ICON Ressearc Area and Interests

Our research interests are in all aspects of Internet of Things (IoT) networks and systems, from the physical layer to the application layer. ICON research group develops software-hardware systems that deliver ubiquitous sensing, efficient computing, and wireless communication at scale. We borrow techniques from diverse areas including computer networks, machine learning, signal processing, hardware design, RF circuits, and HCI. Our current research projects mainly focus on "mmWave networks for IoT" and "ubiquitous sensing with RFID" [*, 24, 3, 7, 4, 8, 11, 12, 9, 1, 6, 10, 5, 2, 16, 13, 18].

References

- Omid Abari, Dinesh Bharadia, Austin Duffield, and Dina Katabi. "Cutting the cord in virtual reality". In: Proceedings of the 15th ACM Workshop on Hot Topics in Networks. 2016, pp. 162–168.
- [2] Omid Abari, Dinesh Bharadia, Austin Duffield, and Dina Katabi. "Enabling {highquality} unterhered virtual reality". In: 14th USENIX Symposium on Networked Systems Design and Implementation (NSDI 17). 2017, pp. 531–544.
- [3] Omid Abari, Fred Chen, Fabian Lim, and Vladimir Stojanovic. "Performance trade-offs and design limitations of analog-to-information converter front-ends". In: 2012 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP). IEEE. 2012, pp. 5309–5312.
- [4] Omid Abari, Ezz Hamed, Haitham Hassanieh, Abhinav Agarwal, Dina Katabi, Anantha P Chandrakasan, and Vladimir Stojanovic. "27.4 A 0.75-million-point fourier-transform chip for frequency-sparse signals". In: 2014 IEEE International Solid-State Circuits Conference Digest of Technical Papers (ISSCC). IEEE. 2014, pp. 458–459.
- [5] Omid Abari, Haitham Hassanieh, Michael Rodreguiz, and Dina Katabi. "Poster: A millimeter wave software defined radio platform with phased arrays". In: Proceedings of the 22nd Annual International Conference on Mobile Computing and Networking. 2016, pp. 419–420.
- [6] Omid Abari, Haitham Hassanieh, Michael Rodriguez, and Dina Katabi. "Millimeter wave communications: From point-to-point links to agile network connections". In: *Proceedings of the 15th ACM Workshop on Hot Topics in Networks*. 2016, pp. 169–175.
- [7] Omid Abari, Fabian Lim, Fred Chen, and Vladimir Stojanović. "Why analog-to-information converters suffer in high-bandwidth sparse signal applications". In: *IEEE Transactions* on Circuits and Systems I: Regular Papers 60.9 (2013), pp. 2273–2284.
- [8] Omid Abari, Hariharan Rahul, and Dina Katabi. "One clock to rule them all: A primitive for distributed wireless protocols at the physical layer". In: (2014).
- [9] Omid Abari, Hariharan Rahul, and Dina Katabi. "Poster: Clock synchronization for distributed wireless protocols at the physical layer". In: Proceedings of the 20th annual international conference on Mobile computing and networking. 2014, pp. 337–340.

- [10] Omid Abari, Hariharan Rahul, and Dina Katabi. "Over-the-air function computation in sensor networks". In: *arXiv preprint arXiv:1612.02307* (2016).
- [11] Omid Abari, Hariharan Rahul, Dina Katabi, and Mondira Pant. "Airshare: Distributed coherent transmission made seamless". In: 2015 IEEE Conference on Computer Communications (INFOCOM). IEEE. 2015, pp. 1742–1750.
- [12] Omid Abari, Deepak Vasisht, Dina Katabi, and Anantha Chandrakasan. "Caraoke: An e-toll transponder network for smart cities". In: Proceedings of the 2015 ACM Conference on Special Interest Group on Data Communication. 2015, pp. 297–310.
- [13] Ali Abedi and Omid Abari. "WiFi Says" Hi!" Back to Strangers!" In: Proceedings of the 19th ACM Workshop on Hot Topics in Networks. 2020, pp. 132–138.
