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The looming power and cooling challenge for data centers and liquid cooling solutions from Park Place Technologies

In this paper we will focus specifically on the cooling challenges that are resulting in traditional cooling solutions failing to keep up with hugely increased thermal demands, making liquid cooling an increasingly necessary solution. We will identify the various different types of liquid cooling with examples of the sort of use cases that best suit each liquid cooling approach and also highlight some of the non-technical challenges posed by their proposed adoption.

Introduction

It goes without saying that advances in Information Technology (IT) have had a profound, and growing, impact on business over the last decade. The rise of AI, ML, and IoT has spurred the development of high-powered processors like GPUs and TPUs that consume more power and produce much more heat than previous generations of chips.

In this paper we will focus specifically on the cooling challenges that are resulting in traditional cooling solutions failing to keep up with hugely increased thermal demands, making liquid cooling an increasingly necessary solution. We will identify the various different types of liquid cooling with examples of the sort of use cases that best suit each liquid cooling approach and also highlight some of the non-technical challenges posed by their proposed adoption.

In the context of these challenges, we will highlight a new suite of services from Park Place Technology and describe how, and how well, this meets the technical, implementation and ongoing support challenges of introducing new liquid cooling solutions while allowing companies to focus on developing and deploying new AI-based applications without sacrificing environmental sustainability targets.

GenerativeAI heralds an energy cost and availability crunch

According to figures from the Data Centre Research organization, DCByte, data center power consumption in the Americas stands at 101.1 Gigawatts (Gw) as of January 2025. In the last year alone, power usage grew by 36Gw. In Europe in Q42024 current usage stood at nearly 9 Gw and, existing construction, committed and early phase plans will see that figure grow to close to 30Gw by 2030.

This huge increase in power consumption is coming at a time when national power grids around the world are already working near to capacity and who are dealing with the additional challenge of how to incorporate new, renewable energy sources into the power network that are neither consistent from an availability point of view, nor, in many cases positioned close to major centres of energy demand.

The implications for traditional air-cooling systems

Data centers with CRAC units (Computer Room Air Conditioning) was and remains the most used solution to cooling the space. But with, initially, bitcoin mining and highly graphical multi-player on-line gaming, rack densities moved towards 20kw/h. The rapid increase in AI LLM (Large Language Models) training and on-going deployment of AI based applications has already pushed rack densities well beyond that point and the latest Nvidia Blackwell processors each have a potential power draw of 1200 watts each, which could see rack densities exceeding 100kw/h. At that point you would need gale force, chilled winds inside the data centre to keep the servers cool. Clearly, that is not an option from either a power usage or noise point of view.

> “...in countries like Ireland, the energy used by the rapidly growing number of data centres accounted for 21% of its total energy supply capacity in 2023, leading to calls for a moratorium on new data center construction.”

It's estimated that data centers consume about 1% of the world's electricity, and a large portion of that is used for cooling. That doesn't sound like very much. However, in countries like Ireland, the energy used by the rapidly growing number of data centres accounted for 21% of its total energy supply capacity in 2023, leading to calls for a moratorium on new data center construction. When you consider that, for the average data center with CRAC units, energy use for cooling amounts to around 40%* of total electricity costs. Reducing that percentage offers both significant cost savings and provides more headroom to overstretched national power grids.

Additionally, evaporative cooling using CRACs consumes a surprisingly large amount of water. According to research undertaken at Lawrence Berkeley National Laboratory in the United States, a mid-size data center uses approximately 300,000 litres of water a day. That equates to the average water use of about 1,000 U.S. homes. So, there are both water and power usage concerns that need to be addressed when considering new liquid cooling solutions.

Liquid Cooling offers a viable and sustainable way forward

Liquid cooling for computers is not exactly a new idea... think of the top-end IBM System/360 Model 91 from 1966 and, more recently, some power-hungry gaming PCs. Even full immersion of servers in a dielectric liquid first saw the light of day about 10 years ago. But, up to now, it has very much been a niche requirement for certain HPC configurations.

But now, liquid cooling in data centers has become a transformative approach to handling the increasing power demands and thermal loads of modern computing equipment, be they CPUs or GPUs. As technology advances and data processing demands continue to grow, so does the need for efficient and sustainable cooling solutions that go beyond traditional air-cooling systems. Let's explore what liquid cooling in data centres entails, how it works, why it's crucial in today's technological landscape, and the steps businesses need to consider for effective adoption.

