

Robotized Offshore Wind Turbine Blade Inspection

Use case definition

The Energy-2 (E2) use case addresses the challenges in wind turbine Inspection, Operation and Maintenance (IO&M). Due to the rapid developments in the offshore wind sector and the future shortage of skilled technicians, the wind industry is moving towards robotized IO&M, where drones equipped with various sensors are used to assess the structural health of the turbine blades.

This use case will demonstrate how B5G connectivity and edge computing can significantly improve wind turbine IO&M.

The main objective is to reduce the time between inspection and decision-making, to lower risks (less people offshore), increase sustainability (less boat transfers), and lower costs (less downtime).

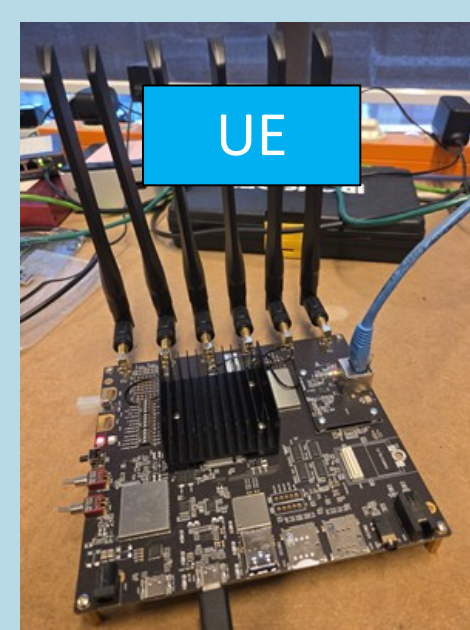
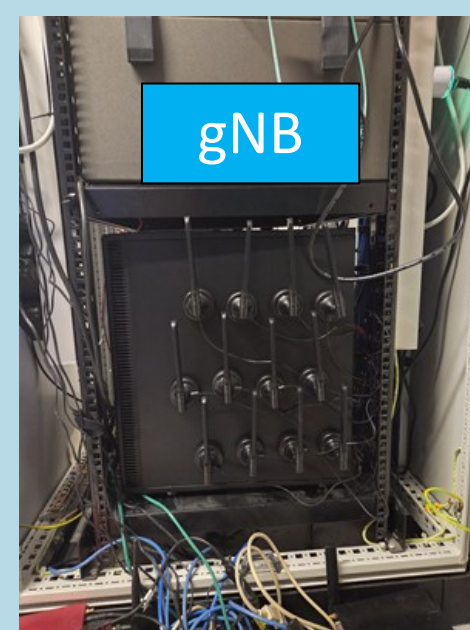
- Using the B5G connectivity, the sensor data collected by the drone can be transferred in real-time to a Digital Twin system located at the edge and the onshore monitoring center.
- Based on the Digital Twin output, a decision on what action to be taken can be made within one inspection window.

Use case technology enablers:

- Network slicing:** Dedicated slice can be deployed to meet the specific QoS for the drone traffic, ensuring constant performance under dynamic network condition.
- Public-private network integration:** Connectivity at the offshore location is usually rather limited and often provided by only one network operator. Wind farm operators can establish their own private networks based on the public network, operated and maintained by the network operator.
- Advanced localization system:** Precise localization of the drone on the blade surface during inspection is critical. Using a combination of GNSS and RTK techniques, a centimeter-level accuracy can be achieved.

B5G network deployment:

- Radio Access Network (RAN):** Amarisoft Callbox Classic
- Core Network:** Open5GS
- User Equipment (UE):** Quectel RM500Q-GL modem
- Frequency band:** n77
- Bandwidth:** 50 MHz
- TDD frame structure:** DDDSUUUUUU



Testbed location:

- Fieldlab Zephyros in Vlissingen, The Netherlands.
- Decommissioned wind turbine blades from offshore windfarm.

Initial KPIs were collected in the pre-trial tests, including engineering effort of minimizing the weight of the GNSS and RTK setup to about 150 grams.