- [14] Ali Abedi and Omid Abari. "Can WiFi Backscatter Achieve the Range of RFID? Nulling to the Rescue". In: Proceedings of the Twentieth ACM Workshop on Hot Topics in Networks. 2021, pp. 171–177.
- [15] Ali Abedi, Omid Abari, and Tim Brecht. "Wi-le: Can wifi replace bluetooth?" In: Proceedings of the 18th ACM Workshop on Hot Topics in Networks. 2019, pp. 117–124.
- [16] Ali Abedi, Tim Brecht, and Omid Abari. "PNOFA: Practical, near-optimal frame aggregation for modern 802.11 networks". In: Proceedings of the 23rd international ACM conference on modeling, analysis and simulation of wireless and mobile systems. 2020, pp. 63–72.
- [17] Ali Abedi, Tim Brecht, and Omid Abari. "Demystifying frame aggregation in 802.11 networks: Understanding and approximating optimality". In: *Computer Communications* 180 (2021), pp. 259–270.
- [18] Ali Abedi, Farzan Dehbashi, Mohammad Hossein Mazaheri, Omid Abari, and Tim Brecht. "Witag: Seamless wifi backscatter communication". In: Proceedings of the Annual conference of the ACM Special Interest Group on Data Communication on the applications, technologies, architectures, and protocols for computer communication. 2020, pp. 240– 252.
- [19] Ali Abedi, Haofan Lu, Alex Chen, Charlie Liu, and Omid Abari. "WiFi Physical Layer Stays Awake and Responds When it Should Not". In: *IEEE Internet of Things Journal* (2023).
- [20] Ali Abedi, Mohammad Hossein Mazaheri, Omid Abari, and Tim Brecht. "Witag: Rethinking backscatter communication for wifi networks". In: Proceedings of the 17th ACM Workshop on Hot Topics in Networks. 2018, pp. 148–154.
- [21] Abhinav Agarwal, Haitham Hassanieh, Omid Abari, Ezz Hamed, Dina Katabi, et al. "High-throughput implementation of a million-point sparse Fourier transform". In: 2014 24th International Conference on Field Programmable Logic and Applications (FPL). IEEE. 2014, pp. 1–6.
- [22] Arthur Chang, Omid Salehi-Abari, and Sung Sik Woo. "Viterbi decoder". In: Project Report, Massachusetts Institute of Technology (2011).
- [23] Liqiong Chang, Ju Wang, Omid Abari, and Srinivasan Keshav. "ID-Clicker: A Battery-Free In-Class Response System Using RFID Tags". In: 2020 IEEE/ACM Fifth International Conference on Internet-of-Things Design and Implementation (IoTDI). IEEE. 2020, pp. 238–244.
- [24] Fred Chen, Fabian Lim, Omid Abari, Anantha Chandrakasan, and Vladimir Stojanovic. "Energy-aware design of compressed sensing systems for wireless sensors under performance and reliability constraints". In: *IEEE Transactions on Circuits and Systems I: Regular Papers* 60.3 (2013), pp. 650–661.

- [25] Kun Woo Cho, Mohammad H Mazaheri, Jeremy Gummeson, Omid Abari, and Kyle Jamieson. "mmWall: A reconfigurable metamaterial surface for mmWave networks". In: Proceedings of the 22nd International Workshop on Mobile Computing Systems and Applications. 2021, pp. 119–125.
- [26] Kun Woo Cho, Mohammad H Mazaheri, Jeremy Gummeson, Omid Abari, and Kyle Jamieson. "mmWall: A Transflective Metamaterial Surface for mmWave Networks". In: arXiv preprint arXiv:2209.11554 (2022).
- [27] Kun Woo Cho, Mohammad H Mazaheri, Jeremy Gummeson, Omid Abari, and Kyle Jamieson. "{mmWall}: A Steerable, Transflective Metamaterial Surface for {NextG}{mmWave} Networks". In: 20th USENIX Symposium on Networked Systems Design and Implementation (NSDI 23). 2023, pp. 1647–1665.
