Spatially Enabling Australia Recommendations

ICSM ASDI Consultancy

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1. EXECUTIVE SUMMARY

Developed over ten years ago, the vision and structure for the Australian Spatial Data Infrastructure (ASDI) requires a review in order to accommodate the spatially enabled society. The vision for the ASDI is bold, but one that can be realistically achieved within the next five to ten years.

Somewhat paradoxically, the ASDI is expected to gain increased importance and use but less prominence in its own right. The services and applications provided by the ASDI however will be highly visible but not necessarily branded as ASDI services.

A number of recommendations have been proposed to help guide and progress the evolution of the ASDI. Some of the key recommendations include:

Vision

The ASDI should facilitate the spatial enablement of Australia

The ASDI should contribute to and help support the Virtual Australia concept

The ASDI should act as a foundation for the delivery of resources

Components

The ASDI should avoid resource duplication where possible

The ASDI should consist of Policy, Standards, Data, Access Service, Integration Service and User Interface components

Policies should be developed for each ASDI component at a national level

Information and Service Access

A policy should be established to recommend that all government agencies provide access to their resources via the ASDI

A policy should be established to enforce the inclusion of metadata for all ASDI resources

Governance

ASDI governance should be a collaborative effort between government, the private sector and academia

An independent body should coordinate the governance of the ASDI

Data Standards and Systems

Reviewing and monitoring data standards and systems should be the responsibility of all ASDI stakeholders

Metadata standards should be defined and enforced

Resources should be required to meet a base standard in order to be included within the ASDI

Organisational Responsibilities

Nominated leader organisations should drive ASDI implementation

Commercial framework should be developed that ensures service quality and stakeholder investment security

2. INTRODUCTION

2.1 PURPOSE OF THIS DOCUMENT

This document provides a framework and tangible directions for activities that will generate a supportive infrastructure for the future development of spatial information and service initiatives across Australia.

The recommendations within this document have been based upon the current knowledge, understanding and practices within the spatial information industry. The contribution obtained from a number of spatial professionals with differing roles in relation to the current Australian Spatial Data Infrastructure (ASDI) has been greatly appreciated and duly acknowledged.

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2.4 ACRONYMS & DEFINITIONS

Term	Definition
ANZLIC	The Spatial Information Council
ASC	Australian Spatial Consortium
ASDD	Australian Spatial Data Directory

Term	Definition
ASDI	Australian Spatial Data Infrastructure *The environment/framework from which resources can be provided in order to spatially enable society. The ASDI comprises the people, policies and technologies necessary to enable the use of spatially referenced data through all levels of government, the private sector, non-profit organisations and academia.*
ASIBA	Australian Spatial Industry Business Association
COAG	Council of Australian Governments
CRCSI	Cooperative Research Centre for Spatial Information
data	*A collection of facts or observations.*
DRM	Digital Rights Management
ICSM	Intergovernmental Committee on Surveying and Mapping
information	*The result of processing, manipulating and organising data in a way that adds to the knowledge of the receiver.*
ISO	International Organization for Standardization
OSDM	Office of Spatial Data Management
resource	*A generic term for data, information, services, publications, documents or software registered with, or provided by, the ASDI.*
SDI	Spatial Data Infrastructure
service	*The provision of, or system of supplying, one or more functions of interest to an end-user or software application.*
TC211	Geographic information/Geomatics Technical Committee

2.5 DOCUMENT STRUCTURE AND CONVENTIONS

This document examines a series of aspects of the ASDI as identified by the consultancy brief. Specific output required from the consultancy is provided in a box within each section, as:

Required output from the consultancy

Each recommendation has been uniquely numbered and appears in bold typeface. Where based on ideas from a specific reference source, attribution is noted, followed by a description of the recommendation:

R1. Recommendation

(RF-xx)

Recommendation discussion/description.

Each section contains a summary of actions arising from the proposed recommendations. Appendix A relates each recommendation to specific actions.

3. BACKGROUND

As the organisation currently responsible for the Australian Spatial Data Infrastructure (ASDI), the Intergovernmental Committee on Surveying and Mapping (ICSM) has recognised that the current model for the ASDI requires review and

possible revision. This document builds upon the work previously undertaken by ICSM, including a workshop held in August 2006, to review the direction of the ASDI as a tool to support the future users of spatial information.

The Spatial Data Infrastructure (SDI) concept has been evolving over the last decade or so and will continue to do so – moving from an approach to facilitate static data access predominantly amongst government and spatial professionals to one that accommodates real-time decision making and spatial services across a range of industries (not necessarily those in the spatial domain).

Australia can be regarded as a leader in the SDI field with the implementation of its national SDI, the ASDI, almost a decade ago. As indicated in RF-06, the majority of the initial activities surrounding the ASDI involved justification and demonstration of its need, rather than the technical issues involved in its implementation. Now the value and benefits of the ASDI are accepted and the use of spatial information is gaining wider acceptance in the broader community. Decision making in high profile areas such as emergency management, disaster relief, natural resource management, water rights, pest and disease control increasingly relies on spatial information, and obtaining accurate, current and complete data is critical (RF-10).

SDIs or at least data information networks are being built at many different levels (jurisdictional through to disciplinary), with many different areas of focus. Each of these networks should be able to contribute to, and form part of, larger networks and ultimately the ASDI. As described by Searle (RF-13), interoperability and semantic consistency will be key to achieving this.

The environment for the delivery and use of spatial information has changed dramatically over the last decade, and will continue to change as technology develops further, however the concept of the ASDI is likely to remain relatively constant. The framework that has been created, initially by the digital storage of data and then initiatives such as the ASDI, should now evolve to support a spatially enabled society, across all sectors of government, business and the community; spatial information can provide the important link between data sets. As shown in Figure 1, this evolution also reflects progression along the information continuum and is now possible as a result of the convergence of information, computing and communication capabilities.

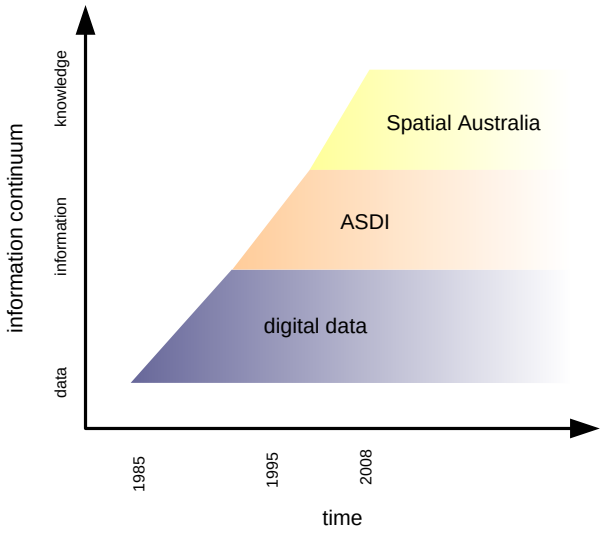

Figure 1 – ASDI Evolution (RF-20)

This vision of spatial information providing the essential element to link previously unconnected data and services to support society is not unique, indeed Michael Jones a chief technologist for Google Earth recently explained that Google's mission is to 'geographically organise the world's information and make it universally accessible and useful' (RF-26). SDIs are not necessarily required in order to achieve this, but from Australia's perspective the ASDI can contribute to achieving this vision by providing the framework through which context and information links (often based on spatial attributes) can be made.

Throughout this document the term ASDI has been used to describe the environment from which data, information and services (or more generically, resources) can be provided in order to spatially enable society. Although the term has had some criticism in relation to its applicability in describing the vision for the future (refer to RF-02), the ASDI will still be required as the supporting platform to provide the foundation upon which sophisticated spatial services can be built and accessed. In terms of marketing/promotion, particularly to those outside the spatial industry, an alternative phrase would be beneficial and this point is covered by R10 below.

4. THE ASDI VISION

A consolidated description of the national vision for the ASDI, Spatially Enabling Australia, and recommendations for building support for that vision.

4.1 VISION STATEMENT

The ASDI will provide a transparent supporting structure for spatial decision making and information access that will be used on a regular basis by all members of society.

4.2 RECOMMENDATIONS

R1. The ASDI should facilitate the spatial enablement of Australia

RF-03

'Spatially enabling Australia' will involve leveraging and maximising the potential of the spatial information that is currently locked away in corporate and government databases. The spatial attribute/component that exists within a range of data sets can and should be used to help correlate information previously regarded as disparate, allowing greater analysis and improved decision making. Additionally, spatial enablement implies more than just providing access to data; the ASDI should accommodate and provide access to services and business processes.

R2. The ASDI should contribute to and help support the Virtual Australia concept

RF-02, RF-04

Virtual Australia describes a vision of a knowledge base that includes complete, correct and current information about the natural and built environment, together with spatial information applications in a usable and readily available manner. Refer to RF-29 and RF-28.

R3. The ASDI should include a range of information

RF-03, RF-13, RF-14

Traditionally SDI definitions have focused on identifying a set of framework or fundamental data sets (refer to RF-23) for which the policy, standards and access apply. Moving forward, the ASDI should not be restricted to only a set of fundamental data sets but rather should be able to support a dynamic set of data, information, services, publications or software.

The ASDI should inherently promote the reuse of data ('collect once, use many times'), leading to efficiencies related to economics and time.

