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A multi-dimensional hierarchical performance evaluation model for edge cloud platform

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Abstract

Edge computing is a new trend in the development of Internet of things, which can integrate network, computing, storage and applications to provide intelligent services. It has a broad development prospects, but also brings a lot of new problems. The performance evaluation of edge cloud platform is a crucial aspect. Existing cloud platform performance evaluation research is mostly aimed at one aspect of performance so it needs more in-depth research and improvement. In this paper, we propose a new multi-dimensional hierarchical performance evaluation model. We first study the application scenarios of the edge cloud platform and select key performance indicators. Then, we divide indicators into five categories: capacity, performance, reliability, agility and equilibrium, each category is classified to three levels. Finally, we use Analytic Hierarchy Process(AHP) method to calculate the whole performance score to evaluate edge cloud platform.

1. Introduction

With the continuous development of network technology and intelligent mobile terminal, Internet application continues to be popular. For enterprises that provide data services, IT systems need to handle more traffic, which puts

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a lot of pressure on the infrastructure. Cloud computing[1] can break the traditional server restrictions and provide flexible "unlimited" resources in "pay-as-you-go" way. However, traditional cloud platform has higher network delay and may result in network congestion. It is not suitable for real-time, large data, high reliability applications. So the industry introduced the concepts of fog computing[2] and edge computing[3].

As various edge cloud platform has been introduced into market, users have not only concerned about the cloud platform features -- that cloud can do, more concerned about "how did it do"[4]. It has become an urgent problem needed to be solved to measure the performance of different cloud platform.

At present, there are many enterprises and universities in the study of how to build edge cloud platform performance evaluation model. The present modeling strategies are no longer applicable in new environment because calculation scale is very large and constantly changing, so we require a new performance evaluation method. By analyzing the characteristics and application scenarios of edge cloud platform, we select some key performance indicators and propose a multidimensional hierarchical performance evaluation model. This model divides indicators into five categories: capacity, performance, reliability, agility and equilibrium. Each category includes three level detailed indicators. Finally we use Analysis Hierarchy Process(AHP)[5] method to calculate overall performance score, which is widely used by academics.

This paper is organized as follows. In Section 2, we discuss the related work. The Section 3 focuses on multidimensional hierarchical performance evaluation model. In Section 4, we show the modeling method. Section 5 contains the summary and future works about this topic.

2. Related work

In ETSI GS NFV-TST 001[6], performance indicators are divided into compute, storage, and network subgroups. Each subgroup is organized by the following categories:

(1) Performance/Speed: Reflecting the basic performance of VNF application. Processing speed(number of instructions per second) is an example of compute performance indicators.

(2) Capacity/Scale: Reflecting the maximum value that application can achieve when deployed on the NFV infrastructure. The maximum throughput of Ethernet frames exchanged per second is an example of network capability indicators.

(3) Reliability/Availability: Reflecting the reliability and availability of infrastructure to deploy applications. The average disk failure time is an example of storage reliability indicators.

SPEC(Standard Performance Evaluation Organization) launched SPEC Cloud ™ IaaS 2016 benchmark[7] on May 3, 2016. This work can help cloud computing operators, hardware vendors and users to evaluate the performance of various IaaS cloud platforms. It presents three key indicators: scalability, flexibility, and mean instance configuration time.

In academia, performance evaluation of edge cloud platform mainly focuses on the relevant test indicators, the traditional test tools, and establishment of evaluation model[8][9][10]. The general purpose is to evaluate virtual machine performance. Among them, the performance of virtual machine testing can be classified into processor performance, network performance, memory performance and storage performance.

3. New performance evaluation model

In this section, we propose a new multidimensional and hierarchical performance evaluation model. This model has three levels. Users can evaluate edge cloud platform from five L1 indicators: capacity, performance, reliability, agility and equilibrium. Each L1 indicators has different L2 and L3 underlying indicators. Next we will describe the concept of these five indicators and their related underlying indicators.

3.1. Capacity

Capacity indicator reflects the whole hardware con-figurations of edge cloud platform. By testing the number of nodes, servers, CPU cores, NIC(Network Interface Card) and storage size, users can visually understand the overall scale of cloud.