OCP SUMMIT

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Immersion Cooling for Green Computing

Fangzhi/Director/Alibaba

Key Points

1、Background

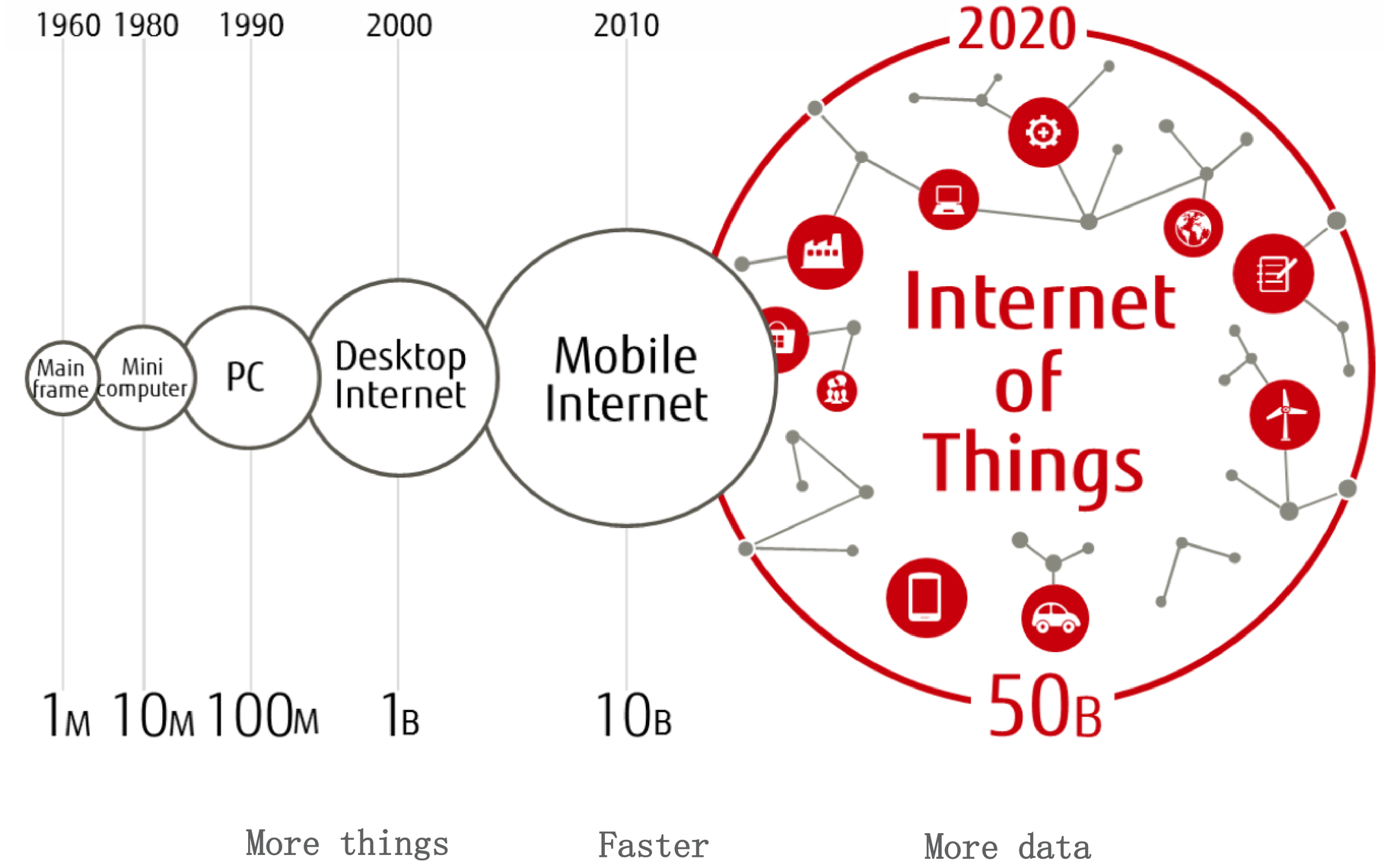
2、Today’s Datacenter Challenges

3、Why immersion cooling?

