Quantum threat...and quantum solutions

How can quantum key distribution be integrated into a quantum-safe security infrastructure

Bruno Huttner
ID Quantique

ICMC 2017

Outline

- Presentation of ID Quantique
- The Quantum Threat
- Quantum Solutions (1): QRNGs
- Quantum Solutions (2): QKD
- Integration of QKD in optical networks today
- Towards a world-wide QKD network
- Conclusion

ID Quantique – Company Profile

Founded in 2001

Geneva, Switzerland

Key technology: photon counting

Three business units:

- Photon counting & Instrumentation
- Quantis: Quantum Random Number for Key Generation
- Quantum-Safe Security

Performs R&D, production, professional services, integration, support

Clients : Governments / Banks / Gaming Industry / Universities / IT Security

The Quantum Threat

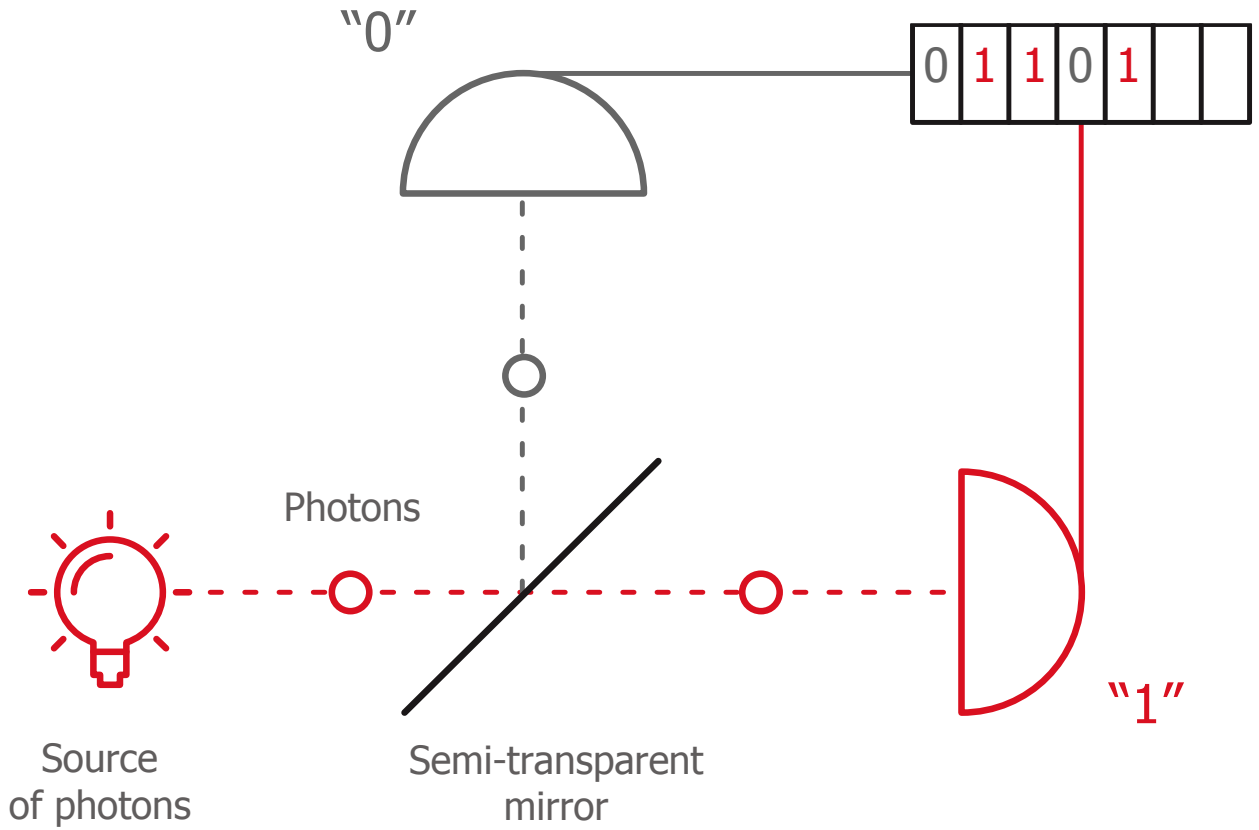
The hacker's point of view today…

… and after the Quantum Computer

QUANTUM SOLUTION (1):

