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A Review of Grid Computing and its Security Challenges

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I. ABSTRACT

Applications that are emerging scientifically and are now developing need for rapid access to enormous volumes of information and comparably speedy processing resources. Grid computing is a cutting-edge registering procedure that consolidates various little and feeble networks to give a huge handling power and capacity asset. Since we mainly use the network, it is important to address the security challenges that we may face and possible solutions to these problems.

Keywords: Distributed Computing, Grid Computing, Grid Security

II. INTRODUCTION

Spite of the accessibility of enormous parallelism, registering power, multi-center arrangements, and capacity in a solitary company or site, the developing necessities of uses additionally kept on presenting colossal difficulties for conventional equal and appropriated registering frameworks as of late [1] . In recent generations, distributed computing has become increasingly important in solving huge issues [2]. An evolving infrastructure can meet the never-ending needs of application programs. There are five categories of distributed computing and one of these categories is the topic of this paper, grid computing. The other categories we are going to explain shortly below. To different people, grid computing can mean different things [3]. According to author [4], Grid computing is a cutting-edge registering procedure that consolidates various little and feeble networks to give a huge handling power and capacity asset. Grid computing has the capability of integrating multiple dispersed capabilities that can also be interconnected and address issues that were previously impossible to solve individually [5]. Grid computing provides access to previously unavailable resources [6]. There are five levels in grid computing, and each level provides a service. In the fifth section of this paper, we are going to explain the types of grid computing: desktop grid, date grid, high performance computing grid, and collaboration grid. Section 6 includes the common security issues and challenges of grid computing and a literature survey, including the last solution to these issues.

III. DISTRIBUTED SYSTEMS

Because of the fast digital revolution and the availability of sophisticated computers, the way we perform computing has changed. In recent generations, distributed computing has become increasingly important in solving huge issues. It enabled the solving of big, complicated issues that were previously thought to be impossible to solve

[7]. In this section we are going to explain the types of distributed computing: peer-to-peer computing, cluster computing, grid computing, cloud computing, jungle computing Figure below is showing the categories of distributed computing [2].

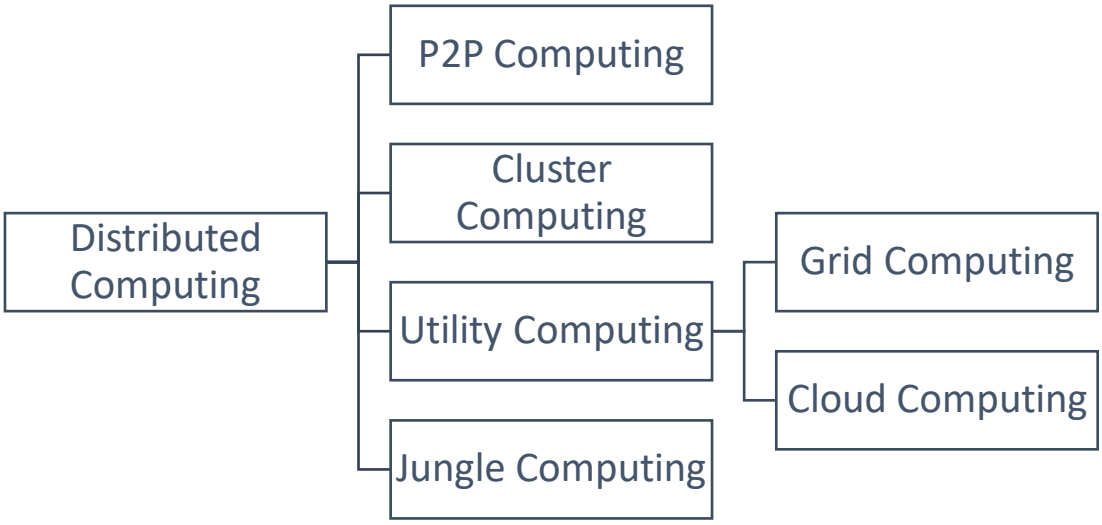

Figure 1. Categories of Distributed Computing

1. **Peer-to-peer Computing:** The word "peer-to-peer" describes a type of system or application that uses dispersed resources to complete a task in a decentralized environment [8], [9]. A peer-to-peer distributed system is a network in which peers share network resources like processing power, and data storage without the need for a central controller. Peer-to-peer systems are frequently used for file sharing, real-time data streaming, and computationally heavy jobs and are implemented as overlay networks over the Internet [10].

