The Internet of Underwater Things

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Understanding the potential of new platforms and integration for a multi-prong approach to marine pollution

EOOS technology Forum 2022

SAPIENZA
UNIVERSITÀ DI ROMA

WSENSE

WSense is a deep-tech company **spinoff of La Sapienza** specialized in underwater monitoring and communication systems, based on patented technologies that have pioneered the Internet of Underwater Things (IoUT). WSense's technologies are at the forefront of underwater wireless networking, enabling multi-modal secure wireless communications and networking among submerged and surface sensing and robotic platforms.

30+ people located in Italy and Norway

Market segments: sustainable aquaculture and fisheries, environmental monitoring, homeland security, offshore renewable energy

Some of our clients and partners:

SAIPEM

LERØY

MARINA MILITARE

ENEA

LEONARDO

National Oceanography Centre

MiBAC MINISTERO PER I BENI E LE ATTIVITÀ CULTURALI

Our Mission

70% of our planet is covered by water…

…however, wireless connectivity is not available underwater

PROBLEM

- Satellite technologies provide only **low-depth** information
- Existing legacy systems are **complex, marginally versatile , expensive** and **"cable-intensive"**
- Lack of underwater real time data generates a **huge knowledge gap** and might lead to uncontrolled adverse phenomena

We need underwater IoT systems providing the big data needed to understand this environment, develop safe and sustainable processes for underwater resources exploitation, as well as a flexible wireless infrastructure connecting heterogeneous underwater/surface assets, able to connect to the terrestrial Internet.

W-Cloud

- Highly customizable Cloud Software platform running on Amazon Web Services
- Sensor data and alarms are visualized at the regional, farm, cage - and sensor level; Historical data are stored and can be searched, combined, filtered and displayed
- Patented 3D web interface for effective cage control

W-Gateway

- Bridge between underwater and above- water networks
- Supports communication through 3G/4G and WiFi networks for above water communications
- Supports up to three underwater modems to communicate with the underwater network
- Optional: Underwater GPS; AquaCloud IoT Hub.

W-Node

- Multi-parametric, battery-operated underwater sensor nodes equipped with acoustic modems
- Bidirectional acoustic communications, also through multi-hop networks.
- Integrated multi-vendor sensors of DO, O2, Temperature, Depth/ Pressure, Salinity levels, Currents.
- Integrated load cells for structural monitoring.

Underwater IoT System Components

5. CUTTING EDGE TECNOLOGICAL SOLUTIONS

- **Underwater wireless mesh networks**
- **Real time, bidirectional communications**
- **Multimodal comms**
- **Adaptive learnings systems**
- **Enabling**
  - Cooperation towards complex tasks
  - Real time data gathering
  - Remote control and reconfiguration

6. WSENSE SOLUTIONS
Key Benefits

- **Large area coverage**
- **High performance, highly reliable**
- **Enabling Autonomous Operation**
- **Risk Reduction**
- **Multi-Vendor Interoperability**
- **Support of emerging standards**
- **Underwater Cyber Security**
- **Low power, long lasting (years)**

W•SENSE

LERØY

SEASTAR

Smart Bay Santa Teresa: the vision

develop and study ecosystem-based climate change adaptation, mitigation, and water quality improvement

KNOWLEDGE

Marine and terrestrial ecosystems, their ecological and economic potential, environmental status *via* in situ observatories

QUESTION

How the Nature Capital of a territory might help the ecological transition of the area?

AIM

Local actors (municipality, stakeholders) have to become the drivers of the change: less polluted ocean, more sustainable management

ACTIONS: SMALL COOPERATIVE PROJECTS

To calculate the contribution of local aquaculture as blue carbon sink by measuring CO_2 fixation and production (via fuel, energy, plastic pollution) of local activities

To test and validate innovative monitoring network in aquaculture fields to improve environmental monitoring (Internet of Underwater Things-IoUT)

To measure ES (biodiversity promotion, CO_2 storage) by local ecosystems and model their functions under climate change threats for local management interventions

To promote citizen engagement *via* dissemination actions and questionnaires valuating the social perception of the nature capital

METHODS: UNDERSTANDING AND SHARING NEEDS

Municipality - Scientific support for innovative and sustainable actions for coastal management (e.g. sea level rise, coastal erosion, port area regeneration, biodiversity promotion..)