QUANTUM KEY GENERATION

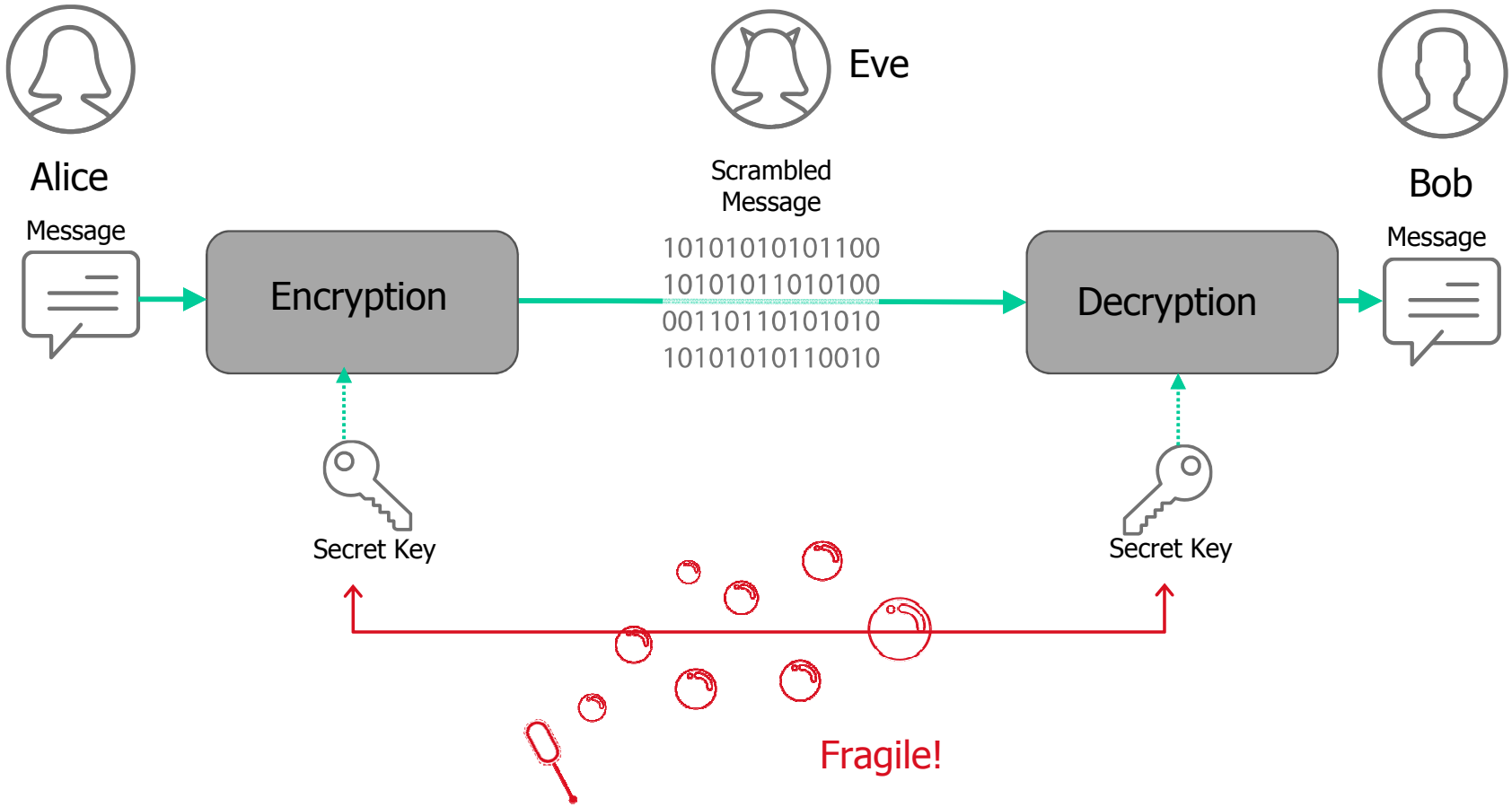
True Random Number Generator based on Quantum Physics



