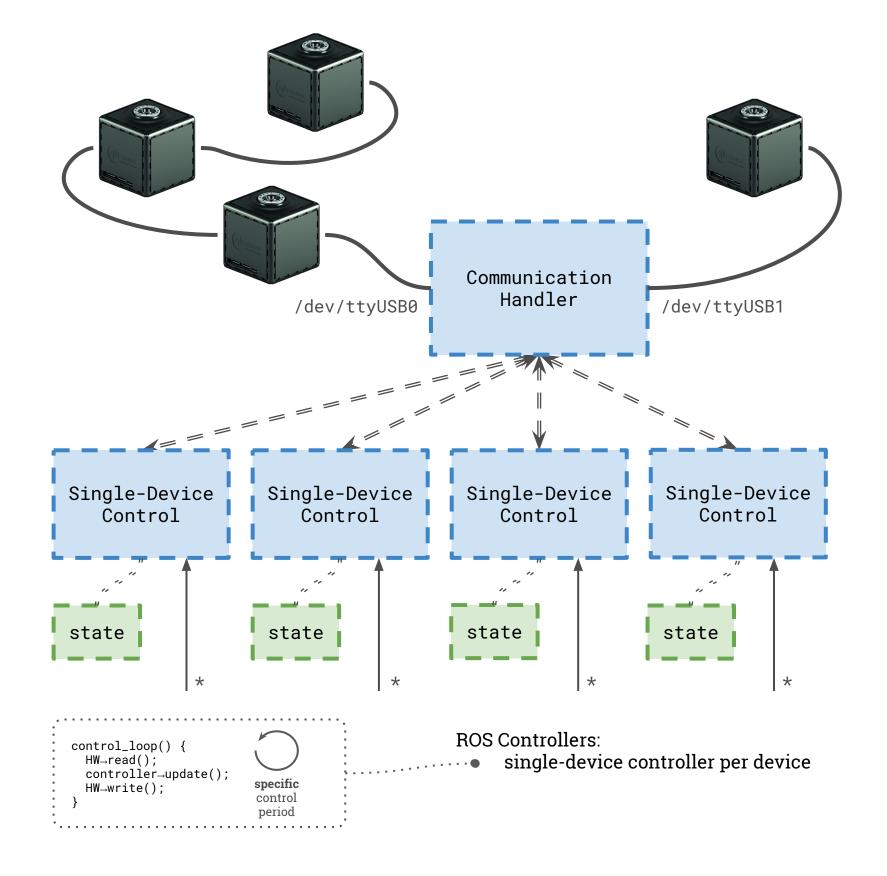
ROS packages olorobotics

one synchronous control node



asynchronous control nodes













multi-device synchronous setup

```
<launch>
<!-- robot settings -->
 <arg name="control_duration" default="0.01" doc="The duration of the control loop [s]."/>
 <arg name="robot_name" default="3dof_chain" doc="The unique robot namespace."/>
 <arg name="robot_namespace" default="$(arg robot_name)" doc="The unique robot namespace."/>
 <arg name="robot_package" default="qb_chain" doc="The base package name prefix for the robot configurations [urdf, rviz, ...]."/>
 <arg name="source_list" default="[control/joint_states]" doc="The joint_states source list for the joint_state_publisher."/>
<!-- read/write settings -->
 <arg name="get_currents" default="true" doc="Choose whether or not to retrieve current measurements from the device."/>
 <arg name="get_positions" default="true" doc="Choose whether or not to retrieve position measurements from the device."/>
 <arg name="get_distinct_packages" default="false" doc="Choose whether or not to retrieve current and position measurements from the device in</pre>
two distinct packages." />
 <arg name="max_repeats" default="3" doc="The maximum number of consecutive repetitions to mark retrieved data as corrupted."/>
 <arg name="set_commands" default="true" doc="Choose whether or not to send command positions to the device."/>
 <arg name="set_commands_async" default="false" doc="Choose whether or not to send commands without waiting for ack."/>
 <!-- initialization settings -->
 <arg name="activate_on_initialization" default="false" doc="Choose whether or not to activate the motors on node startup."/>
 <arg name="rescan_on_initialization" default="false" doc="Choose whether or not to rescan the serial ports on node startup."/>
 <!-- launch settings -->
 <arg name="standalone" default="false" doc="Choose whether or not to start the Communication Handler."/>
 <arg name="use_controller_gui" default="false" doc="Choose whether or not to use the controller GUI."/>
 <arg name="use_rviz" default="true" doc="Choose whether or not to use rviz."/>
 <arg name="use_waypoints" default="false" doc="Choose whether or not to use the waypoint references."/>
 <include file="$(find qb_device_driver)/launch/communication_handler.launch" if="$(arg standalone)"/>
 <include file="$(find qb_device_bringup)/launch/device_bringup.launch" pass_all_args="true">
  <arg name="device_id" value="1"/>
  <arg name="device_name" value="cube1"/>
  <arg name="device_type" value="qbmove"/>
 </include>
 <include file="$(find qb_device_bringup)/launch/device_bringup.launch" pass_all_args="true">
  <arg name="device_id" value="2"/>
  <arg name="device_name" value="cube2"/>
  <arg name="device_type" value="qbmove"/>
 </include>
 <include file="$(find qb_device_bringup)/launch/device_bringup.launch" pass_all_args="true">
  <arg name="device_id" value="3"/>
  <arg name="device_name" value="cube3"/>
  <arg name="device_type" value="qbmove"/>
  <!-- override global settings -->
  <ard name="get currents" value="false"/>
  <arg name="get_positions" value="true"/>
  <arg name="max_repeats" value="1"/>
