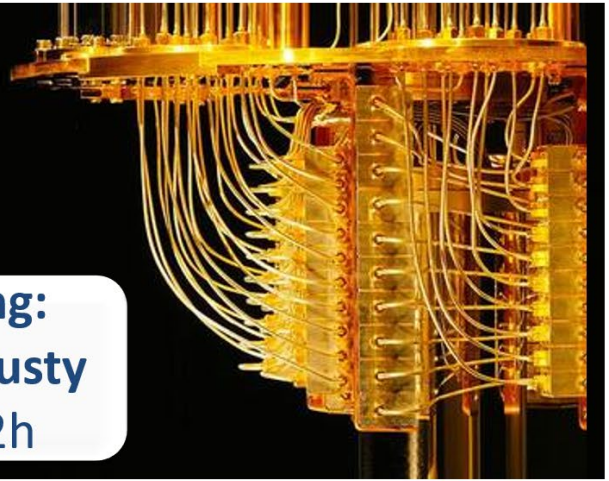
European Commission

EuroHPC Joint Undertaking

Karim Azoum
NCC France

CCFR & EURO
CENTRE DE COMPÉTENCE HPC.HPDA.IA
NETHERLANDS



Quantum Computing: From research to Industy

27-02-2024, 10h-12h

Carlos Teijeiro Barjas
NCC Netherlands

CCFR CENTRE DE COMPÉTENCE HPC.HPDA.IA

Jean-Baptiste Latre
Qualitative Computing

Julien Mellaerts
EVIDEN

Félix Givois
GENCI
Le calcul intensif au service de la connaissance

EURO NETHERLANDS

David Maier
SURF

Victor Land
QuSoft
Research Center for Quantum Software

Daan Kuitenbrouwer
Delft Circuits
Hardware for quantum engineers

Webinare CC-FR, February 27, 2024

NCC: National Competence Centre

CCFR
CENTRE
DE COMPÉTENCE
HPC.HPDA.IA

&

EURO
NETHERLANDS

HPC- HPDA-IA-Quantum Computing
Industry, Academia, Public Administration

- **Support on the use of this technologies (POC, projects...)**
- **Trainings**
- **Webinars**
- **Events**

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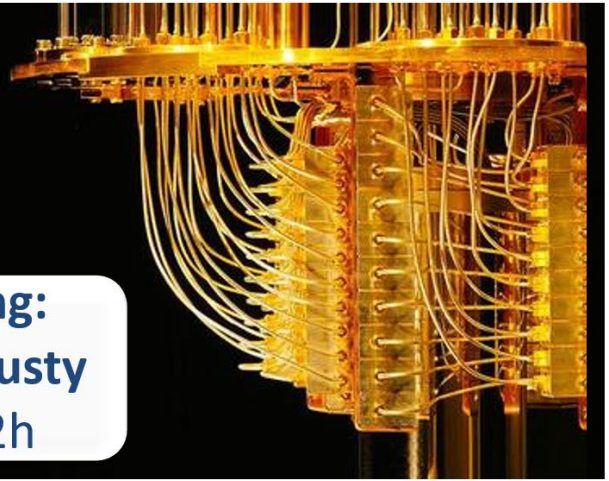

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- Daan explained the activities of IMPAQT toward the integration of hardware components into a quantum computing system.

