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Resource Discovery and Resourse Management in Grid Computing : A Survey

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Abstract: Decrease in hardware costs and advances in computer networking technologies have led to increased interest in the use of large-scale parallel and distributed computing systems. One of the biggest issues in such systems is the development of effective techniques/algorithms for the distribution of the processes/load of a parallel program on multiple hosts to achieve goal(s) such as minimizing execution time, minimizing communication delays, maximizing resource utilization and maximizing throughput. The inter-process communication amongst the various processes during the computation is the major factor for the high speed distributed computing. In this paper, the performance of the most common several parallel processing tools are discussed and compared. PVM is a software infrastructure that emulates a generalized distributed memory in heterogeneous networked environments. Now parallel MATLAB is most widely used computing environment in the distributed parallel computing. Parallel and Distributed computing techniques have proved to be effective in tackling the problem with high computational complexity in a wide range of domains, including areas of computational bioengineering.

Keywords: Grid computing, resource management, Resource discovery

I. INTRODAUCTION

One of the substantial concerns in the Grid environment is to utilize the resources efficiently and provide the user with a cost effective infrastructure. The geographically distributed resources have to be coupled logically in order to make the most out of the grid [1]. Grid resources are owned by multiple domains across the grid. The goal of resource management is to schedule the applications to utilize the available resources in a seamless manner [2]. The grid resource management system is responsible for receiving resource requests, finding and matching the request with resources, executing and returning results to the user and storing resource information. A resource [3] in the Grid may be a computational resource such as CPU, memory, storage unit or network; it may be a data resource, which provides metadata and its contents such as database; or it may be a service, which is programmed to accomplish a specific task. The main objective of Grids is to provide a powerful and robust platform, which serves those resources without being affected by the dynamicity of the nodes.

Resource management systems are often categorized based on grid type, machine organization, resource model, dissemination protocols, namespace organization, data store organization, resource discovery, QoS support, scheduler organization, scheduling policy, state estimation and rescheduling approach [4, 5].

Resource management systems can be classified into centralized and decentralized systems based on scheduler architecture. Decentralized systems are further classified into distributed, hierarchical and peer-to-peer systems [6].

In this paper we propose a survey on the various resource discovery approaches. The main aim is to explore the various approaches that is suitable for the grid environment. The mechanisms should find a suitable resource quickly and should return the results within a destined time.

II. RESOURCE DISCOVERY APPROACHES

Resource discovery in a Grid environment is a critical problem, as a typical Grid system includes a very large number of resources, which must be readily identified and accessed to run applications. It also has some constraints such as resource should be discovered in shortest amount of time and at minimum cost.

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Resource discovery approaches like Peer-to-Peer Approach, De-Centralized approach, Agent-Based Approach, Ontology Description- Based Approach, Routing Transferring Model-Based Approach, Parameter-Based Approach, Quality of Service (QoS) -based Approach, Request Forwarding Approach are discussed in this paper.

A. Peer-to-peer Approach:

P2P-based resource discovery systems allow nodes participating in the system to share both the storage load and the query load [7].The peer-to-peer approach discussed in reference [8] have four components:

a. Membership protocol
b. Overlay construction
c. Preprocessing
d. Request processing

B. Ontology Description- Based Approach:

Ontology [9] refers to a description of a service. The main idea behind this approach is the advertisement of the resources. In this approach, service provider registers its service description into the service registry database.

C. Routing Transferring Model-Based Approach:

It has three basic roles - resource requester, resource router and resource provider as stated in paper [10]. The provider links itself to the router and in turn the router itself with another router. The request will be sent by the requester with the resource type and value. The routers maintain multiple routing tables. When it receives a request from the requester the router checks it with its own routing table and finds a neighbour to transfer the request. The router periodically receives the resource information from the neighbour and updates its routing table for efficient resource discovery. To locate the resource as soon as possible it uses the shortest Distance Routing-Transferring (SD-RT) algorithm. This algorithm will choose a router by which the resource is nearest to a particular router.

D. Parameter-Based Approach:

The resource discovery approaches rely on maintaining and querying the resource status database. Dissemination of the resource status helps to maintain the database consistent. To support this new concept called potential is introduced in paper [11].Grid potential at a point can be considered as the computing power that can be delivered to an application at that point on the grid. The dissemination algorithms are executed on every node. The dissemination algorithm uses swamping approach for dissemination. The incoming messages in every node are validated based on type of disseminations such as universal awareness, neighbourhood awareness and distinctive awareness. On performance evaluation the authors found that this dissemination algorithm reduced the communication overhead during the resource discovery.

E. Request Forwarding Approach:

According to [7][8] following four-request forwarding Approaches are identified.

a. Random Walk Approach
b. Learning-Based Approach
c. Best-Neighbor Approach

III. RESOURCE MANAGEMENT APPROACHES

Resource management systems can be classified into centralized and decentralized systems based on scheduler architecture. Decentralized systems are further classified into distributed, hierarchical and peer-to-peer systems [14].

A. Centralized Architecture: In centralized architecture, requests are submitted to the central scheduler. The central scheduler is liable for making the scheduling choices at runtime and allocates the jobs to suitable resources [13]. The centralized architecture is easy to manage and very simple to implement the grid RMS but it lacks scalability [13] and fault tolerance [12].

B. Decentralized Architecture: In decentralized architecture, resource requestors and resource owners schedule the jobs to resources independently [13]. The central scheduler is not present. The decentralized architecture is highly scalable and fault tolerant. In addition, it addresses the problems of site autonomy and multi-policy scheduling [12]. However, there is a need to manage the co-operation of schedulers in making the scheduling decisions.

C. Hierarchical Architecture: In hierarchical architecture, the schedulers are organized in a hierarchy. Higher level schedulers manage the high level resources and lower level schedulers manage the low level resource [13]. This architecture addresses the issues of scalability and fault tolerance well but it does not provide site autonomy and multi-policy scheduling [12].

D. Peer-to-Peer Architecture: In P2P architecture [11], a resource provider joins the P2P network through any of the grid portals. The job announcement submitted by a consumer is broadcasted in the P2P network. The providers which are able to meet the deadline bid for the job. Then, the consumer analyses the bids and selects a provider to submit its job.

IV. CONCLUSION

Resource discovery is one of the most important aspects of ongoing Computational Grid research. In this paper various grid resource discovery approaches are analyzed. Resource management is the fundamental constituent of grid infrastructure. In this paper, a classification of grid resource management is presented based on scheduler architecture. Several resource management techniques have been reviewed under appropriate category. Each approach is found to satisfy the user requests and it can be made efficient with some modifications.

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