European Quantum Projects Overview

ICFO

QUANTUM FLAGSHIP

QUCATS   IncoQFLAG

QUANTUM FLAGSHIP

COORDINATION

QSN PARTNERSHIP

QIA QUANTUM INTERNET ALLIANCE
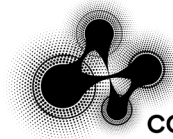
PASQuanS²

COMMUNICATION

SIMULATION

EUROQCI

Petrus

EURO QCI SPAIN

COMUNICACIONES CUÁNTICAS

CUCO
COMPUTACIÓN CUÁNTICA EN INDUSTRIAS ESTRATÉGICAS

SPIN-OFFs
Quantum

LUXQUANTA

EUROPEAN PROJECTS
Quantum

QNETWORKS

Quango

QUDICE
QUantum Devices and subsystems for Communications in spacE

Dynamite
Next Generation Quantum Simulators:
From Dynamical Gauge Fields to Lattice Gauge Theory

MQsens

DAALI

FLIGHT

Others: PoLIGHT, VeriqTAS II, NeQST, ExTRaQT, ADEQUADE, OPMMEG, DIGIQ, QTINDU, QUANTIFY

QUCATS

Coordination & Support Action for the Quantum Flagship

QUANTUM FLAGSHIP

The Quantum Flagship's new Coordination and Support Action 'QUCATS' will run from 1 May 2022 to 30 April 2025. As a continuation of QSA and QFlag, QUCATS will strengthen the Flagship's foundations and steer it through the next phase, in which European quantum technologies mature and the ecosystem of initiatives expands.

GOALS

1
Foster an open and inclusive ecosystem at the European and international levels

2
Contribute to the development of QT benchmarks and standards

3
Step-up training and education of a quantum aware workforce

HIGHLIGHTS

1b €
Quantum Technology will be funded with at least one billion Euro by the European Commission.

5000+
researchers residing in all EU and associated countries involved

140
Research and Innovation Actions (RIA) proposals submitted in response of the first Quantum Flagship call

PROJECTS

COMMUNICATIONS	SIMULATIONS	COMPUTING	TESTING & PILOT
QSNP QIA	PASQUANS^2	OPENSUPERQ+	QUTEST QUPILOT

qt.eu

@QuantumFlagship

QSN PARTNERSHIP

QUANTUM FLAGSHIP
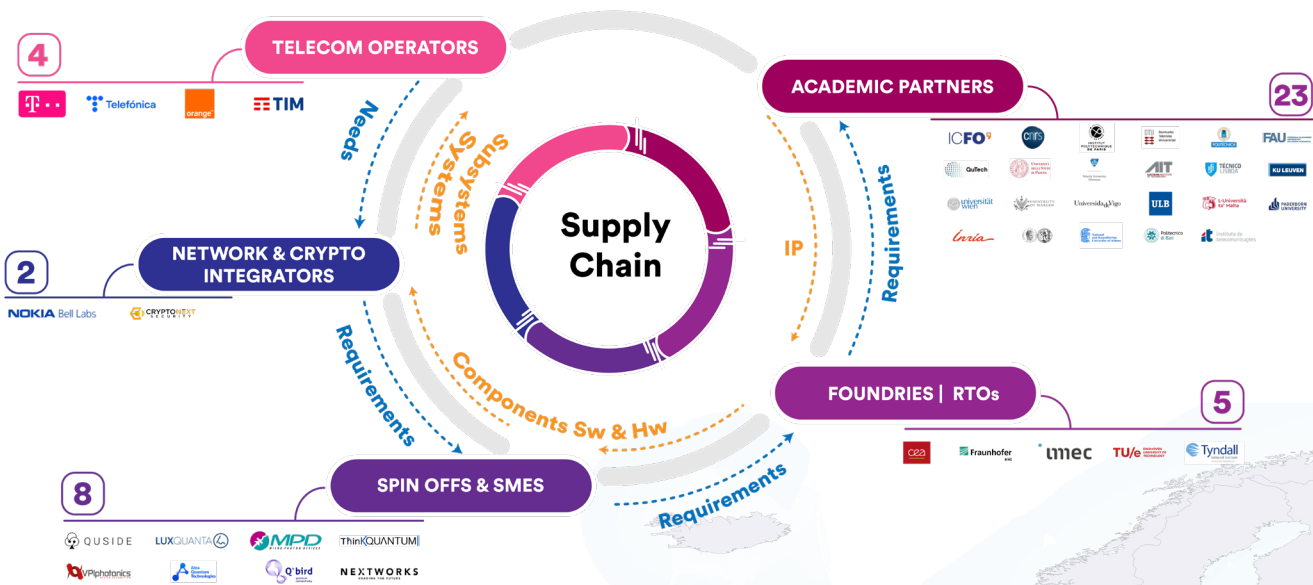
Quantum Secure Networks

