DAVID P. REED, Ph.D.

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RESEARCH INTEREST

Internet and telecommunications technology, policy, and economics: Applying interdisciplinary research methods to examine the evolution of Internet infrastructure to advanced wireless and broadband platforms and the resulting implications on business strategy and public policy.

Current research interests include:

- Broadband roadmaps to address the Digital Divide and for emerging countries
- Availability and prospects for competition for broadband Internet access services
- Developing efficient spectrum management models to support broadband deployments
- Advanced broadband platforms such as DSL, DOCSIS 3.1, 5G, Next Generation Orbiting System technologies, and fiber-to-the-home
- Estimating broadband network capacity costs to accommodate forecasted growth of broadband network usage

EDUCATION

Carnegie Mellon University   1991
Doctorate of Philosophy in Engineering and Public Policy
Dissertation: Engineering, Economic, and Public Policy Analysis of Residential Fiber Networks

Carnegie Mellon University   1988
Master of Science in Engineering and Public Policy

Colorado State University   1985
Bachelor of Science in Electrical Engineering (with Distinction)
Silver Medal Award 1985 recipient as outstanding senior at the College of Engineering.

ACADEMIC EXPERIENCE

University of Colorado at Boulder, College of Engineering & Applied Science   2012 – *present*
  Senior Research Associate, Department of Computer Science, (2022 – present)
  Scholar In Residence, Department of Computer Science, (2020 – 2022)
  Senior Fellow, Silicon Flatirons Center for Law, Technology, and Entrepreneurship at the CU Law School (2012 – present)
  Faculty Director, Interdisciplinary Telecom Program (2014 – 2018)
  Associate Faculty Director, Interdisciplinary Telecom Program (2012 – 2014)
  Scholar In Residence, Technology, Cybersecurity and Policy (formerly Interdisciplinary Telecom Program), (2012 – 2020)

From 2014-2018, served as Director of Interdisciplinary Telecom Program consisting of 150 - 200 master's and Ph.D. graduate students, 6 full-time and 10 adjunct faculty, as well as 4 administrative staff. Led a major curriculum redesign creating four new education tracks focused on Network Engineering, Network Security, Wireless Networking, and Telecom Policy and Strategy, along with new Telecom Lab, Security Lab and Wireless Lab facilities to support hands-on courses in each track.

PROFESSIONAL EXPERIENCE

California Public Utilities Commission (CPUC)

Frontier Compliance Monitor (2022 – 2027)

Awarded Research Contract from the CPUC to serve as the Frontier Compliance Monitor who is responsible for reviewing Frontier Communications' reports and making findings on Frontier's compliance with, and progress toward, the conditions associated with its approved bankruptcy settlement agreements with the state of California. The Compliance Monitor will also be responsible for reporting these findings to the CPUC's Commissioners and Communications Division.

Relocation Payment Clearinghouse, LLC

Senior Advisor (2020 – 2026)

Selected by the Federal Communications Commission to establish and operate the C-Band Clearinghouse, which performs key functions in the FCC's relocation plan to clear spectrum used by Satellite Service Operators for 5G.

Cable Television Laboratories, Inc. ("CableLabs"), Louisville CO   1994 – 2012

Executive Vice President and Chief Strategy Officer (2004 – 2012)
Senior Vice President and Chief Technology Officer (2000 – 2004)
Vice President, Strategic Assessment Department (1994 – 2000)

Over 10 years of experience establishing strategic direction of R&D efforts (170 employees, $65-million budget), including Lead of the Program Management Group directing major technical program efforts.

