Monisha Ghosh, Ph.D.

Brief bio:

Monisha Ghosh is a Professor in the Electrical Engineering department at the University of Notre Dame, a member of the Notre Dame Wireless Institute, Policy Outreach Director for SpectrumX and an Adjunct Research Professor at the University of Chicago.

Monisha recently completed a term as the Chief Technology Officer at the FCC on June 14, 2021. In this role she reported to the Chairman of the FCC and was closely involved with setting national strategy and technology specifications related to the explosive growth of broadband wireless communications technologies. These have included helping to craft rules or the 6 GHz unlicensed bands, overseeing protocols for the standardized measurement of broadband signals, and open RAN. Prior to that she served in the NSF as a rotating Program Director (IPA) between 2017-2019, within the Directorate of Computer & Information Science and Engineering (CISE) where she helped manage wireless networking research. During her tenure at the NSF she is credited with initiating one of the first large scale programs that targets applications of machine learning to wireless networks. She was concurrently a Research Professor at the University of Chicago where she conducted research on wireless technologies for the IoT, 5G cellular, next generation Wi-Fi systems, coexistence and spectrum sharing. Prior to joining the University of Chicago in September 2015, she has worked extensively in industrial research and development at Interdigital, Philips Research and Bell Laboratories, on various wireless systems such as the HDTV broadcast standard, cable standardization and cognitive radio for the TV White Spaces. She has made active technical contributions to many industry standards, including IEEE 802.22 and 802.11. While at Philips she was responsible for conceiving of and designing the first blind equalization architecture to be incorporated into an integrated circuit product chip (Philips, digital TDA 8960 VSB channel decoder IC for digital TV, 1999). She received her Ph.D. in Electrical Engineering from the University of Southern California in 1991, and her B. Tech from the Indian Institute of Technology, Kharagpur (India) in 1986. She is a Fellow of the IEEE.

Education

(1) University of Southern California, Los Angeles, CA: 1987 - 1991

(a) Ph.D. in Electrical Engineering, Sept. 1991. Dissertation title: An Optimal Approach to Blind Equalization. GPA: 4.0/4.0.

(b) M.S. in Electrical Engineering, Dec. 1988. GPA: 4.0/4.0.

(2) Indian Institute of Technology (IIT), Kharagpur, India: 1982 - 1986

(a) Bachelor of Technology (Hons.) in Electronics and Electrical Communication Engineering 1986.

Expertise/Interests

(1) Complete publication and patent list: Google Scholar page (~7500 citations)
(2) Coexistence and spectrum sharing, e.g. Wi-Fi/LTE coexistence, Wi-Fi DSRC coexistence.
(3) Broadband wireless mapping for 5G and Wi-Fi.
(4) Wireless Underground Sensor Networks (WUSNs).
(5) mmWave channel characterization and system design.
(6) Physical layer (PHY) development (standardization and receiver implementation) of various wireless/wired systems: Wi-Fi (802.11a/b/g/n/ac/ad/af/ah), 802.22, cellular, ATSC, cable TV.

(7) Cross-layer investigations related to cooperative networking, power control and power savings.
(8) Extensive regulatory experience with the FCC and ECC on TV White Spaces and Medical Body Area Networking.
(9) Extensive standardization experience with 802.11, 802.22 and Ecma.
(10) Application of Bayesian theory to Clinical Informatics.

Work Experience

(1) Professor, Electrical Engineering Department, University of Notre Dame, January 2022 – present

Research and teaching in spectrum coexistence, next generation cellular and Wi-Fi, broadband mapping. Member of the Notre Dame Wireless Institute (https://wireless.nd.edu/); Policy Outreach Director of SpectrumX, the first NSF Center for Spectrum Innovation (https://www.spectrumx.org/); co-chair of the Advanced Spectrum Sharing Working Group of the FCC's Technological Advisory Council (TAC); Fellow at AnaltyXIN, https://analytixindiana.com/talent/university-of-notre-dame/

Funded Projects:

(i) Award Abstract # 2226437, NSF Convergence Accelerator, Track G : SONIC: Securely Operate through 5G Networks with Informed Control, August 2022.
(ii) Award Abstract # 2229387, Collaborative Research: SWIFT: Coexistence and Interference Mitigation in the Mid-Band Spectrum: Analysis, Protocol Design, and Experimentation, October 2022.

(2) Chief Technology Officer, Federal Communications Commission, January 2020 – June 2021

As CTO, my role was to advise the Chairman of the FCC on all technical matters related to wireless communications with respect to US communications strategies, spectrum policies and standards. With the current and anticipated rapid growth in wireless communications, I was particularly involved in (a) developing strategy and crafting rules that will foster the continued growth of Wi-Fi in the 6 GHz unlicensed bands, (b) developing a strategy for measuring wireless broadband performance, and (c) developing a strategy for the adoption of open radio access network (Open RAN) architectures. A methodology developed at UChicago was used in a wireless broadband mapping pilot program between the FCC and the USPS. The Congressional report on this is here: https://www.fcc.gov/sites/default/files/report-congress-usps-broadband-data-collection-feasibility-05242021.pdf

(3) Program Director, NSF, CISE/CNS/NeTS, September 2017 – January 2020

Responsible for managing and funding the core programs in wireless networking within CNS and creating joint programs with other directorates, such as Spectrum and Wireless Innovations enabled by Future Technologies (SWIFT). Was responsible for initiating one of the first major national funding programs for exploring machine learning applications in wireless networking, jointly with Intel (MLWiNS). I was also actively involved in the Spectrum Innovation Initiative that proposed the establishment of Spectrum Institutes in universities: these are envisaged to be centers of excellence for research into various uses of spectrum and balancing the needs of commercial, federal and scientific users.

