Federico De Marchi

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Research Interests

My research interests span **data center network systems**, with emphasis on **transport protocols, host networking, and software-defined networking**. I am currently investigating new approaches to designing network stacks for alternative data center architectures, including reconfigurable networks.

Education

Max Planck Institute for Informatics — Saarbruecken, Germany
Ph.D. in Computer Science — *2023 – Present*

Saarland University — Saarbruecken, Germany
M.Sc. in Computer Science — *2021 – 2023*

University of Bologna — Bologna, Italy
B.Sc. in Computer Science, Cum Laude — *2018 – 2021*

Research Experience

Credit-based Transport for Reconfigurable Networks — 2023 – Present
Max Planck Institute for Informatics — *Data Center Networking*

- Designed **Flare**, a dedicated credit-based transport protocol that can precisely and efficiently control traffic on Opera, a reconfigurable (optical) network architecture that reconfigures at microsecond scale.
- Implemented and ran evaluation against other state-of-the-art solutions in network simulations, demonstrating up to 2× throughput increase and 3.5× tail Flow Completion Time (FCT) reduction.
- Demonstrated that, with Flare, the Opera architecture can achieve higher throughput than Clos networks.
- Implemented a functioning prototype from scratch in DPDK and P4 on Tofino programmable switches.
- **Published at SIGCOMM 2025** and 3rd place at Student Research Competition in SIGCOMM 2024.

Multi-path Routing for Reconfigurable Networks — 2022 – 2025
Max Planck Institute for Informatics — *Data Center Networking*

- Participated in designing and developing **UCMP**, a novel and efficient routing system for reconfigurable networks, achieving up to 94% lower FCT than previous solutions.
- Implemented both the routing and transport systems in network simulations.
- Implemented and evaluated a testbed prototype, particularly the host-side network stack in the libvma userspace network stack.
- **Published at SIGCOMM 2024**. Further work on generalizing the system also led to a publication in IEEE Transactions on Networking in 2025.

Practical Framework for Reconfigurable Network Research — 2022 – Present
Max Planck Institute for Informatics — *Data Center Networking*

- Participated in developing the first research framework for optical networks on programmable switches.
- Implemented a system for flow admission within the TCP stack operating at sub-microsecond precision in both the libvma userspace network stack and the Linux kernel (via Netfilter).
- Set up a physical testbed that enables full end-to-end evaluation of several optical architectures.

Transport Protocol Performance Survey in Reconfigurable Networks — 2022 – 2023
Max Planck Institute for Informatics — *Data Center Networking*

- Migrated several state-of-the-art protocols (TDTCP, HPCC, Bolt, ExpressPass) based on the original ns-3/Linux implementations to the htsim simulator for evaluation on fast-switching reconfigurable networks.

- Surveyed and identified weaknesses in several state-of-the-art protocols on reconfigurable networks.
- Published at HotOptics 2024.

DNS Proxy for Resolution of Special IPv6 Domains 2020 – 2021
University of Bologna *Internet Protocols*

- Implemented an epoll-based DNS proxy in C to enable the resolution of special one-time and hash-based IPv6 addresses, enabling the use of novel security and deployment features.
- Implemented both compatibility to forward EDNS, and TCP support with request pipelining.
- The proxy is able to natively bind to virtual network interfaces through userspace virtualization libraries.

Skills

Programming Languages | *C, C++, Python, Rust, P4, Bash scripting*

Host Networking | *DPDK, libvma, Linux kernel, RDMA*

In-network Programmability | *DPDK, P4, Tofino switches configuration*

Network Simulation | *htsim, ns3*

Awards

ACM SIGCOMM Student Research Competition 3rd Place Award, *ACM* 2024

ACM SIGCOMM Travel Grant, *ACM* 2024

Service

Artifact Evaluation Committee *OSDI, ATC* 2024

Teaching Assistant for Distributed Systems Course *Saarland University* 2023

Teaching Assistant for Hot Topics in Data Networks Seminar *Saarland University* 2023

Publications

Unlocking Superior Performance in Reconfigurable Data Center Networks with Credit-Based Transport
Federico De Marchi, Jialong Li, Ying Zhang, Wei Bai, Yiting Xia
SIGCOMM 2025

Unlocking Diversity of Fast-Switched Optical Data Center Networks With Unified Routing
Jialong Li, **Federico De Marchi**, Yiming Lei, Raj Joshi, Balakrishnan Chandrasekaran, Yiting Xia
IEEE Transactions on Networking 2025

Uniform-Cost Multi-Path Routing for Reconfigurable Data Center Networks
Jialong Li, Haotian Gong, **Federico De Marchi**, Yiming Lei, Aoyu Gong, Wei Bai, Yiting Xia
SIGCOMM 2024

Rethinking Transport Protocols for Reconfigurable Data Centers: An Empirical Study
Federico De Marchi, Jialong Li, Wei Bai, Yiting Xia
HotOptics 2024

Opportunistic Credit-Based Transport for Reconfigurable Data Center Networks with Tidal
Federico De Marchi, Jialong Li, Wei Bai, Yiting Xia
SIGCOMM Posters and Demos 2024, 3rd Place Student Research Competition

Hop-On Hop-Off Routing
Jialong Li, Yiming Lei, **Federico De Marchi**, Raj Joshi, Balakrishnan Chandrasekaran, Yiting Xia
APNet 2022