

# Kaushik Veeraraghavan

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## RESEARCH INTERESTS

Operating systems, file systems, mobility, distributed systems

## EDUCATION

University of Michigan, Ann Arbor, MI September 2005 – September 2011  
Ph.D. in Computer Science & Engineering  
M.S. in Computer Science & Engineering May 2007  
*Advisor: Jason Flinn*

University of Maryland, College Park, MD January 2000 – December 2003  
B.S. in Computer Engineering  
Electrical & Computer Engineering honors; Dean's List: all semesters  
Engineering Co-op distinction; Hinman CEOs program citation

## AWARDS

Best paper award, ASPLOS '11  
Finalist, Facebook Fellowship Program 2010-2011  
Best paper award, FAST '10  
Best student presentation award, HotMobile '08  
University of Michigan Center for Entrepreneurship: Bay Area Innovators, 2008  
Best paper award, OSDI '06  
University of Michigan CSE Department Fellowship, 2005-2006  
Google Summer of Code 2005: one of 400 students from ~9000 worldwide  
Dr. Adisai Bodharamik Scholarship (UMD), 2001-2002, 2002-2003  
ASPIRE Outstanding Undergraduate Research Award (UMD), 2002  
Tau Beta Pi Best Signature Bent Award (UMD), Spring 2002  
Tau Beta Pi Outstanding Sophomore/Junior award (UMD), Fall 2001, Spring 2002

## PROFESSIONAL EMPLOYMENT

Facebook, Palo Alto, CA September 2011 – present  
*Software engineering post-doc*  
Address performance issues in Facebook's geographically distributed services.

Microsoft Research Silicon Valley, Mountain View, CA September 2008 – December 2008  
*Research intern*  
Built a new replication framework that enables the sharing and synchronization of data across a collection of personal devices that use data of different fidelities.

Atlan Laboratories, McLean, VA January 2003 – August 2005  
*Computer Security Engineer*  
Developed Atlan's proprietary cryptography test suite and conducted product evaluations.

Reduce NOPs in Itanium schedules by moving instructions across basic blocks.

## PUBLICATIONS

Kaushik Veeraraghavan, Dongyoon Lee, Benjamin Wester, Jessica Ouyang, Peter M. Chen, Jason Flinn, Satish Narayanasamy. “DoublePlay: Parallelizing sequential logging and replay” (extended version of ASPLOS ’11 publication). *ACM Transactions on Computer Systems (TOCS)*, to appear.

Kaushik Veeraraghavan, Peter M. Chen, Jason Flinn, Satish Narayanasamy. “Detecting and Surviving Data Races Using Complementary Schedules.” *Proceedings of the 23rd ACM Symposium on Operating Systems Principles (SOSP ’11)*, Cascais, Portugal, October 2011.

Kaushik Veeraraghavan, Dongyoon Lee, Benjamin Wester, Jessica Ouyang, Peter M. Chen, Jason Flinn, Satish Narayanasamy. “DoublePlay: Parallelizing sequential logging and replay.” *Proceedings of the 2011 International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS ’11)*, Newport Beach, CA, March 2011. **Best Paper Award.**

Venugopalan Ramasubramanian, Kaushik Veeraraghavan, Krishna P. N. Puttaswamy, Thomas L. Rodeheffer, Douglas B. Terry, Ted Wobber. “Fidelity-Aware Replication for Mobile Devices” (extended version of MobiSys ’09 publication). *IEEE Transactions on Mobile Computing (TMC)*, Volume 9, Issue 12, December 2010.

Kaushik Veeraraghavan, Jason Flinn, Edmund B. Nightingale, Brian Noble. “quFiles: The right file at the right time” (extended version of FAST ’10 publication). *ACM Transactions on Storage (TOS)*, Volume 6, Issue 3, September 2010.

Dongyoon Lee, Benjamin Wester, Kaushik Veeraraghavan, Satish Narayanasamy, Peter M. Chen, Jason Flinn. “Respec: Efficient Online Multiprocessor Replay via Speculation and External Determinism.” *Proceedings of the 2010 International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS ’10)*, Pittsburgh, PA, March 2010.

