

Tianzhu Zhang, Ph.D.

✉ tianzhu.zhang1989@gmail.com

✉ tianzhu.zhang@nokia-bell-labs.com

🌐 <https://ztz1989.github.io/>

🌐 <https://www.linkedin.com/in/tianzhu-zhang-a390485b/>

🌐 <https://www.researchgate.net/profile/Tianzhu-Zhang-3>

🌐 <https://github.com/ztz1989>



Experience

- Aug, 2020 – till now** ■ **Research Engineer** Nokia Bell Labs, Paris-Saclay, France.
Permanent member of the Augmented Machine Interaction group.
- Sep, 2020 – till now** ■ **Associate Member** Laboratory of Information, Networking and Communication Sciences (LINCS), Paris, France.
** The time gap here is due to the delayed visa process by COVID-19.*
- Oct, 2017 – Nov, 2019** ■ **PostDoc Researcher** Telecom ParisTech & Cisco Systems, Paris, France.
Supervisor: Prof. Dario Rossi, Prof. Luigi Iannone
- Jun, 2017 – Aug, 2017** ■ **Intern** Nokia Bell Labs, Paris-Saclay, France.
Supervisor: Dr. Massimo Gallo
- Nov, 2014 – Nov, 2017** ■ **Ph.D. Researcher** Joint Open Lab, Telecom Italia, Turin, Italy.
Supervisor: Dr. Pino Castrogiovanni, Dr. Dario Mana, Dr. Claudio Borean

Education

- Nov, 2014 – Nov, 2017** ■ **Ph.D., Politecnico di Torino** in the Department of Electronics and Telecommunications, Scholarship by Telecom Italia.
Supervisor: Prof. Paolo Giaccone, Prof. Marcello Chiaberge.
Thesis title: *Control Plane Optimization in Software Defined Networking and Task Allocation for Fog Computing.*
- Oct, 2012 – Oct, 2014** ■ **M.Eng., Politecnico di Torino** in Computer and Communication Networks Engineering, *Compagnia di San Paolo* First-class Scholarship.
Thesis title: *Distributed Controllers in Software Defined Networks.*
- Sep, 2008 – Jun, 2012** ■ **B.Sc., Huazhong University of Science and Technology** in the department of Computer Science and Technology.

Publications

Journal Articles





- 1** Zhang, T., Qiu, H., Castellano, G., Rifai, M., Chung Shue, C., & Pianese, F. (2022). System Log Parsing: A Survey. *IEEE Transactions on Knowledge and Data Engineering (under review)*.
- 2** Zhang, T., Qiu, H., Mellia, M., Li, Y., Li, H., & Xu, K. (2022). Interpreting ai for networking: Where we are and where we are going. *IEEE Communications Magazine*, 60(2), 25–31.
- 3** Qiu, H., Zhang, T., **Zhang, T.**, Li, H., & Qiu, M. (2021). DefQ: Defensive Quantization against Inference Slow-down Attack for Edge Computing. *IEEE Internet of Things Journal*, 1–1.
<https://doi.org/10.1109/JIOT.2021.3138935>
- 4** Zhang, T., Linguaglossa, L., Giaccone, P., Iannone, L., & Roberts, J. (2021). Performance benchmarking of state-of-the-art software switches for NFV. *Computer Networks*, 107861.
<https://doi.org/https://doi.org/10.1016/j.comnet.2021.107861>

- 5 **Zhang, T.**, Qiu, H., Linguaglossa, L., Cerroni, W., & Giaccone, P. (2020). NFV Platforms: Taxonomy, Design Choices and Future Challenges. *IEEE Transactions on Network and Service Management*, 18(1), 30–48. <https://doi.org/10.1109/TNSM.2020.3045381>
- 6 **Zhang, T.**, Linguaglossa, L., Gallo, M., Giaccone, P., & Rossi, D. (2019). FloWatcher-DPDK: Lightweight line-rate flow-level monitoring in software. *IEEE Transactions on Network and Service Management*, 16(3), 1143–1156. <https://doi.org/10.1109/TNSM.2019.2913710>
- 7 **Zhang, T.**, Chiasserini, C. F., & Giaccone, P. (2018). TAME: An efficient task allocation algorithm for integrated mobile gaming. *IEEE Systems Journal*, 13(2), 1546–1557. <https://doi.org/10.1109/JSYST.2018.2829496>
- 8 **Zhang, T.**, Giaccone, P., Bianco, A., & De Domenico, S. (2017). The role of the inter-controller consensus in the placement of distributed SDN controllers. *Computer Communications*, 113, 1–13. <https://doi.org/https://doi.org/10.1016/j.comcom.2017.09.007>

