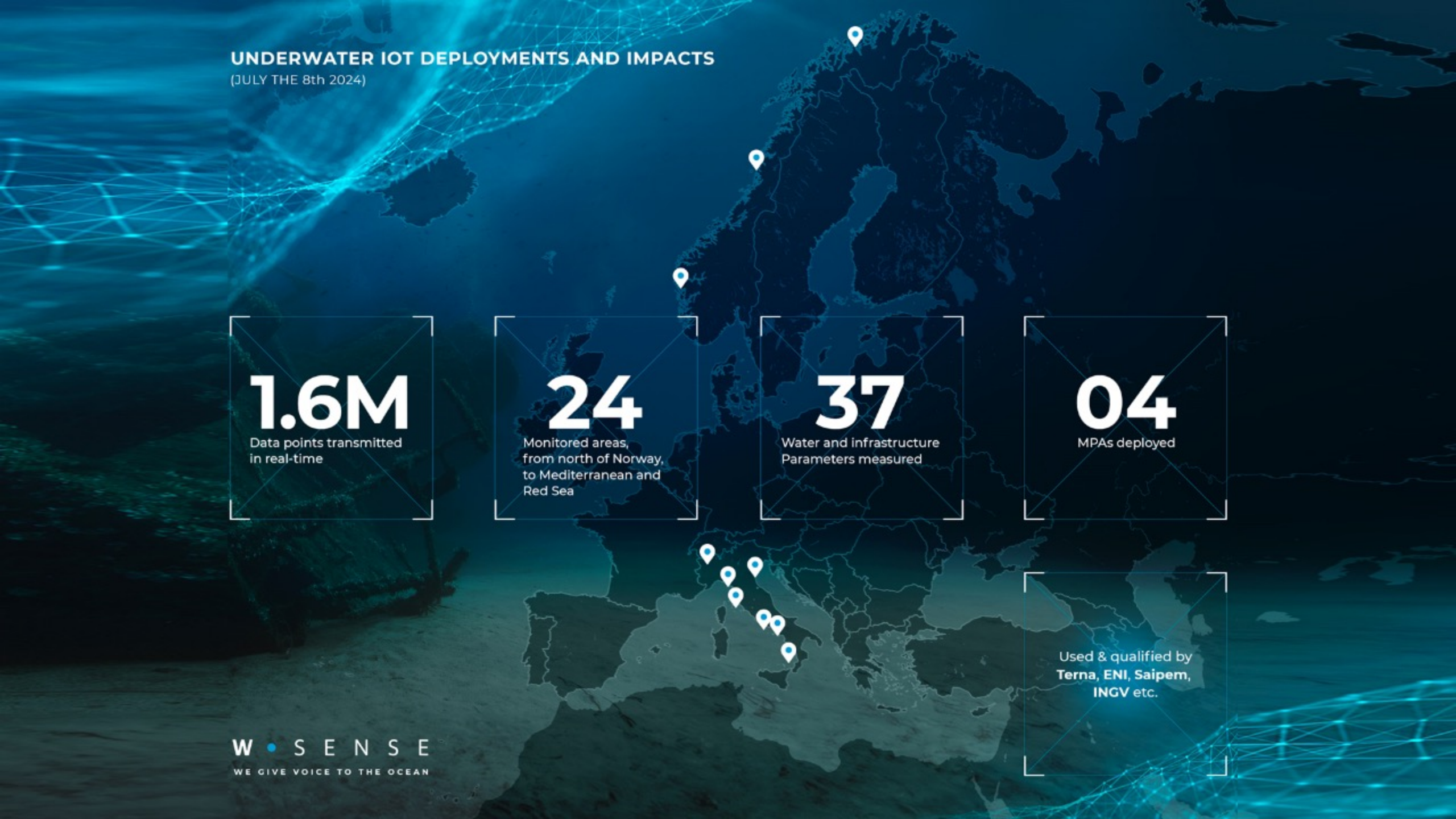

WiFi of the Ocean
W • SENSE
WE GIVE VOICE TO THE OCEAN

WSense | Underwater IoT

- Offices and operations in **Italy. Norway, UK. KSA**
- 2 Global **Patents**
- **50+** Employees
- 30% **PhDs**
- **€+15M Seed Round** closed between 2021 and ‘23


UNDERWATER IOT DEPLOYMENTS AND IMPACTS
(JULY THE 8th 2024)
1.6M
Data points transmitted in real-time
24
Monitored areas, from north of Norway, to Mediterranean and Red Sea
37
Water and infrastructure Parameters measured
04
MPAs deployed
Used & qualified by Terna, ENI, Saipem, INGV etc.
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Investment and Partners' Traction

tech eu | News | Topics | Insights | Summit London 2024

IOT

WSense raise €9M for underwater wireless communication 'harnessing the ocean's untapped potential'

WSense, an Italian IoT startup has developed underwater wifi for critical infrastructure monitoring and environmental protection. The €9 million funding will boost its international expansion.

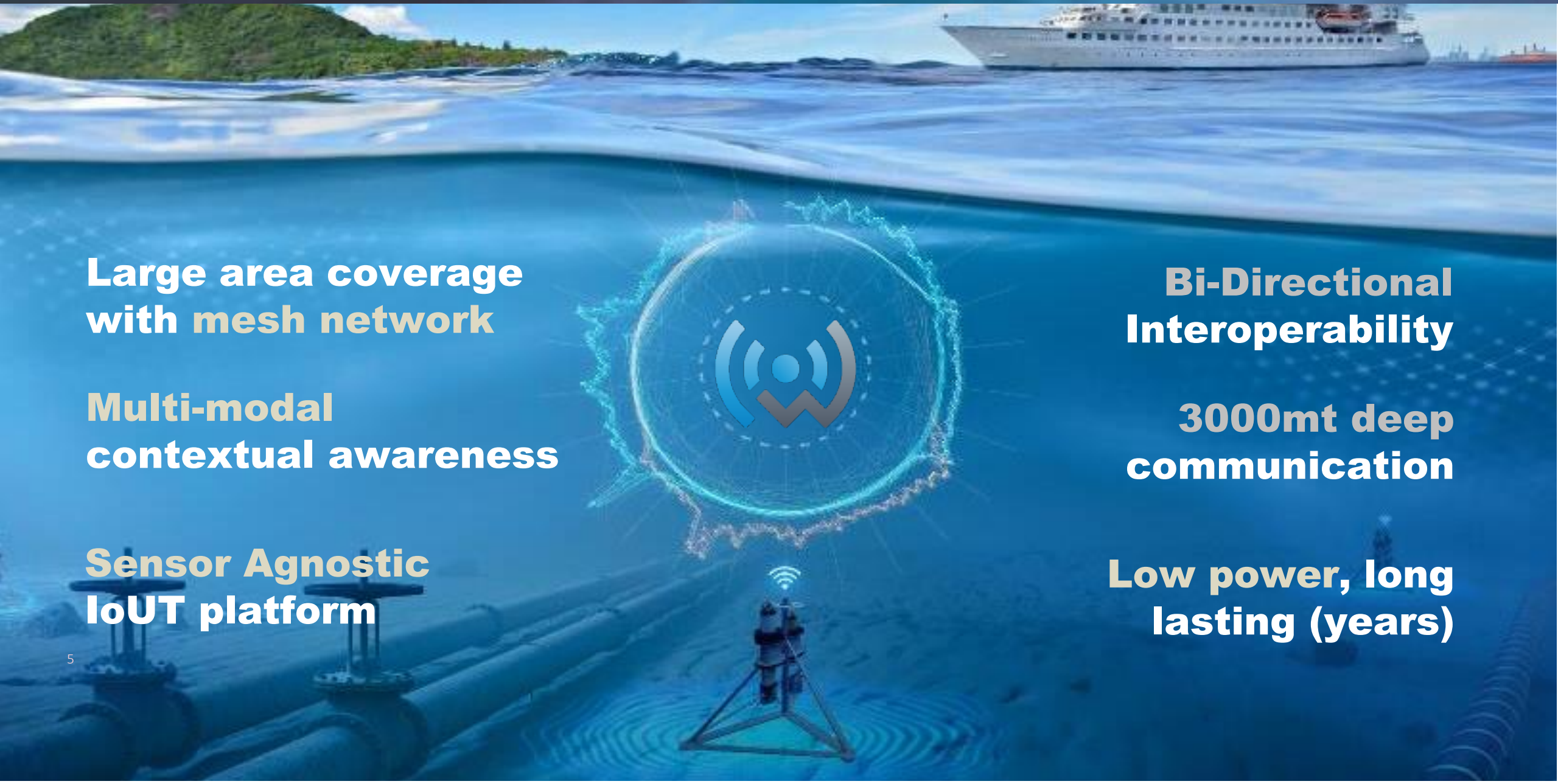
The spin-out from Sapienza University in Rome has raised a €9 million funding round which was led by **SWEN Blue Ocean**. **CDP Ventures**, **RunwayFBU**, **Axon Partners Group**, Katapult Ocean, CoreAngels Climate and Moonstone also got in on the investment action.

