

# YI CUI

## CONTACT INFORMATION

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## RESEARCH INTERESTS

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Distributed systems and computer networks with a focus on overlay network, peer-to-peer system, multimedia system, ubiquitous computing, and wireless network.

## EDUCATION

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*Aug 1999 – May 2005 (Expected)*      *University of Illinois at Urbana-Champaign*      *Urbana, IL*  
Ph.D. in Computer Science

- Dissertation: “Multimedia Content Distribution in Overlay Multicast”  
Advisor: Klara Nahrstedt

*Aug 1997 – May 1999*      *Tsinghua University*      *Beijing, China*  
M.S. in Computer Science

- Dissertation: “A 3D Ultrasonic Visualization System for Medical Diagnosis and Surgery Simulation”  
Advisor: Long Tang

*Aug 1992 – May 1997*      *Tsinghua University*      *Beijing, China*  
B.S. in Computer Science

## DISSERTATION

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My dissertation targets the problem of large-volume on-demand content distribution in large-scale networks. The proposed solution is based on a new communication paradigm called overlay multicast, in which end hosts self-organize into a peer-to-peer network, and use unicast relay service to distribute data. This dissertation investigates the feasibility and advantage of overlay multicast through theoretical modeling, algorithm design, and system deployment. By extending the multicommodity flow theory, a theoretical foundation of overlay multicast is laid down. Based on this foundation, a series of distributed multicast routing algorithms are presented, which are proved to maximize end-to-end throughput. Extensive theoretical analysis and simulation demonstrate the advantage of overlay multicast solution to IP multicast solution at saving server load and network bandwidth consumption, under a variety of network topologies and user access patterns. The solution is implemented and deployed on the PlanetLab global testbed.

## RESEARCH EXPERIENCE

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*May 2004 – Aug 2004*      *Research Intern*      *Microsoft Research, Redmond*

Mentor: Jin Li

- PeerStreaming: Design and Implementation of an On-demand Distributed Streaming System  
Designed and implemented a peer-to-peer streaming system. Employing the digital rights management technology, the system was able to combat the copyright violence, the most serious problem in peer-to-peer system.

*May 2000 – Present      Research Assistant      Department of Computer Science, University of Illinois*

Advisor: Klara Nahrstedt

- Layered Peer-to-Peer Streaming

Proposed and developed a scalable media distribution solution in peer-to-peer networks. Considering the heterogeneity of end host resource capabilities, the media stream is divided and distributed among peer hosts as layered substreams. Each host with constrained bandwidth can still recover the signal with certain quality degradation, by receiving a subset of all layers.

- Price-based Resource Allocation in Overlay Multicast

Based on non-linear optimization theory, proposed a price-based resource allocation scheme for overlay multicast. In this solution, end nodes adjust their sending and receiving rates independently by exchanging pricing signals. The solution can be implemented in an entirely distributed fashion, and guarantee to converge to the optimal point, where the aggregated utility of all receivers is maximized.

- Middleware Solution for QoS-aware Ubiquitous Multimedia Service Delivery

Proposed a QoS-aware dependency management scheme for component-based systems, which dynamically and automatically adjusts the system configuration based on the end host and network resource availabilities. This scheme was built into *MobiMan*, a middleware system supporting configurable multimedia service delivery in the ubiquitous computing environment.

*Aug 1997 – Aug 1999      Research Assistant      Department of Computer Science, Tsinghua University*

Advisor: Long Tang

- 3D Ultrasonic Visualization for Medical Diagnosis and Surgery Simulation

Designed and developed a visualization system, which reconstructs the 3D image from parallel 2D ultrasonic scanned slices. This system was used by the PLA general hospital in Beijing for liver cancer diagnosis and simulated radiofrequency ablation surgery to destroy liver tumors.

## TEACHING EXPERIENCE

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*Jan 2000 – May 2000      Teaching Assistant      Department of Computer Science, University of Illinois*

- CS273: Introduction to Theory of Computation

*Aug 1999 – Dec 1999      Teaching Assistant      Department of Computer Science, University of Illinois*

- CS101: Introduction to Computing with Application to Engineering and Physical Science

## HONORS AND AWARDS

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- Student Travel Grant, awarded by the programming committee of HPDC 2001
- Excellent Graduate Student Scholarship, awarded by Tsinghua University, 1998.
- Excellent B.S. Thesis, awarded by Tsinghua University, 1997.
- Excellent Student Scholarship, awarded by Tsinghua University, 1994–1996.

## PUBLICATIONS

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(All publications are available online at <http://cairo.cs.uiuc.edu/~yicui/publications.html>)

### REFERED JOURNAL/MAGAZINE PUBLICATIONS

1. **Yi Cui**, Baochun Li, and Klara Nahrstedt, oStream: Asynchronous Streaming Multicast in Application-Layer Overlay Networks, *IEEE Journal on Selected Areas in Communications*, Special Issue on Recent Advances in Service Overlays, vol. 22, no. 1, 2004.

