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IMPROVED PROXIMITY AWARE LOAD BALANCING FOR HETEROGENEOUS NODES

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Abstract

Conventional load balancing schemes are efficient at increasing the utilization of CPU, memory, and disk I/O resources in a Distributed environment. Most of the existing load-balancing schemes ignore network proximity and heterogeneity of nodes. Load balancing becomes more challenging as load variation is very large and the load on each server may change dramatically over time, by the time when a server is to make the load migration decision, the collected load status from other servers may no longer be valid. This will affect the accuracy, and hence the performance, of the load balancing algorithms. All the existing methods neglect the heterogeneity of nodes and contextual load balancing. In this seminar, context based load balancing and task allocation with network proximity of heterogeneous nodes will be studied.

Introduction

Advancement in computer networking technologies have led to increase interest in the use of large-scale parallel and distributed computing systems. Distributed systems are gaining popularity by one of its key feature: resource sharing. A Load balancing algorithm tries to balance the total systems load by transparently transferring the workload from heavily loaded nodes to lightly loaded nodes in an attempt to ensure good overall performance relative to some specific metric of system performance. Effective load balancing algorithms/techniques are used to distribute 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 throughputs.

Distributed systems are characterized by resource multiplicity and system transparency. A variety of widely differing techniques and methodologies for scheduling processes of a distributed system have been proposed. These techniques are broadly classified into three types: task allocation approach, load balancing, load sharing. The main goal of load balancing is to equalize the workload among the nodes by minimizing execution time, minimizing communication delays, maximizing resource utilization and maximizing throughput.

The main motivation for our study is to improve the efficiency and usability of networks and processing units in cluster computing environments considering the context information of nodes.

Literature survey

Generally, the performance of Load Balancing in contextual environment depends upon the selection of an agent based on nodes social or physical context [1]. On the other hand, using Distributed hash tables (DHTs) virtual server can be designed to find suitable resources on a node for load assignments and proximity aware load balancing [2]. In a practical scenario if a given node has all the resources available for task execution minimum load balancing overhead will incur otherwise the amount of load transfer will be more.

From the P2P system perspective, "efficiently" is interpreted as striving to ensure fair load distribution among all peer nodes. Many solutions have been proposed to tackle the load balancing issue in DHT-based P2P systems [6]. However, existing load balancing approaches have some limitations; they either ignore the heterogeneity of node capabilities, or transfer loads between nodes without considering proximity relationships, or both.

In distributed load balancing if all the resources are located at the same site; the load transfers may be negligible. However, for large-scale, where the resources may be distributed across different heterogeneous nodes, the load transfers may no longer be neglected. As a result, when any node fall out of resources its load status to be declared and load migration decisions should be made accordingly. As the nodes are heterogeneous the load on each node may change continuously. This will affect the accuracy, and hence the performance, of the load balancing algorithms. All the existing methods neglect the heterogeneity of nodes and load assignments considering the proximity of nodes on the accuracy of the load balancing solutions. Hence a comparative study of different load balancing algorithms considering context aware is discussed.

Features

- **Load Balancing**: - The computing power of any distributed system can be realized by allowing its constituent computational elements (CEs), or nodes, to work cooperatively so that large loads are allocated among them in a fair and effective manner. Any strategy for load distribution among CEs is called load balancing (LB). An effective LB policy ensures optimal use of the distributed resources whereby no CE remains in an idle state while any other CE is being utilized. Effective utilization of parallel computer architecture requires the computational load to be distributed, more or less, evenly over the available CEs. Distribution of computational load across available resources is referred to as the *load balancing* problem.
- **Context based load balancing**: - The context of an agent can be simply regarded as the environment it is situated which includes the physical context and the social context (organizational one). The physical context is produced by the agent's physical environment, which can be regarded as the agent's physical location, and the physically nearby agents within the subsystem; the resources owned by the agents within its physical context are called the physically contextual resources. On the other hand, agents in the complex system should be organized within some social organizations, so the counterpart agents in the social organizations can be regarded as the agent's social context, and the resources of the agents in the social context are called socially contextual resource.