(4) Research Professor, University of Chicago: September 2015 – December 2021

The role and vision of my group here has been to research and understand the co-existence of Wi-Fi (unlicensed) and Cellular (licensed) technologies in the unlicensed 5 and 6 GHz bands. A

significant part of this research relies on obtaining reliable, crowd-sourced, network measurements by using specially designed apps on smartphones. We measure signal strength, resource block allocations, latencies and delays and use this data to understand network behavior, especially 5G mmWave and co-existence. We corroborate our conclusions with analysis, simulation and lab measurements. The output from this work was presented to the IEEE Workshop on Coexistence and the recommendations were included by Cisco in submissions to ETSI BRAN for inclusion in coexistence standard specifications. More recently, our work on coexistence of Wi-Fi and LAA in the cellular bands using measurements of deployed systems in Chicago received wide interest in the media: https://www.fiercewireless.com/tech/uc-research-finds-severe-degradation-wi-fi-due-to-laa

(a) **Teaching:** MENG 23400/33400 "Applied Probability for Engineers", Spring Quarter 2016. Graduate level course on applied probability.

(b) **Funded research projects:**

I. Coexistence between DSRC and Wi-Fi in U-NII-4 bands, funded by Hyundai America, Jan 2016 – Dec. 2016, $ 88,000.

II. NSF, joint with University of Washington, "Can LTE and Wi-Fi live happily ever after?" Oct. 2016 – Sept. 2020, $203,000 LTE Wi-Fi Coexistence

III. NSF, joint with NCSU and FIU, "Towards mmWave communications for Unmanned Aerial Vehicles", Oct. 2016 – Sept. 2021, $ 150,000 mmWave for UAVs

(c) Collaboration with SIGFOX to deploy an experimental buried sensor network on the UChicago campus to research Wireless Underground Sensor Networks (WUSNs), Thoreau.

(d) Member of CERES, Center For Unstoppable Computing at the CS dept.

(3) Principal Engineer (Director-level), InterDigital, Melville, NY: January 2012 – August 2015

(a) Physical Layer (PHY) technology development for IEEE 802.11ah (Sub-1 GHz non TV White Spaces) in the areas of preamble design, multiple-antenna and multi-user modes.

(b) Physical Layer (PHY) technology development for next-generation Wi-Fi (802.11ax).

(c) Research on PHY-MAC cross-layer interactions for power control and power savings in Wi-Fi.

(d) Research in the area of next-generation 802.11ad-based mmWave solutions for small-cell backhaul.

(e) Developing mmWave access link for 5G cellular.

(4) Principal Member of Research Staff and Project Leader, Philips Research, Briarcliff Manor, NY 10510: August 1999 to December 2011.

Responsible for initiating and leading new projects that have long term research potential as well as product impact for Philips. Some of these activities are:

(a) Cognitive radio in the TV White Spaces (2006 - 2011): Technical lead for TVWS activities in Philips, an early participant in this space. Worked on the following aspects:

(i) Active IEEE 802.22 standards participation in the physical layer design. Architect of several proposals that are now part of the IEEE 802.22 standard.

(ii) Influencing FCC's regulatory directions: lead architect for the Philips prototype for sensing television and wireless microphone signals at extremely low signal levels. Among the number of prototypes tested by FCC and submitted by a collection of international companies, the Philips prototype was identified as the best performer. Invited to participate

in a meeting on Spectrum Experiment test beds for testing dynamic spectrum access by the White House Office of Science and Technology policy on Jan 10, 2011.

(iii) Lead PHY architect for the Ecma 392 standard for personal/portable devices in the TV White Spaces. Innovative personal contributions include: enhanced retransmission schemes and low-overhead preamble design for multiple-antenna support. This standard is now also an ISO standard, ISO/IEC 16504.

(iv) Active participant and contributor to the European White Spaces effort via SE 43 and contribution to ECC Report 159. Developed algorithms for sensing DVB-T signals for UK and Europe, implemented a prototype and conducted lab and field tests.

(v) An invited paper from my team: J. Wang, M. Ghosh and K. Challapali, "Emerging cognitive radio applications: a survey," IEEE Communications Magazine, vol. 49, no. 3, pp. 74 – 81, March 2011 was no. 8 in the Top 100 downloads from IEEExplore in March 2011.

(b) Active participant in the regulatory proceeding for allocating the 2360 – 2400 MHz band for Medical Body Area Networks since 2009: visited FCC, prepared comments on proceedings, proposed coexistence mechanisms between MBANs and aeronautical telemetry systems. This activity led to the FCC issuing rules for MBANS in 2012, based largely on the Philips proposal.

(c) Active participant in the 802.11n standardization activity since 2002: Technical lead from Philips for the physical layer (PHY) proposal for 802.11n. Developed advanced equalization and diversity reception algorithms for 802.11a/b/g/n wireless LANS.

(d) Equalizers for 3G cellular systems: Developed algorithms for adaptive equalization for 3G cellular phones. This project was funded by PCC, a product division that made cell-phones.

(e) Other research areas: Cooperative communications, multiple antenna systems (MIMO, STBC etc.), interference cancellation, analytics for clinical informatics. Please see publication list for contributions in these areas.

(5) Member Technical Staff, Digital Communications Research, Bell Labs., Lucent Technologies Murray Hill, NJ 07974: July 1998 to July 1999.

Design and analysis of wideband wireless cellular data networks based on OFDM, low-complexity multiuser detection algorithms for CDMA, interference cancellation for Digital Audio Broadcast (DAB) systems.

(6) Senior Member of Research Staff, Advanced Television Research, Philips Laboratories, Briarcliff Manor, NY 10510: October 1991 to June 1998.

(a) VSB receiver implementation: algorithm development for the key components of equalization, interference cancellation and trellis decoding. These algorithms were incorporated into the first generation Philips VSB IC for HDTV in 1998.

(b) Participated in IEEE 802.14 Working Group for the physical layer specification of the upstream cable channel. Developed ingress cancellation techniques for use in this channel.