4、Challenges of immersion cooling

5、Alibaba progress and plan

Background：Big Data Era

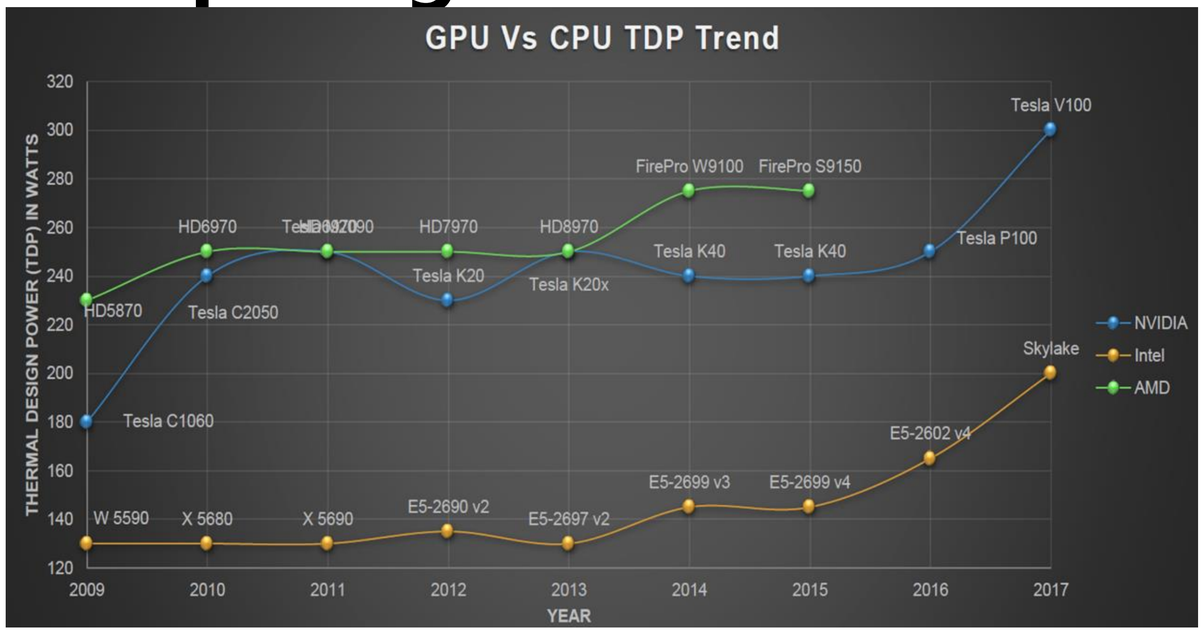


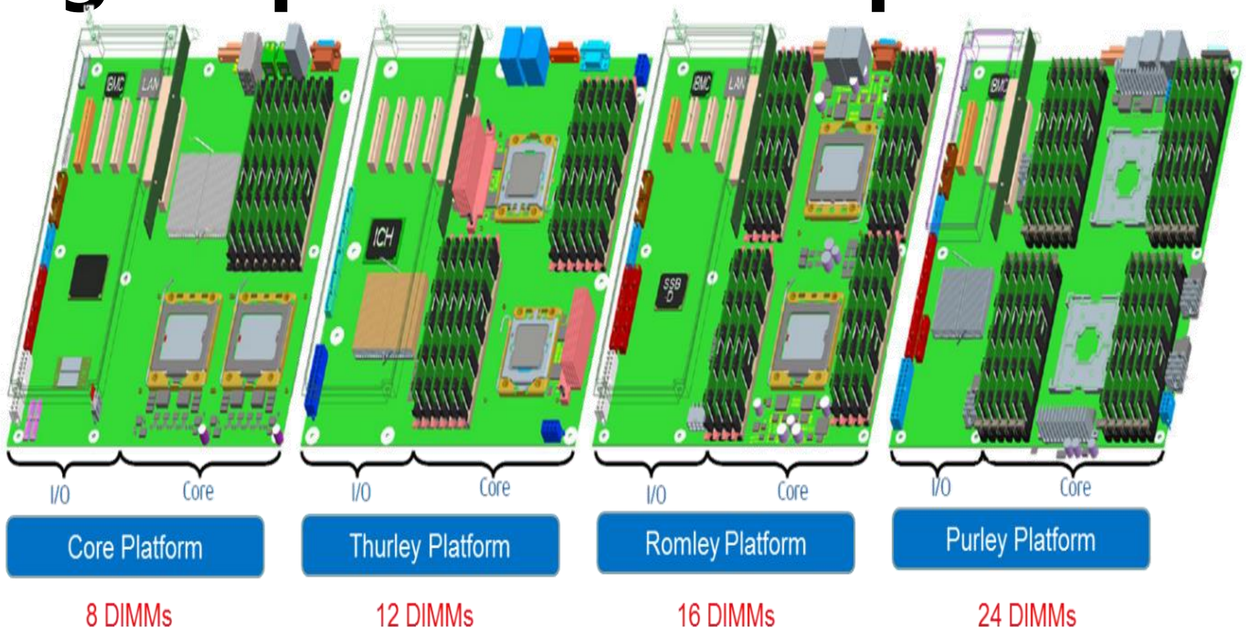
+44ZB

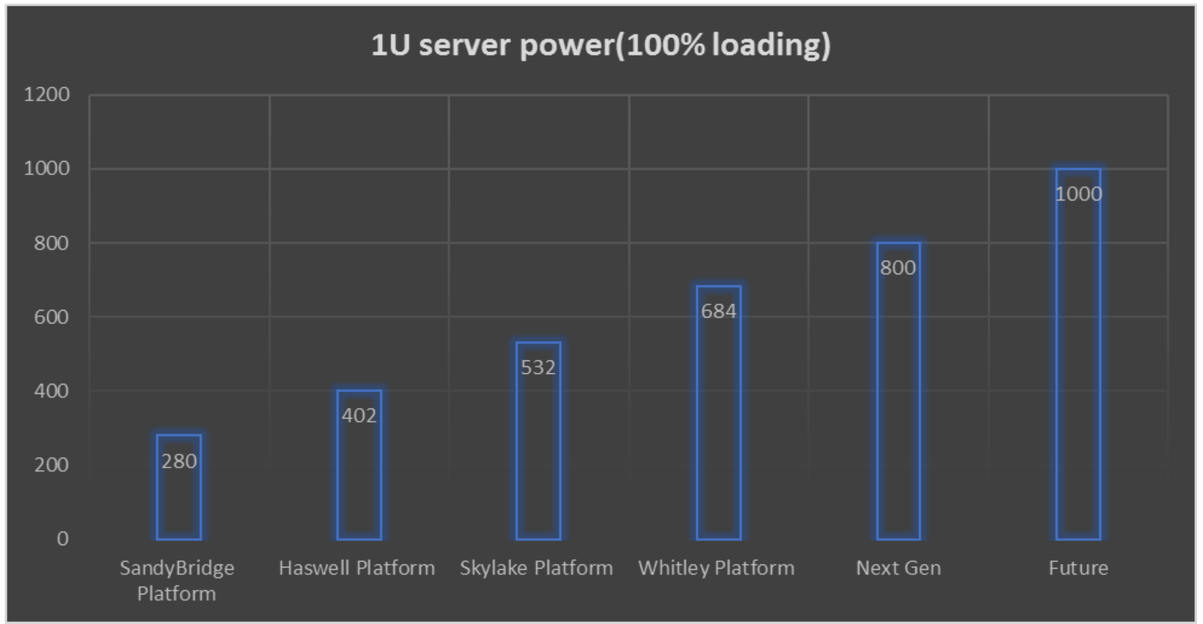
Data generated per year by 2020

Source: EMC "Digital Universe Study" with data and analysis by IDC // April 2014

Background：
Computing drives devices into higher power consumption







- Computing drives devices into higher power consumption.

