

# 2018 USENIX Annual Technical Conference

JULY 11–13, 2018 • BOSTON, MA, USA



## Wednesday, July 11

7:30 am–8:45 am

Continental Breakfast

8:45 am–9:00 am

### Opening Remarks and Awards

Program Co-Chairs: Haryadi Gunawi, *University of Chicago*, and Benjamin Reed, *Facebook*

9:00 am–10:00 am

### Keynote Address

**Blockchain in the Lens of BFT**

Dahlia Malkhi, *VMware Research*

10:00 am–10:30 am

Break with Refreshments

10:30 am–12:10 pm

### Refereed Papers Track I

#### Performance

**Tributary: spot-dancing for elastic services with latency SLOs**

Aaron Harlap and Andrew Chung, *Carnegie Mellon University*; Alexey Tumanov, *UC Berkeley*; Gregory R. Ganger and Phillip B. Gibbons, *Carnegie Mellon University*

**FastTrack: Foreground App-Aware I/O Management for Improving User Experience of Android Smartphones**

Sangwook Shane Hahn, *Seoul National University*; Sungjin Lee, *DGIST*; Inhyuk Yee, *AlBrain Asia*; Donguk Ryu, *Samsung Electronics*; Jihong Kim, *Seoul National University*

**Mainstream: Dynamic Stem-Sharing for Multi-Tenant Video Processing**

Angela H. Jiang, Daniel L.-K. Wong, Christopher Canel, Lilia Tang, and Ishan Misra, *Carnegie Mellon University*; Michael Kaminsky, Michael A. Kozuch, and Padmanabhan Pillai, *Intel Labs*; David G. Andersen and Gregory R. Ganger, *Carnegie Mellon University*

**VideoChef: Efficient Approximation for Streaming Video Processing Pipelines**

Ran Xu, Jinkyu Koo, Rakesh Kumar, and Peter Bai, *Purdue University*; Subrata Mitra, *Adobe Research*; Sasa Misailovic, *University of Illinois Urbana-Champaign*; Saurabh Bagchi, *Purdue University*

12:10 pm–2:00 pm

Lunch (on your own)

2:00 pm–3:40 pm

#### Security 1

**AIQL: Enabling Efficient Attack Investigation from System Monitoring Data**

Peng Gao, *Princeton University*; Xusheng Xiao, *Case Western Reserve University*; Zhichun Li and Kangkook Jee, *NEC Laboratories America, Inc.*; Fengyuan Xu, *National Key Lab for Novel Software Technology, Nanjing University*; Sanjeev R. Kulkarni and Prateek Mittal, *Princeton University*

**Application Memory Isolation on Ultra-Low-Power MCUs**

Taylor Hardin, *Dartmouth College*; Ryan Scott, *Clemson University*; Patrick Proctor, *Dartmouth College*; Josiah Hester, *Northwestern University*; Jacob Sorber, *Clemson University*; David Kotz, *Dartmouth College*

**Peeking Behind the Curtains of Serverless Platforms**

Liang Wang, *UW-Madison*; Mengyuan Li and Yinqian Zhang, *The Ohio State University*; Thomas Ristenpart, *Cornell Tech*; Michael Swift, *UW-Madison*

**Soteria: Automated IoT Safety and Security Analysis**

Z. Berkay Celik, Patrick McDaniel, and Gang Tan, *The Pennsylvania State University*

### Refereed Papers Track II

#### Kernel

**SOCK: Rapid Task Provisioning with Serverless-Optimized Containers**

Edward Oakes, Leon Yang, Dennis Zhou, and Kevin Houck, *University of Wisconsin-Madison*; Tyler Harter, *Microsoft, GSL*; Andrea C. Arpaci-Dusseau and Remzi H. Arpaci-Dusseau, *University of Wisconsin-Madison*

**DynaMix: Dynamic Mobile Device Integration for Efficient Cross-device Resource Sharing**

Dongju Chae, *POSTECH*; Joonsung Kim and Gwangmu Lee, *Seoul National University*; Hanjun Kim, *POSTECH*; Kyung-Ah Chang and Hyogun Lee, *Samsung Electronics*; Jangwoo Kim, *Seoul National University*

**The Battle of the Schedulers: FreeBSD ULE vs. Linux CFS**

Justinien Bouron, Sebastien Chevalley, Baptiste Lepers, and Willy Zwaenepoel, *EPFL*; Redha Gouicem, Julia Lawall, Gilles Muller, and Julien Sopena, *Sorbonne University/Inria/LIP6*

