

WILLIAM HERNDON LEHR

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Biographical Description

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Biographical Description

Dr. William Lehr is a telecommunications and Internet industry economist and consultant with over twenty-five years of experience. He regularly advises senior industry executives and policymakers in the U.S. and abroad on the market, industry, and policy implications of events relevant to the Internet ecosystem. He is a research scientist in the Computer Science and Artificial Intelligence Laboratory (CSAIL) at the Massachusetts Institute of Technology, currently engaged in a number of multidisciplinary research projects within the Advanced Networking Architecture Group in CSAIL. Dr. Lehr's research focuses on the economics and regulatory policy of the Internet infrastructure industries. He teaches courses on the economics, business strategy, and public policy issues facing telecommunications, Internet, and eCommerce companies, and is a frequent speaker at international industry and academic conferences. He is the author of numerous publications on such topics as the measurement of economic impacts of Information technologies, the economics of technical standard setting, the pricing of Internet services, and the implications of commercializing novel Internet and wireless technologies for industry structure and regulatory policy.

In addition to his academic research, Dr. Lehr provides litigation, economic, and business strategy consulting services for firms in the information technology industries in the U.S. and abroad. Dr. Lehr has advised information technology companies on strategic marketing, pricing, financial planning, and competitive strategy; and government agencies in the United States and abroad on telecommunications and Internet policy matters. Dr. Lehr has prepared expert witness testimony for both private litigation and for regulatory proceedings before the FCC, before numerous state commissions, and for a number of regulatory agencies abroad.

Dr. Lehr holds a PhD in Economics from Stanford (1992), an MBA from the Wharton Graduate School (1984), and MSE (1984), BS (1979) and BA (1979) degrees from the University of Pennsylvania.

Curriculum Vitae

WILLIAM HERNDON LEHR

EDUCATION

Ph.D., Economics, Stanford University, 1992.

M.B.A., with distinction, The Wharton School, University of Pennsylvania, 1984.

M.S.E., Chemical Engineering, University of Pennsylvania, 1984.

B.S., Chemical Engineering, *cum laude*, University of Pennsylvania, 1979.

B.A., European History, *magna cum laude*, University of Pennsylvania, 1979.

Academic Honors: Graduate Student Research Award, Telecommunications Policy Research Conference, 1991; Lynde and Harry Bradley Foundation Fellowship, 1990; Stanford Fellowship, 1987

PROFESSIONAL EXPERIENCE

Computer Science and Artificial Intelligence Laboratory (CSAIL), Massachusetts Institute of Technology (Cambridge, MA), Research Scientist, July 2006-present; previously, in Center for Technology, Policy and Industrial Development, MIT, 1997- June 2006. Working with MIT Internet Telecoms Convergence Consortium (1997-2004); Communications Futures Program (2004-2017); Advanced Network Architecture Group (2006-present).

Independent Economic and Strategy Consultant, 1991 to present (Concord, MA).

Graduate School of Business, Columbia University (New York, NY), Associate Research Scholar of Finance and Economics, 1997-2002; Assistant Professor of Finance and Economics, 1991 to 1996; Research Scholar, 1997-2002.

RAND Corporation (Santa Monica, CA), Graduate Student Intern, 1990.

Economic Analysis Group, Ltd. (Washington, DC), Senior Consultant, 1985-1987.

M.C.I. Telecommunications (Washington, DC), Manager of Financial Analysis, 1985; Senior Financial Analyst, 1984.

Office of Management and Budget, National Security Division (Washington, DC), Graduate Student Intern, 1983.

Putnam, Hayes and Bartlett (Cambridge, MA), Research Associate 1980-1982.

