



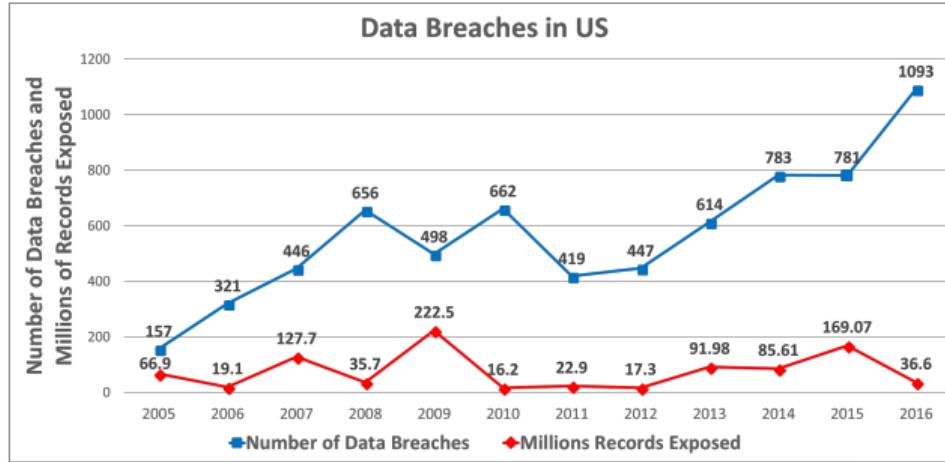
NuCypher

<fname lname>, <title>

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Problem

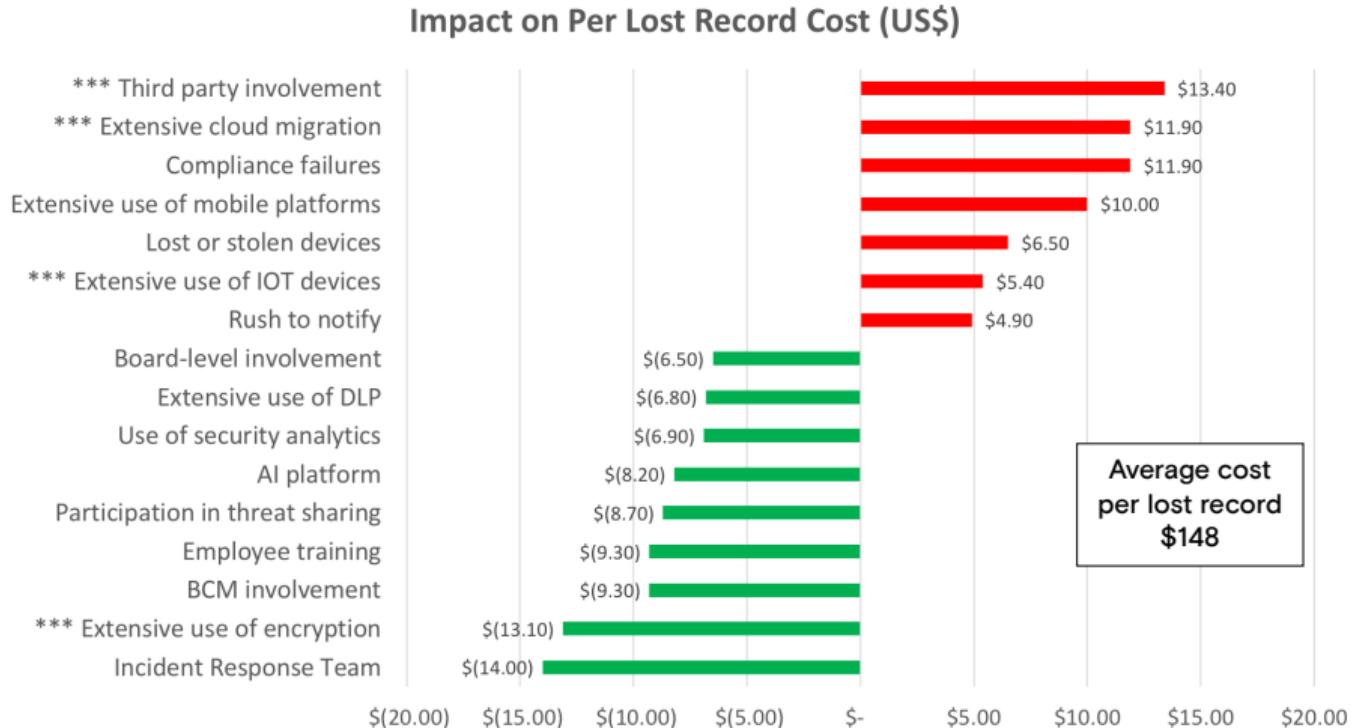
Data Breaches



Source:

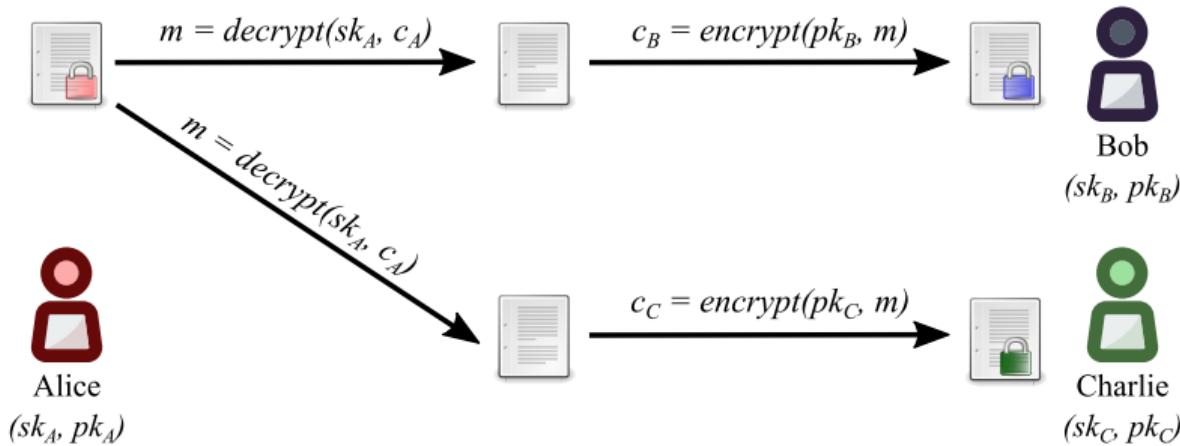
<https://www.statista.com/statistics/273550/data-breaches-recorded-in-the-united-states-by-number-of-breaches-and-records-exposed/>

Impact of Data Breaches



Source: IBM 2018 Cost of a Data Breach Study: Global Overview, <https://www.ibm.com/security/data-breach>

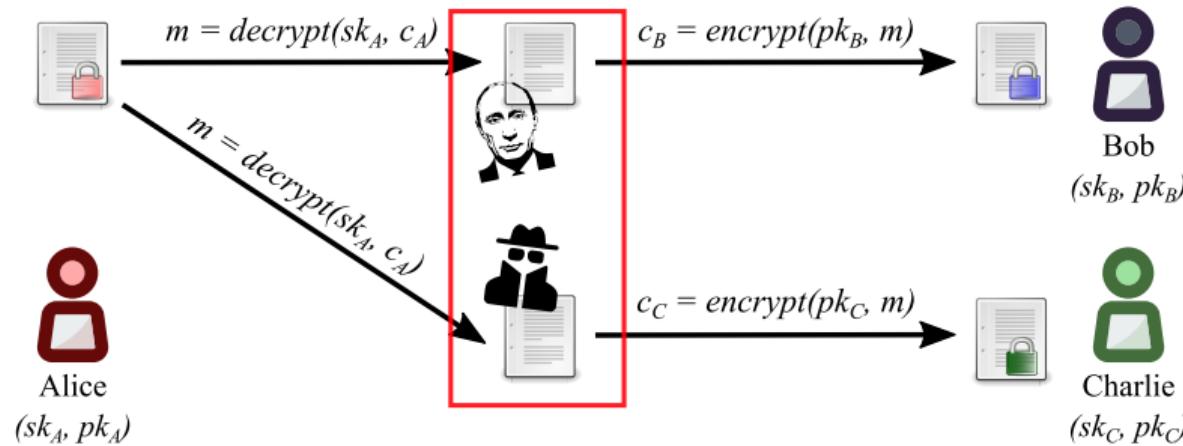
Public Key Encryption (PKE)



