WIN: A NEW SERVICE ORIENTED ARCHITECTURE FOR RISK MANAGEMENT

Christian Alegre, Cecile Monfort

Thales Alenia Space, France[1]

Keywords

Risk management, service oriented architecture

Abstract

The Wide Information Network (WIN) Integrated Project (EU FP6 Call 2 DG IST) has started in September 2004 and will end by end of 2007.

The project integrates existing reference results and initiatives to contribute to the design, the development, and the validation of a scalable solution contributing to the future Single Information Space for Environment and risk management in Europe (SISEE), Information space where environmental institutions and services providers, irrespective of size or location, can do business or simply collaborate with no technical restraints

The solution proposed by WIN is based on a Service Oriented Architecture (SOA), the strong advantage of this kind of architecture is to allow to build information systems enabling the creation of applications by combining loosely coupled and interoperable services without the knowledge of the underlying systems.

A maximal interoperability is guaranteed by WIN compliance with main current and emerging standards.

The solution includes a set of generic services, standard data modelling components which facilitate the deployment on various thematic cases.

The project has successfully passed the second annual review, focused on the service oriented architecture.

The last year of WIN project will be focused on validation, experimentation, evaluation and preparation of the deployment of the solution, in several thematic.

Sections

Introduction

The general requirements put in priority in the design of WIN architecture are fully in line with DG INFSO main guidelines on future architecture of systems:

- Maximal interoperability to inter-operate data, services, and environment or risk management actors;
- Easy access to various sources of data, connection with existing data sources to reuse existing information spaces;

[1] 100, bd du Midi-BP99 06156 –Cannes la Bocca Cedex, win.gmes@thalesaleniaspace.com

- No constraint on the localization of the data themselves, data being hosted at the favourite location in line with the applicable practices and rules;
- Generic solution and potential deployment for environmental or risk management applications;
- Reuse of standards ensuring the compatibility with other developments and enabling an easy integration with existing systems;
- Modularity of the solution which can be deployed on one or several computing nodes;
- Low cost solution and very light Client configuration offering an easy-to-use access for both SMEs and institutions;
- Support of business processes to model and execute real world business processes and enable service chaining.

WIN project covers in particular the following issues:

- The definition of a data/information model valid for risk management issues relevant to Europe and in line with European geo-information standards (INSPIRE);
- The design of the Info-structure optimised in terms of use of state-of-the-art information technologies and high capability to inter-operate data, services, and risk management actors;
- The development of a basic set of generic core services that can be deployed to cover major needs of various actors, whatever the specific thematic field;
- The investigation of multiple stakeholder business and organisational models;
- The evaluation of WIN added value through real life experimentation scenarios;
- The definition of the info-structure deployment roadmap.

Theory and method

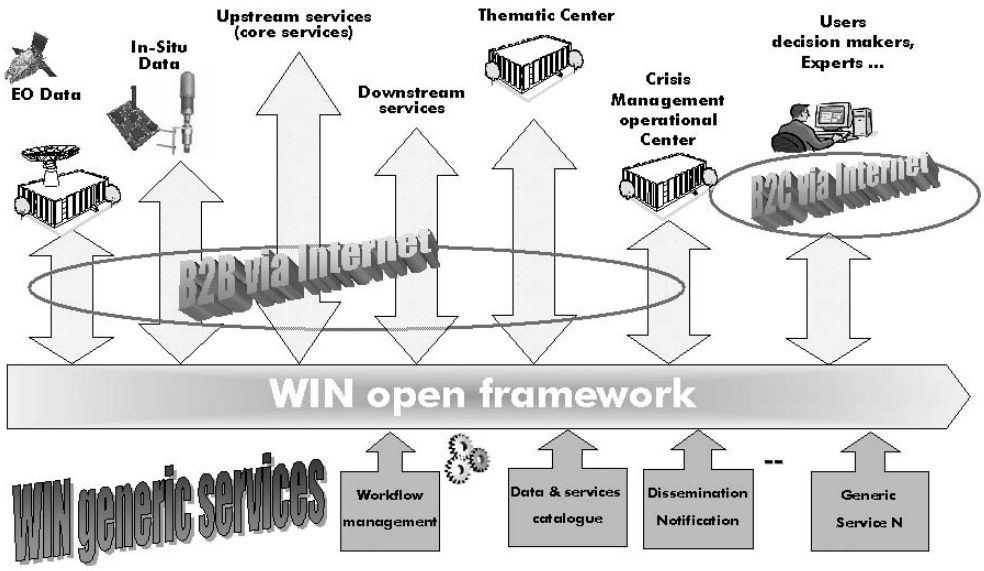
Interoperability is considered as the main driver of WIN solution. Indeed, WIN high interoperability directly results from the compliance of WIN architecture with existing and emerging standards (ISO, OASIS, W3C, OGC,…) and the collaboration established with several other projects like :