R4. The ASDI should act as a foundation for the delivery of resources

RF-11, RF-15

Currently the ASDI can be regarded as a collection of technologies and services that deliver spatial information to those that need it, in the timeframes that they require, as a result of standards, protocols and governance frameworks. The ASDI should provide a foundation from which data, solutions, business processes and applications can be built. It must be stable, reliable, scalable, interoperable and distributed. Like other infrastructure, the ASDI should be free or of minimal cost to use, but value added services built upon it may be provided for a fee (refer to Figure 5).

R5. The ASDI should provide efficient and timely delivery of resources to users

RF-03, RF-04

The ASDI must support efficient access, retrieval and delivery of data, information, services, publications or software to users. Efficient and timely delivery encompasses both the time taken to extract the appropriate resource, as well as any processing required in order to render the resource on the requesting device (ranging from desktop computers through to mobile devices).

R6. The ASDI should provide resources for a 'reasonable' price

RF-03

Without devaluing the data, information, services, publications and software that the ASDI will offer, cost should not be a barrier to its use. Options for sourcing or generating the necessary funding to build and maintain the infrastructure should be examined – e.g. can funding be obtained from general taxes or from a small percentage of the fee charged for

services built upon the infrastructure? In a practical sense the administration and control of funding may be linked to the governance arrangements for the ASDI (refer to section 8).

R7. The ASDI should seamlessly serve society

RF-16, RF-13

Typically a thorough awareness and understanding of spatial concepts and principles is not prevalent throughout society. However the popularity of spatially enabled systems such as Microsoft Virtual Earth, Google Maps and Google Earth indicate that an in depth understanding is not necessarily required in order to perform queries and undertake decision making using spatial information. The ASDI should be able to provide access to spatial resources in an easy to use and seamless manner; users should not have to understand or even be aware that they are relying on the ASDI.

R8. The ASDI should have a national focus

RF-02, RF-14

Incorporating data, information, services, publications and software from various jurisdictions, the ASDI should be able to support data from a variety of levels – e.g. from highly localised and specialised street level data through to generalised national data, the services necessary to deliver the data also need to be supported by the ASDI.

R9. The ASDI should be implemented with interoperability in mind

RF-24

Given that spatial problems rarely exist solely within state or national boundaries, the ASDI should be implemented so that it can be incorporated as required with other national/regional SDI initiatives (e.g. through interfaces such as Google Earth or World Wind).

R10. A review of the term ASDI should be undertaken

Debate has commenced on whether the ASDI term appropriately describes the proposed role of the supporting structure that allows spatially related decision making, or whether an updated term is required. While the SDI term has gained acceptance internationally, it is currently unclear whether it can adequately represent the vision of spatial enablement that the revised ASDI is intended to achieve. However, the 'infrastructure' element of the ASDI may remain as a building block, upon which the spatially enabling services are provided in which case the term will not be heavily publicised or promoted outside the spatial industry.

4.3 ACTIONS

A1. Develop a network of spatial resources (data, information, services, publications and software) from government, private and academic sectors
A2. Promote the ASDI concept outside the spatial industry
A3. Publicise the content of the ASDI (to promote reuse)
A4. Identify standards and protocols that will be supported by the ASDI
A5. Develop a pricing structure policy for ASDI infrastructure
A6. Develop metrics to assess efficiency of the ASDI
A7. Develop a pricing structure policy for ASDI components (actual data/service prices should be able to be set by individual service providers within the policy)
A8. Develop guidelines for services and interfaces that do not require spatial knowledge or expertise

A9. Examine standards used by other SDI initiatives, in order to ensure interoperability with standards selected for the ASDI

A10. Examine appropriateness of the term ASDI

5. CONCEPTUAL ASDI FRAMEWORK

A conceptual framework for the ASDI representing the key components and their relationships that will generate a spatial data infrastructure to support the development of spatial information initiatives.

5.1 DISCUSSION

Conceptually, the ASDI should facilitate the access and use of spatial data, information, services, publications and software. Participants in the ASDI environment can be described as a range of actors: Data Producers, Value Adders, Service Providers and Service Requesters/Consumers (Users).

Data Producers capture and/or generate data that is made available for use through the ASDI. The term 'data' is used here to refer to the raw data elements of the ASDI and should be assumed to encompass spatial data sets, information and publications. The service and business process components included in descriptions of the 'ASDI resources' used above are not raw data elements, but are rather built from them and are therefore the outcomes generated by Service Providers. The custodial role for data within an SDI will remain a critical element, and given that the vision for the ASDI is to include a wide range of data sources it is expected that the number of data producers will increase, although their focus may be narrower (RF-03). The ASDI should ensure that Data Producers maintain the rights to define usage, access and pricing of their data sets (RF-11).

Value Adders use data from Data Producers and enhance it in some way (e.g. adding new data to it, aggregating or combining data in a unique way).

Service Providers use data from Data Producers and/or Value Adders and manipulate it into a form to facilitate its access and use. This may be as simple as providing access to a data set (either in its entirety or small subsets), or by developing a web service to perform geocoding tasks.

Service Requesters/Consumers are the users of the ASDI. They may range from highly trained spatial professionals through to general public users. This actor group should accommodate anyone looking for any type of spatial resource – from school children creating maps, through to scientists obtaining data to develop and model scenarios (RF-24). Although most easily thought of as humans, Service Requesters/Consumers may just as equally be software agents or applications. Some examples of the expected applications/uses that the ASDI is expected to be able to support are provided in Appendix B.

The identification of the different roles within the ASDI environment accommodates individual providers focusing their attention on a single area, but does not exclude the possibility of providers taking on multiple roles. For example, some stakeholders may only be interested in contributing their data to the ASDI, others may wish to publish their data or services (e.g. geocoders, gazetteers, etc.) without the burden of having to accommodate a myriad of possible end users and applications, and still others may want to focus on building and maintaining registries and search engines (RF-11).

The four actors described above can interact with one another in any combination as shown in Figure 2. Actors may take on one or many roles and may interact with one another in any combination. The result is a rich multi-dimensional environment of dynamic value adding. Data generated by a Data Producer may be provided to Users via Value Adders (a), Service Providers (b), or to other Data Producers (c). A single organisation may take on multiple roles within this network, for example an organisation that receives data may be a Data Producer in their own right and could act as a Service Provider collating data in order to meet a specific business need for their Users (c). The relationship between actors is not restricted to one-to-one or one-to-many configurations; Service Providers for example may retrieve data from multiple sources (Value Adders, other Service Providers) in order to develop a service for Users (d). Appendix C demonstrates some examples of different actor configurations using the network of Figure 2.

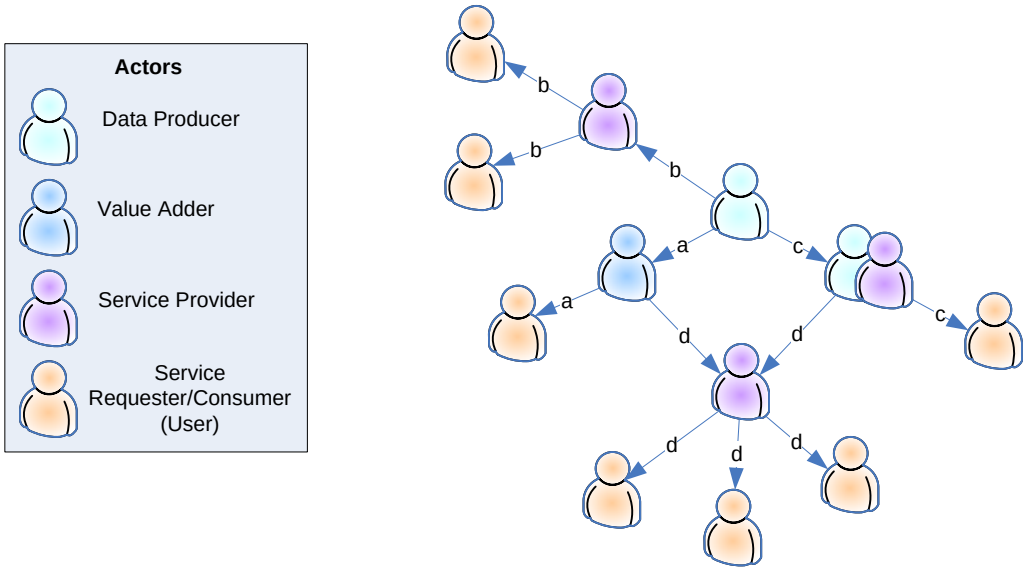

Figure 2 - ASDI Actor Relationships

The ASDI needs to operate within an institutional framework that defines the policy and administrative arrangements for building, maintaining and applying the necessary standards for data sharing and dissemination. Conceptually the ASDI should be analogous to the web based social networks (such as Facebook, MySpace, LinkedIn) that have evolved over the last couple of years. These networks grow exponentially and information is openly contributed to them as a result of the benefits associated with gaining access to a broader collection of knowledge.

6. ASDI COMPONENTS

Descriptions of future ASDI components and their roles in supporting the exchange of information and services.

6.1 DISCUSSION

The core components of the ASDI as initially defined by Coleman and McLaughlin (RF-17) and Rajabifard (RF-18) as being: People, Access, Policy, Standards and Data (refer to Figure 3) are principally still relevant today (RF-15) and support the vision for the ASDI moving forward. However, in light of the ASDI providing more than just access to data,

the nature and configuration of these components should be revised. Nebert (RF-19) presents an alternative view of the SDI components as shown in Figure 4 that is more service oriented.

