EUROMARINE
EUROPEAN MARINE RESEARCH NETWORK

2019 General Assembly meeting

CEIMAR, Cádiz, Spain

30-31 January 2019

From genes to ecosystems in changing oceans

www.euromarinenetwork.eu

cei·mar
campus de excelencia internacional del mar

UCA Universidad de Cádiz

ASIMO Autonomous Systems for Integrated Marine and Maritime Observations in Coastal areas

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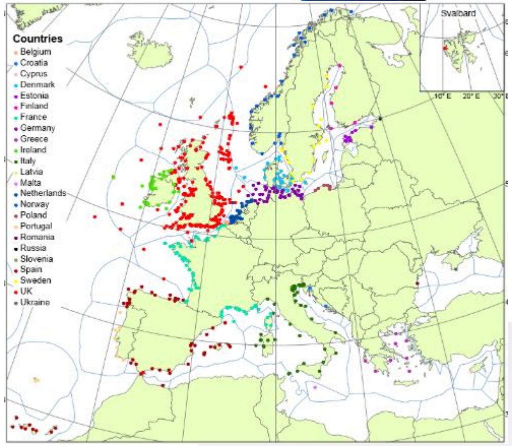
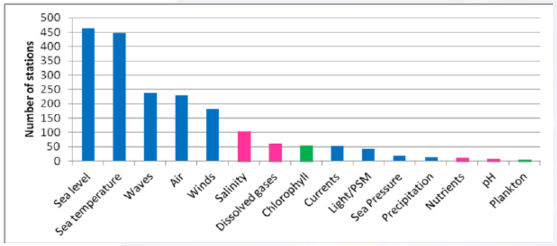
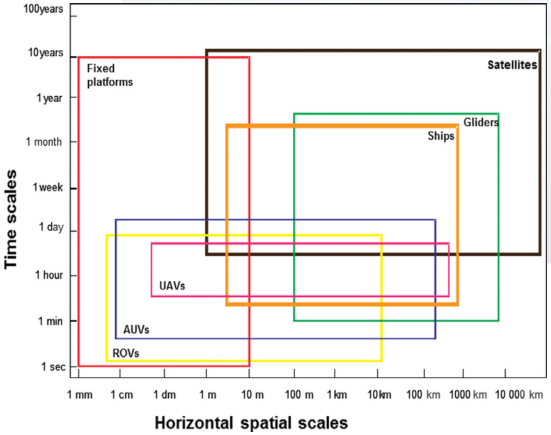
EUROPEAN MARINE RESEARCH NETWORK

Rationale

- The coastal ocean is the most productive and the most dynamic part of the world ocean, which makes it a significant source of resources and services for mankind.
- It is also the part of the world ocean, which is located directly in contact with human populations and therefore the one, which is most sensitive to anthropogenic disturbance, which in turn places these resources and services under threat.
- These concerns explain why in European coastal seas, a rapidly increasing number of observing systems have been implemented in the last decade.
- However this expansion of “coastal observatories” has been done in a fragmented way, driven by national interests and mainly undertaken through short-term research projects.
- we cannot understand the complexity of the coastal ocean if we do not understand the coupling between physics, biogeochemistry and biology.







GOOS

GOOS-193 Requirements for Global Implementation of the Strategic Plan for Coastal GOOS

Need for "Coastal" GOOS to observe and model a broad range of scales from the ocean basins to estuarine systems in order to achieve its mandate, i.e., changes in local ecosystems cannot be anticipated without observing and modeling larger scale changes and the propagation of change across scales

Building blocks of a system of systems for coastal observations and predictions:

- Surface phytoplankton biomass and subsurface oxygen fields,
- Distribution and abundance of waterborne pathogens and toxic phytoplankton,
- Spatial extent of living benthic habitats (coral reefs, seagrass beds, mangrove forests and tidal marshes) and ecological buffers to coastal flooding,
- Distribution and condition of calcareous organisms (cold and warm water corals, coccolithophores and pteropods), and
- Distribution and abundance of exploitable fish stocks.

Establish data management and communication systems for interoperability among monitoring systems and data integration within and among regions

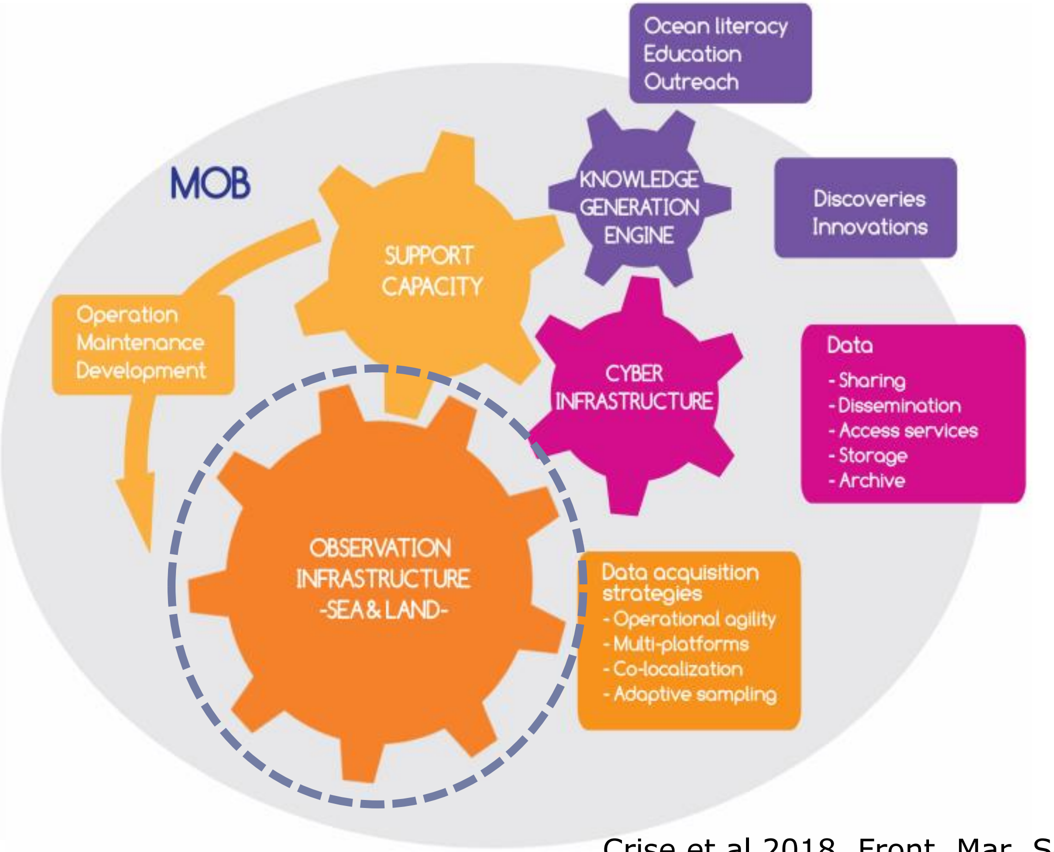
Meeting

- 17-19 September 2018, Parque Científico Tecnológico Marino, University of Las Palmas, Canary Islands, Spain ECOAQUA group
- 15 Participants + researchers and students from ULPGC
- Expected outcome Perspective paper to be submitted in e.g., Frontiers in Marine Science

