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Grid Technology and its Strategic Adoption in Various Industries

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ABSTRACT

Grid computing has emerged as one of the innovative technology in the field of information Technology. The tremendous benefit of Grid computing technologies has procured the interest of various the industries to adopt it but still the adoption this technology is at nascent stage. Much of research is being carried out to make this technology more viable according the requirements of various industries.

This research paper endow with analytical view of research initiatives which brings this technology to be used in various industries, the adoption of grid enterprise grid in various industries i.e Oil and Gas , Electronic , Financial, Manufacturing, Life sciences and Government. The research also has highlighted the trends towards the strategic adoption of Grid technology according to classification of industry. The analysis on Grid technology and its adoption in various industries has been derived from multiple sources of information, i.e research journal, grid technology website and

This paper is organized in five sections, first Section has provided the introduction to grid technology, second section has highlighted the Grid computational services, third Section has described the capabilities of grid technology, fourth section has discussed the adoption of Grid technology in various industries and section five is conclusion.

Keywords: *Grid computing, Grid computing services, Grid capabilities.*

1. INTRODUCTION

Currently, commercial enterprise has taken keen interest in the field of Grid computing. They are beginning to focus on the use of grid computing in the business industry, keeping in view the tremendous benefits of Grid computing. An enterprise Grid provides an economy of scale access to one common High Power computing service for all the departments. It is one of several mechanisms where the industry can exploit the use of connected networked resource i.e computers, sensors and data repositories. The Grid provides an infrastructure that tightly integrates computational resources i.e storage devices, software, databases, specialized instruments from widespread locations under different management authorities. It is another paradigm from the existing Internet that provides inexpensive and constant access to vast portions of shared information to the next generation in a secure and effective manner. Grid computing provides a infrastructure to the companies that facilitates them to run an application, acting as a single machine. The grid infrastructure can help companies in reducing the cost of hardware by utilizing compute power of many machines without adding new CPUs (Schopf, 2003). Grid computing is essentially a set of computing resources shared over a network and it differ from more traditional distributed systems in the way resources are utilized on large-scale resource sharing and high-performance orientation The grid could be productive and meaningful when it comprises a large set of resources and as well serves a sizable community. This research has reviewed the development of grid technology by using secondary source of information derived from research journals and website of grid computing.

2. GRID COMPUTATIONAL SERVICES

2.1 Grid Computational Services

The computational service includes the services offered by the processors on the Grid. This type of service is related with providing secure services for executing application jobs on distributed computational resources, individually or collectively.

2.2 Grid Data services

When datasets are carried out using computational Grid services and such a combination is commonly called data Grids. The data grid provides secure access to distributed datasets and their management. It also provides scalable storage and access to the data sets. The datasets are replicated, catalogued, and stored in different locations to create an illusion of mass storage.

2.3 Grid Application Services

In the Application services, the grid infrastructure facilitates the user to access remote Software applications transparently. The emerging Web services technologies are projected to play a leading role in defining application services. These web technologies have been developed on computational and data services provided by the Grid. In this context, NetSolve service is one of the example that can be used to develop such services.

2.4 Grid Information Services

The information service of the Grid computing provides the information about the Grid resources available in the Grid. The grid infrastructure facilitates the user in extradition and presentation of data by using computational data services or application services. It provides the details about the ways that information is represented stored, accessed, shared and maintained.

2.5 Grid Knowledge services

The knowledge service of Grid computing provides the knowledge that can be retrieved, published and used to help users in achieving their particular goals and objectives. The Knowledge is understood as information that can be applied to achieve a goal, solve a problem or execute a decision. The data mining services can help in building a new knowledge (Buyya, 2005).

2.6 A view of Simple Grid Computing

The simple grid structure below shows the four layers of grid computing. The first layer contains grid user and grid administrators, second layer contains grid management and organization, third layer contains CPU resources, storage resources, data resources and fourth layer contains grid data sharing mechanism.

