Integrated Systems and Services Strategy for the Natural Resource Sector v1.2

Natural Resource Sector – Information Management Branch

EXECUTIVE SUMMARY

The Information Management Branch of the Natural Resource Sector (NRS) is committed to advancing an Information Management/Information Technology (IM/IT) strategy to develop integrated systems and to transform the management of business data across the NRS. The IM/IT strategy is predicated on the need for extensive business transformation in order to achieve a citizen-centric focus for NRS IM/IT systems. Many business transformation requirements can be addressed at the technology level by providing integration between existing legacy systems using a Service-Oriented Architecture (SOA) and Web services. Where the development of new IM/IT systems are required, an "Application Framework" will be employed to streamline development and provide a consistent user experience. In addition, a comprehensive data management strategy is proposed to rationalize and consolidate the operational data holdings managed within the NRS.

Foundational IM/IT Strategies:

- Deploying Web services between legacy systems to provide the interconnectivity required to facilitate Sector-wide Integrated Decision Making (IDM). The IDM paradigm is a crucial first step in achieving the "One Land Base, One Land Manager (OLB-OLM)" vision for the Sector;
- Promoting sector-wide sharing of business data through consolidation and rationalization – creating a single authoritative database that implements history (time-tracking) for business data;
- Deploying dynamic Web forms with workflow tracking through a generic application framework to support IDM and OLB-OLM.

A future vision in IM/IT may be considered a somewhat tenuous construct given that technology changes are frequent and often difficult to predict in advance. The IM/IT future vision and strategies formulated for the NRS have been generalized as much as possible. They will be reviewed annually and where appropriate, adjusted to align with changes in technology and business priorities.

The specific vision and strategies outlined in this document are intended to interlock with current LEAN initiatives underway within the provincial government . Adherence to LEAN principles entails significant changes concerning how IM/IT systems are to be developed and managed within the NRS. Integrating IM/IT systems at the Sector level will significantly improve automated business processes.

The Integrated Systems and Services Strategy vision described in this document involves a significant culture shift away from systems that are rigidly structured along vertical lines of business towards systems that are services based. Strong executive support is required in order to realize such an overarching vision. The ultimate goal is to provide improved self-serve systems for businesses and the public and to develop an IM/IT infrastructure that can be adapted more readily to evolving business priorities within the NRS.

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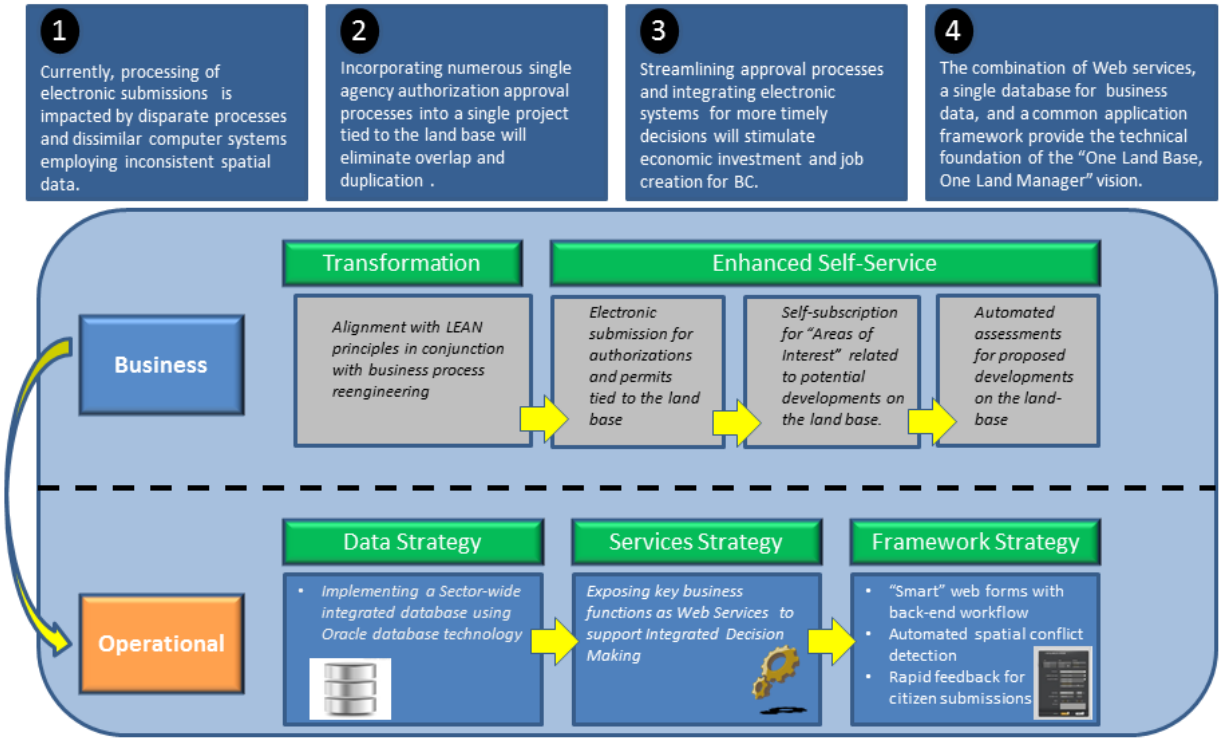
OVERVIEW

