Geo-Processing Networks in a European Territorial Interoperability Study

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1 Introduction

The key objective of GETIS is to show how it is possible today to build Web-based networks in Europe that enable people to quickly find and use geographic information for disaster management and many other purposes. The main task of GETIS is therefore to validate and propose an approach that commercial solution and service providers could follow to build nodes of a pan-European geoprocessing and geospatial information network.

Close discussion with experts and end-users and the creation of detailed use-case scenarios provided the foundations upon which a framework proposal for interoperable web-based information services was built. Due to this user-centric approach and the close relationship to global standardization organisations, GETIS might be in a unique position to offer a win-win situation to all, users and solution / service providers as well as standards organisations: demonstrating the benefits of true interoperability and web-based information services over traditional business processes, which have largely been influenced by data providers, will most likely stimulate a demand for according products; at the same time it is anticipated that the increasing demand will accelerate the standardization processes, requiring, but also enabling, software vendors and service providers to better serve the markets.

In addition to exploring new, interoperable communication opportunities that enable spatial analysis in the broadest sense between users concerned within both governance and commercial activities, the result of GETIS laid the foundation for a bi-directional communication between standards organisations and the end-users. By linking these sides, a process has been initiated that will ensure that interoperability standards actually help to support workflows and productivity in a real world environment and that standardisation processes are more than academical exercises.

This report describes the methodology that has been chosen to reach these targets, the major requirements on information derivable from geodata that have been identified for selected exemplary disaster management processes and an outline of the proposed interoperable web services framework.

There are very few examples of 'information communities' existing either at the national or pan-European level. "Information Communities" in our context being defined as groups of people whose profession, discipline, industry, region or nation, government mission or other common interest (or, very importantly, natural language) causes them to have special shared requirements for naming geographic features and for representing relationships among these features. 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. For example, when the Ordnance Survey (United Kingdom) began to digitise its maps, the business case and technical specification were based on the requirement to improve the economy of the internal flow line. Even today, the marketed product lends more to these early origins than it does to a rigorous analysis of users' digital needs. Much the same experience is repeated across Europe for mapping, cadastres, thematic data etc. This mismatch between user requirements and marketed products disenfranchises SMEs and citizens alike, whilst it is assumed that large enterprises can afford to circumnavigate such hindrances to successful business.

Existing data sources are rarely complete: for example, the property database of a gas supply company excludes properties that do not take the supply. The same limitation applies across a whole range of private and governance databases. However, building new databases that are 'complete', e.g. in terms of covering the requirements of a broad application domain, would not only be extremely costly and but is inhibited by a whole array of legal and administrational obstacles. Though 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 forward and best way to build commercially sustainable solutions that accommodate the business requirements of all involved

parties.

Another important aspect lies in the benefits derivable from combining information derived from traditional data sources and processes with new data-sources.

For example, commercial Earth Observation (EO) sources nowadays can provide complete and nearly instant coverage of most areas of the world with in a sufficiently high resolution for most requirements. However, on its own and un-calibrated, the value of EO sources is restricted and needs the involvement of highly skilled experts. The EO sector is evolving rapidly and is ready to offer better as well as more complete data coverage, particularly at higher resolutions than only 5 years ago, equivalent to traditional map content at scales of 1:25,000.

After all, 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, which contain quite a potential for new value chains for commercial service suppliers whilst at the same time allowing users access to geospatial information without requiring expert knowledge.

GETIS has established 'information services in disaster management' as a headline under which to address the user requirements topic. It was expected that this topic would span most application and information domains and services and it was anticipated at the same time that disaster management would draw a high level of interest and therefore help to get potential users and experts interested in contributing to the project.

