ROSCon 2019

Wheeled Humanoid Hubo ROS API

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KAIST

Hubo Lab
Humanoid Robot Research Center

1. Motivation

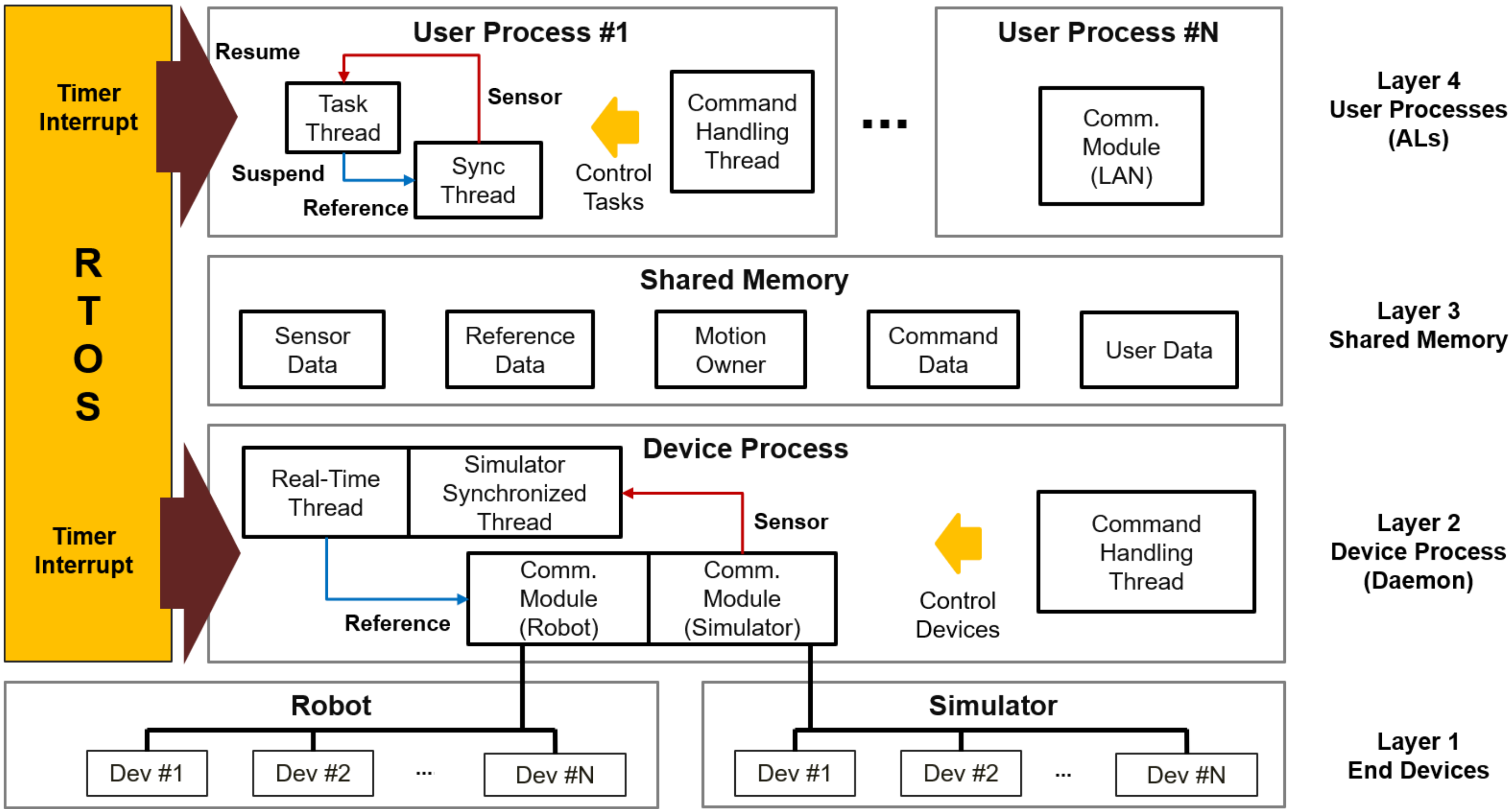
- **Strengths** of DARPA Robotics Challenge Winning Platform (Hardware)

Locomotion (Strong Actuators)

Manipulation (Precise Control)

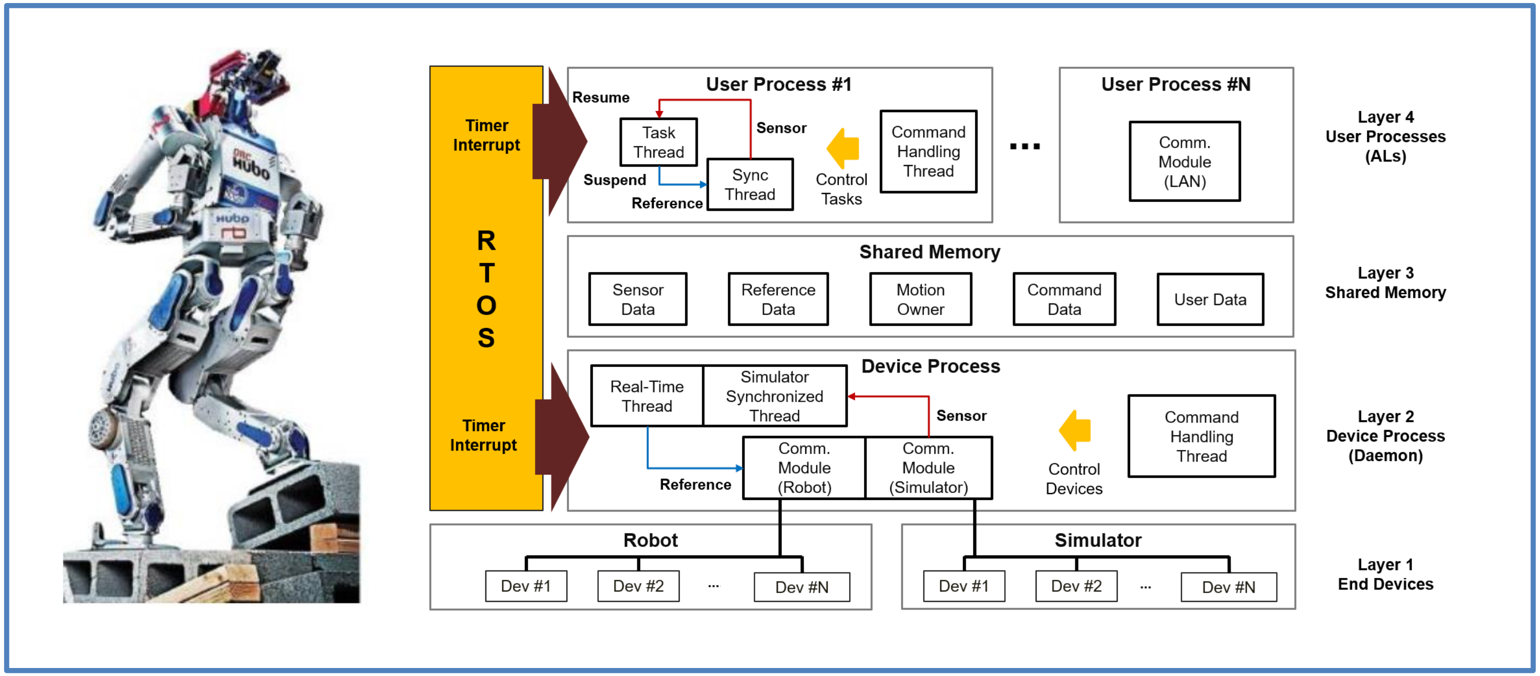
1. Motivation

- **Strengths** of DARPA Robotics Challenge Winning Platform (Software PODO)



