EUROPEAN COMMISSION
DG DEFIS

TEMPLATE FOR THE CALL FOR IDEAS FOR RECOMMENDATIONS ON RESEARCH & INNOVATION (R&I) TOPICS IN QUANTUM TECHNOLOGIES FOR SPACE BASED SYSTEMS.

1. General information

Company/organisation	*Your name and institution*
E-mail of the company/organisation	*Your email*
Country	*Your Country*
Current field of interest	*Your main fields*

2. Provide here your 3 short-term priorities of R&I in the field of space based quantum technologies (for example in quantum communication, remote sensing, navigation and positioning, data processing, standards).

1) **Quantum communications (QComms): demonstration of a space/ground (fixed terminals) secure cryptographic key exchange using LEO satellites.**
2) **Qcomms: users authentication and message integrity in satellite operations via QKD space-to-ground links.**
3) **QComms: integration of classical and quantum communication for high speed secure data exchange from Space.**
4) **Alternative: Comms: demonstration of a space/ground (fixed terminals) secure cryptographic key exchange using MEO satellites.**

3. Provide here your 3 long-term priorities of R&I in the field of space based quantum technologies (for example in quantum communication, remote sensing, navigation and positioning, data processing, standards)

1) **QComms: cryptographic key exchange with small and mobile terminals.**
2) **QComms: intersatellite links for QKD**

3) ***QComms: distribution of quantum entanglement between two ground locations via a satellite links.***
4) ***Alternative: Comms: demonstration of a space/ground (fixed terminals) secure cryptographic key exchange using GEO satellites.***
5) ***Alternative: QComms: quantum repeaters in channels including space links***
6) ***Alternatives: QComms: quantum memories in satellites for QComms.***

4. **Provide here your priorities of R&I in the field of space based quantum technologies components (satellite payload components, optical terminals, photon source developments…) and identify their use for a space mission.**

QKD hardware for satellite payload: robust and lightweight state generators

QKD hardware for satellite payload: integrated photonics space qualified.

QKD hardware for satellite payload: optical link with losses below 30 dB via microrad-class pointing accuracy and reduced beam divergence.

QKD hardware for satellite payload: interplay of quantum and classical communication payloads

QKD hardware for satellite payload: efficient and robust key storage system

QKD hardware for satellite payload: wavelength division multiplexing for QKD protocols

QKD hardware for satellite payload: quantum random number generators (QRNG) for qubit generation and for the classical algorithms eventually onboard.

QKD software for satellite payload: efficient and robust key management

QKD hardware for satellite payload: efficient and robust key storage system

Theoretical development of QKD protocols over high-loss fluctuating channels using discrete-variable photon encodings.

Theoretical development of QKD protocols over high-loss fluctuating channels using continuous-variable encodings.

Optical terminals for QKD receivers

QComms certification procedures developed by the relevant agencies on both national and international levels.

Protocols beyond QKD for links including satellites, addressing oblivious key transfer, digital-signature, quantum coin-flipping, quantum fingerprinting.

5. **Provide here your assessments of threats and risks associated to the deployment of a European space based quantum ecosystem.**

Please use the required space for your answer.

The principal objectives of satellite QComms is to protect the European economy and society from cyber threats, to provide a stronger users authentication and to link ground networks on different areas via space.

Europe-wise assets directly at risk include money transfer, commercial transactions, medical data, remote control of infrastructures (power grid, telecom etc.). Examples of successful attacks are known from years and increasing in intensity.

For these aims, end-to-end network architectures leveraging on several innovative technologies are put together, creating the vision of a quantum communication infrastructure encompassing Space and ground links.

6. **R&I topic detailed proposal (one per topic): Provide here a detailed description of your proposed R&I topic for a space based quantum technology or for a specific quantum technology component.**

Proposed R&I topic	Prototyping Wavelength division multiplexing for space QComms
Justification and main achievements expected, for example expected performance vs classical technology, TRL improvement…	WDM QComms 16 channels transmitter at TLR 7. The key rate scaled accordingly to the multiplexing capacity.

Estimated required budget	1 M€
Estimated timeline	24 months
Potential synergies with other funding sources to be exploited	May benefit of a synergy with advancement in space-qualified integrated photonics. May benefit of a synergy with advancement in high speed quantum random number generators May benefit of a synergy with advancement in fast optical re-pointing on different ground/space terminals.

7. Abstract

Please use the required space for your answer.

8. Contacts database

Please indicate below whether you provide your consent for becoming part of a contacts database with the purpose of facilitating the interaction between the Commission and its stakeholders on the topic of the consultation.

YES	NO
X	☐