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| **Purpose:** | Other |
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| **Keywords:** | Focus group; Quantum information technology (QIT); Quantum information network (QIN); Quantum key distribution (QKD); |
| **Abstract:** | This TD provide revised TOR for C54, for the ad-hoc meeting discussion. |

Introduction

Research and applications of quantum information technology (QIT) are accelerating globally, which have become focus not only in academia, but also in industry and standardization community. The computational power brought by quantum computing will improve the performance of signal processing and big data analysis, but it also has a threat on the security of existing ICT networks. Quantum communication, such as quantum key distribution (QKD), can provide long-term security guaranteed by the principles of quantum mechanics. Quantum sensing enhances the accuracy and sensitivity of measurement and metrology, which can provide more accurate time reference for ICT networks. Quantum information network (QIN) can connect quantum information processing nodes such as quantum computing processors and quantum sensors to realize quantum information transmission and networking.

Since ITU is the United Nations specialized agency for information and communication technologies (ICT), ITU-T is the most official and important international standardization platform for bringing together world-wide academic institutions, high-tech companies, network operators, system vendors and ICT regulators to evaluate the research status, application prospects and industry impact of QIT for ICT networks, and to investigate the global standardization requirement and roadmaps.

Some QKD related activities have already been started both in ITU-T SG13 and SG17 since July 2018, already commenced developing the draft Recommendation and the Technical Reports. Quantum-safe cryptography related topics also caused great interests in the CTO meeting took place in 9 September 2018, Durban, South Africa during ITU Telecom World. *“The impending arrival of quantum computing poses significant risks to security. Quantum-safe cryptography is essential to preparations for that arrival”, said CTOs, as mentioned in TSAG-TD295.* ETSI and ISO/IEC JTC1 also accelerate the research and standard activities on quantum computing and Quantum-safe cryptography in recent years.

The development and application of quantum information technology will have a significant impact on existing ICT networks, such as information security threat posed by quantum computing, information security improvement provided by QKD, as well as new features and applications enabled by QIN. Comprehensive research and assessments of the impact of QIT on ICT networks and related standardization requirement analysis are very essential.

Hence, in order to build a broader and in-depth research platform for investigating all these aspects above, and to lay a more comprehensive and solid foundation for future international standardization in several related Study Groups of ITU-T, and to accelerate on-going and upcoming standardization activities such as SG13 and SG17 in ITU-T, it is proposed to set up a new Focus Group committed to perform the pre-standardization research and technical impact analysis on QIT for ICT networks within the mandate of TSAG, which could facilitate the cooperation and coordination between several SGs, and also enhancing overall influence of ITU-T in QIT.

Proposal

This TD proposes to set up a new ITU-T Focus Group with provisional name “Quantum Information Technology for Networks (QIT4N)” at this TSAG meeting, with the Terms of Reference as provided below and TSAG as the parent organization.

# Attached the presentation martial

Please see attached presentation martial, “Proposal to set up a new ITU-T Focus Group on Quantum Information Technology for Networks (FG-QIT4N)”.

 Proposed Terms of Reference:
ITU-T Focus Group on “Quantum Information Technology for Networks” (FG-QIT4N)

**1. Rationale and Scope**

Research and applications of quantum information technology (QIT) are accelerating globally. The computation power brought by quantum computing has a threat on the security of ICT networks. On the other hand, quantum key distribution provides long-term security guaranteed by the principles of quantum mechanics. Quantum teleportation could connect distributed quantum computing processors, quantum sensors and other quantum information processing nodes to form a QIN, and distribute quantum information in a long distance. New applications of QIN, such as distributed quantum computing and quantum sensors network, might be provided in the future. It is necessary to perform comprehensive investigations and analysis of the impact of QIT on networks.

The metro/backbone QKD network construction and satellite-based quantum communication experimental application have been realized in last decade. These developments provide specific requirements for QKD standardization, including QKD equipment reliability and practical security, QKD network survivability and robustness, inter-domain operation and management, and QKD integration with existing optical communication networks. These requirements involve the scope of several study groups of ITU-T which have already been working on “Framework for Networks to supporting Quantum Key Distribution” in SG13, “Security framework for Quantum Key Distribution in Telecom network” in SG17, and “Quantum Noise Random Number Generator Architecture” in SG17 and are essential for the future application of QKD technology.

Apart from QKD, tremendous efforts had been devoted to the realization of other QIN technologies. In recent years we have witnessed a rapid development of quantum teleportation, quantum repeater, and quantum computing, whose feasibility has been demonstrated through various prototypes and experiments. Thus it is urgent and essential to conduct relevant technical progress investigation, impact assessment, and standardization possibility analysis.

The ITU-T Focus Group on “Quantum information technology for networks” (FG-QIT4N) would provide an important platform to study the impact of QIT on networks and QIN related technologies. It engages researchers, engineers, practitioners, entrepreneurs and policy makers, to take full advantages of ability and potential of QIT in networks.

**2. Objectives of the FG-QIT4N**

The objective of the Focus Group is to provide a platform to facilitate global collaboration for investigating impact of QIT on networks and QIN related technologies, and to conduct relevant analysis in order to identify gaps and issues in standardization and application.

1. To analyse and evaluate the impacts of QIT on the existing and future networks.
2. To identify the challenges for QKD network development, and to study the status and issues of QKD networks standardization, and to accelerate on-going and upcoming activities in relevant bodies and groups.
3. To study key features, enabling technologies, network architecture, application scenarios, development trends, and potential standardization aspects of QIN.
4. To establish liaisons and relationships with other SDOs and between the study groups (SGs) in ITU-T.