* The figure of 40% is widely quoted in press articles and vendor content. It appears to have come from a scientific research report delivered to the The 7th International Conference on Applied Energy – ICAE2015. There may have been some energy usage improvements in the last 10 years, but the basic premise about “the cost in average data centres” still appears to hold.

What is liquid cooling?

Liquid cooling is a technique that uses liquid as a thermal conductor to dissipate heat from computer systems, servers, and other high-density computing equipment. Unlike traditional HVAC systems that rely on air circulation and cooling to regulate temperature, liquid cooling directly interfaces with heat-producing components, such as CPUs, GPUs, and memory units. There are three main types of liquid cooling technologies used in data centres: rear door cooling, direct-to-chip cooling and immersion cooling. All three types of liquid cooling can dramatically reduce or even, in some cases, eliminate the need for traditional air cooling, offering a more efficient and sustainable approach to managing heat in data centres.

Rear Door Cooling

Rear door cooling is an efficient data center cooling solution where a heat exchanger or cooling unit is installed on the rear door of a server rack. The system draws hot air from the back of the servers and cools it down before releasing it back into the data centre space. This method directly targets the hot air exiting the equipment, minimizing the amount of heat that enters the data center room and helping maintain a stable, cooler environment without needing extensive airflow management.

Direct to-chip cooling:

This method circulates a liquid coolant through cold plates attached to the chips or processors within the servers. The coolant absorbs heat directly from the components and is then pumped away, where the heat is expelled through a heat exchanger.

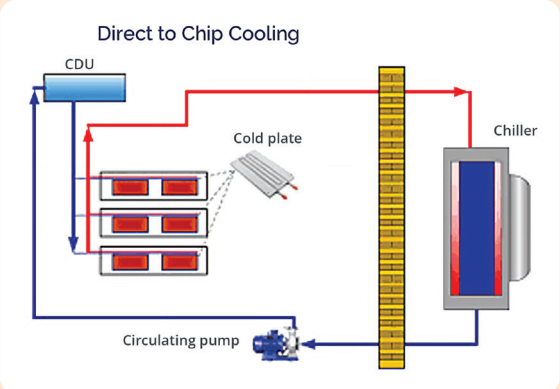

Figure 1 – Direct to chip cooling

Immersion cooling:

Unlike Direct-to-Chip cooling, immersion cooling submerges the entire server or computing unit in a non-conductive, dielectric liquid that absorbs heat from all the components it contacts. There are two types of immersion cooling:

Single-Phase Immersion

The liquid absorbs heat without evaporating, and heat exchangers circulate and cool it down.

Two-Phase Immersion

The liquid evaporates upon contact with heat, removing energy from the system, then condenses back into liquid form to be recirculated.

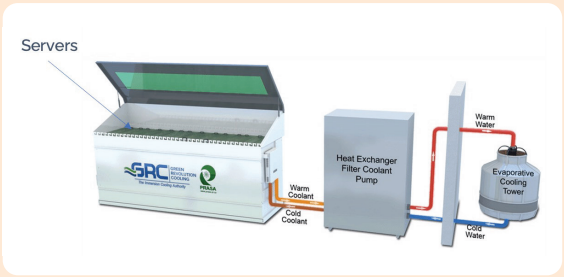

Figure 2 – Immersion Cooling

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What does liquid cooling do?

Liquid cooling enhances heat removal from servers and computing components, particularly those involved in high-performance computing (HPC), artificial intelligence (AI), and machine learning (ML) applications, which generate significantly more heat than traditional computing tasks. Liquid cooling is essential for cooling high-density racks that air-based systems cannot efficiently support. Let's have a look at some of the key functions and benefits of liquid cooling.

Provides efficient heat dissipation

Due to the higher thermal conductivity of liquids compared to air, liquid cooling systems can remove heat from components faster and more efficiently, enabling data centers to manage high-density computing loads without the risk of overheating.

Delivers energy and cost savings

By reducing reliance on fans, chillers, and other HVAC components, liquid cooling systems can lower energy usage, leading to operational cost savings. Data center operators have reported reductions of up to 50% in energy consumption with the implementation of liquid cooling solutions.

Enhances computing density

As demand for data-intensive computing increases, liquid cooling enables the deployment of denser and more powerful racks. Traditional air-cooled systems may only support up to 10-15 kW per rack, while liquid-cooled racks can handle loads of up to 100 kW, significantly increasing computing capacity per square foot.

Extends hardware lifespan

Liquid cooling provides stable and efficient thermal management, which can reduce thermal stress on hardware components, potentially extending their operational lifespan and reducing maintenance costs over time. For an estate of 700 servers with a standard maintenance contract you might expect to see annual maintenance savings of between $50,00 and $100,000.

