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RESEARCH INTERESTS

Computer Networking, Network Security, Distributed Systems, Blockchain, Payment Channel Networks, Internet of Things, Quantum Networks, AI Security

EDUCATION

University of California, Santa Cruz, CA, USA 09/2019 - 06/2024
Ph.D., Computer Engineering
Advisor: Prof. Chen Qian

University of Science and Technology of China, Hefei, Anhui, China 09/2014 - 06/2019
B.E., Computer Science and Technology
Thesis: *Design and implementation of coding and modulation for backscatter communication with high throughput*
Advisor: Prof. Panlong Yang, Prof. Xiangyang Li

PUBLICATIONS

1. **[ICNP]** Yifan Hua, Jinlong Pang, **Xiaoxue Zhang**, Yi Liu, Xiaofeng Shi, Bao Wang, Yang Liu and Chen Qian. Towards Practical Overlay Networks for Decentralized Federated Learning, in *Proceedings of IEEE International Conference on Network Protocols* (*ICNP*), 2024.
2. **[TON]** **Xiaoxue Zhang**, and Chen Qian. Toward Aggregated Payment Channel Networks, in *IEEE/ACM Transactions on Networking* (*TON*), 2024.
3. **[TON]** Shouqian Shi, **Xiaoxue Zhang**, and Chen Qian. Concurrent Entanglement Routing for Quantum Networks: Model and Designs, in *IEEE/ACM Transactions on Networking* (*TON*), 2024.
4. **[ICNP]** **Xiaoxue Zhang**, and Chen Qian. A Cross-chain Payment Channel Network, in *Proceedings of IEEE International Conference on Network Protocols* (*ICNP*), 2023. **Accept Rate 34/181=18.8%**.
5. **[ICNP(Poster)]** **Xiaoxue Zhang**, Yifan Hua, and Chen Qian. Poster: Verifiable Blockchain-based Decentralized Learning, in *Proceedings of IEEE International Conference on Network Protocols* (*ICNP*), 2023.
6. **[ICNP(Poster)]** **Xiaoxue Zhang**, Sammy Tesfai, Fei Fang, and Chen Qian. Poster: Measurement on Lightning Network Performance, in *Proceedings of IEEE International Conference on Network Protocols* (*ICNP*), 2023.
7. **[QCE]** Yuhang Gan, **Xiaoxue Zhang**, Ruilin Zhou, Yi Liu, and Chen Qian. A Routing Framework for Quantum Entanglements with Heterogeneous Duration, in *Proceedings of IEEE International Conference on Quantum Computing and Engineering* (*QCE*), 2023.
8. **[SRDS]** **Xiaoxue Zhang**, Shouqian Shi, and Chen Qian. Low-overhead Routing for Off-chain Networks with High Resource Utilization, in *Proceedings of International Symposium on Reliable Distributed Systems* (*SRDS*), 2023.
9. **[MASS]** **Xiaoxue Zhang**, Yifan Hua, and Chen Qian. Secure Decentralized Learning with Blockchain, in *Proceedings of IEEE International Conference on Mobile Ad-Hoc and Smart Systems* (*MASS*), 2023.

10. **[IoTDI]** Minmei Wang, Shouqian Shi, **Xiaoxue Zhang**, Song Han, and Chen Qian. LOIS: Low-cost Packet Header Protection for IoT Devices, in *Proceedings of ACM/IEEE International Conference on Internet of Things Design and Implementation* (*IoTDI*), 2023.

11. **[ICNP] Xiaoxue Zhang**, and Chen Qian. Towards Aggregated Payment Channel Networks, in *Proceedings of IEEE International Conference on Network Protocols* (*ICNP*), 2022. **Accept Rate 33/154=21.4%**.

12. **[SIGCOMM N2Women)] Xiaoxue Zhang**, and Chen Qian. Scalable Decentralized Routing for Blockchain Payment Networks, in *ACM SIGCOMM Networking Networking Women Professional Development Workshop* (*N2Women*), 2020.

13. **[FAB] Xiaoxue Zhang**, and Chen Qian. Scalable Decentralized Routing for Blockchain Payment Networks, in *Proceedings of International Symposium on Foundations and Applications of Blockchain* (*FAB*), 2020.

14. **[ICDCS]** Nanhuan Mi, **Xiaoxue Zhang**, Xin He, Jie Xiong, Mingjun Xiao, Xiang-Yang Li, and Panlong Yang. CBMA: Coded-Backscatter Multiple Access, in *Proceedings of IEEE International Conference on Distributed Computing Systems* (*ICDCS*), 2019. **Accept Rate 33/154=19.6%**.

15. **[BIGCOM] Xiaoxue Zhang**, Nanhuan Mi, Xin He, and Panlong Yang. On Measurement of the Spatio-Frequency Property of OFDM Backscattering, in *Proceedings of International Conference on Big Data Computing and Communications* (*BIGCOM*), 2018.

