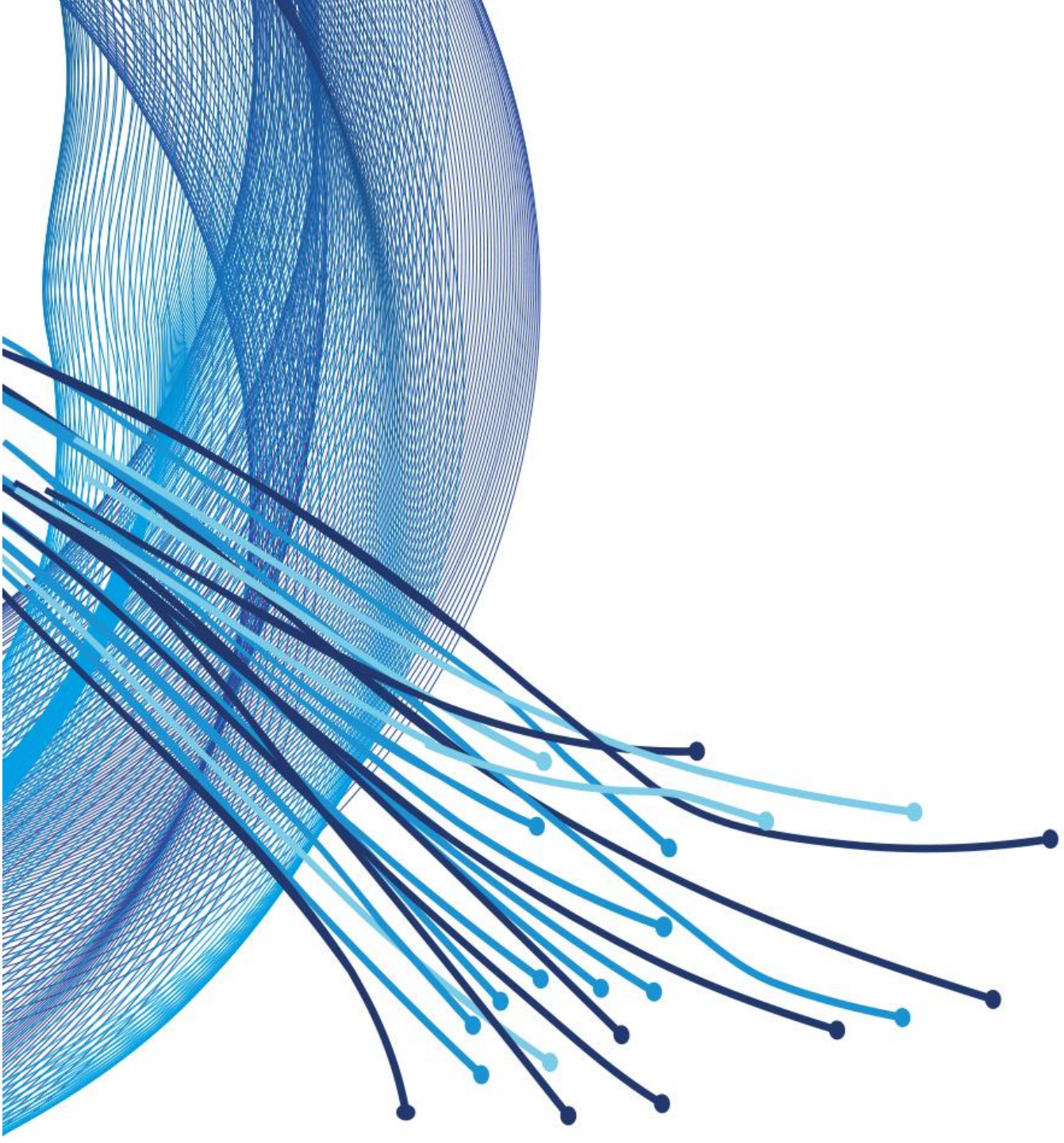


HellasQCI - Quantum Communication Infrastructure for Greece

HellasQCI overview and its use cases

Dr. Ilias Papastamatiou, GRNET

HellasQCI Coordinator

GN5-1 WP6 Quantum sub-task

Celebrating The World Quantum Day, 14 April 2023

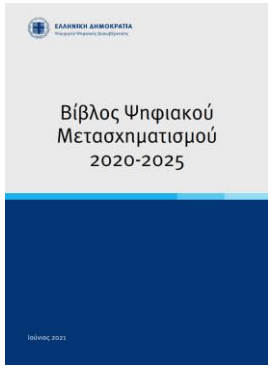
EuroQCI - Greece

Since **June 2019**, all 27 EU Member States have signed the **EuroQCI Declaration**, signaling their commitment to the EuroQCI initiative.

The participating countries are working with the **European Commission** and the **European Space Agency** to design and deploy the EuroQCI.