  <arg name="set_commands" value="false"/>
 </include>
 <include file="$(find qb_device_bringup)/launch/robot_bringup.launch" pass_all_args="true"/>
</launch>
```

single-device setup

```
<launch>
  <!-- device info -->
  <arg name="device_id" default="1" doc="The ID of the device [1, 128]."/>
  <arg name="device_type" value="qbmove" doc="The type of the device [qbhand, qbmove, ...]."/>
  <arg name="device_name" default="$(arg device_type)$(arg device_id)" doc="The unique device name used in the yaml controller 🗥
configurations (also in the urdf if not already specified there)." />
  <!-- robot settings -->
  <arg name="control duration" default="0.01" doc="The duration of the control loop [s]."/>
 <arg name="robot_hardware" default="[$(arg device_name)]" doc="The robot hardware interface namespaces, e.g. [device1, device2, ...]."/>
  <arg name="robot_name" default="$(arg device_type)" doc="The unique robot namespace."/> /\bigcaperage{A}
  <arg name="robot_namespace" default="$(arg device_name)" doc="The unique robot namespace."/>
  <arg name="robot_package" default="qb_move" doc="The base package name prefix for the robot configurations [urdf, rviz, ...]."/>
  <arg name="source_list" default="[control/joint_states]" doc="The joint_states source list for the joint_state_publisher."/>
 <!-- read/write settings -->
  <arg name="get_currents" default="true" doc="Choose whether or not to retrieve current measurements from the device."/>
  <arg name="get_positions" default="true" doc="Choose whether or not to retrieve position measurements from the device."/>
 <arg name="get_distinct_packages" default="false" doc="Choose whether or not to retrieve current and position measurements from the device in</pre>
 two distinct packages." />
 <arg name="max_repeats" default="3" doc="The maximum number of consecutive repetitions to mark retrieved data as corrupted."/>
  <arg name="set_commands" default="true" doc="Choose whether or not to send command positions to the device."/>
  <arg name="set_commands_async" default="false" doc="Choose whether or not to send commands without waiting for ack."/>
 <!-- initialization settings -->
  <arg name="activate_on_initialization" default="false" doc="Choose whether or not to activate the motors on node startup."/>
 <arg name="rescan_on_initialization" default="false" doc="Choose whether or not to rescan the serial ports on node startup."/>
  <!-- launch settings -->
  <arg name="standalone" default="false" doc="Choose whether or not to start the Communication Handler."/>
  <arg name="use_controller_gui" default="false" doc="Choose whether or not to use the controller GUI."/>
  <arg name="use_rviz" default="true" doc="Choose whether or not to use rviz."/>
 <arg name="use_waypoints" default="false" doc="Choose whether or not to use the waypoint references."/>
 <include file="$(find qb_device_driver)/launch/communication_handler.launch" if="$(arg standalone)"/>
 <include file="$(find qb_device_bringup)/launch/device_bringup.launch" pass_all_args="true"/>
  <include file="$(find qb_device_bringup)/launch/robot_bringup.launch" pass_all_args="true"/>
</launch>
```



