Lesson Proper for Week 16

Grid Computing

Since its beginnings, the concept of grid computing has grown in popularity, surpassing that of the Web itself. Not only has the notion found use in a variety of scientific endeavors (e.g., in medicine), but it is also being employed in a variety of commercial applications.

Additionally, grid computing is well-suited for resource-intensive tasks and enables scientists to collaborate in novel ways. Despite these advantages, several characteristics of grid computing have not yet been created, and certain downsides of grid computing are explored in this article.

What is Grid Computing?

Grid computing is a sort of data management and computer infrastructure that was initially developed to support scientific research but is now being used in a variety of commercial concepts, corporate research, entertainment, and lastly by governments from many countries.

Grid computing, at its most fundamental level, combines four components: information, computation, networking, and communication. When these components are joined to form a grid, a virtual platform enabling advanced data and computation management is created.

When this notion is applied to the above-mentioned domains (science, for example), it creates a platform for dynamically linking resources together, which are then used to enable the execution of programs that need a substantial amount of computer resources.

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"?

Governments and International Organizations?

Traditionally, issues such as disaster response, urban planning, and economic modeling have been delegated to national governments or coordinated through International Organizations such as the United Nations or the World Bank. Consider how these organizations may leverage the combined computing capacity of the nation's fastest computers to more easily and effectively share their data archives.

The military?

It's a fairly reasonable guess that many countries' militaries are already developing grid technologies. Historically, the United States has reserved its most powerful computers for military applications. However, it is highly improbable that this Virtual Organization will allow other users access to its grid!

Teachers and educators?

Education is a natural use of grid technologies because it involves students, instructors, mentors, parents, and administrators. Grid-based solutions for accessing distributed data and constructing virtual classrooms with distant students, resources, and instructors are already being used by e-libraries and e-learning centers.

Businesses?

Global firms and multinational corporations have locations, data, people, and resources spread across the globe. Grids will enable these businesses to conduct large-scale modeling and computing simultaneously across their numerous locations.

Grid Computing Applications

One of the most alluring uses of radio astronomy is the monitoring of radio transmissions in the context of Extraterrestrial Intelligence Searches (SETI). In the late 1950s, the first SETI project employed a radio astronomy dish. A few years later, the SETI Institute was founded as a privately funded institution to conduct more thorough searches utilizing numerous radio telescopes throughout the United States. The SETI Institute is presently constructing its array, using private finances but in close collaboration with radio astronomy engineers and researchers at numerous observatories and colleges.

The massive amount of computing power required for SETI radio signal processing resulted in the development of a novel grid computing paradigm that has now been used in a wide variety of applications. SETI@home is a scientific experiment in which computers linked to the Internet are used to download and analyze data from radio telescopes for the SETI program. A free computer software program pools the computing power of millions of home computers and works in the background, taking advantage of idle computer capacity. Over 5.2 million individuals have together clocked over 2 million years of computer time.

Grid computing is now being utilized in a variety of other fields, including biology, medicine, earth sciences, physics, astronomy, chemistry, and mathematics. BOINC is a free, open-source software project for volunteer computing and desktop grid computing. By utilizing the BOINC platform, users can distribute work among many grid computing projects, allocating a percentage of CPU time to each.

These initiatives have enormous humanitarian and economic implications. For instance, the malariacontrol.net project is a network-based tool that employs stochastic modeling to study the clinical epidemiology and natural history of Plasmodium falciparum malaria. Malaria control requires the use of simulation models of the transmission dynamics and health impacts of malaria. They can be used to find the most effective techniques for distributing mosquito nets, chemotherapy, or newly developed and tested vaccines.

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 lays the resource layer: actual grid resources, such as computers, storage systems, electronic data catalogs, 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.

Type of Grid

Grid computing can be used in a variety of ways to address various kinds of application requirements. Often, grids are categorized by the type of solutions that they best address. The three primary types of grids are

a. Computational Grid:

A computational grid is focused on setting aside resources specifically for computing power. In this type of grid, most of the machines are high-performance servers.

b. Scavenging Grid:

A scavenging grid is most commonly used with large numbers of desktop machines. Machines are scavenged for available CPU cycles and other resources. Owners of the desktop machines are usually given control over when their resources are available to participate in the grid.

c. Data Grid:

A data grid is responsible for housing and providing access to data across multiple organizations. Users are not concerned with where this data is located as long as they have access to the data. For example, you may have two universities doing life science research, each with unique data. A data grid would allow them to share their data, manage the data, and manage security issues such as who has access to what data. Another common distributed computing model that is often associated with or confused with Grid computing is peer-to-peer computing. Some consider this is another form of Grid computing.

Advantages

For improved product quality. By employing existing resources, grid computing helps protect IT investments, containing costs while providing more capacity.

[a] **Increased user productivity**

By ensuring that resources are accessible transparently, work can be accomplished more rapidly.

Users increase their productivity by devoting more time to design and development rather than wasting time seeking resources and manually scheduling and managing big numbers of jobs.

[a] **Scalability**

Grids can expand indefinitely, allowing for the integration of thousands of CPUs into a single cluster. Components can be updated independently of one another, and extra resources can be added as needed, resulting in significant one-time costs being avoided.

[a] **Flexibility**

Grid computing concentrates computing power where it is most required, enabling it to better meet the demands of constantly changing workloads. Grids can comprise heterogeneous compute nodes, allowing for the addition and removal of resources as needed.

Disadvantages

1. For memory-intensive programs that do not support MPI, you may be compelled to operate on a big SMP.

2. You may require a high-speed connection between computational resources (gigabit ethernet at a minimum). Infobahn is optimized for MPI-intensive applications.

3. Some programs may require modifications to fully utilize the new model.

4. Licensing across several servers may be too expensive for some applications. Vendors are becoming more adaptable to this environment.

5. Several areas currently benefit significantly from grid computing, including bioinformatics, cheminformatics, oil & gas, and financial applications.

6. As a result of the benefits outlined above, Grids will begin to see considerably greater adoption, which should benefit everyone involved. Education, I feel, is the primary impediment at the moment.

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