Sharan Naribole

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Research Areas Wireless networking, wireless systems engineering, wireless platform architecture, IEEE 802.11 Wireless LANs, modeling and simulations, Coexistence, mobile applications and sensing, AR/VR, QoS, millimeter wave, Visible Light communications, latency-sensitive networks, software-defined radios, testbeds etc.

Education

Rice University, Houston, Texas, USA (**2012-2018**)

Ph.D., Electrical and Computer Engineering, March 2018.

- Area of study: 60 GHz communication, Visible light communication, Light-Radio WLANs
- Dissertation Topic: "Enhanced WLAN Performance with New Spectrum at 60 GHz and Visible Light", *Advisor:* Prof. Edward W. Knightly

M.S., Electrical and Computer Engineering, May 2014.

- Area of study: Heterogeneous cellular networks, Service quality management, Statistical Learning
- Thesis: "Small Cells and Mobile Clients: a Measurement Study of an Operational Network", *Advisor:* Prof. Edward W. Knightly

Indian Institute of Technology Kharagpur, Kharagpur, India (**2008-2012**)

B.Tech. (Honors), Electronics and Electrical Communication Engineering, May 2012.

GRE: Quantitative - 800/800 (*94 percentile*), Verbal - 690/800 (*97 percentile*), Writing - 4.0/6.0

IIT JEE: All India rank of 312 (*99.9 percentile*) in IIT Joint Entrance Examination 2008.

Computer Skills git, C++, ns-3 network simulator, Python (scikit-learn, PyTorch, TensorFlow, Keras, numpy, pandas, matplotlib, seaborn), MATLAB, R, SQL, perl, LaTeX, software defined radios, Wireshark, Unix.

Experience

Apple Inc., California, USA **March 2021 - present**
Wireless Platform Architect

- Invent and develop mobile wireless protocols for current and future Apple products.
- Architect the modeling of protocols, device behaviors, applications, etc. in C++.
- Conduct network-scale end-to-end performance evaluation of next-generation wireless features and products.
- Debug Wi-Fi driver functionality, stability and performance issues. Investigate and resolve issues in 802.11 protocol and state machines.

Samsung Semiconductor Inc., San Jose, California, USA **March 2018 - March 2021**
Senior Software Engineer, US Connectivity & Wi-Fi Systems Group

- **Protocol design.** Designing algorithms and protocols at MAC layer and joint MAC-PHY cross-layer for wireless communication in the unlicensed spectrum.
- **Network Simulations.** Implement latest 802.11 standards (802.11ac, 802.11ax, 802.11be etc.) features in custom ns-3 network simulator and perform comprehensive evaluation for various WLAN scenarios.
- **IEEE 802.11 Standards activities.** Active participation and contributions to 802.11ax and next-generation 802.11be task groups.

Rice University, Houston, Texas, USA **August 2012 - December 2017**
Research Assistant, Rice Networks Group

- **Light-Radio WLAN.** Designed, implemented and experimentally evaluated a WLAN that fuses simplex Visible Light downlink and bi-directional Wi-Fi on a frame-by-frame basis at the MAC layer. In order for Visible Light clients to transmit ACKs via Wi-Fi without excessive contention-based delays, designed a scalable Visible Light feedback channel over RF. Designed protocol to utilize Visible Light as a uni-directional control channel for contention-free access on the radio band.
- **Multicast in 60 GHz WLANs.** Designed, implemented and experimentally evaluated scalable techniques for (a) training the access point with per-beam per-client RSSI measurements via partially traversing a codebook tree. The training balances the objectives of limiting overhead with collecting sufficient data to form efficient beam groups. (b) beam grouping that approximates the minimum multicast group data transmission time.
- **Small Cells.** Performed the first large-scale measurement study of voice and data service performance of operational small cell cellular network. Analyzed nation-wide fine-grained service measurements to gain insight into the nature and implications of handovers on service performance.
- **Wireless Health Monitoring.** Deployed Blue Scale, a CVD measuring device for wireless health monitoring, at homes in an under-served community of Houston. Designed anomaly detection algorithms and framework for early cardiac event detection.

