

# Securing MoveIt 2

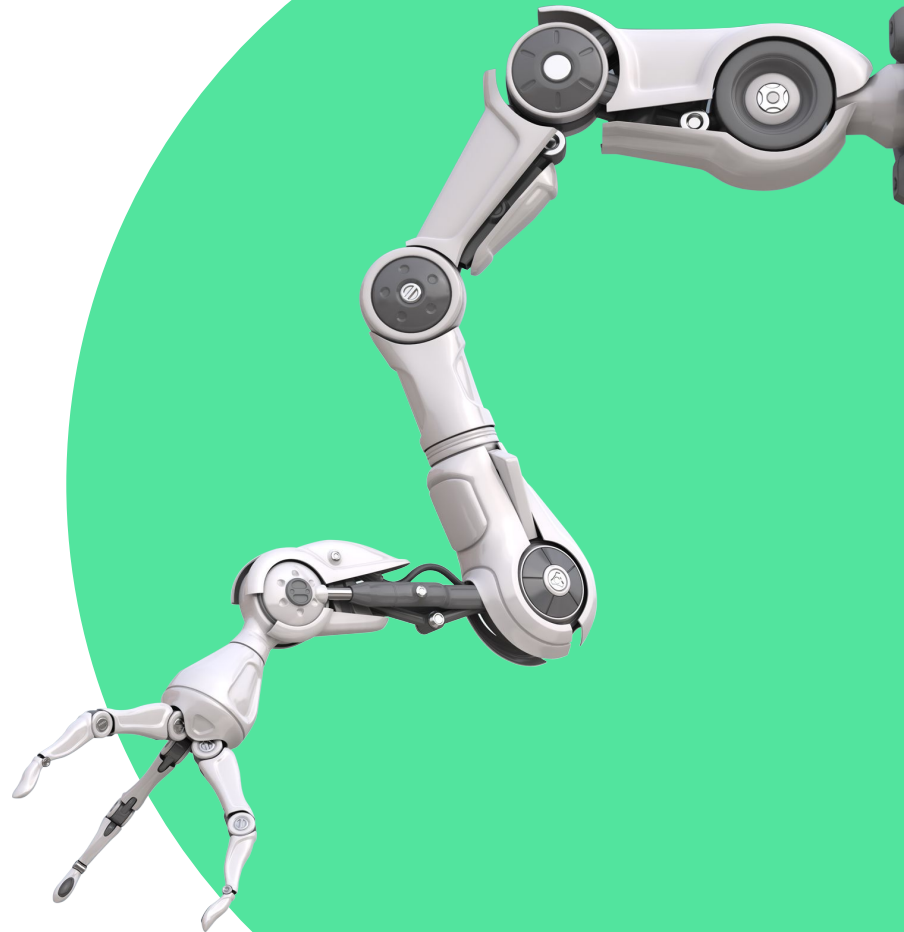
ROS 2 Security WG - January 2021



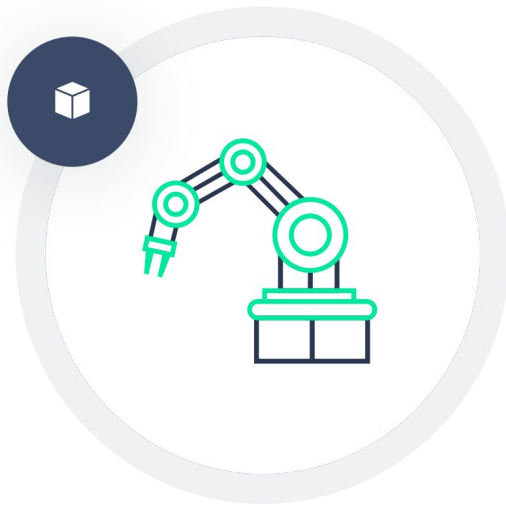
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- **Movelt Features and Interfaces**
  - **MoveGroup**
  - **MoveltCpp**
  - **Movelt Servo**
- **Example Use Case: MoveGroup**
- **Securing Hardware Access**



