



NuCypher

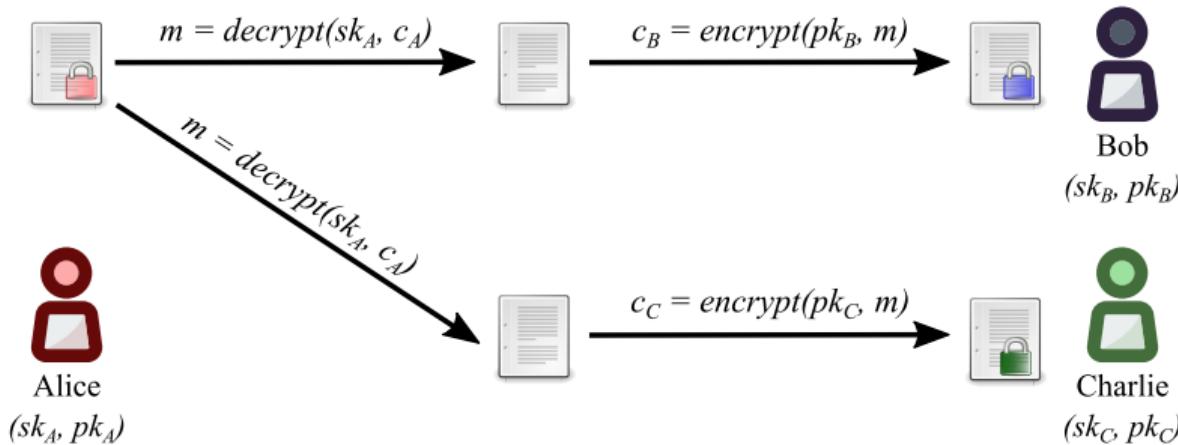
MacLane Wilkison, CEO

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

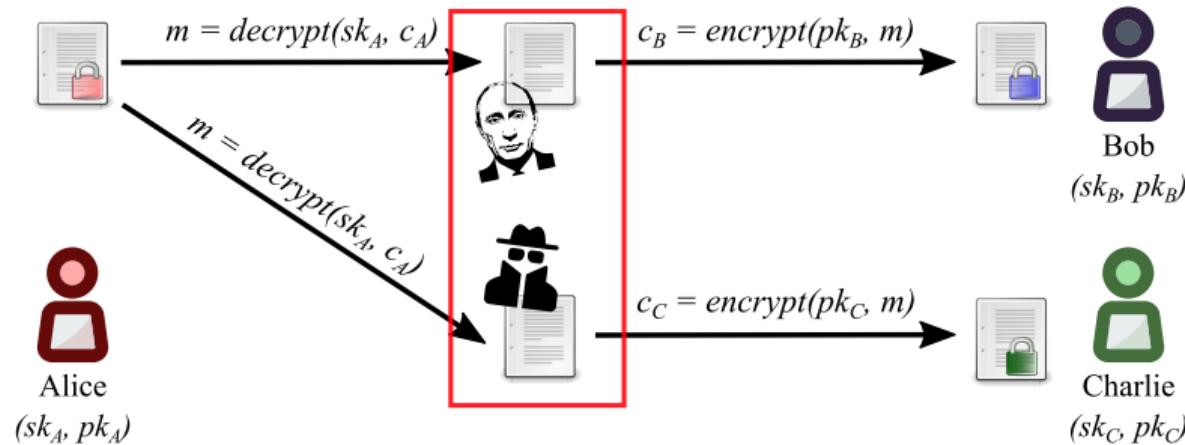
Public Key Encryption (PKE)



