The Integration of Visualisation Services into the e-Development Process in the Northern Territory of Australia.

Phillip RUDD and Robert SARIB, Australia

Key words: digital cadastre, land management, GSDI, sustainable development.

SUMMARY

Currently in Australia there is a move by governments to streamline the land development process by utilising digital technology so that the land development process becomes more interoperable with contemporary land information management systems and spatial data infrastructures. There are national initiatives to create e-development applications, e-plan, e-lodgement, e-conveyancing, e-title etc and this paper outlines the Northern Territory's version of this 'e' process and describes how these initiatives have been integrated with the NT Land Information Systems (NTLIS) and spatial data infrastructure.

The Northern Territory Government (NTG) purchased a Google Earth Enterprise (GEE) software and data package to provide a whole of government spatial data visualisation service to support these "e" initiatives. The deployment of the Google Earth Enterprise Client (GEEC) across the NTG to staff with a wide range of disciplines and technological competency levels has required a highly integrated approach capable of linking an array of datasets required for the land development process with minimal intervention from either the end users or data administrators. This has been achieved by implementing a Service Orientated Architecture and a distributed data fusion and serving environment.

The techniques employed in the NTG to integrate the diverse range of data required to support and visualise the land development and management process into the Google Earth Enterprise framework in a sustainable and transparent fashion are described. Issues of audience-specific content, data access, maintenance, redundancy, presentation and licensing are also discussed. The challenge of implementing these GEE services to be compatible with other third party business applications and GIS software packages has been a natural progression that should be of interest to all spatial data infrastructure providers.

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1. INTRODUCTION

State and Territory governments in Australia have been working together to streamline the land development process by utilising digital technology and formats so that the land development process becomes more interoperable with contemporary land information management systems and spatial data infrastructures. Currently in Australia, there are national initiatives to enhance and facilitate an electronic land development and administration process. The 4 main initiatives that the Northern Territory (NT) is contributing to are:-

- e-development applications(eDA);
- e-plan;
- e-conveyancing (NECS); and
- e-geodesy.

To put this challenge into perspective, the Northern Territory has to provide these services to its population of just 211,000 people who are spread across its 1,352,000 km^2. Its cadastre consists of approximately 93,000 parcels, of which almost 70,000 are current and has 36 forms of tenure. The land development environment comprises of, on average, around 5000 land development applications, the lodgement and processing of 350 survey and unit title plans and the registration of approximately 31,000 land transactions every year.

The purpose of this paper is to outline the Northern Territory's implementation of several of these 'e' processes and describe how these initiatives have been integrated with the NT Land Information Systems (NTLIS), its visualisation service (known as NT Visualiser) and spatial data infrastructure.

2. THE EMERGING "e" ENVIRONMENT

The concepts of *eGovernance* and *eAdminstration* are expanding and evolving worldwide. In the Northern Territory (NT) the Land Information Division of the Department of Planning and Infrastructure is exploring and developing digital or electronic "e" systems to better manage the land administration and development processes, streamline decision making, and permeate efficiencies within government (Picco et al, 2006). The NT's approach to the creation of the "e" environment to assist the management of NT land development information and processes is to not simply develop systems which promote the exchange of electronic data via images of paper documents, such as 'tiff' files, but rather a digital environment with structured, intelligent digital file formats that are:-

- interactive;
- form the basis of a legal record (Cumerford, 2006); and
- interoperable and integrable with other systems and applications in a Services Oriented Architecture (SOA).

To effectively accomplish and progress this concept the Northern Territory Government (NTG) is involved with various “e” initiatives via national forums, work groups, technical committees which are commonly facilitated by state and national government surveying, mapping and land administration agencies in Australian and New Zealand. One of the core functions or fundamental drivers of these groups is to ensure “e” projects coordinate and promote the development and maintenance of key national spatial datasets through a standard and contemporary strategy.

The cooperative development paradigm of these “e” projects, which is depicted in Figure 1, recognises the large investment made by the 8 Australian jurisdictions and the key stakeholders in their own internal information technology and systems and the often complex interdependencies between spatial information systems, and the legal and fiscal business systems that have a role in the land development and management process. These “e” initiatives do not attempt to change either the information technology or the workflow of anyone involved in the process. However, by standardising the way information technology systems communicate with each other, information used in these individual systems will be translated into a common XML vocabulary so that the data can be easily passed between stakeholders.

