Chapter 50
Building Intelligent Transportation Cloud Data Center Based on SOA

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ABSTRACT

This paper is targeted at issues including traditional stovepipe data center, low utilization of IT equipment and data resources as a result of rigid IT structure, high maintenance costs and high energy consumption in system operation. By taking Beijing Municipal Committee of Transport (BMCT)'s data center as an example, a way to establish distributed traffic cloud data center based on SOA (Service-Oriented Architecture) fused with cloud computing is introduced in this paper; in addition, network-aware energy conservation scheduling DENS (Data- center Energy-efficient Network-aware Scheduling) algorithm applied in cloud data center is put forward to realize the full utilization of all kinds of resources in the cloud data center. Experimental results also show the effectiveness of the proposed algorithm by comparing with traditional DENS algorithms.

INTRODUCTION

With the wide application and long-term development of network, cloud computing technology has become mature gradually, technologies like virtualization, distributed processing, data processing and cloud storage are also making it more comprehensive and perfect (Zissis & Lekkas, 2011, Jing & Fortes, 2010, Al-Rousan, 2015). Cloud computing applied in traffic system, has brought significant economic and

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social benefits, many countries including America, Europe and Japan have already integrated it into the development strategy of intelligent traffic system (Armbrust et al. 2010, Kim, Kyong Hoon, et al. 2011, Ismail, 2011, Menzel & Ranjan, 2012). As a result, the wide application of cloud computing technology in the field of traffic and the establishment of traffic cloud data center has become an irreversible trend.

Based on the current construction situation of traffic system in our country, this paper integrates SOA with distributed cloud data center building technology of cloud computing, takes advantage of open-source virtualization technology OpenStack to build the framework of the whole traffic cloud data center (Yao et al., 2012, Ma, 2011, Azeez et al., 2010, Li & Svard, 2010). Moreover, by taking Beijing Municipal Committee of Transport (BMCT)'s cloud data center establishment as an example, incorporated with DENS algorithm, it can overcome the obstacles in terms of unified management, business collaboration and resources allocation among BMCT's data center and its sub-centers (Azeez, Perera, 2010, Feuerlicht, 2010, Kliazovich et al., 2010).

SOA (Service-oriented Application) is an architectural model applying its components' services to others by using communications protocols or networks including standardized service contract, service loose coupling, abstraction, reusability, autonomy, compensability and granularity. Previous scholars focused on model-driven development (Ameller, et al., 2015), quality-driven approach (Teixeira et al., 2015) and some applications on cloud computing paradigm (Valilai & Houshmand, 2013), cost-effective data farming (Król & Kitowski, 2016), and ensemble flood forecast (Shi et al., 2015). Recently, it is also widely used in cloud computing; Geerts & O'Leary (2015) presented an architecture for integrating cloud computing and enterprise systems based on the Resource-Event-Agent (REA) model in RosettaNet system and showed different characteristics of the approach; Li et al., 2016 proposed service-oriented mobile cloud computing model in a flexible service provisioning method based on context constraint, and Barry & Dick (2013) introduced Savvy Manager's Guides of Service-Oriented Architectures, and Cloud Computing.

As the surveys from governmental, industrial, and academic, the energy utilized by computing and communication units in the data center will lead operational costs of the data center, so a data- center energy-efficient network-aware scheduling method (DENS) was applied to reduce the cost (Kantarci & Mouftah, 2014). DENS algorithms were recently dramatically developed and some scholars applied DENS algorithm in Ad Hoc Networks (Cupertino et al., 2015), heterogeneous distributed systems (Zhang et al.,2016) and computational grids (Teodoro et al., 2016); Zhu et al. (2016) developed a component for energy monitoring and routing in OpenNaaS; Jiang et al. (2016) formulated the problem in mathematical format by integer linear programming to minimize the power usage of data center networks by consolidating traffic flows and turning off unnecessary network devices, and Lei et al. (2016) introduced an enhanced multi-objective co-evolutionary algorithm to improve the efficiency of the renewable energy utilization and the task implementation of data center.

THE OVERALL ARCHITECTURE OF CLOUD DATA CENTER

SOA is a component model, which can build a good connection between different functional units (that is, service) in the system by means of well-defined interfaces and contracts. Traffic cloud data center based on SOA can have access to a variety of services (a service is a functional unit) from relative departments or subordinate units, which can then be transformed into required service by different combination mechanism. In cloud data center, all resources are service; relative system of traffic department can

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