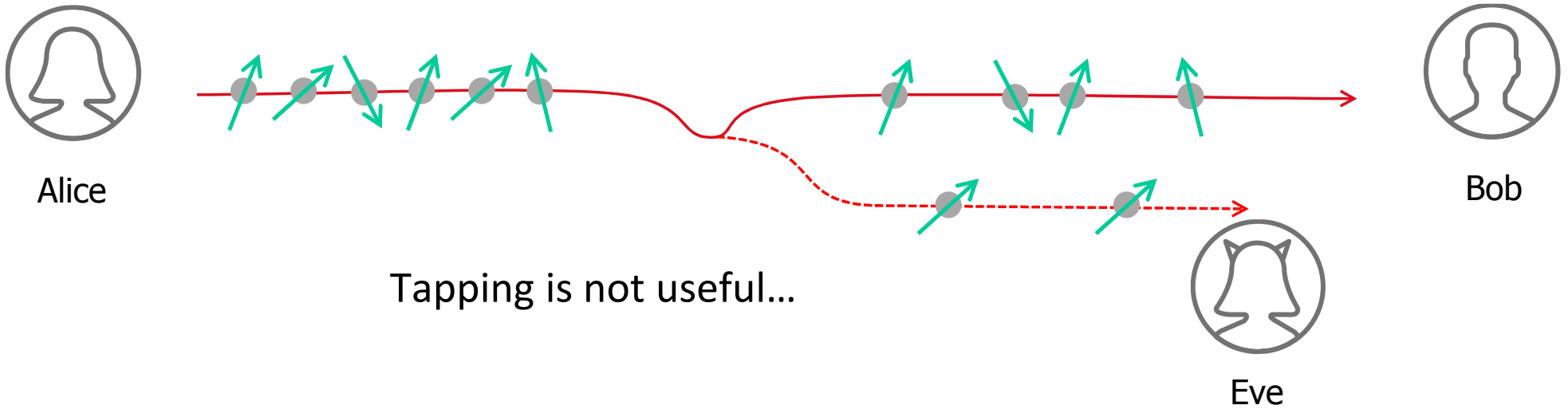
QUANTUM SOLUTION (2):

