

Sangtae Ha

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Research Interests

My research focuses on building and deploying practical systems that span multiple disciplines, including machine learning and deep learning systems, networks and distributed systems, mobile systems, internet protocols and algorithms, networks and video streaming, and storage systems.

Previously, I developed CUBIC (RFC 9438), which serves as the default TCP congestion control algorithm on the Internet for Linux/Android, MacOSX, and Windows. It is currently employed by the majority of Internet servers worldwide and utilized by several billion internet devices.

Education

- November, 2009 **Ph.D., Computer Science, North Carolina State University, USA**
Thesis: Improving TCP Congestion Control for High Bandwidth and Long Distance Networks
Advisor: Prof. Injong Rhee
- February, 2001 **M.S., Computer and Communication Engineering, POSTECH, Korea**
Thesis: Design and Implementation of High-Speed Internet Gateway
Advisor: Prof. James W. Hong
- February, 1999 **B.E., Computer Science and Engineering, Kyung Hee University, Korea**

Academic Appointments

- 08/2021 - Current **Associate Professor** of Computer Science, University of Colorado Boulder
- 08/2014 - 07/2021 **Assistant Professor** of Computer Science, University of Colorado Boulder
- 11/2010 - 05/2013 **Associate Research Scholar**, Princeton University
Associate Director, the Princeton EDGE Lab, Princeton University
Mentor: Prof. Mung Chiang (Now the President at Purdue University)
- 11/2009 - 11/2010 **Postdoctoral Research Associate**, Princeton University
Associate Director, the Princeton EDGE Lab, Princeton University
Mentor: Prof. Mung Chiang (Now the President at Purdue University)

Work Experience

- 1/2022 - Current Technical Advisor for Earable Inc.
<http://www.earable.ai>.
- 10/2019 - 12/2021 Chief Architect Officer for Earable Inc.
- 08/2017 - Current Technical Advisory Board for Myota Inc.
<http://www.myota.io>.
- 09/2012 - Current Co-Founder and Consulting IT architect for Zoomi Inc.
<http://www.zoomi.ai/>
- 05/2013 - 07/2014 Co-Founder (Founding CTO) and VP of Advanced Technology, DataMi Inc.
<http://www.datami.com>.

05/2008 - 08/2008 Summer Research Intern, Cisco Systems, San Jose, CA
 07/2002 - 07/2004 Senior Research Engineer, Telson I&C Research Center, Seoul, Korea
 03/2001 - 06/2002 (Part-time) Linux Consultant and Writer, Linux@Works, Seoul, Korea
 11/2000 - 03/2002 Senior Research Engineer (Linux Kernel), Netstech R&D Center, Seoul, Korea

Awards and Honors

2021	Best Paper Award at ACM MobiSys 2021
2019	Best Paper Award at ACM MobiSys 2019
2018	AT&T Faculty Research Award (VURI)
2017	Samsung 2017 GRO Award
2017	AT&T Faculty Research Award (VURI)
2017	IEEE INFOCOM'17 Distinguished TPC Member Award
2014	INFORMS ISS Design Science Award
2013	Princeton IP Accelerator Fund Winner, Princeton, NJ
2011	Princeton Innovation Competition Finalist, Princeton University
2011	Vodafone Wireless Innovation Competition Finalist, "TUBE-ing Over Digital Divide."

Professional Service

Fog Computing/Networking

TPC Co-Chair	IEEE MASS 2024
TPC	ACM CoNEXT 2024
TPC	IEEE ICNP 2024
TPC	ACM MOBICOM 2022
TPC	IEEE INFOCOM 2024-2016
TPC	IEEE ICDCS 2023, 2022, 2017
TPC	IEEE MASS 2022, 2021
TPC	IEEE SEON 2021, 2020, 2015, 2014, 2013
TPC	IEEE PIMRC 2020
TPC	WiOPT 2017, 2014, 2013, 2012, 2011
Reviewer	CVPR 2023-2022, ACM MM 2024
Co-Chair	ACM CoNEXT'19 Student Workshop, 2019
TPC Co-Chair	Fog World Congress 2017
Organizing Committee	IEEE DSN 2017
Organizing Committee	IEEE MASS 2022, 2021

Publicity Co-Chair ACM 2017

Co-Chair Software Infrastructure Working Group, OpenFog Consortium, 2016 - 2018

Guest Editor IEEE Comm. Magazine Feature Topic on Fog Computing and Networking, Sept 2016

Panelist NSF Edge Workshop, Oct, 2016

TPC Co-Chair Asia-US Forum on Fog Networking for IoT, 2015

General Co-Chair IEEE SECON Workshop on Fog Networking For IoT, 2015

Associate Editor IEEE Internet of Things Journal 2013 - 2018

Smart Data Pricing

General Co-Chair IEEE INFOCOM Smart Data Pricing Workshop 2017, 2016, 2013

TPC IEEE INFOCOM Smart Data Pricing Workshop 2015, 2014

Guest Editor IEEE Network Magazine special issue on Smart Data Pricing, Aug 2015

Co-Editor Book "Smart Data Pricing", John Wiley & Sons, 2014

Miscellaneous

Panelist NSF RINGS Review Panel, 2021

Panelist NSF MLWiNS Review Panel, 2019

Panelist NSF NeTS Small and Medium Panel 2017, 2016, 2015

Panelist NSF CREST Reviewer, 2018

TPC International Teletraffic Congress (ITC), 2016

Editorial Board IEEE ComSoc Technology News (CTN) 2012 - 2014

TPC IEEE GLOBECOM 2016, 2014, 2013

TPC MobileSoft ACM Student Research Competition, 2015

TPC IEEE VTC 2014

TPC IEEE IPCCC 2014, 2012

TPC The International Workshop on Smart Complex Engineered Networks (SCENE 2014)

TPC IEEE Workshop on Green Multimedia 2013

TPC IEEE NAS 2012

TPC PFLDNeT 2010

Session Chair CISS 2012, 2010

Panel List Smart Data Pricing Forum, Princeton, July, 2012

Judge Princeton Undergraduate Research Symposium, May, 2011

Membership IEEE Senior member, ACM Member

Reviewer	IEEE/ACM Transactions on Networking, IEEE Transactions on Mobile Computing, IEEE Transactions on Communications, IEEE Transactions on Multimedia, IEEE Journal on Selected Areas in Communications, Elsevier Computer Networks, Computer Communications, IEEE Communications Letters, ACM Multimedia, IEEE INFOCOM, IEEE ICDCS, IWQoS, PFLDNet, CISS, WiOPT, IEEE SECON, IEEE Networking, ACC, CDC, ICCCN, IMSA, MILCOM, IJCAS
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Campus Service

Departmental Service

2016F –	Computing Co-Chair, Computer Science, University of Colorado
2023 F	Computer Science Research Professors Search Committee, University of Colorado
2022 S	Instructor Search Committee, Computer Science, University of Colorado
2021F – 2022S	Faculty Search Chair, Computer Science, University of Colorado
2018F – 2019S	Faculty Search Committee, Computer Science, University of Colorado
2016F – 2017S	Faculty Search Committee, Computer Science, University of Colorado
2014F – 2016S	Graduate Committee, Computer Science, University of Colorado
2014F – 2020S	Ph.D. Committee, Interdisciplinary Telecom Program (ITP), University of Colorado

University Service

2016F – 2018F	Cloud Working Group, University of Colorado Boulder
2014F	Faculty Student Mentorship Program (FSMP), University of Colorado Boulder

Outreach

2/23/–24/2019	Mentor, HackCU V
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Publications

(Google Scholar Citations: 7612, h-index: 33, i10-index: 63)

<https://scholar.google.com/citations?user=GcMKuu8AAAAJ&hl=en>

Internet Drafts

- 11 Lisong Xu, Sangtae Ha, Injong Rhee, Vidhi Goel, and Lars Eggert, “RFC 9438: CUBIC for Fast Long-Distance Networks,” DOI: <https://doi.org/10.17487/RFC9438>.

Books

- B1 Soumya Sen, Carlee Joe-Wong, Sangtae Ha, Mung Chiang, eds., *Smart Data Pricing*, Wiley & Sons, 536 pages, Sept., 2014 (available at Amazon).

