ISO FORM 1
ISO/IEC JTC Quantum technologies

PROPOSAL FOR A NEW FIELD OF TECHNICAL ACTIVITY

PROPOSER:

BSI

DATE OF CIRCULATION:

2023-06-24

CLOSING DATE FOR VOTING:

2023-09-16

A proposal for a new field of technical activity shall be submitted to the Office of the CEO (to tmb@iso.org), which will process the proposal in accordance with ISO/IEC Directives, Part 1, Clause 1.5.

Furthermore, a proposal will be considered as complete if every information field is complete and follows the guidelines for proposing and justifying a new field of activity given in the ISO/IEC Directives, Part 1, Annex C.

Statement from the ISO Technical Management Board and the IEC Standardization Management Board

The ISO Technical Management Board (TMB) and IEC Standardization Management Board (SMB), would like to draw your attention to the BSI proposal under consideration in this consultation.

As this proposal may have implications and impact on existing work in other committees, we kindly request your input on the scope of the proposed Joint Technical Committee (JTC). Please express your view on whether standardization efforts in this field should be approached holistically within a single JTC or with a limited scope for the new JTC maintaining current related activities in already existing technical bodies. Please provide a brief rationale for your choice.

The TMB and SMB will jointly decide on the allocation of work after considering the comments of ISO and IEC members obtained through the consultations.

Please submit your feedback using the usual commenting function. Your response is greatly appreciated. Thank you for your cooperation and valuable input.

TITLE
(Please see the ISO/IEC Directives, Part 1, Annex C, Clause C.4.2)

ISO/IEC/JTC Quantum technologies

SCOPE
(Please see the ISO/IEC Directives, Part 1, Annex C, Clause C.4.3)

Standardization in the field of quantum technologies

PURPOSE AND JUSTIFICATION (Please use the field immediately below or attach an annex.)
(Please see the ISO/IEC Directives, Part 1, Annex C, Clause C.4.13)

Quantum technology (QT; quantum computing and closely related technology) is the second generation of technologies to exploit quantum effects, manipulating the quantum states of individual particles (eg photons or atoms). It promises revolutionary advances for some sectors of industry and society, with rapid financial growth.

For example, quantum sensing has applications in a wide variety of fields, including distributed, high-precision time, magnetic-field sensors, inertial sensors, and distributed quantum computing; quantum communications, in principle, will be invulnerable to eavesdropping.

Various industrial sectors, as highlighted by IEC SEG 14, have also started to apply quantum technologies, such as in aviation and space, energy and oil, finance and insurance, logistics and distribution, health and medical care, chemical and materials. Although hardware products currently dominate quantum developments, software and service products are steadily on the rise.

Whilst standards for some aspects of quantum technologies are already under development, there is a pressing need to begin standardization at the global level, for example in: quantum computing (device characterization, hardware and software benchmarking), quantum simulation (validation of results, common languages), quantum sources (characterization of single photon/electron sources), quantum detectors (calibration and characterization of single-photon avalanche photodiodes), quantum communications (characterization of quantum random number generators, specifications for quantum key distribution products and systems).

To prevent multiple and competing standards from confusing and fragmenting the market, taxing the limited community of experts, as well as to ensure that there is a coordinated effort within a unified governance structure to streamline technical contributions and to maximise their impact, it is vital that IEC and ISO establish a new Joint Technical Committee to produce a comprehensive, robust, and consistent suite of standards that cater to the global quantum marketplace.

PROPOSED INITIAL PROGRAMME OF WORK (Please use the field immediately below or attach an annex)
Please see the ISO/IEC Directives, Part 1, Annex C.4.4 and C-4.5)

For each item, the initial work programme shall define the deliverable type and target dates. The initial work programme shall also assign priorities to the different items.

