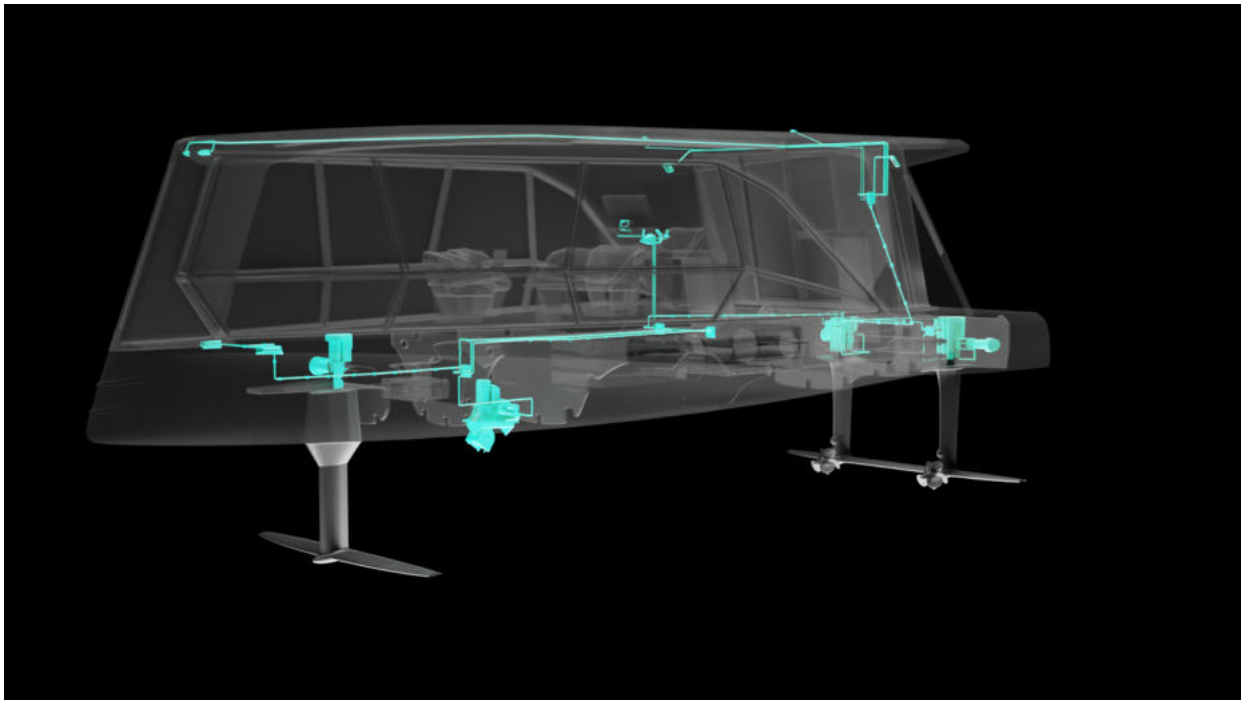
Oceanflight Innovation Plattform

Cornerstone for the future of boating



1 Introduction

In the evolving world of boating, achieving optimal efficiency, safety, and user comfort requires a significant rethink of traditional onboard electronics. Recognizing this need, we developed the Oceanflight Innovation Platform. This revolutionary hardware solution acts as a central nervous system for boats, seamlessly integrating with a wide range of third-party components. It transforms fragmented control systems into a unified, interactive network.

Unlike conventional setups where each supplier's control system and interface contribute to a cluttered and isolated helm station, the Oceanflight Innovation Platform offers a cohesive solution. It provides a flexible and adaptable system, easily extendable with additional interface boxes to meet the unique needs of every shipyard. This new paradigm simplifies the integration of advanced technologies, paving the way for modern, efficient boat operations.