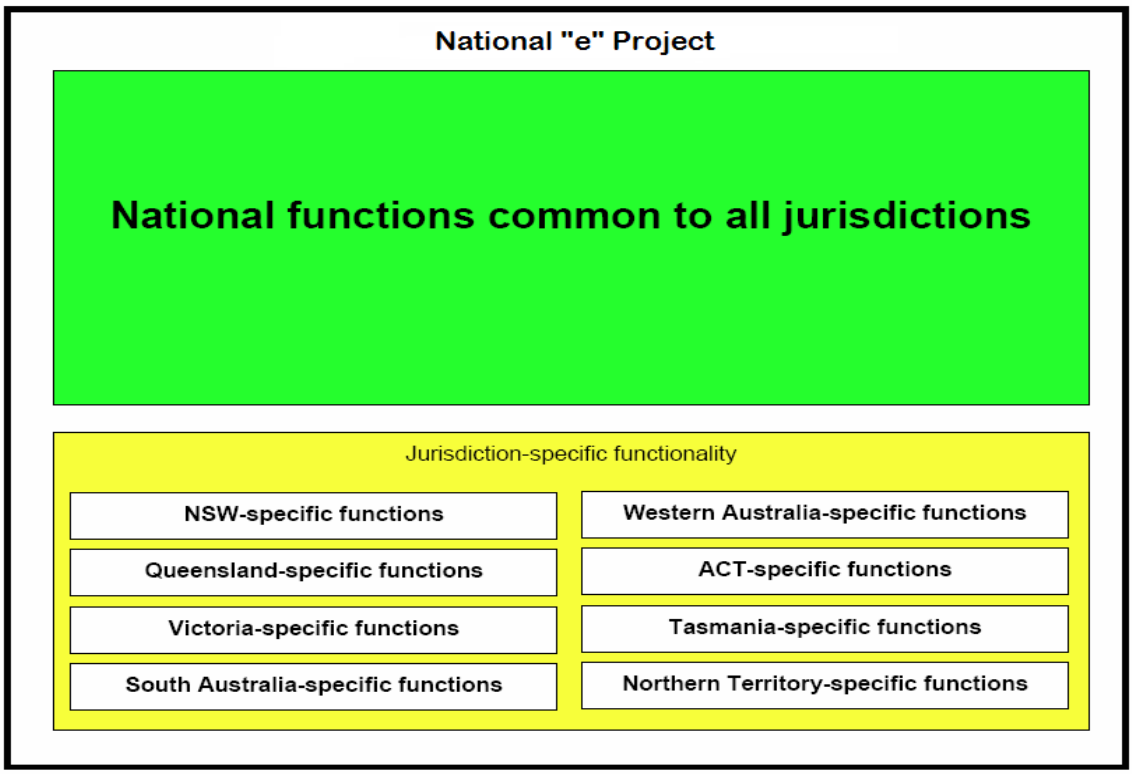


Figure 1 - National "e" Project Cooperative Development Model

The model used for these national "e" projects essentially consists of two parts. One part contains all of the national functionality common to all jurisdictions. The other part contains the eight separate functionalities specific to each jurisdiction. The jurisdiction-specific functions have some commonalities between some jurisdictions, but not sufficient commonality to enable their inclusion in the national functionality. Each jurisdiction-specific function is the responsibility of the jurisdiction's system custodian to describe, specify, test, certify and maintain.

The data transfer and communication protocols developed through these national initiatives concentrate on the generic processes and information required for the land development and conveyancing with the goal of improving the interoperability between the main actors in the processes which then leads to an improvement in the overall efficiency and veracity of these transactions.

The current national "e" projects and initiatives in the Australia, which are pertinent to the NT's "e" development environment, are described in the following sections.

2.1 eDA (Electronic Development Assessment)

The Electronic Development Assessment initiative is a national project sponsored the Australian Government Department of Transport and Regional Services (DOTARS) and is funded by AUSIndustry through its Regulation Reduction Incentive Fund (RRIF). The eDA project is coordinated through the Development Assessment Forum (DAF) and aims to create a national communication and data transfer protocol to facilitate the electronic processing and assessment of development applications.

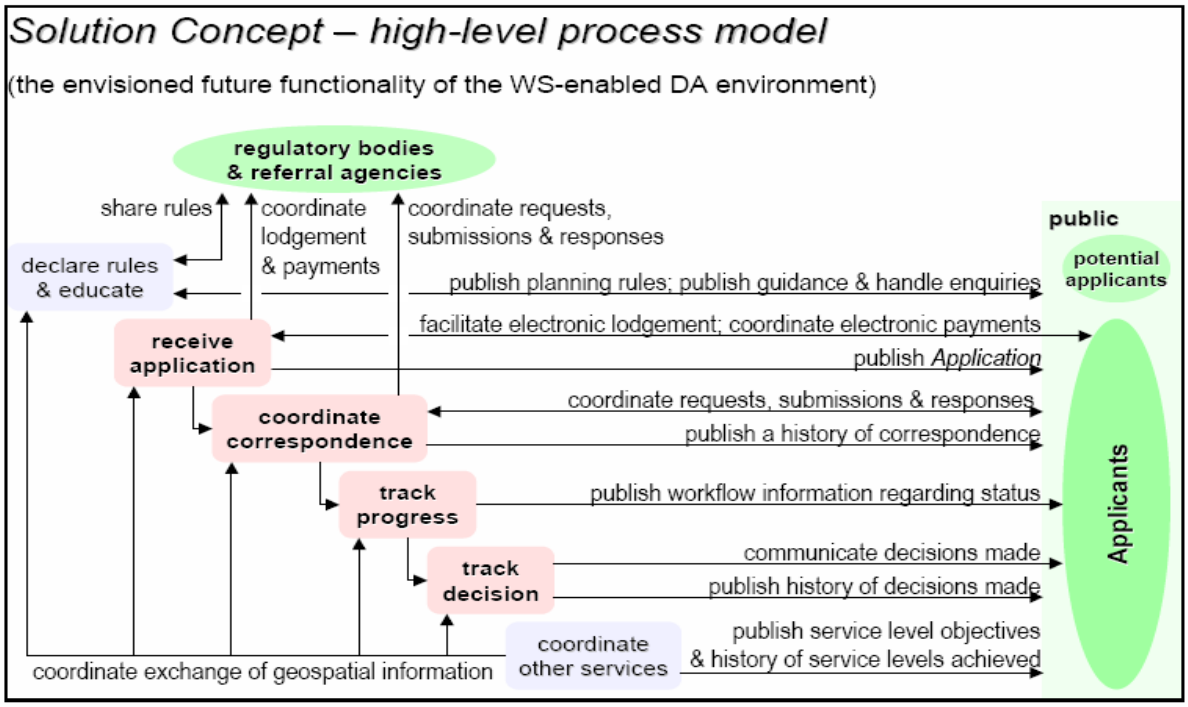


Figure 2 - eDA Process Model

Figure 2 depicts the conceptual solution proposed for the eDA protocol that was used to formulate the web service definitions required to communicate the application information and the status of the application through the assessment and decision process and then to the issue of permit (and conditions if any) to the applicant.

The XeDA protocol is being designed to cover the entire development application process, which includes the lodgement of the application with the associated reports, plans and drawings, and the communication of this information electronically between all the main actors in the process. This interaction is shown in Figure 3.

