Efficient Server Power Supply Configuration for Cloud Computing Data Center

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Abstract—This paper presents a highly efficient power-redundant system for rack mount servers by changing the power backplane of the server main board. The proposed system does not need an additional redundant power supply for supporting power redundancy by sharing power at each rack mount server. In addition, the proposed power sharing architecture can provide more power efficiency than the existing rack mount server power supply.

Keywords—Power; Redundant; Efficiency; PSU; Server; Rack

I. INTRODUCTION

Energy efficiency is a key technology of cloud computing data centers. Large sized data centers such as Google and Facebook are developing reduced power technologies by changing the power delivery or uninterruptible power supply (UPS) architecture and using a highly efficient power supply unit (PSU) in the server, or by developing a more efficient cooling system [1]-[3]. Lawrence Berkeley National Laboratory has experimented using high voltage DC entirely throughout the data center, saving 10% to 20% of the power cost [4]. And rack-level high-voltage DC delivery also has been researched [5]-[7].

Server power consumption increased linearly up to 2008 as the CPU increased in density and operating frequency. However, since 2008, it has decreased gradually by improvements in semiconductor technologies such as the CPU, memory, storage, and power management of the OS even when increasing the CPU density and number of cores [8]. On the other hand, PSU capacity and power efficiency are increased gradually. The highly efficient 80 PLUS certified PSU, which has over 80% energy efficiency is widely used in the market.

Low-cost x86 platform-based 1U or 2U servers have been extensively used in search and cloud computing fields at data centers. These servers usually do not support hardware PSU redundancy for certain problems that need additional PSUs, and the efficiency drops from the standby power consumption. Therefore, if these servers experience a power failure, the services are not supported or recovered using software service backup.

In this paper, we show the new idea of a new power-redundant architecture for low-cost rack mount servers by changing the server power backplane considering the connection with other servers. The proposed idea is very simple and immediately applicable in the field and can be variety of power configurations according to the PSU capacity and server power consumption.

II. POWER PROBLEMS AND SOLUTIONS

A. Problems of server power

An idle server consumes just 60% of maximum power consumption, and 70% of the servers remain in an idle state at a data center [9]. Therefore, it is very important that the server remain highly efficient when idling. Because the PSU efficiency is not good below a 20% load, it is recommended that the idle power consumption of the server be over 20% of the PSU power capacity. But the problem is, actually the PSU power capacity is much bigger than the recommended power capacity considering the maximum or idle power consumption in the server. Therefore server working in idle state is located in a poor efficiency area. Moreover, if the server supports hardware power redundancy, the server has at least two PSUs installed, one active, and the other used for standby. Because a standby PSU consumes some standby power, the efficiency of the server decreases.

B. Simple idea for solving the problems

PSU is generally used for only one server, and there are a lot of redundancies considering the operating power consumption of the server. If this redundant power can be used as the redundant power of another server, it is a useful and easy way to solve the power redundancy of low-cost rack mount servers. We propose a new power-sharing configuration with no use of an additional PSU and no loss of power efficiency, which supports redundant power in a rack mount server.

Figure 1 shows the proposed power-sharing PSU backplane architecture of each rack mount server. The proposed PSU backplane is shared with two other extended external power connectors, redundant DC#1 and DC#2, as well as a PSU. Generally, the connection of a PSU and a motherboard uses mainly separated DC power pins and control pins. DC power pins consist of single or multi power lines, including standby power and GND. There are also...
load-share pins, which have a power load sharing function between all connected PSUs, and power on/off control pins, power state pins, and PMBUS signals as control pins. The PSU power backplane shares DC power and load-share pins with two redundant power inputs located near the PSU through a backplane board, as shown in Fig. 1.

The proposed power-sharing backplane can be used not only power-redundant configuration but also reduced PSU system. If the server meets the condition that PSU capacity over two times of maximum server power consumption, it may be possible to operate two servers using only one PSU. The same method, various highly efficiency efficient power configurations can be configured as in terms of the PSU capacity and server maximum power consumption of the server while booting.

III. CONCLUSION AND FUTURE WORKS

This paper proposed a power-sharing backplane for supporting power redundancy without an additional PSU in a rack mount server. The proposed system can be configured into various daisy chain connections according to the PSU capacity and the maximum power consumption of the server. A redundant configuration can reduce the installation costs of a redundant PSU, and a highly efficiency configuration can reduce both the power consumption and installation costs by operating the server at a high efficiency area. In the future, we will experiment using servers with the proposed power sharing backplane and measure the power to prove our assumption.

REFERENCES
