Circumventing traffic jams on the Internet

During the 6 months that Carolina Cruz-Neira of Iowa State University in Ames and her collaborators at various institutions in Illinois worked to develop an elaborate, interactive computer simulation of molecules, they actually met in person only twice. Except for a few telephone calls, everything was done over the Internet—from sending messages to transferring programs and data.

"We were able to exchange information quickly, reliably, and easily many times per day," says Cruz-Neira.

In creating the Virtual Biomolecular Environment, Cruz-Neira and her coworkers envisioned a system that any scientist with a desktop computer connected via the Internet could use to study biochemical interactions. The Internet, however, doesn't yet have the capacity or reliability to handle such a challenge.

"Our application requires real-time manipulation of a remote simulation as the simulation is running," Cruz-Neira says. Even a 0.1-second delay in transmitting commands could be so frustrating that a researcher might not want to use the system.

Similar problems have hindered other research projects, ranging from direct control of a remote electron microscope to on-line visualization of black holes. "If you look at the Internet as a whole, you can't reliably deliver the kind of performance you need at busy times, even for existing applications," says Mark Luker, who manages the network connections program at the National Science Foundation in Arlington, Va.

To help remedy this situation, NSF last week introduced a grant program to fund specific scientific and engineering projects that require innovative ways of regulating traffic flow on the Internet.

At present, the Internet encompasses more than 100,000 networks connecting millions of computers throughout the world. It carries all the information in small packets that are treated equally, whether they consist of simple messages or portions of complex video images, whether they are part of vital research or a student's home page photo.

As traffic increases, the Internet responds by slowing down.

"We need to take a deeper look at this, not just try to expand capacity and stay ahead of demand," Luker says. "Some traffic needs better or different service than other traffic."

This means developing schemes for setting priorities and implementing them.

Cruz-Neira *et al.*

In the Virtual Biomolecular Environment, a researcher can steer molecules and manipulate their physical characteristics.

It may be possible, for example, to tag certain data streams so they have right-of-way on the Internet just as emergency vehicles do on highways. Other solutions may involve setting aside specific channels for priority traffic during peak periods. As a temporary measure, research groups can apply for links to NSF's experimental, high-performance vBNS system, which connects its five supercomputer centers.

"There's a vision here of a more effective Internet—one that has different qualities of service for different needs and can guarantee the kind of service you need to do what you want to do," Luker says.

— I. Peterson

Tracking clan behavior of brown hyenas

Top-ranking female brown hyenas hold equal status with males, and they fight as often as males for food, water, mates, and dominance, report two scientists in one of the first reports on the animals' social system.

The study by Delia Owens and Mark Owens "fills in a major gap in our behavioral knowledge of the animal," says Laurence Frank of the University of California, Berkeley.

The researchers observed brown hyenas in the Central Kalahari Game Reserve in Botswana for more than 3,000 hours in the 1970s and 1980s. Before they could analyze their data, however, they became involved in elephant conservation efforts and wrote a popular account of their experience in the Kalahari. Only recently did they return to the hyena study, Delia Owens explains. "The data have been burning holes in our guts."

Dominance has many benefits in hyena clans, particularly for the females, the team reports in the March ANIMAL BEHAVIOUR. Alpha, or dominant, females spend more time feeding than other members of the clan. They may force subordinate females to leave the clan or to abandon their newborn cubs, which then die. Alpha females don't produce more litters than subordinates, but more of their cubs survive. Their offspring are guaranteed a spot in the group's communal den, which all clan members help provision and protect.

M. Owens

Brown hyena cubs play at fighting near their den.

Alpha males also spend more time feeding than subordinate males, and they copulate more often, report the researchers, who founded the Owens Foundation for Wildlife Conservation in Stone Mountain, Ga.

A clan usually consists of one to five related adult females, one dominant adult male that mates with the females, and the pups. The group occasionally includes subordinate adult males.

When they reach maturity, female pups either stay with their group or become nomadic. Young males usually leave the family and go in search of another clan. Some males, however, linger at home and help feed their half-siblings. A few of these try to become top dog, but they seldom succeed.

Nomadic males never join a group. They "sneak copulations with clan females and occasionally mate with nomadic females," the researchers report.

Mating protocols change with the weather. During dry seasons or years, when food becomes scarce, animals roam far from their dens and even the alpha males sometimes leave their groups. Female clan members then mate regularly with nomads.

Brown hyenas in the same group fight among themselves; the team saw 277 fights between clan members. In contrast, Delia Owens explains, "in spotted hyenas, there's a lot of selection against fighting," and they seldom attack each other.

Spotted hyenas need to cooperate in order to bring down their prey, but brown hyenas scavenge alone and spend little time together. The researchers saw two adult brown hyenas together at the den only 9 of the 200 occasions on which they observed the animals feeding their cubs.

— T. Adler