PUBLICATIONS IN SUBMISSION

1. **Xiaoxue Zhang**, Chen Qian, et.al. Verifiable Secure Decentralized Learning with Blockchain (submitted to IEEE Transactions on Dependable and Secure Computing (TDSC))

2. **Xiaoxue Zhang**, Chen Qian, et.al. A Flexible Cross-chain Payment Channel Network (submitted to IEEE Transactions on Dependable and Secure Computing (TON), Under revisions)

3. **Xiaoxue Zhang**, Chen Qian, et.al. WebFlow: Scalable and Decentralized Routing for Payment Channel Networks with High Resource Utilization (submitted to IEEE Transactions on Dependable and Secure Computing (TDSC))

TALKS & PRESENTATIONS

1. **Guest Lecture: Utilization and Interoperability in Payment Channel Networks**, on CSE 250A: Computer Networks, University of California Santa Cruz, Dec. 2023;

2. **A Cross-chain Payment Channel Network**, on IEEE ICNP conference, Reykjavik, Iceland, Oct. 2023;

3. **Low-overhead Routing for Off-chain Networks with High Resource Utilization**, on IEEE SRDS conference, Marrakech, Morocco, Sep. 2023;

4. **Secure Decentralized Learning with Blockchain**, on IEEE MASS conference, Toronto, Canada, Sep. 2023;

5. **Guest Lecture: Introduction to Blockchain and Payment Channel Networks**, on CSE 250A: Computer Networks, University of California Santa Cruz, Dec. 2022;

6. **Towards Aggregated Payment Channel Networks**, on IEEE ICNP conference, Kentucky, USA, Oct. 2022;

7. **Scalable Decentralized Routing for Blockchain Payment Networks**, on ACM SIGCOMM N2Women Workshop, Virtual, Aug. 2020;

MAJOR PROJECTS

A Cross-chain Payment Channel Network

- Propose XHub, the first decentralized network architecture of a cross-chain PCN.

- Design a series of protocols, including the auditor communication protocol, hub registration protocol, transaction protocol, and hub management protocol to achieve the security properties.
- Conduct both prototype implementation and large-scale simulations to demonstrate the effectiveness of XHub.

  Keywords: **Blockchain, Payment Channel Networks, Cross-chain Technology**

Secure Decentralized Learning with Blockchain

- Design BDFL, the first blockchain-based fully decentralized federated learning system for model verification with high learning accuracy and system robustness.
- Design and implement the BDFL protocol suite, which includes an incentive mechanism to encourage clients to participate in the model exchange, and a reputation model to evaluate the trustworthiness of each client to avoid malicious model updates from attackers.
- Evaluate BDFL on real ML datasets. Results show that BDFL achieves a high model accuracy and fast convergence. It also has strong resilience to client dynamic and malicious model updates.

  Keywords: **Blockchain, Federated Learning, Decentralized Learning**

A Routing Framework for Quantum Entanglements with Heterogeneous Duration

- Propose a new routing framework for quantum entanglements with heterogeneous duration with a Synchronous Multi-time-slots (SynMts) routing model that supports heterogeneous device with various capability.
- Design a request management algorithm to improve the network resources utilization in the network and a predictable links scheduling algorithm to manage the links in the network.
- Evaluate SynMts using three recently-proposed routing algorithms. Results show that they all achieve evident throughput improvement in the new framework.

  Keywords: **Quantum Networks, Routing**

Towards Aggregated Payment Channel Networks

- Propose APCN, a novel design of Payment Channel Networks in Blockchain with shared funding that could improve transaction throughput and avoid high locked-in funds in channels.
- Adopt Trusted Hardware to guarantee system security and prevent users from misbehavior.
- Design a routing protocol with congestion control for APCN that could lower the average processing time of the whole network.
- Design and Implement the prototype with Intel SGX SDK in C++. The evaluation shows that APCN achieved transaction success rate higher than 95% with an average routing latency of $300ms$.

  Keywords: **Blockchain, Payment Channel Networks, Trusted Hardware**

WebFlow: Scalable and Decentralized Routing for Payment Channel Networks with High Resource Utilization

- Designed WebFlow, a new routing protocol for Payment Channel Networks(PCN) based on Delaunay triangulation with low overhead and high resource utilization.
- Designed a privacy-enhanced routing protocol to hide the identities of source and destination of transactions.
- Conduct simulation with two real-world PCN (Lightning and Ripple) topologies and transactions in Python.
- Designed and implemented the prototype in Golang with TCP for network communication. Evaluation showed that PCN achieved 25% lower storage overhead, 50% lower communication cost and 10% higher throughput compared to existing state-of-the-arts.

  Keywords: **Blockchain, Payment Channel Networks, Routing**

ACADEMIC SERVICES

External Reviewer: ACM/IEEE IoTDI, ACM SIGMETRICS, IEEE INFOCOM, IEEE ICNP, IEEE ICCCN, IEEE ICDCS, IEEE ICPAD, ACM MOBICOM, IFIP NETWORKING

Reviewer: IEEE Transactions on Dependable and Secure Computing (TDSC), ACM Transactions on Sensor Networks (TOSN), IEEE/ACM Transactions on Networking (TON)

Volunteer: IEEE MASS 2019

TEACHING EXPERIENCE

Teaching Assistant — University of California, Santa Cruz

- CSE 107 Probability and Statistics for Engineers — WINTER 2022, FALL 2022, SPRING 2023
- CSE 101 Introduction to Data Structures and Algorithms — FALL 2021
- CSE 102 Introduction to Analysis of Algorithms — WINTER 2021, FALL 2020
- CSE 150 Introduction to Computer Networks — FALL 2019, SPRING 2024

INDUSTRIAL EXPERIENCE

PhD Software Engineer Intern at Meta — June 2023 - September 2023

- Worked in Meta Network Delivery Engineering team to improve the reliability, performance, and robustness of Meta's critical real-time network monitoring service, which covers 240k+ network devices with 450+ data models, and results in 3M+ collection jobs per minute.

PhD Software Engineer Intern at Meta — June 2022 - September 2022

- Developed a test framework to verify the correctness of migration of the job manager in the network device collection pipeline, and consolidated the ping service with IP selection feature to provide users with a unified generic IP selection configuration.