TEACHING EXPERIENCE

Communications & Information Policy
Internet Pricing and Quality of Service
Internet Commerce
Internet Economics 101
Internet Telephony Tutorial
Internet Commerce Video Course
Economics of Telecommunications Pricing
Economics and Strategy in Media Industries
Economics of Strategic Management
Managerial Economics
Telecommunications: Technologies and Policies in the Networked Digital World
Theory of the Firm (teaching assistant for Paul Milgrom)
Wireless Broadband in the Developing World

Professional Consulting Experience

Dr. William H. Lehr

In addition to his academic research, Dr. Lehr provides litigation, economic, business strategy and public policy consulting services for firms and governments in the U.S. and abroad on matters related to the information technology and communications policy. Dr. Lehr has advised information technology companies on strategic marketing, pricing, financial planning, and competitive strategy; and government agencies in the United States and abroad on telecommunications and Internet policy matters. Dr. Lehr has prepared expert witness testimony for both private litigation and for regulatory proceedings before the FCC, before numerous state commissions, and to a number of regulatory agencies abroad. Dr. Lehr had also assisted on the preparation of reports providing advice to government agencies on a range of development and communications policy matters.

- Dr. Lehr has provided advice to public sector authorities in the U.S. and abroad, including the Department of Commerce, the Federal Communications Commission, the National Science Foundation, and numerous Public Utility Commissions. Dr. Lehr has advised public authorities at the International Telecommunications Union, European Commission, OECD, World Bank, United Kingdom's Ofcom, Hong Kong Telecommunications Regulatory Authority, Australian Department of Communications, Information Technology and the Arts (DCITA), Forfas, Irish National Policy and Advisory Board for Enterprise, Trade, Science, Technology, and Innovation, Swiss Telecommunications Regulator, Jamaican Regulatory Authority and numerous others. He has advised and written reports on matters ranging from broadband and Internet policy to the management of radio frequency spectrum and institutional reforms.
- Dr. Lehr's private sector industrial clients have included national communication satellite service operators, telephone service providers, and equipment vendors. A partial list of clients includes AT&T, Broadcom, Charter, Comcast, Hewlett-Packard, ICO, Sprint/PCS, Wireless Grids, Verizon, Vietnam Telecom, and Vonage. Dr. Lehr also consults with the investment community on trends and developments in the ICT industries.

A sampling of such engagements includes:

- Co-editor of a volume on the role of ICTs in promoting the Strategic Development Goals to be published by the ITU at the World Telecommunications Development Conference in Buenos Aires in October 2017.
- Assisting the World Bank in its efforts to develop a Digital Economy tool-box for assessing the impact of ICTs and assisting in the design of sector-specific ICT development strategies.
- Contributing expert to President's Council of Advisors on Science and Technology (PCAST) report on government use of radio spectrum and co-organizer of multiple workshops for the Wireless Spectrum Research and Development (WSRD) Senior Steering Group (SSG) focused on coordinating spectrum-related R&D activities across the Federal government.

- Preparing a white paper on emerging trends in wireless and the implications for spectrum management for regulatory authorities in Canada and Australia.
- Developed a tool to estimate the impact of broadband infrastructure investments in Egypt as part of a World Bank project.
- Advised Canadian regulators on the implications of extending broadcast-style taxation to ISPs.
- Prepared a report on best practices for on measuring and assessing the status of broadband for the State of Massachusetts.
- Developed and delivered a custom course on the state of current research on the pricing of digital services for a computer equipment vendor.
- Provided expert testimony on the economic implications of copyright infringement in commercial litigation.

Papers and Publications

"Revisiting Wireless Internet Connectivity: 5G vs. Wi-Fi 6," with E. Oughton, K. Katsaros, I. Selinis, D. Bublely, and J. Kusuma (2020), submitted to Telecommunications Policy, August 2020.

"5G and Mobile Broadband Disruption," with F. Queder and J. Haucap (2020), presented to Euro ITS 2020, June 2020, available at <https://www.econstor.eu/bitstream/10419/224872/1/Queder-Lehr-Haucap.pdf>.

"Next Generation Wi-Fi and 5G NR-U in the 6 GHz Bands: Opportunities and Challenges," with G. Naik, J. Park, and J. Ashdown, IEEE Access, vol. 8, pp. 153027-153056, 2020, doi: 10.1109/ACCESS.2020.3016036

"Dynamic Exclusion Zones for Protecting Primary Users in Database-Driven Spectrum Sharing," with S. Bhattarai and J. Park, IEEE/ACM Transactions on Networking, 2020, 1-14.