Book Chapters

- BC1 Jaeyoon Chung, Carlee Joe-Wong and Sangtae Ha, “Extending the Cloud to Fog: Highly Available Elastic Fog,” *Fog and Fogonomics*, Wiley & Sons, ch. 12, pp. 295–324, 2020.
- BC2 Carlee Joe-Wong, Liang Zheng, Sangtae Ha, Soumya Sen, Chee Wei Tan, and Mung Chiang, “Smart Data Pricing in Systems,” *Key Technologies for Wireless Systems*, Cambridge University Press, pp. 478–500, April, 2017.
- BC3 Carlee Joe-Wong, Sangtae Ha, Zhenming Liu, Felix Ming Fai Wong, and Mung Chiang, “Mind Your Own Bandwidth,” *Fog*, Wiley & Sons, ch. 2, pp. 24–51, April, 2017

- BC4 Soumya Sen, Carlee Joe-Wong, Sangtae Ha, and Mung Chiang, "Human Factors in Smart Data Pricing," in *Smart Data Pricing*, Wiley & Sons, pp. 127-166, Sept., 2014.
- BC5 Soumya Sen, Carlee Joe-Wong, Sangtae Ha, and Mung Chiang, "Smart Data Pricing (SDP): Economic Solutions to Network Congestion," in *SIGCOMM eBook on Recent Advances in Networking*, Volume I, ch. 5, pp. 221-274, Aug., 2013.

Peer-Reviewed Journals Published/Accepted

- J1 Anh Nguyen, Galen Pogoncheff, Ban Xuan Dong, Nam Bui, Hoang Truong, Nhat Pham, Linh Nguyen, Hoang Nguyen-Huu, Khue Bui-Diem, Quan Vu-Tran-Thien, Sy Duong-Guy, Sangtae Ha, and Tam Vu, "A Comprehensive Study on the Efficacy of a Wearable Sleep Aid Device Featuring Closed-loop Real-time Acoustic Stimulation," *Scientific Report*, 13, 17515 (2023).
- J2 Beom-Su Kim and Byung Hyun Lim, Beomkyu Suh, Sangtae Ha, Ting He, Babar Shah and Ki-Il Kim, "Enabling Grant-Free URLLC for AoI Minimization in RAN-Coordinated Health Monitoring System," *IEEE Internet of Things Journal*, 2023.
- J3 Hyoyoung Lim, Jinsung Lee, Jongyun Lee, Sandesh Dhawaskar Sathyanarayana, Junseon Kim, Anh Nguyen, Kwang Taik Kim, Youngbin Im, Mung Chiang, Dirk Grunwald, Kyunghan Lee, and Sangtae Ha, "An Empirical Study: Effect of Edge on Transport Protocol and Application Performance," *IEEE Transactions on Mobile Computing*, 2023.
- J4 Taejin Kim, Sandesh Dhawaskar Sathyanarayana, Siqi Chen, Youngbin Im, Xiaoxi Zhang, Sangtae Ha, and Carlee Joe-Wong, "MODEMS: Optimizing Edge Computing Migrations For User Mobility," *IEEE Journal on Selected Areas in Communications*, 2023.
- J5 Xiaoxi Zhang, Siqi Chen, Youngbin Im, Maria Gorlatova, Sangtae Ha, and Carlee Joe-Wong, "Optimal Network Protocol Selection for Competing Flows via Online Learning," *IEEE Transactions on Mobile Computing*, 2022.
- J6 Seyeon Kim, Kyungmin Bin, Sangtae Ha, Kyunghan Lee and Song Chong, "zTT: Learning-based DVFS with Zero Thermal Throttling for Mobile Devices," *ACM GetMobile*, vol. 25, no. 4, pp. 30-34, Mar. 2022.
- J7 Raza Qazi, Kyle E. Parker, Choong Yeon Kim, Ruediger Rill, Makenzie R. Norris, Jaeyoon Chung, John Bilbily, Jenny R. Kim, Marie C. Walicki, Graydon B. Gereau, Hyoyoung Lee, Yanyu Xiong, Jenna R. Lee, Melissa A. Tapia, Alexxai V. Kravitz, Matthew J. Will, Sangtae Ha, Jordan G. McCall, and Jae-Woong Jeong, "Scalable and modular wireless-network infrastructure for large-scale behavioral neuroscience," *Nature Biomedical Engineering*, 2021.
- J8 Jihoon Lee, Gyuhong Lee, Jinsung Lee, Youngbin Im, Max Hollingsworth, Eric Wustrow, Dirk Grunwald, and Sangtae Ha, "Wireless Emergency Alerts System", *Communications of the ACM*, vol. 64, no. 10, pp. 85-93, Oct. 2021.
- J9 Sandesh Dhawaskar Sathyanarayana, Jinsung Lee, Jihoon Lee, Dirk Grunwald, and Sangtae Ha, "Exploiting Client Inference in Multipath TCP over Multiple Cellular Networks", *IEEE Communications Magazine*, vol. 59, no. 4, pp. 58-64, Apr. 2021.
- J10 Jason Schnitzer, Prasanth Prahladan, Parisa Rahimzadeh, Chad Humble, Jinsung Lee, Jihoon Lee, Kyunghan Lee, and Sangtae Ha, "Toward Programmable DOCSIS 4.0 Networks: Adaptive Modulation in OFDM Channels," *IEEE Transactions on Network and Service Management (TNSM)*, pp. 441-455, Mar. 2021.

- J11 Taeho Kim, Phuc Nguyen, Nhat Pham, Nam Bui, Hoang Truong, Sangtae Ha, and Tam Vu, "Epileptic Seizure Detection and Experimental Treatment: A Review," *Frontiers in Neurology*, vol. 11, pp. 701 (24 pages), 2020.
- J12 Soumya Sen, Carlee Joe-Wong, Sangtae Ha, and Mung Chiang, "Time-Dependent Pricing for Multimedia Data Traffic: Analysis, Systems, and Trials," *IEEE Journal on Selected Areas in Communications*, vol. 37, no. 7, pp. 1504–1517, July 2019.
- J13 Won Seok Jang, Yonggwan Lee, Jason C. Neff, Youngbin Im, Sangtae Ha, and Luca Doro, "Development of an EPIC parallel computing framework to facilitate regional/global gridded crop modeling with multiple scenarios: A case study of the United States," *Computers and Electronics in Agriculture*, vol. 158, pp. 189–200, 2019.
- J14 Christopher Brinton, Swapna Buccapatnam, Liang Zheng, Da Cao, Andrew Lan, Felix Wong, Sangtae Ha, Mung Chiang, and Vince Poor, "On the Efficiency of Online Social Learning Networks," *IEEE/ACM Transactions on Networking*, vol. 25, issue 5, pp. 2076–2089, Oct. 2018.
- J15 Carlee Joe-Wong, Soumya Sen, and Sangtae Ha, "Sponsoring Mobile Data: Analyzing the Impact on Internet Stakeholders," *IEEE/ACM Transactions on Networking*, vol. 26, no. 3, pp. 1179–1192, June 2018.
- J16 Ibrahim Ayad, Youngbin Im, Eric Keller, and Sangtae Ha, "A Practical Evaluation of Rate Adaptation Algorithms in HTTP-based Adaptive Streaming," *Computer Networks*, vol. 133, pp. 90–103, 2018.
- J17 Kyuyong Shin, Carlee Joe-Wong, Sangtae Ha, Yung Yi, Injong Rhee and Douglas Reeves, "T-Chain: A General Incentive Scheme for Cooperative Computing," *IEEE/ACM Transactions on Networking*, vol. 25, no. 4, pp. 2122–2137, Aug. 2017.
- J18 Liang Zheng, Carlee Joe-Wong, Chee-Wei Tan, Sangtae Ha, and Mung Chiang, "Customized Data Plans for Mobile Users: Feasibility and Benefits of Data Trading," *IEEE Journal on Selected Areas in Communications*, vol. 35, no. 4, pp. 949–963, Apr. 2017.
- J19 Ioannis Kamitsos, Sangtae Ha, Lachlan Andrew, Jasika Bawa, Dana Butnariu, Hongseok Kim, and Mung Chiang "Optimal Sleeping: Models and Experiments for Delay Tradeoff," *International Journal of Systems Science: Operations & Logistics*, vol. 5, no. 4, pp. 356–371, 2017.
- J20 Youngbin Im, Carlee Joe-Wong, Sangtae Ha, Soumya Sen, Taekyoung Kwon and Mung Chiang, "AMUSE: Empowering Users for Cost-Aware Offloading with Throughput-Delay Tradeoffs," *IEEE Transactions on Mobile Computing*, vol. 15, no. 5, pp. 1062–1076, May 2016.
- J21 Soumya Sen, Carlee Joe-Wong, Sangtae Ha, and Mung Chiang, "Smart Data Pricing: Using Economics to Manage Network Congestion," *Communications of the ACM*, vol. 58, no. 12, pp. 86–93, Dec. 2015.
- J22 Ioannis Kamitsos, Paschalis Tsiaflakis, Sangtae Ha, and Mung Chiang, "Stable Sleep Mode Optimization for Efficient DSL Broadband Access," *IEEE Transactions on Communications*, vol. 63, no. 12, pp. 5116–5127, Dec. 2015.
- J23 Jaeyoon Chung, Sangtae Ha and James Won-Ki Hong, "A Management Architecture for Client-Defined Cloud Storage Services," *International Journal of Network Management*, vol. 25, no. 6, pp. 435–453, July 2015.
- J24 Carlee Joe-Wong, Ioannis Kamitsos, and Sangtae Ha, "Inter-Datacenter Job Routing and Scheduling with Variable Costs and Deadlines," *IEEE Transactions on Smart Grid*, vol. 6, no. 6, pp. 2669–2680, Nov. 2015.
- J25 Christopher Brinton, Ruediger Rill, Sangtae Ha, Mung Chiang, Robert Smith and William Ju, "Indi-

visualization for Education at Scale: MIIC Design and Preliminary Evaluation,” *IEEE Transactions on Learning Technologies*, vol. 8, no. 1, pp. 136–148, Jan. 2015.

