Project contract no. 036851
ESONET European Seas Observatory Network

Instrument: Network of Excellence (NoE)
Thematic Priority: 1.1.6.3 – Climate Change and Ecosystems
Sub Priority: III – Global Change and Ecosystems

Project Deliverable D68
ESONET LABEL DEFINITION

Due date of deliverable: month 36
Actual submission date of report: April 2010

Start of project: **March 2007** Duration: **48 months**
Project Coordinator: Roland PERSON Coordinator
Organisation name: IFREMER, France

Work Package 8
Organization name of lead contractor for this deliverable: **IFREMER**

Lead Authors for this deliverable: **Jean-François ROLIN**
Xavier BOMPAIS
Contributors:
D. Choqueuse, E. Delory, R. Huber, C. Waldmann, F. Salvetat, H. Ruhl, K. Schleisiek, F.Grant

Revision 1.0 [25th May 2011]

Project co-funded by the European Commission within the Sixth Framework Programme (2002-2006)		
Dissemination Level		
PU	Public	x
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

CONTENTS

EXECUTIVE SUMMARY

The FP6 project *European Seas Observatory NETwork (ESONET)* has documented here several rules and recommendations that can be applied in setting up an ocean observatory.

The ESONET Label is a set of criteria to be applied in order to make choices for the specifications of deep-sea observatories. It contains mandatory aspects, in point of view expressed and experienced in ESONET, as well as recommended solutions or options.

It is aimed to subsea observatories which are intended to be designed, deployed and used with a high controlled quality level. Two classes of observatories are considered: stand alone and cabled observatories.

It helps ensure that the equipment can be fully integrated in the scientific community network, with generally free access to data.

This document is one of the main ESONET deliverables to be issued after a 4-year period. It informs on the definition of the label and its implementation modalities, including rules, control and protection of the label.

It includes recommendations and mandatory rules to be applied at different levels of the entire observatory network.

First of all, it gives recommendations on power supply, connectors, communications and materials for the infrastructure design.

Then it describes the generic sensor module which we recommend be set up on a subsea observatory. It gives recommendations on scientific sensors interface in order to ensure compatibility and interoperability between networks and instruments. Metrology issues are presented.

It highlights the importance of performing tests before planning any long term at sea deployment. It gives guide lines to define and implement a test plan.

Several methods for deployment are described, including recommendations in the way to apply them, mainly based on previous scientific experiments or offshore industry best practices, especially those concerning ROV operations. Maintenance and training issues are discussed.

Data management is presented in terms of data policy access and interoperability.

At last, environmental impact is considered.

- *This document needs to be updated continuously with the evolution of technology, of gained experience and new needs.*

ESONET label definition

Author(s): Roland Person, Jean-François Rolin, Xavier Bompais (IFREMER) & ESONET partners

Contract References: (if required)

FP6 Project	ESONET
Contract number	036851
Confidentiality, copyright and reproduction	Public.

Document History:

Rev.	**Date**	**Author(s):**	**Comments**
0.1		R. Person	Format Initial Proposal
0.2	14-04-2011	J.-F. Rolin & X. Bompais	Version after *Best Practices Workshop 3*
0.6	6-05-2011	J.-F. Rolin & X. Bompais	Temporary submission to EC
0.9	21-05-2011	J.-F. Rolin & X. Bompais	With partners' contributions
1.0	25-05-2011	J.-F. Rolin & X. Bompais	Submitted to EC (30th may 2011) Approved by Esonet Steering committee (16th June 2011)

Validated by:

Role:	**Name:**	**Organization:**	**Date**	**Signature:**

Approved by:

ESONET Steering Committee			**16th June 2011**	

1 - LABEL DEFINITION AND IMPLEMENTATION

1.1 Definition

The ***ESONET Label*** is a set of criteria to be applied in order to make choices for the specifications of deep sea observatories. It contains mandatory aspects, in point of view expressed and experienced in ESONET, as well as recommended solutions or options.

The ESONET Label is aimed to subsea observatories which are intended to be designed, deployed and used with a high controlled quality level.

This label helps ensure that the equipment can be fully integrated in the scientific community network, with generally free access to data.

It is intended to provide benefits for:

- **Users** who will have a guidance for interfaces and planning of experiments;
- **Funding agencies** who will have a description of the standardisation level needed for European subsea Observatory Infrastructures;
- **Providers** who will benefit from a set of specifications common to all European subsea Observatory Infrastructures.

Two classes of observatories are considered:

- Stand alone observatories;
- Cabled observatories.

1.2 Rules applied

The ESONET label does not superseed existing legal or safety regulations or requirements. ESONET label in most cases applies as a subsidiary to existing standards.

In particular the ESONET label will be in compliance with the specification of the GEO label which is under preparation currently. The main goal of the GEO label is to specify an approach on how to judge on the quality of data based on the completeness of information on how the data have been acquired, i.e. completeness of metadata description. One of the key issues in this context to what extent basic data sets have been quality controlled and the methodologies to derive products have been reviewed. This is surely of high relevance for the ESONET label as within observatories the data are generated by operation centres where the individual scientists is no longer involved in the deployment and operation of the according instrument.

1.3 Attribution of the Label

The ESONET label is attributed to an infrastructure project by the ESONET-EMSO permanent structure through a dedicated ESONET label group on request of the observatory operator for periods of three years, the initial period is one year. Three experts are mandated to evaluate the request and the application of the criteria.

1.4 Control of the label

At any moment, and at least every three years, the ESONET-EMSO permanent structures can ask for a new expertise.

1.5 Protection of the Label

The ESONET Label is neither linked to any responsibility of its authors, nor to their organizations nor to the legal bodies funding their activities. No liability is attached to its mandatory requirements.

The document may be distributed freely but may not be considered in a public domain. Its ownership is protected under reciprocity rules as defined by the "copyleft" principle: a user of ESONET Label document must not claim any ownership on it or on documents he may derive from it. The use of ESONET Label or abstracts requires to reference the ESONET Label and the current web site where it may be found[1].

1.6 Update of the label

Yearly best practices meeting of ESONET-EMSO permanent structure will examine the ESONET label requests and attribute label.

New technologies are expected for ESONET label. They will be examined from a report on cost effectiveness and risk.

The process will follow the recommendations of *Cost control management issues of global research infrastructures* issued by the European Commission. Namely for the 2010 document[2]:

- "Independant scientific and technical evaluation [...] must be carried out and acted upon."
- "Best practices systems for project control and risk management have to be fully embedded in the project management, covering technical, financial and schedule issues; together with mitigating measures in case of deviations."

[1] currently www.esonet-noe.org and http://visobservatories.webs.com/
[2] ec.europa.eu/research/infrastructures/pdf/cost_control.pdf

1.7 Mitigating measures

The ESONET Label is not able to deal with all cases. In the case of an infrastructure not coping with all the ESONET label requirements, when good reasons can be advocated, the Label attribution will be accompanied with either a restriction mention or a mitigation suggestion with a time delay for its application.

2 - INFRASTRUCTURE

2.1 Recommendations on power

AC or DC?

As an international interoperability need, a 400V DC output is recommended at the end of the backbone infrastructure for downlink uses.

It is often necessary to provide higher voltage feeds to obtain the 400V DC at this junction level.

In any case, a qualification is required. High power converters have to be validated and experienced in a similar environment. Extensive simulations and tests of transients conditions are necessary prior to final design (mandatory).

DC power feeding is the most common choice and will gain from previous experiences. AC may be a solution for short distance (example of AC for *Catania NEMO* and *Antares* infrastructures)

Power return by sea water

Magnetic field and by products of the corrosion of the current return devices must be evaluated with respect to their environment disturbance effect. A specific biologic study will be recommended over *X* kW (AC) or *Y* kW (DC). (*X and Y to be determined by bibliography and consultation of experts*) (*see § 7*).

2.2 Connectors

Bulkhead part of connectors, including **dry mateable** should withstand open face pressure and be studied for long-term ageing (cf. *Ifremer testing specification of submarine engineering n° 31 SE19 B*) (mandatory) [3].

a) Electrical and optical transmission must satisfy recognized standards such as MIL-STD-1344 section 3000 (mandatory).

b) Moulded interlink cables must be completely tested, when the length allows it, in a pressure tank (recommended). This reveals moulding anomalies.

ESONET label group will contribute to establish, or join existing (if any), a European group on **wet mateable** connectors for exchange of experience and sharing of qualification procedures. It should share expertise with deep offshore oil and gas providers and users (such as (the Industry Technology Faclitator group http://www.oil-itf.com/).

[3]French and English versions available on Ifremer website: http://www.ifremer.fr/tsi/qualite/specif/31SE19B.pdf and http://wwz.ifremer.fr/institut/content/download/21181/305450/file/Ifremer-Connector tests-31 SE 19 B.pdf

2.3 Recommendation on stand alone observatories

For moored-buoy networks, which are not linked to the shore by cables, energy management and telecommunications are major concerns.

Notes:

a) a lander or mooring without a bi-directional telecommunication link is NOT a subsea observatory and is not in the scope of the ESONET Label.

b) the experience on tethered buoys transmitting data and/or energy to the seafloor is not sufficient worldwide to issue recommendations

The available power is limited (few Watts). Batteries are needed on a buoy at sea surface and on the seafloor near a subsea junction box. It is recommended that subsea nodes function as docking stations where ROVs can occasionally exchange batteries or gather recorded data (differed time) by using a wireless transmission, an inductive connector (contact-less) or a wet-mate connector.

Telecommunication is closely linked to the available power. For saving energy and for reducing the cost of the satellite or cellular network link, the data flow is usually non-continuous but near real-time (few hours) and the data rate is limited. This implies that the data frequency sampling might be lower than in the case of a cabled network. Furthermore, in order to save energy, the data communication occurs, for example, several times a day during a few minutes. It is mandatory that this frequency may be tuned:
-increased for alarm transmission or crisis monitoring (for instance transmission of a seismogram or an image) as well as technical debugging,
-decreased for energy saving.

A bi-directional link enables a permanent seabed monitoring and data receiving via acoustic transducers (underwater segment) and hertzian link (above water segment).

Redundancy (mandatory)
Two separate channels are needed on a buoy acoustic modem, electronics and satellite modems and power feeding for all these pieces of equipment.

Acoustic modem energy efficiency
Less than 20mJ per bit is achievable for 2500 m waterdepth (45° angle). For a specific distance, this energy efficiency must be the major criteria towards the manufacturer. Compatibility with other acoustic equipments (ADCP, sonar…) must be checked.

- *ESONET deliverable D57 gives details about an underwater acoustic modems intercomparison experiment.* *http://fr.esonet-noe.org/content/download/20980/303134/file/Deliverable_D57.pdf*

Batteries
Lithium batteries: ingress of water is a major difficulty and safety hazard.

Containers
Pressure relief devices are recommended and mandatory for large volumes (>1 dm^3). A pressure control system (house keeping in the pressure vessels) is mandatory. Size of the containers must be limited (reference to the limit for air freight, legal limit of manual transportation and capacity of pressure tanks for testing).

Messengers
Messenger buoys able to store data, reaching sea surface and sending data in case of failure or an exceptional event are recommended for high value data.

Moored Buoy

- Must be tracked in any conditions (GPS position transmitted by a back-up transponder (such as ARGOS) (mandatory).
- Mooring design and final manufacturing should be controlled by an independent expert.
- Intermediate floats should allow recovery of bottom section.
- Double releases are mandatory.
- Damping of the cable motion is recommended near buoy interface and along segments subject to vortex induced vibration (VIV).

