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QKD linie Monitoring and Performance

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NLPQT PROJECT

• **Metro QKD** research and operational infrastructure, integration of QKD solutions
  – QKD infrastructure (operational and R&D QKD devices, encryptors and quantum random number generators)

• **Construction of the long-distance QKD Poznań - Warsaw link** – June 2022
  – 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 entanglement)
The demanding links from the distance point of view were tested first using existing metro QKD equipment. Procured IDQ Cerberis XG system tested and configured in the lab. Deployed on sites over 3 days. ISK (Initial Shared Key) required to start QKD exchange needs to be set manually and physically over each node. Network addressing scheme to integrate Key, KMS and MGMT services. At the first stage only point to point links were deployed. At the second stage trusted node approach and key relay mechanism was implemented. Monitoring services implementation with NOC. System under constant adjustment and modification (new software, new consumers). Measures to improve budget margin on two longest, critical links. System uses COW 4 states protocol. System uses four different channels – quantum, service, KMS, managements. Apart from that we have key and encrypted traffic services. All these elements can be potentially multiplexed and with different combinations.
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Keys ETSI

Quantum Channel (multiplexed or dark fiber)

KMS Channel (multiplexed or dedicated data channel)

Service Channel (multiplexed or dedicated spectrum)

Management Channel (multiplexed or dedicated data channel)

QMS
Keys, KMS, MGT services can be implemented on different physical interfaces.

System uses three dedicated fibers – one fiber for quantum channel and one pair for service and sync channel (can be multiplexed with existing traffic and systems).
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**Point-to-point (with relay for long distance)**

- End node
- Trusted node
- Trusted node
- End node

**Ring network**

- Trusted nodes

**Star**

- Optical unit Alice - 1U
- Optical unit Bob - 1U

Quantum channel (dark fiber or wavelength in O-band)
KMS channel (logical mux possible) / ETH
Service channel (C-band)
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• QKD line Poznań – Warsaw is monitored using two systems: NOC infrastructure and built-in KMS services

• NOC monitors the current QKD line performance using SNMP mechanisms and thresholds set for key parameters such as keyrate, QBER, visibility and temperatures

• QKD infrastructure constantly adjusts Quantum channel characteristics to achieve best possible performance.

• Three key parameters to monitor – secret keyrate, Quantum Bit Error Rate (QBER) and visibility – closely related to COW protocol characteristics.

• Leakage (noise) from outside to patchcords can be observed in specific situation.
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• System monitors the status of all links in the system – QKD links, QNC links between the KMS nodes and consumer links between the interfaces where keys are provided through the ETSI 014 or 020 API

• Each link has own parameters and topology
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SUMMARY

• Implementation of Metro and long distance QKD links

• Infrastructure supports research activities in the area of monitoring and performance analysis

• QKD links parameters constantly adjusted

• Offers interesting insight into single photon devices operation in real world environment

• Monitored data collected and analysed
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