Conference Proceedings

- 1 Shelbourne, C., Linguaglossa, L., **Zhang, T.**, & Lipani, A. (2021). Inference of virtual network functions' state via analysis of the CPU behavior, In *2021 33th International Teletraffic Congress (ITC-33)*.
- 2 Shelbourne, C., Linguaglossa, L., Lipani, A., **Zhang, T.**, & Geyer, F. (2019). On the learnability of software router performance via CPU measurements, In *Proceedings of the 15th International Conference on Emerging Networking EXperiments and Technologies Student Workshops*, Orlando, FL, USA, Association for Computing Machinery. <https://doi.org/10.1145/3360468.3366776>
- 3 **Zhang, T.**, Linguaglossa, L., Roberts, J., Iannone, L., Gallo, M., & Giaccone, P. (2019). A benchmarking methodology for evaluating software switch performance for NFV, In *2019 IEEE Conference on Network Softwarization (NetSoft Posters and Demos)*. <https://doi.org/10.1109/NETSOFT.2019.8806695>
- 4 **Zhang, T.**, Linguaglossa, L., Gallo, M., Giaccone, P., Iannone, L., & Roberts, J. (2019). Comparing the performance of state-of-the-art software switches for NFV, In *Proceedings of the 15th International Conference on Emerging Networking Experiments And Technologies*, Orlando, Florida, Association for Computing Machinery. <https://doi.org/10.1145/3359989.3365415>
- 5 **Zhang, T.**, Linguaglossa, L., Gallo, M., Giaccone, P., & Rossi, D. (2018a). FlowMon-DPDK: Parsimonious per-flow software monitoring at line rate, In *2018 Network Traffic Measurement and Analysis Conference (TMA)*. <https://doi.org/10.23919/TMA.2018.8506565>
- 6 **Zhang, T.**, Linguaglossa, L., Gallo, M., Giaccone, P., & Rossi, D. (2018b). High-speed per-flow software monitoring with limited resources, In *Proceedings of the ACM SIGCOMM 2018 Conference on Posters and Demos*. <https://doi.org/10.1145/3234200.3234203>
- 7 Bianco, A., Giaccone, P., Kelki, S., Campos, N. M., Traverso, S., & **Zhang, T.** (2017). On-the-fly traffic classification and control with a stateful SDN approach, In *2017 IEEE International Conference on Communications (ICC)*. <https://doi.org/10.1109/ICC.2017.7997297>
- 8 **Zhang, T.**, Bianco, A., Giaccone, P., & Nezhad, A. P. (2017). Dealing with misbehaving controllers in SDN networks, In *GLOBECOM 2017-2017 IEEE Global Communications Conference*. IEEE. <https://doi.org/10.1109/GLOCOM.2017.8254752>
- 9 **Zhang, T.**, Bianco, A., & Giaccone, P. (2016). The role of inter-controller traffic in SDN controllers placement, In *2016 IEEE Conference on Network Function Virtualization and Software Defined Networks (NFV-SDN)*. <https://doi.org/10.1109/NFV-SDN.2016.7919481>

R&D Projects

- Sep, 2020 – now**  **Edge Intelligence for Industrial IoT (Co-PI)**
This is an ongoing project at Bell Labs. The ultimate goal is to enable the adaptive execution of the heavyweight AI models in Industrial IoT (IIoT) environments. I am in charge of the management and coordination of this project. This project consists of two parts. The first part is model splitting, and the second part is model deployment. My contributions involve two parts. I have developed the algorithm to partition three state-of-the-art deep neural network models by layers for model splitting. I have implemented another algorithm that can split convolution layers by output channels. For model deployment, I have explored the communication aspect of the problem and benchmarked several existing remote communication techniques. To validate our work in a real IIoT use case, we have embedded the distributed AI models into heterogeneous ground robots to make them avoid obstacles autonomously. The next step is to explore different QoS profiles and optimize the overall performance in more realistic IIoT settings.
- Jun, 2019 – now**  **IONOS^{DX}: Inference Of Network characteristics via nOn-invasive Data eXploration (Collaborator)**
This is a joint project for network monitoring via non-intrusive data collection. Prof. Leonardo Linguaglossa of Telecom Paris leads this project, and Nokia Bell Labs currently support it. The other academic partners include University College London, Norwegian University of Science and Technology, University of Wuerzburg, and Politecnico di Bari. We are also in the process of applying for French-national funding to enable long-term collaboration. The goal is to infer VNF states via the indirectly collected CPU features from the substrate NFV infrastructure. I have been in charge of the data collection process. At present, I am supervising an intern to extend the current results.
- Nov, 2020 – now**  **Log analysis using cluster computing (Collaborator)**
This is a joint Nokia internal project between the Augmented Machine Interaction team and the Data Analytics team. This project aims to build a common analytic environment for seamless code reuse, evaluation, and benchmarking at a large scale. My role in this project is to build the environment using Big Data frameworks and integrate the research department assets. Currently, I am exploring existing distributed computing techniques (e.g., Hadoop, HBase, Spark, and Kubernetes) to accommodate a Bell Labs root cause analysis asset.
- Apr, 2018 – Dec, 2020**  **Performance benchmarking of software switches for NFV (Main contributor)**
This is a joint research project related to Network Function Virtualization (NFV). The collaborators include Telecom Paris, Cisco System, Nokia Bell Labs, and Politecnico di Torino. This project's objective is to investigate the performance characteristics of the software virtual switches in the high-speed NFV data plane. I was the primary technical contributor to this project. In particular, I have built the testbed in a high-speed network environment and deployed all the related components, including the software switches, virtual interfaces, virtual machine hypervisors, traffic generators, and monitors. I have also conducted all the experiments and collected and analyzed the results. The outcome of this project had been published to top-tier conferences and journals, including ACM CoNEXT and IEEE TNSM. The source code had been released on GitHub (<https://github.com/ztz1989/software-switches>). This project provides a comprehensive guideline for researchers and developers to choose the most desirable software switches for their NFV settings.

