



*OPEN ARCHITECTURE FOR SMART AND INTEROPERABLE
NETWORKS IN RISK MANAGEMENT
BASED ON IN-SITU SENSORS*

Targeting the Global Monitoring for Environment and Security (GMES) initiative, the **OSIRIS** Project has defined, developed and validated services dedicated to surveillance and crisis management, thus significantly enhancing the overall efficiency of the related operations. **OSIRIS** provides a Service Oriented Architecture based on standards from OGC (Open Geospatial Consortium) and delivering functions ranging from in-situ earth observation to user services. The project has been structured around four key areas of major environmental risk: forest fires, fire in an industrial building, fresh water pollution and air pollution in urban areas.



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Objectives

OSIRIS addresses the **monitoring, preparation and response** phases of environmental risk and crisis management.

Its main challenge is to demonstrate the relevance of an open and smart information system, based on a Service Oriented Architecture and web services capable of supporting and configuring different types of in-situ observation systems covering various environmental domains.

OSIRIS covers the GMES three stage process:

- In-situ observation.
- Information management through modelling and processing of the data generated by the observation systems.
- Service production and delivery.

OSIRIS has thus a three-dimensional objective.

At the **operational level**, OSIRIS:

- Facilitates the access for users to multi-domain sensor information. The services and data are accessible through a web portal or a Geoinformation System .
- Provides a generic solution addressing environmental requirements, implementing real live experiments for **Forest Fire management, Ground Water quality management, Air pollution management, management of fire in an industrial building.**

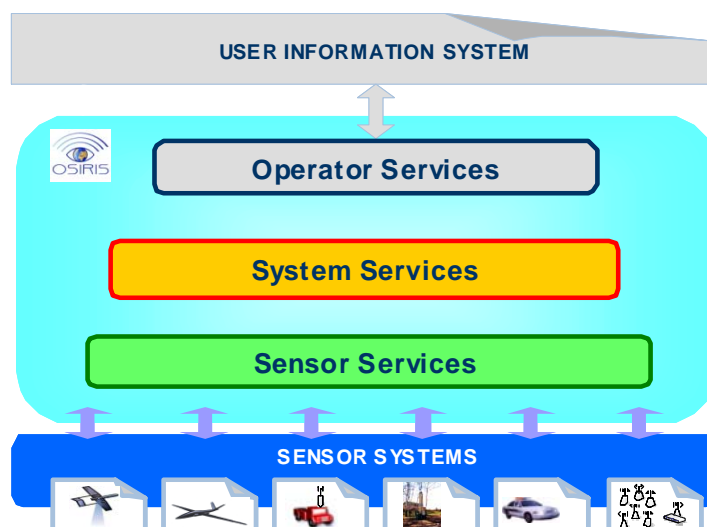
At the **system level**, OSIRIS:

- Provides an open and flexible system architecture.
- Enables the management of the configuration of the system and its evolution, providing a searching engine to identify the available sensors and observation capacities.
- Allows data workflow management, data processing and fusion of information.

At the **sensor level**, OSIRIS:

- Defines the technologies for plug & play of either individual sensors or networks of sensors into a web service architecture.
- Implements the Sensor Web Enablement services (OGC – Open Geospatial Consortium – standards) and adopts the OpenSource approach.
- Develops the required technologies for cooperation of sensors or networks of sensors.

These three dimensions are reflected by the OSIRIS Service Oriented Architecture:



The key aspects addressed are:

Accessibility, by facilitating access for users to various in-situ data in order to benefit from an overall service; this is achieved by the infrastructure framework hosting different types of in-situ sensors and standardised access to the data.

Interoperability, between various in-situ sensors and systems.

Standardisation, which is a very important step in order to reach interoperability. Thus OSIRIS provides a set of services for controlling sensors and accessing their data. Additionally OSIRIS relies on standardised data formats which enables the exchange of information. Especially the standardisation activities of the OGC (Open Geospatial Consortium) are taken into account.

Flexibility, by developing smart sensors networks based on original services for sensors network deployment and organisation strategies.

Autonomy, allowing sensor networks to change their configuration notably when operational needs change. For example, when the situation changes from monitoring to crisis management, the characteristics of the observations required may change in quantity (increased sampling frequency, spatial distribution and measurement dynamics) and even in nature.

