

Krishna P. N. Puttaswamy

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Research Interests Security and privacy, cloud computing, distributed systems and applications, Internet measurement.

Education Ph.D. in Computer Science, Sept. 2005 - Present
Department of Computer Science, University of California at Santa Barbara

Bachelor of Engineering (Computer Engineering), May 2003
National Institute of Technology Karnataka, Surathkal, Karnataka, India

Research Experience **Toward Confidentiality in Third-Party Compute Clouds**
By offering high availability and elastic access to resources, third-party cloud infrastructures such as Amazon AWS and Microsoft Azure are revolutionizing the way today's businesses operate. However, data confidentiality concerns are hindering cloud adaption by many businesses. In this project, we have developed a novel approach for businesses to obtain elasticity from the cloud while also obtaining data confidentiality guarantees. We are now building developer tools to enable businesses to adapt our approach automatically into their deployed applications with very little developer support.

Collaborative Editing of Fidelity Reduced Documents on Mobile Devices
In this project, we are building a new framework to support editing shared documents on mobile devices. Three high-level requirements influenced its design. Namely, a) the need to adapt content, especially textual content, on the fly according to the quality of the network connection and the form factor of each device. b) Support for concurrent, uncoordinated editing on different devices, whose effects will later be merged on all devices in a convergent and consistent manner without sacrificing the semantics of the edits. And c) flexible replication that accommodates both device-to-device and cloud-mediated synchronization. The framework supports on-the-go editing for XML documents, such as documents in Microsoft Word and other commonly used formats.

Anonymity-Preserving Data Aggregation
Data aggregation is a key aspect in many distributed applications. In these applications, user anonymity is a key concern of the participants. In the absence of an assurance of anonymity, users may be reluctant to participate. In this project, we developed novel aggregation techniques to perform data aggregation while preserving user anonymity. In addition, we bound the data "pollution" caused by malicious users behind the cloak of anonymity, while maintaining overall system scalability using a novel "multi-tree" data structure for aggregation.

Privacy Protection for Social Content-Sharing Applications
Online social network applications are popular means for interaction, communication and collaboration between friends. While sharing content promotes the overall utility of these applications, many users are wary of being associated with their sensitive data. In this project, we identified the key attacks possible due to compromised third-party application servers or due to compromised user accounts (by botnets, for example) that weaken user privacy, proposed techniques to defend against these attacks, and

validated the techniques using datasets from several social networks and applications.

Flexible and Robust Anonymous Communication

Deployed anonymous systems such as Tor use static end-to-end paths for communication. These static paths are “brittle” and must be rebuilt following a failure of any node on the path. This is costly in terms of resource overhead and also leaks information to various attacks leading to significant degradation of anonymity over long sessions. In this project, we developed a new abstraction for building anonymous systems called *hooks*. We showed that hooks can build robust anonymous paths, and provide orders of magnitude stronger anonymity compared to existing systems.

Improving Rare Object Search in Unstructured Overlays

Existing peer-to-peer search protocols are effective in locating highly popular objects, but they fail to locate a significant portion of the rare objects existing in the network. High recall for these rare objects would drastically improve the user experience, and make these networks the ideal distribution infrastructure for user-generated content such as home videos and photo albums. In this work, we developed simple techniques that can improve search recall for rare objects while minimizing the overhead incurred by participating peers. We proposed several multihop index replication strategies that improve the performance of peer-to-peer overlays by orders of magnitude in both lookup success and lookup overhead.

Securing Structured Overlays Against Identity Attacks

To support applications such as global-scale storage, structured peer-to-peer (P2P) overlay networks use *key-based routing* (KBR) to choose servers and perform application tasks. KBR, however, is vulnerable to *identity attack*. By hijacking and responding to KBR messages, malicious peers can usurp application connections, and thus severely disrupt overlay applications. Attackers can assume arbitrary application roles such as storage server for a specific file or root of a specific multicast tree through this attack. The impact is amplified when this attack is launched by colluding peers following a Sybil or Eclipse attack. In this work, we studied these identity attacks, analyze the costs to perform them, and proposed lightweight mechanisms to detect and evade attackers.

Publications

Krishna P. N. Puttaswamy, Ranjita Bhagwan and Venkat Padmanabhan “Anonymity-Preserving Data Aggregation using Anonymator” *To Appear: ACM/IFIP/USENIX 11th International Middleware Conference (Middleware 2010) Bangalore, India. November 2010*

Krishna P. N. Puttaswamy, Cathy Marshall, Venugopalan Ramasubramanian, Patrick Stuedi, Douglas B. Terry and Ted Wobber “Docx2Go: Collaborative Editing of Fidelity Reduced Documents on Mobile Devices” *To Appear: 8th Annual International Conference on Mobile Systems, Applications and Services (MobiSys 2010) San Francisco, CA, USA. June 2010*

Venugopalan Ramasubramanian, Kaushik Veeraraghavan, Krishna P. N. Puttaswamy, Thomas L. Rodeheffer, Douglas B. Terry and Ted Wobber “Fidelity-Aware Replication for Mobile Devices” *IEEE Transactions on Mobile Computing (TMC), 2010*

