10th Anniversary

GISC 2026

Global ICT Standards Conference 2026

The Future of the Global Quantum Ecosystem

Commercializing Quantum Technologies: Scaling Computing, Networking, and PQC-QKD Security through Global Collaboration

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ICT Standards and Intellectual Property:
Shaping the Physical AI

주최 과학기술정보통신부 지식재산처 주관 국립전파연구원 TTA IITP KEA kista ETRI

Presentation outline

01 IonQ technology and computing cases

02 IDQ technology and quantum security cases

03 Global standards and joint validation

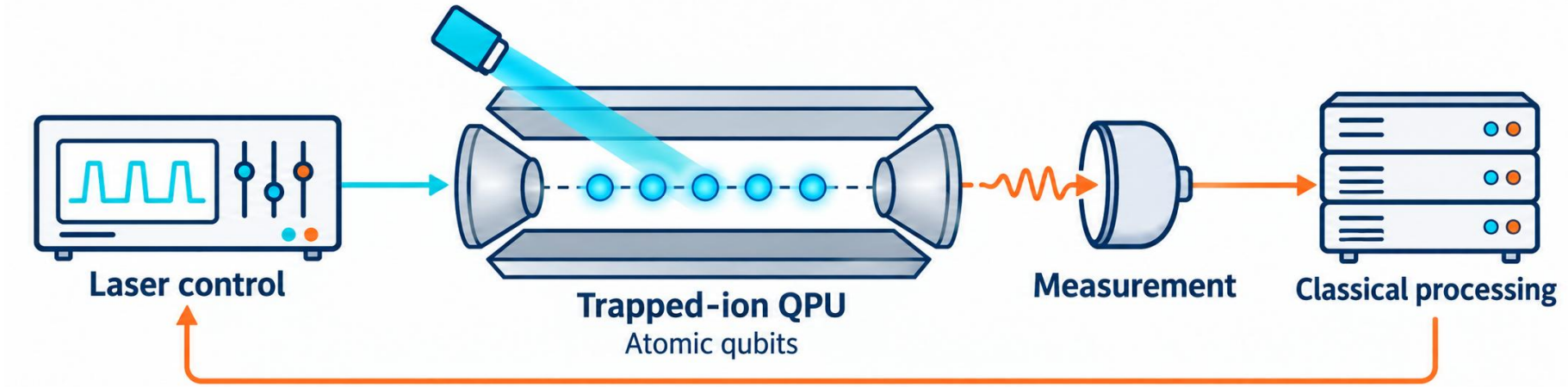
IonQ and IDQ: industrial applications

Customer projects connect computing, networking and security

Computing	IonQ trapped-ion QPUs with classical HPC Hyundai, KISTI and Ansys
Networking	EPB infrastructure and optical connections Quantum memory research
Quantum security	IDQ QRNG, Clavis XG, Clarion KX and Solteris Korean government networks, Singtel and Europe

