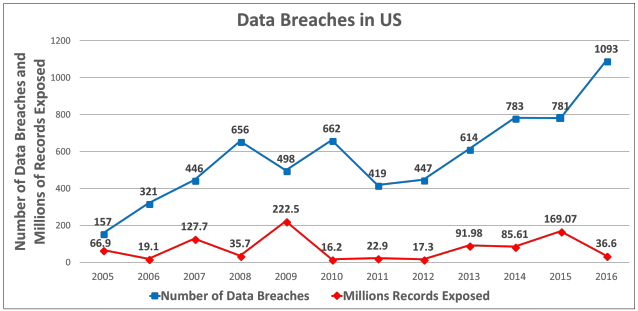
NuCypher

<fname lname>, <title>

<event>, <dd Mon yyyy>

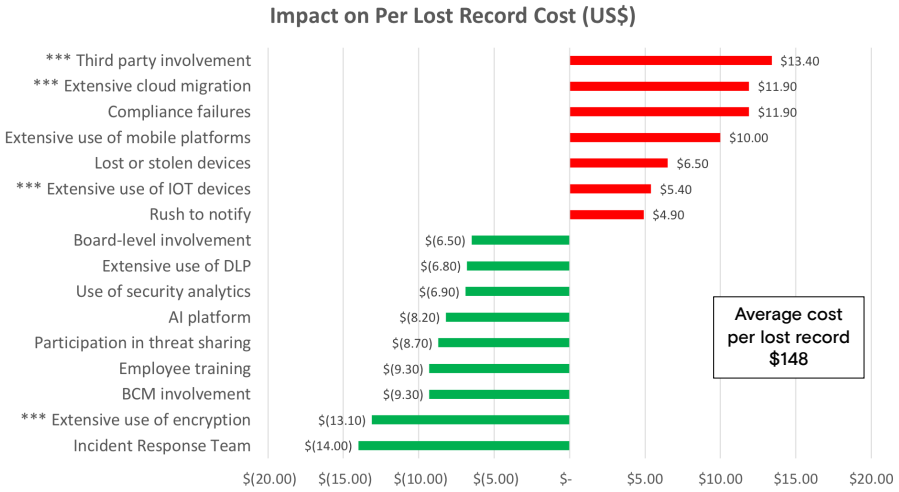
Problem

Data Breaches



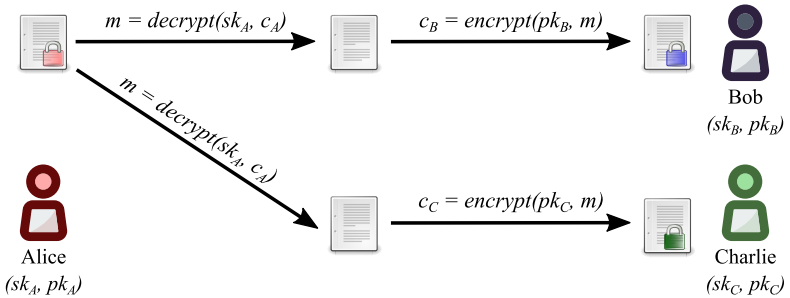
Source:
`https://www.statista.com/statistics/273550/data-breaches-recorded-in-the-united-states-by-number-of-breaches-and-records-exposed/`

Impact of Data Breaches



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

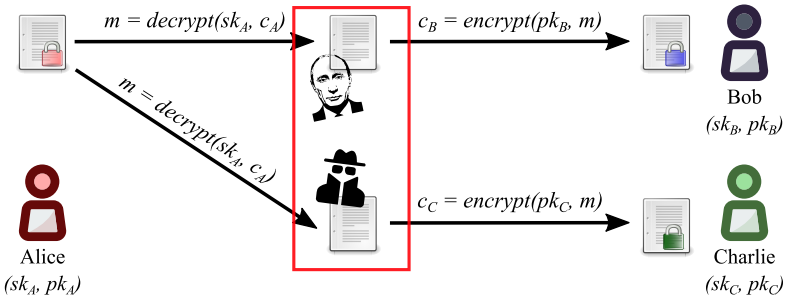
Public Key Encryption (PKE)



