Indian Journal of Science and Technology, *Vol 8(S4), 44-49, Febuary 2015*
ISSN (Print) : 0974-6846
ISSN (Online) : 0974-5645

Improving Efficiency of Data Centres in India: A Review

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Abstract

In the past decade, India has witnessed an exponential increase in the demand for digital storage, from 1 petabyte in 2001 to more than 34 petabytes by 2007. They also continue to grow at a compounded rate of 25-30%. Datacenter growth is driven by increasing requirements from the sectors such as financial institutions, telecom operators, manufacturing and services. While large financial institutions and telecom companies are likely to build captive Datacenters for hosting their growing data storage needs, Datacenter service providers are expected to invest significantly to multiply their capacities, so as to fulfill the demand arising from small and midsize users. Datacenter is highly energy intensive. With the increasing energy cost, the increase in operational cost is inevitable. Therefore it becomes necessary to reduce the energy consumption to offset the increasing operational cost and to maintain competitiveness. Hence the Datacenters in India need to incorporate innovative designs for energy efficiency and embrace the concept of "Green IT" for sustained growth. Existing Datacenters need to adopt the best practices in design, operation and maintenance to achieve operational excellence. New datacenters have to adopt the energy efficiency measures by design. The objective of this paper l is to identify the best practices followed in Indian Datacenters as well as provide guidelines on incorporating energy efficiency aspects at design stage for new datacenter. Design/methodology/approach – Conducting research exploring secondary data and web based resources including white papers, consolidating research articles, industrial and technological hypothecation.

Keywords: Data Centre, DCiE, PUE

1. Introduction and Motivation

The recent proliferation of tablets and smartphones, coupled with the content required to satisfy the (seemingly insatiable) end user needs, has led to an increased demand on data centre services, across the globe. Billions of dollars are spent on data centre infrastructure in order to meet the growing demands of businesses and their customers. Having the right data centre infrastructure has become the new "arms race" for companies trying to differentiate themselves in this crowded, technology driven world. Datacenter growth is driven by increasing requirements from the sectors such as financial institutions, telecom operators, manufacturing and services. While large financial institutions and telecom companies are likely to build captive Datacentres for hosting their growing data storage needs, Datacenter service providers are expected to invest significantly to multiply their capacities, so as to fulfill the demand arising from small and midsize users. Currently there are 3442 co-location datacentres from 103 countries out of which 101 are in India in 20 areas as indicated by Data center map. Within four years, India's data centre capacity is expected to reach 6.6 million square feet. According to Gartner, the data centre co-location and hosting market is estimated to reach USD $609 million by the end of this year and forecasted to reach USD $1.3 billion in the next four years. A recent IDC report notes that data storage requirements by 2020 are set to reach 40 zetabytes (i.e. 40,000,000,000,000,000,000,000 bytes of data). This, along with the other macro trends

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identified, is going to have a massive impact on the data centre industry.

2. Demand Side

Global Demand as a broader picture is shown in Figure 1.

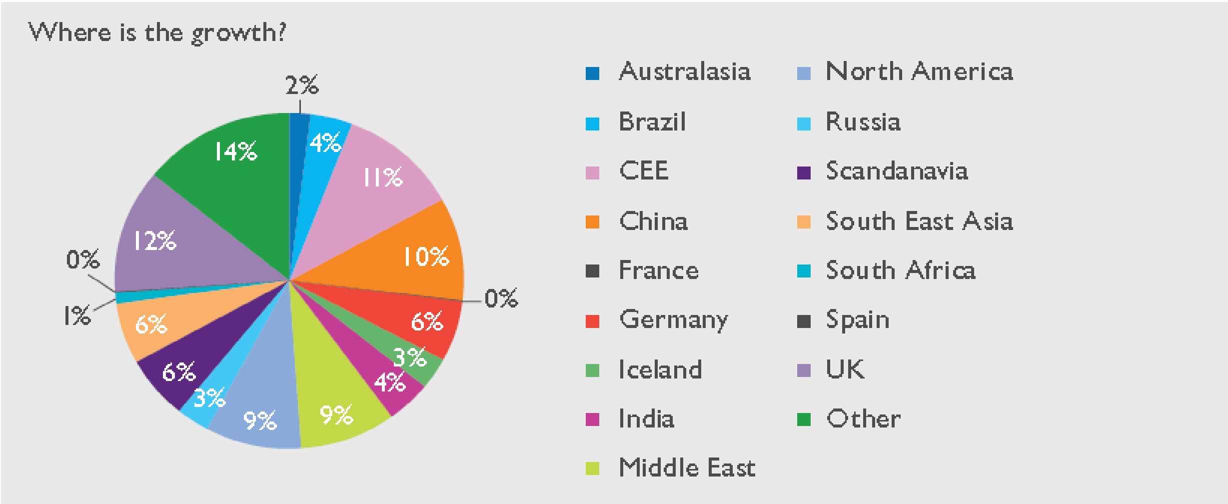

Figure 1. Source DLA piper report 2014.