IonQ trapped-ion computing

Atomic qubits with laser control and classical processing



Atomic qubits

Trapped ions store quantum information

Circuit execution

Laser control and measurement execute circuits

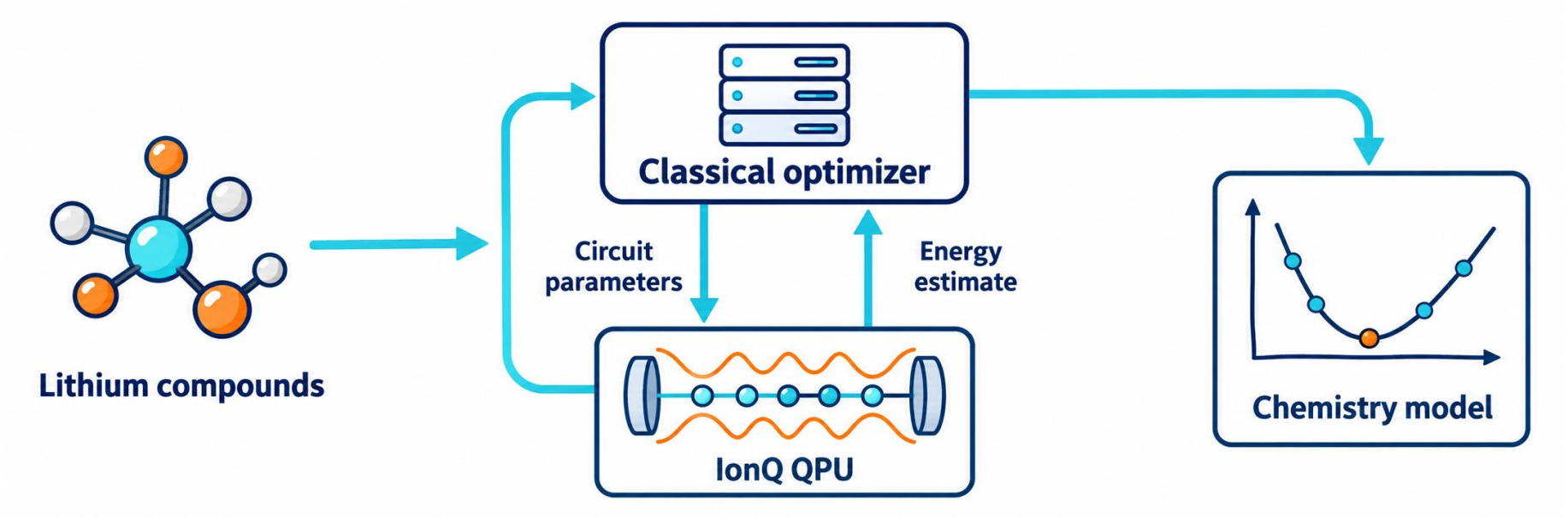
Scaling

HPC integration and optical links support expansion

Conceptual schematic based on the cited public announcements

Hyundai and IonQ: battery chemistry research

VQE combines quantum energy estimation with classical optimization



Industry problem

Lithium compounds and chemical reactions

Research approach

Joint VQE development announced in 2022

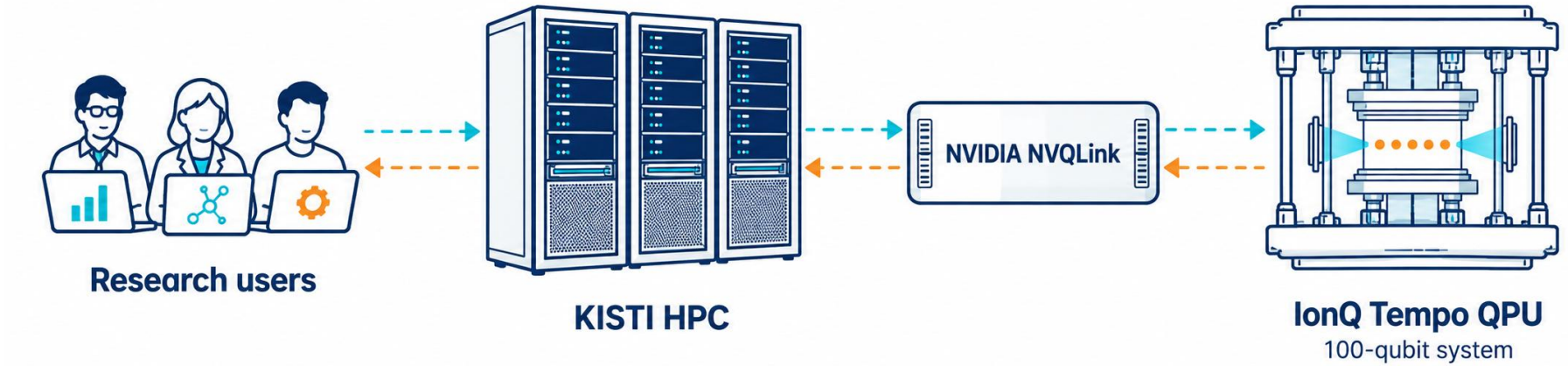
Application stage

Battery chemistry research partnership

Conceptual schematic based on the cited public announcements

KISTI and IonQ: quantum–HPC integration

A national infrastructure plan for hybrid research workflows



December 2025

Contract for a 100-qubit Tempo system

March 2026

MOU includes NVIDIA NVQLink integration

Application stage

Supply agreement and phased integration plan

Conceptual schematic based on the cited public announcements

Ansys and IonQ: blood-pump simulation

A hybrid workflow within an existing engineering environment

Engineering workflow	Quantum method	Evidence scope
LS-DYNA sparse matrix Coarsened graph	VarQITE graph partitioning Matrix reordering	Linear-solver benchmark Up to 12% less time
Classical factorization and linear solution	Separate experiments on IonQ Aria / Forte	Total QPU-inclusive runtime advantage not established

