Request for Study

OCU-Robot Communication

Overview

1.Robots are not yet full autonomous and therefore need to be remotely controlled

2. The goal of this study is to evaluate various solutions to the "communication" problem mainly in terms of performance.

3. The station remotely controlling the robot is traditionally called OCU: Operation Center Unit

Assumptions

We will start with the following assumptions:

1. The robot and the OCU are using internally ROS2 and work within their respective domain ID.

Clearly the communication between the two ROS2 worlds is the target of the study.

The setup

We need two computers with a configurable network between them: it should be a delay box with the possibility to simulate various network failures but specifically very long delays.

ROBOT: ROS2 Humble

1

Network
Failures
Simulator

3

OCU: ROS2 Humble

2
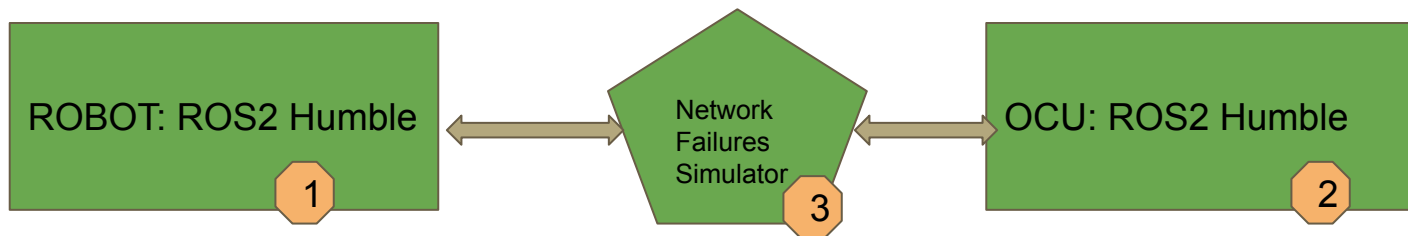
The robot

ROS2 Humble:
1. Receives and sends topics
2. Receives service request

Interface Software

1

1. The first set of tests will be done one a desktop station

2. Wireshark should be installed

3. For each set of tests, the following information should be stored:

1. Bag file on the robot
2. Logs and wireshark output when relevant

4. A second set of tests might be necessary to perform on the jetson

The OCU (Operational Central Unit)

ROS2 Humble:
1. Receives and sends topics
2. Sends service request

Interface Software

2

1. The OCU is a desktop station

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1. Bag file on the OCU
2. Logs and wireshark output when relevant

The network failure simulator ⑧ 3

The box between the OCU and the robot should implement the following functionality:

1. Add latency
2. Change bandwidth
3. Lose packets

Scenarii

The following scenarii will be executed:

1. **Discovery elimination**: we know beforehand the exact addresses and configuration of each end-point of the setup and we don't want any propagation of any packets related to discovery
    a. Options:
        i.   Unicast-based discovery
        ii. Centralized discovery
        iii. zenoh
    b. Processus:
        i.   Turn on robot: capture packets issued
        ii. Turn on OCU: capture issued packets
        iii. Turn off/on each one and examine behavior
        iv. Check if a steady state can be reach where without any activity, you don't have any activity on the network

Scenarii

1. **Reliability**: we will send topics and check if and how packets are lost
   a. Processus:
      i. From the OCU: run chatter (topic send /chatter)
         1. On the robot: check the way it arrives:timing
         2. Do the same with service
      ii. From the robot: run chatter
         1. On the OCU: records the way packets arrive
      iii. Check CPU consumption
   b. Data set:
      i. The size of the data sent will change progressively from 1 byte to the size of a point cloud
      ii. The frequency will change accordingly from 50 to 10 Hz
   c. QOS:
      i. Activating appropriate QOS can be a game changer so should be studied.