Aquaculture - Data provisioning and interpretation for production threaten by climate change and direct anthropogenic impacts

Sustainable tourism - Dissemination actions to engage citizens in more sustainable behaviours

Research - The use of marine and terrestrial ecosystems – still neglected- in NBS

Jobs - opportunities for local traditional business; circular economy

FINAL GOAL

The first carbon-neutral bay regenerated on common shared Nature Based Solutions

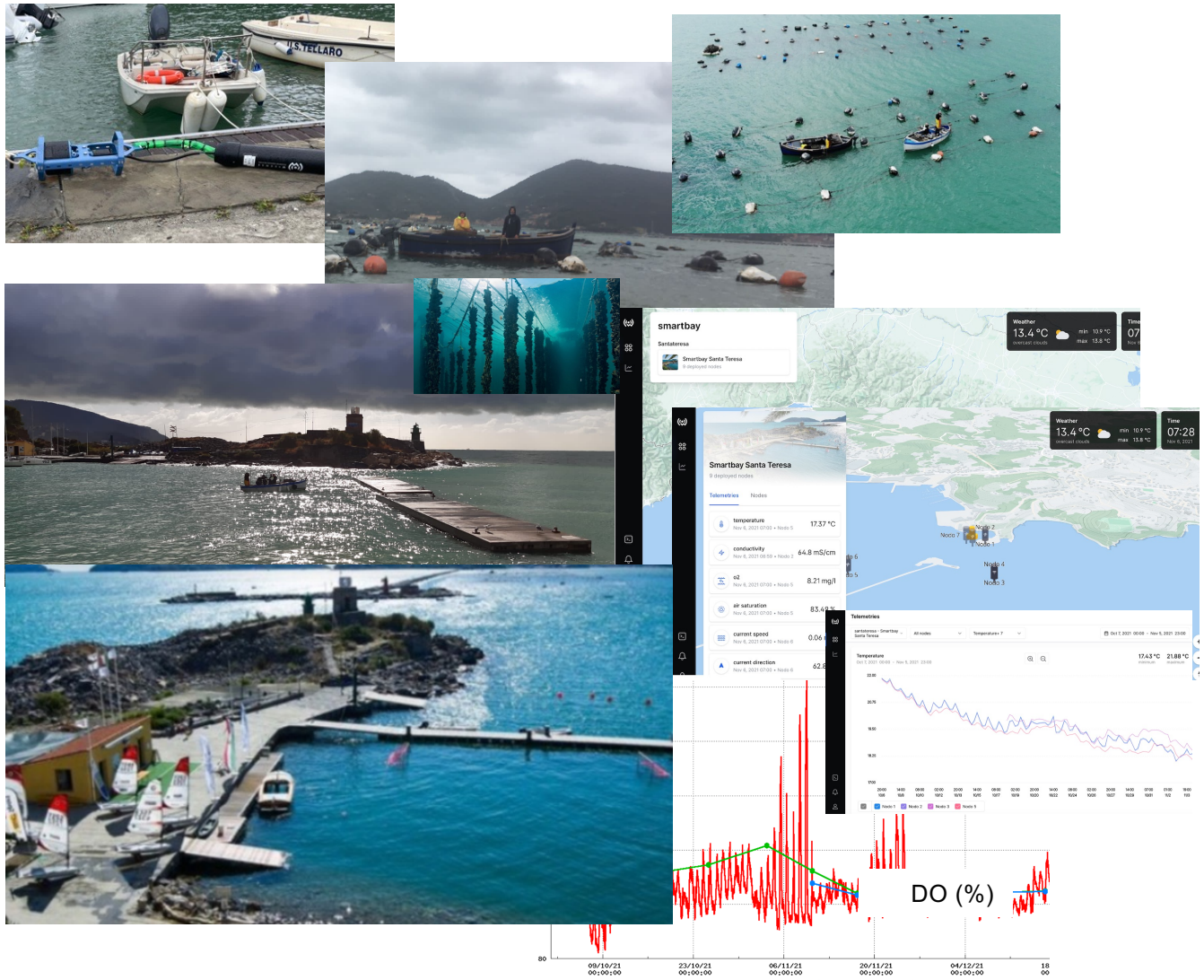
W • SENSE
INTEGRATED CABLELESS SOLUTIONS

Accurate,in situ contineous data, with enough density are key to identify the best mitigation and adaptation strategies

Internet of Underwater Things Techologies
GreenStar Project in SMART BAY

14 LIFE BELOW WATER

13 CLIMATE ACTION — TAKE URGENT ACTION TO COMBAT CLIMATE CHANGE AND ITS IMPACTS



SEASTAR https://www.seastar-project.eu

WSense is technology provider of the underwater IoT infratructure of the Smart Bay.
In GreenStar, joint project between WSense's led EASME SEASTAR project and Smart Bay we have worked on **data accuracy (full validation), data correlation and visualization to support at best needs of scientists and mussel farmers operating in the area.**

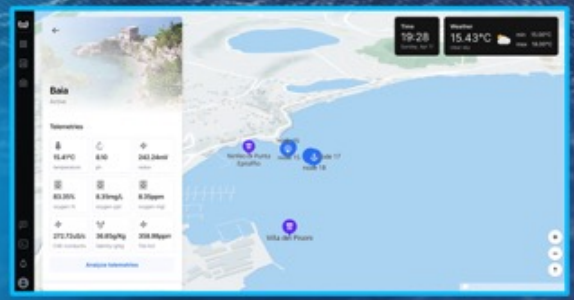
Lessons learnt: 1. Full system validation and high performance, even if low cost. 2. Crucial role of in situ real time continuous monitoring to provide scientists with timely (for decision making) information and dense time series (to understand correlations between biological processes and climate change). Real time data also allows to understand when and how often to calibrate the sensors.