Limitations

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

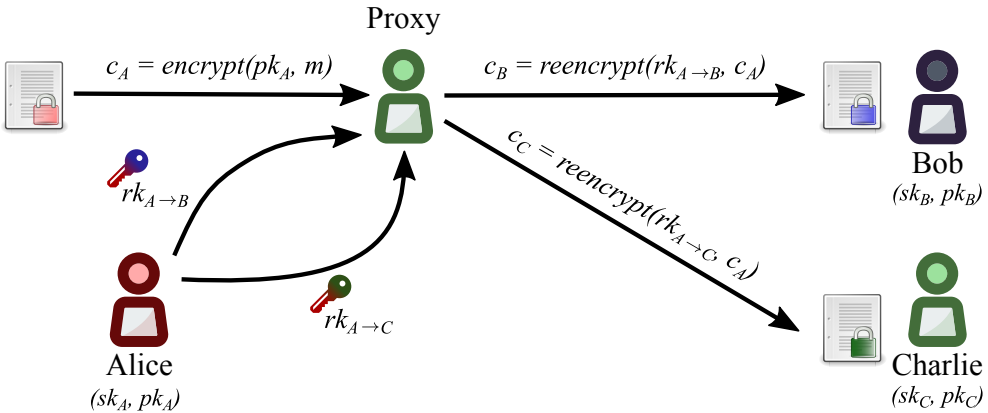
Public Key Encryption (PKE)



Limitations

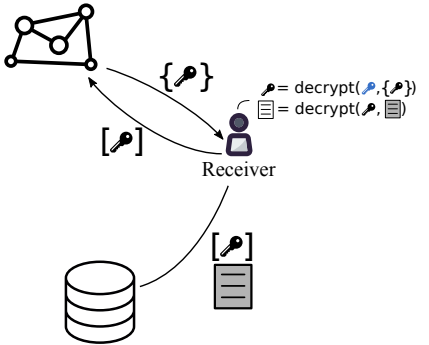
- Decryption required before sharing
- Not scalable
- Complex access revocation

What is proxy re-encryption (PRE)



Solution

Proxy Re-encryption + KMS

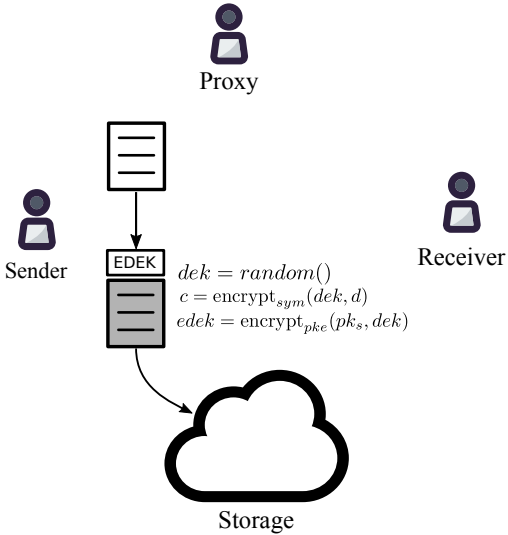


Advantages

- Data not decrypted to facilitate sharing
- Scalable and performant
- Access revocation through re-encryption key deletion
- Secure use of data storage providers

