Searchable Encryption

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Searchable Encryption

kw : keyword

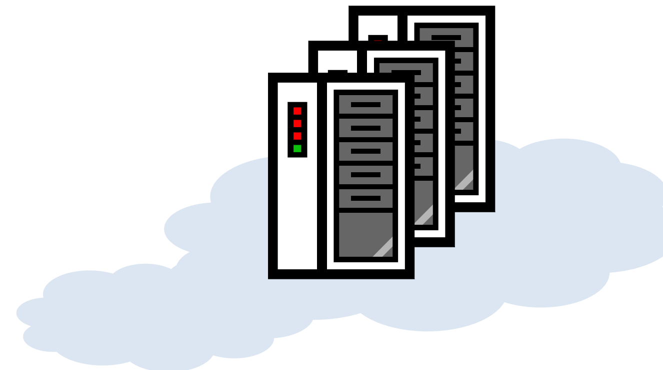
Encrypt:

- Encrypted data
- PEKS(kw)s

Alice

Search kw:

- Trapdoor(kw’)



Test:
for each file
tests PEKS
(using pairing-based cryptography)

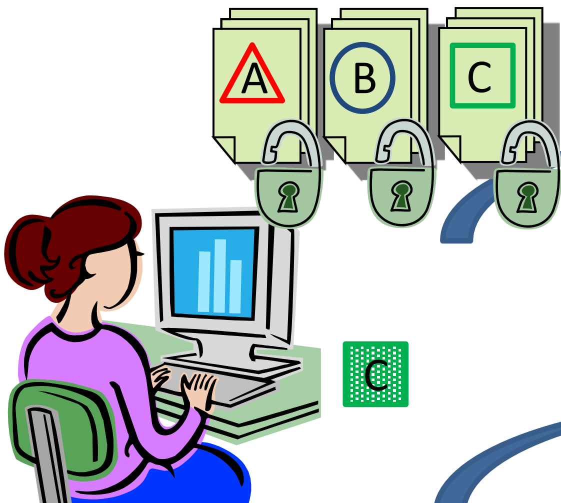
Reply:

- Encrypted files which contains kw’

Server gains no knowledge about kw or the file content stored on the Cloud Storage

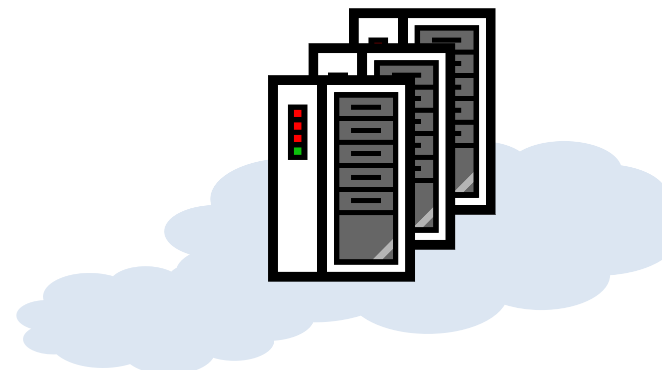
Searchable Encryption

kw : keyword



Encrypt:
- Encrypted data
- PEKS(kw)s

Search kw:
- Trapdoor(kw')



Alice

Reply:
- Encrypted files which contains kw'

Test:
for each file
tests PEKS
(using pairing-based cryptography)

Server gains no knowledge about kw or the file content stored on the Cloud Storage

Data Example

Cryptology ePrint Archive

eprint.iacr.org/2011/

Cryptology ePrint Archive: Listing for 2011

2011/714 (PDF)
Position-Verification in Multi-Channel Models
Huajun Zhang and Zongyang Zhang and Zhenfu Cao

2011/713 (PDF)
A server-aided verification signature scheme without random oracles
Bin Wang and Qing Zhao

2011/712 (PDF)
Efficient Java Implementation of Elliptic Curve Cryptography for J2ME-Enabled Mobile Devices
Johann Gro{\ss}sch{\"a}dl and Dan Page

2011/711 (PDF)
Evolutionary Construction of de Bruijn Sequences
Meltem Sonmez Turan

2011/710 (PDF)
Cryptanalysis of the Full AES Using GPU-Like Special-Purpose Hardware
Alex Biryukov and Johann Gro{\ss}sch{\"a}dl