Above water segment
The telecommunication segment is relied on and will use the most suitable existing technology that may vary from one site to another. Its functions are to link in a bi-directional way to at least one node (named gateway) of the seabed network to an onshore data server.

Technologies currently used are:

- Satellite communications : Iridium, ORBCOMM, ARGOS-3 ;
- Radio frequencies dedicated devices: VHF, Wi-Fi long-range like AirMax;
- Cellular telecommunications technologies: GSM, GPRS, EDGE, UMTS, HSPA, WiMAX.

The most adapted solution for world coverage is Iridium (recommended).

Documents references

Title	*Lead authors*	*Date and version*	*Where?*
EMSO D8.2 - *Reliability of examined sub-sea infrastructures*	***J. Blandin J.-F. Rolin (Ifremer)***	***2009***	***Under request to emsopp@ingv.it***

2.4 Recommendations on materials

The text below assumes that "short term" is usual and that structural aspects are validated by designer know-how (design rules, direct calculations, Finite Element Analysis) and test plan.

In the definition of subsea observatories, from the scientific vision to cost estimates, long-term sustainable operation is a key issue. Any improvement in ageing and durability of materials and components merits further study.

Based on the experience gained mainly in the offshore industry, where materials are exposed in deep sea (up to 2000 m) for long periods of time (up to 25 years), in the framework of ESONET/EMSO program recommendations for the choice and selection of materials for long-term, deep-sea exposure are proposed below. These recommendations are based on existing literature, feedback from previous experiences and the ESONET Best Practices Workshop 2 white paper.

Generally speaking, design of structure, choice of material and associated protection method should be performed by skilled people in order to avoid reinventing solutions already evaluated.

While pressure loading must be taken into account in terms of mechanical loading on hulls for instance, the intrinsic properties of the material are generally not or only weakly affected by pressure. Materials subject to creep such as some thermoplastics can be easily replaced with materials having more suitable characteristics.

However a description of the deep-sea environment is recommended to accompany system design in order to highlight the influence of parameters behind acting on the degradation process: oxygen concentration, fouling, temperature, chemical seeps, etc.

In order to avoid most of the problems of corrosion, the use of **cathodic protection** for metallic structure is strongly recommended. That might limit the use of "exotic" and "expensive" materials (see materials review hereunder), which could be proposed. The distance needed to avoid any biological effect from anodes on the monitored abyssal ecosystem is 50 m. The distance recommended by ESONET must be addressed in future studies. It is recommended to perform a cathodic protection checking by certified personnel according to standard NF EN 15257.

Cathodic protection is recommended with a **painted coating**. Nevertheless, the coating must be compatible with this associated cathodic protection in order to avoid disbounding.

For any subsea equipment (mandatory) and for any equipment (recommended), the painting type, the painting process and the painter will be performed according to the following standards:
- NORSOK M501-revision 5
- ISO 12944-1998
- ISO 20340-2003
In addition a number of NACE publications, recommended practices etc. are also available.

Isolators between systems with independent cathodic protection are mandatory. The quality of isolation must be checked before deployment. Some pieces of equipment will impose their material choice. In any case theses pieces should be isolated. Electrical mass link through cables might endanger this isolation. This must be dealt with on a case-by-case principle.

2.4.1 Review of materials used in service deep sea applications

Metallic materials

Steel with cathodic protection is the standard solution. Rules of the offshore industry may be applied. The control and exchange of anodes will represent a maintenance cost that must be accounted for in the operating costs.

Stainless steel: Common stainless steel (ie AISI 304) is liable of cavernous corrosion and must be prohibited. AISI 316L and AISI 316LTi may be used with care in some non-security components. In any case they must be associated with cathodic protection (mandatory).

High corrosion resistance alloy: Several grades of high cost alloys such as nickel based are available and constitute safe solutions: Inconel 625, Hastelloy C22, Superduplex…

Titanium alloys: They have been one of the technical enhancements allowing deep underwater intervention. Their extensive use is limited by the cost. Alloys in alpha-beta phase such as 6% Aluminium and 4% Vanadium (or equivalent Russian grades) are a reliable solution.

Unalloyed titanium (T40) is used when the mechanical requirements are not stringent. Keep in mind that high performance of titanium alloys have electrochemical potential which may be detrimental to other metals. It is suggested to protect it by painting for instance to limit its active surface.

Bronze. Among copper alloys, some have a good behaviour for long time exposure to seawater. They may have the advantage of intrinsic biofouling protection by release of copper ions when they are not cathodicaly protected.

Aluminium alloys of several kinds are a solution for underwater components. The ANSI series 5000 is not prone to heavy corrosion and may be used with simple anodizing or unprotected (<4 years). The powder produced by corrosion may be a disturbance for some very precise measurements of particles in the abyss. The ANSI 6000 series and to some extend ANSI 7000 series (with better mechanical performances) are used with hard anodizing specified for marine application (<4 years). A cathodic protection with Aluminium-Indium alloys anodes is ensuring long-term endurance.

On sensor heads, small or thin surfaces of **noble materials** (gold, platinum…) are welcome.

Non metallic materials

For polymer and composite materials good knowledge of behavior in water has to be considered in order to limit the risk of long-term detrimental degradation processes (hydrolysis, etc.). However, it must be noted that degradation of such material is generally thermally activated and except in really specific areas (black smokers, etc.), temperature is low enough (around 4°C) to avoid initiation of degradation processes.

An approach based on accelerated test using time-temperature equivalence can be used to predict long-term performance of polymeric materials however good knowledge of degradation phenomena is needed in order to guarantee pertinence of the accelerated test.

For specific materials as syntactic foam, synthetic fiber for mooring cable, knowledge of long-term behavior has already been addressed through specific program related to offshore industry.

Thermoplastic materials have the great advantage of no electrochemical corrosion. Their limitation of use is due to the water ingress and creep. The temperature limit must be checked. Thermoplastics with brittle behaviour (e.g. PVC) are not recommended. Using these materials implies the load is permanent because of the potential creep. PEEK or PCTFE (chlorined, fluorined or chlorofluorined) are a good choice but are quite expensive.

Polyurethane is commonly used, but its formula must be especially suited for long-term seawater exposure. The polyether type of molecule has acceptable performance. The components of polyurethane and of most thermoplastic materials are changing quite often due to environment regulations and medical regulations for the workers. This may lead one to perform acceptance tests or tests again on mechanical characteristics. In general, characteristics for under-water ageing are dependent on the crystalline to amorphous ratio.

Composites

The high mechanical strength characteristics of composite materials and the lack of corrosion are excellent arguments for their use at sea. In long-term sea floor deployments, these performances have been demonstrated. In the telecom cable industry, repeaters in glass epoxy have been produced and used for the last twenty years by Alcatel for instance. Components of sensor strings implemented in underwater wells, by industrial companies such as Schlumberger or academic institutes like Ifremer, have shown their cost effectiveness.
In these applications, thick glass epoxy is machined and used as any material.

Resin
The plastic matrix to be reinforced by fibres must be well tested. The criteria are, as such, an R&D issue in: water ingress, creep, shock, ageing of matrix-fibre interface. The choice of epoxy and vinyl-esther is acceptable. Other matrices such as polyester are not recommended. The production methods (responsible for the void ratio) and chemical components are changing according to the manufacturer. The qualification is specific, unfortunately existing

standards are not sufficient. A good example of methodology was given by the EC MAST project "Light weight composite pressure housing for mid-water and benthic applications" [4]

Glass fibres
The reinforcement by glass fibre is providing good performances for the long term. The high glass/matrix ratios are giving better hydrostatic pressure and compressive strength (70 - 80 % in mass). The use of S or R glass for the fibre and the choice of manufacturing method such as filament winding, fabric prepreg, injection have been qualified in several design of underwater equipment.

Carbon fibres
Lighter structures may be designed using carbon fibres. Under tensile or flexural strength design criteria, the additional cost finds good arguments. It is more limited for structures dimensioned by the compressive strength. The feasibility of carbon epoxy pressure hulls has been demonstrated by EC projects. The electrical conductivity of carbon must be taken into account : it is not an isolator.

Syntactic foam
A composite material made up with very small hollow glass spheres inside a plastic matrix is able to provide buoyant material. It has been qualified for full water depth floats as well as pipe insulation material. The floats must be unitary tested when they are a safety component. They must be preferred to glass spheres.

- Note that functional properties of non-metallic materials must be checked with respect to ageing (for instance, impedance of acoustic transducers may vary).

Brittle materials such as glass or ceramics have exceptional compressive strength. But any tensile or shear stress may lead to rupture. They are used for electric insulation in connectors with a very stringent manufacturing process.

Glass spheres, although they were the basis of deep ocean exploration in the 20th century, are not recommended for ESONET type of long-term deployments. Further studies on probability of rupture are expected from KM3Net project. The minimum distance between spheres to avoid the transmission of implosion is investigated by KM3Net (20 m distance for 2 000 dbar pressure on 6 000 dbar rated spheres is a first recommendation).

Documents references

Title	***Lead authors***	***Date and version***	***Where?***
ESONET D50 - Report on Best Practices Workshop #2	***C. Waldmann (KDM-UniHB)***	***2011***	***www.esonet-noe.org***

[4] (V. Papazoglou et al. "Light weight composite pressure housing for mid-water and benthic applications" - 11th European Conference on Composite Materials – Rhodes, 2004)

Biofouling

Marine biofouling is a natural process occurring in the ocean as soon as a material is moored underwater and biofouling effects on marine instrumentation are numerous.

The most convenient antifouling strategies must be determined during a rigorous qualification phase and should not interfere during measuring sequences with the instruments or with the environment. A particular attention must be paid to calibrations of the sensors with the antifouling system in place, before deployment and after deployment.

For subsea observatories, biofouling protection on sensors must be involved since deployment duration is commonly long. Active biofouling protection is very convenient since free biocide production period can be managed in order not to disrupt the sensor and the measured environment. Local chlorination is a response to these requests. Mechanical sweeping may be integrated as well provided it is qualified for long-term reliability. Validation of the design by an independent expert is recommended.

3 - Generic and Scientific Modules

3.1 Generic Sensor module

ESONET should implement a generic module on each node (mandatory). The generic module is designed to consistently and continuously measure parameters of interest for most major science areas covered by the ESONET NoE, such as temperature, conductivity, pressure, turbidity, passive acoustics, dissolved oxygen, and ocean currents. These systems will provide accurate records on environmental change from a distributed network around Europe. The generic module will be directly influential in addressing most of the physical oceanographic questions and the primary means for comparisons of processes between sites. Because these data are related to all of the major science areas, they will be **the core service of the system**. Sensors for these generic parameters have been tested in operational conditions for long time periods at the deepest depths in European Seas, and are now commercially available. Hence, they can be used and maintained with relative ease. Multi-probe, CTD-type (conductivity temperature, and depth [pressure]) systems often come with a basic set of sensors and possibilities to add a wide variety of others. Another advantage of such systems is that data capture and power supply units have already some integration and interoperability standardization and can be used for quite different sensors and thus parameters. As sensor development continues other parameters can be added. Sensors for *p*CO2, pH, CH_4, H_2S, Eh, Chlorophyll-*a*, and hydrocarbons are likely to become part of the generic scheme as sensors for them become adapted for long-term deployments to abyssal depths.

The minimum generic sensor package has to fulfil following characteristics (mandatory).

Table 1: Overview of specifications under consideration for generic sensor modules that may be used across European ocean observatory sites.

