RAMSES SYSTEM : AN OPERATIONAL THEMATIC EO-APPLICATION ON OIL SPILL MONITORING.

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ABSTRACT

RAMSES (Regional earth observation Application for Mediterranean Sea Emergency Surveillance) is an operational thematic EO-application for oil spill detection and monitoring. Involving many geographically distributed resources and competencies, the system had to meet strong requirements in terms of platform-independence and expandability. In addition, because thematic applications using remote sensing data share a lot of commonalties, the system has been designed in a modular way to ease components reusability. The fulfillment of these objectives was largely supported by recent technologies such as CORBA and Java. After defining the services provided by RAMSES, this paper presents the architecture of the system. It then outlines further improvements that will be considered for the oil spill application itself as well as further steps required towards a full multi-application support system.

1. INTRODUCTION

Since the mid 70's Europe has been investing in Earth Observation (EO) satellite systems. In order to let the wider user community benefit from this new source of information, the European Industry, supported by ESA and the European Commission, is encouraged to develop new thematic and processing applications.

RAMSES financed by the European Commission in the frame of the ESPRIT program is part of this strategy. It will provide an operational service in the field of oil pollution monitoring in the Mediterranean sea. Although RAMSES will initially support end users in Egypt, France, Italy, Malta and Morocco , the system has been designed from the beginning to support extension to additional countries as already foreseen in the exploitation plan.
MATRA SYSTEMES & INFORMATION, a French industrial company inside the AEROSPATIALE MATRA group, is the coordinator of the project consortium that includes different partners of Mediterranean countries:

- Italy (ESA, ACS, EURIMAGE, FMA, ICG , THETIS, Regione Sicilia)
- France (CEDRE, SPOT IMAGE)
- Malta (ICOD)
- Egypt (NARSS)
- Morocco (CRTS)

2. RAMSES SERVICES

RAMSES provides oil slick monitoring services to operational and scientific users. The main service for the operational user provides, in near-real-time, information products in a specified high risk area, while scientific users will benefit from the off-line statistical information derived from the operational usage of these thematic products.

RAMSES products contain geographical , morphologic and radiometric parameters about the detected oil slicks. Meteo information derived from a high resolution numerical model is also appended to support oil trajectory hindcast and forecast activities.

The product can be distributed in a variety of standard formats including ASCII reports, postscript and GIS compatible (SHAPE) formats that best suit the needs of the different user communities.

3. RAMSES ACTORS / EXTERNAL INTERFACES

Fig. 1 shows the main actors involved in the RAMSES project

The detection of oil slick is primarily based on remote sensing data from several Data Providers including ESA (ERS Synthetic Aperture Radar – SAR) and SPOT (SPOT XS – optical images). For interpretation these satellite data are completed by other geodata with the most important being meteorological information (wind and current speed , sea surface temperature).

The above raw data are further processed and analyzed by Value Adders. They can play a global role as in the first release of RAMSES but can also specialize on a particular geographical business area in which case they can enrich the mere oil slick data with additional , regional restricted information such as ship routes.

At the end of the chain, Users receive the final high level products. They can have an operational role receiving near real time notification about oil pollution and sending planes on-site to trap polluters or have a more scientific role deriving for e.g. (off-line) risk maps of polluted areas.

In general there is gap between Value Adders and Users. It is filled by Business User Intermediaries. In the provisional RAMSES version , this role is played by a single entity at a global level, though in the next version Regional Service Providers with deeper knowledge of local users will also participate.

The distribution of roles and functions described for the RAMSES project applies to most thematic end-to-end applications using remote sensing data. In this sense , RAMSES has been designed as a modular system with reusable components paving the way towards a generic multi-application architecture.

