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15 Years and 350000 servers of Liquid cooling

Octave KLABA
Founder and Chairman
OVH

Why are we here today ?

- OVH is a technology company : we build everything in house
- Crazy bet in 2003 around water cooling
- 350k servers using water cooling → Allowing us record PUE early on :<1.2 always and less than 1.07 in some DCs
- OCP Water cooling groups just created : Natural forum for us
- Excited to share our experience in operating the largest known fleet of “commoditized” liquid cooled servers in the world

Caution : We innovate daily. Everything presented today dates back 2016 and before

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What is happening about liquid cooling ?

LIQUID COOLING



COMPANIES > GOOGLE (ALPHABET)

When Air No Longer Cuts It: Inside Google's AI-Driven Shift to Liquid Cooling

Alphabet CEO Sundar Pichai shows a photo of a liquid-cooled TPU 3.0 pod inside a Google data center at I/O 2018

The company's latest AI processors drove its data



DESIGN

Alibaba to Use Own Immersion Cooling Tech in Cloud Data Centers

View of Alibaba's cloud data center in Chun'an County, Zhejiang Province, China. (Image: Alibaba video)

Plans to contribute technology to Open Compute Project

Yevgeniy Sverdlik | Jun 14. 2017

OVH not alone any more to bet on liquid cooling at industrial scale !!

ZDNet | CENTRAL EUROPE | MIDDLE EAST | SCANDINAVIA | AFRICA | UK | ITALY | SPAIN | MORE | NEWSLETTERS | ALL WRITERS

MUST READ: How to decide: Picking the 2018 iPhone that's right for you

Lenovo bets big on liquid cooling going mainstream, launches Neptune

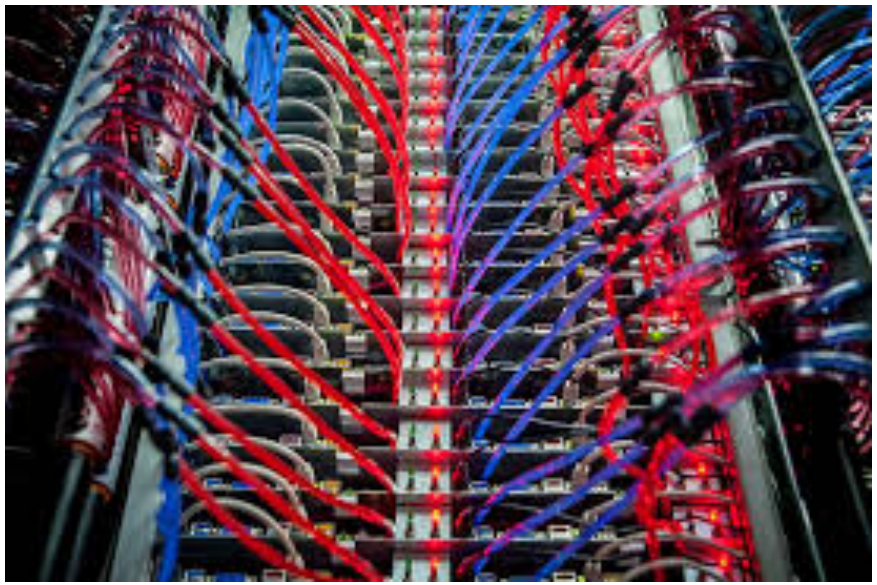
Liquid cooling in the data center was usually reserved for supercomputing. Lenovo is betting that cooling techniques will go mainstream.

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2003-2018 : the 100x Journey
From 3500 to 350 000 servers