- [28] Farzan Dehbashi, Ali Abedi, Tim Brecht, and Omid Abari. "Verification: can wifi backscatter replace RFID?" In: Proceedings of the 27th Annual International Conference on Mobile Computing and Networking. 2021, pp. 97–107.
- [29] Farzan Dehbashi, Ali Abedi, Tim Brecht, and Omid Abari. "Are WiFi Backscatter Systems Ready for the Real World?" In: *GetMobile: Mobile Computing and Communications* 26.1 (2022), pp. 30–34.
- [30] Farzan Dehbashi, Nauman Ahmed, Manav Mehra, Ju Wang, and Omid Abari. "Swimtrack: drowning detection using rfid". In: Proceedings of the ACM SIGCOMM 2019 conference posters and demos. 2019, pp. 161–162.
- [31] Justin Feng, Timothy Jacques, Omid Abari, and Nader Sehatbakhsh. "Demo Abstract: Leveraging Side-Channels to Turn Processors into Low Overhead Radios". In: Proceedings of the 22nd International Conference on Information Processing in Sensor Networks. 2023, pp. 360–361.
- [32] Justin Feng, Timothy Jacques, Omid Abari, and Nader Sehatbakhsh. "Everything has its Bad Side and Good Side: Turning Processors to Low Overhead Radios Using Side-Channels". In: Proceedings of the 22nd International Conference on Information Processing in Sensor Networks. 2023, pp. 288–301.
- [33] Haitham Hassanieh, Omid Abari, Michael Rodreguez, Mohammed Abdelghany, Dina Katabi, and Piotr Indyk. "Agile millimeter wave networks with provable guarantees". In: arXiv preprint arXiv:1706.06935 (2017).
- [34] Haitham Hassanieh, Omid Abari, Michael Rodriguez, Mohammed Abdelghany, Dina Katabi, and Piotr Indyk. "Fast millimeter wave beam alignment". In: Proceedings of the 2018 Conference of the ACM Special Interest Group on Data Communication. 2018, pp. 432–445.
- [35] Haitham Hassanieh, Omid Abari, Michael Rodriguez, and Dina Katabi. "Millimeter Wave Communications: From Point-to-Point Links to Agile Network Connections". In: ().
- [36] Haitham Hassanieh, Lixin Shi, Omid Abari, Ezz Hamed, and Dina Katabi. "GHz Spectrum Acquisition in Realtime". In: ().
- [37] Haitham Hassanieh, Lixin Shi, Omid Abari, Ezzeldin Hamed, and Dina Katabi. "GHzwide sensing and decoding using the sparse Fourier transform". In: *IEEE INFOCOM* 2014-IEEE Conference on Computer Communications. IEEE. 2014, pp. 2256–2264.
- [38] Haitham Hassanieh, Lixin Shi, Omid Abari, Ezzeldine Hamed, and Dina Katabi. "Bigband: Ghz-wide sensing and decoding on commodity radios". In: (2013).

- [39] Antony Albert Raj Irudayaraj, Rishav Agarwal, Nikhita Joshi, Aakar Gupta, Omid Abari, and Daniel Vogel. "PocketView: Through-Fabric Information Displays". In: The 34th Annual ACM Symposium on User Interface Software and Technology. 2021, pp. 511– 523.
- [40] Antony Albert Raj Irudayaraj, Jeremy Hartmann, Omid Abari, and Daniel Vogel. "Scatterpixels: Ad Hoc Reconfigurable Physical Pixel Displays". In: *Graphics Interface 2023*. 2022.
- [41] Kyle Jamieson, Kun Woo Cho, Mohammad Mazaheri, Jeremy Gummeson, and Omid Abari. RECONFIGURABLE METAMATERIAL SURFACE FOR mmWAVE NETWORKS. US Patent App. 17/710,772. Oct. 2022.