KPI description	Target value	Measurement results
Uplink data rate	> 50 Mbps	51 – 55 Mbps
One-way end-to-end latency	< 100 ms	8 – 12 ms
Localization accuracy	< 10 cm	Horizontal accuracy: 1.4 cm Vertical accuracy: 1.0 cm

Next steps:

- Development of Digital Twin system.
- Integration of other enablers relevant to this use case.

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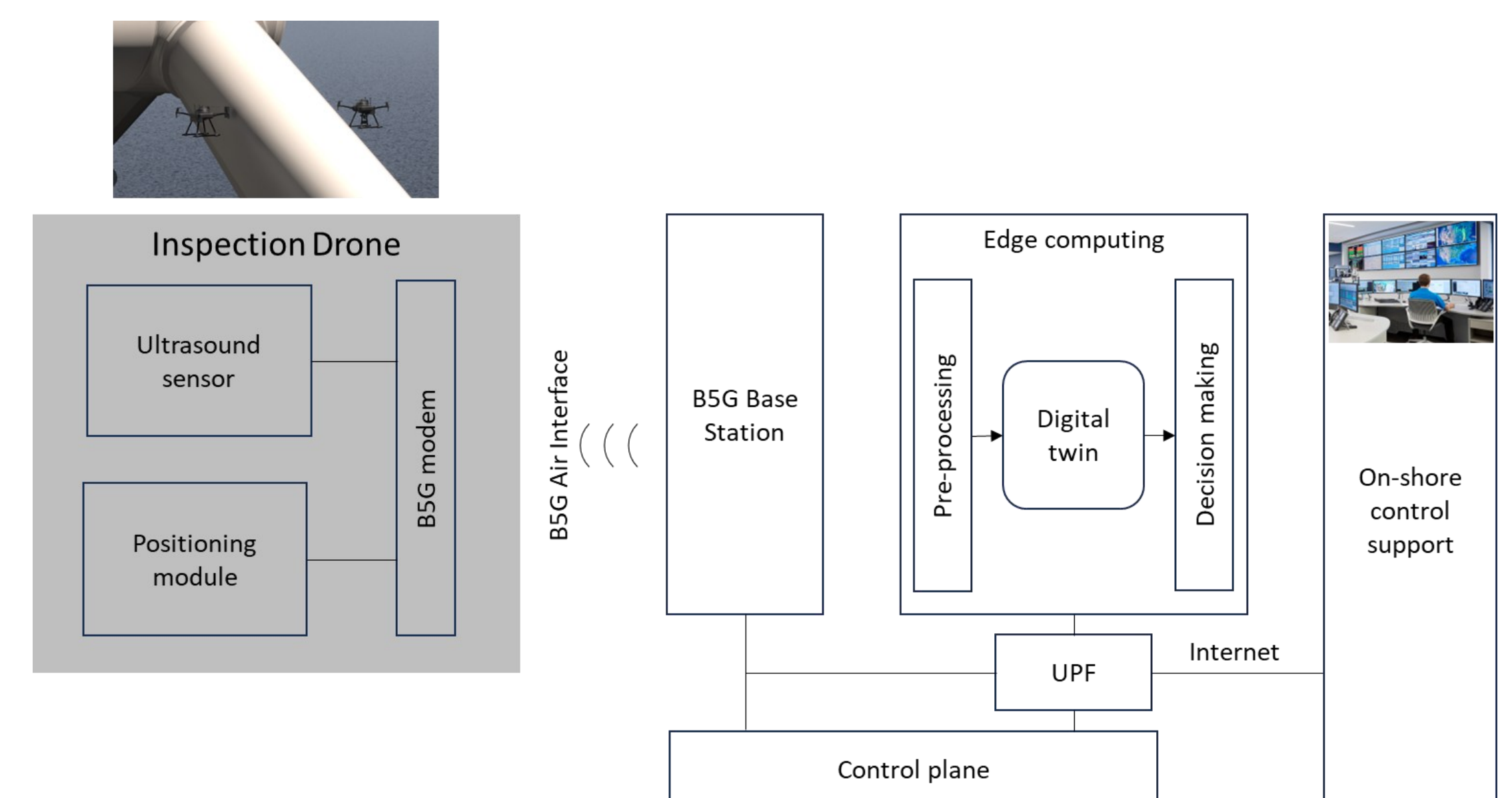


