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| **Keywords:** | Minutes; 2nd Adhoc Quantum; |
| **Abstract:** | This document carries the minutes of the second adhoc session on Quantum. It focused on a granular argumentation for a Focus Group followed by a debate. It informed the team that it will take more time than expected to determine the outcome and Chairman proposed a new way forward. |

# Introduction

This adhoc session was scheduled on Wednesday 12th of December at the ITU from 13:15 to 12:30 and chaired by M. Arnaud Taddei with the support from Mrs. Xiaoya Yang, from the ITU-T Secretariat.

# Proposed Agenda

The proposed agenda in [TD425](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-TSAG-181210-TD-GEN-0425) was approved.

# Minutes

## Welcome and opening Remarks

Since the first meeting, the team engaged and several bilateral consultations happened either between the chairman and the delegates or between delegations.

Chairman produced minutes ([TD424](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-TSAG-181210-TD-GEN-0424)) of the first session to put in writing what happened but as well documented his own guidance and spent time to help especially China to have a good understanding and to have a chance to be well prepared.

As well he organized consultations to test a few ideas and evaluate the gap to reach a consensus.

## Identification of documents pertaining to this session

The following documents were identified

* Proposal to set up a new ITU-T Focus Group on Quantum Information Technology for Networks (FG-QIT4N) [C54](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-TSAG-C-0054)
* Tutorial - Introduction to Quantum Information Technology and Network Evolution [TD416R1](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-TSAG-181210-TD-GEN-0416)
* LS on Response to proposal to set up a new ITU-T Focus Group on Quantum Information Technology for Networks (FG-QIT4N) [from ETSI ISG QKD] [TD406R1](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-TSAG-181210-TD-GEN-0406)
* Minutes of the first adhoc session on Quantum [TD424](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-TSAG-181210-TD-GEN-0424)
* Entities interested in ITU-T work on quantum communication [TD426](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-TSAG-181210-TD-GEN-0426)

Japan had a few remarks on [TD424](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-TSAG-181210-TD-GEN-0424) which will be integrated into [TD424](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-TSAG-181210-TD-GEN-0424)R1

## Arguments for a FG according to the table in Annex which was proposed by the 1st adhoc (ref. Table of [TD424](https://www.itu.int/md/meetingdoc.asp?lang=en&parent=T17-TSAG-181210-TD-GEN-0424))

