CEN Reference: BT N 13141

Draft BT C156/2022

CENELEC Reference: BT172/DG12774/DV

Simultaneous circulation to CEN and CENELEC TECHNICAL BOARDS

BT by correspondence **CENELEC Agenda item:** 5.1.16

For decision

Issue date: 2022-07-13 **Deadline:** **2022-10-04**

SUBJECT

New CEN-CLC/JTC on Quantum Technologies

BACKGROUND

Quantum Technologies (QT) is one of the most promising key technologies bringing transformative advances to science, economy and society and creating new commercial opportunities worldwide. Novel quantum technologies are emerging in a number of sectors, namely communication, computing, sensing and measuring.

In some sectors already, several companies - including the whole range of small, medium and large enterprises - have started to develop quantum devices or have begun to integrate them into their products. In other sectors, further development and great improvement is yet needed. Also, further technologies or applications might emerge in the future that have not even been thought of so far.

On 2022-05-23, DIN submitted a proposal to CCMC for the creation of a new Joint CEN and CENELEC Technical Committee (CEN-CLC/JTC) on Quantum Technologies (QT). DIN's proposal is provided in Annex 1. DIN is committed to provide the secretariat of the proposed JTC.

The intention to propose the creation of a CEN-CLC/JTC on Quantum Technologies was presented by DIN at the CEN-CLC Focus Group on Quantum Technologies (CEN-CLC FGQT) meeting, which took place from 18 to 20 May 2022. The FGQT members (including the European Commission) fully supported the creation of a JTC on Quantum Technologies and expressed their willingness to participate in the future JTC.

It should be noted that the CEN-CLC FGQT is currently finalising the development of a European standardization roadmap for Quantum Technologies. The release of the first version is expected in December 2022. While the work on the roadmap has demonstrated the need for quantum standardization in Europe, DIN has highlighted, with the support of the CEN-CLC FGQT, that the creation of the JTC will allow to set up the necessary standardization infrastructure to implement the roadmap without delay.

The proposed Joint Technical Committee will be responsible for standardization in the field of quantum technologies including quantum enabling technologies, quantum sub-systems, quantum platforms & systems, quantum composite systems as well as quantum applications covering the following areas:

- Quantum metrology, sensing and enhanced imaging;
- Quantum computing and simulation;
- Quantum communication and cryptography.

Leading to creation of 4 working groups inspired by the structure of the CEN-CLC FGQT (draft) road map. Details of the scope of each working group is mentioned in Annex 1.

The initial work programme will include identification and possible adoption of relevant International Standards such as ISO/IEC JTC 1 and other TCs at ISO, IEC or ITU-T in an effort to address European market needs, as well as underpinning EU legislation and policies. Where relevant, the work programme will include the development of CEN and CENELEC deliverables that address European needs and requirements.

The Joint Technical Committee will build on the work, projects and suggestions of the CEN-CLC FGQT. The Joint Technical Committee would be created in October 2022 while the standardization roadmap will be finalised in December 2022. It is expected that, during this period, a transition phase is ensured between the JTC and the FG, so that the JTC can start implementing the roadmap without delay.

The draft roadmap is currently available at CEN Documents.

The JTC will submit its final title and scope for CEN and CENELEC
BTs approval, after its kick-off meeting.

By BT 49/2017 and D157/041, CEN and CENELEC BTs respectively, decided that the following criteria are to be met for creation a CEN-CLC/JTC:

- 12 weeks consultation by correspondence;
- Vote according to IR2 clause 6.1.4 in CEN and a synchronized 12-Week BT consultation in CENELEC;
- At least 5 countries committed to participate

Consequently, **members are requested to state explicitly whether or not they are committed to participate in the work:**

- CEN by means of the commenting field provided in the BT-balloting tool;
- CENELEC on the Collaboration Platform under the relevant item.

