

ARMONIO – “Plug and Play” ARchitecture for a MONItoring System of the Portuguese Ocean

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The ARMONIO Project

⌘ Environmental monitoring systems

⌘ Monitoring the ocean margins:

☒ Water quality measures:

☒ Temperature, conductivity, pH, turbidity, tide level, solved oxygen, organic compounds, ...

☒ Air quality:

☒ Temperature, humidity, wind speed, VOCs, ...

☒ Other measures, e.g., seismic data

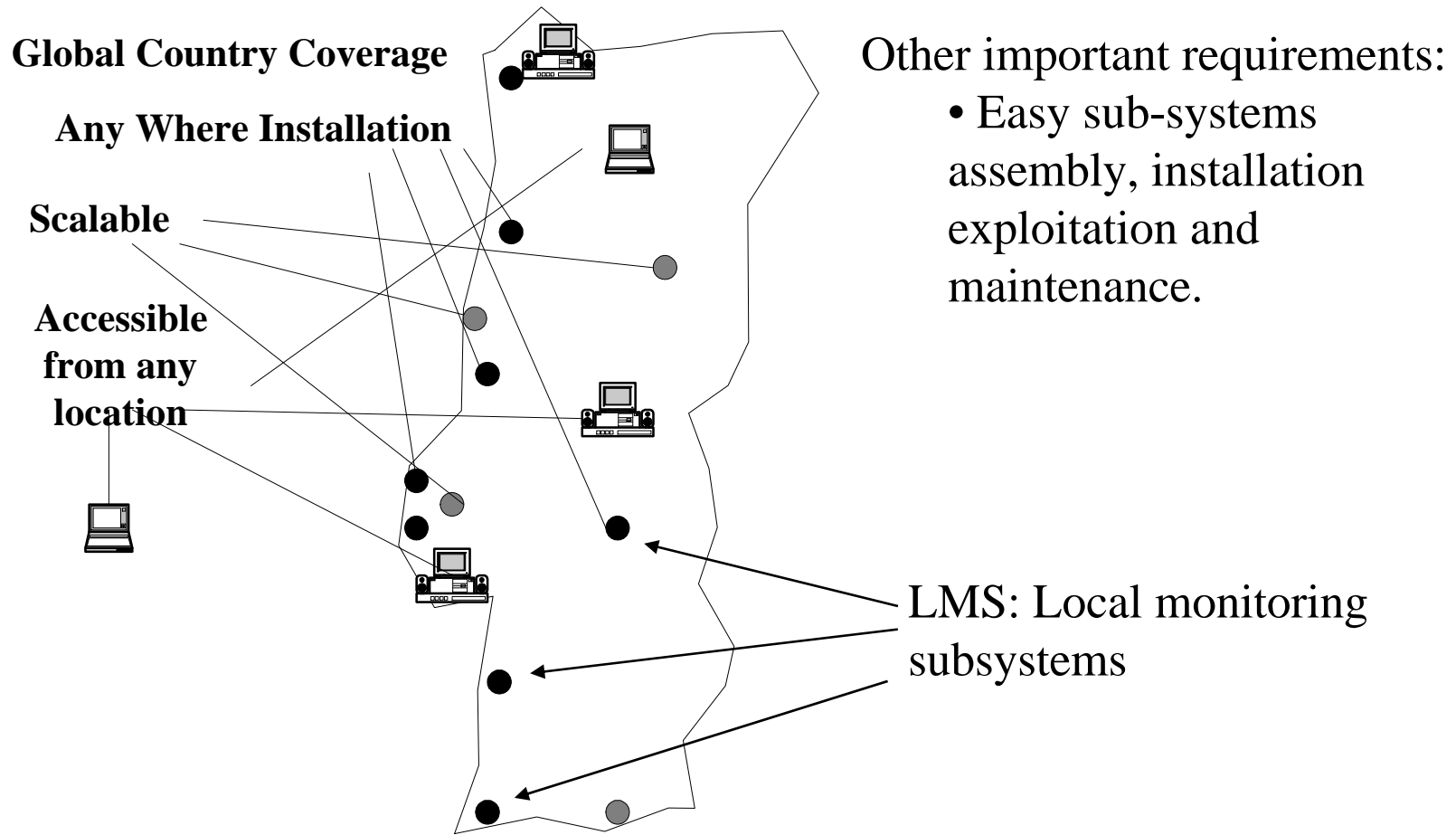
⌘ The ARMONIO Project is funded by Fundação das Universidades Portuguesas and the Portuguese Ministry of Defence under the Program “Ocean and its Margins”