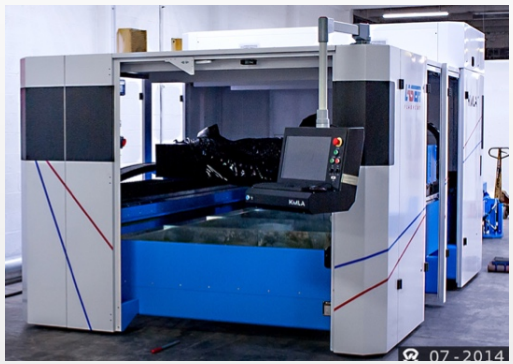




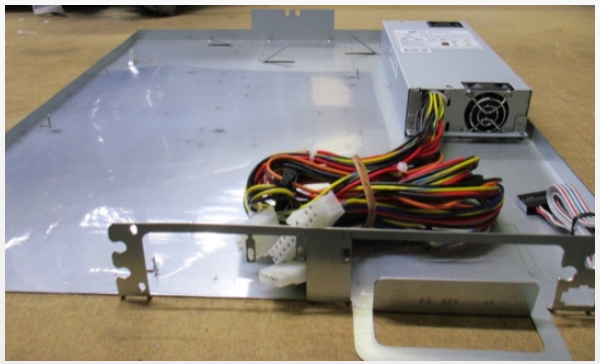
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OVH: An industrial model & Innovation