2.1 Data Centre Market in India (Demand Factor and Future Growth)

"Indian IT infrastructure is poised to be a US$2.35 billion market by 2017," said Naveen Mishra, research director at Gartner. "After sluggish market conditions in 2013, the Indian infrastructure market will witness investments primarily fuelled by key IT initiatives that include mobility, cloud and big data." According to NASCOM report the growth will be doubled by 2015 (9%) in India (NASCOM 2012).

2.2 Demand Drivers for India

Technology Advancements - More and more smart devices are being added to India ASIAN and ASEAN market. Increased use of Social networks, analytics and virtualization leading to more cloud based service models.

Growing Connectivity - Leads to more users in market with increased internet usage, more storage demands and new online businesses.

Business Requirements - With increased number of endpoints in the market there is a growing demand of processing power and applications and the open need to be kept low. All this will lead to Virtualization of infrastructure demanding affordable cloud based services defined by the software (SDI Software Defined Infrastructure).

Demand from Developing Countries - Government initiatives towards e-governance and building relations and trade with ASEAN and Asian Countries will result into new opportunities.

2.3 Growing Concern of Data Centre Efficiency

More and more IT setups would move towards centralized model. BPO and BFSI contribution will be more in this respect. Data Centre involves considerable amount of investment in terms of Real estate, Computer hardware, Storage systems all this poses questions about the efficiency of those Datacentres.

3. Metrics for Data Centre Efficiency

3.1 Data Centre Performance Metrics

BEE (Bureau of Energy Efficiency) recommends the use of the following metrics and tools to analyze the energy performance of a Datacentre. It enables the Datacenter professionals to understand the overall system in a better way and facilitate in improving the energy efficiency levels. It also provides a common platform for comparing the performance levels with other Datacentres.

- Power Usage Effectiveness (PUE) and
- Datacentre Infrastructure Efficiency (DCiE)

PUE =Total facility power/IT Equipment power

DCiE =1/PUE

3.2 Efficiency in Power Utilization (PUE)

Distribution and Losses related to IT power delivery are shown in Figure 2.

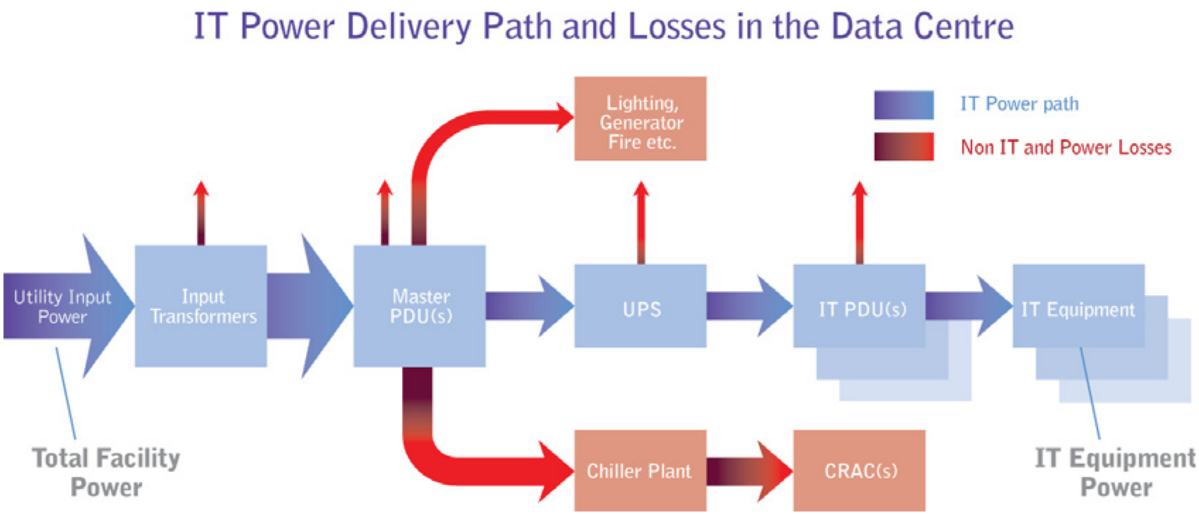

Figure 2. IT power delivery path and losses in the data centre.

