Irene Y. Zhang

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Education

University of Washington Seattle, WA
Ph.D. in Computer Science and Engineering Sept 2017
Advisors: Hank Levy and Arvind Krishnamurthy
Thesis: *Towards a Flexible, High-Performance Operating System for Mobile/Cloud Applications*

University of Washington Seattle, WA
M.S. in Computer Science and Engineering December 2013
Advisors: Hank Levy, Arvind Krishnamurthy, and Steve Gribble
Thesis: *Simplifying Mobile/Cloud Applications with Sapphire*

Massachusetts Institute of Technology Cambridge, MA
M.Eng. in Electrical Engineering and Computer Science June 2009
Advisors: M. Frans Kaashoek and Jeremy Stribling
Thesis: *Efficient File Distribution in a Flexible, Wide-area File System*

Massachusetts Institute of Technology Cambridge, MA
S.B. in Computer Science and Engineering June 2008

Interests

Operating systems, distributed systems, virtualization, and networking

Recent Research Highlights

Capybara SIGCOMM 2026
A microsecond-scale load balancer that uses TCP migration to move established TCP connections between servers. Capybara uses a programmable switch to implement transparent L4 load balancing and a user-space TCP stack to encapsulate and move application-level state. Using this co-designed architecture, Capybara achieves up to 149x lower tail latency and more than 2x higher throughput for scale-out services compared to state-of-the-art load balancing approaches.

Beehive MICRO 2024
A flexible programmable NIC architecture designed to offload complex network protocols. The Beehive architecture uses a network-on-a-chip with message passing between protocol modules to dynamically scale up and add functionality to remove load from the CPU. This flexibility enables the co-design of microsecond-scale software network stacks and NIC offloads to minimize CPU usage and lower tail latencies.

Demikernel SOSP 2021
A new datapath OS and architecture for microsecond-scale datacenter systems and kernel-bypass devices. Demikernel accommodates heterogenous kernel-bypass devices with a flexible library OS architecture and new high-level datapath API with an asynchronous I/O interface and zero-copy memory semantics for microsecond I/O processing. Demikernel implements this API for RDMA, DPDK and SPDK devices with new nanosecond-scale I/O stacks in Rust. Once ported to Demikernel, microsecond datacenter systems can run across different devices with no code changes.

Conference Publications

I. Choi, N. Wadekar, G. Sun, R. Joshi, J. Fried, O. S. Navarro Leija, D. R. K. Ports, **I. Zhang**, J. Li. *Capybara: Dynamic Load Balancing with Microsecond-Scale TCP Migration.* ACM Special Interest Group on Data Communication (SIGCOMM). August 2026.

K. Lim, M. Giordano, T. Stavrinos, **I. Zhang**, J. Nelson, B. Kasikci, T. Anderson. *Beehive: A Flexible Network Stack for Direct-Attached Accelerators.* IEEE/ACM Symposium on Microarchitecture (MICRO). November 2024.

D. Raghavan, S. Ravi, G. Yuan, P. Thaker, S. Srivastava, M. Murray, P. H. Penna, A. Ousterhout, P. Levis, M. Zaharia, **I. Zhang**. *Cornflakes: Zero-copy Serialization for Microsecond-scale Networking.* Proceedings of the ACM Symposium on Operating Systems Principles (SOSP). October 2023. **Distinguished Artifact Award.**

I. Zhang, A. Raybuck, P. Patel, K. Olynyk, J. Nelson, O. S. Navarro Leija, A. Martinez, J. Liu, A. Kornfeld Simpson, S. Jayakar, P. H. Penna, M. Demoulin, P. Choudhury, A. Badam. *The Demikernel Datapath OS Architecture for Microsecond-scale Datacenter Systems.* Proceedings of the ACM Symposium on Operating Systems Principles (SOSP). October 2021.

H. M. Demoulin, J. Fried, I. Pedisich, M. Kogias, B. T. Loo, L. T. X. Phan, **I. Zhang**. *When Idling is Ideal: Optimizing Tail-Latency for Highly-Dispersed Datacenter Workloads with Persephone.* Proceedings of the ACM Symposium on Operating Systems Principles (SOSP). October 2021.