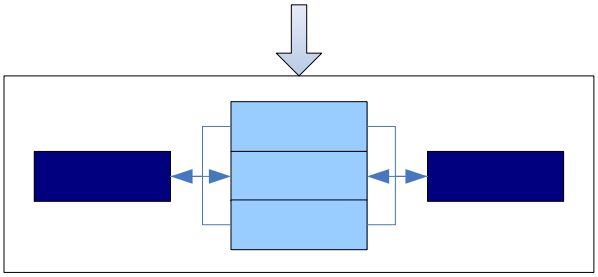

Figure 3 – SDI Components (RF-18)

Nebert describes an SDI component stack emerging from Data Sources, Access Services, and Integrative Services to ultimately produce User Interfaces. The 'infrastructure' is made up of the lower stack elements (Data Sources, Access Services and Integrative Services) with 'applications' (made up of Integrative Services and User Interfaces) represented by the higher elements in the stack. Integrative Services provide the important link between Infrastructure and Applications. Nebert's model for the delivery of data-based services is aligned with the proposed direction of the ASDI as described above.

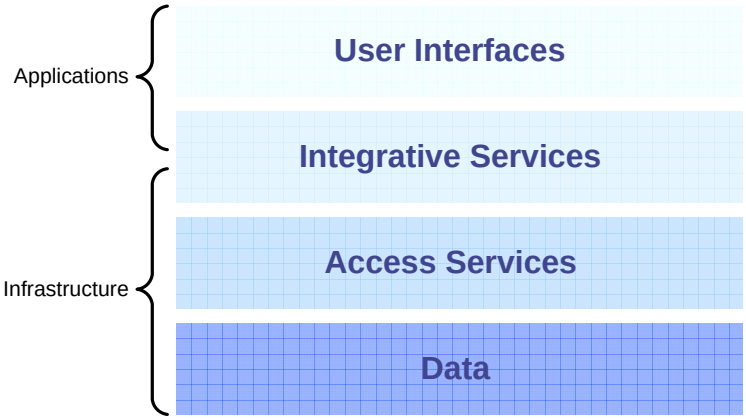

Figure 4 – SDI Components (RF-19)

Combining Nebert's and Rajabifard's models, the recommended components for the ASDI are as shown in Figure 5.

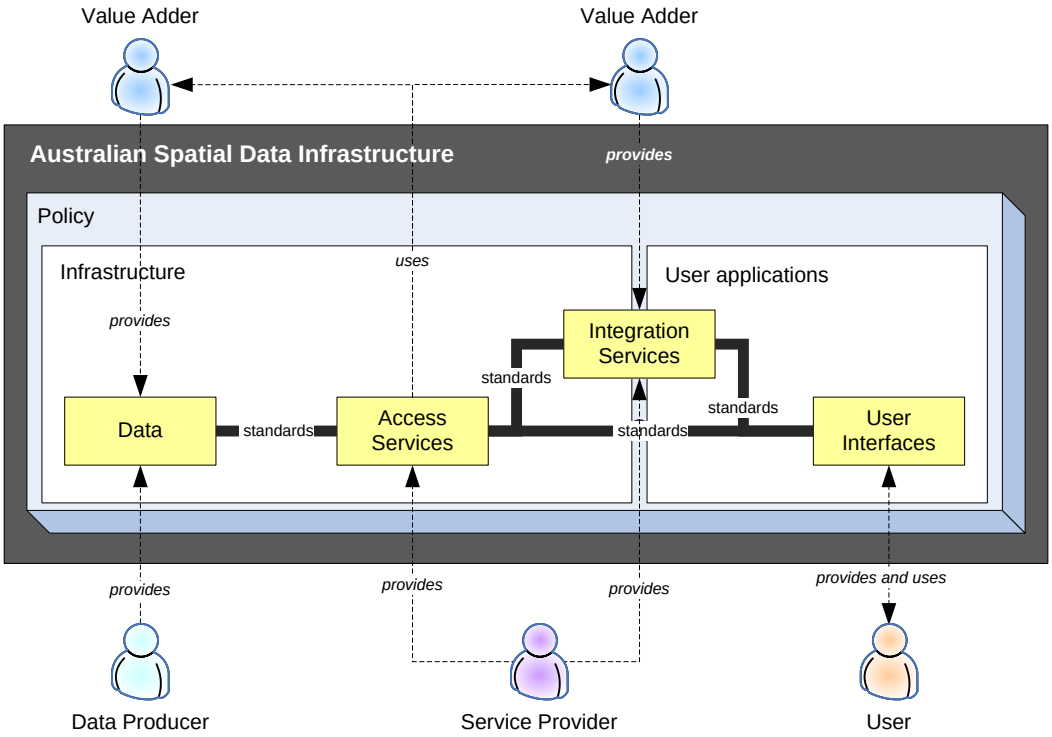

Figure 5 – Recommended ASDI components

Data (or raw information) remains a fundamental component of the ASDI, but is proposed as being accessed by users through User Interfaces that in turn communicate with Access Services. Services may be chained or integrated together (via Integration Services) in order provide more sophisticated information as opposed to just providing data access. All the components communicate based on standards and operate within a policy framework.

The four key proposed actors of the ASDI: Data Producers, Value Adders, Service Providers and Users; are represented aligned to their corresponding components. The following section describes the key components in more detail.

6.1.1 Policy Component

Policy underpins each of the components, the way in which they should interact and operate.

Policies should be developed at a national level to encourage consistency and commonality. For example, from a data perspective, policies should be developed to:

- encourage data to be collected with the intention of it being reused (RF-13);
- prescribe a common structure for metadata (RF-14);
- ensure that metadata is a mandatory accompaniment to any data collected (RF-13);
- define the use of common data models, consistent licensing and pricing (RF-14).

6.1.2 Standards Component

To ensure interoperability, the ASDI will need to rely on a set of common standards and protocols, the use of which should be mandated and compliance monitored and enforced (RF-13). The current perception that the use of standards on small projects is an unnecessary expense, needs to be altered so that the long term benefits arising from data set and business process reuse are obtained.

In order to maximise the benefits from standards adoption, Australia should present a focused approach on a variety of standards development boards (RF-13). While Australia is represented in a number of working groups within the geographic information standardisation technical committee (TC211) of the International Organization for Standardization (ISO) (refer to Appendix D), the coordination of participation in these groups tends to occur on an ad hoc basis with interested representatives presenting themselves for nomination via Standards Australia (who undertake the formal notification process for the ISO/TC211). Historically participation in standards groups has typically been undertaken by public servants however increasing representation and involvement from academia and industry, or involving these groups in the standards development processes/activities would be extremely beneficial (RF-21).

6.1.3 Data Component

Traditionally the ASDI has been defined with a set of fundamental or framework data sets, namely: Geodetic, Hydrography, Topography, Cadastral, Names and Addressing (RF-23). While these sorts of data sets will remain important as the ASDI evolves, additional data (at various scales and resolution) will need to be able to be included in the ASDI. Data should be able to be added and removed throughout the ASDI's lifespan. Ultimately data residing within the ASDI should be the main and authoritative source, with data revisions and updates being made within the ASDI environment rather than the ASDI simply acting as a data repository holding a copy of data sets.

6.1.4 Access Services Component

Access Services define how Users obtain information and services. Access services may provide a means to access an entire (or portion of a) data set, or be a more focused delivery of a spatially related function (e.g. an address validation service).

Controlling access to data sets has typically been dictated by licensing arrangements; however there is currently no standard licensing arrangement for spatial data sets, and none that incorporates user authentication. Requirements associated with user authentication are non trivial in their complexity yet have considerable influence on applications requiring access based pricing. A common licensing framework, such as that provided by the Creative Commons (refer to http://creativecommons.org/ , could provide the structure and consistency that is currently lacking in this area. Indeed Geoscience Australia has begun a pilot project with the Office of Spatial Data Management involving Creative Commons (RF-13).

Policy could be defined to dictate the types of licensing for different situations, for example government collected data should by default be free and open under Creative Commons, but could be restricted if demonstrated as necessary (e.g. to protect privacy).

Data quality often dictates which data set is used in a particular situation. Provided that accurate metadata is available for data sets, the quality of the data itself (in terms of currency, accuracy etc.) is not necessarily important. While there is increased demand for the most current and accurate data to be available and accessible, in some situations, valuable decisions can still be made provided the metadata accurately describes the quality of the data set (RF-13).
Automated licensing and metadata assessment will become increasingly important for machine-to-machine communication (e.g. as data and services are combined in real time to solve specific problems) (RF-13).

6.1.5 Integration Services Component

The integration of multiple services is necessary in order to deliver user interfaces. By including processes such as transformation, symbolisation, web mapping or modelling or more low level processes involving data integration or fusion, integration services can play a key role in the delivery of applications built on the underlying infrastructure.

The ASDI should support the chaining of services in order to deliver sophisticated spatial business processes. For example, a data set could be sent to a transformation service and then to a visualisation service that shows the data in a particular projection (RF-24). The ASDI should act as the means by which services that can be chained together are discovered. Ultimately the identification, selection and chaining of services should be able to be performed automatically on the fly to solve problems in real time (RF-13).

