



EIN Quantum NRW. Jahres-Kick-off 2026.  
Signal-Iduna-Park. Dortmund.

Bernd Jungbluth, Carsten Schuck | February 20<sup>th</sup>

# Networks - Towards a Quantum Internet in NRW.



# EIN Quantum NRW – Roadmapping

A Joint Vision for Quantum Networks in NRW.



*We aim to establish North Rhine-Westphalia as a leading hub for quantum communication.*

*In and with NRW, the quantum internet is taking shape: connecting quantum computers, large-scale quantum sensor networks, and secure quantum communication. To this end, we are implementing a statewide quantum network as the foundation for a European infrastructure.*

*To realize this vision, we are advancing the development, production, and application of key components for quantum networks from NRW.*

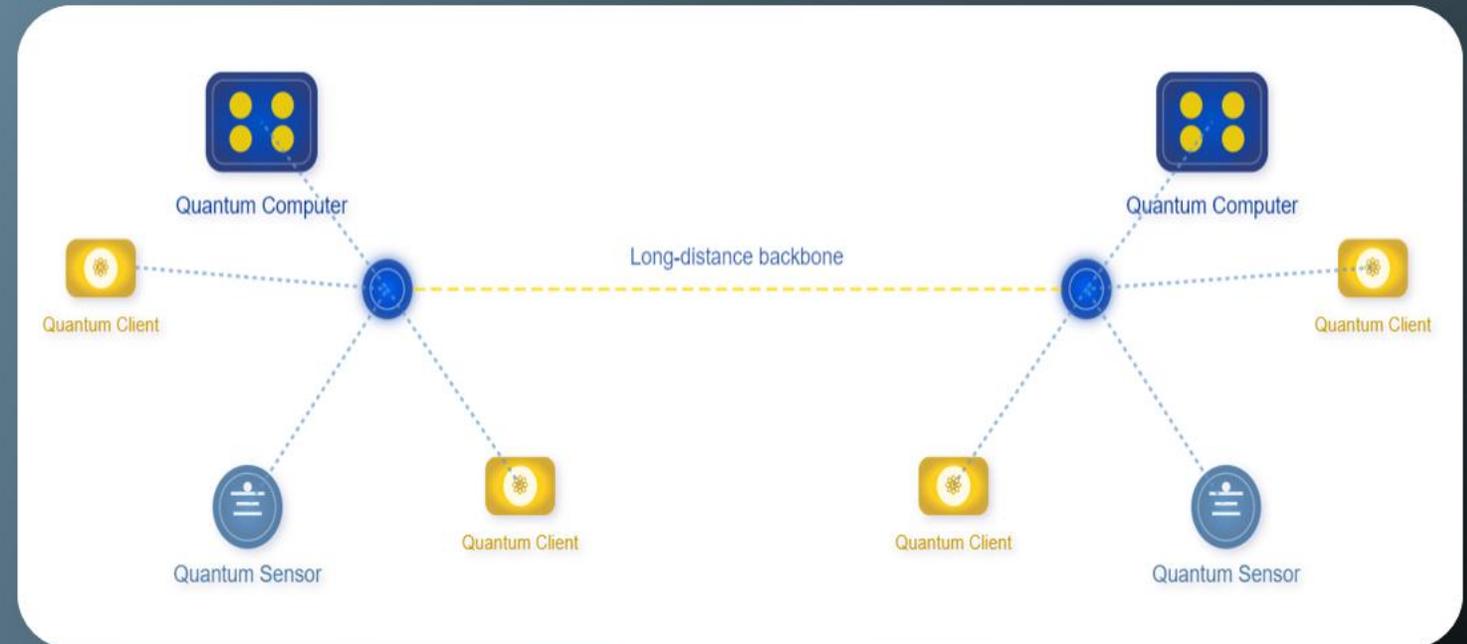
# What is a Quantum Internet?