Limitations

- Decryption required before sharing
- Not scalable
- Complex access revocation

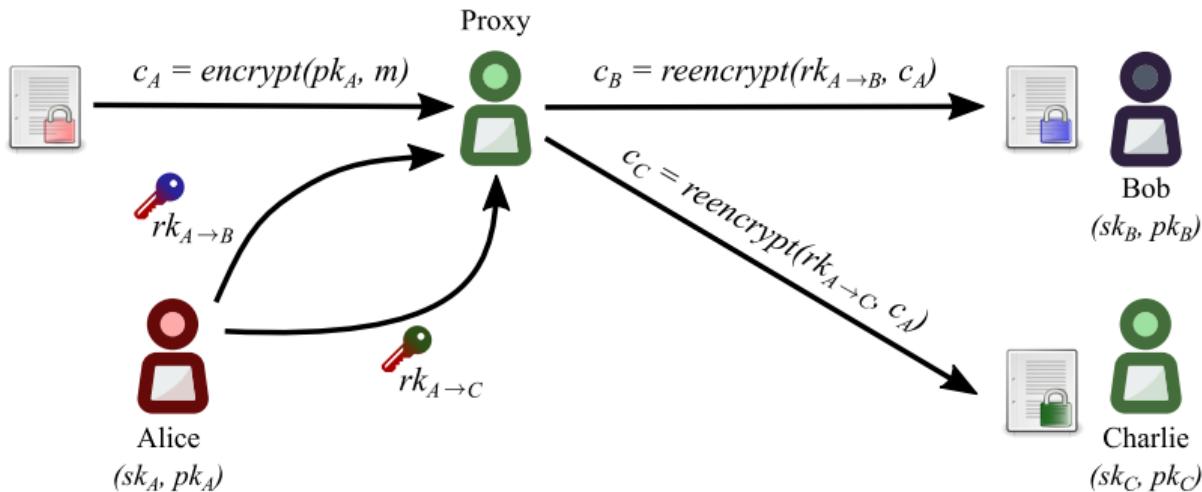
Public Key Encryption (PKE)



Limitations

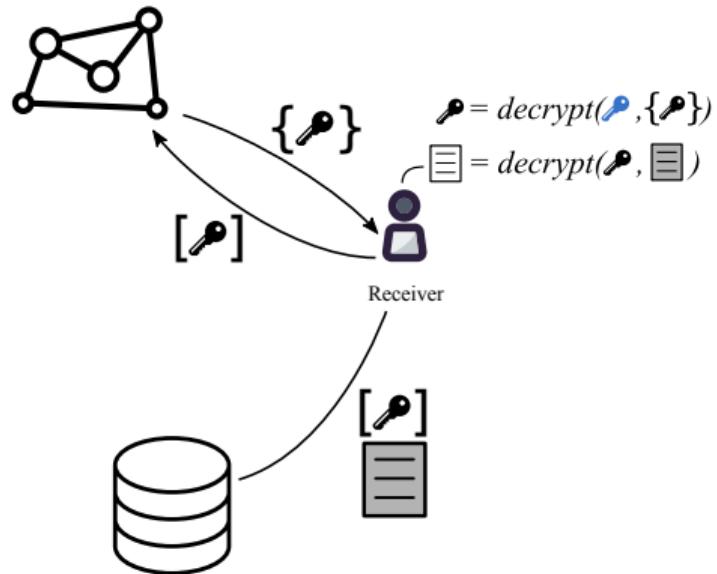
- Decryption required before sharing
- Not scalable
- Complex access revocation

What is proxy re-encryption (PRE)



Solution

Proxy Re-encryption + KMS

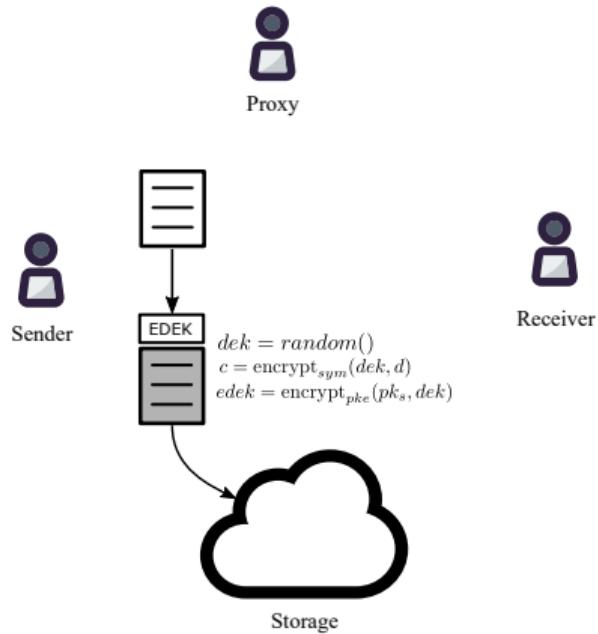


Advantages

- Data not decrypted to facilitate sharing
- Scalable and performant
- Access revocation through re-encryption key deletion

