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Advancing Web GIS for Infrastructure

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Abstract
This paper discusses content of advancing Web GIS for infrastructure by using the C.O.T.S Web GIS. The paper also briefly describes the usage of the Web GIS for engineers and advantages of implementing the Web GIS as part of the infrastructure development cycle. A process of familiarizing the Web GIS is reported and it also highlights several important features that are potentially utilized by engineers in their daily engineering tasks. Then, the paper discusses further about the specialize functionalities required by the telecommunication engineers. It aims to explain the capability of the Web GIS in handling and performing the requirement. Several successful users' stories of Bentley Geo Web Publisher implementation are presented and highlighted at the end of the paper and finally some conclusions on the web server.

(Keywords: Web GIS, Bentley Geo Web Publisher, Infrastructure.)

1. Introduction

World Wide Web (WWW) technology advances to disseminate information related to projects like roadway, telecommunications, construction industry, etc. Making such information available over the Web or Internet has simplified the information conveying process within the working committee which are carried out by many enterprises and professionals and thus increase the flexibility level of projects' operation and management.

This paper describes the potential of using Web GIS for infrastructure development. In section 2 discusses the scenario of information technology for the infrastructure and briefly introduces the system architecture of Geo Web Publisher and its content in section 3. Section 4 debriefs the specific Web GIS utilization by telecommunications engineers. Finally, some users' success stories of the Web GIS are highlighted in section 5 and 6.

2. Information technology for infrastructure

During the life of an infrastructure project, communication about engineering and business is essential. The content of the information relies on the complexity of the project and the detail level of information required (from an overview to individual design elements). Tremendous amounts of information in a variety of formats are available. Delivering the right information to the right people at the right time has become a potential hurdle to any infrastructure projects. However, this phenomenon has generated the demand of engineering information management of Web GIS implicitly in the infrastructure world (Jean-Baptiste Monnier and David Keam).

Despite the long history of usage of geospatial technologies through survey, photogrammetry, CADD and GIS, exploitation of these technologies to continuously service entire infrastructure lifecycle is rarely, if ever, accomplished to available potential (Todd Slind, 2007). Perhaps it is incontrovertible about the utilization of geospatial technologies in infrastructure project. Nevertheless, adapting the Web solution of geospatial furnishes significant impacts and benefits to the infrastructure project development. This has allowed the interfacing in between business partners (B2B), business and government agencies (B2G) and in between government agencies (G2G) globally, depending on the scope of the project.

Heretofore, almost all road design, pipeline network, electric, coax, copper and fiber network can be published on web via map publishing engine. A variety of tools are possibly applicable on the web-enable interface such as information retrieving, querying, redlining, printing and so forth. Apart of publishing the engineering information via the Internet, it is also essential to manage the information of infrastructure project in the Internet environment as part of an integrated system at the enterprise level.

3. The Web GIS

Web GIS implementation is popular in governmental agencies, geospatial data producers and users nowadays. It helps to increase the level of information accessibility to the desire user groups via intranet or internet. User can easily browse map and search information by using web browser in anytime, any place, provided with the intranet or internet connection, wire or wireless mode. Because of these advancements, many users who were not able to easily get information that they may want before can now have it at their fingertips. This phenomenon also applies to infrastructure world which deal with tremendous amounts of graphical and tabular information in a variety of formats.

Before the age of Web GIS, an individual needs to purchase a software package to view, use and manipulate the geospatial data (graphical or combination of graphical with tabular information). However, this scenario has been turned by implementing Web GIS where plug-ins application can be added into web

browser and hence leverage web technology to view and search geospatial information.

The system architecture

To implement an Internet-based GIS, a map server is required as a middleware program in retrieving data from the database (Alias Abdul Rahman, 2002). The map server with the appropriate software architecture and network infrastructure will disseminate geospatial information and provide interactive GIS functions. A sample of system architecture of Web GIS, namely Bentley Geo Web Publisher (GWP) has been illustrated in Figure 1.

