Andrea Lacava

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My main research interests focus on 5G and beyond cellular networks, Deep Reinforcement Learning, Cybersecurity, the security of AI models, programmable controllers for the Open RAN architecture, and Digital Twins.

Education

Nov 2020 – Present
Double PhD program in Computer Engineering and ICT (5 years, English)
Northeastern University, Boston (MA), USA & Sapienza University of Rome, Italy
During my PhDs, I have researched innovative methodologies to enable intelligence in the Open RAN context and to leverage the RAN Intelligent Controller centralized abstraction to create data-driven solutions for various use cases such as on-demand Traffic Steering, Anomaly Detection, and Quality of Service management. Selected publications from the PhD: [1, 2, 3, 4, 5].

Oct 2018 – Oct 2020
MSc in Cybersecurity - Laurea Magistrale in Cybersecurity (2 years, English)
Sapienza University of Rome - **Final grade:** 110/110 - **Thesis title**: *Intrusion Detection System for Bluetooth Mesh Networks: Data Gathering and Experimental Evaluations [6]*

Sept 2014 – Oct 2018
BSc in Computer Engineering - Laurea Triennale in Ingegneria Informatica
Sapienza University of Rome **Final grade:** 101/110

Research Activities

Dec 2022 - Present
Research project: dApps: Enabling Real-Time AI-Based Open RAN Control
I designed and implemented a logical interface to connect disaggregated RAN nodes with distributed controllers called dApps, enabling real-time control loops in the Open RAN architecture. Demonstrated the feasibility of dApps within the O-RAN ecosystem through measurements of intelligent closed control loops achieving periodicities of less than 1 ms. Related works to this project: [7].

Mar 2021 - Present
Research project: ns-O-RAN: Simulating O-RAN 5G Systems in ns-3
I designed and developed ns-O-RAN, a software integration that combines a real-world near-real-time RIC with an ns-3 simulated RAN, enabling researchers and telecom operators to build, test, and integrate xApps while exploiting advanced simulation capabilities to generate realistic datasets without experimental infrastructure. Related works to this project: [1, 2, 4, 5, 8].

3 - 6 June 2024
Invited Tutorial - *IFIP/IEEE Networking 2024* - Thessaloniki, Greece
I presented the current status of the O-RAN architecture, highlighting its potential and addressing current challenges in enabling intelligence for next-generation cellular networks. I also shared updates on ns-O-RAN, my latest research findings, and my vision for its future development.

15th Dec 2022
Invited Seminar - *Politecnico di Milano*, Italy
In this seminar, I demonstrated the potential of ns-O-RAN and how students can use it as a framework for developing xApps and generating realistic datasets.

Jul 2019 – Sep 2019
Technical Student - *CERN*, Geneva, Switzerland
I was selected as an Openlab Student for the summer with a full-time contract. During this time, I deployed and explored StackStorm, an open-source automation platform by Extreme Networks. Once familiar, I extended the CERN Intrusion Detection System to support multiple network vendors, enabling dynamic traffic steering rule modifications.

Aug 2016 – Dec 2016
Laboratory Development - Physics Department, *Sapienza* University of Rome
I developed and implemented an environment controller for a clean room 10000 using an Arduino board and the Python serial communication library.

Work Activities

Apr 2020 – Jun 2020
Android developer - *Teleskill*, Rome, Italy
Developed an Android application designed to detect falls in elderly people and Alzheimer's patients using sensory data from their mobile phones.

Feb 2018 – Sep 2018	**Front-End Developer - *WSENSE*, Rome, Italy *(BSc dissertation)*** Control Dashboard for Underwater Autonomous Vehicles built in Angular that communicates via HTTP and MQTT to cloud and Underwater Autonomous Vehicles.
Jul 2018 – Oct 2018	**Full-stack Developer - Colibrì** Development of a website with a newsletter service. The website's back-end is fully written with Nodejs and the front-end is pure Bootstrap, CSS3 and HTML5.

