DemoQuanDT: Controlling Quantum Key Distribution Networks

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Outline

DemoQuanDT Overview

DemoQuanDT Project Overview

- Goal: setup a Quantum Key Distribution Network across Germany
  - from Bonn to Berlin (approx. 600 km)
  - multi-hop QKDN
  - multi-vendor
- Partners: Adva, Deutsche Telekom, Hochschule Darmstadt, KeeQuant, Rhode & Schwarz, Technical University Darmstadt
- Funded by Germany's Federal Ministry of Education & Research (2022 to 2024)
- QKDNs probably a first step towards Quantum Internet

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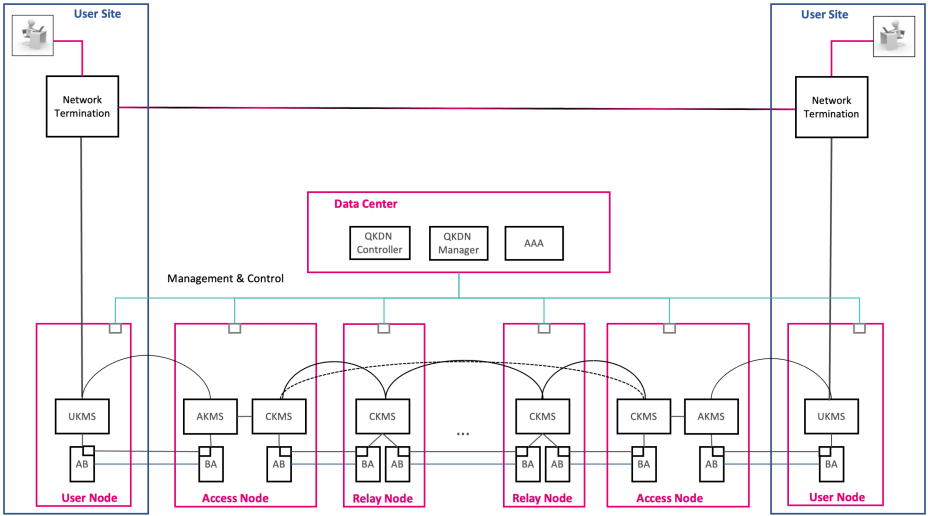
Controlling QKDNs

Controlling QKDNs

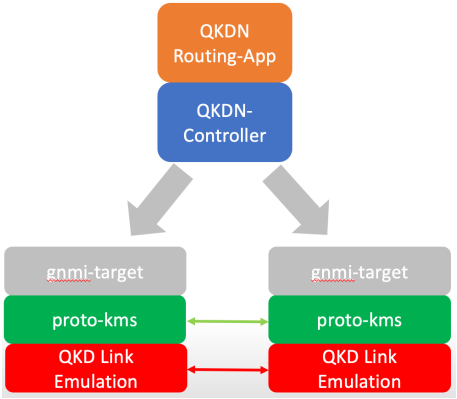
- In an nutshell: end-to-end user-key forwarding
  - encryption keys to transport user-key out of quantum layer (QL)
  - encryption of user keys between two adjacent peer Key Management Systems (KMS)
  - KMS: key retrieval from QL, key management, and forwarding
- centralized control of network
  - multiple quantum links: mainly network management
  - key management systems for key routing and forwarding
  - routing decisions done in QKDN Controller
  - forwarding path is a "switched-circuit"
- placement in DT's carrier network
  - actual behavior of a real "complete" QKDN deployment with all pros and cons
  - study country-wide behavior of QKDN with all "bells and whistles".
  - separation of user, access & carrier network parts

DemoQuanDT System Architecture (simplified)



Current Implementation (h_da)

- Routing-App: simple, static routing
- QKDN-Controller basis: *goSDN* [4]
  - model-driven SDN controller
- Interface Controller & proto-kms: *gnmi-target* [3]
  - gnmi-based agent for controlling network elements
  - self-developed Yang-Model (not *ETSI GS QKD 015*)
- KME/KMS basis: *proto-kms* [2]
  - a yet very naive implementation of a KMS
- QKD link emulation part of proto-kms [2]
  - using plain random numbers
- Using a system emulator (runs in containerlab [1])
- source code is all BSD3 open-source
  - constantly moving forward, feel free to ask



Summary & Outlook

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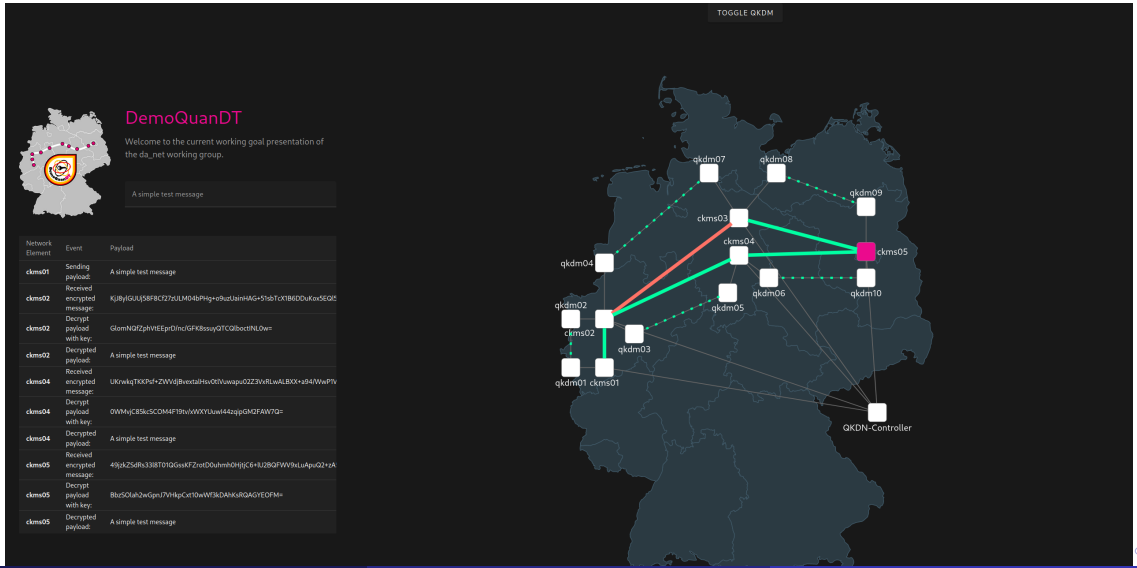
- A naive implementation of (parts) QKDN network
  - taking the quantum layer as just given
  - tons of open questions
- Research questions (some of them ;-)
  - actual behavior of a real "complete" QKDN deployment
  - how secure are quantum links in real networks?
  - the need and the implementation of key hybridization
    - combined quantum derived keys with post quantum cryptography (PQC)
  - centralized vs decentralized control/routing (classical question, isn't)
- Outlook
  - deployment in 2024 Bonn to Berlin
  - authentication of quantum modules and KMS peers with Wegman-Carter hashes
  - system emulator, including coupling with live QKDN

Demo

Demonstration



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