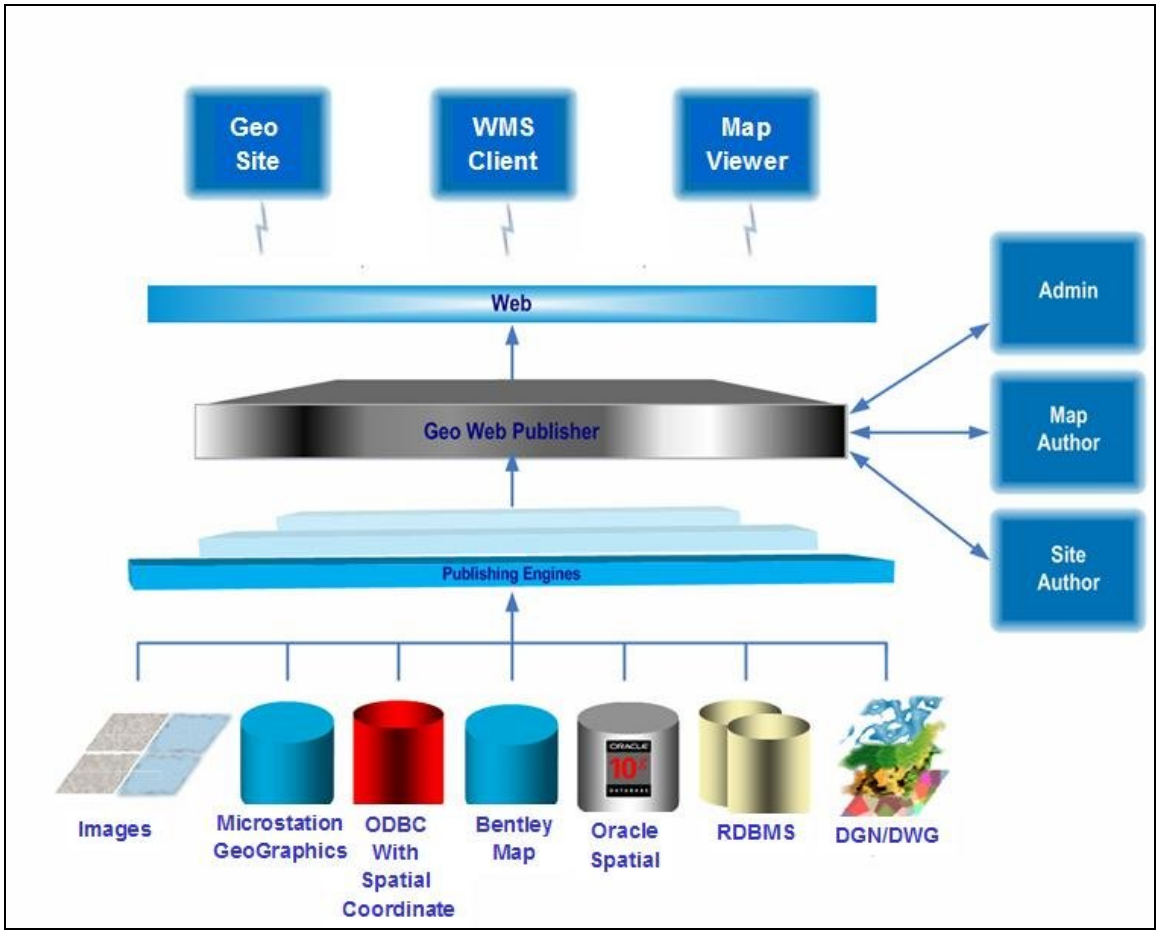

Figure 1. System Architecture of Bentley Geo Web Publisher

GWP is a comprehensive Web GIS for publishing engineering content that comprises geospatial information, as well as drawing and other documents in DGN or DWG formats, over the web. It is a 3-tiers system architecture that consists of Geo Site, Map Viewer and WMS client as first tier, the web server and GWP (map server) as second tier and the geospatial data sources as third tier. There are five major components in GWP, namely Admin program, Map Author program, Site Author program, map server and iDPR converter. These programs

are inter-dependent and provide different functionalities as shown in the table below:

Admin	• Defining general setting like setting server and imaging request port, checking the web server extension status and so forth. • Creating connection to spatial, non-graphics and raster data sources.
Map Author	• Creating map by filling layers in the map with graphical elements. • Authoring symbology of layers and determining the display scale.
Site Author	• Creating geo web site to publish map such as creating legend, overview map, selection bar and so forth.
Map server	• Serving as middleware program in receiving request from clients and retrieving information from the database to response to any request from the client.
iDPR Converter	• Preparing the relevant data sources to publishing format (iDPR).

Table 1. Functionality of GWP components.

GWP is capable to bring together many types of information for integrated display, analysis, and reporting. These include DGN, DWG, MicroStation GeoGraphics (MGE) and Bentley Map features, information in Oracle Spatial and other relational databases, spatial information (via coordinates in tables) through any ODBC connection, more than 30 industry-standard raster formats, raster mosaics, multimedia, hyperlinks to other information.