The use of combined_robot_hw::CombinedRobotHW requires the ROS Parameter robot_hardware to be set and filled with all the device name list.



packages overview

pkg: qb_device_driver ns: qb_device_driver

qbDeviceAPI()

Wrap the qbrobotics API functions:

- openRS485()
- commGetCurrAndMeas()
- commSetInputs()

pkg: qb_device_driver ns:gb_device_communication_handler

qbDeviceCommunicationHandler()

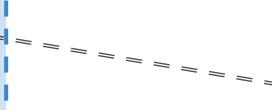
Advertise the following Services in "/communication_handler/":

- "activate_motors" → qb_device_srvs::Trigger
- $"deactivate_motors" \ \rightarrow \ qb_device_srvs::Trigger$
- "get_info" → qb_device_srvs::Trigger
- "get_measurements" → qb_device_srvs::GetMeasurements
- "initialize_device" → qb_device_srvs::InitializeDevice

 $1 \rightarrow n$

- "set_commands" → qb_device_srvs::SetCommands
- "set_pid" → qb_device_srvs::SetPID





pkg: qb_device_control ns: qb_device_control

qbDeviceControl()

Exploit the following ros_control structures:

- $\textbf{actionlib::SimpleActionClient} \ \rightarrow \ \textbf{one} \ \textbf{per} \ \textbf{loaded} \ \textbf{controller}$
- combined_robot_hw::CombinedRobotHW → parsed from "robot_hardware"
- controller_manager::ControllerManager

Set up a control loop with the given period (parsed from "control_duration"):

- CombinedRobotHW->read() → call all the specific HW->read() sequentially
- ControllerManager->update()
- CombinedRobotHW->write() → call all the specific HW->write() sequentially
- [optional] serve spare asynchronous requests (if pending)

Advertise the following Services:

- "get_async_measurements" → qb_device_srvs::GetMeasurements
- "set_async_commands" → qb_device_srvs::SetCommands
- "set_async_pid" → qb_device_srvs::SetPID

Provide methods to generate simple joint trajectories to be used by Action Clients:

- getSinusoidalPoints
- getTrapezoidalPoints
- getCustomTrajectory

pkg: qb_move_hardware_interface ns: qb_move_hardware_interface

qbMoveHW()

Build a Hardware Interface with the specific Transmission: qb_move_transmission_interface::qbMoveTransmission

- two actuators with shaft position [rad] and stiffness preset [%] command references
- two actuators with position [rad] command references

pkg: qb_hand_hardware_interface ns: qb_hand_hardware_interface

qbHandHW()

Build a Hardware Interface with the specific Transmission: qb_hand_transmission_interface::qbHandVirtualTransmission

• one actuator with position [%] command reference

ns: qb_device_hardware_interface

pkg: qb_device_hardware_interface

qbDeviceHW()

init():

- set up resources for and initialize: hardware_interface, joint_limits_interface, transmission_interface
- retrieve robot_description
 - wait for Communication Handler then retrieve device parameters and settings, e.g. read/write configuration

read():

- make a call to "/communication_handler/get_measurements"
- propagate actuators state to joints
- publish device state to a namespaced topic

write():

- enforce joint limits for all registered interfaces
- propagate joint commands to actuators
- make a call to "/communication_handler/set_commands"

pkg: hardware_interface ns: hardware_interface

RobotHW()

Provide the following base methods:

- init()
- read()
 - write()