Work performed

Besides the overall coordination and management of the Project (WP1000), the project allowed to perform the following OSIRIS technical activities.

The capture of initial end-users requirements was realised in **WP2000: End-users requirements and scenario definition** where i) a “users requirements survey” was performed based on interviews led by the Consortium members with users in various GMES domains and ii) a “State of the art of sensors and technology analysis” was established and specified the existing components of interest for OSIRIS.

Both activities represent the inputs for iii) the “System requirements” extending the users requirements at a system level, and iv) the “Scenario definition” for the definition of four experimental validations (which will be deployed in WP7000): forest fire, fire in an industrial building, air pollution management, ground water quality management.

These experiments will allow to validate the architectural concepts of OSIRIS (developed in WP6000) in real conditions with a set of real and innovative sensors (however, with the implementations limitations due to the R&D context of the project, its budget and time schedule).

Other activities were dedicated to the **sensors**.

The study of the various possible (and ad hoc) strategies for sensors deployment or sensor use was performed and a simulation environment was developed in **WP3000: Sensors management**.

The customisation of the sensors for their use in the scenarios was performed in the WP4000 (Sensors Network) and WP5000 (stand-alone sensors).

This customisation was done in order i) to ensure the compatibility of the sensors with the OGC SWE standards and OSIRIS added services, and ii) to better answer to some smart requirements of the operational implementation, thus in strong interaction with the end-users, and this leads to innovative sets of sensors.

The sensors covered by **WP4000**: wireless sensors network for fire in building, environmental pollution sensors implemented on a bus fleet, positioning sensors network for firemen, water pollution sensors network.

Those covered by **WP5000** were a High Altitude Platform (first a UAV called HAP then a manned aircraft called ARS), wireless smart imaging sensors, mini-UAV.

The definition of a freeware allowing the connection of major home weather stations to an OSIRIS dedicated network was also performed.

The generic **OSIRIS architecture** has been specified, designed and implemented in the **WP6000: Sensor Web Architecture**. Strong links have been established with the OGC and thanks to the experience gained through the implementation of real sensors, in particular mobile ones, OSIRIS provides enhancements to existing OGC specifications as well as a specification of additional services. Most of OSIRIS services are Open Source implementations.

The definition of the services has been done in strong interaction with the WP4000 and 5000 activities, in order to

take into account the constraints of the different sensors and their interactions.

The main activities regarding the SWE (**Sensor Services**, as shown in the previous 3-layers figure) have been: **SOS** - Sensor Observation Service, allowing the access to the measurements and characteristics of sensors, the **SAS** - Sensor Alert Service, for the delivery of measurements and notifications with threshold management (user defined alerting conditions), **SPS** - Sensor Planning Service, command and control of the sensor and its acquisition process, and new services for sensor discovery: **SIR** - Sensor Instance Registry, **SOR** - Sensor Observation Registry. These discovery services benefits from ontology concepts.

At the **System level**, OSIRIS sets up an “Enterprise Service Bus” integrating different services:

- Registration of sensors and search engines (sensors and observations) exploiting ontology.
- Sensor supervision and Services supervision.
- Data Processing Infrastructure, hosting different processing services and managing the workflows towards them.
- User notification mechanisms, multi-protocol and multi standards enabled.
- Data storage service (Transactional) with management of automatic insertion of data from identified sources (through plug-ins, SOS plug-in implemented).

At the **operational level**, OSIRIS provides generic capacities for displaying data provided by the SWE and System services:

- A Web portal is set up, offering an access to the supervision of the services and the sensors, to the measurements and observations (for registered SOS and services), through a web client. Security access is managed.
- A rich client is provided, allowing rendering of measurements from SOS instances, command and control of sensors (SPS) and connection to SAS instances

In addition, OSIRIS sets up specific displays interfaced to legacy services and applications, addressing domain specific needs

In WP7000, Experimental validation, the architecture was really implemented and evaluated in four life demonstrations, which were launched during the last 6 months of the project.

In Spain, in Valladolid, the demonstration focused on air quality, with sensors on a bus fleet associated to fixed sensors, in monitoring context and a mini-UAV with a plume modelling in a crisis (accident of a truck of dangerous transportation material).