Limitations

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

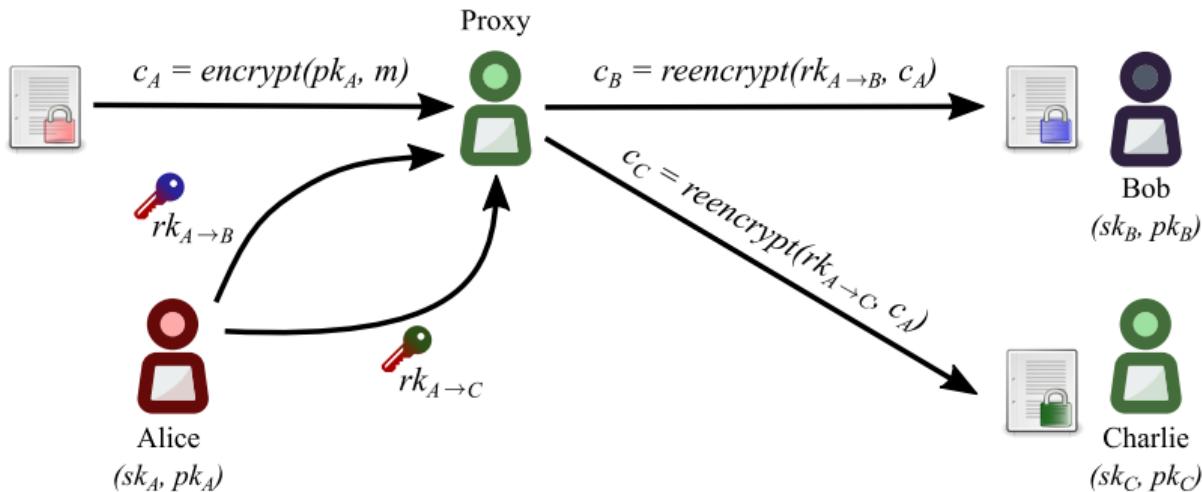
Public Key Encryption (PKE)



Limitations

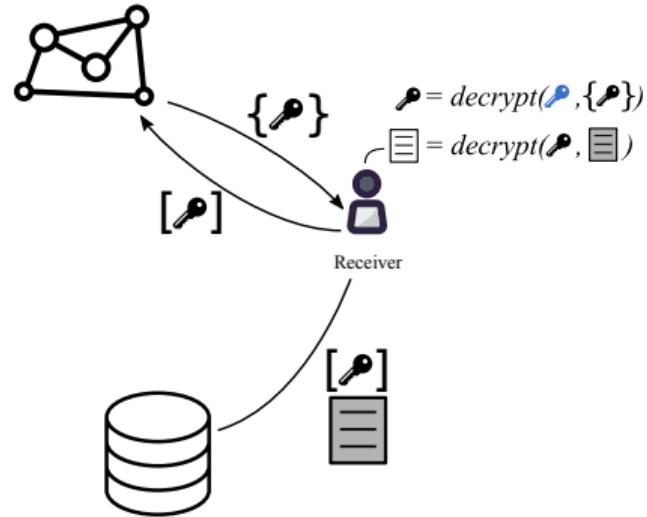
- Decryption required before sharing
- Not scalable
- Complex access revocation

What is proxy re-encryption (PRE)



