Novel Research Reachs Record-Setting Data Transfer Speeds

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Courtesy of SynEvol

Credit: Peng Cheng Laboratory

The foundation of today's infrastructure for information technology is the data center. These centralized hubs serve as the worldwide control centers for digital services and enterprises, managing, storing, and distributing vast amounts of data and applications. They are necessary to enable the seamless operation of our globally connected digital world by enabling scalability, aiding disaster recovery, assuring robust security procedures, and preserving data access.

Data center interconnects, the essential networking infrastructure in charge of enabling communication between various components both inside and across data centers, are at the core of data center operations. In order to transform digital impulses into analog signals for transmission over copper cables, digital-to-analog converters, or DACs, are essential parts of these interconnects. It is impossible to overestimate their contribution to low-latency, high-speed, and affordable connectivity. The problem, however, is the need for high-resolution DACs, which creates a major bottleneck because it drives up the price of optical modules.

In order to tackle this problem head-on, scientists have developed a novel method that combines digital resolution augmentation with a nonlinear predistortion methodology based on look-up tables. This novel method, as described in Advanced Photonics Nexus, attempts to preserve effective data transport and communication within data center interconnects while mitigating the constraints imposed by high-resolution DACs.

The suggested method has produced amazing experimental results, beyond the limits of possible data transmission rates. The study team has achieved record-breaking data transmission performance by using digital resolution enhancement to lower the demand for DAC resolution and look-up-table-based predistortion to minimize nonlinear degradation.

Significantly, employing 3/3.5/4-bit DACs, the digital signal processing technique allowed signals to be transmitted over 2 km of typical single-mode fiber at rates more than 124 GBd PAM-4/6 and 112 GBd PAM-8. Furthermore, it enabled 1.5/2/3-bit DACs to be used to transmit 124 GBd PAM-2/3/4 signals over 40 km of conventional single-mode fiber. With these discoveries, data center interconnect technology has made a huge step forward and it is now possible to handle the next generation of ethernet links, which aim to reach speeds of up to 800-GbE or even 1.6-TbE.

The relevance of these results is emphasized by the corresponding author Zhaopeng Xu of Peng Cheng Laboratory, who notes that they show "the transmission of the highest data rates with the lowest-cost digital-to-analog converters for data center interconnects."

These developments have the potential to change a variety of applications across 6G access networks and passive optical networks, in addition to reinventing data center interconnects. This novel method clears the path for more economical and effective data transfer by addressing the issues with high-resolution DACs.