In Germany, in Aachen, the objective was to reduce the number of false alarms and rise the fire detection in industrial buildings by associating networks of multi-criteria sensors.

In Tuscany, the objective was to implement a monitoring strategy for fresh water delivery management and water quality.

In South of France, the objective was to use a controlled fire and a set of sensors deployed dynamically on the terrain to gain a better knowledge of the operational picture.

All the demonstrations allowed to show and validate from acquisition with real sensors to operational exploitation with end-users the interest of the OSIRIS architecture.

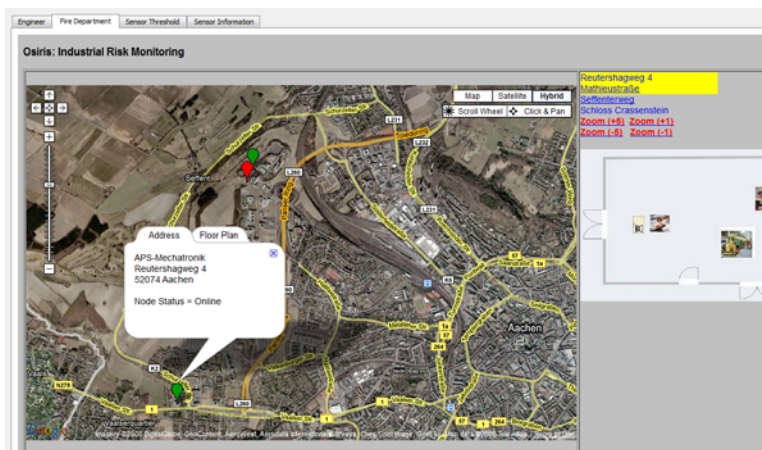
A "Cost Benefit Analysis" was also realised to allow the evaluation of added value brought by the generic OSIRIS architecture.

Some photos of the demonstrations are provided hereafter.

Air quality management – Valladolid Spain



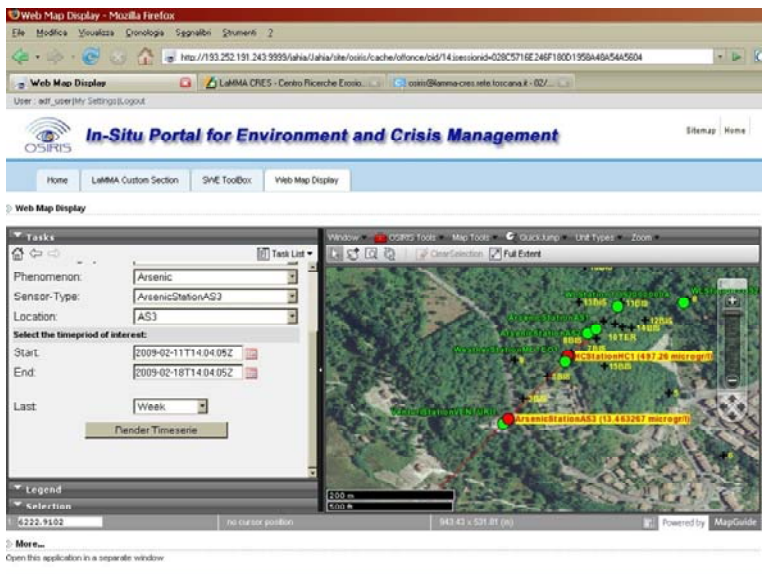
Fire in industrial building – Aachen Germany



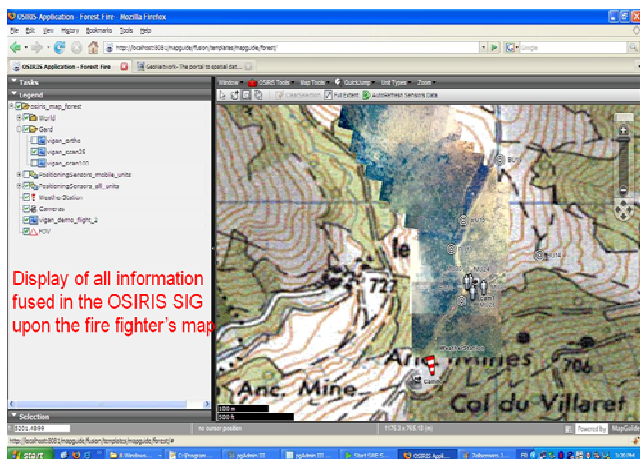
Water quality management – Tuscany Italy