"The State of Network Neutrality Regulation," with V. Stocker and G. Smaragdakis, ACM SIGCOMM Computer Communications Review, Vol. 50, Issue 1, January 2020.

"Gigabit Broadband Measurement Workshop Report," with S. Bauer and D. Clark, ACM SIGCOMM Computer Communications Review, Vol. 50, Issue 1, January 2020.

"Regulation when Platforms are Layered," with D. Clark and S. Bauer, TPRC47: Research Conference on Communications, Information and Internet Policy, Washington DC, September 2019.

"Beyond 5G: The Role of THz Spectrum," with R. Singh and D. Sicker, TPRC47: Research Conference on Communications, Information and Internet Policy, Washington DC, September 2019.

"Economics of Spectrum Sharing, Valuation and Secondary Markets," in C. Papadias, T. Ratnarajah and D. Stock (eds.), *Spectrum Sharing: the Next Frontier in Wireless Networks*, New York: Wiley, 2020.

"5G and the Future of Broadband," in G. Kneips & V. Stocker (eds.), *The Future of the Internet - Innovation, Integration, and Sustainability*, Baden-Baden: Nomos, 2019 (forthcoming).

"The Changing Context for Broadband Evaluation," in K. Mossberger, E. Welch, and Y. Wu (eds), *Transforming Everything? Evaluating broadband's impacts across policy areas*, Oxford: Oxford University Press, 2019 (forthcoming).

"Telecom Déjà vu: a model for sharing in the broadband Internet," with D. Sicker, *Information and Telecommunications Policy*, forthcoming 2019.

"Whither the Public Internet?" with D. Clark, S. Bauer, A. Berger, and P. Richter, *Journal of Information Policy* 9 (2019): 1-42. doi:10.5325/jinfopoli.9.2019.0001

"Communications Act 2021," (2018) with D. Sicker, *Journal of High Technology Law*, Volume 18, Number 2 (2018) 270-330.

"SMAP: A Scalable and Distributed Architecture for Dynamic Spectrum Management," (2018) with P. Karimi, D. Raychaudhuri and I. Seskar, IEEE DySPAN 2018, Seoul, Korea, October 2018

"When cyber threats loom, what can state and local governments do?", (2018) with J. Wolff, *Georgetown Journal of International Affairs*, Fall 2018.

"Whither the Public Internet?" (2018) with D. Clark, S. Bauer, A. Berger and P. Richter, 46th TPRC: (2018), TPRC46: The 46th Research Conference on Communication, Information, and Internet Policy 2018, available at <https://ssrn.com/abstract=3141969>.

"Spectrum Valuation: Implications for Sharing and Secondary Markets," (2018) with M. Gomez, M. Weiss, and G. McHenry, TPRC46: The 46th Research Conference on Communication, Information, and Internet Policy 2018, available at <https://ssrn.com/abstract=3142182>.

"Measuring Mobile Broadband Performance," (2018) with S. Bauer, TPRC46: The 46th Research Conference on Communication, Information, and Internet Policy 2018, available at <https://ssrn.com/abstract=3138610>.

"Roles for Policy-Makers in Emerging Cyber Insurance Industry Partnerships," (2018) with J. Wolff, TPRC46: Research Conference on Communications, Information and Internet Policy, American University, Washington, DC, September 21-22, 2018, abstract available at <https://ssrn.com/abstract=3141409>.

"Future of Broadband Competition in a 5G World" (2018), White paper, available at <http://dx.doi.org/10.2139/ssrn.3240191>.

"Analysis of Proposed Modifications to the CBRS PAL License Framework," Ex parte comment submitted to Federal Communications Commission in the Matter of Promoting Investment in the 3550-3700 MHz Band, Docket 17-258, December 2017.

ICT-centric economic growth, innovation and job creation, co-editor with Ahmad Sharafat, ITU Publishing: Geneva, October 2017.

