Quantum Delta
the Netherlands

Quantum Network Testbed Developments in NL

IETF 116 Meeting March 2023,
Yokohama

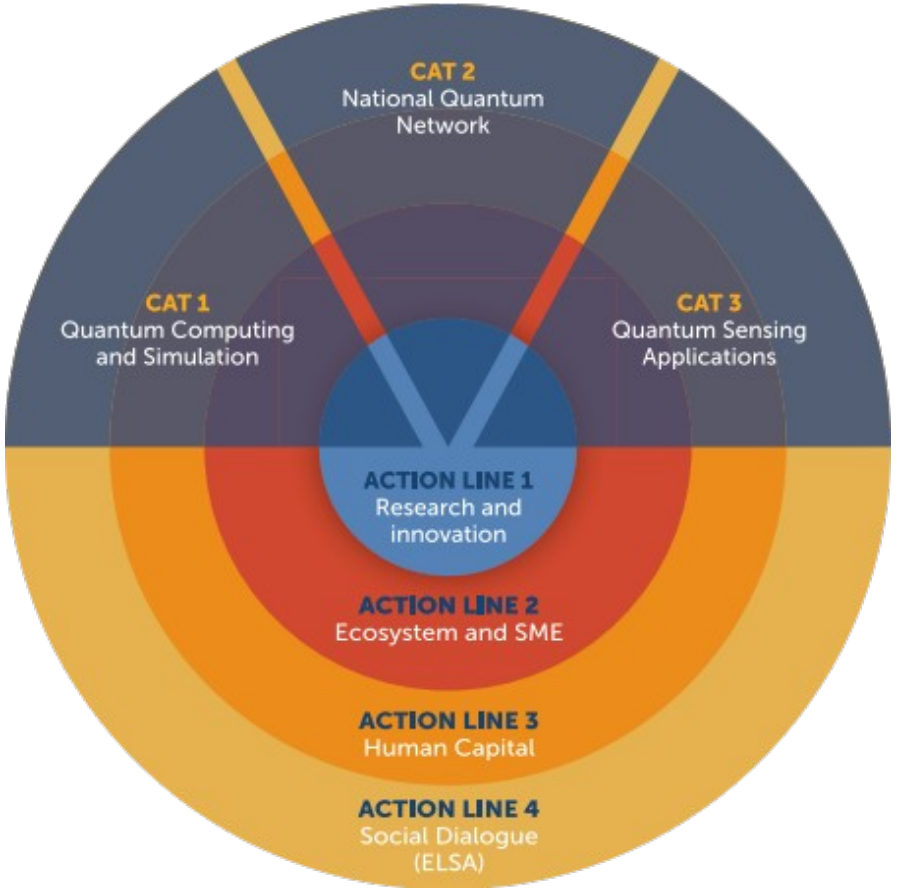
Jesse Robbers
Executive Director Industry & Digital Infrastructure
- Co-Founder
- National Lead Quantum (Internet) Networks
- Board Member EuroQCI
- Advisory Board Member EuroHPC

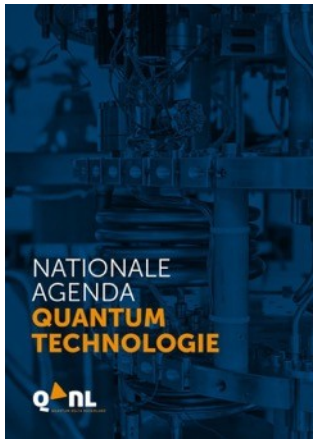
March 27th, 2023

IETF®

About Jesse Robbers

About Quantum Delta NL





National Cleanroom Infrastructure

World leading Dutch research institutes

QuTech

TU Delft

TU/e

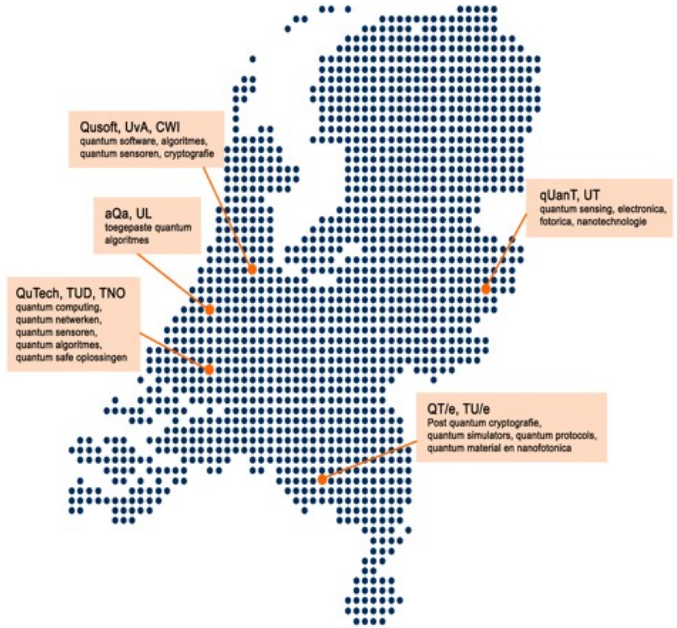
QuSoft

QT/e CENTER FOR QUANTUM MATERIALS AND TECHNOLOGY EINDHOVEN

TNO

UNIVERSITY OF TWENTE.

CWI



Important Quantum Network Milestones from NL

2015: World

rtl nieuws

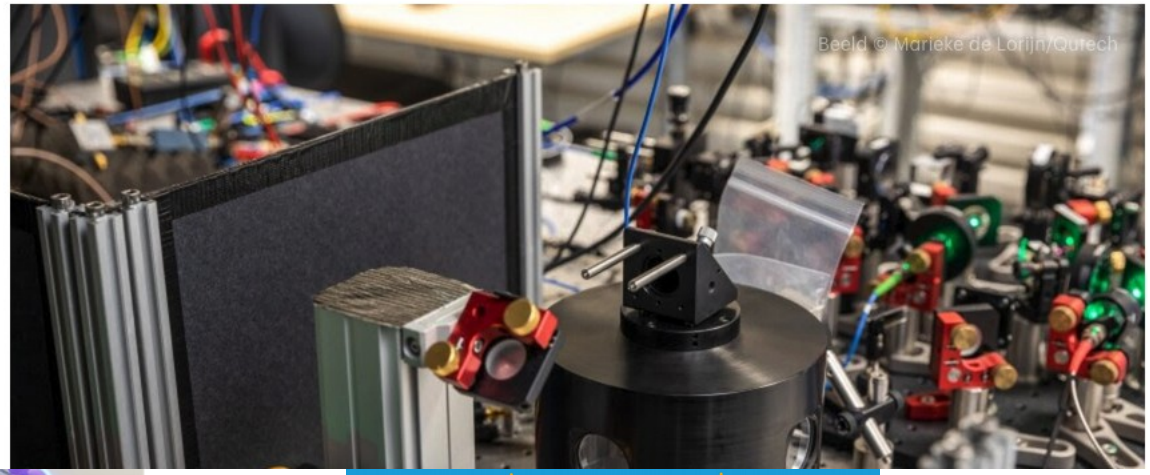
RTL Nieuws
Bekijk de laatste uitzending

Nieuws Economie Sport Entertainment Tech Lifestyle EditieNL Uitzendingen 27° 0 files • 0 km 6 OV

Wetenschap

Delftse wetenschappers teleporteren informatie: 'Stap naar onkraakbare communicatie'

