Report on Technical Session on interoperability, GEOSS and underwater acoustic networks

This session took place on Thursday 6th of September 2007, Hotel Rey Don Jaime, CastelldeFels Platja, Barcelona, Spain.

Session co-chairs, and authors of this report:

Eric Delory, dBscale, Spain
e-mail: eric.delory@dbscale.com
Christoph Waldmann, Uni. of Bremen/MARUM, Germany
e-mail: waldmann@marum.de

Participants:

Eric Delory <eric.delory@dbscale.com>,
Christoph Waldmann <waldmann@marum.de>,
Kate E. Larkin <kel1@noc.soton.ac.uk>,
Anne Holford <a.holford@abdn.ac.uk>,
Anne Deschamps <deschamps@geoazur.unice.fr>,
Juanjo Danobeitia <jjdanobeitia@cmima.csic.es>,
Joaquin Del Rio <joaquin.del.rio@upc.edu>,
Antoni Bermudez <ugbo-acu@utm.csic.es>,
Antoni Manuel <antoni.manuel@upc.edu>,
Jean Francois Rolin <Jean.Francois.Rolin@ifremer.fr>,
Gioirgio Riccobene <riccobene@lns.infn.it>,
Per Hall <perhall@chem.gu.se>,
Thomas Buettgenbach <tb@send.de>,
Laura Beranzoli <beranzoli@ingv.it>

SUMMARY

This session addressed data and technology interoperability and the GEOSS compliance of ESONET. There was unfortunately no speaker present to address the underwater acoustic networks topic, hence the time allocated for this two hour session was entirely dedicated to interoperability and some GEOSS-compliance concepts.

The session started with Eric Delory's presentation on interoperability issues in ESONET and the GEOSS (Global Earth Obsevation System of Sytems) .
Data and technology interoperability issues in ESONET, with a focus on standardization, were at the center of the diccussion. The GEOSS component registration process and the currently running efforts towards global and cross-disciplinary interoperability were addressed.

Eric's talk addressed the following topics:

- Interoperability initiatives
- ESONET statement and WP2 a) work items
- Where we are: inventory of standards and interoperability initiatives
- sketch of the application of standards to a

generic sensor system
• Where we are going: existing systems, map necessities and drawing recommendations