- J26 Carlee Joe-Wong, Soumya Sen, and Sangtae Ha, “Offering Supplementary Network Technologies: Adoption Behavior and Offloading Benefits,” *IEEE/ACM Transactions on Networking*, vol. 23, no. 2, pp. 355–368, Apr. 2015.
- J27 Amitabha Ghosh, Sangtae Ha, Edward Crabbe and Jennifer Rexford, “Scalable Multi-Class Traffic Management in Data Center Backbone Networks,” *IEEE Journal on Selected Areas in Communications*, vol. 31, no. 12, pp. 2673–2684, Dec. 2013.
- J28 Soumya Sen, Carlee Joe-Wong, Sangtae Ha, and Mung Chiang, “A Survey of Smart Data Pricing: Past Proposals, Current Plans, and Future Trends,” *ACM Computing Survey*, vol. 46, no. 2, pp. 15:1–15:37, Nov. 2013.
- J29 Soumya Sen, Carlee Joe-Wong, Sangtae Ha, and Mung Chiang, “Incentivizing Time-Shifting of Data: A Survey of Time-Dependent Pricing for Internet Access,” *IEEE Communications Magazine*, vol. 50, no. 11, pp. 91–99, Nov. 2012.
- J30 Carlee Joe-Wong, Soumya Sen, Sangtae Ha, and Mung Chiang, “Optimized Day-Ahead Pricing for the Smart Grid with Device-Specific Scheduling Flexibility,” *IEEE Journal on Selected Areas in Communications*, vol. 30, no. 6, pp. 1075–1085, July 2012.
- J31 Hongseok Kim, Sangtae Ha, Mung Chiang, Dae Kyung Kang, and Jin Hee Kim, “Iterative Resource Pooling for Bandwidth Allocation in TDM-PON: Convergence Results and Experimental Evaluation,” *IEEE Photonic Network Communications*, vol. 24, no. 2, pp. 138–150, Oct. 2012.
- J32 Sangtae Ha and Injong Rhee, “Taming the Elephants: New TCP Slow Start,” *Elsevier Computer Networks*, vol. 55, no. 9, pp. 2092–2110, 2011.
- J33 Han Cai, Do Young Eun, Sangtae Ha, Injong Rhee, and Lisong Xu, “Stochastic Convex Ordering for Multiplicative Decrease Internet Congestion Control,” *Elsevier Computer Networks*, vol. 53, no. 3, pp. 365–381, 2009.
- J34 Sangtae Ha, Injong Rhee, and Lisong Xu, “CUBIC: A New TCP-Friendly High-Speed TCP Variant,” *ACM SIGOPS Operating Systems Review*, vol. 42, no. 5, pp. 64–74, 2008.
- J35 Sangtae Ha, Long Le, Injong Rhee, and Lisong Xu, “Impact of Background Traffic on Performance of High-Speed TCP Variant Protocols,” *Elsevier Computer Networks*, vol. 15, no. 4, pp. 852–865, 2007.

Non-Peer Reviewed Journals Published

- J1 Mung Chiang, Sangtae Ha, Chih-Lin I, Fulvio Risso, and Tao Zhang, “Fog Computing and Networking: Part 2 [Guest editorial],” *IEEE Communications Magazine*, vol. 55, no. 8, pp. 13–13, Aug. 2017.
- J2 Mung Chiang, Sangtae Ha, Chih-Lin I, Fulvio Risso, and Tao Zhang, “Clarifying Fog Computing and Networking: 10 Questions and Answers,” *IEEE Communications Magazine*, vol. 55, no. 4, pp. 18–20, Apr. 2017.
- J3 Mung Chiang, Sangtae Ha, Chih-Lin I, Fulvio Risso, and Tao Zhang, “Fog Computing and Networking: Part 1 [Guest editorial],” *IEEE Communications Magazine*, vol. 55, no. 4, pp. 16–17, Apr. 2017.
- J4 Matthew Andrews, Mung Chiang, Sangtae Ha, Jianwei Huang, and Soumya Sen, “Innovation in Network Pricing [guest editorial],” *IEEE Network*, vol. 30, no. 2, pp. 4–5, Mar. 2016.

Conferences Published/Accepted

- C1 Jongseok Park, Kyungmin Bin, Gibum Park, Sangtae Ha and Kyunghan Lee, "ASPEN: Breaking Operator Barriers for Efficient Parallelization of Deep Neural Networks," 37th Conference on Neural Information Processing Systems (*NeurIPS*), 2023 (acceptance ratio: 26.1%)
- C2 Beom-Su Kim, Byung Hyun Lim, BeomKyu Suh, Ki-Il Kim, and Sangtae Ha, "Modeling of AoI Minimization for (m,k)-firm Streams in Networks," 31st International Symposium on the Modeling, Analysis, and Simulation of Computer and Telecommunication Systems (*MASCOTS*), 2023 (acceptance ratio: 30%)
- C3 Seyeon Kim, Kyungmin Bin, Donggyu Yang, Sangtae Ha, Song Chong, and Kyunghan Lee, "ENTRO: Tackling the Encoding and Networking Trade-off in Offloaded Video Analytics," Proceedings of the 31th ACM International Conference on Multimedia (*ACM Multimedia*), 2023. (902 out of 3072 submissions, acceptance ratio: 29.3%)
- C4 Sungyong Lee, Wooseung Nam, Jinsung Lee, Sangtae Ha, and Kyunghan Lee, "N-epitomizer: Enabling Semantic Offloading for Neural Network Inferences," *IEEE MASS*, 2023.
- C5 Sandesh Dhawaskar Sathyanarayana, Kyunghan Lee, Dirk Grunwald, and Sangtae Ha, "Converge: QoE-driven Multipath Video Conferencing over WebRTC," In Proceedings of the ACM SIGCOMM 2023 Conference (*ACM SIGCOMM '23*). Association for Computing Machinery, New York, NY, USA, 637–653 (71 out of 323 submissions, acceptance ratio: 21.98%).
- C6 Zhang Liu, Dirk Grunwald, Joseph Izralevitz, Gaukas Wang, and Sangtae Ha, "MRTOM: Mostly Reliable Totally Ordered Multicast, a Network Primitive to Offload Distributed Systems," 2023 43th IEEE Conference on Distributed Computing Systems (*IEEE ICDCS*), 2023 (83 out of 439 submissions, acceptance ratio: 18.9%)
- C7 Weipeng Zhuo, Ka Ho Chiu, Jierun Chen, Ziqi Zhao, S.-H. Gary Chan, Sangtae Ha, and Chul-Ho Lee, "FIS-ONE: Floor Identification System with One Label for Crowdsourced RF Signals," 2023 43th IEEE Conference on Distributed Computing Systems (*IEEE ICDCS*), 2023 (83 out of 439 submissions, acceptance ratio: 18.9%)
- C8 Weipeng Zhuo, Ka Ho Chiu, Jierun Chen, Jiajie Tan, Edmund Sumpena, S.-H. Gary Chan, Sangtae Ha, and Chul-Ho Lee, "Semi-supervised Learning with Network Embedding on Ambient RF Signals for Geofencing Services," *IEEE ICDE 2023 - IEEE International Conference on Data Engineering*, 2023.
- C9 Tu Van Nguyen, Kyungchan Ko, Sangwoo Ryu, Sangtae Ha, and James W. Hong, "Improve Video Conferencing Quality with Deep Reinforcement Learning," *NOMS 2023 - IEEE/IFIP Network Operations and Management Symposium*, 2023.
- C10 Taejin Kim, Sandesh Dhawaskar Sathyanarayana, Siqi Chen, Youngbin Im, Xiaoxi Zhang, Sangtae Ha, and Carlee Joe-Wong, "MoDEMS: Optimizing Edge Computing Migrations for User Mobility," *IEEE INFOCOM 2022 - IEEE Conference on Computer Communications*, 2022 (255 out of 1129 submissions, acceptance ratio: 22.6%)
- C11 Weipeng Zhuo, Ziqi Zhao, Ka Ho Chiu, Shiju Li, Sangtae Ha, Chul-Ho Lee, and S.-H. Gary Chan, "GRAFICS: Graph Embedding-based Floor Identification Using Crowdsourced RF Signals," 2022 42th IEEE Conference on Distributed Computing Systems (*IEEE ICDCS*), pp. 11 pages, 2022 (114 out of 573 submissions, acceptance ratio: 19.9%)
- C12 Jierun Chen, Tianlang He, Weipeng Zhuo, Li Ma, Sangtae Ha and S.-H. Gary Chan, "TVConv: Efficient Translation Variant Convolution," *IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR)*, New Orleans, LA, USA, 2022 pp. 12538-12548 (2067 out of 8161 submissions,

