



Poznańskie Centrum Superkomputerowo-Sieciowe
Poznan Supercomputing and Networking Center



Quantum Computing and Quantum Sensing



SIG-Quantum meeting 01.12.2025

Piotr Rydlichowski

Hybrid approach to Quantum Technologies



- Quantum Technologies are being developed and integrated at PCSS and PIONIER environment since 2014
- Closely connected with European Commission programs and GÉANT project
- Quantum Strategic and Research Agenda (Quantum Flagship)
- Focused on hybrid and joint approach to all quantum technologies
- The 2025 International Year of Quantum Science and Technology (IYQ)

European Commission Programs

Strategic Pillars of the EU Quantum Ecosystems



Quantum Computing at PCSS - systems

- PCSS installed three physical Quantum Computing Infrastructures: EuroQCS-Poland ion trap machine (AQT), EuroHPC-PL two photonic ORCA PT-1 systems
- Remote access to superconducting qubits quantum computing infrastructure: IBM Quantum. PCSS is IBM Quantum Excellence Centre
- Active projects for quantum computing systems integration (EuroQCS-I) and quantum excellence centre (QEC4QEA)
- Cooperation with different vendors of quantum computing systems and infrastructures – also in the aspect of quantum memories and integrating quantum communication between the quantum computing systems



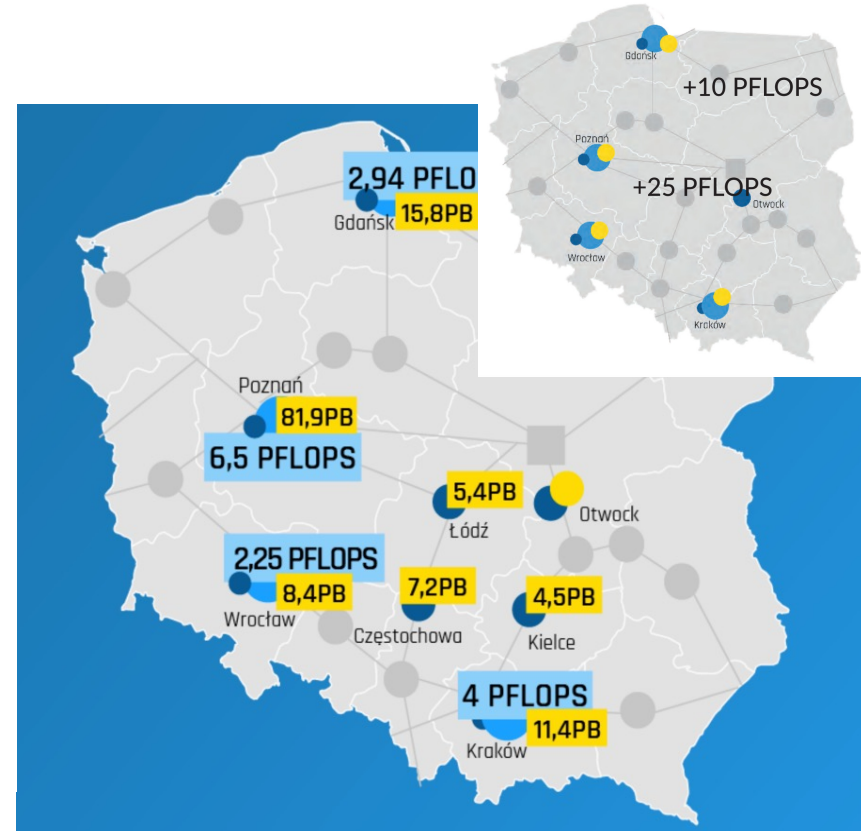
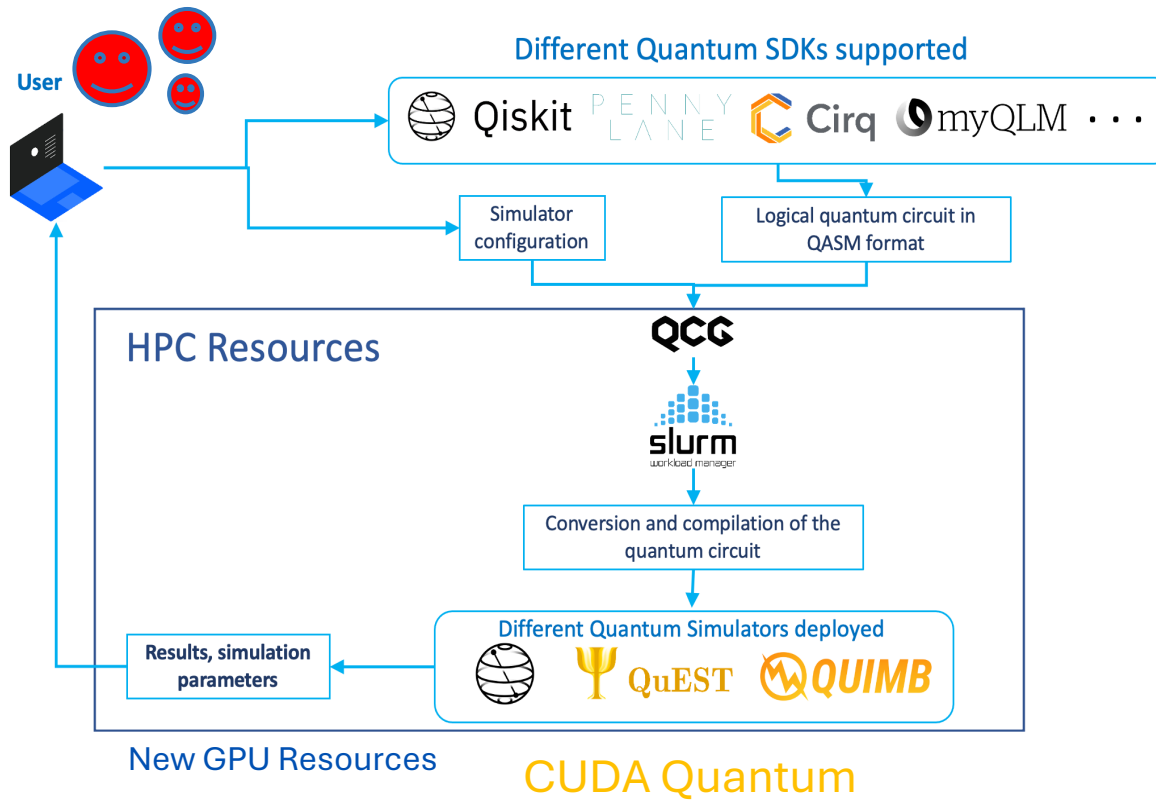
- **2 Quantum Simulators^{*} (100+ Qubits)**
 - Jülich: *Jewels – PASQAL QS (Germany)*
 - GENCI: *Joliot-Curie – PASQAL QS (France)*
- **6 Selected Hosting “Entities”**
 - Euro-Q-Exa, *superconducting Qubits (DE)*
 - LUMI-Q, *superconducting Qubits[†] (CZ)*
 - EuroQCS-Spain, *superconducting Qubits (ES)*
 - EuroQCS-Italy, *neutral atom Qubits (IT)*
 - EuroQCS-Poland, *trapped ion Qubits (PL)*
 - EuroQCS-France, *photonic Qubits (FR)*
- **> 100.000.000 EUR of total investment**