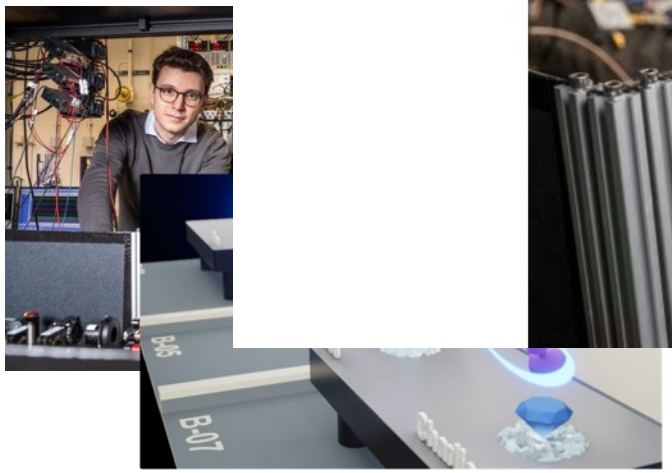
27 mei 2022 22:40



ch QIA, by QuTech

QUANTUM INTERNET ALLIANCE

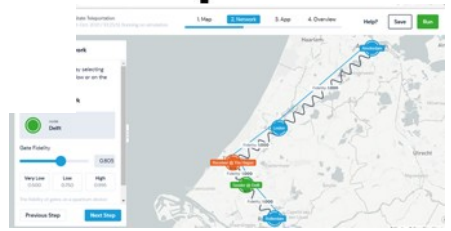
2021: 1st Er
Quantum N



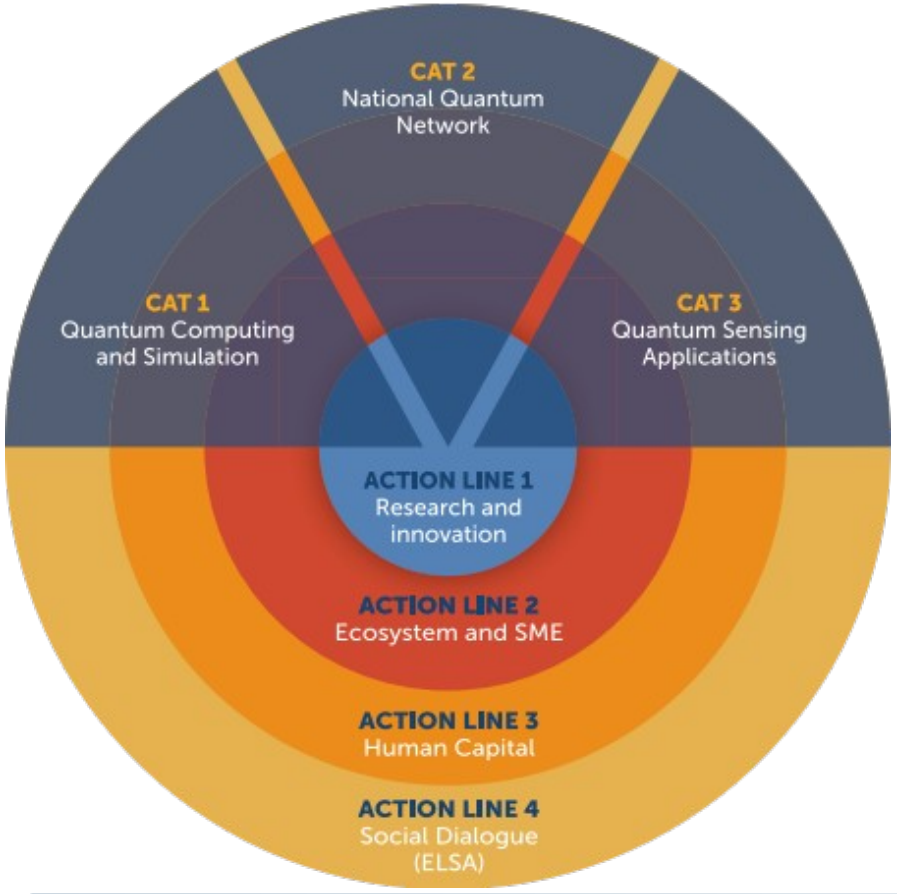
Quantum Key Distribution

QNE

m
k Explorer



QDNL CAT-2 | National Quantum Network Development

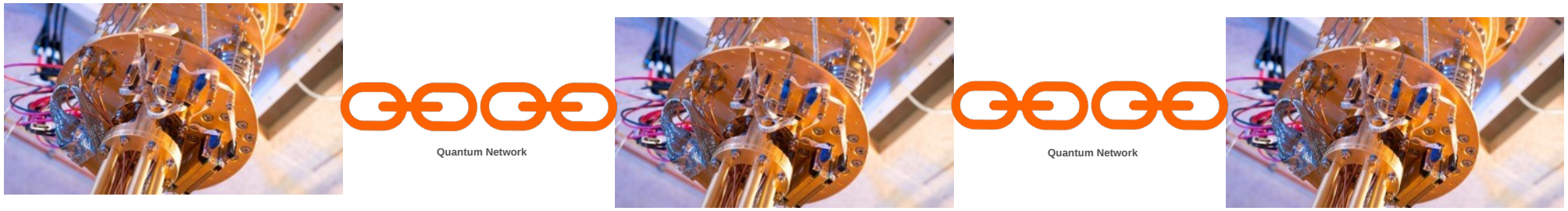


National Cleanroom Infrastructure

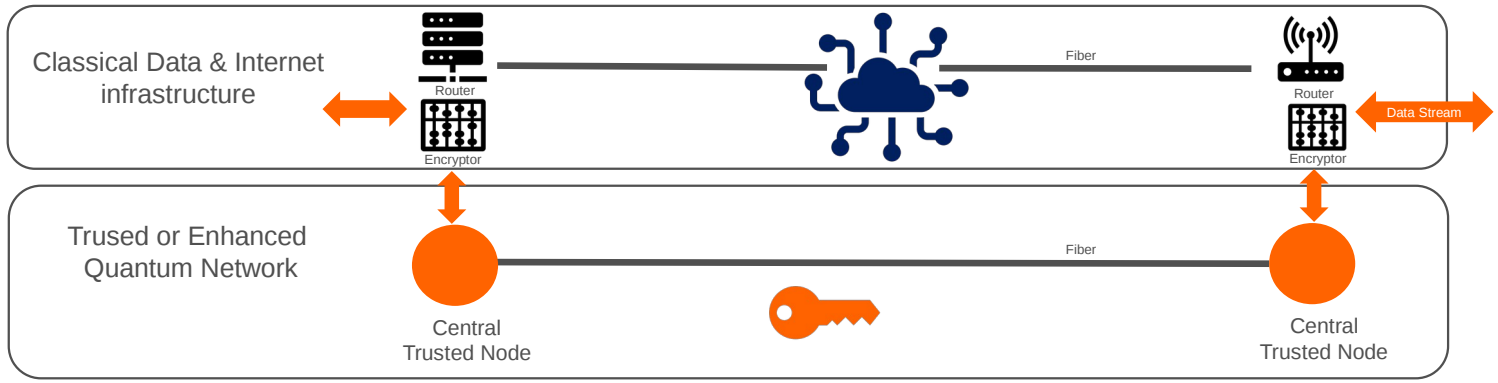
- Development of Quantum Networks and Quantum Internet
- Quantum connectivity between different NL locations
- Link potential users
- National testbed for Cloud, 5G/6G, S/W, security application and more
- Connect the industry on the testbed to test H/W, S/W and future applications