- DG INFSO other projects on risk management , in particular ORCHESTRA project;
- DG ENTREPRISE support actions on Data harmonization (RISE…);
- DG ENV INSPIRE initiative;
- European Space Agency (ESA) GMES Services Elements and HMA (Heterogeneous Mission Access) projects for what concerns interfaces with GMES services and interfaces with Space systems Ground Segments.

This high interoperability allows building a variety of powerful solutions based on cooperative systems for environment or risks management, using WIN as a core of the solution.

The hereafter figure 1 illustrates the use of WIN as a federating infrastructure which allows building a powerful overall solution by loosely coupling of cooperative systems or components, in an environmental or risk management domain.

Figure 1 : WIN, a federating infrastructure



The user requirements have been collected and analysed in relation with actors of two risk management communities: actors involved in oil spill process and Civil protection managing forest fires.

The inputs collected from these actors have been merged with the ones coming from lessons learned on past events or coming from previous projects on same thematic fields.

The whole risk cycle has been addressed, from risk assessment to capitalization and every type of actors has been considered:

- The policy & decision makers (European, National, local levels)
- The scientists and experts
- The on fields operators
- The data & service providers

The collected users' requirements, classified, characterised with the thematic and technical attributes and arranged into a data base, have been the basis for further data modelling and design activities.

Using user requirements specifications, the data modelling work has produced a data model specification and developed consistent and generic risk data models. Special attention has been put on the interoperability with data models produced by complementary projects - such as ESA HMA (Heterogeneous Missions Accessibility); EC ORCHESTRA and EC MOTIIVE/RISE – via the use of standards from standard bodies notably W3C, ISO, OGC and OASIS.

Main objectives of WIN data modelling have been :

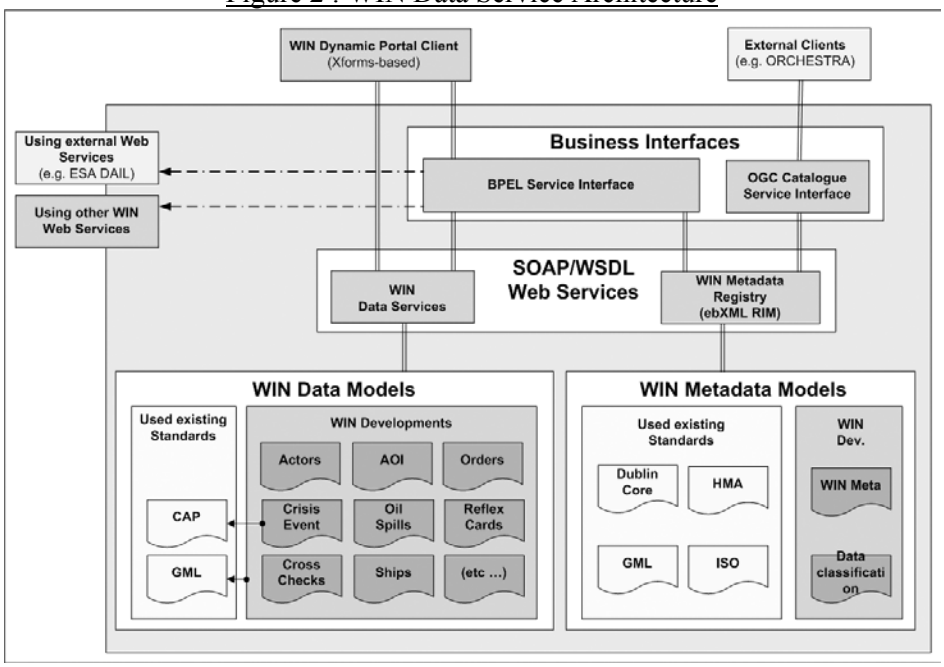
- To assure interoperability of the created data models;
- To use standards wherever possible and to limit developments to strict specific features;
- To deal with complexity of data models;
- To combine generic and specific elements of the data model;
- To produce data models that allows easy exchange of datasets.

