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## Qualifications

02/2018– **Doctor of Philosophy,**

03/2022 *Faculty of Information Technology, Monash University*

**PhD thesis:** *Efficient Implementation Techniques for Lattice-based Cryptosystems*

**Supervisors:** Associate Professor Ron Steinfeld and Associate Professor Amin Sakzad

### Selected Projects:

- **Discrete Gaussian Sampling Algorithms** [1, 2]

- I created *two new* discrete Gaussian sampling algorithms. Discrete Gaussian sampling is a crucial algorithm used by the post-quantum cryptography.
- My algorithms are *faster*, consuming *less* memory, and/or supporting a *wider* range of discrete Gaussian distributions, compared to previous techniques.
- My techniques have been employed by the **FALCON** post-quantum digital signature scheme, a **pending standard** by the NIST.

- **Post-quantum Privacy Preserving Protocols** [3, 4, 5, 6, 7]

- I investigated the implementation aspects for post-quantum privacy preserving protocol primitives, in *ongoing* research collaborations with researchers in the Monash University. These protocols are crucial for cryptocurrencies such as the Monero and the Algorand.
- I developed *efficient* techniques and/or implementations for these cryptography primitives. My techniques are *faster* than previous post-quantum solutions for the same protocol.
- Four media articles (1, 2, 3, 4) have been released by the CSIRO and/or the Monash University.

02/2016– **Master of Networks and Security,**

12/2017 *Faculty of Information Technology, Monash University*

**Minor thesis:** Efficient implementation techniques for lattice-based crypto

**Achievements:**

- **Dux of Postgraduate (Master of Networks and Security)**, Cliff Bellamy Awards 2018, Monash University.

09/2011– **Bachelor of Engineering,**

06/2015 *College of Computer Science & Technology, Zhejiang University, China*

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## Employments

11/2022–now **Postdoctoral Fellow,**

*Data61 Cybersecurity and Quantum Systems Group, CSIRO*

**Awards:**

- SCS Biannual Award May 2023 (Engineering and Technology Award).
- SCS Biannual Award May 2024 (Early Career in Engineering Award).

**Program Committee:** *Asiacrypt 2023, ACM CCS 2024 Artifact Evaluation, ICISC 2024, TCCS 2024.*

**PhD Supervisions:**

- Mert Yassı (Jul 2023–present, co-supervisor)

### Selected Projects:

- **MIKA: A Minimalist Approach to Hybrid Key Exchange** [8]

- I worked with researchers in CSIRO's Data61 and the Australian company **Penten** to develop a new framework for hybrid key exchange protocols. The framework achieves *minimal* modifications to the core codebase and the state machine of the protocol compared to existing solutions.
- I developed and tested a proof-of-concept implementation of MIKA in the IPsec software strongSwan.

○ **GPU-accelerated FALCON Digital Signature Scheme [9]**

- I *initiated* a research collaboration with researchers from South Korea.
- I created *new* techniques to solve the unique challenges of efficiently implementing the **FALCON** post-quantum digital signature scheme, a **pending standard** by the NIST, on a GPU. My techniques increase the throughput of a crucial algorithm in FALCON by *ten times* on a GPU.
- We developed the *first* GPU-accelerated FALCON implementation with *high throughput*.
- A **media article** has been released by the Monash University.

08/2021– **Research Assistant,**

10/2022 *Faculty of Information Technology, Monash University*

**Selected Projects:**

○ **LATTE Hierarchical Identity-based Encryption [10]**

- I *initiated* a research collaboration with researchers from Canada and the United Kingdom.
- I developed the *first* complete optimized practical implementation of LATTE, a post-quantum Hierarchical Identity-based Encryption scheme endorsed by the **ETSI**.
- I created *new* optimization techniques for the algorithms in LATTE. My techniques significantly *accelerate* the algorithms and *reduce* the communication costs. With my techniques, a crucial algorithm in LATTE now only takes *less than a second* computational time on a desktop computer, significantly *faster* than the order of minutes previously estimated by the ETSI.
- A **LinkedIn blog** has been released by the Monash University.

○ **Implementation of Post-Quantum Algorithms for Bouncy Castle Library**

- I was a Chief Investigator for the **project** of post-quantum cryptography integration in the **Bouncy Castle**, an *Australian sovereign* software cryptography library.
- I was part of the supervision team, providing cryptographic engineering insights and guidance to four student research assistants.
- My name has been listed on the **Contributors** of the Bouncy Castle.

02/2018– **Teaching Associate,**

10/2022 *Faculty of Information Technology, Monash University*

**Teaching:**

- Semester 2, 2022: FIT9137 Introduction to computer architecture and networks
- Semester 1, 2022: FIT9137 Introduction to computer architecture and networks
- Semester 1, 2022: FIT2093 Introduction to cyber security (Admin Tutor)
- Semester 1, 2021: FIT9137 Introduction to computer architecture and networks
- Semester 1, 2021: FIT3173 Software security
- Semester 1, 2020: FIT9137 Introduction to computer architecture and networks
- Semester 1, 2020: FIT5163 Information and computer security
- Semester 1, 2020: FIT2093 Introduction to cyber security (Admin Tutor)
- Semester 2, 2019: FIT5124 Advanced topics in security (Admin Tutor)
- Semester 1, 2019: FIT2093 Introduction to cyber security (Admin Tutor)
- Semester 2, 2018: FIT5124 Advanced topics in security
- Semester 1, 2018: FIT2093 Introduction to cyber security

06/2017– **Research Assistant,**

11/2017 *Faculty of Information Technology, Monash University*

**Selected Projects:**

○ **Titanium Key Encapsulation Mechanism [11]**

- I developed an *efficient* and *secure* software implementation of the Titanium, a new post-quantum Key Encapsulation Mechanism designed by the Monash University.
- I created *new* techniques to significantly *accelerate* its arithmetic computations.
- My **implementation** has been submitted to the **Post-Quantum Cryptography Standardization Process** by the NIST.