*Fundamentally new communication technology*

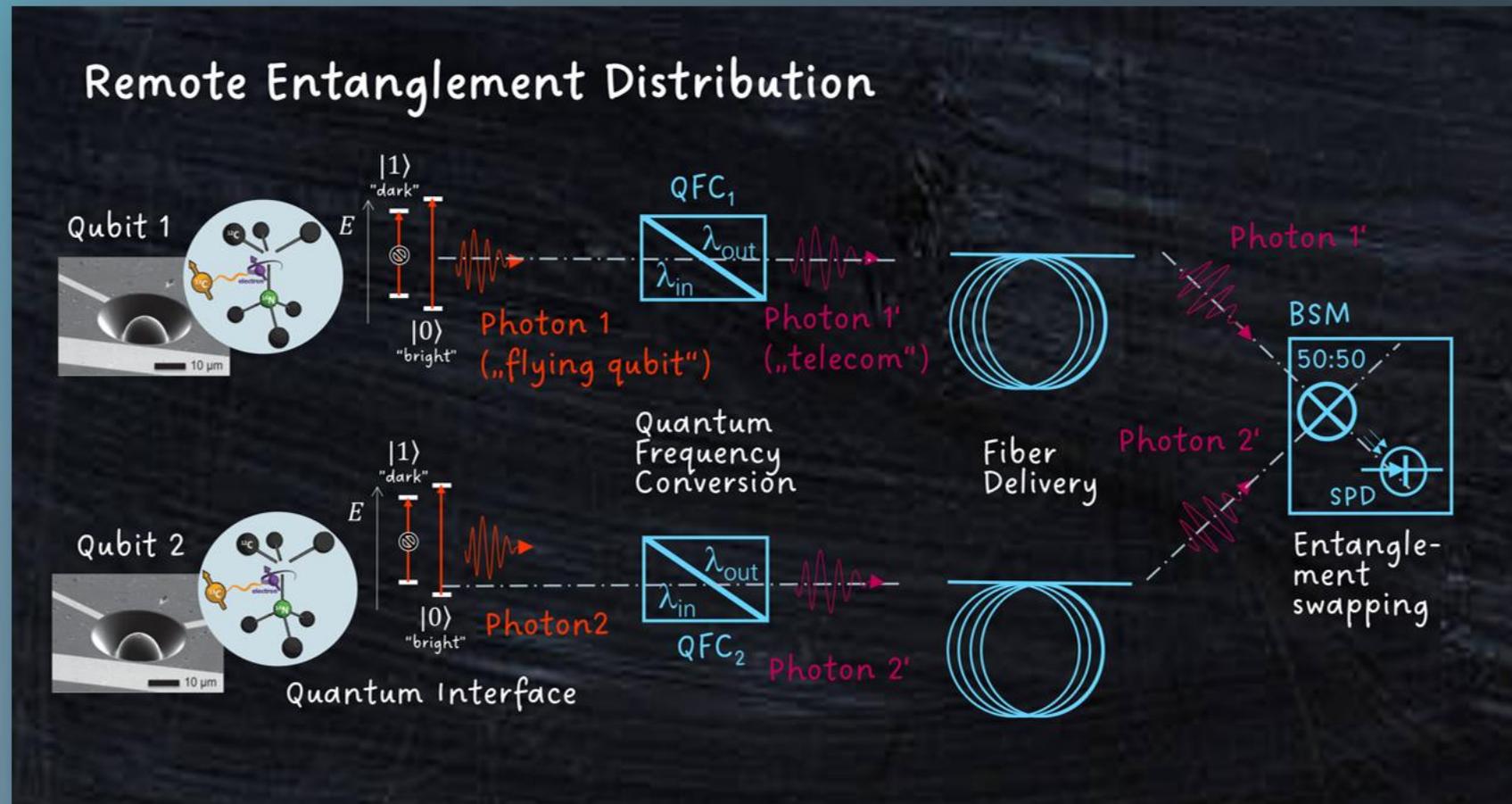
- General purpose network.
- Long-distance connectivity.
- Connecting quantum devices.

*Unlocking novel features impossible using the classical internet*

- Security and privacy.
- Accelerate networks.
- Scalable Quantum Computing.



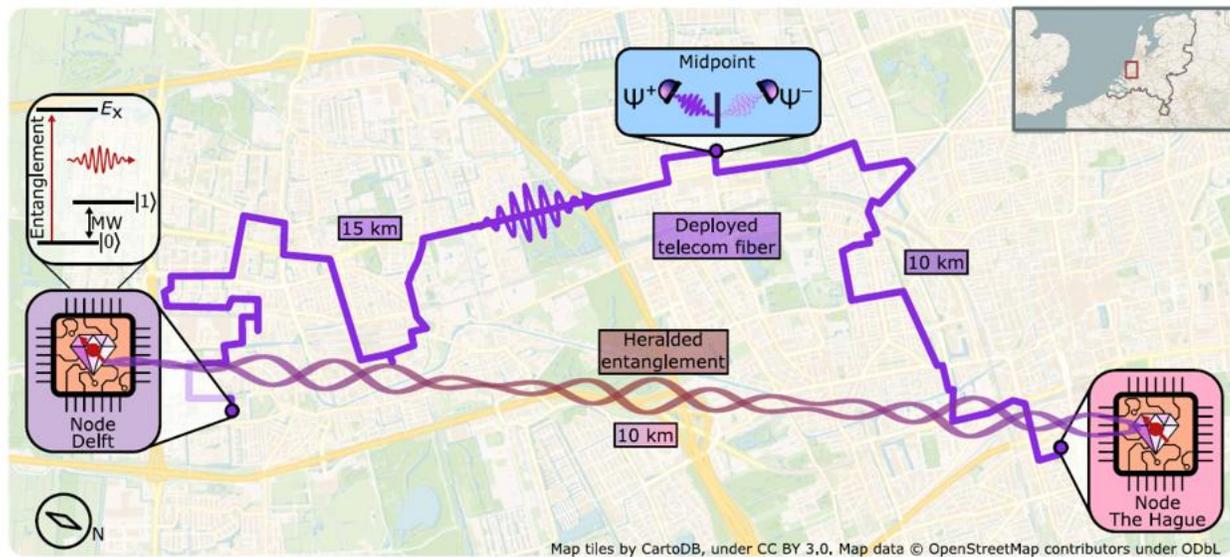
# How Photonics Comes Into Play?



