SUSTAINABLE AND FUTURE READY COOLING SOLUTIONS

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What's happening?

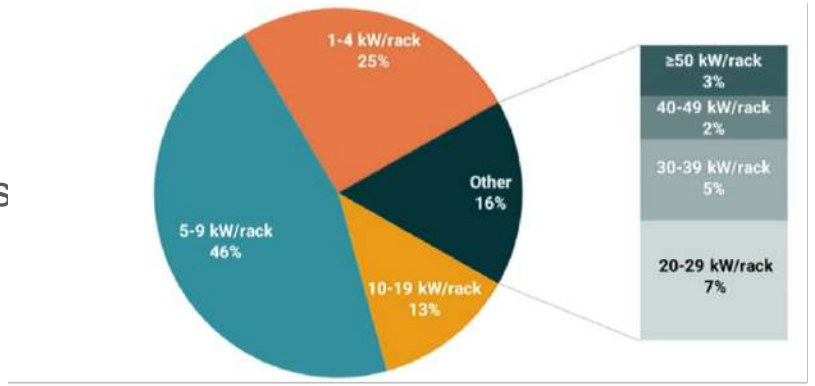
UPTIME → COOLING IS KEY FOR AVAILABILITY OF IT EQUIPMENT.

CAPEX vs OPEX

- Energy consumption and TCO perspective

DENSITY

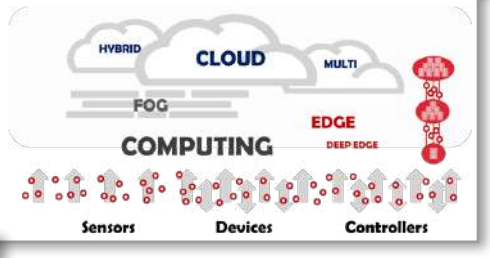
- The average density per rack was rising from 2.4kw by 6kW in the last 9 years.
- Chip power roadmap shows majority of chip power will be increasing pas the limit of air cooling within the next 24 months - Market size for liquid-based cooling techniques to grow from $1.5B in 2020 to $6.5B in 2027
- More compute power housed in less real estate



Source: Uptime Institute Global Survey of IT and Data Center Managers 2020, n=422

DOWNLOAD VS UPLOAD WORLD

- Decentral installations challenge the designers and operators
- "By 2025, 75% of enterprise-generated data will be created and processed outside a traditional centralized data center or cloud" *Gardner*



SUSTAINABILITY

Net Zero programs and Water usage restrictions, ESG targets

DATA CENTER COOLING

Server Rack

Server Rack w/Fans

Server Rack w/AC

Row Aisle Containment (Passive)

Row Aisle Containment (Active w/IRC)

COOL THE SERVER, NOT THE ROOM

AIR AND LIQUID COOLING SOLUTIONS

Chassis Level Immersion Cooling

Row and Rack Coolant Distribution Unit (CDU) & Rack Manifolds

Rear Door Cooling (Passive/Active)

In Row Cooling – LX

Rack w/Integrated LX Cooling (MicroEdge)

FULL PORTFOLIO OF WHITESPACE COOLING SOLUTIONS

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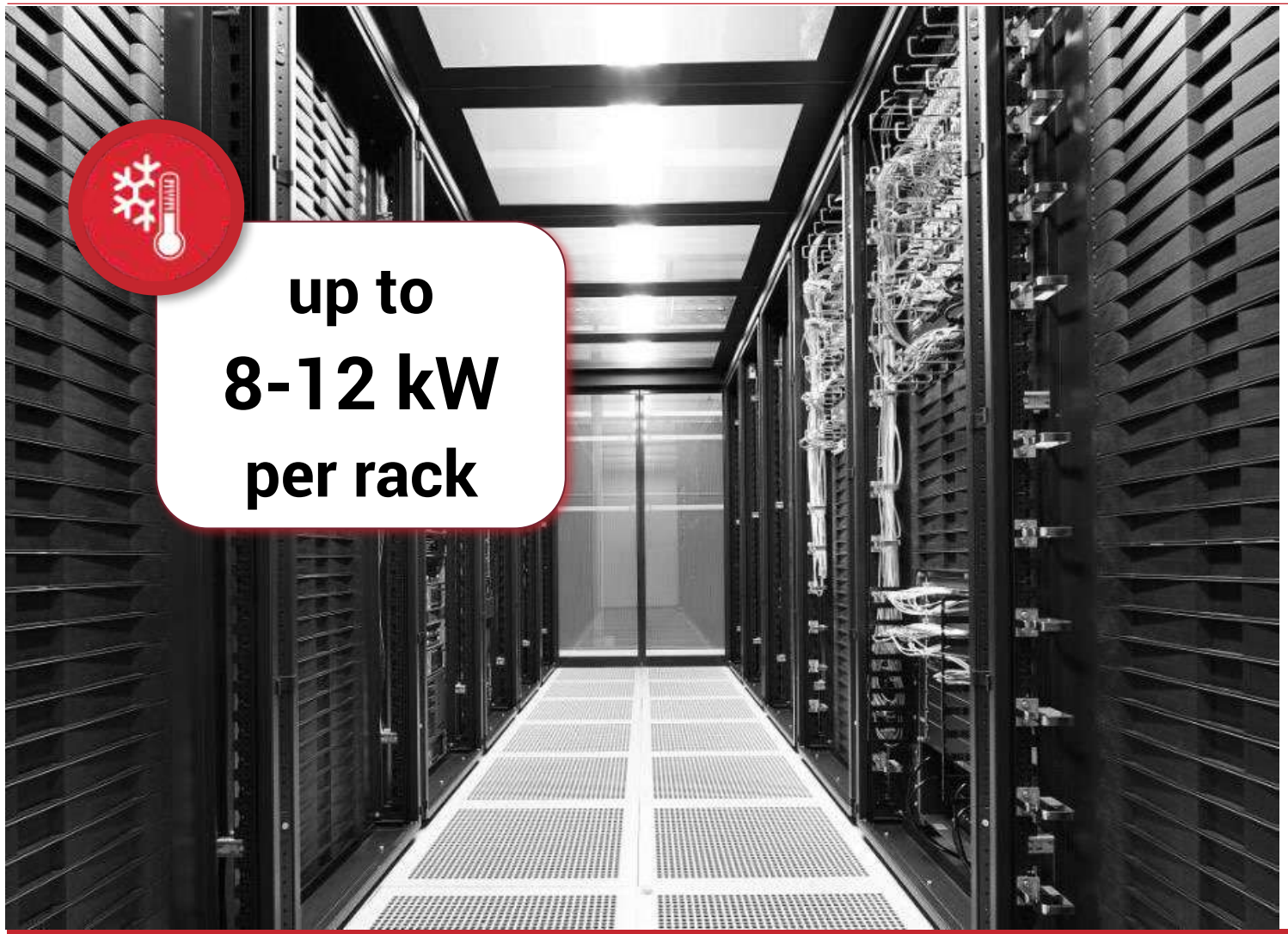
CONTAINMENT



