

Computer Network and Computer Grid Joins to E-Learning

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Abstract

According to the development of communications and web-based technologies in recent years, e-Learning has become very important for everyone and is seen as one of the most dynamic teaching methods.

Grid computing is a pattern for increasing the computing power and storage capacity of a system and is based on hardware and software resources in a network with common purpose. In the present article grid architecture is shown and its different layers are described. This layer is heart of grid learning architecture and, in fact, regardless of this layer, e-Learning based on grid architecture will not be feasible.

Keywords: Grid computing, protocol, topology, different types.

Introduction

A computer network is the infrastructure that allows two or more computers (called hosts) to communicate with each other. The network achieves this by providing a set of rules for communication, called protocols, which should be observed by all participating hosts. The need for a protocol should be obvious: it allows different computers from different vendors and with different operating characteristics to 'speak the same language'.

Web-based learning tries to ease the process of teaching and learning. So all electronic tools and equipments are used to relate learner with environment. This model has benefits that can be rarely found in classic learning environments: such as interaction between learner and resources, independency from time and place, supervisory capability and continuous validation (Foster, Kesselman, and Tuecke, 2001).

On the other hand, according to increasing band-width and usage of multimedia, e-Learning is used widely in on-line classes.

Although there are many benefits of e-Learning, we can name some of its disadvantages as follows:

- 1) Difference between LMS (Learning Management System) and LCMS (Learning Content Management System).
- 2) Difference between standards and formats of creating electronic contents.
- 3) Difference between learner's and teacher's skills.
- 4) More attention to content and less attention to interaction and co-operation.

Considering that most of the current e-Learning systems are based on client-server or peer-to-peer model, they have some limitations: such as scalability, share ability, accessibility, availability, distributed computing and storage.

In this paper a new suitable architecture is introduced for e-Learning which is based on grid computing and Grid Learning Architecture is shown as well. Grid computing opens a new horizon to e-Learning. In other terms, e-Learning will:

- 1) use power of distributed computers in grid network to create virtual labs.
- 2) use distributed contents to create a completely customized class for learners.
- 3) make possible collaboration between education resources, contents and services within grid network (Hall, 2003).

Computer Network

A computer network is interconnection of various computer systems located at different places. In computer network two or more computers are linked together with a medium and data communication devices for the purpose of communication data and sharing resources. The computer that provides resources to other computers on a network is known as server. In the network the individual computers, which access shared network resources are known as nodes.

- Types of Networks. There are many different types of networks. However, from an end user's point of view there are two basic types:

- Local-Area Networks (LANs). The computers are geographically close each other (that is, in the same building).

- Wide-Area Networks (WANs). The computers are farther apart and are connected by telephone lines or radio waves. In addition to these types, the following characteristics are also used to categorize different types of networks.

- Topology. It is a geometric arrangement of a computer system. Common topologies include bus, star, and ring.

- Protocol. The protocol defines a common set of rules and signals that computers on the network use to communicate. One of the most popular protocols for LANs is called Ethernet. Another popular LAN protocol for PCs is the IBM token-ring network.

- Architecture. Networks can be broadly classified as using either peer-to-peer or client/server architecture. Computers on a network are sometimes called nodes. Computers and devices that allocate resources for a network are called servers (Ahmadi, and Denzel, 1999).

Local Area Network (LAN). LAN is a computer network that spans a relatively small area. Most LANs are confined to a single building or group of buildings. However, one LAN can be connected to other LANs over any distance via telephone lines and radio waves. A system of LANs which is connected in this way is called a wide-area network (WAN).

Each node (individual computer) in a LAN has its own CPU with which it executes programs, but it is also able to access data and devices anywhere on the LAN. This means that many users can share expensive devices, such as laser printers, as well as data. Users can also use the LAN to communicate with each other by sending e-mail or engaging in chat sessions.

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Wide Area Network (WAN). A WAN is a computer network that spans a relatively large geographical area. Typically, a WAN consists of two or more local-area networks (LANs). Computers connected to a wide-area network are often connected through public networks, such as the telephone system. They can also be connected through leased lines or satellites. The largest WAN in existence is the Internet.

Network Architecture. The term architecture can refer to either hardware or software, or a combination of hardware and software. The architecture of a system always defines its broad outlines, and may define precise mechanisms as well.

An open architecture allows the system to be connected easily to devices and programs made by other manufacturers. Open architectures use off-the-shelf components and conform to approved standards. A system with a closed architecture, on the other hand, is one whose design is proprietary, making it difficult to connect the system to other systems. As we have seen before, network architectures can be broadly classified as using either peer-to-peer or client/server architecture.

Important terms used in Networking.

(a) **Internet.** The newest type of network to be used within an organization is an internet or internet web. Such networks enable any types of computers (or network) to communicate easily. The hardware and software needs are the same as for the internet, specifically TCP/IP, server and browser software used for the World Wide Web. Because most organizations have a need for more dynamic ways to link people and information, the internet market is expanding day by day.

Moreover, there is no need to adjust the network when a new user joins in. With the help of Internet, all computers of an organization can work as stand-alone systems, connected to a mainframe, or a part of a LAN or WAN.