To achieve these objectives, the most appropriate support technologies have been selected:

- W3C standards to develop the WIN data models: XML as format to exchange data and XMLSchemas to model XML. Selecting XMLSchemas has allowed integrating easily existing standards (like. GML, CAP, ISO, SensorML, CIQ, etc…) which are also expressed in XMLSchema.
- OASIS standard ebRIM (electronic business Registry Information Model) to design the Registry Model. Note : On January 5, 2007 - The Open Geospatial Consortium, Inc.®(OGC) selected the OASIS standard ebRIM (electronic business Registry Information Model) as the preferred cataloguing metamodel foundation for future application profiles of the OpenGIS® Catalogue Service Web (CS-W) specification.

Results are depicted in the figure 2:

Figure 2 : WIN Data Service Architecture



The WIN Data Models cover management of important objects that play a role in Crisis / Risk management – like identification of all types of Actors, Ordering of data and services, performing Cross Checks, managing crisis alerts, follow-up particular crisis events (like oil spill or fire) and description of particularities of a type of disaster (like oil spill or fire).

The WIN Metadata Model is based by large on existing standards (such as Dublin Core, GML and ISO19115) - and includes some additional specifications for WIN. All this metadata is managed in the same way by using the ebRIM standard, which can express any type of metadata and – on top of that – make valuable associations between metadata. This allows very powerful querying and managing of metadata.

The WIN Data models are implemented via the Data Web Service component, the metadata via a ebXML Registry tool. Both components/tools are using SOAP/WSDL type of Web Services, which is the standard. This allows standard-based connections to other tools like for Workflow management –based on BPEL standard.

WIN functional architecture is based on user requirements. Basically, the user requirements underline the need of an information system providing:

- Easy access to reference data managed by the different actors at European, National and Local level;
- Easy access to historical data collected during past disasters to benefit of lessons learned;
- Supports to establish the relationships between users and providers;

- Interfaces with service providers acting in domains of interest such as oil spill monitoring, detection, drift forecast services, rapid mapping services, etc … ;
- Tools to facilitate information exchange between actors including dissemination means, collaborative applications, multi-linguality to overcome the language barrier etc…;
- Tools for efficient decision process;
- Communication means with scaleable QoS according to the risk phase;
- Support and training.

According to these needs, WIN has been designed as a backbone data infrastructure offering a set of generic services and interfacing Services & Products providers, Data providers, End users and other stakeholders for risk management purpose.

In short, WIN generic services can be classified into 4 functional groups :

- User management (registration, profile information, authentication & authorisation);
- Data/Products/Service access (registration, catalogue, ordering, exploration of external standardized catalogues);
- Support tools (Object viewers & GIS, Multi-lingual glossary, Alert Services, Crisis Event follow-up, Reflex cards, Directory of contact, Collaborative working tool);
- Administration (data handling & dissemination, workflow management, system monitoring, data storage, backup, traceability, help desk).

All these generic services are accessible to the users through a Web Portal.

Regarding the data, there are several kinds of issues :

- Technical issues mainly related to interoperability : WIN supports various formats (raster, vectors, documents, etc) and complies with interoperability standards, in particular OGC CS-W (Catalogue Service Web) specification. As a consequence, WIN can be "connected" to various sources of data, either directly when WIN and external system share common standards (OGC,…), or through specific connectors when alignment of legacy system is required. A demonstration of WIN multi-catalogue capability in relation ESA HMA (Heterogeneous Mission Access) has been performed during ESA-EC interoperability workshop (in Frascati on April 3rd 2007),
- Organisational/Business issues related to data access rights and pricing policy : WIN solution is generic, it allows to manage different types of business / organisational models, but it requires a prior agreement between the parties.

