

Development of a Virtual Australia Utilising an SDI Enabled Platform

Abbas RAJABIFARD, Andrew BINNS and Ian WILLIAMSON, Australia

Key words: SDI, Virtual Australia, enabling platform

SUMMARY

Spatial Data Infrastructure (SDI) which is an evolving concept and can be viewed as an enabling platform linking data producers, providers and value adders to data users. With this in mind, many nations and jurisdictions are investing in developing such platforms and infrastructures that enable their stakeholders to work together in a more mutual approach to create distributed virtual systems that support better decision-making. The success of these systems depend on collaboration between all parties and need to be designed to support efficient access, retrieval and delivery of spatial information to where it is needed.

Within Australia, through the Cooperative Research Centre for Spatial Information (CRC-SI), there is a vision to provide a single entry point to SI, modeling and visualization tools, making spatial information available and useful to all – at any time and in any place. This requires the seamless integration of SDIs at different levels including state and national to form a virtual jurisdiction such as Virtual Australia, providing a foundation for identifying best practice and key performance indicators of SDIs in terms of their policy, technology and institutional frameworks.

This paper will discuss how SDIs can be used as an enabling platform in the construction and delivery of a Virtual Australia, based on the SDI hierarchy model where data flows with minimal impediments within and between state and federal/national levels. The benefits of Virtual Australia will be more than just the representation of feature based structures of the world, it will also include the administration and institutional aspects of such features, enabling both technical and institutional aspects to be incorporated into decision-making. This is an aspect of research identified as more challenging than complex technical issues.

Development of a Virtual Australia Utilising an SDI Enabled Platform

Abbas RAJABIFARD, Andrew BINNS and Ian WILLIAMSON, Australia

1. INTRODUCTION

While 80% of all information has a spatial dimension or location, the majority of government organisations and businesses currently under-utilise this dimension. The major use of spatial data is currently in dealing with land management and administration. Australia is a Federation of states with each State undertaking its own system for land administration. This causes fragmentation of spatial data, as each jurisdiction collects, manages and disseminates spatial data differently (Dalrymple et al., 2004). There are also many issues regarding the storage and access of data in various jurisdictions concerned with custodianship, different jurisdictional responsibilities, different institutions, privacy and different legal and regulatory regimes, which all impact on the effective delivery of spatial data. In order to address this, the concept of a Spatial Data Infrastructure (SDI) has been developed.

SDIs have become a crucial tool in facilitating how spatial data and spatial information systems are used. They allow the sharing of data, which enables users to save resources, time and effort when trying to acquire new datasets. Effective use of spatial information requires the optimisation of SDIs to support spatial information system design and applications, and subsequent business uses. The need to find optimal SDI models requires ongoing research that reflects current social, cultural and business systems. The development of the concept of Virtual Australia builds on this, creating a focus for and building relationships between all federal, state and local based projects with similar aims. The overall concept is as much about relationship and capacity building as well as communication processes and the use and profile of spatial data, as it is about technical solutions.

The capacity to meet user needs and deliver services and tools within the spatial information market has gone well beyond the ability of single organisations. Users require precise spatial information in real-time about real-world objects. Users are no-longer happy with simply an accurate positioning of a future subdivision, they require it to be visualized as well, in order to take into account outside influences. SDIs have been effective in meeting user needs to a point, however to fully meet such requirements, there is a need to create a collaborative environment such as Virtual Australia in which spatial information providers from various backgrounds can work together with current technologies to meet the dynamic and fast growing user market. This has led to the rapid advancement in information and communications technology to meet these differing needs.

The ability to deliver the concept of Virtual Australia through information and communications technology also requires an investigation of the way that data will be stored in the future. There is a need for the ability to allow massive consolidation of spatial data sets across all jurisdictions. It will be important that the concept is based upon and takes advantage of the latest technologies. It is acknowledged that new data base management software and technology promises to change the way that data is stored and the underlying technology that

will support and drive a Virtual Jurisdiction in general. The benefits of such technology are already being seen in the development of the Geocoded National Address File (GNAF), the concept of virtual libraries, the emerging GRID computing technologies and super servers throughout the world.

