Thursday, 16th July 2020

Building Whiteboxes: attacks and defenses

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Hardware Security Conference and Training

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Whiteboxes: an introduction

Introduction (1/2)

- Why?

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...and our **attacker model**

Attacker Model

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To sum up: think of the **worst possible situation**!

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In a nutshell...

Example: standard AES

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1  C=AES.new("this is some key")
2  C.encrypt("data to encrypt!")
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1  C=WBAES.new() # extracting a key from WBAES is **hard enough**
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- Idea: generate cryptographic algorithms that process encoded [2] keys

[2] read this as "somewhat concealed from such kind of omniscient attacker"

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Making the attacker's work *hard enough*

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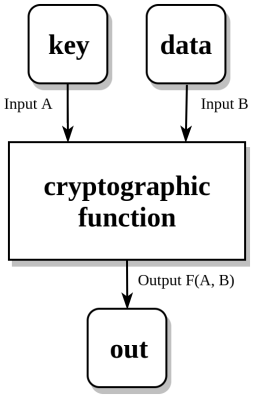
Building Whiteboxes with Tables



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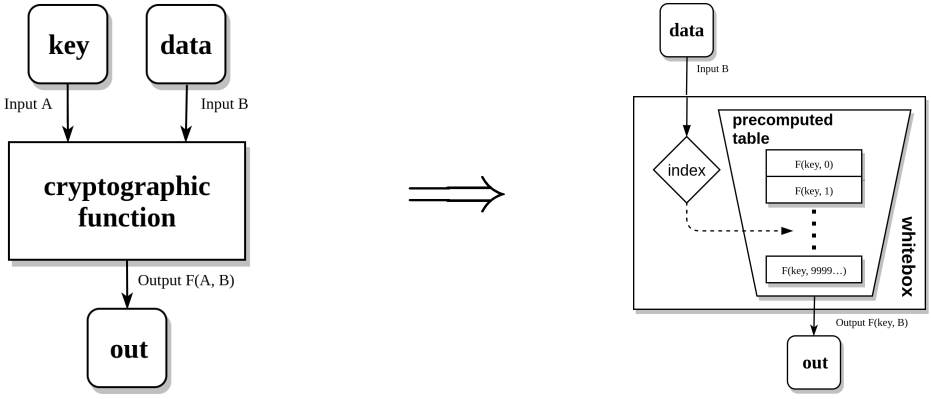

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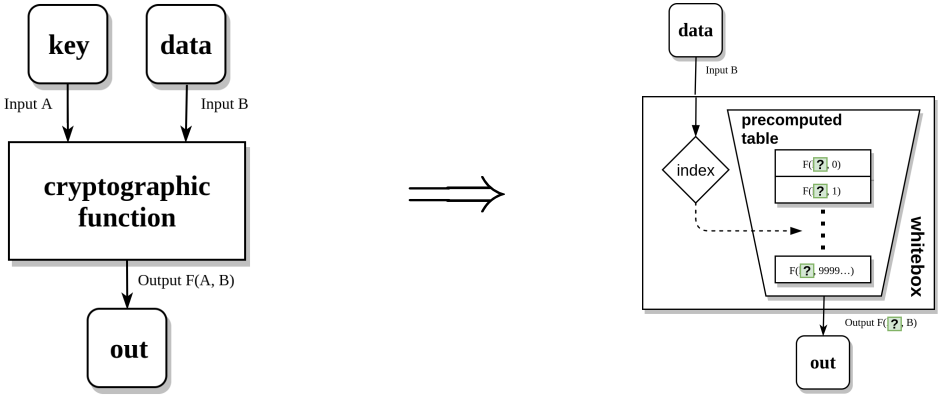

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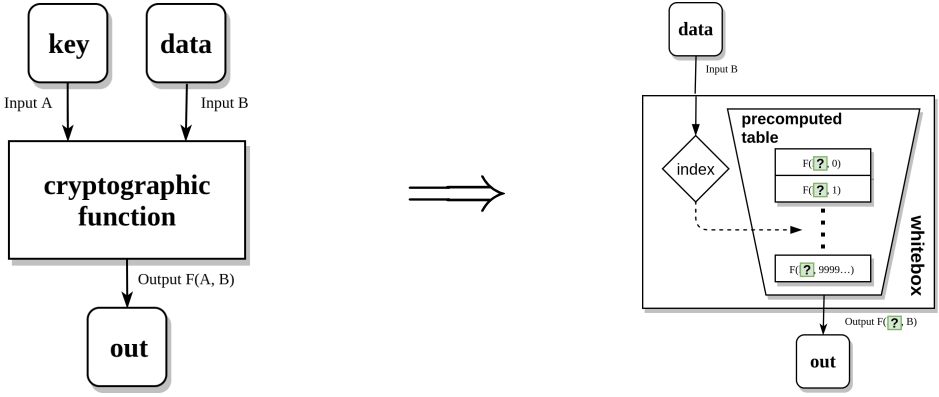

