Cold-Plate Liquid-cooled Server Reliability White Paper

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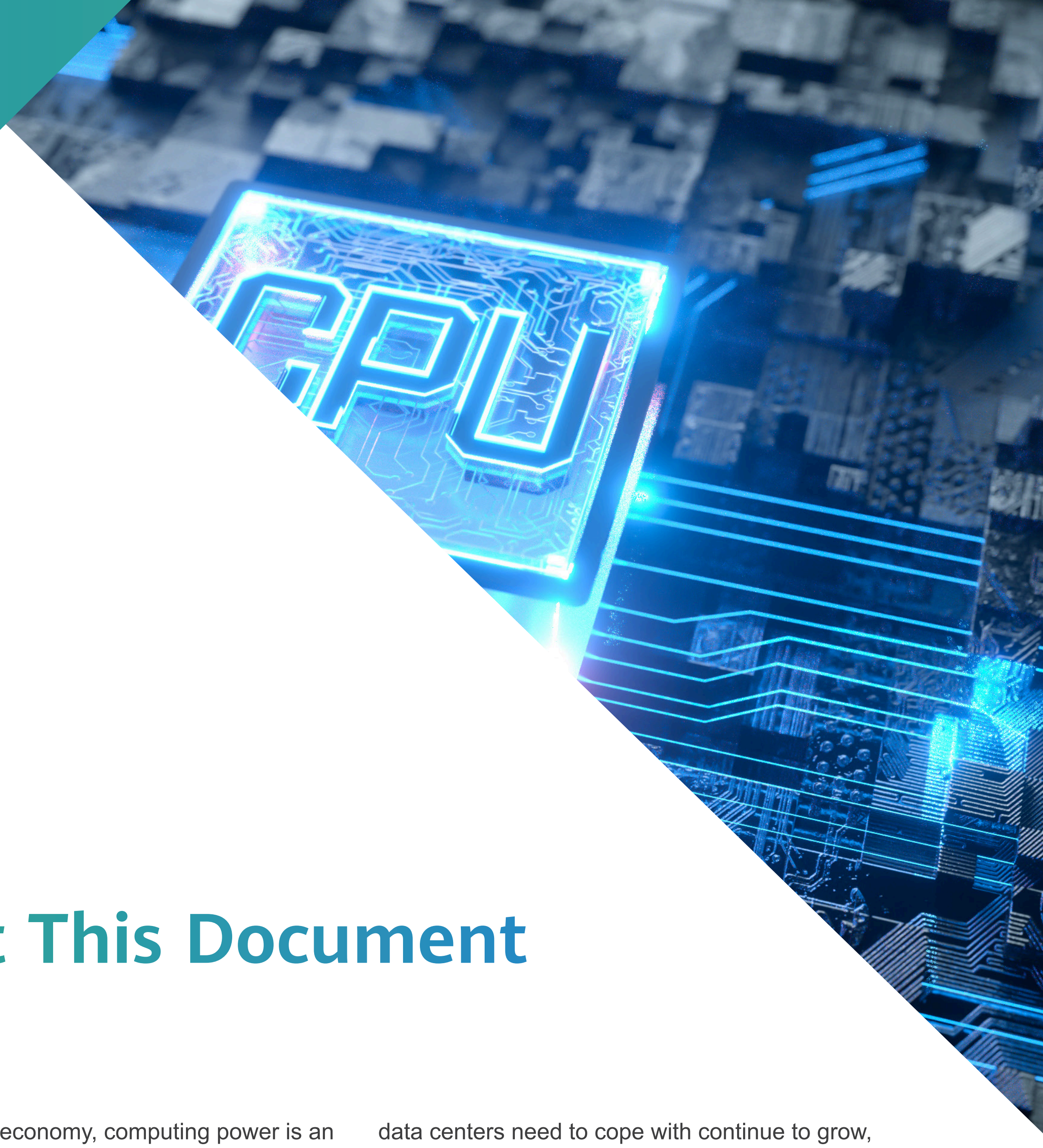

About This Document

In the era of digital economy, computing power is an important engine of national economic development and one of the new core indicators to measure economic development. As the demand for computing power grows, the heat generated by computing equipment is also increasing. To enable major components such as chips to work at appropriate temperatures and deliver optimal performance, investment in the heat dissipation system of the equipment needs to be increased.

Advantageous over traditional heat dissipation technologies, liquid cooling will become the main heat dissipation technology of data centers. That is, data centers will gradually enter the liquid cooling era.

As the scale and complexity of the services that data centers need to cope with continue to grow, power density of data centers is increasing. Moreover, in most traditional data centers, more than 30% of energy is consumed by cooling systems. Therefore, how to reduce the energy consumption of data centers has become the focus of national and local governments. It become a basic requirement on construction of large data centers in China that the PUE must be less than 1.3.

This document focuses on the reliability of cold-plate liquid-cooled servers, introduces the cooling solution and reliability assurance of the servers in detail, and shows the development level of cold-plate liquid-cooled servers in China using typical application cases.