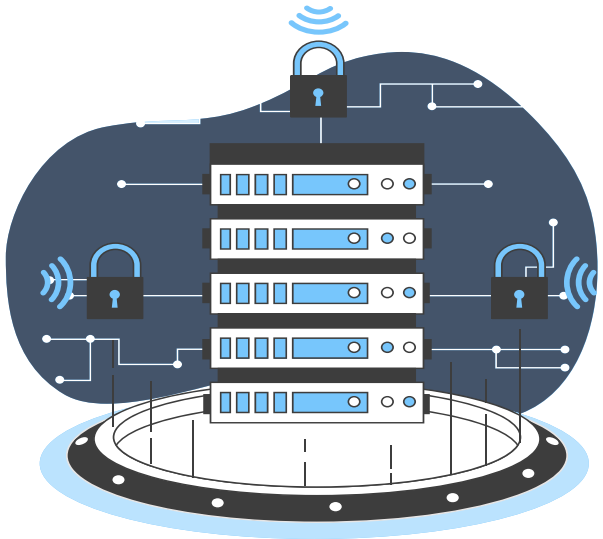
The **Ministry of Digital Transformation** signed on behalf of **Greece**

EuroQCI is part of the **Digital Transformation Strategy of Greece** (2020-2025)



EuroQCI - GRNET

According to **Law 4623/2019** Art. 58 GRNET "has the central role of **coordinator of all digital infrastructures** for Education and Research" and "constitutes **the national representative of the research and technological community** in the research infrastructures of the EU" and according **to Law 4727/2019** Art. 87, GRNET "manages the **Government Cloud of the RE**".



GRNET is **appointed** (October 2021) **by the Ministry of Digital Transformation and the General Secretariat for Telecommunication and Post** to act as part of the national representation scheme to the **EuroQCI special group** and responsible for the **DEP-CEF proposals** coordination and submission.

HELLENIC REPUBLIC
Ministry of Digital Governance

HellasQCI

EDU
- NKUA (BEN)
- FORTH (BEN)
- NCSRD (BEN)
- AUTH (BEN)
- NOA (BEN)
- ICCS (AP)

GOV
- MinDigital (BEN)
- NIS (LoS)
- Army (LoS)
- Police (LoS)

HellasQCI Consortium

GRNET (COO)

IND
- Cosmote (BEN)
- Motor Oil Hellas (BEN)
- Space Hellas (BEN)
- Qubitech (BEN)

National QCI Partnerships

Luxembourg (AP)
Ireland (AP)
Austria (LoS)
Bulgaria (LoS)
Cyprus (LoS)
Poland (LoS)
Malta (LoS)

HellasQCI Budget: 9.997.545 €	
EU funding rate at 50%	
EU Funding: 4.998.772,50 € National Funding: 4.998.772,50 € Around 6M € for equipment and fibers	Project Started: 1 January 2023 Project Ends: 30 June 2025

DEP 2 - Results	
Excellent score (13.5/15)	Ranked in the 2nd cluster based on rating (out of 7) along with Germany's, Finland's and Ireland's National QCI proposals.

HellasQCI Objectives

O1: Build the National Quantum Networks infrastructure as part of the EuroQCI

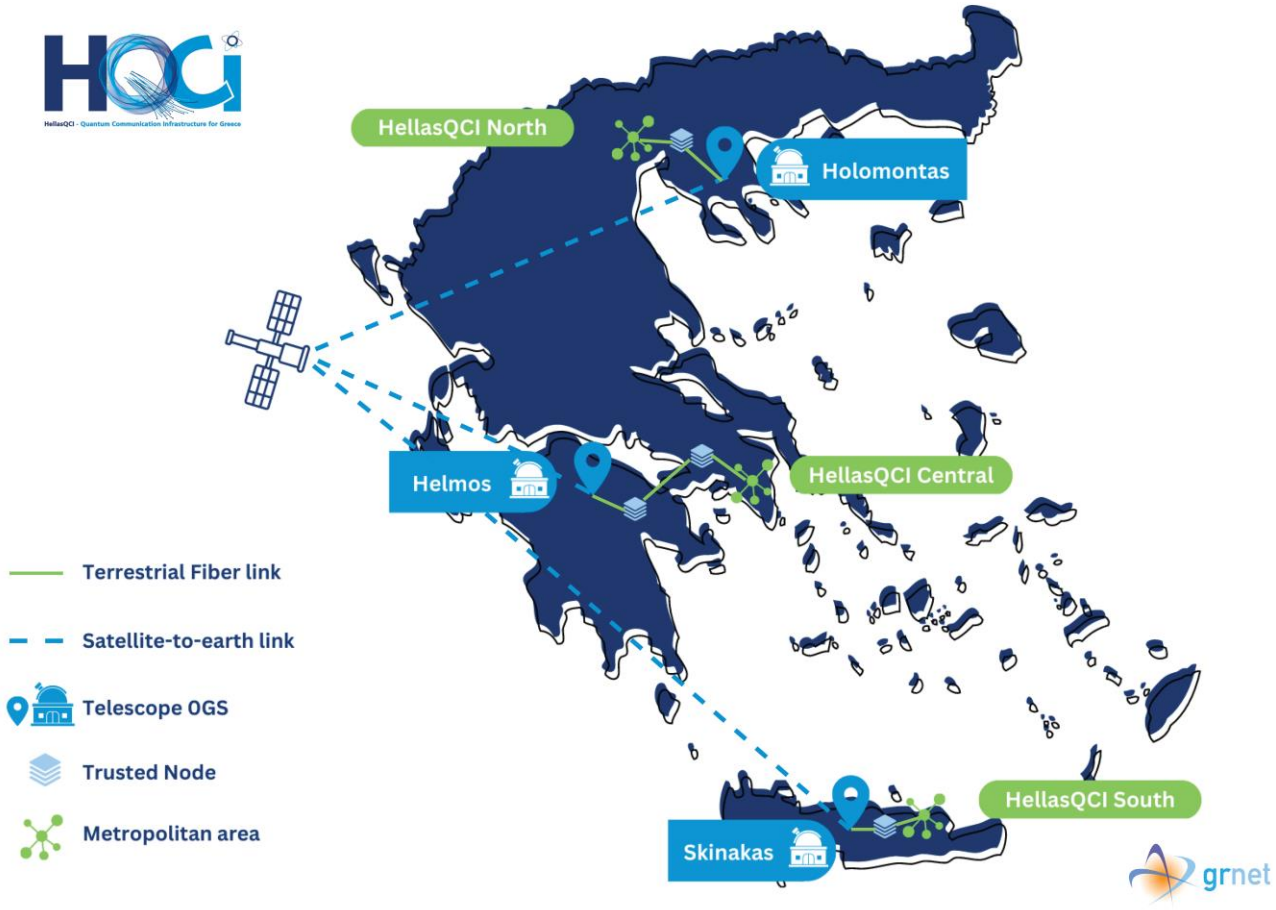
- 3 national HellasQCI test-sites
- 3 OGS will be connected
- 450km length of fiber links will be deployed