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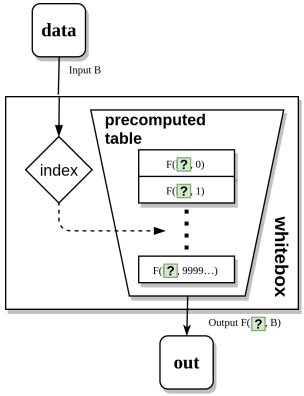

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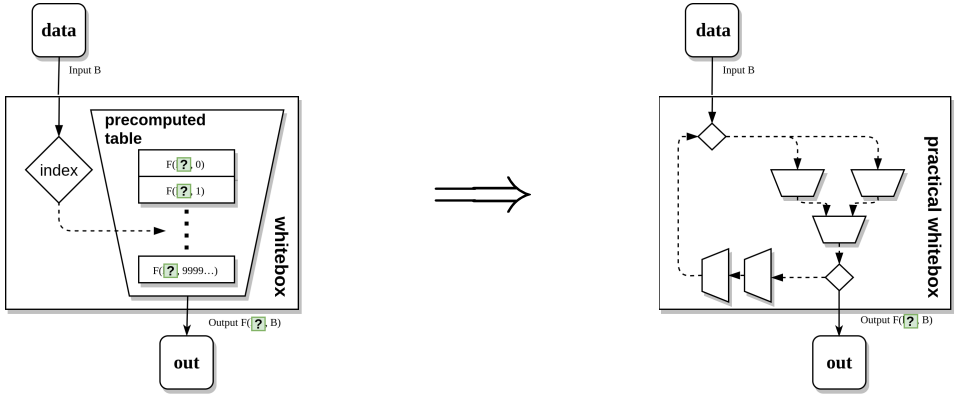

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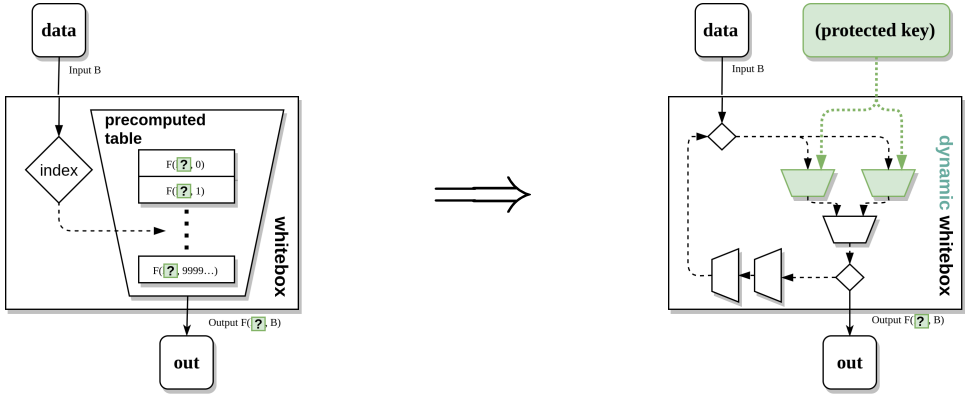

Tabulate **smaller operations** on **internal states**
(you can even make a **dynamic** whitebox)

Building Whiteboxes: Tradeoffs

Practical whiteboxes

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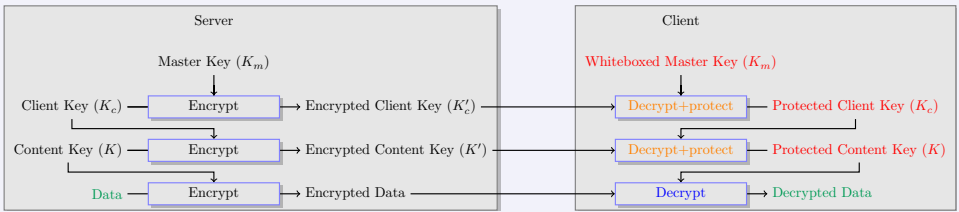
The goal is to give the user the choice of a **tradeoff**!