R&D Projects (continued)

Jun, 2017 – Mar, 2018

High-speed traffic monitoring (Main contributor)

Cisco Systems and Nokia Bell Labs sponsored this research project. The goal is to enable high-performance packet monitoring and measurement on commodity hardware. I was the primary technical contributor in charge of designing, implementing, and testing the tool. The first part of this project was conducted at Nokia Bell Labs. I developed the prototype of the traffic monitor using the Intel Data Plane Development Kit (DPDK). The monitor could measure 14 million packets per second input traffic with minimal packet loss and resource occupancy at different granularity. The second part of this project was supported by Cisco Systems, LINCS, and Telecom Paris. I further optimized the design choices and refined the implementation details in this phase. The source code of this project had been released on GitHub (<https://github.com/ztz1989/FloWatcher-DPDK>). The outcome of this project has been demonstrated at ACM Sigcomm'18 and published at IFIP TMA'18 and IEEE TNSM'19.

Jan, 2015 – Jan, 2016

SDN@Edge (Collaborator)

This joint European project strived to push the SDN frontier to the network edge. I joined this project as a member of the Joint Open Lab of Telecom Italia. I was in charge of implementing a remote control mechanism for bandwidth sharing between two neighboring access gateways. The prototype implementation of this work was included in the project's final deliverable.

Research interest

- Network Function Virtualization
- High-speed network systems
- Software Defined Networking
- Application of AI in networking

Supervision

Jan, 2021 - Jun, 2021

Vitor Crestani Goergen, Intern

Nov, 2021 - May, 2022

Cedric Koukoui, Intern

Invited talks

- 08, Nov, 2021 "Edge Intelligence for Industrial IoT". Telecom Paris, invited by Prof. Leonardo Lingua-glossa.
- 14, Oct, 2020 "Performance benchmarking of software switches in the context of NFV". Seminar at LINCS, invited by the LINCS scientific committee.
- 11, Oct, 2017 "High-speed traffic generation and monitoring". University of Rome Tor Vergata, invited by Dr. Salvatore Pontarelli.

Community services

Technical program committee

- TPC Member, IEEE Conference on Innovation in Clouds, Internet and Networks (ICIN), 2022.

Community services (continued)

- **TPC Member**, 21st International Conference on Algorithms and Architectures for Parallel Processing (ICA3PP 2021).
- **TPC Member**, IEEE Conference on Network Softwarization (Netsoft), 2021.
- **TPC Member**, IEEE Conference on Innovation in Clouds, Internet and Networks (ICIN), 2021.
- **Member**, ACM Sigcomm Artifact Evaluation Program Committee, 2020.
- **TPC Member**, IEEE Conference on Network Softwarization (Netsoft), 2020.
- **TPC Member**, IEEE Conference on Innovation in Clouds, Internet and Networks (ICIN), 2020.

Scientific review

- **Shadow PC**, ACM Internet Measurement Conference (IMC), 2018.
- **Guest Reviewer**, IEEE Communications Letters. (* *Exemplary reviewer award*)
- **Guest Reviewer**, IEEE Transactions On Networking.
- **Guest Reviewer**, IEEE Communications Magazines.
- **Guest Reviewer**, IEEE Transactions on Network and Service Management.
- **Guest Reviewer**, IEEE Global Communications Conference.
- **Guest Reviewer**, IEEE International Conference on Communications
- **Guest Reviewer**, Elsevier Computer Communications.
- **Guest Reviewer**, IEEE Transactions on Network and Service Engineering.