Government Collaboration and Public Distribution with Spatial Data Infrastructures

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SUMMARY

Intergraph® provides geographic information systems (GIS) and interoperability technologies to enable the deployment of spatial data infrastructures (SDIs) for collaboration and distribution of geospatial data. This integrated framework of geospatial data, metadata, and tools allow government agencies around the world to use and share geospatial data in an efficient and flexible way. Sharing geospatial data is enforced by law in some regions of the world, and there is also a strong demand for it from a business perspective.

Interoperability- Intergraph's SDI application provides communication and collaboration between government entities, businesses, and the public. The resulting SDI-based solutions are in accordance with government initiatives such as the European Union INSPIRE, United Nations SDI, Canadian Geospatial Data Infrastructure, and the U.S. National SDI.
Standards – All of Intergraph's technology and services for Collaboration and distribution respect and implement the standards of the world's relevant standardization bodies, such as the International Organization for Standardization (ISO) or the Open Geospatial Consortium (OGC®).
Easy Discovery and Access to Geospatial Data – Our services are designed to empower all variants of discovering resources through ISO 19115 metadata, as well as provide access to these resources based on visualization and downloading services.

Geoportal- A SOA based, OGC and INSPIRE directed COTS solution, makes examining, discovering, ordering and using geographic data easier for the public, commercial businesses and government agencies. The Geoportal includes the Commercial Module and the Portal of Map Services. The Commercial Module makes available the office's complete portfolio of products, including its metadata, based on ISO standards. It issues data in separate files in existing vector and raster formats, as well as in geography markup language (GML) and analog forms. The module provides the solution for managing and administrating the entire process for purchase orders and transactions. Its unique feature is the automatic export of digital data according to specifications from the purchase order. The map services portal offers online access to map data via rich or thin clients.

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1. INTRUDUCTION AND BACKGROUN

Geographic information is vital to making sound decisions at local, regional, and national government levels, and is applicable to several different areas, such as:

Border security, primarily at the national government level
- Emergency management, involving prevention planning, monitoring, and analysis of natural disasters and large public events

Infrastructure management for water and wastewater systems, transportation systems, city services (garbage, snow, parks), field equipment, and some utility systems

Land information management, including cadastre, forestry, agriculture, natural resources, urban planning, environmental protection, and economic development

Mapping and cartographic production, primarily at the regional and national government level

Public services (e-Government), including businesses and citizens purchasing government information, accessing government information, and requesting services

The above areas are just a few examples where decision makers are benefiting from geographic information, coupled with the associated spatial data infrastructure (SDI) that supports information discovery, access, and use of this information in the decision-making process. The examples also clearly indicate the importance of collaboration between organizations – interoperability for spatial data and publication of spatial information. According to gdi.initative.sachen, the components of a SDI include:

- Geospatial data resources as the repository for all spatial-related data
- Networks as the physical and logical infrastructure component
- GIS services for communicating the different elements
- Standards ensuring interoperability

The relationship between the different components is shown in Figure 1. From a software technology point of view, services are the heart of the infrastructure. Intergraph®'s SDI product portfolio facilitates different kinds of services, enabling our customers to participate within a SDI as a node. These services embrace the following areas:

- **Human-interaction Services (Portal Services)** – Client services for the management of user interfaces, graphics, multimedia, and presentation of compound documents

- **Model/Information Services (Data and Catalogue Services)** – Services for the management of the development, manipulation, and storage of metadata, conceptual schemas, and datasets

- **Workflow/Task Services** – Services supporting specific tasks or work-related activities conducted by humans. These services support the use of resources and product development involving a sequence of activities or steps that may be conducted by different persons.

