

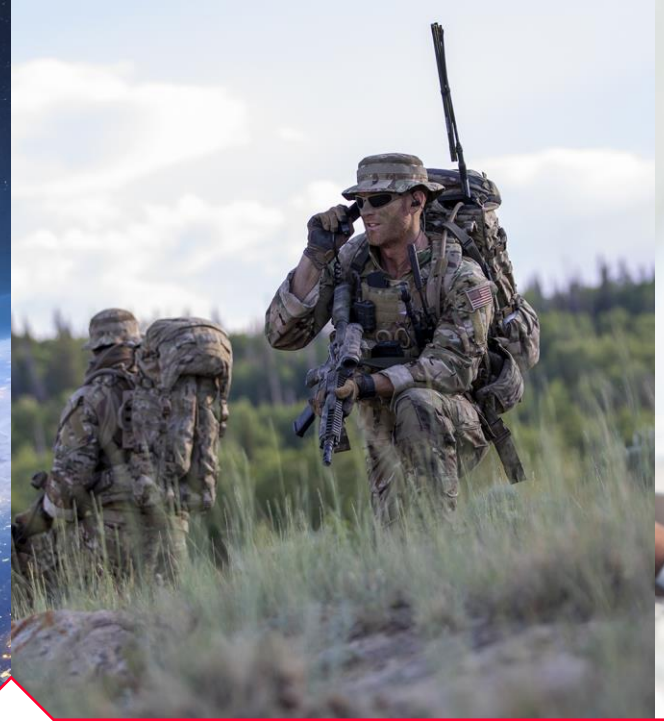


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INTRODUCTION TO THE ITU-T FOCUS GROUP ON QUANTUM INFORMATION TECHNOLOGY FOR NETWORKS

June 10th, 2020

JAMES NAGEL, PHD | Co-Chair FG-QIT4N

ITU-T Focus Group on Quantum Information Technology for Networks

Who/What

- The ITU-T Focus Group on Quantum Information Technology for Networks – FG-QIT4N
- Created by the ITU-T Telecommunications Standardization Advisory Group (TSAG) *to provide a collaborative platform for pre-standardization aspects of Quantum Information Technology (QIT) for networks*
- Participation is open to all interested parties and stakeholders

When/Where

- Established September 2019
- First official meeting held December 2019 in Jinan, China
- One year lifetime from date of first meeting (till December 2020)
- Up to one year extension possible

Why

- *QIT has promoted the booming of the second quantum revolution and will have a profound impact on ICT networks*

An ITU-T Focus Group is…

- *an instrument to augment the Study Group work programme by providing an alternative working environment for the quick development of specifications in a chosen area*
- *widely used to address industry needs as they emerge, and when they are not covered within an existing Study Group*
- independent from the Study Groups concerning working methods, types of outputs, membership, and administration
- generates outputs in well-defined areas within a short term charter, and that are either stand-alone deliverables or proposals to the ITU-T Study Groups

https://www.itu.int/en/ITU-T/focusgroups/Pages/default.aspx

https://www.itu.int/en/ITU-T/focusgroups/qit4n/Pages/default.aspx

Terms of Reference – Objectives

- **Considering evolution and applications of QIT for networks,**
- The topics of study include:
  - **telecom/network aspects of QKD networks** that are identified in close coordination with ITU-T SG13 and SG17 as not within the scope of SG13 (QKD network architecture aspects) and SG17 (security aspects of QKD networks and applications of QRNG for security)
  - **QIN technology and network evolution**.
- **The FG outputs will focus on terminology and use cases.** The FG will reference relevant terminology defined in the pertinent ITU-T SGs. When necessary, the FG will liaise with the relevant SGs if terminology needs to evolve to take into account technology evolution.
- **To provide necessary technical background information and collaborative conditions** in order to effectively support QIN-related standardization work in ITU-T study groups.
- **To provide an open cooperation platform with ITU-T study groups and other SDOs,** including collaborative standardization work, co-located meetings, and workshops on quantum topics.

https://www.itu.int/en/ITU-T/focusgroups/qit4n/Pages/ToR.aspx

Terms of Reference – Specific Tasks & Deliverables

- To collaborate and cooperate with ITU-T study groups and other SDOs and sub-groups, such as
  - ETSI ISG-QKD and TC Cyber
  - IEEE
  - ISO/IEC JTC1 SC27/WG3 and AG4
  - IETF and IRTF
- To develop technical report(s) about evolution and applications of QIT (e.g., quantum computing, quantum communication) for networks
- To develop technical report(s) on telecom/network aspects of QKD networks that are identified in close coordination with SG13 and SG17 as not within the scope of SG13 and SG17, focused on terminologies, new use cases, protocols and transport technologies
- To develop technical report(s) on the evolution of QIN, focused on terminologies and use cases
- To organize thematic workshops on QIT for networks, bring together interested stakeholders to promote the FG activities, and encourage both ITU members and non-ITU members to jointly contribute on this topic

https://www.itu.int/en/ITU-T/focusgroups/qit4n/Pages/ToR.aspx

FG-QIT4N Structure

Co-Chairmen

- Mr. Alexey Borodin, Rostelecom, Russian Federation
- Mr. James Nagel, L3Harris Technologies, USA
- Mr. Qiang Zhang, University of Science and Technology of China (USTC), China

