27 March 2025

Statement of Work

Executive Summary

The contract pertains to the implementation of “Secured data sharing using a Quantum Key Distribution network” for the execution of project SST Networking, Security & Data sharing (Horizon Europe TOP5 subcontract: 5H3.2_01). The contract includes the study, design, deployment and demonstration of a quantum secured interconnection between the GR_KRYONERI and GR_NOC nodes, both of which are part of the EU-SST consortium and belong to the National Observatory of Athens. The National Observatory of Athens, by participating in both the EU-SST program (through the GR_KRYONERI telescope and the GR_NOC operational center) and the HellasQCI program, aims to establish a quantum communication link between the GR_KRYONERI located in Kryoneri, Corinth, in the Peloponnese and the GR_NOC at its Penteli, Attica premises. This connection will utilize quantum encryption technology to secure the transfer of data between these two locations. The contract includes all necessary services for the comprehensive study, implementation and operation readiness of the quantum telecommunication infrastructure linking the GR_NOC and GR_KRYONERI nodes and securely transfer EU-SST related data.

Contents

1. CONTRACTING AUTHORITY AND SUBJECT OF THE CONTRACT

Contracting Authority Details

Name	**Special Research Funds Account (SRFA) of the National Observatory of Athens (NOA)**
Value Added Tax (VAT)	997028265
Κωδικός ηλεκτρονικής τιμολόγησης	1035.E00664.0001
Mail address	Akteou 11, Thissio
City	Athens
Postal Code	11851
Country	Ελλάδα
NUTS code	EL301, EL303
Telephone	+30 210 3490031, +30 210 3490069
e-mail	gvlaxaki@noa.gr, kantoniou@noa.gr
Responsible for information (technical matters)	Vlahaki Georgia, Antoniou Konstantinos
URL	www.noa.gr

Type of Contracting Authority

The Contracting Authority is a Research Center of article 13a of Law 4310/2014 (Government Gazette A' 258), supervised by the General Secretariat for Research and Innovation of the Ministry of Development and belongs to the other bodies of General Government (except Central Administration) according to the subdivisions of article 14 of Law 4270/2014.

Contact Details

a) The contract documents are available for free, complete, direct & free electronic access through the ESIDIS Procurement and Services Portal in the following link

b) Any type of communication and exchange of information is carried out through ESIDIS Procurement and Services (hereinafter referred to as ESIDIS), which is accessible from the ESIDIS Procurement and Services Portal (www.promitheus.gov.gr).

c) Further information is provided: a) For issues concerning the procedure, from the Procurement Office of SRFA/NOA, tel. +302103490031/+302103490069 and b) For technical issues from Dr. Manolis Xilouris, tel. +302103490870, email: xilouris@noa.gr.

d) The contract documents are also available on the website of the Contracting Authority (https://www.noa.gr/competition)

e) Unlimited, full, direct and free access to the said tools and devices is possible at the address (URL): http://www.eprocurement.gov.gr

Total budget

Description of services provided	**Estimated contract value (plus 24% VAT)**	**VAT (24%)**	**Estimated contract value (including 24% VAT)**
Secured data sharing using a Quantum Key Distribution network.	**112903,23€**	**27096,77€**	**140000,00€**

Deadline for receipt of offers

The deadline for receipt of tenders is 30/04/2025 at 10:00 Athens Time

The procedure will be carried out using the National Electronic Public Procurement System (ESIDIS), (Website www.promitheus.gov.gr)

After the deadline, it is not possible to submit a tender to ESIDIS. The time of submission of tenders and any electronic communication through the system is automatically confirmed by ESIDIS with timestamping services in accordance with the provisions of article 37 of Law 4412/2016.

2. DETAILED DESCRIPTION OF THE PHYSICAL AND ECONOMIC SUBJECT OF THE CONTRACT

Brief Description of the services and operation of Contracting Authority

The National Observatory of Athens, the first research center of modern Greece, has been operating continuously since 1842, offering its services to science and society. Its public nature has existed since 1846, the year of its first operation on the Hill of the Nymphs in Thissio, while its course is intertwined with the very history of modern Greece. The Center's course is marked by enlightened and distinguished scientists who transmitted scientific methodology to Greece and opened the way to knowledge. The National Observatory of Athens today plays an important role in developments and research trends in Astronomy, Astrophysics, Space applications, Environment, Energy and Meteorology, Seismology and Geodynamics, at a European and international level. It implements major research programs, which are funded by the European Community, the European Space Agency (ESA) and other

international organizations, contributing to the promotion of research, scientific development and the attraction and employment of young talented researchers and scientists from Greece and abroad.