The 2001 IFRC World Disaster Report e.g. underlines this perception:

> *'More disasters were reported for 2000 than in any year over the last decade. Fortunately these disasters proved less deadly than in previous years: around 20,000 people lost their lives worldwide, compared to the decade's average of 75,250 deaths per year. However, last year 256 million people were reported affected by disasters, well above the decade's average of 211 million.*
>
> *[…]*
>
> *While the number of geophysical disasters reported over the last decade has remained fairly steady, the number of hydro-meteorological disasters since 1996 has more than doubled. During the past decade, over 90 per cent of those killed by natural disasters lost their lives in hydro-meteorological events such as droughts, wind storms and floods.*
>
> *Floods accounted for over two-thirds of the annual average of 211 million people affected by natural disasters, while famine affected nearly one-fifth. Yet floods proved less deadly, accounting for 15 per cent of deaths from natural disasters, compared to famine's 42 per cent.*
>
> *The cost of damage inflicted by disasters is notoriously difficult to estimate. Our data reflects only estimates of direct economic damage, not indirect or secondary effects. Statistics adjusted for inflation reveal that natural disasters worldwide inflict an average of US$ 78 billion per year in damage. The most expensive disasters are floods, earthquakes and windstorms. While earthquakes accounted for 30 per cent of estimated damage, they killed just 9 per cent of all those killed by natural disasters. Meanwhile, famine killed 42 per cent, but accounted for just 4 per cent of damage, over the past decade.'*
>
> *[quoted from : http://www.cred.be/emdat/intro.html]*

2 The GETIS Approach

GETIS is a user driven information study to link 'real-world' user requirements with Data and Systems Providers and with the established global standardization processes. A key result is a best practice approach proposal to overcome identified gaps in the established processes and information flow.

As an initial activity, GETIS established a Working Group (WG) of practitioners in the field of disaster management. Starting on the assumption that either re-structuring of existing or the introduction of new data sources would hold the key to fulfilling most geospatial requirements, it was quickly understood that this perception was largely driven by established data providers and their current business models and not necessarily by end user requirements. Not really surprisingly, user requirements tend to be information requirements in the first place. Only because of traditional workflows, which are adopted to derive information from any available data-source, in many minds user requirements were perceived as data source requirements. However, by drilling down to the core activities and processes a typical end user has to pursue in everyday business, it becomes apparent that in reality state-of-the-art technology based on interoperability interfaces can provide the link between existing data-sources and information requirements, eliminating the need for the introduction of new data-sets.

In order to ensure sustainable uptake of results, institutional linkages continue to be established between relevant standards bodies, managers in relevant EU programs, international standards bodies and other entities (see dissemination plan for specific details). It is very clear, however, that the end user community must become more involved in the process to ensure that follow on work results in appropriately useful IST. As such, the GETIS partners in full concert with end users in the Working Group have participated in dissemination activities and intend to continue to exploit the project results beyond the project lifetime.

As discussed in more detail in the GETIS Exploitation Plan, the 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 FP6 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.

In parallel with EU programmes activities, there is a series of other initiatives underway in both the EU and international bodies. The GETIS team will monitor these opportunities, disseminate GETIS results outside the EU as required and evaluate potential projects.

3 User Driven Evolution of Objectives

The ultimate need for the end user is information, not data, new technologies or new standards. Providing the means to manage the information supply chain, creating new information on a demand basis and allowing the end users to determine how they want to handle the information ultimately builds an "in-context" method for dealing with geospatial information. Thus, the development of the Information Society is furthered, rather than the proliferation of varied and proprietary data sources.

As it stands today, there are large numbers of complex, data centric technologies that provide powerful and useful tools and toolkits to the end user community. However, it is still up to the end user to make certain that these tools are appropriately applied and, as well, that he makes tools from different vendors functional effectively on proprietary and often difficult to convert data sources. In short, the tools are present, the data is present, but solutions to derive and provide geospatial information are few.

The initial main purpose of GETIS was to identify the key data domains in Europe that provide relevant data and to establish an understanding of standards, either existing or to be defined, which allow would true interoperability in information communities. The GETIS project as originally conceived therefore included a "domain modelling" effort which would have resulted in a prescribed family of data schemas

appropriate to the use cases identified as key information in Europe that can be shared by information communities.

However, when defining application scenarios and identifying the relevant information needed in decision making processes, it was determined that most requirements can actually be satisfied by existing data sources, but that there's a distinct gap in deriving user-relevant *information* from the existing data-sets in their proprietary GIS formats. There is a lack of accessibility both on an administrational or legal level as well as on a technical interoperability level. Thus GETIS adapted its main emphasis away from 'prescribing' domain data models towards proposing a framework model, which will allow public and private players in the geospatial marketplace to build nodes in an interoperable information services network.

3.1 User Requirement Survey

A survey on user information requirements related to disaster management process stages revealed a distinct gap between most involved end-users and the providers of data.