Quantum Network Developments in NL

Connecting (Distributed) Quantum Computers



Protect Classical Data & Internet Networks



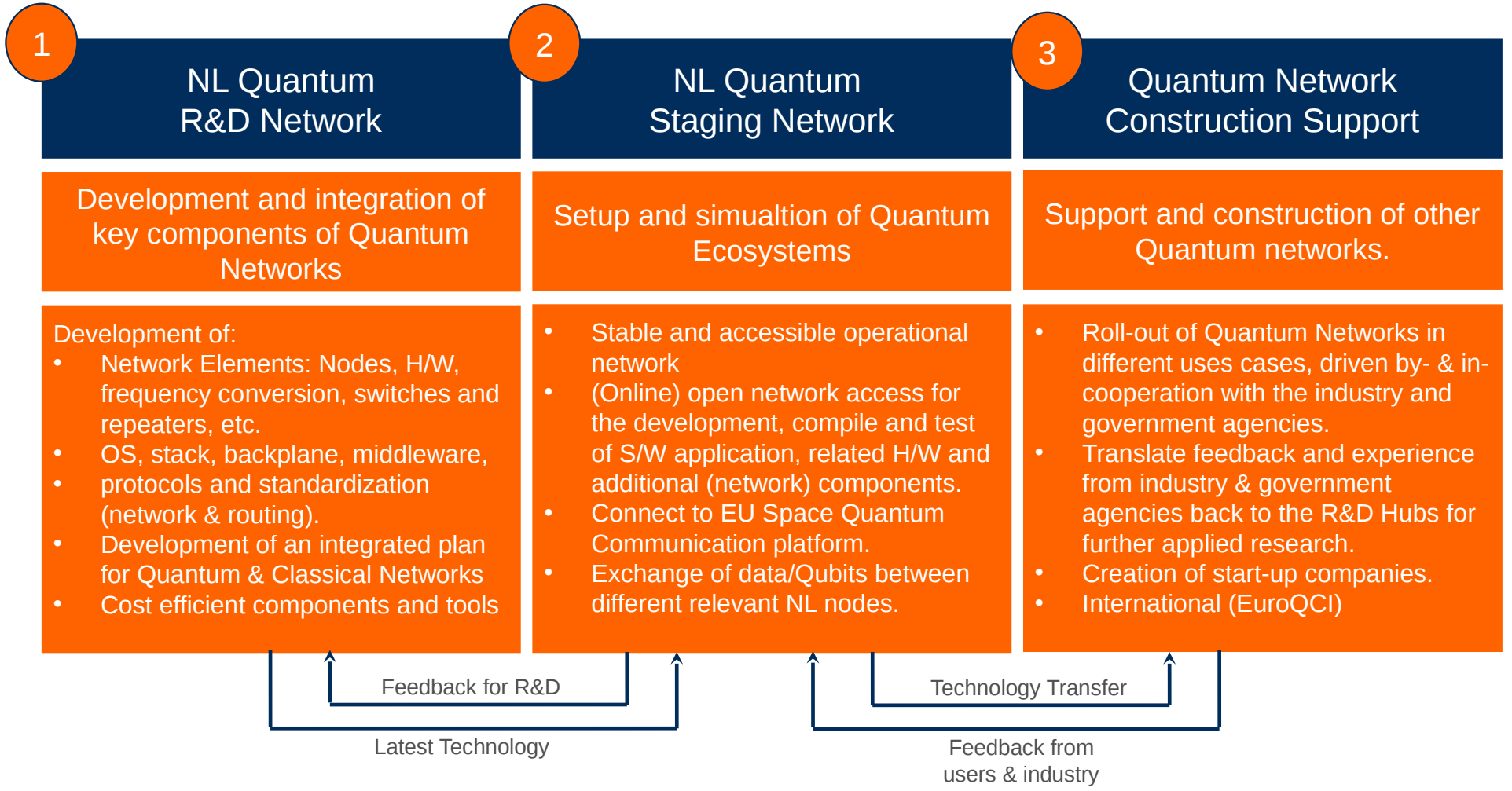
QDNL Quantum Network | Main Goals

1. Build the fundament for a NL National Quantum Network
2. The network will be a testbed and showcase on Quantum Networking
3. Focussing on Hardware, Software and Standardization
4. Develop and execute different use cases / Applications
5. Position the NL on International Level (e.g. EuroQCI, FPA on QI and QKD)

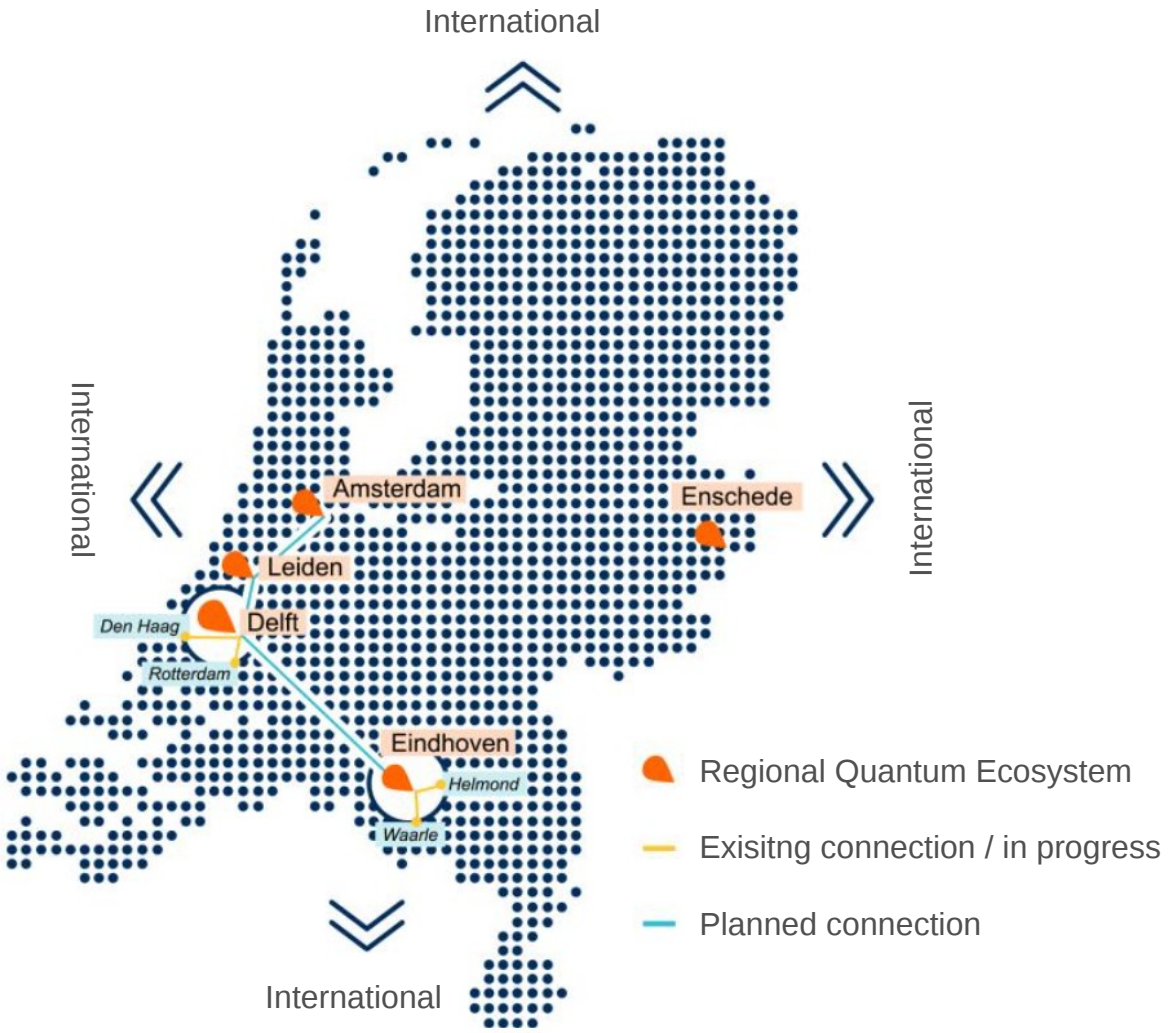
Our Promise:

Robust and secure Quantum Network infrastructure

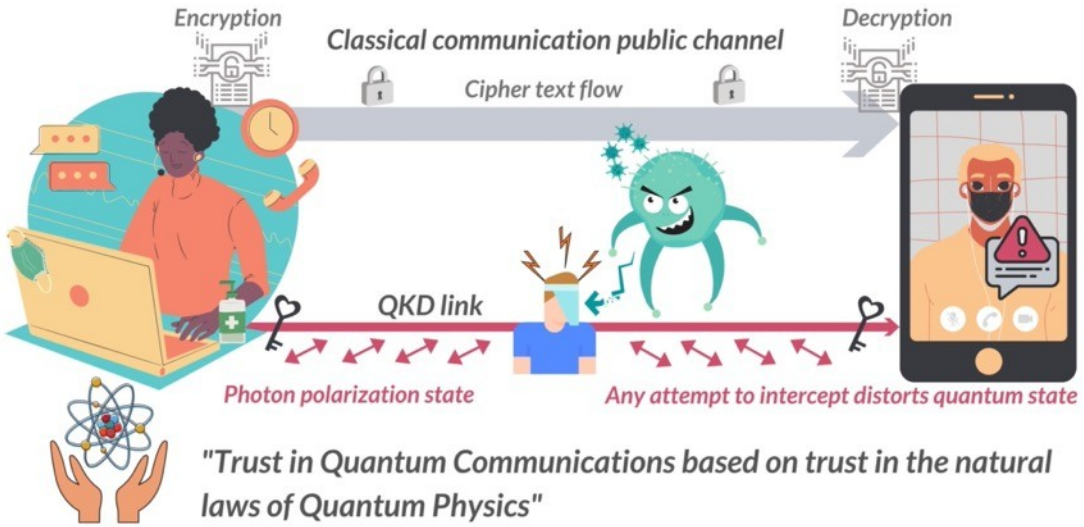
The Setup of Quantum Network Infra in NL