https://tech.eu/2023/10/23/wsense-raises-eur9m-for-underwater-wireless-communicatio/

May 2024 | WSense selected as EU Blue Champion by the European Investment Bank

May 2024 | TERNA looks to the future with WSense technology for the Internet of Underwater Things

Added Value| Underwater IoT, Multi Hop, Real-Time



Large area coverage with mesh network

Multi-modal contextual awareness

Sensor Agnostic IoUT platform

Bi-Directional Interoperability

3000mt deep communication

Low power, long lasting (years)

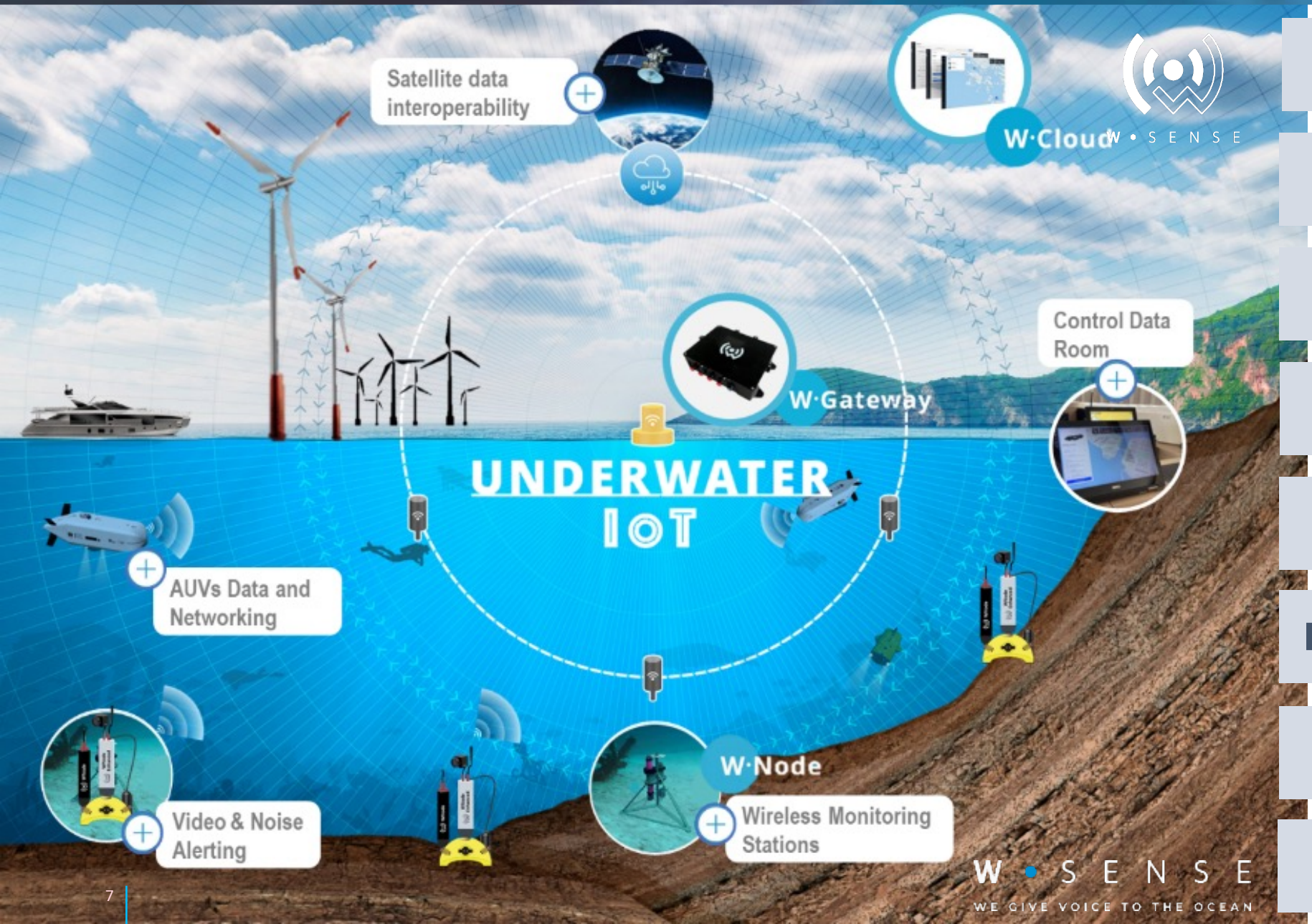
Why WSense? Underwater IoT Success KPIs

- **KPI1: With our technology our customers *reduce of 50% the costs of underwater monitoring*** (usually done with dedicated missions)

- **KPI2: With our technology our customers *increase of >100 times the number of water data points* collected for a given monitoring scenario**. Our technology offers continuous real-time monitoring, while most of the current solutions require dedicated, one-off monitoring mission.

- **KPI3: With our solution our customers *increase of over 5 times the underwater area monitored***. With the same cost of traditional monitoring activities, our solution deploy at least 5 monitoring devices, thus increasing the area monitored, which traditionally cover only one precise point.

FIELD OF APPLICATIONS

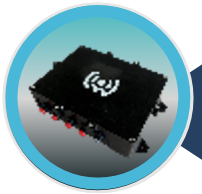


- Cables & Pipelines
- HydroElectric basins
- OffShore Energy
- Defense & Critical Infrastructures
- Environmental Monitoring
- Robotics, AUVs Comms
- Seismic & Vulcanic Events
- Desalination Plants

WSense IoUT System Components

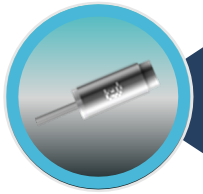
WNode: the underwater multi-sensor node with acoustic modem for Shallow water

WNode Enhanced: the underwater multi-sensor node supporting Deep water and AI



WGateway: the bridge between underwater and terrestrial networks

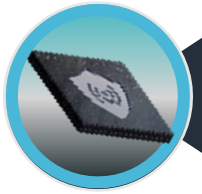
WSwitch: the enabler of multi-sensor management and system logics



WMicro: the smallest modem to enable the power of data transfer among tablets, ROVs

HW

WCloud: the highly customizable Cloud-based data collection and visualization



WMesh: the patented multi-protocol for adaptive network & interoperable and secure

SW

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WSense gives the ocean a voice by enabling ***large scale, high density, continuous ocean data collection****, taking care of marine ecosystems.*