PROPOSAL(S)

BT,

- having considered the proposal for a new field of technical activity submitted by DIN , as included in Annex 1;
- having considered that the following members have expressed commitment to participate: <members>
- decided to create a new CEN-CLC/JTC 22 on ‘Quantum Technologies’ with the following preliminary scope:

  The JTC shall produce standardization deliverables in the field of Quantum Technologies including quantum enabling technologies, quantum sub-systems, quantum platforms & systems, quantum composite systems as well as quantum applications covering the following areas: Quantum metrology, sensing and enhanced imaging, Quantum computing and simulation; Quantum communication and cryptography, as well as provide guidance to other technical committees concerned with Quantum Technologies. The JTC shall also consider the adoption of relevant international standards and standards from other organisations, like ISO/IEC JTC 1 and its subcommittees. The JTC shall produce standardization deliverables to address European market and societal needs, as well as underpinning EU legislation, policies, principles, and values.
- allocated the secretariat of CEN-CLC/JTC 22 to DIN;

- asked the new CEN-CLC/JTC 22 to submit its final title and scope for BT approval after its kick-off meeting.
- Invited CEN-CLC Focus Group on Quantum Technologies to finalize its roadmap by December 2022.

2022-07-05 – NA

PROPOSAL for a NEW FIELD OF TECHNICAL ACTIVITY	
Date of circulation ……	**CEN/TC / SC** N …… (where appropriate)
Secretariat ……	**CENELEC/TC / SC** (Sec) …… (where appropriate)
Type of technical body proposed (TC / SC / BTTF)	**CEN-CLC/JTC**

IMPORTANT NOTE: Incomplete proposals risk rejection or referral to originator.

☒ The proposer has considered the guidance given in Annexes 1 and 2 during the preparation

Proposal (to be completed by the proposer)

Title of the proposed new subject
(The title shall indicate clearly and unambiguously, yet concisely, the new field of technical activity which the proposal is intended to cover.)

Quantum Technologies

Scope statement of the proposed new subject
(The scope shall precisely define the limits of the new field of technical activity. Scopes shall not repeat general aims and principles governing the work of the organization but shall indicate the specific area concerned.)

Developing deliverables on quantum technologies including quantum enabling technologies, quantum sub-systems, quantum platforms & systems, quantum composite systems as well as quantum applications covering the following areas:

- Quantum metrology, sensing and enhanced imaging;
- Quantum computing and simulation;
- Quantum communication and cryptography.

This JTC shall also consider the adoption of relevant International Standards from ISO and IEC, in an effort to address European market needs, as well as underpinning EU legislation and policies.

Purpose and justification for the proposal.

Quantum Technologies (QT) will be one of the most promising key technologies in the coming decades. In January 2019, the European Commission launched the QT Flagship, a EUR 1 billion initiative funding leading scientists and engineers over the next ten years, managed as part of the FET (Future and Emerging Technologies) program.

This initiative is highlighted as a very important and urgent action to place and keep Europe at the forefront of the second quantum revolution, which is unfolding worldwide, bringing transformative advances to science, economy and society. This will create new commercial opportunities addressing global challenges; provide strategic capabilities for security and seed yet unimagined applications for the future.

Following the CEN-CENELEC workshop Putting-Science-Into-Standards (PSIS) *Making Quantum Technology ready for industry* in March 2019 (A progress report on preparation of the PSIS event was circulated to CEN and CENELEC BTs (BT N 11317 and BT160/DG11052/DC)) the CEN-CENELEC Focus Group on Quantum Technologies (FGQT) was founded in mid-2020. The main goal of this group is the creation of a standardization roadmap that covers the following areas of QT: quantum metrology, sensing and enhanced imaging; quantum computing and simulation and

quantum communication and cryptography.

With the tangible goal of this Focus Group (FG) within reach and dozens of loosely formulated new work item proposals being discussed in its meetings, DIN would like to propose the creation of a new CEN-CENELEC Joint Technical Committee focussing on the challenges of quantum technologies. With the second quantum revolution's wave of metrological possibilities ahead of us, DIN, as the secretariat of the above-mentioned FG believes that the metrological fundamental research will soon be resulting in technological applications.

Sovereignty over innovations in quantum technologies will become the critical building block for the digital self-determination of societies and their economic development. Quantum technologies are believed to play a special role in this regard, as their disruptive potential will have fundamental implications for society. The European Quantum Flagship stated that proper "use of quantum technologies will make it possible to solve societal problems that are considered simply insoluble today, whether in the development of entirely new medicines, the optimisation of traffic flows or financial strategies, the development of new materials that are still unimaginable today or the use of unbreakable secure communication."

