NuCypher

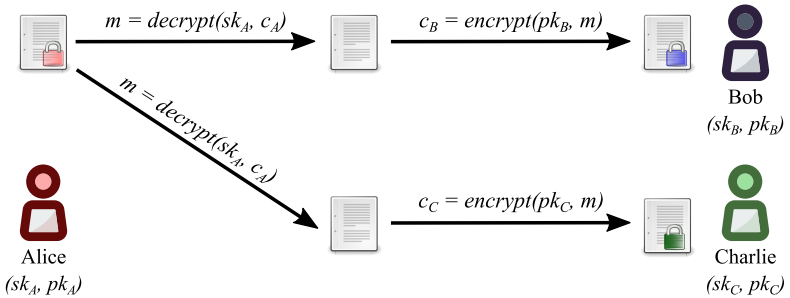
MacLane Wilkison, CEO

Thales Group Cyber@StationF, 05 Sep 2018

NuCypher Overview

- Use cryptography to build the tools & infrastructure to preserve data privacy
- Privacy-preserving solutions for distributed applications
  - Proxy Re-encryption (PRE)
    - Secure data-sharing and access control of encrypted data
  - Fully Homomorphic Encryption (FHE)
    - Perform arbitrary operations on encrypted data
- Blockchain & Private Deployments

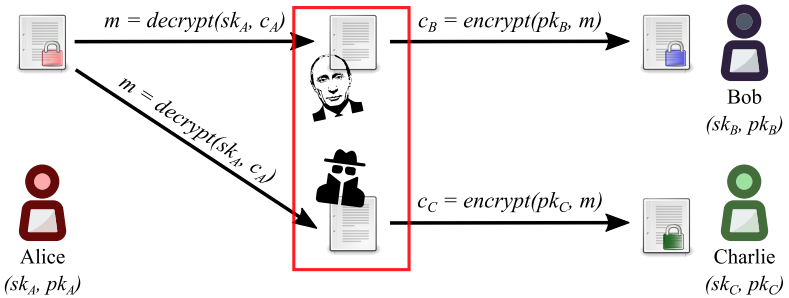
Public Key Encryption (PKE)



Limitations

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

Public Key Encryption (PKE)



Limitations

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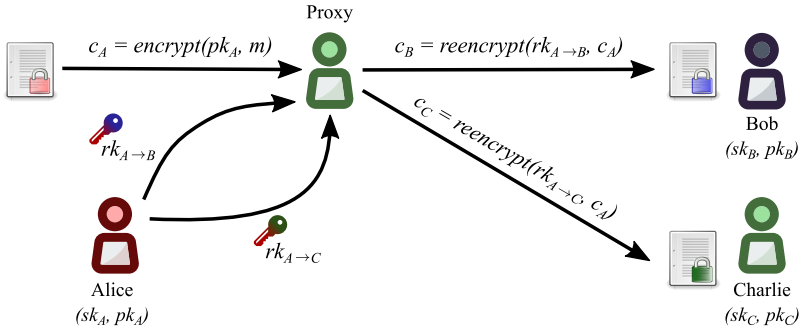
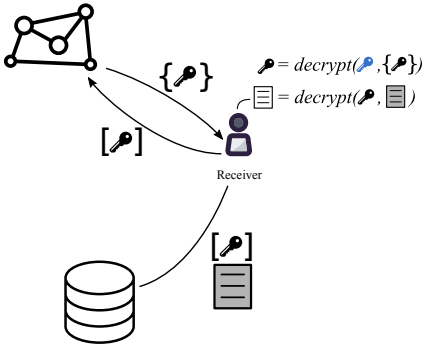
What is proxy re-encryption (PRE)



