

Krišjānis Petručeņa

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Research assistant focused on quantum-safe communication, confidential computing, and secure infrastructure. In my free time, I maintain programme.lv: a non-profit Latvian informatics olympiad task archive. I care about digital sovereignty, resilient systems, and the occasional tasteful premature optimization.

Professional Experience

Research Assistant, Institute of Math and Computer Science, UL 2024/09 – Present

- QKD (Quantum Key Distribution) network deployment, performance analysis;
- Development of Intel SGX-secured Q-KMS using Fortanix EDP for hop-by-hop key relaying;
- Configured Juniper SRX1500 encryptors with Q-Safe IPsec VPN;
- Paper *Shared QRNG Integration into GNU/Linux via D-Bus* write up;
- Participation in project [LATQN](#) deliverable writing and review;

Lead Programming Technician, Institute of Math and Computer Science, UL 2022/08 – 2024/09

- Software development, data analysis, and result validation; participation in scientific projects;
- Development of Linux kernel module; Integration of QRNG output into OpenSSL library;
- Development of distributed QKD key management system with ETSI GS QKD 014 support.

Programming Teacher, *Pirmā Programmēšanas skola* 2022/01 – 2024/06

- Development of lesson plans (Python, C++, Web);
- Teaching classes and evaluating student work.

Software Developer, ZZ Dats - Software Development Company 2020/07 – 2021/09

- Database query optimization for Latvian Post warehouse software;
- CMS (Content Management System) development for [Latvija.lv](#).

Peer-reviewed Publications

- 2026 “Secure Decentralized Key Relaying via Random Walks in Dynamic Semi-Trusted QKD Networks.” Sergejs Kozlovičs, **Krišjānis Petručeņa**, Elīna Kalniņa, Juris Viksna. *Advanced Quantum Technologies*. [doi:10.1002/qute.70393](https://doi.org/10.1002/qute.70393)
- 2026 “Topology-Oblivious Random-Walk Key Relaying in Quantum Key Distribution Networks.” **Krišjānis Petručeņa**, Sergejs Kozlovičs, Juris Viksna, Elīna Kalniņa, Reinis Isaks, Edgars Celms, Lelde Lāce, Edgars Rencis. *Entropy*. [doi:10.3390/e28060696](https://doi.org/10.3390/e28060696)
- 2026 “Integrating Remote Quantum Random Number Generator as a Shared Resource into GNU/Linux via D-Bus.” **Krišjānis Petručeņa**, Sergejs Kozlovičs, Elīna Kalniņa, Edgars Rencis, Juris Viksna, Edgars Celms, Lelde Lāce. *ACM Transactions on Privacy and Security*. [doi:10.1145/3799895](https://doi.org/10.1145/3799895)
- 2026 “The Butterfly Protocol: Secure Symmetric Key Exchange and Mutual Authentication via Remote QKD Nodes.” Sergejs Kozlovičs, Elīna Kalniņa, Juris Viksna, **Krišjānis Petručeņa**, Edgars Rencis. *Symmetry*. [doi:10.3390/sym18010153](https://doi.org/10.3390/sym18010153)
- 2026 “An Information-Theoretically Secure QKD Protocol for One-Time Pad Encryption.” Sergejs Kozlovičs, **Krišjānis Petručeņa**, Juris Viksna. [doi:10.1007/978-3-032-01823-6_12](https://doi.org/10.1007/978-3-032-01823-6_12)
- 2026 “Integration of PQC and QKD: Applications, Challenges and Implementation Frameworks.” Elina Kalnina, Rihards Balodis, Edgars Celms, Sergejs Kozlovics, Inara Opmane, **Krišjānis Petručeņa**, Edgars Rencis, Juris Viksna. [doi:10.1007/978-3-032-01799-4_15](https://doi.org/10.1007/978-3-032-01799-4_15)
- 2025 “Integration of Cisco ISE-Based AAA Framework into Quantum-Secure Cloud Access Architecture.” Edgars Rencis, Rihards Balodis, Edgars Celms, Elīna Kalniņa, Sergejs Kozlovičs, Ināra Opmane, **Krišjānis Petručeņa**, Juris Viksna. 2025 *14th International Conference on Networks, Communication and Computing (ICNCC)*. [doi:10.1109/ICNCC68912.2025.00023](https://doi.org/10.1109/ICNCC68912.2025.00023)
- 2024 “Towards Quantum Telecommunications: Point of View of the Implementation Task of the Experimental

Quantum Key Distribution Backbone Deployment Project.” Inara Opmane, Rihards Balodis, Arvils Bulavs, Edgars Celms, Elina Kalnina, Rita Kucinska, Arturs Medenis, Sergejs Kozlovics, **Krišjānis Petručeņa**, Edgars Rencis, Juris Viksna. *Frontiers in Artificial Intelligence and Applications*. doi:10.3233/faia241378