Essentials for Advanced Liquid-Cooled Data Centers

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New-generation information technologies such as 5G, artificial intelligence (AI), big data, and cloud computing are developing rapidly, and data is soaring. During construction of large data centers carrying computing infrastructure, more attention must be called to the new requirements brought by new technologies. Under the influence and requirements of policies, technologies, and environments, liquid cooling has become an increasingly important option for data center construction. Liquid cooling has unique advantages in solving the high energy consumption problem in high-density data centers.

According to relevant national policies, large data centers in the planned eight national computing hubs must use new cooling solutions. Moreover, the PUE of the data centers in the eastern region (including South China) should be reduced to less than 1.25, and that of the data centers in the western region with suitable climate should be reduced to less than 1.2.

Advanced liquid-cooled data centers typically have the following elements:

a. High-density computing power

Liquid-cooling is suitable for data centers providing high-density computing, improving the server density in a single cabinet and the utilization rate per unit area of data centers.

Compared with air, liquid can transfer heat more quickly (20 to 25 times difference) and remove more heat (2000 to 3000 times difference). Therefore, for high-density deployment, liquid cooling is preferred over air cooling. Generally, a single cabinet in a liquid-cooled data center supports heat dissipation capacity of more than 30 kW, which is scalable to over 100 kW.

b. Easy deployment and maintenance

Liquid-cooled data centers pose higher requirements for quick deployment and simplified maintenance of servers.

Compared with an air-cooled server, a liquid-cooled server has the same power supply units (PSUs) and switching network, but it additionally provides two liquid cooling pipe loops (one for supply and the other for return). Moreover, The PSUs, network, and water pipes of the liquid-cooled servers are be plug-and-play, which facilitates deployment, operation, and maintenance.

As server nodes in a single cabinet become more dense, the number and complexity of PSUs, networks, and liquid cooling pipelines in the cabinet increases. The prefabricated assembly of a single cabinet greatly shortens the onsite deployment and delivery time (from over one week to one day .) The liquid-cooled rack-scale servers are ideal for data centers.

c. Reliable liquid cooling protection and intelligent monitoring

With liquid cooling water pipes, liquid-cooled data centers pose higher requirements on intelligent operation and maintenance (O&M) functions, such as fault prevention, fault detection, and fault isolation. Comprehensive reliability measures must be taken at the server level, cabinet level, and micro-module level to ensure safe and stable operation of liquid-cooled servers.

Advantages of Cold-Plate Liquid Cooling

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As Moore's Law slows down, the computing power and power consumption of the chips are greatly improved. In 2022, the power consumption of an Intel fourth-generation server CPU exceeded 350 W, and that of an NVIDIA GPU exceeded 700 W. Moreover, the AI cluster computing power density generally reached 50 kW per cabinet. Air cooling heat dissipation technology is facing great challenges.

Higher chip computing power density increases the power consumption of a single cabinet. (The evolution of chips and the increase of server power drive up the energy consumption density of data centers. It is predicted that 15 kW to 20 kW cabinets will become the mainstream in the future.)

Generally, an ordinary air-cooled data center delivers power density of only 8 kW to 10 kW per cabinet. It can use micro-modules with isolated hot and cold air channels and water-cooled air conditioners to increase the power density to over 15 kW. However, in this case, the cooling cost-effectiveness greatly falls. Compared with air cooling, liquid cooling has obvious advantages in terms of heat dissipation capacity and cost-effectiveness.

