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THE GETIS ARCHITECTURE FOR DISASTER MANAGEMENT

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1. INTRODUCTION

GETIS is a European Commission (EC) funded IST supporting measure to provide practical guidelines for building nodes on a geo-processing network such as that envisioned by INSPIRE. A two-year project, GETIS passed its 18 month review on November 21, 2002. The GETIS consortium partners are PCI-UK (UK), SICAD Geomatics (Germany), OGC-Europe (UK) and ITC (Netherlands).

The partners selected disaster management as the application domain, because is requires users to find and integrate diverse kinds of geospatial data in a very short time, sometimes a matter of minutes. They evaluated user requirements and propose an interoperable, web-based system using commercially available product upgrades based on emerging standards. Although using disaster management as the subject, the user requirements and subsequent architecture do not preclude adaptation in other geospatial applications, namely environment and security.

While it is not within the scope of GETIS to address issues of policy directly, recommendations can be taken after strengthening links to society and e-government through active dissemination of the results therein. The main focus of this paper will be to illustrate some of these results, the first being user requirements and the second the standards framework developed to address them, with the final outcome being increased interoperability and usability of web services for information collection, automatic processing and web-map dissemination.

The results summarized herein are publicly available in the original project reports at http://www.getis.net

2. USER REQUIREMENTS AND STUDY OBJECTIVES

GETIS is a user-driven study, in that one of the earliest tasks was the creation of a Working Group of Experts. This small Working Group (WG) guided the project by supplying real examples of their geospatial data use, problems they encountered and solutions they would recommend. Their input led to the proposed architecture and standards framework which we will soon be entering the testing phase. Their secondary task was the critique and evaluation of project plans and results. The WG was assembled from industry, academic, government and policy related fields and provide a cross-section of the geospatial community, as one of the key tasks set out within this study was to begin with an analysis of their needs, both in terms of data and services. An initial survey of over 200 members of the GI community yielded the following requirements, summarized here:

- Visualization should be possible on mobile devices.
- Relevant information should be available for low prices or even free of charge.
- Information should be available in a seamless information service; 24 hours per day and 7 days per week.

- Update frequency, accuracy, scale and other quality aspects should be based on user needs.

There are two main conclusions drawn from these initial survey activities:

- Interoperability interfaces are a strong requirement to overcome the barriers of (not yet standardized) access to existing data-sets.
- Specific information services, which overcome the need for highly sophisticated, end user GIS skills, are more important and much better value than applying yet another data model to existing data sets.

The initial foray into examining existing data turned up support for users' complaints. For instance, there are very few examples of 'information communities' existing either at the national or pan-European level. The spatial data market in Europe is mainly derived from pre-computer, hard-copy publishing practice, be it of maps, atlases, statistical reports or the like. This mismatch between user requirements and marketed products disenfranchises small enterprises and citizens alike, whilst it is assumed that large enterprises can afford to circumnavigate such hindrances to successful business.

Existing data sources are often incomplete, such as the property database of a gas supply company, which excludes properties that are not supplied. The same limitation applies across a range of private and government databases. However, building new databases that are 'complete' in terms of the requirements of a broad application domain would not only be extremely costly, but is also inhibited by obstacles on the legal and administrational side. While in some cases the introduction of new data sources might be exploited to help solve such problems, providing interoperable interface layers to existing proprietary data stores is the most promising way to build commercially sustainable solutions that accommodate those involved.

Today's technology and IT infrastructure in most parts of Central and Western Europe are now capable of supporting solutions which can actually provide relevant information directly to specific user groups. It is bridging the gaps between traditional, data-centric expert systems and modern, web-based information sources. These sources have potential for new value chains for commercial service suppliers whilst at the same time allowing users access to geospatial information without requiring expert knowledge.

