UNIVERSITÀ DEGLI STUDI DI MESSINA

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MicroROS implementation through different communication transport protocols

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1 Abstract

The final goal is to achieve microROS communication through other communication protocols like Bluetooth/BLE, LoraWAN, CANbus/fdCAN and automotive ethernet.

MicroROS communication works through a middleware called XRCE-DDS. DDS stands for "Data Distribution Service" which thanks to its way of communicating (publish-subscribe) it **ensures that datas are exchanged with low latency, high reliability and high scalability**.

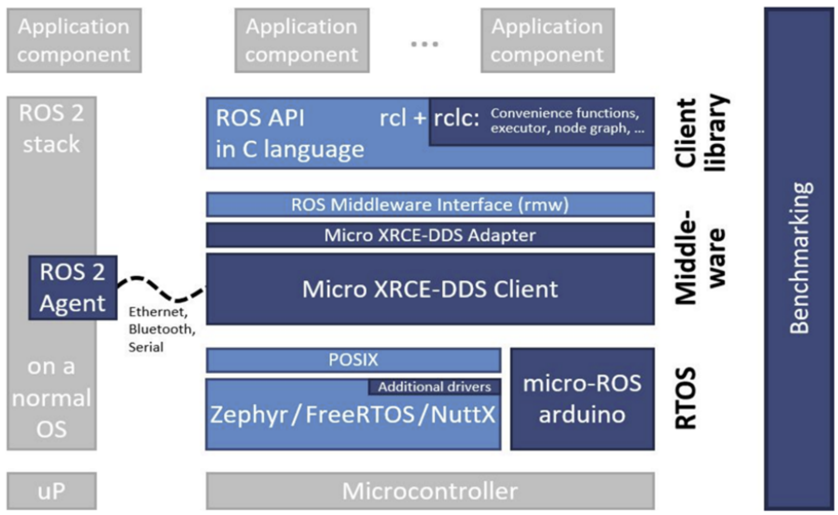

Figure 1: MicroROS communication architecture

With MicroROS it's possible to create topics to which you can subscribe and from which you can retrieve datas.

The advantage of this approach is going to be that once DDS is working with through different transport protocols, it's possible to exchange datas between sensors, actuators and other devices keeping DDS advantages.

A way of doing that can be through a central gateway (generally a computer) which contains an interface for every protocol used. **The central idea is then to replace the usual serial communication with wireless communications and other transports.**

2 General online documentation

MicroROS provides official documentation in order to implement custom transport protocols. All the informations about the implementations can be found in the official MicroROS documentaion: https: //micro.ros.org /docs /tutorials /advanced /create$_custom_transports$/.

A big role is played by **eProsima** which is the primary maintainer and contributor of Fast DDS, an implementation of the Data Distribution Service (DDS) protocol. EProsima provides examples and documentation with a focus on resource costrained enviroments. Useful informations can be found either on the following repository: https: //github.com /eProsima /Micro-XRCE-DDS /tree /master or in the following website: https: //micro-xrce-dds.docs.eprosima.com /en /latest /transport.html?highlight =hdlccustom-serial-transport which also depicts examples for Packet-oriented transports and Stream-oriented transports:

3 CANbus protocol overview

3.1 Online documentation

Looking for existing application of microros connection through CANbus on the internet, **several solutions can be found**. Eprosima, mentioned in chapter 2, published several sources of knowledge about these applications. On youtube it's possible to find the following video https: //www.youtube.com /watch?v=PSMqrtf5864 which shows a communication example applied in autonomous agricultural system using 2 different CAN protocols: **J1939 and CANOpen**.

At the beginning of the video it's shown which is the general architecture implementing both microROS and CANFD. (figures 2 and 3).

