

Levi D. Perigo, Ph.D.

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PROFILE

Information technology professional with nearly 20 years of experience in industry and academia designing, researching, and teaching advanced networking solutions. Subject matter expert in software-defined networking, routing/switching, network automation, and Voice over IP.

PROFESSIONAL EXPERIENCE

Academic Experience

Scholar in Residence | Co-Director of Professional Master's Program in Network Engineering

University of Colorado - Boulder, Department of Computer Science, College of Engineering and Applied Sciences, Boulder, CO

2015 - Present

- Integrate extensive industry experience and future trends to design and teach graduate courses and perform research in the Department of Computer Science (with an additional appointment in the Technology, Cybersecurity and Policy (TCP) program (formally ITP)), with a focus on Next Generation Networks: Software-Defined Networking (SDN) and Network Functions Virtualization (NFV); Network Automation, Design, Operations, and Management; Internetworking Technologies (CCNA/CCNP); VoIP Design and Deployment
- Provide a technology driven, blended learning environment to promote active learning to all students through in class lectures, online discussions, real-world/hands-on lab work, and live interactive video
- Mentor and advise master's/Ph.D. students and teaching assistants with thesis, capstone projects, multi-year dissertations, lab design/management, assignment/report grading, supplemental lectures, and applied research
- Assist with developing an Industry Advisory Committee to review/predict the future of the Network Engineering curriculum, and to provide feedback for the skills graduates will need for immediate employment
- Led the renovation of the Network Engineering Track curriculum within ITP to make it relevant with current and future industry
- Created and manage professional master's degree in network engineering
- Course Designed (F'15): Software-Defined Networking (**Innovative Course Award-ITERA Conference 2019*)
 - Utilize multivendor software to enforce the theory and fundamentals of SDN/NFV, such as OpenFlow, Floodlight, OpenDaylight, OpenStack, ONOS, Ryu
 - Python and REST API application programming to configure SDN controllers and Network Functions

- o Utilize multi-vendor (Arista, Cisco, Dell, HP, Pica8) and bare-metal hardware to implement labs in real-world applications
- Course Designed (S'17): SDN Virtualization and Orchestration
 - o Developed a compounding SDN/NFV hands-on lab course
 - o Students transition the fundamental understanding of SDN/NFV into a service provider cloud implementation: REST-API and Python application/automation programming; OpenStack and OpenContrail orchestration; BGP implementation with SDN and Quagga/FRR; CORD for NFV; Docker/Kubernetes containers; AWS
 - o Labs enforce how software can manipulate, control, and automate legacy, hybrid, virtual, and SDN
- Course Designed (F'15): Voice over IP Lab: Voice Network Design and Implementation
 - o Focus on SIP technologies, certifications, and applications: call control, SDP, RTP, SRTP, SIP trunking, PSTN gateway, SBC, SIP security, registration, authentication, etc.
 - o Technical labs that incorporate multivendor equipment, such as ADTRAN, Cisco Call Manager Express (CME), and Asterisk/FreePBX
 - o Labs include: call routing, SIP trunk failover, legacy voice PSTN, hosted PBX and phones, softphones, caller-ID manipulation, troubleshooting, QoS, voice security, etc.
- Course Designed (F'15): Network Management, Operations, and Automation
 - o Focus on core technologies and applications used to manage, operate, and automate networks including: Wireshark/TCPDUMP, Amazon Web Services (AWS) with Boto3, SNMP, IPv6, DHCP, NETCONF/Yang, Network Automation (Python, Netmiko, NAPALM), DevOps (Ansible, YAML, Jinja2), SDN, and Network Design
 - o Technical labs to reinforce training include utilizing a virtualized environment (VirtualBox for Linux VMs and GNS3 for router/network programmability, design, and configuration)
 - o Python programming and scripting to automate network configuration and change management
- Course Designed (F'16): Enterprise Network Security
 - o Focus on network hardware security, policies, and best practices
 - o Utilize Cisco ASA 5500 series hardware to reinforce training on: IPsec VPN (client and hardware), Port Security, ACLs (NAT/PAT), Wireless Security, InterVLAN and DMZ routing, VoIP Security
 - o Security+ certification fundamentals
- Course Designed (F'17 & F'18) Internet Lab I & II
 - o Lab course to teach network engineering, security, Linux, and wireless technologies to students with non-technical backgrounds; typically from MBA or Law school
- Dissertation (Ph.D.), Thesis (Masters), and Capstone (Masters) advisor
 - o Dissertation
 - 2020 – Gandotra, Rahil – Energy Efficient Networking