# The Quantum Internet Demonstrator Project

Entanglement exchange via telecom fibers thanks to photonic technology from Aachen

SCIENCE ADVANCES | RESEARCH ARTICLE



**Fig. 1. The metropolitan-scale quantum link.** Cartographic layout of the distant quantum link and the route of the deployed fiber bundle, with similar quantum processor nodes in Delft and The Hague. Fiber length between node Delft and midpoint is 15 km and between node The Hague and midpoint is 10 km, with losses on the quantum channels at 5.6 and 5.2 dB, respectively. Inset to the quantum processor are the used qubit energy levels where the qubit is encoded in the electronic ground state addressable with microwave (MW) pulses, and the spin-selective optical transition ( $\lambda = 637\text{nm}$ ) is used for entanglement generation and state readout.

nature

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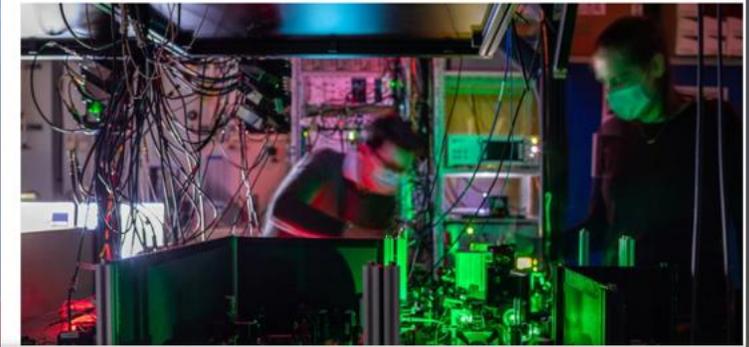
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NEWS | 15 May 2024

## 'Quantum internet' demonstration in cities is most advanced yet

Experiments generate quantum entanglement over optical fibres across three real cities, marking progress towards networks that could have revolutionary applications.

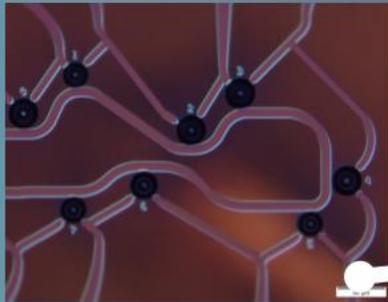
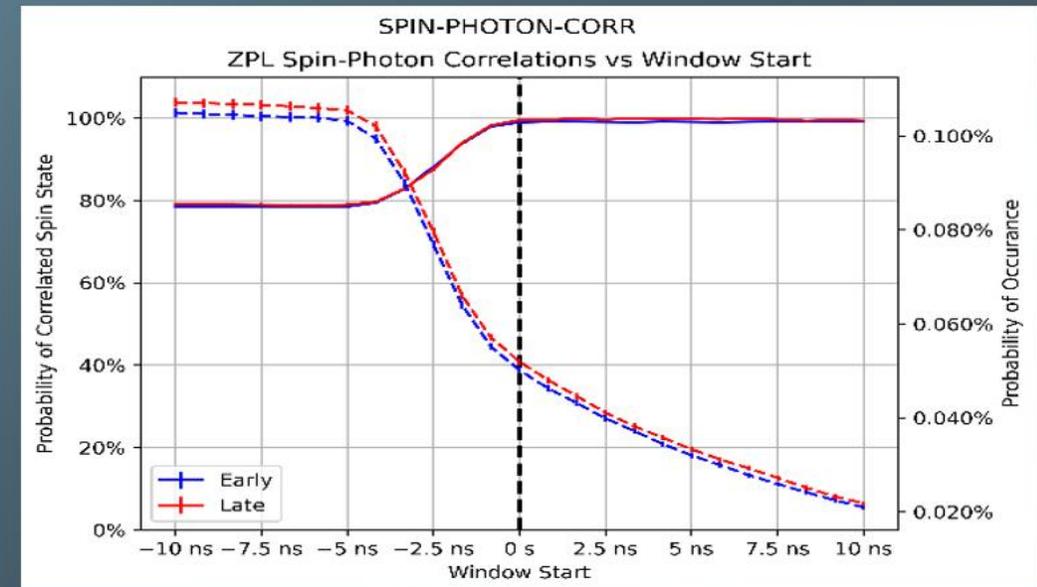
By Davide Castelvecchi



