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Resource Allocation in Grid: A Review

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Abstract

Grid computing is a distributed method for solving computing problem, when we have an application that is ready to execute; we can run this on other free machine. Resource management in grid is one of most important aspect. Resource management has consists of three parts such as resource discovery, resource selection and resource allocation. Each application needs all resources for run; therefore, resources should be ready and available. In grid, resources are heterogeneous and distributed. Resource allocation is one of important concepts in grid. In this paper we discuss some of important exists algorithm for resource allocation and compare these on the field’s used technique, resource discovery, and similarity degree method.

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Keywords: Grid computing; Resource allocation; Distributed system

1. Introduction

Nowadays the scientific problems are very complexly so that for solving them we need huge computing power. The term grid, coined in the mid-90s in the academic world, was originally proposed to denote a distributed computing system that would provide computing services on demand just like conventional power and water grids do (Luis Ferreira at el., 2005). The goal is to create the illusion of a simple yet large and powerful self-managing virtual computer out of a large collection of connected heterogeneous systems sharing various combinations of resources (Luis Ferreira at el., 2003). Figure 1 illustrates a sample of grid.

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The term resource management in grid computing can be defined as those operations that control the way that grid resources and services are made available for use by entities like users, applications and services (Khanli, & Analoui, 2008) to ensure efficient utilization of computer resources and for optimization performance of specific tasks. In grids, we need to consider the conditions such as network status and resources status. If the network or resources are unstable, jobs would be failed or the total computation time would be very large (Chang, Chang & Lin, 2009). Because resources are distributed by individual machines, grid cannot have full control on the resources in network. The standardization of communications between heterogeneous systems created the Internet explosion. The emerging standardization for sharing resources, along with the availability of higher bandwidth, are driving a possibly equally large evolutionary step in grid computing (Ferreira at el., 2003).

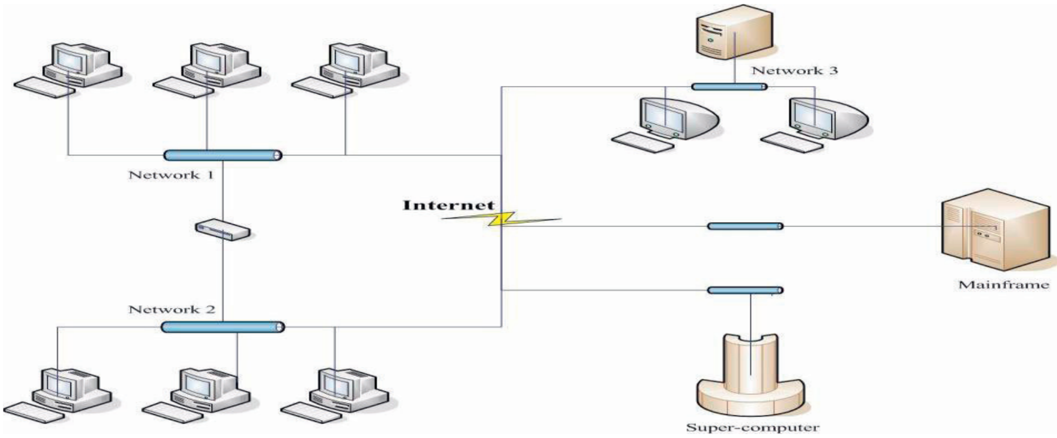

Figure 1. Grid Sample

Grids based of resources types divided in three types: Computational grid, a computational grid is a grid that has the processing power as the main computing resource shared among its nodes. This is the most common type of grid and it has been used to perform high-performance computing to tackle processing-demanding tasks (Luis Ferreira at el., 2005), Data grid, and Network grid.

In this survey we aim to highlight the concept of resource allocation, therefore we describe and discuss important algorithms in section 4 and in section 5 we compare these algorithms in the field of used technique, resource discovery, and similarity degree method and in last section we have a conclusion of this discuss.

2. Type of resources

In this section we explain type of resource in grid. Some of resources are uses by users and some may have specific restrictions. Figure 2 shows the resource type in grid (Abba, Zakaria & Haron, 2012) and this divide in two category hardware and software and each category divide 3 parts.

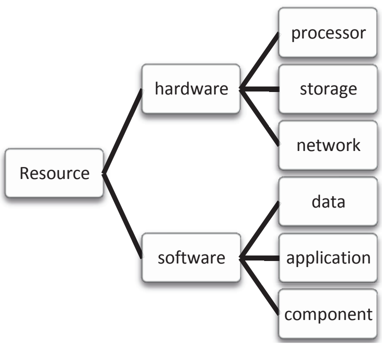

Figure 2. Type of resources

3. Styles of resource allocation

Krawczyk et al (2008) taxonomy styles of resource allocation in 3 styles. They believed that resource allocation be in one of types, volunteer, agreement based and economic. Volunteer computing or public resource computing is based on the idea that willing participants with idle resources, like CPU, will happily donate these in the aid of some cause or task without any tangible remuneration for their use. It is characterized by the ease of entry and exit of resource providing participants in sharing their resources.

Agreement based resource allocation is a model where the negotiation and management of resources is formed by set policy. In essence either through negotiation (automated or not) a set of policies setting the requirements or regulations for resource are established and used for the allocation decisions. Each participant adheres to the policy set out. Economic resource allocation is where the negotiation of resources is done via an economic mechanism. A currency is used as the medium of exchange, independent of whichever economic mechanism is in place. As is seen in modern economies, this greatly enables the exchange (or at least a chance to) of needs and wants in return for goods and services. In this paper we without seen this taxonomy aim to describe some of resource allocation algorithms and comparing them.