A particular attention has been put on the characterisation of the actors communities (groups of end users and providers sharing a same theme or mission).

In the Risk and Environment Management (*) framework, a community may group users and providers according to various criteria such as : Geographical areas (European, trans national, national, local and also sub-local); risk thematic (Oil Spill, Fire, Flood); risk phase (pre-crisis, crisis, post-crisis).

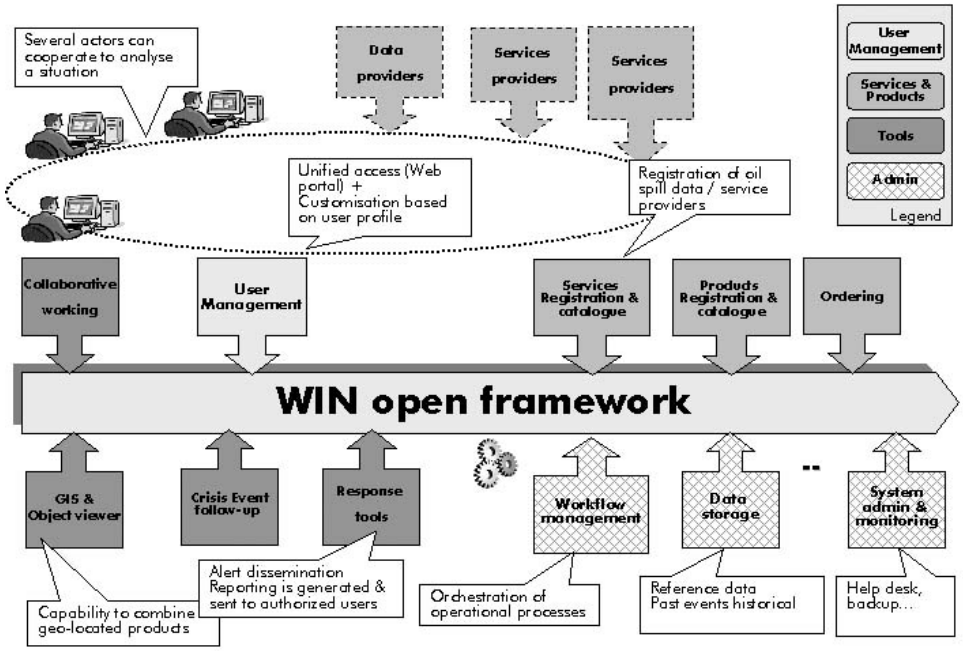
In WIN system, the community characterisation is based on charters concept (business, mission, quality, interoperability charters) and results in enhanced user profile management and cataloguing services.

This allows to provide a so called "profile based system" where users access to relevant information according to their needs and rights (figure 3).

(*) Note : Risk management and Environment management share most of needs in term of architecture, even if Risk management requires specific capabilities (like forces management) to manage the crisis. These specific capabilities for crisis management are

provided by other complementary projects (like OASIS CM), while generic capabilities for the whole risk management cycle (from prevention to damage assessment) are provided by WIN architecture and services. WIN, which is being validated on Risk management cases, can also support as well other environmental thematic fields, provided the data models are enriched as needed.

Figure 3



Results

Since the WIN infrastructure is to interoperate in a context of cooperative systems, the Service Oriented Architecture (SOA) is most appropriate type of design methodology to be followed.

SOA represents a style of architecture, primarily for application development, that is typically multi-tier and based on the principle of dividing business processes into a series of subunits or services.

The services can then be assembled and linked together to perform a desired application.