Type of sensor	Range†	Accuracy†
Conductivity	0 to 9 S/m	0.001 S/m
Temperature	-5 to +35°C	0.01 K
Pressure	0 to 600 bar	0.1 % FSR
Dissolved oxygen	0 to 500µM	5%
Turbidity	0 to 150 NTU	10%
Currents	0 to 2 m/s	2%
Passive acoustics	50 - 180 dB re 1 µPa	+/-3dB

†*Range and accuracy given are often adjustable through calibration and given here as suggestions.*

References

Title	***Authors***	***Date and version***	***Where?***
ESONET D13 – Science modules of the ESONET	***H. A. Ruhl, L. Géli, Y. Auffret, J. Grienert***	***2011***	***www.esonet-noe.org***

ESONET label group should:

- Continue best practices exchanges and advisory, especially about duration and time between calibration;
- Examine requests for the implementation of a smaller number of sensors on generic sensor modules (i.e. hydrophones too power consuming for a stand alone observatory).

3.2 Standard interface for scientific modules

The easiest way to ensure compatibility and interoperability between networks and instruments is to define the interface requirements and a generic connector pin-out between infrastructures and instruments. The specifications so defined for the interface are standards which should be met to obtain the ESONET/EMSO Label (recommended).

The tables below describe minimal recommendations in terms of voltage/power (Table 2), data interfaces (Table 3), clock synchronization (Table 4), plug-and-play capabilities (Table 5) and connector pin-out (Table 6).

Table 2: Recommendations for infrastructure interface (instrument side): voltage and power

Voltage/Power	Cabled observatory	Stand-alone acoustic link observatory
375-400 VDC	Yes	Not a requirement
48 VDC	Yes	Yes
15 VDC	Yes	Yes
Remote power control (power up and power down)	Yes	Yes
Additional services: ground fault detection, power management, short circuit management…	Yes	Yes
600 W min. available (at least one port)	Yes	No
200 W min. available (at least two ports)	Yes	Not a requirement
20 W min. available (at least four ports)	Yes	Yes

Table 3: Recommendations for infrastructure interface (instrument side): voltage and power

Data Interfaces	Cabled observatory	Stand-alone acoustic link observatory
RS 232 (3 wires TX, RX, GND)	Yes	Yes
RS 422 (4 wires)	Yes	Yes
RS 485 (2 wires)	Yes	Yes
Ethernet 100BaseT (copper)	Yes	Yes
Ethernet 1000BaseT (copper)	Yes	Not a requirement
Ethernet 1000LX or 1000ZX (fiber)	Optional - Only for long range extension	Not a requirement

Table 4: Recommendations for infrastructure interface (instrument side): clock synchronization

Clock	Cabled observatory	Stand-alone acoustic link observatory
NTP/Ethernet instrument: Network Time Protocol (2-10 ms)	Yes	Yes (generated with a local clock reference)
PTPv2/IEEE1588-2008/Ethernet instrument: Precision Time Protocol (Better than 1 microsecond)	Yes	Partially (generated with a local clock reference)
Underwater GPS clock emulation PPS (Pulse per second) + NMEA Time code/ Serial instrument	Yes	Partially (generated with a local clock reference)
Local time stamping service	Yes	Yes

Table 5: Recommendations for the infrastructure interface (instrument side): plug-and-play capabilities

Plug-and-Play capabilities	Cabled observatory	Stand-alone acoustic link observatory
1-wire tag for metadata information, compatible with any data interface (inside instrument or cable)	Optional - Not a requirement	Optional - Not a requirement
Zeroconf/Bonjour compatible Ethernet instruments	Yes	Yes
Puck for serial instruments	Yes	Yes

Table 6: Recommendations for the infrastructure interface (instrument side): connector pin-out (copper) for short-range connection

Junction box connector pin-out	Signal
1	GND_48VDC_15VDC
2	48VDC
3	15VDC
4	Data1
5	Data2
6	Data3
7	Data4
8	1-Wire tag for metadata information (optional plug-and-play capabilities)
9	PPS1
10	PPS2
11	NMEA1
12	MNEA2

Legend:

GND_48VDC_15VDC.. Power supply ground for the instrument
48VDC .... 48 VDC power supply for the instrument
15VDC .... 15 VDC power supply for the instrument
Data[1..4] .... Serial (RS232/RS422/RS485) or Ethernet 100BaseT
1-Wire tag...................... metadata information memory that contains Transducer Electronic Data Sheets (Standard IEEE 1451 TEDS)
PPS[1..2] .... Pulse Per Second output
NMEA[1..2] .... NMEA serial interface that contains Time Code ASCII message

Table 7: Recommendations for the infrastructure interface (instrument side): connector pin-out (hybrid: copper and optical fiber) for long-range connection

Junction box connector pin-out	Signal
1	GND_375VDC
2	375VDC
3	VDSL2 - 1
4	VDSL2 - 2
Optical fiber 1	Optical fiber 1 - Ethernet 1000LX or Ethernet 1000ZX
Optical fiber 2	Optical fiber 2 - Ethernet 1000LX or Ethernet 1000ZX

Legend:

GND_3755VDC .... Power supply ground for the instrument
48VDC .... 48 VDC power supply for the instrument
VDSL2 1 & 2 .... Twisted pair for VDSL2
Optical fiber 1 & 2 .... Ethernet 1000LX or Ethernet 1000ZX

Documents references

Title	*Lead author*	*Date and version*	*Where?*
ESONET D50 - Report on Best Practices Workshop #2	***C. Waldmann (KDM-UniHB)***	***2011***	***www.esonet-noe.org***
EMSO Deliverable 8.2	***Y. Auffret (Ifremer)***	***2009***	***Under request to emsopp@ingv.it***

The ESONET label group should continue on standardisation issues (based on the main conclusions from the Best Practices workshop #3 -WG 2 session *"Standards implementation for Observatory instruments)"* :

- Work as an Ocean observation technical expert working group
- Coordinate with ocean data management strategy at EU level
- Support to test observatories
- Address mobile platform sensor services
- Observing infrastructure harmonisation with respect to Quality of Service
- Ensure International participation to standardisation groups on this topic
- Define a clearinghouse role for ESONET-EMSO with clear strategy with respect to data and sensor metadata policy
- Implement quality of service procedures from sensor to data presentation
- Establish and disseminate best practices
- Identify standardization needs/opportunities
- Define /refine standardisation projects
- Contribute to GEOSS best practices

it includes the following recommendations for the ESONET label:

- Recommend sensor registration in a standard format
- Recommend standard metadata: functional & operational characteristics, common thesaurus/ontology
- Recommend unique description of the sensor, e.g. via ESONET sensor registry
- Promote Standard Interface Descriptor
- Promote Service Oriented Architecture (SOA)
- Implement the mechanisms to move to SOA architecture
- Promote prototyping of interoperable web services

Documents references

Title	*Authors*	*Date and version*	*Where?*
ESONET D69 - Report of the 3rd Esonet general assembly	***I. Puillat (Ifremer)***	***2011***	***www.esonet-noe.org***

3.3 Metrology issues

The instrument calibration must be performed according to recognized standards. For parameters where international references exist, the methodology must be followed and documented (mandatory). The instrument must relate to national agreed laboratory with the shortest possible link, for instance by frequent calibration of reference sensor.

Table 8: Traceability to SI units: existing status.

Parameter	Calibration means	Reference
Temperature	Regulated bath + Pt25 reference thermometer	S.I. units
Pressure	Relative or absolute pressure balance	S.I. units
Current	Towing or circulation tanks	Achievable S.I. units
Dissolved oxygen	Mixed freshwater/seawater bath + Winkler reference	Achievable[5]
pH	pH standard solution	No S.I. reference
Salinity	Salinometer calibrated by IAPSO standard	Ongoing SCOR/IAPSO WG 127 (Unesco)
Turbidity	Formazin solutions	Difficult[6]; no S.I. reference/units
Fluorescence	Fluorescein solutions	Difficult; no S.I. reference/units
Passive acoustics	Acoustic tank	S.I. units

For all parameters, the ESONET label group should follow-up the ongoing metrology standardisation processes and support national or international inter-comparaison projects.

3.4 Redundancy and time overlap

Redundancy of sensors of key parameters is recommended.

It is suggested to validate with in situ reference measurements the parameters of the exchanged sensors during maintenance cruise. If not possible, it is suggested to set up at least three sensors for each parameter the observatory is intended to measure. The two first will stay on the observatory during two periodic maintenance periods separated by a maintenance period and the third could be replaced for periodic calibration at each maintenance period. It will deal with the gaps at sensor exchange and might avoid to wait for the periodic calibration for the validation of data.

[5] See *HYPOX* project.
[6] See granulometry (particle size analyser)

3.5 Specific instrumentation

Acoustics

The coexistence of acoustic applications such as positioning or remote control systems, hydrophones, ADCPs, sonars, echosounders… may pose the problem of time-frequency overlap that must be addressed by synchronisation processes, spatial separation and software based-solutions. In some cases, the use of frequencies will have to be shared by temporary stop of some equipments. Such acoustic sharing must be documented.

Others issues to be addressed:
- Calibration procedures (standardized tank calibration, sea tests or auto-calibration *in situ*) must be documented;
- Following standardization of raw and processed data format as standardized by ICES are recommended;
- Bio-fouling.

Pressure tsunameter

According to standards from the Intergovernmental Coordination Group of the Intergovernmental Oceanographic Commission (UNESCO) for the North-Eastern Atlantic and Mediterranean Tsunami Warning System (ICG/NEAMTWS).

Seismometer

According to standards

Documents references

Title	*Lead authors*	*Date and version*	*Where?*
ESONET D50 - Report on Best Practices Workshop #2	***C. Waldmann (KDM-UniHB)***	***2011***	***www.esonet-emso.org***

4 - Qualification and testing

Performing tests should be considered of prime importance before planning any long term at sea deployment (see ESONET deliverable D36 which gives guide lines to define and implement test plan and reviews practical application of guide lines to various tests)[7].

The necessity to define a test plan early in the development process of an equipment is now a widespread and recognised issue, in order to get assurance the developed equipment brings the expected service in conformity with its functional specifications, taking into account the various conditions it will be submitted to during its life time. For off the shelf equipments, the manufacturer must prove the fulfilment of a test plan. It is mandatory to perform lacking tests to obtain the ESONET Label.

It is mandatory to write a ***Test Plan Definition Document*** for each equipment to gather pertinent information on the items reviewed there below.

It should precise whether each qualification test will be valid for a serie of identical equipment or will be performed individually on next equipment even if identical.

Recommendation: this test plan may be inspired by the document NF-XP X 10-812***: Marine environment – Oceanographic instrumentation – Guide for environmental tests.*** An English version (XP X 10-800) is available on ESONET website and on Ifremer website: http://www.ifremer.fr/tsi/qualite/specif/31SE09.pdf

4.1 Define a life cycle of the equipment

- Listing the situations: home base storage, transport, temporary storage on operation base, transit to operation site, deployment, underwater maintenance, return to home base…
- Listing the situation parameters the equipment will be subjected to in each of the situations listed above:
    - the environment parameters (*in situ* natural environment and man built environment): temperature, air humidity, pressure, solar radiation;
    - the operations parameters: vibrations acceleration and mechanical shocks, thermal shocks.
- Quantifying range of parameters values.

[7] http://www.esonet-noe.org/content/download/20951/302815/file/Deliverable_D36_report.pdf

4.2 Define the list of equipment parts to be tested

Tests can performed on some components, or on each of them (recommended), on some sub-assembly systems and on the complete system.