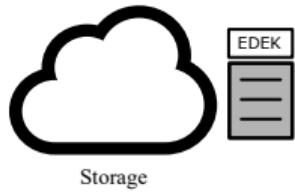
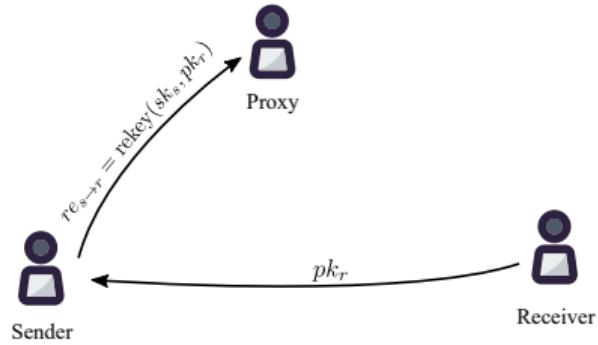
Centralized KMS using PRE

Encryption



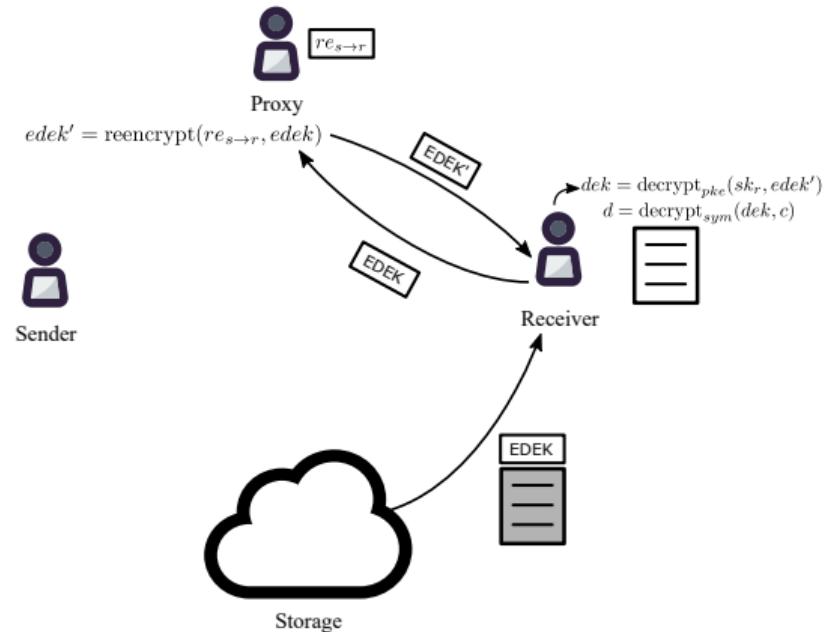
Centralized KMS using PRE

Access delegation



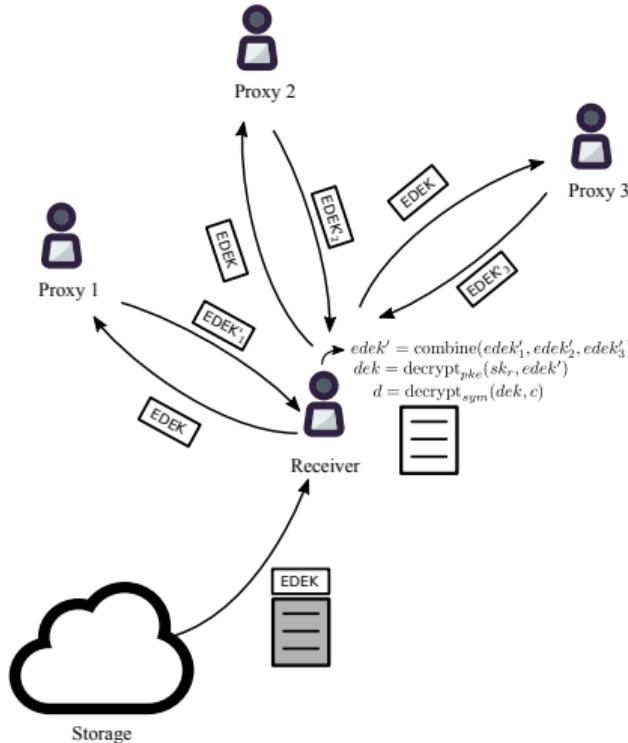
Centralized KMS using PRE

Decryption



Decentralized KMS using PRE

Using threshold split-key re-encryption (Umbral)



NuCypher PRE Properties

- Unidirectional
- Single hop
- Non-interactive

KEM/DEM Approach

- Umbral KEM for threshold re-encryption
- ECIES for key encapsulation
- DEM can be any AE (ChaCha20-Poly1305)