This document describes a vision and strategy intended to transform the IM/IT systems within the Natural Resource Sector (NRS). The approach to realize this vision is tightly bound to LEAN principles, specifically the principles of standardization, cultures shift, and client focus. The vision and strategies described in this document also interlock tightly with the Citizen at the Centre approach advocated in the OCIO's IM/IT Enablers Strategy.

The "One Land Base, One Land Manager vision proposed within the NRS can only be achieved through extensive business transformation, and tightly linked IM/IT transformations to support the business. Currently, Sector IM/IT systems are rigidly structured along traditions lines of business. Three IM/IT strategies have been identified that will facilitate breaking down barriers between legacy IM/IT systems and make possible the citizen-centric, corporate systems focus embodied by "One Land Base, One Land Manager. These strategies include:

- Consolidate and rationalize management of operational data, including temporal-spatial data, using standard Oracle Database technology;
- Extend legacy IM/IT systems using Service-Oriented Architecture and Web services, and
- Introduce an application framework for the development of next generation integrated IM/IT systems.

Evolving Integrated Systems to Support "One Land Base, One Land Manager"



In industry and government, the primary function of IM/IT is to automate business processes. Automation is intended to produce efficiencies, to ensure consistency in processing, and to reduce much of the manual effort associated with paper-based systems. Conventional wisdom is that within the business environment, IM/IT exists primarily to serve the business. Budgets, system design methodologies, and IT staff placements in most large organizations are predicated on this approach to serving business needs. While this approach has worked relatively well for many years, it has unfortunately resulted in the proliferation of business systems that are rigidly structured into vertical lines of business. There is a growing recognition that this approach is no longer effective in meeting the wider strategic goals of most organizations.

Researchers examining IM/IT spending in Fortune 500 companies[1] over the last decade have identified systems that were developed along rigidly structured vertical lines of business as among the major causes of escalating IM/IT costs. Many of the systems developed in the last decade provide citizens with Web-based access to industry and government services. However, Web-based access to services has typically been implemented using many different technologies, even with in individual organizations. Incompatible Web technologies and the fact that the underlying business services continue to be structured along vertical lines of business (i.e. "siloed") has proven to be confusing to users of these services.

The NRS supports a very large number of systems compared to other Ministries within the provincial government. Significantly, the majority of public facing systems within the provincial government are managed within the NRS, making the Sector a leader in providing on-line services for citizens and businesses. Unfortunately, the majority of the systems managed by the NRS are rigidly structured into vertical lines of business.

Over the last decade, Service-Oriented Architecture (SOA) has emerged as the technology best suited for developing integrated systems in a complex system environment similar to the IM/IT systems environment within the NRS. A key advantage of SOA is that it does not require existing systems to be re-written. Instead, SOA provides "wrappers" for existing legacy systems. These wrappers use standard protocols to allow systems of different design, different age, and different architecture to communicate. Many NRS systems contain complex business processes that would provide considerable additional value if these business processes could be shared among multiple NRS IM/IT systems. Web services (part of a complete SOA strategy) are the technology that best addresses this need.

The recent focus within the provincial government on LEAN processes aligns well with an IM/IT strategy employing SOA. LEAN transformation is a term used to characterize moving from a traditional way of thinking to LEAN thinking. LEAN thinking leads to optimization of processes across lines of business.