- **Processing Services** – Services that perform large-scale computations involving substantial amounts of data

- **System Management Services** – Services for the management of system components, applications, networks, user accounts, and user access privileges

- **Communication Services** – Services for encoding and transfer of data across communications networks

2. PHILOSOPHY AND ARCHITECTUTR

To become a node in a SDI, organizations must first accomplish several key steps:
- Identify the related parties and persons
- Identify and define the process which is to be supported by the infrastructure
- Identify the spatial resources and empower them with appropriate technology
- Identify the needs of the infrastructure and outline how to meet those needs

These steps make it clear that applying only software and hardware is not sufficient enough to becoming a node of a SDI. Indeed, becoming a well-respected node requires the

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implementation of a fully empowered solution covering all different aspects of processes, organization, infrastructure, and software.

Becoming a leader in a SDI solution also requires involvement in all necessary standardization bodies and nation or regional SDI initiatives. Consequently, Intergraph actively participates in all major relevant teams, from serving as a principal member of the Open Geospatial Consortium (OGC[®]) to participating in INSPIRE drafting teams and local initiatives like state SDI groups. This active involvement lays the foundation for Intergraph to collect requirements from all different applicable areas and gives our customers a profound basis for realizing the solution.

From a technology point of view, being a node in a SDI requires different technologies for:

- Providing interoperable services
- Consuming interoperable services
- Structuring geospatial data according to determined models
- Publishing/displaying the geospatial data

This leads to principle architecture for storing, reading, writing, and displaying data in a SDI-technology manner, as shown in Figure 2 on the following page. Enterprise GIS includes all the existing geospatial software and infrastructure available in this node.
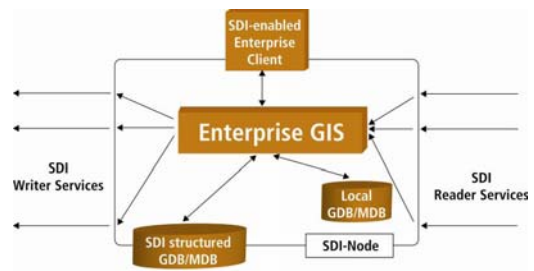
The mission from the technical point of view is to set up a SDI technology extension to Intergraph's GeoMedia® product portfolio, which gives users a customizable turnkey solution. The major objective for this technology extension is to fulfill the core requirements of sustainability, interoperability, and flexibility.

Sustainability is important, as it pertains to the upcoming changes in related standards. The solution must be open for users to adapt the new versions in an easy-to-modify manner. Interoperability relates to the usage of standards. Model inherent, SDI is a network theme where different players each have their own role. Interoperability of data and services is reached through the use of standards. Flexibility applies to different solution characteristics. The solution must be easy to integrate into an organization's environment, adopt its security policies, and adapt to its corporate standards.

Flexibility and scalability also refer to the needs of different kinds of users. From municipalities to nations or even pan-national organizations, all must realize the node of a SDI in an appropriate scale and manner, each with their different requirements in services and scales. For example, a state or nation SDI node has a strong demand for harmonizing the data provided by services to generate a homogeneous "picture" of geospatial data, whereas a municipality's needs relate more to acquiring metadata for geospatial data.

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3. INTERGRAPH SDI SOFTWARE

The SDI technology extension is available (where applicable) for GeoMedia Desktop, as well as GeoMedia WebMap as an industry application to the existing product portfolio. Keeping in mind different requirements and customer needs, it is divided into three major areas, as indicated in

Figure 3, helping users develop a collaborative distribution solution for geospatial data.

Figure 3: SDI Building Structure

These three major software application components – SDI Basic, SDI Pro, and SDI Portal – embrace all necessary services, structures, and user-interface elements.

Please Note: All elements of this section of the whitepaper do have ISO, OGC, or INSPIRE standards or discussion papers as a reference, which will be not mentioned. Since some of the services are available in different versions according to the corresponding standard, please contact your local sales representative for a concrete list of supported versions.

It is also necessary to mention that some of these services, such as the secured services of SDI Pro, are not adopted standards yet. In fact, different discussion papers do tackle this issue within OGC. Intergraph conducted an in-depth evaluation of the different positions regarding these services, including an estimation of a user's operational costs, and chose the version which minimizes the total costs of ownership for a user. As previously mentioned, whenever one of these discussion papers becomes standard, Intergraph will implement the service accordingly.