The information-flow relating to data sets between different governments agencies and between those agencies and the public needs to be encouraged. Whilst access to data, its collection, custody and updating should be facilitated at a local level, the overall information infrastructure should be recognised as an international uniform service shared within and between nations.

General information and data-set-requirements have been identified through a survey of more than 200 members of the disaster management community, which led to the formation of the Working Group of experts. General information requirements were primarily for content found in topographic maps with a high level of detail, such as information about property and residents, including street addresses.

In general those data-sets are digitally available in most organisations, but potential users in disaster management are often insufficiently aware of the existence of those data or lacking necessary rights or skills to derive specific information from the raw data.

Some access conditions related to these data-sets have been formulated as requirements:

- Information should be available in a seamless information service;
  24 hours per day and 7 days per week.
- Relevant information should be available for low prices or free of charge.
- Visualisation should be possible on mobile devices.
- Update frequency, accuracy, scale and other quality aspects should be based on user needs.

There are two main conclusions from the initial survey activities:

- Interoperable interfaces are a strong requirement to overcome the barriers of not yet standardised access to existing data-sets. To share data across information communities requires technical interoperability, i.e. the ability of diverse spatial processing systems to communicate in real time via shared interfaces which need to conform with ISO/TC211 and OGC's OpenGIS® Specifications.

  In addition, semantic interoperability is required which refers to standards related to data content (including quality issues), naming of geographic features, and schemas for metadata.

- Specific information services overcoming the need for highly sophisticated GIS skills at the end user / practitioner side are of higher importance and much better value than the introduction of yet another set of data models to apply on already existing or 'to be re-captured' data sets.

The management of an up-to-date system inevitably involves the use of modern information and communication technology, building the information service nodes in a framework for a geo-spatial information infrastructure. It must be able to accommodate new user demands and take advantage of new technologies as they become available. The technology adopted should be sufficiently flexible to meet anticipated future needs and to permit a system of growth and change.

3.2 Proposed Application Frameworks & Standards

A review of available standards *frameworks* to support a European Geo-Processing Interoperability Framework lead to the conclusion that there is a practical framework available: the Web-based OGC Open Web Services (OWS) framework. OWS enables automatic publishing and discovery of geodata and geoprocessing services, and automated chaining and execution of these services based on internationally developed and accepted standards.

Enough framework elements are already 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 a selected GETIS use case scenario highlights the benefits of this approach, based on the OWS framework.

Part of the framework, GML, is a standard for encoding geodata and geoprocessing instructions in XML. GML opens the door to greater flexibility in information sharing among Information Communities whose data schemas are similar but not the same, and enables the development of new Web-based tools to facilitate information coordination: users develop *data schemas* consisting of a set of geographic feature descriptions and feature attributes appropriate to their application requirements. Users who produce or use the same data schemas comprise "*information communities."* To overcome the problems associated with proprietary formats, the Open GIS Consortium (OGC) has specified (and continues to do so) common interfaces that enable systems to interoperate despite their proprietary data formats. This allows users to share information from a variety of sources on the one hand and to specify the Geography Markup Language (GML), an extension of the World Wide Web Consortium's XML (eXtensible Markup Language) standard, for data exchange on the other. GML is based on the abstract model of geography that is a central element of OGC's interface architecture. It is not an interface but an encoding designed for the transport and storage of geographic information, including both the geometry and properties of these features. With GML a new, more practical approach to creating similar but different "families" of data schemas is at hand, which allows standardised and efficient access to data sources, enabling and supporting the process of deriving and disseminating information.

Because XML provides a powerful platform for parsing and operating on structured text, the GML data modelling approach can greatly reduce the need for re-capturing and updating basic data-sets to comply with information community specific data models. Thus, the traditional approach to domain modelling is no longer a part of the GETIS project. To facilitate European adoption of this newer technical approach, the GETIS project was reoriented to demonstrate practical applications of GML using commercially available standards-based commercial off-the-shelf ("SCOTS") technology in conjunction with the existing data-sources in their current proprietary formats products.

3.3 Conceptual Interface Architecture

Based on OpenGIS Consortium and ISO standards, the GETIS conceptual architecture provides a framework for unifying spatial information flow involving any number of Web-connected participants. Both geodata and remotely executable geoprocessing modules (services) reside on servers and publish their content and capabilities, just as text based websites publish their contents.

