Grid Computing, Compute and Data Storage Services

Jude Iyke NICHOLARS[1], Jude NAMUKANGULA [1]

[1]*NDEJJE UNIVERSITY, P.O Box 7088, Kampala Uganda*

Tel: +256-782-909117, +256-703-040979, Email: judiyke2@gmail.com

Abstract

The development of grid computing is a cutting-edge technology that brings a number of benefits for many Universities and Research Institutions around the world. Grid computing enables Universities and Research Institutions manage Information Technology resources in a centralized multi-core architecture, irrespective of their location in the world. It enables them to solve their ever increasing computing and storage problems. Universities and Research Institutions would undoubtedly enhance the quality of their output, while reducing costs by sharing resources through Grid technology. A number of Universities and Research Institutions believe that grid computing has the capacity to improve research work and other University operations, especially among the growing Institutions in Africa. Nevertheless, many African Universities and Research institutions have not yet embraced and adopted the use of Grid Computing Technology. Accordingly, there is a need for an extensive study in the adoption methods of this technology, especially among NREN member institutions in Sub- Saharan Africa. Study on such Information Technology solutions are needed to align academic processes to improve the utilization of grid computing and reduce the cost of computer hardware and increase in computing power. To examine this, the researchers will adopt a comparative research design to evaluate several related cases and NRENs operations within the region and Uganda in particular. These cases will provide the researchers with a clear difference, the benefits, the implementation method and the challenges of adopting grid computing technology. Subsequently, the NRENs would make use of these results to adopt such technologies.

Keyword: Grid Computing.

1. Introduction

Grid computing has become crucial in distributed computing, specifically among university research, (Xhafa & Abraham, 2010). Grid computing provides a degree of service and resource sharing that will go beyond even the internet as they will not only change the method which data is accessed, also how this information is created, used and also kept. Grid computing focuses on making sure that all resources are available on a regular basis, (Zhang, Chen, Zhang & Huo, 2010). Many huge firms such as Boeing are presently using grid computing to improve their operations. Nonetheless, future grids will permit universities and also organizations to benefit from computing since using grid computing improves effectiveness as well as reducing business costs and will be a catalyst for economic expansion and organization growth, benefiting markets across numerous sectors and university resources sharing and also research, (Moreno-Vozmediano, Montero & Llorente, 2013).

ISSN 2223-7062 Proceedings and Report of the 9th UbuntuNet Alliance Annual Conference, 2016 pp 87-94

The current grid computer model highlights the sharing of computational cycles as well as is tailored to compute-intensive and parallelizable applications, (Avram, 2014). As this version develops, it will certainly enable university systems to share other resources, such as storage, data and computer software. This evolution will certainly increase the requirement for high bandwidth interactions throughout the grid and also enhance its importance as a possible source of development. Grids create a dispersed network of computers that share sources over a heterogeneous collection of systems, merging resources to ensure that numerous computer systems can share work and comfortably access remote resources. There is a clear need for grid computer in medicine layout, geophysical prospecting as well as mechanical engineering in universities as Grid computing utilizes the idle time of hundreds or thousands of web servers that could be leased to any person who requires massive processing power, (Tian, & Fang, 2014).

Nonetheless, the needed communication framework to support large-scale grid computing in African universities and particularly in the sub-Saharan Africa has actually not yet been established (Bothun, 2016). Security is a prime problem; it might be difficult to persuade people to invest in a technology that seems to provide outsiders with access to their servers. However, there is need to note that network restrictions will not interfere with the capability of users to access computational power, yet these restrictions will be a constricting factor in the advancement of complete resource-sharing models. The broad adoption of grid computing in universities depends on solving technical and economic problems, including end-to-end safety. One more challenge is postured by the typical business software program, which is not tailored to support the grid version. It is vital for grids to have interoperability standards that fit elements from different vendors. However, XML is starting to play a vital role in solving this issue, (Dean, *et al*., 2012).

