# OPENMODS 2.0 “Instrument Jamming Meeting” report

*11-12 November 2020*

Gerin R., Brunetti F., Crise A., Pietrosemoli E., Zennaro M.,
Brodte E., Seeyave S., Akita L., Boudaya L., Corbo A., Diviacco P.,
Kivva K., Krug L., Kuchler S., Marcelli M., Mobio B., Olubunmi N.,
Rick J., Rodrigo C., Sarker S., Silva P. and Sohou Z.

## Summary

## The OpenMODs 2.0 contribution to POGO's Mission

One of the POGO aims is to narrow the data and knowledge gaps between the advanced and the developing countries through education, training and access to technology programmes. The OpenMODs 2.0 project is an enabling mechanism through which coastal countries in the developing world can consolidate and develop the expertise and the know-how requested for providing timely information and knowledge for a responsible stewardship of their marine patrimony. In OpenMODs we received immensely positive responses and interactions from countries from all over the world for this project. OpenMODs was particularly successful in engaging countries from African countries, as an essential group in facilitating a sustainable ocean future.

OpenMODs 2.0 is a second, concrete step towards achieving more mature and concrete results to establish a user community willing to contribute/take home the message and to keep on working on the idea of affordable user friendly coastal observing systems.

## OpenMODs 2.0 Prototyping

The overarching objective of OpenMODs 2.0 is to produce a prototype of a versatile low-cost ocean observing platform ready to be tested and equipped with a variety of sensors and to consolidate and enlarge the potential user community (notably African countries and Asian coastal countries) and verify the potential of this class of platform for networking, research and educational purposes.

In particular, we intend to implement in practice what has been worked out and envisaged in concepts and meetings in OpenMODs community. Pivotal to the project is the development of working prototypes of the low-cost platform up to a Technological Readiness Level (TRL) level 6/7 (corresponding to "technology/system demonstrated in relevant/operational environment").

Three elements need to be defined considering the OpenMODs outcome (Fig.1) and choosing among off-the-shelf solutions: the **platform**, the **sensors** and the **communication** systems.

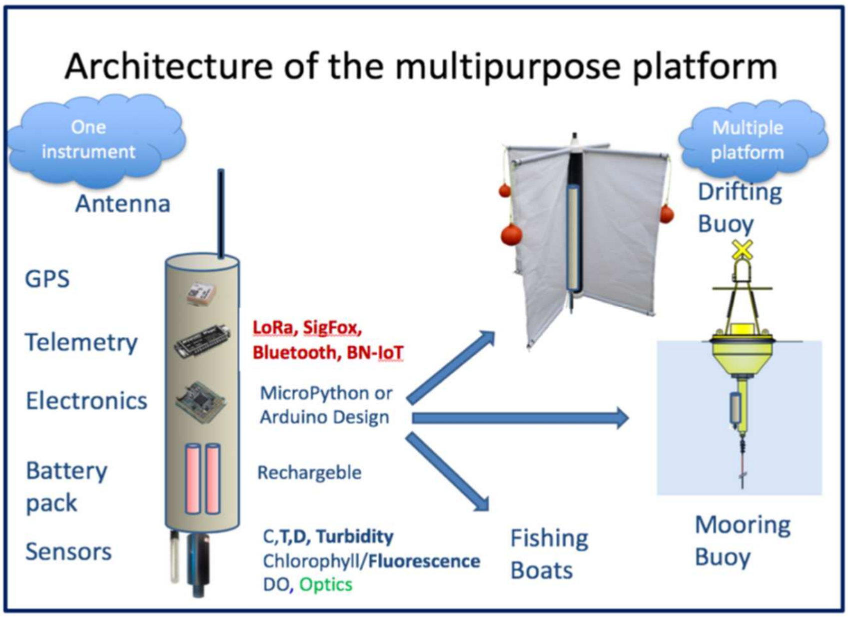



*Fig 1: General structure of the multipurpose platform as defined within the OpenMODs project.*

The platform will implement the following functionalities:

- it can operate with minimum modifications as moored system, drifting buoy or manually deployed equipment;
- it can mount essential sensors and operate in dual mode as a self-recording system or real-time autonomous system;
- it mounts a low-cost low-power embedded system to acquire, control, process, store and (in case) transmit data;
- it employs low-cost material (e.g. plastic pipes for domestic use for the housing);
- it simplifies the assembling process of the system in order to be done on-site by trained non-professional operators or for educational purposes.

The sensors are not supposed to substitute the best technological products available on the market. Instead, they are meant to complement/integrate these, by extending the coverage/number and by making them deployable also by trained non-professional operators. The sensor choice will be defined by their performance starting with temperature and pressure sensors. An accurate GPS system is also needed for localization and tracking. The general idea is that the platform has to be an open and expandable system. Although, the implementation on the platform of other sensors for example for the measurements of salinity, chlorophyll, dissolved oxygen, turbidity is not part of this step of the project, it has been considered.

Lastly, the communication system will implement the following functionalities:

- it will use the most popular low-cost/no transmission cost communication systems;
- it will enable the timely communication of the relevant data and control flags and its delivery on the web;
- it will be ready to exploit at best the present and future opportunities and facilities offered by the Internet of Things technologies.

In particular, LoRaWAN and its low-cost variant, TTN, as well as Narrowband IoT are viable options.

The resulting platform will be then tested and used as educational equipment in a conceptual framework of science, technology and practice transfer and dissemination to the local user communities. The prototype potential is not limited to the developing countries. It is useful for any infrastructural remote and poorly observed regions and it can be advantageous for those applications requiring a dense coverage of timely observations in remote/under-observed sites, especially along coasts.