- State of the art
- Proven technology
- Availability of components

- PUE <1,7 possible

- Return air temperature <35°C
- Water inlet n/a
- High airflow required
  (10 m³/h per kW → 100m³/h @10kW)

Room based Cooling Solution

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CONTAINMENT WITH INROW COOLING

- State of the art
- Proven technology
- Availability of components
- Planning / Redundancies
- No raised floor mandatory

- PUE <1,5 possible

- Return air temperature <45°C
- Water inlet <18°C
- Efficient regulation

Aisle based Cooling Solution

REAR DOOR COOLER

- State of the art (?)
- Proven technology (?)
- Availability of components
- Planning / Redundancies
- No raised floor mandatory
- Can be operated fan less

- PUE <1,2 possible

- Return air temperature <50°C
- Water inlet <22°C
- Efficient regulation

Rack based Cooling Solution

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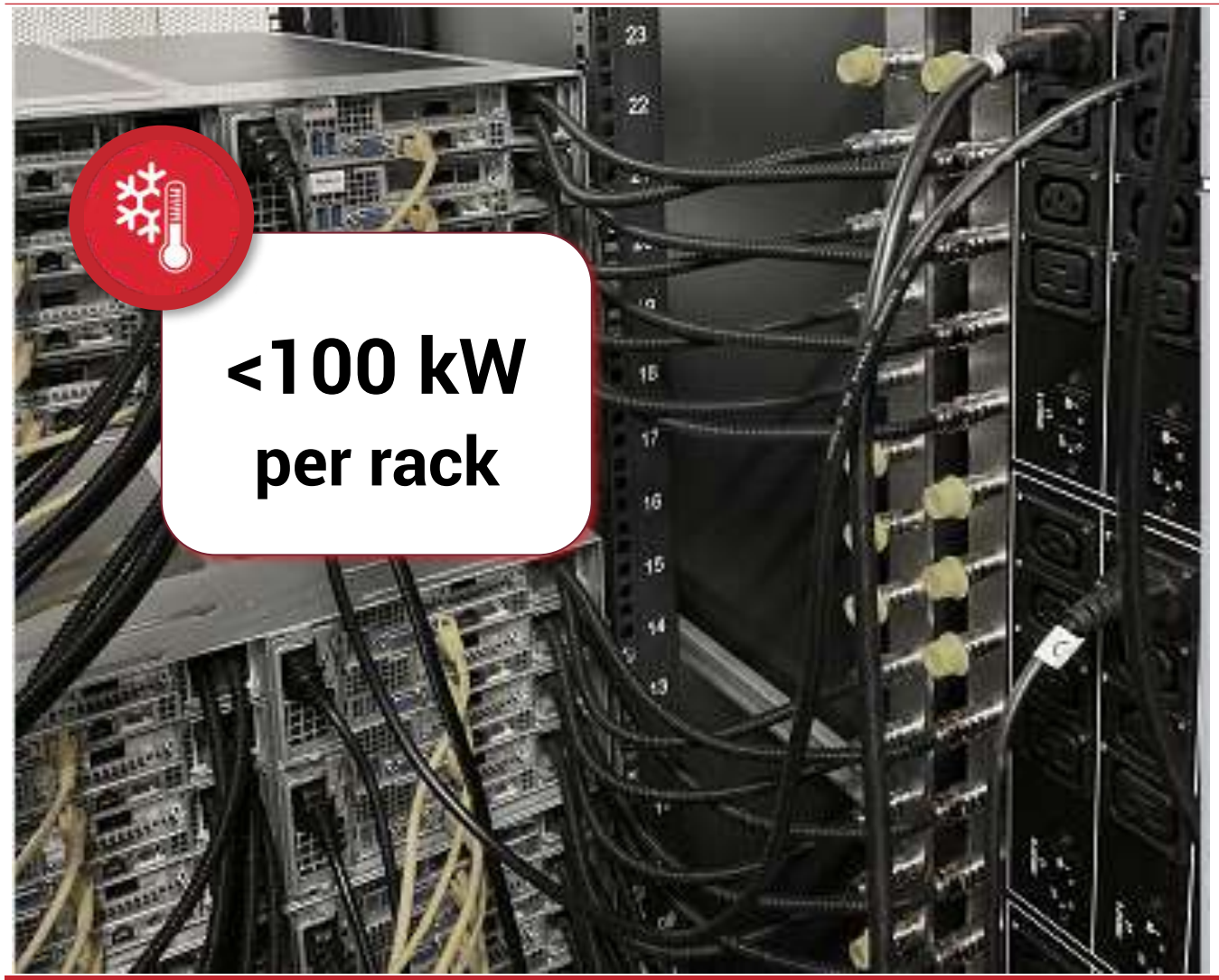
DIRECT TO CHIP COOLING



- State of the art (???)
- Proven technology (?)
- Availability of components (?)
- No raised floor mandatory
- Can be operated fan less