Three test-sites

- Athens (Capital of Greece) – Economic/Administrative Centre
- Thessaloniki - North Greece/ terrestrial boarder
- Heraklion/Crete - Island Greece, South European Boarder

Quantum Satellite Connectivity

- Builds on Helmos, Holomontas and Skinakas OGS
- All 3 telescopes part of ESA ARTES Skylight programme
- HellasQCI to provide the terrestrial links to the OGS
- Connect to ESA Eagle-1 QKD satellite
- Implement the National Quantum Backbone Network
- Connect with other EU Member States
- Avoid costly terrestrial QKD links



HellasQCI Powerful Metropolitan Testbeds

O2: Develop and Deploy advanced quantum systems and networking technologies

- **3 QKD technologies will be deployed**
  - ✓DV-QKD technology (Most mature solution)
  - ✓CV-QKD technology (low-cost deployment)
  - ✓Single photon detectors and sources (entanglement)

Three Quantum Network domains

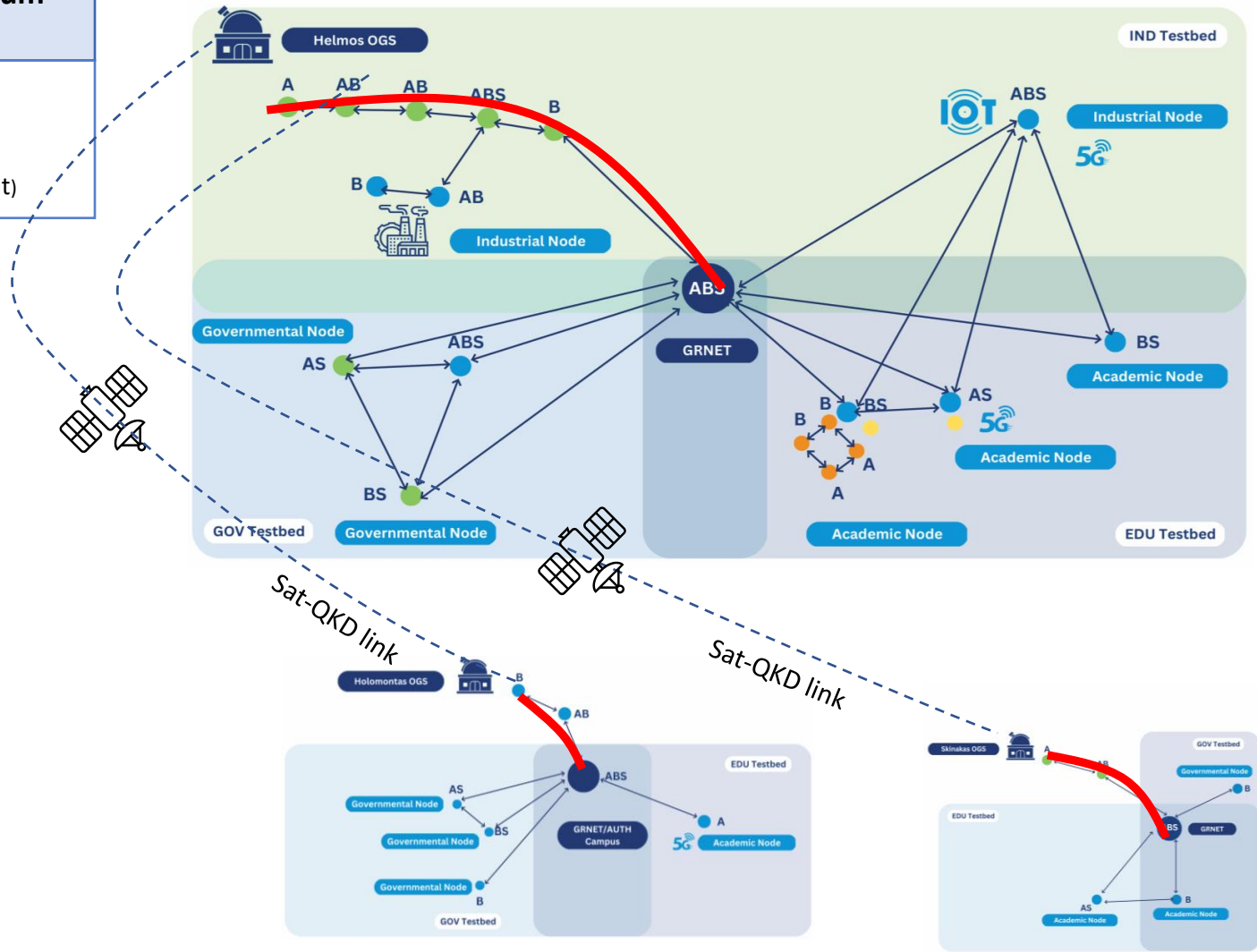
- Governmental (GOV)
- Industrial (IND)
- Research and Innovation (EDU)