## OpenMODs 2.0 Jamming Meeting

A two-day "Instrument Jamming meeting" with technicians and engineers from the countries already involved in the previous OpenMODs project, other POGO members who are interested and POGO representatives, was virtually organized on 11 and 12 November 2020 (see participant list in Annex). The scope of the meeting was to compare, combine and network different viewpoints and expertise and to determine the best solutions for the realization of the low-cost (or cost-effective) prototype and finalize a technical document as a final plan.

The meeting started with three short presentations:

- activities of the National Institute of Oceanography and Applied Geophysics – OGS (by Alessandra Giorgetti, deputy director of the OGS oceanography section);
- introduction to POGO (by Lilian Krug, Scientific Coordinator of POGO);
- fundamental points of the OpenMODs 2.0 project (by Alessandro Crise).

Then Riccardo Gerin, Fabio Brunetti and Ermanno Pietrosemoli made a quick overview of the three topics related to platforms, sensors and communications. At the end of the morning, during a roundtable, it emerged that it is very important to take into account once again the needs of the users.

During the afternoon, 4 working groups, one by topic (platforms, sensors, communications and user needs) were organized to face the emerged issues and requirements. The major achievements were then presented.

Lastly, on the second day, the solutions for the construction of the prototype in order to demonstrate the feasibility of the OpenMODs idea were presented.

## Major achievements

The feedback provided by potential users on their needs was very much appreciated. They underlined the importance of having:

- an easy to deploy instrument (i.e.: from small fishing boats);
- multi-parameter sensors in ONE device;
- less maintenance effort

and prioritized the variables to measure.

Although, there are technical limitations and different solutions and there is no one tool that can do everything, which is low cost, has high resolution and low maintenance, the outcomes of the platforms/sensors/communications working group meet the main requirements that emerged.

Priority was given to:

- a platform that will operate in drifter mode which is extremely easy to deploy and perfect for studies associated with search and rescue operations (another need that has emerged). It also constantly guarantees the knowledge of the instrument position. The platform can be easily converted into the moored mode.
- temperature and pressure sensors. The sensors will be low -cost with the idea to replace them rather than calibrate them;
- LoRaWAN communications preferably with Bluetooth integration for the in-situ download of the data.

## Platform details

(by Riccardo Gerin, Nubi Olubunmi, Pericles Silva, Lailah Gifty Akita, Kirill Kivva, Johannes Rick)

Having the platform to operate in different ways (Fig. 2) after a very small modification of the structure, the element that joins the main tube to the arms on the drifter-mode platform has to be carefully designed. Furthermore, it is desirable that the inside of the main tube is accessible and watertight in case additional batteries need to be placed inside it to increase the capacity of the batteries and consequently the autonomy of the instrument.

*Fig 2: drifter-mode platform (left) and moored-mode platform (right).*

The proposed solution for the joining element is sketched out in Fig. 3.