acceptance ratio: 25.33%)

- C13 Insoo Lee, Seyeon Kim, Sandesh Sathyanarayana, Kyungmin Bin, Song Chong, Kyunghan Lee, Dirk Grunwald and Sangtae Ha, "R-FEC: RL-Based FEC Adjustment for Better QoE in WebRTC," Proceedings of the 30th ACM International Conference on Multimedia (*ACM Multimedia*), pp. 2948–2956, 2022. (690 out of 2473 submissions, acceptance ratio: 27.9%)
- C14 Taeho Kim, Yongin Kwon, Jemin Lee, Taeho Kim and Sangtae Ha, "CPrune: Compiler-Informed Model Pruning for Efficient Target-Aware DNN Execution," European Conference on Computer Vision (*ECCV*), 2022. (1650 out of 5803 submissions, acceptance ratio: 28%)
- C15 Insoo Lee, Jinsung Lee, Kyunghan Lee, Dirk Grunwald and Sangtae Ha, "Demystifying Commercial Video Conferencing Applications," Proceedings of the 29th ACM International Conference on Multimedia (*ACM Multimedia*), pp. 3583–3591, 2021. (542 out of 1942 submissions, acceptance ratio: 27.9%)
- C16 Seyeon Kim, Kyungmin Bin, Sangtae Ha, Kyunghan Lee, and Song Chong, "zTT: Learning-based DVFS with Zero Thermal Throttling for Mobile Devices," In Proceedings of the 19th Annual International Conference on Mobile Systems, Applications, and Services (*MobiSys '21*), pp. 41–53, 2021. , acceptance ratio: 21.7%)
- C17 Zhang Liu, Hee Won Lee, Yu Xiang, Dirk Grunwald, and Sangtae Ha, "eMRC: Efficient Miss Ratio Approximation for Multi-Tier Caching," Proceedings of the 19th USENIX Conference on File and Storage Technologies (*FAST '21*), pp. 293–306, 2021. (28 out of 130 submissions, acceptance ratio: 21.5%)
- C18 Jinsung Lee, Sungyong Lee, Jongyun Lee, Sandesh Dhawaskar Sathyanarayana, Hyoyoung Lim, Jihoon Lee, Xiaoqing Zhu, Sangeeta Ramakrishnan, Dirk Grunwald, Kyunghan Lee, and Sangtae Ha, "PERCEIVE: Deep Learning-based Cellular Uplink Prediction Using Real-time Scheduling Patterns," In Proceedings of the 18th International Conference on Mobile Systems, Applications, and Services (*MobiSys '20*), pp. 377–390, 2020. (34 out of 175 submissions, acceptance ratio: 19.4%)
- C19 Parisa Rahimzadeh, Jinsung Lee, Youngbin Im, Siun-Chuon Mau, Eric C. Lee, Bradford O. Smith, Fatemah Al-Duoli, Carlee Joe-Wong, and Sangtae Ha, "SPARCLE: Stream Processing Applications over Dispersed Computing Networks," 2020 40th IEEE Conference on Distributed Computing Systems (*IEEE ICDCS*), pp. 11 pages, 2020. (105 out of 584 submissions, acceptance ratio: 18%)
- C20 Blake Caldwell, Youngbin Im, Sepideh Goodarzy, Sangtae Ha, Richard Han, Eric Keller, and Eric Rozner, "FluidMem: Full Flexible and Fast Memory Disaggregation for the Cloud," 2020 40th IEEE Conference on Distributed Computing Systems (*IEEE ICDCS*), pp. 11 pages, 2020. (105 out of 584 submissions, acceptance ratio: 18%)
- C21 Xiaoxi Zhang, Siqi Chen, Youngbin Im, Maria Gorlatova, Sangtae Ha, and Carlee Joe-Wong, "Towards Automated Network Management: Learning the Optimal Protocol Selection," the IEEE 27th International Conference on Network Protocols (*ICNP*), pp. 1–4, 2019. (Acceptance ratio: 19.3%)
- C22 Parisa Rahimzadeh, Youngbin Im, Gueyoung Jung, Carlee Joe-Wong and Sangtae Ha, "ECHO: Efficiently Overbooking Applications to Create a Highly Available Cloud," 2019 39th IEEE Conference on Distributed Computing Systems (*IEEE ICDCS*), pp. 1–11, 2019. (Acceptance ratio: 19.6%)
- C23 Gyuhong Lee, Jihoon Lee, Jinsung Lee, Youngbin Im, Max Hollingsworth, Eric Wustrow, Dirk Grunwald and Sangtae Ha, "This is Your President Speaking: Spoofing Alerts in Networks," In Proceedings of the 17th Annual International Conference on Mobile Systems, Applications, and

Services (*MobiSys '19*), pp. 404–416, 2019. (acceptance ratio: 23.2%)

- C24 Jihoon Lee, Jinsung Lee, Youngbin Im, Sandesh Sathyanarayana, Parisa Rahimzadeh, Xiaoxi Zhang, Max Hollingworth, Carlee Joe-Wong, Dirk Grunwald and Sangtae Ha, “CASTLE over the Air: Distributed Scheduling for Cellular Data Transmissions,” In Proceedings of the 17th Annual International Conference on Mobile Systems, Applications, and Services (*MobiSys '19*), pp. 417–429, 2019. (Acceptance ratio: 23.2%)
- C25 Youngbin Im, Parisa Rahimzadeh, Brett Shouse, Shinik Park, Carlee Joe-Wong, Kyunghan Lee and Sangtae Ha, “I Sent It: Where Does Slow Data Go to Wait?,” In Proceedings of the Fourteenth EuroSys Conference (*EuroSys '19*), Article 22, pp. 1–15, 2019. (Acceptance ratio: 21.7%)
- C26 Shinik Park, Jinsung Lee, Junseon Kim, Jihoon Lee, Sangtae Ha, and Kyunghan Lee, “ExLL: An Extremely Low-Latency Congestion Control for Mobile Cellular Networks,” In Proceedings of the 14th International Conference on emerging Networking EXperiments and Technologies (*CoNEXT '18*), pp. 307–319, 2018. (Acceptance ratio: 17.3%)
- C27 Youngbin Im, Prasanth Prahlanad, Tae Hwan Kim, Yong Geun Hong, and Sangtae Ha, “SNN-Cache: A Practical Machine Learning-based Caching System Utilizing the Inter-relationships of Requests,” 2018 52nd Annual Conference on information Science and Systems (*CISS*), pp. 1–6, 2018.
- C28 Gueyoung Jung, Parisa Rahimzadeh, Zhang Liu, Sangtae Ha, Kaustubh Joshi, and Matti Hiltunen, “Virtual Redundancy for Active-Standby Cloud Applications,” *IEEE INFOCOM 2018 - IEEE Conference on Computer Communications*, Honolulu, HI, 2018, pp. 1916–1924. (Acceptance ratio: 19.2%).
- C29 Taeyeol Jeong, Jaeyoon Chung, James Won-Ki Hong, and Sangtae Ha, “Towards a distributed computing model for fog,” 2017 IEEE Fog World Congress (*FWC*), Santa Clara, CA, 2017, pp. 1–6.
- C30 Jincao Zhu, Youngbin Im, Shivakant Mishra, and Sangtae Ha, “Calibrating Time-variant, Device-specific Phase Noise for COTS WiFi Devices,” In Proceedings of the 15th ACM Conference on Embedded Network Sensor Systems (*SenSys '17*), Article 15, pp. 1–12. (Acceptance ratio: 17.4%)
- C31 Youngbin Im, Ji Hoon Lee, Jinyoung Han, Yoon Kwon, Carlee Joe-Wong, Ted “Taekyoung” Kwon, and Sangtae Ha, “FLARE: Coordinated Rate Adaptation for HTTP Adaptive Streaming in Cellular Networks,” 2017 IEEE 37th International Conference on Distributed Computing Systems (*ICDCS*), Atlanta, GA, 2017, pp. 298–307. (Acceptance ratio: 16.94%).
- C32 Parisa Rahimzadeh, Carlee Joe-Wong, Kyuyong Shin, Youngbin Im, Jongdeog Lee and Sangtae Ha, “SVC-TChain: Incentivizing Good Behavior in Layered P2P Video Streaming,” *IEEE INFOCOM 2017 - IEEE Conference on Computer Communications*, Atlanta, GA, 2017, pp. 1–9. (Acceptance ratio: 20.93%).
- C33 Carlee Joe-Wong, Youngbin Im, Kyuyong Shin, and Sangtae Ha, “A Performance Analysis of Incentive Mechanisms for Cooperative Computing,” 2016 IEEE 36th International Conference on Distributed Computing Systems (*ICDCS*), Nara, 2016, pp. 108–117. (Acceptance ratio: 17.6%)
- C34 Liang Zheng, Carlee Joe-Wong, Christopher Brinton, Cheewei Tan, Sangtae Ha, and Mung Chiang, “Viability of Virtual Cloud Providers,” In Proceedings of the 2016 ACM SIGMETRICS International Conference on Measurement and Modeling of Computer Science (*SIGMETRICS '16*), pp. 235–248, 2016. (Acceptance ratio: 13.46%).