- PUE <1,1 possible

- Return air temperature <45°C
- Water inlet <45°C
- Efficient regulation

Server based Cooling Solution

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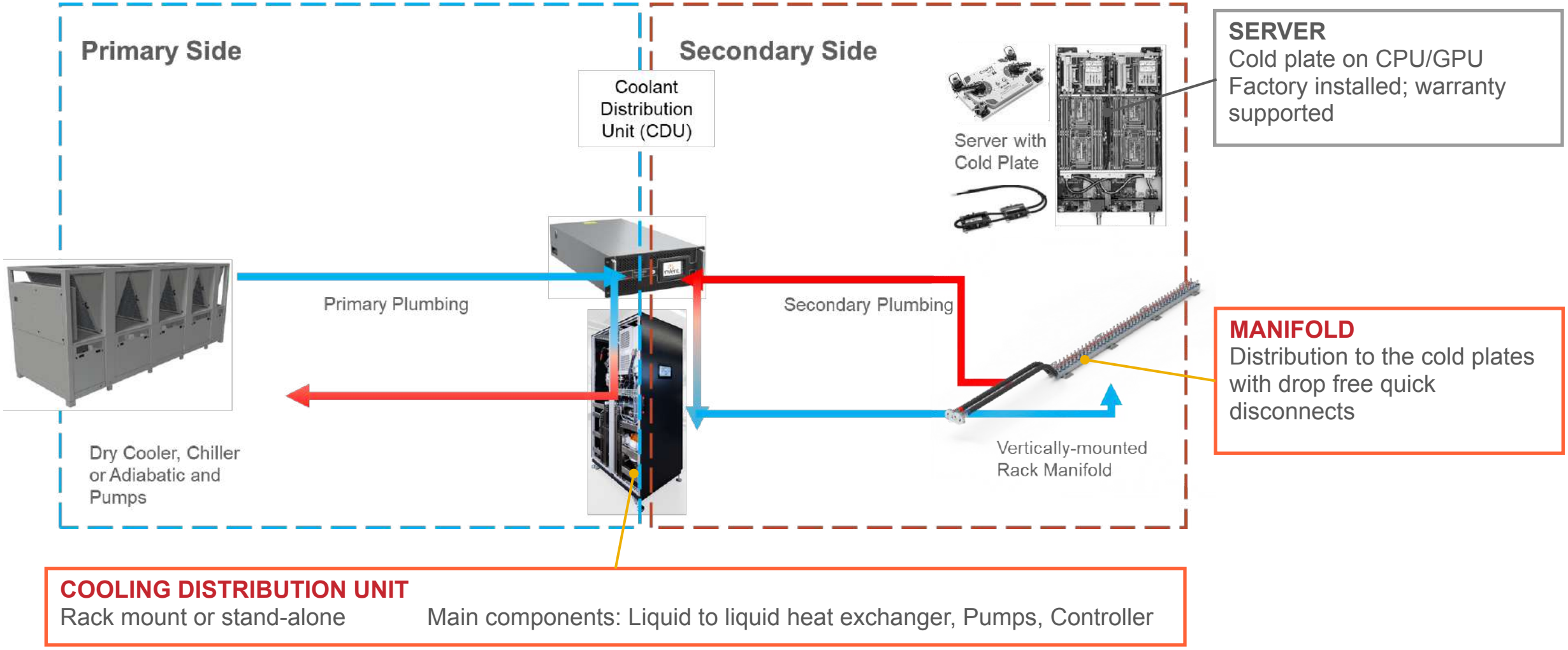
DIRECT TO CHIP COOLING



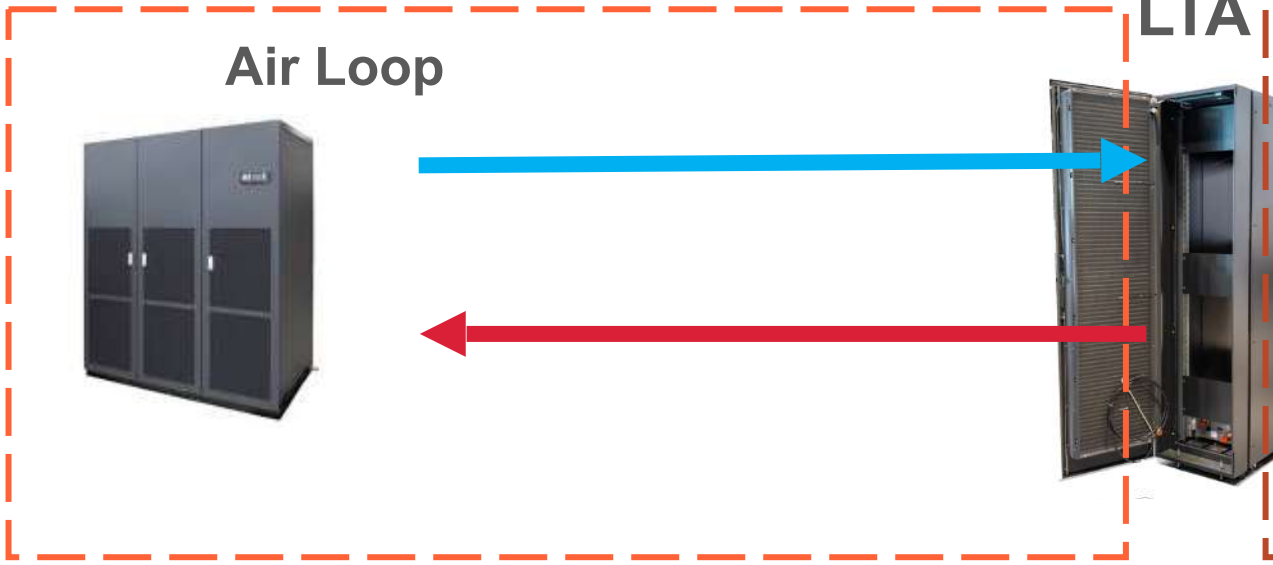
SERVER
Cold plate on CPU/GPU
Factory installed; warranty supported

