Open Source MANO by ETSI

Orchestration Service for QKD Network Digital Twins

29/11/2023

Blanca López
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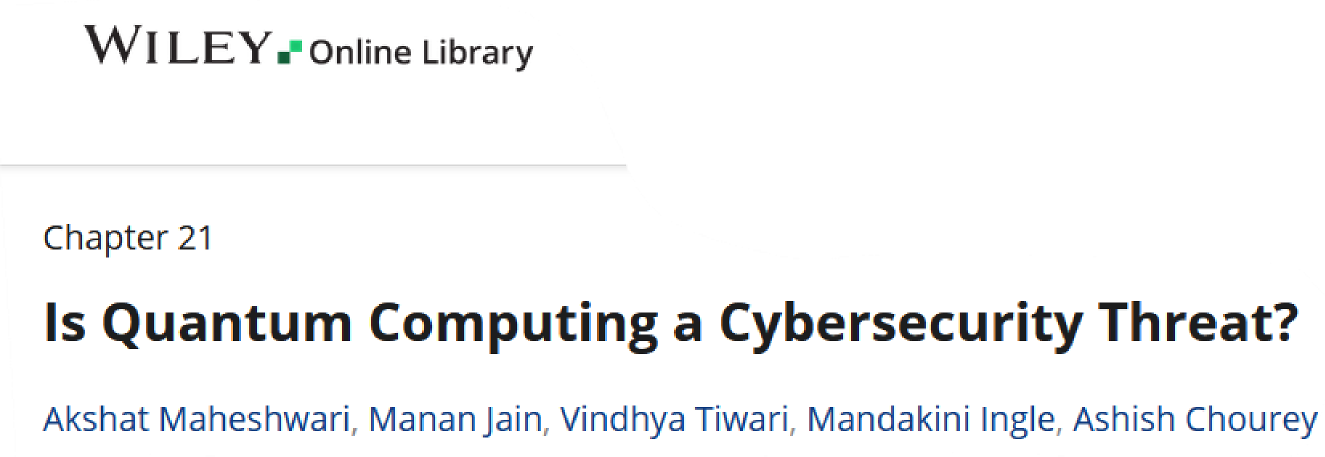

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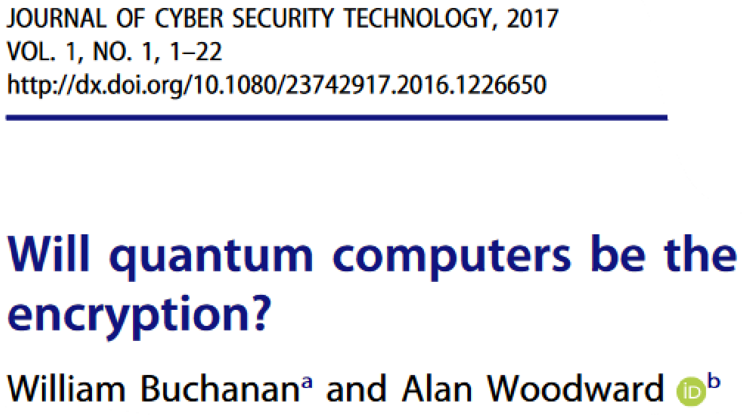
Chapter 21

Is Quantum Computing a Cybersecurity Threat?

Akshat Maheshwari, Manan Jain, Vindhya Tiwari, Mandakini Ingle, Ashish Chourey



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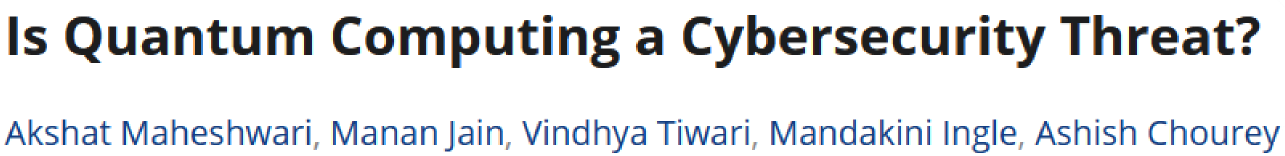
Will quantum computers be the end of public key encryption?

William Buchanan[a] and Alan Woodward[b]



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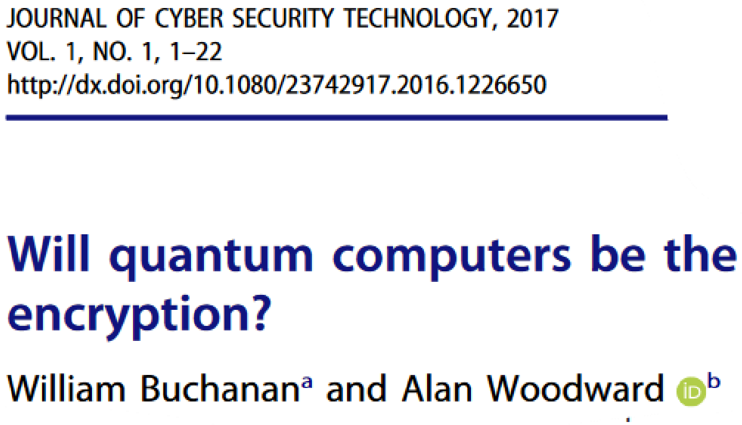

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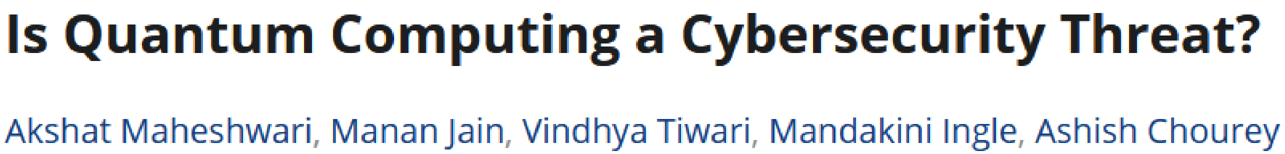

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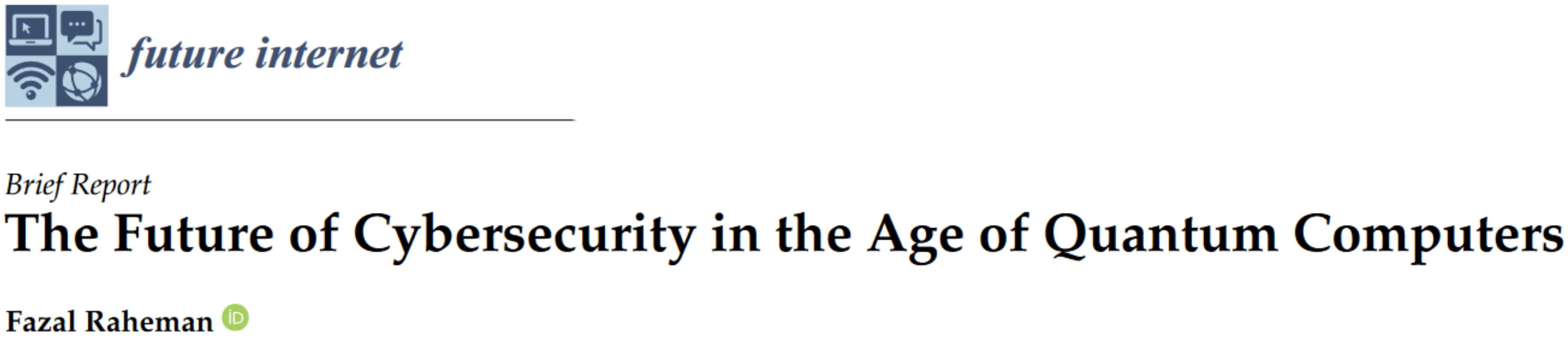
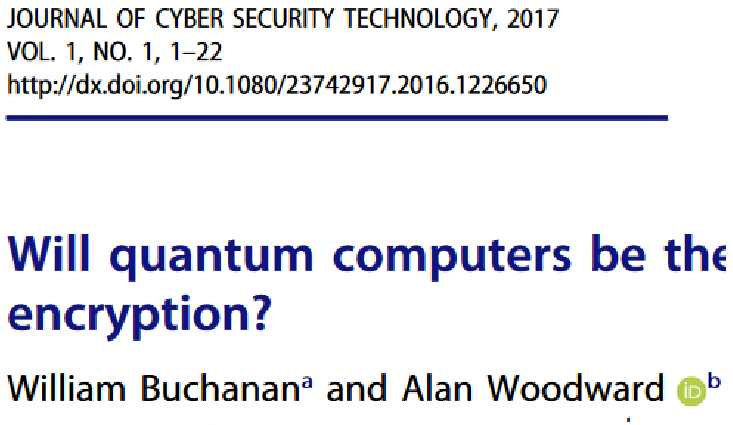


future internet

Brief Report

The Future of Cybersecurity in the Age of Quantum Computers

Fazal Raheman



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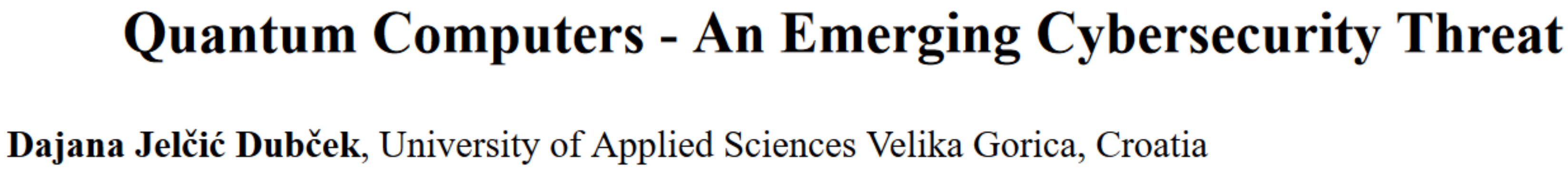
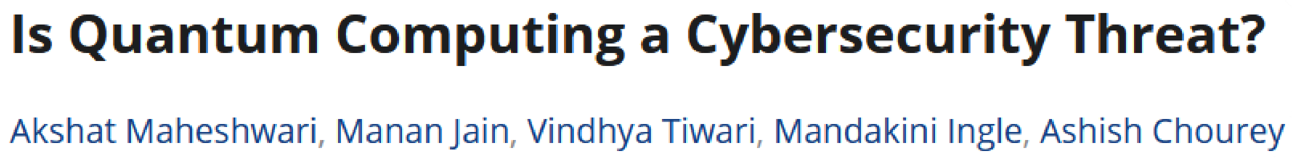