- C35 Felix Ming Fai Wong, Carlee Joe-Wong, Sangtae Ha, Zhenming Liu, and Mung Chiang, "Improving User QoE for Residential Broadband: Adaptive Traffic Management at the Network Edge," 2015 IEEE 23rd International Symposium on Quality of Service (IWQoS), Portland, OR, 2015, pp. 105–114. (Acceptance ratio: 22.5%).
- C36 Kyuyong Shin, Carlee Joe-Wong, Sangtae Ha, Yung Yi, Injong Rhee and Douglas Reeves, "T-Chain: A General Incentive Scheme for Cooperative Computing," 2015 IEEE 35th International Conference on Distributed Computing Systems, Columbus, OH, 2015, pp. 163–174. (Acceptance ratio: 12.89%).
- C37 Jaeyoon Chung, Carlee Joe-Wong, Sangtae Ha, James Won-Ki Hong, and Mung Chiang, "CYRUS: Towards Client-Defined Cloud Storage," In Proceedings of the Tenth European Conference on Computer Systems (*EuroSys '15*). Article 17, 1–16. (Acceptance ratio: 21.33%)
- C38 Carlee Joe-Wong, Sangtae Ha, and Mung Chiang, "Sponsoring Mobile Data: An Economic Analysis of the Impact on Users and Content Providers," 2015 IEEE Conference on Computer Communications (*INFOCOM*), Kowloon, 2015, pp. 1499–1507. (Acceptance ratio: 19%).
- C39 Liang Zheng, Carlee Joe-Wong, Chee-Wei Tan, Sangtae Ha, and Mung Chiang, "Secondary Markets for Mobile Data: Feasibility and Benefits of Traded Data Plans," 2015 IEEE Conference on Computer Communications (*INFOCOM*), Kowloon, 2015, pp. 1580–1588. (Acceptance ratio: 19%).
- C40 Carlee Joe-Wong, Soumya Sen, and Sangtae Ha, "Do Mobile Data Plans Affect Usage? Results from a Pricing Trial with ISP Customers," *Passive and Active Measurement Conference*, pp. 96–108, 2015 (Acceptance ratio: 27%).
- C41 Carlee Joe-Wong, Soumya Sen, and Sangtae Ha, "Offering Supplementary Wireless Technologies: Adoption Behavior and Offloading Benefits," in *Proceedings of the IEEE INFOCOM*, pp. 1061–1069, Apr. 2013 (17.4% acceptance rate).
- C42 Youngbin Im, Carlee Joe-Wong, Sangtae Ha, Soumya Sen, Ted "Taekyoung" Kwon and Mung Chiang, "AMUSE: Empowering Users for Cost-Aware Offloading with Throughput-Delay Tradeoffs," 2013 Proceedings IEEE INFOCOM, Turin, 2013, pp. 435–439. (Acceptance ratio: 17.4%).
- C43 Soumya Sen, Carlee Joe-Wong, Sangtae Ha, Jasika Bawa and Mung Chiang, "When the Price is Right: Enabling Time-Dependent Pricing of Broadband Data," in *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, pp. 2477–2486, 2013 (Acceptance ratio: 20%).
- C44 Sangtae Ha, Soumya Sen, Carlee Joe-Wong, Youngbin Im and Mung Chiang, "TUBE: Time-Dependent Pricing for Mobile Data," in *Proceedings of the ACM SIGCOMM*, pp. 247–258, Helsinki, Finland, 2012. (Acceptance ratio: 13%).
- C45 Sangtae Ha, Carlee Joe-Wong, Soumya Sen, and Mung Chiang, "Pricing by Timing: Innovating Broadband Data Plans", *Broadband Access Communications Technologies VI (SPIE OPTO)*, vol. 8282, pp. 67 – 79, 2012.
- C46 Ioannis Kamitsos, Paschalis Tsiaflakis, Ken Kerpez, Sangtae Ha, and Mung Chiang, "Efficient DSL via Heterogeneous Sleeping States: Optimization Structures and Operation Guidelines," 2012 IEEE Global Communications Conference (*GLOBECOM*), Anaheim, CA, 2012, pp. 3128–3134. (Acceptance ratio: 37.7%).
- C47 Joe Wenjie Jiang, Tian Lan, Sangtae Ha, Minghua Chen, and Mung Chiang "Joint VM Placement and Routing for Data Center Traffic Engineering," 2012 Proceedings *IEEE INFOCOM*, Orlando, FL, 2012, pp. 2876–2880. (Acceptance ratio: 18%).
- C48 Ioannis Kamitsos, Lachlan Andrew, Hongseok Kim, Sangtae Ha, and Mung Chiang "Better

Delay Tradeoff via Server Resource Pooling,” 2012 International Conference on Computing, Networking and Communications (ICNC), Maui, HI, 2012, pp. 611-616.

- C49 Ioannis Kamitsos, Paschalis Tsiaflakis, Sangtae Ha, and Mung Chiang, “Stable Sleeping in DSL Broadband Access: Feasibility and Tradeoffs,” 2011 IEEE Global Telecommunications Conference - GLOBECOM 2011, Houston, TX, USA, 2011, pp. 1-6. (Acceptance ratio: 36.6%).
- C50 Carlee Joe-Wong, Sangtae Ha, and Mung Chiang, “Time-Dependent Broadband Pricing: Feasibility and Benefits”, 2011 31st International Conference on Distributed Computing Systems (ICDCS), Minneapolis, MN, 2011, pp. 288-298. (Acceptance ratio: 15.4%).
- C51 Mung Chiang, Prashanth Hande, Hongseok Kim, Sangtae Ha, and Robert Calderbank, “Pricing Broadband: Survey and Open Problems,” 2010 Second International Conference on Ubiquitous and Future Networks (ICUFN), Jeju, 2010, pp. 303–308.
- C52 Ajit Warrier, Sankar Janakiraman, Sangtae Ha, and Injong Rhee, “DiffQ: Practical Differential Backlog Congestion Control for Wireless Networks,” in Proceedings of the *IEEE INFOCOM*, pp. 262–270, Rio de Janeiro, Brazil, Apr. 2009. (Acceptance ratio: 19.65%).
- C53 Han Cai, Do Young Eun, Sangtae Ha, Injong Rhee, and Lisong Xu, “Stochastic Ordering for Internet Congestion Control and its Applications,” *IEEE INFOCOM 2007 - 26th IEEE International Conference on Computer Communications*, Barcelona, 2007, pp. 910–918. (Acceptance ratio: 18%).