Kaushik Veeraraghavan, Jason Flinn, Edmund B. Nightingale, Brian Noble. “quFiles: The right file at the right time”. *Proceedings of the Eighth USENIX Conference on File and Storage Technologies (FAST ’10)*, San Jose, CA, February 2010. **Best Paper Award.**

Kaushik Veeraraghavan, Venugopalan Ramasubramanian, Thomas L. Rodeheffer, Douglas B. Terry, Ted Wobber. “Fidelity-Aware Replication for Mobile Devices.” *Proceedings of the Seventh Annual International Conference on Mobile Systems, Applications and Services (MobiSys ’09)*, Krakow, Poland, June 2009. **One of 5 top papers forwarded to IEEE Transactions on Mobile Computing (TMC) 2010.**

Edmund B. Nightingale, Kaushik Veeraraghavan, Peter M. Chen, Jason Flinn. “Rethink the Sync” (extended version of OSDI '06 publication). *ACM Transactions on Computer Systems (TOCS)*, Volume 26, Issue 3, September 2008.

Jon Oberheide, Kaushik Veeraraghavan, Evan Cooke, Jason Flinn, Farnam Jahanian. “Virtualized In-Cloud Security Services for Mobile Devices.” *Proceedings of the First Workshop on Virtualization and Mobile Computing (MobiVirt '08)*, Breckenridge, CO, June 2008.

Kaushik Veeraraghavan, Edmund B. Nightingale, Jason Flinn, Brian Noble. “quFiles: A unifying abstraction for mobile data management.” *Proceedings of the Ninth Workshop on Mobile Computer Systems & Applications (HotMobile '08)*, Napa, CA, February 2008. **Best student presentation award.**

Kaushik Veeraraghavan, Andrew Myrick, Jason Flinn. “Cobalt: Separating content distribution from authorization in distributed file systems.” *Proceedings of the Fifth USENIX Conference on File and Storage Technologies (FAST '07)*, San Jose, CA, February 2007.

Edmund B. Nightingale, Kaushik Veeraraghavan, Peter M. Chen, Jason Flinn. “Rethink the Sync.” *Proceedings of the Seventh Symposium on Operating Systems Design and Implementation (OSDI '06)*, Seattle, WA, November 2006. **Best paper award.**

Ashwini Kumar, Kaushik Veeraraghavan, Benjamin Wester, Kang G. Shin. “Online feedback-based estimation of dynamic page service time” (extended version of FeBID '06 publication). *SIGBED Review*, Volume 3, Issue 2, April 2006.

Ashwini Kumar, Kaushik Veeraraghavan, Benjamin Wester, Kang G. Shin. “Online feedback-based estimation of dynamic page service time.” *Feedback Control Implementation and Design in Computing Systems and Networks (FeBID '06)*, Vancouver, BC Canada, April 2006.

## TALKS

“Detecting and Surviving Data Races Using Complementary Schedules.”  
SOSP '11, October 2011  
Facebook, October 2011

“DoublePlay: Parallelizing sequential logging and replay.”  
ASPLOS '11, March 2011

“quFiles: The right file at the right time.”  
Microsoft Research (Redmond), October 2010  
Storage Developers Conference '10, September 2010  
FAST '10, February 2010  
SysChat reading group, University of Maryland (College Park), November 2010

“Fidelity-Aware Replication for Mobile Devices.”  
MobiSys '09, June 2009  
Microsoft Sync Framework product group, December 2008  
End-of-internship talk. Microsoft Research Silicon Valley, December 2008

“quFiles: A unifying abstraction for mobile data management.”

HotMobile '08, February 2008

Nokia Research Center, February 2008

“Cobalt: Separating content distribution from authorization in distributed file systems.”

FAST '07, February 2007

## RESEARCH VISION

Jessica Ouyang, Kaushik Veeraraghavan, Dongyoon Lee, Peter Chen, Jason Flinn, Satish Narayanansamy . “Epoch parallelism: One execution is not enough.” *The Ninth Symposium on Operating Systems Design and Implementation (OSDI '10)*, Vancouver, Canada, October 2010.