6.1.6 User Interfaces Component

The ASDI should be able to support a range of user interfaces and applications. Not intended to act as the physical host of all applications, the ASDI should provide an interface that allows the discovery and connection to services and data of the ASDI (RF-24). This interface should allow users to visualise spatial data as part of their assessment of whether it will be appropriate for their intended use. Once identified as appropriate, users should be able to directly retrieve data using this interface for use in their own software packages or applications.

The framework (described in section 5) and components proposed for the ASDI should be technically designed as an open source, interoperable platform. This will help to promote coordination and cooperation between all actors in the value network, facilitate the delivery of services and business processes, and ultimately improve access and response time for information and data retrieval (RF-05).

6.2 RECOMMENDATIONS

R11. The ASDI should avoid resource duplication where possible

Different organisations have different definitions for ‘fundamental’ data sets. While the ASDI’s ability to reference multiple copies of data across the same spatial extents contradicts the collect once, use many approach that it promotes, the scenario should not be prohibited. The data storage environment(s) of the ASDI should be able to act as a repository for historical data as well as current data and thus the definition of ‘duplication’ needs to be clarified.

R12. A mechanism to register resources with the ASDI will be required

New resources should be able to be added to and made available through the ASDI at any time. Additionally, existing resources may need to be revised/updated as they evolve.

R13. Mechanisms to modify resources within the ASDI should be provided

In the future, with the ASDI acting as the main and authoritative source for resources registered within it, mechanisms for resource modification and update should be provided (e.g. allowing authorised users to directly edit data within the ASDI framework).

R14. A standardised approach to licensing should be defined for spatial resources

Licensing arrangements that encompass user authentication should be developed and form part of the ASDI's access policies. Given that the vision is for resources to be automatically chained together, methods for automated licensing creation and assessment should be considered.

R15. The ASDI should consist of Policy, Standards, Data, Access Service, Integration Service and User Interface components

The ASDI components should interact with one another through standards as shown in Figure 5. Each component will be defined and operate within a set of policies and standards, as will the cohesive structure of the combination of the components.

R16. Policies should be developed for each ASDI component at a national level

In order to achieve the nationally focused vision for the ASDI (described in section 4), policies will need to be developed and mandated at a national level.

R17. Australia should present a focused approach on a variety of standards development boards

RF-13

The ASDI is and will remain to be highly dependent on standards, thus an awareness of existing and emerging standards is imperative. A broader discussion and promotion of standards activities will help to ensure that Australia can have a say in the development of standards that impact and are of relevance in our specific context.

R18. Services arising from the ASDI should be able to be chained together

In order to deliver spatial business processes that can be integrated into standard workflows or processes, ASDI services should be able to be chained together. Initially this is expected to be a manual process of identifying the relevant services to execute, but in future could be a process undertaken directly machine-to-machine.

6.3 ACTIONS

A11. Develop guidelines by which resources are defined to help avoid duplication
A12. Develop guidelines to distinguish historical versus current resources
A13. Develop a tool to manage ASDI resources (including registration and modification)
A14. Develop a standardised approach to resource licensing
A15. Identify the standards through which ASDI components should interact
A16. Develop a policy for each ASDI component
A17. Promote awareness of standards groups and existing standards
A18. Improve industry involvement in standards development and organisations

7. INFORMATION AND SERVICE ACCESS

Results of a review of the current policies and mechanisms for access to information and services and recommendations for new areas of development.

7.1 DISCUSSION

Discovery and access within the current ASDI is based on the Australian Spatial Data Directory (ASDD). The ASDD currently takes the form of a dedicated web site (http://asdd.ga.gov.au/asdd/search.html) that allows searching and identification of spatial data across a series of nodes (a custodian's collection of data set descriptions).

The site, and to some extent the concept itself, requires a high level of spatial knowledge in order to retrieve information about data sets that might be of use in particular situations (RF-08). In some instances the ASDD provides direct access to data sets, but in the majority of cases, search results only reveal metadata information. The ASDD was developed prior to the emergence of web services and is not easily suited to service based data/information delivery. In response to this, Geoscience Australia is undertaking a pilot project to review the replacement of the current ASDD with GeoNetwork (RF-24).

GeoNetwork is a Free and Open Source catalogue application to manage spatially referenced resources via the web (RF-25). With powerful searching capabilities, metadata editing and an interactive map viewer, GeoNetwork is expected to provide a renewed and more usable interface for the ASDD. The software is currently being configured to meet the requirements of the ANZLIC metadata profile (RF-24). While an improvement on the current interface, significant work will be required in order to achieve an easy to use interface for the general public, and to provide an interface that is capable of machine-to-machine identification and chaining of information and services.

Currently, the majority of nodes servicing the ASDD are government departments or agencies (refer to Appendix E). While this is a valuable start and the importance of government data sets should not be underestimated, academic, commercial and public nodes will need to be established in order to fully realise the vision of a spatially enabled society.

A service discovery model that articulates the roles and communication channels within an SDI is described in Figure 6. Based on the Open Geospatial Consortium's Publish-Find-Bind concept (RF-07), this model allows for both the discovery and delivery of services to users and is inherently scalable due to the distribution of effort amongst the participating actors. The existence of services, whether a means to download a data set or a transaction based mechanism to obtain information, needs to be advertised by each Service Provider. Users should then be able to perform queries (using a natural interface) in order to obtain the information that they need. Users will be trying to solve a specific problem (such as those described in Appendix B) and will therefore be interested in having relevant, accurate and appropriate data or information being returned in response to their queries; the indication of the existence of a data set (in the requested area, or related to the requested subject) that could potentially be of use may not be of relevance to a general user. Significant work is required in this area to satisfy this vision.

In order to identify whether a particular service will be of relevance for a particular User, ratings or reviews from other Users may be beneficial. Users should therefore be able to provide feedback on a particular service that can be taken into account in the discovery process as shown in Figure 6.

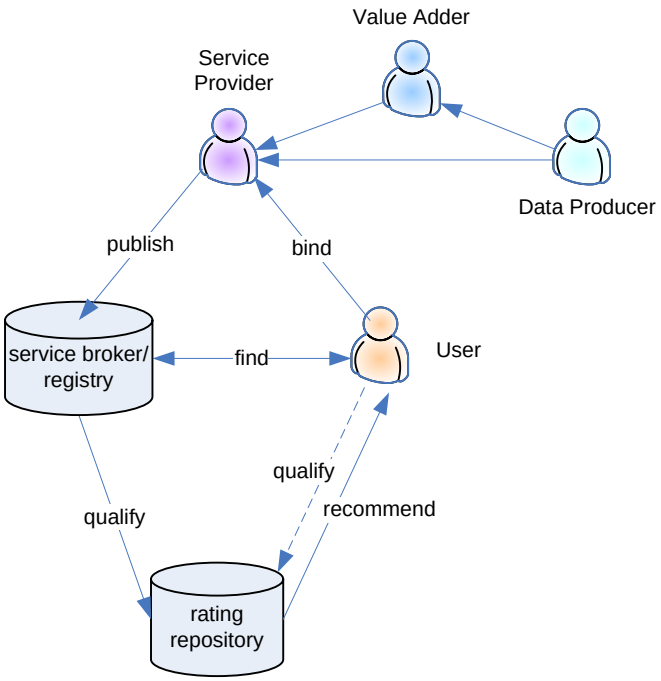

Figure 6 – Service Discovery Model

7.2 RECOMMENDATIONS

R19. Policies describing the access to services should be established

RF-12

Policies should be developed that cover the spectrum of issues encompassed within Digital Rights Management (DRM) as it relates to spatial data and services (e.g. ownership, access, maintenance, distribution and stewardship (RF-22)). Guidelines for the pricing of data should be developed, and a decision made as to the price of government spatial data. Feedback received to date on this issue has suggested that government data should be made available for free, however those adding value to it (either government or the private sector) may then charge users (RF-11, RF-13).
These policies should be developed by a national organisation.

R20. A policy should be established to recommend that all government agencies provide access to their resources via the ASDI

RF-24

The ASDI should be regarded as the main framework for access to government resources. While also including a range of non-government resources, initially government resources will form the bulk of the content within the ASDI and thus promotion will be required. Private organisations, academia and the general public will also need to be encouraged to contribute to the ASDI.

R21. Interfaces for the discovery of ASDI resources should include all registered resources

The ASDI does not need to be a single physical data storage facility, but rather a unified interface should exist for the discovery of all resources registered within the ASDI.

R22. Resource access should be provided as seamlessly as possible

RF-15

In order to facilitate spatial data and information as a ubiquitous commodity, access to it must be provided as seamlessly as possible. Data transfer standards should be adopted and employed and pricing and licensing should not be a barrier to the use of data/information; Users should not have to be aware that they are relying on the ASDI.

The ASDD should be revised to ensure usability amongst a range of users, not just spatial professionals (RF-03).

R23. A policy should be established to enforce the inclusion of metadata for all resources available through the ASDI

RF-24

Metadata will be the key component in identifying and assessing resources for particular purposes. As such, it should be mandatory to include metadata as part of the resource registration process. The structure and content of the required metadata elements must be defined. The minimum set of metadata elements should allow an assessment of data quality of the resource to be made.

The metadata policy should allow for the possibility of restricted data sets, and indeed restrictions in metadata elements themselves.