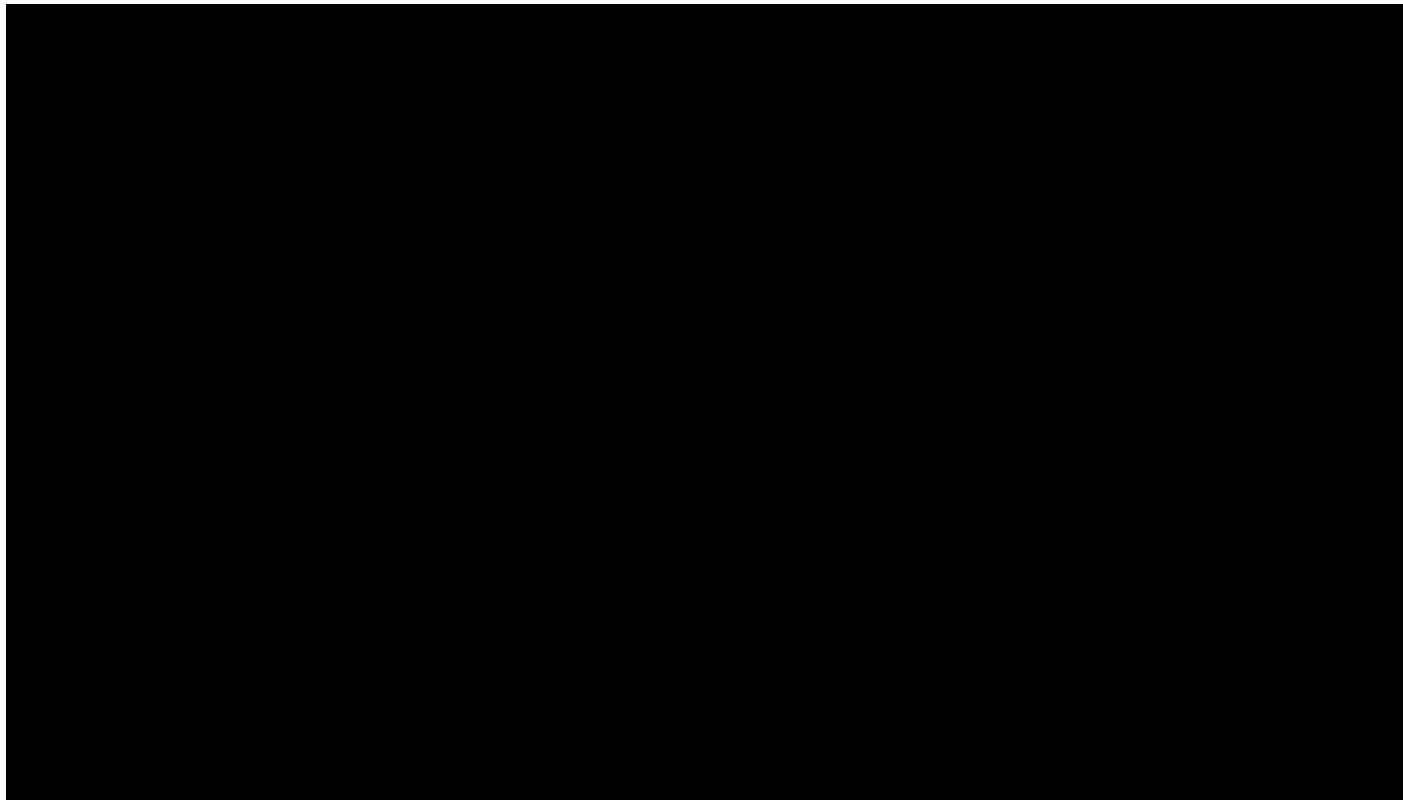
# Features and Interfaces

***“Easy-to-use open source robotics manipulation platform for developing commercial applications, prototyping designs, and benchmarking algorithms.”***