- Executive leader of key cable industry initiatives covering a wide range of technologies:
    - *DOCSIS and other Advanced Network Technologies:* Executing industry development plans for next generation broadband access network technologies for DOCSIS and DOCSIS over EPON.
    - *tru2way and Enhanced Television*: Continued development of key application platforms for the Cable industry to deliver interactive video applications in open software environments.
    - *Digital Video*: strategic assessment of business implications posed by the emergence and capabilities of Internet video technologies and consumer devices.
    - *Business Services*: Program to develop common technologies for cable entry into business service markets such as Ethernet Data, PBX Trunking of Voice, and SIP interconnection.
    - *Public Key Infrastructure*: Established security initiative that has issued over 100-million software security certificates in cable devices worldwide.
    - *VoIP Peering*: Created an industry registry of cable telephone numbers to assist establishment on on-net calls based on IETF standards.
    - *PacketCable*: Led fast-track development project (1996-1998) to deliver VoIP over cable networks.
    - *Go2Broadband*: Led software project in 1999 – 2003 building an online sales lead generator for U.S. cable companies that now forwards millions of sales leads every year.
- Plan and execute Technology Tours for CableLabs' Executive Committee (2003-2012).
- Successfully established and led the Strategic Assessment Department to incubate new projects and conduct strategic assessments on topics including:
    - Technology, Economics and Deployment Strategies over Cable Systems of Digital Video Platforms, High-Speed Data Services, Internet Video, Switched Broadcast Video, and Wireless
    - Competitive Assessments of New Technologies Deployed by Telephone Companies, Wireless Service Providers, and Broadband Application Providers
    - Trends in Broadband Consumption and Bandwidth Management

o Engineering-Economic Assessments of Two-Way Cable Networks, Home Networking Technologies and Caching (Network versus Local DVRs)
- Led industry forums on strategies for cable operators to develop strategies for business services, bandwidth management, wireless, backbone networks, and business-to-business commerce.
- Moderated and managed "Innovation Showcase" at CableLabs conferences highlighting over 100 new innovations developed for the cable industry through the time period of 2007-2012.

Federal Communications Commission   **1991 - 1994**

Telecommunications Policy Analyst, Office of Plans and Policy. Researched emerging telecom policy issues, technical and economic review of policy items, and wrote sections of policy items.
- Research identified economic benefits of Hybrid Fiber-Coax (HFC) networks relative to other optical network architectures in residential areas.
- Helped design Personal Communications Services (PCS) spectrum bandplan, technical standards, and auction format.

RAND Corporation, Santa Monica, CA   **1989 - 1991**

Engineering Consultant. Developed extensive engineering cost model of residential fiber-based networks and examined the competitive implications.

Bell Communications Research (BellCore), Navasink, NJ   **1988**

Member Technical Staff, Broadband Architecture Group. Conducted engineering and economic studies of alternative advanced network architectures.

PUBLICATIONS

BOOKS

David P. Reed. *Residential Fiber Optic Networks: An Engineering and Public Policy Analysis*, Artech House, Boston 1991.

BOOK CHAPTERS

- David P. Reed. "The Transition to Digital Television Distribution Systems: A Technological View of Expected Interoperability," *The Internet and Telecommunications Policy*, Lawrence Erlbaum Associates, New Jersey 1996.

- David P. Reed, "Taking It All Apart: Principles of Network Modularity," Private Networks, Public Objectives, Elsevier, New York, 1996.

- David P. Reed and Marvin Sirbu, "An Engineering, Economic, and Policy Analysis of Integrated Broadband Networks," *Telephone Company and Cable Television Competition*, Artech House, Boston 1991.

- David P. Reed and Marvin Sirbu, "An Engineering Cost and Policy Analysis of Proposed Fiber Optic Telephone Networks in the Subscriber Loop," *Integrated Broadband Networks: The Policy Issues*, North Holland, New York 1990.

REFEREED JOURNAL PAPERS

- Reed DP. "Examining the prospects for Gigabit Broadband: Lessons learned from Google Fiber." *Telecommunications Policy*. 44 (5) (June 01, 2020)

- David Espinoza and David P. Reed, "Wireless Technologies and Policies for Connecting Rural Areas in Emerging Countries: A Case Study in Rural Peru," *Digital Policy, Regulation and Governance Journal*, Vol. 20, Issue 5, 2018.

- David P. Reed, Jennifer Haroon, and Patrick S. Ryan, "Technologies and Policies to Connect the Next 5 Billion" (January 13, 2014). *Berkeley Technology Law Journal*, Vol. 29, 2014.

- David P. Reed and Jim Lansford, "Wi-Fi as a Commercial Service: New Technology and Policy Implications". *Telecommunications Policy,* Vol. 38(8), pp. 827-837, 2014.