While the Quantum flagship engages stakeholders and launches infrastructure programs, it is the industry's responsibility to identify and generate the technical standards necessary to move from lab to fab and scale these activities.

This proposal for a new CEN-CLC/JTC is based on the content of the almost completed standardization roadmap of CEN-CLC FGQT and a national workshop, in which numerous representatives of the German quantum technology community participated. Furthermore, the intention of proposing the creation of a CEN-CLC/JTC on Quantum Technologies was presented by DIN at the last meeting of the FGQT, which took place in Delft from 18 to 20 May 2022. There were exclusively positive reactions from the experts present and from representatives of the European Commission. The experts present from the FGQT fully supported the creation of a JTC on Quantum Technologies and expressed their willingness to participate in this JTC.

Is the proposed new subject actively, or probably, in support of European legislation or established public policy?

☒ **Yes** ☐ **No**

If Yes, indicate if the proposal is

- **in relation to EC mandate(s): ……..(which one(s))**
- **in relation to EC Directive(s)/Regulation(s): ……..(which one(s))**
- **in relation to other legislation or established public policy:** ECI 19/4/2016 ("*…unlock the full potential of quantum technologies, accelerate their development and bring commercial products to public and private users…*"), and COMPET 26/5/2016 ("*…unlock the full potential of quantum technologies and accelerate their development and take-up in commercial products…*")

Proposed initial programme of work

The proposed programme of work shall correspond to and clearly reflect the aims of the standardization activities and shall therefore show the relationship between the subject proposed.

Each item on the programme of work shall be defined by both the subject aspect(s) to be standardized (for products, for example, the items would be the types of products, terminology, characteristics, other requirements, data to be supplied, test methods, performance requirements, etc.). Supplementary justification may be combined with particular items in the programme of work (e.g. output from a research project).

The proposed programme of work shall also suggest priorities, target dates and the most appropriate type of deliverable (e.g. EN, TS) for each item

The initial work programme will include identification and possible adoption of quantum related documents already published or under development by ISO/IEC JTC 1 and other TCs at ISO, IEC or ITU-T. Where not being developed by other TCs, the work programme will include the development of CEN-CENELEC

publications that address specific European needs and requirements.

According to current knowledge, quantum technologies can be divided into the following three areas: Quantum metrology, sensing and enhanced imaging, quantum computing and simulation and quantum communication and cryptography. In addition, so-called enabling technologies are also needed, which can be applied in each of the three areas mentioned. Furthermore, the CEN-CENELEC Focus Group on Quantum Technologies (FGQT) exists since mid-2020 and is currently finalizing its first version of the standardization roadmap which is expected to be published in the summer of 2022.

As far as possible, the JTC should follow the suggestions of the FGQT and include the standardization projects as proposed in the FGQT standardization roadmap in its work program. Once established, the JTC should discuss with FGQT the strategic planning of European QT standardization

In order to avoid duplication of work at the European and international level and to benefit from the structures of existing bodies, it is proposed to establish the following (working) groups under the JTC (this structure also corresponds to the structure of the current FGQT roadmap):

- **WG 1: Quantum enabling technologies**
  To make quantum technologies possible, different enabling technologies are needed. This includes (but is not limited to) for example lasers, ion traps, cryogenics, NV centers in diamonds, control electronics, etc. Possible standardization topics are, for example (but are not limited to), the following:
  - Characterization of ion traps that enables comparison and benchmarking, e.g. electrode geometry, dielectric surfaces, mounting and connection requirements, maximum bakeout temperature, confinement parameters, vacuum compatibility
  - Material, infrastructure and device standardization of colour centres in (nano)diamonds and other crystals (e.g. SiC)
  - Characterization of quantum memories and their interfaces (with strong link to quantum computers)