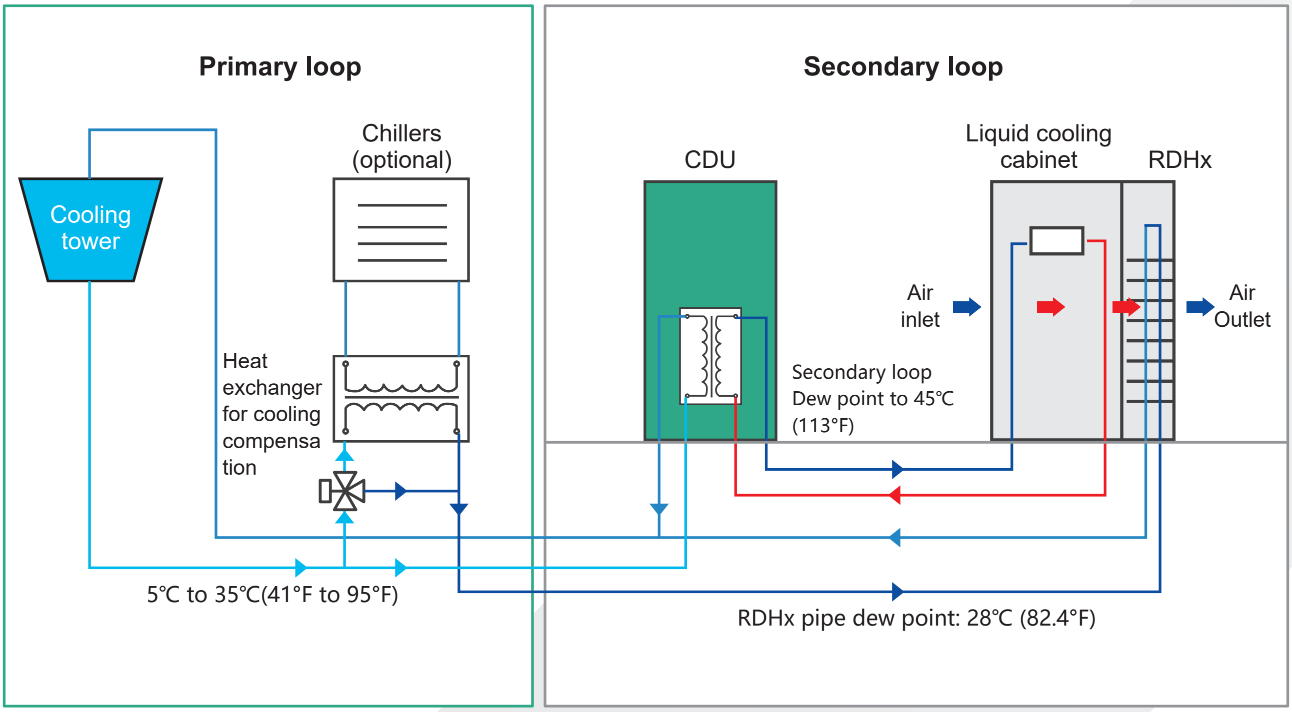

Figure 1 Cooling architecture of a liquid-cooled data center (example)

Liquid cooling technology is divided into non-contact liquid cooling and contact liquid cooling according to the contact mode between liquid and components that produce heat. Liquid-cooled servers are also divided into non-contact liquid-cooled servers (using cold-plate cooling) or contact liquid-cooled servers (using immersion or spraying liquid cooling).

Cold-plate liquid cooling has been commercially used in HPC and AI high-density computing for more than eight years. The technology is mature, the ecosystem is complete, and the overall cost is controllable. What's more, cold-plate liquid cooling does not change customers' usage habits. Components such as drives and optical modules are the same as those in air cooling scenarios. The O&M mode and requirements on equipment room load bearing capacity are also consistent with those in air cooling scenarios. In addition, cold-plate liquid cooling delivers single-node heat dissipation capacity of more than 700 W and effectively reduces the data center PUE. Therefore, it is more suitable for large-scale commercial use.

Immersion liquid cooling can ring lower PUE values. In recent years, it has been gradually applied in cloud data centers. However, it requires customized components, dedicated maintenance equipment, equipment rooms with higher load bearing capacity, as well as heavy, expensive, and volatile working medium. The industry believes that immersion liquid cooling in high power density cabinets will also develop as the price of working medium and custom components will fall.

Cold-Plate Liquid Cooling Server Solution

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3.1 Overview of the Cold-Plate Liquid Cooling Solution

Cold-plate liquid cooling refers to the non-contact liquid cooling technology which uses liquid (heat transfer working medium) flowing in the inner channels of the cold plate to cool the heat source through heat transfer. During the process, the heat is transferred from an electronic component that needs to be cooled to the cold plate assembled on the component, and then from the cold plate to the liquid working medium. Such a process is also is called non-contact liquid cooling. It is different from the immersion and spray liquid cooling technologies, which require direct contact between the liquid cooling working medium and the electronic components. (Generally, heat sink fins are also required on the surface of the heat source to increase the heat exchange area.)

Benefited from the industry's over 10 years research in liquid cooling and refined by customer requirements, cold-plate liquid-cooled servers (and their infrastructure) have formed mature commercial solutions. Figure 2 shows one of the liquid cooling architectures. This solution removes more than 80% of the excessive heat from IT equipment through cold plates and the CDU. This part of heat is then directly carried away by the cooling tower. The other 20% is transferred to the innovative rear-mounted passive rear door heat exchanger (RDHx; no fan) and then removed by heat exchange between the chillers and the cooling towers. This solution supports a high water supply temperature from 25°C to 28°C (77°F to 82.4°F), which is higher than the water supply temperature required by row air conditioners (below 18°C or 64.4°F). This allows the chiller to be off for most time of the year and be on only in the summer to supplement a small amount of cooling, achieving the optimal PUE.

