NEWSLETTER

DIGI4ECO PROJECT: 18 MONTHS OF ACHIEVEMENTS

The DIGI4ECO project has completed 18 months of impactful research and innovation, marking a period of significant achievements.

DIGI4ECO's first 18 months have been full of progress. Our technical work packages continue to advance toward ambitious goals, while the project's outreach has successfully shared its objectives and key highlights with a wider audience.

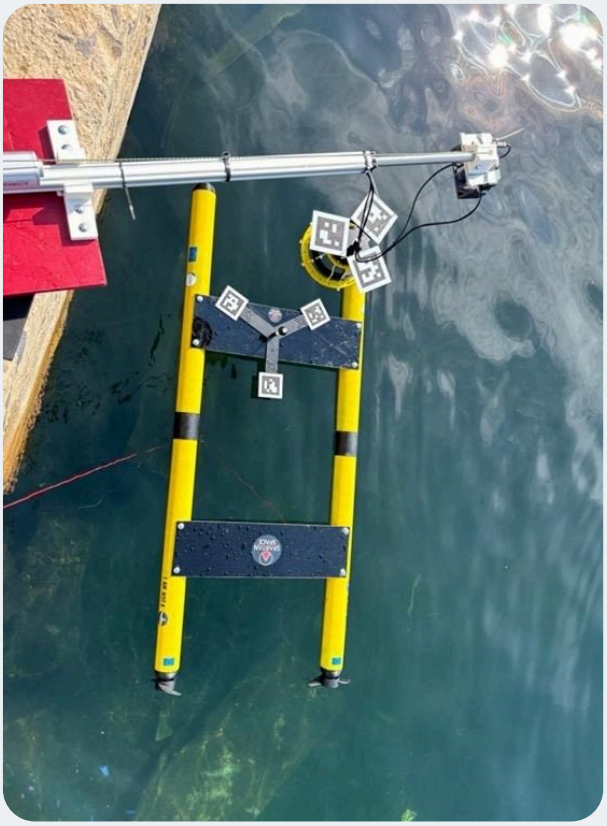
Funded by the European Union

DIGI4ECO has received funding from the European Union's Horizon Europe programme under grant agreement No 101112883.

NEWSLETTER

SCIENTIFIC UPDATES

SPARTAN SPACE AUTONOMOUS UNDERWATER VEHICLE (AUV)



Withing the framework of DIGI4ECO, SPARTAN SPACE is designing a docking mechanism that enables an Autonomous Underwater Vehicle (AUV) to be "captured" at sea and connected to an Unmanned Surface Vehicle (USV).

Such systems could in the future allow AUVs to

- be resupplied directly at sea
- recharge batteries or transmit data
- extende their endurance and making missions more efficient.

Initial tests with a vision-based docking system, conducted in harbour conditions using a mock-up AUV, have already been completed.

The next steps will focus on refining the system to increase its robustness, particularly for open-sea operations. The concept and technologies draw inspiration from space applications, where robotic rovers are resupplied in similar ways on the lunar surface.

Funded by the European Union

DIGI4ECO has received funding from the European Union's Horizon Europe programme under grant agreement No 101112883.