(c) Comparing and contrasting different modulation schemes such as QAM, VSB, and OFDM; developing forward error correction schemes using trellis coded modulation concatenated with Reed-Solomon codes; developing adaptive/blind equalizer structures and synchronization algorithms for high-rate systems, development of algorithms for cochannel interference

cancellation. Worked on the above aspects of the Grand Alliance HDTV transmission system and QAM cable modems.

(7) Graduate Research and Teaching Assistant, Communication Sciences Institute, EE Dept. University of Southern California, Los Angeles: January 1987 to October 1991.

(a) Carried out research on adaptive equalization with emphasis on blind equalization techniques. This research resulted in the development of optimal maximum likelihood based algorithms for the blind identification of channel and data that performed as well in terms of probability of error as when the channel is known at the receiver.

(b) Was a teaching assistant for senior level and graduate courses in communications and signal processing such as transform theory, information theory, and random processes. Conducted weekly discussion sessions in these courses.

Awards and professional activities

1) Column Editor, Spectrum Policy and Regulatory Issues, IEEE Wireless Communications Magazine, 2023.
2) General co-chair, COMSNETS 2023, https://www.comsnets.org/
3) Invited member of the National Academy of Science panel to review NIST's Communication Technology Lab in 2019 and 2022: NIST Review 2019, NIST Review 2022
4) IEEE Fellow, 2015, "for contributions to cognitive radio and signal processing for communication systems"
5) Certification of Appreciation awarded by IEEE 802.22 for outstanding contributions to the IEEE 802.22 – 2011 Standard, July 2011.
6) Distinguished Engineer Award, Philips Research, 2008.
7) Member of the research team that was awarded the 2007 North American Cognitive Networks Excellence in Research of the Year Award from Frost and Sullivan.
8) Outstanding paper award, second place winner, at ICCE 2000 for presentation of the paper, ``Decision feedback equalizer (DFE) design issues for terrestrial television receivers'' at ICCE 1999.
9) NSF panel reviewer 2014, 2015, 2016, 2017, 2021.
10) TPC Member: Globecom, ICC, VTC, PIMRC, IWWAN etc.
11) Invited member of the National Academy of Science panel to review NIST's Communication Technology Lab in 2019 and 2022: NIST Review 2019, NIST Review 2022
12) Member of the NextG Alliance, https://nextgalliance.org/

Advisory and Board Positions

1) Technological Advisory Council (TAC), FCC, co-chair of the Advanced Spectrum Sharing Working Group, FCC TAC
2) IEEE ComSoc Standardization Programs Development Board Member, ComSoc standardization Board
3) Advisory Committee, IEEE Connecting The Unconnected (IEEE CTU), IEEE CTU
4) Technical Advisory Committee, Duality, Duality Accelerator
5) Technological Advisory Board, US-Ignite, US-Ignite
6) 5G Technological Advisory Board, Center for Development of Telematics (CDOT), Government of India, CDOT
7) Scientific Advisory Committee, VistaMilk, Ireland, Vistamilk

Keynotes, Invited Talks and Panels

1) Invited panelist, ACM India, "Digital Transformation: The Road Ahead," March 02, 2023.
2) Keynote speaker, UK Spectrum Policy Forum Plenary Meeting, February 14, 2023
3) Invited Panelist, Federal Communications Bar Association Meeting on Improving Interference Immunity, January 17, 2023.
4) Keynote speaker, 6G Evolution Summit, December 13, 2022
5) Panel Moderator, "The evolution of Spectrum Sharing – Future models to increase the efficiency of spectrum usage across federal and commercial bands," 11th Americas Spectrum Management Conference, October 12, 2022, Washington DC.
6) Keynote Speaker, "Spectrum for NextG: licensed, unlicensed or shared?" IEEE Future Networks 2nd Massive MIMO Workshop, October 04, 2022.
7) Invited Panelist, "The role of sharing and innovative licensing models in meeting the needs of 6G," 6G Global Summit September 15, 2022.
8) Keynote Speaker, "Diversity in wireless communications: what is good for technology is good for people," Third VTS Workshop on Diversity and Inclusion, June 19, 2022.
9) Invited Speaker, "What 6G should learn from 5G: A Measurement Study of 5G mmWave," First IEEE NextG Summit, June 14, 2022.
10) Invited Speaker, "Signal strength Measurements Using Smartphones," IEEE RFID 2022 Workshop on Digital Spectrum Twinning, May 19, 2022.
11) Invited Panelist, "Building and leveraging 5G infrastructure for a 6G world," Fierce Wireless 5G Blitz Week, Spring Edition, March 30, 2022.
12) Keynote, "Lessons learnt from 5G mmWave deployments," ACM mmNets 2021, March 28, 2022.
13) Invited participant, Silicon Flatirons Round table on Interference Resolution, March 22, 2022.
14) Invited Panelist, Panel on STEM Education, Women in Telco, March 08, 2022.
15) Invited talk, IEEE Connecting the Unconnected Summit, Nov. 5, 2021.
16) Panel moderator, FCC open RAN Solutions Showcase, July 14, 2021.
17) Invited Panelist, NAE Member led Workshop on NextG, June 24, 2021.
18) Invited Panelist, "Policy, Regulation and Spectrum," Small Cell World Forum, May 11 – 13, 2021
19) Invited Panelist, "The Spectrum Roadmap," 6G Symposium, May 5, 2021
20) Invited talk, "Spectrum Options for 5G," Idaho National Lab (INL) Wireless Security Workshop, November 17, 2020.
21) Keynote, "Spectrum Challenges for Next Generation Wireless Systems: the need for better coexistence," UCSD Center for Wireless Communications, 5G and Beyond Forum, November 12, 2020.
22) Invited Talk, "Modernizing the Wireless Priority Service (WPS) rules," IEEE Workshop on 5G Technologies for First Responder and Tactical Networks, October 23, 2020.
23) Invited Panelist, "Spectrum Sharing in 6G Systems," 6G Symposium, October 21, 2020
24) Panelist, "AI meets 5G," DC Area CTO Roundtable, October 1, 2020.
25) Panel moderator, Technical Deep Dive Panel, FCC Forum on Open RAN, September 14, 2020.
26) Keynote speaker at IEEE 5G World Forum, "Blurring the lines between licensed and unlicensed: 6G or 6 GHz?" September 10, 2020
27) Panelist, NSF Workshop on Wireless, Spectrum and Innovation, August 28, 2020.
28) Tutorial Panelist, ISART 2020, "Spectrum For Next Generation Wireless: 5G and Wi-Fi," August 8, 2020.
29) Keynote speaker, OpenWireless 2020, "The Spectrum Sharing Future," June 19, 2020.
30) Keynote speaker, IEEE ICC 2020, "6 GHz: The New Unlicensed Frontier", June 8, 2020.
31) IEEE Future Networks Webinar, "NSF Platforms For Advanced Wireless Research," October 29, 2019.