Engineering task

Blood-pump fluid-flow simulation

Reported result

Up to 12% reduction in linear-solver time in the reported benchmark

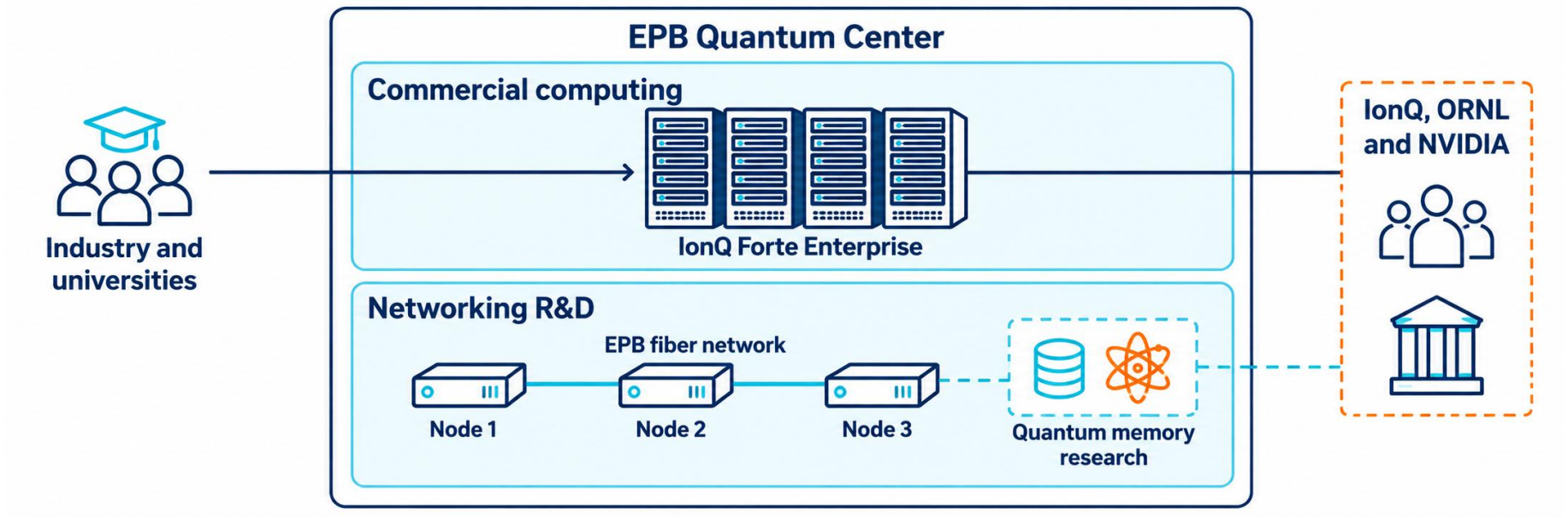
Evidence scope

Joint research benchmark, March 2025

Source: Aboumrad et al., arXiv:2503.13128, Sections IV-C and IV-D (March 2025)