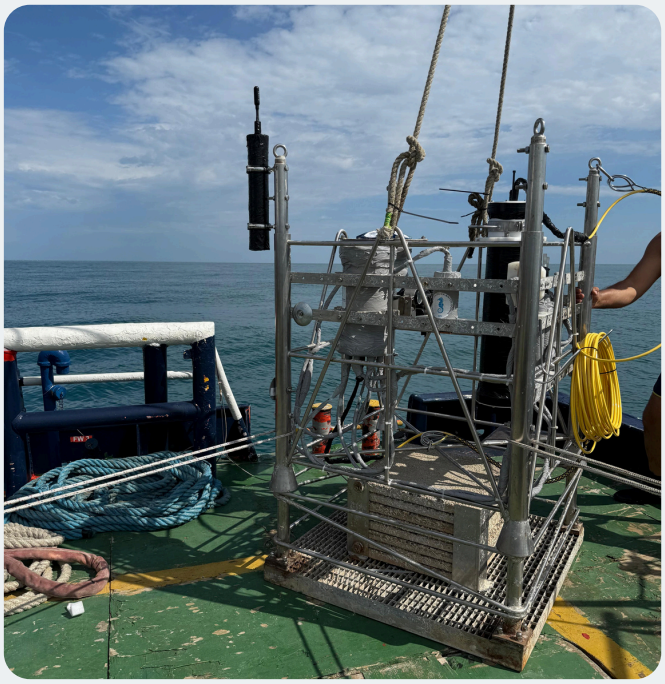
NEWSLETTER

SCIENTIFIC UPDATES

Deployment of underwater monitoring structure at DIGI4ECO Demo Site in Italy.

The team of Università Politecnica delle Marche (UNIVPM), in collaboration with Stazione Zoologica Anton Dohrn (SZN), successfully deployed an underwater monitoring structure at the DIGI4ECO Demonstration Site, located off the coast of Fano, Italy.

The structure is equipped with a range of multiparametric sensors that will enable continuous monitoring of environmental and oceanographic parameters.



Funded by the European Union

DIGI4ECO has received funding from the European Union's Horizon Europe programme under grant agreement No 101112883.

NEWSLETTER

SCIENTIFIC UPDATES

Deployment of underwater monitoring structure at DIGI4ECO Demo Site in Italy.

Among the instruments there are:

- **CTD sensor (Conductivity, Temperature, Depth) for profiling water column properties.**
- **Optical sensors for measuring turbidity and chlorophyll-a fluorescence.**
- **Dissolved oxygen and CH4 probes.**
- **Current meter (ADCP).**
- **Underwater camera.**
- **Hydrophone.**

Through this platform, DIGI4ECO will gather high-resolution, time-series data important for understanding the ecosystem dynamics occurring in coastal areas of the Adriatic Sea, allowing the replicability and the expansion of the sustainable solutions to other regions.

Funded by the European Union

DIGI4ECO has received funding from the European Union's Horizon Europe programme under grant agreement No 101112883.

NEWSLETTER

DISSEMINATION ACTIVITIES

DIGI4ECO at European Researchers' Night 2025!

UNIVPM proudly took part once again in SHARPER – the European Researchers' Night, the large-scale dissemination event that celebrates research and innovation across Europe.

The initiative, held on 26 September 2025, brought science to the main streets and squares of Ancona and 14 other Italian cities, connecting researchers and citizens through talks, exhibitions, and interactive activities.

Funded by the European Union

DIGI4ECO has received funding from the European Union's Horizon Europe programme under grant agreement No 101112883.

NEWSLETTER

DISSEMINATION ACTIVITIES

DIGI4ECO at European Researchers' Night 2025!

At the Life and Environmental Sciences – DIVSA stand, a dedicated space was devoted to the DIGI4ECO project, where a poster illustrated the project's main objectives, activities, and expected results. Researchers from UNIVPM engaged with visitors, explaining how DIGI4ECO contributes to the sustainable management of marine ecosystems through digital innovation.

The stand also offered educational games and creative activities for children, aimed at raising awareness of marine biodiversity and the impacts of fishing on the environment.