The ARMONIO Project

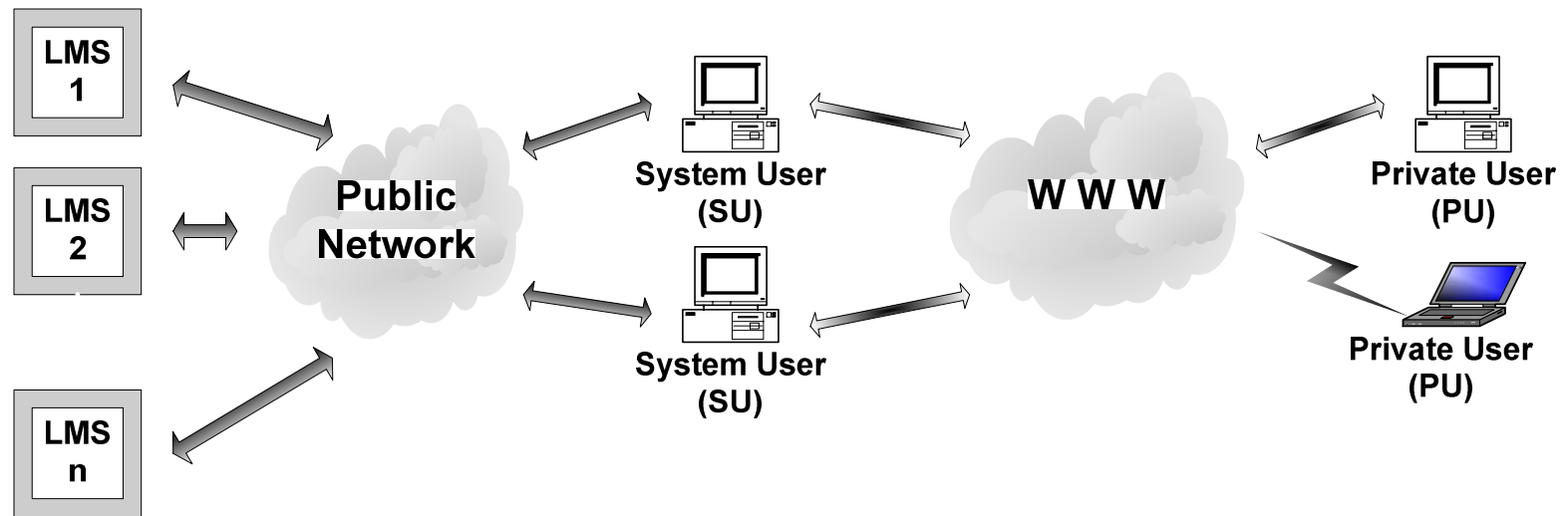
Requirements:

- ☒ Coverage of a large geographic area
- ☒ Sub-systems located in remote regions
(portuguese view)
- ☒ Places with difficult access and/or complex installation (e.g. tide levels)
- ☒ High density of sensors in specific monitoring spots
- ☒ Easy sub-systems assembly, installation exploitation and maintenance.

The ARMONIO global architecture



The ARMONIO global architecture



Local Monitoring Systems' Operation

⌘ “Plug and Play” operation of the LMSs.

- ☒ Solved by using geographically referenced information associated to each LMS.
- ☒ Once plugged, a new LMS starts transmitting its measurement data stamping in it its geographical coordinates.
- ☒ The resolution of the coordinates can be adapted to the application, depending on the required proximity of different LMSs.