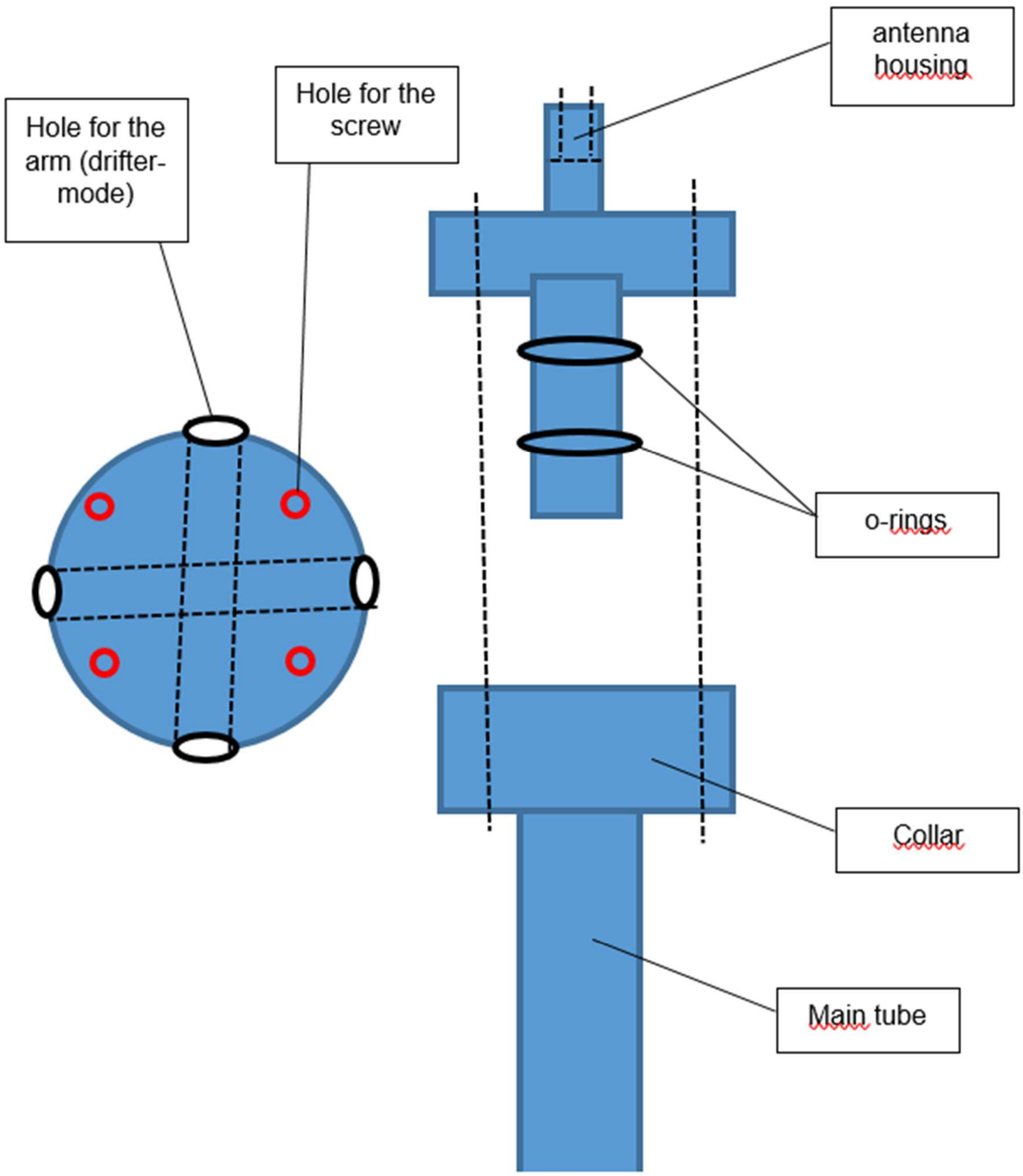



*Fig 3: Design of the joining element.*

## Sensor details

(by Fabio Brunetti, Zacharie Sohou, Marco Marcelli, Paolo Diviacco, Stefano Küchler, Brice Mobio, Andrea Corbo)

The session regarding the sensors was divided into two parts, one focused on the best choice for the system to be used as a controller of the entire platform and one dedicated to the sensors to be implemented.

Regarding the first point, several options have been evaluated:

Controller based on **Arduino microcontroller board**:

- Advantages: very popular, easy programming, low cost, low power consumption, wide availability of hardware and open source libraries.

- Disadvantages: use of a proprietary programming language, poor long-term system stability, need for periodic resets, poor robustness, not very suitable for use in remote and harsh environments.

Controller based on **Pyboard microcontroller board**:

- Advantages: fairly widely used, easy to program, use of a widely used programming language (Python), good availability of open source libraries, low cost, low power consumption, stable and robust even when used in marine environments.

- Disadvantages: operating system with limited functionality, only one programming language available (Python).

Controller based on **single board computer BEAGLEBONE and RASPBERRY**:

- Advantages: widely used, equipped with LINUX operating system, low cost, stable even if there is no information about its behaviour in the marine environment.

- Disadvantages: High consumption for use on remote systems, oversized for the platform to be developed.

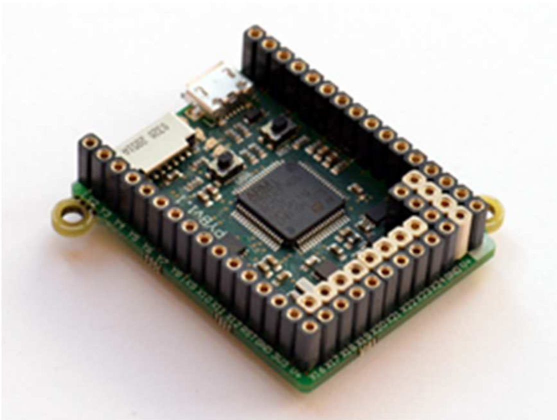
Controller based on **Roadrunner single board computer**:

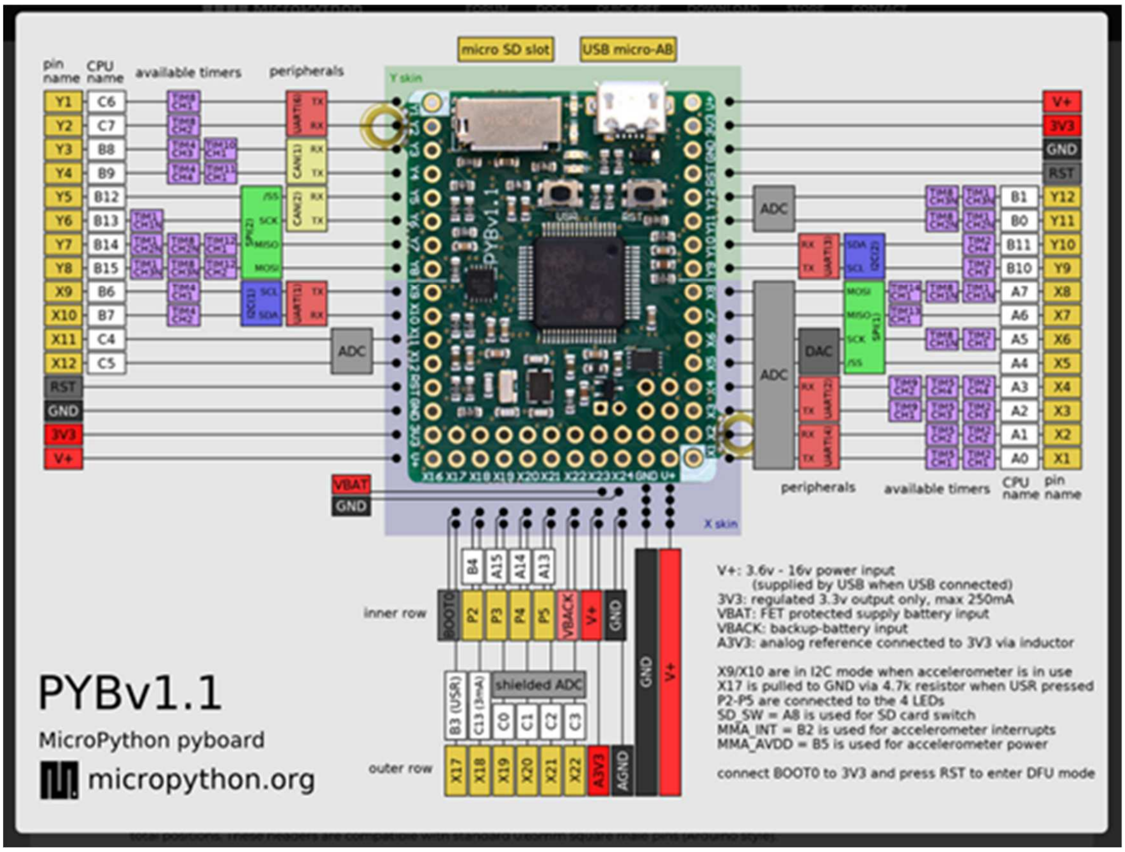
- Advantages: equipped with LINUX embedded operating system, stable and robust in both laboratory and marine environment tests, low cost, low power consumption.

