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Grid Developments and Deployment

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Abstract Grid computing is a term referring to the combination of computer resources from multiple administrative domains 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. What distinguishes grid computing from conventional high performance computing systems such as cluster computing is that grids tend to be more loosely coupled, heterogeneous, and geographically dispersed. Although a grid can be dedicated to a specialized application, it is more common that a single grid will be used for a variety of different purposes. Grids are often constructed with the aid of general-purpose grid software libraries known as middleware.

Grid size can vary by a considerable amount. Grids are a form of distributed computing whereby a "super virtual computer" is composed of many networked loosely coupled computers acting together to perform very large tasks. Furthermore, "distributed" or "grid" computing, in general, is a special type of parallel computing that relies on complete computers (with onboard CPUs, storage, power supplies, network interfaces, etc.) connected to a network (private, public or the Internet) by a conventional network interface, such as Ethernet. This is in contrast to the traditional notion of a supercomputer, which has many processors connected by a local high-speed computer bus.

Keywords Sulphurhexafluoride (SF_6 gas), particle movement.

Introduction

The growth of the Internet, along with the availability of powerful computers and high-speed networks as low-cost commodity components, is changing the way scientists and engineers do computing, and are also changing how society in general manages information and information services. These new technologies have enabled the clustering of a wide variety of geographically distributed resources, such as supercomputers, storage systems, data sources, instruments, and special devices and services, which can then be used as unified resources. Furthermore, they have enabled seamless access to and interaction among these distributed resources, services applications and data. The new paradigm that has evolved is popularly termed as "Grid" computing. Grid Computing and the utilization of the global Grid infrastructure have presented significant challenges at all levels including conceptual and implementation models, application formulation and development, programming systems, infrastructures and services, resource management, networking and security, and led to the development of a global research community.

Increased network bandwidth, more powerful computers, and the acceptance of the Internet have driven the on-going demand for new and better ways to compute. Commercial enterprises, academic institutions, and research organizations continue to take advantage of these advancements, and constantly seek new technologies and practices that enable them to seek new ways to conduct business. However, many challenges remain. Increasing pressure on development and research costs, faster time-to-market, greater throughput, and improved quality and innovation are always foremost in the minds of administrators - while computational needs are outpacing the ability of organizations to deploy sufficient resources to meet growing workload demands.

On top of these challenges is the need to handle dynamically changing workloads. The truth is, flexibility is key. In a world with rapidly changing markets, both research institutions and enterprises need to quickly provide compute power where it is needed most. Indeed, if systems could be dynamically created when they are needed, teams could harness these resources to increase innovation and better achieve their objectives.

Grid Computing– An Overview

Grid Computing delivers on the potential in the growth and abundance of network connected systems and bandwidth: computation, collaboration and communication over the Advanced Web. At the heart of Grid Computing is a computing infrastructure that provides dependable, consistent, pervasive and inexpensive access to computational capabilities. By pooling federated assets into a virtual system, a grid provides a single point of access to powerful distributed resources.

Researchers working to solve many of the most difficult scientific problems have long understood the potential of such shared distributed computing systems. Development teams focused on technical products, like semiconductors, are using Grid Computing to achieve higher throughput. Likewise, the business community is beginning to recognize the importance of distributed systems in applications such as data mining and economic modeling.

With a grid, networked resources -- desktops, servers, storage, databases, and even scientific instruments -- can be combined to deploy massive computing power wherever and whenever it is needed most. Users can find resources quickly, use them efficiently, and scale them seamlessly.

Grid computing combines computers from multiple administrative domains to reach a common goal, to solve a single task, and may then disappear just as quickly.

One of the main strategies of grid computing is to use middleware to divide and apportion pieces of a program among several computers, sometimes up to many thousands. Grid computing involves computation in a distributed fashion, which may also involve the aggregation of large-scale cluster computing-based systems.

The size of a grid may vary from small—confined to a network of computer workstations within a corporation, for example to large, public collaborations across many companies and networks. "The notion of a confined grid may also be known as an intra-nodes cooperation whilst the notion of a larger, wider grid may thus refer to inter-nodes cooperation".

Grids are a form of distributed computing whereby a “super virtual computer” is composed of many networked loosely coupled computers acting together to perform very large tasks. This technology has been applied to computationally intensive scientific, mathematical, and academic problems through volunteer computing, and it is used in commercial enterprises for such diverse applications as drug discovery, economic forecasting, seismic analysis, and back office data processing in support for e-commerce and Web services.

The Grid Concept

The term ‘grid’ is variously used to describe a number of different, but related, ideas, including utility computing concepts, grid technologies, and grid standards. In this paper the term ‘*Grid*’ is used in the widest sense to describe the ability to pool and share Information Technology (IT) resources in a global environment in a manner which achieves seamless, secure, transparent, simple access to a vast collection of many different types of hardware and software resources, (including compute nodes, software codes, data repositories, storage devices, graphics and terminal devices and instrumentation and equipment), through non-dedicated wide area networks, to deliver customized resources to specific applications.

At the most general level *Grid* is independent of any specific standard or technology. Any practical grid is realized through specific distributed computing technologies and standards that can support the necessary interoperability.

Today, there are no universally agreed grid standards, but there are freely available, open source and proprietary grid technologies that implement emerging standards recommendations. Separate web services standards are also emerging which have many grid-like capabilities. Indeed grids are already being built by integrating and enhancing web standards technology.