Computer Skills

Protocols & Concepts	O-RAN, 5G and beyond, Digital Twins, AI, DRL, Adversarial AI, Network Security, UAV, BLE mesh networking, Complex System Design, Data Science and Big Data Analysis, Multiprocessing Concurrency Management, Real-Time Applications
Major frameworks	scikit-learn, Stable Baselines, Gymnasium (gym), pandas, OpenAirInterface, srsRAN, ns-3
Programming Languages	C++, C-UNIX, Python, Javascript, Arduino, BASH, NodeJS, Java, HTML, and more
Other Software	near-RT RIC, xApps, SQL and NoSQL DB, Github et al, StackStorm, Docker, Cisco Packet Tracer, UNIX system administration, MAC-OS, Windows
Typesetting	Office, Wordpress, LaTeX

Language Skills

Italian	Native
English	Advanced

Research Grants and Awards

December 2024 (Announced Nov 2024)	**Best Paper Award at IEEE Globecom 2024** *Twinet: Connecting Real World networks to their Digital Twins through a Live Bidirectional Link* [3]
June 2023	**ACM Artifacts Available badge for Workshop on ns-3 (WNS3) 2023 paper** *ns-O-RAN: Simulating O-RAN 5G Systems in ns-3 [2]*
November 2022	**Progetti per Avvio alla Ricerca 2022 - Tipo 1 by Sapienza University of Rome** *Programmable and Customized Intelligence for Traffic Steering and Quality of Service optimization in 5G Networks Using Open RAN Architectures.* Related works: [1, 2, 4, 5, 8].
December 2021	**Progetti per Avvio alla Ricerca 2021 - Tipo 1 by Sapienza University of Rome** *End-to-End Simulation of Bluetooth Low Energy Networks.* Related works: [9, 6, 10, 11, 12, 13]
Jun 2019 – Jul 2019	**Research Grant - *Sapienza* University of Rome** *Studio di Soluzioni Implementative di Piattaforme Wireless per e-Health IoT [14].*
June 2019	**De Maggi Award - Best Engineering student of Sapienza University of Rome** *Awarded by "Fondazione per la promozione dello studio e della ricerca La Sapienza"*

Academic service

November 2024	TPC Member for IEEE WCNC 2025
September 2024 September 2023	**Technical Chair - RESTART Tech Camp, Italy** The Tech Camp is an event for PhD students that equips participants with foundational knowledge in wireless experimentation through expert keynotes, hands-on sessions, and a workshop where researchers showcase mature research, fostering collaboration and advancing the field.
Sep 2023 – Dec 2023 Sep 2022 – Feb 2023	**Teaching - *Sapienza* University of Rome** I taught the fundamentals of C++, Wireshark, and the ns-3 simulator to undergraduate students in the "Telecomunicazioni" course held by the Computer and Control Engineering Department.

November 2020 – June 2021
Teaching - *Young Gladiators* - Northeastern University
I conducted tutoring sessions to graduate-level participants from industry and academia how to use Colosseum, the world's largest RF emulator.

Since 2018
Reviewer of countless submissions to top tier conferences such as IEEE INFOCOM, ACM Mobycom, etc., and journals such IEEE TMC, Elsevier Computer Networks, and more.

Publications

[1] A. Lacava, M. Polese, R. Sivaraj, R. Soundrarajan, B. S. Bhati, T. Singh, T. Zugno, F. Cuomo, and T. Melodia, "Programmable and Customized Intelligence for Traffic Steering in 5G Networks Using Open RAN Architectures," *IEEE Transactions on Mobile Computing*, 2023.

[2] A. Lacava, M. Bordin, M. Polese, R. Sivaraj, T. Zugno, F. Cuomo, and T. Melodia, "ns-o-ran: Simulating O-RAN 5G Systems in ns-3," in *Proceedings of the 2023 Workshop on Ns-3*, WNS3 '23, (New York, NY, USA), p. 35–44, Association for Computing Machinery, 2023.

[3] C. P. Robinson, A. Lacava, P. Johari, F. Cuomo, and T. Melodia, "TwiNet: Connecting Real World Networks to their Digital Twins Through a Live Bidirectional Link," *arXiv preprint arXiv:2411.03503*, 2024.