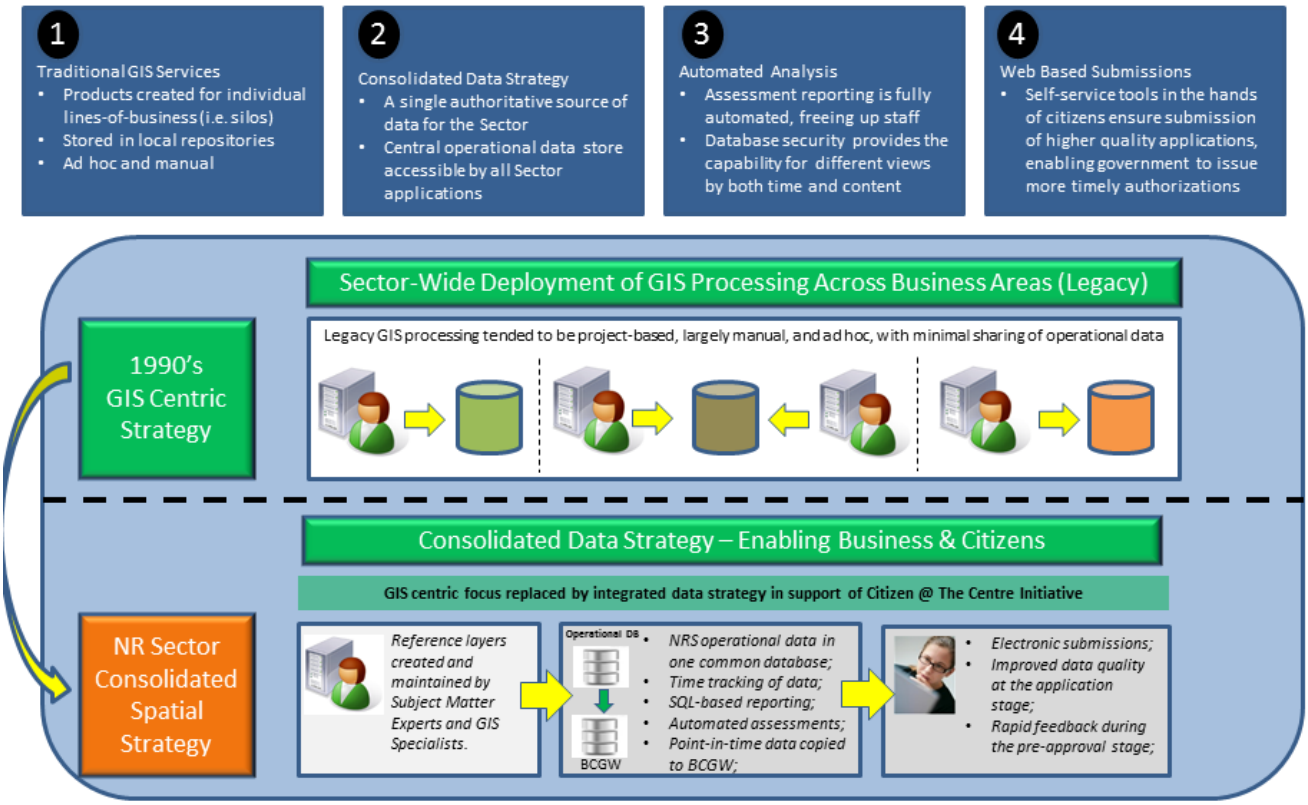
The Enterprise Data Services (Data BC) group within Citizens' Services and Open Government provides a rich portfolio of spatial services (described later in this document under the heading "Secondary Enablers"). Many NRS IM/IT systems make use of the spatial and warehouse services, and the ongoing reliance of NRS on these services is a key success factor in advancing the NRS vision of leveraging common services and reducing data redundancy.

1 Raines, G. (2009) Leveraging Federal IT Investment with Service-Oriented Architecture. The Journal of Defense Software Engineering, 22(2) , 4-8.

INTEGRATED DATA MANAGEMENT STRATEGY

Another major issue facing the NRS concerns the fragmentation of operational data, including spatial data, across a number of data repositories. Not only have business system been rigidly structured along lines of business, but many of these same business systems manage spatial data separately from attribute data, using different technologies and processes. Further, many NRS line-of-business systems continue to rely upon manual, ad-hoc GIS technology for handling the spatial aspects of line-of-business data. Moving forward, the NRS has the opportunity to bring attribute and spatial data together, providing the Sector with the capability to manage operational data, both attribute and spatial, in a coordinated and integrated manner. The integrated data management strategy for the NRS is intended to provide Sector business systems with reliable, integrated transactional management using modern database technology.

Evolving NRS Data Strategy to Support "One Land Base, One Land Manager"



Timely and effective resource management requires access to data that spans multiple lines of business. NRS has chosen a two-part strategy to achieve this goal. The principal focus of the NRS data integration strategy is the creation of a centralized operational database for NRS core business needs related to its clients and the land. The NRS integrated operational database will incorporate a leading edge spatial data model that is independent of legacy GIS technology. In addition, the NRS integrated operational database will include the

(temporal) capability for tracking changes on the land base over time. Thus, the spatial-temporal capabilities of the new database will address both existing and emerging operational requirements within the NRS.