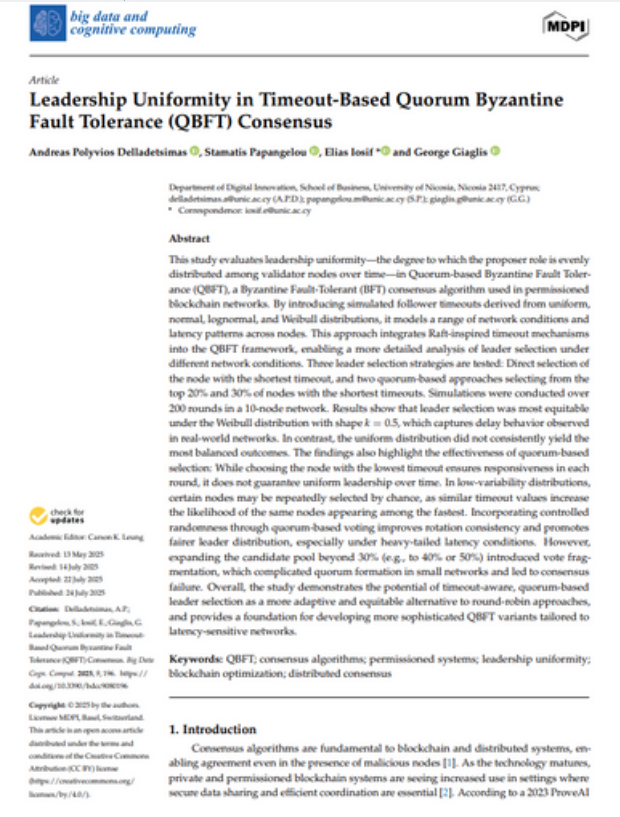
Through its participation in SHARPER, UNIVPM and DIGI4ECO reaffirmed their commitment to science communication and public engagement, promoting a deeper understanding of marine research and the importance of sustainability for the ecosystems that support us all.

Funded by the European Union

DIGI4ECO has received funding from the European Union's Horizon Europe programme under grant agreement No 101112883.

NEWSLETTER

JOURNAL PUBLICATIONS



big data and cognitive computing

MDPI

Article

Leadership Uniformity in Timeout-Based Quorum Byzantine Fault Tolerance (QBFT) Consensus

Andreas Polyvios Delladetsimas, Stamatis Papangelou, Elias Iosif * and George Giaglis

Department of Digital Innovation, School of Business, University of Nicosia, Nicosia 2417, Cyprus; delladetsimas.a@unic.ac.cy (A.P.D.); papangelou.m@unic.ac.cy (S.P.); giaglis.g@unic.ac.cy (G.G.)
* Correspondence: iosif.e@unic.ac.cy

Abstract

This study evaluates leadership uniformity—the degree to which the proposer role is evenly distributed among validator nodes over time—in Quorum-based Byzantine Fault Tolerance (QBFT), a Byzantine Fault-Tolerant (BFT) consensus algorithm used in permissioned blockchain networks. By introducing simulated follower timeouts derived from uniform, normal, lognormal, and Weibull distributions, it models a range of network conditions and latency patterns across nodes. This approach integrates Raft-inspired timeout mechanisms into the QBFT framework, enabling a more detailed analysis of leader selection under different network conditions. Three leader selection strategies are tested: Direct selection of the node with the shortest timeout, and two quorum-based approaches selecting from the top 20% and 30% of nodes with the shortest timeouts. Simulations were conducted over 200 rounds in a 10-node network. Results show that leader selection was most equitable under the Weibull distribution with shape $k = 0.5$, which captures delay behavior observed in real-world networks. In contrast, the uniform distribution did not consistently yield the most balanced outcomes. The findings also highlight the effectiveness of quorum-based selection: While choosing the node with the lowest timeout ensures responsiveness in each round, it does not guarantee uniform leadership over time. In low-variability distributions, certain nodes may be repeatedly selected by chance, as similar timeout values increase the likelihood of the same nodes appearing among the fastest. Incorporating controlled randomness through quorum-based voting improves rotation consistency and promotes fairer leader distribution, especially under heavy-tailed latency conditions. However, expanding the candidate pool beyond 30% (e.g., to 40% or 50%) introduced vote fragmentation, which complicated quorum formation in small networks and led to consensus failure. Overall, the study demonstrates the potential of timeout-aware, quorum-based leader selection as a more adaptive and equitable alternative to round-robin approaches, and provides a foundation for developing more sophisticated QBFT variants tailored to latency-sensitive networks.