Laurent Delauney	IFREMER	France
Ermanno Pietrosemoli	ICTP	Italy
Paul Holthus	WOC	USA
Eric Delory	PLOCEAN	Spain
Terje Thorsnes	NGU	Norway
George Petihakis	HCMR	Greece
Ralf Bachmayer	MARUM	Germany
Douglas Connelly	NOC	UK
Juan A. Montiel Nelson	ULPGC	Spain
Jorge Cabrera Gámez	ULPGC	Spain
Sandro Crise	OGS	Italy
Patrizio Mariani	DTU	Denmark
Murat Ardelan	NTNU	Norway
Ricardo Haroun Tabraue	ULPGC	Spain
Sokol Kosta	AAU	Denmark

MOB: Integrated systems

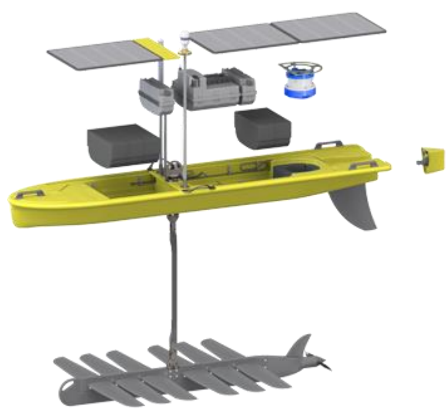
- four interconnected components or “gears”
- primary scope to generate knowledge via data synthesis addressing scientific, societal, or economic challenges
- Long-term sustainability is a key feature that should be guaranteed through an appropriate governance
- A deeper biological understanding of the marine ecosystem should be reached with the proliferation of MOBs



Crise et al 2018, Front. Mar. Sci.

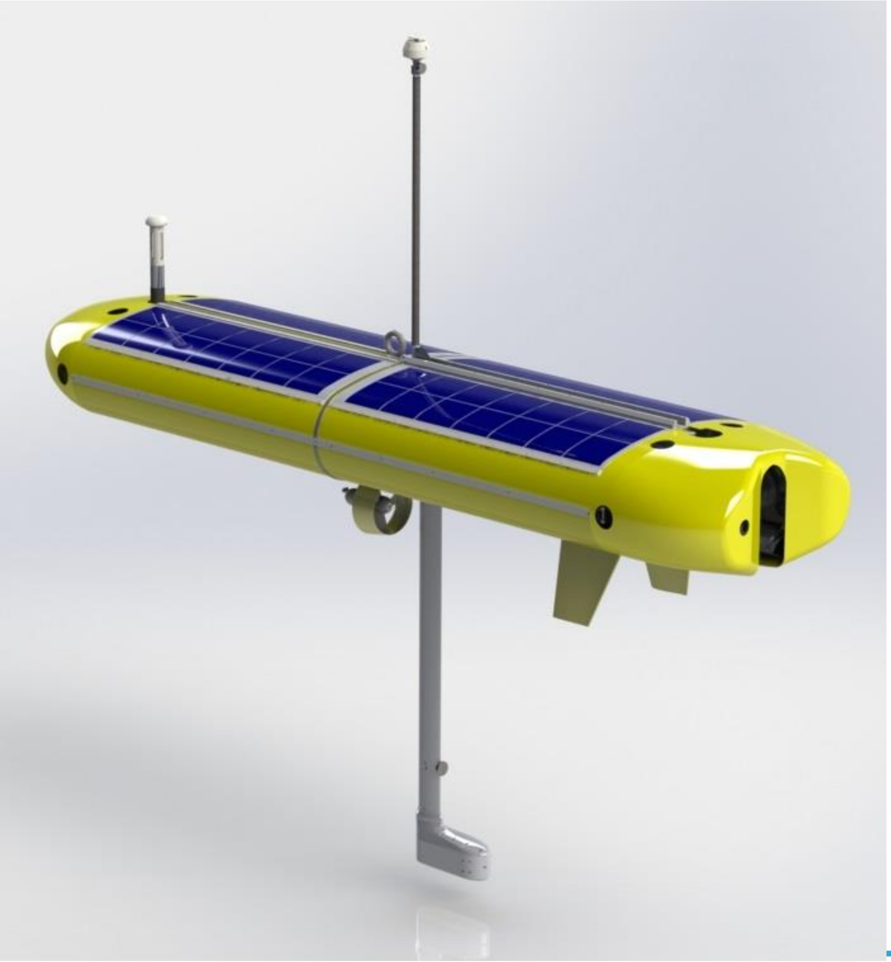
Current and emerging technologies

- Autonomous Underwater Vehicles (survey, intervention)
  - Survey class
  - Intervention class
- Gliders
  - Endurance, cost, semi-lagrangian
- Mooring
- Drifters
- Ships
- …

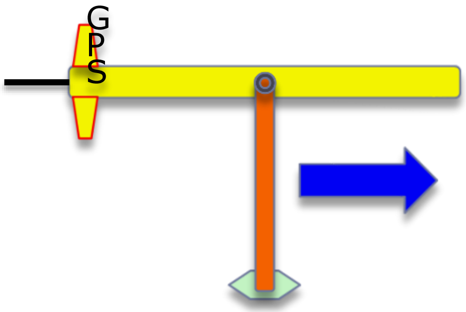


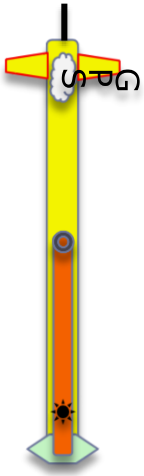
Current and emerging technologies

New vehicle developments
USSV SeaDuck - An unmanned submersible surface vehicle developed at AOSL@MUN Canada)



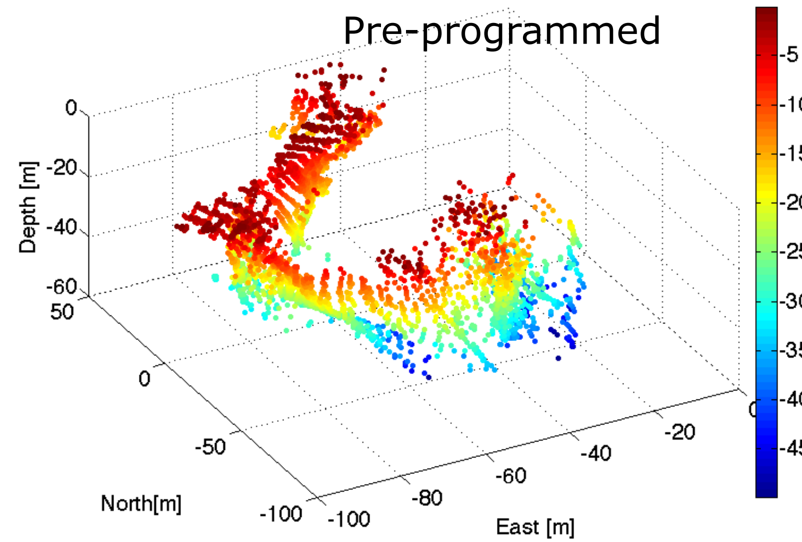
- Payload Sensors
  - Weatherstation
  - ADCP
  - CTD
- Surface mode
  - Horizontal drive mode
  - Vertical Buoy
- Dive Mode (<200m)
  - Vertical profiling
  - Watercolumn Hovering

