Orca — Orchestration and Reconfiguration Control Architecture

SHOWCASE 2

LOW LATENCY INDUSTRIAL COMMUNICATION

GOALS

This demonstration illustrates how effectively low-latency flexible SDRs establish a robust robot remote control in a real-world scenario.

CHALLENGES

- Providing low-latency communication in order to remotely balance inverse pendulum robots
- Increasing the network traffic and the number of robots while maintaining the robot's stability

CONCEPT

In this showcase, ORCA offers three various solutions:

- Low-latency IEEE 802.15.4 unslotted CSMA/CA (KUL)
- TDMA MAC based on low-latency PHY-MAC integration (IMEC)
- GFDM framework and FDMA MAC (TCD)

DEMO SET UP

- ORCA SC2 brings various wireless technologies together to form a non-homogeneous network, to build a real-time radio link in order to control a set of balancing robots (Fig. 1).
- Each robot transmits its sensory data, to the processing unit. This unit then processes the data and generates an appropriate command to keep the robot balanced (Fig. 2).
- To increase the traffic, the two nodes in the KUL network (Fig. 3) play both roles of the interface (for its own robot) and process unit (for the other node's robot).
- Through TCP/UDP link, a control unit can send a simultaneous command to all three networks. Hence, one can compare the networks' response time by observing the robot's reaction to the command.

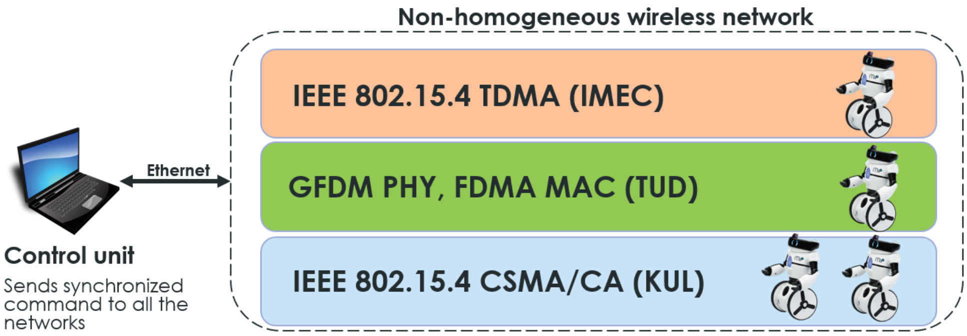

Fig. 1. ORCA Showcase 2, non-homogenous network for low-latency robot control

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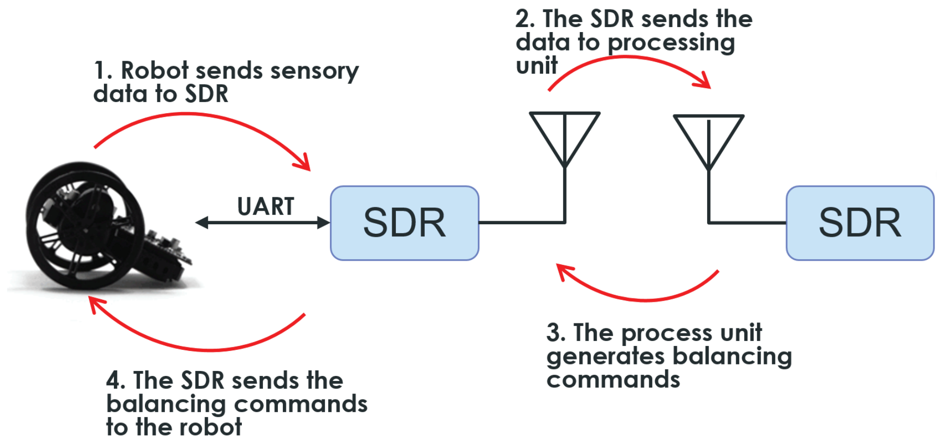

Fig. 2. Low-latency link for balancing robot, TDMA/FDMA

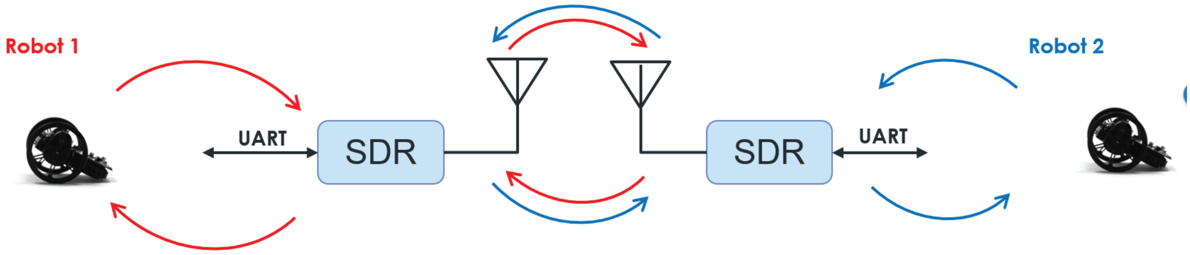

Fig. 3. Sharing spectrum between two robots using CSMA/CA

RESULTS

In this demo, ORCA shows a non-homogeneous network to control four balancing robots. Each sub-network provides reliable links. In fact, utilizing real-time SDRs in this showcase reveals that ORCA's solutions allow low-latency communication in real-world scenarios.

INNOVATION

In the KUL network, the innovative PHY/MAC architecture enables low-latency radio connection (1.3 ms PHY RTT) as well as run-time MAC programming to share the spectrum between more than one robot. In the IMEC network, the flexible framework TAISC is portable on several real embedded IoT devices and the communication between flexible IMEC-SDR and commercial IoT devices can be achieved. In addition, the GFDM transceiver in the TUD network allows adapting the physical layer to the demands of the network during runtime with reconfiguration times lower than 500 ns. Thus, very different waveforms can be used depending on the offered services.

IMPACT

The developed networks in SC2 open a wide perspective for researchers by employing three different technologies in a realistic scenario. In other words, it shows how ORCA facilitates experiments in which various networking technologies are required to perform a time-critical task.

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