The Development of an Open Source Ubiquitous Geographic Information Management and Service Environment

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Outline

- Ubiquitous Computing and GIS Development
- Service-Oriented Architecture
- Ubiquitous Geographic Information Service
- The SOA for UbGIMS Framework
- Results and Discussions
- Conclusions and Future Studies: Smart UbGIMS
- Q & A
Ubiquitous Computing and GIS Development
The term ‘ubiquitous computing’ was coined by Mark Weiser in a 1991 Scientific American article. He points out that “We believe that people live through their practices and tacit knowledge so that the most powerful things are those that are effectively invisible in use.”

The highest ideal of “invisible” in ubiquitous computing is to make a computer so imbedded, so fitting, so natural, that we use it without even thinking about it.
Ubiquitous Computing (Cont.)

- The development of Internet environment makes the ubiquitous computing reaches the level of maturity that allow the computers to be integrated in a manner that permits user to access the service at anywhere and anytime.
The Marriage of GRID and Ubiquitous Computing

- Grid technologies could be an ideal starting point for developing future infrastructure support for ubiquitous computing, facilitating the deployment of ubiquitous computing technologies and helping to accelerate progress toward Weiser's vision.

~IEEE Pervasive Computing, Volume 3, Issue 2 (April 2004), Pages: 74 - 75
The Development of GIS

- As early as the 1980's, the GIS community has been accused of elitism, archaism and being, in essence, “ivory tower geomancers”.
- The development of navigation systems and then by web mapping and imagery services such as those available from Google™ Earth or Microsoft® Virtual Earth™ has cracked the shell of the “ivory tower”.
- GI has begun a move into the mainstream and taken that “last mile” step into the “general public”.
The Design of Ubiquitous Geographic Information Management and Service
The goal of ubiquitous GIMS is to make the “user experience” intuitive, and simple to use. Usually, users of GI seldom care how something is implemented, just how well it is implemented.

Within ISO TC 211 an internal discussion paper on *Ubiquitous Geographical Information* (*UbiGI*) has been published in 2005, which shows the awareness within these institutions for these emerging trends.
4 Major Characteristics of UbiGIMS to be Fulfilled (1)

**Distributed**: That is data storage, processing and user interaction can occur at locations that are potentially widely scattered.

**Disaggregated**: That is the monolithic systems we have today are replaced by 'plug and play' components, possibly from different vendors, that are designed to interoperate through conformance with industry-wide standards.
4 Major Characteristics of UbiGIMS to be Fulfilled (2)

Decoupled: That is the system must be able to access a number of components that may be required to complete a specific task, which may be distributed over many networks.

Interoperable: Which means the system is based on an "open" system such as that promulgated by the Open GIS Consortium (OGS).
The Framework of SOA for UbiGIMS
The Concept of Service-Oriented Architecture

The Application of SOA for UbiGIMS

- A common *UbiGIMS* structure, in general, brings together four important technology components: *user appliances*, *networks*, *server-hosted data and applications*, and *a location fixing technologies*.

- In order to create *Service-Oriented Architecture* (SOA) for the *UbiGIMS* we need to create *Web Service* correspondences of each *UbiGIMS with multi-participant, multi-user computing environment*. 
Three Categories of UbiGIMS

1. **Data Services**: These types of services are tightly coupled with specific data sets and offer access to customized portions of that data.

2. **Processing Services**: These types of services provide operations for processing or transforming data in a manner determined by user-specific parameters.

3. **Registry or Catalog Service**: These types of services allow users and applications to classify, register, describe, search, maintain, and access information about Web Services.
The Application of SOA for UbiGIMS (with GRID Computing)
The Middleware and Web Service

- The middleware is used to manage the database as well as allocate data and assign processing job to the TPs.

- The top layer of this framework shows the web-based user interface and a X-Windows environment to operate and display UbiGIMS results.
The Trigger Point

- The trigger points (TP) shown in the bottom layer of this framework represent the nodes for grid computing. Each TP is installed with the open source GIS software for which has been set up for GI data processing service.
- The TP are linked to the middle layer, which has a middleware to retrieve the IP from users and using a preset control mechanism to perform registry and catalog service of the UbiGIMS.
The Trigger Point Working Flow Design

Program functions developed in this work by using shell scripts embedded in php.

Trigger Working flow

1. Set Display argument to client IP
2. Loading user’s profiles for AP needed
3. Startup remote server’s AP

Send the client’s IP

Check user’s privilege

Check user’s profiles for GI AP

Display result on client side

Auto-create user’s profiles

Trigger Point
Results and Discussions
The Ultimate Goal

“A hardware and software infrastructure that provides dependable, consistent, pervasive and inexpensive access to high-end computational capabilities.”

This is the same as the initial thinking of GRID Computing by Ian Foster
Implementation Server Environment

- CPU: Intel Pentium IV 3.00GHz with HT
- HDD: 150 GB SATA Hard Disk
- RAM: 512 MB Memory
- NIC: Realtek RTL-8169 Gigabit Ethernet
- OS: Gentoo GNU/Linux with kernel 2.6.17 and Apache Web Server with PHP and MySQL database
- Open Source GIS: GRASS 6.2
System Architecture
Prototype

- Globus Toolkits
- 3 Terabyte Storage
- Open Source GIS: GRASS
- SRB
- Linux
- Windows
- Breeze
- Gateways
- Labs 1, 2, 3
MS Windows X-Window Server Solution

- **Xming X Server for Windows**: Xming is the leading free unlimited X Window server for Microsoft Windows (XP/2003/Vista).

- Xming is fully featured, small and fast, simple to install and being standalone native Microsoft Windows, easily transported portable as a Pocket PC X server.
The User Interface of Accessing UbiGI Service

http\:210.240.178.29/xscript.php
The Local Host Display Results in MS-Window Environments
Conclusions
Virtual Reality vs Ubiquitous
Conclusions

- We have proposed a framework for UbiGIMS by the integration of Service-Oriented Architecture (SOA) and GRID Computing concept. A working flow for implementing the framework also has been proposed.
- By using the hardware, open source software and trigger functions designed in this research, we have successfully build a ubiquitous open source GIS environment, which provides the full functions and database management applications of GIS in cyberspace.
Future Works: Smart UbiGIMS

- Try on the implementation of GRID Computing middleware for registry, data catalog and resource management: Globus Toolkit and SRB.
- Firewall and VPN Access.
- To implement performance measurement and evaluation.
- Exploring the Grid's Potential for UbiGIMS.
- The introduction of the development of Smart Geographic Information Management and Service.
The Challenges

- Invisibility
- Context Management and Awareness
- Mobility
- Spontaneous Interoperation
- Privacy and Trust
- Dependability and Security
- Scalability
- Heterogeneity
Q & A

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