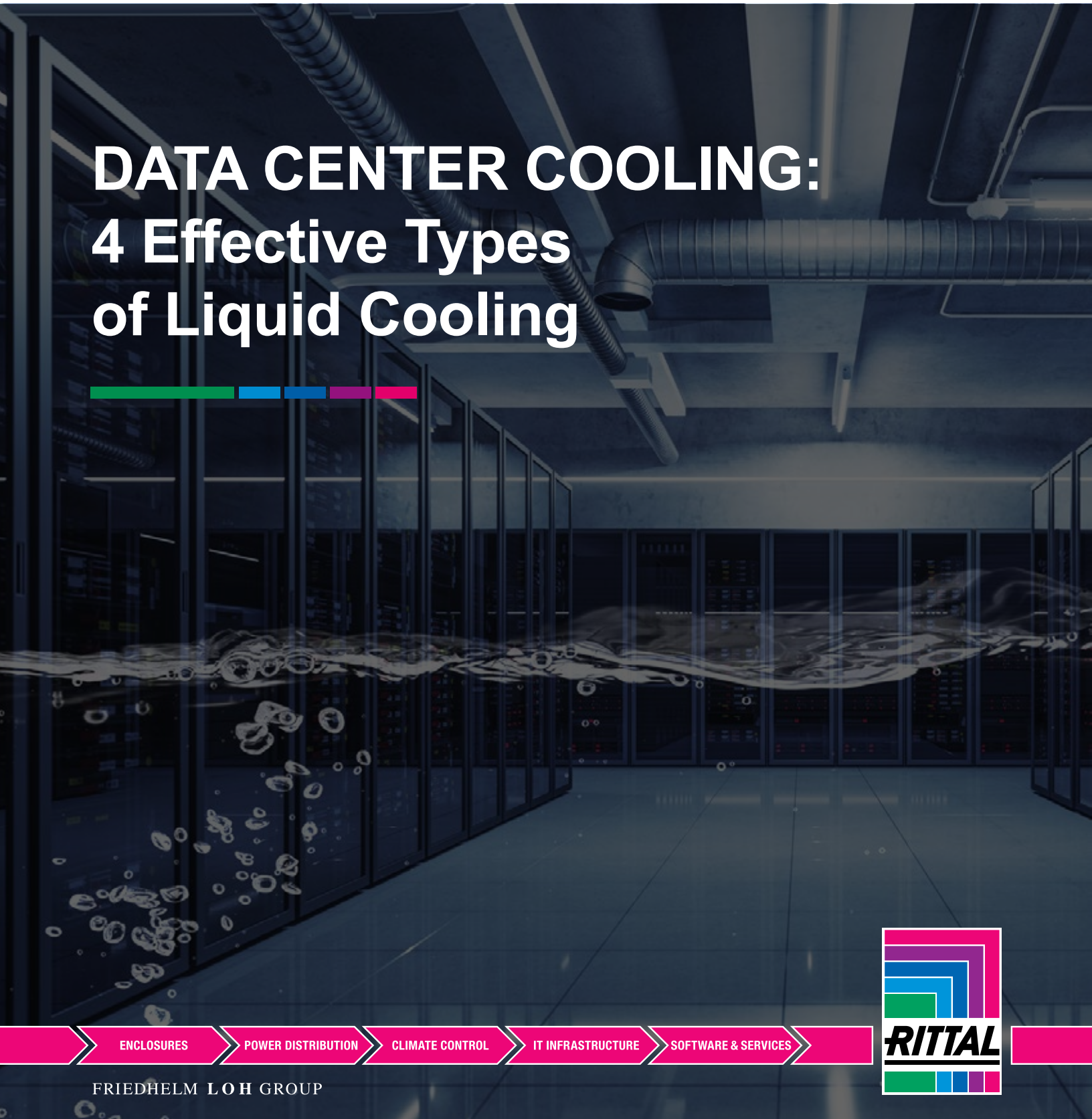
RITTAL

LBS

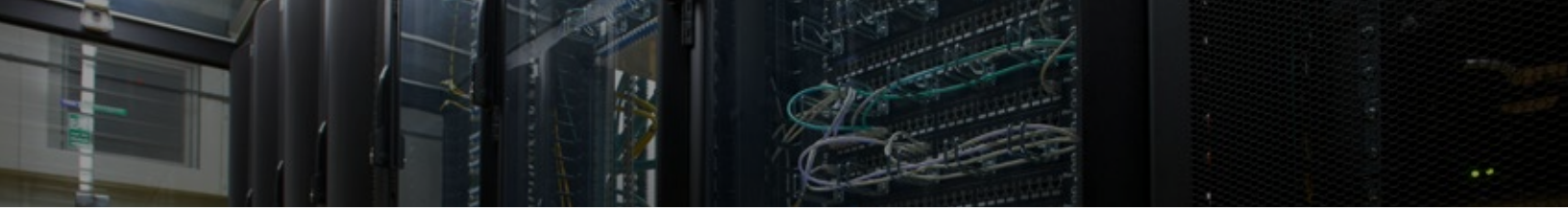
DATA CENTER COOLING: 4 Effective Types of Liquid Cooling



ENCLOSURES | POWER DISTRIBUTION | CLIMATE CONTROL | IT INFRASTRUCTURE | SOFTWARE & SERVICES

RITTAL

FRIEDHELM LOH GROUP



Even outpacing Moore's Law, processor compute power and densities are growing at an almost exponential pace, and those advancements present a challenge to IT Managers: remove the massive amounts of heat being generated or risk costly downtime. Gone are the days of relying on air alone to manage climates in data centers – for the higher density installation, it is not as effective as newer methods, and in the long-term less efficient and more costly. Today, data center managers are coming to the realization that liquid cooling is one of the best ways to support these new demands – and do it efficiently and cost-effectively.

Liquid cooling systems provide much greater heat removal capacity compared to ambient air cooling – water being able to carry about **3,500 times more heat than air** – providing multiple opportunities for data center deployment. For new high-density installations, liquid cooling can provide significant space and energy savings. For existing installations, these systems can be used to supplement site climate control systems, allowing an ordinary space to become an IT space. Or increase installation densities in constrained locations where it will not be possible to install additional traditional air based systems.

water is able to carry

3,500 X

more heat than air

(Note: While water is the primary medium, other liquid coolants can be used as well, as their heat transfer properties are similar.)

Why is Liquid Cooling on the Rise?

The global data center liquid cooling market is estimated to grow from **$1.2 billion last year (2019) to $3.2 billion by 2024** – a clear indication that IT Managers are seeing this as a vital option for thermal management. There are two primary reasons for the growing investment in liquid cooling:

- **AI and accelerators.** **According to Data Center Knowledge**, most data centers that Uptime Institute tracks now have at least some racks that are over 10kW, and **20% of them have a rack that's 30kW or higher**. This is in part due to the growth of content delivery, machine learning and high-performance computing.
