Chapter 10
Green Energy in Data Centers Using Internet of Things

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ABSTRACT

Green energy infrastructure with the internet technologies relies on five important domains: green machine to machine (M2M), green cloud computing (CC), green data center (DC), green ICT, and green cellular. The ever-increasing demand for cloud computing and heavy dependence on cloud for storage, processing, and applications results in the need for more data centers with high capacity. Power management using wireless sensor networks (WSN) can be a potential solution as there has been a lot of works suing WSN for power management for green buildings, green home, and green farming. The same design can be applied to data centers with modifications to cater for data centers. Since WSN is part of IoT, various IoT-related solutions can be proposed for green data center solutions. A hybrid model that consists of virtualization, cooling systems, and IoT shows energy efficient data center designs. There have been various efforts as such, and this research will present green energy designs and mainly IoT-related initiatives for green-aware data centers.

INTRODUCTION

The increase in need of data processing has led to a demand in obtainability for cheaper, faster, efficient and larger data management system. This has further introduced a significant problem in terms of energy consumption and energy usage as mentioned in (Barroso. L.A, 2005). Since the trend of Internet

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Infrastructure is moving towards services-based computing, data center plays a key role in this new computing architecture. It is used widely in variety of services independent encapsulating any vendor, product and technology including web hosting, application services, electronic markets, outsourced storage, online-monitoring system, mashups, digital nervous system and other network services. Fostering renewable energy production, developing better renewable technologies and improving the environmental performance of conventional electricity benefits heightened through improving the long-term strategy of data center performance. Environmental Protection Agency (EPA) shows that the data center and database management system in the US consume power doubled between 2000 and 2006 and may multiply again within the next decade. According to EPA, it is projected that energy consumption by data centers for the year 2008 is more than 80 billion kWh. (US Department, 2013). Report to the Congress, EPA's Energy Star Program estimates that increase efficiency in data centers could yield energy savings as the burgeoning efforts to make data centers greener is the energy and the word 'green' adds multiple meaning when applied to the data centers. (Koomey J, 2011).

Many works have been done to produce efficient result in reducing the energy usage for the purpose of data center and data management for example by Cisco System Inc., Google Inc., and many more (Barroso.L.A,2005). Some of the approaches were to design highly efficient systems at the peak performance point with maximum utilization of resources. But very few studies have addressed the energy problem comprehensively (US Department, 2013).

PROBLEM STATEMENT

In today's technological world, it is proven that there is a significant relationship between data center and investment in capital overlay and outgoing costs. Table 1 shows the detailed breakdown on the distribution of the cost from data center (Greenberg et al., 2008).

The design of computing system is being optimized based on the execution time and operates at low consumption due to entrapment of resources and fragmentation of data. No concern was made for the issue of energy consumption by the system. Uncontrolled usage of energy in data centers has negative effects on the reliability, density, scalability of information processing and the environment. Need and awareness are raised across nation through multiple solution and disciplines to optimize and save energy use in data management system (Barroso. L.A, 2005). System or even its components like CPUs, memory and disk are hardly distributing energy efficiently. It trades power for performance (US Department, 2013). Power management has become a critical issue due to large energy usage and all over the world government has started imposing the taxes on the carbon emission, ultimately aiming to reduce the emission and help make computing into green computing (Bansal et al., 2011).

Although research was conducted in designing power aware applications, an effort for implementing has not been taken place. Large expenses and allocations need to be augmented when data center reaches maximum provisioned power (Bansal et al., 2011). In the very near future, energy efficiency is expected to be one of the key procuring arguments in the society. Research should focus in building power-aware database management systems (DBMS) or GreenDB.

Analysis shows that giant companies are also working towards energy efficiency using green database system. Huge volume of energy usage goes to the data center. The global business market intelligence is a billion dollar market and still growing to see double-digit growth rates (US Department, 2013). With the growth of the internet data center (IDC), data systems are also running its management workload