As proposed by chairman, China prepared an argumentation structured as per below

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| # | Question to answer | Why this question | Comments |
| 1 | Why a FG? | What is the value of a Focus Group on Quantum. What it would achieve that should be so unique | What is the business case for Quantum without Quantum Safe Cryptography: $1m, $10m, $1B?want to make sure that an FG is justified and is truly global and not coming from ‘just’ one country |
| **Answer from China**As we know, there are three emerging innovative trends which will have significant impact on ICT networks in the future, which are AI, block chain and quantum. For AI and blockchain, ITU-T have already set up relevant focus groups to carried out forward-looking research work. However, the understanding and participation of quantum information technology research are still very limited.Recent years, with global efforts, quantum information technology has been developing very rapidly and has received great attention in the ICT community. Relevant standardization research and layout have been carried out in international levels, just as we have introduced and discussed extensively in past few days. ITU-T, as the leading SDO in ICT area, is exactly the right place to study QIT impacts to networks. Indeed, we would like to suggest that the quantum information technology should be an indispensable link to the ITU-T long-term development, evolution strategies and standardization roadmap. The value of the proposed focus group lies in building capabilities in key strategic areas and setting up industry influences. |
| 2 | Why now? | What is the compelling event that makes it relevant to start a FG now?  | Why not in a year? or later?Is it triggered by an industry need? Market need? |
| **Answer from China**In last several years, the development of quantum information technology was rapid, various quantum computing prototypes have emerged, the quantum information network construction project has been proposed, the satellite-to-ground quantum communication experiments are implemented, and the QKD network has begun to be scaled up. It is quite a proper time to conduct focus group for quantum information technology research and to lay a solid foundation for ITU-T’s 2020 research period.For market expectations of quantum information technology, we could provide a few examples such as Global Industry Analysts company forecasted the global market for quantum cryptography will reach $2 billion by 2024. IDC predicted that the quantum computing market is expected to exceed $10 billion in 2027.We also would like to point out that the ICT industry has obvious characteristics of standardization first. The ITU-T focus group such as NGN, IPTV and 5G/IMT-2020 has made great achievements to promote technology progress and commercial applications. The industrial and market value of these focus groups were not so obvious at the beginning of their establishment. Therefore, for quantum information technology, qualitative research on the impact and prospects might be more important than quantification of industrial and market value. |
| 3 | What? | What is the scope? | Currently the proposed ToR is 80% about QKD. What are exactly the 20% other than QKD? Is slide 24 and 44 of the presentation giving the main answer?Some aspects of Quantum have matured but some others are really theoretical and very long term. We need a crisp story. |
| **Answer from China**The proposed Focus Group would provide an important platform to study the impact of QIT on networks and QIN related technologies. It engages in researchers, engineers, practitioners, entrepreneurs and policy makers, to take full advantages of ability and potential of QIT in networks.The objectives of FG include content of three aspects: First is to analyse the impacts of QIT on networks, including security threats and countermeasure, information processing capability improvements, and emerging new applications.Second is trusted repeater based QKD networking. QKD is the first practical application of QIT, and QKD network is the first stage of quantum information network evolution. Although current ITU-T work has covered some issues of this topic, but there are still significant issues uncovered for QKD network development, such as network routing, survivability, scalability, cross-domain management and the integration of QKD with legacy optical communication networks.Third is to study the further evolution of quantum information networks, including key features, enabling technologies, network architecture, application scenarios, development trends, and potential standardization aspects. We should also mention that the specific terms of reference could be further discussed and adjusted if we achieve consensus about the setup of focus group. |
| 4 | How? | How are you going to organize this FG?  | Any Working Group to anticipate? How to collaborate with SGs and other ITU entities? How to collaborate externally? |
| **Answer from China**We would like to propose three working groups for the organization of focus group for further discussion, including:WG1 to study the impact of quantum information technologies on ICT network, including quantum computation, new research directions and application scenarios of quantum key distribution, such as satellite-to-ground QKD, QKD chips and miniaturization, post-quantum cryptography (PQC), quantum teleportation, quantum repeater and other frontier techniques in quantum information, and their impacts on network. For example, information security threats and solutions, new application scenarios, and potential standardization directions.The WG2 is to study the status and requirements of QKD network standardization. To analyse current QKD standardization works of ETSI, ITU-T and IEEE, study the needs and future direction of QKD network standardization, especially on the networking issues for QKD networks. The WG3 is to study further evolution of QIN and analysis of potential standardization aspects. To study the key features, enabling technologies, architecture, application scenarios, development trends, and potential standardization aspects of QIN.For WG1, it needs to collaborate with ISO/IEC JTC1 and IEEE on the analysis of potential impacts of quantum computing. For WG2, it needs to collaborate with SG13 on QKD network framework and SG17 on QKD security framework and other possible involved SGs to coordinate and accelerate systematic standardization for QKD networks. Externally, WG2 also need to align with the work in ETSI ISG QKD and ISO/IEC JTC1. WG2 should make clear the scope of its work not to duplicate with other bodies and make complementary contributions to promote QKD network standards together with them.  |
| 5 | When? | What is the term of this FG?  | When does it starts and ends and on which triggers? |
| **Answer from China**It is expected to hold focus group meeting quarterly for a total of six times during one-and-a-half-year research period. China would like to host two or three meetings.Considering the cooperation on the working items which have already carried out by ITU-T SG13 and SG17, it is recommended that some meetings, if it’s applicable, can be organized as a back-to-back meeting with SG13 and SG17 meeting.At the first meeting of FG which is supposed to be held in the first quarter of 2019, we could first determine the top-level design of FG-QIT4N, such as the research plan, organization structure and work division. Then, the QKD standardization analysis and related works can be prioritized for discussions, which can promote subsequent QKD standardization working progress in ITU-T. |
| 6 | Risk of doing? | What are the risks of doing this FG?  | Are we going too far, too fast, etc.? |
| See below |
| 7 | Risk of not doing? | What are the risks of not doing this FG? | Are we missing an opportunity for the Union? |
| **Answer from China to Questions 6 and 7**The research and application development of quantum information technology is accelerating, and other standardization organizations already have begun research works. If we are sitting in this room today and to think that quantum information technology is too far away, and we will not do anything further, which might cause ITU-T to miss opportunities to open new technology areas and enhance international influences.It is beneficial for ITU-T to perform analysis on the whole picture of quantum information technology to networks, the exploration of quantum information technology to network impact analysis and its possible standardization directions, which will further improve and accelerate the standardization of QKD technology.Although during the research period of the focus group, the practical application of the technologies such as quantum computing and quantum information networks might not make a breakthrough, it still will be of great value to fully analyse the enabling technologies, problem bottlenecks, development trends, possible application scenarios and future impacts on the network. Moreover, history has repeatedly proved that conservative predictions and judgments on rapidly developing technology trends are often unreliable, so analysing and mastering their development status are the right choice to avoid risks. |