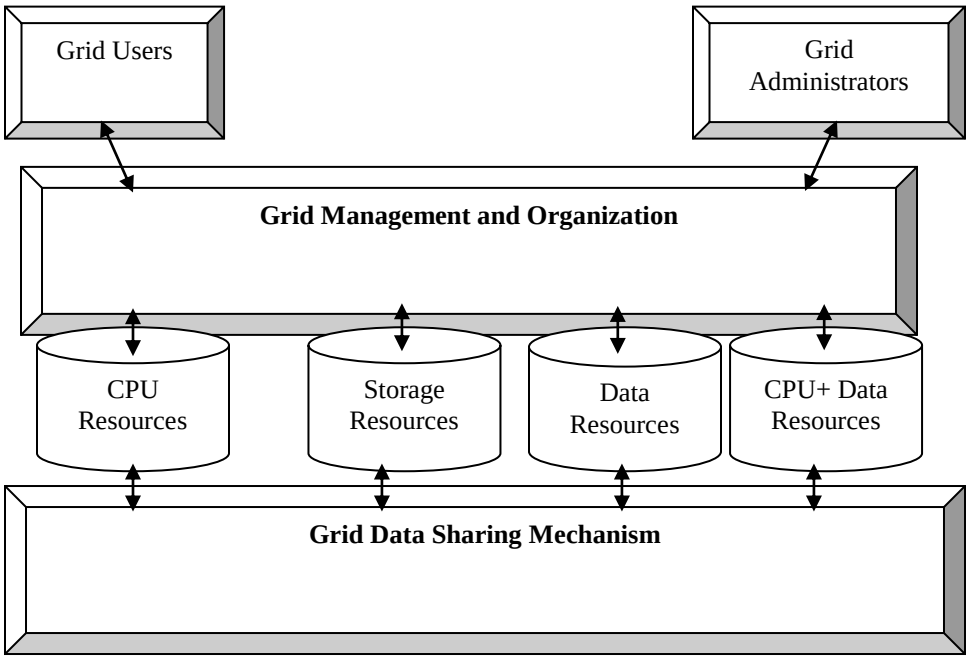


Fig. 1. shows the physical structure of simple Grid
(Source: Buyya, Venugopal, 2005)

3. GRID COMPUTING CAPABILITIES

There are remarkable capabilities of Grid computing. The industry wide adoption of the Grid computing is one of the evidence that this new innovative technology can be used for performing high end capabilities in the scientific and commercial field. The major capabilities of Grid computing are described follow;

3.1 Harnessing Underutilized Resources

Grid computing provides the capability of running existing application on any idle machine on the Grid. In the enterprises, most of computers remain busy only 5% of the time of processor. In order to utilities 95% of time of processor, Grid provides framework to effectively utilize the idle resources of the organization. In case of peak load hours, if existing machine is busy then the same application can be executed on other desktop machine available on the Grid, provided that remote machine must meet hardware and software requirement imposed by the application. Similarly, the data Grid also possesses the capability to aggregate unused storage resources into much larger virtual data storage. This enhances the performance and reliability over any single machine.

3.2 Parallel CPU Capacity

Grid computing has the potential of developing a massive parallel CPU capacity. Grid computing provides the capability to use power of all CPUs available on the Grid to execute given task by the Grid user. The usage of massive capacity of computing power has been very productive in the industries such as bio-medical, financial, modeling and oil exploration etc. The CPU intensive Grid applications split job into many smaller jobs and each part can be executed on separate machine on the Grid. This execution mechanism enhances the scalability of Grid. A scalable application can finish job 10 times faster than if it uses the number of processor 10 times.

3.3 Grid computing Application

The Grid computing is consisting of Grid enabled applications which are being used to execute the jobs on the Grid. Because all the applications cannot run on the Grid is no any tool which may enable common application to use. But there are some practical tools that skilled application designer can use to write a parallel Grid applications.

3.4 Virtualization of Resources

The virtualization of the resources available on the Grid is one of the important capabilities of Grid Computing. It provides important standards that make capable heterogeneous system to form the image of large virtual computing system. Data can be shared in the Form of files and databases. In this respect Data Grid can expand data capabilities in various ways. First Data Grid can seamlessly span files and databases on many systems. Second Data can be duplicated on the Grid to serve as a backup on host or nearest machine which is in need of required data. Grid computing virtualizes these resources to provide uniform inter-operability among heterogeneous Grid participants.