Users' information requests launch automated processes that find and automatically select appropriate data and services (using registries and catalogues that keep track of the servers' published contents and capabilities) and access these to process and present 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, while others may be raster. 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.

Practical application of the architecture as in the GETIS Proof of Concept based on the flood management use case shows improvements in spatial information access that are achievable today through interoperation between standards-based commercial-off-the-shelf products that implement OpenGIS Specifications. That use case and the other GETIS use cases could be the focus of similar demonstrations or pilot projects in the future. Such future pilot projects would be able to prototype multivendor distributed geo-information systems using a much broader array of commercial products. These products will implement an expanded set of OpenGIS Specifications and will provide an even more expanded set of proprietary technologies. So future pilot projects will be able to address a much broader array of user requirements.

For example, in flood management:

- Vendors could install a representative array of web-connected rain gauges and water level sensors and monitor these using applications implementing OpenGIS Specifications developed in OGC's Sensor Web Enablement program.

- Field workers with LBS-enabled cell phones and handheld computers could show the value to emergency personnel of Location Based Services applications implementing OpenGIS Specifications developed in OGC's OpenLS program.

- Software implementing OpenGIS Specifications developed in OGC's Spatial Fusion program could demonstrate how lists of addresses can be quickly sorted and mapped to obtain and call the phone numbers of people and businesses in an area that will soon be underwater.

- Imagery obtained from sensors on planes and satellites can be analyzed in different ways using Web Services that provide access to different online servers. These might be linked to Decision Support applications that also draw from other data sources.

Similar prototyping of multi-vendor information resource networks can be undertaken in other kinds of disaster scenarios. Disaster information networks are inherently and necessarily multi-vendor networks. Standards provide the "glue" for such networks, enabling interoperability and also supporting innovation and the widespread fitness, quality, and timely delivery of geospatial solutions.

A practical outline description and a scenario based sample implementation are given in the next section:

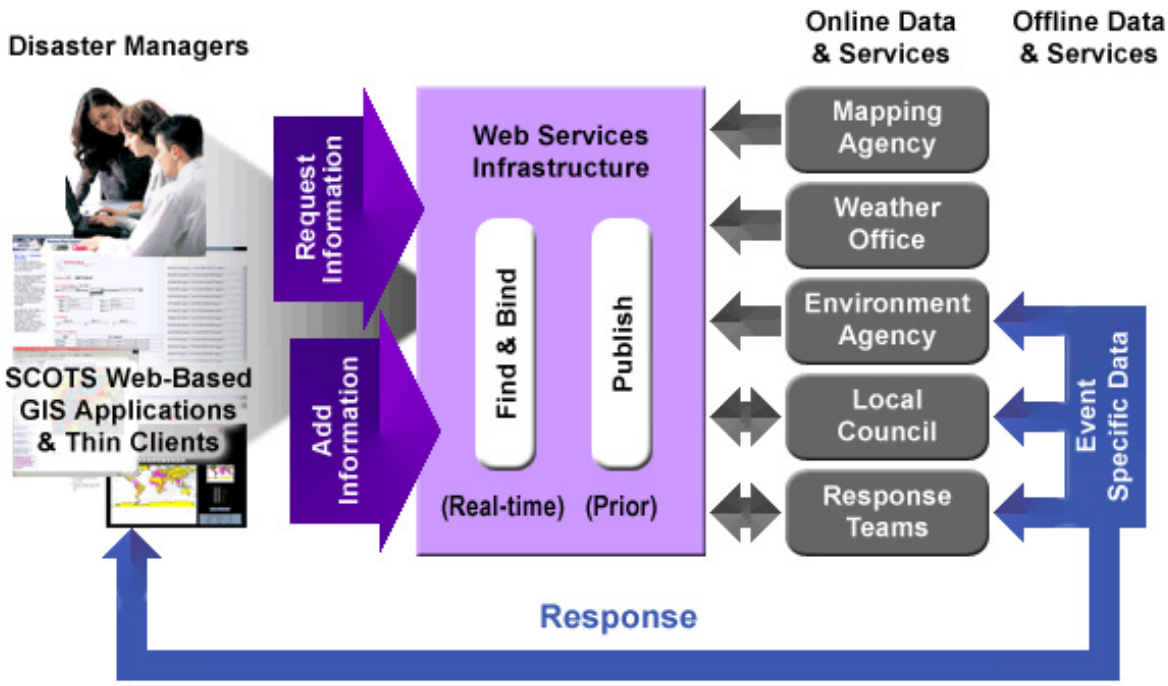
3.4 The Proof of Concept

In planning a geographic information network, one first looks at the network users' information requirements and the context of the users' workflow into which the requested information feeds. The GETIS Proof of Concept is based on a simplified inland flooding incident in the South West of England. The scenario describes disaster management activities typical of how flooding incidents are dealt with at the local government level anywhere in the world. To demonstrate the different stages in moving from traditional data-centric set-ups to information networks serving user requirements, the Proof of Concept has been implemented as a tool to aid iterative dialogues with user communities by:

- Providing an overview of a set-up with traditional data sources to highlight the currently involved processes which 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.

The GETIS Proof of Concept has shown how important parts of this architecture can be implemented with currently available commercial standards based products. GETIS has also shown the way to migrate existing systems forward, efficiently and economically, along an interoperability path that leads to a geoprocessing network that is as open as the Web.

Below is a general architecture diagram for the Proof of Concept, in which disaster managers use Web-based client applications to request information from (or add information to) a heterogeneous collection of data servers and processing services. These requests are mediated by a web services infrastructure that includes catalogues populated with data and service meta-information that describes the available data and information services. The infrastructure also provides the means for software "binding", i.e. communication between the service and the remote client application, facilitating the provision of information as opposed to the traditional exchanges of mere raw data sets:



A detailed description of the proposed framework can be found in the 'Information Requirements and Data Strategy' report, available at the GETIS web site.

4 Exploitation

The Results from the GETIS project act as indications of the convergence between the world of standards, technology, interoperability and end user need for real information within the organizations interested in Disaster management in specific, and Geospatial information services in general.

However, these results represent one step in the process of connecting all interested parties using the modern, fast changing approach offered by Web based Geospatial information Services. Dissemination of results to the wider community is a key activity of the GETIS project. The concepts and proposed methods require support from all levels of the community with an interest in Geospatial Information and infrastructure. As such, clear marketing and communication of the project results and follow on intentions are required, to select, key stakeholder groups, both within the European context and internationally.

The level of interest generated amongst the GETIS project group, Working Group members, standards experts and the geospatial information community in general, combined with the specific headline of disaster management, suggests a strong interest in the results as well as follow on projects. To date, dissemination activities show that the results of the GETIS project are of high interest to stakeholders ranging from data providers to end-users. The GETIS Exploitation Plan describes an approach to ensure the results from GETIS are carried forward and taken up by the relevant organizations and that a proposed follow on project receives endorsement and investor interest.

The need for improvements and development of infrastructure enabling Geospatial Information Services is, in certain ways, more urgent than it was during the original conception of the GETIS project. In addition, the overall environment within the EU and the international community has evolved to the

point where the need to create real world, needs based, pilot information services and technologies has a high profile. The results from GETIS are in line with this evolution and, in the case of standards bodies, helped accelerate the interest in building actual infrastructure. It was the intent of the partners for the duration of the project and beyond to aggressively pursue a follow on project targeted at the Geospatial Information Service needs of the disaster management community in general, with the specific application area being highly influenced by the end user community.

Rather than finding new sources of data, Geospatial Information Services have emerged as a strong requirement from end users and the community in general. Any follow on work must involve end user organizations with real-world geospatial information requirements and needs. In short, the connection between the end user and information sources must be as simple as possible and not necessarily require extensive data conversion expertise.

The approach taken by GETIS shows that the market is still some distance away from large-scale investment in operational projects based on our results. However, as mentioned in the Exploitation Plan, uptake of the results of GETIS continues to be successful. In order to stimulate further uptake and eventual investment, a pilot node to initiate a Geoprocessing Network is required. With a rapid prototyping and implementation approach it is believed that the value can be easily proven to the user community at large. From this point, operations of multiple nodes and large-scale commercial exploitation can be attained.