7.3 ACTIONS

A19. Develop policies to describe access to ASDI mechanisms and services
A20. Investigate Digital Rights Management as it applies to ASDI resources
A21. Develop guidelines for resource pricing
A22. Develop a policy encouraging the contribution of resources to the ASDI by government agencies
A23. Develop guidelines to encourage the contribution of resources to the ASDI by private organisations, academia and the general public
A24. Identify standards for the seamless access of resources
A25. Revise the Australian Spatial Data Directory to enhance its usability and functionality
A26. Develop a policy to mandate the inclusion of metadata for ASDI resources

8. GOVERNANCE ARRANGEMENTS

Recommendations for the establishment and maintenance of governance arrangements that support the vision.

8.1 DISCUSSION

The governance of the ASDI is a significant issue, however should not be overly complicated. While coordinated and structured governance is required particularly in the short term, the ASDI should in some respects be able to operate in a self-governing manner (in a similar way in which the Internet operates with users contributing and consuming data/information/services based on standard interfaces) (RF-15).

8.2 RECOMMENDATIONS

R24. The governance model of the ASDI should incorporate:

- **education/outreach** (RF-03)
- **collaboration/partnerships** (RF-03)
    - accountabilities, reporting structures, resources and operational aspects (RF-09)
- **standards, policy and legal issues** (RF-08)
- **custodianship** (RF-08)
    - responsibilities
    - incorporating points of truth, single authority sources, distribution points
- **resource delivery and maintenance** (RF-08)
    - including data creation and collection (RF-09)
    - framework data (RF-08)
- **metadata** (RF-08)

The governance model should provide the institutional arrangements for delivering spatial information and services in a coordinated and integrated environment, and where possible should leverage existing frameworks/collaborative arrangements (e.g. PSMA's relationship with jurisdictions, and jurisdictions relationships with local government) (RF-09).

R25. The governance of the ASDI should be a collaborative effort between government, the private sector and academia

RF-09, RF-10, RF-13

The governance model should accommodate all SDI stakeholders (e.g. manufacturers, suppliers, users and researchers). Currently there is little communication between SDI stakeholders, which may account for the lack of development/progression with the ASDI over the last couple of years. Basic mechanisms exist to communicate between ANZLIC, the Office of Spatial Data Management (OSDM) and the spatial councils in each jurisdiction, but better communication between these groups would be beneficial (RF-13).

Governments are seen as having an overarching role with regards to the provision of frameworks and services to the community. Unlike other bodies, governments are in a unique position in terms of knowledge of strategic direction and planning and can often guarantee that proposed strategies are indeed implemented. (RF-09)

The private sector's immediate focus is on solving business problems. With a great knowledge of current and emerging technology, processes and practices, the private sector understands the technical and commercial practicalities of delivering services to customers.

Academia can help to provide new ideas and directions as well as valuable context and comparison on local, national and international levels. The foresight and vision that results from academic research can help to ensure that strategies and policies proposed today will still be relevant in the future. Additionally academic environments will need to continue to train professionals in relation to all aspects of the ASDI, particularly in areas of data models and standards (two areas that are often challenging from an implementation perspective).

Additionally established community groups (e.g. those created within the emergency service sector or natural resource management area) should be involved in the formation and creation of the governance model. Collaboration can encompass more than just data sharing, it has the potential to provide arrangements for commercial and community activities (RF-09).

The governance model should consider intrastate, interstate and international collaboration to ensure that decisions made on standards, best practice and interoperability topics are inclusive and beneficial to all (RF-09, RF-11). Similar international models should be reviewed and evaluated in determining the governance model for Australia (RF-11).

Collaboration will ensure an effective environment for the ASDI based upon the alignment of policies, strategies, goals, standards and practices of ASDI stakeholders (RF-09).

R26. Government agencies should participate in the policy, coordination and provision of data/products

RF-03, RF-08

Issues related to policy development and coordination will principally remain the focus of government agencies, however should be undertaken within the collaborative framework of government, private sector and academia (RF-08).

R27. An independent body should coordinate the governance of the ASDI

RF-11, RF-13

The generation and distribution of funds for the creation, maintenance and operation of the ASDI should be administered by a national agency responsible for the ASDI. This organisation may need to be established or the priorities of an existing organisation adjusted. To be effective, this organisation will require authority to define policies and encourage conformance to standards and practices, and will need a strong connection between each of the jurisdiction's governing bodies (RF-13).

Existing structures such as the Council of Australian Governments (COAG) and the proposed Australian Spatial Consortium (ASC) should be used as a model for operational organisation and collaborative initiatives that should be employed by the ASDI governing body.

8.3 ACTIONS

A27. Establish a governance model for the delivery of spatial information and services from the ASDI that encompasses government, private industry and academia

A28. Define a policy to encourage the participation of government agencies in the policy, coordination and provision of resources for the ASDI

A29. Review and identify an independent organisation to coordinate the governance of the ASDI

9. DATA STANDARDS AND SYSTEMS

Recommended strategies for reviewing and monitoring data standards and systems.

9.1 DISCUSSION

The current selection of data standards for use with the ASDI falls within ANZLIC's (or more correctly ICSM's) responsibility. While ANZLIC has the authority to promote the use of particular standards, they have little control over the

use and conformance of these standards. If the independent governing authority recommended above were to manage the funding for the ASDI, they may be able to have more control over the conformance to the nominated standards (this approach has proved useful for the geoConnections model in Canada (RF-11)).

If the ASDI is to grow to encompass the vision described in section 4, regular data and information audits would become an extremely time consuming task. Regulation of resources as they enter the ASDI environment will help to overcome some of these issues and a system to keep track of user review could help to monitor content and services within the ASDI (RF-14). Data and service providers would receive the feedback/reviews and be able to adjust their content or delivery as necessary to improve their rating and usage; providers will need to become increasingly responsive to user requirements (RF-15).

9.2 RECOMMENDATIONS

R28. Reviewing and monitoring data standards and systems should be the responsibility of all ASDI stakeholders

In support of a self governing approach for the ASDI, reviewing and monitoring processes should be able to be performed by all ASDI stakeholders.

R29. The process of monitoring standards and systems should be automated where possible

RF-14

The extent to which the ASDI will need to ensure the quality of the resources that it provides needs to be defined, however ideally this should be performed in an automated manner with no or little human interaction. Benefits associated with the ability to track user review and use of content should not be dismissed.

R30. Metadata standards should be defined and enforced

RF-11

Accurate metadata facilitates data and service discovery. A standard for the description of metadata has been developed for Australia, but should be more strongly mandated and enforced.

R31. Resources should be required to meet a base standard in order to be included within the ASDI

The ‘base standard’ may simply be a requirement that metadata (of a particular form) accompanies the resource. Actual details for the ‘base standard’ will need to be researched and identified.

9.3 ACTIONS

A30. Develop guidelines for ASDI stakeholder responsibilities
A31. Develop processes to automatically monitor standards and systems use
A32. Develop a policy for resource metadata
A33. Identify a ‘base standard’ for ASDI resources

10. PROPOSED ORGANISATIONAL RESPONSIBILITIES

Note: This section is presented as series of interrelated recommendations, as such, no separate recommendations are listed.

10.1 THE VISION

In order to implement the recommended vision and framework for the ASDI (described in sections 4 - 9 above), a program of work will be required, which in turn will need to be monitored and managed to ensure successful delivery. This should be undertaken by a national organisation that interacts across the government, private and academic sectors.

Ultimately the promotion of the ASDI vision should be undertaken by all ASDI stakeholders. In a similar manner to the more physical elements of the ASDI, education and promotion of the ASDI concept should be coordinated by a national organisation across all sectors, both within and outside the spatial industry (RF-09). The ASC could take on this coordinating role, acting as the overarching organisation for all ASDI related activities, managing and harmonising activities as required with its constituent groups: the Spatial Information Council (ANZLIC), the Australian Spatial Industry Business Association (ASIBA), the Cooperative Research Centre for Spatial Information (CRCSI), and PSMA Australia; all participating in the design, implementation and use of the ASDI.

Ideally the ASDI should be able to operate in a modular, collaborative manner reliant on common standards and protocols, in a similar way to which the Internet operates. However initially some structure and coordination from an overarching authority will probably be necessary. This vision and the relationships between the proposed ASDI and stakeholders are shown in Figure 7.