Laser cutting



Servers assembly



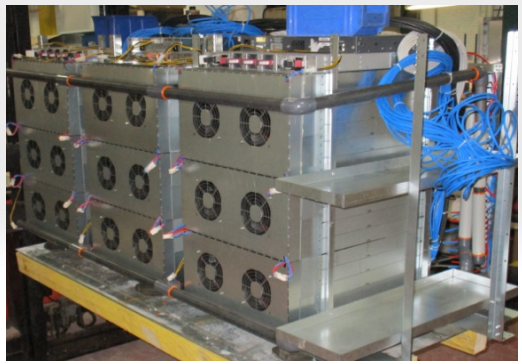
Racks assembly



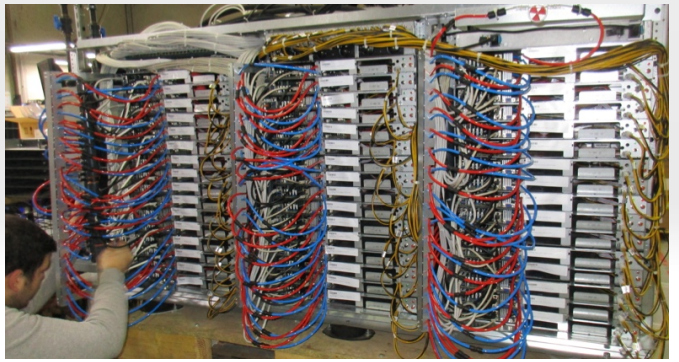
Water-cooling systems



Air-cooling systems

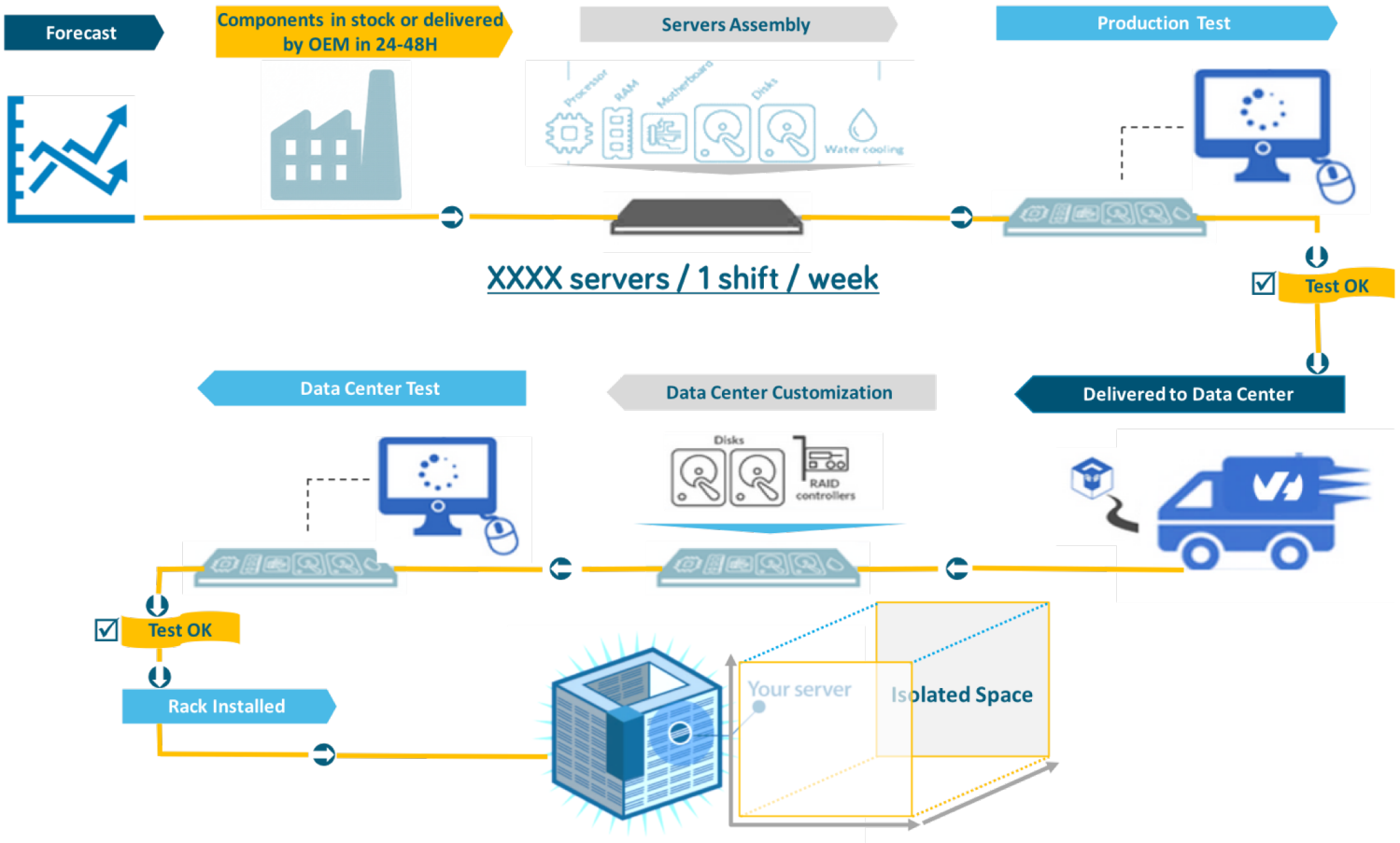


Bench in racks for rapid connection in datacenters



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OVH: From innovation to industrialisation