Workshops

- WS1 Xiaoxi Zhang, Siqi Chen, Youngbin Im, Maria Gorlatova, Sangtae Ha, and Carlee Joe-Wong, “Optimal Learning-Based Network Protocol Selection,” *IEEE/ACM ISCA Workshop on Machine Learning for Systems*, 2019.
- WS2 Zaid Al-Ali, Sepideh Goodarzy, Ethan Hunter, Sangtae Ha, Richard Han, Eric Keller and Eric Rozner, “Making Serverless Computing More Serverless,” 2018 IEEE 11th International Conference on Cloud Computing (CLOUD), San Francisco, CA, 2018, pp. 456-459. (Acceptance ratio: 20%).
- WS3 Soumya Sen, Carlee Joe-Wong, Sangtae Ha and Mung Chiang, “Time-Dependent Pricing in Mobile Data Plans: Results from a Field Deployment in Alaska,” *Workshop on Information Technology and Systems*, 2016.
- WS4 Seungwon Kim, Gun Lee, Sangtae Ha, Nobuchika Sakata and Mark Billingham, “Automatically Freezing Live Video for Annotation during Video Conferencing,” In Proceedings of the 33rd Annual ACM Conference Extended Abstracts on Human Factors in Computing Systems (CHI EA '15), pp. 1669–1674.
- WS5 Ming-Jye Sheng, Carlee Joe-Wong, Sangtae Ha, Felix Ming Fai Wong and Soumya Sen, “Smart Data Pricing: Lesson from Trial Planning,” 2013 *IEEE INFOCOM Workshop - Smart Data Pricing (in conjunction with IEEE INFOCOM)*, pp. 3327-3332.
- WS6 Soumya Sen, Carlee Joe-Wong and Sangtae Ha, “The Economics of Shared Data Plans,” *Workshop on Information Technology and Systems (in conjunction with ICIS)*, pp. 6 pages, 2012.
- WS7 Yaogong Wang, Injong Rhee, and Sangtae Ha, “Augment SCTP Multi-Streaming with Pluggable Scheduling,” 2011 IEEE Conference on Computer Communications Workshops (*INFOCOM WK-SHPS*), Shanghai, 2011, pp. 810–815.
- WS8 Carlee Joe-Wong, Sangtae Ha, and Mung Chiang, “Time-Dependent Internet Pricing,” *Information Theory and Applications Workshop*, UCSD, Feb., 2011.

- WS9 Sangtae Ha and Injong Rhee, "Hybrid Slow Start for High-Bandwidth and Long-Distance Networks," *PFLDNeT*, Manchester, UK, 2008, pp. 6 pages.
- WS10 Lachlan Andrew, Cesar Marcondes, Sally Floyd, Lawrence Dunn, Romaric Guillier, Wang Gang, Lars Eggert, Sangtae Ha and Injong Rhee, "Towards a Common TCP Evaluation Suite," *PFLDNeT*, Manchester, UK, 2008. pp. 5 pages.
- WS11 Han Cai, Do Young Eun, Sangtae Ha, Injong Rhee, and Lisong Xu, "Stochastic Ordering for Internet Congestion Control," *PFLDNeT*, ISI, Marina Del Rey, CA, 2007.
- WS12 Sangtae Ha, Yusung Kim, Injong Rhee, and Lisong Xu, "A Step toward Realistic Performance Evaluation of High-Speed TCP Variants," *PFLDNeT*, Japan, Feb., 2006, pp. 8 pages.

Demo and Posters

- D1 Taejin Kim, Siqi Chen, Youngbin Im, Xiaoxi Zhang, Sangtae Ha, and Carlee Joe-Wong, "MoDEMS: Optimizing Edge Computing for User Mobility," 2021 IEEE/ACM 29th International Symposium on Quality of Service (IWQOS) (poster), pp. 1–2, 2021.
- D2 Max Hollingsworth, Gyuhong Lee, Jihoon Lee, Jinsung Lee, Youngbin Im, Eric Wustrow, Dirk Grunwald, and Sangtae Ha, "This is Your President Speaking: Spoofing Alerts in Networks (demo)," In Proceedings of the 17th Annual International Conference on Mobile Systems, Applications, and Services (*MobiSys '19*), pp. 663–664, 2019.
- D3 Sandesh Dhawaskar Sathyanarayana, Jihoon Lee, Jinsung Lee, Youngbin Im, Parisa Rahimzadeh, Xiaoxi Zhang, Max Hollingsworth, Carlee Joe-Wong, Dirk Grunwald, and Sangtae Ha, "CASTLE over the Air – Distributed Scheduling for Cellular Data Transmissions (demo)," In Proceedings of the 17th Annual International Conference on Mobile Systems, Applications, and Services (*MobiSys '19*), pp. 673–674, 2019.
- D4 Zhang Liu, Eric Keller, and Sangtae Ha, "Mitigating Network Resource Abuses and DDoS attacks with Client Puzzle based Software-Defined Networks," *USENIX Network Systems Design and Implementation (NSDI)*, Poster Session, Santa Clara, CA, Mar., 2016.
- D5 Sangtae Ha, Soumya Sen, Carlee Joe-Wong, and Mung Chiang, "DataMi," *NYC Media Lab Research Summit*, Sept., 2012.
- D6 Sangtae Ha, Soumya Sen, Carlee Joe-Wong, Rudiger Rill and Mung Chiang, "Demo: A System for Time-Dependent Pricing," *ACM Mobisys*, Low Wood Bay, UK, 2012.
- D7 Sangtae Ha, Soumya Sen, Carlee Joe-Wong, Justin Mifkovich, Rudiger Rill, Youngbin Im, Dana Butnariu, Jasika Bawa and Mung Chiang, "Demo: Pricing by Timing of Mobile Data," *IEEE INFOCOM 2012*.
- D8 Sangtae Ha, Carlee Joe-Wong, Soumya Sen and Mung Chiang, "TUBE: Pricing by Timing," *Poster, Celebrate Princeton Invention*, Chancellor Green, Princeton, Dec., 2011.
- D9 Sangtae Ha and Soumya Sen, "Princeton TUBE trials: Discussions with US ISPs," *Demo and Poster, NECA (National Exchange Carrier Association) EXPO*, Chicago, Sept., 2011.
- D10 Carlee Joe-Wong, Sangtae Ha, Soumya Sen, and Mung Chiang, "TUBE: Pricing by Timing," *Poster, 4th Computer Sciences & Economics Day*, New York Academy of Sciences, Sept., 2011.
- D11 Ajit Warriar, Sangtae Ha, Prashant Wason, and Injong Rhee, "DiffQ: Differential Backlog Congestion Control for Multi-hop Wireless Networks," *Demo, SECON*, 2008.

D12 Sangtae Ha, Ajit Warriar, and Injong Rhee, "TCP problem under high bandwidth delay product networks - Demo III (B)," *The Future of TCP: Train-wreck or Evolution?*, Stanford University, Stanford, CA, 2008.

Technical Reports

- TR1 Ehab Ababneh, Zaid Al-Ali, Sangtae Ha, Richard Han and Eric Keller, "Elasticizing Linux via Joint Disaggregation of Memory and Computation," *arXiv 1806.00885*, June 2018.
- TR2 Blake Caldwell, Youngbin Im, Sangtae Ha, Richard Han and Eric Keller, "FluidMem: Memory as a Service for the Datacenter," *arXiv 1707.07780*, July 2017.
- TR3 Murad Kablan, Carlee Joe-Wong, Sangtae Ha, Hani Jamjoom and Eric Keller, "The Cloud Needs a Reputation System," *arXiv 1509.09057*, Sept 2015, pp. 14 pages.
- TR4 Carlee Joe-Wong, Sangtae Ha and Mung Chiang, "Time-dependent broadband pricing: Feasibility and Benefits," *Princeton University Technical Report*, 2011.
- TR5 Victor Glass and Princeton EDGE Lab, "United States' Broadband Goals: Managing "Spillover Effects" to Increase Availability, Adoption, and Investment – A Discussion," *Joint Whitepaper with NECA on Broadband Plan*, June 2010.
- TR6 Sangtae Ha and Injong Rhee, "Taming the Elephants: New TCP Slow Start," *NCSU Technical Report*, 2008.
- TR7 Ajit Warriar, Sangtae Ha, and Injong Rhee, "DiffQ: Differential Backlog Congestion Control for Multi-hop Wireless Networks," *NCSU Technical Report*, 2008.
- TR8 Sangtae Ha, Yusung Kim, Injong Rhee, and Lisong Xu, "A Step toward Realistic Performance Evaluation of High-Speed TCP Variants," *NCSU Technical Report*, 2006.