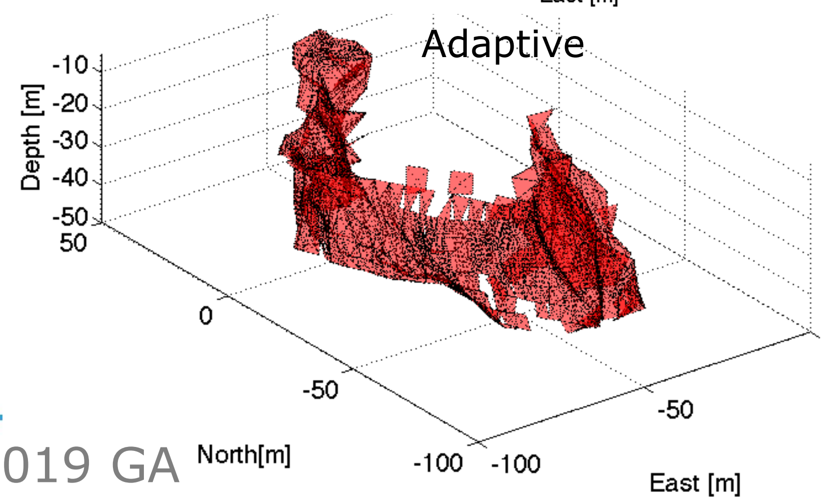




Current and emerging technologies

Adaptive sampling
Underwater glider iceberg mapping and terrain following





New sensors

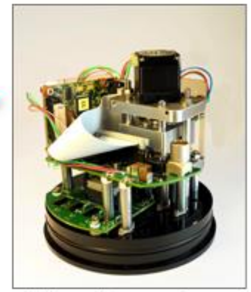
Must be light
Must be reliable
Constrained metrology
Long term deployments
Sensitive
Cheap

Sense OCEAN

Marine sensors for the 21st Century

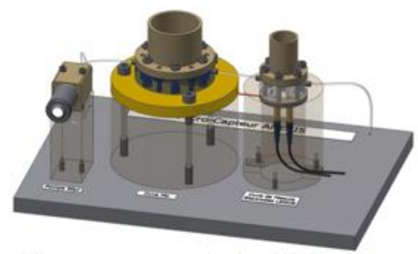
www.senseocean.eu

- In situ sensors to measure crucial biogeochemical parameters.
- Deployable on many platforms.
- Low cost & mass producible.
- Using a variety of sensor technologies.



Lab on chip sensor (image courtesy OTE Group, NOC)

Optode sensors mounted on CTD frame ready for deployment (image courtesy E. Fritzsche

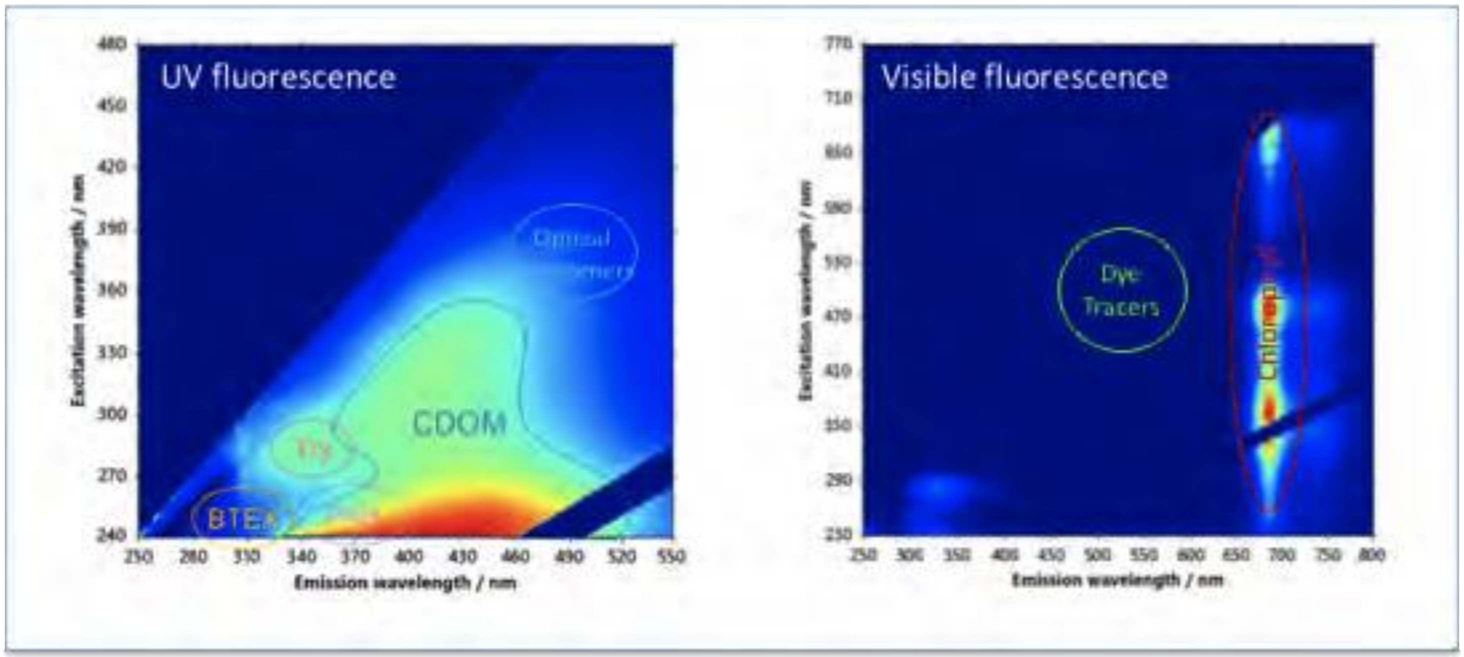


Silicate sensor prototype developed by CNRS (image courtesy CNRS)

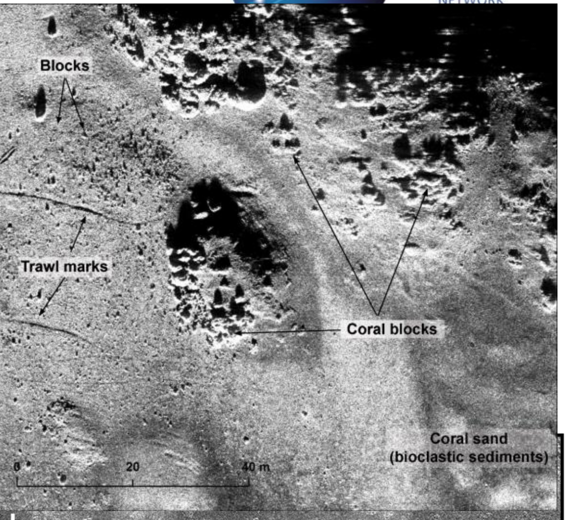
Deploying sensors on an observatory system (Hypersub) in Helgoland (image courtesy A. Chennu)

