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# Syncing Up Cyberspace

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*by Amy Oprean*

**About Dr. Monica Brockmeyer:**

Dr. Brockmeyer received a B.S. in mathematics and statistics, and an M.S. and Ph.D. in computer science and engineering from the University of Michigan. She joined Wayne State University in 1999.

When Monica Brockmeyer received a Faculty Early Career Development (CAREER) award from the National Science Foundation in 2004, her goal was to make the Internet – a vast network of servers and other computers communicating with one another – more timely and predictable. Five years and countless algorithms later, she has reached her goal with the Predictable Services Overlay Network, or PSON, an overlay system which integrates communication timeliness and predictability into the Internet.

"When messages are sent on the Internet, they do not take a direct route, but bounce from router to router, each one sending it a little bit closer to its destination," said Brockmeyer, associate professor of computer science the College of Liberal Arts and Sciences. "Because you don't know what path a message is going to take when you send it, it's difficult to make guarantees about how long it will take. There's also the chance that servers will simply discard a message if they are too busy."

The difference between one second and 100 milliseconds might not be a major concern for e-mail, but this unpredictability poses problems in several areas of computing. One example is scientific simulations carried out on different computers that are connected by the Internet. In these simulations which model everything from brain function to world climate patterns, a lack of synchrony can lead to erroneous results. "Say you are doing a model of global warming, and are looking at a migration pattern. There could be an error where a population appears to be at one location on one computer, and a different location on another, which could disrupt the entire simulation. Timely communication is important to keep everyone's view of the simulation consistent."

The world of gaming also can experience problems from Internet asynchrony. Games such as World of Warcraft, which involve millions of people interacting through Internet servers across the world, occasionally experience asynchrony during fast-paced battles. "There are instances in gaming where the actions of one player get mixed up and little reconciliations must be made," Brockmeyer said. "One gamer's computer screen might show that he is standing 10 feet from his opponent, whereas another screen might show them standing right next to each other. It can lead to situations where, for example, a player thinks he has gotten out of harm's way in time but then suddenly dies."

Although total synchrony may never be achieved, Brockmeyer demonstrated partial synchrony by engineering timeliness into the internet through the PSONs, which are deployed on top of the internet over a wide area to guarantee reliable and timely communications between routers and data centers.

## Clouds of data

As the nature of computing has shifted, the potential role of PSONs has evolved as well. In recent years, large IT companies including Microsoft, Google and Amazon have begun to offer their extensive IT infrastructures as a resource for outsourcing computing power and data storage space – a service widely referred to as "cloud computing." Because of their immense computing power, data centers can now process even the largest applications within one "cloud," potentially eliminating the need for multiple servers to perform large computing tasks.

Brockmeyer sees the further development of PSONs moving in step with developments in cloud computing technology. "The PSON model fits nicely into the cloud computing concept, because companies that offer cloud computing will need to provide guarantees of timeliness to their customers. PSONs are designed to guarantee this type of efficiency."

PSONs also could be used for their original function, in the form of communication guarantees between data centers. Although data centers have the capacity to hold very large amounts of information, institutions still may wish to split up their data between servers for security and fault tolerance.

"Cloud computing, if turns out to be the preferred method of large-scale computing, poses interesting challenges in communication," Brockmeyer said. "You'll have data centers, where all the different pieces of information are really close and reliable, and then you'll have these massive virtual wires between data centers around the world that are relatively unreliable and slow. PSONs could be the solution to making both types of communication more timely and predictable."

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