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Liquid Cooling System and Air Cooling System in Data Center: A Comparison

Ekta Saheblal Maurya
Academic Research Student, Department of Information Technology, B.K. Birla College of Arts, Science and Commerce (Autonomous) Kalyan, Thane, India.

Abstract: The data center is a storage and processing of data facility which consists of multiple computer systems such as a server, network, storage, switch, and infrastructure. The refrigeration system is a requirement that must be owned by the data center. Each electrical devices produce heat and if the device is overheated, the performance of the device will decrease, even it can run into shut down. A data center may be a facility that centralizes an organization's shared IT operations and equipment to store, processing, and disseminate data and applications.

Datacenter Cooling refers to the collective equipment, tools, techniques, and processes that ensure a perfect operating temperature within a knowledge center facility. This paper, explains why liquid cooling is better than air cooling.

Keywords: Data center, cooling system, liquid cooling, air cooling.

I. INRODUCTION

A data center is a physical facility that organizations use to deal with their critical applications and data. A data center's design is predicated on a network of computing and storage resources that enable the delivery of shared applications and data. The key components of a knowledge center design include routers, switches, firewalls, storage systems, servers, and application-delivery controllers. Here two cooling system were explained with there aspects. Liquid cooling is effective in reducing energy consumption of cooling systems in data centers because the warmth capacity of liquids is orders of magnitude larger than that of air and once heat has been transferred to a liquid, it are often faraway from the info center efficiently. Therefore liquid cooling is that the perfect solution to the wants of the info center because it provides various benefits over conventional air cooling systems.

The sole purpose of knowledge center cooling technology is to take care of environmental conditions suitable for information technology equipment (ITE) operation. during this paper a critical discussion on existing and emerging technologies for data center cooling systems was administered. Fundamental aspects concerning advantages and disadvantages of cooling system were discussed.

II. LITERATUREE REVIEW

The basic aspects of data center cooling technology was introduced by Capozzoli, A., et al. [3] Fundamental aspects concerning the advantages and drawbacks of each examined cooling system were discussed. The article explaining the concept of Future views on waste heat utilization was introduced by Wahlroos, M. et al. [1]. The article explains the biggest barriers for utilizing waste heat are the low quality of waste heat. Free cooling technologies for data centers: energy-saving mechanism was introduced by Zhang, Y., Wei, et al. [2]. The article explains four typical free cooling systems are introduced and analyzed, including direct fresh air cooling, rotating wheel heat exchange, heat pipe back rack, and water-based free cooling system. Potential for waste heat utilization of hot-water-cooled data centers was explained by Oltmanns, J. et al. [4].The comparison of the results for all parameters presented above shows that no single scenario performs best in all relevant aspects. The concept of Water-based data center was introduced by Clidaras, J. et al. [5].This document discussed water-based data centers, including a system that may be powered by the motion of water. The Data center: energetic and economic analysis of a more efficient refrigeration system with free cooling and the avoided CO2 emissions was explained by Afonso, C. et al. [6].The objective of this work is the study of a new air conditioning system for a data processing center, to replace the old one. Concept of Waste heat from Data centers was introduced by Pärssinen, M. et al. [7]. The article is about improving energy efficiency and increasing the use of renewable energy. Reuse of Data center Waste Heat in Nearby Neighbourhood was explained by Antal, M. et al. [8]. Analysis of this case provides motivation and requirements for the models and methods of heat reuse prediction and optimization proposed in this paper. Aspect of a New Methodology towards effectively assessing data center sustainability explained by Lykou, G. et al. [9]. In this paper, a new methodology is presented, for assessing sustainability based on five major quantifiable. Design and economic analysis of liquid-cooled Data Centers for waste heat recovery: A case study for an indoor swimming pool was explained by Oró, E. et al. [10]. In this paper, comparing liquid-cooled data centers with the state-of-the-art solution(air-cooled data centers), it is shown that the overall energy consumption can be reduced above 70% when implementing heat reuse solution.

III. METHODOLOGY

We have tested and validated our methodology with various documents from data center located everywhere. during this section, we present the conclusion from existing data centers, they being advertised for there energy efficiency performance. All data were collected from publicly available information.

IV. ANALYSIS

Based on price, liquid cooling comes with a higher Capex, its greater efficiency can translate to lower Opex, especially as densities grow. Besides, liquid cooling uses less power and water, which may be especially important in areas where water is briefly supply. On the opposite hand, the danger of vendor lock-in could impact long-term TCO. Based on ease of installation and maintenance, there is an important consideration, what it will take to deploy and maintain a cooling system. With air cooling, operating the equipment and swapping out components is usually straightforward.

Such advantages for liquid cooling definitely exist as compared to average air-cooling deployments and particularly as compared to most legacy air-cooled data center spaces, those efficiency, and density gaps are much narrower in comparison to air-cooled data centers more fully exploiting industry best practices. Nevertheless, there are other benefits derived from liquid cooling, together with density and efficiency capabilities, which will make liquid cooling particularly attractive for a few applications.

