Grid Computing: Introduction and Overview

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Abstract **Grid Computing is an emerging computing model that provides the ability to perform higher throughput computing by taking advantage of many networked computers to model a virtual computer architecture that is able to distribute process execution across a parallel infrastructure. Grids use the resources of many separate computers connected by a network usually the Internet to solve large-scale computation problems. The paper discusses about Introduction to Grid computing and its overview. It addresses Grid computing architecture along with the components needed to form the architecture for computing, users and Applications**.

Keywords: Parallel infrastructure, Virtual computer architecture, Grids, Computational resources.

I. INTRODUCTION

According to Kleinrock in 1969 Grid computing is defined "We will probably see the spread of 'computer utilities', which, like present electric and telephone utilities, will service individual homes and offices across the country." According to Foster and Kesselman in 1998 Grid is defined as "a hardware and software infrastructure that provides dependable, consistent, pervasive, and inexpensive access to high-end computational facilities". Finally Foster in 2002 says that it Coordinates resources not subject to centralized control. Uses standard, open, general purpose protocols and interfaces. Deliver nontrivial qualities of service, for example response time, throughput, availability, security. Facilitates flexible, secure, coordinated large scale resource sharing among dynamic collections of individuals, institutions, and resource. Enable communities ("virtual organizations") to share geographically distributed resources as they pursue common goals. There were many definitions exist in early days.

In short, Grid computing can be defined as it is the collection of computer resources from multiple locations to reach a common goal. The grid can be thought of as a distributed system with non-interactive workloads that involve a large number of files.

The grid vision has been described as a container in which computational power is readily available as electrical power, water and other utilities which can be accessible to the users as and when they require. Grid computing will offer the computational services available to the users with different levels of expertise in diverse areas and in which services can interact to perform specified tasks efficiently and securely with minimum human interaction.

II. GRID COMPONENTS

The major components that are necessary to form a grid as are shown in the Figure (a).
The components are as follows:

• *User Level*
This layer houses the Application and High level Interfaces. Applications can be varied and encompass a vast variety of problems from chemistry to Nuclear Engineering. The high level interfaces implement an interface and protocols allowing the applications and users to access the middleware services.

• *Middleware Level*
The major functionalities of grid systems normally occur in this layer. This layer provides many services like Resource discovery, resource scheduling and allocation, fault tolerance, security mechanisms and load balancing. It should Provide the users a transparent view of the resources available.

• *Resource Level*
This layer typically provides local services that render computational resources like CPU cycles, storage, computers, Network infrastructure, software etc.

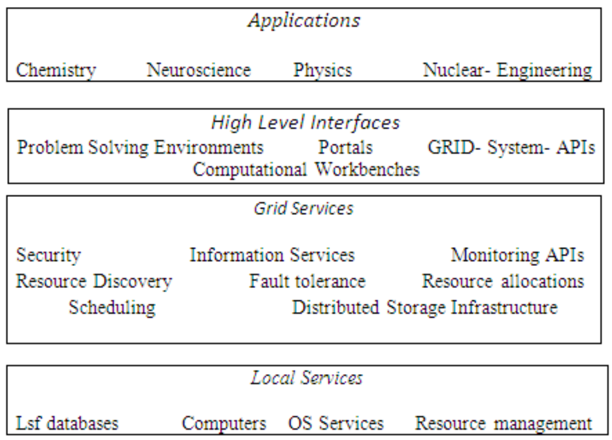

Figure (a): Grid Components

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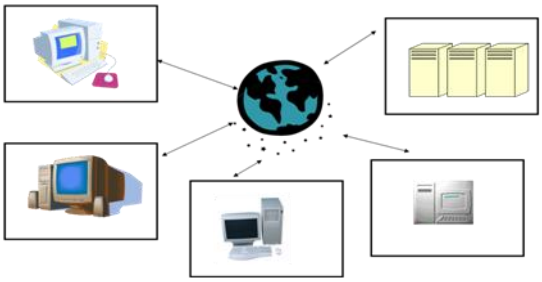
III. GRID ARCHITECTURE

A grid's architecture is often described in terms of "layers", where each layer has a specific function. The higher layers are generally user-centric, whereas lower layers are more hardware-centric, focused on computers and networks.

The lowest layer is the network, which connects grid resources. Above the network layer lies the resource layer: actual grid resources, such as computers, storage systems, electronic data catalogues, sensors and telescopes that are connected to the network.