Reduces environmental impact

Many liquid cooling systems, especially immersion cooling, require little to no water use compared to traditional evaporative cooling, which depends on water-based cooling towers. Furthermore, the higher energy efficiency reduces the carbon footprint of data centre operations, aligning with sustainability goals.

Additional considerations

Governmental and environmental regulations, particularly in regions like the EU, are setting stricter guidelines on data center efficiency, requiring better cooling practices and the reuse of waste heat. Data centers must navigate a mix of standards and regulations to manage their energy and water usage. Compliance with frameworks like ISO 50001 and ASHRAE 90.4, along with regional mandates from the EU, the U.S., and other nations, allows data centers to minimize environmental impact, reduce operating costs, and achieve sustainability goals. Adopting these standards is also essential to meet future targets, such as climate neutrality goals set by the EU, and individual nations or emerging water usage guidelines.

Liquid cooling is one of the few solutions that can meet these stringent standards by achieving very low Power Usage Effectiveness (PUE) and Water Usage (WUE) ratios.

> "Governmental and environmental regulations, particularly in regions like the EU, are setting stricter guidelines on data center efficiency, requiring better cooling practices and the reuse of waste heat."

What you need to do next

As liquid cooling becomes more prominent, businesses looking to transition to this technology need to consider several critical steps to ensure successful implementation and ROI:

Step One has to be, evaluating your workloads and density requirements. You need to assess your data processing requirements and computing density. There are a number of capacity planning and workload placement tools available to help determine if and where liquid cooling is necessary and which type (rear-door, direct-to-chip or immersion) is most suitable. Clearly high-density applications, like AI or HPC, will benefit the most from liquid cooling. But there are other considerations.

Consider infrastructure investments

As a rule of thumb, Direct-to-chip cooling is best for extreme density or maximum heat removal efficiency, especially in greenfield projects or where full-scale modernization is possible. Full immersion cooling is best suited in situations that require extreme density or maximum heat removal efficiency, especially in greenfield projects or where full-scale modernisation is possible. And rear-door cooling can be considered for moderate density data centres looking for an efficient, cost-effective cooling upgrade without substantial infrastructure overhauls.

Greenfield implementations are fairly simple to understand and cost from an investment point of view. However, if you are implementing liquid cooling into existing data centers, this may require retrofitting existing facilities or constructing new ones that support the unique requirements of liquid cooling systems. This could include specialized piping, tanks for immersion cooling, and additional space for heat exchangers.

Focus on compatibility and standards

Since liquid cooling interacts directly with hardware components, businesses must work with vendors to ensure compatibility with their equipment. Several industry standards and guidelines from bodies such as ASHRAE, the Open Compute Project and the European Union address the use of liquid cooling in data centers, focusing on efficiency, sustainability, and operational safety. These standards ensure the proper design, implementation, and management of liquid cooling systems in alignment with global best practices.

Partner with experienced technology companies:
Partnering with vendors can provide guidance on system design, implementation, and maintenance. These vendors offer expertise in liquid cooling solutions and can help customize setups based on an organization's specific needs. Just be aware of the risk that the vendor may only focus on one of the three liquid cooling technologies highlighted in the Spotlight paper.

Liquid cooling requires specialised maintenance and safety protocols to prevent leaks and handle dielectric fluids. Therefore, it may be better to partner with third-party maintenance companies or systems integrators who have focused, consulting-led liquid cooling programs that are not focused solely on a single, specific technology.

Consider long-term sustainability and cost benefits:
You should weigh the upfront costs of liquid cooling against the long-term savings in energy, water, and maintenance expenses. Calculating the total cost of ownership (TCO) can help justify the investment and align with corporate sustainability goals.

Stay updated on technological developments:
Liquid cooling technology continues to evolve, with advancements in fluid types, cooling efficiency, and system designs. Staying informed about these developments can help you optimise your liquid cooling investments over time.

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Conclusion

Liquid cooling has emerged as a vital technology in data centers, enabling high-density computing while meeting sustainability and efficiency goals. With the proliferation of AI and high-performance computing, liquid cooling's importance will only continue to grow. By assessing workloads, investing in infrastructure, partnering with experienced vendors, and focusing on long-term benefits, businesses can leverage liquid cooling to build more resilient, sustainable, and cost-effective data centre operations.

The liquid cooling solutions offered by Park Place Technologies and the benefits they bring to customers

Introduction

In context to the power and cooling challenges we have identified in the first part of this paper, and the potential benefits offered by modern liquid cooling technologies, we now turn our attention to the recent announcements of new liquid cooling services and solutions from Park Place Technologies.