WSense makes possible a deeper understanding of the ocean – including its vital role to address climate and biodiversity crisis – and a ***transition towards a regenerative, productive and accountable ocean economy***

www.wsense.it

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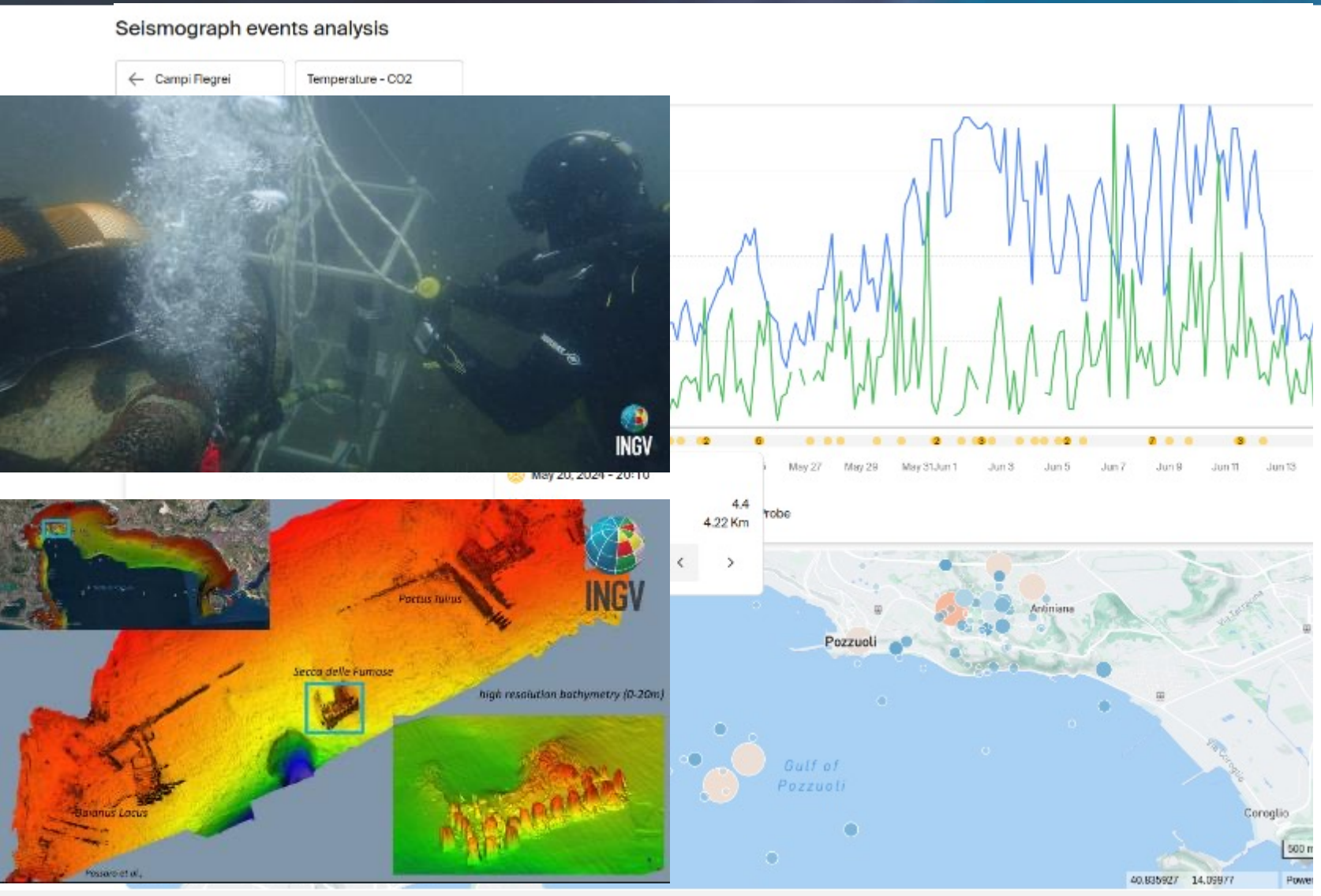
Relevant Use Cases

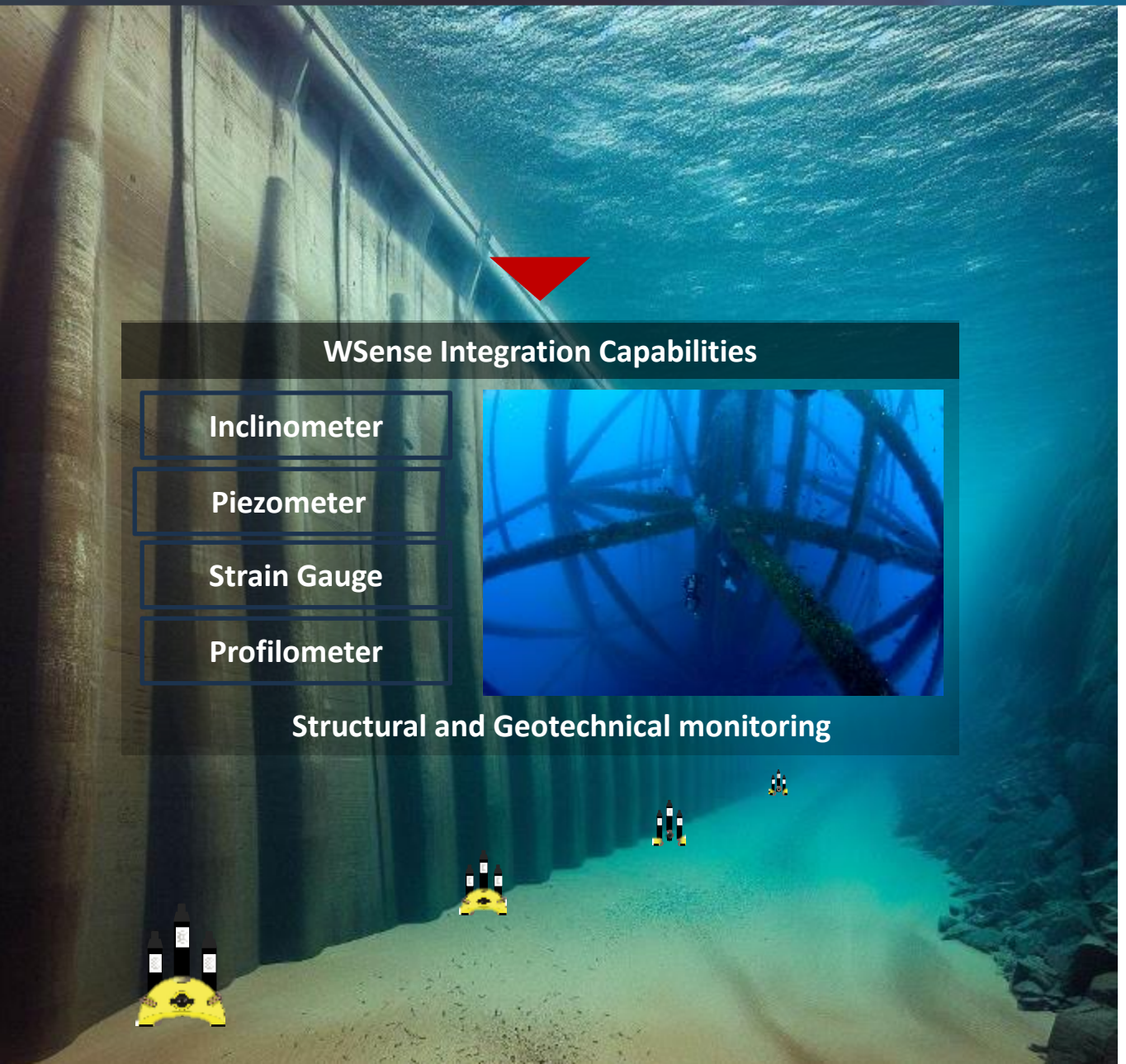
SEISMIC & VULCANIC Monitoring : INGV, PANAREA and Campi Flegrei (Naples)



Wcloud | Correlation analysis between in situ water data and actual seismic activities in Campi Flegrei area with INGV

- **Real-time data and monitoring of hazardous** gases, methan and currents (CO2), salinity, and volcanic activity
- **Build models** risk of eruptions and **create early warning systems**
- Decision support for **mission critical events**

Bridges, Dames. Ports: Structural Monitoring



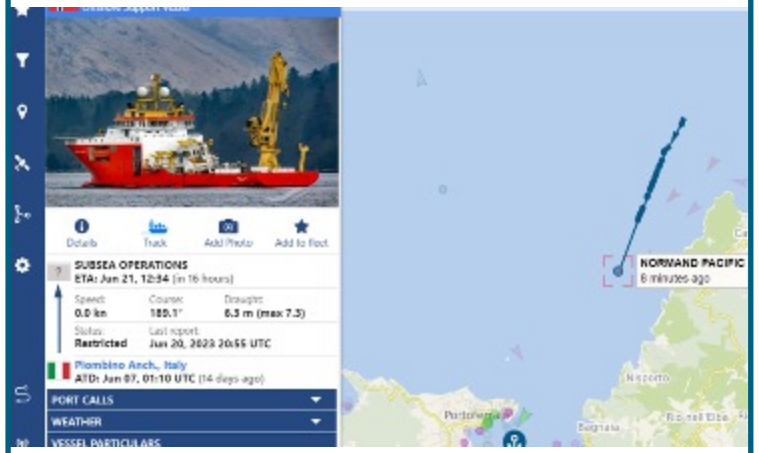
Using wireless real time communication to avoid use of cables in operational intensive areas

- Early warning systems based on **Infrastructure sensors** (vibration, accelerometer, inclinometers)
- **Alerting in case of exceptional changes**

- **Monitoring of movements** in submerged structure (e.g. stresses and strains status)
- Monitoring and analysis of **geotechnical failures** (e.g. seabed subsidence)
- Market available **corrosion sensors can be integrated** to operate in real-time wirelessly.

