PSNC

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Poznań Supercomputing and Networking Center

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Center of e-Infrastructure

- National Research and Education Network PIONIER
- Research Metropolitan Area Network - POZMAN
- HPC Center
- Data repositories and Digital Libraries Federation

Center of Research & Development

- New Generation Networks
- HPC, Grids & Clouds
- Grand challenge applications
- New media and visualization technologies
- Knowledge Platforms
- Future Internet - Technology, Applications and Services for IS
- Cyber Security
- Quantum Communication and Computing – use cases and practical scenarios

# Poznań Supercomputing and Networking Center

PIONIER NETWORK - POLAND
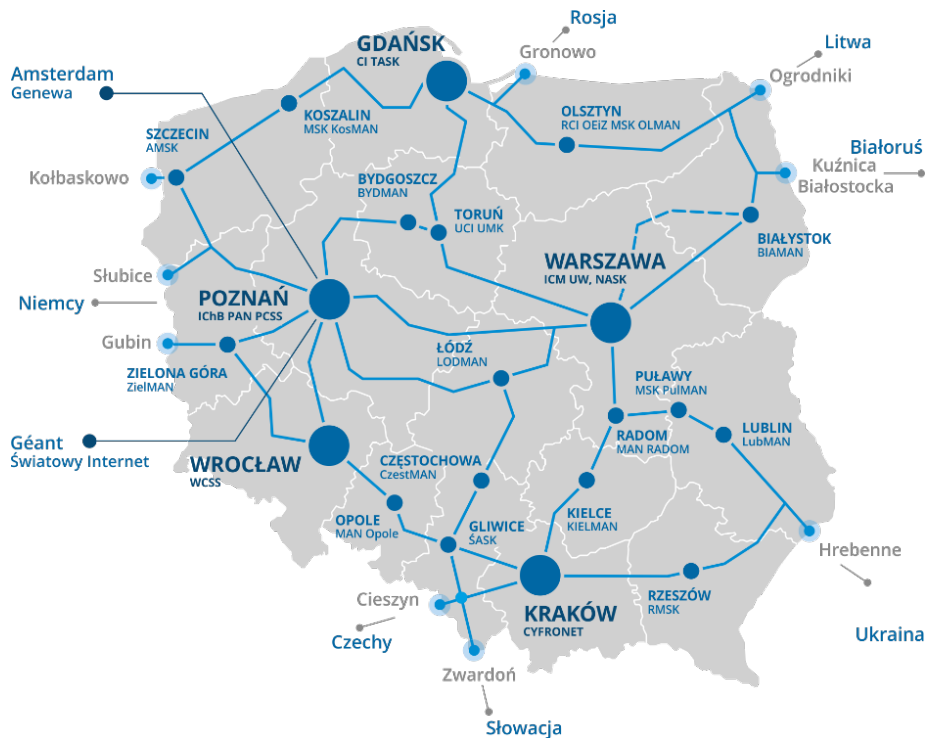
Type of connected unit	Number of units
Research institutions	221
Universities	196
Post-secondary schools	21
High schools, secondary schools, primary schools and vocational schools	234
Healthcare	59
Public safety	27
Goverment administration	27
Provincial administration	59
District, municipality and city administration	73
Other administration	9
Court and public prosecutor's office	26
Cultural institutions	104
Other educational	27