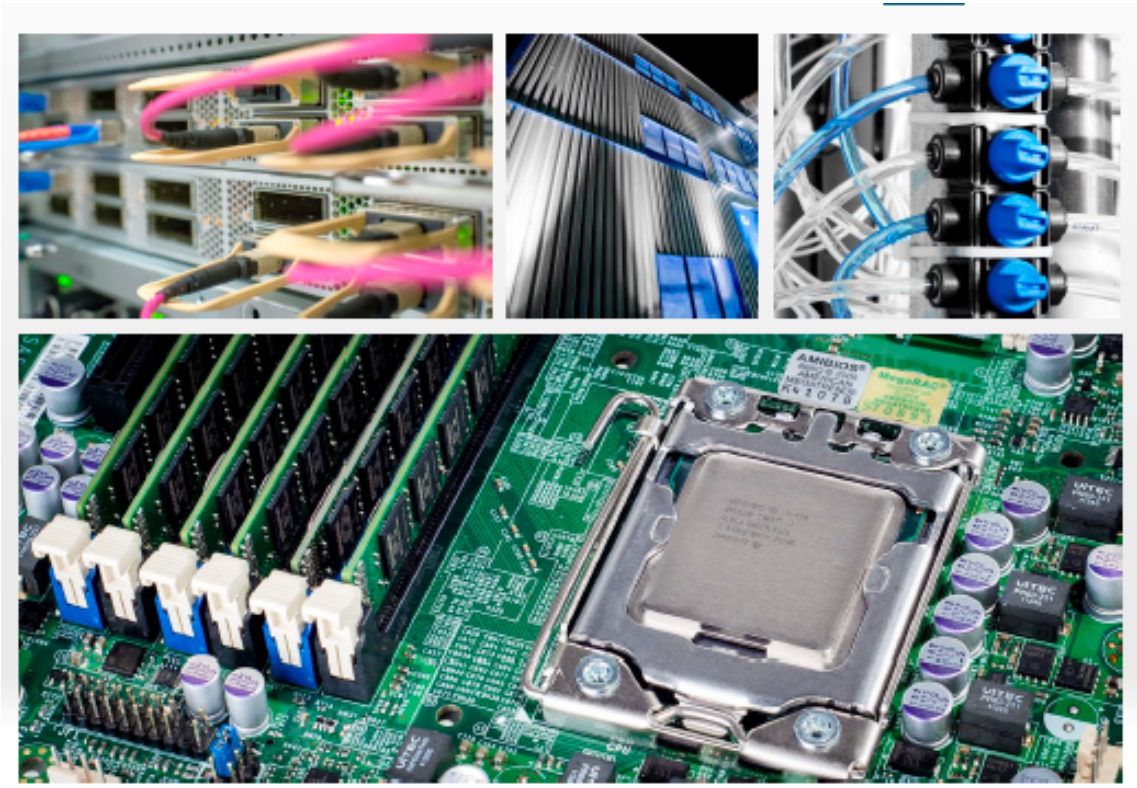


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OVH : Innovation for Freedom

A long history of innovation



- WW First to provide FPGA integration for anti-DDOS protection (2016)
- First cloud provider to provide ARM micro server for disagregated storage (early 2015)
- WW second cloud provider to propose FPGA as a service on public cloud offer (Apr 2018)
- Still the only one to propose overclocked dedicated servers, thanks to watercooling system (since mid 2014)
- First time to market for new processor generations
- First to replace Sata by NVMe SSD drives in all dedicated servers (early 2017)
- European First to integrate 10GbE (2010)

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OVH cooling system

OVH racks thermal management

Water cooling:
Servers' CPU dissipating
70% of total heat load

Cooled using OVH water blocks

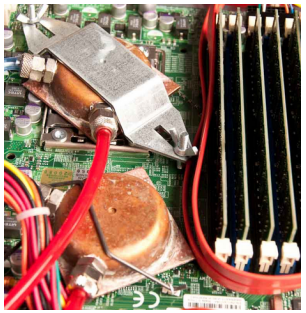
Air cooling:
Equipment rather than CPU
dissipating 30% of total heat load

Cooled using OVH air cooling technology

Traditional CPU cooling



OVH CPU water cooling

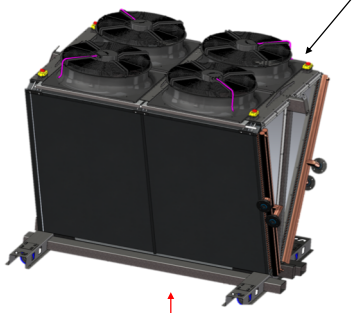


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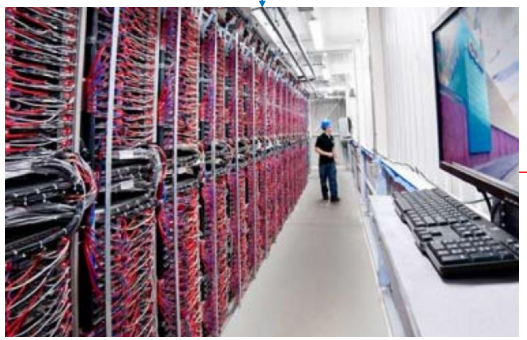
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OVH cooling system