4.3 Define the type of tests to be performed

- Sensor laboratory calibrations: to verify sensor performances and determine the relation between the measured physical parameter and output signal (cf. § *Metrology issues*).
- Environmental tests: to reveal possible conception, manufacturing or assembly deficiencies and to ultimately verify that the equipment is able to endure the "service conditions" of the different situations of life cycle and **at each integration level** (components, sub-assembly systems, complete system).
- Functional tests: to verify that the intended functions of the equipment (operating and maintenance conditions) are performed according to the specifications.

Define the programme of measures and the functionnal checks –corresponding to the operation of the subsea observatory– to be performed before, during and after each test.

4.4 Define the needed testing facilities

Give the type and description of the needed facility (e.g. climatic chamber, water test basin). Give also the main required characteristics (e.g. range of temperature, main dimensions) and performances (e.g. parameter variation speed).
Identify existing testing facilities or necessary custom built installations.

4.5 Test archiving

For each test performed, a *Test Archiving File* (TAF) should be produced. It should keep trace of the test plan as it has been effectively implemented and keep trace of the results (positive or negative). The owner of the equipment accepts to report the results to Esonet Best Practices meetings.

4.6 Documents references

Titles	Authors	Date and version	Where?
ESONET D36 Report of testing facilities survey	J. Marvaldi (Ifremer)	February 2009	www.esonet-noe.org
XP X 10-800 : Marine environment – Oceanographic instrumentation – Guide for environmental tests	AFNOR	April 1997 (under updating process)	www.afnor.org (French version) www.esonet-emso.org (English version) www.ifremer.fr/tsi/qualite/specif/31SE09.pdf (English version)

5 - Deployment and maintenance

5.1 Plan for deployment

All the methods and procedures planned for the equipment deployment will be completely presented and detailed in a ***Deployment document*** (mandatory).

A reference to standards (see §5.5) is recommended.

Note that the cases when a manned submersible is liable to operate the subsea equipment, special rules must be applied (mandatory) such as those issued by the ASME Safety Standard for *Pressure Vessel for Human Occupancy – PVHO 2007*.

5.2 Deployment methods

Deliverable D27 of ESONET presents a review of existing Best Practices and standards in offshore industry and the possible benefits for the scientific community. The most important elements are presented below.

5.2.1 Site survey

Prior to permanent cable laying, and any installation works, a proper site survey has to be carried out, in order to acquire hydrographical and geotechnical data.

The first objective is to carry out a reconnaissance of the route to be followed by a cable.

A second objective may concern a detailed seabed survey, prior to installing any underwater structure or module at the selected site, to assess the geotechnical characteristics of the local soil and to verify that no natural or artificial obstacles will present a danger for the installation and the exploitation of the system.

The use of offshore cable route survey documents issued by experienced companies is mandatory, at least to check the validity of a previous academic survey for laying purposes.

5.2.2 Cable deployment

For seafloor cabled observatories, it is more than likely that planning, installation, and future maintenance of the main backbone cable and cable fittings will be committed to commercial submarine telecommunications systems and specialized survey companies that make use of existing and proven commercial hardware, jointing, methods and techniques.

A model contract has been issued by the offshore cable community (see *"Model contract with guidelines for construction of submarine cable system"* on the website suboptic.org: http://www.suboptic.org/getattachment/Model-Contract-with-Guidelines-for-Construction-of-Submarine-Cable-System----2010-04-08.doc.aspx).

Recommendations issued from

- The International Cable Protection Committee (ICPC),
- The Atlantic Cable-Repair and Maintenance Agreement (ACMA),
- The Submarine Cable Improvement Group (SCIG),

related to submarine cable planning, installation, operation, maintenance and retirement must be followed.

5.3 Equipment deployment

Different methods of deployment can be used. They can be grouped in two main categories.

The deployment of heavy equipment by cable lifting and lowering

This technology concerns equipment with weights of few hundred kilo to less than ten tons. It is very used in offshore industry and often cost effective. Many offshore standards can be applied to lifting equipment, such as API RP 2D, British Standard BS 7121-11.

All lifting equipment shall be in accordance with human safety rules (mandatory) -for example those described in ISO 13628-1- and labelled with safe working load. It's recommended to make it certify by an official certifying authority (DNV, Lloyds, BV…).

However, due to a smaller size of the modules, a more flexible approach than those applied in offshore industry would be recommended for the scientific community:

- If the vessel hasn't any active heave compensation systems, deployment operations will be done by sea-state 3 maximum;
- Uncoupling of dynamic loads from support surface will be allowed by a smart rigging arrangement (*e.g.* by means of a flexible arch with buoyancy);
- A precise orientation could be achieved by ROV assistance in coordination with deposit operation.

For all the operations, a precise acoustic positioning system (LBL or SBL) is essential.

Free Fall Mode (FFM) of neutral or almost neutral equipment

The deployment of a neutral equipment could be done in free falling mode (FFM). Because the landing point is not precise, it could be necessary to use a ROV in order to horizontally translate the equipment to the right position afterwards. This technique is well adapted when the weight and displacement in water are moderate, typically less than 50 daN (depending on the vehicle).

In this case, a "two cables operation", when ship captain agrees, may induce shorter intervention time.

Acoustic positioning system, sonar and by end optical means are highly recommended for these operations.

For small equipment, a direct deployment by ROV or dynamically positioned power pod is also possible.

5.3.1 Downlink cable laying

Concerning long cables deployment (>some tens of metres) between an equipment and some remote instrument sites, scientific institutions have now developed tools and procedures for first operational experiences. They are based on two generic solutions:

- deployment of a special drum sent from the surface in FFM and manipulated by a ROV;
- directly use of a dedicated toolsled on the ROV.

Examples can be found in documents describing *Antares* interconnecting cable installation (Victor 6000), MBARI *Mars* installation (Tibuton), Neptune Canada undersea observatory (Ropos) or Donet Japan (Hyper Dolphin). For more details, please see presentations during Esonet meetings.

In offshore industry, there are no specific standards covering the installation of subsea cables, but API 17E and ISO 13628-5 (same document) have a section concerning the design and installation of subsea umbilicals which is partly applicable to subsea cables installations.

5.3.2 Underwater connections

The ISO 13628-8 lists the key elements that should be considered during the design of a submarine system to ensure future intervention by ROV.

For example, connectors would be ROV friendly designed, by adding T-type handles on top of their flying part. Guide cones must be sited around the point where a connector is inserted. Their face upwards should be open-ended or equipped with a suitable debris cap. Grasping devices on the structure may also make the operation easier for the ROV. Docking and interface points should be a minimum of 1,5 m above the clear local seabed. Interface shall be accessible to standard 7 functions manipulators.

At the end of deployment operations, it's mandatory to check that all the sensors, connections and data processing are working well on the subsea observatory before the ROV leaves. Check all transmission before leaving the site.

- Prior to deployment, rehearsal in dry conditions are recommended reference to D51 Training and simulation manual.
- Written procedures are mandatory.

5.3.3 Buoy deep mooring deployment

Deployment and recovery of such a device can be implemented by medium size multi-purpose vessels that have sufficient space on deck, handling system with high clearance and lifting capabilities up to several tons for the buoy and its mooring, and dynamic positioning possibilities. There are no standards for this operation. A good positioning of the deadweight on the seafloor is mandatory.

5.3.4 Training

ESONET Deliverable D51 provides the scientific users and operators with design recommendations for training, simulation and testing.

Two existing dry manipulator testing facilities may be used for the design and training courses :

- Ifremer, Toulon:
    - existing Cybernetix 7P proportional electro-hydraulic arm test setup and positioning and control software simulator;
    - ROV simulation Platform (Victor).

- Marum, Bremen: existing Schilling Orion 7PE proportional electro-hydraulic arm training setup with 2 proportional pan/tilt camera heads.

It is recommended that Deployment and maintenance plans benefit from these facilities in order to check the procedures.

5.4 Maintenance

A **maintenance plan** will be established to describe **periodic maintenance** operations that have to be carried out (mandatory). It will deal with:

- Maintenance procedures available for ROVs to replace modules or subsystem. Standard procedures would allow to use any opportunity ROV for these operation and would, so, minimize operational costs;

- Planning at European level, would allow to refit and calibrate sensors for redeployment on different nodes.

N.B. Maintenance cruises are also scientific cruises during a learning phase of a few years and consequently operate short time instruments complementary to the ESONET-EMSO connected ones.

The management plan will also take into account **exceptional maintenance** operations:

- Protocols to be studied for the major components, for example extra length of cable for retrieval, additional connectors…

- Existing agreements with ROV operators to maintenance operation under a short delay.

- Agreement on cable ships operation (Ex: MECMA / ACMA interval activity,…).

- Existing spare component stock related to a failure analysis study (reliability, redundancy, availability). They could be stored at the manufacturer's shop or at regional level.

All the maintenance operations should be budgeted initially as well as spare parts. It would be preferable that restricted high quality work is undertaken, rather than to try and undertake too much with insufficient funds.

5.5 Standards that can be applied for deployment or maintenance

API RP 2D.............. Recommended practice for the operation and maintenance of offshore cranes
BS 7121-11............. British code of practice for safe use of offshore cranes
ISO 13628-1 .... Guidelines on proper maintenance planning and tooling design
ISO 13628-5 .... Design and installation of subsea umbilicals
ISO 13628-8 .... Functional requirements and guidelines for ROV interfaces
NORSOK U-102 .... Remotely Operated Vehicles (ROV) services.

5.6 Documents References

Titles	Authors	Date and version	Where?
ESONET D27	J.-F. Drogou (Ifremer)	February 2009 Revision 1	www.esonet-noe.org
ESONET D51	J.-F. Drogou, L. Brignone (Ifremer) V. Ratmeyer (UniHB)	March 2011	www.esonet-noe.org

6 - DATA MANAGEMENT

All statements written here are issued from ESONET deliverables D9, D43-44, D50, D69, D70 and D71.

6.1 Data policy access

ESONET is recommending the following points concerning data policy access:

1. Free and open access according to Aarhus Convention on environmental data as expressed by IOC Data Policy (International oceanographic Commission UNESCO) programmes is applied for basic data, especially the data requested for risk assessment in real time and delayed mode (mandatory).

2. Registration of users is highly recommended for downloading taking into account the protection of individuals as defined by Directive 95/46/EC and Regulation No 45/200 (optional).

3. Experimental data should follow classical scientific confidentiality rules : no more than 2 years restriction. A low resolution data set such as a display of images is proposed to the public in the meantime (recommended).

4. Data classified for security and environment protection reason, and other exceptions as defined by the INSPIRE directive and the Directive 2003/4/EC (on public access to environmental information), must at least be stored and be available as soon as they will be de-classified. Access to classified data will be granted on request to agreed scientists (mandatory).

5. Access to citizens is facilitated by implementation of specific tools (recommended).

6. Long term archiving (more than 20 years) policy and implementation has to be performed for all types of data, including classified data. Archived datasets should be citable with a mention of the observatory network (mandatory).

7. This archiving is assumed by data centres complying with Esonet data management plan and standards (recommended).

8. Training should be provided to the various levels of staff handling subsea observatory data (recommendation).

9. Clear mechanism must be in place to guarantee data authorship traceability (mandatory)

The use of a sensor registry is recommended (mandatory for a new infrastructure). It means the registration of sensors in an open standard[8] machine -and human- readable format including sufficient information to facilitate automated discovery, access, traceability of sensors, functional and operational characteristics and the scientific exploitation of sensor data products".

6.2 Recommendations for ESONET sites data

- Provide an overview of the sensors (and set-up) in SensorML (ESONET provides templates for several sensors, more templates will be made available progressively).

- Define the process of how data is managed.