^{*}) Fresnel analogue Quantum Simulator [†]) Star-shaped topology

Quantum Computing at PCSS – Simulators

Quantum simulators running on classical HPC resources at PSNC



Quantum Computing at PCSS – Hybrid and Distributed demo at SC24 CPU+GPU+QPU

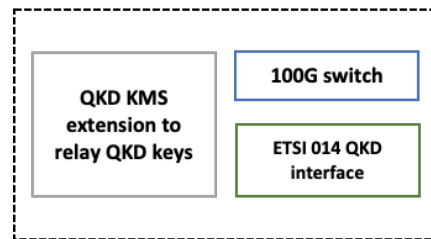
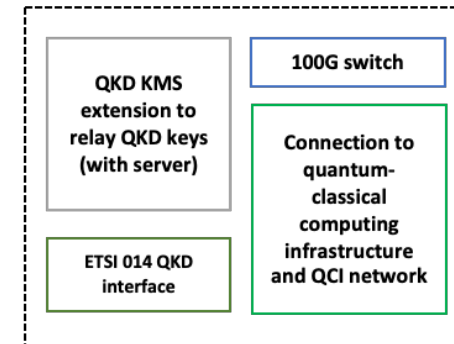


Encrypted traffic for distributed hybrid Quantum Computing + classical use case/algorithm