QSNP is a project of the Quantum Flagship initiative within the Quantum Communication research pillar. It will work towards further developing and deploying post-quantum protocols based on Quantum Key Distribution (QKD) and integrating them into the classical telecommunications network adding a new layer of ultra-secure communications. Ultimately, it seeks to create a sustainable European quantum communications technology ecosystem.

1 Develop advanced technology for quantum secure communication networks against the ever increasing power of computers and sophistication of algorithms (also for quantum computers)

2 Integrate quantum cryptography technology at component, system and network levels, also into classical communication

3 Deploy technology into Quantum-safe critical governmental infrastructures, private telecommunication market sector and future quantum internet

Supply Chain

4 TELECOM OPERATORS
· · ·T· · · Telefónica orange TIM

2 NETWORK & CRYPTO INTEGRATORS
NOKIA Bell Labs CRYPTONEXT

8 SPIN OFFS & SMES
QUSIDE LUXQUANTA MPD ThinkQUANTUM
VPIphotonics Aliro Quantum Technologies Q'bird NEXTWORKS

23 ACADEMIC PARTNERS
ICFO CNRS DTU FAU
QuTech AIT TÉCNICO LISBOA KU LEUVEN
Universität Wien Universidde Vigo ULB PADERBORN UNIVERSITY
Inria Politecnico di Bari

5 FOUNDRIES | RTOs
cea Fraunhofer imec TU/e Tyndall

Needs · Subsystems · Systems · IP · Requirements · Components Sw & Hw · Requirements · Requirements

3.5 yrs **25** M€ **42** partners **14** countries

qsnp.eu @QSNP_eu

QIA QUANTUM INTERNET ALLIANCE

QUANTUM FLAGSHIP

The mission of the Quantum Internet Alliance (QIA) is to build a global Quantum Internet made in Europe – by developing a full-stack prototype network, and by driving an innovative European Quantum Internet ecosystem capable of scaling the network to worldleading European technology.

1 Realize a full-stack prototype network able to distribute entanglement between two metropolitan-scale networks via a long-distance backbone (>500 km) using quantum repeaters

2 Establish a European platform for Quantum Internet development, which will act as a catalyst for a European Quantum Internet Ecosystem including actors all along the value chain
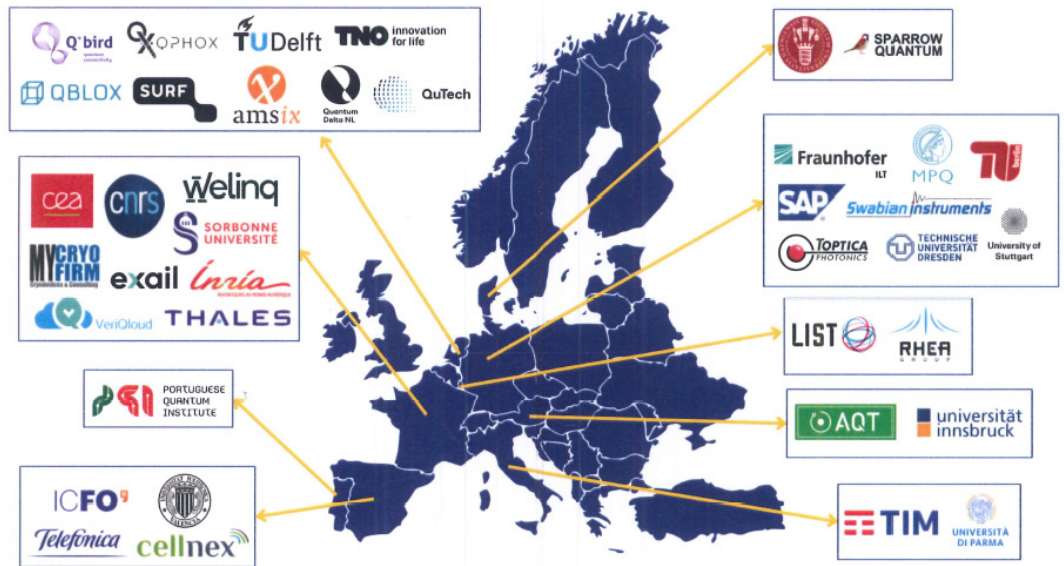
3.5 yrs   **25** M€   **39** partners   **9** countries