This paper aims to discuss the requirements to define the concepts, functions and principles of a virtual jurisdiction, such as the Virtual Australia vision being implemented by the Cooperative Research Centre for Spatial Information. The limitations and issues with current spatial information access and distribution initiatives are discussed, leading to the need to create a framework such as Virtual Australia to meet the needs of users in the current dynamic and fast growing ICT environment. International research and the concept of Spatial Data Infrastructures which will aid in facilitating Virtual Australia are also investigated.

2. CONCEPT OF A VIRTUAL JURISDICTION

A virtual jurisdiction can have different meaning to different people. The adjective *virtual* is used in various ways to denote things, activities and organisations that are realised or carried out chiefly in an electronic medium. For example virtual conversations are conversations that are carried out over computer networks and virtual communities are genuine social groups that assemble around the use of email, webpages and other networked resources. Jurisdiction is the extent of authority or control or territorial range of authority or control. Hence the term Virtual Jurisdictions, meaning an entity (such as a government) representing a defined territory (such as the State of Victoria) operating in an electronic medium, principally the internet (Robertson, 2004).

According to Radwan *et al.* (2003), in a virtual jurisdiction, individual (small as well as large) organisations or partners work as a collaborative network to deliver specialised products or services on the basis of common standards (like OGC) and business understanding. A virtual jurisdiction combines distributed functions provided by the participating organisations to deliver services. It is structured and managed in such a way that it is seen by third parties as one single enterprise. Within this context, an SDI - which is developed for the purpose of supporting ready access to and application of spatial information to support decision making at different scales for multiple purposes - is viewed as an infrastructure linking data users and providers on the basis of the common goal of data sharing (Radwan *et al.*, 2003). SDI is said to comprise data, standards, access network, institutions and policies, and human resources as illustrated in Figure 1 (Rajabifard, 2002). Such an entity can be enhanced so that it is possible to share in addition to data, business goals, strategies, processes, operations and value-added products – a Virtual Jurisdiction.

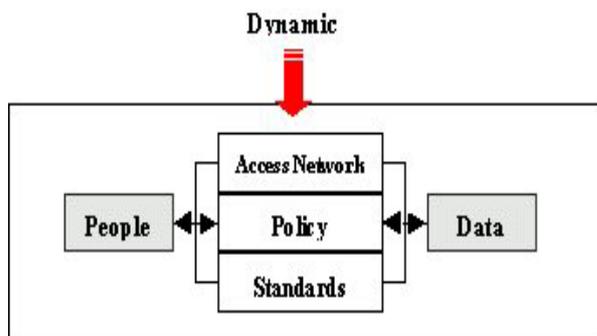


Figure 1: SDI- Linking data and people

In this environment all types of organisations participating (incl. governments, industries, and academic) can gain access to a wider share of the information market. This is done through organisations providing access to their own spatial data and services, and in return, becoming a contributor and hence gaining access to the next generation of different and complex services. In this setting, the SDI will become a collaborative working environment, linking autonomous nodes that cooperate in order to achieve business goals and deliver services to their end users (Radwan *et al.*, 2003).

The development of such a virtual system requires a set of concepts and principles to enable the design of an integration platform that facilitates interoperability and inter-working of functional entities within a heterogeneous environment. The spatial data communities within any jurisdiction can benefit from the various models and tools that have been developed in other jurisdictions for integrated modeling, as well as the work of OGC to develop standard, interoperable access interfaces, to facilitate access to GIS services over the Internet (Web Services, Internet GIS). With this in mind, a project under the Cooperative Research Centre for Spatial Information (CRC-SI) is being undertaken to identify concepts and principles for the development of a Virtual Australia.

3. VIRTUAL AUSTRALIA

Current Federal and State policy within Australia calls for the lowering of the barriers to access and use of spatial data, to both government and the wider community, and particularly to the spatial information industry. If barriers are minimized, then entities would be able to pursue their core business objectives with greater efficiency and effectiveness. In particular, industry would be able to reduce their costs, which would encourage investment in capacity for generating and delivering a wider range of spatial information products and services to a wider market, both in Australia and internationally.

Currently, SDI has taken a lead role in attempting to meet policy and Governments have had some success in creating SDI for their internal use of data. What is needed however is link into industry, enabling industry to have access to a huge amount of government data so that their core business can grow, adding value to the data and also creating new and useable tools

and systems. This is the concept of a Virtual Jurisdiction, which attempts to link in both the public and private spatial information sectors in a way that has not been achievable under the top-down approach which the Australian SDI concept has taken so far.