2 Product Overview:

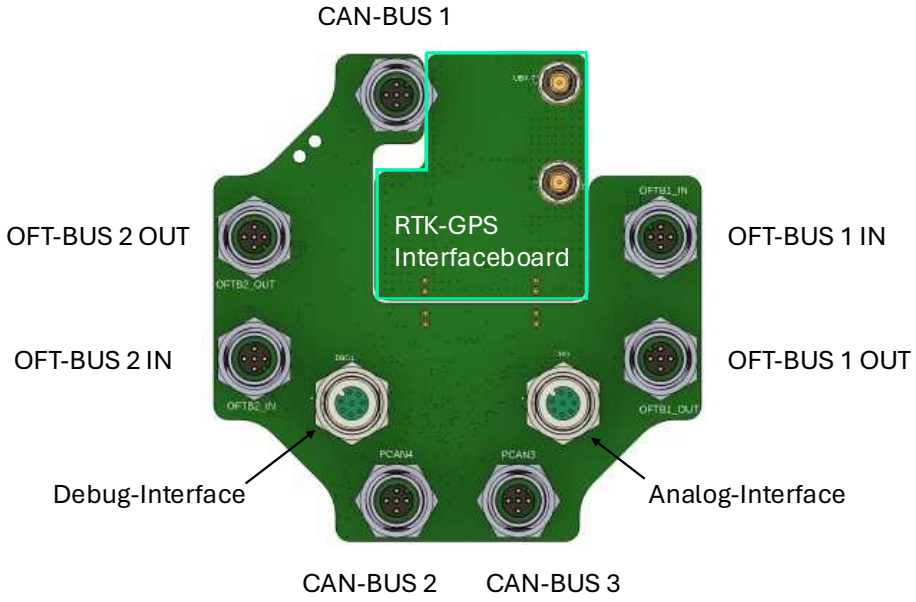
Caption 1: Universal Communication Node (UCN) with RTK.GPT-Interface

The Oceanflight Innovation Platform is composed of two essential hardware units: the Central Compute Unit (CCU) and the Universal Communication Node (UCN). Both units share the same robust housing but are tailored with distinct electronics and interfaces to fulfill their specific roles.

At the heart of the platform is the Central Compute Unit (CCU). It features a microcontroller for real-time operations and a Linux compute board for high-level tasks. The CCU is equipped with dual CAN interfaces for peripheral devices such as motors, rudders, and thrusters, an Ethernet interface, a debug interface, an 8-pin analog interface, and dual redundant communication interfaces for internal networking.

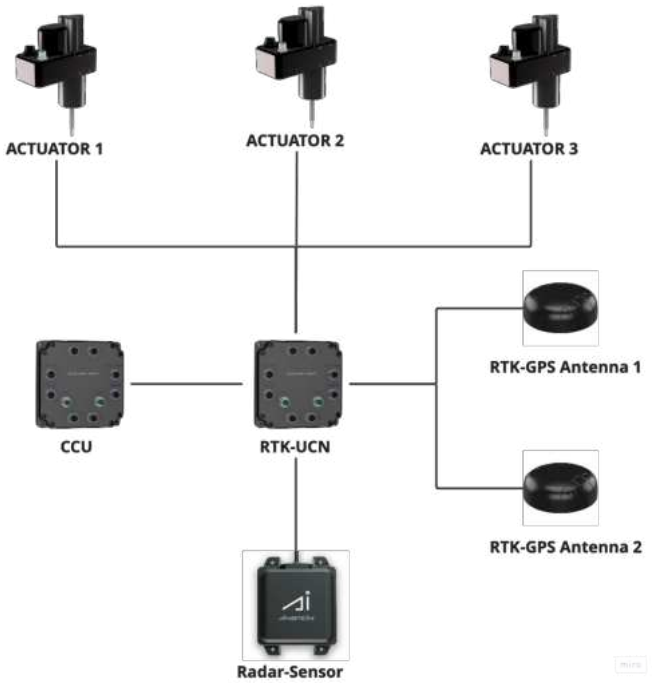
Complementing the CCU is the Universal Communication Node (UCN), which facilitates connections with various third-party components. The UCN also includes redundant communication interfaces for the internal network, as well as debug and analog interfaces. It is outfitted with three additional CAN-Bus interfaces, catering to the 90% of marine components that use NMEA 2000. For the remaining 10%, the UCN can be customized with a small interface board to support other communication protocols, such as RTK-GPS for precise positional data.

Both the CCU and UCN are housed in an IP67-rated enclosure, ensuring durability and reliability in marine environments.

