Geography Cartography Service: A Case Study of On-Demand Geo-Computing

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1. Introduction

Open and cooperative computation characterizes current information technologies, which bring opportunities to provide open, agile and on-demand geo-computation capacities (GCC), by which people can solve spatiotemporal issues. Several study activities are performed about the target, three significant of them are GRID GIS, UbiGIS and Open GIS. GRID GIS is the application of GRID philosophies and technologies to geo-computation; it now mainly aims to CPU-intensive, data-intensive and high-throughput computation, such as remote sensing data processing and imagery processing. UbiGIS relates to pervasive computing, mobile geo-computation is the current emphases. Open GIS is a specification-driven industry consortium by scientists and IT experts, its main object is the interoperability of different geo-computational resources.

Comparing with the investment on GRID GIS, UbiGIS and open GIS, the acquirement of GCC is still expensive, low-efficiency, and difficult, especially for those who are not familiar to geospatial information knowledge and technologies, even traditional geographers. An investigation by our group on those geo-computation approaches shows that a user-oriented and application-level geo-computation paradigm is necessary to release GCC to common people. In other words, a user-oriented and task-oriented geo-computation approach for common users to utilize GCC easily should be studied. The on-demand geo-computation (ODGC) presented in the paper attempts exploring how to provide GCC on easy-to-use and on-demand way.

There are five sections to discuss ODGC in the paper. Section 2 concludes the pressures and requirements that current geospatial information technologies face, and suggests that an on-demand providing of GCC is a reasonable way. The section, furthermore, analyzes the implication of on-demand feature. At the end of the section, a detailed comparison with GRID GIS, UbiGIS, Open GIS and ODGC is made to distinguish the relationship among them and clarify the superior domain of ODGC. Section 3 outlines ODGC by a testbed named Geographic Cartography Service(GCS), which is constructed as an example to illustrate the on-demand features of ODGC. From the end-user's perspective, GCS shields complex heterogeneous of geo-computational resources and simplifies user's operations from traditional 3-5 steps to one step with little requirements of his/her geospatial information knowledge. Section 4 discusses the key of

ODGC and two apt-to-misconceive points to discourse upon ODGC furthermore. Section 5 concludes the paper, discusses the success and failures exposed by the example, and explores the future studies of ODGC.

2. On-Demand Computing and On-Demand Geo-Computing

On-demand computing (ODC) in the paper is inspired by IBM's on-demand computing initiative that aims to deal with the fluctuation of customer's computing requirement mainly at the infrastructure level. By extended to software, data and other 'soft' computing resources (SCR), ODC grows into a computing strategy that aims to provide on-demand computing capacity (CC). The strategy comprises philosophy, model, technology, architecture and other ingredients to fulfil its target.

2.1 ODC Features

According to IBM and other related studies, ODC indicates suitably and on-demand providing of CC—the former feature means different users can obtain their personalized CC; the later feature means consumers can get CC whenever they want. While extended to SCR, ODC of the paper implies more features as follow.

Contract-Based Computing Model.(as shown in fig.1)

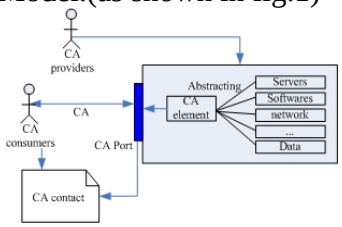

Fig.1. the contract-based computing model

Business-Procedure-Oriented Organization of CC.

Real-time Providing of CC.

The Shield of Heterogeneous Computing Resources that Produces CC.

Easy-To-Use.

2.2 On-Demand Geospatial Computing

On-demand geo-computing (ODGC) is not only the simple domain application of ODC, but also expected to overcome the obstacles mentioned above in order to crash the 'nutshell' of current geo-computing. Except for the features of ODC, and considering the characteristic of geo-computing, ODGC will deal with some special issues to prove its value. The most important three of them are discussed below.

Issues Related to geo-computational resources (GCR) Inter-operability.

Issues Related to GCR Time-Validity.

Issues Related to High Network Throughput and Intensive Computing.

2.3 GRID GIS, UbiGIS, OpenGIS and ODGC

Expect for ODGC, there are still some approaches for open geo-computation, including GRID GIS, UbiGIS, OpenGIS, etc. Each of them has its focuses and emphases. It is helpful to distinguish the differences among them and clarify their superior domains. The comparison shows that ODGC, GRID GIS, UbiGIS can be complementary one another, while Open GIS can function at interoperability issues for all of them.

3. Case Study--Geographic Cartography Service

An illustrative example benefits to explain ODGC, including its concept, principle, features and working mechanism. The paper extracts geographic cartography ability as a GCC and implements it as geographic cartography service (GCS) to illustrate ODGC.