- David P Reed, "Critiquing the Layered Regulatory Model,*" Journal on Telecommunications & High Technology Law,* pp. 281 – 297, Volume 4, Issue 2, 2005.

- Leland Johnson and David P. Reed, "Telephone Company Entry Into Cable Television: A Reply," *Telecommunications Policy*, April 1993.

- Leland Johnson and David P. Reed, "Telephone Company Entry Into Cable Television: An Evaluation," *Telecommunications Policy,* pp. 122-134, March 1992.

- David P. Reed, "Economic Comparisons of Alternative Fiber-Based Local Access Architectures Using ATM Components," *International Journal of Digital and Analog Cabled Systems,* March 1990.

- David P. Reed and Marvin Sirbu, "An Optimal Investment Strategy Model for Fiber to the Home," *Journal of Lightwave Technology,* **2,** pp. 1868-1875, November 1989. Also in *Proceedings of the 1988 ISSLS,* IEEE, September 1988.

- David P. Reed, Marvin Sirbu, and Frank Ferrante, "An Engineering and Policy Analysis of Fiber Introduction into the Residential Subscriber Loop," *Journal of Lightwave Technology,* **2,** pp. 1876-1884, November 1989.

REFEREED MAGAZINE ARTICLES

- David P. Reed, *"*The Cost Structure of Personal Communications Services," *IEEE Communications Magazine*, p. 102-108, April 1993.

REFEREED CONFERENCE AND WORKSHOP PAPERS

- David Reed and Levi Perigo, "Measuring ISP Performance in Broadband America: A Study of Latency Under Load", Internet Advisory Board Workshop on Measuring Network Quality for End-Users, September 15, 2021.

- Adnan Mian and David Reed, "Tomorrow's Backhaul: Comparative Analysis of Backhaul Cost for Policy Decisions", 2018 IEEE 5G World Forum (5GWF), Santa Clara, CA, July 9-11, 2018.

- David P. Reed, "New Prospects for Gigabit Networks", ITS Seoul 2018, Seoul, South Korea, June 24-27, 2018.

- Adnan Mian and David Reed, "LTE Backhaul Modeling: Comparative Analysis of LTE Backhaul Cost Using Different Local Access Networks," ITERA Conference, Nashville, TN, April 2017. Winner of the Katherine B. Snow Best Research Paper Award.

- David P. Reed, *"*Cable Networks – Evolution to New Services*" 13th Annual Conference on European Fibre Optic Communications and Networks*, pp. 15-18, Brighton, England, 1995.

- David P. Reed and Marvin Sirbu, "A Cost Analysis of a Fiber Upgrade for a Coaxial Cable Network to Support On-Demand Video," *SPIE OE/Fibers 89 Symposium on Optoelectronic and Fiber Optic Devices and Applications*, 1989.

- David P. Reed and Marvin Sirbu, "An Optimal Investment Strategy Model for Fiber to the Home," *Proceedings of the 1988 ISSLS,* IEEE, September 1988.

TECHNICAL REPORTS

- David P. Reed and Lauren Crean. *OECD (2017), "The evolving role of satellite networks in rural and remote broadband access",* OECD Digital Economy Papers*, No. 264, OECD Publishing, Paris.

- David P. Reed, "Technical Analysis of the FCC NPRM on Navigation Devices", Reply Comments of Comcast Corporation and NBCUniversal Media LLC, In the Matter of Expanding Consumers' Video Navigation Choices, MB Docket No. 16-42, May 23, 2016.

- David P. Reed. *Putting It All Together: The Cost Structure of Personal Communications Services,* OPP Working Paper Series, No. 28, Office of Plans and Policy, Federal Communications Commission, November 1992.

- Leland Johnson and David P. Reed. *Residential Broadband Services by Telephone Companies? Technology, Economics, and Public Policy,* RAND Corporation, R-3906-MF/RL, June 1990.