- 2020 – Gedia, Dewang - Decision-Tree Placement Algorithm for Containerized Network Functions
- o Thesis
 - 2019 – Self-sustained, LSTM Recurrent Neural Network Managed, Intrusion Detection with Software-Defined Networking
 - 2017 – Visualization of Route Forwarding State to Identify Routing Errors in Mission Critical Military Networks
 - 2017 - BGP Route Manipulation with SDN and OpenFlow
 - 2017 - Improving the Security of the OpenDaylight SDN Controller
- o Capstone
 - 2020 – Containerized Intelligent Network Functions at Hosts
 - 2020 – SDN Enterprise as a Service
 - 2020 – Smart Network Systems
 - 2019 – BGP Data Analytics for Service Provider Networks
 - 2019 – Implementing Quality of Service for Voice Over IP Using a SDN-based PBX
 - 2019 - VoIS-Net: An SDN-Driven, Voice-assisted, Intent-based, Self-healing Network Framework
 - 2019 – SDN/NFV VNF Service-Chaining
 - 2019 – SDN Enterprise Network Orchestration Application: E-NetO-App
 - 2018 – Decision-Making System Driven by Big Data Telemetry for SDN and Traditional Networks
 - 2018 – Self-Healing Network System
 - 2018 – Visually Represented, Intent-Based, Voice-Assisted Networking
 - 2018 – SDN/NFV Solution for Public Safety
 - 2017 - Automation of Legacy Devices using SDN and DevOps
 - 2016 - IPv4/IPv6 VoIP Security
 - 2016 - Improving QoS in SDN
 - 2016 - Round Robin Load-balancer using SDN

Adjunct Instructor

DeVry University, College of Engineering & Information Sciences, Westminster, CO
2014 - 2015

- Taught undergraduate courses in wireless technologies, with a focus on Certified Wireless Network Administrator (CWNA) certification
- Designed, developed, and presented teaching material: lectures, quizzes, exams, and labs to reinforce instruction

Graduate Assistant

Center for Information and Communication Sciences, Ball State University, Muncie, IN
2004 - 2005

- Cisco Quality Assurance Manager
 - Performed interviews with Professors, Guidance Counselors, Principals, IT Directors, Deans, and Superintendents to assess and evaluate the goals, progress, and needs and wants of their Cisco Networking Academy institutions
- Led and participated in Cisco re-tooling and WebEx training sessions, and web-based seminars (Webinar)
- Managed telecommunications labs which were used by faculty and students for research, training, testing, and implementation

Industry Experience

Technical Advisory Board

Zayo Group, Boulder, CO / Worldwide

2021 - Present

- Advise C-level management about product technology and strategize future plans
- Meet with product management and development team to plan company goals and roadmaps
- Act as subject matter expert on network automation and next generation networking technologies

MEF Research Council – SDN/NFV

MEF Forum, Boulder, CO / Worldwide

2017 - Present

- It is composed of industry leading professors and lecturers from academic institutions as well as key staff from research organizations.
- Help the MEF identify strategic work projects and research to be facilitated by MEF and the MEF Software Development Community, and introduce MEF to suitable departments, academic institutions, and research organizations that would be interested in collaborating with MEF on those projects.
- Subject Matter Expert for MEF certifications programs for SDN, NFV, Orchestration, and Networking

