

2-Phase Immersion Cooling



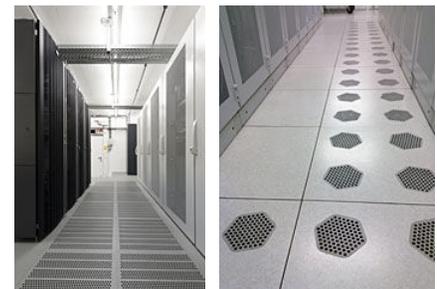
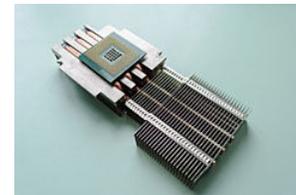
Current Data Centers

- Data centers account for about 2% of the planet's entire electricity consumption
- 30 billion watts of electricity or 30 nuclear power plants are used for data centers
- In reality 67% of global electricity generated with fossil fuels
- Surge in power usage by 63% in 2012 and trend is still rising
- Government and social pressure to save electricity and CO²



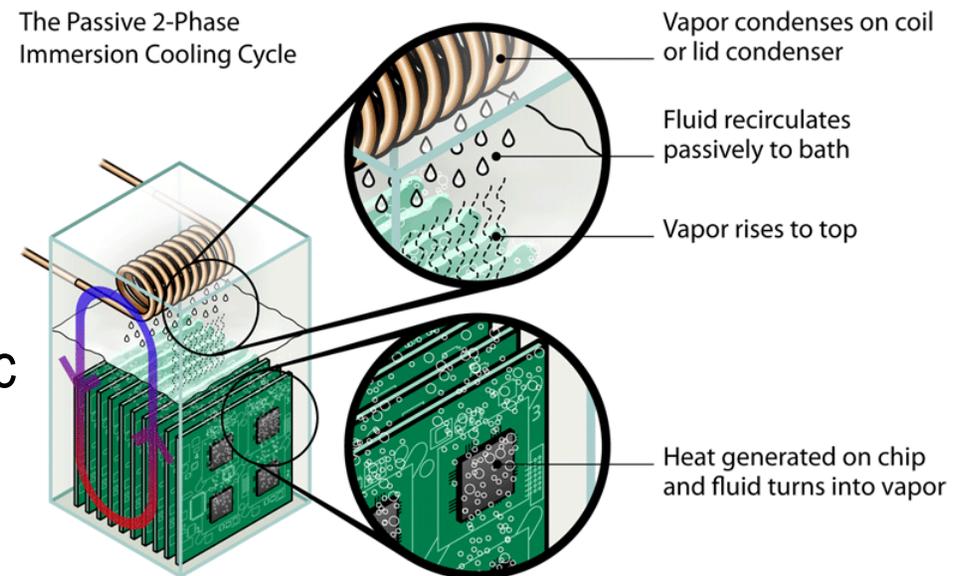
Traditional Air Cooling

- Bulky heat sinks, thousands of fans, raised floors, energy-hungry and expensive Computer Room A/C (CRAC), huge A/C condensers
- Fans on CPU, on server cases and CRAC create a lot of noise and blow dust into servers
- Low density - a lot of space is wasted
- A lot electricity only to cool down IT hardware
- Power Usage Efficiency (PUE) is the ratio of IT vs. Facility electricity incl. cooling
- Very inefficient and often PUE's of 2.0 (50% of electricity wasted on cooling etc.)



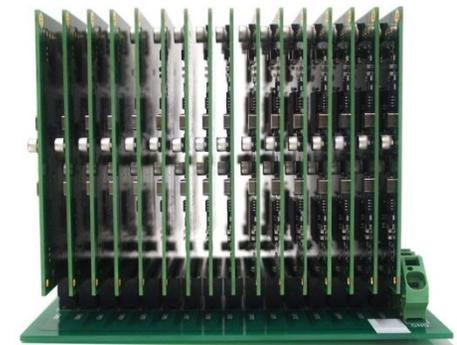
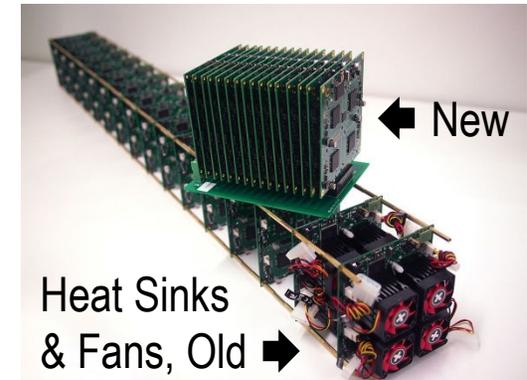
Alternative: 2-Phase Immersion Cooling

- Electronics completely immersed in dielectric (non-conductive) 3M™ Novec™ fluid without any additional attachments
- Chip temperatures reach fluid boiling temperature
- Rising hot vapor takes heat away
- Vapor transfers heat by condensing on lid or coil
- Colder fluid flows back to tank where cycle begins again
- Boiling action leads to automatic convection without pumps



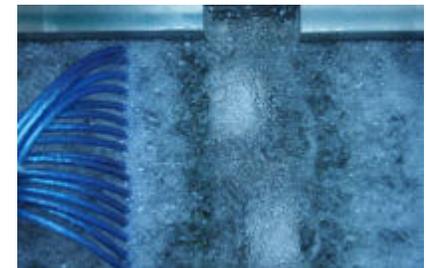
Advantages of 2-Phase Immersion Cooling

- No bulky heat sinks and fans, or cold plates and water pipes needed
- Extremely high densities by stacking boards very tightly - massive space savings and new hardware designs which were not possible yet
- Very energy-efficient; passive boiling 4000X higher heat transfer coefficient than forced air
- Future-proof – next generation hardware doesn't require redesign of cooling system unlike air and water cooling
- Non-toxic and non-flammable, inherent fire protection
- Zero Ozone Depletion and very low Global Warming Potential



IMMERSION-1: First 3M Novec Data Center

- World's largest FPGA Cluster with 6048 Spartan®-6 LX150 FPGA chips from Xilinx
- 1512 hot swappable boards (only 8.5mm from board to board)
- Total heat dissipation of 70kW, record-breaking PUE of only 1.02 in hot and humid Hong Kong
- Saves more than 90% on electricity in comparison to traditional air cooling
- Performance equivalent to 8,500 Dual Xeon servers in 200 racks, consuming 6.4 Megawatts
- Saves 45,000 tons of CO2 every year - same as produced by 1.65% of all Hong Kong cars



Allied Control Limited

- Built IMMERSION-1 in less than half a year with budget lower than traditional CRAC equipment, using SMD line for custom hardware
- Professional solutions provider to consult and implement practical immersion cooling
- Founders & supporters from various electronics and industrial fields
- 3M Technology Partner
- Services Provided:
 - Initial feasibility studies
 - Conceptual design of immersion cooling setups
 - Technical consultation
 - OEM/ODM services

