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Research Interests

My research broadly addresses research challenges in distributed data management systems, Internet-scale query processing, and the application of data-centric techniques and formal methods to the design, analysis, and implementation of networked systems. I am particularly interested in the development of novel software methodologies and platforms to aid in the development of secure and formally verifiable distributed information-centric systems that can be easily composed and adapted in the face of changing network conditions and application requirements.

My group research website is available at <http://netdb.cis.upenn.edu/>.

Education

2006 **University of California at Berkeley**
Ph.D. in Computer Science
Thesis: *The Design and Implementation of Declarative Networks*
Advisors: Joseph M. Hellerstein and Ion Stoica.
Winner of the 2007 ACM-SIGMOD Dissertation Award
Winner of the 2006 David J. Sakrison Memorial Prize (UC Berkeley)

2000 **Stanford University**
M.S. in Computer Science

1999 **University of California at Berkeley**
B.S. (Highest Honors) Electrical Engineering and Computer Science

Employment

2007 - Assistant Professor, CIS Department, University of Pennsylvania
2008 - Consulting Faculty, National University of Singapore College in Bio Valley
2006 Visiting Researcher, Microsoft Research Silicon Valley
2001-2005 Graduate Research Assistant, EECS CS Dept, UC Berkeley,
2005 Research Intern, Intel Research Laboratory at Berkeley
2002 Visiting Student, EECS Dept, MIT
2002 Research Intern, Intel Research Laboratory at Seattle
2000 Intern, VMWare
1999 Research Intern, IBM Almaden Research Center
1998 Research Intern, IBM Almaden Research Center

Current Grants

- **NeTS Large: Collaborative Research: A Massively Parallel Internet Architecture.** (PI: Roch Guerin, Co-PIs from UMass Amherst and U. of Minnesota), \$2.7 million for five years. (Pending).
- **CAREER: Towards a Unified Declarative Platform for Composable Verifiable Networks,** NSF CNS-0845552, (PI: Boon Thau Loo), \$450,000, (06/01/2009 – 05/31/14).
- **Network Opposing Botnets (NoBot),** ONR N00014-09-1-0770, (PI: Jonathan M. Smith, Co-PIs from Princeton University and Harvard University, \$2.2 million for three years. (2009-2012).

- **NGNI-Small: Declarative Secure Networked Information Systems**, NSF IIS-0812270 (PI: Boon Thau Loo), \$450,000, (09/01/2008 – 08/31/2011).
- **Policy-based Information centric Reliable Ad hoc Network (PIRANA)**, part of the Wireless Network After Next Program, sponsored by DARPA-STO AFRL #FA8750-07-C-0169, \$245,391 (Penn's subcontract total), (10/2007 – 12/2008)
- **Collaborative Research: Scalable Knowledge-based Middleware for Networked and Mobile Systems**, NSF CCF-0820208/0819845 (PI, Co-PI: William Regli from Drexel University), \$499,866, (09/01/2008-08/31/2011).
- **CT-S: Application-Aware Anonymity (A3) for the Masses**, NSF CNS-0831376. (PI: Boon Thau Loo, Co-PI: Matthew Blaze), \$400,000, (09/01/2008-08/31/2011).
- **CSR-EHCS(CPS) TM: Robust Composition and Interoperability of CPS Components**, NSF CSR-0834524. (PI: Insup Lee, Co-PI: Oleg Sokolsky, Boon Thau Loo, and Rahul Mangharam), \$950,000, (09/01/2008-08/31/2011).
- **FIND: Wireless Knowledge Infrastructure (WiKI)**, NSF CNS-0721845, (PI, Co-PIs: Zachary Ives and Jonathan M. Smith), \$235,300, (08/01/2007 - 07/31/2009).