Table I. A comparison between air and liquid cooling

Based on	Liquid Cooling	Air Cooling
Cost (price)	Inexpensive ($6.98/watt)	Expensive ($7.02/watt)
Power Usage	Less	More
PUE (Power Usage Effectiveness)	1.6	1.8
Cost effective	More effective than air cooling	Less effective than liquid cooling
Installation	Complex than air cooling	Easy than liquid cooling
Construction	Not Easy (heavier)	Easy (lighter)
Heat exchange location	Liquid-to-Liquid in coolant Distribution Unit	Air-to-Air liquid in rear door of cabinet
Pump location	Coolant Distribution Unit	Rooftop chiller
Rooftop cooling	Water-to-Air Dry cooler	Compressor-Enabled chiller
CPU cooling	Series-Parallel copper cold plates, Parallel copper cold plates	Copper-fin heat sink with embedded heat pipes
Total utility cost	$2,296,704	$2,522,880
Total power consumed / year	14,016,000 kWh	15,768,0000 kWh ^2
Annual water cost	$54,144	$0
Electrical room supply air delta T	8.4 deg C (15.12 deg F)	8.4 deg C (15.12 deg F)
Electrical room supply air set point	24.6 deg C (76.28 deg F)	24.6 deg C (76.28 deg F)
Adiabatic cooling	No	Yes
Floor type	Hard floor	Hard floor
IT design capacity (kW)	1,880	2,000
Non-cooling server capacity (kW)	1,820	1,820
IT equipment fan savings	9%	N/A
Micro-pump penalty	3%	N/A
Glycol %	25%	25%
Chilled/ Condenser water set point	40/47.75 deg C (104/117.95 deg F)	20/30 deg C (68/86 deg F)

V. CONCLUSION

In this paper an analysis on currently available and emerging data center cooling systems was carried out. The advantages and drawbacks of technologies were discussed. A variety of aspects that must be carefully examined. Another option to efficiently address the cooling process is that the adoption of liquid cooling solutions, that are capable of supporting high density power and offer a good range of benefits . In order to further increase energy savings, the evolution of cooling systems goes towards the elimination of active mechanical equipment. Both liquid cooling and advanced air-side economizer based cooling systems can potentially allow the reduction of using mechanical equipment and therefore the achievement of upper efficiency levels.

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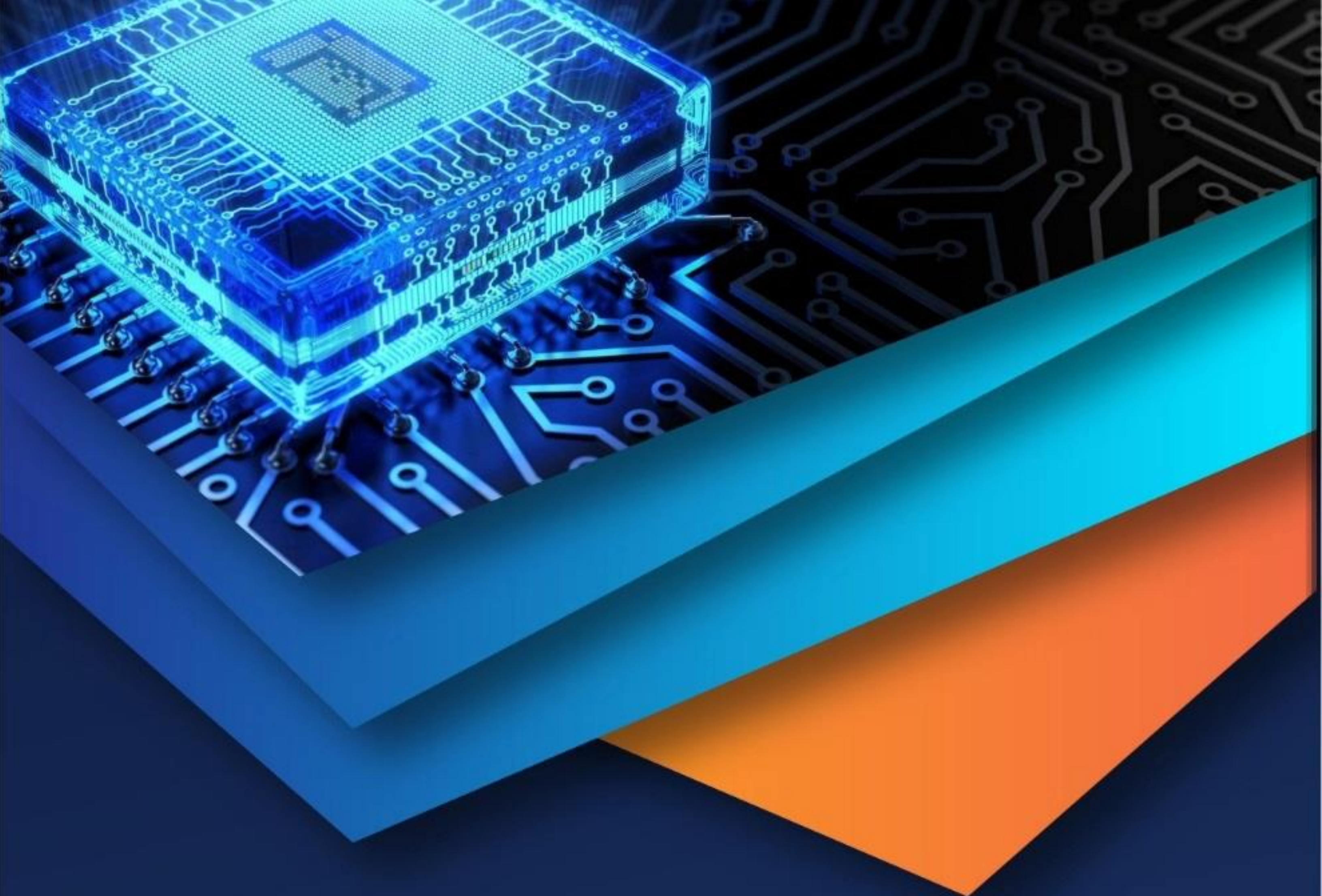

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