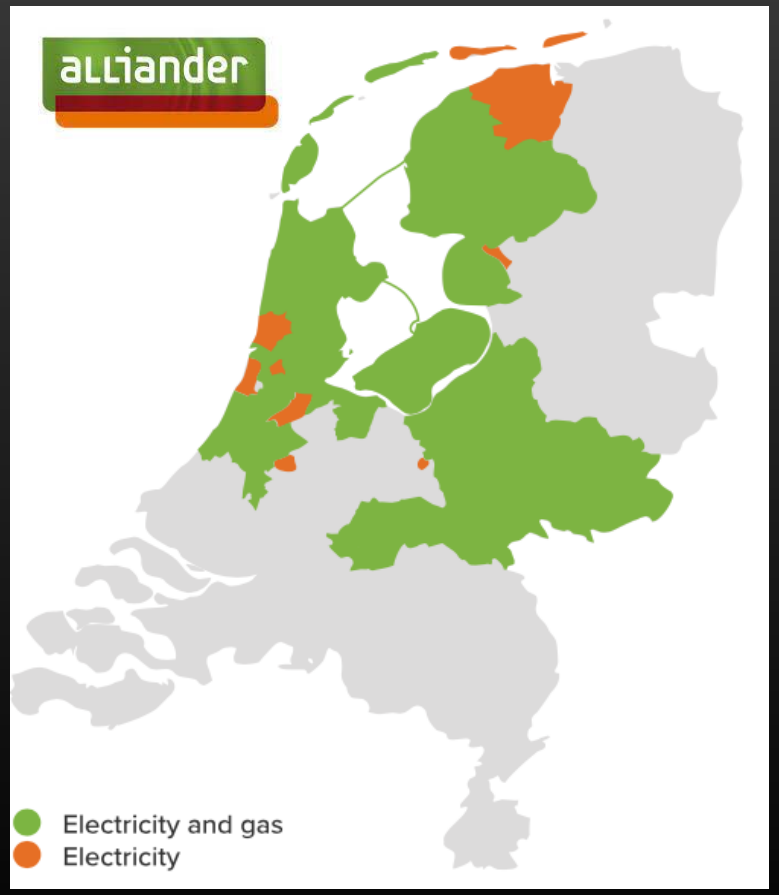
- David explained the work by SURF to integrate quantum computing platforms in HPC environments, to do the classical-quantum integration and to train both experts and users so that easy access to quantum computing becomes possible.

But, what problems do end users experience? And can we begin to develop solutions and applications for their problems based on using quantum computers? And does that add value?

Example

Could Quantum Computing be Useful for Energy networks ?