Quantum Computers - An Emerging Cybersecurity Threat

Dajana Jelčić Dubček, University of Applied Sciences Velika Gorica, Croatia



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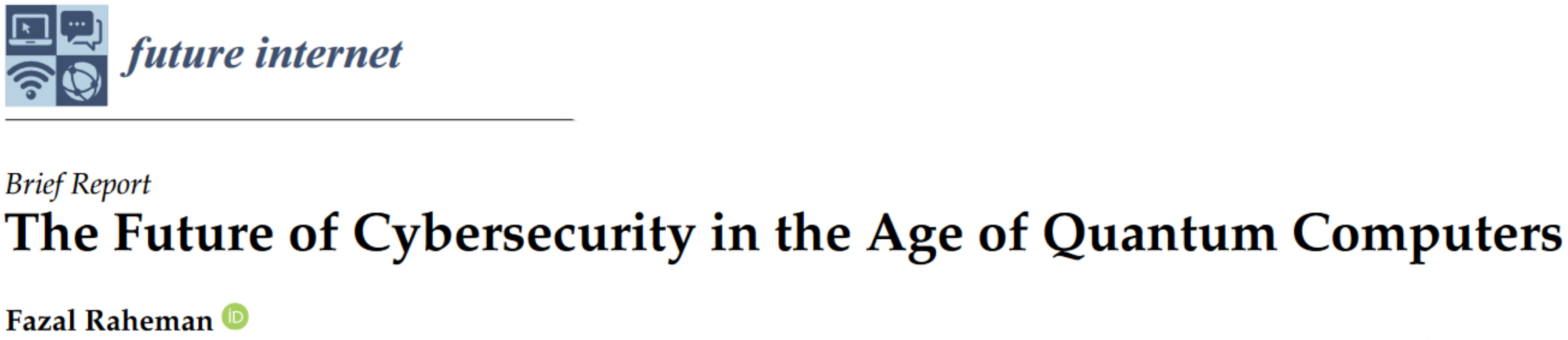

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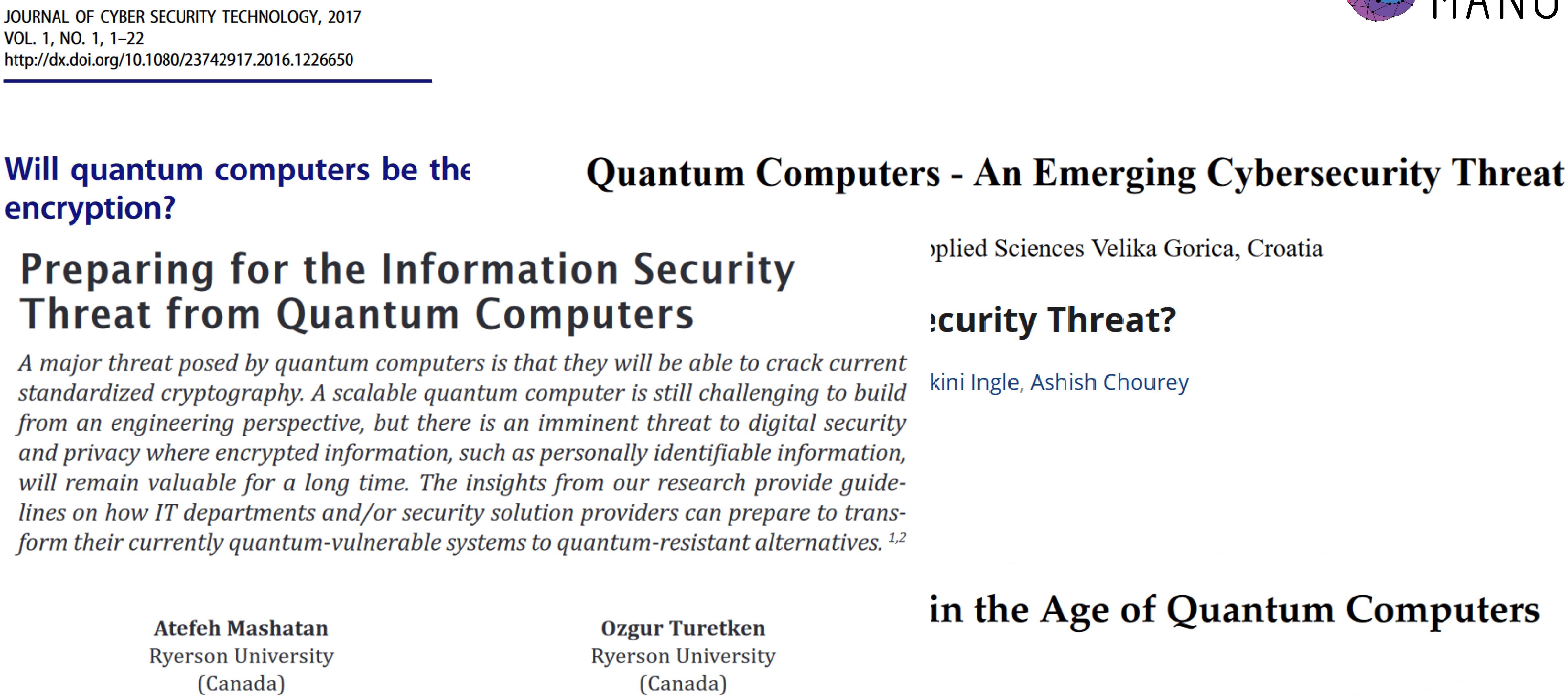

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Quantum Computers - An Emerging Cybersecurity Threat

Preparing for the Information Security Threat from Quantum Computers

A major threat posed by quantum computers is that they will be able to crack current standardized cryptography. A scalable quantum computer is still challenging to build from an engineering perspective, but there is an imminent threat to digital security and privacy where encrypted information, such as personally identifiable information, will remain valuable for a long time. The insights from our research provide guidelines on how IT departments and/or security solution providers can prepare to transform their currently quantum-vulnerable systems to quantum-resistant alternatives. [1,2]

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Ryerson University
(Canada)

Ozgur Turetken
Ryerson University
(Canada)

plied Sciences Velika Gorica, Croatia

curity Threat?

kini Ingle, Ashish Chourey

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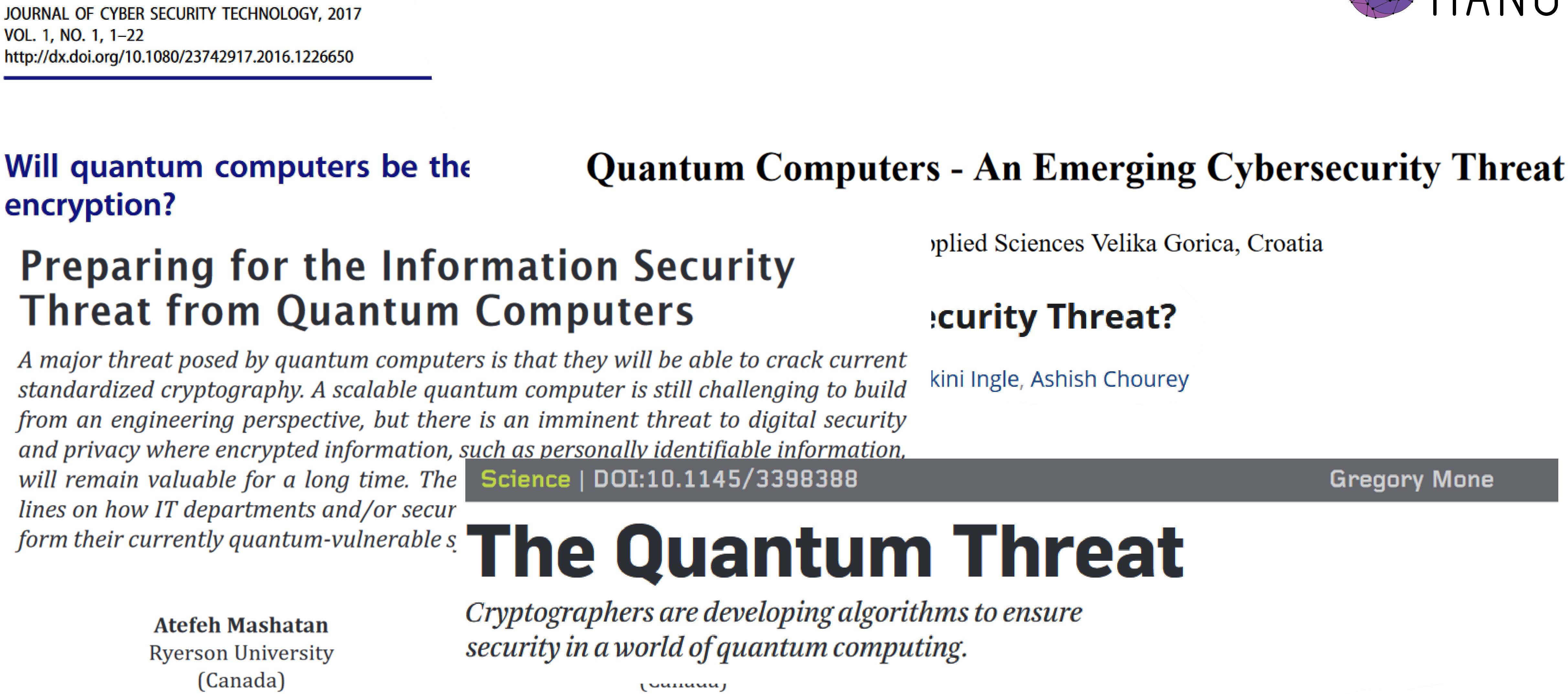

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Science | DOI:10.1145/3398388 Gregory Mone

The Quantum Threat

Cryptographers are developing algorithms to ensure security in a world of quantum computing.