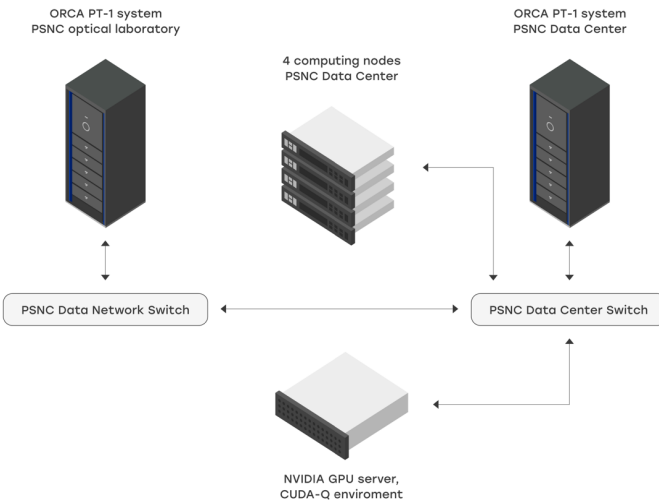
Data Center and laboratory
Poznań, PL



PSNC booth
Atlanta, US

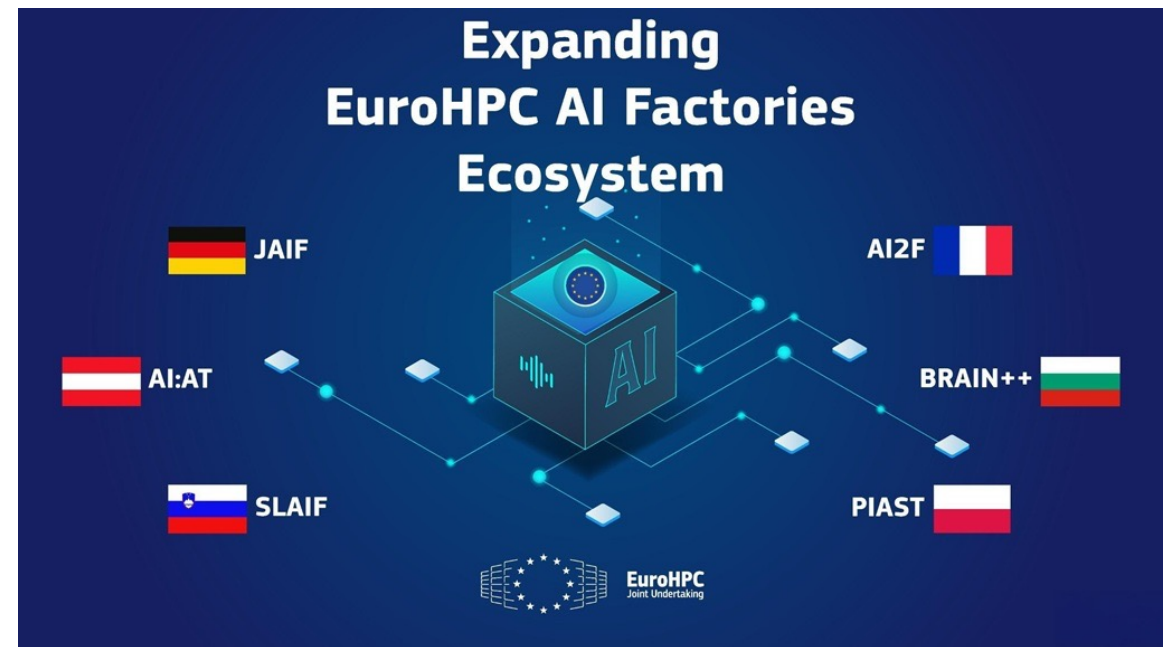


PQC encrypted QKD keys over classical link



Quantum Technologies integration with AI Factories

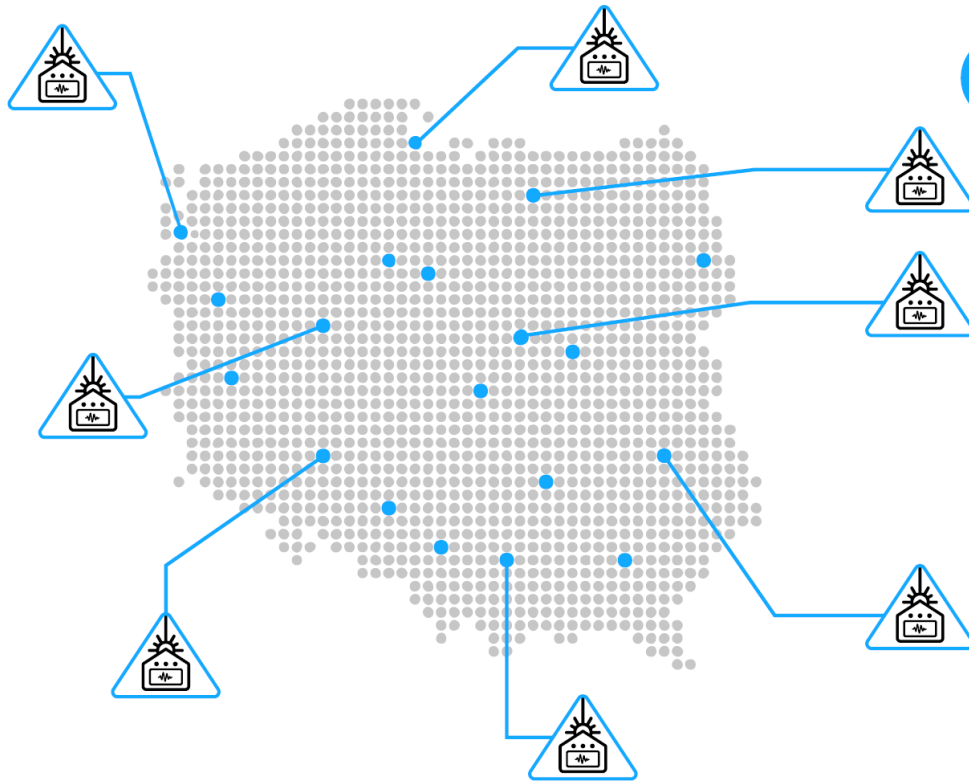
- AI Factory infrastructure and services are planned to be integrated with quantum computing, quantum communication and quantum sensing infrastructures
- Hybrid infrastructure and use cases:
- Quantum Computing – error mitigation, correction, system calibration, monitoring and optimization
- Quantum communication – QKD network optimization, monitoring data analysis, digital twin, simulation
- Quantum sensing – sensors measurement data analysis and processing



Quantum Sensing at PCSS - Gravimetry

GRAVIQ

Synchronic Network of Mobile Quantum Gravimeters



AI-Enhanced Signal Processing

Geosensing Meets Supercomputing

Quantum-powered gravimetry

Precision Gravimetry

Gravity as a Service

Smart Sensing Grid

Field-Ready Sensors

Next-Gen Metrology

- Development and deployment of mobile quantum gravimeters based on atom interferometry
- The project aims to establish synchronous network of mobile quantum gravimeters
- Platform for data analysis, storage and transmission. Also using secure QKD links
- Integration with AI system for data processing and analysis

Quantum Sensing at PCSS – Atomic Clocks

- The Q-ChronoS project will build a system of mobile quantum sensors based on optical atomic clocks and an optical frequency transfer infrastructure.
- This infrastructure will enable use mobile optical clocks in various locations in Poland. The planned infrastructure includes terminals for optical frequency transfer in free-space and via telecommunications fiber infrastructure, including using DWDM technology.
- Duration 2025 - 2029



Quantum Sensing - Metrology Infrastructure

The National System for Generation and Distribution of Reference Optical Carrier

- Distribution ultrastable optical frequency - Optical Carrier
- Precision of signals 10-17
- Precision of our distribution system 10-19
- Implementation Optical Carrier distribution system:

- Optical Clock signal source - KL FAMO,
- Transmission elements - PSNC / AGH
- Transmission network - PSNC

- Users:

- Warsaw - University of Warsaw
- Poznan - PSNC
- Wroclaw - Wroclaw University of Technology
- Technology manufactured by PSNC & AGH
- Operational since VIII 2023