2011/709 (PDF)
Fault Attack against Miller's algorithm
Nadia El Mrabet

2011/708 (PDF)
Computational Extractors and Pseudorandomness
Dana Dachman-Soled and Rosario Gennaro and Hugo Krawczyk and Tal Malkin

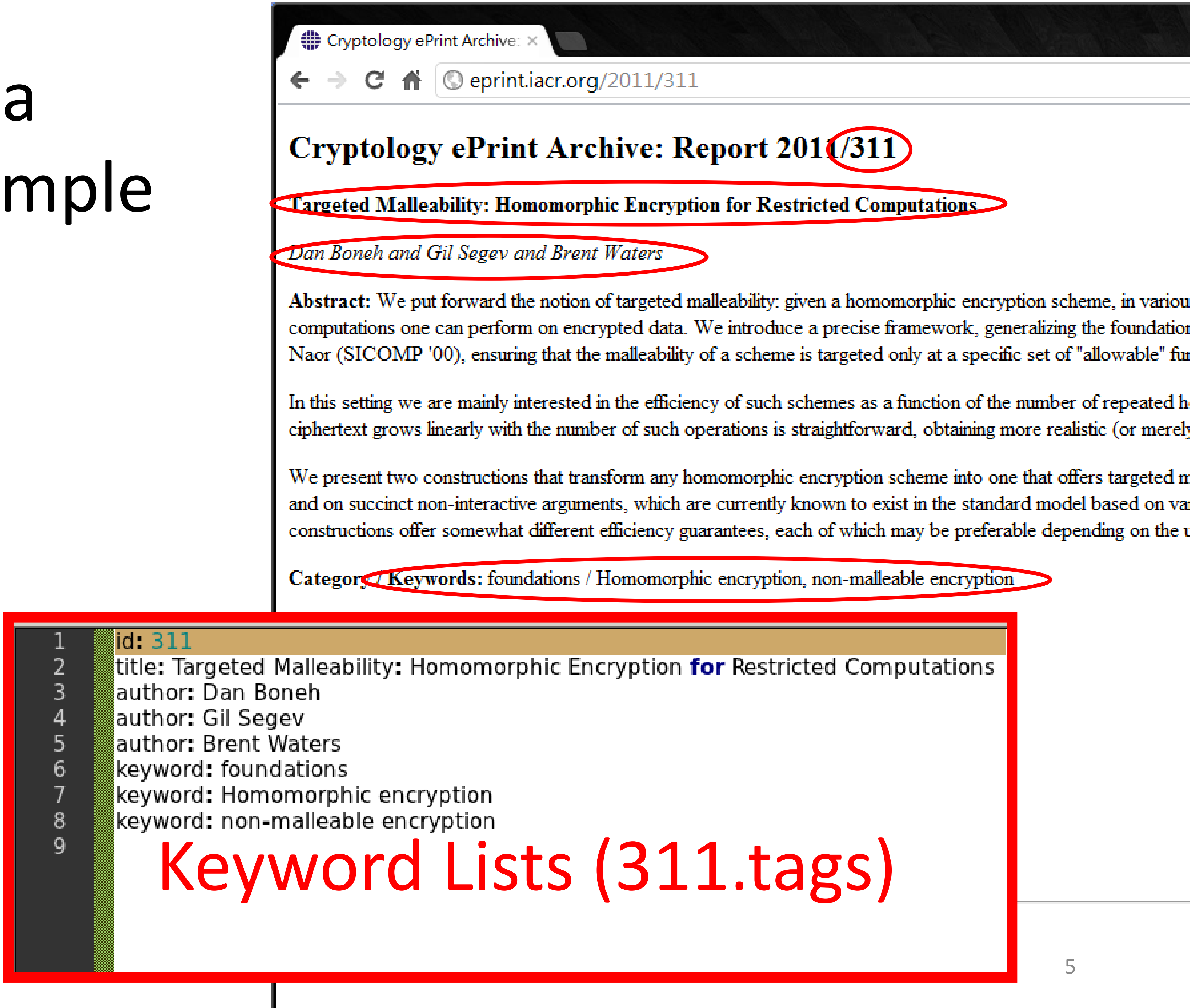
2011/707 (PS PS.GZ PDF)
Cryptanalysis of The Atmel Cipher in SecureMemory, CryptoMemory and CryptoRF
Alex Biryukov and Ilya Kizhvatov and Bin Zhang