"ICT Engines for Sustainable Development," with A. Sharafat, in A. Sharafat & W. Lehr (eds.), ICT-centric economic growth, innovation and job creation, Geneva, Switzerland: International Telecommunications Union (ITU), 2017, available at <http://handle.itu.int/11.1002/pub/80fc3264-en>

"Degrees of Ignorance About the Costs of Data Breaches: What Policymakers Can and Can't Do About the Lack of Good Empirical Data," with Josephine Wolff, *45th Research Conference on Communications and Internet Policy*, Alexandria, VA, September 2017.

"The growing complexity of content delivery networks: Challenges and implications for the Internet ecosystem," with V. Stocker, G. Smaragdakis, and S. Bauer, *Telecommunications Policy*, Vol 41 (10) 1003-1016, 2017, <https://doi.org/10.1016/j.telpol.017.02.004>.

"Would you like your Internet with or without video?" with D. Sicker, *Journal of Law, Technology & Policy*, vol 2017 (Issue 1 Spring), available at <http://illinoisjltip.com/journal/wp-content/uploads/2017/05/Lehr.pdf>.

"Ex-post mitigation strategies for theft of non-financial data," with J. Wolff, TPRC44, September 2016, Alexandria, VA, available at [available at SSRN: http://ssrn.com/abstract=2756842](http://ssrn.com/abstract=2756842) or <http://dx.doi.org/10.2139/ssrn.2756842>

"Improving the Measurement and Analysis of Gigabit Broadband Networks," with S. Bauer and M. Mou, TPRC44, September 2016, available at <http://dx.doi.org/10.2139/ssrn.2757050>.

"Content may be King, but (Peering) Location matters: A Progress Report on the Evolution of Content Delivery in the Internet," with V. Stocker, G. Smaragdakis, and S. Bauer, EuroITS2016, Cambridge University, Cambridge UK, September 2016, available at <http://people.csail.mit.edu/gsmaragd/publications/ITS2016/>

"An Overview of Dynamic Spectrum Sharing: Ongoing Initiatives, Challenges, and a Roadmap for Future Research," with S. Bhattarai, J. Park, B. Gao, and K. Bian, *IEEE Transactions on Cognitive Communications and Networking*, Vol. 2, No. 2, June 2016, 110-28.

"Spectrum License Design, Sharing, and Exclusion Rights," *Journal of Law, Technology, & Policy*, Vol. 2016, Spring, No. 1, 1-33.

"Interconnection in the Internet: peering, interoperability, and content delivery," with D. Clark and S. Bauer, Chapter 16 in J. Bauer and M. Latzer (eds) *Handbook on the Economics of the Internet*, Edward Elgar: Northampton MA, 2016.

"Socio-Technical Considerations for Spectrum Access System (SAS) Design," with M. Weiss, A. Acker, and M. Gomez (2015), IEEE DySPAN 2015.

"Gigabit Broadband, Interconnection Propositions, and the Challenge of Managing Expectations," with S. Bauer and S. Hung, TPRC2015, Alexandria, VA, September 2015.

"The Road to an Open Internet is Paved with Pragmatic Disclosure & Transparency Policies," with E. Kenneally and S. Bauer, TPRC2015, Alexandria, VA, September 2015.

"Reliability and the Internet Cloud," C.Yoo and J-F. Blanchette (eds), in *Regulating the Cloud: Policy for Computing Infrastructure*, MIT Press: Cambridge, MA, 2015.

"Measurement and Analysis of Internet Interconnection and Congestion," with D. Clark, S. Bauer, K. Claffy, A. Dhamdhere, B. Huffaker, and M. Luckie, *Journal of Information Policy*, Vol 4 (2014).

"Benefits of Competition in Mobile Services," a white paper submitted as Ex Parte to FCC in the matter of Wireless Telecommunications Bureau Seeks Comment on the State of Mobile Wireless Competition, WT Docket No. 13-135, 24 March 2014, available at <http://apps.fcc.gov/ecfs/document/view?id=7521094963>.

"Toward More Efficient Spectrum Management: New Models for Protected Shared Access," (WG Chair), a White Paper prepared by the MIT Communications Futures Program Spectrum Working Group, submitted to FCC's 3.5GHz proceeding (Docket #12-354), available at <http://apps.fcc.gov/ecfs/comment/confirm?confirmation=201437236301>.