**The Design and Implementation of Hyperupcalls**

Nadav Amit and Michael Wei, *VMware Research*

#### Virtualization

**Scaling Guest OS Critical Sections with eCS**

Sanidhya Kashyap, *Georgia Institute of Technology*; Changwoo Min, *Virginia Tech*; Taesoo Kim, *Georgia Institute of Technology*

**KylinX: A Dynamic Library Operating System for Simplified and Efficient Cloud Virtualization**

Yiming Zhang, *NiceX Lab, NUDT*; Jon Crowcroft, *University of Cambridge*; Dongsheng Li and Chengfen Zhang, *NUDT*; Huiba Li, *Alibaba*; Yaozheng Wang and Kai Yu, *NUDT*; Yongqiang Xiong, *Microsoft*; Guihai Chen, *SJTU*

**Virtualizing Energy Storage Management Using RAIBA**

Tzi-cker Chiueh, Mao-Cheng Huang, Kai-Cheung Juang, Shih-Hao Liang, and Welkin Ling, *Industrial Technology Research Institute*

**Cntr: Lightweight OS Containers**

Jörg Thalheim and Pramod Bhatotia, *University of Edinburgh*; Pedro Fonseca, *University of Washington*; Baris Kasikci, *University of Michigan*

3:40 pm–4:10 pm

Break with Refreshments

Wednesday, July 11 continues on next page →

## Wednesday, July 11 (continued)

4:10 pm–5:50 pm

### Refereed Papers Track I

#### Security 2

##### Throwhammer: Rowhammer Attacks over the Network and Defenses

Andrei Tatar and Radhesh Krishnan, *Vrije Universiteit Amsterdam*; Elias Athanasopoulos, *University of Cyprus*; Cristiano Giuffrida, Herbert Bos, and Kaveh Razavi, *Vrije Universiteit Amsterdam*

##### Varys: Protecting SGX enclaves from practical side-channel attacks

Oleksii Oleksenko, Bohdan Trach, Robert Krahn, and André Martin, *TU Dresden*; Mark Silberstein, *Technion*; Christof Fetzer, *TU Dresden*

##### Kernel-Supported Cost-Effective Audit Logging for Causality Tracking

Shiqing Ma, *Purdue University*; Juan Zhai, *Nanjing University*; Yonghwi Kwon, *Purdue University*; Kyu Hyung Lee, *University of Georgia*; Xiangyu Zhang, *Purdue University*; Gabriela Ciocarlie, Ashish Gehani, and Vinod Yegneswaran, *SRI International*; Dongyan Xu, *Purdue University*; Somesh Jha, *University of Wisconsin-Madison*

##### EPTI: Efficient Defence against Meltdown Attack for Unpatched VMs

Zhichao Hua, Dong Du, Yubin Xia, Haibo Chen, and Binyu Zang, *Institute of Parallel and Distributed Systems, Shanghai Jiao Tong University*

### Refereed Papers Track II

#### Multicore

##### Effectively Mitigating I/O Inactivity in vCPU Scheduling

Weiwei Jia, *The University of Hong Kong, New Jersey Institute of Technology*; Cheng Wang and Xusheng Chen, *The University of Hong Kong*; Jianchen Shan and Xiaowei Shang, *New Jersey Institute of Technology*; Heming Cui, *The University of Hong Kong*; Xiaoning Ding, *New Jersey Institute of Technology*; Luwei Cheng, *Facebook*; Francis C. M. Lau and Yuexuan Wang, *The University of Hong Kong*; Yuangang Wang, *Huawei*

##### Placement of Virtual Containers on NUMA systems: A Practical and Comprehensive Model

Justin Funston, Maxime Lorrillere, and Alexandra Fedorova, *University of British Columbia*; Baptiste Lepers, *EPFL*; David Vengerov and Jean-Pierre Lozi, *Oracle Labs*; Vivien Quéma, *IMAG*

##### Getting to the Root of Concurrent Binary Search Tree Performance

Maya Arbel-Raviv, *Technion*; Trevor Brown, *IST Austria*; Adam Morrison, *Tel Aviv University*

##### TerseCades: Efficient Data Compression in Stream Processing

Gennady Pekhimenko, *University of Toronto*; Chuanxiong Guo, *Bytedance Inc.*; Myeongjae Jeon, *Microsoft Research*; Peng Huang, *Johns Hopkins University*; Lidong Zhou, *Microsoft Research*

6:30 pm–8:00 pm

#### Poster Session and Happy Hour

Posters of the papers presented in Wednesday's Technical Sessions, as well as invited posters, will be on display.