Krishna P. N. Puttaswamy and Ben Y. Zhao “Preserving Privacy in Location-based Mobile Social Applications” *11th Workshop on Mobile Computing Systems and Applications (ACM HotMobile) Annapolis, MD, February 2010*

Krishna P. N. Puttaswamy, Alessandra Sala, and Ben Y. Zhao “StarClique: Guaranteeing User Privacy in Social Networks Against Intersection Attacks” *ACM Conference*

on emerging Networking EXperiments and Technologies (CoNEXT 2009) Rome, Italy, December 2009

Christo Wilson, Bryce Boe, Alessandra Sala, Krishna Puttaswamy and Ben Y. Zhao
“User Interactions in Social Networks and their Implications” *ACM EuroSys 2009, Nuremberg, Germany, April 2009*

Krishna P. N. Puttaswamy, Alessandra Sala, Omer Egecioglu, and Ben Y. Zhao
“Rome: Performance and Anonymity using Route Meshes” *IEEE INFOCOM 2009 Minisymposium, Rio de Janeiro, Brazil, April 2009*

Krishna P. N. Puttaswamy, Alessandra Sala, and Ben Y. Zhao
“Improving Anonymity using Social Links” *IEEE Workshop on Secure Network Protocols (NPSec 2008), Orlando, FL, October 2008*

Krishna P. N. Puttaswamy, Alessandra Sala, Christo Wilson, and Ben Y. Zhao
“Defending Anonymity against Predecessor Attacks in Bluemoon” *IEEE International Conference on Network Protocols (ICNP 2008), Orlando, FL, October 2008*

Krishna P. N. Puttaswamy, Ben Y. Zhao and Haitao Zheng,
“Securing Structured Overlays Against Identity Attacks”, *IEEE Transactions on Parallel and Distributed Systems (TPDS), 2008*

Krishna P. N. Puttaswamy, Alessandra Sala and Ben Y. Zhao,
“Searching for Rare Objects using Index Replication” *Proceeding of 27th IEEE International Conference on Computer Communications (INFOCOM 2008), Phoenix, AZ, April 2008*

Krishna P. N. Puttaswamy and Ben Y. Zhao,
“A Case for Unstructured Distributed Hash Tables” *Proceedings of IEEE Global Internet Symposium (GI 2007), Anchorage, AK, May 2007*

Papers in Submission

Krishna P. N. Puttaswamy, Christopher Kruegel and Ben Y. Zhao “Silverline: Toward Confidentiality in Third-Party Clouds”

Posters

Krishna P. N. Puttaswamy, Christopher Kruegel and Ben Y. Zhao “Silverline: Toward Confidentiality in Third-Party Clouds” *Poster at the 7th USENIX Symposium on Network Design and Implementation (NSDI 2010) San Jose, CA, April 2010*

Krishna P. N. Puttaswamy, Christopher Kruegel and Ben Y. Zhao “Protecting Private Data in Third-Party Compute Clouds” *Poster at the 11th Workshop on Mobile Computing Systems and Applications (ACM HotMobile) Annapolis, MD, February 2010*

Professional Experience

University of California at Santa Barbara

Research Assistant

Sept. 2006 - Present

Advisor: Ben Y. Zhao

Microsoft Research, India

Research Intern

May 2010 - July 2010

Research Intern

and June 2008 - Sept 2008

Mentors: Ranjita Bhagwan and Venkat Padmanabhan

Microsoft Research, Silicon Valley

Research Intern June 2009 - Sept 2009
Mentor: Venugopalan “Rama” Ramasubramanian

HP Laboratories

Research Intern June 2006 - Sept. 2006
Mentor: Rick McGeer

University of California at Santa Barbara

Teaching Assistant Sept. 2005 - June 2006

Microsoft India R&D Center

Software Design Engineer April 2004 - Aug. 2005

D.E.Shaw Software India Pvt. Ltd.

Member - Information Technology Aug. 2003 - April 2004

Teaching Experience

Fall 2005 Teaching Assistant, UCSB
Undergraduate Operating Systems (CS170), Taught by: Ben Y. Zhao

Winter 2006 Teaching Assistant, UCSB
Introduction to Computer Programming (CS10), Taught by: C. Michael Costanzo

Spring 2006 Teaching Assistant, UCSB
Network Computing (CS176C), Taught by: Ben Y. Zhao

Professional Service

Reviewer for ICDCS 2006, DSN 2007, Concurrency and Computation: Practice and Experience 2007, Journal for Advances in Multimedia 2007, IH 2008, ICDE 2009, PPOPP 2009, INFOCOM 2009, SIGCOMM CCR 2009, IEEE Transactions on Wireless Communications 2009, SecureComm 2009, P2P 2009, SRDS 2009, Euro-Par 2009, INFOCOM 2010, and IPDPS 2010.

Awards And Honors

Awarded student travel grant to attend OSDI 2006, NSDI 2010, and MobiSys 2010.
Ranked 12th (out of 100,000) in the state level engineering entrance exam, 1999.
Ranked among the top 2% of all students in IIT-JEE, 1999.
Recipient of “Best Outgoing Student Award” among 400 students, Sarvodaya Pre-University College, Tumkur.