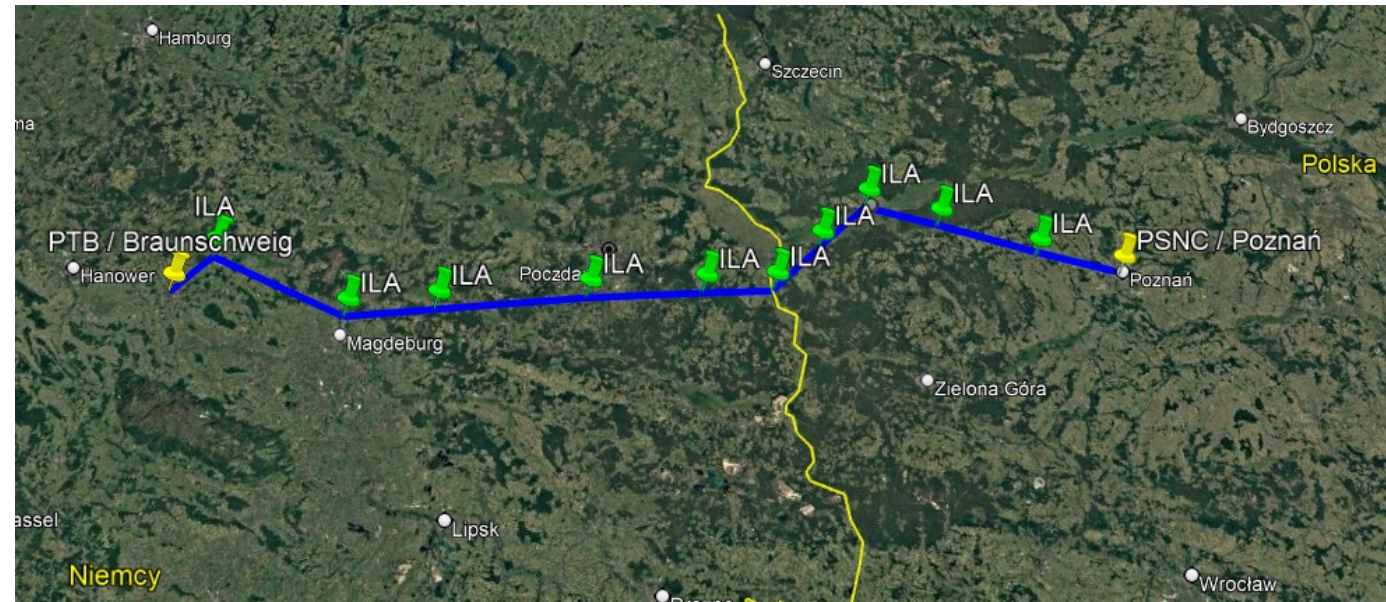
- Optical Carrier Access points
- Optical Carrier Distribution points
- Optical Carrier links
- Cross border connections
- PIONIER network



