Grid Computing: Technicalities and Overview

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Abstract— the last some years there has been a rapid rampant increase in computer processing power, communication, and data storage. Grid is an infrastructure that contains the integrated and collective use of computers, databases, networks and experimental instruments managed and owned by various organizations. Grid computing is a kind of distributed computing whereby a "super and virtual computer" is built of a cluster of networked, loosely coupled computers, working in concert to perform large tasks. Here paper presents an introduction of Grid computing providing wisdom into the gird components, terms, architecture, Grid Types, Applications of grid computing.

Keywords— *Grid computing, gird components, architecture, Grid Types, Applications.*

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I. GRID COMPUTING INTRODUCTION:

Further research in the area metacomputing technologies were developed in direction of providing numerous users with simultaneous access to a large number of computational resources (up to several thousand computers in local or global networks) , scientific equipment, data storage, computer network etc. in same time their quantity turned into the quality and created a new term **Grid Computing**. This paper accords with the later one Grid Computing. The basic idea of grid came into presence in mid 1990s but still Grid means different to different people. Grid is similar to the electric power grid which is supposed to given steady going, astonishingly consistent, transparent access to electricity irrespective of from its source. The consumer just utilizes the electricity plugged through wall sockets. Numbers of definitions for the Grid are provided by various network technologies. Ian Foster definition of the Grid as "a system that coordinates resources which are not subject to centralized control, using standard, open, general-purpose protocols and interfaces to deliver nontrivial qualities of service" [1]. The Grid bus Project as "Grid is a type of distributed and parallel system that enables the selection, sharing, and cluster of geographically distributed "autonomous" resources dynamically at runtime depending on their capability ,availability, cost, performance and user's quality-of-service requirements" [2]**.** Also The Globus Project defines Grid as "an infrastructure that enables the integrated, collaborative use of high-end computers, databases, networks, and scientific instruments managed and owned by multiple organizations" [3]. The efficiency of latest computer systems and computer networks has increased growing as compared to traditional computer systems. This raise in their performance, most of the times lead to loss of computational resources because most of the time the CPU sits idles. Grid applies this idle CPU cycles to do the computation when requested by the grid users, otherwise would have been wasted. This entitle the users to perform complex computations that in traditional cases would have wanted large-scale computing resources e.g. image rendering, climatology, scientific researches etc. There are large number of people belonging to business houses, academia and scientific research laboratories working on grid. Catching the idea from electric power grid major progress has been under laid and scientist, researchers subsequently have developed various solutions. Computational Grid is a collection of distributed, possibly heterogeneous resources which can be used as an ensemble to execute large-scale applications. Grid computing concept were first explored and studied in 1995 I-WAY experiment in which large-speed networks were used to connect, for a short time, high-end resources at 17 sites throughout the USA. From this experiment various Grid research projects arrived that developed the core technologies for Grids in scientific disciplines and various communities. Beyond the United States and Europe the closely related European Particle Physics Data Grid, Data Grid and Grid Physics Network (GriPhyN) projects plan to consider data from frontier physics experiments.

Selection and sharing resources worldwide is the fundamental working logic behind grid computing can be represented by Figure.1:

Figure 1: Grid computing

Types of grid:

On the basis of use grid computing can be divided into different types:

- **Computational grids:** is a loose network of computers linked to perform grid computing. Computational Grid is a collection of distributed, likely heterogeneous resources which can be used as an ensemble to execute large-scale applications.

- **Collaboration grid:** With the advances in hardware network resources and network services, demand for better collaboration has increased. Such type of collaboration is best possible with these kinds of grids.

- **Utility Grid:** In this utility grid not only CPU cycles are shared, also special peripherals like sensors and other software's are also shared.

- **Network grid:** Even if we have computational machines with enough computational power as a part of grid but with poor network communication one can't utilize those machines optimally. Network grid gives the huge performance communication using data caching between nodes there by speed-up communication nodes acting as router with each cache.