NL Quantum Staging Network

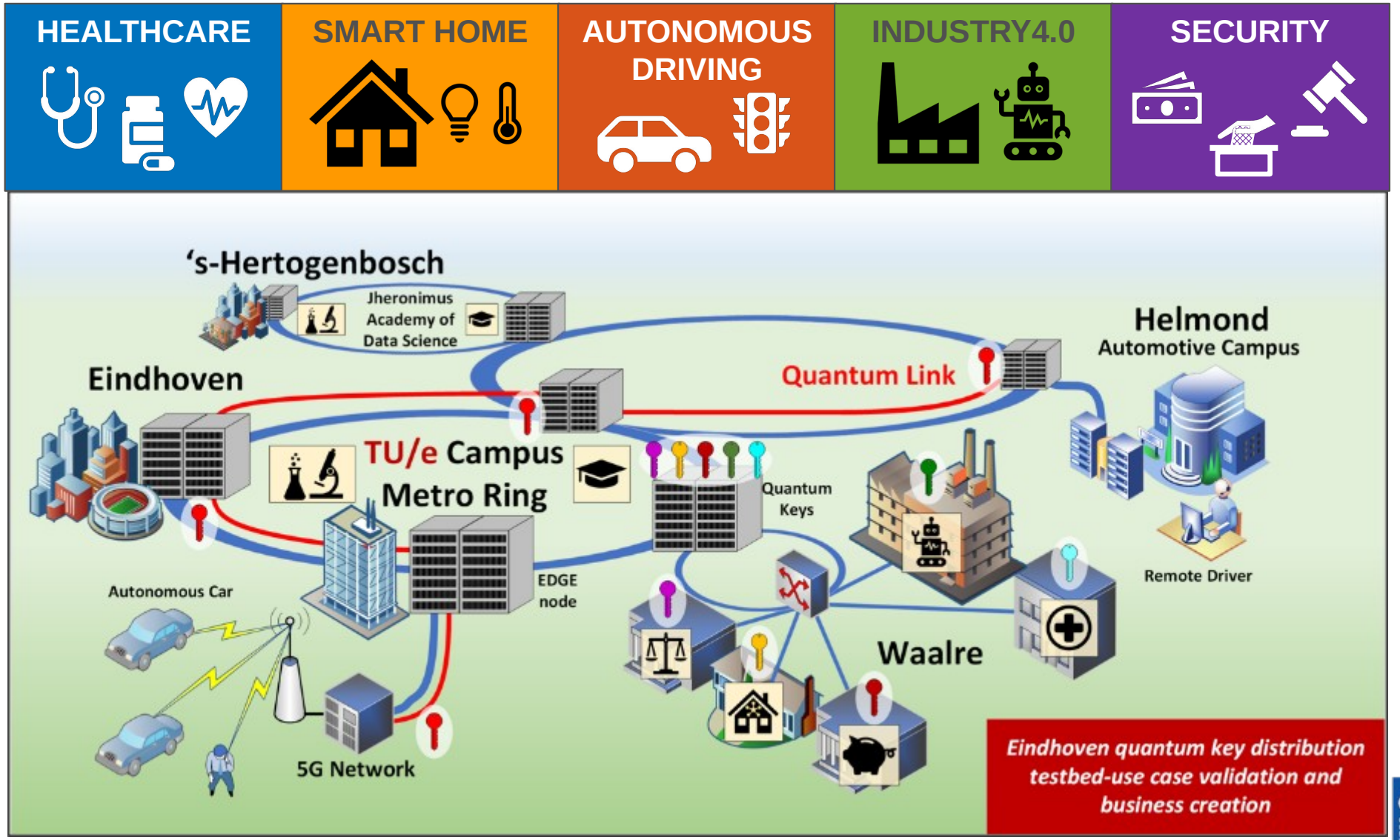


Use-Case | 5G/6G and self driving cars



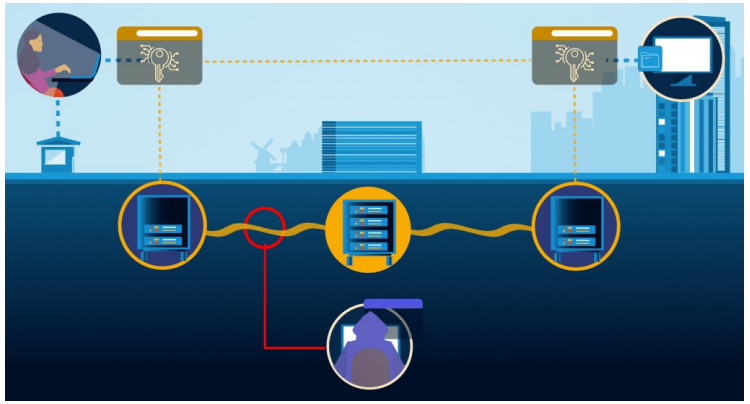
Picture: Bart van Overbeeke

CAT-2 Use-Case | Testbed Applications

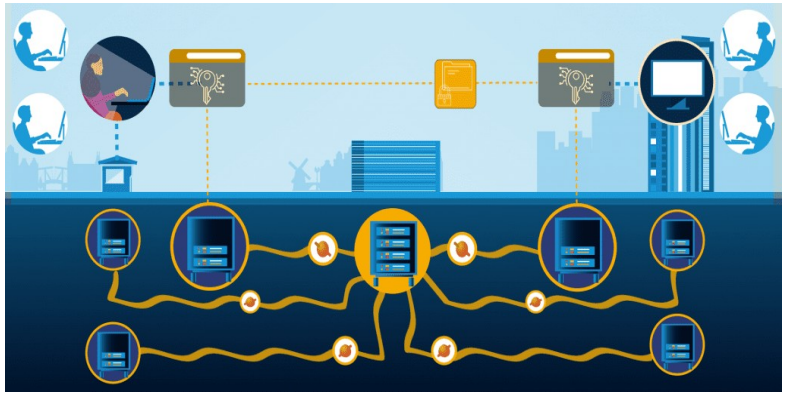


Untappable quantum cryptography becomes practical with MDI-QKD | July 2021

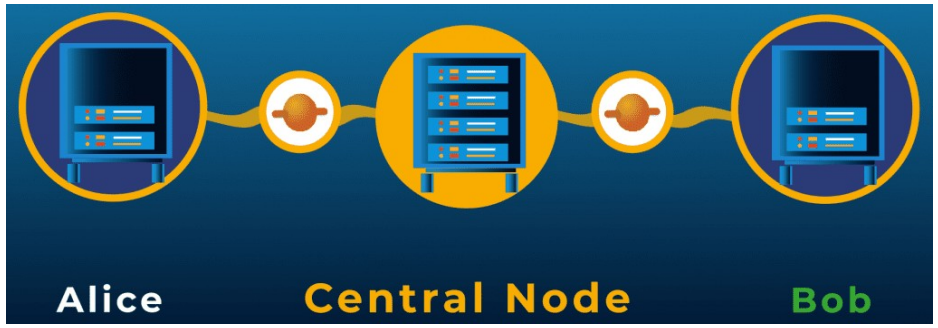
Alice & Bob can use quantum keys to communicate and send files securely using MDI-QKD. Credit: QuTech



Because of the quantum key distribution (QKD) used by Alice & her bank, a hacker cannot eavesdrop on them. Also, the central node doesn't have to be trusted for Alice & her bank to communicate securely. Credit: QuTech



Because of the measurement-device independent (MDI) system the whole network is rather easy to scale up to many users. Credit: QuTech



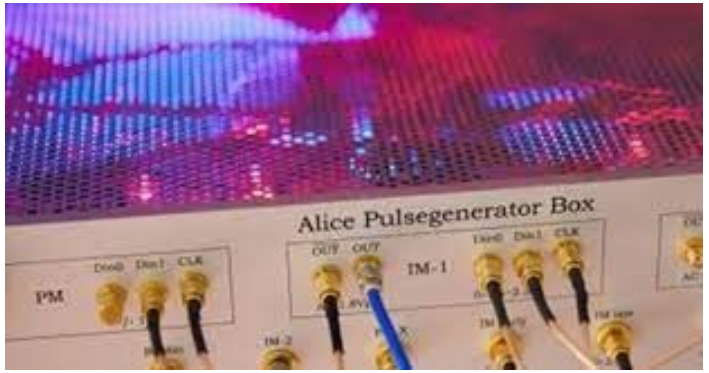
Alice is a standard telco rack located at the Delft University of Technology (the Netherlands), the central node in a neighbouring city Rijswijk, and Bob is at KPN in The Hague. Credit: QuTech

https://qutech.nl/2021/07/06/untappable-quantum-cryptography-becomes-practical-with-mdi-qkd/