3.5 Access to Additional Resources.

Grid computing possesses the capability to provide access to additional resources other than CPU and storage available on the Grid i.e special equipment or increasing the internet bandwidth. If any user needs to increase the Internet bandwidth to implement data mining search engine, the task can be split among Grid machines connected to internet. And in this way the searching capability is increased by multiplying the capability of each connected machine**.** Grid computing is also provides the capability to access special devices on the Grid, i,e remote printers, or high speed self-feeding DVD writer, remote medical diagnostic and robotic surgery tools with two way interaction from a distance. The access to all type resources, no matter where it is located, is making grid gird computing like a large virtual machine with the collection of multiple resource.

3.6 Resource Balancing

Grid computing has the capability to provide resource balancing specially at the peak load times. As we discussed earlier that Grid federates a large number of resources as a greater total virtualized resources. The Grid can provide resource balancing effectively by routing the job execution on the low utilized machines on the Grid. There are two ways of resource balancing on the Grid. The First is n unexpected peak load be routed to relatively idle machines on the Grid. If the Grid is already busy, the lowest priority work is temporarily suspended and higher priority work is being given the room for execution first and the lowest priority work is executed later. Such a like balancing of tasks execution is impossible without having Grid infrastructure. Another form of Resource balancing is that, when jobs communicate with each other on storage resources, the advance scheduler plays the role to minimize the communication traffic. Grid also provides

excellent infra-structure for broker resources. Individual resources can be profiled to determine their availability and capacity.

3.7 Reliability

In the high end conventional computing systems, the reliability is achieved by using expensive hardware but in the Grid computing, the reliability lies on hardware and software. The Grid provides the reliability at geographically dispersed location with inexpensive systems. For instance the power failure at one location does not affect the operation of other part of the Grid computing. In this respect Grid Management automatically detected the failure and distributed jobs to other machines on the Grid.

3.8 Management of Virtualized Resources

Management of heterogeneous and dispersed located resources is one of the most complex tasks. Grid computing provides the infrastructure that makes it easier for Information technology department to reduce the expenditure of computing resources over a larger organization. The Grid management prioritize projects in the manner that the completion of one project does not effect on the result of other project. The grid administrators can change any policy that is expected to affect the utilization of data over larger set of projects (Buyya & Venugopal, 2005).

4. GRID APPLICATIONS IN VARIOUS INDUSTRIES

Keeping in view the strategic advantages of Grid computing technology, the following trends are predicted of its adoption in the business industry. The Platform computing software solutions is the largest distributed and grid computing software vendor continuously strengthening its global leadership position in enterprise grid computing. Shanghai Supercomputer Center has adopted grid technology which is recently ranked as the 17th most powerful computer system in the world

4.1 Grid computing in Oil and Gas Industry

The Oil and Gas industry is dependent on rapid access to critical information for their effective and efficient operation. The challenge is to bring product to market without increasing total cost of operations. For instance seismic analyses and reservoir simulations can consume days or weeks of valuable time. By distributing many of these applications to dozens or hundreds of nodes in enterprise grid cluster, the run-times are highly reduced. Geologists and engineers can access valuable data in hours rather than days.

4.2 Grid computing in Electronics

Grid Platform offers end-to-end enterprise grid solutions for the Electronics industry. It provides the functionality that gives the ability to accelerate the design and testing system of new compute-intensive designs. Similarly, the grid platform has helped hyper-competitive Electronics sector to reduce its margin of error in designing process. Furthermore it provides industry an agility to accelerate product development process and manage IT assets more intelligently to yield a higher quality of results.

4.3 Grid computing in Financial Industry

Currently, financial industry is keenly inclined to adopt grid technology in their business operations. Amidst the intensive competitions in the financial marker, financial services firms are under increasing pressure under growing need for enterprise risk management. At the same time customers are compelled to shrink their total cost of ownership of resources and become more agile and adaptive to changing demand of business environment. The adoption of grid platform can provide a virtual pool of resources where the multiple user can share compute resources – hardware and software licenses to adjust firm's needs. The grid infrastructure provides hardware architectures and high-speed interconnect technologies that economically and reliably deliver supercomputer performance to the applications with almost immediate payback.

4.4 Grid Computing in Manufacturing Industry

Manufacturing industry always coping with increasing competition in product quality for their business success. Grid computing platform is providing the manufacturing industry is in dire need of making design cycle a faster and cheaper for their production process. For example the IT managers of Aerospace and Automotive industries are forced to focus on the need of superior design, improved quality and shorter time to market with low IT utilization and over-provisioned hardware and software licenses. The grid platform provides solutions **to** maximize the utilization of costly IT assets while improving workload throughput for better testing, faster model development cycles and superior products.