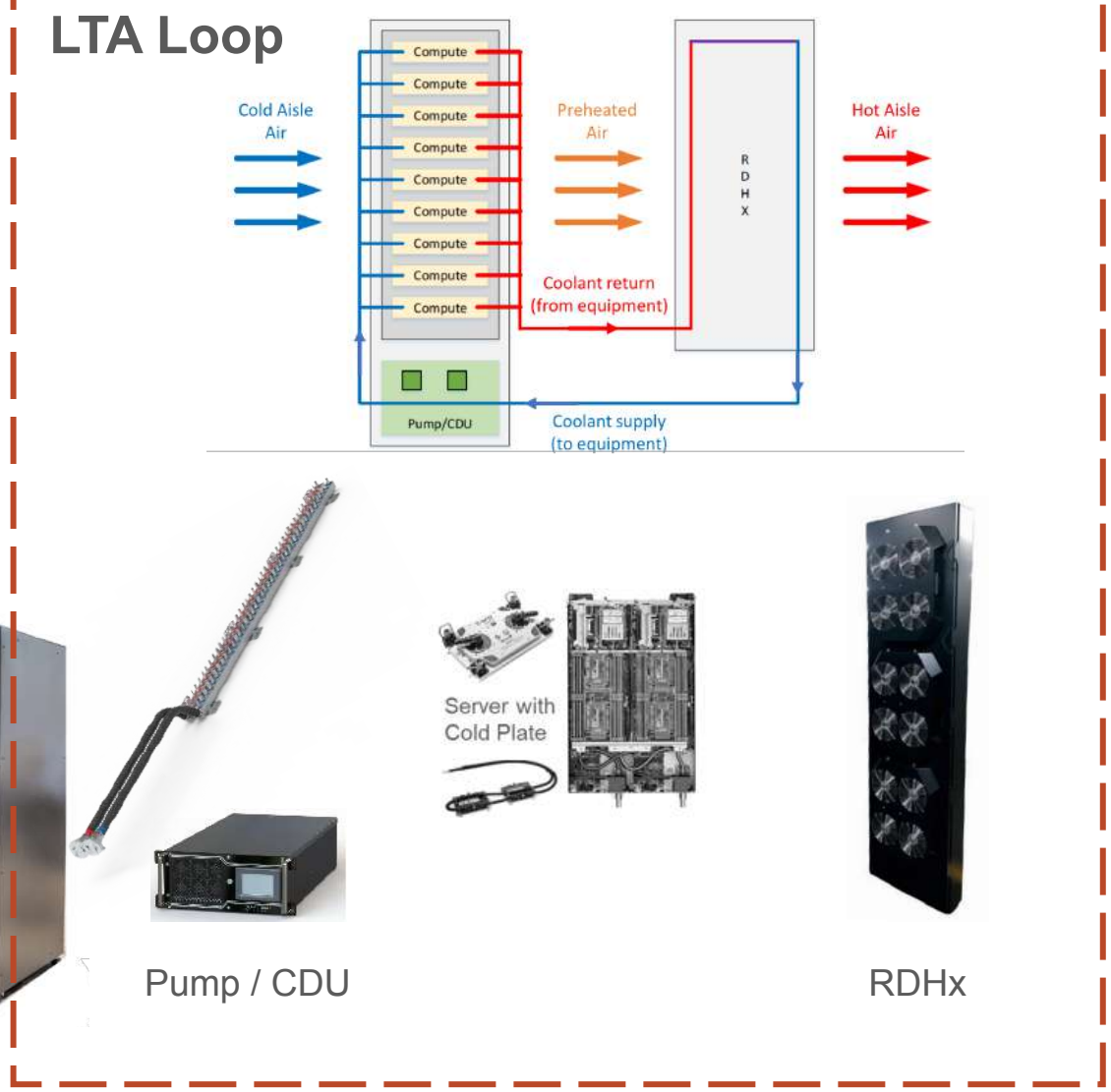
MANIFOLD
Distribution to the cold plates with drop free quick disconnects

COOLING DISTRIBUTION UNIT
Rack mount or stand-alone Main components: Liquid to liquid heat exchanger, Pumps, Controller

AIR-ASSIST LIQUID COOLING – LIQUID-TO-AIR (LTA)

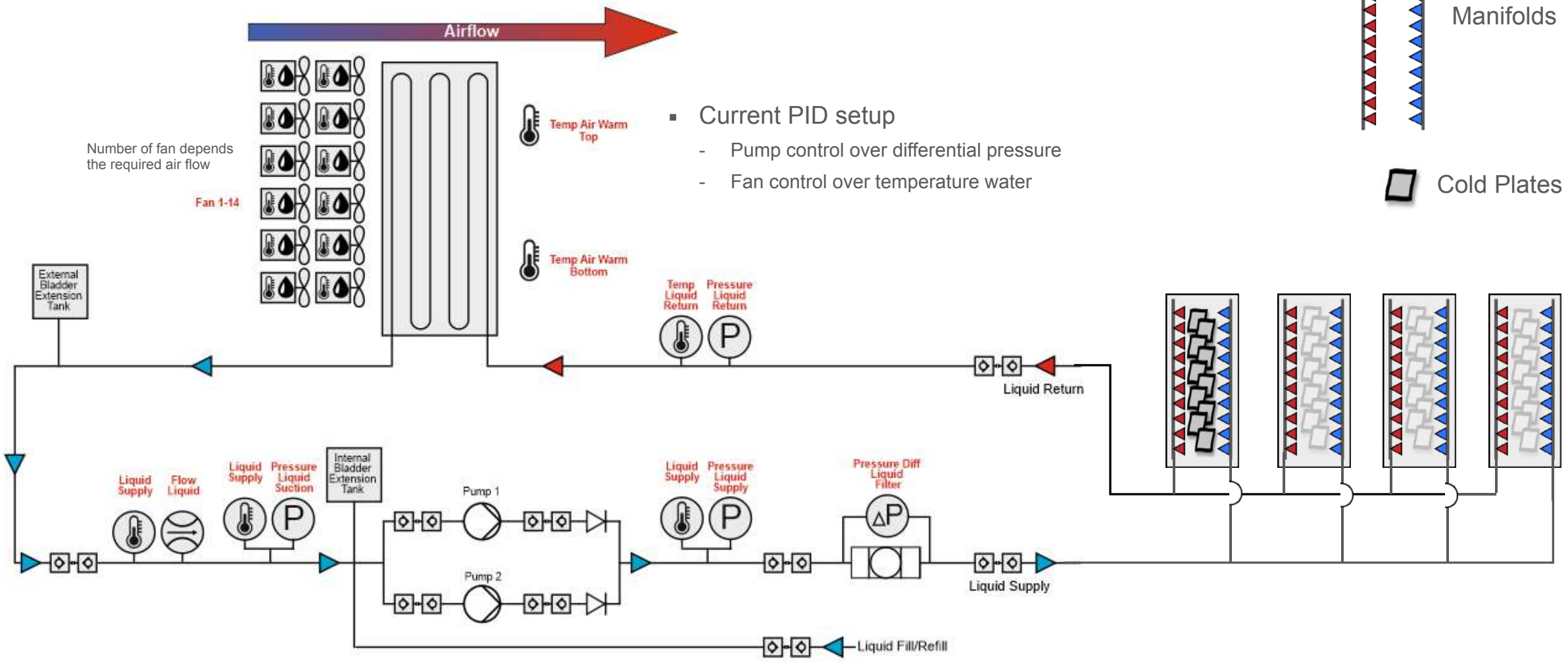
- Enables direct-to-chip liquid cooling in air-cooled data centers
- No need to retrofit facility water cooling cycle, extend life of existing CRAC / CRAH units and aisle containments
- Cold aisle air is used to cool the warm liquid returning from equipment