Director of OCSP Program and Research Associate – SDN/NFV

Open Networking Foundation, Boulder, CO / Worldwide

2016 - Present

- ONF RAs are thought leaders and innovators appointed by the ONF Executive Director with guidance from ONF Leadership based on their contributions to the creation and advancement of SDN and the OpenFlow standard
- Subject Matter Expert for Open Networking Foundation Certified SDN Professional Program (OCSP)

Owner / Network Engineering Consultant

Raven Innovation LLC, Boulder, CO / Worldwide

2015 - Present

- Work individually and with industry colleagues on network engineering design, development, implementation, and maintenance
- Provide onsite and remote training and research for business needs
- raveninnovation.com

Lead / Senior Network Engineer – Converged Access & Internetworking Product Support

ADTRAN Inc., Huntsville, AL / Boulder, CO

2005 - 2015

- Served as an escalation point for isolation and resolution of heterogeneous problems with existing networks including: IPv6, VoIP (SIP), Wireless (802.11), routing protocols (BGP, OSPFv2/v3, RIP), Firewall Security, NAT, VPN (IPSec/IKE, GRE, DMVPN), QoS, Multicast (IGMP/PIM), VLANs/Trunking, Frame Relay, PPP, HDLC, legacy voice (FXS, FXO, ISDN PRI, T1 trunks)
- Perform design and implementation of new installations for several CPE product families including routers, switches, firewalls/VPN, wireless controllers and access points, and VoIP SBC/Gateways/Proxies
- Managed and led 15-20 industry award winning WAN, internetworking, and VoIP support engineers
- Managed and led team of remote engineers, monitoring productivity and maintaining accountability
- Created and taught technology training and product training to engineers, as well as designed labs to reinforce technical training (Routing, Switching, Security (Firewall/VPN), Legacy WAN, ADTRAN product training, and an internally developed CCNA course)
- Awarded ABCD by Technical Support Senior Management (2007 & 2009) – for continual job performance that exemplifies going “Above and Beyond the Call of Duty”
- Received Award of Excellence - for superior performance voted by peers
- Conducted technical and situational interviews for every new candidate, as well as year end performance reviews for engineers
- Developed and edited technical writing documents, software release notes, and ADTRAN certification exams; created design/configuration/troubleshooting guides for ADTRAN’s support community website, as well as responded to forum posts as the subject matter expert: <https://supportforums.adtran.com/>
- Interfaced with technical and business points of contact at major accounts and service providers to resolve critical situations
- Worked with hardware and software developers to investigate and address reported issues, which often involved researching RFCs and other official documentation to ensure the designed feature follows the industry standard specifications for the technology

- Involved with the initial development of new products and features; acted as the definitive authority for how customers/users will be expected to implement ADTRAN products and features in the future
- Provided network design and troubleshooting consultation to other departments of the company, including Information Technology, Project Managers, Design Engineering Managers, Product Managers, Systems Engineers, and Sales Managers (up to Director and VP level representatives of those parts of the organization)

INDUSTRY CERTIFICATIONS & SKILLS TRAINING

Software-Defined Networking and Network Functions Virtualization:

- MEF SDN/NFV Certified Professional (SNCP) (2018)
- MEF Network Foundations (MEF-NF) (2017)
- ONF-Certified SDN Engineer (2017)
- ONF-Certified SDN Instructor (2016)

Routing / Switching / Wireless:

- Cisco Certified Network Professional (CCNP) – R&S Certification (2007-2019)
- Cisco Certified Design Professional (CCDP) Certification (2008-2019)
- ADTRAN Technical Solutions Expert (ATSE) Certification – Internetworking (2013)
- Certified Wireless Network Administrator (CWNA) Certification (2014)
- IPv6 Forum Certified Engineer (Gold) Certification (2015)

Voice over IP:

- SIP School Certified Associate (SSCA) Certification (2015)
- ADTRAN Technical Solutions Professional (ATSP) Certification – IPBG (2007, 2010, 2013)

Internet of Things:

- Home Technology Integration (HTI+) Certification (2005)