NEC Labs America, Princeton, New Jersey, USA **June 2015 - August 2015**
Summer Research Assistant, Mobile Communications and Networking

- **60 GHz Signature Extraction.** Developed wireless testbed for fine-grained signature extraction using commercial off the shelf 60 GHz technology and analyzed techniques for phase extraction from raw signal traces.

AT&T Labs Research, Florham Park, New Jersey, USA **June 2013 - August 2013**
Technical Intern, Service Quality Management Group

- **Statistical Correlation.** Designed and implemented a novel framework for automated learning of statistical dependencies between network events and service events across multiple base stations and multiple cellular technologies. Demonstrated the effectiveness of framework using real traces collected from UMTS, LTE and Small Cell cellular networks.

Universität Paderborn, Nordrhein-Westfalen, Germany **May 2011 - July 2011**
Summer Intern, Theory of Distributed Systems Group

- **Jamming-resistant MAC.** Developed and simulated adversarial jammer-resistant wireless medium access control protocol using the signal-to- noise-interference ratio model. The protocol was thoroughly investigated against different types of jammers and different distributions of nodes.

Scholarships

Texas Instruments Fellowship, 2012 - 2017

National Science Foundation Travel Grant for IEEE SECON 2016 and IEEE SECON 2017

DAAD (German Academic Exchange Service) WISE scholarship 2011

Publications

S. Naribole, S. Kandala and A. Ranganath, "Multi-Channel Mobile Access Point in Next Generation IEEE 802.11be WLANs," in *Proceedings of IEEE ICC*, Montreal, Canada, June 2021.

S. Naribole, S. Kandala, W. Lee and A. Ranganath, "Simultaneous Multi-Channel Downlink Operation in Next Generation WLANs," in *Proceedings of IEEE GLOBECOM*, Taipei, Taiwan, December 2020.

S. Naribole and E. Knightly, "LiSCAN: Visible Light Uni-Directional Control Channel for Uplink Radio Access," in *Proceedings of IEEE WCNC*, Seoul, South Korea, April 2020.

S. Naribole, W. Lee, S. Kandala and A. Ranganath, "Simultaneous Transmit-Receive Multi-Channel Operation in Next Generation WLANs," in *Proceedings of IEEE WCNC*, Seoul, South Korea, April 2020.

S. Naribole, W. Lee, and A. Ranganath, "Impact of MU EDCA channel access on IEEE 802.11ax WLANs," in *Proceedings of IEEE VTC Fall*, Honolulu, USA, September 2019.

S. Naribole, "Enhanced WLAN Performance with New Spectrum at 60 GHz and Visible Light," Ph.D. Thesis, May 2018.

S. Naribole and E. Knightly, "Scalable Multicast in Highly-Directional 60 GHz WLANs," in *IEEE/ACM Transactions on Networking*, 25 (5): 2844-2857, October 2017.

S. Naribole, S. Chen, E. Heng, S. Zheng and E. Knightly, "LiRa: a WLAN architecture for Visible Light Communication with a Wi-Fi uplink," in *Proceedings of IEEE SECON*, San Diego, USA, June 2017.

S. Naribole and E. Knightly, "Scalable Multicast in Highly-Directional 60 GHz WLANs," in *Proceedings of IEEE SECON*, London, UK, June 2016.

S. Naribole, "Small Cells and Mobile Clients: a Measurement Study of an Operational Network," Masters Thesis, December 2014.

J. Chen, S. Quadri, L. Pollonini, S. Naribole, J. Ding, Z. Zheng, E. Knightly and C. Dacso, "Blue Scale: Early Detection of Impending Congestive Heart Failure Events via Wireless Daily Self-Monitoring," in *Proceedings of IEEE EMBS HIC-POCT*, Seattle, October 2014.