1. Motivation

Strengths of DARPA Robotics Challenge Winning Platform



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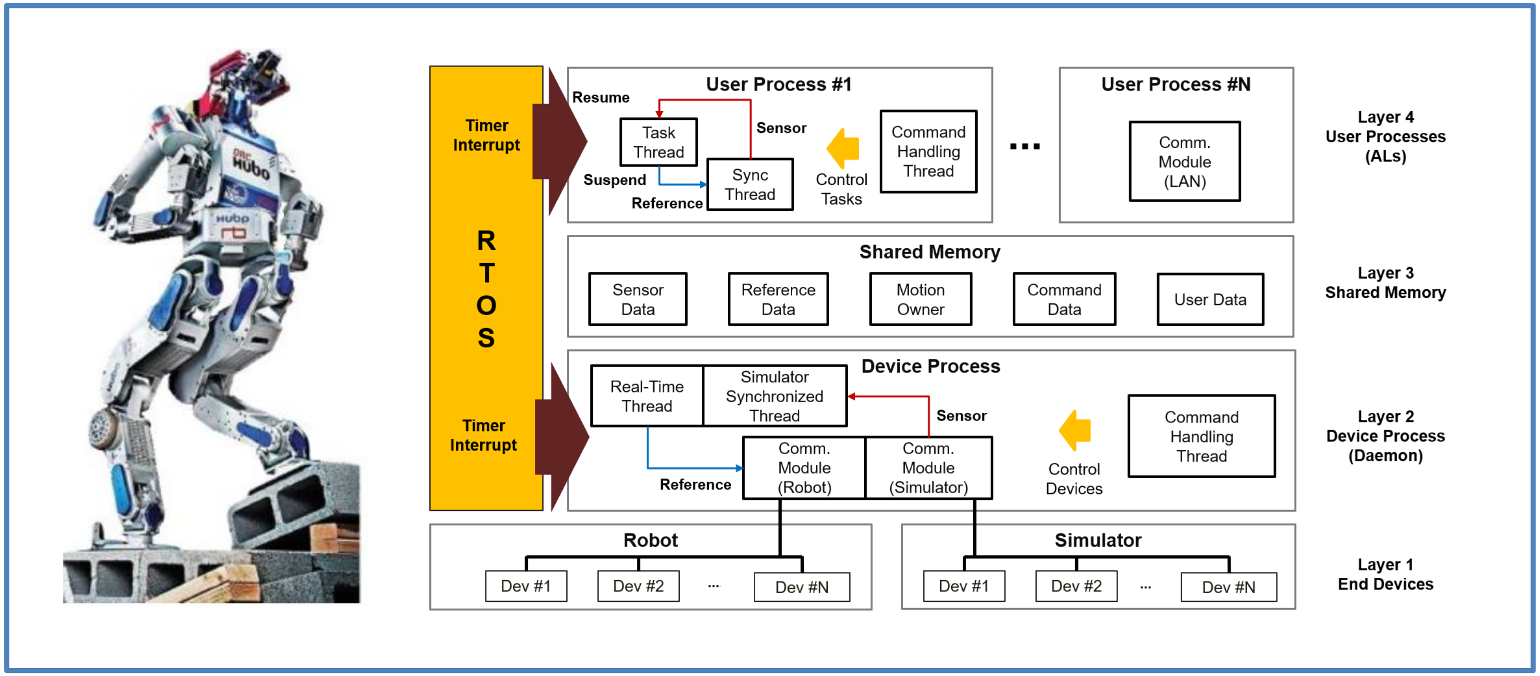

SGVR Lab

KIST Korea Institute of Science and Technology

DASL Drones and Autonomous Systems Lab @ UNLV

KAIST NMAIL Neuro-Machine Augmented Intelligence Lab

RIT Robot Intelligence Technology Laboratory Challenge for Knowledge Creation and Innovative Technology

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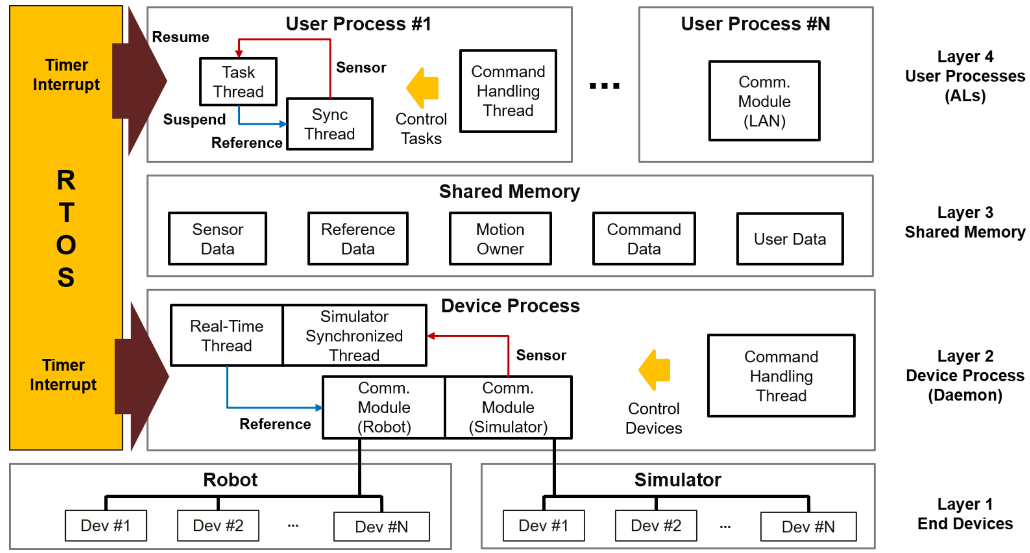
Strengths of DARPA Robotics Challenge Winning Platform



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Limitations?

DASL
Drones and Autonomous Systems Lab @ UNLV

NMAIL
Neuro-Machine Augmented Intelligence Lab

RIT Robot Intelligence Technology Laboratory
Challenge for Knowledge Creation and Innovative Technology