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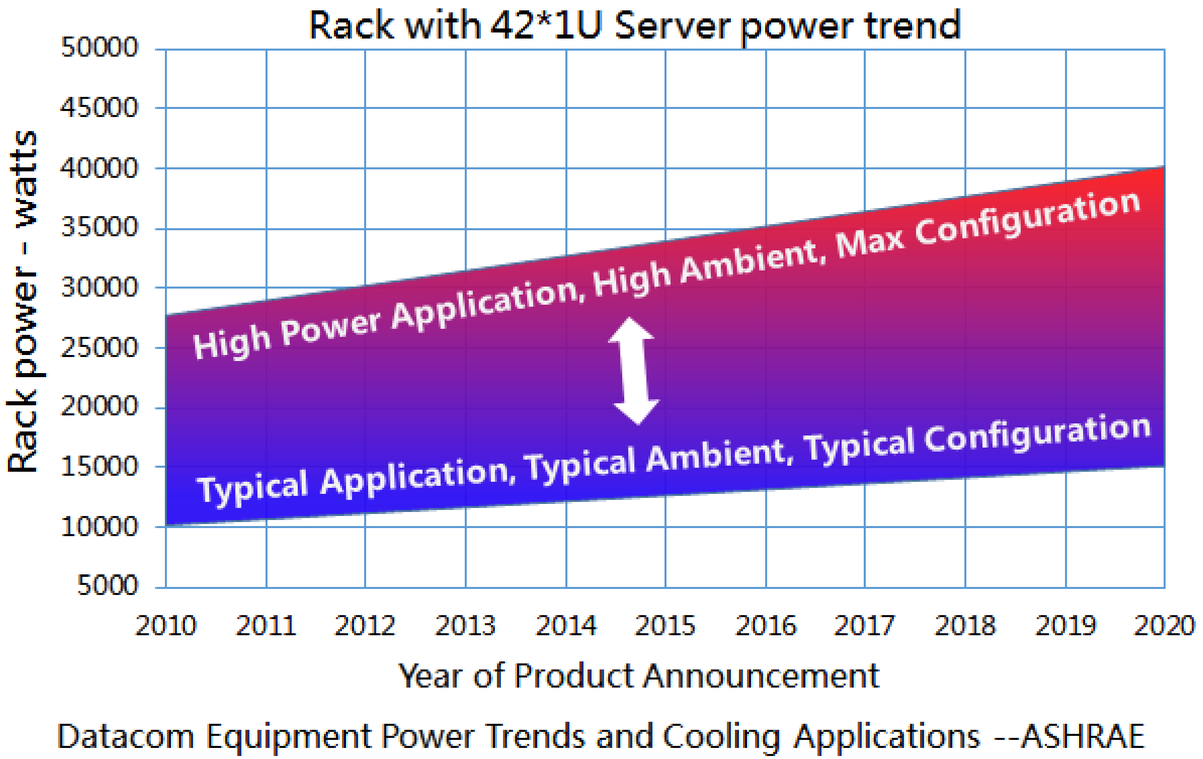
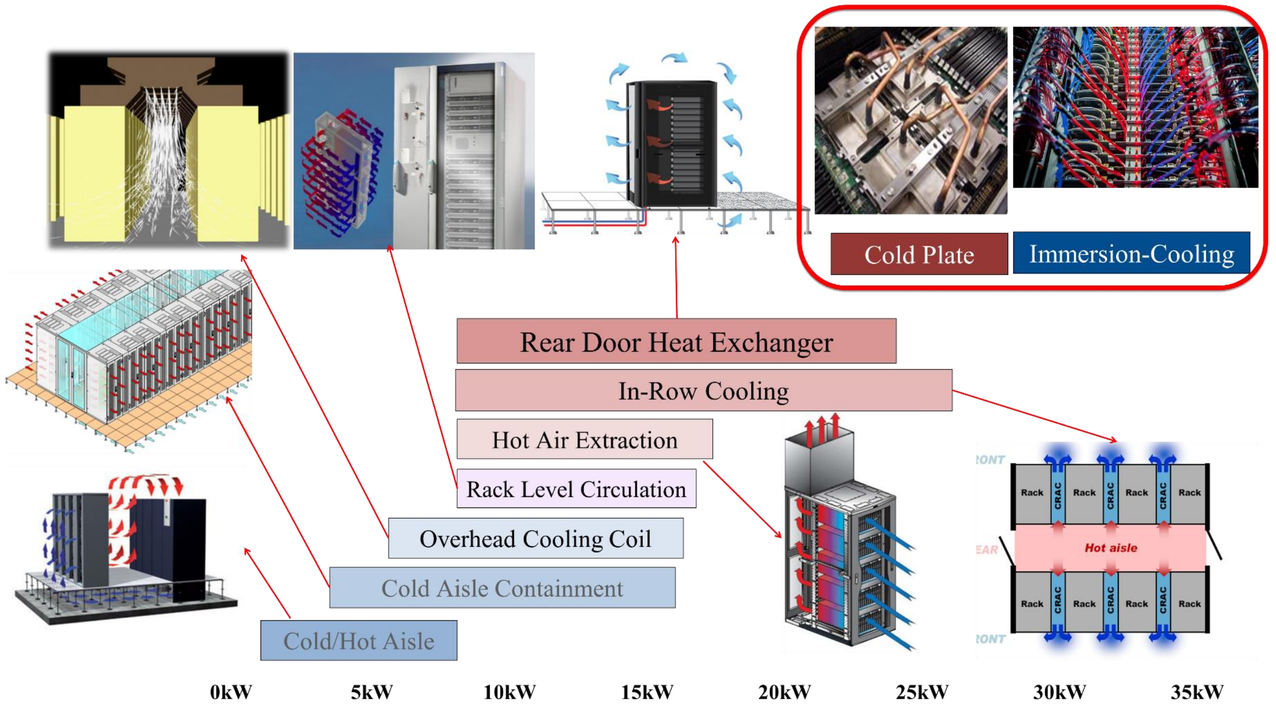
Today’s Datacenter Challenges

1. high power density racks’ cooling



Datacom Equipment Power Trends and Cooling Applications --ASHRAE



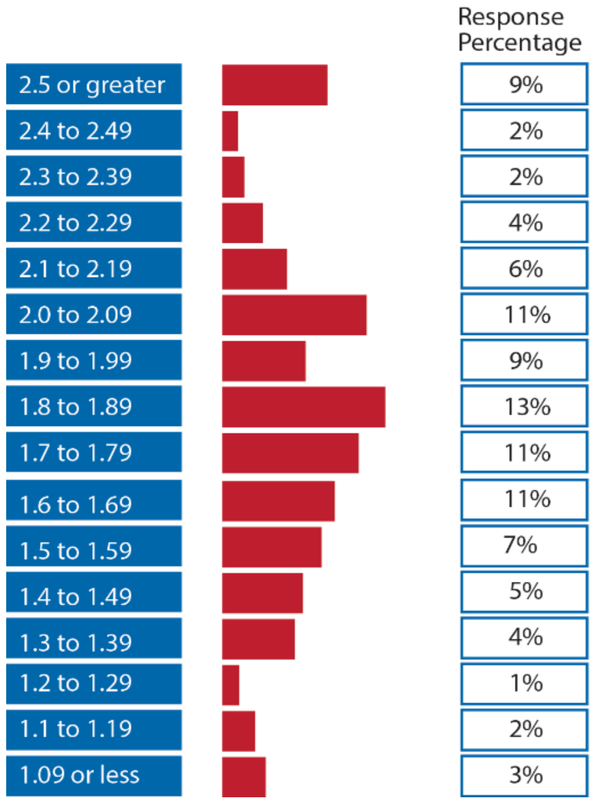
- Computing drives devices into higher power consumption. Rack power density is growing rapidly
- Air-Cooling cannot meet the heat dissipation demand any more