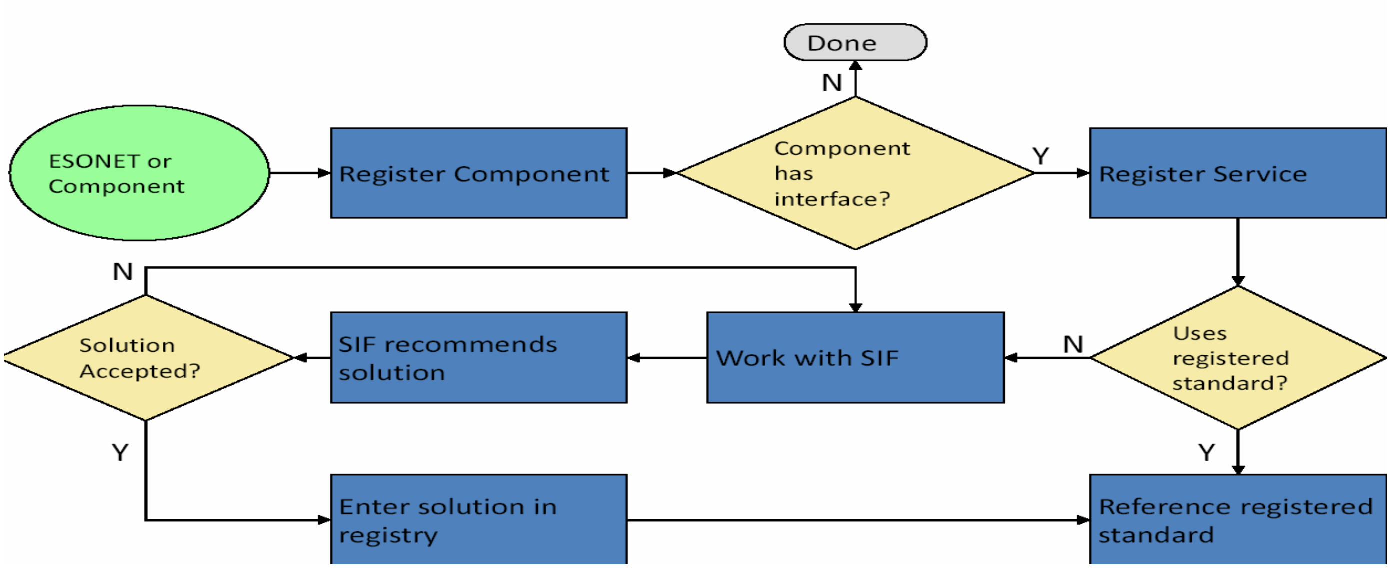
INTRODUCTION

In view of the following Esonet's statement: <<The ESONET federation will oversee standards, data management and co-ordinate observatory deployment. Data will be interfaced to national and international data centres.>> and the objectives of WP1 on data management and WP2 on interoperability and standardisation aspects of deep sea observatories, the technical aspects of what should be standardised and what can be standardised to reach interoperability from the sensor interface to data handling are just one part of a greater and more complex issue, that is the questioning of the engineering processes and culture that led to the requirements, the planning, the design, construction, maintenance and data management at every node of ESONET. In order to make things simple and create ground for useful questions and answers, we steered the discussion at the technical layer of the data acquisition chain.
The first step of the interoperability effort is to gather technical data from all observatories and start with finding common needs and solutions at the sensor interface and the data management layer.

Status of WP2 interoperability task was addressed in Eric's presentation. Eric Delory and Antoni Manuel are working on the following aspects:
• Identification and mapping of existing standards
– Sensing systems
– Communication
– Data management
• Identification of relevant interoperability initiatives (INSPIRE, GMES, IOOS, GEOSS) and actions (VENUS/NEPTUNE DMAS)
    • INSPIRE: Infrastructure for Spatial Information in Europe
    • GMES: Global monitoring for Environment and Security
    • EuroGOOS, IOOS Data Management and Communications
    • IEEE Committee on Earth Observations
    • GEOSS Global Earth Observation System of Systems

GEOSS COMPONENT REGISTRATION

A diagram (Siri Jodha Singh Khalsa, Uni of Colorado) of the GEOSS component registration process was presented:



As underlined in the diagram, the above component standards registration in GEOSS is mandatory so that the Standards Interoperability Forum (SIF) can identify missing bridges and advise the component owner on possible standards to be implemented in order to make the component GEOSS compliant (i.e. interoperable at global scale). This diagram is oriented to Data Managers and Information System Architects, but the concept can be extrapolated to the process of standardizing at other layers in ESONET. As GEOSS is a running effort, it is probably good practice in ESONET to learn from the processes being put in place by the GEO in order to reach the double objective of making ESONET interoperable and be GEOSS compliant.

ESONET WP2: Interoperability and standardization

As a consequence, ESONET WP2, in a parallel effort with the GEO Architeture and Data Committee and the IEEE Committee on Earth Observation Standards Working Group's standards registry applicable to earth observation data, is creating a similar type of registry for standards applicable to sensor interfaces, or more broaldy speaking, sensing systems.
On top of the registry we defined the following functional groups:

Sensing systems functional groups

– Networks topologies
– Power
– Data Storage/Memory
– Clock
– Interface
– System Engineering
– Languages
– Cables
– Connectors
– Signal Modulation
– Other features

These groups or categories are now being populated as follows:

(...)

Data Storage/Memory	Standards defining hardware, form factors, memory access protocols and buses of interest applicable underwater sensor systems.	Bus/protocol: I2C, SPI, DMA Proprietary EEPROM: SD, CompactFlash, USB Drives: SCSI, IDE, ATA, Fibre Channel
Clock	Standards defining technical specifications and protocols to provide clock information and synchronise underwater sensors and sensor packages	LXI, IEEE 1588-2002, Network Time Protocol
Interface	Standards defining hardware interfaces, of interest to underwater sensor and sensor packages, and general Science Instrument Interface Modules (SIIM)	IEEE 1451, IEEE 488, NMEA 0183, LXI TransducerML, USB, Firewire, Ethernet
System Engineering	Standards defining complex systems engineering processes, architectures, other system engineering concepts and modeling	UML, SysML, ISO 10303-AP233, ANSI/GEIA EIA-632, EIA/IS 731.1, ECSS-E-10 (part 1B, 6A, 7A), ISO/IEC 15288: 2002, ISO/IEC 19760:2003, ISO/IEC 15504: 2004, ANSI/AIAA G-043-1992,

(...)