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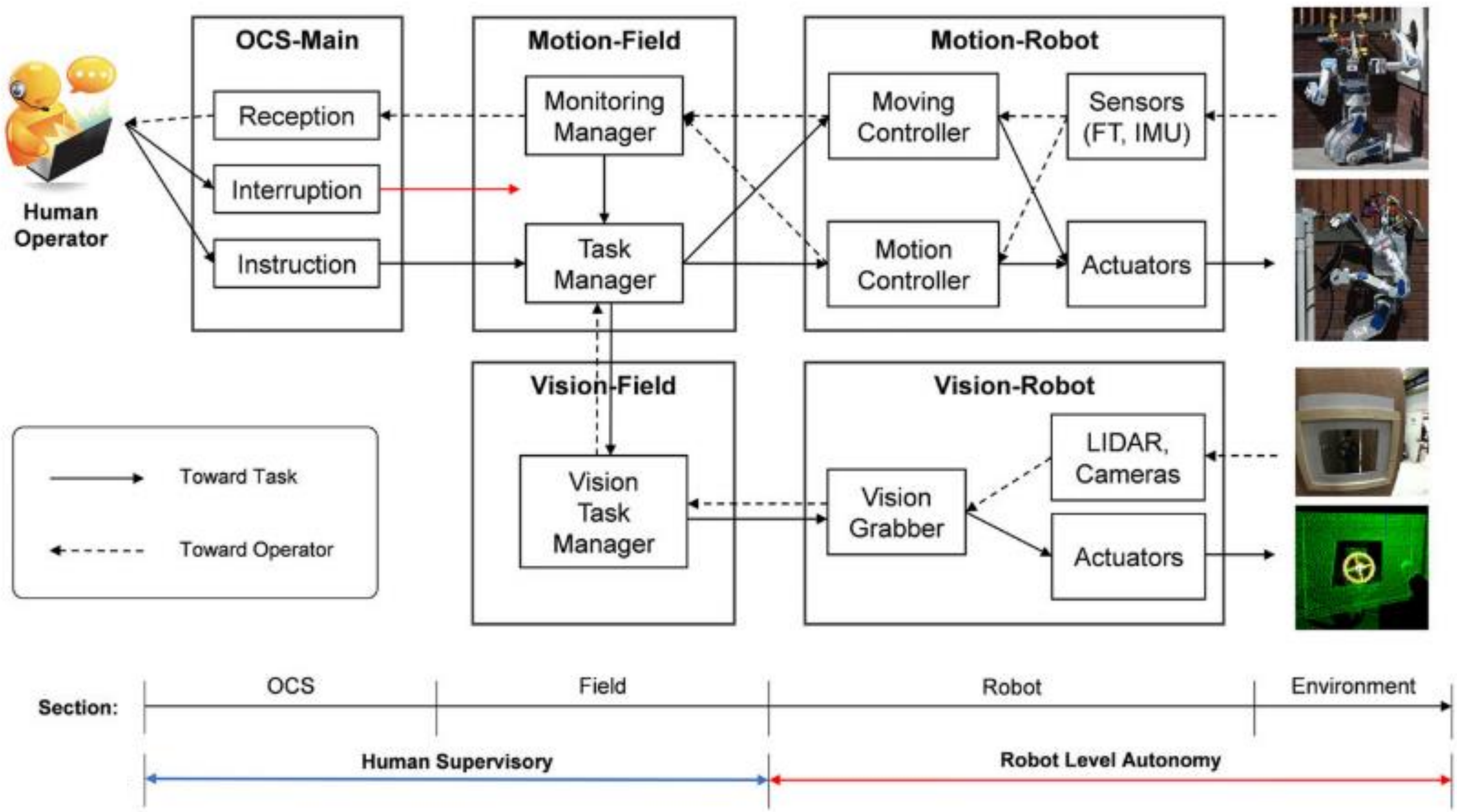
1. Motivation

Limitations of DARPA Robotics Challenge Winning Platform

SW for tele-operation & precise control → limited framework for autonomy



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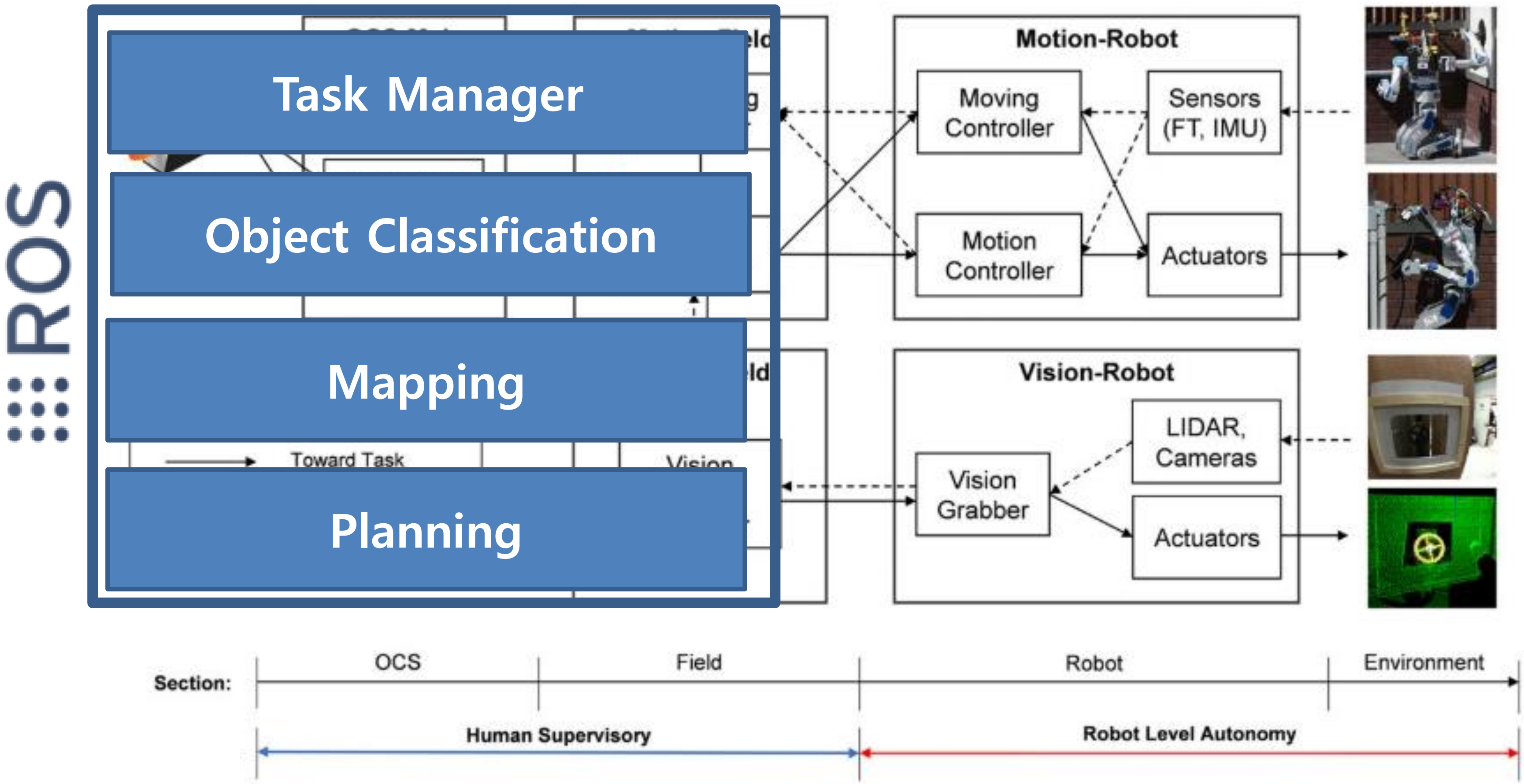
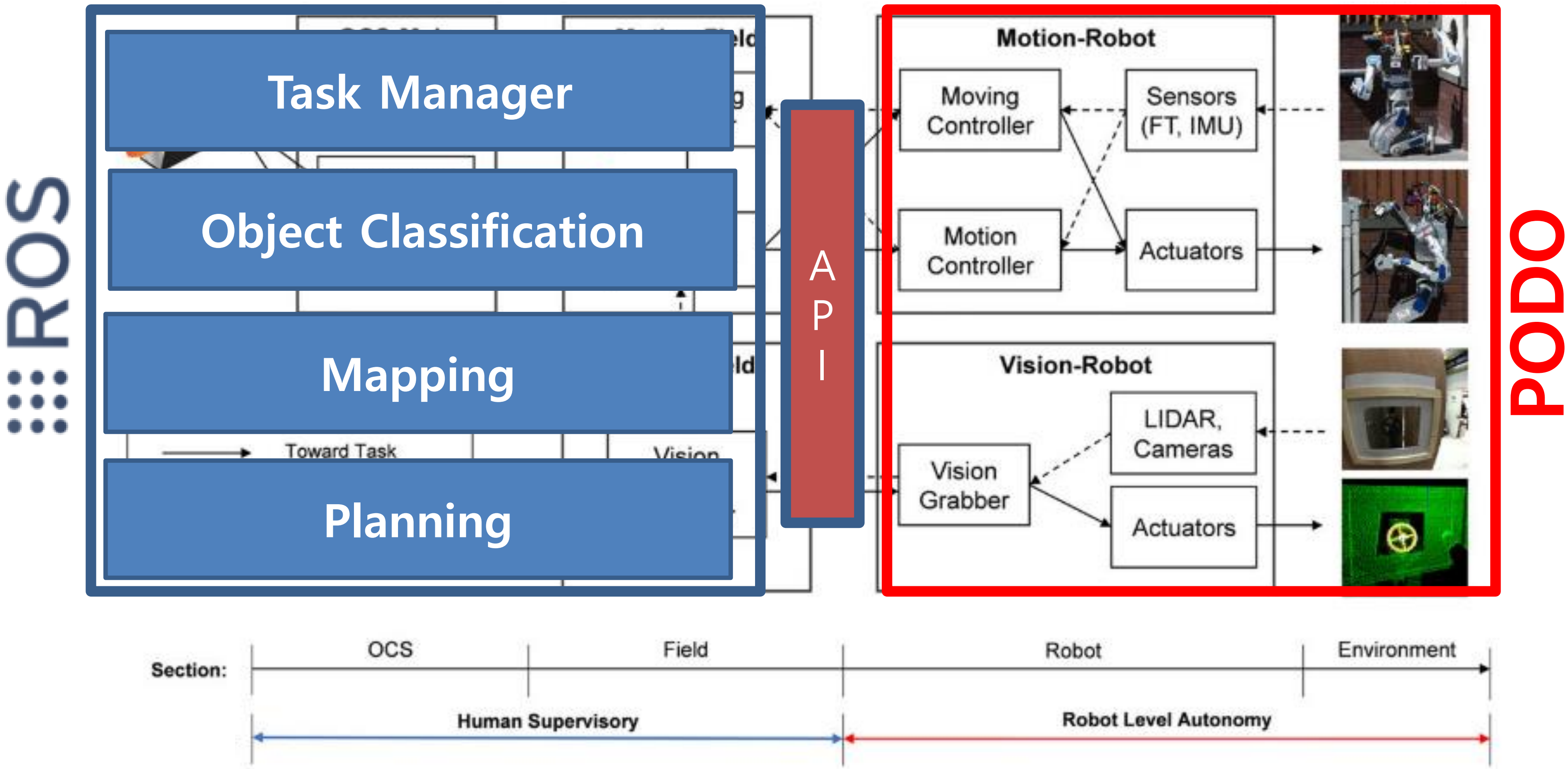