- Disadvantages: new product, still not widely used.

Then the choice has been reduced to two products:

**Pyboard microcontroller board**:





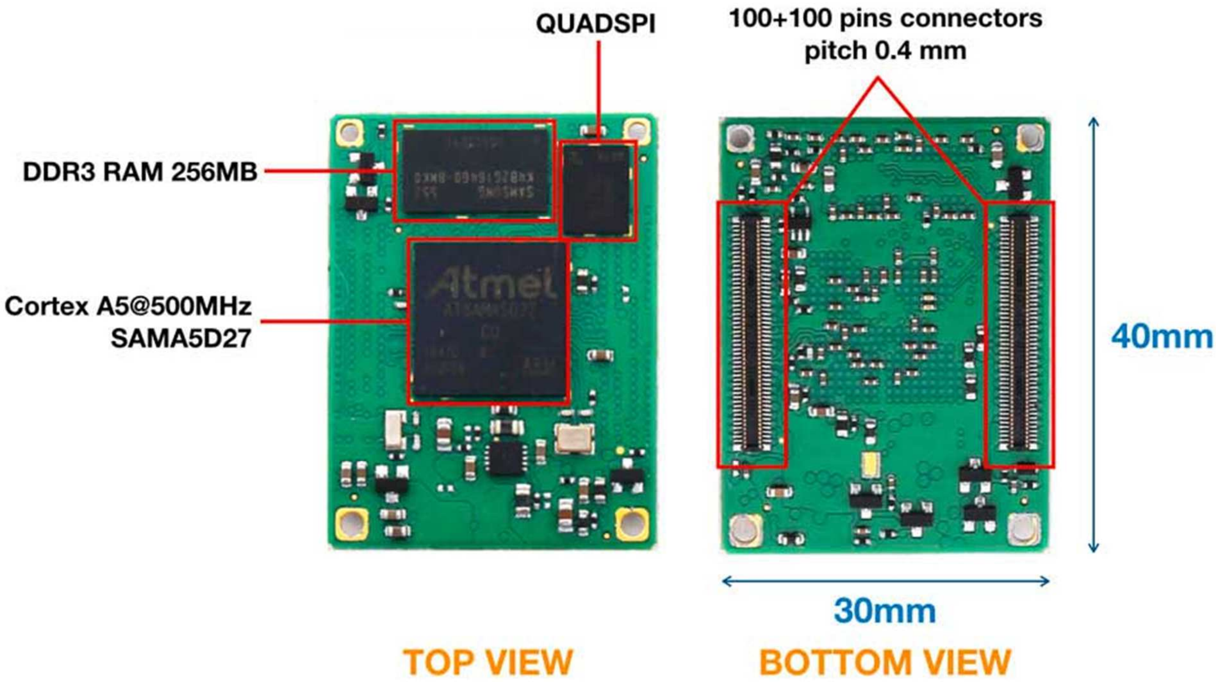

The Pyboard v1.1 integrates the STM32F405RG microcontroller, a 32-bit ARM Cortex-M4 core and 168 MHz clock. This SoC has all the essential peripherals for the development of the application in question. In addition to 5 UARTs necessary to interface with the digital probes used in oceanography, there are 2 SPI bus, 2 I2C bus, 3 ADC@12-bit, a real time clock with backup power supply, several GPIO and a microSD slot for local storage of data and configuration files.

On the other hand, a RAM of only 192 KiB makes unavoidable the optimization of each line of code and the compilation in byte-code of all, or part of the application, inside the firmware that is loaded on a 1024KiB flash ROM. (https://micropython.org/)

**KEY FEATURES**

- Core: ARM®32-bit Cortex®-M4 CPU with FPU, Adaptive real-time accelerator (ART Accelerator™) allowing 0-wait state execution from Flash memory, frequency up to 168 MHz, memory protection unit, 210 DMIPS/1.25 DMIPS/MHz (Dhrystone 2.1), and DSP instructions
- Memories
  - Up to 1 Mbyte of Flash memory
  - Up to 192+4 Kbytes of SRAM including 64-Kbyte of CCM (core coupled memory) data RAM
  - Flexible static memory controller supporting Compact Flash, SRAM, PSRAM, NOR and NAND memories
- LCD parallel interface, 8080/6800 modes
- Clock, reset and supply management
  - 1.8 V to 3.6 V application supply and I/Os
  - POR, PDR, PVD and BOR
  - 4-to-26 MHz crystal oscillator
  - Internal 16 MHz factory-trimmed RC (1% accuracy)
  - 32 kHz oscillator for RTC with calibration
  - Internal 32 kHz RC with calibration
  - Sleep, Stop and Standby modes
  - $V_{BAT}$supply for RTC, 20×32 bit backup registers + optional 4 KB backup SRAM
- 3×12-bit, 2.4 MSPS A/D converters: up to 24 channels and 7.2 MSPS in triple interleaved mode
- 2×12-bit D/A converters
- General-purpose DMA: 16-stream DMA controller with FIFOs and burst support
- Up to 17 timers: up to twelve 16-bit and two 32-bit timers up to 168 MHz, each with up to 4 IC/OC/PWM or pulse counter and quadrature (incremental) encoder input
- Debug mode
  - Serial wire debug (SWD) & JTAG interfaces
  - Cortex-M4 Embedded Trace Macrocell™
- Up to 140 I/O ports with interrupt capability
  - Up to 136 fast I/Os up to 84 MHz
  - Up to 138 5 V-tolerant I/Os
- Up to 15 communication interfaces
  - Up to 3 × $I^2C$ interfaces (SMBus/PMBus)
  - Up to 4 USARTs/2 UARTs (10.5 Mbit/s, ISO 7816 interface, LIN, IrDA, modem control)
  - Up to 3 SPIs (42 Mbits/s), 2 with muxed full-duplex I2S to achieve audio class accuracy via internal audio PLL or external clock
  - 2 × CAN interfaces (2.0B Active)
  - SDIO interface
- Advanced connectivity
  - USB 2.0 full-speed device/host/OTG controller with on-chip PHY
  - USB 2.0 high-speed/full-speed device/host/OTG controller with dedicated DMA, on-chip full-speed PHY and ULPI
  - 10/100 Ethernet MAC with dedicated DMA: supports IEEE 1588v2 hardware, MII/RMII
- 8- to 14-bit parallel camera interface up to 54 Mbytes/s
- True random number generator
- CRC calculation unit
- 96-bit unique ID
- RTC: subsecond accuracy, hardware calendar