Today’s Datacenter Challenges

2. PUE/TCO

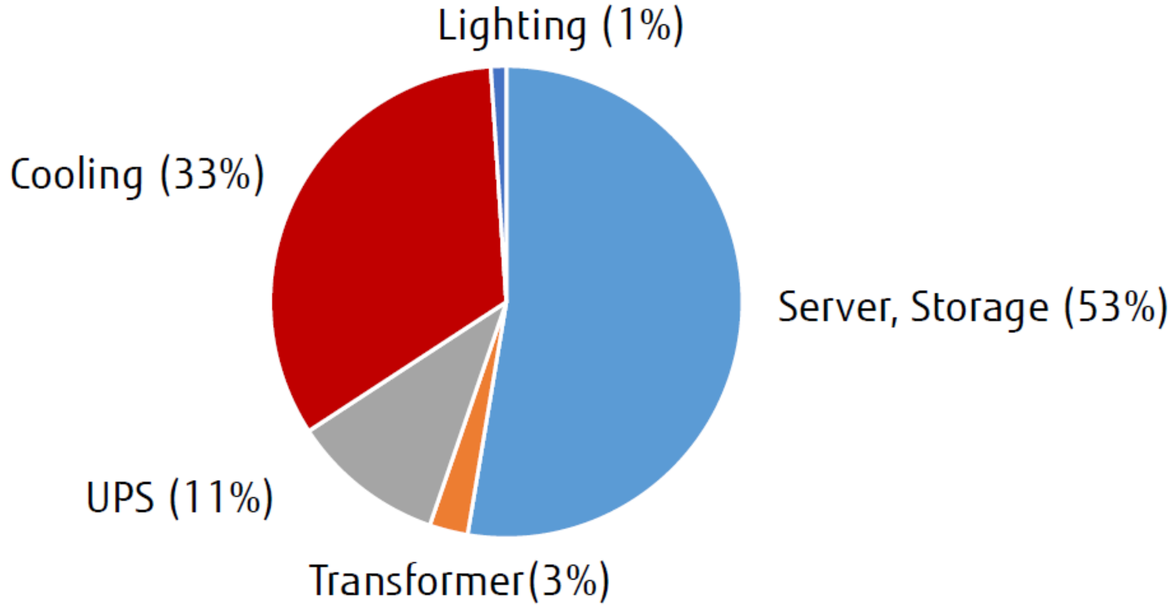
$$\text{Data center Power usage effectiveness(PUE)} = \frac{\text{Total data center power (kw)}}{\text{Total IT Power (kw)}}$$

Average PUE of your largest data center:



AVERAGE PUE 1.8 – 1.89

Source： Uptime Institute survey of over 1100 data centers



*A Shehabi: LAWRENCE BERKELEY NATIONAL LABORATORY "United States Data Center Energy Usage Report", 2016.

- The energy consumption of the data center for cooling is quite large.
- How to achieve low PUE and optimized TCO? That has become a new challenge.

Key Points

Alibaba Group 阿里巴巴集团

基础架构事业群 Alibaba Infrastructure Service

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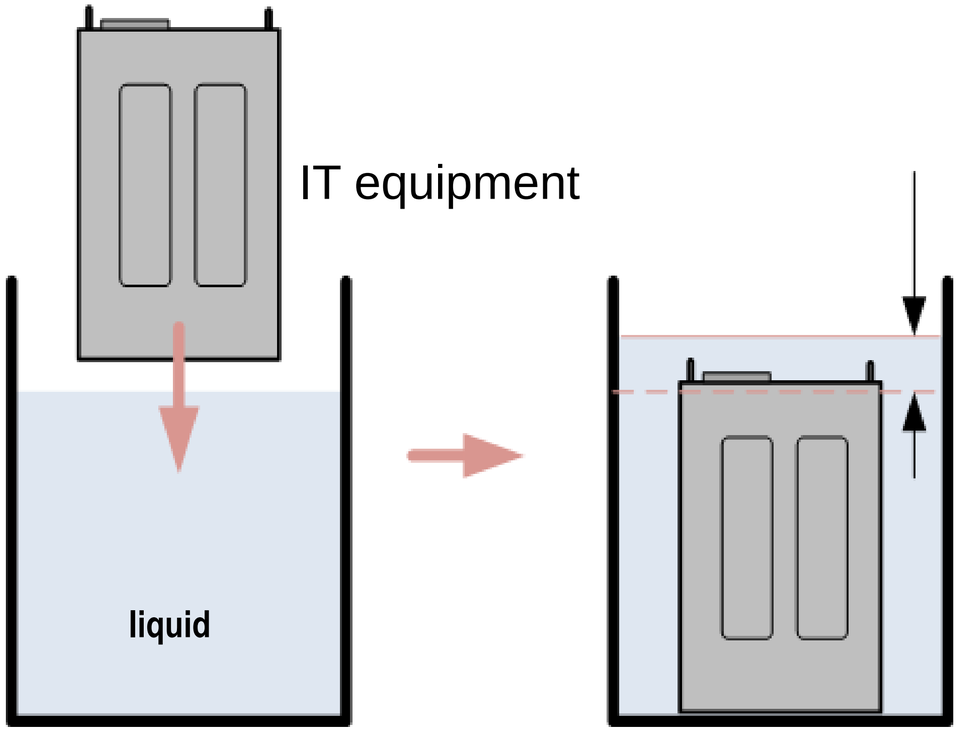
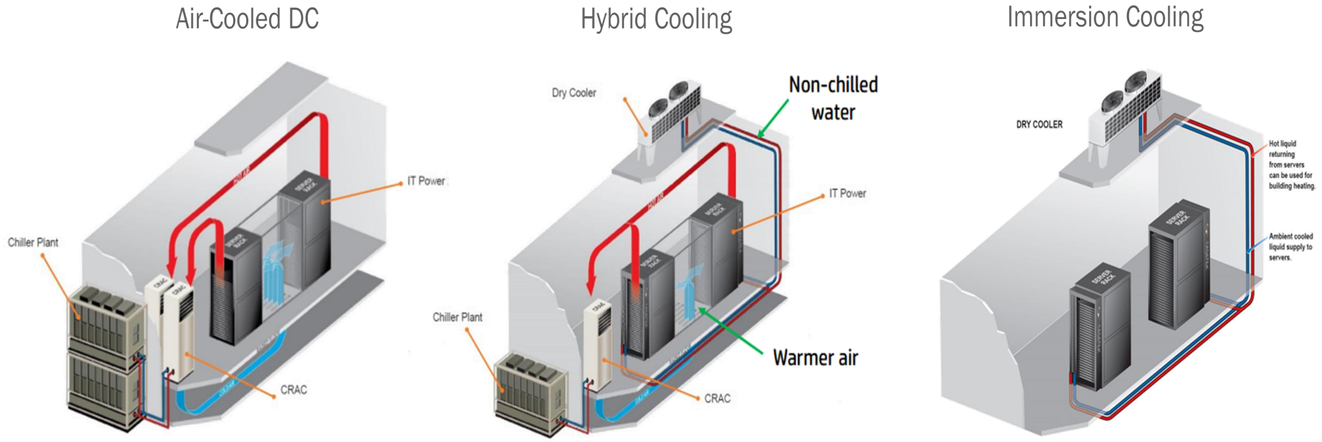
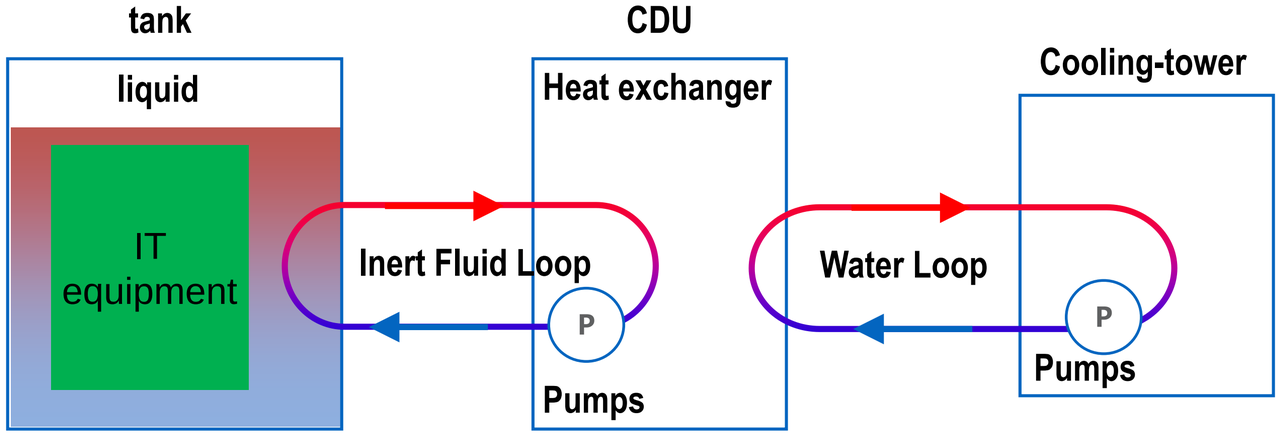
What is immersion cooling?

