Susmit Shannigrahi

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Research Interests

Internet Architectures, Information Centric Networks, Distributed Systems, Data Science for Networking, Large Scale Content Delivery, 5G Mobile Networks, and IoT

Education

Colorado State University
2019. Ph.D. in *Computer Science*,
Dissertation: **The Future of Networking is the Future of Large Data**
Committee chair: Prof. Christos Papadopoulos

2013. Master of *Computer Science*

Jadavpur University
2009. Master of Science in *Computer Science*
Thesis: **Fast BGP Convergence Following Link/Router Failure**
Thesis Supervisor: Prof. Swapan Kumar Ray

West Bengal University of Technology
2007. Bachelor of Computer Science and Engineering

Appointments

2013-2019. Graduate Research Assistant, Colorado State University, CO

- ▶ Investigated architectural shortcomings of existing data management systems and TCP/IP networks.
- ▶ Addressed these problems using novel network protocols such as Information Centric Network (ICN) and Software Defined Networking (SDN).
- ▶ Encouraged early adoption of ICN in scientific communities; developed software has been deployed at CERN, CalTech, CSU, Clemson, LBNL, and other institutes

2017. Research Intern, CableLabs, Louisville, CO

- ▶ Investigated the design challenges of a future 5G mobile network.
- ▶ Used Named Data Networking (NDN) to build a next-generation mobility plane.
- ▶ Published a research paper demonstrating novel features such as lossless handover, simultaneous use of WiFi and 5G links, and improved application throughput.

2013. Research Scientist Intern, Lawrence Berkeley National Lab, Berkeley, CA

- ▶ Investigated the limitations of the TCP/IP network architecture for high speed, high volume scientific data transport.

- ▶ Developed a bit-torrent like data transfer application using ICN to address these limitations.
- ▶ Received the internal "most innovative work" award.

2011-2016. System Administrator, NetSec Lab, Colorado State University, CO

2010-2013 Teaching Assistant, Colorado State University, CO

2009. Programmer Analyst, Cognizant Technology Solutions, Kolkata, India

2008. Teaching Assistant, Data Communication and Networking Lab, Jadavpur University, Kolkata, India

Publications

Refereed Articles

1. Susmit Shannigrahi, Chengyu Fan, and Christos Papadopoulos. Scari: A strategic caching and reservation protocol for icn. In *Proceedings of the Asian Internet Engineering Conference*, pages 1–8, New York, NY, USA, 2018. ACM. DOI: 10.1145/3289166.3289167

2. H. Lim, A. Ni, D. Kim, Y. Ko, S. Shannigrahi, and C. Papadopoulos. Ndn construction for big science: Lessons learned from establishing a testbed. *IEEE Network*, pages 1–13, 2018. DOI:10.1109/MNET.2018.1800088

3. Susmit Shannigrahi, Chengyu Fan, and Christos Papadopoulos. Ndn-sci - building a large scientific data management framework using named data networking(under review). *IEEE Transactions on Computing Systems*, pages 1–18, 2018

4. Susmit Shannigrahi, Chengyu Fan, and Greg White. Bridging the icn deployment gap with ipoc: An ip-over-icn protocol for 5g networks. In *Proceedings of the 2018 Workshop on Networking for Emerging Applications and Technologies*, NEAT '18, pages 1–7, Budapest, Hungary, 2018. ACM. DOI: 10.1145/3229574.3229575

5. Susmit Shannigrahi, Chengyu Fan, and Christos Papadopoulos. Named data networking strategies for improving large scientific data transfers. In *2018 IEEE International Conference on Communications Workshops (ICC Workshops)*, pages 1–6, May 2018. DOI: 10.1109/ICCW.2018.8403576

6. Susmit Shannigrahi, Chengyu Fan, and Christos Papadopoulos. Request aggregation, caching, and forwarding strategies for improving large climate data distribution with ndn: A case study. In *Proceedings of the 4th ACM Conference on Information-Centric Networking*, ICN '17, pages 54–65, New York, NY, USA, 2017. ACM. DOI: 10.1145/3125719.3125722