Verification of Correctness

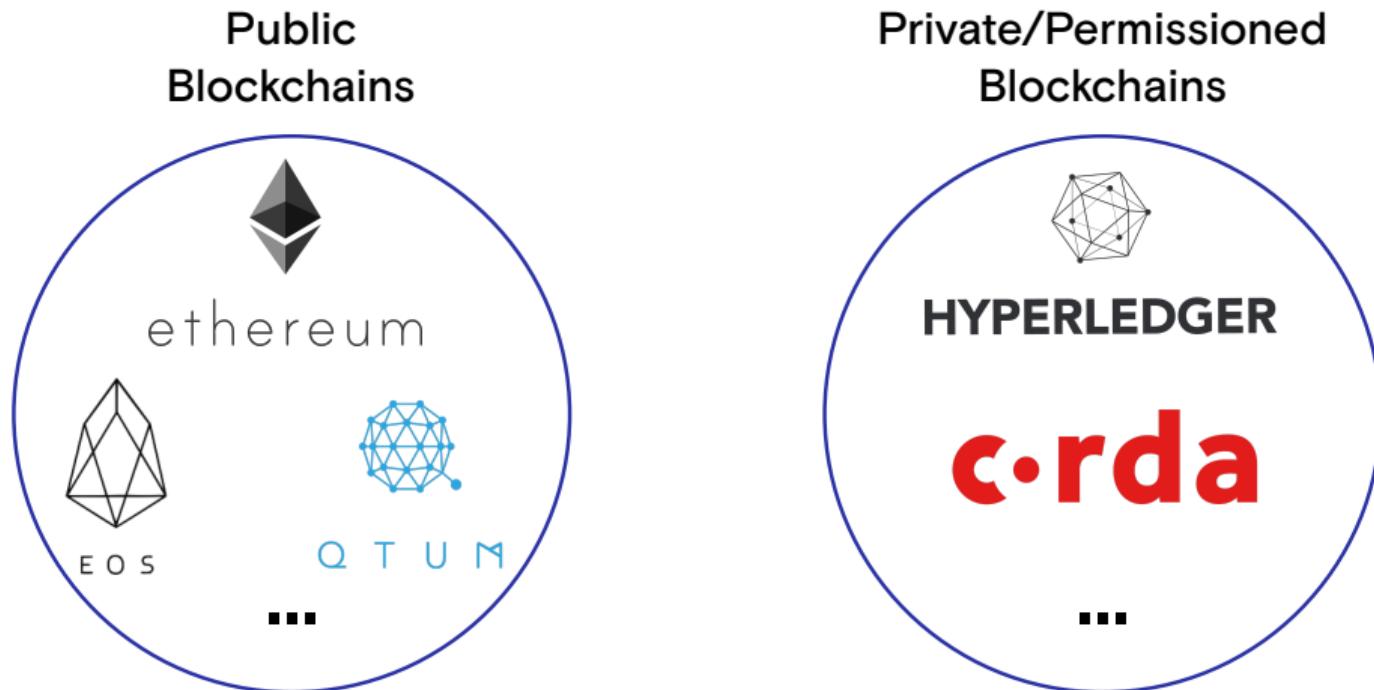
- Verification through non-interactive ZK-proof
- Incentive layer via NU staking token
- Re-encryption validated by challenge protocol