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The New York Times

The Race to Save Our Secrets From the Computers of the Future

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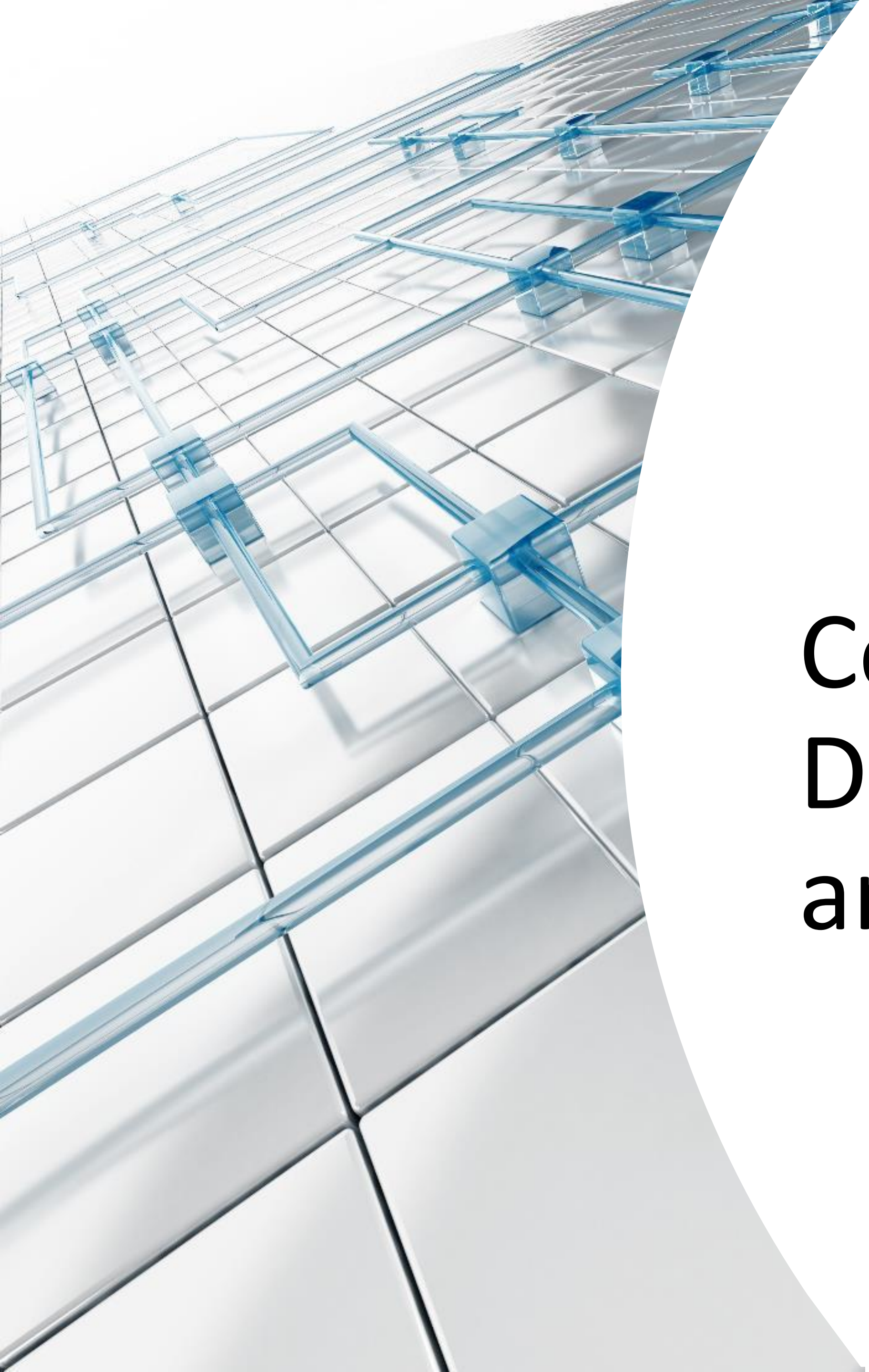
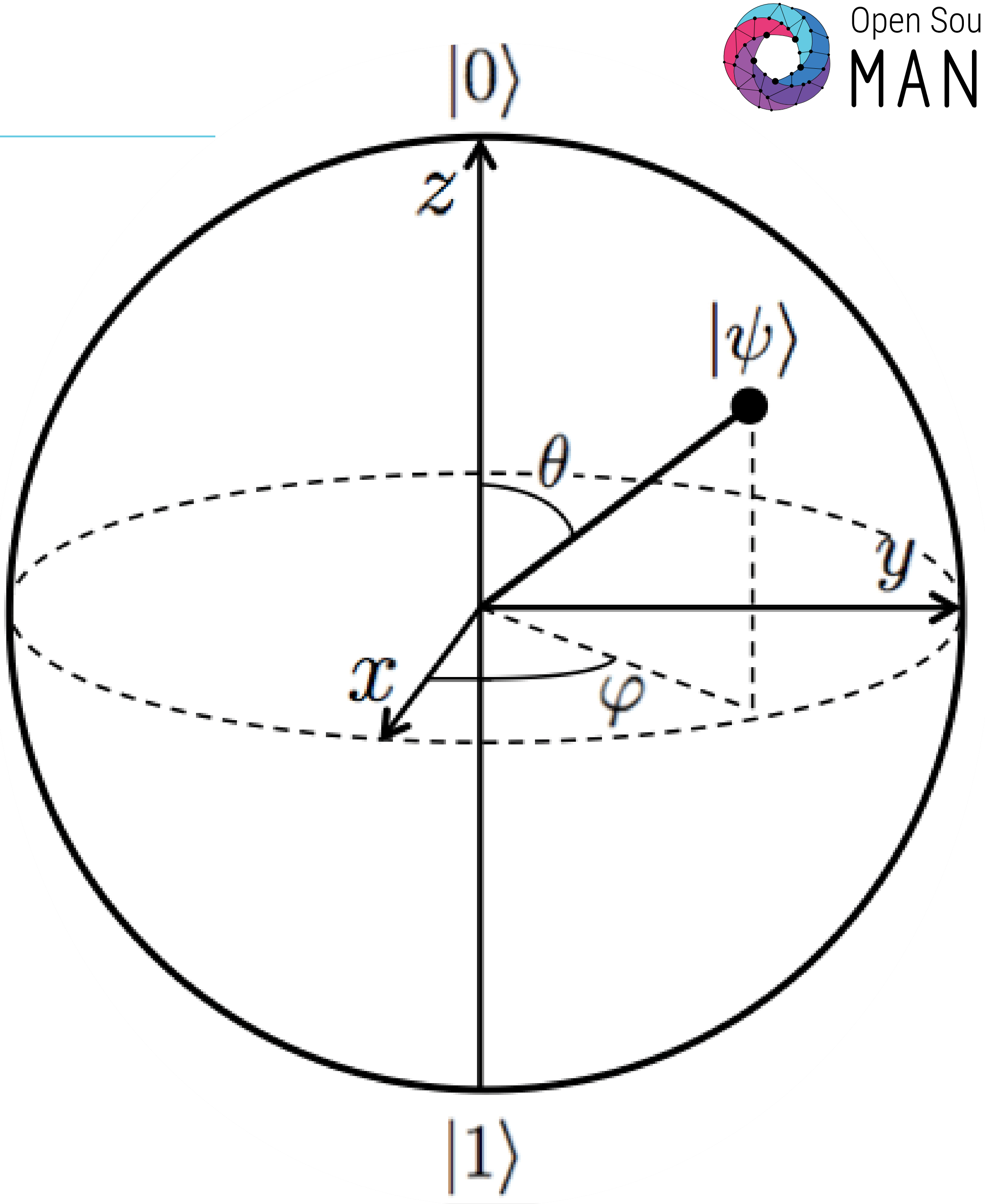


Could Quantum Key Distribution (QKD) be the answer?

Bits vs Qubits

Bits	Qubits
States 0 or 1	Can present superposition
Can be cloned	Can **not** be cloned
----	Measurement destroys the original state
----	Can be entangled
Protocols security based in **computational assumptions**	Protocols security based in **Quantum Mechanics principles**



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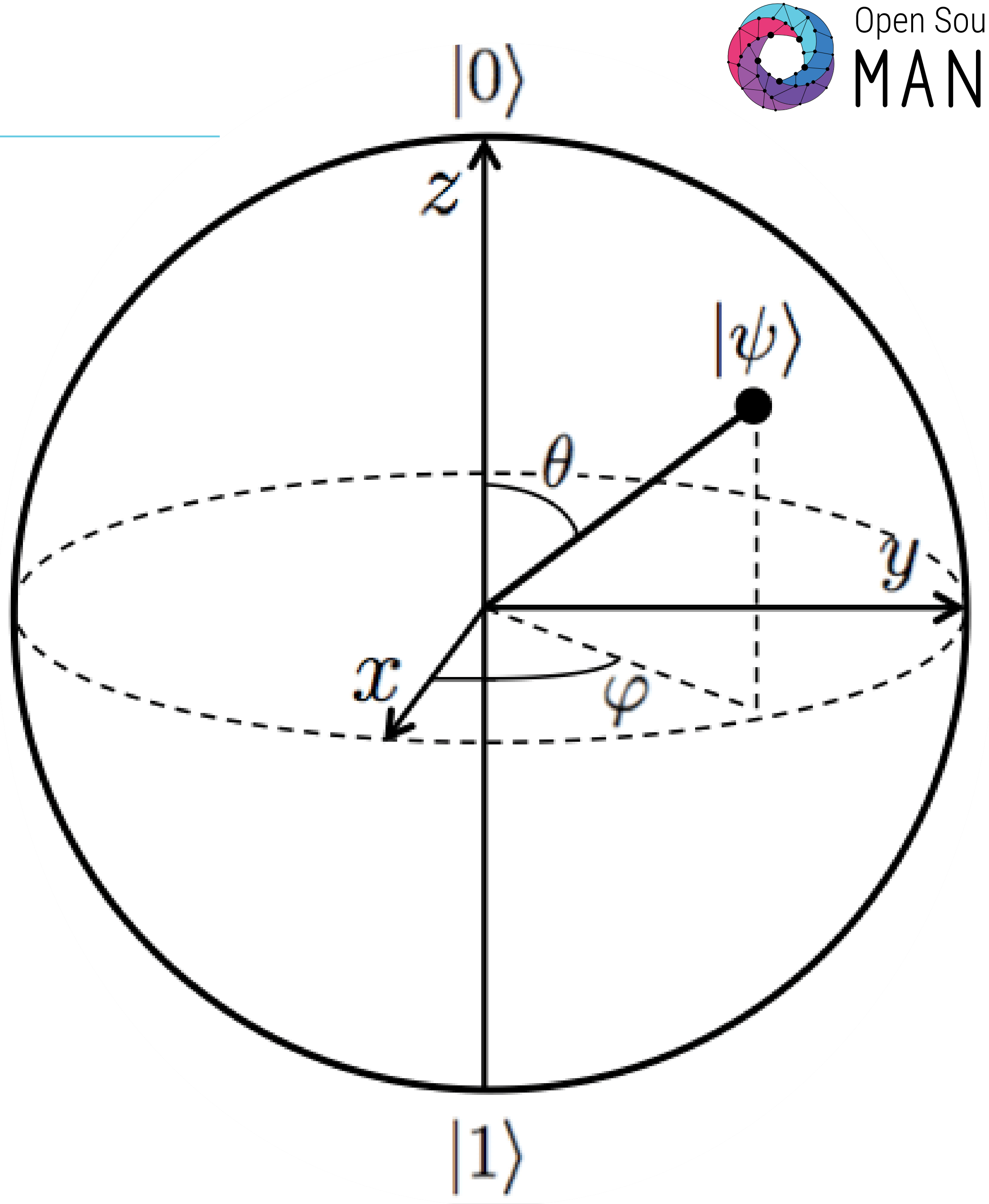
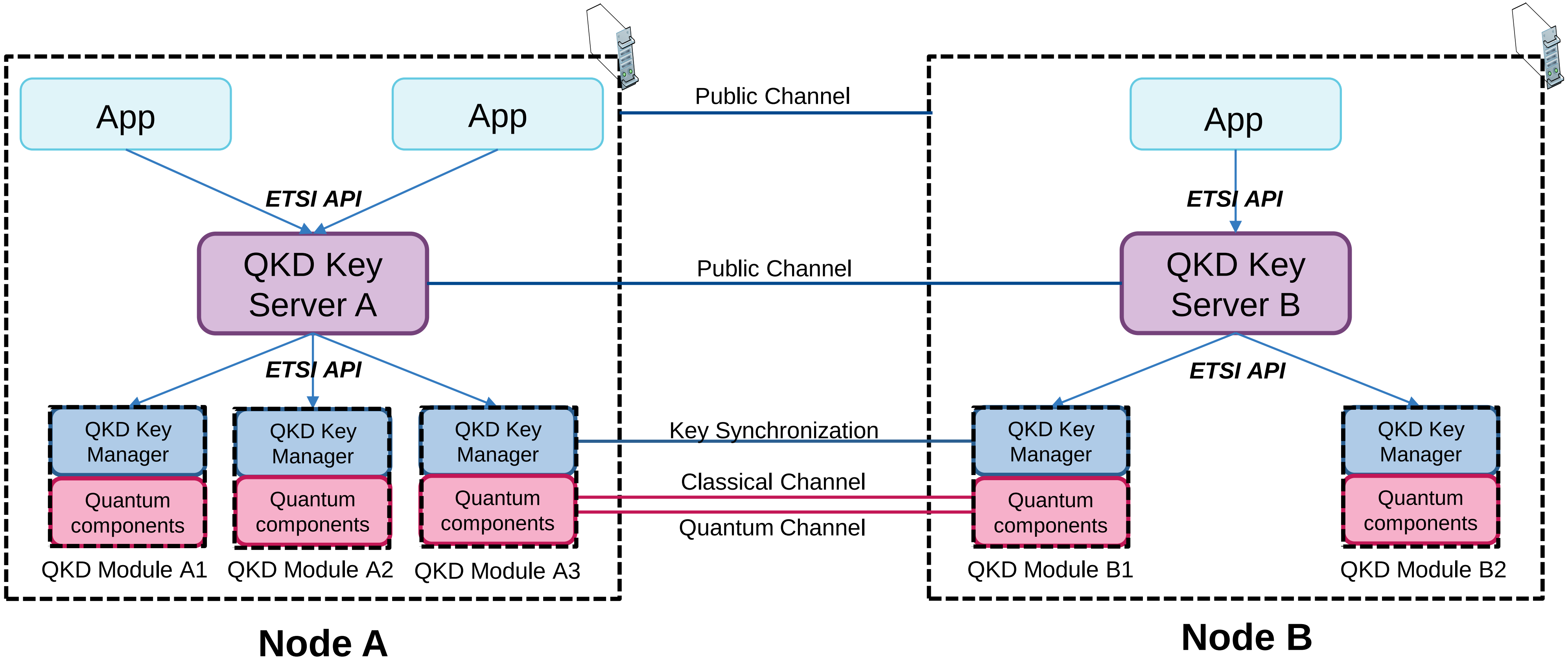
Protocols security based in **computational assumptions**	Protocols security based in **Quantum Mechanics principles**
Easy to work with	**… not so easy**