32) Panelist, Silicon Flatirons Workshop on "Saving our Spectrum: Handling Radio Layer Vulnerabilities in Wireless Systems," October 10, 2019.
33) Keynote speaker at HDR-Nets Workshop, October 7, 2019
34) Invited presentation to the FCC Technological Advisory Committee on AI/ML, "LTE-U/Wi-Fi Coexistence: can ML help?", September 25, 2019.
35) Invited speaker, NI Roundtable on Advanced Wireless Research, September 29, 2019
36) Invited panelist, Infocom, "Smart Networks: What is Next?", April 30, 2019.
37) Keynote speaker, International Workshop on Wireless Communications and Networking in Extreme Environments (WCNEE 2019), April 29, 2019.
38) Invited participant, Silicon Flatirons Round table on Spectrum Vulnerabilities in 5G, March 22, 2019, Report
39) Plenary speaker, ICNC 2019, February 2019
40) Invited Speaker, COMSNETS 2019, January 7 – 11, 2019
41) Distinguished Symposium Speaker, Signal Processing for mmW Communications, GlobalSIP 2018, Nov. 29, 2018.
42) Invited Talk, C-NetSys 2018, Oct. 29, 2018
43) Plenary Keynote Speaker, IEEE 5G World Forum, July 9 – 11, 2018
44) Invited Speaker, 5G Forum, UCSD, June 1, 2018
45) Keynote Speaker, Joint N2Women and WICE Workshop, IEEE ICC, May 20, 2018
46) Invited Colloquium Speaker, Wireless Institute, University of Notre Dame, April 26, 2018.
47) Invited Speaker at IEEE 5G Summit, Dallas, June 08, 2017.
48) Invited Speaker at IEEE IoT Vertical and Topical Summit on Agriculture, Paris, May 21, 2017.
49) Invited panelist at NITRD WSRD Workshop IX on "Radio Receiver Systems: R&D Innovation needs and impact on Technology and Policy", NSF, May 05, 2017.
50) Invited Speaker at IEEE Globecom 2016 Session on Design and Development of Emerging Low Power Wake-up Receivers, "Thoreau: An experimental, low-power, wireless underground sensor network for soil sensing," Dec. 07, 2016.
51) Panelist at NI Week 5G summit, "Cellular Technologies in Unlicensed Spectrum: LTE-U, LAA, and Beyond," Aug 3, 2016
52) Keynote at 5G Round Table at NCC 2016, IIT Guwahati, March 06, 2016.
53) Invited lecture on coexistence in unlicensed bands at ICNC 2016, Feb. 18 2016.
54) Panelist at Globecom 2015, "Emerging Technologies in IEEE 802.11", Dec. 2015.
55) Invited Speaker and panelist at the Global Summit of Digital India, Oct. 26 – 27 2015.
56) Panel organizer and moderator at VTC-Fall 2015 "5G Challenges: Spectrum, Technology and Regulation," Sept. 8, 2015.
57) Panel organizer and moderator at ICC 2015, "Towards a complete picture for mmW based 5G technology: From regulatory issues to first deployment," June 10, 2015.
58) Invited speaker at Wireless Innovation Workshop, Notre Dame, "Future directions in Wi-Fi and mmWave backhaul," April 21- 22, 2015.
59) Panel organizer and moderator at IEEE Globecom 2014, "Emerging Technologies For Next Generation Wi-Fi: What's Beyond IEEE 802.11ac?" Dec. 09, 2014.
60) Panelist at IEEE ICC 2014, "Wireless backhauls for future broadband networks", June 13, 2014.
61) Panel organizer and moderator at IEEE Globecom 2013, "Next Generation WiFi", Dec. 12, 2013.
62) Panel organizer and moderator at IEEE VTC 2013-Fall, "Next Generation WiFi: 802.11ac/af/ah/ad/aj and High Efficiency WiFi (HEW)," Sept. 5, 2013.
63) Invited speaker at IEEE RWW Workshop on M2M Communications, "M2M Evolution: Applications, Technologies and Standards," Jan. 2013.
64) Invited Panelist in Wireless Innovation Forum Workshop on TV White Spaces, Sept. 16, 2010.
65) "Cognitive Radio in the TV White Spaces," PHYDYAS Workshop, Perugia, June 2009.

66) "Cognitive Radio for the TV White Spaces," Intel Workshop on Cognitive Radios - Enabling Cognitive Radios in the Low Cost Consumer Industry, Nov 2008.
67) Workshop on Safely Accessing the TV White Space Spectrum, June 2008.
68) "Cognitive Radios in TV White Spaces," Columbia University CITI Workshop on Future of Digital Television, Nov 2007.
69) Invited Panelist in Intel Workshop on Cooperative Wireless Networks, April 2007.