The Institute of Astronomy, Astrophysics, Space Applications and Remote Sensing (IAASR) is one of the three Institutes of the National Observatory of Athens (NOA) and the largest Institute in its field in Greece. The Institute operates a wide range of national facilities aimed at supporting research and services in the respective fields, such as: (a) the Aristarchos 2.3 m and Kryoneri 1.2 m telescopes and their corresponding instruments; (b) the European Digital Upper Atmosphere Server System (DIAS) and the Athens Digisonde DPS4D station for ionosphere monitoring; (c) the BEYOND operational unit that maintains satellite reception antennas and computing infrastructure; (d) the HESPERIA operational unit for space weather forecasting; (d) the IAASARS remote sensing section concerning the PANGEA climate observatory in Antikythera; (e) the HellENIc GeoMagnetic Array - ENIGMA. Under the coordination of the National Observatory of Athens, Greece participates in the EU Space Surveillance & Tracking Program (EU-SST) partnership during the period 2023-2026. In the context of this cooperation, the NOA, as coordinator of the Greek partners, Aristotle University of Thessaloniki, National Technical University of Athens and the Foundation for Technology and Research of the University of Crete, co-signed with the other 15 members of the EU-SST partnership the contracts for the implementation of the Operational Program EUSST2023-GA, with the participation of the telescopes GR_THESSALONIKI-1, GR_HOLOMON-1, GR_KRYONERI and the operational center GR_NOC, and furthermore participates in the implementation of the research projects HETOPs 1-5. At the same time, at the end of 2019, Greece signed the Declaration on the European Quantum Communication Infrastructure (EuroQCI), signaling its commitment to the EuroQCI initiative, which aims to create a high-security infrastructure for quantum communications (QCI) that will cover the entire European Union. In response to this commitment, HellasQCI, the National QCI of Greece, was created, which aims to strengthen Europe's scientific and technological capabilities in the field of cybersecurity and quantum communication technologies. Through HellasQCI, an advanced national testbed infrastructure for quantum systems and networks is expected to be created, for experimentation with quantum communication technologies and for their integration with existing communication networks.

The National Observatory of Athens, wishing to leverage its participation in both the EU-SST program (through the GR_KRYONERI telescope and the GR_NOC operational center) and the HellasQCI program, intends to establish a connection between these two locations (GR_KRYONERI is located in Kryoneri, Corinth, Peloponnese, and GR_NOC on the premises of the National Observatory of Athens in Penteli, Attica) through a network that will use quantum encryption technology. This contract will include all the relevant services required to complete the connection of the GR_NOC/GR_KRYONERI quantum telecommunication nodes with the ultimate goal of transferring data related to the EU-SST program between these two locations. List your competitors here, and include reasons why your company is positioned well to handle any competition.

Scope of the activity

In order to establish a connection link between the GR_KRYONERI and GR_NOC nodes (both participating in the EU-SST consortium and belonging to the National Observatory of Athens),

using quantum communication technologies, a specialized telecommunications consultancy service is required. The service will carry out a detailed study of the network architecture, assess the necessary system components within the existing network infrastructure, specification and deployment of the required systems, staff training as designated by the Contracting Authority, maintenance and the demonstration of the efficient operational performance. The HellasQCI project aims at developing an advanced National Quantum Communication Infrastructure (QCI) in Greece. HellasQCI, is part of the European Quantum Communication Infrastructure Initiative (EuroQCI), contributing to the security of sensitive data and critical sectors, such as governmental agencies, healthcare institutions, financial systems, and other critical infrastructures. This will be achieved by integrating quantum-based technologies and systems, and in particular, by leveraging quantum key distribution (QKD) and QKD-based encryption technologies into existing communication infrastructures that will offer an information-theoretically secure encryption mechanisms, ensuring resilience against future quantum computing threats. These quantum cryptographic systems, by utilizing QKD-generated keys to encrypt sensitive data, will provide the highest level of security in terms of data protection. HellasQCI project provisions the deployment of three metropolitan quantum networks (MQN) in Athens, Thessaloniki and Heraklion, Crete, where each of them will connect to a respective ESA-selected optical ground station (OGS) – Helmos OGS to Athens MQN, Holomondas OGS to Thessaloniki MQN, and Skinakas OGS to Heraklion MQN. These connection links will utilize, among others, QKD devices, terrestrial optical fibers, and ground-to-satellite technologies. In the coming years, the national QCI backbone established within HellasQCI will be further expanded to interconnect additional cities in Greece, as well as with other European Member States, forming a key component of the EuroQCI Pan-European Quantum Communications Infrastructure.