4. Related works

4.1. A new approach for flexible matching of grid resources

This algorithm proposed by Bayat et al (2012). Their method divides the resource properties into two classes: numeric properties and non-numerical properties. It utilizes ontology to compare the non-numeric properties of the request and the advertised resources. It also uses some simple mathematical operations to match the numeric properties of the request and the advertised resources.

Suppose a request R is received and a repository of advertised resources is available. They match the request R with each advertised resource and assign a score to each resource in the repository. Then sort the advertised resources based on their score in decreasing order. The rank of each available resource shows how good it can satisfy the request. Each property of the advertised resource compares with the corresponding property in the request to determine the score that the advertised resource gets for satisfying the request. The score given to each advertised resource is a quantitative measure so we have to express the result of matching each advertised resource property with the corresponding request property in quantity.

4.2. Scalable grid resource discovery through distributed search

Butt et al (2011) proposed the model that provides a scalable solution for information administrative requirements when the grid system expands over the Internet. Distributed search in this model is based on sending DNS queries to the repositories that are distributed in the Internet. Two architectures required for regional grid resource discovery in the model are implemented: Direct and Centralized Web- Based Grid Resource Discovery.

These two architectures act as the best-case scenarios of the model because they simulate a successful regional search for the URL of resource finder service which is used in the model. The DWGRD architecture implemented in this work is obviously the best-case scenario of our model. In DWGRD, the client knows the resource finder's URL from the beginning.

CWGRD implementation is the second implemented architecture that is based on contacting central UDDI database registry located in the same region as the client. They consider this case the second-best case scenario because we assume the URL of regional UDDI is known by the client and UDDI successfully returns the URL of the required resource finder web service to the client.

4.3. A New Grid Resource Discovery Framework

Hassan et al in (H. A. Abba, N. B. Zakaria and N. Haron, 2012) design a novel semantic-based scalable decentralized grid RD framework. The new RD framework initially consists of two aspects: description and locating of the resources. Description includes the ontology model and locating includes the resource node organization and resource search process. Node organization composes of four components, which are class formulation, head appointment, node subscription and class maintenance.

The nodes are organized in graph, since a grid has a set of resources and applications, they form two vectors. The first one is for the resources, and the second is for the applications. To allocate resources for users tasks we develop an algorithm that searches resources on the network based on local information and dynamic matching. Local information is the presence of particular resources in a node, which is described in the sub resource node matrix. Dynamic matching is the similarity calculation between agents that represent resource provider and requester using the similarity function.

4.4. Improving Grid Resource Allocation via Integrated Selection and Binding

Kee et al in (Y.S. Kee, K. Yocum and A. A. Chien, 2006) presents a new formulation of the resource selection problem and a new solution to the resource selection and binding problem called integrated selection and binding. Composition operators in our re-source description language and efficient data organization enable our approach to allocate complex resource collections efficiently and effectively even in the presence of competition for resources. Their empirical evaluation shows that the integrated approach can produce solutions of significantly higher quality at higher success rate and lower cost than the traditional separate approach. The success rate of the integrated approach can tolerate as much as 15%-60% lower resource availability than the separate approach.

They proposed the integrated selection and binding algorithm. One critical aspect of this approach is the ability to decompose specifications flexibly .We can see below this algorithm.

1. Identify components in a specification, clustering closely related entities together into one
2. For each component, select N best selections.
3. Remove the best one from the selections for each component, and attempt to bind them in parallel.
4. If a component fails to bind its selection, only the component fails. Try binding with next best ones for the component. If any component exhausts all N selections, return failure.
5. If every component succeeds to bind its selection, compose the bound resources into a solution to the entire specification, exploiting the compositional structure, and return the solution to the application.

4.5. A Market Based Approach for Sensor Resource Allocation in the Grid

In (L. Chunlin, H. J. Hui and L. LaYuan, 2012) Li Chunlin at el. present a market based approach for sensor resources allocation in sensor enabled grid computing environment. Their goal is to find a sensor resource allocation that maximizes the total profit. Their method was distributed. The proposed model consists of two types of agents: the sensor resource agents that represent the economic interests of the underlying sensor resources providers of the sensor grid, the sensor user agents that represent the interests of grid user using the grid to achieve goals. Interactions between the two agent types are mediated by means of market mechanisms.

Market mechanism in economics is based on distributed self-determination, the variation of price reflects the supply and demand of resources, and market theory in economics provides precise depiction for efficiency of resource scheduling. Sensor user agents are allowed to specify their requirements and preference parameters by a utility model. As a result, a market based sensor grid model inherently supports sensor users with diverse requirements for the execution of their sensor jobs. The utility values are calculated by the supplied utility function that can be formulated with the sensor job parameters. The request is analyzed by the scheduler of grid market.

5. Comparison methods

In this Section we aims to comparison mentioned methods in previous section in fields used technique, resource discovery, and similarity degree method. Previously, we discussed completely about all of these fields. Table 1.5 shows the result of this comparison.

Table 1.5. Comparison Table

Algorithm Name	Used technique	Resource discovery	similarity degree method
A New Approach for Flexible Matching of Grid Resources	Mathematical	Matchmaking Algorithm	Grid-JQA
Scalable Grid Resource Discovery Through Distributed Search	Caching(similar to the DNS Protocol)	Web-Based	Not discuss
A New Grid Resource Discovery Framework	Ontology, P2P Network, and Intelligent Agents	Graph	Dice distance fraction
Improving Grid Resource Allocation via Integrated Selection and Binding	Relational Database	Database Technique	Classification
A Market Based Approach for Sensor Resource Allocation in the Grid	Market Based	Not discuss	Prices base

6. Conclusion

Resource allocation is one of the major fields in grid environment. As we said, the grids divided in three types and the resources type have very important role in this divided. In this paper, we represent resource allocation concepts in grid and discuss some of common algorithms. Last section presents the comparison result of these algorithms.

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