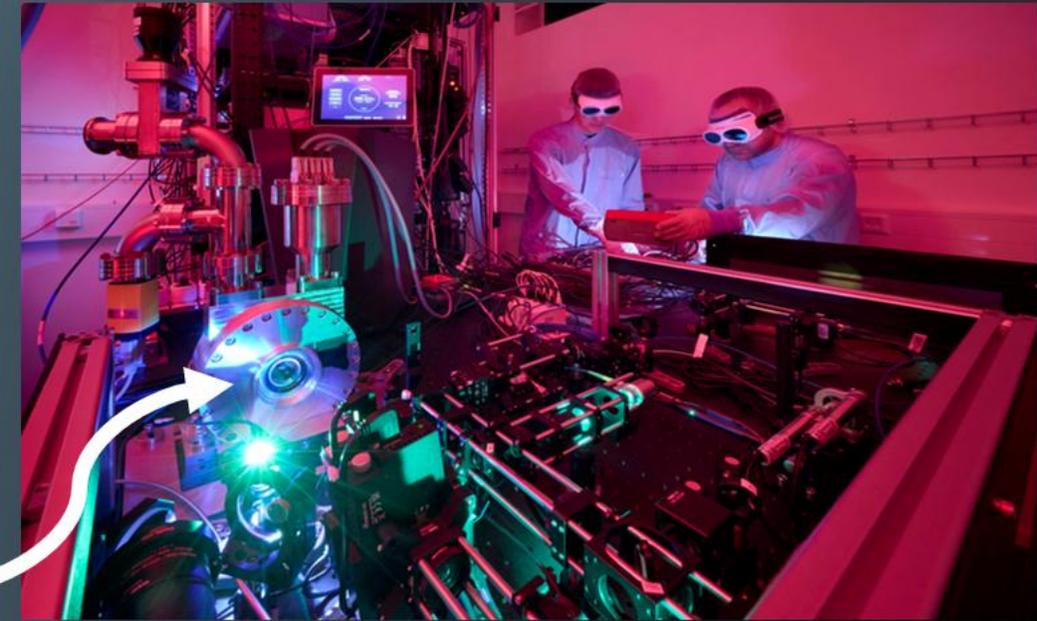
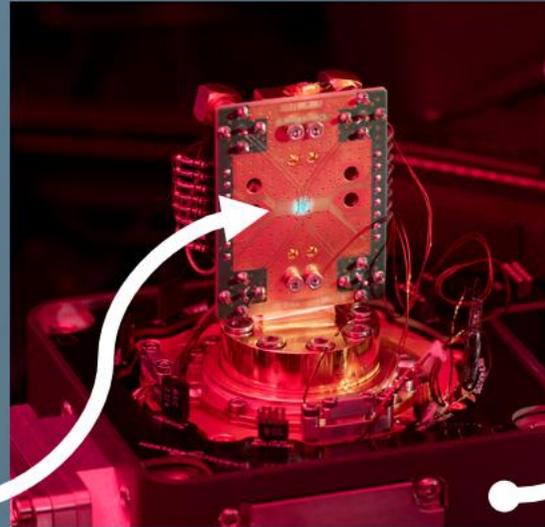
# N-QUIK: NRW's first Quantum Internet Node

## NV-Technology from the Quantum Link Delft – The Hague

- Joint design and implementation with TNO (based on Q.Link architecture)
- Transferred to Aachen and commissioned at ILT as part of the N-QUIK project
- Serves as a test and development platform for
  - Advanced components,
  - Integrated systems,
  - Quantum networks.



N-QUIK: Chip,  
NV in Diamant



# PLUQ\_IN: A Pilot-Link for Utility Testing in Quantum Internet Networks

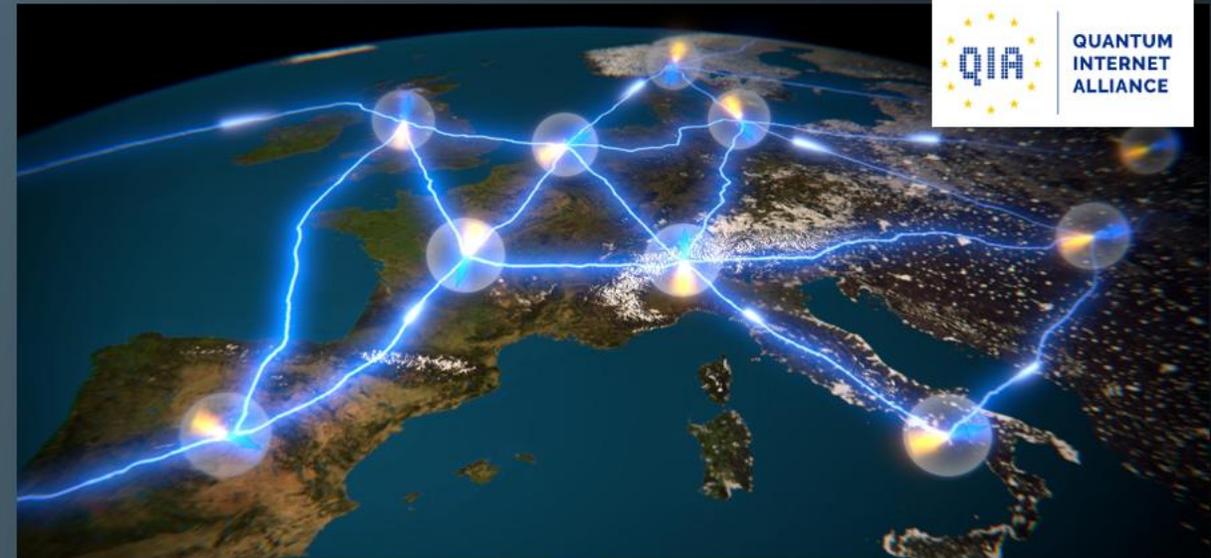
- Connection of the NV-based quantum node N-QUIK to the Aachen fiber testbed as a pilot link; funded by the State of North Rhine-Westphalia (MWIKE).