**Roadrunner single board computer**:




Linux embedded system on module designed around the Microchip SAMA5D27 Cortex-A5@500 MHz MPU. (https://www.acmesystems.it/roadrunner).

## CPU features

- Microchip SAMA5D27 MPU (Cortex A5 single core @500MHz)
- On-the-fly AES encryption/decryption on DDR and QSPI memories
- 32-Kbyte L1 data cache, 32-Kbyte L1 instruction cache
- 128-Kbyte L2 cache configurable to be used as an internal 32 bit single cycle SRAM
- 5 Kbytes of internal scrambled SRAM:
  - 1 Kbyte non-erasable on tamper detection
  - 4 Kbytes erasable on tamper detection
- 256 bits of scrambled and erasable registers
- Up to seven tamper pins for static or dynamic intrusion detections
- Secure Boot Loader
- RTC including time-stamping on security intrusions
- Programmable fuse box with 544 fuse bits including JTAG protection and BMS
- NAND controller
- ARM NEON (tm) SIMD Media Processing Engine
- Hardware Floating Point Unit
- Hardware cryptography
  - SHA: SHA1, SHA224, SHA256, SHA384, SHA512; compliant with FIPS PUB180-2
  - AES: 256, 192, 128 bit key algorithm; compliant with FIPS PUB 197
  - TDES: two-key or three-key algorithms; compliant with FIPS PUB 46-3
  - True Random Number Generator (TRNG); compliant with NIST Special Publication 800-22 Test Suite and FIPS PUBs 140-2 and 140-3

## SOM features

- **RAM**: 256 MBytes of DDR3L RAM @ 166MHz
- **FLASH**: Up to 128 MBytes of QSPI flash memory @ 133MHz
- Extended temperature range: -40°C to +85°C
- Small form factor: 40 x 30 (3.5mm height over carrier board)
- Weight: 5g
- 10 layers VIPPO technology PCB
- Single power supply at 3.3 Volt DC
- Ultra Low-power mode with fast wakeup capability
- Low-power Backup mode with 5-Kbyte SRAM and SleepWalking (tm) features
- Wakeup from up to eight wakeup pins, UART reception, analog comparison
- Extended Backup mode with DDR in Self-Refresh mode
- Low power consumption:
  - 100% CPU (memtester): 120mA @ 3.3V (396mW)
  - idle (at Linux prompt): 60mA @ 3.3V (198mW)
  - Standby mode (resume in 159ms): 5.3mA @ 3.3V (17mW)
  - Suspend To RAM mode (resume in 1.5s): 3mA @ 3.3V (10mW)
  - Backup mode (poweroff with RTC and event wakeup, resume <14s with Debian; <6s with Buildroot): 0mA @ 3.3V (0mW)

## Signals on pins

Two Hirose 6Gbps 100-pin connectors 0.4 mm pitch, with all the CPU signals:

- 10/100 Mbit/s Ethernet MAC with IEEE1588 Precision Time Protocol (PTP)
- RGB interface @ 24 bit for LCD TFT
- Resistive and capacitive touch panel interface
- Synchronous Serial Controllers SSC/I2S (up to 2)
- TWI compatible I2C interface (up to 7 buses) up to 400 Kbits/s supporting I2C and SMBUS
- SPI bus interface (up to 7 buses)
- Quad Serial Peripheral Interfaces QSPI (up to 2)
- One Stereo Class D audio amplifier integrated
- Peripheral Touch Controller PTC with up to 8X-lines and 8Y-lines (64-channel capacitive touch)
- Pulse Density Modulation Interface Controller PDMIC (digital microphone)
- Two master CAN-FD MCAN controllers with SRAM-based mailboxes
- GPIO lines (up to 128)
- A/D converter @ 12 bit (up to 12)
- Serial ports (up to 10: five USART and five UART)
- One additional Rx only UART in backup area RXLP
- One analog comparator ACC in backup area
- 2 high-speed USB Host, or 1 USB Host and 1 USB device
- 1 high-speed Inter-Chip HSIC USB port interface
- Two high-speed memory card hosts (SDIO, SD or MMC):
  - SDMMC0: SD 3.0, eMMC 4.51, 8 bits
  - SDMMC1: SD 2.0, eMMC 4.41, 4 bits only
- ITU-RBT.601/656/1120 Image Sensor Controller ISC supporting up to 5M-pixel sensors
- Two 3-channel 32-bit Timer/Counters TC , supporting PWM modes (up to 6 out)
- One full-featured 4-channel 16-bit PWM controller
- Programmable clock (up to 3)
- JTAG port
- Debug serial port
- Battery input for internal RTC, backup area and backup RAM

The project involves the realization of a platform equipped with GSM or LoraWAN telemetry, GPS for geolocation and clock synchronization, temperature, pressure and later conductivity sensors.

