Luca Baldesi

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Interests

All aspects of **Internet-of-Things**, including **embedded systems**, **real-time** communication, privacy, and **machine learning**/AI at the edge. Applications of interest include medical devices, testbeds, and telecommunication.

Experience

08/2023–now **Project Scientist**, *Proper Data NSF SaTC Frontier Center*, University of California, Irvine, USA.

- Led, designed, and coded in Python and Javascript an IoT device testbed; coordinated using SCRUM/Agile practices;
- Led a project on smart glasses privacy, focusing on Bluetooth LE communication and traffic sniffing;
- Led a project on audio advertisement classification robust to adversarial attacks; designed and implemented a residual neural network in Pytorch;
- Implemented in Python a framework for LLM React agents, based on ChatGPT and Llama 3.

01/2023–07/2023 **Team Lead for IoT/IoMT**, Hamilton Medical, Switzerland.

- Led, designed, and coded in C/C++ a platform for real-time processing of data from medical devices to the cloud;
- Led a team of other three engineers with SCRUM/Agile practices;
- Managed and coordinated with other teams the CI/CD of our platform through Azure and docker;
- Designed and implemented a library in C/C++ to interface with legacy code to mitigate heterogeneity in the code base.

04/2022–01/2023 **Software Engineer for IoT/IoMT**, Hamilton Medical, Switzerland.

- Designed and coded user space applications in C/C++ for Yocto/Open embedded systems for connectivity of medical devices;
- Maintained a distribution of the Yocto/Open embedded OS for medical devices (ARM architecture);
- Designed and coded linux device drivers for medical devices connectivity (NFC, through I2C) and testing automation (USB);
- Maintained a u-boot distribution for medical devices and its device tree;
- Led and performed the migration of the team code base from SVN to git.

10/2020–03/2022 **Postdoctoral Research Associate**, *Institute for the Wireless Internet-of-Things*, Northeastern University, USA.

- Led, designed and coded in Python/Pytorch a wireless waveform classifier for 5G (3GPP) and WiFi (802.11g);
- Extended the code base of srsRAN in C/C++, a 5G base station implementation, to support seamless inter-cell handovers;
- Modified the linux driver implementation in C/C++ of OpenWiFi, a WiFi AP implementation, to mitigate packet drops inside our testbed (Colosseum) due to ACK package delay resulting from the wireless channel simulation;
- Prototyped smart 5G base stations, able to sense and react to their environment, using Software Defined Radio (Ettus USRP x310) and GNU Radio.

10/2019–02/2020 **Research and Development Engineer**, MindMaze, France.

- Designed and implemented in C/C++ an energy saving mechanism for our board based on a STM32 chip;
- Designed and implemented in C/C++ a CAN bus communication module;
- Contributed code to the compatibility library mmpack for deployments on both Windows and GNU/Linux systems.

05/2018–09/2019 **Research Fellow**, University of Trento, Italy.

- Maintained and released a distributed platform in C/C++ and Javascript, PeerStreamer-ng, for live video streaming with minimal memory and computational footprint;
- Led the test deployment of our distributed platform in one of the largest European wireless community networks, AWMN;
- Analysed packet loss and delay of distributed real-time streaming and proposed a dynamic topology optimization for mesh networks with proved guarantees on maximum reception delay.

11/2014–04/2018 **PhD. Student**, University of Trento, Italy.

- Led, designed, and coded a distributed platform in C/C++ and Javascript, PeerStreamer-ng, for live video streaming with minimal memory and computational footprint;
- Designed and implemented a network emulator in Python and Mininet for Wireless Community Networks;
- Designed and implemented a discrete-event simulator in C/C++ for real-time streaming applications;
- Designed and proposed a topology optimization for distributed real-time applications to reduce average reception delay by 60% and packet loss by 50% in simulated networks;
- Designed and proposed a topology cross-layer optimization technique to reduce link bottlenecks up to 66% for distributed real-time applications.

03/2016–12/2016 **Visiting PhD. Student**, University of California, Irvine, USA.

- Led a project on social network anonymization based on the structural properties of graph eigenvectors;
- Designed and implemented a graph anonymization algorithm in Python and contributed the code to the Python NetworkX library.

05/2013–09/2014 **Research Fellow**, University of Trento, Italy.

- Maintained and contributed to a peer-to-peer application for real-time streaming in C/C++;
- Analysed peer-to-peer application performance for real-time streaming.