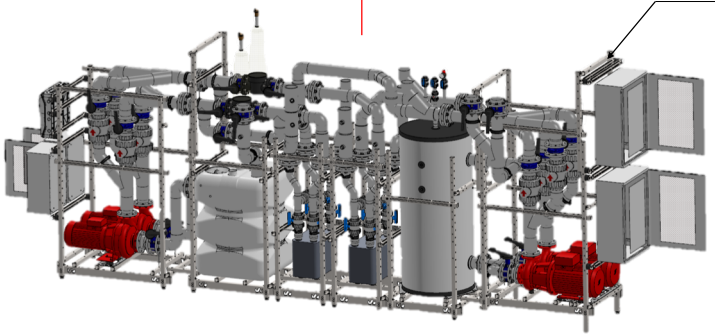
Hydraulic distribution



OVH dry coolers



DC



OVH plug and play 6 m^2 cooling module

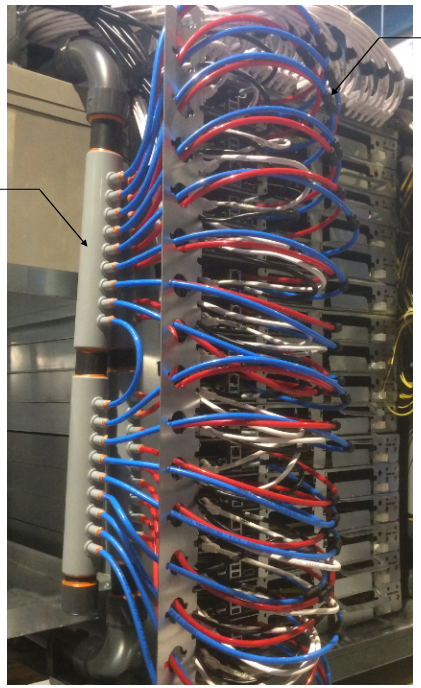
Due to water blocks high hydraulic performance:

- Low flow rates are needed
- Cooling modules could handle up to 5,000 servers

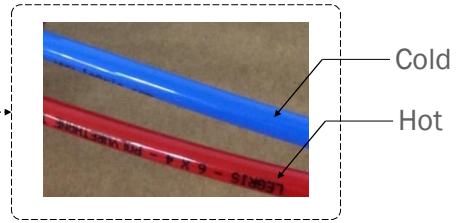
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OVH: Cooling Distributing Unit



Plastic polyurethane flexible pipes



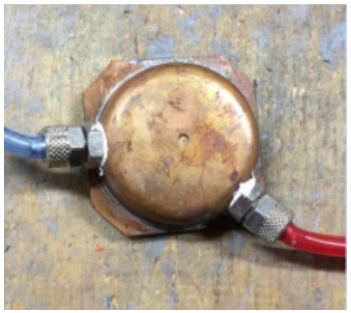
OVH cost effective and standardized cooling distribution module for a rack

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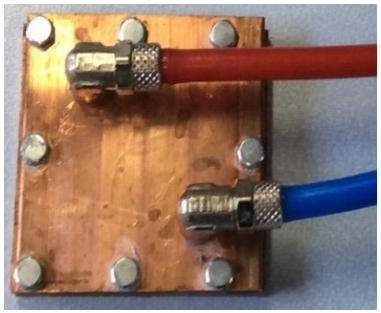
OVH: Water blocks evolution

Water blocks evolution: main configurations



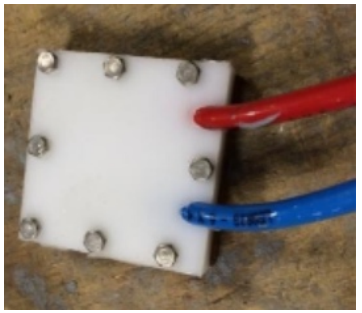
1st OVH water block
Welded reservoir

2003



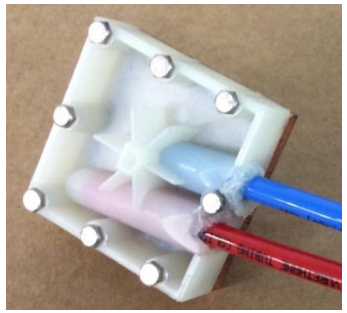
1st milled copper base with mini-channels
→ Reduced congestion

2008



Fittings elimination
and cost reduction

2015



Enhanced sealing and
clamping

2016

OVH water blocks development depended on:

- Copper base: thermal and hydraulic performance enhancement
- Cover: geometry and material for efficient sealing and clamping

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OVH : Copper base enhancement

Major challenges
Drill smallest diameter used is of 2mm to prevent any special machinery
Fabrication cost and time were improvement

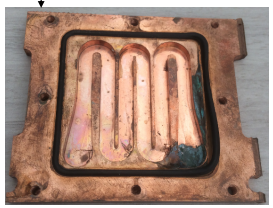
Increase heat exchange surface and friction