The Pyboard has all the necessary functionalities to realize the probe. But since this is an expandable project with the possibility in the future to add other sensors, it was decided to use the road runner, which has a greater number of interfaces to external devices.

The management software of the platform will be developed in Python and in a way to be, as far as possible, portable from one board to the other, thus making available both solutions to the project.

Regarding the second point, sensors:

The prototype involves the realization of a TD probe, for the temperature sensor will be used a PT100, the pressure sensor is not yet defined but it will be piezoresistive. The innovative aspect lies in the smart sensor approach, so that the whole chain of source signal injection, analog output signal conditioning, AD conversion and digital data transmission is entrusted to a single, small and cost-effective integrated circuit located near the sensors. To this end we plan to use a new generation of integrated circuits widely employed in electro-medical devices. After a careful analysis of what is available on the market it was chosen the AD7124-8. It is an 8-Channel, Low Noise, Low Power, 24-Bit, Sigma-Delta ADC with PGA and reference, developed by Analog Devices. The expected accuracy is 0.01°C for the temperature and 0.01dbar for the pressure.

The next step will be the implementation of a conductivity sensor. Following the same philosophy but using a different integrated circuit we think to realize a conductivity sensor based on an inductive conductivity cell instead of an electrical conductivity cell. The inductive sensor was chosen for its economy, robustness and insensitivity to fouling;

As a result of some input received from the user group the following possible expansions of the platform have been discussed:

- possibility to download data from the probe using a Bluetooth connection and a cell phone instead of using a cable and a PC.

- possibility to recharge the batteries of the probe with a wireless magnetic charger.

- possibility to add to the probe a Chl-A detector developed by the LOSEM (Laboratory of Experimental Oceanology and Marine ecology)

All those suggestions will be taken into account during the development of the prototype and given the many common points of interest, a closer collaboration has been established with the SAGITTA project.

## Communication details

(by Ermanno Pietrosemoli, Marco Zennaro, Carbajales Rodrigo)

The remarkable growth of Internet of Things (IoT) in the last decade has provided new opportunities for satisfying the communication needs of MOBs, which in the past were restricted to Cellular modems and limited capacity satellite devices, both with costs not always affordable for many organizations.

We have seen not only improvements in terms capabilities and costs of these solutions, but also the appearance of disrupting technologies natively oriented to provide low cost, small size, low power consumption and long-range data communications.

The so-called low power wide area networks (LPWAN) sacrifice data throughput in favour of improved range and energy efficiency and come in two variants, those based on cellular IoT (LTE-M and NB-IoT) and those based on proprietary solutions (LoRaWAN and Sigfox). Both variants can also rely on a plethora of new satellite technologies to further extend their range capabilities.

LTE-M and NB-IoT services are provided by cellular operators and entail the payment of a monthly fee for each device deployed. They differ in terms of data throughput and energy consumption, and currently they are not available in many places of interest.

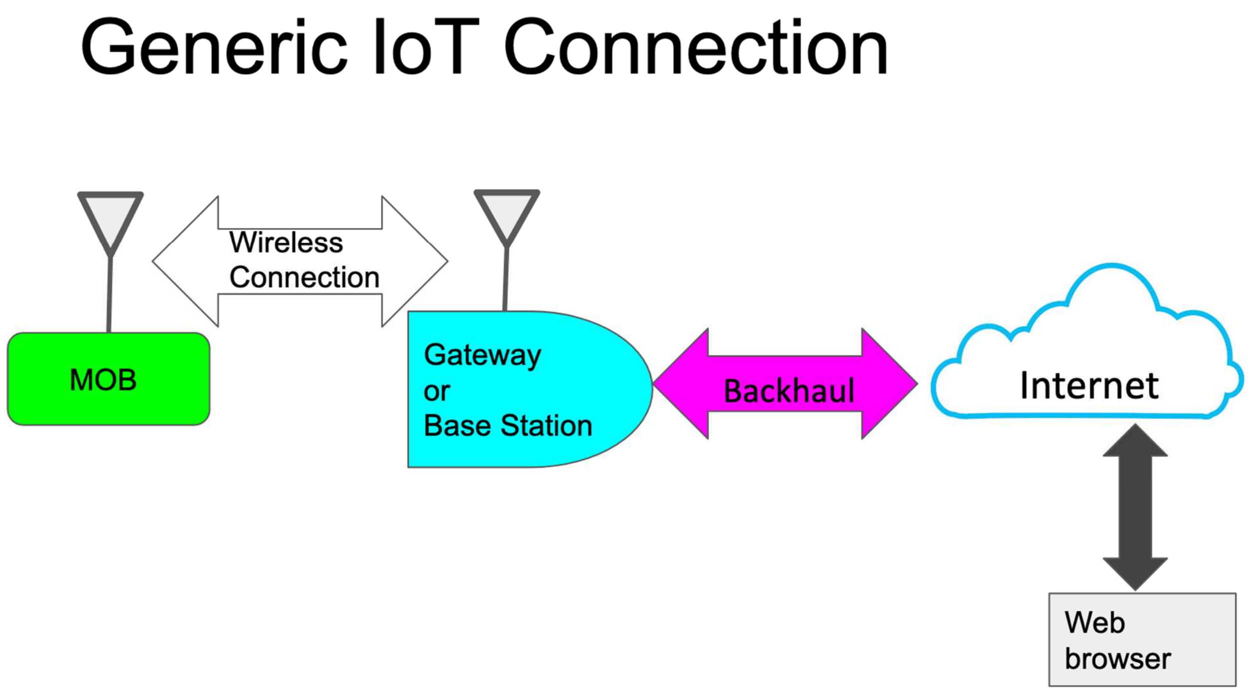
Sigfox also offers a subscription service with usage fees that are considerably lower than those for LTE-M and NB-IoT, due to the fact that the data throughput and maximum number of messages per day is much lower.