| 8 | Resources? | Who will join this FG?  | Which are the constituencies that will join to support and commit time to this FG? |
| **Answer from China**As we know, the development of quantum information technology and quantum information networks have become global trends of science and technology developments. In many countries, academic institutions, technology companies and industry are conducting research and developing in the field of quantum information technology. The focus group is an effective way to attract extensive attentions and participations from academia, industry and government around the world, and it can enhance the technical and industrial influences of ITU-T in the field of quantum information technology in a short period of time.The establishment of the Focus Group provides a platform for countries around the world to participate in the study of the impact of quantum information technology on ICT. It also provides us an opportunity to learn comprehensive information about quantum information technology from authoritative channels. Therefore, perhaps we can see from the following discussion and comments that if any other members and experts are also interested in this focus group.We are completely open on the organization of the focus group and the discussion of the meeting. We welcome wide participations of all members or non-members concerned with the development of quantum information network technology. This is also a necessary guarantee for the effective progress of the focus group work. |
| 9 | Alignments? | What are the internal ITU and external ITU alignments? | How to not duplicate the work inside and outside the ITU? How to deal properly with ETSI ISG QKD? How to deal with current ongoing standardisation work? |
| **Answer from China**For the relationship between FG and other standards organizations:FG needs to maintain connections and open cooperation with ETSI and ISO/IEC in QKD standardizations. Currently, ETSI mainly focus on the standardization of QKD link layer including components, system and physical interface and so on. ISO/IEC has started the research on the security analysis of QKD system. FG would like to provide a comprehensive analysis of the overall development status and further needs of QKD standards and will pay its attentions to the standardization research related to QKD network technology. Thus, FG’s work does not overlap with those of ETSI and ISO/IEC.For the development of quantum computing and its possible impact analysis in QIT, it is necessary to maintain cooperation with ISO/IEC research groups and IEEE standard projects. ISO/IEC JTC1 and IEEE have already started the researches on the terminology and performance evaluation of quantum computing, which helps to analyse the development status of quantum computing and its influences on the networks.The researches and potential standardization analysis of QIN are currently not covered by any other standard organizations, which is an advantage area of IUT-T.For the relationship between FG and ITU-T SG13 and SG17:SG13 has started the standard work of QKD network architecture. The definition of this architecture is very important issue. SG17 has carried out researches on the QKD network security framework, which is very important to ensure the security of QKD interface and network.From the perspective of better promoting and accelerating the development of QKD network standardization, the Focus Group will focus on the standardization requirements of QKD network technologies, such as QKD network routing, survivability, scalability, cross-domain management, and integration of QKD with existing networks. This requires a close coordination with the network architecture defined by the SG13 and the security framework defined by the SG17.Regarding to the form of specific cooperation, we welcome experts from SG13 and SG17 to participate in the organization and research work of the Focus Group. On the other hand, we are also very willing to actively participate in the existing research works of other research groups, submit contributions, promote consensus formation and accelerate the standardization process.  |
| 10 | Outcome? | What are the deliverables?  | Are they for standardisation? For WTSA? |
| **Answer from China**There are three aspects of expected deliverables. The first is to draft reports on the impacts of QIT on ICT networks, including security threats and enhancements, boosting information processing capability for network performance optimization and data analysis, and emerging new applications. The second is 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 relay and quantum repeater technologies for realizing scalable QKD networks;The third is to draft reports on the further evolution of QIN, including the application requirements and potential use cases, the state-of-the-art and evolving trends of key components and enabling technologies, the architecture of future QIN, its relationship with existing networks and the evolution roadmaps.We also would like to organize 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.These deliverables will try to identify the whole picture of QIT impacts on ICT networks and network evolutions including near term and long-term issues，which can be used as pre-standardization inputs for specific SGs and also provide reference for WTSA’s future planning. |
| 11 | Requirements? | Have we assessed the core requirements from the ITU perspective?  | How are we going to fulfil the core requirement for coordination between SG13, 15 and 17? |
| **Answer from China**By our understanding, there are two relevant core requirements for ITU. We know that quantum information technology is bringing changes to the ICT industry. One requirement is the research will clarify the impact of quantum information technology on ICT standardization and promote the technology evolution. Secondly, quantum information network technology involves various aspects of work including network architecture, networking technology, security, etc. Another core requirement is to effectively coordinate the work that are being carried out and will be carried out in ITU.On the other hand, the establishment of QIT4N FG will help us systematically study the impact of quantum information technology on ICT, thus can meet the first requirement. Also, the FG is supposed to conduct the standardization status and demand analysis of QKD, thus can meet the second requirement. A systematic research on the status of QKD network standardization in FG can clarify the relationship between the standardization work that is being carried out and will be further developed in ITU, and help us coordinate future work in SG13, 15 and 17. |
| 12 | Alternatives? | Are there any other alternatives to a FG? | For example did we consider a JCA? |
| **Answer from China**In the past discussion, some suggestions have been proposed to setup a JCA to consider QKD related standardization issues. We would like to do some analyse about it.JCA will have a SG as its leader group and its main function is to coordinate progress of existing projects of Study group and Questions, exchange information, inform each other's progress, but not to research and output standards, nor organize new technologies and pre-standardization study.The current QKD standardization work in SG and Q are just started, thus it seems a bit early to have the JCA coordination for this moment. We expect the FG can do some coordination work after it is initiated, especially when the experts in SG13 and SG17 can participate in the FG.Furthermore, the research on the influences of quantum information technology on the network involves quantum technology, network technology, security and many other aspects. It is not a task that single SG can handle individually, and the work is forward-looking and requires industry and academic communities to work together.Therefore, it is recommended to perform the above-mentioned work in FG, to obtain relevant fields and the broadest supports, and to cooperate in preliminary research on technology development trends, future impacts, standardization needs and possibilities to ensure ITU's technical researches and standardization impacts in the field of quantum information technology. |