3.1 SDI Basic

The services offered by SDI Basic could be viewed as the fundamental building block to empowering an infrastructure to become a SDI node. All fundamental data interoperability services are part of this extension package. The general requirements for SDI Basic are:
- Services compliant to:
    - o ISO and OGC standards
    - o INSPIRE directives and implementation rules
- Practical services:
    - o Extendibility, scalability, and reusability, and other abilities

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o Performance services

According to the principal architecture in Figure 2, SDI Basic offers services for publishing data (writer services) typically based on the server, as well as consuming services (reader services) which are located either on the desktop or on a server as the recipient (client). The following services form SDI Basic:

- Server (SDI Writer Services)
    o Web Map Service (WMS)
    o Web Feature Service (WFS)
    o Web Coverage Service (WCS)
    o Open Location Services (OpenLS)
- Client (SDI Reader Services)
    o WMS/sWMS data server
    o WFS/sWFS data server
    o WCS/sWCS data server
    o WFS-T data server

3.2 SDI Pro

The SDI Pro extension package offers a set of highly valuable services extending beyond SDI Basic. These services are typically equipped with additional functionality and some monitoring capabilities. The general requirements for SDI Pro are:

- Services compliant to:
    o ISO and OGC standards
    o INSPIRE directives and implementation rules
- Useful services:
    o Rights management
    o Quality measures
- Practical services:
    o Extendibility, scalability, reusability, and other abilities
    o Performance services

To protect our customers from illegal usage, Intergraph provides SDI writer and secured services with the following protection methods for rights management:

- User authentication:
    o Username and password
    o IP address of the caller
- User authorization:
    o Access rights on feature classes/layers
    o Access rights on geographic extent (bbox)
    o Time-based access rights

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As part of a SDI, each node should have a clear understanding of its serving capabilities. To be a reliable part of an external value chain, these nodes will be "confronted" with Service Level Agreements (SLA), which guarantees a certain level of quality of the services. The service provider must have valid, up-to-date information about its services for this to be successful. Classical operational monitoring tools alone are not sufficient. Furthermore, monitoring the content is also essential, especially whenever these services are connected to a billing system. SDI Pro offers services for:

- Events logging:
    o No response from resource
    o No connection
    o Incompatible version of request and grounding service (third-party WMS)
- Performance measurements:
    o Number of calls/sec
    o Average service response time
- Content logging:
- Requested layers
    o Requested spatial extend
    o Requested feature objects

In terms of Enterprise Application Integration (EAI) or Service Oriented Architectures (SOA), the transport protocol is also an issue. OGC services typically relay on the http post/get paradigm, while EAI and SOA are typically looking for Simple Object Access Protocol (SOAP) bindings. Within SDI Pro, users can configure the transportation protocol between HTTP and SOAP, according to their needs. Most of the named functionality is gained by applying a façade technology to the services. Within the façade, different pipes are used to realize a dedicated functionality. By this concept, the user gets an easy-to-configure, powerful, flexible, and scalable extension package customizable to his or her concrete needs.

Within SDI Pro, Intergraph offers the following services:

- Server (SDI Writer Services):
    o Transactional WFS (WFS-T)
    o Gazetteer Service (WFS-G)
    o Secured WMS (sWMS)
    o Secured WFS (sWFS)
    o Secured WCS (sWCS)
    o Coordination Transformation Service (WCTS/WPS)
    o Catalogue Service (CS-W)

3.3 SDI Portal

Intergraph's SDI Portal services can be viewed as building blocks for empowering existing browser applications for SDI technology. SDI Portal offers a set of connectors, or handles, which can enhance the functionality of thin clients, as well as smart clients. WEB 2.0 is an actual topic, especially for thin clients. Therefore, the implementation is AJAX-based with well-defined interfaces (controls) for the integration. In addition, these connectors are an

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integral part of a fully equipped portal, serving as the visual representative of a SDI node (see example of this in section 4).