For communication between systems specifically, it was decided to create a side register, which is being developped according to the following criteria or functional groups:

Within the same system: - Communications between electronic circuits.
- •Parallel Bus communications : Backplane
- •Serial Bus communications (same board)

- Communication between different systems
- •Parallel Communication
- •Serial Communication
- •Serial Multimedia Communications
- •Home Automation communications
- •Telephone Communications
- •Wireless Communications
- •Radio Frequency Communications. Free Band
- •Light Communications. IRDA
- •Acoustic communications
- •Optical fiber Communications

These groups or categories are now being populated as follows:

1	Parallel Communication between electronic circuits Backplane	Local bus using backplane (printed circuit bus lines). Rack size 3U, each U: , 160 x (Eurocard). Connectors DIN 41612.	Microprocessors local bus Eurocard. VME (Versa Module Eurocard). IEEE 1014. Future Bus IEEE 896. PC104 Bus. VME Bus extensions for instrumentation (VXI). (PCI Extensions for Instrumentation)PXI ISA Bus (Industry Standard Architecture). PCI Bus (Peripheral Component Interconnect). RapidIO Bus. AGP Bus (Accelerated) IDE (Integrated Drive Electronics). ATA Bus (Advanced Technology Attachment*)*. ATAPI Bus (Advanced Technology Attachment Packet Interface) PPI Bus(Parallel Peripheral Interface)
2	Communications between electronic circuits. Serial Bus between electronic circuits	Communication between microprocessor peripheral using the minimum number of lines.	Microwire SPI™ (Serial Peripheral Interface), QSPI I2C™ (Inter Integrated Circuit Bus) SMBus (System Management Bus) and ACCESS.bus SCI (Serial Communication Interface) UART (Universal Asynchronous Receiver Transmitter)
3	Communication between different systems: Parallel		IEEE1284 Centronics, Parallel Bus SPP ( ), EPP (Enhanced), ECP (Extended).

(etc.)

SMART SENSORS - SENSOR INTEROPERABILITY

The IEEE1451 standards suite, along with SensorML and TransducerML were mentioned as promising candidates to be implemented at sensor level or data server layer as metadata.
See the IEEE (ieee1451.nist.gov/) and the OGC websites for further information on and use cases of these standards.

DATA MANAGEMENT

As mentioned in the above, the GEO and the ICEO SWG are already developping a registry of standards, that ESONET will keep track of in its effort to make each node or the resulting ESONET data holding central node interoperable.
The recent creation of a GEOSS Standards Registry table and a taxonomy of standards was addressed. Here are the funcitonal groups that define the main registry categories:

– Metadata (content)
– Data Format
– Catalog/Registry Service
– Data Access
– Streaming Protocols
– Semantics
– Portrayal and Display Service
– Data Transformation Services
– Quality/Assurance, Quality Control
– Schema
– Modeling, Simulation, or Analytic Processing Service
– Archival
– Communications and Telecommunications

– Data Acquisition
– Engineering Process
– Development Environments and Software Languages
– Technical Documentation

For further details regarding the taxonomy, point of contact is Steve Holt from the ICEO SWG, whereas the GEOSS Standards Registry portal is accessible at http://seabass.ieee.org .
For further details on data management in ESONET, contact ESONET NoE WP1 leader.

DISCUSSION

After Eric's talk took place a 1 hour discussion on the following specific topics:

- Time synchronization
- Sensor Calibration and encoding
- TEDS and Smart sensors
- Identification of standardisation needs & Type of standards to be used
- Metadata & Marine XML
- Seismic data file formats
- Surveying ESONET nodes
- Where should we start, what are the priorities ?

As the above list suggests, the discussion were utterly technical and applied to current observatories, keeping in mind that the standardisation is not going to imply major changes but help make interoperability within ESONET a progressive initiative. Standardisation of sensor interfaces, communication and data were luckily not perceived as an extra burden, and the general feeling is that the level of standardisation, the needs and the benefits must be clearly identified. The session therefore turned out to be technical and field-specific:

- Time synchronization: The IEEE 1588 standard was created to respond to the sub-microsecond synchronization needs over long distances (50ns until 400m, and over 400m using boundary clocks) and is the only standard available at this time that responds to both needs. Comments were made on the proper technical implementation of this standard and its actual efficiency in real-world applications. Some participants promoted its use and one negative experience for over 40km distances was mentioned. On highly distributed systems the standard may give problems. Participants to give feedback on their future experience. Recommending its use was therefore premature, especially considering the standard is not yet broadly used, but rather raised the need for a demonstration of efficiency in a test bed or observatory. Nevertheless, no-one mentioned an alternative and it is likely that the standard must be implemented still with some level of uncertainty or prior test-bed validation for known situations.