EuroFiber Quantum Network testbed

eurofiber

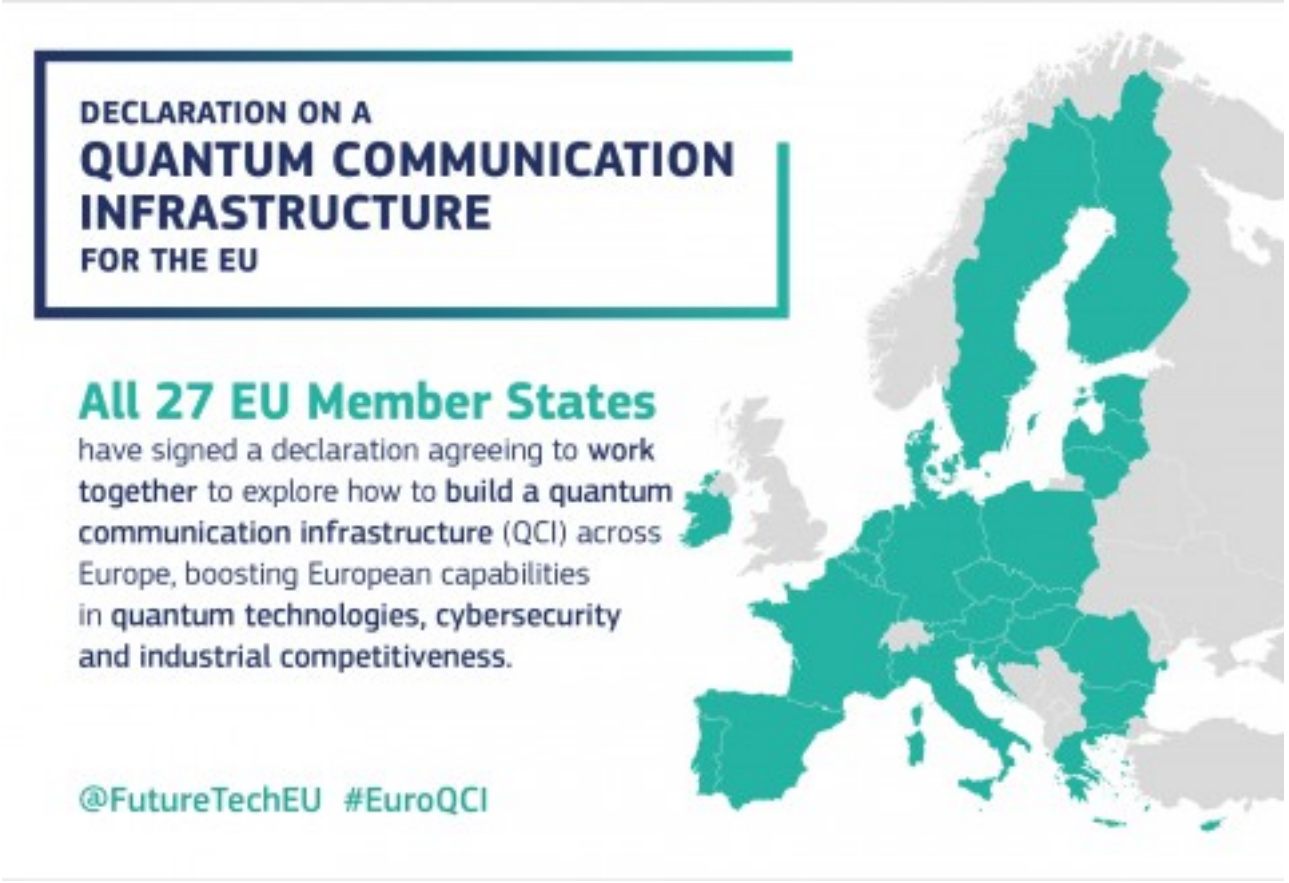
QuTech



Q*bird
quantum connectivity

JUNIPER NETWORKS

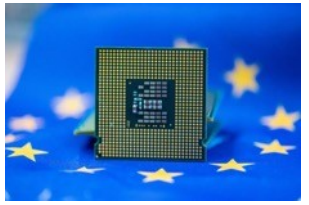
EC strategy on Quantum Networks in EU27



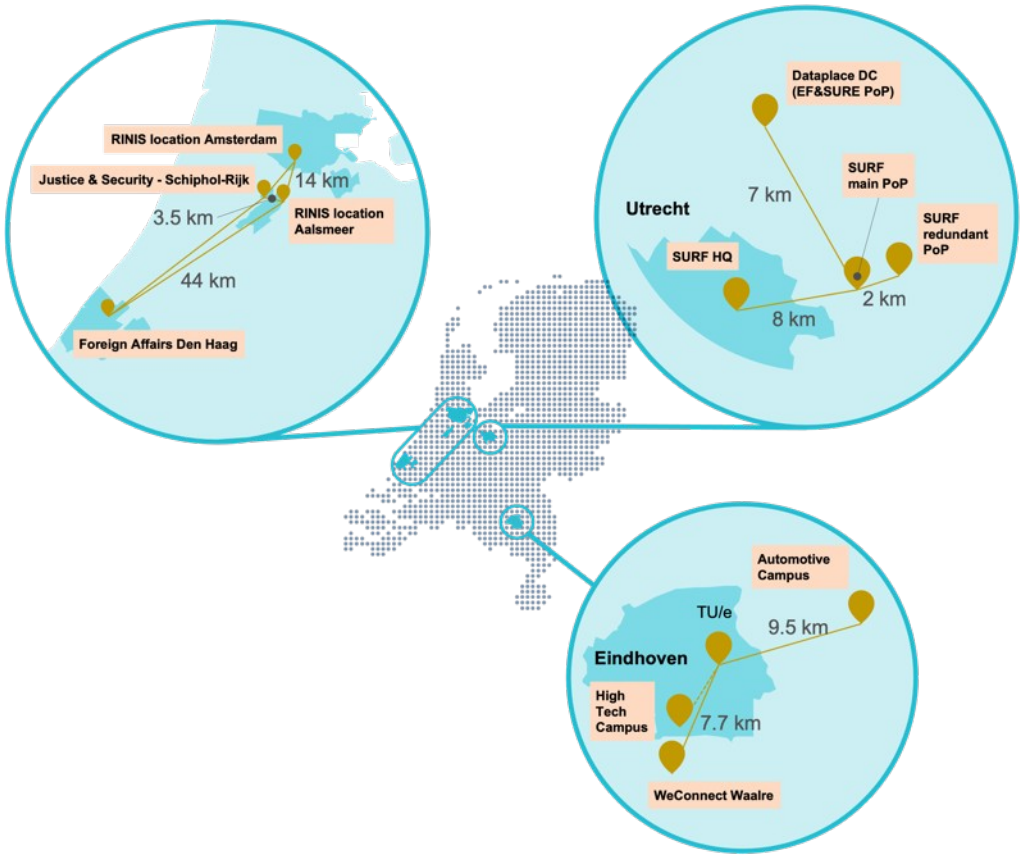
QUANTUM INTERNET ALLIANCE

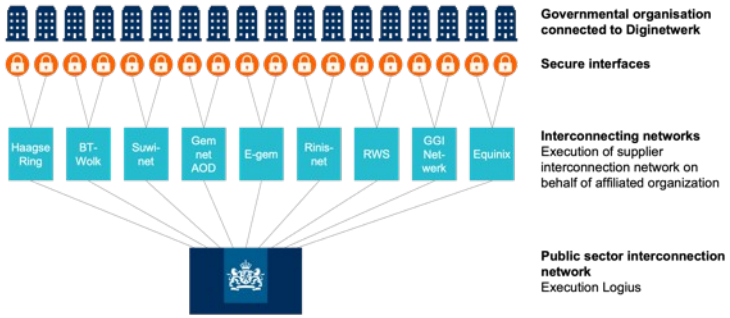
QUANTUM FLAGSHIP

EuroHPC Joint Undertaking

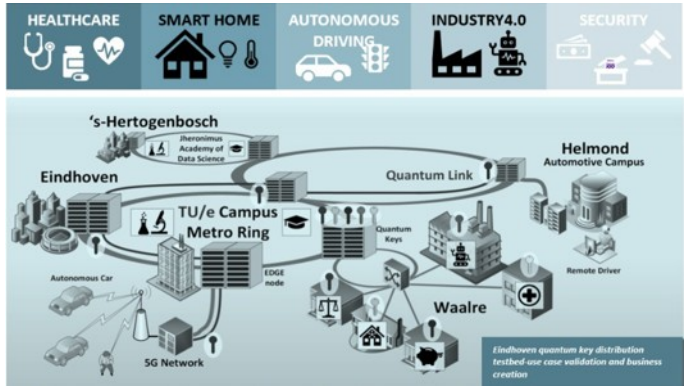


QCINed | Deployment in 3 different regions



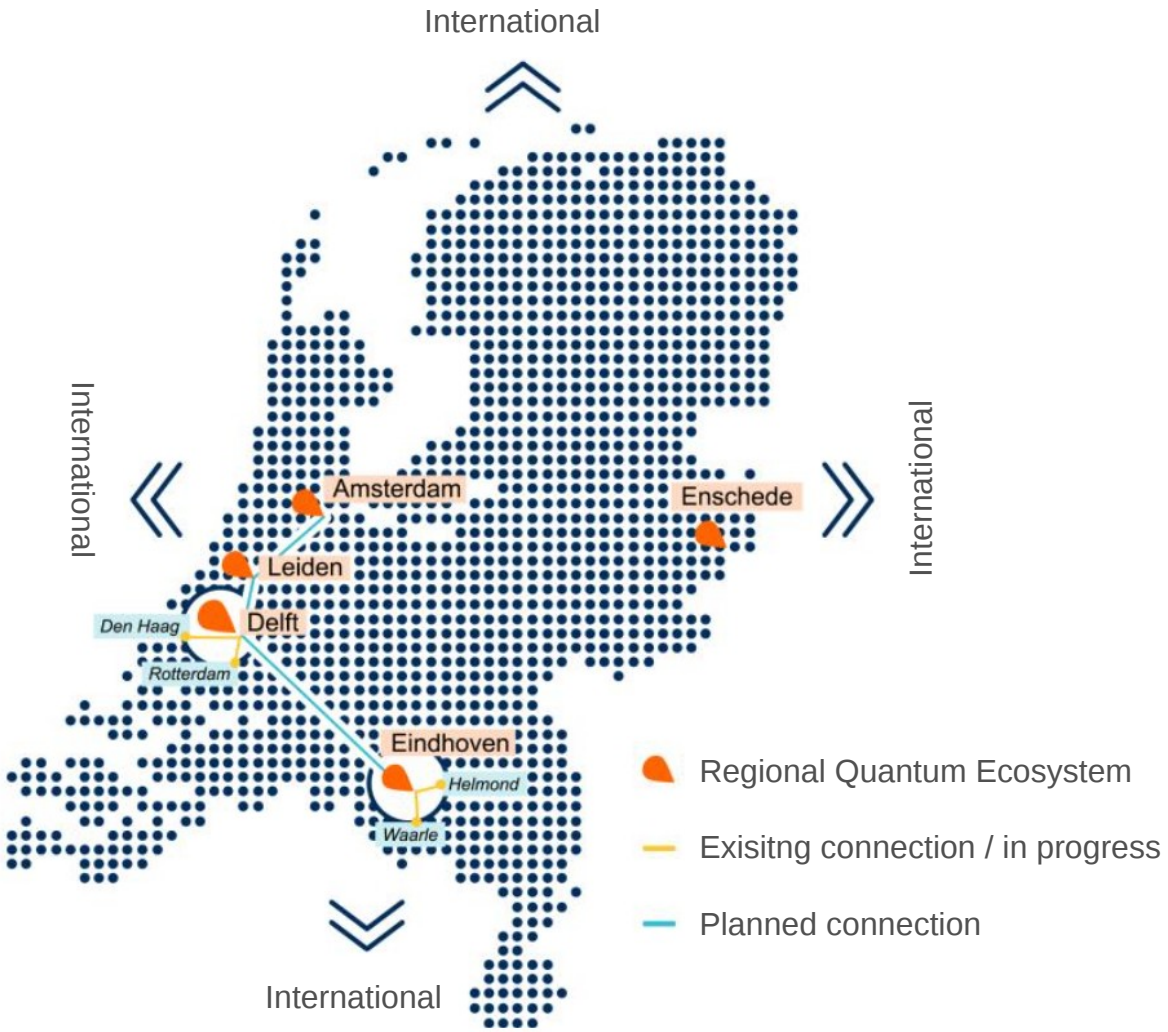


** High level overview NL Governmental Infra*



** Technology agnostic testbed environment setup*

Quantum Networking



Quantum Network Eco-System in the Netherlands

Institutes

QuTech · TU Delft · QT/e Center for Quantum Materials and Technology Eindhoven · TU/e · QuSoft · TNO

Industry

kpn · eurofiber · data place datacenters · SURF · amsix

Start-Ups & SME

SINGLE QUANTUM Excellence in photon detection · QPHOX · QBLOX · Q* bird quantum connectivity

Different Start-Ups Under Construction

Quantum Internet Alliance (QIA)

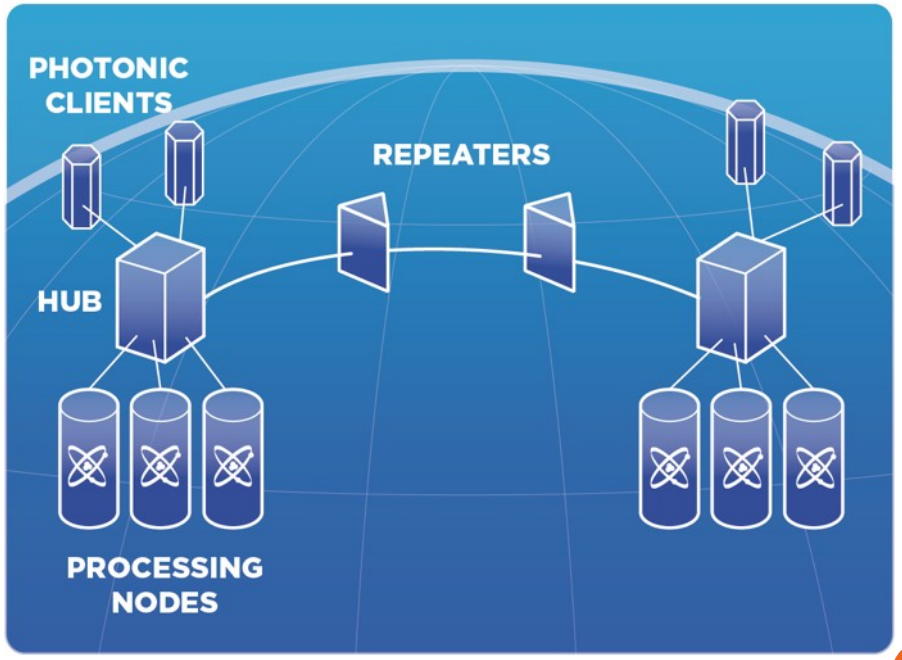
QIA's objective is to build by 2029 two metropolitan networks containing quantum processors, connected by a long-distance fibre backbone using quantum repeaters. This network will be fully programmable to allow the realization of any application supported by the hardware using platform-independent software.