While the concept of a “computing utility” providing “continuous operation analogous to power and telephone” can be traced back to the 1960s and the Multics Project [1], the origins of the current Grid revolution can be traced to the 1980's and early 1990's and the tremendous amounts of research being done on parallel programming and distributed systems. Parallel computers is a variety of architectures had become commercially available, and networking hardware and software were becoming more widely deployed. To effectively program thee new parallel machines, a long list of parallel programming languages and tools were being developed evaluated [2]. This list included Linda, Concurrent Prolog, BSP, Occam, Programming Composition Notion, Fortan-D, and Compositional C++, pC++, Mentat, Nexus, Lightweight threads, and the Parallel Virtual Machine, to name just a few.

"*The Metacomputer is similar to an electricity grid.*
When you turn on your light, you don't care where the
power comes from; you just want the light to come on.
The same is true for computer users. They want their
job to run on the best possible machine and they really
Don't care how that gets done."

The trials and tribulations of such as arduous demonstration paid-off since it crystallized for a much broader segment of the scientific community, what was possible and what needed to be done [3]. In early 1996, the Globus Project officially got under way after being proposed to ARPA in November 1994. The process and communication middleware system called *Nexus* [4] was originally built by Argonne National Laboratory to essentially to be a compiler target and provide remote service requests across heterogeneous machines for application codes written in a higher-level language. The goal of the Globus Project was to build a global Nexus that would provide support for resource discovery, resource composition, data access, and authentication etc. The first Globus applications were demonstrated at Supercomputing.

"(Our vision) is the integration of many computational,
Visualization and information resources into a coherent
infrastructure… We refer to the integrated resources
As the 'Power Grid' or simply the Grid".

Making Grids A Reality

While Grids have come a very long want from the efforts of several labs trying to address thomy, fundamental issues in distributed computing by building research prototypes, Grids still have a very long way to go before they are a practical, widely deployed reality. At the current time, several basic Grid tools are stabilizing and many Grid projects, including some very well funded international projects, are deploying sizeable Grids. However, one can argue that Grids will not be a practical reality until (1) there is a core set of Grid services, with (2) sufficient reliability, that are (3) widely deployed enough to be usable. This is the current challenge for making Grids a reality. This issue is how to make this happen.

(A) Expanding the Scale and Scope of Deployment

A number of very large Grid projects are currently underway. Examples include the EU DataGrid project, the NSF TeraGrid project, and the Japanese NaReGi project. Many other smaller projects are currently underway, too, involving just a few institutions in a specific application domain. There are also a number of Grid-like Commercial products for cycle harvesting, distributed scheduling, etc. Hence, tools must be simpler for reliable deployment and use by non-specialists.

(B) Standards- The Web/Grid Convergence

A key to defining exactly what the core Grid services are and facilitating their easy deployment on all scales in standards. To this end, the Global Grid Forum defined the Open Grid Services Architecture (OGSA) extending the Web Services (to Support transient and stateful behaviors) and combined them with Grid protocols to define the Open Grid Service Infrastructure (OGSI), providing a uniform architecture for building and managing Grids and Grid applications.

(C) *Non-Technical Barriers to Acceptance*

Besides the technical issues concerning Grid adoption mentioned above, there are clearly many non-technical or cultural barriers as well. Grid computing in many ways, is about resource sharing while the "corporate culture" of many organization may be fundamentally oppose to this. Some Organizational units may jealously guard their machines or data out of a perceived economic or security threat.

Grid Developments and Deployment

A key issue facing the industry is the timing and mode of deployment of *Grid* technology to ensure that it is sufficiently mature to deliver the expected business benefits. There is emerging evidence that the technology can achieve significant operational benefits (e.g. in telemedicine), improvements in performance (e.g. in climate modeling and genomics) and a significant reduction in costs. Nevertheless, current grid technologies are not yet viewed as sufficiently mature for industry scale use, and remain largely unproven in terms of security, reliability, scalability, and performance.

Short Term

For the short term (within the next two years), *Grid* is most likely to be introduced into large organizations as internal 'Enterprise grids', i.e. built behind firewalls and used within a limited trust domain, perhaps with controlled links to external grids. A good analogy would be the adoption into business of the Internet, where the first step was often the roll out of a secure internal company 'Intranet', with a gradual extension of capabilities (and hence opportunity for misuse) towards fully ubiquitous Internet access. Centralized management is expected to be the only way to guarantee qualities of service. Typically users of this early technology will be expecting to achieve IT cost reduction, increased efficiency, some innovation and flexibility in business processes. At the same time the distinction between web services and grid services is expected to disappear, with the capabilities of one merging into the other and the interoperability between the two standards being taken for granted.

Medium Term

In the midterm (say a five year timeframe) expect to see wider adoption - largely for resource virtualization and mass access. The technology will be particularly appropriate for applications that utilize broadband and mobile/air interfaces, such as on-line gaming, 'visualization-on-demand' and applied industrial research. The emphasis will move from use within a single organization to use across organizational domains and within Virtual Organizations, requiring issues such as ownership, management and accounting to be handled within trusted partnerships. There will be a shift in value from provision of computer power to provision of information and knowledge. At the same time open standards based tooling for building service oriented applications are likely to emerge and *Grid* technology will start to be incorporated into off-the-shelf' products. This will lead to standard consumer access to virtualized compute and data resources, enabling a whole new range of consumer services to be delivered.

Long Term

In the longer term, *Grid* is likely to become a prerequisite for business success - central to business processes, new types of service, and a central component of product development and customer solutions. A key business change will be the establishment of trusted service providers, probably acting on a global scale and disrupting the current supply chains and regulatory environments.

Refernces

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