Figure 1. Use case architecture



Figure 2. Testbed location at Fieldlab Zephyros (Vlissingen, NL)

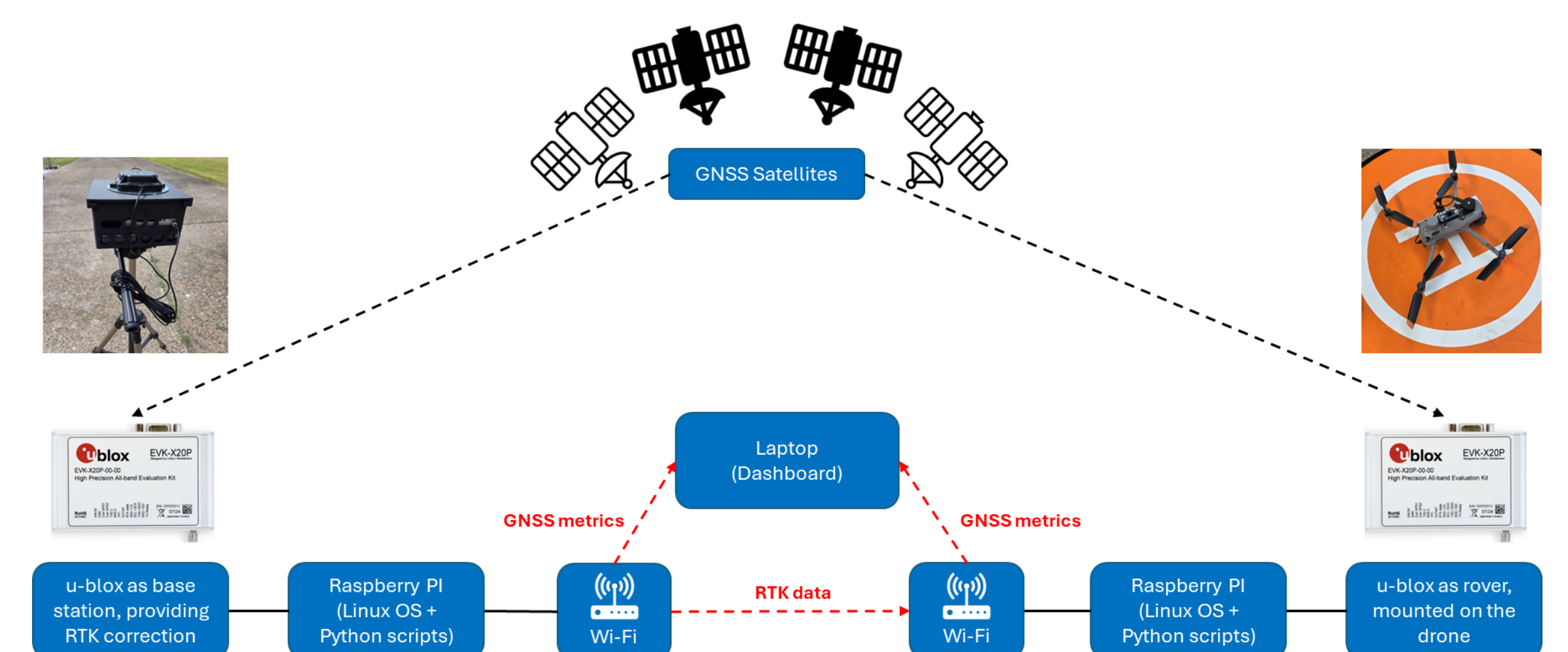


