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A REVIEW OF GRID COMPUTING

Armu Sungkar[1], Tena Kogoya[2]
[1,2] Faculty of Computer Science, President University, Indonesia

*Corresponding Author: Armu Sungkar
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ABSTRACT

Grid computing is a combination of interconnected resources which can be spread all over the world having higher computing capabilities. The benefit of grid computing includes higher computation and memory capacity because of grid resources spread all over the world. The grid computing is managed by intra-grid scope which refers to the methodologies and the algorithms used for managing the grid network related issues such as task scheduling, resource balancing and security of the network. The advantages of grid computing include access to inaccessible resources, resource utilization and balancing, reliability, and parallel computing and scalability. The limitations of the grid computing include application in limited fields and suitability with applications running in batch mode only based on parallel processing.

Keywords: Grid Computing, Data, Computing.

INTRODUCTION

In modern computing technologies, two important technologies are cloud computing and the grid computing. The grid computing is a next generation computing technology with the focus of combining several weak and smaller networks in order to make a strong processing power and storage resource (Wang, Jie, & Chen, 2018). Thus, grid computing is a combination of interconnected resources which can be spread all over the world having higher computing capabilities. Grid computing provide benefit of combining several disperse resources which can be interconnected and solving problems which were not possible individually (Guharoy, Sur, Rakshit, Kumar, Ahmed, Chakborty, & Srivastava, 2017). Unlike distributed processing which relies on similar or homogeneous resource, the grid computing consists of different resources

based on heterogeneous platforms and specifications. The resources in the grid are grouped based on some classification such as personal network, educational networks, companies' networks and local networks. For developing the entire grid model, these different networks are connected with an end using the internet (Alkhanak, Lee, Rezaei, & Parizi, 2016). Intra-grid scope refers to the methodologies and algorithms which are used for managing the grid network related issues such as resource balancing, task scheduling, and managing security of the network (Mishra, Patel, Ghosh, & Mund, 2017).

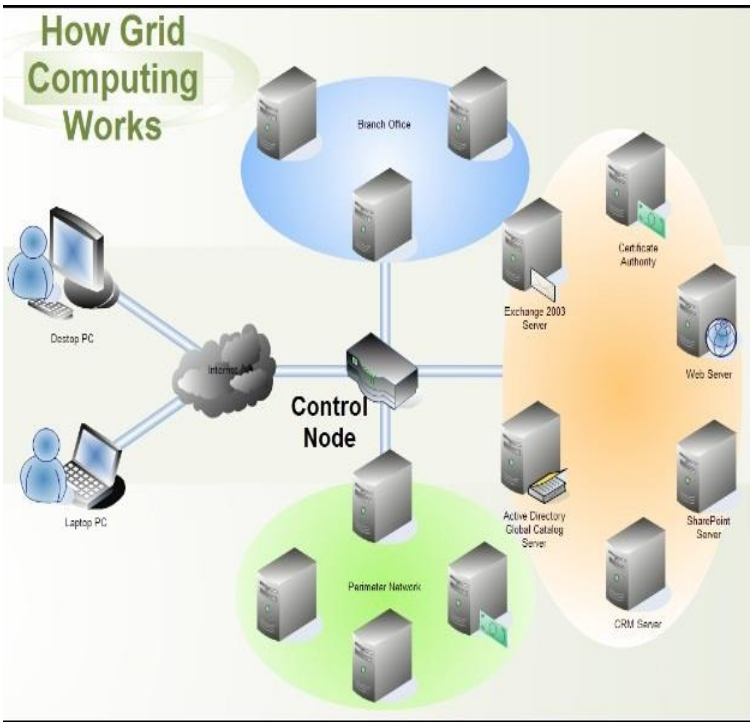

Figure 1: How Grid Computing Works

Generally, grid computing can be divided in to two main branches. The first branch is the computing grid and the second branch is the data grid (Singh, 2019).

Computing Grid: Collection of distributed computing resources are known as computing grid. Internet connection is mostly used for connecting these different resources; however, LAN can be used in some instances. The goal of making a computing grid is to achieve higher processing power. The goal is achieved by pooling different computers processing resources and managing it efficiently.