Extensive Metropolitan Networks

- >12 Nodes in Athens
- >6 nodes in Thessaloniki
- >4 Nodes in Heraklion

Advanced QKD technologies

- Dynamic QKD for optimal resource allocation and flexible networking
- Co-existence of Quantum and Classical Channels
- Enhanced PUF encryption schemes



HellasQCI 16 Multidisciplinary Use cases

O3: Advanced use cases in different application scenarios

- 16 use cases
- 7 National Security and Governmental nodes connected
- 6 Critical infrastructures, health sector and ICT industry nodes connected
- 6 Research and Innovation nodes connected
- Entanglement distribution network 4 receivers – 2 nodes

National Security

Use Case 1 — QKD for National Security
Use Case 2 — Enhanced QKD resilience for National Security Links
Use Case 3 — Satellite QKD connectivity for remote National Security Nodes
Use case 16 — HellasQCI space and terrestrial segments

Public Health

Use Case 4 — Secure communications for Public Safety applications
Use Case 5 — Quantum Secure technologies for cloud Health Applications
Use Case 6 — Secure transmission of medical imaging data for Public Hospitals
Use Case 7 — QKD for secure connectivity to supercomputing infrastructure

Industrial | Critical Infrastructure | ICT

Use Case 8 — Quantum cryptography to secure communication links of critical infrastructures
Use Case 9 — ICT sector | Secure storage in cloud data centres
Use case 10 — ICT sector | QKD over 5G
Use case 11 — ICT sector |Next Generation Quantum Secured FTTH services
Use case 15 — Preparation of a quantum encrypted software application

Research

Use case 12 — Preparing for the quantum internet
Use Case 13 — Advanced quantum network controls
Use case 14 — PUF-based hybrid authentication for switched QKD

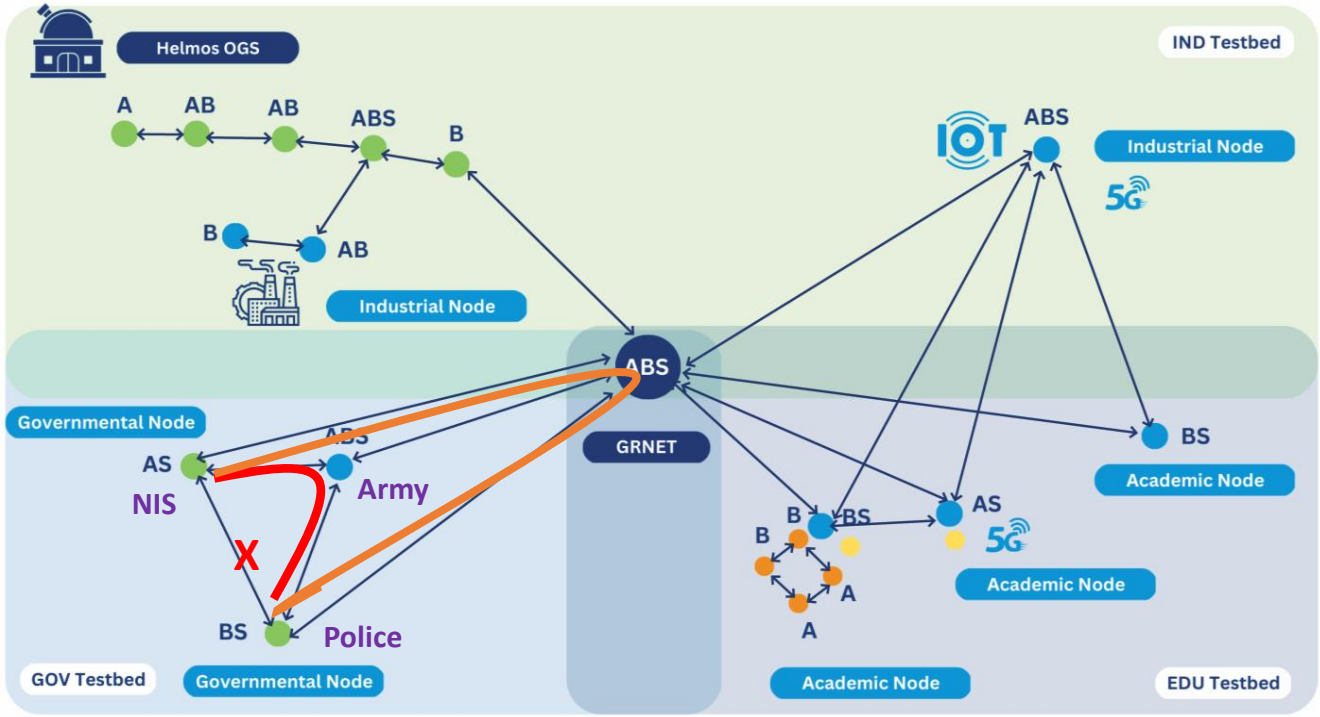
Use Case – Enhanced QKD resilience for National Security Links

Key objective

demonstrate resilience in DDoS attacks using the switched QKD operation

Implementation

Emulate the Secure Ring Network in the lab (Phase 0)
and demonstrate the plethora of scenarios for interconnecting the GOV nodes (Phase1)



