

Orbis-Executive Summary

Orbis is a modular system for the storage and distribution of drinking water designed for emergency response, developed within the scope of ElectroCap 2026 at Instituto Superior Técnico. The project addresses a critical vulnerability of modern societies: the strong dependence on centralised water infrastructure, which can collapse rapidly in disaster scenarios such as earthquakes, conflicts, cyberattacks or contamination, leaving populations without access to safe water quasi-instantly.

The solution is centered around strategically placed smart, energy-autonomous and remotely manageable 1000-litre IBC tanks. Pre-disaster, these tanks operate in storage and maintenance mode, with an array of sensors and sterilisation equipment that broadcast their status to a central platform. In the event of infrastructure disruption, the system deploys into active distribution mode, where it transitions to focus on access to drinking water without additional human intervention. Energy autonomy, ensured AGM deep-cycle batteries recharged by solar panels, keeps the system operational without the need for grid connectivity.

Each tank integrates water quality sensors (pH, turbidity, temperature and level) and an internal sterilization and recirculation system that prevents sedimentation and microbiological growth. Water is dispensed by gravity through a controlled motorised valve, with access authenticated via RFID or chip card, limiting each user to a variable volume quota per person per day. Local displays communicate tank status and quota to end users and authorities.

Communications are ensured by LoRa, allowing for low-energy remote monitoring and control, even in urban range of several kilometres. When Internet access is possible, gateways serve as a mid-point from the tanks to a centralised server-platform managing quotas and diagnostics across the entire network. In many events of disaster, Internet access is lost, and the system then transitions to a decentralised mode: gateways communicate peer-to-peer through a distributed ledger system that records individual consumptions across the geographic range.

The system's backbone is a Django/PostGIS web platform providing an interactive map and real-time monitoring of all nodes to competent authorities. As a fallback measure, monitoring of local nodes stays accessible to responsible authorities on a local GUI terminal at each corresponding gateway. As long as Internet access persists, citizens can also consult the web frontend tank for information on locations and availability.

Orbis is being developed with support from INESC-ID, LAIST, and DEEC-IST's OpenLAB.