"Small cells and the mobile broadband ecosystem," with M. Oliver, Euro ITS2014, Brussels, June 2014, available at <http://econpapers.repec.org/paper/zbwitse14/101406.htm>.

"PALs as Options to Exclude GAA," Reply Comments submitted in the matter of Amendment of the Commission's Rules with Regard to Commercial Operations in the 3550-3650 MHz Band, GN Docket 12-354, August 15, 2014, available at <http://apps.fcc.gov/ecfs/document/view?id=7521763142>.

"The Mistake of One-Sided Open Internet Policy," a white paper, prepared with support from the American Cable Association, July 2014, available at <http://apps.fcc.gov/ecfs/document/view?id=7521683605>.

"Mobile Broadband: toward a sustainable ecosystem," (with M. Montpetit), a White Paper prepared by the MIT Communications Futures Program Mobile Broadband Working Group, May 2014, available at http://cfp.mit.edu/publications/CFP_Papers/CFP%20Mobile%20Broadband%20White%20Paper%20May%202014.pdf

"The NEBULA Future Internet Architecture," with Anderson, T., K. Birman, R. Broberg, M. Caesar, D. Comer, C. Cotton, M. Freedman, A. Haeberlen, Z. Ives, A. Krishnamurthy, B. Loo, D. Mazieres, A. Nicolosi, J. Smith, I. Stoica, R. Renesse, M. Walsh, H. Weatherspoon, and C. Yoo forthcoming in *The Future Internet: Future Internet Assembly 2013*, A. Galis and A. Gavras (eds), Lecture Notes in Computer Science – Volume 7858, Springer: New York, 2013.

"MobilityFirst, LTE and the Evolution of Mobile Networks," with R. Yates, IEEE DySPAN2012, Bellevue, Washington, October 2012

"Enforcement in Dynamic Spectrum Access Systems," with M. Weiss, L. Cui, and M. Altamini, TPRC2012, Alexandria, VA, September 2012

"A Data Driven Exploration of Broadband Traffic Issues: Growth, Management, and Policy," with Steve Bauer and David Clark, TPRC2012, Alexandria, VA, September 2012

"Reliability and the Internet Cloud," paper prepared for *Workshop on Cloud Computing: Economic and Regulatory Implications*, University of Pennsylvania, February 24, 2012 (paper June 2012).

"Measuring Broadband Performance when Broadband is the New PSTN," with D. Clark and S. Bauer, MITAS Working Paper, *The End of the Phone System Workshop*, University of Pennsylvania, May 2012

"Measuring the Internet: the data challenge," Organization for Economic Cooperation and Development (OECD) Digital Economy Working Paper 184, ISSN 2071-6826, April 2012.

"Mobile Broadband Growth, Spectrum Scarcity, and Sustainable Competition," with John Chapin, *39th Research Conference on Communications, Information and Internet Policy* (www.tprcweb.com), Alexandria, VA, September 2011.

"Assessing broadband reliability: Measurement and policy challenges," with Steven Bauer, Mikko Heikkinen, and David Clark, *39th Research Conference on Communications, Information and Internet Policy* (www.tprcweb.com), Alexandria, VA, September 2011.

"Interconnection in the Internet: the policy challenge," with David Clark and Steven Bauer, *39th Research Conference on Communications, Information and Internet Policy* (www.tprcweb.com), Alexandria, VA, September 2011.

"Powerboost," with Steven Bauer and David Clark, *Proceedings of IEEE HomeNets '11*, Toronto, Canada, August 2011.

"Clouds, Cable And Connectivity: Future Internets And Router Requirements," with Robert Broberg, Andrei Agapi, Ken Birman, Douglas Comer, Chase Cotton, Thilo Kielmann, Robbert VanRenesse, Robert Surton, and Jonathan Smith, *Proc. 2011 Cable Connection Spring Technical Conference*, June 14-16, Chicago, IL.

"SCADA for the Rest of Us: Unlicensed Bands Supporting Long-Range Communications," with John Chapin, *38th Research Conference on Communications, Information and Internet Policy* (www.tprcweb.com), Alexandria, VA, October 1-2, 2010.