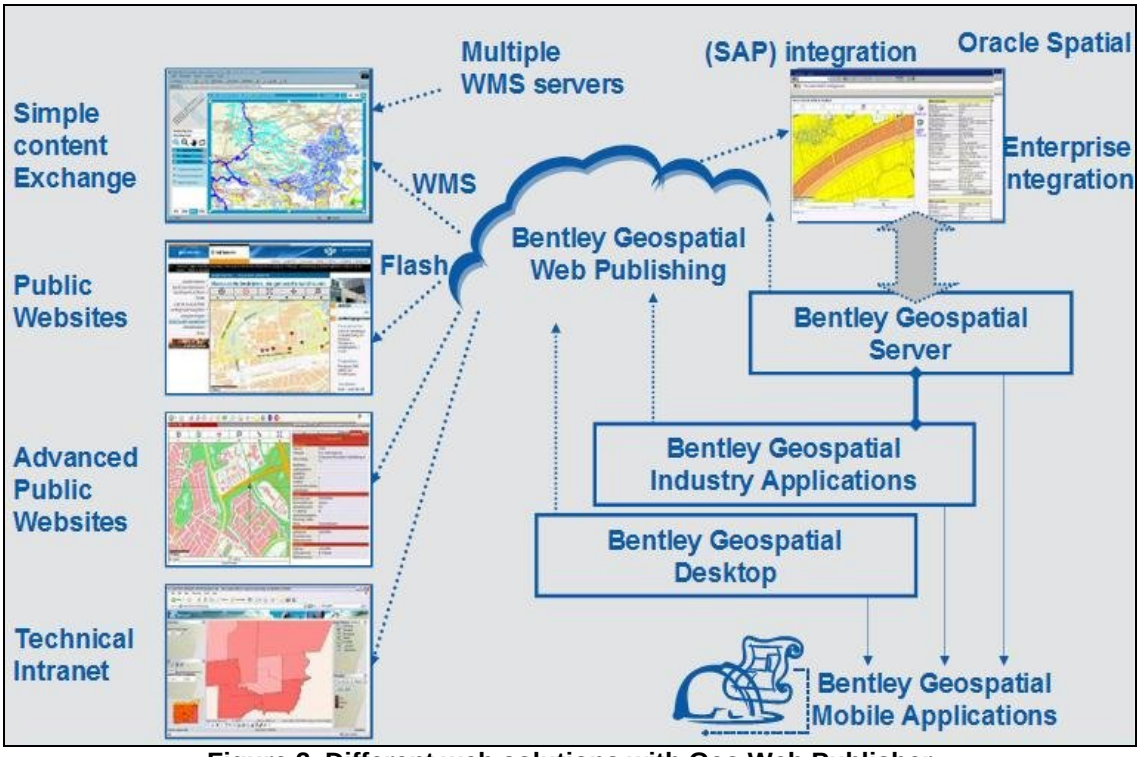

Figure 2. Different web solutions with Geo Web Publisher

It was designed to be easy to implement, bring together multiple graphic and non-graphic data sources, and offers advanced site authoring and administration tools that do not require web development experience. It is fully integrated with Bentley's geospatial desktop applications, and is Open Geospatial Consortium's (OGC) Web Mapping Services (WMS) server and client compliant in order to serve the different requirements of web publishing as shown in Figure 2.

3.2 The Compliance to Open Geospatial Consortium (OGC)

The OpenGIS® Web Map Service (WMS) Implementation Specification provides three operations (GetCapabilities, GetMap, and GetFeatureInfo) in support of the creation and display of registered and superimposed map-like views of information that come simultaneously from multiple remote and heterogeneous sources (Opengeospatial).

Several commercial Web GIS products support the OpenGIS specification such as the GWP has implemented the OGC's WMS Specification to support the WMS server and client in 2006. This has increased the interoperability level in between Web GIS products from different vendors supporting the WMS specification.

As the result, end users can take advantage from the Web GIS that is WMS compliant to publish and access geospatial information from many sources and systems. By supporting the WMS Server, any WMS client able to view information published by any WMS compliant server. WMS layers are added to maps published by the WMS compliant server and a map layer may be a combination of one or more WMS layers. This makes it possible to take advantage of the wealth of information publicly available through WMS servers.

4. The Web GIS for Communication

Indeed, most communication industries are developing dramatically with all driven by the major world-wide Telecom providers' desire to be the first to deliver to consumers and businesses with the quadruple-play of voice, data, video and wireless service. One of the key factors to achieve their goal is to provide a better network infrastructure resulting from the comprehensive design and planning of network model and accurate map to get service to customers or potential customers more quickly.

Although it is important to Telecom providers to opt and implement the powerful communications solution to operate, manage and monitor the network, but it is also critical to them to disseminate and share the information of the network system with all the committee members of the project in order to increase the production and shorten up the decision making process.