2011/706 (PDF)
Improved Side Channel Attacks on Pairing Based Cryptography
Johannes Blömer and Peter Günther and Gennadij Liske

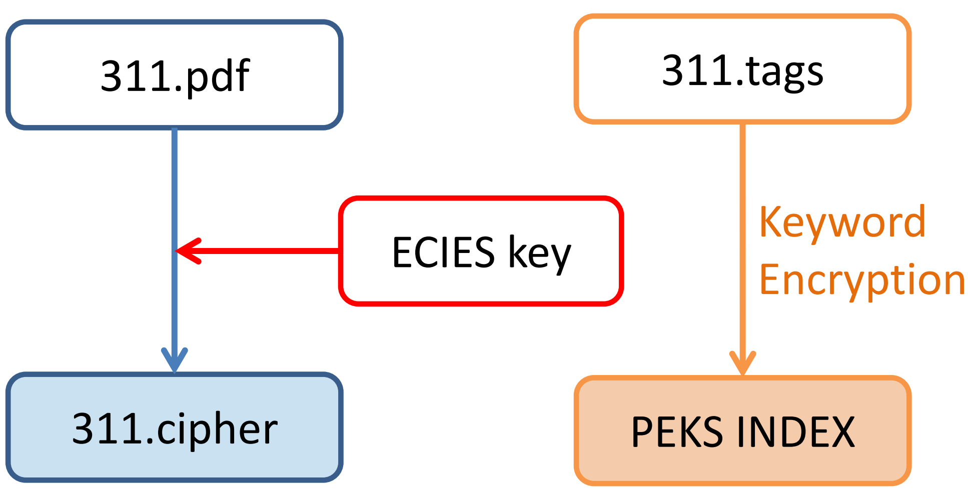
2011/705 (PDF)
Differential Attacks on Generalized Feistel Schemes
Valerie Nachef and Emmanuel Volte and Jacques Patarin

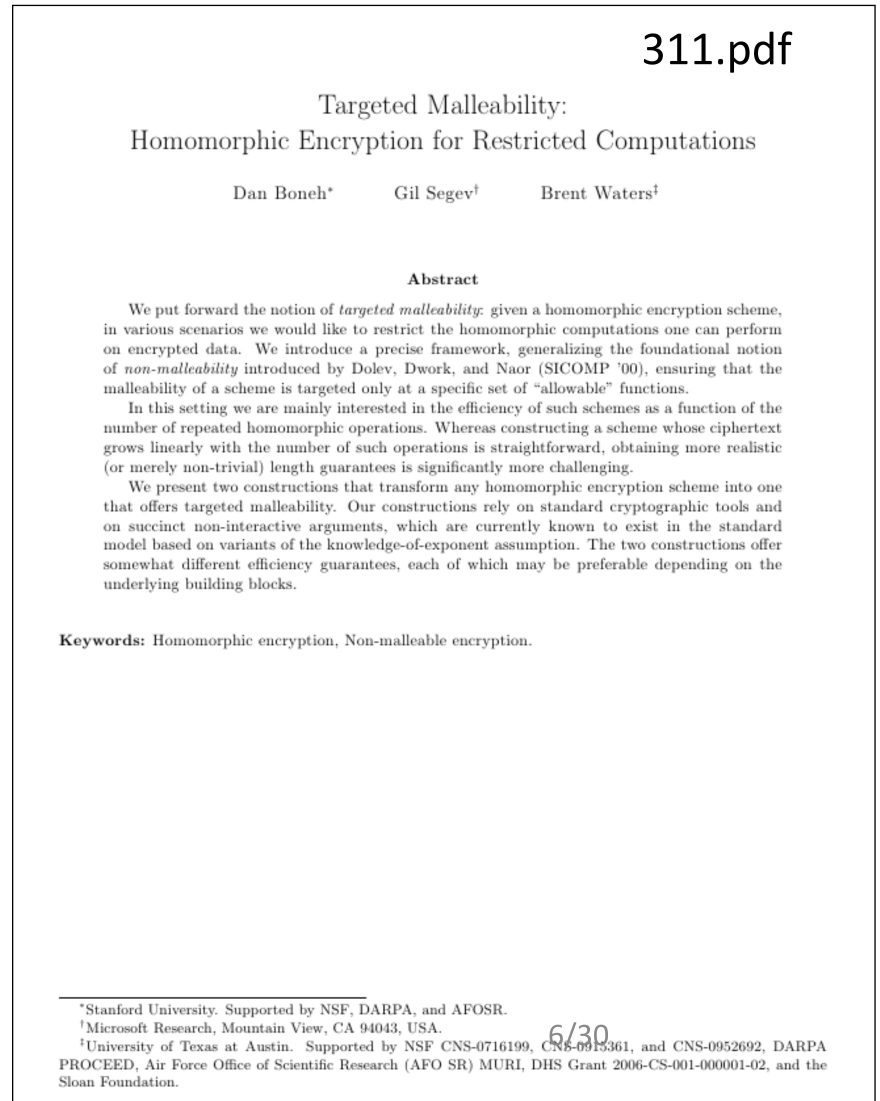
2011/704 (PS PS.GZ PDF)
Security Analysis of a PUF based RFID Authentication Protocol
Masoumeh Safkhani and Nasour Bagheri and Majid Naderi