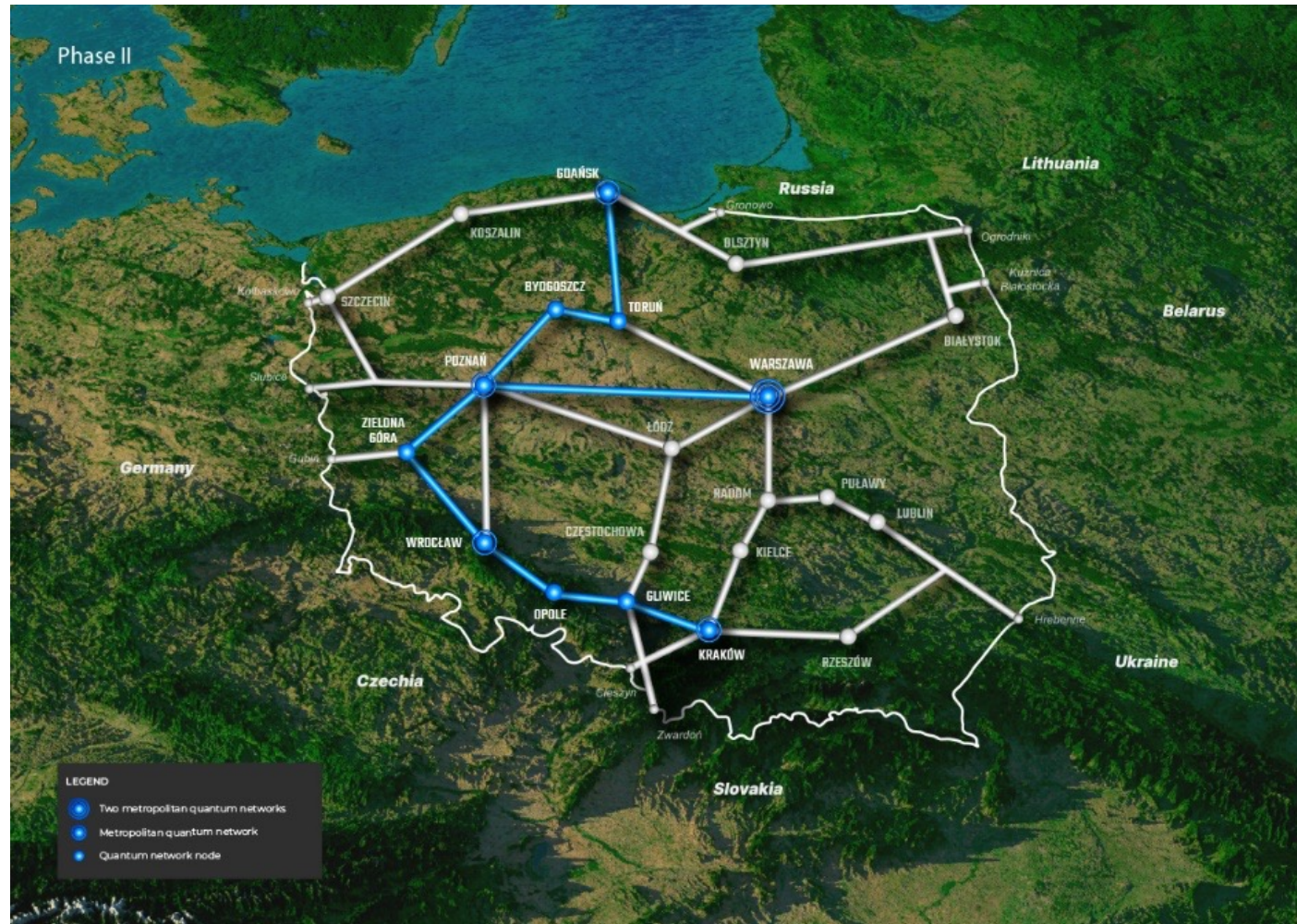
Quantum Sensing – Metrology Infrastructure

Generation and Distribution of Reference Optical Carrier – connection between Poland (PCSS) and Germany (PTB)

- 2 dark fibres
- Overall fibre length: ~690 km (270 km in Poland; Pionier/PSNC) (420 km in Germany; GÉANT)
- 10 ILA points (5 in Poland) (5 in Germany)
- The longest section between ILAs: 106,7 km / 22,6 dB



Quantum Communication at PSNC - EuroQCI



PIONIER-Q project

- 6 partners (PCSS coordinator)
- Start date: 01.02.2023
- Duration: 30 months
- Budget: 10 MEUR
- Deliverables: EU restricted
- Infrastructure
 - 1770 km of intercity QKD links implemented in March 2024, dedicated fibers and KMS network
 - Intermediary nodes in main cities of Poland and ready to QKD metro system installations
 - Each partner has 2 QKD metro systems with encryptors
 - NSA connected by dedicated QKD system
 - Additional MAN networks connected.
- QKD and quantum communication protocols can be implemented and simulated on quantum computing infrastructure