Upon reviewing these results with the WG, a set of minimum baseline data requirements was proposed and the example scenarios were developed within this framework. After several rounds of review, a conceptual architecture (to follow) was created to illustrate the general flow of information and specific, key elements and tasks. The data could be designated as belonging to one of five major domains:

- Transport Infrastructure, e.g. airport, road, rail.
- Supply Infrastructure, e.g. electricity, telecommunications
- Buildings, e.g. residence, warehouse
- Response Infrastructure, e.g. public shelter, police station
- Coverage, e.g. DTM, hydrology, aerial photograph

Based on the WG input, it was also important to account for the locations of various emergency resources, such as fire, police, hospital and helicopter pad locations, which lead to the final baseline data list to be used in the architecture:

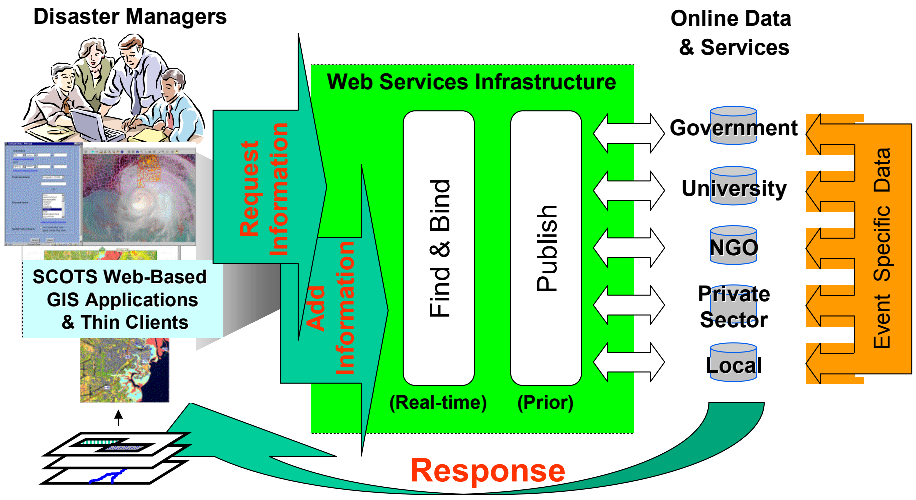
1. Residential Buildings - locations and addresses
2. Resources (Fire, Police, Shelters, etc.) – locations, jurisdictions, contact info
3. Hazardous Objects – locations

4. Disaster Area - delineated extents
5. Topography - at appropriate scales
6. Raster Images - of disaster extents and surrounding area at appropriate scales
7. Contact Information - of authorities for co-operation and exchange of information

By incorporating these data needs into the example workflows, the conceptual architecture took shape in conjunction with standards development, although the influence on emerging web-service standards is currently in its early stages.

3. CONCEPTUAL ARCHITECTURE

Based on OpenGIS Consortium and ISO standards, the GETIS conceptual architecture (below) provides a framework for unifying spatial information flows involving any number of web-connected participants. The architecture has been generalized from a number of specific, user-supplied cases, which is essentially the reverse of the typical top-down development previously seen in proprietary data communities. In this architecture, both geospatial data and remotely executable geoprocessing modules (web services) reside on servers and publish their content and capabilities, just as text based web sites publish their contents and links. An information request from a user launches automated processes that find and select appropriate data and services (using registries and catalogs that keep track of various, independent servers' published contents and capabilities) and access these to process and present real information. This may involve extracting "views" of multiple thematic data layers from multiple sites in which the data resides in different spatial reference systems at different resolutions. Some layers may be vector, others raster, or perhaps database tables. Operations to retrieve, manipulate, and present the data may involve "chaining" of services which have been developed by multiple vendors and which reside on multiple organizations' servers. In addition, there are event specific data, which exist only temporarily, but which are relevant and need to be integrated into the information flow.



The above diagram illustrates the architecture derived from user needs and examples. In this case, the Users are Disaster Managers and Emergency Planning Officers, but the request/response method can be adapted for other users as well. The key feature is the central Web Services Infrastructure, which includes, among other things, a set of programmable, modular, user-defined tasks for data location, integration and analysis. The test of the architectures and standards as a new method of interoperability for disaster management will take place in the Proof of Concept.

