SMBNC/41/DV

PROPOSAL FOR A NEW FIELD OF TECHNICAL ACTIVITY

PROPOSER:	DATE OF CIRCULATION:
UK NC	**2023-06-23**

A proposal for a new field of technical activity shall be submitted to the IEC Secretariat, which will assign it a reference number and process the proposal in accordance with ISO/IEC Directives, Part 1, 1.5. Guidelines for proposing and justifying a new field of activity are given in the ISO/IEC Directives, Part 1, Annex C.

THE PROPOSAL (to be completed by the proposer):

TITLE (the title shall be described unambiguously and as concisely as possible)

ISO/IEC/JTC Quantum technologies

SCOPE (the scope shall define precisely the limits of the proposed new field of activity and shall begin with "Standardization of ..." or "Standardization in the field of ...")

Standardization in the field of quantum technologies

PURPOSE AND JUSTIFICATION (the justification shall endeavour to assess the economic and social advantages which would result from the adoption of International Standards in the proposed new field)

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.

Please select any UN Sustainable Development Goals (SDGs) that this committee will support. For more information about SDGs, please visit our website at https//www.iec.ch/SDG/

- ☐ **GOAL 1:** No Poverty
- ☐ **GOAL 2:** Zero Hunger
- ☐ **GOAL 3:** Good Health and Well-being
- ☐ **GOAL 4:** Quality Education
- ☐ **GOAL 5:** Gender Equality
- ☐ **GOAL 6:** Clean Water and Sanitation
- ☐ **GOAL 7:** Affordable and Clean Energy
- ☐ **GOAL 8:** Decent Work & Economic Growth
- ☒ **GOAL 9:** Industry, Innovation & Infrastructure
- ☐ **GOAL 10:** Reduced Inequality
- ☐ **GOAL 11:** Sustainable Cities and Communities
- ☐ **GOAL 12:** Responsible Consumption & Production
- ☐ **GOAL 13:** Climate Action
- ☐ **GOAL 14:** Life Below Water
- ☐ **GOAL 15:** Life on Land
- ☐ **GOAL 16:** Peace, Justice Strong Institutions
- ☐ **GOAL 17:** Partnerships to achieve the Goals

Quantum technologies can help improve infrastructure, modelling, and logistics which lead to gains and benefits across a number of SDGs but in a less direct way.

PROGRAMME OF WORK (list of principal questions which the proposer wishes to be included within the limits given in the proposed scope, indicating what aspects of the subject should be dealt with, e.g. terminology, test methods, dimensions and tolerances, performance requirements, technical specifications, etc.)

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.

PREFERRED TYPE OF DELIVERABLES

International standards

RELEVANT EXISTING DOCUMENTS AT THE INTERNATIONAL, REGIONAL AND NATIONAL LEVELS (relevant documents to be considered: national standards or other normative documents)

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.

RELATION TO AND IMPACT ON EXISTING WORK

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.

RELEVANT COUNTRY PARTICIPATION

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

LIAISON ORGANIZATIONS (list of organizations or external or internal bodies with which co-operation and liaison should be established)

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.

STAKEHOLDERS

Large IT companies, investors, hardware and software suppliers, procurement, cross sector stakeholders, SME, start-ups, academia/research institutions, consumer interest, government, assurance, metrology institutes.

LEADERSHIP COMMITMENT

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

OTHER COMMENTS (if any)

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

COMMENTS OF THE SECRETARY-GENERAL (to be completed by the IEC Secretariat):

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

The IEC Standardization Management Board (SMB) and The ISO Technical Management Board (TMB) 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 SMB and TMB will jointly decide on the allocation of work after considering the comments of ISO and IEC members obtained through the consultations.