QKD Networks (an example from ETSI GS QKD 004)



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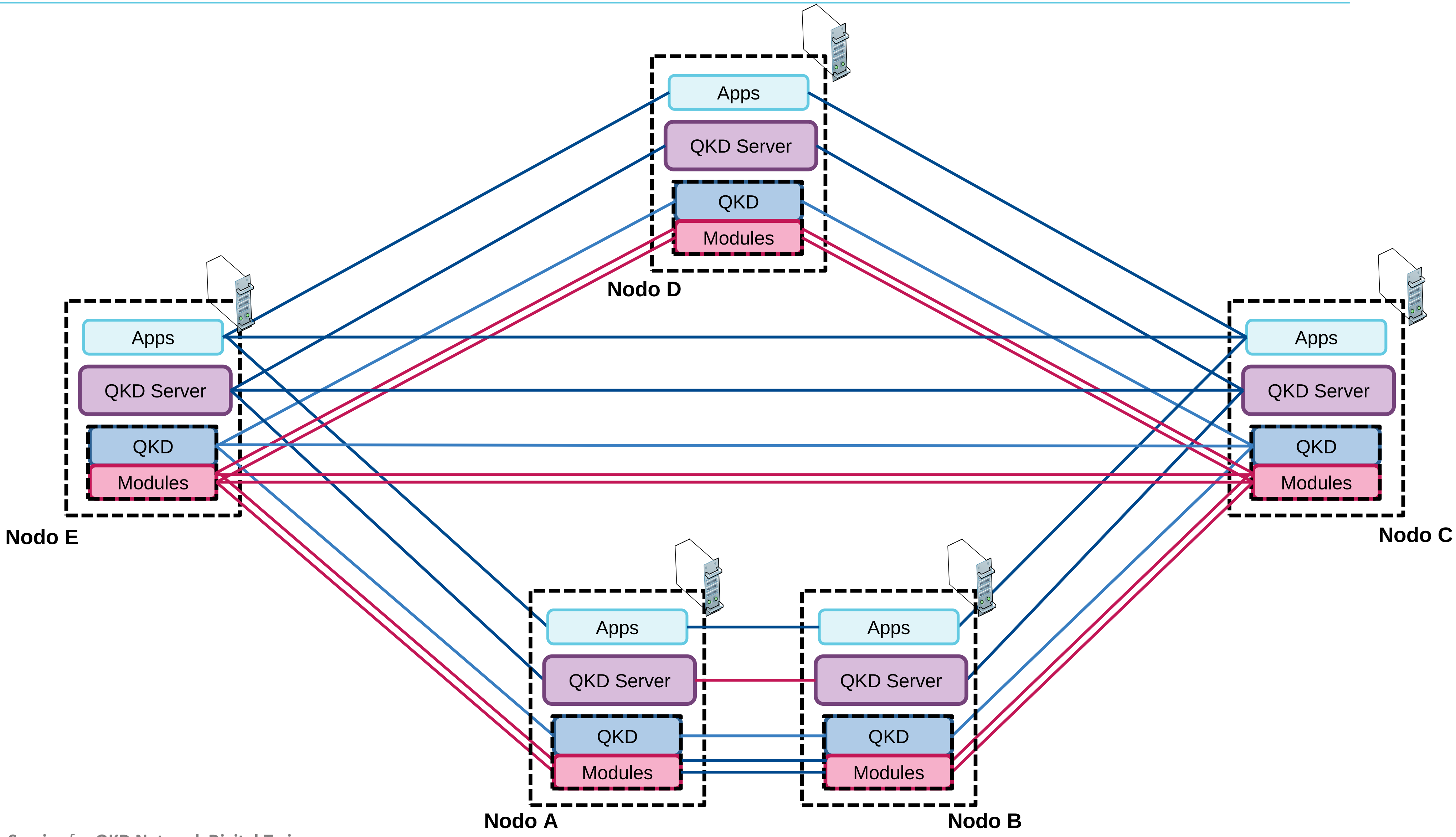

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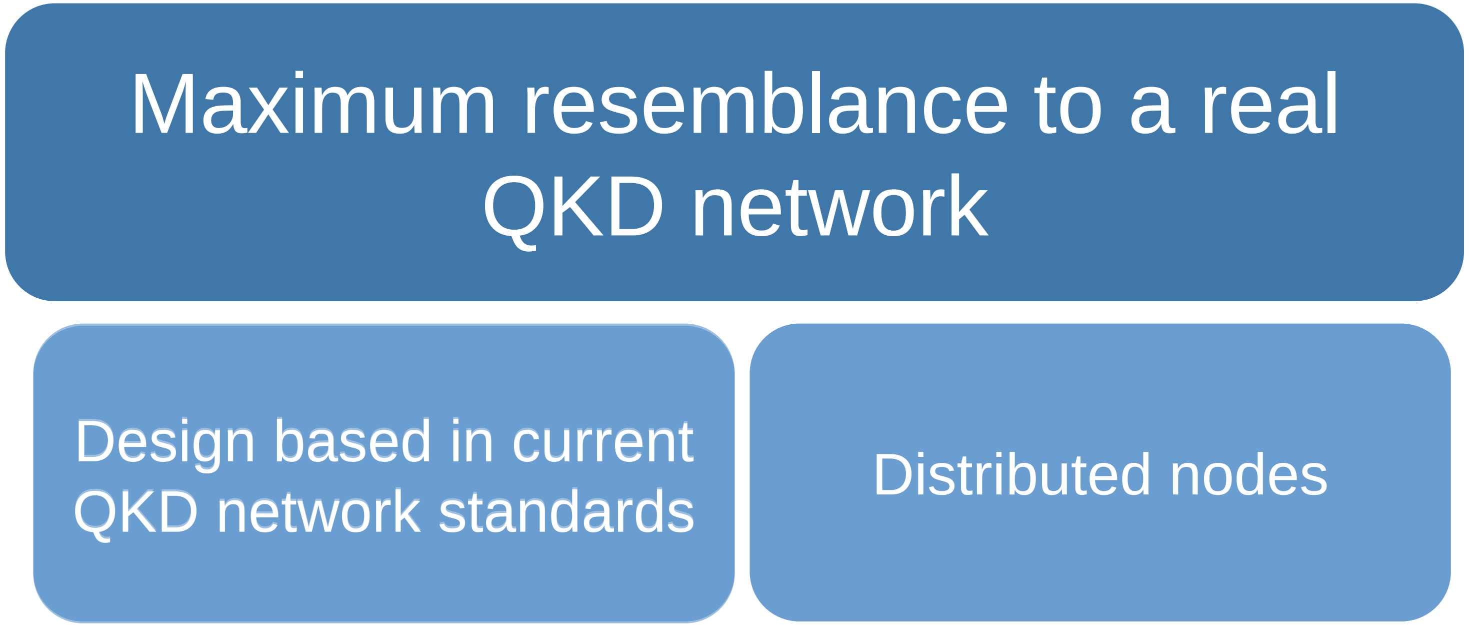
Building a Digital Twin to ease the QKD networks development