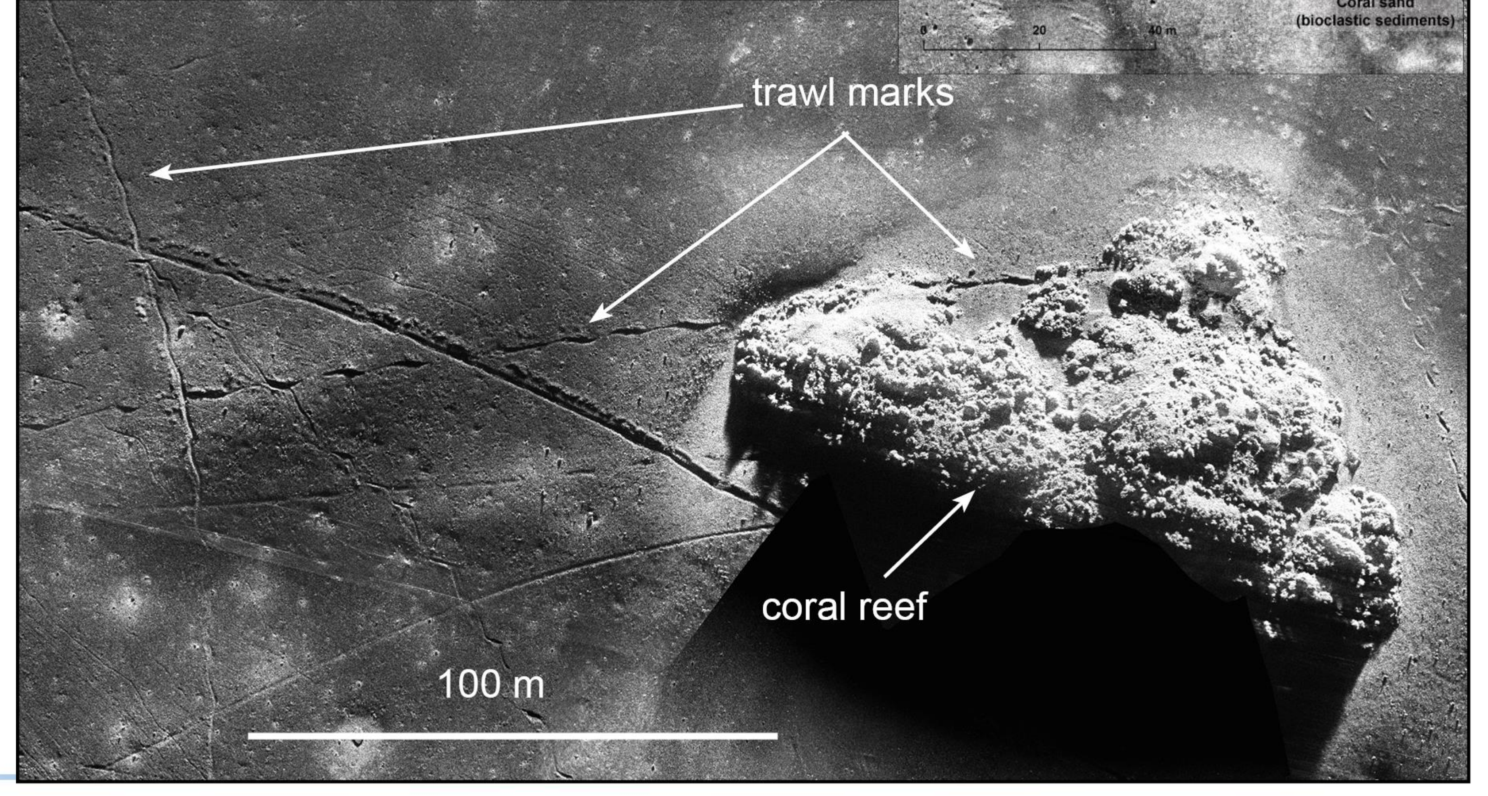
New sensors

Multiparameter optical sensors

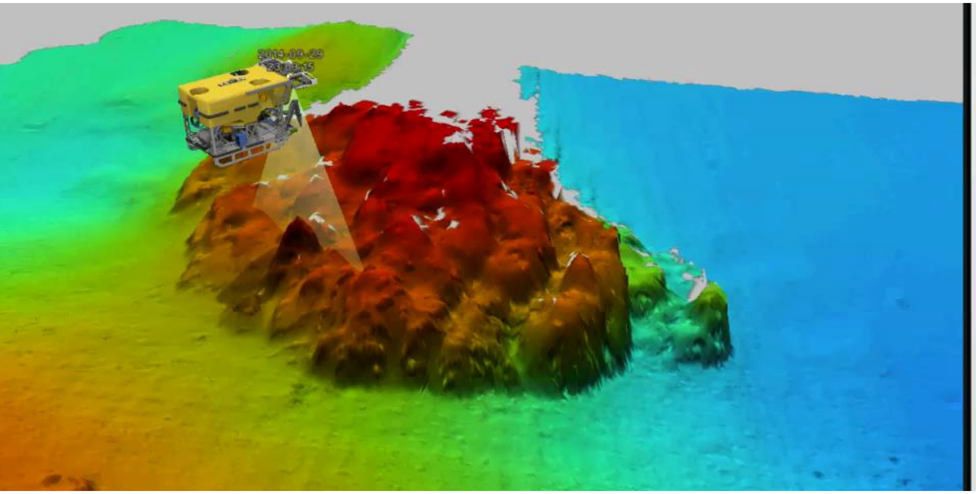


- Synthetic aperture sonar – HiSAS 1030
- EM2040 multibeam echosounder
- Edgetech 2200 subbottom profiler
- Franatech methane sniffer
- Tfish electro-optical imagery system