~10 000 km of fiber in total

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PIONIER NETWORK
EUROPE
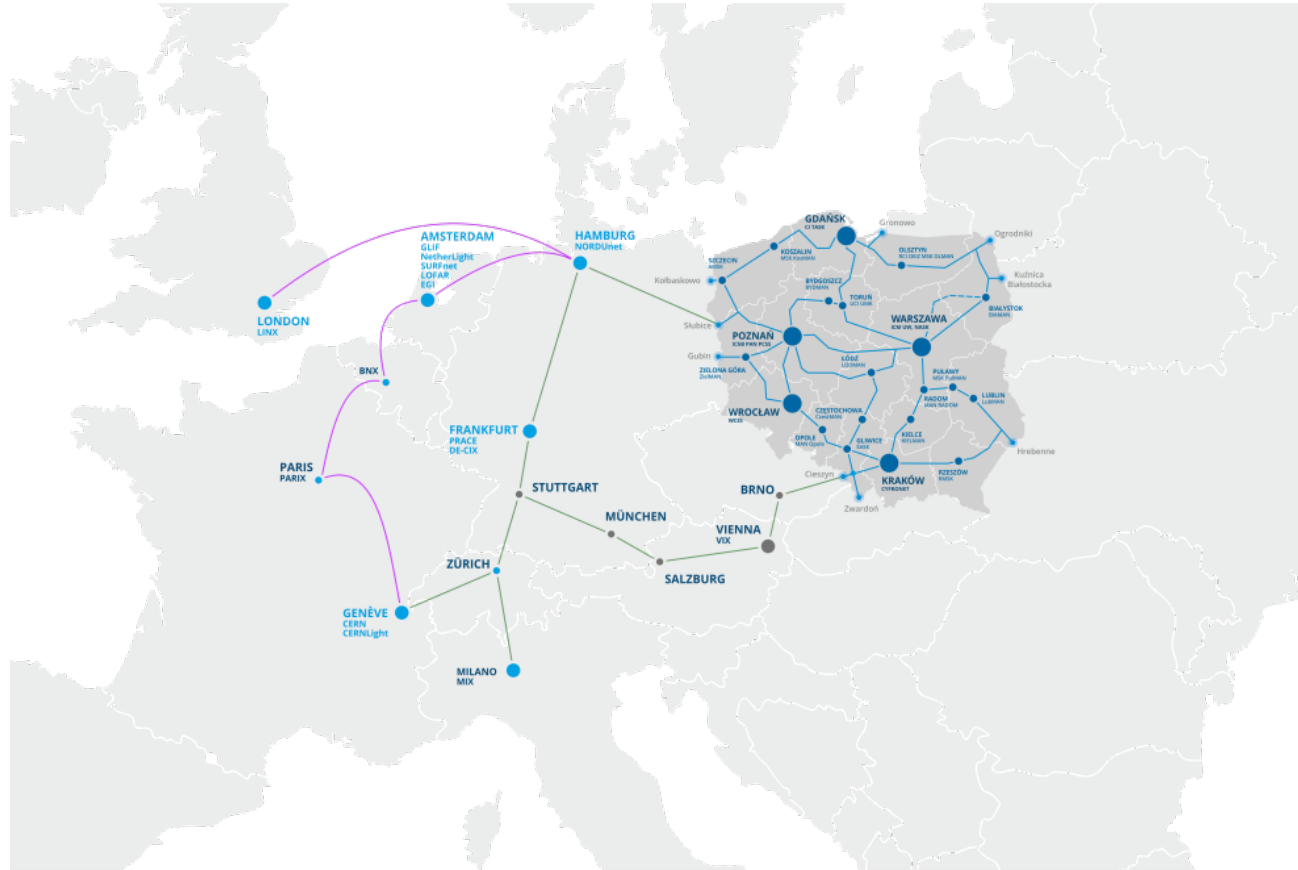
QUANTUM COMMUNICATION ACTIVITIES

- PSNC is active in the areas of quantum computing and quantum communication

- PSNC Qauntum computing projects are focused on algorithms, uses cases and hardware evaluation

- These works and projects are in most cases carried out together under one umbrella project and initiative

- It provides potential foundations for future hybrid networks and quantum communication infrastructure that will potentially connect quantum computing infrastructure

QUANTUM COMMUNICATION ACTIVITIES

PROJECTS

- PSNC takes part in the following projects and activities connected with Quantum Communication an QKD Technologies:

  - **OPENQKD (HORIZON2020)**
  - **NLPQT (NCBiR)**
  - **QUAPITAL**
  - **Quantum Internet Research Group QIRG (IETF)**
 - **GÉANT**