The concept of a Virtual Jurisdiction is being facilitated in Australia by researchers within the Cooperative Research Centre for Spatial Information (CRC-SI). The aim is to develop a set of concepts, functions and principles that will facilitate the development of a framework for “Virtual Australia”. This will be an integrated spatial information system to support different jurisdictional levels (local, state and national) based on Australia’s existing federal, state and local spatial data initiatives for the enhancement of data access and sharing.

The benefits of Virtual Australia will be more than just the representation of feature-based structures of the world; it will also include the administration and institutional aspects of such features, enabling both technical and institutional (eg. policies) aspects to be incorporated into decision-making. This is an aspect of research identified as more challenging than complex technical issues. The concept will focus on the institutional level of data interoperability and integration. It will take into account and build on recent and emerging initiatives (nationally) to enhance access to reliable, high quality and authoritative data/information.

Within this environment, the achievement of Virtual Australia is largely dependent on collaboration between all the parties and importantly having effective SDI and spatial information system designs to support efficient access, retrieval and delivery of SI to locations where it is needed from locations where it is stored.

Spatial data is held, structured, analysed and disseminated in a host of forms. Importantly SDIs underpin an information society and promote on-line government. Therefore, there is a need to better understand the nature of SDIs and to model and compare effective SDIs to be able to describe and map their complex components. This will aid in developing the concepts and principles that will guide the creation of Virtual Australia through different jurisdictional levels (local, state and national). A fundamental component of the development of Virtual Australia is the recognition that Australia is a Federation with different jurisdictions having different protocols and standards. This applies across the jurisdictional hierarchy in Australia. Consequently an important component of research is to develop principles and functions for Virtual Australia based on the SDI hierarchy model where data will flow within and between local, state and federal/national levels (Figure 2). Therefore it is important to understand and model these flows and the complexity of the relationships within and between the different hierarchy levels.

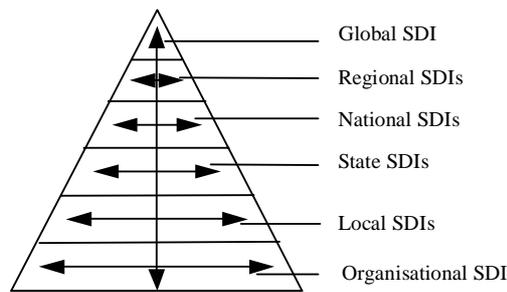


Figure 2: SDI Hierarchy – the complex relationships within and between different levels

Several government entities (federal, state and local) have already identified the need for improved data access and sharing arrangements and have started building their spatial data infrastructures and virtual systems for their jurisdictions. The development of Virtual Australia needs to link with and build on this international experience and any progress already made towards the development of a virtual jurisdiction, such as systems like Virtual Japan and initiatives in Europe and North America.

Current developments in the industrial and service sectors are focusing on the concept of the virtual environment and on the issues that have to be addressed to achieve inter-organisational data integration. The development of an integrated platform that enables interoperability and inter-working of functional entities within heterogeneous environments is required to make such an environment feasible. Therefore, the achievement of the vision of Virtual Australia requires the concept to be based on the hierarchical model to be clearly researched and articulated by drawing on experiences both in Australia (through current state SDI initiatives) and internationally.

3.1 Concepts and Principles of Virtual Australia

A research team within the CRC-SI are undertaking a project titled Concepts and Principles of Virtual Australia. The project aims to review selected Australian state and national spatial data and SDI initiatives to identify their potential and limitations to assist the development of an enabling platform to link public and private industries, facilitating the sharing of spatial data and services. From this, a preliminary set of concepts, functions and principles will be identified to facilitate the development of Virtual Australia. The outcomes will also provide a foundation for developing best practice and key performance indicators to aid in implementing the CRCs overall vision of making world class spatial information applications that are affordable, useable and readily available to all – at any time and in any place.