Elimination of dead channels



60W @ 30°C water temperature

2003



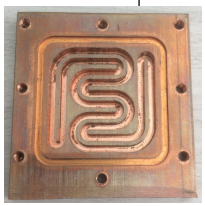
80W @ 30°C water temperature

2008



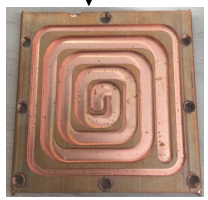
100W @ 30°C water temperature

2014



120W @ 30°C water temperature

2014



150W @ 30°C water temperature

2016

>200W @ 30°C water temperature

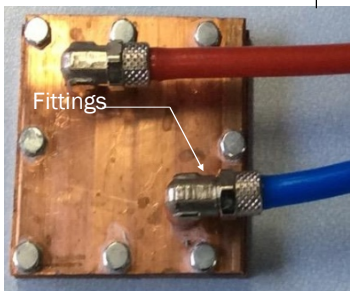
2017

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OVH: How to prevent leakage ?

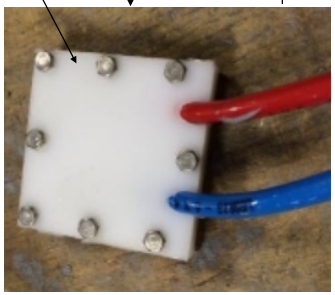
Copper → ABS plastic cover



Fittings showed 2 issues:

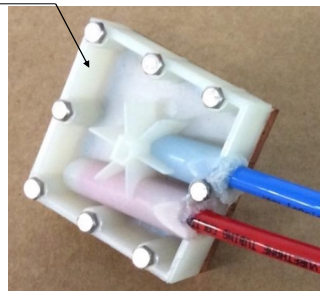
- Fracture due to oxidation
- Sensible tightening

ABS → Polyamide plastic cover

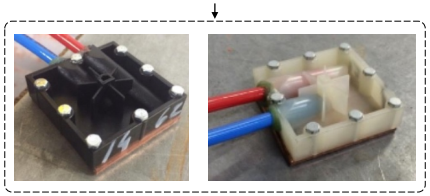


Fittings were eliminated but:

- Incompatibility of different cements with the ABS cover and plastic pipes → leakage

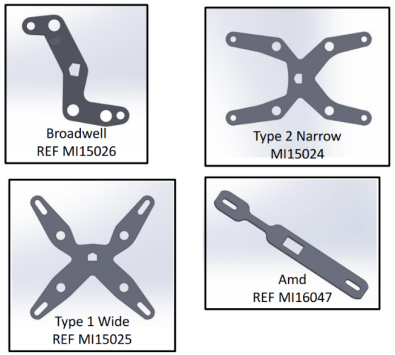


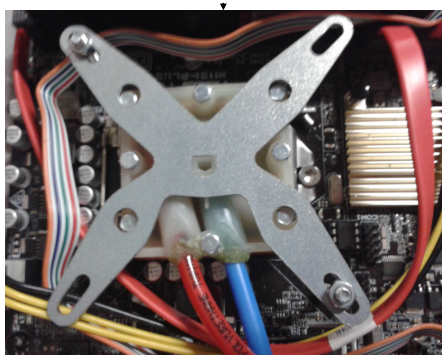
- Leakage was minimized
- Facility to standardize



Enhanced clamping

✚





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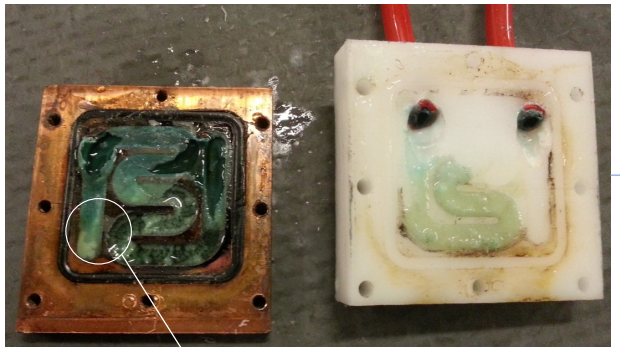
OVH: Water quality challenges

- Open water tanks → fluid is exposed to light and air
- Missing of well water treatment + high temperatures

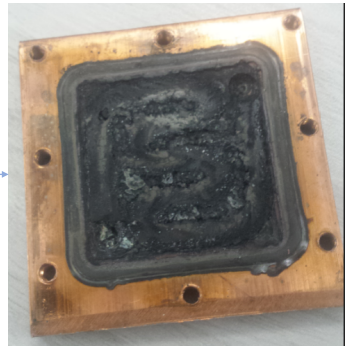
Calcium and magnesium deposit and algae formation inside channels