EPB: computing and networking in Chattanooga

A regional hub connects infrastructure, users and research partners



Commercial computing

Forte Enterprise launched on 18 September 2026

Local demand

Grid optimization research and university access

Networking research

Live-fiber quantum memory research initiative

Conceptual schematic based on the cited public announcements

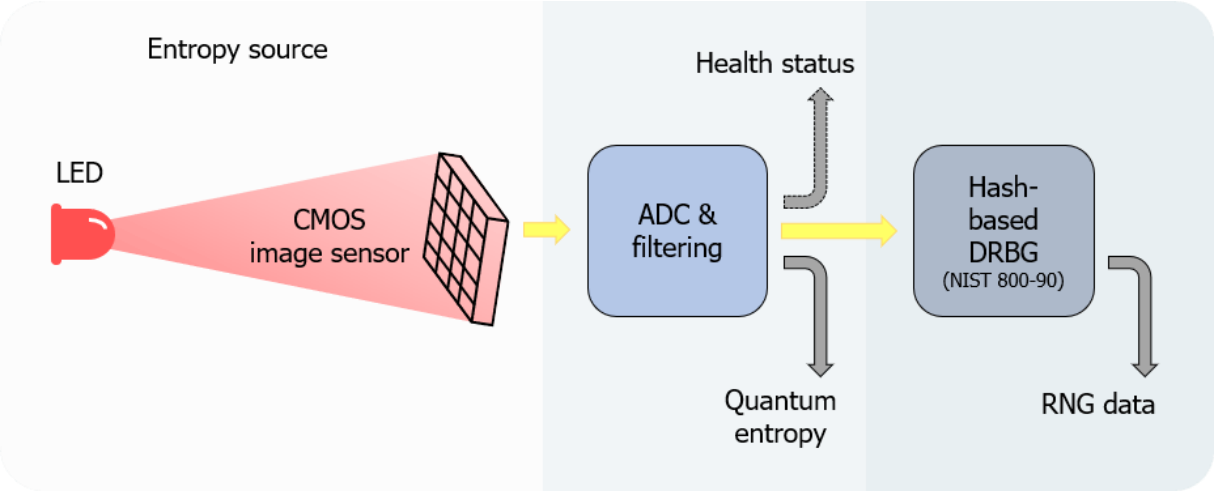
QKD networks and entanglement networks

Different resources and deployment requirements

Dimension	IDQ QKD networks	IonQ networking research
Resource	Cryptographic key material	Quantum states and entanglement
Examples	Korean government network Singtel NQSN+	EPB live-network research
Components	QKD links, Q-KMS and encryptors	Ion–photon interfaces and memory
Scaling needs	Interoperability, availability and trusted-node security	Fidelity, generation rate and storage time

IDQ QRNG technology

Quantum entropy provides input for cryptographic key generation



Generation

Quantum optical noise and sensor measurement

Validation

Entropy assessment, health tests and processing

Applications

Mobile devices, security equipment and satellites

Galaxy Quantum phones: QRNG in consumer devices

SK Telecom and Samsung integrate IDQ QRNG chips

Product adoption

First QRNG-enabled 5G smartphone in 2020
Expansion through the Galaxy Quantum series

Protected functions

Key generation and authentication in supported apps
Mobile finance and payment services