4.5 Grid in Government industry

Platform's enterprise grid provides a breadth of functionality to solve the complex and grand challenges problem faced by the government industry. It has provided a capability to run more analyses, simulation

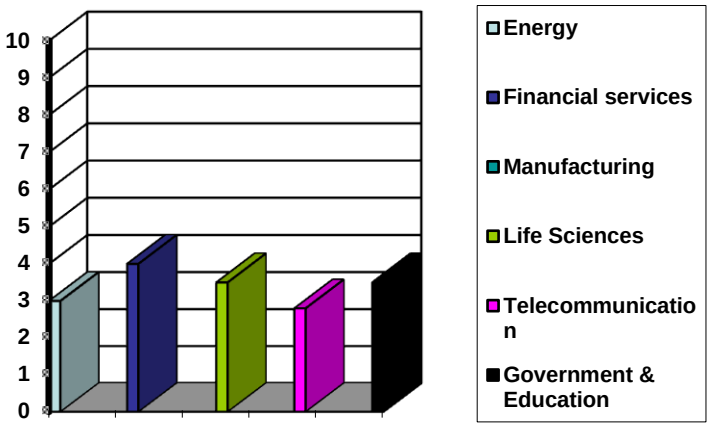
and testing so as to conduct a greater volume of computations with improved resource utilization.

4.6 Grid in Life Sciences

Platform Grid provides a best-in-class suite of integrated solution to the Life Sciences indus-try. Platform grid software provides functionality that help to shorten the drug development cycle. It streamline and replicate processes and reducing physical lab testing. It also help to optimize existing IT resources, improve resource utilization and reduce the cost of ownership for overall increased competitive advantage (Gentzsch, 2005).

Table 1: Application of Grid computing Technology in various Industries and its Benefits.

Industry	*Grid Benefit*	*Application Area*
Life Sciences	Less investment of high computer and faster discovery	Molecular modeling, computational chemistry and protein folding
Geo Sciences	Enhanced decision Support	Reservoir modeling and material sciences analysis
Financial Services	Higher quality decision making	Risk assessment liability, maket strategy analysis
Government	Market-leading security and reliability for max uptime	Bio defense and drug discovery, pattern recognition and decryption
Industrial Engineering	Running simulations and modeling faster and to more precision	CAD, computational fluid dynamics, and element analysis.
Multimedia	Processing scalability and support for a wide range of applications	Digital rendering, image processing and content compression/decoding
Chemical and Materials science	Improved precision and quality of output and increased ROI on existing machines	Quantum mechanics, polymer science and crystallization and formulation design.



Graph1

The above graph shows the adoption levels of Grid Technology in various industries, where each industry is identified with different color. The energy sector industry is shown in purple color, financial service industry is shown in blue color, Life sciences industry is shown in green color, telecommunication industry is shown in pink color and government and education.

5. CONCLUSION

From the above discussions related to adoption of grid technology in various industries, it is analyzed that grid technology is the future IT infrastructure for the business enterprises in the competitive environment. With reference to the case study of Platform grid solution, we have also analyzed that how enterprise grid can bring the potential benefits in respect to each different industry's business operation.

In the strategic adoption of the enterprise grid , the given static has showed that 5000 organization have been using grid computing technology since last 10 years and this trend is growing gradually to the extant that 9% of the organizations are expected to deploy grid technology in near future. The information given in the table has also clearly indicated the application of grid computing technology in the various industries along with benefits obtained by the organizations.

In life Sciences industry grid computing technology provides faster discovery with the less investment. In Geosciences, it has enhanced decision support; in financial sector, it has provided the higher quality of

decision making. It has provided the government sector a marketing leading security and reliability for maximum up time. It has provided industrial engineering, a running simulation and faster modeling. In multimedia, it has provided processing scalability and support for wide range of applications and in chemical and material sciences, it has improved precision and quality of output.

Keeping in view the tremendous benefits of the Grid technology, it can be rightly predicted that the application of this technology in business enterprise or in government sector can minimized the cost of business operation by utilizing IT resources properly in an more efficient and effective manner.

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