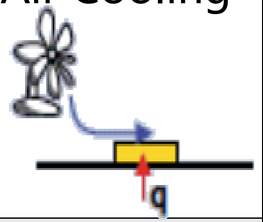
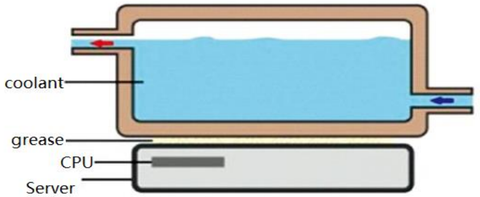
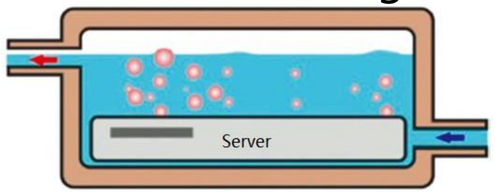






- **Liquid (3M Fluids) has better Specific Heat Capacity than air.**
- **No CRAC in IDC , low PUE 1.05-1.07**

Why immersion cooling?

	Air Cooling 	Cold Plate 	Immersion Cooling 	**0 means "Base Line"** **+ means "Better"** **- means "Worse"**
Cooling Capacity	0	+	++	Immersion Cooling is the best.
Hardware Integration	0	+	++	No fans in immersion Cooling.
Maintenance	0	--	-	New mechanical design.
Hardware Reliability	0	-	+	Unaffected by dust , humidity and vibration.
Hardware Performance	0	+	++	Cooling helps improving performance.
Energy Efficiency	0	+	++	No fans, chillers, CRAHs.
Heat Recovery	0	+	++	Easy to be recovered from liquid.
Noise	0	+	++	No fans, no noise.
Corrosion	0	+	++	Isolation from air, no corrosion.
Material Compatibility	0	0	?	Material compatibility needs to be tested.
Initial Capex	0	-	--	Liquid cost is temporarily high.
Opex	0	+	++	No fans, chillers, CRAHs. Low PUE.
Weight	0	-	--	Liquid is heavy.

Advantages of immersion cooling: (1) Best cooling capacity (2) lowest TCO/PUE ….

Why immersion-cooling?