quantuminternetalliance.org   @eu_qia

PASQuanS2 sets out to transform the development of programmable quantum simulation in Europe over the next seven years. Following a two-stage approach, one of the major objectives of this first project phase PASQuanS2.1 (running for the next 3.5 years), is the development of quantum simulators with at least 2,000 atoms and a path towards 10,000 while improving control, stability, and scalability

PASQuanS2 's mission is to bring about transformative advancements in quantum simulation. This includes leveraging cutting-edge technologies and fostering collaborative partnerships with industry technology partners, supply chain stakeholders, and end-users.

Hardware Platforms and Software

Develop advanced hardware platforms along with tailor-made software. These platforms will enable the demonstration of quantum advantage in solving real-world problems, both in academic and industrial settings. The successful implementation of this technology will pave the way for the subsequent phase of the project, PASQuanS2.2.

Integrated Hardware Supply Chain

A robust supply chain will be created to produce modular systems that can be seamlessly integrated into experiments during PASQuanS2.2. These modular systems will serve as building blocks, facilitating further advancements in quantum simulation research.

Collaboration with Industrial Partners

We aim to establish a pipeline that allows the transfer of these building blocks to our industrial partners. This collaboration will enable the industry-driven production of quantum simulators and the development of open online platforms. This initiative will foster innovation and promote accessibility to quantum simulation technology.

01/04/2023
START DATE

27 PARTNERS
FROM 7 COUNTRIES

16.6 MIL €
BUDGET

pasquans2.eu   @pasquans2

IncoQFLAG

QUANTUM FLAGSHIP

The Quantum Flagship International Cooperation on Quantum Technologies InCoQFlag project aims at identifying the win-win situations in terms of collaborations with countries investing massively in Quantum, such as the United States of America, Canada and Japan.

