

## Enhancing Business Processes through Web Based Mapping

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The aim of spatial information systems is to provide the ability to improve the quality and timeliness of decisions made within an organisation. Several challenges have historically limited the ease with which this goal is achieved. Issues such as the cost of access to current spatial data, the complex nature of the decisions and the cost of distributing conclusions have contributed to the scarcity of operational examples of such systems for which significant return on investment has been measured.

Recently, new technologies offer a means to develop spatial information systems which focus more directly on business decision and processes. The advent of Web Services, development frameworks and improved network infrastructures have precipitated a new generation of off-the-shelf, open, scalable and loosely-coupled applications. These new applications enable organisations to rapidly deploy systems that spatially enhance existing business processes with a significant reduction of the traditional data management, system development and process delivery overheads.

This paper reviews projects that are achieving business benefits through the use of web based mapping applications. It focuses on open solutions and identifies the issues, both business and technical, associated with successful implementation throughout an organisation. It addresses the latest innovations in web based mapping technologies using the following examples:

- The Western Australian Department of Land Information is using Web Services to share key spatial information layers into Local Government Web Applications which integrate this data into their own business processes.
- The Australian Spatial Cooperative Research Centre is undertaking a project to show the practical use of spatial Web Services and Online applications for Emergency Management.

*Key Words: Emergency Management, Local Government, interoperability, SOAP, Internet*

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## I. Introduction

**T**HE aim of spatial information systems is to provide the ability to improve the quality and timeliness of decisions made within organisations. Several barriers have historically limited or prevented organisations from achieving significant measurable return on investment for these systems.

The root cause of this failure can be traced to several issues:

1. The nature of traditional spatial information systems and the proliferation of the data warehouse model for information dissemination have meant that establishing access to spatial data is prohibitive. The sheer size of the databases created; the complex nature of their configuration; the high level of management skill needed; and the cost of associated infrastructure required.
2. The actual cost of the data needed to provide context for any system has in Australia been prohibitive. For example: any system requiring access to a routable national road centreline dataset would five years ago, attract a licensing cost in excess of AUS\$100,000 per user seat. Although these numbers have reduced they are still a large proportion of the total cost of ownership (TCO). Land ownership datasets and high resolution imagery are similarly priced with updates at up to 30% of the initial amount.
3. The complex nature of spatial processing operations has meant that software products have, in the past, also been priced high and licensed predominantly for desktop usage. Multiple products would traditionally have to be tightly coupled with the data at high development cost in order to deliver solutions.
4. The cost of communicating and distributing conclusions derived from such systems has in the past been high with manual intervention required in most instances.

These issues have all contributed to the commonly held perception that spatial information management systems are an expensive luxury rarely delivering clear benefit to organisations outside of the resource industry sectors (Ref 1.).

Recently, new technologies offer a means to develop spatial information systems which focus more directly on business decision and processes:

5. Improved network infrastructures have driven a new wave in service oriented software offerings that use the Internet as their mode of delivery. (Ref 4, 10, 11.)
6. The advent of Development Frameworks has meant that software can be built more rapidly and robustly than ever before. (Ref 9.)
7. The advent of Web Services and Service Oriented Architectures (SOA) has meant that separate software components can be easily connected through loosely coupled “message” based interfaces like SOAP. A new concept of “interoperability” has emerged with important implications for spatially aware systems. It promises reduced time and cost developing composite software solutions and total cost of ownership. Components and their costs can now be shared between applications that have different purposes. (Ref 2.)
8. Event driven processing, made possible through SOA, are enabling real-time integration of information into decision support systems. This ensures the most accurate, efficient and timely delivery of spatial decision support capability to organisations. (Ref 2.)

These advances have spawned a new generation of off-the-shelf, open, scaleable, loosely-coupled software products enabling organisations to rapidly deploy systems that spatially enhance existing non-spatial business processes. These products offer a significant reduction of the traditional data management, system development, directly address business process, improved delivery overheads, low TCO and high ROI.

