NuCypher KMS: Decentralized Key-Management System

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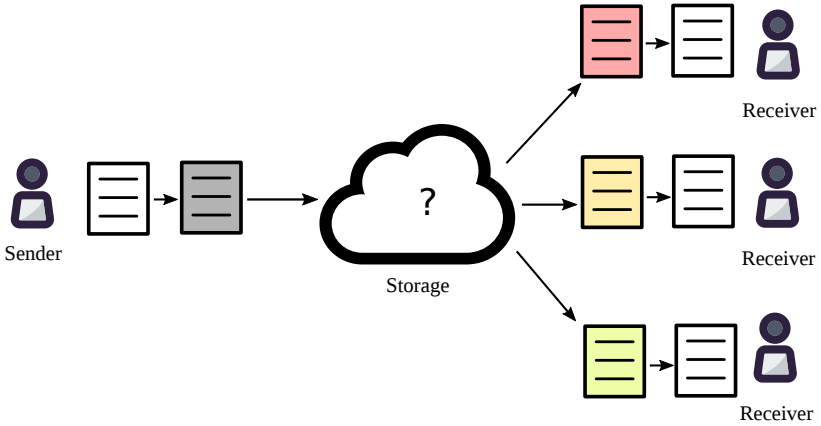
Silicon Valley Ethereum, 25 Feb 2018