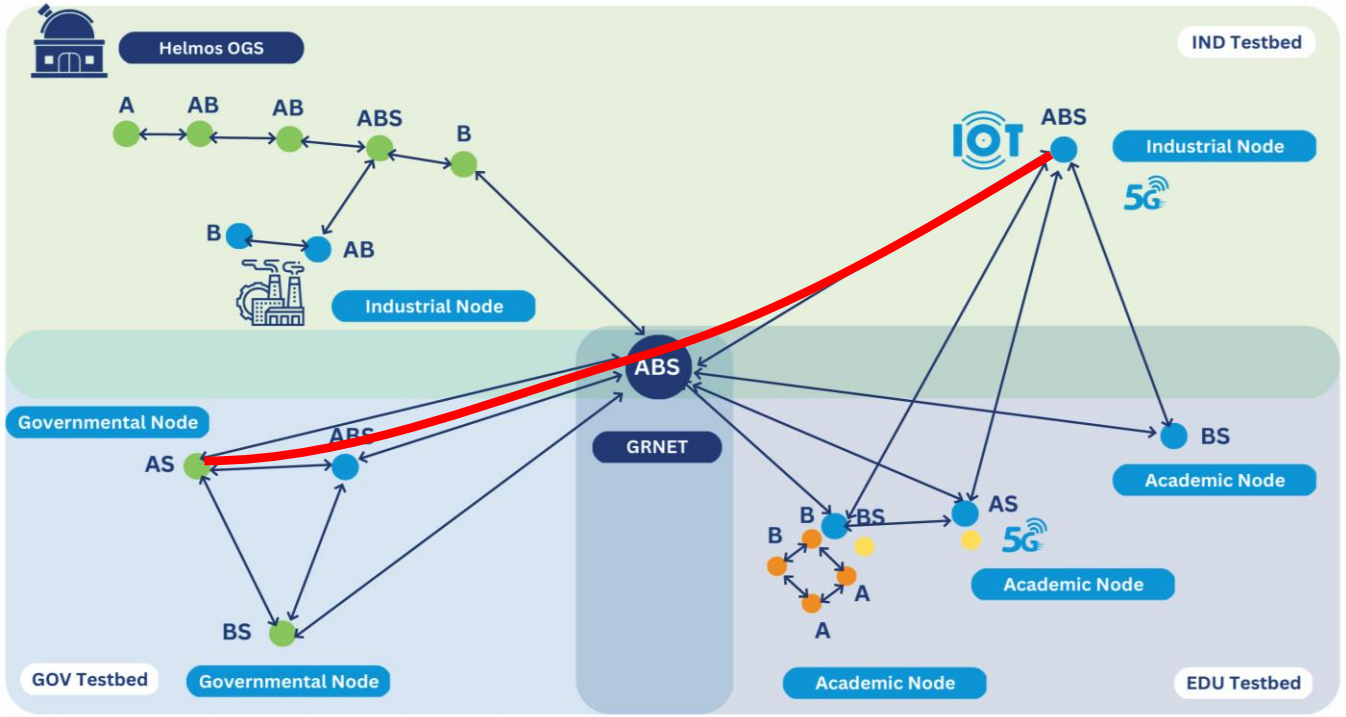
Use Case – Secure communications for Public Safety applications

Key objectives

- demonstrate inter-domain QKD connectivity
- Relayed or switched QKD depending on the losses
- Optional demonstration of unified control system

Implementation

Demonstrate relayed or switched QKD link from COSMOTE to GOV node through GRNET (Phase 1)



Use Case – Advanced quantum network controls

Key objectives

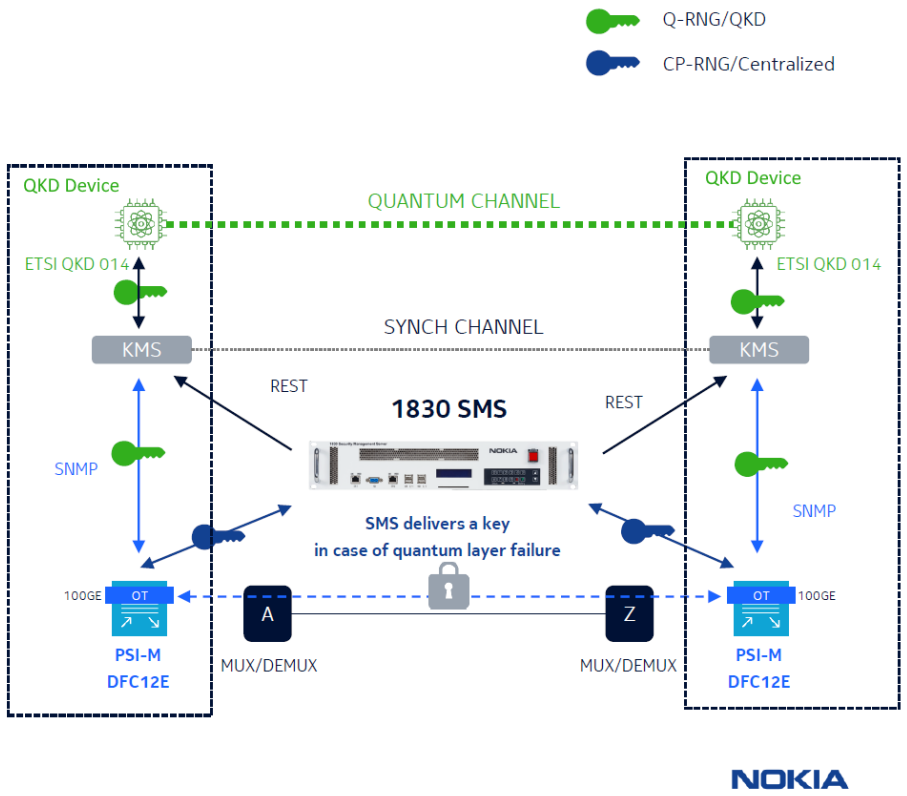
- Explore the monitoring tools and control software for the QKD and switches and adapt control interfaces for switched QKD