## Utilization Perspectives & Outlook

- Open infrastructure for cross-platform interoperability and cross-border connectivity in Europe.
- Core contribution to Germany's Open Infrastructure initiative within the QI<sup>2</sup> program.
- Enabling photonic interface technologies and quantum network applications with European partners.
- Future link to quantum computing infrastructure in Jülich and secure quantum networks across Europe.



ALICE: Access Link for Interplatform Communication Experiments



# Europe. Quantum Internet Initiative.



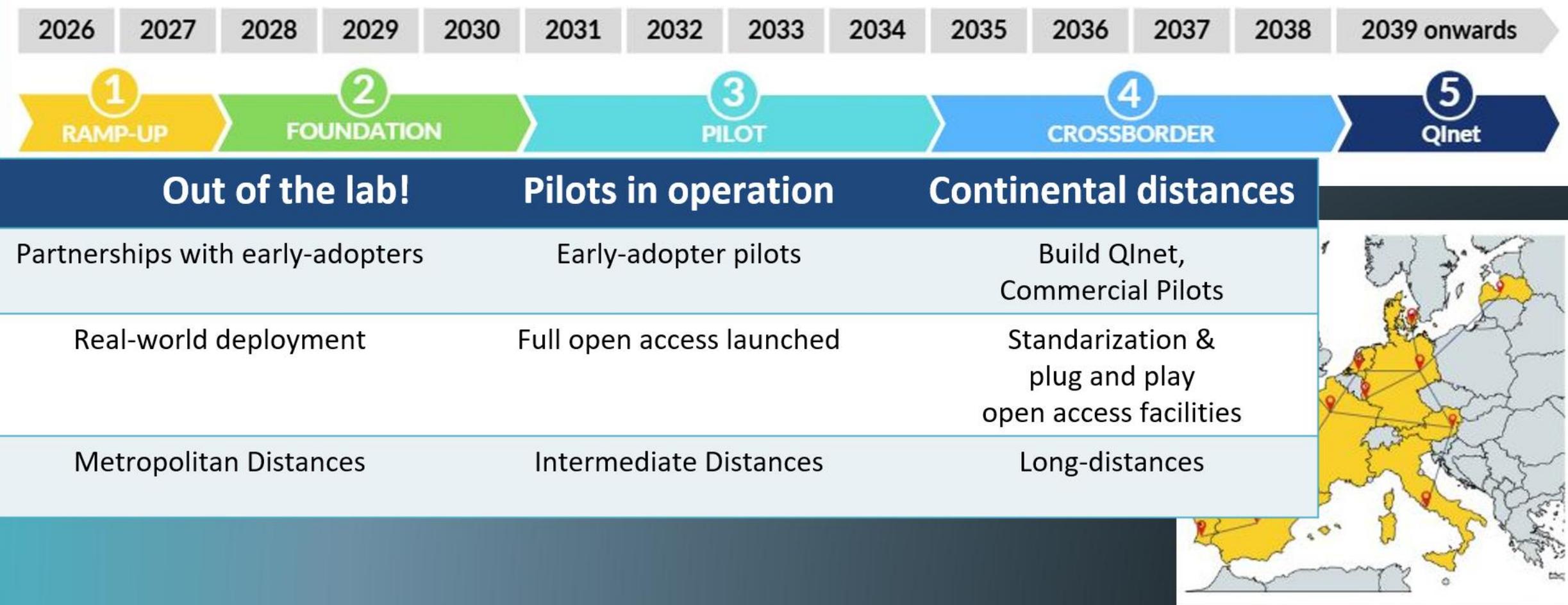
## A Quantum Internet Strategy for Europe QInet

European quantum internet backbone connecting users and developers across member states.

This open quantum network will unleash **collaborative innovation on a continental scale**, positioning Europe as the architect of the quantum internet age.



# Europe. Quantum Internet Initiative.



# Collaboration with RWTH Aachen University - Chair of Laser Technology

BMFTR – Quantum Future Junior Research Group

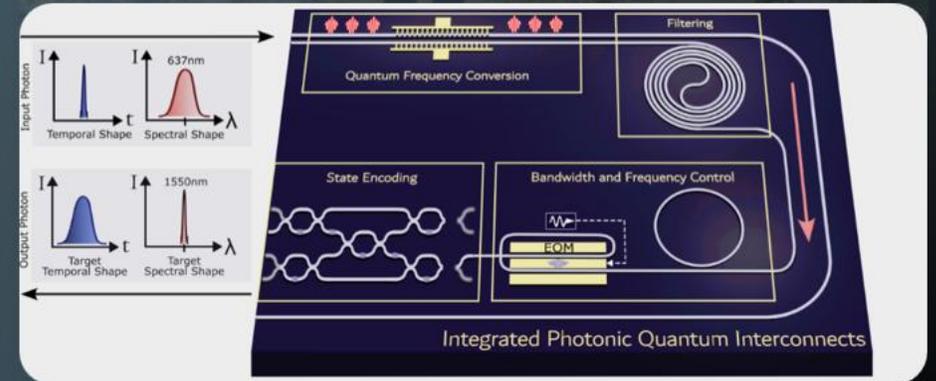
EPIQS- Engineering Photonic Interconnects for Distributed Quantum Systems