## Questions and Discussions

To Be Developped

## Meeting agreement (or not) for the establishment of a Focus Group

As there was clearly no consensus in the room and as there was not enough time, the chairman proposed to

* Pre-empt more time to determine a position and requested 2 more adhocs on Thursday
* As the slot of mid day was taken, there will be an 8am 3rd adhoc and anticipates with confidence that there will be a 4th adhoc at 6pm
* Engage with more consultations in the meantime
* Asked China to share their argumentations in writing for the minutes
* Prepare an agenda for 3rd session

## Conclusion and agenda for 3rd adhoc

The conclusion is that we didn’t have enough time to conclude and Chairman asked for time later in the afternoon to structure an efficient approach for the 3rd adhoc

## Any Other Business

None

## Closing

The meeting closed at around 2:45

# Conclusions

In this 2nd adhoc, more delegation joined and probably around 60-80 people attended.

Hopefully the method proposed helped to get argumentation more crisp and lead to a discussion were the team was sincerely engaged.

A lot of positions clarified yet with no consensus and a significant difference on approaches:

* One side is convinced that Quantum must be studied and would like the ITU to be in the leading role
* One side which is more concerned by the efficiency of a Focus Group which would be premature as they don’t have clarity on what can be investigated with in addition a clear risk of duplication

Finally chairman is concerned by the fact that a basic requirement of coordination between SG13, SG17 and ETSI ISG QKD cannot be tackled by the focus group

It was therefore agreed to have more consultation and have more time to resolve the situation

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