Whiteboxes: Usage

Digital Right Managements



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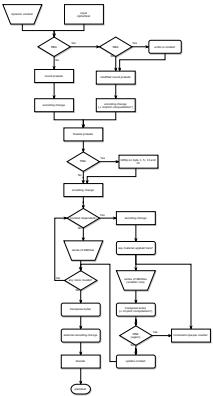

Imagine a complex whitebox decrypting a media stream...

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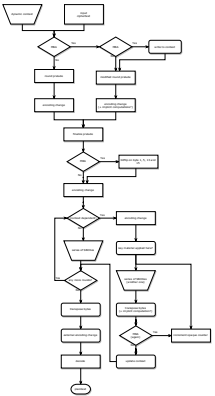

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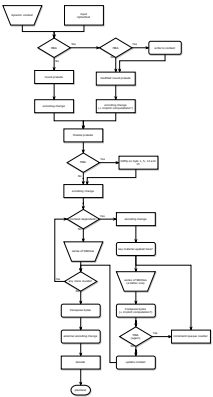

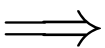

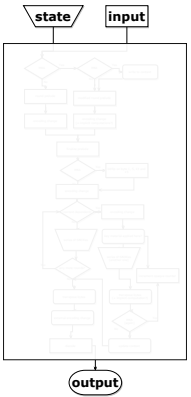

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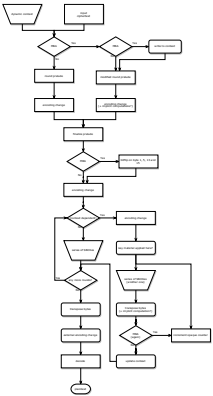

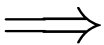

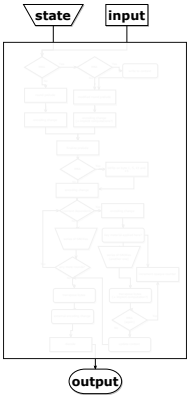

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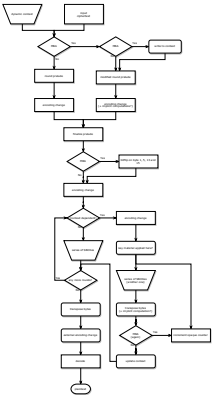

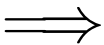

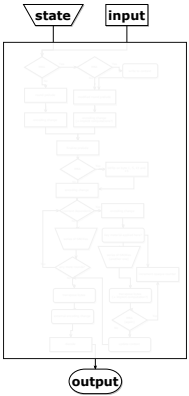

Me attacker can steal movie now, without the key 

Code Lifting: In Practice

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Ask yourself: is my whitebox protected against code lifting?
. . . and protections are not trivial to implement [4]

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[4] especially when integrating with large projects or third-party code

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The dataflow problem

In practice: whiteboxing "end-to-end"

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- and complex key derivation processes...

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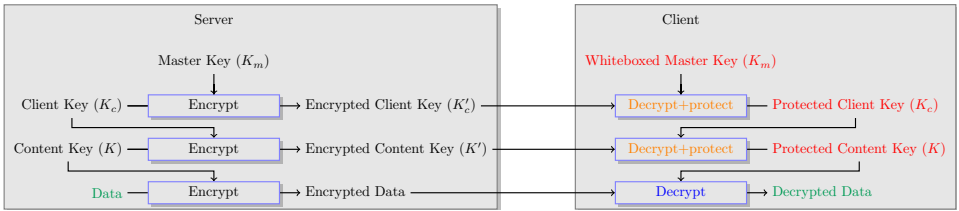

Example

In the example above:

- K_m is used to decrypt+protect K_c (also called *unwrapping*)
- K_c is used to decrypt+protect K
- K is used to decrypt the encrypted data to plaintext data