Figure 3. Localization enabler setup with GNSS and RTK

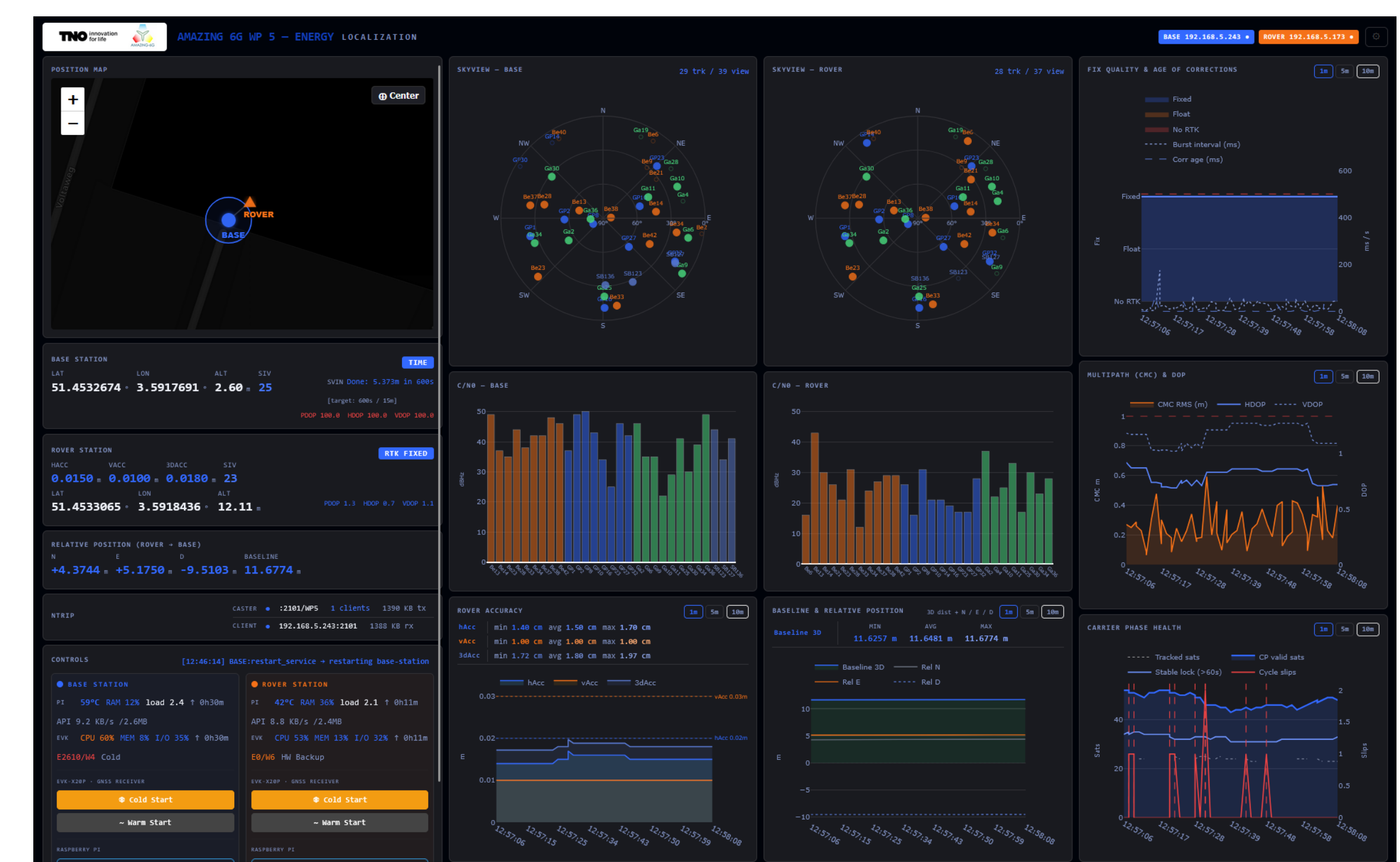


Figure 4. Dashboard for GNSS and RTK system