International Journal of Computer and Communication Technology

Volume 4 | Issue 3 Article 5

July 2013

Modifying Modern Power Systems Quality by Integrating Grid Computing Technology

deepshikha verma
Fairleigh Dickinson University, deepshikha@gmail.com

Pawan Dahiya
Electronics & Communication, Bhagat Phool Singh Mahila Vishwavidyalaya, Sonipat, Haryana, pawandahia@gmail.com

Available online at www.interscience.in

Modifying Modern Power Systems Quality by Integrating Grid Computing Technology

[1]Deepshikha Verma & [2]Pawan Dahiya
[1] IT, JIMS, Delhi, [2] Electronics & Communication, Bhagat Phool Singh Mahila Vishwavidyalaya, Sonipat, Haryana

Abstract - The need for reliable, powerful, and clean power generation in power systems is becoming more importance. This need requires geographically-distributed power systems to be integrated as a single entity where among the main features of this integration are large data base and computing intensive. Hence the current power systems are not able to handle this huge datasets required for that integration, Grid Computing is a gateway to virtual storage media and processing power. This paper describes the research work on why grid computing is needed for power systems, what are the major challenges and problem to implement grid computing into power systems, and how grid computing can be utilized to fulfil the requirement for efficient power generation.

1. INTRODUCTION

Modern power systems and electrical energy applications are demanding more and more computational power, which cannot be achieved by the existing computing technology or computers. In order to meet these computational challenges, it is necessary to have a standardized means of connecting disparate resources over high speed networks to build high power virtual supercomputers [4] and the methodology to compute these computational processes with efficient and high quality of services. Computational power refers to processor processing speed, data storage capacity and network performance. Modern electrical grids are computer enabled power networks that provide efficient and smooth management, monitoring and information exchange of distributed power networks with diverse widespread resources of power generation [5]. The electrical grid will be transformed from central generation down to collaborative networks that will incorporate customer appliances and equipment and modern information devices in the distribution. The future electrical grids will consist of large small-scale generation units of renewable energy sources and other disparate energy sources. Highly scalable and decentralized integrated communication, computing and power networks will be necessary to monitor these smart grids of the future [3].

2. GRID COMPUTING

Grid computing is a powerful and efficient computational technology which represented as an advanced step for the previous distributing computing. Along with the high network communication speed and high technical specified machines (PC, Desktops, super computers...) distributed computing still suffering from some limitations because of the way and the percentage of using these resources (power gaining)[6,7]. Grid computing as a new computing generation that uses the resources of many separated computers connected by a network for solving such massive computation problems by making use of the underutilized resources or grid shared resources. Grid computing shares the heterogeneous resources (based on different platforms (operating systems), hardware/software architectures, and computer languages, located in different locations depending on Grid systems architecture using open standards and protocols [8]. Grid computing is solving such large scale of problems which could not be solved within the traditional computing methods due to the limited memory, or computing power. Grid system required a high speed network working under specific or specialized software called grid middleware [6,7,9], which allows the distributed resources to work together in a relatively smooth and transparent manner. Using or getting benefit from idle computer's lost power make Grid distributed computing work much faster with high accuracy, lead to more progress and increase development curve.

3. GC AND ELECTRICAL ENERGY ENGINEERING

Grid Computing is now seen as a powerful and important tool for the electrical engineering applications. These days the power system operation and control involves large data intensive, time-intensive applications. Therefore it can get a better solution by using this new technology. Also the power system is moving towards the renewable energy sources. In this case it helps them in providing cheap and efficient electrical energy supply. The demand for conservation of the current conventional energy has been increased due to the growing concern on the deteriorating condition of our environment. [1] The control and operations of modern power systems are becoming data-intensive, information-intensive, communication-intensive and computation-intensive due to much of the reliance of these power systems on computerized communications and control. [11] Therefore, since Grid Computing is considered as an inexpensive means for "super-computing" for dealing with heterogeneous and distributed computing [7], Grid Computing is the best option in providing the necessary storage media for the huge data, intensive computational processes and also the required computing resources. In the same time electrical energy engineering is looking to the future vision of electrical power systems which has to be more stable, more accurate power load and market forecasting, better power generation scheduling, and real time weather forecasting. All these parameters are playing the major role in shaping current and future electrical energy and the best way for engineering them. On the other hand time, cost and reliability are considered as the key control for all mentioned parameters. Therefore, GC technology comes as a best solution which offering secured, high capacity and capability within cheap ways to integrate it with electrical energy application.