- Encode data in standard conform formats as for instance the O&M, proposed by OGC which is now an ISO standard as well.

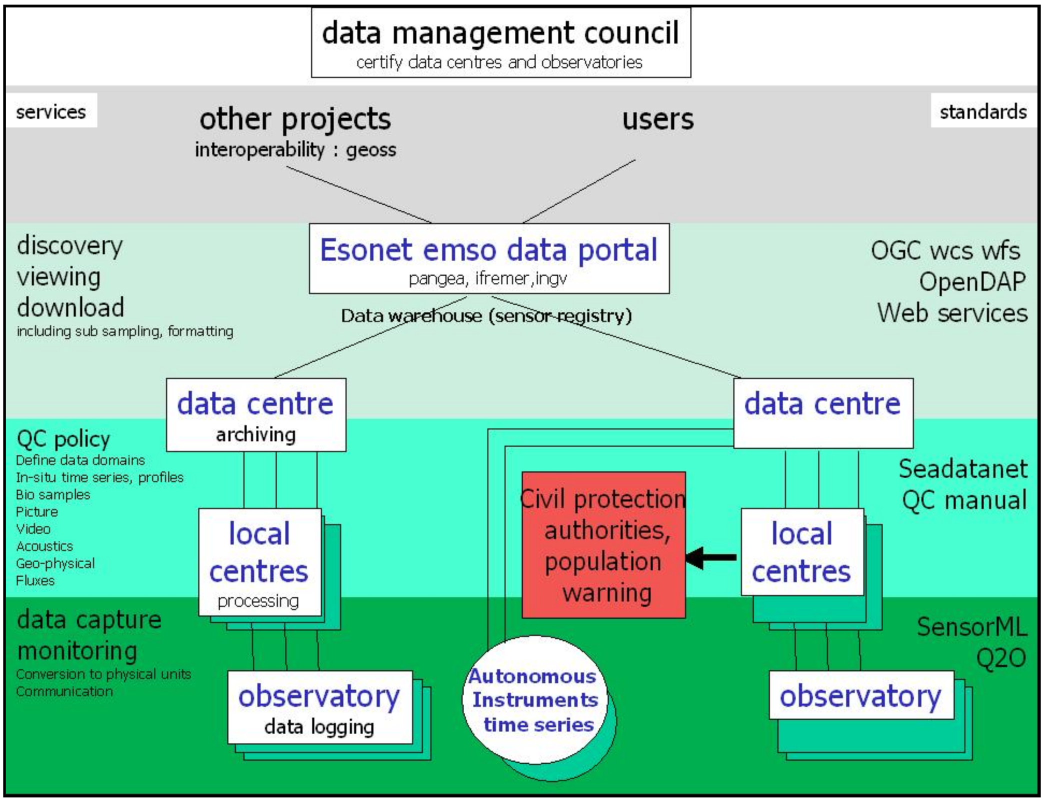
- Provide schema files for the data encodings that allow automatic validation and interpretation of the data. Such schema files shall be specific for a certain sensor type. For different sensors of that type these schema files can be reused by multiple parties. The schema files may be provided by sensor manufacturers or user groups. In future, it is envisaged that a public repository of such schema files supports their reuse (see Discussion Paper @OGC [9]).

- Offer public distribution of the data through the Sensor Observation Service, as for instance Oostethys PERL server, UMN Mapserver etc..

- Register sensors in the ESONET sensor registry.

[8] "Open standard" refers to the European Union definition: http://en.wikipedia.org/wiki/Open_standard
[9] **Bröring, A.**, S. Below & T. Foerster (2010): Declarative Sensor Interface Descriptors for the Sensor Web. WebMGS 2010: 1st International Workshop on Pervasive Web Mapping, Geoprocessing and Services. 26.-27. August 2010. Como, Italy. [final] [slides]

The figure below shows the proposed data management plan:



6.3 Recommendations on interoperability

Use of the standards as defined in the ESONET data management plan and infrastructure (see data policy) e.g. SensorML, SOS, O&M, DIF, ISO19XXX, OAI-PMH...

Definition of a long term Archive format for Esonet

- The archive data format has to be open (fully documented) and self-descriptive
- Scalability
  - Can manage data with different sampling schemes -> high sample rate, filtered or averaged data.
  - Offer different levels of processing, record the different calibrations and history records
- Citation statement
  - Archived datasets should be citable
    Use a citation statement, a DOI when possible
  - Licence for comments: interactive comments?
- Usage of proven metadata standards (DIF, ISO19139)

6.4 Recommendation on Esonet YellowPages

http://www.esonetyellowpages.com/sensor.php?id=179

The data management group issues a recommendation to describe ESONET metadata with SensorML. Ideally, the sensor description should come directly from manufacturers. It is envisaged that suppliers could have an Esonet label. The first condition will be this metadata description. The most important condition will be a consensus from ESONET users on the good reliability of the equipment. The usage of equipments by ESONET/EMSO teams will be displayed on the column "Esonet Reference" of the Esonet Yellow Pages.

6.5 Documents References

Titles	*Lead authors*	*Date and version*	*Where?*
ESONET D9 ***Data management plan***	M. Diepenbroek	*2008*	**www.esonet-noe.org**
ESONET D43-44 ***Data Infrastructure Productive Version*** ***Esonet Knowledge Base***	R. Huber, A. Behnken, T. Carval, E. Delory, C. Robin	*3-11-2010* *Rev. 4*	**www.esonet-noe.org**
ESONET D50 - Report on Best Practices Workshop #2	C. Waldmann (KDM-UniHB)	*2011*	**www.esonet-noe.org**
ESONET D69 - Report of the 3rd Esonet general assembly	*I. Puillat (Ifremer)*	*2011*	**www.esonet-noe.org**
ESONET D70 ***Updated Data management plan***	M. van der Schaar, M. André, R. Huber	*6-4-2010* *Rev. 1*	**www.esonet-noe.org**
ESONET D71 ***Sensor registry***	E. Delory	*11-12-2010* *Rev. 1*	**www.esonet-noe.org**

7 - ENVIRONMENTAL IMPACT

- A precautionary approach should be adopted.
- Attention will be paid on the effect of acoustic or optical devices on sea mammals and other organisms and effect of emf's from power cables on certain species or fish.
- Electrical and acoustical noise would be under the levels identified in the OSPAR agreement. Rules and recommendations of international bodies such as IUCN and ICES are strictly followed.
- During fieldwork the disturbance to species and habitats is restricted to the minimum required. For marine protected areas, permission for fieldwork are requested where necessary.
- All deadweight or unused device will be retrieved.

Esonet label group should participate or initiate workshops on these topics which are lacking standards.

Documents References

Titles	***Lead authors***	***Date and version***	***Where?***
ESONET D47 ***Online database to include local national and European legal ethical and environmental (LEE) documents***	M. André (UPC)	*28-02-2010*	www.esonet-noe.org
ESONET D48 ***Final report on Best Practices, guidelines for LEE issues and implementation plans***	F. Grant, M. Gillooly (IMI), J. Piera, X. Garcia (CSIC), M. André (UPC), N. O'Neill (SLR), J.-F. Rolin (Ifremer), ESONET Steering Committee	*28-02-2010*	www.esonet-noe.org

8 - ESONET GLOSSARY

To be updated – inspired by OOI glossary

Accuracy
Closeness of the agreement between the result of a measurement and the value of the measurand (or true value of the measurement). (Taylor and Kuyatt, 1994).

Acquire
Obtain the rights to use an entity or resource. Note that the entity itself is not acquired, only the rights to use it.

Activity
A task or grouping of tasks that provides a specialized capability, service, or product.

Actuator
A device that responds to commands to carry out some physical action (e.g., a pump).

Adaptive Sampling.
Adaptive sampling is a sampling design in which sampling regions are selected based on values of the variables of interest observed. Within OOI, adaptive sampling can be used to modify sampling times of fixed platforms, sampling times and depths of profilers and sampling times, depths, and positions of mobile platforms. Adaptive sampling may be user-directed based on real time data or autonomous based on programmed mission files.

Architecture
A concept that identifies components and their associated functionality, describes connectivity of components, and describes the mapping of functionality onto components. Architectures can be of different types, e.g., hardware, software, or system, and can be domain-specific.

Architecture Document
A representation that identifies components and their associated functionality, describes connectivity of components, and describes the mapping of functionality onto components. Architectures can be of different types, e.g., hardware, software, or system, and can be domain-specific.

Array
A collection of sites, nodes and platforms with a common scientific focus

Ancilary functions
Functions of an element devoted to keep its operation capacity over time including its health, its protections against fouling and corrosion, the sensing of internal parameters,…

Authentication
The act of establishing or confirming an entity as a trusted member of a community. This might involve confirming the identity of a person, the origins of an artefact, or assuring that a computer program is what it is reported to be.

Availability
The ratio of (a) the total time a functional unit of software or hardware is capable of being used during a given interval to (b) the length of the interval.

Backhaul
The link (fibre-optic) between the shore station and "centre"

Basic Core Seafloor Measurements (BCSM)
Co-located measurement of pressure, single point near bottom currents, acoustic pressure waves, ground motions associated with variable magnitude earthquakes (<1 to > 7), and water temperature in sites located at all plate boundaries and intraplate. Competes with generic sensors.

Beach Manhole
A vault at a beach to allow buried cable to come to the surface at the shore station.

Benthic experiment package
A mounting platform for sensors that require proximity to the seafloor. Complementary to generic sensors.

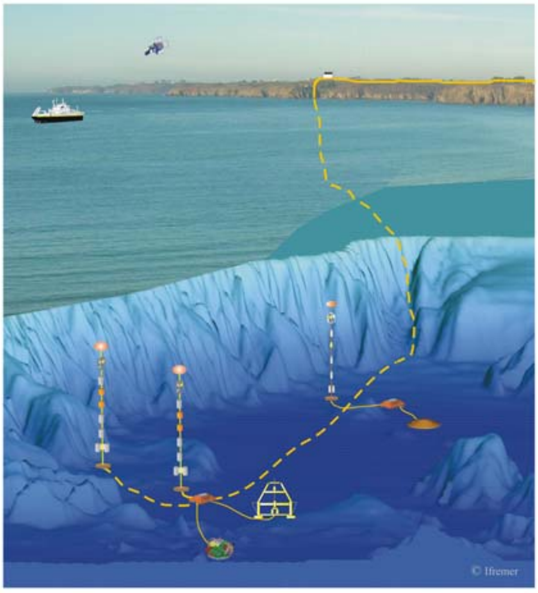
Buoy
A device whose weight is less than that of an equal volume of the sea water in which it is deployed. The excess buoyancy provided by the buoy can be used to counter the weight of a mooring and drag forces caused by current, wind, or wave actions. A buoy may be either a surface or subsurface buoy.
(1) Surface buoys have some of their volume above mean sea level and can be used to support components, such as meteorological instruments or radio telemetry subsystems that must be operated above the water level.
(2) Subsurface buoys remain completely submerged except during deployment and recovery of a mooring.

Burst sampling
Intermittent rapid sampling that far exceeds the standard time series measurements requirements. The rate of burst sampling and the duration will generally be instrument specific but will require the ability to measure and record data at rates that can exceed 1 Hz.

Cable
A bundle of electrical and/or optical conductors, insulated from each other and protected as a whole with an external jacket, used for transmission of power and data. Cables may include a strength member and external armoring. Cable can refer to bundles with our without connectors or terminations. Cables may connect seafloor components, or may be components of moorings.

Cable Assembly
Cable segments with connectors or terminators.

Cabled observatory



Cable Line
The entire string of Cable Segments extending from a Cable Shore Station to the last Primary Node on the string.