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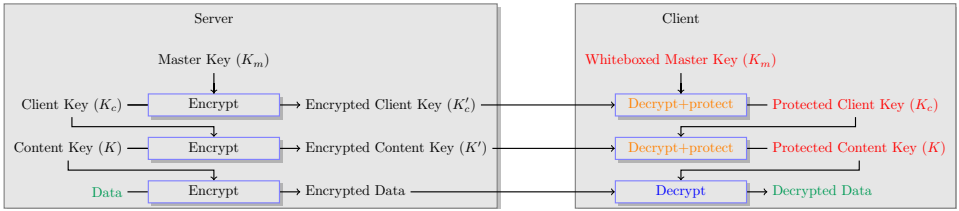

In the whitebox code, we thus have **two functions**:

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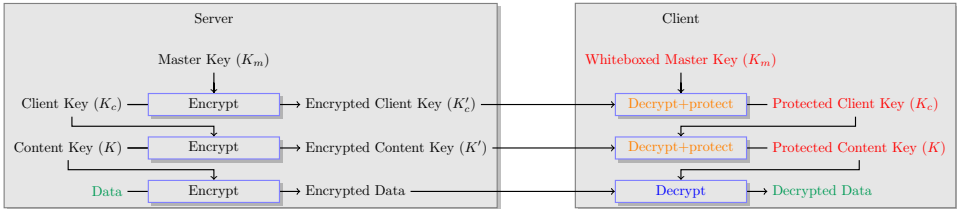

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The attacker **modifies the dataflow** to extract an unprotected copy of K_c:

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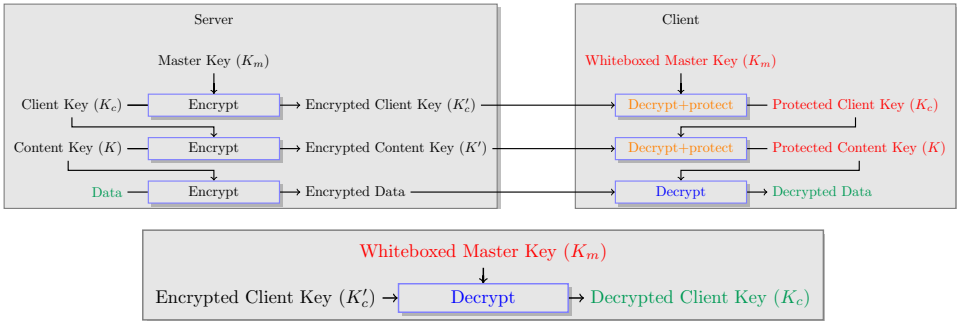

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Ask yourself: is my whitebox dataflow properly enforced?

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Can we do **cheaper?**

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Greybox Attacks

Bringing back the **Greybox Attack Model** from the hardware world:

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script-kiddie p0w3r 

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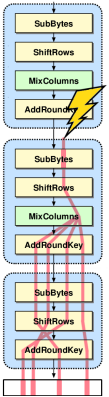
- Faults injected statically or dynamically in the last rounds



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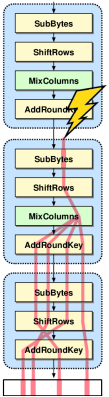

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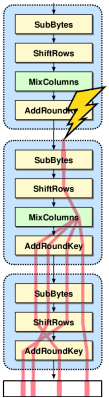

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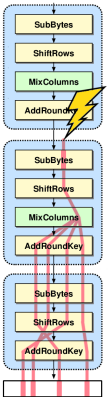
script-kiddie p0w3r (again)



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If not protected **explicitly**, my whitebox will likely be an easy break!

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What about whiteboxing more exotic cryptography...

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Just as AES: **Inspire yourself from hardware attacks**

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(but first, a crash-course on ECDSA)

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Let's read literature on **ECDSA hardware attacks**!

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Bonus: works on actual designs commercially available!

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Spoilers: ECDSA tricks you don't know about
(the last one will surprise you)

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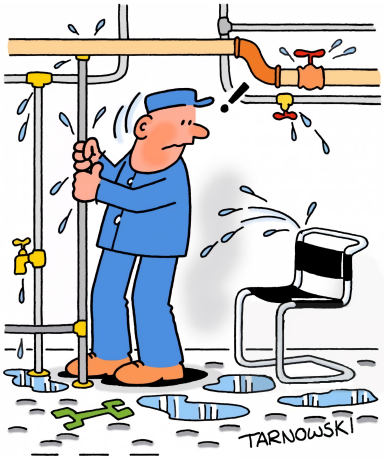

Fig. 1: whitebox cryptography
(without proper software protections)

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