4. MODERN POWER SYSTEMS

It is estimated that by 2050, the world's electrical energy needs will be somewhere between 30 and 60 Terra Watts (TW) of electric power from the current 12 TW [12]. This kind of electric energy will require efficient and secure distributed, storage, transmission modern grid technologies in order to be delivered globally within high quality. GC technology will be necessary to provide a computational infrastructure to solve the diverse computational problems involved in future envisioned electrical grid operation. Traditional monitoring and control that is employed in the current electrical grids is highly centralized and not scalable enough to include new highly scaled, distributed and embedded renewable energy sources [3]. Monitoring and control of the future power systems will be both highly scalable and universally adoptable because of its distributed nature and use of open standards. The application of GC helps to solve problems that may be too large for the single supercomputer but at the same time retains the flexibility to work on distributed smaller problems [13]. Application of suitable Information Technologies such as GC will enable active and collaborative participation of consumers, utilities and third parties in energy markets. This will help to stabilize the prices and to be a key for shaping future power market [13]. Two instances of massive power failures have highlighted the need and the urgency to develop enveloping, intelligent and reliable smart or modern electrical grids in order to manage with the ever increasing energy demands. The 2003 large scale power failure in North America that affected many parts of US and Canada is one instance. The other more recent power failure occurred in early November, 2006 and affected many parts of Germany, France and Belgium. National or regional modern grid implementations, will allow power utilities to virtually upgrade power lines, substations and other electrical transmission equipment without huge expensive physical replacements [14]. Distributed monitoring and control of the small-scale generation units will virtually eliminate national power failures. Implementation of modern electrical grid into grid computing will achieve many benefits scaling from enhancement energy security and stability through the incorporation of automatic system reconfiguration in response to disruptions, reduction of computational costs through utilization of networked computer resources which owned and operated by others (less power consuming, less cost for buying machines, and less maintaining costs …), using the clean and renewable energy sources will reduce environmental pollution. Active customer participation enables energy conservation. Pilot projects indicate that fewer power stations would be needed than is the case now if the whole grid went intelligent or smart [3]. Future electrical grids will thus effectively reduce gas emissions and help in reducing effects of global warming and environmental degradation, some of the biggest challenges facing humanity in modern times, increased integration of distributed generation which leads to reduced forced outages and reduction in blackout probability, and reduction of a single point of failure / vulnerability due to the distributed network based electric system.

5. WHY GRID COMPUTING

The development of GC is also motivated by the possible benefits that can be gained by using GC within any organisation [17]. To get the reasons why GC is needed, some GC characteristics and benefits are followed:

a) Utilising Underutilised Resources In most organisations, many computing resources are idle and underutilised at most of the times. For example, most desktop computers are idle more than 95% of their time [17]. Realising that these idle times are being wasted and not profitable to the organisation, GC provide the solution for exploiting underutilised resources. In addition to processing resources, it is often that computing resources have also large amount of unused storage capacity. And Grid Computing allows these unused capacities to be considered as a single virtual storage media where the need of huge storage capacity within a particular application is resolved. Thus, the performance of this application is improved if compared running this application over a single computer.

b) Parallel CPU Capacity The possibility of applying massive parallel CPU activity within an application is one of the main exciting features of GC. While the need for parallel CPU activity may initially pertaining to scientific purposes, this need is now being extended to different fields such as financial modelling, oil exploration and motion picture animation, causing revolutionary working methodology in these fields. Though this idea of parallel CPU activity is chillingly attractive to be implemented, many barriers that exist within GC infrastructure have to be overcome before a perfect parallel CPU utilization can be realised.

c) Resource Balancing GC groups multiple heterogeneous resources into a single virtual resource. Furthermore, the grid also facilitates in balancing these resources depending on the requirements of the tasks. As a result, appropriate resources are selected based on the time of execution and the priority of each task. In larger organisations, unexpected peak load of activity is handled effectively by the grid and therefore ensures the smoothness of load balancing. This invaluable feature of GC is realised through the process of profiling individual resource based on its availability and capacity. From these individual benefits, the benefits of GC as described above [18], can be categorised into:

a) Business benefits - Faster time to obtain the results (Faster results guide to best of manage and first in market) - Increase productivity

b) Technology benefits - Optimise existing infrastructure - Increase access to data and collaboration Resilient, highly available infrastructure