Features sought in our DT

Maximum resemblance to a real QKD network

Features sought in our DT



Maximum resemblance to a real QKD network

Design based in current QKD network standards

Distributed nodes

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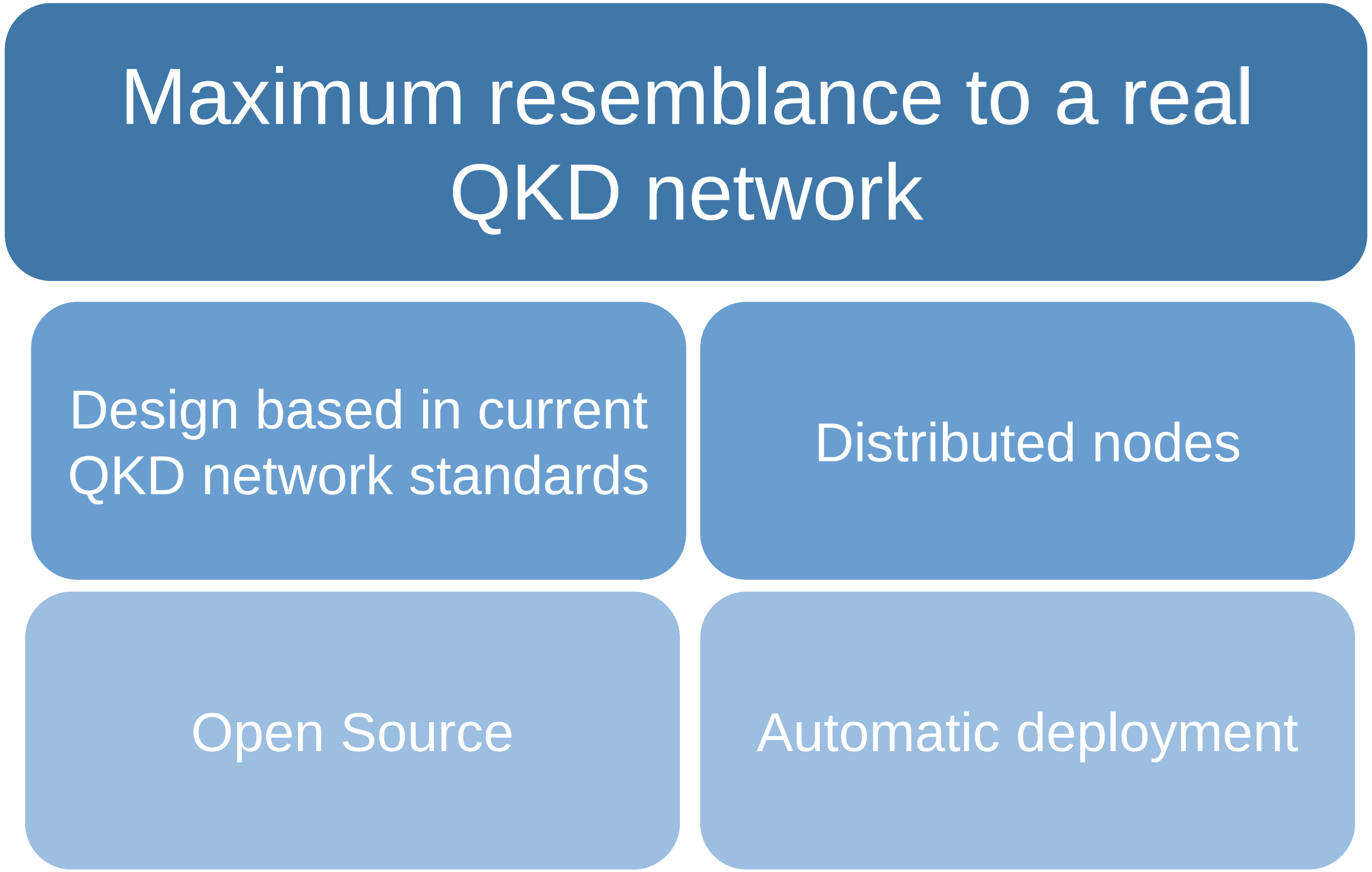


Maximum resemblance to a real QKD network

Design based in current QKD network standards

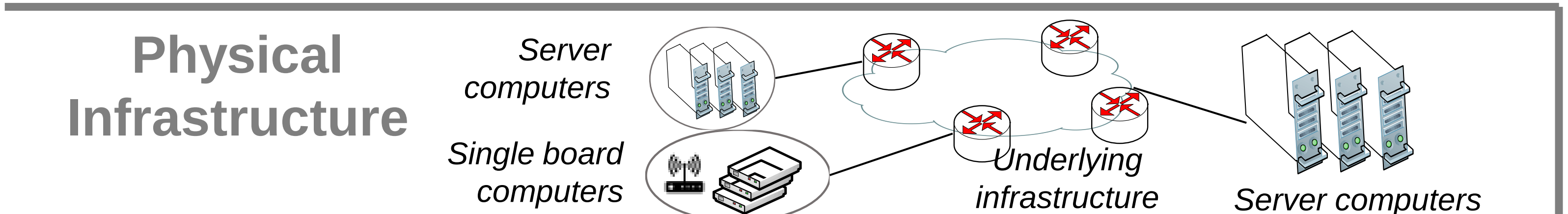
Distributed nodes

Open Source

Automatic deployment

Functioning

YAML description file



Physical Infrastructure

Server computers

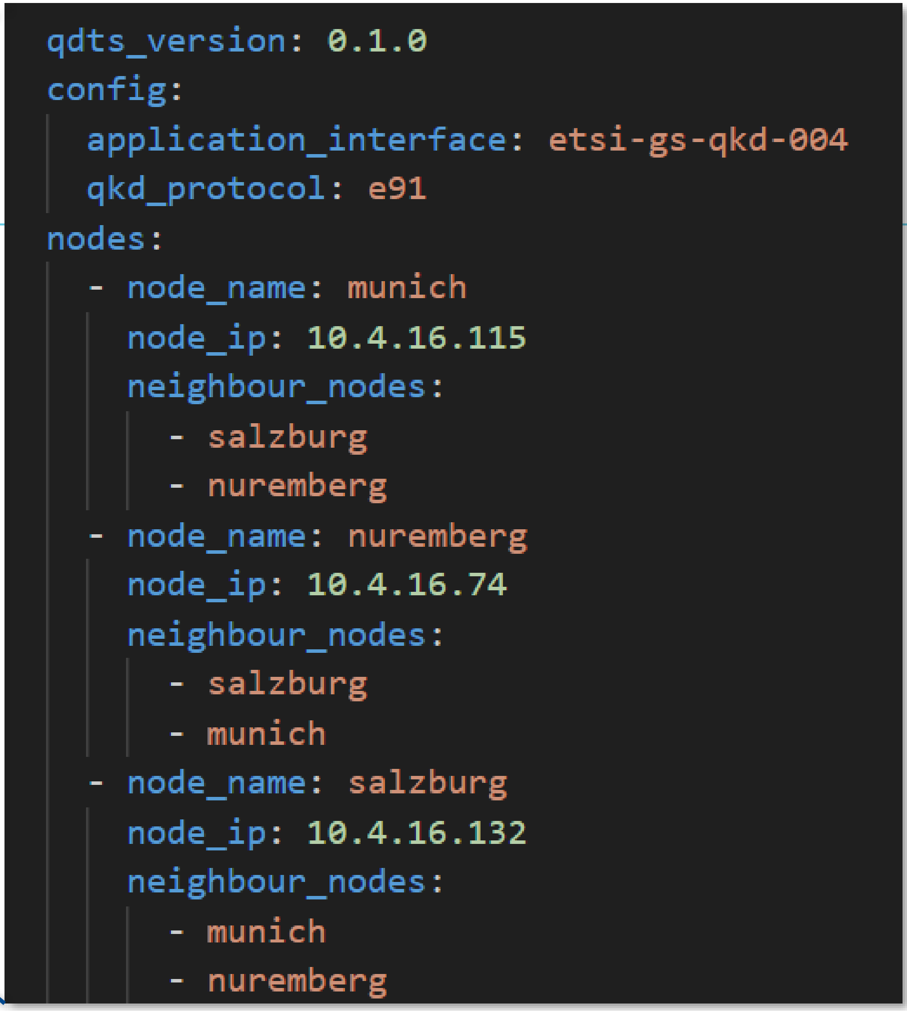
Single board computers

Underlying infrastructure

Server computers

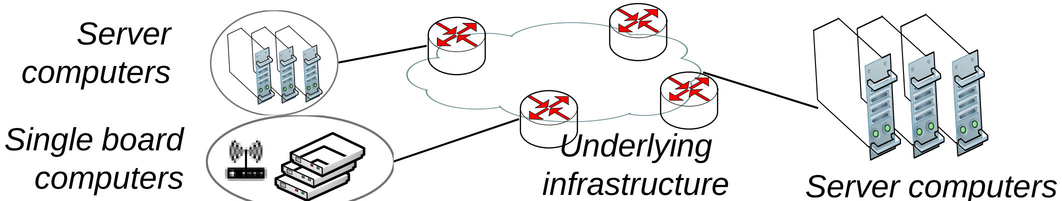
Functioning

YAML description file

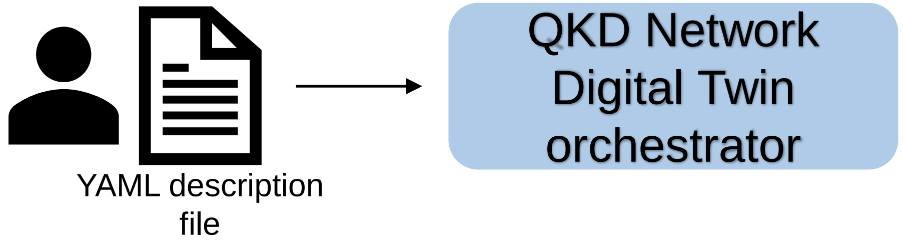


```
qdts_version: 0.1.0
config:
  application_interface: etsi-gs-qkd-004
  qkd_protocol: e91
nodes:
  - node_name: munich
    node_ip: 10.4.16.115
    neighbour_nodes:
      - salzburg
      - nuremberg
  - node_name: nuremberg
    node_ip: 10.4.16.74
    neighbour_nodes:
      - salzburg
      - munich
  - node_name: salzburg
    node_ip: 10.4.16.132
    neighbour_nodes:
      - munich
      - nuremberg
```