UNREFEREED CONFERENCE AND WORKSHOP PAPERS

- David Reed, Is Speed Enough? Examining the Definition of Broadband and Its Implications for Public Policy, 49th *Annual Telecommunications Policy Research Conference* September 2021, Virtual Conference. [Abstracts are refereed]

- David Reed, Prospects for Competition in the Provision of Internet Access Services over Broadband Local Access Networks: Technology Trends, 48th *Annual Telecommunications Policy Research Conference* February 2021, Washington, DC. [Abstracts are refereed]

- Irena Stevens and David Reed, Imagining Future Cities: Design Guidelines for Wireless Small Cells in Urban Landscapes, 47th *Annual Telecommunications Policy Research Conference* September 2019, Washington, DC. [Abstracts are refereed]

- Nadia Yoza Mitsuishi; Peter Mathys; David Reed, Spectrum sharing analysis for unlicensed use in 6 GHz using Risk-Informed Interference Assessment, 47th *Annual Telecommunications Policy Research Conference* September 2019, Washington, DC. [Abstracts are refereed]

- Mark Lofquist and David P. Reed. Applying an Information Based Decision Analysis to Spectrum Management Regulatory Decisions. 46th *Annual Telecommunications Policy Research Conference* September 2018, Arlington, Virginia. [Abstracts are refereed]

- Waleed Almarshedi and David P. Reed. Economic Critiques of National and International NGSO Spectrum Regulations Concerning the Ku-And Ka-Bands. 46th *Annual Telecommunications Policy Research Conference* September 2018, Arlington, Virginia. [Abstracts are refereed]

- David P. Reed. Trends in Cable Network Economics: Implications for the Open Internet. 44th *Annual Telecommunications Policy Research Conference* September 2016, Arlington, Virginia. [Abstracts are refereed]

- Irena Stevens and David P. Reed, LTE–U/LAA and Spectrum Sharing - Coexistence Principles in the Unlicensed Spectrum Bands. 44*th Annual Telecommunications Policy Research Conference* September 2016, Arlington, Virginia. [Abstracts are refereed]

- David P. Reed, Donny Warbritton, and Douglas Sicker, Current Trends and Controversies in Internet Peering and Transit: Implications for the Future Evolution of the Internet. 43*rd Annual Telecommunications Policy Research Conference* September 2014, Arlington, Virginia. [Abstracts are refereed]

- David P. Reed and Jim Lansford, "Wi-Fi as a Commercial Service: New Technology and Policy Implications". *TPRC 41: The 41st Research Conference on Communication, Information and Internet Policy.* September 2013, Arlington, Virginia. [Abstracts are refereed]

- David P. Reed and Jerry Bennington, "Developments in the Cable Industry", *26th Annual Telecommunications Policy Research Conference*, September 1998, Arlington, Virginia. [Abstracts are refereed]

- David P. Reed, "The Transition to Digital Television Distribution Systems," *23rd Annual Telecommunications Policy Research Conference*, 1995. [Abstracts are refereed]

- David P. Reed, "The Prospects for Competition in the Subscriber Loop: The Fiber-to-the-Neighborhood Approach," *21st Annual Telecommunications Policy Research Conference*, 1993. [Abstracts are refereed]

- Leland Johnson and David P. Reed, "Integrated Broadband Networks: The Role of the Telephone Companies," *17th Annual Telecommunications Policy Research Conference*, Airlie, Virginia, 1989. [Abstracts are refereed]

- David P. Reed and Marvin Sirbu, "Integrated Broadband Networks: The Role of the Cable Companies," *17th Annual Telecommunications Policy Research Conference*, Airlie, Virginia, 1989. [Abstracts are refereed]

OTHER PUBLICATIONS

- David P. Reed and Marvin Sirbu, Peer Review of the Connect America Phase II Cost Model at the request of Julie A Veach, Chief, Wireline Competition Bureau, Federal Communications Commission. http://www.fcc.gov/document/cacm-peer-review-reed-sirbu-0, 2013.

- David P. Reed, "Standardization Issues in Local Competition," Conference on the Future of Local Communications, Columbia Institute of Tele-Information, New York, 1993.

- David P. Reed and Robert Pepper, "Opening the Local Loop: Technologies for Competition," *24th Annual Williamsburg Conference*, The Institute of Public Utilities, Williamsburg, Virginia, 1992.

- David P. Reed, "A Question of Network Evolution," *Telephone Engineer & Management Magazine*, September 1, 1992.