Teaching Experience

- **University of Pennsylvania, Computer and Information Science Department**
 - CIS 505 Software Systems (Spring 2009, Spring 2008)
 - Core advanced undergraduate / masters level distributed systems course
 - Latest course and instructor ratings: 2.69/4.0 and 2.84/4.0 (74 students)
 - Course and instruction ratings and enrollment are the highest since 2003.
 - CIS 553 / TOCM 512 Networked Systems (Fall 2008, Fall 2007)
 - Advanced undergraduate / masters level networking course
 - Developed this course in Fall 2007
 - Latest course and instructor ratings: 3.15/4.0 and 3.1/4.0 (72 students)
 - Spring 2007 – CIS 700/005 Networking meets Databases
 - Research seminar on topics at the intersection of databases and networking.
 - Latest course and instructor ratings: 3.27/4.0 and 3.27/4.0 (11 students)

Current PhD Students

- Changbin Liu, completed WPE-I and WPE-II.
- Mengmeng Liu (co-advise with Zachary Ives), completed WPE-I.
- Shivkumar C. Muthukumar
- Anduo Wang (co-advise with Andre Scedrov and Oleg Sokolsky), completed WPE-I.
- Steven Wenchao Zhou, completed WPE-I.

Graduated PhD Students

- Micah Sherr (co-advised with Matt Blaze) – Post-doctoral researcher at the University of Pennsylvania
Thesis: *Coordinate-Based Routing for High Performance Anonymity* (Aug 2009)
- Yun Mao (co-advised with Jonathan M. Smith) – AT&T Labs Research
Thesis: *“A Unified Data-centric Approach towards an Extensible Internet Architecture”* (Aug 2008)

Undergraduate Research Students

- William Marczak – Honorable mention for the CRA Outstanding Undergraduate 2009. SEAS Computer Science Academic Award. Ph.D. program in Computer Science at the University of California-Berkeley (2009-)

- Andrew Quishi Mao – Ph.D. program in Computer Science at Harvard University (2009-)
- Senior thesis project supervision: William Marczak, Andrew Mao, Mihai Oprea, Dan Kefei Zhou (2009)

Dissertation Committees

- Nicholas Taylor (advisor: Zachary Ives). Dissertation committee chair.
- Grigoris Karvounarakis (advisors: Zachary Ives and Val Tannen). Dissertation committee chair.
- Gaurav Shah (advisor: Matthew Blaze)
- Arvind Easwaran (advisors: Insup Lee and Oleg Sokolsky).

Course Development

- **CIS 700: Networking-meets-Databases.** Created new course in Spring 2007 which introduces students to current research at the intersection of databases and networking. The class was attended by several doctoral students in diverse areas of networking, databases, and security. As indication of its success, in its first offering, papers that emerged from final projects led by students have been published in security, peer-to-peer, networked data management, and mobile networking workshops, with a number of follow-up conference paper submissions. URL: <http://www.cis.upenn.edu/~boonloo/cis700-sp07/>
- **CIS 553: Networked systems.** Started a new advanced undergraduate / graduate level networking course in Fall 2007. In this course, students work in teams to develop routing protocols and the Chord Distributed Hash Table which they have to demonstrate working on a cluster of machines. To provide students with the valuable experience of building a system after synthesizing the concepts from a publication, students develop the Chord protocol based on the Chord SIGCOMM paper. Moreover, the Chord DHT has to work as a layer above their own routing protocol implementation, and a p2p keyword search engine has to function as a layer above their Chord implementation. This course is cross-listed with Penn's Electrical and Systems Engineering department, hence reflecting its cross-departmental appeal. This course has one of the highest enrollment among CIS masters elective (>70 students in Fall 2008). URL: <http://www.cis.upenn.edu/~cis553/>
- **CIS 505: Distributed software systems:** In Spring 2008, overhauled a required core course for advanced undergraduates and first-year graduate students. In addition to fundamentals in distributed computing, introduced contemporary topics that applies these fundamentals to large-scale data management in cloud computing platforms and data centers. For the final project, students work in teams to build a mail client/server based on the POP3 and SMTP RFC specifications, and then extend their implementations to enable fault tolerance and distribution. The project provides students with the experience of implementing systems from RFCs, and extending their implementations based on concepts they learnt in class. As indication of the course's popularity, the enrollment in Spring 2008 increased by 73% (from 38 to 66 students) compared to the previous year. Course ratings in Spring 2008 and 2009 are the highest since 2003 (when online evaluations become available). URL: <http://www.cis.upenn.edu/~cis505/>

University Activities and Services

- Consulting faculty and student mentor for the National University of Singapore (NUS) College in Bio Valley, an undergraduate work-study exchange program between Penn Engineering and NUS (2008 -)
- Adviser for CIS masters students (2008)
- Adviser for BSE undergraduates (2009 -)
- Administrator of the popular CIS mini-course series in Python, C#, C++, Unix. (Fall 2009 -)