Education

2014-2018 **PhD. on Real-Time Content Delivery in Distributed Networks**, *University of Trento*, Italy, Advisor: Renato Lo Cigno.
Thesis: Distributed Live Streaming on Mesh Networks.

2011–2013 **M.S. in Computer Science Engineering**, *The University of Florence*, Italy, cum laude and career mention. Advisor: Romano Fantacci.
Thesis: Analysis of the Bluetooth protocol and robustness testing of its implementations in mobile devices and operating systems.

2007–2011 **B.S. in Computer Science Engineering**, *The University of Florence*, Italy, Advisor: Romano Fantacci.
Thesis: Analysis and implementation of a seamless handover system using a router with two Wi-Fi interfaces.

Awards

2024 **Distinguished Reviewer Award** as member of the Program Committee of USENIX Security Artifact Evaluation.

2022 **Best Paper Award** at IEEE Conference on Computer Communications, INFOCOM. Paper: *ChARM: NextG Spectrum Sharing Through Data-Driven Real-Time O-RAN Dynamic Control*.

2018 **Best in-Session Presentation** at IEEE Conference on Computer Communications, INFOCOM. Paper: *Spectral graph forge: Graph generation targeting modularity*.

2013 **Summa Cum Laude** and **Career Mention** for my M.S. degree, at the University of Florence, Italy, titled: *Analysis of the Bluetooth protocol and robustness testing of its implementations in mobile devices and operating systems*.

Teaching and Outreach

2023-2024 **Curriculum Lead and Instructor**, *University of California, Irvine*, **Summer school**: *Privacy, IoT & AI Research Exploration*, Summer program for under represented populations; I was responsible for the curriculum project design, based on OpenAI ChatGPT, and I contributed as lecturer. Length: 1 week, Students: 26.

2023-2024 **Guest Lecturer**, *University of California, Irvine*, Graduate course EECS 221: *Topics in Computer Engineering*, Class title: *Audio Security & Privacy for IoT devices*.

2021-2022 **Instructor**, *Northeastern University*, **Summer school**: *Colosseum Young Gladiators 2021: experimenting with a large scale spectrum emulator*, Length: 3 days, Students: ~30.

2015-2016 **Co-Lecturer**, *University of Trento, Italy*, Master course: *Privacy, Trust and Security*, Length: 10 weeks, Students: ~40.

2014-2016 **Teaching Assistant**, *University of Trento, Italy*, Master course: *Simulation and Performance Evaluation*, Length: 10 weeks, Students: ~50.

Mentoring

2023-2024 Working closely and supervising the research at different levels: post-doc researcher **Tu Le** on advertisement and user profiling; graduate student **Jad Aaraj** on smart glasses and network analysis; graduate student **Yu Duan** on social network graphs and misinformation spreading; undergraduate **Shraddha Hardikar** on social network profiling; undergraduate **Alison Iversen** on ML adversarial examples. University of California, Irvine.

2014-2019 Co-advising undergraduate thesis on real-time distributed streaming, working with **Lorenzo Ghiro**, **Riccardo Francescato**, **Riccardo Martinelli**, **Enrico Egidi**, **Giulia Nardó**, and **Massimo Girondi**. University of Trento, Italy.

Service

2024-now **Program Committee Member**, *USENIX Security*.

2023-now **Program Committee Member**, *USENIX Security Artifact Evaluation*.

2020-2022 **Associate Editor**, *Elsevier Software Impact*.

Open Source & Industry Impact

ChARM Designed and implemented a wireless spectrum optimization mechanism based on wireless spectrum classification (5G, WiFi) using PyTorch. Source Code.

srsRAN Extended the interface of the 5G RAN to support user handover between telecommunication cells. Source Code.

OpenWiFi Extended the interface of the user- and kernel-land for FPGA radios (tested on the Xilinx boards), to allow the customization of the acknowledgement timeouts. This proved crucial in order to run state-of-art hardware and software in the wireless emulator Colosseum. Source Code.

mmpack Contributed to mmpack, a cross-platform, multi-versioning user package manager. Source Code.

Python NetworkX Contributed two network graph generators:
- a generator for BGP autonomous system graphs. Source code in NetworkX 2.4;
- a generator targeting global structural properties, such as modularity and community structure. Source code in NetworkX 2.2.