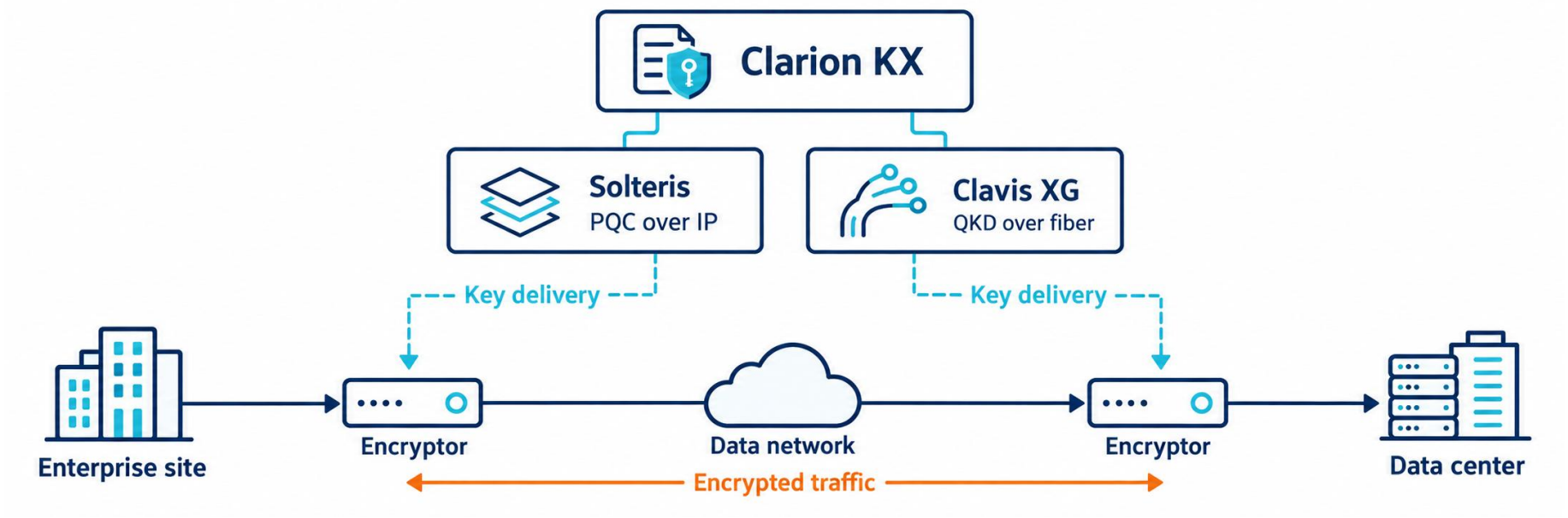
Deployment value

Quantum technology embedded in the endpoint
Protection depends on app and security integration



IDQ and IonQ: key management architecture

Key exchange and policy management complement the encrypted data path



Clarion KX

Central key policy and distribution

Solteris

IP-based PQC key exchange

Clavis XG

QKD key material over optical links

Conceptual schematic based on the cited public announcements

Clarion KX and Solteris

Central key policy with network endpoints

Component	Publicly described functions	Integration checks
Clarion KX	Key exchange and policy management PQC and QKD integration	Key identifiers, synchronization and access control
Solteris	Standalone Q-KMS appliance PQC over IP and QRNG	Latency, redundancy and interfaces
Existing encryptors	Traffic protection with external keys	Key injection, rotation and recovery

Korea: the government convergence network

SK Broadband and IDQ deployed a multi-link QKD infrastructure

48 organizations

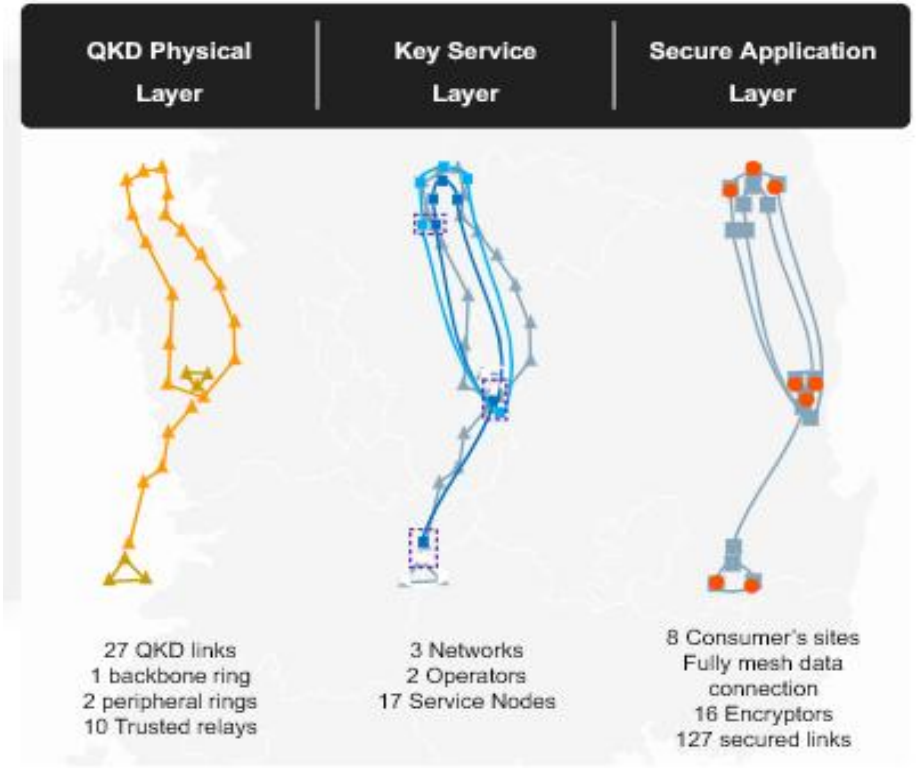
800 km network scale
Phase-one completion announced in 2022