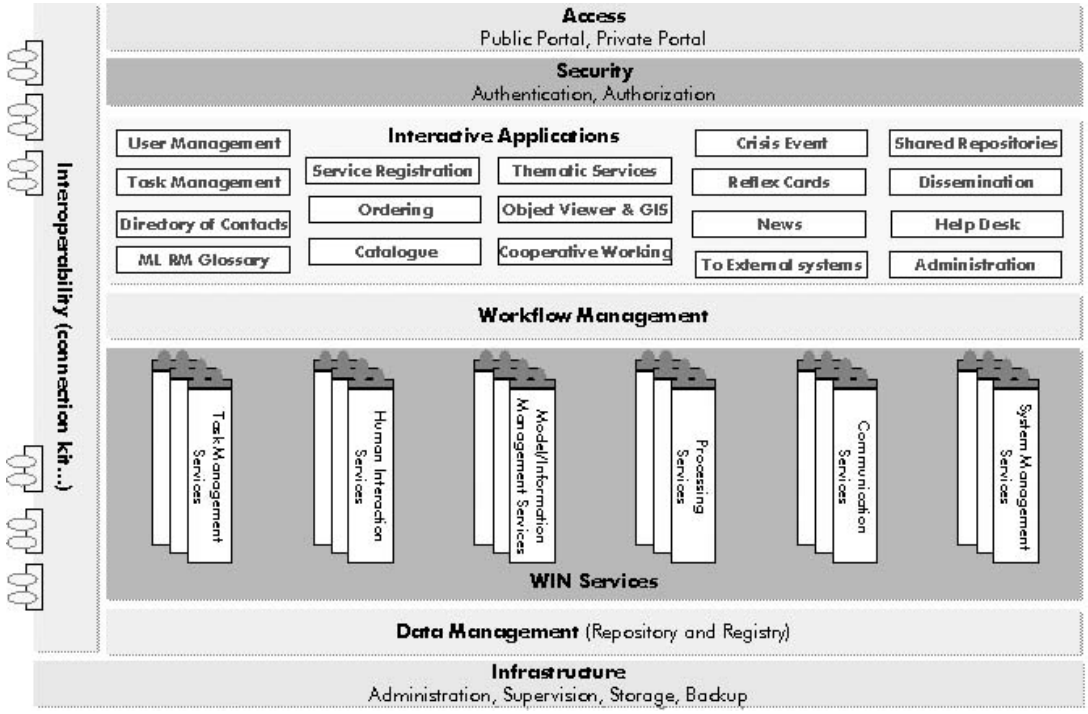
The services are defined at a level above that of the traditional view of components.

As a consequence, this approach allows the definition of system architectures having the following characteristics:

- Stateless services, ensuring re-usability, since they are designed to be used in any context,
- Interoperable services, ensuring, of course, interoperability, since they are defined and realized according to market standards (XML, XSDL, WSDL, SOAP…) in order to interact in a 'plug and play' mode, both internally and externally,
- Loosely coupled services, enabling an optimum flexibility.

The figure 4 shows a high level vision of the WIN architecture from a SOA standpoint, illustrating the component structure approach.

Figure 4 : WIN SOA Model



Then, in line with this SOA model, the logical architecture schema is based on 3 layers:

- The presentation layer;
- The service layer;
- The data/information layer.

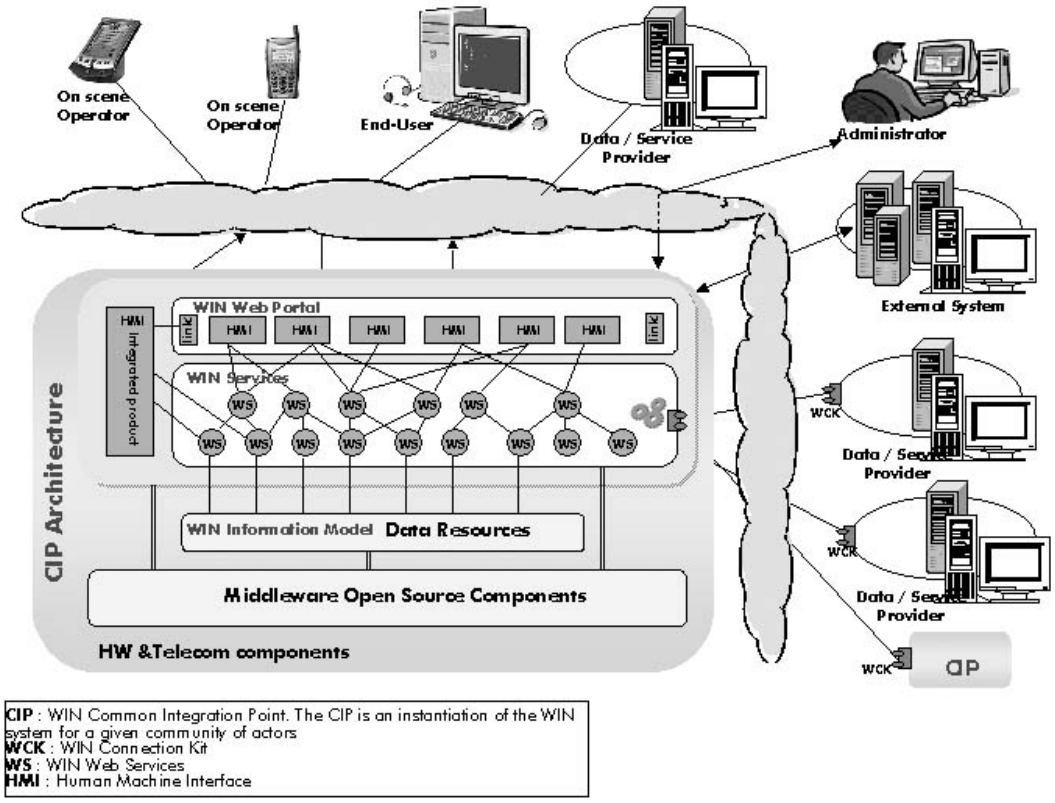
Through the presentation layer, the user can connect the WIN portal and, after authentication, accesses to WIN services.

