Cost-efficient Resource Allocation for Green Distributed Clouds

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Résumé du projet de recherche (Langue 1)

Distributed clouds have recently attracted many cloud providers and researchers as a topic of intensive interest. High energy cost and carbon emission are two significant problems in distributed clouds. Virtual machine (VM) placement (i.e., resource allocation) method has a direct effect on both cost and carbon emission. Considering the geographic distribution of data centers (DCs), there are a variety of resources, energy prices and carbon emission rates to consider in a distributed cloud, which makes the placement of VMs for cost and carbon efficiency even more critical and complex than in centralized clouds. The goal of this thesis is to present new VM placement algorithms to optimize cost and carbon emission in a distributed cloud. The first part proposes, develops and evaluates static VM placement algorithms to reach the goal where an initial placement of a VM holds throughout the lifetime of the VM. The second part proposes algorithms for dynamic VM placement where the initial placement of VMs is allowed to change (e.g., through VM migration and consolidation). This thesis first focuses on cost efficiency problem in distributed clouds and, then, extends the problem to optimization of both cost and carbon emission at the same time. The first contribution is a survey of the state of the art on cost and carbon emission resource allocation in distributed cloud environments. The second contribution targets the challenge of optimizing inter-DC communication cost for large-scale tasks and proposes a Network-Aware Cost-Efficient Resource allocation method, called NACER, for distributed clouds. The goal is to minimize the network communication cost of running a task in a distributed cloud by selecting the DCs to provision the VMs in such a way that the total network distance (hop count or any reasonable measure) among the selected DCs is minimized. The third contribution proposes a Network-Aware Cost Efficient VM Placement method (called NACEV) for Distributed Clouds. While NACER only considers inter-DC communication cost, NACEV optimizes both communication and computing cost at the same time and also proposes a mapping algorithm to place VMs on PMs inside of the selected DCs. NACEV also considers some aspects such as heterogeneity of VMs, PMs and switches, variety of energy prices, multiple paths between PMs, effects of workload on cost (energy consumption) of cloud devices (i.e., switches and PMs) and also heterogeneity of energy model of cloud elements. The forth contribution presents a Cost and Carbon Emission-Efficient VM Placement Method (called CACEV) for green distributed clouds. In addition to cost efficiency, CACEV considers carbon emission efficiency and green distributed clouds. It is a VM placement algorithm for joint optimization of servers and network, which also considers price, location and carbon emission rate of resources. It also, unlike previous contributions, considers IaaS Service Level Agreement (SLA) violation in the system model. The fifth contribution proposes a dynamic VM placement algorithm using static CACEV algorithm as its initial VM placement part and adding new algorithms for VM reallocation part. The joint VM placement-reallocation mechanism can constantly optimize both cost and carbon emission at the same time in a distributed cloud.