Proposed priority areas and deliverables include:

Quantum computing

- device characterization, classification
- qubit and gate characterization, test methods
- hardware and software benchmarking, specifications and test methods
- quantum internet definition and requirements, vocabulary and specifications

Fundamental quantum technologies

- characterization of ion traps, colour centres, etc, test methods

Quantum simulation

- validation of results, test methods
- common languages, specification

Quantum sources

- characterization of single photon/electron sources, test methods
- characterization of entangled photon sources, test methods

Quantum metrology

- Metrics and characterization of quantum technologies

Quantum detectors

- calibration and characterization of single-photon detectors, test methods

Related areas and deliverables, for which the JTC would monitor and provide expertise:

Quantum communications

- characterization of quantum random number generators, test methods
- quantum key distribution products and systems, guides, specifications and test methods
- guidance on integrated approach with post-quantum cryptography, guides

Low-loss photonics

- characterization of photonic integrated circuits
- requirements for low insertion-loss and low-loss fibre couplers, specifications
- requirements for fibre couplers outside the 1550 nm telecoms window, specifications

Radio-frequency electronics for cryogenic temperatures

- requirements for RF connectors and other components to operate at <4K or <77K

Within this new JTC a detailed work programme delivery plan will be agreed once it has been constituted, including initial work items and the process by which the delivery plan will evolve with the rapidly changing QT industry. Device characterisation, benchmarking, use case are examples of active discussions already under way. Existing work on planning, prioritization and consideration of opportunities for collaboration can be seen in the annex, which will be useful reference material in developing future deliveries. We expect the work programme to evolve based on input from groups such as IEC SEG 14, maturity of each type of quantum technology and input from stakeholders.

RELATION OF THE PROPOSAL TO EXISTING INTERNATIONAL STANDARDS AND ON-GOING STANDARDIZATION WORK

☒ The proposer has checked whether the proposed scope of the new committee overlaps with the scope of any existing ISO or IEC committee or JTC1 sub-committee

Note: A review of the scope and any overlap has been carried out by the proposer. Whilst there is some overlap with JTC 1 in very select areas, based on some of the comments made by members of the technical boards on the prior proposal and from SEG 14, quantum technology (QT) encompasses a broader scope than quantum information technology (QIT). The IT aspects of quantum are being codeveloped with the physical aspects of quantum. Thus, the appropriate structure to develop quantum standards will need to include both the IT and non-IT aspects of quantum.

For example, as noted by experts in the field, the development of topological materials in itself does not fit within the scope of IT but takes on IT relevance when those materials are used for qubits – and that use may motivate further materials research. Similarly, quantum sensors on their own do does not fall within the scope of IT, but networks of quantum sensors would be IT-relevant and may imply changes to the sensor primitives. QIT cannot be disentangled from QT. Therefore, a new Joint Technical Committee is required, and standardization needs to be pursued holistically.

☐ If an overlap or the potential for overlap is identified, the affected committee has been informed and an agreement has been reached between proposer and committee on
   i. modification/restriction of the scope of the proposal to avoid overlapping,
   ii. potential modification/restriction of the scope of the existing committee to avoid overlapping.

☐ If agreement with the existing committee has not been reached, please explain why the proposal should be approved.

Click or tap here to enter text.

☐ Have proposals on this subject been submitted into an existing committee and rejected? If so, what were the reasons for rejection?

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LISTING OF RELEVANT DOCUMENTS (SUCH AS STANDARDS AND REGULATIONS) AT INTERNATIONAL, REGIONAL AND NATIONAL LEVEL

(Please see the ISO/IEC Directives, Part 1, Annex C, Clause C.4.6)

General quantum technologies

IEEE

In draft

P7130 Standard for Quantum Technologies Definitions

Quantum communications

ETSI

Published

ETSI GS QKD 002 V1.1.1 (2010-06) Quantum Key Distribution (QKD); Use Cases

ETSI GR QKD 003 V2.1.1 (2018-03) Quantum Key Distribution (QKD); Components and Internal Interfaces

ETSI GS QKD 004 V2.1.1 (2020-08) Quantum Key Distribution (QKD); Application Interface

ETSI GS QKD 005 V1.1.1 (2010-12) Quantum Key Distribution (QKD); Security Proofs

ETSI GR QKD 007 V1.1.1 (2018-12) Quantum Key Distribution (QKD); Vocabulary

ETSI GS QKD 008 V1.1.1 (2010-12) Quantum Key Distribution (QKD); QKD Module Security Specification