- **WG 2: Quantum metrology, sensing and enhanced imaging**
  This group should work on the standardization of quantum metrology. With new sensors that exploit quantum mechanical state changes, it is possible to perform even more precise measurements. Possible standardization topics are, for example (but are not limited to), the following:
  - Characterization of single photon sources, e.g. photon rate, wavelength and spectrum, bandwidth, stability, photon statistics, spectral diffusion, coherence time and indistinguishability (purity)
  - Characterization of entangled photon sources, e.g. vocabulary, requirements and parameters
  - Characterization of single photon detectors, e.g. detection probability, detector gate repetition rate, dark count rate probability, after pulse probability, dead time, recovery time, jitter, spectral sensitivity, temporal sensitivity and back flash emission

- **WG 3: Quantum computing and simulation**
  By means of quantum computers, computing operations can be performed much faster in perspective. At some point, quantum computers will take over today's high-performance computing centers, leading to a wide range of possibilities. Quantum computers are classified into the following categories, depending on their architecture: cryogenic solid state based, room temperature solid state based, trapped ions, neutral atoms or photonic quantum computers. Possible standardization topics are, for example (but are not limited to), the following:

- Functional descriptions of the different architecture families of quantum computers
- Benchmarking of quantum computers in order to compare different architecture families of quantum computers
- Requirements on the architecture of the above listed types of quantum computers
- Common language to configure a quantum simulator

– **WG 4: Quantum communication and cryptography**
By exploiting quantum mechanical states, data can be encrypted so securely or communication paths implemented in such a way that a readout of the data can be noticed and stopped immediately. These processes are generally summarized under the term quantum communication or quantum cryptography. In this area, there are already some specifications from ETSI and ITU, which are, however, only limited to the area of QKD and QSC. Other or additional topics are for example (but are not limited to) the following:

- Characterization of quantum random number generators (QRNGs)
- Requirements needed for quantum communication systems
- Definition, requirements and application of the quantum internet
- Security standards (certification of quantum communication systems, analysis of applications, protocols, software)
- quantum networks (architecture, control and management, integration in telecommunication/security infrastructures)

A statement from the proposer as to how the proposed work may relate to or impact on existing work, especially existing CEN, CENELEC, ISO and IEC deliverables.
The proposer should explain how the work differs from apparently similar work, or explain how duplication and conflict will be minimized. If seemingly similar or related work is already in the scope of other committees of the organization, or in other organizations, the proposed scope shall distinguish between the proposed work and the other work. The proposer shall indicate whether his or her proposal could be dealt with by widening the scope of an existing committee or by establishing a new committee.)

For WG 1, Quantum enabling technologies:
At European and international level, there are already TCs in fields dealing with some of these basic aspects, e.g. CEN/TC 123 “Lasers and Photonics” or ISO/TC 172 “Optics and photonics”. Within this WG, the aim is to enter into a close exchange (e.g. by means of a liaison) with the relevant TCs, in order to identify possible gaps in standardization and to prevent duplication of work. Committees at CEN, CENELEC, ISO or IEC that deal with the standardization of the quantum enabling technologies do not yet exist.

For WG 2, Quantum metrology, sensing and enhanced imaging:
Until now, there are no Committees at CEN, CENELEC, ISO or IEC that deal with the standardization of quantum metrology. EURAMET – the European Association of national metrology institutes - is strongly involved in the elaboration and research of quantum metrologies. Therefore, it is planned to enter into a close exchange with it to identify possible standardization needs. Representatives of EURAMET are already active in the CEN-CLC FGQT and would also participate in a JTC or in a WG.

For WG 3, Quantum computing and simulation:
Standards in this area do not yet exist. Only ISO/IEC JTC 1 has established a WG 14 “Quantum Computing” under Chinese leadership, which has started a work item on terminology. Since further work items in this direction are to come, we see it as enormously important to establish a European counterpart to WG 14 and to jointly develop standards that are valid worldwide and at the European level. In addition, it would be advantageous if a European working group is

formed with a view to adopting ISO standards and publishing them as EN ISO standards. Furthermore, the topic of quantum computing is increasingly becoming the focus of the European Commission. Therefore, standardization requests on this subject are quite likely to come.