- 2022: Group Quantum Photonics at RWTH-LLT
  - Leader: **Dr. Florian Elsen**
  - Team 7 students (5 PhD, 2MSc,...).
- 2025: EPIQS "BMBF Quantum Futur Nachwuchsgruppe".



## Mission:

- New applications through the interconnection of quantum computers, sensors, and communication systems (Quantum Internet)
- To enable this, various physical quantum systems must be efficiently coupled.
- Beyond wavelength matching (quantum frequency conversion), additional photonic properties such as bandwidths and pulse durations must be adapted → **Development of photonic quantum interconnects**



# Department for Quantum Technology – U Münster



Prof. Tobias Heindel  
Photonic Quantum Networks



Prof. Matthias Kleinmann  
Foundations of Quantum Theory



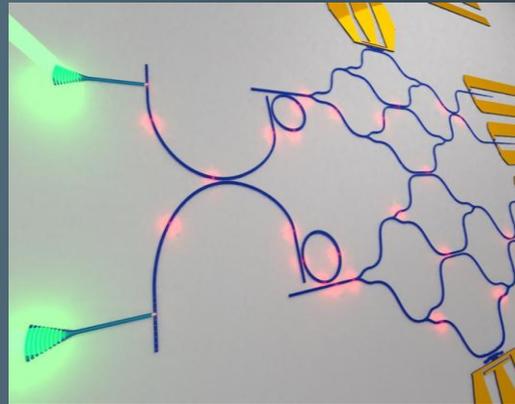
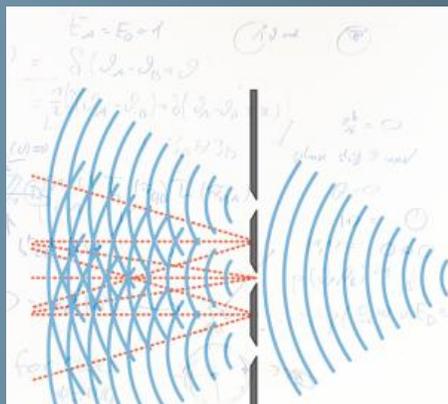
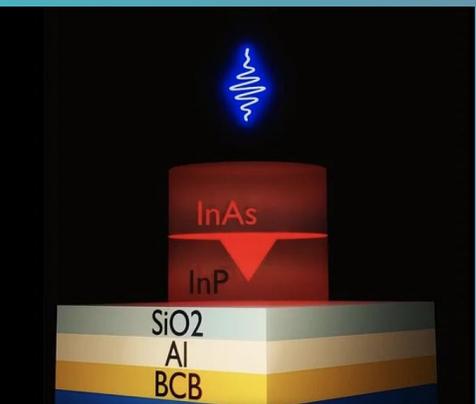
Prof. Carsten Schuck  
Integrated Quantum Technology



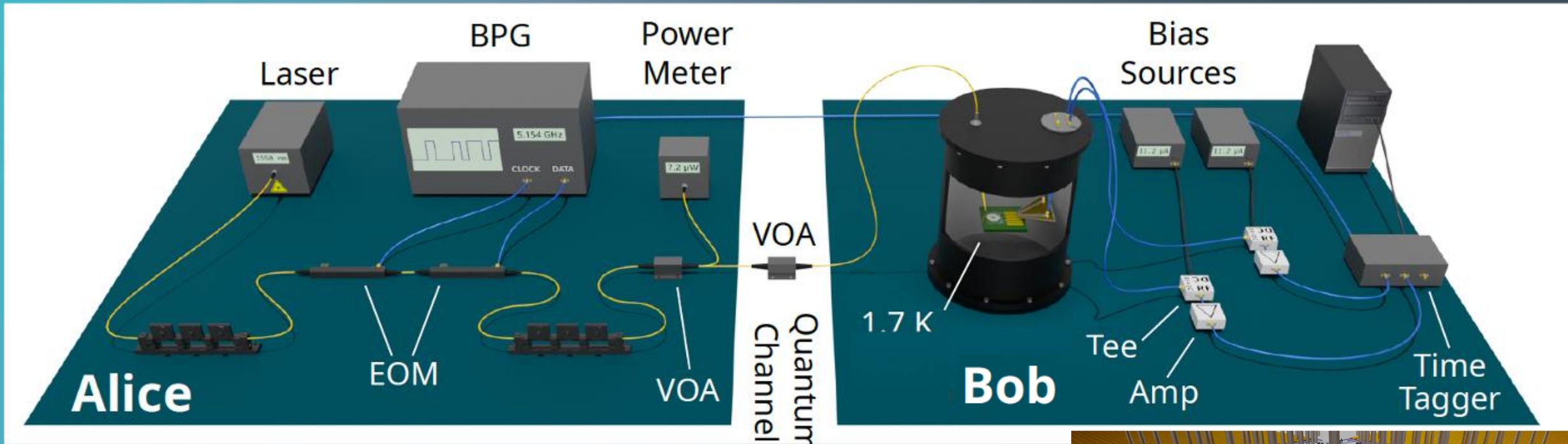
To be filled 2026/2027  
W3-Experimental Q-Tech



