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Analyzing the Data Center Efficiency by using PUE to make Data Centers More Energy Efficient by Reducing the Electrical Consumption and Exploring New Strategies

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Abstract

In today's technology driven world the growth of the data centers have been enormous to match the required needs of various institutions, organizations and governments etc. for storing data in a safe and secure manner. Similarly efficient use of electrical energy is gaining importance due to diminishing resources and ever growing demands. Therefore the efficient energy utilization is a must in a data center. In this paper we have discussed the architecture, electrical system and the cooling system of a data center in a generalized manner. Also all the basic required parameters for calculating the energy efficiency of the data center are considered. Suggested procedure can be utilized for the power consumption analysis of a data center and obtained results can help taking measures to improve the energy utilization of the data center.

Keywords: Data Center, Blade Servers, Modular Power Distribution Units, Hot aisle/Cold aisle Cooling, Power Usage Effectiveness (PUE), Energy Efficiency

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1. Introduction

At present data centers have become an integral part for the functioning of any firm in the world at present. A data center is a technical building which is used to house computer systems and its associated components like telecommunication and storage systems together. Back-up power supplies, redundant communication connections, environmental controls and security devices. Data center is a technical facility that has various energy consuming equipments such as servers, network devices, data storage devices and cooling units etc. As a whole these equipments process, store and transmit digital information are termed as IT equipments. The power consumption varies greatly with respect to building [1]. The site level infrastructure network or topology which is mandatory for sustaining the data center operations is described by the Tier classification. The tier standard is established on the fact that the data centers themselves, which are highly dependent on the efficient integrated operation of numerous separate subsystems, the quantity of which is dependent upon the individual technologies like electricity generation, refrigeration, and regulated power supplies etc. to sustain the services and operations. The standards are comprised of a four tired-scale, with Tier IV being the most robust and efficient according the Uptime Institute; certifies the data centers with the tier numbers in the range Tiers I to Tier IV. [2]

2. Power Requirements of a Data Center

Every data center is unique in its own way of operation and requirements. Depending on the work performed the infrastructure is customized accordingly. The technology is developing in such a way that it is capable of providing solutions which would result in the increase of business proportions by decreasing power disruptions. It is a necessity to have the required infrastructure like products, services and systems which adequately meet the requirement as per the desired tier working. High efficiency equipment by design for enhancing the efficiency of the data center is often snubbed due to high initial cost. As the companies create new applications for their growth the business dependence on the data centers increases which also results in the increase of equipment density and criticality. Higher operating flexibility, lower operating costs and higher system availability created by the advancement of technologies resulting in dynamic response to variations in capacity, density and availability in the present world can become a reality.   Once the energy needs of the critical IT load are established, simple rules can be used to precisely determine the power consumption of these elements. We would now discuss in detail the electrical and cooling systems of the data center [3] [4]. The study of the carbon foot print of a data center is also important while analyzing the efficiency of a data center [5] [6].

2.1. Electrical System of a Data Center

Due to the advancement in technology and growing demands, the energy requirement of the IT Racks have altered a lot in last few years. The total power consumption of a rack has increased to more than 20 KW from 4KW initially due to the increase in the power receptacles from fourteen to eighty four required for the support of fully populated rack. The change at present is driven by the evolution of blade servers which on an average consume twenty four kilowatts of power [4]. Critical Part consists of UPS, PDUs, Server farms, Computer Room Air Conditioning (CRAC) units and emergency lighting. The non-critical part consists of office loads, DG sets and workstations. The size and spread of the data center determines the voltage rating of the transformer. The transformer is the ultimate gateway for the power into the data center. The essential factors to be considered during selection and operation of transformers are harmonics and it's K-Rating. The soul of any critical power infrastructure is the UPS. It provides primary protection from the harmful power disturbances. It provides the required back-up power during the outage times. UPS protects the data center from unpredicted power disruption which would cause loss of data resulting in the disastrous consequences of the business firm. The power distribution to the critical IT load is done through the power distribution units (PDUs).

2.2. Cooling System of a Data Center

Cooling system to remove heat from the data center is of prime importance and consumes around 35 to 40 % of the total power consumption. Effective heat removal is one of the most vital processes for optimum operation of data center irrespective of its location. Operating temperature and humidity levels should be maintained at recommended levels. Therefore reliable and efficient cooling system is extremely important [7]. Conventional Method and Contemporary Method are two ways of cooling.