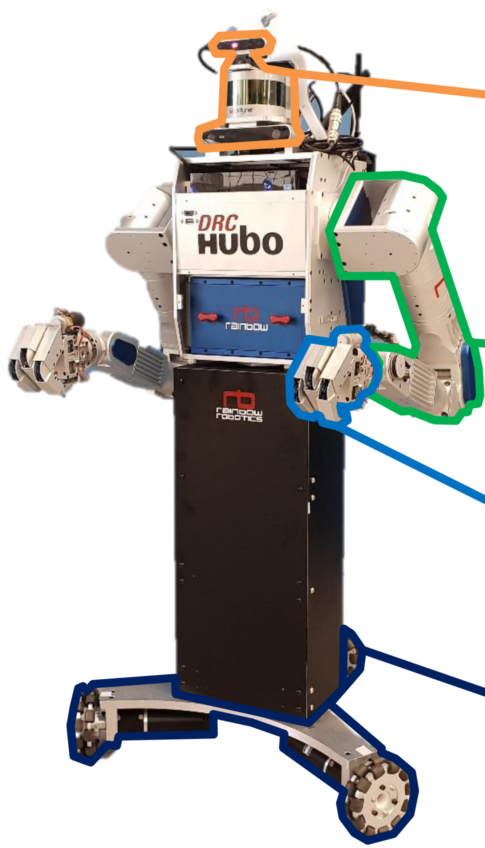
1. Motivation

- **Limitations** of DARPA Robotics Challenge Winning Platform
  - SW for tele-operation & precise control → limited framework for autonomy



2. Solution : API

Interface for Hubo platform in ROS

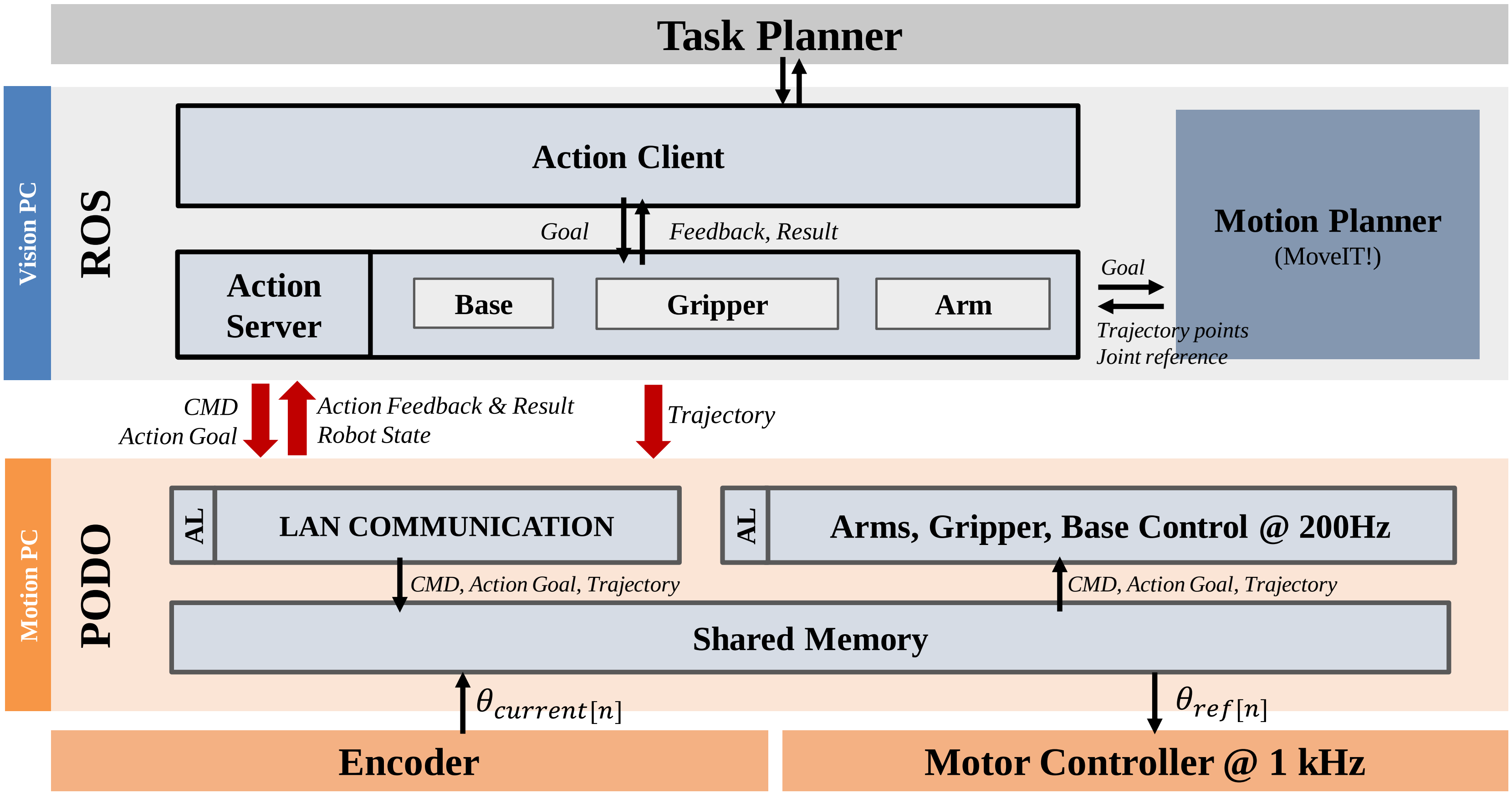


Mobile Hubo

Vision	**RGB-D Camera** **3D Lidar & IMU**
Arm	**Joint Space** Reference(angle), time **Task Space** Position(x,y,z), orientation(quaternion), time **Joint trajectory** Reference array
Gripper	**Open / Close** Side, command
Base	**Move goal** Position(x,y), orientation(yaw) Velocity(x,y), orientation(yaw)