Reducing the thermal and hydraulic performance of the water blocks

→ Performance could be reduced to 0% in some cases



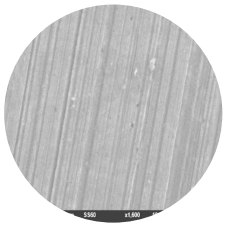
Biofouling



Carbonic algae due to heat excess



Impacted copper surface VS

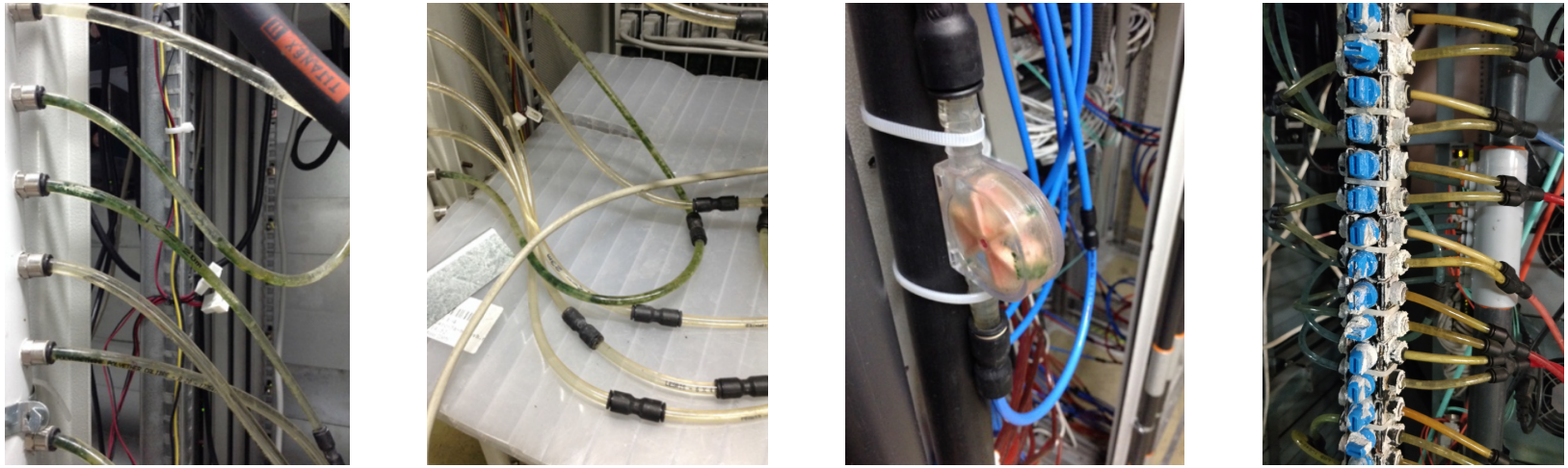


Normal copper surface

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OVH: Water quality challenges



Impact of water quality on the cooling distribution module

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OVH: Water quality challenges

Water cooling challenges: water quality → precautions



100 µm filters are added to the circuit



Ultra violet lamps are installed on all water storage tanks



Metallic water storage tanks covers → changed to plastic

\+ Softeners are added to system to assure water of low hardness

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OVH: Water quality challenges

Water cooling challenges: water quality → actions

Solution 1

Corrective action using magnetic polarization showed +ve results:

↓

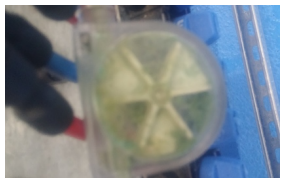
Without any modification of water physico-chemical properties

↓

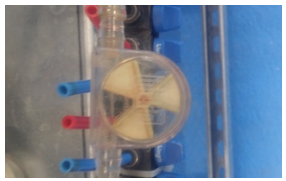
Decomposition of algae, calcium and magnesium deposits