Park Place Technologies was founded in Cleveland, Ohio in 1991. Best known as a global, post-warranty Third Party Maintenance (TPM) organization, its position, dealing with IT infrastructure issues around maintenance and break-fix for over 21,500 customers in 154 countries, has given them a deeper insight into the day-to-day issues affecting IT operations departments than many of their competitors and is a tremendous, stable base from which it has developed a wider set of IT operations management services, including now, a range of liquid cooling solutions.

Park Place Technologies is now the largest third-party maintenance (TPM) company in the world. But it has also evolved rapidly into a more rounded data center and network optimization organization, and this announcement fits nicely into that positioning.

Overview of liquid cooling in data centres

Park Place Technologies liquid cooling offer is focused on three types of systems.

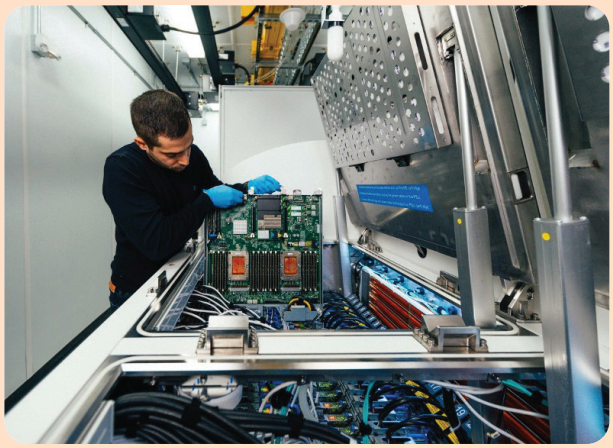

Figure 3 – Full Immersion of servers in a tank

Single Phase Immersion Cooling Systems for customers with high-density workloads. These solutions use Dielectric Coolants. These are non-conductive fluids that safely absorb heat while protecting sensitive electronics. They support densely packed server configurations without compromising on thermal management. They simplify maintenance due to the reduction the number of moving parts, such as fans, and minimize wear and tear on equipment.

Two Phase Direct-to-Chip Cooling Solutions that are designed to target the most heat-intensive components of data center infrastructure. This solution features closed-loop systems that minimise the risk of fluid leakage and ensure long-term reliability. It provides efficient heat transfer, removing heat directly from CPUs, GPUs, and other critical components, preventing thermal throttling and maintaining optimal performance. Their modular design allows for seamless integration into existing data centre infrastructure, thereby reducing the need for large-scale retrofitting.

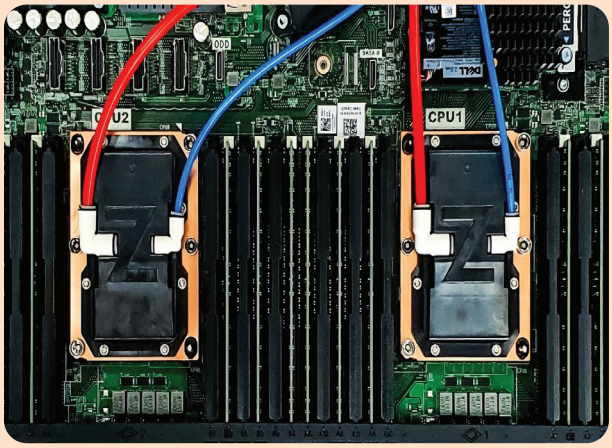

Figure 4 – Direct to Chip water-cooled plates

Rear-Door Cooling, also known as Rear Door heat exchangers, offer a hybrid solution that combines the benefits of liquid cooling with minimal disruption to existing air-cooled setups. Features include efficient heat dissipation where liquid-cooled doors absorb and dissipate heat directly from the rear of server racks. They are easy to deploy and are compatible with standard server racks, making it ideal for retrofitting. Energy savings come from reducing reliance on traditional HVAC systems, leading to lower operational costs.

A whole product offer

Park Place Technologies service offer includes the whole cycle from initial detailed analysis of current data centre infrastructure and cooling requirements, through procurement, installation, implementation, monitoring and management to asset disposal if required.

Figure 5 – Park Place Technologies Full Lifecycle Management

The decision to invest in Immersion Cooling, Direct-to-Chip Cooling or Rear-Door Heat Exchangers depends on various factors. These include the specific requirements of the data center, budget constraints, the desired level of cooling efficiency, and infrastructure complexity. Park Place Technologies trained consultants and engineers will work closely with customers to find the best solution for their business, and can guide them towards the best long-term strategy, while offering short-term results. This takes much of the complexity out of the process, which will enable more businesses to capitalize on this new technology.

