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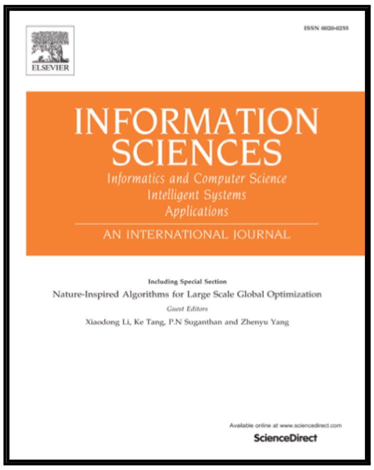

Multi-Resource Scheduling and Power Simulation for Cloud Computing

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Multi-Resource Scheduling and Power Simulation for Cloud Computing

Weiwei Lin*, Siyao Xu, Ligang He and Jin Li

Abstract—Resource scheduling and energy consumption are the two of most significant problems in cloud computing. Owing to the scale and complexity of various resources, it is often difficult to conduct the theoretical analysis of the performance and power consumption of scheduling and resource provisioning algorithms on Cloud testbeds. Thus, simulation frameworks are becoming important ways to complete evaluation. CloudSim is one of the most popular and powerful simulation platforms for cloud computing. However, it requires much improvement to enable CloudSim to perform multi-resource or energy-aware simulations. To overcome this problem, we have extended CloudSim with a multi-resource scheduling and power consumption model, which allows more accurate valuation of power consumption in dynamic multi-resource scheduling. Extensive experiments on six combinations of task assignment algorithms and resource allocation algorithms demonstrate the powerful functionality and superior convenience of the extended CloudSim, MultiRECloudSim. Different task assignment and resource scheduling policies will bring about very different energy cost. We could easily repeat the experiment to find out the efficiency and the power consumption of the algorithms under diverse arguments with MultiRECloudSim.

Index Terms—cloud computing; multi-resource scheduling; power modeling; power simulation; CloudSim

1 Introduction

Cloud computing [2,6,11,31] has rapidly attracted more and more attention in both academic and industry community. In cloud computing, server consolidation is an approach to the efficient usage of server resources in order to reduce the total number of servers that user requires [34]. The growth of server consolidation is owing to virtualization technology which enables multiple VMs to share the physical resources of a computer. The total resources of VMs shared the same server must not exceed that of the server while the number of servers is required to be as small as possible. Server virtualization provides technical ways to consolidate multiple servers bringing about increased utilization and energy saving. As for resource scheduling for tasks, Resource provisioning consists of two provisioning plan for allocating resources in cloud. These are long term Reservation plan and short term On-demand plan [9]. On-demand plan is a scheme where the users can obtain resources when they need. Reservation plan is a scheme where the resources could be reserved earlier. The on-demand plan could satisfy user's need but it usually charges higher fees compared to Reservation plan. The drawbacks of Reservation plan is obvious as well. One is the under provisioning problem in which the resources could not fully meet the need due to dynamic varying workload. Some other problem is over provisioning, where the reserved resources is provisioned more than what actually needed. Thus, the resources reserved will not be fully used and results in energy waste. It remains an important and difficult issue to take full advantage of various resources and reduce power consumption. Resource utilization and power consumption in cloud computing are tightly coupled. A host with low resource utilization typically still consumes much power in comparison with the power consumption when it is being fully utilized. For example, recent studies reported in [4,13] indicate that average resource utilization of the hosts in most datacenters can be as low as 20% and that an idle host still consumes as much as 60% of the power consumed by a fully utilized host. On the other hand, a lot of researches [3,15-17,32,35] focus on multi-resource allocation and they usually perform simulations on a cluster instead of simulators. We think one of the reasons may be most of the cloud simulators do not support multiple resources. Furthermore, a few papers discuss about multi-resource allocation and power consumption at the same time, it is a non-trivial task to evaluate a candidate solution on real Cloud platforms. Firstly, demands and supply patterns, system scale and platform infrastructure vary from one cloud to another. Moreover, background workloads in a cloud change dynamically. It is very difficult, if not impossible, to repeat the experiments with the exactly same settings to compare two candidate solutions. Secondly, many factors may influence the application performance and the power consumption of the supporting data center, such as users' QoS (Quality of Service) requirements, various dynamic workloads, complex scheduling strategies on multiple resources and different power consumption pattern of diverse hardware. Thirdly, the real experiments are time-consuming and sometimes impossible because it is typically required to perform a num-

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