- **Data grid:** Data Grid is the storage element of a grid environment. Engineering and scientific related applications require access to large amounts of data, and often this data is widely distributed. A data grid provides seamless access to the local or remote data required to complete compute intensive calculations.

I.I. Components of Grid [4]

The large components are required to form a grid as are shown in the Figure1. The components are as follows:

- **User Level**

This layer houses the Application and High level Interfaces. Applications can be separated and create a vast variety of problems from chemistry to Nuclear Engineering. The high level interfaces implement an interface and protocols allowing the applications and users to access the middleware services.

- **Middleware Level**

The major functionalities of grid systems normally occur in this layer. This layer provides many services like Resource scheduling, Resource discovery and fault tolerance, allocation, security mechanisms and load balancing. It gives the users a transparent view of the available resource.

- **Resource Level**

This layer typically provides local services that render computational resources like CPU cycles, storage, computers, Network infrastructure, software etc.

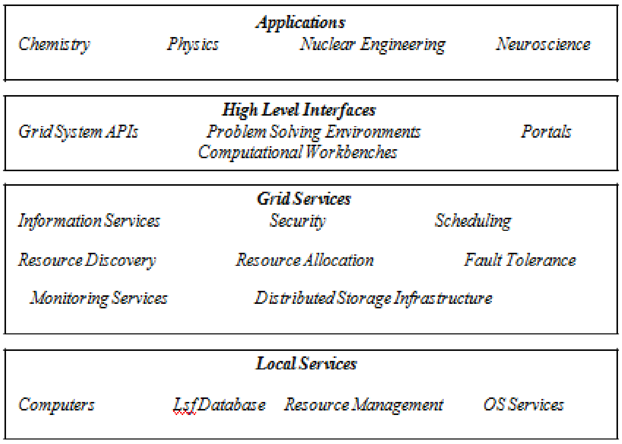

Figure 1: Grid Components [4]

Computational grids have been formed as to deliver different communities with requirements and varying characteristics. For of this reason we cannot have a uniform single architecture. But in normal we can analyze basic services that almost all the grids will provide although various grids will use different approaches for the realization of these services. [5]**.**The computers joined to form a grid may even have different operating systems and hardware.

Grid consists of a layered architecture providing services and protocols at five layers represented By Figure 2.

Fabric layer: This layer provides the resources, which could contains computers (PCs running UNIX or Windows NT), databases and storage devices. The resource keep also be a

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157 – 160

logical entity such as a computer pool or distributed file system. For this, it should support enquiry mechanisms to discover their structure, state and capabilities.

Connectivity layer: This layer consists of the basic authentication protocols and basic communication required for transactions. Communication protocols allow the interchange of data between fabric layer resources. Authentication protocols given secure cryptographic mechanisms for identifications of resources and users. For communication routing, naming and transport are required. These protocols can be peaked from TCP/IP protocol stack.

Resource layer: This layer defines the protocols for operating with shared resources. Resource layer construct on the authentication protocols and connectivity layer's communication to define Application Program Interfaces and software development kit for accounting, initiation, monitoring, secure negotiation control and payment of sharing resources. Resource layer protocols can be distinguished primarily into two classes, which are ***Information Protocols*** and ***Management Protocols.***

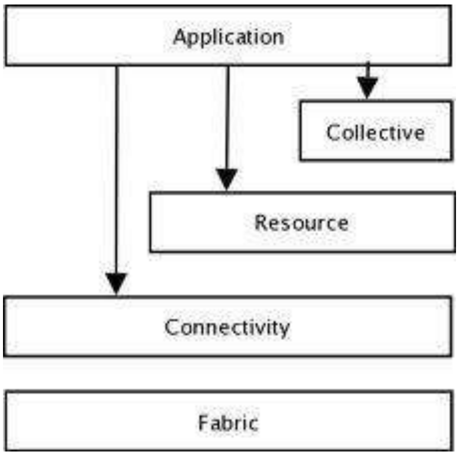

Figure 2. Grid Architecture

Collective layer: collective layer consists of general purpose utilities. Collective Layer is other from the resource layer in the sense, while resource layer concentrates on interactions with single resource. Any collective operations in the shared resources are placed in this layer and it coordinates sharing of resources like co-allocation, directory services, brokering services, monitoring, scheduling, and diagnostic services, data replication services.