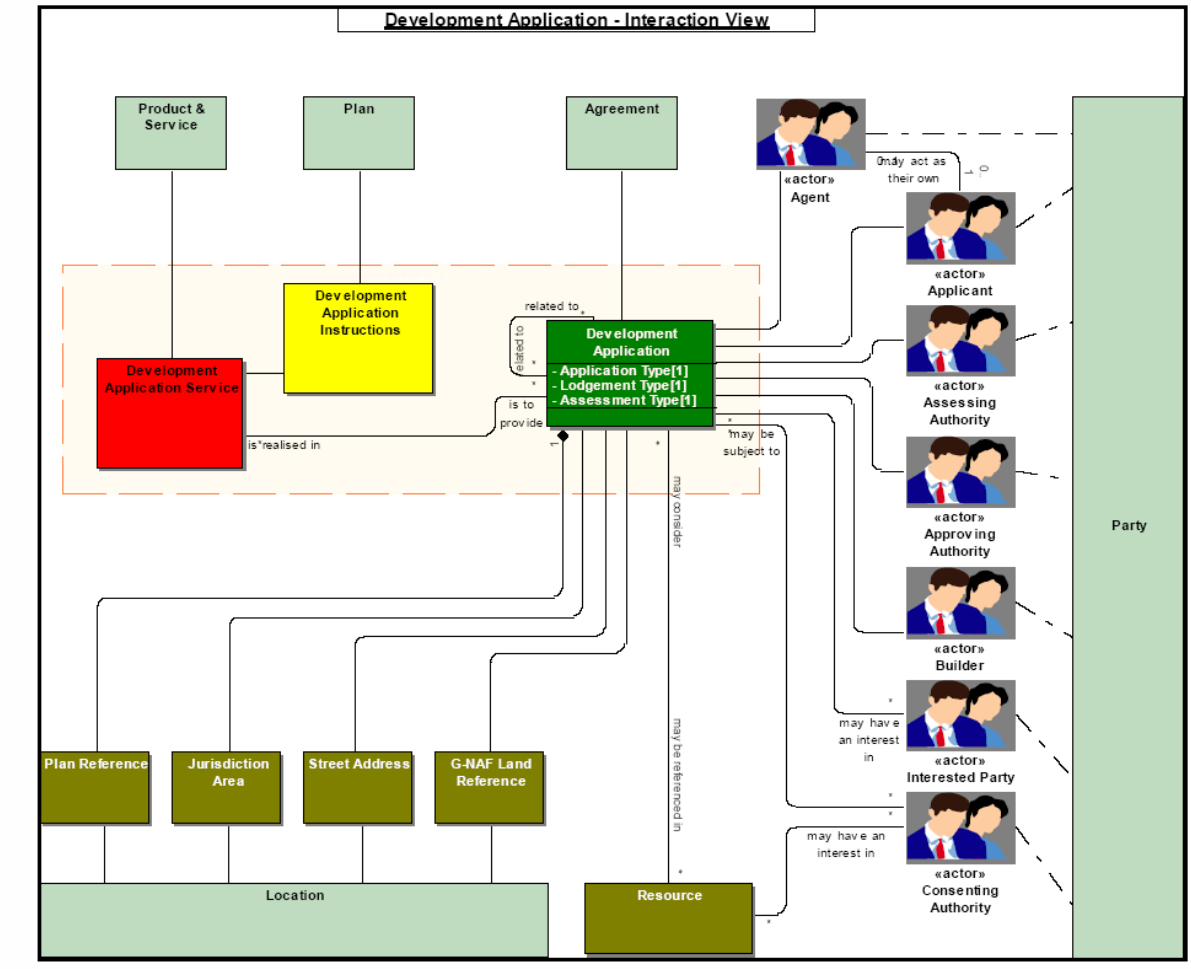


Figure 3 - Development Assessment Model

As a general principle eDA (and all the national "e" projects for that matter) have, wherever possible adopted existing industry or national standards and established schemas for data elements that are common between them.

In the diagram above (Figure 3), the application of this principle can be seen in the adoption of the Geocoded-National Address File (G-NAF) and its schema for the address data elements. It also calls on the legal parcel definition from the NECS model and data elements from the ePlan model are also critical to the development assessment process, especially

where land division (either subdivision or consolidation) is the subject of the development application. The ePlan schema then goes on to become a source of information to create the titles that are the subject of the eConveyancing process.

2.2 eConveyancing (Electronic Conveyancing)

The National Electronic Conveyancing System (NECS) is Australia's joint government and industry initiative to create an efficient and convenient way of completing property based transactions. It provides the means for electronic settlement of property transactions and electronic lodgement of associated real property instruments (dealings) for registration with the relevant Land Registry (LR) in any State or Territory in Australia. It also provides the means for (or for proof of) payment of duty on property transactions in accordance with the statutory requirements of the relevant Revenue Office (RO) in each jurisdiction.

The NECS model, which is shown in Figure 4 below, consists of three major modules:-

- **Preparation** provides the infrastructure for preparation, certification and signing of instruments, settlement statements and information reports;
- **Settlement** provides the means for the availability of pre-approved funds for settlements to be certified and for irrevocable settlement electronically through established financial system facilities and services; and
- **Lodgement** provides the means for instruments to be validated and subsequently lodged, for duty and tax liabilities to be assessed, and for compliance, valuing and rating information reports to be delivered.

The National Business Model (NBM) for the NECS is an electronic business environment for the conveyancing and mortgage financing industry in Australia. It addresses the industry's desire for a single national facility for settling property transactions, lodging instruments electronically with the appropriate Land Registry and meeting associated duty and tax obligations. However, it does not encompass the whole of the conveyancing process, and in particular it does not include any aspects of the:-

- disclosures required of vendors prior to sale;
- preparation and exchange of contracts for sale;
- pre-settlement investigations undertaken on behalf of purchasers;
- procurement of any insurances required by purchasers;
- creation of loan documentation by lenders;
- non-financial aspects of settlement; and
- processes for examining and registering instruments once lodged with a Land Registry.

In addressing the industry's desire for such a single national facility, the NBM does not assume, nor attempt to achieve or enforce, uniformity in each jurisdiction's Land Registry requirements. To the maximum extent possible the NBM presumes that appropriate systems design and technology approaches will be deployed to seamlessly accommodate the variations in the Land Registry requirements of the 8 jurisdictions across Australia.