# Thursday, July 12

8:00 am–9:00 am

Continental Breakfast

9:00 am–10:15 am

## Refereed Papers Track I

### Problem Determination

#### Troubleshooting Transiently-Recurring Errors in Production Systems with Blame-Proportional Logging

Liang Luo, *University of Washington*; Suman Nath, Lenin Ravindranath Sivalingam, and Madan Musuvathi, *Microsoft Research*; Luis Ceze, *University of Washington*

#### NanoLog: A Nanosecond Scale Logging System

Stephen Yang, Seo Jin Park, and John Ousterhout, *Stanford University*

#### Model Governance: Reducing the Anarchy of Production ML

Vinay Sridhar, Sriram Subramanian, Dlucardo Arteaga, Swaminathan Sundararaman, Drew Roselli, and Nisha Talagala, *ParallelM*

## Refereed Papers Track II

### Consistency

#### Fine-grained consistency for geo-replicated systems

Cheng Li, *University of Science and Technology of China*; Nuno Pregoica, *NOVA LINCS & FCT, Univ. NOVA de Lisboa*; Rodrigo Rodrigues, *INESC-ID & Instituto Superior Técnico, Universidade de Lisboa*

#### Log-Free Concurrent Data Structures

Tudor David, *IBM Research, Zurich*; Aleksandar Dragojevic, *MSR Cambridge*; Rachid Guerraoui and Igor Zablotchi, *EPFL*

#### Stable and consistent membership at scale with Rapid

Lalith Suresh, Dahlia Malkhi, and Parikshit Gopalan, *VMware Research*; Ivan Porto Carreiro, *One Concern*; Zeeshan Lokhandwala, *VMware*

10:15 am–10:45 am

Break with Refreshments

10:45 am–12:25 pm

### Big Data Faster

#### On Smart Query Routing: For Distributed Graph Querying with Decoupled Storage

Arijit Khan, *Nanyang Technological University, Singapore*; Gustavo Segovia, *ETH Zurich, Switzerland*; Donald Kossmann, *Microsoft Research, Redmond, USA*

#### Locality-Aware Software Throttling for Sparse Matrix Operation on GPUs

Yanhao Chen and Ari B. Hayes, *Rutgers University*; Chi Zhang, *University of Pittsburgh*; Timothy Salmon and Eddy Z. Zhang, *Rutgers University*

#### Accelerating PageRank using Partition-Centric Processing

Kartik Lakhotia, *University of Southern California*; Rajgopal Kannan, *US Army Research Lab*; Viktor Prasanna, *University of Southern California*

#### CGraph: A Correlations-aware Approach for Efficient Concurrent Iterative Graph Processing

Yu Zhang, Xiaofei Liao, Hai Jin, and Lin Gu, *Huazhong University of Science and Technology*; Ligang He, *University of Warwick*; Bingsheng He, *National University of Singapore*; Haikun Liu, *Huazhong University of Science and Technology*

### Availability

#### Don't share, Don't lock: Large-scale Software Connection Tracking with Krononat

Fabien André, Stéphane Gouache, Nicolas Le Scouarnec, and Antoine Monsifrot, *Technicolor*

#### Accurate Timeout Detection Despite Arbitrary Processing Delays

Sixiang Ma and Yang Wang, *The Ohio State University*

#### Improving Service Availability of Cloud Systems by Predicting Disk Error

Yong Xu and Kaixin Sui, *Microsoft Research, China*; Randolph Yao, *Microsoft Azure, USA*; Hongyu Zhang, *The University of Newcastle, Australia*; Qingwei Lin, *Microsoft Research, China*; Yingnong Dang, *Microsoft Azure, USA*; Peng Li, *Nankai University, China*; Keceng Jiang, Wenchi Zhang, and Jian-Guang Lou, *Microsoft Research, China*; Murali Chintalapati, *Microsoft Azure, USA*; Dongmei Zhang, *Microsoft Research, China*