The SDI Portal offers connectors for the following services (sWXX denotes a secured service):

- WMS/sWMS
- WFS/sWFS
- WFS-T
- WFS-G
- WCTS/WPS
- Single CS-W
- OpenLS
- WMC Context information

4. INTERGRAPH GEOPORTAL COTS (commercial of the shelf) SOLUTION

Intergraph Geoportal is a complex productized solution developed for data and metadata publication in accordance with both existing and expected demands of INSPIRE directive.

Intergraph's Solution is designed for all (data providers), but not only, who will be obliged to comply with INSPIRE directive demands for data publication. Namely it is designed for municipalities, districts authorities, national mapping agencies, utility companies, environmental agencies and others. Solution can be implemented in-house or provided as externally hosted web service. Intergraph Geoportal is a fully scalable solution, ready to meet end-users' requirements. It is based on application framework, comprising following components:

E-shop – internet based application, providing simple and intuitive GUI designed for automated ordering and invoice processing for various analog and digital products (printed maps, digital geodata and web mapping services, other services, and software).

WMS Server – providing service for map data publishing compliant with OGC WMS specification (supported versions 1.0 to 1.3).

WFS Server – providing service for feature data publishing compliant with OGC WFS specification

Catalog Services (CS-W) – metadata publishing services compliant with OGC specification and preliminary INSPIRE directive.

Client Applications – designed for viewing data published by WMS and CS-W modules. Additional services for feature based queries or printing are available per request.

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Editing Portal – special application for vector and/or attribute data editing by means of a thin client.

On-line Delivery Module – special application for automatic on-line data delivery according to the users' demands.

Admin Interface – application for Geoportal management and administration

Export – fully automatic back-end service for assembling of data packages in follow-up to the users' requests registered by E-Shop or On-line Delivery module. Original vector data are exported from database to various requested data formats (raster images, PDF..) and coordinate systems.

Print, Print to PDF, and Batch Plotting – toolbox for printing outputs (both paper and digital).

Geoportal ETL (Extract Transform Load) – fully automated tool for regular acquisition (updating) of various data sources. Data produced and governed by separated departments of the enterprise are loaded and saved directly to geoportal's database structure and transformed into structures optimized for publishing.

Migration and Performance tools – toolbox for vector and raster data uploading, optimisation, and cleaning.

Database – core unifying component of the Geoportal solution. All data and main configuration are stored at this level (procedures, functions, jobs). Database is the only obligatory module for Geoportal implementation.

5. SUMMARY

This white paper clearly highlights the benefit of using SDI technology for collaboration and distribution of geospatial data. In some regions around the world, providing data is enforced by law, and there is a strong demand for sharing geospatial data from business perspective as well. In terms of interoperability, this technology helps to streamline processes and improve efficiency.

Intergraph, a world-leading geospatial solution vendor, clearly understands the demands and necessities of our customers in implementing an SDI-enabled solution. To facilitate this, our core technology products, GeoMedia and GeoMedia WebMap, are empowered by three extension packages:

- **SDI Basic** – Provides all necessary core services to become an SDI-node

- **SDI Pro** – Provides additional services covering more aspects for high-performance SDI-nodes

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- **SDI Portal** – Enriches smart and thin clients in their ability of becoming the visual front-end of an SDI-node

- **INTERGRAPH Geoportal COTS Solution**- A ready to use modules for data services and metadata management and publication.

By being active in all relevant standardization groups and SDI initiatives around the globe, Intergraph provides our customers with a sustainable solution to fulfill their concrete needs. We also realize that building spatial data infrastructures from the ground up and redesigning data models and architecture is a complex process. In addition to our state-of-the-art SDI technology, we offer proven support and services capabilities to help our customers achieve a successful and cost-effective SDI solution. This is truly a step forward toward a collaborative geospatial infrastructure that easily distributes geospatial information to the public.

As SDI evolves, there is a foreseeable demand for service-based data harmonization and remodeling. Already today, Intergraph's roadmap of SDI technology is ready for these challenges. We are already working on research projects to help us tackle issues and provide the next level of excellent services to our customers in the near future.

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