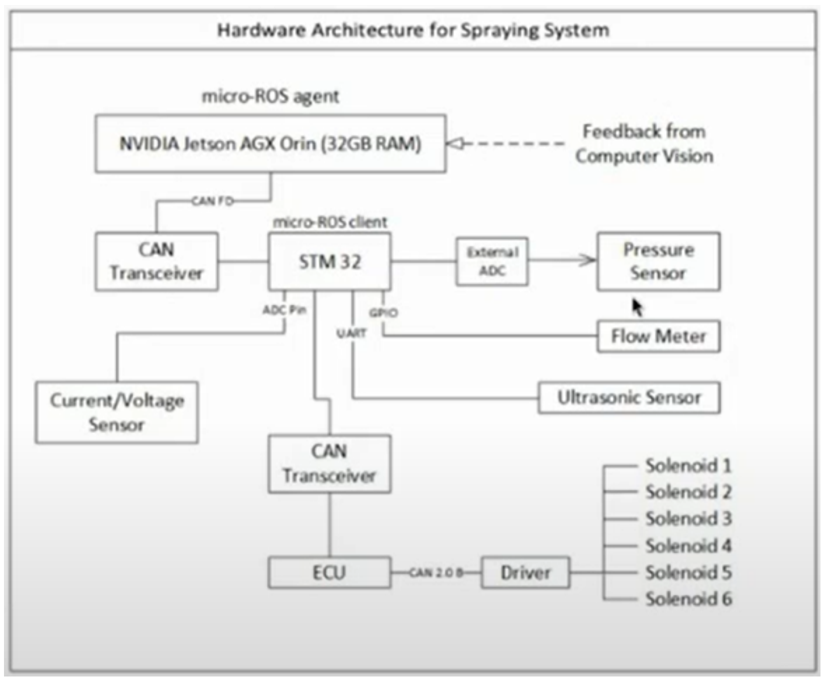

Figure 2: Communication architecture using microROS and CANFD

At the end of the video is shown the proof of work with a real time application (figure 4).

It's possible to see publisher and subscriber with datas retrieved by a camera.

Another interesting documentation can be found in a thesis which explains **how to implement CANbus over a ST microcontroller (STm32F446RE)**: https: //tesi.supsi.ch /4039 /1 /microros%20tesi.pdf

This thesis not only goes through how microROS and CAN works but offers

Figure 3: CAN bus communication using 2 hosts

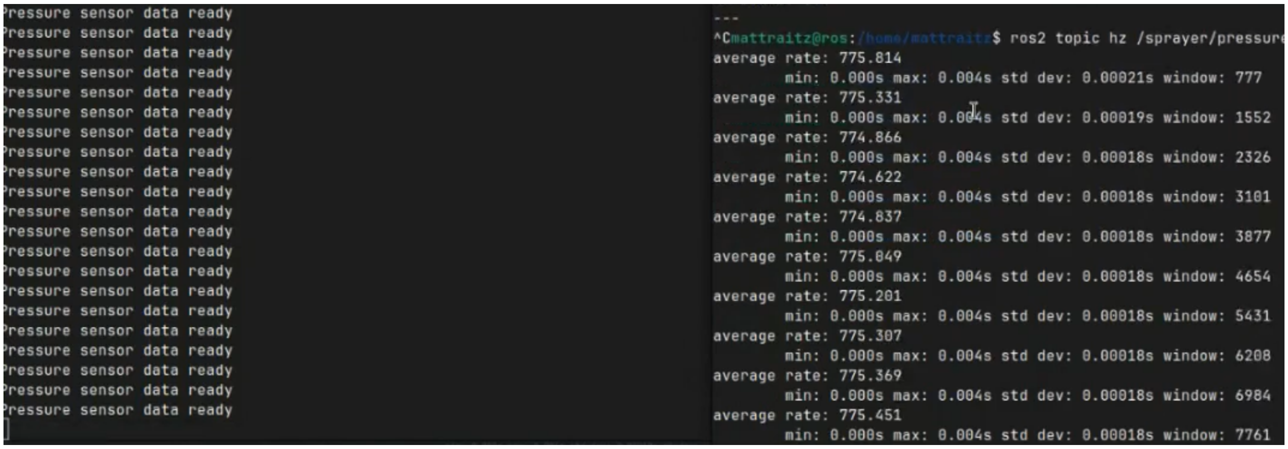

Figure 4: Working publisher and subscriber using CAN and microROS

implementations and example for how it is done.

Last but not least, online can be found reports on a specific **case scenario where microROS is implemented through UAVCAN**, in the following sources the discussion is described: https: //discourse.ros.org /t /uavcan-to-ros2-bridge /19672 /2; https: //forum.opencyphal.org /t /an-exploratory-study-uavcan-as-a-middleware-for-ros /872.

Further applications are described on the internet using renesas board which offer themselves more facilities to get through the process.

4 Bluetooth protocol overview

4.1 Online documentation

Online there is nothing that can be found about current applications, the only available contents are to be referred to the general documentation introduced in chapter 2.

5 LoraWAN protocol overview

5.1 Online documentation

Thanks to long distance transmissions ensured by LoRa, connecting it to ROS 2 would mean stepping up the game in terms of rescue teams in natural disaster using resource costrained hardware.

Unfortunatly, online there are no applications on LoRa + ROS 2 but they are limited to old ROS (ROS 1). Following, 3 applications are linked in order to give an idea of what can be found:

https: //www.instructables.com /Long-Range- Machine- Control- System- Using- Multiple-L/;

https: //hackaday.io /project /184672-long-range-machine-control-system /details;

https: //ieeexplore.ieee.org /stamp /stamp.jsp?arnumber=9783031.

6 Automotive ethernet protocol overview

6.1 Online documentation

As well as what shown in chapter 5.1, even when it comes to automotive ethernet there are many applications achieved only through ROS 1. Since we are interested in ROS 2 and its connection to microROS, in the following source **is shown an application that can get us closer to our needs**. In the following website https://adityakamath.github.io/2022-06-26-more-microros-examples/ it's documented an application which uses WiFi UDP transport instead of the serial one.