7. Susmit Shannigrahi, Chengyu Fan, Steve DiBenedetto, Catherine Olschanowsky, Christos Papadopoulos, and Harvey Newman. Managing scientific data with named data networking. In *Proceedings of the Fifth International Workshop on Network-Aware Data Management*, NDM '15, pages 1:1–1:7, New York, NY, USA, 2015. ACM. DOI: 10.1145/2832099.2832100

8. Susmit Shannigrahi, Christos Papadopoulos, Edmund Yeh, Harvey Newman, Artur Jerzy Barczyk, Ran Liu, Alex Sim, Azher Mughal, Inder Monga, Jean-Roch Vlimant, and

John Wu. Named data networking in climate research and hep applications. *Journal of Physics: Conference Series*, 664(5): pages 1–8, 2015. DOI: 10.1088/1742-6596/664/5/052033

9. Catherine Olschanowsky, Susmit Shannigrahi, and Christos Papadopoulos. Supporting climate research using named data networking. In *2014 IEEE 20th International Workshop on Local Metropolitan Area Networks (LANMAN)*, pages 1–6, May 2014. DOI: 10.1109/LANMAN.2014.7028640

10. Swapan Kumar Ray and Susmit Shannigrahi. Fast bgp convergence following link/router failure. In Krishna Kant, Sriram V. Pemmaraju, Krishna M. Sivalingam, and Jie Wu, editors, *Distributed Computing and Networking*, pages 473–484, Berlin, Heidelberg, 2010. Springer Berlin Heidelberg. DOI:10.1007/978-3-642-11322-2

In Preparation/Under Submission

1. Susmit Shannigrahi, Spyridon Mastorakis, Francisco R. Ortega, *Next-Generation Networking and Edge Computing for Mixed Reality Real-Time Interactive Systems*

2. Susmit Shannigrahi, Alex Feltus, *Piloting Genomics Datasets into an Information Centric Networking Framework*

3. Susmit Shannigrahi, Chengyu Fan, Christos Papadopoulos, *What's in a Name? Design Trade-offs of Content Naming in ICN Networks*

4. Susmit Shannigrahi, Alex Feltus, Christos Papadopoulos, *Integrating Information Centric Networking with the iRods Genomics Data Management System*

Extended Abstracts, Technical Reports and Internet-Drafts

1. A Afanasyev, Susmit Shannigrahi, and the NFD team, **NFD Developer's Guide**, NDN Technical Report, 2018

2. Greg White, Susmit Shannigrahi, Chengyu Fan, **Internet Protocol Tunneling over Content Centric Mobile Networks**, ICNRG Internet Draft, 2017

3. Susmit Shannigrahi, **Solving Large Scientific Data Management using Named Data Networking**, CSU Graduate Student Showcase, Fort Collins, CO, 2017

4. Susmit Shannigrahi, **SciNet: A Secure Science Data Infrastructure with Named Data Networking**, NSF Data Science Workshop, Seattle, WA, 2016

5. Susmit Shannigrahi, **Named Data Networking for Large Scientific Data Management**, Seattle, NSF Data Science Workshop, WA, 2015

6. Susmit Shannigrahi, **Evaluating Named Data Networking for Large Scientific Data**, Poster, ACM student research competition, Supercomputing, 2013

7. Susmit Shannigrahi, **Evaluating Named Data Networking for Large Scientific Data**, Poster, LBNL, CA, 2013

8. Susmit Shannigrahi, Daniel Massey, Christos Papadopoulos, **Traceroute for Named Data Networking**, NDN Technical Report, 2013

Thesis

1. Susmit Shannigrahi, **Fast BGP Convergence Following Link/Router Failure**, Masters Thesis, Jadavpur University, Kolkata, India, 2010

Grants and Awards

Grants

1. Cisco Gift, "X86 node for CICN testbed integration", Approximate Value $35000, PI: Susmit Shannigrahi
2. Cisco URP, "Creating a CICN based software infrastructure for distributed Genomics data management", Pending
3. Co-author, NSF grant on "Supporting Climate Modeling Over Named Data Networking (NDN)". (Total award: $1M, Funded Over 2013-2016, PI: Christos Papadopoulos, Co-PI: Cathie Olschanowsky and David Randall.)

