

FAN YI

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RESEARCH INTEREST

My research is in systems and networking, specializing in optimizing network performance for real-time applications, with expertise in:

- Video streaming systems & WebRTC optimization
- Network measurement & congestion control
- 5G networks & cellular protocol stack

EDUCATION

Princeton University

Sep. 2019 – Present

Ph.D. candidate in Computer Science

Princeton, NJ

- Advisor: Prof. Kyle Jamieson

Shanghai Jiao Tong University

Sep. 2014 – June 2018

B.S. in Electrical Engineering

Shanghai, China

- Advisor: Prof. Fan Wu

EXPERIENCES

Princeton University | *Research Assistant, Advisor: Kyle Jamieson*

Sep. 2019 – Present

- **Project Athena:** a cross-layer measurement framework
 - Built first-of-its-kind millisecond-precision synchronization system correlating **Layer 1 to Layer 7** data to diagnose video conferencing QoE issues in 5G networks .
 - Performed **deep WebRTC customization** by modifying source code to extract real-time performance metrics (jitter buffer, freeze count, bandwidth estimation, .etc) and **Google Congestion Control** internals.
 - Analyzed video streaming adaptation mechanisms including **SVC (Scalable Video Coding)** layers and codec behavior; identifying how 5G/WAN conditions trigger bitrate/resolution changes.
 - Conducted comprehensive analysis of video streaming latency in 5G, **discovering root causes of QoE degradation in 5G protocol stack** (120+ms jitter from scheduling, ReTX); identified optimization opportunities that can reduce video streaming jitters by 50%; published in **ACM HotNets 2024**.
- **Project PBE-CC:** a wireless-aware congestion control system
 - Designed and implemented a **wireless-aware congestion control system** achieving 6.3% higher throughput while reducing network latency by 1.8x compared to BBR.
 - Developed a novel **cellular phy-layer decoder** that precisely measures wireless bandwidth at millisecond granularity in real-time; built multi-threaded architecture to increase decoding efficiency.
 - Implemented a user-space, UDP-based PBE-CC prototype (874 LoC C++); published in **ACM SIGCOMM 2020**.
- **Project WaveFlex:** an autonomous smart surface system
 - Led end-to-end design and implementation of WaveFlex, which achieved **18.4% throughput improvement** for Private 5G networks, integrating custom PCB hardware, SDR-based monitoring, and real-time control software.
 - Developed novel multi-channel RF architecture with tunable filters and phase shifters, enabling concurrent optimization across 3 base stations while maintaining 8.5+ dB SNR gains; published in **ACM CoNEXT 2024**.
- **Project Caper:**
 - Developed a cellular-assisted COVID-19 **contact tracing system** that leverages cellular PHY-layer CSI and **neural networks** to identify close contacts while preserving user privacy; Published in **ACM UbiComp 2022**.
 - Designed a novel architecture combining Siamese and **multi-task attention networks** for close-contact feature extraction, built the system tested by modifying srsRAN (C/C++), and trained models using PyTorch.

Qualcomm Technologies | *Research Intern, Host: Alberto Rico Alvariano*

June 2021 – Sep 2021

- Designed a cooperative protocol for low power IoT devices by leveraging both NB-IoT and Bluetooth to save energy.
- Simulated in MATLAB from scratch to evaluate the proposed protocol, where the results show that the cooperative protocol provides more than 11 times longer battery life than the baseline method.

- Developed a novel system that enables rapid aggregation of sensor data across LP-WAN devices over a wide area within just one packet duration (seconds), while traditional methods take hours to query all sensors individually.
- Implemented the system to be compatible with both LoRa and NB-IoT in C++ without hardware modifications; published in ACM/IEEE IPSN 2020 (**Best Paper Award**).

SELECTED PUBLICATIONS

Athena: Seeing and Mitigating Wireless Impact on Video Conferencing and Beyond

- **Fan Yi**, Haoran Wan, Kyle Jamieson, Jennifer Rexford, Yaxiong Xie, Oliver Michel
- *ACM HotNets 2024*

WaveFlex: A Smart Surface for Private 5G CBRS Networks

- **Fan Yi**, Kun Woo Cho, Yaxiong Xie, Kyle Jamieson
- *ACM CoNEXT 2024*

Cellular-assisted, Deep Learning Based COVID-19 Contact Tracing

- **Fan Yi**, Yaxiong Xie, Kyle Jamieson
- *ACM UbiComp/IMUWT 2022*

PBE-CC: Congestion Control via Endpoint-Centric, Physical-Layer Bandwidth Measurements

- Yaxiong Xie, **Fan Yi**, Kyle Jamieson
- *ACM SIGCOMM 2020*

Quick (and Dirty) Aggregate Queries for Low-Power WANS

- Akshay Gadre, **Fan Yi**, Anthony Rowe, Bob Iannucci and Swarun Kumar
- *ACM/IEEE IPSN 2020 (Best Paper Award)*

MISEN: A Mobile Indoor White Space Exploration Method

- Xiaoyang Zheng*, **Fan Yi***, Dongxin Liu and Fan Wu (*co-primary)
- *IEEE ICC 2019*

(Invited Paper) The Case for Small-Scale, Mobile-Enhanced COVID-19 Epidemiology

- **Fan Yi**, Yaxiong Xie, Kyle Jamieson
- *IEEE WiOpt 2021*

(Patent) Cooperation Techniques for Low-power Devices

- **Fan Yi**, Umesh Phuyal, Alberto RICO ALVARINO, Lorenzo Casaccia
- Patent Number: US20230379664A1, Filing Date: 2022-05-20

HONORS & AWARDS

ACM/IEEE IPSN 2020 Best Paper Award	Apr. 2020
“Hong Yi” Academic Scholarship (1%)	Dec. 2017
”Chun-Tsung” Academic Scholarship (2%)	May 2016
School Excellence Scholarship (5%)	Oct. 2015, 2016, 2017
“Xin Dong” Enterprise Scholarship, First Prize (2%)	Oct. 2015

SKILLS

Programming Languages: C/C++, Python, HTML, CSS, JavaScript, MATLAB

Knowledge: WebRTC, PyTorch, Linux, srsRAN, LATEX, Git, SDR

Others: Familiar with 5G/LTE protocols, data analysis, machine learning, and wireless networks