Application layer: the top of the grid layered architecture sits the application layer. This layer consists of application which the user will implement. This layer consists of the programs and user applications which call upon another layer.

III. Grid computing Application:

The four important procedures which must be carried out in a distributed computing system before it can be called The Grid. These are the Authentication, Authorization, Resource Discovery and Resource Access. These four vital procedures lead to the idea of Virtual Organizations of associates who share resources over a Grid. Above mentioned four procedures are the series of steps too from task submission to the grid and getting task executed over grid.

Major benefits which can be utilized by application of grid are the following [8]:

- Reduced costs/Improved efficiency.
- Virtual Organization (VO) and Virtual resources
- Increase capacity and productivity
- Parallel processing capacity
- Optimized utilization of underutilized resources.
- Exploiting underutilized resources
- Support to Heterogeneous system
- Reduced result time.
- Resource balancing

Grid Resources used to solve complex problems in many areas like biophysics, high-energy physics, weather monitoring and prediction, nuclear simulations, financial analysis, chemical engineering etc.

Projects, such as Distributed and Net SETI@Home develop grids by associating multiple low-end computational resources, like individuals computers from the Internet to detect extraterrestrial intelligence and crack security algorithms respectively.

Today high scale parameter study applications are using computational grid resources to crack algorithms and search for extraterrestrial intelligence.

IV. Grid Computing Challenges:

Although awesome benefit can be drawn from grid computing but track of grid is not free of blow. Inherent nature of grid i.e. heterogeneity of hardware and software, handling wide spread resources, control of different organizations pose serious challenges before the researchers. Numbers of scientific issues which cannot be tested practically are simulated over grid. But this simulation in itself is a challenge for grid because no standard has been built for simulation over grid. Moreover, simulation models evolved for traditional hardware systems are not valid for the modern systems [11]**.** No doubt grid computing seems like a promising solution to eliminate the resource islands and to provide resources and services over internet in a transparent way. But to attain all above, we need to analyses the current barriers and challenges in developing, deploying, promoting and use of grid computing.

The various challenges of grid are the following:

- Grid reliability:
- Scheduling of tasks
- Load balancing
- Resource monitoring
- Service availability
- Distributed management [1]
- Availability of data
- Uniform user friendly environment.
- Grid application development
- Standard protocols
- Efficient algorithms and problem solving methods
- Programming tools and models
- administration and Management of grid
- resource monitoring and Performance analysis
- Centralized management

The list of grid challenges is not confined to the above. There are various other challenges to grid like no widely accepted definition, hidden costs and scope of grid computing, lack of significant applications for grid, availability of widely accepted standard protocols to control and manage grid and much more. All these leading to the shift of user's attention from grid computing to service computing. Above mentioned issues forces to rethink, "for what actually the grid computing is".

V. Conclusion:

Today Grid computing has been utilized by most of the scientific domains like biological science, astronomy, climatology, and much more. There are number of grid computational projects like netsolve, globus, entropia, condor, SETI, legion which are constantly improving the grid architecture and application interface. Grid computing has genuine consequences and its implications are huge in the field of computing. But the first requisite for using grid is high speed internet; if one does not have a speed of internet one cannot get the benefits and advantages from grid. On one end of grid is high computation and optimized use of resources and at other the ability to manage distributed and heterogeneous systems. We need security with high availability of data and resources on demand and at the same time ease of approach to implement these.

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