Network architecture

QKD physical layer, key service layer
and secure application layer

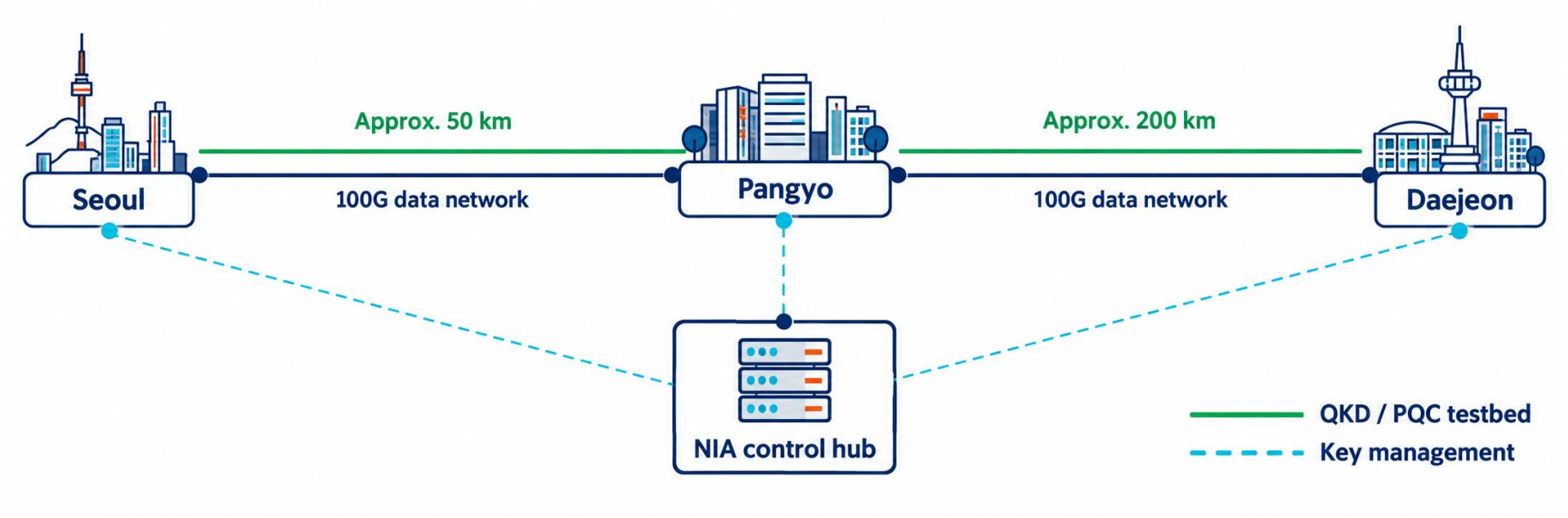
Operating experience

Key routing across multiple links
Monitoring and encryptor integration



Korea: NIA open quantum-safe testbed

Seoul, Pangyo and Daejeon provide an integration environment



Reference topology

Seoul–Pangyo: approximately 50 km
Pangyo–Daejeon: approximately 200 km

Test scope

QKD, PQC and key management
Integration with a 100G data network

2026 expansion

NIA upgrade and expansion program
Cooperation with users and operators

Source: NIA topology reproduced in IDQ material. Route lengths are approximate. 100G is the data rate.

Singtel NQSN+: quantum security as a service

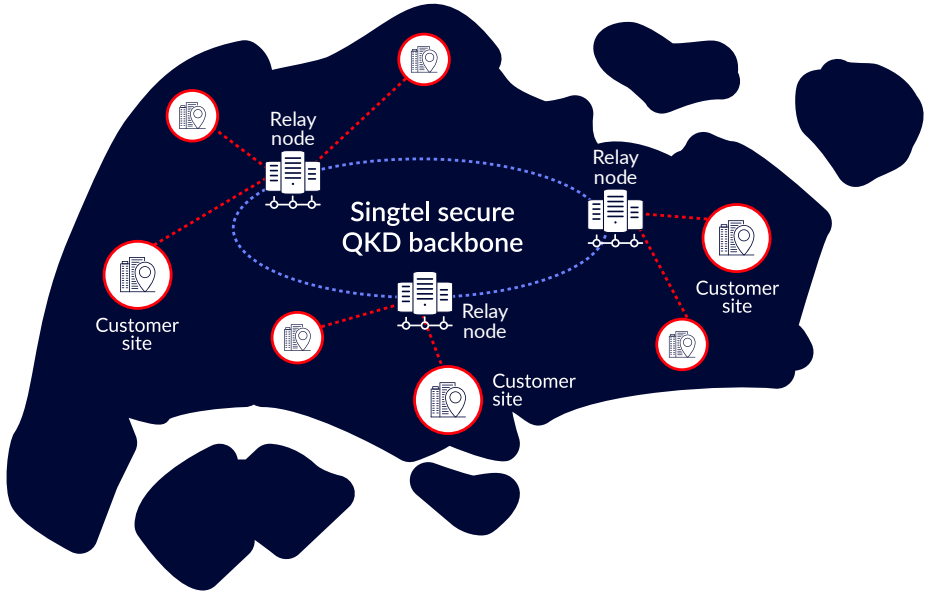
A telecom operator integrates quantum security into enterprise connectivity