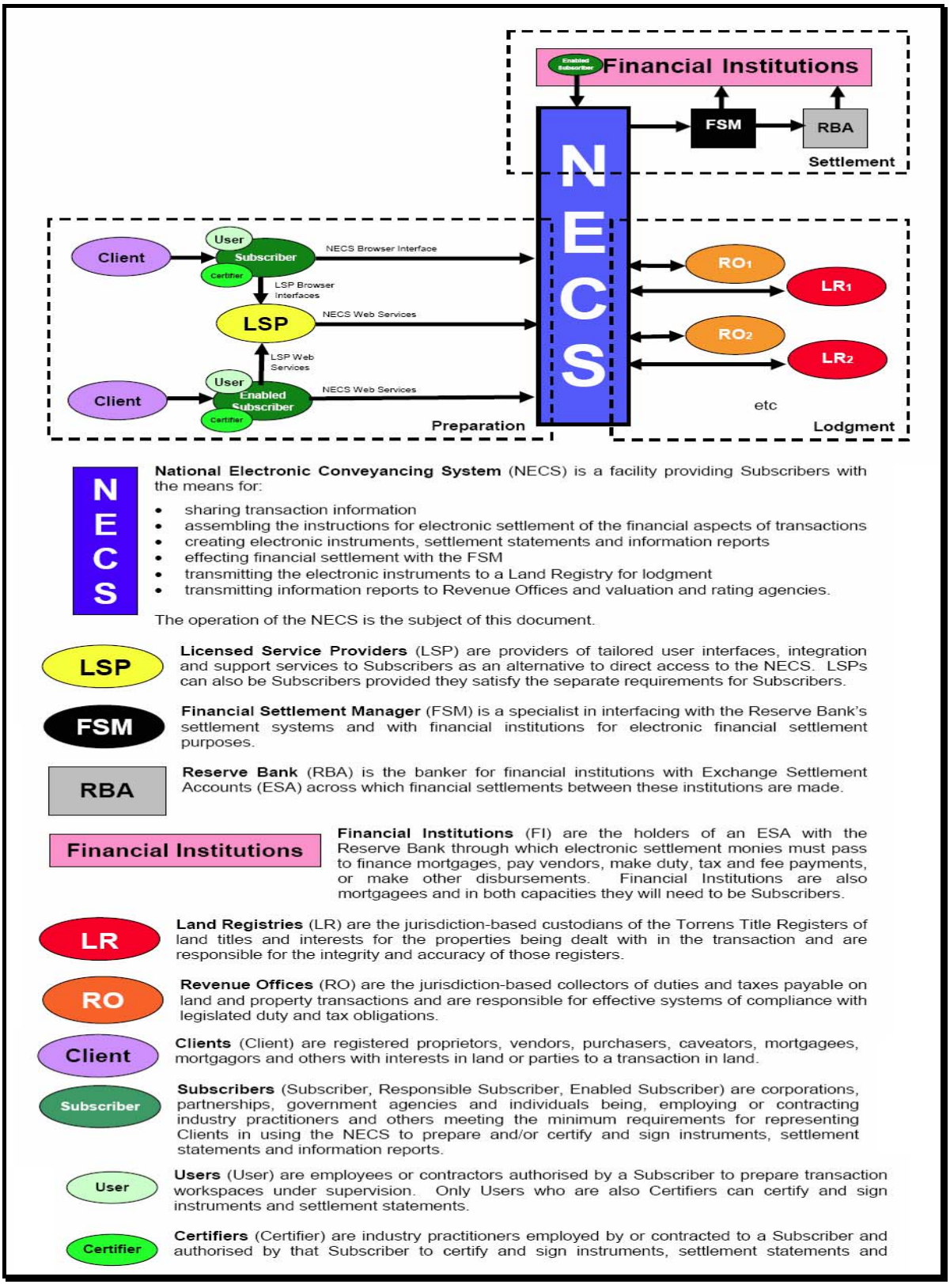


Figure 4 - National Business Model for eConveyancing

2.3 ePlan (Electronic Plan)

The ePlan initiative is modelling the business and standardising the digital format of cadastral survey data used in the land development process. This project is sponsored by the Intergovernmental Committee on Surveying and Mapping (ICSM), whose members from various Australian and New Zealand government agencies are responsible for standards and guidelines relating to surveying and mapping issues.

The ePlan project includes:-

- producing a generic UML (unified modelling language) model of ePlan for cadastral surveys, business rules and data dictionary ;
- data harmonising with other existing ICSM data models ;
- development of standard tools to facilitate data capture, visualisation, and validation functions;
- an XML (extensible mark-up language) schema for survey control, cadastral survey, and infrastructure that satisfy the legal and spatial requirements ; and
- business and strategic plans for its implementation.

To date this project has adopted Land XML as the data transfer standard and ePlan will be fully supported in Land XML 1.1. Also, the standard tools have been developed and software vendors are showing interest and support of the ePlan concept.

Figure 5 is a high level view of the survey node in the ePlan model shows that, depending on the type of observation and survey, there will be a requirement to provide data from geodetic control observations and adjustments.

2.4 eGeodesy (Electronic Geodesy)

This project is also sponsored by the ICSM and is managed by the Geodesy Technical Sub-Committee (GTSC). eGeodesy focuses on the UML modelling and developing a data exchange format for geodetic control information, in particular the business relating to creating ‘positional’ or coordinated data. This project aims to generate a standard data exchange format that will facilitate the management, creation, archival of geodetic control observations, adjustments, and results.

Presently this project is in the ‘analysis’ phase. This involves examining the business user needs, systems and processes, requirements and generally developing models for the ‘what’ of the business. The next phase of the project is ‘design’ which investigates ‘how’ the project will operate, be built and be implemented (Picco et al, 2006). At this stage it is feasible a version of LandXML will be the data exchange format for geodetic data.

From the brief description provided for these 4 national initiatives, the importance of the interdependencies between these projects in the land development process is evident. The key to their interaction is the data exchange format and the systems oriented architecture of the

information technology to manage and visualise the data and the processes. There is currently good communication and cooperation between the various national working groups to harmonise the definition of the common data elements and the adoption of established national and/or industry schemas.

