SUNRISE
Building and Experimenting with the Internet of Underwater Things

*How to leverage European and US infrastructures for smarter monitoring and control of seas and oceans*

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SUNRISE Vision

• MOTIVATION
  o Oceans and lakes
    • Cover 71% of the earth surface, and play a key role for the equilibrium of many of earth systems, including climate and weather.
    • Support the life of nearly half of all species on earth.
    • About 40% of the global population lives within 100 kilometers of the coast.

The future of mankind depends on careful monitoring, control and exploitation of the marine environments. As of today, however, our ocean basins are less well mapped, explored and understood than the moon, or even Mars.
SUNRISE Vision

**SUNRISE AIM**
- SUNRISE aims to provide all the tools for unprecedented monitoring and exploration of the marine environments, extending the concept of Future Internet (i.e., the so called "Internet of things") to the underwater domain.

**SUNRISE OBJECTIVE**: An enabler for the Internet of Underwater things.
- Develop innovative adaptive solutions for networking smart devices to monitor and control the marine environments.
- Ease experimentation and fast development of novel technologies in the field:
  - Software defined acoustic modems and communication stacks
  - Pre-deployment and deployment support tools
  - **Integration of testing facilities deployed in five different marine areas including the Mediterranean Sea, the Atlantic Ocean, the Black Sea, lakes and canals.**
  - Web based access and use of the testbeds by different classes of users.
SUNRISE Partners

Project Coordinator
- University of Rome La Sapienza

Project partners
- NATO STO Centre for Marine Research and Experimentation
- Nexse S.r.l.
- Evologics
- University of Twente
- University of Porto
- Suasis
- SUNY Buffalo
SUNRISE Approach

• Novel paradigm of SoftWare (SW) Defined Open Architecture Modem (SDOAM) and SW Defined Communication Stack (SDCS)
• Tool chain decreasing the time from ideas generation to prototyping to at sea testing/evaluation
  o Accurate yet simple channel models + channel recording and replaying+ in lab accurate performance characterization;
  o Framework to seamlessly move from simulation to in field tests of solutions
  o Integrated emulator of the different components
  o Tools for fast test-bed reconfiguration, run time data analysis for early problem identification
• SUNRISE Gate
  o Users AAA, testbed scheduling
  o Easy configuration of experiments
  o Data analysis and presentation
  o Integration with FED4FIRE
Demonstrations

- SUNRISE has been demonstrated at different venues
- **Best demo award at ACM WUWNET 2014**
SUNRISE Testbeds

**TWENTE**
- Acoustic signal recording
- Arbitrary waveform transmission
- Underwater acoustic arrays and beam forming

**UB**
- Acoustic signal recording
- Arbitrary waveform transmission
- MIMO data collection and processing compatibilities

**UPORTO**
- Static and mobile assets (AUV/ASV)
- Synergetic interactions with harbor systems and operations
- Vehicle command and control operations
- Visualization tools for onsite and remote monitoring and evaluation
- Several sensors onboard of vehicles for extensive monitoring

**SUASIS**
- Static and mobile assets (MANTA + RHIB)
- Arbitrary waveform transmission
- Multiple bandwidths and frequencies support
- Vector sensors and hydrophone array

**CMRE**
- Heterogeneous acoustic modems, including SW defined modem
- Static and mobile assets (AUV/ASV)
- Acoustic signal recording
- Arbitrary waveform transmission
- Environmental underwater and above the water monitoring
LOON Testbed @ CMRE

• The Littoral Ocean Observatory Network (LOON)
• Semi-permanent underwater communications test bed
• Access to deployed acoustic modems:
  – Evologics
  – WHOI Micro Modem
  – Teledyne Benthos
• Possibility to transmit arbitrary waveforms and experiment with custom coding schemes.
• Raw acoustic data recording capability.
• Collection of surface wave spectra and temperature profile data.
Accessing the test bed

- Access is done through the LOON workstation.
- Instruments are only accessible from the LOON workstation.
- Access to the LOON is granted upon signing a user agreement.
- CMRE provides authentication procedures.
- Institutions from NATO countries are eligible to access the LOON.
UPORTO Testbed

Assets
UPORTO Testbed access

- The PORTO testbed can be accessed through the SUNRISE Gate
- The open-source LSTS toolchain is available for more advanced usage at http://lsts.pt/toolchain
- The LSTS toolchain consists of
  - Onboard software: DUNE
  - Planning and mission control: NEPTUS
  - Inter-message protocol – IMC
  - Open source!
• Energy efficient research platform for:
  o Network protocol designers
    • to test new protocols,
    • Analyze impact of parameter changes on performance evaluation,
    • to (re)configure node/modem parameters
  o Scientists/end users:
    • to develop new applications,
    • to query data
• Being applied for heterogeneous applications of:
  o Shallow water (lakes, canals, harbors, …)
  o High density
  o Short range
  o Long lasting (months)
• Low cost, small, easy to deploy platform
Lake Sapanca is a fresh water lake, 5 km from the SUASIS R&D laboratory.

SUASIS has a test-bed facility and a small boat at the Lake. Broad band acoustic tests/calibrations and a 3 node net for underwater communication experiments.

For static tests there are 3 bottom mounted nodes working at 20 kHz-40 kHz Tx/Rx net for communication tests.

For dynamic measurements AUV equipped with communication hardware.
SUNRISE project open calls (collaborations)

SUNRISE is an FP7 FIRE Integrated Project

• 60.6% of the project budget has been allocated to the implementation of open calls, corresponding to 50.1% of the requested EC contribution.
  
  o Around 1 million funding for the first open call

• Open calls are the mechanism that allows other partners to enter the partnership to enhance and extend SUNRISE facilities

• Average duration of projects lies between 6 and 10 months (6 typical)

• Budget may range from 100-400 K euro
Availability of testbeds

• In the first open call, two test beds were available
  o LOON Testbed (CMRE)
  o UPORTO Testbed

• In the second open call, all the five testbeds are available for experimentations
Five kinds of projects:

- **The federation of additional sites** or experiments on already existing SUNRISE testing facilities to further enhance SUNRISE testing infrastructure (Project “**TYPE A**”); Max 250K euro
- The incorporation of novel algorithms, protocols, sensors, node platforms, communication devices and technologies to be included in SUNRISE facilities (Project “**TYPE B**”); Max 250K euro
- The development of applications and services exploiting SUNRISE technology and deployments (Project “**TYPE C**”); Max 150K euro
- End-user experiments leveraging on SUNRISE permanent testing infrastructures or re-deployable testing facilities (Project “**TYPE D**”); Max 150K euro
- Development of business cases for SUNRISE technologies exploitation (Project “**TYPE E**”). Max 50K euro

Proposals can address multiple project types but have to select the ‘main Type’. 
**SUNRISE SECOND OPEN CALL TIMELINE**

- Proposals should be submitted via email to: [sunriseopencall@di.uniroma1.it](mailto:sunriseopencall@di.uniroma1.it) according to the procedure described in the Guide for Applicants (Section 5.1)

- Submission deadline: The call closes at **23:59 on July 31, 2015** (Brussels time)

- Expected duration of participation in SUNRISE project:
  
  - The expected start date for selected sub-projects is November 1, 2015 with an end date falling between April 2016 and August 2016.
Questions

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