GeoSamba by NGIS is a leading product in this group which incorporates all of the new technologies listed above to offer state-of-the-art solutions to governments and commercial organisations. Two high-profile government projects are incorporating the GeoSamba Web Service Product with traditional best practice data management and ICT systems in the delivery of innovative solutions that address long standing issues for Local Government in Western Australia and National Regional Emergency Management.

## II. Western Australian Local Government Solutions

### A. Background

Although Geographic Information Systems (GIS) are recognised now as a key information management tool for local government, its adoption has been restricted to councils with the financial capacity to establish the required support infrastructure. This technology has for the most part been out of reach for regional and small Local Government Authorities. These same regional authorities are charged with managing very large areas of land with limited physical resources and would benefit greatly from access to spatial decision support capabilities.

Even Local Government Authorities with advanced GIS capabilities face issues today which restrict the effectiveness of the technology. The majority of spatial information layers held within GIS are acquired from state, federal or commercial custodians. The currency of these layers varies from weeks to years and directly determines the effective use of the information for decision support purposes.

The effective delivery of spatially enhanced decision capabilities to business users has also been a challenge. Traditionally the options have been to adopt manual techniques to bridge the gap between business process and spatial analysis; or to invest significantly, a process at a time, in developing proprietary solutions.

Recent technology advances in web map servers, SOA, network availability and development tools have combined to make spatially enhanced decision capabilities available to any Western Australian local government authority. The entry of event driven real time information access is providing a new challenge to traditional silo style GIS databases linked to proprietary solution systems. An opportunity exists for progressive councils to migrate today from the old “stovepipe” solutions to interoperable service oriented architectures that deliver accurate information on demand directly from source.

The Western Australian Department of Land Information (DLI) is a leading agency progressing interoperability and event driven real time information access through their “Shared Land Information Platform” initiative and the “LandGate Web Portal”.

### B. WALGA Application Service Provision

The Western Australian Department of Land Information (DLI) in conjunction with the Western Australian Local Government Association (WALGA) are working with to deliver land information decision support capability to 114 remote and regional Local Government Authorities using NGIS’s GeoSamba<sup>†</sup> web solution servers. This new state-of-the-art system will deliver spatial decision support and custom task automation to staff throughout each authority.

Implemented as an Application Service by DLI the GeoSamba servers will host a Project for each authority which they will manage remotely using a browser based administrator interface. Underlying the GeoSamba servers is DLI’s state-of-the-art spatial information storage and delivery platform consisting of:

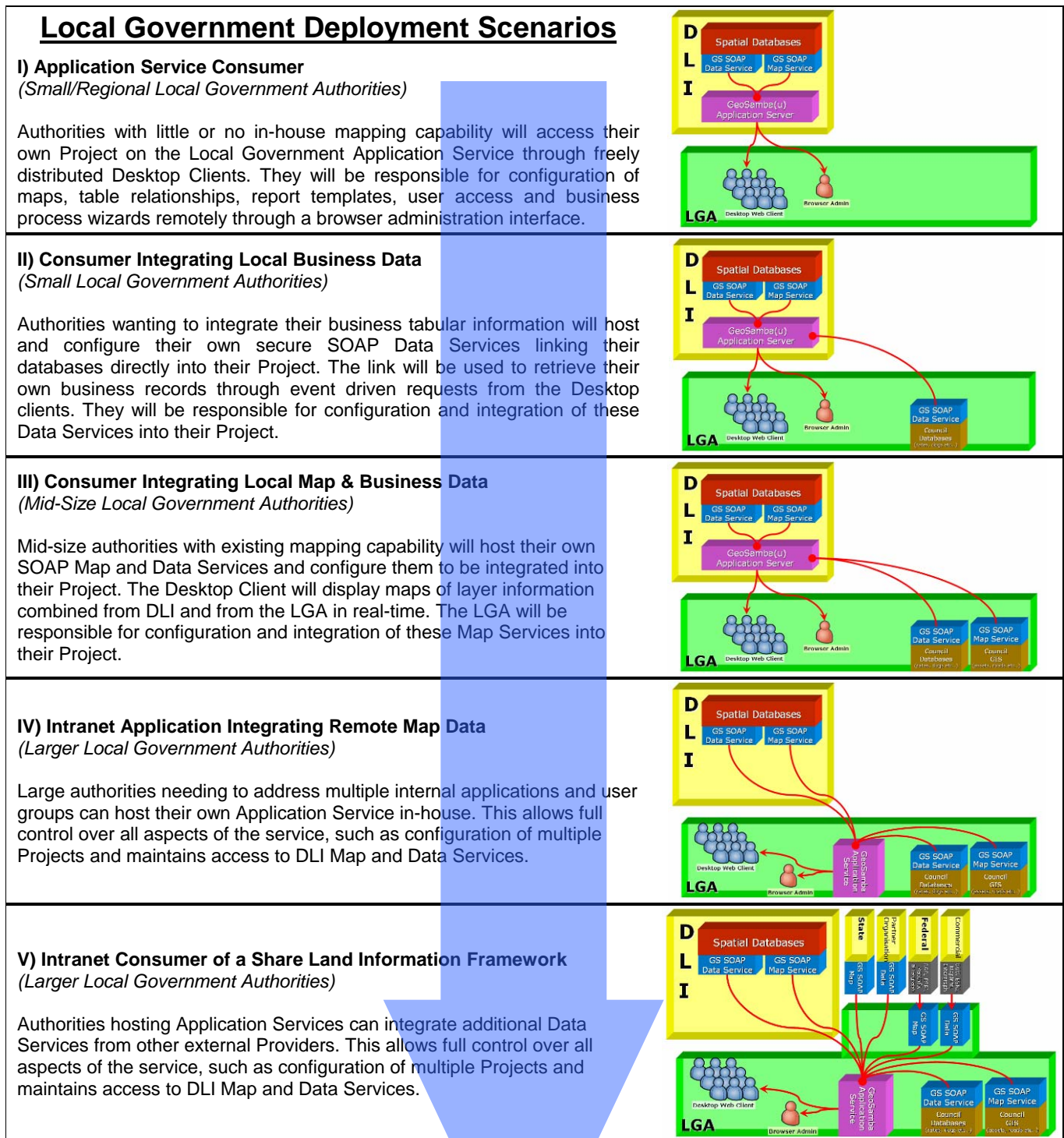
- **SmartPlan** Spatial Cadastral Database and Public Plan management system which incorporates ESRI’s ArcSDE spatial data gateway and ORACLE’s 9i database handling all vector information.
- **SkyView** aerial photograph server built on ERMapper Image Web Server (IWS) handling all raster layer information. <http://www.landonline.com.au/>
- **LandGate** spatial information portal which incorporates ESRI ArcIMS and Open GIS WMS Internet Map Servers acting to combine and render layers into maps. <http://www.landgate.com.au/>

Mid and large size Local Government Authorities with established an GIS will be able to establish their own Intranet application service which will integrate local spatial and business databases directly with DLI’s Cadastral and Topographic data layers. They are also free to extend the scope of this Intranet application service to link to live data streams from other organisations through a variety of streaming standards. Eventually such systems can be exposed as an Extranet to users in partnering organisations through specifically configured Projects and even customised client interfaces, such as browser pages or portlet modules.

The system is founded on highly flexible service oriented architectures that offer Local Government Authorities a clear path to extend their capabilities to meet future needs. See Figure 1 - Local Government Deployment Scenarios.

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<sup>†</sup> See <http://www.GeoSamba.com.au/>



## VI) Application Service Provider (Larger Local Government Authorities)

Authorities with an established Intranet can offer access to business process to partner organizations through configured business wizard in the desktop client or custom client interfaces. Access through such clients can be fully secured and metered.