Media Coverage

1) Fierce Wireless interview on 5G/6G, "Can 5G set the building blocks for 6G?: Special Report," March 25, 2022, https://www.fiercewireless.com/private-wireless/5g-infrastructure-wont-fall-wayside-6g-special-report
2) NOVA PBS, "What is 5G and is it safe to use on planes?", NOVA PBS
3) Senza Fili, Sparring Partners Episode, "Does 5G deliver the user experience it promised?" September 30, 2021, Sparring Partners
4) Fierce Wireless coverage on Wi-Fi/LAA coexistence, July 16 2021, https://www.fiercewireless.com/tech/uc-research-finds-severe-degradation-wi-fi-due-to-laa
5) Medill News on 5G, Jan. 30 2019, https://news.medill.northwestern.edu/chicago/5g-rollout-brings-to-life-the-smart-hospital/
6) Chicago Tribune coverage of Thoreau, Sept. 14, 2016, http://www.chicagotribune.com/bluesky/originals/ct-sigfox-internet-of-things-network-chicago-bsi-20160914-story.html
7) Boston Globe coverage of 5G Panel at VTC 2015, http://www.betaboston.com/news/2015/09/09/5g-is-coming-what-is-5g-anyway/
8) EE Times interview on 5G and Wi-Fi research, Dec. 29 2014, http://www.eetimes.com/document.asp?doc_id=1325112
9) EDN article on next generation Wi-Fi, March 10 2014, http://edn.com/design/wireless-networking/4429406/Addressing-expanding-wireless-data-usage--Turn-To-carrier-grade-Wi-Fi
10) Wall Street Journal coverage on White Spaces Testing, Aug. 18 2008, http://online.wsj.com/news/articles/SB121902086259648443
11) PCMag article on White Spaces, Aug. 15 2008, http://www.pcmag.com/article2/0,2817,2328185,00.asp
12) TVTechnology Article, Aug. 01 2008, http://www.tvtechnology.com/news/0110/fcc-nears-end-of-white-space-spectrum-sensing-field-tests/198859

Patents

(1) Approximately eighty patents granted (Google Patents)

Tutorials

(1) "Cognitive Radio Networks for License-exempt Use of TV Spectrum: FCC Regulation, Technical Challenges and Emerging Standards," Virginia Tech Wireless Symposium, (Invited), June 2009.

(2) "Cognitive Radio Networks in TV White Spaces: Regulation, Theory and Practice," Crowncom 2009, June 2009.
(3) "Dynamic Spectrum Access in Cognitive Radio Networks: New Opportunities and Challenges for Efficient Spectrum Utilization," with Milind Buddhikot (Alcatel-Lucent) and Dave Cavalcanti (Philips), IEEE WCNC April 2008.

Demonstrations

(1) V. Sathya and M. Ghosh, "LTE Wi-Fi Coexistence: Impact of interference on real-time video streaming over Wi-Fi," DySPAN 2017.
(2) White Space Cognitive Radio prototype, FCC headquarters, June 2008.
(3) M. Ghosh, V. Gaddam, G. Turkenich and K. Challapali, "A Cognitive Radio Prototype Operating In UHF TV Bands," DySPAN 2008 (DySPAN 2008 demo)

Book/Book Chapters

(1) Book chapter: "Cognitive Wireless Regional Area Network Standard," A. Mody, G. Chouinard, S. J. Shellhammer, M. Ghosh, and D. Cavalcanti, in "Opportunistic Spectrum Sharing and White Space Access: The Practical Reality", Wiley, May 2015.
(2) Book chapter: "Cognitive Radios in Television White Spaces," in "Television Goes Digital", Springer 2009.

Significant university collaborations while working in industry

(1) Board member representing Interdigital's participation in the Broadband Wireless Access Center (BWAC) at the University of Notre Dame. Conducting joint projects on next generation Wi-Fi and mmW with students and faculty at the University.
(2) Research collaboration with Mayo Clinic on clinical informatics for early diagnosis of Acute Lung Injury, 2011.
(3) Research collaboration with NYU/Polytechnic University in the area of cooperative communications, 2004 – 2006.
(4) Coordinated a joint research collaboration with Cornell University, Australia National University and FOX to improve VSB reception, 2000 – 2002.

Teaching and student mentoring while working in industry

(1) Adjunct Professor at NYU/Polytechnic University, Brooklyn, New York. Course taught: Digital Communications, Fall 2006.
(2) Ph.D. Committee Member of Zinan Lin, Ph.D. 2006, NYU/Polytechnic University.
(3) Mentored numerous summer interns in cooperative communications and cognitive radio.

Publications and presentations

Google Scholar Page (~7500 citations)

1) M. I. Rochman, V. Sathya and M. Ghosh, "Outdoor-to-indoor performance analysis of a commercial deployment of 5G mmWave," IEEE Future Networks World Forum, October 14 – 15, 2022.