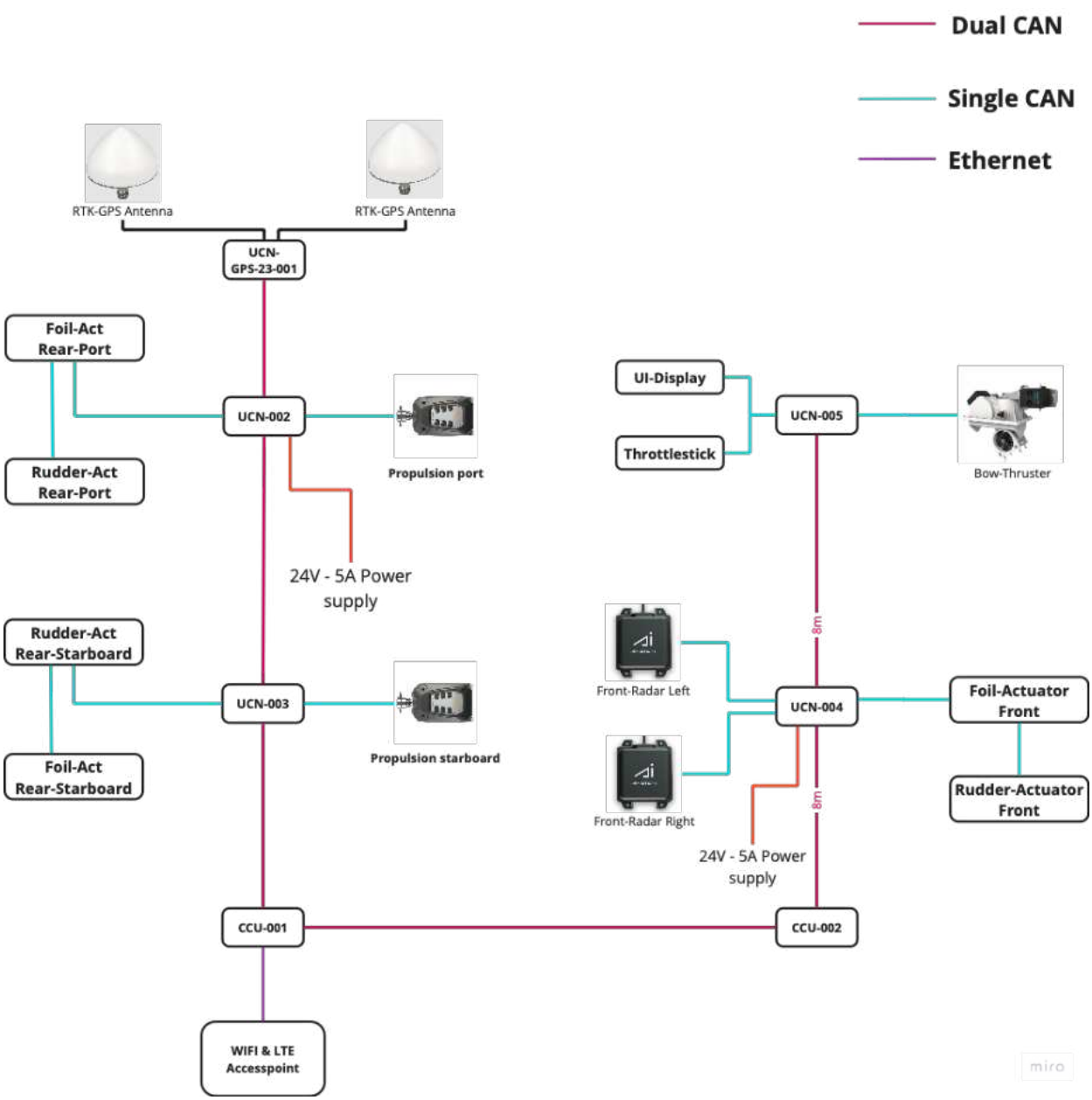


Caption 2: Interfaces of an UCN

These two Hardware components allows to build various network configurations, from very simple ones for small boats like at Caption 3, over medium complex systems for bigger leisure boats like at Caption 4, up to very complex ones for big boats and ferries.



Caption 3: Example of an Oceanflight Network for a simple and small Foiling Boat



Caption 4: Example of an Oceanflight Network with medium complexity

3 Technology and Features:

3.1 Flight control

One key feature of our system is the integrated flight control. The minimal setup includes a Central Compute Unit (CCU) and an RTK-GPS, plus one additional radar sensor for height sensing. All other necessary sensors, such as the Inertial Measurement Unit (IMU), are already integrated into each CCU. This integration sets our system apart. Unlike many competitors who use expensive external IMU sensors (ranging from €500 to €5000) with internal data fusion1, our hardware features a compact IMU chip (costing less than €20) and performs data fusion in-house. Additionally, each CCU and Universal Communication Node (UCN) includes an air-pressure sensor, enabling accurate flight height detection independent of wave conditions and enhancing foiling performance (patent pending). This approach not only maintains low hardware costs but also provides complete control over the system, making our hardware versatile for both foiling and non-foiling applications.