The middleware layer provides the tools that enable the various elements (servers, storage, networks, etc.) to participate in a grid. The middleware layer is sometimes the "brains" behind a computing grid.



The highest layer of the structure is the application layer, which includes applications in science, engineering, business, finance and more, as well as portals and development toolkits to support the applications. This is the layer that grid users "see" and interact with. The application layer often includes the so-called service ware, which performs general management functions like tracking who is providing grid resources and who is using them.

IV.GRID COMPUTING APPLICATIONS

There are several grid computing systems, though most of them only fit part of the definition of a true grid computing system. Academic and research organization projects account for many of the systems currently in operation. These systems take advantage of unused computer processing power. The most accurate term for such a network is a shared computing system.

The Search for Extraterrestrial Intelligence *(SETI)* project is one of the earliest grid computing systems to gain popular attention. The mission of the SETI project is to analyze data gathered by radio telescopes in search of evidence for intelligent alien communications. There's far too much information for a single computer to analyze effectively. The SETI project created a program called SETI@home, which networks computers together to form a virtual supercomputer instead.

A similar program is the Folding@home project administered by the Pande Group, a nonprofit institution in Stanford University's chemistry department. The Pande Group is studying proteins. The research includes the way proteins take certain shapes, called folds, and how that relates to what proteins do. Scientists believe that protein "misfolding" could be the cause of diseases like Parkinson's or Alzheimer's. It's possible that by studying proteins, the Pande Group may discover new ways to treat or even cure these diseases.

There are dozens of similar active grid computing projects. Many of these projects aren't persistent, which means that once the respective project's goals are met, the system will dissolve. In some cases, a new, related project could take the place of the completed one.

While each of these projects has its own unique features, in general, the process of participation is the same. A user interested in participating downloads an application from the respective project's Web site. After installation, the application contacts the respective project's control node. The control node sends a chunk of data to the user's computer for analysis. The software analyzes the data, powered by untapped CPU resources. The project's software has a very low resource priority, if the user needs to activate a program that requires a lot of processing power; the project software shuts down temporarily. Once CPU usage returns to normal, the software begins analyzing data again.

Eventually, the user's computer will complete the requested data analysis. At that time, the project software sends the data back to the control node, which relays it to the proper database. Then the control node sends a new chunk of data to the user's computer, and the cycle repeats itself. If the project attracts enough users, it can complete ambitious goals in a relatively short time span.

As grid computing systems' sophistication increases, we'll see more organizations and corporations create versatile networks. There may even come a day when corporations internetwork with other companies. In that environment, computational problems that seem impossible now may be reduced to a project that lasts a few hours. We'll have to wait and see.

To learn more about grid computing and related topics, take a look at the links on the following page.

V WHO CAN USE GRID COMPUTING

Scientists use grid computing for their research. But what about you? And who else might be interested? Who wants to invest time and money in "resource sharing"?

1. *Governments and International Organisations?* Problems like disaster response, urban planning and economic modeling are traditionally assigned to national governments or coordinated by International Organisations like the United Nations or the World Bank. Imagine if these groups could apply the collective power of the nation's fastest computers and share their data archives more simply and effectively...

2. *The military?* It's a pretty safe bet that the military in many countries is already developing grid technology. The United States have traditionally used their most powerful computers for military applications. But this Virtual Organisation is unlikely to let other users access its grid!

3. *Teachers and educators?* Education involves students, teachers, mentors, parents and administrators and so is a very natural application of grid technologies. E-libraries and e-learning centers are already benefiting from grid-based tools for accessing distributed data and creating virtual classrooms with distributed students, resources and tutors.

4. *Businesses?* Global enterprises and large corporations have sites, data, people and resources distributed all over the world. Grids will allow such organisations to carry out large-scale modeling or computing by simultaneously using the resources at their many sites.

5. *What about ordinary people like me?* One of the most obvious applications is in medicine. Imagine if your doctor had access to a grid that could handle administrative databases, medical image archives and specialized instruments such as MRI machines, CAT scanners and cardioangiography devices... This could enhance diagnosis procedures, speed analysis of complex medical images, and enable life-critical applications such as telerobotic surgery and remote cardiac monitoring.

VI CONCLUSION

Grid computing makes computing resources, data facilities and other on-line services available to the users immediately. Grid computing involves cost saving, high speed computing facility and agility. The grid can store and manage the volumes of data related to the many large applications. Also accommodate the fluctuating data volumes that are typically in the seasonal business.

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