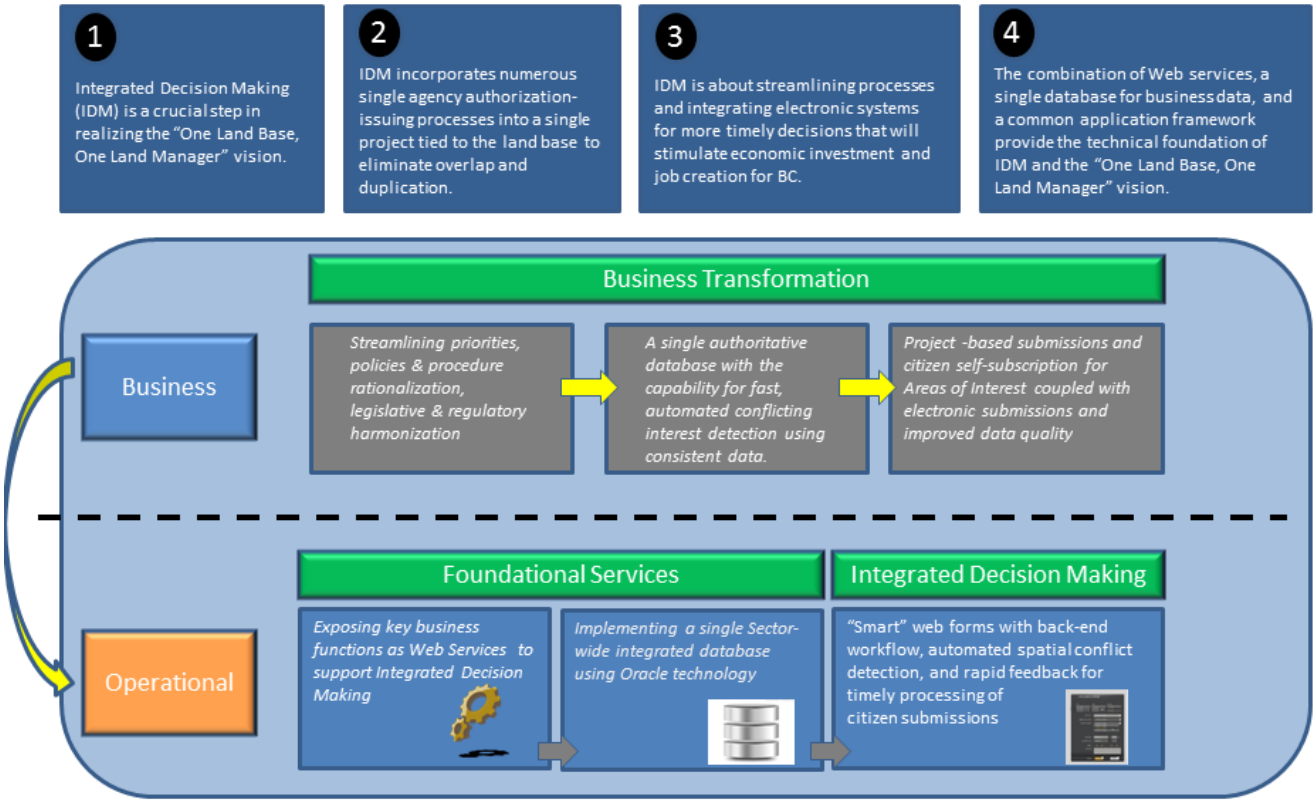
NRS firmly recognizes the value provided by the BC Geographic Warehouse (BCGW) and other Enterprise Data Services (EDS) service offerings based upon published (warehouse) data. The NRS will continue to rely upon, and where appropriate, expand the use of BCGW warehouse services (e.g. Geomark). BCGW warehouse services complement the operational data services developed for the NRS and will continue to be a core component of the NRS architecture.

INTEGRATED DECISION MAKING

The IDM initiave is the first crtical step in realizing the greater vision embodied by the Sector's "One Land Base, One Land Manager" vision. To be viable over the long term, One Land Base, One Land Manager depends upon integrated systems, integrated spatial data, and a consistent Web presence for online access by businesses and the public. The technical foundation or "enablers" for IDM include:

- Adoption of Service Oriented Architecture to revitalize and extend legacy IM/IT systems;
- Adoption of Oracle database technology for storage of corporate spatial and temporal data;
- Standardization upon representational state transfer (REST) Web services as the most appropriate mechanism to provide interconnectivity between legacy systems;
- Increased use of "Smart" Web forms that include embedded error correction to improve the quality of data associated with authorization and permit electronic submissions;
- Sector-wide use of back-end workflow in line-of-business systems to allow better process management, tracking and reporting;
- Streamlining of business processes to remove the need for duplicate manual entry of data.