**3. Structure**

The FG-QIT4N may establish sub-groups if needed.

**4. Specific Tasks and Deliverables**

Tasks and deliverables developed by the FG-QIT4N may include the following:

1. To draft reports on the impacts of QIT on networks:
	1. To provide a description of key concepts related to QIT, and analysis of their relationship with network.
	2. To analyze the impact of quantum computing to networks, including security threats and enhancements on signal processing and big data analysis.
	3. To analyze the impact of quantum communication technology for its capability of anti-eavesdropping, long term security guarantee, and quantum information transmission.
	4. To study new network applications brought by QIT such as high precision network time reference and distributed quantum computing.
2. To draft reports on the status and issues of QKD networks standardization, and to accelerate on-going and upcoming activities by relevant bodies and groups for promoting flexible applications, scalable network deployments and commercialization, and on possible extensions from current QKD network technologies to wider domains including the integration with quantum-safe cryptographic, and the merger with quantum rely and quantum repeater technologies for realizing scalable QKD networks:
	1. To provide comprehensive landscape on the status and issues of QKD technologies and QKD networks standardizations such as by ITU-T (SG13 and SG17), ISO/IEC JTC1 SC27, ETSI ISG-QKD.
	2. To identify and study the new application scenarios and use cases of QKD, e.g., satellite-based wide-area QKD, miniaturized and free space QKD, integration of QKD and classical cryptography including quantum-safe cryptography (or often call post-quantum cryptography: PQC, as well).
	3. To identify the gaps and challenges for integration of QKD networks with existing optical networks, and to study the solutions and technical requirements for co-fiber transmission of quantum and classical signal.
	4. To study the solutions and technical requirements for quantum relay and quantum repeater technologies to extend the reach of QKD networks and to make them scalable.

*Note: The following items on QKD have already been studied or are under preparation for proposing new work items for standardizations in ETSI ISG-QKD, ITU-T (SG13 and SG17), and ISO/IEC JTC1 SC27. So, these following items should be out of scope of this FG.*

1. *To study security threats on a QKD network, and methods to operate the QKD network securely, including key management, key supply, network management etc., and to work on standardization of QKD network security (ITU-T SG13&17).*
2. *To study the function model, inter-domain managements, interaction interfaces of QKD networks to ensure interoperability, and to work on network architectural issues to integrate QKD networks into conventional networks, and the study on the service models, enabling QKD-as-a-service (QAAS) (ITU-T SG13).*
3. *To propose solutions to ensure practical security and reliability of QKD systems, and interfaces between QKD systems and applications (ISO/IEC JTC1 SC27, ETSI ISG-QKD).*
4. To draft reports on the evolution of QIN including:
	1. To provide description of key concepts related to QIN and relevant terminology.
	2. To study the application requirements and potential use cases for QIN, especially on connecting quantum information processing nodes such as quantum computing processors and quantum sensors to realize quantum information transmission and networking.
	3. To study the state-of-the-art and evolving trends of key components for the above b) and enabling technologies for QIN.
	4. To study the architecture of future QIN, its relationship with existing networks and the evolution roadmaps.
	5. To study and document the technology and market requirements for the potential standardization on QIN.
5. To organize thematic workshops and forums on QIT for networks, which will bring together all stakeholders to promote the FG activities, and encourage both ITU members and non-ITU members to jointly contribute on this work.
6. To make liaison with other SDOs, such as ETSI specific ISGs, IEEE, ISO/IEC.

**5. Relationships**

This Focus Group will work in close collaboration with all ITU-T study groups, especially SG13, SG15, and SG17.

This FG QIT4N will collaborate with relevant entities, in accordance with Recommendation ITU-T A.7. These entities include the following: SDOs, industry forums and consortia (such as ISO/IEC JTC 1, ETSI ISG-QKD, IEEE QuantumComm), tech companies, academic institutions, research institutions and other relevant organizations.

**6. Parent group**

The parent group is ITU-T TSAG.

**7. Leadership**

See clause 2.3 of Recommendation ITU-T A.7.

**8. Participation**

See clause 3 of Recommendation ITU-T A.7. A list of participants will be maintained for reference purposes and reported to the parent group.

It is important to mention that the participation in this Focus Group has to be based on contributions and active participations.

**9. Administrative support**

See clause 5 of Recommendation ITU-T A.7.

**10. General financing**

See clauses 4 and 10.2 of Recommendation ITU-T A.7.

**11. Meetings**

The schedule and location of meetings will be determined by the Focus Group and the overall meetings plan will be announced after the approval of the terms of reference. The Focus Group will work electronically using teleconferences and with face-to-face meetings. Meetings will be held as determined by the Focus Group and the meetings will be announced by electronic means (e.g., e-mail and website, etc.) at least four weeks in advance.

**12. Technical contributions**

See clause 8 of Recommendation ITU-T A.7.

**13. Working language**

The working language is English.

**14. Approval of deliverables**

Approval of deliverables shall be taken by consensus.

**15. Working guidelines**

See clause 13 of Recommendation ITU-T A.7.

**16. Progress reports**

See clause 11 of Recommendation ITU-T A.7.

**17. Announcement of Focus Group formation**

The formation of the Focus Group will be announced via TSB Circular to all ITU membership, via the ITU-T News log, press releases and other means, including communication with the other involved organizations.

**18. Milestones and duration of the Focus Group**

The Focus Group lifetime is set for one and half year from the first meeting but extensible if necessary by decision of the parent group. (see ITU-T A7, clause 2.2).

**19. Patent policy**

See clause 9 of Recommendation ITU-T A.7.

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