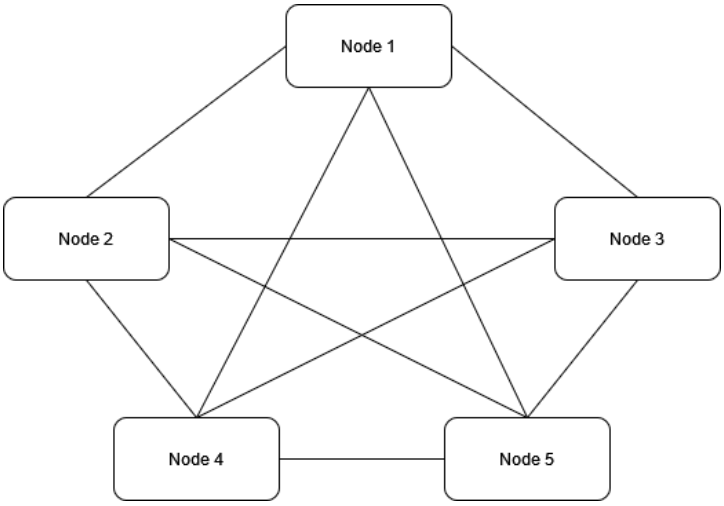

Figure 2. P2P System

2. **Cluster Computing**: is the use of a group of closely connected computers to function as if they were a single entity. Cluster computing offers solutions to hard tasks by accelerating processing and improving data integrity [11].

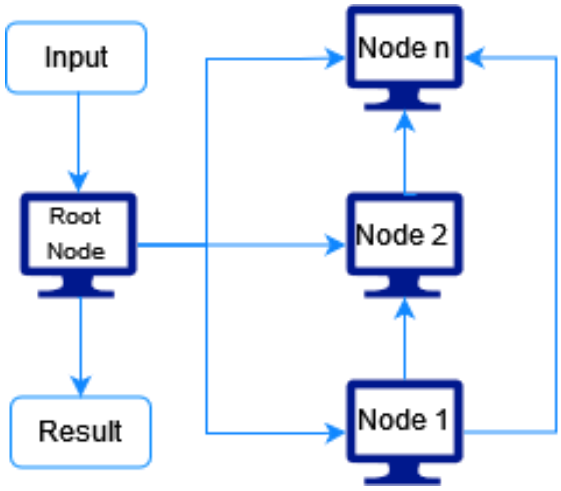

Figure 3. Cluster Computing

3. **Grid Computing:** is a next-generation computing approach that connects several tiny and weak networks together to offer a vast amount of processing power and storage. Grid computing enables the integration of many scattered skills that may also be networked, as well as the resolution of difficulties that were previously impossible to tackle separately [5].

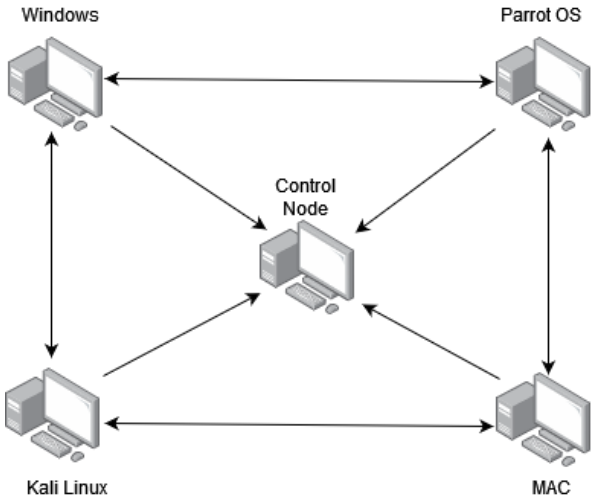

Figure 4. Grid Computing

4. **Cloud Computing:** Cloud computing covers both the applications that are presented as administrator through the Internet and the innovation and programming that power the server farms that supply such administration [12]. Cloud computing helps us to develop, configure, and personalize commercial apps online.

