Timing Side-Channel Attack

Using linear correlation to reveal secrets

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21st June, 2019

Outline

Leaking informations

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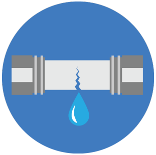
2. timing information, power consumption, electromagnetic leaks or even sound can provide an extra source of information
3. such information are therefore exploitable by an attacker

Therefore, our goal will consist in investigate such leaked information, trying to unveal secrets.



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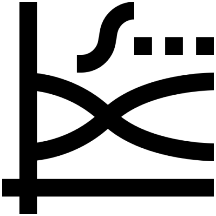

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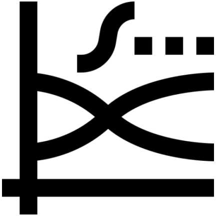

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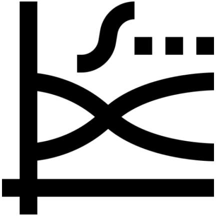

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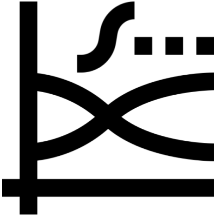

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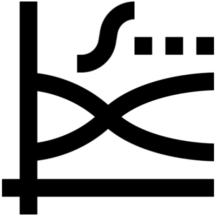

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- this correlation can be used to unveal part of the secret

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- a timing model can be built

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- logical comparison

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An interesting discovery

We have found out that the shift bt 32 bits (or multiples) does not produce an effect. This special case has to be handled in our library.

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Bare metal

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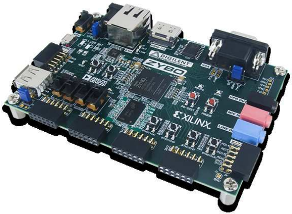
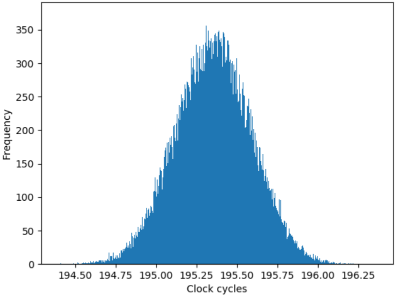
- compile our code for an ARM architecture
- add it to an *Eclipse* project
- used the MAKEFILE generated by Xilinx SDK
- copy the executable on the Zybo board



Finding correlations

PCC: our game changer

In order to find the linerar contribution of each sample in the overall time, we have used the *Pearson Correlation Coefficient* as an estimator. It has proved to be really effective for our needs, working on the realizations of a random variable.



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4. Get rid of fixed threshold by using multi bit analysis and the max of the accumulated PCCs on a common path

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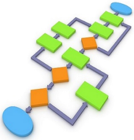
- Error-detection capabilities



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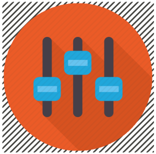
- Tweakable filtering of input data with `#define` parameters



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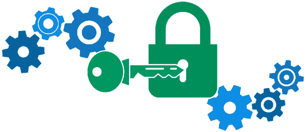
- our attack works also when mounted for other devices, including different architectures (Intel x86, ..)
- with an OS, more tuples (cipher, timing) are needed
- the attack is still feasible

We have completely tested what is mentioned above.

Bigger keys



RSA on 512/1024/2048/4096

The algorithm is capable of handling larger keys on 512, 1024, 2048 and 4096 bits. However, the processing time is longer, and a more complex backtrack might be necessary in some cases.

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- you can automatically receive an outline out of this section by the command

  `\tableofcontents`

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- all this settings have to be done in the preamble of the `presentation.tex` file

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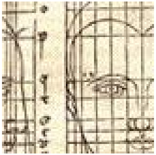
- in connection with `pdflatex` this supports a wider range of graphic formats, including GIF, PNG, JPG



Useful hints

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- if you use a verbatim environment on a slide, declare that slide `fragile`:

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- bibliography actually works as usual, just keep in mind that not all bibliography styles are supported by the *beamer* package, maybe you have to include some other packages to get your preferred style working

Possible solution

Blinding

The proposed countermeasure is the one given in Kocher (1996). It consists in blinding the message before the encryption using a couple of values v_f, v_i chosen in such a way that:

$$v_i^e \cdot v_f \, mod \; N = 1$$

This contermeasure, in all our tests, has proven to be really effective. Ciphers are completely masked, no correlation can be identified.

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- find an optimal filter and explain the strange behavior of the implemented filter
- try to parallelize the estimation for all the messages, as every message is data-independent from each other

Our team

ANSELMO, Alberto

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CHIATANTE, Fausto

ROGGERO, Giulio

References I

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