Question(s):	16/13	Geneva, 4 -15 July 2022

TD

Source:	Editors
Title:	Draft new Recommendation ITU-T Y.QKDNi_SDNC: "Quantum Key Distribution Network Interworking – Software Defined Networking Control"

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Abstract:	This TD is to propose a new work item for Software Defined Networking control for the interworking between two QKDN providers.

Proposal

A new work item proposal with A.1 justification and the very first draft with the skeleton is attached in Annex I and II respectively. This TD is the output based on the discussion of C177(Rev2).

Attachments:

Annex I: A.1 justification for proposed draft new recommendation

Annex II: A new work item proposal Y.QKDNi_SDNC "Quantum Key Distribution Network Interworking – Software Defined Networking Control

Annex I :

A.1 Justification for proposed draft new recommendation

Question:	16/13	**Proposed new ITU-T Recommendation**		Switzerland [Geneva], 4 - 15 July 2022	
Reference and title:	ITU-T Y.QKDNi_SDNC "Quantum Key Distribution Network Interworking – Software Defined Networking Control"				
Base text:	Annex II of this TD		**Timing:**		2023-12
Editor(s):	Dong-Hi SIM, SK Telecom, Yuhang Liu, BUPT; Yongli Zhao, BUPT; Xiaosong Yu, BUPT; Zhangchao Ma, CAS Quantum Network.		**Approval process:**		AAP

Scope (defines the intent or object of the Recommendation and the aspects covered, thereby indicating the limits of its applicability):

This draft new Recommendation specifies the Software Defined Network Control for the interworking scenarios between QKDN providers.

In particular, the recommendation covers:

- Overview of the role of SDN control for the interworking between QKDN providers
- Functional requirements of SDN control for QKDN interworking (QKDNi)
- Functional entities of SDN control for QKDNi
- Interfaces of SDN control for QKDNi
- Overall operational procedures of SDN control for QKDNi
- Security considerations

Summary (provides a brief overview of the purpose and contents of the Recommendation, thus permitting readers to judge its usefulness for their work):

The recommendation specifies the Software Defined Network (SDN) control for the interworking between QKDN providers focusing on the requirements for SDN controller in QKDN control layer and functional architecture for SDN control in QKDNi when SDN is used to provision the services for QKDNi. For SDN control of QKDNi, the reference points and the hierarchy of SDN controllers will be specified.

Relations to ITU-T Recommendations or to other standards (approved or under development):

This work item will refer to ITU-T Y.3802 and Y.QKDN_iwfr as the main reference recommendations for architecture, entities, and interfaces of QKDN.

This work item will refer to Y.3805 (Y.QKDN_SDNC) as the reference recommendation for SDNC.

This work item will refer to ETSI GS QKD 015 V2.1.1 and ETSI GS QKD 018 V1.1.1.

Draft recommendation will be studied in a harmonious manner with existing and ongoing works in ITU-T and other SDOs but there are no duplications identified so far.

Liaisons with other study groups or with other standards bodies:

ITU-T SG11, SG15 and SG17, ETSI ISG-QKD

Supporting members that are committing to contributing actively to the work item:

SK Telecom; Beijing University of Posts and Telecommunications; CAS Quantum Network Co., Ltd. China;

Annex II:

Draft Recommendation ITU-T Y.QKDNi-SDNC

Quantum Key Distribution Network Interworking - Software Defined Network Control

Summary

This draft Recommendation specifies the Software Defined Network control for the interworking including the overview of the role of SDN control for the interworking between QKDN providers, the functional entities of SDN control for the interworking, the interfaces of SDN control for the interworking, the functional requirements of SDN control for the interworking, and the security considerations.

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Draft Recommendation ITU-T Y.QKDNi-SDNC

Quantum Key Distribution Network Interworking - Software Defined Network Control

1. Scope

This draft Recommendation specifies the Software Defined Network Control for the interworking scenarios between QKDN providers.

In particular, the recommendation covers:
- Overview of the role of SDN control for the interworking between QKDN providers
- Functional requirements in SDN control for QKDNi
- Functional entities in SDN control for QKDNi
- Interfaces in SDN control for QKDNi
- Overall operational procedures of SDN control for QKDNi
- Security considerations

2. References

[ITU-T X.1701] Recommendation ITU-T X.1701 (2020), *Security framework for quantum key distribution networks*.

[ITU-T Y.3800] Recommendation ITU-T Y.3800 (2019), *Framework for Networks to support Quantum Key Distribution*.

[ITU-T Y.3801] Recommendation ITU-T Y.3801 (2020), *Functional requirements for quantum key distribution networks*.

[ITU-T Y.3802] Recommendation ITU-T Y.3802 (2020), *Functional architecture of the Quantum Key Distribution network*.

[ITU-T Y.3803] Recommendation ITU-T Y.3803 (2020), *Key management for quantum key distribution network*.

[ITU-T Y.3804] Recommendation ITU-T Y.3804 (2020), *Control and Management for Quantum Key Distribution Network.*

[ITU-T Y.3805] Recommendation ITU-T Y.3805 (2022), *Quantum Key Distribution Networks - Software Defined Networking Control*

[ITU-T Y.QKDN_iwfr] draft Recommendation ITU-T Y.QKDN_iwfr, *Quantum Key Distribution Networks – interworking framework*

[ITU-T Y.QKDN_iwrq] draft Recommendation ITU-T Y.QKDN_iwrq, *Quantum Key Distribution Networks – interworking requirements*

< Others to be added>

3. Terms and definitions

3.1. Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 **quantum key distribution (QKD)** [b-ETSI GR QKD 007]: Procedure or method for generating and distributing symmetrical cryptographic keys with information theoretical security based on quantum information theory.