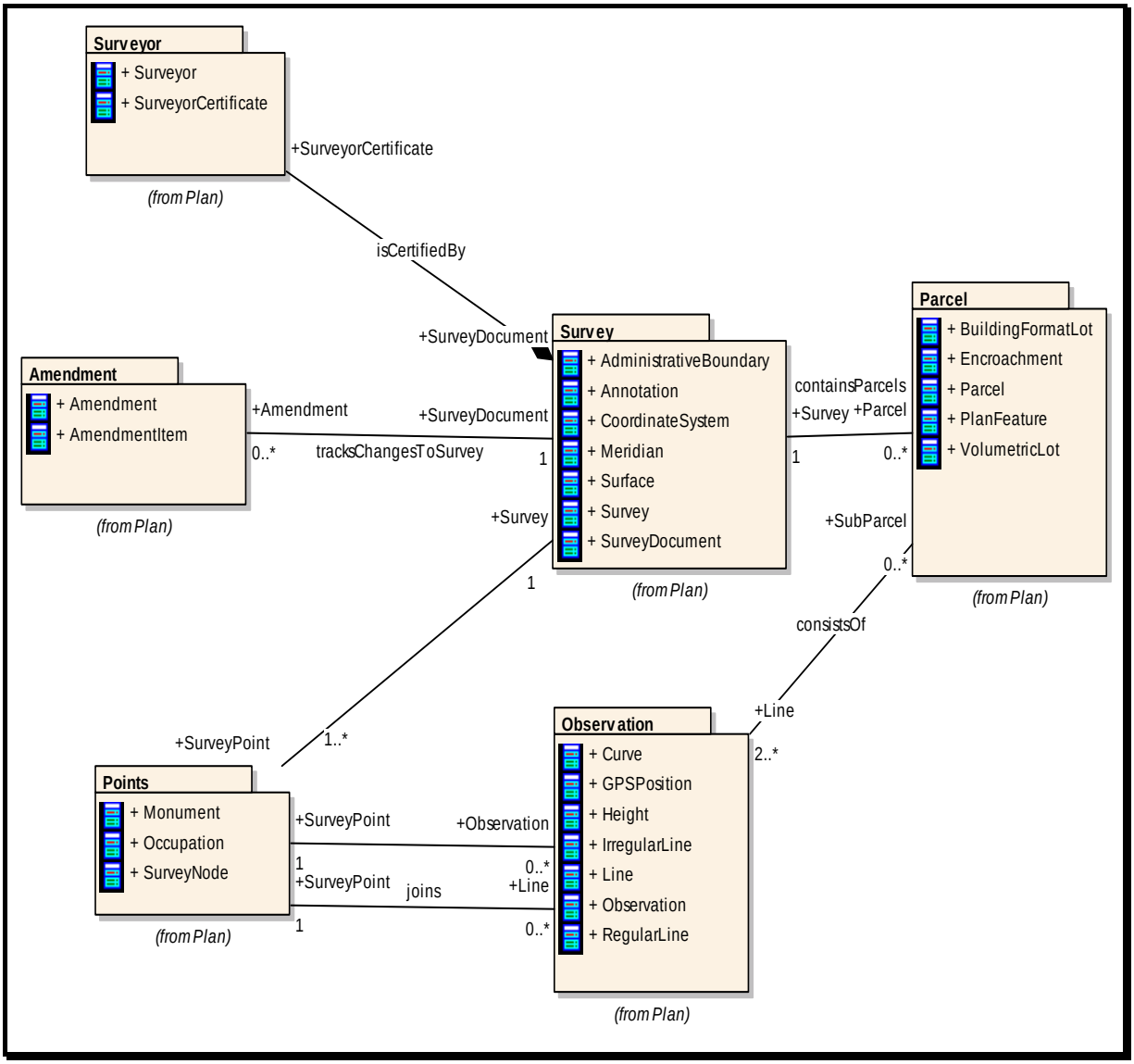


Figure 5 - ePlan Model

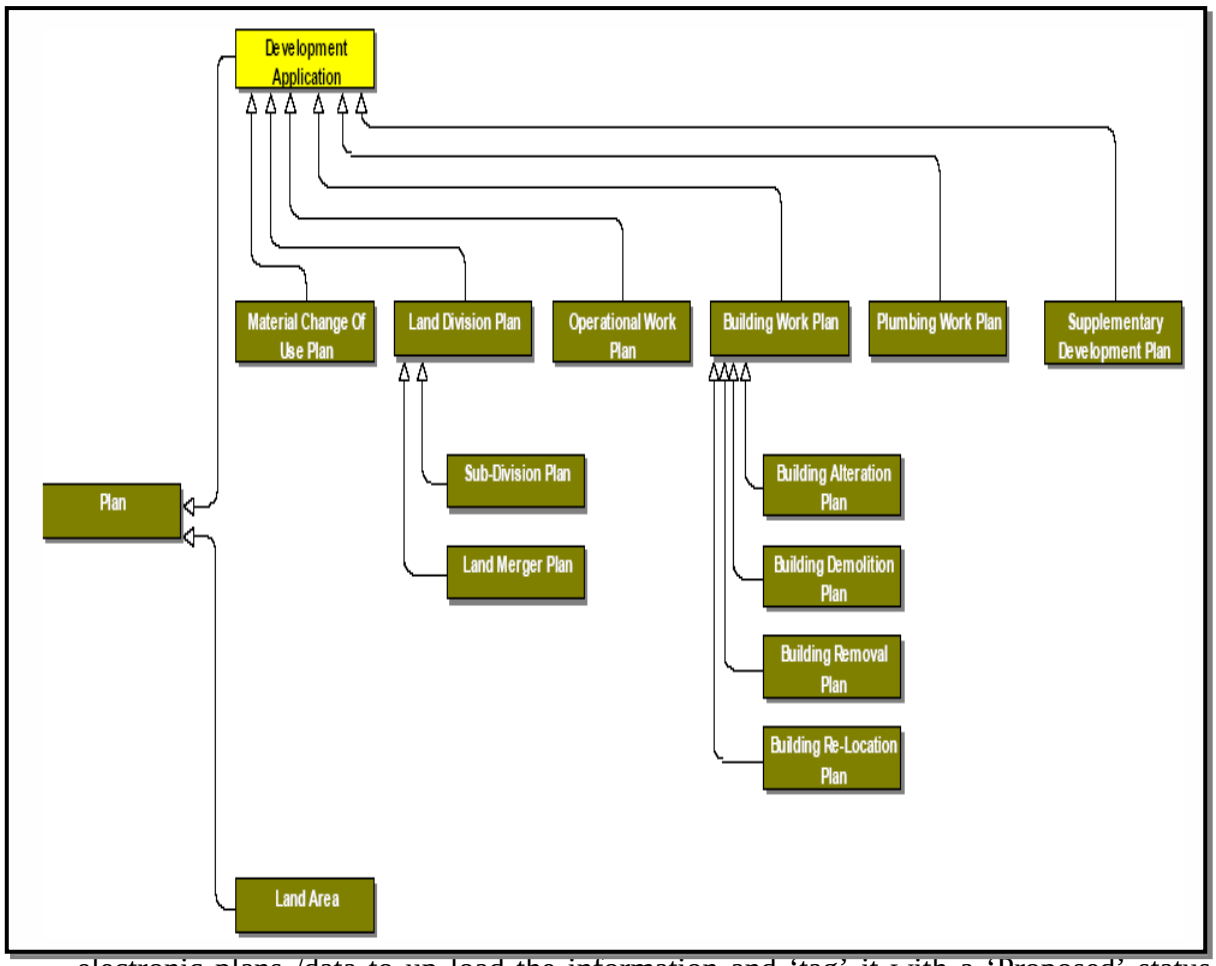
3. ENVISAGED "e" LAND DEVELOPMENT ENVIRONMENT