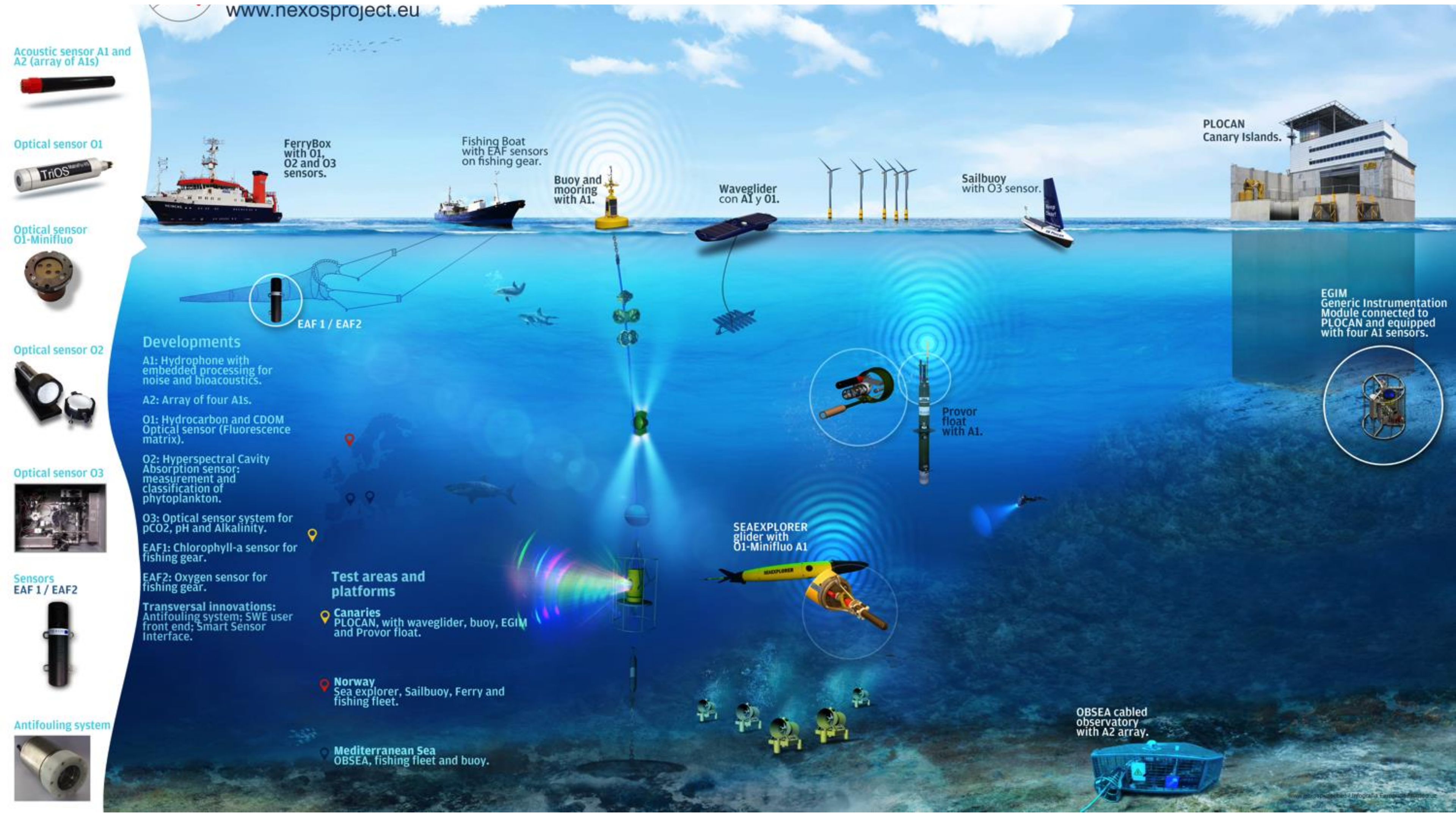


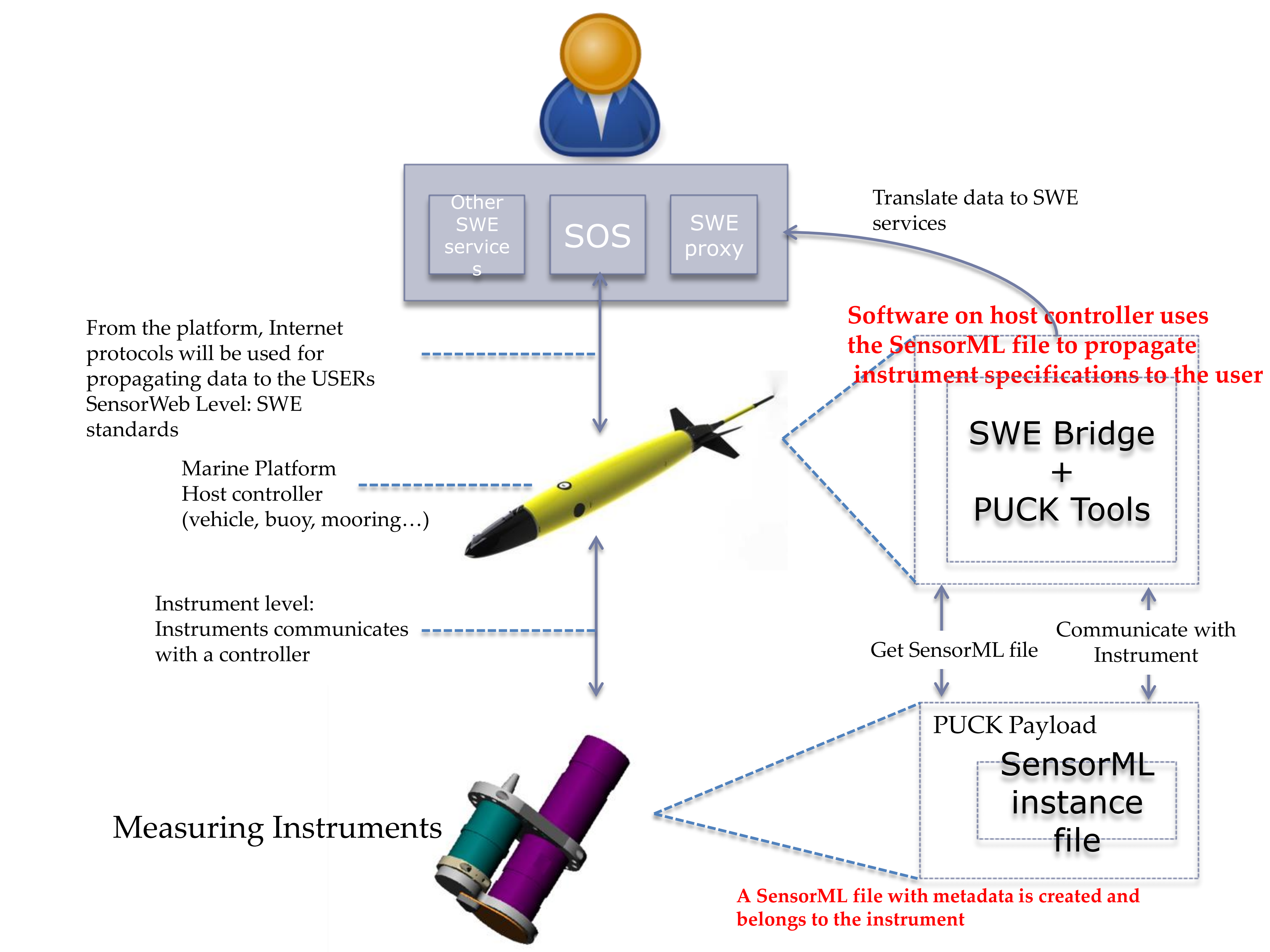
Coral reef damage

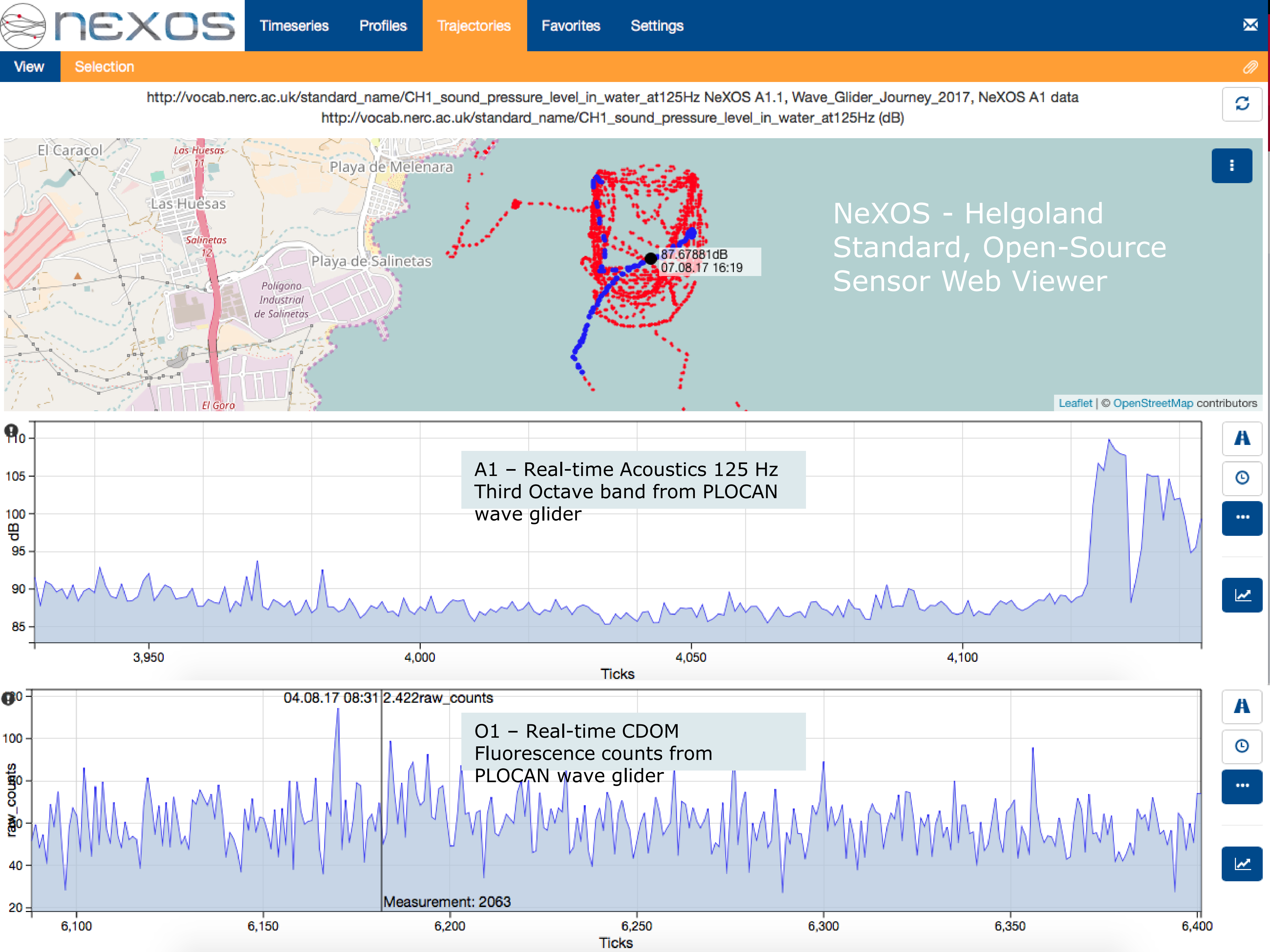


mareano
collecting marine knowledge

NeXOS RESULTS	Eight new low-power multifuncitonal compact sensors developed, from TRL 2 to TRL>7 - 50% already commercial – Coordinated and field tested (O1 and A1) by PLOCAN (EMSO ERIC) on autonomous platforms Three types: Acoustic, Optical, and Ecosystem Approach to Fisheries Full OGC-SWE standard services and visualisation tools, all open-source Low-power biofouling protection of optical windows Demonstration on fixed and mobile platforms in Atlantic, Mediterranean and Norwegian waters



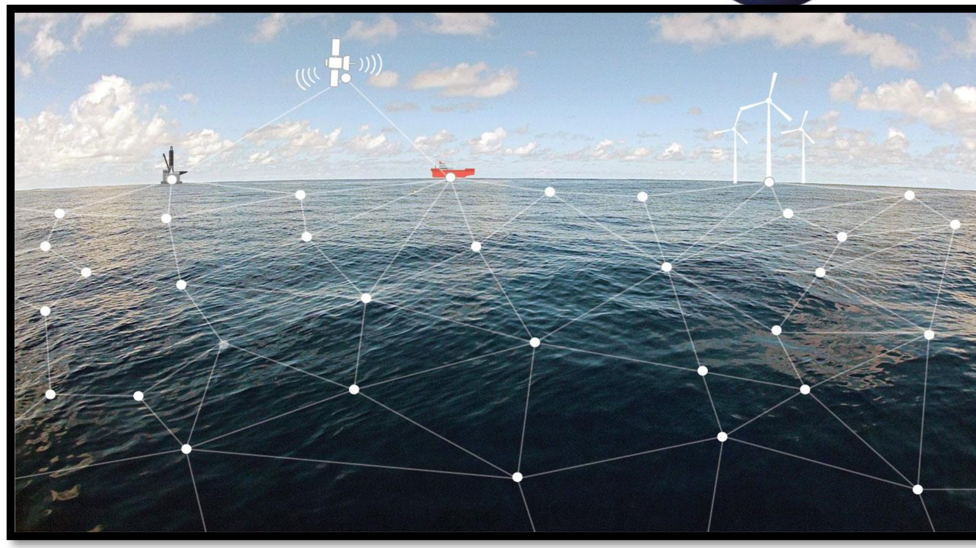

Other SWE services
SOS
SWE proxy
Translate data to SWE services
Software on host controller uses the SensorML file to propagate instrument specifications to the user
From the platform, Internet protocols will be used for propagating data to the USERs SensorWeb Level: SWE standards
SWE Bridge + PUCK Tools
Marine Platform Host controller (vehicle, buoy, mooring…)