The following conferences and workshops have been attended or organized to disseminate and discuss the work and results of GETIS and to pave the way for commercial uptake past the project end:

1. A GETIS presentation was given to the CYCLEAU FP5 project meeting hosted by Cornwall County Council in Truro in May 2002.
2. A GETIS Introduction was given at the EC-GI&GIS 7th Workshop ETII: Managing the Mosaic was held in Potsdam, Germany on 13-15 June 2001.
3. The first Working Group meeting was held the 18th of February 2002 in Horsham, UK.
4. The second Working Group meeting was held the 15th and 16th of April 2002 in Munich.
5. The first GETIS Validation Meeting was held at the University of London Senate House, London, UK from 1400 to 1600 on June 11, 2002.
6. The International Conference GDIN-Global Disaster Information Network has been attended in Rome, 17 - 21 June 2002.
7. A GETIS presentation was given at the 8th Annual *EC-GI & GIS Workshop ESDI: A Work in Progress* at Dublin Castle, Dublin, Ireland, 3-5 July 2002
8. A 2nd Standards Validation Workshop was held at the OGC September 2002 TC Meeting in Noordwijk, NL.
9. A GETIS Introduction was given at the GMES Briefing in Rome, September 2002.
10. The third Working Group Meeting was held October 2002 in Frankfurt, GER.
11. A 5th Framework Concertation Meeting and the 6th Framework Info Day were attended in Luxembourg, October 2002.
12. A brief status update was done for the EUROGI Meeting in December 2002, Apeldoorn, NL.
13. A standards status update has been carried out during the OGC TC Meeting in December 2002 in Thousand Oaks, USA.
14. A brief presentation was given at the GINIE Meeting in January 2003, Munich, GER.

15. A standards status update was carried out during the OGC TC Meeting in February 2003 in Washington DC, USA.
16. A 1-day workshop to evaluate commercial exploitation opportunities and to verify the second version of the Proof of Concept was held with Cornwall County Council in February 2003.
17. A brief presentation has been given at the GINIE Meeting in March 2003, Rome.
18. A 1-day workshop to refine and verify requirements for a pilot implementation was held with Cornwall County Council in March 2003.
19. The final standards status update was carried out during the OGC TC Meeting in April 2003 in Orleans.
20. A GETIS presentation was given at AGILE, in Lyon on April 24th, 2003.

The EC's support of this program indicates their acceptance of the Open Web Services approach and raises the EC's level of interest in supporting uptake of products and services using OGC specifications in Europe. At the same time the pro-active involvement of OGC Europe in GETIS safeguards the accommodation of European requirements in the global geospatial standardization processes.

Though the project has been carried forth with a particular focus on disaster management, the final report emphasizes that the approach applies to most other spatial related application areas as well. By providing a framework for interoperable web based information services and proposing a best practice approach to transform traditional, data-centric processes and business models into modern, services based ones, successful commercial exploitation is anticipated in due course.

Accordingly the following meetings and activities were scheduled at the time of compiling this document:

- A 1-day workshop is proposed with the Natural Resources Canada to evaluate joint commercial exploitation opportunities in early May 2003 in Ottawa, Canada.
- A 5-day workshop addressing the requirements and technical specifications for the installation of an information services pilot at a potential customer site is scheduled for June 2003.
- Preparations for a follow-on project proposal under the 6th Framework are under way and forthcoming meetings in support of this will be attended.

5 Recommendations

There is a strong need for co-operation between data-collection and data-management.

Co-ordination, what technology should be acquired so that all components are compatible, which common standards should be adopted (e.g. OpenGIS, ISO, CEN standards), how common procedures can be developed, and other system related decisions need guidance on a more generic IT integration level rather than just from a GIS perspective.

5.1 Global Recommendations

5.1.1 Developing Information Services

In the context of disaster management, results from GETIS show that there is a minimum set of baseline information (extracted from data) required by the community. For follow on work and exploitation, this baseline data set must be provided in a form where end users can easily ask questions such as 'show me all objects at risk' rather than taking delivery of a series of layers that may contain only vectors, points and EO data. These data are generally in proprietary formats and require extensive end user processing to produce the required information.

Data and information protection issues and IPR need to be addressed to provide a sustainable legal foundation for any commercial activities to start building infrastructure information services. The public agencies must understand and accept the need for certain information to be placed in defined user community domains.