Cable Segment
The cable and equipment between a Cable Shore Station and a Primary Node or the cable and equipment between two Primary Nodes.

Cable Shore Station
The shore terminus of a Cable Line and contains all equipment required to operate that particular Cable Line. Synonymous with Shore Station (see below).

Calibrate
Test and/or adjust the accuracy of a measuring instrument or process by comparing its output with a reference.

Catalogue
Entity that keeps track of resources and enables their discovery or query.

Co-located
Different measurements located in proximity adequate enough to accomplish the specified effort.

Communications and power manager
A microcomputer that monitors and controls the use of telemetry devices and forwards power restrictions to DCL's based on the availability of platform power.

Compliant mooring
A taut mooring that incorporates compliant hose to allow a surface buoy to move freely with the waves without accelerating subsurface mooring components and deeper instrumentation.

Configuration
The set of parameters that defines how a computer or system operates.

Configuration Control
An element of configuration management consisting of the evaluation, coordination, approval or disapproval, and implementation of changes to configuration items after formal establishment of their configuration baseline.

Configuration Management
The technical and administrative direction and actions taken to identify and document the functional and physical characteristics of a configuration item; to control changes to a configuration item and its characteristics; and to record and report change processing and implementation status.

Configure
Set up an entity for use, testing, or operation. An entity can be configured for normal or specific operating modes; this may happen at any point in the life cycle of the entity, as long as it does not violate OOI policy.

Controller
A device or system that may manage power and/or communication for multiple sensors or multiple actuators.

Co-registered
Different measurements made within 1 meter of each other. For black smoker systems, co registered measurements of temperature and chemistry are made in the same orifice, space allowing.

Creep
Slow movement along a fault that may be seismic or aseismic; slumping of landforms (rock or sediment) such as may occur in zones of gas hydrate formation.

Cyberinfrastructure
The term "**cyberinfrastructure**" describes research environments that support advanced data acquisition, data storage, data management, data integration, data mining, data visualization and other computing and information processing services distributed over the Internet beyond the scope of a single institution.

Data
Term that is not used in its unqualified form. In the oceanography domain, refers to the measurements that come from sensors and not to any data products computed based on these measurements. Observational data is synonymous.

Data Acquisition System
An assembly of controllers, sensors, actuators.

Data Circuit-terminating Equipment
Equipment that handles the signal conversion and coding necessary for coupling the Data Terminal Equipment (DTE) to a communications link.

Data Concentrator/Logger
A microcomputer based entity that is the hardware interface to moored CGSN sensors, responsible for configuring, powering and monitoring health of sensors, acquiring and storing data and forwarding data as requested either directly to a telemetry device or via the Communications and Power Manager (CPM).

Data Logger
Data Sampler with persistence. Can have a concept of time.

Data Management
The principles, processes, and systems for sharing and controlling information resources.

Data Product
An information product that is derived from observational data through any kind of computation or processing. This includes aggregation, analysis, modelling, or visualization processes.

Data Source
An entity that produces data, possibly including all antecedent data. products and data sources.

Data Stream
A sequence of data packets used to continuously transmit or receive information, typically in real time and without any direct action on the part of the data consumer.

Data Terminal Equipment
The functional unit that serves as a data source or sink. It is typically connected to Data Circuit-Terminating Equipment (DCE) in order to send or receive data over a communications link.

Database
A collection of data arranged for ease and speed of search and retrieval.

Dataset
Any information product handled by the CI Data Management services network. A dataset contains the actual information product as well as descriptive metadata on potentially multiple levels. Examples of data sets include observational data, derived data, data products, aggregate data, or analysis and visualization data products.

Deactivate
Disable to preclude further use; stop using.

Decommission
To permanently take out of service.

Deep profiler
A profiler used to profile the water column from as close as practicable to the seafloor to 150-200 m below the sea-surface.

Deploy
Put an entity into a given location, context, or configuration (typically, the final location where it is intended to operate-this is part of the OOI activity commission. Deployment may be hierarchical, with entities deployed on other entities. Deployment may also be repeated, with entities deployed over and over for operation, as a CTD rosette off a ship-this corresponds to the OOI activity activate.

Deployment
Interval The period between launch and recovery.

Detect
Derive from a stream of information or data the knowledge that a condition has been met. Detection may be followed by other automated actions, including notification of interested parties, presentation of relevant information, and controlling the response.

Determination
To ascertain a quantity or trend by application of observation(s) or investigation.

Device
An electronic or optronic apparatus that can be connected through peer-to-peer communication and can provide information and data about itself and/or its environment. Device can encompass both sensor and actuator.

Documentation
The list of artefacts used to describe the entities identified and the operations performed on them. Documentation can be embedded or external, static or dynamic, automatically generated or manually composed. It can be more or less structured, and can encompass comments and other auxiliary information.

Domain Model
A conceptual model of a system that describes the involved entities and their relationships.

EIA RS-232-C
Serial Link Standard for serial binary data signals connecting between a DTE

Electrical Mechanical (EM)
Designating mooring elements with copper conductors to allow power and data to flow through the mooring line. EM elements include molded chain and stretch-hose with spiral-wrapped conductors.

Electrical Optical Mechanical (EOM)
Applied to transmission system such as a cable. It transmits power through electrical wires, data through fiber optics and has a mechanical function such as mooring.

Element Management System
System to manage power, communication, ancillary functions and equipment health for specific nodes or subsystem components.

Enable
(1) Make possible; does not directly perform; provide basic measurements, data, or components to a system or process; a catalyst;
(2) For the OOI network, defined as providing the measurement, data, and/or services to allow the end-user to conduct scientific research into one of more OOI high priority science topics.

Encryption
The translation of data into a secret code, unreadable without special knowledge.

Environmental Consumable
Natural resources or properties such as sound, light, terrain, chemicals, etc. represent those consumables that the observatory sensors will attempt to use. Those consumables may or may not be renewable.

Erbium Doped Fiber Amplifier
Sometimes called an optical amplifier, an EDFA is a section of optical fiber that is doped with rare earth elements and pumped with a diode laser that boosts the intensity of an optical signal. This allows optical transmissions to be amplified without any electronic conversions.

ESONET-EMSO Service Class ROV
A ROV that has the following characteristics:
1) is rated for a depth of at least 3,500 meters;
2) has the ability to deploy extension cables up to 0.70 inches in diameter and 5 km in length;
3) has the ability to deploy, recover and manoeuvre loads weighing up to 4000 lbs in water;
4) has at least two force feedback manipulator arms that are compatible with the Wet-Mateable Connectors;
5) has real-time video transmission and communications capabilities, in particular to verify proper function of the system with the Operations Centre immediately following its installation;
6) has an ultra-short baseline system for efficient navigation;
7) has the ability to be deployed from a UNOLS Global Class Research Vessel.

Estimate
The calculated approximation or indication of the value of an unknown quantity based on observed sample data.

Ethernet
A family of frame-based computer networking technologies for local area networks (LANs) standardized as IEEE 802.3.

Exchange Point
A topic of conversation within an exchange. Producers and consumers of information messages interact in a publish-subscribe way through an exchange point. Each exchange point is represented as message queue on a message broker.

Exchange Space
A collection of exchange points within an exchange, often driven by topic or organizational structure.

Expandable
Capable of increasing in scope, number of components, or reach (physical extent).

Experiment The combination of one or more users, tools, and instruments used in concert to (in)validate a scientific hypothesis. An experiment will produce data products and metadata describing it. An experiment can be interactive (requiring the presence of a user to drive it and make decisions to alter its course) or autonomous (pre-programmed).

Extensible
Capable of expanding in scope, effect or meaning (logical concept) Ex: adding features.

Extensible Markup Language (XML)
A cross-platform, extensible, and text-based standard for representing data. It is a key technology in the development of web services.

Extension Cable
Includes Connectors - Cable - CTA. Synonymous with Extension Cable Assembly

External Aggression
Potentially damaging force(s) which may result from human activities (e.g. trawling, drilling, anchoring), but which are not caused by normal system operation.

External Stakeholder
An interested party that is not normally a member of the observing system or cyberinfrastructure; often refers to governmental or organizational entities that will benefit from or be affected by outputs of the system.

Federation
The process of transparently integrating multiple, autonomous, distributed elements of the cyberinfrastructure.

Firewall
A network security system used to monitor and restrict traffic between two networks.

Flux
The rate at which momentum, energy, or mass passes over a distance or through an interface (e.g., airsea, mixed layer-deep ocean, sediment-water).

Format
The structure of something, e.g., a data product or data stream.

Galvanic
Isolation Isolating functional sections of an electric system so that there is no electrical path for current to directly flow from one section to the next.

Glider
An autonomous underwater vehicle that propels itself through changes in buoyancy.

IEEE 802.3 10/100Base-T
Standard 10 Mbits/sec and 100 Mbits/sec Ethernet over 2 pair of copper conductors.

IEEE 802.3ab 1 GigE
Standard for gigabit (1000 Mbits/sec, 125 MBytes/s) Ethernet over wiring that requires four pairs of copper wires.

Infrastructure
a) Technical structure that supports observations. In regard to ocean observatories infrastructure encompasses the platforms, supporting structures, cables, power supply, communication components and also the software components that are needed for operating the observing system. In some cases instruments and sensors are seen as part of the infrastructure in others not.
b) A set of research equipments allowing to host several types of experiments.

Infrastructure-Instrument Port (ii-port)
Physical interface between instrument link and infrastructure. SIIM would be an example or instance of an ii-port that includes communications, time management, and power management capabilities.

Instrument
A device that contains one or more sensors and a method for converting the information from the sensor into a transmittable and storable form.

Instrument Life Cycle
The suite of events that define the life of an instrument from the expression of its mandate (via the requirements); its purchase or fabrication; its test, integration and deployment; its operational life, including maintenance activities; through to its decommissioning and removal.

Instrument Link
Cable or other (acoustic) connection between instrument and infrastructure.

Interactive Visualization
A visualization that allows human control of some aspect of the visual representation of information, and in which changes made by the human are incorporated into the visualization in a timely manner. In general, interactive visualization is considered a soft real-time task. (http://en.wikipedia.org/wiki/Interactive_visualization)

Interface Requirements (IR)
Requirements which describe interactions across a boundary, e.g., between IOs, between an IO and an external entity, or between ESONET-EMSO and an external entity.

JBox (Junction Box)
Physical instance of a node, incorporates one or more Instrument Interface (II) ports (to be discussed).

Key Performance Parameter
Key Performance Parameters (KPPs) are the performance characteristics that must be achieved by the design solution. They are the minimum set of measurable and testable attributes or characteristics considered most essential for the system's capability. They flow from the operational requirements and the resulting derived measures of effectiveness (MOEs). They can be identified by the user, the decision authority, or the operational tester.

Lights Out Management
In computing, involves the use of a dedicated management channel for device maintenance. It allows a system administrator to monitor and manage servers and other network equipment by remote control regardless of whether the machine is powered on.

Low Power Junction Box (LPJBox)
A node providing regulated DC power and 100BaseT or serial interfaces to Instruments through and Instrument Interface (II) ports.

Low Voltage Node (LVNode)
A node distributing 375 VDC power and 1 GigE datalinks to other LVNodes or MPJBoxes and 48 VDC power and 100/100 Mbps datalinks to LPJBoxes.

Maintain
Keep an entity in an operational state; includes the following sub-activities: configure, calibrate, monitor, clean and refurbish.

Maintainability
Probability that a specified software or hardware item will be retained in, or restored to, a given condition in a given period of time, when maintenance is performed in accordance with prescribed procedures and resource.