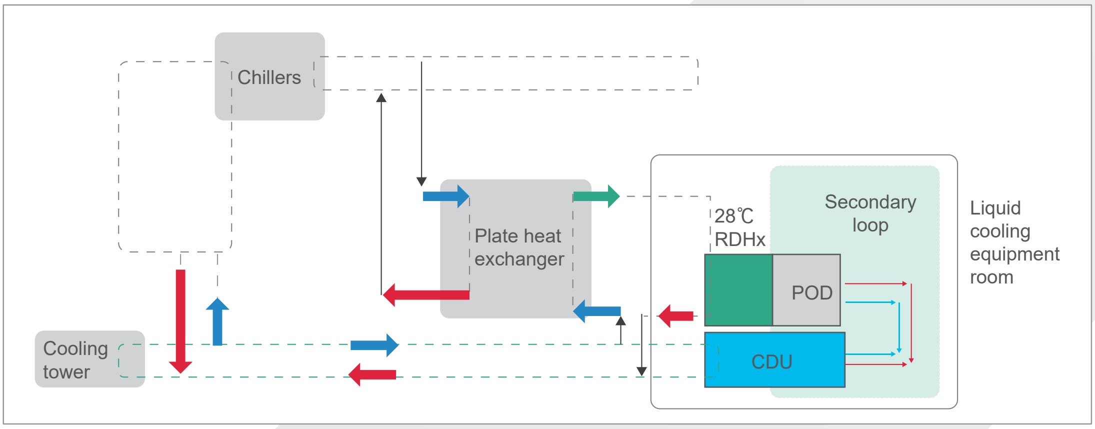

Figure 2 Cold-plate liquid cooling architecture (example)

3.2 Liquid Cooling Solution of Liquid-cooled Rack-Scale Servers

Liquid-cooled rack-scale servers feature high density, powerful performance, high energy efficiency, robust reliability, integrated delivery, simplified O&M, and low total cost of ownership (TCO). They are applicable to cloud computing, virtualization, big data, and HPC applications. They can be widely deployed in data centers such as enterprise data centers, Internet Data Centers, and carriers' data centers.

The full liquid cooling solution can be used to provide heat dissipation for the servers. It combines cold plates and RDHxs to carry all of the excessive heat generated by the servers out of the equipment room through working medium. This solution eliminates air conditioners and greatly shortens the use time of the chiller to reduce energy consumption. It meets the PUE requirement in the "Processing Eastern Data in the West" strategy (less than 1.25).

3.2.1 High Density

To meet cloud-based service development requirements, enterprises build data center infrastructure, including infrastructure as a service (IaaS), platform as a service (PaaS), and service as a service (SaaS). IaaS is divided into basic services such as computing, storage, network, and security services. Liquid-cooled servers are suitable for computing-intensive application scenarios such as computing resource virtualization and computing nodes in big data clusters with decoupled storage and compute.

High-density nodes are deployed in the liquid-cooled rack-scale servers. The computing power density of a rack-scale server is several times higher than that of a common cabinet. For example, a 47 U rack-scale server can host up to 72 dual-socket server nodes and support up to 33 kW power. Another model of rack-scale server can host up to thirty-two 1 U four-socket liquid-cooled server nodes with up to 128 CPUs, supporting up to 66 kW power supply.

3.2.2 High Energy Efficiency

In a fully liquid-cooled environment, server nodes can run at higher frequencies and deliver super computing power.

Low PUE: A typical node uses cold plates for CPUs and memory modules. Liquid cooling accounts for 80% of the total, and the cooling PUE can be reduced to less than or equal to 1.15.

Highly efficient CPU liquid cooling: CPUs use high-density shovel-tooth cold plates, of which the direct liquid cooling heat exchange efficiency can reach 90%.

Efficient memory liquid cooling: The memory modules use shovel-tooth tube heaters, improving the cooling efficiency up to 90%.

3.2.3 High Reliability

In a typical scenario, a rack-scale server is configured with a maximum of 22 + 2 PSUs, two switch nodes, server nodes with fans in N+1 mode, and passive cable backplanes, and supports operating temperature derating by 5°C (9°F).

Three-level leak-proof design: leak-proof design for nodes, cabinets, and equipment rooms ensure zero liquid leakage accidents.

Node: Each node base is fully sealed. Once liquid in a node is leaked to the node base, it can be diverted in time and will not spread to other nodes in the cabinet.

Cabinet: The quick connectors adopt a leak-proof and anti-spray design, and the cabinet solenoid valve automatically controls the refrigerant.

Equipment room: The dual-loop design adopted to isolate a cabinet that suffers liquid leakage, safeguarding normal operation of the other cabinets.