Development and launch

IDQ collaboration announced in 2023
NQSN+ launch and enterprise trials in August 2024

Service model

Integration with enterprise WAN services
Managed infrastructure and operations



Hybrid expansion

PQC and QKD architecture expanded in November 2024
Optical corridors and remote IP coverage

Source: Singtel, 8 Aug 2024; Singtel / IDQ, 11-12 Nov 2024

European networks: Poland and Slovakia

National deployments provide a basis for cross-border interoperability

Poland

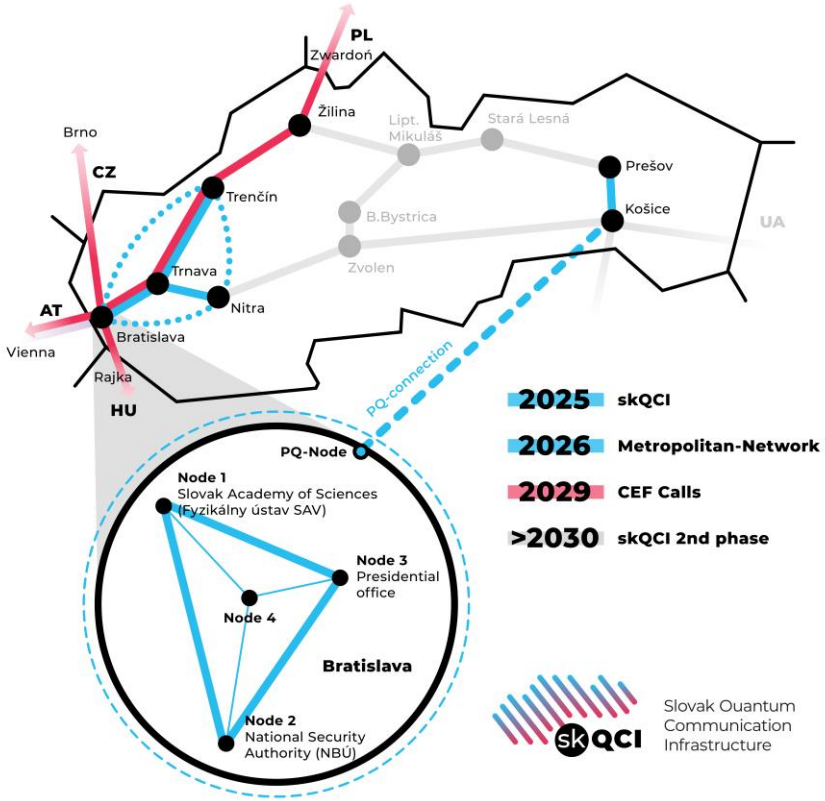
IDQ reports a 1,770 km network
Connecting five HPC centers

Slovakia

National architecture combining QKD and PQC
Supplied map includes phased expansion plans

Collaboration

Aligned key interfaces and operating policies
Cross-border testing and assurance



Slovakia map: supplied deployment and expansion concept. Future stages represent plans.

