Efficient Cooling Solution Implementation at Grid Computing Facility

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Introduction and motivation

LHC has been producing enormous amount of data, which requires huge computing power to compute & analyze the data, in this regard Worldwide LHC Computing Grid (WLCG) had been developed which is based on tier architecture and a Tier-2 Center for ALICE experiment had been setup at VECC Kolkata in late 2002. Since its inception Grid Computing Facility at VECC has been enhancing its CPU and storage resources and contributing to ALICE Grid. Grid Computing Facility has also been providing computing infrastructure to VECC users and the Indian collaborators who are involved in different projects like ALICE, CBM, STAR, INO, Medical imaging among others. For supporting the entire Grid Computing Facility infrastructure, an efficient cooling solution was required. Continuously increasing cooling requirement for the facility motivated us to design and implement an efficient cooling solution. Solution should be such that it can provide cooling to present infrastructure and also can cater with the cooling need of the future procurement as per requirement and available physical space. In this report we show the design and implementation of the efficient cold aisle containment cooling for the Grid Computing facility lab and show that the implemented new cooling solution consumes half the power than earlier cooling arrangements.

Older AHU based arrangement

In the beginning in 2002, we had placed 6 nos of 2 Ton split ACs on the wall of the lab for cooling. Year after year IT infrastructure increased and heat load also increased. From year 2006 the facility had been cooling with the conventional AHU (Air Handling Unit) based cooling arrangement. An AHU cools the air with the help of centralized chilled water supply which is 20 meter away from the room and then via 1 m duct that cooled air, thrown into the lab from the top of the room and from there cooled air spread across the lab. As hot air, produced by IT equipments, moves upward and accumulated in the top (due to lighter weight) and this hot air gets mixed with AHU cooled air directly at the top of the room. Therefore when air comes down in front of IT equipments it is already around 28^{o}C. It became 34^{o}C after passing through IT equipments. Recommended inlet air for the IT equipments is around 20-22^{o}C, which we could not be achieved with this arrangement.

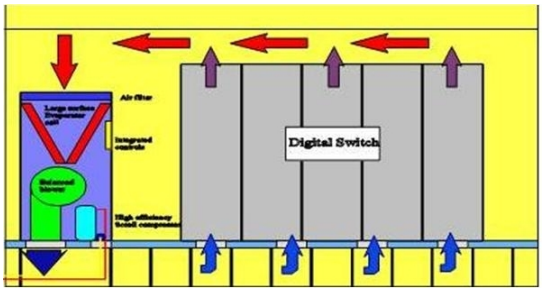

FIG. 1: Conceptual air flow diagram between PAC to Cold aisle containment

Cooling Solution Concept and Technical Details

New Cooling Solution is based on Cold and Hot Aisle Containment concept. Cold air containment significantly improves the efficiency of data center cooling solution. Concept behind the solution is that separation of hot and cool air, it is one of the most promising energy efficient measures for legacy data centers. In this solution all IT equipments are confined in

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FIG. 2: Grid Computing Facility after Cold aisle Containment implementation

a containment, cooled air circulates through Precision AC via a Duct below false floor and open only in the containment as shown in fig 1. Here IT equipments suck the cooled air from front and throw from back. This arrangement was not implemented in older system where cold and hot air get mixed thereby reducing the efficiency of the entire system. We have procured, installed and commissioned 2 PAC (1Active+1Standby) units (BlueBox make) each 25TR cooling capacity consisting of micron filter, dehumidifier, humidifier etc, after raising the floor by 45 inches.

We created a containment with all the IT equipment and cold air from PAC thrown in this via insulated duct below raised floor. Cold Aisle containment is the least accessible area and is only accessed when any hardware fault occur in any resource. For all other purposes like monitoring, managing, cabling including power, network etc are from outside this cold area fig 2. In this solution, cooling is precise and efficient; Cooling is not wasted for human, room walls, chairs, table, light etc and only used for IT resources unlike earlier. Human intervention to this Cold Aisle Containment is also restricted. Temperature gradient between Cold and Hot aisle is 5^{o}C so that water condensation not happens on the common walls. Temperature inside cold air containment is maintained at 18-20^{o}C with 50%+/-5% humidity.

Conclusion

Efficiency and effectiveness of any Data centre cooling can be measured by PUE (Power usage effectiveness=Total Facility Power/IT Equipment Power) factor. Grid Computing facility at VECC has been running with 1.47 PUE since new cooling solution implemented.

TABLE I: Comparisons between old (traditional) cooling solution and New Cooling Solution.

S. No.	Old Cooling Solution	New Cooling Solution
1	Hot and cold air mixed.	Cold air is separated from Hot Air.
2	Room Temperature was 35^{o}C.	Room Temperature is 25^{o}C.
3	Approx 30Ton of cooling was also not sufficient.	25Ton cooling is sufficient for all IT equipment.
4	Around 90-100Amp power consumption.	Only 55 Amp power consumption.
5	Server room was less tidy.	Room is more spacious and tidy.
6	Cooling was not efficient and sufficient.	Efficient and sufficient cooling.
7	More power consumption.	Less power consumption.

We measured power usage after averaging for 6 months of power consumption data, which comes 1200 units per day consumption for entire facility in which 816Units consumption is only for IT equipments. Due to new cooling solution cooling power consumption is reduced by a factor of two compared to earlier. Earlier PUE factor was almost 2.

Grid computing facility at VECC is the first one in entire Eastern India with such cooling solution implemented. Such solution is energy efficient and comes under the Green Data Center community. In conclusion we can say that the IT equipments efficiency also increased as inlet air temperature is constant at 18^{o}C and consistent. Comparison between two cooling solution shown in Table I. Over all system downtime have been reduced and resources utilization increased after cooling solution implementation.

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