The energy grid of Alliander



Electricity grid length

93,000 km

92,000 km in 2020

Gas grid length

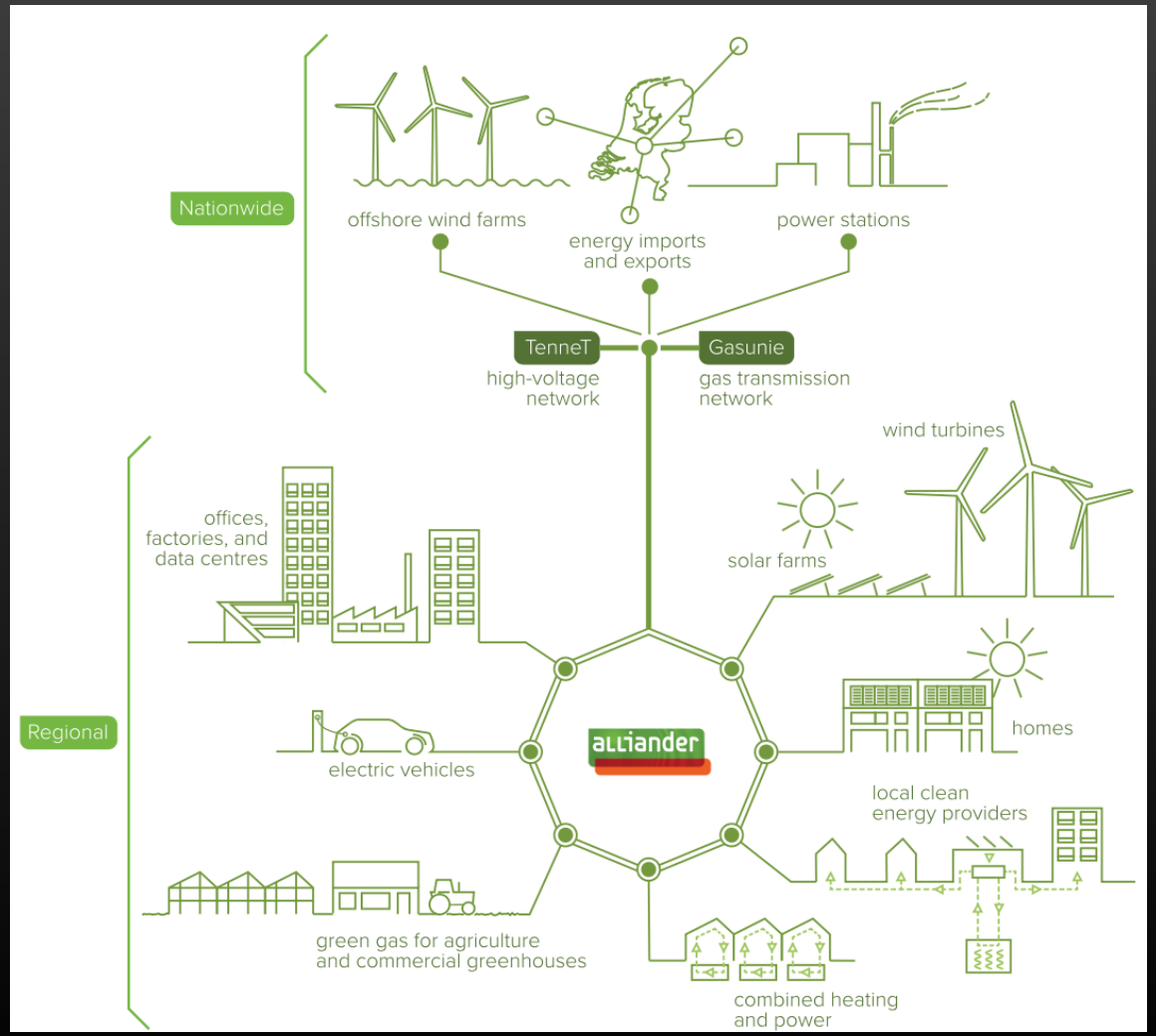
42,000 km

42,000 km in 2020

Publicly owned

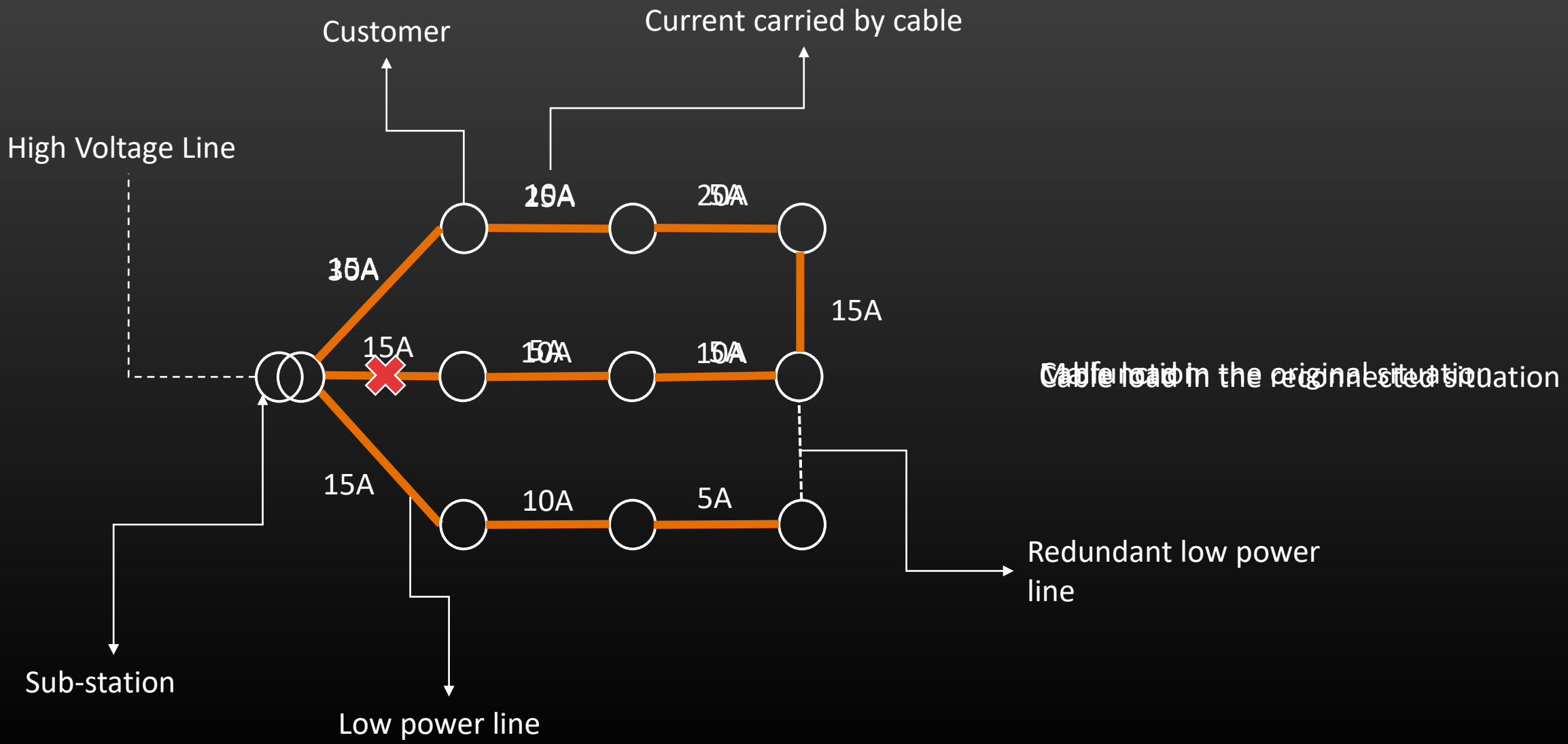
Responsible for distributing and managing energy from the generation sources to the final consumers