"Understanding Broadband Speed Measurements," with Steve Bauer and David Clark, MITAS Working Paper, June 2010, available at: http://mitas.csail.mit.edu/papers/Bauer_Clark_Lehr_Broadband_Speed_Measurements.pdf.

"On the convergence of wired and wireless access network architectures," with John Chapin, *Internet Economics and Policy*, 22 (2010) 33-41.

"Mobile Broadband and Implications for Broadband Competition and Adoption," a white paper prepared on behalf of *Broadband for America*, November 2009.

"Broadband microfoundations: the need for traffic data," with Stephen Bauer and David Clark, *Beyond Broadband Access* conference, NewAmerica Foundation, Washington DC, September 22-24, 2009.

"The Evolution of Internet Congestion," with Stephen Bauer and David Clark, paper prepared for 37th Research Conference on Communication, Information and Internet Policy (www.tprcweb.com),^[1]_{SEP} Arlington, VA, September 2009.

"Hybrid Wireless Broadband," with John Chapin, paper prepared for 37th Research Conference on Communication, Information and Internet Policy (www.tprcweb.com),^[1]_{SEP} Arlington, VA, September 2009.

"Rethinking wireless broadband platforms," with John Chapin, invited paper presented at *Wireless Technologies: Enabling Innovation and Growth*, Georgetown Center for Business and Public Policy, Washington DC, April 17, 2009.

"Internet Policy – A Mix of Old and New Challenges," with Lorenzo Pupillo, in *Internet Policy and Economics: Challenges and Perspectives*, W. Lehr and L. Pupillo (editors), Springer: New York, 2009.

"The role of Unlicensed in Spectrum Reform," in *Internet Policy and Economics: Challenges and Perspectives*, W. Lehr and L. Pupillo (editors), Springer: New York, 2009.

Internet Policy and Economics: Challenges and Perspectives, co-edited with Lorenzo Pupillo, Springer: New York, 2009.

"Measurement and Assessment of Broadband Availability," with Tony Smith-Grieco, Report prepared for the John Adams Innovation Institute at the Massachusetts Institute of Technology, January 2009.

"Public Safety Radios Need to Pool Spectrum," with Nancy Jesuale, *IEEE Communications Magazine*, March 2009.

"The Growing Complexity of Internet Interconnection," with Peyman Faratin, David Clark, Steven Bauer, Patrick Gilmore, and Arthur Berger, *Communications & Strategies*, No. 72, 4th Quarter 2008, pages 1-21.

"Spectrum Pooling for Next Generation Public Safety Radio Systems," with Nancy Jesuale, prepared for IEEE Dynamic Spectrum Access Networks (DySPAN08) Conference, Chicago, October 14-17, 2008.

"Running on Empty: the challenge of managing Internet addresses," with Tom Vest and Eliot Lear, prepared for the 36th Research Conference on Communication, Information, and Internet Policy, George Mason University, Arlington, VA, September 26-28, 2008.

"Broadband Metrics Best Practices: Review and Assessment," with Tony Smith-Grieco and Grace Rusi Woo, report prepared for Massachusetts Technology Collaborative/John Adams Innovation Institute (MTC/JAII), February 2008.

"Measuring Broadband: Improving Communications Policymaking through Better Data Collection," with Kenneth Flamm, John Horrigan, and Amy Friedlander, Pew Internet & American Life Project, Washington, DC, November 2007.

"Coordinating User Behavior and Device Behavior in Wireless Grids," with Lee McKnight and James Howison, in *Cognitive Wireless Networks*, edited by Fitzek, F. and M. Katz, Springer: The Netherlands, 2007.

"Study of Market-based Exclusive Spectrum Rights," with Adrian Foster, Martin Cave, and Robert Jones, report prepared for Industry Canada, August 2007.

"Complexity of Internet Interconnections: Technology, Incentives and Implications for Policy," with P. Faratin, D. Clark, P. Gilmore, and A. Berger, paper prepared for 35th Annual Telecommunications Policy Research Conference, George Mason University, September 2007.