Many managers in organizations and academicians in universities are not knowledgeable about the advantages and characteristic of reducing the expense using Grid computing (Bothun, 2016). Information technology companies aspire to motivate educational institutions to adopt the use of grid computing; for instance, Pharmaceutical giant Novartis has actually linked nearly 3,000 of its scientists' desktop computers in a grid that provides more than 5 teraflops of computing power. This allows their scientists examine bigger information sets with higher precision and to target new issues (Aher, 2012). Bank One is utilizing grid middleware innovation to disperse risk-analytics processing. It aims to cut hardware expenses while increasing the performance of analytics for its interest-rate derivatives trading business. Johnson & Johnson uses grid innovation to run powerful applications that design scientific trials of pharmaceuticals. Entelos, a biotechnology company in California, uses a grid structure to speed the procedure of drug discovery. It can run simulations in a matter of hours or days with its network. A variety of innovation companies have actually made possible platforms for educational use within grid computing and offer global forums for educators, scientists and Information Technology specialists from education industry to pursue grid computing initiatives, establish abilities and share finest practices for decreasing operating costs while enhancing quality and access to education, (Rittinghouse & Ransome, 2016)

2. Statement of the problem

In an enterprise, servers typically sit idle, with just 10% to 20% of servers storage and computing power utilized, (Lee & Zomaya, 2012). Computer resources are even less utilized about 1% or 2 % of these resources are used on average. This suggests that grid computing can leverage substantial amounts of idle business resources.

ISSN 2223-7062 Proceedings and Report of the 9th UbuntuNet Alliance Annual Conference, 2016 pp 87-94

Therefore, there is need to study how Grid computing can be adopted by the NRENs that are endeavoring to meet the global competition with renowned institutions around the globe

3. Main objective

To develop a suitable Grid Computing Model that could be adopted by the NRENs in the Region and Uganda in Particular for more effective and efficient academic and research activities among its members that would stand the tests of time.

4. Specific objectives

i. To study the existing grid technology usage among the NRENs in Uganda and collect requirements for a suitable model for improving research and academic activities.
ii. To design a suitable grid computing model for improving research and academic activities among NRENs in Uganda.
iii. To implement a prototype of the developed model.
iv. To test and validate the developed prototype

5. The concept of grid computing

Grid computing is a computer network in which each computer's resources are shared with every other computer in the system. Processing power, memory and data storage are all community resources that authorized users can tap into and leverage for specific tasks. A grid computing system can be as simple as a collection of similar computers running on the same operating system or as complex as inter-networked systems comprised of every computer platform you can think of. (http://computer.howstuffworks.com/)

ISSN 2223-7062 Proceedings and Report of the 9th UbuntuNet Alliance Annual Conference, 2016 pp 87-94