Physical Infrastructure

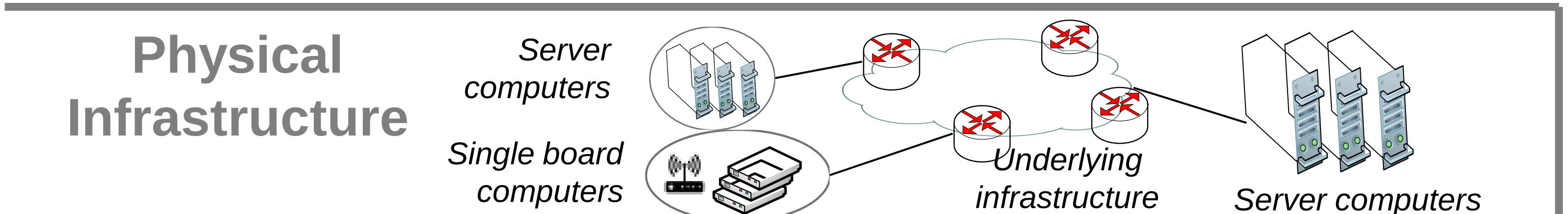


Functioning



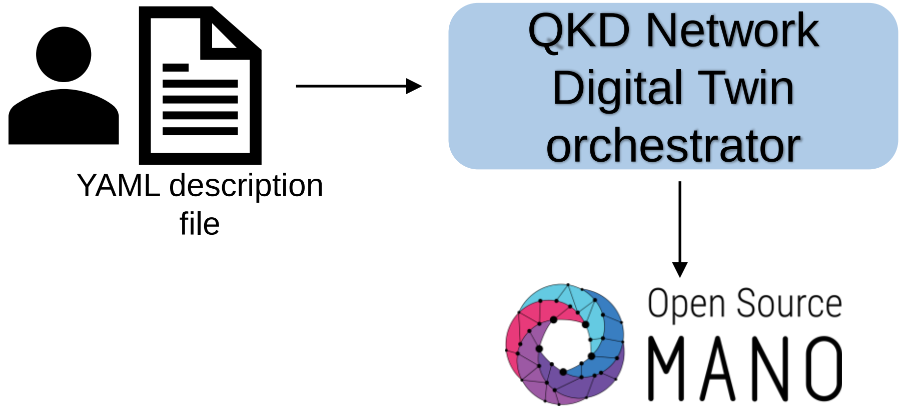
QKD Network Digital Twin orchestrator

YAML description file



Physical Infrastructure

Functioning



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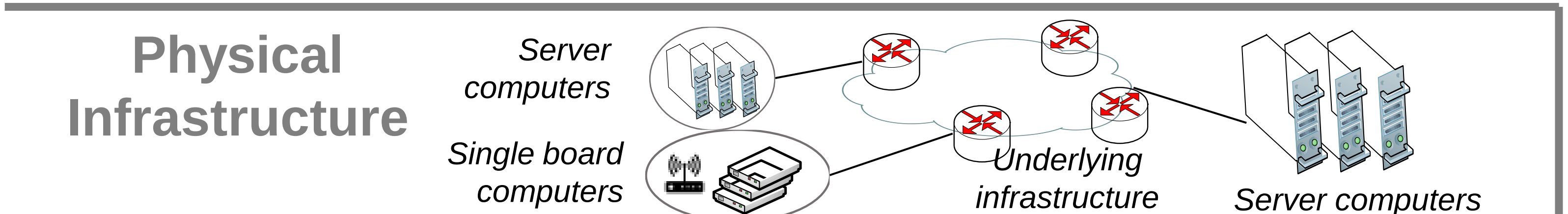
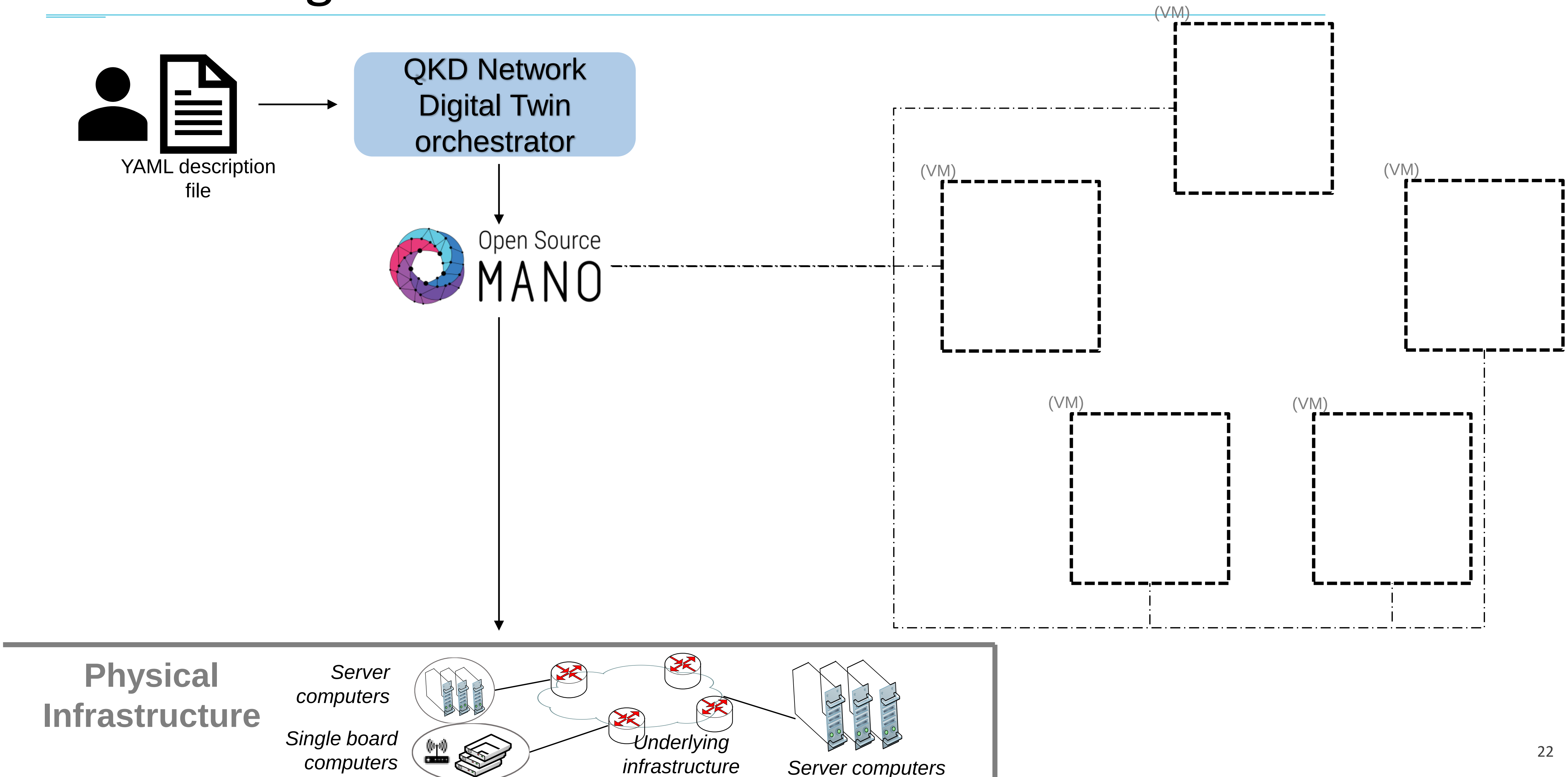
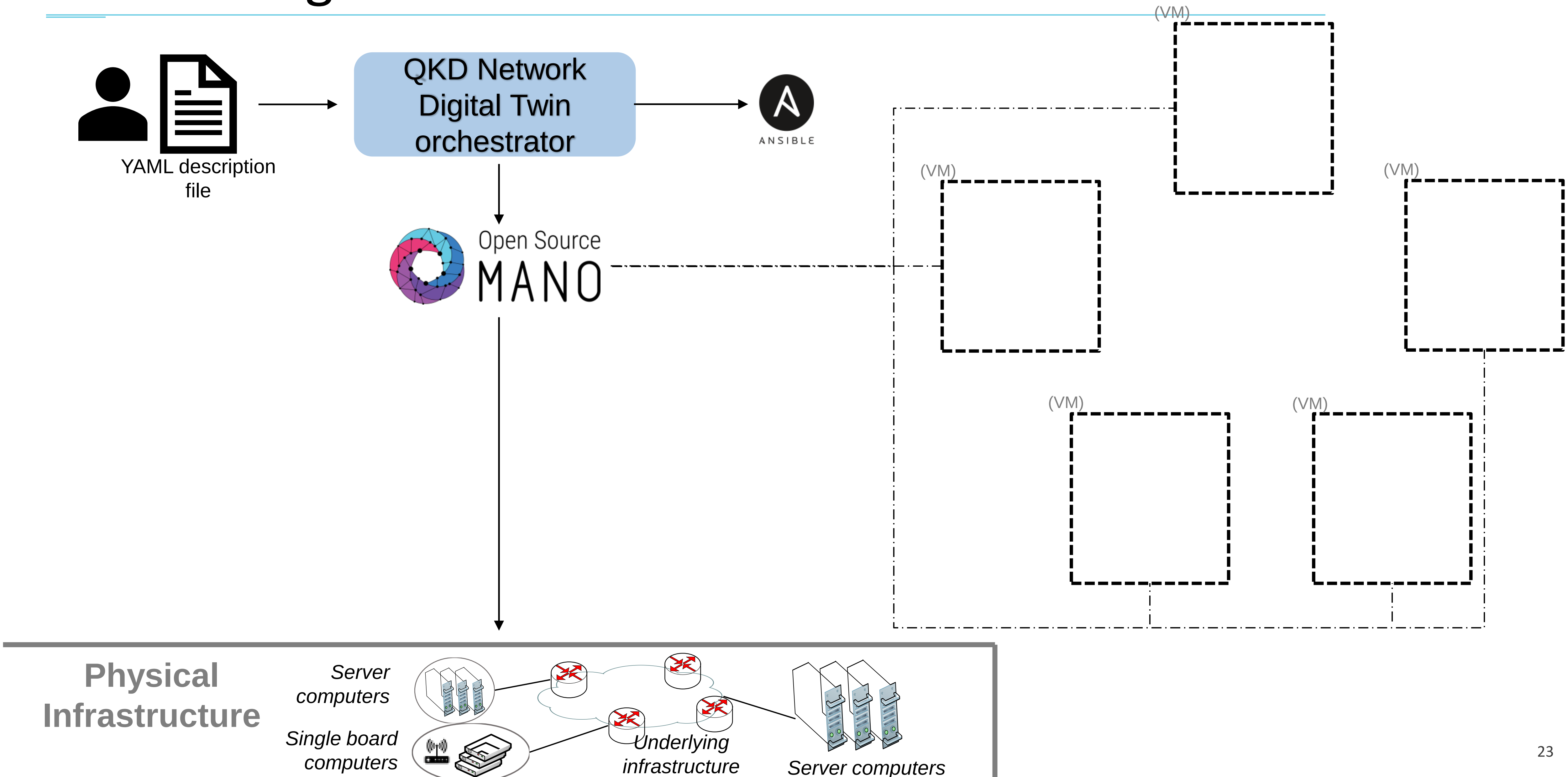


Physical Infrastructure

Functioning



Functioning



YAML description file

QKD Network Digital Twin orchestrator

ANSIBLE

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(VM)

(VM)

(VM)

(VM)

(VM)