Keywords: QBFT; consensus algorithms; permissioned systems; leadership uniformity; blockchain optimization; distributed consensus

1. Introduction

Consensus algorithms are fundamental to blockchain and distributed systems, enabling agreement even in the presence of malicious nodes [1]. As the technology matures, private and permissioned blockchain systems are seeing increased use in settings where secure data sharing and efficient coordination are essential [2]. According to a 2023 ProveAI

“Leadership Uniformity in Timeout-Based Quorum Byzantine Fault Tolerance (QBFT) Consensus”

DOI: https://doi.org/10.3390/computers13120329

“A digital-twin strategy using robots for marine ecosystem monitoring”

DOI: https://doi.org/10.1016/j.ecoinf.2025.103409

Ecological Informatics 91 (2025) 103409

Contents lists available at ScienceDirect

Ecological Informatics

journal homepage: www.elsevier.com/locate/ecolinf

ELSEVIER

A digital-twin strategy using robots for marine ecosystem monitoring

Jacopo Aguzzi, Elias Chatzidouros, Damianos Chatzievangelou, Morane Clavel-Henry, Sascha Flögel, Nixon Bahamon, Michael Tangerlini, Laurenz Thomsen, Giacomo Picardi, Joan Navarro, Ivan Masmitja, Nathan J. Robinson, Tim Nattkemper, Sergio Stefanni, José Quintana, Ricard Campos, Rafael García, Emanuela Fanelli, Marco Francescangeli, Luca Mirimin, Roberto Danovaro, Daniel Mihai Toma, Joaquín Del Rio-Fernandez, Enoc Martinez, Pol Baños, Oriol Prat, David Sarria, Matias Carandell, Jonathan White, Thomas Parissis, Stavroula Panagiotidou, Juliana Quevedo, Silvia Gallegati, Jordi Grinyó, Erik Simon-Lledo, Joan B. Company, Jennifer Doyle

ARTICLE INFO

Keywords:
Marine monitoring
Robotic platforms
Data integration
Ecological indicators
Machine learning
Spatial modelling

ABSTRACT

Effective marine conservation and management require ecological monitoring in the form of intensive real-time data collection over large spatial scales. The combined use of fixed platforms (e.g., cabled observatories) and research vessels with platforms of different levels of teleoperated autonomy (e.g., remotely operated vehicles (ROVs) and autonomous underwater vehicles (AUVs) can contribute to the acquisition of large multiparametric biological and environmental data. If those data are spatially combined, sufficient spatial coverage can be achieved for ecological monitoring. A digital twin of the ocean (DTO) approach can then be used as a virtual representation of that monitored space, enabling multiparametric analyses of environmental patterns and processes affecting biodiversity and species distributions, as well as socioeconomic activities. Here, we propose a general architecture for a DTO centred on real-time data collection from local networks on fixed and mobile platforms, such as the physical twin observers (PTO), which is synergistically merged with platforms operating at large geographic scales. We describe a roadmap to achieve this DTO via 4 key steps: (1) acquisition of in situ data with a robotic network of platforms; (2) the application of AI in image processing for extracting biological data; (3) big data management with data bubbles; and (4) development of the resulting DTO framework for providing ecosystem monitoring via the computation of ecological indicators and socioecological modelling.

* Corresponding author at: Paseo Marítimo de la Barceloneta 37-49, 08003 Barcelona, Spain.
E-mail address: jaguzzi@icm.csic.es (J. Aguzzi).

https://doi.org/10.1016/j.ecoinf.2025.103409
Received 20 August 2024; Received in revised form 30 July 2025; Accepted 26 August 2025
Available online 28 August 2025
1574-9541/© 2025 The Authors. Published by Elsevier B.V. This is an open access article under the CC BY license (http://creativecommons.org/licenses/by/4.0/).

