Chapter 3.5
Implementing Geospatial Web Services for Cloud Computing

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ABSTRACT

Cloud computing is concerned with the provision of hardware, infrastructure, software and data as services on the internet. A key attraction of cloud computing is that the infrastructure from which services are offered is able to scale upwards automatically as the load on the services increases. This chapter examines the potential for offering capabilities of the Geographic Resources Analysis Support System (GRASS) as a service within a compute cloud. GRASS is a free and open source desktop Geographic Information System (GIS). The chapter describes a prototype service that adopts the Web Processing Service (WPS) standard of the Open Geospatial Consortium (OGC). A case study is presented applying the prototype in the analysis of satellite imagery. The chapter concludes that the WPS standard can facilitate the provision of geospatial capability in compute clouds.

INTRODUCTION

It is estimated that approximately 80% of all digital information is referenced to a location, for example, any addressed document has a post code/zip code that can be referenced to a geographic space (MacEachren & Kraak, 2001). Geographically-referenced information is a fundamental aspect of operations in aviation, disaster management, e-government, environmental management, public administration, town planning, weather forecasting, security and policing. Further, most events reported in the news (such as football matches, floods, elections) happen at a spatially-referenced location. The growing availability of data through advances in Earth observation systems is expected to result in an increase in the need for geospatial processing capability. For example, former US

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Under Secretary of Commerce for Oceans and Atmosphere, Condrad Lautenbacher (2006: pp. 10) cautioned that "new observation systems will lead to a 100-fold increase in Earth observation data. Only by viewing observations as part of an end-to-end process will we fully maximize their utility". Further, mobile phones with built-in positioning devices now offer home users the ability to determine the geographic coordinates of any location and potentially map the location using web-based applications such as Google Maps, Google Earth or Microsoft Bing Maps. Although such mobile phones make it easier for home users to map locations, additional services are needed for processing collected data and integrating the data with other existing datasets; cloud computing offers a framework through which such processing and integration could be provided(NIST, 2009).

Cloud computing is concerned with the provision of hardware, infrastructure, software and data as services on the internet. Users interact with the services through thin clients such as web browsers. Wang et al (2008) identify three primary functionalities of cloud computing: Hardware as a Service (HaaS), Software as a Service (SaaS) and Data as a Service (DaaS). Recent studies have referred to HaaS as Infrastructure as a Service (IaaS) with recognition that virtualization offers more than just hardware (Vaquero, Rodero-Merino, Caceres, & Lindner, 2009). IaaS offer on-demand computational resources in the form of virtual machines, hosted in a cloud service provider's infrastructure. An example of IaaS is Amazon's Elastic Compute Cloud (EC2). Cloud computing also offers platforms on which systems can run, this is referred to as Platform as a Service (PaaS). An example is the Google App Engine (GAE), which does not offer direct access to a virtual machine but instead offers deployment in a running application server. Consistent with Vaquero et al (2009: pp.51), this book Chapter defines compute clouds as a "large pool of easily usable and accessible virtualized resources (such as hardware, development platforms and/or services). These resources can be dynamically re-configured to adjust to a variable load (scale), allowing also for an optimum resource utilization. This pool of resources is typically exploited by a pay-per-use model in which guarantees are offered by the Infrastructure Provider by means of customized SLAs".

Within a geospatial context IaaS could offer a virtualization environment where users could deploy Geographic Information Systems (GIS) software to run computationally intensive tasks. DaaS could offer storage and retrieval of the petabytes of data that Earth Observing satellites produce every year. SaaS, as this paper will demonstrate, could offer geospatial functionality remotely hosted on third party machines. This paper will describe a specialization of SaaS involving the provision of geospatial capability; we shall refer to the approach as Geospatial SaaS (GeoSaaS). Approaches for distributed and parallel processing within cloud computing are inherited from web services and Grid computing. This often leads to confusion between cloud and grid computing as Vaquero et al (2009) observe. However, Vaquero et al (2009) also identify areas such as security and interoperability where there is a clear distinction between the cloud and grid computing. We contend that lessons learnt in the integration of Grid computing and geospatial web services(Lee & Percivall, 2008) provide a foundation for the development of GeoSaaS. One such lesson is the provision of geospatial capability in distributed platforms through the Geographic Resources Analysis Support System (GRASS).

This Chapter will address the question *"can a compute cloud offer geospatial processing capability as a service using a standardized interface?"*. The Chapter shall discuss the implementation of a prototype GeoSaaS and its deployment in a compute cloud. The prototype service is a wrapping of the free and open source GRASS in a web service compliant to standards of the Open Geospatial Consortium (OGC), which is a group of over 300 private, public and academic

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