#### RAFI: Risk-Aware Failure Identification to Improve the RAS in Erasure-coded Data Centers

Juntao Fang, *Wuhan National Laboratory for Optoelectronics, Huazhong University of Sci. and Tech.*; Shenggang Wan, *School of Computer Science and Technology, Huazhong University of Sci. and Tech.*; Xubin He, *Department of Computer and Information Sciences, Temple University*

12:25 pm–2:00 pm

Conference Luncheon

Thursday, July 12 continues on next page →

## Thursday, July 12 (continued)

2:00 pm–3:40 pm

### Refereed Papers Track I

#### Big Data 1

##### **Siphon: Expediting Inter-Datacenter Coflows in Wide-Area Data Analytics**

Shuhao Liu, Li Chen, and Baochun Li, *University of Toronto*

##### **PerfIso: Performance Isolation for Commercial Latency-Sensitive Services**

Călin Iorgulescu, *EPFL*; Reza Azimi, *Brown University*; Youngjin Kwon, *U. Texas at Austin*; Sameh Elnikety, Manoj Syamala, and Vivek Narasayya, *Microsoft Research*; Herodotos Herodotou, *Cyprus University of Technology*; Paulo Tomita, Alex Chen, Jack Zhang, and Junhua Wang, *Microsoft Bing*

##### **On the diversity of cluster workloads and its impact on research results**

George Amvrosiadis, Jun Woo Park, Gregory R. Ganger, and Garth A. Gibson, *Carnegie Mellon University*; Elisabeth Baseman and Nathan DeBardeleben, *Los Alamos National Laboratory*

##### **SLAOrchestrator: Reducing the Cost of Performance SLAs in the Cloud**

Jennifer Ortiz, Brendan Lee, and Magdalena Balazinska, *University of Washington*; Johannes Gehrke, *Microsoft*; Joseph L. Hellerstein, *eScience Institute*

### Refereed Papers Track II

#### Analyzing Code

##### **Spindle: Informed Memory Access Monitoring**

Haojie Wang, *Tsinghua University, Qatar Computing Research Institute*; Jidong Zhai, *Tsinghua University*; Xiongchao Tang, *Tsinghua University, Qatar Computing Research Institute*; Bowen Yu, *Tsinghua University*; Xiaosong Ma, *Qatar Computing Research Institute*; Wenguang Chen, *Tsinghua University*

##### **Touchstone: Generating Enormous Query-Aware Test Databases**

Yuming Li and Rong Zhang, *East China Normal University*; Xiaoyan Yang and Zhenjie Zhang, *Singapore R&D, Yitu Technology Ltd.*; Aoying Zhou, *East China Normal University*

##### **DSAC: Effective Static Analysis of Sleep-in-Atomic-Context Bugs in Kernel Modules**

Jia-Ju Bai and Yu-Ping Wang, *Tsinghua University*; Julia Lawall, *Sorbonne Université/Inria/LIP6*; Shi-Min Hu, *Tsinghua University*

##### **Coccinelle: 10 Years of Automated Evolution in the Linux Kernel**

Julia Lawall and Gilles Muller, *Sorbonne University/Inria/LIP6*

3:40 pm–4:10 pm

Break with Refreshments

4:10 pm–5:50 pm

#### Big Data 2

##### **Albis: High-Performance File Format for Big Data Systems**

Animesh Trivedi, Patrick Stuedi, Jonas Pfefferle, Adrian Schuepbach, and Bernard Metzler, *IBM Research, Zurich*

##### **Litz: Elastic Framework for High-Performance Distributed Machine Learning**

Aurick Qiao, *Petuum, Inc. and Carnegie Mellon University*; Abutalib Aghayev, *Carnegie Mellon University*; Weiren Yu, *Petuum, Inc. and Beihang University*; Haoyang Chen and Qirong Ho, *Petuum, Inc.*; Garth A. Gibson, *Carnegie Mellon University and Vector Institute*; Eric P. Xing, *Petuum, Inc. and Carnegie Mellon University*

##### **Putting the “Micro” Back in Microservice**

Sol Boucher, Anuj Kalia, and David G. Andersen, *Carnegie Mellon University*; Michael Kaminsky, *Intel Labs*

##### **Fast and Concurrent RDF Queries using RDMA-assisted GPU Graph Exploration**

Siyuan Wang, Chang Lou, Rong Chen, and Haibo Chen, *Shanghai Jiao Tong University*