OPENQKD

- Construction of QKD testbeds in Europe and implementation of 40 different scenarios for services using QKD technology
- Project start - October 2019
- Poznań is one of the main testbeds. Implementation and integration of QKD technology in the existing infrastructure and services of the POZMAN and PIONIER networks.
- Testing experimental QKD solutions in Poznań
- PSNC participates in works related to standardization activities and IPR
- PSNC will develop data management and analysis software
- Testbeds currently running in Geneva, Madrid, Berlin (June 2021). The epidemiological situation has suspended work for the remaining testbeds.
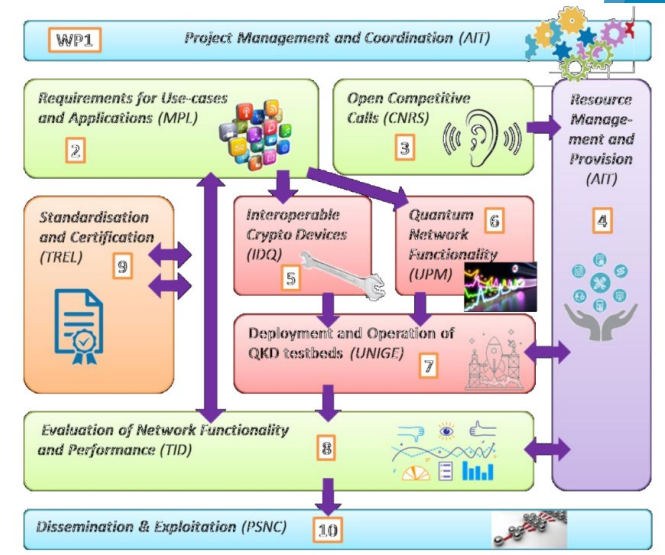
PSNC – VSB crossborder testbed

TRIAL PREPARATION

- First intercity and international trial in **CZ**
- **Ostrava Cieszyn line – fibre itself 75km, 16 dB**
- **QKD channel in 1550 nm band,** will be disturbed by parallel traffic
- **Line is very close to maximum system performance**
- **QKD system „fibre hungry", service OOK channel will consume 2 additional optical channels**
- **Offer for aditional fibre pair uncompetitive**
- **All data (incl. QKD service channel) moved into bidi DWDM**
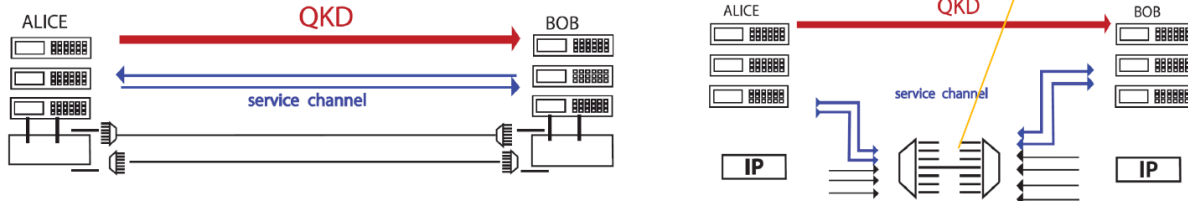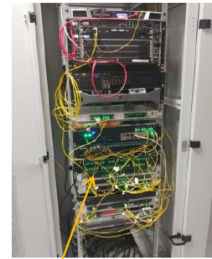
NATIONAL LABORATORY FOR PHOTONICS AND QUANTUM TECHNOLOGIES

- **Construction of metro QKD** research and operational infrastructure, integration of QKD solutions
  - QKD infrastructure (operational and R&D QKD devices, encoders and quantum random number generators)

- **Construction of the QKD Poznań - Warsaw link**
  - experiments related to quantum communication between University of Warsaw nodes and PSNC in Warsaw.
  - Experiments related to sources and detectors of single photons
  - Integration of the infrastructure with the optical carrier infrastructure
  - Next generation QKD prototypes testing (based on enatnglement)

QUANTUM COMMUNICATION ACTIVITIES

QUAPITAL

- Project related to QKD technology and quantum communication in general
- Talks on cross-border connections

QIRG

- Document "**Applications and Use Cases for the Quantum Internet**" (draft-wang-qirg-quantum-internet-use-cases-06) during the last revision (end of May 2020).