ENEA Cooperativa Mitilicoltori Associati — Mitilicoltori Spezzini — AMA Associazione Mediterranea Acquacoltori

Remote in situ continous monitoring of marine parks

ENVIRONMENTAL MONITORING

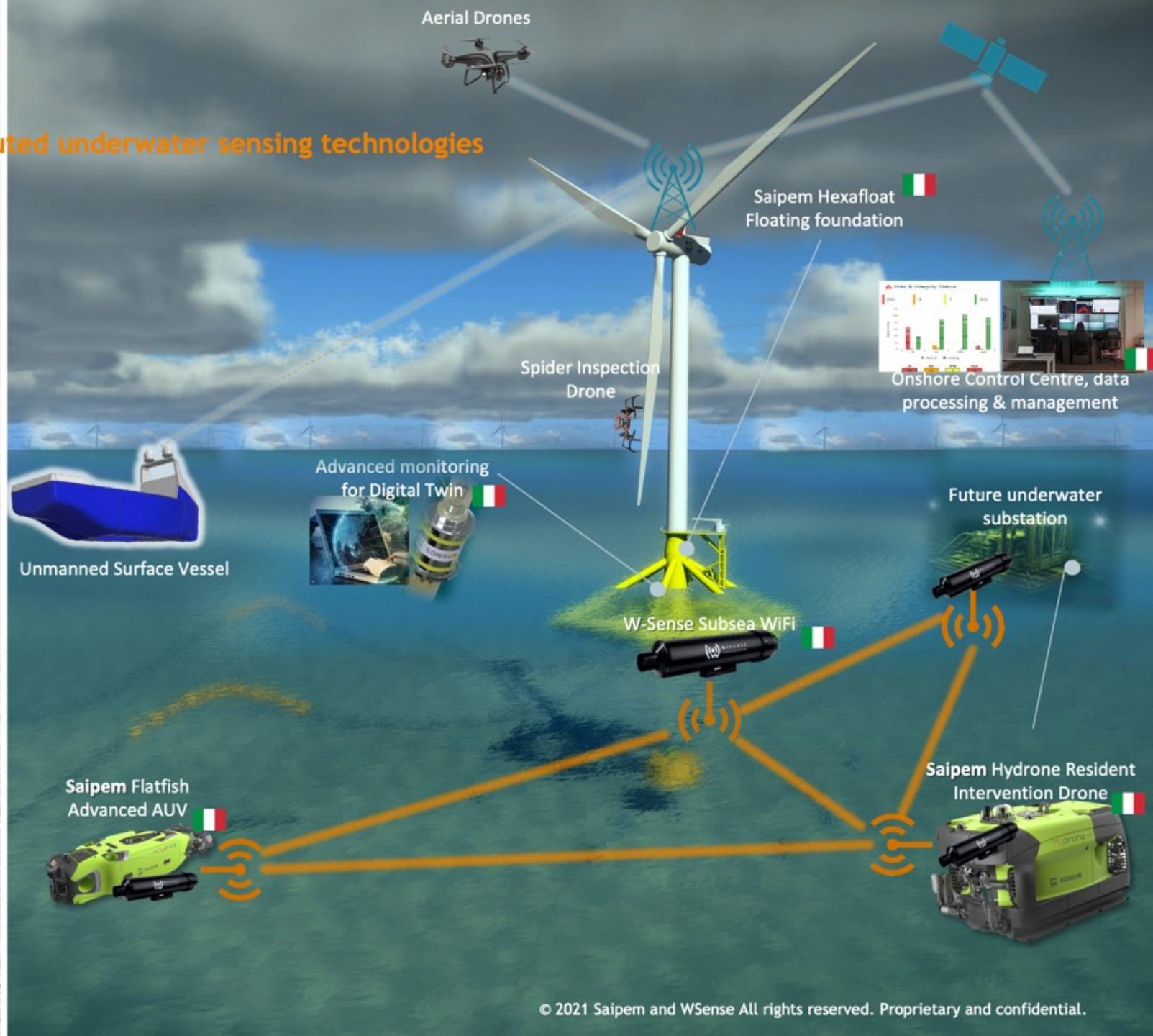
Wsense in action - Italy



The future of Offshore Wind

Advanced monitoring & intervention via distributed underwater sensing technologies