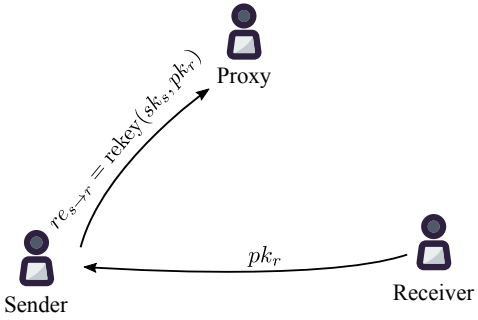
Centralized KMS using PRE

Encryption



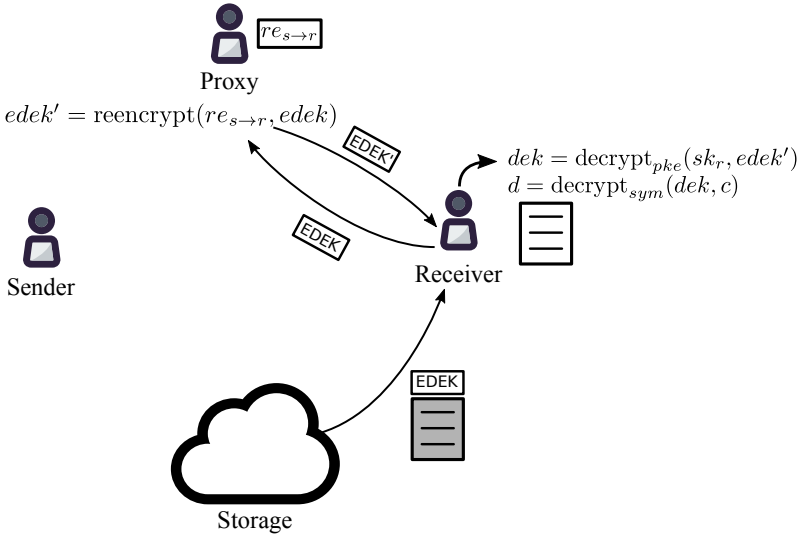
Centralized KMS using PRE

Access delegation



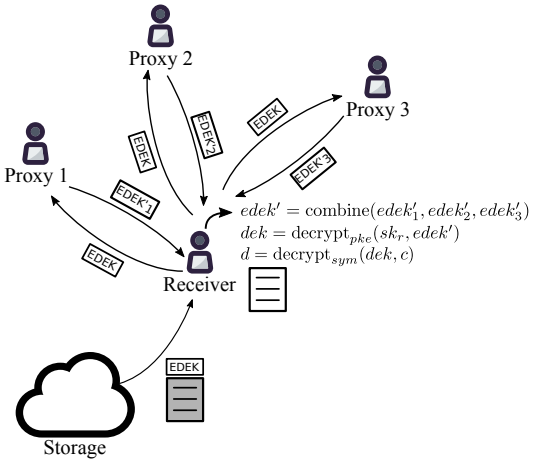
Centralized KMS using PRE

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

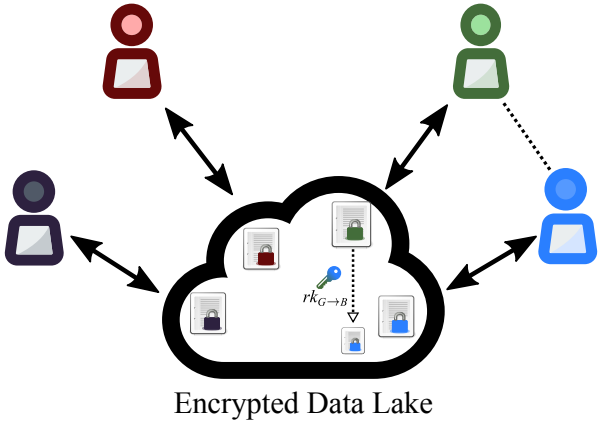
Blockchain & Smart Contract Agnostic

Public Blockchains

Private/Permissioned Blockchains

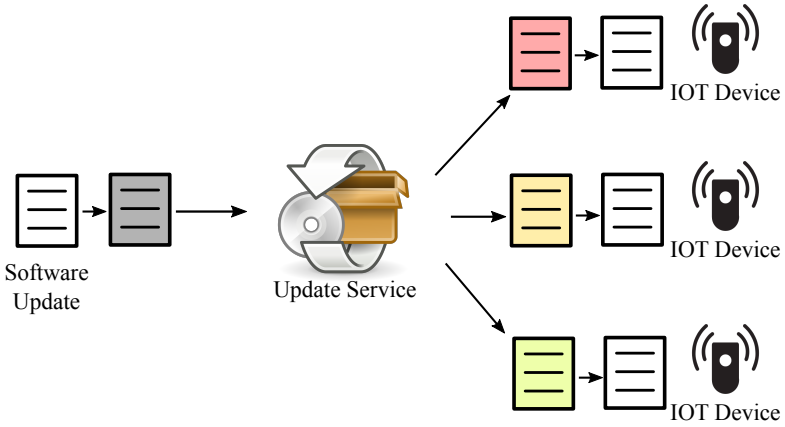
Use Cases

Multi-tenant, Multi-source Encrypted Data Lake



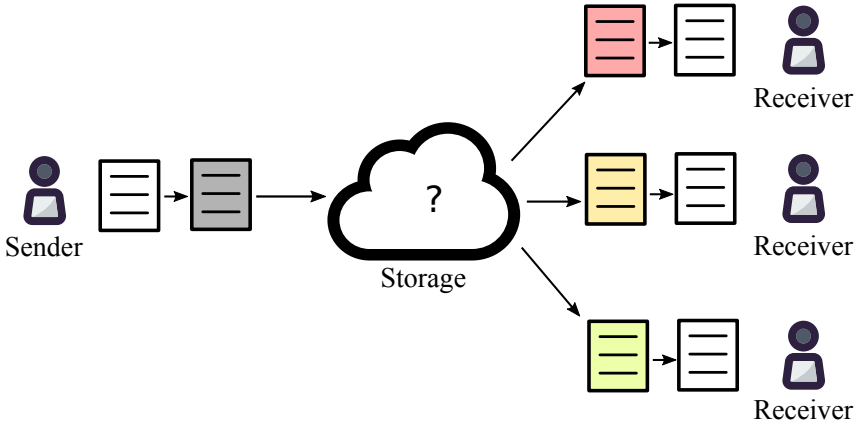
Use Cases

Scalable, Secure IOT Updates



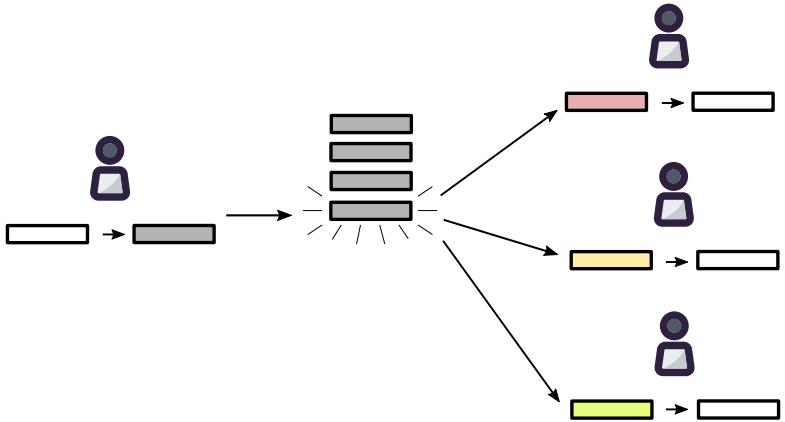
Use Cases

Encrypted file sharing



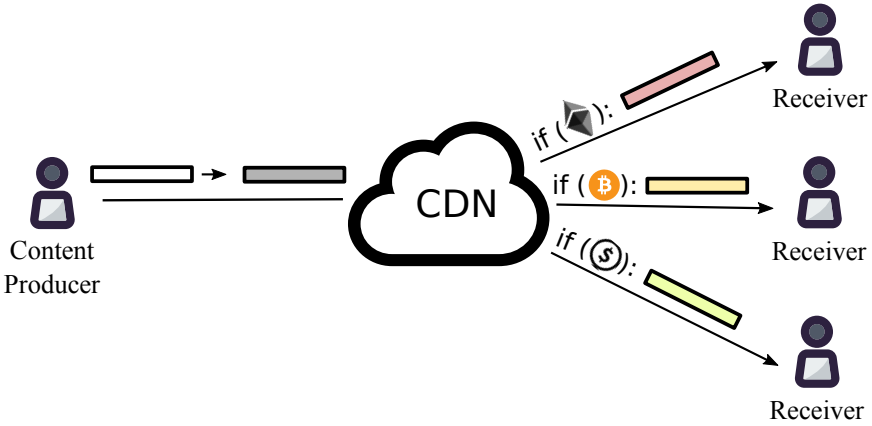
Use Cases

Encrypted multi-user chats

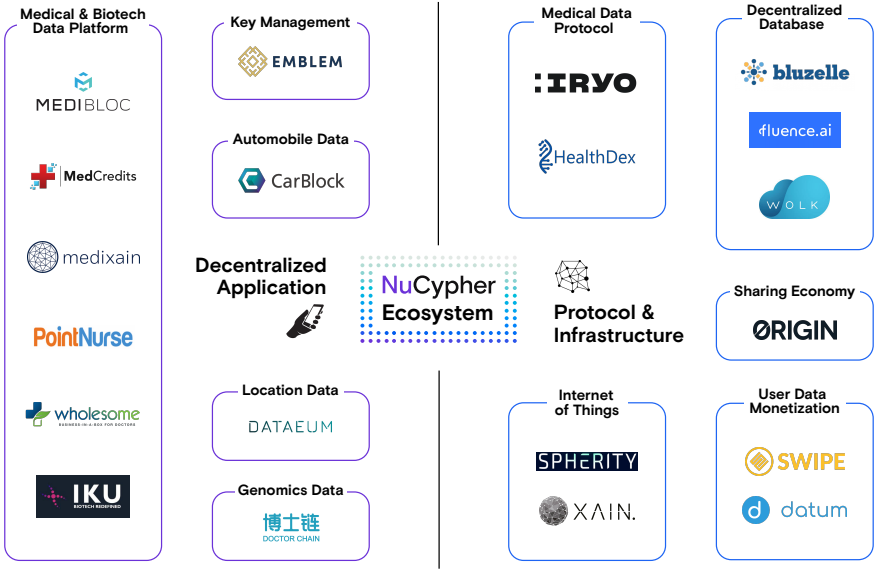


Use Cases

Decentralized Access-Controlled Content



Early Users


Medical & Biotech Data Platform