Side LTA

Usage for rack row or containment cube



- Current PID setup
  - Pump control over differential pressure
  - Fan control over temperature water

DIRECT TO CHIP (HYBRID) COOLING SOLUTION LAYOUT

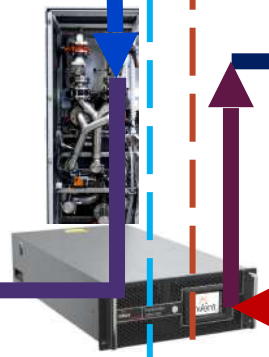
- Cold Plates do not capture 100% of the heat with liquid.
- Setup an air loop with CRAC, InRow or Rear Door cooler
- Water circuits can be optimized in regards to temperatures

Air Loop

Primary Side

Secondary Side

Primary (Facility) Plumbing



Secondary (Internal) Plumbing

Coolant Distribution Unit (CDU)

Vertically-mounted Rack Manifold

Dry Cooler, Chiller or Adiabatic and Pumps

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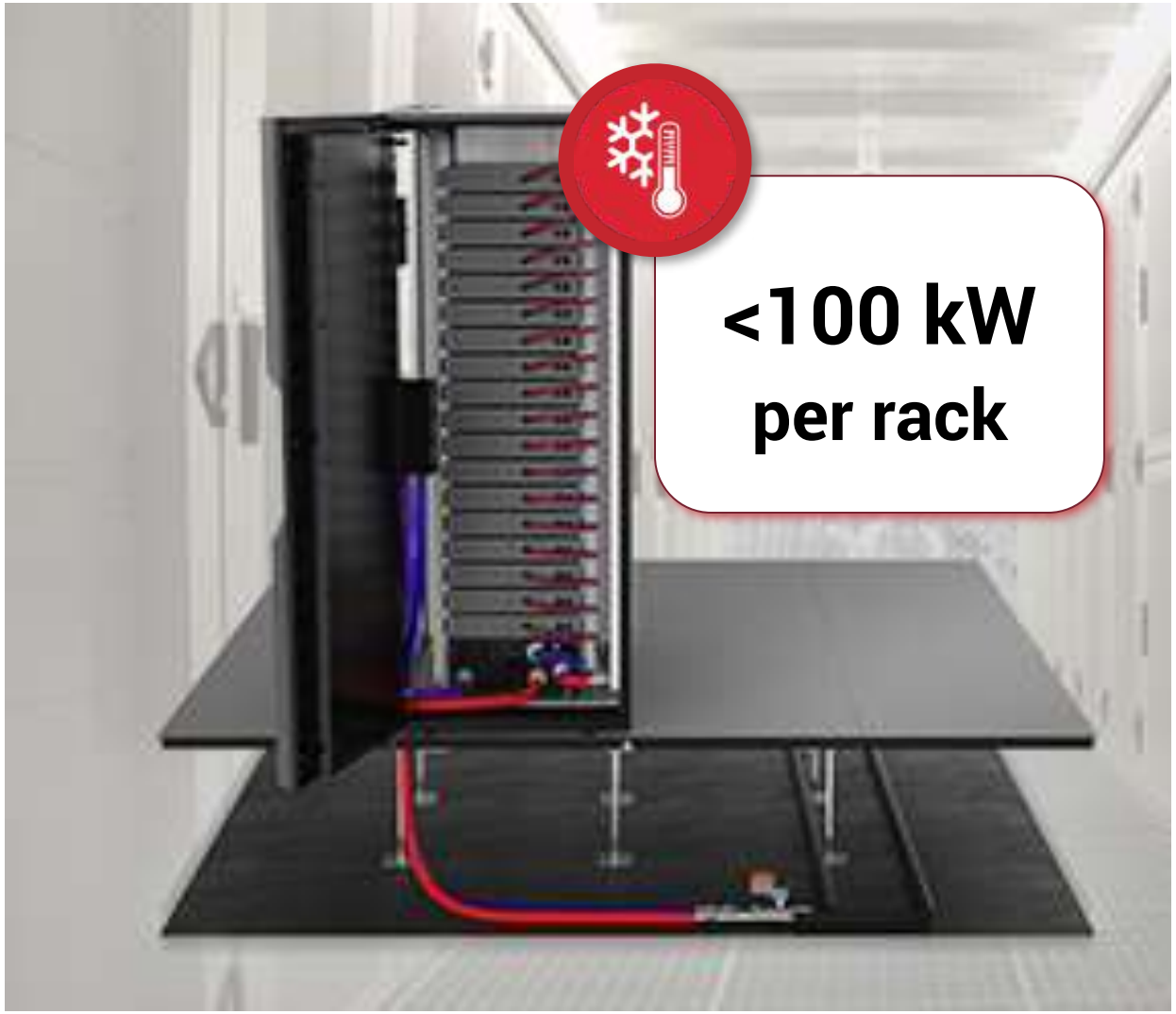
HYBRID DIRECT TO CHIP COOLING