4. INTEROPERABILITY STANDARDS

A review of available standards frameworks which support European Geo-Processing Interoperability lead to the conclusion that there is a practical framework available: The web-based OGC Web Services (OWS) framework.

OWS enables automatic publishing and discovery of geospatial data and geoprocessing services, and automated chaining and execution of these services based on internationally developed and accepted standards. Enough framework elements have already been implemented in commercial products to enable demonstrations and limited practical applications. OWS is under active development, which means that new services are added every few months, and the international OGC process is open to input from European users. A Proof of Concept based on selected GETIS use case scenario will highlight the benefits of this approach, based on the OWS framework.

Part of the framework, GML, is a standard for encoding geospatial data and geoprocessing instructions in XML. GML allows greater flexibility in information sharing among Information Communities whose data schemata are similar, and enables the development of new web-based tools to facilitate information coordination. This method is believed to be more efficient for analysis and dissemination of geospatial data than traditional, hardcopy methods and a prototype has been developed for a flooding scenario.

5. PROOF OF CONCEPT

To test the speed and effectiveness of the prototype, an emergency scenario (flooding) was mapped onto the architecture and development began. This requires not only the implementation of the standards and processes into an architecture application, but also of the architecture into existing infrastructure. The scenario follows the current information flow and at each stage calls upon the new architecture to deliver the information:

- Receive Flood Warning
- Identify Properties at Risk
- Identify Occupants
- Initiate Evacuation
- Refine Model

Using the developed architecture, XML and standard software, the GETIS proof-of-concept will show how important parts of this architecture can be implemented now with currently available commercial products. Creation of a functioning prototype is required to prove the value of the proposed approach to the community at large, before the community will be willing to invest. As such, the GETIS partners intend to approach amongst others both the GMES program and relevant FP 6 programmes to allow for the implementation of a follow on project in the near term. Exploitation and dissemination of results from prototype development will include a significant portion dedicated to ensuring the next phase, Pilot to Operations, is attained.

To demonstrate the different stages in moving from traditional data-centric set-ups to information networks serving user requirements, a Proof of Concept demonstration has been implemented as a tool to aid iterative dialogues with user communities. This proof of concept, accessible from the GETIS homepage, is a specific example of a typical application and the necessary standards based interoperability. The proof of concept has the following goals:

- Providing an overview of a set-up with traditional data sources to highlight the currently involved processes to address the requirements of a selected use case scenario.
- Simulating potential information services based on demonstrated information requirements and real world commercial data sets. By plugging web services based on SCOTS products into the traditional proprietary system set-ups, the conversion from 'data' into 'information', still based on traditional data sources and representation styles, is demonstrated.
- Showing how GML can provide further improvements.
- Illustrating how geospatial information can feed into mainstream ISTs.
- Visualizing the way to move towards an interoperable information service network supporting end-users in production environments.
- Demonstrating the benefit of SCOTS technologies and the value of OGC/ISO international standard interoperability initiatives.

With completion of the fully operational proof of concept scheduled for April 2003, testing of the new architecture integration of emerging standards will be the main focus, with results expected by summer 2003. The remainder of the study is to forge ongoing development with other projects, notably INSPIRE, GMES, other FP6 work and initiatives in government, academic and industry throughout the European community. These phases will include further business and infrastructure development, as well as refining the architecture to accommodate emerging standards and web services. The user-driven, bottom-up approach has proven successful in designing a framework, especially for identifying gaps between production and uptake in the Geospatial Community as a whole. The information flows of real examples has produced an architecture framework which can incorporate and influence existing and emerging standards, which can only further the usefulness and interoperability of geospatial data.

Further information can be found at the GETIS homepage: www.getis.net, including details of the Working Group, structure, analysis, results and future work.