Energy grids - The N-1 principle



If one assets fails, then it must be possible to resolve the failure utilizing the remaining assets in the network

Example of the N-1 principle



Cable load in the original situation

Cable load in the reconnected situation

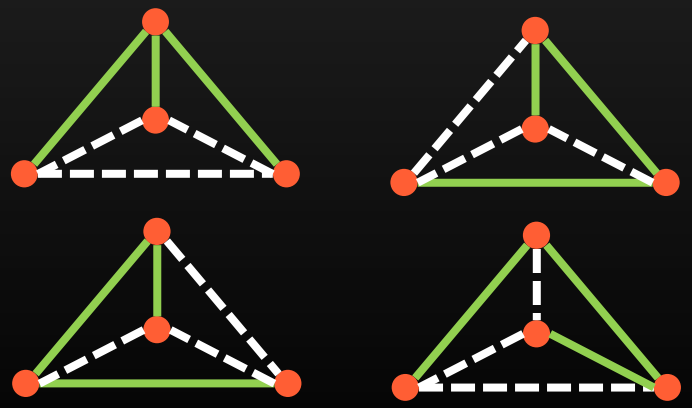
Quantum computers used

QAL

Gate-Based

IBM Quantum

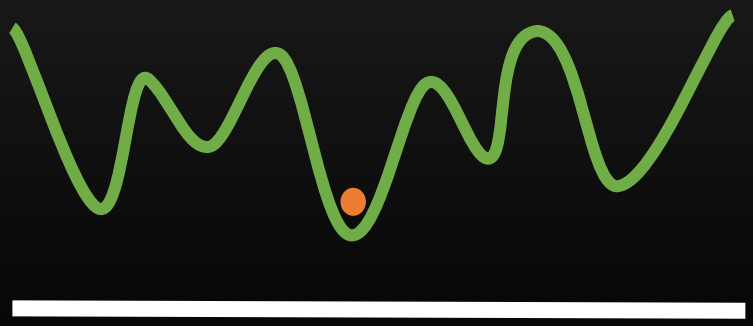
Use quantum parallelism to access multiple reconfigurations in superposition



Quantum Annealing

D-Wave

Let quantum system evolve towards optimal solution in controlled setting



Quantum Application Lab:

Co-creating valuable quantum computing applications with end-users

Victor Land
Quantum Application Lab

(Centrum Wiskunde & Informatica)

Quantum Application Lab

QAL

What we believe:

Rapid maturity of quantum computing, by the hand-in-hand development of user-inspired applications and quantum computing technology.

What we want to achieve:

Bringing value to end-users by co-developing quantum computing applications that can be tested on current or near-term quantum computing systems.

Who?