2) M. I. Rochman, D. Fernandez, N. Nunez, V. Sathya, A. S. Ibrahim, M. Ghosh and W. Payne, "Impact of device thermal performance on 5G mmWave communication systems," IEEE CQR, September 2022, https://arxiv.org/abs/2202.04830
3) V. Sathya, M. I. Rochman, T. V. Pasca and M. Ghosh, "Impact of hidden node problem in association and data transmission in LAA Wi-Fi coexistence," Journal of Computer Communication, August 2022.
4) S. Balida, G. Grant, X. Zhang, M. Ghosh, S. Guha and R. Matamala, "A Wireless Underground Sensor Network Field Pilot for Agriculture and Ecology: Soil Moisture Mapping Using Signal Attenuation," Sensors 2022.
5) A. Ramamurthy, V. Sathya, M. I. Rochman and M. Ghosh, "ML based classification of device environment using Wi-Fi and cellular signal measurements," IEEE Access, March 2022, https://ieeexplore.ieee.org/document/9734732
6) A. Narayanan, M. I. Rochman, A. Hassan, B. S. Firmansyah, V. Sathya, M. Ghosh, F. Qian and Z.-L. Zhang, "A comparative measurement study of commercial 5G mmWave deployments," Infocom 2022.
7) M. I. Rochman, V. Sathya, N. Nunez, D. Fernandez, M. Ghosh, A. S. Ibrahim and W. Payne, "A Comparison Study of Cellular Deployments in Chicago and Miami Using Apps on Smartphones," ACM WiNTECH 2021.
8) V. Sathya, M. I. Rochman and M. Ghosh, "Hidden nodes in coexisting LAA and Wi-Fi: a measurement study of real deployments," IEEE ICC 2021 Workshop on Spectrum Sharing.
9) V. Sathya, M. I, Rochman and M. Ghosh, "Measurement-based coexistence studies of LAA & Wi-Fi deployments in Chicago," IEEE Wireless Communications Magazine, November 2020.
10) V. Sathya, A. Ramamurthy, M. I. Rochman and M. Ghosh, "QoS guaranteed radio resource scheduling in stand-alone unlicensed MulteFire," 2020 IEEE 3rd 5G World Forum (5GWF), pp. 86-91. September 2020.
11) V. Sathya, S. M. Kala, M. I. Rochman , M. Ghosh and S. Roy, "Standardization advances for cellular and Wi-Fi coexistence in the unlicensed 5 and 6 GHz Bands,"GetMobile: Mobile Computing and Communications, August 2020.
12) A. Dziedzic, V. Sathya, M. I. Rochman, M. Ghosh and S. Krishnan, "Machine Learning enabled Spectrum Sharing in Dense LTE-U/Wi-Fi Coexistence Scenarios," IEEE Open Journal of Vehicular Technology, March 2020.
13) V. Sathya, A. Dziedzic, M. Ghosh and S. Krishnan, "Machine learning based detection of multiple Wi-Fi BSSs for LTE-U CSAT," ICNC 2020, February 2020.
14) V. Sathya, M. Mehrnoush, M. Ghosh and S. Roy, "Wi-Fi/LTE-U coexistence: real time issues and solutions," IEEE Access, vol. 8, January 06, 2020.
15) V. Sathya, M. Mehrnoush, M. Ghosh and S. Roy, "Auto-correlation based sensing of multiple Wi-Fi BSSs for LTE-U CSAT," IEEE VTC-Fall 2019, September 2019.
16) M. Ghosh, "Coexistence of LTE-LAA and Wi-Fi: analysis, simulations and experiments," presented at the IEEE 802.11 Coexistence Workshop, July 17, 2019.
17) A. Fouda, A. S. Ibrahim, I. Guvenc and M. Ghosh, "Interference management in UAV-assisted integrated access and backhaul networks," IEEE Access, vol. 7, July 05, 2019.
18) N. Rupasinghe, Y. Yapici, I. Guvence, M. Ghosh and Y. Kakishima, "Angle feedback for NOMA transmission in mmWave drone networks," IEEE Journal on Selected Topics in Signal Processing, vol. 13, issue 3, June 2019.
19) X. Zhang, A. Andreyev, C. Zumpf, M. C. Negri, S. Guha and M. Ghosh, "Invited Paper: Thoreau: a fully buried wireless underground sensor network in an urban environment," 11th International Conference on Communication Systems & Networks (COMSNETS), January 2019.
20) M. Mehrnoush, S. Roy, V. Sathya and M. Ghosh, "On the fairness of Wi-Fi and LTE-LAA coexistence," IEEE Transactions on Cognitive Communications and Networking, Dec. 2018.