3.1 Geographic Cartography Service

GCS is a web service to provide geographic cartography ability. The component serves agent or application for displaying spatiotemporal distribution of their geo-referenced data real-timely (Fig.2).

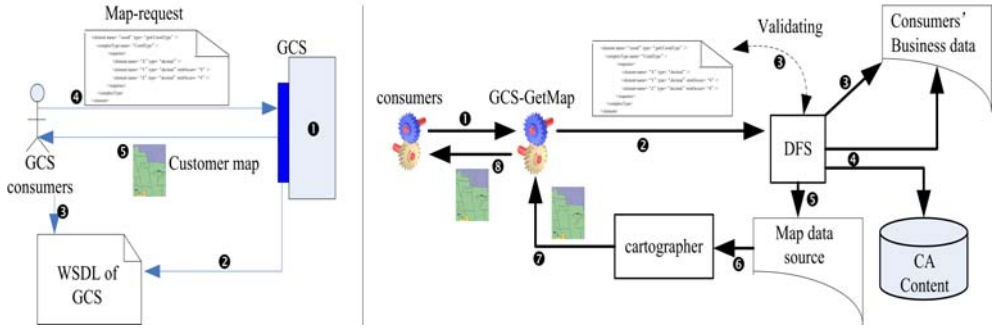

Fig.2. the mechanism of GCS

As an implementation of ODGC computing node, GCS put up the on-demand and real-time features. The right part of Fig2 shows the internal working mechanism of GCS to conduce these features. To illustrate the shield of GCR heterostructure, GCS deploys dual systems sharing the same geographic cartography ability contract (Fig.3). Both systems are deployed in national engineering research centre for information technology in agriculture (NERCITA) and open to its core departments via LAN and affiliated departments via Internet. A simple client with two components is developed to illustrate how to consume the geospatial ability. One is a GPS-enable truck that emits GPS signal continuously, the other is an IE-based web page that receives signal, encodes signals into geographic cartography ability contract-compatible message, sends messages to GCS, and renders the result map. Web page is set to automatically send messages to GCS one time per 10 seconds (Fig.4).

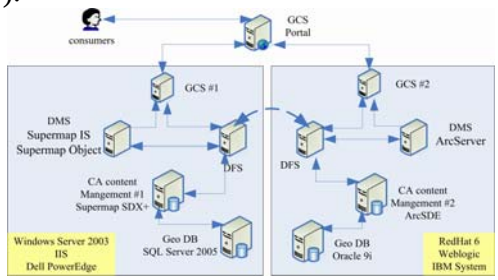

Fig.3. the deployment of GCS

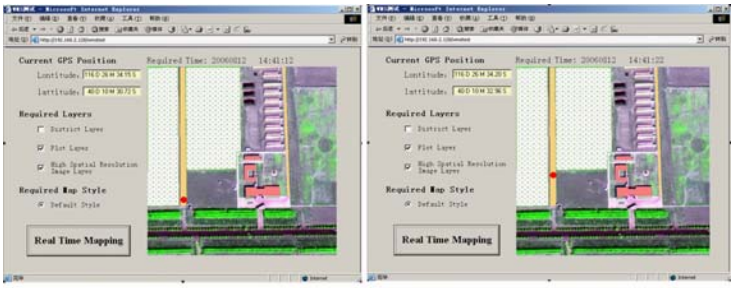

Fig.4. the result of GCS testbed

3.2 Case study

The construction and utilization of geographic cartography ability effectively illustrate on-demand computing features and the traits of geo-computing. Some of them are discussed below.

Suitability, Real-time, and Easy-to-Use Features.
On-Demand Computing Model and Contract-Based Computing.
Shielding of Heterogeneous Computing Resource.
Universal Geo-processing of Heterogeneous GCR.
High Network Throughput and Intensive Computing.
Geospatial Data Updating.

4. Discussion

Except for the analysis above, the case is also benefited to clarify some apt-to-confused viewpoints of ODGC. Two typical of them are listed below.

Misconstrue 1: ODGC is the same as geospatial web service..
Misconstrue 2: ODGC is another GRID computing.

5. Conclusion

As a sort of net-centric computing, ODGC is more close to business operations and seeks to provide a new format and method of utilizing geo-computing resources by abstracting computing resources to CC and mapping business chain into the set of CC. ODGC is not a single technology but a CC-based geo-computing strategy that comprises a series of new computing viewpoints, algorithms, specifications, technologies, architectures, and other ingredients to provide on-demand geo-computing ability.

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7. References