# Davide Sanvito

Curriculum Vitae

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## About me

- PhD candidate in Information Technology
- Research interest in computer networks and systems
- Strong hands-on experience: low-level programming languages, networking domain languages, scripting languages, emulated network testbeds
- o Mathematical background: operation research, linear programming
- Basic understanding of Machine Learning
- Contributions to open source projects



# Professional experience



**Research Scientist**, *NEC Laboratories Europe GmbH*, Heidelberg (Germany).

Intelligent Software Systems (ISS) group



**Assistant Research Engineer**, Huawei Technologies Co. Ltd., France Research Center, Mathematical and Algorithmic Science Lab, Boulogne-Billancourt (France).

- Network Layer Team
- Research topic: SD-WAN Traffic Engineering
  - Design of a robust routing optimization model (operation research, linear programming) implemented in COIN-OR/LEMON (C++) for a Software-Defined Wide Area Network
  - Performance evaluation under realistic and synthetic traffic scenarios
  - Design and implementation of automated test suites (Python, Bash scripting, MATLAB)

Jan 2018-June 2018

PhD Student Intern, NEC Laboratories Europe GmbH, Heidelberg (Germany).

- Systems and Machine Learning (SysML) group
- Research topic: In-Network Computing with SDN programmable data plane
  - Analysis and profiling of Neural Networks computation on Intel CPU (Intel Caffe)
  - Design and implementation of automated test suites to collect hardware performance counters (Linux Perf, Python, Bash scripting)
  - Definition of techniques and methods to split the computation of a Neural Network using heterogeneous processors (CPU and Network Flow Processor)
  - Implementation of a Neural Network executor on a Netronome NFP SmartNIC based on P4 and architecture-specific MicroC

Jan 2015-Apr 2016

Research Associate, CNIT – Consorzio Nazionale Interuniversitario per le Telecomunicazioni, UdR Politecnico di Milano, Milano (Italy).

- Extension of open source SDN software (CPqD ofsoftswitch13 in C and Ryu controller in Python) to support stateful SDN programming abstractions and applications (OpenState and BEBA projects)
- Design and implementation of a failure detection and recovery scheme based on OpenState
- Experimental validation with automated testbeds (Mininet, Python)

# Projects and open source contributions

ONF ONOS, https://onosproject.org/.

ONOS (Open Network Operating System) is a production-ready open source SDN network operating system built for service provider networks, hosted by the Linux Foundation, designed for scalability, high performance and high availability, in Java. I contributed with an Intent Monitor and Reroute service which enables an off-platform plug&play routing logic for intent-based ONOS applications. The code has been included in ONOS 1.13 in the master branch.

**CPqD** ofsoftswitch13, https://github.com/CPqD/ofsoftswitch13.

Open source OpenFlow 1.3 user-space software switch implementation, in C. In the context of OpenState and BEBA projects, I was part of the team contributing with the stateful packet processing implementation. The code has been integrated in the project repository as an experimental branch.

**OpenState**, http://www.openstate-sdn.org.

Open source project for the development of an OpenFlow extension that adds support for stateful packet processing, to reduce the need for switches to rely on external controllers. I was part of the team focusing on the design and implementation of an OpenState softswitch and controller based on CPqD ofsoftswitch13 (C) and OSRG Ryu (Python).

BEBA (BEhavioural BAsed forwarding), http://www.beba-project.eu/.

European H2020 project on SDN data plane. BEBA's ultimate goal is the implementation of future-proof network devices capable to be repurposed with middlebox-type functions well beyond static packet forwarding, with focus on monitoring and network security applications. I was part of the team focusing on the software prototyping and on the design and implementation of stateful SDN applications.

### Education

May 2016-Mar 2020



PhD Student in Information Technology, Politecnico di Milano, Milano (Italy).

- Advanced Network Technologies LABoratory (ANTLab) research group (prof. Antonio Capone)
- Research topic: Traffic Engineering in Software-Defined Networking with programmable dataplanes
- Design of robust routing optimization models (operation research, linear programming) implemented in Gurobi (Python) exploring the tradeoff between dynamic and stable routing
- Design and implementation of stateful SDN applications (OpenState) related to network load balancing, network failure resiliency and traffic classification offloading
- Experimental validation with emulated SDN networks (Mininet, OpenFlow, P4, Ryu, ONOS, Java)
- Contribution to open source projects (see *Projects and contributions*)
  - CPqD ofsoftswitch13 and OSRG Ryu: added support for in-switch stateful packet processing
  - ONF ONOS: added new Intent-Based Networking monitoring service
- Research projects (see *Projects and contributions*):
  - OpenState
  - BEBA (BEhavioural BAsed forwarding)
- Teaching assistantship in Engineering of Computing Systems Bachelor of Science
  - Fundamentals of Internet and communication networks 097246 50 hours
  - The Internet and communication networks (2nd module Internetworking with TCP/IP) 086203 10 hours
- Teaching for Progetto SHELL Cluster Smart Living Technologies master (Sep 2016)
  - Protocols for data collection and transmission MA1.4 36 hours

- 2020 PhD, Information Technologies, Politecnico di Milano, Italy, cum laude.
  - Thesis: Traffic management in networks with programmable data planes

Advisor: Prof. Antonio Capone

2014 **MS, Telecommunications Engineering**, *Politecnico di Milano*, Italy, 110/110 cum laude.