21) V. Sathya, M. Mehrnoush, M. Ghosh and S. Roy, "Energy detection based sensing of multiple Wi-Fi BSSs for LTE-U CSAT," IEEE Globecom 2018, December 2018.
22) A. Fouda, A. S. Ibrahim, I. Guvenc and M. Ghosh, "UAV-Based in-band Integrated Access and Backhaul for 5G Communications," IEEE-VTC Fall 2018, August 2018.
23) M. Mehrnoush, V. Sathya, S. Roy and M. Ghosh, "Analytical Modeling of Wi-Fi and LTE-LAA Coexistence: Throughput and Impact of Energy Detection Threshold," IEEE/ACM Transactions on Networking, vol. 26, pp. 1990 – 2003, Aug. 2018.
24) V. Sathya, M. Mehrnoush, M. Ghosh and S. Roy, "Analysis of CSAT performance in Wi-Fi and LTE-U coexistence," IEEE Workshop on 5G Ultra Dense Networks at ICC, May 20, 2018.
25) V. Sathya, M. Mehrnoush, M. Ghosh and S. Roy, "Association fairness in Wi-Fi and LTE-U coexistence," IEEE WCNC 2018, April 25, 2018.
26) N. Sapoval, M. Ghosh and S. K. Mahmud, "Coexistence of Wi-Fi and WAVE in the DSRC Spectrum: Impact on WAVE Latency and Throughput," Vehicle-to-Vehicle, World Congress Experience, April 11, 2018.
27) X. Zhang, A. Andreyev, C. Zumpf, M. C. Negri, S. Guha and M. Ghosh, "Thoreau: a subterranean wireless sensing network for agriculture and the environment," INFOCOM 2017 Workshop on Wireless Communications and Networking in Extreme Environments (WCNEE 2017), May 2017.
28) M. I. C. Rochman, V. Sathya and M. Ghosh, "Impact of changing energy detection thresholds on fair coexistence of Wi-Fi and LTE in the unlicensed spectrum," IEEE WTS 2017, April 28, 2017.
29) M. Ghosh, S. Salous and Y. Gao, "MIMO measurements and analysis for the 60 GHz band," IEEE WCNC Workshop on mmW5G, March 19, 2017.
30) O. Oteri, F. LaSita, R. Yang, M. Ghosh and R. L. Olesen, "Improved spatial reuse for dense 802.11 WLANS," IEEE Globecom 2015 Workshop on Enabling Technologies for Future WLANS.
31) A. Sahin, R. Yang, M. Ghosh and R. L. Olesen, "An improved unique word DFT spread OFDM scheme for 5G systems," IEEE Globecom 2015 Workshop on 5G and Beyond: Enabling Applications and Technologies.
32) M. Ghosh, M. Bielinski and S. Ferrante, "Equalization for outdoor mmW deployments," IEEE VTC 2015-Spring, May 2015.
33) N. Shah, M. Ghosh, P. Xia, Z. You, F. LaSita, R. L. Olesen and O. Oteri, "Carrier Frequency Offset Correction for Uplink Multi-User MIMO for Next Generation Wi-Fi," IEEE ICNC 2015, pp. 1004 – 1008, Feb. 2015.
34) H. Lou, J. Fang, O. Oteri, M. Ghosh, P. Xia, R. L. Olesen, "Sub-channel selection for multi-user channel access in next generation Wi-Fi," IEEE PIMRC 2014, Sept. 2014.
35) H. Lou, X. Wang, J. Fang, M. Ghosh, G. Zhang and R. L. Olesen, "Multi-user parallel channel access for high efficiency carrier grade wireless LANS," IEEE ICC 2014, pp. 3865 – 3970, June 2014.
36) X. Wang, H. Lou, M. Ghosh, G. Zhang, P. Xia, O. Oteri, F. LaSita, R. L. Olesen and N. Shah, "Carrier Grade Wi-Fi: Air Interface Requirements and Technologies," IEEE Long Island Systems, Applications and Technology Conference, May 2014.
37) M. Ghosh, "A comparison of normalizations for ZF precoded MU-MIMO systems in multipath fading channels," IEEE Wireless Communication Letters, vol. 2, no. 5, pp. 515 – 518, Oct. 2013.
38) H. Lou, M. Ghosh, P. Xia and R. L. Olesen, "A comparison of implicit and explicit channel feedback methods for MU-MIMO WLAN systems," PIMRC 2013, pp. 419 – 424, Sep. 2013.
39) Z. Lin, M. Ghosh and A. Demir, "A comparison of MAC aggregation vs. PHY bonding for WLANs in TV White Spaces," PIMRC 2013, pp. 1829 – 1834, Sep. 2013.
40) M. Ghosh and F. LaSita, "Puncturing of CRC codes for IEEE 802.11ah," IEEE VTC Fall 2013, Sep. 2013.
41) D. Wang, D. Smith, R. Krasinski, M. Ghosh and A. Batra, "Emerging spectrum regulation for medical body area networks," IEEE Conference on Body Sensor Network, pp. 1 – 6, May 2013.

42) P. Xia, M. Ghosh, H. Lou and R. L. Olesen, "Improved transmit beamforming for WLAN systems," IEEE WCNC 2013, pp. 3500 - 3505, April 2013.
43) N. W. Chbat, W. Chu, M. Ghosh, G. Li, M. Li, C. M. Chiofolo, S. Vairavan, V. Herasevich, O. Gajic, "Clinical Knowledge-Based Inference Model for early detection of Acute Lung Injury," Annals of Biomedical Engineering, Dec 2011.
44) N. W. Chbat, W. Chu, M. Ghosh, G. Li, M. Li, C. M. Chiofolo, S. Vairavan, V. Herasevich, O. Gajic, "Inference model for Acute Lung Injury Detection in the ICU," 2nd Annual AMA-IEEE Medical Technology, October 2011.
45) R. Davies and M. Ghosh, "Field trials of DVB-T sensing for TV White Spaces," 2011 IEEE Symposium on New Frontiers in Dynamic Spectrum (DySPAN), pp. 285 - 296, May 2011.
46) J. Wang, M. Ghosh and K. Challapali, "Emerging cognitive radio applications: a survey," IEEE Communications Magazine, vol. 49, no. 3, pp. 74 – 81, March 2011 **(*Invited*).**
47) V. Gaddam and M. Ghosh, "Robust Sensing of DVB-T Signals," 2010 IEEE Symposium on New Frontiers in Dynamic Spectrum (DySPAN), pp. 1 - 8, April 2010.
48) J. Wang, M. S. Song, S. Santhiveeran, K. Lim, G. Ko, K. Kim, S. H. Hwang, M. Ghosh, V. Gaddam, K. Challapali, "First Cognitive Radio Networking Standard for Personal/Portable Devices in TV White Spaces," 2010 IEEE Symposium on New Frontiers in Dynamic Spectrum (DySPAN), pp. 1-12, 2010.
49) J. Wang, V. Gaddam, M. Ghosh, K. Challapali, "Home Multimedia Networking using TV White Space," IEEE Comsoc MMTC E-Letter, March 2010.
50) M. Ghosh, V. Gaddam, G. Turkenich and K. Challapali, "Spectrum sensing prototype for sensing ATSC and wireless microphone signals," CROWNCOM 2008, pp. 1 – 7, May 2008 ***(Invited).***
51) D. Cavalcanti and M. Ghosh, "Cognitive radio networks: enabling new wireless broadband opportunities," CROWNCOM 2008, pp. 1 – 6, May 2008 **(*Invited*).**
52) S. Das and M. Ghosh, "Implementation of full-diversity distributed STBC in cluster-based cooperative communication," VTC – Spring 2008, pp. 1216 – 1220, May 2008.
53) S. Das and M. Ghosh, "High-rate full diversity STBC design with option to provide unequal error protection," VTC – Spring 2008, pp. 1448– 11452, May 2008.
54) C. M. Cordeiro, M. Ghosh, D. Cavalcanti and K. Challapali, "Spectrum sensing for dynamic spectrum access of TV bands," CROWNCOM 2007, pp. 225 – 233, Aug. 2007 (***Invited***).
55) M. Ghosh, "Improved equalization for coded, zero-padded OFDM systems," IEEE ICC 2007, pp. 4263 – 4268, June 2007.
56) J. Yang and M. Ghosh, "A cooperative modulation scheme for wireless relay networks," VTC-Spring 2007, pp. 1628 – 1632, April 2007.
57) J. Yang and M. Ghosh, "A simplified design for MIMO system with symbol spreading," IEEE CCNC 2007, pp. 440 – 444, Jan 2007.
58) Z. Lin, E. Erkip and M. Ghosh, "Rate adaptation for cooperative systems," IEEE GLOBECOM 2006, pp. 1- 5, Nov. 2006.
59) C. M. Cordeiro, K. Challapali, and M. Ghosh, "Cognitive PHY and MAC layer for dynamic spectrum access and sharing of TV bands," *IEEE International Workshop on Technology and Policy for Accessing Spectrum (TAPAS)*, August 2006 (***Invited***).
60) Sai Shankar N, Chun-Ting Chou and M. Ghosh, "Cooperative communication MAC (CMAC) – a new MAC protocol for next generation wireless LANs," International Conference on Wireless Networks, Communications and Mobile Computing, vol. 1, pp. 1 - 6, June 2005. (***Invited***)
61) Z. Lin, E. Erkip and M. Ghosh, "Adaptive modulation for coded cooperative systems" IEEE Workshop on SPAWC, pp. 615 - 619, June 2005.
62) M. Ghosh, P. Li and X. Ouyang, "Reduced-complexity ML detection for coded MIMO systems using an absolute-value search," ICASSP' 05, vol. 3, pp. –1025 - 1028, Mar. 2005.