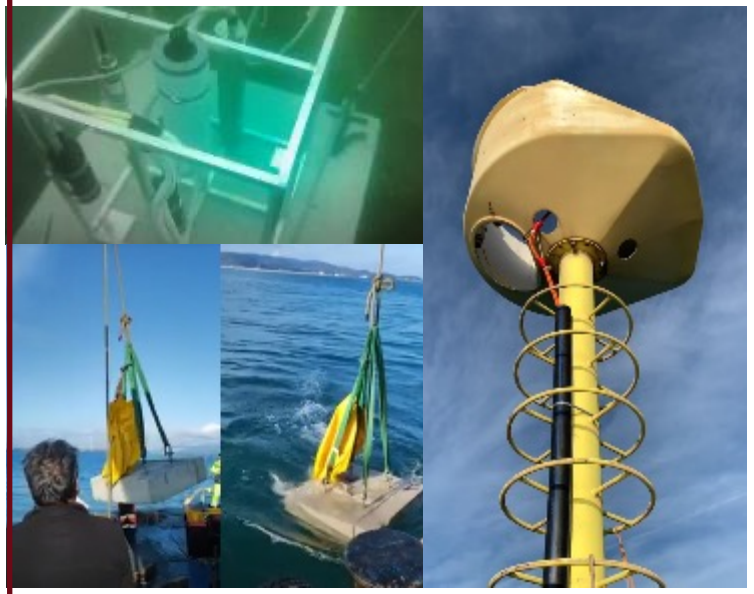
Terna IoUT Environmental Monitoring | Noise, Turbidity & Currents

May 2024 | TERNA looks to the future with WSense technology for the Internet of Underwater Things



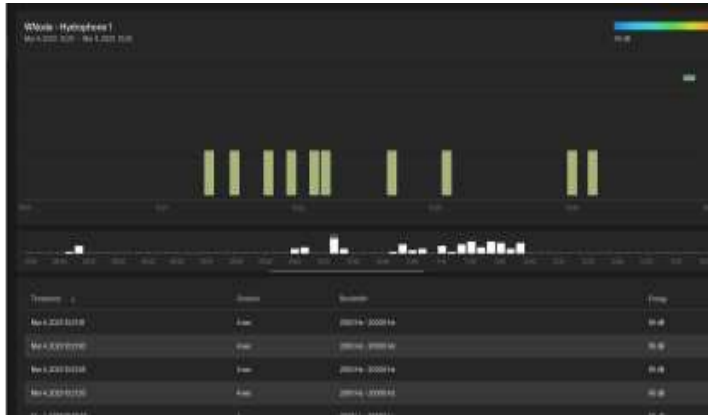
Terna has deployed a network of marine sensors for the **continuous, real-time monitoring** of environmental conditions **before and during the construction of submarine cable infrastructures (Dredging, Jetting)**

Piombino/Follonica (Before)



Isola d'Elba (During)

- **Noise Threshold detection** and setting in **real time**
- Able to easily **change position and distance between monitoring** units
- Real time Correlation with **Turbidity, current direction** and strength.



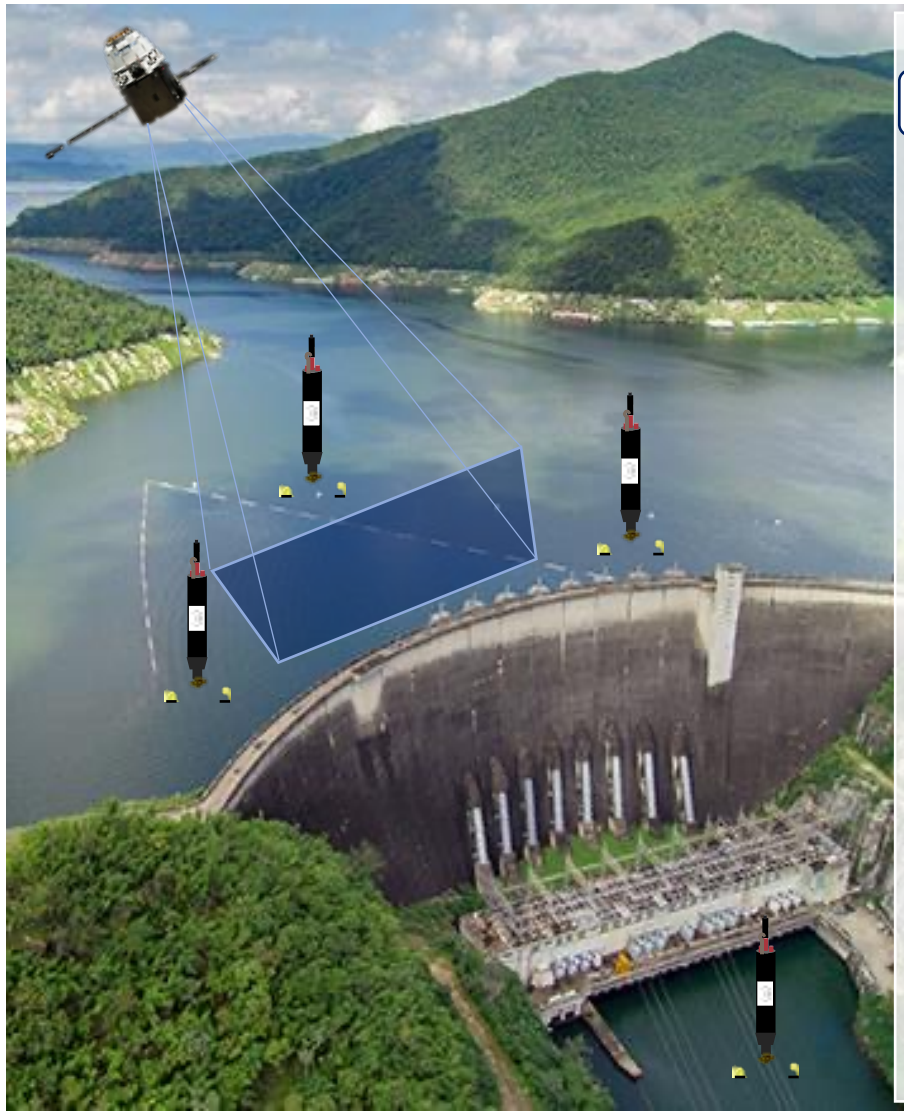
Hydroelectric basins & rivers monitoring

The proper facility management of the hydroelectric basins can be performed through a **new technological infrastructure** that can support managers and concessionaires of the main Italian reservoirs during their operations and analysis of the basin parameters.

Since an accurate analysis of the basin parameters takes into account near real-time the collection and monitoring of chemical-physical, geomorphological and biological variables in three different moments of the reservoir operations (ante, during and post), only an evolved infrastructure (such as fully integrated by satellite and in situ data) can enable the exact knowledge of the basins water quality.