Manage
Administer, maintain, and regulate, as in resources under one's control.

Marine Node
A node in the marine environment.

Marine Repair
Repair required seaward of the beach manhole.

Materials Resource Planning
Materials Resource Planning (MRP) is a system for effectively managing material requirements, inventory, and costs in a manufacturing process.

Measurement
The sampling and determination of mass, volume, quantity, composition or other property of an object or event.

Medium Power Junction Box (MPJBox)
A node providing regulated DC power and 100BaseT or serial interfaces to Instruments through Instrument Interface (II) ports. Medium Power Junction Boxes have expansion capabilities to connect other MPJBoxes.

Medium Voltage Converter
A DC/DC converter that takes a voltage of order 10 kV at its input and delivers a reduced voltage of a few hundred volts as output.

Message
A unit of communication between agents.

Message Broker
Software system installation that enables asynchronous message passing communication between distributed processes. Provides queues as end-points for message providers and consumers and performs routing of messages from producers to consumers, potentially across several queues.

Metadata
The set of attributes and their values that characterize a particular resource.

Midwater platform
A component of the cabled hybrid profiler mooring. The midwater platform is a subsurface float located 150-200 m beneath the ocean surface. The RSN midwater platform is connected by conducting cable to the low voltage junction box. The midwater platform will provide a resting position for the winched profiler. It will also serve as the upper float supporting the deep profiler. The platform will also support fixed sensors.

Mission
An operational task, defined by a mission plan, during which the vehicle is active and sampling. A mission may be bounded by launch and recovery, docking events for AUVs, or quiescent mode for gliders.

Mission file
Command files used by AUV's/gliders to allow new waypoints to be specified along with revised sensor sampling strategies, revised speed, etc.

Modem, acoustic
An electronic device which transmits data bidirectionally between two subsystems using modulated sound waves.

Modem, inductive
An electronic device which transmits data bidirectionally between two subsystems using an inductive loop. In oceanography the loop typically consists of a plastic-jacketed wire rope (to which sensors employing inductive modems are mounted) closed by a return path through sea water.

Module
Functional component in a distributed system. The unit of granularity in an operational distributed system architecture. Modules can be hierarchically decomposed if necessary.

Molded chain
Mooring chain with spiral-wrapped conductors (and optionally) optical fibres encased in urethane.

Monitor
Observe and check the progress or quality of something over a period of time.

Mooring
Physical platform, containing a buoyant element constrained to a geographic location by an anchoring device.

Mooring, Flanking
An oceanographic mooring located at a horizontal distance from a main mooring to allow the resolution of mesoscale structure, typically at a distance of 50 to 100 kilometres.

Mooring, Hybrid Profiling
A mooring that enables measurements over nearly the entire water column using two, potentially different, types of profilers. One profiler covers the range between a midwater float and the surface and another covers the range between the midwater float towards the bottom.

Mooring, Sub-surface
Buoyant element is below the surface, no surface expression.

Mooring, Surface Permanent surface expression, Buoyant element is at the surface.
Multi-function Node (to be renamed)
A base component used by CGSN moorings. The MFN serves as the mooring anchor, terminates the bottom of the mooring and provides data and power ports for benthic instrumentation.

Network
(1) A physical or virtual link allowing the instantiation of peer-to-peer communication between computing entities in the system;
(2) A system of interconnected components.

Network Management System
Supplier furnished hardware/software that manages each EMS component.

Node
(1) Entity that aggregates ports and/or distributes power, time, communications; can be chained. Examples: buoy controller, DCL, glider, profiler, J-Box.;
(2) An abstract unit used to build linked architectural structures. Each node contains activities and possibly links to other nodes.

Observatory
An infrastructure that is able to accommodate sensors and instruments either permanently installed or by demand. Observatories are able to provide certain services like power supply and communication links for all connected instruments.
Example: Global, Regional,

Observatory Management System
A software application with interfaces to all of the Primary and Secondary Infrastructure Element Management Systems (EMS) to provide a single point of interface for command and control of the regional infrastructure for the CyberInfrastructure and for the Regional Operations Centre.

Ocean Ground Bed
The Primary Infrastructure "ground anode" located at the Cable Shore Station or on the ocean floor near the ocean terminus of the bore pipe. The return current from all Primary Nodes terminated at the Cable Shore Station will be retuned to "earth" at this location.

Operate
(1) Correctly performing designed functionality;
(2) To cause to function.

Operational Period
The period of time less than or equal to the deployment interval during which the vehicle is actively operating (i.e. executing missions). The operational period may not be continuous (e.g., for AUVs this does not include times the vehicle is docked).

Operational Unit
Instantiation of a deployable unit in an execution environment after all initialization and contextualization activities are finished and the unit exposes its services.

Operations Centre
An area containing computer consoles with network connections to the CI control/management system and the Observatory Management System used to monitor, troubleshoot and maintain the whole of the infrastructure.
Peer-To-Peer Communication
The direct exchange of information between two entities using a communication network following a well-defined protocol that can include authentication and authorization.

Performance Parameter
A measure of behavior or effectiveness of a system; can be used to guide and control progressive development.

Persist
The process of storing information resources throughout the ESONET observatory lifecycle.

Physical location
Measurements at the same physical location not only have to be geographically close but also within close proximity on a platform, i.e., they may be as close as a few centimetres (as determined by the specific instruments).

Platform
Collection of nodes, sensors, instruments together with necessary controllers physically connected together, with a known external geometry. Example: Mooring, Surface Mooring, Profiler, AUV, Glider.

Platform controller
The electronic hardware (deep and shallow moorings, gliders and AUV's) that is responsible for autonomously or interactively conducting the operation of these platforms.

Plume
A buoyantly-rising volume of water that has anomalous chemical and physical properties with respect to background ocean water.

Point of Presence (POP)
Aggregation point for resources on a network; Example: CyberPOP.

Port
An individually identified physical connection point for a sensor, instrument, node.

Power Feed Equipment
The electronic subsystem, normally located in a shore station, that converts mains power to high voltage DC to supply a submarine cable system.

Precision
The closeness of agreement between independent measurements obtained under stipulated conditions of repeatability, generally expressed as a standard deviation (or standard uncertainty) of measurement results (Taylor and Kuyatt, 1994). Used as a measure of the stability of an instrument/sensor and its capability of producing the same measurement over and over again for the same input signal.

Primary Node
An underwater unit that receives high-voltage DC power and multi Gbps communication links from a Cable Shore Station and provides regulated low voltage power and Gbps communication to a set of "Secondary Infrastructure" science instruments.

Privilege
The necessary authorization requirements that give a user a right to perform a particular role.

Process
Designated sequence of operations or events, possibly taking up time, computation power, or other resources, that produces some outcome; may be identified by the changes it creates in the properties of one or more objects under its influence.

Process Definition
Source or executable format of a user-provided process to analyze, transform or otherwise manipulate resources, such as data and data products, and to produce output in various forms to the data distribution network, such as derived data products, detected events, etc. A process definition can be scheduled and instantiated into a process.

Processing Level
A rating given to a data product indicating the level of sophistication of the data set.
DATA PRODUCT LEVEL. Data levels 1 through 4 as designated in the Product Type and Processing Level Definitions document. Source: SPSO.
Raw Data - Data in their original packets, as received from the observer, unprocessed by EDOS.
Level 0. Raw instrument data at original resolution, time ordered, with duplicate packets removed.
Level 1A. Reconstructed unprocessed instrument data at full resolution, time referenced, and annotated with ancillary information, including radiometric and geometric calibration coefficients and georeferencing parameters (i.e., platform ephemeris) computed and appended, but not applied to Level 0 data.
Level 1B. Radiometrically corrected and geolocated Level 1A data that have been processed to sensor units.
Level 2. Derived geophysical parameters at the same resolution and location as the Level 1 data.
Level 3. Geophysical parameters that have been spatially and/or temporally re-sampled (i.e., derived from Level 1 or Level 2 data).
Level 4. Model output and/or results of lower level data that are not directly derived by the instruments.

Profile
One vertical transit by the profiler between its end points (i.e., a round trip is two profiles)

Profiler
A platform (profiler body) containing a suite of instruments and sensors that are raised and lowered through the water column on a regular basis.

Protocol
A well-defined exchange of tokens (words, packets, etc.) allowing two or more peers to communicate.

Publish
Make something generally known; present something in a format for others to assimilate.

Publish/Subscribe
An asynchronous messaging paradigm where senders (publishers) of messages are not programmed to send their messages to specific receivers (subscribers). Instead, published messages are characterized into classes without knowledge of what (if any) subscribers there may be. Subscribers express interest in one or more classes, and only receive messages that are of interest, without knowledge of what (if any) publishers there are. This decoupling of publishers and subscribers provides greater scalability and a more dynamic network topology.

Quality Assurance
A planned and systematic means for assuring management that defined standards, practices, procedures, and methods of the process have been followed in the performance of a job.

Quality Control
The operational steps performed to enforce quality of a particular product.

Quantification
The analysis of measurements to describe a change in properties expressed as a numeric value.

Queue
Separates producers and consumers of messages in a message passing system; provides a virtual channel with quality of service guarantees. Sink for messages provided by producers and sources of messages forwarded to consumers. Guarantees message ordering, and exactly once message delivery semantics in a transactional context.

Range
The distance a vehicle can travel relative to the water without recharging. Range is dependent on mission parameters and environmental conditions.

Raw Data
The unmodified set of information provided to the CI by an instrument or the marine infrastructure. Synonymous with observed data. Raw data might have already undergone transformation, filtering and correction by the instrument provider. Any such modifications are outside of the control of the CI. The CI will make sure that any raw data it receives from instruments and marine infrastructure will be persisted in their unmodified form.

React/respond
Perform a pre-planned action once an event has been detected. The response can be a simple warning message sent to the owner of the event detection or a more elaborate process that involves the intervention or mobilization of various actors who will further observe and confirm the detected phenomenon.
Real Property
Land, including land improvements, structures and appurtenances thereto, but excluding movable machinery and equipment.

Recipient
The receiver of information.

Recover
To disconnect and retrieve a deployed component from the system.

Refurbish
Bring a device to its nominal state and confirm it is ready for re-deployment in operations.

Register
Provide information about an entity or resource to a service that is responsible for logging and publishing it.

Registrar
Operational entity responsible for ingesting and organizing information about resources.

Registry
An official list, catalogue, or source of information about resources.

Release
(1) As a verb, it indicates that an entity no longer wishes to use another entity or a resource (the inverse of acquire);
(2) As a noun, it refers to the distribution of an initial or upgraded version of a system, subsystem, or component (which can be hardware, software, or a combination of both).

Reliability
Probability that a specified software or hardware item performs a given task successfully under specified conditions for a specified length of time or number of cycles.

Remotely-Operated Vehicle
A remotely operated vehicle (ROV) is a tethered underwater robot. An ROV may sometimes be called a remotely operated underwater vehicle to distinguish it from remote control vehicles operating on land or in the air. ROVs are unoccupied, highly maneuverable and operated by a person at a distance. They are linked to the power and communications source by a tether (sometimes referred to as an umbilical cable), a group of cables that carry electrical power, video and data signals back and forth between the operator and the vehicle.

Repository
A facility providing permanent storage, preservation, disposition, and distribution of information about resources, particularly data and their associated metadata.

Resolution (pertaining to instruments/sensors)
The smallest amount of input signal change that the instrument/sensor can detect reliably.

Resolution (pertaining to spatial or temporal characterization requirements)
The capability to distinguish (i.e., resolve) physical, chemical, or biological features within a specified spatial or temporal interval.