- State of the art (???)
- Proven technology (???)
- Availability of components (?)
- No raised floor mandatory
- PUE <1,15 possible
- Return air temperature <35°C
- Water inlet <30°C
- Efficient regulation

Server based Cooling Solution

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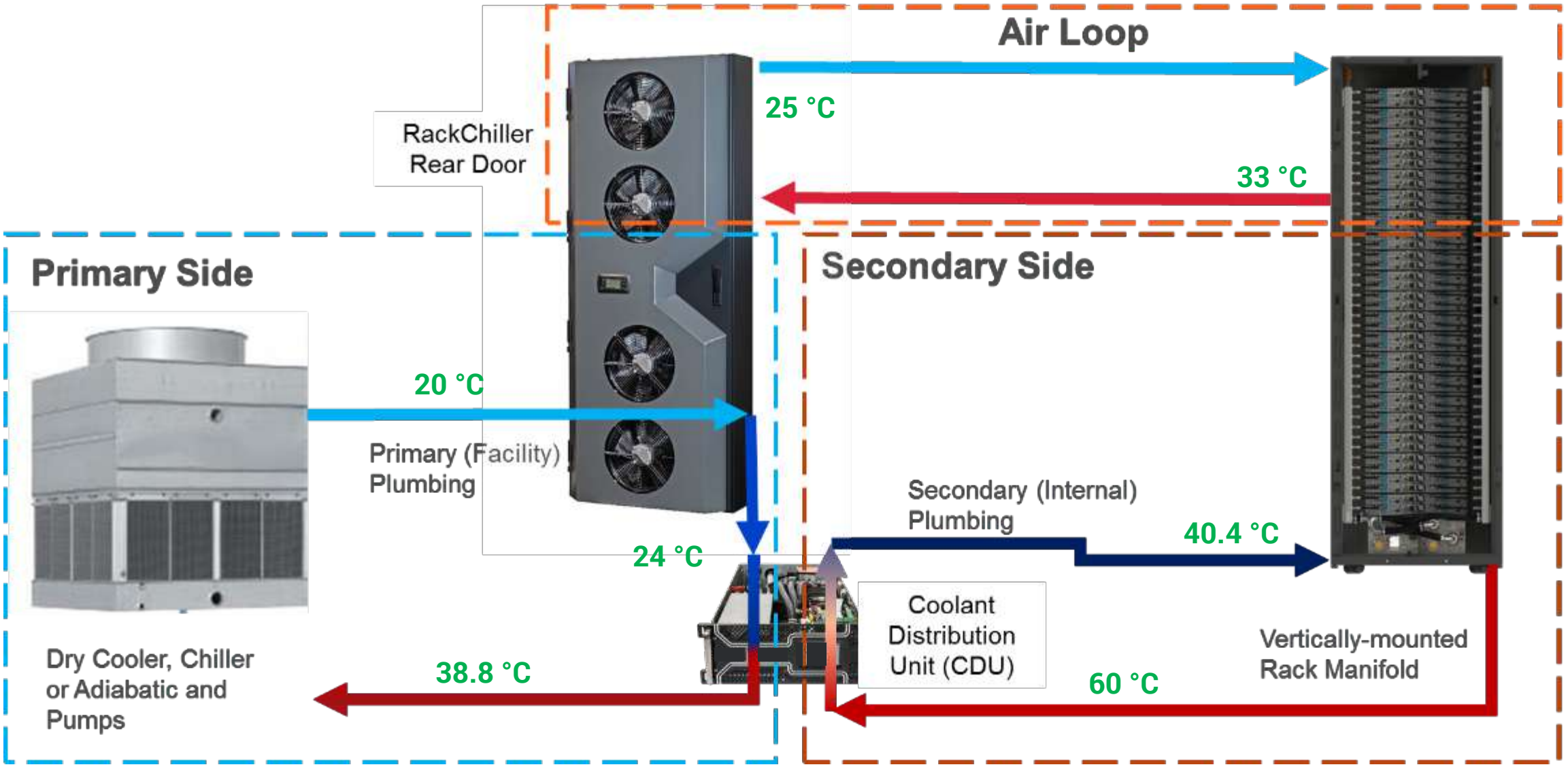
HYBRID DIRECT TO CHIP LIQUID COOLING



Next step to increase % heat captured by liquid

Chassis Level Immersion Cooling

- State of the art (???)
- Proven technology (???)
- Availability of components (??)
- No raised floor mandatory