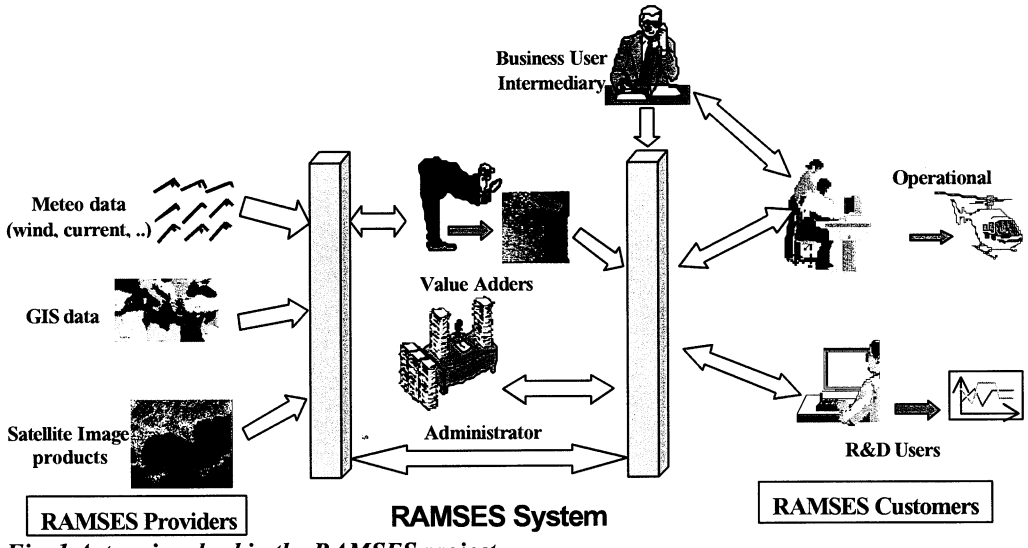

Fig. 1 Actors involved in the RAMSES project

4. SYSTEM ARCHITECTURE

The RAMSES architecture takes into account the inherent distributed nature of such systems in particular :

Remote sensing data are generally very large (e.g. 140 Mbytes for an ERS high resolution image). To alleviate network cost, the data are stored and pre-processed (quick look generation ...) at the data providers premises. Only part of the images relevant to the application are actually transferred on request to (remote) Value-Adders. The cost of the service is also reduced by the fact that user do not need to buy full scenes.
Regional Value Adders may want to complement the oil slick information with proprietary information (GIS data, drifting models) for their customers and which are not available at a global scale.

Therefore the system is built around a Central Node and possibly several additional Data Providers (DP) and regional Value Adders nodes. Fig 2. shows the topology of the first version active since January 2000. The central node located at ESA/ESRIN in Italy is the entry point for SAR and meteo products and interfaces with all external users. A second data provider node located in SPOTIMAGE Toulouse provides access to SPOT data.

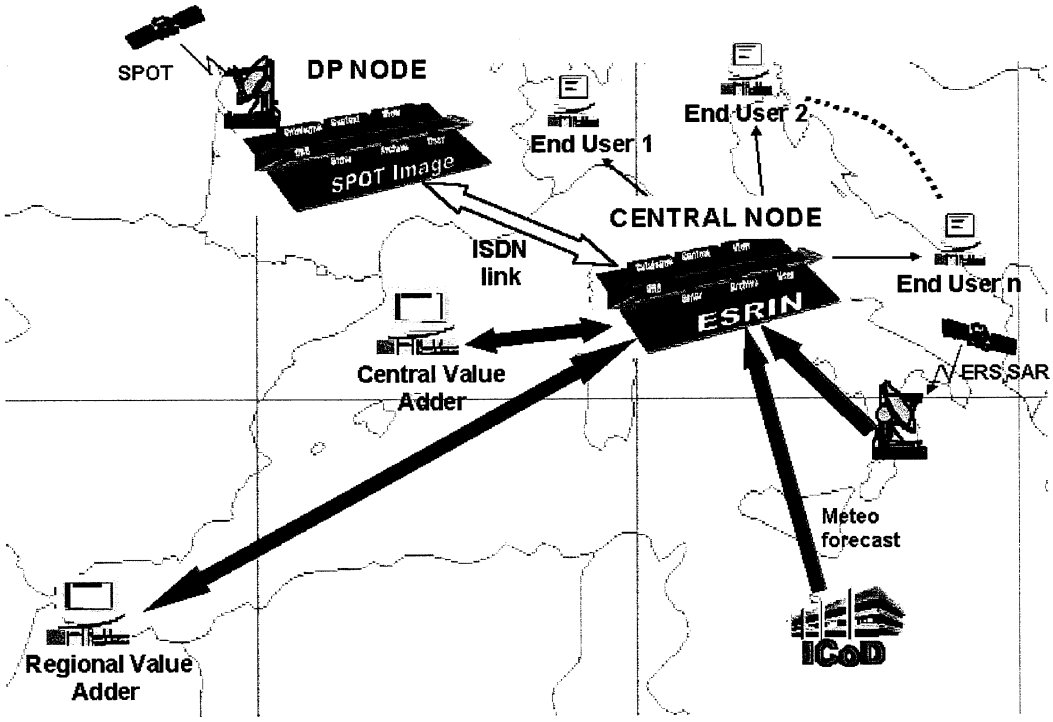

Fig. 2 Current RAMSES Topology : one central node + one data provider node.

The above described RAMSES nodes share common functionalities in terms of data handling and user support. These functions are grouped within the so-called Core-Server depicted on Fig 3. Built upon a CORBA bus, this server offers a set of objects providing general functions for data handling (import, pre-processing, cataloging ....) and user support (registration, billing, transaction logging ...).