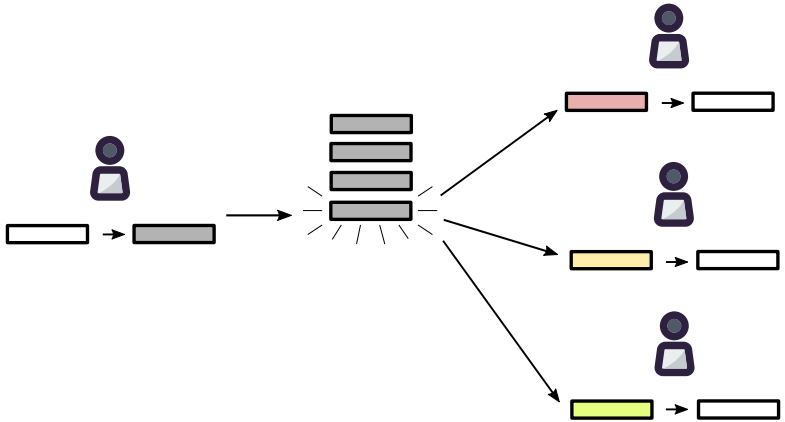
Why

Encrypted file sharing



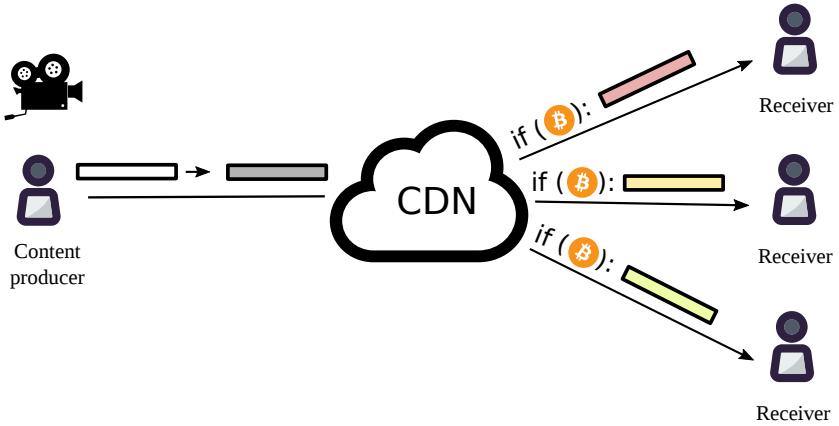
Why

Encrypted multi-user chats



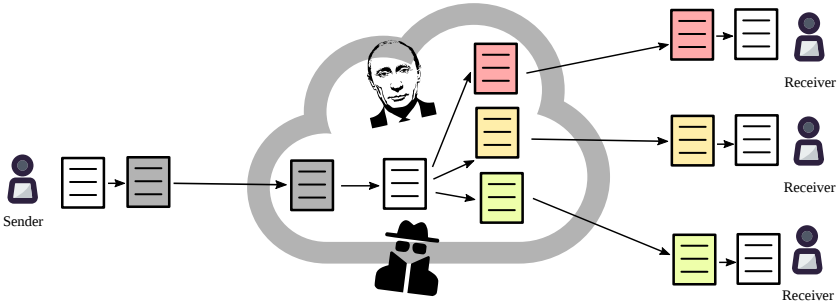
Why

Decentralized Netflix



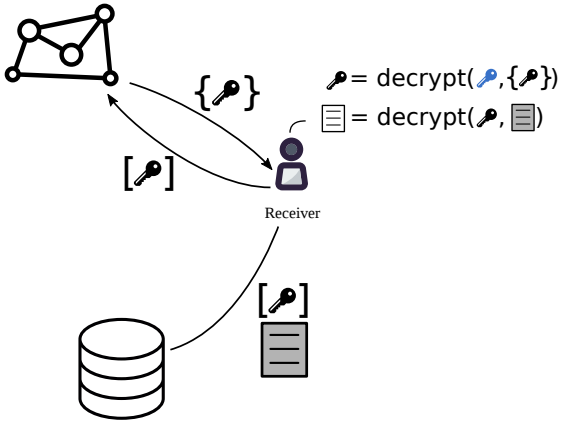
Central server + TLS

Data vulnerable to hackers, state actors etc

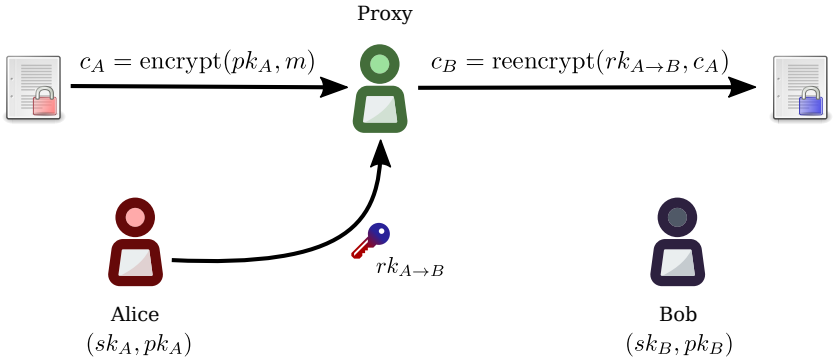


Solution

Proxy re-encryption + decentralization

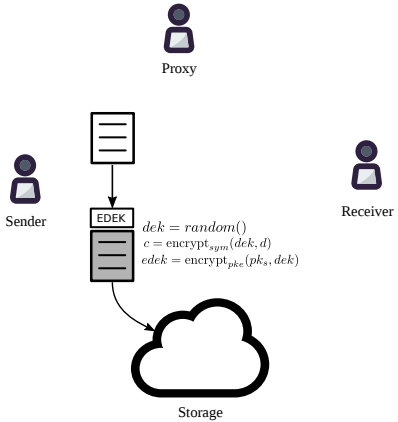


What is proxy re-encryption (PRE)



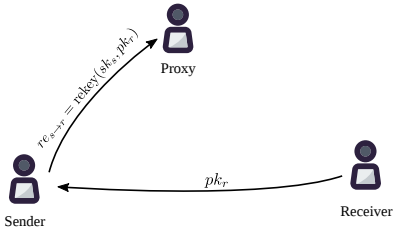
Centralized KMS using PRE

Encryption



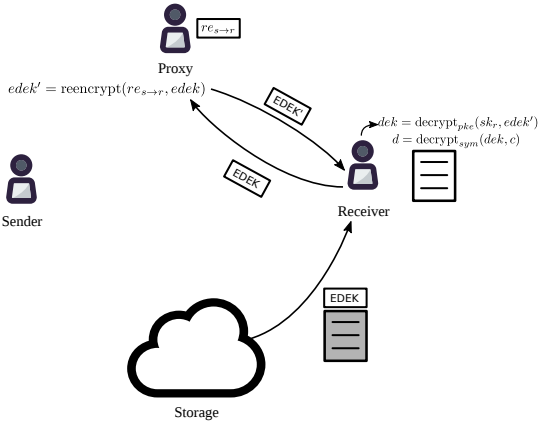
Centralized KMS using PRE

Access delegation



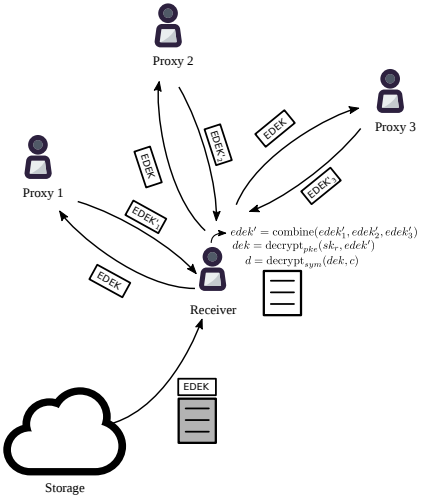
Centralized KMS using PRE

Decryption



Decentralized key management

Using threshold split-key re-encryption (Umbral)



https://github.com/nucypher/nucypher-kms/

KMS token

Purpose

- Splitting trust between re-encryption nodes (more tokens = more trust and more work);
- Proof of Stake for minting new coins according to the mining schedule;
- Security deposit to be at stake against malicious behavior of nodes

KMS token

Mining

Mining reward:

$$\text{reward} = \frac{\text{locked\_tokens} \times \text{reward\_rate}}{\sum_{\text{all miners}} \text{locked\_tokens}} + \sum_{\text{this miner}} \text{miner\_fees}$$

Usage examples

Decentralized marketplaces:

- Datum.

Decentralized databases:

- Bluzelle;
- Fluence;
- Wolk.

Medical data sharing

- Medibloc;
- IRYO;
- Medixain;
- Wholesome.

IoT

- Spherity (together with BigchainDB).

Cryptocurrency keys

- Coval Emblem Vault

Useful links

Website: `https://nucypher.com/blockchain.html`
Github: `https://github.com/nucypher/`
PyUmbral on Github: `https://github.com/nucypher/pyUmbral/`
Discord: `https://discord.gg/7rmXa3S`
Whitepaper: `https://arxiv.org/abs/1707.06140`
E-mail: `maclane@nucypher.com`
E-mail: `john@nucypher.com`

Umbral: Threshold Proxy Re-Encryption

- “Umbral” is Spanish for “threshold”
- PRE properties: Unidirectional, single-hop, non-interactive
- It follows a KEM/DEM approach:
  - UmbralKEM provides the threshold re-encryption capability
  - The DEM can be any authenticated encryption (currently ChaCha20-Poly1305)
- IND-PRE-CCA security
- Verification of re-encryption correctness through Non-Interactive ZK Proofs
- Code: `https://github.com/nucypher/pyUmbral/`
- Documentation (WIP): `https://github.com/nucypher/umbral-doc`

PRE demo