Population concerned 380 000 people



Forest fire – Gard France



The WP8000 Dissemination and exploitation activities cover all items defining the promotion strategy. A set of slides for the presentation of OSIRIS, the definition of a logo, the production of a brochure for promoting the project, the definition and the implementation of the website including an educational demonstration, the contributions to conferences and workshops for professional and public dissemination, the leaflets/demos for public dissemination, a film, has been accomplished. Strong links have been established with the OGC SWE working group, where OSIRIS is represented through two partners, who participate and promote the OSIRIS architectural results.

Results & deliverables

The following lists show the results leading to the deliverables of the whole project, independently from the management reports (intermediate and final reports).

- D2100 Users Requirements
- D2200 System Requirements
- D2300 State of the Art
- D8110 Promotion Plan, Logo, D8111 OSIRIS Project Web site on Internet, D8112 Educational demonstration on Web site, D8120 OSIRIS Brochure.
- D2400 Scenario definition
- D3100 Network Management Report
- D3130 Guidebook on Network Organisation
- D3200 Sensors Deployment Report
- D3300 Sensor deployment planning system
- D4100 Wireless Sensor Systems
- D4200 Sensors on the Fleet:
- D4300 Positioning system
- D4400 Legacy Sensors Network:
- D5100 HAP Sensor System Components Customisation justification & link between GCS and data receiver station
- D5101 Clearance and frequency allocation
- D5102 HAP & ARS Sensor data system processing Report
- D5200 Smart Imaging Sensors
- D5300 Low Altitude Sensor
- D5400 Home Weather Station
- D6001 SWE Architecture Specifications & Justifications
- D6002 SWE Architecture Detailed Design
- D6152 Global Architecture demonstrator
- D7110 Data fusion and data processing report
- D7120 Monitoring network application

- D7130 Generic display
 - D7140 Customisation mission planning for the ARS
 - D7150 Demonstration Protocol for Air Pollution management
 - D7160 Demonstration Protocol for Ground Water management
 - D7170 Demonstration Protocol for Industrial Fire Risk management
 - D7180 Demonstration Protocol for Forest Fire management
 - D7410 Return of Experience report
 - D7420 Cost Benefit Analysis
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- D8122 Consolidation Report
 - Final plan for using and disseminating the knowledge
 - Film

Publications and workshops

The OSIRIS consortium participated to an important number of workshops and several publications have also been performed.

For the Air Quality management, Water Quality management, Forest fire demonstrations, workshops were also organised, with invitation sent to a large community of stake holders. The demonstrations were also filmed and a global film covering the whole project was realised by the project coordinator, Thales Communications.

Finally, OSIRIS consortium also organised an open international workshop "OSIRIS Sensor Web workshop" led on 23rd and 24th March 2009.

Intentions for use and impact

The OSIRIS architecture is already highly considered as an valuable input for several future GMES Projects.

The OSIRIS project has the following impacts:

- The services are defended at the international level, in GEO and OGC. This consolidates OSIRIS solution and more, European strategy towards these bodies. The set of OSIRIS services have been already presented as a valuable input to the evolution of the OGC services.
- OSIRIS contributes to the Open Source activities, ensuring that the software products that result of the project are made available to a broad community.
- OSIRIS allows to validate a set of European innovative sensors in various scenarios proposed, that possibly opens new markets for them.
- Extend the community of potential users of the OSIRIS infrastructure and services: the project provides a set of standardised services dedicated to the users, and the OSIRIS solution is validated through real-life experiments, causing attraction to potential additional users.

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ESYS - ESYS PLC, United Kingdom



ReMiFOR - Réseau Euro-Méditerranéen d'Information et de Formation à la gestion des risques



FWA - Stadt Aachen, Feuerwehr Aachen, Germany



AUVASA - Autobuses Urbanos de Valladolid S.A, Spain



RT - Regione Toscana, Italy