Improving Persistent Storage of SCEC Simulation Results

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Situation and Requirements

- Some SCEC simulation results have long term value and should be saved for use by scientists.
- These data sets are can be very large and include many files.
- These data sets are distributed across many sites in a grid system.
- These data sets may be moved from one physical storage system to another.
- SCEC Scientists need a way to find which data sets are available.
- SCEC Scientists need a way to extract data from these archives.
- SCEC data sets should be citable in scientific publications.

Motivation

To help geologists manage the data, we create a system called the SCEC Data Management System (SDMS).
In this poster, we describe our work on SDMS. Our SDMS development has two primary goals:
(1) Help SCEC researchers save important simulation results into persistent storage, and
(2) Help SCEC researchers discover and access existing SCEC simulation results.

Data Sets

Include:
- 3D Motion in Basin
- Peer Validation
- TeraShake 1.0
- TeraShake 2.0
- ShakeOut Broadband
- ShakeOut-D
- CyberShake Map 1.0
- Chino Hills 1Hz Graves
- Chino Hills 2Hz Olsen
- Chino Hills 2Hz Bielak

Component Design

The SCEC Data Management System will include three main parts:
- Data Set Registration
- Data Set Discovery
- Data Set Access

Data Set Registration
Tools that enable users to define a data set

Data Set Discovery
Tools that enable users to find a data set

Data Set Access
Tools that enable users to retrieved data from data set

Besides the three main components, SDMS also provide an integrity check to ensure that each archive persisted in the system is valid and can be accessed when needed.

System Design

Because the data are in a distributed environment, so we apply the concept of Logical File Name (LFN) and Physical File Name (PFN) into the system. Each physical location will be converted and mapped to a logical location. A LFN can have more than one PFN associated with it. Then the system will work with LFNs and therefore reduce the complexity of the design.

SDMS also use many grid-based technologies from Globus Toolkit middleware, including: Replica Location Service (RLS), Globus Resource Allocation Management (GRAM), and GridFTP.

RLS - Tools that enable mapping between LFN and PFN
GRAM - Tools that monitor the resource and manage remote job submission
GridFTP - Tools that do the transfer files in a distributed system

Case Study

As a case study, we develop a discover and access tool for CyberShake Map 1.0 data. This data set access will help scientists discover useful information they need and access the data at remote sites easier. The data are in a form of records in the CyberShake database and also zips of seismogram files.

Moreover, we created a tool for the data set registration of CyberShake Map 1.0 data. The registration tool will create an inventory for the CyberShake Map 1.0 data. Later the tool can be used to query for a collection of files in the inventory. The tool also ensure the integrity of a file by applying MD5 checksum into each file.

Evaluation

We use the CyberShake Map 1.0 data set as our working example. The tools are developed for CyberShake Map 1.0 data which consists of over 42,000 zips of seismogram files with approximate size of 2.2TB. The system takes about 4-5 hours to do the index of seismogram files (This process needed to be run once). For normal usage, to find the peak amplitude for the specific site, it would take about 1-2 minutes per site. Using the discovery tools, scientists can find the LFNs of files they need, and then use the LFNs and access tools to get the actual files from remote sites. Generally, the system enables scientists to register, discover and access the data they need quicker and much more convenient.

Technology Used

- Python
- Globus Toolkit
- RLS, GRAM, GridFTP
- PyGlobus
- MySQL, SQlLite

Future Direction

Future direction of development of the project will be focused on the design to simplify the complex data management task as much as possible. Besides focusing on the system design, we will concentrate on studying the state-of-art technologies and techniques. Then apply them to be used within the project. One of the possible technology that we are interested is to convert our code to conform the new WebService Resource Framework (WSRF) standard which is by the Globus Toolkit version 4.0. This change is mostly about to use WebService technology in our project and this would allow the system to be more powerful, and easier for each component to work together.