Patents Granted

S. Naribole, S. Kandala, W. Lee and A. Ranganath, "Shared transmission opportunity operation in multi-access point coordination," US11723006B2, August 2023.

S. Naribole, S. Kandala, W. Lee and A. Ranganath, "Systems, methods, and devices for association and authentication for multi-access point coordination," US11696129B2, July 2023.

S. Naribole, S. Kandala, W. Lee and A. Ranganath, "Systems and methods for managing power usage of a multi-link device equipped with a plurality of radio interfaces," US11690012B2, June 2023.

J.Han, C. Chung, S. Naribole and S. Kandala, "Apparatus and method for coordinated spatial reuse in wireless communication," US11595994B2, February 2023.

S. Naribole, S. Kandala, and A. Ranganath, "Apparatus and method for multi-link operation by access point with simultaneous transmit-receive constraints," US11452116B2, September 2022.

S. Naribole, S. Kandala, W. Lee and A. Ranganath, "Method and system for simultaneous multi-channel downlink operation in wireless local area network," US11438926B2, September 2022.

S. Naribole, S. Kandala, W. Lee and A. Ranganath, "Multi link TXOP aggregation," US11357025B2, June 2022.

R. Gidvani, S. Naribole and A. Ranganath, "Method and system for transitioning station to uplink multi-user disable mode and uplink multi-user enable mode," US11234243B2, January 2022.

R. Gidvani, A. Ranganath, W. Lee, S. Naribole and Shailender Karmuchi, "System and method for providing a synchronized mode for WLAN operation in a WLAN band," US11102740B2, August 2021.

Patents Pending

S. Naribole, S. Kandala, W. Lee and A. Ranganath, "Systems and methods for managing power usage of a multi-link device equipped with a plurality of radio interfaces," US20250097840A1, March 2025.

S. Kandala, W. Lee, A. Ranganath and S. Naribole, "Systems, methods, and apparatus for multi-link spatial multiplexing," US20220046621A1, July 2021.

IEEE 802.11 Standards Contributions

TGbe 11-20/1263, "Non-STR Blindness Rules Discussion," November 2020.

TGbe 11-20/977, "MLD Spatial Multiplexing Considerations," August 2020.

TGbe 11-20/370, "Multi-link Power Save Discussion," May 2020.

TGbe 11-20/277, "Shared TXOP Operation," April 2020.

TGbe 11-20/226, "MLO Constraint Indication and Operating Mode," March 2020.

TGbe 11-19/1836, "Multi-link Channel Access Discussion Follow-up," January 2020.

TGbe 11-19/1505,"Multi-link Aggregation Considerations," September 2019.

TGbe 11-19/1451, "Virtual BSS for Multi-AP Coordination Follow up," September 2019.

TGbe 11-19/1405, "Multi-link Channel Access Discussion," September 2019.

TGbe 11-19/824, "Multi-band Operation Performance," July 2019.

EHT TIG/SG 11-19/360, "MAC Architectures for EHT Multi-band Operation," March 2019.

TGax 11-18/1827, "6 GHz operation for 11ax follow up", Jan 2019.

Presentations

"Multi-Channel Mobile Access Point in Next Generation IEEE 802.11be WLANs," IEEE ICC, Montreal, Canada, June 2021.

"Simultaneous Multi-Channel Downlink Operation in Next Generation WLANs," IEEE GLOBECOM, Taipei, Taiwan, December 2020.

"Non-STR Blindness Rules Discussion," IEEE 802.11 TGbe, November 2020.

"MLD Spatial Multiplexing Considerations," IEEE 802.11 TGbe, August 2020.

"IEEE 802.11be Multi-link Operation in ns-3," Workshop on ns-3, June 2020.

"Multi-link Power Save Discussion," IEEE 802.11 TGbe, May 2020.

"Simultaneous Transmit-Receive Multi-Channel Operation in Next Generation WLANs," IEEE WCNC, Seoul, South Korea, April 2020.

"Shared TXOP Operation," IEEE 802.11 TGbe, April 2020.