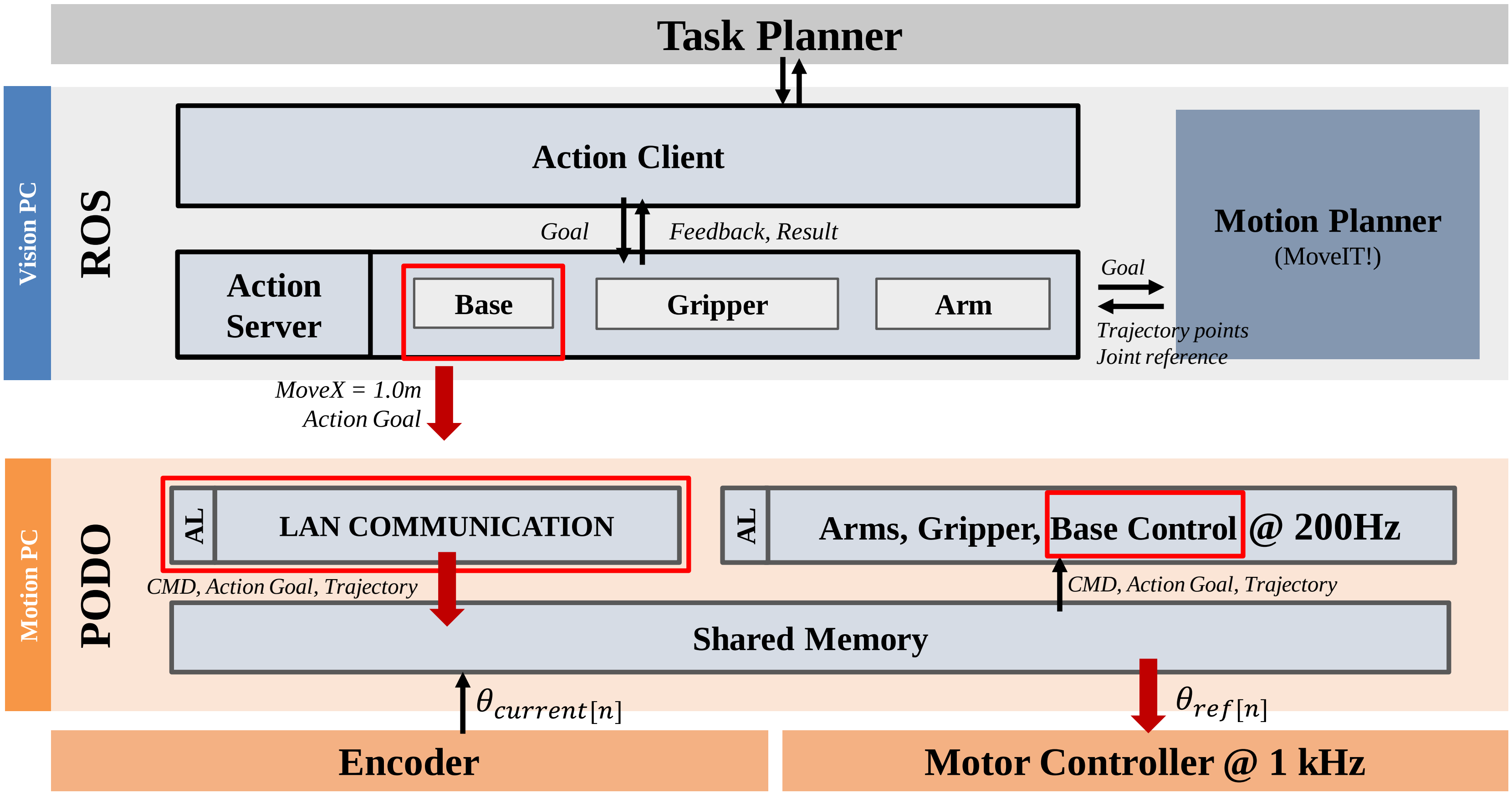
2. Solution : API

Software Architecture



2. Solution : API

Software Architecture



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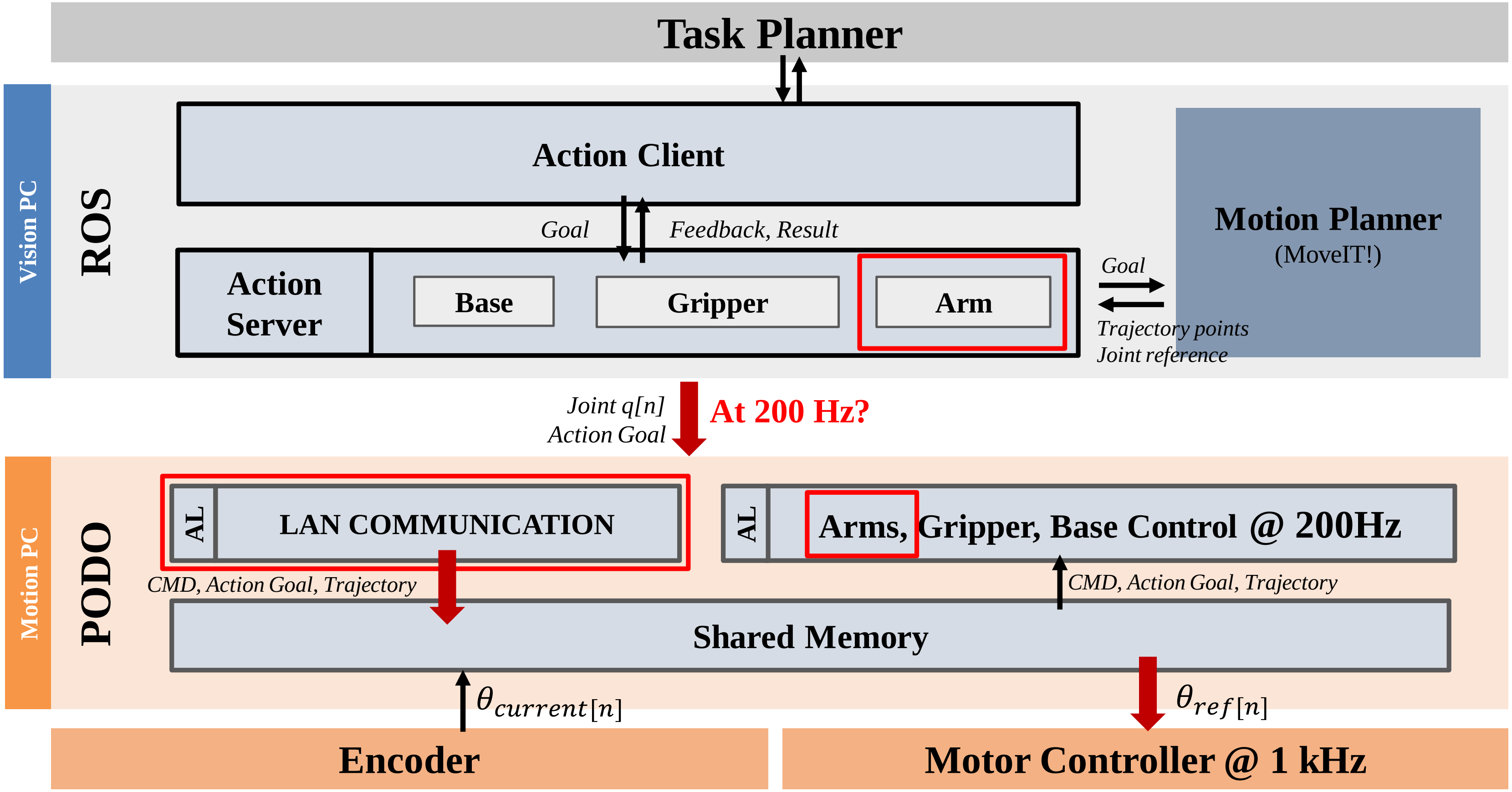
2. Solution : API