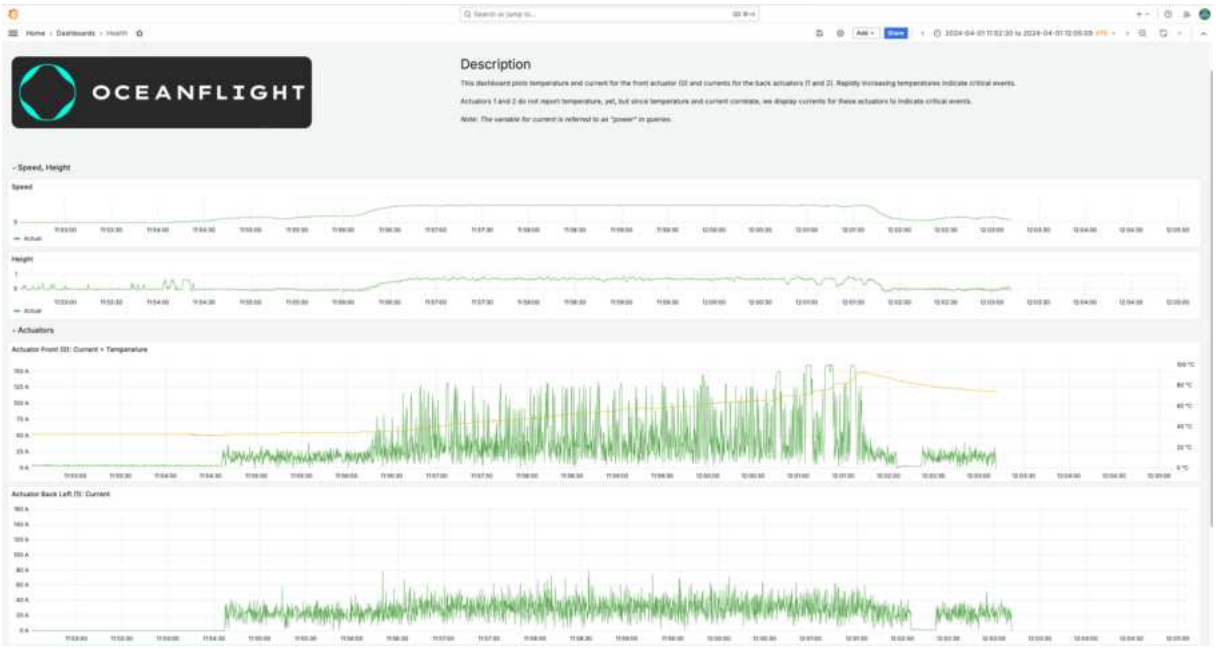
3.2 Remote Access

The CCU features an Ethernet interface, enabling connection to any LTE access point. Through our advanced WireGuard remote access, we can connect to the boat for remote support, over-the-air software updates, parameter tuning for flight control, and more. This capability allows us to maintain a global fleet efficiently, reducing maintenance costs and offering fast, flexible service. We've successfully brought boats to foiling for customers on the other side of the world without needing to travel on-site.

3.3 Datalogging and Analytics

For our development, we have implemented a high-performance data logging tool that records all data from our communication network at a frequency of 100Hz. During the flight control development phase, this tool has been crucial for understanding boat performance and diagnosing failures. To enhance this tool's capabilities, we have built an automated data upload system to a database, enabling advanced data analytics. This setup supports functions such as automated fleet management and preventive maintenance analytics. For example, we analyze data from our in-house developed flap actuators for hydrofoil boats to detect wear on the ball screw before it fails. Additionally, for remote support, this data is invaluable in understanding and diagnosing issues on the boat in real-time.

[1] Combines data from multiple sensors (e.g., GPS, accelerometers) using complex algorithms to enhance accuracy and stability, while eliminating errors and biases.



Caption 5: Example of the Data-Logging Tool for automated Actuator Healthmonitoring

3.4 Situational Awareness & Autonomy

For flight control, we already use a variety of sensors to monitor the boat's condition and maintain stability. These sensors can also provide numerous autopilot functions that enhance skipper comfort, such as heading hold, virtual anchor, waypoint navigation, and wind compensation during docking. Additionally, we can integrate various environmental sensors like radar, lidar, sonar, or stereo cameras. This allows us to achieve a comprehensive understanding of the boat's surroundings, enabling autonomous features such as auto-docking, obstacle detection and avoidance, and park distance control. These advanced functionalities, familiar in modern cars, are now becoming a reality for boats.

