Quantum-based Product Development at Battelle

"Or - good things can happen when your boss doesn't really understand what you're doing…"

Don Hayford
Battelle

Discussion

- Battelle
- QKD
- Quantum Networks
- $LiNbO_3$ nonlinear optical devices

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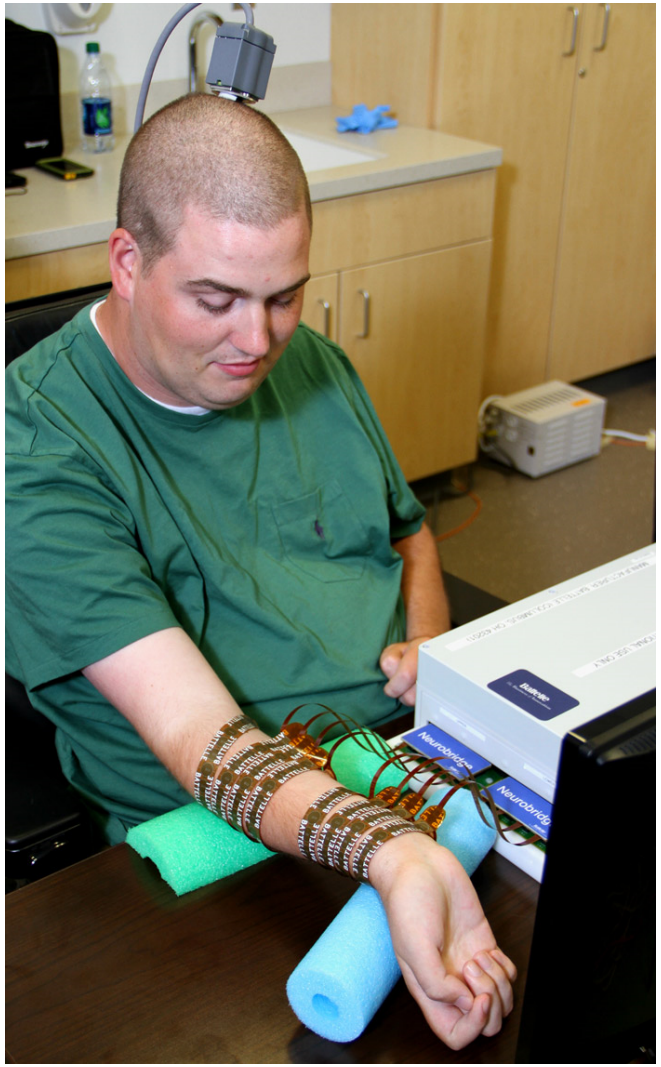
- Private contract R&D organization, headquartered in Columbus, Ohio (USA)
- Manage eight national labs (seven in US, one in the UK)
- Technical advances
  - Xerox
  - Desert bar (chocolate with a high-melting point)
  - Air-powered grappling hook gun
  - Neurobridge (with The Ohio State University Wexner Medical Center)



(courtesy of The Ohio State University Wexner Medical Center)