Professional Activities

- Program co-chair, 5th International Workshop on Networking meets Databases (NetDB), co-located with SOSIP, 2009.
- Program co-chair, 4th International Conference on emerging Networking EXperiments and Technologies (CoNEXT) Student Workshop, 2008
- Program Committee, IEEE International Symposium on Policies for Distributed Systems and Networks (POLICY), 2010.
- Program Committee, 34th Conference on Very Large Databases (VLDB), 2007, 2008, 2009, 2010.
- Program Committee, 25th International Conference on Data Engineering (ICDE), 2009, 2010.
- Program Committee, 4th Biennial Conference on Innovative Data Systems Research (CIDR), 2009.
- Program Committee, Conference on Computer Communications (IEEE INFOCOM), 2009.
- Program Committee, ACM International Conference on emerging Networking EXperiments and Technologies (ACM CoNEXT), 2009.
- Program Committee, 6th International Workshop on P2P Systems (IPTPS), 2007, 2009, 2010.
- Program Committee, 3rd International Workshop on Networking meets Databases (NetDB), 2007, 2008.
- Program Committee, 2nd SIGMOD PhD Workshop on Innovative Database Research (IDAR) 2008
- Program Committee, VLDB PhD Workshop, 2008
- Program Committee, 9th International Workshop on Web Information and Data Management (WIDM), 2007
- Program Committee, International Conference on Distributed Computing Systems (ICDCS) Operating Systems and Middleware track, 2007.
- NSF grant panelist, 2007
- Member, DARPA Information Science and Technology Study Group on Engineering Ensemble Effects, 2007
- GENI project office proposal reviewer, 2008.
- NSF grant panelist, 2007.
- Journal Reviewer, VLDB Journal, ACM Transactions of Programming Languages and Systems (TPLS), ACM Transactions of Parallel and Distributed Databases (TPDS), IEEE/ACM Transactions on Networking (ToN), International Journal for Information Technology (IJIT), IEEE Transactions on Knowledge and Data Engineering (TKDE), ACM Transaction of Computer Systems (TOCS)

Invited Talks

- **DS2: Declarative Secure Distributed Systems.** University of California-Berkeley Database Seminar, Dec 2009.
- **Applying PL and Database Techniques to Networking.** DIMACS Workshop on Designing Networks for Manageability, Rutgers University, Nov 2009.
- **DS2: Declarative Secure Distributed Systems.** University of Waterloo Database seminar, June 2009.
- **Declarative DSL: A Declarative Networking Perspective.** Panelist, ICDE 2008 panel on Declarative domain-specific languages.
- **Boon Thau Loo Speaks Out.** ACM SIGMOD Record (Sept 2007 edition)
- **The Design and Implementation of Declarative Networks**
 - AT&T Labs Research, New Jersey, Jul 2007.
 - National University of Singapore, Jun 2007.
 - ACM SIGMOD dissertation award presentation, Beijing, China, Jun 2007.
 - BBN Technologies, Boston, Apr 2007.
- **Declarative Networking: Extensible Networks with Declarative Queries.**
 - UC Santa Cruz Database Seminar, June 2006.
 - Academic Job talk, [Yale University, California Institute of Technology, University of Pennsylvania, University of Toronto, IBM Almaden, Cornell University, Microsoft Research Silicon Valley, Duke University, University of Texas-Austin, ETH Zurich, University of Michigan-Ann Arbor, University of California at Los Angeles], Feb-Apr 2006

Selected Awards and Honors

- Honorable mention for best demonstration competition in SIGMOD 2009.
- Selected best papers of the 25th International Conference on Data Engineering (ICDE), 2009
- NSF's Faculty Early Career Development (CAREER) Award, 2009
- ACM SIGMOD Dissertation Award, 2007.
- UC Berkeley David J. Sakrison Award made annually to a graduate student who has completed what is deemed by a faculty committee to be a truly outstanding piece of research. (2006)
- National Kidney Foundation Singapore (NKFS) Young Achiever award. This award recognizes children of NKFS patients who excel in their studies. (2001)
- Computing Research Association (CRA) Outstanding Undergraduate Awards (Honorable mention).