- **Physical context** If an agent lacks the necessary resources to implement the allocated task (we call such agent as initiator agent), it may negotiate with its physically contextual agents; if the physically contextual agents have the required resources (we call those agents that lend resources to the initiator agent as response agents), then the initiator agent and the response agents will cooperate together to implement such task. The negotiation relations from agent to other agents within its physical context form a directed acyclic graph with single source a, which is called the physically contextual resource negotiation topology (PCR-NT) of agent a.
- **Social context** In the social organizations, it is more likely that the near individuals may have more similarities and, being closer together in the organizational hierarchy, share more common interests than the remote individuals Therefore, in the social organizations of complex systems, each agent will negotiate with

other agents for the requested resources gradually from near places to remote places. Let a be an agent that will negotiate with other agents within its social context and the agents in the nth round of negotiation of agent a be called the social contexts with gradation n.

- **Existing System***:* - All the existing context based algorithms are based on homogeneity of network but ignore distance between nodes.

- **Proposed System**: - The proposed algorithm will take care of the social context of nodes in the network at the time of making load balancing decision. All the nodes in the network are heterogeneous in the sense of their functionality and (or) resources. For this purpose, virtual server concept is used which is not actually present on nodes it is just a notion of load transfer between nodes in network. Virtual server is used in cluster environment. Virtual server is the notion of load transfer and it can transfer active jobs from one node to another. In case of agent based approaches administrative control is required which will guide load transfer. Using virtual machine we can handle security boundaries for job transfer. Rearranging the topology will reduce the load migration cost and bound the contextual similar nodes in one closure.

Proposed Methodology/algorithm

/* let a be the initiator agent, and the set of agents in a's social context be A,
Tx: the subtree whose root is agent x in the hierarchical structure; Px: the parent node of x in the hierarchical structure. */

1) set the tags for all agents in A to 0 initially;

2) b = 0;

3) At = {a}; /*the allocated agent set for task t*/

4) R^t_a = Rt - Ra; /*The lacking resources of agent a to implement task t*/

5) If R^t_a = = {}, then b= 1; /*Agent a can provide all resources to implement task t*/

6) If (b == 0), then:

6.1) Negotiation (a, a); /*a negotiates with the agents within Ta using following steps

6.1.1. Gather load balancing information (LBI) in the form of $< L_i, C_i, L_{i,\,min} >$

<total load on virtual server, capacity of a node i, minimum load of virtual server on node i>

6.1.2. Classify nodes as

A heavy node if $L_i > T_i$

A light node if $(T_i - L_i) >= L_{min}$

A neutral node if 0 <= if $(T_i - L_i) >= L_{min}$

6.1.3 For Virtual server assignment a heavy node chooses a (say i) chooses a subset of its virtual servers $\{v_{i,1}; \ldots; v_{i,m}\}$ (m >= 1)

6.1.4 Upon receiving the paired VSA information the heavy node i will transfer the virtual server $v_{i,r}$ to the light node j.

7) If (b ==1), then Return (A_t) /*All resources for implementing t are satisfied*/

else return (False);

8) End.

In the social organizations, it is more likely that the near individuals may have more similarities and, being closer together in the organizational hierarchy, share more common interests than the remote individuals Therefore, in the social organizations of complex systems, each agent will negotiate with other agents for the requested resources gradually from near places to remote places. Let a be an agent that will negotiate with other agents within its social context and the agents in the nth round of negotiation of agent a be called the social contexts with gradation n.

In the hierarchical structures, each agent can interact directly only to its superiors and subordinates; thus, each agent will first negotiate with its superiors or subordinates for resources. Moreover, in the hierarchical organizations, resource negotiation always happens between pairs of agents that share the same immediate superior; and agents will always negotiate resources through the lowest common ancestor. Therefore, let there be an agent a that can negotiate with other agents within the hierarchical structure according to the following orders:

1. The subordinates of agent a in the hierarchical structure;

2. The immediate superior of agent a;

3. The sibling agents with the lowest common superiors.

When CRM (context based task allocation model) is used, the allocated agents will always incline to be located within the near physical contexts or social contexts, so the communication time will be reduced; however, the allocated agents in SRM (self owned resource based task allocation model) will always be distributed through the system, so the communication time among agents will incline to be more than the one of CRM model. Therefore, the task execution time of CRM model is always less than the one of the SRM model and while the number of tasks increases, the communication time will also increase.

Conclusion

In this project we studied contextual load balancing techniques for distributed systems considering the homogeneous and heterogeneous environment of network. We come to following conclusions:-

- The task allocation and load balancing can be done based on contextual resource negotiation which outperforms the previous methods based on the self-owned resource distribution of agents.
- Relocation of nodes in network according to their social context is possible and

hence it reduces the resource migration cost within the social context.

- Virtual server can be used as a unit of load migration which can transfer active jobs from one node to other as per requirement.

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