Quantum Communication at PSNC - EuroQCI



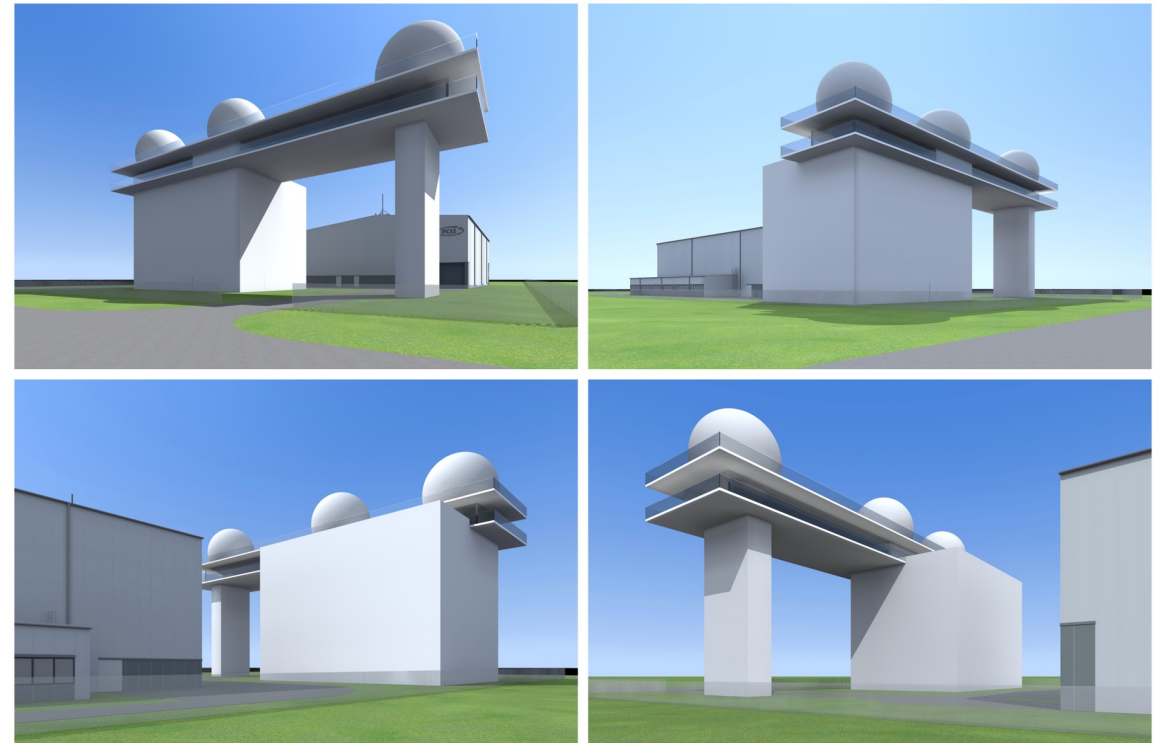
EuroQCI CEF Call proposals – GAP Phase

- Direct cross-border connections with Denmark, Germany, Czech Republic, Slovakia, Lithuania
- 2 OGS satellite projects, 1 national and 1 with cooperation with Czech Republic and Slovakia
- Prepared in March-April 2025

Quantum Communication at PSNC - WEDROWNIQ

Satellite Quantum Communication

- Long distance optical quantum communication systems – bases and free space propagation are essential element to interconnect global quantum communication networks, its services (like QKD) and enable future distributed quantum computing.
- Possible scenarios are connected with but also not limited to:
 - fundamental research physics,
 - quantum networks and quantum internet
 - next-generation precision positioning and navigation in both civilian and military applications,
 - Deep space optical communication systems
- Duration 2025 - 2029



Quantum Communication at PSNC - WEDROWNIQ

Satellite Quantum Communication

- The WEDROWNIQ project will provide Optical Ground Station platform for satellite quantum communication (operational and experimental) for optical communication development in free space (classical and quantum communication). Infrastructure will be associated with quantum gravimetry laboratory.
- This infrastructure will contribute and allow to use EuroQCI infrastructure. It will be integrated with Polish National QCI infrastructure – PIONIER-Q and contribute to quantum communication and quantum computing infrastructures.



Poznan Supercomputing
and Networking Center



Space Research Center
Polish Academy of Sciences

Quantum Technologies Standardization

- PSNC is part of and chair of Polish PKN group focused on quantum technologies standardization; PSNC takes part in CEN/CENELEC JTC 22 group meeting WG1-WG4
- PKN KT341 committee was formed in December 2024

PKN Komitety techniczne PKN
POLSKI KOMITET NORMALIZACYJNY

Q Wyszukaj Wykaz Organów Technicznych PKN Program prac normalizacyjnych PKN Program prac normalizacyjnych PKN - normy własne Deklaracja dostępności Język

Lista członków

KT 341 ds. Technologii Kwantowych

[Powrót](#)

I.p.	Członek
1	AROBSPolska Sp. z o.o.
2	BEIT Spółka z ograniczoną odpowiedzialnością
3	Fundacja Quantum AI
4	Instytut Chemii Bioorganicznej Polskiej Akademii Nauk Poznańskie Centrum Superkomputerowo Sieciowe
5	Quantum Blockchain Sp z o.o.
6	Quantum Optical Technologies sp. z o.o.
7	SONOVERO R&D Sp. z o.o.
8	Sieć Badawcza Łukasiewicz - Instytut Mikroelektroniki i Fotoniki
9	Uniwersytet Mikołaja Kopernika w Toruniu
10	Uniwersytet Warszawski

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BLUE SOFT



PCSS

01.12.2025