Awards

1. Travel award to participate in NSF early career workshop, Alexandria, VA, 2019
2. Travel award to participate in NSF Data Science Workshop, UW, Seattle, 2016
3. Travel award to participate in NSF Data Science Workshop, UW, Seattle, 2015
4. NSF travel award for attending ICNP, 2013
5. Best Innovative Poster, NDN for Scientific Data, LBNL, 2013
6. Post Graduate Scholarship from Ministry of Human Resources Development (MHRD), Government of India, 2007

Panels, Workshops, and Presentations

Panels

1. S. Shannigrahi, L. Zhang, A. Afanasyev, T. Hasegawa, A. Grieco, T. Leng, "Real-world ICN deployments - perspective and challenges" - Kansas City, MO, ICC 2018

Workshops

1. "Address emerging challenges and pursue promising research opportunities in networking" - NSF sponsored NeTS-ECI workshop, Alexandria, VA, 2019
2. "Discuss and collaborate on Big Data/Data Science challenges" - NSF sponsored graduate data science workshop", UW, Seattle, WA, 2016
3. "Addressing problems facing Data Enabled Science & Engineering - NSF sponsored graduate data science workshop", UW, Seattle, WA, 2015
4. "Building the next-gen campus infrastructure for supporting data-intensive science - Operating Innovative Networks", LBNL, Berkeley, CA, 2014

Invited Talks

1. Susmit Shannigrahi, **The Future of Networking is the Future of Big Data**, California State University, Long Beach, California, 2019
2. Susmit Shannigrahi, **The Future of Networking is the Future of Big Data**, Valdosta State University, Valdosta, Georgia, 2019
3. Susmit Shannigrahi, **The Future of Networking is the Future of Big Data**, North Carolina A&T State University, Greensboro, North Carolina, 2019
4. Susmit Shannigrahi, **The Future of Networking is the Future of Big Data**, SUNY Buffalo State, Buffalo, New York, 2019
5. Susmit Shannigrahi, **The Future of Networking is the Future of Big Data**, Tennessee Technological University, Cookeville, Tennessee, 2019
6. Susmit Shannigrahi, **The Future of Networking is the Future of Big Data**, Hobart and William Smith Colleges, Geneva, New York, 2019
7. Susmit Shannigrahi, **The Future of Networking is the Future of Big Data**, University of Houston-Victoria, 2018
8. Susmit Shannigrahi and Mike Shepherd (Cisco), **ICN for Large Science Data**, Profiles in Partnership, Internet2 Technology Exchange, Orlando, Florida, 2018
9. Susmit Shannigrahi, John Hicks (Internet2), and Michael Kowal (Cisco), **Advancing Scientific Data Sharing, Discovery, and Security with Information Centric Networking (ICN)**, Internet2 Technology Exchange, Orlando, Florida, 2018
10. Susmit Shannigrahi, **NDN for Data Intensive Science - SANDIE**, NDNComm, NIST, Maryland, 2018
11. Susmit Shannigrahi **Named Data Networking in Scientific Applications**, Montana Tech, Montana, 2018
12. Susmit Shannigrahi **Named Data Networking in Scientific Applications**, Southern Illinois University Edwardsville, IL, 2018
13. Susmit Shannigrahi, Chengyu Fan, Christos Papadopoulos, **Named Data Networking in Scientific Applications**, Memphis, TN, 2017
14. Susmit Shannigrahi, Christos Papadopoulos, **Supporting Climate Applications over Named Data Networking (NDN)**, NOAA, Boulder, CO, 2014
15. Susmit Shannigrahi, Daniel Massey, Christos Papadopoulos, **Benefit of CCN for large data**, University of Colorado, Boulder, CO, 2012