Patents (granted)

- P1 Jin-Sung Lee, Young-Bin Im, Sangtae Ha, Sang-Jun Moon, Jung-Shin Park, Ji-Cheol Lee, and Joo-Hyung Lee, Method and Apparatus for Controlling Send Buffer of Transmission Control Protocol in Communication System, *United State Publication#*: US 10560389, Feb. 11, 2020.
- P2 Mung Chiang, Carlee Joe-Wong, Sangtae Ha and Soumya Sen, System and Methods for Time Deferred Transmission of Mobile Data, *United State Publication#*: US 10536584, Jan. 14, 2020.
- P3 Gueyoung Jung, Kaustubh Joshi, and Sangtae Ha, Virtual redundancy for active-standby cloud applications, *United State Publication#*: US 10417035, Sept. 17, 2019.
- P4 Christopher Greg Brinton, Weiyu Chen, Mung Chiang, Sangtae Ha, and Stefan Ruediger Rill, Systems and Methods for Automated Course Individualization via Learning Behaviors and Natural Language Processing, *United States Publication#*: US 10339822, July, 2019.
- P5 Mung Chiang, Sangtae Ha, Soumya Sen, and Carlee Joe-Wong, System and Method for Variable Pricing of Data Usage, *United States Publication#*: US 9865009, Jan. 9, 2018.
- P6 Mung Chiang, Sangtae Ha, Carlee Joe-Wong, Shantigram Jagannath and Wim Sweldens, System and Method for Scheduling Mobile Data During a Spectrum Valley, *United States Publications#*: US 9820291, Nov. 14, 2017.
- P7 Jagan Shantigram, Minyan Shi, Carlee Joe-Wong, and Sangtae Ha, System and Method for Coordinating Client-Side Inference of Mobile Network Loading and Capacity, *United States Publication#*: US 9794155, Oct. 17, 2017.

- P8 Mung Chiang, Sangtae Ha, Carlee Joe-Wong, Harjot Saluja, Jagan Shantigram and Wim Sweldens, Client-Side Inference of Wireless Network States, *United States Publication#*: US 9407508, Aug. 2, 2016.
- P9 Nandita Dukkipati, Sangtae Ha, Vijay Subramanian, and Flavio Bonomi, "Increasing Transmission Rate to a Remote Device In Response to Attributing Information Loss at Not Being a Result of Network Congestion," *United States Publication#*: US 8625622, June 30, 2011, *European Patent#*: US 2010060517, Dec. 15, 2010.

Patents (pending)

- PP1 Chris Brinton, Ruediger Rill, Mung Chiang, Sangtae Ha, William Ju, James Walker, Da Cao, and Weiyu Chen, Systems and Methods for Integrating an eLearning Course Delivery Platform with an Enterprise Social Network, U.S. Patent Application #14/876239, filed Oct. 2015.
- PP2 Chris Brinton, Mung Chiang, Sangtae Ha, William Ju, Ruediger Rill, and James Walker, Systems and Methods for Authoring an Integrated and Individualized Course or Textbook, U.S. Patent #14/829202, filed Aug. 2015.
- PP3 Chris Brinton, Mung Chiang, Sangtae Ha, William Ju, Ruediger Rill, and James Walker, Systems and Methods to Assist an Instructor of a Course, U.S. Patent #14/712108, filed May 2015.
- PP4 Mung Chiang, Carlee Joe-Wong, Sangtae Ha and Soumya Sen, System and Methods for Time Dependent Internet Pricing, U.S. Patent Application #13/780941, filed Feb. 2013.
- PP5 Mung Chiang, Sangtae Ha, Ruediger Rill, Christopher Brinton and William Ju, "Methods and Systems for Creating, Delivering, Using, and Leveraging Integrated Teaching and Learning," *U.S. Patent Application # 14,063,289 and International Application # PCT/US13/67010*, Oct. 2013.

Made Contributions to Internet Standards Related to Digital Subscriber Line (DSL).

- ST1 Ioannis Kamitsos, Paschalis Tsiaflakis, Ken Kerpez, Sangtae Ha, and Mung Chiang, "G.adsl: Stable Sleep Mode Optimization for Efficient DSL," *ATIS COAST-NAI contribution COAST-NAI 2012-019*, Aug. 22, 2012.
- ST2 Ken Kerpez, Ioannis Kamitsos, Paschalis Tsiaflakis, Sangtae Ha, and Mung Chiang, "G.adsl: Proposal to Enable Optimal Sleeping," *ATIS COAST-NAI contribution COAST-NAI-2012-020R1*, Aug. 22, 2012.
- ST3 Ioannis Kamitsos, Paschalis Tsiaflakis, K. Kerpez, Sangtae Ha, and Mung Chiang, "G.adsl: Stable Sleep Mode Optimization for Efficient DSL," *US Study Group B contribution B12-08-40*, Aug. 24, 2012.
- ST4 Ken Kerpez, Ioannis Kamitsos, Paschalis Tsiaflakis, Sangtae Ha, and Mung Chiang, "G.adsl: Proposal to Enable Optimal Sleeping," *US Study Group B contribution B12-08-41*, Aug. 24, 2012.
- ST5 Ioannis Kamitsos, Paschalis Tsiaflakis, Ken Kerpez, Sangtae Ha, and Mung Chiang, "G.adsl: Stable Sleep Mode Optimization for Efficient DSL," *ITU-T contribution T09-SG15-C-2066*, 10-21 Sept., 2012.
- ST6 Ken Kerpez, Ioannis Kamitsos, Paschalis Tsiaflakis, Sangtae Ha, and Mung Chiang, "G.adsl Stable Sleep Mode Optimization for Efficient DSL: Proposal," *ITU-T contribution T09-SG15-C-2057*, 10-21 Sept., 2012.

Professional Magazine Articles

- M1 Sangtae Ha and Hyunjoon Cha, "Design and Implementation of Embedded Linux," *Programmer's World*, issue 3-1, April, 2001.
- M2 Sangtae Ha and Hyunjoon Cha, "Embedded Linux for Network Devices," *Linux@Works*, Nov., 2001.

M3 Sangtae Ha and Hyunjoon Cha, "Compare Embedded Linux with Other Real-Time Operating Systems," *Linux@Works*, Oct., 2001.

Presentations

PT1 MRTOM: Most Reliable Totally Ordered Multicast, a Network Primitive to Offload Distributed Systems, *IEEE ICDCS*, Hong Kong, P.R. China, July., 2023.

PT2 Research Challenges in Fog Networking, *NSF WiFiUS Meeting*, Helsinki, Finland, Aug., 2016.

PT3 T-Chain: A General Incentive Scheme for Cooperative Computing, *IEEE ICDCS*, Columbus, Ohio, Jun., 2015.

PT4 TUBE: Time Dependent Pricing for Mobile Data, *ACM SIGCOMM*, Helsinki, Finland, Aug., 2012.

PT5 Pricing Broadband Access, *ICUFN*, Jeju, Korea, June, 2010.

PT6 Hybrid Slow Start for High-Bandwidth and Long-Distance Networks, *PFLDNeT*, UK, Mar., 2008

PT7 Stochastic Ordering for Internet Congestion Control, *PFLDNeT*, ISI, Marina Del Rey, Feb., 2007

Invited Seminars/Lectures

T1 Accelerating Distributed Systems with Network and Software Programmability, *Invited Talk*, ETRI, Korea, Dec. 8, 2022.

T2 Towards AI-Driven Mobile Systems, *Invited Talk*, *Computer Science*, Chungnam University, Korea, Dec. 8, 2022.

T3 Enabling Closed-loop Personalized Sleep Care Through High-fidelity Brain Tracking and Just-in-time Brain Stimulation Wearables, *Invited Talk*, ETRI, Dec. 7, 2022.

T4 Towards Enhancing Rate Adaptation Behaviors in Video Conferencing using Reinforcement Learning, *Invited Talk*, UNIST, Korea, Dec. 6, 2022.

T5 Towards Enhancing Rate Adaptation Behaviors in Video Conferencing using Reinforcement Learning, *Invited Talk*, Hanyang University, Korea, Dec. 2, 2022.

T6 This is Your President Speaking: Spoofing Alerts in Networks, *Invited Talk*, Yonsei University, Korea, Nov. 30, 2022.

T7 Towards Enhancing Rate Adaptation Behaviors in Video Conferencing using Reinforcement Learning, *Invited Talk*, *2nd SNU-BK Workshop on Next-generation Wireless Communication and Networking*, Aug. 31, 2022.