## DEMO/POSTER

“DoublePlay: Parallelizing sequential logging and replay.” *The Ninth Symposium on Operating Systems Design and Implementation (OSDI '10)*, Vancouver, BC, Canada, October 2010.

“Fidelity-Aware Replication for Mobile Devices.” *The Seventh Annual Int. Conf. on Mobile Systems, Applications and Services (MobiSys '09)*, Krakow, Poland, June 2009.

## PATENTS

Venugopalan Ramasubramanian, Thomas L. Rodeheffer, Douglas B. Terry, Kaushik Veeraraghavan, Edward P. Wobber. “Multiple fidelity level item replication and integration.” *US Patent 20110016100*, January 2011.

## RESEARCH SUMMARY

My research focuses on operating systems (multiprocessor execution, file systems & mobility).

### **Frost** [SOSP '11]

May 2010 – August 2011

Frost is a new data race detection and survival tool for multiprocessors. Frost executes multiple replicas of a program with *complementary schedules* that are specially crafted to ensure that at least one replica avoids the harmful ordering of racing instructions that leads to incorrect program execution. Frost's *outcome-based race detector*, which compares replica states to check for divergences caused by a data race, is substantially faster than current dynamic race detectors for unmanaged code. Further, Frost can survive unknown data race bugs that manifest at runtime by diagnosing replica outcomes and initiating recovery.

### **DoublePlay** [TOCS '12] [ASPLOS '11]

August 2009 – August 2011

DoublePlay is an efficient deterministic replay system for commodity multiprocessors. Our insight in DoublePlay is that one can use the simpler and faster mechanisms of single-processor record and replay, yet still achieve the scalability offered by multiple cores, by using an additional execution to parallelize the record and replay of an application. DoublePlay timeslices multiple threads on a single processor, then runs multiple time intervals (epochs) of the program concurrently on separate processors. This strategy, which we call *uniparallelism*, makes logging much easier because each epoch runs on a single processor (so threads in an epoch never simultaneously access the same memory) and different epochs operate on different copies of memory. Thus, rather than logging the order of shared-memory accesses, we need only log the order in which threads in an epoch are timesliced on the processor.

**quFiles** [TOS '10] [FAST '10] [HotMobile '08]

August 2007 – July 2009

quFiles are a new file system abstraction for implementing data storage policies. A quFile encapsulates different physical representations of the same logical data. The particular representation to be displayed is determined at the instance the quFile is accessed by executing a data-specific policy that accounts for context such as the requesting application as well as device characteristics (e.g., platform, screen size, battery status, network connectivity).

**Fidelity-Aware Replication** [TMC '10] [MobiSys '09]

September 2008 – December 2008

Polyjuz is a new replication framework that enables the sharing and synchronization of data across a collection of personal devices that use data of different fidelities. Layered transparently between the application and an off-the-shelf replication platform Polyjuz ensures that data items created or updated on high-fidelity devices (e.g., desktops) are automatically replicated onto low-fidelity, mobile devices. Similarly, data items updated on low-fidelity devices are reintegrated with their high-fidelity counterparts, when the application permits it. Polyjuz performs fidelity reductions and reintegrations as devices exchange data in a peer-to-peer manner, extending the eventual consistency guarantee of the underlying replication platform to the multi-fidelity universe.

**Cobalt** [FAST '07]

March 2006 – February 2007

Cobalt is a new system for managing access to protected content in distributed storage. Rather than limit data access to a small set of authorized computers, Cobalt grants access based on the physical proximity of authorized users. Protected content is stored encrypted in a distributed file system; files can only be decrypted through the cooperation of a personal, mobile device such as a cell phone. Wireless communication is used to determine the physical proximity of the Cobalt device; when the user moves out of range, protected content is made inaccessible. Cobalt enables new forms of interaction such as the ability to access protected content on ad hoc media players and create playlists that adapt to the tastes of nearby users.

## SERVICE

Reviewer: TMC 2011, 2010; FAST 2010, 2007; ICISS 2008; HotMobile 2007

University of Michigan graduate student visit day: 2006, 2007, 2008, 2009, and 2010

Computer Science & Engineering Graduate student organization (CSEG): 2007 - 2010

## REFERENCES

Jason Flinn  
University of Michigan  
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