#### SSDs

##### **MDev-NVMe: A NVMe Storage Virtualization Solution with Mediated Pass-Through**

Bo Peng, *Shanghai Jiao Tong University, Intel*; Haozhong Zhang, *Intel*; Jianguo Yao, *Shanghai Jiao Tong University*; Yaozu Dong, *Intel*; Yu Xu and Haibing Guan, *Shanghai Jiao Tong University*

##### **AutoSSD: an Autonomic SSD Architecture**

Bryan S. Kim, *Seoul National University*; Hyun Suk Yang, *Hongik University*; Sang Lyul Min, *Seoul National University*

##### **Geriatric: Aging what you see and what you don't see. A file system aging approach for modern storage systems**

Saurabh Kadekodi, Vaishnavh Nagarajan, and Gregory R. Ganger, *Carnegie Mellon University*; Garth A. Gibson, *Carnegie Mellon University, Vector Institute*

##### **Can't We All Get Along? Redesigning Protection Storage for Modern Workloads**

Yamini Allu, Fred Douglass, Mahesh Kamat, Ramya Prabhakar, Philip Shilane, and Rahul Ugale, *Dell EMC*

6:30 pm–8:00 pm

### Poster Session and Reception

Posters of the papers presented in the Technical Sessions on Thursday and Friday will be on display.

Friday, July 13

8:00 am–9:00 am

Continental Breakfast

9:00 am–10:15 am

### Refereed Papers Track I

#### The Network

##### STMS: Improving MPTCP Throughput Under Heterogeneous Networks

Hang Shi and Yong Cui, *Tsinghua University*; Xin Wang, *Stony Brook University*; Yuming Hu and Minglong Dai, *Tsinghua University*; Fanzhao Wang and Kai Zheng, *Huawei Technologies*

##### Pantheon: the training ground for Internet congestion-control research

Francis Y. Yan, Jestin Ma, and Greg D. Hill, *Stanford University*; Deepti Raghavan, *Massachusetts Institute of Technology*; Riad S. Wahby, Philip Levis, and Keith Winstein, *Stanford University*

##### ClickNF: a Modular Stack for Custom Network Functions

Massimo Gallo and Rafael Laufer, *Nokia Bell Labs*

10:15 am–10:45 am

Break with Refreshments

10:45 am–12:25 pm

#### Transactions

##### Solar: Towards a Shared-Everything Database on Distributed Log-Structured Storage

Tao Zhu, *East China Normal University*; Zhuoyue Zhao and Feifei Li, *University of Utah*; Weining Qian and Aoying Zhou, *East China Normal University*; Dong Xie and Ryan Stutsman, *University of Utah*; Haining Li, *Bank of Communications*; Huiqi Hu, *East China Normal University*; *Bank of Communications*

##### Toward Coordination-free and Reconfigurable Mixed Concurrency Control

Dixin Tang and Aaron J. Elmore, *University of Chicago*

##### Scaling Hardware Accelerated Monitoring to Concurrent and Dynamic Queries With \*Flow

John Sonchack, *University of Pennsylvania*; Oliver Michel, *University of Colorado Boulder*; Adam J. Aviv, *United States Naval Academy*; Eric Keller, *University of Colorado Boulder*; and Jonathan M. Smith, *University of Pennsylvania*

##### Applying Hardware Transactional Memory for Concurrency-Bug Failure Recovery in Production Runs

Yuxi Chen, Shu Wang, and Shan Lu, *University of Chicago*; Karthikeyan Sankaralingam, *University of Wisconsin — Madison*

12:25 pm–2:00 pm

Lunch (on your own)

2:00 pm–3:40 pm

#### Data Center/Machine Learning

##### HeavyKeeper: An Accurate Algorithm for Finding Top-k Elephant Flows

Junzhi Gong, Tong Yang, Haowei Zhang, and Hao Li, *Peking University*; Steve Uhlig, *Queen Mary, University of London*; Shigang Chen, *University of Florida*; Lorna Uden, *Staffordshire University*; Xiaoming Li, *Peking University*

##### SAND: Towards High-Performance Serverless Computing

Istemi Ekin Akkus, Ruichuan Chen, Ivica Rimac, Manuel Stein, Klaus Satzke, Andre Beck, Paarijaat Aditya, and Volker Hilt, *Nokia Bell Labs*