Movelt comes with 3 main Interfaces:

- **MoveGroup:** ROS-based interface for remote robot interactions
- **MoveltCpp:** C++ API with direct access to Movelt core components
- **Movelt Servo:** Online position command streaming via ROS or C++ API

Demo URL: [https://github.com/ros-planning/moveit2/tree/main/moveit\\_demo\\_nodes/run\\_move\\_group](https://github.com/ros-planning/moveit2/tree/main/moveit_demo_nodes/run_move_group)



**MoveGroup** - single node maintaining robot, scene and capabilities

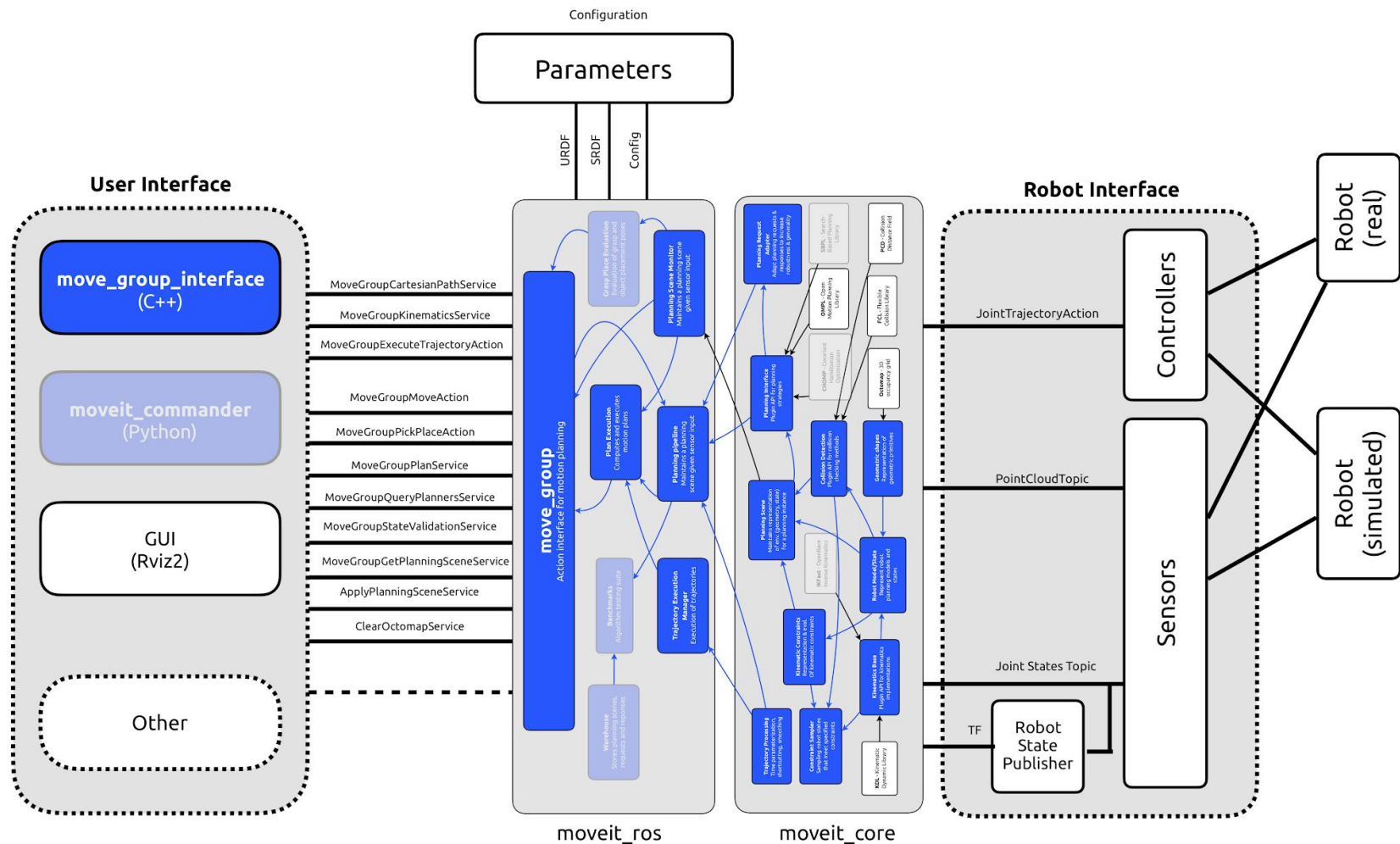
- Robot is accessed using ROS2-control message interfaces
- Sensor input via topics, e.g. PointCloud->Octomap for collision checking
- Applies updates to TF, scene geometry, joint state