Instrument level: Instruments communicates with a controller
Get SensorML file
Communicate with Instrument
PUCK Payload
SensorML instance file
Measuring Instruments
A SensorML file with metadata is created and belongs to the instrument

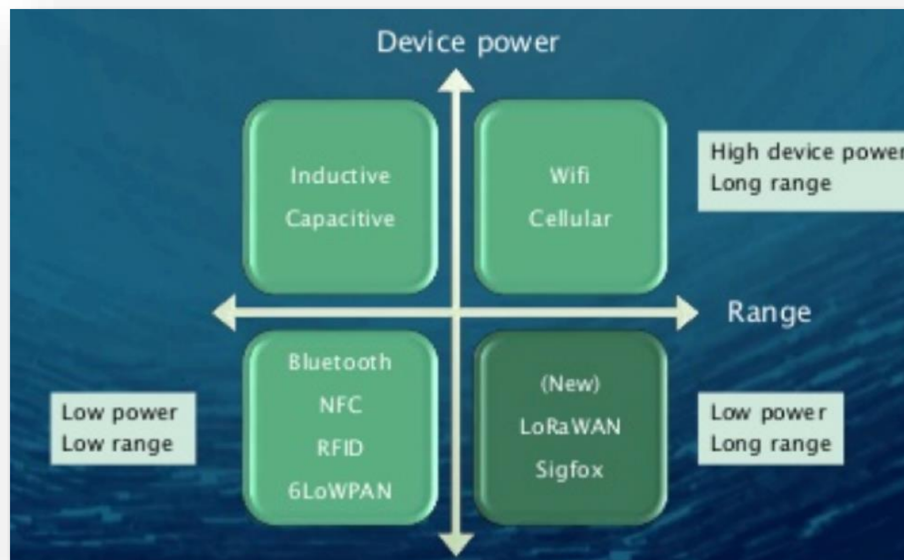

nexos
Timeseries
Profiles
Trajectories
Favorites
Settings
View
Selection
http://vocab.nerc.ac.uk/standard_name/CH1_sound_pressure_level_in_water_at125Hz NeXOS A1.1, Wave_Glider_Journey_2017, NeXOS A1 data
http://vocab.nerc.ac.uk/standard_name/CH1_sound_pressure_level_in_water_at125Hz (dB)
El Caracol
Las Huesas
Playa de Melenara
Salinetas
Playa de Salinetas
Polígono Industrial de Salinetas
El Goro
87.67881dB
07.08.17 16:19
NeXOS - Helgoland Standard, Open-Source Sensor Web Viewer
Leaflet | © OpenStreetMap contributors
A1 – Real-time Acoustics 125 Hz Third Octave band from PLOCAN wave glider
dB
110
105
100
95
90
85
3,950
4,000
4,050
4,100
Ticks
04.08.17 08:31
2.422raw_counts
O1 – Real-time CDOM Fluorescence counts from PLOCAN wave glider
raw_counts
100
40
20
Measurement: 2063
6,100
6,150
6,200
6,250
6,300
6,350
6,400
Ticks

