

Intel takes further step toward Terabit/s data transmission

III-V/silicon hybrid demonstrates 50Gb/s transmission over fiber.

Intel has combined developments over the past several years to create the first 50Gbps optical data link using silicon opto-electronic technology with hybrid indium phosphide (InP) infrared laser diodes. The 'concept vehicle' demonstrator system was on show at the Optical Society of America's 'Integrated Photonics Research, Silicon and Nano Photonics' conference (IPR 2010) in Monterey, CA, USA (25–28 July).

The system (Figure 1) consisted of four InP lasers of different emission wavelengths coupled to four silicon modulators capable of 12.5Gbps data speeds. The four signals are then combined to give the 50Gbps headline speed. After transmission, the signals are separated and detected in silicon-germanium (SiGe) photodetectors.

The company hopes that the technology will become even faster, aiming at the terabit/sec (1000Gbps) level (see Table 1). Higher speed is being sought through increasing the performance of the modulators and through increasing the number of lasers with different wavelengths. Intel believes that the technology will "allow computer makers to completely rethink traditional system design from netbooks to supercomputers" based on its low cost and high speed.

Server farms and datacenters would benefit from eliminated bottlenecks and savings from replacing

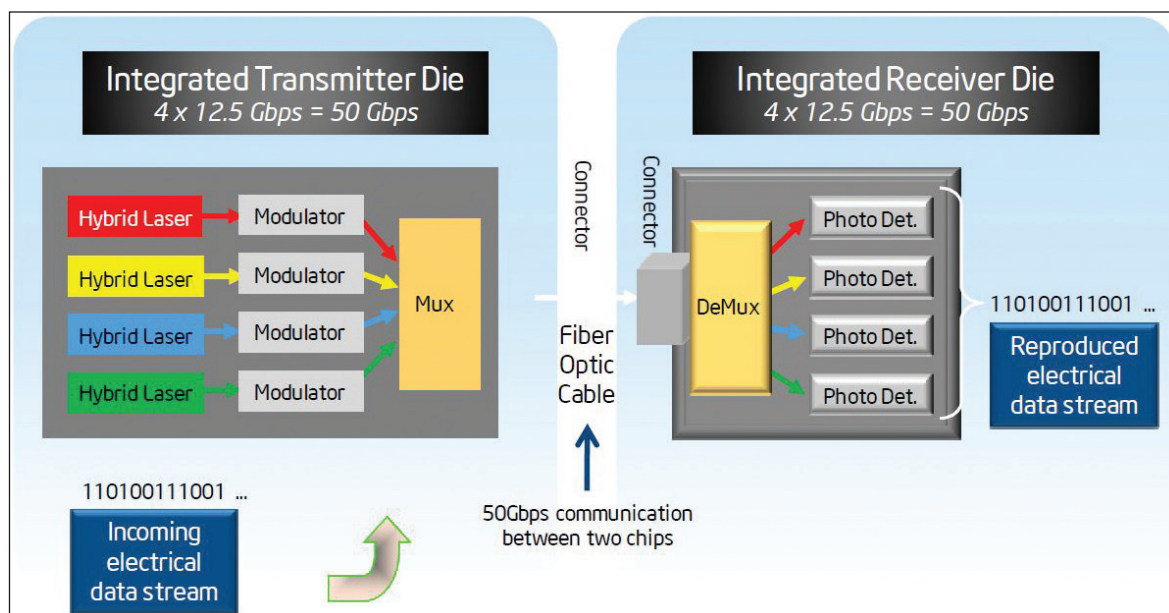


Figure 1. Optical 50Gbps interconnect system demonstrated by Intel.

many cables with one fiber, consuming less energy, Intel believes. Further application could come from the high-data-rate needs of new 3D television formats.

The 50Gbps transmission speed is the equivalent of one high-definition (HD) movie per second. The use of optical fiber enables higher-speed transmission over longer distances compared with what is available from

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using traditional copper wiring. Today's electronics devices are limited to interconnections of at most a few inches of copper for the highest-speed data.

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Table 1. Intel's proposed route to 1Tbit/sec.

Modulator speed	Channels	Data rate
12.5Gbps	x4	50Gbps
12.5Gbps	x8	100Gbps
25Gbps	x16	400Gbps
40Gbps	x25	1Tbps

▶ In 2006, the company announced that it had developed technology with University of California Santa Barbara (UCSB) to integrate indium phosphide lasers with silicon opto-electronic structures using plasma-enhanced bonding techniques. The individual lasers are then etched out of the hybrid material.

These laser devices were based on aluminum gallium indium arsenide (AlGaInAs) multi-quantum well active regions that emit light into silicon waveguides (Figure 2). In 2008, Intel developed gratings to vary the laser output wavelength (Figure 3).

To put signals into the laser light beams, the Intel system uses silicon modulators. Intel announced 1GHz silicon modulators in 2004, increasing this to 40Gbit/s in 2007. Modulators allow better signaling performance compared with direct modulation of the laser itself. The multiplexing is achieved passively, combining signals on different-wavelength laser beams.

The detection end of the system consists of a de-multiplex system followed by silicon-germanium photodiodes. Intel announced a p-i-n photodiode capable of 40Gbit/s in 2007 and an avalanche photodetector (in conjunction with US Defense Advanced Research Projects Agency) with a gain-bandwidth product of 340GHz in 2008.

Intel stresses that these results are separate from its 'Light Peak' project, which is targeting nearer-term applications connecting systems to high-speed optical networks. In January, Intel said it was preparing to ship Light Peak devices later this year.