- The main thing with GC is time saving since it speeds the application. Time intensive problems can be solved quickly in less time.
- Many companies and organizations can improve the speed and quality of the product.
- In order to reduce the computational time all the resources all over the world are aggregated.
- Cooperating with other organizations and sharing the resources is easy.
- There is access to remote database. Sharing of these database systems is very much important in certain application where they analyze huge data sets.
- Existing resources are utilized efficiently and effectively.
- GC provides increased and cost-effective storage.
- There is increased productivity as they provide the required resources, which are there on demand, to the users. Productivity also rises due to increase in computational activity.
- Grid resources are connected securely. Sharing of the computer resources and data are very secure. Security is important in the case of file sharing and other data sets.
- Good infrastructure for balancing the load.
- Not only computer resources are brought together but also the human resources, thus forming a virtual organization.

REFERENCES

[1] R. Al-Khannak, B. Bitzer. “Load Balancing for Distributed and Integrated Power Systems using Grid Computing”. ICCEP07, Capri, Italy May 2007. IEEE

[2] R. Al-Khannak, B. Bitzer. “Grid Computing for Power and Automation Systems Implementations” 41st International UPEC2006, New Castle, September 2006. IEEE

[3] Taylor, G.A., Hobson, P.R., Huang, C., Kyberd, P. and Taylor, R.J. “Distributed monitoring & control of future power systems via Grid computing.” Retrieved August 20, 2006, from http://people.brunel.ac.uk/~eesrgat/research/pdf_pubs/ IEEEPES2006.pdf

[4] Deak.O. (2005). “GRID SERVICE EXECUTION FOR JOPERA.” Retrieved October 05, 2006, from http://www.iks.ethz.ch/publications/files/Oliver_Deak _MT.pdf

[5] Cascio, J. (2005). “Smart Grids, Grid Computing, and the New World of Energy.” Retrieved October 4, 2006, from http:// www. worldchanging. com/ archives/002152.html

[6] Rajkumar Buyya and Srikumar Venugopal, CSIC communications, computer society of India' July 2005

[7] Foster, Ian and Carl Kesselman ed.: The Grid: Blueprint for a New Computing Infrastructure; Morgan Kaufmann; San Francisco; 1999.

[8] Grid Computing Info Centre (GRID Infoware), http://www.gridcomputing.com

[9] Joshy Joseph, Craig Fellenstein. Grid Computing, 2004.

[10] Qi Huang, Kaiyu Qin and Wenyong Wang, Development of a Grid Computing platform for electric power system applications. Power Engineering Society General Meeting, 2006. IEEE

[11] “Smart Electric Grid of the Future: A National “Distributed Store-Gen.” Test Bed.” Retrieved October 04, 2006, from http:// www.ldeo.columbia.edu/4d4/testbeds/Smart-Grid-White-Paper.pdf

[12] “Grid Computing.” Retrieved September 05, 2006, from http://en.wikipedia.org/wiki/Grid_computing

[13] Global Environment Fund. (2005). “The Emerging Smart Grid.” Retrieved August 29, 2006, from

http://www.globalenvironmentfund.com/GEF%20 w hite%20paper_Electric%20Power%20Grid.pdf

[14] Yini Chen, Chen Shen, Wei Zhang and Yonghua Song. Grid computing infrastructure for power systems.

[15] Malcolm Irving and Gareth Taylor' Prospects for Grid-Computing in Future Power Networks, September 2003.

[16] Features of the Java Commodity Grid Kit. Available from: http://aspen.ucs.indiana.edu/ gce/C536javacog/c536f eaturesOfCoG.pdf

[17] Parvin Asadzadeh, Rajkumar Buyya, Chun Ling Kei, Deepa Nayar and Srikumar Venugopal, Global Grids and Software Toolkits: A Study of Four Grid Middleware Technologies. Available from: http://www.gridbus.org/papers/gmchapter.pdf

[18] Gannon, D., Ananthakrishnan, R., Krishnan, S., Govindaraju, M., Ramakrishnan, L. and Slominski, A. “Grid Web Services and Application Factories.” Retrieved October 03, 2006, from http:// www.extreme.indiana.edu/ xcat/publications/A ppFactory.pdf

❑❑❑