COURSES TAUGHT AT CU BOULDER

Data Communications, (CYBR 5010) Spring 2020 – Fall 2021, Univ. of Colorado Boulder
Spectrum Management and Policy, (CYBR 5420, w/Dale Hatfield), Maymester 2020 – 2021, CU Boulder
Principles of Internet Policy, (CYBR 4400/5400) Fall 2019 – Fall 2020, Univ. of Colorado Boulder
Principles of Telecommunications Policy, (TLEN 5210) Spring 2013 – 2019, Univ. of Colorado Boulder

Future of Video: Technology, Policy, and Economics, (TLEN 5380) Fall 2013 – 2015 Univ. of Colorado Boulder
Research Methods, (TLEN 5700) Fall 2013 – 2016, Univ. of Colorado Boulder
Capstone Projects, (TLEN 5710) Spring 2013-2017, Univ. of Colorado Boulder
Interdisciplinary Telecom Analysis (TLEN 7001) Fall 2013, 2015, 2017 Univ. of Colorado Boulder

RESEARCH GRANTS AND GIFTS

Comcast Innovation Fund Award, 2021
Comcast Innovation Fund Award, 2019
Google Faculty Research Award, 2014
Comcast Research Gift, 2013
Google Faculty Research Award, 2012

SELECTED INVITED TALKS, PODCASTS (STARTING 2014)

- Panel Moderator, National Broadband Plan at 10, Lessons Learned and Should There Be Another? 48th *Annual Telecommunications Policy Research Conference* February 2021, Virtual Conference

- "Impact of Broadband Infrastructure Policy on Rural Entrepreneurship", Silicon Flatiron's Entrepreneurial Policy Academy, November 3, 2021

- Podcast by Nebraska Governance and Technology Center, University of Nebraska, discussing working paper entitled "Estimating the Cost of Broadband in Ultra-Rural Areas" (with Matt Larsen)

- Podcast discussing "Intersection of Security and Policy with David Reed" with Joe McManus, Director of Security, Ubuntu

- Workshop Educator, "Broadband 101" Workshop, Mountain Connect Broadband Development Conference, Colorado, 2015 - *present*.

- Panelist, Can API Standardisation Ensure Fair Competition with the Tech Giants? 11th International Conference on Standardisation and Innovation in Information Technology (SIIT), September 3, 2020

- Lead instructor for educational symposium on "Broadband Deployment Essentials for Electric Cooperatives and Municipal Utilities", EUCI, Denver, Colorado (2019-20)

- Plenary Panelist, "Revolutionizing Communications – Industry Challenges and Opportunities", IEEE Global Communications Conference, Waikoloa, HI, December 11, 2019.

- Panelist, "Evolving Internet Business Models", IEEE Global Communications Conference, Waikoloa, HI, December 10, 2019.

- "Comparison of 477 and California Broadband Map Data," Workshop on Internet Economics hosted by CAIDA and MIT, San Diego, CA, December 14, 2018.

- "Disruptive Innovation in Broadband and Beyond", United States Telecommunications Teaching Institute, June 27, 2019

- "Hands-on Graduate Education", ITERA conference, Nashville, TN, April 8, 2018.

- "Prospects for Broadband - A Draft", ITERA Conference, Nashville, TN, April 7, 2018.

- "Disruptive Innovation in Broadband" to the Technical Advisory Committee of the Federal Communications Commission, September 6, 2017.

- Presented talk entitled "Disruptive Innovation in Broadband" to the Technical Advisory Committee of the Federal Communications Commission, September 6, 2017

- "Economics of Emerging Last Mile Broadband Networks," International Telecommunications Society Conference, Passau, Germany, July, 2017.

- "Trends in Local Access Network Economics", 7th Workshop on Internet Economics, CAIDA/MIT, December 8-9, 2016.

- "Satellite Broadband", Presentation to OECD's Working Party on Communication Infrastructures and Services Policy, Paris, France on November 14.

- "Unlicensed LTE Controversy", TPRC Session for Hill Staff, Rayburn Building, Washington DC, September 29, 2016.

- "Trends in Cable Network Economics", 2016 NCTA INTX Academic Workshop, May, 2016.