S. Dharanipragada, S. Joyner, M. Burke, A. Szekeres, J. Nelson, **I. Zhang**, D. R. K. Ports. *PRISM: Rethinking the RDMA Interface for Distributed Systems.* Proceedings of the ACM Symposium on Operating Systems Principles (SOSP). October 2021.

R. Cheng, W. Scott, E. Masserova, **I. Zhang**, V. Goyal, T. Anderson, A. Krishnamurthy, B. Parno. *Talek: Private Group Messaging with Hidden Access Patterns.* Annual Computer Security Applications Conference (ACSAC). December 2020.

W. Zhang, S. Shenker, **I. Zhang**. *Persistent State Machines for Recoverable In-memory Storage Systems with NVRam.* Proceedings of the USENIX Symposium on Operating Systems Design and Implementation (OSDI). November 2020.

N. Lebeck, A. Krishnamurthy, H. M. Levy, **I. Zhang**. *End the Senseless Killing: Improving Memory Management for Mobile Operating Systems.* Proceedings of the USENIX Annual Technical Conference (ATC). July 2020.

A. Szekeres, M. Whittaker, N. K. Sharma, J. Li, A. Krishnamurthy, **I. Zhang**, D. R. K. Ports. *Meerkat: Multicore-scalable Replicated Transactions Following the Zero-Coordination Principle.* Proceedings of the European Conference on Computer Systems (Eurosys). April 2020.

H. Li, M. Hao, S. Novakovic, V. Gogte, S. Govindan, D. R. K. Ports, **I. Zhang**, R. Bianchini, H. S. Gunawi, A. Badam. *Efficient and Portable Virtual NVMe Storage on ARM SoCs.* Proceedings of the International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS). March 2020.

J. Goldstein, A. Abdelhamid, M. Barnett, S. Burckhardt, B. Chandramouli, D. Gehring, N. Lebeck, C. Meiklejohn, U. F. Minhas, R. Newton, R. Peshawaria, T. Zaccai, **I. Zhang**. *A.M.B.R.O.S.I.A: Providing Performant Virtual Resiliency for Distributed Applications.* Proceedings of the International Conference on Very Large Data Bases (VLDB). December 2019.

I. Zhang, N. Lebeck, P. Fonseca, B. Holt, R. Cheng, A. Norberg, A. Krishnamurthy, H. M. Levy. *Automating Data Management for Wide-area, Reactive Applications.* Proceedings of the USENIX Symposium on Operating Systems Design and Implementation (OSDI). November 2016.

B. Holt, J. Bornholt, **I. Zhang**, D. R. K. Ports, M. Oskin, L. Ceze. *Disciplined Inconsistency.* Proceedings of the ACM Symposium on Cloud Computing (SoCC). October 2016.

I. Zhang, N. K. Sharma, A. Szekeres, A. Krishnamurhty, D. R. K. Ports. *Building Consistent Transactions with Inconsistent Replication.* Proceedings of the ACM Symposium on Operating Systems Principles (SOSP). October 2015.

I. Zhang, A. Szekeres, D. V. Aken, I. Ackerman, S. D. Gribble, A. Krishnamurthy, H. M. Levy. *Customizable and Extensible Deployment for Mobile/Cloud Applications.* Proceedings of the USENIX Symposium on Operating Systems Design and Implementation (OSDI). October 2014.

S. Peter, J. Li, **I. Zhang**, D. R. K. Ports, D. Woos, A. Krishnamurthy, T. Anderson, T. Roscoe. *Arrakis: The Operating System is the Control Plane.* Proceedings of the USENIX Symposium on Operating Systems Design and Implementation (OSDI). October 2014. **Best Paper Award.**

I. Zhang, T. Denniston, Y. Baskakov, A. Garthwaite. *Optimizing VM Checkpointing for Restore Performance in VMware ESXi.* Proceedings of the USENIX Annual Technical Conference (ATC). June 2013.