**MoveGroupCapability** - plugin running Actions or Services

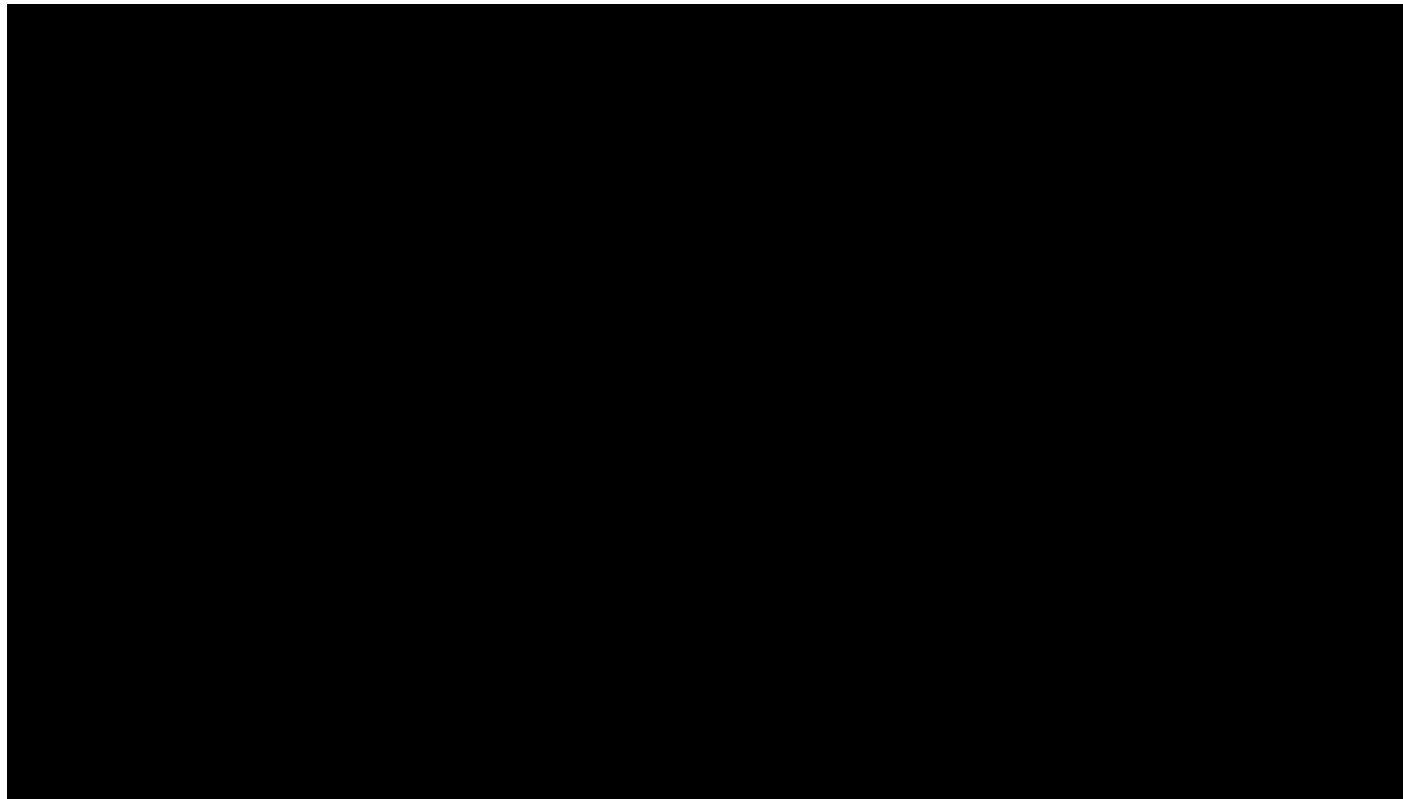
- e.g. MoveGroupAction capability provides access to motion planning and trajectory execution