Technical Specifications

The scope of the contract includes the study, design, deployment and demonstration of the GR_KRYONERI and GR_NOC nodes interconnection (both part of the EU-SST consortium and belonging to the National Observatory of Athens), through cutting-edge quantum communication technologies. To establish the necessary connections, two distinct requirements must be met: (i) the design of a “dark” fiber optic network for the generation and distribution of QKD keys from one end to the other (GR_NOC to GR_KRYONERI and vice versa), as well as the fiber optic links that will transport the encrypted information through designated trusted nodes and (ii) to identify and employ the necessary equipment for the realization and efficient operation of the fiber optic network.

(i) Fiber optic network architecture. The existing fiber optic network infrastructure for the secure transfer of encrypted information (satellite orbital data recorded by GR_KRYONERI and satellite orbit tracking requests by GR_NOC) is largely in place. This network is operated by GRNET and maintained by COSMOTE S.A, offering end-to-end connectivity between GR_NOC and GR_ KRYONERI with data transfer speeds of up to 10 Gbps. The network for the transfer of the QKD-generated keys (which will be used to encrypt the data to be transferred) is based in a great degree on the HellasQCI network, which is currently under development in Greece. The necessary fiber infrastructure is already deployed along the full route from GR_ KRYONERI to GR_NOC. Once the appropriate equipment [with Quantum Key Distribution (QKD) capabilities] is integrated, the network should be able to exchange quantum encrypted information using QKD-generated keys.

(ii) Equipment. To establish a quantum secure interconnection between the GR_ KRYONERI and GR_NOC sites, the existing “dark fiber” network will serve as the communication channel. Both sites will be directly connected to the HellasQCI network backbone, requiring the following additional equipment (the final specifications of which will be determined and finalized by the contractor by providing the corresponding technical study):

A) Optical switches: The optical switches will allow the existing HellasQCI network to be dynamically connected to both the GR_ KRYONERI and GR_NOC sites, without affecting the normal operation of the network. Specifically, optical switches will be installed at designated nodes of the HellasQCI network for the flexible and on-demand switching of the optical connection between the nodes of the network. These optical switches should meet, at a minimum, the following criteria:
- Operate in the C-band, where the quantum key distribution (QKD) channels installed in the HellasQCI backbone operate.
- Have low insertion loss (< 0.8 dB), to accommodate potentially long-distance high-loss fiber optic links within the power budget of the QKD systems.
- Provide low level of interference (crosstalk < -70 dB) to the classical signals required by QKD devices for synchronization, timing, authentication and error correction, which are performed in parallel with the transfer of quantum information in the quantum channel.
- Have low back reflection (< -50 dB), good loss repeatability and connection stability.
- Be accompanied by an interface board (breakout board) and support remote control (e.g. via RS232 and/or USB interface).

B) Ethernet Switches: Ethernet switches are essential components in a QKD node, as they serve the classic communication management, its integration with key management systems and the network control and monitoring function. In the context of this use case, Ethernet switches must support encryption at the MAC (Layer 2 / MACsec) or IP (Layer 3 / IPsec) level, ensuring that data traffic between the GR_KRYONERI and GR_NOC nodes is encrypted. The Ethernet switches/encryptors at L2, L3 level must at least:
- Have demonstrated full compatibility with quantum key distribution (QKD) systems currently used in the HellasQCI network, and interface via standardized protocols, such as ETSI QKD GS 014.
- The encryption software should be integrated into the switch management software. The encryption parameterization, as well as the switch interface with the quantum key distribution devices, should be implemented either through the encryption software itself, or through an external code file (e.g. script file) that will accompany the main software of the switch. In the case where an external script file is required, this should provide the ability to automate the management and encryption processes, ensuring easy and efficient operation.
- Have a sufficient number of copper ports (ethernet ports) (≥16) and at least two (2) optical ports (SFP ports) to cover the needs of the QKD node rack for the current quantum connection and possible future expansions.
- Must be accompanied by a suitable SFP for its connection to the existing HellasQCI network. The exact type, model and characteristics (e.g. SFP+, DWDM, 10G, ITU channel) will be determined by the contractor after studying the characteristics and architecture of the HellasQCI network.
- Have a number of interfaces >2 with the ability to encrypt network traffic with a capacity greater than 10Gbps.