5.1.2 Linking User Communities and Standardization Orgs.

Ensuring interoperability of data and information along the supply chain is addressed by a combination of SCOTS technologies and appropriate metadata handling abilities inherent in the use of Geography Mark-up Language (GML). This means that as part and parcel of the follow on exploitation, care must be taken to ensure that the continued development of GML takes into account the specific requirements of relevance to the disaster management information community as well as other information communities in general.

It is clear that full exploitation will require operationalization of the internationally recognized Web Services approach advocated by the OpenGIS Consortium and it members. GETIS has resulted in a proposed Interface Architecture that acts as an important enabling structure in the information supply chain.

5.1.3 Reviewing New Technologies and Standards

The GETIS results point mainly in the direction of OGC and ISO based standards, since the primary objective was to understand spatial requirements and propose approaches addressing these specific needs. Of course, on an overall IT integration scale, other standards would have to be included and adopted in a solution to ensure full interoperability on all system levels. One of the most often mentioned a question was how GETIS relates to other 'standards' like Microsoft's .NET and the like.

First of all, we must understand the role that .NET plays in building distributed interoperable systems. .NET is a "software platform". It's a language-neutral environment for writing programs that can easily and securely interoperate in the legacy Microsoft environment. It is also the collective name given to various products and services built upon the .NET platform. Within the OGC, this type of technology is referred to as a Distributed Computing Platform (DCP).

.NET itself uses a number of open standards extensively; Its Web Services components use SOAP (which uses XML data over an HTTP transport) to interact. They also use UDDI for learning about Web Services, and it uses other standards. .NET is an implementation of open standards, but .NET itself is not "open". (This description adapted from http://www.arstechnica.com/paedia/n/net/net-1.html .)

It is important to understand that while a DCP can enable interoperability, there is a lot more to building an interoperable system. Most implementations of OpenGIS Specifications, and most Web-based applications of every kind, have used the REST (Representational State Transfer) approach to Web Services. The REST model relies on HTTP and URLs to invoke standard interfaces (such as those defined in OpenGIS Specifications) with understood behaviours. This “Service Model” approach provides a layer of mediation “between business logic and the dangerous outside world.” Since the service components are well understood, they can be shared among different and changing sets of business logic. This ability to integrate components as needed is true interoperability.

.NET (combined with SOAP and WSDL) breaks from the REST/Service Model paradigm and makes any function on a desktop system, for example, almost as directly accessible to a calling program on a remote computer as it would be to a program running on the same computer. This tight coupling of components captures the business logic in software. There are distinct performance advantages to this approach. Any change in business logic, however, requires changes in software. By adding standard services and interfaces to the .NET DCP, it becomes possible to approach the degree of interoperability provided by the REST/Service Model approach.

At this point, there is no effort underway among OGC commercial members to build a set of OpenGIS Implementation Specifications for the .NET platform. There is an effort at InovaGIS.org (http://www.inovaGIS.org) to develop free GIS tools, such as Web Services based on OpenGIS Specifications, using SOAP and other Microsoft technologies, including some implementations for .NET. Such an effort would have value for solution strategies that depend heavily on .NET.

The two likely reasons that such an effort is not underway among OGC commercial members are that:

1. The basic Web protocols, http and URIs, are adequate for a majority of the applications undertaken to date.

2. .NET is a proprietary platform. A .NET service can only interoperate with other Microsoft services. The protocols, interfaces and tools that support REST are readily available from numerous sources. The ubiquity of REST makes it the platform of choice for global interoperability.

In considering what could be done with .NET in OGC, it is useful to consider what is happening in OGC’s GeoObjects Interoperability Initiative (GO-1). (See the GO-1 Request for Technology at http://ip.opengis.org/go1/index.html.)

The vision for GO-1 is to define platform-independent and implementation-neutral interface models of specific geographic services or component objects. The specific Geographic Object interfaces to be modelled relate to mapping processes (render or query, for example) or an input or output of those processes (a coordinate or a map, for example). Creating high-level interface models to Geographic Objects in Unified Modelling Language (UML) will allow developers to take advantage of the valuable components on any DCP (such as .NET or J2EE). GO-1 sponsors and supporters, including government organizations in the United States, want these models because they allow straightforward reuse of existing capabilities for new projects and new implementation environments, an important goal of software systems development.