- **Edge deployments.** Business today is more connected than ever to machines (and vice versa), and for industrial manufacturers and others, bringing computing power and storage close to the source is critical for generating the real-time insights needed for decision making.

The Benefits of Liquid Cooling

- **Reduced power usage.** First and foremost, liquid cooling can reduce the amount of power a data center consumes, thereby improving power usage effectiveness (PUE) – the ratio of power used for computing equipment and power used for cooling. This is due in part because of the reduced need for fans to move air
- **Reduced footprint.** While rising installation densities translate to fewer enclosures in the data center, traditional air cooling actually negates any reduction in rack numbers, as a significant amount of equipment is needed to cool it all. With liquid cooling, the overall footprint of the data center can be reduced because these systems do not require as much floor space. It may even be desirable to remove most, if not all, room based cooling components; liquid cooling can remove all generated heat, and facility systems can provide any ambient cooling as needed
- **Improved flexibility.** With traditional air cooling, airflow is best managed with a cold/hot aisle arrangement, often supplemented with aisle containment. Liquid cooling allows for greater flexibility in how the data center's equipment is arranged
- **Improved air quality.** Liquid cooling is also cleaner than traditional air cooling methods. Air cooling requires a lot of power in the form of fans, and introduces harmful particles/pollutants and moisture into the data center, both of which can erode efficiency and compromise equipment performance

Types of Liquid Cooling

There are a number of liquid cooling solutions available for both “traditional” data centers out to The Edge. Which you choose will depend on several factors; among them:

- Load (kW) per enclosure
- Size of data center/space available
- Power and cabling needs
- Temperature and humidity in the environment
- Existing infrastructure
- Type of floor (raised or not raised)