Working Group Chairs

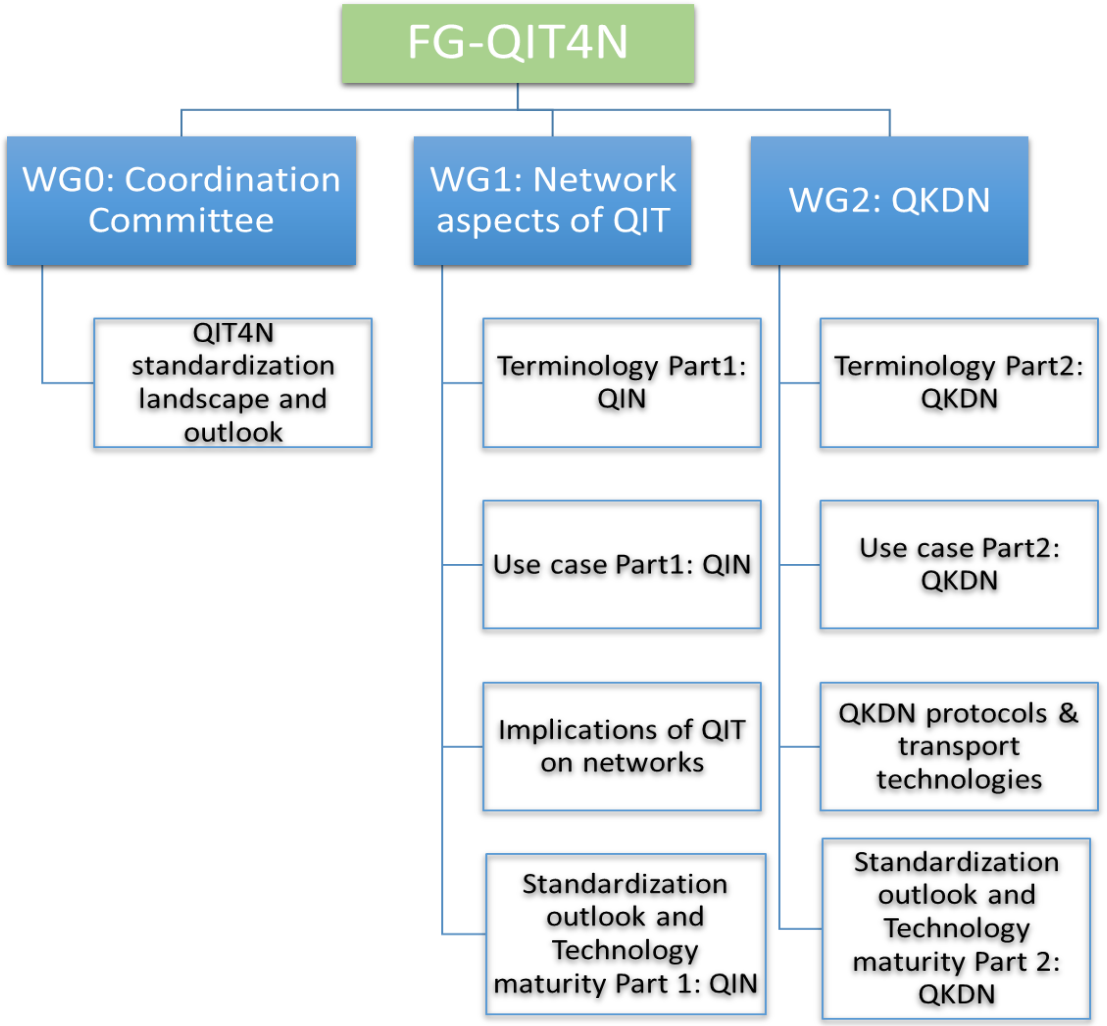
- WG0: Co-Chairmen
- WG1: Mr. Helmut Griesser, Adva Optical Networking, Germany
- WG2: Mr. Zhangchao Ma, CAS Quantum Network, China

WG1: Network aspects of QIT

To provide technical context in relation to the study topics and deliverables related to network aspects of quantum information technology