T8 Towards AI-Driven Mobile Systems, *Invited Talk*, *Graduate School of Artificial Intelligence*, Pohang University of Science and Technology (POSTECH), Korea, Dec. 17, 2021.

T9 AI, Wireless and System Threats, *Invited Talk*, *The Workshop on AI Applications Trends in Health & Agriculture*, HCMC University of Technology and Education, Vietnam, Dec. 17, 2019.

T10 Networks Performance, *Invited Talk*, *Yonsei University*, South Korea, June 18, 2019.

T11 Networks Performance, *Invited Talk*, *The 9th International Workshop on Physical Systems (IWPCS 2019)*, DGIST, South Korea, June 13, 2019.

T12 Networks Performance, *Invited Talk*, *Kyung Hee University*, South Korea, June 13, 2019.

T13 Networks Performance, *Invited Talk*, *UNIST*, South Korea, June 14, 2019.

- T14 Combating Internet Latency in the Age of Fog and Cloud Computing, *Invited Talk*, UNIST, Ulsan, Korea, Dec. 14, 2018.
- T15 Bridging Theory and Practice: Towards More Accurate Wireless Sensing for Neural Devices, *Invited Talk*, KAIST, Daejeon, Korea, Aug. 6, 2018.
- T16 Bridging Theory and Practice: Towards More Accurate Wireless Sensing, *Computer Science Colloquium*, Colorado School of Mines, Golden, Colorado, Nov. 16, 2017.
- T17 Linux CUBIC: From Idea to Actual Deployment, *Invited Speaker*, Samsung Research America, Richardson, Texas, Nov. 3, 2017.
- T18 Bridging Theory and Practice: Towards More Accurate Wireless Sensing, *Computer Science Colloquium*, POSTECH, Pohang, Korea, Oct. 20, 2017.
- T19 Calibrating Time-variant, Device-specific Phase Noise for COTS WiFi Devices, *Invited Speaker*, The 8th International Conference on ICT Convergence (ICTC), Oct. 19, 2017.
- T20 Bridging Theory and Practice: Towards More Accurate Wireless Sensing, *Invited Speaker*, ETRI Seminar, Oct. 17, 2017.
- T21 Combating Internet Latency in the Age of Fog and Cloud Computing, *Invited Speaker*, Samsung Electronics, Suwon, Korea, Oct. 16, 2017.
- T22 Bridging Theory and Practice: Towards More Accurate Wireless Sensing, *Invited Speaker*, Hanyang University (ERICA), Korea, Oct. 16, 2017.
- T23 Combating Internet Latency in the Age of Fog and Cloud Computing, *Computer Science Colloquium*, University of Colorado Boulder, Sep. 28, 2017.
- T24 Fog Networking for IoT: Empowering End-User Devices, *Distinguished Speaker*, ETRI Seminar, Daejeon, Korea, Feb., 2016.
- T25 T-Chain: A General Incentive Scheme for Cooperative Computing, *Distinguished Speaker*, ETRI Seminar, Daejeon, Korea, Feb., 2016.
- T26 Fog Networking for IoT: Empowering End-User Devices, *Distinguished Speaker*, IoT World Forum Research and Innovation Forum, Hosted by Cisco, Dubai, Dec., 2015.
- T27 Fog Networking: Architecture, Algorithms, and Applications, *Invited Speaker*, Asia-US Forum on Fog Networking 2015, Taipei, Taiwan, Sep., 2015.
- T28 Challenges in Internet of Things, *IEEE SECON Workshop on Fog Networking*, Seattle, Washington, Jun., 2015.
- T29 CYRUS: Towards Client-Defined Cloud Storage, *ETRI Invited Seminar*, Daejeon, Korea, Apr., 2015.
- T30 Improving TCP Congestion Control for High Bandwidth and Long Distance Networks, *ITP Seminar*, University of Colorado Boulder, Nov., 2014.
- T31 Smart Data Pricing: From Theory to Practical Deployment, *Computer Science Seminar Talk*, University of Colorado Boulder, May, 2014.
- T32 CUBIC: Algorithm to Practical Deployment, *IT Convergence Division*, POSTECH, Korea, Dec., 2012.
- T33 CUBIC: Algorithm to Practical Deployment, *Guest Lecturer*, ELE 381, Princeton University, Nov., 2012.
- T34 TUBE: Time Dependent Pricing for Mobile Data - From Economic Theory to Trial Deployment, *Invited Speaker*, Industry (Samsung, ETRI, Korea Telecom), Korea, Dec., 2012.

- T35 TUBE: Time Dependent Pricing for Mobile Data - From Economic Theory to Trial Deployment, *Department Seminar, Academia (SNU, KAIST, POSTECH, UNIST, Sogang, KHU), Korea, Dec., 2012.*
- T36 Better Delay Tradeoff via Server Resource Pooling, *Invited Speaker, ICNC, Hawaii, Feb., 2012.*
- T37 TUBE – Pricing (Mobile Data) by Timing, *CTIF/Aalborg University Meeting, Princeton Univ., April, 2011*
- T38 TUBE – Pricing (Mobile Data) by Timing, *Princeton EDGE Lab Open House, Princeton Univ., April, 2011*
- T39 TUBE – Pricing (Mobile Data) by Timing, *Guest Lecture, Princeton University, March, 2011*
- T40 TUBE – Pricing (Mobile Data) by Timing, *Vodafone Wireless Innovation Competition, March, 2011*
- T41 Research Vision on Video-Aware Wireless Networks, *Intel VAWN Workshop, CA, Apr., 2010.*
- T42 Improving TCP Congestion Control for High Bandwidth and Long Distance Networks, *Invited Talk, Electrical Engineering, Princeton University, Oct., 2009*

Outreach Seminars/Lectures

- O1 Computer Science As Your Career, *Korean Presbyterian Church of Denver (KPCD), Arvada, Colorado, Oct. 29, 2017.*

Teaching, Mentoring and Advising

Courses Taught

2023 Fall	CSCI/ECEN 5273 Network Systems (001): 17 Graduate Students
2022 Spring	CSCI/ECEN 5273 Network Systems (001): 25 Graduate Students
2022 Spring	CSCI/ECEN 5273 Network Systems (001): 25 Graduate Students
2021 Fall	CSCI 4273 Network Systems (001): 26 Undergraduate Students
2021 Spring	CSCI/ECEN 5273 Network Systems (001): 15 Graduate Students
2020 Fall	CSCI 4273 Network Systems (001): 47 Undergraduate Students
2019 Fall	CSCI 4273 Network Systems (001): 55 Undergraduate Students: FCQ (Course: 5.03, Instructor: 5.44)
2019 Fall	CYBR 5010 Data Communications (001): 21 Graduate Students: FCQ (Course: 4.94, Instructor: 5.17)
2018 Fall	CSCI 4273/5273: Network Systems (001): 68 Graduate and Undergrad Students, FCQ (Course: 4.93, Instructor: 5.16) (001B): 17 Graduate Students, FCQ (Course: 5.5, Instructor: 5.58)
2018 Fall	TLEN 5330: Data Communications 1 (001): 33 Graduate Students (Course: 4.93, Instructor: 4.83)

2017 Fall	CSCI 4273/5273: Network Systems (001): 85 Graduate and Undergrad Students, FCQ (Course: 4.69, Instructor: 5.04) (001B): 29 Graduate Students, FCQ (Course: 4.82, Instructor: 4.88)
2017 Fall	TLEN 5330: Data Communications 1 48 Graduate Students, FCQ (Course: 4.49, Instructor: 4.11)
2016 Fall	CSCI 4273/5273: Network Systems, 92 Undergraduate Students, FCQ (Course: 4.7, Instructor: 4.7) 22 Graduate Students, FCQ (Course: 4.6, Instructor: 4.6)
2016 Fall	TLEN 5330: Data Communications 1, 47 Graduate Students, FCQ (Course: 5.4, Instructor: 5.1)
2016 Spring	CSCI 7000-010: Advanced Internet Protocols, 9 Graduate Students, FCQ (Course: 5.2, Instructor: 5.7)
2015 Fall	CSCI 4273/5273: Network Systems, 89 Undergraduate Students, FCQ: (Course: 4.1, Instructor: 4.1) 19 Graduate Students, FCQ: (Course: 5.5, Instructor: 5.2)
2015 Fall	TLEN 5330: Data Communications 1, 87 Graduate Students, FCQ (Course: 4.9, Instructor: 4.5)
2014 Fall	TLEN 5330: Data Communications 1, 48 Graduate Students, FCQ: (Course: 3.8, Instructor: 3.7)