ID17 BRIDGING HETEROGENEOUS NETWORKS IN CHALLENGING AND DISRUPTIVE MARITIME ENVIRONMENTS

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ABSTRACT

In this work, we describe the development of a system that aims to deal with different communication means when operating in a network of heterogeneous systems with ad-hoc behaviour that has proved helpful in real-life scenarios. Using the LSTS toolchain, we can support the deployment of ocean, surface and air vehicles, providing transparent communication between them in a fashion way.

Keywords – autonomous;systems; networks; bridging; toolchain.

INTRODUCTION

Recent advancements in autonomous vehicles, such as underwater (AUVs), surface (ASVs), and aerial vehicles (UASs), have led to an increasing use in a wide range of civil and military applications. With their increased capabilities, either as single units or as a team, they are being used for surveillance, search and rescue, oceanographic and atmospheric studies and infrastructure inspection, to name a few. This diversity, both at the level of scenarios and type of vehicles, leads to increased difficulty in guaranteed interoperability concerning communication between them and between different means.

This paper outlines the development and testing of a communication gateway – Manta, as a centralized communication hub for maritime assets, which provides support to different communication means for heterogeneous systems, using the LSTS software toolchain [1] in a real environment where oceanographic studies can take place.

CONTEXT & MOTIVATION

The pursuit of science is crucial in advancing our understanding of the world around us, including the complex ecosystems of the oceans. By studying the effects of pollution, climate change, and other stressors on marine life, we can develop strategies to protect and preserve these fragile environments. This is where the importance of scientific pursuit comes into play. It enables us to improve our ability to explore and study the oceans, leading to the development of new technologies that can enhance our understanding and allow us to take action to protect and maintain the maritime environment.With this pursuit in mind, over the past decade, at Laboratório de Sistemas e Tecnologias Subaquáticas (LSTS) based at the University of Porto [2], we have been designing, building and deploying AUVs, ASVs and UASs [3][4], as well as buoys and communication gateways, along with a powerful software toolchain, capable of integrating not only in-house built heterogeneous systems but also systems from other manufacturers.

In order to abstract the complexity of interacting with multiple and heterogeneous systems that can enter and exit the network in an ad-hoc way, there was a need for a hub that could act as an intermediary between these different systems, allowing them to communicate with each other even if they are using different communication protocols or frequencies. This can help to ensure that all systems in a multi-vehicle network are on the same page and that information is being shared effectively between them.

DEVELOPED WORK

To address this, we created a portable communication hub – The Manta gateway (Fig 1), which is essentially a rugged, waterproof enclosure with in-house developed electronics to support off-the-shelf communication modules, designed and built to allow multiple operators to control and monitor multiple vehicles in a networked environment over distinct platforms, running the LSTS toolchain on a single-board computer. The device is battery-powered for full autonomy and portability, capable of providing between a minimum of 8-hour uninterrupted operation, composed of different radio modules such as Wi-Fi (typically 2.4GHz), Iridium, GPS, GSM/4G, RFD868, and acoustic modems (compatible with SeaTrac[5], Evologics[6], uModem[7])

Fig 1. Manta gateway with two distinct acoustic modems

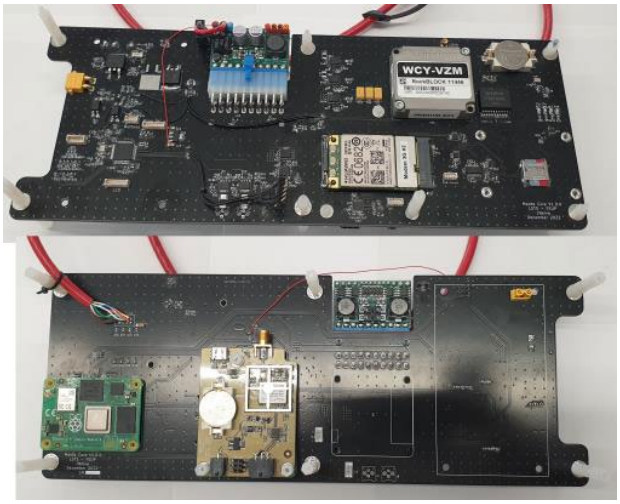

Fig 2. Manta main carrier board for V2

CONCLUSIONS AND FUTURE WORK

In conclusion, the Manta has emerged as a valuable tool for bridging communication between diverse assets and operators, using the LSTS toolchain to interface several different protocols. This technology has been used in various real-life scenarios, and its usefulness has been demonstrated in several exercises in recent years [8][9].

With the clear intention of further pursuing this topic, we also started working on a more modular and improved version (Fig 2) of the Manta that features a 'carrier' board concept, simplifying development and debugging for different modules that can be attached or removed as needed, also supporting latest 5G technology, and with an increased battery capacity to extend operation time further.

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