FAN YI

35 Olden Street, Princeton, NJ 08540
Personal Website 609-356-3198 fanyi@princeton.edu Google Scholar

RESEARCH INTEREST

My research is in systems and networking, specializing in building networked systems by combining network and physical layers to improve network performance and application quality of experience, 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 with SDR** 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 testbed by modifying srsRAN (C/C++), and trained models using PyTorch.

Qualcomm Technologies | *Research Intern, Host: Alberto Rico Alvariño* June 2021 – Aug. 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.

Carnegie Mellon University | *Research Intern, Advisor: Swarun Kumar* Aug. 2018 – Feb. 2019

- 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