**MoveGroupInterface** - Remote client node for MoveGroup access

- Implements client side of default Action/Service capabilities
- Multiple node instances possible



Demo URL: [https://github.com/ros-planning/moveit2/tree/main/moveit\\_demo\\_nodes/run\\_moveit\\_cpp](https://github.com/ros-planning/moveit2/tree/main/moveit_demo_nodes/run_moveit_cpp)

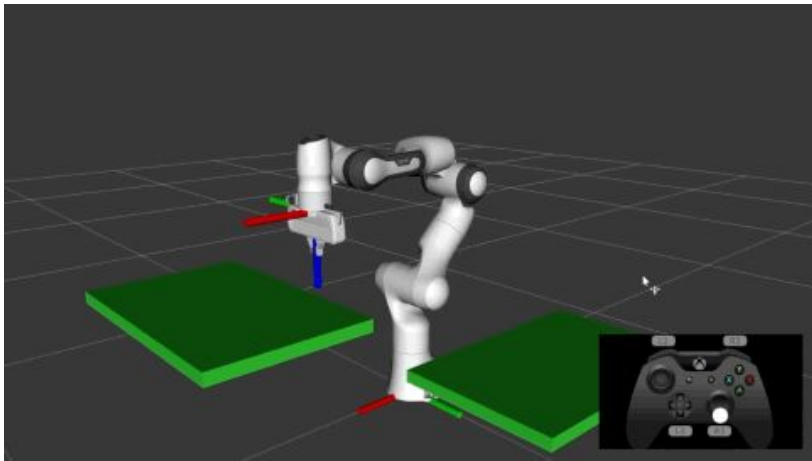




## MoveItCpp - C++ library for running MoveIt core components

- Similar to MoveGroup, only without remote ROS access (no MoveGroupInterface)
- Application code is implemented in same node instead of plugin capabilities
- Still uses ROS interfaces for TF, ROS control, planning scene maintenance, sensors...