With respect to land development, the Land Information division of the NTG endeavours to provide accessible, timely and accurate land information to facilitate the statutory decision making and the processing of land transactions. In other words it provides the infrastructure and interfaces to deliver services that will enable a client/customer or applicant to identify, search, and define a parcel of land for a specific purpose and subsequently to gain security to

land through a land title that has complied with relevant statutory and/or land administration requirements.

As previously mentioned the NT is endeavouring to combine the various "e" projects to streamline the land development process and utilise digital technology. The current plan envisages the following process and milestones –

- The Applicant searches the parcel of land to ascertain or confirm the:-
  - tenure details (i.e. land status such as freehold, lease Crown etc);
  - ownership and registered title details;
  - parcel boundary and survey control information;
  - town planning or development assessment information (i.e. zoning, allowable land use, planning instruments and permits);
  - building permits;
  - utility particulars (eg power, water, sewerage details); and
  - other rights, obligations and restrictions that affect the land which are not registered on the title.
- This information is accessed via the web based service know as ILIS – Integrated Land Information System. Details are downloadable as 'PDF' documents or in a GIS/CAD product specific digital file format. Currently the alternate digital data exchange format being implemented for the "e" projects is the simple and flexible XML structured file format.
- The Applicant engages a spatial professional to prepare and lodge the electronic application to the Development Assessment Services (DAS).
  NOTE:- It is expected software vendors will integrate XML vocabularies such as XeDA, KML or LandXML into their product thereby enabling most users to enter/access details and create applications on various web services using specified style sheets or forms.
- The Development Application is lodged digitally via the ILIS web service and will primarily consist of spatial plans of proposed development, and textual information relating to that development and the administrative and legal process. The plans that may be included in the Development Application have been modelled as part of the National eDA project as shown at Figure 6 (Barnes et al, 2006).
- An electronic message notifying DAS of an application is sent and application is assessed by DAS. Using the ILIS web service, relevant authorities or stakeholders (such as Local Councils, Service Authorities, Environment and Resource Agencies etc) are sent copies of the applications electronically seeking comments and their requirements, which are then relayed back to DAS for compilation. Once in order a Development Permit outlining the conditions of the development is issued.
- Upon the issue of the Development Permit, a copy is sent to the applicant or their representative (often a spatial professional such as a Surveyor). Receipt of this indicates that the land development has NT Government approval to proceed.
- An electronic message and copy of the Development Permit is also sent to the Land Information Division (LID) – Office of the Surveyor General (OSG), who then use the



electronic plans /data to up load the information and 'tag' it with a 'Proposed' status into the textual and graphical components of ILIS.

Figure 6 – Development Application Model

- The OSG allocate data (parcel, plan, survey control numbers etc) and notify applicant's Surveyor, DAS, and other stakeholders.
- Applicant's Surveyor uses ILIS web service to source boundary, survey control and other parcel information. This information is expected to be downloaded via a XML structured format in accordance with ePlan and eGeodesy models.
- Survey and construction works of the land development begins.
- Near or at completion of the land development the Surveyor lodges the survey (cadastral) plan of subdivision electronically (ePlan) and survey control information (eGeodesy) to the OSG for approval. As previously mentioned the plan will most likely be in XML or Land XML format and contain all spatial and textual information that will allow issue of title.
- OSG sends a electronic message to DAS that the survey plan has been lodged and will be examined or validated for spatial and survey related statutory compliance.
- DAS view the ePlan through ILIS web service and then electronically notify stakeholders of the Development Permit that the applicant will be seeking or has sought

compliance with the relevant statutory requirements and /or conditions of the subject Development Permit.

- Through the ILIS web service DAS and stakeholders submit their comments and their subsequent approval by appending an electronic signature to the ePlan.
- Whilst DAS process the development for compliance with the Development Permit the OSG examines or validates the spatial, survey and title aspects of ePlan. This process involves:
  - Extracting parent parcel data from the digital cadastral database (DCDB) and SPICAD environment to ensure the subdivision action is within parent parcel boundaries.
    NOTE:- SPICAD is a database using Oracle technology and manages the cadastral co-ordinates, the survey geometry and parcel data in a seamless environment.
  - Confirming that the spatial aspects meet the survey technical statutory requirements i.e. marking, survey accuracies, data allocation
  - Checking that the lodged survey control information complies with NT Geodetic Survey System (NTGESS) protocols and standards based on eGeodesy.
    NOTE:- NTGESS is an administrative interface, which utilises Oracle database technology and manages all geodetic data in tree directory structure.
  - Maintaining the survey and spatial information in DCDB, SPICAD, NTGESS and ILIS as amendments to the ePlan and Geodesy data occur during the process.
  - Liaising with stakeholders to resolve ePlan issues.
- DAS issue a Compliance Certificate that states the subject land development satisfies all conditions of the Development Permit. Updates and endorses the subject ePlan via the ILIS web service.
- OSG is notified electronically of DAS approval and if all spatial and survey related statutory requirements comply, then the OSG approves the subject ePlan.
- OSG now changes the status of the subject ePlan to 'Approved', which will be automatically updated in SPICAD, NTGESS, DCDB and ILIS.
- All stakeholders, including applicant and their representatives are notified electronically of the ePlan approval. The subject ePlan, documents and surrounding information can be visualised through the ILIS web service.
- The subject parcels of the approved ePlan are now ready for land title issue by the Registrar General's Land Title Office (LTO).
- Once the appropriate LTO documents are lodged with the Registrar General via the ILIS web service and are then examined, a electronic land title can be issued (eConveyancing)
- Original applicant is notified and sent a copy of the electronic title.

