

# IRENE Y. ZHANG

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## EDUCATION

### University of Washington

Ph.D. in Computer Science and Engineering

Advisors: Hank Levy and Arvind Krishnamurthy

Thesis: *Towards a Flexible, High-Performance Operating System for Mobile/Cloud Applications*

Seattle, WA

Sept 2017

### University of Washington

M.S. in Computer Science and Engineering

Advisors: Hank Levy, Arvind Krishnamurthy, and Steve Gribble

Thesis: *Simplifying Mobile/Cloud Applications with Sapphire*

Seattle, WA

December 2013

### Massachusetts Institute of Technology

M.Eng. in Electrical Engineering and Computer Science

Advisors: M. Frans Kaashoek and Jeremy Stribling

Thesis: *Efficient File Distribution in a Flexible, Wide-area File System*

Cambridge, MA

June 2009

### Massachusetts Institute of Technology

S.B. in Computer Science and Engineering

Cambridge, MA

June 2008

## INTERESTS

Operating systems, distributed systems, virtualization, and networking

## RECENT

### Capybara

SIGCOMM 2026

## RESEARCH

*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.

## HIGHLIGHTS

### 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 heterogeneous 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. Stavrinou, **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. Krishnamurthy, 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. Krishnamurthy, 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

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

#### SERVICE

|                                   |      |
|-----------------------------------|------|
| <b>ASPLOS, Vice Program Chair</b> | 2027 |
| <b>HTPS, Program Committee</b>    | 2026 |
| <b>APSys, Program Chair</b>       | 2024 |
| <b>NSDI, Program Chair</b>        | 2024 |
| <b>SOSP, DEI Chair</b>            | 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

|                                              |                     |
|----------------------------------------------|---------------------|
| <b>Microsoft Research</b>                    | Redmond, WA         |
| Principal Researcher, Systems Research Group | Oct 2017 - current  |
| <b>VMware, Inc.</b>                          | Cambridge, MA       |
| MTS, Virtual Machine Monitor Group           | Jan 2010 - Feb 2013 |
| <b>VMware, Inc.</b>                          | Cambridge, MA       |
| R&D Intern, Virtual Machine Monitor Group    | Jul - Dec 2009      |
| <b>VMware, Inc.</b>                          | Cambridge, MA       |
| R&D Intern, Core Performance Group           | Jun - Aug 2008      |

**Quickware Engineering and Design**  
FPGA Engineering Intern

Waltham, MA  
Jun - Aug 2007

**Cummins, Inc.**  
Engineering Intern, Analysis Led Design

Columbus, IN  
Jun - Aug 2005

**Cummins, Inc.**  
International Business Intern

Beijing, China  
Jun - Jul 2004

**ArvinMeritor, Inc.**  
Web Development Intern

Columbus, IN  
Aug 2003 - May 2004