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ID Quantique SA

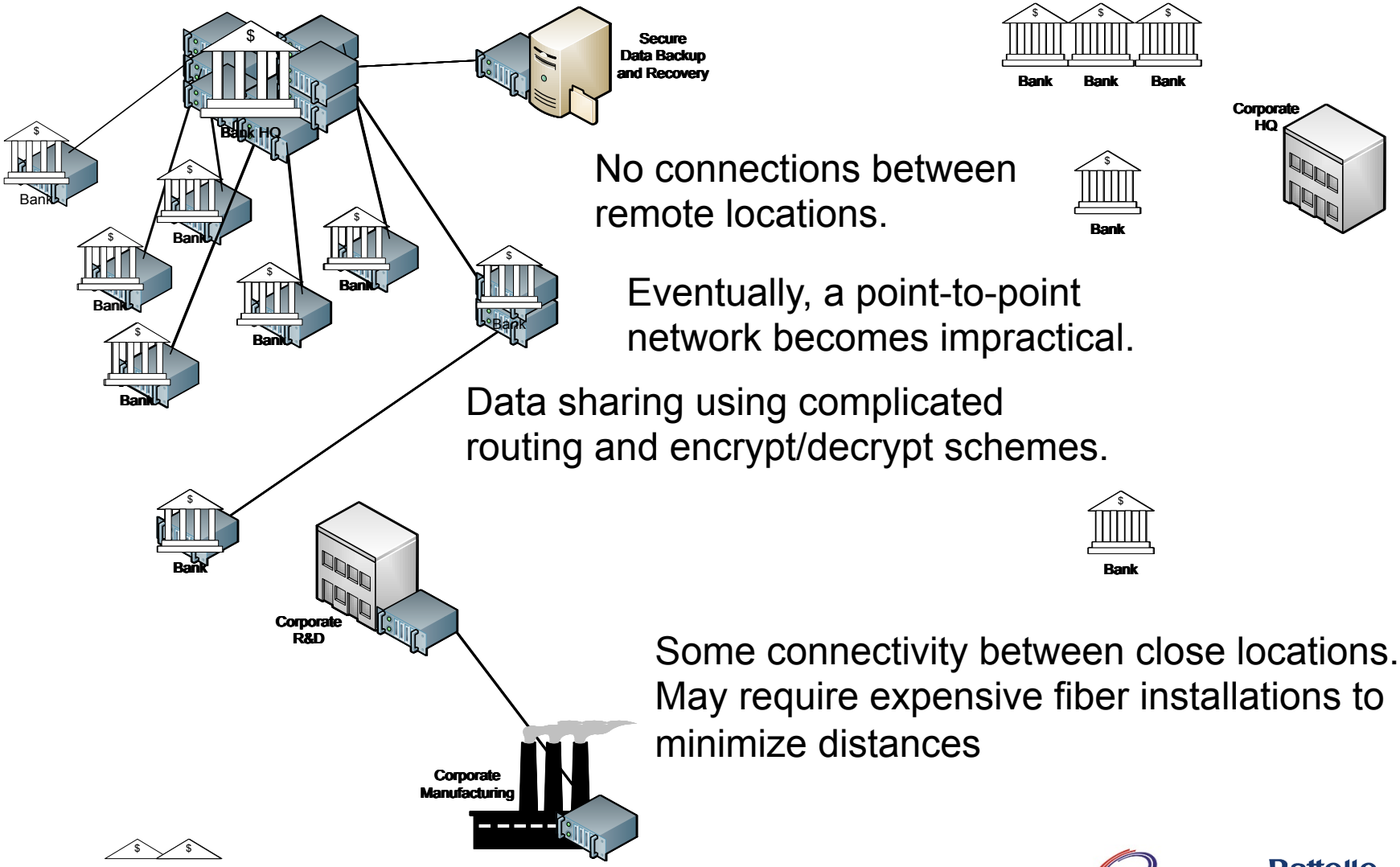
REDEFINING RANDOMNESS
RANDOM NUMBER GENERATORS (RNG)

REDEFINING SECURITY
NETWORK ENCRYPTION

REDEFINING PRECISION
SCIENTIFIC INSTRUMENTATION

Quantis-PCIe-4M (4Mbits/s)

Quantum Network Using Existing Solutions



No connections between remote locations.

Eventually, a point-to-point network becomes impractical.

Data sharing using complicated routing and encrypt/decrypt schemes.

Some connectivity between close locations. May require expensive fiber installations to minimize distances