6. Grid computing architecture

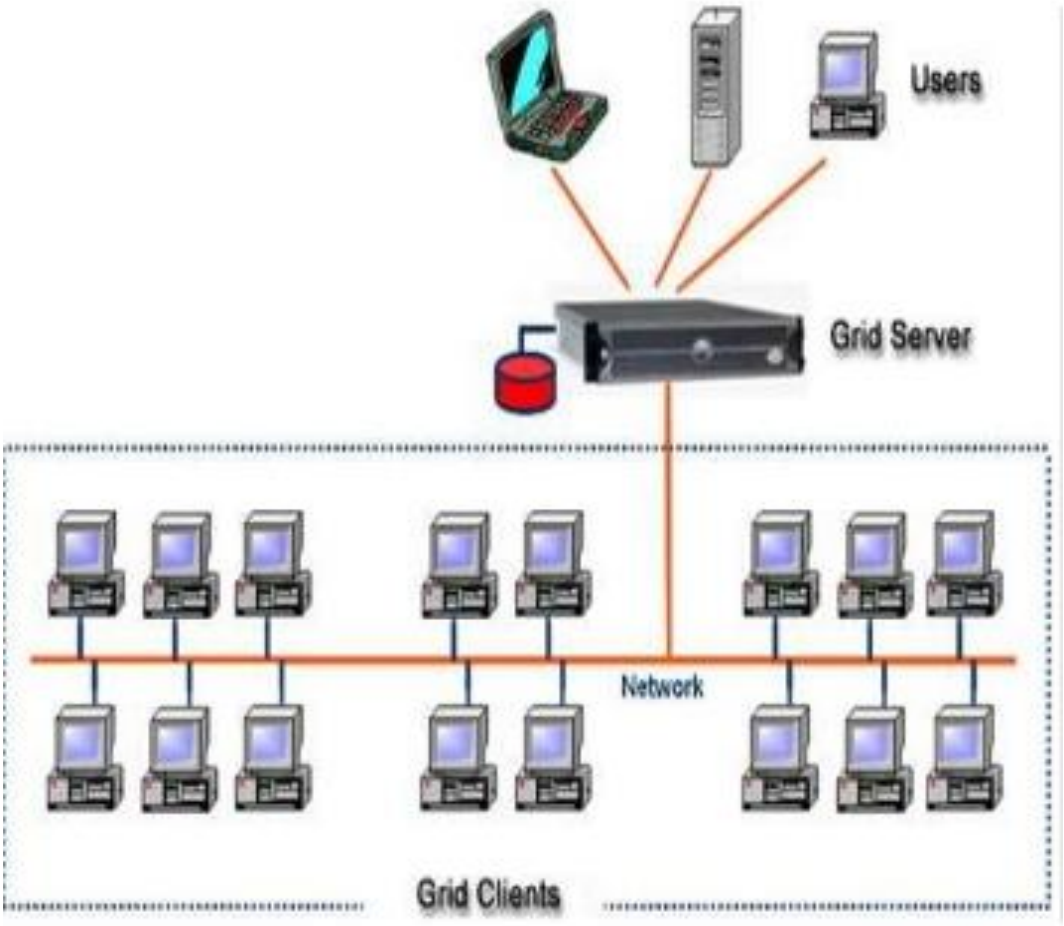

Figure 1 Source**:** wiki images.

The Grid Computing Architecture consists of

6.1 User

The users could be any individual devices connected to the grid server through guided/unguided media, and these devices must house a collection of computer software program referred to as middleware**.** The essences of having the middleware in place are to allow different computers to run a process or application across the entire network of devices. Actually, the Middleware is perceived as the workhorse of the grid network. Communication in any grid network may not happen without this middleware. However, the challenge is that there's no standard format for middleware.

6.2 Grid Server

There must be at least a mainframe computer system, i.e. a server, which handles all the administrative duties for the entire Grid network. In other words, this mainframe computer may be called a control node. However, different applications and Web servers in the Grid network, no matter the media connection type, provides specific services to this Grid server,

6.3 Grid Clients

This tier consists of interconnection of computers running special grid computing network software. These computers act both as a point of interface for the user and as the resources the

ISSN 2223-7062 Proceedings and Report of the 9th UbuntuNet Alliance Annual Conference, 2016 pp 87-94

system will tap into for different applications. Grid computing systems can either include homogeneous system i.e. several computers of the same make running on the uniform operating system or heterogeneous system i.e. different computers running on various different types of operating systems. It will also be very important to note that the interconnectivity of these Grid clients could be done through the use of guided or unguided media technology.

7. Methodology

This research will adopt an integrative model of both qualitative and quantitative methods. An analytical research design will be done to evaluate several related cases and comparative design to NRENs operations within the region and Uganda. These cases will provide the researchers with clear business requirements; these will be used for analysis and design of a suitable Grid computing model for the NRENs using a UML notation and this model will be implemented using Network simulation tools, such as NS2 or OMNet++, and to test and validate the operation of the prototype.

8. Conclusion

Grid computing is a brand-new approach to producing a solution for old issues. This technology offers lots of advantages to business, industries and universities. Many substantial Information Technology companies establish new Grid-based applications and construct new Grid facilities. The majority of the research in literature focused on advantages, chances, downsides, risks and configuration of Grid computing for enterprises. Having gone through these, we can confidently establish that Grid Computing can also be utilized by all the NREN member Universities in the East African region and beyond. Furthermore, the use of Grid Computing in universities has many benefits such as accessing the file storages, e-mails, databases, educational resources, research study applications and tools anywhere for professors, administrators, personnel, students and other users in university, on demand, to mention but just a few. Therefore, there is need to study how Grid computing can be adopted by the NRENs in the pursuit of meeting some of the goals of the UbuntuNet Alliance, In addition, study on such Information Technology solutions are needed, in order to leverage by aligning most academic processes with information technology to improve the utilization of grid computing and reduce the cost of computer hardware and increase in computing power.

9. Proposed Budget

The summary of the proposed budget presented on the next page contains five main spending categories. First, the research team (see Professional Honoraria) is composed of a Systems/Analyst (SA). The SA will assist with analysis, coordinate the research and write the majority of the document and as well will be responsible for leading the research and writing all relevant part of the report. The SA will also advise on methodology and provide recommendations. Additionally, it will be necessary to hire a Network administrator and a Full Stack systems programmer who will be contracted for advising on the technicalities and implementation of the proposed Grid Computing Model.

The second part of the budget is attributed to data collection efforts within the five main areas of research – Data collection, Analysis, Design, Implementation, and Testing. This section is calculated in accordance to the necessity.

The travel related expenses considers four round trips to and from Morocco, Tanzania, Kenya, and various districts in Uganda between February 2017 and October 2017, the trip to Morocco will be for learning experience as well as other contingencies which may not have been covered

ISSN 2223-7062 Proceedings and Report of the 9th UbuntuNet Alliance Annual Conference, 2016 pp 87-94

in the budget, there will also be a trip . Subsequently, a prototype Grid model will be ready for presentation in the UbuntuNet Connect conference by November 2017. (Annex 1)

References

Aher, Y. (2012). *Development and application of distributed computing tools for virtual screening of large compound libraries* (Doctoral dissertation, uniwien).