Presentations

1. Susmit Shannigrahi, **Bridging the ICN Deployment Gap with IPoC: An IP-over-ICN protocol for 5G Networks**, SIGCOMM Workshops, Budapest, Hungary, 2018
2. Susmit Shannigrahi, **Performance Evaluation of Named Data Networking Forwarding Daemon (NFD)**, Online Seminar, 2018
3. Susmit Shannigrahi, **NDN-Android**, ICN 2017, Berlin, DE, 2017
4. Susmit Shannigrahi, **Reqest Aggregation, Caching, and Forwarding Strategies for Improving Large Climate Data Distribution with NDN: A Case Study**, ICN 2017, Berlin, DE, 2017
5. Susmit Shannigrahi, **Revisiting Traceroute for NDN**, Online Seminar, 2017
6. Susmit Shannigrahi, **Applying NDN to large scientific data**, Online Seminar, 2016
7. Susmit Shannigrahi, **Scientific Data Applications in NDN**, Online Seminar, 2016
8. Susmit Shannigrahi, Chengyu Fan, Steve DiBenedetto, Catherine Olschanowsky and Christos Papadopoulos, **Supporting Scientific Applications with NDN**, Denver, CO, 2015
9. Susmit Shannigrahi, Christos Papadopoulos, **Managing Scientific Data with Named Data Networking** , Denver, CO, 2015
10. Susmit Shannigrahi, Chengyu Fan, **NDN for Scientific Data Applications**, Online Seminar, 2015
11. Susmit Shannigrahi, **Managing Scientific Data with NDN**, UCLA, CA, 2015
12. Susmit Shannigrahi, Christos Papadopoulos, **NDN-fuse**, Denver, CO, 2014
13. Susmit Shannigrahi, Christos Papadopoulos **NDN-atmos**, CSU, Fort Collins, CO, 2014
14. Susmit Shannigrahi, Steve DiBenedetto, **NDN for Scientific Data**, UCLA, CA, 2013
15. Susmit Shannigrahi, Christos Papadopoulos **NDN-traceroute**, UCLA, CA, 2012
16. Susmit Shannigrahi, Christos Papadopoulos **Benefit of CCN for large data**, UCLA, CA, 2012
17. Susmit Shannigrahi, Fedora Medical Spin: In search of a comprehensive solution for the healthcare community, Bangalore, India, 2010
18. Susmit Shannigrahi, Redrawing and rewriting the Fedora Distribution process, Bangalore, India, 2009

Teaching and Mentoring

Teaching and Guest Lectures

2013, 2015, 2016, 2017, 2018: Several guest lectures in CS557, "Advanced Networking", Colorado State University

▶ **Selected topics:** Internet Design, Congestion Control, Advanced Border Gateway Protocol, Domain Name System, Named Data Networking, Software Defined Networking, and others

2014, 2015, 2016, 2017, 2018: Several Guest Lectures in CS457, "Advanced Networking", Colorado State University

▶ **Selected topics:** History of Networking, Network Architecture, Routing in the Internet, Security in the Network, TCP/IP, Congestion control, Border Gateway Protocol

2013. Several Lectures in CS370, "Operating Systems", Colorado State University

▶ **Selected topics:** Introduction to operating systems, processes and threads, process scheduling, interprocess communication, synchronization, deadlock and livelock, file systems, virtualization

2012. Several Lectures CT320, "Network and System Administration", Colorado State University

▶ **Selected topics:** Bash scripts, access aontrol , software installation, backups, network configuration, TCP/IP networking, security and firewall, Python for automation

2011. Several Lectures in CS451, "Operating System", Colorado State University

▶ **Selected topics:** OS Structures, CPU scheduling, Main and virtual Memory, file systems and mass storage devices, multimedia systems, security

Teaching Facilitation

2013. Teaching Assistant for CS370, "Operating Systems", 42 local students

2012. Teaching Assistant for CS470DL, "Computer Architecture", 10 online/remote students

2012. Teaching Assistant for CT320, "Network and System Administration", 30 students

2012 . Designed Assignments for Graduate Students, Using Named Data Networking over GENI, CSU and Purdue University

2011. Teaching Assistant for CS451, "Operating Systems", 66 local students

2011. Teaching Assistant for CS451DL, "Operating Systems", 20 online/remote students

2010. Teaching Assistant for CS155/156/157 , "Introduction to Unix and C Programming", 90 local students

Student Mentoring

2011. Ankur Sinha, Google Summer of Code, 2011

2015-2018. Tyler Scott (B.S. Student), Andres Calderon Jaramillo (M.S. Student)