A summary of this eDevelopment process as described above is depicted in Figure 7 on the following page.

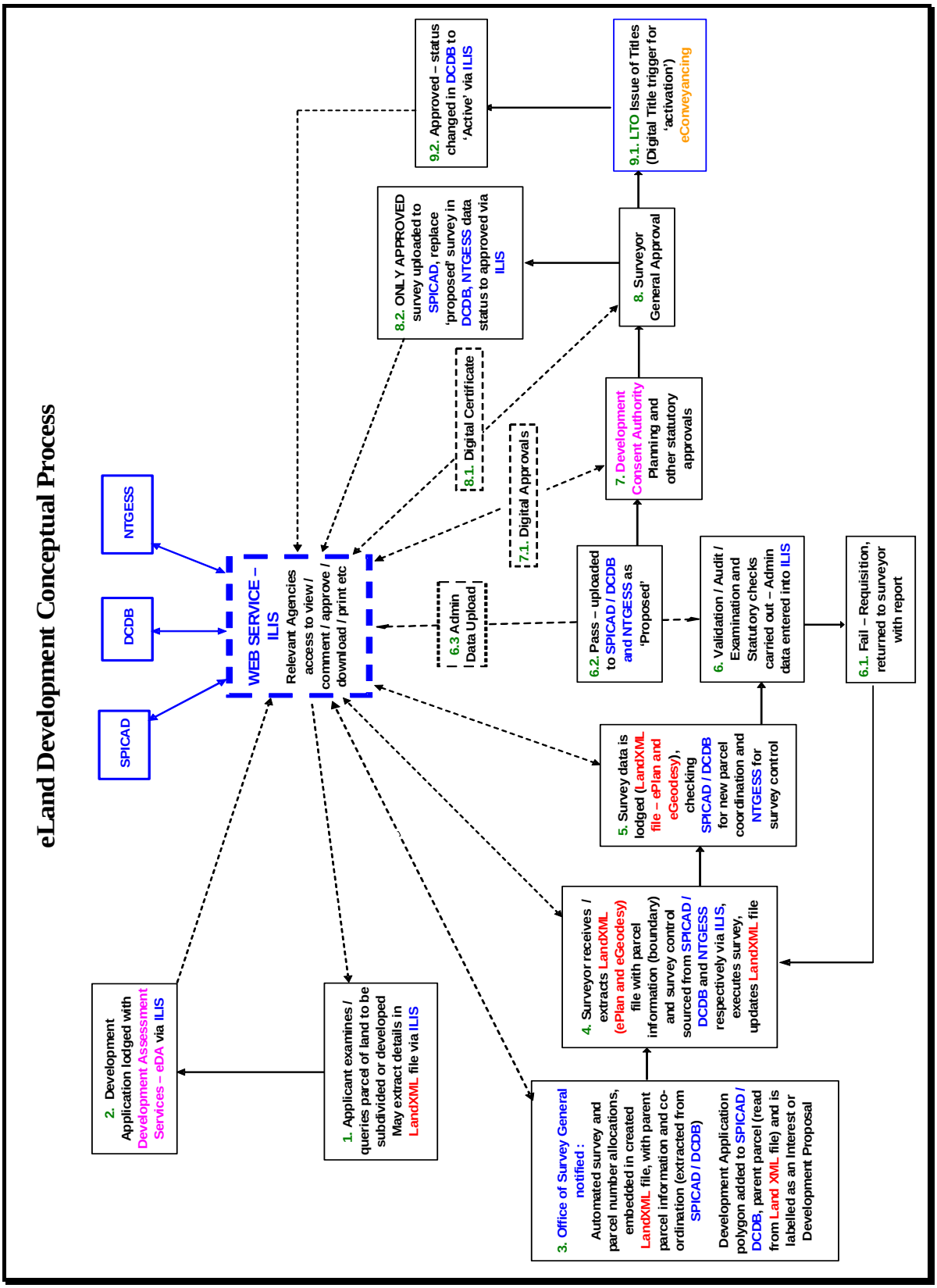


Figure 7 - eLand Development Process Flowchart

4. VISUALISATION

The introduction of the Google Earth visualisation client into the Internet marketplace has revolutionised the accessibility and appreciation of geographic information in the home and workplace. The intuitive interface and highly functional KML data format provide for a rich user experience and provide plenty of opportunity for the NTG to display the various stages and processes in the land development process so there is greater visibility to the community as part of its eGovernment services. As an example, rather than advertising a planning application for a new office building in a relatively uninformative and hard to understand public notice in a newspaper, it would now be possible to publish a KML file on the NTG website that included a 3D model of the proposed building to show how it fits in with the surrounding structures as shown in Figure 8.

Figure 8 - Visualisation of Proposed Hotel Development

There are many stages during the planned 'e' land development process described in the previous section where it is necessary to convey spatial relationships between the proposed and the existing worlds. In the past this capability was mostly restricted to specialist software packages that skilled operators use to produce a "static" visualisation for the actors in the land develop process to use. Now it is possible to provide a dynamic and interactive "world" that can be used by all the actors in the land development process as a tool to assist in the administrative process and their decision making.

The NTG purchased a Google Earth Enterprise (GEE) server and client software and data package in February 2005 to provide a whole of government spatial data visualisation service to support the "e" initiatives outlined in previous sections of this paper. The deployment of the Google Earth Enterprise Client (GEEC) across the NTG to staff with a wide range of disciplines and technological competency levels has required a highly integrated approach capable of linking an array of datasets with minimal intervention from either the end users or data administrators (Price 2006).