The services layer offers a panel of elementary services that can be combined and chained into workflows. The richness of the model comes from the fact that WIN services, external services, and human tasks can be orchestrated to support automation of operational practises.

The data information layer, including data models and metadata model, is fully based on standards; this increases the overall interoperability, allowing to share data/information with other cooperative systems.

The figure 5 illustrates the layered approach.

Figure 5 : WIN layered architecture overview



To sum up, WIN solution includes in particular:

- An open architecture and info-structure based on ISO, OGC, OASIS, W3C standards;
- A set of generic services like catalogue of data and services and GIS allowing an easy access and powerful combination of various sources of information;
- A generic registration capability which provides a very efficient way to extend the information system by "plug and play" of various external services in relation with the thematic domains;
- A work flow management, allowing to support domain practises by design and execution of most frequently activities work flow;
- A set of data/information models corresponding to generic and specific requirements for WIN experimentations (generic, oil spill, fires and floods models) , this set being easily extendable in relation with new target application.

Apart from its high interoperability, other advantages of this solution are:

- A cost-effective deployment consequence of the maximal use of open source components in the infrastructure implementation and, basically, no specific needs on client side;
- The architecture can be deployed at several levels (geographical levels or thematic domains), and a level can be considered as a data/service provider for another level.

Development of an open architecture like WIN is guided by the compliance with the standards of the domain (OGC, W3C, OASIS and INSPIRE recommendations) in order to provide highly interoperable systems and to ensure sustainability. And besides this high level requirement, is the need of using new information technologies.

Implementation of WIN software components is fully based on these principles. Most of the developments are realised in JAVA within a J2EE light architecture (JBoss, Tomcat). The WIN services are provided as Web Services using SOAP-formatted XML envelopes and having their interfaces described by WSDL. BPEL is used to manage the workflows.