In this situation, Web GIS is the most useful tool to publish the graphical and tabular engineering information of the project to the project team via internet or intranet. It also offers handy tools in general to navigate the map, review and search information, locate serviceable address of customer within a buffer from a desire network cable and so forth. However, there are more available functionalities of Web GIS that are appropriately utilized by the network engineers, such as:

- **Tracing** - Tracing out the signal graphically that is conveyed to reach the destination. Detailed information about the length of an optical system, the restoration priority, as well as the job description is available. With this results, the technical engineers able to identify the source of a problem within a network.
- **Outage Analysis** - Customers satisfaction levels are commonly improved through minimized downtime. Web GIS provides a tool to select a sheath and enter a distance to promptly display the outage location, rather than spending time to search result from paper plan or spreadsheet.
- **Cross Section Review** – This is vital information to the designer (to identify the available cable for new customers) and field technician (to determine all connection to aid in repair). Users can easily view the detail cross section of the selected cable with the color coded fiber depicted the connection via the web interface.
- **Splice Report** – Displaying splicing information of the network system from a single source of information which eliminates the possibility of errors caused by duplicated data on different systems.
- **Inside Plant View** – Displaying and navigating all the inside plant equipments located in a central office (CO) with a detail graphical display of all the equipment ports, exact positioning in the racks and their IDs.

Web GIS provides easy access via a web browser to operations and customer service and potentially be used for “Call Before You Dig” scenarios and to locate a device and addresses being affected by an outage. Any facility, whether it is a pole/pedestal, amplifier, splice, sheath, power supply, node, headend, or optical system can easily be located.

5. Saudi Telecoms E-Maps GIS Project

Saudi Telecom Co. (STC) is the telecommunication services provider in the country serving millions of customers and offering services for Landline, Mobile, Data services (DSL, IP-VPN, etc) and Internet Services. The Customer Facing Services/GIS department is vested with the responsibility of planning and managing the development and expansion of automated mapping, facilities management and GIS and to make sure that decision-makers, network users and others have access to geospatial information that is complete, timely, accurate, and reliable.

The E-Map GIS project is a strategic initiative of the CFS department. The primary goal of the project is to streamline the operations and improve efficiency of departments by enabling Web access to telecom facilities data and other geospatial data and application services such as network data, telecom facilities, landbase, and points of interest, navigable street data, and satellite imagery. The system architecture is designed to integrate different geospatial data sources like FRAMME networks and telecom facilities, map landbase, navigable street networks, and more into a central Oracle Spatial store.

Figure 4 shows a sample interface of the system that Bentley Geo Web Publisher provides the geospatial web publishing services. Via the client interfaces, users can perform tasks like finding shortest route/driving directions, produce thematic maps, perform vicinity searches, pin-point landmarks and generate custom reports in English and Arabic language.

All level of users from Saudi Telecoms earn the benefits from the system. It is obviously that the desire information of engineering from diversity of resources is able to be hosted and disseminated by utilizing the GWP. The user friendly web interface enables the users to get the right information at the right time easily.

