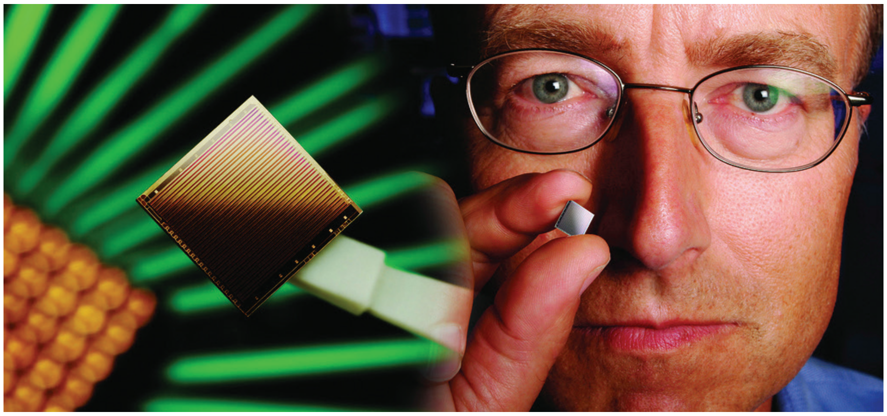
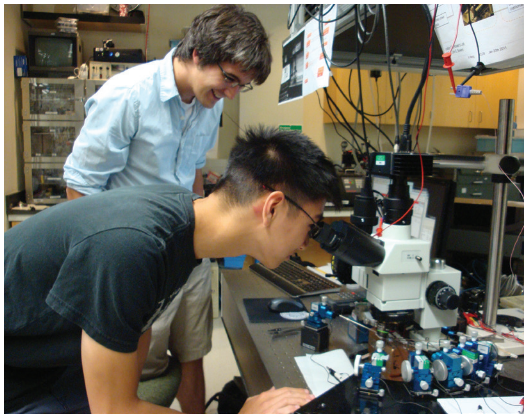
SUCCESS STORY: COMPUTING AT THE SPEED OF LIGHT





John Bowers and his team are in pursuit of faster, cheaper, more efficient solutions to the data center overload

THE SITUATION

Today's data centers are insatiable consumers of global electricity – and that appetite is only growing. In 2010, data centers gobbled up between 1.1 and 1.5 percent of total global electricity, and 1.7 and 2.2 percent in the United States. By 2015, Internet traffic will total nearly 1 Zettabyte per year, equivalent to all digitally stored information in 2010.

Global internet traffic increased eight times from 2005-2010, and will increase another four times by 2015. The worst "hog" of all? Web-based video, which is expected to surpass 50 percent of all traffic in 2012.

THE CHALLENGE

Two important technologies – silicon and phototonics – have been on separate but parallel development paths in the last half century. In the past 30 years, the power required to transmit a bit has decreased by 200,000 times, while fiber optics have dramatically increased Internet speeds by a factor of 100,000. Why don't we just combine the low production cost of silicon with the speed and efficiency of lasers? If we did, we could revolutionize computing.

THE OBSTACLES

What's in the way of that brilliant solution? A few bumps in the road:

Half the energy of a microchip is consumed by the interconnect that transfers data off the chip. Then, the electrical process creates a bottleneck between that point and the high-speed fiber optic lines that carry information globally. More powerful chips also generate lots of heat, which means computers and data-centers need to be cooled down, a process that consumes still more energy.

THE BIG IDEAS

Optical transmission can eliminate the interconnect bottleneck, but silicon is a poor light emitter. Bowers and his team used the emission properties of Indium Phosphide to make hybrid silicon lasers. Their next challenge was to turn this beam on and off rapidly enough to accommodate the higher flow of data. Bowers' research team also moved on this front, creating modulators with world record bandwidths. Intel has used the hybrid silicon technology to demonstrate a chip combining four lasers and four modulators to achieve a 50 Gbit/s transmitter. It's like winning the Indy 500 for modulation speed. Bowers says, "Right now we've got the world record for the fastest modulator on silicon. It runs as a 50 gbit per second." And his team has already raised the bar, "Our goal is to make it at least twice, or even 10 times faster in the future."

But doing something in the lab doesn't guarantee affordability or performance out in the world. What makes the new chips truly viable is that they can be made using traditional, low-cost silicon manufacturing techniques. According to Bowers, "We're going to literally leap seven generations of process equipment and fabricate photonic chips in a modern silicon CMOS foundry."

WHAT'S NEXT?

The future of the technology is wide open. Imagine 200 colored beams of light traveling through fiber optic wires, at speeds reaching 1 terabit/second or more. With more efficient lasers and transmitters, data centers and supercomputers can scale to sizes 1000 times larger than today.

High definition, interactive virtual conferencing services would also reduce the need for business travel and the associated carbon emissions from auto and air transport. Hybrid silicon photonics can be game-changers on many levels – from computation to communications.

Faster, cheaper, more efficient computing – all within reach thanks to an inventive hybrid model of silicon and