↓

Filtration



Before



After



Residuals collected by the filter

+

Solution 2

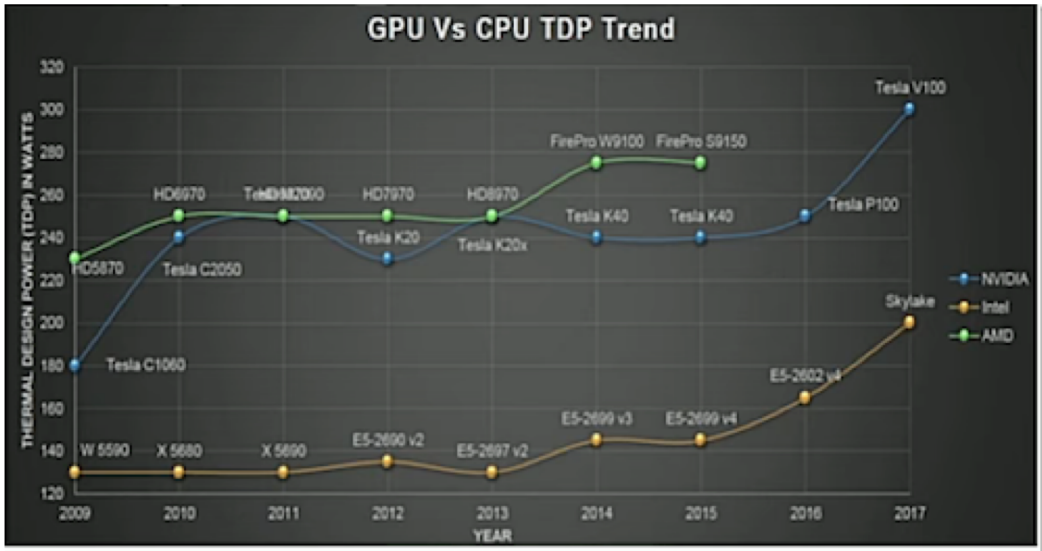
The complete recycling of water:

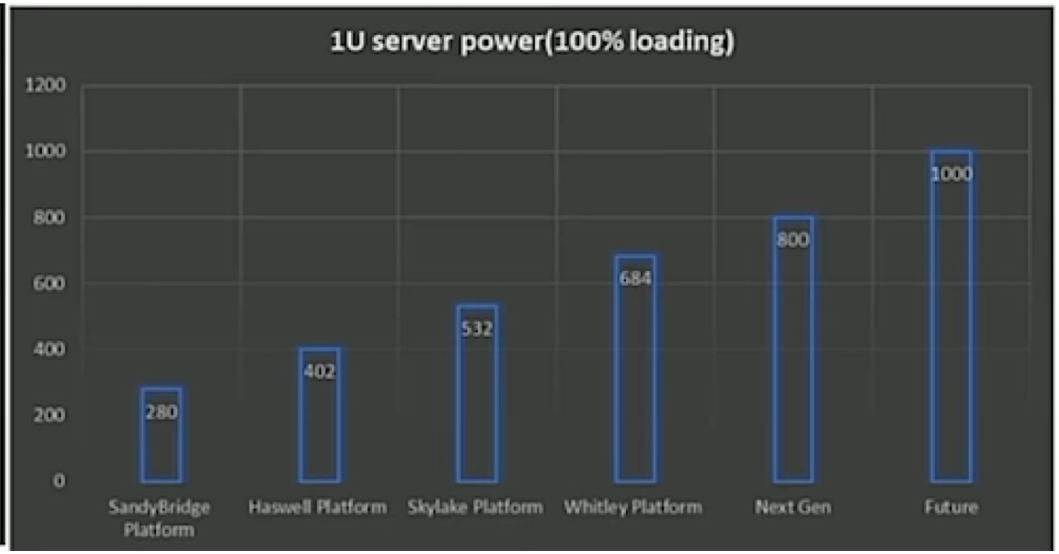
Injection of clean water and discharge of existing water without system disturbance

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Why does this matter again?





- TDP par xPU >300 and growing
- 1KW par U is here
- Liquid cooling is not an option, it is a must !

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CLOSING THOUGHTS

- Very excited to join open compute
- Keen to help standardize common parts of water cooling systems
- We'll focus on ACS (Advanced cooling Systems) working group

COME TO

OUR SUMMIT



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FOR BUSINESS.