ETSI GS QKD 011 V1.1.1 (2016-05) Quantum Key Distribution (QKD); Component characterization: characterizing optical components for QKD systems

ETSI GS QKD 012 V1.1.1 (2019-02) Quantum Key Distribution (QKD); Device and Communication Channel Parameters for QKD Deployment

ETSI GS QKD 014 V1.1.1 (2019-02) Quantum Key Distribution (QKD); Protocol and data format of REST-based key delivery API

ETSI GS QKD 015 V2.1.1 (2022-04) Quantum Key Distribution (QKD); Control Interface for Software Defined Networks

ETSI GS QKD 018 V1.1.1 (2022-04) Quantum Key Distribution (QKD); Orchestration Interface for Software Defined Networks

ETSI White Paper No. 27 Implementation Security of Quantum Cryptography: Introduction, challenges, solutions

In draft

ETSI GS QKD 013 V1.1.2 Quantum Key Distribution (QKD); Characterisation of Optical Output of QKD transmitter modules

ETSI GS QKD 016 V1.1.1 QKD Common Criteria Protection Profile for QKD

ETSI GS QKD 017 V1.1.1 Quantum Key Distribution (QKD) Network architectures

ETSI GS QKD 018 V1.1.1 Quantum Key Distribution (QKD) Orchestration Interface of Software Defined Networks

ETSI GS QKD 019 V1.1.1 Quantum Key Distribution (QKD) Design of QKD interfaces with Authentication

ISO/IEC

In draft

ISO/IEC 23737-1 Information technology security techniques — Security requirements, test and evaluation methods for quantum key distribution — Part 1: Requirements

ISO/IEC 23837-2 Information technology security techniques — Security requirements, test and evaluation methods for quantum key distribution — Part 2: Evaluation and testing methods

IEEE

In draft

P1913 Software-Defined Quantum Communication

ITU-T

Published

Y.3800 Cor1 Overview on networks supporting quantum key distribution

Y.3801 Functional requirements for quantum key distribution networks

Y.3802 Cor1 Quantum key distribution networks – Functional architecture

Y.3803 Quantum key distribution networks – Key management

Y.3804 Quantum key distribution networks – Control and management

Y.3805 Quantum key distribution networks – Software-defined networking control

Y.3806 Quantum key distribution networks – Requirements for quality of service assurance

Y.3807 Quantum key distribution networks – Quality of service parameters

Y.3808 Framework for integration of quantum key distribution network and secure storage network

Y.3809 A role-based model in quantum key distribution networks deployment

Y Suppl 70 ITU-T Y.3800-series – Quantum key distribution networks - Applications of machine learning

X.1710 Security framework for quantum key distribution networks

X.1712 Cor1 Security requirements and measures for quantum key distribution networks – key management

X.1714 Key combination and confidential key supply for quantum key distribution networks

In draft

Y.QKDN-iwfr Quantum key distribution networks - interworking framework

Y.QKDN-iwrq Quantum key distribution networks - interworking requirements

Y.QKDN-ml-fra Quantum key distribution networks - functional requirements and architecture to enable machine learning

Y.QKDN-rsfr Quantum key distribution networks - resilience framework

Y.supp.QKDN-roadmap Standardization roadmap on Quantum Key Distribution Networks

Y.TR-QEFN ITU-T's Views for Quantum-Enabled Future Networks

Quantum computing and simulation

IEEE

In draft

P3155 Standard for Programmable Quantum Simulator

P3120 Standard for Quantum Computing Architecture

P2995 Trial-Use Standard for a Quantum Algorithm Design and Development

P7131 Standard for Quantum Computing Performance Metrics & Performance Benchmarking

ISO/IEC

In draft

ISO/IEC 4879 Information technology -- Quantum computing -- Terminology and vocabulary

CEN/CENELEC

Quantum Technologies Standardisation Roadmap

The listing of relevant documents is limited to standards at this moment as no regulation on this topic has been identified.