QUANTUM KEY DISTRIBUTION

Quantum Key Distribution (QKD): Basic idea

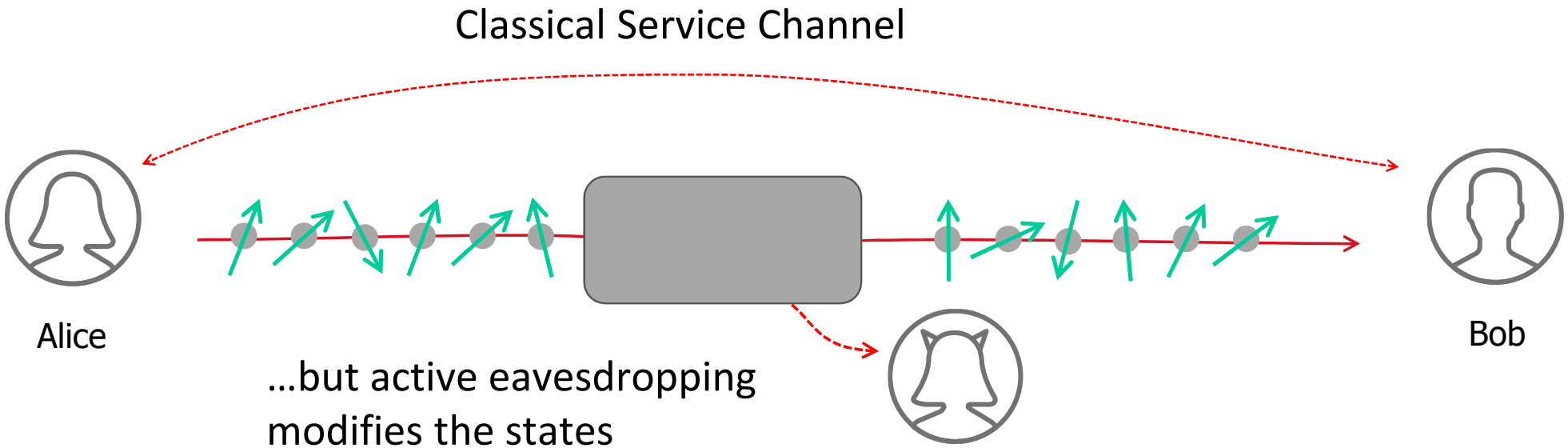


QKD: The quantum Channel



Tapping is not useful…

QKD: The quantum Channel



…but active eavesdropping modifies the states

…and generate errors, which will be detected through discussions over the Service Channel

QKD: Pros & Cons

Pros	Cons
Based on different principle (physics)	Need physical infrastructure
Not impacted by QC	Limited distance between nodes (to date)
Provable security of transmission	Only part of the solution: Needs conventional crypto to use the key (e.g. symmetric key encryption); And post-quantum Authentication
Real-time eavesdropping possible only	
Adds one layer of security	

➔ More complicated and costly to implement

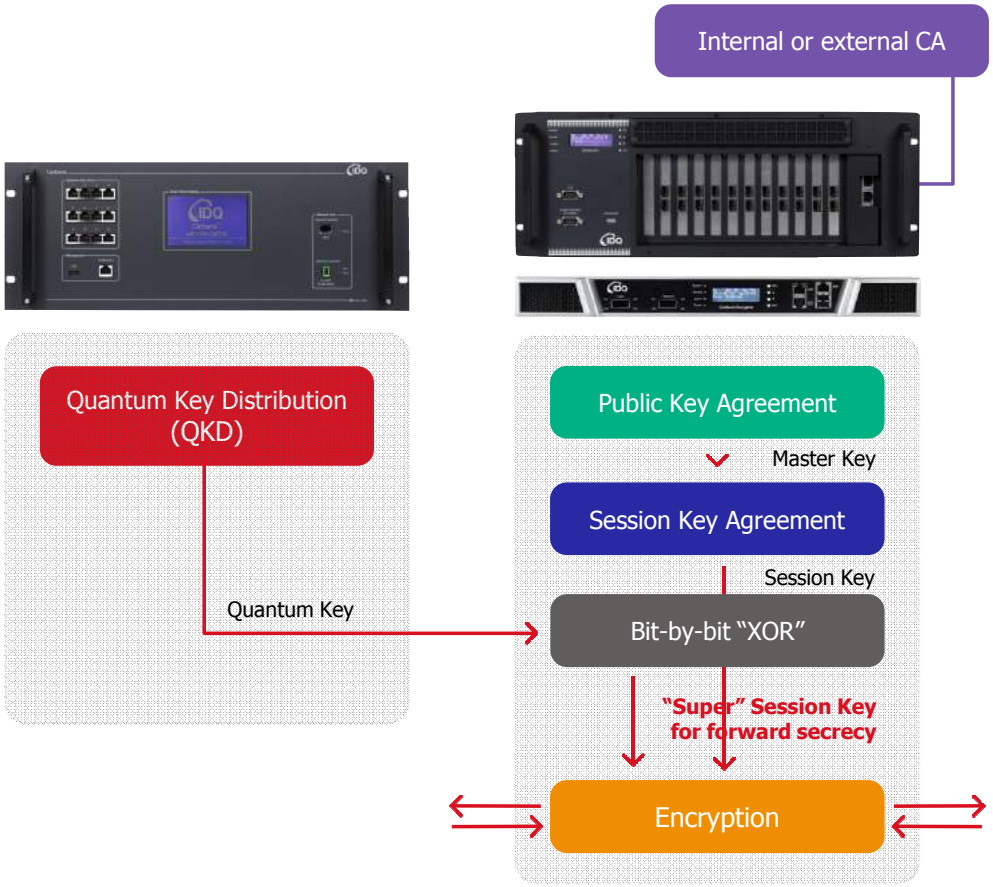
➔ Useful for high-level and long-term security