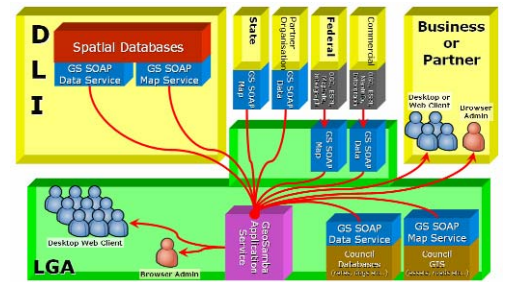


Figure 1 - Local Government Deployment Scenarios

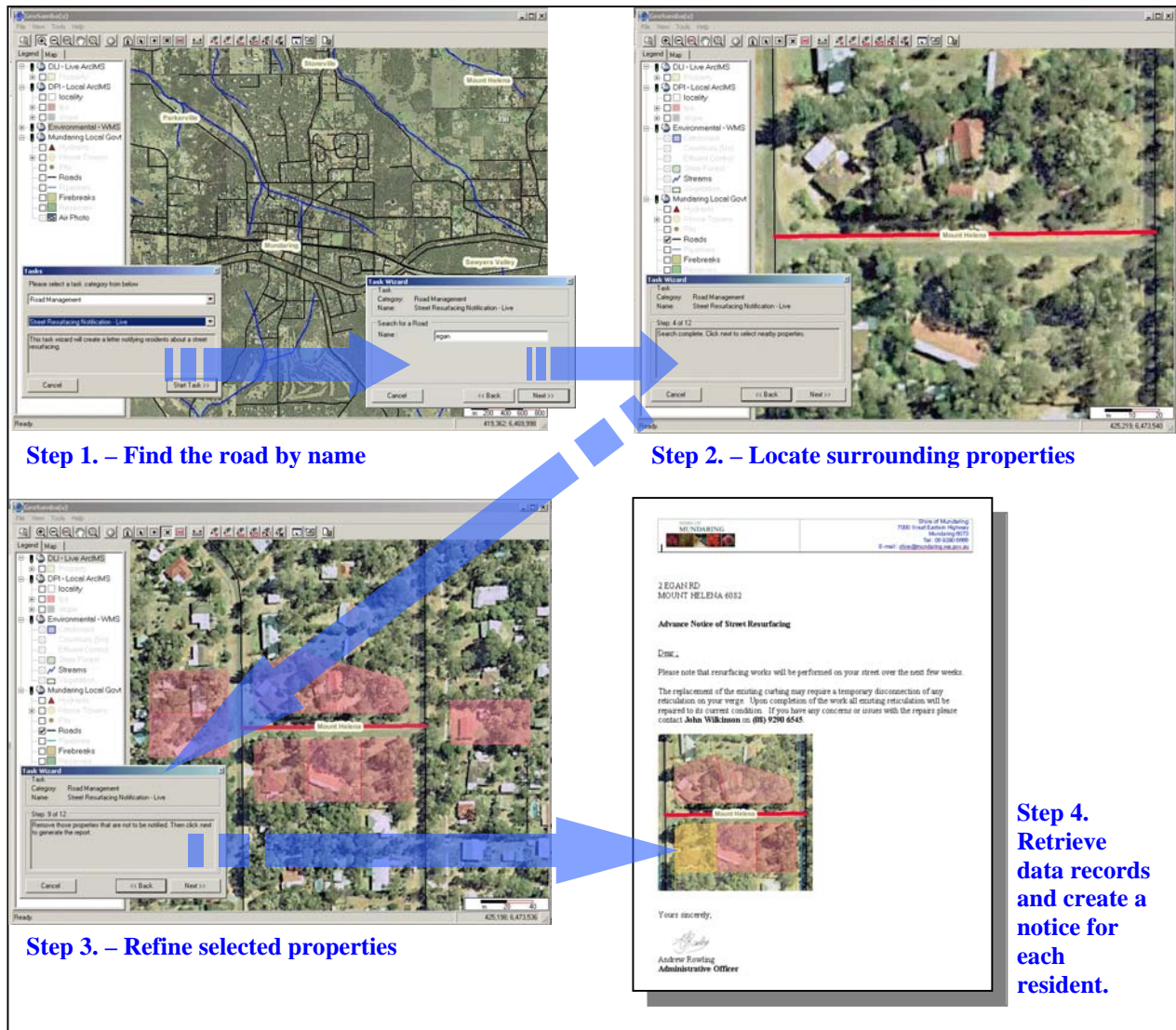
## C. Spatial Decision Enhancement

An important feature of the GeoSamba software implemented in this solution is the powerful task based decision support wizards that are configured through a browser based interface by the individual local authority administrators.