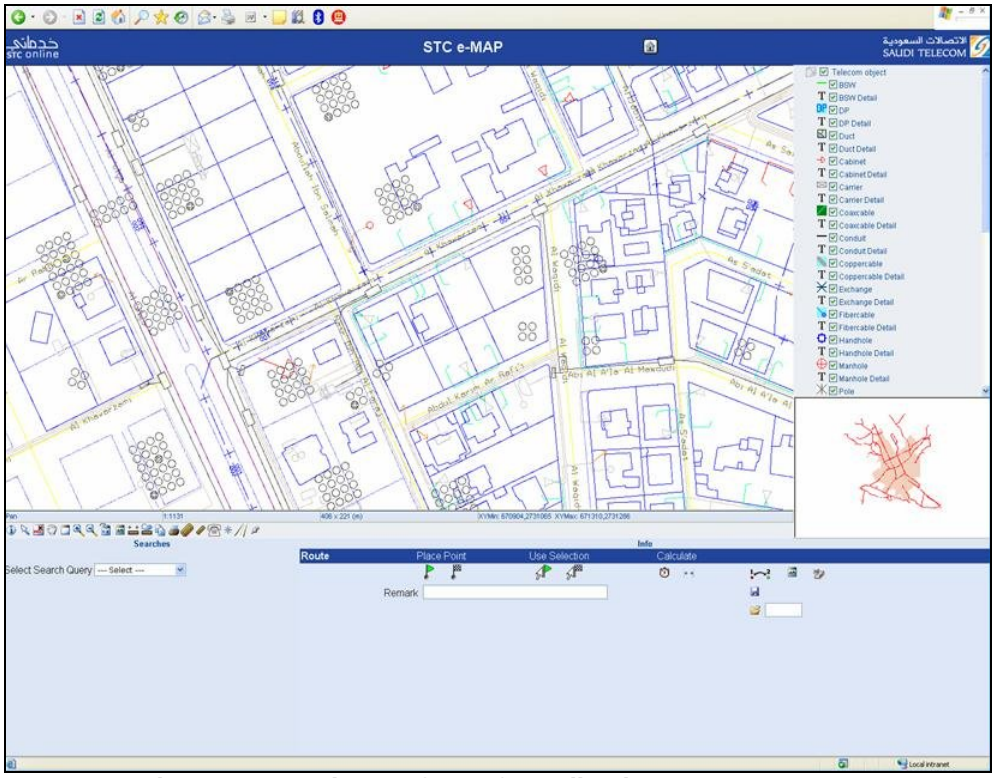

Figure 4. Sample Interface of Saudi Telecoms E-Map GIS

6. Vattenfall Europe's Power and Heat Network Information System

Vattenfall, one of the largest generator of electricity and the largest generator of heat in Europe, generates, distributes and sells electricity and heat, both to private households and industrial customers. The goal of the company is to continually improve customer service and therefore increase customer satisfaction and reduce the total cost of ownership.

Unimpeachable, Vattenfall must provide the up-to-date information of all the equipments to his utility's employees. It has become realistic when the company initiated an online access system implementation by using Bentley Geo Web Publisher in order to achieve the goal.

The online GIS system developed using the GWP has facilitated the employees to access to the desire information in a rapid way. It also serves to reduce total cost of ownership by providing the information via the Web to public authorities, other utilities, planning agencies and civil and underground engineering companies. A sample interface of the system is shown in Figure 5 as below.

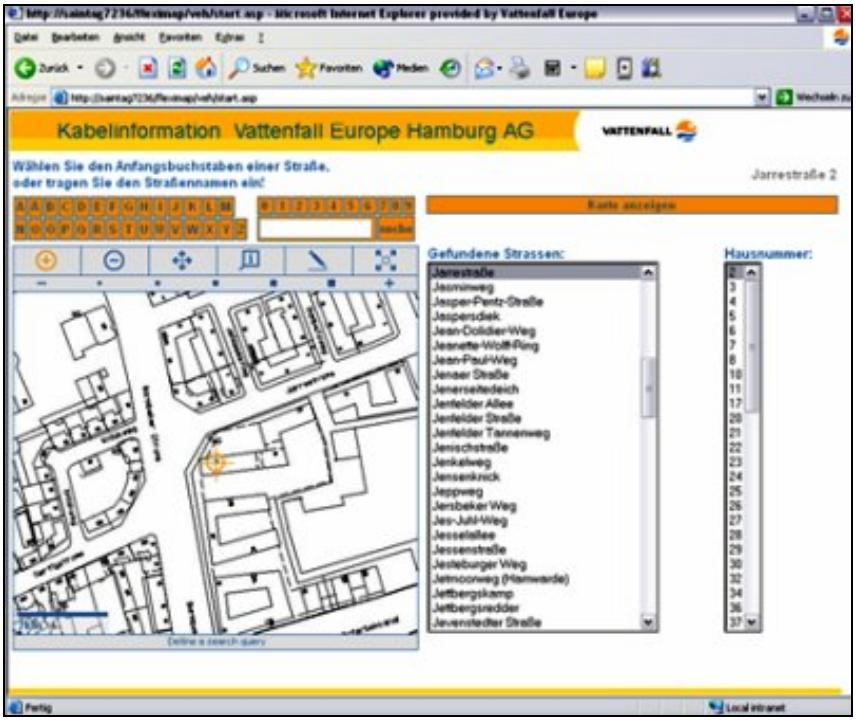

Figure 5. Sample Interface of Vattenfall Europe's Power and Heat Network Information System

7. Conclusion

This paper reports some findings and works done on Web GIS particularly for infrastructure industry. Also, the debriefing of the potential Web GIS implementation highlighted several considerations for the industry providers to implement Web GIS, instead of the traditional methodology of information retrieving.

Technically, the graphic user interface (GUI) offered by the C.O.T.S Web GIS helps and enhances Web GIS development. Basically, there is no need to have a powerful programming skill for one to develop Web GIS via the C.O.T.S Web GIS like Geo Web Publisher. The Web GIS developed by using Geo Web Publisher able to improve the infrastructure project implementation especially in operating and managing the resources and disseminating information to relevant users, as in the case of Saudi Telecom and Vattenfall Europe.

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