- QuTech coordinate this ambitious European effort.
- Dutch partners:
- AMS-IX, KPN, "MDI-QKD startup", Qblox, Qphox, SURF and Quantum Delta NL are part of this effort.

- Large EU industry players are involved in this effort: Cellnex Telecom, RHEA, SAP, Telecom Italia, Telefonica, Thales.

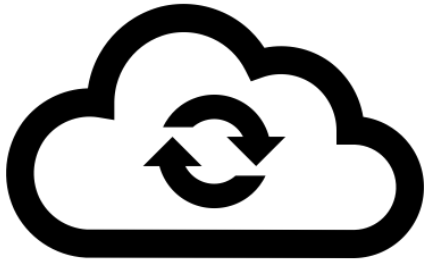
QuTech

QIA QUANTUM INTERNET ALLIANCE



Quantum Network Applications

Cloud & Hyperscalers

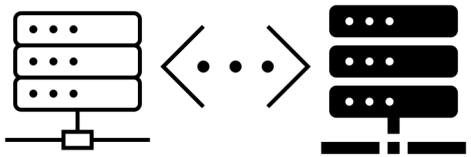


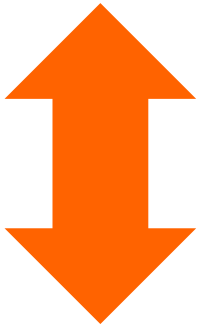
Secure data from/to/in the Cloud

Mobile Networks

Secure the Mobile Network Chain

High Performance Computing (HPC)

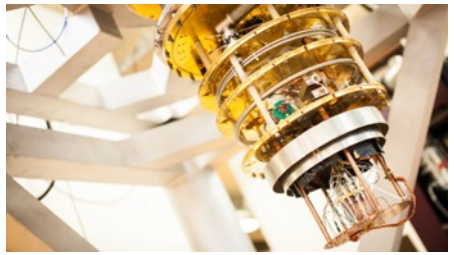




Secure the Hybride setup of HPCs and Early Quantum Computers

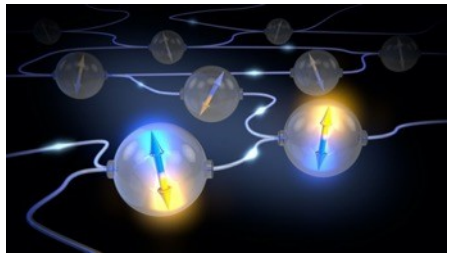
Quantum Technology is important for the future of the Digital Infrastructure

High Performance Computing, Hyperscalers & Cloud



Quantum Computers

Connectivity



Quantum Networks

Applications

Quantum Software

The Netherlands has an important role in the EU Digital Infrastructure

In the EU the Digital infrastructure is concentrated around
Frankfurt – London – **Amsterdam** – Paris (FLAP)