Solution

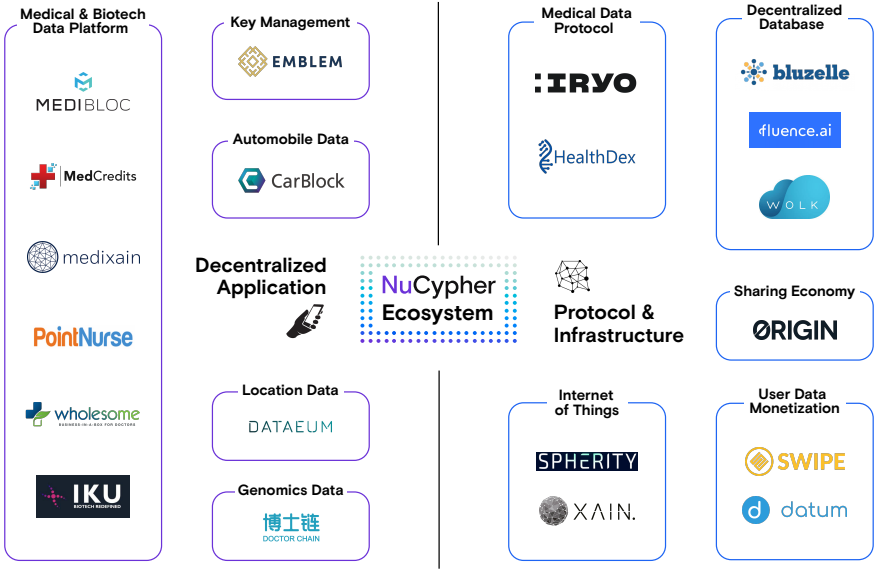
Proxy Re-encryption + KMS



Advantages

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

Early Users


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

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

BASE

Blockchain Partners Korea

CoinFund

compound

FIRST MATTER

Satoshi•Fund

semantic capital

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

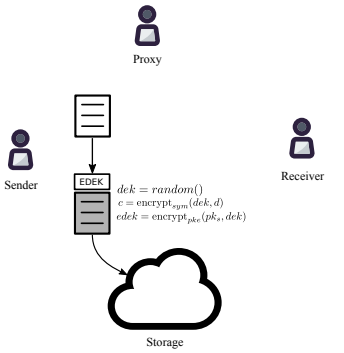
Tony Bishop
Equinix

More Information

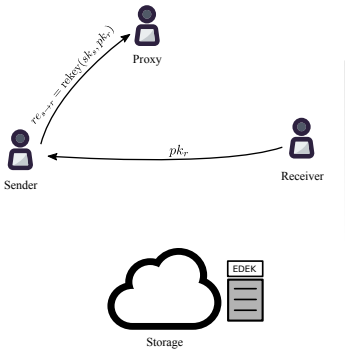
NuCypher

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

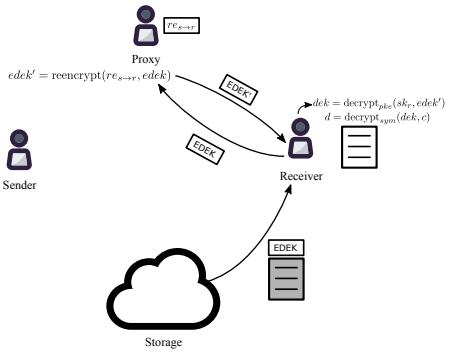
Appendix: Centralized KMS using PRE



Encryption



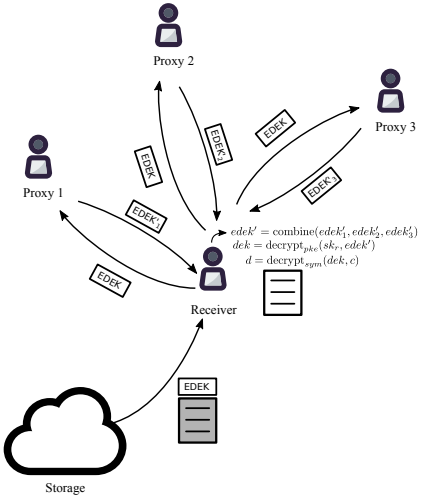
Access Delegation



Decryption

Appendix: 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

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: 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
    - nuFHE library achieved 100x performance over TFHE's benchmarks