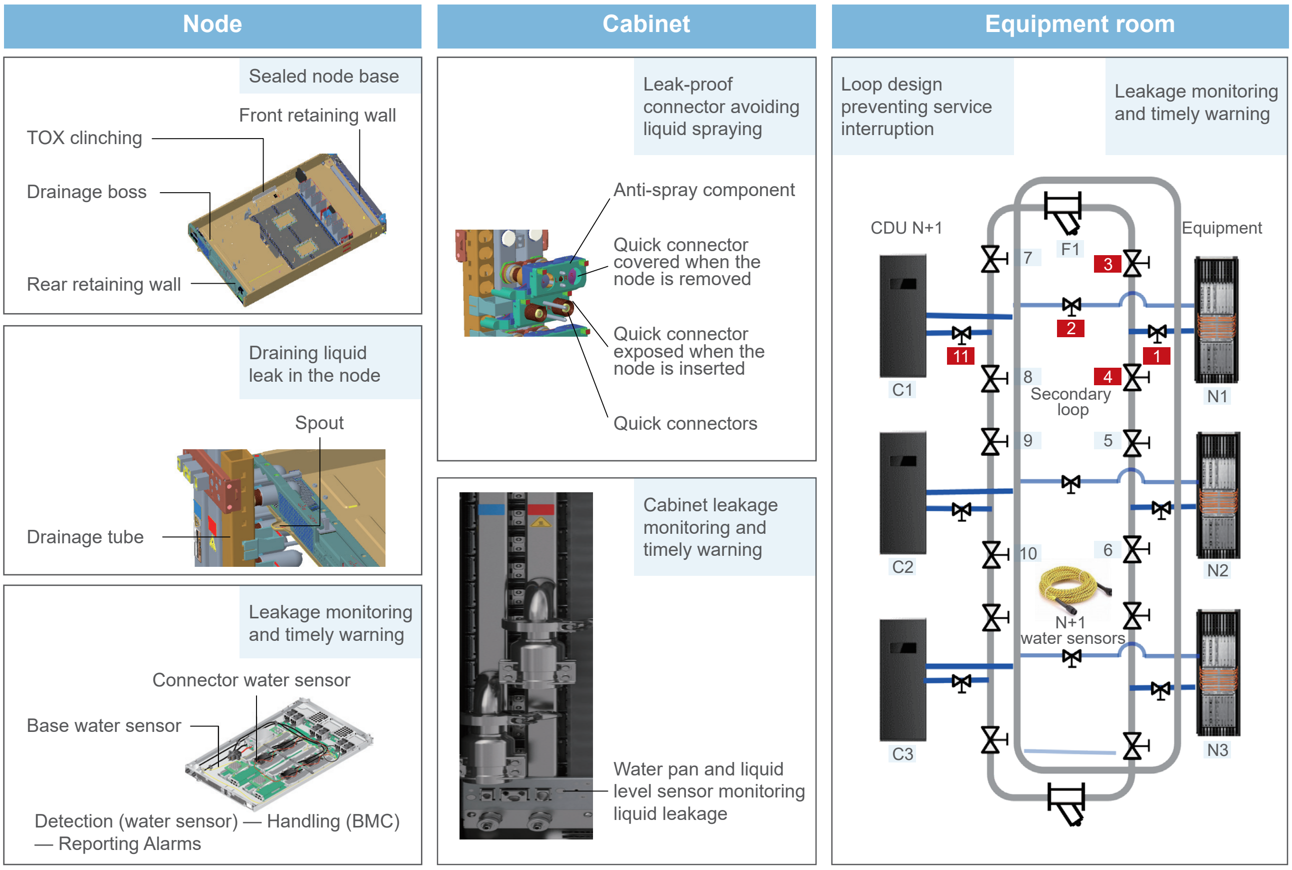

Figure 3 Main structure of a node, a cabinet, and an equipment room (example)

Comprehensive monitoring of liquid leakage: The rack-scale server provides three-level liquid leakage detection and refined liquid leakage alarms.

Node: Water sensors are used to detect liquid leakage at server nodes. Once leakage is detected, the leakage detector reports the leakage to the BMC for monitoring.

Cabinet manifold: Photoelectric liquid leakage sensors are installed on the water inlet and water outlet respectively. If leakage is detected, the sensors report the leakage to the network management system (NMS) platform through the RMU.

Air/Liquid heat exchanger (RDHx): The float leakage sensors monitor the condensate water level of the air/liquid heat exchanger. If leakage is detected, the sensors report the leakage to the NMS platform through the RMU.

System reliability: Fault prediction, fault diagnosis and self-healing change emergency O&M to proactive O&M.

Intelligent fault diagnosis: The intelligent fault management engine delivers a fault diagnosis accuracy of up to 93%.

AI drive fault prediction: An AI-powered algorithm is used to identify risky drives 7 to 30 days in advance.

AI-powered memory fault self-healing: Memory fault self-healing and PCIe fault isolation are adopted to reduce service downtime.

Integrated delivery and transportation by rack-scale server (including the cabinet, server nodes, switching nodes, management modules, power frames, battery frames, power modules, and sensors and excluding the air/liquid heat exchanger and cabinet doors) are supported.

3.2.4 Simplified O&M

The liquid-cooled rack-scale server adopts an integrated design that supports blind mating for three buses (the manifold of liquid cooling water pipes, the power supply busbar, and the cable backplane of the switching network), realizing automatic O&M without manual cable connections. It adopts key technologies such as three-dimensional float quick connectors, 48 V power supplies, and network cable backplanes. For example, if a cabinet has 72 nodes, it requires 360 network cables, 144 water pipes, and 36 power cables. The three-bus blind mating technology realizes zero manual cable connections inside the cabinet.

Liquid cooling pipeline solution: The manifold design with blind-plug quick connectors is used. The water inlet and outlet pipes of the cold plate of a server node are connected to the cabinet manifold through blind-plug quick connectors. That is, the liquid cooling water pipes are plug-and-play.

Referential power supply solution: The +48 V busbar design is used. The cabinet power modules receives the external three-phase 380 V power and outputs +48 V power to the copper bars on the busbar of the cabinet. The server nodes obtain power from the copper bars on the busbar which is plug-and-play.