- Nowadays, offshore wind farms (OWF) are inspected and maintained via legacy IMR methods derived from oil & gas
- The future floating OWF installation will call for advanced solutions and reduced costs, to win the LCOE challenge
- In the underwater domain, distributed sensing technologies will unlock real time monitoring and digital twin implementation, bundled with unmanned inspection and intervention capabilities



SAIPEM

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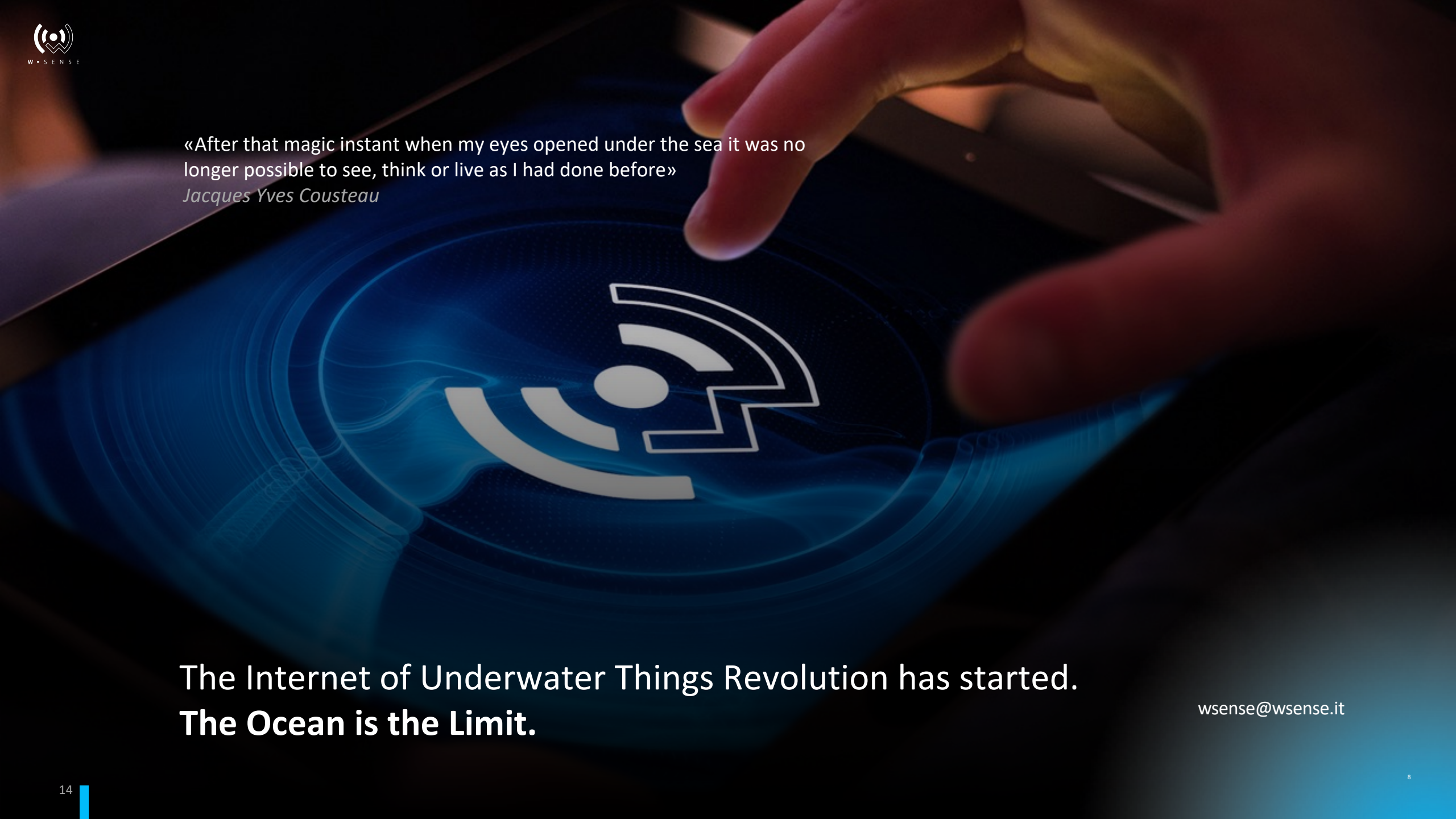

«After that magic instant when my eyes opened under the sea it was no longer possible to see, think or live as I had done before»
Jacques Yves Cousteau

The Internet of Underwater Things Revolution has started.
The Ocean is the Limit.

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