Grid-Based Distributed Learning

Punam
Assistant Professor, Punjabi University Campus, Maur, Bathinda, Punjab,India

Abstract **-** According to development in communications and web-based technologies in recent years, distributed learning has become very important for everyone and is seen as one of most dynamic teaching methods. Grid computing is a pattern for increasing of computing power and storage capacity of a system and is based on hardware and software resources in a network with common purpose. Here we will introduce a new suitable mechanism for distributed learning which is based on grid network, and for this reason we call it Grid Based Distributed Learning Framework. Various sections and layers of suggested framework will be analyzed.

Keywords— *Distributed Learning, Grid Computing, Grid Resource*

I. INTRODUCTION

Distributed learning is an instructional model that allows students or users either on or off campus education providing greater flexibility and eliminating time and space barriers. Due to the wide spread use of internet in the recent years, distributed learning gained popularity as an effective way of providing discussion and sharing knowledge all over the world. But today distributed learning systems have limits due to limitations in resource sharing, management, scalability and integration in the dynamic environment. Grid based service gives solution to this problem by enabling the integration of distributed information systems within the heterogeneous environment.

Grid is an infrastructure that involves the integrated and collaborative use of computers, networks, databases and scientific instruments owned and managed by multiple organizations. Grid applications often involve large amounts of data and/or computing resources that require secure resource sharing across organizational boundaries. This makes grid application management and deployment a complex undertaking. Grid middleware provide users with seamless computing ability and uniform access to resources in the heterogeneous grid environment. Several software toolkits and systems have been developed, most of which are results of academic research projects, all over the world.

We can consider distributed computing resources as services delivered by different organizations, which are used for covering and improving e-learning domain. Grid-Based architectures are advantages as they are modular, extensible and offer more interoperability. The main motivation of distributed learning system is to provide information accessible to any type of users. Grid-Based architecture supports multiple independent course specific collaborative information and knowledge networks across distributed servers over the Internet. Grid-Based distributed learning can bring many benefits to higher education, such as enhanced learning experiences, improved access to education, greater learner flexibility, expansion of education to new group and increased interaction and collaboration. By forming grid of resources, institutes, organizations and researchers can share their resources and valuable knowledge with other institutes or organizations. Since, many institutions are not able to maintain and renew their computer hardware and software facilities due to the lack of budget. So by using grid computing these institutes can use resources of other institutions by realizing huge amount of saving in hardware and software resources.

This paper describes the distributed learning framework and how it is incorporated within the grid. In section 2 we explain about the distributed learning framework. In section 3 we specify the collaborative and problem solving environment to describe the interaction between distributed learning and grid framework. Finally conclusion is there.

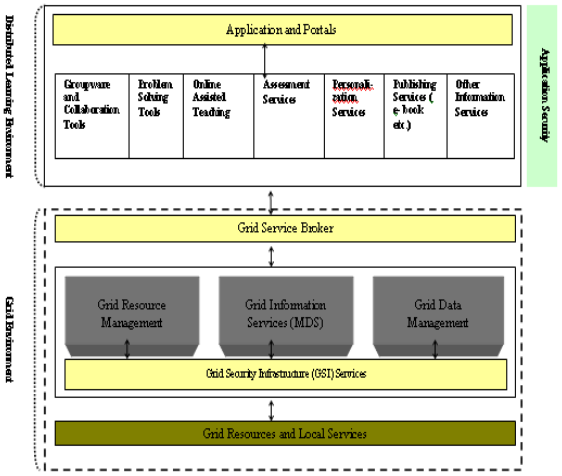

Fig-1 Grid-Based Distributed Learning Framework

II. GRID - BASED DISTRIBUTED LEARNING FRAMEWORK

By proposing the use of grid technology, many content providers and service providers (Institutes or organizations) can participate in the resource sharing environment. These institutes can cooperate under some common policies to reach their goals. So for meeting the requirements of distributed learning, here a grid framework is specified as shown in Fig-1. It describes two environments: first is distributed leaning and second is grid environment. Using the grid technology users such as students, experts or researchers are able to access remote resources such teaching material, discussions with subject experts, computing power from institutes for the solutions of complex problems and other facilities such as digital library.