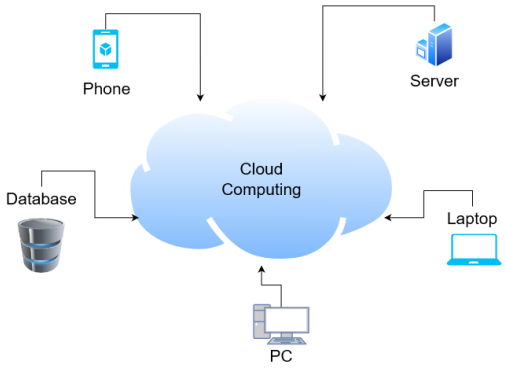

Figure 5. Cloud Computing

5. **Jungle Computing:** is a paradigm for distributed computing. It just arose from the abundance of scattered resources accessible. It refers to the utilization of heterogeneous and distributed computing systems such as clusters, grids, and clouds at the same time [13].

IV. ARCHITECTURE OF GRID COMPUTING

In the Grid protocol architecture, there are five levels of protocols and services, each of which is denoted by a unique number in the Grid protocol architecture. These are the five levels that make up the grid architecture: fabric layer, connectivity layer, resource layer collective layer, application layer [14], [15].

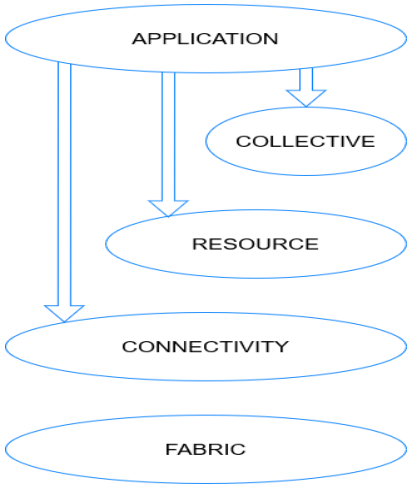

Figure 1. The layers of Grid Protocol Architecture

Fabric layer is the most basic level of grid architecture [16]. it allows users to get access to a variety of resources, including computation, memory, and networking devices, as well as coding repositories, and so on. In most cases, grids depend on preexisting fabric parts, such as local and regional resource managers [15], [16].

Connectivity layer is responsible for defining the fundamental communication and authentication protocols necessary for grid-specific network transactions. Communication protocols make it possible for fabric layer resources to share and exchange data with one another [17].

Resource layer. Its primary purpose is to facilitate the sharing of a single resource [16]. This layer provides direction for all of the typical activities that have been associated with the network components, such as the negotiation, commencement, surveillance, management, accountancy, and payment of sharing operations that are performed on individual resources [18].

Collective layer. This layer's responsibility is to record the interactions that occur between the various groupings of resources. The Grid's collective layer is concerned with the synchronization of a number of different resources. Services for monitoring and diagnostics, as well as data replication, are included in the collective layer. This layer contributes to the process of coordinating the use of numerous resources [16], [17].

Application layer. The fifth and final layer is comprised of the user applications and programs, each of which makes a request to a higher layer [16]. Through a variety of interaction and resource access protocols, the application layer makes it possible to take advantage of the resources available in a grid environment [14].

The services supplied by grid architecture are listed in the table below. It also identifies who is accountable for providing these services.

	Grid Architecture	
Services	**Layer**	**Responsibly**
Storage	Fabric Layer	Local Resources Interface
Hardware	Fabric Layer	Grid Protocol
Costing	Resource Layer	Resource Layer Protocol
Communication	Connectivity Layer and Collective Layer	Connectivity Layer Protocol
Development of Applications	Application Layer	Virtual Organizational Environment

Table 1. Services of Grid Architecture [16].