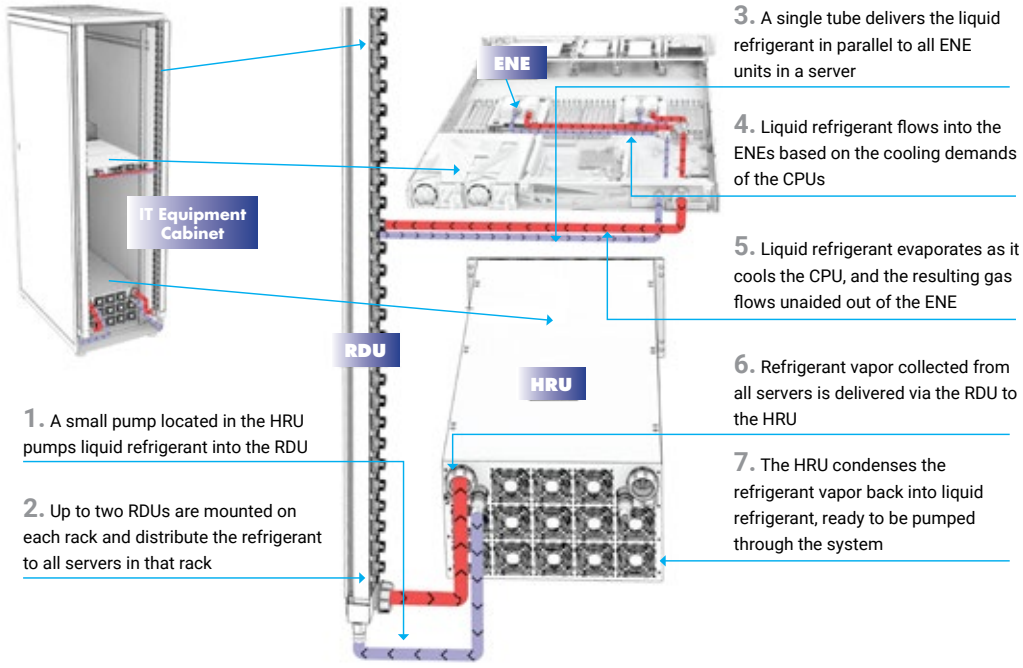
Once the decision is made to employ liquid cooling for a high density deployment, the next choice is which system, or combination of systems, is best suited for your application, installation location, operating environment and related factors.

Direct-to-chip (DTC). This is one the most effective forms of equipment cooling, as it is focused directly on the sources generating the majority of heat in an individual appliance: the main processors. Pipes deliver coolant directly to the chips in order to extract and disperse heat. The heat is fed into a chilled-water loop and diverted to the facility’s chiller plant.

As a reminder, even with direct-to-chip cooling, not ALL of the heat generated in an individual chassis will be removed. There will still be the need to remove any remaining heat generated by the other subsystems (power supplies, other boards, etc.) in the chassis not supported by the DTC system.

Closed Loop (In-rack cooling). Closed loop enclosure based cooling systems are often used in space-constrained locations, in high-density areas within large data centers to eliminate hot spots, or to support traditional cooling systems in high-density environments. The Closed loop unit(s) is installed adjacent to the IT enclosure(s), bayed together in a continuous row, providing a direct and uninterrupted airflow path from heat exchanger to IT appliances.