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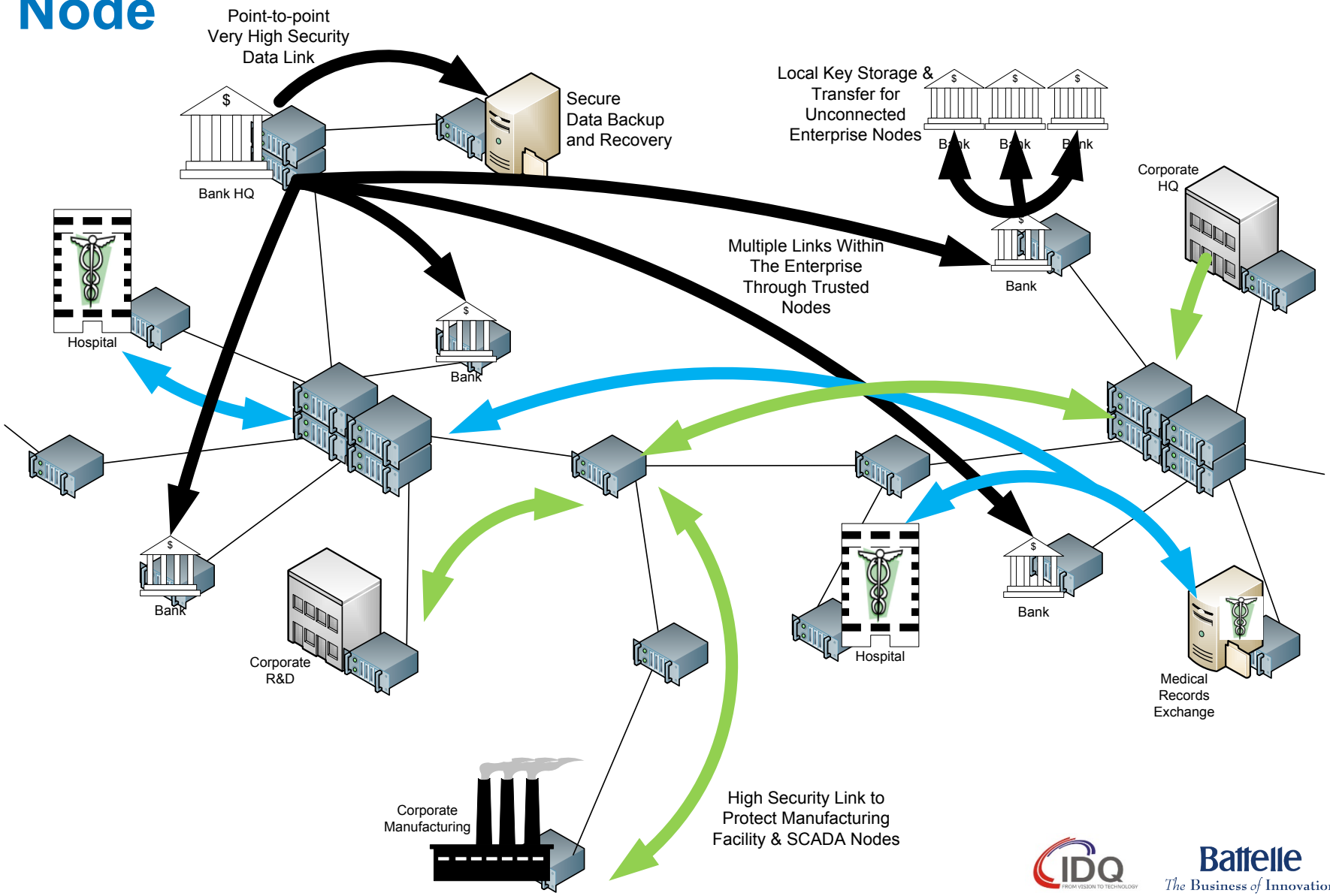
Quantum Network Architecture With Trusted Node