[4] A. Lacava, T. Pietrosanti, M. Polese, F. Cuomo, and T. Melodia, "Enabling Online Reinforcement Learning Training for Open RAN," in *2024 IFIP Networking Conference (IFIP Networking)*, pp. 577–582, IEEE, 2024.

[5] M. Polese, L. Bonati, S. D'Oro, P. Johari, D. Villa, S. Velumani, R. Gangula, M. Tsampazi, C. Paul Robinson, G. Gemmi, A. Lacava, S. Maxenti, H. Cheng, and T. Melodia, "Colosseum: The Open RAN Digital Twin," *IEEE Open Journal of the Communications Society*, vol. 5, pp. 5452–5466, 2024.

[6] A. Lacava, E. Giacomini, F. D'Alterio, and F. Cuomo, "Intrusion Detection System for Bluetooth Mesh Networks: Data Gathering and Experimental Evaluations," in *SPT-IoT 2021: The Fifth Workshop on Security, Privacy and Trust in the Internet of Things (SPT-IoT 2021)*, (Kassel, Germany), Mar. 2021.

[7] R. Gangula, A. Lacava, M. Polese, S. D'Oro, L. Bonati, F. Kaltenberger, P. Johari, and T. Melodia, "Listen-While-Talking: Toward dApp-based Real-Time Spectrum Sharing in O-RAN," *arXiv preprint arXiv:2407.05027*, 2024.

[8] M. Bordin, A. Lacava, M. Polese, S. Satish, M. A. Nittoor, R. Sivaraj, F. Cuomo, and T. Melodia, "Design and Evaluation of Deep Reinforcement Learning for Energy Saving in Open RAN," *arXiv preprint arXiv:2410.14021*, 2024.

[9] A. Lacava, V. Zottola, A. Bonaldo, F. Cuomo, and S. Basagni, "Securing Bluetooth Low Energy networking: An overview of security procedures and threats," *Computer Networks*, vol. 211, p. 108953, 2022.

[10] A. Lacava, P. Locatelli, and F. Cuomo, "Friendship Security Analysis in Bluetooth Low Energy Networks," in *2023 21st Mediterranean Communication and Computer Networking Conference (MedComNet)*, pp. 83–92, IEEE, 2023.

[11] E. Giacomini, F. D'Alterio, A. Lacava, and F. Cuomo, "Blues: A self-organizing ble mesh-network paradigm for iot environments," in *2020 IEEE 21st International Symposium on "A World of Wireless, Mobile and Multimedia Networks" (WoWMoM)*, pp. 409–414, 8 2020.

[12] A. Lacava, P. Locatelli, P. Spadaccino, F. Cuomo, *et al.*, "Internet of Things Security Issues in Lorawan and Bluetooth Low Energy," in *Towards a trushworthy information exchange in the digital era*, pp. 159–190, Texmat, 2023.

[13] P. Locatelli, M. Perri, D. M. J. Gutierrez, A. Lacava, and F. Cuomo, "Device Discovery and Tracing in the Bluetooth Low Energy Domain," *Computer Communications*, 2023.

[14] A. Petroni, A. Lacava, P. Locatelli, G. Nero, M. Pediconi, and F. Cuomo, "Exploiting edge computing for adaptive data update in internet of things networks.," in *AmI (Workshops/Posters)*, pp. 27–37, 2019.

[15] A. Lacava, G. Nero, P. Locatelli, F. Cuomo, and T. Melodia, "Demo abstract: BE-Mesh: Bluetooth Low Energy Mesh Networking," in *2019 IEEE INFOCOM Demo (INFOCOM 2019 Demo)*, (Paris, France), Apr. 2019.

[16] A. Feraudo, S. Maxenti, A. Lacava, P. Bellavista, M. Polese, and T. Melodia, "xDevSM: Streamlining xApp Development With a Flexible Framework for O-RAN E2 Service Models," *arXiv preprint arXiv:2409.16754*, 2024.

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