Journal Publications

- **Declarative Secure Distributed Information Systems**
Wenchao Zhou, Tao Tao, Boon Thau Loo, and Yun Mao.
Submitted to the VLDB Journal.
- **Declarative Networking**
Boon Thau Loo, Tyson Condie, Minos Garofalakis, David E. Gay, Joseph M. Hellerstein, Petros Maniatis, Raghu Ramakrishnan, Timothy Roscoe, Ion Stoica
Communications of the ACM, 2009. (Invited)
- **Maintaining Recursive Views of Regions and Connectivity in Networks**
Mengmeng Liu, Nicholas E. Taylor, Wenchao Zhou, Zachary Ives, and Boon Thau Loo.
IEEE Transactions of Knowledge and Data Engineering (TKDE) Journal, 2009. (Invited)
Best papers of the 25th International Conference on Data Engineering (ICDE), 2009

Conference and Selective Workshop Publications

- **A3: An Extensible Platform for Application-Aware Anonymity.**
Micah Sherr, Andrew Mao, William R. Marczak, Wenchao Zhou and Boon Thau Loo.
17th Annual Network & Distributed System Security Symposium (NDSS), Feb 2010.
- **Formally Verifiable Networking.**
Anduo Wang, Limin Jia, Changbin Liu, Boon Thau Loo, Oleg Sokolsky, and Prithwish Basu.
8th Workshop on Hot Topics in Networks (ACM SIGCOMM HotNets-VIII), New York, Oct 2009.
[16.0% acceptance]
- **Declarative Policy-based Adaptive MANET Routing.**
Changbin Liu, Richardo Correa, Xiaozhou Li, Prithwish Basu, Boon Thau Loo, and Yun Mao.
17th IEEE International Conference on Network Protocols (ICNP 2009), Princeton, New Jersey, Oct, 2009. *[18.3% acceptance]*
- **Scalable Link-Based Relay Selection for Anonymous Routing.**
Micah Sherr, Matt Blaze, and Boon Thau Loo.
9th Privacy Enhancing Technologies Symposium (PETS), Seattle, WA, Aug 2009.
[31.8% acceptance]
- **Veracity: Practical Secure Network Coordinates via Vote-based Agreements.**
Micah Sherr, Matt Blaze, and Boon Thau Loo.
USENIX Annual Technical Conference, San Diego, CA, June 2009. *[16.8% acceptance]*
- **Recursive Computation of Regions and Connectivity in Networks.**
Mengmeng Liu, Nicholas E. Taylor, Wenchao Zhou, Zachary Ives, and Boon Thau Loo.
25th International Conference on Data Engineering (ICDE), Shanghai, China, Apr 2009.
[16.8% acceptance]
- **Unified Declarative Platform for Secure Networked Information Systems.**
Wenchao Zhou, Yun Mao, Boon Thau Loo, and Martín Abadi.
25th International Conference on Data Engineering (ICDE), Shanghai, China, Apr 2009.

[16.8% acceptance]