Physical Infrastructure

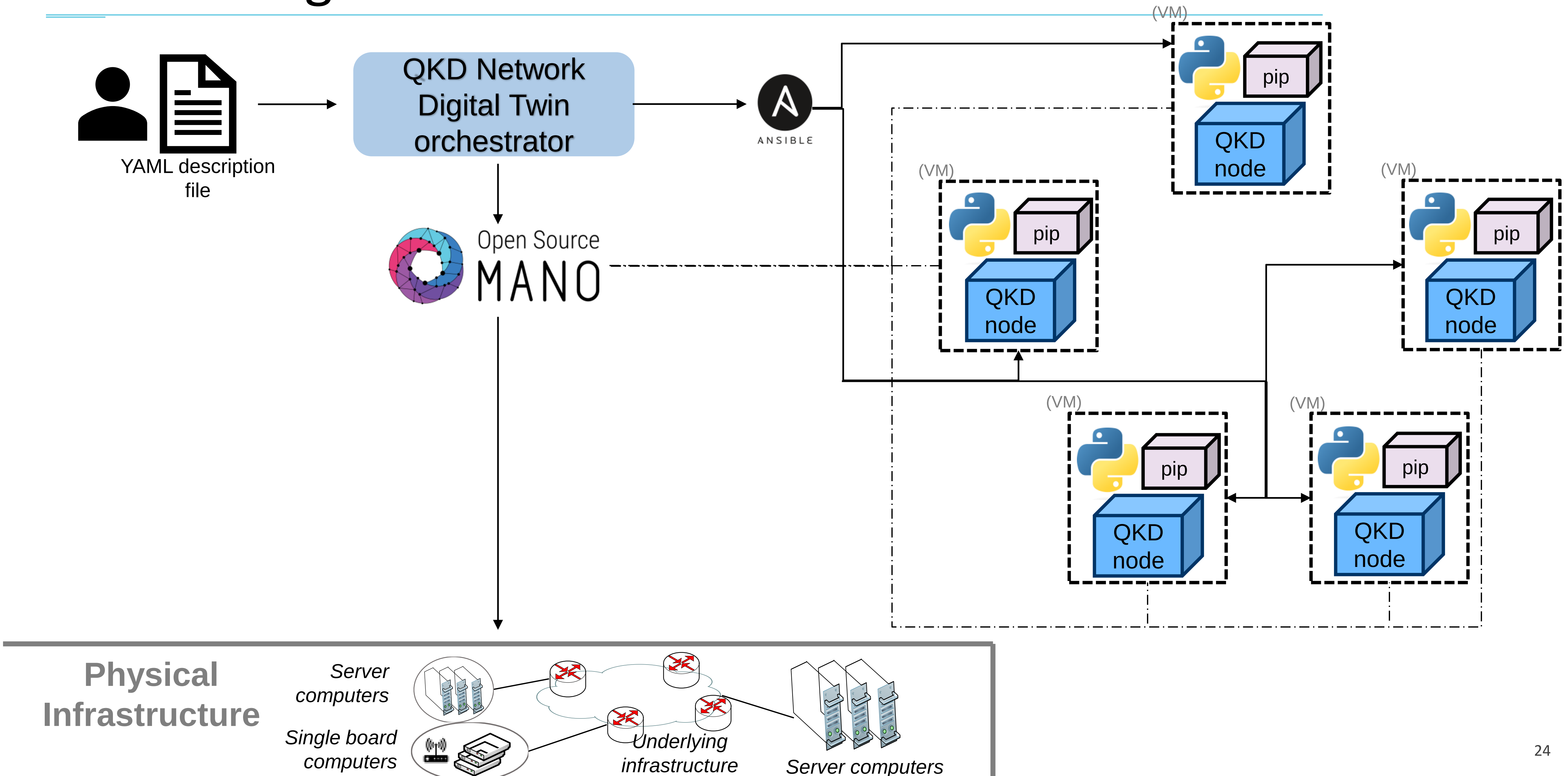
Server computers

Single board computers

Underlying infrastructure

Server computers

Functioning



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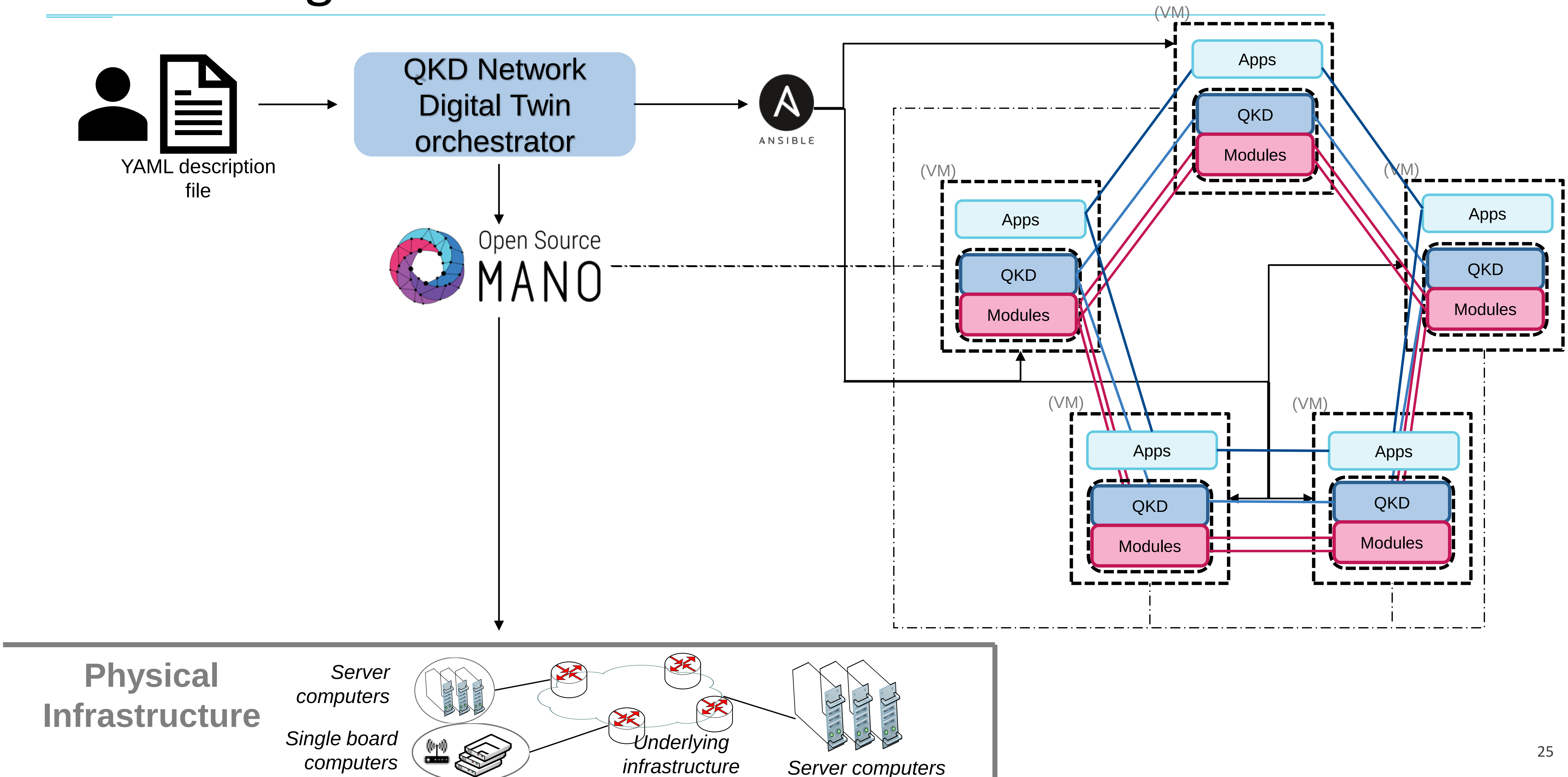
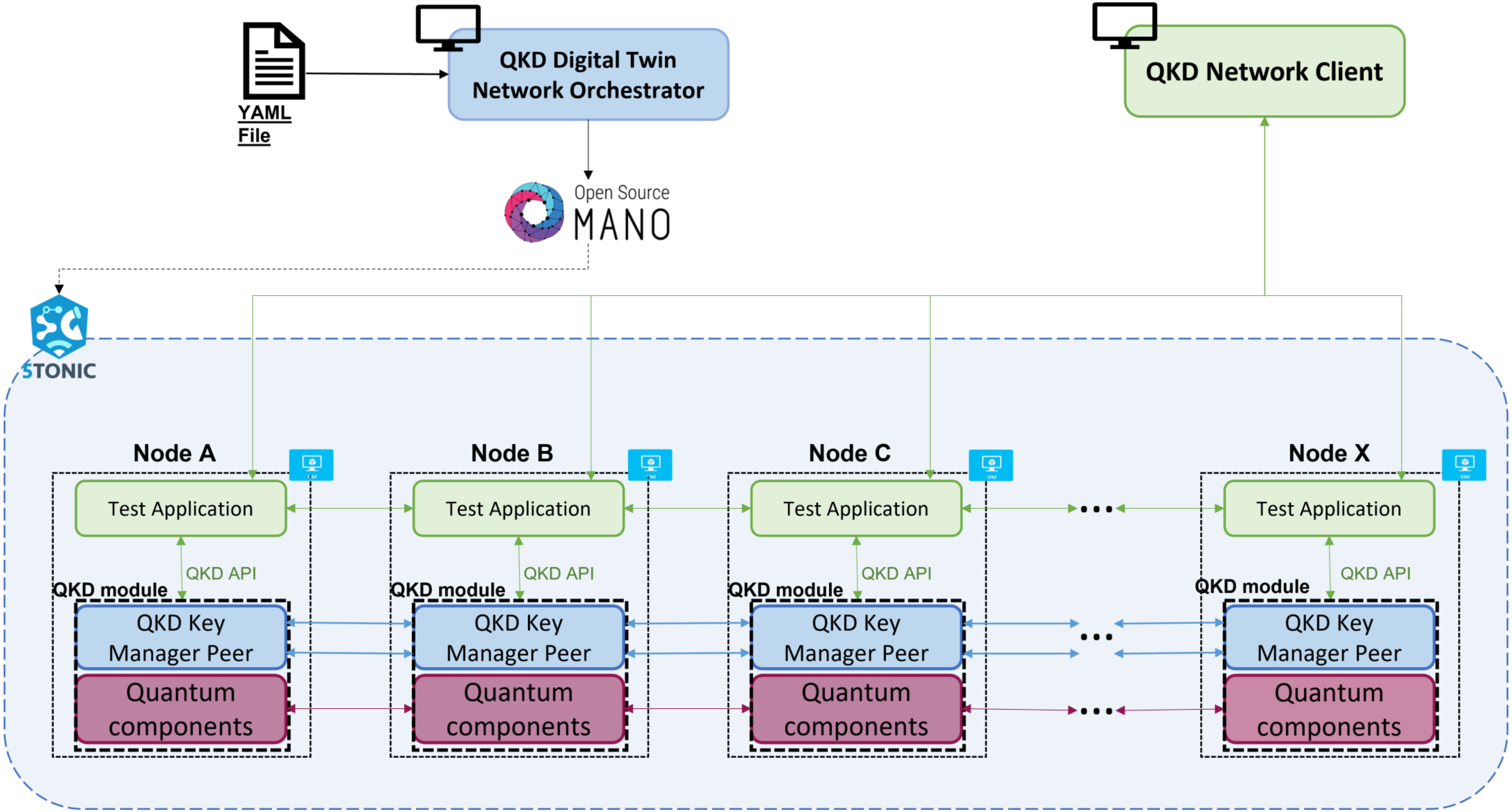


