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Title Name

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[1]*Assistant Professor, Department of Information Technology, Hindustan Institute of Technology and Science, Chennai, India. E-mail:bvb.ithits@gmail.com.*
[2]*Professor, Department of Computer Science and Engineering, Hindustan Institute of Technology and Science, Chennai. India.*

Abstract

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Keywords Datacenter design, energy efficiency of datacenter, energy efficient metrics, datacenter, carbon footprint computation.

1 Introduction

Energy efficiency and low carbon strategies have attracted a lot of concern. The goal for 20% energy efficiency and carbon reduction by 2020 drove the Information Communication Technologies (ICT) sector to

strategies that incorporate modern designs for a low carbon and sustainable growth [1, 2]. The ICT sector is part of the 2020 goal and participates in three different ways. In the direct way, ICT are called to reduce their own energy demands (green networks, green IT), in the indirect way ICT are used for carbon displacements and in the systematic way ICT collaborate with other sectors of the economy to provide energy efficiency (smartgrids, smart buildings, intelligent transportations systems, etc…). ICT and in particular data centers have a strong impact to the global CO_2 emissions. Moreover, an important part of the OPEX is due to the electricity demands. This paper presents the sources and challenges that have to be addressed to reduce carbon emissions and electricity expenses of the sector demands without considering the data volume. Taking into consideration this ratio, green IT technologies have important benefits in terms of:

- Reduce electricity costs and OPEX;
- Improve corporate image;
- Provide sustainability;
- Extend useful life of hardware;
- Reduce IT maintenance activities;
- Reduce carbon emissions and prevent climate change
- Provide foundations for the penetration of renewable energy sources in IT systems.

2 Data Center Infrastructures and Power Consumption

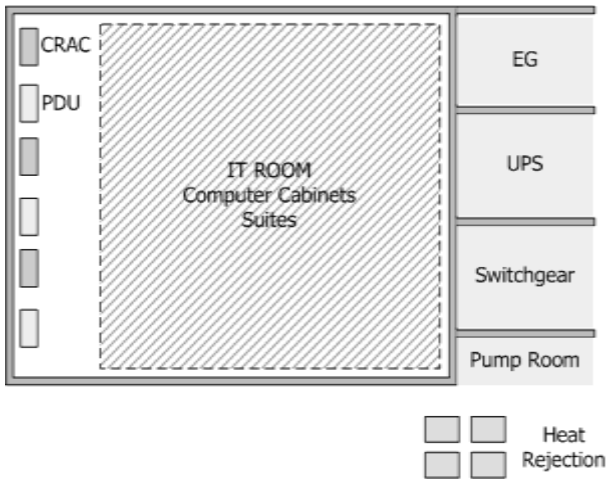

Figure 1 Typical Data Center Infrastructure

The overall design of a data center can be classified in 4 categories Tier I-IV each one presenting advantages and disadvantages related to power consumption and availability [18, 19]. In most cases availability and safety issues yield to redundant N+1, N+2 or 2N data center designs and this has a serious effect on power consumption. According to Figure 1, a data center has the following main units

2.1 *Power Consumption in Data Centers*

Maximum capacity workloads, the efficiency of the UPS cannot be considered constant and equal to the imposed by the manufacturer value.

In general energy efficiency in the telecommunication industry is related to,

$$Energy\ \ Efficiency \sim \frac{Joule}{bit} \sim \frac{Watt}{Gbps} \sim \frac{Watt}{bitrate/Hz} (spectral\ \ efficiency) \quad (1)$$

The optimal description of this value depends on the system's characteristics and the type of equipment. As an example, for modulation and coding techniques in wireless communications the spectral efficiency is

a common measure. For electronic components the ratio of joule per bit best describes performance. In telecommunication networks and datacenters the ratio of watts consumed over the Gbps of data processed is preferred. In [22] absolute energy efficiency metric is introduced, named as dBε. The metric is computed according to the equation

$$dB\varepsilon = 10\log_{10}\left[\frac{Power/bitrate}{kT\ln 2}\right] \quad (2)$$

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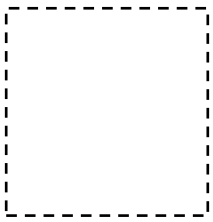
Biographies



S.XXXXX received his B.Tech degree in Electrical and Electronics Engineering from xxxxxxxx, xxxxxxx, India in the year 2018. His area of interests includes Renewable Energy, Power Electronics etc.,