A key objective of this project will be the need to obtain an understanding of the needs and priorities of the states and territories, the Australian Government and the Spatial Information Industry across the Nation. The understanding of state-federal relationships, which in an SDI context usually focuses on large-scale people relevant data and small scale data issues, is

particularly critical to the success of the project, as is articulating the framework of policies, protocols and standards for SDIs.

Within the first year of the project, a review of selected State (Victoria, New South Wales, Western Australia and Queensland) and National spatial data initiatives is being undertaken in the form of case studies. This allows for the potential and limitations of such systems to be assessed, as well as determining the interoperability of each states systems. Implied privacy concerns from both state governments and private industry have also limited the ability to access and utilise many spatial data sets. The case studies also help to focus the business needs of the spatial information community, with the ability of private companies to gain access to the vast amounts of government spatial data being a key business need identified so far.

A common theme from all of the case studies conducted is the need for private-public cooperation in order to build effective SDIs. Governments and agencies such as ANZLIC cannot 'build' SDIs by themselves – they set policy and an overarching framework. It is the private sector involvement that enables the infrastructure to be built physically. This link is a key driver behind Virtual Australia, with the project bringing together four state governments agencies, Geoscience Australia (Federal Government agency) and a representative of 43 pty ltd, a venture bringing together different private sector companies. Australian governments are currently attempting to implement a range of whole-of-government initiatives within the spatial information sector Having this cooperation will enable Virtual Australia to become the “common rail gauge” access path to spatial information and services.

The case studies have also identified the need for more research into the important institutional and cultural issues associated with access and delivery of spatial information and services. Current spatial information arrangements are only meeting very basic requirements through ad-hoc and limited accessing and sharing arrangements. This has been a big barrier to implementing an effective SDI or enabling framework across government and the wider community. There is a need to build a culture of the value of information sharing and collaboration and address governance models across all forms of government.

3.2 Outcomes/Benefits of Virtual Australia

The development of Virtual Australia will enhance the capability of government, the private sector and the general community in engaging in systems based, integrated and holistic decision making about the future of Australia. It will allow decisions to be based on a model where a wide variety of data/information in both vector format (such as topographic data, land and marine cadastre data, land use data, environmental data) and raster format (such as aerial photographic photos and images and satellite imageries) can be accessed to build a view of the nation's social, environmental and economic management.

In order to achieve this, SDI performance indicators and benchmarking methodologies need to be developed which take into account the limitations and functions of existing state and national based spatial information initiatives. Recent and emerging technologies, both national

and international as discussed within this paper, also need to be built upon to enhance access to reliable, high quality and authoritative data/information.

The aim of Virtual Australia is to create an enabling platform to support government and business activities and services at both a small and large scale. The infrastructure needs to be open sourced and interoperable to meet the needs of producers, users and other stakeholders in order to have the ability for information and services to be created once and used many times. Harmonization of data standards and specifications through the adoption of common data definitions, formats, models and exchange formats will be crucial to the success of Virtual Australia. This will ensure that there is an unimpeded flow of data and information between the various levels of government and the private sector within Virtual Australia.

