Agilent and Flow Science Collaborate to Simulate Photonic Switch

By Jerry Fireman, Structured Information

Computer simulation played a critical role in understanding and solving a problem with microscopic bubbles in a revolutionary switch used to switch optical signals in fiber-optic circuits. The Agilent Photonic Switching Platform operates by blowing bubbles in just the right spots in a tiny trench cut in a planar lightwave circuit. The bubbles redirect light beams into different paths in order to reconfigure fiber-optic networks. Early prototypes showed performance problems that indicated the something was unstable with the bubble reflection. But the small size of the bubbles made it impossible to make the comprehensive physical measurements that would be needed to diagnose and solve the problem.

Agilent senior scientist John Uebbing used computational fluid dynamics (CFD) software to simulate the bubble. The bubble is sustained by evaporation induced by electrical heaters located in the silicon substrate. The Agilent team discovered that the corresponding condensation on the walls of the trench causes a fluid buildup. It is this buildup that determines much of the behavior of the switch. Further simulations helped the researchers validate two different methods of altering the device to give stable signals. "At first, some members of our team refused to believe these results, but continued physical testing proved they were true," Uebbing said. "Without CFD, we would never have gotten to the bottom of this problem."

Developing a New Technology

Fiber-optic cable has provided dramatic increases in data communications throughput, and there has been a big desire to be able to switch large volumes of fiber optic data without turning the optical signals into electrical signals for switching and then back to optical signals. In the mid-1990's, Agilent Laboratories (when it was part of Hewlett-Packard Labs) realized the importance of an all-optical circuit switch and started a research program to develop such a technology. A team of engineers and scientists was formed within what is now Agilent Labs' Communications and Optical Research Laboratory (CORL) to develop this unique switch fabric, which is compact, scalable, and has minimal impact on the optical signal. The team capitalized on two very established technologies - inkjets and planar lightwave circuits — to build a switch that routes an optical beam from one path to another without having to convert the switching signal from optical to electronic and back.

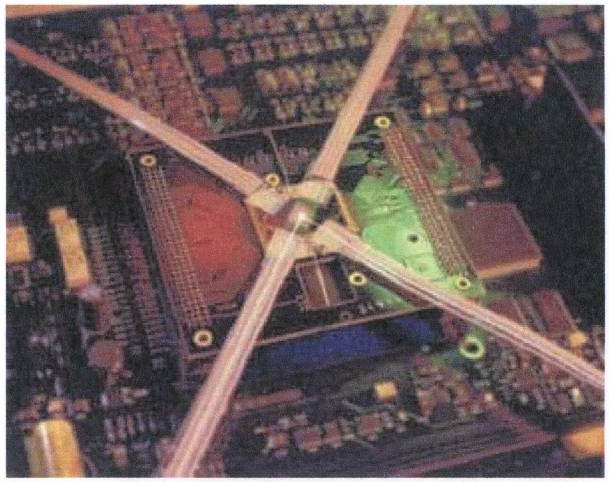

Figure 1: The Agilent Photonic Switching Platform.

In order to work, the Agilent Photonic Switching Platform is placed at the intersection of two fiber-optic networks (Figure 1). When a light signal comes in through a fiber, it can cross the planar lightwave circuit unimpeded via