Software Projects

Software Projects

- **NDN-SCI** - https://github.com/named-data/ndn-atmos - A NDN based Scientific Data Management Framework
- **IPoC** - https://github.com/named-data/IPoC - An IP over ICN protocol for 5G mobile networks
- **NFD** - https://github.com/named-data/NFD - The Named Data Networking forwarding daemon (NFD)
- **ndn-cxx** - https://github.com/named-data/ndn-cxx - A c++ library that implements the Named Data Networking primitives
- **SANDIE** - https://github.com/cmscaltech/sandie-ndn - SDN assisted NDN for Data Intensive Science

Evidence of Service/ Outreach

Academic Service

2019. Third International Conference on Smart Technologies in Data Science and Communication, SMART-DSC 2019

2019. 1st ACM CoNEXT workshop on Emerging in-Network Computing Paradigms, ENCP, 2019

2019. Technical Program Committee Member, Demos and Posters tracks, ACM ICN 2019

2017. Technical Program Committee Member,"NOM: Named-Oriented Mobility", INFOCOM 2017

2017. Technical Program Committee Member, Demos and Posters tracks, ACM ICN 2017

Workshop Facilitation

2017. Tutorial: Running IoT Applications over ICN, ICN 2017, Berlin, DE

2017. NDN Hackathon, University of Memphis, Memphis, TN

2016. NDN Retreat and Hackathon, CSU, Fort Collins, CO

2016. NDN Hackathon, UCSD, La Jolla, CA

Conference and Journal Reviewer

IEEE/ACM Transactions on Networking, ACM ICN, IFIP-Networking, INFOCOM-NOM, ICNP, INFOCOM, Computer Communication Review, COMSOC Journal, IEEE Future Generation Computer Systems, Transactions on Services Computing, Caching for Communication Systems and Networks.

Other Activities

Selected Professional and Non-profit activities

2011-2016. System Administrator, Network Security Lab, Colorado State University

2008-2009. System Administrator, Data Communication and Networking Lab, Jadavpur University, Kolkata, India

2007-2009. Fedora Mirror Manager, WBUT, Kolkata, India

2009-2012. Founder and contributor, Fedora Medical Special Interest group

2009-2011. Fedora Ambassadors Steering Committee Member, The Fedora Project

2005-2010. Fedora Ambassador, mentor, Fedora Freemedia leader, The Fedora Project

Non-academic articles

2009. Save Bandwidth by Setting Up a Fedora Mirror, Open Source For You Magazine

News

2015. CISL booth stands tall at SC15 - https://www2.cisl.ucar.edu/news/cisl-booth-stands-tall-sc15

2018. IPoC: A New Core Networking Protocol for 5G Networks - https://medium.com/@CableLabs/ipoc-a-new-core-networking-protocol-for-5g-networks-5428ab60699f

2018. Global Petascale to Exascale Science Workflows Accelerated by Next Generation Software Defined Network Architectures and Applications - http://supercomputing.caltech.edu/SC18/

References

References

1. Christos Papadopoulos, Professor, Computer Science Department. Colorado State University, Fort Collins, CO 80523
   Email: christos@colostate.edu, Phone: +1 (970) 491-3267

2. Craig Partridge, Department Chair and Professor, Computer Science Department. Colorado State University, Fort Collins, CO 80523
   Email: craig.partridge@colostate.edu, Phone: +1 (970) 491-6633

3. Lixia Zhang, Professor, Computer Science Department, UCLA, Los Angeles, CA 90095
   Email: lixia@cs.ucla.edu, Phone: +1 (310) 825-4033

4. Harvey Newman, Marvin L. Goldberger Professor of Physics, Department of Physics, California Institute of Technology, 1200 California Blvd, Pasadena, CA 91125
   Email: newman@hep.caltech.edu Phone: +1 (626) 395-6656

5. Inder Monga, Executive Director, ESnet and Division Director, Scientific Networking, Lawrence Berkeley National Laboratory, 1 Cyclotron Rd, Berkeley, CA 94720
   Email: IMonga@es.net, Phone: +1 (510) 486-6531

6. Edmund Yeh, Professor, Northeastern University, 413 ISEC 360 Huntington Avenue, Boston, MA 02115
   Email: eyeh@ece.neu.edu, Phone: +1 (617) 373-5400