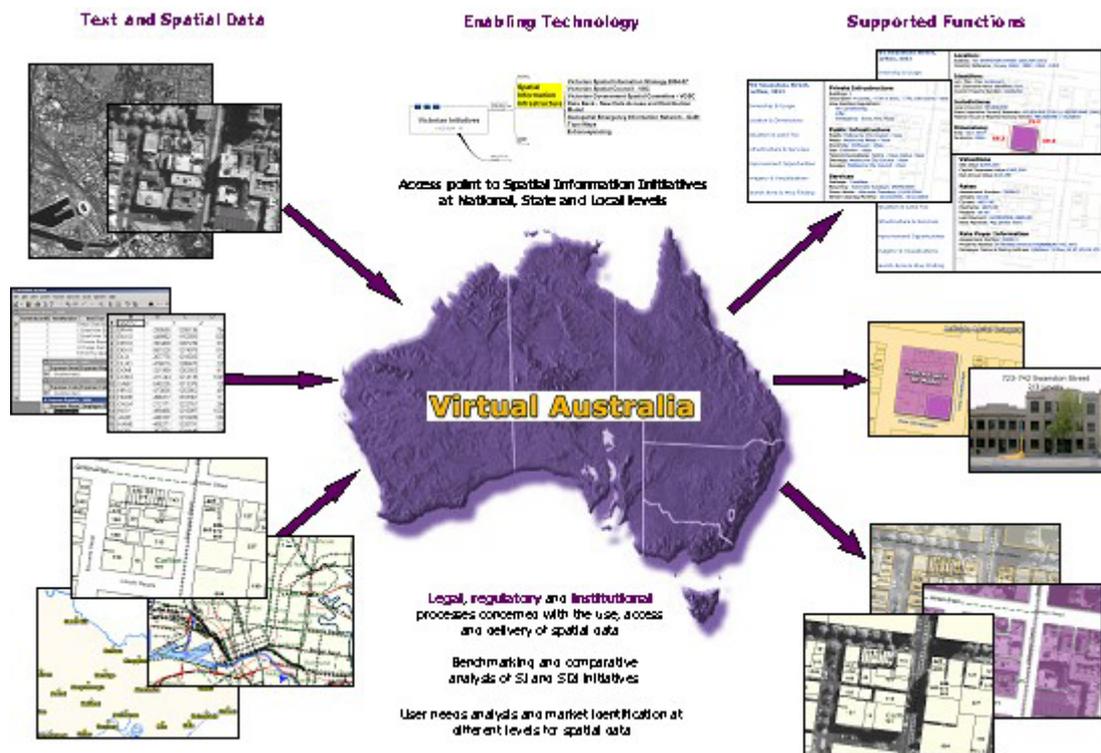


Figure 3: Virtual Australia concept

As Figure 3 shows, Virtual Australia is a vehicle from which both textual and spatial data are utilized to form a range of supported functions for those within the industry as well as non-spatial and non-technical customer groups. The ability to create specific functions will be guided by legal, regulatory and institutional processes concerned with the use, access and delivery of spatial data. The case studies currently being undertaken in this project at a state and national level will go a long way to identifying these processes through the comparative analysis of each jurisdictions Spatial Information and SDI initiatives. The functions that would be included within Virtual Australia are also being investigated within the case studies. Each state jurisdiction has a range of initiatives and functions being both used and created

often in isolation from one another. The creation of Virtual Australia will help to modularize the development of SDI – creating services and functions that can be utilized at further levels up the information chain, including across jurisdictions.

The consultation phase of case studies being undertaken as part of the project are nearing completion, with analysis of the results providing direction for future activities of the project, as well as helping to shape the research direction of the CRC as a whole.

4. CONCLUSION

Virtual Australia is an enabling platform to link public and private industries, facilitating the sharing of spatial data and services. The ability to deliver Virtual Australia successfully depends on the ability to research and implement key institutional arrangements and a governance framework that encourages whole-of-government solutions to major economic, social and environmental issues. A pervasive feature of organisations world-wide, including Australian governments and industry is a reluctance to collaborate with others outside ones immediate work group. Where a strong business driver exists, then collaboration and sharing is possible, however negotiations are generally time-consuming and difficult and at best short-term rather than strategic long-term. This makes multi-agency cooperation on long-term strategic SDIs very difficult to organize. Virtual Australia would not only provide ready and seamless access to spatial data, information products and tools, but would also comprise jurisdictional governance & inter-agency collaborative arrangements for such cross jurisdictions and government-industry collaboration.

The major outcomes of the current phase of the project will provide a foundation for identifying best practice and key performance indicators to aid in integrating jurisdictions to facilitate the development of Virtual Australia. Technically, existing state based spatial information and SDI initiatives have the potential to contribute to the development of Virtual Australia – however a lot of work needs to be done with respect to institutional practices to make the technology effective. Virtual Australia must have systematic interaction between developers and potential end-users to understand information needs as a data centric design approach – where Virtual Australia becomes a mere “creator and generator of demand for technology producers products and services” is not desired. An enabling environment for all needs to be created which includes both a top-down and bottom-up approach to building Virtual Australia:

- Top-down required to specify strategic goals and vision, prioritise plans, arrange core funding, contribute to the definition of fundamental datasets, develop metadata stds, resolve policy issues and build enabling framework – Research level.
- Bottom-up required to promote various local initiatives and build application-specific and enterprise-wide databases and services – Commercialisation level.

