

# Silicon-based optical modulator for ultra-fast telecommunications

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Imagine being able to download 10 high-definition movies (each of 4 GB capacity) in less than 1 second or be able to enjoy superior lag-free online gaming experience with multiple players from anywhere in the world. Researchers from A\*STAR Institute of Microelectronics (IME) have designed and developed a silicon-based optical modulator for ultra fast long-distance telecommunications. The device would enable 50% faster download speed than the latest Ethernet standard. The technology can be realised with existing industry fabrication processes, paving way for affordable high speed data communications to the masses.

A modulator in an [optical telecommunication](#) network transforms [electrical signals](#) into [optical signals](#). It performs one of the most critical steps as its switching speed in the signal conversion process dictates the overall rate at which data packets are sent out. In long distance optical communications, the quality of signals transmitted takes on greater significance ? a critical performance feature defined by the extinction ratio of the modulator.

At record-high extinction ratio of 5.5 dB with 50Gbps data speed, IME's modulator exhibits the highest reported immunity against data distortion to deliver high quality optical signals over even longer distances. The modulator uses the on-off keying (OOK) format, which is widely used commercially. When this format is applied to advanced multilevel modulation format such as QPSK and DP-QPSK, the [information capacity](#) and total data communication can be increased to 100 Gbps and 200 Gbps, respectively. Compared to current state-of-the-art, IME's modulator would need 50% less input power to impart optimised cooling, energy and cost savings in high-performance computing and data centres.

On the breakthrough, Dr Tu Xiaoguang, the IME scientist involved in the project, said, "By applying a novel structure design, our team was able to

achieve a precisely-defined P-N junction profile that can reach high modulation speed without compromising optical signal quality, which has troubled designers in the past. This leads to the remarkable performance of the silicon modulator. Work is underway to develop new designs for pushing the switching speed further."

Professor Dim-Lee Kwong, Executive Director of IME, said, "Silicon photonics offers promising solutions to marry photonic functionality with electronic intelligence. With the results achieved using CMOS technology, we expect IME's silicon modulator to offer a distinct lead that is competitive with optical modulators in the market."

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