Tests and results



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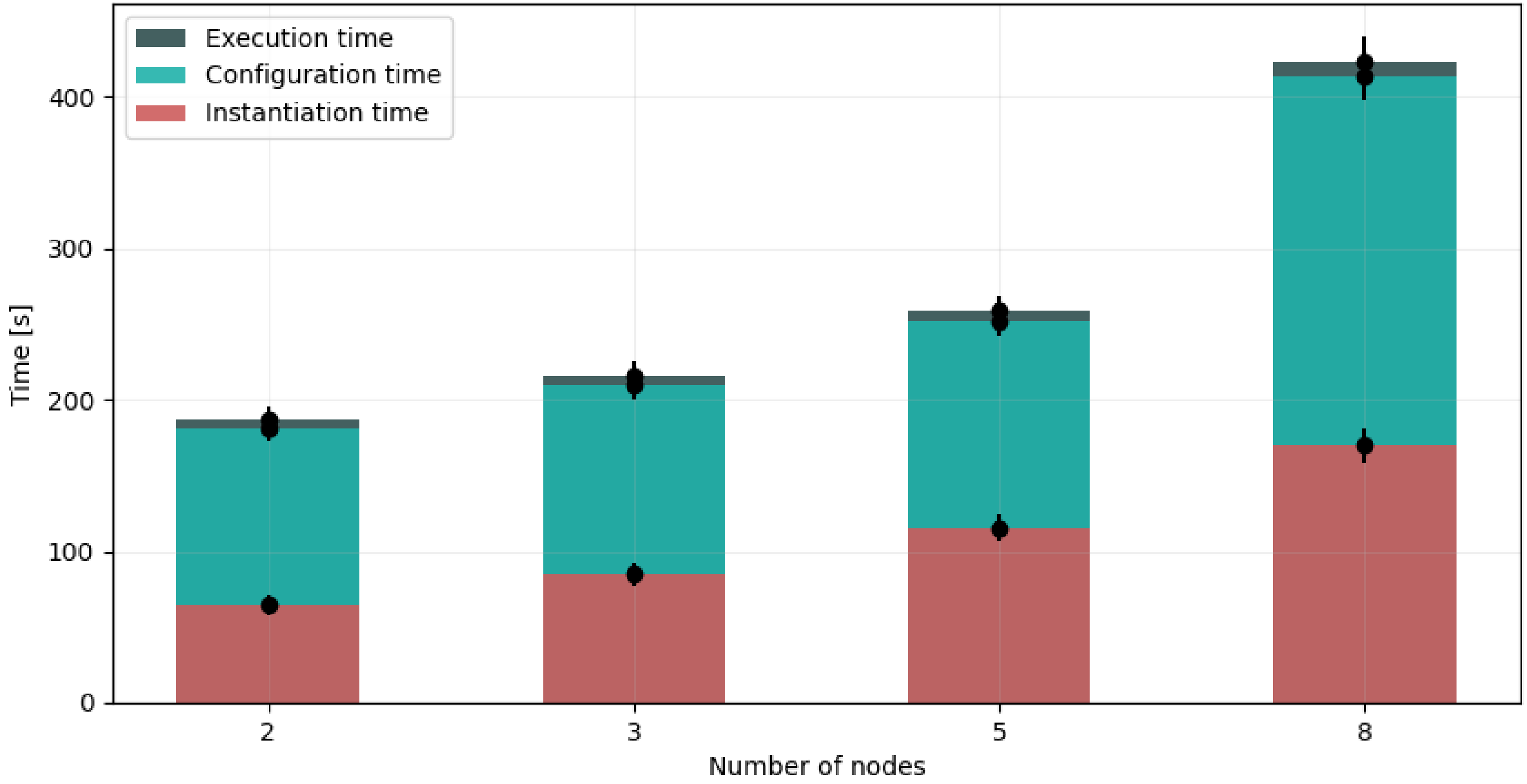
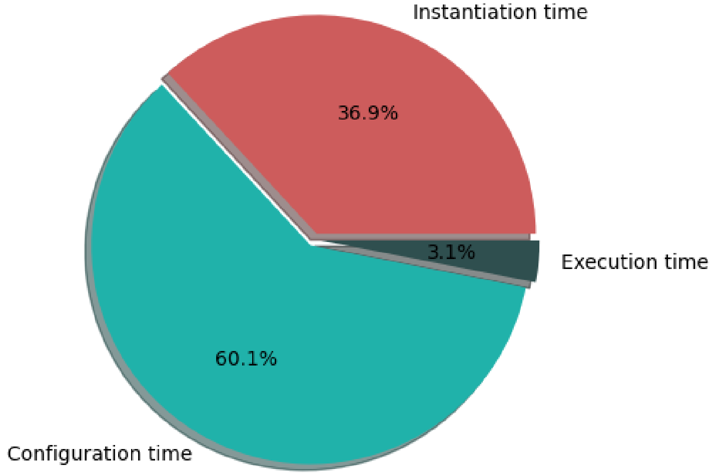




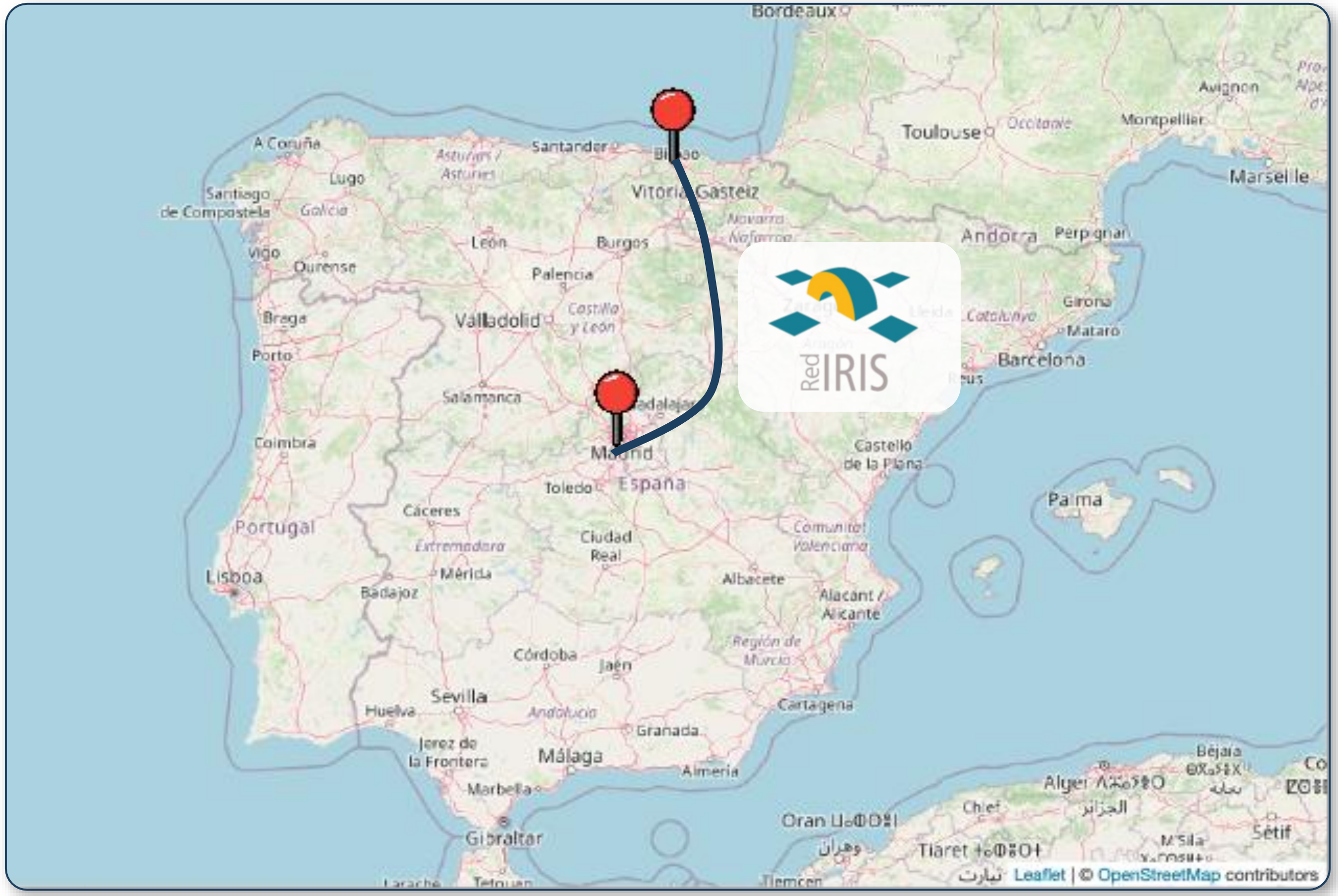
To sum up

- ✓ We now **have access to a digital twin** environment for the **development of QKD networking issues**.
- ✓ The service **can deploy, and start up, moderate sized networks** (6-10 nodes) **in 7 minutes** thanks to OSM.
- ✓ **Quantum applications can run** over the QKD network digital twin **using a standardized API**.

Next steps

- ❑ Support **hybrid deployments**.
- ❑ Add **quantum parameters**.
- ❑ Emulate **channel authentication**.
- ❑ Incoming field test!

Use case: Collaboration with EHU/UPV



Leaflet | © OpenStreetMap contributors

***Objective**: Deployment of a QKD network using the digital twin with network nodes in different locations (Madrid, Bilbao).*

- Collaboration in the context of the Spanish national project TRUE5G:
  - Universidad Carlos III de Madrid
  - Universidad del País Vasco
- Use the digital twin to emulate the automated deployment of a QKD network in which the nodes involved may span across multiple locations
- Dedicated layer-2 link: VLAN provided by RedIRIS at national scale, with a transmission rate of 10 Gbps

uc3m Universidad Carlos III de Madrid

eman ta zabal zazu Universidad del País Vasco Euskal Herriko Unibertsitatea

TRUE5G

Open Source MANO by ETSI

Thank You!

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