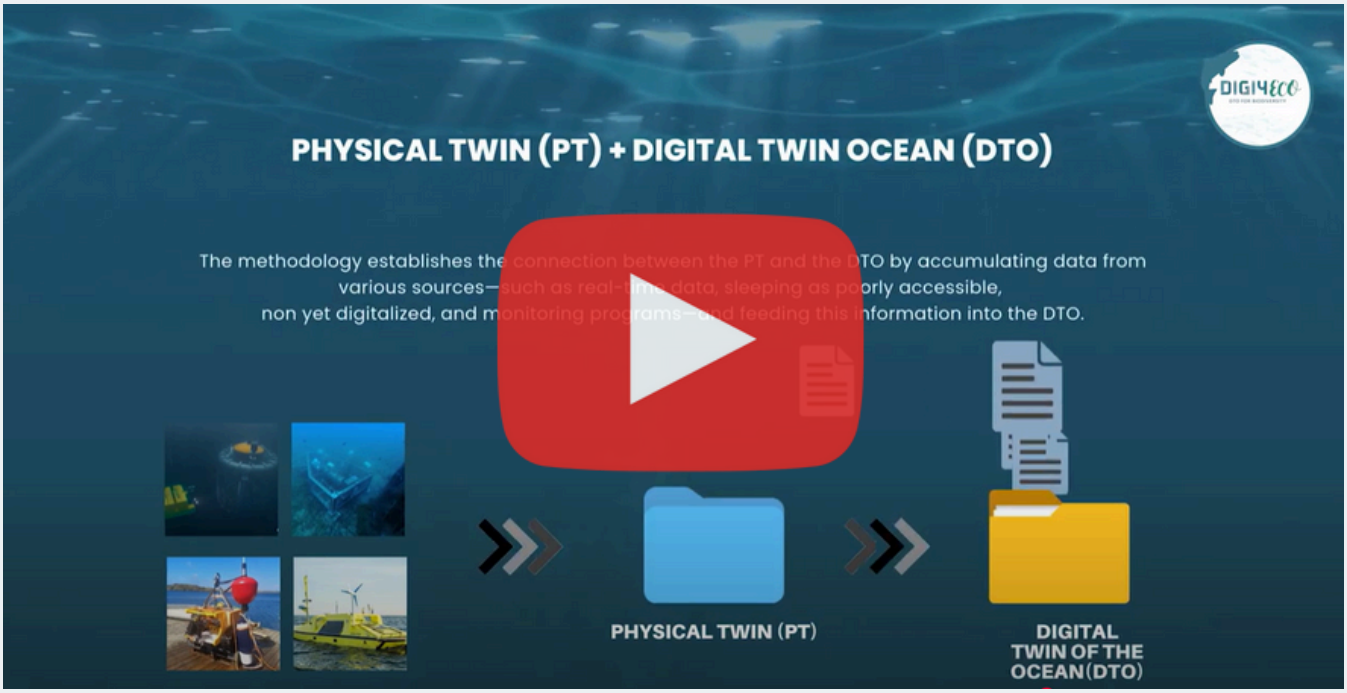
Funded by the European Union

DIGI4ECO has received funding from the European Union’s Horizon Europe programme under grant agreement No 101112883.

NEWSLETTER

WANT TO LEARN MORE ABOUT DIGI4ECO?

DON'T FORGET TO WATCH OUR OFFICIAL VIDEO!



In just a few minutes, the video introduces the project's main goals and explains the specifications of the PTO-DTO architecture and different work aspects in relation to data elaboration.

WATCH THE VIDEO

Funded by the European Union

DIGI4ECO has received funding from the European Union's Horizon Europe programme under grant agreement No 101112883.

NEWSLETTER

OUR TEAM

Funded by the European Union

DIGI4ECO has received funding from the European Union's Horizon Europe programme under grant agreement No 101112883.

NEWSLETTER

Stay in Contact

https://digi4eco.eu/

@DIGI4ECO

@DIGI4ECO

@DIGI4ECO

Funded by the European Union

DIGI4ECO has received funding from the European Union's Horizon Europe programme under grant agreement No 101112883.