WG2: QKDN

To provide technical context in relation to the study topics and deliverables related to quantum key distribution networks and those aspects not covered in SG 13 and SG 17



Adopted at the first meeting of the FG-QIT4N, Jinan, China, December 2019

Terminology

Technical Report(s) on relevant Terminology with reference to standardized lists either in existence or preparatory phases, as well as contributions from SDOs, academia, and industry consortia

D1.1 QIN Terminology

- Mr. Mingan Li, Jinan Institute of Quantum Technology, China

D2.1 QKDN Terminology

- Mr. K Karunaratne, Qubitekk Inc., United States

Submission Type	☐	SDO-current	☐	SDO-proposed	☐	Commercial-suggested	☐	Academia-suggested
	☐	Matter of Opinion			☐	Gap	☐	Erroneous/ Conflicting
Submission Source	Insert link to relevant SDO documents, published papers, etc as appropriate.							
Notes	Insert notes as appropriate.							
Clearly format lists of terminology and submit on following pages with individual source links as appropriate.								

i. Terminology Landscape
   - Those engaged in terminology standardization activities
   - Explicit scope of these efforts and their stage of development
   - Links and references to these terminology lists

ii. Terminology Survey
   - Comparative analysis of formal terminology efforts
   - Discussion of terminology within academia and commercial industry
   - Identification of gaps and conflicts in current standardized terminology

iii. Matters of Opinion
   - Terminology that may be deemed outdated, erroneous, or ambiguous

iv. Source Attribution

Use Cases

Technical Report(s) presenting a collection of relevant use cases with a clear application scenario and problem statement which result in specific requirements and a corresponding QIT-based solution

D1.2 QIN Use Cases

- Mr. JiDong XU, ZTE Corp., China

D2.2 QKDN Use Cases

- Mr. Andreas Poppe, AIT, Austria

The objective of the use case study is to identify and describe applications with significant relevance and market application that have potential for becoming essential market drivers for further technology development and advancement as well as wide deployment of QIT for networks

Use case identification:	[name of use case application field]
Target end users:	[identification of end users, e.g. individual end users, organisations, administrations, companies]
Application description:	[Summary description of the use case background, application scenario and field, etc.]
Motivation/Advancement	[describe the limitations and problems of current technical solution, why to use quantum technology, technical advantage and benefits]
Technical solution	[explain how the quantum technology-based solution can be achieved, describe the high-level mechanism and solution]
Function requirements	[description of functions and technical requirements]
Maturity of the use case:	[statement on the maturity and enabling technologies and key modules of use cases, development level and commercialization level, service and product providers, etc.]
Application prospects	[Description of the future development prospect and the possibility of standardization.]

Standardization Outlook and Technology Maturity

Technical Report(s) reviewing the standardization landscape and outlook including past progress, current state-of-the-art and potential future directions, as well as challenges or barriers to standardization and identification of validated standardization needs

D1.4 Standardization Outlook and Technology Maturity Part 1: QIN

- Ms. Barbara Goldstein, NIST, United States

i. QIN landscape
   - Standardization activities and participants relevant to quantum networks
   - Technical areas of these activities and their stage of development

ii. Benefits of and needs for standardization of QIN

iii. Barriers to development and adoption of standards for QIN

iv. Technology maturity and standardization readiness
   - Best practices for assessing standardization readiness
   - Assessment methodology and standardization readiness criteria
     - Commercial availability of technical elements
     - Existence or robustness of commercial marketplace
     - Multi-vendor interoperability needs and availability
     - Availability of enabling technologies

D2.5 Standardization Outlook and Technology Maturity Part 2: QKDN

- Mr. Junsen Lai, CAICT, China

i. Overview of QKDN technologies and industry development

ii. Maturity assessment of QKDN technologies

iii. QKDN standardization landscape and gap analysis

iv. Standardization outlook
   - Standardization roadmap, including suggestions for ITU-T standardization

QKDN Protocols and Transport Technologies

D2.3 QKDN PROTOCOLS – PART 1

- Part 1 – *The Quantum Layer*
- Study and review of protocols in the quantum layer of a QKDN
- Focus on QKD protocols as an essential part of a QKDN
  - overview of different types of QKD protocols
  - protocol workflows
  - protocol features
  - parameters
  - commercialization status
  - security proofs
  - future network integrations
- Discussion and suggestions for future directions

D2.3 QKDN PROTOCOLS – PART 2

- Part 2 – *Key Management and QKDN Control & Management Layers*
- Study and review of classical communication protocols in a QKDN
- Focus on traditional network strata, based according to their functionality
  - key management layer
  - QKDN control layer
  - QKDN management layer
- Includes discussion of necessary workflows and parameters