Data Example



Public Key Encryption with Keyword Search (PEKS) (1/3)





Targeted Malleability:
Homomorphic Encryption for Restricted Computations

Dan Boneh* Gil Segev† Brent Waters‡

Abstract

We put forward the notion of *targeted malleability*: given a homomorphic encryption scheme, in various scenarios we would like to restrict the homomorphic computations one can perform on encrypted data. We introduce a precise framework, generalizing the foundational notion of *non-malleability* introduced by Dolev, Dwork, and Naor (SICOMP '00), ensuring that the malleability of a scheme is targeted only at a specific set of "allowable" functions.

In this setting we are mainly interested in the efficiency of such schemes as a function of the number of repeated homomorphic operations. Whereas constructing a scheme whose ciphertext grows linearly with the number of such operations is straightforward, obtaining more realistic (or merely non-trivial) length guarantees is significantly more challenging.

We present two constructions that transform any homomorphic encryption scheme into one that offers targeted malleability. Our constructions rely on standard cryptographic tools and on succinct non-interactive arguments, which are currently known to exist in the standard model based on variants of the knowledge-of-exponent assumption. The two constructions offer somewhat different efficiency guarantees, each of which may be preferable depending on the underlying building blocks.

Keywords: Homomorphic encryption, Non-malleable encryption.

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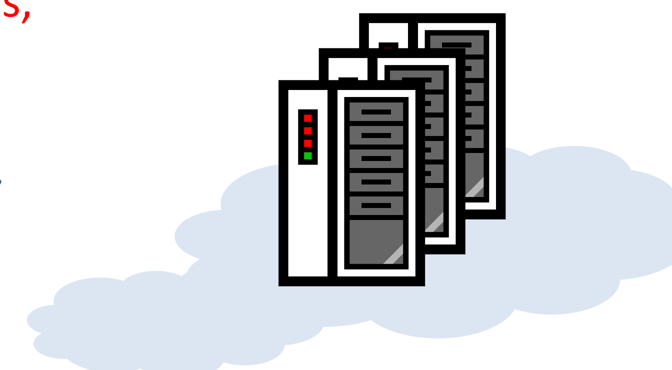
Search Keyword

Search kw:

- Trapdoor(author: Brent Waters, Alice's private key)

Alice



Test:

for each file

tests PEKS in

PEKS INDEX

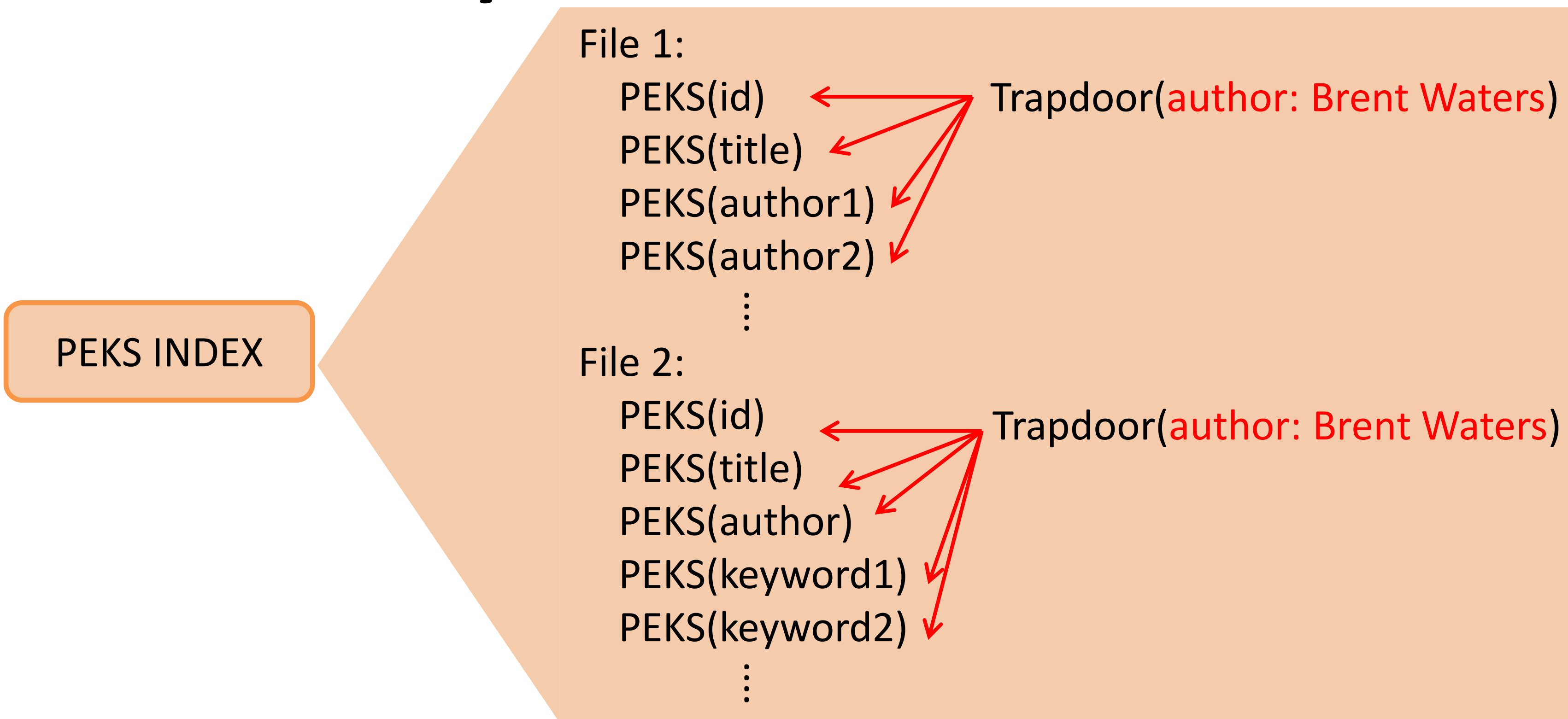
Reply:

- Encrypted files which contains kw

311.aes128

311.rsa

Search Keyword



$PEKS = (g^r, H_2(t)), \quad t = e(H_1(KW), h^r), \quad h = g^\alpha$

$Trapdoor = H_1(KW)^\alpha$

$Server\ tests\ each\ PEKS\ whether \quad H_2(e(H_1(KW)^\alpha, g^r) = H_2(t)$

Implementation

- PBC Library by Ben Lynn
- Tate Pairing
- supersingular curve: $y^2 = x^3 + x$ over F_q
  - embedding degree $k = 2$
  - q is a prime and $q \equiv 3 \bmod 4$
  - q is 1536-bit long
  - group order r is 256-bit long
- Key Length:

NIST Recommendations (2011)