Decentralized KMS: Token

Purpose

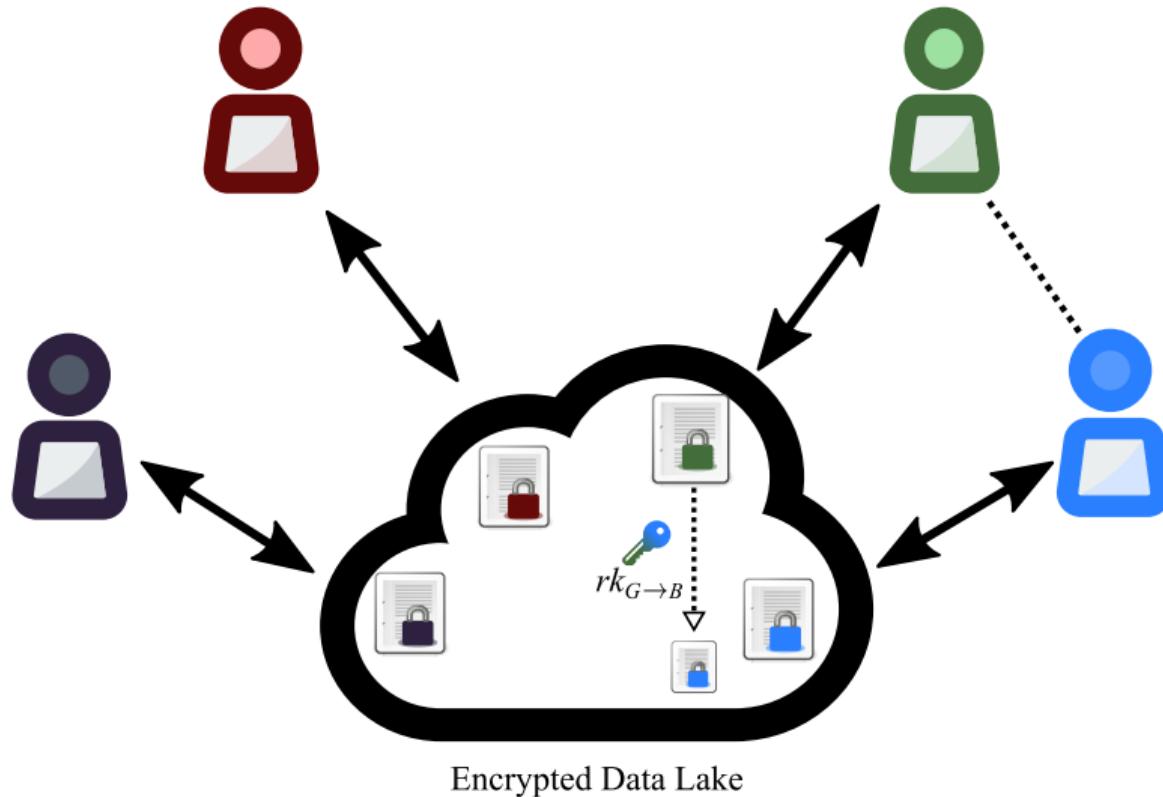
- Splitting trust between re-encryption nodes (more tokens = more trust and more work)
- Proof of Stake for minting new coins according to the mining schedule
- Security deposit to be at stake against malicious behavior of nodes

