Countermeasure against the SPA attack on an embedded mceliece cryptosystem

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COUNTERMEASURE AGAINST THE SPA ATTACK ON AN EMBEDDED MCELIECE CRYPTOSYSTEM

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INTRODUCTION

The code-based cryptosystems are very attractive because of their robustness regarding attacks based on the use of quantum computers. The first code-based cryptosystem was proposed by R. McEliece in 1978 [1]. However, it appeared that the code-based cryptosystems are as vulnerable to side channel attacks (SCA) proposed by Kocher in 1996 [2] as other cryptosystems. The first known SCA against the McEliece public key cryptosystem (PKC) appeared in 2008 [3].

MCELIECE PKC

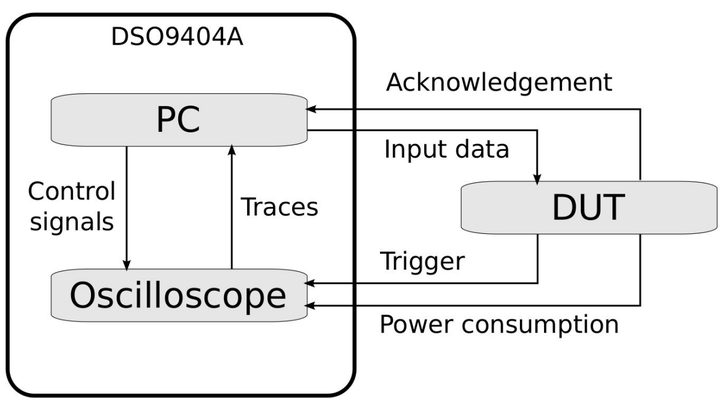
Encryption:

- Encode message m using generator matrix G: $\bar{c} = m.SGP$
- Add error vector e to produce ciphertext c: $c = \bar{c} + e$

Decryption:

- *Permute ciphertext c using permutation matrix P^{-1}: $\hat{c} = c.P^{-1}$
- *Use decoding algorithm: $\hat{m} = DEC(\hat{c})$
- Unscramble message using scrambling matrix S^{-1}: $m = \hat{m}.S^{-1}$

WORKPLACE & MEASUREMENT



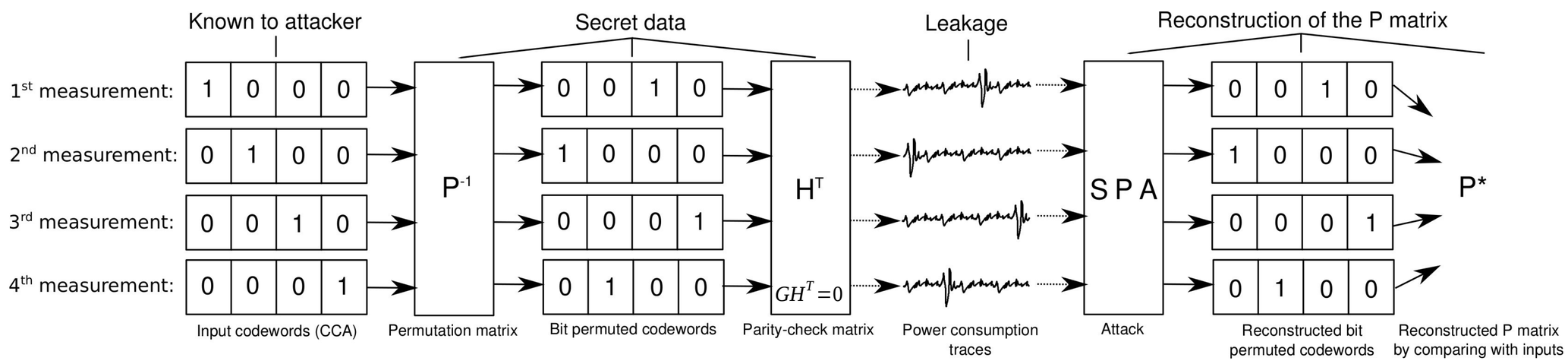
Attacked HW:
ARM Cortex-M3 based STM32F103 MCU