##### Cavs: An Efficient Runtime System for Dynamic Neural Networks

Shizhen Xu, *Carnegie Mellon University*, *Tsinghua University*; Hao Zhang, Graham Neubig, and Wei Dai, *Carnegie Mellon University*, *Petuum Inc.*; Jin Kyu Kim, *Carnegie Mellon University*; Zhijie Deng, *Tsinghua University*; Qirong Ho, *Petuum Inc.*; Guangwen Yang, *Tsinghua University*; Eric P. Xing, *Petuum Inc.*

##### DeepCPU: Serving RNN-based Deep Learning Models 10x faster

Minjia Zhang, Samyam Rajbhandari, Wenhan Wang, and Yuxiong He, *Microsoft AI and Research*

### Refereed Papers Track II

#### Storage 1

##### Selecta: Heterogeneous Cloud Storage Configuration for Data Analytics

Ana Klimovic, *Stanford University*; Heiner Litz, *UC Santa Cruz*; Christos Kozyrakis, *Stanford University*

##### Remote regions: a simple abstraction for remote memory

Marcos K. Aguilera, Nadav Amit, Irina Calciu, Xavier Deguillard, Jayneel Gandhi, Stanko Novakovic, Arun Ramanathan, Pratap Subrahmanyam, Lalith Suresh, Kiran Tati, Rajesh Venkatasubramanian, and Michael Wei, *VMware*

##### Understanding Ephemeral Storage for Serverless Analytics

Ana Klimovic, Yawen Wang, and Christos Kozyrakis, *Stanford University*; Patrick Stuedi, Jonas Pfefferle, and Animesh Trivedi, *IBM Research*

#### Storage 2

##### Tailwind: Fast and Atomic RDMA-based Replication

Yacine Taleb, *Univ Rennes*, *Inria*, *CNRS*, *IRISA*; Ryan Stutsman, *University of Utah*; Gabriel Antoniu, *Univ Rennes*, *Inria*, *CNRS*, *IRISA*; Toni Cortes, *BSC*, *UPC*

##### On Fault Tolerance, Locality, and Optimality of Locally Repairable Codes

Oleg Kolosov, *School of Electrical Engineering*, *Tel Aviv University*; Gala Yadgar, *Computer Science Department*, *Technion and School of Electrical Engineering*, *Tel Aviv University*; Matan Liram, *Computer Science Department*, *Technion*; Itzhak Tamo, *School of Electrical Engineering*, *Tel Aviv University*; Alexander Barg, *Department of ECE/ISR*, *University of Maryland*

##### TxFs: Leveraging File-System Crash Consistency to Provide ACID Transactions

Yige Hu, Zhiting Zhu, Ian Neal, Youngjin Kwon, and Tianyu Cheng, *The University of Texas at Austin*; Vijay Chidambaram, *The University of Texas at Austin and VMware Research*; Emmett Witchel, *The University of Texas at Austin*

##### Towards Better Understanding of Black-box Auto-Tuning: A Comparative Analysis for Storage Systems

Zhen Cao, *Stony Brook University*; Vasily Tarasov, *IBM Research - Almaden*; Sachin Tiwari and Erez Zadok, *Stony Brook University*

#### Key/Value Storage

##### Closing the Performance Gap Between Volatile and Persistent Key-Value Stores Using Cross-Referencing Logs

Yihe Huang, *Harvard University*; Matej Pavlovic, *EPFL*; Virendra Marathe, Margo Seltzer, Tim Harris, and Steve Byan, *Oracle Labs*

##### Metis: Robustly Tuning Tail Latencies of Cloud Systems

Zhao Lucis Li, *USTC*; Chieh-Jan Mike Liang, *Microsoft Research*; Wenjia He, *USTC*; Lianjie Zhu, Wenjun Dai, and Jin Jiang, *Microsoft Bing Ads*; Guangzhong Sun, *USTC*

##### Redesigning LSMs for Nonvolatile Memory with NovelSM

Sudarsun Kannan, *University of Wisconsin-Madison*; Nitish Bhat and Ada Gavrilovska, *Georgia Tech*; Andrea Arpaci-Dusseau and Remzi Arpaci-Dusseau, *University of Wisconsin-Madison*

##### HashKV: Enabling Efficient Updates in KV Storage via Hashing

Helen H. W. Chan, *The Chinese University of Hong Kong*; Yongkun Li, *University of Science and Technology of China*; Patrick P. C. Lee, *The Chinese University of Hong Kong*; Yinlong Xu, *University of Science and Technology of China*