Thesis: Software-Defined Networking Applications Based on OpenState

Advisor: Prof. Antonio Capone

- 2012 BS, Telecommunications Engineering, Politecnico di Milano, Italy, 108/110.
- 2009 **Scientific School Diploma**, *Liceo Scientifico G.B. Vico*, Cologno Monzese (MI), Italy, 97/100.

#### Online Courses

2016 Machine Learning, Stanford University (prof. Andrew Ng), Coursera QVVUBBR2X4WZ.

#### **Publications**

- D. Sanvito, A. Marchini, I. Filippini, and A. Capone. **CEDRO:** an in-switch elephant flows rescheduling scheme for data-centers. In *IEEE NetSoft 2020*, June 2020.
- <u>D. Sanvito</u>, I. Filippini, A. Capone, S. Paris, and J. Leguay. **Clustered Robust Routing for Traffic Engineering in Software-Defined Networks**. In *Computer Communications*, volume 144, pages 175–187. Elsevier, 2019.
- A. Tomaszewski, M. Pióro, <u>D. Sanvito</u>, I. Filippini, and A. Capone. **On Optimization of Semi-stable Routing in Multicommodity Flow Networks**. In *EURO/ENOG INOC 2019*, June 2019.
- S. Pontarelli, R. Bifulco, M. Bonola, C. Cascone, M. Spaziani, V. Bruschi, <u>D. Sanvito</u>, G. Siracusano, A. Capone, M. Honda, F. Huici, and G. Bianchi. **FlowBlaze: Stateful Packet Processing in Hardware**. In *USENIX NSDI 2019*, February 2019.
- D. Sanvito, G. Siracusano, and R. Bifulco. Can the Network be the Al Accelerator? In ACM SIGCOMM NetCompute 2018 Workshop, August 2018.
- <u>D. Sanvito</u>, D. Moro, M. Gulli, I. Filippini, A. Capone, and A. Campanella. **ONOS Intent Monitor and Reroute service: enabling plug&play routing logic**. In *IEEE NetSoft 2018*, June 2018.
- <u>D. Sanvito</u>, I. Filippini, A. Capone, S. Paris, and J. Leguay. **Adaptive Robust Traffic Engineering in Software Defined Networks**. In *IFIP Networking 2018*, May 2018.
- N. Bonelli, G. Procissi, <u>D. Sanvito</u>, and R. Bifulco. **The Acceleration of OfSoftSwitch**. In *IEEE NFV-SDN 2017*, November 2017.
- <u>D. Sanvito</u>, D. Moro, and A. Capone. **Towards Traffic Classification Offloading to Stateful SDN Data Planes**. In *IEEE NetSoft NEAF-IO 2017 Workshop*, July 2017.
- C. Cascone, <u>D. Sanvito</u>, L. Pollini, A. Capone, and B. Sansò. **Fast Failure Detection and Recovery in SDN with Stateful Data Plane**. In *IJNM Special Issue: Softwarization of networks, clouds, and internet of things*, volume 27, page e1957. Wiley Online Library, March 2017.
- A. E.C. Redondi, <u>D. Sanvito</u>, and M. Cesana. **Passive Classification of Wi-Fi Enabled Devices**. In *ACM MSWiM 2016*, November 2016.
- C. Cascone, L. Pollini, <u>D. Sanvito</u>, A. Capone, and B. Sansò. **SPIDER: Fault Resilient SDN Pipeline with Recovery Delay Guarantees**. In *IEEE NetSoft 2016*, June 2016.
- C. Cascone, L. Pollini, <u>D. Sanvito</u>, and A. Capone. **Traffic Management Applications for Stateful SDN Data Plane**. In *IEEE EWSDN 2015*, September 2015.

## Technical skills

Programming languages

Python, C, C++, Java, MATLAB

Networking technologies

 $\mathsf{TCP}/\mathsf{IP}$ , switching, routing, SDN, ONOS, P4, OpenFlow, Ryu, Mininet, Netronome SmartNIC

tools

Mathematical Operation Research, Linear Programming, Gurobi, COIN-OR, Lemon, AMPL

# Languages

Italian Native

English Professional proficiency - (2012) - ETS TOEIC - Listening and Reading Test: 910/990 - C2

## Interests and activities

Music Studying classical piano at Civica Scuola di Musica "G. Donizetti" - Sesto San Giovanni (Mi) obtaining Licenza di Teoria, Solfeggio e Dettato musicale (2009) and Esame di Compimento Inferiore di pianoforte (2010) from Istituto Superiore di Studi Musicali "F. Vittadini" - Pavia.

Volunteer activity as cinema projectionist at CineTeatro Don Bosco - Carugate (Mi). Devel-Social opment of tools to automate the tasks of the projectionists (http://bit.ly/ctdb-tools).