For WG 4, Quantum communication and cryptography:
There are already SDOs at European and international level that deal with the standardization of quantum communication and cryptography. The ETSI TC CYBER (Cybersecurity) has published several Technical Reports dealing with quantum safe cryptography. Additionally, ETSI has the "Quantum-Safe Cryptography (QSC) working group" (actually that group is inactive and their work was transferred to ETSI TC CYBER) and the "Industry Specification Group (ISG) QKD", which have published group specifications and group reports on quantum key distribution (QKD) and quantum-safe cryptography (QSC) or have them in their work program. At ITU-T, there are two study groups: 13 "Future Networks" and 17 "Security". These deal with the topics QKD and QKD for networks (QKDN). Other topics that are related to the communication area (e.g. quantum random number generator (QRNG) or the quantum internet) are hardly or not at all covered by the working groups. Strong liaison with the concerned TC and working groups at ETSI and ITU-T is recommended in order not to duplicate work. In any case, it is not planned to compete with ETSI or ITU and develop complementary standards that contradict their current documents. This can be avoided if key representatives from these groups are involved in the proposed WG 4 for information.
CEN-CLC/JTC 13 "Cybersecurity and data protection" has no work items related to Quantum Communication in its work programme. It is recommended that both committees should coordinate closely with each other, especially when it comes to quantum-related secure communications. The JTC QT to be established can serve as a first point of contact for this.

A listing of relevant existing documents at the international, regional and national levels.
Any known relevant documents (such as standards and regulations) shall be listed, regardless of their source, and should be accompanied by an indication of their significance.

Examples of documents already published or under development by ISO/IEC JTC 1, ETSI TC CYBER and DIN, includes but are not limited to:

Relevant for WG 3:

- **ISO/IEC CD 4879**, Information technology — Quantum computing — Terminology and vocabulary
- **ISO/IEC TR**, Introduction to quantum computing

Relevant for WG 3 and WG 4:

- **DIN SPEC 91444**, Definition of a quantum computer resistant encryption scheme

Relevant for WG 4:

- **ISO/IEC CD 23837-1.2**, Information technology security techniques — Security requirements, test and evaluation methods for quantum key distribution — Part 1: Requirements
- **ISO/IEC CD 23837-2.2**, Information technology security techniques — Security requirements, test and evaluation methods for quantum key distribution — Part 2: Evaluation and testing methods
- **ETSI TR 103570**, CYBER; Quantum-Safe Key Exchanges
- **ETSI TR 103616**, CYBER; Quantum-Safe Signatures
- **ETSI TR 103617**, Quantum-Safe Virtual Private Networks
- **ETSI TR 103618**, CYBER; Quantum-Safe Identity-Based Encryption
- **ETSI TR 103619**, CYBER; Migration strategies and recommendations to Quantum Safe schemes
- **ETSI TR 103692**, CYBER; State management for stateful authentication

mechanisms

- **ETSI TS 103744**, CYBER; Quantum-safe Hybrid Key Exchanges
- **ETSI TR 103823**, CYBER; Quantum-Safe Public-Key Encryption and Key Encapsulation

Furthermore, some Group Specifications (GS) and Group Reports (GR) as well as other informative documents have been published or are under development by some industry groups at ETSI and ITU-T. For the sake of completeness, these are listed in Annex 3. However, these are relevant for WG 4 only.

Known patented items

☐ **Yes** ☒ **No If "Yes", see CEN-CENELEC Guide 8 and provide full information in an annex**

A simple and concise statement identifying and describing relevant affected stakeholder categories (including small and medium sized enterprises) <u>in particular those who are immediately affected from the proposal</u> (see Annexes 1 and 2**) and how they will each benefit from or be impacted by the proposed deliverable(s)**

Affected stakeholders:

- Industry and commerce including SME's and start-ups (especially, supplier, manufacturer, service provider and user of the product or service)
- Government
- Consumers
- Labour
- Academic and research bodies
- Non-governmental organisations (NGO)
- Standards application business (e.g. testing laboratories, certification bodies)

Market needs:

- Consumer protection and welfare
- Innovation
- Support to:
  - public policy
  - European legislation/regulation
- Market access/barriers to trade, i.e. enhancing the free movement of:
  - services
  - goods
- Interoperability
- Health/Safety
- Terminology

Liaisons:

A listing of relevant external European or international organizations or internal parties (other CEN, CENELEC, ETSI, ISO and/or IEC committees) to which a liaison should be established (in the case of ISO and IEC committees via the Vienna or Dresden Agreements).

