Building an E-learning Platform by Access Grid and Data Grid Technologies

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Abstract

Due to overall popularity of the Internet, e-learning has become a hot method of learning in recent years. Through the Internet, learners can freely absorb new knowledge without the restriction of time and place. Many companies have adopted e-learning to train their employees. The e-learning system can make an enterprise more competitive by increasing the knowledge of its employees. As we know, e-learning has become one of the most potential e-commerce businesses.

At present, most e-learning environment architectures are in consideration of a single computer or server as its erecting foundation. As soon as its work load increases, the software and hardware need to be updated or renewed; this is a big burden to a company with insufficient budget. Thus, in this research we employ a kind of Grid Computing technology, called "Access Grid", to integrate the idle computer resources in an enterprise into an e-learning platform for substituting the purchase of costly high-level server and equipment.

The Access Grid supports group-to-group communication via high-speed networking over the Internet. It provides high quality audio and real-time video interactive interface for e-learning users. All the hardware cost is reasonable so that companies or academies can easily set up their own Access Grid Node. By using Access Grid technologies, enterprises can integrate their training materials into knowledge repository such as "Data Grid" as the e-learning VOD platform so that the knowledge can be shared and published more flexibly and widely.

Keywords: E-learning, Grid computing, Web services

1. Introduction

With the development in communication and network technology in recent years, under the gradual improvement of network bandwidth and quality, the real-time transmission of high-quality video and audio becomes possible. Therefore, the transmission of multimedia and relative network application technologies have gradually been developed and become popular, such as the technology of Distance Education, Video Conference and Video on Demand, etc.

Distance Education is a very effective method of learning. The advantage of Distance Education is that it can overcome the obstacle of geographical location; making students on remote sides feel that they are at the incidence like being in the environment of attending classes in a classroom. Moreover, it can save cost and time of the students for their commutation to and fro the classroom.

Although Distance Education has many advantages, the biggest obstacle is the investment on equipment. For instance, teaching mode that intends to achieve real-time two-way video/audio teaching effect needs to be established with costly Video Conference system. This type of system usually demands exclusive equipment and very high bandwidth. To enterprises or schools with insufficient budget, it is almost impossible for them to establish the system.

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In order to enable more enterprises and schools to apply Distance Education, this research has combined two kinds of Grid Computing technologies such as Access Grid and Data Grid for building one set of teaching system that consists of expandability and resources sharing capability.

2. E-learning and Distance Education

The development of current Distance Education System for E-learning can roughly be classified into 3 types as follows [1]:

2.1. Multicast Teaching System:

This type of system is that the teacher and the students can be located in different places. By using network technology, the video/audio of the classroom teaching and multimedia teaching materials can be transmitted real-time to the remote side classrooms. Furthermore, it allows the two-way real-time communication between the teacher and the students in remote side classrooms.

2.2. Virtual Classroom Teaching System:

This type of system adopts one set of teaching management system to simulate the scenario of attending class in a classroom (such as teacher's lecture, holding examination, specified assignment or questions answering, student proposed question or participating examination, etc). Teacher and students can link to the teaching management system at any time through the Internet in front of computer for teaching or learning.

2.3. Video on Demand Teaching System:

This type of system adopts the technology of VOD (Video on Demand). Students can obtain the learning teaching materials through the Internet by using the computer or TV furnished with Set-Top Box and to process distance learning in accordance with personal learning speed by controlling the broadcasting process.

The teaching mode of this research combines Multicast and VOD teaching modes. Real-time video teaching is performed at fixed time but the rest of time is only web teaching. For instance, after the class, the video teaching course is produced as video stream file for broadcasting online for the convenience of learners who can not watch the real-time video teaching course.

3. Access Grid and Grid Computing

Access Grid is the technology developed by U.S. Argonne National Laboratory. It enables many people to process interactions and opinion exchanges through video and audio. At present, it has been used in many sites that need video such as training, teaching, conference and seminar, etc. The application software of Access Grid is called Access Grid Toolkit. This is a freeware that anybody can freely download from the Access Grid web site. On the web site, it also provides complete technical archives for giving necessary assistance to its users. Up to September 2003, the latest version of Access Grid Toolkit is Version 2.1 [2].

Before Access Grid Toolkit Version 2.0, Access Grid is only a kind of video conference system. After Version 2.0, Access Grid has already tightly combined with Grid technology, therefore the Grid Middleware Globus Toolkit needs to be installed before the installation of Access Grid Toolkit 2.0.