- [42] Dina Katabi, Haitham Z Al-Hassanieh, SHI Lixin, Omid Salehi-Abari, and Ezzeldin Hamed. Methods and apparatus for monitoring occupancy of wideband GHz spectrum and sensing and decoding respective frequency components of time-varying signals using sub-nyquist criterion signal sampling. US Patent 9,544,167. Jan. 2017.
- [43] Dina Katabi, Omid Salehi-Abari, Ezzeldin Hamed, Haitham Z Al-Hassanieh, SHI Lixin, Abhinav Agarwal, Anantha Chandrakasan, and Vladimir Stojanovic. Integrated circuit implementation of methods and apparatuses for monitoring occupancy of wideband GHz spectrum, and sensing respective frequency components of time-varying signals using subnyquist criterion signal sampling. US Patent 9,313,072. Apr. 2016.
- [44] Dina Katabi, Omid Salehi-Abari, Haitham Zuhair Al-Hassanieh, Michael Rodriguez, and Piotr Indyk. *Hash based beam alignment*. US Patent 10,674,435. June 2020.
- [45] Dina Katabi, Omid Salehi-Abari, and Deepak Vasisht. Transponder localization. US Patent 9,504,006. Nov. 2016.
- [46] Dina Katabi, Omid Salehi-Abari, Deepak Vasisht, and Guo Zhang. In-body backscatter communication and localization. US Patent App. 16/456,406. Jan. 2020.
- [47] Keiko Katsuragawa, Ju Wang, Ziyang Shan, Ningshan Ouyang, Omid Abari, and Daniel Vogel. "Tip-tap: battery-free discrete 2D fingertip input". In: Proceedings of the 32nd Annual ACM Symposium on User Interface Software and Technology. 2019, pp. 1045– 1057.
- [48] Tianxiang Li, Haofan Lu, Reza Rezvani, Ali Abedi, and Omid Abari. "Bringing wifi localization to any wifi devices". In: Proceedings of the 21st ACM Workshop on Hot Topics in Networks. 2022, pp. 46–52.
- [49] Tianxiang Li, Mohammad Hossein Mazaheri, and Omid Abari. "5g in the sky: the future of high-speed internet via unmanned aerial vehicles". In: Proceedings of the 23rd Annual International Workshop on Mobile Computing Systems and Applications. 2022, pp. 116– 122.
- [50] Andrea Liao, Omid Salehi-Abari, and Calvin Plett. "Comparative study of passive and active correlators for UWB impulse radio". In: *Proceedings of the 8th IEEE International* NEWCAS Conference 2010. IEEE. 2010, pp. 13–16.
- [51] Haofan Lu, Mohammad Mazaheri, Reza Rezvani, and Omid Abari. "A Millimeter Wave Backscatter Network for Two-Way Communication and Localization". In: Proceedings of the ACM SIGCOMM 2023 Conference. 2023, pp. 49–61.
- [52] Mohammad Mazaheri and Omid Abari. "A Low-Power mmWave Platform for the Internet of Things". In: *GetMobile: Mobile Computing and Communications* 26.4 (2023), pp. 14–18.

- [53] Mohammad Mazaheri, Rafael Ruiz, Domenico Giustiniano, Joerg Widmer, and Omid Abari. "Bringing Millimeter Wave Technology to Any IoT Device". In: Proceedings of the 29th Annual International Conference on Mobile Computing and Networking. 2023, pp. 1–15.
- [54] Mohammad H Mazaheri, Ali Abedi, and Omid Abari. "Bringing mmwave communications to raspberry pi". In: Proceedings of the 24th Annual International Conference on Mobile Computing and Networking. 2018, pp. 687–689.
- [55] Mohammad H Mazaheri, Soroush Ameli, Ali Abedi, and Omid Abari. "A millimeter wave network for billions of things". In: Proceedings of the ACM Special Interest Group on Data Communication. 2019, pp. 174–186.