Implementation (Phase O)

- Review existing commercial solutions for the QKD management
- Define strategy to adapt to switched QKD

Implementation (Phase 1)

- Demonstrate the integrated control software in operation with the GRNET classical optical network and the deployed QKD network

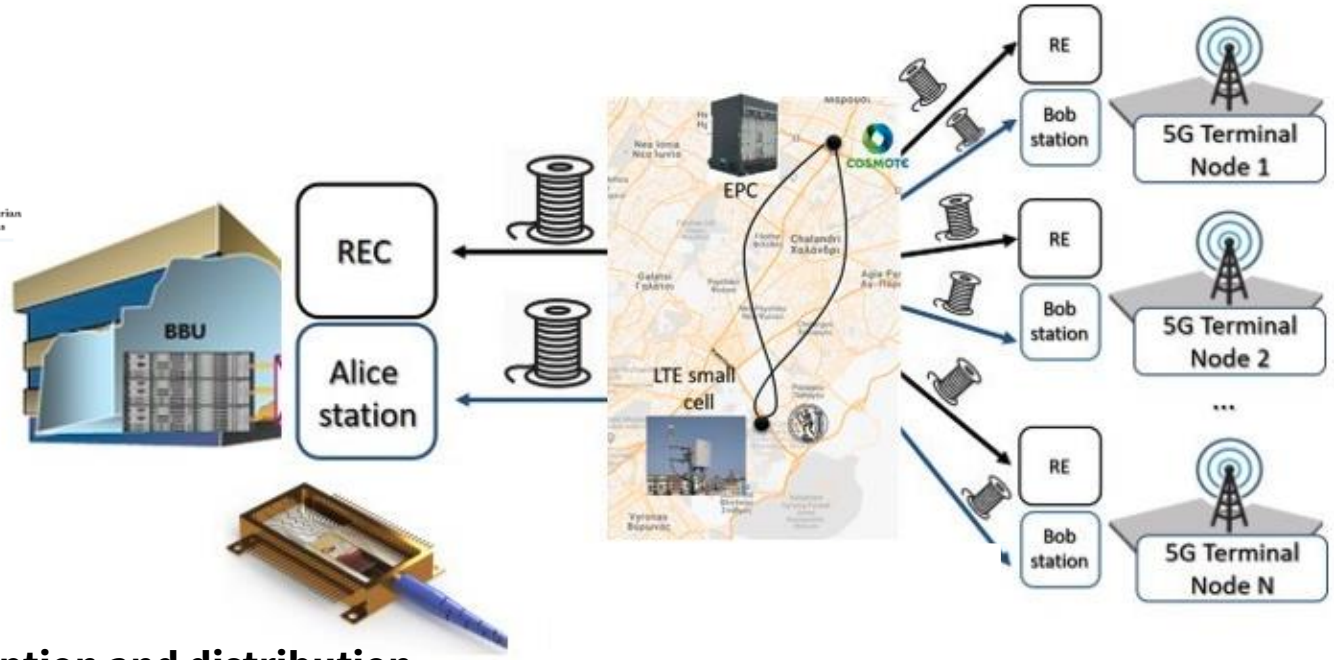


Research and Industrial Use Cases

- Industrial and Academic partners have demonstrated novel technologies for QKD
- HellasQCI offers a field testbed as the sandpit to further develop the technologies