DURING OPERATIONS MONITORING

BEFORE and POST OPERATIONS MONITORING



In situ MUST HAVE DATA

- Flow rate
- Turbidity
- Solid transport to the bottom
- Dissolved oxygen
- pH
- Temperature
- Ammoniacal nitrogen
- Macroinvertebrates
- Fish life
- Macrophytes
- Pollutants

Satellite data NICE TO HAVE

- Morphology
- Bathymetric river reliefs
- Bathymetric basins reliefs
- + Integration with parameters of in situ data

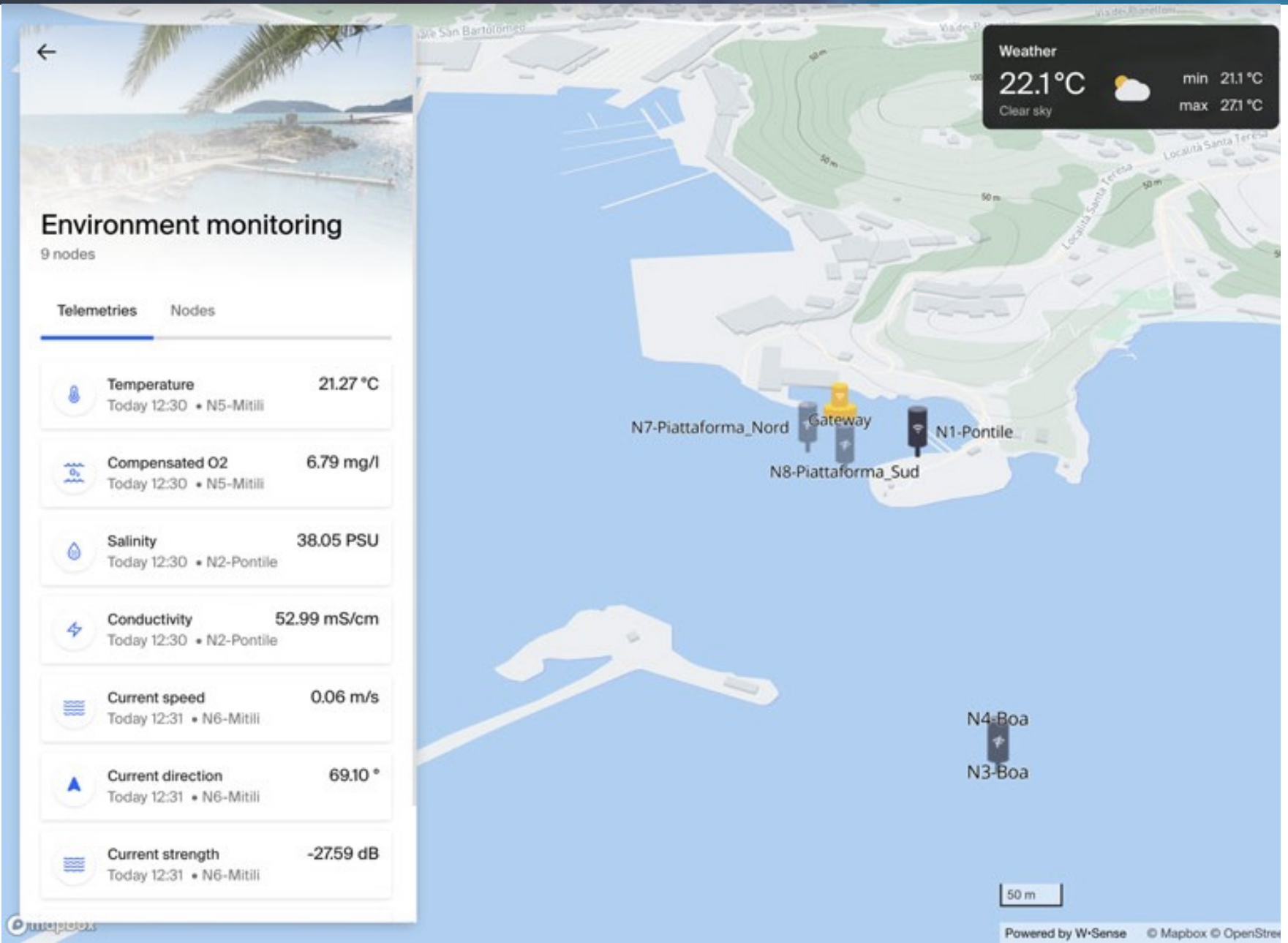
Saipem signs agreement for developing networks for drones

Target critical infrastructure and deep ocean technology.

Wsense at REPMUS22 in Portugal (NATO)

Safety/security with a JANUS encryption Wi-Fi underwater technology

Smart Port & Aquaculture: Smart Bay, La Spezia

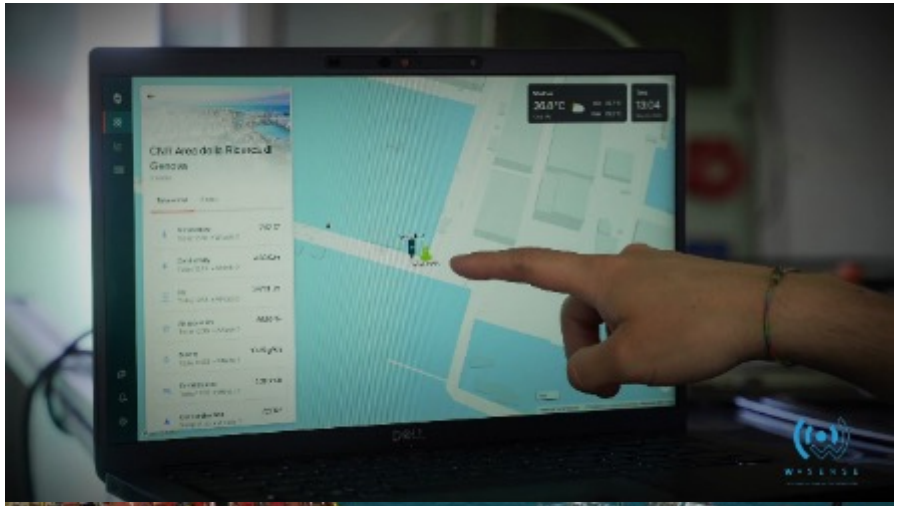


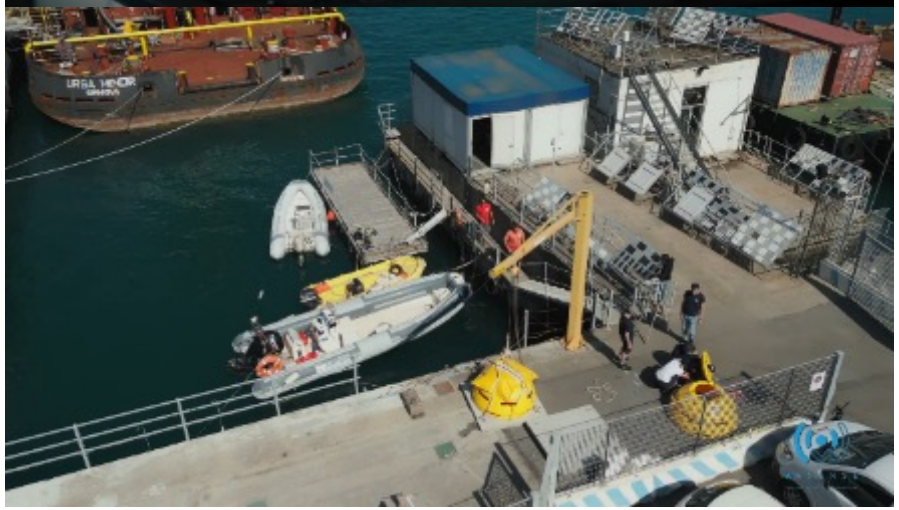
- **Shared eco-system** (harbor, authority, scientists, marine parks, mussel farmers)
- **Identify and reduce pollutants** causing damage to inventory
- **High quality dense data**
- **Reduced cost of monitoring with** higher accuracy
- **Carbon Sink mapping**