- Telecom Exchange West, CEO Roundtable – Net Neutrality: Unchartered Territory, March 6, 2014

- "Wi-Fi as a Commercial Service: New Technology and Policy Implications", workshop sponsored by CAIDA on Active Internet Measurements, March 27, 2014

- Moderated joint Silicon Flatirons and NCTA workshop at 2014 Cable Show, April 29-30, 2014, presented "Wi-Fi as a Commercial Service".

- "Prospects for Gigabit Broadband" at the Workshop on the Future of Broadband Regulation co-sponsored by Institute for Information Policy (IIP) of Pennsylvania State University and Federal Communications Commission, May 30, 2014

- Discussant on "Polices Enabling Access, Growth and Development on the Internet" main focus session at Internet Governance Forum 2014, Istanbul, Turkey, September 3, 2014.

- Moderator of "Technologies & Policies to Connect the Next Five Billion" workshop at Internet Governance Forum 2014, Istanbul, Turkey, September 3, 2014.

ACADEMIC HONORS AND AWARDS

- Winner of the Katherine B. Snow Best Research Paper Award at the ITERA Conference: Adnan Mian and David Reed, "LTE Backhaul Modeling: Comparative Analysis of LTE Backhaul Cost Using Different Local Access Networks", Nashville, TN, April 2017.

- First Prize, Graduate Student Paper Contest of the TPRC, 1991

- Prize for MITRE Best Papers Award Program, 1989 (David P. Reed, Marvin Sirbu, and Frank Ferrante, *An Engineering and Policy Analysis of Fiber Introduction into the Residential Subscriber Loop*)

- Silver Medal Award 1985. Outstanding senior at the College of Engineering, Colorado State University, awarded by the Colorado Council of Engineer

- 1985 IEEE Outstanding Service Award – Colorado State University

- Phi Kappa Phi, Tau Beta Pi, Eta Kappa Nu, President Colorado State Student Chapter of IEEE

OTHER SERVICE and ACCOMPLISHMENTS

- Member of the Regional Digital Divide Task Force of the San Diego Association of Governments (SANDAG) advising on strategies to develop and deploy regional broadband infrastructure to close the digital divide in order to achieve long-term community benefits.

- Telecommunications Policy Research Conference (TPRC)
  - Programming Committee member (2019 – 2020), Vice-Chair (2021)
  - Board of Directors (2020)

- Organizing Committee for IEEE International Communications Conference 2024, Co-Chair (2020)

- Dean's Administrative Council in the College of Engineering and Applied Science of CU Boulder (2014 – 2018)

- Chair, Prelim Exam Committee, Interdisciplinary Telecom Program at CU-Boulder (2013 – 2016)

- College of Engineering and Applied Science Graduate Education Committee (2014 – 2018)

- Faculty sponsor of a 5-person student team to compete in the "ANSI Standards Team Competition" held in San Jose, California

- Be Boulder Advisory Board for distance education (2015 – 2016)

- Mentoring Board of the Technology Law and Policy Clinic at the CU Law School (2014-15)

- Activities with Silicon Flatirons Center for Law, Technology, and Entrepreneurship at the University of Colorado Law School:
  - Member of Advisory Board (2012 – 2018)
  - Member of Executive Committee (2014 – 2018)
  - Senior Fellow (2012 – 2016, 2020 - present)

- U.S. Patents Issued
  - No. 8,060,648–Method and System of Allocating Data for Subsequent Retrieval (with T. Shaw)
  - No. 8,566,888–System for Updating Channel Lineup for Broadcasting and Switched Digital Broadcasting Services (with J. Gong)
  - No. 8,332,902–Method and System of Providing Switch Broadcast Television (with J. Gong and J. Cary)

- Dean's Advisory Board for Colorado State University College of Engineering (2006-2012)

- Served on Technical Paper Selection Committee of NCTA Convention (2007-2012)

- Served on Committee on Intellectual Property Rights and the Emerging Information Infrastructure to produce *Digital Dilemma: Intellectual Property in the Information Age*, Computer Science and Telecommunications Board, National Research Council, Washington, D.C., 2000

- Technical Advisory Boards of VocalPoint (startup), QBeo (startup), and ITU Ventures

- Served on Organizing Committee of TPRC (1991-1993)

- Current member of IEEE and IEEE Communications Society