Solution

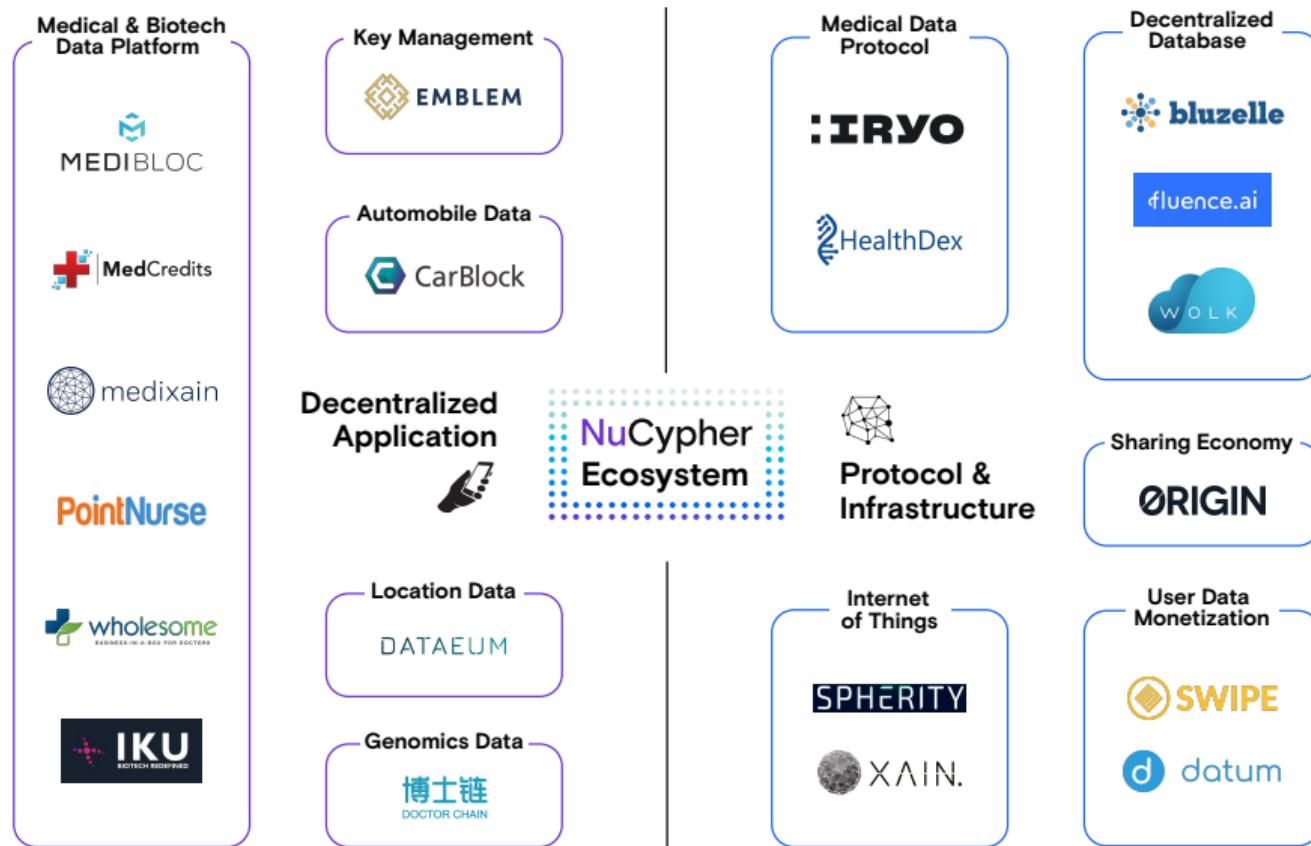
Proxy Re-encryption + KMS



Advantages

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

Early Users



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



DHVC



F BIG
CAPITAL

FIRST MATTER



GALAXY
DIGITAL ASSETS



Kenetic
Capital

MISSION
MARKET

POLYCHAIN
CAPITAL

Satoshi•Fund

semantic
capital



Team

Founders



MacLane Wilkison
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

Employees



David Nuñez, PhD
Cryptographer



John Pacific (tux)
Engineer



Justin Myles Holmes
Engineer



Sergey Zотов
Engineer



John Bantleman
Rainstor



Tony Bishop