Augmented Diving Experience & Localization

Port Of Genova

Wireless Environmental Monitoring

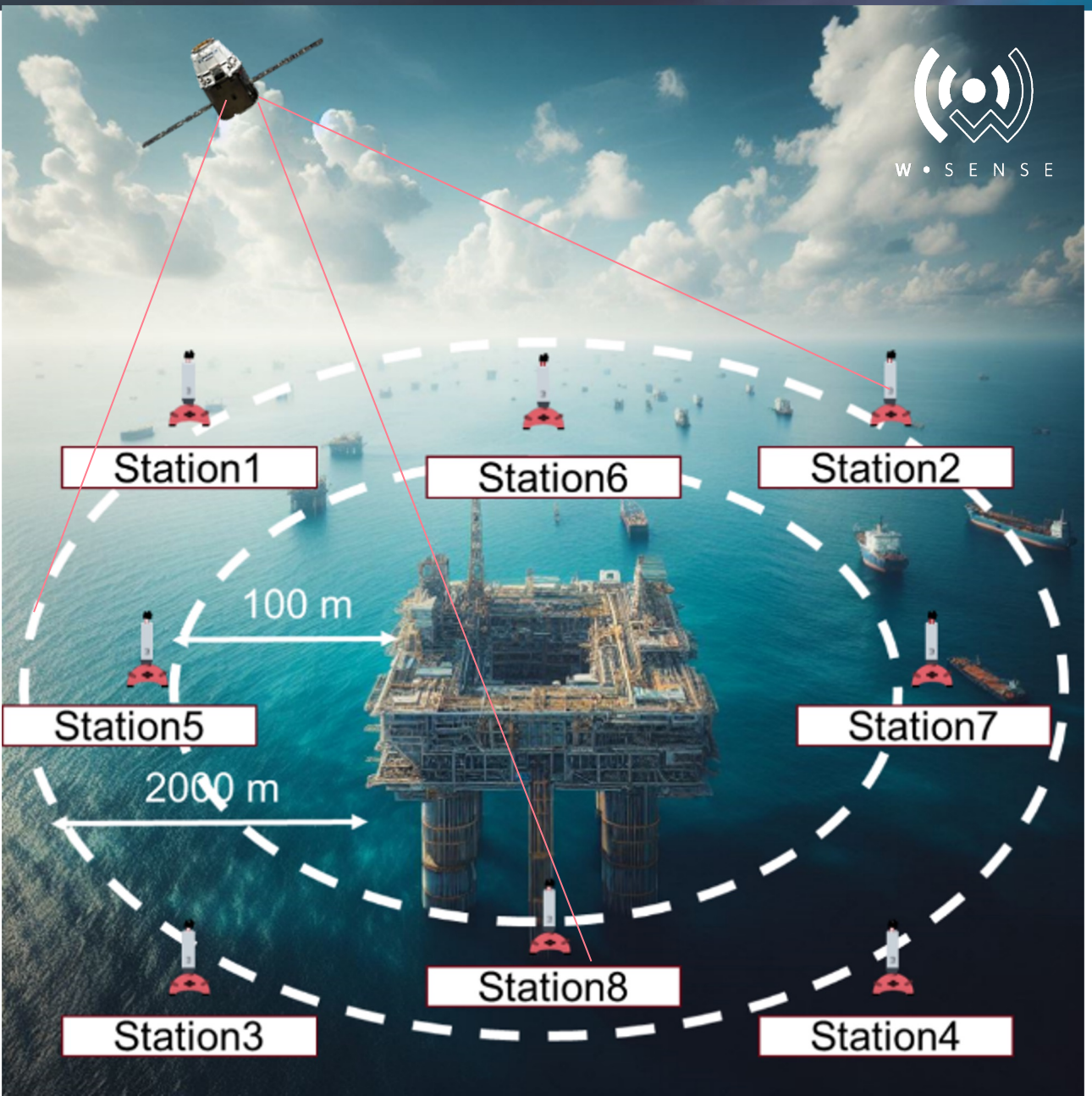




Portofino

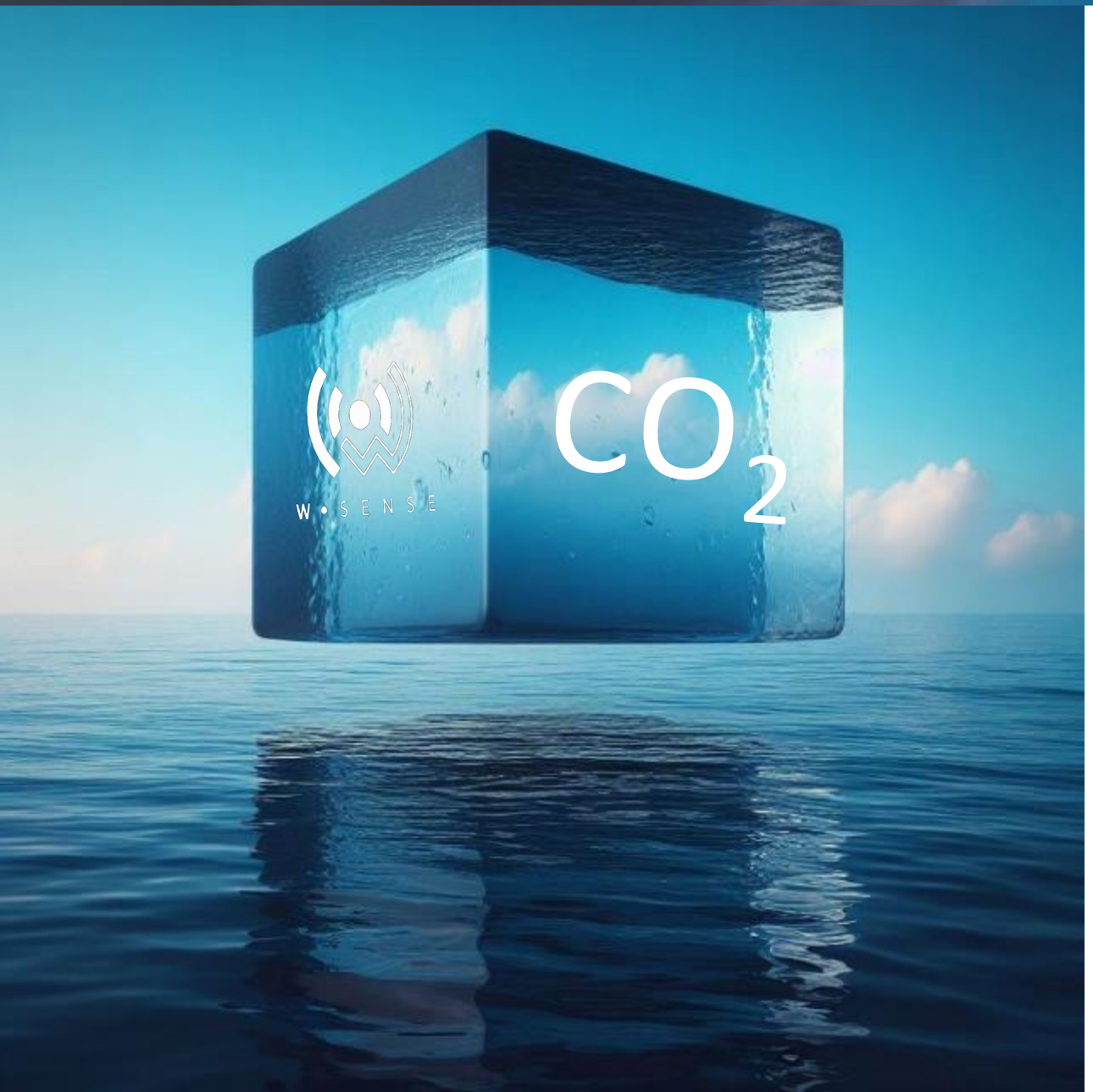
Chat and Localization for divers

OFFSHORE OIL & GAS | ENVIRONMENTAL MONITORING



- Measuring and predict **oil spill dispersion effect**
- **Reduce time and cost** of oil recovery operations
- **Satellite Data** integration for **tip & cue**

CARBON SINKING & CCS



- Promotion of **carbon sinking approach** for **carbon-intensive industries**
- Infrastructure based on **satellite and underwater nodes** monitoring, can measure in near real time CO2
- The punctual assessment of CO2 can contribute to generate **Carbon Credits** from the sea activities.
- **Social ROI** evaluation for **ESG**

Underwater Archeological Heritage

- Real-time **Environmental monitoring**
- **Surveillance and detection** against unauthorized visitors
- **Connected divers** and visitors
- **Touristic enriched experience** when visiting the site
- **3D Image AI based** reconstruction

OFF Shore Wind | ENVIRONMENTAL MONITORING and DESIGN

Baseline from **real time in situ monitoring data**

EIA (Environmental Impact Assessment) **accelerated process**

Evaluation of **biomass** and **marine life in the Offshore areas**.