Combining the same level forces to reach critical mass to cope with targeted challenges, or selecting complementary competencies to investigate the same objective, are two different approaches to international collaborations.
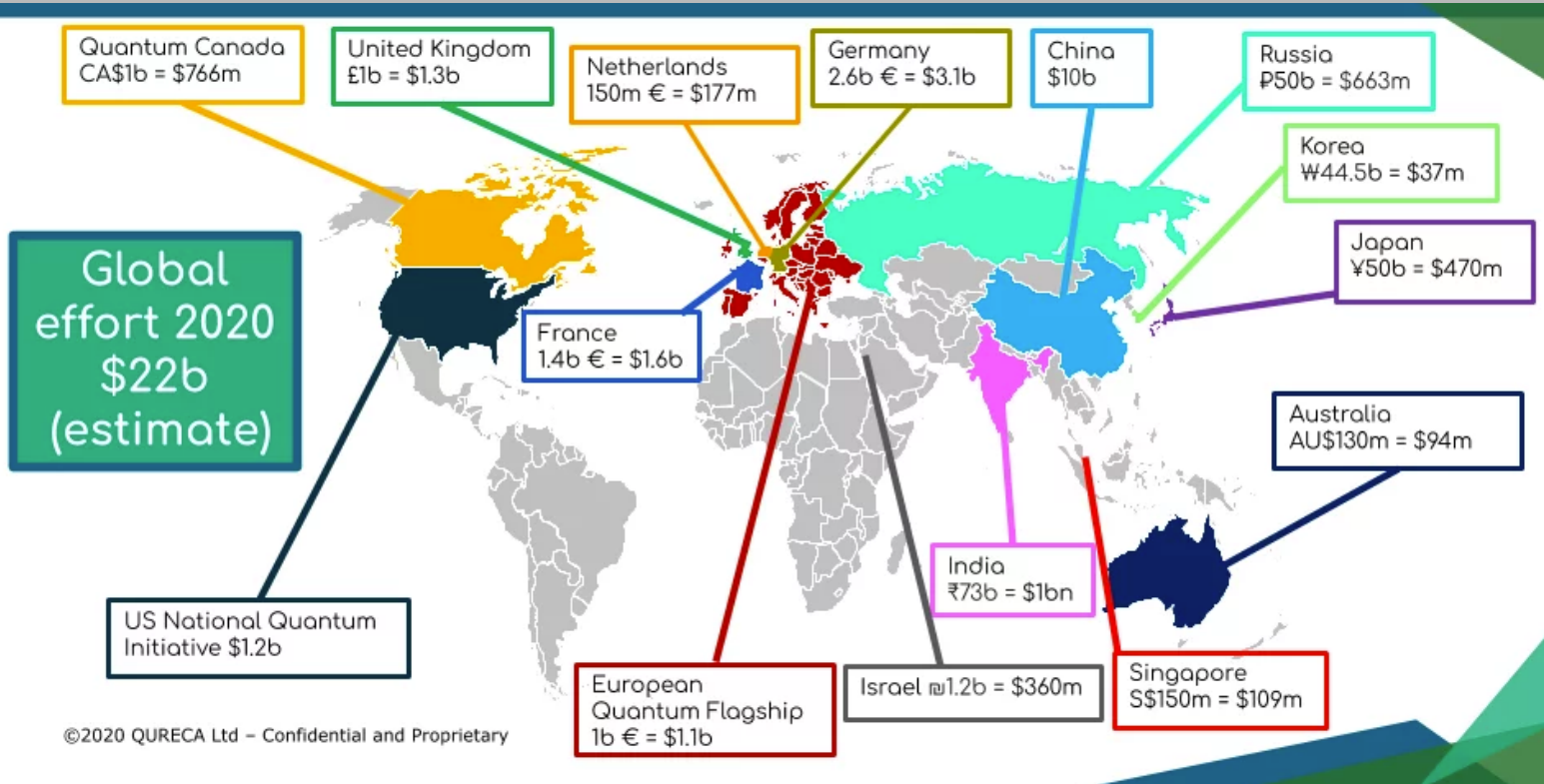
Objective 1

Outline Europe's strengths and missing competences to benefit from international collaboration

Objective 2

Mapping national innovation strategies and available funding schemes in targeted countries

Objective 3

Roadmap for win-win International Cooperation in Quantum research and innovation

Quantum Canada
CA$1b = $766m

United Kingdom
£1b = $1.3b

Netherlands
150m € = $177m

Germany
2.6b € = $3.1b

China
$10b

Russia
₽50b = $663m

Korea
₩44.5b = $37m

Japan
¥50b = $470m

France
1.4b € = $1.6b

Global effort 2020 $22b (estimate)

Australia
AU$130m = $94m

US National Quantum Initiative $1.2b

India
₹73b = $1bn

Israel ₪1.2b = $360m

Singapore
S$150m = $109m

European Quantum Flagship
1b € = $1.1b

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DAALI

DISRUPTIVE APPROACHES TO ATOM-LIGHT INTERFACES

New and disruptive platforms and protocols of achieving efficient interfaces between photons and atoms, in applications such as quantum memories for light and nonlinear optics at the single-photon level.

GOALS

1 Develop state-of-the-art interfaces between atomic media and nano/micro photonic systems

2 Demonstrate novel protocols for quantum memories and photon-photon gates

3 Bring together theoretical and experimental expertise in atomic physics, quantum optics, photonics

HIGHLIGHTS

Re-define the technological possibilities of atom-light interfaces

Develop new nano/micro photonic-based systems

Demonstrate for the first time a new paradigm based on ordered atomic arrays

TOOLS

THEORY   EXPERIMENTAL

Novel frameworks

Solid-state emitters

Ordered atom arrays

Nanocavities

Waveguide QED

PARTNERS

ICFO   SORBONNE UNIVERSITÉ   HUMBOLDT-UNIVERSITÄT ZU BERLIN   C2N   cnrs   WEIZMANN INSTITUTE OF SCIENCE   iXblue

daali-project.eu   #DAALI_EU

QUANGO

Objective 1

Design of a 12U-CubeSat low-earth-orbit satellite offering combined capabilities for communication secured by QKD and for 5G connection for Internet of Things (IoT)

