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The method to secure scalability and high density in cloud data-center

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ABSTRACT

Recently IT infrastructures change to cloud computing, the demand of cloud data center increased. Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared computing resources that can be rapidly provisioned and released with minimal management effort, the interest on data centers to provide the cloud computing services is increasing economically and variably. This study analyzes the factors to improve the power efficiency while securing scalability of data centers and presents the considerations for cloud data center construction in terms of power distribution method, power density per rack and expansion unit separately. The result of this study may be used for making rational decisions concerning the power input, voltage transformation and unit of expansion when constructing a cloud data center or migrating an existing data center to a cloud data center.

1. Introduction

Cloud computing refers to both the applications delivered as services and the hardware and infrastructure in the data centers. Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared computing resources that can be rapidly provisioned and released with minimal management effort. It relies on sharing of resources to achieve coherence, economics of scale, and business agility [2,5].

Generally, cloud computing is based on metering, making the consumer pay for the usage, refers to the ability of an ICT organization to track and measure the ICT expenses per business unit and charge them back accordingly. To provide cloud computing service, the data center has to change to get flexible, efficient resource allocation, and rapid change management. That is, the cloud computing providers cannot estimate the customer's demand, so they will expand the resource from demand.

Data centers providing the variable cloud computing service need to secure scalability as the ICT service demand changes[1,7,8]. The most basic element of data center operation is the power, and the power is eventually consumed by the servers. Therefore, the power supplied at high voltage by the power plant must be transformed to the low voltage so that it can be used by the ICT equipment. Such transformation can occur differently at the

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Table 1
Comparison of traditional data center and cloud data center.

Items	Traditional data center	Cloud data center
Power density	Low density (1–3 kW/Rack)	High density (10 kW/rack or higher)
Data center architecture	Difficult to expand the facility	Flexible architecture to support expansion of ICT infrastructure (modularized architecture)
Operation	Independent management of ICT infrastructure and facility	Integrated management for stability and cost efficiency

isolated steps from the power reception unit to server in the data center, and each method has the strengths and weaknesses according to the power amount, wiring, power factor, etc.

This study describes the factors – separated to power supply method, power management unit and expansion unit – to be considered to construct a data center with consideration to scalability according to cloud computing demand. Particularly, it categorizes the types of the transformation steps of supplying the power from the power plant to the data center and to the server then presents the power distribution method most appropriate for the cloud data center to help administers determine the power density of the cloud data center which requires the large capacity power.

2. Features of cloud data center

Due to the characteristics of cloud computing service, it is difficult to determine the capacity of the ICT infrastructure after predicting the demand since which services will be provided are not known. Since it is inefficient to own a large scale ICT infrastructure right from the beginning, a cloud service provider generally starts with a small capacity and gradually expands it as there is the need for additional capacity. As such, a cloud data center must be designed and constructed to quickly enable expansion of the center and subsidiary equipment as the ICT infrastructure is expanded [3,4].

As most cloud computing is deployed with the virtualization technology using the low-priced Intel based x86 servers, it requires more servers than using the mainframe or Unix server and thus the power density per rack is relatively high. Therefore, the number of servers installed on a rack must be reduced in order to support cloud computing with the data center equipment which conventionally has low power density per rack. In that case, larger data center space is needed and price competitiveness decreases due to the higher operating cost. Thus the trend is to deploy cloud computing in high density.

Since the cloud users would prefer the service providers offering the good quality services at lower prices, the cloud service providers have the intention to lower the operating cost. Moreover, it is essential to provide the uninterrupted service stably as the IT service trend is changing from owning the ICT infrastructure and data center to cloud computing environment using the ICT infrastructure of the service provider. Therefore, the operation paradigm must be changed to enable operating optimization while providing the stable service and integration of the ICT infrastructure and data center systems is more beneficial for that. In other words, an integrated operation measures of flexibly operating the power and HVAC according to the ICT infrastructure utilization to ensure cost efficiency and surveying the impact of ICT infrastructure problem for each element and planning the countermeasures in advance to minimize the impact of the data center equipment fault is needed.

A data center supporting cloud computing must have the equipment supporting the high density as the ICT infrastructure is advancing to high density environment, the architecture to support flexible expansion of ICT infrastructure to cope with external environment, and operation system enabling service stability and cost optimization in order to increase the cost competitiveness of the cloud service [6] (Table 1).

3. Measures to construct high density data center

For data center operation, it is the most critical to stably supply the power to the ICT systems. The high voltage power supplied by a power plant goes through the power receipt unit, UPS and power distribution unit before it reaches the ICT system. A large scale data center is typically organized of two power lines to supply the power to dual powered CIT system to ensure the stability of the power supply so that the IT services can be provided uninterrupted even when there is a problem with the main line or the equipment is changed.

The high voltage power supplied by a power plant must be transformed to the low voltage power to be used by the ICT systems. Such transformations can be combined into different sets at the various isolated steps in the data center, and each method has the strengths and weaknesses according to the power amount, wiring, power factor, etc. Unlike the conventional data centers, a cloud data center requires the variable attribute thus must consider the expansion unit when there is the need for additional demand.

Therefore, the elements that must be considered to construct the high density data center with scalability are separated into the power distribution type, power density per rack for power management, and expansion unit settings (Fig. 1).

3.1. Power distribution type setting

The most important factor for data center safety and efficiency is utilization of the power supplied by the power plant, and the location of the voltage transformation to supply the power to ICT systems determines wiring and power efficiency. To minimize the waste and reduce the