# Qiang Su

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## Education

2019 – Now **City University of Hong Kong**, Kowloon, Hong Kong SAR
**Doctoral Student**, Advisor: *Prof. Chun Jason Xue & Prof. Hong Xu*
*GPA*: 4.15/4.30

2014 – 2018 **Northeastern University**, Shenyang, China
**Bachelor Student**
*GPA*: 4.1146/5.0, *Rank*: 6/256

## Work Experience

2022 - 2022 **Microsoft Research**, *Research Intern*, Beijing, China.
Project: Research on SmartNIC as a service.

2018 – 2019 **City University of Hong Kong**, *Reaserch Assistant*, Kowloon, Hong Kong SAR.
Project: Research on big data analytics and datacenter networking.

## Publications

SIGCOMM 2022 Demos and Posters **Qiang Su**, Chuanwen Wang, Zhixiong Niu, Ran Shu, Peng Cheng, Yongqiang Xiong, Dongsu Han, Chun Jason Xue, Hong Xu. PipeDevice: A Hardware-Software Co-Design Approach to Intra-Host Container Communication. ACM SIGCOMM Demos and Posters, 2022.

ToN 2021 Zhixiong Niu, **Qiang Su**, Peng Cheng, Yongqiang Xiong, Dongsu Han, Keith Winstein, Chun Jason Xue, Hong Xu. NetKernel: Making Network Stack Part of the Virtualized Infrastructure. IEEE/ACM Transactions on Networking, 2021.

ATC 2020 Zhixiong Niu, Hong Xu, Peng Cheng, **Qiang Su**, Yongqiang Xiong, Tao Wang, Dongsu Han, Keith Winstein. NetKernel: Making Network Stack Part of the Virtualized Infrastructure. Proceedings of the USENIX Annual Technical Conference, 2020. (AR: 65/348 = 18.6%)

## Projects

SmartNIC Virtualization

*Exploring lightweight virtualization for SoC-based SmartNICs (e.g., Mellanox BlueField2 NIC).* This project aims to explore lightweight virtualization for SoC-based SmartNICs (e.g., Mellanox BlueField2 NIC). SmartNIC is increasingly popular in today's data centers as it can provides significant performance benefits for a variety of applications by offloading parts of software computation onto hardware, especially latency-critical applications, like microservices and network functions. However, it is still challenging to enable the usage of SmartNIC in public clouds and there is no proper virtualization mechanism. Problems including resource and performance isolation and offloading paradigm are still not well-solved.

PipeDevice

*A hardware-software co-design approach to intra-host container communication.* Containers are prevalently adopted due to the deployment and performance advantages over virtual machines. For many containerized data-intensive applications, however, bulky data transfers may pose performance issues. In particular, communication across colocated containers on the same host incurs large overheads in memory copy and the kernel's TCP/IP stack. Existing solutions such as shared-memory networking and RDMA have their own limitations, including insufficient memory isolation and limited scalability. PipeDevice is a new system for low overhead intra-host container communication. PipeDevice follows a hardware-software co-design approach — it offloads data forwarding entirely onto hardware, which accesses application data in hugepages on the host, thereby eliminating CPU overhead from memory copy and TCP/IP processing. PipeDevice preserves memory isolation and scales well to connections, making it deployable in public clouds. Isolation is achieved by allocating dedicated memory to each connection from hugepages. To achieve high scalability, PipeDevice stores the connection states entirely in host DRAM and manages them in software. Evaluation with a prototype implementation on commodity FPGA shows that for delivering 80 Gbps across containers PipeDevice saves 63.2% CPU compared to kernel TCP stack, and 40.5% over FreeFlow.PipeDevice provides salient benefits to applications. For example, we port baidu-allreduce to PipeDevice and obtain $\sim 2.2\times$ gains in allreduce throughput

NetKernel

*A system that decouples the network stack from the guest VM and offers it as an independent module.* NetKernel represents a new paradigm where network stack can be managed as part of the virtualized infrastructure. It provides important efficiency benefits: By gaining control and visibility of the network stack, operators can perform network management more directly and flexibly, such as multiplexing VMs running different applications to the same network stack module to save CPU cores, and enforcing fair bandwidth sharing. Users also benefit from the simplified stack deployment and better performance: For example mTCP can be deployed without API change to support nginx natively, and shared memory networking can be readily enabled to improve performance of colocated VMs. Testbed evaluation using 100G NICs shows that NetKernel preserves the performance and scalability of both kernel and userspace network stacks, and provides the same isolation as the current architecture.

## Honor and Award

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| 2019 - 2023 | Postgraduates Studentship in City University of Hong Kong. |
| 2016 - 2017 | China National Encouragement Scholarship (top 1%) |
| | Second-Class Scholarship of NEU (top 5%) |
| | Excellent Student Leader in NEU |
| 2015 - 2016 | Chinese National Scholarship (top 1%) |
| | Second-Class Scholarship of NEU (top 5%) |
| | Honorable Mention of Interdisciplinary Contest in Modeling(ICM) for international college students |
| | Excellent Student in NEU |
| 2014 - 2015 | "Zhong Tian Gang Tie" Educational Scholarship (top 1%) |
| | First-Class Scholarship of NEU (top 1%) |
| | Pacesetter of Excellent Student in NEU |

## Teaching

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|---|---|
| Fall 2022 | CS5222 Computer Networks & Internets |
| Fall 2021 | CS5222 Computer Networks & Internets |
| Spring 2021 | CS3402 Database Systems |
| Fall 2020 | CS1102 Introduction to Computer Studies |
| Fall 2019 | CS2311 Computer Programming |

## Services

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| AEC for | 2022: OSDI, ATC, CoNEXT |

## Skills

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| Programing | C, Python, Linux Kernel Programming, Docker, PyTorch |
| Language | Chinese (native), and English (fluent) |