Design strategies for Virtual Australia need to link the old – state based SDI infrastructure development, with the new – developed functions and principles identified within research, in an interoperable way. The research being undertaken as part of this project aims to overcome

the inherent, locked-in effects that current systems have created over time, providing an enabling environment in which spatial based applications and user communities can flourish.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the support of the Cooperative Research Centre for Spatial Information, the University of Melbourne, and the members of the Centre for SDIs and Land Administration at the Department of Geomatics, the University of Melbourne, in the preparation of this paper and the associated research. However, the views expressed in the paper are those of the authors and do not necessarily reflect the views of these groups.

REFERENCES

- Dalrymple, K., Williamson, I. and Wallace, J. (2003), Cadastral Systems within Australia, *The Australian Surveyor*, 48 (1) 37-49.
- Radwan, M., Alvarez, A., Onchaga, R. And Morales, J. (2003), Designing an Integrated Enterprise Model to support Partnerships in the Geo-Information Industry, MapAsia, 2003.
- Rajabifard, A. (2002), *Diffusion of Regional Spatial Data Infrastructures: with particular reference to Asia and the Pacific.*, PhD, Department of Geomatics, University of Melbourne, Melbourne. <http://www.geom.unimelb.edu.au/research/publications/IPW_online_publ.html> 10 June 2003.
- Robertson, A. (2004), Department of Land Information Project Participnat Response, An internal report compiled for Project 3.1 CRC-SI.

BIOGRAPHICAL NOTES

Abbas Rajabifard is Deputy Director of the Centre for Spatial Data Infrastructures and Land Administration, and a Senior Research Fellow in the Department of Geomatics at the University of Melbourne. He holds BSurv (Tehran), Postgrad-Dipl (ITC), MSc (ITC), and has PhD from the University of Melbourne. He has been an Executive Board member and National representative to Permanent Committee on GIS Infrastructure for Asia and the Pacific 1994-1999, and member of International Steering Committee for Global Mapping 1997-2001. His current research and interest are spatial data management, SDI development models and SDI capacity building.

Andrew Binns is a Research Fellow in the Cooperative Research Centre for Spatial Information (CRC-SI) and member of the Centre for Spatial Data Infrastructures and Land Administration at the University of Melbourne. He previously worked as part of a project team who looked into the development of a marine cadastre for Australia. His research areas include marine cadastre and administration, SDI development, Land Administration and Remote Sensing.

Ian Williamson is Head, Department of Geomatics, University of Melbourne, Australia, where he is Professor in Surveying and Land Information, and Director of the Centre for Spatial Data Infrastructures and Land Administration. He is Chair, Working Group 3 (Cadastre) of the United Nations sponsored Permanent Committee for GIS Infrastructure for Asia and Pacific (PCGIAP). He was Chairman of Commission 7 (Cadastre and Land Management) of the International Federation of Surveyors (FIG) 1994-98 and Director, United Nations Liaison 1998-2002. His teaching and research interests are concerned with designing, building and managing land administration, cadastral, and land and geographic information systems in both developed and developing countries. He has consulted and published widely within these areas.

CONTACTS

Dr Abbas Rajabifard
Deputy Director, Centre for Spatial Data Infrastructures and Land Administration
Department of Geomatics, The University of Melbourne
Vic, 3010
AUSTRALIA
Tel. + 61 3 8344 0234
Fax + 61 3 9347 2916
Email: abbas.r@unimelb.edu.au
Web site: http://www.geom.unimelb.edu.au/research/SDI_research

Mr Andrew Binns
Research Fellow, Cooperative Research Centre for Spatial Information
Ground floor, 723 Swanston St.
Parkville, 3052
AUSTRALIA
Tel. + 61 3 8344 9185
Fax + 61 9349 5185
Email: a.binns@unimelb.edu.au
Web site: <http://www.crcsi.com.au>
<http://www.geom.unimelb.edu.au/people/abinns.html>

Prof. Ian Williamson
Director, Centre for Spatial Data Infrastructures and Land Administration
Department of Geomatics, The University of Melbourne
Vic, 3010
AUSTRALIA
Tel. + 61 3 8344 45597
Fax + 61 3 9347 4128
Email: ianpw@unimelb.edu.au
Web site: http://www.geom.unimelb.edu.au/research/SDI_research