3.3 Data Centres and Energy Consumption

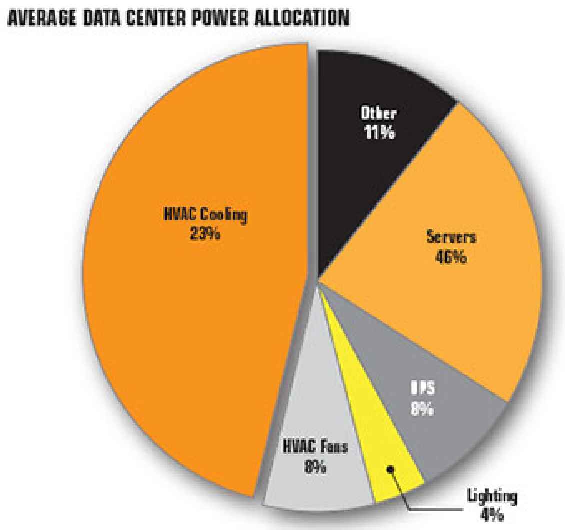

Figure 3. Relative shares of power consumption for a data centre.

This indicates a considerable amount of power is consumed by cooling. Typically the cooling system consumes 35–40% of the total Data centre electricity use. Demands on cooling systems have increased substantially with the introduction of high density servers. As a result, the cooling system represents the second highest energy consumer next to IT load. Architecture for power distribution within a data centre is shown in Figure 4.

4. Power Supplyy

Data centre electrical system is responsible for power supply to Data centre.
Following are matters of Concern:
Diesel Generators (DG)
Selection of an appropriate DG its location and DG efficiency factors need to be monitored and controlled
Transformer
Transformer is the Power gateway for the Data centre. CII and BEE Recommends for non-linear loads and computer rooms, transformer with K-factor 4 to 9. Transmission losses to be kept at minimum.
ATS
It also recommends a use of Automatic Transfer Switches (ATS) for continuous supply from alternate sources with compliances from
A. UL 1008 - Standard for Automatic Transfer Switches
B. NFPA 70 - National Electrical Code
C. NFPA 110 - Emergency and Standby Power Systems
D. IEEE Standard 446 - IEEE Recommended Practice for Emergency and Standby Power
Systems for Commercial and Industrial Applications
E. NEMA Standard ICS10-1993 (formerly ICS2-447)
As per IEEE standards, it is a recommended practice that both the input circuit to the UPS and the associated bypass circuits (including the manual bypass circuit) be equipped with effective Transient Voltage Surge Suppression (TVSS)

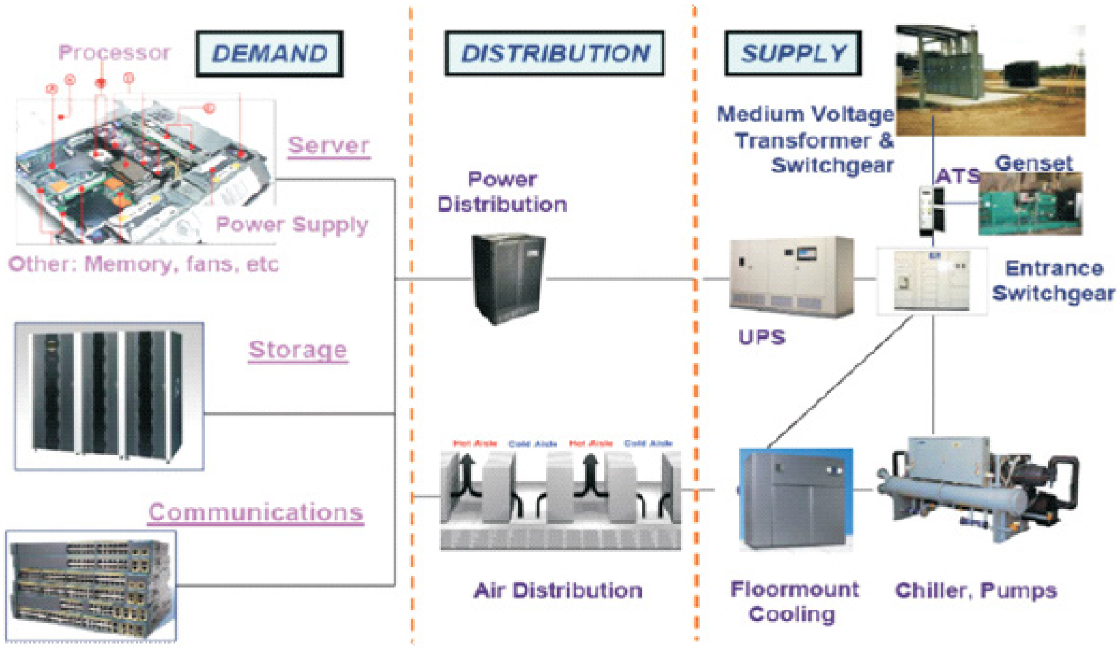

Figure 4. Data center power distribution architecture source CII Data Centre book.

