Partnership for International Research and Education
A Global Living Laboratory for Cyberinfrastructure Application Enablement

Mobile Web Services using Globus

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I. Research Overview and Outcome

Problem Statement

- The Globus Toolkit 4 provides support for grid computing through web services. The standard implemented by GT4 is called the Web Services Resource Framework (WSRF).
- Previous work has been done to the development of the WSRF-ME framework. [2]
- The WSRF-ME framework's goal is to enable the use of web services on mobile devices based on the Web Services Resource Framework while adhering to the method in which web services invocations are utilized in JSR-172 (which is the standard API for accessing web services from a J2ME enabled mobile phone).
- One of the future developments could involve the solution of issues regarding cross-manufacturer interoperability.
- Considering today's market and the diverse of mobile devices heterogeneous nature, the implementation of grid computing should prioritize the solution of such manufacturer inherent issues.

Research Objectives

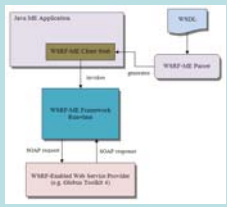
- Continue the work of accessing to WSRF from Nokia S60 [2]
- Migrating the access to WSRF to Android platform
- Comparing and evaluating components to develop guidelines to implement mobile services using Globus
- Identify a usable Grid application in order to evaluate and compare the performance

References

1. LIGO Scientific Collaboration. "Introduction to LIGO and gravitational waves". Online at: http://www.ligo.org/science/overview.php
2. Mangs, Jan C.; Huang, Shihong; Cao, Junwei. "Enabling Access to WSRF from Mobile Devices". Fourth International Conference on Semantics, Knowledge and Grid 2008

Research Development

The project consists of two different components, mainly the server and the client, joined together by the web service component. As an evolution of the 2008 WSRF framework proposed in [2], this project still considers the mobile phone as a passive component, i.e., a client and not a host in the grid environment (even though it's active participation remains a future enhancement possibility).



WSRF-ME Architecture

The server - the Globus Grid

The server component should enable the web services required for the application selected, in this case, LIGO services, a gravitational wave monitoring system. A grid computer makes viable server option because of the need for high computing power and the open option of offline processing.
A Linux based Globus toolkit 4.0.8 implementation of a grid is thus created to house two example web services which are discussed next.

The Web Services – LIGO services

Two java based web services are created in the Globus grid in order to make LIGO monitoring available to mobile devices. These services include the search for time intervals where high number of gravitational wave candidates are detected and the correlation analysis of two different observatories' detected signals.

The client – Java Mobiles

The original Java ME based framework is modified mainly keeping the original framework's concept WSRF compliance and of complex data types support, which has been proven necessary as far as the LIGO web services are concerned.
A case study implementation on an Android phone emulator, selected for its open-source nature, should prove the independence of the new framework from Java ME platforms and in particular from JSR-172 from which it was based.

Case Study: Gravitational Wave Observation

Gravitational waves are created by moving masses, in a similar way like electromagnetic waves are created by moving charges.
For physicists, a strong gravitational wave will produce displacements on the order of 10^{-18}meters, a thousand times smaller than the diameter of a proton. Waves of this strength can only be produced by very massive systems undergoing large accelerations, for example two orbiting black holes that are about to merge into one. These systems are rare and are light-years away [1].

The search for gravitational waves is seeking the effects of some of the most energetic astrophysical systems in the universe and since they're not absorbed or reflected by the matter in the rest of it, it's possible to see them in the form in which they were created. Thus, their study provides insight not just only into astrophysical objects that would have otherwise been obscured and into phenomena that do not produce light but into Einstein's theory of relativity and into the origins of the universe as well [1].

The observation of gravitational waves has been accomplished in the US through several different laser interferometers which are collectively called LIGO (Laser Interferometer Gravitational-wave Observatory).

Multiple interferometers are required to locate the sources of gravitational waves since each of them is sensitive to a large portion of the sky. The detection delay between two different interferometers is used to help pinpoint the detected signal's location and rule out locally generated events. However, the data analysis that is required to search for gravitational waves is much greater than that associated with traditional optical telescope and real-time detection of gravitational waves is usually not possible. Thus, high computing power and offline processing make Grid computing a viable candidate for their processing [1].

II. International Experience

Beijing, China

We spent a total of 9 weeks in Beijing.
Amazing in size, the excellent subway and bus system allowed us to go anywhere we wanted, from the Forbidden City, to the Olympic Stadium. Distance was never a problem and walking or biking was always a possibility.

The Great Wall

Close to Beijing there are beautiful sites to visit including parks, the Ming Tombs and the Great Wall.
The Great Wall is one of the most impressive sites I've ever seen. I never imagined I would be able to see it myself. If you go to China you shouldn't miss it. The day we were there, it was foggy and we seemed to be walking in the clouds! Prepare yourself for quite a walk but do not worry about walking down because you could use a tobogan to slide all the way back!

Tsinghua University

During this summer I had the opportunity to work with Dr. Junwei Cao at Tsinghua University.
Tsinghua University is one of the most renowned universities in China and it was an honor to participate in the lab's activities. The students in the lab were wonderful and were always willing to help. I learned a lot from them and their attitude towards work and the world. To them, I am most grateful.
Additionally, working in the lab, which is focused on grid computing, allowed me not just to learn about grids, but to investigate and finally select one specific application for this project: LIGO. LIGO is one of the main research projects for the Chinese team and is also an NSF effort with several universities around the world.

The Chinese Food

The food in China is delicious. Spicy by nature, you can choose among a thousand different dishes and every plate is shared between friends or colleagues! Eat until you can't eat another bite and don't worry if you have a little left over. It tells your host you've had enough….

The Chinese People

People in China are extremely friendly and polite! We always felt welcome and well cared for and to the people who helped us get settled and shared with us their passions, hobbies or just some spare time. I'm very thankful. I consider them my dear friends.

East Meets West

During the nine weeks I spent in Beijing, the city struck me as a metropolis, where technology and ancient culture combine perfectly! East and West, never clash either! From a German ballet, to the Chinese Opera all kinds of activities are available. Restaurants and bars from all over the world can be found too. There is never a dull moment in Beijing. There, I was able to see a classical music concert, a ballet and the Chinese acrobats!

III. Acknowledgement

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