The Fairest Ransomware

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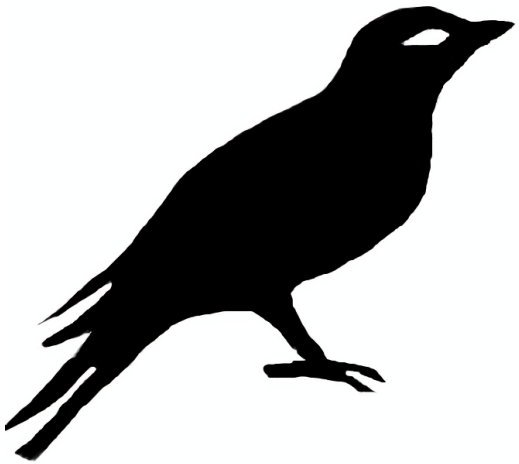
Who am I?



- University of Tsukuba (Undergraduate)
- Authentication Platform Section, DCS Dept
- I'm interesting in Cryptography

Twitter @_yyu_

Qiita yyu

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Introduction

- Recentry, *Ransomwares* are being famous.

Ransomware

Ransomware is one of the malwares, which encrypts the data on a victim's comptuer and then make they pay ransom in exchange for decrypting.

Famous Ransomwares

- WannaCry
- Petya
- GoldenEye

Will ransomwares decrypt the data if the victim pays Bitcoin?

The Fairnest Ransomware

> If the victim pays some Bitcoins, their data will be decrypted under the probability on which they agreed.

It's possible using cryptographic technique

Encryption

Symmetric Key Encryption (SKE) is a cryptographic scheme that uses the *same* key to encrypt and decrypt data like AES. An encryption function is denoted Enc, a decryption function is denoted Dec. The following equation holds for the symmetric key k.

$$x = \mathrm{Dec}_k\left(\mathrm{Enc}_k\left(x\right)\right)$$

RSA Encryption is a cryptographic scheme that uses the *different* keys between encrypting and decrypting data. The key using encryption is called *public key* and The key using description is called *secret key*. The following holds for a public key (e, N) and the secret key d.

$$x = \left(x^e\right)^d = \left(x^d\right)^e \pmod{N}$$

Hash Function

Hash Function

A hash function H is a *one way function*, which means that:

- It's easy to calculate the output $H(x)$ from input x
- But it's hard to calculate the input x from output $H(x)$

A hash function H has the following properties:

Preimage Resistance A hash value h, it's difficult to find any message m such that $h = H(m)$.

Second Preimage Resistance An input m_1, it's difficult to find different input m_2 such that $H(m_1) = H(m_2)$.

Collision resistance It's difficult to find two different messages m_1 and m_2 such that $H(m_1) = H(m_2)$.

Zero-Knowledge Proof

There are two people, Alice and Bob.

Prover Alice has the secret key d for RSA chipher text c encrypted by public key (e, N). And she has chipher text $s := \mathrm{Enc}_k\left(c^d \bmod N\right)$ and its symmetric key k.

Verifier Bob has the cipher text c, its public key (e, N) and the cipher text s.

Bob want to verify as follows:

> “A preimage of the hash value $H(k)$ is a symmetric key k that can decrypt SKE chipher text s.”

without knowing the secret key d or symmetric key k.

Zero-Knowledge Proof

We use *cut-and-choose protocol* where RSA chipher text c encrypted by public key (e, N) and its secret key d.

Alice		**Bob**
$F := \{\sigma_1, \ldots, \sigma_n\}$		
$R := \{d_1, \ldots, d_m\}$		
β is a random permutation		
for $\{\sigma_1, \ldots, \sigma_n, d_1, \ldots, d_m\}$		
	$\xrightarrow{\beta}$	
		$f(\beta)$
finalize		

Thank you for your attention!

Any question?