UNIQORN
Affordable Quantum Communication for Everyone

QKD over 5G
QKD for FTTH



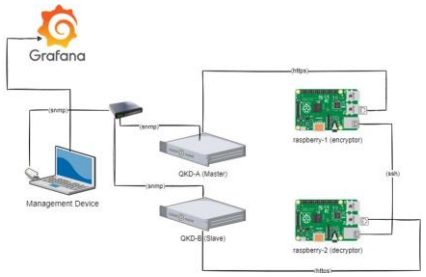
Quantum key encryption and distribution

SPACE

HELLENIC REPUBLIC
National and Kapodistrian University of Athens

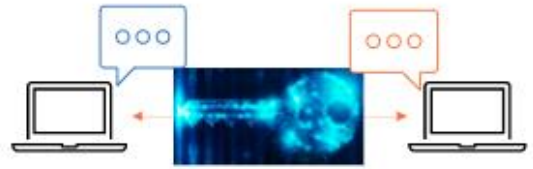
QGOV

OPEN QKD

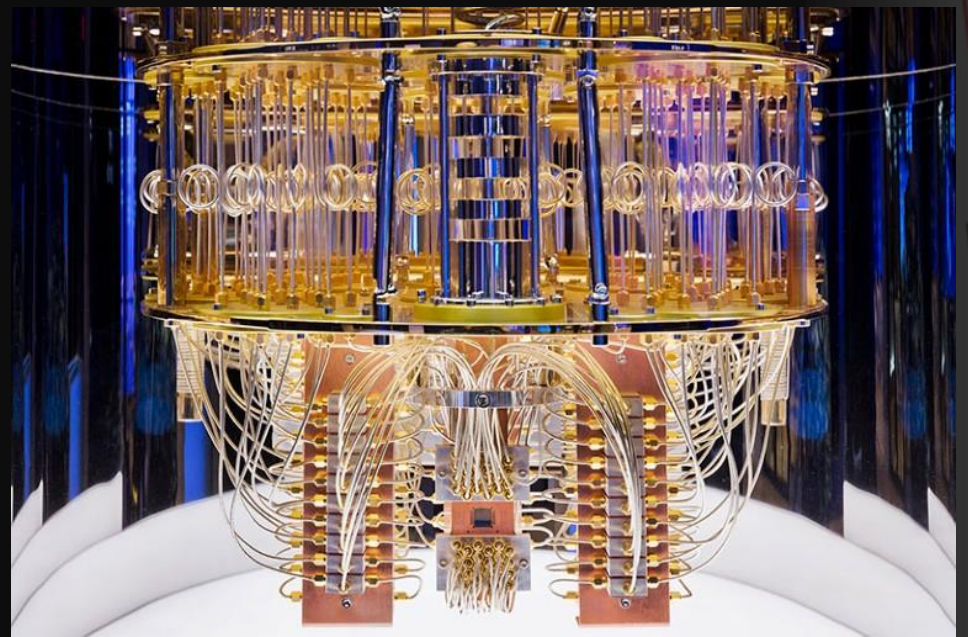


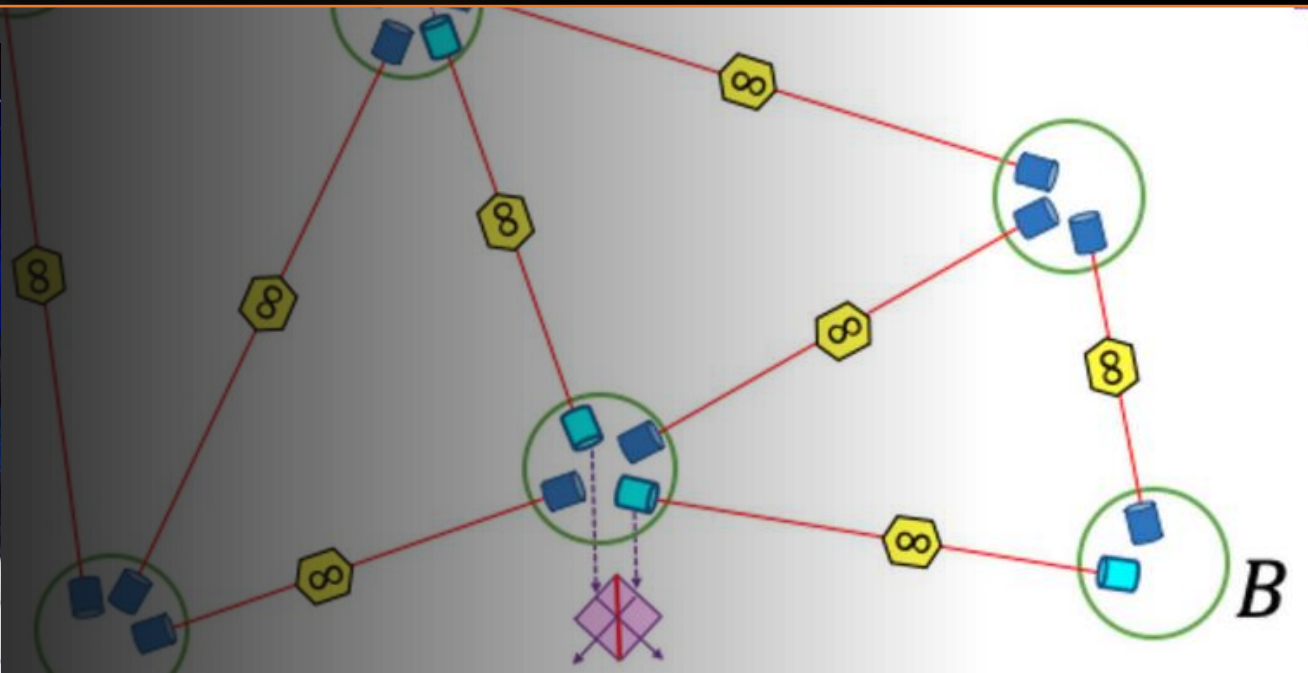
quantum-safe messaging and communication application