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**Referees**

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## Publications

- [1] ZHAO, Raymond K. ; STEINFELD, Ron ; SAKZAD, Amin: FACCT: FAsT, Compact, and Constant-Time Discrete Gaussian Sampler over Integers. In: *IEEE Trans. Computers* 69 (2020), Nr. 1, S. 126–137
- [2] ZHAO, Raymond K. ; STEINFELD, Ron ; SAKZAD, Amin: COSAC: COmpact and Scalable Arbitrary-Centered Discrete Gaussian Sampling over Integers. In: *PQCrypto* Bd. 12100, Springer, 2020 (Lecture Notes in Computer Science), S. 284–303
- [3] ESGIN, Muhammed F. ; ZHAO, Raymond K. ; STEINFELD, Ron ; LIU, Joseph K. ; LIU, Dongxi: MatRiCT: Efficient, Scalable and Post-Quantum Blockchain Confidential Transactions Protocol. In: *CCS, ACM*, 2019, S. 567–584
- [4] ESGIN, Muhammed F. ; STEINFELD, Ron ; ZHAO, Raymond K.: Efficient Verifiable Partially-Decryptable Commitments from Lattices and Applications. In: *Public Key Cryptography (1)* Bd. 13177, Springer, 2022 (Lecture Notes in Computer Science), S. 317–348
- [5] ESGIN, Muhammed F. ; STEINFELD, Ron ; ZHAO, Raymond K.: MatRiCT+: More Efficient Post-Quantum Private Blockchain Payments. In: *IEEE Symposium on Security and Privacy*, IEEE, 2022, S. 560–577
- [6] ESGIN, Muhammed F. ; ERSOY, Oguzhan ; KUHTA, Veronika ; LOSS, Julian ; SAKZAD, Amin ; STEINFELD, Ron ; YANG, Xiangwen ; ZHAO, Raymond K.: A New Look at Blockchain Leader Election: Simple, Efficient, Sustainable and Post-Quantum. In: *AsiaCCS, ACM*, 2023, S. 623–637
- [7] STEINFELD, Ron ; SAKZAD, Amin ; ESGIN, Muhammed F. ; KUHTA, Veronika ; YASSI, Mert ; ZHAO, Raymond K.: LUNA: Quasi-Optimally Succinct Designated-Verifier Zero-Knowledge Arguments from Lattices. In: *CCS, ACM*, 2024, S. 3167–3181
- [8] ZHAO, Raymond K. ; SULTAN, Nazatul H. ; YIALELOGLOU, Phillip ; LIU, Dongxi ; LIEBOWITZ, David ; PIEPRZYK, Josef: MIKA: A Minimalist Approach to Hybrid Key Exchange. In: *PST, IEEE*, 2024, S. 1–11
- [9] LEE, Wai-Kong ; ZHAO, Raymond K. ; STEINFELD, Ron ; SAKZAD, Amin ; HWANG, Seong O.: High Throughput Lattice-Based Signatures on GPUs: Comparing Falcon and Mitaka. In: *IEEE Trans. Parallel Distributed Syst.* 35 (2024), Nr. 4, S. 675–692
- [10] ZHAO, Raymond K. ; MCCARTHY, Sarah ; STEINFELD, Ron ; SAKZAD, Amin ; O'NEILL, Máire: Quantum-Safe HIBE: Does It Cost a Latte? In: *IEEE Trans. Inf. Forensics Secur.* 19 (2024), S. 2680–2695
- [11] STEINFELD, Ron ; SAKZAD, Amin ; ZHAO, Raymond K.: Practical MP-LWE-based encryption balancing security-risk versus efficiency. In: *Des. Codes Cryptogr.* 87 (2019), Nr. 12, S. 2847–2884
- [12] TASOPOULOS, George ; LI, Jinhui ; FOURNARIS, Apostolos P. ; ZHAO, Raymond K. ; SAKZAD, Amin ; STEINFELD, Ron: Performance Evaluation of Post-Quantum TLS 1.3 on Resource-Constrained Embedded Systems. In: *ISPEC* Bd. 13620, Springer, 2022 (Lecture Notes in Computer Science), S. 432–451
- [13] TASOPOULOS, George ; DIMOPOULOS, Charis ; FOURNARIS, Apostolos P. ; ZHAO, Raymond K. ; SAKZAD, Amin ; STEINFELD, Ron: Energy Consumption Evaluation of Post-Quantum TLS 1.3 for Resource-Constrained Embedded Devices. In: *CF, ACM*, 2023, S. 366–374
- [14] FRAILE, Lidia P. ; TASOPOULOS, Georgios ; KOULAMAS, Christos ; ZHAO, Raymond K. ; HAQUE SULTAN, Nazatul ; REGAZZONI, Francesco ; FOURNARIS, Apostolos P.: Enabling Quantum-Resistant EDHOC: Design and Performance Evaluation. In: *IEEE Access* 13 (2025), S. 75861–75884. <http://dx.doi.org/10.1109/ACCESS.2025.3554010>. – DOI 10.1109/ACCESS.2025.3554010