Battling Internet Gridlock with Light

KEREN BERGMAN

Charles Batchelor Professor of Electrical Engineering

Gridlock doesn't just happen on highways. Interlocking congestion that prevents movement is also a threat to the Internet. As more people exchange more information on a more frequent basis, the Internet's traffic management system (routers) is forced to use more energy to forward and receive data between computer networks. As routers lose ground against traffic demands, performance bottlenecks occur.

Photonics, the science and technology of generating and controlling photons, could ease up electronic traffic jams by providing the solution to Internet gridlock. Through photonics, the potential exists to achieve advanced information traffic management performance along with energy efficiency by symbiotically merging the computation-communications infrastructure. Optical routers would transmit data as light, avoiding unnecessary electronic processing. In addition, they would use less power consumption while manipulating gargantuan amounts of data with complete format transparency in a smaller device footprint.

Keren Bergman leads the Lightwave Research Laboratory at Columbia University. She investigates the realization of dynamic optical data routing in transparent optical interconnection networks. Through this work, she is developing potentially disruptive technology solutions with ultra-high throughput, minimal access latencies, and low-power dissipation that remain independent of data capacity. These solutions will ultimately capitalize on the enormous bandwidth advantage enabled by dense wavelength division multiplexing.

Her work on large-scale optical networks focuses on embedding real-time substrate measurements for cross-layer communications. As envisioned by the community, this suite will support a wide range of network science and engineering experiments such as new protocols and data dissemination techniques running over a substantial fiber optic infrastructure with next-generation optical switches, novel high-speed routers, city-wide experimental urban radio networks, high-end computational clusters, and sensor grids.

Bergman's research in large-scale optical switching fabrics includes cross-layer optimized optical substrate and embedded real-time measurements. Her work in optical interconnection networks for high-performance computing systems includes data vortex optical packet switching fabric, optical network interface card and scalable optical packet buffers. Her work in integrable interconnection network systems and subsystems includes parametric optical processes and systems and nanophotonic optical broadband switches. Her work in inter- and intra-chip multi-processor interconnection networks includes on- and off-chip photonics communications for multi-processor systems and silicon photonic devices for networks-on-chip.

B.S., Bucknell University, 1988; M.S., Massachusetts Institute of Technology, 1991; Ph.D., MIT, 1994