Blockchain & Smart Contract Agnostic



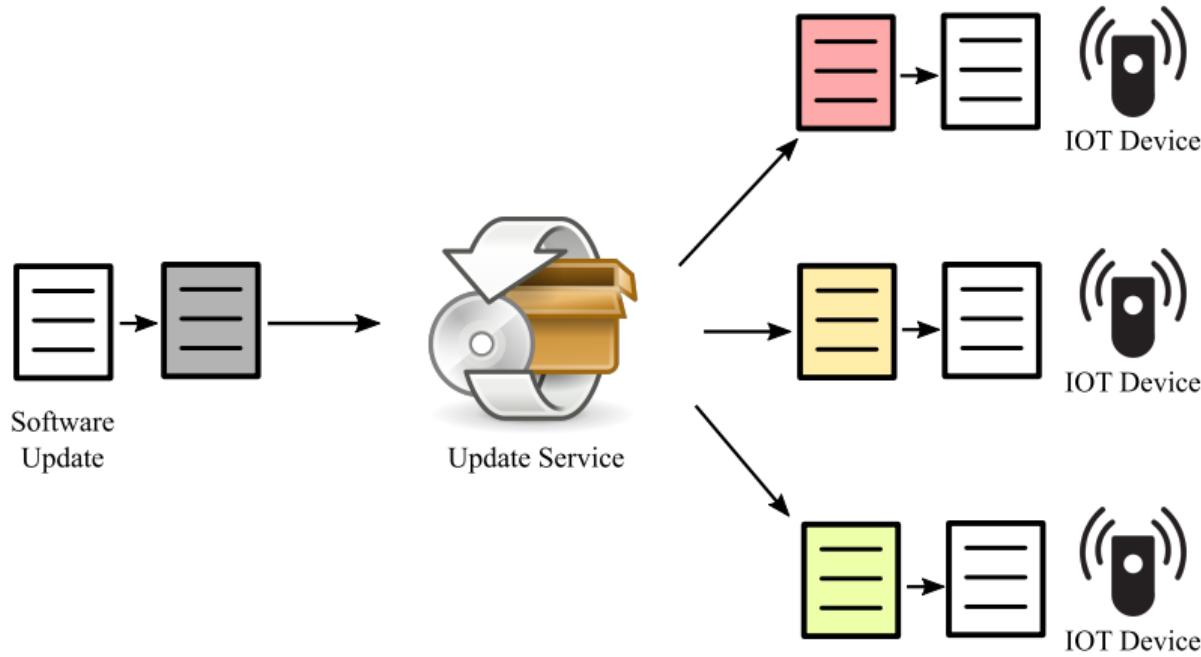
Use Cases

Multi-tenant, Multi-source Encrypted Data Lake



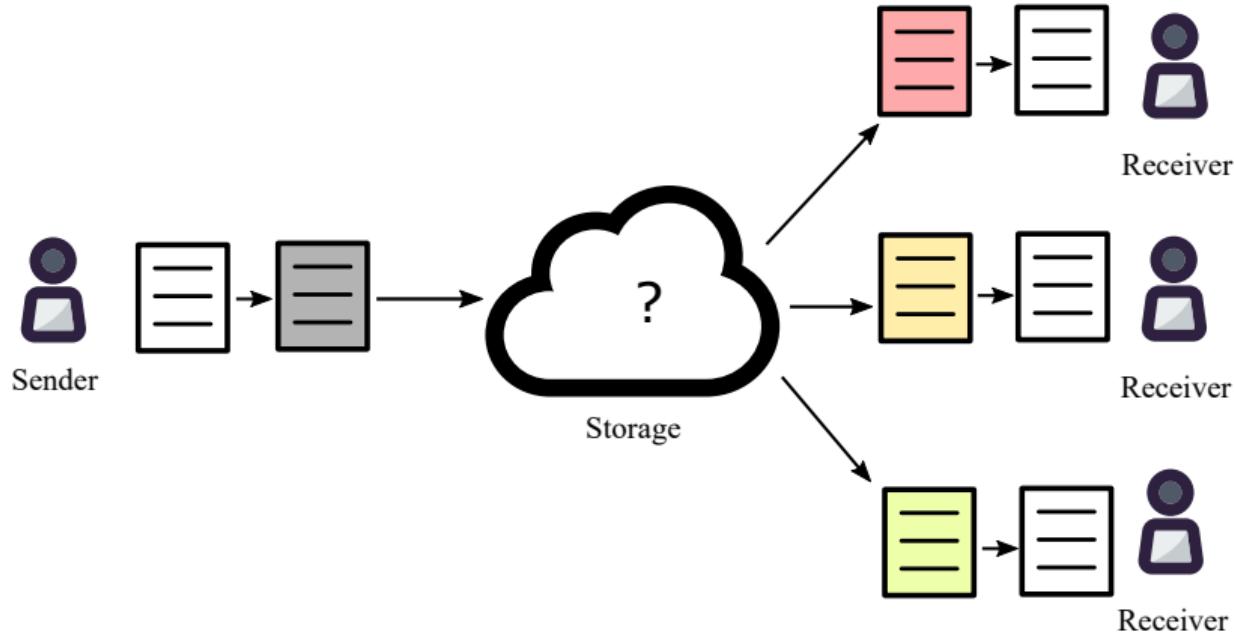
Use Cases

Scalable, Secure IOT Updates



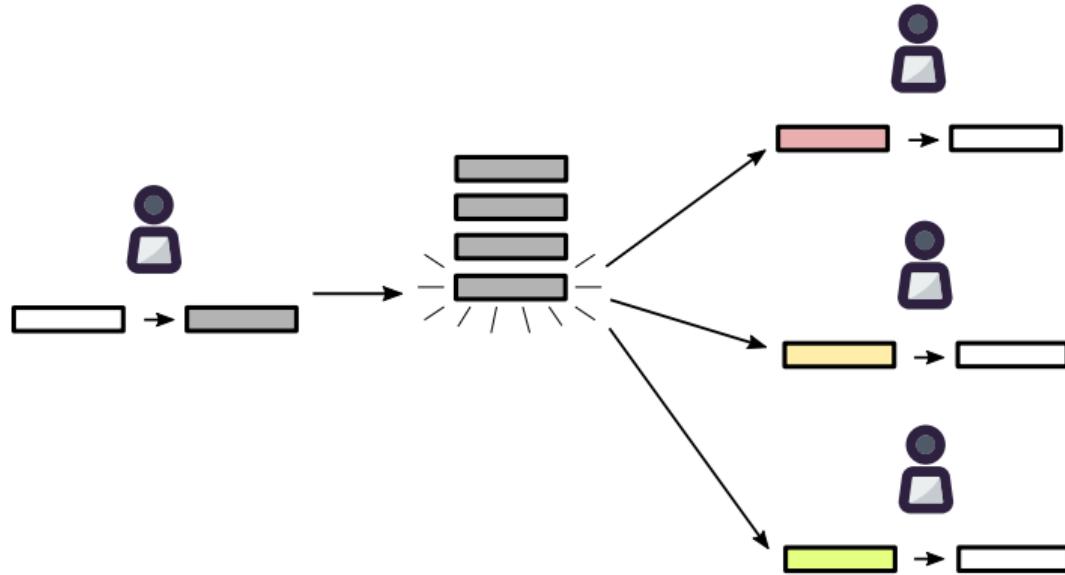
Use Cases

Encrypted file sharing



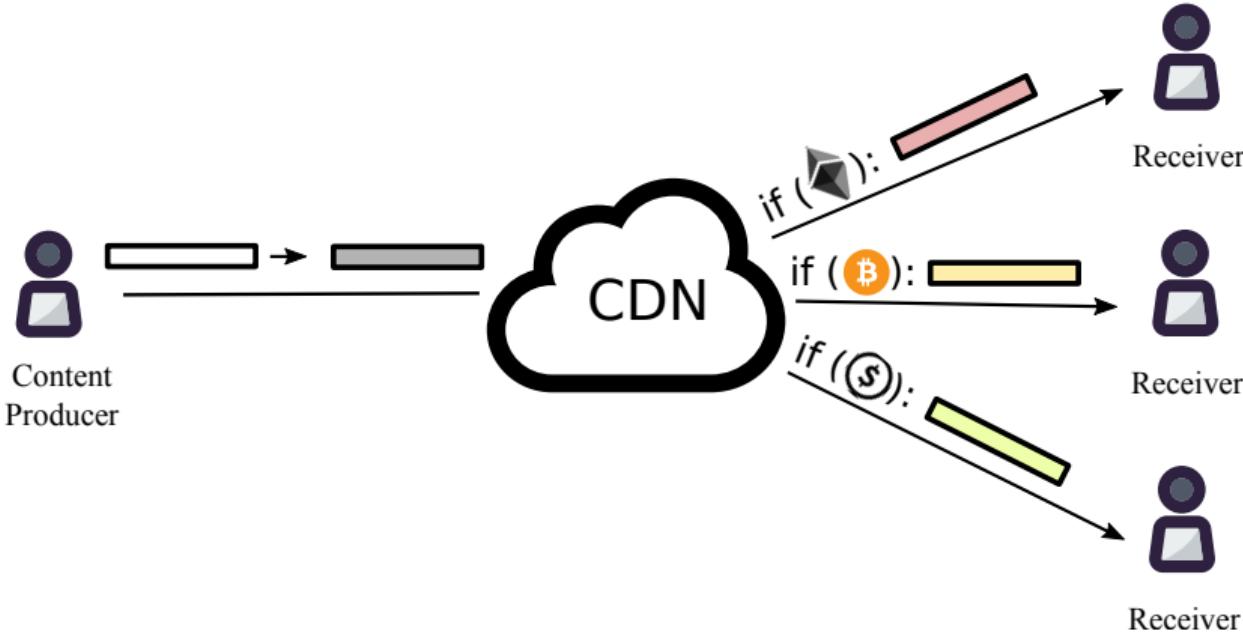
Use Cases

Encrypted multi-user chats



Use Cases

Decentralized Access-Controlled Content



Early Users

Decentralized Marketplaces



Decentralized Databases



Medical Data Sharing



Internet of Things



SPHERITY



Sharing Economy



Genomic Data



Competing Technology

Data Masking and Tokenization

- Less secure for data with underlying patterns
- Reduce the value of data by obfuscating it

Multi-Party Computation

- Early Research Stage
- Slow Performance

Fully Homomorphic Encryption

- Early Research Stage
- Slow Performance
 - ▶ NuCypher has invested efforts in this area

Investors



AMINO Capital

BASE



Blockchain Partners Korea

CoinFund

compound



DHVC



F BIG
CAPITAL

FIRST MATTER



GALAXY
DIGITAL ASSETS



Kenetic
Capital



POLYCHAIN
CAPITAL

Satoshi•Fund

semantic
capital



Team

Founders



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Co-founder and CEO



Michael Egorov, PhD
Co-founder and CTO

Advisors



Prof. Dave Evans
University of Virginia



Prof. Giuseppe Ateniese
Stevens Inst. of Technology



John Bantleman
Rainstor



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Equinix

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John Pacific (tux)
Engineer



Justin Myles Holmes
Engineer



Sergey Zotov
Engineer



Kieran Prasch
Engineer



Bogdan Opanchuk, PhD
Engineer



Ryan Caruso
Community



Derek Pierre
Business Development



Arjun Hassard
Product & Partnerships

More Information



NuCypher

Website: <https://nucypher.com>

Whitepaper: <https://www.nucypher.com/whitepapers/english.pdf>

Github: <https://github.com/nucypher>

Discord: <https://discord.gg/7rmXa3S>

Email: <fname>@nucypher.com

Email: hello@nucypher.com

Appendix: Umbral – Threshold Proxy Re-Encryption

Designed by: David Nuñez, University of Malaga, NICS Lab

- “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>

Appendix: Fully Homomorphic Encryption