INTEGRATING QKD IN QUANTUM-SAFE SECURITY INFRASTRUCTURE

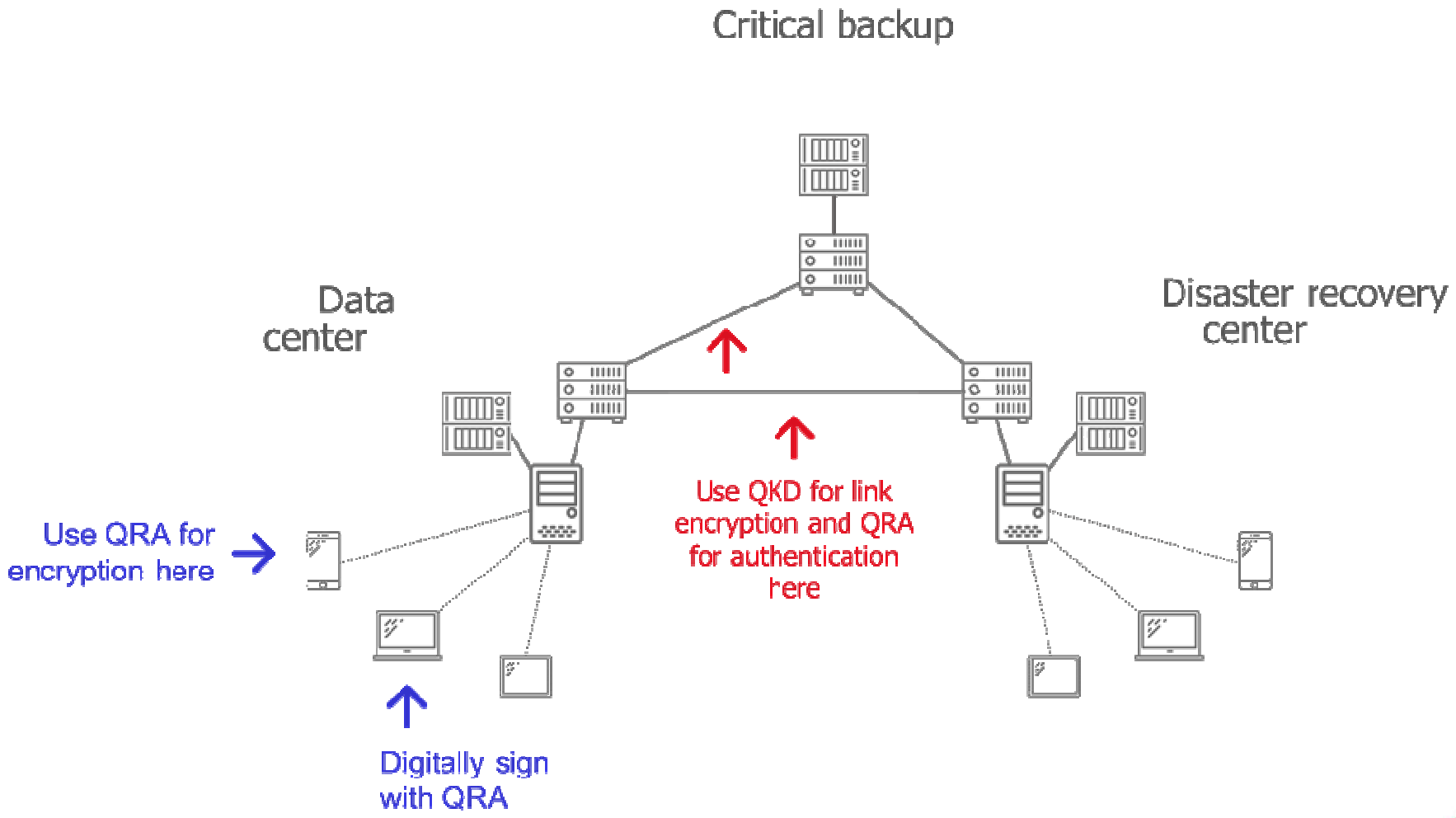
All links are NOT born equal!

Safety has to be adapted to the communication links.