I. Zhang, A. Garthwaite, Y. Baskakov, K. C. Barr. *Fast Restore of Checkpointed Memory Using Working Set Estimation.* Proceedings of the International Conference on Virtual Execution Environments (VEE). March 2011.

D. R. K. Ports, A. T. Clements, **I. Zhang**, S. Madden, B. Liskov. *Transactional Consistency and Automatic Management in an Application Data Cache.* Proceedings of the USENIX Symposium on Operating Systems Design and Implementation (OSDI). October 2010.

J. Stribling, Y. Sovran, **I. Zhang**, X. Pretzer, J. Li, M. F. Kaashoek, R. Morris. *Flexible, Wide-Area Storage for Distributed Systems with WheelFS.* Proceedings of the USENIX Symposium on Networked Systems Design and Implementation (NSDI). April 2009.

Journal Publications

I. Zhang, N. K. Sharma, A. Szekeres, A. Krishnamurhty, D. R. K. Ports. *Building Consistent Transactions with Inconsistent Replication.* ACM Transactions on Computer Systems (TOCS). December 2018.

I. Zhang, F. Adib, P. Bailis. *Research for Practice: Distributed Transactions and Networks as Physical Sensors.* ACM Queue. October 2016.

I. Zhang, N. K. Sharma, A. Szekeres, D. R. K. Ports, A. Krishnamurthy. *When Is Operation Ordering Required in Replicated Transactional Storage?.* IEEE Data Engineering Bulletin. March 2016.

S. Peter, J. Li, **I. Zhang**, D. R. K. Ports, D. Woos, A. Krishnamurthy, T. Anderson, T. Roscoe. *Arrakis: The Operating System is the Control Plane.* ACM Transactions on Computer Systems (TOCS). November 2015.

Workshop Publications

K. Lim, M. Giordano, **I. Zhang**, B. Kasikci, T. Anderson. *Apiary: An OS for the Modern FPGA*. Proceedings of the Workshop on Hot Topics in Operating Systems (HotOS). May 2025.

I. Choi, N. Wadekar, R. Joshi, J. Fried, D. R. K. Ports, **I. Zhang**, J. Li. *Capybara: Microsecond-Scale Live TCP Migration.* ACM SIGOPS Asia-Pacific Workshop on Systems (APSys). August 2023.

T. Anderson, A. Belay, M. Chowdhury, A. Cidon, **I. Zhang**. *Treehouse: A Case For Carbon-Aware Datacenter Software.* Proceedings of the Workshop on Sustainable Computer Systems Design and Implementation (HotCarbon). July 2022.

D. Raghavan, P. Levis, M. Zaharia, **I. Zhang**. *Breakfast of Champions: Towards Zero-Copy Serialization with NIC Scatter-Gather.* Proceedings of the Workshop on Hot Topics in Operating Systems (HotOS). June 2021.

A. Simpson, A. Szekeres, J. Nelson, **I. Zhang**. *Securing RDMA for High-Performance Datacenter Storage Systems.* Proceedings of the Workshop on Hot Topics in Cloud Computing (HotCloud). July 2020.

A. Ousterhout, A. Belay, **I. Zhang**. *Just In Time Delivery: Leveraging Operating Systems Knowledge for Better Datacenter Congestion Control.* Proceedings of the Workshop on Hot Topics in Cloud Computing (HotCloud). July 2019.

I. Zhang, J. Liu, A. Austin, M. L. Roberts, A. Badam. *I'm Not Dead Yet! The Role of the Operating System in a Kernel-Bypass Era.* Proceedings of the Workshop on Hot Topics in Operating Systems (HotOS). May 2019.

A. Szekeres, **I. Zhang**. *Making Consistency More Consistent: A Unified Model for Coherence, Consistency and Isolation.* Proceedings of the Workshop on Principles and Practice of Consistency for Distributed Data (PaPoC). April 2018.