In GO-1, the automated generation of J2EE code from UML Geographic Objects models will be tested. If code suitable for use in the .NET environment can be automatically generated from the same UML models, it would provide further validation of the Geographic Objects approach and it would enable rapid development of geoprocessing code that could reap the performance benefits and the benefits of interoperability within the Microsoft environment offered by .NET.

5.1.4 Exploring New Application Areas

Disaster Management is a large field of study and work and contains almost limitless application areas, which may range from emergency practitioners to academics working on better ways to model areas at risk.

As such, and to ensure a good strong focus for projects to come, the GETIS consortium will move forward on the elaboration and exploitation as determined by existing use case scenarios, with an initial focus on inland flooding. It is important to note, however, that the approach taken will not limit the results to inland flooding. The approach allows for the creation of multiple nodes with different application areas, including, ultimately, those with a headline other than Disaster Management.

5.2 Detailed Recommendations from the Working Group

The following key recommendations have been derived from the initial survey as well as extensive use case modelling with the Working Group and discussions of the findings at various for events:

5.2.1 There is a need for efficient on-line access for both practitioners and the public.

In all analysed cases, on-line access internally and to the public was minimal, if non-existent. Discussion with the Working Group tells us that most organizations tend to use the Web as a dissemination/communications tools after an event, rather than during an event when it is most required.

5.2.2 Emergency planning organizations need information, not heterogeneous data.

It is apparent that most organizations end up manually fusing all sorts of data (reports, contours, maps, pollution plumes, etc.) in an inefficient manner, often based on inaccurate field reports. There is a need for delivery of not only a baseline data set, but also baseline services, such as rapid change detection, to provide quick tools for risk assessment.

5.2.3 Information products, as opposed to raw data, should be automated wherever possible.

Rather than local agencies, for example, having to collect and create the information product themselves, a subset of functions (automation, modelling etc) should be available via Web services. Speed saves lives.

5.2.4 The Baseline Data Set needs to be maintained, updated and to be at least cost neutral.

Since the baseline data set is crucial for saving lives, not only should it be keep up to date across the European Union, but it should also, at a minimum, be cost neutral.

5.2.5 Baseline Data should be freely shared across Europe.

There is a need to ensure that the Baseline Data set is shared, from a sub-urban level all the way to a supra-national level. This would require changes in legislation on a country-by-country basis. The governance aspects of the problem are outside the scope of GETIS, however this is a major point that has arisen repeatedly.

It is clear that when a disaster crosses national boundaries, the preparation and response varies not only from country by country, but also from sub-region to sub-region. Again, by providing a cost-neutral base data set as well as a dissemination method (internet, web), at the very least a basic infrastructure can begin to be established across the EU.

5.2.6 There is a time lag between local agencies' and national agencies' responses to an event.

For some classes of event, such as e.g. an earthquake, both local and national agencies are aware, simultaneously, that an event has occurred (yet the reaction time for connecting national agency information (plume modelling, for example) differs. This is due mostly to data transmission limitations, which are easily overcome by internet-based approaches.

5.2.7 Resilience is an issue.

Resilience and redundancy of Baseline Data Sets, dissemination and the reactions to an event must be improved, planned and executed to ensure that at least the minimal critical data is available at all times.

5.2.8 Best practices need to be established to ensure that the common Baseline Data Set is efficiently utilized.

Establishment of a minimum set of Best Practices on a Use Case by Use Case basis should be proposed for making full and most efficient use of the Base Line Data Set/Information Set.

5.2.9 Over the medium term, the Baseline Data Set should begin to include Baseline Information Sets, on a Use Case by Use Case basis.

There is a demonstrable need for the provision of a baseline set of information products on a use case by use case basis across national boundaries. The prioritization of the first use cases requires further examination, which is outside the scope of GETIS. However, preliminary results show that cross boundary ocean/river based events are a likely place to start. It is clear that a potentially large number of smaller localities may never actually have the capacity to create their own information from raw data, but would understand information products.

5.2.10 There is a need for European-specific instantiation of OGC services.

In order to ensure that correct service chaining and services exist in the European context, there is a need for follow-up work to create a prototype for a result-based approach. This particular issue is further discussed in the Exploitation Plan.

The interoperability issues in the European Union are not limited to data or information exchange, but include services as well. Even if interoperability were achieved on a pure data level, disseminating, publishing and sharing the processes and added information would still hinder the true sharing of knowledge.