New technique may enable all-optical data-center networks

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A new technique that synchronizes the clocks of all connected servers via optical fiber, and programming hardware to memorize clock phase values so clock time does not have to be re-checked, the time to "recover" the clock could be practically eliminated.

Ph.D. candidate Kari Clark (Optical Networks Group, UCL Electronic & Electrical Engineering, winner of the EPSRC Connected Nation Pioneers competition), lead author of the study, said: "Our research makes optical switching viable for the data center for the first time by providing a solution to the clock synchronization problem. It has the potential to transform communication between computers in the cloud, making key future technologies like the internet of things and artificial intelligence cheaper, faster and consume less power."

Until now, cloud providers have been able to accommodate rapid growth in demand by relying on Moore's Law for networking, whereby, about every two years, electronic switch integrated circuits double their data transmission speed at the same cost and power. However, the sustainability of this trend is increasingly being questioned due to the difficulty of continuing to be able to make silicon transistors smaller and faster.

Dr. Hitesh Ballani and Dr. Paolo Costa, researchers with Microsoft Research Cambridge and co-authors of the study, added: "With the expected slowdown of Moore's Law and ever-increasing cloud traffic, all-optical networks represent an attractive technology that has remained elusive so far. We are very excited by this collaboration with the UCL Optical Networks Group, which started from Kari's internship in our lab back in 2016 and evolved into a multi-year journey as part of the Optics for the Cloud Research Alliance. While there is still a long way to go, this technique brings us a step closer to the vision of an all-optical data center."

Dr. Zhixin Liu (Optical Networks Group, UCL)
Electronic & Electrical Engineering), senior author of the study, said: "We started this work by investigating how to support future cloud services beyond the end of Moore's law. By bringing the top minds from cloud operators and optical communication research, we propose a future-proof alternative using optics, helping data centers to cope with demand in the long term."

The team, working with researchers at Microsoft Research Cambridge, developed a prototype and found that their technique, called "clock phase caching," could synchronize the clocks of thousands of computers in under a billionth of a second, or the time it takes for light to travel 30 cm in air.


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