QAL

Joint initiative of:

CWI

TNO innovation for life

Universiteit van Amsterdam

netherlands eScience center

Quantum Inspire

SURF

Quantum Information scientists
Computer scientists
HPC experts
Systems Architects
Software Engineers
Business Developers
Project Managers

With technology partners:

IBM Quantum

QuTech QUANTUM

Microsoft

aws

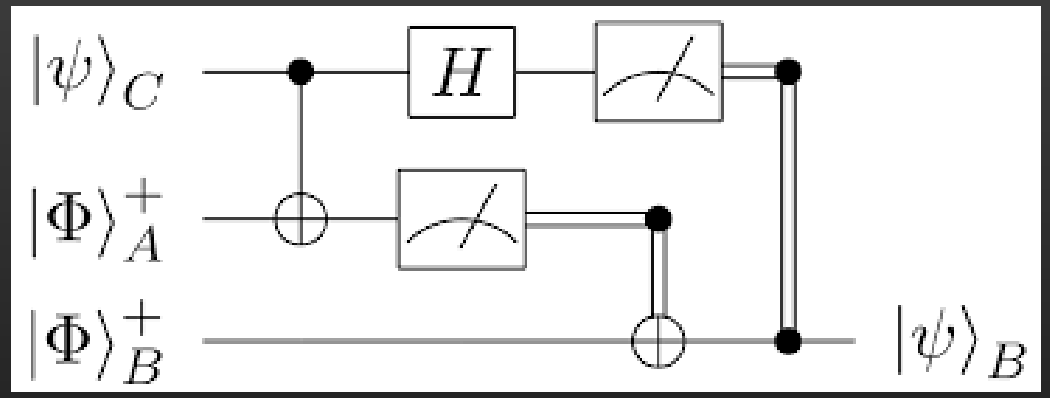
XANADU

Access
Expertise
Network

Co-Creation with end users

Strategic exploration	Use case selection & Road map development	Application development & implementation
Goal: Determine the potential of quantum computing including expected timelines.	Goal: Assess specific use cases that could benefit from quantum computing. A ranking on impact, time and potential can be provided.	Goal: Work out a specific, pre-determined, use case in more detail. Including algorithm design, classical benchmark and implementation on available hardware/simulators within QAL.
Deliverable: basic technology roadmap: how can an application be part of existing technologies and application roadmaps. A baseline assessment on its future potential and routes to integration into the organization.	Deliverable: impact and benefit analysis of possible applications used in the organization. Additional deliverables could include scientific publications (aligned with organization).	Deliverable: proof of concept implementation of a specific use-case for quantum computing. Additional deliverables may include scientific publications (aligned with organization), developed software implementation, implementation license, etc.
Duration: +/- 3 months	Duration: +/- 6 months	Duration: 6 to 12+ months

Deliverables



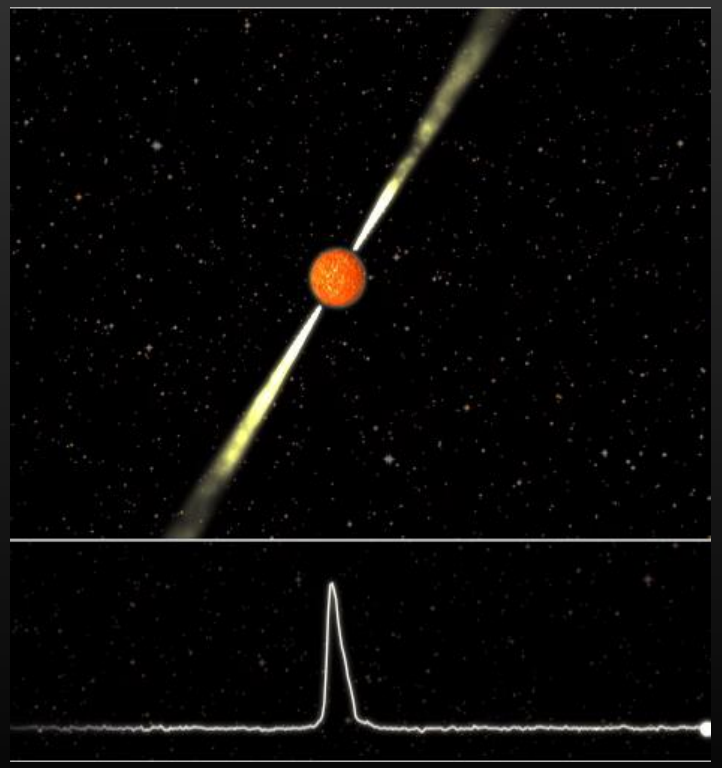
Report: Analysis of different approaches to the problem