PeerStreamer-ng Designed and implemented the PeerStreamer-ng platform (written in C, HTML, and Javacript), a real-time video streaming system meant to serve thousands of users. It has been designed to be fast, with very low system requirements and to minimize the latency. Source Code.

NePA TesT Designed and implemented a lightweight network emulator based on mininet. Source Code.

Publications (Google Scholar link)

J: journal, *C*: conference.

J6 Mattia Milani, Michele Segata, Luca Baldesi, Marco Nesler, Renato Lo Cigno, and Leonardo Maccari. Optimizing MRAI on Large Scale BGP Networks: An Emulation-Based Approach. *Computer Communications*, 2024. Accepted, to appear

C8 Luca Colombo, Luca Baldesi, Tommaso Melodia, and Matteo Rinaldi. Neural Network-Aided Spurious Modes Optimization Targeting Lithium Niobate MEMS Resonators. In *IEEE IMS 2022 - IEEE International Microwave Symposium*, 2022

C7 Luca Baldesi, Francesco Restuccia, and Tommaso Melodia. ChARM: NextG Spectrum Sharing Through Data-Driven Real-Time O-RAN Dynamic Control. In *IEEE INFOCOM 2022 - IEEE Conference on Computer Communications*, 2022. **Best Paper Award**

C6 Mattia Milani, Marco Nesler, Michele Segata, Luca Baldesi, Leonardo Maccari, and Renato Lo Cigno. Improving BGP Convergence with Fed4FIRE+ Experiments. In *39th IEEE Conference on Computer Communications (INFOCOM 2020), 5th International Workshop on Computer and Networking Experimental Research using Testbeds (CNERT 2020)*, 2020

J5 Luca Baldesi, Leonardo Maccari, and Renato Lo Cigno. Infective Flooding in Low-Duty-Cycle Networks, Properties and Bounds. *Computer Communications*, 2020

J4 Luca Baldesi, Athina Markopoulou, and Carter Butts. Spectral graph forge: A framework for generating synthetic graphs with a target modularity. *IEEE/ACM Transactions on Networking*, 2019

C5 Luca Baldesi, Leonardo Maccari, and Renato Lo Cigno. Keep it fresh: Reducing the age of information in v2x networks. In *1st ACM Workshop on Technologies, mOdels, and Protocols for Cooperative Connected Cars (TOP-Cars)*, 2019

C4 Luca Baldesi, Leonardo Maccari, and Renato Lo Cigno. On the properties of infective flooding in low-duty-cycle networks. In *15 th Wireless On-demand Network systems and Services Conference*, 2019

C3 Luca Baldesi, Carter T. Butts, and Athina Markopoulou. Spectral graph forge: Graph generation targeting modularity. In *IEEE INFOCOM 2018 - IEEE Conference on Computer Communications*, 2018

J3 Leonardo Maccari, Nicoló Facchi, Luca Baldesi, and Renato Lo Cigno. Optimized P2P streaming for wireless distributed networks. *Pervasive and Mobile Computing*, 2017

J2 Luca Baldesi, Leonardo Maccari, and Renato Lo Cigno. On the Use of Eigenvector Centrality for Cooperative Streaming. *IEEE Communications Letters*, 2017

C2 Luca Baldesi, Leonardo Maccari, and Renato Lo Cigno. Optimized cooperative streaming in wireless mesh networks. In *IFIP Networking Conference (IFIP Networking) and Workshops*, 2016

C1 Luca Baldesi and Leonardo Maccari. NePA TesT: network protocol and application testing toolchain for community networks. In *12th Annual Conference on Wireless On-demand Network Systems and Services (WONS)*, 2016

J1 Luca Baldesi, Leonardo Maccari, and Renato Lo Cigno. Improving P2P streaming in Wireless Community Networks. *Computer Networks*, 2015

Patents

2023 Provisional Patent, Channel-Aware Reactive Mechanism (ChARM), US 63/244,192

Skills

Languages	C, C++, Python, Ruby, JavaScript.
Operating Systems	GNU/Linux, Yocto/OpenEmbedded, u-boot
Embedded	ARMv7, STM32, Atmel attiny, NXP i.MX6ULL, AMD Zynq 7000 SoC
Protocols	TCP/IP, UDP, WebRTC, CAN, USB, I2C, HTTP(S)
AI/ML	PyTorch, CNN, ResNet, React LLM agents
Tools	Docker, LXC, Jira, git

References

Available upon request.