Special Issue on Network Neutrality, co-edited with Jon Peha and Simon Wilkie, *International Journal of Communication* (volume 1, 2007), August 2007 (available at <http://ijoc.org/ojs/index.php/ijoc/issue/view/1>).

"Introduction: The State of the Debate on Network Neutrality," with Jon Peha and Simon Wilkie, *International Journal of Communication* (volume 1, 2007), August 2007, pages 8-20 (available at <http://ijoc.org/ojs/index.php/ijoc>).

"Scenarios for the Network Neutrality Arms Race," with Marvin Sirbu, Jon Peha, and Sharon Gillett, *International Journal of Communication* (volume 1, 2007), August 2007, pages 8-20 (available at <http://ijoc.org/ojs/index.php/ijoc>) (paper originally presented at the 34th Annual Telecommunications Policy Research Conference, George Mason University, September 2006.)

"The Effects of Broadband Deployment on Output and Employment: A Cross-sectional Analysis of U.S. Data," with Robert Crandall and Robert Litan, *Issues in Economic Policy*, The Brookings Institution, Number 6, July 2007 (available at: <http://www.brookings.edu/views/papers/crandall/200706litan.htm>)

"The path to market success for dynamic spectrum access technologies," with John Chapin, *IEEE Communications Magazine*, May 2007.

"Time-limited Leases for Innovative Radios," with John Chapin, *IEEE Communications Magazine*, June 2007.

"Overlay Networks and Future of the Internet," with David Clark, Steve Bauer, Peyman Faratin, Rahul Sami, and John Wroclawski, *Communications and Strategies*, no. 63 (3rd Quarter 2006) 1-21.

"Measuring Broadband's Economic Impact," with Sharon Gillett, Carlos O'sorio, and Marvin Sirbu, *Broadband Properties*, vol. 24, no. 12 (Revised January 2006) 12-24.

"Managing Access to a Spectrum Commons," with Jon Crowcroft, paper prepared for IEEE DySPAN Conference, Baltimore, MD, November 2005.

"The Growth of Internet Overlay Networks: Implications for Architecture, Industry Structure and Policy," with David Clark, Peyman Faratin, Rahul Sami, and John Wroclawski, paper presented at the 33rd Annual Telecommunications Policy Research Conference, George Mason University, September 2005.

"Evolving Wireless Access Technologies for Municipal Broadband," with Marvin Sirbu and Sharon Gillett, *Government Information Quarterly*, 23 (2006) 480-502.

"Wireless is Changing the Policy Calculus for Municipal Broadband," with Marvin Sirbu and Sharon Gillett, *Government Information Quarterly*, 23 (2006) 435-453

"Measuring Broadband's Economic Impact," with Sharon Gillett, Marvin Sirbu, and Carlos Osorio, paper presented at the 33rd Annual Telecommunications Policy Research Conference, George Mason University, September 2005.

"The Role of Unlicensed in Spectrum Reform," draft mimeo, Massachusetts Institute of Technology, March 2005.

"Broadband Open Access: Lessons from Municipal Network Case Studies," with Marvin Sirbu and Sharon Gillett, paper presented at the 32nd Annual Telecommunications Policy Research Conference, George Mason University, September 2004.

"The Municipal Role in U.S. FTTH Market Growth," with Sharon Gillett and Carlos Osorio, prepared for the FTTH Council's 3rd Annual FTTH Conference and Expo, October 4-6, 2004, Orlando, FL.

"Municipal Electric Utilities' Role in Telecommunications Services," with Sharon Gillett and Carlos Osorio, *Telecommunications Policy*, vol 30, issue 8-9 (September-October 2006) 464-480.

"Municipal Wireless Broadband: Policy and Business Implications of Emerging Access Technologies," with Marvin Sirbu and Sharon Gillett, paper prepared for "Competition in Networking: Wireless and Wireline," London Business School, April 13-14, 2004.

"Wireless Broadband: Coming to a Town Hall Near You?" MIT Technology Insider, August 2004.