Local monitoring subsystems (LMSs)

LMSs' elements:

- ⌘ Measurement devices and intelligent sensor subsystems.
- ⌘ Gateway(s) to connect to System Users using telecommunication networks.
- ⌘ GPS to stamp geographical information and time information.
- ⌘ Debugging systems (intermittent operation).

System operation model

⌘ Using the producer-consumer model:

- ☒ A measurement device is a producer of data.
- ☒ Any entity interested in the data, e.g., a meteorological observatory, a research laboratory, an individual, can be a consumer.
- ☒ When a measurement device is added to the global system it must start producing its data and make it available to the interested consumers.
- ☒ This addition should just require turning the device on (“plug and play” concept).

System operation model

⌘ A measurement device is associated with just one physical parameter:

- ☒ Minimal configuration requirements: acquisition period and parameter ID can be previously defined.
- ☒ Data production can be done at the rate required by the consumer that needs more resolution or by the adequate acquisition period for the parameter (bandwidth requirements are modest).
- ☒ On-line changes of the acquisition period within specified ranges can be accepted with adequate procedures.

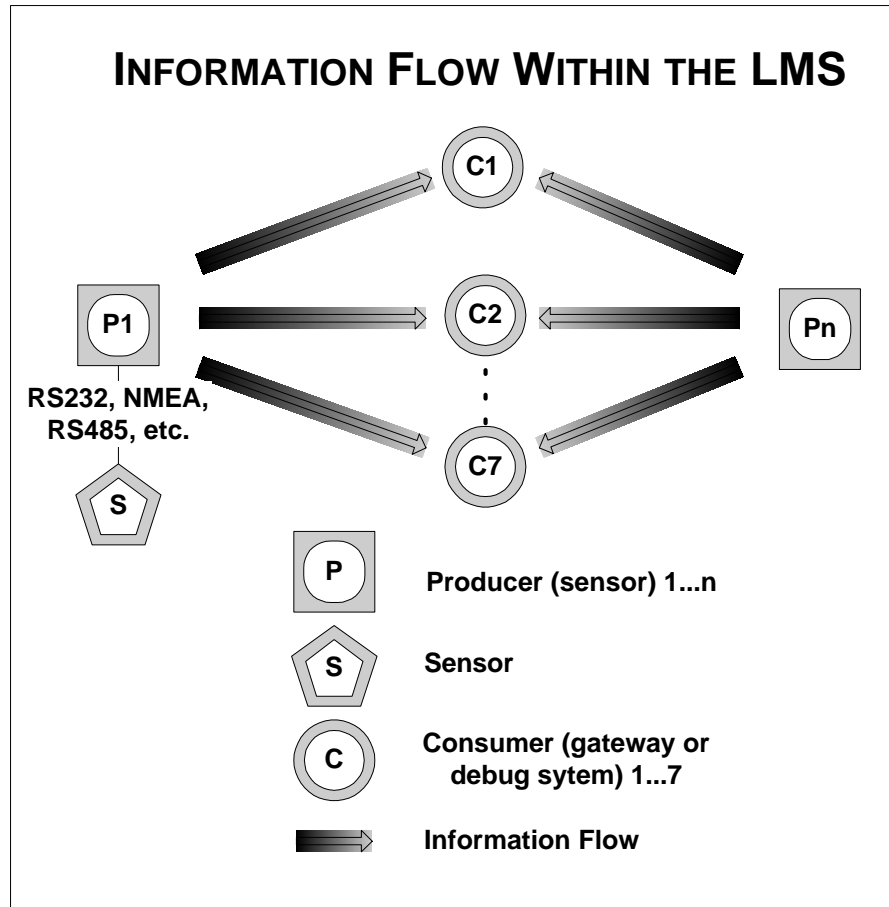
Local monitoring subsystems (LMSs)

Mapping LMSs' elements in the producer-consumer model:

- ⌘ Producers: Measurement devices; Intelligent sensor subsystems; GPS; Gateways.