W·Gateway

Sounds

Pressure, Wave and Tides

Turbidity

Images

pH

Current intensity & direction

Salinity & Conductivity

Chlorophyll

W·Nod - Enhanced

W·Nod - Enhanced

CO2 percentage

Temperature

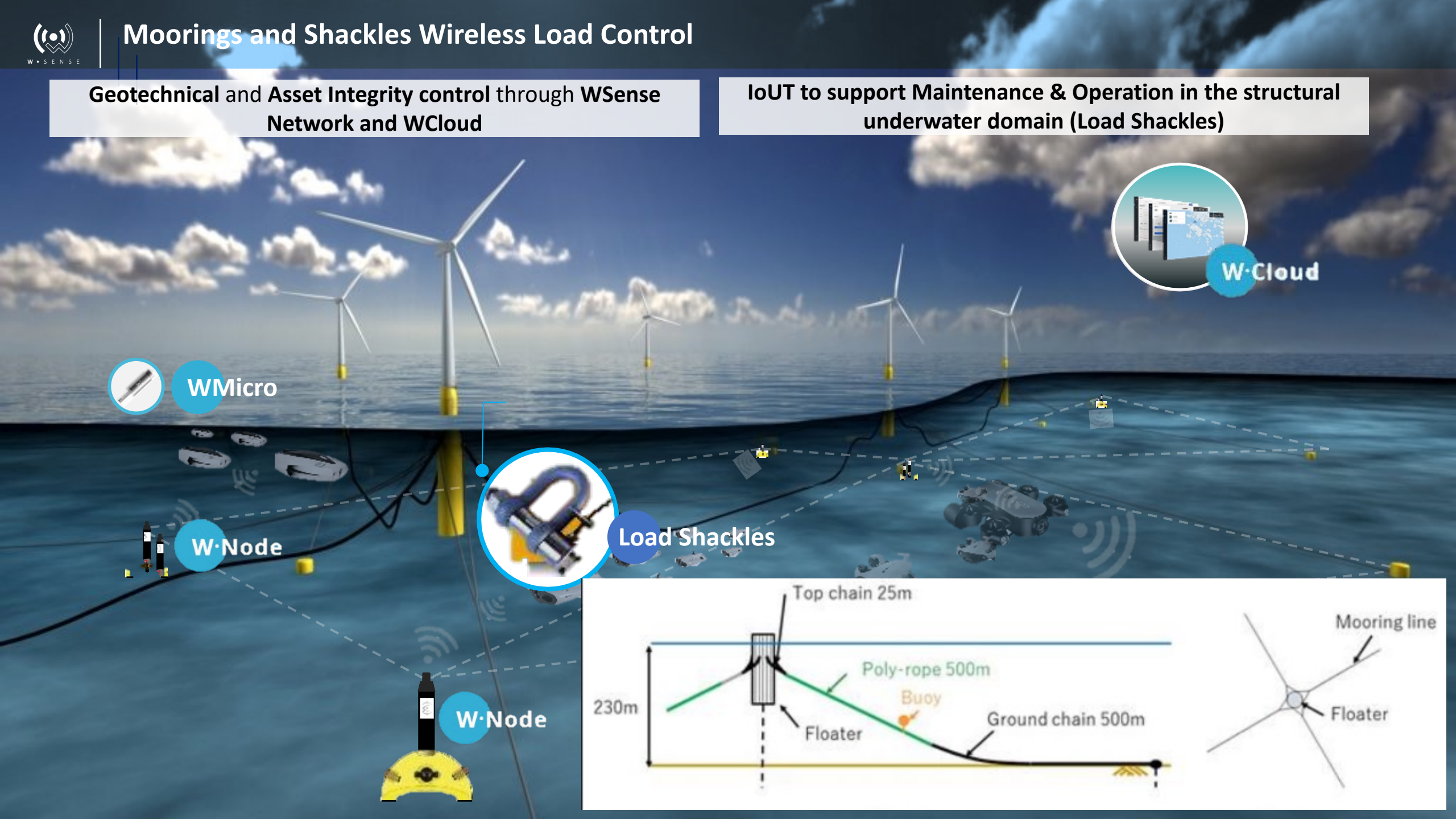
Current intensity & direction

Dissolved Oxygen

Moorings and Shackles Wireless Load Control

Geotechnical and **Asset Integrity control** through **WSense Network and WCloud**

IoUT to support Maintenance & Operation in the structural underwater domain (Load Shackles)



Appendix - WSense Components

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PATENT-PROTECTED SOLUTIONS ENABLING UNMATCHED TECHNOLOGY OFFER

WSENSE owns patents on how to develop effective and reliable underwater wireless networks.

PATENT titled "POLICY MAC" - "Method and device for dynamical protocol selection" Priority No.102015000062624 granted on 16.03.2018

EPO no. 3363183 granted

USPTO No. 10659570 granted on 19.05.2020

Patent titled "CARMA" - "Method for managing in an adaptive and joint way the routing policy and the retransmission policy of a node in an underwater network, and means for its implementation" Priority no. 10201500006262 granted on 04.04.2018

EPO No. 3289799 granted on 27.11.2019

USPTO Nr. 10581533 granted on 03.03.2020

Patent also granted in Israel, Japan, Chile, Russia, Australia, Cina. Patent also filed in Canada and various countries in Asia.

Industrial Design IP protection of WSENSE 3D Graphical User Interface: International Design Registration no. DM/214843 granted 12.04.2021.

Granted in Europe UK and Norway. Filed in Chile and Canada

Europaisches Patentamt
European Patent Office
Office européen des brevets

WIPO

WNode

The underwater multi-sensor node with acoustic modem

WNode – WSense proprietary underwater acoustic modem for shallow waters, which supports different types of sensors.

It allows the remote configuration of the parameters to be collected and measured, by controlling underwater variables through the underwater acoustic network.

WNode supports protocol stacks that enable multi-hop adaptive communication over the network and allows the full integration of multi-vendor family multi-parameter submarine sensors through the use of standard 8-pin submarine connectors (Subconn).

Collected data by WNode can be stored offline and then sent online to managing platform for further in-depth analysis.

WNode supports network MESH protocols for multi-hop communication and secure encrypted and authenticated communication according to the National Institute of Standards and Technology.

Wnode Enhanced

The underwater multi-sensor node supporting Deep water and AI

- High computational power to perform AI based tasks
- Can work in deep water (Up to 1500m)
- Remote reconfiguration and control through the underwater acoustic network
- Full integration of submarine energy-intensive devices (multiparametric probes, camera and hydrophone)
- Easy integration with external auxiliary power supply
- Can work with external additional acoustic and optical underwater modems with different modulations and transmission speeds and frequencies
- CE certified

WSwitch

Enabling Underwater Nodes Capabilities

WSwitch – device that extends the number of sensors that can be supported by a single WSense node and external power supply systems.

It can work jointly with an auxiliary battery pack to extend the operational life of WNode and WNode Enhanced.

Each WSwitch consists of 1 input and 4 outputs for sensors and 1 additional output (subconn) to connect additional WSwitch (ensuring up to 8 WSwitch in cascade).

WSwitch supports the connection and communication of data from up to 4 multi-vendor sensors. This device allows to configure the sampling frequency of the data from the individual probes.
A multiple WSwitch cascade configuration can be used to increase the number of usable sensors, up to a maximum of 32 (8 WSwitch cascade).

WSwitch also guarantees, in off-line mode, up to 512 memory recordings, which can be interrogated both by tool and by acoustic channel.

