Chapter 3
Enabling Quality of Geospatial Web Services

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ABSTRACT

Following concerted efforts in service chaining and increased maturity of requisite technologies, the potential of geospatial web services in mission-critical applications and business processes is increasingly becoming apparent. Use of geospatial web services in mission-critical applications and business processes nonetheless raises important quality concerns for which guarantees should be provided. As a contribution to the subject of quality of geospatial web services, this chapter identifies and elaborates quality concerns pertinent to geospatial web services and their use in mission critical applications and business processes. The chapter defines a quality model for geospatial web services comprising data quality and quality of service. Quality propagation is outlined and the influence of quality of input data and that of component geospatial web services in a service chain on the quality deliverable end-to-end illustrated. Further, an ontology framework for quality of geospatial web services is presented. The framework comprises an upper ontology, two domain ontologies and potentially many application ontologies. Collectively, the ontologies provide a consistent set of concepts that can be used to unambiguously define and reason about quality of geospatial web services. The chapter also proposes a domain middleware to facilitate efficient and cost-effective quality-aware chaining of geospatial web services. The service design and high-level architecture for the middleware are presented.

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INTRODUCTION

Geospatial web services have emerged as a novel and promising framework for acquiring and disseminating geographic information (Yue, Di, Yang, Yu & Zhao (2007); Alameh, 2003). The services are not only enabling interoperability among disparate geographic information systems (GISs) but are also mainstreaming geographic information (GI) and GIS technology by integrating GIS with other enterprise information technology (IT) systems across technology and organizational boundaries (Onchaga, 2005). More fundamentally though, the services afford added flexibility in that autonomous but interoperable geospatial web services can be located and chained on-demand to create customized geoprocessing solutions (Alameh, 2003).

With maturity of requisite technologies, geospatial web services are increasingly being deployed and made available for exploitation; see for instance Tait (2005). Furthermore, it is anticipated that as the services proliferate, they will increasingly form part of mission-critical applications and business processes (Onchaga, 2006). Meanwhile, pioneering attempts at service chaining are yielding promising results; see for instance Alameh (2003), Poveda, Gould & Grannel (2004), Yue, Di, Yang, Yu & Zhao (2007) and Open Geospatial Consortium (OGC) web services interoperability demonstrations.

While expected and desirable, use of geospatial web services in mission-critical applications and business processes will nonetheless raise pertinent quality concerns – users are likely to be concerned about the performance, reliability and security of the services in addition to quality of the information delivered by the services (Herring, 2001; Tait, 2005; Subbiah, Alam, Khan & Thuraisingham, 2007; Umuhoza, Agbinya, Moodley & Vaheed, 2008).

In order to achieve and sustain user-satisfaction in the marketplace, there is a need to continuously guarantee acceptable levels of quality of geospatial web services for users. However, providing quality guarantees to individual users in a heterogeneous and increasingly dynamic geospatial web services environment is not a trivial challenge. The challenge becomes even more difficult when user requirements are addressed by locating and orchestrating two or more geospatial web services in a service chain. In the context of a service chain, given a set of (quality) requirements, an optimal set of geospatial services has to be located from a potentially large population of candidate services and subsequently orchestrated and their execution monitored so as to ensure delivery of required geospatial information while adhering to specified quality constraints.

In this chapter, we call a chaining process in which quality requirements of users and quality capabilities of candidate geospatial web services are considered as quality-aware service chaining. Quality-aware service chaining is a highly complex process fraught with many challenges. This is partly due to the distributed and dynamic nature of the computing environment for geospatial web services and partly due to the following factors (Onchaga, 2006):

- In an open geospatial web service marketplace, one is likely to find multiple services (from different providers) offering similar functionality but with rather different qualities;
- In a geospatial web service (chain), achievement of one quality will not necessarily contribute positively to the achievement of other qualities e.g. providing secure access to a service is likely to compromise its performance;
- In a service chain, quality deliverable end-to-end is not known a priori but can only be estimated;
- In an open competitive environment, it is possible to have same levels of quality being offered at different costs e.g. two providers can offer the same level of quality at