Equinix



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>

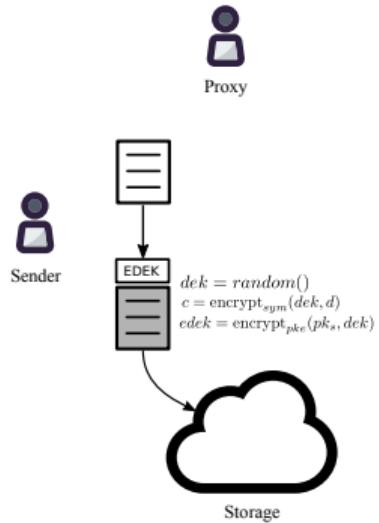
Github: <https://github.com/nucypher>

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

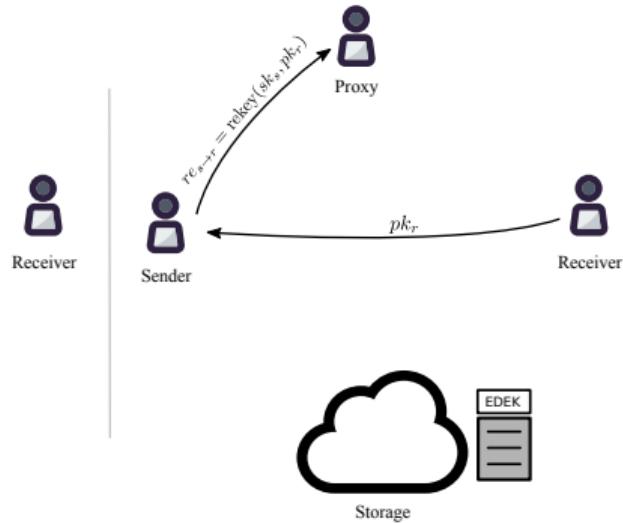
Email: maclane@nucypher.com

Email: hello@nucypher.com

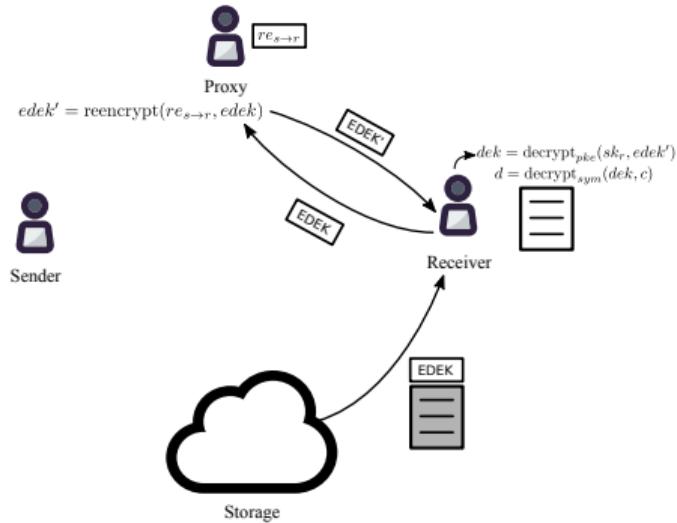
Appendix: Centralized KMS using PRE



Encryption



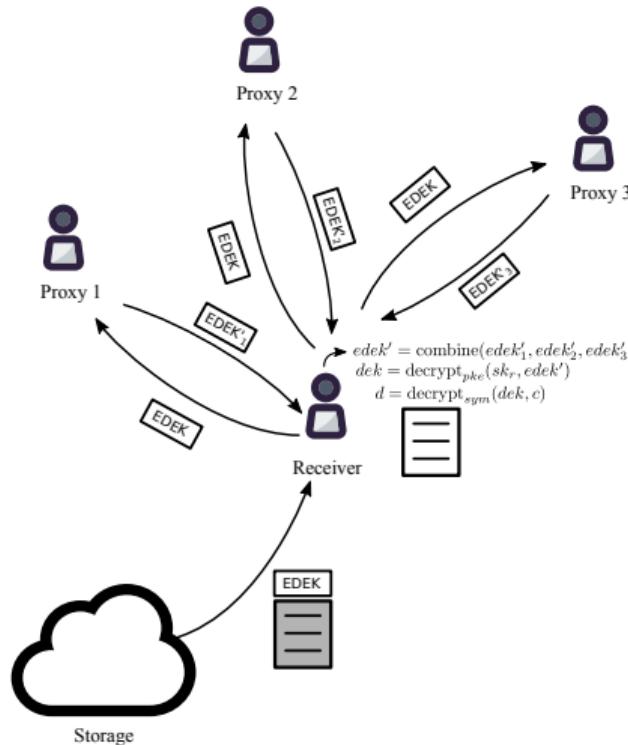
Access Delegation



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 Performance
 - ▶ NuCypher has invested efforts in this area
 - ★ nuFHE library achieved 100x performance over TFHE's benchmarks