Referential switching network solution: The cable backplane design is used. The service and management network ports of a server node are connected to the switch through the cable backplane of the cabinet. Cable connectors are used inside the node. In this way, plug and play is realized without cable connections between nodes and external devices.

Referential easy parts replacement solution: robot O&M. Users do not need to remove the cold plates before removing a memory modules. They even can use robots to replace memory modules and server nodes.

Integrated delivery: The rack-scale servers are installed with components, tested, and commissioned in the production line. After being delivered to the customer's equipment room in an integrated way, the rack-scale servers require no onsite installation. The delivery period is shortened from weeks to days.

The secondary loop pipes are modularized and prefabricated in the factory, which frees onsite delivery from welding and flushing and improves the delivery efficiency by 50%.

The rack-scale servers also provide other O&M capabilities, such as automatic identification of server U positions, integration with third-party NMSs, intelligent management features, and simplified O&M for liquid-cooled servers.

3.3 Main Failure Modes of Cold-Plate Liquid Cooling

Compared with traditional air-cooled products, cold-plate liquid-cooled servers have more complex failure modes affecting reliability because of the introduction of working medium. Attention especially needs to be paid to problems of the working medium pipes, such as leakage and corrosion. Common key components and their failure modes are as follows:

Table 1 Common key components and their failure modes

	Equipment Room		Cabinet	Node
Key component	CDU	Secondary loop	Manifold	Cold plate
Sub component	Pump system, heat exchanger, monitoring system, refill tank, pipe connector	Pipes Valves	Tube body Quick connectors Clamps	Quick connectors Water blocks
Failure mode	Leakage/blockage/corrosion/deformation/fracture/overheating/short circuit	Leakage/blockage/corrosion/looseness	Leakage/blockage/corrosion/overheating	Leakage/blockage/looseness/corrosion
Failure cause	Poor sealing of joints Defects in manufacturing Low nitrogen pressure Sensor failure Erosion corrosion External shock Environmental adaptability	Poor sealing of joints Pipes not thoroughly cleaned during construction Long-term erosion corrosion	Quick connector assembly defect Quick connectors with unqualified tolerance of size Insufficient compression of sealing materials for quick connectors Long-term poor elasticity of sealing materials Looseness caused by external shocks Long-term erosion corrosion Environmental adaptability	Residues in cold plate after cleaning Sealing ring not pressed Small pagoda head Insufficient pressure at welding positions Offset seal ring Poor consistency of shovel teeth Environmental adaptability

Reliability Assurance of Cold-Plate Liquid-cooled Servers

Reliability Assurance of Cold-Plate Liquid-cooled Servers

4.1 Leakage Prevention Function Analysis

The leakage prevention performance of the liquid-cooling cabinet and server nodes in the liquid-cooling environment is an important indicator for evaluating the reliability of a cold-plate liquid-cooled server. The following leakage prevention function analysis results are obtained from a leakage prevention function test performed on randomly-selected and normally-produced liquid cooling cabinets, cold-plate liquid-cooled servers, and cold plates.

Table 2 Leakage prevention function test

Test Item	Sub Test Item	Test Result for Reference
Leakage prevention function test	Air tightness (by pressure drop)	Pressure drop test
	Air tightness (by helium leak detection)	Helium leak detection test
	Hydrostatic pressure	Pipes have no damage or leak
	Pulse fatigue	Pipes have no damage or leak
	Long-term damp heat	Pipes have no damage or leak
	High temperature creep	Pipes have no damage or leak
	Life (by insertion and removal)	Pipes have no leak
	Leakage (caused by insertion and removal) test	The leakage caused by insertion and removal meets the requirements
	Long-term running	Pipes have no damage or leak

4.2 Blockage Prevention Function Analysis

Because the liquid cooling system has high precision and high requirements on liquid flow, pipe blockage will affect the functioning of the liquid cooling system. The anti-blocking function of the liquid cooling system must meet the performance requirements. The following blockage prevention function analysis results are obtained from a blockage prevention function test performed on randomly-selected and normally-produced liquid cooling cabinets, cold-plate liquid-cooled servers, and cold plates.

Table 3 Blockage prevention function test

Test Item	Sub Test Item	Test Result for Reference
Blockage prevention function test	Impurity blockage	The flow resistance and the pressure test result meet the requirements
	Pipe bending	The flow resistance and the pressure test result meet the requirements
	Erosion corrosion	The flow resistance and the pressure test result meet the requirements

4.3 Compatibility (Corrosion Resistance) Reliability Analysis

The cold-plate liquid-cooled products use ethylene glycol solution as the working medium for the secondary loop, and the cooling system involves various materials (metal, plastic, and rubber). During long-term operation, the working medium may corrode the components of the cold plate liquid cooling system. Therefore, the service life of the cold plate liquid cooling system materials and components in the working medium must meet the service life requirements. The following corrosion resistance test results of the cold-plate liquid cooling system are obtained from corrosion resistance tests performed on randomly-selected material samples and components of the liquid cooling system.