- PUE <1,05 possible

- NO return air
- Water inlet <40°C
- Efficient regulation

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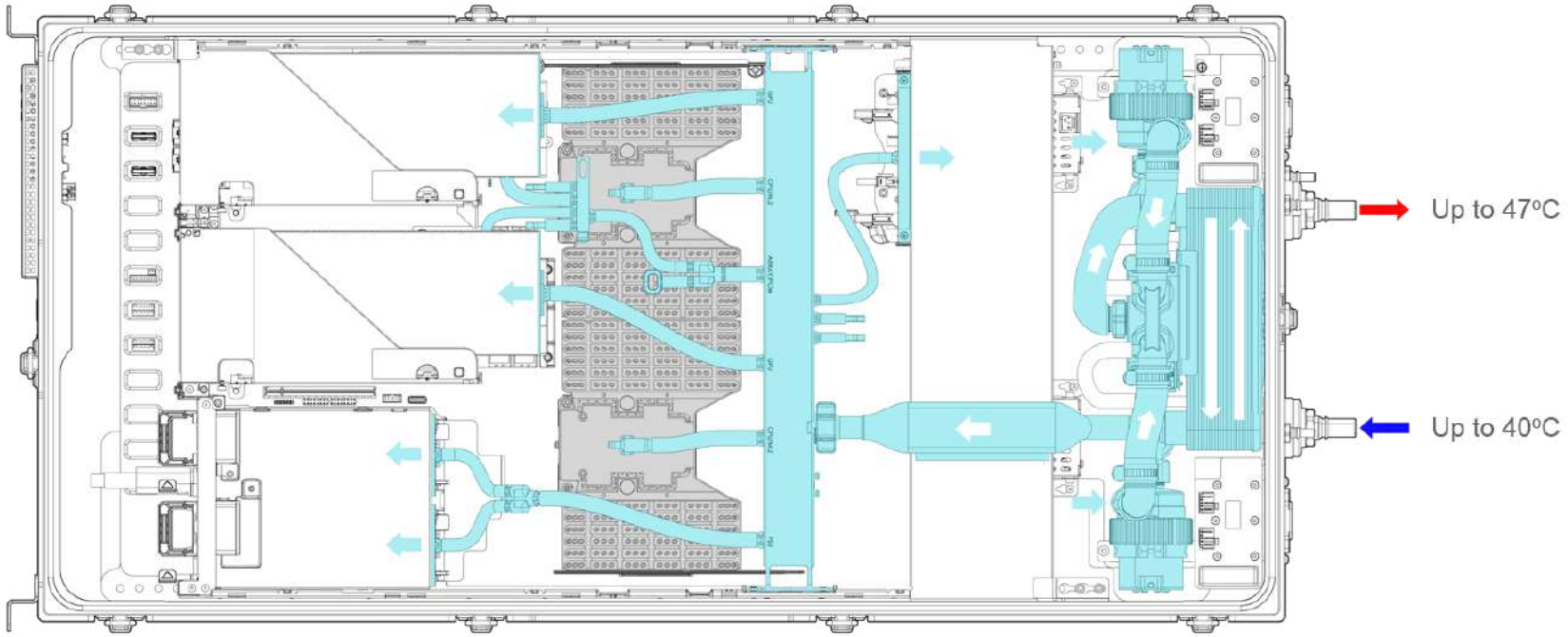
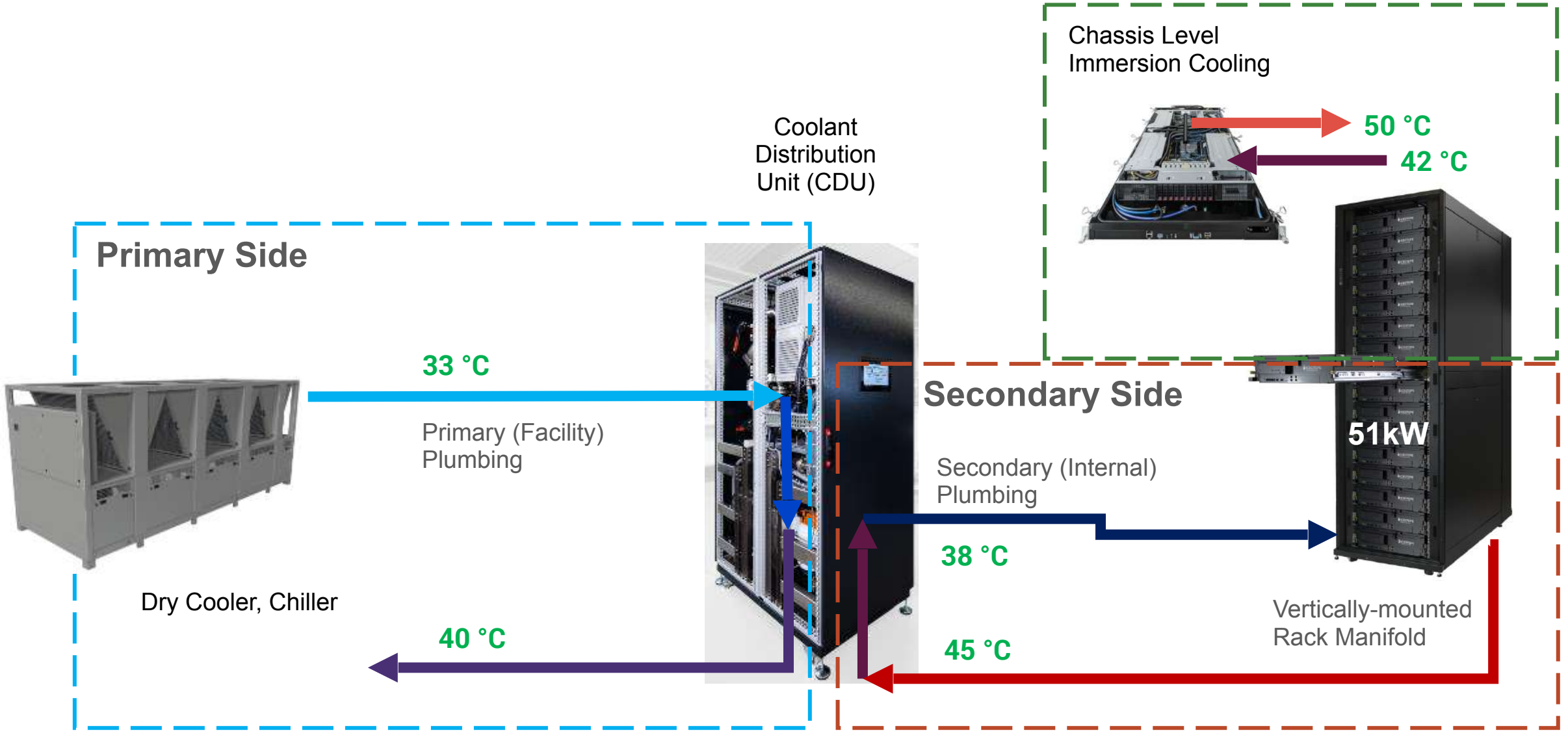
HOW IT WORKS AT SYSTEM LEVEL