"MLO Constraint Indication and Operating Mode," IEEE 802.11 TGbe, March 2020.

"Multi-link Channel Access Discussion Follow-up," IEEE 802.11 TGbe, January 2020.

"Impact of MU EDCA channel access on IEEE 802.11ax WLANs," IEEE VTC Fall, Honolulu, USA, September 2019.

"Virtual BSS for Multi-AP Coordination Follow up," IEEE 802.11 TGbe, September 2019.

"Multi-link Aggregation Considerations," IEEE 802.11 TGbe, September 2019.

"Multi-link Channel Access Discussion," IEEE 802.11 TGbe, September 2019.

"Multi-band Operation Performance," IEEE 802.11 TGbe, July 2019.

"MAC Architectures for EHT Multi-band Operation," IEEE 802.11 EHT TIG/SG, March 2019.

"Enhanced WLAN Performance with New Spectrum at 60 GHz and Visible Light," Ph.D. Thesis Defense, December 2017.

"LiRa: a WLAN architecture for Visible Light Communication with a Wi-Fi uplink," IEEE SECON, San Diego, USA, June 2017.

"Li-Fi meets Wi-Fi," Rice 90-second Thesis Competition, November 2016.

"Scalable Multicast in Highly-Directional 60 GHz WLANs," IEEE SECON, London, UK, June 2016.

"Multicasting over mm-Wave," Rice 90-second Thesis Competition, November 2014.

"Small Cells and Mobile Clients: a Measurement Study of an Operational Network," Masters Thesis Defense, May 2014.

Professional Activities

Affiliations

IEEE P802.11 - Working Group Voting Member	2020 - *present*
IEEE Member	2019 - *present*
IEEE Standards Association Member	2019 - *present*
IEEE Communications Society Member	2013 - *present*
IEEE Student Member	2013 - 2017

Technical Program Committee Member

International Conference on ns-3 (ICNS3) 2025
IEEE VTC Fall Conference 2019 - State-of-the-Art Wi-Fi Technologies (**Session Chair**)
IEEE ICC 2023, 2024 - Mobile and Wireless Networks Symposium
IEEE INFOCOM 2023 - Posters and Demos
IEEE WCNC 2023 - International Workshop on Smart Spectrum
IEEE WoWMoM 2023, 2024
IEEE PIMRC 2023, 2024 - Practical and Experimental Systems track
IEEE/ACM International Symposium on Quality of Service (IWQoS) 2023
ICCCN 2023 - Network Architecture, Algorithm, Protocol, and Evaluation
Workshop on ns-3 (WNS3) 2023, 2024
IEEE SECON 2023
MedComNet 2023

Reviewer

IEEE Transactions on Communications
IEEE Transactions on Wireless Communications
IEEE Communications Magazine
IEEE Transactions on Mobile Computing
Ad Hoc Networks
IEEE/IFIP Annual Conference on Wireless On-demand Network Systems and Services (WONS)
ACM Workshop on Visible Light Communication Systems (VLCS)
ACM Workshop on Millimeter-Wave and Terahertz Networks and Sensing Systems (mmNets)
IEEE International Symposium on Dynamic Spectrum Access Networks (DySPAN)
International Teletraffic Congress (ITC)

Relevant Coursework

- Random Processes & Applications
- Mobile and Wireless Networking
- Algorithm Design & Analysis
- Statistical Learning & Mining
- Professional Communications
- Data Analysis with Python
- Communication Networks
- Adv. Topics in Wireless Networking
- Computer Architecture
- IEEE 5G mmWave Course
- Data Analysis with R
- Machine Learning with Python

Leadership

Professional Development Director, Rice ECE Graduate Student Association May 2016 - May 2017
SCREECH Committee Member, Rice Center for Engineering Leadership Sept 2016 - Nov 2016
Secretary, Indian Students at Rice (ISAR) May 2013 - May 2015
Graduate Mentor, ECE Department, Rice University 2013 - 2016

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