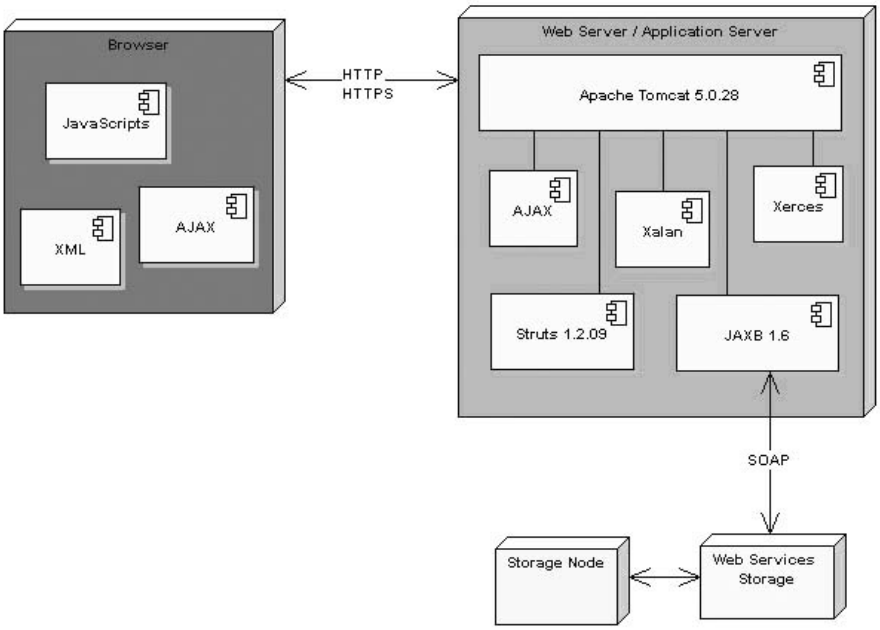
The WIN web-application respects the VMC (View Model Controller) model. The selected implementation of VMC is Apache Struts. The view part of the VMC is realized by JSPs and XSLT Transformations running by Apache Xalan. Further more, in order to propose advanced Man Machine Interactions, the AJAX technology is used to interact with the server side of the web-application.

On the server side, the web-application resources are protected by the JAAS standard coupled to an LDAP resource.

We can also mention ATOM as technology used for syndication.

The figure 6 provides an overview of the WIN Web Application Software Components (almost all of them are Open Source):

Figure 6 : WIN Web Application Software Components



WIN software is developed by several partners of the WIN consortium across Europe. This implies many exchanges of information (documents, emails, brainstorming…) and increases the complexity of integration and testing tasks.

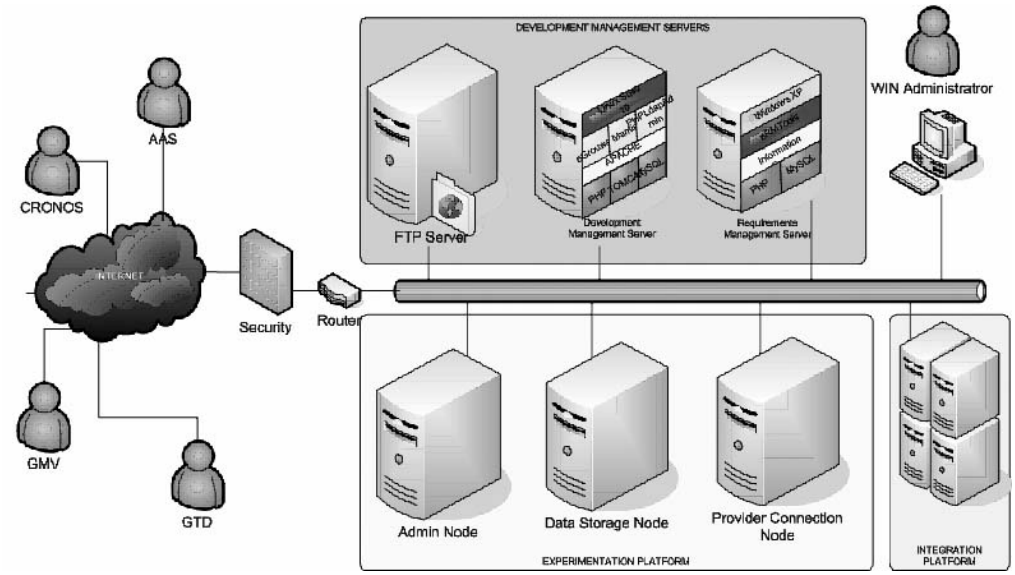
To ease these exchanges and to prevent integration problems, the different companies have agreed to work with a common development methodology.

According to this methodology, a collaborative platform (see figure below) has been set up in order to provide over internet:

- A management environment including :
  - Configuration management and version control tool (Subversion)
  - Bug tracking (Mantis)
  - Content management system including forums, wiki, etc … (eGroupware)
- A integration environment (for integration and validation testing)

- A experimentation environment (for end-to-end validation and experimentation)

Figure 7 : WIN Integration & Experimentation platform



Two domains of experimentations are defined:

- Marine and Coastal domain with experimentations related to oil-spill monitoring and response process, in relation with Marcoast GSE project and several users and service providers in France, Spain, Italy, and Greece,
- Land risk management domain, with experimentations on fire and floods disaster management in relation with French and other countries Civil protections.