Resource Reference
A link, pointer or bookmark that will indicate the location of a resource of interest, without having to copy it.

Role
Function to be fulfilled by a particular user. Roles allow granting specific functionality to a certain user or group of users.

Sampling
(1) Physically extract a given volume of the milieu (with bottle, core, pumping,…) in the laboratory or in an *in situ* analyser.
(2) Get a measurement from the milieu.

Sampling protocol
The set of rules used to describe scientific measurement, physical sampling and reporting.

Scale
(1) System of grouping or classifying in a series of steps or degrees according to a standard of relative size;
(2) According to a hierarchy.

Seafloor
The interface between the bottom of the water column and the upper few meters of solid surface beneath it. The seafloor is sampled by instruments on benthic packages and seafloor packages.

Seawater Ground
The return current ground “cathode” for a Primary Node.

Seismonument
A cement housing that hosts a short-period seismometer that provides coupling to the seafloor.

Semantic Metadata
Information characterizing the meaning of an entity (often a data set).

Sensor
A device that will convert a physical phenomenon into an electrical signal that can in turn be digitised through the use of an analog to digital converter. A sensor is normally housed in an instrument. Data coming from sensors is normally raw and needs to be calibrated.

Service
Agreement The legally binding document that describes the service offering to the service user.

Service Agreement Proposal
Request to use a resource together with a proposal of conditions, constraints and parameter ranges. Part of the negotiation process. For instance, the request to use a specific sensor in a certain time interval once an hour for 1 minute, along with its associated bandwidth and impact on the environment.

Service Network
A group of interdependent services covering a specific topic (such as Sensing and Acquisition) that will be implemented as a subsystem.

Serviceable Design Life
The period of time commencing from the date of the Final Acceptance that the System is designed to operate in conformance with the Specifications with proper maintenance.

Shallow Profiler
A profiler used to profile the water column from 150-200 m below the sea-surface to just below the seasurface.

Shore Station
Physical structure housing the marine infrastructure termination and support equipment that interfaces to terrestrial infrastructure (internet and power).

Site
Geographic domain of interest within an array occupied by a collection of physical instances of nodes and/or platforms together with their instruments and sensors. Examples: Hydrate Ridge, Pioneer Central Surface Mooring, Mobile Assets operating within an Array.

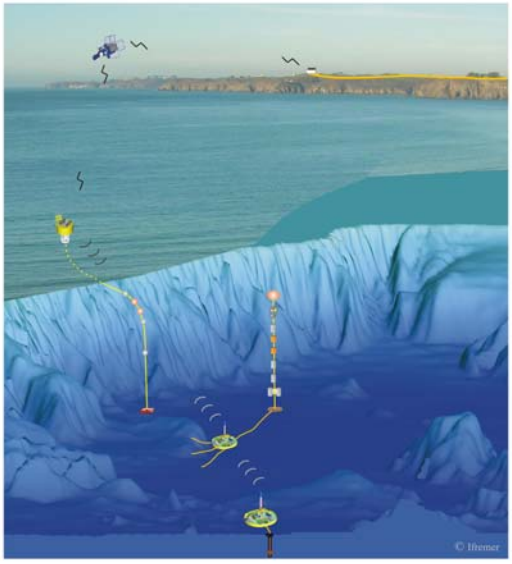
Software Application
A computer program that performs the transformation of an input into an output.

Software Component Package
Entity that wraps and describes a software component. Packages can depend on other packages. A package has a unique name and a version. Packages can be stored in a repository.

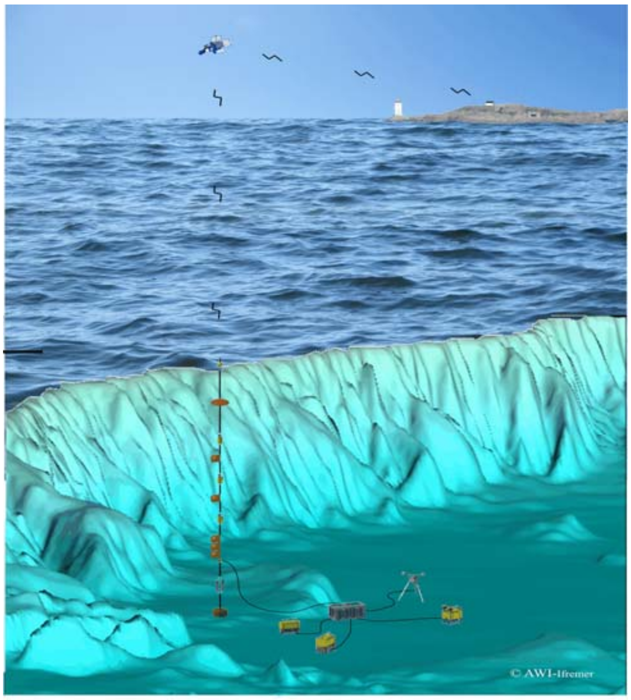
Spot measurement
A single measurement in time for which an instrument samples only for the time it takes to record the measurement. This is different from instruments that need to average data for some time period before acquiring a valid measurement. An example of a spot measurement is a water temperature measurement in which the temperature probe is always immersed.

Stand alone observatory
Non cabled infrastructure

Stand alone acoustic observatory (SAAO)
Observatory in which the observation data are typically transmitted from the seabed to the users thanks to an acoustic modem. The receiver can be placed either on a ship for occasional transmissions or on relay-buoy towards a permanent data server on shore.
The main limit of such architectures lies in the modest amount of data they can transmit between two maintenance interventions on the seabed.



Stand alone winch observatory (SAWO)
In a SAWO design, a winch allows a float equipped with satellite transmission system to reach the sea surface to transmit data. This float is immersed when the sea is ice covered or too rough.



State
A property of a resource that persists over time.

Steady-State
Continuous demonstrative behavior of the system within the limits or range of the requirements.

Storage Resource
Physical or virtual unit for arbitrary data storage and retrieval. Can be a network file system, a distributed database, or a read-only data-warehouse interface. Operational units can make use of many storage resources.

Stretch hose
A mooring element comprised of high strength hose, typically encasing spiral wrapped conductors and (optionally) optical fibres. Can stretch upwards of 200% of original length while maintaining electrical and optical continuity.

Submersible
Short range non-military submarine.

Subscribe
Arrange for access to an on-line service; request direct provision of a particular type of information, for example a particular stream of data.

Subseafloor
First layer of the earth crust or sediment situated under the sea. It is applied to depth reachable without specialized drilling vessel.

Subsystem
Implementation and integration unit for all services of a services network together with their data models and user interfaces.

Support
(1) Provide basic physical infrastructure to which things can be added or appended without replacement of the infrastructure;
(2) Enable to function or act, does not specifically inhibit or exclude future capability or modification;
(3) Provide assistance to people or systems that require it.

Survive
Experience an event without major loss of hardware. System may experience loss of functionality requiring repair to return to normal mode functionality. Also see "operate" and "sustain". An example would be Solar panels blown out in a 50 year storm, the mooring remains on station and continues to operate on battery power with reduced sampling and telemetry.

Sustain
Experience an event (environmental extreme or condition) without permanent loss of normal mode functionality. System may experience reduction of functionality during event. Also see "operate" and "survive". Example: Profiler parks on bottom during 25 year storm.

System
A collection of interacting components designed to satisfy a set of requirements.

System Design Life
The period of time commencing from the date of the Final Acceptance that the System is designed to operate in conformance with the Specifications without the need to replace key elements.

Technical Environment
Technologies, interfaces and frameworks required to deploy and instantiate a node in the network. Part of the technical environment is the specification of how to interact with operational units of nodes for monitoring and management purposes.

Technical Performance Measure
Technical Performance Measure (TPM) is a formal method of measuring the technical performance of the system design that is implemented and used during the entire course of the program. TPM enables early assessment of technical risks associated with meeting system requirements. The TPM methodology includes four steps:
(1) Identification of requirement to measure
(2) Definition of TPM parameters
(3) Selection of critical parameters
(4) Monitor and assessment of parameter values.

Test Procedure
The detailed instructions for the setup, execution, and evaluation of results for a given verification procedure.

Threshold
As used in TPM, the limiting acceptable value of a technical parameter; usually a contractual performance requirement.

Tilt
A measurement of inflation, deflation or faulting as recorded by changes in the angle of topographic relief as measured in degrees.

Time Stamping
Process of associating time with measurement.

Tolerance Band
Management alert limits placed each side of the planned profile to indicate the envelope or degree of variation allowed. The tolerance band represents the projected level of estimating error. Used in TPM.

Transducer
Collective term for sensors and actuators.

Usability
Usability measures the quality of a user's experience when interacting with a product or systemwhether a Web site, a software application, mobile technology, or any user-operated device. In general, it refers to how well users can learn and use a product to achieve their goals and how satisfied they are with that process (US HHS 2006; http://www.usability.gov/).

Use
Employ an entity or resource for some purpose.

User
A user is an agent (human or software) that will consume and optionally act upon the infrastructure. A user belongs to a user class.

User Class
Defines the role of a user from which privileges of the user can be derived.

User Identity The collective set of user credentials by which a user can be identified or authorized.

Validation
Confirms that the product, as defined, will fulfill its intended use.

Variation
As used in TPM, the difference between the planned value of the technical parameter and the achievement-to-date value derived from analysis, test, or demonstration.

VDSL2
Very-high-speed digital subscriber line 2 (VDSL2 - ITU-T G.993.2) is an access technology that exploits the existing infrastructure of copper wires (twisted pairs).

Verification
Confirms that work products properly reflect the requirements specified for them. In other words, verification ensures that “you built it right.”

Virtual Environment
An environment that is partially or totally based on computer generated sensory inputs. (http://www.fas.org/spp/military/docops/usaf/2020/app-v.htm).

Virtual Local Area Network A group of hosts (i.e., network ports) that communicate as if they

Virtual Observatory
The network of inter-operable representations of observatories.

Virtual Participation
Participation in an online rather than onsite venue.

Visualization
The depiction of information in a graphical form to aid in its understanding. May include multiple sources or types of information, geographic (2-D), geospatial (3-D), temporal, or geospatiotemporal (4-D) representations of information.

Waypoints
Specific locations used to define the path of a vehicle. Waypoints are typically defined by latitude-longitude pairs or range and angle offsets from another waypoint, and may include depth.

Web Client
An application that can use HTTP (and related protocols) to receive documents written in HTML (and potentially extended languages) from a web server and present those documents to a user.

Web Server
A networked computer and software that can receive HTTP (and related protocols) requests and return HTML documents.

Web Tools
Tools that reside on the internet and allow OOI education providers and users to manipulate OOI data, models and other resources.

Web-based
Information and/or an application made available via the World Wide Web and requiring a web-browser for access (see http://techcollab.csumb.edu/techsheet2.1/glossary.html).

Well-coupled
To obtain high resolution seismic measurements, sensors are either buried in sediments in a caisson (broadband measurements) filled with silica beads or placed in drill holes in basaltic substrate or in seismonuments. This allows direct contact of the sensor to the seafloor (coupling) and an acoustically quiet environment in terms of anthropogenic “noise” and that from currents.

Wet-mateable connector
Electrical and/or fiber-optic connector that can be mate/de-mated under water, at depth, by a ROV.

Wire-Following Profiler
A profiler that ascends and descends along a mooring wire segment.

Workflow
Sequence of work steps in a complex structure. Workflows can be pre-programmed or static, can have dynamic decision points, or can be composed dynamically.

Workstation
Computer to run Element or Observatory Management System software.