Connectivity

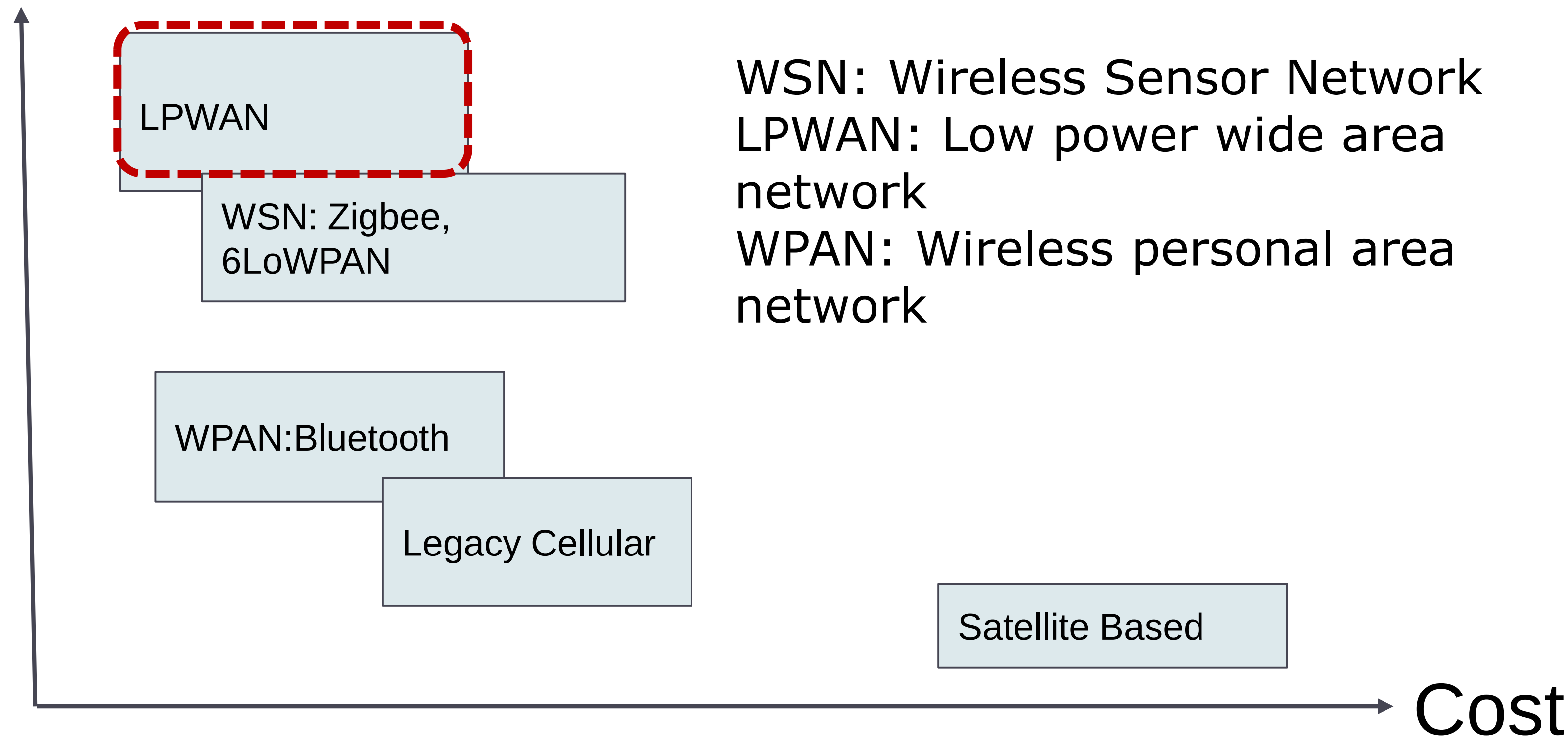
- WiFi
- Modified WiFi for Long Distance
- Cellular based, legacy and upcoming
- Low Power Wide Area Network (LPWAN)
- Satellite based

- IoT is a step-change technology also in ocean observation
- Low-cost, low-power consumption, long- range technologies are already available





Energy Efficiency

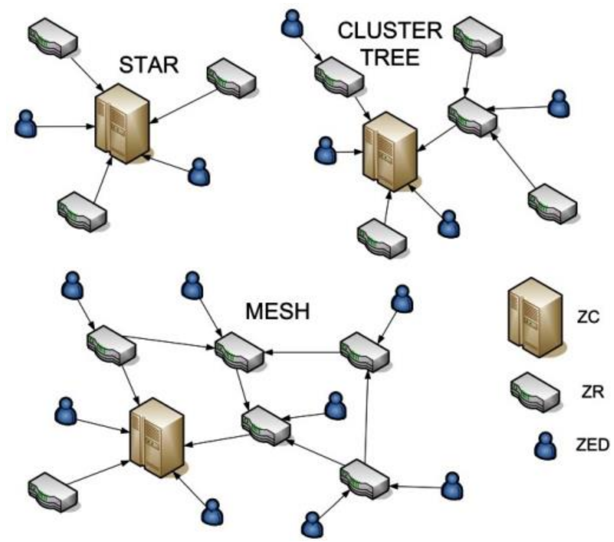


WSN: Wireless Sensor Network
LPWAN: Low power wide area network
WPAN: Wireless personal area network

1. **Long Range:** 1 – 100 Kms including indoor and underground locations.
2. **Low Power:** Optimized for power consumption
3. **Low Cost:** low complexity in hardware design

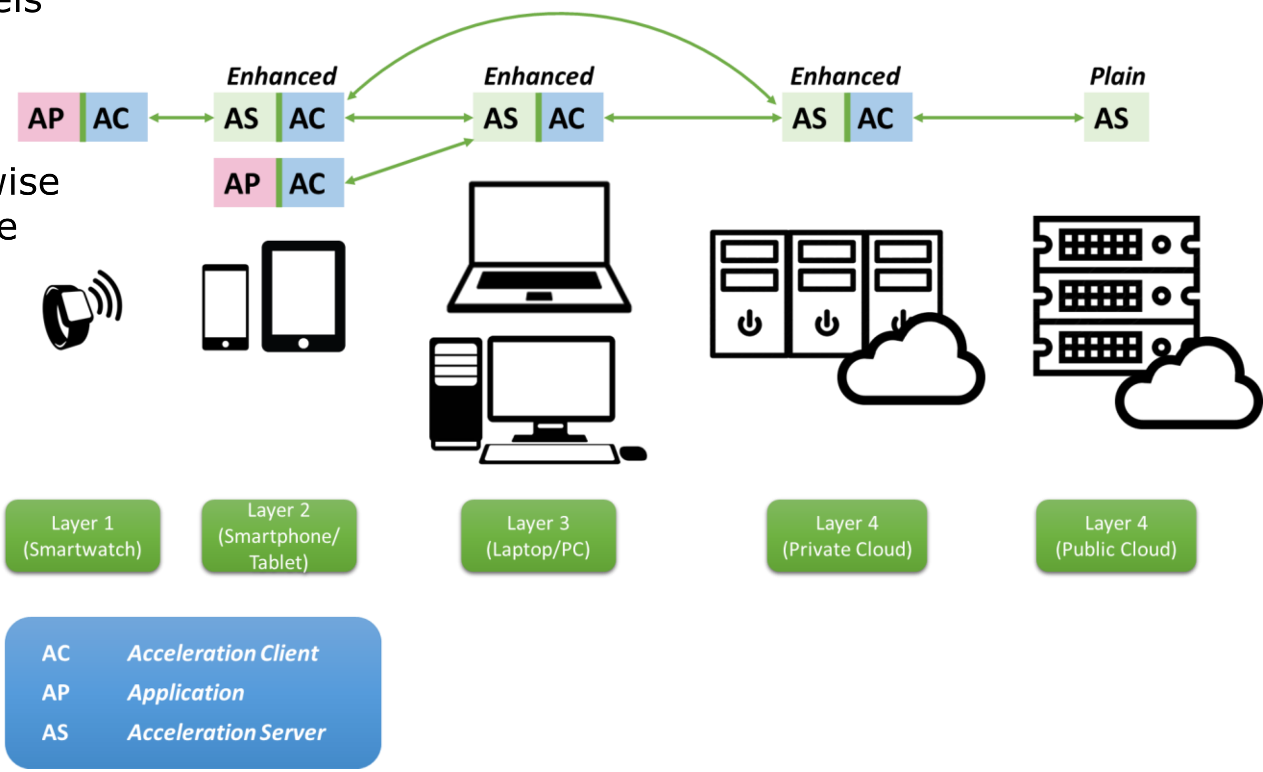
Low Power Wide Area Network LPWAN

- Optimized for **IoT** and **Machine to Machine** (M2M) applications
- Trade **throughput** for **coverage** (up to several kilometers)
- **Star** or **star-of-stars** topology
- **Low power consumption**
- **Low** on board processing **power requirements**
- **SigFox and LoRa**