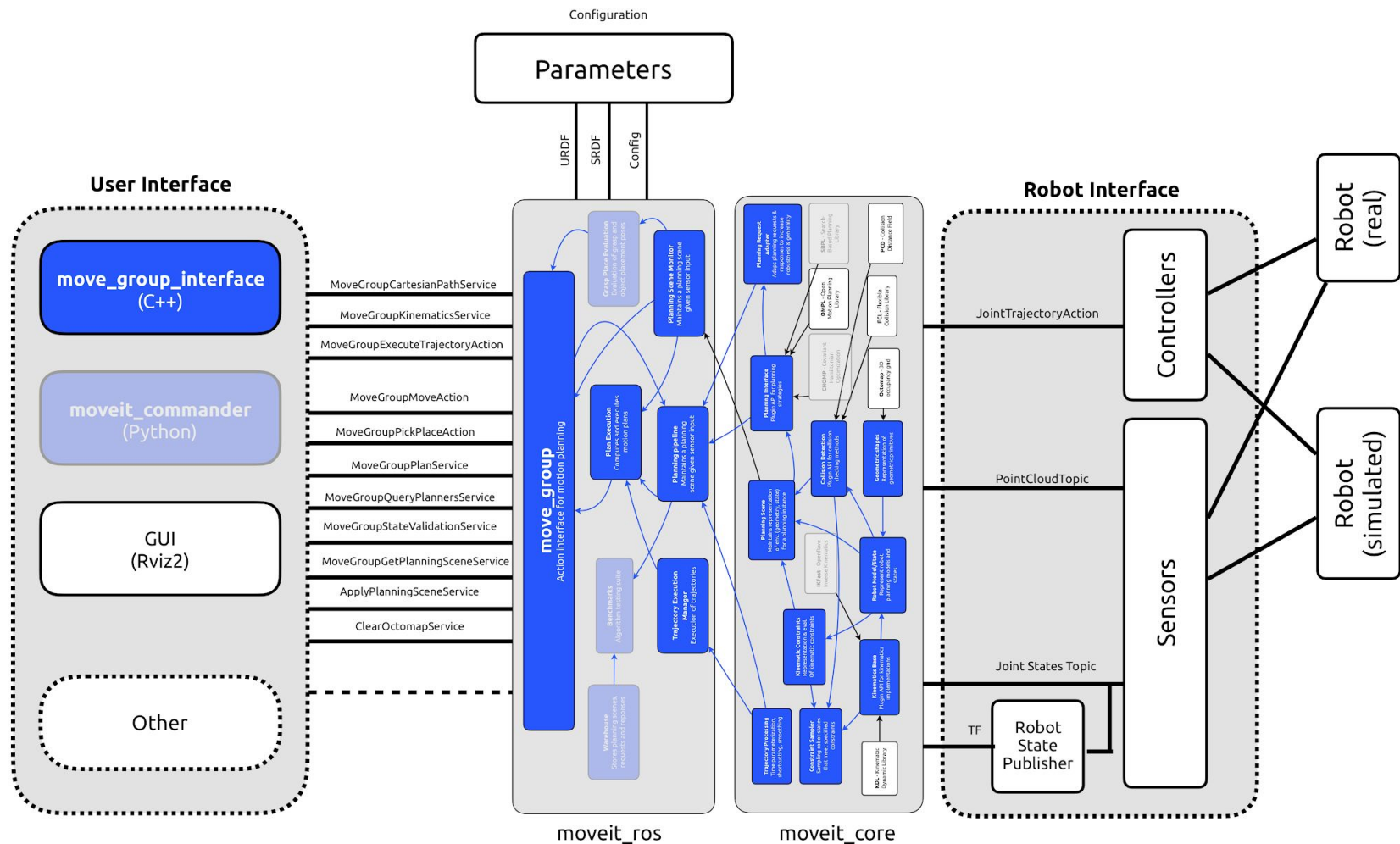
- Joint/Velocity-streaming controller
- Input message allows wide range of input devices
- Checks for joint limits, collision, singularity safety



## **Movelt Servo** - C++ library for streaming ROS control motion commands

- Uses Movelt core components for scene handling and collision avoidance
- Provides a ROS message interface, but can be run in C++-only mode
- Uses moveit core components: ROS interfaces for TF, ROS control, planning scene maintenance, sensors...

# Example Use Case: MoveGroup



### MoveGroupCapability

- MoveGroupAction called by third-party node  
-> Robot plans and executes an insecure motion

### PlanningSceneMonitor

- Modify world geometry, robot state or TF  
-> Robot runs into collision, fails to pick a target, or is unable to move

### ROS Control

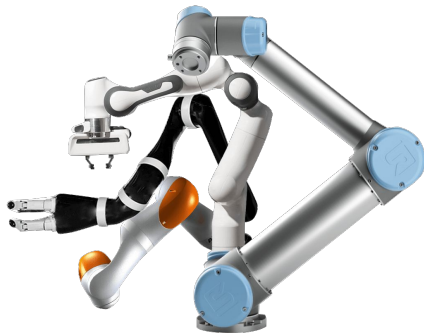
- Publish fake or invalid joint state messages  
-> Robot fails to plan or execute motions due to invalid states
- Execute motions from third-party node