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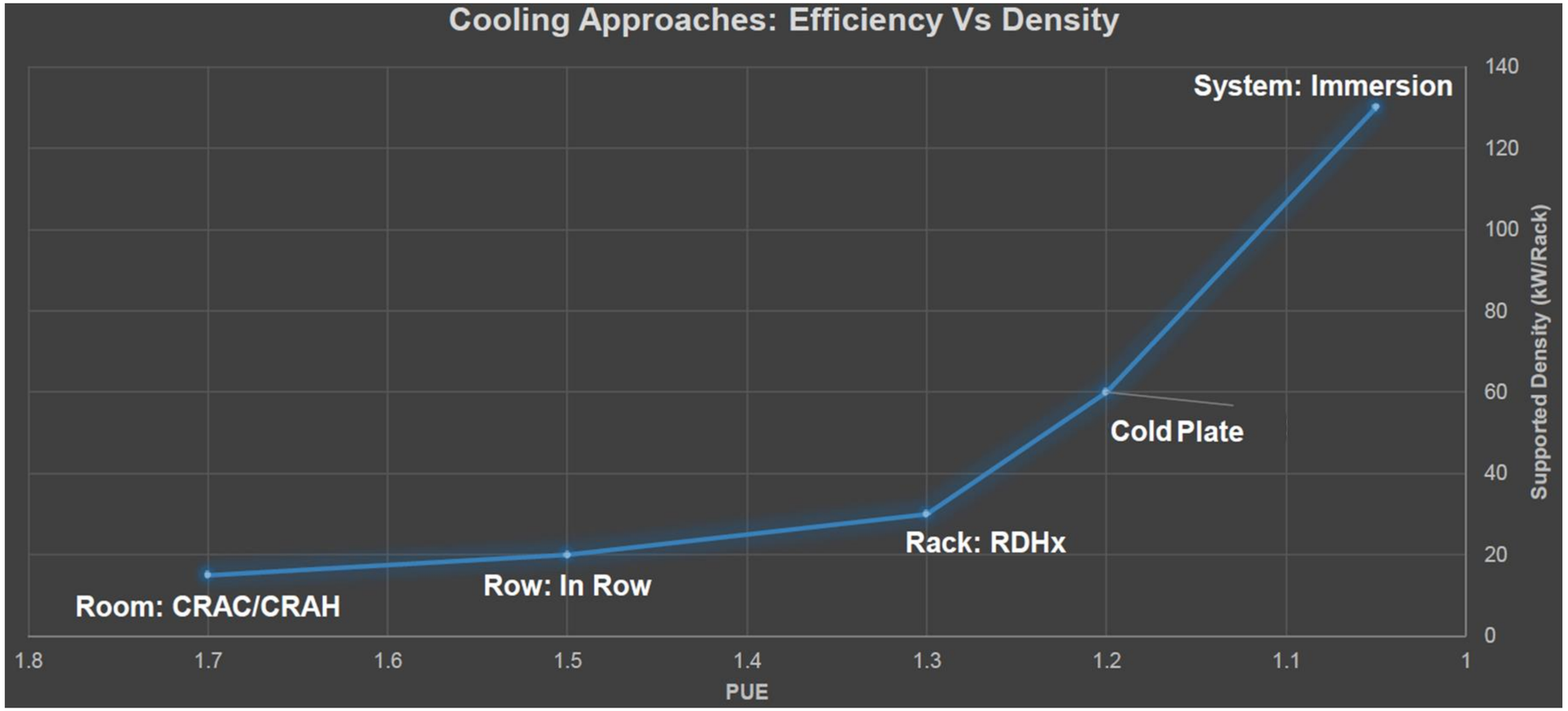
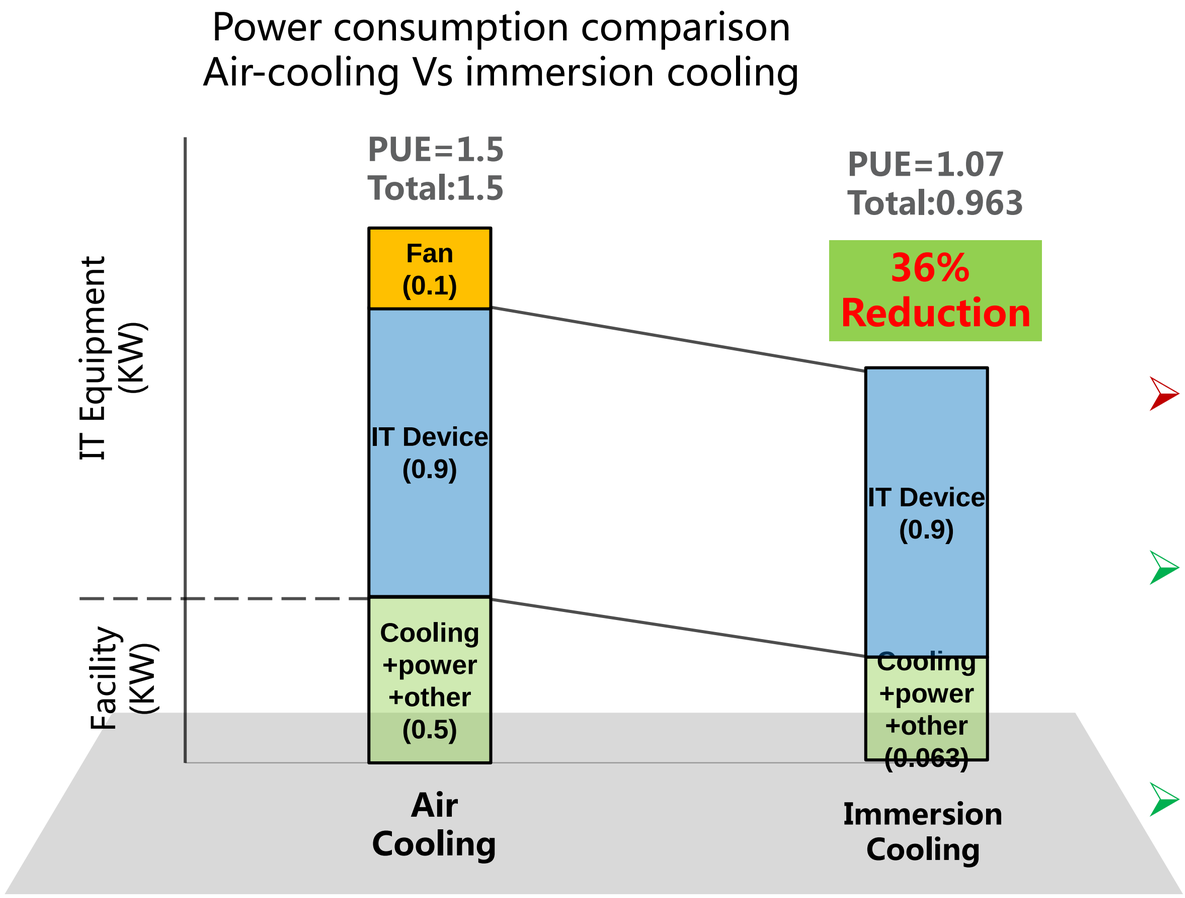
300%+ Higher Density