- Sensor calibration and encoding: The problem of nutrient sensors was mentioned as an example of the lack of standardisation process for these types of sensors. The case of a seismometer was addressed too, where participants agreed on the interest of applying standards to calibration and finding a way to encode the calibration curve either within the sensor interface or the metadata. IEEE 1451, sensorML and TransducerML were mentioned as promising candidates for the encoding. As these standards are rather young, it is advised that the ESONET community take note of their existence and potential at the time of refurbishing scientific packages or wrapping up the data. Though there was no objection among participants that the process of calibration should follow standard procedures, a strict recommendation of calibration curves encoding would be highly desirable but at the present time can only be recommended where specific needs are identified. On already deployed systems, the calibration curve could be software encoded in metadata following broadly used data format and metadata standards.

- TEDS and Smart sensors: Transducer Electronic Data Sheet, less known as IEEE 1451.4 sensors, allows sensors to be detected, identified and configured remotely. Sensor position, data and calibration data and measuring range logging is made easier. Advertised as plug&play by National Instruments and endorsed by other sensor manufactures such as BK and Honeywell, TEDS sensors are probably the short and medium term future of what are refered to as "smart sensors". There seemed to be agreement on this standard and no alternative was mentioned, though there should be further discussions on this important aspect. Unfortunately this discussion could not take place in the allocated time.

- Identification of standardisation needs & type of standards: A survey of "who uses what" in terms of sensing technology and spatial data infrastructures procedures, standards or de-facto standards will be sent to the ESONET node points of contact. Currently the ESONET WP2 team is working on a document that will map standards to needs. The identification process will follow a procedure similar to the GEOSS, though with a more applied view, preferably faster application , and evidently an ocean observatory-centric focus.

- Metadata & Marine XML: Consensus doesn't seem to exist for one metadata standard for marine data, and some widely used standards unfortunately leave room for metadata custom fields that seem to make the use of these standards counterproductive. The Marine Metadata Initiative was mentioned as a possible source to dig in order to make a recommendation. MarineXML (EU MOTIVE project) is under development and should respond with the existing gaps by providing a common ontology for marine metadata, therefore answering the simple but important question of how data should be described. Mention of the Swiss Federal Institute of Technology (ETH, Zurich) was made for their effort towards the standardisation of data holdings.

- Seismic data file formats: SEED (Standard for the Exchange of Earthquake Data) was mentioned as example of a broadly used standard that, nevertheless, seems to give rise to data exchange issues and data conversion problems. Conversion software are lacking too. No specific recommendation as regards the use of SEED or the search for an alternate candidate was made.

- Surveying ESONET nodes: ESONET to create a web interface where all ESONET nodes will be catalogged and properly specified with a focus on interoperability needs. WP2 and WP1 will work out a mock-up to feed the database. It was also clearly agreed that an inventory of all instruments in ESONET is needed. This ESONET node web interface could be the right tool to provide such information too (to be disussed). This database will then be a component of the ESONET data portal (WP1).

- Where should we start, what are the priorities: Needs must be identified first (hence the surveys) so as not to overload the ESONET community with unnecessary recommendations. Data interoperability is the priority over technology for two reasons: it can be implemented now or progressively and at reasonable cost, and the fluidity and quality of data exchange seems more urgent than technological upgrades. The INSPIRE directive should be implemented in ESONET hence providing the tools to open-access of observatory data. The data interoperability implementation should use open-source software. Documents with standard-to-need mapping will be made accessible from the ESONET website and continuously updated.

ACTION ITEMS

As an outcome of the session, the following task items were identified:

- Survey ESONET technologies and identify relevant standards
- Create a repository of key interoperability documents available to ESONET
- Create a searchable web interface where ESONET nodes can register components, services and standards used (WP1&2)

• Recommend the implement standardisation at the physical layer in a DM or a test bed (IEEE 1451, 1588)