- Support real-time control and monitoring capabilities, aiming at reliability and secure data distribution.

C) Polarization Analyzer: A Polarimeter is a critical tool for the holistic configuration, evaluation and optimization of communication network operations. In the context of HellasQCI, polarization-based QKD systems require constant control of the polarization state of light for the reliable transmission of quantum keys. Changes in polarization can occur due to environmental factors (e.g. temperature changes or mechanical stresses in optical fibers), affecting the performance of the system. The polarization analyzer will contribute to the timely detection and correction of these changes in the network, as well as the accurate measurement of polarization reduces the possibility of errors or vulnerabilities that could affect the security of the QKD system or the transport of encrypted traffic in the network. The polarization analyzer must at least:
- Be compatible with the operating wavelengths of QKD systems.
- Support at least one optical fiber input.
- Provide measurement of the polarization state (SOP) with an accuracy suitable for ensuring the stability of the QKD system.
- Support continuous monitoring and analysis of polarization changes in real time.
- Be easily integrated into the optical devices of QKD systems, with the possibility of low insertion loss.
- Have a high dynamic range (>=70dB)
- Support a high sampling rate (e.g. >=400 Samples/s).
- Be accompanied by polarization monitoring and analysis software, and include an alignment tool and an extinction ratio measurement tool.
- In case an external PC is required to read the polarization analyzer software, it should support interfaces for remote control (e.g. via RS232 and/or USB interface).

D) Server: To support QKD communications, the use of one or more specialized servers is required. These servers will serve a dual role: as data storage machines for encryption and transfer over the QKD network and as platforms for the operation of the Key Management System (KMS) software for communication, key management and interconnection with other systems and functionalities, such as satellite interconnection. The server must at a minimum:
- Have an operating system compatible with the KMS software.
- Have sufficient computing power through a powerful processor (server type CPU).
- Support virtualization functions for parallel execution of applications.
- Have enough RAM to support all demanding applications and efficient data processing.
- Have storage media with sufficient capacity for storing and transmitting data over the network.
- To be designed for operation in data center environments with support for 1U/2U rack-mounted cooling.
- To be able to withstand 24/7 operation with overheating prevention systems (hot-swappable fans).

The requested service is expected to include at least the following:
1. Detailed study of the architecture of the specific network and finding the optimal systems required for the functionality of the network in relation to the existing architecture of the HellasQCI network.

2. The complete determination of the specifications of the systems required for the correct operation of the quantum network between GR_KRYONERI and GR_NOC based on the produced architecture study.
3. The supply of these systems.
4. Their installation.
5. Training in their operation.
6. The guarantee of good operation and maintenance of these systems.
7. Demonstration of their proper operation.

Deliverables

The contract deliverables will be produced in three (3) Phases, which will be completed in the 3rd month, the 9th month, respectively, from the signing of the contract and on 31/8/2026 respectively, and will include:

Deliverable 1: Detailed study of the architecture of this specific network and the identification of the systems required for the functionality of the network in relation to the existing architecture of the HellasQCI network, as well as the determination of the specifications of the systems required for the proper operation of the quantum network between GR_KRYONERI and GR_NOC. This specific study will be in the form of an analytical text which will be delivered electronically to the Contracting Authority (NOA)

Deliverable 2: The implementation of the said quantum network between GR_KRYONERI and GR_NOC which will include:
1. The installation of the required systems for the provision of the services that resulted from the above study.
2. Their installation in the appropriate locations.
3. The training of the NOA personnel in their operation.
4. The guarantee of proper operation and maintenance of these systems.
This specific Deliverable will include the application of the study on the systems resulting from Deliverable 1, their installation, concession, and operation, as well as equipment operating manuals and a guarantee of good operation and maintenance that will be delivered electronically to the Contracting Authority (NOA).

Deliverable 3: The demonstration of the correct operation of the quantum network between GR_KRYONERI and GR_NOC. This specific Deliverable will also include a report describing the procedure followed for the demonstration as well as the results and which will be delivered electronically to the Contracting Authority (NOA).

