Chapter XXVII
Grid Computing and its Application to Geoinformatics

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ABSTRACT

The definition of the Grid computing and its application to geoinformatics are introduced. Not only the comparison of power Grid and computing Grid is illustrated, also Web technology and Grid technology are compared. The Hourglass Model of Grid architecture is depicted. The layered Grid architecture, relating to Internet protocol architecture, consists of the fabric (computer, storage, switches, etc.) layer, connectivity layer, resource layer, collective layer, and application layer. Grid computing has been applied to many disciplines and research areas, such as physics, Earth science, astronomy, bioinformatics, etc. By applying the Grid computing to Open Geospatial Consortium, Inc.'s Web services and geospatial standards from International Organization for Standardization, US Federal Geographic Data Committee and US NASA, a geospatial Grid is proposed here, which consisting of Grid-managed geospatial data and Grid-enabled geospatial services.

INTRODUCTION

Grid computing, defined in the mid-1990s, has appeared as a new e-science information technology for addressing the formidable challenges associated with the integration of heterogeneous computing systems and data resources. Its goal is to build a global computing space with global resources by securely bringing together geographically and organizationally dispersed computational resources to provide users with advanced ubiquitous distributed sharable computing (Foster et al., 2002; 2001). Currently, the most popular and widely used Grid software is Globus Toolkit. The newest 4.0.1 version uses Open Grid Service Architecture (OGSA) and Web Service Resource Framework (WSRF) specifications to build the computational Grid.

Geoinformatics is the science and art of acquiring, archiving, manipulating, analyzing, communicating, and utilizing spatially explicit data for understanding the physical, biological, and social systems on or near the Earth's surface (Di, et al. 2005). In order to share distributed geospatial resources and facilitate interoperability, the Open Geospatial Consortium (OGC), an industry-government-academia consortium, has developed a set of widely accepted Web-based interoperability standards and protocols, such as Web Mapping Service (WMS), Web Coverage Service (WCS), and Catalogue Service - Web profile (CS/W) specifications. These services have been widely developed and used by diverse geoinformatics communities.

Grid technologies provide a platform to make every digital resource securely sharable and usable by every qualified user no matter how the resources are related to a discipline, organization, science, or anything else. The OGC is leading the development of geospatial resource standards for sharing geospatial data and geoprocessing services. Therefore, it is very natural to apply Grid technology to geoinformatics to reach the goal that is being pursued by the OGC. It not only extends Grid capabilities to the geospatial discipline for enriching Grid technology, but also utilizes the newest computer technology for advancing discipline research.

BACKGROUND

Grid computing is not simply a means for researchers to do existing research faster, but also promises them a number of new capabilities. While the ability to carry out existing experiments in less time is definitely beneficial, other features such as ease of collaboration, reduced cost, and access to increased resources and instrumental results, allow more advanced research to be carried out. In order to achieve these goals, considerable work has been put into Grid-enabling technology, including Grid architecture, Grid middleware, authentication mechanisms, resource schedulers, data management and information services. These technologies form the basic services for achieving the goals of the Grid – creating e-Research and e-Commercial environments (Hey & Trefethen 2002).

The ultimate target of Grid Computing is to establish the Computational Grid whose idea is analogous to the electric power grid where power generators are distributed, but the users are able to access electric power without concern for the source of energy and its location (Figure 1). Today, the Grid computing technology is trying to provide computing capabilities as the electric power grid provides energy capabilities by using the same characteristics such as reliability, scalability, security, low cost, and convenience.

Grid technology has boomed as a result of the Internet and the rapid development of Web technology. As the Web revolutionizes information sharing by providing a universal protocol and syntax (HTTP and HTML) for information exchange, The Grid, which mainly consists of the standard protocols and syntaxes, comes up for revolutionizing general resource sharing. The

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