Software Architecture



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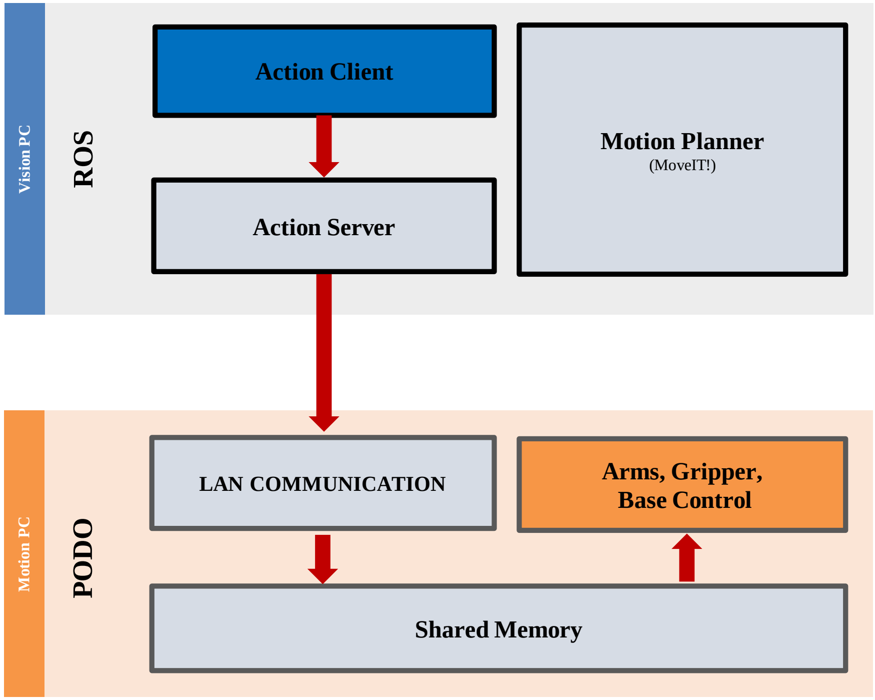
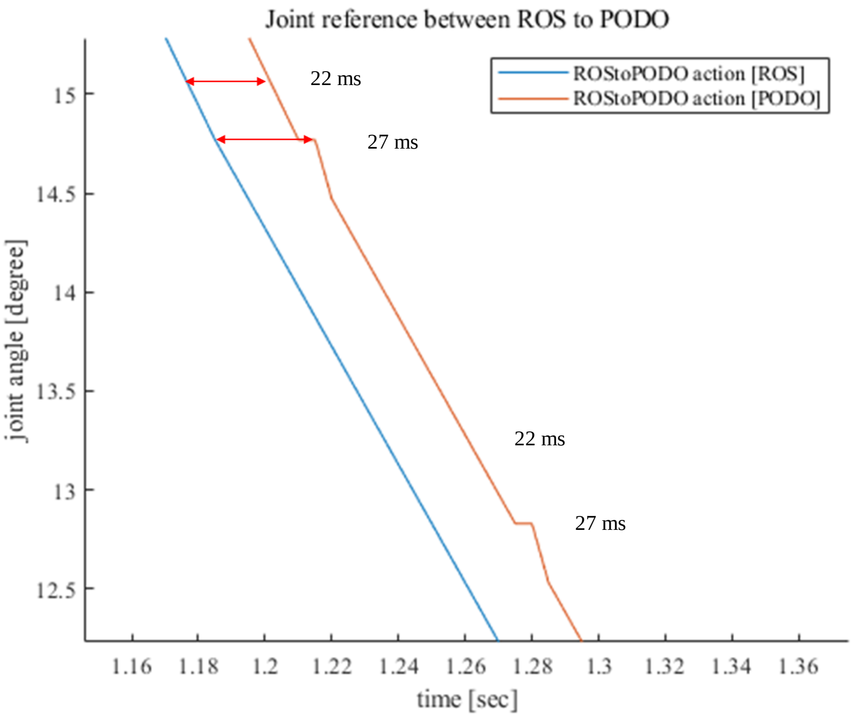
3. Problem: Delay