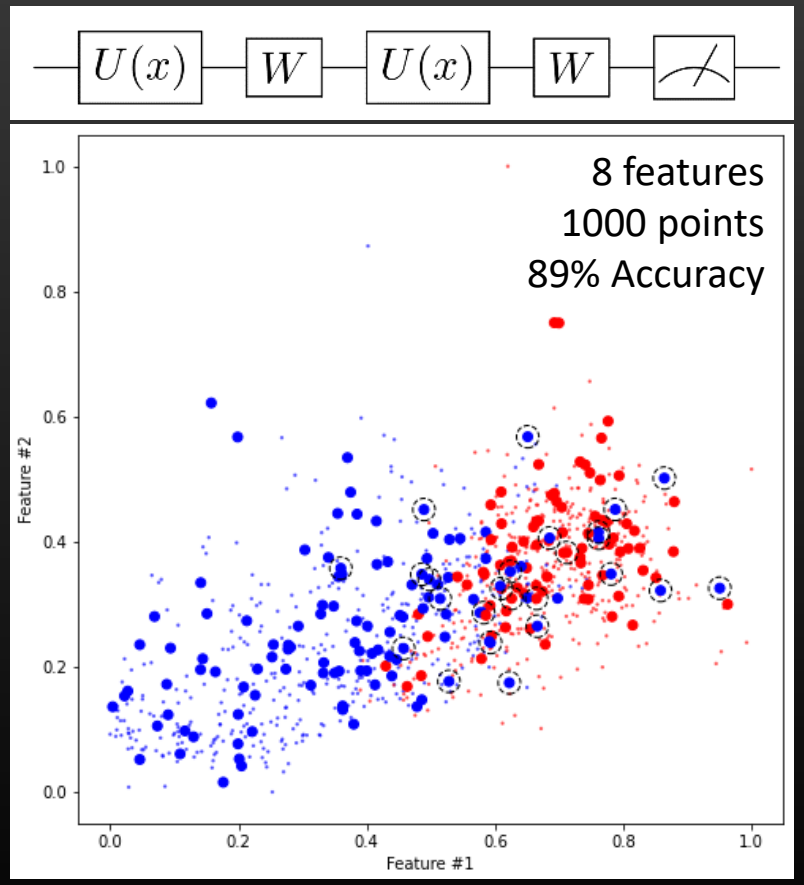
Proof of Concept: ideally an implementation; piece of software written for quantum hardware e.g., IBM machines, QuiX, other…

Example

Could Quantum Computing be Useful for Radioastronomy ?