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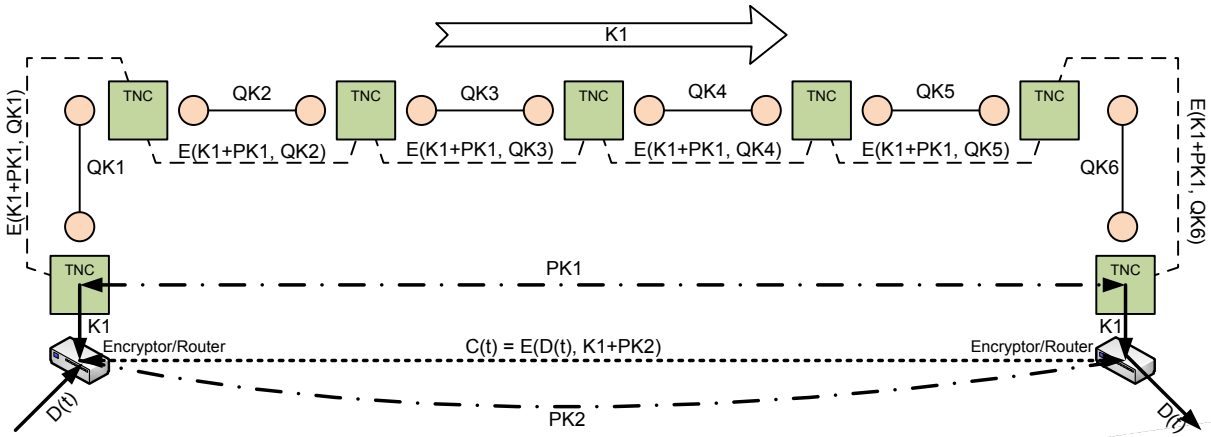
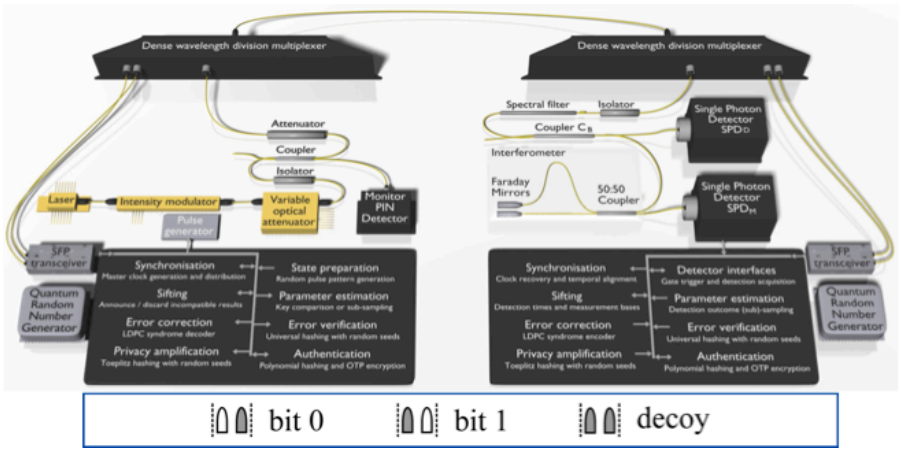
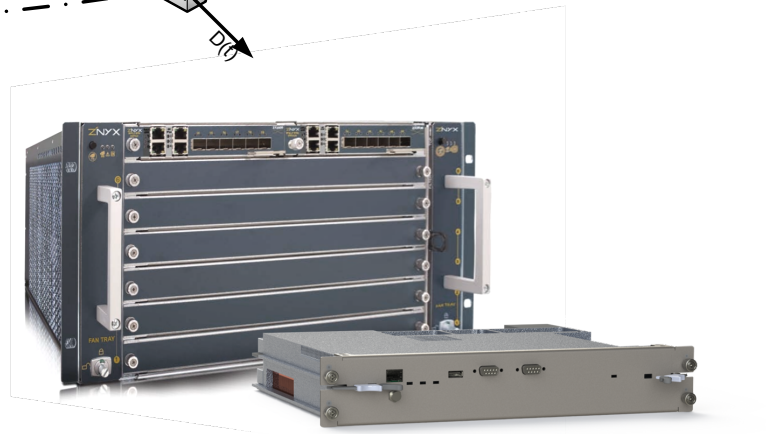
QKD Trusted Node



Keys move securely across the network in a piece-wise fashion

Coherent One-Way (COW) Protocol





Telecom-compatible architecture (ATCA)
Up to 8 quantum blades per chassis

FIPS 140-2 Certification (Planned)
CC Evaluation (Planned)