- CEN/CLC JTC 13 Cybersecurity and data protection
- CEN/TC 123 Lasers and Photonics
- ETSI Industry Specification Group (ISG) QKD
- ETSI TC CYBER
- EURAMET
- European Quantum Industry Consortium (QUIC)
- EuroQCI (European Quantum Communications Infrastructure)
- GSMA Internet Group Quantum Network Service
- IEEE Quantum
- ISO/TC 172 Optics and photonics
- ITU Study group 13 "Future networks"

Joint/parallel work:

Possible joint/parallel work with:

☐ CEN (please specify committee ID)

☐ CENELEC (please specify committee ID)

☒ ISO (please specify committee ID)

☒ IEC (please specify committee ID)

- ISO/IEC JTC 1/SC 27 Information security, cybersecurity and privacy protection

- ISO/IEC JTC 1/WG 14 Quantum computing

☐ Other (please specify)

– ITU Study group 17 “Security” – Quantum Internet Research Group (QIRG) at IETF (Internet Engineering Task Force)	

Name of the Proposer
(include contact details)

DIN Deutsches Institut für Normung e.V.
Am DIN-Platz
Burggrafenstr. 6
10787 Berlin
Germany

Contact person:
Joachim Lonien
E-Mail: joachim.lonien@din.de
Tel: +49 30 2601-2350

An expression of commitment from the proposer to provide the committee secretariat if the proposal succeeds.

DIN is committed to provide the secretariat of the proposed Joint Technical Committee, and thereby continuing the well-established practice from holding the secretariat of the CEN-CENELEC Focus Group on Quantum Technologies.

Signature of the proposer

German CEN/BT member

Annex(es) are included with this proposal (give details)

☒ **Annex 3: List of documents developed by ETSI ISG QKD, ETSI WG QSC and ITU-T**

Informative Annex 1 "Principal categories of market needs"

- Consumer protection and welfare
- Environment
- Innovation
- Support to:
    - -public policy
    - -European legislation/regulation
- Market access/barriers to trade, i.e. enhancing the free movement of:
    - - services
    - - goods
    - - people
- Interoperability
- Health/Safety
- Terminology

Informative Annex 2 "Principal categories of stakeholders"

- Industry and commerce,
    where particularly appropriate, to be identified separately as
        - Large enterprises (those employing 250 staff or more)
        - Small and medium sized enterprises (SME), (those employing 250 staff or fewer)
- Government
- Consumers
    including those organizations representing interests of specific societal groups, e.g. people with disabilities or those needing other particular consideration)
- Labour
- Academic and research bodies
- Non-governmental organisations (NGO),
    including organizations representing broad or specific environmental interests
- Standards application business (e.g. testing laboratories, certification bodies)

Sometimes it is valuable also identify the immediate affected stakeholders from industry and commerce in terms of their position in a product value chain, as follows:
- Supplier
- Manufacturer
- Intermediary (e.g. warehousing, transport, sales)
- Service provider
- User of the product or service
- Maintenance / disposal

NOTE: ‘Immediately affected stakeholders’ are considered to be those who, within the context of the proposal, would be in a position to implement the provisions of the intended standard(s) into their products, services or management practices.

Informative Annex 3
"List of documents developed by ETSI ISG QKD, ETSI WG QSC and ITU-T"

Since ETSI and ITU-T are already active in this area, all the documents that have been developed by

- ETSI Industry Specification Group (ISG) QKD
- ETSI Quantum-Safe Cryptography (QSC) working group
- ITU-T Study Group 13 “Future Networks”
- ITU-T Study Group 17 “Security”

are listed below for the sake of completeness. It should be noted that these topics only concern quantum communication and cryptography and are therefore only relevant for the proposed WG 4. Furthermore, these documents do not correspond to any standards or specifications in the sense of CEN/CENELEC but represent papers developed by industry groups.