WGateway

The bridge between underwater and terrestrial environment

WGateway is the interface between the underwater and the terrestrial network.

The communication capabilities of this device are guaranteed by using three acoustic transceivers contained in a single unit. All data received by the network through radio frequencies communication is forwarded by acoustic modems to the underwater network and vice versa.

WGateway is also the interface between sensor systems and commercial peripherals (such as cameras, computers, etc.) via ethernet connection.

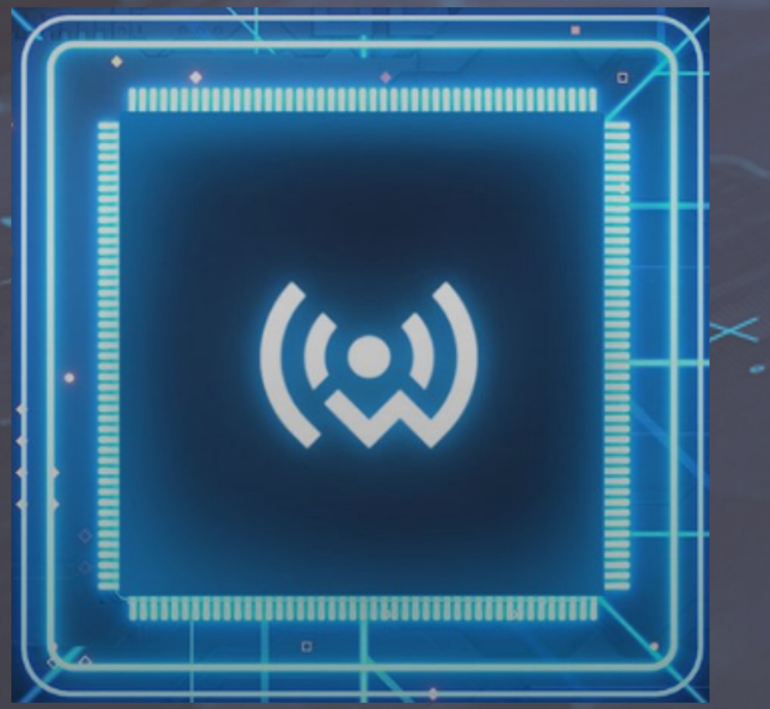
The protection of this component's electronics is also guaranteed by a special compact waterproof IP68 easily installed on different systems (buoys, medes, cages for aquaculture, ground bases, etc.) and in different weather conditions.
WGateway can also support an external GPS system to provide real-time location and connection of a number of underwater nodes.

WGateway also benefits from advanced techniques and algorithms for compressing camera images and subsequent transmission.

In weak acoustic channel scenarios, WGateway contains an automatic recovery system for undelivered data packets.

WMesh

Patented multi-protocol networking software for underwater communication



WMesh is the WSense patented multiprotocol routing application, which aims to increase the degree of reliability of data transmitted in the wireless network through the creation of robust and adaptive multi-hop submarine networks.

The use of WMesh allows to define a robust and adaptive multi-hop underwater network in relation to the conditions in which the network nodes are diplayed (WNode, WNode Enhanced and WGateway), thanks to machine learning algorithms and the analysis of the best protocol parameters.

Robustness of WMesh is ensured by machine learning algorithms that allow to convey the packets containing or collected data to the available nodes of the network according to a mechanism of optimization of the reception path in relation to parameters, such as, channel occupancy level, energy levels, and network topology and quality of environmental conditions.

This results in the high reliability of the transmission of information that crosses the entire infrastructure up to the terminal nodes.

WCloud

WSense Software Platform for data collection and analysis

WSense's proprietary software platform based on Cloud services, which allows the data transferred from the WGateway to be stored in real time and continuously and processed to extract information and trends, which can be consulted through analysis graphs and interactive dashboards, to extract valuable information from the underwater environment.

WCloud interfaces and its functionalities can be managed and customized directly from this powerful software tool, including the definition of alarm thresholds for the set-up of a reporting system in case of exceeding these values and sending alert and alarm messages. The platform offers the possibility of threshold values different from those initially established and obtaining the related analyzes and statistics.
The WCloud user interface allows to view on a georeferenced map the exact position of the deployed architecture, including the WNodes and WGateways installed at sea, as well as their operational status.

The WCloud platform allows interfacing with third-party platforms, allowing to import or export data according to standard protocols (REST, MQTT, FTP), guaranteeing security and reliability in the transmission of information. It is possible to access the WCloud platform and its functions via the web with dedicated User accounts.

CHOOSE YOUR SENSORS! WIRELESS INTEGRATED SENSORS (July 2024)

Environmental Sensors

Aanderaa

Turbidity Sensors	
Temperature	C°
Turbidity	FTU

Doppler Current Sensor & current profiler (DCS & DCPS)	
Abs speed	cm/s
Direction	Deg.M
North	cm/s
East	cm/s
Heading	Deg.M
Tilt	Deg
SP std	cm/s
Strength	dB
Ping count	
Abs Tilt	Deg
Max Tilt	Deg
Std Tilt	Deg
Temperature	C°

Conductivity Sensors	
Conductivity	mS/cm
Salinity	PSU
water Density	kg/m3
Speed of Sound	m/s

YSI

EXO2 & EXO3 – Multiparametric	
Oxygen	mg/L
Conductivity	mS/cm
pH/ORP	pH
fDOM	Ppb QSE
Chlorophyll	µg/L
Turbidity	FNU

SeaBird

SeapHOx v.2	
Conductivity, Temp, Depth	mS/cm
pH	pH
Oxygen	mg/L

Oxygen Optode	
O2-concentration	µM
Temperature	C°
Air Saturation	%

Pressure, Wave and Tide sensors	
Pressure	kPa
Tide pressure	kPa
Tide level	m
Significant wave height	m
Maximum wave height	m
Mean period	s
Peak period	s
Energy wave period	s
Mean zero crossing period	s
Steepness	-
Irregularity of sea-state	-
Cut-off frequency	Hz
Pressure Series	kPa
Spectrum	m2

Aqualabo

TRIPOD : Numerical multi probe	
temperature	°C
pH	pH
Redox	mV
Oxygen	%
Oxygen	mg/L
Oxygen	ppm
C4E conductivity	µS/c
Salinity	g/kg
TDS_ Kcl	ppm

Nortek

AWAC Acoustic Doppler Current profiler	
ADCP	

S::CAN

I::SCAN multi-parameter	
Turbidity	NTU/FTU
Color (app)	Hazen
Color (tru)	Hazen
Total Organic Carbon (TOC)	mg/L
Dissolved Organic Carbon (DOC)	mg/L
UV254 (organic matter in water)	Abs/m
UV254 f	Abs/m
UVT10	%

In-Situ

RDO PRO-X	
O2-concentration	µM
Temperature	C°
Air Saturation	%

Franatech

METS Methane sensor	
Gas Temperature	C°
Raw Methane	V

ANB Sensors

Ph Sensor DC300	
pH	pH

Chelsea

Uvilux Trilux – Biological sensors	
Trilux- Chlorophyll, turb, algae	µg/l
Uvilux - PAH, CDOM, TLF, BOD	µg/l

Pro-Oceanus

Solu-Blu series	
CO2	Ppmv – mg/L

Video and Audio Acquisition

OceanSonics

Hydrophone IcListen RB9
Noise recording controlled by WNode. Real time feedback on noise power triggering events (10 Hz to 200 kHz)

LH Camera

Underwater Camera HD-PTZ	
Ethernet Underwater Camera	

Imenco

LABRUS Underwater Camera	
Ethernet Underwater Camera	

Structural Sensors

BlueRobotics

Ping2 Sonar Altimeter & Echosounder	
Altitude	m
Confidence	%

Strainstall

Underwater Load Shackles	
Cells excitation voltage	VDC

Measurand

Structural Sensors (accelerometers arrays)	
SAAX Model 003 (Accelerometer)	m/s2
SAAV Model 001 (Inclinometer)	Degrees

Gestecno

Structural Sensors (Piezometer arrays)	
Resistive Electric Piezometer	cm