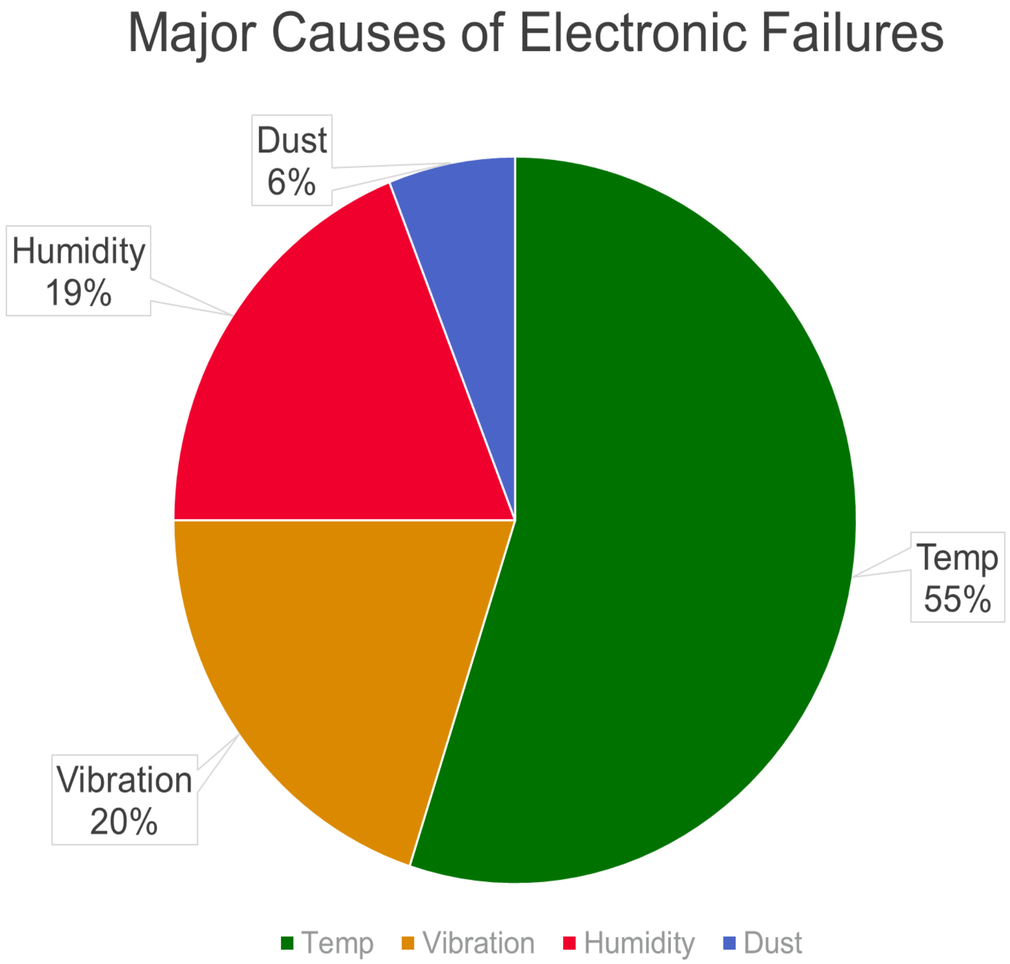
Why immersion cooling?



Less Power Consumption
Less Carbon emission
Better TCO

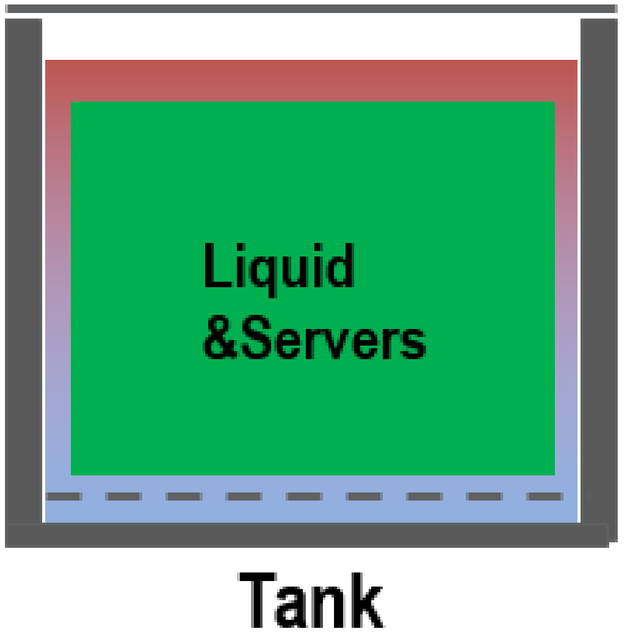
- **36% less power by using immersion cooling**
- **Reduce 3 tons carbon dioxide emission per IT KW per year**
- **TCO optimization**

Why immersion cooling?



Source: US Air Force Avionics Integrity Program

Higher Reliability



Liquid protects IT devices from harsh environment including high temperature, humidity, vibration, dust

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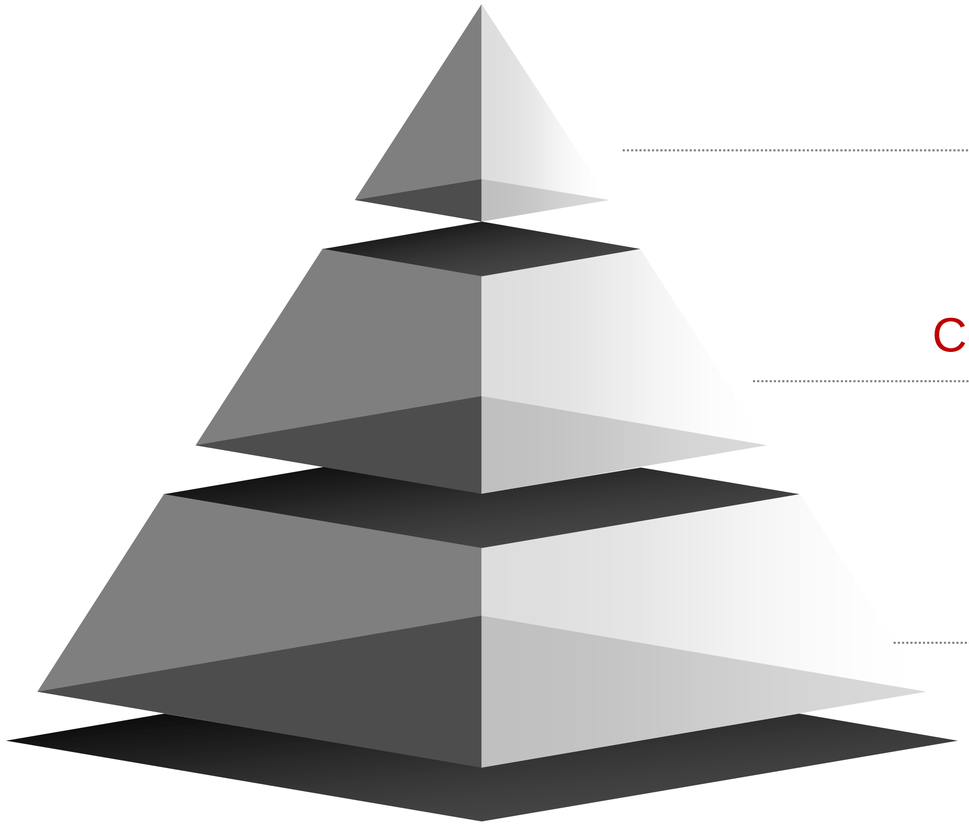
The challenge of immersion cooling