B. Holt, **I. Zhang**, D. R. K. Ports, M. Oskin, L. Ceze. *Claret: Using Data Types for Highly Concurrent Distributed Transactions.* Proceedings of the Workshop on Principles and Practice of Consistency for Distributed Data (PaPoC). April 2015.

S. Peter, J. Li, D. Woos, **I. Zhang**, D. R. K. Ports, T. Anderson, A. Krishnamurthy, M. Zbikowski. *Towards High-Performance Application-Level Storage Management.* Proceedings of the USENIX Workshop on Hot Topics in Storage and File Systems (HotStorage). June 2014.

Fellowships & Awards

ACM SIGOPS Dennis Ritchie Doctoral Dissertation Award	2018
UW CSE William Chan Memorial Dissertation Award	2018
Rising Stars Workshop	2016
NCWIT Collegiate Award, Runner-up	2016
Microsoft Research PhD Fellowship	2015
Google Anita Borg Memorial Fellowship	2015
Bob Bandes Teaching Award, Honorable Mention	2015
National Science Foundation Fellowship	2013
ARCS Foundation Fellowship	2012
Jeff Dean and Heidi Hopper Endowed Regental Fellowship	2012
CRA Outstanding Undergraduate Award, Honorable Mention	2008
UW CSE Industrial Affiliates Madrona Prize Runner-Up	2015
UW CSE Industrial Affiliates Madrona Prize	2014

Service

ASPLOS, Vice Program Chair	2027
HTPS, Program Committee	2026
APSys, Program Chair	2024
NSDI, Program Chair	2024
SOSP, DEI Chair	2023

SIGOPS Dissertation Award Committee, Chair	2022
VEE, Program Chair	2021
OSDI, Program Committee	2021
SOSP, Program Committee	2021
EuroDW, Program Chair	2021
NSDI, Program Committee	2021
OSDI, Program Committee	2020
EuroSys, Program Committee	2020
EuroDW, Program Committee	2020
APSys, Program Committee	2019
SOSP, Program Committee	2019
ASPLOS, Program Committee	2019
NSDI, Program Committee	2019
OSDI, Program Committee	2018
USENIX ATC, Program Committee	2018
VEE, Program Committee	2018
ASPLOS, External Review Committee	2017
OSDI, External Review Committee	2016

Patents

US Patent App. 12/559,484. *Saving and Restoring State Information for Virtualized Computer Systems.* **I. Zhang**, K. C. Barr, G. Venkitachalam, I. Ahmad, A. Garthwaite, J. Pool.

US Patent App. 13/710,185. *Method for Saving Virtual Machine State from a Checkpoint File.* A. Garthwaite, Y. Baskakov, **I. Zhang**, K. Christopher, J. Pool.

US Patent App. 13/710,215. *Method for Restoring Virtual Machine State from a Checkpoint File.* A. Garthwaite, Y. Baskakov, **I. Zhang**, K. Christopher, J. Pool.

US Patent App. 13/935,382. *Identification of Page Sharing Opportunities within Large Pages.* Y. Baskakov, A. Garthwaite, R. Venkatasubramanian, **I. Zhang**, S. Kim, N. Bhatia, K. Tati

Work Experience

Microsoft Research — Redmond, WA
Principal Researcher, Systems Research Group — Oct 2017 - current

VMware, Inc. — Cambridge, MA
MTS, Virtual Machine Monitor Group — Jan 2010 - Feb 2013

VMware, Inc. — Cambridge, MA
R&D Intern, Virtual Machine Monitor Group — Jul - Dec 2009

VMware, Inc. — Cambridge, MA
R&D Intern, Core Performance Group — Jun - Aug 2008

Quickware Engineering and Design — Waltham, MA
FPGA Engineering Intern — Jun - Aug 2007

Cummins, Inc. — Columbus, IN
Engineering Intern, Analysis Led Design — Jun - Aug 2005

Cummins, Inc. — Beijing, China
International Business Intern — Jun - Jul 2004

ArvinMeritor, Inc. — Columbus, IN
Web Development Intern — Aug 2003 - May 2004