The middleware Globus will check thoroughly all the available resources in the Grid when making a computing task, such as which hosts are available, how much processing capability is left, what the available data is in the database. Then, the tasks required by the users will allocate its resources and control its action by the system [3].

As AG (Access Grid) 2.0 has already tightly combined with Grid so that all the functions of Grid technology such as authentication, resource allocation, and remote data access and fault detection are the standard function of Access Grid; at the same time, XML Web service is also the data transmitting method of Access Grid.

In Globus Toolkit 3.0, Web Service is already the standard architecture named OGSA (Open Grid Services Architecture). The Web Service based on OGSA is also named Grid Service [4].

4. The Access Grid Architecture

The system established in this research will use the following architecture as Implementation.

4.1. The front end

The experiment location of this research is in Li Zen High School in Taichung, Taiwan. By using Access Grid technologies, the school can integrate their training courses and materials into Grid environment which provides more flexible teaching mode.

It is necessary to set up a Portal Web Site in the Access Grid system first, which not only provides services to the members of the Grid, but also acts as a teaching platform for the other academies through the Internet [5]. Figure 1 is the architecture of Access Grid.

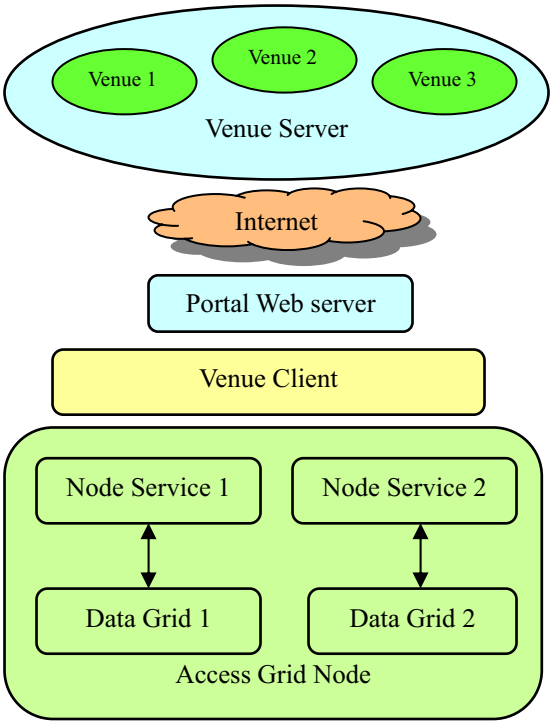

Figure 1. Architecture of Access Grid

Behind the Portal Web Site, We will set up a Video Conference Platform via Access Grid Toolkit. This Platform requires the following hard wares:

(1) 4 sets of PC – one for Display, one for Video Capture, one for Audio capture, and the other one for management.
(2) 4 sets of Video Camera.
(3) Several Microphones, based on how many people in the conference room.
(4) 3 sets of projector

In AG 2.0, Virtual Venue is the most important part that provides the following functions [6]:

- Entry/Exit Authorization Information
- Connections to other Venues
- Coherence among Users
- Client Capabilities Negotiation
- Applications

Virtual Venue is divided into three major parts, which are Venue server, Venue client and Venue Server Management Client. Their major function is to provide one collaborate place to all users [7].

The advantage of Virtual Venue is unlimited expansion; that is, if a new organization is to join the e-learning parade of Access Grid only if this new organization establishes its own Virtual Venue and establishes the inter-authentication relationship with other existing Virtual Venue, it can join the Access Grid and become one of the members.

4.2. Access Grid and Data Grid

Virtual Venue is a place where users collaborate so that we can establish one Data Grid Node in one Virtual Venue as the place for storing teaching resources. For the students who could not participate in the real-time courses, they can also watch them after the classes. Nevertheless, the files that record the video of the classes are usually so huge that they require high capacity of storage device such as Disk Array, NAS or SAN, Therefore, we can use Data Grid technology to substitute the above storage device [8].

Establishment of Data Grid only uses the internal idle teaching or administration computer resources within the school. In this way, it is possible that the storage space obtained will not be less than that of an expensive storage device. Figure 2 is the architecture figure of the combination of Access Grid and Data Grid.