(b) **E-Mail.** E-mail stands for electronic mail. This is one of the most widely used features of Internet. Mails are regularly used today where without the help of postage stamp we can transfer mails anywhere in the world. With electronic mail the service is similar. But here data is transmitted through Internet and therefore within minutes the message reaches the destination anywhere in the world. Therefore the mailing system through e-mail is excessively fast and is being used widely for mail transfer.

© **Voice Messaging.** It is a new communication approach which is similar to electronic mail except that it is audio message rather than text messages that are processed. A sender speaks into a telephone rather than typing, giving the name of the recipient and the message. That sender's voice signal is then digitized and stored. Voice messaging requires a computer with an ability to store the audio messages in digital form and then convert them back in an audio form upon verification. Each user has a voice mailbox in secondary storage and special equipment converts the audio message to and from the digital form. The main advantage of voice mail over electronic mail is that the sender does not have to type. Voice mail also makes it easy to include people in the firm's environment in a communication network.

(d) **E-Commerce.** Electronic commerce or e-commerce refers to the paperless exchange of business information using Electronic Data Interchange, Electronic mail, Electronic Bulletin Boards, Electronic Fund Transfer and other network based technologies. Few organizations have recently started conducting EC over Internet, the network of networks. Internet has also helped EC to boost up because it is a low cost alternative to the proprietary networks. EC standards are however under development. Electronic Data Interchange (EDI) is still the dominant part of EC.

Information Technology has transformed the way people work. Electronic Commerce (EC) has unearthed yet another revolution which is changing the way business houses buy and sell products and services. EC is associated with buying and selling of products and services over computer communication networks (Black, 2005)..

(e) **Electronic Data Interchange (EDI).** EDI is the computer-to-computer exchange of business documents in a standard format. These formats look much like standard forms and are highly structured.

(f) **Teleconferencing.** It refers to electronic meetings that involve people who are at physically different sites. Telecommunication technology allows participants to interact with one another without travelling to the same location.

Grid Computing

Grid computing is a pattern for increasing the computing power and storage capacity of a system according to hardware and software resources in a network.

The name Grid is based on electric power distribution grids. In those networks, consumer does not know that his/her power is supplied from which specific power plant. The connection, itself, is more important (Adelsberger, Collis, & Pawlowski, 2002).

Grid Architecture. Grid architecture has a 5-layer basis.

1) **Fabric Layer:** It is the lowest layer in grid architecture. All shareable resources are placed in this layer: such as processors, memories, sensors and actuators.

2) **Connectivity Layer:** Protocols which are placed to communication and authentication are placed in this layer.

3) **Resource Layer:** All common actions related to network parts are guided in this layer: They include negotiation, initiation, monitoring, control, accounting and payment.

4) **Collective Layer:** Any Collaborative operations in the shareable resources are placed in this layer.

Web Services. Web services are methods for required software which we want to access in WWW easily: In fact, they prepare a platform for relationship between installed software and different hardware.

Web service standards are known as W3C. These standards are supported by software's based on XML, SOAP, WSDL and UDDI; therefore, good approaches for heterogeneous resources problem are implemented. Forming XML-based metadata is a useful solution for interacting with different data; because not only it makes management of those data possible, but also eases interchange of such information and data.

Web services are described by XML and some details are considered for interaction between various services: such as message format, transport protocol and position of every required resource.

You can see web services architecture in Fig. 1. This architecture has 3 layers which are built on XML and DTD.

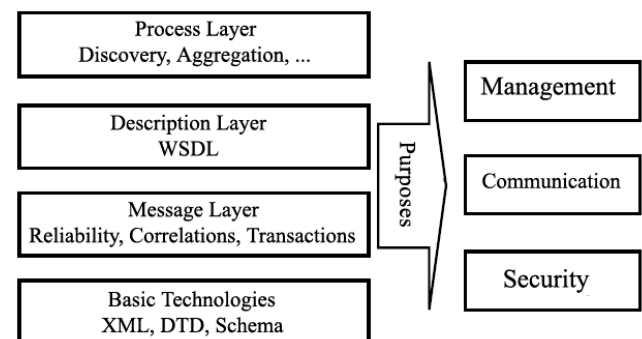


Figure. 1. Web services architecture and its purposes.

Three other layers are considered as purposes; such as management, security and communication via different services.

1) SOAP (Simple Object Access Protocol): This protocol is the lowest layer in web services architecture and is responsible for relation between consumer and provider of services. SOAP has a mechanism for sending and receiving messages and is compatible with STMP, FTP and HTTP protocol.

2) WSDL (Web Services Description Language): This language is the middle layer in architecture and describes web services; therefore, WSDL creates a framework for describing web services based on service protocols.

3) UDDI (Universal Description, Discovery and Integration): It is the highest layer in web services architecture. This layer has stored a standard description for services in itself. In other words, UDDI is a discovery service in WSDL layer to search a service properly.

Suggested Architecture for E-Learning Grid. According to grid network architecture, our suggested layered structure is shown in Fig.2.