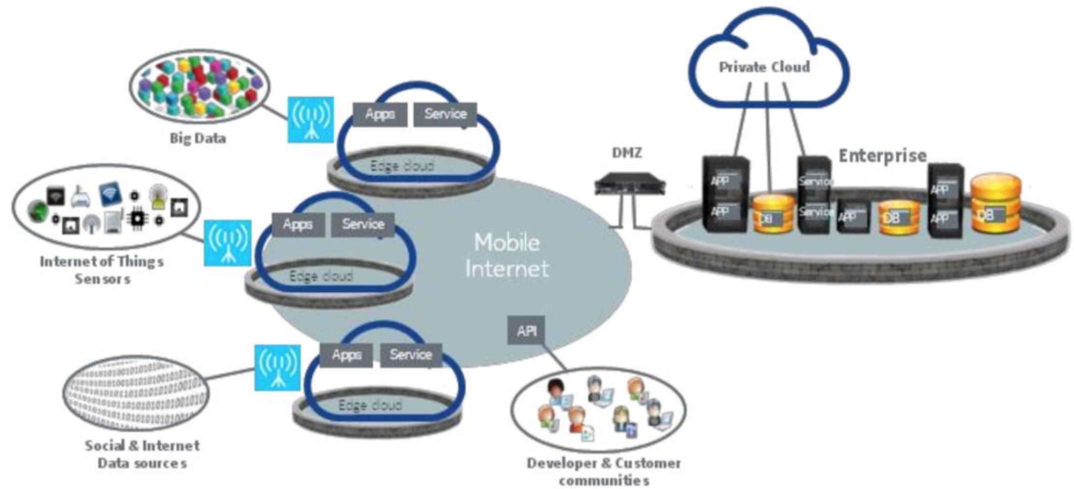
COMPUTATION OFFLOADING FROM THINGS TO THE CLOUD

- Different layers of devices (computational resources)
- *Offloading* heavy operations from low-power devices to higher levels
- Lower energy consumption
- Faster execution
- Enables computation otherwise impossible: e.g. GPGPU code execution

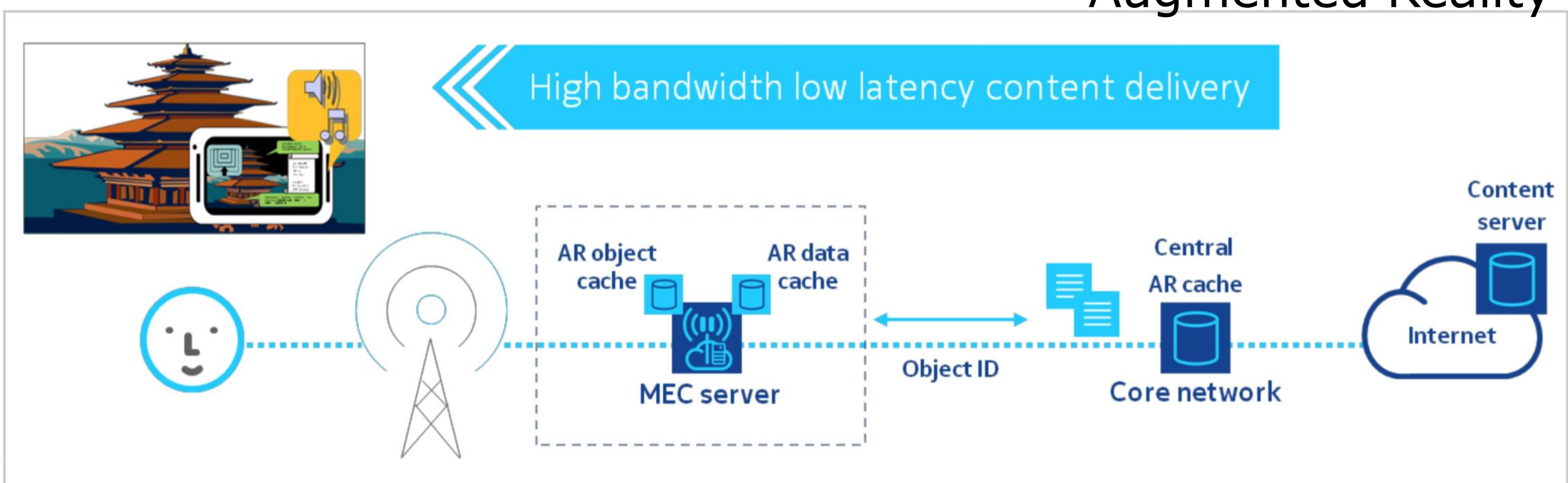


Mobile Edge Computing

- Latency is crucial in computation offloading
- Similar to Content Delivery Networks (CDN), Mobile Edge Computing (MEC) brings resources close to final users
- Multiple use cases scenarios



Augmented Reality

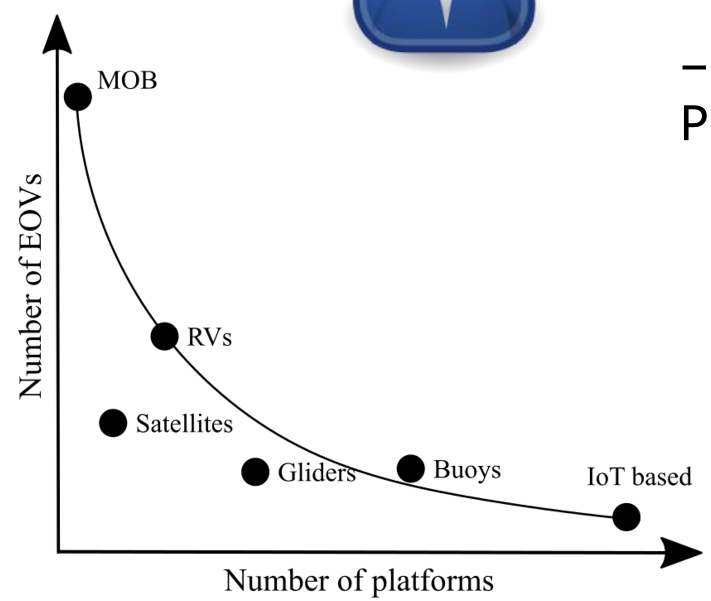


Distributed observation system

A system is composed by a network of fixed and mobile heterogeneous nodes, which coordinate data acquisition tasks and data management (secure assembly, storage and services) to deliver fit-for-purpose products

Features:

- Larger geographical coverage
- Autonomous and nRT design
- Adaptive sampling
- Reduced node failure
- Transparency and secure



– Private and Public clouds

THANK YOU

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