- [56] Mohammad Hossein Mazaheri, Alex Chen, and Omid Abari. "Millimeter wave backscatter: Toward batteryless wireless networking at gigabit speeds". In: Proceedings of the 19th ACM Workshop on Hot Topics in Networks. 2020, pp. 139–145.
- [57] Mohammad Hossein Mazaheri, Alex Chen, and Omid Abari. "Mmtag: A millimeter wave backscatter network". In: Proceedings of the 2021 ACM SIGCOMM 2021 Conference. 2021, pp. 463–474.
- [58] David Radke, Omid Abari, Tim Brecht, and Kate Larson. "Can future wireless networks detect fires?" In: Proceedings of the 7th ACM International Conference on Systems for Energy-Efficient Buildings, Cities, and Transportation. 2020, pp. 286–289.
- [59] Omid Salehi-Abari. "Building compressed sensing systems: sensors and analog-to-information converters". Massachusetts Institute of Technology, 2012.
- [60] Omid Salehi-Abari. "Software-hardware systems for the Internet-of-Things". PhD thesis. Massachusetts Institute of Technology, 2018.
- [61] Omid Salehi-Abari, Furkan Alaca, James R Green, and Rafik Goubran. "Application of Sensor Networks in a Smart Apartment". In: *CMBES Proceedings* 33 (2010).
- [62] Omid Salehi-Abari and Calvin Plett. "A differential 5 th derivative Gaussian pulse generator for UWB transceivers". In: Proceedings of 2010 IEEE International Symposium on Circuits and Systems. IEEE. 2010, pp. 1089–1092.
- [63] Deepak Vasisht, Guo Zhang, Omid Abari, Hsiao-Ming Lu, Jacob Flanz, and Dina Katabi. "In-body backscatter communication and localization". In: Proceedings of the 2018 Conference of the ACM Special Interest Group on Data Communication. 2018, pp. 132–146.
- [64] Christopher Vattheuer, Charlie Liu, Ali Abedi, and Omid Abari. "Are Home Security Systems Reliable?" In: *arXiv preprint arXiv:2301.07202* (2023).
- [65] Christopher Vattheuer, Charlie Liu, Ali Abedi, and Omid Abari. "Is Z-Wave Reliable for IoT Sensors?" In: *IEEE Sensors Journal* (2023).
- [66] Daniel John Vogel, Keiko Katasuragawa, and Omid SALEHI ABARI. Multi-positional switch using passive wireless tags and systems and methods for using a multi-positional switch that uses passive wireless tags. US Patent 11,397,864. July 2022.
- [67] Ju Wang, Omid Abari, and Srinivasan Keshav. "Challenge: RFID hacking for fun and profit". In: Proceedings of the 24th Annual International Conference on Mobile Computing and Networking. 2018, pp. 461–470.
- [68] Ju Wang, Liqiong Chang, Omid Abari, and Srinivasan Keshav. "Are RFID sensing systems ready for the real world?" In: Proceedings of the 17th Annual International Conference on Mobile Systems, Applications, and Services. 2019, pp. 366–377.

- [69] Ju Wang, Liqiong Chang, Omid Abari, and Srinivasan Keshav. "How Manufacturers Can Easily Improve Working Range of Passive RFIDs". In: 2022 19th Annual IEEE International Conference on Sensing, Communication, and Networking (SECON). IEEE. 2022, pp. 452–460.
- [70] Ju Wang, Liqiong Chang, Shourya Aggarwal, Omid Abari, and Srinivasan Keshav. "Soil moisture sensing with commodity RFID systems". In: Proceedings of the 18th International Conference on Mobile Systems, Applications, and Services. 2020, pp. 273–285.
- [71] Ju Wang, Jianyan Li, Mohammad Hossein Mazaheri, Keiko Katsuragawa, Daniel Vogel, and Omid Abari. "Sensing finger input using an rfid transmission line". In: *Proceedings* of the 18th Conference on Embedded Networked Sensor Systems. 2020, pp. 531–543.