D2.4 QKDN TRANSPORT TECHNOLOGIES

- Review of QKDN transport technologies
  - transport system components
  - technical solutions
  - requirements for co-fibre transmission of quantum and classical signals

i. DV-QKD
- Systems and transport requirements
- Co-fibre transmission with classic optical communications systems

ii. CV-QKD
- Systems and transport requirements
- Co-fibre transmission with DWDM

D2.3 studies protocols of QKDN based on the architecture and reference points being specified in SG13 and may include other SDOs to ensure network interoperability and facilitate certification

D2.3 QKDN Protocols
- Mr. Karou Kenyoshi, NICT, Japan

D2.4 QKDN Transport Technologies
- Mr. Yalin Li, QuantumCTek Co. Ltd., China

Implications of QIT on Networks

Technical Report surveying research activities, existing or anticipated products, and known deployments of QIT, and how these technologies impact the network, either classical or QIN, to which they pertain

D1.3 Implications of QIT on Networks

- Mr. Fred Baker, Internet Systems Consortium, United States

Submission title:										
Submission source: *(Name, affiliation)*										
Source type:	☐	SDO	☐	Commercial	☐	Academic	☐	Government	☐	Other (explain)
Submission type:	☐	Research activity in QIT technology	☐	QIT Product description	☐	Known deployment of QIT Technology				
Relevance:	☐	Necessary technology (explain)	☐	QIT that imposes requirements onto a QIN (explain)	☐	Additional over a classical network (explain)				
Contribution:	*In this section, identify the technology and describe its impact on the network in question. Is it, for example, used in the network? How? Does it or its presence change the network or require specific capabilities of the network? What requirements are being imposed?*									

i. Building Blocks for QINs
   - **Necessary network technologies, which provide fundamentally enabling aspects of a QIN**
   - Includes lower level essential components up through higher level systems

ii. Application-Driven Network Applications
   - **QIT that imposes requirements onto a QIN to function within it**
   - QIT that uses a QIN in a piecewise manner
   - QIT that uses a QIN end to end

iii. Benefits to Classical Networks
   - **QIT overlaid on a classical network that substantially alters the networks quality beyond what is possible with classical technology**

QIN – any network that incorporates quantum communication technologies for the purpose of transporting quantum states

Opportunities to Participate

We invite members of ETSI and other interested stakeholders to participate and contribute to FG-QIT4N

#	Tentative Date	Tentative Location	Proposal
1	December 9 – 10, 2019	Jinan, China	Concluded
2	February 18 – 20, 2020	E-meeting	Concluded
3	April 20 – 30, 2020	E-meeting	Concluded
4	June 10 – 23, 2020	E-meeting	Joint session with ETSI ISG QKD is confirmed for June 10, 2020. FG-QIT4N 4th meeting dates will be announced.
5	August 2020	Washington DC, USA	Proposal to hold the meeting at the Optical Society (OSA) HQ. Tentative dates are: - Week of 3rd August for a face to face meeting - 27 Jul – 7 Aug for an e-meeting *NOTE: The scheduling of the e-meeting will take into consideration the planned July 25-31, 2020 IETF meeting.*
6	October 2020	TBD (Japan)	Potential for joint meeting with IRTF QIRG
Dec 2020 – 1 year after 1st FG-QIT4N meeting			
7	December 2020	Riyadh, Saudi Arabia	Originally planned to be held as the 2nd meeting, postponed to December due to coronavirus and its impact on travel limitations.

Supplemental Material

FG-QIT4N Leadership

Co-Chairmen

- Mr. Alexey Borodin, Rostelecom, Russian Federation
- Mr. James Nagel, L3Harris Technologies, USA
- Mr. Qiang Zhang, University of Science and Technology of China (USTC), China

Vice-Chairmen

- Mr. Fahad Alduraibi, Communications and Information Technology Commission (CITC), Saudi Arabia
- Mr. Helmut Griesser, Adva Optical Networking, Germany
- Mr. Kaoru Kenyoshi, National Institute of Information and Communications Technology (NICT), Japan
- Mr. Hyungsoo (Hans) Kim, KT Corporation, Korea (Rep. of)
- Mr. Junsen Lai, China Academy of Information and Communications Technology (CAICT), China
- Mr. Jiajun Ma, QuantumCTek Co. Ltd., China
- Mr. Momtchil Peev, Huawei Technologies Duesseldorf GmbH (HWDU), Germany
- Mr. Dong-Hi Sim, SK Telecom, Korea (Rep. of)

Working Group Chairs

- WG1: Mr. Helmut Griesser, Adva Optical Networking, Germany
- WG2: Mr. Zhangchao Ma, CAS Quantum Network, China

ITU-T Counsellors

- Mrs. Xiaoya Yang & Ms. Gillian Makamara