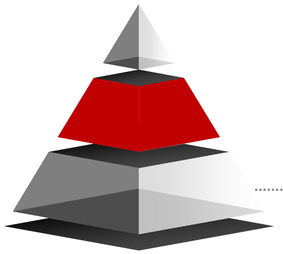


System level

Component level

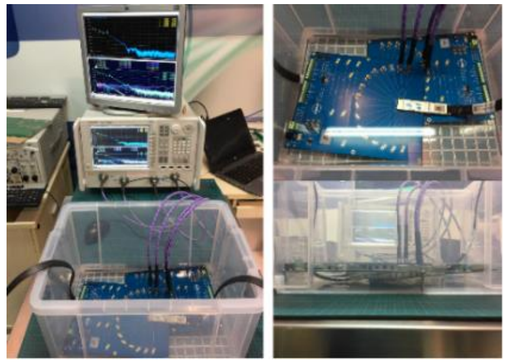
Basic Level

Challenges of immersion cooling

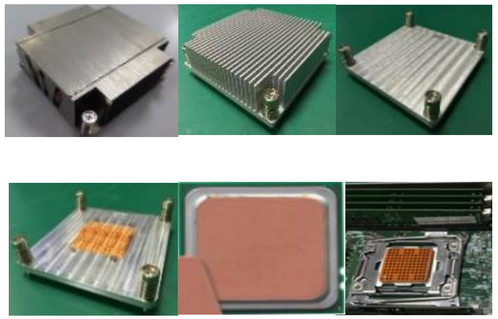


Basic Level

Material Compatibility



Signal Integrity
(PCB/ CONN)



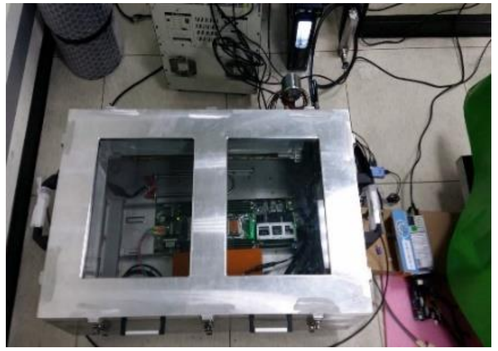
Heat Dissipation
Surface Treatment

Challenges of immersion cooling

Component Level

CPU, Storage, Memory, HBA

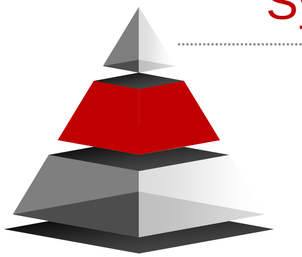
Optical Devices

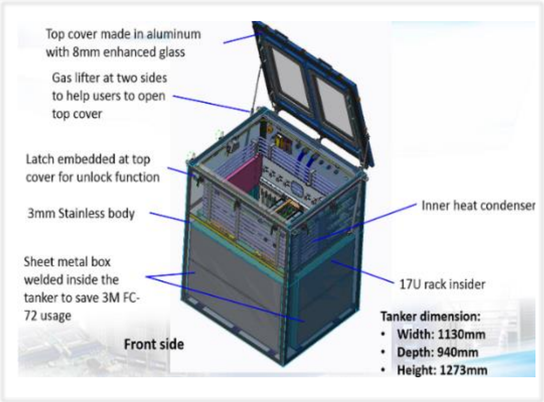


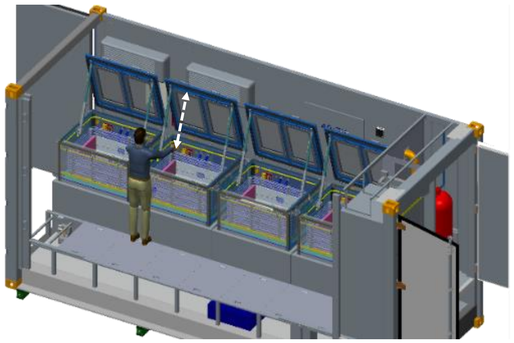
Performance, Stability, Energy efficiency

Challenges of immersion cooling

System Level







Server architecture,
Tank sealing,
Maintainability,
Space utilization

Data center architecture
CDU pipe layout

Monitoring and
Management system

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Alibaba Progress and Plan

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2017 2018 2019 2020

Phase 1

Design & Validation&Pilot Run

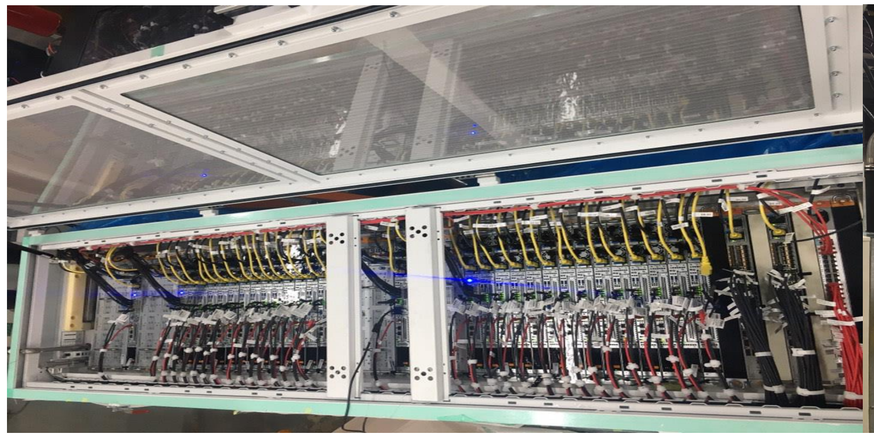
Server/Tank/IDC/Network product long tern reliability data collection

Maintain operation consolidation

Phase 2

High power density co-design

and mass deployment



Summary &Key Takeaways

1. Immersion cooling is a better way to tackle the high power density challenges

2. Immersion cooling is not far away , but still needs ecosystem partners to support

3. Alibaba is the first CSP to deploy the immersion cooling systems, willing to contribute to the community

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