Undergraduates in Research: Through a research internship, undergraduate Christopher Badger (Computer Science, 2012) boosted the security of peer-to-peer networks

BY MELISSA VAN DE WERFHORST

Christopher Badger was eager for research experience as an undergraduate when professors Louise Moser and P. Michael Melliar-Smith of the Computer Engineering department were looking for an intern to assist with a peer-to-peer (P2P) network project.

By the time Badger graduated in June 2012, he walked away with the Chancellor’s Award for Excellence in Undergraduate Research, a published paper in P2P networks, and a job secured in software technology.

“I always had an interest in P2P, so I was grateful for the opportunity to help out among a team of grad students,” said Badger. “After a while, I stumbled on some stuff that I thought was more interesting. They gave me free leave to delve into it more, which was great.”
That “stuff” became Badger’s published research on the iTrust project, a new P2P networking system that is robust and secure in the presence of restrictive entities or malicious attacks. Peer-to-peer (P2P) networks are systems of individual computers that share information with each other, instead of connecting through a large server the way most websites are hosted on the Internet. In recent years, P2P networking has grown to user bases in the hundreds of millions.

Some P2P networks, such as the infamous Napster, have gained notoriety in the past decade for enabling the illegal trade of copyrighted content. However, P2P technology is a legitimate business application in many ways. The VoIP application Skype, for example, is a modified P2P network. Its live video messaging service uses logged-in users as a network, passing around each video call encrypted data via its 650 million users worldwide.

To bolster the security of vulnerable P2P networks, Badger’s idea was to “decluster” peers within a network, randomizing how they connect to each other “instead of clustering in what’s called a neighborhood,” explained Badger. “The result is a robust network that is a lot harder to attack because the connections are random.”

iTrust was conceived by Moser and Melliar-Smith to combat security threats, but also to address potential Internet censorship associated with centralized search engines. It aims to provide reliable information retrieval that cannot easily be censored or disabled by large entities such as governments that seek to restrict search engine access.

iTrust’s declustering algorithm goes even further by reducing the “expectation of cooperation” between peers. This means node connections are short-lived and rely less on the information provided by their peers, so therefore less predictable by security threats.

“When you lower the expectation of cooperation, maybe the network’s peak performance isn’t as good,” said Badger. “But in the event of an attack, you have what’s called a ‘graceful degradation’ instead of a full meltdown. When things start to fail, the network can still function for longer while someone addresses the breach.”

Badger was encouraged by his faculty advisors to submit his work to WEBIST, the International Conference on Web Information Systems and Technologies. His paper was accepted as a full length presentation, among 8-9 percent of total submissions for programming. In April 2012, Badger traveled to Porta, Portugal to present at WEBIST among other accomplished researchers and corporate technology experts in mobile and Internet technology, eBusiness, and web intelligence.

Professor Melliar-Smith commented that “Chris’s intellectual development as a researcher has been exceptional. His work is quite different from that of typical undergraduate students, and is fully comparable to the work of our doctoral students.”

Participation in research has given Badger a boost in his post-graduation career. He attended a career fair hosted by UCSB Career Services and was offered a position with Santa Barbara-based Green Hills Software, a technology company that specializes in embedded software.
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