Quantum Computing for Pulsar Detection

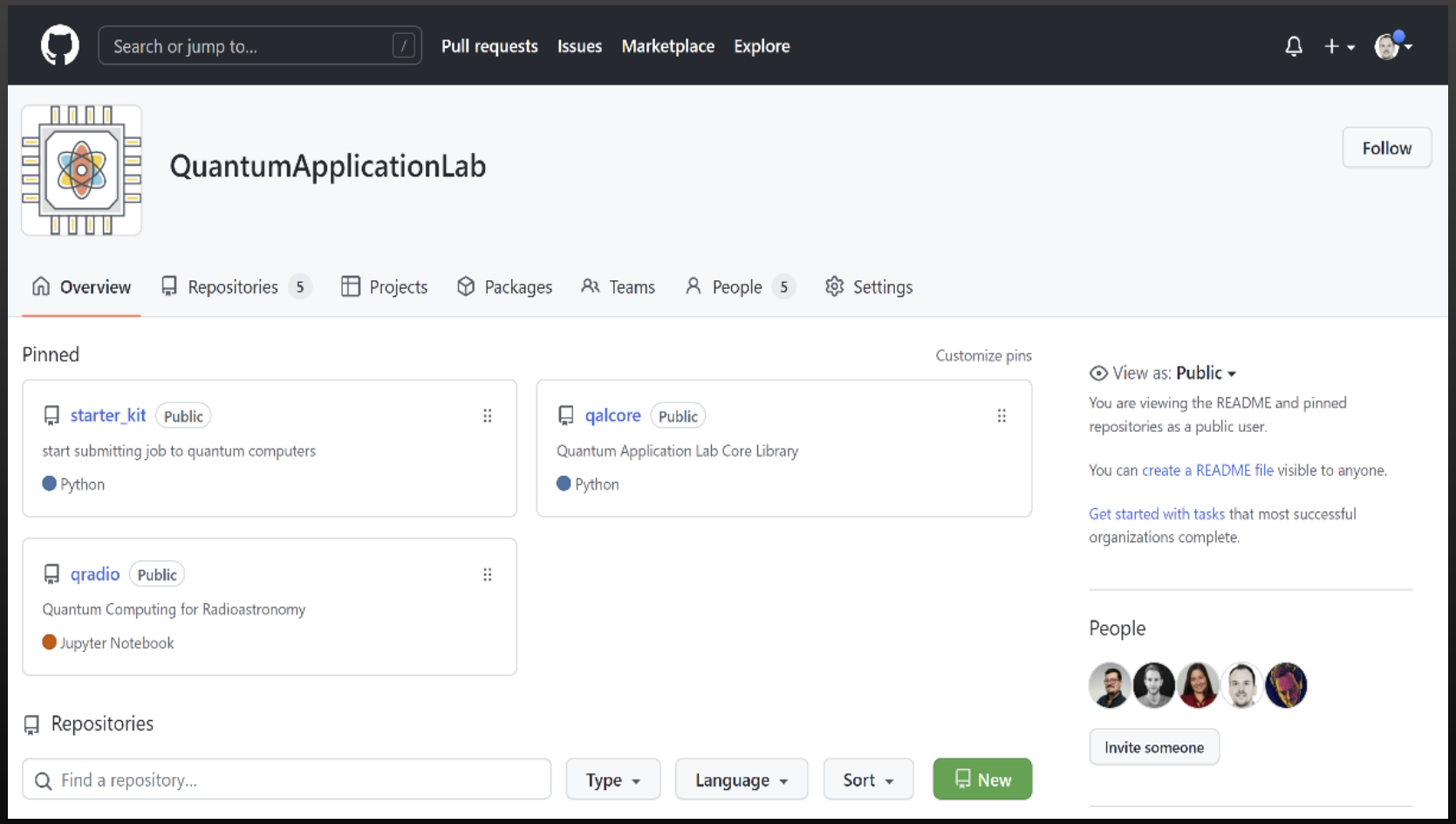


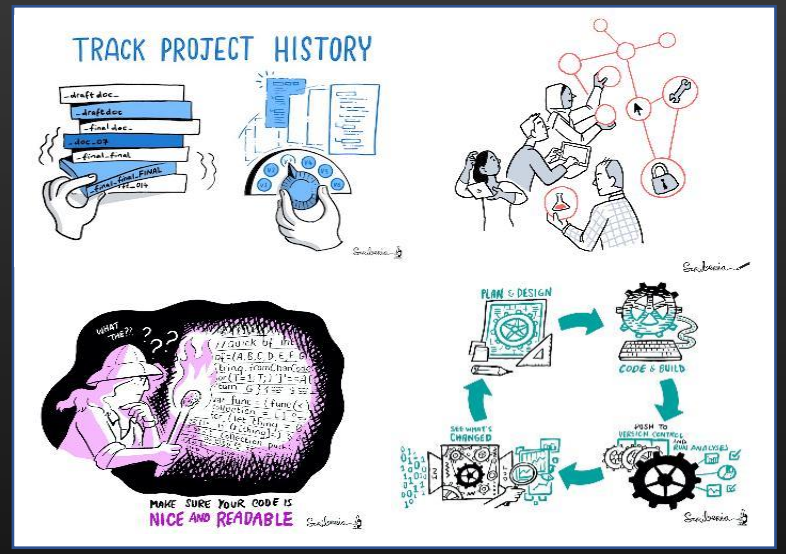


Simple 1-qbit classifiers can be trained to identify real pulsars from artefacts.

Open dissemination of code: QAL GitHub

https://github.com/QuantumApplicationLab





Share Knowledge | Develop Software Solutions | Disseminate output

Technical workshops

- Workforce training
- Connect hardware with problems
- Community building
- Benchmarking
- Keeping up-to-date

Access to hardware:
Workshop with Classiq and NVIDIA – using GPU cluster on Snellius with support of SURF

Collaborate with us!

In case you are interested to collaborate with QAL,

Email us at: info@quantumapplicationlab.com

Visit our website: quantumapplicationlab.com

And follow us on LinkedIn:
https://www.linkedin.com/company/quantum-application-lab/

QAL

Thank you for your attention!

Powered by Quantum Delta NL

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City of Amsterdam

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