European Data Centre Association's
Technical Committee

AI and the Future of Data Centre Design

EUDCA Viewpoint

EUROPEAN
DATA CENTRE
ASSOCIATION

Rue Montoyer 47, 1000 Brussels, Belgium

European Data Centre Association's
Technical Committee

AI and the Future of Data Centre Design

EUDCA Viewpoint

The Evolving AI Landscape

The data centre sector is at an inflection point. The rapid adoption of AI and its projected growth will transform the entire data centre ecosystem. But there's enormous uncertainty about what this means in practice for owners and operators.

Data centres have already experienced a rapid increase in capacity demands which commenced during the COVID pandemic. This is now being increased further by customers requesting additional capacity to support AI, but due to rapid developments in technology and associated power increases there are varying requirements. Hyperscalers and equipment manufacturers are developing specialist servers, and GPU manufacturers are optimising chip design, however, the specifications are constantly changing as AI technology evolves and our use of AI develops. Data centre and colocation facilities will need to provision for higher densities, whilst adhering to current regulatory requirements on efficiency and refrigerants, as well as addressing cooling technology changes to meet the increased power demands.

Amidst this uncertain landscape, data centre design must evolve so operators can accommodate the increased demand from AI. It is fundamental to have a design strategy, access to energy, and European governmental support that encompasses future growth with sustainability goals.

Key Issues and Challenges

AI server racks are forecast to operate up to 300 kW per rack in the next few years. This has considerable implications for data centre design, including floor loading, switchgear, PDU equipment and cooling.

Standard air cooling is not practical for cooling higher density AI racks, therefore, liquid cooling becomes a requirement in order to cool higher density racks as AI chips need a cooler operating environment to optimise performance.

A Hybrid Approach to Cooling Design

Many colocation operators have already supplemented their existing air-cooling system with a liquid cooling loop, located outside the server room. Using this existing loop, data centres could potentially introduce an additional liquid cooling circuit without significantly modifying their buildings. Immersion cooling should not be overlooked as this could allow cooling to move away from air-cooling altogether.

However, the current transition period is creating a complex environment. Customers are asking for flexibility. Data centres are responding by offering both traditional and AI servers and by using a hybrid of air and liquid cooling.

This hybrid approach brings water from the supplementary liquid loop into the server room. Operators must manage the risk of water in the server room and potential ingress to servers.

This brings added complexity to Service Level Agreements (SLAs) - which must now include details on managing this risk and clearly define the responsibilities of each party for both installation and maintenance requirements.

Efficiency and Operating Temperatures

With liquid cooling, Power Usage Effectiveness (PUE) will improve. However, with a transitional hybrid solution, data centres are running two cooling circuits, but with potentially higher temperatures in the liquid cooled circuits, PUEs should remain low.

Cooling Distribution Unit (CDU) manufacturers are currently engineering optimal pressure and temperature parameters. However, due to current demand there is an extended lead time on CDUs. Ideally, the liquid cooling circuit would reuse the warm return water from the air-cooling system to maximise efficiency. If we assume this water is 30-35°C, liquid cooling should also be effective at 30-35°C. However, this would be subject to what temperatures are required on the AI chips. The increased temperature differential (ΔT) reduces the cooling flow rate and makes the system more efficient, but with an increase in temperature.

However, currently recommended operating temperatures for CDU water loops are 20-28°C, which are close to the existing temperature, but in hybrid mode where operators will have to manage both the Direct Liquid Cooling (DLC) and the air-cooled system, the need to implement both CDU and standard air-cooled units can increase the plant's PUE.

Similarly, to meet DLC requirements, the use of water may be necessary as part of the adiabatic system. As operators strive to reduce their WUE, by reducing or eliminating the use of water and the adiabatic system, the new requirement for higher density cooling with DLC technology could once again increase the use of water.

Operators, engineering companies, leading chip and equipment manufacturers are currently working together on these new solutions to meet customers' needs for higher density and scalability while reducing the environmental footprint.

As with all new technologies, this is an iterative process, where the ecosystem learns as it goes along. What is certain is (1) there is still a great deal of technical uncertainty about the eventual design (2) even more so about the transition period when data centres will have to adapt to high-density cooling solutions while preserving space for medium-density solutions, which currently represents the majority of the market.

This will make it difficult for data centres to meet the regulatory requirements of the Energy Efficiency Directive (EED) during the two to three-year transitional period.

Impact and Recommendations

1. European data centres, vendors and policymakers must work together to reconcile AI growth with European sustainability regulations.
2. Over the next two to three-years as the industry transitions to liquid cooling, efficiency metrics may stall or even reverse. As an industry, we must highlight this issue with policymakers and regulators at European and national levels, outlining why this transition period temporarily may decrease efficiency. In certain cases, time and flexibility need to be introduced in the regulation to allow the market to design, implement, learn and improve.

3. Operators must continue to work with customers and vendors to address liquid cooling temperatures. We need industry-recognised adoption paths and standards.
4. The European data centre industry must engage with chip manufacturers to ensure European regulations can be met.

Marie Chabanon – Deputy Chair of the Technical Committee, EUDCA