Objective 2

The development of satellite payloads, sub-systems, and the corresponding ground stations

Objective 3

The study of the implementation feasibility of the network

GOALS

1 Design of a nano-satellite with both QKD and 5G capabilities for low orbit satellite-to-ground communication

2 Design and development of the quantum payload and ground station.

3 Laboratory demonstrations of the critical components and subsystems.

4 Theoretical study of future technologies: inter-satellite QKD and integration of QKD security into 5G protocols.

5 Exploitation and business plan for the 5G-QKD satellite.

3 Years

7 Partnering Institutions

5 Countries

4 M€ Budget for the project

quango.dei.unipd.it

#QUANGO

QUDICE
QUantum DevIces and subsystems for Communications in spacE

Integration of Quantum Key Distribution into Space Communications

Onboard 5G system and Quantum Key Distribution (QKD)

Bringing the latest quantum technology into space

Securing the Satellite communication network with Space-based QKD

Creating a quantum network in space

Enabling the Future of the EU space infrastructure with Quantum Technologies

Developing and aiming to deploy the future network of space-based quantum satellites that covers the entire European region

STATE-OF-THE-ART TECHNOLOGY

QRGNs

A redundant and high-speed (>1Gbps) QRNG containing two different Quantum Entropy Sources (QESs) will be designed, developed and tested.

DV-QKD source

The consortium seeks to develop a QKD source with a repetition rate 200MHz and able to modulate between at least two intensity levels and three ≥ polarization states, two of them orthogonal to each other and the third mutually unbiased.

Entangled source

A fully functional two-photon polarization entangled source will be manufactured in telecommunications wavelength range, and already developed technology will be utilized to reach space quality standards.

CV-QKD Source

The goal of the consortium is to design of the EM of a CV-QKD source meeting all the constraints of a satellite environment, the realization of the prototype and its validation in a relevant environment.

PAT system

The project intends to increase the Pointing Acquisition and Tracking subsystem Technology Readiness Level, in awareness that the key requirement of the design will be the pointing error in disturbed environment (jitter of satellite), the Field of Regard and the optical performance (degree of polarization, wavefront error) in different operating conditions.

5G systems

The QKD post-processing process via the onboard 5G system will be tested and demonstrated under realistic channel conditions, involving radio channel emulation for LEO scenarios with realistic link budget configurations and proper modeling of the different impairments in terms of delay and frequency shift and shift variation rates.

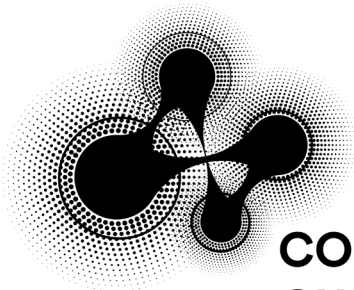| 3	11	5	4.3M€
Years	Partnering Institutions	Countries	Budget for the project

qudice.eu

#QUDICE

COMUNICACIONES CUÁNTICAS

This subprogram aims to consolidate and enhance the quantum technologies communications ecosystem in Catalonia through the development and deployment of related technologies that will channel via the design and development of hardware and software for technology technologies quantum communication.

LINE 1: EuroQCI

Development of a local Quantum Network at the autonomous community level, compatible with those developed by other autonomous communities, in order to have of the first versions of the infrastructure at the state level that will allow growth towards EuroQCI.

LINE 2: Hardware for Quantum Comms

Development of components and systems for Quantum Communication, Quantum Key Distribution and Quantum Internet

LINE 3: Software for Quantum Comms

Design and security analysis of quantum cryptography protocols, networks quantum communications and quantum certification

LINE4: Quantum Processing Hardware

Advances in the design and development of systems and materials appropriate for the construction of Quantum Processing devices

LINE 5: Quantum Processing Software

Development of quantum processing technologies that allow more complex tasks to be carried out and obtain better results

LINE 6: Human Resources |Training for Innovation and Entrepreneurship

Development of quantum processing technologies that allow more complex tasks to be carried out and obtain better results

LINE 7: Ecosystem of Industrial Innovation, Diffusion and Exploitation of Results

Dissemination of program results, facilitate the transfer of knowledge to the productive sector, attraction of technology-based companies to create an industrial ecosystem in the environment of quantum communications.