Communication Delay between ROS and PODO

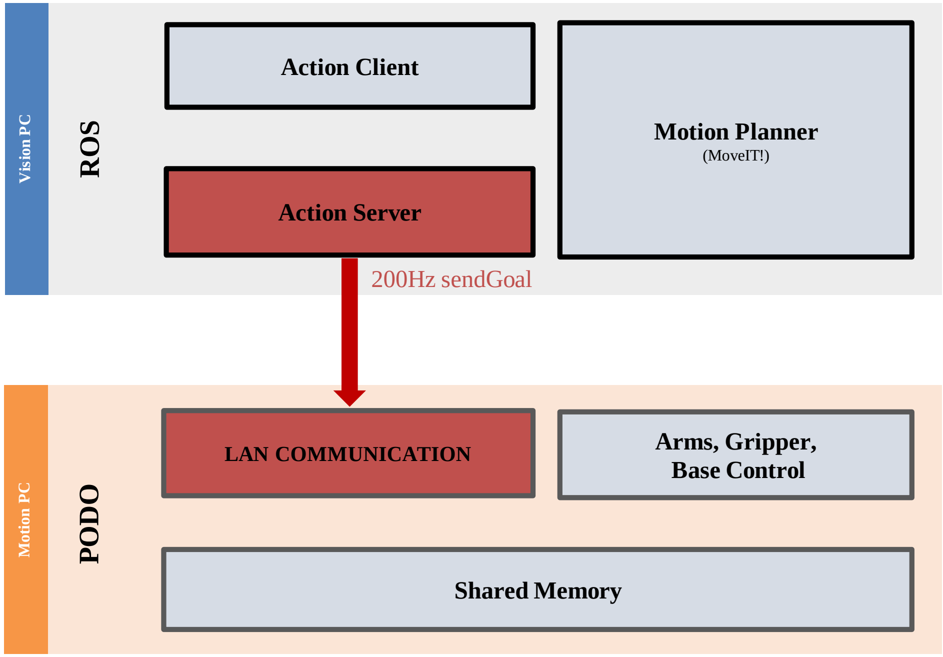


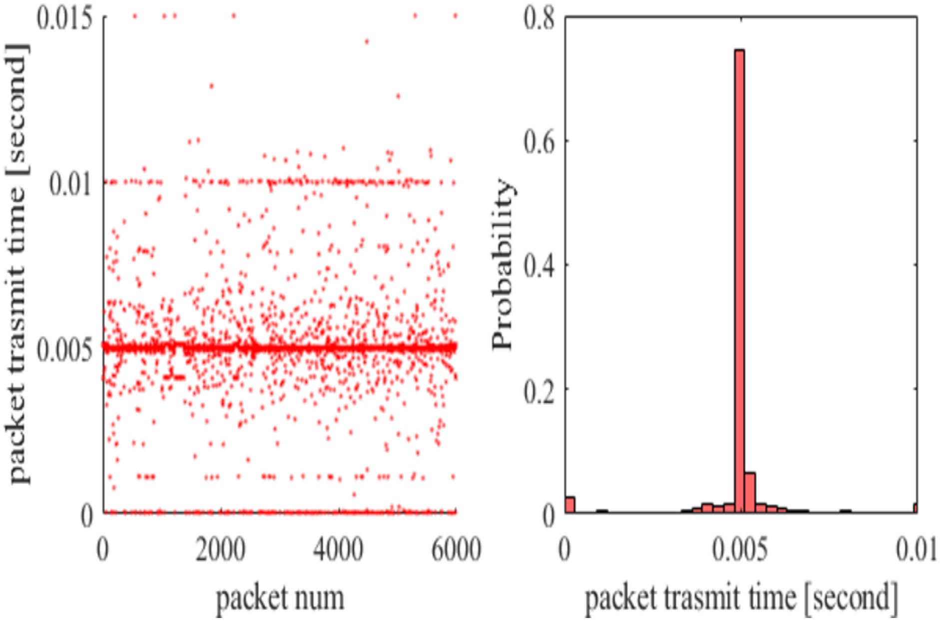


1. Total communication delay: 22 ms (on average)
2. Delay inconsistency from NRT & RT communication

3. Problem

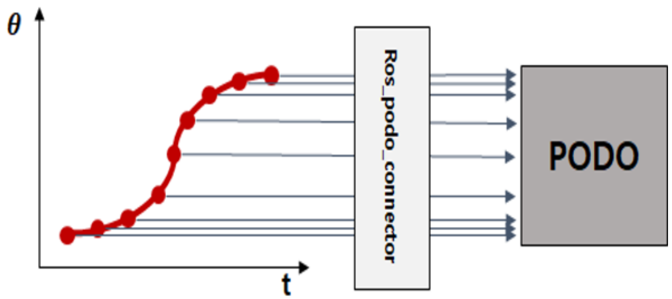
3 **Transmit time** of the packet from ROS to PODO



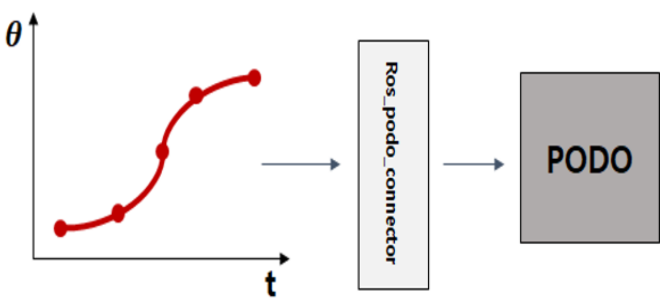


3. Problem

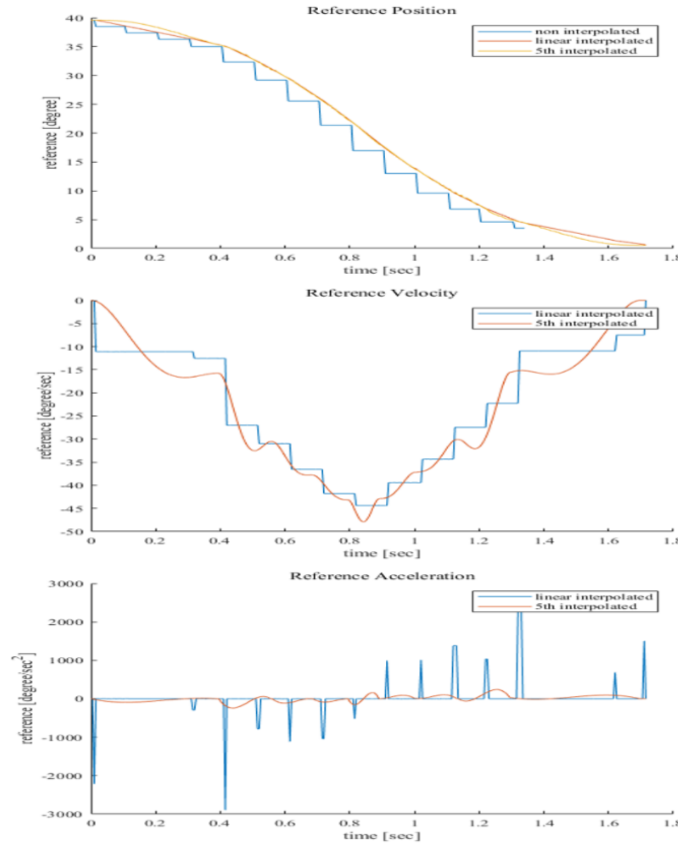
4 **The method** chosen to minimize the impact of delays



