

NSDI '18: 15th USENIX Symposium on Networked Systems Design and Implementation

April 9–11, 2018
Renton, WA, USA

New Hardware

- Approximating Fair Queueing on Reconfigurable Switches** 1
Naveen Kr. Sharma and Ming Liu, *University of Washington*; Kishore Atreya, *Cavium*; Arvind Krishnamurthy, *University of Washington*

- PASTE: A Network Programming Interface for Non-Volatile Main Memory** 17
Michio Honda, *NEC Laboratories Europe*; Giuseppe Lettieri, *Università di Pisa*; Lars Eggert and Douglas Santry, *NetApp*

- NetChain: Scale-Free Sub-RTT Coordination** 35
Xin Jin, *Johns Hopkins University*; Xiaozhou Li, *Barefoot Networks*; Haoyu Zhang, *Princeton University*; Nate Foster, *Cornell University*; Jeongkeun Lee, *Barefoot Networks*; Robert Soulé, *Università della Svizzera italiana*; Changhoon Kim, *Barefoot Networks*; Ion Stoica, *UC Berkeley*

- Azure Accelerated Networking: SmartNICs in the Public Cloud** 51
Daniel Firestone, Andrew Putnam, Sambhrama Mundkur, Derek Chiou, Alireza Dabagh, Mike Andrewartha, Hari Angepat, Vivek Bhanu, Adrian Caulfield, Eric Chung, Harish Kumar Chandrappa, Somesh Chaturmohta, Matt Humphrey, Jack Lavier, Norman Lam, Fengfen Liu, Kalin Ovtcharov, Jitu Padhye, Gautham Popuri, Shachar Raindel, Tejas Sapre, Mark Shaw, Gabriel Silva, Madhan Sivakumar, Nisheeth Srivastava, Anshuman Verma, Qasim Zuhair, Deepak Bansal, Doug Burger, Kushagra Vaid, David A. Maltz, and Albert Greenberg, *Microsoft*

Distributed Systems

- zkLedger: Privacy-Preserving Auditing for Distributed Ledgers** 65
Neha Narula, *MIT Media Lab*; Willy Vasquez, *University of Texas at Austin*; Madars Virza, *MIT Media Lab*

- Exploiting a Natural Network Effect for Scalable, Fine-grained Clock Synchronization** 81
Yilong Geng, Shiyu Liu, and Zi Yin, *Stanford University*; Ashish Naik, *Google Inc.*; Balaji Prabhakar and Mendel Rosenblum, *Stanford University*; Amin Vahdat, *Google Inc.*

- SnailTrail: Generalizing Critical Paths for Online Analysis of Distributed Dataflows** 95
Moritz Hoffmann, Andrea Lattuada, John Liagouris, Vasiliki Kalavri, Desislava Dimitrova, Sebastian Wicki, Zaheer Chothia, and Timothy Roscoe, *ETH Zurich*

Traffic Management

- Balancing on the Edge: Transport Affinity without Network State** 111
João Taveira Araújo, Lorenzo Saino, Lennert Buytenhek, and Raul Landa, *Fastly*

- Stateless Datacenter Load-balancing with Beamer** 125
Vladimir Olteanu, Alexandru Agache, Andrei Voinescu, and Costin Raiciu, *University Politehnica of Bucharest*

- Larry: Practical Network Reconfigurability in the Data Center** 141
Andromachi Chatzieleftheriou, Sergey Legtchenko, Hugh Williams, and Antony Rowstron, *Microsoft Research*

- Semi-Oblivious Traffic Engineering: The Road Not Taken** 157
Praveen Kumar and Yang Yuan, *Cornell*; Chris Yu, *CMU*; Nate Foster and Robert Kleinberg, *Cornell*; Petr Lapukhov and Chiun Lin Lim, *Facebook*; Robert Soulé, *Università della Svizzera italiana*

NFV and Hardware

- Metron: NFV Service Chains at the True Speed of the Underlying Hardware** 171
Georgios P. Katsikas, *RISE SICS and KTH Royal Institute of Technology*; Tom Barbette, *University of Liege*; Dejan Kostic, *KTH Royal Institute of Technology*; Rebecca Steinert, *RISE SICS*; Gerald Q. Maguire Jr., *KTH Royal Institute of Technology*