"Local Government Broadband Initiatives," with Sharon Eisner Gillett and Carlos Osorio, *Telecommunications Policy*, 28 (August 2004) 537-558.

"Economic Case for Dedicated Unlicensed Spectrum Below 3GHz," paper prepared for New America Foundation Conference, April 2004.

"TELRIC and the Cost of Capital," with R. Glenn Hubbard, white paper prepared on behalf of AT&T for *ex parte* submission to the FCC, December 2003.

"Coordinating User and Device Behavior in Wireless Grids," with Lee McKnight and James Howison, draft paper, Syracuse University, October 2003.

"Local Government Broadband Initiatives," with Sharon Eisner Gillett and Carlos Osorio, paper prepared for the 31st Annual Telecommunications Policy Research Conference, George Mason University, September 2003.

"Economic Case for Voluntary Structural Separation," with R. Glenn Hubbard, paper prepared for the 31st Annual Telecommunications Policy Research Conference, George Mason University, September 2003.

"Software Radio: Implications for Wireless Services, Industry Structure, and Public Policy," with Sharon Gillett and Fuencisla Merino, *Communications and Strategies*, IDATE, Issue 49 (1st Quarter 2003) 15-42.

"Wireless Internet Access: 3G vs. WiFi?," with Lee McKnight, *Telecommunications Policy*, 27 (2003) 351-370.

"Local Government Stimulation of Broadband: Effectiveness, E-Government, and Economic Development," with David Clark, Sharon Gillett, Marvin Sirbu, and Jane Fountain, A White Paper Prepared from A Proposal to the U.S. National Science Foundation Program on Digital Government, Massachusetts Institute of Technology, November 7, 2002.

"Stimulating Investment and the Telecommunications Act of 1996," with Robert Willig, John Bigelow, and Stephen Levinson, white paper prepared on behalf of AT&T, October 2002.

Cyber Policy and Economics in an Internet Age, co-edited with Lorenzo Pupillo, Kluwer Academic Press: Norwell, MA, November 2002.

"Optical Networks and the Future of Broadband Services," with Pedro Ferreira and Lee McKnight, *Technological Forecasting and Social Change*, 69 (2002) 741-758.

"Show Me the Money: Contracts and Agents in Service Level Agreement Markets," with Lee McKnight, *info*, vol. 4, no. 1 (2002) 24-36.

"Promoting Broadband Investment and Avoiding Monopoly," with Robert Hall, white paper prepared on behalf of AT&T, February 2002.

"Best Effort versus Spectrum Markets: Wideband and Wi-Fi versus 3G MVNOs?" with Raymond Linsenmayer and Lee McKnight, forthcoming in Proceedings of the 29th TPRC: Research Conference on Information, Communication, and Internet Policy, edited by Shane Greenstein and Lorrie Cranor.

"The Disruptive User – Internet Appliances and the Management of Complexity," with Sharon Gillett, David Clark, and John Wroclawski, *BT Technology Journal*, Vol. 19, No. 4 (October 2001) 40-45.

"Rescuing Competition to Stimulate Telecom Growth," with Robert Hall, white paper prepared on behalf of AT&T, October 2001.

"Do Appliances Threaten Internet Innovation?" with Sharon Gillett, David Clark, and John Wroclawski, *IEEE Communications Magazine*, vol. 39, no. 10 (October 2001) 46-51.

"No Optical Illusion: A market for Bandwidth is Emerging," with Lee McKnight, *WorldLink*, World Economic Forum, May/June 2001.

Book Review of *Letting Go: Deregulating the Process of Regulation* by Alfred Kahn, *Journal of Economic Literature*, vol. XXXIX (September 2001) 943-944.

"Competition in Telecommunications and Economic Growth," with Jim Glassman, report prepared for TechCentral Station, July 2001.

"The Economics of the Tauzin-Dingell Bill: Theory and Evidence," with Jim Glassman, report prepared for TechCentral Station, June 2001.

"Assessing the Cost of Capital for a Standalone Transmission Company," with Michael Cragg and Ron Rudkin, *The Electricity Journal*, Volume 14, Issue 1, January-February 2001, Pages 80-88.

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