- The document "**Architectural Principles for a Quantum Internet**" (draft-irtf-qirg-principles-03)

- The GÉANT WP6 T1 QKD Group submits its comments

- Abstract: "The Quantum Internet has the potential to improve Internet application functionality by incorporating quantum information technology into the infrastructure of the overall Internet. In this document, we provide an overview of some applications expected to be used on the Quantum Internet, and then categorize them using various classification schemes. Some general requirements for the Quantum Internet are also discussed. The intent of this document is to provide a common understanding and framework of applications and use cases for the Quantum Internet. "

QUANTUM COMMUNICATION ACTIVITIES

QUNATUM NETWORKS SIMULATORS

- **QuISP, Keio/WIDE**
- SimulaQron, TU Delft http://www.simulaqron.org/
- NetSquid, Dahlberg, TU Delft https://netsquid.org/
- SeQueNCe, Suchara, Argonne https://cpb-us-w2.wpmucdn.com/voices.uchicago.edu/dist/0/2327/files/2019/11/SeQUeNCe.pdf
- SQUANCH, Bartlett https://pypi.org/project/SQUANCH/
- https://arxiv.org/abs/1808.07047
- QuNetSim, DiAdamo https://arxiv.org/abs/2003.06397
- **QKD simulator in ns-3, including routing, Mehic et al** https://ieeexplore.ieee.org/document/8935373 https://www.qkdnetsim.info/ https://twitter.com/mickeyze2
- Physical-layer, online calculator for SPDC http://spdcalc.org/
- QuISP - Quantum Internet Simulation Package https://aqua.sfc.wide.ad.jp/quisp_website/

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QUANTUM COMMUNICATION ACTIVITIES

IBM Quantum Network Hub

Architektura platformy dostępowej

Polski węzeł obliczeń kwantowych IBM Quantum stanowi interfejs pomiędzy komputerem kwantowym a użytkownikami końcowymi.

W efekcie możliwe jest uruchamianie wielu różnych eksperymentów i zadań obliczeniowych użytkowników na fizycznych zasobach komputera kwantowego.

Platforma i narzędzia pozwalają użytkownikom na zarządzanie i monitorowanie zleconych zadań oraz odczytywanie wyników. Rozwój oprogramowania możliwy jest dzięki bibliotekom programistycznym oraz środowisku testowemu wykorzystującym klasyczne komputery i superkomputery.
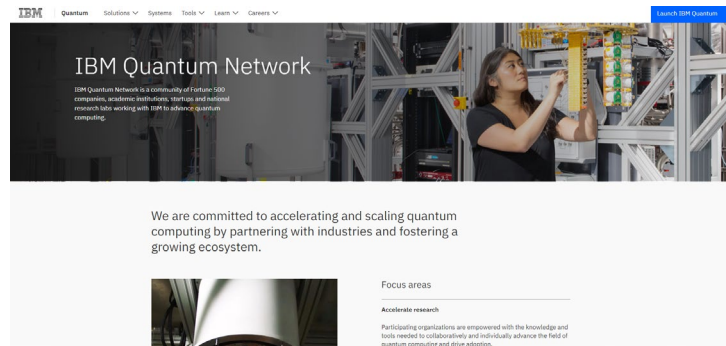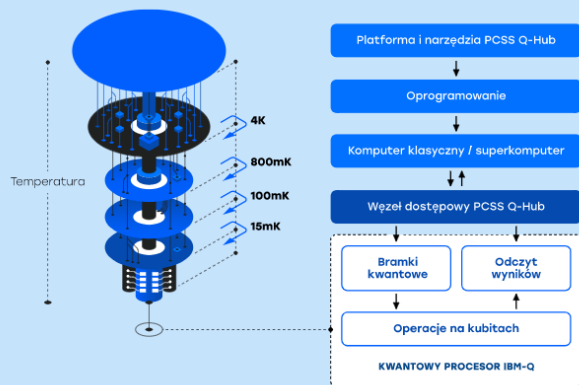
QUANTUM COMMUNICATION ACTIVITIES