- 19“ server is placed in a 21“ chassis
- The liquid is floating around the components
- Heat exchanger in the rear transfers the heat to another liquid circuit



Chassis Level Immersion Cooling (Data Center Application with Chiller)



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NORMALLY ASKED…

Environmentally friendly dielectric fluids

Zero Global Warming Potential (GWP)

Readily biodegradable (>95% degraded in 28 days)

10 year operational warranty

25 year shelf life

Extended server life deferring tech refresh

Contained at chassis-level with zero spillage

Full end of life recycling

COMPARISON OF DIFFERENT WHITE SPACE COOLING SOLUTIONS

	CRAC with Containment	In-Row	Rear Door	Direct-to-chip water cooling	Hybrid Direct-to-chip water cooling	Chassis-Level Immersion
Thermal load per rack	< 12 kW	5 – 30 kW	10 – 55 kW	25-120kW	25-120kW	20 - 120kW
Temperature control / Cooling setup	Room-based	Aisle-based	Rack-based	Rack-based	Rack-based	Chassis-Based
Air flow	High especially for higher densities (10 m3/hr per kW)	Lower airflow but still noisy due to fan size on a 300mm IRC	Lower airflow less noise due to larger fans on the cooling device	Low air flow only for air cooled components in the equipment	Low to medium airflow	NO airflow
It Equipment heat captured by water	n/a	n/a	n/a	60-85%	60-85%	>95%
Coolant supply temperature The higher the inlet temperature the longer is free cooling possible	n/a	< 18°C	< 22°C	< 45°C	< 45°C	< 45°C
ASHREA Classes	A1 to A4 depending on equipment A1 - 15C to 32C A2 - 10C to 35C A3 - 5C to 40C A4 - 5C to 45C	W17	W17 to W27	W27 to W45	W17 to W32	W27 to W45
Air return temperature	< 35°C delta T of 8 to 15C	< 45°C	< 50°C	< 45°C	< 30°C	N/A
Coolant facility complexity	low	medium	medium/high	high	high	high
Power Usage Effectiveness Total DC Power divided by IT Power	< 1.7	< 1.5	< 1.2	< 1.1	<1.15	< 1.05
Example 1MW Data Center						
IT Power [kW]	1.000	1.000	1.000	1.000	1.000	1.000
Facility power [kW]	700	500	200	100	150	50
Anual power cost [1000$] for Facility Power @0.1 Cent kWh	$614	$438	$175	$88	$131	$44
Power Savings [1000$]		**-$175**	**-$438**	**-$526**	**-$482**	**-$570**
Carbon Impact [t CO_2] 0.85 pounds of CO_2 emissions per kWh	2.366	1.690	676	338	507	169
CO_2 savings in tons		**676**	**1.690**	**2.028**	**1.859**	**2.197**

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40-60% more CAPEX required **OR / BUT**

Due to higher density possible you can **reduce** your required DC footprint by **80% to 90%**

You can **save tons CO^2** emissions per year

0.2 improved PUE at 1MW DC equals ~680 tons CO^2

You can **save significant energy costs**

0.5 improved PUE at 1MW DC ~450k USD per year

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Our Mission

At nVent, we believe that safer systems ensure a more secure world. We connect and protect our customers with inventive electrical solutions.

Trusted Data Center & Networking Solutions for a Connected World

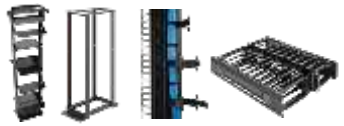
Networking & Server Cabinets

Power Management

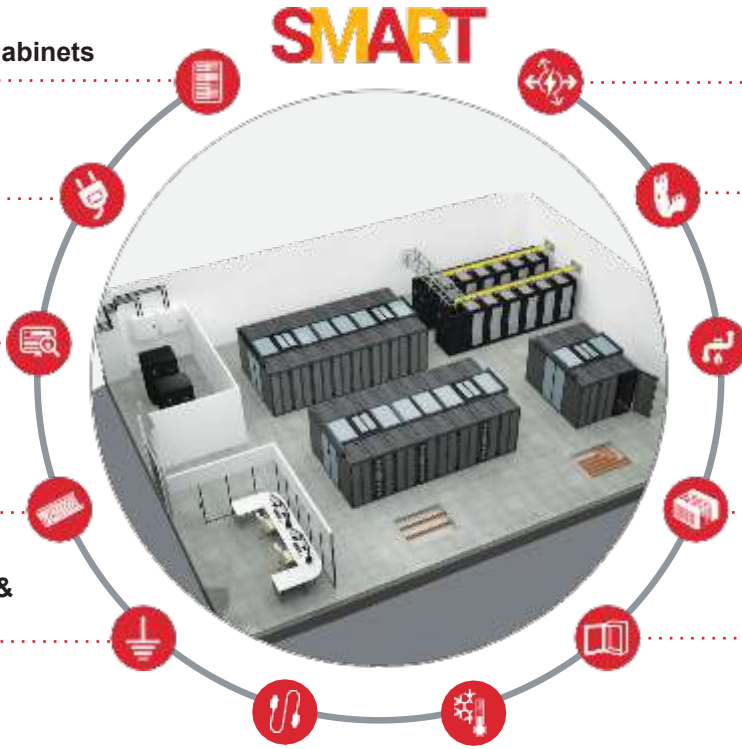
Monitoring & Access Control

Cable Support & Pathways

Grounding, Bonding & Protection



Cable Management



Power Distribution

Fixing & Fastening

Leak Detection

Aisle Containment

Wall-mount Racks & Enclosures

Precision & Direct-to-chip Liquid Cooling

Our flexible modular portfolio, combined with design and project support, enables you to specify and deploy your project on time to ensure data and network infrastructure availability and protection.

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Work with experts to get the best fitting solution

nVent