Table 4 Corrosion resistance test

Test Item	Sub Test Item	Test Result for Reference
Corrosion resistance test	Metal corrosion resistance	The mechanical properties meet the requirements
	Non-metallic medium compatibility test	The mechanical properties meet the requirements
	Long-term running	The pipe strength and the corrosion size meet the test requirements
	High temperature and high pressure aging	The pipe strength and the corrosion size meet the test requirements

Test Item	Sub Test Item	Test Result for Reference
Corrosion resistance test	Pipe erosion corrosion	The pipe strength and the corrosion size meet the test requirements
	Microbial corrosion of liquid cooling metal pipes	The pipe strength and the corrosion size meet the test requirements
	Salt spray	The pipe strength and the corrosion size meet the test requirements

4.4 Reliability Assurance In Terms of Mechanical Stress

The main functional components of a liquid-cooled server node include cold plates, connectors, and hoses. One server can be configured with four liquid-cooled server nodes. The following table describes the reliability requirements of liquid-cooled servers and their nodes (a FusionPod cabinet as an example) on mechanical stress.

Table 5 Mechanical stress reliability test

Test Item		Reference Standard	Sub Test Item	Test Result for Reference
Connector reliability	Manufacturing & installation service	/	Anti-stretching performance	The mechanical strength meets the requirements
		/	Seal ring rotation durability	The wear strength meets the requirements
	Work operation & capacity expansion during maintenance	/	Repeated insertion and removal	The service life meets the requirements.
		GJB150.16A	Vibration stress screening	The sealing reliability meets the requirements
Hose reliability	Manufacturing & installation service	GB/T 10000-1988	Stomping resistance	The strength meets the reliability requirements
		None	Anti-Piercing performance	The strength meets the reliability requirements
		ISO1746	Anti-bending performance	The strength meets the reliability requirements

Reliability of cold plates	Manufacturing & installation service	GB50243	Hydrostatic pressure	The strength meets the reliability requirements
		GB/T 5861	Resistance to negative pressure	The air tightness and strength meet the reliability requirements
		GB50243	Hydrostatic pressure	The strength meets the reliability requirements
		GB/T 5861	Resistance to negative pressure	The air tightness and strength meet the reliability requirements
	Packaging and transportation	GB/T4857.4	Normal static pressure of the package	The transportation reliability meets the requirements
		GB/T 2423.56	Package random vibration	The transportation reliability meets the requirements
		GB/T 2423.8	Package fall	The transportation reliability meets the requirements
		GB/T 2423.5	Half sine wave shock on package	The transportation reliability meets the requirements
		GB/T 2423.5	Package collision	The transportation reliability meets the requirements
	Installation service	GB/T 2423.56	Transportation of bare-metal products	The transportation reliability meets the requirements
		GJB 2873	Moving of bare-metal products	The user experience meets the requirements
		GR63	Fall of bare-metal products	The transportation reliability meets the requirements
	Operation	GB/T 2423.56	Operating random vibration	The operating reliability meets the requirements
		GB/T 2423.10	Operating sine sweep	The operating reliability meets the requirements
		GB/T 2423.5	Operating half sine wave shock	The operating reliability meets the requirements
		GB/T 2423.56	Non-operating random vibration	The operating reliability meets the requirements
		GB/T 2423.10	Non-operating sine sweep	The operating reliability meets the requirements
		GB/T 2423.5	Non-operating half-sine wave shock	The operating reliability meets the requirements
		/	Pressure pulse	The operating reliability meets the requirements

4.5 Environmental Reliability Assurance

Table 6 Environment reliability test

Test Item		Reference Standard	Sub Test Item	Test Result for Reference
Connector reliability	Work operation & capacity expansion during maintenance	GB5861	Leakage caused by connector insertion and removal	The mechanical strength and leakage amount meet the requirements
		GB/T 2423.3	Long-term damp heat	The environment reliability meets the requirements
		/	Pipe erosion corrosion test	The environment reliability meets the requirements
Hose reliability	Work operation & capacity expansion during maintenance	/	Pipe erosion corrosion test	The environment reliability meets the requirements
Reliability of cold plates	Manufacturing & installation service	GB/T 2423.23	Air tightness test	The environment reliability meets the requirements
		/	Helium leak detection test	The environment reliability meets the requirements
	Work operation & capacity expansion during maintenance	GB/T 2423.2	Storage at high temperature	The environment reliability meets the requirements
		GB/T 2423.3	Long-term damp heat	The environment reliability meets the requirements
		GB/T 2423.22	High-speed thermal cycling	The environment reliability meets the requirements
Reliability of liquid cooled nodes	Manufacturing	/	Air tightness test	The environment reliability meets the requirements
		/	Helium leak detection test	The environment reliability meets the requirements
	Packaging and transportation	GB/T 2423.1	Storage at low temperature	Storage reliability meets the requirements
		GB/T 2423.2	Storage at high temperature	Storage reliability meets the requirements
		GB/T 2423.3	Storage in an environment with constant damp and heat	Storage reliability meets the requirements
	Operation	GB/T 2423.1	Storage at low temperature	Storage reliability meets the requirements
		GB/T 2423.2	Storage at high temperature	Storage reliability meets the requirements
		GB/T 2423.17	Constant salt spray	The corrosion resistance meets the requirements
		GB/T 2423.22	High-speed thermal cycling	The environment reliability meets the requirements