Contract duration - Delivery times

The duration of the Agreement is set from the date of its signing until 31/08/2026. For the individual stages (Phases) of service provision, interim deadlines are defined as follows:

Phase 1: three (3) months from the signing of the Contract (linked to Deliverable 1)
Phase 2: nine (9) months from the signing of the Contract (linked to Deliverable 2)
Phase 3: until the end of the Contract on 31/08/2026 (linked to Deliverable 3)

The contractor's payment will be made as follows:
1. Payment of 5% of the contractual price, plus VAT, upon completion of 3 months from the signing of the contract and by the 2 parties upon delivery and acceptance by the acceptance committee of the deliverables of Phase 1.
2. Payment of 65% of the contractual price, plus VAT, upon completion of 9 months from the signing of the contract and by the 2 parties upon delivery and receipt by the acceptance committee of the deliverables of Phase 2.
3. Payment of 30% of the contractual price, plus VAT, upon delivery and receipt by the acceptance committee of the deliverables of Phase 3, in the last month of the contract, i.e. no later than 31/08/2026.

Place of implementation - provision of services

The service - which concerns study, application on equipment, learning how to operate it as well as demonstrating its correct operation by the Contractor - is carried out by visiting the premises of the Contractual Authority and after consultation with the Contractual Authority. Any documents associated with Deliverables are delivered electronically to the Contractual Authority (NOA).

Good Operation Guarantee Services

For the systems on which the study will be implemented within the framework of the contractor's provision of services, a free good operation guarantee of at least 2 years from the date of final acceptance of the project (Phase 3) is required.

Technical Support and Training Service

For the items being procured, the following is required: a. Technical Support Service for at least 2 years from the date of final acceptance of the project (Phase 3), as well as b. Training in the proper use of the equipment upon its installation (Phase 2). The date and time of the training will be confirmed by the contracting authority and the contractor. The training can be completed on-site or remotely, depending on the needs of the equipment.

Requirements

The contractor should be able to provide and fulfill the following requirements:

General

SOW-REQ-1: Detailed study of the architecture of the existing network and the identification of the systems required for the functionality of the network in relation to the existing architecture of the HellasQCI network.

SOW-REQ-2: Determination of the system specifications required for the proper operation of the quantum network between GR_KRYONERI and GR_NOC.

SOW-REQ-3: Commissioning of the selected systems.

Installation – configuration – cabling services

SOW-REQ-4: Full compliance with the requirements of paragraph "Duration - Delivery times", paragraph " Place of implementation - provision of services", and paragraph "Deliverables".

SOW-REQ-5: The contractor will fully undertake the transportation of the equipment to the site and its installation on the location that will be indicated to him. The contractor's responsibilities include the complete cabling of the system.

SOW-REQ-6: Upgrade all firmware/software to the latest version recommended by the manufacturer.

SOW-REQ-7: Configuration of the equipment for the basic settings according to those indicated by the Contracting Authority.

SOW-REQ-8: The contractor, in accordance with the instructions of the Contracting Authority, must install the systems at the exact locations GR_KRYONERI and GR_NOC.

Installation and Tests of nominal operation

SOW-REQ-9: Submission of a program of installation and tests of nominal operation during the implementation phase in agreement with the Contracting Authority. The program of these tests should include, at a minimum, equipment installation tests and equipment good operation tests.

Equipment warranty services

SOW-REQ-10: Full compliance with the requirements of paragraph “Good Operation Guarantee Services” of the equipment subject to the Contract.

SOW-REQ-11: Full support for proper operation from the manufacturer (of more than three years), included in the offer price and which will cover the cost of hardware, spare parts, components and labor, his travel expenses in the context of emergency calls to him, as well as other travel expenses.

SOW-REQ-12: Response from a certified technician from the manufacturer from the moment the fault is reported (within the next working day).

SOW-REQ-13: The failure notification will be documented by data from the management tools (log events, alerts) of the management environment of each subsystem without further diagnostics.

SOW-REQ-14: In the event of hardware damage, full recovery is provided by repairing or replacing the problematic part of the equipment.

SOW-REQ-15: Any deviation or exception to the warranty provided must be reported and explained in detail.

SOW-REQ-16: In the event that the installation, supply, availability of components/spare parts and/or repair/maintenance services are affected due to force majeure or crisis (e.g. pandemic), the warranty period will be extended to cover the period of interruption or disruption of service provision suffered by the Contracting Authority.

Training services

SOW-REQ-17: Full compliance with the requirements of paragraph "Technical Support and Training Service".

SOW-REQ-18: Training of personnel designated by the Contracting Authority on how the systems operate.

Other services

SOW-REQ-19: The Contractor shall transfer intellectual property rights to the Contractor Authority on all the methods, processes, software and analysis developed within this activity, accordingly to the EU SST Partnership IPR.

SOW-REQ-20: Application of the study proposed by the Contracting Authority on operating equipment/system.