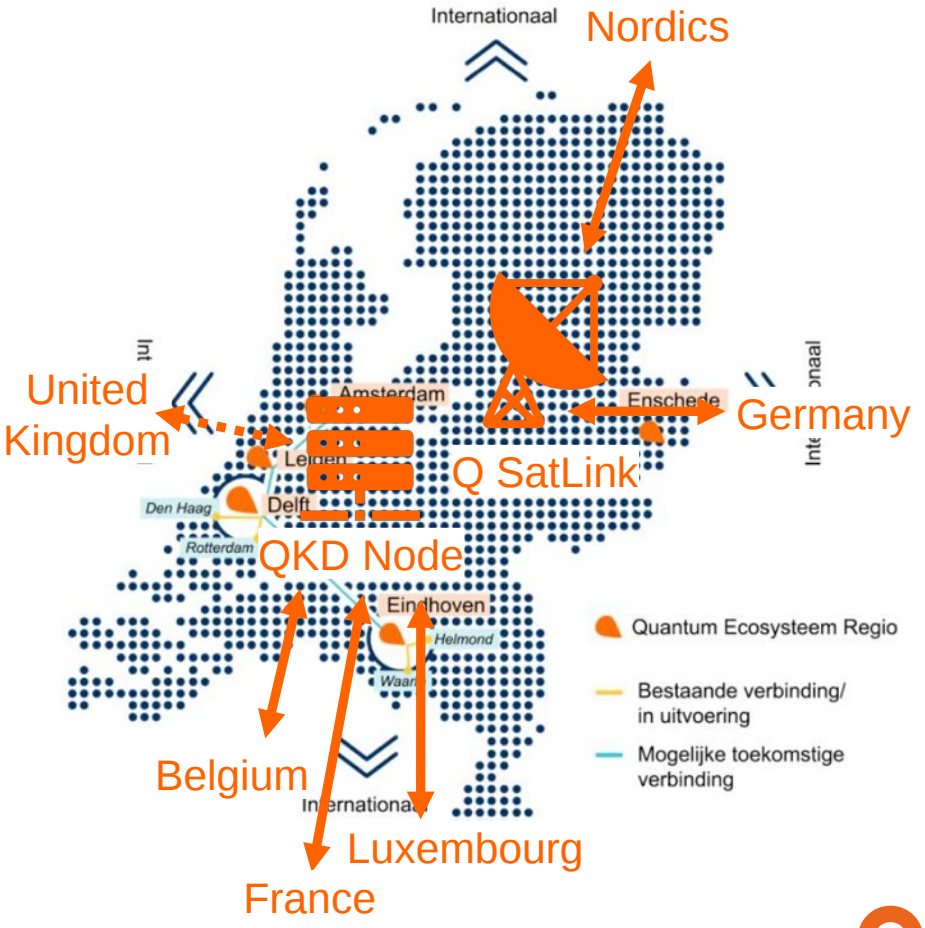
The Netherlands is right in the heart of EU Single Market and in between the largest economies Germany, France, Scandinavia and UK

Some facts:
- 1000+ years experience in (data) logistics & trade
- Fine-meshed cable and fibre - infrastructure
- Lowest average network latency in Europe
- World's largest Internet exchanges
- Fast growing datacentre market
- World's nr 3 Cloud adoption

NL Quantum Network | International strategy & vision

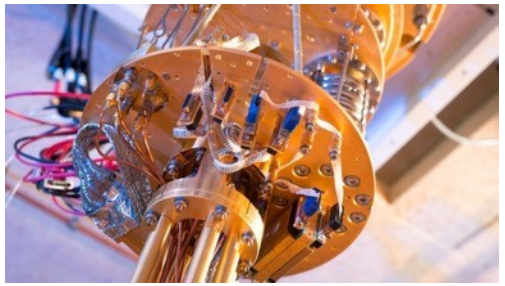
- **Extend the Quantum R&D Networks in the metro areas** of Eindhoven and Delft.
- Setup of **Quantum Network Testbeds**
- Realize the **National NL Quantum Staging network**
- **Take Leadership in the EU27**
- Realize **cross border connections with neighbouring countries**
- Cooperate with the **Quantum Satellite communication** on National and International level
- Build **new partnerships** to drive the eco-system

……. and more.



Strategic Importance of Quantum Networks

- Secure data exchange (Urgent)
- Secure the Digital & Critical Infrastructure
- Stimulate network technology development
- Develop technology for the next generation of our digital infrastructure
- Prepare connectivity which is required for Quantum Computers



Quantum Delta
the Netherlands

Let’s kick some QuBits!
Questions?

Jesse Robbers
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Quantum Delta
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Quantum Networks

Fundament for our next generation Digital Infrastructure

Jesse Robbers
Executive Director Industry & Digital Infrastructure
- Co-Founder
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February 14th, 2023

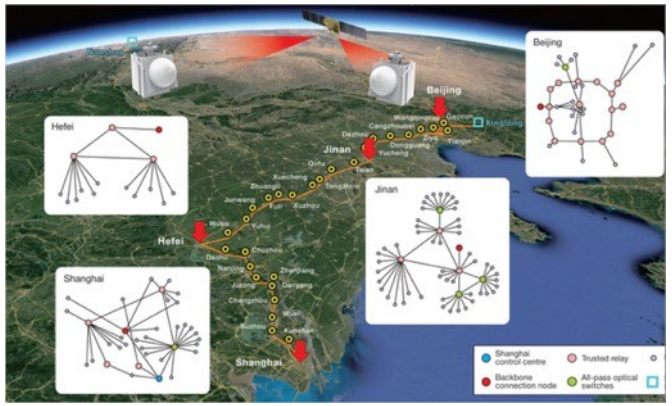
International Developments

BT

NTT

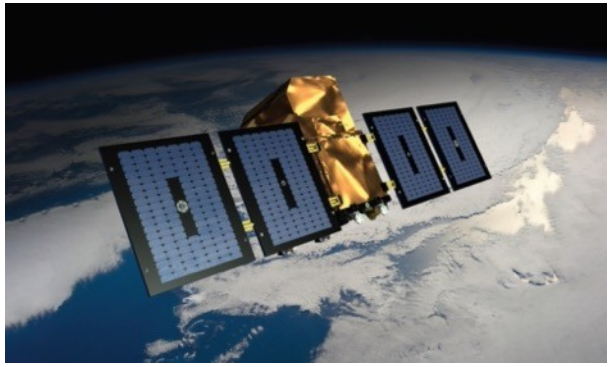
Deutsche Telekom

QuNET



Other important developments

Quantum Communication in Space



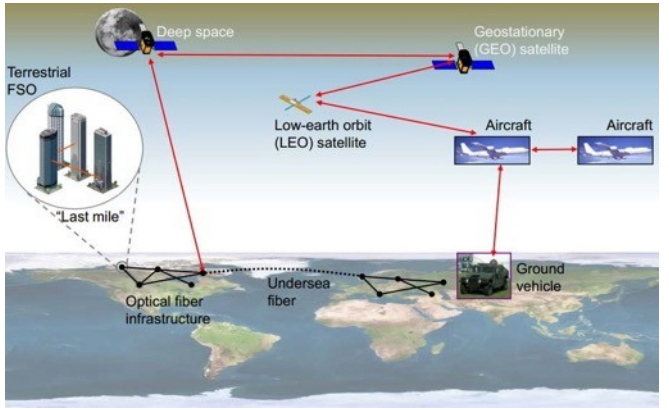
SES TNO AIRBUS DEFENCE & SPACE EASA European Aviation Safety Agency

Quantum Communication & Defense

NATO OTAN

QUANTUM5

Free Space Quantum Communication



Impact period 2020 - 2040

- 100+ Start ups
- 15.000 – 30.000 Direct Jobs
- Private Investments EUR 700 million
- Added value EUR 5 – 7 Billion

Business Climate – Level of education - Knowledge spillovers