BRIEFING PAPER

Prototyping Tomorrow's Optical Cyberinfrastructure

Project:	OptIPuter
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Funding:	Information Technology Research, National Science Foundation
Division:	UCSD and UCI
Corporate Partners:	IBM, Chiaro Networks; and Telcordia Technologies
Start Date:	October 2002

Optical networking is going to revolutionize large-scale scientific research, allowing researchers to crunch numbers or collaborate across thousands of miles as long as they are hooked up to an optical Grid linking computer storage, processing, and visualization resources. This is the vision of the OptIPuter project, and it is based on the realization that the growth rate of optical bandwidth capacity far exceeds Moore's Law (which states that the amount of information stored on a given amount of silicon doubles every 18 months). This new paradigm means that the central architectural element in computing is no longer the computer platform, but the optical network and the *lambdas* (individual wavelengths of light) that can be multiplexed and traverse the network's fiber.

Like in the old Jack in the Box commercials, the traditional computer is being blown up and scattered across the Grid. The OptIPuter can be seen as a "virtual" computer in which the individual "processors" are widely distributed clusters; the backbone network is provided by IP delivered over multiple dedicated lambdas (each 1-10 Gigabits per second); and, the "mass storage systems" are large distributed scientific data repositories, fed by scientific instruments as near-real-time peripheral devices.

"Optical bandwidth and storage capacity are growing much faster than processing power, turning the old computing paradigm on its head: We are going from a processor-centric world to one centered on optical bandwidth where the networks will be faster than the computational resources they connect."
– Larry Smarr, Cal-(IT)^2 Director

The five-year, $13.5-million OptIPuter project is developing and prototyping this new type of distributed cyberinfrastructure in San Diego, Chicago, and elsewhere, initially to respond to the needs of two major data-intensive scientific research projects: NSF's EarthScope in the earth sciences, and NIH's UCSD-based Biomedical Informatics Research Network (BIRN). Both are beginning to produce an accelerating flood of data stored in distributed, federated data repositories. The progress of their science has been hampered because the individual data objects (e.g., a 3D brain image or terrain data set) are too large (gigabytes in size) to be exchanged, manipulated, or visualized interactively over today's high-speed networks. If the OptIPuter project is successful, scientists thousands of miles away will be able to exchange and collaborate in real time on massive data objects as easily as consumers today exchange family snapshots over the World Wide Web. This new vision of a "virtual-reality Internet" will result in more powerful capabilities to support large-scale, federally funded, networked research activities.

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