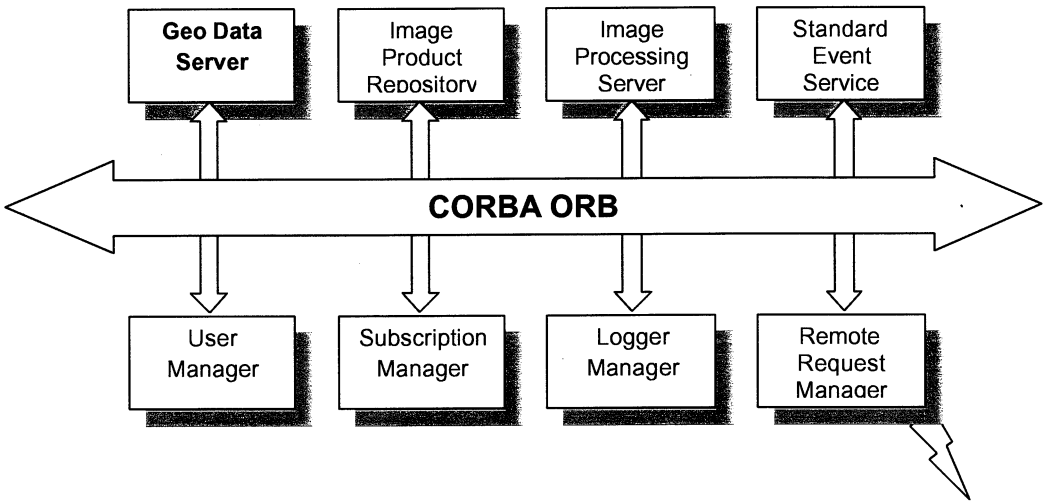

Fig. 3 :Architecture of a RAMSES Core Server

The table below provides a list of the CORBA objects available in the core-server together with a short description.

Acronym	Extended Name	Description
GDS	Geo Data Server	Local repository of server including : Catalog of satellite images Catalog of vector data (meteo , GIS) Vector data themselves
IPR	Image Product Repository	Local archive for the satellite images
IPS	Image Processing Server	Image processing functions Resampling Geo-coding Format conversion … Vector processing functions Conversion between different cartographic projections Flatten GIS layers …
USR	User Manager	Management of new and registered users
SUB	Subscription Manager	Handling of user orders
LOG	Logger Manager	Record transaction on the server. Support billing activities
RRM	Remote Request Manager	Inter-connects the nodes of the RAMSES system. Decides whether specific actions / request can be handled locally or need to be forwarded to another node.

Users and Value Adders access the system through dedicated clients called RAC (Remote Access Clients). Three different RACs have been developed to support the different external entities :

a-Value Adders Application : browsing of satellite data, selection of potentially polluted scenes and tools to detect and analyze the oil slick. Includes the possibility to overlay vectorial meteo fields on top of the satellite raster image. After analyses, oil slick parameters are sent back to the RAMSES server which can notify registered end users.
b- End User Application : Via this interface, end users can browse the oil slick catalog and select products on-line.
c- Business User Intermediary Application : let Business User Intermediaries providers register new users and retrieve users profiles.

RAC are running remotely and are associated to an appropriate RAS (Remote Access Server) running on one RAMSES server. The RAS provides an entry point to the RAMSES services. It receives the different requests from the related client and handles them using the different RAMSES services provided by the CORBA objects of the core server.

All client applications and their RAS counterparts are written in Java allowing an easy distribution to users on many different platforms.

5. FURTHER IMPROVEMENTS

Improvements of the initial version of the RAMSES system will be considered at two levels :

Improvement of the oil spill application itself

The first version of the RAMSES system is running since January 2000. The first notifications of oil pollution have been successfully sent to end users. Nevertheless, in order to further improve the quality of the service new algorithms and models will be considered for the next version including :

- Forecast and hindcast models
- Ship detection algorithms
- Initial automatic flagging of potentially polluted scenes.
  Initial work performed with neural networks.
- Use of extended range of spaceborne sensors to reduce revisit time period.

Multi-application support system

On top of providing an operational system for oil pollution, the RAMSES system has also been designed as a set of generic functions able to support new thematic application. In this sense, RAMSES is already supporting a flood monitoring application (Decide – ESA funded project). Only flood specific client application and corresponding RAS had to be developed.

6. CONCLUSIONS

Struggle against maritime pollution constitutes a permanent and tough combat requiring international cooperation, deployment of advanced means including spaceborne surveillance, distributed information : RAMSES initiative, at its level, paves the way to such an approach.

REFERENCES

- RAMSES web site : http://ramses.esrin.esa.it

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