A. Distributed Leaning Environment

Distributed leaning environment provides facility to access applications, portals and services for users and institutes. With the help of grid portals students or learners are capable of accessing the grid resources and services in seamless and uniform manner. The top most layer represents applications and portals carries various end-user applications e.g. collaborative software, scheduling and leaning software. Portals offer web-enabled application services by which users can interact with the grid-based distributed learning environment and use the capabilities of grid. Application level security is provided for the portals to enable users executing applications securely. As shown in Fig-1 users are able to use number of services. Following are the tools and services accessible for the users:

i) Groupware and Collaboration Tools: These typically utilize computer-communication capabilities and facilitate the sharing of data among all group members. Groupware services help people increase their productivity through collaboration and sharing of information. Collaborative learning brings the benefits to users of distance or co-locative learning via grid computers. Researchers or experts can perform their research irrespective of geographical location, interacting with other, accessing equipment, sharing of data and computing power and obtaining information from digital libraries with the help of these collaboration tools and services. Grid captures the new approach for users involving the distributed collaboration enabled by the internet and using the large scale computing & data resources and high performance visualizations. In the next section we will explore the collaboration services in more detail.

ii) Problem Solving Tools: Problem solving tools can be used by students, experts and researchers to solve complex problems and they can discuss their valuable ideas and knowledge with others. Problem solving tools are capable of utilizing the grid resources in efficient and effective way using the grid resource broker and its associated services. Using the grid technology complex problems can be analysed and solved in less time by incorporating the resources form multiple domains or institutes. We will explore problem solving environment in more detail along with collaboration environment in the next section.

iii) Online Assisted Teaching: Grid computing can be utilized to assist the teaching process in economic and efficient way. Students or learners can obtain teaching material from the remote servers administrative by multiple organizations or institutes. Teaching assistance can be provided in real time using whiteboards which are maintained by organizations. Using these whiteboards online classes are taken by subject experts and learners are able to get remote assistance without wasting their time for attending the class. The maintenance of whiteboards is done at the grid side not at the learner or experts side. The selection of resources for the teaching assistance is entirely done by the grid resource broker. The role of the grid resource broker will be discussed later in this section.

iv) Assessment Services (AS): It will be used to provide services such as conducting online test. The role of user in AS can be of student, tutor or researcher. Test Tool (TT) can be used for AS realization. TT is highly interactive assessment system developed in Kaunas University of Technology based on the graphical components [4]. Test application programs such as TT are used by students for giving test. Also the test questions are not stored in AS rather than discovered through metadata services and extracted from knowledge base repository services which are associated with grid data management

v) Personalization services (PS): It plays important role by personalizing the individual information means that the study materials of some special domain can be retrieved with low latency if someone interested in it by executing PS as a backend process. This could also change the static learning processes to efficient, personalized, distributed and dynamic learning processes. Depending on the requirement of users, the PS can be based on specific rules and indexing approaches [8].

vi) Publishing services: With the advent of internet and Grid information system, the scope of publishing can be expanded to include electronic resources such as e-books, e-journals, e-magazines etc. Digital library facilities can be provided efficiently and in most economic way by utilizing the capability of Grid. E-books and other electronics material can be maintained over resources maintained by multiple organizations. The grid data management component of grid maintains these type of resources in seamless manner and providing the uniform services for these resources.

v) Other information services: More information services such as teacher's orientation and training programs, event and news and so on can be provided using grid computing effectively.

B. Grid Environment

Grid Environment acts as a major back support for the effectiveness of distributed learning facility. It offers services such as information registration, resource discovery, resource scheduling, co-allocation of resources, security and quality of service e.g. resource reservation. Grid environment provides the accessibility of distributed resources in the heterogeneous environment maintained by multiple administrative domain. We describe the major components of grid environment briefly as follow:

i) Grid Service Broker: The grid resource and service broker is the core part of the any grid. It provides the facility to discover resources, scheduling of jobs, monitoring the jobs status with the help of its associated services. Also it has the power to select the best data repository from distributed learning locations. When request comes from the users for accessing the resources it is the duty of grid resource broker to matching and selecting the best resource form the available resources handled by different organizations and institutes.

ii) Grid Resource Management: It provides resource allocation, coordination during execution of jobs, job monitoring and gathering of result. Job manager are created for monitoring the execution of jobs. Job details are specified through the Resource Specification Language (RSL), which is a part of grid resource management. Resource management is a complex task in the grid involving fault tolerance, security along with the scheduling of jobs. Resources include computing power, storage capacity, software applications etc.