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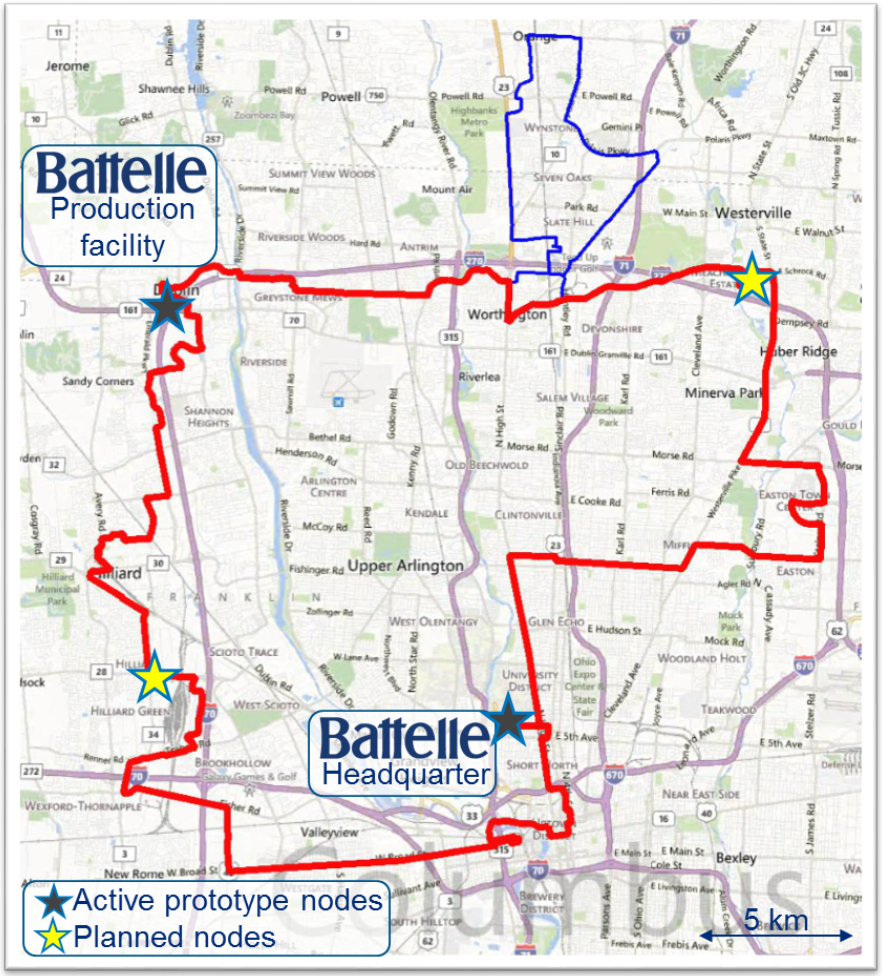
Battelle Quantum Network



- First commercial QKD system in the US, in operation since September, 2013
  - IDQ Cerberis with 1 Gbps layer-2 encryptors to secure traffic between Battelle's headquarter and production facility
- Trusted Nodes will be installed to protect all Battelle facilities in Central Ohio (planned 2015)
- Plans to connect Ohio locations to offices in the Washington, DC area (650 km – planned 2016)

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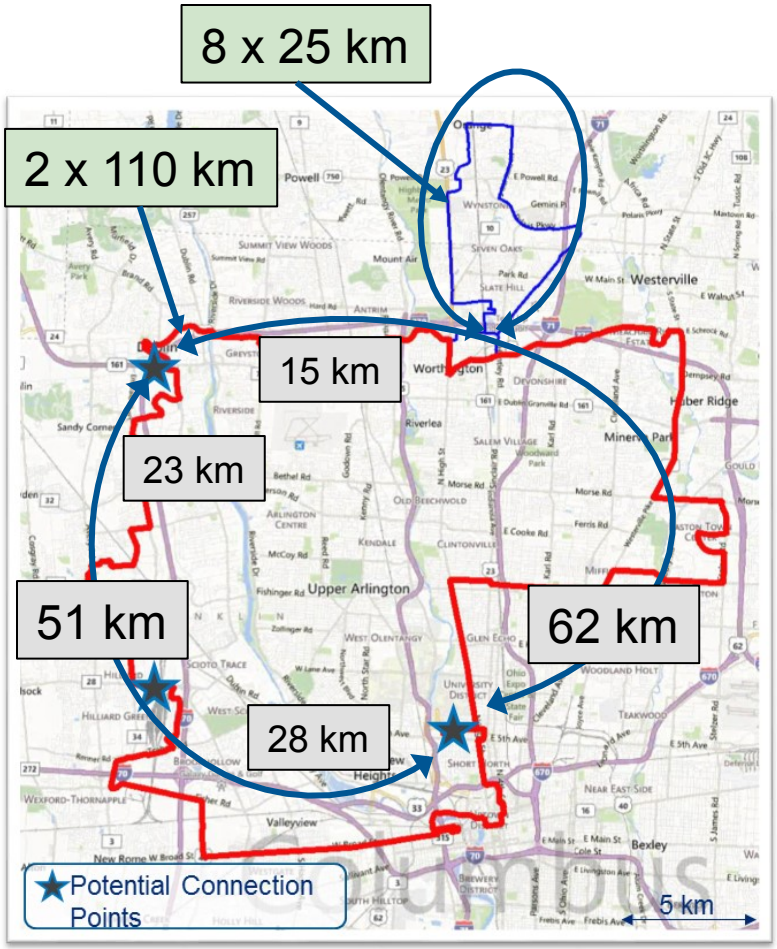
Central Ohio Quantum Test Network