Planned experimentations will allow evaluating benefits of WIN and in particular:

- The capability of WIN to support end-to-end oil spill monitoring and response process, orchestrating the required data information models, interfaces with dedicated services, information dissemination to relevant users, including notification and alert in case of crisis;
- The capability of WIN to improve risk management for what concerns fire and floods, through the advantages resulting from GIS capabilities (combination of different sources of information, like Earth Observation data and in-situ or cadastral data), the management of on-demand data ordering in case of disaster, and several facilities (collaborative working, …) contributing to a more efficient disaster management process.

WIN benefits have been widely disseminated and positive appreciated in user forums like the European Group of experts in satellite monitoring and assessment of sea based oil pollution (EGEMP) and the Gestion des Risques and Vulnérabilités des Territoires (GERI) forum.

Discussion

WIN deployment roadmap includes many opportunities at European and regional level, on several thematic like shoreline monitoring, land-based risks management and environment management domains. According to the needs, various deployment of WIN can be performed.

Two typical models are presented hereafter:

- WIN can be deployed using a “Internet-based” model where all actors involved on a given thematic field can find easily the relevant data and information they need, the WIN infrastructure acting like a “broker” between the providers and the users (data and services consumers), helping the users to perform their activity in various phases

of risk management cycle, and providing data/service providers with a wider "audience",

- WIN can also be deployed on a "case-by case" model, after a customisation phase helping to adjust the model to specific practises; in particular the customisation allows to design the different work flows to support specific processes, to extend the data/information models needed in a given thematic domain, or to integrate complementary tools or services like decision-support or response management services.

WIN project has defined an open architecture to support risk management process and more generally environment management processes. A first implementation has been performed through a core set of generic services.

The solution, based on Web services, is generic and modular, and as such, it can be adjusted to any context of environment management or risk management:

- Cooperation with other systems compliant with the standards can be easily performed,
- New thematic domains can be modelled,
- New data/services services can be registered,
- New work-flows can be designed.

The compliance with current and emerging standards is the guarantee of the sustainability of the solution, and of its interoperability with other standard-compliant systems.

WIN utility value is its contribution to the build of efficient and secure systems of systems for environment or risk management ; in particular :

- WIN facilitates user access to several data sources, masking the complexity related to the variety and heterogeneousness of sources,
- WIN facilitates collaborative working between actors,
- WIN supports operational practises through automated work flows,
- WIN facilitates the set-up of links between users and data/ service providers
- WIN supports tracability of events, actions, exchanges,…

The added value of the solution is being demonstrated in relation with several kind of actors on two thematic (oil spill, fires).

WIN results constitute a major contribution to the future Single Information Space for Environment in Europe.

Author Biography

Christian ALEGRE (Thales Alenia Space) : Engineer from SUPELEC (French Electronic & Computer sciences high school) has developed a strong experience in technical and project management in a European context in remote sensing and software domains. After various programs as SW developer, he was responsible of a SW department for five years before to take the responsibility of the Integration for the ENVISAT Ground segment in Italy and then to be in charge of the project management. He has developed the know-how to work with European partners coming from various countries: Spain, Italy, Germany, United Kingdom, Sweden, for both technical and contractual matters. Christian Alegre is the WIN Project & Technical coordinator since September 2004, the beginning of the project.

Cecile MONFORT (Thales Alenia Space) : Computer Science Engineer from Ecole Nationale Supérieure d'Electronique, Electrotechnique, Informatique et Hydraulique de Toulouse (ENSEEIHT) . She has acquired her skill in computer sciences through various projects in

many domains notably image processing, ground segments, information system. In 2001, she has joined Thales Alenia Space to take the technical responsibility of the IQGSE (Image Quality Ground Support Equipment), a software suite for the MSG (Meteosat Second Generation) commissioning. Since April 2005, Cecile Monfort is the WIN technical manager and brings her support to the System Design and Development WP.