Avram, M. G. (2014). 'Advantages and challenges of adopting cloud computing from an enterprise perspective. '*Procedia Techology*, 12, pp. 529-534.

Bothun, G. D. (2016). 'Data networks and sustainability education in African universities: A case study for Sub-Saharan Africa.' *International Journal of Sustainability in Higher Education*, 17(2), pp. 246-268.

Dean, J., Corrado, G., Monga, R., Chen, K., Devin, M., Mao, M., & Ng, A. Y. (2012). 'Large scale distributed deep networks.' In : *Advances in neural information processing systems* pp. 1223-1231

Du, W., Murugesan, M., & Jia, J. (2010)' Uncheatable grid computing.' In : *Algorithms and theory of computation handbook* N.p :Chapman & Hall/CRC. pp. 30-30

Lee, Y. C., & Zomaya, A. Y. (2012). 'Energy efficient utilization of resources in cloud computing systems.' *The Journal of Supercomputing*, 60(2), pp.268-280.

Moreno-Vozmediano, R., Montero, R. S., & Llorente, I. M. (2013). 'Key challenges in cloud computing: Enabling the future internet of services.' *IEEE Internet Computing*, 17(4), pp.18-25.

Rittinghouse, J. W., & Ransome, J. F. (2016). *Cloud computing: implementation, management, and security*. N.p. : CRC press.

Schüller, F., Ostermann, S., Prodan, R., & Mayr, G. J. (2015)).' Experiences with distributed computing for meteorological applications: Grid computing and Cloud computing. *Grid computing* 8, pp. 1171-1199

Tian, G., & Fang, L. (2014). 'A new mobile spatial information system grid computing model based on mobile agent.' *IEEE Int Conf Commun Mob Comput*. 2, pp. 596-600

Xhafa, F., & Abraham, A. (2010). 'Computational models and heuristic methods for Grid scheduling problems. *Future generation computer systems*, 26(4),pp. 608-621.

Zhang, S., Chen, X., Zhang, S., & Huo, X. (2010) 'The comparison between cloud computing and grid computing.' *International Conference on Computer Application and System Modeling (ICCASM 2010)* 11, pp. V11-72 IEEE.

Websites:

http://computer.howstuffworks.com/

ISSN 2223-7062 Proceedings and Report of the 9th UbuntuNet Alliance Annual Conference, 2016 pp 87-94

Annex

Annex 1 Research Proposed Budget

	Cost (US$)
1. Professional Honoraria	
Systems Analyst	4500
Network Administrator	5000
Full Stack Systems Programmer	5500
Sub total	**15000**
2. Data collection Data collection will require a total of 990 "research assistant hours (RAH)" at $8.00 per hour. The project will gather and analyze data in the following countries in the East African region	
i. Uganda 390 RAH to gather data from around 50 Campuses and carry out analysis	3120
ii. Kenya 400 RAH to gather data from around 57 Universities and carry out analysis	3200
iii. Tanzania 200 RAH to gather data from around 27 institutions and carry out analysis	1600
Sub total	**7920**
3. Travel Related Expenses	
Two round trip tickets to/from Uganda and Kenya for two people @ $500 each person	1000
Lodging expenses, meals and per diem@$2800 (14 day, $200 per day for each person)	5600
Two round trip tickets to/from Uganda and Tanzania for two people @ $560 each person	1120
Lodging expenses, meals and per diem@$2800 (7 day, $200 per day for each person)	2800
One round trip tickets to/from Uganda and Kenya for one person @ $2721 Plus	2721
Lodging expenses, meals and per diem@$1400 (7 day, $200 per day)	1400
Sub total	**22,561**
4. Technology Cost	
i. Softwares: OMNeT++ (stands for Objective Modular Network Testbed in C++ UML (stands for Unified Modeling Language)	Open source
ii. Hardware: Two PCs, a Printer and other Scholastic materials	3200
Sub total	**3200**
5. Contingencies	**2600**
Total Proposed Budget ($)	**51281**

ISSN 2223-7062 Proceedings and Report of the 9th UbuntuNet Alliance Annual Conference, 2016 pp 87-94

ISSN 2223-7062 Proceedings and Report of the 9th UbuntuNet Alliance Annual Conference, 2016 pp 87-94