- **Declarative Reconfigurable Trust Management.**
William R. Marczak, David Zook, Wenchao Zhou, Molham Aref, and Boon Thau Loo.
4th Biennial Conference on Innovative Data Systems Research (CIDR) Proceedings Track, Pacific Grove, CA, Jan 2009. [27.1% acceptance]
- **MOSAIC: Unified Declarative Platform for Dynamic Overlay Composition.**
Yun Mao, Boon Thau Loo, Zachary Ives and Jonathan M. Smith
4th Conference on emerging Networking EXperiments and Technologies (ACM CoNEXT), Madrid, Spain, Dec 2008. [17.5% acceptance]
- **The Case for a Unified Extensible Data-centric Mobility Infrastructure.**
Yun Mao, Boon Thau Loo, Zachary Ives, and Jonathan M. Smith.
2nd ACM International Workshop on Mobility in the Evolving Internet Architecture (MobiArch), in conjunction with SIGCOMM, Kyoto, Japan, Aug 2007. [23.4% acceptance]
- **Public Health for the Internet (PHI): Towards a New Grand Challenge for Information Management**
Joseph M. Hellerstein, Tyson Condie, Minos Garofalakis, Boon Thau Loo, Petros Maniatis, Timothy Roscoe, Nina Taft.
3rd Biennial Conference on Innovative Data Systems Research (CIDR), Asilomar, CA, Jan 2007.
- **Declarative Networking: Language, Execution and Optimization**
Boon Thau Loo, Tyson Condie, Minos Garofalakis, David E. Gay, Joseph M. Hellerstein, Petros Maniatis, Raghu Ramakrishnan, Timothy Roscoe, Ion Stoica
ACM SIGMOD International Conference on Management of Data, Chicago, June 2006.
[70 citations]
- **Implementing Declarative Overlays.**
Boon Thau Loo, Tyson Condie, Joseph M. Hellerstein, Petros Maniatis, Timothy Roscoe, Ion Stoica.
20th ACM Symposium on Operating Systems Principles (SOSP), October 2005. [145 citations]
- **Declarative Routing: Extensible Routing with Declarative Queries.**
Boon Thau Loo, Joseph M. Hellerstein, Ion Stoica, Raghu Ramakrishnan.
ACM SIGCOMM Conference on Data Communication, Aug 2005. [98 citations]
- **The Architecture of PIER: an Internet-Scale Query Processor.**
Ryan Huebsch, Brent Chun, Joseph M. Hellerstein, Boon Thau Loo, Petros Maniatis, Timothy Roscoe, Scott Shenker, Ion Stoica, Aydan R. Yumerefendi.
2nd Biennial Conference on Innovative Data Systems Research (CIDR), Jan 2005. [144 citations]
- **Enhancing P2P File-Sharing with an Internet-Scale Query Processor.**
Boon Thau Loo, Joseph M. Hellerstein, Ryan Huebsch, Scott Shenker, Ion Stoica.
30th International Conference on Very Large Databases (VLDB), Sep 2004. [109 citations]
- **The Case for a Hybrid P2P Search Infrastructure.**
Boon Thau Loo, Ryan Huebsch, Ion Stoica, Joseph M. Hellerstein.
3rd International Workshop on Peer-to-Peer Systems (IPTPS), Feb 2004. [165 citations]
- **Querying the Internet with PIER.**
Ryan Huebsch, Joseph M. Hellerstein, Nick Lanham, Boon Thau Loo, Scott Shenker, Ion Stoica.
29th International Conference on Very Large Databases (VLDB), Sep 2003. [494 citations]
- **On the Feasibility of Peer-to-Peer Web Indexing and Search.**
Jinyang Li, Boon Thau Loo, Joseph M. Hellerstein, Frans Kaashoek, David Karger, Robert Morris.
2nd International Workshop on Peer-to-Peer Systems (IPTPS), Feb 2003. [253 citations]
- **Complex Queries in DHT-based Peer-to-Peer Networks.**
Matthew Harren, Joseph M. Hellerstein, Ryan Huebsch, Boon Thau Loo, Scott Shenker, Ion Stoica.
1st International Workshop on Peer-to-Peer Systems (IPTPS), Mar 2002. [347 citations]
- **Adaptive Precision Setting for Cached Approximate Values.**
Chris Olston, Boon Thau Loo, Jennifer Widom.
20th ACM SIGMOD Conference on Management of Data, May 2001. [166 citations]

Demonstrations

- **A Demonstration of the Rapidmesh Development Toolkit.**
Xiaozhou Li, Shivkumar C. Muthukumar, Changbin Liu, Joseph B. Kopena, Mihai Oprea, Richardo Correa, Boon Thau Loo, and Prithwish Basu.
4th ACM International Workshop on Wireless Network Testbeds, Experimental Evaluation and Characterization (WiNTECH 2009) demonstration, in conjunction with ACM MobiCom, Beijing, China, Sept, 2009.
- **Declarative Toolkit for Rapid Network Protocol Simulation and Experimentation.**
Shivkumar C. Muthukumar, Xiaozhou Li, Changbin Liu, Joseph B. Kopena, Mihai Oprea, and Boon Thau Loo.
ACM SIGCOMM Conference on Data Communication, Barcelona, Spain, Aug 2009.
- **SmartCIS: Integrating Digital and Physical Environments.**
Mengmeng Liu, Svilen Mihaylov, Zhuwei Bao, Marie Jacob, Zachary G. Ives, Boon Thau Loo, and Sudipto Guha.
ACM SIGMOD International Conference on Management of Data, Providence, RI, June 2009.
Honorable mention for best demonstration competition.
- **Querying at Internet-Scale.**
Brent Chun, Joseph M. Hellerstein, Ryan Huebsch, Shawn R. Jeffery, Boon Thau Loo, Sam Mardanbeigi, Timothy Roscoe, Sean C. Rhea, Scott Shenker, Ion Stoica.
ACM SIGMOD 2004, Paris, France, Jun 2004.