EDUCATION

Ph.D. in Information Systems Nova Southeastern University

- Dissertation – An Examination of the Design, Development, and Implementation of an Internet Protocol Version 6 Network: The ADTRAN Inc. Case Study

Graduation date: December 2013

M.S. in Information and Communication Ball State University
Sciences

- Concentration in Network Engineering
- Core Studies- Network Engineering, Security, Management, Human Factors, Regulatory

Graduation date: July 2005

B.A. in Computer Information Systems, Minor in Computer Anderson University
Science

Graduation date: December 2003

INVITED TALKS AND PRESENTATIONS (STARTING 2016)

- NANOG Online “Future Engineers: Stay Ahead of This Curve (What might surprise you about Network Engineering),” Online, September 2021.
- Ubuntu Network Security Podcast “SDN/NFV and Future Trends,” Online, August 2020
- IEEE NFV-SDN conference “Algorithmic and Data Aspects of NFV-SDN,” Dallas, TX, November 2019
- NANOG conference “The Future Network Engineer,” Austin, TX, October 2019
- ITERA conference “The State of Telecommunications,” Indianapolis, IN, April 2019.
- ITERA conference “Innovation – SDN in Academia,” Indianapolis, IN, April 2019.
- ITERA conference panelist “Developing State-of-Art Infrastructure in Academia,” Lexington, KY, April 2018.
- “Next Generation Networks—Maintaining State-of-Art,” Inspir[ED] NFV Workshop, Louisville, CO, February 2018.
- “Software-defined, Dynamic Network Manipulation Application (SDNMA) to Enhance BGP Functionality,” Open-Source Networking User Group, Louisville, CO, February 2018.
- “Network Orchestration Application for Centralized Network Management in Academia: NetO-App,” Open-Source Networking User Group, Louisville, CO, February 2018.
- “Application Drivers—Gaps to Operational SDN,” Large Scale Networking Workshop on Operationalizing SDN, Washington, D.C, October 2017.
- ITERA conference case study competition SME on Network Engineering, Nashville, TN, April 2017.
- “Next Generation Networks—Teaching SDN in Academia,” OpenDaylight User Group, Louisville, CO, January 2017.
- “Why SDN Skills are a Big Boost to Network Engineering Careers,” Keynote webinar presenter, ITpreneurs and Open Networking Foundation, December 2016.

SERVICE AND DONATIONS

University of Colorado Boulder

Boulder, CO

- (2021-present) Director of Professional Master's in Network Engineering
- (2020-present) IEEE Technical Program Committee: NFV-SDN
- (2017-present) Serve as TCP and Computer Science faculty sponsor for 5-student conference participation at NANOG and corresponding hackathons
- Committees
 - (2021-present) Department of Computer Science Graduate Education Committee
 - (2020-present) Department of Computer Science Graduate Committee member
 - (2020-present) Department of Computer Science Graduate Admissions
 - (2015-2019) ITP Industry Advisory Committee Network Engineering chair
 - (2017-2019) ITP Unit Review Committee member
 - (2018) Reappointment Committee chair for ITP Director Dr. David P. Reed
 - (2018) Reappointment Committee member for ITP Faculty Professor Jose Santos
 - (2015-2019) ITP Master's Curriculum Committee member
 - (2015-2019) ITP Ph.D. Curriculum Committee member
 - (2018-2019) ITP Ph.D. Preliminary Examinations Committee member
 - (2015-2019) Serve as ITP chair for industry sponsored hackathons (Facebook, Cisco, Applied Trust)
 - (2017) Reappointment Committee member for ITP Faculty Professor Joe McManus
- (2018) Served as ITP Faculty sponsor of 5-student team competing in the ITERA National Case Study Competition held in Lexington, Kentucky
- (2017) Designed and installed the Security Operations Center (SOC) core network of switches, routers, firewalls, VPN concentrators (and clients)
- (2015) Orchestrated the donation of \$15,000 worth of ADTRAN Inc. internetworking equipment for deployment in the Interdisciplinary Telecom Program's multivendor telecommunications lab