QNETWORKS

Q-NETWORKS aims at developing the foundational building blocks for a Quantum Internet, and to perform first field demonstrations. The ever-increasing range of applications of quantum technologies will soon require a fully functional quantum network. ICFO and XOC have created a common roadmap that includes the creation of a quantum network testbed, the identification of the first use cases and the promotion of IP protection and commercialisation measures. The technology has a powerful position with a clear international dimension (European and Global) placing Spain in a leading position with regard to the development of Quantum Repeaters for entanglement distribution.

GOAL

Develop quantum technology for

- Entanglement based QKD (photonic entanglement sources)
- Quantum Repeater for long distance quantum communication (quantum memories)

Entanglement distribution in quantum networks

- Novel sources of photonic entanglement (fast, compact, deployable)
- Demonstration of entanglement based QKD
- Realization of spatially multiplexed quantum memory
- Generation of long distance matter-matter entanglement
- Field demonstrations of entanglement distribution (photonic and matter qubits)

Quantum Network

Quantum Repeater

PARTNERS

#QnetworksBCN

EURO QCI SPAIN
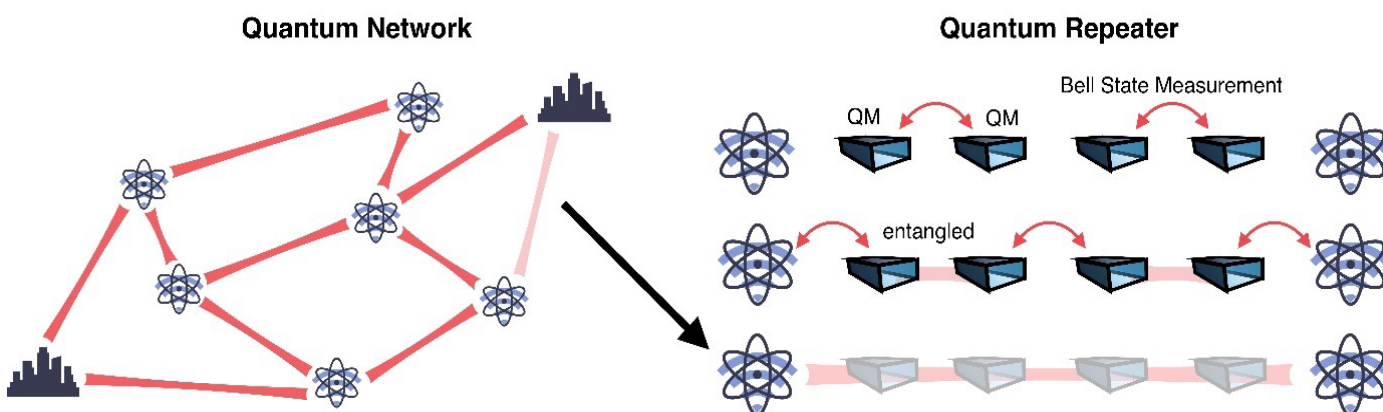
DESIGN

Design quantum cryptography encryption methods based on quantum physics

DEVELOP

Develop Develop technology based on Quantum Key Distribution cryptograph approaches

DEPLOY

Integrate this innovate novel technology into the current existing telecommunications networks to facilitate an additional ultra-secure layer in the transmission of information.

GOALS

1 Design the preliminary National architecture of EuroQCI in Spain, starting from the nodes in the metropolitan areas of the largest Spanish cities, Madrid (MAD) and Barcelona (BCN), and then extending to more locations.

2 Deploy QKD and cryptography systems and demonstrate their functionality in the field, in the BCN and MAD nodes. And design the extension to additional cities.

3 Make quantum networks available first to public authorities and demonstrate use cases, developing a national-based quantum communication ecosystem, that can also be extended to the private sector in the future.

4 Assess feasibility of free-space and long-distance quantum communication networks (including trusted nodes and quantum repeater demonstrators) compatible with the EuroQCI architecture, intracity and intercity, the latter in preparation of large-scale deployment of QCI beyond national borders.

5 Prepare for very long-distance links by studying the interface between QCI space and terrestrial segments.

6 Cooperate and participate with other Member States in the deployment plan and strategic efforts towards designing and building the EuroQCI system architecture.