Oscilloscope:
Agilent Technologies DSO9404A

PERMUTATION MATRIX REVELATION

- Quantification of a threat that poses revealed P matrix to an attacker – is it a complete breakdown of the encryption?
- Using parameters: $n = 1024$ $m = 10$
- Complexity of the attack: $m^2(n^3 + n^2)$
- Complexity decreases from 2^{62} to 2^{37} binary operations

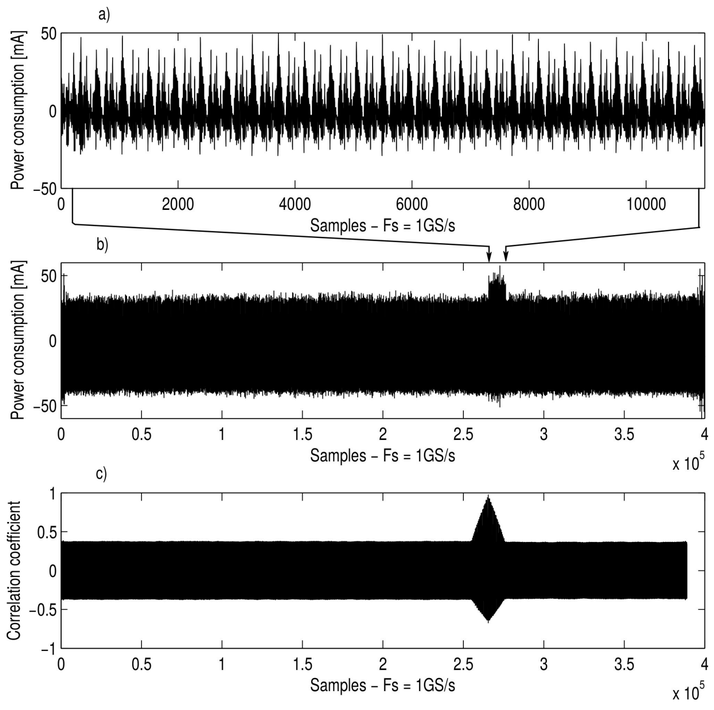
HOW DOES SIMPLE POWER ANALYSIS USING CHOSEN CIPHERTEXT ATTACK WORK?

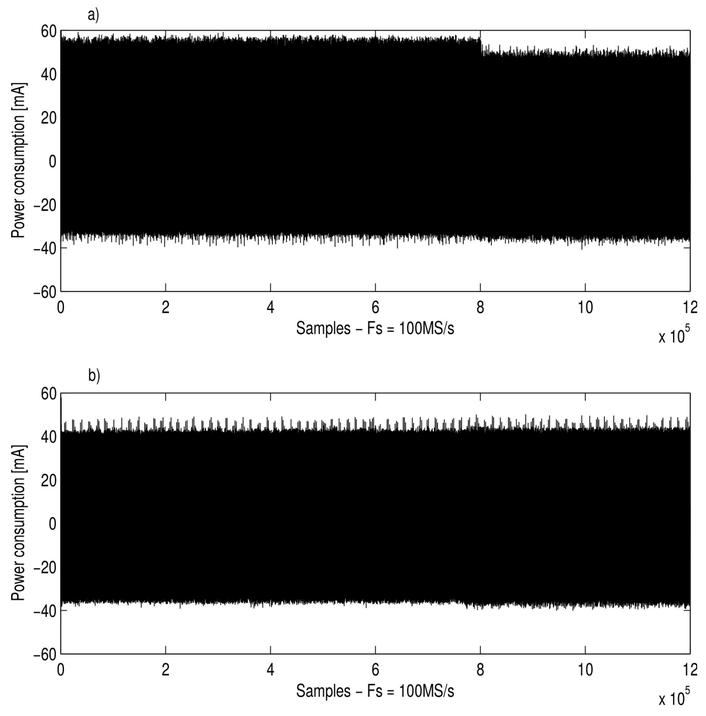


RESULTS & CONLCUSION

- Recreation of the SPA attack
- Quantification of the threat: $2^{62} \rightarrow 2^{37}$ operations
- Application of the software countermeasure based on avoiding conditional statements and creating time and instruction constant software
- Countermeasure 3x slower on average
- Advantage of the linear complexity
- Problem with initialization of variables
- Test of the SPA resistant implementation

- Future steps:
  a) DPA attack on the secure implementation
  b) Attack on an FPGA implementation





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