# Securing Hardware Access

# Securing Hardware Access

## Considerations when working with hardware:

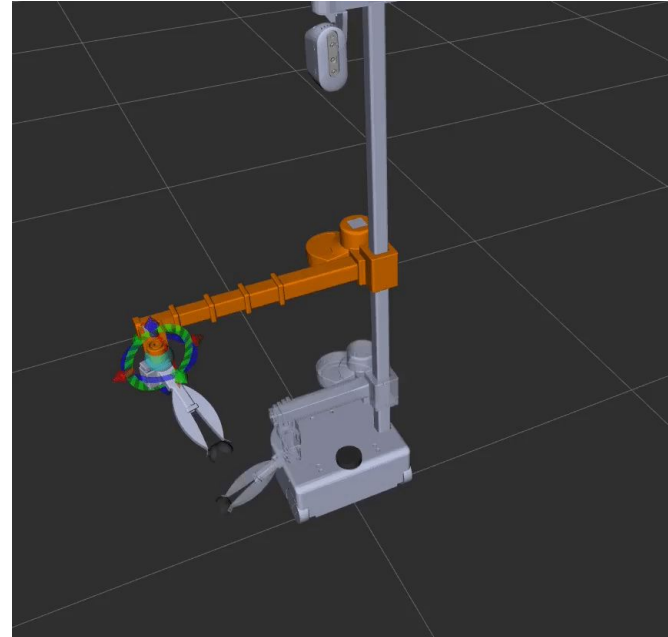
- How to secure communication with robot and sensors?
- MoveIt needs to be able to “trust” ROS control
- In reverse, ROS control access might be limited to MoveIt instance
- Still not a lot of hardware supported in ROS 2



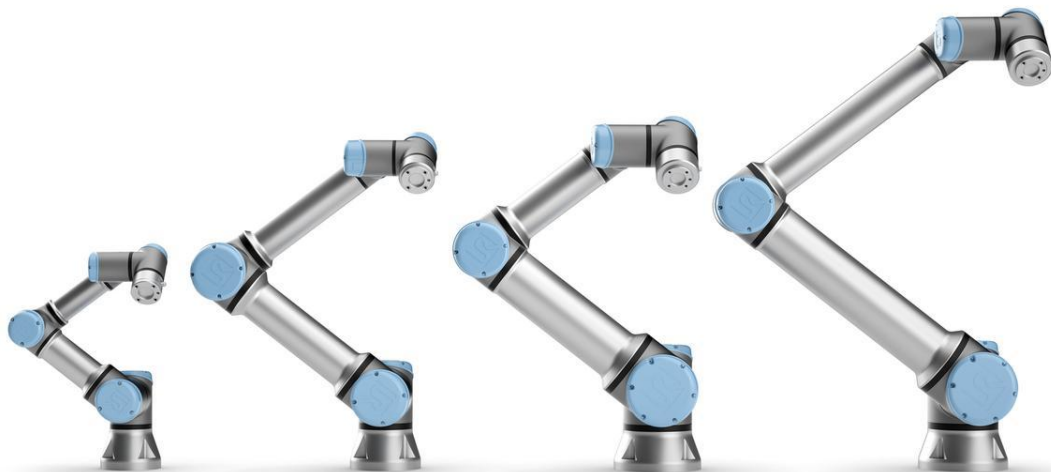
PickNik is working on multiple hardware integration efforts...



# Hello Robot - "Stretch"



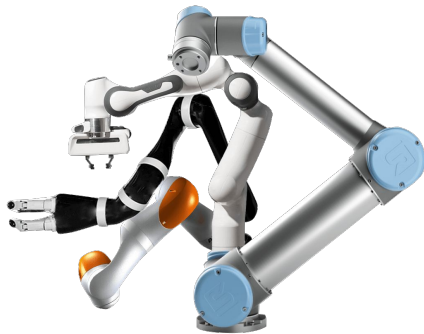
# Universal Robots - ROS 2 driver



# Securing Hardware Access

Example scenarios could involve real-world factors like:

- ROS communication over Wi-Fi
- Multiple conflicting MoveGroup instances
- Conflicting sensor topics or input devices
- ...



# Discussion