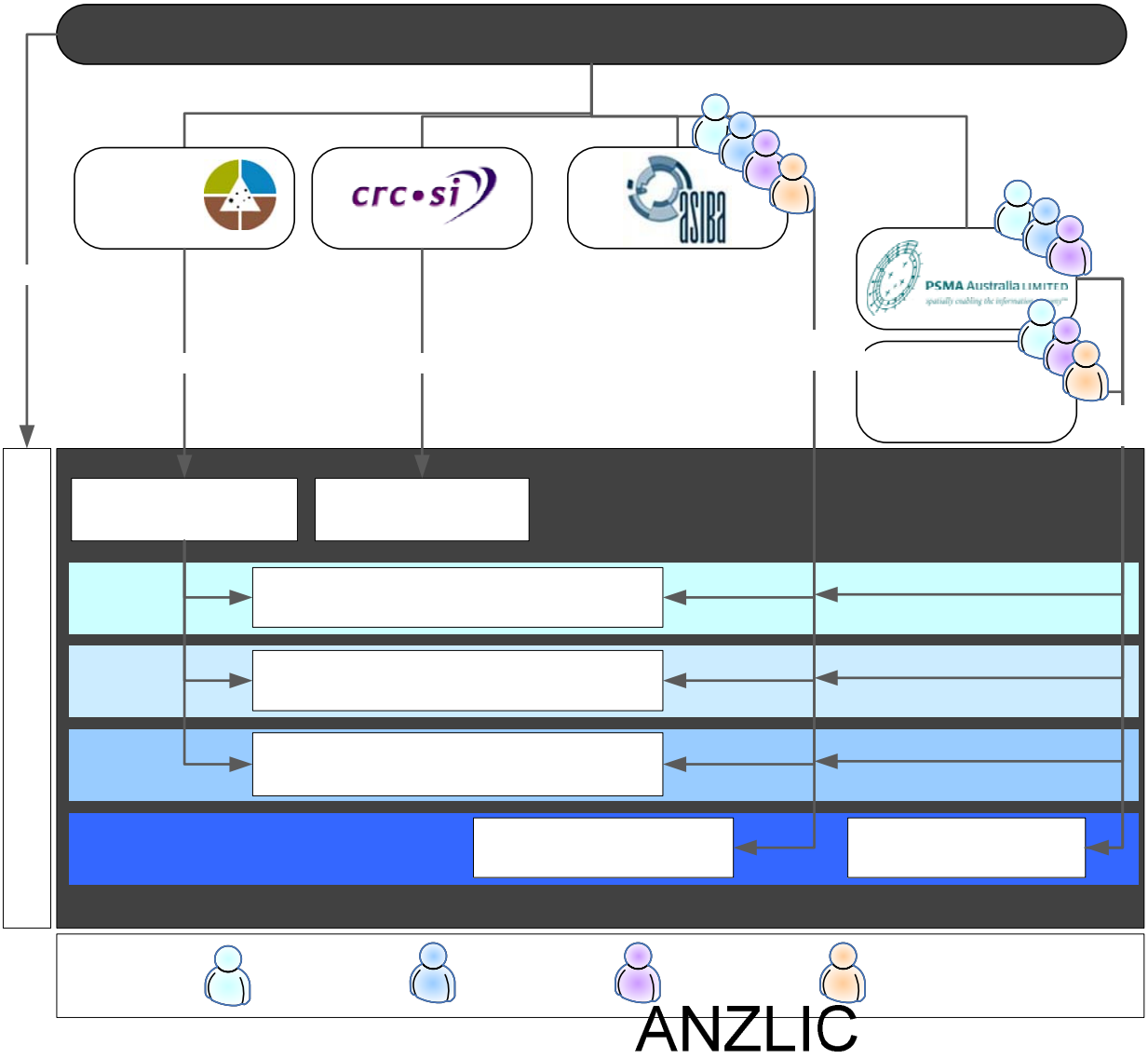

Figure 7 – Proposed Organisational Relationships to ASDI

10.2 LEADERSHIP AND INITIAL IMPLEMENTATION

responsible for

10.2.1 Commercial Framework

In order for the implementation and delivery of the ASDI to be successful, appropriate funding will be required to coordinate, implement and support initial components and or services of the ASDI. In order to ensure ongoing viability, appropriate pricing models and policies must be developed. It is recommended that a commercial framework that addresses these requirements, be developed and overseen by the ASC to ensure investment security for all stakeholders. Commercial framework development should be undertaken with leadership from members of the consortium based on their experience and expertise.

create and maintain

The commercial framework should define the following:

- Mechanisms for funding development of ASDI infrastructure
- Mechanisms for funding ongoing support and maintenance of ASDI infrastructure
- Mechanisms for pricing model development and implementation

10.2.2 ASDI Lead Organisations

With the exception of the Integration Services and User Interface components of the ASDI, each of the other components of the ASDI: policy, standards, data and access services; will require a lead organisation. Initially, the organisations as shown in Table 1 have been recommended as the lead groups for each ASDI component. Integration Services and User Interfaces do not require a lead organisation to coordinate them. Initially some user interfaces may be developed by PSMA Australia to facilitate access to their access services.

Table 1 - Proposed Lead Organisations

COMPONENT	LEAD ORGANISATION
Policy	ANZLIC
Standards	ANZLIC
Data	Government data: PSMA Australia Non-government data: ASIBA Lead Collator: PSMA Australia
Access Services	PSMA Australia
Integration Services	*None required*
User Interfaces	*None required*

To be effective, the ASDI will need to provide access to both government and non-government data. PSMA Australia has been nominated as the lead organisation for data collation, given their experience and expertise in this area. Initially, PSMA should also continue to be the lead organisation responsible for the collation of government data given the existing relationships that have been formed between the jurisdictions and PSMA. ASIBA has been nominated as the lead organisation for the collation of non-government data. ASIBA's responsibility will lie in encouraging contribution of data from private organisations both within and outside the spatial industry.

Data collection and collaboration via general public users (e.g. through geowiki style interfaces (refer to http://www.geowiki.com/)) should be supported through the ASDI. Identification of an obvious organisation for this activity is non trivial. In due course, commercial opportunities may govern leadership of this activity. It is in the industries best interest for the initiative to be part of the ASDI.

Standards and policy definition should remain the responsibility of government (under the ultimate coordination of ASC), thus ANZLIC has been nominated as the initial lead agency. Standards and policy is a large area and sub-committees and groups within ANZLIC should be established where appropriate to tackle smaller elements (for example ICSM could be responsible for data related standards, while access and integration standards could be managed by a different group). As identified above, Australia's involvement in standards definition groups should be managed in a more centralised manner with developments publicised and promoted to a wider audience to broaden awareness and encourage participation.

Initially a centralised discovery mechanism (based on the principles of the ASDD) and delivery/access services should be established for the ASDI. Following development of the recommended commercial framework for the ASDI, given the current geographic expanse of PSMA data product, it is recommended that the initial lead organisation for these activities should be PSMA.

The organisations suggested above have been nominated based on their experience and expertise in the relevant areas. The suggestion of these organisations is not intended to preclude other organisations from taking on similar roles, nor is it intended to indicate that only one organisation should be responsible for each component. Figure 8 demonstrates these proposed leadership responsibilities. The organisation suggestions are designed to provide a practical direction for the initial ASDI evolution developments in order to achieve the recommendations identified throughout this report.

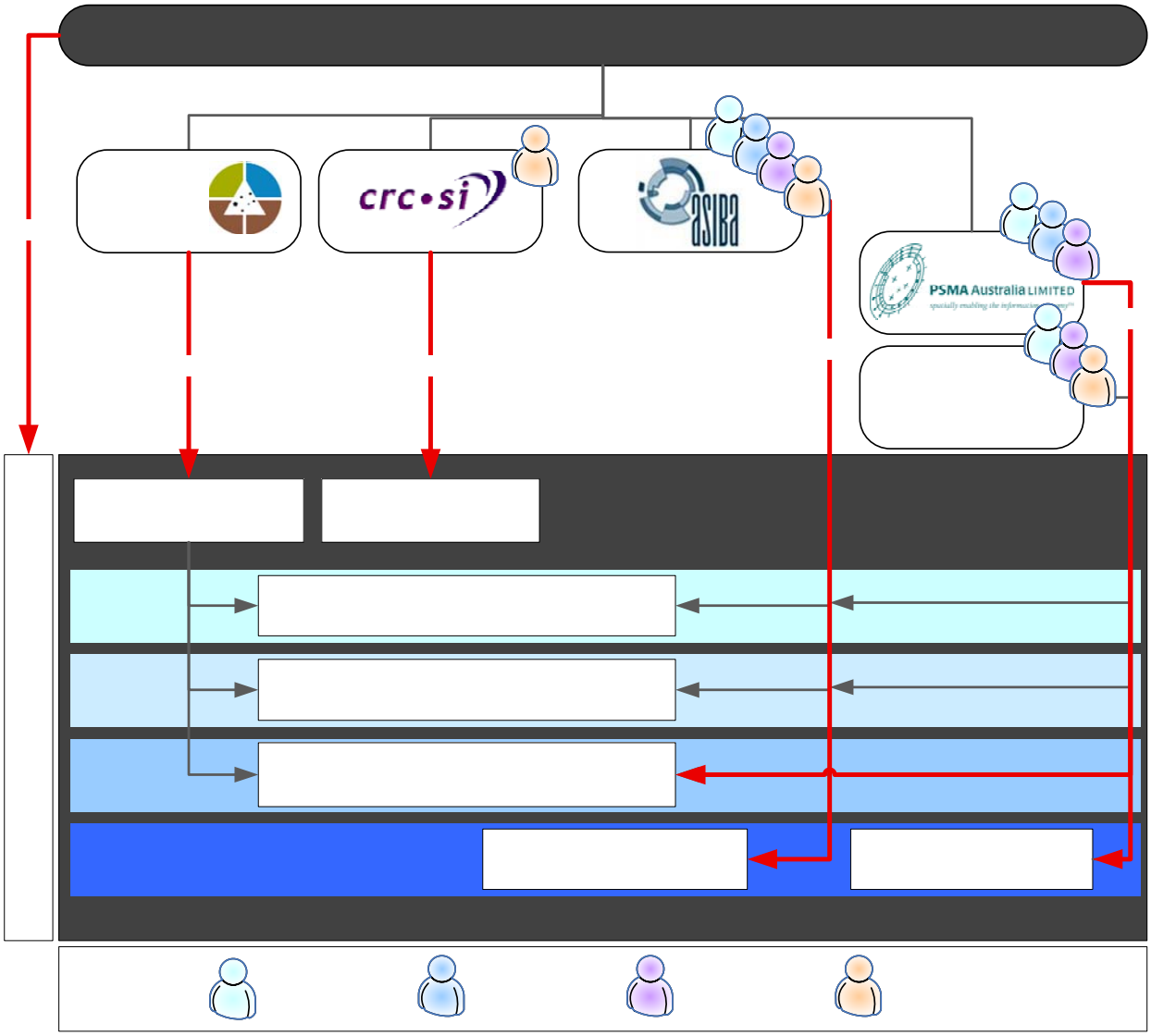

Figure 8 – Proposed Organisational Relationships associated with leadership (red arrows) of the ASDI