The NTG has "fused" a diverse range of data into the GEE platform in a sustainable and transparent fashion. This has been achieved by implementing a Service Orientated Architecture and a distributed data fusion and serving environment. This data is now being used across the NTG as a spatial "portal" by many people, ranging from front counter staff to executives, who have previously never used a GIS or spatial data as part of their day to day work process.

5. CHALLENGES

The NT's cadastre, development applications (outline polygon) and survey plans (images) had been available to the public in the NT Atlas (http://www.ntlis.nt.gov.au/atlas/) web mapping application, so the challenge was how to make this public information available in Google Earth. The NT Atlas layers were also available as a Web Mapping Service (WMS) and it was decided to make the cadastre boundaries available as an overlay image to dynamically display the cadastre in a Google Earth viewer. However, when a file was published on the NTLIS Collaboration Forum so that the cadastral WMS could viewed by the community in the free Google Earth, it highlighted the less accurate georeferencing of the imagery and terrain streamed from the Google server, which could be up to 20 metres in some places around Darwin. This misalignment means that the widely available Google Earth is not always suitable for identifying land parcels or displaying the location of detailed concept model of proposed building developments as shown in Figure 9.

If the NTG is going to have a very good, publicly available visualisation framework upon which it can show its WMS and Web Feature Service (WFS) information that the NTG might wish to "publish" for community consultation (eg all the planning application notices) or public information for flood/cyclone or any other emergency management event, then it will have to work with Google to provide better geodetic control for the digital globe imagery or publish its own accurately georeferenced imagery to the public.

Other challenges still to be faced from a survey data perspective include:-

- the creation of legislation (from a survey practice perspective) to support the role of the ePlan and land development process;
- the implementation of business processes and the development of spatial tools to manage and visualise the third dimension of a cadastre (i.e. the vertical component) from volumetric surveys, unit or strata title developments and 'building lot' subdivisions;

- the management and back capture of registered easements prior to 1994 to complete the picture of rights and restrictions that will be required for eConveyancing and eDevelopment Applications;
- the facilitation of 'as constructed surveys' and their visualisation into the land development process to assist the management of utility or service or infrastructure assets such as telecommunications, power, water, sewage, drainage, gas, rail etc.

Figure 9 – Visualisation of Proposed Commercial Development

6. CONCLUSION

To date there has been good cooperation between all the jurisdictions and a genuine willingness to work together to deliver the enabling standards to make it feasible to implement national *eAdminstration* and *eGovernance* for the land development process in Australia.

The NTG has faced the challenge of implementing its GEE services to be compatible with and to compliment the free Google Earth client and other third party applications which has greatly increased the visibility and use of its publicly available spatial data during the land development process. A natural progression that should be of interest to all spatial data infrastructure providers is that decision makers at all levels and citizens now expect to access reliable and detailed spatial information in a high performance, interactive interface that accelerates and enhances the decision making right through the land development process.

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BIOGRAPHICAL NOTES

Phillip RUDD, Director of Land Information Systems (NTLIS) in the Land Information Division of the Northern Territory Government's Department of Planning and Infrastructure, Licensed Surveyor in the Northern Territory and Victoria, Batchelor of Applied Science (Surveying) from the RMIT University, Foundation member of the Australian Spatial Sciences Institute, Member of the Institution of Surveyors, Australia.

Phillip moved to the Northern Territory in 1982 to take up a position as Licensed Surveyor after 8 years working in the private sector in Victoria, Australia. He quickly realised that surveying in the hot tropical sun wasn't much fun and moved into a computer systems job in the Land Management Division of the then Department of Lands. It was here that he first became involved in the Land Administration Information System in 1985.

Phillip is currently the Director of the NT Land Information Systems (NTLIS) Program for the Department of Planning and Infrastructure, which includes the Integrated Land Information System (ILIS), and the GIS support groups. As Director of the NTLIS he has whole of NT Government service obligations as well as supporting the Department's own spatial information business systems. In this role, Phillip has been involved in the planning, development and implementation of the NTLIS architecture and spatial data infrastructure for the NT Government over the past 20 years.

Phillip has worked as a land information management consultant and technical adviser in Sarawak, Taiwan, the Solomon Islands and in China where he provided a major input of 15 months on AusAID's Hainan Land Resource Fundamental Information System Project in 1996 and 1997.

Robert SARIB, Manager, Survey Services in the Land Information Division of the Northern Territory Government's Department of Planning and Infrastructure, Licensed Surveyor, Foundation member of the Australian Spatial Sciences Institute, Member of the Institution of Surveyors, Australia, and Vice Chair of Administration for FIG Commission 5 – Position and Measurement.

Robert Sarib obtained his degree in Bachelor Applied Science – Survey and Mapping from Curtin University of Technology Western Australia in 1989. He was registered to practice as a Licensed Surveyor in the Northern Territory, Australia in 1991 and achieved this during his employment with the Northern Territory Government. Since then he has work in the private sector as a cadastral surveyor, and more recently re-employed by the Northern Territory Government to manage the NT Geodetic Infrastructure and administer the Survey Services unit of the Surveyor General's office. He also holds a Graduate Certificate in Public Sector Management received from the Flinders University of South Australia.

Mr Sarib is currently a member of the FIG Commission 5.2 Working Group – Reference Frame in Practice, and the Northern Territory delegate on the Australian Inter-governmental Committee on Survey and Mapping - Geodesy Technical Sub Committee. He is the Northern Territory Federal Councillor of the Institution of Surveyors Australia, and the Northern Territory Vice-President and representative for the Land Survey Commission of the Spatial Sciences Institute of Australia. He is also a board member of the Surveyors Board of Northern Territory for licensed or registered surveyors.

CONTACTS

Mr Phillip RUDD Department of Planning and Infrastructure GPO Box 1680 Darwin NT AUSTRALIA Tel. +61 8 89244144 Fax. +61 8 89244045 Email: phillip.rudd@nt.gov.au Web site: www.ntlis.nt.gov.au	Mr Robert SARIB Department of Planning and Infrastructure GPO Box 1680 Darwin NT AUSTRALIA Tel. +61 8 89996081 Fax. +61 8 89997750 Email: robert.sarib@nt.gov.au Web site: www.dpi.nt.gov.au