Post Quantum and QKD algorithms demo - TNC18 conference
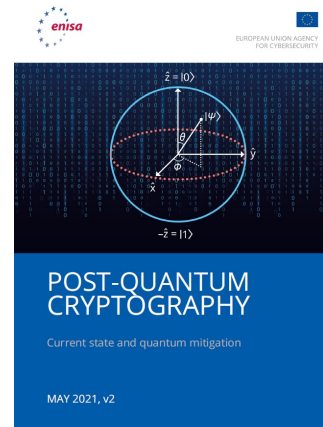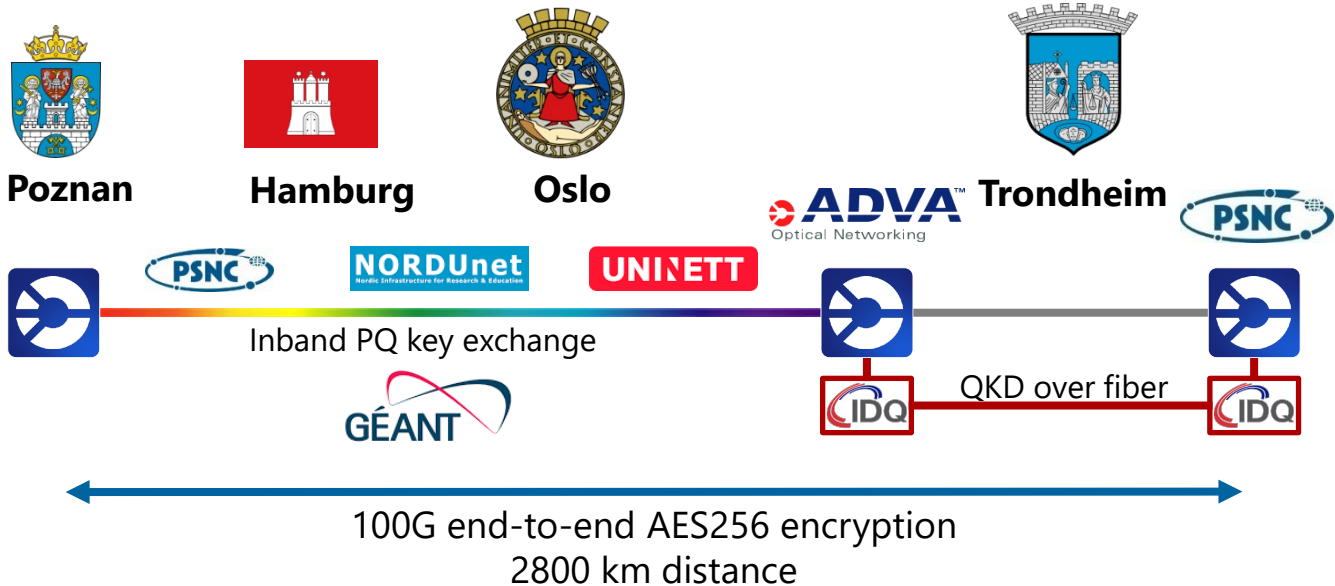
TNC21 conference demo

Demo:

Secure Key Management for Multi-vendor Interoperable Quantum Key Distribution Network

When: 22 June 2021 11.40-12.00
Where: Virtual

QUANTUM COMMUNICATION ACTIVITIES

EuroQCI and Digitial Europe

DECLARATION ON A QUANTUM COMMUNICATION INFRASTRUCTURE FOR THE EU

24 Member States

have signed a declaration agreeing to work together to explore how to build a quantum communication infrastructure (QCI) across Europe, boosting European capabilities in quantum technologies, cybersecurity and industrial competitiveness.

The countries taking part in the initiative are Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain and Sweden.

@FutureTechEU #EuroQCI

European Commission

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Home > The Digital Europe Programme

The Digital Europe Programme

The Digital Europe Programme (DIGITAL) is a new EU funding programme focused on bringing digital technology to businesses, citizens and public administrations.

How to make Europe greener and more digital are the twin challenges for our generation, and our success in meeting them will define our future.

The European Commission has begun to look at a greener Europe through the lens of the European Green Deal. At the same time, it is opening up discussions about the move to a more digital world: the digital transition.

Digital technology and infrastructure have a critical role in our private lives and business environments. We rely on them to communicate, work, advance science and answer current environmental problems. At the same time, the COVID-19 pandemic highlighted not only how much we rely on our technology to be available to us, but also how important it is for Europe not to be dependent on systems and solutions coming from other regions of the world. Paving the way for achieving this goal is DIGITAL programme.