- G-NET: Effective GPU Sharing in NFV Systems** 187
Kai Zhang, *Fudan University*; Bingsheng He, *National University of Singapore*; Jiayu Hu, *University of Science and Technology of China*; Zeke Wang, *National University of Singapore*; Bei Hua, Jiayi Meng, and Lishan Yang, *University of Science and Technology of China*

- SafeBricks: Shielding Network Functions in the Cloud** 201
Rishabh Poddar, Chang Lan, Raluca Ada Popa, and Sylvia Ratnasamy, *UC Berkeley*

Web and Video

- Vesper: Measuring Time-to-Interactivity for Web Pages.....** 217
Ravi Netravali and Vikram Nathan, *MIT CSAIL*; James Mickens, *Harvard University*; Hari Balakrishnan, *MIT CSAIL*

- Towards Battery-Free HD Video Streaming** 233
Saman Naderiparizi, Mehrdad Hessar, Vamsi Talla, Shyamnath Gollakota, and Joshua R Smith, *University of Washington*

- Prophecy: Accelerating Mobile Page Loads Using Final-state Write Logs** 249
Ravi Netravali, *MIT CSAIL*; James Mickens, *Harvard University*

- Salsify: Low-Latency Network Video through Tighter Integration between a Video Codec and a Transport Protocol.....** 267
Sadjad Fouladi, John Emmons, and Emre Orbay, *Stanford University*; Catherine Wu, *Saratoga High School*; Riad S. Wahby and Keith Winstein, *Stanford University*

Performance Isolation and Scaling

- ResQ: Enabling SLOs in Network Function Virtualization.....** 283
Amin Tootoonchian, *Intel Labs*; Aurojit Panda, *NYU, ICSI*; Chang Lan, *UC Berkeley*; Melvin Walls, *Nefeli*; Katerina Argyraki, *EPFL*; Sylvia Ratnasamy, *UC Berkeley*; Scott Shenker, *UC Berkeley, ICSI*

- Elastic Scaling of Stateful Network Functions.....** 299
Shinae Woo, *KAIST, UC Berkeley*; Justine Sherry, *CMU*; Sangjin Han, *UC Berkeley*; Sue Moon, *KAIST*; Sylvia Ratnasamy, *UC Berkeley*; Scott Shenker, *UC Berkeley, ICSI*

- Iron: Isolating Network-based CPU in Container Environments** 313
Junaid Khalid, *UW-Madison*; Eric Rozner, Wesley Felter, Cong Xu, and Karthick Rajamani, *IBM Research*; Alexandre Ferreira, *Arm Research*; Aditya Akella, *UW-Madison*

Congestion Control

- Copa: Practical Delay-Based Congestion Control for the Internet** 329
Venkat Arun and Hari Balakrishnan, *MIT CSAIL*

- PCC Vivace: Online-Learning Congestion Control** 343
Mo Dong and Tong Meng, *UIUC*; Doron Zarchy, *The Hebrew University of Jerusalem*; Engin Arslan, *UIUC*; Yossi Gilad, *MIT*; Brighten Godfrey, *UIUC*; Michael Schapira, *The Hebrew University of Jerusalem*

- Multi-Path Transport for RDMA in Datacenters** 357
Yuanwei Lu, *Microsoft Research and University of Science and Technology of China*; Guo Chen, *Hunan University*; Bojie Li, *Microsoft Research and University of Science and Technology of China*; Kun Tan, *Huawei Technologies*; Yongqiang Xiong, Peng Cheng, and Jiansong Zhang, *Microsoft Research*; Enhong Chen, *University of Science and Technology of China*; Thomas Moscibroda, *Microsoft Azure*

(continued on next page)

Cloud

Andromeda: Performance, Isolation, and Velocity at Scale in Cloud Network Virtualization373
Michael Dalton, David Schultz, Jacob Adriaens, Ahsan Arefin, Anshuman Gupta, Brian Fahs, Dima Rubinstein, Enrique Cauich Zermeno, Erik Rubow, James Alexander Docauer, Jesse Alpert, Jing Ai, Jon Olson, Kevin DeCabooter, Marc de Kruijf, Nan Hua, Nathan Lewis, Nikhil Kasinadhuni, Riccardo Crepaldi, Srinivas Krishnan, Subbaiah Venkata, Yossi Richter, Uday Naik, and Amin Vahdat, <i>Google, Inc.</i>	
LHD: Improving Cache Hit Rate by Maximizing Hit Density389
Nathan Beckmann, <i>Carnegie Mellon University</i> ; Haoxian Chen, <i>University of Pennsylvania</i> ; Asaf Cidon, <i>Stanford University/Barracuda Networks</i>	
Performance Analysis of Cloud Applications.....	.405
Dan Ardelean, Amer Diwan, and Chandra Erdman, <i>Google</i>	