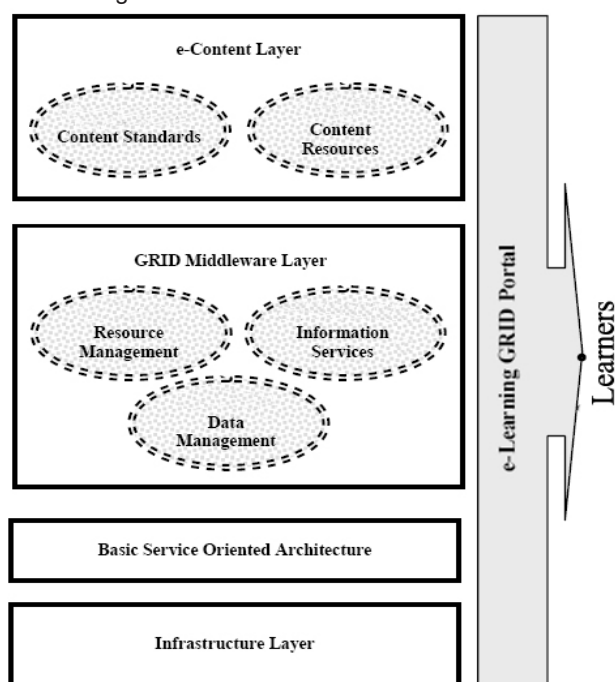


Figure. 2. Suggested Architecture for e-Learning Grid.

This architecture has 5 layers as shown below:

1) Infrastructure layer: This layer constructs network communication infrastructure and consists of computer equipments and network protocols.

2) Basic service oriented architecture: This layer contains all services related to protocols such as WSDL, SOAP, UDDI and XML; so flexible and reliable interaction with upper layers will occur.

3) Grid middleware layer: This layer is heart of the suggested architecture. E-Learning based on grid architecture will be feasible with this layer.

4) Content layer: This layer consists of all educational resources, which are placed in separated systems.

5) E-Learning grid protocol: This layer is an interface between learners and grid network.

E-Content Layer. This is the last layer in our suggested model and all learning contents are placed there. As we know, for containing and management of e-Contents we need a LCMS or Learning Content Management System. SCORM reference model (IMS Global Learning Consortium, Inc. 2002) indicates factors for validating e-Contents. This standard is concerned to 2 subjects: packaging contents and interchanging information with run-time environment.

According to SCORM standard, a content package consists of 3 parts.

1) Manifest: Part of e-Content that gives necessary information for that package.

a. Meta data: Identification information for introduction of e-Content: such as subject, author, multimedia type, etc.

b. Organization: Information that show structure of e-Content.

c. Resources: Part of the manifest that indicates resources in a tree structure.

b) Physical Files: All files which are used in creation of an electronic lesson.

c) Content Package Interchange File: Prepares a common infrastructure for interchange between packaging content and run-time environment.

E-Learning Grid Portal. In this architecture, grid portal is an interface between all learners and resources all over the learning grid; so all users after authentication (entering their user name and password) can access to related resource.

Learning Process Design in E-Learning

One of the most important problems facing e-Learning designers is the role of pedagogical requirements. Therefore, we should consider learner's activities in the process.

An important achievement in recent years is a framework called IMS-LD. This framework introduces a language for description of learning process which is known as learning Scenario. In short terms, we have to consider a suitable scenario for learning in grid. In this case, 2 factors are notable: IMS-LD and technologic approaches for implementation of the scenario.

Service Oriented Distributed E-Learning. Every Learning Management System (LMS) or Learning Content Management System (LCMS) has different capabilities and tools for users. Also, it may only use a text chat environment, not a video conference tool.

A Service is an entity in grid which has specific capability to do a job. As we mentioned before, service oriented architecture combines grid network with web services to reach a distributed frame work for learners.

Conclusion

Grid learning presents a new approach for e-Learning services. It is necessary to consider new technologies and architectures for grid networks. Consideration of standards and policy is notable too. According to geographical separation of grid networks, we should pay attention to user's behavior and pedagogical requirements. Finally, a suitable process for learning must be designed.

References:

Foster, I. C. Kesselman, and Tuecke, S. (2001) - "The Anatomy of the Grid Enabling Scalable Virtual Organizations," - International Journal - Of supercomputer Applications, Vol. 15, No.3,.

Hall, B. (2003) - "New Technology Definitions", -Retrieved August 5, from <http://www.brandonhall.com/public/glossary/index.htm>.

Ahmadi H., and Denzel W. E. (1999) - 'A Survey of Modern High-Performance Switching Techniques,' -IEEE Journal on Selected Areas in Communications, Vo. 7(7), pp. 1091-1103.

Black, U. (2005) Frame Relay Networks: Specification and Implementation, McGraw-Hill, NY.

Adelsberger H.H., , Collis, B. Pawlowski, J. (2002) , "Handbook on Information Technologies for Education and Training", Springer-Verlag, Berlin: Springer-Verlag.

IMS Global Learning Consortium, Inc. (2002) Draft Standard for Learning Object Metadata. IEEE Publication P1484.12.1/D6.4.