The Digital Europe Programme will provide strategic funding to answer these challenges, supporting projects in five key capacity areas: in supercomputing, artificial intelligence, cybersecurity, advanced [...] the economy and society, [...] budget of €7.5 billion (in current [...] e digital transformation of Europe's [...]

Funding & Tender Opportunities >

Horizon Europe >

Connecting Europe Facility >

Work as an expert: Call for

DIGITAL-2021-QCI-01-INDUSTRIAL – Create a European Industrial Ecosystem for secure QCI technologies and systems

DIGITAL-2021-QCI-01-DEPLOY-NATIONAL – Deploying advanced national QCI systems and networks

DIGITAL-2021-QCI-01-EUROQCI-QKD– Coordinate the first deployment of national EuroQCI project and prepare the large-scale QKD testing and certification infrastructure
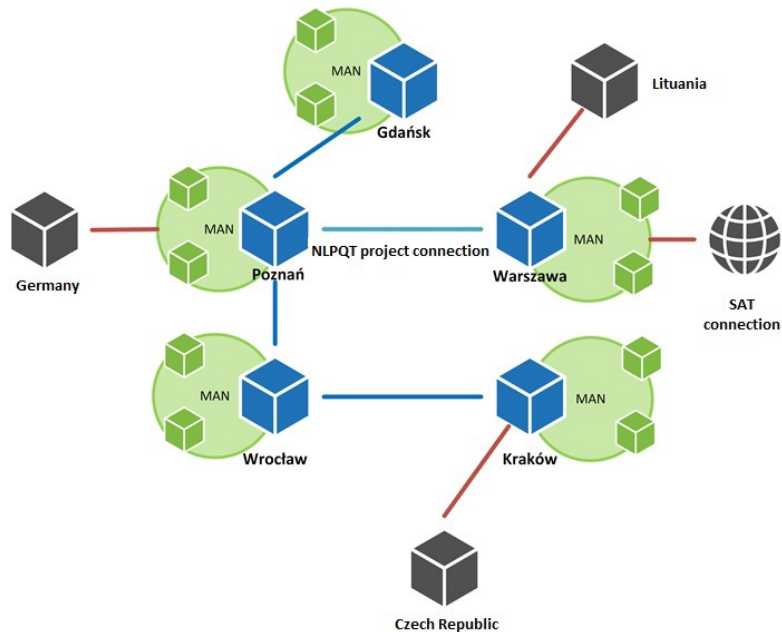
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QUANTUM COMMUNICATION ACTIVITIES

PIONIER-Q QCI proposal

QCI proposal based on PIONIER network and MAN, HPC centers

QKD, GN4-3 - WP6 approach

- **WP6 QKD sub-task**
  - Lead by Piotr Rydlichowski (PSNC)
  - NRENs involved: CESNET, DFN, GÉANT, GRNET, KIFU, PSNC, RENATER, RiċerkaNet,
  - Email list and contact: https://lists.geant.org/sympa/info/quantum-discuss

- **Objectives** :
  - Identify the R&E network community interest and needs
  - Involve GÉANT and NREN community in the QKD technology. Establish a cooperation between GÉANT community and commercial QKD vendors
  - Make the European NRENs 'quantum aware' and increase the 'knowledge capital'
  - Establish a QKD testbed
  - Investigate QKD technology and quantum solutions and use cases for GÉANT

QKD, GN4-3 - WP6 work results

- A **survey** on the state of the art in NRENs has been carried out

- **Dissemination**
  - Four infoshares have been held with speakers from the EC and industry
  - White paper: 'Quantum Technologies Status Overview' has been distributed
  - Quantum meetings for all NRENs on the first Friday of each month
  - Materials are available on the wiki:
    https://wiki.geant.org/display/NETDEV/QKD

- **Technology testing**
  - Quantum simulators (QKDNETSIM for NS-3 and QUISP) installed
  - Physical testbed established
  - PoC between GÉANT PoPs with Toshiba/OpenQKD

GÉANT

Long-haul QKD proof-of-concept

- Between 2 GÉANT PoPs (254 Km)