Enablers for Integrated Decision Making (IDM)



GAP ANALYSIS

Two major gaps are not fully addressed in this vision document. The vision document promotes the use of enabling technology (i.e. SOA and Web services) to extend and prolong the functionity offered by large, complex legacy applications. The gaps address areas where new IM/IT systems will be required to provide the requisite business functionality. These include:

- The requirement for a common revenue management system that interfaces with the Coporate Accounting System (CAS), the Government Agent Revenue Management System (GARMS), BC Express Pay, and BC Online. Within the NRS there are multple financial subsystems within specic life-of-business applications. Ideally there should be a single, common revenue management system that can be shared across multiple line-of-business applications using SOA and Web services;
- Identification of an application framework product that can be used as the foundation for developing the next generation of integrated systems. The framework should be robust, flexible, well supported, and integrate seamlessly with NRS spatial-temporal data. Oracle-Seibel is one potential solution that meets these requirements. However, licensing, operational, and infrastructure costs for large-scale commercial framework environments are of significant concern to the NRS. Potentially, there are Open Source solutions that could provide similar functionality, albeit with lower price-performance costs,

given that the NRS may not require all of the case management functionality bundled with commercial application framework products.

Developing strategies to address these gaps has been identified as part of the Phase 1 work for IDM.

STRATEGIC COMMITMENTS

- Review the vision document and approach annually to ensure that planned activities and approaches align with business requirements and NRS commitments to citizens, businesses and government;
- Ensure that units of work associated with the proposed initiative provide good value for funding expended and are organized into manageable phases that align with business and budget cycles.

PRIMARY ENABLERS

The proposed integrated systems and services vision is dependent upon a number of enabling technologies. This section provides additional information about specific technologies that underlie the proposed strategy.

STRATEGY 1: SERVICE ORIENTED ARCHITECTURE

Service Oriented Architecture (SOA) is an approach to designing systems that promotes sharing of information. Traditionally, computer systems (applications) have been developed to be stand-alone, often with each system requiring its own separate servers and databases. While developing stand-alone systems does provide individual business areas with tight control over line-of-business systems, it results in unnecessary duplication, does little to promote a corporate approach to data sharing, and ultimately leads to increased operational costs. SOA is an architectural approach that enables organizations to retrofit legacy systems and develop new systems in a manner that satisfies business needs through integration and sharing.

STRATEGY 2: ORACLE LOCATOR

The Oracle relational database management system has supported spatial data management since 1992. Oracle Locator is the basic feature (included in the standard edition of the Oracle database) that provides capabilities for spatial data management. Oracle Locator includes spatial data types, spatial operators, and spatial indexing capabilities that support a sophisticated spatial data management strategy without the need to purchase Oracle's Spatial Data Option (SDO). The spatial capabilities included with Oracle Locator can be augmented where necessary with Open Source spatial middle-tier software like the Java Topology Suite (JTS) and the automated error correction capabilities provided by the Java Conflation Suite (JCS). The NRS has operational experience with all these technologies.

STRATEGY 3: WEB SERVICES

Web services provide a method of communication between two software systems connected via a network. The network connection can be either local or worldwide via the Internet. There are two recognized types of Web services: Web services based upon Simple Object Access Protocol (SOAP) and Web services based upon Representational state transfer (REST). SOAP Web services are the older and predominant type of Web services. However, with the emergence of Web 2.0 technology, REST Web services are being viewed as the successor to SOAP. A further advantage provided by REST Web services is that multiple REST Web services can be combined using technology termed the "Web Application Programming Interfaces". However, the use of REST Web services can be processing intensive and must be implemented on scalable infrastructure to ensure consistent quality of service.

STRATEGY 4: ESRI ARCGIS DESKTOP

The NRS has invested heavily in ESRI's ArcGIS desktop technology. ArcGIS is a geographic information system (GIS) toolset used for processing of geographic data and spatial analysis. Given that ArcGIS licensing costs

constitute a significant expenditure, licensing of the ArcGIS desktop deployments is closely managed within the NRS. The preferred deployment for ArcGIS desktop is the GIS Terminal Servers (GTS) environment. The GTS consists of a pool of high-end shared servers dedicated to GIS analysts and licensed for use of ArcGIS desktop product. ArcGIS desktop users typically access two quite separate sources of spatial database. Operational spatial data sets are retrieved from NRS file systems and operational databases, while reference data sets are accessed from the BCGW. Thus, GIS desktop users can combine dynamic NRS operational data with BCGW point-in-time reference data in order to generate spatial analysis reports or to create new spatial data products.