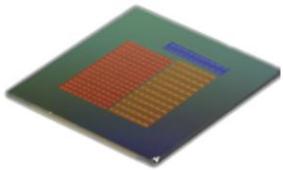
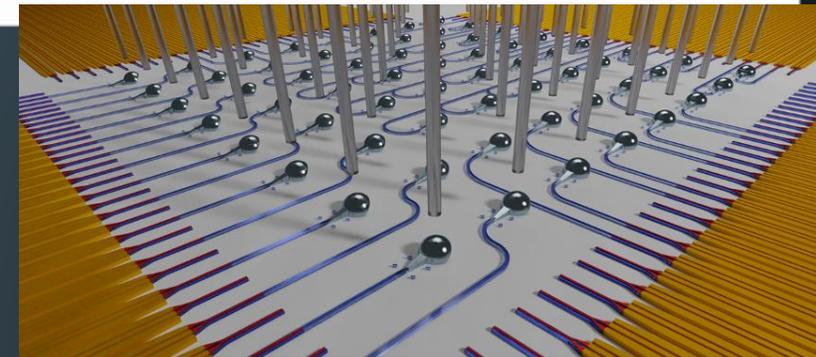
Jun.-Prof. Summer 2026  
Theory of Quantum  
Communication



# Quantum Network Technology Solutions



**MANTIS**  
ADVANCING QKD SYSTEMS



**MultiQomm**



**QuGrids**

# Quantum Network Activities NRW-DE

## Zielbildworkshop

1

*Realisierung lokaler Quantennetze mittels Dark-Fiber-Verbindungen als Keimzelle für ein landesweites Netzwerk in NRW und als Testbeds für Wissenschaft und Unternehmen.*

