PayBreak: Defense Against Cryptographic Ransomware

Eugene Kolodenker‡*, Wil Koch*, Gianluca Stringhini†, and Manuel Egele*

⋆Boston University, ‡MITRE, †University College London

INTRODUCTION

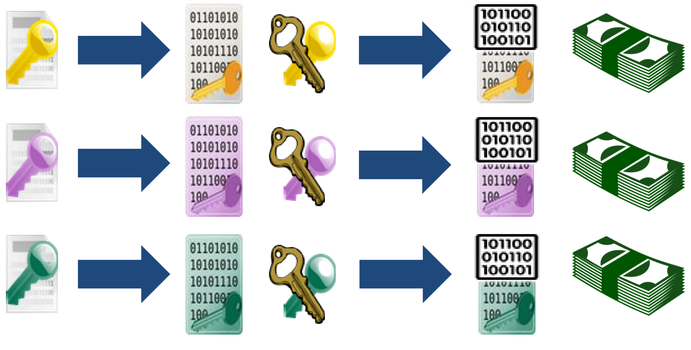
- Cryptographic ransomware is malware that **prevents the victim user access** to some resource by encrypting it, and **extorts a ransom** payment to perform decryption.

CRYPTO RANSOMWARE

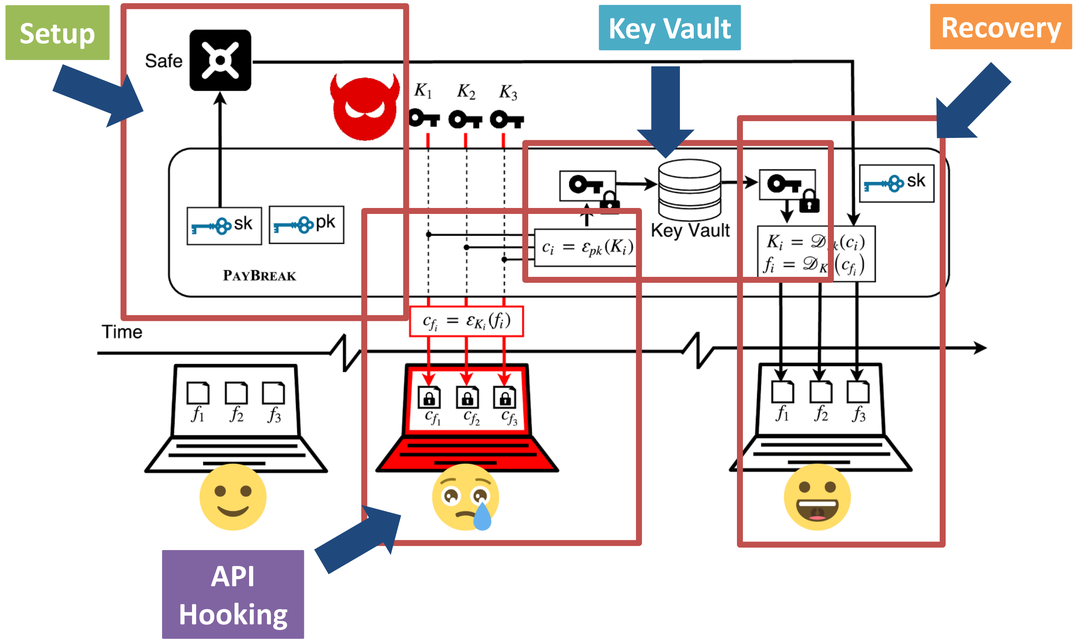
Malware start - Create private-public key pair. Transfer public key to victim to be used later

Victim forced to generate session key per file...

Encrypt each file	Encrypt each session	Pay



OVERVIEW



IMPLEMENTATION

Setup

- Set up systems with a public private-key pair
- Public key is for key vault input and the private key is used during recovery

API Hooking

- Augmented cryptographic library functions with extra code to export out keys
- Hooked dynamically and statically linked functions

Key Vault

- Store exported keys from the API hooking step into a secure container
- Secure with setup key pair and assure integrity

Recovery

- Decrypt the key vault using previously set up private key
- Attempt decryption for each file, at different file offsets, with each key in the key vault

EFFECTIVENESS

- Evaluated against the **largest set of ransomware families at date (20).**
- **Successful file recovery from 9** previously unrecoverable families.

Families	# Samples	Previously defeated	Defeated by	Defeated	Library	Algorithm
Almalocker	1	✓	✓	✓	CryptoAPI	RSA+AES-128-CBC
Cerber	14	✓	✓	✓	CryptoAPI	RSA+RC4-256
Chimera	1	✗	✓	✓	CryptoAPI	RSA+AES-256-ECB
CryptoFortress	2	✗	✓	✓	CryptoAPI	RSA+AES-256-ECB
CryptoLocker	33	✗	✓	✓	CryptoAPI	RSA+AES-256-CBC
CryptoWall	7	✗	✓	✓	CryptoAPI	RSA+AES-256-CBC
CrypWall	4	✗	✓	✓	CryptoAPI	RSA+AES-256-CBC
GPcode	2	✓	✓	✓	CryptoAPI	RSA+AES-256-ECB
Locky	7	✗	✓	✓	CryptoAPI	RSA+AES-128-CTR
SamSam	4	✗	✓	✓	CryptoAPI	RSA+AES-128-CBC
Thor Locky	1	✗	✓	✓	CryptoAPI	RSA+AES-128-CTR
Tox	9	✗	✓	✓	Crypto++	RSA+3DES-128-CBC
DXXD	2	✓	✗	✓	Unknown	XOR with Constant Key
MarsJokes	1	✓	✗	✓	Unknown	ECC+AES-256-ECB
PokemonGo	1	✓	✗	✓	.NET Crypto	AES with Constant Key
Troldesh	5	✓	✗	✓	Unknown	RSA+AES-256-CBC
VirLock	4	✓	✗	✓	Unknown	XOR with Constant Key
Androm	2	✗	✗	✗	Unknown	RSA+AES-256-CBC
Razy	3	✗	✗	✗	.NET Crypto	AES-128
TeslaCrypt	4	✗	✗	✗	Unknown	ECC+AES-256-CBC
Total	20	107	8	12	17	

GENERAL

- Compiled **12 encryption programs** using different crypto libraries, and different compilers at different optimization levels – required **2 signatures** to detect all variations.

PERFORMANCE IMPACTS

- Macro benchmark showed a **a 4.1ms overhead increase** in loading HTTPS webpages, and neglible overhead in 21 common software applications.

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