STRATEGY 5: COMMON CLIENT

A shortcoming of many systems deployed across the NRS is the dependency upon client names and client addresses that must be managed within each individual line-of-business system. Ideally, there should be a single, definitive repository of client names and addresses that are shared among all line-of-business systems. Without a common client database, manual procedures must be used discover and link electronic records for specific clients. This is less of a problem in the case of businesses where the business number can be used as a common key to link electronic records. It is however a serious problem in the case of applications from private citizens where name and address information that is stored electronically typically exhibits considerable variation. Thus, the lack of a common client-address database constitutes a major impediment to the realization of the One Land Base, One Land Manager vision.

STRATEGY 6: WORKFLOW

Workflow provides a mechanism that allows routing of authorizations, permits, documents and tasks between individuals and systems within an organization or across organizational boundaries given the right technology. The logic employed by the workflow engine can be based upon regulations, procedures and business rules.

STRATEGY 7: "SMART" WEB FORMS

Allowing submission of applications from the Web provides a number of opportunities. The capability for self-service offers businesses and citizens the means to submit applications whenever it is convenient for the business or individual. A critical problems that must be addressed as part of the One Land Base, One Land Manager vision is the quality of data in application submissions from the Web. Poor data quality delays application processing and places additional workload on staff members that are responsible for assisting with application submissions. Electronic data entry with validation (i.e. smart Web forms) provides the best and most cost effective mechanism for improving data quality at entry time. In addition, by linking multiple smart Web forms together, the need for citizens to enter the same data multiple times can be reduced or eliminated.

SECONDARY ENABLERS

Enterprise Data Services (EDS) and Workplace Technology Services (WTS), both part of the Ministry of Labour, Citizens' Services and Open Government, provide shared services that are intended to be called by line-of-business systems operating within the provincial government computing environment. The BC Express Pay service provided by Provincial Treasury Branch (PTB) is another shared service available to line-of-business systems that require credit card payments. These shared services provide foundational enablers and are important components of the overall architecture that supports the Integrated Systems and Services Strategy for the NRS.

STRATEGY 1: IDENTITY MANAGEMENT SERVICES (WTS)

Workplace Technology Services provides common authentication services for applications and services for government staff and external parties doing business with the Province of BC. Authentication services are currently implemented using Microsoft Active Directory technology. One Active Directory (IDIR) provides services for government staff and a second Active Directory (BCeID) provides authentication services for citizens, businesses and public partners. Secure authentication for Web base systems (applications) are provided through SiteMinder, which interfaces to both IDIR and BCeID through the Corporate Authentication (CAP) Web services and Web pages. In the future, authentication services provide by WTS will move towards "claims based" identity management mechanisms. Claims based identity management will provide businesses and citizens with an effective means to control the use of their identity information and facilitate enhanced privacy protection of personal data.

STRATEGY 2: BC EXPRESS PAY

Provincial Treasury provides a shared credit card payment system known as BC Express Pay (BCEP). Use of BCEP is mandatory for all public facing provincial government systems that allow credit card payments. BCEP provides a standard Web based interface for credit card payments. When credit card payments are required, the system (application) calls BCEP and the BCEP system handles all of the processing for the credit card payment. When the payment transaction is complete, BCEP passes control back to the calling system. Under this architecture, provincial government systems do not retain any credit card information.

STRATEGY 3: APPLICATION FRAMEWORK

The NRS requires a mature application framework environment for new and redeveloped systems. Fortune 500 companies are investing heavily in application framework technologies such as Oracle-Seibel and IBM WebSphere as application frameworks are perceived as the best technical solution for containment of long-term system maintenance costs. The long-term maintenance and operational costs associated with stand-alone systems is proving to be prohibitively expensive. Consolidating multiple systems within an application framework environment provides opportunities for sharing infrastructure, sharing common software components, and improving the consistency of systems developed within a single application environment.

STRATEGY 4: BC GEOGRAPHIC WAREHOUSE (EDS)

The BC Geographic Warehouse (BCGW) is a spatial data repository of integrated land, resource and geographic information that supports a variety of business requirements across the NRS. Most operational systems in the NRS publish point-in-time data to the BCGW at the end of each business day. Thus, the BCGW constitutes a cross-sector spatial data store that spans multiple business areas. Recently, the Province entered into agreement with Google to allow selected public data sets from the BCGW to be available through Google Earth. Although the BCGW may not contain historical information or the day-to-day transactional data of NRS operational systems, it remains an important source of reference information for NRS systems and a distribution point for NRS information to the broader public service and the general public.

STRATEGY 5: GEOMARK WEB SERVICE (EDS)

The Geomark Web Service can be used by businesses, citizens, and provincial government staff to store an area of interest or shape, called a 'Geomark'. The Geomark is stored on a public facing server with only the geometry, creation, and expiry dates stored. The Geomark Web service allows individuals to share and retrieve this area of interest across systems, GIS systems and the web in a variety of file formats. Public users who are considering submitting an application for Crown resources to Front Counter BC or any other agency can use the tool to create a Geomark; the users' area of interest can then be shared and included with the user's system.