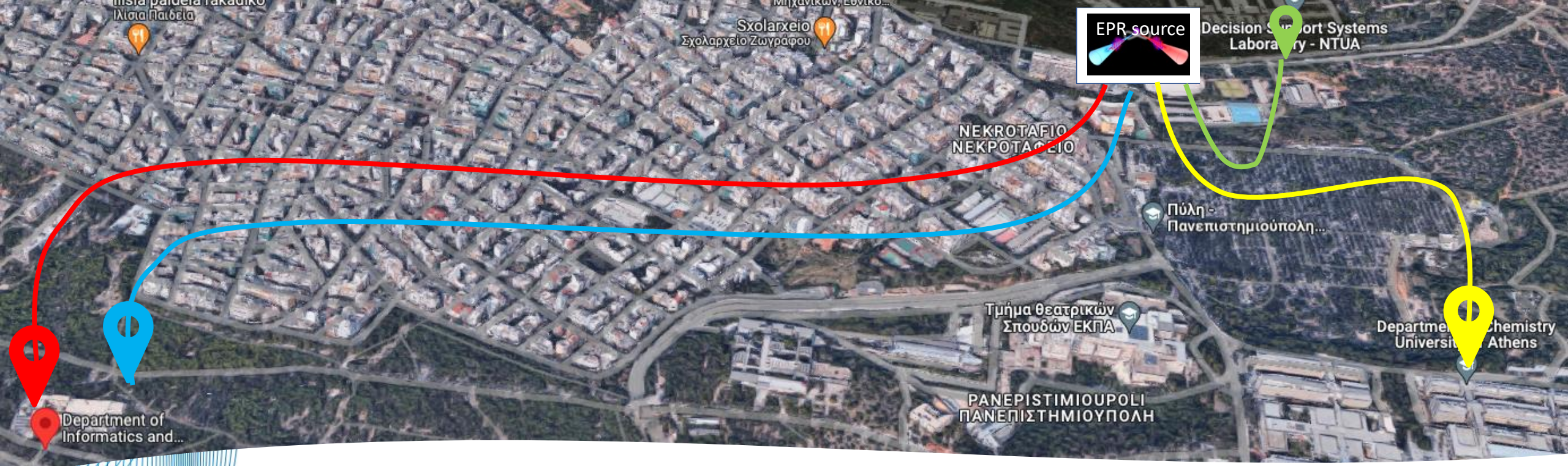
UBITECH quantum technologies



HellasQCI → Towards the Quantum Internet







World-class Entanglement distribution in Greece

- ✓ **Entanglement** distribution and **quantum teleportation** is an essential element for the quantum internet
- ✓ HellasQCI will implement a state-of-the-art active entanglement distribution network using **cryogenic single photon detectors in NKUA** and **entanglement sources in ICCS/NTUA**

HellasQCI Objectives

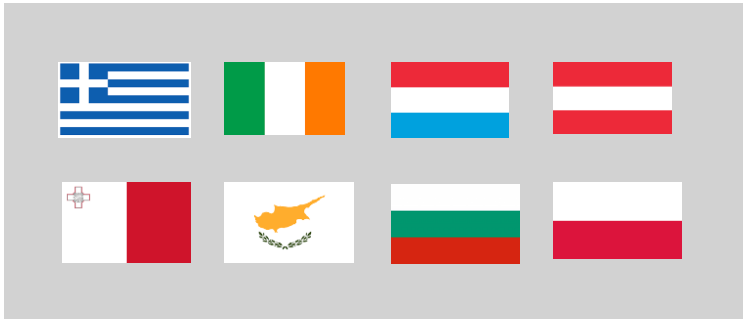
O4: Provide a training environment for technical, research and end-users staff

- Training workshop events
- Summer schools for MsC/PhD students
- Integration of HellasQCI training material in MSc and undergraduate courses
- Online training platform

O5: Cooperation with EU Member States to build robust, interoperable and secure QKD systems and networks for the EuroQCI

- 7 partnerships with **Austria, Luxembourg, Bulgaria, Cyprus, Malta, Poland** and **Ireland** National QCI proposals
- GRNET is partner to **PETRUS CSA** project and participates in the Quantum subtask of the **GN5-1 GEANT's** project
- University of Luxembourg (UNILU) the coordinator of **Lux4QCI** and the Walton Institute, Waterford Institute of Technology (SETU-WIT) **IrishQCI** are Associated Partners (AP) in the HellasQCI proposal and vice-versa

HellasQCI training plan		Academia & Research	Security & IT experts	End users & Public authorities
M04 - M18	Stage 1	Undergraduate and Msc Courses PhD programs Workshops & Tutorials	Workshops & Tutorials	High-level tutorials & High-level material
M18-M24	Stage 2	Lab-scale demo & summer school in Athens (July 2023)	Key management – QKD Hardware installation/operation /interfaces/classical encryptors	Emulation platforms for hands-on experience in lab
M24-M30	Stage 3	Demo activities in EDU/IND testbeds	Demo activities in EDU/IND testbeds	Demo activities in GOV testbeds



HellasQCI Objectives

O6: National Stakeholder Engagement	• Establishment of the **HellasQCI community** from all relevant national stakeholders that can benefit and support the HellasQCI networks, gather expertise and share knowhow on QCI and QKD that can be applied in practical and sustainable use cases •Ensure **better participation** into the **EuroQCI** and **leverage** new **end-users** for the expansion of the HellasQCI networks
O7: Provide a secure architecture compatible with EU Standards and Certifications	•**Alignment with QKD security standards, certifications, and regulations**: To assure HellasQCI alignment with the latest European and International QKD standards •Cooperation with the EuroQCI DEP-Topic 3 CSA "Petrus"
O8: Space segment connectivity	•All 3 telescopes part of ESA ARTES Skylight programme •Each one of the 3 observatories is going to be connected via optical fibers to the closest HellasQCI test-site, and will serve as a permanent trusted node in the HellasQCI •Upon the availability of Eagle-1 satellite the OGSs will be ready to allow for the demonstration of various scenarios

ETSI

CENELEC
EUROPEAN COMMITTEE
ELECTROTECHNICAL STANDARDIZATION

scylight

6th Annual ScyLight Conference

6th Annual ScyLight Conference
Athens, Greece 15 - 16 May 2023

Workshop - Quantum Internet
Kalavryta, Greece 17 May 2023

Ministry of Digital Governance
co-host the Conference with ESA
and **HellasQCI** project is an official supporter

https://atpi.eventsair.com/scylightconference2023/

Thank you

Dr. Ilias Papastamatiou

Any Questions?

HellasQCI.eu

HellasQCI - Quantum Communication Infrastructure for Greece

Co-funded by the European Union

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