Interestingly they will advise on and implement retrofitting of servers to accommodate single or 2-phase DTC implementations. While Park Place Technologies has existing relationships with ZutaCore, for 2-phase DTC and Green Revolution Cooling (GRC) for full immersion cooling, it is capable of and happy working with a range of different vendor solutions.

Park Place Technologies recognize that implementing a liquid cooling solution can come with its own set of challenges. Many vendors are involved, from the tanks to the cooling liquid and more, Park Place Technologies removes the complexities of the immersion cooling journey – serving as a single-vendor solution for the entire process.

Liquid Cooling is not without its challenges. For example, existing hardware needs to be prepared for the DTC cooling process. In many cases, it requires modification to manufacturer-certified equipment which voids their warranties. In this instance Park Place Technologies will implement and warranty the modified product. Training is required for the regular maintenance of immersed gear. All support engineers go through rigorous training that covers not just maintenance procedures, but also more complex health and safety concerns around dealing with hot and slippery liquids as well as dealing with the weight of heavy servers being lifted into and out of immersion tanks for maintenance. For example, Park Place Technologies send two engineers and a crane to site when maintenance of such devices is required.

Within the data center space, the more specific challenges in implementing liquid cooling are spatial design considerations, plumbing/chiller line modifications, server internals and connections, unique maintenance needs and support training, ambient air cooling, cabinet requirements, weight loads, warranties and slab/raised floor considerations.

In conclusion

Customers will have flexibility of choice, but also, importantly, impartial advice and guidance on the best fit of technologies for the customer's use case. Let's face it, unless you are building a completely new data centre and installing the latest range of servers, then there will be some significant trade-off decisions to be made. These will revolve around various space, power and water restrictions, along with more complex capital (capex) and operational (opex) cost comparisons. In a greenfield scenario for a 2-phase DTC solution vs. an air-cooled solution, covering 700 servers that absolutely need liquid cooling, Park Place Technologies claim a 20% reduction in initial capex and a 37% saving on opex over 3 years. In an existing facility, with a mix of sever technologies and existing investments in air cooling, the actual solution and associated calculations on return on investment are not likely to be as straightforward, but experienced and knowledgeable consultants and engineers will be on hand to guide customers through the process.

Park Place Technologies has a very strong focus on the customer and also a very focused and inclusive approach to employee relations that has stood it in good stead as it has grown and acquired companies around the globe and managed the transfer of employees with minimal churn. It also has a very active Customer Advisory Board that I have had the privilege of interacting with and that gives me the confidence to say that I think this launch of liquid cooling services will be a significant help for customers looking to navigate the journey away from air cooling and towards liquid cooling.

About the author

PAUL BEVAN
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Paul has had a near 50-year career in industry that started in logistics with a variety of operational management roles. For the last 40+ years he has worked in the IT industry, mostly in sales and marketing, covering everything from mainframes to personal computers, development tools to specific industry applications, IT services and outsourcing. In the last few years, he has been a keen commentator and analyst of the data centre and cloud world. Until recently he was also a non-executive director in an NHS Clinical Commissioning Group.

Paul has a deep knowledge and understanding about the IT services market and is particularly interested in the impact of Cloud, AI and their underpinning tools and methodologies on I.T. infrastructure in general, and data centres in particular. His mix of business and IT experience, allied to a passionate belief in customer focus and "grown-up" marketing, has given him a particular capability in understanding and articulating the business benefits of technology. This enables him to advise businesses on the impact and benefits of particular technologies and services, and to help IT vendors position and promote their offerings more effectively.

Bloor overview

Technology is enabling rapid business evolution. The opportunities are immense but if you do not adapt then you will not survive. So in the age of Mutable business Evolution is Essential to your success.

We'll show you the future and help you deliver it.

Bloor brings fresh technological thinking to help you navigate complex business situations, converting challenges into new opportunities for real growth, profitability and impact.

We provide actionable strategic insight through our innovative independent technology research, advisory and consulting services. We assist companies throughout their transformation journeys to stay relevant, bringing fresh thinking to complex business situations and turning challenges into new opportunities for real growth and profitability.

For over 25 years, Bloor has assisted companies to intelligently evolve: by embracing technology to adjust their strategies and achieve the best possible outcomes. At Bloor, we will help you challenge assumptions to consistently improve and succeed.

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