GeoSamba's tasking engine delivers event driven real-time process execution that combines spatial analysis, information mining, editing and advanced reporting. The browser based administrator provides a means for repeatable tasks to be modelled from a collection of linkable business operators.

*“GeoSamba represents business processes as **Tasks** comprised of multiple **Steps** which are based on a library of **Operator Types** which have customisable **Properties** configured in the Administration Interface and portrayed as **Wizards** to the Users”. – Richard Bentley, WA State Manager NGIS*

These tasks play a critical role in the measurable delivery of high degree of return on investment for users of the system. For example: The preparation of a council road closure notification tasks by council, to be sent to residents, would, using a traditional process, take up to 2 days to complete. When configured in GeoSamba the entire notification process has been demonstrated to be completed in minutes. See Figure 2 – GeoSamba road closure wizard in action.



**Figure 2 - GeoSamba road closure wizard in action**

GeoSamba's tasking engine enables complex unlimited step tasks to be configured through the internet addressing numerous operations that are common to business processes enhanced through maps. Examples that have been modelled include:

- Effluent disposal application approvals
- Sub-division application approvals
- Firebreak management: creating, deleting, moving and reporting
- Resident notification
- Street furniture management: creating, deleting, moving and reporting
- Work detail/inspection scheduling

An additional benefit derived from this web service architecture is that these local government business processes are made available to take part in SOA solutions on the Intra and Extranet.

Development of the system is complete and deployment to larger Local Government Authorities has already commenced. Deployment to the 114 regional Local Government Authorities is expected to commence in September 2004.

## III. Regional On-line Spatial Information Emergency Management System

### D. Background

Australia's population, concentrated within small coastal fringe areas of a large resource rich continent, has created unique challenges for emergency agencies. Remote regions host many critical industries and transportation corridors. Thus providing emergency service coverage over such very large regions stretches the capabilities of the limited resources. Adding pressure to improve the efficient use of these resources is an increasing public awareness and concern over health, safety and environmental issues.

People expect that emergency management organisations will be prepared and have the tools available to deal with emergencies. While several emergency organisations already use spatial information it is widely recognised that a more cooperative system that addresses compatibility across services and agencies is essential in the future.

Recent lessons overseas, notably September 11, have shown flexible access to accurate spatial information as critical to effective strategic assessment, tactical planning and resource deployment for emergency incidents. It was found that commonly the only factor connecting key elements of information was the physical spatial location of those elements.

The Victoria Bush Fire Report on the fires of January 2003 noted that spatial information had been underutilised in the response. (Ref 3)

One of the key findings of the Australian Federal GeoInsight Project was that much needs to be done to make agencies "information ready" by improving access to essential data and developing processes and systems. The study also identified that web based information access for emergency management was likely to increase.

### E. Project outline

This project aims to demonstrate the practical on-line application of Spatial Information technology to regional Emergency Management for both government and private organisations. The project will identify critical requirements in collaboration with end user organisations, define these requirements within a specification, build prototypes based on these specifications and validate the specifications through user testing of these prototypes

The project will also demonstrate how advanced Spatial Information technology can support Emergency Management activities in both government and private organisations at varying scales. This will be achieved by developing requirements with end user organisations, building prototypes based on these requirements and testing the prototypes with end users. Alignment with existing systems will be actively sought through the various participants.

Prototyping of an online system will be undertaken in the project to assist emergency managers working in regional geographies initially and consider extending scope to urban scenarios. The project will demonstrate how emergency managers can get access to critical map-based information quickly and how appropriate tools can be provided to the end users to make use of this information.