Use QKD today as an add-on to current encryption systems



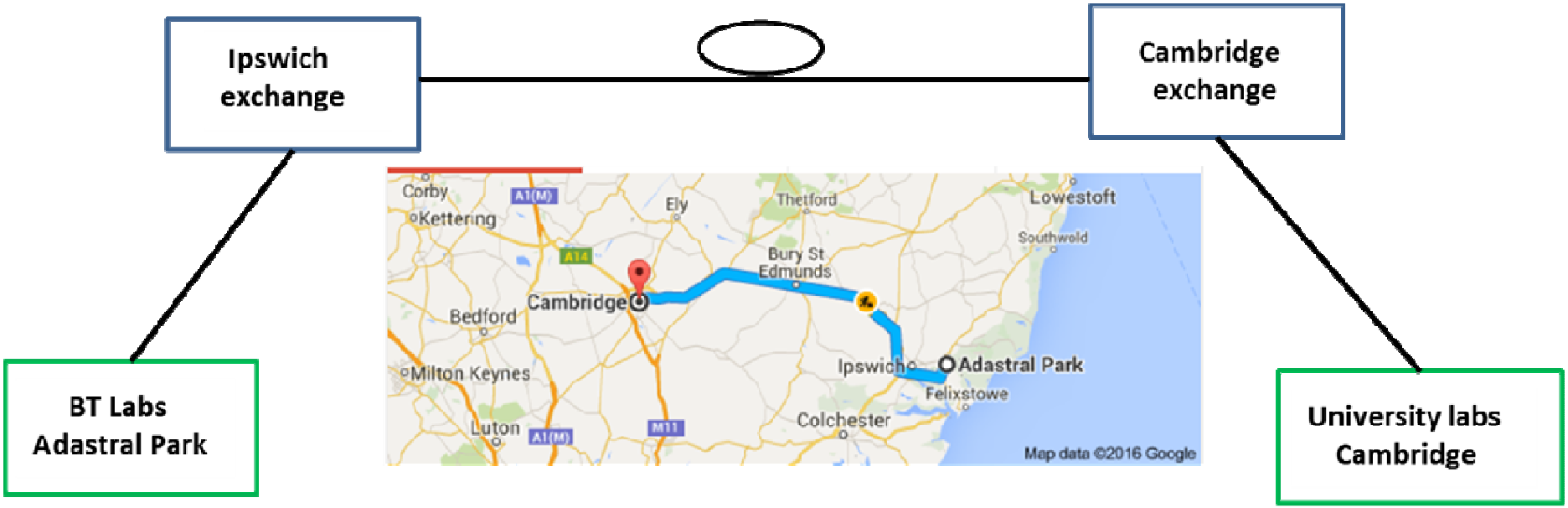
Use QKD today for Critical Links



ROADMAP FOR QKD

- Trusted Nodes for long-distance QKD
- Free Space QKD with satellites
- Global QKD Network based on Quantum Memories

Step 1: Long distance QKD with Trusted Nodes



What about longer links: The Chinese Quantum Backbone

- Total Length 2000 km
- 2013.6-2016.12
- 32 trustable relay nodes
  31 fiber links
- Metropolitan networks
  Existing: Hefei, Jinan
  New: Beijing, Shanghai
- Customer: China Industrial & Commercial Bank; Xinhua News Agency; CBRC

Step 2: A Global Network Based on Free Space QKD

- Free Space QKD
  - QKD links with LEO satellites
  - LEO acts as a **trusted node** to transport the key to the necessary location.
- Free space QKD is moving out of the lab & into industry
  - Chinese have launched a QKD satellite in August 2016 and QKD system in space station in September.
  - Worldwide interest at the academic/government level
  - IDQ has started feasibility studies for practical systems (Eurostars and Swiss Space Office)

Step 3 : A world-wide QKD infrastructure

- Build a QKD infrastructure based on Quantum Memories (QM)
- Each node exchanges QMs with the others
- Customers come to any node to recharge their QMs (similar to bank notes and ATM infrastructure)
- Nodes need not be trusted anymore

In Conclusion…

What the Quantum has taken away…

…the Quantum can give back!

For more information
http://www.idquantique.com