EAGLE-1: IDQ technology in a satellite project

QRNG-based key generation supports the satellite QKD payload

IDQ contribution

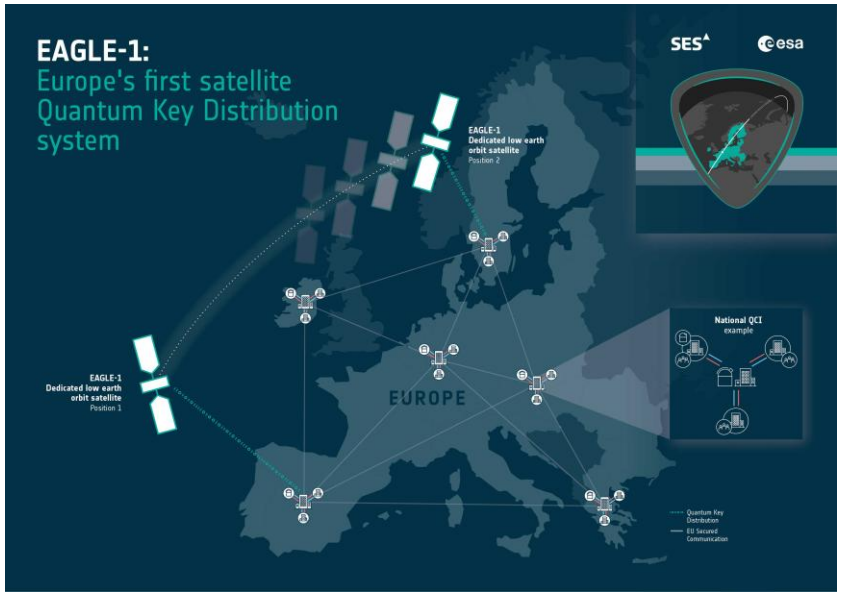
Space-qualified key generation development with TESAT
QRNG chips supply random key material

International team

SES-led consortium with ESA and EC support
Ground and satellite QKD integration

Application stage

Space and ground demonstration project
Satellite service remains a development program



Service requirements from deployment experience

Customers need continuous key supply and predictable recovery

Validation area	Field checks	Relevant products and roles
Key supply	Secret key rate, demand and synchronization	Clavis XG and Clarion KX
Existing infrastructure	Encryptor, VPN and external-key interfaces	Solteris and encryptor partners
Failure policy	Key depletion, fiber outage and approved fallback	Operator and Q-KMS
Security boundary	Authentication, trusted nodes and device access	Customer, supplier and evaluator

Standards: scope and deployment responsibilities

Each standard covers a defined layer. Integration and assurance need additional evidence

Layer	Reference	Scope
PQC key establishment	NIST FIPS 203	ML-KEM key encapsulation
Digital signatures	NIST FIPS 204 / 205	ML-DSA / SLH-DSA signatures
Key delivery API	ETSI GS QKD 014	REST key delivery to applications
QKD network	ITU-T Y.3800 family	Architecture and network functions
QKD evaluation	ISO/IEC 23837-1 / -2	Security requirements and test methods

Algorithm compliance and API support require separate implementation and interoperability testing

Deployment experience and joint interoperability tests

A shared test profile makes behavior and security assumptions comparable

Field condition	Joint test	Evidence to compare
Key delivery	Key IDs, rotation and restart	Matching keys and consumption logs
Fiber outage	Depletion and approved fallback	Alarms, policy state and recovery time
Hybrid operation	PQC / QKD policy transitions	Active methods and protected traffic
Security boundary	Authentication and trusted nodes	Versions, assumptions and test scope

Proposed output: shared test cases, agreed pass criteria and evidence for standards contributions

Joint validation with Korean and global partners

Customer problems and operational data define measurable collaboration

Cooperation area	Starting examples	Shared deliverables
Computing applications	Hyundai, KISTI and Ansys	Classical baselines and application benchmarks
Hybrid security	Government network, NIA and Singtel	Multi-vendor PQC–QKD and recovery tests
Networking research	EPB and quantum memory	Fidelity, generation rate and operating data
International standards	Korea, Europe and Singapore	Test methods and security assumptions

Commercialization through global collaboration

Industry demand guides infrastructure and standards work

Computing	Application research and QPU–HPC integration
Quantum security	QRNG, PQC, QKD and managed key services
Collaboration	Shared field evidence, validation and standards

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Thank you

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Clavis XG: matching QKD to the optical route

Deployment options depend on fiber loss and traffic coexistence

Model	Distance in supplied material	Deployment environment
Short Haul	Up to 60 km	Dedicated fiber, access and metro
Backbone	60–100 km	Dedicated fiber, data-center links
Long Haul	100–150 km	Dedicated fiber, longer spans
Hub & Spoke	Up to 90 km	Star topology
Multiplex	Up to 60 km	Shared fiber with data traffic

Ranges from supplied material. Reach and key rate depend on optical loss and operating conditions.