Data Grid: The data grid is used for data storage purpose. In some situations, such as medical or research field, the data requirements runs in to terabytes or perabytes which can be managed easily by using the data grid.

Difference between Grid Computing and Cloud Computing

The main difference between grid computing and cloud computing are as follows;

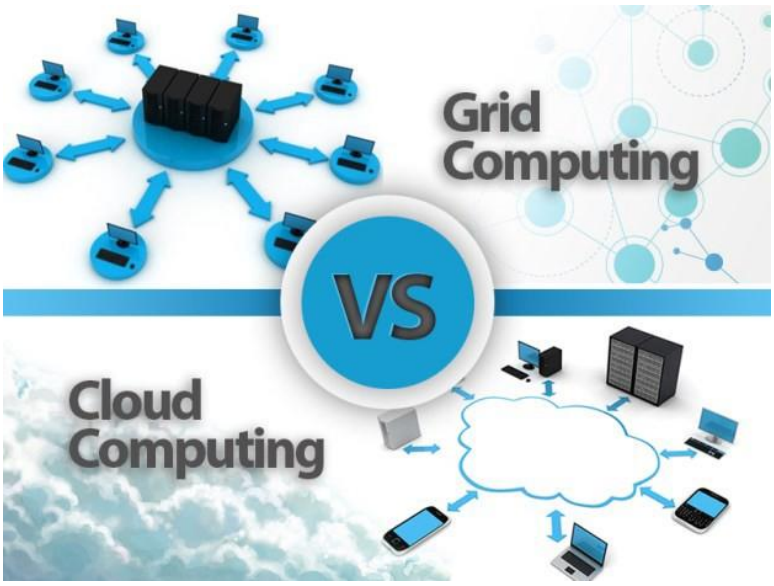

Figure 2: Grid versus Cloud Computing

The grid computing is about connecting various disperse computing resources to make one big computer in order to achieve greater computing power. Whereas, the cloud computing is about providing cloud of services which are used by clients.

The computing grid and the data grid are two main types of grid computing which is to deal with achieving higher computing power or higher storage capacity. On the other hand, the cloud computing types includes infrastructure as a service, platform as a service, and software as a service. These three types provide infrastructure storage, platform and its application, and specific software as a service respectively.

Figure 3: Grid Computing Functioning

The component of the grid computing includes clients who are submitter or host and grid manager based on the grid model. The component of the cloud computing includes the client and cloud server's infrastructure.

The function of the grid computing is such that client submit task to the grid manager who utilize the grid computing and data resources to perform that task. Client has no knowledge about where the work is executed. The task is returned to the client once it is completed. The resources fee is handled by the grid manager. On the other hand, the functioning of cloud computing is such that work is submitted by client to the cloud servers. The cloud servers manage the task internally

and return the task to the client after it is completed. A cloud server can be established internally as parallel servers or distributed servers. The services fee is handled by utility computing.

Application wise, the grid computing is mostly used in remote education services, bioinformatics data storage and chemical calculations processing. The cloud computing application mostly includes the ERP systems (Sathish & Reddy, 2017; Ochoa, Watowich, Florez, Mesa, Robledo, & Muskus, 2016).

MERITS OF GRID COMPUTING

The merits of the grid computing are provided.

Access to Inaccessible Resources

A user has access to several resources by using the grid computing which are not accessible to user otherwise. Previously, organizations attempt to capitalize their own resources for achieving greater computing power, however, with the use of grid computing, the unused computing resources from other organizations can be utilized. These resources may not be available to an individual client because of financial or some other constraints. These resources go beyond simple hardware and may include other resources such as applications or software and network connectivity.

Resources Utilization and Balancing

In grid computing, there is a grid-enabling architecture which combine the dispersed resources and enable a centralized controlling system. Without such centralized system, the grid cannot perform its function as a grid. The resources in a grid can be well utilized means the tasks are similar to the grid capability. The resources can be overloaded in situation where there are more tasks then the capacity of the grid. The resources can be under-loaded where there are less tasks but the grid system have greater capability. The benefit of the grid computing becomes more visible in overloaded grid system since if any one part of the grid system is overloaded, so some of the tasks can be shifted to other under-utilized resources. This way, grid computing enables optimum utilization of the resources.