- Approximately 400 km of dark fiber, provided by dubLINK (City of Dublin)
- Three potential connection points located at Battelle facilities in Central Ohio
- Access to fiber for testing purposes can be provided for researchers engaged in the development of quantum communications systems
- Will be operated on a “non-profit” basis, but there will be some cost associated with using the facility
- More details to come

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North American Quantum Network

Our goal – a network of nodes that can be used as the basis for secure network across North America

(and the rest of the world!)

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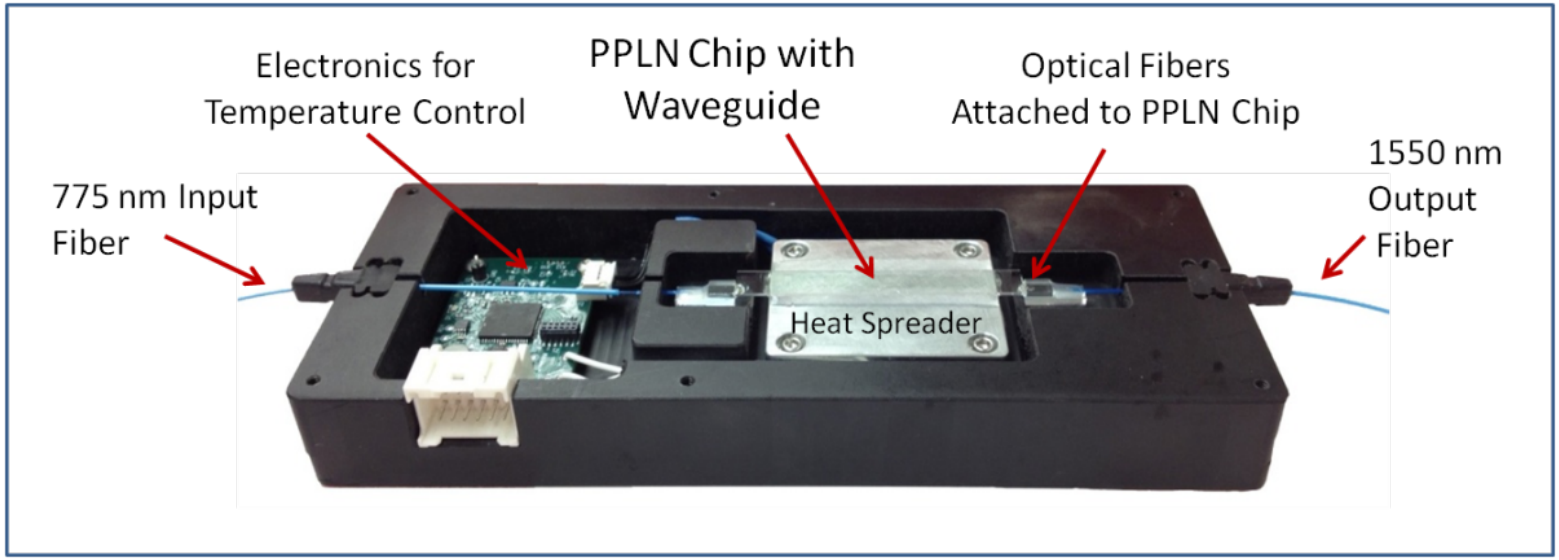
Periodically Poled Lithium Niobate



- Designed for a specific range of input and output wavelengths
- Advantages
  - High quality poling -> narrow spectral widths
  - Bonded fiber connections -> repeatable, consistent results (but slightly higher losses)
  - Integral temperature control with GUI and vi -> simple to use
- Available from ID Quantique