LoRaWAN is more versatile, allowing for a range of transmission speeds that can fit the needs of most MOBs. It can be obtained from commercial service providers in many countries, but it can also be self-installed by the organization requiring the service, which can either install the required infrastructure, or rely on a widely deployed number of Gateways publicly available by means of The Things Network (TTN) crowd sourced initiative: https://www.thethingsnetwork.org/

Both Sigfox and LoRaWAN use unlicensed frequencies, which are subject to interference from other users, and restricted in the amount of time that each device can occupy a channel, but these limitations do not impede the delivery of most services, as witnessed by the widely deployed WiFi networks, which also use unlicensed frequencies.

Cellular operators have exclusive access to the frequencies they use, for which they have paid hefty sums, and are protected from interference from other users.

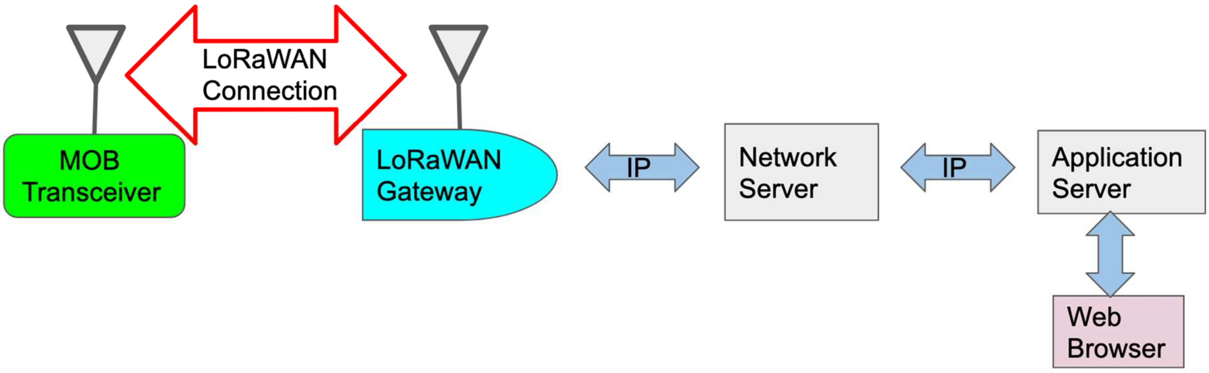
The generic IoT architecture is the following:




The MOB connects to the Gateway or Base Station using a specific wireless communication protocol among the previously mentioned. The Base Station connects to servers in the Internet Cloud by a variety of technologies in what is called "Backhaul". The server processes the data and makes them available to the user through a web browser.

Considering the specific needs of coastal observation, satellite backhaul is probably not required, and since cellular services might not be available in some of the areas of interest, our discussion group has chosen LoRaWAN as the better suited technology for our purpose. The previous diagram then is distilled in the following:

# LoRaWAN architecture



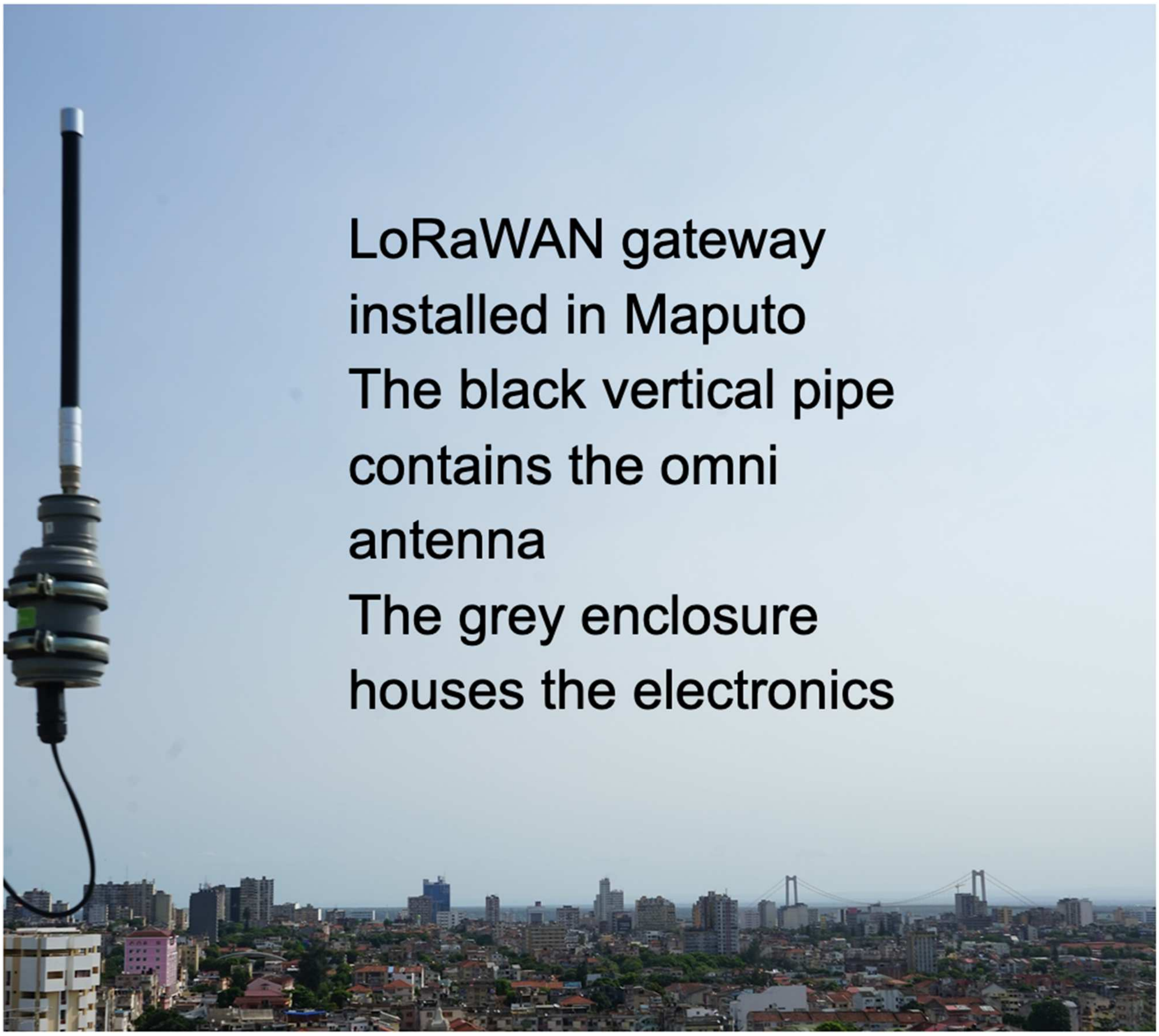

There are a number of devices that can be used as LoRaWAN transceivers for the MOB, some of them have also WiFi or Bluetooth interfaces that will connect to a smartphone in the close proximity, for instance the LoPy 4 manufactured by Pycom, which has interfaces for a variety of sensors: https://pycom.io/product/lopy4/.

Publicly available LoRaWAN gateways have been installed in many places as part of TTN, and they can be used for free, while the traffic of each user is protected by its own application key. In this case the only cost involved is that of the MOB transceiver, with no recurring costs. Of course, the traffic is limited, but well within the requirements of many sensor applications.

Alternatively, if no TTN gateway is available in the area of interest, one can resort to installing a LoRaWAN gateway, that must be provided with Internet connectivity (by cabled Ethernet, WiFi or Cellular) and powered by the electrical grid or a photovoltaic system. A number of LoRaWAN gateways are commercially available with prices starting at about 200 Euro. In this case the Network and Application servers provided by TTN can still be leveraged, since they are reachable through the Internet from any Internet connected gateway.

If the area of interest is served by a LoRaWAN commercial service provider, the user might opt for simply paying for the service without further concerns.

Example of a low-cost gateway installed in Mozambique:




The black cable at the bottom provides the DC power as well as the Internet connectivity

## User needs
(by Lobna Boudaya, Subrata Sarker, Eva Brodte)

Needs very similar in Bangladesh, Tunisia or Senegal

**Platform**: no permanent deployment (neither drifting or moored) **BUT** cooperation with fishermen: e.g. bi-weekly deployment of sensors when going to fishing grounds.

Resulting requirements for platform

- easy to deploy (from small fishing boats)
- multi-parameter sensors in ONE device
- less maintenance effort!!

If moored- or drifting-version, it is important to have a trackable device (again cooperation with fishermen needed).

**Sensors:** types

- 1. Priority Temperature, Salinity and Chlorophyll A;
- 2. Priority current, nutrients, pH, oxygen, tides.

Sensors must be easy to operate and easy to handle (ability to measure data for a long period of time after each calibration).

**Communication:** Information should be easily downloaded via the smartphone of the deploying person after recovery and sent to institutes (Fig.4). Maybe a combination with AIS systems brought for boats, which help deploying.

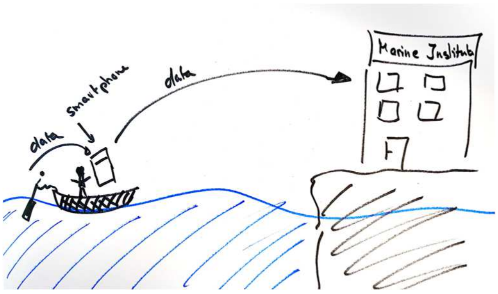



*Fig 4: In-situ data download.*

# Annex: Participants to OpenMODs 2.0 Jamming Meeting

| Participant | Affiliation | Country | email |
|---|---|---|---|
| Alessandro Crise | OGS, retired | Italy | acrise@inogs.it |
| Andrea Corbo | OGS | Italy | acorbo@inogs.it |
| Brice Mobio | CURAT | Ivory Coast | mobiobrice@yahoo.fr |
| Carbajales Rodrigo | OGS | Italy | rcarbajales@inogs.it |
| Ermanno Pietrosemoli | ICTP | Italy | ermanno@ictp.it |
| Eva Brodte | AWI | Germany | eva-maria.brodte@awi.de |
| Fabio Brunetti | OGS | Italy | fbrunetti@inogs.it |
| Johannes Rick | AWI | Germany | johannes.rick@awi.de |
| Kirill Kivva | VNIRO | Russia | kirill.kivva@gmail.com |
| Lailah Gifty Akita | University of Ghana | Ghana | lailah.lailah@gmail.com |
| Lilian Krug | POGO | Portugal | lakrug@ualg.pt |
| Lobna Boudaya | University of Sfax | Tunisia | lobnaboudaya@gmail.com |
| Marco Marcelli | unituscia | Italy | marcomarcell@unitus.it |
| Marco Zennaro | ICTP | Italy | mzennaro@ictp.it |
| Nubi Olubunmi | NIOMR | Nigeria | nubiao@niomr.gov.ng |
| Paolo Diviacco | OGS | Italy | pdiviacco@inogs.it |
| Pericles Silva | OSCM/IMAR | Cape Verde | pericles.silva@oscm.cv |
| Riccardo Gerin | OGS | Italy | rgerin@inogs.it |
| Sophie Seeyave | POGO | UK | ssve@pml.ac.uk |
| Stefano Küchler | OGS | Italy | skuchler@inogs.it |
| Subrata Sarker | Shahjalal University of Science and Technology | Bangladesh | subratasrk-ocg@sust.edu |
| Zacharie Sohou | IRHOB | Benin | zsohou@yahoo.fr |