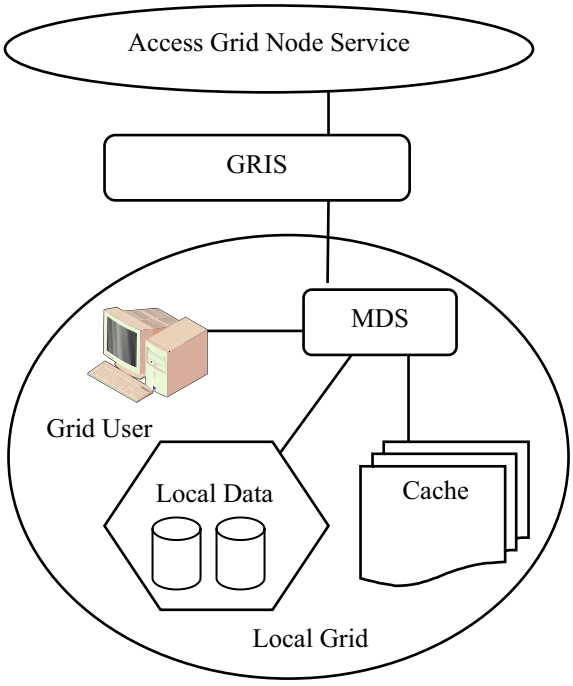

Figure 2. Data Grid Architecture

Data Grid environment consists of two important elements: GRIS (Grid Resource information Services) and MDS (Metacomputing Directory Services). GRIS provides an infrastructure for storing and managing the

status and components around the Whole Grid. MDS is based on LDAP (Lightweight Directory Access Protocol), which is used for storing and looking up data related to information on the Grid [9].

The Data Grid Architecture we adopt is separated into two parts. For the part inside the school we call it Local Grid, which is formed by two Nodes. Each Node is comprised of a PC Cluster formed by 4 PCs. For the above PC, its configuration is Pentium III 600 MHz CPU, 128 MB RAM, 20 MB HDD, 10/100 Fast Ethernet and its operation system is Red Hat Linux 9.0.

4.3. The Back End

The system set up by this research can not only be applied to the teaching on campus, but also provide other academies through the Internet to share its teaching material. Herein we bring up an Internet virtual organization concept of "Partner Academy", which can be regarded as a "Resources Receivers" who can not only share the present sources on the Internet, but also act as a "Resources Providers" who provides resources. Each partner academy can provide different resources according to its specialty.

Based on the architecture of Data Grid, information placed in each Local Grid should have its uniqueness and will not be repeated. For example, what is placed in school A will be mathematics and what is placed in school B will be teaching content of literature. In so doing, it will not result in waste of teaching resource investment. Figure 3 shows the framework of partner academy.

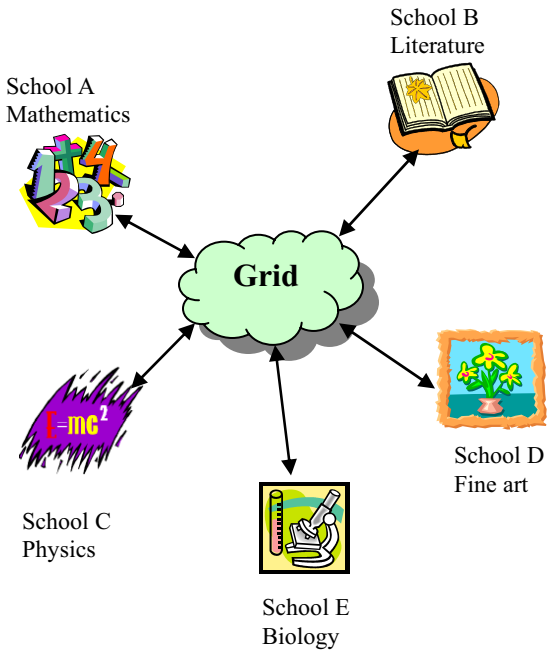

Figure 3. Framework of partner academy

5. Conclusions

This research hopes to integrate those idle computer facilities in academies by Grid Computing and the techniques of Access Grid and Data Grid so as to save cost and make best use of resources. For those academies that have insufficient budges, they can then obtain better services and enormous teaching resources through the techniques of Access Grid. With the continual participation of partner academies, the expected accomplishments and experiences of this research can be provided as reference to those academies which hope to develop e-learning so as to save their cost and time to develop the similar system.

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