High-frequency-request

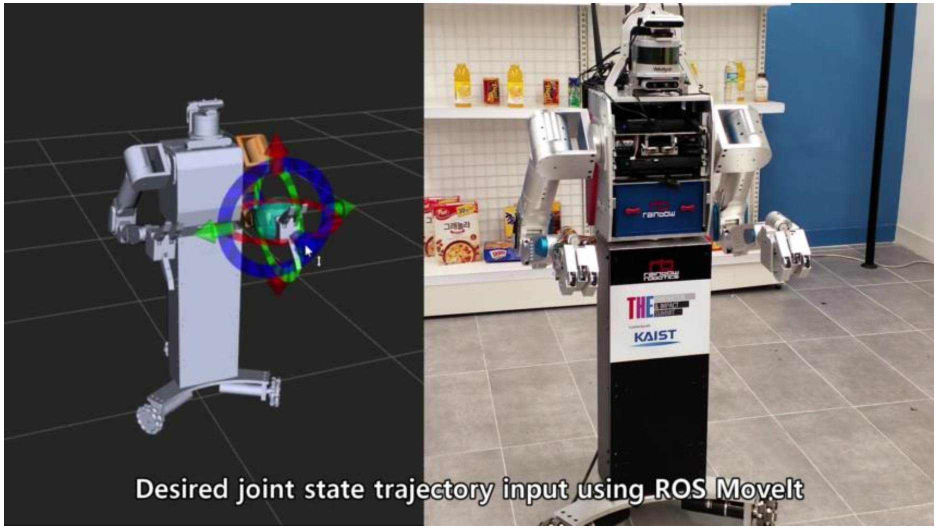


Single-request



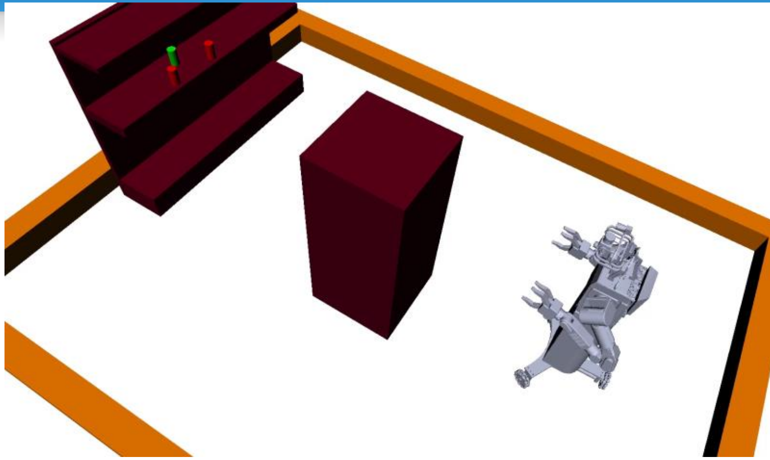
Interpolation

4. Result

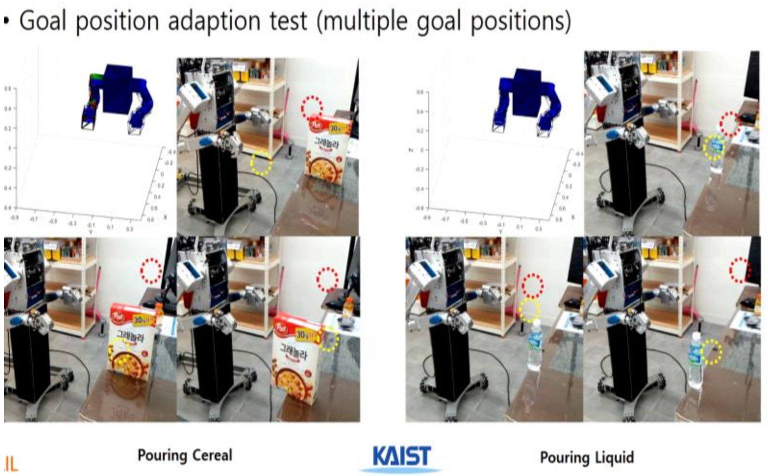

Desired joint state trajectory input using ROS MoveIt
KAIST


Collision-free path is generated for the robot

4. Result



Trajectory Planning:
Whole Body Collision Checking
SGVR Lab

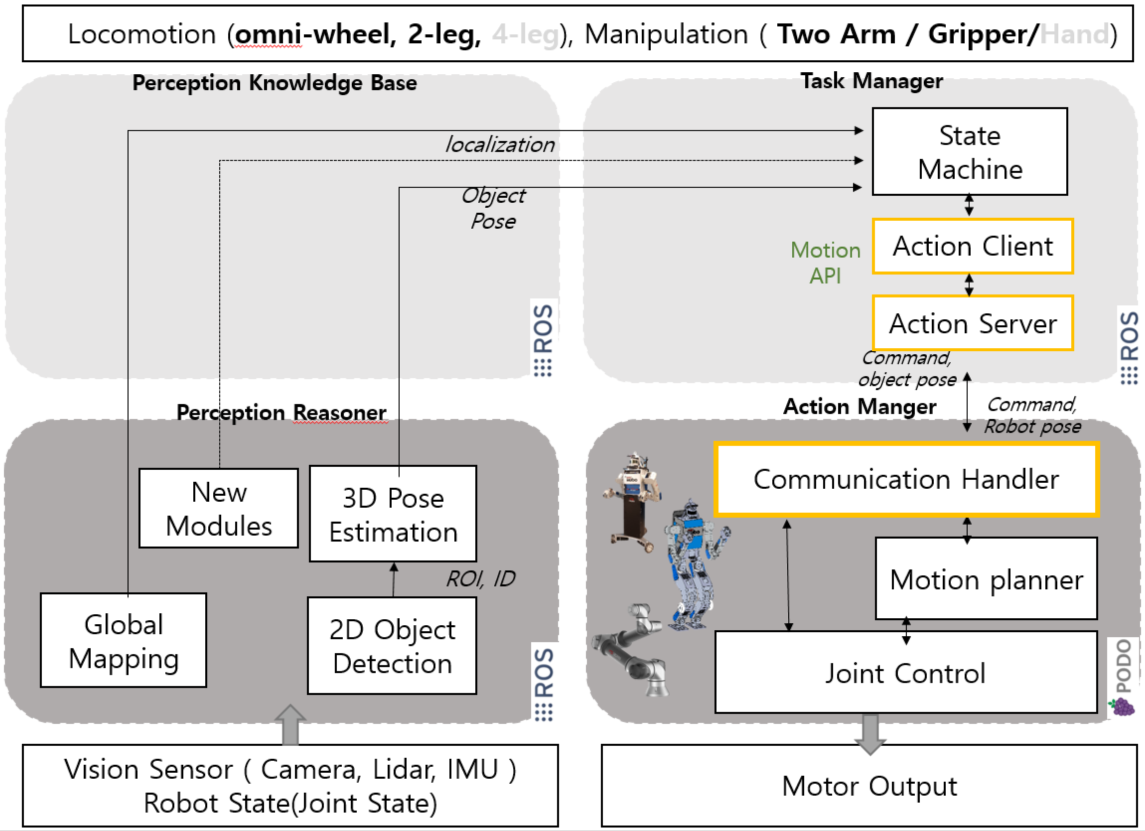


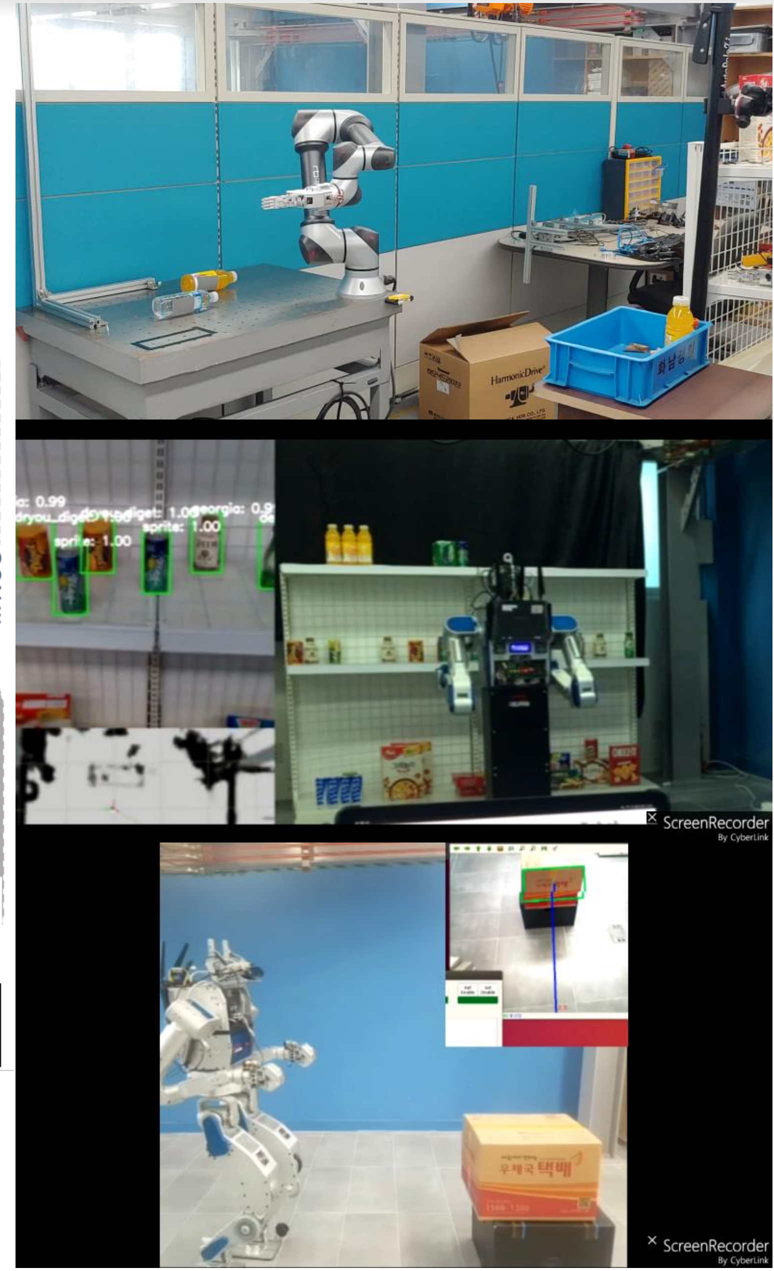
Machine Learning:
Learn from Human Imitation
NMAIL
Neuro-Machine Augmented Intelligence Lab

Task Manager:
Service Robot Application
Korea Institute of Science and Technology

5. Future work

Robot independent API with autonomy





Acknowledgements

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