MEDIBLOC
MedCredits
medixain
PointNurse
wholesome
IKU
Key Management
EMBLEM
Automobile Data
CarBlock
Location Data
DATAEUM
Genomics Data
博士链
DOCTOR CHAIN
Medical Data Protocol
IRYO
HealthDex
Internet of Things
SPHERITY
XAIN.
Decentralized Application
NuCypher Ecosystem
Protocol & Infrastructure
Decentralized Database
bluzelle
fluence.ai
WOLK
Sharing Economy
ORIGIN
User Data Monetization
SWIPE
datum

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 Peformance
  - NuCypher has invested efforts in this area

Fully Homomorphic Encryption

nuFHE Library

- GPU implementation of fully homomorphic encryption
- Uses either FFT or integer NTT
- GitHub: `https://github.com/nucypher/nufhe`
- Achieved 100x performance over TFHE benchmarks

Platform	Library	Performance (ms/bit)	
		Binary Gate	MUX Gate
Single Core/Single GPU - FFT	TFHE (CPU)	13	26
	nuFHE	0.13	0.22
	Speedup	**100.9**	**117.7**
Single Core/Single GPU - NTT	cuFHE	0.35	N/A
	nuFHE	0.35	0.67
	Speedup	**1.0**	**-**

Investors

>$15M in Venture Funding

AMINO Capital

CoinFund

compound

FIRST MATTER

Satoshi•Fund

Team

Founders

MacLane Wilkison

Co-founder and CEO

Michael Egorov, PhD

Co-founder and CTO

Employees

David Nuñez, PhD

Cryptographer

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

Advisors

Prof. Dave Evans

Prof. Giuseppe Ateniese

Stevens Inst. of Technology

John Bantleman

Rainstor

Tony Bishop

Equinix

More Information

NuCypher

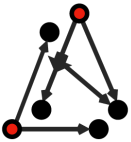
Website: https://nucypher.com
Whitepaper: https://www.nucypher.com/whitepapers/english.pdf
Github: https://github.com/nucypher
Discord: https://discord.gg/7rmXa3S
Email: <fname>@nucypher.com
Email: hello@nucypher.com

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: Security Audits



Least
Authority
Freedom Matters

Appendix: Fully Homomorphic Encryption