V. TYPES OF GRID COMPUTING

In this section we are going to explain the most common types of grid computing: desktop grid, date grid, high performance computing grid, and collaboration grid.

1. **Desktop Grid:** is a computing environment that makes use of computers that are linked to the Internet. There are numerous distinctions between Desktop Grid and the network in terms of resource kinds and features, as well as participation types [19].
2. **Data Grid:** The data grid is quickly becoming the most important aspect of the infrastructure for large-scale information-heavy applications that require high energy physical science as well as bioinformatics. [20]. A Data Grid offers two major types of assistance: a safe, trustworthy, and effective information movement convention and imitation administration [21].
3. **HPC Grid:** HPC which refers to high-performance computing, is a technology that has a long history of utilizing concepts and technologies from the larger computing sector to address challenging problems requiring huge processing using computer clusters [22].
4. **Collaboration Grid:** The collaboration grid may assist you in managing the cooperation process carefully. Collaboration entails two or more people who are geographically separated working with each other to interact and transfer data, communication, expertise, and activities [23].

VI. CHALLENGES OF GRID COMPUTING

Service in the future infrastructures may need the capability of providing a secured computing environment for apps [24]. Grid security challenges are grouped into three types [25]:

Architecture Related Issues: here the problems address concerns regarding the grid's structure. Clients of a grid were worried about the information recorded by the grid. Therefore information privacy and anonymity, and also user identification, are required.

Infrastructure Related Issues: Those difficulties were connected to the grid infrastructure's host address parts. Hosting levels of security challenges are those which cause a host to be nervous while connecting to the grid system.

Management Related Issues: The last group of problems with grid management. Because of the undeniable different nature of framework frameworks and applications, controlling identities becomes progressively critical in grid frameworks.

Author	Problem	Method	Accuracy	Advantages	Limitations
Song et al. [26]	Trusted Grid Resource Allocation	Discrete-event Simulator	92.6%	reproduce the trust joining and asset streamlining processes.	The difference between the accuracy of the jobs in trust integration is very high.
Bourgeois and Hasan [27]	Securing grid computing networks	Grid Security Operation Center	-	offers an effective approach for managing trust across numerous administrative entities linked to the grid.	In this mechanism the level of confidentiality is not verified.
Foster et al. [28]	Issues in the policy of grid system	Globus Security Infrastructure, GUSTO	-	supports resource proxies as well as user proxies.	When there are many users or resources, it will be necessary to set up global to local mappings.
Welch et al. [29]	Security In the Grid Infrastructure	Version 3 of the Globus Toolkit	-	Improve on the security model used in the toolkit.	The Compatibility in the firewall in not enough.
Eskandarpour et al. [30]	Solve problem that addressed by system operators	Quantum computing	-	Improving grid performance.	The quantum CPU has its own performance and thermal issues.
Azzedin and Maheswaran [31]	Improve domains' trust in using or sharing resources	Trust management architecture.	-	Validating an entity's identification, establishing a confidence level depending on the entity, develop a trust-based conduct related to direct trust connections.	In the last classification rang that is little harm the trust level is not high.

Smith et al. [32]	threats in service-oriented on-demand grid computing.	Sandbox, JNI jailing, Xen hypervisor system.	-	allow security at progressively high levels.	The performance parameters of the offered solutions for the three levels in the relation to real are not thoroughly examined.
Liu et al. [33]	Security of service in Grid.	Detection algorithm for each atomic services in grid application.	-	This suggested auditing architecture for service safety may easily monitor the grid patient's disengagement state while delivering tasks to specific GNs.	-
Syed et al.	Security of service in Grid, Cross-Domain Attacks.	Grid Security Operation Center.	-	It is scalable towards the capacity of the grid computer system.	Some sophisticated reporting features are restricted.

VII. CONCLUSION

Nowadays, distributed computing, particularly grid computing, is critical due to the large, complicated problems that were previously thought to be impossible to solve or would take too long to solve using a single computer. Because of the importance of this technology, we must ensure the safety of transportation, storage, and processing operations through grid computing.

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