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Singapore's NTU proposes cooling servers by spraying chips with fluid

Two-phase cooling without the pipes

April 05, 2023 By: [Peter Judge](#) [1 Comment](#)

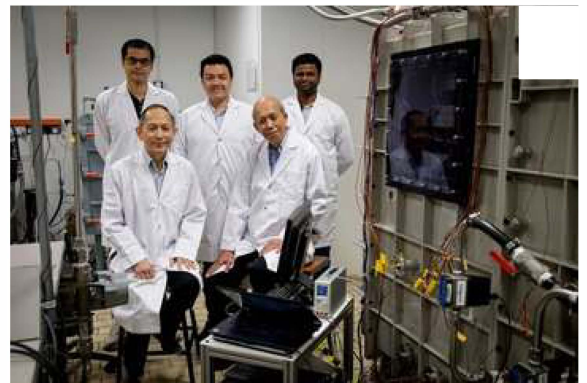
A group at Singapore's Nanyang Technical University (NTU) has tested a strange, but simple idea: spraying the hot CPUs with dielectric cooling fluid, and allowing it to evaporate.

The team ran 12 servers in a box, and sprayed a dielectric fluid on the CPUs. The systems were kept cool more effectively than by conventional air cooling, according to a [paper published in the journal Energy](#) in April.

The team, led by NTU Associate Professor Wong Teck Neng, described the spray system as "a 'chillerless' novel spraying architecture which has the capability of performing high heat flu, is highly scalable and easily adaptable by modern data centers."

The prototype system, built by research fellow Liu Pengfei, sealed a 24U rack, containing 12 servers, in a box. Nozzles sprayed dielectric fluid on each CPU, where it evaporated, cooling the server. The fluid was condensed and collected for reuse in a closed-loop system.

While most data centers are cooled by air conditioning systems, [Immersing the IT in dielectric fluid](#), proposed by vendors including Submer, GRC, and Asperitas, removes heat more efficiently and reduces the energy used. Other vendors including LiquidCool and Zutacore, have proposed [two-phase cooling](#), in which the immersion fluid is allowed to boil in order to remove more heat.



Professor Wong Teck Neng (front left), with inventor Liu Pengfei (front right), and the team, with the spray cooling system (R)

– NTU

The NTU team's approach eliminates the giant tubs of the immersion vendors, and the piping used by two-phase advocates, as well as heatsinks. However, the existing two-phase solutions currently [use PFAS \(poly-fluoroalkyl substances\)](#) which have been labeled a health risk.

Excerpts seen by *DCD* do not give details of the fluid used - we have requested a full copy of the NTU group's paper to find out more.

Data centers use some seven percent of Singapore's total electricity consumption, and the country has very little renewable electricity supply, so the government has been [rationing permissions for new data centers](#). The Singapore National Research Foundation (NRF) runs a Green Data Centre Research Programme which supported the NTU work.

The group first proposed its idea of spray cooling for tropical data centers in [November 2021](#), based on a more basic prototype, and followed up with an [evaluation of performance in January 2022](#).