- Currently limited number of testbed-environments and dark fiber links in NRW

## Testbeds für Quantenkommunikation Deutschland (SQuaD)



Quelle: SQuaD

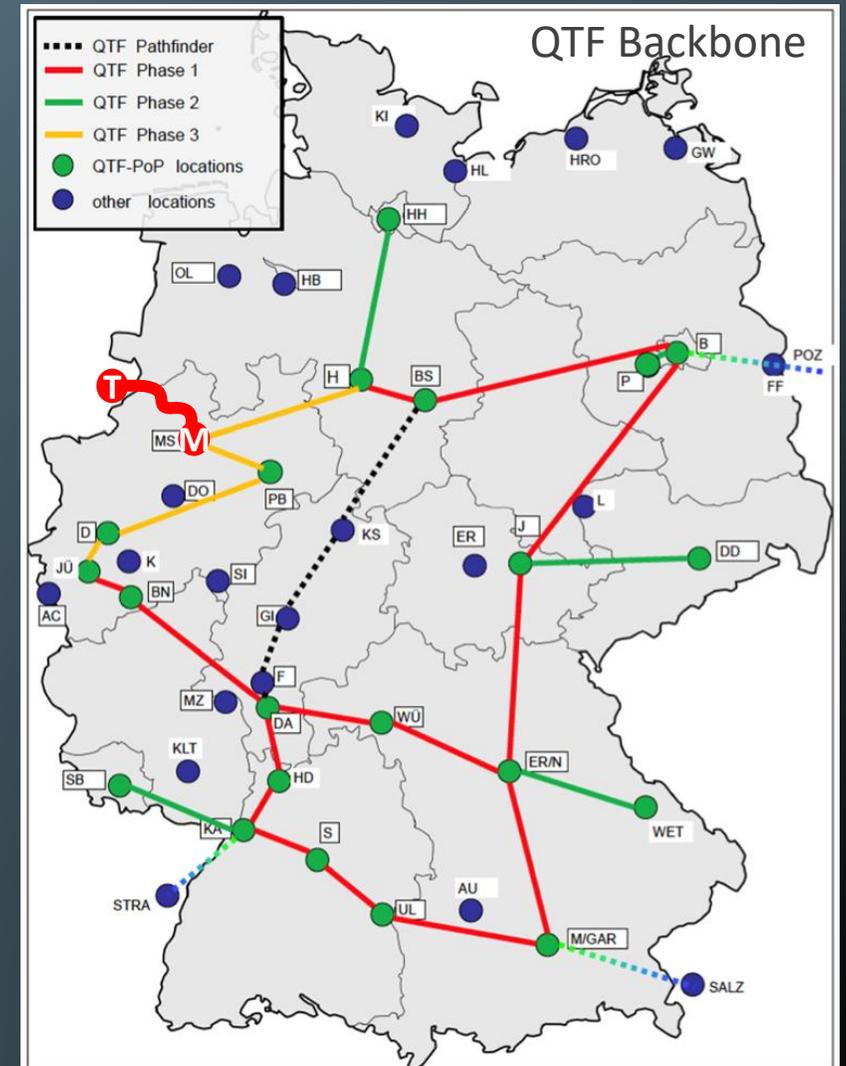
# Quantum Network Activities NRW-DE

## Zielbildworkshop

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Realisierung lokaler Quantennetze mittels Dark-Fiber-Verbindungen als Keimzelle für ein landesweites Netzwerk in NRW und als Testbeds für Wissenschaft und Unternehmen.

- Currently limited number of testbed-environments and dark fiber links in NRW
- ...but significant QTF backbone activities are foreseen in NRW (most access points of all states)
- Münster: 120 m<sup>2</sup> Lab for testbed access planned
  - Intra-campus quantum network
  - Münster – Twente dark fiber link



# Quantum Network Activities NRW-NL

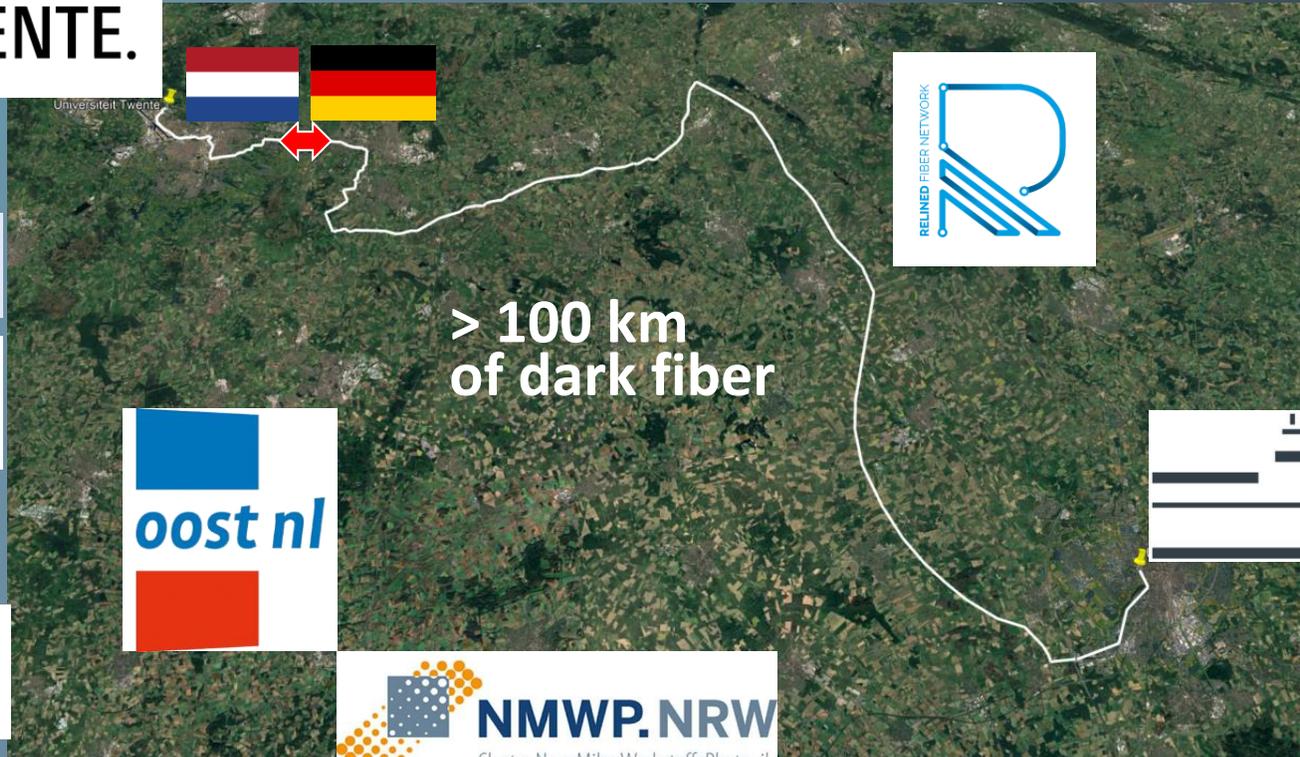
## Making ConneQtions



UNIVERSITY OF TWENTE.



$\pi$ CARD



Pixel Photonics

Sabrattha TFLN Photonics

QSA TECHNOLOGY

Associated partners

PRODRIVE TECHNOLOGIES

arcadiz beyond connectivity

QUIX QUANTUM

oost.nl

NMWP.NRW Cluster NanoMikroWerkstoffePhotonik

Universität Münster

Associated partner

REACH EUREGIO START-UP CENTER

FRAUDEHELPDESK.nl

TU/e EINDHOVEN UNIVERSITY OF TECHNOLOGY

Thank you for your attention.



## Contact

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