iii) Grid Information Services: This provides Monitoring and Discovery Services (MDS) for the resources. It gathers data about resource status and responds to queries. MDS is a LDAP based network directory. It consists of two components Grid Resource Information Service (GRIS) and Grid Index Information Service (GIIS). GRIS provides resource discovery services and responds to queries about the resource properties. GIIS provides a global view of the resources extracting information from other GRISs and GIISs that are registered with it

iv) Grid Data Management: It provides the facility for transmitting, storing and managing massive data sets of the distributed leaning applications. It is the duty of grid data management to keep the data over the scattered resources in heterogeneous environment effectively. Metadata and knowledge base repository services are provided by this grid data management. It consists of two elements: GridFTP and Replica Location and Management (RLM). GridFTP is an extended version to standard FTP protocol which provides effective, efficient, reliable and secure data movements in the grid environment. RLM supports multiple locations for the same data file distributed over the entire grid. A data file can be registered within the Replica Location Service (RLS) and its duplicates locations can be created and deleted in the grid.

v) GSI security layer: Grid Security Infrastructure (GSI) layer provides the facility for authentication of grid users and secure communication in the heterogeneous environment. It could be based on SSL (Secure socket layer), PKI (Public key infrastructure) and X.509 certificate architecture. GSI provides services in order to achieve the aims such as resource authentication through host certificates, authorization and data encryption etc.

III. COLLABORATIVE AND PROBLEM SOLVING PORTAL WITH GRID RESOURCES

In this section we specified collaborative and problem solving environment in order to describe the interaction between distributed learning and grid framework. Figure 2 depicts the collaborative and problem solving portal interfaces with grid resources. Institutes shown in figure may be educational institutes or research institutes. The integrated collections of resources of all the institutes involved in this grid are called grid resources such as computing resources (servers or clustered computers), data resources (database, teaching materials). For example institute 1 may contribute medical resources, institute 2 mathematics resources, institute 3 software resources and so on.

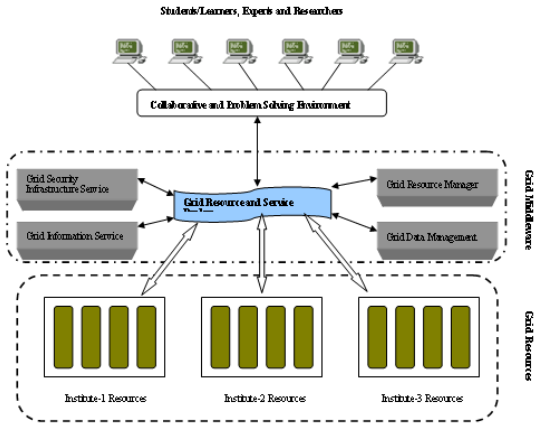

Fig.-2 Collaborative and Problem Solving Portal with Grid Resources

The grid resources are accessible for the users using the grid middleware. Grid middleware is the core element of any grid. Grid resource and service broker provides resource allocation, scheduling, monitoring and security using grid information services and grid security services. Information about grid resources or institutes resources is tracked by grid information services. Another main function performed is seamless and uniform access to institute resources in heterogenous and dynamic environment. Heterogeneity means resources managed by numerous administrative institutes. Dynamic environment means resources can be added or deleted at any time by the institute from the grid. So, grid middleware provides user access to institutes resources. The users such as students, learners, experts and researchers are able to use collaborative and problem solving portals. These are grid portals, which are extension to web portals providing facility to access the grid resources along with the access to a particular domain of interest. For example a grid portal may authenticate users, allow them to access remote resources and help them making decision about scheduling of jobs (problems) with the help of grid resource broker. With these portals students are able to access teaching material stored on the grid institutes, they can obtain expert opinion about some problems and also they are able to communicate with other remote students. Students and experts can communicate using e-mail, newsgroups and advance collaboration virtual environment. The advance collaboration virtual environment provides real time support using more advance tools in the grid. Similarly problem solving environment can provide support for solution to the complex problems. Complex problem from users can be executed on multiple resources managed by multiple institutes and solution can be generated with less time. The overall function related to scheduling of problem like selection of resources for a particular problem and to monitor the status of resources is done by grid resource and service broker using the grid information service. Single problem can be scheduled on multiple machines which are handled by numerous institutes, resulting the less time to solve the problem. The main advantage of grid computing is that institutes can use resources of other remote institutes.

IV. CONCLUSION

Grid based distributed learning presents a new approach for e-Learning systems. To overcome the limitations of scalability, availability, distribution of computing power and storage systems, as well as sharing of information between users that contribute to these systems, we proposed the use of grid technology as the scalable, flexible, coordinated and secure resource sharing among geographically distributed individuals and institutes, in the context of e-learning. By the use of grid based distributed learning framework we are able to use the functionalities and contribute in developing the large scale integrated e- learning system.

V. REFERENCES

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