10.3 ACTIONS

A34. Adopt an ASDI Organisational Vision that supports industry wide collaboration and benefit

A35. Nominate leader organisations to drive ASDI implementation

A36. Develop a commercial framework

11. ACTION SUMMARY

11.1 DISCUSSION

The recommendations established in this report culminate in a set of actions that will create a successful ASDI. Table 2 lists all actions derived from the recommendations in this report. Actions are presented in the order they were generated based on recommendations. Note that it will be necessary to regroup and define the associated detail of these actions, in order create an appropriate action plan.

Table 2 – Action Summary

	#	DESCRIPTION
VISION	A1	Develop a network of spatial resources (data, information, services, publications and software) from government, private and academic sectors
	A2	Promote the ASDI concept outside the spatial industry
	A3	Publicise the content of the ASDI (to promote reuse)
	A4	Identify standards and protocols that will be supported by the ASDI
	A5	Develop a pricing structure policy for ASDI infrastructure
	A6	Develop metrics to assess efficiency of the ASDI
	A7	Develop a pricing structure policy for ASDI components (actual data/service prices should be able to be set by individual service providers within the policy)
	A8	Develop guidelines for services and interfaces that do not require spatial knowledge or expertise
	A9	Examine standards used by other SDI initiatives, in order to ensure interoperability with standards selected for the ASDI
	A10	Examine appropriateness of the term ASDI
COMPONENTS	A11	Develop guidelines by which resources are defined to help avoid duplication
	A12	Develop guidelines to distinguish historical versus current resources
	A13	Develop a tool to manage ASDI resources (including registration and modification)
	A14	Develop a standardised approach to resource licensing
	A15	Identify the standards through which ASDI components should interact
	A16	Develop a policy for each ASDI component
	A17	Promote awareness of standards groups and existing standards
	A18	Improve industry involvement in standards development and organisations
ACCESS	A19	Develop policies to describe access to ASDI mechanisms and services
	A20	Investigate Digital Rights Management as it applies to ASDI resources
	A21	Develop guidelines for resource pricing
	A22	Develop a policy encouraging the contribution of resources to the ASDI by government agencies
	A23	Develop guidelines to encourage the contribution of resources to the ASDI by private organisations,

	#	DESCRIPTION
		academia and the general public
	A24	Identify standards for the seamless access of resources
	A25	Revise the Australian Spatial Data Directory to enhance its usability and functionality
	A26	Develop a policy to mandate the inclusion of metadata for ASDI resources
GOVERNANCE	A27	Establish a governance model for the delivery of spatial information and services from the ASDI that encompasses government, private industry and academia
	A28	Define a policy to encourage the participation of government agencies in the policy, coordination and provision of resources for the ASDI
	A29	Review and identify an independent organisation to coordinate the governance of the ASDI
STANDARDS AND SYSTEMS	A30	Develop guidelines for ASDI stakeholder responsibilities
	A31	Develop processes to automatically monitor standards and systems use
	A32	Develop a policy for resource metadata
	A33	Identify a 'base standard' for ASDI resources
ORGANISATION	A34	Define and adopt an organisational vision that enables industry wide collaboration and benefit
	A35	Nominate leader organisations to drive ASDI implementation
	A36	Develop a commercial framework that ensures service quality and provides investment security

12. CONCLUSION

The vision for the ASDI is bold, but one that can be realistically achieved within the next five to ten years. Providing the means by which to empower citizens, spatial information is an extremely valuable resource and one that should be used and re-used where appropriate.

The recommendations provided throughout this document have been identified as a starting point from which to progress the evolution of the ASDI to achieve the desired vision. Undoubtedly numerous other issues and questions will arise as activities commence on the ASDI, both in relation to the organisational and political aspects as well as technical aspects of the necessary development.

Building on what has been established to date; the ASDI is expected to gain increased importance and use, but probably less prominence in the broader community. The services and applications which the ASDI will enable however will be highly visible and will hopefully become a fundamental aspect of the day to day activities of citizens around the nation.

13. APPENDIX A

Recommendation – Action Matrix

		RECOMMENDATIONS																													
		Vision										Components								Access					Governance				Standards			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
ACTIONS	1	✓	✓																												
	2	✓																													
	3			✓																											
	4				✓	✓																									
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14. APPENDIX B

ASDI Use Scenarios

Reiterating the sentiments described in the body of this document, every citizen should be able to use applications/interfaces that are built on the ASDI in order to solve their problems. Users should not necessarily be aware that the ASDI exists or be specifically trained in how to use it, interfaces to it should be intuitive, and ultimately should enable machine-to-machine communication in order to perform spatially related tasks. While these casual/public users will probably perform the bulk of the transactions with the ASDI, interfaces and services will still need to support professional users with their activities.

The following example scenarios describe some envisaged uses of the ASDI. The applications built using ASDI data or services should operate on a range of hardware devices (from desktop computers through to augmented reality headsets).

14.1 INSURANCE

If an insurance company needed to superimpose the location of all their insurance claims in a spatial context the ASDI should be an easily interfaced option to a) geocode the addresses and b) plot that location on a base map of some sort within the insurance company's own application which may access other web services not on the ASDI and that are capable of performing sophisticated analysis locally.

The insurance claim addresses and potentially other company data will typically need to remain private and secure and will never be published on the ASDI.
RF-07

14.2 LOGISTICS/NAVIGATION

A trucking company may have GPS devices in all their trucks which they monitor in their own tracking database, but deploy on top of a base map from the ASDI for internal visualisation purposes.
RF-07

An in-car navigation system may superimpose the position of a car on data layers retrieved from the ASDI.
RF-08

14.3 CHILD FINDER

Send a text message to receive, on your mobile screen, a map of the area in which your child's phone is located. You could also receive a text description, telling you that the target is within so many metres of a specific (predefined) point (e.g. school).
RF-08

14.4 AUGMENTED REALITY

An augmented reality system that allows the visualisation of underground pipes and equipment in situ with the real environment could be developed using the ASDI.
RF-08

14.5 SERVICE CHAINING

Users should be able to find services and chain them together to create their own web applications or processes and share this information with others.

RF-24

14.6 USER COLLABORATION/MAP INPUT

The creation of content by users is being explored in a number of geowiki type applications. For example users of Google Maps can utilise the built in map creation tools to recommend places or leave ratings and reviews to share with others. Google Maps is beginning to explore a concept similar to service chaining in that from a particular user's Google Map creation it is now possible to view information about the user and other maps that they have created.

RF-30

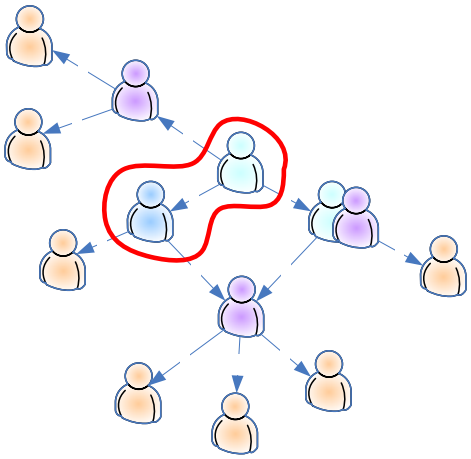
14.7 ALGORITHM MODELLING

Scientists will use the ASDI to find data and computing resources that they can use to test, develop and model their algorithms.