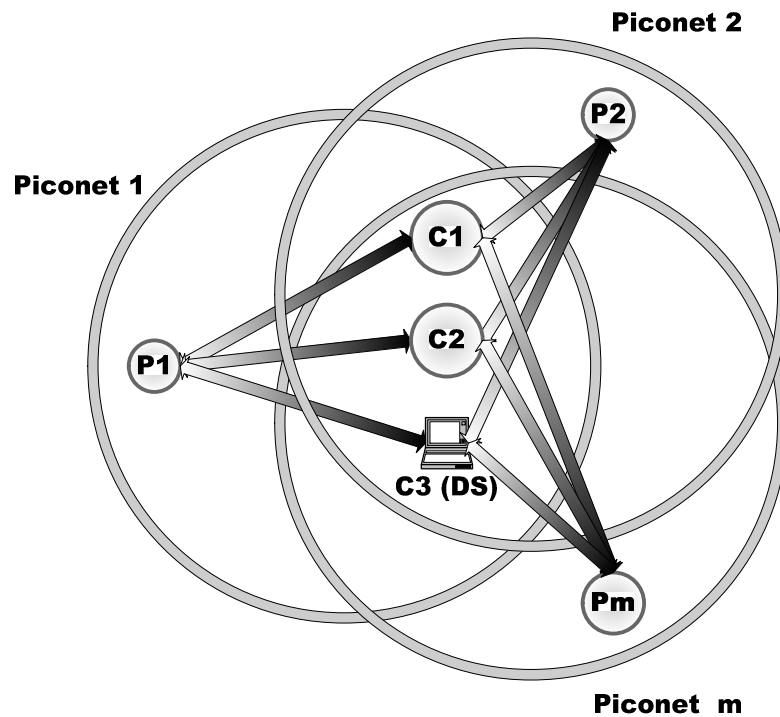
- ⌘ Consumers: Gateways; Debugging systems.

LMSs: Information flow



- Producers:
Measurement devices;
Intelligent sensor subsystems;
GPS;
Gateways.
- Consumers:
Gateways;
Debugging systems.

Using Bluetooth in the LMSs



- C** Consumer(s) 1..3 (slave(s) in piconets 1..m)
- P** Producer 1..m (master in piconets 1..m)

- Each producer has its own individual network.
- Every consumer participates in all the producer/ sensor mastered piconet networks.
- Efficient use of Bluetooth low power modes.

Using Bluetooth in the LMSs

- ⌘ Responsibility of creating and managing the group issued to the information producer.
- ⌘ When the producer awakes after acquiring data, it discovers active consumers and creates a group channel.
- ⌘ The group is closed after transmitting the information.
- ⌘ Consumers must stay always active.
- ⌘ L2CAP primitives for group communication are used: Group Create, Group Add Member, Group Remove Member, Get Group Membership, Group Close.

Current development state of the LMSs

⌘ Prototypes of 8051 based LMSs modules:

☒ Using a Cygnal C8051F041 processor.

☒ Ericsson ROK 101008 class 2 Bluetooth modules (Airlogic ABM-200 under evaluation).

⌘ Falcom GPS JP3 module.

⌘ Air quality PIC based modules.

CONCLUSIONS

⌘ The ARMONIO project proposes:

- ☒ A producer-consumer based architecture for environmental monitoring systems.
- ☒ The architecture must facilitate the set-up, operation and maintenance of the target applications.

CONCLUSIONS

⌘ The architecture:

- ☒ Uses Bluetooth based wireless modules organized as Local Monitoring Systems (LMSs).
- ☒ LMSs include a set of independent sensor mastered piconets whose slaves (gateways and debugging systems) are the common consumer nodes.
- ☒ LMSs use geographically referenced information from GPS to identify the measures produced and the producing instant.
- ☒ GSM is the current solution to convey data to final consumer systems.

Work in progress

- ⌘ To finish the LMSs prototype and a global small scale demonstrator.
- ⌘ To study the possibilities to optimize the energy consumption of the piconet master (shutting off the piconet versus keeping the master in low-power modes).
- ⌘ To evaluate the interference among piconets and its influence in the timeliness of the measurement transmission.