Reliability

In an individual computing source, the computing depends on a single processor which pose a higher risk or threat. It is risky since if the individual processor fails, it can the whole system can stop functioning. On the other hand, if the tasks are performed under grid computing architecture, so it will benefit the system since tasks are distributed and the overall failure of the grid computing is not likely to occur. In grid computing, if there is partial failure at one processor point, so the tasks can be migrated to the other processor using the grid computing infrastructure. Here, the reliability can also be influenced if the migration of the tasks is not possible due to some problem over the network.

Parallel Computing and Scalability

Parallel computing is one key feature of the grid computing. This parallel computing is possible for those applications where programs are written in such a manner that different parts of the program can be performed simultaneously. These parts are called ‘sub-jobs’. With grid computing, many applications which have such sub-jobs can be performed simultaneously which

improves the speed and efficiency of completing that task or set of tasks. So theoretically speaking, if a job takes 10 seconds to complete, by doing the parallel computing, that task can be performed in 5, 2 or 1 second providing the number of sub-jobs written in that program.

GRID COMPUTING APPLICATIONS

Grid computing have several applications. Some of these applications are listed below.

Microprocessor Design: microprocessor design can be used to improve the product development life cycle by creating simulations which can be performed using the grid computing. Usually such simulations require higher computing power which is not possible doing at local level.

Medical Field: The grid computing is frequently used in the medical field for sharing knowledge and creating repositories which can be used by the experts around the world.

Pharmaceutical Industry: Pharmaceutical industry can use the grid computing to stimulate the process of creating new medicine or cure for incurable diseases.

E-Learning: In education field, there is greater need for computing due to the increased dependence of educational institutes for e-learning. Thus, grid computing can provide important resources for e-learning to occur.

Scientific Applications: Complex scientific problems and research work in fields such as physics, googology, astrology is possible using the grid computing. Mostly, these scientific applications require higher level of computing power which can be easily met by the grid computing.

Medical Imaging: Medical imaging requires storage of large size of medical images which requires not only large computing power but also higher data storage requirements. This can be done by using the grid computing.

LIMITATIONS OF THE GRID COMPUTING

The grid computing can provide solutions to the problem of large computing and data requirements. However, its limitations are that it cannot be used in every setting. For example, there are several applications which do not need higher computing power and running such applications using the grid computing will not result in any significant benefit. Furthermore, for some benefits to occur, it is necessary that the other resource on which the application is run using the grid computer, should have higher computing capacity compare to the user's own computer. If there is no significant difference between the two resources, so the grid computing will not lead to any improvement in the performance. Finally, a limitation of the grid computing is that it is more suitable for the applications which can be run in a batch mode. On the other hand, applications require graphical user interface are not very suitable for the grid computing.

The CPU consideration is also a limitation of the grid computing. If the application can be run in parallel processors, then grid computing is suitable as it can utilize heterogeneous resources to run that application in parallel mode based on different sub-tasks or sub-jobs. However, if the applications do not design in parallel mode, so the grid computing will not be very suitable for such application which is also a limitation (Alkhanak, et al., 2016).

Data is also a factor in grid computing use. In grid computing, large data can be transferred over the network to other data grid resources which is a benefit of grid computing. However, moving large data to other computing resources itself poses some challenges such as security and the network capacity. Good solution is to reduce the size of the data to minimum possible before moving it to the target location and use of some encryption method and security protocol for data security.

A solution to the data security over the grid computing can be making multiple copies of the data which is also a good solution but also creates other problems such as increased load on the network and the continuous upgradation of all data sets.

In summary, we can say that grid computing provide solution to the requirement of higher computing and data storage problems. However, the limitations of the grid computing include CPU and data considerations. Furthermore, some applications which are not designed in the parallel mode cannot be operated on grid computing. The grid computing is also not very suitable for the applications which requires higher user interface.

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