3.1.2 **quantum key distribution network (QKDN)** [ITU-T Y.3800]: A network comprised of two or more quantum key distribution (QKD) nodes connected through QKD links.

3.1.3 **software-defined networking (SDN)** [ITU-T Y.3300]: A set of techniques that enables to directly program, orchestrate, control and manage network resources, which facilitates the design, delivery and operation of network services in a dynamic and scalable manner.

Editor's Note: More definitions will be added as work progresses

3.2   Terms defined in this Recommendation

This chapter defines all the terms used in this recommendation.

-TBD

4   Abbreviations and acronyms

This chapters describes all the abbreviations and acronyms used in the recommendation.

API   Application Programming Interface

QKD   Quantum Key Distribution

QKDN   Quantum Key Distribution Network

QKDNi   Quantum Key Distribution Network interworking

QoS   Quality of Service

SDN   Software-Defined Networking

SDNC   Software-Defined Networking Controller

5   Conventions

In this Recommendation:

The keywords "is required to" indicate a requirement which must be strictly followed and from which no deviation is permitted if conformance to this document is to be claimed.

The keywords "is prohibited from" indicate a requirement which must be strictly followed and from which no deviation is permitted if conformance to this document is to be claimed.

The keywords "is recommended" indicate a requirement which is recommended but which is not absolutely required. Thus, this requirement need not be present to claim conformance.

The keywords "is not recommended" indicate a requirement which is not recommended but which is not specifically prohibited. Thus, conformance with this specification can still be claimed even if this requirement is present.

The keywords "can optionally" indicate an optional requirement which is permissible, without implying any sense of being recommended. This term is not intended to imply that the vendor's implementation must provide the option and the feature can be optionally enabled by the network operator/service provider. Rather, it means the vendor may optionally provide the feature and still claim conformance with the specification.

6   Overview of the role of SDN control for the interworking between QKDN providers

The initial deployment of QKD networks was that of infrastructures for symmetric key delivery decoupled from the telecommunication network. A major objective is to enable QKD networks without building parallel physical infrastructures by finding ways to integrate QKD in communication networks, increasing their security as long as trust on the intermediary nodes is assumed.

The software defined networking (SDN) paradigm has emerged to intrinsically increase the flexibility of communication networks. The SDN approach introduces a centralized network controller, which creates on demand a dedicated virtual infrastructure out of general purpose but programmable resources. Using standard interfaces, any networking functionality is realized on a flexible, programmable environment, allowing a quick adaptation to new requirements. SDN is now a major trend in telecommunication, deployed by many operators. The adoption of SDN methods also is in practical QKD networking [b-ETSI GS QKD 015][b-ETSI GS QKD 018][ITU-T Y.3805].

SDN is defined as a control framework that supports the programmability of network functions and protocols by decoupling the data plane and the control plane, which are currently integrated vertically in most network equipment. SDN proposes a logically centralized architecture where the control entity (SDN controller) is responsible for providing an abstraction of network resources through Application Programming Interfaces (API). This abstraction enables SDN to perform network virtualization, that is, to slice the physical infrastructure and create multiple co-existing network slices (virtual networks) independent of the underlying wireless or optical technology and network protocols. Ideally, the SDN architecture is based on a single control domain comprising multiple network nodes featuring diverse technologies provided by different vendors that are controlled through standard interfaces.

For the interworking scenarios of QKDNs, a multi-domain network orchestration is required as each domain can be provided by a different vendor where each domain can be independently controlled by means of their own customer SDN controller. This recommendation presents the framework of SDN orchestration and virtualization which allows a unified control allowing the composition, at an abstracted level, of end-to-end provisioning services across multiple domains.

Editor's Note: Further descriptions will be added for the concept of SDN control for the interworking of QKDNS between two QKDN providers as work progresses

7   Functional requirements in SDN control for QKDNi

Editor's Note: Functional requirements for SDN control for the interworking will be studied

8   Functional entities of SDN control for QKDNi

Editor's Note: Two conceptual models for interworking of QKDNs in [ITU-T Y.QKDN_iwfr] will be taken into account to consider the functional entities of SDN control

9   Interfaces of SDN control for QKDNiing

Editor's Note: Reference points for SDN control for the interworking will be studied

10   Overall operational procedures of SDN control for QKDNi

Editor's Note: Operational procedures to orchestrate the SDN control for the interworking between two QKDN providers will be described.

11   Security considerations

Editor's Note: General security perspective are addressed here for SDN control for the interworking, however, the details of security are outside of scope of this recommendation

Bibliography

[b-ETSI GR QKD 007]   ETSI GR QKD 007 (2018), *Quantum Key Distribution (QKD) – Vocabulary*

[b-ETSI GS QKD 015]   ETSI GS QKD 015 V2.1.1 (2022-04), *Quantum Key Distribution (QKD); Control Interface for Software Defined Networks*.

[b-ETSI GS QKD 018]   ETSI GS QKD 015 V1.1.1 (2022-04), *Quantum Key Distribution (QKD); Orchestration Interface for Software Defined Networks*.

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