Ball State University – 2014

Muncie, IN

- Orchestrated the donation of \$30,000 worth of ADTRAN Inc. internetworking equipment for deployment in the graduate school of Information and Communication Sciences' multivendor telecommunications lab

Food for the Hungry (FH) - 2012

Kenya, Africa

- Traveled throughout the country of Kenya for two weeks installing voice and data networks for all the branches of FH
- Configured and installed switches, routers, firewalls, VPNs, and wireless hardware; ran new cabling, troubleshot PCs and radio equipment
- Worked with local ISPs to optimize routing and current infrastructure

- Provided training for IT staff
- Procured equipment donations from internetworking manufacturers

PUBLICATIONS

University of Colorado Boulder

Boulder, CO

Refereed Journal Papers:

1. R. Gandotra and L. Perigo, "SDVoIP – A Software-Defined VoIP Framework for SIP and Dynamic QoS," *The Computer Journal* vol. 64, no. 2, pp 254-263, Feb. 2021.
2. L. Perigo, R. Gandotra, D. Gedia, M. Hussain, P. Gupta, S. Bano, and V. Kulkarni, "VoIP Security: A Performance and Cost-benefit Analysis," *Information Technology in Industry*, vol. 8, no. 2, pp. 35-43, Sep. 2020.
3. D. Gedia, L. Perigo, and R. Gandotra, "Micro-Economic Benefits of Peer-Producing Containerized Network Functions," *Open Journal of Business and Management*, Sept, 2020, Vol. 8, No. 5., pp. 2285 - 2302.
4. R. Gandotra and L. Perigo, "We've Got the Power: A Framework for Real-Time Network Power Monitoring," in *Journal of Computer and Communications*, May, 2020, vol. 8, pp.75-88.
5. D. Anand, H. Kumar, R. Kulkarni, S. Ninale, L. Perigo, D. Gedia, and R. Gandotra, "SDN/NFV VNF Service Chaining" in *Information Technology in Industry (ITII)*. April, 2020, pp. 1-6, Vol. 8, No. 1. Available: <https://it-in-industry.com/issue/archive/103.html>
6. M. Jain, S. Suneja, S. Srivatsa, V. Ananthasubramanian, Y. Maramraj, L. Perigo, R. Gandotra, and D. Gedia, "Intent-Based, Voice-Assisted, Self-Healing SDN Framework," *Journal of Network Communications and Emerging Technologies (JNCET)*, Vol. 10, Issue 2, Feb., 2020.
7. A. Jain, A. Gupta, A. Gupta, D. Gedia, L. Perez, L. Perigo, R. Gandotra, and S. Murthy, "Trend-based Networking Driven by Big Data Telemetry for SDN and Traditional Networks" in *International Journal of Next-Generation Networks (IJNGN)*. Mar, 2019, Vol. 11, No.1.
8. A. Chaudhari, A. Asthana, A. Kaluskar, D. Gedia, L. Karani, L. Perigo, R. Gandotra, and S. Gangwar, "VIVoNet: Visually-Represented, Intent-Based, Voice-Assisted Networking," *International Journal of Computer Networks and Communications (IJCNC)*, vol. 11, no.2, March, 2019. [Online]. Available: arXiv, doi: 10.5121/ijcnc.2019.11201
9. D. Gedia, and L. Perigo, "A Centralized Network Management Application for Academia and Small Business Networks" in *Information Technology in Industry (ITII)*. Aug, 2018, pp. 1-10, Vol. 6, No. 3.

Refereed Conference Papers:

1. D. Gedia and L. Perigo, "Decision-Tree Placement Algorithm for Containerized VoIP VNFs: A Network Management Approach" in *IEEE International Conference on Intelligence in Next Generation Networks (ICIN)*, Mar. 7, 2022.
2. R. Gandotra and L. Perigo, "A Comprehensive Survey of Energy-Efficiency Approaches in Wired Networks," in *Proceedings of the 11th International Conference on Computer Science, Engineering and Applications (ICCSEA 2021)*, pp. 261-282, Nov. 2021.
3. R. Gandotra and L. Perigo, "GPF: A Green Power Forwarding Technique for Energy-Efficient Network Operations," in *Proceedings of the 10th International Conference of Networks and Communications (NECO 2021)*, pp. 83-97, Nov. 2021.

