Chapter 8

# Geospatial Semantic Web Services:
## A Case for Transit Trip Planning Systems

**Zhong-Ren Peng**
*University of Florida, USA & Tongji University, China*

**Tian Zhao**
*University of Wisconsin-Milwaukee, USA*

**Chuanrong Zhang**
*University of Connecticut, USA*

## ABSTRACT

*Semantic heterogeneity in diverse data sources is a major obstacle in real time data access, exchange and integration. This chapter provides a unique approach to address this issue by developing a framework and prototype for a geospatial semantic web service, through a case study of transportation road networks and transit networks for a transit trip planning system. The uniqueness of this approach is that it takes advantage of the merits of ontology, Web Feather Services (WFS) and relational database query functions. Ontological constructs provide semantic definitions for geospatial data, making use of the spatial query functions of WFS for spatial data searches, the WFS client library for feature rendering, and relational database search functions for non-spatial data queries. The results show that this approach is more efficient than conventional methods of converting all data into ontology instances, as it avoids the costs and consistency problems of data replication.*

## INTRODUCTION

In the age of ubiquitous data access empowered by smart mobile devices and mobile applications, users demand instant access to location-based

information wherever they go. Data accessibility and reusability are some of the most important forces that drive geospatial information research and technology development. The initial research effort in this research area focused on data clearinghouses and data warehousing to make data available. The second stage focused on data

interoperability and accessibility by developing standard data services. The third stage focused on application access and interoperability by providing web services for applications. Through this process, it was found that semantic differences among datasets and applications were major obstacles in advancing geospatial web services. Therefore, recent research has focused on geospatial semantic web services, rather than geospatial web services. This chapter provides an overview of recent studies in this research area and reports our efforts to develop a geospatial semantic web service for online transit trip planning services.

This chapter begins with an introduction of the concepts of semantics, web services, geospatial web services and geospatial semantic web services. It then describes the unique problems in transportation databases and transit trip planning systems, as well as the necessity of semantic interoperability. Next, the chapter outlines the general framework of a geospatial semantic web service, followed by an implementation of the framework

Describe the general perspective of the chapter. Toward the end, specifically state the objectives of the chapter.

## BACKGROUND

### Semantics, Geospatial Web Services, and Geospatial Semantic Web Services

Geospatial databases created from a variety of sources have syntactic (data formatting), structural (schemas), and semantic (meaning of terms in specific contexts) heterogeneity problems (Lutz and Klien 2006). Previous research focused on addressing accessing data with syntactic and structural heterogeneity in distributed locations. Web services are one of the important technologies that have been developed. Standards such as OGC web services have also been created to

facilitate the exchange and share of heterogeneous geospatial information (OGC White Paper 2001).

Web services are reusable software components that interact in a loosely coupled environment, and are designed to interoperate in a loosely-coupled manner. A web service can be used by other web services, applications, clients, or agents. Web services can be combined or chained to create new services. They can also be recombined, swapped or substituted, or replaced. Due to the fact that web services are based on XML standards, they are currently used by enterprises for interoperability. Web services provide interoperable capability of cross-platform and cross-language in distributed net environments (Anderson and Moreno 2003).

Geospatial web services are a special kind of web services that provide access to heterogeneous geographic information on the Internet. OGC has developed several web service specifications to standardize geospatial web services to access geospatial data and applications. The important geospatial web services include Web Feature Services (WFS), Web Map Services (WMS), Web Coverage Services (WCS), Catalogue Service (CS), and Web Processing Services (WPS), etc. The Web Feature Services allow users to retrieve, inquire, and manipulate feature-level geospatial data encoded in Geography Markup Language (GML) from multiple sources over the Internet (OGC document 04-094, 2005). The Web Map Services were developed to create and display maps that come simultaneously from multiple heterogeneous sources in a standard image format (OGC document 04-024, 2004). The Web Coverage Services provide access to detailed and rich sets of geospatial information in forms useful for users rendering and input into scientific models (OGC document 03-065r6, 2003). Web Processing Services provide standard interface for accessing geospatial processing services and geospatial models (OGC document 05-007r7, 2005). The Catalog services allow users to classify, maintain, register, describe and search for information about web services. The Catalog

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