5. Distribution

The distribution of power to the IT load is done through Power Distribution Units (PDU).

An ideal power distribution system suggested would have the following attributes:

- New circuits can be added or changed on a live system
- No under-floor cables are needed
- All circuits can be monitored
- Capacity and redundancy can be managed on every circuit
- The system is highly efficient
- Transmission losses are kept to minimum

CII and BEE report suggests that 40% loading on UPS helps achieving optimum efficiency anything below 40% loading will result in underutilization of UPS System.

5.1 Air Distribution

Air distribution is important for efficient cooling. Best practices are:

Balancing the air flow-Over-head ducted systems can be adequately balanced using conventional methods whereas raised-floor systems are balanced by providing the required number of perforated tiles. The amount of cold air required at each rack should be supplied by placing the adequate number of tiles in front of racks.

Removal of obstructions-Removal Abandoned Cables and Other Obstructions in raised flooring or overhead cables.

Increase supply air temperature-Increase the supply air temperature as per ASHRAE recommendations. Open architectures is often dictated by the hottest intake temperature whereas enclosed architectures allow the highest supply temperatures and efficient cooling.

Texas Instruments provides the following indices for Air Distribution.

5.1.1 Rack Cooling Index (RCI)

RCI is a dimensionless measure of how effectively the equipment is cooled within a given intake temperature specification. It provides a measure of the conditions at the High (HI) end and at the Low (LO) end of the specified temperature range. RCIHI=100% means that no intake temperature is above the maximum recommended, and RCILO=100% means that no intake temperature is below the minimum recommended. Using ASHRAE Class 1 temperature specification, "poor" conditions are ≤90% whereas "good" conditions are ≥96%. The RCI is assuming the ASHRAE Class 1 recommended intake temperature.

5.1.2 Return Temperature Index (RTI)

The Return Temperature Index (RTI) is a dimensionless measure of the actual utilization of the available

Temperature differential in the equipment room as well as a measure of the level of by-pass air or recirculation air in the Datacentre. 100% is generally the target; >100% ® recirculation air; <100% ®by-pass air.

5.1.3 Supply Heat Index (SHI)

The Supply Heat Index (SHI) is a dimensionless measure of recirculation of hot air into the cold aisles.SHI is a number between 0 and 1 and the lower the better. SHI is typically < 0.40. An SHI = 0 meansthat all inlet temperatures are equal to the supply temperature.

Demand (Power)

The last block in power Distribution architecture is the IT devices that consume power. These Devices include Servers, storage devices and communication equipment. These units contribute almost 50% of power. Any saving in IT load would have a direct impact on the loading of most of the support systems such as Critical Cooling, Uninterruptible Power supply, and Power Distribution Units thereby affecting the overall energy performance of the Datacentre positively. Efficiency of each of those units will contribute towards DCiE whereas the heat dissipation of those units will also contribute towards PUE and indirectly to DCiE.

Best practices in this area to reduce power consumption are

- Using low consumption processors and power management functions in processors
- Use of Server Power Management Software (SPMS)
- Use of High Density Server Blades (HDSB)
- Server virtualization
- Air Management using Computational Fluid Dynamics (CFD)
- Monitor and update SAN and NAS

Datacentre Cooling

Cooling is second highest factor with respect to power consumption.

Open Architecture

The cooling coils are deployed near the heat load either, inside or outside the server rack and utilizes the room air volume as a thermal storage ride through short power outages.

Closed Architecture

The cooling coils are deployed inside a fully enclosed rack

Cooling methods

- Conventional method - Room cooling technique
- Contemporary method - Hot aisle/Cold aisle containment technique

The cooling system has various components such as

- Chiller units
- Chilled water pumping system
- Precision air conditioner unit
- Air distribution system

Best practices in cooling are:

- Determine and monitor Heat output. Measure the Return Temperature Index (RTI) and Rack Cooling Index (RCI)
- Improve efficiency of air Distribution
- Keep the cooling units efficient and well maintained.
- Implement Cooling on Demand i.e. Deliver cooling capacity as needed.

6. Conclusion

Consolidation of IT setups and refreshing the setup from time to time to improve power efficiency is needed. Best practices in each vertical in power distribution will improve Data centre efficiency. Lowering PUE and improving on DCiE is very important for Data Centre efficiency. Efficiency of Air Distribution and cooling system will contribute to lower PUE. ASHARE thermal guidelines for maintaining datacentres at comfortable temperature specifies allowable airflow, filtration, humidity and temperature limit. Using power efficient IT devices will reduce the load on entire system. Existing data centre can adopt best practices to improve PUE whereas the upcoming data centers should implement best practices as a part of design.

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