Diagnosis

007: Democratically Finding the Cause of Packet Drops419
Behnaz Arzani, <i>Microsoft Research</i> ; Selim Ciraci, <i>Microsoft</i> ; Luiz Chamon, <i>University of Pennsylvania</i> ; Yibo Zhu and Hongqiang (Harry) Liu, <i>Microsoft Research</i> ; Jitu Padhye, <i>Microsoft</i> ; Boon Thau Loo, <i>University of Pennsylvania</i> ; Geoff Outhred, <i>Microsoft</i>	
Efficient and Correct Test Scheduling for Ensembles of Network Policies437
Yifei Yuan, Sanjay Chandrasekaran, Limin Jia, and Vyas Sekar, <i>Carnegie Mellon University</i>	
Distributed Network Monitoring and Debugging with SwitchPointer453
Praveen Tammana, <i>University of Edinburgh</i> ; Rachit Agarwal, <i>Cornell University</i> ; Myungjin Lee, <i>University of Edinburgh</i>	
Stroboscope: Declarative Network Monitoring on a Budget467
Olivier Tilmans, <i>Université Catholique de Louvain</i> ; Tobias Bühler, <i>ETH Zürich</i> ; Ingmar Poese, <i>BENOCS</i> ; Stefano Vissicchio, <i>University College London</i> ; Laurent Vanbever, <i>ETH Zürich</i>	

Fault-Tolerance

PLOVER: Fast, Multi-core Scalable Virtual Machine Fault-tolerance483
Cheng Wang, Xusheng Chen, Weiwei Jia, Boxuan Li, Haoran Qiu, Shixiong Zhao, and Heming Cui, <i>The University of Hong Kong</i>	
Odin: Microsoft's Scalable Fault-Tolerant CDN Measurement System501
Matt Calder, <i>Microsoft/USC</i> ; Manuel Schröder, Ryan Gao, Ryan Stewart, and Jitendra Padhye, <i>Microsoft</i> ; Ratul Mahajan, <i>Intentionet</i> ; Ganesh Ananthanarayanan, <i>Microsoft</i> ; Ethan Katz-Bassett, <i>Columbia University</i>	
Deepview: Virtual Disk Failure Diagnosis and Pattern Detection for Azure.....	.519
Qiao Zhang, <i>University of Washington</i> ; Guo Yu, <i>Cornell University</i> ; Chuanxiong Guo, <i>Toutiao (Bytedance)</i> ; Yingnong Dang, Nick Swanson, Xinsheng Yang, Randolph Yao, and Murali Chintalapati, <i>Microsoft</i> ; Arvind Krishnamurthy and Thomas Anderson, <i>University of Washington</i>	

Physical Layer

LiveTag: Sensing Human-Object Interaction through Passive Chipless WiFi Tags533
Chuhan Gao and Yilong Li, <i>University of Wisconsin-Madison</i> ; Xinyu Zhang, <i>University of California San Diego</i>	
Inaudible Voice Commands: The Long-Range Attack and Defense547
Nirupam Roy, Sheng Shen, Haitham Hassanieh, and Romit Roy Choudhury, <i>University of Illinois at Urbana-Champaign</i>	
PowerMan: An Out-of-Band Management Network for Datacenters Using Power Line Communication561
Li Chen, Jiacheng Xia, Bairen Yi, and Kai Chen, <i>The Hong Kong University of Science and Technology</i>	

Configuration Management

<i>NetComplete: Practical Network-Wide Configuration Synthesis with Autocompletion</i>	.579
Ahmed El-Hassany, Petar Tsankov, Laurent Vanbever, and Martin Vechev, <i>ETH Zürich</i>	
Automatically Correcting Networks with NEAt	.595
Wenxuan Zhou, Jason Croft, Bingzhe Liu, Elaine Ang, and Matthew Caesar, <i>University of Illinois at Urbana-Champaign</i>	
<i>Net2Text: Query-Guided Summarization of Network Forwarding Behaviors</i>	.609
Rüdiger Birkner, Dana Drachsler-Cohen, Laurent Vanbever, and Martin Vechev, <i>ETH Zürich</i>	