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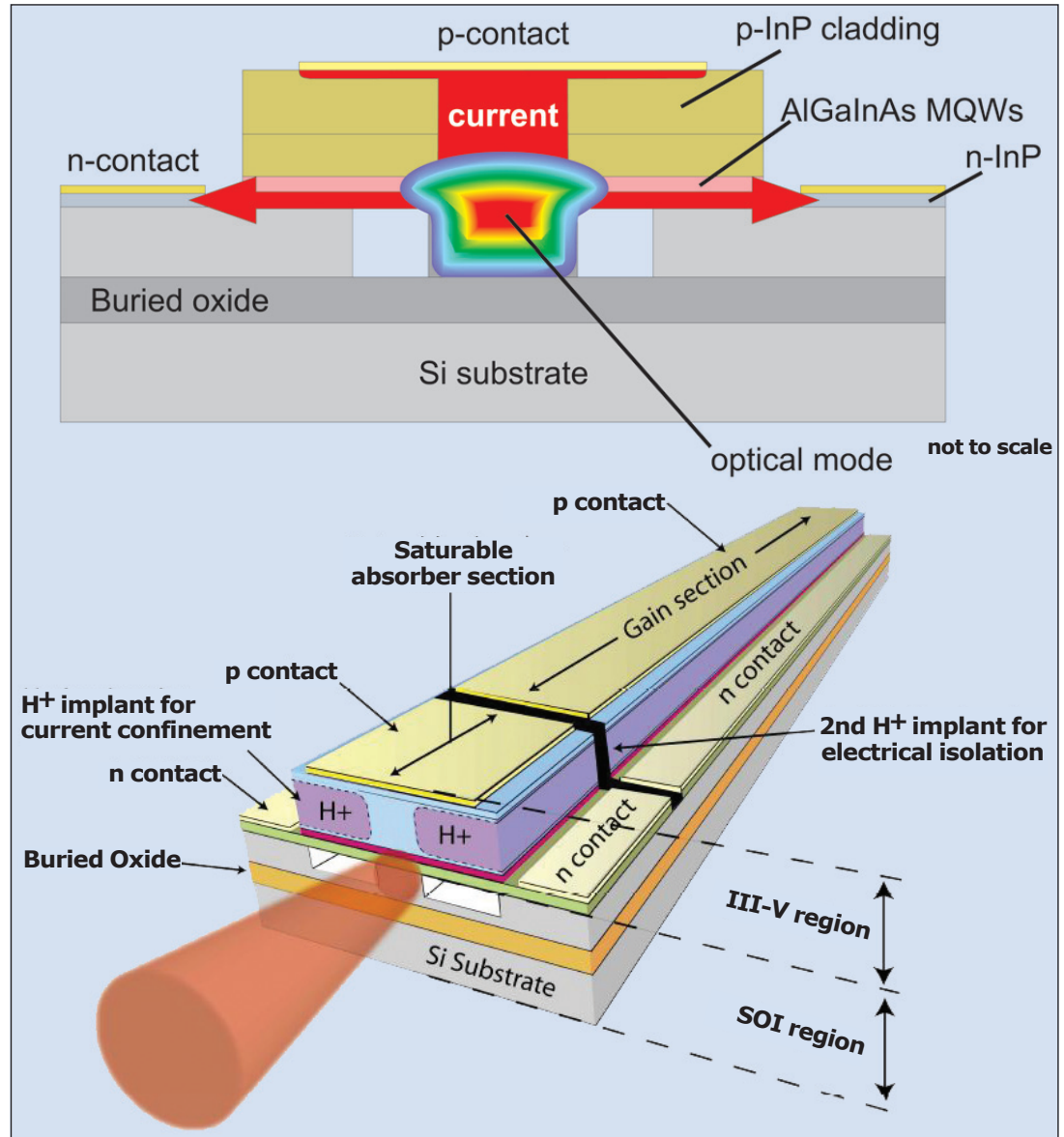


Figure 2. Hybrid InP/silicon laser schematics.

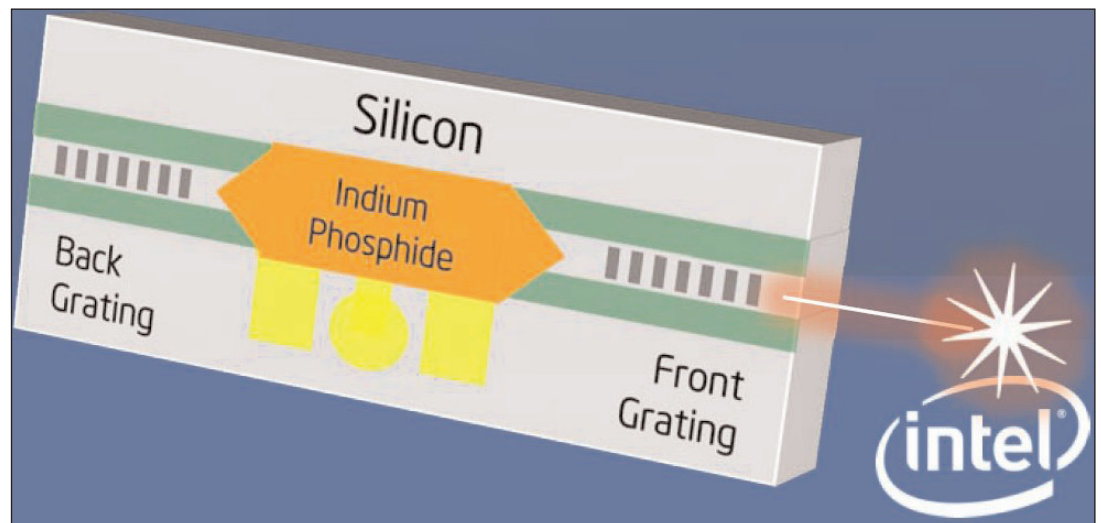


Figure 3. Etched gratings added to laser enable wavelength tuning.

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