# Introduction to ITU-T FG-QIT4N D1.2: QIT4N use case part 1: Network aspects of quantum information technology

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# Purpose of D1.2

Technical Report

Collecting and analyzing the use cases of QIT for network towards key findings and suggestions for the way forward to Standards Developing Organizations (SDOs) and industries

# Structure of D1.2

- Guidelines for use cases on the network aspects of QIT
- Use cases in relevant fields of application
- Key findings and suggestions
- Other regular sections

# Guidelines for the use cases

- Problem statement
- Target end users
- Application description
- Motivation/Advancement
- Technical solution
- Application prospects

# Overview of the use cases

- So far three types of use cases have been worked out
  - ◆Use case for quantum time synchronization
  - ◆Use case for quantum computing
  - ◆Use case for quantum random number generator

# Use case for quantum time synchronization

Describing how quantum technology can be used to achieve high-precision or safe and reliable frequency/time synchronization

- UC-QTS-001 Quantum time synchronization in telecommunication

  Describes the applicability of quantum time synchronization technology in existing communication networks to achieve ultra-high precision time synchronization and the potential to evolve into fully quantum networks in the future.

- UC-QTS-002 Secure Quantum Clock Synchronization /synchronization network

  Describes the applicability of quantum technology in resisting security attacks in synchronous networks.

- UC-QTS-003 Quantum network of entangled clocks

  Describes the applicability of quantum frequency/time synchronization technology in quantum star networks. Frequency and time information can be transmitted using entangled qubits and auxiliary classical channels in quantum networks.

# Use case for quantum computing (1)

Focused on the application and method of quantum computing with network

- UC-QC-001 Quantum Cloud Computing

  All resources are hosted in the cloud computing platform, provding a sharing model that allows many users to access expensive quantum computing resources  in affordable cost.

- UC-QC-002 Distributed Quantum Computing

  The computational power is expanded beyond what any single quantum device can provide based on a distributed network of quantum devices to run quantum algorithms.

- UC-QC-003 Blind Quantum Computing

  Provides a way for a client to implement a quantum computation using one or more remote quantum servers while keeping the privacy of the delegated computation.

# Use case for quantum computing (2)

- UC-QC-004 Quantum Simulator in Centralized/Distributed Quantum Computing

  Describes how quantum simulation can be implemented with centralized or distributed classical computation over classical networks.

- UC-QC-005 Hybrid Classical Quantum Computing

  Introduces the classical and quantum computing units can work together via classical communication networks to improve the performance of some typical quantum algorithm.

# Use case for quantum random number generator

Describing how quantum random number generator serves the applications concerning trust and confidential issues

- UC-QRNG-001 Quantum Randomness Beacon Service for Smart Contract

  A trusted third party who provides a randomness beacon service is employed to replace the usual intermediary agent to overcome potential liability and confidential issues.

- UC-QRNG-002 Quantum Randomness Beacon Service for Confidential Disclosure

  A Disclosure Beacon Protocol can solve the problem of confidential disclosure without the trusted third party.

# Key findings and suggestions (1)

QTS

- Advantages

  Higher accuracy (ps, even sub-ps level) and security enhancement (resisting protocol packet attack and delay attack )

- Key enabling technology

  Atom / ion manipulation, Preparation and distribution of entanglement source, High order quantum correlation detection, Quantum synchronization protocols

- Maturity

  There are many technical routes of quantum synchronization technology, and many key enabling technologies are still in the laboratory stage, but showing huge application potentials.

# Key findings and suggestions (2)

QRNG

- Advantages

  Quantum random numbers based on the intrinsic properties of quantum physics are considered to be a truly unpredictable random resource that is different from classical pseudo random numbers.

- Key enabling technology

  Quantum source, Quantum state measurement, Entropy verification, Extraction of randomness

- Maturity

  Security (High --> Low) / Practicality (Low --> High): DIQRNG, Semi-DIQRNG, device-dependent QRNG

# Key findings and suggestions (3)

QC

- Need further efforts to work out more key findings
- Quantum Simulator in Centralized/Distributed Quantum Computing is relatively mature in computation, network and commercial practice

# Future work

Further contributions are invited to supplement and improve

- Existing use cases
- Key findings and suggestions, e.g. clause 7.2 for quantum computing
- Editorial refinement of the entire document

# Backup

Draft D1.2 output document ( QIT4N-O-088 )

https://extranet.itu.int/sites/itu-t/focusgroups/qit4n/_layouts/15/WopiFrame.aspx?sourcedoc=%7B9DE7491B-1524-4C4F-90A5-5964B336E871%7D&file=QIT4N-O-088.docx&action=default

# Thank you!