2. **Yi Cui**, Klara Nahrstedt, and Dongyan Xu, Seamless User-level Handoff in Ubiquitous Multimedia Service Delivery, *Multimedia Tools and Applications Journal (ACM/Kluwer)*, Special Issue on Mobile Multimedia and Communications and m-Commerce, vol. 22, no. 2, 2004.
3. **Yi Cui**, Yuan Xue, and Klara Nahrstedt, Optimal Distributed Multicast Routing using Network Coding: Theory and Applications, *ACM SIGMETRICS Performance Evaluation Review*, vol. 32, no. 2, 2004.
4. Yuan Xue, **Yi Cui**, and Klara Nahrstedt, Maximizing Lifetime for Data Aggregation in Wireless Sensor Networks, to appear in *ACM/Kluwer Journal of Mobile Networks and Applications*, Special Issue on Energy Constraints and Lifetime Performance in Wireless Sensor Networks, 2004. (acceptance ratio: 24%)

#### REFERRED CONFERENCE/WORKSHOP PUBLICATIONS

5. **Yi Cui**, Yuan Xue, and Klara Nahrstedt, Optimal Distributed Multicast Routing using Network Coding: Theory and Applications, in *Proc. of ACM Workshop on MAThematical performance Modeling and Analysis (MAMA, in conjunction with SIGMETRICS)*, New York, NY, June, 2004.
6. **Yi Cui**, Baochun Li, and Klara Nahrstedt, On Achieving Optimized Capacity Utilization in Application Overlay Networks with Multiple Competing Sessions, in *Proc. of ACM Symposium on Parallelism in Algorithms and Architectures (SPAA)*, Barcelona, Spain, June, 2004.
7. **Yi Cui**, Yuan Xue, and Klara Nahrstedt, Max-min Overlay Multicast: Rate Allocation and Tree Construction, in *Proc. of IEEE International Workshop on Quality of Service (IwQoS)*, Montreal, Canada, June, 2004. (acceptance ratio: 19%)
8. **Yi Cui**, Yuan Xue, and Klara Nahrstedt, Optimal Resource Allocation in Overlay Multicast, in *Proc. of IEEE International Conference on Network Protocols (ICNP)*, Atlanta, GA, November, 2003. (acceptance ratio: 13%)
9. **Yi Cui** and Klara Nahrstedt, Layered Peer-to-Peer Streaming, in *Proc. of ACM International Workshop on Network and Operating Systems Support for Digital Audio and Video (NOSSDAV)*, Monterey, CA, June, 2003. (acceptance ratio: 30%)
10. **Yi Cui** and Klara Nahrstedt, Proxy-based Asynchronous Multicast for Efficient On-demand Media Distribution, in *Proc. of SPIE Multimedia Computing and Networking (MMCN)*, Santa Clara, CA, January, 2003.
11. **Yi Cui** and Klara Nahrstedt, Supporting QoS for Ubiquitous Multimedia Service Delivery, in *Proc. of ACM Multimedia (Doctoral Symposium)*, Ottawa, Canada, November, 2001.
12. **Yi Cui** and Klara Nahrstedt, QoS-Aware Dependency Management for Component-Based Systems, in *Proc. of IEEE International Symposium on High Performance Distributed Computing (HPDC)*, San Francisco, CA, August, 2001.
13. **Yi Cui**, Dongyan Xu, and Klara Nahrstedt, SMART: A Scalable Middleware Solution for Ubiquitous Multimedia Service Delivery, in *Proc. of IEEE International Conference on Multimedia and Expo (ICME)*, Tokyo, Japan, August, 2001.

#### MANUSCRIPTS UNDER REVIEW

14. **Yi Cui**, Baochun Li, and Klara Nahrstedt, On Achieving Optimized Capacity Utilization in Application Overlay Networks with Multiple Competing Sessions, submitted to *IEEE/ACM Transactions on Networking*.
15. **Yi Cui**, Yuan Xue, and Klara Nahrstedt, Optimal Resource Allocation in Overlay Multicast, submitted to *IEEE Transactions on Parallel and Distributed Systems*.

16. Jin Li and **Yi Cui**, PeerStreaming: Design and Implementation of an On-demand Distributed Streaming System, submitted to IEEE Transactions on Multimedia.

## SOFTWARES

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(All softwares are available online at <http://cairo.cs.uiuc.edu/~yicui/software.html>)

- 3D Teleimmersive System  
A 3D teleimmersion system, which is capable of 3D scene capture via camera clusters, 3D video streaming, and 3D scene reconstruction. I am in charge of the design and development of 3D data compression and streaming functions. The live-streaming testbed has been successfully setup between UIUC and the CITRIS Center at Berkeley.
- PlanetVAM (PlanetLab Video/Audio Meeting)  
An overlay-based open desktop video conferencing system deployed on the PlanetLab global testbed. The system consists of proxies and end hosts. Proxies coordinate with each other to construct source-based overlay multicast tree, and relay audio/video packets during the conferencing. Attached to proxies are end hosts, through which users send and receive audio/video streams. I designed and implemented the proxy system, which runs on Linux. PlanetVAM has successfully broadcasted the PlanetLab PI meeting in November, 2003.
- Layered Peer-to-Peer Streaming System  
The system has two modules. The server module supports transforming of AVI video to PVH (Progressive Video with Hybrid transform) layer-coded streams, and live transmission of these streams. The client module is capable of receiving, rendering and relaying of layered streams. The system runs on Windows-based PC and handheld device running Windows CE.
- MobiMan (Mobile Multimedia Access Network)  
A middleware system supporting ubiquitous multimedia service delivery. The main functions of the framework include user-level handoff management and configurable service instantiation across heterogeneous computing platforms. Two sample multimedia applications, mobile MP3 audio and mobile MPEG video streaming, have been built as proof-of-concept. The system runs on Unix, Windows and Windows CE. It has been integrated with the Gaia Operating System.

## PROFESSIONAL ACTIVITIES

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- External Referees for Conferences and Journals  
IEEE Wireless Communications Magazine, IEEE Transactions on Multimedia, Multimedia Tools and Applications Journal. IEEE Transactions on Networking, IEEE Transactions on Parallel and Distributed Systems  
INFOCOM 2003, ICDCS 2003, ICME 2001–2002, ICNP 2002, IwQoS 2001–2003, ACM Multimedia 2001–2003, ICC 2003–2004, Middleware 2003, SIGMETRICS 2004, PerCom 2004
- Session Chair  
SPIE Multimedia Computing and Networking (MMCN 2003).

## REFERENCES

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Available Upon Request