STRATEGY 6: WEB MAPPING (EDS)

iMapBC and the DataBC Mashup Framework (DMF) are web-based mapping tools managed by Enterprise Data Services (EDS) within the Ministry of Labour, Citizen's services and Open Government. These self-serve Web mapping tools provide access to more than 500 NRS datasets hosted in the BCGW. iMapBC and the DMF are available to the public. As well, a secure version of iMap/BC is available that requires users to authenticate with provincial government IDs or valid BCeIDs in order to view restricted content.

Note: WebADE is a common authorization framework used by NRS, Citizens' Services and Open Government, and Transportation and Highways.

STRATEGY 7: SPATIAL OVERLAY ENGINE (EDS)

The spatial overlay engine (SOE) is a Java application that allows a specified location on the map to be analyzed against dozens of layers of mapping data for information about features that coincide spatially with that location. SOE produces a text-based report containing the results of the spatial overlay analysis. The SOE is executed interactively via an HTTP request, normally from within a system (application). It may be desirable in the future to provide enhancements to the SOE to allow access from NRS operational systems via a secure REST Web service.

STRATEGY 8: CIVIC ADDRESS GEOCODER (EDS)

The Civic Address Geocoding service provides standardized, accurate, up-to-date locations for B.C. civic addresses. The service accepts an input (BC) address, and returns the coordinates of the location of that address. The BC Digital Road Atlas (DRA) is used to perform geocoding operations. The DRA is the authoritative source for provincial road data with respect to geocoding addresses.

STRATEGY 9: CLOUD PROCESSING FRAMEWORK (EDS)

The Cloud Processing Framework (CPF) is a Web service framework that allows end-users and systems to submit one or more requests to run automatically. In essence, the CPF is a batch submission framework. The CPF provides the ability to equitably schedule batch jobs and to load-balance batch jobs between multiple worker processes. The CPF was designed primarily for cloud deployment, particularly Amazon EC2 or Open Stack, but the CPF can also be deployed on conventional physical or virtual servers. The CPF employs SiteMinder and WebADE roles to offer access control for user submitted jobs.