Workshop and other Publications

- **RapidMesh: Declarative Toolkit for Rapid Experimentation of Wireless Mesh Networks.**
Shivkumar C. Muthukumar, Xiaozhou Li, Changbin Liu, Joseph B. Kopena, Mihai Oprea, Richardo Correa, Boon Thau Loo, and Prithwish Basu.
4th ACM International Workshop on Wireless Network Testbeds, Experimental Evaluation and Characterization (WiNTECH 2009), in conjunction with ACM MobiCom, Beijing, China, Sept, 2009.
- **A Theorem Proving Approach towards Declarative Networking.**
Anduo Wang, Boon Thau Loo, Changbin Liu, Oleg Sokolsky, and Prithwish Basu.
22nd International Conference on Theorem Proving in Higher Order Logics (TPHOLs) emerging trends proceedings, Munich, Germany, Aug 2009.
- **Message Models and Aggregation in Knowledge Based Middleware for Rich Sensor Systems.**
Joseph B. Kopena, William C. Regli, and Boon Thau Loo.
6th International Workshop on Data Management for Sensor Networks (DMSN), in conjunction with VLDB, Lyon, France, Aug 2009.
- **Formalizing Metarouting in PVS.**
Anduo Wang, and Boon Thau Loo.
Automated Formal Methods (AFM), in conjunction with CAV, Grenoble, France, Jun 2009.
- **DMaC: Distributed Monitoring and Checking.**
Wenchao Zhou, Oleg Sokolsky, Boon Thau Loo, and Insup Lee.
9th International Workshop on Runtime Verification (RV), Grenoble, France, Jun 2009.
- **Declarative Network Verification.**
Anduo Wang, Prithwish Basu, Boon Thau Loo, and Oleg Sokolsky.
11th International Symposium on Practical Aspects of Declarative Languages (PADL), in conjunction with POPL, Jan 2009.
- **A Declarative Perspective on Adaptive MANET Routing.**
Changbin Liu, Yun Mao, Mihai Oprea, Prithwish Basu, and Boon Thau Loo.
ACM SIGCOMM Workshop on Programmable Routers for Extensible Services of Tomorrow (PRESTO), Seattle, WA, Aug 2008.
- **Trace-driven Analysis of an Internet-scale Cloud Computing Platform (Poster).**
Harrison Duong, Boon Thau Loo, and Godfrey Tan
33rd ACM Usenix Annual Technical Conference (USENIX), Boston, MA, June 2008.

- **OntoNet: Scalable Knowledge-Based Networking.**
Joseph B. Kopena and Boon Thau Loo.
4th International Workshop on Networking meets Databases (NetDB), in conjunction with ICDE, Cancun, Mexico, Apr 2008.
- **Provenance-aware Secure Networks.**
Wenchao Zhou, Eric Cronin and Boon Thau Loo.
4th International Workshop on Networking meets Databases (NetDB), in conjunction with ICDE, Cancun, Mexico, Apr 2008.
- **Veracity: A Fully Decentralized Service for Securing Network Coordinate Systems.** Micah Sherr, Boon Thau Loo, and Matt Blaze
7th International Workshop on Peer-to-Peer Systems (IPTPS), Tampa Bay, Florida, Feb 2008. *[30.9% acceptance]*
- **Towards Application-Aware Anonymous Routing.**
Micah Sherr, Boon Thau Loo, and Matt Blaze
2nd USENIX Workshop on Hot Topics in Security (HotSec), in conjunction with USENIX Security Symposium, Boston, MA, Aug 2007. *[33.3% acceptance]*
- **Towards a Declarative Language and System for Secure Networking.**
Martín Abadi and Boon Thau Loo.
3rd International Workshop on Networking meets Databases (NetDB), Cambridge, MA, Apr 2007.
- **Customizable Routing with Declarative Queries.**
Boon Thau Loo, Joseph M. Hellerstein, Ion Stoica.
3rd Workshop on Hot Topics in Networks (ACM SIGCOMM HotNets-III), Nov 2004.