63) M. Ghosh, ``Joint equalization and decoding for complimentary code keying (CCK) modulation,'' ICC 2004, vol. 6, pp. 3465 – 3469, June 2004.
64) M. Ghosh and V. Gaddam, ``Bluetooth interference cancellation for 802.11g WLAN receivers,'' ICC 2003, vol. 2, pp. 1169-1173, May 2003.
65) X. Ouyang, M. Ghosh and J. P. Meehan, ``Optimal antenna diversity combining for IEEE 802.11a system,'' IEEE Trans. Consumer Electronics, vol. 48, pp. 738-742, Aug. 2002.
66) J. Meehan, D. Birru, and M. Ghosh, "Indoor reception of ATSC terrestrial digital TV using smart equalization techniques", Proc. Int. Symp. Broadcast. Technol. (ISBT) 2001, 2001.
67) M. Ghosh, ``Adaptive chip-equalizers for synchronous DS-CDMA systems with pilot sequences,'' GLOBECOM 2001, vol. 6, pp. 3385-3389, Nov. 2001.
68) M. Ghosh, ``Decision feedback equalizer (DFE) design issues for terrestrial television receivers,'' ICCE 1999, pp. 192-193, June 1999. (***Invited***)
69) M. Ghosh, ``Co-channel interference cancellation for HDTV receivers,'' ICASSP 1999, vol. 5, pp. 2675-2678, Mar. 1999.
70) M. Ghosh, ``Blind decision feedback equalization for terrestrial television receivers,'' Proceedings of the IEEE: Special issue on Blind Identification and Estimation, vol. 86, no. 10, pp. 2070-2081, Oct. 1998. (***Invited***).
71) D. A. Bryan, M. Ghosh and P. Kelliher, ``A digital vestigial-sideband (VSB) channel decoder IC for digital TV,'' IEEE Trans. Consumer Electronics, vol. 44, no. 3, pp. 811-816, Aug. 1998. (Also presented at ICCE in June 1998).
72) M. Ghosh, ``A sign-error algorithm for blind equalization of real signals,'' ICASSP 1998, vol. 6, pp. 3365-3368, May 1998.
73) M. Ghosh, ``Analysis of the MMSE-DFE with error propagation,'' IEEE GLOBECOM Communication Theory Mini-Conference, vol. 4, pp. 85-89, Nov. 1997.
74) M. Ghosh, ``Combating ingress and multipath in a CATV return channel,'' Proc. 20th Montreaux International Television Symposium, pp. C1/6/1-8, June 1997.
75) S. N. Hulyalkar, M. Ghosh, D. A. Bryan, C. Basile, Lee-Fang Wei, A. Aman, R. Cupo and G. Kustka, ``A New NTSC Co-Channel Interference Rejection Filter with Coded 6-VSB Modulation for Improved ATV Coverage,'' SMPTE Journal}, vol. 106, no. 9, pp. 583-600, Sept. 1997.
76) M. Ghosh, ``Analysis of the effect of impulse noise on multicarrier and single carrier QAM Systems,'' IEEE Trans. on Communications, vol. 44, no. 2, pp. 145-147, Feb. 1996.
77) M. Ghosh, ``Digital Video Broadcasting: Cable Specification,'' Philips Journal of Research, vol. 50, no. 1-2, pp. 79-90, July 1996.
78) D. A. Bryan, M. Ghosh and S. N. Hulyalkar, ``Channel coding, modulation and transmission for North American digital television,'' Philips Journal of Research, vol. 50, no. 1-2, pp. 131-157, July 1996.
79) M. Ghosh, ``Error correction schemes for digital television broadcasting,'' IEEE Trans. on Consumer Electronics, vol. 41, no. 3, pp. 400-404, Aug. 1995. (***Invited paper at ICCE in June '95***).
80) M. Ghosh and C. L. Weber, ``Maximum-likelihood blind equalization,'' The Journal of SPIE, vol. 31, no. 6, pp. 1224-1229, June 1992. (Also presented at SPIE 1991).
81) M. Ghosh and C. L. Weber, ``Blind deconvolution using a maximum-likelihood channel estimator,'' Proceedings of the Tenth Annual IEEE International Phoenix Conference on Computers and Communications, pp. 448-452, March 1991. (***Invited***)
82) M. Ghosh and C. L. Weber, ``Blind equalization with maximum-likelihood channel estimators,'' IEEE International Symposium on Information Theory, June 1991.