- **2024** “Hybrid QKD-based framework for secure enterprise communication system.” Edgars Rencis, Juris Viksna, Sergejs Kozlovics, Edgars Celms, Dāvis Jānis Lāriņš, **Krišjānis Petručeņa**. *Procedia Computer Science*. doi:10.1016/j.procs.2024.06.189
- **2023** “Quantum Key Distribution as a Service and Its Injection into TLS.” Sergejs Kozlovics, **Krišjānis Petručeņa**, Dāvis Lāriņš, Juris Viksna. doi:10.1007/978-981-99-7032-2_31

Preprints

- **2026** “Random-Priority Frontier Routing: Tight $\Theta(n^c)$ Bounds Against c -Node Cartels.” **Krišjānis Petručeņa**. arXiv:2609.00893

Conference Presentations

- **2026/06/27** *SGX-QKMS: Remotely Attested Key Relaying in Quantum Key Distribution Networks* — ICCCI. Covered Intel SGX fundamentals, attestation-gated relay admission, enclave-resident mTLS termination, and fail-closed routing with support for progressive rollout for semi-trusted-node QKD networks.
- **2026/04/26** *Random-Walk Key Relaying for Decentralized QKD Networks* — Theory Days Estonia-Latvia 2026, University of Tartu Delta Center. Presented decentralized multi-path key relaying via random walks, exposure analysis, and optimizations including LRV, highest-score neighbor, node coloring, and loop erasure.
- **2026/03/26** *Securing Data in the Quantum Era* — Data State Inspectorate 25th anniversary conference, Mežaparks/Rīga Forest Park. Focused on quantum risk to RSA/ECC, TLS handshake vulnerabilities, and hybrid quantum-safe architecture combining PQC, QKD, and symmetric cryptography.
- **2025/10/30** *Q-Ready’25 presentations: From Quantum Threats to Shields: QKD, PQC, and Beyond; Quantum Random Number Generators* — Q-Ready 25 conference and training day, Latvia. Presented a hybrid quantum-safe roadmap combining PQC, QKD, and QRNG-backed architectures, and a practical QRNG integration approach for Linux/OpenSSL covering conditioning, testing, and fair distribution.
- **2025/06/25** *Integration of PQC and QKD: Applications, Challenges and Implementation Frameworks* — QSHC’25 (Workshop on Quantum-Safe Hybrid Cryptography), ACNS 2025 Workshops, Munich Urban Colab, Munich, Germany. Argued that QKD and PQC are complementary in real deployments, with integration points at IPsec/MACsec encryptors, QKD-as-a-Service routing, and HAKE-style TLS based on LatQN testbed experience.
- **2024/02/03** *Quantum Key Distribution (QKD) as a Service and Its Injection into TLS* — Theory Days at Randivālja (35th Estonian and 9th Joint Estonian-Latvian Theory Days), Klaara-Manni Holiday Center, Estonia. Presented a quantum-safe TLS roadmap combining QKD-as-a-Service with PQC, and introduced the Butterfly Protocol for integrating QKD key material into TLS workflows.

Awards and Honors

- **2023/12** - Bronze medal in ICPC Central European Regional Contest (CERC)
- **2022/08** - Participation in the 34th International Olympiad in Informatics in Yogyakarta, Indonesia (IOI)
- **2022/05** - Bronze medal in the 28th Baltic Informatics Olympiad (BOI)
- **2022/02** - 3rd place in digip.lv National Artificial Intelligence Olympiad
- **2021/04** - Gold medal in the 45th Latvian High-schooler Scientific Research (ZPD)

Certificates

- **2026/04** - *Certified 7.2 Practitioner*, OpenNebula Systems

Education

Bachelor’s Degree in Computer Science, University of Latvia

2022/09 – 2026/06

- Thesis (LV): *Nejaušās klejošanas atslēgu pārraide kvantiskās atslēgu sadales tīklos* – random-walk key relaying in

quantum key distribution networks: empirically showed that random walks improve security by exploiting *partially-disjoint* paths, and introduced a path diversification heuristic. Findings were then published in *Entropy*.

- Specialization coursework: Quantum Computing, Programming Practice in Quantum Computing, and Computational Complexity.

Completed Secondary education, Riga State Gymnasium Nr. 2

2020/09 – 2022/07

Technical Skills

- **Experience with:** GraphQL, AWS, gRPC, PostgreSQL, Kubernetes.
- **Programming Languages:** Go, C++.
- **Other Skills:** Postman, Docker, Git, TypeScript, Design Patterns, TDD, CI/CD.

Other Projects

- **Online Judge for Latvian Informatics Olympiad**
 - Developed and currently maintaining an online judge system to archive tasks from Latvia's Informatics Olympiad.
 - **Backend:** Written in Go; handles submission enqueueing into AWS SQS.
 - **Frontend:** Built with Next.js for a responsive user interface.
 - **Worker Server:** Processes submissions from SQS, evaluates them using IOI isolate for sandboxing, and streams back results.
 - **Database:** Utilizes PostgreSQL for data persistence.
 - **Storage:** Employs AWS S3 to store large test files efficiently.

Language Abilities

Native Language: Latvian

Other Languages:

- English (C1 - Advanced level)
- Russian (B1 - Intermediate level)