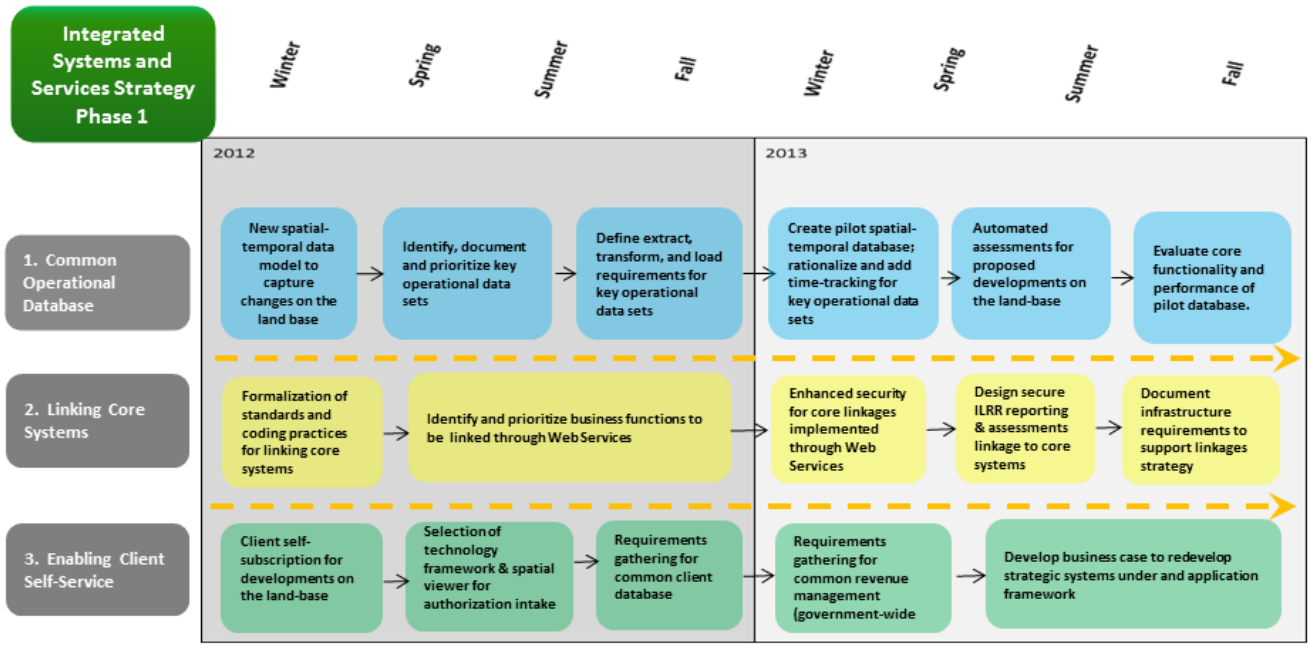
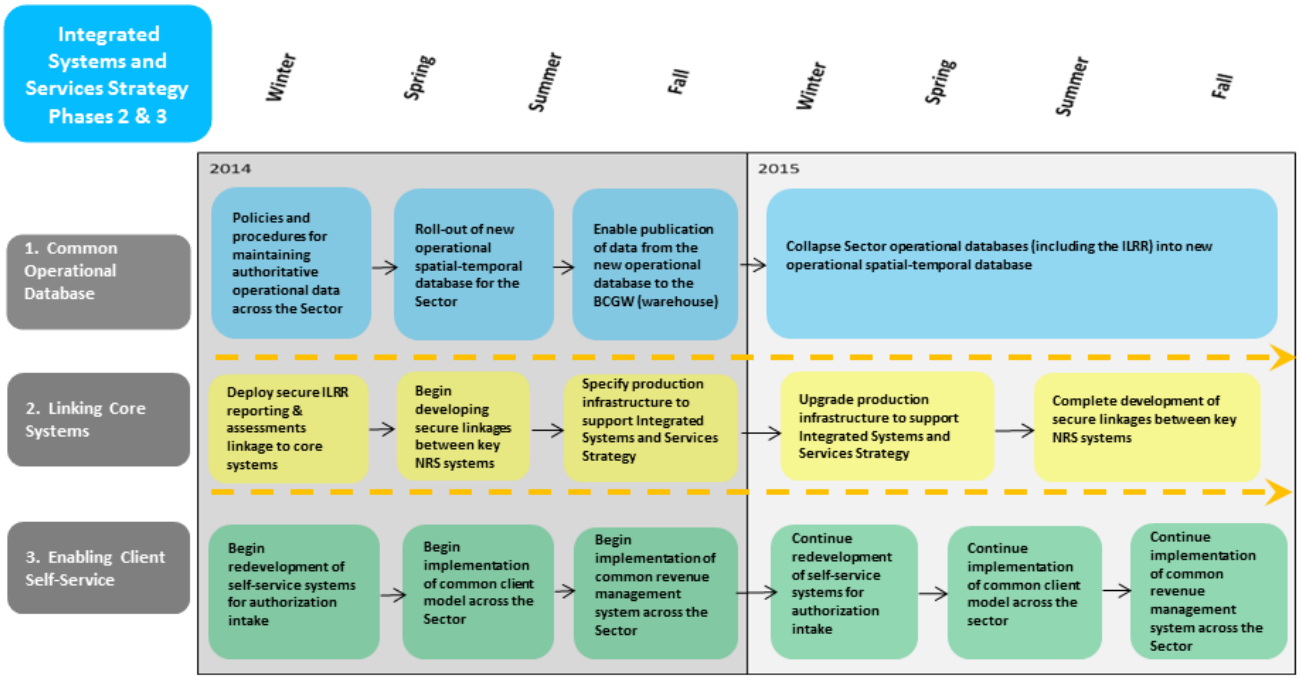
STRATEGY 10: GEOANALYTICAL GRID ENGINE (EDS)

The GeoAnalytical Grid Engine (G2e) is a Java application based upon open source packages and geographic data stored in raster format. G2e was designed to provide scientists, researchers, government staff and others with access to geographic information without the need for Geographic Information System (GIS) skills or GIS software. G2e provides the ability to perform spatial analysis via user-built queries. Data available through G2e may be viewed through a Web browser or downloaded from the G2e ftp site.

Note: G2e functionality is currently available through the Hectares BC Web site. G2e may be available as a stand-alone service at a future date.

STRATEGY 11: ENTERPRISE DATA CATALOGUE (EDS)

The Enterprise Data Catalogue is a service provided by EDS that stores metadata (information about data) for data products residing in the BC Geographic Warehouse (BCGW) and for other data products encompassed by the Province's Open Data initiative. Metadata can be searched though a Discovery Service provided by EDS. Metadata provides such information as owner, appropriate use, and currency of data. In the not too distant future, it is expected that EDS will provide metadata search capabilities via REST Web services.

ROAD MAP

A multi-year strategic roadmap has been developed. The roadmap describes the strategies and tasks that have been identified as leading to realization of the integrated systems and spatial data vision for the NRS.