- A collaboration between GN4-3 (WP6, WP7), OpenQKD and Toshiba – coordinator GÉANT

- Based on a Twin Field Solution

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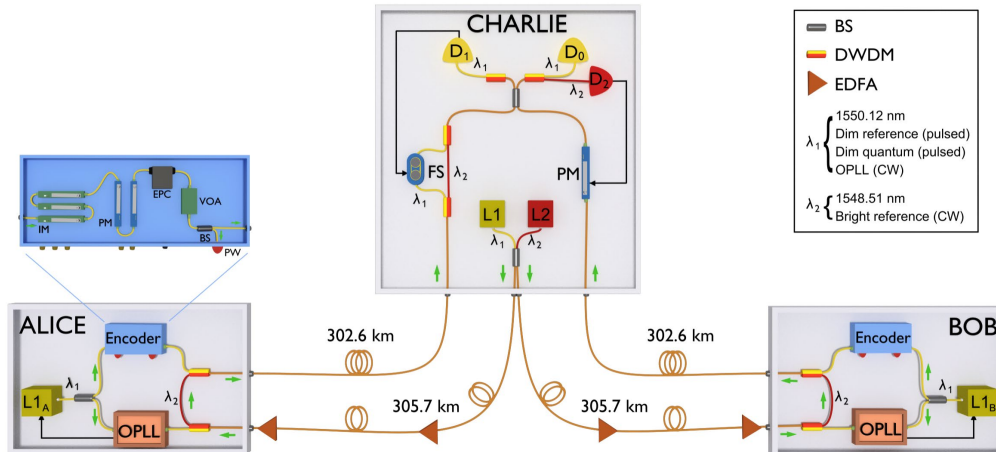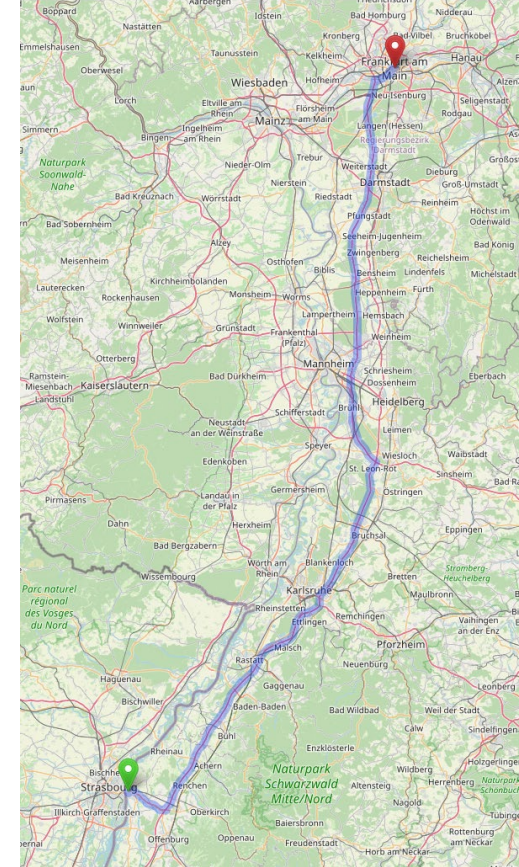
QKD, GN4-3 - WP6 future work

- **Continue dissemination**
  - Quantum meetings for all NRENs on the first Friday of each month
  - Training under preparation

- **Technology testing**
  - Test on quantum simulators (QKDNETSIM for NS-3 and QUISP)
  - Test on the physical testbed
  - PoC demonstration between GÉANT PoPs with Toshiba/OpenQKD

- **Exploring QT solutions and use cases for GÉANT**

Subtask led by piotr Rydlichowski

QUANTUM COMMUNICATION ACTIVITIES

EuroQCI and Digitial Europe

- Signifficant number of NRENs joined the National QCI proposals – directly or indireclty in cooperation. Funding 154M EUR. Calls closed on 29.03.2022

- Some NRENs joined the QCI call for building the QKD devices and call for QCI coordination in Europe.

- Horizon Europe Quantum FPA proposals are under evaluation. GEANT and NRENs potentially can participate in SGAs.

- Collaboration and coordination possibilities at the GEANT community-level in strategy and technical aspects.

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