	Operation	GB/T 2423.3	Long-term damp heat	The environment reliability meets the requirements
		GBT 14832	Non-metallic medium compatibility	The corrosion resistance meets the requirements
		/	Metal medium compatibility	The corrosion resistance meets the requirements
		/	Pipe erosion corrosion test	The corrosion resistance meets the requirements
		/	Microbial corrosion test	The corrosion resistance meets the requirements

4.6 Electrical Safety Requirements

The electrical safety of the products shall be designed and tested in compliance with the GB 4943.1, IEC 62368-1, and IEC 60950-1 standards.

4.6.1 Requirements on the Pressurized and Liquid-Filled Components of the Equipment

Liquid-filled components (LFCs) located inside the equipment meet all of the following requirements:

In terms of electrical safety, the products are designed and tested in compliance with GB 4943.1, IEC 62368-1, and IEC 60950-1 standards.

a. Combustible or conductive liquids shall be stored in containers, and the LFCs shall pass the compatibility tests, vibration tests, thermal cycling tests and force tests of pipes and fittings.

b. The liquid should be coped with as a harmful substance. Corresponding protective measures should be taken.

c. Non-metallic parts of the vessel system shall pass the hydrostatic pressure tests and creep resistance tests.

d. When an LFC is installed in the equipment, the pipe of the LFC does not contact with sharp edges or any other surface that may damage the pipe, and the liquid does not invalidate the safety protection when the LFC bursts or releases its pressure.

4.7 Electromagnetic Compatibility Requirements

The electromagnetic compatibility of the product complies with the GB/T 9254 Class A, GB 17625.1, and IEC 61000-3-2 Class A requirements. The EMC requirements are designed and tested according to delivery scenarios in China. The EMC of the whole product meets the access requirements of the target market.

4.8 Electromagnetic Compatibility/Electrical Safety Test Methods

4.8.1 Electromagnetic Compatibility Test

Develop the certification strategy and break down the EMC design baseline based on the certification requirements of the target market. Then determine the test methods based on the baseline and certification regulations.

a. Test the radio disturbance limits of power ports & telecommunications ports using the method specified in GB/T 9254 (test frequency band: 30 MHz-6 GHz).

b. Test the harmonic current emission limit using the method specified in GB/T 17625.1.

4.8.2 Electrical safety test

Perform the pressurized LFC tests on liquid cooling components:

a. Perform the hydrostatic pressure tests in accordance with G.15 in IEC 62368-1.

b. Perform the creep strength tests in accordance with G.15 in IEC 62368-1.

c. Perform the compatibility tests of pipes and fittings in accordance with G.15 of IEC 62368-1.

d. Perform the vibration tests in accordance with G.15 in IEC 62368-1.

e. Perform the thermal cycle test in accordance with G.15 in IEC 62368-1.

f. Perform the force tests in accordance with G.15 in IEC 62368-1.

Application Case

Application Case

5.1 xFusion's Liquid Cooling Solution

After over 10 years of accumulation in reliability research and 170 reliability tests, xFusion Digital Technology Co., Ltd. (hereinafter referred to as xFusion) has successfully delivered more than 10,000 liquid-cooled servers around the world for commercial use. The commercial use cases cover entities such as Internet service providers, universities, cloud data centers, governments and enterprises, supercomputing data centers, and financial institutes.

xFusion introduces liquid-cooled rack-scale servers with an innovative architecture that features overhead cabling and underfloor piping and highly reliable original 100% liquid cooling design. With PUE less than 1.10 which meet the requirements of the national "Processing Eastern Data in the West" strategy, the rack-scale servers are ideal for large data centers. They support high-density deployment (up to 144 CPUs per cabinet) and do not require air conditioners in the equipment room, improving the space utilization of the equipment room by 20%. The rack-servers incorporate the industry-unique three-bus blind mating (liquid, network, and power supply buses) design, realizing zero cable connections in cabinets. They support the evolution of equipment rooms towards robot O&M. xFusion's intelligent O&M management software improves the service rollout efficiency of the servers by more than 10 times.

Through innovation in architecture and system engineering, xFusion is committed to providing green energy-saving computing power for customers and providing high-quality solutions for data centers in national computing hubs.

In a liquid-cooled data center in China, tens of thousands of xFusion's liquid-cooled server nodes are deployed, forming the world's largest liquid-cooled cluster, which reduces the TCO is reduced by 30%. The delivery efficiency of this project is 100% higher than that of a traditional project.


D01
D02
D03

About xFusion

xFusion is a leading global provider of computing power infrastructure and services. xFusion serves customers from 130 countries and regions, including 211 Fortune Global 500 companies, covering finance, telecom, Internet, transportation, energy, and other industries. For more information, please visit https://www.xfusion.com/en. And search “**xFusion Global**” on LinkedIn, Twitter, and Facebook

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