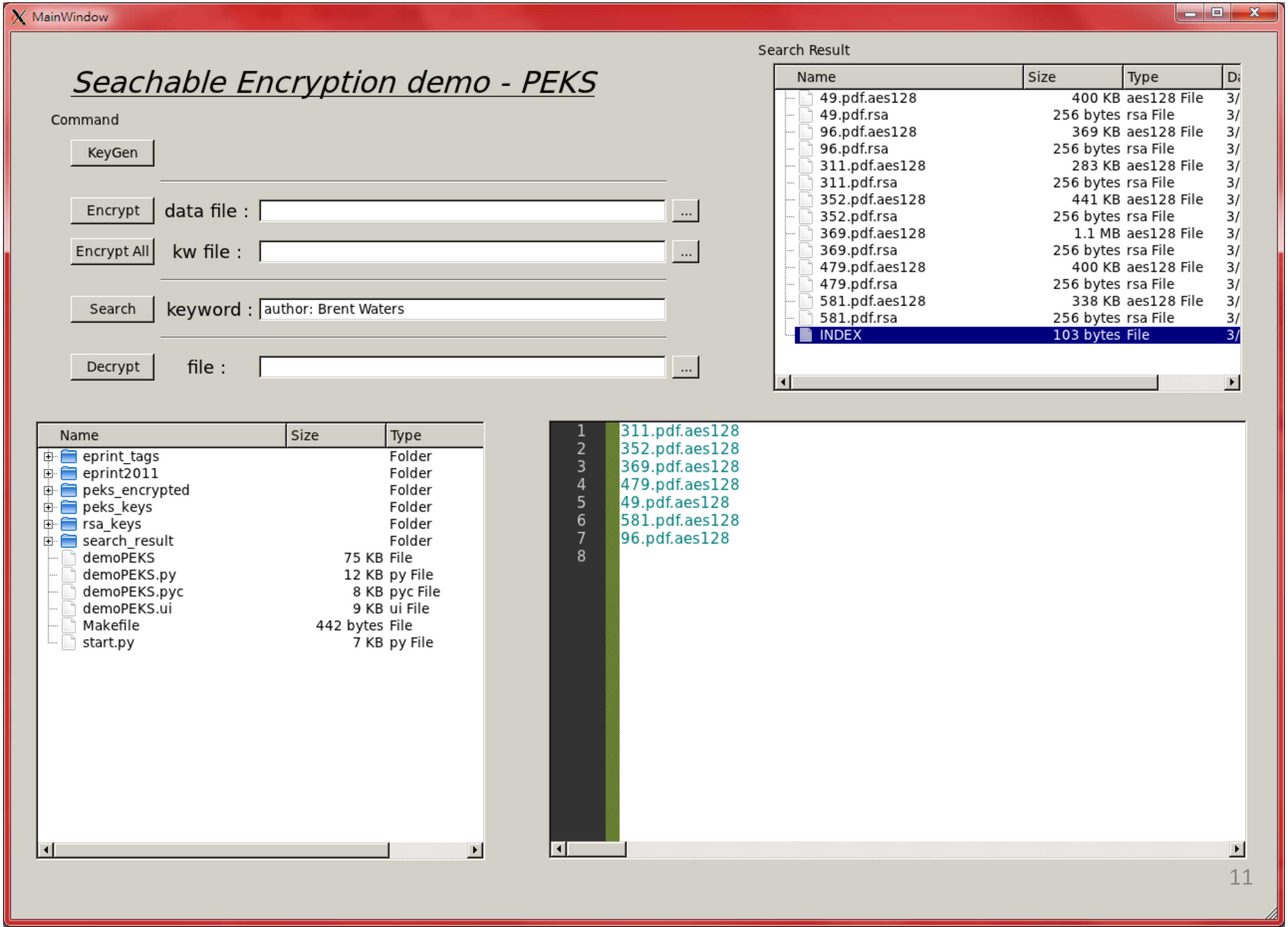
Date	Minimum of Strength	Symmetric Algorithms	Asymmetric	Discrete Logarithm Key	Discrete Logarithm Group	Elliptique Curve	Hash (A)	Hash (B)
> 2030	128	AES-128	3072	256	3072	256	SHA-256 SHA-384 SHA-512	SHA-1 SHA-224 SHA-256 SHA-384 SHA-512

Forthcoming Research

To enhance search capability

Query Type	
Equality query: $(x_i = a)$	for any $a \in T$
Comparison query: $(x_i \geq a)$	for any $a \in T$
Subset query: $(x_i \in A)$	for any $A \subseteq T$
Equality conjunction: $(x_1 = a_1) \wedge \ldots \wedge (x_w = a_w)$	
Comparison conjunction: $(x_1 \geq a_1) \wedge \ldots \wedge (x_w \geq a_w)$	
Subset conjunction: $(x_1 \in A_1) \wedge \ldots \wedge (x_w \in A_w)$	

Demo PEKS library



- Questions?

- Thank you