The tools will give users direct access to a range of local, state and federal data sets, demonstrating the Virtual Australia vision of the CRC. The demonstrator will show how the various state and federal programs assessing the use of interoperability standards and the various e-Government Interoperability Framework (E-GIF) initiatives can be utilised. Near real-time inputs from applications that automatically detect and extract spatial information about emergency situations from existing advanced sensors will also be accessible through all the tools.

End users of the system will have the ability to combine near real-time information with other relevant local, state and federal data sets in a user-friendly and accessible interface. Innovations to be considered will include vehicle tracking, condition monitoring, proximity monitoring, online collaboration, live integration of multiple data sets from various sources and fax/SMS/email notification.

### F. Focus Scenarios

While many of the components being developed and demonstrated within the project will be applicable to a wide range of scenarios, for the first 18 months of the project the participants have agreed to focus on two specific scenarios:

#### 1. On and Off-shore Incident Management System

Ensuring the safety of customers, staff and assets in Australia's remote regions is of critical importance to public and private organisations. The rapid assessment and response to emergency incidents relating to search & rescue, contaminant spill and industrial accidents in these areas has traditionally proved extremely difficult. In off-shore environments the management of infrastructure and individuals is even more challenging. The dynamic and often volatile nature of marine conditions intensifies the need for a very rapid emergency incident assessment and

response capability to the near real-time. Both on and off-shore incidents scenarios of this type will be addressed by the project.

A secure application will be created that directly integrates government map information sources with live corporate map information sources through incident management processes delivered on-line. As well as being able to easily customise these processes to meet their individual needs, inter-organisation collaboration tools will be available through the system facilitating a secure means of rapid communication during an incident.

With this system, companies or emergency agencies conducting searches or planning resource deployment to incident areas will be provided with immediate access to accurate consistent maps on a national basis. These maps, along with web-based tools, will be designed to support critical decision processes.

## 2. *Bushfire Management System*

Bushfires pose a serious threat to a majority of the Australian landscape, and are particularly threatening in rural areas where critical infrastructure is frequently under threat. Rapid access to current information as bushfires advance is critical to saving property and lives.

Near real-time fire hotspot information will be used to automatically assess threats to critical infrastructure in remote areas. Imminent threat notification messages will be automatically sent to specific infrastructure stakeholders. Each incident situation will be directly and securely accessible through an online map application via the message.

This process will involve the integration of email, SMS, stakeholder address databases and live spatial data feeds. The spatial information identified that will be needed to support this process includes:

- Fire hotspots
- Aerial photography
- Utility assets
- Land ownership
- Satellite imagery
- Meteorology
- Satellite imagery
- Topography
- Transport network
- Vegetation
- Fire history

This online system will offer two components: one will be a secure environment for operational personnel involved in the management of incidents. The other will be a freely accessible interface with which information can be “published” to the general public.

The secure interface will offer tools allowing stakeholder representatives to view common live maps and collaborate across various organisations or geographic regions. Stakeholder organisations will be given control over their own assets and choose which information will be “published” to the general public interface. Sensitive or controversial information will remain protected.

## **G. Outcomes and Deliverables**

The development of specifications for incident and bushfire emergency management processes demonstrated through a functioning on-line prototypes, will show the path to improving efficiencies in remote region emergency management. Government and various industry sectors have indicated an interest in the project as a possible pilot to future systems of their own. This project provides the opportunity to demonstrate the tangible benefits that could be realised through a Virtual Australia.

The prototypes will comprise several systems including a variety of web service data sources, the GeoSamba application service and several user interfaces. The prototypes will be available to any supplementary or complimentary CRC research or demonstrator projects.

Based on the requirements developed and with the assistance of interested project participants NGIS will commercialise some aspects of regional emergency management products for sale both domestically and overseas. Other SMEs involved in the CRC will also be encouraged to address other aspects.

More information will be released through the project website: <http://www.spatialinfocrc.org/emdp>

## **IV. Acknowledgments**

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