3.5 Developer Interface

One small disadvantage of the Oceanflight Innovation Platform is that each new component, which we do not yet support, requires custom implementation of its communication protocol. While we provide this as an engineering service, to prevent long lead times, we've decided to open a developer interface for our customers. This interface allows them to implement their own protocols and features without our direct involvement. It doesn't stop with communication protocols; customers can also develop features like custom autopilots or control algorithms to suit their specific needs. Although this may reduce some engineering orders, we prioritize giving our customers the flexibility and independence they need. We have always avoided becoming a closed-source, walled-garden system.

3.6 Custom Helmstation and User-Interface

As a partner in the Garmin OneHelm Project, we provide a standard user interface integrated into Garmin displays. However, many shipyards desire a custom, modern UI design, and this is something we fully support. All the necessary data is published on an MQTT server, allowing shipyards to access it and seamlessly integrate the information into

their own custom UI design. In Caption 6 you can see an excellent example of how this could look like.

Caption 6: UI and Helmstation at The Icon by Tyde

3.7 Smartphone App

Since our system processes all boat-related data and includes a remote access tunnel, we have all the technology in place to provide this data to a custom-designed smartphone app. This app allows the skipper or owner to always access their boat and monitor its current status in real-time. If needed, even camera footage can be shared.

4 Pricing

The Oceanflight Innovation Platform is a complex and versatile system, with each installation uniquely configured based on the specific requirements of the boat. As a result, providing a simple price as a single figure, like you would for an engine or a display system, is not feasible. To ensure flexibility, we have chosen to separate the hardware and software costs. This allows our customers to activate or deactivate various software features on the same hardware, depending on their needs.

Furthermore, we do not charge software license fees during the prototyping and development phases, supporting young companies and minimizing initial costs. The software license fee is only required once the boat is sold, helping our customers manage costs by only paying for the license after they have generated revenue from the boat.

Below is a table of our hardware prices for small quantities. Discounts for larger orders can be negotiated on a case-by-case basis.

Product	Price [€]
Central Compute Unit	1.200
Universal Communication Node	800
Universal Communication Node with RTK-GPS	1.500
Antennas for RTK-GPS	500
Altimeter-Radar (height Sensor for Foiling)	500
Small Foiling Actuator (for boats up to 1.000kg)	1.500
Big Foiling Actuator (for boats up to 10.000kg)	7.500

Our software licenses are tailored to meet the specific needs of each customer, taking into account factors such as boat size, functionalities, and quantities. Below are a few examples to provide a sense of pricing (software license only, hardware excluded):

Example 1: Small foiling boat

- Size of the boat: 6m
- Required Features:
- Flight control
- RTK-GPS
- Data-logging
- Remote Access
- Batch of 10 boats: 8.640 € per boat
- Batch of 50 boats: 6.480 € per boat
- Batch of 100 boats: 5.400 € per boat

Example 2: Mid-size foiling boat without additional features

- Size of the boat: 9m
- Required Features:
- Flight control
- RTK-GPS
- Data-logging
- Remote Access
- Batch of 10 boats: 9.936 € per boat
- Batch of 50 boats: 7.452 € per boat
- Batch of 100 boats: 6.210 € per boat

Example 3: Mid-size foiling boat with additional features

- Size of the boat: 9m
- Required Features:
- Flight control
- RTK-GPS
- Data-logging
- Remote Access

- Engine-Interface
- Thruster-Interface
- Helmstation Interface
- Heading-Hold
- Virtual Anchor
- Smartphone Interface
- Batch of 10 boats: 16.320 € per boat
- Batch of 50 boats: 12.240 € per boat
- Batch of 100 boats: 10.200 € per boat

Example 4: Big foiling boat fully equipped

- Size of the boat: 9m
- Required Features:
- Flight control
- RTK-GPS
- Data-logging
- Remote Access
- Engine-Interface
- Thruster-Interface
- Redundancy
- Helmstation Interface
- Heading-Hold
- Virtual Anchor
- Waypoint Navigation
- Auto-Docking
- Obstacle detection
- Smartphone Interface
- Batch of 1 boat: 73.620 € per boat
- Batch of 5 boats: 69.939 € per boat
- Batch of 50 boats: 44.172 € per boat

For more information about the pricing or an additional custom offer, please contact us.

5 Conclusion

By rethinking how electronic onboard networks operate, the Oceanflight Innovation Platform opens up a nearly limitless range of possibilities. It serves as a cornerstone for a sustainable, smart, and safe future of boating. A very good example therefore is The Icon by BMW and Tyde, which already today is operated by the Oceanflight Innovation Platform.