RF-24

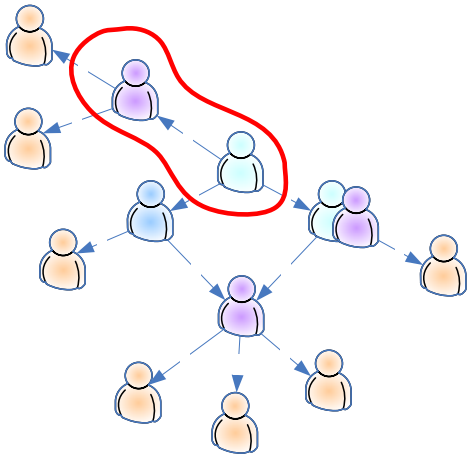
15. APPENDIX C

Example ASDI Actor Configurations



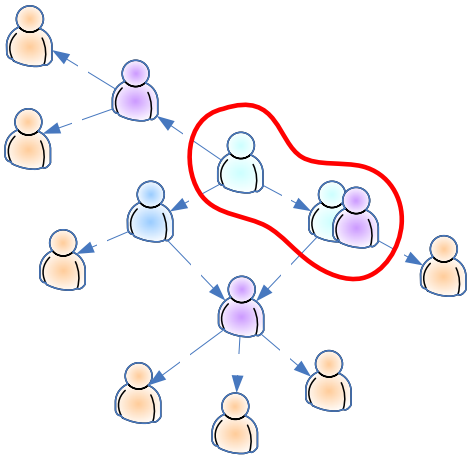
Data Producer: State government

Value Adder: Water authority



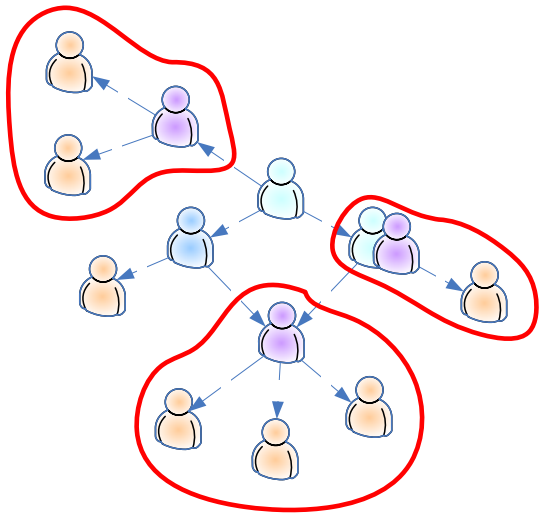
Data Producer: State government

Service Provider: Spatial organisation e.g. Geomatic Technologies



Data Producer: State government

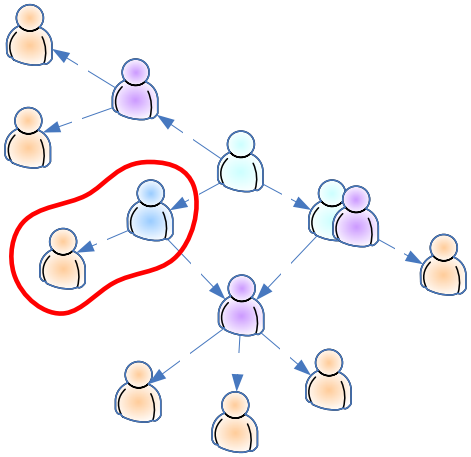
Data Producer/Service Provider: Town planner



Service Provider 1: Spatial organisation e.g. Geomatic Technologies

Service Provider 2: Local government

Service Provider 3: Town Planner



Value Adder: Water authority

Users: Water authority

In this case the Users are internal customers of the Value Adder's.

b

1

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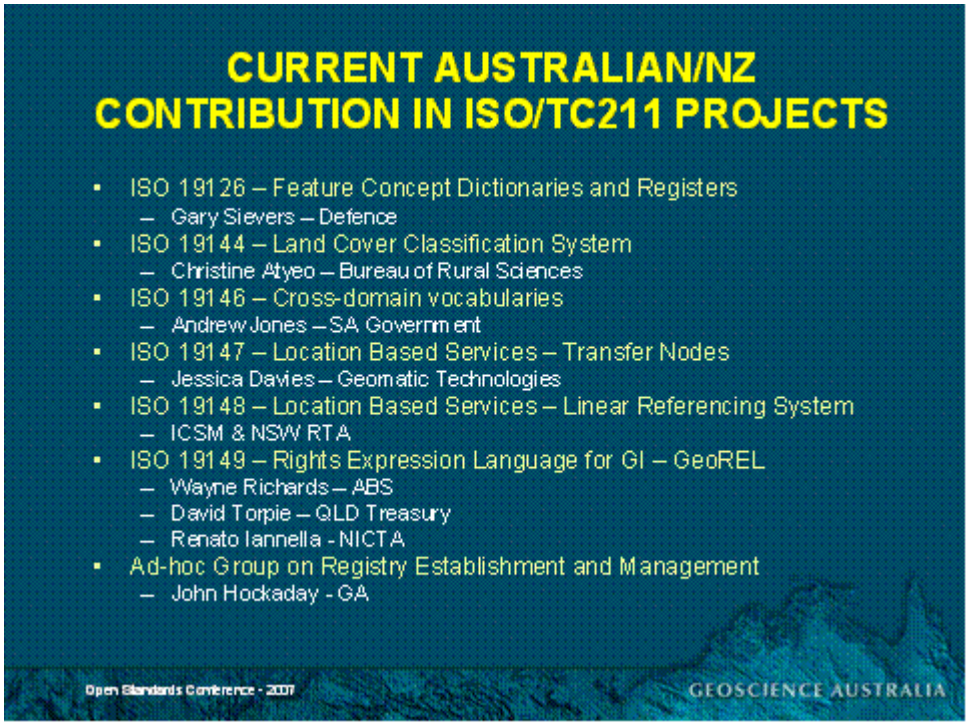
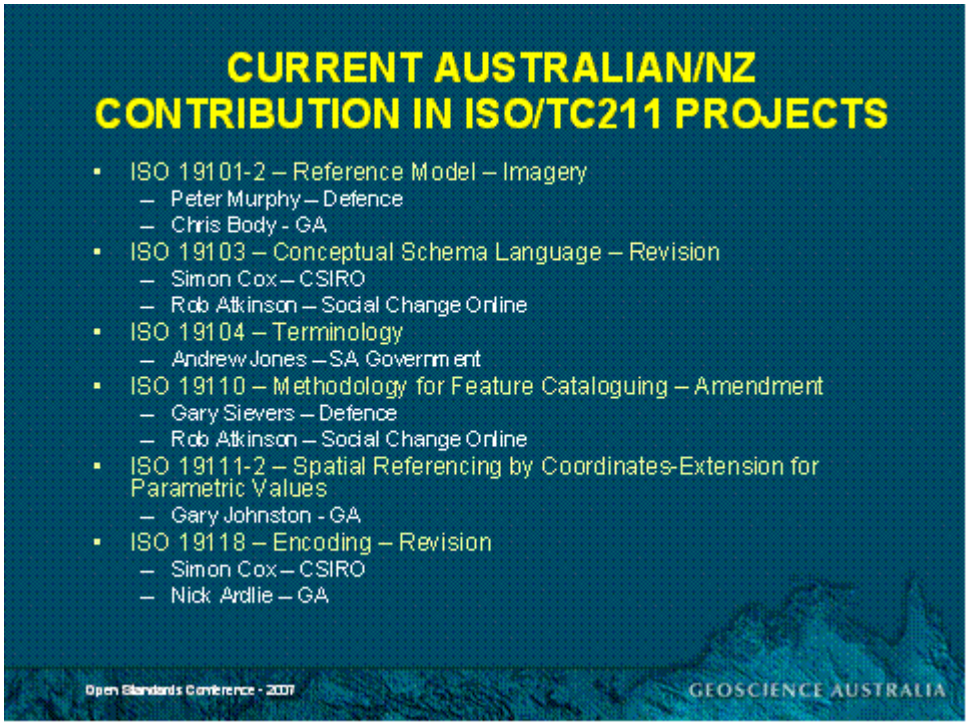
16. APPENDIX D

Australia's ISO/TC211 Involvement





RF-27

Australia's OGC Involvement

There are 14 Australia members of OGC with Geoscience Australia, Defence and CSIRO as Technical members.

Australia's main focus has been in the areas of:

- SensorML
- Observations & Measurements
- GML Application Schema
- GML Encoding of Discrete Coverage's
- XML Schema policy
- WFS Gazetteer Application Profile

RF-27

17. APPENDIX E

Australian Spatial Data Directory Nodes

Node	Type
ACT Geographic Data Directory	Territory government
Australian Antarctic Data Centre	Commonwealth government
Australian Hydrographic Service - Product Metadata	Commonwealth government
Australian Hydrographic Service - Publication Metadata	Commonwealth government
Australian Hydrographic Service - Source Metadata	Commonwealth government
BRS and Australian Natural Resources Data Library (ANRDL)	Commonwealth government
Bureau of Meteorology	Commonwealth government
CSIRO Marine and Atmospheric Research	Commonwealth government
DEW Discover Information Geographically (DIG)	Commonwealth government
Geoscience Australia	Commonwealth government
IndexGeo Pty Ltd - Eco Companion catalogue	Commercial, Public input
Murray-Darling Basin Commission	Statutory authority
National Oceans Office	Commonwealth government
NSW Natural Resources Data Directory	State government
NT Spatial Data Directory	Territory government
Other Commonwealth Agencies (hosted by BRS)	Commonwealth government
PSMA Australia Limited	Commercial
Qld Spatial Data (QSIC)	State government, Local government, Statutory authority, Commercial
Queensland Department of Natural Resources and Mines Spatial Data	State government
RAN Directorate of Oceanography and Meteorology	Commonwealth government
South Australian Spatial Information Directory	State government, Local government
Tasmanian Spatial Data Directory	State government, Local government, Non-government organisation, Statutory authority, Academic, Commercial, Public input
Victorian Spatial Data Directory	State government, Local government, Non-government organisation, Statutory authority, Academic, Commercial, Public input
WALIS Interragator-Aerial Photography	State government
WALIS Interragator-Bibliographic Data	State government
WALIS Interragator-Environmental Impact Statements	State government
WALIS Interragator-Natural Resource Monitoring	State government
WALIS Interragator-Spatial Data	State government

RF-01