LISTING OF RELEVANT COUNTRIES WHERE THE SUBJECT OF THE PROPOSAL IS IMPORTANT TO THEIR NATIONAL COMMERCIAL INTERESTS
(Please see the ISO/IEC Directives, Part 1, Annex C, Clause C.4.8)

Australia, Austria, Belgium, Canada, China, Denmark, France, Germany, India, Japan, Korea, Netherlands, Spain, Switzerland, UK, US. This list is not exhaustive.

LISTING OF RELEVANT EXTERNAL INTERNATIONAL ORGANIZATIONS OR INTERNAL PARTIES (OTHER THAN ISO AND/OR IEC COMMITTEES) TO BE ENGAGED AS LIASONS IN THIS WORK
(Please see the ISO/IEC Directives, Part 1, Clause C.4.9)

Interested organisations might include ITU, ETSI, EC, IEEE, and IETF. QED-C, European QuIC and other regional industry organizations should also be invited as liaison organizations. Moreover, as highlighted by IEC SEG 14, quantum technology standards development should be pursued in an integrated fashion and the new JTC should include an extensive systems integration function to avoid duplication of efforts. Many different SDOs are conducting efforts to address a variety of needs. The new JTC should establish communications and pursue relationships with key SDOs, NCs, NSBs and other entities engaged in activities relevant to quantum standardization, e.g., the newly constituted CEN/CLC/JTC 22, and incorporate and align their activities as appropriate.

IDENTIFICATION AND DESCRIPTION OF RELEVANT AFFECTED STAKEHOLDER CATEGORIES
(Please see ISO Connect)

	Benefits/Impacts/Examples
Industry and commerce – large industry	Improved confidence and the simplification of trade in products and services/faster, more sustainable growth in the market/for example, in selling access to quantum computer services
Industry and commerce – SMEs	Simplified access to markets for innovative SMEs and SMEs providing support services, subcomponents and products to a new market as it grows and changes/faster, more confident growth and greater certainty in the stability of the market/for example, software developers focused on detailed aspects of algorithm development or error-correction.
Government	Enhanced return-on-investment in a new industry by avoiding nation- or region-specific approaches/promotion of national policy through consensus of international standards/for example, ensuring the consideration of qubit technologies in which their nation/region is invested
Consumers	Ensure that consumer issues such as equitable access to new technology is considered and that its implementation does not disproportionately affect any group in society (poorer, vulnerable, ethnic minorities, etc)/internationally agreed guidelines/for example, in quantum computing for optimisation of public transport provision, awareness that routes provided to less able groups might be inherently slower.
Labour	Ensure that workers in these new industries are respected and rewarded in compliance with internationally recognised rights, with support for a diverse workforce/the new industry will be more sustainable and will benefit from direct involvement of diverse individuals
Academic and research bodies	Quantum technology is still under rapid development from proof-of-principle to commercialization, so academics and research bodies will play a vital role in ensuring that innovation is not inadvertantly stifled in standards development/both the pace of development and content of new standards will remain open to innovation/for example, qubit characterization will remain technology agnostic, to remain relevant to technologies that are not yet commercialized

Standards application businesses	Certification and accredditation of quantum technologies will be comparable globally/providers of certification services will be more easily comparable and setting up schemes will be straightforward/for example, in certifying components for use in cryogenic temperatures.
Non-governmental organizations	Include guidance on sustainable and socially equitable operations, products and services/help avoid unjustified claims of the benefits of the new technology (which in turn would discredit the industry)/for example, provide a holistic estimate of energy impact of quantum computing
Other (please specify)	Related technical and subcommittees across ISO, IEC, CEN, CENELEC.

EXPRESSION OF LEADERSHIP COMMITMENT FROM THE PROPOSER
(Please see the ISO/IEC Directives, Part 1, Annex C, Clause C.4.12)

BSI commits to provide the secretariat for the new JTC if approved.

☒ **The proposer confirms that this proposal has been drafted in compliance with ISO/IEC directives, part 1, annex c**

SIGNATURE OF THE PROPOSER

Click or tap here to enter text.

COMMENTS OF THE ISO CENTRAL OFFICE (IF ANY)

This revised JTC proposal has also been submitted to the IEC Secretariat, as a joint approval is required by ISO and IEC.