- **ETSI GS QKD 002**, QKD Use Cases
- **ETSI GR QKD 003**, QKD Components and Internal Interfaces
- **ETSI GS QKD 004**, QKD Application Interface
- **ETSI GS QKD 005**, QKD Security Proofs
- **ETSI GS QKD 007**, QKD Vocabulary
- **ETSI GS QKD 008**, QKD Module Security Specification
- **ETSI GS QKD 010**, QKD Implementation security: protection against Trojan horse attacks in one-way QKD systems
- **ETSI GS QKD 011**, QKD Component characterization: characterizing optical components for QKD systems
- **ETSI GS QKD 012**, QKD Device and Communication Channel Parameters for QKD Deployment
- **ETSI GS QKD 013**, QKD Characterisation of Optical Output of QKD transmitter modules
- **ETSI GS QKD 014**, QKD Protocol and data format of REST-based key delivery API
- **ETSI GS QKD 015**, QKD Control Interface for SDN
- **ETSI GS QKD 016**, QKD Common Criteria Protection Profile for QKD
- **ETSI GS QKD 017**, QKD Network architectures
- **ETSI GS QKD 018**, QKD Orchestration Interface of Software Defined Networks
- **ETSI GS QKD 019**, QKD Design of QKD interfaces with Authentication
- **ETSI GR QSC 001**, QSC Quantum-safe algorithmic framework
- **ETSI GR QSC 003**, QSC Case Studies and Deployment Scenarios
- **ETSI GR QSC 004**, QSC Quantum-Safe threat assessment
- **ETSI GR QSC 006**, QSC Limits to Quantum Computing applied to symmetric key sizes
- **ITU Y.3800**, Overview on networks supporting QKD
- **ITU Y.3800 Cor.1**, Overview on networks supporting QKD - Corrigendum 1
- **ITU Supplement 70 to ITU-T Y.3800-series**, QKDN - Applications of Machine Learning
- **ITU Y.3801**, Functional requirements for QKDN
- **ITU Y.3802**, QKDN - Functional architecture
- **ITU Y.3802 Cor.1**, QKDN - Functional architecture - Corrigendum 1
- **ITU Y.3803**, QKDN – Key management
- **ITU Y.3804**, QKDN - Control and Management
- **ITU Y.3805**, QKDN - Software Defined Networking Control

- **ITU Y.3806**, QKDN - Requirements for QoS assurance
- **ITU Y.3807**, QKDN - QoS parameters
- **ITU Y.3808**, Framework for integration of QKDN and secure storage network
- **ITU Y.3809**, QKDN - Business role-based models
- **ITU Y.QKDN-qos-fa**, Functional architecture of QoS assurance for QKDN
- **ITU Y.QKDN-qos-ml-req**, Requirements of machine learning based QoS assurance for QKDN
- **ITU Y.QKDN-iwfr**, QKDN - interworking framework
- **ITU Y.QKDN-iwrq**, QKDN - interworking requirements
- **ITU Y.QKDN-ml-fra**, QKDN - functional requirements and architecture to enable machine learning
- **ITU Y.QKDN-rsfr**, QKDN - resilience framework
- **ITU Y.supp.QKDN-roadmap**, Standardization roadmap on QKDN
- **ITU Y.TR-QEFN**, ITU-T's Views for Quantum-Enabled Future Networks
- **ITU TR.sec-qkd**, Security considerations for QKDN
- **ITU XSTR-SEC-QKD Cor.1**, Security considerations for QKDN - Corrigendum 1
- **ITU X.1702**, Quantum noise random number generator architecture
- **ITU X.1710**, Security framework for QKDN
- **ITU X.1714**, Key combination and confidential key supply for QKDN
- **ITU X.1811**, Security guidelines for applying quantum-safe algorithms in 5G systems
- **ITU TR.qs-dlt**, Technical Report: Guidelines for quantum-safe DLT system
- **ITU X.sec_QKDN_AA**, Authentication and authorization in QKDN using QSC
- **ITU X.sec_QKDN_CM**, Security requirements and measures for QKDN - control and management
- **ITU X.sec-QKDN-tn**, Security requirements and designs for QKDN - trusted node