Principal System Overview



1. A small pump located in the HRU pumps liquid refrigerant into the RDU

2. Up to two RDUs are mounted on each rack and distribute the refrigerant to all servers in that rack

3. A single tube delivers the liquid refrigerant in parallel to all ENE units in a server

4. Liquid refrigerant flows into the ENEs based on the cooling demands of the CPUs

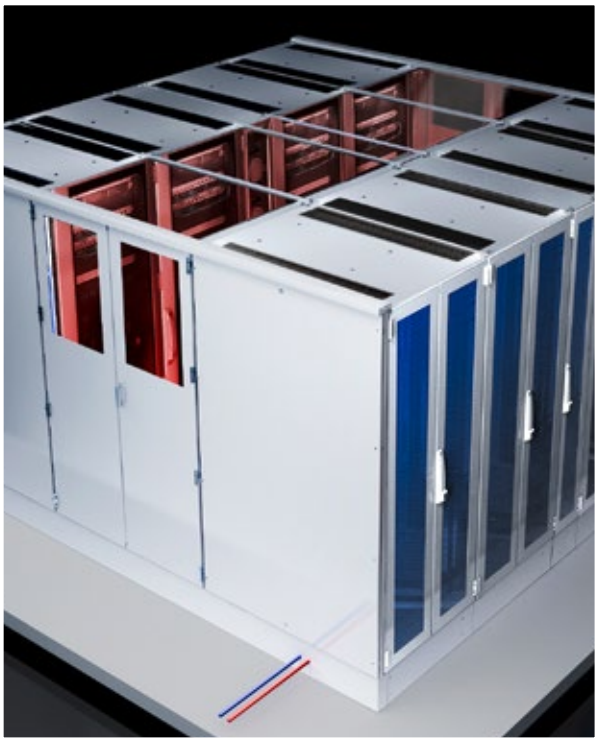
5. Liquid refrigerant evaporates as it cools the CPU, and the resulting gas flows unaided out of the ENE

6. Refrigerant vapor collected from all servers is delivered via the RDU to the HRU

7. The HRU condenses the refrigerant vapor back into liquid refrigerant, ready to be pumped through the system

In the Closed Loop installation, hot air expelled by the equipment in the rear of the footprints is drawn across the heat exchangers to be cooled; the cooled air is then sent out the front of the unit and back to the servers. No air – cold or hot – is rejected into the surrounding space. A closed loop system becomes its own microclimate, as it cools only the environment within the rack and is not impacted by any ambient air (nor does it affect that air). Because hot and cold air never mix, heat removal efficiencies are significantly improved. And as a further benefit, airflow paths from hot to cold and back are greatly reduced, so less energy is required for fans.

Close Coupled (In-row cooling). Using comparable row based heat exchangers, this variation on the Closed Loop system, also known as Open Loop, cooling units are placed between server enclosures in the row to deliver cool air to the server equipment. The key difference - both cold and hot airflow paths are not contained inside the enclosures, going instead into the IT space. Aligned with the Cold Aisle/Hot Aisle orientation, In-row solutions can reduce air mixing, improving thermal balance in the IT space. Heated exhaust air from installed IT appliances is pulled directly from the hot aisle, is cooled, then directed to the cold aisle and the intakes of the components. In-row cooling can be used to supplement existing CRAC/ CRAH installations, increasing heat removal capacity and improving thermal management.



In-row units may be a supplement to raised-floor cooling or can act as the primary cooling source on a slab floor. Additionally, a further increase in heat removal capacities can be realized by combining In-row systems with aisle containment.

Immersion cooling. A relatively new method being used by data centers is immersion cooling, where equipment is completely submerged in a bath of non-conductive dielectric fluid. Equipment is protected from high temperature as well as environmental effects of humidity, dust and even vibration and, because there's no HVAC component to these solutions, operating costs may be reduced. Drawbacks include the need for new protocols and new equipment to support this type of cooling, difficulty handling the immersion fluid when equipment needs to be removed, and the floor space required for tanks and related fluid handling components.

The Future of Data Center Cooling is Liquid

The once mind-boggling densities only dreamed of not too long ago are already here – experts are predicting densities of up to **52kW per rack within the next five years**. Some users are demanding even higher capacities, all the way up to 100kW PER FOOTPRINT. Air cooling alone will not be able to adequately protect tomorrow's equipment and the applications they support; to keep up with the evolving needs of organizations around the globe, data center IT managers need to turn their sights to more effective and scalable heat removal: Liquid Cooling.

52KW

per rack within the next

5 YEARS

Leverage the Insights of the Experts

Each member of our sales team is an expert in the challenges and needs of data centers and Edge deployments – needs such as security/monitoring, safety, flexibility, modularity, scalability and more. Working closely with you, we'll evaluate your situation and help identify the total enclosure solution to optimize efficiency and uptime, and make your facility as future-proof as possible.

Learn more about the value Rittal brings today's Facility Managers and IT Managers by reading our **IT Thermal Management Handbook**.

US528 ■ 05/20

LBS Power
415 NW Flagler Ave Suite 301, Stuart Fl, 34994• Phone: (844)832-1142 • (772)444 3135 Email: info@lbspower.com • Website: www.lbspower.com