4. D. Reed and L. Perigo, "Measuring ISP Performance in Broadband America: A Study of Latency Under Load," in *Internet Architecture Board: Measuring Network Quality for End-Users (2021)*, Virtual Conference, Sept. 2021.
5. R. Gandotra and L. Perigo, "NFEH: An SDN Framework for Containerized Network Function-enabled End Hosts," in *Proceedings of the 29th International Conference on Computer Communications and Networks (ICCCN)*, Honolulu, USA, Aug. 2020, in press.
6. R. Gandotra and L. Perigo, "Comparing Energy Efficiencies of SDN Hardware Based on Forwarding Configurations," in *Proceedings of the 29th International Conference on Computer Communications and Networks (ICCCN)*, Honolulu, USA, Aug. 2020, in press.
7. D. Gedia, and L. Perigo, "Latency-Aware, Static, and Dynamic Decision-Tree Placement Algorithm for Containerized SDN-VNF in OpenFlow Architectures," in *2019 IEEE Conference on Network Function Virtualization and Software Defined Networks (NFV-SDN)*, Dallas, Texas, Nov. 2019.
8. D. Gedia, L. Perigo, and R. Gandotra, "Micro-Economic Analysis of Peer-Producing Containerized Virtual Network Functions," ITERA Conference, Indianapolis, IN, April 2019. Winner of the Katherine B. Snow Best Research Paper Award.
9. L. Perigo, S. Bano, D. Gedia, R. Gandotra, P. Gupta, M. Hussain, and V. Kulkarni, "High-Performance and Cost-Effective VoIP Security Techniques," ITERA Conference, Indianapolis, IN, April 2019.
10. D. Gedia, and L. Perigo, "Performance Evaluation of SDN-VNF in Virtual Machine and Container," in *2018 IEEE Conference on Network Function Virtualization and Software Defined Networks (NFV-SDN)*, Verona, Italy, Nov. 2018.
11. D. Gedia, and L. Perigo, "NetO-App: A Network Orchestration Application for Centralized Network Management in Small Business Networks" in *4th International Conference on Computer Science, Engineering and Information Technology (CSITY-2018)*, Sydney, Australia, July 2018, pp. 61-72, DOI: 10.5121/csit.2018.81106.
12. R. Gandotra, and L. Perigo, "SDNMA: A Software-defined, Dynamic Network Manipulation Application to Enhance BGP Functionality" in *The 20th IEEE International Conference on High Performance Computing and Communications (HPCC-2018)*, Exeter, England, June 2018.

Working Papers (Accepted but not yet Published):

1. F. Shen, L. Perigo, and J. Curry, "SR2APT: A Detection and Strategic Alert Response Model Against Multistage APT Attacks." *The Journal of Security and Communications Networks*.

Academic Awards

University of Colorado Boulder
Boulder, CO

- Outstanding Graduate Faculty Advisor (2019) – Awarded the top advisor for the College of Engineering
- Marinus Smith Award Recipient (2017 & 2019) – Nominated by students for having a significantly positive impact on their lives by teaching, supporting, and serving both in and outside of the classroom
- Winner of the "Innovative Course" award for TLEN 5100 – Next Generation Networks at the ITERA conference, Indianapolis, IN, 2019.

- Winner of the Kathrine B. Snow Best Research Paper award at the ITERA conference: D. Gedia, L. Perigo, and R. Gandotra, "Micro-Economic Analysis of Peer-Producing Containerized Virtual Network Functions," ITERA Conference, Indianapolis, IN, April 2019.
- National Science Foundation– Awarded scholarship (including two graduate students) to attend and present at the "Large Scale Networking Workshop on Operationalizing SDN," Washington, D.C, October 2017.